GREAT RIVER HYDRO, LLC

Vernon Hydroelectric Project
FERC Project No. 1904-073

AMENDED

APPLICATION FOR NEW LICENSE

Initial Statement and
Exhibits A, B, C, D, F (Public),
G (excluding maps), and H

December 7, 2020

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Amended Final Application for New License for Major Water Power Project—Existing Dam

Vernon Project (FERC No. 1904)

INITIAL STATEMENT AND EXHIBIT A: PROJECT DESCRIPTION

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INITIAL STATEMENT

BEFORE THE FEDERAL ENERGY REGULATORY COMMISSION

Application for License for Major Project—Existing Dam

1. Great River Hydro, LLC (Great River Hydro or Applicant), applies to the Federal Energy Regulatory Commission (Commission or FERC) for a new license for the existing Vernon Hydroelectric Project (Vernon Project or Project) (FERC No. 1904) as described in the attached exhibits. The current license for the Vernon Project was issued on June 25, 1979, with an expiration date of April 30, 2019. By notice dated May 9, 2019, FERC authorized Great River Hydro to continue operation of the Bellows Falls Hydroelectric Project until such time as the Commission acts on its application for a subsequent license.

2. The location of the Project is:

State:	New Hampshire	Vermont
Counties:	Cheshire	Windham
Township or Nearby Town:	Hinsdale	Vernon
Waterbody:	Connecticut River	

3. The exact name and business address of the Applicant is:

Great River Hydro, LLC
112 Turnpike Road, Suite 202
Westborough, MA 01581

The name and mailing address of the persons authorized to act as the Applicant's agent for this application are:

John L. Ragonese
FERC License Manager
Great River Hydro, LLC
40 Pleasant St., Suite 202
Portsmouth, NH 03801

Erin O'Dea
Vice President, Legal
Great River Hydro, LLC
112 Turnpike Road, Suite 202
Westborough, MA 01581

Scott Hall
President
Great River Hydro, LLC
112 Turnpike Road, Suite 202

Westborough, MA 01581

4. The Applicant is a Delaware limited liability company and is not claiming preference under Section 7(a) of the Federal Power Act. See 16 U.S.C. 796.

5. The statutory or regulatory requirements of the States of New Hampshire and Vermont that affect the Project as it exists with respect to bed and banks and the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power and in any other business necessary to accomplish the purpose of the license under the Federal Power Act, are:

   - Great River Hydro must obtain a water quality certification from the New Hampshire Department of Environmental Services and Section 401 (a)(1) of the Clean Water Act.
   - Great River Hydro must obtain a water quality certification from the Vermont Department of Environmental Conservation and Section 401 (a)(1) of the Clean Water Act.

   The steps which the Applicant has taken or plans to take to comply with the regulations cited above are:

   - Great River Hydro will submit requests for water quality certification from the two state agencies[1] in accordance with 18 C.F.R. § 5.23(b) within 60 days of FERC's issuance of a notice that the license application is ready for environmental analysis.

6. Great River Hydro owns all of the existing Project facilities. No federally owned or operating facilities are associated with the Project.

[1] By letters dated April 1, 2016, both New Hampshire and Vermont agencies indicated that the Applicant must apply to each state for state-specific water quality certification.

ADDITIONAL INFORMATION REQUIRED BY 18 C.F.R. § 5.18(a)

1. *Identify every person, citizen, association of citizens, domestic corporation, municipality, or state that has or intends to obtain and will maintain any proprietary right necessary to construct, operate or maintain the project:*

   Great River Hydro has or intends to obtain and will maintain the proprietary rights necessary to construct, operate, and maintain the Project.

2. *Identify (providing names and mailing addresses):*

   a. *Every county in which any part of the project and any Federal facilities that would be used by the project would be located:*

   Cheshire County Administration
   33 West Street
   Keene, NH 03431

   Windham County Clerk
   PO Box 207
   Newfane, VT 05345

   b. *Every city, town, or similar local political subdivision:*

      (i). *In which any part of the Project, and any Federal facility that would be used by the project, would be located:*

   Town of Hinsdale
   PO Box 13
   Hinsdale, NH 03451-0013

   Town of Vernon
   PO Box 66
   Vernon, VT 05354

   Town of Chesterfield
   PO Box 175
   Chesterfield, NH 03443

   Town of Brattleboro
   230 Main Street
   Brattleboro, VT 05301

   Town of Westmoreland
   PO Box 55
   Westmoreland, NH 03467

   Town of Putney
   PO Box 233
   Putney, VT 05346

   Town of Walpole
   PO Box 729
   Walpole, NH 03608

   Town of Dummerston
   1523 Middle Road
   E. Dummerston, VT 05346

   Town of Westminster
   PO Box 147
   Westminster, VT 05158

(ii). That has a population of 5,000 or more people and is located within 15 miles of the project dam.

Based on 2010 U.S. Census data the following municipalities meet this criterion.

Town of Swanzey
PO Box 10009
Swanzey, NH 03446

City of Greenfield
14 Court Square
Greenfield, MA 01301

(iii). Every irrigation district, drainage district or similar special purpose political subdivision (A) in which any part of the project is located, and any Federal facility that is or is proposed to be used by the project is located, or (B) that owns, operates, maintains, or uses any project facility or any Federal facility that is or is proposed to be used by the project:

No irrigation or drainage districts meet these criteria.

(iv). Every other political subdivision in the general area of the Project that there is reason to believe would likely be interested in, or affected by, the application.

Great River Hydro is not aware of other political subdivisions in the general area of the Project.

(v). All Indian tribes that may be affected by the Project.

A. No federally recognized Tribes are located in New Hampshire or Vermont; however, FERC identified the following federally recognized Tribe based in Charlestown, Rhode Island:

Narragansett Indian Tribe
Doug Harris, Deputy Tribal Historic Preservation Officer
4425-A South County Trail
Charlestown, RI 02813

B. The four Vermont state-recognized Abenaki Tribes, whose traditional lands encompass the Project are listed below:

i. Nulhegan Band of the Coosuk Abenaki Nation
Chief Don Stevens
156 Bacon Drive
Shelburne, VT 05482

ii. Elnu Tribe of the Abenaki
Chief Roger Longtoe Sheehan
5243 VT Route 30
Jamaica, VT 05343

iii. Koasek Traditional Band of the Koas Abenaki Nation
Co-chiefs Shirley Hook, Amy Hook Therrien, Carrie Gendreau
PO Box 272
Newbury, VT 05051

iv. Sovereign Abenaki Nation of Missisquoi
Chief Lawrence Moose Lampman
PO Box 133
Swanton, VT 05488

C. Additional Abenaki Tribal groups:

i. Cowasuck Band – Pennacook/ Abenaki People
Sôgmo Paul Pouliot
PO Box 52
840 Suncook Valley Rd
Alton, NH 03809-0052

ii. Koasek Traditional Band of the Sovereign Abenaki Nation
Chief Paul J. Bunnell
32 Hoit Mill Rd, #202
Weare, NH 03281

iii. Abenaki Nation of New Hampshire
262 Lancaster Rd.
Whitefield, NH 03598

3. *For a license (other than a license under Section 15 of the Federal Power Act), state that the applicant has made, either at the time of or before filing the application, a good faith effort to give notification by certified mail of the filing of the application to:*

   a. *Every property owner of record of any interest in the property within the bounds of the Project, or in the case of the Project without a specific boundary, each such owner of property which would underlie or be adjacent to any Project works, including any impoundments; and*

   b. *The entities identified in paragraph (2) above, as well as any other federal, state, municipal or other local government agencies that there is reason to believe would likely be interested in or affected by the application.*

   Because this is an application for a new license under Section 15 of the Federal Power Act (FPA), this regulatory provision does not apply.

4. *PURPA Benefits:*

   Great River Hydro is not seeking any PURPA benefits in association with the relicensing of the Project.

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VERIFICATION STATEMENT

This application is executed in the:

State of: Maine,

County of: Penobscot,

By Scott Hall, whose signature on this 4th day of December, 2020, certifies that the he has read the filing and knows its contents, the contents are true as stated, to his best knowledge and belief, and he possesses full power and authority to sign the filing. (18 CFR 385.2005(a)).

Great River Hydro, LLC

By: _____

Name: Scott Hall

Title: President and CEO

Address: 112 Turnpike Road, Suite 202, Westborough MA 01581

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ACRONYMS AND ABBREVIATIONS

µS/cm	microsiemens per centimeter
1D	one-dimensional
2D	two-dimensional
acre-ft	acre-feet
ACHP	Advisory Council on Historic Preservation
A.D.	Anno Domini
APE	area of potential effects (as pertains to Section 106 of the National Historic Preservation Act)
ASMFC	Atlantic States Marine Fisheries Commission
AWS	area weighted suitability
B.C.	Before Christ
B.P.	Before Present
CCA	claimed capacity audits
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
CRASC	Connecticut River Atlantic Salmon Commission
CSO	combined sewer overflow
CTDEEP	Connecticut Department of Energy and Environmental Protection
CWA	Clean Water Act
°C	degrees Celsius
DA	drainage area
DO	dissolved oxygen
DOI	U.S. Department of the Interior
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
El.	elevation
EO	element occurrence
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act

°F	degrees Fahrenheit
FCA	Forward Capacity Auction
FERC	Federal Energy Regulatory Commission
FirstLight	FirstLight Power Resources
FLA	Final License Application
FMF	Fifteen Mile Falls Hydroelectric Project
FPA	Federal Power Act
ft	foot or feet
ft/s	feet per second
FWS	U.S. Department of the Interior, Fish and Wildlife Service
GIS	Geographic Information System
Great River Hydro	Great River Hydro, LLC
HI-Z	HI-Z Turb'N
HPMP	Historic Properties Management Plan
IEO	inflow equals outflow
ILP	Integrated Licensing Process
IPANE	Invasive Plant Atlas of New England
ISO-NE	New England Independent System Operator
ISR	Initial Study Report
KOP	key observation point
kV	kilovolt
kVA	kilovolt-ampere
kW	kilowatt
kWh	kilowatt-hour
m^2	square meter
mgd	million gallons per day
mg/L	milligram(s) per liter
mg/m^3	milligrams per cubic meter
mL	milliliter
m.s.l.	mean sea level
MW	megawatt
MWh	megawatt-hour
National Register	National Register of Historic Places

NEIWPCC	New England Interstate Water Pollution Control Commission
NEPA	National Environmental Policy Act
NGVD29	National Geodetic Vertical Datum of 1929
NAVD88	North American Vertical Datum of 1988
NHA	New Hampshire Audubon
NHDES	New Hampshire Department of Environmental Services
NHFGD	New Hampshire Fish and Game Department
NHNHB	New Hampshire Natural Heritage Bureau
NHPA	National Historic Preservation Act
NHSHPO	New Hampshire State Historic Preservation Officer
NITHPO	Narragansett Indian Tribal Historic Preservation Officer
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity unit
NWI	National Wetlands Inventory
PAD	Pre-Application Document
PGA	peak ground acceleration
PHABSIM	Physical Habitat Simulation
PIT	passive integrated transponder
PLP	Preliminary Licensing Proposal
PM&E measures	protection, mitigation, and enhancement measures
Projects	Wilder (FERC No. 1892), Bellows Falls (FERC No. 1855), and Vernon (FERC No. 1904) Hydroelectric Projects
PSP	Proposed Study Plan
PURPA	Public Utility Regulatory Policies Act of 1978
REC	Renewable Energy Credit
RPD	reactive power demonstrations
RPM	revolutions per minute
RM	river mile
R.S.A.	New Hampshire Revised Statutes Annotated

RSP	Revised Study Plan
RTE	rare, threatened, or endangered
§	Section of a statute such as 18 C.F.R. § 5.6 (c)
SD1	Scoping Document 1
SD2	Scoping Document 2
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
Sound	Long Island Sound
SPD	Study Plan Determination
sq. mi.	square mile(s)
TCP	Traditional Cultural Property
TMDL	total maximum daily load
TransCanada	TransCanada Hydro Northeast Inc.
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USGS	U.S. Geological Survey
USR	Updated Study Report
VAR	volt-ampere-reactive
VANR	Vermont Agency of Natural Resources
VDEC	Vermont Department of Environmental Conservation
VFWD	Vermont Fish & Wildlife Department
VTNHI	Vermont Natural Heritage Inventory
VTSHPO	Vermont State Historic Preservation Officer
VY	Vermont Yankee Nuclear Power Plant
WAP	Wildlife Action Plan
WSE	water surface elevation
WUA	weighted usable area

Amended Final Application for New License for Major Water Power Project—Existing Dam

Vernon Project (FERC No. 1904)

EXHIBIT A: PROJECT DESCRIPTION

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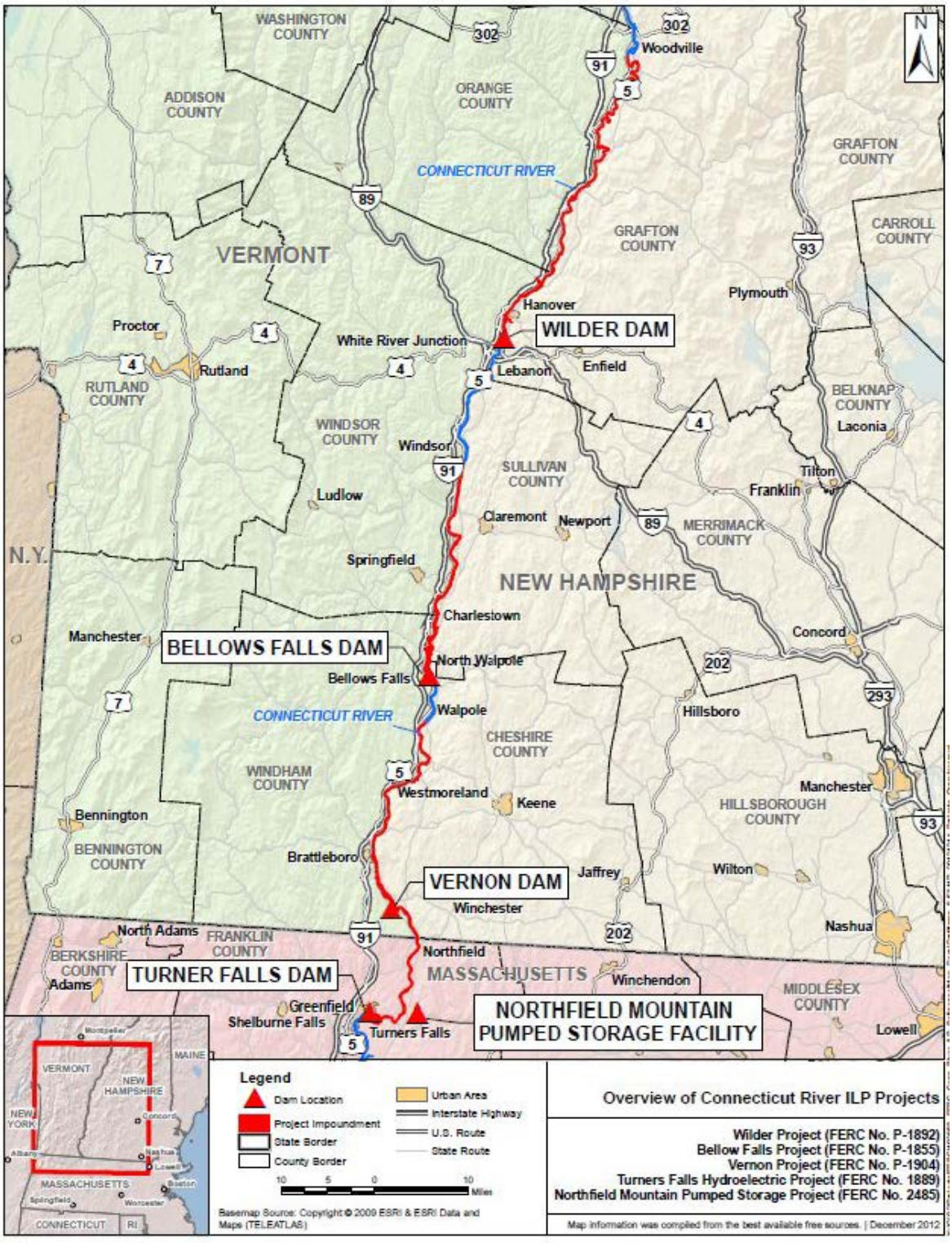
EXHIBIT A: PROJECT DESCRIPTION

Section 5.18(a)(5)(iii) of Title 18 of the Code of Federal Regulations (CFR) refers to Section 4.51 (License for Major Project—Existing Dam) for a description of information that an applicant must include in Exhibit A of its license application. Exhibit A is a description of the Project.

A1 Project Description

The Vernon Project dam and powerhouse are located on the Connecticut River at river mile (RM) 141.9, about 2 miles upstream of the Ashuelot River and 7.4 miles downstream of the West River, in the town of Vernon, Windham County, Vermont, and the town of Hinsdale, Cheshire County, New Hampshire. Figure A-1 illustrates the location of the Project in relationship to the other Projects undergoing concurrent relicensing.[2] The Project is located in the towns of Vernon, Brattleboro, Dummerston, Putney, and Westminster, Vermont; and Hinsdale, Chesterfield, Westmoreland, and Walpole, New Hampshire.

[2] The five projects are collectively referred to as "the Connecticut River Projects" and include Great River Hydro's Wilder (FERC No. 1892), Bellows Falls (FERC No. 1855), and Vernon (FERC No. 1904) Projects along with FirstLight's Turners Falls (FERC NO. 1889) and Northfield Mountain Pumped Storage (FERC No. 2485) Projects.



Source: FERC (2013)

Figure A-1. Project location in relationship to the Connecticut River Projects.

Primary Project facilities are shown in Figure A-2 and include the dam and spillway; the powerhouse, switchyard, and garage/service building (located southwest of the powerhouse across Governor Hunt Road). The Project also includes fish passage facilities, as described in Section A1.5 below, and recreation areas and facilities including a boat launch, portage, picnic areas, fish ladder viewing area, and fishing access (see Exhibit E, Section 3.9, *Recreation Resources and Land Use*).

Great River Hydro holds fee ownership of 287 acres of land in the Vernon Project. Of this, 16 acres are used for plant and related facilities, 34 acres are for public outdoor recreational use, 14 acres currently support local agriculture, and the remaining 223 acres are currently natural forest areas.

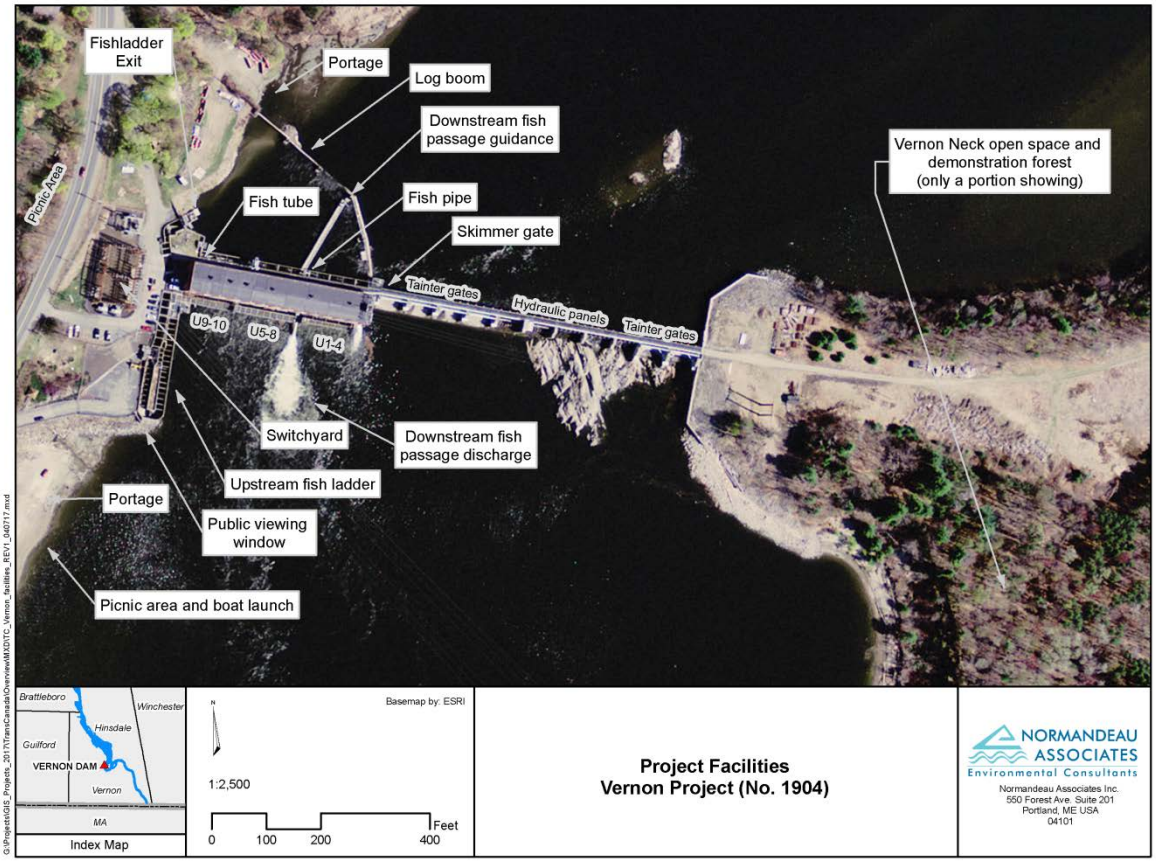


Figure A-2. Primary Project facilities.

A1.1 Impoundment

The Project impoundment is approximately 26 miles long and extends upstream approximately to the Walpole Bridge (Route 123 Bridge) at Westminster Station, Vermont. The impoundment has a surface area of 2,550 acres and a total volume of about 40,000 acre-ft at El. 220.13 ft (National Geodetic Vertical Datum of 1929 [NGVD29]) at the top of the stanchion boards.

The overall operating range of the Project, accounting for both low inflow and most high inflows conditions, is typically between El. 212.13 ft and El. 220.13 ft providing about 18,300 acre-ft of storage in the 8-ft range. The more typical impoundment operating range under non-spill conditions is between El. 218.3 and El. 220.1 ft for usable storage capacity of 4,489 acre-ft or 24.5 percent of the overall usable storage.

A1.2 Dam and Spillway

The dam is a composite overflow and non-overflow ogee-type, concrete gravity structure extending across the Connecticut River between Hinsdale, New Hampshire, and Vernon, Vermont (Figure A-3). The dam is 956 ft long with a maximum height of 58 ft. It consists of the integral powerhouse with a sluice gate block section that is about 356 ft long and a concrete overflow spillway section about 600 ft long. The spillway portion of the dam is divided into 12 bays containing, from west to east, a trash/ice sluice, four tainter gates, two hydraulic flashboard bays, three stanchion bays, and two tainter gates. In addition, eight submerged hydraulic flood gates are located below the ogee spillway and the 10-ft by 50-ft tainter gates (Table A-1). The various bays are separated by concrete piers supporting a steel and concrete bridge that runs the length of the dam for access and for operation of flashboards. The trash sluice is a skimmer gate that passes logs and other debris deflected away from the powerhouse by a log and ice boom in the powerhouse forebay.

Figure A-3. Dam spillway and powerhouse (looking upstream).

Table A-1. Spillway facilities.

Gate Type	Number	Size (height or width, by length in ft)	Elevation (NGVD29)
Fishway sluice	1	9 x 6 (inlet end) 4 x 5 (discharge end)	210.13 194.33
Trash/ice sluice	1	13 x 13	209.13 (sill)
Tainter gates	2	20 x 50	202.13 (crest)
Tainter gates	4	10 x 50	212.13 (crest)
Hydraulic panel bays	2	10 x 50	212.13 (crest)
Stanchion bays	2	10 x 50	212.13 (crest)
Stanchion bay	1	10 x 42.5	212.13 (crest)
Hydraulic floodgates	8	7 x 9 (invert)	173.13 (sill)

A1.3 Powerhouse and Appurtenant Facilities

The powerhouse is integral to the dam and is approximately 356 ft long by 55 ft wide by 45 ft high; it is a reinforced concrete substructure with a structural steel and brick superstructure. It contains 10 turbine generating units, electrical transformers, switchboard (for local station operation in emergency conditions), machine shop, excitation equipment, emergency generator, air compressor, an overhead crane, offices, storage rooms, and ancillary equipment. The maximum hydraulic capacity (calculated as the sum of each individual unit's maximum discharge capacity) is 17,130 cubic feet per second (cfs) and nameplate generating capacity of the Project as a whole is 32,400 kilowatts (kW). Table A-2 provides turbine and generator specifications and Figure A-4 shows Unit No. 10.

Table A-2. Turbines and generators.

Unit Nos.	Nos. 1–4	Nos. 5–8	Nos. 9–10
Turbines			
Type	Single runner vertical Francis	Vertical axial flow Kaplan	Single runner vertical Francis
Design head (ft)	35	32	34
Horsepower rating at design head	4,190	5,898	6,000
Maximum hydraulic capacity (cfs)	1,465	1,800	2,035
Minimum hydraulic capacity (cfs)	400	300	500
Revolutions per minute (rpm)	133.3	144	75
Intake trashrack clear spacing (inches)	1.75	1.75	3.625
Generators			
Nameplate capacity (kilovolt-ampere ([kVA])	2,500	5,000	6,000
Power factor	0.8	0.9	0.7
Nameplate kW	2,000	4,000	4,200
Phase/frequency	3/60	3/60	3/60
Voltage	2,300	13,800	13,800

Figure A-4. Powerhouse, Unit No. 10.

The concrete gravity intake is integral with the powerhouse structure with two water passages for Unit Nos. 9 and 10, and a single water passage for Unit Nos. 1–8. Water enters directly from the forebay intakes and into the scroll or wheel cases. The draft tubes discharge into a short tailrace excavated partly in the bank (for Unit Nos. 9 and 10) and partly in the bedrock bed of the river. The scroll cases and draft tubes are formed in the concrete of the substructure which was poured on bedrock. The only units that have draft tube gates are Units No. 5 through No. 8. These gates are operated with a common electrical hoist that can be positioned in any bay via an overhead monorail (Table A-3).

The water passages for Unit Nos. 9 and 10 have trashracks with 3.625-inch clear spacing and head gates consisting of two concrete gates with an electrically driven fixed hoist. Units Nos. 1–8 have trashrack clear spacing of 1.75-inches. Unit Nos. 1–4 head gates consist of a single steel-hinge gate, one for each unit. Units Nos. 5–8 have one steel slide gate for each unit equipped with an electrically driven fixed hoist (Table A-3). A hydraulic trashrack rake is used to pull river debris away from the unit intakes. It is manually operated and is driven to the trashracks in front of each unit on a set of tracks that are located on top of the forebay intake structure. The rake head is lowered to the bottom of the racks and is then retracted riding up the rack removing the debris. The debris is then conveyed into a trailer for removal. An ice sluice/skimmer gate is located on the east side of the forebay and is 13 ft wide by 13 ft high.

Table A-3. Dimensions and composition of head gates, draft tubes and draft tube gates.

Unit	Type	Dimensions	Composition
Units 1–4	Head gates	16 ft, 6 inches high x 19 ft wide	Steel
	Draft tubes	Varies in dimension Maximum = 12 ft high x 16 ft wide	Cast into concrete foundation
	Draft tube gates	No draft tube gates	n/a
Units 5–8	Head gates	18 ft high x 18 ft, 6 inches wide	Steel
	Draft tubes	Varies in dimension Maximum = 11 ft high x 19 ft wide	Cast into concrete foundation
	Draft tube gate	11 ft high x 19 ft wide	Steel
Units 9–10	Head gates	2 gates per unit 18 ft high x 16 ft, 6 inches wide	Concrete filled steel
	Draft tube	Varies in dimension Maximum = 20 ft high x 27 ft wide	Cast into concrete foundation
	Draft tube gates	No draft tube gates	n/a

A1.4 Electrical Facilities

Project electrical facilities include the turbine generating units, four step-up transformers, bus structures, switching equipment and switchboard, generator terminals and an approximately 500-ft, 13.8-kilovolt (kV) interconnection that runs underneath the station to two outdoor 13.8- to 69-kV step-up transformers located in an outdoor substation west of the powerhouse (Figure A-4). Non-Project facilities located within the Project boundary include switchgear, bus work, and a 69-kV interconnection owned by the regional transmission company, New England Power Company, doing business as National Grid.

[This drawing is considered Critical Energy Infrastructure Information [CEII] and has been removed from this public document].

Figure A-5. Transmission interconnection schematic.

A1.5 Fish Passage Facilities

A1.5.1 Upstream Passage Facilities

The fish ladder (Figure A-6) is a reinforced concrete structure (Ice Harbor and vertical slot design) that is 984 ft long and has accessory electrical, mechanical, and pneumatic equipment that is designed to provide passage for migrating Atlantic Salmon and American Shad past the dam, a vertical distance of about 35 ft. Upstream migrating fish enter the tailrace area where they are attracted to entrance weirs at the west end of the powerhouse. Fish are attracted into the fish ladder and "climb" by swimming through a series of 51 pools created by a sequence of overflow weirs in the lower section and by a series of vertical slot pools in the upper section. After passing the first 26 overflow weir pools, each 15 ft wide by 10 ft long, and 12 inches higher than the last, fish enter the counting/trapping area and a regulating pool.

Figure A-6. Upstream fish passage facilities.

A constant WSE of about 208 ft is maintained in the regulating pool and a steady flow is provided. Flow in the regulating pool can be supplemented as needed by a floor diffuser from the attraction water intake at the fish ladder exit. Fish are guided by flow and crowder screens through a narrow opening, passing an underwater viewing window where they can be observed and counted. They can also be trapped and diverted to a holding pool by means of manually activated pneumatic trapping gates. From the counting/trapping area, fish continue to climb through the vertical slot section of the fish ladder, consisting of an additional 25 pools each about 6 inches higher than the last. At the upper end of the fish ladder, fish pass through a flume, past screens protecting the attraction water intake, through a 12-ft-wide exit channel, and into the forebay. The exit channel is divided by a concrete center pier and includes pairs of motor-driven head gates, widely-spaced trashracks (11-1/8-inch clear spacing, sufficient to pass adult salmon), and slots for wooden stop logs. A public viewing area and underwater window are located just south of the powerhouse parking lot.

The Connecticut River Atlantic Salmon Commission (CRASC) provides an annual *Fish Passage Notification Schedule*, which sets the dates for upstream passage for all dams on the Connecticut River. As of 2020 and if required, upstream passage is provided in spring from April 15 through July 15 (actual start date depends on passage counts at Turners Falls and Holyoke) for Atlantic Salmon and American Shad (and for Blueback Herring, although none have passed since 2000; See Exhibit E, Section 3.6, *Fish and Aquatic Resources*) and in fall from September 15 through November 15 for Atlantic Salmon; however, in recent years, fish ladder operation has been suspended because of low salmon returns and abandonment of the program by the U.S. Department of the Interior, Fish and Wildlife Service (FWS) and the states.

A1.5.2 Downstream Passage Facilities

Downstream fish passage facilities consist of a “fish pipe” that discharges about 350 cfs through the powerhouse at a point located between Unit Nos. 4 and 5, and a 156-ft-long louver array that extends from the forebay to the fish pipe entrance. The angled louver array consists of stainless steel panels with 3/8-inch x 2-inch louver vanes placed 3 inches on center and angled 60 degrees from the direction of the panels. Panels extend to a depth of 12–14 ft below the normal operation impoundment WSE. The louver intercepts and directs downstream-migrating fish that enter the forebay from mid-river and from the east shoreline into the fish pipe. A second smaller “fish bypass" (or “fish tube”) is located near Unit No. 10. It discharges about 40 cfs and functions as a secondary passage route for fish that are not intercepted by the louver array and are able to enter the western end of the forebay. Downstream passage is provided for:

- Adult American Shad from April 15 (or the same date as upstream passage begins) through July 31;
- Juvenile American Shad from August 1 through November 15;
- Adult American Eels from September 1 through November 15; and

- Adult Atlantic salmon from October 15 through December 31, if 50 or more adults are documented passing upstream.

As of February 11, 2016, CRASC no longer requires downstream passage operations at Vernon for Atlantic Salmon smolts (see Exhibit E, Section 3.6, *Fish and Aquatic Resources*).

A2 Lands of the United States

No lands of the United States are located within or adjacent to the Project boundary.

A3 Literature Cited

FERC (Federal Energy Regulatory Commission). 2013. Scoping document 2 for the Wilder (FERC No. 1892-026), Bellows Falls (FERC No. 1855-045), Vernon (FERC No. 1904-073), and Turners Falls (FERC No. 1889-081) hydroelectric projects, and the Northfield Mountain Pumped Storage Project (FERC No. 2485-063). Federal Energy Regulatory Commission, Washington, DC. April 15, 2013.

Amended Final Application for New License for Major Water Power Project—Existing Dam

Vernon Project (FERC No. 1904)

EXHIBIT B: PROJECT OPERATIONS AND RESOURCE UTILIZATION

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EXHIBIT B: PROJECT OPERATIONS AND RESOURCE UTILIZATION

Section 5.18(a)(5)(iii) of Title 18 of the Code of Federal Regulations (CFR) refers to Section 4.51 (License for Major Project—Existing Dam) for a description of information that an applicant must include in Exhibit B of its license application. Exhibit B is a statement of Project operation and resource utilization.

B1 Existing and Proposed Project Operation

B1.1 Existing Project Operations

Project operations are automated and controlled from a consolidated hydro operations control center located in Wilder, Vermont. Great River Hydro, LLC (Great River Hydro), typically operates the Project in a coordinated manner with other Great River Hydro generating facilities on the Connecticut River, taking into consideration variations in electricity demand as well as natural flow in order to maximize the efficient use of available water.

When inflows are within the Project's generating capacity, Great River Hydro uses the limited impoundment storage at the Project to dispatch generation as required to meet the generation schedule managed by the New England Independent System Operator (ISO-NE). During the course of any day, generation can vary between the required minimum flow and full generating capacity, depending on inflow and impoundment storage. Over the course of a day, the Project generally passes the average daily inflow.

Estimated and anticipated inflow forms the basis for bidding into the ISO-NE's day-ahead energy market. Day-ahead hourly bids reflect must-run generation periods associated with minimum flow periods, periods when sustained higher flows are anticipated, and opportunistic generation when inflow and available storage allows and electricity demand is anticipated to be high. Anticipated inflow calculations predict impoundment water surface elevations (WSEs) and determine whether spill gates must be operated to pass flow in excess of Project generating capacity. Estimated inflow is calculated using discharge from the Project plus/minus changes in impoundment elevation measured at the dam on an hourly basis, averaged over a rolling 6-hour period. Impoundment drawdown rates are typically less than 0.1 to 0.2 foot (ft) per hour and do not exceed 0.3 ft per hour and depend upon station turbine discharge capability and rate of inflow. Due to the length and [river] channel characteristics of the impoundment, changes in WSE and flow at the dam are not mirrored at upstream locations within the impoundment due to reduced influence and affect from operations at the dam and increased influence and contribution from inflow as distance from of the dam is increased. There is approximately 3,000 cubic feet per second (cfs) per hour per 0.1 ft of elevation and 0.3 ft per hour represents a maximum station output with little to no inflow.

The maximum station discharge with all ten units operating is approximately 15,400 cfs, although 98 percent of the time flows are less than 14,500 cfs. The Project itself has a maximum discharge (generation plus spill) capacity of 127,600 cfs, and the flood of record, which occurred in March 1936, was 176,000 cfs. Five U.S. Army Corps of Engineers (USACE) flood control structures (Union Village, Ompompanoosuc River; North Hartland, Ottauquechee River; North Springfield, Black River; Ball Mountain and Townsend, West River), and Moore dam, which has some flood control capability, have helped to decrease the peak flow during flood events. Since Moore dam began operating in the late 1950s and USACE dams were constructed in the 1960s, the highest flow recorded at Vernon dam has been less than 110,000 cfs. The peak discharge from Vernon dam during Tropical Storm Irene reached 102,626 cfs.

The licensed minimum flow requirement at Vernon of 1,250 cfs (or inflow if less) is provided primarily through generation and is typically at least 1,500 cfs and more than 1,600 cfs approximately 99 percent of the time. Additional non-generation flows are provided seasonally on a schedule provided annually by the Connecticut River Atlantic Salmon Commission (CRASC) based on fish counts at downstream projects. If required, fish passage flows are provided in spring (April 15–July 15) and in fall (September 15–November 15) for upstream fish passage for adult Atlantic Salmon and adult American Shad (65-cfs fishway flow and 200-cfs attraction flow) and for downstream fish passage of several species from April 1–December 31 (350 cfs from the fish pipe and 40 cfs from the fish tube) (Exhibit A1.5, *Fish Passage Facilities*). During the summer recreation season, beginning the Friday before Memorial Day and continuing through the last weekend in September, Great River Hydro maintains a self-imposed minimum impoundment WSE of elevation (El.) 218.6 ft as measured at the dam from Friday at 4:00 p.m. through Sunday at midnight and on holidays during this period, unless the Project is experiencing high flows above generating capacity.

B1.2 Operations during Adverse, Mean, and High Water Years and Emergency Conditions

High flows occur routinely throughout the year at the Project, most often during the spring freshet, the fall rainy season and significant rainfall events affecting the Connecticut River watershed downstream of Moore dam. Annually flows at the dam exceed station capacity approximately 22 percent of the time. During periods of sustained high flows, Great River Hydro dispatches Project generation in a must-run status to use available water for generation. Spring runoff on the Connecticut River typically occurs in phases based on latitude. The seasonal storage capability of the Fifteen Mile Falls Project (FMF), Moore dam primarily, is limited in comparison to the total amount of inflow it receives. However, the storage capacity at the FMF Project is used during spring runoff to “shave” the maximum anticipated peak flows downstream and refill the impoundments. This operation reduces high water conditions at the downstream dams including the Vernon Project, which is typically spilling at that time. During periods of ice movement, frequent upstream observations and river elevation checks are made within the impoundment. When there is an ice jam immediately upstream of the dam, an increased or artificial

inflow condition is created by a large swell of water in front of the jam as the water behind the jam pushes the ice and water in front of it. When this condition occurs, the station or roller gate discharge must be increased to pass water during this temporary situation and to keep the impoundment elevation within its operating limits because there is no impoundment storage capacity in this circumstance.

When anticipated inflows to the Project impoundment increase above Project generating capacity, Great River Hydro initiates "river profile" operations by lowering the impoundment elevation at the dam. When the calculated anticipated inflows exceed Project generating capacity, various combinations of spill gates (see Table A-1 in Exhibit A, *Project Description*) are operated and impoundment elevations are maintained at certain set-points until flows exceed the total spill capacity of the Project, when flows would surcharge WSE at the dam. Table B-1 lists maximum impoundment elevations that are maintained based on different anticipated inflow levels at the Project.

Typically, routine and periodic maintenance does not require impoundment drawdown, outside the license-specified full operating impoundment range. Gate inspections and minor repairs are often performed during spill conditions when gates are out of water. Otherwise, coffer dams are installed, or other methods are employed to avoid deviating from normal operation or potentially restricting the ability to pass flows in emergencies. If the need arises for unanticipated reasons or emergencies, Great River Hydro will consult with state and federal regulatory agencies, seek FERC authorization if needed, and secure any necessary permits to conduct such work. Requirements such as minimum flow are ensured through the use of alternative conveyance structures (other units or gates). Extreme high water emergencies requiring impoundment drawdowns beyond normal operating levels, as specified in Project operating procedures, are necessary for public safety, flood management, and dam safety purposes.

Table B-1. River profile and high flow operations, inflows, and impoundment elevations.

Anticipated Inflow (cfs)	Maximum Water Surface Elevation (ft) at the Dam (NGVD29)[a]
<17,000	220.13
17,000–45,000	219.6
45,000–70,100	218.6
70,100–<105,000	Impoundment elevation rises from 218.5 and is maintained at 220.1 as long as possible, including partial to full stanchion board removal as needed
>105,000	All gates, flashboard panels are opened and all stanchion bays removed, WSE surcharges as inflow increases.

a. All vertical elevations in Exhibit B are stated in National Geodetic Vertical Datum of 1929 (NGVD29).

B1.3 Proposed Project Operations

Great River Hydro, with support from relevant state and federal resource agencies, and regional and national non-governmental organizations that have actively participated in scoping and study phases of relicensing, proposes a modified project operation that significantly reduces both the frequency, amplitude and rate of change in project-related discharge and impoundment water surface fluctuation in comparison to existing project operation. See Attachment A, *Great River Hydro's Proposed Alternative Operation for the Projects*, and Attachment B, *Evidence of Support for Proposed Alternative Operation*, for further information.

The proposed operation focuses on creating more stable reservoir water surface elevations, reducing the magnitude of changes and the frequency of sub-daily changes in discharge from the project, increasing the amount of time that the project is operated as inflow equals outflow (IEO) and at full reservoir. At the same time, the proposed operation maintains Great River Hydro's capability to be flexible and responsive to current wholesale energy, forward capacity, reserve and other ancillary services markets managed by the New England Independent System Operator (ISO-NE). The proposed operation will also remain responsive to ISO-NE system emergencies when ISO-NE requires operation for reserves, security, system stability (e.g., VAR support), system over-supply conditions (ISO-NE minimum generation emergency or negative prices), or critical events and other emergencies involving dam and public safety. The proposed operation ensures the Project's ability to address future regional energy demands and system needs as those evolve over time.

The proposed Project operation will predominantly maintain a specified WSE (Target WSE) at the dam and as a result, maintain flow below the Project equal to the approximate inflow as measured or calculated at the dam (inflow equals outflow or IEO). Specifically, a Target WSE of 219.63 ft m.s.l. (NVGD 29) will be maintained at the Vernon dam by passing inflow within a Target WSE Bandwidth between 220.13 ft and 219.13 ft to account for potential differences between anticipated inflow and actual instantaneous inflow. In addition to IEO Operation, the Project will have restricted discretionary Flexible Operation capability to respond to elevated energy prices as well as unrestricted capability to respond to emergencies and ISO-NE transmission and power system requirements. The proposed Project operation is described in detail in Attachment A, and evidence of Stakeholder support is provided in Attachment B. Elements associated with the proposed Project operations including modes of operation, capabilities, restrictions, requirements and allowances are defined and described below.

B1.3.1 Proposed Project Operations Definitions and Terms

The terms defined in this section are specific to the Proposed Project Operation. Terms are capitalized so that terms used before they are defined and after may be easily referenced.

Emergency and System Operation Requirements

- Emergencies outside the control of Great River Hydro when dam safety, public safety or flood control require action or response.
- Emergency System Operations, Conditions and Emergencies when the ISO-NE requires Great River Hydro to be fully available and if necessary responsive. Examples include ISO-NE reserve deficiencies (a.k.a. reserve constraint penalty factors) when reserves are depleted on the power grid, for fuel security emergencies or scarcity events, for ISO-NE system (or system) stability (e.g., VAR support), and system over supply (negative prices).
- ISO-NE required audits, demonstrations and tests are necessary for participation in and to qualify resources for systems support and markets. Present audits include claimed capacity audits (CCA) and reactive power demonstrations (RPD). A CCA demonstrates maximum capacity for the Project through a two-hour generation run and is used by the ISO-NE for calculating capacity related market participation. Reactive capacity demonstrations (RCD) are ISO-NE audits currently required under both minimum and maximum generation conditions every five years, to verify capability of providing voltage reactive power or VAR to the regional power grid. Other future requisites are requirements specified by the ISO-NE, which are unknown and unanticipated at this time, to demonstrate and meet performance capability requirements, in accordance with ISO-NE market rules that may be changed from time to time.

Flexible Operation

When the Project is operated at the discretion of Great River Hydro and deviates from IEO Operation.

Flexible Operation Hours

The hours of Flexible Operation that will count towards the maximum number of hours of Flexible Operation allowed each month. Determination of the number of Flexible Operation Hours that have been used each month for comparison to the maximum number of Flexible Operation Hours allowed, will be as follows:

- The minimum duration of a Flexible Operation event is one hour. Should an event be less than an hour for any reason, the event will be counted as one hour. ISO-NE is responsible for the dispatch of a unit or station and as such Great River Hydro is not able to precisely determine or dictate when a unit starts or stops. ISO-NE typically dispatches units at or near the top of the hour (e.g., 1:00, 2:00, etc.) under non-emergency situations. Should an event last more than 15 minutes past the top of the hour that event will be considered to have lasted and counted as if it were for that entire hour (e.g., if an event ends and down-ramping Transition Operation is initiated within 15 minutes past the top of the hour, it will not be considered an additional hour; if after 15 minutes past the top of the hour, it will count as an additional Flexible Operation Hour). Examples are:

Approximate Time Flexible Operation Event Begins*	Time Flexible Operation Event Ends and Down-ramping Begins	Number of Flexible Operation Hours
2:00 pm	2:57 pm	1
2:00 pm	3:15pm	1
2:00 pm	3:16 pm	2

* ISO-NE dispatches units near the top of the hour

- When up-ramping is implemented in accordance with Transition Operation, hours for Flexible Operation begin the hour immediately following the up-ramp hour. If up-ramping is not implemented in accordance with Transition Operation, due to Real-Time pricing, hours for Flexible Operation begin as soon as Flexible Operation begins as specified above. In all cases, the time that Flexible Operation ends for the purpose of determining the number of allowed hours which have been used each month is when Down-ramping begins in accordance with Transition Operation.
- If Great River Hydro needs to conduct more than two CCA tests per year at the Project (due to problems, changing conditions, or failure to reach expected levels), it will alert the relevant resource agencies that: 1) it must conduct additional tests, 2) each additional test will require maximum impoundment elevation of 220.13.0 ft (see Full Operating Impoundment Range) and no ramping, and 3) the number of Flexible Operation Hours for each additional test will be determined as described above and counted either in the current or in the next month's allocation if none were available in the current month (see Section B1.3.2).

Flexible Operation Maximum Discharge

The maximum discharge from the Project powerhouse during Flexible Operation and a function of Inflow and the Maximum Station Generating Capacity.

Flexible Operating Impoundment Range

The WSE bounded limits; they are as follows:

WSE Range (m.s.l. NGVD29)	Maximum Fluctuation During Any Flexible Operation Event (ft)
218.3 – 219.63	1.33

It is anticipated that the typical impoundment operating range as a function of Flexible Operation will be on average less than the Flexible Operating Impoundment Range measured at the dam and as specified in the table above. Great River Hydro may, at some future date and at its discretion, after gaining more operating experience with the proposed operation, request to meet with relevant resource agencies to discuss the potential for reducing the Target WSE Bandwidth and/or modifying the Flexible Operating Impoundment Range, by raising both the upper

and lower limits of the range, but not increasing the difference between the upper and lower limits (i.e., the maximum fluctuation shown in the table above).

Full Operating Impoundment Range

The historic full operating range for the Vernon Project that generally corresponds with the maximum height (top) of the flashboards or gates down to the low limit. This range is used for managing high flows and not for power generation. Water surface elevations must be lower if extreme high water or dam safety emergencies require stanchion flashboards and beams to be removed from the concrete dam crest. To rebuild the stanchion flashboards, the impoundment WSE must be lowered to the crest before rebuilding the structures can be accomplished. The Full Operating Impoundment Range for the Vernon Project is top of boards - 220.13 ft; low range to manage flood flows - 218.63–213.13; and concrete stanchion flashboard crest - 212.13.0 ft (m.s.l. NGVD29).

High Water Operation

When inflow at the dam exceeds the maximum station generating capacity. In most cases this requires implementing high water procedure including management of the impoundment flood profile operating procedures, that require specific elevations be maintained at the dam for specific ranges of flow (see Section B1.2). These elevations fall within the Full Operating Impoundment Range of the Project.

Inflow

Flow to the Project estimated based on anticipated inflow arriving at the dam from upstream. In real-time, it is calculated and monitored through actual change in WSE measured at the dam on an hourly basis and adjusted through actual discharge from the Project.

Inflow Equals Outflow (IEO) Operation

When the Project maintains discharge through the powerhouse equal to Inflow at the dam by maintaining a stable Target WSE together with any required non-generation fish passage related flow or, when inflow exceeds the Maximum Station Generating Capacity and all inflow is passed via a combination of spillage and discharge through the powerhouse or if the station were out of service, via spillage alone.

Maintenance Requirements

Either scheduled periodic maintenance or unscheduled maintenance due to an unanticipated situation or condition. Maintenance Requirements can, in some cases, be pre-planned and executed accordingly or unplanned and require various elements such as investigation and problem identification, engineering, planning and execution.

Maximum Station Generating Capacity

The maximum flow that can be passed through the powerhouse as shown in the last column of the table below:

Number and Type of Turbines	Maximum Flow / Turbine (cfs)	Minimum Flow / Turbine (cfs)	Maximum Nameplate Rated Capacity* (cfs)	Maximum Station Generating Capacity** (cfs)
4- Vertical Francis	1,465	400	17,130	15,400
4-Vertical Kaplan	1,800	300		
2-Vertical Francis	2,035	500		

* The maximum nameplate hydraulic capacity is based on design specifications of the turbine (or nameplate rating) and is the sum of the hydraulic capacities of all units in the powerhouse. It is not a realistic representation of what the Station can actually pass through the turbines at the same time, which is largely determined by net head.

** The maximum station generating capacity represents the maximum Station discharge based on operating data and represents the maximum discharge that can actually be passed through the turbines

Minimum Base Flow

The minimum flow required to be maintained below the Project at all times. As described below, flows are expected to be equal to inflow and significantly higher than these base flows the vast majority of time. The proposed Minimum Base Flow includes a seasonal component. During the following periods the requirement will be to provide, at a minimum, the approximate Inflow as measured at the dam.

- While operating in IEO Operation – discharging Inflow will require maintaining Target WSE within the Target WSE Bandwidths specified and hourly adjustments as necessary to maintain proximity to Target WSE. While operating in Flexible Operation and Transition Operation modes of up-ramping and down-ramping, flows will be maintained above or equal to Inflow.

- The economic minimum dispatch flow (Eco-Min) specified to the ISO-NE will be the estimated hourly Inflow. When prices go negative, station discharge will be set to the specified Eco-Min (i.e., the estimated Inflow). When a system minimum generation emergency is declared by the ISO-NE, a combined spill plus station discharge will equal the Eco-Min. Both of these situations will resemble IEO Operation and any discrepancy between estimated Eco-Min and real-time inflow would be captured within the Target WSE Bandwidth and adjusted once either the negative pricing situation or the system minimum generation emergency has ended.

- While operating in the refill mode of Transition Operation discharge will be approximately 70 percent of estimated Inflow and adjusted as necessary through hourly real-time monitoring and calculation of estimated Inflow. Discharge during refill will not fall below the seasonal Minimum Base Flow thresholds shown below.
- For the purpose of establishing a base flow below the dams for IEO/Flexible Operational planning purposes and deciding whether or not to implement Flexible Operation by utilizing allocated Flexible Operation Hours in the Day-Ahead (DA) market or in responding to Real-Time (RT) price signals in the RT market, all flows associated with Transition Operation up-ramping, Flexible Operation, Transition Operation down-ramping, and Transition Operation refill will be maintained above the following Project and seasonal Minimum Base Flow thresholds. The only time Project flows prior to or following these periods may be less than these thresholds is when the calculated Inflow is less. It is anticipated that flows will be higher than the base flows the vast majority of the time.

Oct 1 - March 31: 1,600 cfs
April1 - May 31: 3,000 cfs
June 1 - Sept 30: 1,400 cfs

Emergencies, facility outages, and station trips that result in unanticipated reductions in station discharge will be considered unavoidable flow reductions, and Great River Hydro will restore flows below the Project to at least the estimated Inflow as quickly as possible either through spill or station discharge or both.

Target Water Surface Elevation

A specified elevation at Vernon dam to be maintained under IEO Operation by adjusting station discharge. The Target WSE would be monitored no less frequently than hourly, and station discharge would be adjusted as frequently as reasonably possible to ensure accurate WSE. Vernon station discharge is calculated and adjusted based on unit discharge curves and formulas within the accuracy of the unit's control systems.

Target WSE Bandwidth

A range, 0.5 ft above and 0.5 ft below the Target WSE, available for use during IEO Operation, in order to absorb unanticipated changes in Inflow at the dam or slight deviations or imbalances between hourly inflow and hourly discharge due to miscalculation of Inflow or unit discharge. Great River Hydro may, at some future date and at its discretion, after gaining more operating experience with the proposed operation, request to meet with relevant resource agencies to discuss the potential for reducing the Target WSE Bandwidth.

Transition Operation

Actions required to precede Flexible Operation in some cases and follow Flexible Operation in all cases. There are three modes associated with Transition Operation:

- Up-ramping: A flow increase for the hourly period that would precede most (exceptions specified below) initial Flexible Operation Hours at a specified flow so that the overall flow difference between the IEO Operation flow and the scheduled Flexible Operation flow is gradual and not instantaneous. Up-ramping rates only apply when Flexible Operation is scheduled in advance (i.e., in the Day-Ahead market) and not when Flexible Operation is initiated in Real-Time or for CCA and RCD audits. The up-ramp rate specific to Vernon Project is the lesser of 6,266 cfs (representing 1 cfs/square mile of drainage area or cfsm) or the flow half-way between current IEO Operation flow and the Flexible Operation flow.

- Down-ramping: A flow decrease at a specified rate for the period following Flexible Operation until the flow is equal to Inflow at the dam. Decreases will occur on an hourly basis, as a percentage of the previous hourly flow. The first hour after the Flexible Operation Hour will be no greater than approximately 70% of the Flexible Operation flow and each successive hour will be approximately 70% of the previous hour.

- Refill: A maximum 48-hour period subsequent to Flexible Operation down-ramping when the impoundment WSE is restored to the Target WSE by passing a fraction of the Inflow at the dam and retaining the remaining fraction as impounded water above the dam. The hourly flow rate below the dam during refill will be the greater of approximately 70% of Inflow or the Minimum Base Flow.

- The 48-hour maximum refill period begins immediately following down-ramping after a Flexible Operation event and ends no more than 48 hours later unless the reservoir is within 0.1 foot of the Target WSE. The 48-hour period includes any temporary interruptions during refill (e.g., purposely pausing refill and passing all Inflow, or decisions to implement another Flexible Operation event prior to the impoundment reaching Target WSE minus 0.1 ft. Great River Hydro expects to only pause refill for extended periods as needed when participating in the Real-Time Market (see Transition Operation – up-ramping). Based on analysis of Flexible Operation simulations provided by Great River Hydro, it is expected that the number and duration of pauses will be minimal especially during the critical spawning months spanning from April through July 15.

B1.3.2 Description of Proposed Project Operation

The Project will comply with IEO Operation, applying Target WSE and associated Target WSE Bandwidths as described below, unless:

- Flexible Operation along with Transition Operation are applied as specified herein, and implemented;

- IEO Operation is suspended due to either High Water Operation or Emergency and System Operation Requirements; or

- IEO Operation is suspended due to non-emergency Maintenance Requirements that mandate deviating from IEO Operation, but only after consultation with relevant State and Federal resource agencies prior to initiating a necessary deviation and developing a suitable refill plan and schedule.

Target WSE for the Vernon Project is 219.63 ft. The corresponding Target WSE Bandwidth is between 220.13 and 219.13 ft, representing 0.5 ft above and below the Target WSE.

Rates of change in station discharge to maintain a Target WSE (matching inflow with outflow) will be limited to reasonable changes necessary to continue or adjust the actual WSE to the Target WSE within the Target WSE Bandwidth, largely dependent upon rate of change in inflow, the degree of flow control using MW setpoints on the generator and the monitoring accuracy of WSE at the dam. Changes in station discharge necessary to match Inflow should not occur more than once per hour (unless rate of change in Inflow is rapidly accelerating or declining) and would not be greater than reasonably necessary to restore a balanced IEO condition at the Target WSE. Specifics regarding how to distinguish between flow adjustments for IEO Operation and Flexible Operation for compliance purposes will be addressed in operation compliance and monitoring plans (OCMPs) anticipated to be filed with the Commission.

Flexible Operations are limited, in part, by maximum allowable hours specified below, which are allocated on a monthly basis in order to reflect the seasonal criticality of instream aquatic resources as well as the criticality and fuel security concerns associated with winter peaking loads in New England:

- December, January, February, March: no more than 65 hours in each month

- April, May, June: no more than 10 hours in each month

- July: A total of 20 hours with no more than 10 hours from July 1 through July 15. Although a maximum of 10 hours is allowed from July 1 through July 15, in order to further enhance the potential for successful Sea Lamprey spawning, Great River Hydro will strive to minimize the hours of Flexible Operation during this period when conditions allow.

- August, September, October: a total of no more than 20 hours in each month.

- November: a total of 42 hours with no more than 10 hours from November 1 through 15.

Flexible Operations will comply with the Flexible Operating Impoundment Range. The duration (in hours) of each Flexible Operation event will be determined in accordance with Flexible Operation Hours. The minimum duration of a Flexible Operation event will be one hour in most cases.

Flexible Operation Maximum Discharge will be based upon the calculated Inflow at the hour in which the Flexible Operation will occur as follows:

- When calculated inflow is approximately 1,800 cfs or less, Flexible Operation Maximum Discharge is 4,500 cfs.
- When calculated inflow is greater than approximately 1,800 cfs, the Flexible Operation Maximum Discharge is limited to 2.5 times the calculated Inflow and will not exceed Maximum Generating Station Capacity of 15,400 cfs.

There are no limitations on the number of Flexible Operation events per day or the duration of Flexible Operation events other than those indirect limitations due to Inflow and Transition Operation requirements as specified herein.

Scheduled Flexible Operation will require one hour of Transition Operation up-ramping. Unscheduled (in response to Real-Time price signals) Flexible Operation, and Emergency and System Operation Requirements will not require up-ramping.

All Flexible Operation events will require Transition Operation down-ramping and refill.

The Transition Operation modes will be applied at the Project as follows:

	Up-Ramping	Down-Ramping	Refill
IEO Operations	Not Applied	Not Applied	Not Applied
Flexible Operations, Scheduled	Applied during the hour prior	Applied as Defined	Applied as Defined
Flexible Operations, Un-Scheduled	Not Applied	Applied as Defined	Applied as Defined
High Water Operations	Not Applied	Not Applied	Not Applied
CCA and RPD Audits	Not Applied	Applied as Defined	Applied as Defined
Emergencies and System Emergencies	Not Applied	Not Applied	Not Applied

B1.3.3 Compliance

Specifics regarding how compliance with the proposed Project operation will be determined and the information that will be provided by Great River Hydro for this purpose, will be included in operation compliance and monitoring plans (OCMPs)

developed in consultation with relevant resource agencies and filed with the FERC. Should review of information submitted to the relevant resource agencies pursuant to the OCMPs indicate that operation of any Project is not complying with the Proposed Project Operation, Great River Hydro will consult with the State and Federal resource agencies to discuss their concerns and, if necessary, will identify and implement appropriate corrective actions.

B1.3.4 Consultation

If after evaluating operation data pursuant to OCMPs, the resource agencies observe instances where operations do not appear to adequately represent the proposed Project operation (Attachment A), specifically, a) the simulations discussed in the last paragraph of the Introduction, or b) attain the five bulleted focus areas listed in the Introduction, Great River Hydro will, if requested, meet with the agencies to discuss their concerns and possible corrective actions.

B2 Dependable Capacity and Annual Generation

B2.1 Estimate of Dependable Capacity and Average Annual Generation

At full load, with inflow equaling a maximum station discharge of at least 14,500 cfs, the Project has the capability of producing 35.0 megawatts (MW). Current ten-year average annual generation is approximately 158,028 megawatt-hours (MWh). Generation is expected to remain close to this average under the proposed operations. The difference between generating continuously under inflow equals outflow and current operations would be negligible because the electricity would be produced continuously as opposed to in peaks.

B2.2 Annual Plant Factor

The average annual plant factor is calculated as the average annual generation / nameplate capacity x 8,760 hours per year. Nameplate capacity of the Project is 32.4 MW. Based on the 10-year average annual generation, average annual plant factor = 158,028 MWh / (32.4 MW x 8,760 hours) = 55.7 percent.

B2.3 Project Flows and Flow Exceedance Curves

The Vernon Project has a total drainage area (DA) of 6,266 square miles (sq. mi.). Inflow is from discharge from the Wilder and Bellows Falls Projects and natural inflow from the 852 sq. mi. of intermediate DA downstream of the Bellows Falls Project. Only 13.5 percent of inflow enters as unmanaged flow downstream of the Bellows Falls Project, except under flood flow conditions when the USACE dams on the West River store water temporarily (see Exhibit E, Section 3.1.1, *Overview of the Basin*). Under normal generating conditions, it takes about 4 hours for flow releases from the Bellows Falls Project to reach Vernon dam.

The Vernon impoundment is approximately 26 miles long and extends upstream approximately to Dunshee Island, located downstream of the Walpole Bridge (Route

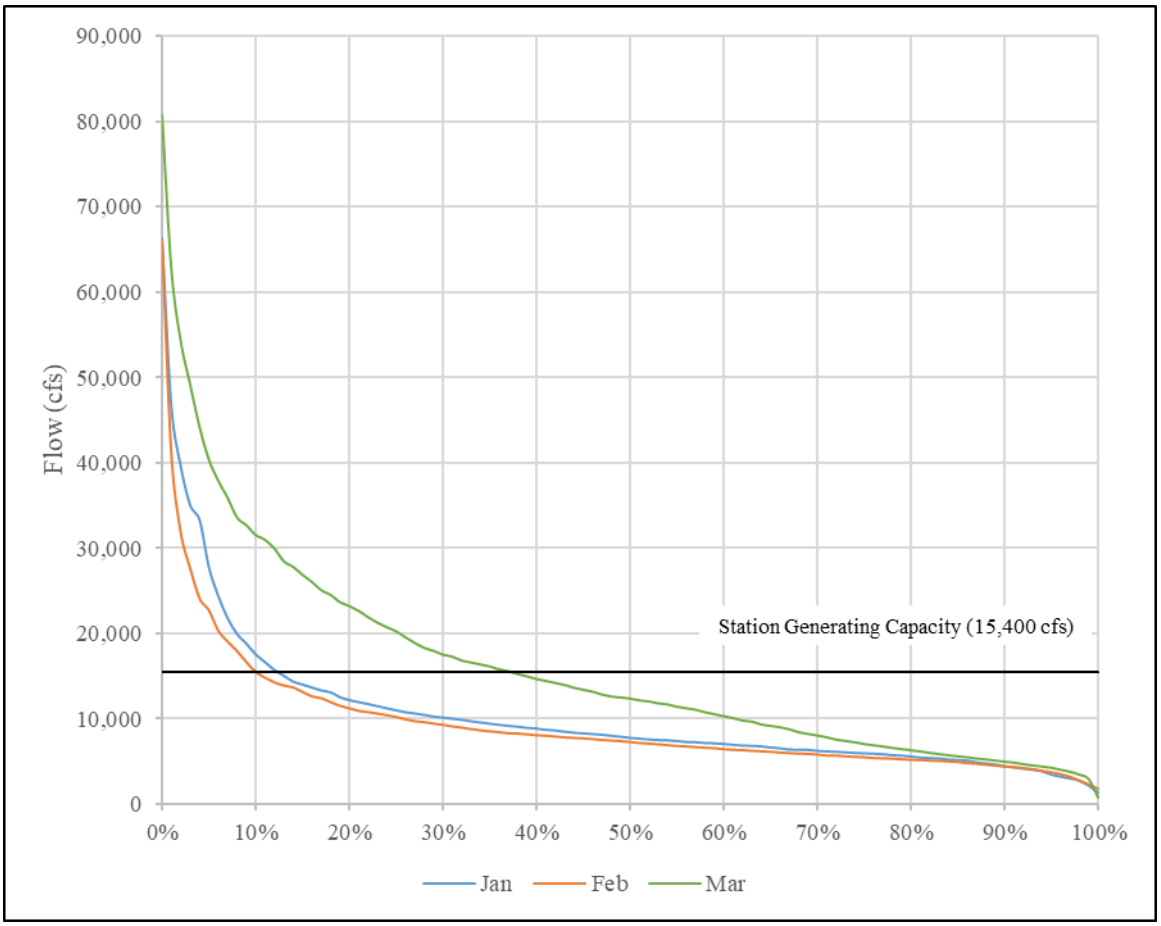
123) at Westminster Station, Vermont. The impoundment is riverine in character and ranges in depths of several feet to about 50 ft near the dam. Bathymetry in the impoundment changes rapidly as a result of underlying bedrock, channel constriction, deposition, and scour primarily associated with high flows, such as those that occurred with Tropical Storm Irene in late August 2011. Because of the relatively flat terrain from the upper extent of the impoundment to the dam, the Project has limited storage capacity, which is primarily a function of impoundment length and operating range. Under normal generation conditions, regulated flow from the FMF Project reaches Wilder dam in about 8 hours on average. Flows released at the Wilder Project generally reach the Bellows Falls dam in another 8 hours on average and another 4 hours to the Vernon dam. Table B-2 summarizes the minimum, mean, and maximum values of average monthly flows from 1979 through 2019.

Table B-2. Vernon Project estimated minimum, mean, and maximum average monthly flow values (cfs), January 1979—December 2019.

Month	Minimum	Year	Mean	Maximum	Year
January	2,996	1981	10,259	23,816	2006
February	3,122	1980	9,271	24,888	1981
March	5,100	2015	15,816	38,967	1979
April	8,903	1995	30,016	47,089	2008
May	8,262	1995	17,564	34,040	1996
June	3,517	1999	10,399	24,279	2006
July	2,195	1991	6,900	19,541	2013
August	1,889	2001	5,710	20,609	2008
September	1,775	1995	4,755	16,158	2011
October	2,095	2001	9,176	29,578	2005
November	3,208	2001	11,617	26,388	2005
December	4,119	2001	12,058	25,978	2003

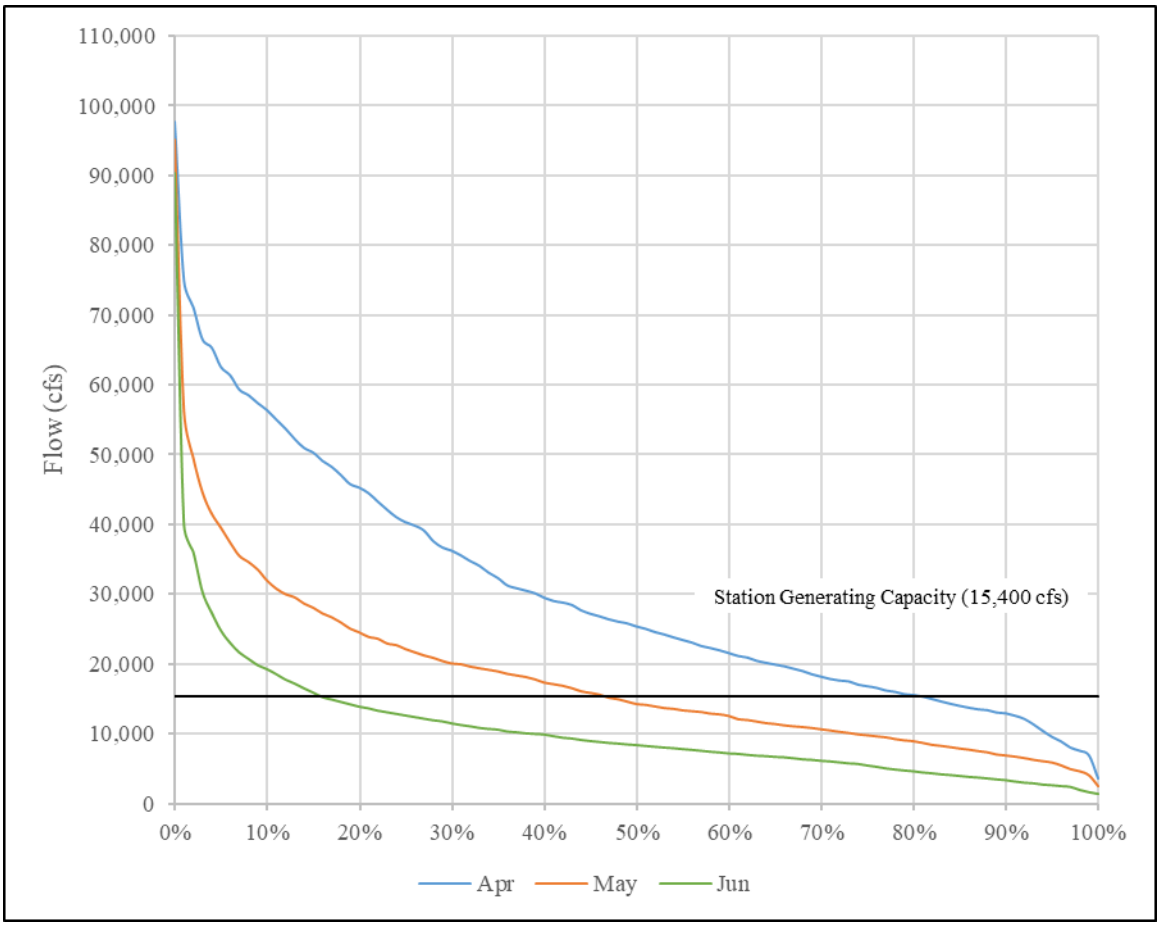
Source: USGS (2020, as modified by Great River Hydro)

Figures B-1 through B-4 provide monthly flow exceedance curves for the Vernon Project from January 1, 1979, to December 31, 2019. Data are based on U.S. Geological Survey (USGS) gage no. 01154500, Connecticut River at North Walpole, New Hampshire (subsequently referred to as the North Walpole gage), located downstream of the confluence with Saxtons River (about 2 miles downstream from Bellows Falls dam). To estimate flow at only the Vernon Project, the daily flow data from the North Walpole gage were prorated by 1.141 based on gaged DA to produce the monthly flow exceedance curves. This proration was used to account for the normally small amount of inflow from the Cold and West rivers and smaller tributaries that flow into the North Walpole gage.



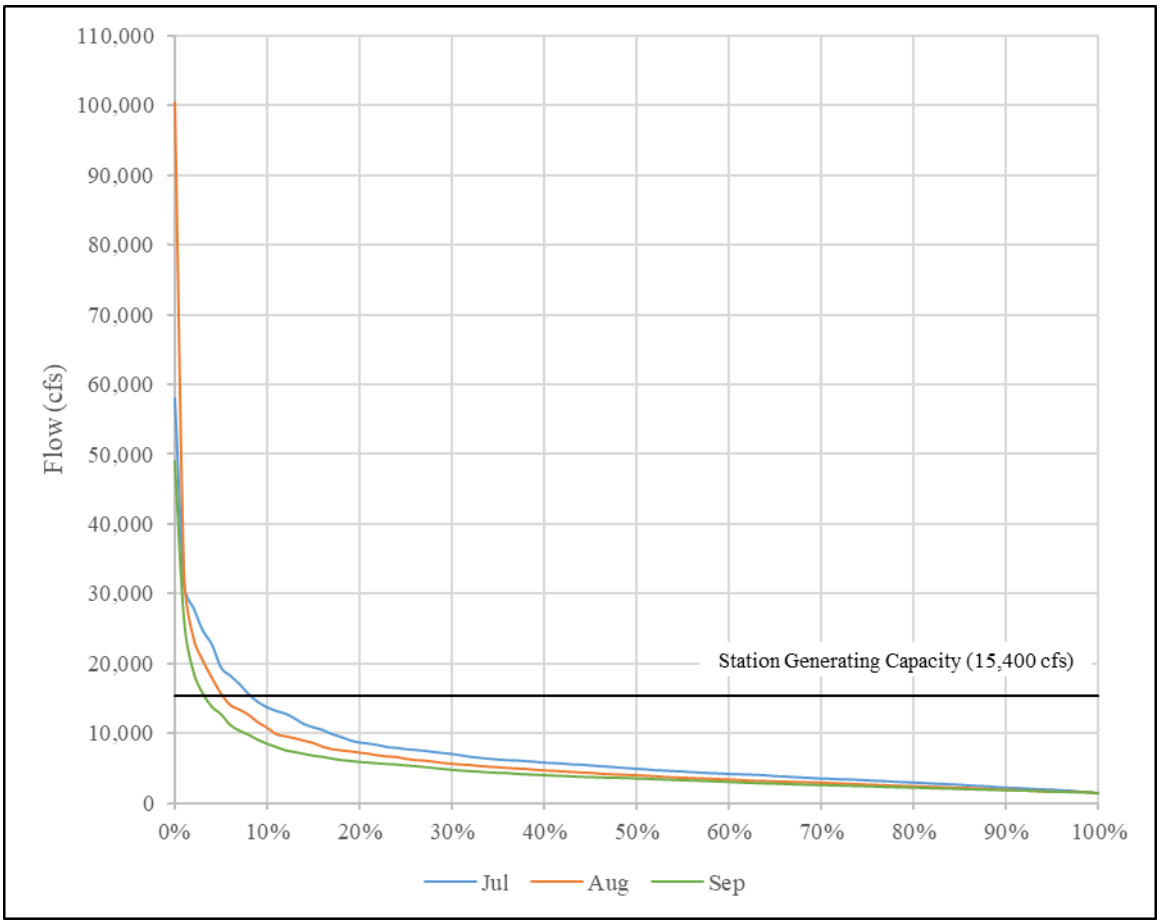
Source: USGS (2020, as modified by Great River Hydro)

Figure B-1. Flow exceedance curves, January–March (based on flow data from January 1, 1979 to December 31, 2019).



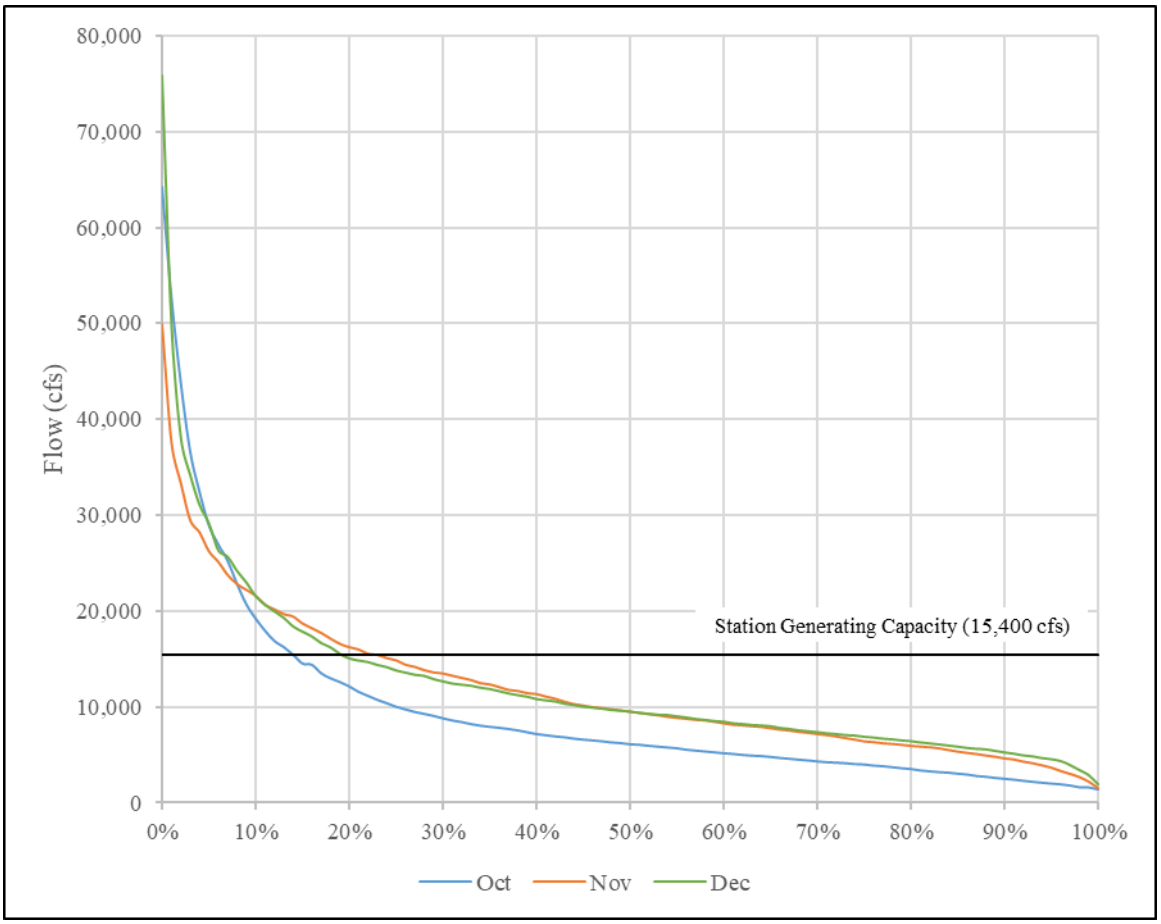
Source: USGS (2020, as modified by Great River Hydro)

Figure B-2. Flow exceedance curves, April–June (based on flow data from January 1, 1979 to December 31, 2019).



Source: USGS (2020, as modified by Great River Hydro)

Figure B-3. Flow exceedance curves, July–September (based on flow data from January 1, 1979 to December 31, 2019).



Source: USGS (2020, as modified by Great River Hydro)

Figure B-4. Flow exceedance curves, October–December (based on flow data from January 1, 1979 to December 31, 2019).

B2.4 Area-Capacity Curve

The impoundment has a surface area of 2,550 acres and a maximum total volume of about 40,000 acre-ft at El. 220.13 ft (NGVD29) at the top of the stanchion boards. The overall operating range of the Project, accounting for both low inflow and most high inflows conditions, is typically between El. 212.13 ft and El. 220.13 ft providing about 18,300 acre-ft of storage in the 8-ft range. The more typical impoundment operating range under non-spill conditions is between El. 218.3 and El. 220.1 ft for usable storage capacity of 4,489 acre-ft or 24.5 percent of the overall usable storage. The stage versus storage values are shown in Table B-3 and plotted in Figure B-5.

Table B-3. Stage versus storage curve.

Elevation (ft NGVD29)	Approximate Storage (acre-ft)
212.0	21,711
213.0	23,531
214.0	25,637
215.0	27,821
216.0	30,074
217.0	32,395
218.0	34,782
219.0	37,233
220.0	39,747
220.1	40,000

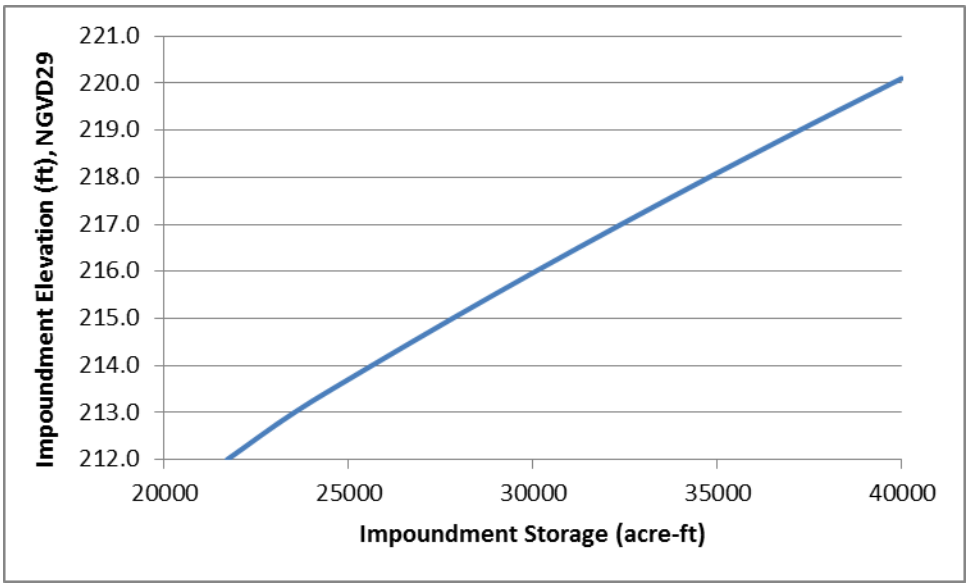


Figure B-5. Area-capacity curve.

B2.5 Hydraulic Capacity

The estimated maximum hydraulic capacity of each unit is: Unit Nos. 1–4 (each) 1,465 cfs at 35.4 ft of head; Unit Nos. 5–8 (each) 1,800 cfs at 32.0 ft of head; and Unit Nos 9–10 (each) 2,035 cfs at 36.6 ft of head. The Project maximum hydraulic capacity (calculated as the sum of each individual unit's maximum discharge capacity) is therefore 17,130 cfs.

Minimum hydraulic capacities are 400, 300, and 500 cfs for Unit Nos. 1–4, Nos. 5–8, and Nos. 9–10, respectively, for a Project minimum hydraulic capacity of 3,800 cfs.

B2.6 Tailwater Rating Curve

The Project discharges directly into the Connecticut River. Normal tailwater elevation is 184.63 ft. The tailwater curve data represent the stage discharge relationship just downstream of the dam in the Vernon tailrace. The tailwater rating values are shown in Table B-4 at Turners Falls impoundment WSE of 176 ft, and in Table B-5 at Turners Falls impoundment WSE of 185 ft. The curves are plotted in Figure B-6.

Table B-4. Tailwater rating curve (Turners Falls impoundment WSE at 176 ft NGVD29).

Tailwater Elevation (ft NGVD29)	Flow (cfs)
150.2	0
184.3	10,000
187.6	20,000
190.4	30,000
192.9	40,000
195.2	50,000
197.3	60,000
199.3	70,000
201.2	80,000
202.9	90,000
204.6	100,000
218.6	200,000
229.5	300,000
239.1	400,000

Table B-5. Tailwater rating curve (Turners Falls impoundment WSE at 185 ft NGVD29).

Tailwater Elevation (ft NGVD29)	Flow (cfs)
150.2	0
186.5	10,000
189.0	20,000
191.5	30,000
193.8	40,000
195.9	50,000
197.9	60,000
199.8	70,000
201.6	80,000
203.3	90,000
204.9	100,000
218.6	200,000
229.5	300,000
239.1	400,000

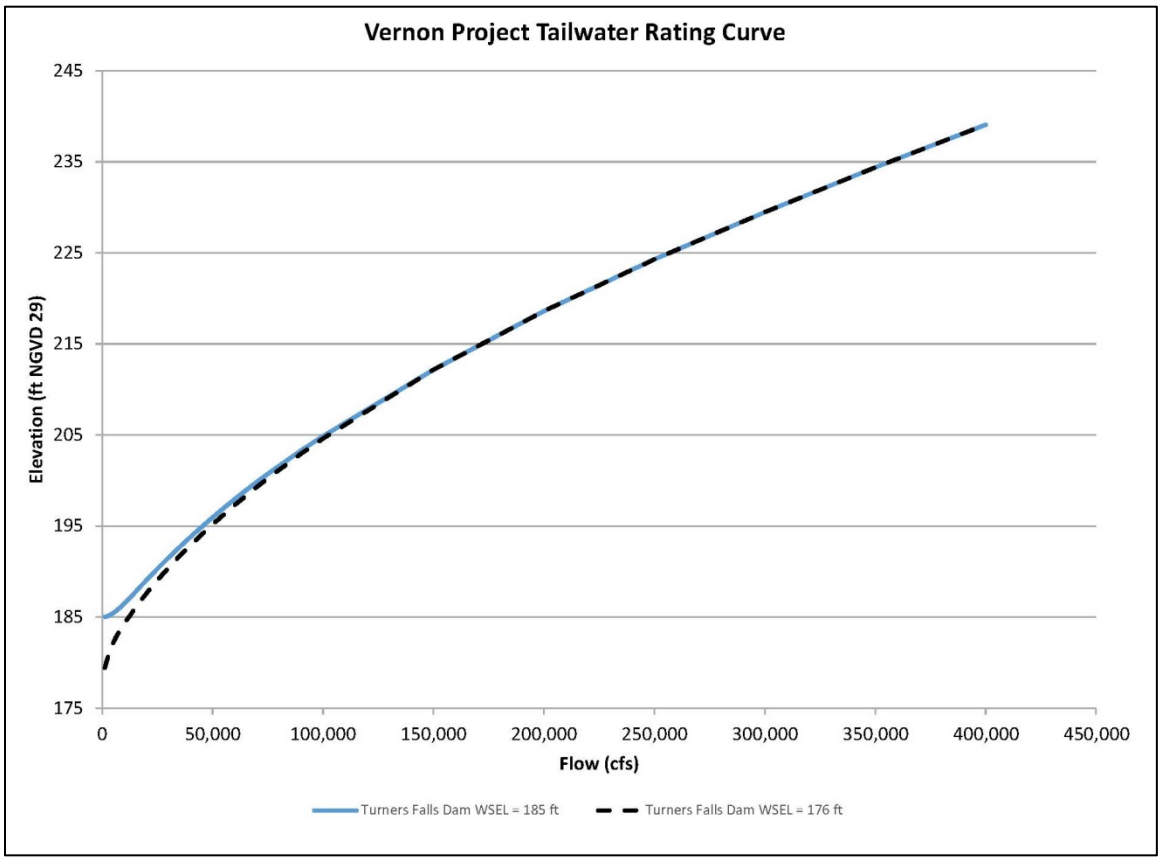


Figure B-6. Tailwater rating curve.

B2.7 Powerplant Capability

Powerplant capability is the Project's output in MW over a range of gross heads, depicted in Figure B-7.

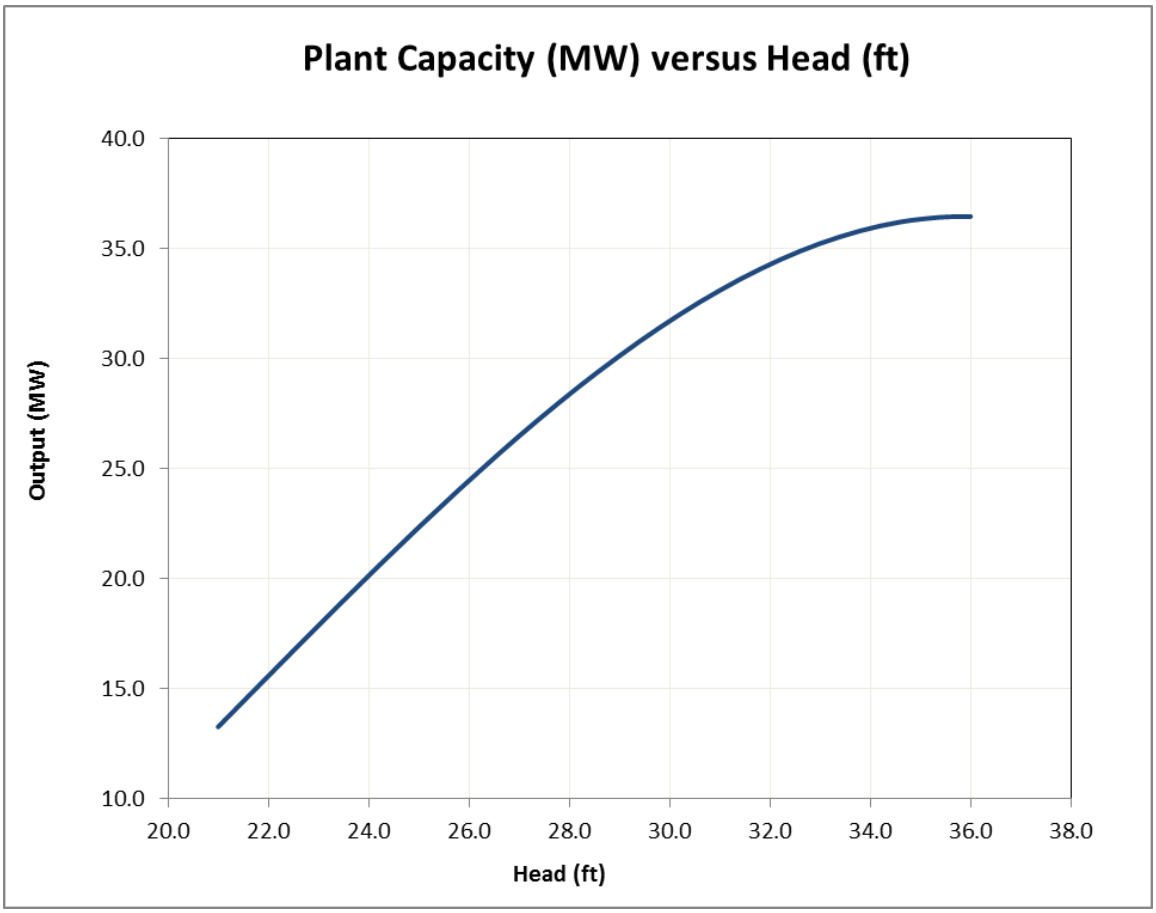


Figure B-7. Powerplant capability.

B3 Utilization of Project Power

The Project is located in the regional electric system that is operated by ISO-NE, which supplies electric power to the New England states. ISO-NE is responsible for regional grid operation, dispatch of generation, wholesale market administration, and power system analysis and planning to ensure that system reliability and adequate generation and transmission resources are available to meet regional needs. ISO-NE prepares both short- and long-term projections of electricity supply and demand. The 2020–2029 Forecast Report of Capacity, Energy, Loads, and Transmission projects the summer peak demand under typical summer peak weather conditions to rise annually at a rate of 0.9 percent, as well as projecting the winter peak demand under typical winter weather conditions to rise by an average of 1.1 percent, and 0.4 percent in annual overall electricity use from 2020 to 2029 (ISO-NE, April 30, 2020 reports).

As stated in Section B2.1, the Project has the capability of producing 35.0 MW and 158,028 MWh annually, on average, to the regional power grid. The Project uses approximately 1.218 MWh annually for station service.

Over the term of the new license, the Project will continue to directly provide renewable power and can support and facilitate the further penetration of additional variable energy (wind and solar) resources into the region through reserve capacity and grid stability functionality. Project generation displaces fossil-fired generation, reduces power plant emissions, and provides substantial environmental benefit. The Projects also provide forward capacity, real-time reserves, voltage-ampere reactive (VAR) support,[1] and Renewable Energy Credits (RECs) within the ISO-NE power pool.

B4 Plans for Future Development

Great River Hydro has no specific plans for future efficiency improvements, incremental development, or re-development of the Project.

B5 Literature Cited

ISO-NE (New England Independent System Operator). 2016. ISO New England CELT report – 2016-2025 forecast report of capacity, energy loads and transmission. May 2, 2016. Available at: https://www.iso-ne.com/system-planning/system-plans-studies/celt/?document-type=CELT%20Reports&publish-date=[2016-01-01T00:00:00Z%20TO%20*. Accessed March 21, 2017.

USGS (U.S. Geological Survey). 2020. National Water Information System web page, Water data for the Nation. Available at: https://waterdata.usgs.gov/nwis/rt. Accessed February 18, 2020.

[1] Voltage is regulated through reactive power production and consumption, and resources on the grid may be compensated for providing this reactive power capability. Voltage-ampere reactive (VAR) is the unit of measurement for reactive power.

Attachment A

Great River Hydro's Proposed Alternative Operation for the Projects

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Exhibit A

Great River Hydro's Proposed Alternative Operation for the Projects

INTRODUCTION

Great River Hydro, LLC (Great River Hydro or GRH) proposes to operate each of the Wilder, Bellows Falls and Vernon Projects (Projects or Facilities) in a similar manner under the terms of a new License, as the preferred (or proposed) alternative over the No-Action Alternative. The proposed alternative (also referred to herein as the Proposal) focuses on

- creating more stable impoundment water surface elevations,
- reducing the magnitude and frequency of sub-daily changes in discharge from the stations,
- increasing the amount of time that the project is operated as inflow equals outflow (IEO) and at full impoundment,
- reducing the magnitude and rate of change in flows downstream of the dams, and
- reducing the average frequency, average duration and average range of impoundment fluctuation under conditions when inflow to the Project at the dam is within the range of the Project powerhouse hydraulic capacity.

At the same time, the proposed alternative maintains Great River Hydro's capability to be flexible and responsive to current wholesale energy, forward capacity, reserve and other ancillary services markets managed by the New England Independent System Operator (ISO-NE). Great River Hydro also proposes to remain responsive to ISO-NE system emergencies and critical events and other emergencies involving dam and public safety. The proposal ensures the Project's ability to address future regional energy demands and system needs as those evolve over time. Additional non-operational elements of the proposal are also specified.

This Proposal is largely based on model simulations (simulations) provided by GRH that compared historic to proposed operation at each Project for the months of February, June, August and November in 2009, 2015, 2016 and 2017. GRH believes the simulations present an overly opportunistic representation with respect to the utilization of flow and managing to operational limits, which may result in overstatement of the actual impact of proposed Flexible Operations on the natural resources. This is because the simulations were created with perfect foresight with regards to pricing and inflow. Such perfect foresight will not be available during implementation of the proposal which will likely result in the Projects being operated more conservatively than indicated in the simulations in order to ensure compliance with the operational requirements specified herein.

The term agencies, resource agencies, or relevant resource agencies, used herein includes, but may not be limited to, the United States Fish and Wildlife Service, the New Hampshire Department of Environmental Services, the New Hampshire Fish and Game Department, the Vermont Department of Environmental Conservation, and the Vermont Department of Fish and Wildlife.

DEFINITIONS

1. **Cobblestone Tiger Beetle (CTB) Management Goal**: Maintain multiple consecutive-day periods (≥3) in which Flexible Operations (item 6) do not exceed flow thresholds that maintain ≥75% uninundated habitat at most sites for each month during the CTB active period (June through September), excluding periods when inflows are above these thresholds.

   Rationale: Existing Project operations impact the State listed Cobblestone Tiger Beetle (CTB). The thresholds stated in the goal are intended to increase the duration and area of available CTB habitat to facilitate CTB reproduction and survival from June 1 through September 30. This time period is considered the primary active period for CTB adults and larvae. Lack of persistent habitat can reduce the available time for feeding and/or prey availability. Limited habitat availability resulting from prolonged or repeated inundation also can cause delays in pupae and larvae development, decrease survival of larvae and affect the mating behavior of adults. Based on analysis of IEO/ Flexible Operation simulations provided by GRH, the expectation is that the limited number of Flexible Operation hours allowed during the active season for these species will meet this species-specific goal.

2. **Dwarf Wedgemussel (DWM) Management Goal**: Increase habitat stability by stabilizing/reducing impoundment fluctuations and providing multiple consecutive-day periods (≥3) at IEO each month during the period April 1 through October 15.

   Rationale: Existing operations impact the State and Federally listed Dwarf Wedgemussel. The identified goal is intended to facilitate DWM growth, breeding, and juvenile settlement in the riverine section below the Wilder Project and in the Wilder and Bellows Falls impoundments. Time spent moving in response to relatively rapid changes in water level that could occur due to Flexible Operation is time not spent feeding, which can lead to increased energy expenditure and predation risk, resulting in reduced growth and/or increased susceptibility to mortality. Periods of IEO are also intended to facilitate successful breeding (male gamete release/fertilization in females), believed to occur in the months of August and September, by maximizing the chance male gametes will reach females and not be mobilized to points downstream. Similarly, extended periods of IEO will increase the potential for metamorphosed glochidia released from host fish to successfully settle on a DWM bed versus being mobilized and settling off-bed. Based on analysis of Flexible Operation simulations provided by GRH, the expectation is that the limited number of Flexible Operation hours allowed during the active season for these species will meet this species-specific goal.

3. **Dwarf Wedgemussel Pre-Winter Habitat Operation**: Dwarf Wedgemussel pre-winter habitat protection operation is intended to create overwintering habitat that is protected from potential water drawdown that could expose mussel beds to freezing air temperatures. Mussels reduce their mobility and settle into the substrate for the winter as water temperatures drop below 15° Celsius (° C). By lowering the water surface elevation (WSE), the habitat they occupy will remain submerged over the winter, protecting largely immobile mussels from exposure and freezing air temperatures. To accomplish this, GRH will lower the WSE at the Wilder and Bellows Falls dams to an elevation at or above the low limit of each of the respective Flexible Operating Impoundment Ranges (specified below in item 9) and maintain that WSE for the limited period of time during which water temperatures consistently drop from 15° C to 10° C.

This period is typically 10-21 days in length, occurring in the late-October to early-November timeframe. Once water temperatures are consistently below 10° C within identified DWM habitats within the Wilder and Bellows Falls Project impoundments, the WSE can be adjusted upward to the Target WSE (item 17) and utilize the elevation range above the low limit described above for Flexible Operations. The WSE at each the Wilder and Bellows Falls dams will remain at or above this DWM habitat winter protection WSE throughout the subsequent period when water temperatures are at or below 10° C and no earlier than March 1 unless inflow exceeds respective station capacity and inflow levels require flood profile operation WSE at the dams (item 11).

4. **Emergency and System Operation Requirements** are when a Project must respond to:

   a. Emergencies outside the control of GRH when dam safety, public safety or flood control require action or response.

   b. Emergency System Operations, Conditions and Emergencies when the ISO-NE requires GRH to be fully available and if necessary responsive. Examples include ISO-NE Reserve Deficiencies (a.k.a. Reserve Constraint Penalty Factors) when reserves are depleted on the power grid, for fuel security emergencies or scarcity events, for ISO-NE system (or system) stability (e.g., VAR support), and system over supply (negative prices). GRH is not informed as to how the Projects are called upon or held in reserve to respond to specific system conditions or emergencies. However, based on ISO-NE Reserve Constraint Penalty Factors (RCPF) reports, which indicate when the region's power grid is short of operating reserves, there were 109 activations between 2011 and July 2013 within the entire ISO-NE System that may or may not have required actions at the Wilder, Bellows Falls or Vernon Projects. A summary of information gleaned from these reports for the period 2014 through 2018 is provided in the table below which shows that, in general, these events occurred relatively infrequently and are often short in duration. This information only provides a sense of the limited scale, frequency and number of these events; it does not mean any action actually took place with regard to the GRH projects. GRH facilities are often held in reserve even in a portion of the events referred to below. With regards to ISO-NE declared "Minimum Generation Emergencies" or "MIN GEN Emergencies" which may initiate and produce negative pricing, GRH consulted ISO-NE staff who stated that, to the best of their knowledge, the last MIN GEN Emergency occurred in March 2016.

YEAR	# of System Events	System Event Duration Range	# of Local * Events	Local Event Duration Range
2014	20	5-110 minutes	Cannot determine	
2015	3	10-65 minutes	6	5-20 minutes
2016	3	5-115 minutes	1	5 minutes
2017	2	15-20 minutes	8	5-305 (5-19-17) minutes
2018	2	10-160	0 listed	

*Local event but precisely where is not identified in the RCPF report

5. **ISO-NE required audits, demonstrations and tests** are requirements necessary for participation in and to qualify resources for systems support and markets. Present audits include Claimed Capacity Audits and Reactive Power Demonstrations (see below).

a. Claim Capacity Audit (CCA) is an ISO-NE audit currently required at the Wilder Project and may be (unanticipated presently) required in the future at the Bellows Falls and Vernon Projects. A CCA demonstrates maximum capacity for the Project through a two-hour generation run and is used by the ISO-NE for calculating capacity related market participation. Wilder Project requires a CAA to be performed annually to address summer capacity capability and every three years to demonstrate winter capacity capability. CCAs are performed under conditions specified by the ISO-NE and are performed under the best conditions related to head and inflow in order to maximize the generation within the two-hour audit as specified in the table below. While the ISO-NE does not require CCAs at Vernon and Bellows Falls, Great River Hydro may need to perform a similar test on occasion in order to demonstrate claimed capacity to the ISO-NE should a disparity arise between ISO-NE and GRH capacity numbers.

Project	Maximum Impoundment Elevation at start of CCA (NGVD29)	Maximum Impoundment Drawdown during 2-hour CCA and prior to Refill (feet)	Impoundment Refill
Wilder	385.00	0.60	See item 19.c
Bellows Falls	291.63		
Vernon	220.13		

b. Reactive Capacity Demonstration (RCD) is a 2-step ISO-NE audit currently required at the Wilder, Bellows Falls and Vernon Projects every five years, to verify capability to provide voltage reactive power or VAR to the regional power grid. Hydro generators are excellent sources of VAR support to the power grid, through which voltage can be increased or decreased depending upon the need to boost or reduce voltage of the grid. This audit requires GRH to demonstrate capability in both a minimum [station] generation and a maximum generation condition. Minimum station generation would typically be less than the required minimum base flow specified in item 16. Maximum station generation (item 15) would typically be higher than the calculated inflow. A 5-business day advance notice must be given to the ISO-NE, which determines if system conditions are suitable for a test before authorizing GRH to conduct the audit on a specified date/time. The duration of each portion (minimum generation and maximum generation condition) of the audit generally last an hour if things perform as planned; otherwise the audit could require an additional hour(s). The minimum generation audit will pass inflow either through generation, spill or a combination of both. The maximum generation audit will require a maximum pond elevation (Top of Boards) as specified in item 10 (Full Operating Impoundment Range) below.

c. Other future requisites are requirements specified by the ISO-NE, which are unknown and unanticipated at this time, to demonstrate and meet performance capability requirements, in accordance with ISO-NE market rules that may be changed from time to time. Great River Hydro will notify and consult with the relevant resource agencies a minimum of 60 days in advance of ISO-NE's implementation if GRH determines there is a significant modification to ISO-NE CCAs or RCDs as described above, or present additional requisites or requirements which require GRH to deviate from present demonstration capabilities and which cannot be reasonably accomplished through IEO/Flexible Operation as proposed and implemented under a new License.

6. **Flexible Operation** is when the Projects are operated at the Licensee's discretion and deviate from operation at IEO and stable pond (item 13) in accordance with this Proposal.

7. **Flexible Operation Hours** are the hours of Flexible Operation (item 6) that will count towards the maximum number of hours of Flexible Operation allowed each month as specified in item 23. Determination of the number of Flexible Operation hours that have been used each month for comparison to the maximum number of Flexible Operation hours allowed, will be as follows:

a. The minimum duration of a Flexible Operation event is one hour. Should an event be less than an hour for any reason, the event will be counted as one hour. ISO-NE is responsible for the dispatch of a unit or station and as such GRH is not able to precisely determine or dictate when a unit starts or stops. ISO-NE typically dispatches units at or near the top of the hour (e.g., 1:00, 2:00, etc.) under non-emergency situations. Should an event last more than 15 minutes past the top of the hour that event will be considered to have lasted and counted as if it were for that entire hour (e.g., if an event ends and Down-ramping Transition Operation is initiated within 15 minutes past the top of the hour, it will not be considered an additional hour; if after 15 minutes past the top of the hour, it will count as an additional Flexible Operation hour.) Examples are provided below.

When Up-ramping is implemented in accordance with item 19.a, hours for Flexible Operation begin the hour immediately following the Up-ramp hour. If Up-ramping is not implemented in accordance with item 19.a, due to Real-Time pricing, hours for Flexible Operation begin as soon as Flexible Operation begins as specified above. In all cases, the time that Flexible Operation ends for the purpose of determining the number of allowed hours which have been used each month (item 23) is when Down-ramping begins.

Examples (assuming no Up-ramping)

Approximate Time Flexible Operation Event Begins*	Time Flexible Operation Event Ends and Down-ramping Begins	Number of Flexible Operation Hours
2:00 pm	2:57 pm	1
2:00 pm	3:15pm	1
2:00 pm	3:16 pm	2

* ISO-NE dispatches units near the top of the hour.

b. Should GRH need to conduct more than two CCA tests per year at a single Project (due to problems, changing conditions, or failure to reach expected levels), GRH will alert the relevant resource agencies that 1) it must conduct additional tests, 2) that each additional test will require maximum impoundment elevation (see table under item 5.a) and no ramping, and 3) that the number of Flexible Operation hours for each additional test will be determined in accordance with 7.a above and counted either in the current or in the next month's allocation (item 23) if none were available in the current month.

8. **Flexible Operation Maximum Discharge** (item 27) is the maximum discharge from the Project powerhouse during Flexible Operation and is a function of inflow (item 12) and the maximum station generating capacity (item 15).

9. **Flexible Operating Impoundment Range** is bounded by the following Water Surface Elevation (WSE) limits except during the Dwarf Wedgemussel (DWM) pre-winter habitat protection operation (item 3). These limits are no greater than the current typical range of operation under normal operating condition for Bellows Falls and Vernon, one foot less than current operation for Wilder [which is 382.0 to 384.5 ft (msl NGVD 29)], 0.5 feet less at Bellows Falls during the active DWM period, and will be no greater than 1.5 feet at any of the Projects.

Project	WSE Range (msl NGVD 29)	Maximum Fluctuation During Any Flexible Operation Event (feet)
Wilder	383.0 and 384.5	1.5
Bellows Falls	Oct 1 – May 31: 289.6 and 291.1 June 1-Sept 30: 290.1 and 291.1	Oct 1 – May 31: 1.5 June 1-Sept 30: 1.0
Vernon	218.3 and 219.63	1.33

It is anticipated that the typical impoundment operating range as a function of Flexible Operation will be on average less than the Proposed Flexible Operating Impoundment WSE Range measured at each dam and as specified in the table above. GRH may, at some future date and at its discretion, after gaining more operating experience with the proposed operation, request to meet with relevant resource agencies to discuss the potential for reducing the Target WSE Bandwidth (Item 18) and/or modifying the Flexible Operating Impoundment Range, by raising both the upper and lower limits of the range, but not increasing the difference between the upper and lower limits (i.e., the maximum fluctuation shown in the table above).

10. **Full Operating Impoundment Range** is the historic full operating range for each Project that generally corresponds with the maximum height (top) of the flashboards or gates down to the low limit. This range is utilized for managing high flows and not for power generation. Water surface elevations (WSE) must be lower if extreme high water or dam safety emergencies require stanchion flashboards and beams to be removed from the concrete dam crest. In order to rebuild the stanchion flashboards, the impoundment WSE must be lowered to the crest before rebuilding the structures can be accomplished.

Wilder Project: Top of Boards 385.0 ft; Low limit to manage flood flows 380.0 ft; Concrete Stanchion Flashboard Crest 368.0 ft (msl NGVD 29).

Bellows Falls Project: Top of Boards 291.63 ft; Low limit to manage flood flows 288.63 ft; Concrete Stanchion Flashboard Crest 278.63.0 ft (msl NGVD 29).

Vernon Project: Top of Boards 220.13 ft; Low range to manage flood flows between 218.6 - 212.13 ft; Concrete Stanchion Flashboard Crest 212.13 ft (msl NGVD 29).

11. **High Water Operation** is when inflow at the dam exceeds the maximum station generating capacity (item 15). In most cases this requires each project to follow its Flood Profile Operating procedures, that require specific elevations be maintained at the dam for specific ranges of flow. These elevations fall within the Full Operating Impoundment Range of each Project (item 10).

12. **Inflow** to each Project is estimated based on anticipated inflow arriving at the dam from upstream. In real-time it is calculated and monitored through actual change in WSE measured at the dam on an hourly basis and adjusted through actual discharge from the Project.

13. **Inflow Equals Outflow (IEO) Operation** is defined as follows:

    a. When the Project maintains discharge through the powerhouse equal to inflow at the dam by maintaining a stable target WSE together with any required non-generation flow (e.g., Bellows Falls bypass flow, fish passage related flow) or,

    b. When inflow exceeds the maximum station generating capacity (item 15) and all inflow is passed via a combination of spillage and discharge through the powerhouse or if the station were out of service, via spillage alone.

14. **Maintenance Requirements** are either scheduled periodic maintenance or unscheduled maintenance due to an unanticipated situation or condition. Maintenance requirements can, in some cases, be pre-planned and executed accordingly or unplanned and require various elements such as investigation and problem identification, engineering, planning and execution.

15. **Maximum Station Generating Capacity** (in cfs) is the maximum flow that can be passed through the powerhouse for each Project as shown in the last column of the table below:

Project	Number and Type of Turbines	Maximum Flow / Turbine (cfs)	Minimum Flow / Turbine (cfs)	Maximum Nameplate Rated Capacity * (cfs)	Maximum Station Generating Capacity** (cfs)
Wilder	2- Kaplan 1-Vertical Francis	6000 700	400 400	12,700	11,700
Bellows Falls	3- Vertical Francis	3670	700	11,010	11,400

Project	Number and Type of Turbines	Maximum Flow / Turbine (cfs)	Minimum Flow / Turbine (cfs)	Maximum Nameplate Rated Capacity * (cfs)	Maximum Station Generating Capacity** (cfs)
Vernon	4- Vertical Francis	1465	400	17,130	15,400
	4-Vertical Kaplan	1800	300		
	2-Vertical Francis	2035	500		

* The maximum nameplate hydraulic capacity is based on design specifications of the turbine (or nameplate rating) and is the sum of the hydraulic capacities of all units in the powerhouse. It is not a realistic representation of what the Station can actually pass through the turbines at the same time, which is largely determined by net head.

** The maximum station generating capacity represents the maximum Station discharge based on operating data and represents the maximum discharge that can actually be passed through the turbines.

16. **Minimum Base Flows** are minimum flows required to be maintained below each dam at all times. As described below, flows are expected to be equal to inflow and significantly higher than these base flows the vast majority of time. The proposed Minimum Base Flows are all greater than the minimum base flows required in the current FERC licenses and include a seasonal component.

During the following periods the requirement will be to provide, at a minimum, the approximate inflow as measured at the dam.

- While operating in the Inflow Equals Outflow (IEO) mode (item 13) – discharging inflow will require maintaining Target WSE within the bandwidths specified (item 18) and hourly (minimum required frequency) adjustments necessary to maintain proximity to Target WSE.
- While operating in Flexible Operation and Up-ramping and Down-ramping Transition Operation (item 19), flows will be maintained above or equal to inflow. Instantaneous inflow measurements will be calculated in accordance with item 12.
- The economic minimum dispatch flow (Eco-Min) specified to the ISO-NE will be the estimated hourly inflow. When prices go negative, station discharge will be set to the specified Eco-Min (i.e., the estimated inflow). When a System Minimum Generation Emergency is declared by the ISO-NE, a combined spill plus station discharge will equal the Eco-Min. Both of these situations will resemble IEO and any discrepancy between estimated Eco-Min and real-time inflow would be captured within the Target Elevation Bandwidth and adjusted once either the negative pricing situation or the System Minimum Generation Emergency has ended.

While operating in Transition Refill Operation (item 19.c) discharge will be approximately 70% of estimated inflow and adjusted as necessary through hourly real-time monitoring and calculation of estimated inflow. Discharge during refill will not fall below the seasonal Minimum Base Flow thresholds shown below.

For the purpose of establishing a base flow below the dams for IEO/Flexible Operational Planning purposes and deciding whether or not to implement Flexible Operation by utilizing allocated hours (item 23) in the Day-Ahead (DA) market or in responding to Real-Time (RT) price signals in the RT market, all flows associated with Transition Operation Up-ramping; Flexible Operation; Transition Operation Down-ramping and; Transition Operation Refill will be maintained above the following Project and seasonal Minimum Base Flow thresholds. The only time Project flows prior to or following these periods may be less than these thresholds is when the inflow calculated in accordance with item 12 is less. It is anticipated that flows will be higher than the base flows the vast majority of the time.

Wilder	**Bellows Falls***	**Vernon**
Oct 1 - March 31: 1,500 cfs April 1 - May 31: 2,000 cfs June 1 - Sept 30: 1,100 cfs	Oct 1 - March 31: 1,600 cfs April1 - May 31: 3,000 cfs June 1 - Sept 30: 1,400 cfs Bypass Reach below dam: 300 cfs year round	Oct 1 - March 31: 1,600 cfs April 1 - May 31: 3,000 cfs June 1 - Sept 30: 1,400 cfs

***** Minimum Base Flow is the combined flow below dam and station.

Emergencies, facility outages, station trips that result in unanticipated reductions in station discharge will be considered unavoidable flow reductions, and GRH will restore flows below the Project to at least the estimated inflow as quickly as possible. When spill, other than the continuous 300 cfs in the Bellows Falls bypassed reach, is required during non-business hours to respond to emergencies or System minimum generation emergencies noted above, to maintain IEO, transition flows or the base flows as described, GRH will require personnel to come to the affected station(s) and check for public safety risks below the gates and confirm none exist before opening a spill gate. As soon as that is accomplished a gate(s) will be opened to provide the proper flows. This entire process typically takes one hour or less.

17. **Target Water Surface Elevation (WSE)** is a specified elevation (item 21) at each Project dam to be maintained under IEO Operation by adjusting station discharge. The Target WSE would be monitored no less frequently than hourly, and station discharge would be adjusted as frequently as reasonably possible to ensure accurate WSE. Station discharge is calculated and adjusted based on unit discharge curves and formulas within the accuracy of the unit's control systems.

18. **Target WSE Bandwidth** is a range, 0.5 ft above and 0.5 ft below the Target WSE, available for use during IEO Operation, in order to absorb unanticipated changes in inflow at the dam or slight deviations or imbalances between hourly inflow and hourly discharge due to miscalculation of inflow or unit discharge. See item 21 for elevations associated with the bandwidth. GRH may, at some future date and at its discretion, after gaining more operating experience with the proposed operation, request to meet with relevant resource agencies to discuss the potential for reducing the Target WSE Bandwidth and/or modifying the Flexible Operating Impoundment Range (item 9) by raising both the upper and lower limits of the range, but not increasing the difference between the upper and lower limits (i.e., the maximum fluctuation shown in the table under item 9).

19. **Transition Operation** describes actions required to precede Flexible Operation in some cases and follow Flexible Operation in all cases. There are three elements associated with Transition Operation:

a. **Up-ramping**: A flow increase for the hourly period that would precede most (exceptions specified below) initial Flexible Operation hours at a specified flow depending upon the Project, so that the overall flow difference between the IEO flow and the scheduled Flexible Operation flow is gradual and not instantaneous. Up-ramping rates are specific to each Project and would only apply when Flexible Operation is scheduled in advance (i.e., in the Day-Ahead market) and not when Flexible Operation is initiated in Real-Time or for CCA and RCD audits. Up-ramp rates are specified at each Project as:

Wilder Project: the lesser of 1 of 2 large units (approximately 5000 cfs) or half-way between the IEO flow and the Flexible Operation flow;

Bellows Falls Project: the lesser of 1 cfs/square mile of drainage area (cfsm) (approximately 5,414 cfs) or the flow half-way between current IEO flow and the Flexible Operation flow;

Vernon Project: the lesser of 1 cfsm (approximately 6,266 cfs) or half-way between current IEO flow and the Flexible Operation flow.

b. **Down-ramping**: A flow decrease at a specified rate for the period following Flexible Operation until the flow is equal to inflow at the dam. Decreases will occur on an hourly basis, as a percentage of the previous hourly flow. The first hour after the Flexible Operation hour will be no greater than approximately 70% of the Flexible Operation flow and each successive hour will be approximately 70% of the previous hour.

c. **Refill**: A maximum 48-hour period subsequent to post-Flexible Operation Down-ramping when the impoundment WSE is restored to the stable Target WSE by passing a fraction of the inflow at the dam and retaining the remaining fraction as impounded water above the dam. The hourly flow rate below each Project dam during refill will be the greater of approximately 70% of inflow or the base flow specified in item 16.

The 48-hour maximum refill period begins immediately following Down-ramping after a Flexible Operation event and ends no more than 48 hours later unless the reservoir is within 0.1 foot of the Target WSE (item 21). The 48-hour period includes any temporary interruptions during refill (e.g., purposely pausing refill and passing all inflow, or decisions to implement another Flexible Operation event prior to the impoundment reaching a WSE equal to the Target WSE minus 0.1 feet.) GRH expects to only pause refill for extended periods as needed when participating in the Real-Time Market, as described in 19.a above. Based on analysis of Flexible Operation simulations provided by GRH, it is expected that the number and duration of pauses will be minimal especially during the critical spawning months spanning from April through July 15.

PROJECT OPERATION DESCRIPTIONS

20. All Projects will comply with IEO Operation (item 13), applying Target WSE (item 17) and associated Target WSE Bandwidths (item 18) as described below, unless:

    a. Flexible Operation (item 6) along with Transition Operation (item 19) are applied as specified herein, and implemented;

    b. IEO Operation is suspended due to either High Water Operation (item 11), or Emergency and System Operation, Requirements and Audits (items 4 and 5); or

    c. IEO Operation is suspended due to non-emergency Maintenance Requirements that mandate deviating from IEO Operation, but only after consultation with relevant State and Federal resource agencies prior to initiating a necessary deviation and developing a suitable refill plan and schedule.

21. Target WSEs and Target WSE Bandwidths for each Project are described in the following table (all elevations are mean sea level (msl), NGVD 29):

	Wilder Project	**Bellows Falls Project**	**Vernon Project**
Target WSE	384.5 ft *	291.1 ft *	219.63 ft
Target WSE Bandwidth	Between 385.0 and 384.0 ft, representing 0.5 ft above and below the Target WSE	Between 291.6 and 290.6 ft, representing 0.5 ft above and below the Target WSE	Between 220.13 and 219.13 ft, representing 0.5 ft above and below the Target WSE

*Except during DWM pre-winter habitat protection operation period, triggered and maintained as water temperatures drop from 15° Celsius (° C) to 10° C within identified DWM habitats within the projects (item 3).

22. Rates of change in station discharge to maintain a Target WSE (matching inflow with outflow) will be limited to reasonable changes necessary to continue or adjust the actual WSE to the Target WSE within the Target WSE Bandwidth, largely dependent upon rate of change in inflow, the degree of flow control using MW setpoints on the generator and the monitoring accuracy of WSE at the dam. Changes in station discharge necessary to match inflow should not occur more than once per hour (unless rate of change in inflow is rapidly accelerating or declining) and would not be greater than reasonably necessary to restore a balanced IEO condition at the Target WSE. Specifics regarding how to distinguish between flow adjustments for IEO and Flexible Operation for compliance purposes will be addressed in the operation compliance and monitoring plans (OCMPs) required by the §401 Water Quality Certifications and the FERC Licenses.

23. Flexible Operations are limited, in part, by maximum allowable hours specified below, which are allocated on a monthly basis in order to reflect the seasonal criticality of instream aquatic resources as well as the criticality and fuel security concerns associated with winter peaking loads in New England:

    December, January, February, March: no more than 65 hours in each month

    April, May, June: no more than 10 hours in each month

July: A total of 20 hours with no more than 10 hours from July 1 through July 15. Although a maximum of 10 hours is allowed from July 1 through July 15, in order to further enhance the potential for successful Sea Lamprey spawning, GRH will strive to minimize the hours of Flexible Operation at each Project during this period when conditions allow.

August, September, October: a total of no more than 20 hours in each month.

November: a total of 42 hours with no more than 10 hours from November 1 through 15.

24. Flexible Operations (item 6) will comply with the Flexible Operating Impoundment Range (item 9).

25. The duration (in hours) of each Flexible Operation event will be determined in accordance with item 7.

26. The minimum duration of a Flexible Operation event will be one hour in most cases.

27. Flexible Operation Maximum Discharge will be based upon the calculated inflow at the hour in which the Flexible Operation will occur as follows:

    a. When calculated inflow is approximately 1800 cfs or less, Flexible Operation Maximum Discharge is 4,500 cfs.

    b. When calculated inflow is greater than approximately 1800 cfs, the Flexible Operation Maximum Discharge is limited to 2.5 times the calculated inflow and will not exceed the maximum station generating capacity (item 15).

28. For the purpose of protecting Dwarf Wedgemussels (DWM) from freezing in the winter, the Wilder and Bellows Falls Project impoundments will be temporarily lowered in the Fall of each year as described in item 3.

29. There are no limitations on the number of Flexible Operation events per day or the duration of Flexible Operation events other than those indirect limitations due to inflow and Transition Operation requirements as specified herein.

30. Scheduled Flexible Operation will require one hour of Transition Operation Up-ramping (item 19.a). Unscheduled (in response to Real-Time price signals) Flexible Operation, and Emergency and System Operation, Requirements and Audits (Items 4 and 5) will not require Up-ramping.

31. All Flexible Operation events will require Transition Operation Down-ramping and Refill as specified in item 19.

32. The Transition Operation elements specified in item 19 will be applied at the Projects as follow:

	Up-Ramping	**Down-Ramping**	**Refill**
IEO Operations	Not Applied	Not Applied	Not Applied
Flexible Operations, Scheduled	Applied during the hour prior	Applied as Defined	Applied as Defined
Flexible Operations, Un-Scheduled	Not Applied	Applied as Defined	Applied as Defined

High Water Operations	Not Applied	Not Applied	Not Applied
CCA and RPD Audits	Not Applied	Applied as Defined	Applied as Defined
Emergencies and System Emergencies	Not Applied	Not Applied	Not Applied

33. **Compliance:** Specifics regarding how compliance with this Proposal will be determined and the information that will be provided by GRH for this purpose, will be included in the operation compliance and monitoring plans (OCMPs) required by the §401 Water Quality Certifications and the FERC licenses. Should review of information submitted to the relevant resource agencies pursuant to the OCMPs indicate that operation of any Project is not complying with this Proposal, GRH will consult with the State and Federal resource agencies to discuss their concerns and, if necessary, will identify and implement appropriate corrective actions.

34. **Consultation**: If after evaluating operation data pursuant to Item 33, the relevant resource agencies observe instances where operations do not appear to adequately represent a) the simulations discussed in the last paragraph of the Introduction, b) attain the five bulleted focus areas in the Introduction, or c) attain CTB and DWM management goals (items 1 and 2) at levels suggested by GRH simulations, GRH will, if requested, meet with the agencies to discuss their concerns and possible corrective actions.

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Attachment B

Evidence of Support for Proposed Alternative Operation

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MEMORANDUM OF UNDERSTANDING
WILDER, BELLOWS FALLS AND VERNON
HYDROELECTRIC PROJECTS FERC RELICENSING

The parties to this Memorandum of Understanding, dated as of December 1, 2020, are **Great River Hydro, LLC** ("Great River Hydro"), together with the following: **the United States Fish and Wildlife Service**, **the New Hampshire Department of Environmental Services**, **the New Hampshire Fish and Game Department**, **the Vermont Department of Environmental Conservation**, **the Vermont Department of Fish and Wildlife** (collectively, the "Resource Agencies"), **The Nature Conservancy**, and **the Connecticut River Conservancy** (such two parties, together with the Resource Agencies, the "Stakeholders").

Recitals

Great River Hydro is the owner and licensee of the Wilder Hydroelectric project (FERC No. 1892) ("Wilder Project"), the Bellows Falls Hydroelectric Project (FERC No. 1855) ("Bellows Falls Project"), and the Vernon Hydroelectric Project (FERC No. 1904) ("Vernon Project"), collectively, the "Projects".

The licenses for each of the Projects expire on April 30, 2021. If issuance of a new license (or other disposition) does not take place on or before April 30, 2021, pursuant to 18 C.F.R. 16.18(c), annual licenses under section 15(a)(1) of the FPA are renewed automatically. In accordance with the Federal Energy Regulatory Commission's ("FERC") Integrated Licensing Process regulations set forth in 18 C.F.R. Part 5, Great River Hydro submitted applications for new licenses for each of the Projects on May 1, 2017.

Great River Hydro and the Stakeholders have been engaged in discussions focused on reaching agreement on proposed operations of the Projects under new FERC licenses. The parties to this memorandum concur with the Proposed Alternative Operation for the Projects, attached as **Exhibit A**.

Understanding Between the Parties

The parties hereby recite as follows:

A. FERC License Application and WQC Proceedings. The Proposed Alternative Operation will be presented in the amended license applications as Great River Hydro's proposed operation of each Project (the "FERC License Application") and, pending any new information that would suggest otherwise, as its proposed operation of each Project in Great River Hydro's applications for water quality certifications from the New Hampshire Department of Environmental Services and the Vermont Department of Environmental Conservation in accordance with Section 401 (a)(1) of the Clean Water Act (the "WQC Proceedings").

B. Stakeholder Representations. Subject to the Resource Agency Reservations below, the Stakeholders represent the following:

The Stakeholders support the Proposed Alternative Operation as representing an agreed upon operation of the Projects, addressing many flow, impoundment and operational related resource concerns that are a result of, or are perceived to be a result of, operations of the Projects.

The Proposed Alternative Operation will be acceptable and supported by the Stakeholders in the FERC License Application process and, pending any new information that would suggest otherwise, included in the draft WQC issued for public comment. No further data or information related to the Proposed Alternative Operation is anticipated to be required to support the inclusion of the Proposed Alternative Operation in the draft WQC. However, if additional data or information is necessary to support the inclusion of the Proposed Alternative Operation in the draft WQC, the Stakeholders will confer with Great River Hydro.

The Stakeholders represent they will not propose additional or alternative operation proposals or license conditions that are inconsistent with the Proposed Alternative Operation, or would require a modification to the Proposed Alternative Operation.

Nothing in this Memorandum shall preclude the state and federal resource agencies from complying with their obligations under the National Environmental Policy Act, the Clean Water Act, the Endangered Species Act, the Federal Power Act, the Fish and Wildlife Coordination Act or any other applicable state or federal laws or regulations. However, by entering into this Memorandum the Resource Agencies represent, based on the information available to them as of the date of this Memorandum and subject to the Resource Agency Reservations below, that they believe their statutory obligations are, or can be, met consistent with the Proposed Alternative Operation.

Nothing in this Memorandum shall be interpreted to limit the right of The Nature Conservancy and the Connecticut River Conservancy from providing information or giving testimony in any regulatory, administrative or judicial proceeding, or to fully pursue any issue that, in its opinion, is not adequately addressed by Exhibit A.

C. Resource Agency Reservations. Nothing in this Memorandum shall preclude the state resource agencies responsible for issuing water quality certifications:

- from modifying the format or language of Exhibit A to better match typical water quality certification format or language provided it is consistent with the Proposed Alternative Operation;
- from including, if necessary, conditions in the WQCs related to potential resource issues not specifically addressed by the Proposed Alternative Operation, including, but not limited to, fish passage, whitewater rafting, recreation and monitoring;

- from including other conditions in the water quality certification provided they are not inconsistent with the Proposed Alternative Operation;
- from making revisions to the Proposed Alternative Operation in the draft Water Quality Certification prior to issuance for public comment based on any new information that would suggest revisions are necessary to support the inclusion of the Proposed Alternative Operation (as revised), in the draft WQC; and
- from issuing a final Water Quality Certification with revisions to the Proposed Alternative Operation based on comments received on the draft Water Quality Certification.

Prior to issuing the final Water Quality Certification, the States shall confer with Great River Hydro and the other Stakeholders in an effort to reach agreement on any substantive amendments to the draft Water Quality Certification made as a result of public comment or new information.

Nothing in this Memorandum shall be interpreted to preclude or otherwise limit EPA from complying with its obligations under the Clean Water Act, Clean Air Act, and National Environmental Policy Act, or other federal statutes. Nothing herein shall preclude EPA or the States of New Hampshire and Vermont from fully and objectively considering all public comments received in any regulatory process related to the Project, from conducting an independent review of the Projects under applicable statutes, or from providing comments to FERC.

Nothing in this Memorandum shall be interpreted to preclude or otherwise limit the U.S. Fish and Wildlife Service from completing consultation with FERC under Section 7 of the Endangered Species act, or as predetermining the outcome of such consultation.

D. Great River Hydro Representations. Great River Hydro supports the Proposed Alternative Operation as representing a reasonable balance between power and non-power resources by significantly increasing a broad range of resource protection while maintaining the Projects' capabilities to be flexible and responsive to current wholesale energy, forward capacity, reserve and other ancillary services markets managed by the New England Independent System Operator (ISO-NE). Under the Proposed Alternative Operation, the Projects can remain responsive to ISO-NE system emergencies and critical events, other emergencies involving dam and public safety and ensures their ability to address future regional energy demands and system needs as those evolve over time.

E. Confidentiality. Other than information regarding how Great River Hydro currently participates and intends to participate in ISO-NE wholesale energy, capacity, reserve and ancillary markets, any data or technical supporting information shared as a part of the Mitigation Discussions that supports the conclusion of this Memorandum that the Proposed Alternative Operation meets the regulatory obligations of a Resource Agency shall be

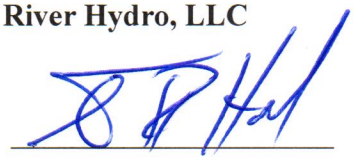
considered public and may be used by the Stakeholders to support its decision, provided that the terms of the Confidentiality Agreement for Mitigation Discussions shall continue to govern the use of proposals, counterproposals, meeting notes and informal discussions.

F. Representations and Warranties. The Parties represent and warrant to each other that: (1) this Memorandum has been duly authorized, signed and delivered by each party; (2) this Memorandum shall not, in any manner, limit any regulatory function of a Resource Agency; (3) this Memorandum shall not grant any person the right to initiate a suit to enforce its terms against a Resource Agency; (4) this Memorandum shall not be construed as a waiver of sovereign immunity or any other defense any Resource Agency may raise to any claim in a suit related to the subject matter of this agreement; and (5) this Memorandum shall not be construed to limit the right of The Nature Conservancy and the Connecticut River Conservancy to provide information or give testimony in any regulatory, administrative or judicial proceeding, or to fully pursue any issue that, in its opinion, is not adequately addressed by Exhibit A.

G. Counterpart Signatures and PDF Signatures. This Memorandum may be executed by the parties in separate counterparts, each of which when so executed and delivered shall be an original, but all such counterparts shall together constitute one and the same instrument. Signatures to this Memorandum transmitted by fax, by electronic mail in "portable document format" (.pdf), or by any other electronic means intended to preserve the original graphic and pictorial appearance of the Memorandum, shall have the same effect as physical delivery of the paper document bearing the original signature. The parties agree that any such reproduction shall, to the extent permitted by law, be as admissible in evidence as the original itself in any judicial or administrative proceeding (whether or not the original is in existence and whether or not the reproduction was made in the regular course of business) and that any enlargement, facsimile or further reproduction shall likewise be admissible in evidence.

[*signatures on following page*]

Great River Hydro, LLC

By: 

Name: Scott D. Hall

Title: President and CEO

United States Fish and Wildlife Service

By: _____

Name: _____

Title: _____

New Hampshire Department of Environmental Services

By: _____

Name: _____

Title: _____

New Hampshire Fish and Game Department

By: _____

Name: _____

Title: _____

Vermont Department of Environmental Conservation

By: _____

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Vermont Department of Fish and Wildlife

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The Nature Conservancy

By: _____

Name: _____

Title: _____

Connecticut River Conservancy

By: _____

Name: _____

Title: _____

Great River Hydro, LLC

By: _____

Name: _____

Title: _____

United States Fish and Wildlife Service

By: THOMAS CHAPMAN Digitally signed by THOMAS CHAPMAN Date: 2020.12.03 12:36:34 -05'00'

Name: _____

Title: _____

New Hampshire Department of Environmental Services

By: _____

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New Hampshire Fish and Game Department

By: _____

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Vermont Department of Environmental Conservation

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Title: _____

Vermont Department of Fish and Wildlife

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The Nature Conservancy

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Connecticut River Conservancy

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Great River Hydro, LLC

By: _____

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Title: _____

United States Fish and Wildlife Service

By: _____

Name: _____

Title: _____

New Hampshire Department of Environmental Services

By: _____ 4 DEC '20

Name: THOMAS E. O'DONOVAN

Title: DIRECTOR, WATER DIVISION

New Hampshire Fish and Game Department

By: Scott R Mason

Name: Scott R. Mason

Title: Executive Director

Vermont Department of Environmental Conservation

By: _____

Name: _____

Title: _____

Vermont Department of Fish and Wildlife

By: _____

Name: _____

Title: _____

The Nature Conservancy

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Connecticut River Conservancy

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Great River Hydro, LLC

By:_____

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Title: _____

United States Fish and Wildlife Service

By:_____

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Title: _____

New Hampshire Department of Environmental Services

By:_____

Name:_____

Title: _____

New Hampshire Fish and Game Department

By:_____

Name:_____

Title: _____

Vermont Department of Environmental Conservation

By:_____

Name: Peter LaFlamme

Title: Director, Watershed Management Division

Vermont Department of Fish and Wildlife

By:_____

Name:_____

Title: _____

The Nature Conservancy

By:_____

Name:_____

Title: _____

Connecticut River Conservancy

By:_____

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Great River Hydro, LLC

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United States Fish and Wildlife Service

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New Hampshire Department of Environmental Services

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New Hampshire Fish and Game Department

By: _____

Name: _____

Title: _____

Vermont Department of Environmental Conservation

By: _____

Name: _____

Title: _____

Vermont Department of Fish and Wildlife

By: Eric Palmer

Name: Eric Palmer

Title: Fish Division Director

The Nature Conservancy

By: _____

Name: _____

Title: _____

Connecticut River Conservancy

By: _____

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Great River Hydro, LLC

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United States Fish and Wildlife Service

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New Hampshire Department of Environmental Services

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Title: _____

Vermont Department of Environmental Conservation

By: _____

Name: _____

Title: _____

Vermont Department of Fish and Wildlife

By: _____

Name: _____

Title: _____

The Nature Conservancy

By: Mark Zankel

Name: Mark Zankel

Title: NH State Director

Connecticut River Conservancy

By: _____

Name: _____

Title: _____

Great River Hydro, LLC

By: _____

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Title: _____

United States Fish and Wildlife Service

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New Hampshire Department of Environmental Services

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Vermont Department of Environmental Conservation

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Title: _____

Vermont Department of Fish and Wildlife

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Title: _____

The Nature Conservancy

By: _____

Name: _____

Title: _____

Connecticut River Conservancy

By: _____

Name: ___Andrew Fisk_____

Title: ____Executive Directo___

EXHIBIT A

Proposed Alternative Operation

Exhibit A

Great River Hydro's Proposed Alternative Operation for the Projects

INTRODUCTION

Great River Hydro, LLC (Great River Hydro or GRH) proposes to operate each of the Wilder, Bellows Falls and Vernon Projects (Projects or Facilities) in a similar manner under the terms of a new License, as the preferred (or proposed) alternative over the No-Action Alternative. The proposed alternative (also referred to herein as the Proposal) focuses on

- creating more stable impoundment water surface elevations,
- reducing the magnitude and frequency of sub-daily changes in discharge from the stations,
- increasing the amount of time that the project is operated as inflow equals outflow (IEO) and at full impoundment,
- reducing the magnitude and rate of change in flows downstream of the dams, and
- reducing the average frequency, average duration and average range of impoundment fluctuation under conditions when inflow to the Project at the dam is within the range of the Project powerhouse hydraulic capacity.

At the same time, the proposed alternative maintains Great River Hydro's capability to be flexible and responsive to current wholesale energy, forward capacity, reserve and other ancillary services markets managed by the New England Independent System Operator (ISO-NE). Great River Hydro also proposes to remain responsive to ISO-NE system emergencies and critical events and other emergencies involving dam and public safety. The proposal ensures the Project's ability to address future regional energy demands and system needs as those evolve over time. Additional non-operational elements of the proposal are also specified.

This Proposal is largely based on model simulations (simulations) provided by GRH that compared historic to proposed operation at each Project for the months of February, June, August and November in 2009, 2015, 2016 and 2017. GRH believes the simulations present an overly opportunistic representation with respect to the utilization of flow and managing to operational limits, which may result in overstatement of the actual impact of proposed Flexible Operations on the natural resources. This is because the simulations were created with perfect foresight with regards to pricing and inflow. Such perfect foresight will not be available during implementation of the proposal which will likely result in the Projects being operated more conservatively than indicated in the simulations in order to ensure compliance with the operational requirements specified herein.

The term agencies, resource agencies, or relevant resource agencies, used herein includes, but may not be limited to, the United States Fish and Wildlife Service, the New Hampshire Department of Environmental Services, the New Hampshire Fish and Game Department, the Vermont Department of Environmental Conservation, and the Vermont Department of Fish and Wildlife.

DEFINITIONS

1. **Cobblestone Tiger Beetle (CTB) Management Goal**: Maintain multiple consecutive-day periods (≥3) in which Flexible Operations (item 6) do not exceed flow thresholds that maintain ≥75% uninundated habitat at most sites for each month during the CTB active period (June through September), excluding periods when inflows are above these thresholds.

   Rationale: Existing Project operations impact the State listed Cobblestone Tiger Beetle (CTB). The thresholds stated in the goal are intended to increase the duration and area of available CTB habitat to facilitate CTB reproduction and survival from June 1 through September 30. This time period is considered the primary active period for CTB adults and larvae. Lack of persistent habitat can reduce the available time for feeding and/or prey availability. Limited habitat availability resulting from prolonged or repeated inundation also can cause delays in pupae and larvae development, decrease survival of larvae and affect the mating behavior of adults. Based on analysis of IEO/ Flexible Operation simulations provided by GRH, the expectation is that the limited number of Flexible Operation hours allowed during the active season for these species will meet this species-specific goal.

2. **Dwarf Wedgemussel (DWM) Management Goal**: Increase habitat stability by stabilizing/reducing impoundment fluctuations and providing multiple consecutive-day periods (≥3) at IEO each month during the period April 1 through October 15.

   Rationale: Existing operations impact the State and Federally listed Dwarf Wedgemussel. The identified goal is intended to facilitate DWM growth, breeding, and juvenile settlement in the riverine section below the Wilder Project and in the Wilder and Bellows Falls impoundments. Time spent moving in response to relatively rapid changes in water level that could occur due to Flexible Operation is time not spent feeding, which can lead to increased energy expenditure and predation risk, resulting in reduced growth and/or increased susceptibility to mortality. Periods of IEO are also intended to facilitate successful breeding (male gamete release/fertilization in females), believed to occur in the months of August and September, by maximizing the chance male gametes will reach females and not be mobilized to points downstream. Similarly, extended periods of IEO will increase the potential for metamorphosed glochidia released from host fish to successfully settle on a DWM bed versus being mobilized and settling off-bed. Based on analysis of Flexible Operation simulations provided by GRH, the expectation is that the limited number of Flexible Operation hours allowed during the active season for these species will meet this species-specific goal.

3. **Dwarf Wedgemussel Pre-Winter Habitat Operation**: Dwarf Wedgemussel pre-winter habitat protection operation is intended to create overwintering habitat that is protected from potential water drawdown that could expose mussel beds to freezing air temperatures. Mussels reduce their mobility and settle into the substrate for the winter as water temperatures drop below 15° Celsius (° C). By lowering the water surface elevation (WSE), the habitat they occupy will remain submerged over the winter, protecting largely immobile mussels from exposure and freezing air temperatures. To accomplish this, GRH will lower the WSE at the Wilder and Bellows Falls dams to an elevation at or above the low limit of each of the respective Flexible Operating Impoundment Ranges (specified below in item 9) and maintain that WSE for the limited period of time during which water temperatures consistently drop from 15° C to 10° C.

This period is typically 10-21 days in length, occurring in the late-October to early-November timeframe. Once water temperatures are consistently below 10° C within identified DWM habitats within the Wilder and Bellows Falls Project impoundments, the WSE can be adjusted upward to the Target WSE (item 17) and utilize the elevation range above the low limit described above for Flexible Operations. The WSE at each the Wilder and Bellows Falls dams will remain at or above this DWM habitat winter protection WSE throughout the subsequent period when water temperatures are at or below 10° C and no earlier than March 1 unless inflow exceeds respective station capacity and inflow levels require flood profile operation WSE at the dams (item 11).

4. **Emergency and System Operation Requirements** are when a Project must respond to:

   a. Emergencies outside the control of GRH when dam safety, public safety or flood control require action or response.

   b. Emergency System Operations, Conditions and Emergencies when the ISO-NE requires GRH to be fully available and if necessary responsive. Examples include ISO-NE Reserve Deficiencies (a.k.a. Reserve Constraint Penalty Factors) when reserves are depleted on the power grid, for fuel security emergencies or scarcity events, for ISO-NE system (or system) stability (e.g., VAR support), and system over supply (negative prices). GRH is not informed as to how the Projects are called upon or held in reserve to respond to specific system conditions or emergencies. However, based on ISO-NE Reserve Constraint Penalty Factors (RCPF) reports, which indicate when the region's power grid is short of operating reserves, there were 109 activations between 2011 and July 2013 within the entire ISO-NE System that may or may not have required actions at the Wilder, Bellows Falls or Vernon Projects. A summary of information gleaned from these reports for the period 2014 through 2018 is provided in the table below which shows that, in general, these events occurred relatively infrequently and are often short in duration. This information only provides a sense of the limited scale, frequency and number of these events; it does not mean any action actually took place with regard to the GRH projects. GRH facilities are often held in reserve even in a portion of the events referred to below. With regards to ISO-NE declared "Minimum Generation Emergencies" or "MIN GEN Emergencies" which may initiate and produce negative pricing, GRH consulted ISO-NE staff who stated that, to the best of their knowledge, the last MIN GEN Emergency occurred in March 2016.

YEAR	# of System Events	System Event Duration Range	# of Local * Events	Local Event Duration Range
2014	20	5-110 minutes	Cannot determine	
2015	3	10-65 minutes	6	5-20 minutes
2016	3	5-115 minutes	1	5 minutes
2017	2	15-20 minutes	8	5-305 (5-19-17) minutes
2018	2	10-160	0 listed	

*Local event but precisely where is not identified in the RCPF report

5. **ISO-NE required audits, demonstrations and tests** are requirements necessary for participation in and to qualify resources for systems support and markets. Present audits include Claimed Capacity Audits and Reactive Power Demonstrations (see below).

a. Claim Capacity Audit (CCA) is an ISO-NE audit currently required at the Wilder Project and may be (unanticipated presently) required in the future at the Bellows Falls and Vernon Projects. A CCA demonstrates maximum capacity for the Project through a two-hour generation run and is used by the ISO-NE for calculating capacity related market participation. Wilder Project requires a CAA to be performed annually to address summer capacity capability and every three years to demonstrate winter capacity capability. CCAs are performed under conditions specified by the ISO-NE and are performed under the best conditions related to head and inflow in order to maximize the generation within the two-hour audit as specified in the table below. While the ISO-NE does not require CCAs at Vernon and Bellows Falls, Great River Hydro may need to perform a similar test on occasion in order to demonstrate claimed capacity to the ISO-NE should a disparity arise between ISO-NE and GRH capacity numbers.

Project	Maximum Impoundment Elevation at start of CCA (NGVD29)	Maximum Impoundment Drawdown during 2-hour CCA and prior to Refill (feet)	Impoundment Refill
Wilder	385.00	0.60	See item 19.c
Bellows Falls	291.63		
Vernon	220.13		

b. Reactive Capacity Demonstration (RCD) is a 2-step ISO-NE audit currently required at the Wilder, Bellows Falls and Vernon Projects every five years, to verify capability to provide voltage reactive power or VAR to the regional power grid. Hydro generators are excellent sources of VAR support to the power grid, through which voltage can be increased or decreased depending upon the need to boost or reduce voltage of the grid. This audit requires GRH to demonstrate capability in both a minimum [station] generation and a maximum generation condition. Minimum station generation would typically be less than the required minimum base flow specified in item 16. Maximum station generation (item 15) would typically be higher than the calculated inflow. A 5-business day advance notice must be given to the ISO-NE, which determines if system conditions are suitable for a test before authorizing GRH to conduct the audit on a specified date/time. The duration of each portion (minimum generation and maximum generation condition) of the audit generally last an hour if things perform as planned; otherwise the audit could require an additional hour(s). The minimum generation audit will pass inflow either through generation, spill or a combination of both. The maximum generation audit will require a maximum pond elevation (Top of Boards) as specified in item 10 (Full Operating Impoundment Range) below.

c. Other future requisites are requirements specified by the ISO-NE, which are unknown and unanticipated at this time, to demonstrate and meet performance capability requirements, in accordance with ISO-NE market rules that may be changed from time to time. Great River Hydro will notify and consult with the relevant resource agencies a minimum of 60 days in advance of ISO-NE's implementation if GRH determines there is a significant modification to ISO-NE CCAs or RCDs as described above, or present additional requisites or requirements which require GRH to deviate from present demonstration capabilities and which cannot be reasonably accomplished through IEO/Flexible Operation as proposed and implemented under a new License.

6. **Flexible Operation** is when the Projects are operated at the Licensee's discretion and deviate from operation at IEO and stable pond (item 13) in accordance with this Proposal.

7. **Flexible Operation Hours** are the hours of Flexible Operation (item 6) that will count towards the maximum number of hours of Flexible Operation allowed each month as specified in item 23. Determination of the number of Flexible Operation hours that have been used each month for comparison to the maximum number of Flexible Operation hours allowed, will be as follows:

a. The minimum duration of a Flexible Operation event is one hour. Should an event be less than an hour for any reason, the event will be counted as one hour. ISO-NE is responsible for the dispatch of a unit or station and as such GRH is not able to precisely determine or dictate when a unit starts or stops. ISO-NE typically dispatches units at or near the top of the hour (e.g., 1:00, 2:00, etc.) under non-emergency situations. Should an event last more than 15 minutes past the top of the hour that event will be considered to have lasted and counted as if it were for that entire hour (e.g., if an event ends and Down-ramping Transition Operation is initiated within 15 minutes past the top of the hour, it will not be considered an additional hour; if after 15 minutes past the top of the hour, it will count as an additional Flexible Operation hour.) Examples are provided below.

When Up-ramping is implemented in accordance with item 19.a, hours for Flexible Operation begin the hour immediately following the Up-ramp hour. If Up-ramping is not implemented in accordance with item 19.a, due to Real-Time pricing, hours for Flexible Operation begin as soon as Flexible Operation begins as specified above. In all cases, the time that Flexible Operation ends for the purpose of determining the number of allowed hours which have been used each month (item 23) is when Down-ramping begins.

Examples (assuming no Up-ramping)

Approximate Time Flexible Operation Event Begins*	Time Flexible Operation Event Ends and Down-ramping Begins	Number of Flexible Operation Hours
2:00 pm	2:57 pm	1
2:00 pm	3:15pm	1
2:00 pm	3:16 pm	2

* ISO-NE dispatches units near the top of the hour.

b. Should GRH need to conduct more than two CCA tests per year at a single Project (due to problems, changing conditions, or failure to reach expected levels), GRH will alert the relevant resource agencies that 1) it must conduct additional tests, 2) that each additional test will require maximum impoundment elevation (see table under item 5.a) and no ramping, and 3) that the number of Flexible Operation hours for each additional test will be determined in accordance with 7.a above and counted either in the current or in the next month's allocation (item 23) if none were available in the current month.

8. **Flexible Operation Maximum Discharge** (item 27) is the maximum discharge from the Project powerhouse during Flexible Operation and is a function of inflow (item 12) and the maximum station generating capacity (item 15).

9. **Flexible Operating Impoundment Range** is bounded by the following Water Surface Elevation (WSE) limits except during the Dwarf Wedgemussel (DWM) pre-winter habitat protection operation (item 3). These limits are no greater than the current typical range of operation under normal operating condition for Bellows Falls and Vernon, one foot less than current operation for Wilder [which is 382.0 to 384.5 ft (msl NGVD 29)], 0.5 feet less at Bellows Falls during the active DWM period, and will be no greater than 1.5 feet at any of the Projects.

Project	WSE Range (msl NGVD 29)	Maximum Fluctuation During Any Flexible Operation Event (feet)
Wilder	383.0 and 384.5	1.5
Bellows Falls	Oct 1 – May 31: 289.6 and 291.1 June 1-Sept 30: 290.1 and 291.1	Oct 1 – May 31: 1.5 June 1-Sept 30: 1.0
Vernon	218.3 and 219.63	1.33

It is anticipated that the typical impoundment operating range as a function of Flexible Operation will be on average less than the Proposed Flexible Operating Impoundment WSE Range measured at each dam and as specified in the table above. GRH may, at some future date and at its discretion, after gaining more operating experience with the proposed operation, request to meet with relevant resource agencies to discuss the potential for reducing the Target WSE Bandwidth (Item 18) and/or modifying the Flexible Operating Impoundment Range, by raising both the upper and lower limits of the range, but not increasing the difference between the upper and lower limits (i.e., the maximum fluctuation shown in the table above).

10. **Full Operating Impoundment Range** is the historic full operating range for each Project that generally corresponds with the maximum height (top) of the flashboards or gates down to the low limit. This range is utilized for managing high flows and not for power generation. Water surface elevations (WSE) must be lower if extreme high water or dam safety emergencies require stanchion flashboards and beams to be removed from the concrete dam crest. In order to rebuild the stanchion flashboards, the impoundment WSE must be lowered to the crest before rebuilding the structures can be accomplished.

Wilder Project: Top of Boards 385.0 ft; Low limit to manage flood flows 380.0 ft; Concrete Stanchion Flashboard Crest 368.0 ft (msl NGVD 29).

Bellows Falls Project: Top of Boards 291.63 ft; Low limit to manage flood flows 288.63 ft; Concrete Stanchion Flashboard Crest 278.63.0 ft (msl NGVD 29).

Vernon Project: Top of Boards 220.13 ft; Low range to manage flood flows between 218.6 - 212.13 ft; Concrete Stanchion Flashboard Crest 212.13 ft (msl NGVD 29).

11. **High Water Operation** is when inflow at the dam exceeds the maximum station generating capacity (item 15). In most cases this requires each project to follow its Flood Profile Operating procedures, that require specific elevations be maintained at the dam for specific ranges of flow. These elevations fall within the Full Operating Impoundment Range of each Project (item 10).

12. **Inflow** to each Project is estimated based on anticipated inflow arriving at the dam from upstream. In real-time it is calculated and monitored through actual change in WSE measured at the dam on an hourly basis and adjusted through actual discharge from the Project.

13. **Inflow Equals Outflow (IEO) Operation** is defined as follows:

    a. When the Project maintains discharge through the powerhouse equal to inflow at the dam by maintaining a stable target WSE together with any required non-generation flow (e.g., Bellows Falls bypass flow, fish passage related flow) or,

    b. When inflow exceeds the maximum station generating capacity (item 15) and all inflow is passed via a combination of spillage and discharge through the powerhouse or if the station were out of service, via spillage alone.

14. **Maintenance Requirements** are either scheduled periodic maintenance or unscheduled maintenance due to an unanticipated situation or condition. Maintenance requirements can, in some cases, be pre-planned and executed accordingly or unplanned and require various elements such as investigation and problem identification, engineering, planning and execution.

15. **Maximum Station Generating Capacity** (in cfs) is the maximum flow that can be passed through the powerhouse for each Project as shown in the last column of the table below:

Project	Number and Type of Turbines	Maximum Flow / Turbine (cfs)	Minimum Flow / Turbine (cfs)	Maximum Nameplate Rated Capacity * (cfs)	Maximum Station Generating Capacity** (cfs)
Wilder	2- Kaplan 1-Vertical Francis	6000 700	400 400	12,700	11,700
Bellows Falls	3- Vertical Francis	3670	700	11,010	11,400

Project	Number and Type of Turbines	Maximum Flow / Turbine (cfs)	Minimum Flow / Turbine (cfs)	Maximum Nameplate Rated Capacity * (cfs)	Maximum Station Generating Capacity** (cfs)
Vernon	4- Vertical Francis	1465	400	17,130	15,400
	4-Vertical Kaplan	1800	300		
	2-Vertical Francis	2035	500		

* The maximum nameplate hydraulic capacity is based on design specifications of the turbine (or nameplate rating) and is the sum of the hydraulic capacities of all units in the powerhouse. It is not a realistic representation of what the Station can actually pass through the turbines at the same time, which is largely determined by net head.

** The maximum station generating capacity represents the maximum Station discharge based on operating data and represents the maximum discharge that can actually be passed through the turbines.

16. **Minimum Base Flows** are minimum flows required to be maintained below each dam at all times. As described below, flows are expected to be equal to inflow and significantly higher than these base flows the vast majority of time. The proposed Minimum Base Flows are all greater than the minimum base flows required in the current FERC licenses and include a seasonal component.

During the following periods the requirement will be to provide, at a minimum, the approximate inflow as measured at the dam.

- While operating in the Inflow Equals Outflow (IEO) mode (item 13) – discharging inflow will require maintaining Target WSE within the bandwidths specified (item 18) and hourly (minimum required frequency) adjustments necessary to maintain proximity to Target WSE.
- While operating in Flexible Operation and Up-ramping and Down-ramping Transition Operation (item 19), flows will be maintained above or equal to inflow. Instantaneous inflow measurements will be calculated in accordance with item 12.
- The economic minimum dispatch flow (Eco-Min) specified to the ISO-NE will be the estimated hourly inflow. When prices go negative, station discharge will be set to the specified Eco-Min (i.e., the estimated inflow). When a System Minimum Generation Emergency is declared by the ISO-NE, a combined spill plus station discharge will equal the Eco-Min. Both of these situations will resemble IEO and any discrepancy between estimated Eco-Min and real-time inflow would be captured within the Target Elevation Bandwidth and adjusted once either the negative pricing situation or the System Minimum Generation Emergency has ended.

While operating in Transition Refill Operation (item 19.c) discharge will be approximately 70% of estimated inflow and adjusted as necessary through hourly real-time monitoring and calculation of estimated inflow. Discharge during refill will not fall below the seasonal Minimum Base Flow thresholds shown below.

For the purpose of establishing a base flow below the dams for IEO/Flexible Operational Planning purposes and deciding whether or not to implement Flexible Operation by utilizing allocated hours (item 23) in the Day-Ahead (DA) market or in responding to Real-Time (RT) price signals in the RT market, all flows associated with Transition Operation Up-ramping; Flexible Operation; Transition Operation Down-ramping and; Transition Operation Refill will be maintained above the following Project and seasonal Minimum Base Flow thresholds. The only time Project flows prior to or following these periods may be less than these thresholds is when the inflow calculated in accordance with item 12 is less. It is anticipated that flows will be higher than the base flows the vast majority of the time.

Wilder	**Bellows Falls***	**Vernon**
Oct 1 - March 31: 1,500 cfs April 1 - May 31: 2,000 cfs June 1 - Sept 30: 1,100 cfs	Oct 1 - March 31: 1,600 cfs April1 - May 31: 3,000 cfs June 1 - Sept 30: 1,400 cfs Bypass Reach below dam: 300 cfs year round	Oct 1 - March 31: 1,600 cfs April 1 - May 31: 3,000 cfs June 1 - Sept 30: 1,400 cfs

***** Minimum Base Flow is the combined flow below dam and station.

Emergencies, facility outages, station trips that result in unanticipated reductions in station discharge will be considered unavoidable flow reductions, and GRH will restore flows below the Project to at least the estimated inflow as quickly as possible. When spill, other than the continuous 300 cfs in the Bellows Falls bypassed reach, is required during non-business hours to respond to emergencies or System minimum generation emergencies noted above, to maintain IEO, transition flows or the base flows as described, GRH will require personnel to come to the affected station(s) and check for public safety risks below the gates and confirm none exist before opening a spill gate. As soon as that is accomplished a gate(s) will be opened to provide the proper flows. This entire process typically takes one hour or less.

17. **Target Water Surface Elevation (WSE)** is a specified elevation (item 21) at each Project dam to be maintained under IEO Operation by adjusting station discharge. The Target WSE would be monitored no less frequently than hourly, and station discharge would be adjusted as frequently as reasonably possible to ensure accurate WSE. Station discharge is calculated and adjusted based on unit discharge curves and formulas within the accuracy of the unit's control systems.

18. **Target WSE Bandwidth** is a range, 0.5 ft above and 0.5 ft below the Target WSE, available for use during IEO Operation, in order to absorb unanticipated changes in inflow at the dam or slight deviations or imbalances between hourly inflow and hourly discharge due to miscalculation of inflow or unit discharge. See item 21 for elevations associated with the bandwidth. GRH may, at some future date and at its discretion, after gaining more operating experience with the proposed operation, request to meet with relevant resource agencies to discuss the potential for reducing the Target WSE Bandwidth and/or modifying the Flexible Operating Impoundment Range (item 9) by raising both the upper and lower limits of the range, but not increasing the difference between the upper and lower limits (i.e., the maximum fluctuation shown in the table under item 9).

19. **Transition Operation** describes actions required to precede Flexible Operation in some cases and follow Flexible Operation in all cases. There are three elements associated with Transition Operation:

a. **Up-ramping**: A flow increase for the hourly period that would precede most (exceptions specified below) initial Flexible Operation hours at a specified flow depending upon the Project, so that the overall flow difference between the IEO flow and the scheduled Flexible Operation flow is gradual and not instantaneous. Up-ramping rates are specific to each Project and would only apply when Flexible Operation is scheduled in advance (i.e., in the Day-Ahead market) and not when Flexible Operation is initiated in Real-Time or for CCA and RCD audits. Up-ramp rates are specified at each Project as:

Wilder Project: the lesser of 1 of 2 large units (approximately 5000 cfs) or half-way between the IEO flow and the Flexible Operation flow;

Bellows Falls Project: the lesser of 1 cfs/square mile of drainage area (cfsm) (approximately 5,414 cfs) or the flow half-way between current IEO flow and the Flexible Operation flow;

Vernon Project: the lesser of 1 cfsm (approximately 6,266 cfs) or half-way between current IEO flow and the Flexible Operation flow.

b. **Down-ramping**: A flow decrease at a specified rate for the period following Flexible Operation until the flow is equal to inflow at the dam. Decreases will occur on an hourly basis, as a percentage of the previous hourly flow. The first hour after the Flexible Operation hour will be no greater than approximately 70% of the Flexible Operation flow and each successive hour will be approximately 70% of the previous hour.

c. **Refill**: A maximum 48-hour period subsequent to post-Flexible Operation Down-ramping when the impoundment WSE is restored to the stable Target WSE by passing a fraction of the inflow at the dam and retaining the remaining fraction as impounded water above the dam. The hourly flow rate below each Project dam during refill will be the greater of approximately 70% of inflow or the base flow specified in item 16.

The 48-hour maximum refill period begins immediately following Down-ramping after a Flexible Operation event and ends no more than 48 hours later unless the reservoir is within 0.1 foot of the Target WSE (item 21). The 48-hour period includes any temporary interruptions during refill (e.g., purposely pausing refill and passing all inflow, or decisions to implement another Flexible Operation event prior to the impoundment reaching a WSE equal to the Target WSE minus 0.1 feet.) GRH expects to only pause refill for extended periods as needed when participating in the Real-Time Market, as described in 19.a above. Based on analysis of Flexible Operation simulations provided by GRH, it is expected that the number and duration of pauses will be minimal especially during the critical spawning months spanning from April through July 15.

PROJECT OPERATION DESCRIPTIONS

20. All Projects will comply with IEO Operation (item 13), applying Target WSE (item 17) and associated Target WSE Bandwidths (item 18) as described below, unless:

    a. Flexible Operation (item 6) along with Transition Operation (item 19) are applied as specified herein, and implemented;

    b. IEO Operation is suspended due to either High Water Operation (item 11), or Emergency and System Operation, Requirements and Audits (items 4 and 5); or

    c. IEO Operation is suspended due to non-emergency Maintenance Requirements that mandate deviating from IEO Operation, but only after consultation with relevant State and Federal resource agencies prior to initiating a necessary deviation and developing a suitable refill plan and schedule.

21. Target WSEs and Target WSE Bandwidths for each Project are described in the following table (all elevations are mean sea level (msl), NGVD 29):

	Wilder Project	**Bellows Falls Project**	**Vernon Project**
Target WSE	384.5 ft *	291.1 ft *	219.63 ft
Target WSE Bandwidth	Between 385.0 and 384.0 ft, representing 0.5 ft above and below the Target WSE	Between 291.6 and 290.6 ft, representing 0.5 ft above and below the Target WSE	Between 220.13 and 219.13 ft, representing 0.5 ft above and below the Target WSE

*Except during DWM pre-winter habitat protection operation period, triggered and maintained as water temperatures drop from 15° Celsius (° C) to 10° C within identified DWM habitats within the projects (item 3).

22. Rates of change in station discharge to maintain a Target WSE (matching inflow with outflow) will be limited to reasonable changes necessary to continue or adjust the actual WSE to the Target WSE within the Target WSE Bandwidth, largely dependent upon rate of change in inflow, the degree of flow control using MW setpoints on the generator and the monitoring accuracy of WSE at the dam. Changes in station discharge necessary to match inflow should not occur more than once per hour (unless rate of change in inflow is rapidly accelerating or declining) and would not be greater than reasonably necessary to restore a balanced IEO condition at the Target WSE. Specifics regarding how to distinguish between flow adjustments for IEO and Flexible Operation for compliance purposes will be addressed in the operation compliance and monitoring plans (OCMPs) required by the §401 Water Quality Certifications and the FERC Licenses.

23. Flexible Operations are limited, in part, by maximum allowable hours specified below, which are allocated on a monthly basis in order to reflect the seasonal criticality of instream aquatic resources as well as the criticality and fuel security concerns associated with winter peaking loads in New England:

    December, January, February, March: no more than 65 hours in each month

    April, May, June: no more than 10 hours in each month

July: A total of 20 hours with no more than 10 hours from July 1 through July 15. Although a maximum of 10 hours is allowed from July 1 through July 15, in order to further enhance the potential for successful Sea Lamprey spawning, GRH will strive to minimize the hours of Flexible Operation at each Project during this period when conditions allow.

August, September, October: a total of no more than 20 hours in each month.

November: a total of 42 hours with no more than 10 hours from November 1 through 15.

24. Flexible Operations (item 6) will comply with the Flexible Operating Impoundment Range (item 9).

25. The duration (in hours) of each Flexible Operation event will be determined in accordance with item 7.

26. The minimum duration of a Flexible Operation event will be one hour in most cases.

27. Flexible Operation Maximum Discharge will be based upon the calculated inflow at the hour in which the Flexible Operation will occur as follows:

    a. When calculated inflow is approximately 1800 cfs or less, Flexible Operation Maximum Discharge is 4,500 cfs.

    b. When calculated inflow is greater than approximately 1800 cfs, the Flexible Operation Maximum Discharge is limited to 2.5 times the calculated inflow and will not exceed the maximum station generating capacity (item 15).

28. For the purpose of protecting Dwarf Wedgemussels (DWM) from freezing in the winter, the Wilder and Bellows Falls Project impoundments will be temporarily lowered in the Fall of each year as described in item 3.

29. There are no limitations on the number of Flexible Operation events per day or the duration of Flexible Operation events other than those indirect limitations due to inflow and Transition Operation requirements as specified herein.

30. Scheduled Flexible Operation will require one hour of Transition Operation Up-ramping (item 19.a). Unscheduled (in response to Real-Time price signals) Flexible Operation, and Emergency and System Operation, Requirements and Audits (Items 4 and 5) will not require Up-ramping.

31. All Flexible Operation events will require Transition Operation Down-ramping and Refill as specified in item 19.

32. The Transition Operation elements specified in item 19 will be applied at the Projects as follow:

	Up-Ramping	**Down-Ramping**	**Refill**
IEO Operations	Not Applied	Not Applied	Not Applied
Flexible Operations, Scheduled	Applied during the hour prior	Applied as Defined	Applied as Defined
Flexible Operations, Un-Scheduled	Not Applied	Applied as Defined	Applied as Defined

High Water Operations	Not Applied	Not Applied	Not Applied
CCA and RPD Audits	Not Applied	Applied as Defined	Applied as Defined
Emergencies and System Emergencies	Not Applied	Not Applied	Not Applied

33. **Compliance:** Specifics regarding how compliance with this Proposal will be determined and the information that will be provided by GRH for this purpose, will be included in the operation compliance and monitoring plans (OCMPs) required by the §401 Water Quality Certifications and the FERC licenses. Should review of information submitted to the relevant resource agencies pursuant to the OCMPs indicate that operation of any Project is not complying with this Proposal, GRH will consult with the State and Federal resource agencies to discuss their concerns and, if necessary, will identify and implement appropriate corrective actions.

34. **Consultation**: If after evaluating operation data pursuant to Item 33, the relevant resource agencies observe instances where operations do not appear to adequately represent a) the simulations discussed in the last paragraph of the Introduction, b) attain the five bulleted focus areas in the Introduction, or c) attain CTB and DWM management goals (items 1 and 2) at levels suggested by GRH simulations, GRH will, if requested, meet with the agencies to discuss their concerns and possible corrective actions.

John Ragonese

From: Grader, Melissa <melissa_grader@fws.gov>
Sent: Monday, November 9, 2020 3:36 PM
To: John Ragonese; Jennifer Griffin
Cc: Great River Hydro Coordinators; Clinton Birch, Jr.; Rebecca Acosta; Comstock, Gregg; Erin O'Dea; Crocker, Jeff; Sprankle, Ken; Diers, Ted; Katie Kennedy; Carpenter, Matthew; Kathy Urffer; Will, Lael; Henderson, Carol; Davis, Eric; Simard, Betsy; Harris, Hannah
Subject: GRH's Proposed Operations for the Vernon, Bellows Falls, and Wilder Projects
Attachments: CONFIDENTIAL- FINAL GRH PROPOSAL 11-9-2020.pdf

Hello John,

The U.S. Fish and Wildlife Service has reviewed Great River Hydro's Proposal related to future operations under renewed FERC licenses for the Wilder, Bellows Falls, and Vernon Projects (attached to this email). Based on the information submitted to date, we support its adoption as the preferred alternative in Great River Hydro's amended relicensing application(s) and, pending any new information that would suggest otherwise, as the proposed operation in both NH and VT Draft 401s to be issued for public comment. This support does not eliminate the need for further agency consultation under Section 7 of the Endangered Species Act, which will continue to occur informally until such time as FERC has made an effects determination for all listed species within the project-affected area.

You and your team put an enormous amount of effort into the proposal and we appreciate the open discussion, exchange of information and materials, and willingness to work with the stakeholders to develop creative solutions.

Regards,

Melissa Grader
Fish and Wildlife Biologist
Migratory Fish/Hydropower Program
103 East Plumtree Road, Sunderland, MA 01375
p: (413) 548-8002 ext 8124 |
fws.gov/newengland/FERC/ | facebook.com/usfwsnortheast/

From: John Ragonese <jragonese@greatriverhydro.com>
Sent: Monday, November 9, 2020 12:45 PM
To: Comstock, Gregg <WILLIAM.G.COMSTOCK@des.nh.gov>; Crocker, Jeff <jeff.crocker@vermont.gov>; Grader, Melissa <melissa_grader@fws.gov>; Sprankle, Ken <ken_sprankle@fws.gov>; Kathy Urffer <kurffer@ctriver.org>; Will, Lael <Lael.Will@vermont.gov>; Katie Kennedy <kkennedy@tnc.org>; Simard, Betsy <betsy.simard@vermont.gov>; Davis, Eric <eric.davis@vermont.gov>; Carpenter, Matthew <mathew.a.carpenter@wildlife.nh.gov>; Henderson, Carol <Carol.B.Henderson@wildlife.nh.gov>; Harris, Hannah <hannah.harris@vermont.gov>; Diers, Ted <THEODORE.E.DIERS@des.nh.gov>
Cc: Jennifer Griffin <jgriffin@greatriverhydro.com>; Great River Hydro Coordinators

John Ragonese

From: Comstock, Gregg <WILLIAM.G.COMSTOCK@des.nh.gov>
Sent: Monday, November 9, 2020 7:28 PM
To: John Ragonese
Cc: Jennifer Griffin; Great River Hydro Coordinators; Clinton Birch, Jr.; Rebecca Acosta; Mark Allen; rsimmons@normandeau.com; Sarah Allen; Erin O'Dea; Grader, Melissa; Sprankle, Ken; Kathy Urffer; Will, Lael; Katie Kennedy; Simard, Betsy; Davis, Eric; Carpenter, Matthew; Henderson, Carol; Harris, Hannah; Diers, Ted; Crocker, Jeff
Subject: CONFIDENTIAL: NHDES Support of GRH Proposal for Wilder, Bellows Falls, and Vernon
Attachments: CONFIDENTIAL- FINAL GRH PROPOSAL 11-9-2020.pdf

John,

As a representative of the New Hampshire Department of Environmental Services (Department) in the confidential stakeholder mitigation discussions with Great River Hydro, regarding future operations under renewed FERC licenses for the Wilder, Bellows Falls and Vernon Projects, to the extent of my authority to do so, and based on the information submitted to date, I acknowledge the Department's support of the Proposed Alternative Operations (attached to this email) as the preferred alternative in Great River Hydro's amended relicensing application and, pending any new information that would suggest otherwise, as the proposed operation in both NH and VT Draft 401s to be issued for public comment.

We sincerely appreciate the time and effort devoted by the Great River Hydro team to work with the Stakeholders to achieve this milestone.

Regards,

Gregg

Gregg Comstock, P.E.
Supervisor, Water Quality Planning Section
Watershed Management Bureau
Water Division, NH Department of Environmental Services
29 Hazen Drive, P.O. Box 95
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John Ragonese

From: Henderson, Carol <Carol.B.Henderson@wildlife.nh.gov>
Sent: Tuesday, November 10, 2020 11:50 AM
To: Comstock, Gregg; John Ragonese
Cc: Jennifer Griffin; Great River Hydro Coordinators; Clinton Birch, Jr.; Rebecca Acosta; Mark Allen; rsimmons@normandeau.com; Sarah Allen; Erin O'Dea; Grader, Melissa; Sprankle, Ken; Kathy Urffer; Will, Lael; Katie Kennedy; Simard, Betsy; Davis, Eric; Carpenter, Matthew; Harris, Hannah; Diers, Ted; Crocker, Jeff
Subject: RE: CONFIDENTIAL: NHFGD Support of GRH Proposal for Wilder, Bellows Falls, and Vernon
Attachments: CONFIDENTIAL- FINAL GRH PROPOSAL 11-9-2020.pdf

Hi John and GRH staff:

As a representative of the New Hampshire Fish and Game Department (NHFGD) in the confidential stakeholder mitigation discussions with Great River Hydro (GRH), regarding future operations under renewed FERC licenses for the Wilder, Bellows Falls and Vernon Projects, to the extent of my authority to do so, and based on the information submitted to date, I acknowledge the NHFGD's support of the Proposed Alternative Operations (attached to this email) as the preferred alternative in Great River Hydro's amended relicensing application and, pending any new information that would suggest otherwise, as the proposed operation in both NH and VT Draft 401s to be issued for public comment.

The NHFGD staff greatly appreciates the significant time and effort that the GRH staff have applied into developing this proposal in consultation with stakeholders.

Thank you again for all your efforts.

Carol Henderson, Environmental Review Coordinator
NH Fish and Game Department

John Ragonese

From: Crocker, Jeff <Jeff.Crocker@vermont.gov>
Sent: Monday, November 9, 2020 2:50 PM
To: John Ragonese
Cc: Jennifer Griffin; Great River Hydro Coordinators; Clinton Birch, Jr.; Rebecca Acosta; Mark Allen; rsimmons@normandeau.com; Sarah Allen; Erin O'Dea; Comstock, Gregg; Crocker, Jeff; Grader, Melissa; Sprankle, Ken; Kathy Urffer; Will, Lael; Katie Kennedy; Simard, Betsy; Davis, Eric; Carpenter, Matthew; Henderson, Carol; Harris, Hannah; Diers, Ted
Subject: CONFIDENTIAL: VT DEC Concurrence with GRH Proposal for Wilder, Bellows Falls, and Vernon
Attachments: CONFIDENTIAL- FINAL GRH PROPOSAL 11-9-2020.pdf

John,

As a representative of the Vermont Department of Environmental Conservation (Department) in the confidential stakeholder mitigation discussions with Great River Hydro, regarding future operations under renewed FERC licenses for the Wilder, Bellows Falls and Vernon Projects, to the extent of my authority to do so, and based on the information submitted to date, I acknowledge my Department support of the Proposed Alternative Operations (attached to this email) as the preferred alternative in Great River Hydro's amended relicensing application and, pending any new information that would suggest otherwise, as the proposed operation in both NH and VT Draft 401s to be issued for public comment.

Thank you and GRH for engaging in these discussions,

Jeff

Due to the coronavirus (COVID-19) we are taking additional safety measures to protect our employees and customers and are now working remotely while focusing on keeping our normal business processes fully functional. Please communicate with our staff electronically or via phone to the greatest extent possible since our processing of postal mail may be slowed during this period.

Division staff contact information can be found online here: https://dec.vermont.gov/watershed/contacts.

Thank you for your patience during this challenging time. We wish you and your family the best.

Jeff Crocker, *Supervising River Ecologist*

1 National Life Drive, Davis 3
Montpelier, VT 05620-3522
802-490-6151 / Jeff.Crocker@vermont.gov
www.watershedmanagement.vt.gov

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
RIVERS PROGRAM

John Ragonese

From: Harris, Hannah <Hannah.Harris@vermont.gov>
Sent: Monday, November 9, 2020 3:18 PM
To: John Ragonese
Cc: Jennifer Griffin; Great River Hydro Coordinators; Clinton Birch, Jr.; Rebecca Acosta; Mark Allen; rsimmons@normandeau.com; Sarah Allen; Erin O'Dea; Comstock, Gregg; Crocker, Jeff; Grader, Melissa; Sprankle, Ken; Kathy Urffer; Will, Lael; Katie Kennedy; Simard, Betsy; Davis, Eric; Carpenter, Matthew; Henderson, Carol; Diers, Ted
Subject: CONFIDENTIAL: VT FWD Concurrence with GRH Proposal for Wilder, Bellows Falls, and Vernon
Attachments: CONFIDENTIAL- FINAL GRH PROPOSAL 11-9-2020.pdf

Dear John,

As a representative of the Vermont Department of Fish and Wildlife in the confidential stakeholder mitigation discussions with Great River Hydro, regarding future operations under renewed FERC licenses for the Wilder, Bellows Falls and Vernon Projects, to the extent of my authority to do so, and based on the information submitted to date, I acknowledge my Department support of the Proposed Alternative Operations (attached to this email) as the preferred alternative in Great River Hydro's amended relicensing application and, pending any new information that would suggest otherwise, as the proposed operation in both NH and VT Draft 401s to be issued for public comment.

Thank you and the Great River Hydro team for engaging in these discussions,

Hannah

VERMONT

Hannah Harris, *Streamflow Protection Biologist*

Vermont Fish & Wildlife Department
1 National Life Drive, Davis 2
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802 279-7913/hannah.harris@vermont.gov
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Due to the coronavirus (COVID-19), the Agency of Natural Resources is taking additional safety measures to protect our employees, partners and customers. We are now working remotely and focused on keeping our normal business processes fully functional. We encourage you to communicate electronically or via phone to the greatest extent possible. Thank you for your patience and understanding that responses may occasionally be delayed

John Ragonese

From: Katie Kennedy <kkennedy@TNC.ORG>
Sent: Monday, November 9, 2020 3:10 PM
To: John Ragonese
Cc: Jennifer Griffin; Great River Hydro Coordinators; Clinton Birch, Jr.; Rebecca Acosta; Mark Allen; rsimmons@normandeau.com; Sarah Allen; Erin O'Dea; Comstock, Gregg; Crocker, Jeff; Grader, Melissa; Sprankle, Ken; Kathy Urffer; Will, Lael; Simard, Betsy; Davis, Eric; Carpenter, Matthew; Henderson, Carol; Harris, Hannah; Diers, Ted
Subject: CONFIDENTIAL: TNC Concurrence with GRH Proposal for Wilder, Bellows Falls, and Vernon
Attachments: CONFIDENTIAL- FINAL GRH PROPOSAL 11-9-2020.pdf

John,

As a representative of The Nature Conservancy (TNC) in the confidential stakeholder mitigation discussions with Great River Hydro, regarding future operations under renewed FERC licenses for the Wilder, Bellows Falls and Vernon Projects, to the extent of my authority to do so, and based on the information submitted to date, I acknowledge TNC's support of the Proposed Alternative Operations (attached to this email) as the preferred alternative in Great River Hydro's amended relicensing application and, pending any new information that would suggest otherwise, as the proposed operation in both NH and VT Draft 401s to be issued for public comment.

Thanks to you and the Great River Hydro team for your contribution and commitment to these discussions.

Katie Kennedy

Kathryn D Mickett Kennedy, PhD
Applied River Scientist

The Nature Conservancy
136 West Street
Northampton, MA 01060

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+1 413 586 2349 (office)
+1 413 588 1959 (mobile)

nature.org

John Ragonese

From: Kathy Urffer <kurffer@ctriver.org>
Sent: Monday, November 9, 2020 4:26 PM
To: John Ragonese; Jennifer Griffin
Cc: Great River Hydro Coordinators; Clinton Birch, Jr.; Rebecca Acosta; Grader, Melissa; Comstock, Gregg; Erin O'Dea; Crocker, Jeff; Sprankle, Ken; Diers, Ted; Katie Kennedy; Carpenter, Matthew; Will, Lael; Henderson, Carol; Davis, Eric; Simard, Betsy; Harris, Hannah; Andrea Donlon; Andy Fisk
Subject: GRH's Proposed Operations for the Vernon, Bellows Falls, and Wilder Projects
Attachments: CONFIDENTIAL- FINAL GRH PROPOSAL 11-9-2020.pdf

John,
CRC appreciates the significant effort that you and the GRH staff have put into developing this proposal in consultation with stakeholders.

As a non-agency representative in the confidential stakeholder mitigation discussions with Great River Hydro, regarding future operations under renewed FERC licenses for the Wilder, Bellows Falls and Vernon Projects, to the extent of my authority to do so, and based on the information submitted to date, I acknowledge Connecticut River Conservancy's support of the Proposed Alternative Operations (attached to this email) as the preferred alternative in Great River Hydro's amended relicensing application and, pending any new information that would suggest otherwise, as the proposed operation in both NH and VT Draft 401s to be issued for public comment.

We look forward to reviewing and evaluating the entire application and recognize that it will contain many elements beyond the scope of our conversations and this proposal including fish passage modifications, recreation investments, and other mitigations.

Best,
Kathy

~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~

Kathy Urffer, (she/her)
River Steward
Connecticut River Conservancy
PO Box 6219 | Brattleboro, VT 05302 | www.ctriver.org
802-258-0413 | kurffer@ctriver.org

Clean water. Healthy habitat. Thriving communities.
Connecticut River Conservancy

CLICK HERE TO BECOME A MEMBER

Amended Final Application for New License for Major Water Power Project—Existing Dam

Vernon Project (FERC No. 1904)

EXHIBIT C: CONSTRUCTION HISTORY AND PROPOSED CONSTRUCTION

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EXHIBIT C: CONSTRUCTION HISTORY AND PROPOSED CONSTRUCTION

Section 5.18(a)(5)(iii) of Title 18 of the Code of Federal Regulations (CFR) refers to Section 4.51 (License for Major Project—Existing Dam) for a description of information that an applicant must include in Exhibit C of its license application. Exhibit C is a construction history and proposed construction schedule for the Project.

Section 4.51(d) Exhibit C is a construction history and proposed construction schedule for the Project. The construction history and schedules must contain:

(1) If the application is for an initial license, a tabulated chronology of construction for the existing project's structures and facilities described under paragraph (b) of this section (Exhibit A), specifying for each structure or facility, to the extent possible, the actual or approximate dates (approximate dates must be identified as such) of:

(i) Commencement and completion of construction or installation;

(ii) Commencement of commercial operation; and

(iii) Any additions or modifications other than routine maintenance; and

(2) If any new development is proposed, a proposed schedule describing the necessary work and specifying the intervals following issuance of a license when the work would be commenced and completed.

C1 Construction History

This is not an application for an initial license; however, a brief overview of the Project's construction history is provided below.

C1.1 Original Construction

The Vernon Project was originally constructed in 1909 with a powerhouse extension on the Vermont side adding two additional units (Unit Nos. 9–10) in 1925 (see Exhibit E, Section 3.11, *Cultural and Historic Resources*). The original license for the Project was issued by the Federal Power Commission (predecessor to the Federal Energy Regulatory Commission [FERC]) on March 26, 1945, and in 1955, the Project was purchased by New England Power Company. The original license expired on June 30, 1970, and the Project operated under annual licenses until the license was renewed on June 25, 1979. The license had been amended on July 31, 1970, for the use of the Project as a cooling water source for Vermont Yankee located just upstream.

C1.2 Modifications/Additions to the Project

On October 5, 1978, FERC approved a Settlement Agreement concerning fish passage facilities for Atlantic Salmon at the upstream Wilder Project (No. 1892) and Bellows Falls Project (No. 1855), and for Atlantic Salmon and American Shad at the Vernon Project. The settlement was executed on December 30, 1977, among the Licensee; the States of Massachusetts, Connecticut, New Hampshire, and Vermont; U.S. Fish and Wildlife Service; and four non-governmental organizations (the Environmental Defense Fund; the Massachusetts Public Interest Research Group, Inc.; For Land's Sake; and Trout Unlimited). The settlement called for staged design, construction, and operation of passage facilities at the three Projects; Vernon's construction was the first in the series. The upstream fish ladder was subsequently completed, and operation began in 1981.

In 1986, a major reconstruction of the spillway crest water control mechanisms was completed and included the addition of a trash sluice (skimmer) gate, six tainter gates, and two 50-foot bays of hydraulic panels in the spillway section, and a vehicle-accessible metal grid deck was added for access to the gates and spillway improvements. A new trashrack raking system was constructed along the powerhouse forebay at that time.

On July 26, 1990, the Licensee entered into a Memorandum of Agreement with the Connecticut River Atlantic Salmon Commission for permanent downstream fish passage facilities for the Wilder, Bellows Falls, and Vernon Projects. Downstream passage facilities at Vernon were constructed in 1995 and consist of a 250-cubic feet per second (cfs) "fish pipe" and louver array, as well as a 40-cfs "fish bypass" (also known as a "fish tube") (see Exhibit A.5, *Fish Passage Facilities*).

On June 12, 1992, FERC issued an order amending the license for the proposed replacement of four existing 2.0-megawatt (MW) turbine generating units (Units Nos. 5 through 8) with two 14.0-MW turbine generating units (Unit Nos. 11 and 12). As required by Article 403 of the 1992 license amendment, downstream fish passage facilities at the Project were completed in 1995. After several extensions, the license was further amended on July 28, 2006, authorizing the replacement of the original 2.0-MW Unit Nos. 5–8 with four new 4.0-MW units. The redevelopment of Units 5–8 was completed and the units were commissioned in 2008.

On February 27, 1998, FERC approved the transfer of the license from New England Power Company to USGen New England, Inc.

Under a multi-license amendment dated November 19, 1998, regional electrical transmission facilities were removed from the Project including step-up transformers and switchyards. At that time, the powerhouse was automated and began operations via remote control from a consolidated hydro operations center in Wilder, Vermont.

On January 24, 2005, FERC approved the transfer of the license to TransCanada Hydro Northeast Inc.

Under a Purchase and Sale Agreement, dated November 1, 2016, Great River Hydro NE, LLC agreed to acquire all of the equity interests in TransCanada Hydro Northeast Inc. On January 10, 2017, FERC authorized the transaction under Section 203(a)(1)(A) of the Federal Power Act (158 FERC ¶62,019). In furtherance of the acquisition, the licensee was converted to a limited liability company. Accordingly, the licensee applied for FERC approval to transfer the licenses for Project Nos. 1855 (Bellows Falls), 1892 (Wilder), 1904 (Wilder), 2077 (Fifteen Mile Falls) and 2323 (Deerfield River) from TransCanada Hydro Northeast Inc. to TransCanada Hydro Northeast LLC. On February 22, 2017, FERC approved the transfer of the licenses to TransCanada Hydro Northeast LLC, pending submittal of evidence of the conversion and the signed acceptance sheet (158 FERC ¶62,119). On April 18, 2017, TransCanada Hydro Northeast LLC filed the acceptance sheet and evidence of the conversion as required by the February 22, 2017, Order. The transaction closed on April 19, 2017.

On April 19, 2017, TransCanada Hydro Northeast LLC was renamed Great River Hydro, LLC and provided written notice of the name change to FERC by filing dated April 24, 2017 so that FERC could revise its records to accurately reflect the name change of the licensee of the Project as Great River Hydro, LLC.

C2 Schedule for Proposed Project Development

Great River Hydro is not proposing any new construction or new development at the Vernon Project at this time.

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Amended Final Application for New License for Major Water Power Project — Existing Dam

Vernon Project (FERC No. 1904)

EXHIBIT D: STATEMENT OF PROJECT COSTS AND FINANCING

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EXHIBIT D: PROJECT OPERATIONS AND RESOURCE UTILIZATION

Section 5.18(a)(5)(iii) of Title 18 of the Code of Federal Regulations (CFR) refers to Section 4.51 (License for Major Project—Existing Dam) for a description of information that an applicant must include in Exhibit D. Exhibit D is a statement of costs and financing.

D1 Original Cost of the Existing Project

The Vernon Project was previously licensed in 1979, and this Application is for a new license rather than initial license. Federal Energy Regulatory Commission (FERC) regulations at 18 C.F.R. § 4.51(e)(1) do not require a statement of costs of lands, water rights, structures, or facilities in applications for new licenses.

D2 Amount Payable in the Event of Project Takeover

Section 14 of the Federal Power Act (FPA) reserves to the United States the right to take over a non-publicly owned project upon expiration of its license. To date, no agency or interested party has recommended a federal takeover of the Vernon Project. If such a takeover were to occur, Great River Hydro, LLC (Great River Hydro), would be entitled to be reimbursed for its net investment, not to exceed the fair value, of the property taken, plus severance damages suffered (16 United States Code [U.S.C.] § 807). However, the information required by FERC's regulations (18 C.F.R. 4.51(e)(2)) that would be needed to quantify the compensation to be paid to Great River Hydro pursuant to Section 14 is provided below.

D2.1 Fair Value

The FPA does not define the term "fair value"; however, for the purpose of this Application, Great River Hydro will rely upon a historical cost basis (not depreciated) as of December 31, 2019, of $100,152,000 as the estimate of fair market value of the Vernon Project.

D2.2 Net Investment

The FPA generally defines a Licensee's net investment in a project as the original cost of the project, plus additions and betterments, minus depreciation and other amounts (16 U.S.C. § 796(13)). For the purpose of this Application, net investment is represented as the net book value of the Vernon Project, equal to $94,982,000 as of December 31, 2019.

D2.3 Severance Damages

Under Section 14 of the FPA (16 USC § 807(a)) "severance damages" are those "reasonable damages, if any, to property of the licensee valuable, serviceable, and [which is then] dependent [for its usefulness upon the continuance of the license] but not taken" in the event of a federal takeover. All Project structures, facilities, equipment, and contractual obligations or requirements are required for the successful operation of the Vernon Project; therefore, Great River Hydro estimates that there would not be any severance damages but cannot render a definitive determination at this time.

D3 Estimated Capital Cost of New Development

Great River Hydro has no plans for future development of the Vernon Project.

D4 Estimated Average Annual Cost of the Project

This section describes the estimated annual costs of the Vernon Project. The estimated annual cost of the total Project in 2019 (in 2019 dollars) was approximately $7,992,000 based on a full fiscal 2019 year of record. This estimate includes local, state, and federal taxes; depreciation and amortization; and operation and maintenance (O&M) expenses.

Great River Hydro's proposed alternative includes significant modifications in project operation. The proposed operation will largely operate and manage the impoundment to a stable Target water surface elevation (WSE) while discharging estimated inflow. Great River Hydro will install, maintain, and operate equipment and tools required to manage the project under the proposed operation. It will continue to manage its existing Recreation facilities and enhance them as needed to address demands and use. Great River Hydro will develop a Programmatic Agreement for Managing Historic Properties and implement a Historic Properties Management Plan (HPMP). Although it is unclear what specific recommendations under Section 18 of the FPA will be prescribed by the Department of Interior, Great River Hydro's proposed alternative recognizes potential fish passage improvements and potential O&M expansion. Table D-1 identifies annual cost associated with O&M related to this proposed alternative.

D4.1 Capital Costs

The Licensee uses a 10-percent rate to approximate its average cost of capital. Actual capital costs are based on a combination of funding mechanisms that may include contributions from owners, debt issuances, revolving credit lines, cash from operations, or other sources of funding.

D4.2 Local, State, and Federal Taxes

As a limited liability company, income tax liabilities associated with Great River Hydro, other than in the State of New Hampshire, are passed through to the

owners. For 2019, State of New Hampshire taxes were $646,000 for the Vernon Project, and local property taxes were $3,205,000.

D4.3 Depreciation and Amortization

Depreciation for the Vernon Project, in 2019 was $2,005,000.

D4.4 Operation and Maintenance Expenses

Estimated annual O&M expenses for 2019 at the Vernon Project were approximately $2,136,000, including interim replacements, insurance, and administrative and general expenses, but excluding property taxes, income taxes, and depreciation. These costs do not include estimated O&M costs associated with Great River Hydro's proposed alternative; they are however, provided in Table D-1.

D4.5 Estimated Cost of Proposed Environmental Measures

The total direct cost of the operational and environmental measures is estimated at $4,060,000 (2020 $s). The costs for major components with and the cost to operate and maintain the proposed environmental measures for the Wilder Project are identified in Table D-1. These values represent 2020 net present value costs within a 30-year period of economic analysis, allocated to the year incurred at an inflation rate of 2.5 percent per year and discount rate of 10 percent.

Table D-1. Cost of Proposed Environmental Measures.

Measure	Value 2020 $s
Cultural resource surveys, HPMP measures	$250,000
Eel surveys and studies	$360,000
Expanded Fish Ladder O&M	$625,000
Recreation O&M	$120,000
Impoundment WSE monitoring/Inflow forecasting enhancements and O&M	$205,000
Fish ladder modifications	$1,060,000
Downstream fish passage	$1,850,000
Recreation area improvements	$135,000
WSE monitoring inflow forecasting equipment and installation	$275,000
TOTAL	$4,880,000

D5 Estimated Annual Value of Project Power

Project energy is sold into the New England Independent System Operator (ISO-NE) regional market on a day-ahead and real-time basis at the prices that clear for each generating facility. Capacity commitments are priced through a regional Forward Capacity Auction process. The Vernon Project also receives revenue for providing ancillary services to the regional system and the sale of renewable energy credits. Table D-2 summarizes estimated revenues from energy production, capacity, renewable energy credits, and ancillary services based on 2019 prices and generation (161,474 megawatt-hours [MWh]). The total estimated annual valuation of Project power is $9,240,984 or $57.23/MWh.

Table D-2. Valuation of annual Project output.

Revenue Source	Value
On-peak energy	$2,473,939
Off-peak energy	$2,154,321
Forward capacity	$3,127,129
Real-time reserves	$679
Volt-ampere-reactive support	$19,534
Renewable energy credits	$1,465,382
Total value	$9,240,984
Total value per MWh	$57.23MWh

D6 Sources and Extent of Financing and Annual Revenues

Capital projects are financed using cash flow from operations and as necessary, additional debt obligations or equity injections. Based on the value of Project power described in Section D5, the Vernon Project will have adequate financial resources to meet the costs of operations for the term of the new license.

D7 Estimated Cost to Develop License Application

The estimated cost to develop the Vernon Project License Application is approximately $4,300,000.

D8 On-peak and Off-peak Value of Project Power

The average annual price in for on-peak Vernon Project power is estimated as $30.55/MWh. The real-time off-peak price is estimated as $26.77/MWh. Prices are annual average, location-specific prices from ISO-NE at Node 599 based on the full 2019 calendar year. Pricing nodes are specific locations on the transmission system for which the ISO-NE calculates and publishes wholesale electricity prices. Each is related to one or more of the power grid’s electrical buses—specific components at

which generators, loads, or the transmission system are connected. This location-specific pricing helps give market participants a clear and accurate signal of the price of electricity at every location on the grid.

D9 Estimated Average Annual Change in Project Generation and Value of Project Power Due to Changes in Project Operation

Great River Hydro's proposed operation at the Vernon Project is estimated to slightly increase generation due maintaining the impoundment at the Target WSE, which will result in higher average net operating head. The proposed operation is expected to shift a portion of energy from on-peak to off-peak hours due to maintaining Target WSE and passing inflow at the dam under most hours. Study 5 operations modeling was used to compare the impact on generation at all the projects under current relicensing proceedings and show relative changes in energy values between the proposed alternative and the current operation across the five representative hydrologic inflow datasets that were used throughout the relicensing studies. The operations model modeled the proposed operation as a stable impoundment at the Target WSE, discharging inflow equals outflow (IEO), extending current fish ladder operations to July 15 or longer and continuing to manage high flows through river profile operation but did not apply the use of limited discretionary Flexible Operation hours. Under the proposed operation, including added benefits of limited Flexible Operation observed in the IEO/Flexible Operation simulations, Great River Hydro estimates average total annual generation at the Wilder Project to be increased approximately by 2 percent; with a reduction in peak period generation of approximately 13 percent; and an increase in off-peak generation of approximately 19 percent. Table D-3 summarizes estimated change in on-peak and off-peak generation revenue based on 2019 prices and production (Table D-2), reduced by percentages listed above. Under the proposed operation, Great River Hydro does not anticipate any change in value in the Forward Capacity, Renewable Energy Credits, and Ancillary services. The total estimated annual valuation of Project power is $9,221,972 or $57.11/MWh.

Table D-3. Estimated Valuation of Project Power of Proposed Operation.

Revenue Source		Value
On-peak energy		$2,172,539
Off-peak energy		$2,436,709
Forward capacity	No Change	$3,127,129
Renewable energy credit	No Change	$679
Real-time reserves	No Change	$19,534
Volt-ampere-reactive support	No Change	$1,465,382
Total value		$9,221,972
Total value per MWh		$57.11

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Amended Final Application for New License for Major Water Power Project — Existing Dam

Vernon Project (FERC No. 1904)

EXHIBIT F: GENERAL DESIGN DRAWINGS AND SUPPORTING DESIGN REPORT (PUBLIC VERSION)

Courtesy paper copies of Great River Hydro's Exhibit F Drawings are not included with this filing. There have been no changes to the drawings or supporting design report since the Final License Application was filed on May 1, 2017.

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EXHIBIT F: GENERAL DESIGN DRAWINGS

Section 5.18(a)(5)(iii) of Title 18 of the Code of Federal Regulations (CFR) refers to Section 4.51 (License for Major Project—Existing Dam) for a description of information that an applicant must include in Exhibit F of its license application. Exhibit F consists of general design drawings of the principal project works described under section 4.41(b) (Exhibit A) and supporting information used to demonstrate that existing project structures are safe and adequate to fulfill their stated functions.

F1 General Design Drawings for Existing Project Features

Exhibit F consists of general design drawings of the principal Project works. These Exhibit F design drawings are filed separately in the final license application, and Great River Hydro LLC (Great River Hydro) requests that they be treated as Critical Energy Infrastructure Information (CEII) under Federal Energy Regulatory Commission (FERC) regulations at 18 CFR § 388.112.

Only the list of general design drawings is included in this public version of Exhibit F.

Table F1-1. List of general design drawings.

Exhibit No.	Sheet No.	Title
F-1	Sheet 1F	General Layout of Plant
F-2	Sheet 2E	Details of Spillway
F-3	Sheet 3F	Powerhouse & Switchyard
F-4	Sheet 4D	Section of Powerhouse Units 1-4
F-5	Sheet 5E	Section of Powerhouse Unit 6 & 7
F-6	Sheet 6D	Section of Powerhouse Units 9-10
F-7	Sheet 7A	Section of Powerhouse Units 5 & 8
F-8	Sheet 8A	Section of Powerhouse at Removal Shaft
F-9	Sheet 9A	Fish Ladder General Plan
F-10	Sheet 10A	Fish Ladder Sections
F-11	Sheet 11A	Fish Ladder Sections
F-12	Sheet 12A	Fish Passage Facilities: Downstream Fish Migration General Arrangement
F-13	Sheet 13A	Fish Passage Facilities: Downstream Fish Migration Fish Diversion Boom Details
F-14	Sheet 14A	Fish Passage Facilities: Downstream Fish Migration Fish Diversion Boom Details
F-15	Sheet 15A	Fish Passage Facilities: Downstream Fish Migration Fish Diversion Boom Details

Exhibit No.	Sheet No.	Title
F-16	Sheet 16A	Fish Passage Facilities: Downstream Fish Migration Trash Sluice Exit - Plan & Sections

F2 Supporting Design Report

Sections 4.41(g)(3) and (4) require that an applicant file with FERC two copies of a Supporting Design Report when the applicant files a license application. The purpose of the Supporting Design Report is to demonstrate that existing and proposed structures are safe and adequate to fulfill their stated functions.

Great River Hydro hereby requests waiver of the Commission's requirement to include a Supporting Design Report in Section F-3 of Exhibit F (18 CFR § 4.41(g)(3)) because the most recent (6th) Part 12 Independent Dam Safety Inspection Report (filed November 9, 1992) fulfills the requirements of the regulations for filing a Supporting Design Report as part of the application for new license. All the Project's Independent Dam Safety Inspection Reports are on file with FERC. On August 8, 1997, FERC granted an exemption from future Part 12 inspections based on an assessment and documentation provided to FERC demonstrating that the Vernon Project has low hazard potential. On December 10, 2018, Great River Hydro filed an updated dam breach analysis for the Vernon Project affirming low hazard classification.

Amended Final Application for New License for Major Water Power Project — Existing Dam

Vernon Project (FERC No. 1904)

EXHIBIT G: PROJECT AREA MAPS

Courtesy paper copies of Great River Hydro's Exhibit G maps are not included with this filing. There have been no changes to the maps since the Final License Application was filed on May 1, 2017.

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EXHIBIT G: MAPS OF LOCATION, BOUNDARY, FEDERAL LANDS, AND NONFEDERAL LAND OWNERSHIP

Section 5.18(a)(5)(iii) of Title 18 of the Code of Federal Regulations (CFR) refers to Section 4.51 (License for Major Project—Existing Dam) for a description of information that an applicant must include in Exhibit G of its license application. Exhibit G contains a set of Project maps that conform to requirements stated in Section 4.39.

G1 Project Area Maps

Exhibit G drawings are maps of the Project area showing the existing FERC Project boundary for the current license. No tentative boundary is indicated because there are no proposed developments and there are no other adjustments to the boundary.

G1.1 Federal Lands

No federal lands are located within the Project boundary.

G1.2 Non-Federal Lands

The Exhibit G drawings identify lands that Great River Hydro, LLC (Great River Hydro) owns in fee, and lands over which Great River Hydro has acquired, or plans to acquire rights to occupancy and use other than fee title, including rights acquired or to be acquired by easement or lease. These drawings are electronically filed separately as large format documents and Project boundary files as ArcGIS files (in zipfile format).

G2 Exhibit G Drawings

The Exhibit G maps and Project boundary description tables are identified as shown in Table G2.1.

Table G2-1. Exhibit G drawings.

Exhibit No.	Sheet No.	Title
G-1	Sheet 1	Exhibit G: Vernon Project – No. 1904 (Plant Area)
G-2	Sheet 2	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-3	Sheet 3	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-4	Sheet 4	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-5	Sheet 5	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-6	Sheet 6	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-7	Sheet 7	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)

Exhibit No.	Sheet No.	Title
G-8	Sheet 8	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-9	Sheet 9	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-10	Sheet 10	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-11	Sheet 11	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-12	Sheet 12	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-13	Sheet 13	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-14	Sheet 14	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-15	Sheet 15	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-16	Sheet 16	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-17	Sheet 17	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-18	Sheet 18	Exhibit G: Vernon Project – No. 1904 (Project Boundary Sheet)
G-19	Pages 1-4	Vernon Project, P-1904 - Project Boundary Description table

Amended Final Application for New License for Major Water Power Project — Existing Dam

Vernon Project (FERC No. 1904)

EXHIBIT H (PUBLIC): PLANS AND ABILITY OF APPLICANT TO OPERATE PROJECT EFFICIENTLY FOR RELICENSE

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LIST OF FIGURES

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EXHIBIT H: PLANS AND ABILITY OF APPLICANT TO OPERATE PROJECT EFFICIENTLY FOR RELICENSE

Section 5.18(a)(5)(iii) of Title 18 of the Code of Federal Regulations (CFR) describes information that an applicant for a new license (License for Major Project—Existing Dam) must include in Exhibit H of its license application. Exhibit H contains the miscellaneous information specified in the regulation.

H1 Efficiency and Reliability

The purpose of the Vernon Project is to provide energy, capacity, regulation and other ancillary services to the wholesale electricity markets and power grid administered by ISO New England (ISO-NE). Great River Hydro has a long-term commitment to maximizing the hydroelectric power on the Connecticut River. While seeking to maximize power production, Great River Hydro also has a long-term commitment to preserving the environmental resources of the area. Great River Hydro believes that continued operation of the Vernon Project maximizes the public benefit provided by the Project.

Great River Hydro has operated the Vernon Project since the former licensee, TransCanada Hydro Northeast LLC, was acquired by Great River Hydro NE, LLC on April 19, 2017 as explained in the cover letter accompanying this application. Management and operating personnel of the prior licensee have continued with Great River Hydro. Great River Hydro personnel have decades of experience operating these and other hydroelectric assets in the United States.

H1.1 Increase in Capacity or Generation

No additional capacity or generation for the Vernon Project is proposed.

H1.2 Project Coordination with Other Water Resources Projects

Operation of the Vernon Project is coordinated with other Great River Hydro hydroelectric generating facilities on the Connecticut River, taking into consideration variations in demand for electricity, natural flow variations, intermediate tributary inflow, federal flood control projects and travel time for dispatched flows between hydro projects to maximize the efficient use of available water. Estimated and anticipated inflow forms the basis for bidding into the New England Independent System Operator's (ISO-NE) day-ahead energy market. Day-ahead hourly bids reflect must-run generation periods associated with minimum flow periods; periods when sustained higher flows are anticipated; and opportunistic generation when inflow and available storage allows response to anticipated high electricity demand. When inflows are less than maximum generating capacity, Great River Hydro uses the limited impoundment storage at the Project to dispatch generation as required to meet the generation schedule managed by the ISO-NE. Generation can vary during the course of any day

between the required minimum flow and full generating capacity, if flows are available. Over the course of a day, the Project generally passes the average daily inflow. During periods of sustained high flows, Great River Hydro dispatches Project generation in a must-run status to use available water for generation. Once flows exceed powerhouse capacity, it operates the Project in a “river profile” manner. Communication with downstream hydro projects and upstream tributary flood control projects facilitates coordination among all parties when managing for flood flows.

Great River Hydro, with support from relevant state and federal resource agencies, and regional and national non-governmental organizations that have actively participated in scoping and study phases of relicensing, proposes a modified project operation for non-spill flow conditions that significantly reduces project-related flow and water surface fluctuation in comparison to existing Project operation. Capitalized terms used in this section have the meaning given to them in Exhibit B.

The proposed Project operation will predominantly maintain a specified WSE (Target WSE) at the dam and as a result, maintain flow below the Project flow equal to the approximate inflow as measured or calculated at the dam (inflow equals outflow or IEO). Specifically, a Target WSE of 219.63 ft m.s.l. (NVGD 29) will be maintained by passing inflow within a Target WSE Bandwidth between 220.13 ft and 219.13 ft to account for potential differences between anticipated inflow and actual instantaneous inflow. In addition to IEO Operation, the Project will have restricted discretionary Flexible Operation capability to respond to elevated energy prices as well as unrestricted capability to respond to Emergencies and ISO-NE transmission and power system requirements (system Operation Requirements). Elements associated with the Proposed Project Operations including modes of operation, capabilities, restrictions, requirements and allowances are defined and described in Exhibit B, Appendix B-1.

Project operation during periods of sustained high flows will not change. Great River Hydro will dispatch Project generation in a must-run status to use available water for generation. Once flows exceed powerhouse capacity, the Project will be operated in a “river profile” manner. Communication with downstream hydro projects and upstream tributary flood control projects facilitates coordination among all parties when managing for flood flows.

Great River Hydro facilitates flow and real-time operations information with the operators of the downstream Turners Falls Project, owned and operated by FirstLight. Article 304 of the Vernon license requires Great River Hydro to coordinate Project operations with FirstLight. A letter Agreement amending the original 1993 Headwater Benefit Agreement was filed with FERC on June 20, 2003. The Agreement requires Great River Hydro to provide to FirstLight by 10:00 am each day, an estimate of total discharge (cfs-hours) expected the next day at the Vernon Project. As soon as Great River Hydro receives the hourly dispatch schedule for the next day from ISO-New England (ISO-NE), it faxes or emails the schedule for Vernon discharges to FirstLight. Typically, this occurs between 1:30 pm and 2:00 pm. If any subsequent dispatch schedules are received during the day

showing changes in the projected hourly release schedules, the revised schedule for Vernon is faxed or emailed to FirstLight.

FirstLight has stated in its Final License Application, filed April 20, 2016: "Not having reliable and timely estimates of Vernon's hourly release schedule the day ahead prevents FirstLight from the most efficient management of the TFI [Turners Falls impoundment] for power production." Great River Hydro disagrees with this statement. Article 304 does not require coordination to ensure FirstLight efficiently manages the Turners Falls impoundment, as efficient management is largely a function of FirstLight's own coordinated operation of the impoundment that serves two purposes: as the impoundment for the Turners Falls Project and as the lower reservoir for the Northfield Mountain Pumped Storage Project (NMPS). Great River Hydro provides an estimate of total inflow from Vernon early in the day ahead to allow for FirstLight to plan and manage its operations and consider the quantity of inflow it will receive in order to participate in the ISO-NE day ahead energy market, as well as to schedule generation or pumping at NMPS. FirstLight has sufficient operational capability to manage reservoir operations at both Turners Falls and NMPS to accommodate the estimated inflow. Promptly after receiving the hourly dispatch schedule for the next day from ISO-NE, Great River Hydro provides the schedule for Vernon discharges to FirstLight. No other information is available to distribute to FirstLight beyond the ISO-NE schedule. Sharing pre-bid flow or generation forecast information with another wholesale generator participating in the same market is illegal. If flow conditions change, or the ISO-NE dispatch schedule changes, Great River Hydro immediately notifies FirstLight. Lastly, as per the Agreement, FirstLight maintains real-time Vernon tailrace water level monitoring equipment and has the capability to determine precisely what is occurring at Vernon in real time.

With this information, together with their project operations data (unseen by Great River Hydro), FirstLight has the capability to determine Vernon discharge. FirstLight can verify their calculations as Great River Hydro publishes discharge flow information from Vernon, as well as the upstream projects owned by Great River Hydro, in real-time at www.h2Oline.com. Furthermore, Great River Hydro has published travel times for flows between its upstream projects. Great River Hydro estimates the travel time for discharges from Vernon to reach Turners Falls dam to be approximately 4 hours. Collectively, this flow information provides ample flow information for FirstLight to plan, manage, and operate their projects in a coordinated manner as required under Article 304. Therefore it is Great River Hydro's position that: 1) Great River Hydro is in full compliance with the Agreement filed with the Commission on June 20, 2003; and 2) Great River Hydro provides or facilitates the availability of sufficient anticipated dispatch schedule information, real-time flow, and tailrace information such that FirstLight can, should it choose to, operate their projects in an efficient and coordinated manner with the upstream hydro projects. To the extent that FirstLight seeks additional provisions, the need for such provisions is not a matter of flow and operational coordination but perhaps economic optimization, which is not material to, nor the purpose of, Article 304 in the Vernon license.

H1.3 Project Coordination with Other Electric Systems

All power generated by the Vernon Project is sold into the wholesale electricity markets administered by ISO-NE or to wholesale buyers operating in the New England markets. The coordination and dispatch of the power is controlled by ISO-NE, based upon the prices offered to the market and the demands for services.

As the regional transmission organization (RTO), ISO-NE is responsible for the operation of the New England region, including the regional power system, competitive wholesale electricity markets and has responsibility for ensuring open access to transmission lines. As the RTO, ISO-NE oversees the day-to-day operation of the power grid, in accordance with the operating rules and criteria of NERC. Flexible hydropower operations are particularly important for system stability (e.g., VAR support), fuel security emergencies or scarcity events.

H2 Licensee's Need for the Project

Great River Hydro does not directly use Vernon Project output. As stated above, Project output is sold into the wholesale electricity markets administered by ISO-NE or to wholesale buyers operating in the New England markets.

The Vernon Project is located in the regional electric system that is operated by the ISO-NE and that supplies electric power to the New England states. ISO-NE is responsible for regional grid operation and dispatch of generation, wholesale market administration, and power system analysis and planning to ensure system reliability and adequate generation and transmission resources to meet regional needs. ISO-NE prepares both short- and long-term projections of electricity supply and demand. The 2020–2029 Forecast Report of Capacity, Energy, Loads, and Transmission projects annual increases of 0.9 percent in summer peak demand, 1.1 percent in winter peak demand, and 0.4 percent in annual energy use from 2020 to 2029 (ISO-NE, 2020).

The Vernon Project provides 32,400 kilowatts (kW) of authorized capacity and on average 158,028 annual megawatt-hours (MWh) to the regional power grid, 80,983 MWh during peak hours and 77,044 MWh during off-peak hours. In New England, peak hours are defined as the hours between 7:00 a.m. and 11:00 p.m. on non-holiday weekdays. Off-peak hours in New England are weekday hours between 11:00 p.m. and 7:00 a.m., all day Saturdays, Sundays, and six holidays of January 1st, Memorial Day, July 4th, Labor Day, Thanksgiving, and Christmas. Over the term of the new license, the Project will continue to provide renewable power and support variable energy resources (VERs) through reserve capacity, thereby displacing fossil-fired generation and reducing power plant emissions by over 90,000 tons of CO_2 that otherwise would be emitted from a natural gas generating station and thus creating an environmental benefit. The Project also provides

forward capacity, real-time reserves, voltage-ampere reactive (VAR) support[1] and Renewable Energy Credits (RECs) within the ISO-NE power pool.

The New England regional electric system is experiencing an increased penetration of VERs into the energy mix. These resources are, by definition, variable and can affect real-time power supply and grid stability. Vernon Project's capacity to provide reserved capacity and ancillary services such as real-time reserves and VAR support is both complementary to existing VERs and can facilitate greater penetration of these resources into the energy mix. Emerging energy markets such as "firm renewable energy" or expansion of ancillary services will undoubtedly develop over the course of a new license in response to this changing and presently undefined energy landscape. Therefore, maintaining the flexibility and capability to provide these necessary and complementary hydropower benefits is strategically important to ensuring further VER development in the region.

H2.1 Costs and Availability of Alternative Sources of Power

Great River Hydro does not directly use Vernon Project output. Project output is sold into the wholesale electricity markets administered by ISO-NE or to wholesale buyers operating in the New England markets.

H2.2 Effects of Alternative Sources of Power

If the Vernon Project no longer generated energy, the existing mix of peak and off-peak energy, as well as the ancillary services, including load following, capacity, and spinning and non-spinning reserves, would have to be provided by other suppliers to the bulk energy system at market rates.

Flexible and peaking hydropower operations are particularly important to system reliability, including the ability to provide load following and system protection.

H2.2.1 Effects on Customers

Project output is sold into the wholesale electricity markets administered by ISO-NE or to wholesale buyers operating in the New England markets.

H2.2.2 Effects on Operating and Load Characteristics

Great River Hydro has no power distribution role other than delivering Project output into the bulk power system of New England and therefore has no load requirements.

[1] Voltage is regulated through reactive power production and consumption, and resources on the grid may be compensated for providing this reactive power capability. Voltage-ampere reactive (VAR) is the unit of measurement for reactive power.

The Project does provide ISO-NE with the ability to bring units to the electric grid quickly in the event of a grid disturbance such as loss of a major unit or other load change occurrence.

H2.2.3 Effects on Communities Served

Great River Hydro is not a retail supplier and does not own or operate distribution facilities; therefore, the Project does not serve communities directly. If the Wilder Project no longer operated, the energy, capacity, ancillary services, system stability and regulation that it provides to the grid operated by ISO-NE would need to be provided by either increased production by existing resources or by the construction of new generation. In addition, 100% of the generation produced by the Project qualifies for Vermont Tier I and Maine Class II renewable energy credits, and a portion qualifies for Massachusetts Class I renewable energy credits.

The operation of the Project has, and will continue to have, a positive effect on local economies in the area. Great River Hydro employs 7 people at the Vernon Project—5 maintenance technicians, 1 specialist, and 1 manager. It is anticipated that this level of local employment will continue for the foreseeable future. Great River Hydro also has a positive impact on local economies through outside contracted services that are often locally sourced, provision of recreational access and resources, and property tax payments of over $3.8 million for the Vernon Project.

H3 Cost of Production and Alternative Sources of Power

H3.1 Average Annual Cost of Project Power

Exhibit D includes a detailed estimate, including the basis for the calculations, of Great River Hydro's cost of Project power.

H3.2 Projected Resources to Meet Capacity and Energy Requirements

As stated above, Great River Hydro is not a utility with a service territory and, therefore, does not have any electricity capacity or energy requirements with end-users. Great River Hydro does participate in the wholesale electricity markets operated by ISO-NE, including the forward capacity market. Great River Hydro has obligations to provide 35 MWs of capacity from the Vernon Project through May, 2024. In addition, the Vernon Project provides energy, reserve and ancillary services to the New England bulk electric system.

H4 Effect on Industrial Facility

Great River Hydro does not use the Project power for its own industrial facility.

H5 Indian Tribe Need for Project Electricity

Great River Hydro is not an Indian Tribe.

H6 Effect on Transmission System

The Vernon Project facilities do not include a transmission system. Project Single-line diagrams and Asset Separation drawings designating ownership lines of demarcation are included as Figures H-1 and H-2, respectively.

[This drawing is considered Critical Energy Infrastructure Information [CEII] and has been removed from this public document].

Figure H-1. Transmission interconnection schematic.

[This drawing is considered Critical Energy Infrastructure Information [CEII] and has been removed from this public document].

Figure H-2. Asset separation lines of ownership demarcation.

H7 Statement of Need for and Usefulness of Modifications

At this time, Great River Hydro has no plans to modify the generation facilities associated with the Project.

H8 Financial and Personnel Resources

H8.1 Financial Resources

Great River Hydro has sufficient financial resources available to meet its obligations under a new license to operate the Vernon Project.

H8.2 Personnel Resources

Great River Hydro employs personnel resources sufficient to operate, maintain and meet its obligations under a new Vernon Project license. All personnel receive training commensurate with their responsibilities in an ongoing effort to improve their ability to operate the Project in the safest and most efficient manner possible. Great River Hydro also contracts with local outside entities to provide maintenance support for the Project. Training includes topics such as operator and technical trade progression and testing, confined space entry, fall protection, portable fire extinguisher use, HazCom, respiratory protection, lockout/tagout, and FERC dam safety and license compliance. Employees are also trained annually on the site specific EAP, including various role responsibilities and Incident Command System response protocols.

H9 Project Expansion Notification

Great River Hydro currently has no plans to expand the Project to encompass additional lands. The Vernon Project maps provided in Exhibit G indicate the current project boundary.

H10 Electricity Consumption Efficiency Improvement Program

Not applicable. Great River Hydro sells the Vernon Project output to the wholesale electric power market.

H11 Indian Tribe Names and Mailing Addresses

There are no Indian Tribes with lands occupied by the Project or that would otherwise be affected by the relicensing. Tribal groups that have identified themselves as having traditional cultural connections to the Connecticut River Valley in New Hampshire and Vermont consist of the Vermont state-recognized Abenaki Nation, including the Elnu Abenaki Tribe, the Nulhegan Abenaki Tribe, the Koasek Traditional Band of the Koas Abenaki Nation, and the Abenaki Nation at Missisquoi; NH-based Abenaki tribal groups Cowasuck Band – Pennacook/ Abenaki

People, Koasek Traditional Band of the Sovereign Abenaki Nation and Abenaki Nation of New Hampshire; and the Commission identified federally recognized Narragansett Indian Tribe, based in southern Rhode Island. Addresses are included in the Additional Information accompanying the Initial Statement for this Application.

H12 Safe Management, Operation, and Maintenance of Project

Refer to Exhibit B of the License Application for additional information on management, operation and maintenance beyond what is provided below.

H12.1 Existing and Planned Operation of the Project during Flood Conditions

Information on existing and planned operation of the Project during flood conditions is detailed in Exhibit B of this License Application. Great River Hydro maintains a current EAP that is updated on an annual basis and submitted to the FERC for approval. A “state of readiness” test is conducted annually to verify the communications paths and the contacts listed in Great River Hydro’s EAP. Every 5 years, Great River Hydro conducts a full, functional exercise of one of its or Deerfield River project EAPs (alternating each time) that includes all of the facility-related emergency response agencies including state and federal agencies. A complete copy of the Vernon Project's EAP is located at the Vernon Powerhouse. Each of the local Emergency Management Directors has a copy of their sections of the plan. No operational changes are proposed that might affect the existing EAP for the Vernon Project.

H12.2 Warning Devices Used to Ensure Downstream Public Safety

The Vernon Project’s public safety warning devices include signage warning of downstream releases, thin ice hazards, portage trails, and signs warning of no boating, swimming, fishing beyond this point. Warning devices also include boat barriers and buoys near spillways. Real-time flow information and day-ahead generation schedules are provided via phone and web-based systems in an effort to alert recreational instream public users of flow conditions at the dam that could affect downstream areas. These measures are specified in the Vernon Project Public Safety Plan filed with the FERC. A field inspection is conducted annually prior to the start of the primary recreation season to ensure measures are in place and functional.

H12.3 Proposed Changes Affecting the Existing Emergency Action Plan

Great River Hydro updated the EAPs for the Connecticut River in 2018, no operational changes are proposed that might affect the existing EAP for the Vernon Project. Great River Hydro’s EAP program fully complies with FERC’s EAP engineering guidelines.

H12.4 Existing and Planned Monitoring Devices

Great River Hydro conducts periodic visual inspections of Project structures, equipment, and dam embankments to ensure safe operation, and compliance with FERC guidelines. Varying levels of inspections are conducted on weekly, monthly, biannual, and annual intervals.

H12.5 Project's Employee and Public Safety

Great River Hydro personnel, including history under previous licensees, have an outstanding history of operating the Vernon Project in a work-safe environment. There have been zero lost-time accidents for the past nine years at this Project.

Great River Hydro has a commitment to employee safety that begins with compliance with applicable local, state, and federal regulations regarding the safe operation of industrial and electrical facilities. As Great River Hydro operates the Project's generation facilities, this commitment is implemented primarily through a rigorous safety program that includes safety training, inspection and maintenance programs, certification programs, incident reporting and database and root-cause analysis of near-miss safety incidents.

Great River Hydro is committed to maintaining and operating its facilities in a manner that allows the public to safely enjoy recreational activities. The Vernon Project has a Public Safety Plan on file with FERC. It considers a variety of public use and risks based on locations and identifies safety measures implemented to provide adequate warning and safety measures implemented to address the risk and exposure. A field inspection is conducted annually prior to the start of the primary recreation season to ensure measures are in place and functional.

Specific to downstream, in-stream use, real-time flow information is available by telephone (1-800-452-1737) or the "WaterLine" website (www.h2oline.com) providing opportunity flow information for boaters and public safety flow information for anglers that also use areas downstream of the Vernon Project for boating, wading, and fishing.

Records available to Great River Hydro indicate that the Vernon Project has had no public safety incidents tied to operation or maintenance of the Project.

H13 Current Project Operation

Operation of the Project is described in Exhibit B.

H14 History of the Project and Upgrade Programs

A complete Project history is described in Exhibit C.

H15 Generation Lost Over the Last Five Years

There have been three significant unscheduled outages over the last five years. Unit No. 8 shut down due to a failed water bearing resulting in a 9 day outage in June 2017. Units No. 5 and 8 were out of service for 10.5 days in April-May 2019 due to debris load plugging the intake rack, and Unit 6 shut down for 11.5 days in June 2020 due to a failed servo piston. These outages were restored through maintenance and repairs. Lost generation is estimated at approximately 168 MWh in 2017 and 2,087 MWh in 2019. There was no loss of generation during the 2020 outage.

H16 Compliance with Terms and Conditions of Project License

Great River Hydro and the previous licensee have an excellent record of compliance with the terms and conditions of the current license. A review of records indicates a long-standing history of compliance with all the license articles and regulations.

H17 Actions Taken by Licensee Affecting Public

Great River Hydro has worked to ensure that actions at the Vernon Project do not negatively affect the public. Great River Hydro plays a prominent role in ensuring the efficient, productive use of water for hydroelectric generation and public use. The Project provides renewable electricity, contributes to the stability of the regional power system, supports the penetration of additional variable energy resources such as wind and solar into the regional power grid and displaces about 90,000 tons of CO_2 that would otherwise be emitted from a natural gas generation alternative. This significantly affects the public beyond the public use opportunities the Project provides and supports including boating, fishing, hiking, hunting, and camping. The Project also supports other day-use and overnight-use activities, such as multi-day paddling trips, wildlife viewing and picnicking, and recreational sports areas. In addition to the public use benefits, Great River Hydro contributes to the public benefit through the employment of fulltime and seasonal staff. Great River Hydro educates and trains local communities on its EAP that has assisted and encouraged communities to develop local response plans related to flooding and inundation. Lastly, by contributing over $3.8 million in local property tax, Great River Hydro supports community and public services that would otherwise fall on other taxpayers in these communities.

H18 Ownership and Operating Expenses if Project is Transferred

If the Project license were transferred to another entity, Great River Hydro's cost of operating and maintaining the Project (see Exhibit D) would be eliminated.

H19 Annual Fees for Federal or Indian Lands

The Vernon Project is not located on federal or Indian lands.

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