SME
SEVEE & MAHER
ENGINEERS

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Cumberland, ME 04021
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June 8, 2023

U.S. Environmental Protection Agency, Region 1
ATTN: George Papadopoulos, HYDROGP Coordinator
5 Post Office Square – Mailcode 06-1
Boston, MA 02109-3912

Email: Hydro.GeneralPermit@epa.gov

Subject: Notice of Intent (NOI) Applications for Coverage under the EPA Region 1 Hydroelectric Generating Facilities General Permit (Hydro GP) for Facilities in Massachusetts

Dear Mr. Papadopoulos:

On behalf of Bear Swamp Power Company LLC, please see the attached NOI applications for the following facilities located along the Deerfield River in Massachusetts:

- Bear Swamp Project/Cockwell Station – MassDEP Permit No. MAG360012
- Fife Brook Hydro – MassDEP Permit No. MAG360011

Per Sections 6.6 and 6.7 of the 2023 Hydro GP, copies of these NOI applications are not required to be provided to the Massachusetts Department of Environmental Protection (MassDEP) due to neither facility seeking the authority to discharge to an Outstanding Resource Water (ORW).

Should questions arise or additional information be desired, please do not hesitate to contact me at 207.829.5016.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Philip H. Gerhardt, P.E.
Principal/Senior Environmental Engineer

Request for General Permit Authorization to Discharge Wastewater Notice of Intent (NOI) to be covered by Hydroelectric Generating Facilities General Permit (HYDROGP) No. MAG360000 or NHG360000

Indicate Applicable General Permit for Discharge(s): ■ MAG360000 ☐ NHG360000

A. Facility Information

1. Facility Location	Name: Fife Brook Hydro	
	Street: 370 River Road	
	City: Florida	State: Massachusetts
	Zip: 01247	SIC Code: 4911
	Latitude: 42º 41' 5.60" N	Longitude: 72º 58' 38.43" W
	Type of Business: Hydroelectric Generating Station	
2. Facility Mailing Address (if different from Location)	Street: PO Box 461	
	City: Rowe	State: Massachusetts
	Zip: 01367	
3. Facility Owner	Name: Bear Swamp Power Company	Email: Joel.Rancourt@brookfieldrenewable.com
	Street: PO Box 461	Telephone: 207-660-5461

<table>
<tr><td rowspan="2"></td><td>City:
Rowe</td><td colspan="2">State:
Massachusetts</td></tr>
<tr><td>Contact Person:
Joel Rancourt</td><td colspan="2">Zip:
01367</td></tr>
<tr><td rowspan="4">4. Facility Operator (if different from above)</td><td>Name:</td><td colspan="2">Email:</td></tr>
<tr><td>Street:</td><td colspan="2">Telephone:</td></tr>
<tr><td>City:</td><td colspan="2">State:</td></tr>
<tr><td>Zip:</td><td colspan="2"></td></tr>
<tr><td rowspan="9">5. Current Permit Status</td><td>Has prior HYDROGP coverage been granted for the discharge(s) listed in the NOI?</td><td colspan="2">■ Yes ☐ No</td></tr>
<tr><td colspan="3">Permit number (if yes): MA0034878 (Individual-expired) & MAG360011 (General)</td></tr>
<tr><td>Is the facility covered under an Individual Permit?</td><td colspan="2">☐ Yes ■ No</td></tr>
<tr><td>Is there a pending NPDES application of file with EPA for the discharge(s)?</td><td colspan="2">☐ Yes ■ No</td></tr>
<tr><td>Date of Submittal (if yes):</td><td colspan="2">Permit Number (if known):</td></tr>
<tr><td>Attach a topographic map indicating the locations. of the facility and outfall(s) to the receiving water</td><td colspan="2">■ Map Attached</td></tr>
<tr><td>Number of turbines: 1</td><td colspan="2"></td></tr>
<tr><td>Combined turbine discharge (installed capacity) at:</td><td>Maximum capacity?
Minimum capacity?</td><td>1,500 cfs
650 cfs</td></tr>
<tr><td>Is this facility operated as a pump storage project?</td><td colspan="2">☐ Yes ■ No</td></tr>
</table>

B. Discharge Information

1. Name of Receiving Water(s): Deerfield River	■ Freshwater ☐ Marine
2. Waterbody classification: ☐ Class A ■ Class B ☐ Class SA ☐ Class SB	
3. Is the receiving water is listed in the State's Integrated List of Waters (i.e., CWA Section 303(d))?	■ Yes ☐ No
4. If the applicant answered yes to B.3, has the applicant identified the designated uses that are impaired, any pollutants indicated, and whether a final TMDL is available for any of the indicated pollutants in a separate attachment to the NOI?	■ Yes ☐ No
5. Attach a line drawing or flow schematic showing water flow through the facility including location of intake(s), operations contributing to effluent flow, treatment units, outfalls, and receiving water(s).	■ Line Drawing Attached

6. List each outfall (numbered sequentially) discharging effluent from the following categories and provide an estimate of the average monthly flow (in gallons per day) for each discharge type. See Parts 1.1 through 1.5 (for MA) or Parts 2.1 through 2.5 (for NH) for descriptions and permit conditions for each discharge type.

Equipment-related cooling water	Outfalls: A1B-1FB	180,000 gpd
Equipment and floor drain water	Outfalls: A2B-1FB	65,000 gpd
Maintenance-related water	Outfalls:	gpd
Facility maintenance-related water during flood/high water events	Outfalls:	gpd
Equipment-related backwash strainer water	Outfalls: A5B-1FB - This outfall discharges both NCCW and strainer backwash	440,000 gpd

7. For each outfall listed above, provide the following information (attach additional sheets if necessary). Outfalls may be eligible for alternative pH effluent limits. See Parts 1.7.1. and 2.7.1 of the permit for additional information. Contact MassDEP or NHDES to determine the required information and protocol to request alternative pH effluent limits.

Please see the attached documentation explaining the minimum monthly pH values

Outfall No. A2B-1FB	Latitude: 42º 41' 4.61" N	Longitude: 72º 58' 38.13" W
	Discharge is: ■ Continuous ☐ Intermittent ☐ Seasonal	
	Maximum Daily Flow 0.065 MGD	Average Monthly Flow 0.065 MGD
	Maximum Daily Temperature 56.6 °F	Average Monthly Temperature 56.6 °F
	Maximum Daily Oil & Grease <5 mg/L	Average Monthly Oil & Grease <5 mg/L
	Maximum Monthly pH 7.89 s.u.	Minimum Monthly pH 5.24 s.u.
	Alternative pH limits requested? ☐Yes ■ No	State approval attached? ☐ Yes ■ No
Outfall No. A1B-1FB	Latitude: 42º 41' 4.61" N	Longitude: 72º 58' 38.13" W
	Discharge is: ■ Continuous ☐ Intermittent ☐ Seasonal	
	Maximum Daily Flow 0.18 MGD	Average Monthly Flow 0.18 MGD
	Maximum Daily Temperature 57.6 °F	Average Monthly Temperature 57.6 °F
	Maximum Daily Oil & Grease <5 mg/L	Average Monthly Oil & Grease <5 mg/L
	Maximum Monthly pH 7.98 s.u.	Minimum Monthly pH 5.47 s.u.
	Alternative pH limits requested? ☐Yes ■ No	State approval attached? ☐ Yes ■ No

Outfall No. A5B-1FB	Latitude: 42° 41' 4.61" N	Longitude: 72° 58' 38.13" W
	Discharge is: ■ Continuous ☐ Intermittent ☐ Seasonal	
	Maximum Daily Flow 0.44 MGD	Average Monthly Flow 0.44 MGD
	Maximum Daily Temperature 57.6 °F	Average Monthly Temperature 57.6 °F
	Maximum Daily Oil & Grease <5 mg/L	Average Monthly Oil & Grease <5 mg/L
	Maximum Monthly pH 7.55 s.u.	Minimum Monthly pH 5.66 s.u.
	Alternative pH limits requested? ☐Yes ■ No	State approval attached? ☐ Yes ■ No

C. Best Technology Available for Cooling Water Intake Structures

Facilities that checked "equipment-related cooling" as one of the discharges in Part B. of this NOI are subject to the following requirements.	
1. Does the facility intake water for cooling purposes subject to the BTA Requirements at Part 4 of the HYDROGP?	■ Yes ☐ No If no, skip to Part D of this NOI.
2. If yes, indicate which technology employed to comply with the general BTA requirements at Part 4.2.b of the HYDROGP:	
☐An existing technology (e.g., a physical or behavioral barrier, spillway, or guidance device) that directs fish towards a downstream passage that minimizes exposure to the CWIS. Has the applicant attached a narrative description of the barrier to demonstrate that the downstream fish passage effectively transports live fish in a manner that minimizes the likelihood of becoming impinged or entrained at the cooling water intake? ☐ Yes ☐ No	
☐An effective intake velocity at the point of cooling water withdrawal, or alternatively, at the point where cooling water enters the penstock (for intakes located within the penstock), not to exceed 0.5 fps. Has the applicant attached a demonstration of compliance with this intake velocity through observation of live fish in the intake or calculation based on the maximum intake volume and minimum bypass flow? ☐ Yes ☐ No	

Please see the attached documentation describing Option 4

☐For cooling water withdrawn directly from the source waterbody (*i.e.*, not from within the penstock), a physical screen or other barrier technology with a mesh size no greater than ½-inch that minimizes the potential for adult and juvenile fish to become entrapped in the CWIS. Has the applicant attached a description of the technology? ☐ Yes ☐ No If the mesh size of the screen is greater than ½-inch has the applicant demonstrated that the calculated intake velocity is less than 0.5 fps based on the screen dimensions, maximum intake volume, and source water 7Q10 low flow? ☐ Yes ☐ No	
3.	If the answer to question C.1 is yes, in addition to complying with one of the criteria above, the applicant must submit the following information:
Maximum daily volume of cooling water withdrawn during previous five (5) years: 620,000 gpd	
Maximum monthly average volume of cooling water withdrawn during the previous five (5) years: 620,000 gpd	
Maximum daily and average monthly volume of water used exclusively for cooling: Max: 620,000 gpd Avg: 620,000 gpd Maximum daily and average monthly volume of water used for another process before or after being used for cooling: Max: 0 gpd Avg: 0 gpd Has the applicant attached a narrative description explaining how cooling water is reused? ☐ Yes ■ No	
Volume of total intake water withdrawn and used in facility as a percentage of: Installed turbine capacity 0.06 % Average daily flow through penstock 0.11 % - 0.08 % Minimum flow through penstock 0.15 %	These values are based on a range of 60% - 80% of installed turbine capacity
Source water annual mean flow (*e.g.*, available from USGS, MassDEP, or NHDES): 911 cfs	
Source water 7-day mean low flow with 10-year recurrence interval (7Q10): 168 cfs	
Volume of total intake water withdrawn and used in facility as a percentage of: Source water mean annual flow 0.11 % or 1.0 cfs Source water 7Q10 flow 0.57 % or 1.0 cfs	

D. Chemical Additives

1. Does the facility use or plan to use non-toxic chemicals for pH adjustment?	☐ Yes ■ No
2. Does the facility use or plan to use chemicals for anti-freeze purposes?	☐ Yes ■ No
3. If the answer to D.2 is yes, provide the following for **EACH** chemical additive used for anti-freeze:	
Chemical Name and Manufacturer:	
Maximum Dosage Concentration Used:	Average Dosage Concentration Used:
Maximum Concentration in Discharge: mg/L	Average Concentration in Discharge: mg/L
Material Safety Data Sheet (MSDS) or other toxicity documentation for each chemical attached? ☐ Yes ☐ No	

E. Endangered Species Act Certification

Appendix 2 to the HYDROGP explains the certification requirements related to threatened and endangered species and designated critical habitat. Indicate under which criteria the discharge is eligible for coverage under the HYDROGP:	
1. ESA eligibility for species under jurisdiction of USFWS	☐ **Criterion A**: No endangered or threatened species or critical habitat are in proximity to the discharges or related activities or come in contact with the "action area." See Appendix 2, Part B for documentation requirements. Documentation attached? ☐ Yes ☐ No
	■ **Criterion B**: Formal or informal consultation with the USFWS under Section 7 of the ESA resulted in either a no jeopardy opinion (formal consultation) or a written concurrence by USFWS on a finding that the discharges and related activities are "not likely to adversely affect" listed species or critical habitat. Has the operator completed consultation with USFWS and attached documentation? ☐ Yes ■ No If no, is consultation underway? ■ Yes ☐ No
	☐ **Criterion C**: Using the best scientific and commercial data available, the effect of the discharges and related activities on listed species and designated critical habitat have been evaluated. Based on those evaluations, a determination is made by EPA, or by the operator and affirmed by EPA, that the

	discharges and related activities will have "no effect" on any federally threatened or endangered species or designated critical habitat under the jurisdiction of the USFWS. Has the applicant attached documentation of the "no effect" finding? ☐ Yes ☐ No
2. ESA eligibility for species under jurisdiction of NMFS	Is the facility located on: the Connecticut River between the Massachusetts/Connecticut state line and Turners Falls, MA; the Taunton River; the Merrimack River between Lawrence, MA and the Atlantic Ocean; the Piscataqua River including the Salmon Falls and Cocheco Rivers; or a marine water? ☐ Yes ■ No
	If yes, was the applicant authorized to discharge from the facility under the 2009 HYDROGP? ☐ Yes ☐ No
	If the discharge is to one of the named rivers above or to a marine water *and* the facility was not previously covered under the 2009 HYDROGP, has there been any previous formal or informal consultation with NMFS? ☐ Yes ☐ No Documentation of consultation attached? ☐ Yes ☐ No

F. National Historic Properties Act Eligibility

1. Indicate under which criterion the discharge(s) is eligible for covered under the HYDROGP:
☐ **Criterion A**: No historic properties are present.
■ **Criterion B**: Historic properties are present. The discharges and related activities do not have the potential to impact historic properties.
☐ **Criterion C**: Historic properties are present. The discharges and related activities have the potential to impact or adversely impact historic properties.
2. Has the applicant attached supporting documentation for NHPA eligibility described in Appendix 3, Part C of the HYDROGP? ■ Yes ☐ No

3.	Does supporting documentation include a written agreement from the State Historic Preservation Officer, Tribal Historic Preservation Officer, or other tribal representative that outlines measures the operation will carry out to mitigate or prevent any adverse effects on historic properties? ☐ Yes ■ No

G. Supplemental Information

Please provide any supplemental information, including antidegradation review information applicable to new or increased discharges. Attach any certifications required by the HYDROGP. Supplemental information attached? ■ Yes ☐ No

H. Signature Requirements

1. The NOI must be signed by the operator in accordance with the signatory requirements of 40 C.F.R. § 122.22, including the following certification:	
I certify under penalty of law that no chemical additives are used in the discharges to be authorized under this General Permit except for those used for pH adjustment or anti-freeze purposes and that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those directly responsible for gathering the information, I certify that the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I certify that I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	
2. Notification provided to the appropriate State, including a copy of this NOI, if required?	■ Yes ☐ No
Signature: Stephen Michaud (50794) Digitally signed by Stephen Michaud (50794) Date: 2023.06.08 10:06:03 -04'00'	Date:
Print Name and Title: Steve Michaud, Director of Operations	

NOI ATTACHMENT 1

SITE AND FACILITY LOCATION MAPS

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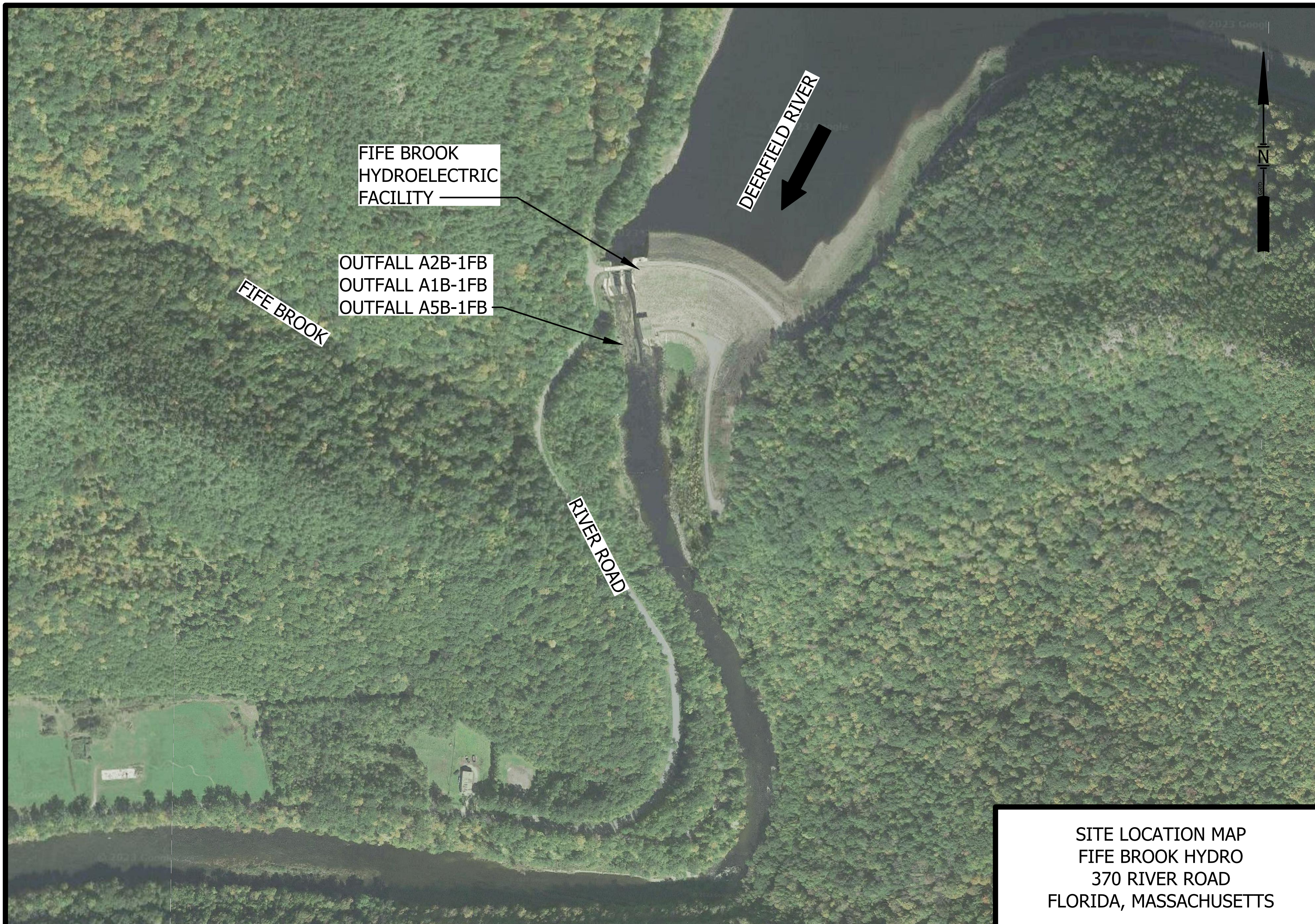

NOTE:
AERIAL IMAGE FROM GOOGLE EARTH, DATED OCTOBER 4, 2018.

250 0 500 FEET

SITE LOCATION MAP
FIFE BROOK HYDRO
370 RIVER ROAD
FLORIDA, MASSACHUSETTS

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DWG: FIFE LMN: SITE CTB: SME-STD REV: 4/25/2023

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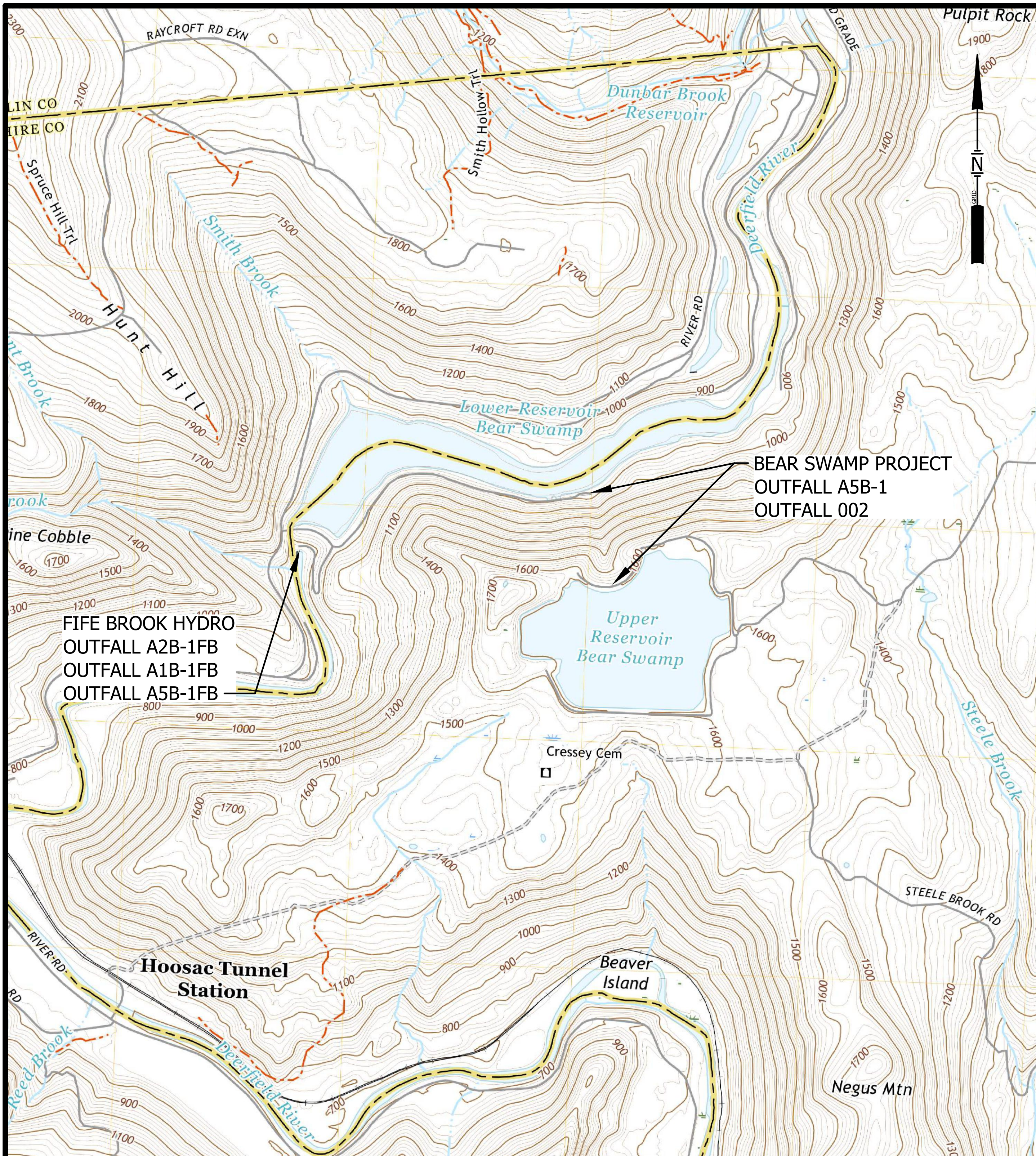

BASEMAP ADAPTED FROM 7.5 MIN USGS TOPO QUADS
ROWE, MASSACHUSETTS - 2021

BROOKFIELD FACILITY LOCATIONS
FIFE BROOK AND BEAR SWAMP
FLORIDA, MASSACHUSETTS

SME
SEVEE & MAHER
ENGINEERS

1000 0 2000 FEET

DWG: FIFE	LMN: USGS	CTB: SME-STD.CTB	REV: 5/19/2023

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NOI ATTACHMENT 2

SITE DIAGRAMS

SME
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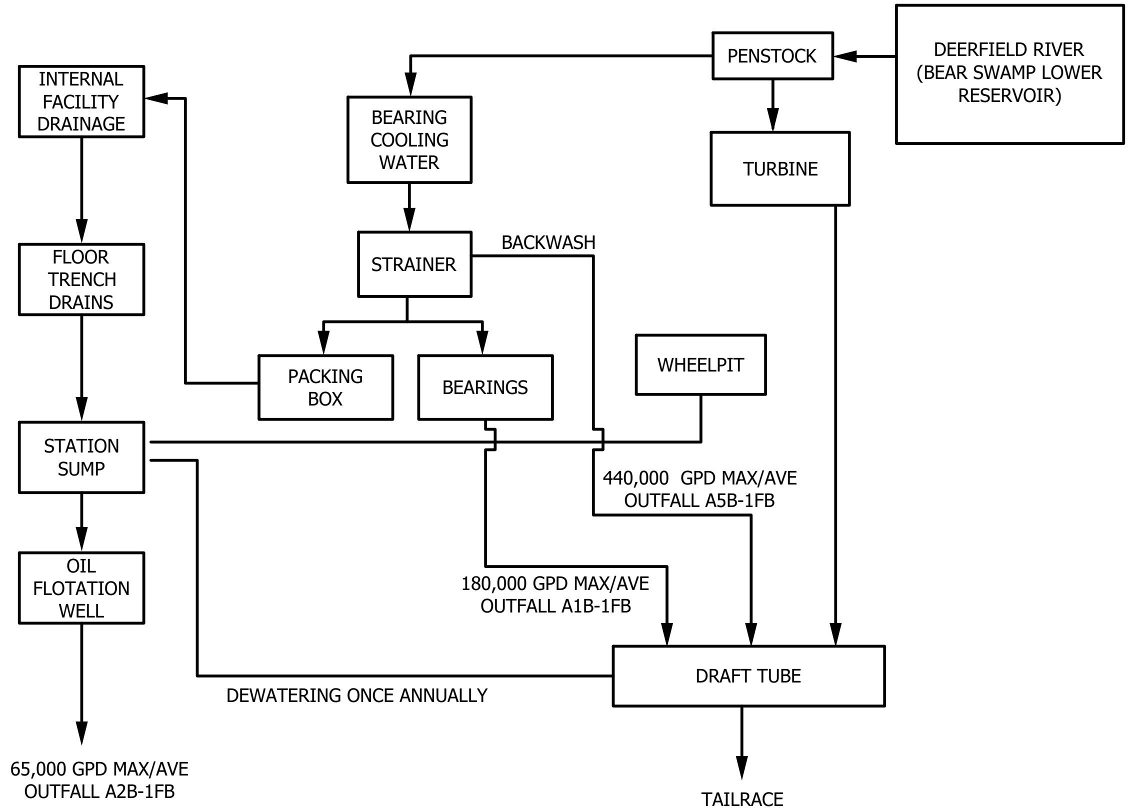

NOTE: OUTFALLS DISCHARGE TO TAILRACE (DEERFIELD RIVER)

NOT TO SCALE

WATER FLOW DIAGRAM
FIFE BROOK
370 RIVER ROAD
FLORIDA, MASSACHUSETTS

SME
SEVEE & MAHER ENGINEERS

DWG: FIFE LMN: SITE CTB: SME-STD REV: 5/22/2023

\\Nserver\cfs\Brookfield\Great Lakes Hydro America\Acad\Figures\FIFE.dwg, FIFE BROOK -FLOW, 5/22/2023 2:07:34 PM, bwb

NOI ATTACHMENT 3

MASSACHUSETTS INTEGRATED LIST OF WATERS AND IMPAIRMENTS

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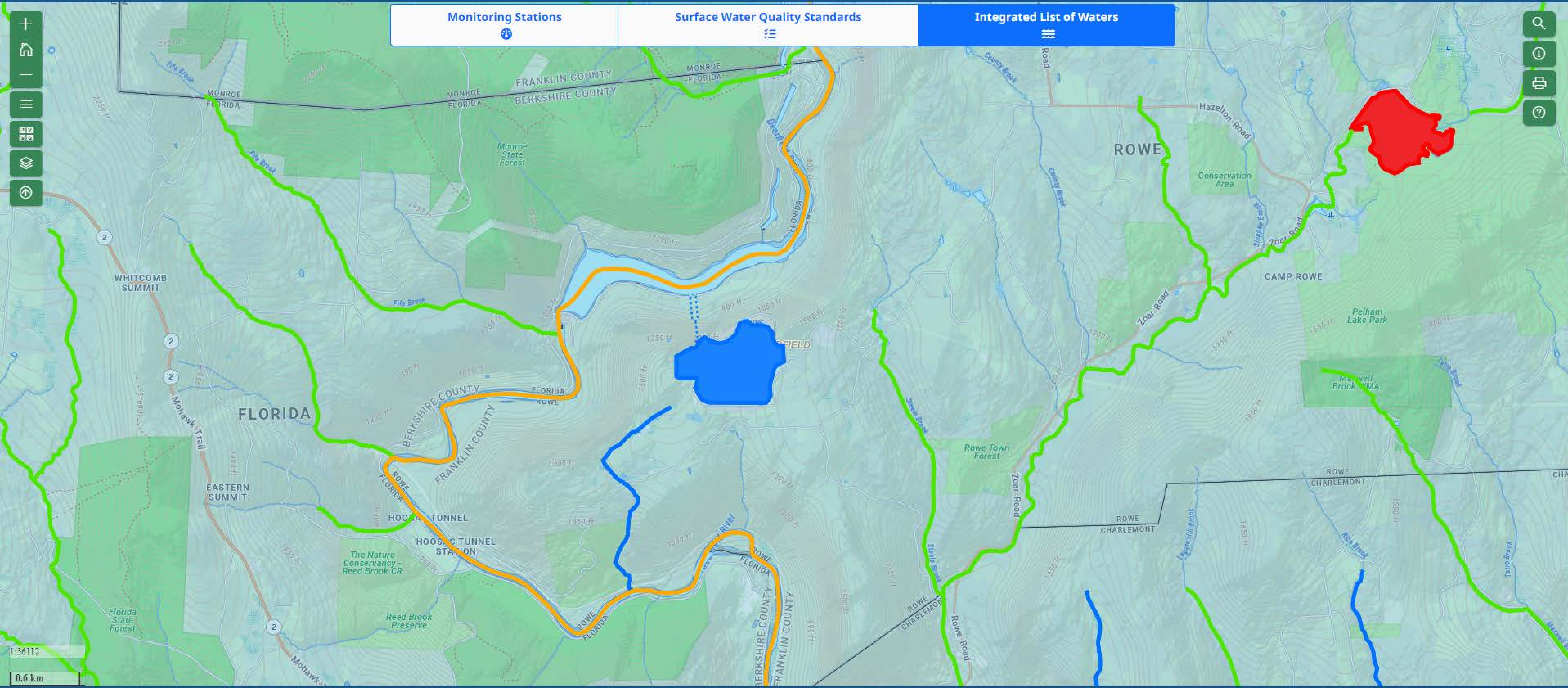
MassDEP | Water Quality Data Viewer

Helpful Links

Monitoring Stations | Surface Water Quality Standards | Integrated List of Waters



Assessment

Assessment

Assessment Unit ID	MA33-01
Water Name	Deerfield River
Watershed	Deerfield
Water Type	RIVER
Size	13.43029 MILES
Class	Class B
Qualifier	CWF
Category	2
TMDL Count	0
Description	Outlet Sherman Reservoir Monroe/Rowe, to confluence with Cold River, Charlemont (through former segment, Lower Reservoir MA33028). null

Show On Map

2018/2020 2016 2014 2012 2010 Download

Use	Attainment	Alert	Cause	Pollutant Flag	Source	Source Confirmed	Action ID	Report ID	Report Title
No Filter	No Filter	No Filter	No Filter	No Filter	No Filter	No Filter	No Filter	No Filter	
Aesthetic	Fully Supporting	N							
Fish Consumption	Not Assessed	N							
Fish, other Aquatic Life and Wildlife	Not Supporting	N	FLOW REGIME MODIFICATION	N	DAM OR IMPOUNDMENT	N			
Fish, other Aquatic Life and Wildlife	Not Supporting	N	FLOW REGIME MODIFICATION	N	IMPACTS FROM HYDROSTRUCTURE FLOW REGULATION/MODIFICATION	N			
Primary Contact Recreation	Fully Supporting	N							
Secondary Contact Recreation	Fully Supporting	N							

Show 10 entries

1 to 6 of 6

NOI ATTACHMENT 4

EXPLANATION OF MINIMUM PH VALUES

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June 8, 2023

U.S. Environmental Protection Agency, Region 1
ATTN: George Papadopoulos, HYDROGP Coordinator
5 Post Office Square – Mailcode 06-1
Boston, MA 02109-3912

Email: Hydro.GeneralPermit@epa.gov

Subject: Fife Brook Hydroelectric Facility – Explanation of Minimum pH Values

Dear Mr. Papadopoulos:

To supplement the information entered under Section B.7 of the Hydroelectric Generating Facilities General Permit (Hydro GP) notice of intent (NOI), the Fife Brook Hydroelectric Facility is providing this explanation for the minimum pH values associated with the facility's outfall discharges. The Fife Brook facility experiences seasonal low pH readings due to conditions within the Deerfield River/Lower Reservoir that are outside of the facility's control. While these minimum pH values measured at the outfall discharges are below the pH range specified within the facility's current general permit (See Attachment 1), the facility demonstrates compliance by maintaining documentation that the outfall discharge pH is within 0.5 standard units of the background receiving water pH (see Attachment 2).

Should questions arise or additional information be desired, please do not hesitate to contact me at 207.829.5016.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Philip H. Gerhardt, P.E.
Principal/Senior Environmental Engineer

Attachments: 1. Discharge Limitations from General Permit
2. Quarterly NPDES Sampling Documentation

ATTACHMENT 1

DISCHARGE LIMITATIONS FROM GENERAL PERMIT

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Summary of specific numeric effluent limitations and monitoring requirements for Bear Swamp Power Company's Fife Brook Station Hydroelectric Generating Facility. Monitoring for this outfall is to be conducted and reported in accordance with Part I.A.6 and Part I.E. This summary is provided as a convenience using the submitted NOI information and it does not replace the effluent limitations and monitoring requirements, and other conditions set forth in Massachusetts General Permit No. MAG360000; effective December 7, 2009.

During the period beginning on the effective date and lasting through expiration, the permittee is authorized to discharge equipment and floor drain water from Outfall 001 to the Deerfield River. These discharges are limited as shown below and on Page 4 of the HYDRO GP.

Effluent Characteristic	Units	Discharge Limitation	Monitoring Requirement	
		Average Monthly	Measurement Frequency	Sample Type
Flow [1]	Gallons/day	Report	1/Quarter	Estimate
pH Range [2]	Standard Units	6.5 to 8.3	1/Quarter	Grab
Oil and Grease [3]	mg/L	15	1/Quarter	Grab

Explanation to Superscripts:

(1) The No Data Indicator Code (NODI) "C" applies when there is no discharge from an outfall and is entered on the monthly Discharge Monitoring Report (DMR). A written explanation for the NODI is required with the DMR report. Additional NODI codes applicable to other conditions are found in the annual NPDES Permit Program Instructions for the DMR forms. These instructions can be found at: http://www.epa.gov/ne/enforcementandassistance/dmr.html.

(2) The pH shall be in the specified range or within 0.5 units of the background pH. For purposes of this permit, the background pH is the receiving water pH measured upstream of the facility at a location that is representative of upstream conditions unaffected by the facility. If the discharge pH exceeds the specified range, the permittee may use the background pH to demonstrate compliance by showing that the discharge pH is within 0.5 units of the background pH. The background pH and the discharge pH shall be measured on the same day. The background pH results shall be submitted as an attachment with the DMR. This is a State certification requirement.

(3) Oil and Grease shall be tested using EPA test method 1664 Revision A as approved in 40 CFR 136.

ATTACHMENT 2

QUARTERLY NPDES SAMPLING DOCUMENTATION

Brookfield Renewable Power Northeast Operations	Doc. SOP-0075 Revision 3
STANDARD OPERATING PROCEDURE	Page 4 of 4
Subject: Quarterly NPDES Sampling	

APPENDIX A

Results Page		Date:			
Bear Swamp			**Fife Brook**		
Combo 24" BS		Value	**A1B-1 FB**		Value
Combo 24" header (cooling water from the air handling system, lower guide bearing and thrust bearing)	Temperature	9.2 C	Equip cooling water from turbine guide bearing; Located in the wall outside the wheel pit	Temperature	4.6 C
	pH	6.23		pH	6.21
	Collect Water Sample for Oil & Grease Analysis	✓		Collect Water Sample for Oil & Grease Analysis	✓
Comments: Low Ph Lower Res Sample Ph: 6.22 Temp: 2.6 C			**A2B-1 FB**		Value
			Floor/sump Located at the sump- former Fife Brook outfall 001	Temperature	3.6 C
				pH	~~5.77~~ 6.00
				Collect Water Sample for Oil & Grease Analysis	✓
			A5B-1 FB		Value
			Combo aux guide and thrust bearing located near backwash strainer (must isolate the backwash prior to taking sample)	Temperature	5.4 C
				pH	6.19
				Collect Water Sample for Oil and Grease Analysis	✓

Obtained by: Joe Tatro
(print)

Joseph [signature]
(sign)

Date: 1/28/22

NOI ATTACHMENT 5

DESCRIPTION OF BTA TECHNOLOGY FOR MINIMIZATION OF IMPINGEMENT MORTALITY

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June 8, 2023

U.S. Environmental Protection Agency, Region 1
ATTN: George Papadopoulos, HYDROGP Coordinator
5 Post Office Square – Mailcode 06-1
Boston, MA 02109-3912

Email: Hydro.GeneralPermit@epa.gov

Subject: Fife Brook Hydroelectric Facility – Description of BTA Technology for Minimization of Impingement Mortality

Dear Mr. Papadopoulos:

As requested within Section C.2 of the Hydroelectric Generating Facilities General Permit (Hydro GP) notice of intent (NOI), the Fife Brook Hydroelectric Facility is providing this description of the technology employed to comply with the general BTA requirements of Part 4.2.b of the Hydro GP. The Fife Brook facility utilizes one 10-foot-diameter penstock to deliver water from the Deerfield River to the generating turbine. Cooling water is withdrawn from the penstock through a 4-inch-diameter pipe prior to the water passing through the turbines. Measured water flow data through this penstock is unavailable; therefore, a calculative approach utilizing the Hazen-Williams Equation was used to determine the volume of water passing through the penstock and the percentage of cooling water withdrawn for the Fife Brook facility. Calculations and assumptions are included in Attachment 1.

The facility has calculated that approximately 0.009 percent of the maximum possible flow through the penstock is withdrawn for the Fife Brook cooling system. As noted in the NOI form, the water withdrawn from the penstock for use as cooling water is approximately 0.06 percent of the installed turbine capacity, and 0.11 percent of the source water 2022 mean annual flow.

In September 2017, HDR, Inc. performed an entrainment and impingement risk study for several resident fish species near the Fife Brook facility. The report states that all target fish species would be able to avoid entrainment at the facility due to the intake velocities being lower than the burst swim speeds. The report concludes that the Fife Brook facility has a low qualitative rating for monthly entrainment potential for most resident target fish species.

In July 2020, an environmental assessment was performed for the Fife Brook facility as part of the Federal Energy Regulatory Commission's (FERC) hydropower licensing program. This assessment included an entrainment and impingement risk study for several fish species near the Fife Brook facility. The report concludes that total entrainment mortality at the Fife Brook facility would be expected to be minimal and not adversely affect fish populations in the Fife Brook impoundment.

The facility believes it has demonstrated that impingement mortality has been minimized due to the unlikelihood of fish entrainment through the penstock and the minimal amount of cooling water withdrawn from the penstock; therefore, the facility should remain eligible for coverage under the Hydro GP in accordance with Option 4 within Section C.2.

Should questions arise or additional information be desired, please do not hesitate to contact me at 207.829.5016.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Philip H. Gerhardt, P.E.
Principal/Senior Environmental Engineer

Attachments:
1. Percentage of Cooling Water Withdrawn Calculations
2. 2017 HDR Fish Entrainment Evaluation Study Report
3. Excerpt from the 2020 FERC Environmental Assessment

ATTACHMENT 1

PERCENTAGE OF COOLING WATER WITHDRAWN CALCULATIONS

Hazen-Williams Equation for Velocity of Water in Gravity Flow

$$v = k\ x\ C\ x\ R^{0.63}\ x\ S^{0.54}$$

v = Fluid velocity *C = Roughness coefficient*
R = Hydraulic radius of the pipe *S= Slope of the energy line*
k = Conversion factor (1.318 for imperial system)

The following assumptions were applied in order to utilize the Hazen-Williams Equation: there are no booster pumps in the pipeline (gravity-fed system only), the piping system is completely full of water, the flow throughout the piping system is turbulent, and the water temperature is in the range of 40 – 75 ºF.

C - Roughness Coefficient Selection
Based on information provided by Brookfield personnel, it was determined that the penstock is constructed of steel and encased in concrete – this corresponds to a roughness coefficient of 100.

S – Slope of the Energy Line
The distance and change in elevation from the inlet of the penstock to the inlet of the cooling water intake structure was utilized to calculate the slope of the energy line. Through the use of aerial imagery and analysis of topographic maps, it was determined that the distance is approximately 250 feet (ft) and the change in elevation is approximately 80 ft. Thus,

$$S = \frac{80\ ft}{250\ ft} = 0.32$$

R – Hydraulic Radius of the Pipe
Based on information provided by the Fife Brook facility, the external diameter of the penstock is approximately 10 ft.

$$R = \frac{Area\ of\ Pipe}{Perimeter\ of\ Pipe} = \frac{\pi *\ (Radius\ of\ Pipe)^2}{\mathbf{2} *\ \pi\ (Radius\ of\ Pipe)} = \frac{\pi * (5\ ft)^2}{2 *\ \pi\ (5\ ft)} = 2.5\ ft$$

v – Fluid Velocity

$$v = k\ x\ C\ x\ R^{0.63}\ x\ S^{0.54} = 1.318\ x\ 100\ x\ (2.5\ ft)^{0.63}\ x\ (0.32)^{0.54} = 126.8\frac{ft}{s}$$

The flow rate of the water passing through the penstock is therefore estimated to be 126.8 ft/s

The estimated velocity and pipe diameter are then used to calculate the volume of water passing through the penstock:

$$Volumetric\ Flow = Area\ of\ Pipe * Fluid\ Velocity = \pi * (5\ ft)^2\ x\ 126.8\frac{ft}{s} = 9{,}959\frac{ft^3}{s}$$

$$1\ \frac{ft^3}{s} = 448\ gallons\ per\ minute\ (GPM)$$

$$Volume = 9{,}959\frac{ft^3}{s} = 4{,}461{,}564\ GPM$$

The volume of water passing through the penstock is estimated to be 4,461,564 GPM

Volume of Water Withdrawn for Cooling vs. Volume of Water Passing Through the Penstock

Based on information provided by the Fife Brook facility, the volume of water withdrawn for cooling was stated to be approximately 400 GPM.

Percentage of Cooling Water Withdrawn from the Penstock

$$Percentage = \frac{Volume\ Withdrawn\ for\ Cooling}{Volume\ within\ the\ Penstock}\ x\ 100 = \frac{400\ GPM}{4{,}461{,}564\ GPM}\ x\ 100 = \ 0.009\%$$

It is estimated that 0.009% of the water flowing through the penstock is withdrawn for cooling at the Fife Brook facility.

ATTACHMENT 2

2017 HDR FISH ENTRAINMENT EVALUATION STUDY REPORT

SEVEE & MAHER ENGINEERS

Fish Entrainment Evaluation Study Report

Bear Swamp Project (FERC No. 2669)

September 30, 2017

Prepared by:

HDR

Syracuse, NY

Prepared for:

Bear Swamp Power Company, LLC
Rowe, Massachusetts

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List of Acronyms

3-D	Three-dimensional
ADCP	Acoustic Doppler Current Profiler
ArcGIS®	ESRI mapping software
Brookfield	Brookfield Renewable
BSPC	Bear Swamp Power Company, LLC
C.F.R.	Code of Federal Regulations
cfs	cubic feet-per-second
EA	Environmental Assessment
EPRI	Electric Power Research Institute
FBD	Fife Brook Development
FERC	Federal Energy Regulatory Commission (or Commission)
fps	feet-per-second
GeoSyntec	GeoSyntec Consultants
GPS	Global Positioning System
ILP	Integrated Licensing Process
MADEP	Massachusetts Department of Environmental Protection (or MassDEP)
MADFW	Massachusetts Division of Fisheries and Wildlife
MW	megawatt
Normandeau	Normandeau Associates Inc.
Project	Bear Swamp Project
PSD	Bear Swamp Pumped Storage Development
RSP	Revised Study Plan
SPD	Study Plan Determination
TIN	triangulated irregular network
YOY	young-of-year

1 Project Introduction and Background

1.1 Introduction

Bear Swamp Power Company, LLC (BSPC), a limited liability company jointly owned indirectly by Brookfield Renewable (Brookfield) and Emera, Inc., is the Licensee, owner, and operator of the 610-megawatt (MW) Bear Swamp Project (Project) (FERC No. 2669). The Project is located along the Deerfield River in Berkshire and Franklin counties in the Commonwealth of Massachusetts.

The Project consists of the Bear Swamp Pumped Storage Development (PSD) and the Fife Brook Development (FBD). BSPC operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on March 31, 2020. BSPC is pursuing a new license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (C.F.R.) Part 5.

In accordance with 18 C.F.R. § 5.15, BSPC has conducted studies as provided in the study plan and schedule approved in the Commission's October 30, 2015 Study Plan Determination (SPD) for the Project[1]. This report describes the methods and results of the Fish Entrainment Evaluation conducted in support of preparing an application for a new license for the Project.

1.2 Background

In general, hydroelectric facilities have the potential for some level of entrainment of biota into intakes. The potential for fish to become entrained or impinged at a hydroelectric facility is dependent on a variety of factors such as fish life history, size, swimming ability, operating regimes, inflow, magnitude and duration of intake velocities, trashrack bar spacing, and intake/turbine configurations (Cada et al. 1997). Proximity to feeding and rearing habitats also affect the potential for a fish to become entrained. These factors and several others are used to make general assessments of entrainment and impingement potential at hydroelectric projects using a desktop study approach.

The issue of entrainment at the Bear Swamp PSD was evaluated by BSPC in its 2008 amendment application materials relative to the proposed upgrade of the Bear Swamp PSD turbines (BSPC 2008). Fish entrainment was also evaluated by the Massachusetts Division of Fisheries and Wildlife (MADFW), Massachusetts Department of Environmental Protection (MADEP or MassDEP), and FERC relative to the 2008 Application for Non-capacity Amendment of License. By letter dated February 20, 2008, the MADEP reported that the MADFW had confirmed that the proposed upgrade to the Bear Swamp PSD would not impact fisheries:

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[1] The Commission issued a Revised Process Plan and Schedule on January 10, 2017 and on September 7, 2017.

MassDEP has received confirmation from the Massachusetts Division of Fisheries and Wildlife that there are no fisheries issues with the proposed upgrade project… The Bear Swamp Hydroelectric facility has received five (5) Water Quality Certifications for various elements of its construction and operation… The Bear Swamp Project, including the resulting changes to the pumping cycle and discharge rate, is consistent with the terms of those existing Water Quality Certificates. As a result, no amendment to the existing Water Quality Certificates will be required for the Bear Swamp Project.

FERC analyzed the issue within its August 13, 2008, Order Amending License and Approving Revised Exhibit A (Amendment Order) and its associated Environmental Assessment (EA) included as part of that order[2]. FERC's August 13, 2008 order states:

The EA evaluates the environmental effects of the proposed runner replacement and generator rewinds and identifies environmental issues in relation to aquatic resources, recreation, and cultural resources. The proposed action would allow the licensee to enhance the efficiency of the project, while increasing the installed capacity by 66 MW, at the least cost to area environmental resources. Most area resources will not be affected by the proposed action, although there has been concern for an attendant increase in entrainment of impoundment fishes. We have concluded that any increased entrainment of rainbow and brown trout would not be significant and recommend the proposed action be approved. Therefore, we conclude that issuance of this order does not constitute a major federal action significantly affecting the quality of the human environment.

Given this context and background, the Revised Study Plan (RSP) focused on performing a desktop evaluation of entrainment potential for the Fife Brook Development (as one had not been performed), and reexamining and updating (as applicable) certain aspects of the prior evaluations of entrainment potential at the Bear Swamp PSD intake/outlet structure within the Fife Brook impoundment (Lower Reservoir) during pumping.

2 Study Goals and Objectives

In accordance with BSPC's September 30, 2015 RSP and the Commission's SPD for the Project, the goal of this study is to verify or update certain aspects pertaining to the pumping cycle of the Bear Swamp PSD and examine entrainment potential at the Fife Brook Development. The study objectives are to:

- Obtain updated information regarding pumping velocities at and near the Bear Swamp PSD intake/outlet structure located within the Lower Reservoir.
- Perform updated desktop review of entrainment potential at the Bear Swamp PSD during the pumping cycle.
- Perform desktop review of entrainment potential at the Fife Brook Development.

[2] 124 FERC ¶ 62,127 Order Amending License and Approving Revised Exhibit A (2008)

3 Study Area

The study area includes the Project's Lower Reservoir (Fife Brook impoundment) as shown in Figure 3-1.

Figure 3-1. Fish Entrainment Analysis Study Area

4 Methodology

4.1 Intake Characteristics and Velocities

BSPC conducted a desktop review of the characteristics of the intake/outlet structures at the Bear Swamp PSD and the intake structure at the Fife Brook Development. BSPC reviewed existing design drawings, pump/turbine performance information, historical operations data, and materials developed for the 2008 Application for Non-capacity Amendment of License. This information was used to characterize physical features of the intake/outlet structures at the Bear Swamp PSD and the intake structure at the Fife Brook Development relevant to factors that could affect water velocities and fish entrainment. The results of the desktop review were also used to calculate pumping velocities at the Bear Swamp PSD, and calculate intake velocities at the Fife Brook Development.

On October 28 and 29, 2016, BSPC collected data regarding velocity fields and vectors in the vicinity of the Bear Swamp PSD intake/outlet structure and the Fife Brook Development. Velocity data was collected in front of the Bear Swamp PSD's Unit 2 intake/outlet structure during pumping operations and at the Fife Brook Development's intake structure during generation. BSPC collected full water column velocity measurements while Lower Reservoir elevations were nominally at 836 feet on October 28, 2016 and 862 feet on October 29, 2016.

Velocity data was collected using an Acoustic Doppler Current Profiler (ADCP) mounted on a motorized jon boat. BSPC collected longitudinal and transverse velocity profiles upstream of, and for a select distance from, the Fife Brook intake structure and the Bear Swamp PSD intake/outlet structure. ADCP instrumentation was applied to measure three-dimensional (3-D) velocity vectors. At least one parallel transverse transect for the velocity measurements were positioned immediately upstream of each structure, as close to the trashrack surface as the instrumentation would allow. Both the longitudinal and transverse transects were located using Global Positioning System (GPS) and positioned to optimize full water column velocity profiles between the reservoir surface and bottom. Efforts were made to position velocity transects as close to the intakes as possible; however, signal interference from the Bear Swamp PSD intake/outlet structure, Fife Brook Dam, and shoreline, limited the transect proximity to the intakes.

Following post-processing of the data, the full set of individual soundings and velocities were exported into ArcGIS® (ESRI mapping software) to interpolate and plot. First, the elevation measurements were combined into a triangulated irregular network (TIN), and a tool was used to identify outliers in the data. Outliers can be caused by a number of reasons, including beams that bounce off bubbles, fish, or debris in the water, or significant heave, waves, or swell along the transect. Once outliers were removed, the ArcGIS® tool "Topo to Raster" was used to grid the data, reducing noise and providing a continuous map of elevation and velocity by interpolation. This gridded data set was clipped to remove data interpolated beyond the borders of the survey areas, and used to generate contour lines and velocity plots.

4.2 Desktop Review of Entrainment Potential

BSPC conducted an entrainment evaluation of target and surrogate fish species identified through field sampling conducted at the Project's Lower Reservoir in 2016 (HDR 2017*c*). The potential for fish to become entrained or impinged at a hydroelectric facility is dependent on a variety of factors such as fish life history, size, and swimming ability; water quality; operating regimes; inflow; and intake/turbine configurations (Cada et al. 1997). A gradient of potential exists both temporally and spatially, where smaller-sized fish may be in higher abundances during certain portions of the year, thus increasing their potential for entrainment. In addition, diurnal and seasonal movements of both small and large fish may bring them in close proximity to intake structures. Physical and operational characteristics of a given project, including trashrack bar spacing, magnitude and duration of intake velocities, intake depth, stratification, and intake proximity to feeding and rearing habitats also affect the potential for fish to become entrained. These and other factors are considered when making general assessments of entrainment potential at hydroelectric projects using a desktop study approach.

4.2.1 Entrainment, Trashrack Spacing, and Intake Avoidance

For this analysis, BSPC considered impingement and intake avoidance based on the 3-inch clear spacing at the Fife Brook Development and the 6-inch clear spacing at the Bear Swamp PSD. This process involved comparing available target fish swim speeds with calculated intake velocities, as well as estimating minimum fish lengths for the target fish species that would be excluded or impinged by either the 3-inch or 6-inch clear spacing. A scaling factor relating fish body width to total length was used for the entrainment assessment to determine minimum sizes of the target fish species that would physically be excluded by the trashracks (Smith 1985).

4.2.2 Fish Entrainment Rates

An extensive literature review was conducted on entrainment studies for various hydroelectric facilities throughout the United States. Recent FERC relicensing entrainment studies (HDR 2011, 2010*a*, 2010*b*, 2010*c*; HDR|DTA 2010*a*, 2010*b*; GeoSyntec Consultants [GeoSyntec] 2005; Normandeau Associates Inc. [Normandeau] 2008; Normandeau 2009) have utilized desktop study approaches for such assessments, where data compiled by the Electric Power Research Institute (EPRI) (1992, 1997*a*, 1997*b*) and FERC (1995*a*, 1995*b*) has most commonly been used for comparative purposes. These reports have detailed trends and correlations between fish community characteristics, entrainment rates, mortality, and passage with hydroelectric plant design and operation.

4.2.3 EPRI Database and FERC Literature

The EPRI (1997*a*) entrainment database provides results from field trials conducted at 43 hydroelectric facilities east of the Mississippi River using full-flow tailrace netting. This involves the placement of a conical net in the immediate tailrace to collect the entire discharge on a seasonal or monthly basis. This results in relatively accurate entrainment rates (fish/volume of water if recorded, or fish/hour/cubic feet-per-second [cfs] of sampled unit capacity), including the number, species, and size of entrained fish.

Characteristics from all 46 developments (Appendix A) from EPRI (1997*a*) and FERC (1995*a*, 1995*b*) and associated entrainment netting study results were considered for use in the entrainment assessment. However, only 38 sites[3] presented in EPRI (1997*a*) were used because five of the EPRI database sites previously mentioned did not calculate net collection efficiency. In addition, the three FERC sites (FERC 1995*a*, 1995*b*) were excluded from this analysis because water quantities were not calculated during entrainment testing.

The entrainment evaluation involved the comparison of Project pump/turbine unit specifics, hydrology, operations, and the calculation of mean annual, monthly, and seasonal entrainment rates for the target or surrogate species. Seasons were defined by the following months: winter = December, January, and February; spring = March, April, and May; summer = June, July, and August; and fall = September, October, and November. Several of the target species were not represented in the EPRI database; therefore, a surrogate rate, family rate, or guild was used (i.e., darter group).

Since only approximately half of the studies in the EPRI database recorded volume of water sampled, the number of fish/hour/1,000 cfs of unit capacity was used in this assessment. This allowed for the standardization of the data and provided a larger sample size to draw from. All of the projects/studies in the database recorded hours sampled, as well as provided the hydraulic capacity of the sampled units. Other potential sources of error in the database include net intrusion of fish in the tailrace. Larger fish will often enter the draft tube before the net is installed, thus potentially allowing for net intrusion of fish that actually did not pass through the turbines.

Some desktop entrainment studies have only used a few hydroelectric projects from the EPRI database which closely resemble the project being evaluated. Projects are often selected based on similarities in hydraulic capacity, operations, reservoir size, species compositions, and regional proximity; however, this method is subjective and can reduce the application of the database in terms of target species representation and monthly entrainment rate data. Fish populations are very dynamic and can change from year-to-year within and between projects, depending on certain biotic (recruitment and year class strength) and abiotic (flow and temperature) interactions. For example, high recruitment in a given year may increase a species potential for entrainment based on density alone. Although certain projects used may not match the specifications of the Bear Swamp Project, it is our opinion that using as many projects as possible from the EPRI database

[3] Data from these 38 sites are referenced herein as the “EPRI database.”

accounts for the variability of aquatic ecosystems and fish populations, while providing a robust database for calculating average monthly entrainment rates for a wide range of species. This is a common approach that BSPC's relicensing consultant, HDR, has used in other entrainment evaluations.

EPRI (1997*a*) developed a five-tier qualitative index of entrainment abundance (i.e., an estimate of the relative amount of fish to become entrained) from low to high based upon break points in relative entrainment abundance between species and sizes. These qualitative categories are utilized in this study to describe entrainment potential of the target fish species on a monthly basis. Most species tended to have a peaked seasonal distribution of entrainment densities in the EPRI database. The mean monthly, seasonal, and annual estimates of entrainment provide a general assessment of entrainment risk for the target species based on empirical data at various hydroelectric projects; however, it does not adequately describe the true potential of a species as a function of the site-specific layout and hydraulics of the Project. A matrix of target species' entrainment potential at the Project was constructed on a seasonal basis using the empirical entrainment rate data from the EPRI database, species periodicity, abundance, and expected distributions.

4.2.4 Turbine Entrainment Estimates

Seasonal and annual target/surrogate species entrainment potential was determined from the EPRI database. These include all fish size classes (<4 inches, 4-8 inches, 8-15 inches, and >15 inches) combined for each species. Mean monthly seasonal target species entrainment rates for each of these size groups is provided in Appendix B. Seasonal entrainment rates were calculated by summing the monthly entrainment rates for the respective months, which represent a mean from all sites in the EPRI database, and excluding those projects that did not adjust values for net collection efficiency mentioned above. Annual entrainment rates were calculated by summing the seasonal rates.

5 Study Results

5.1 Intake Characteristics and Velocities

Pursuant to the SPD, BSPC has identified the key physical characteristics and velocity information associated with the Fife Brook Development intake and the Bear Swamp PSD intake/outlet structure located within the Lower Reservoir. Physical characteristics are taken from Project drawings and velocity information has been developed through both field data collection and hydraulic calculations.

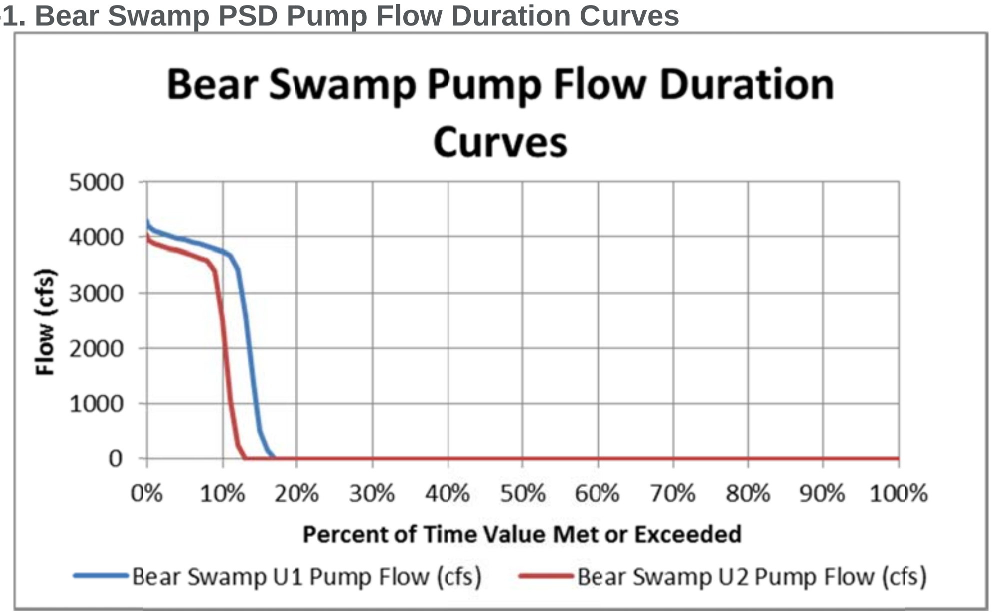
5.1.1 Bear Swamp

Existing Conditions

As described in the PAD, water is conveyed between the Bear Swamp PSD powerhouse and the Lower Reservoir via a 4-bay, Lower Reservoir intake/outlet structure (two, 15-foot-wide by 20-foot-high bays per draft tube tunnel). Each bay is equipped with a slide gate with a sill elevation of 790 feet, and a 28-foot-long (normal to flow), 15-foot-wide trashrack panel consisting of 15/16-inch-wide bars having 6-inch clear spacing. Accordingly, the total flow area at the face of each trashrack panel is 420 square feet, or 840 square feet per unit. The rated maximum pump flow of each of the two existing units is 4,520 cfs, which results in a calculated theoretical maximum velocity of 5.4 feet-per-second (fps) immediately at the face of the trashracks of each unit.

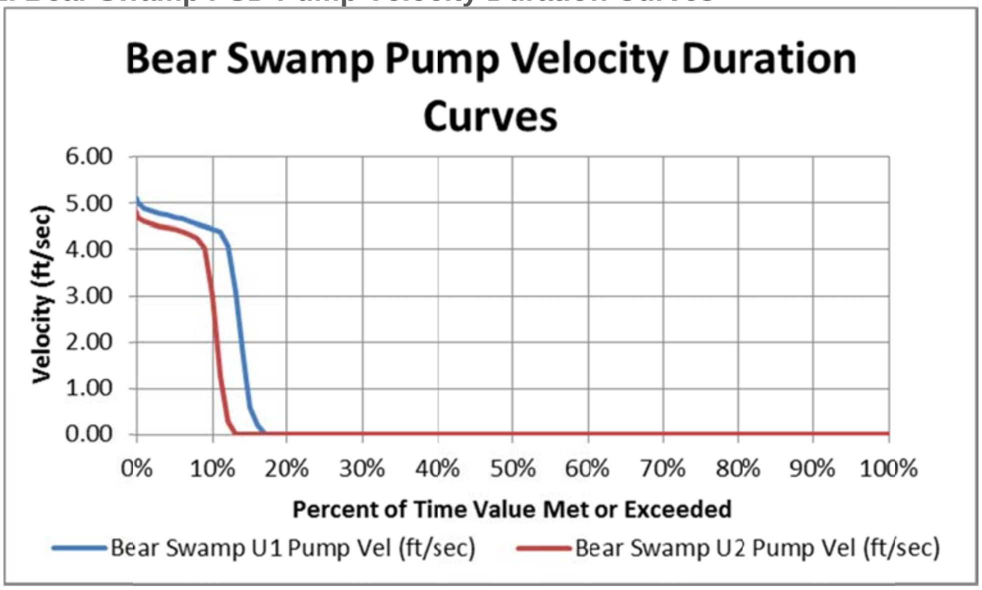
However, the wide range of pump head conditions, in conjunction with an examination of historical operation data (period 2005-2016) indicate this maximum pump flow rating has not been achieved during this period of record. Accordingly, it is noteworthy to examine historical pump flow conditions in the context of pump flow duration curves by unit. As shown in Figure 5-1 below, Unit 1 and Unit 2 historical maximum pump flows are approximately 4,200 cfs and 4,000 cfs respectively (the difference likely reflective of somewhat varying equipment use and site characteristics). Additionally, the concept of pump flows generally decreasing during the pumping cycle as differential pump head increases is apparent in the 0-12 percent range for Unit 1 and 0-9 percent range for Unit 2, and these ranges represents the bulk of the pump cycle (with steep declines beyond these points reflective of transitional pump flows as full pump speed neither begins nor ends instantaneously). Pump flows over the course of the Unit 1 and 2 operational cycles occur approximately 16 percent and 12 percent of the time, respectively; therefore, intake velocities of any magnitude occur only briefly.

Figure 5-1. Bear Swamp PSD Pump Flow Duration Curves



With this, the total flow area at the face of the trashracks (840 square-feet per unit) can be applied to the flow ordinates within the pump flow duration curves to derive Bear Swamp PSD pump velocity duration curves as shown in Figure 5-2 below.

Figure 5-2. Bear Swamp PSD Pump Velocity Duration Curves



As depicted, the maximum velocities immediately at the face of the Unit 1 and 2 trashracks (approximately 5.1 fps and 4.8 fps respectively) are short-lived with the velocities being between 4 and 4.5 fps during the majority of the pump cycle.

To evaluate the potential for entrainment however, the water velocities need to be considered both at the face of the racks and in the immediate vicinity of the intakes; i.e. the trapezoidal area of the rock excavation in front of the intake structure where the intake excavation intersects the reservoir proper. It is also worthwhile to note that, since the racks are deeply submerged, the area of potential influence at full pond elevation will be different than the area of influence when the reservoir is at low pond; i.e. the cross-sectional area at the face of the trapezoidal shaped intake area at a pond elevation of 870 feet is approximately 5,240 square feet, and at a pond elevation of 830 feet it is approximately 2,120 square feet.

The average velocity within the trapezoidal flow area of Unit 1 at its historical maximum pump flow (4,200 cfs) and at a maximum Lower Reservoir elevation of 870 feet (5,240 square-feet) is calculated to be 0.8 fps at a point approximately 1.6 feet away from the trashracks. As noted above, pump flow rates tend to decrease across the pump cycle as minimum Lower Reservoir elevations are reached. However, if the Unit 1 historical maximum pump flow was assumed to exist at a minimum Lower Reservoir elevation of 830 feet (2,120 square-feet); the calculated average velocity would be 1.98 fps. Similar calculations for Unit 2 at its historical maximum pump flow of 4,000 cfs yield 0.76 fps and 1.9 fps respectively. Lastly, if the maximum pump flow rating of 4,520 cfs were assumed to exist within this trapezoidal flow area at elevations 870 and 830, the calculated velocities would be 0.86 fps and 2.1 fps respectively.

Accordingly, not only do pump velocities decrease over the pump cycle, calculated pumped velocities quickly diminish within very short distances from the trashracks, which is corroborated by field data collected using ADCP equipment to measure velocity vectors as summarized below.

From October 28-29, 2016, ADCP velocity vector data was collected immediately in front of Unit 2 with Fife Brook elevations and Bear Swamp PSD Unit 2 pump flows nominally at 836 feet and 3,660 cfs on October 28 and 862 feet and 3,885 cfs on October 29. Unit 1 was out of service during this time; however, the flow area geometry of each unit is identical with only a nominal difference in maximum historical pump flows as described above. As such, data collected in front of Unit 2 reasonably reflects conditions in front of Unit 1. Figure 5-3 through Figure 5-8 below depict the results from each day with slices through the data cloud taken at high, mid and low points within the water column present each day (with Unit 2 being on the left in the plan view orientation of the figures). As is evident from Figure 5-3 through Figure 5-8, all velocities on each day within the area in front of Unit 2 are under 1 fps.

Figure 5-3. Bear Swamp PSD Unit 2 Pump Operation at Nominal Lower Reservoir Elevation of 836 feet, Water Velocity and Direction (Bottom Depth)

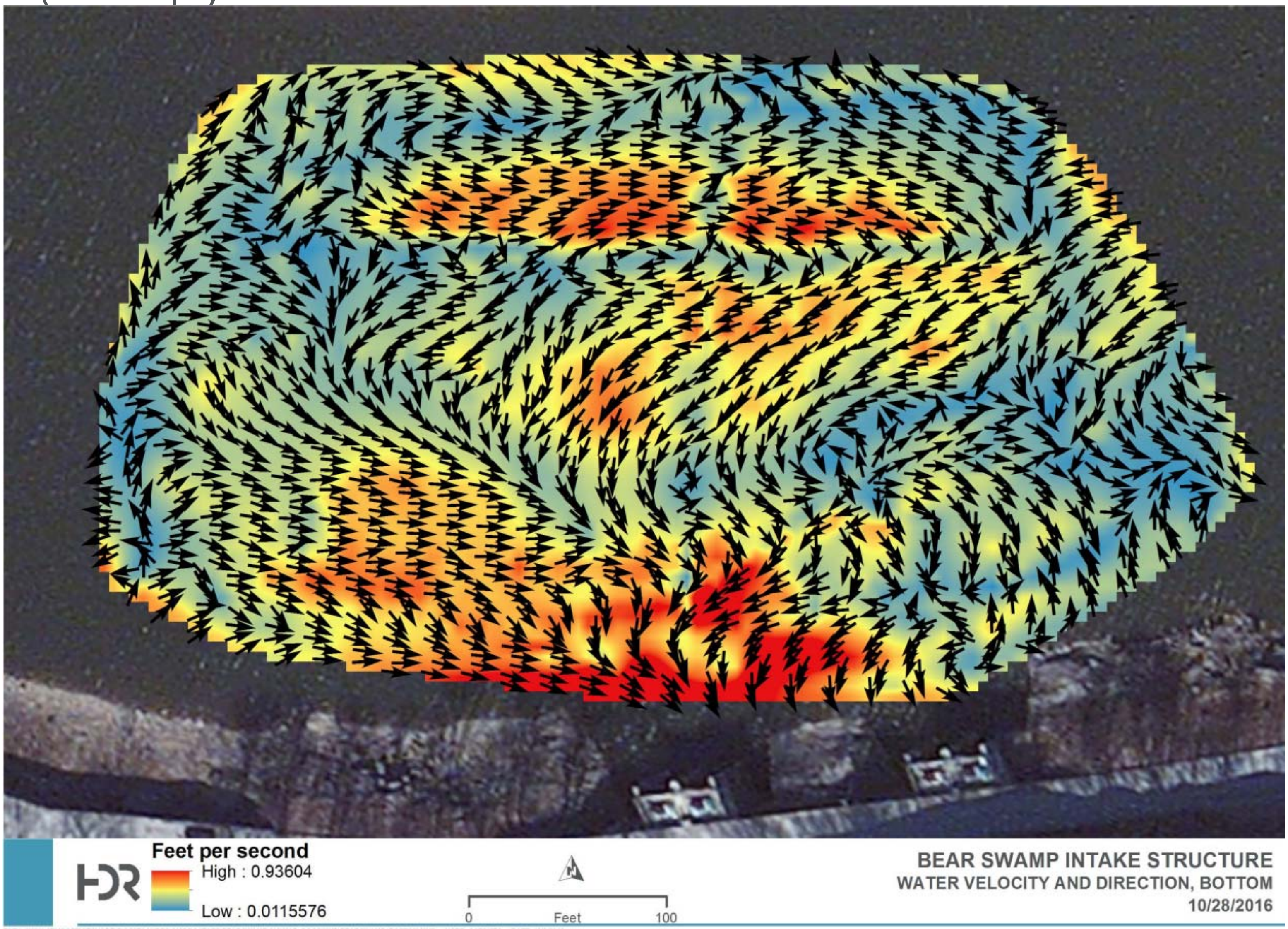


Figure 5-4. Bear Swamp PSD Unit 2 Pump Operation at Nominal Lower Reservoir Elevation of 836 feet, Water Velocity and Direction (Middle Depth)

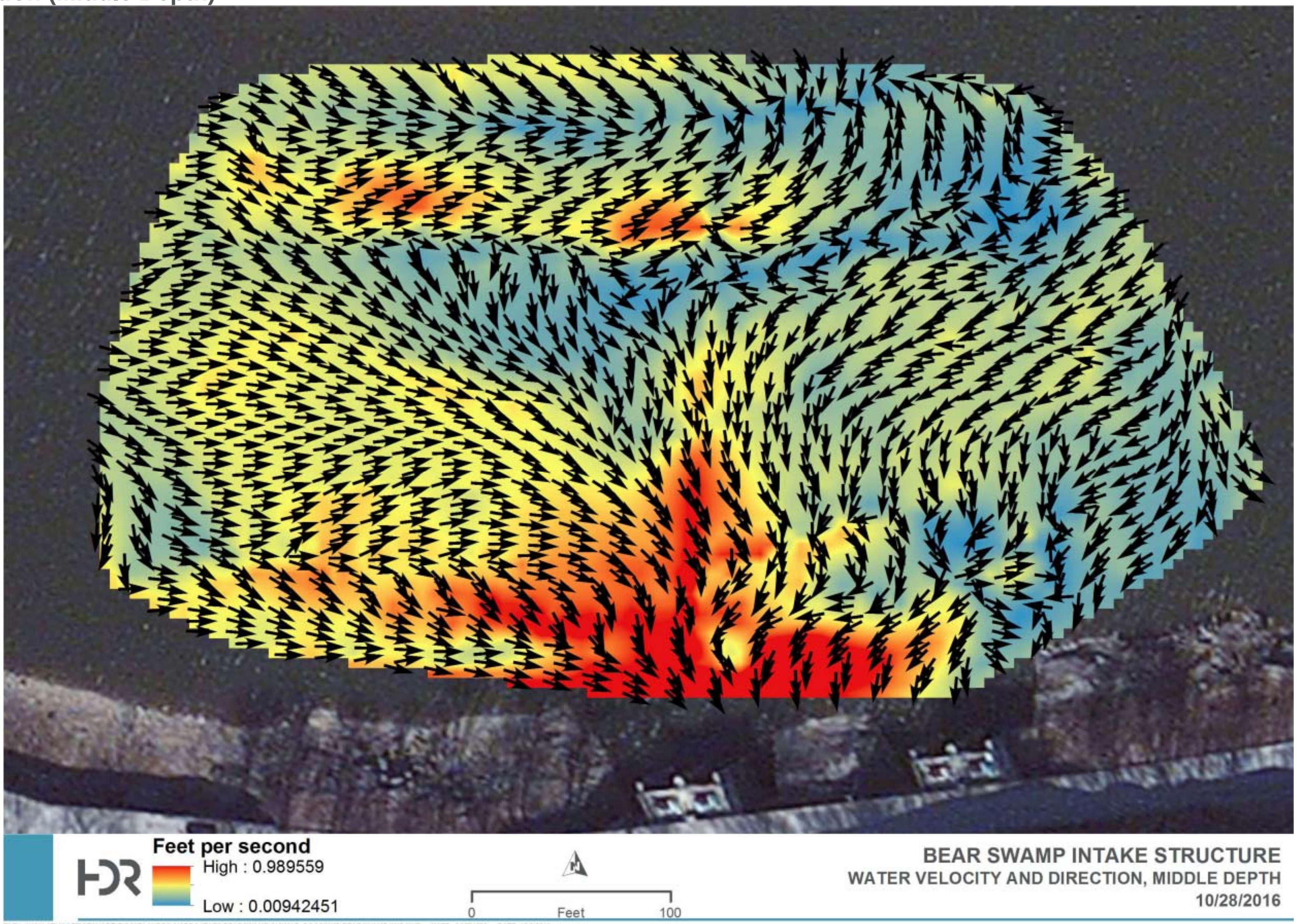


Figure 5-5. Bear Swamp PSD Unit 2 Pump Operation at Nominal Lower Reservoir Elevation of 836 feet, Water Velocity and Direction (Surface Depth)

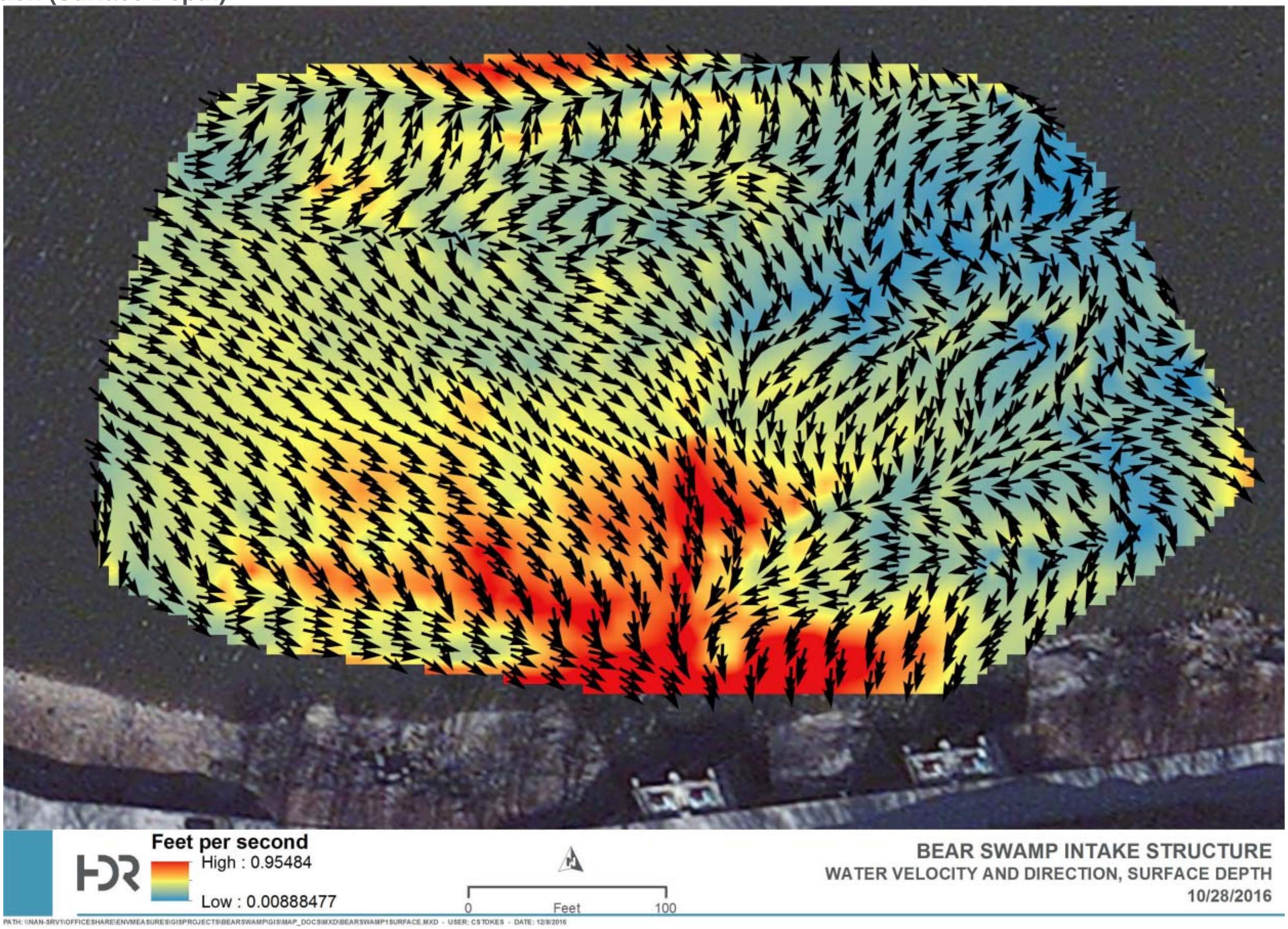


Figure 5-6. Bear Swamp PSD Unit 2 Pump Operation at Nominal Lower Reservoir Elevation of 862 feet, Water Velocity and Direction (Bottom Depth)

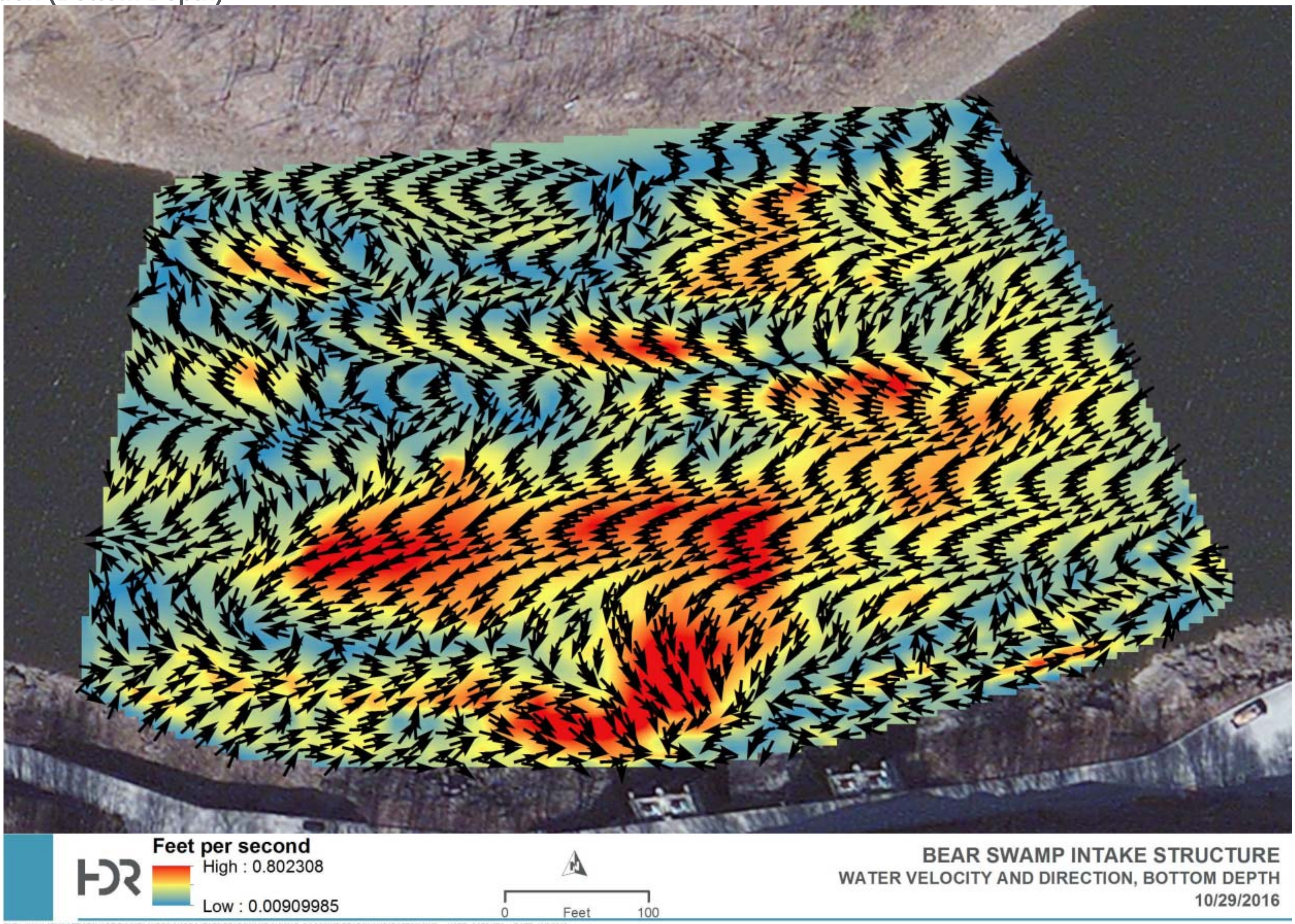


Figure 5-7. Bear Swamp PSD Unit 2 Pump Operation at Nominal Lower Reservoir Elevation of 862 feet, Water Velocity and Direction (Middle Depth)

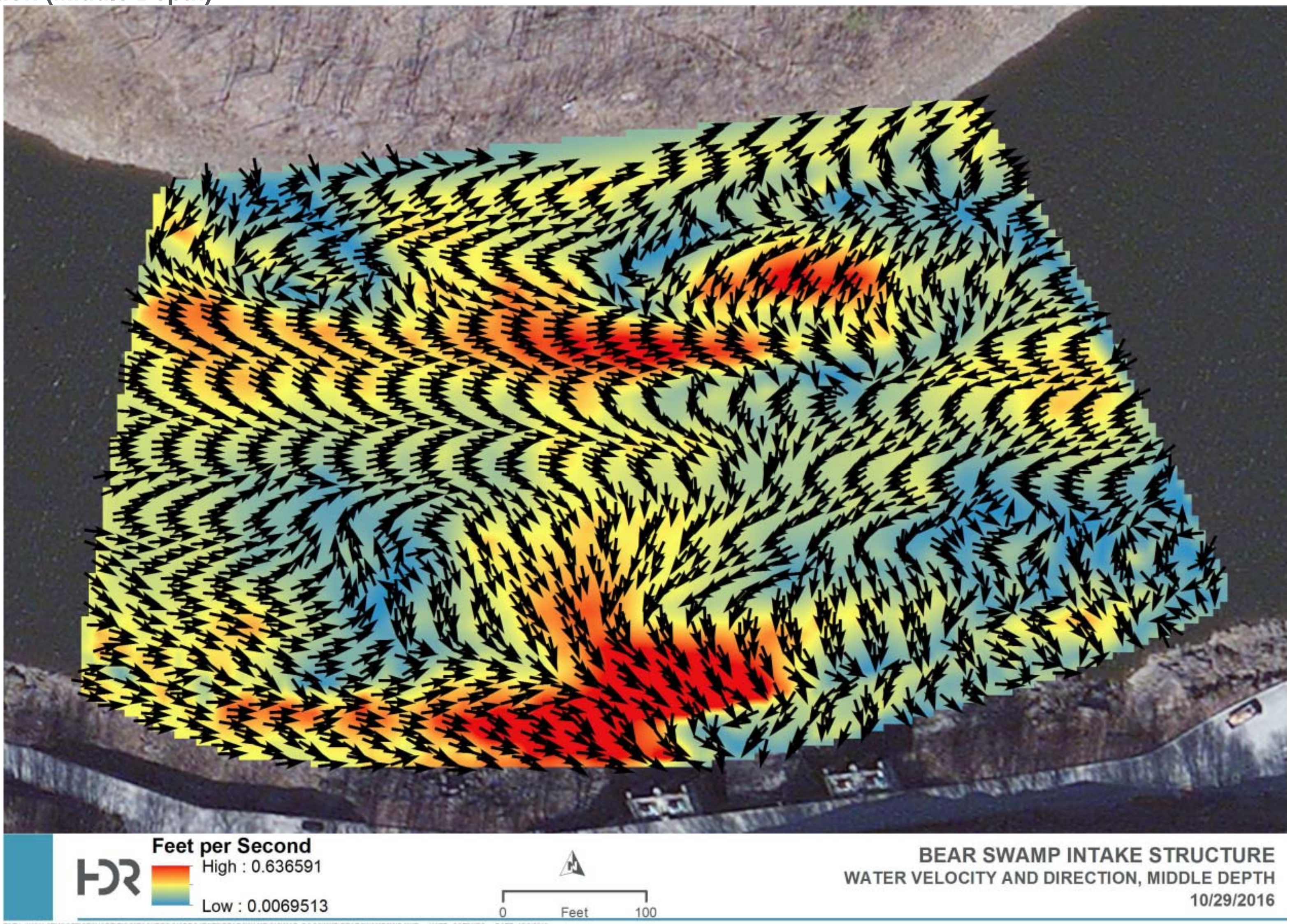
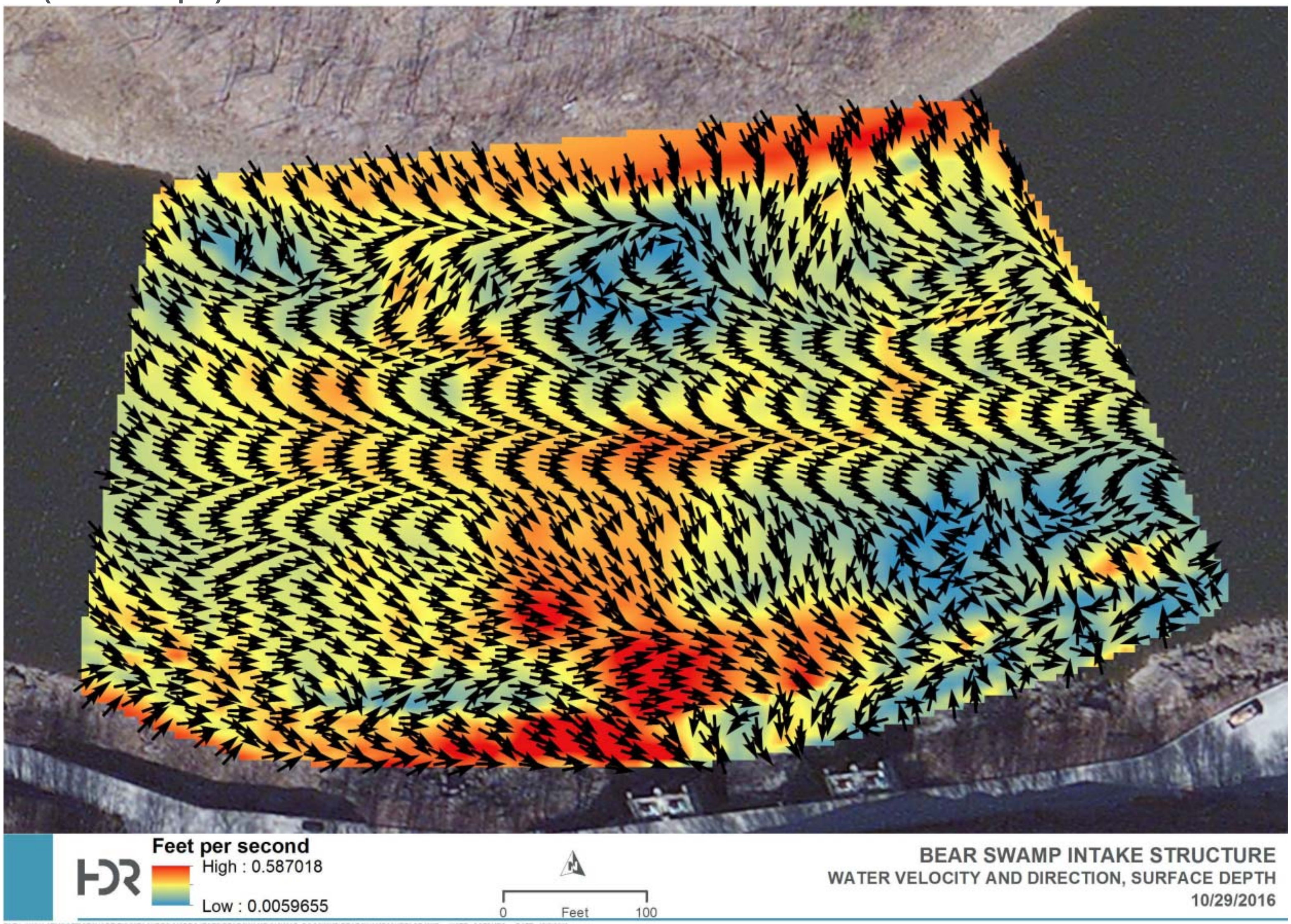


Figure 5-8. Bear Swamp PSD Unit 2 Pump Operation at Nominal Lower Reservoir Elevation of 862 feet, Water Velocity and Direction (Surface Depth)



Inasmuch as velocities at the face of the Unit 1 and 2 trashracks are calculated as approximately 5.1 fps and 4.8 fps, respectively, based on historical data (and could reach 5.4 fps if the maximum pump flow rating of 4,520 cfs were achieved); key observations include:

- Peak velocities at the face of the trashracks are short-lived, decrease over the course of the pumping cycle and are essentially confined to the face of the trashracks;
- Calculated velocities using historical data and at a point approximately 1.6 feet away from the trashracks within the trapezoidal flow areas quickly reduce to less than 2 fps;
- All ADCP velocity vector data in front of Unit 2 was measures less than 1 fps; and
- Pump flows and associated pump velocities of any magnitude only occur approximately 16 percent and 12 percent of the time of the Unit 1 and 2 operational cycles, respectively.

Collectively, these observations confirm that pump velocities decrease substantially within a very short distance from the trashrack face, and there is no substantive influence that exists or extends into the Lower Reservoir.

Prospective Upgrade Conditions

FERC's August 13, 2008 Amendment Order authorizes BSPC to rehabilitate and upgrade the two 40-year-old pump-turbine units at the Bear Swamp PSD. As it relates to pump flow ratings, the existing maximum pump flow rating of 4,520 cfs for each unit would increase by approximately 600 cfs per unit to 5,120 cfs (an increase of 13 percent).

Based on the flow area geometry described above, calculated velocities at the face of the trashracks under an upgraded maximum pump flow rating of 5,120 cfs would be 6.1 fps. Calculated velocities within the trapezoidal flow area 1.6 feet away from the trashracks and at Lower Reservoir elevations of 870 and 830 would be 0.98 fps and 2.4 fps respectively if the 5,120 cfs were to exist at both elevations.

These findings, using drawings and flow area geometry for this study, are generally and thematically consistent with those contained in the 2008 Amendment Application and subsequent filings. That is, although exact values may vary between present and past calculations, each documents the higher velocities immediately at the face of the intake structure with a substantial decrease and decay of velocities within a very short distance of the face of the intake structure. As such, key observations applicable to existing conditions would apply to upgraded conditions and it is not expected that there would be any substantive influence that would extend into the Lower Reservoir under upgraded conditions.

Velocities for Use in Entrainment Characterizations

The velocities used in the Bear Swamp PSD entrainment characterizations later in this report are based on the present calculations within the trapezoidal flow area at a point 1.6 feet from the trashracks. Further, even though maximum pump flow ratings may be rarely achieved and pump flow rates decline over the course of a pump cycle, the entrainment characterizations will consider velocities under worst-case conditions using the higher maximum pump flow ratings coupled with the smaller trapezoidal flow area as summarized in Table 5-1 below, recognizing the low probability of occurrence of such velocities.

Table 5-1. Velocities for Entrainment Characterizations under Existing and Upgraded Conditions

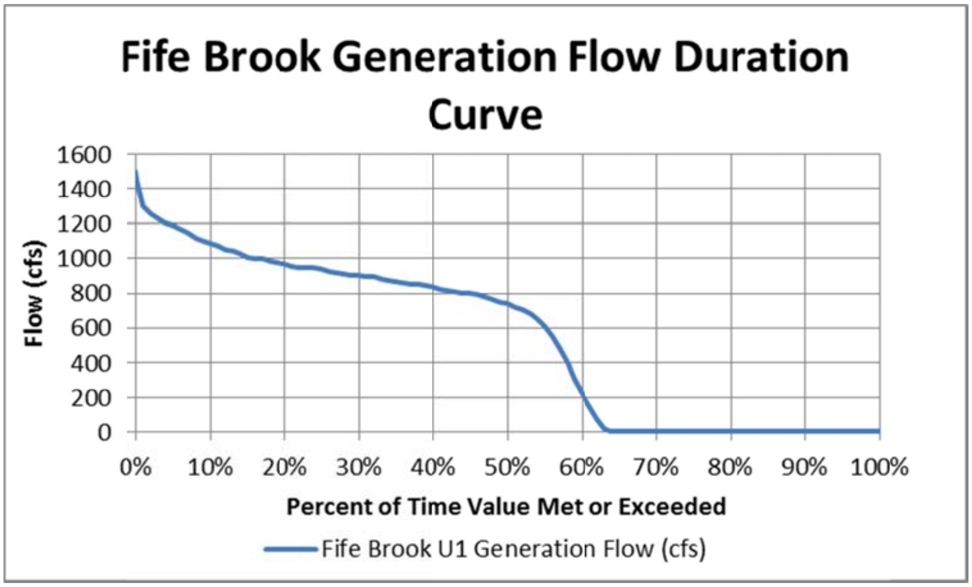
Condition	Location	Theoretical Maximum Pump Flow Rating (cfs)	Area (square-feet)	Worst Case Velocity (ft/sec)
Existing	Trapezoidal Flow Area 1.6 ft from Trashracks	4,520	2,120	2.1
Upgraded	Trapezoidal Flow Area 1.6 ft from Trashracks	5,120	2,120	2.4

5.1.2 Fife Brook

The intake to the Fife Brook powerhouse is located within the Fife Brook Dam adjacent to the eastern abutment of the tainter gate spillway structure. The single intake is equipped with a 25.1-foot-long (normal to flow), 22-foot-wide trashrack panel consisting of 0.5-inch-wide bars having 3.0-inch clear spacing and a 15-foot by 18-foot headgate and hoist, and stoplog slots upstream of the headgate. A 10-foot-diameter steel penstock, encased in concrete and approximately 200 feet long, conveys water to the powerhouse. Accordingly, the total flow area at the face of the trashracks is 552 square feet. The theoretical maximum flow rating of the Fife Brook turbine is 1,540 cfs, which results in a maximum calculated velocity of 2.8 fps immediately at the face of the trashracks.

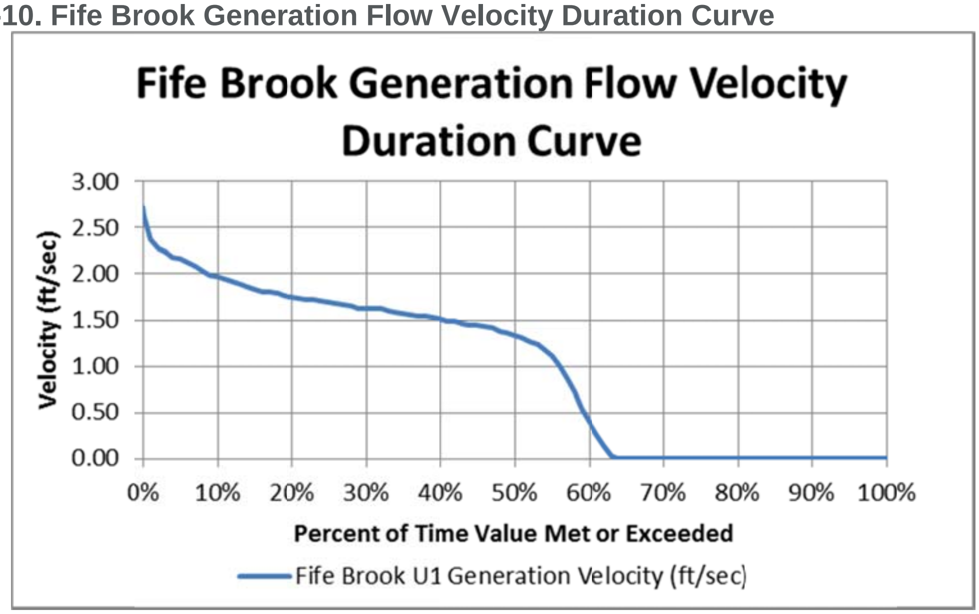
However, the wide range of potential head conditions (870 feet to 830 feet) in conjunction with examination of historical operation data (period 2005-2016) indicate this maximum turbine flow rating has very rarely (if ever fully) been achieved during this period of record. Accordingly, it is noteworthy to examine historical turbine flow conditions in the context of generation flow duration curves. As shown in Figure 5-9 below, Fife Brook historical maximum turbine flow is approximately 1,500 cfs with 96 percent of flows being at or below 1,200 cfs.

Figure 5-9. Fife Brook Generation Flow Duration Curve



With this, the total flow area at the face of the trashracks (552 square-feet) can be applied to the flow ordinates within the generation flow duration curve to derive a Fife Brook generation velocity duration curve as shown in Figure 5-10 below.

Figure 5-10. Fife Brook Generation Flow Velocity Duration Curve



As depicted, maximum velocities at the face of the deeply submerged trashracks are calculated to be approximately 2.7 fps with velocities at or below 2 fps 92 percent of the time.

However, the intake structure sits immediately adjacent to deep and broad open-water flow areas, whereby local velocities at the trashrack face quickly decrease with distance upstream from the trashracks. Unlike the submerged trashrack face area which is fixed and does not change as Lower Reservoir elevations change, the flow area 1 foot upstream from the trashrack changes as water levels change. Accordingly, it is appropriate to examine calculated velocities within the flow area 1 foot upstream from the trashrack at maximum and minimum Lower Reservoir levels, with such areas at Lower Reservoir elevations of 870 feet and 830 feet being approximately 8,550 square-feet and 2,200 square-feet respectively.

Considering this, the average velocity within the flow area 1 foot upstream from the trashrack at the Fife Brook Development's intake structure at its historical maximum turbine flow (1,500 cfs) and at a maximum Lower Reservoir elevation of 870 feet (8,550 square-feet) is calculated to be 0.17 fps. If the historical maximum unit flow was assumed to exist at a minimum Lower Reservoir elevation of 830 feet (2,200 square-feet) the calculated average velocity would be 0.68 fps. Lastly, if the maximum unit flow rating of 1,540 cfs were assumed to exist within this area 1 foot upstream from the trashrack at elevations 870 and 830, the calculated velocities would be 0.18 fps and 0.7 fps, respectively.

As noted above, calculated flow velocities quickly diminish within very short distances from the trashrack, which is corroborated by field data collected using ADCP equipment to measure velocity vectors as summarized below. From October 28-29, 2016, ADCP velocity vector data was collected immediately in front of the Fife Brook intake with Lower Reservoir elevations and generation flows nominally at 836 feet and 800 cfs on October 28, and 862 feet and 800 cfs on October 29th. Figure 5-11 through Figure 5-16 below depict the results from each day with slices through the data cloud taken at high, mid, and low points within the water column present each day. As is evident from Figure 5-11 through Figure 5-16, all velocities on each day are under 2 fps, with the vast majority being below 1 fps.

Figure 5-11. Fife Brook Generation at Nominal Lower Reservoir Elevation of 836 feet, Water Velocity and Direction (Bottom Depth)

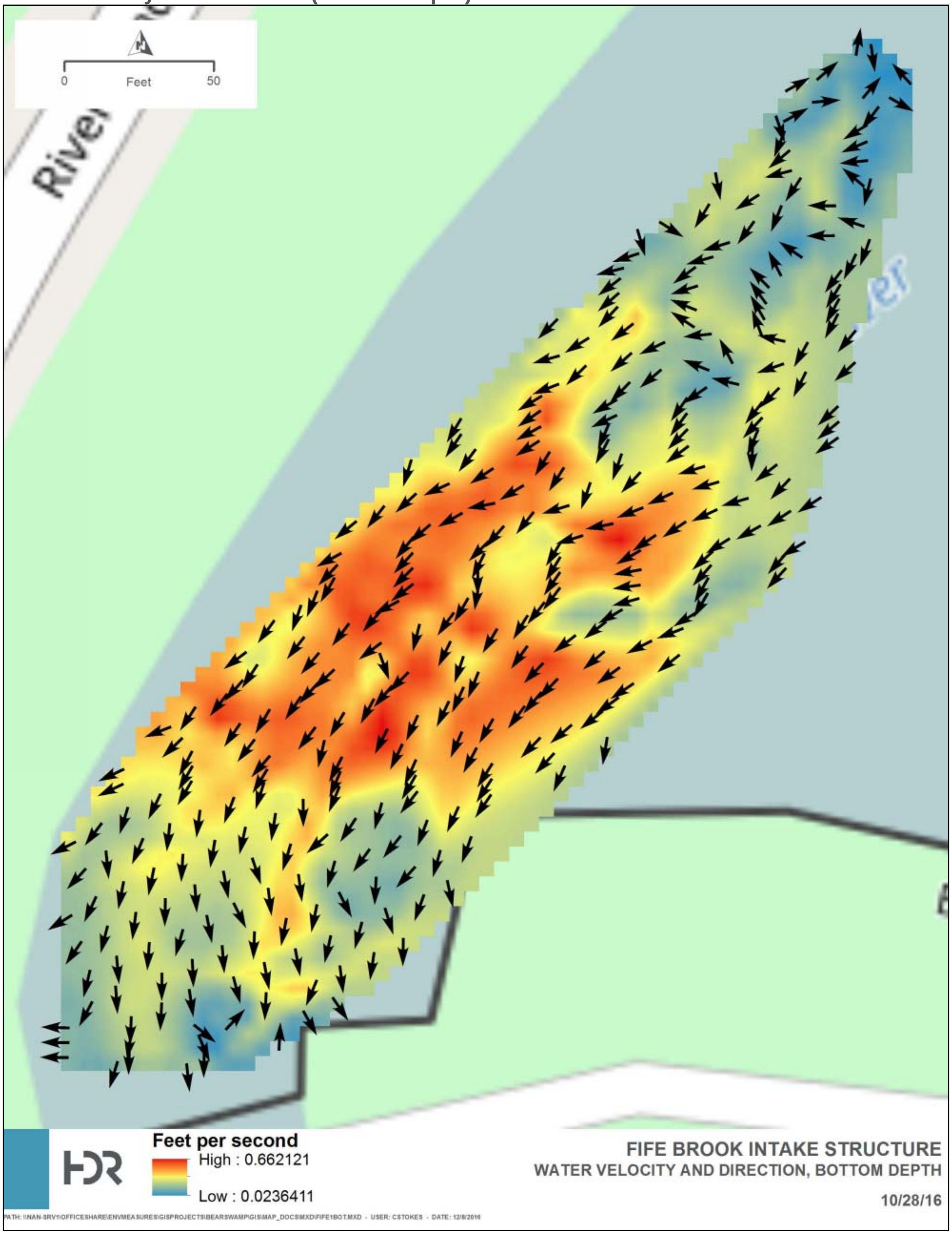


Figure 5-12. Fife Brook Generation at Nominal Lower Reservoir Elevation of 836 feet, Water Velocity and Direction (Middle Depth)

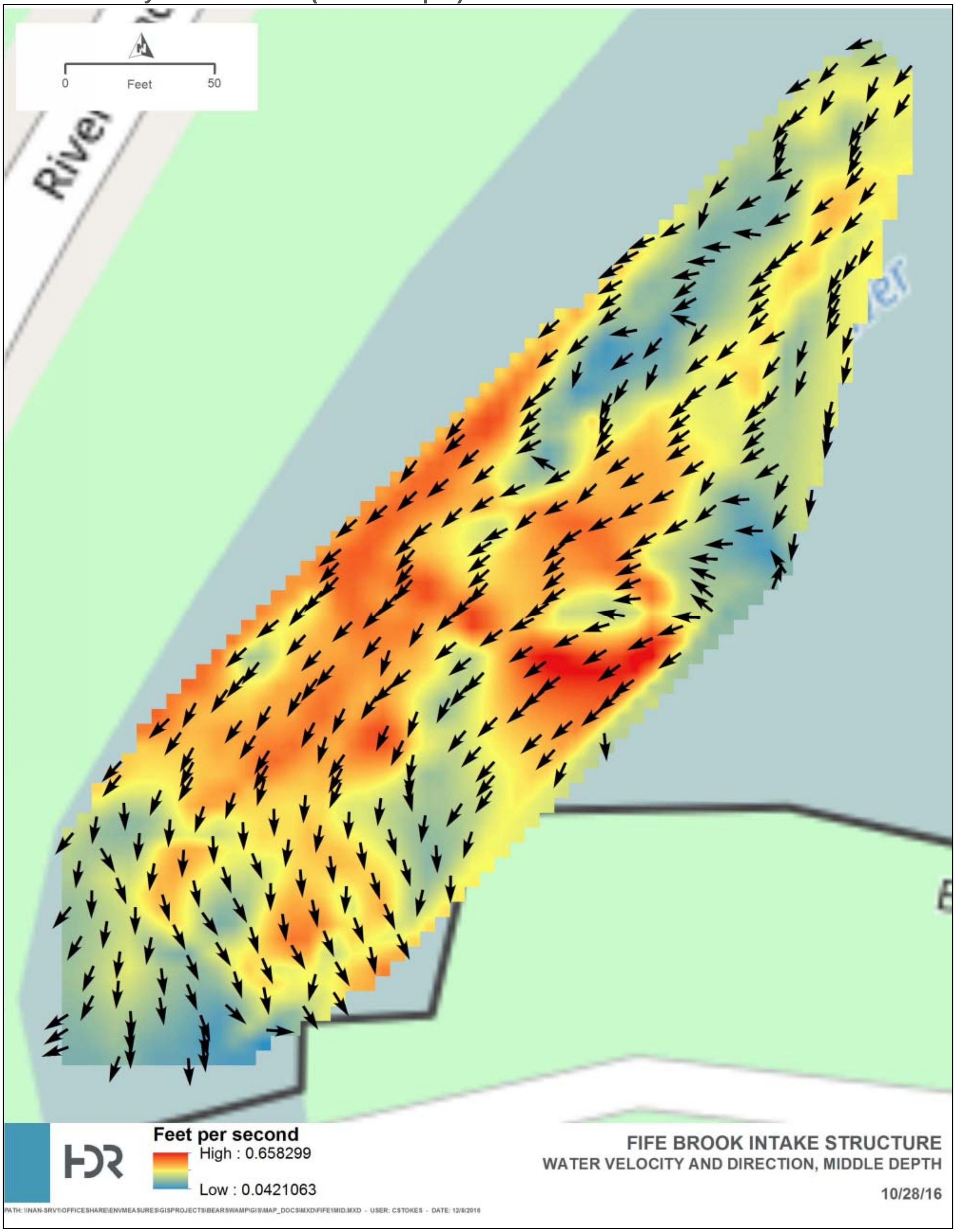


Figure 5-13. Fife Brook Generation at Nominal Lower Reservoir Elevation of 836 feet, Water Velocity and Direction (Surface Depth)

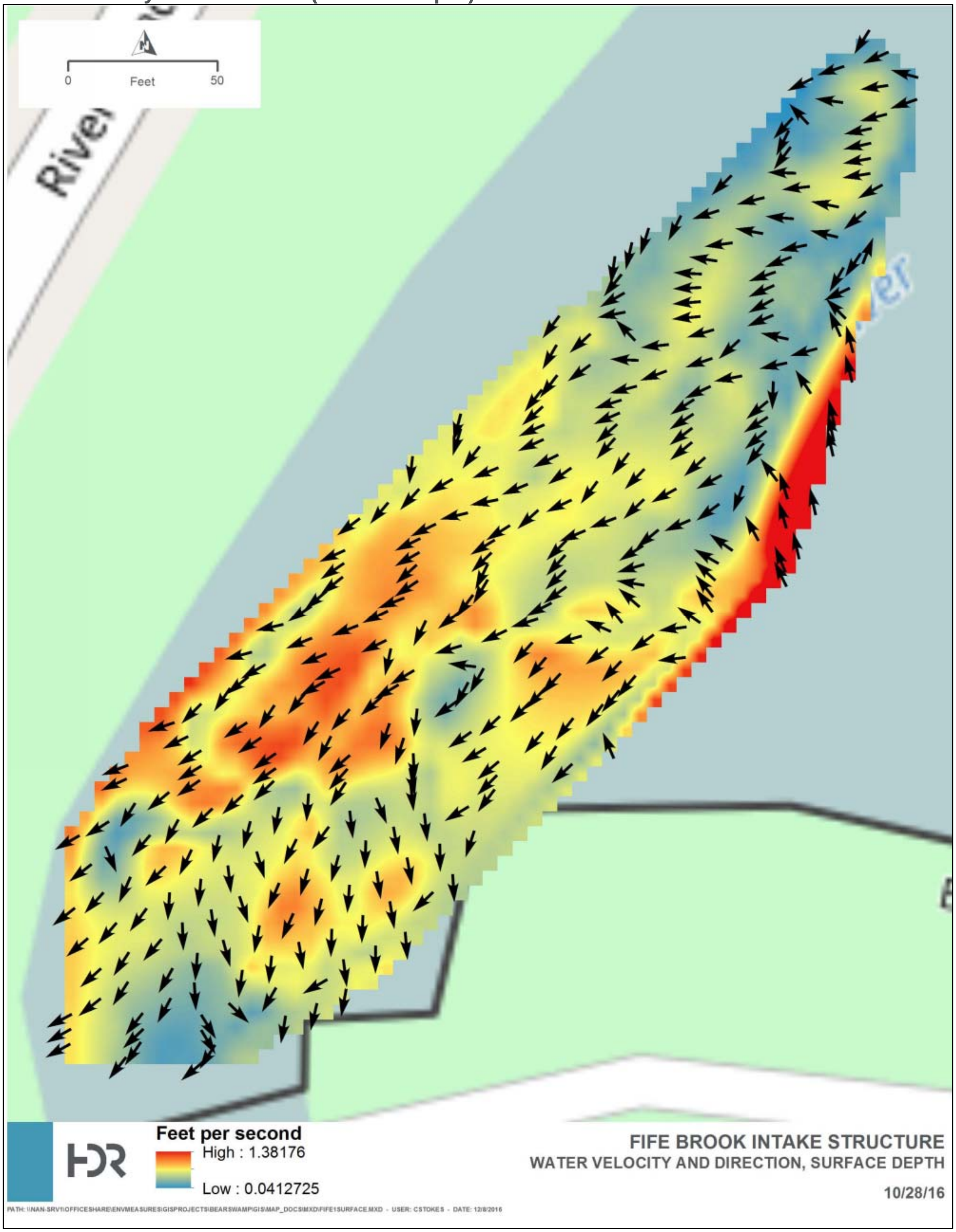


Figure 5-14. Fife Brook Generation at Nominal Lower Reservoir Elevation of 862 feet, Water Velocity and Direction (Bottom Depth)

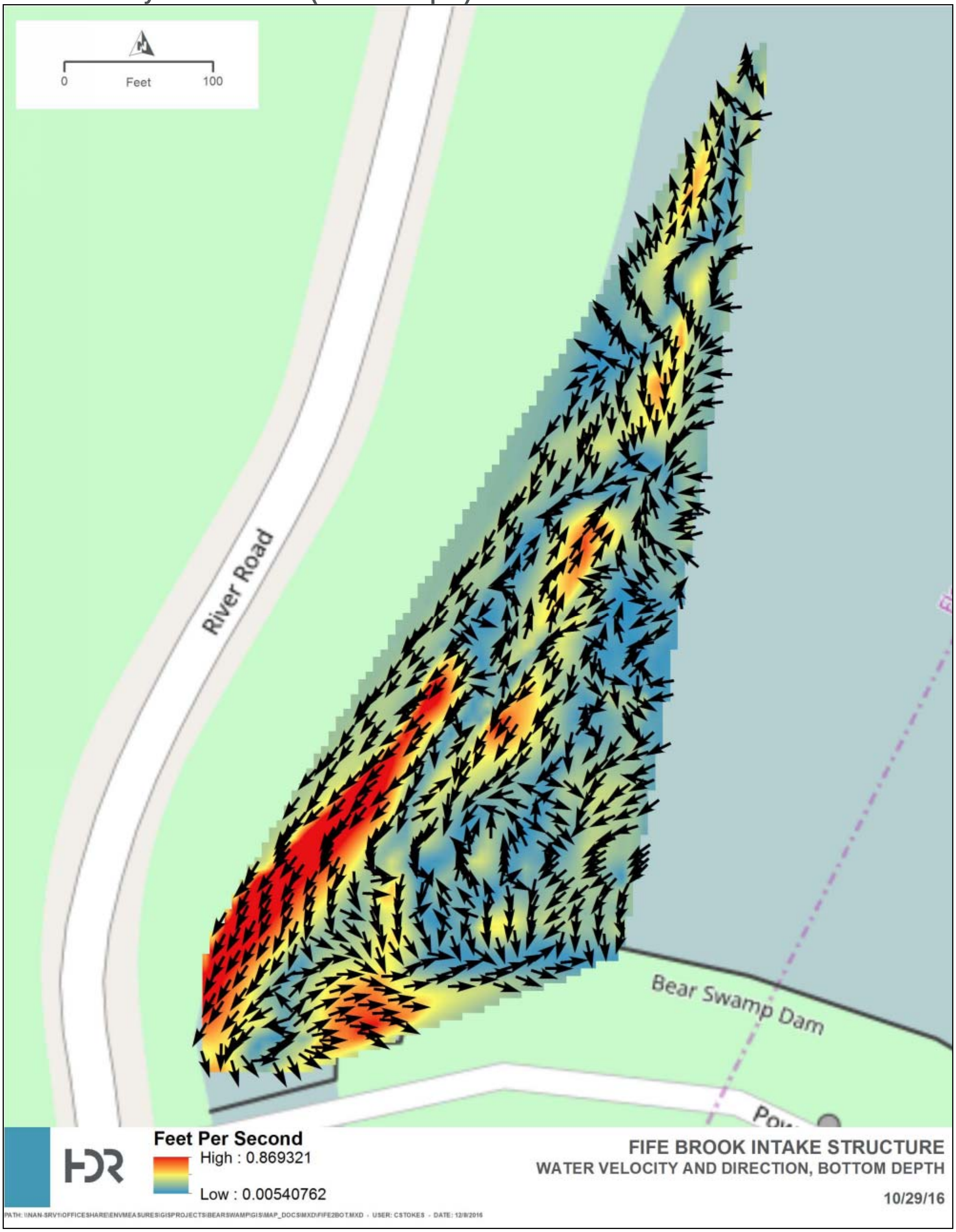


Figure 5-15. Fife Brook Generation at Nominal Lower Reservoir Elevation of 862 feet, Water Velocity and Direction (Middle Depth)

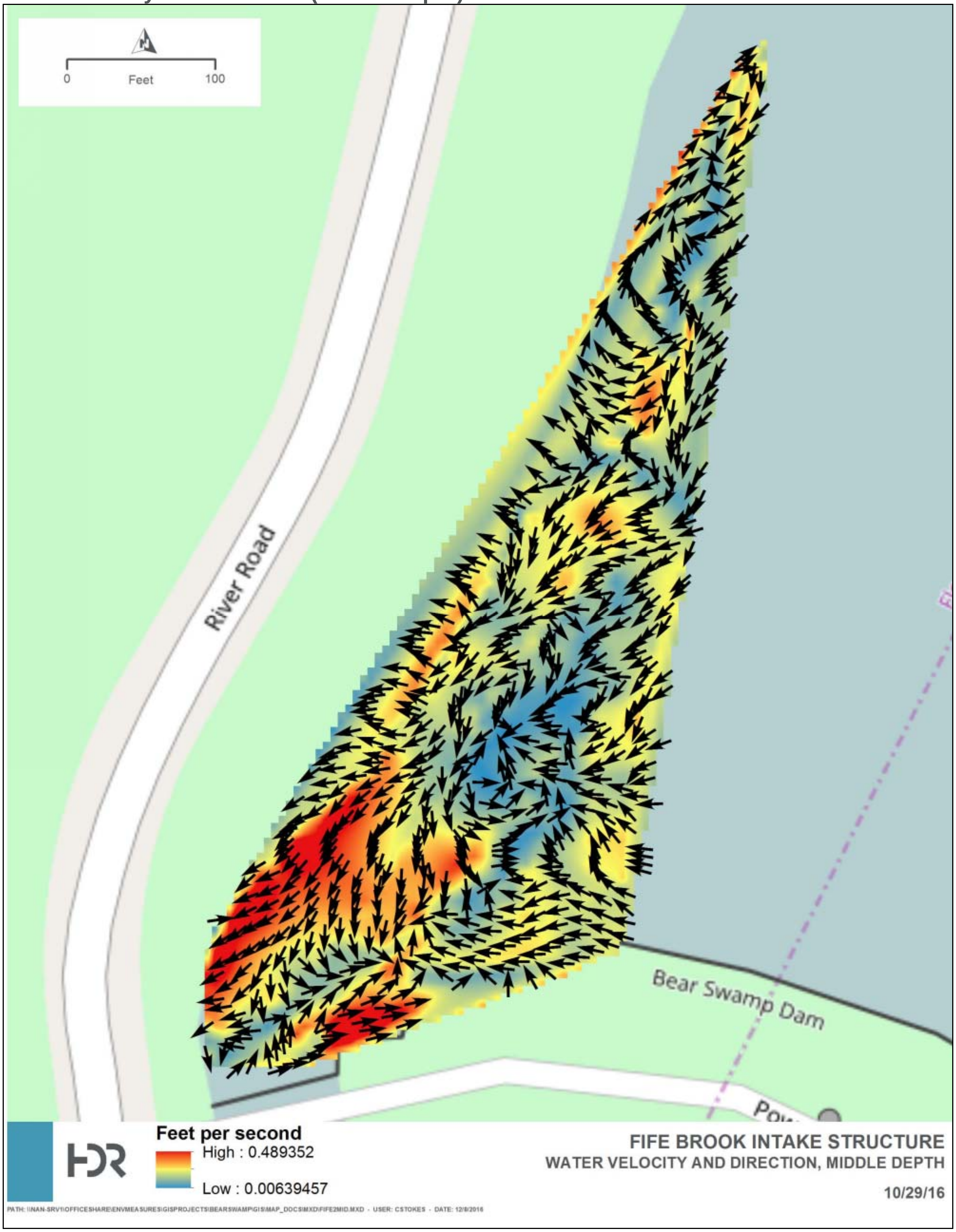
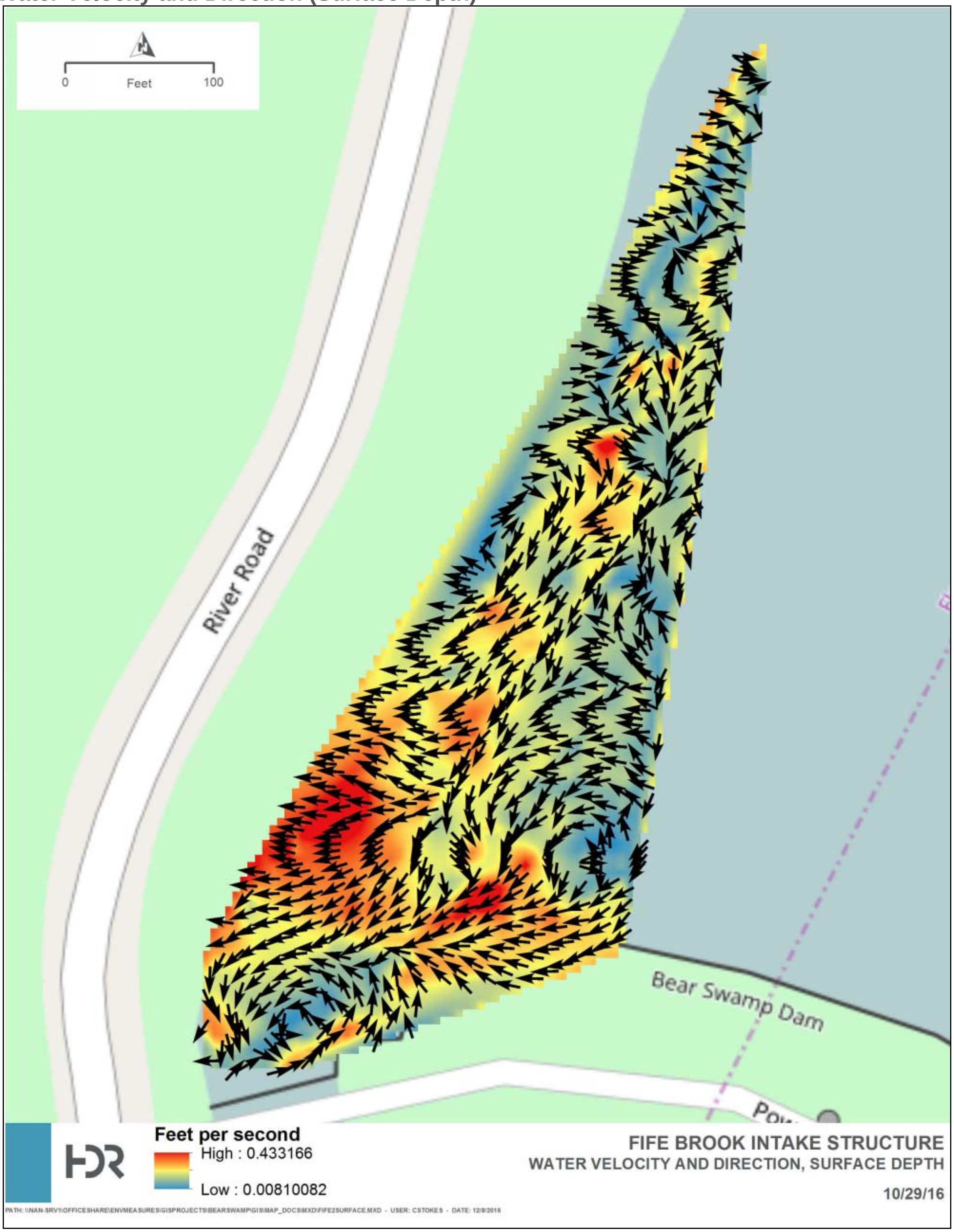


Figure 5-16. Fife Brook Generation at Nominal Lower Reservoir Elevation of 862 feet, Water Velocity and Direction (Surface Depth)



Inasmuch as velocities one foot upstream from the face of the trashrack are calculated as approximately 0.68 fps based on historical data (and could reach 0.7 fps if the maximum generation flow rating of 1,540 cfs were achieved); key observations include:

- Peak velocities at the face of the trashracks are short-lived, and are essentially confined to the face of the trashrack;
- Calculated velocities at the face of the trashracks are less than 2 fps 100 percent of the time; and
- All ADCP velocity vector data in front of the Fife Brook intake is below 2 fps, with the vast majority being below 1 fps.

Collectively, these observations confirm that intake velocities decrease and decay substantially within a very short distance from the trashrack face, and there is no substantive influence that extends into the Fife Brook impoundment.

Velocities for Use in Entrainment Characterizations

Velocities for use in Fife Brook entrainment characterizations that follow are based on the calculations presented herein. Even though the maximum generation flow rating of 1,540 cfs may be rarely achieved and generation flows decline with declining head, the entrainment characterizations will consider velocities under worst-case conditions using the 1,540 cfs and corresponding maximum calculated velocity approximately one foot upstream from the face of the trashrack of 0.7 fps - recognizing the low probability of occurrence of this velocity based on the historical generation flow and velocity duration curves.

5.2 Desktop Review of Entrainment Potential

5.2.1 Lower Reservoir Fish Community and Target Species

BSPC conducted a Fish Assemblage Assessment in 2016 to characterize the Deerfield River fishery in the vicinity of the Project. Details of the methods and result of the Fish Assemblage Assessment are presented in the Fish Assemblage Assessment Study report that was filed with the Commission on March 31, 2017.

For the Fish Assemblage Assessment field sampling, BSPC divided the Lower Reservoir into two study reaches. The Lower Reservoir Study Reach included the lacustrine habitat of the Lower Reservoir. The Upper Extent of the Lower Reservoir Study Reach included the riverine habitat of the Lower Reservoir extending upstream from the Dunbar Brook Take-out Area. Fish species collected in the Lower Reservoir Study Reach and the Upstream Extent of the Lower Reservoir Study Reach are presented in Table 5-2.

Table 5-2. Fish Species Collected in the Lower Reservoir and Upper Extent of the Lower Reservoir Study Reaches during 2016 Sampling

Common Name	Scientific Name	Lower Reservoir		Upper Extent of the Lower Reservoir	
		N	RA (%)	N	RA (%)
Brown Trout	*Salmo trutta*	8	5.76	11	15.7
Brook Trout	*Salvelinus fontinalis*	-	-	16	22.9
Rainbow Trout	*Onchorhynchus mykiss*	-	-	6	8.6
Smallmouth Bass	*Micropterus dolomieu*	3	2.16	-	-
Yellow Perch	*Perca flavescens*	77	55.40	2	2.9
Blacknose Dace	*Rhinichthys atratulus*	-	-	6	8.6
Creek Chub	*Semotilus atromaculatus*	-	-	1	1.4
Fallfish	*Semotilus corporalis*	6	4.32	-	-
Longnose Dace	*Rhinichthys cataractae*	-	-	10	14.3
Spottail Shiner	*Notropis hudsonius*	-	-	2	2.9
Slimy Sculpin	*Cottus cognatus*	-	-	6	8.6
White Sucker	*Catostomus commersonii*	45	32.37	10	14.3
	TOTAL	**139**	N/A	**70**	N/A
	COUNT	**5**	N/A	**10**	N/A

An analysis of the existing fisheries information, scientific literature, and the results of BSPC's Fish Assemblage Assessment Study were used to determine the target species list representative of those species with a management, economic, and ecological perspective. Table 5-3 lists the target species selected for this study. Life histories of target species are included in Appendix C to this study Report.

Table 5-3. Target Fish Species

Common Name	Scientific Name
Brook Trout	*Salvelinus fontinalis*
Brown Trout	*Salmo trutta*
Fallfish	*Semotilus corporalis*
Longnose Dace	*Rhinichthys cataractae*
Rainbow Trout	*Oncorhynchus mykiss*
Slimy Sculpin	*Cottus cognatus*
Smallmouth Bass	*Micropterus dolomieu*

Common Name	Scientific Name
Spottail Shiner	*Notropis hudsonius*
White Sucker	*Catostomus commersonii*
Yellow Perch	*Perca flavescens*

Table 5-4 provides each target species' spawning and early life stage periodicity for use in determining temporal variability in entrainment potential for young life stages.

Table 5-4. Spawning and Early Life Stage Periodicities and Temperatures for Target Fish

Species	Water Temp (°C)[1]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Brook Trout	7.3												
Brown Trout	8.0												
Fallfish	14.4												
Longnose Dace	16.5												
Rainbow Trout	6.5												
Slimy Sculpin	10.0												
Smallmouth Bass	17.5												
Spottail Shiner	Unknown												
White Sucker	8.9												
Yellow perch	9.2												

Spawning Period
Eggs and Larvae (estimated to begin two-thirds through the spawning period and lasting 60 days post spawn)

[1] Average temperature recorded for initiation of spawning

Sources: Jenkins and Burkhead (1993); Smith (1985)

5.2.2 Entrainment, Trashrack Spacing, and Intake Avoidance

Swim speed data for all target species (or surrogate species) were available in the scientific literature. Table 5-5 presents average burst speeds for the target/surrogate species. Burst swim speeds are considered to be the type of fish swim speed used to escape predation, maneuver through high flows, or in this case, escape intake velocities and avoid entrainment.

Table 5-5. Average Burst Swim Speeds and Fish Sizes

Species	Life Stage	Burst/Startle Swim Speed (fps)
Brook Trout	Adult	5.12
Brown Trout	Adult	6.2-13.7
Greenside Darter[1]	Adult	1.02-2.64
Longnose Sucker[2]	Juvenile/Adult	4.0-8.0
Rainbow Trout	Adult	6.4-13.5
Smallmouth Bass	Fry	<1.78
	Juvenile	2.6-3.6
	Adult	3.2-7.8
Spotfin Shiner[3]	Adult	2.11-2.37
Walleye[4]	Fry	2.48
	Juvenile	6.02
	Adult	5.48-8.57

[1]Used to represent Slimy Sculpin.
[2]Used to represent White Sucker.
[3]Used to represent Spottail Shiner, Longnose Dace, and Fallfish.
[4]Used to represent Yellow Perch.
NOTE: Burst/Startle speed calculated at 50% greater than Prolonged/Critical speeds based on Bell (1986) unless burst speed was provided in the literature.

Bear Swamp PSD

As described in Section 5.1 of this study report, entrainment characterizations at the Bear Swamp PSD consider velocities under worst-case conditions including the

- Theoretical existing maximum pump flow rating of 4,520 cfs and corresponding maximum calculated velocity approximately 1.6 feet from the trashracks of 2.1 fps; and

- Theoretical upgraded maximum pump flow rating of 5,120 cfs and corresponding maximum calculated velocity approximately 1.6 feet from the trashracks of 2.4 fps.

Smallmouth Bass fry and Yellow Perch fry and likely other small juvenile species (e.g., cyprinids) have burst swim speeds that are slower than or close to the calculated intake velocities at the Bear Swamp PSD. Swim speeds for most of the larger juvenile and adult fish species are greater than the intake velocities, suggesting that these fish would be capable of escaping entrainment under the existing and upgraded conditions. Spottail Shiner, one of the most abundant forage species in the system, has a burst swim speed higher than the intake velocity, meaning that this important forage species for game fish would likely be able to avoid entrainment.

Fife Brook Development

As described in Section 5.1 of this study report, entrainment characterizations at Fife Brook Development consider velocities under worst-case conditions using the 1,540 cfs and corresponding maximum calculated velocity approximately one foot upstream from the trashracks of 0.7 fps. The burst speeds shown in Table 5-5 suggest that of all target species and life stages (with the exception of eggs and some fry) would be able to avoid entrainment at the Fife Brook Development due to the intake velocities being lower than the burst swim speeds.

Estimated Minimum Lengths of Target Species Excluded by Trashrack Clear Bar Spacing

Proportional estimates of body width to total length (scaling factor) were compiled by Smith (1985) for all of the target species in this study. This proportional measurement was used to determine the minimum length of each species excluded from the intake by the trashracks (Table 5-6). Surrogates or groups/guilds of fish were used to represent certain target species. The scaling factors were divided by 3 (Fife Brook Development trashrack spacing) and 6 (Bear Swamp PSD trashrack spacing) to calculate the minimum length of a given species that would be excluded by that dimension.

The 3-inch clear spacing at the Fife Brook Development would allow passage of all size classes of target darters and minnows based on maximum lengths (Smith 1985). Young life stages, juveniles, and smaller adults of most target species could physically pass through the trashracks, although larger individuals would be excluded as shown in Table 5-6. For example, smallmouth bass less than 23.3 inches long would be able to physically pass through the 3-inch spacing, while those greater than 23.4 inches long would be excluded at the Fife Brook Development.

At the Bear Swamp PSD, the 6-inch clear spacing at the Bear Swamp PSD would allow passage of all life stages of all target species.

Table 5-6. Estimated Minimum Lengths (inches) of Each Target Species Excluded by the 3-inch Trashrack Clear Spacing

Common Name	Scaling Factor for Body Width[1]	Approximate Maximum Size[2]	Minimum Size Excluded by a Trashrack Clear Spacing of 3 in	Minimum Size Excluded by a Trashrack Clear Spacing of 6 in
Brook Trout	0.122	22.0	NE[3]	NE
Brown Trout	0.118	24.0	NE	NE
Fallfish	0.129	17.0	NE	NE
Longnose Dace	0.139	7.0	NE	NE
Rainbow Trout	0.114	24.0	NE	NE
Slimy Sculpin	0.144	5.0	NE	NE
Smallmouth bass	0.128	24.0	23.4	NE
Spottail Shiner	0.140	5.8	NE	NE
White Sucker	0.146	28.0	20.5	NE
Yellow perch	0.114	15.0	NE	NE

[1] Scaling factor expresses body width as a proportion of total length (TL) based on proportional measurements for the target/surrogate species in Smith (1985).
[2] Maximum reported sizes from Smith (1985).
[3] NE = Not Excluded.

Findings from FERC (1995*a*) and Winchell et al. (2000) suggest that the majority of fish size classes entrained at hydroelectric projects is much smaller than the minimum length of fish physically excluded by a certain clear spacing, and that length frequencies of entrainment compositions are similar among sites with differing trashrack spacing. It has been suggested that larger fish collected in entrainment samples may have been in the draft tubes prior to tailrace net deployment and/or they may have entered through gaps in the nets once they were deployed (EPRI 1992, 1997*b*). Such findings indicate that the lack of larger fish in entrainment compositions may be related to their increased swimming performance and ability to avoid intake velocities as they approach a dam. However, entrainment may occur regardless of their swimming performance if the intake openings and resulting intake velocities are the only available attractant flow for downstream migrating fish, particularly in riverine environments (FERC 1995*a*; EPRI 1997*b*).

5.3 Fish Entrainment Rates

Fish measuring less than 4 inches constituted the majority of fish entrainment compositions investigated in the EPRI database and displayed the highest entrainment rates throughout the year (Figure 5-17), with an estimated annual entrainment rate of

55.3 fish/hour/1,000 cfs of unit capacity (Table 5-67). Figure 5-18 displays the distribution and percentage of fish size compositions entrained through varying trashrack spacing. Most of the studies adjusted data based on net collection efficiencies realized during sampling, although studies conducted at the Buzzards Roost, Gaston Shoals, Hollidays Bridge, Ninety-Nine Islands, and Saluda projects did not. These studies were excluded from the entrainment analysis. Higher rates of entrainment in the winter, spring, and fall months for fish less than 4 inches were due in large part to the high numbers of herring species (e.g., Alewife, Gizzard Shad, and Threadfin Shad) collected in entrainment samples at four projects in the EPRI database; two Pennsylvania projects (Youghiogheny and Townsend), one New York project (Minetto), and one Georgia project (Richard B. Russell). Young-of-year (YOY) and juvenile Gizzard Shad, Alewife, and Threadfin Shad (adults as well) become lethargic and can die when water temperatures are 8°C or less for prolonged periods (GeoSyntec 2005; Jenkins and Burkhead 1993; Duke Energy 2008). It is likely that the higher winter, spring, and fall entrainment rates found in the EPRI database of fish less than 8 inches were herring species that succumbed to cold stress and were dead on arrival. Based on historical fisheries data from the Project vicinity, *Clupeidae* species are not present; therefore, the higher EPRI database entrainment rates for fish less than 8 inches in winter and spring are not representative of the Project.

Figure 5-17. Mean Percent and Range of Entrainment Compositions by Fish Size Class According to 43 Hydroelectric Developments (EPRI 1997a)

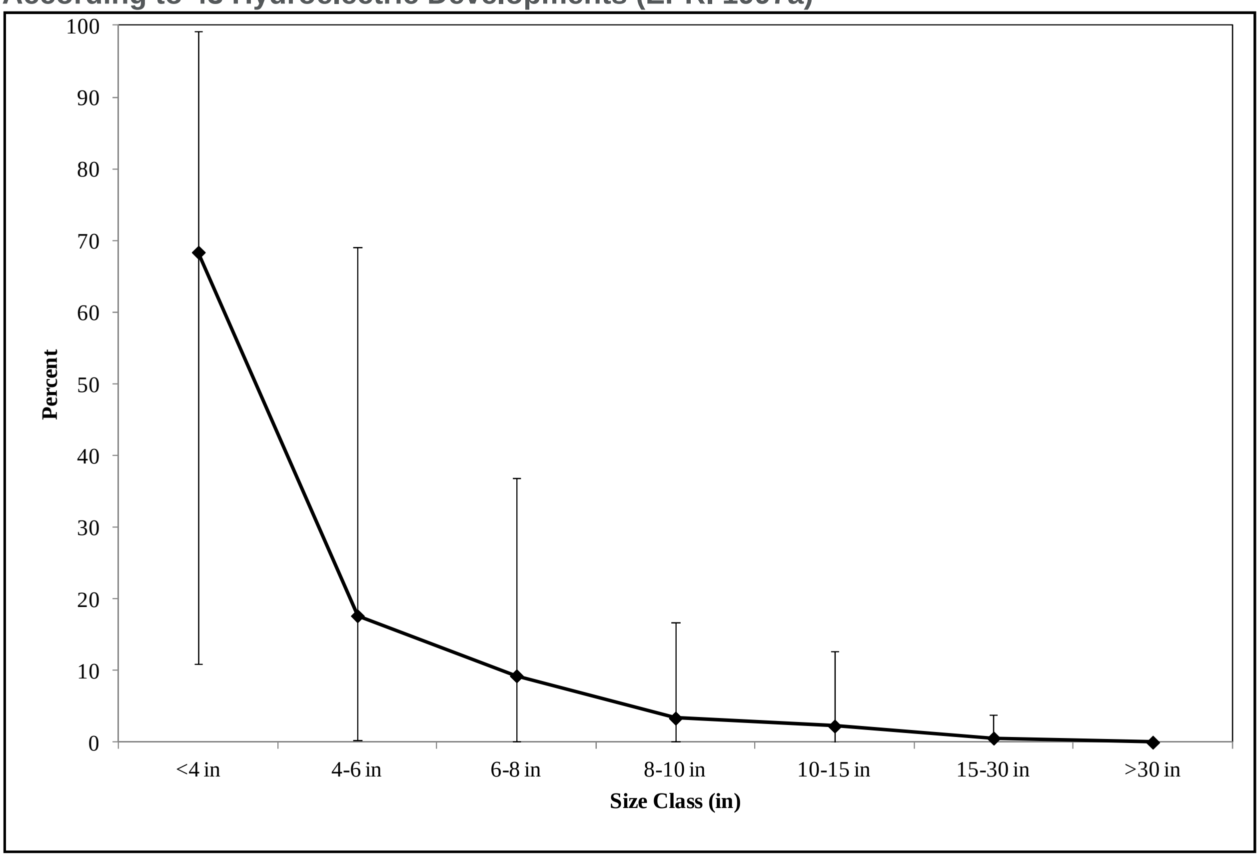
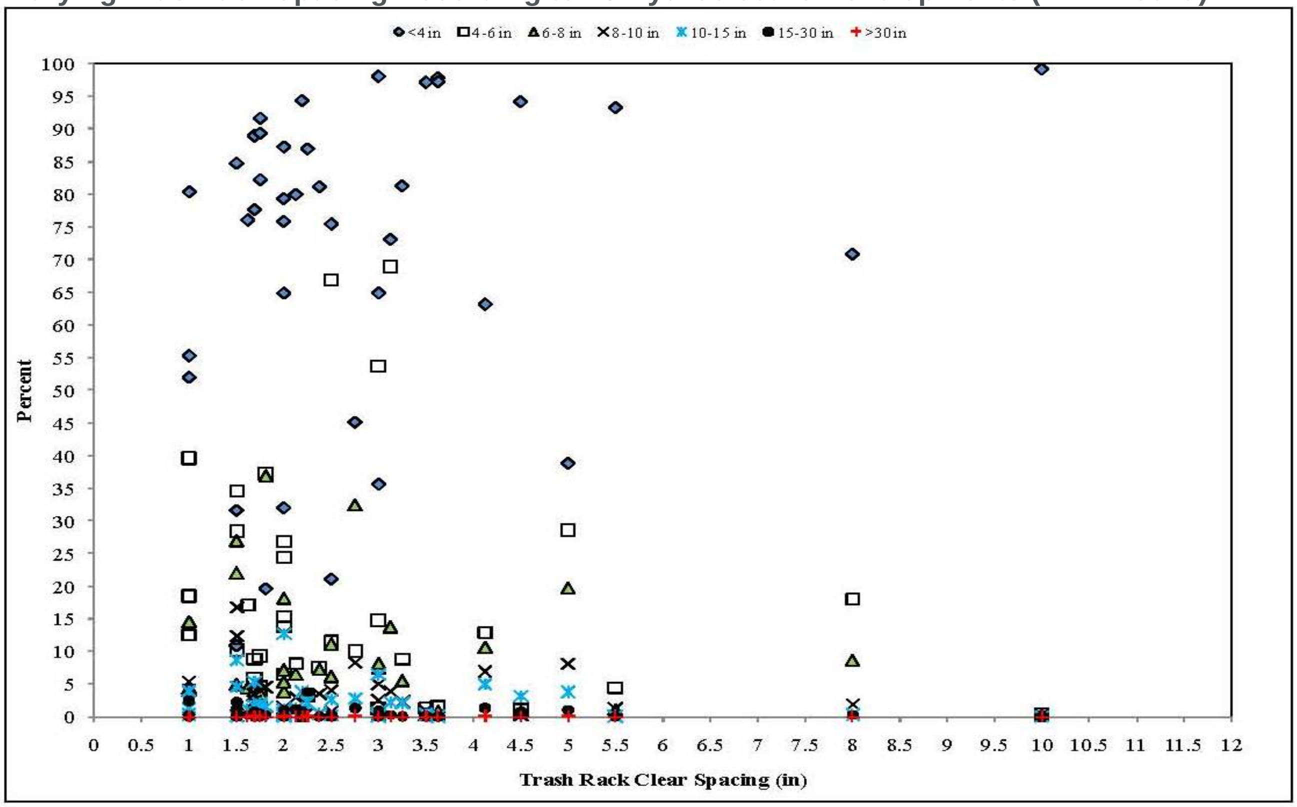


Table 5-7. Annual and Seasonal Entrainment Rates for Fish Size Classes

Fish Size (TL)	Average Entrainment Rate (fish/hr./1,000 cfs)				
	Winter	Spring	Summer	Fall	Annual
<4 in	26.84	21.40	2.99	4.06	55.28
4-8 in	1.70	1.07	1.19	3.04	7.00
8-15 in	0.24	0.16	0.20	0.16	0.76
>15 in	0.01	0.02	0.02	0.02	0.06

Note: Values represent means from all sites, turbine types, and fish species in the EPRI database.

Figure 5-18. Distribution and Percentage of Fish Size Compositions Entrained Through Varying Trashrack Spacing According to 43 Hydroelectric Developments (EPRI 1997a)



For the Bear Swamp Project, seasonal and annual target/surrogate species' potential entrainment rates were estimated from the EPRI database and are provided in Table 5-8. These include all fish size classes (less than 4 inches, 4-8 inches, 8-15 inches, and greater than 15 inches) combined for each species. Mean monthly seasonal target species entrainment rates for each of these size groups is provided in Appendix B. White Sucker and Yellow Perch had the highest potential entrainment rates, respectively. Depending on the target species, entrainment rates increase during certain seasons, likely due to increased activity related to foraging and reproduction resulting in increased juvenile and YOY abundances (GeoSyntec 2005; EPRI 1997*a*; Jenkins and Burkhead 1993).

Table 5-8. Seasonal and Annual Potential Entrainment Rates for Target Species Determined from Projects in the EPRI Database

Target Species	Seasonal Monthly Sums of the Average Number of Fish/Hour/1,000 cfs of Unit Capacity for all Fish Size Groups Combined				
	Winter	Spring	Summer	Fall	Annual
Fallfish	0.22	0.05	0.00	0.00	0.28
Longnose Dace	1.17	0.19	0.09	0.00	1.44
Salmonids[1]	0.64	0.39	0.10	0.35	1.48
Slimy Sculpin	0.43	0.02	0.00	0.00	0.45
Smallmouth Bass	0.13	0.14	2.02	1.17	3.45
Spottail Shiner	5.71	0.66	0.00	0.00	6.37
White Sucker	6.13	22.41	3.33	0.24	32.11
Yellow Perch	2.62	14.05	13.62	19.63	49.92

[1]Used combined entrainment rates of all *Salmonidae* species in the EPRI database to represent Brook Trout, Rainbow Trout, and Brown Trout entrainment.

5.3.1 Qualitative Assessment of Turbine Entrainment Potential

Table 5-9 provides monthly turbine entrainment potential at the Fife Brook Development. Table 5-10 and Table 5-11 provide monthly turbine entrainment potential under the existing and upgrade conditions, respectively, at the Bear Swamp PSD. As shown below, monthly turbine entrainment potential for both the existing and upgraded conditions at the Bear Swamp PSD are the same since the difference in pump flow velocities are minimal (0.3 cfs) between conditions.

Table 5-9 through Table 5-11 were developed for the target species based on the EPRI (1997*a*) five-tier qualitative method. Rationale for determining whether a species may show a low or high risk of entrainment is based on the target species seasonal entrainment rates from the EPRI database, species periodicities, a comparison of burst swim speeds to intake velocities, trashracks bar clear-spacing, relative composition, and expected distributions. For example, at the Bear Swamp PSD, Yellow Perch have relatively high entrainment rates for all seasons in the EPRI database, particularly in warmer months when high abundances of juveniles (less than 4 in) may cause spikes in entrainment. They also occupy both lotic and lentic habitats near the Project. Spawning typically occurs in the spring, and abundant young life stages such as eggs, larvae, fry, and fingerlings are susceptible to entrainment during the summer and fall months. None of the life stages of Yellow Perch are excluded by the trashracks at the facilities. Such rationale was used for each species to assign qualitative risks of entrainment. As a result, qualitative ratings of moderate were assigned to represent Yellow Perch monthly entrainment potential in the spring, summer, and fall seasons at the Bear Swamp PSD. In contrast, a rating of low was assigned to Brook Trout for all months, primarily due to the habitat preferences and the recent fish surveys showing their presence only in the upper extent of the Lower Reservoir. Also, species that tend to favor lotic habitats, such as Slimy Sculpin, and those that might possess small home ranges near the Project were assigned a low entrainment potential. Important game species and forage species also received low entrainment potential estimates throughout the year. Smallmouth Bass and White Sucker received a higher entrainment potential estimate (low to moderate) during the 60-day post spawning period when young life stages may be present, and in the spring when these species are seeking spawning habitats. Based on a review of water quality data collected by BSPC during 2016, stratification of the impoundment does not occur; therefore, water quality parameters do not appear to be a significant driver relative to entrainment.

Entrainment potential was lower at the Fife Brook Development than at the Bear Swamp PSD as a result of lower intake velocities. For example, Yellow Perch entrainment potential in spring and summer is considered low-moderate at Fife Brook, while considered moderate at Bear Swamp PSD.

Table 5-9. Range of Monthly Turbine Entrainment Potential for the Target Species at the Fife Brook Development

Target Species	Qualitative Rating of Monthly Entrainment Potential*											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Brook Trout	L	L	L	L	L	L	L	L	L	L	L	L
Brown Trout	L	L	L	L	L	L	L	L	L	L	L	L
Fallfish	L	L	L	L	L	L	L	L	L	L	L	L
Longnose Dace	L	L	L	L	L	L	L	L	L	L	L	L
Rainbow Trout	L	L	L	L	L	L	L	L	L	L	L	L
Slimy Sculpin	L	L	L	L	L	L	L	L	L	L	L	L
Smallmouth Bass	L	L	L	L	L	L	L	L	L	L	L	L
Spottail Shiner	L	L	L	L	L	L	L	L	L	L	L	L
White Sucker	L	L	L-M	L-M	L-M	L	L	L	L	L	L	L
Yellow Perch	L	L	L-M	L-M	L-M	L-M	L-M	L-M	L-M	L-M	L-M	L

*L (low), L-M (low-moderate), M (moderate), M-H (moderate-high), H (high)

Table 5-10. Range of Monthly Turbine Entrainment Potential for the Target Species at the Bear Swamp PSD under Existing Conditions

Target Species	Qualitative Rating of Monthly Entrainment Potential*											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Brook Trout	L	L	L	L	L	L	L	L	L	L	L	L
Brown Trout	L	L	L	L	L	L	L	L	L	L	L	L
Fallfish	L	L	L	L	L	L	L	L	L	L	L	L
Longnose Dace	L	L	L	L	L	L	L	L	L	L	L	L
Rainbow Trout	L	L	L	L	L	L	L	L	L	L	L	L
Slimy Sculpin	L	L	L	L	L	L	L	L	L	L	L	L
Smallmouth Bass	L	L	L	L-M	L-M	L-M	L-M	L-M	L	L	L	L
Spottail Shiner	L	L	L	L	L	L	L	L	L	L	L	L
White Sucker	L	L	M	M	M	L	L	L	L	L	L	L
Yellow Perch	L	L	M	M	M	M	M	M	M	M	M	L

*L (low), L-M (low-moderate), M (moderate), M-H (moderate-high), H (high)

Table 5-11. Range of Monthly Turbine Entrainment Potential for the Target Species at the Bear Swamp PSD under Upgraded Conditions

Target Species	Qualitative Rating of Monthly Entrainment Potential*											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Brook Trout	L	L	L	L	L	L	L	L	L	L	L	L
Brown Trout	L	L	L	L	L	L	L	L	L	L	L	L
Fallfish	L	L	L	L	L	L	L	L	L	L	L	L
Longnose Dace	L	L	L	L	L	L	L	L	L	L	L	L
Rainbow Trout	L	L	L	L	L	L	L	L	L	L	L	L
Slimy Sculpin	L	L	L	L	L	L	L	L	L	L	L	L
Smallmouth Bass	L	L	L	L-M	L-M	L-M	L-M	L-M	L	L	L	L
Spottail Shiner	L	L	L	L	L	L	L	L	L	L	L	L
White Sucker	L	L	M	M	M	L	L	L	L	L	L	L
Yellow Perch	L	L	M	M	M	M	M	M	M	M	M	L

*L (low), L-M (low-moderate), M (moderate), M-H (moderate-high), H (high)

6 Summary and Discussion

In summary, the primary findings of the Fish Entrainment Evaluation include:

- In its review of the 2008 Application for Non-capacity Amendment of License, the MADFW previously concluded that the proposed upgrade to the Bear Swamp Project would have “no fisheries issues.” FERC concurred with this analysis in the EA issued for the amendment.
- The findings of this study do not contradict the previous assessments by BSPC, FERC, the MADFW, or MADEP or lead to evidence of a known entrainment problem.
- Both the Bear Swamp PSD and Fife Brook Development operate under a variety of head conditions that significantly affect the magnitude and duration of actual intake velocities.
- Peak velocities at the face of the trashracks are short-lived, decrease as Lower Reservoir elevations decrease, and are essentially confined to the face of the trashrack.
- Velocities quickly diminish within very short distances from the trashracks.
    - Under the existing condition, BSPC calculated theoretical maximum velocities approximately 1.6 feet away from the trashracks at the Bear Swamp PSD to range from 0.8 – 2.1 fps, depending on the elevation of the Lower Reservoir.
    - Under the upgraded condition, BSPC calculated theoretical maximum velocities approximately 1.6 feet away from the trashracks at the Bear Swamp PSD to range from 0.98 – 2.4 fps, depending on the elevation of the Lower Reservoir.
    - BSPC calculated theoretical maximum velocities approximately 1 foot upstream from the trashracks at the Fife Brook Development to range from 0.18 and 0.7 fps, depending on the elevation of the Lower Reservoir.
- ADCP data collected by BSPC corroborated the calculated intake velocities at the Bear Swamp PSD and Fife Brook Development.
- These observations confirm that intake velocities decrease and decay substantially within a very short distance from the trashrack face, and there are no substantive entrainment velocities that extend into, and within the Fife Brook impoundment.
- The target species include a range of game fish and forage fish; the Fish Assemblage Assessment did not identify any rare, threatened, or endangered species in the Lower Reservoir Study Reach or the Upper Extent of the Lower Reservoir Study Reach.
- The results of the entrainment analysis indicate that both developments have low qualitative ratings for monthly entrainment potential for most target species.
- The lentic portion of the Lower Reservoir is largely devoid of structure and contains relatively generic habitats and homogenous substrates. These factors limit the amount of available spawning and nursery habitat commonly preferred by resident fish.

7 Variances from FERC-approved Study Plan

The Fish Entrainment Evaluation has been conducted in full accordance with the methods described in the FERC-approved study plan.

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Appendix A

Site Characteristics of Hydropower Facilities from the EPRI Database

Site Name	State	River	Reservoir		Total Plant Capacity (cfs)	Hydraulic Capacity of Sampled Units (cfs)	No. Units	Operating Mode	Avg. Velocity at Trashrack (ft./sec)	Trashrack Clear Spacing (in)	Entrainment Rate	
			Area (ac)	Volume (ac-ft.)							Time (fish/hr.)	Time & Flow (fish/hr./1,000 cfs of unit capacity
Abbeville	SC	Savannah	1,425	25,650	390	-	-	-	-	2.60	12.4	-
Belding	MI	Flat	-	-	416	416	2	-	-	2.00	4.4	10.7
Bond Falls	MI	W.B. Ontonagon	-	-	900	450	2	PK	-	3.00	26.9	59.7
Brule	WI	Brule	545	8,880	1,377	916	3	PK-partial	1.00	1.62	5.4	5.9
Buzzard's Roost*	SC	Saluda	11,404	270,000	3,930	1,310	3	-	-	3.63	1043.1	796.3
Caldron Falls	WI	Peshtigo	1,180	-	1,300	650	2	PK	-	2.00	5.7	8.8
Centralia	WI	Wisconsin	250	-	3,640	550	6	ROR	2.30	3.50	16.2	29.4
Colton	NY	Raquette	195	620	1,503	450	3	PK	-	2.00	0.6	1.2
Crowley	WI	N.F. Flambeau	422	3,539	2,400	1,200	2	ROR	1.40	2.38	6.9	5.7
E. J. West	NY	Sacandaga	25,940	792,000	5,400	5,400	2	-	-	4.50	7.4	1.4
Feeder Dam	NY	Hudson	-	-	5,000	2,000	5	PK	-	2.75	1.6	0.8
Four Mile Dam	MI	Thunder Bay	1,112	2,500	1,500	500	3	ROR	-	2.00	3.4	6.9
Gaston Shoals*	SC	Broad	300	2,500	2,211	837	3	-	-	1.50	5.8	7.0
Grand Rapids	MI/WI	Menominee	250	-	3,870	2,216	5	ROR	-	1.75	3.9	1.7
Herrings	NY	Black	140	-	3,610	1,203	3	ROR	-	4.13	1.0	0.8
High Falls - Beaver River	NY	Beaver	145	1,058	900	300	3	-	0.70	1.81	1.0	3.3
Higley	NY	Raquette	742	4,446	2,045	2,045	3	PK	-	3.63	5.7	2.8
Hillman Dam	MI	Thunder Bay	988	1,600	270	270	1	ROR	-	3.25	10.9	40.4
Hollidays Bridge*	SC	Saluda	466	6,000	4,396	370	4	-	-	-	2.8	7.5
Johnsonville	NY	Hoosic	450	6,430	1,288	1,288	2	PK	-	2.00	10.4	8.1
King Mill	GA	Savannah	-	-	-	-	-	ROR	1.48	2.00	15.8	-
Kleber	MI	Black	270	3,000	400	400	2	ROR	1.41	3.00	38.2	95.4
Lake Algonquin	NY	Sacandaga	-	-	750	750	1	-	-	1.00	0.7	1.0
Luray	VA	S.F. Shenandoah	-	-	1,477	369	3	ROR	-	2.75	0.5	1.5
Minetto	NY	Oswego	350	4,730	7,500	4,500	5	PULSE	2.40	2.50	85.8	19.1
Moshier	NY	Beaver	365	7,339	660	660	2	PK	-	1.50	26.4	40.0

Site Name	State	River	Reservoir		Total Plant Capacity (cfs)	Hydraulic Capacity of Sampled Units (cfs)	No. Units	Operating Mode	Avg. Velocity at Trashrack (ft./sec)	Trashrack Clear Spacing (in)	Entrainment Rate	
			Area (ac)	Volume (ac-ft.)							Time (fish/hr.)	Time & Flow (fish/hr./1,000 cfs of unit capacity
Ninety-Nine Islands*	SC	Broad	433	2,300	4,800	584	6	-	-	1.50	5.7	9.8
Ninth Street Dam	MI	Thunder Bay	9,884	2,600	1,650	550	3	ROR	-	1.00	56.4	102.6
Norway Point Dam	MI	Thunder Bay	10,502	3,800	1,775	575	2	ROR	-	1.69	20.2	35.2
Potato Rapids	WI	Peshtigo	288	-	1,380	500	3	ROR	-	1.75	5.9	11.9
Raymondville	NY	Raquette	50	264	1,640	1,640	1	PK	-	2.25	13.3	8.1
Richard B. Russell	GA/SC	Savannah	31,770	-	60,000	7,200	8	PK	-	8.00	134.3	18.7
Saluda*	SC	Saluda	556	7,228	812	227	4	-	-		4.8	21.1
Sandstone Rapids	WI	Peshtigo	150	-	1,300	650	2	PK	-	1.75	7.7	11.8
Schaghticoke	NY	Hoosic	164	1,150	1,640	1,640	4	ROR	-	2.13	1.7	1.1
Shawano	WI	Wolf	155	1,090	850	850	1	ROR	-	5.00	5.5	6.5
Sherman Island	NY	Hudson	305	6,960	6,600	4,950	4	PK	-	3.13	0.9	0.2
Stevens Creek	GA/SC	Savannah	2,400	23,700	8,000	-	-	PULSE	-	3.25	4.6	-
Thornapple	WI	Flambeau	295	1,000	1,400	700	2	ROR-mod	1.22	1.69	5.8	8.3
Tower	MI	Black	102	620	404	404	2	ROR	0.82	1.00	5.1	12.7
Townsend Dam	PA	Beaver	-	-	4,400	4,400	2	ROR	-	5.50	527.2	119.8
Twin Branch	IA	St. Joseph	1,065	-	3,200	1,200	-	ROR	-	3.00	2.1	1.8
Warrensburg	NY	Schroon	-	-	1,350	1,350	1	-	-	-	1.0	0.8
White Rapids	MI/WI	Menominee	435	5,155	3,994	3,994	3	PK-partial	1.90	2.50	8.2	3.3
Wisconsin River Division	WI	Wisconsin	240	1,120	5150	5,150	10	ROR	1.40	2.19	10.7	24.7
Youghiogheny	PA	Youghiogheny	2,840	149,300	1,600	1,600	2	ROR	0.70	10.00	208.3	130.2

*Projects eliminated from entrainment rate calculations for target species due to lack of net collection efficiency adjustments (EPRI 1997a)

Appendix B

Monthly Mean Entrainment Rates for All Target Species (Average Number of Fish/Hour/1,000 cfs of Unit Capacity)

Figure B-1. Entrainment Results Summarized from EPRI Database for All EPRI Projects

Month	**Salmonidae (used to represent trout species)**			
	<4 in	**4-8 in**	**8-15 in**	**>15 in**
January	0.000	0.041	0.105	0.000
February	0.000	0.007	0.071	0.069
March	0.000	0.006	0.187	0.000
April	0.006	0.069	0.049	0.000
May	0.002	0.043	0.023	0.001
June	0.017	0.004	0.008	0.002
July	0.041	0.003	0.001	0.001
August	0.001	0.005	0.020	0.000
September	0.000	0.027	0.010	0.000
October	0.026	0.007	0.050	0.003
November	0.003	0.156	0.064	0.000
December	0.010	0.308	0.026	0.000

Month	**Longnose Dace**			
	<4 in	**4-8 in**	**8-15 in**	**>15 in**
January	-	-	-	-
February	0.014	0.000	0.000	0.000
March	0.064	0.000	0.000	0.000
April	0.322	0.171	0.000	0.000
May	0.073	0.002	0.086	0.000
June	0.240	0.004	0.000	0.000
July	0.030	0.000	0.000	0.000
August	0.035	0.000	0.000	0.000
September	0.090	0.011	0.000	0.000
October	0.083	0.000	0.000	0.000
November	0.041	0.005	0.000	0.000
December	0.172	0.000	0.000	0.000

Month	**Yellow Perch**			
	<4 in	**4-8 in**	**8-15 in**	**>15 in**
January	0.591	0.419	0.005	0.000
February	0.641	0.463	0.005	0.000
March	0.398	0.306	0.006	0.000
April	11.041	0.972	0.072	0.000
May	0.824	0.408	0.022	0.000
June	6.946	0.185	0.010	0.000
July	5.634	0.138	0.009	0.000
August	0.463	0.226	0.010	0.000
September	2.204	0.857	0.032	0.000
October	13.135	3.021	0.015	0.000
November	0.206	0.151	0.007	0.000
December	0.161	0.332	0.002	0.000

Month	**Slimy Sculpin**			
	<4 in	**4-8 in**	**8-15 in**	**>15 in**
January	-	-	-	-
February	-	-	-	-
March	0.0112	0.0000	0.0000	0.0000
April	0.0585	0.0000	0.0000	0.0000
May	0.146	0.000	0.000	0.000
June	0.116	0.003	0.001	0.000
July	0.010	0.000	0.000	0.000
August	0.009	0.000	0.000	0.000
September	0.016	0.000	0.000	0.000
October	0.035	0.000	0.000	0.000
November	0.000	0.014	0.000	0.000
December	0.0327	0.0000	0.0000	0.0000

Month	Fallfish			
	<4 in	4-8 in	8-15 in	>15 in
January	-	-	-	-
February	-	-	-	-
March	-	-	-	-
April	0.005	0.008	0.003	0.000
May	0.002	0.003	0.002	0.000
June	0.031	0.004	0.000	0.000
July	0.041	0.000	0.000	0.000
August	0.011	0.000	0.000	0.000
September	0.007	0.000	0.000	0.000
October	0.126	0.030	0.000	0.000
November	0.000	0.007	0.000	0.000
December	-	-	-	-

Month	Spottail Shiner			
	<4 in	4-8 in	8-15 in	>15 in
January	0.083	0.001	0.000	0.000
February	0.213	0.012	0.000	0.000
March	0.028	0.001	0.000	0.000
April	1.121	0.372	0.000	0.000
May	0.394	0.105	0.000	0.000
June	0.130	0.002	0.000	0.000
July	0.883	0.036	0.000	0.000
August	1.964	0.008	0.000	0.000
September	0.107	0.003	0.000	0.000
October	0.376	0.001	0.000	0.000
November	0.237	0.103	0.000	0.000
December	0.174	0.015	0.000	0.000

Month	Smallmouth Bass			
	<4 in	4-8 in	8-15 in	>15 in
January	0.037	0.024	0.000	0.000
February	0.017	0.000	0.000	0.000
March	0.021	0.005	0.000	0.000
April	0.017	0.001	0.021	0.001
May	0.004	0.006	0.057	0.005
June	0.469	0.020	0.055	0.001
July	1.043	0.039	0.024	0.000
August	0.229	0.093	0.046	0.000
September	0.405	0.355	0.037	0.001
October	0.188	0.076	0.021	0.001
November	0.033	0.043	0.009	0.000
December	0.029	0.013	0.004	0.000

Month	White Sucker			
	<4 in	4-8 in	8-15 in	>15 in
January	0.270	0.548	0.288	0.000
February	0.190	0.852	0.043	0.000
March	0.128	0.709	0.046	0.000
April	0.278	0.304	0.619	0.156
May	0.052	0.039	0.083	0.017
June	2.010	0.102	0.048	0.004
July	2.625	0.053	0.022	0.001
August	0.184	0.011	0.012	0.000
September	0.080	0.029	0.040	0.010
October	0.194	16.690	0.824	0.052
November	0.074	1.490	0.925	0.002
December	0.049	1.579	0.379	0.000

Appendix C

Life History Accounts for the Target Fish Species

Brown Trout (*Salmo trutta*)

In a riverine environment, Brown Trout prefer clear, cool to cold water, and relatively silt-free rocky substrate in riffle-run areas. Additional preference for riverine habitats include well-vegetated areas, stable streambanks, abundant instream cover, and relatively stable annual water flow and temperature regimes (Raleigh et al. 1986). Optimal lacustrine habitats include clear, cool to cold, deep lakes that are typically oligotrophic, and vary in size and chemical quality, particularly reservoir habitats. This species is normally a stream spawner, and require tributary streams with gravel substrate in riffle-run areas for reproduction (Raleigh et al. 1986).

Brown Trout mature as early as the end of their first year, but most mature in their third to fifth year (Raleigh et al. 1986). Brown Trout spawn during the fall, with spawning migration beginning at water temperatures of 42.8 degrees Fahrenheit (°F) to 45°F; spawning typically occurs when water temperatures reach 42.8 to 48.2°F (Raleigh et al. 1986). Brown Trout construct well-defined redds. Spawning sites are often located at the head of a riffle, or the tail of a pool, where gravel slopes gently upward and sedimentation has less effect and upwelling of water is present through the gravel or water flowing downward into the gravel (Raleigh et al. 1986).

The optimal incubation temperatures are assumed to be 35.6 to 55.4°F, with a tolerance range of 32 to 59°F. Eggs hatch between 30 and 148 days, depending on water temperature (Raleigh et al. 1986). Dispersal of newly hatched fry occurs immediately after emergence, showing aggression and being territorial. Cover is essential to fry survival and they often seek shallow, smooth-bottom areas of a streambank. Juveniles prefer shallower depths and lower velocities than adults and are often found in areas containing both pools and riffles (Raleigh et al. 1986). Brown Trout are size-selective feeders and feed generally on terrestrial and aquatic insects; primarily Ephemeroptera, Trichoptera, and Plecoptera. As they grow larger, fish and crustaceans become more important in their diet (Raleigh et al. 1986).

Brown Trout are not currently listed as a candidate for rare, threatened, or endangered species by the U.S. Fish and Wildlife Service (USFWS) or MADFW.

Rainbow Trout (*Oncorhynchus mykiss*)

Rainbow Trout's preference in the riverine environment are similar to those of the Brown Trout, where areas of clear and cold water, silt-free rocky substrate in riffle-run areas, well-vegetated streambanks, abundant instream cover, and relatively stable annual water flow and temperature regimes are used by this species (Raleigh et al. 1984). Optimal lacustrine habitats include clear, cold and deep lakes that are typically oligotrophic with access to tributary streams for spawning (Raleigh et al. 1984).

Rainbow Trout typically become sexually mature during their second or third year. Spawning occurs from winter to summer (January to July), depending on location. Eggs that are exposed to long periods of 32 to 39.2°F temperatures tend to suffer high mortality and abnormalities. Redd sites are selected by female in gravel substrate at the head of a riffle or downstream edge of a pool (Raleigh et al. 1984).

The incubation time varies inversely with temperature. Eggs are usually hatched within 28 to 40 days, but may take up to 49 days. The optimal incubation temperatures are assumed to be 44.6 to

53.6°F (Raleigh et al. 1984). Newly hatched fry tend to remain in the gravel for approximately 2 weeks after hatching. Rainbow Trout fry residing in streams prefer shallower water and slower velocity than do other life stages of stream trout and are often found in close proximity to escape cover. Habitat preference and use of juvenile Rainbow Trout are very similar to those of the adults (Raleigh et al. 1984). Aquatic insects are the primary diet of Rainbow Trout. Overall, adult and juvenile are opportunistic feeders and consume a wide variety of foods, such as zooplankton, terrestrial insects, and fish, depending on the water type, season, and size of the trout (Raleigh et al. 1984).

Rainbow Trout are not currently listed as a candidate for rare, threatened, or endangered species by the USFWS or MADFW.

Brook Trout (*Salvelinus fontinalis*)

Brook Trout in rivers prefer habitats that are clear, cold, spring-fed, silt-free rocky substrate in riffle-run areas, well-vegetated streambanks, abundant instream cover, and relatively stable water flow and temperature regimes (Raleigh 1982). Lacustrine habitat preference can be characterized as clear, cold, lakes and ponds that are typically oligotrophic. This species is typically a stream spawner, but are also known to spawn in gravel surrounding spring upwelling areas of lakes and ponds (Raleigh 1982).

Age at sexual maturity varies among populations, where males usually mature before females; some male Brook Trout may mature as early as age 0+ (Raleigh 1982). Spawning typically occurs in the fall, but may begin as early as late summer in the northern parts of its range and early winter in the southern parts of its range. Spawning behavior is very similar to Rainbow Trout, and redd sites are constructed in gravel with upwelling water. Spawning occurs at temperatures ranging from 40.1 to 50°F (Raleigh 1982).

The optimal incubation temperatures are assumed to be 40.1 to 52.7°F and eggs hatch between 28 to 165 days, depending on temperature. Fry emerge from gravel redds from January to April, with water temperature being the most important factor of growth and distribution of fry. Temperatures from 49.6 to 59.7°F are considered suitable and temperatures greater than 64.4°F are considered detrimental for fry (Raleigh 1982). Newly emerged fry and juveniles prefer areas of instream cover objects (rubble substrate) rather than overhead streambank cover (Raleigh 1982). Brook Trout are opportunistic sight feeders, with diets consisting of bottom-dwelling and drifting aquatic macroinvertebrates and terrestrial insects. Fish are an important prey for lake populations of Brook Trout (Raleigh 1982).

Brook Trout are not currently listed as a candidate for rare, threatened, or endangered species by the USFWS or MADFW.

Smallmouth Bass (*Micropterus dolomieu*)

Smallmouth Bass in streams prefer cool, clear, and mid-order streams with abundant shade and cover, deep pools, moderate current, and gravel or rubble substrate. Smallmouth Bass grow faster in lakes and reservoirs than in rivers. The preferred lacustrine habitat consists of large, clear, lakes and reservoirs with an average depth greater than 9 meters with rocky shoals (Edwards et al. 1983). This species exhibits strong, cover-seeking behavior and prefer protection from light in all life stages.

Submerged cover such as boulders, rocks, stumps, root-masses, trees, and crevices are often used by this species (Edwards et al. 1983).

Age at sexual maturity of Smallmouth Bass varies throughout its range and is related to latitude and growth rate of the local populations. This species spawns during the spring, usually mid-April to July, depending on geographical location and water temperature. In general, this species requires a clean stone, rock, or gravel substrate for spawning and has been known to spawn on rocky lake shoals, river shallows, backwaters, or moves into creeks and tributaries to spawn. Nests are usually built in shallow water (0.3 to 0.9 meters deep) and spawning occurs when the water temperature is 55.0 to 69.8°F, with most activities occurring at or above 59°F (Edwards et al. 1983).

The optimal incubation temperatures are assumed to be 55.4 to 77°F. Eggs hatch between 7 and 21 days, depending on the water temperature (Smith 1985). Males build and maintain a nest until the fry emerge and disperse. Fry grow faster at higher temperatures, with the ideal range for growth being 77 to 84.2°F. Fry prefer calm, shallow, marginal areas with rocks and vegetation (Edwards et al. 1983). Juveniles are often found in quiet water near or under a dark shelter, such as brush or rocks. Both juveniles and adults prefer low velocity water near a current (Edwards et al. 1983). The diet of Smallmouth Bass changes from small to large food items as the fish grow. Fry feed on microcrustaceans, juvenile prey on larger insects, crayfish, and fish, and adults primarily feed on fish and crayfish in both lakes and streams (Edwards et al. 1983).

Smallmouth Bass are not currently listed as a candidate for rare, threatened, or endangered species by the USFWS or MADFW.

Yellow Perch (*Perca flavescens*)

Yellow Perch are often found in shoreline (littoral) areas in lakes and reservoirs where there are moderate amounts of vegetation that provide both cover and spawning habitat. Suitable riverine habitat resembles the lacustrine habitat (Krieger et al. 1983). Maturation varies, but is typically between 2-4 years of age, with females typically maturing later than males. Spawning occurs from April to June when water temperatures reach 44.6 to 55.4°F. Males and females migrate from deep water into tributaries, lake shallows, or low velocity areas during spawning. Eggs are gelatinous, semi-buoyant string form laid near aquatic or inundated terrestrial vegetation (Krieger et al. 1983).

The optimal egg incubation and hatching temperature range is between 44.6 to 68°F. Fry tolerate temperatures from 37.4 to 82.4°F, with inactivity below 41.5°F and best survival at 60°F. Fry will move to open, warm water during the first two months of life. Juveniles and adults have similar temperature preference ranges of 68 to 73.4°F and are often found inhabiting shallow, littoral water (Krieger et al. 1983). Yellow Perch diet varies depending on size. Larvae and fry feed on zooplankton; juveniles feed on amphipods, ostracods, and chironomid larvae; and adults prey on aquatic insects, fish, and crayfish (Krieger et al. 1983).

Yellow Perch are not currently listed as a candidate for rare, threatened, or endangered species by the USFWS or MADFW.

White Sucker (*Catostomus commersonii*)

White Sucker tolerate a relatively broad range of environmental conditions. Stream populations prefer low to moderate gradient sections of the stream. Adult White Suckers are often found inhabited in pools, and are common in areas of slow to moderate velocity (Twomey et al. 1984). Males reach maturity between 2 and 6 years, depending on geographic location. Females typically mature 1 to 2 years later than males. Spawning migration occurs from spring to early summer, when water temperature reaches 50°F. A clean bottom of coarse sand or gravel is essential to White Sucker spawning and the preferred spawning habitat are areas of inlets, outlets, small creeks, and rivers with relatively shallow waters running over gravel bottom (Twomey et al. 1984).

The fertilized eggs adhere to the gravel in riffles or drift downstream where they adhere to substrate in areas with slower velocity flows, with a temperature tolerance of 51.8 to 60.8°F. Fry emerge approximately 9 to 11 days after hatching and prefer water temperatures of 73.4 to 77°F. Fry prefer moderate currents and are often found in shoreline areas with rock substrate. Juveniles have a temperature tolerance of 41 to 77°F and prefer shallow backwaters, riffles with moderate water velocity, and sand-rubble bottom runs (Twomey et al. 1984). White Sucker diet varies depending on size. Fry prey on zooplankton and benthic organisms, juveniles feed primarily on benthic organisms, and adults would prey on amphipods, gastropods, and large immature aquatic insects (Twomey et al. 1984).

White Sucker are not currently listed as a candidate for rare, threatened, or endangered species by the USFWS or MADFW.

Fallfish (*Semotilus corporalis*)

Fallfish can be found in rivers, streams, and lakes. This species prefers clear, gravel-bottom streams and lakes. Larger adults seek pools and deep runs in riverine habitats (Trial et al. 1983*a*). Age at maturity is typically 4 years, but some populations are known to mature at age 2 or 3. Spawning typically occurs during the spring when water temperature reaches 59°F. Gravel and sand are the preferred spawning substrate, with males constructing nests in stream reaches with overhead cover or in pools near areas with suitable spawning substrate (Trial et al. 1983*a*).

The fertilized eggs are adhesive and incubation usually occurs at temperatures between 60.8 to 64.4°F. Eggs can hatch in 5 to 6 days. Juveniles are typically found in rapid waters more than adults. Adults are commonly found near cascades and falls (Trial et al. 1983*a*). This species is an opportunistic feeder and prey on aquatic insect larvae, terrestrial insects, crustaceans, and fish, with algae consisting of an important part of their diet (Trial et al. 1983*a*).

Fallfish are not currently listed as a candidate for rare, threatened, or endangered species by the USFWS or MADFW.

Spottail Shiner (*Notropis hudsonius*)

Spottail Shiner prefer clear waters and are found in a variety of habitats from large lakes and rivers to small streams. This species is a schooling fish and is known to assemble in large aggregates. Spawning typically occurs in June or July over sandy bottom and at the mouths of streams. The undershot mouth of the Spottail Shiner suggests that it's a benthic feeder, preying on zooplankton and benthic organisms such as insect larvae, algae, and eggs and larvae of its own species (Smith 1985).

Spottail Shiner are not currently listed as a candidate, threatened, or endangered species by the USFWS or MADFW.

Longnose Dace (*Rhinichtys cataractae*)

Longnose Dace are usually associated with steep gradient, cold-water streams, but they are sometimes found in lower-gradient, warm-water rivers. They are sometimes abundant, appearing in densities of almost one fish per square foot. Longnose Dace can live to five years and spend most of their adult lives on or near the bottom in turbulent water or adjacent pools. The long, sloping nose and low pectoral fins help to streamline their bodies in the current. Spawning, which starts in the spring, probably extends into early summer. Although they do not build nests, each male guards a territory about 10 inches in diameter. After spawning, eggs hatch in three to four days at 70°F. Unlike the adults, the young live off the bottom during the early part of their lives. Their diet consists primarily of immature aquatic insects that cling to rocks and boulders. Longnose Dace are one of the chief predators of larval blackflies and midges, but they will also prey on other small aquatic invertebrates (Hartel et al. 2002).

In western Massachusetts, Longnose Dace are common in clear streams with riffles, boulders, and gravel, but have also been sampled in large numbers from lower- gradient, main stem rivers, including the Housatonic River, Stockbridge. Longnose Dace are absent from almost all of the eastern part of the state except in upland tributaries to the Nashua River. They are rare in the lower Merrimack Drainage, where there are only two records: one from Lawrence in 1859 and one from Andover in 1987. The Longnose Dace may have been more common along the Merrimack before industrial pollution and dams. With the exception of one undocumented fisheries record from the upper Taunton drainage, they are absent from all other Massachusetts coastal drainages (Hartel et al. 2002).

Longnose Dace are not currently listed as a candidate, threatened, or endangered species by the USFWS or MADFW.

Slimy Sculpin (*Cottus cognatus*)

Slimy Sculpin prefer clear, coldwater streams with gravel to cobble substrate and moderate to fast flow. This species stays on the bottom of the river, often under cover such as small rocks and cobbles (Jacobs and O'Donnell 2009). Spawning occurs during the spring when water temperatures reach 40 to 60°F. Nesting sites are usually a crevice under a log, rock, or tree root. Eggs typically hatch in approximately 28 days and the male will keep guard of the nest and young until they begin to feed (Smith 1985). The diet of Slimy Sculpin consists primarily of aquatic insects, such as dipterans and caddisflies. Larger individuals may also prey on fish, plant materials, worms, and mollusks (Smith 1985).

Slimy Sculpin are not currently listed as a candidate for rare, threatened, or endangered species by the USFWS or MADFW.

Document Content(s)

ATTACHMENT 3

EXCERPT FROM THE 2020 FERC ENVIRONMENTAL ASSESSMENT

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impoundment to elevation 870 feet NGVD and would also be required to provide some storage within Fife Brook impoundment to accommodate peaking inflow from Deerfield Station No. 5. During the course of the day, inflows could be as high as 1,323 cfs and would accumulate in Fife Brook impoundment because the maximum recommended release rate from Fife Brook dam would be much less than inflow from Deerfield Station No. 5. This, in turn, would raise water levels in the Fife Brook impoundment above 830 feet NGVD, which would restrict BSPC's ability to release the 4,600 acre feet of water stored in the upper reservoir. Water levels in the upper reservoir therefore would be higher than 1,555.5 feet NGVD creating additional habitat for fish. Similar to effects on fish in the Fife Brook impoundment, fish would still be forced to find suitable habitat on a daily basis as water levels fluctuate on a daily basis. Suitable habitat would be limited in the upper reservoir, and any gains in habitat that would benefit fish would be short-term and temporary, as the recommended generator ramping rates would only occur at certain times between May 15 and August 31.

Trout Unlimited's generator ramping release schedule would have similar effects to fish as the proposed mode of operation. Under the existing mode of operation, ramping to generation takes approximately 1.1 hours, which is nearly the same as Trout Unlimited's proposal. After ceasing operation, the tailrace pool attenuates flow releases from the Fife Brook Development down to the minimum flow of 125 cfs for a period of approximately one hour, which is also the same as the rate proposed by Trout Unlimited.

CRC's proposed ramp to a generation releases would take up to 3.1 hours total, which is an additional 2.0 hours more than the existing mode of operation and 2.25 hours more than the proposed mode of operation. Fish would have slightly more time to locate suitable habitat (an additional 2.0 hours), which may require less expenditure of energy over existing conditions. This could provide a marginal benefit to fitness, which could benefit resident fish in the Fife Brook impoundment. However, fluctuating the Fife Brook impoundment 2.0 hours slower than existing conditions and 2.25 hours slower than proposed conditions would not likely provide significant benefits to fish in Fife Brook impoundment, as fish would still be required to find suitable habitat over a relatively short period of time as water levels fluctuate by up to 40 feet on a daily basis. Fish in the upper reservoir would not likely be affected by CRC's proposal.

Entrainment and Impingement

BSPC proposes to continue to operate the Bear Swamp PSD in a store and release mode by pumping water from the Fife Brook impoundment (*i.e.*, the lower reservoir) during periods of low electricity demand, storing the water until periods of high electricity demand, and then generating electricity by discharging water back into the Fife Brook impoundment during periods of high electricity demand. BSPC also proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5."

On August 13, 2008, the Commission authorized the rehabilitation of the existing turbine units to increase the hydraulic capacity of each of the turbines from 5,430 cfs to 6,200 cfs, for a combined hydraulic capacity of 12,400 cfs.[90] When complete, the changes will result in an additional 770 cfs going through the project turbines. The maximum turbine discharge will increase by approximately 14 percent and the maximum pumping rate will increase by 13 percent.

BSPC does not propose any measures to mitigate fish entrainment mortality associated with operation of the Fife Brook Development or Bear Swamp PSD. In addition, no stakeholders filed comments or recommendations to reduce project effects on fish entrainment.

Our Analysis

Fife Brook Development

The passage of large volumes of water through trash racks and turbines can result in fish impingement and entrainment mortality at conventional and pumped storage hydroelectric projects. Blade strikes are thought to be the primary source of mortality for fish entrained through both pumped storage and conventional hydropower projects (Franke *et al*., 1997; Pracheil *et al*., 2016). Pressure-induced mortality is more frequent at pumped storage hydroelectric projects, especially if the area where fish exit the pump-turbine units has a much lower pressure than the point of entrainment (*e.g.*, passing from a deep to shallow reservoir) (Cada *et al*., 1997). Fish life history, size, swimming ability, operating regimes, inflow, intake velocities, trashrack bar spacing, and intake/turbine configurations all play an important role in entrainment susceptibility and turbine mortality. Smaller-sized fish are more likely to be entrained, but experience lower turbine mortality, although the physical properties of turbine units also plays a role in turbine mortality (Winchell *et al*., 2000; Cada *et al*., 1997; Pracheil *et al*., 2016).

The single intake at the Fife Brook dam is equipped with a 24.2-foot-tall (normal to flow), 11.2-foot-wide trashrack panel consisting of 0.5-inch-wide bars having 3.0-inch clear spacing. BSPC proposes to continue using the existing trashrack at the generator intake at the Fife Brook dam. Due to the wide spacing of the trash racks covering the Fife Brook Development intake, there is little potential for impingement at the

[90] *See Bear Swamp Power Co., LLC*, 124 FERC ¶ 62,127 (2008). On December 9, 2016, the Commission granted an extension of time until August 13, 2022 for BSPC to complete the rehabilitation of the turbine units.

development because even the largest adult fish present in the project reservoirs could easily fit through the trash rack bars. For example, a 10-inch brown trout is approximately 1.2 inches wide (Nistor *et al.*, 2014) and could fit through the trashracks.

BSPC calculated approach velocities to the trashrack at the maximum elevation of 870 feet NGVD and the minimum elevation of 830 feet NGVD using the maximum hydraulic capacity of the turbine at the Fife Brook Development (1,540 cfs). At the maximum water surface elevation of 870 feet NGVD, the approach velocity within the flow area at 1 foot in front of the trashrack would be 0.18 feet per second (fps). At the minimum water surface elevation of 830 feet NGVD, the approach velocity within the flow area at 1 foot in front of the trashrack would be 0.68 fps.

BSPC measured intake velocity in front of the trashracks at the surface, mid-depth and the bottom when the Fife Brook impoundment was at 862 feet NGVD (near maximum reservoir elevation) and 836 feet NGVD (near minimum reservoir elevation), respectively to verify the calculated approach velocities at a distance of one foot in front of the trashrack. Measured velocities in flow field in front of the intake were all less than 1.0 fps.

The adult and juvenile life stages of most fish species present in the Fife Brook impoundment can avoid entrainment because their burst swimming speeds exceed the measured approach velocities at the Fife Brook intakes (Table 13). The calculated maximum approach velocity and measured approach velocity one foot in front of the intake at Fife Brook dam were low [less than 1.0 fps]. Fish are able to detect obstacles using stimuli such as flow acceleration, turbulence, and sound (Coutant and Whitney, 2000). As fish approach the intake and the trashrack, they would sense flow acceleration near the trashrack and sound from the turbine operation. Fish sensing these cues would typically respond by swimming away from the intake at burst speed. However, some species of juvenile fish would be susceptible to entrainment because their burst speeds are at or less than the maximum approach velocities at the Fife Brook Development intake; specifically, fallfish, slimy sculpin, rainbow trout, and brook trout are susceptible to entrainment. Nevertheless, due to their small size, the blade strike model presented by Franke *et al.*, 1997, predicts fish in this size range (less than 4-inches) would survive entrainment through the Fife Brook Development's Francis turbine. Therefore, under existing project operation, the total entrainment mortality at the Fife Brook Development would be expected to be minimal and not adversely affect fish populations in the Fife Brook impoundment.

Table 13. Burst speeds of fish species in the Fife Brook impoundment.

Family	Fish Species	Life Stage	Burst Swim Speed (fps)	Length (inches)
Catostomidae (suckers)	White Sucker[1]	Adult	5.2 – 10.2	
		Juvenile	2.4 – 3.8	7.0 – 9.0
Centrachidae (bass)	Smallmouth Bass[1]	Adult	3.5 – 5.6	10.0 – 15.0
		Juvenile	2.0 – 3.2	3.0 – 3.5
Cyprinidae (minnows and carps)	Spottail Shiner[1]	Adult	2.2 – 2.5	3.0 – 4.0
		Juvenile	1.0 – 1.3	2.0 – 2.5
	Longnose Dace[1]	Juvenile	1.4 – 3.2	1.7
	Blacknose Dace[1]	Adult	1.3	1.7
	Creek Chub[1]	Juvenile	1.5	2.2
	Fallfish[2]	Adult/Juvenile	0.6 – 3.6	7.1-11.8
Percidae (perches)	Yellow Perch[1]	Adult/Juvenile	1.0 – 1.5	3.7
Cottidae (sculpins)	Mottled Sculpin[3] (substitute for Slimy Sculpin)	Adult/Juvenile	0.8 – 2.8	1.2 – 3.5

Family	Fish Species	Life Stage	Burst Swim Speed (fps)	Length (inches)
Salmonidae (Trout and Salmon)	Rainbow Trout[1]	Adult/Juvenile	0.3 – 4.9	15.0
	Brown Trout[1]	Adult	7.0 – 12.7	6.0 – 14.0
		Juvenile[4]	1.8	2.0
	Brook Trout[1]	Adult	7.0 – 12.7	6.0 – 16.0
		Juvenile	0.1 – 2.0	3.0 – 5.0

(Source: staff)
[1] NYPA, 2017
[2] Bell, 1991
[3] Katopodis and Gervais, 2016
[4] Scruton *et al*., 1998

Bear Swamp PSD

Both of the reversible Francis-type, pump-turbine units at the Bear Swamp PSD have a maximum pump flow rating of 4,520 cfs. The pump-turbine units convey water from the Fife Brook impoundment to the upper reservoir through a four-bay intake/outlet structure. Each of the four bays of the inlet/outlet structure is equipped with a 15-foot-wide by 26.7-foot-tall trashrack consisting of 15/16-inch-wide bars with 6-inch clear spacing.

BSPC calculated approach velocities within a trapezoidal-shaped flow area 1.6 feet upstream from the trashrack at the maximum and minimum Fife Brook impoundment elevations of 870 feet and 830 feet NGVD, respectively, using the maximum pump flow rating. At the maximum water surface elevation, the calculated approach velocity within the flow area 1.6-feet in front of the trashrack would be 0.86 fps. At minimum water surface elevation, the calculated approach velocity within the flow area 1.6 foot upstream from the trashrack would be 2.1 fps.

BSPC measured intake velocity in front of the trashracks at the inlet/outlet structure at the surface, mid-depth, and the bottom when the Fife Brook impoundment was at 862 feet NGVD (near the maximum elevation) and 836 feet NGVD (near the minimum elevation), respectively, to verify the calculated approach velocities at a distance of 1.6 feet in front of the trashracks. Measured velocities in flow in front of the intake/outlet structure were all less than 1.0 fps.

Similar to the Fife Brook Development, the wide spacing of the trash racks covering the intake/outlet structure of the Bear Swamp PSD (clear spacing of 6.0 inches) reduces the potential for impingement at Bear Swamp PSD because even the largest adult fish present in the Fife Brook impoundment (*i.e.*, brown trout) could easily fit through trash racks.

The Bear Swamp PSD is known to entrain adult and juvenile fish. There are no other inflows to the upper reservoir except for the inflow that is pumped from the Fife Brook impoundment by the Bear Swamp PSD. The presence of yellow perch, smallmouth bass, white sucker, and brown trout in the upper reservoir indicates that these fish species were likely entrained during pumping.

Yellow perch appear to be most susceptible to entrainment as this group has the highest number of individuals in the Fish Assemblage Study. The range of lengths of yellow perch in the upper reservoir (46-174 mm in total length) is evidence that both adult and juvenile fish are present in the upper reservoir. Based on the observed numbers and sizes of yellow perch, it is possible that yellow perch can reproduce in the upper reservoir. Juvenile and adult yellow perch have burst speeds similar to the measured approach velocity in front of the inlet/outlet structure (Table 13). Incidental numbers (less than 20 individuals) of other species of adult fish (brown trout, smallmouth bass, white sucker) also made up the catch in the upper reservoir; however, these species have burst speeds that exceed the measured approach velocity at the inlet/outlet structure (Table 13). Overall, based on the large distribution of juvenile fish in the upper reservoir, it appears that juvenile fish are most susceptible to entrainment. As discussed above, the blade strike model presented by Franke *et al*. (1997) predicts fish less than 4 inches would survive entrainment through a Francis turbine, as evidenced by the numbers of juvenile yellow perch in the upper reservoir.

At pumped storage projects such as the Bear Swamp PSD, where entrained fish are moved (passed) fairly rapidly between two different reservoirs with potentially different environments and water pressures (depending on project operation and water levels), pressure-induced mortality represents an additional source of entrainment mortality. This is especially the case when fish are entrained at high pressures and released into relatively low pressure environments because fish (especially physoclistous fish that lack a connection between their esophagus and swim bladder, such as percids and centrarchids) have difficulty releasing gas when moved rapidly to a lower pressure environment (Bond, 1996). Cada *et al*. (1997) suggest that, as a general fish protection measure, exposure pressures should fall to no less than 60 percent of the value to which entrained fish are acclimated. At the Bear Swamp PSD, under the worst case scenario while the project is generating (and the upper reservoir is at full pool, 1,600 feet NGVD) and the Fife Brook impoundment is at its minimum operating elevation of 830 feet NGVD), the pressure a fish would experience upon release into the Fife Brook impoundment (5.8 pounds per square inch, (psi)) is lower than that experienced at the point of entrainment (26.0 psi). Under the worst case scenario when the project is pumping (and the Fife Brook impoundment is at full pool and the upper reservoir is at its normal operating level of 1,555 feet), the pressure a fish would experience upon release into the upper reservoir (29.4 psi) is considerably less, only 47 percent of that experienced at the point of entrainment (61.6 psi), which could be detrimental based on the 60 percent threshold suggested by Cada *et al*. (1997).

As discussed above, the measured approach velocities in the Fife Brook impoundment inlet/outlet structure are low (less than 2 fps) and adult and juvenile yellow perch is the species most susceptible to entrainment. At Bear Swamp PSD, velocity at the inlet/outlet structure decreases over time as the upper reservoir fills because the pump turbines have to overcome increasing head of the filling upper reservoir. Therefore, fish are most susceptible to entrainment at the beginning of a pump cycle when the upper reservoir starts filling. Effects of entrainment mortality (either pressure-induced or from blade strike) would not be expected to be detrimental to populations of yellow perch, as these fish are highly abundant at the project under current operation. Therefore, under existing project operation the total entrainment mortality at the Bear Swamp PSD would be expected to be minimal and not adversely affect fish populations in the upper and lower reservoirs.

As discussed in the August 2008 environmental assessment for the rehabilitation of the existing turbine units,[91] the Commission-approved changes to the hydraulic capacities of the turbines at the Bear Swamp PSD will increase the intake velocities at the trashracks (by 0.5 fps under high tailwater conditions and by 0.3 fps under low tailwater conditions). In the August 2008 environmental assessment, Commission staff concluded that this increase in flow velocities during the pumping cycle could result in increased fish entrainment and any attendant mortality. However, the intake velocities of the trashracks would be below the prolonged speeds (*i.e.*, speeds that can be maintained for up to 200 minutes) for rainbow and brown trout at 2.95 - 5.9 fps and 2.29 - 6.23 fps, respectively. Thus, these species have the capability to swim against the currents associated with the pumping mode and avoid entrainment. Commission staff concluded in the August 2008 environmental assessment that the increased intake velocities associated with the turbine rehabilitation would not be expected to significantly increase entrainment.

<u>Deerfield River Downstream of Fife Brook Dam</u>

BSPC proposes to continue to operate the Bear Swamp PSD in a store and release mode by pumping water from the Fife Brook impoundment (*i.e.*, the lower reservoir) during periods of low electricity demand, storing the water until periods of high

[91] *See Bear Swamp Power Co., LLC*, 124 FERC ¶ 62,127 (2008).

NOI ATTACHMENT 6

USFWS ESA CERTIFICATION LETTERS

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To: April 04, 2023
Project Code: 2023-0064279
Project Name: Fife Brook Hydroelectric Facility Endangered Species Act Certification

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

Updated 3/8/2023 - Please review this letter each time you request an Official Species List, we will continue to update it with additional information and links to websites may change.

About Official Species Lists

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Federal and non-Federal project proponents have responsibilities under the Act to consider effects on listed species.

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested by returning to an existing project's page in IPaC.

Endangered Species Act Project Review

Please visit the "**New England Field Office Endangered Species Project Review and Consultation**" website for step-by-step instructions on how to consider effects on listed species and prepare and submit a project review package if necessary:

https://www.fws.gov/office/new-england-ecological-services/endangered-species-project-review

NOTE Please do not use the **Consultation Package Builder** tool in IPaC except in specific situations following coordination with our office. Please follow the project review guidance on our website instead and reference your **Project Code** in all correspondence.

Northern Long-eared Bat - (Updated 3/8/2023) The Service published a final rule to reclassify the northern long-eared bat (NLEB) as endangered on November 30, 2022. The final rule will go into effect on **March 31, 2023**. After that date, the current 4(d) rule for NLEB will be invalid, and the 4(d) determination key will no longer be available. New compliance tools will be available in March 2023, and information will be posted in this section on our website and on the northern long-eared bat species page, so please check this site often for updates.

Depending on the type of effects a project has on NLEB, the change in the species' status may trigger the need to re-initiate consultation for any actions that are not completed and for which the Federal action agency retains discretion once the new listing determination becomes effective. If your project may result in incidental take of NLEB after the new listing goes into effect, this will need to be addressed in an updated consultation that includes an Incidental Take Statement. Many of these situations will be addressed through the new compliance tools. If your project may require re-initiation of consultation, please wait for information on the new tools to appear on this site or contact our office for additional guidance.

Additional Info About Section 7 of the Act
Under section 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to determine whether projects may affect threatened and endangered species and/or designated critical habitat. If a Federal agency, or its non-Federal representative, determines that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Federal agency also may need to consider proposed species and proposed critical habitat in the consultation. 50 CFR 402.14(c)(1) specifies the information required for consultation under the Act regardless of the format of the evaluation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/service/section-7-consultations

In addition to consultation requirements under Section 7(a)(2) of the ESA, please note that under sections 7(a)(1) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species. Please contact NEFO if you would like more information.

Candidate species that appear on the enclosed species list have no current protections under the ESA. The species' occurrence on an official species list does not convey a requirement to consider impacts to this species as you would a proposed, threatened, or endangered species. The ESA does not provide for interagency consultations on candidate species under section 7, however, the Service recommends that all project proponents incorporate measures into projects to benefit candidate species and their habitats wherever possible.

Migratory Birds

In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see:

https://www.fws.gov/program/migratory-bird-permit

https://www.fws.gov/library/collections/bald-and-golden-eagle-management

Please feel free to contact us at **newengland@fws.gov** with your **Project Code** in the subject line if you need more information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat.

Attachment(s): Official Species List

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

PROJECT SUMMARY

Project Code: 2023-0064279
Project Name: Fife Brook Hydroelectric Facility Endangered Species Act Certification
Project Type: Power Gen - Hydropower - FERC
Project Description: The Fife Brook Hydroelectric Facility is required to undergo an endangered species act certification as part of the notice of intent (NOI) renewal associated with the 2023 NPDES General Permit for Hydroelectric Generating Facilities (MAG360000).
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@42.68454115,-72.97629769623421,14z

Counties: Berkshire and Franklin counties, Massachusetts

ENDANGERED SPECIES ACT SPECIES

There is a total of 2 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

IPAC USER CONTACT INFORMATION

Agency: Sevee & Maher Engineers, Inc.
Name: Anthony Pais
Address: 4 Blanchard Road
City: Cumberland
State: ME
Zip: 04021
Email aep@smemaine.com
Phone: 2078295016

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To: April 04, 2023
Project code: 2023-0064279
Project Name: Fife Brook Hydroelectric Facility Endangered Species Act Certification

Federal Nexus: yes
Federal Action Agency (if applicable): Environmental Protection Agency

Subject: Record of project representative's no effect determination for 'Fife Brook Hydroelectric Facility Endangered Species Act Certification'

Dear Anthony Pais:

This letter records your determination using the Information for Planning and Consultation (IPaC) system provided to the U.S. Fish and Wildlife Service (Service) on April 04, 2023, for 'Fife Brook Hydroelectric Facility Endangered Species Act Certification' (here forward, Project). This project has been assigned Project Code 2023-0064279 and all future correspondence should clearly reference this number. **Please carefully review this letter.**

Ensuring Accurate Determinations When Using IPaC

The Service developed the IPaC system and associated species' determination keys in accordance with the Endangered Species Act of 1973 (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and based on a standing analysis. All information submitted by the Project proponent into the IPaC must accurately represent the full scope and details of the Project. Failure to accurately represent or implement the Project as detailed in IPaC or the Northern Long-eared Bat Rangewide Determination Key (Dkey), invalidates this letter.

Determination for the Northern Long-Eared Bat

Based upon your IPaC submission and a standing analysis, your project has reached the determination of "No Effect" on the northern long-eared bat. To make a no effect determination, the full scope of the proposed project implementation (action) should not have any effects (either positive or negative), to a federally listed species or designated critical habitat. Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17).

Under Section 7 of the ESA, if a federal action agency makes a no effect determination, no consultation with the Service is required (ESA §7). If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required except when the Service concurs, in writing, that a proposed action "is not likely to adversely affect" listed species or designated critical habitat [50 CFR §402.02, 50 CFR§402.13].

Other Species and Critical Habitat that May be Present in the Action Area

The IPaC-assisted determination for the northern long-eared bat does not apply to the following ESA-protected species and/or critical habitat that also may occur in your Action area:

- Monarch Butterfly *Danaus plexippus* Candidate

You may coordinate with our Office to determine whether the Action may affect the animal species listed above and, if so, how they may be affected.

Next Steps

Based upon your IPaC submission, your project has reached the determination of “No Effect” on the northern long-eared bat. If there are no updates on listed species, no further consultation/ coordination for this project is required with respect to the northern long-eared bat. However, the Service recommends that project proponents re-evaluate the Project in IPaC if: 1) the scope, timing, duration, or location of the Project changes (includes any project changes or amendments); 2) new information reveals the Project may impact (positively or negatively) federally listed species or designated critical habitat; or 3) a new species is listed, or critical habitat designated. If any of the above conditions occurs, additional coordination with the Service should take place to ensure compliance with the Act.

If you have any questions regarding this letter or need further assistance, please contact the New England Ecological Services Field Office and reference Project Code 2023-0064279 associated with this Project.

Action Description
You provided to IPaC the following name and description for the subject Action.

1. Name

Fife Brook Hydroelectric Facility Endangered Species Act Certification

2. Description

The following description was provided for the project 'Fife Brook Hydroelectric Facility Endangered Species Act Certification':

> The Fife Brook Hydroelectric Facility is required to undergo an endangered species act certification as part of the notice of intent (NOI) renewal associated with the 2023 NPDES General Permit for Hydroelectric Generating Facilities (MAG360000).

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@42.68454115,-72.97629769623421,14z

DETERMINATION KEY RESULT

Based on the information you provided, you have determined that the Proposed Action will have no effect on the Endangered northern long-eared bat (Myotis septentrionalis). Therefore, no consultation with the U.S. Fish and Wildlife Service pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (87 Stat. 884, as amended 16 U.S.C. 1531 *et seq.*) is required for those species.

QUALIFICATION INTERVIEW

1. Does the proposed project include, or is it reasonably certain to cause, intentional take of the northern long-eared bat or any other listed species?

   Note: Intentional take is defined as take that is the intended result of a project. Intentional take could refer to research, direct species management, surveys, and/or studies that include intentional handling/encountering, harassment, collection, or capturing of any individual of a federally listed threatened, endangered or proposed species?

   No

2. Do you have post-white nose syndrome occurrence data that indicates that northern long-eared bats (NLEB) are likely to be present in the action area?

   Bat occurrence data may include identification of NLEBs in hibernacula, capture of NLEBs, tracking of NLEBs to roost trees, or confirmed acoustic detections. With this question, we are looking for data that, for some reason, may have not yet been made available to U.S. Fish and Wildlife Service.

   No

3. Does any component of the action involve construction or operation of wind turbines?

   Note: For federal actions, answer 'yes' if the construction or operation of wind power facilities is either (1) part of the federal action or (2) would not occur but for a federal agency action (federal permit, funding, etc.).

   No

4. Is the proposed action authorized, permitted, licensed, funded, or being carried out by a Federal agency in whole or in part?

   Yes

5. Is the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), or Federal Transit Administration (FTA) funding or authorizing the proposed action, in whole or in part?

   No

6. Are you an employee of the federal action agency or have you been officially designated in writing by the agency as its designated non-federal representative for the purposes of Endangered Species Act Section 7 informal consultation per 50 CFR § 402.08?

   Note: This key may be used for federal actions and for non-federal actions to facilitate section 7 consultation and to help determine whether an incidental take permit may be needed, respectively. This question is for information purposes only.

   No

7. Is the lead federal action agency the Environmental Protection Agency (EPA) or Federal Communications Commission (FCC)? Is the Environmental Protection Agency (EPA) or Federal Communications Commission (FCC) funding or authorizing the proposed action, in whole or in part?

   Yes

8. Have you determined that your proposed action will have no effect on the northern long-eared bat? Remember to consider the effects of any activities that would not occur but for the proposed action.

   If you think that the northern long-eared bat may be affected by your project or if you would like assistance in deciding, answer "No" below and continue through the key. If you have determined that the northern long-eared bat does not occur in your project's action area and/or that your project will have no effects whatsoever on the species despite the potential for it to occur in the action area, you may make a "no effect" determination for the northern long-eared bat.

   Note: Federal agencies (or their designated non-federal representatives) must consult with USFWS on federal agency actions that may affect listed species [50 CFR 402.14(a)]. Consultation is not required for actions that will not affect listed species or critical habitat. Therefore, this determination key will not provide a consistency or verification letter for actions that will not affect listed species. If you believe that the northern long-eared bat may be affected by your project or if you would like assistance in deciding, please answer "No" and continue through the key. Remember that this key addresses only effects to the northern long-eared bat. Consultation with USFWS would be required if your action may affect another listed species or critical habitat. The definition of Effects of the Action can be found here: https://www.fws.gov/media/northern-long-eared-bat-assisted-determination-key-selected-definitions

   Yes

PROJECT QUESTIONNAIRE

Will all project activities by completed by April 1, 2024?

No

IPAC USER CONTACT INFORMATION

Agency: Sevee & Maher Engineers, Inc.
Name: Anthony Pais
Address: 4 Blanchard Road
City: Cumberland
State: ME
Zip: 04021
Email aep@smemaine.com
Phone: 2078295016

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Environmental Protection Agency
Name: George Papadopoulos
Email: papadopoulos.george@epa.gov
Phone: 6179181579

NOI ATTACHMENT 7

NATIONAL REGISTER OF HISTORIC PLACES REVIEW

SME
SEVEE & MAHER
ENGINEERS

SME
SEVEE & MAHER
ENGINEERS

4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 • Fax: 207.829.5692
info@smemaine.com
smemaine.com

June 8, 2023

U.S. Environmental Protection Agency, Region 1
ATTN: George Papadopoulos, HYDROGP Coordinator
5 Post Office Square – Mailcode 06-1
Boston, MA 02109-3912

Email: Hydro.GeneralPermit@epa.gov

Subject: Fife Brook Hydroelectric Facility – National Register of Historic Places Review

Dear Mr. Papadopoulos:

As requested within Section F of the Hydroelectric Generating Facilities General Permit (Hydro GP) notice of intent (NOI), Sevee & Maher Engineers, Inc. (SME) has completed a review of the National Register of Historic Places near the Fife Brook Hydroelectric facility located at 370 River Road in Florida, MA on behalf of the Bear Swamp Power Company, LLC. As a result of this review, it was determined that there was one historic property present within the vicinity of the Fife Brook facility: the Hoosac Tunnel (Property ID 73000294). The easternmost portion of the Hoosac Tunnel is located approximately 1.25 miles to the west of the Fife Brook facility and any discharges or related activities at the facility are unlikely to impact this historic property; therefore, the facility should remain eligible for coverage under the Hydro GP in accordance with Criterion B.

Should questions arise or additional information be desired, please do not hesitate to contact me at 207.829.5016.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Philip H. Gerhardt, P.E.
Principal/Senior Environmental Engineer

Attachments: 1. National Register of Historic Places Overhead

ATTACHMENT 1

NATIONAL REGISTER OF HISTORIC PLACES OVERHEAD

SME
SEVEE & MAHER
ENGINEERS

National Register of Historic Places

National Park Service
U.S. Department of the Interior

Public, non-restricted data depicting National Register spatial data processed by the Cultural Resources GIS facility. ...