TRANSCANADA HYDRO NORTHEAST INC.

ILP Study 31
Whitewater Boating Flow Assessment – Bellows Falls and Sumner Falls

Study Report

In support of Federal Energy Regulatory Commission Relicensing of:

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

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March 1, 2016

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EXECUTIVE SUMMARY

The TransCanada Hydro Northeast Inc. (TransCanada) Revised Study Plan (RSP) for relicensing of the Wilder and Bellows Falls projects identified two locations for whitewater boating potential: Sumner Falls (downstream of Wilder) and the Bellows Falls bypassed reach. Field investigations of these two locations used volunteer boaters to respond to pre-developed surveys after multiple demonstration flows at each location. Close-out surveys were used to compare different flows and identify ideal or preferred flow ranges for identified boating features within the two reaches.

Sumner Falls is an existing and popular "park and play" boating destination with dependable flows throughout the summer and runnable at almost any flow during this period. Although there has never been boating in the Bellows Falls bypassed reach, it was identified by stakeholders as a potential whitewater boating location. Volunteer boaters participated in five flows over a weekend in June 2014 to characterize features and ideal flows within the Sumner Falls rapid complex. Survey results confirmed the complex offers a range of boating opportunities across a wide range of flows with areas for both beginners and expert boaters at almost all flows boated as part of the study. Results also identified the ideal flow levels for popular surfing features "Main Wave" (also referred to as "Summer Wave") and "Sign Wave". Participants using kayaks reported flows of 4,700 cubic feet per second (cfs) and 13,000 cfs as the two ideal levels for those surfing locations, respectively. Sumner Falls also offers challenges and opportunities for canoes, squirt boats and down river paddlers not interested in surfing. Results from these non-surfing boaters also indicated there were two preferred flows; a mid-range flow in the 6,700-7,800 cfs range and 13,000 cfs, depending on the boat type and experience level. Four boaters commented that Sumner Falls has good teaching potential due to the ease of access, diversity of areas to boat within the complex, and the whitewater class ratings. Participants reported the minimum skill level necessary to boat Sumner Falls and the majority of scores indicated that up to 6,700 cfs novices and beginners could boat the complex; however above 7,800 cfs, the majority of scores were reported as requiring intermediate skill set.

The Bellows Falls bypassed reach is a 7/10-mile reach of the Connecticut River with only leakage flows from the dam most of the year due to the diversion of the river through a power canal to the powerhouse. Flows in the bypassed reach occur during spring freshet, significant precipitation events, or during outages at the powerhouse and can be between leakage and over 100,000 cfs. TransCanada estimates the damaged seals on the spillway gates currently release about 125 cfs of leakage flow into the bypassed reach. Study group members viewed potential boating study flows prior to assembling the volunteer boaters and identified that the reach has boating potential with the proper safety measures in place to address ingress/egress challenges and avoid the low head/high hazard fish barrier dam near the railroad and Vilas bridges. Expert and advanced volunteer boaters participated in nine different release flows from the Bellows Falls dam over a weekend in May 2015. The Bellows Falls bypassed reach has three features of interest to boaters within the study reach: a large dome rock near the top of the run and two wave trains. Survey results indicate there is interest in boating these features, and ideal

flow levels for canoes and kayaks were identified; however, significant issues such as access, target boater population, and safety with regard to the fish barrier dam would need to be addressed. The flow that provided the highest quality play boating experience (generally associated with advanced to expert skill boaters adept at surfing waves) was 4,370 cfs, followed closely by 2,020 cfs. Not surprisingly, traits such as navigability, powerful hydraulics, technical rapids, whitewater challenge, and aesthetics were all scored high (close to 'totally acceptable') at the highest flow level. Additionally, whitewater class and potential boater skill levels required to boat the reach increased with flow. The length of the run received the lowest scores and was reported as slightly above 'marginal.' Based on average scores, the preferred flow level best suited for boating instruction was 2,020 cfs. Participants reported the minimum skill level necessary to boat the bypassed reach. The majority of scores indicated that up to 2,020 cfs novices and beginners could boat in the bypassed reach; however at 2,370 cfs and above, the majority of scores were reported as requiring an intermediate or advanced boating skill set.

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LIST OF ABBREVIATIONS

cfs	cubic feet per second
FERC	Federal Energy Regulatory Commission
ILP	Integrated Licensing Process
ISO	Independent System Operator
RSP	Revised Study Plan
SCADA	Supervisory Control and Data Acquisition System
SPD	Study Plan Determination
TransCanada	TransCanada Hydro Northeast Inc.
USGS	US Geological Survey

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1.0 INTRODUCTION

This study report presents the findings of the 2014/2015 Whitewater Boating Flow Assessment at Bellows Falls and Sumner Falls (ILP Study 31) conducted in support of Federal Energy Regulatory Commission (FERC) relicensing efforts by TransCanada Hydro Northeast Inc. (TransCanada) for the Wilder Hydroelectric Project (FERC Project No. 1892), Bellows Falls Hydroelectric Project (FERC No. 1855) and the Vernon Hydroelectric Project (FERC No. 1904).

This study was developed as a result of issues that were identified pertaining to the potential effects of project operations on the Connecticut River's whitewater resources. More specifically, a recreation, land use, and aesthetics work group was interested in determining: (1) the existing character of the Connecticut River's whitewater opportunities at Sumner Falls (also known locally as Hartland Rapid) downstream of Wilder dam outside the FERC Project Boundary but influenced by project operations, and (2) the boating potential within the Bellows Falls bypassed reach.

The Revised Study Plan (RSP) listed the following 10 objectives:

- identify recreational paddling opportunities at Sumner Falls and the suitability of the Bellows Falls bypassed reach for whitewater boating;
- describe flow-quality relationships and identify acceptable and optimal ranges at each location; information will be organized independently for Sumner Falls and Bellows Falls bypassed reach;
- describe potential effects of operations on paddling at each location and identify boater sensitivity to current operations regimes (e.g., project discharges ranging from minimum flow to full generation);
- broadly characterize recreational paddling-relevant hydrology of the existing operating regime and qualitatively describe the relationship between paddling opportunities and project operations;
- characterize the potential for whitewater boating in Bellows Falls bypassed reach within the context of regional opportunities and those provided through current operation;
- determine the potential number of days that flows for whitewater boating are available under the projects' current operations at both locations;
- identify resource needs (e.g., aquatic habitat) and competing recreational uses (e.g., canoeing or fishing) that are or will be affected by flows suitable for whitewater boating;
- identify all safety issues associated with whitewater boating and further development of opportunities for such at both locations;
- identify public access obstacles at Sumner Falls and Bellows Falls bypassed reach; and

- characterize effects on current project operations associated with providing various flows for recreational paddling.

The RSP for this study was modified by FERC in its September 13, 2013, Study Plan Determination (SPD) with the following specific changes.

- The study will assess at least three controlled releases from Wilder for the Sumner Falls evaluation and at least four controlled releases from the Bellows Falls dam with provisions for additional releases based on interviews with paddlers and study participants.
- The study will include at least 12 boater participants.

Boaters and flows were documented during the study using digital video photography. A DVD of the videos is being filed separately as part of this study report.

2.0 WHITEWATER RECREATION IN THE REGION

2.1 Regional Whitewater Opportunities

Whitewater opportunities within a 1 to 2 hour drive of the Wilder and Bellows Falls projects include some of the most revered whitewater boating opportunities in New England. Figure 2-1 shows the locations of the majority of boatable reaches within the region while Table 2.1-1 summarizes the reach, whitewater challenge and other attributes based on information presented by FirstLight (2015) and derived from the American Whitewater website, area guidebooks and input from boating participants in the study. These rivers and creeks provide a wide variety of boating opportunities ranging from Class I floats to Class V steep creeks. Whitewater classifications, which are based on the International Whitewater Classification System (American Whitewater, 1998), are summarized in Table 2.1-2.

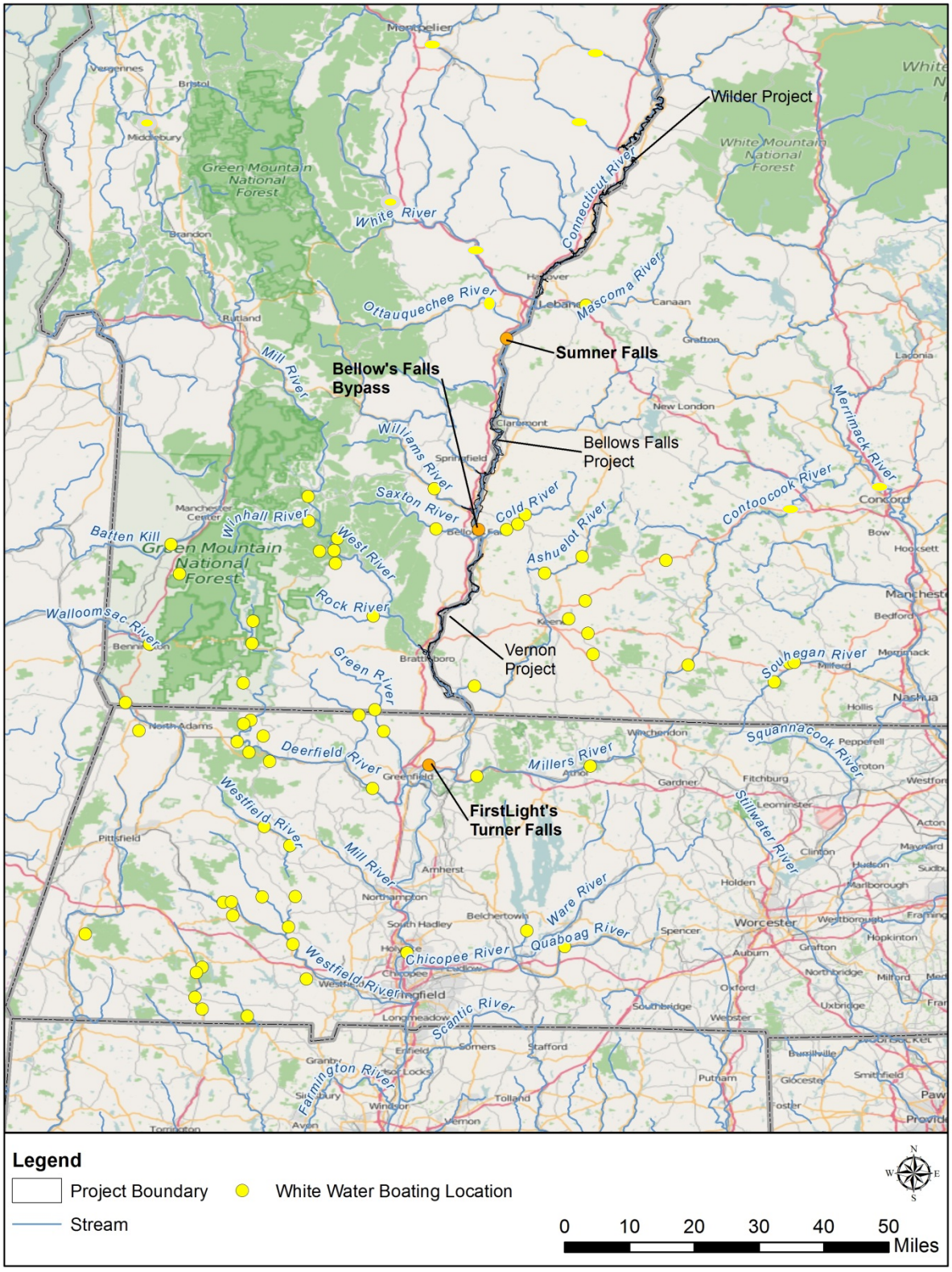

Figure 2-1. Sample whitewater opportunities in the region.

Table 2.1-1. Sample regional whitewater opportunities.

River	Reach	Class	Length (miles)	Season	Miles from Sumner Falls
Androscoggin River	Below Errol Dam	II	1	Hydro releases every day during summer	104
Androscoggin River	Below Pontook Dam	II-III	2.4	Hydro releases most weekends	83
Ashuelot River	Marlow to Gilsum Gorge	III-IV	5.3	Natural flow river with spring high water	35
Ashuelot River	Gilsum Gorge to Shaws Corner	II	4	Natural flow river with spring high water	36
Ashuelot River	Ashuelot to Hinsdale	II-IV	3.5	Dam controlled (spill events)	54
Ashuelot River- South Branch	Troy to Webb	III-IV	2.3	Snow/ice melt and after heavy rains	50
Ball Mountain Brook	Metcalf Road to Jamaica State Park	III-IV	3.5	Snow/ice melt and after heavy rains	39
Battenkill River	Manchester to NY border		11	Snow/ice melt and after heavy rains	49
Black River, VT	Whitesville to Perkinsville	II-III(IV)	7.5	Dam controlled (generating flows)	36
Chickley River	Route 8A to Deerfield River	II-III	6.0	Snow/ice melt and after heavy rains	70
Cold River	South Acworth to Vilas Pool	II	5.5	Dam controlled (spill events)	27
Cold River	Vilas Pool to Alstead	III-IV	0.7	Dam controlled (spill events)	29
Cold River	Alstead to Drewsville	II	2	Dam controlled (spill events)	29
Cold River	Route 2 hairpin turn to Deerfield River	II-IV	4.25	Snow/ice melt and after heavy rains	70
Concord River	Twisted Sister, Three Beauties, and Middlesex Dam	III-IV	1.5	flows between 400 and 6,000 cfs	84
Connecticut River	Turners Falls Bypass	I-IV	2.7	Dam Controlled (spill events)	66
Connecticut River	Holyoke Dam	I-III	2.0	Dam controlled (generating flows)	95
Contoocook River	Jaffery to Peterborough	II	5	Dam controlled (spill events)	54
Contoocook River- North Branch	Route 9 and 123 to Hillsboro Fire Station	V	6	Snow/ice melt and after heavy rains	39
Dead River	Below Flagstaff Lake	III-IV	16	10 releases per year	158

River	Reach	Class	Length (miles)	Season	Miles from Sumner Falls
Deerfield River	Searsburg Dam to Harriman Reservoir	III	4.5	Dam controlled (spill events)	55
Deerfield River	No. 5 Dryway, Monroe Bridge to Bear Swamp	III-IV	3	May-October Scheduled dam releases (~32 days)	65
Deerfield River	Bear Swamp to Route 2	II-III	9.5	April-October Scheduled dam releases (~106 days)	69
Deerfield River	Wilcox Hollow to Stillwater Bridge	I-II	7	Dam controlled (spill events)	71
Deerfield River- East Branch	Somerset Reservoir to Searsburg Reservoir	I-II	6	Dam controlled (spill events)	52
Deerfield River- West Branch	Heartwellville to Readsboro Village	V	3.5	Snow/ice melt and after heavy rains	61
Dunbar Brook	South Road to Deerfield River	V	2.7	Snow/ice melt and after heavy rains	66
Fall River	Otis Reservoir to Farmington River	V	0.9	March-April and Otis Reservoir drawdown (4 releases Sept. - Oct.)	103
Farmington River- West Branch	Lower New Boston (Reservoir Road to Iron Bridge)	II-IIII	2.25	March-April and Otis Reservoir drawdown (4 releases Sept. - Oct.)	104
Farmington River- West Branch	Upper New Boston (Iron Bridge to American Legion Field)	III-IV	3	March-April and Otis Reservoir drawdown (4 releases Sept. - Oct.)	107
Farmington River- West Branch	Upper New Boston (New Boston to near Thorp Brook)	II	5	March-April and Otis Reservoir drawdown (4 releases Sept. - Oct.)	109
Green River	Green River to West Leyden (MA)	II-III	6.8	Dam controlled (spill events)	59
Green River	West Leyden to covered bridge	II-III	5.6	April	62
Green River	US Route 7 to Hoosic River	II-III	8.15	April	73
Hoosic River	North Adams to North Pownal, VT	I-II	11.3	Snow/ice melt and after heavy rains	71
Hubbard River	W. Hartland Road to Route 20	V	2.65	Snow/ice melt and after heavy rains	108
Kennebec River	Below Moosehead Lake	III-V	12	Dam controlled (spill events)	177
Konkapot Brook	Mill River to Ashley Falls	I-III	11	Snow/ice melt and after heavy rains	103
Little River	Dam below Cobble Mountain Reservoir to Northwest Road	III-IV	3.2	High water in March-April, Cobble Hill Reservoir drawdown (spill events)	101
Magalloway River	Aziscohoc Dam to Wilsons Mills	II-III	2.2	Dam controlled with scheduled whitewater releases during summer	116

River	Reach	Class	Length (miles)	Season	Miles from Sumner Falls
Magalloway River	Parmachenee Lake to Aziscohos Lake	V+	1	Dam controlled with scheduled whitewater releases during summer	116
Magalloway River	Third East Branch to First East Branch	I-IV	8	Dam controlled with scheduled whitewater releases during summer	116
Mascoma River	Mascoma Lake to Route 4 Lebanon	II-III (IV)	3.9	during drawdown of the lake in the fall and spring freshet	10
Millers River	South Royalston to Athol	II-III	7.0	High water in March-April, dam controlled (2 releases in April)	67
Millers River	Lower Erving to Millers Falls	II-III	6.5	High water in March-April, dam controlled (2 releases in April)	67
Minnewawa River	Marlborough recycling center to Otter Brook	II-IV	4.5	High runoff period usually in early spring and fall drawdown of lakes	46
North River	Halifax Vermont Gorge to Colrain	II	7	Snow/ice melt and after heavy rains	60
Ottauquechee River	Rt. 4 to 1 mi below Rt. 4	III+(V)	1	Dam controlled (spill events)	7
Otter Brook	East Sullivan to Otterbrook Park	III-IV	3.2	Natural flow river with spring high water	41
Otter Brook	Roxbury to Keene	II	3.1	April (upper section), dam controlled (lower section, 4 releases in April-May)	44
Pelham Brook	Rowe Center to Deerfield River	V	3.25	High runoff period usually in early April	67
Penobscot River		III-V	14	Dam controlled (spill events)	225
Quaboag River	Warren to Route 67	II-IV	5.5	March-May and after rain falls	94
Rapid River	Pond in the River to Lake Umbagog	IV	4	Releases from Middle dam on Lake Richardson	109
Roaring Branch	Roaring Branch, Kelly Stand Road to East Kansas	V	3.5	Snow/ice melt and after heavy rains	52
Rock River	South Newfane to West River	III-IV	3.3	Snow/ice melt and after heavy rains	45
SaxtonΓÇÖs River	Grafton to Connecticut River	II-III	11	Snow/ice melt and after heavy rains	30
Souhegan River	NH Route 101 Bridge to Wilton	III	1.25	Snow/ice melt and after heavy rains	59
Souhegan River	Greenville to New Hampshire Route 101	II-III	5.75	Snow/ice melt and after heavy rains	61

River	Reach	Class	Length (miles)	Season	Miles from Sumner Falls
Stony Brook	Route 31 to Wilton	III-IV	1.25	Snow/ice melt and after heavy rains	59
Swift River	Along Route 9 to North Branch Westfield River	IV-V	1	Snow/ice melt and after heavy rains	91
Walker Brook	3.5 miles West of Chester on Route 20 to Chester	IV	3.5	Snow/ice melt and after heavy rains	94
Walloomsac River	Appalachian Trail Crossing to Park Street in Bennington	I-III	4	Snow/ice melt and after heavy rains	62
Wardsboro Brook	North Wardsboro to West River	III-IV	4.5	Snow/ice melt and after heavy rains	40
West River	Londonderry rapids	II-III	5	Natural flow river with spring high water	33
West River	Ball Mountain Dam to Jamaica State Park	III	2.75	Scheduled releases 1-2 weekends per year; typically spring and fall	36
West River	Salmon Hole to Route 100	II	3.2	Scheduled releases 1-2 weekends per year; typically spring and fall	38
Westfield River	Huntington to Russell	I-II	4	Dam controlled	96
Westfield River- Middle Branch	River Road to Littleville Dam	II-III	7	Snow/ice melt and after heavy rains	90
Westfield River- North Branch	West Cummington to Cummington	I-III	6.2	March-April except for lower 5 miles which is dam controlled (5 releases in March/April)	80
Westfield River- North Branch	Cummington to Chesterfield Gorge	I-III	7.2	March-April except for lower 5 miles which is dam controlled (5 releases in March/April)	82
Westfield River- North Branch	Chesterfield Gorge to Knightsville Dam	I-III	9.2	March-April except for lower 5 miles which is dam controlled (5 releases in March/April)	89
Westfield River- North Branch	Knightsville Dam to Huntington	I-III	5.2	March-April except for lower 5 miles which is dam controlled (5 releases in March/April)	94
Westfield River- West Branch	Westfield River- West Branch	II-III	7.5	Snow/ice melt and after heavy rains	92
Westfield River- West Branch	Westfield River- West Branch	III-IV	9.5	Snow/ice melt and after heavy rains	93
White River	Chelsea Health Center to above Sawmill Dam	II-IV	6	Natural flow river with spring high water	15
White River	North Royalton to West Hartford	I-II(III)	13	Natural flow river with spring high water	15

River	Reach	Class	Length (miles)	Season	Miles from Sumner Falls
White River	Rochester to Bethel	I-II	20	Natural flow river with spring high water	15
Williams River	Northchester to Brockway Mills	II	7.5	Snow/ice melt and after heavy rains	24
Winhall River	Grahamville School Road to Winhall Campgrounds	III+	4.5	Snow/ice melt and after heavy rains	36

Sources: American Whitewater, 2015a, American Whitewater, 2015b, Whitewater Rafting New England, 2015, and FirstLight, 2015.

Table 2.1-2. International Whitewater Classification System (American Whitewater, 1998).

Class	Description
I	Easy. Fast moving water with riffles and small waves. Few obstructions, all obvious and easily missed with little training. Risk to swimmers is slight; self-rescue is easy.
II	Novice. Straightforward rapids with wide, clear channels that are evident without scouting. Occasional maneuvering may be required, but rocks and medium sized waves are easily missed by trained paddlers. Swimmers are seldom injured and group assistance, while helpful, is seldom needed.
III	Intermediate. Rapids with moderate, irregular waves that may be difficult to avoid and that can swamp an open canoe. Complex maneuvers in fast current and good boat control in tight passages or around ledges are often required; large waves and strainers may be present but are easily avoided. Strong eddies and powerful current effects can be found, particularly on large-volume rivers. Scouting is advisable for inexperienced parties. Injuries while swimming are rare; self-rescue is usually easy but group assistance may be required to avoid long swims. Rapids that are at the lower or upper end of this difficulty range are designated "Class III-" or "Class III+" respectively.
IV	Advanced. Intense, powerful, but predictable rapids requiring precise boat handling in turbulent water. The river may feature large, unavoidable waves and holes or constricted passages that demand fast maneuvers under pressure. A fast, reliable eddy turn may be needed to initiate maneuvers, scout rapids, or rest. Rapids may require "must" moves above dangerous hazards. Scouting is necessary the first time down. Risk of injury to swimmers is moderate to high, and water conditions may make self-rescue difficult. Group assistance for rescue is often essential but requires practice and skill. A strong eskimo roll is highly recommended. Rapids that are at the upper end of this difficulty range are designated "Class IV-" or "Class IV+" respectively.
V	Expert. Extremely long, obstructed, or very violent rapids that expose a paddler to above-average endangerment. Drops may contain large, unavoidable waves and holes or steep, congested chutes with complex, demanding routes. Rapids may continue for long distances between pools, demanding a high level of fitness. What eddies exist may be small, turbulent, or difficult to reach. At the high end of the scale, several of these factors may be combined. Scouting is mandatory but often difficult. Swims are dangerous, and rescue is difficult even for experts. A very reliable eskimo roll, proper equipment, extensive experience, and practiced rescue skills are essential. Because of the large range of difficulty that exists beyond Class IV, Class 5 is an open-ended, multiple-level scale designated by Class 5.0, 5.1, 5.2, etc. Each of these levels is an order of magnitude more difficult than the last. Example: increasing difficulty from Class 5.0 to Class 5.1 is a similar order of magnitude as increasing from Class IV to Class 5.0.
VI	Extreme and exploratory. These runs have almost never been attempted and often exemplify the extremes of difficulty, unpredictability and danger. The consequences of errors are very severe and rescue may be impossible. For teams of experts only, at favorable water levels, after close personal inspection and taking all precautions. After a Class VI rapids has been run many times, its rating may be changed to an appropriate Class 5.x rating.

2.2 Connecticut River Whitewater Opportunities

The Connecticut River is predominantly a large, low-gradient river with the largest drops already used for hydropower. Upstream of the Wilder project, the Connecticut River offers very little whitewater boating with the majority of trips below Murphy dam (near Pittsburgh just below the Connecticut Lakes region) down to Gilman dam, considered flat water as the river meanders through the broad, agricultural valley.

About 9 miles downstream of Wilder dam and outside the FERC Project Boundary, is Sumner Falls (or Hartland Rapid), which presents a series of ledges that span a wide section of the Connecticut River. The exposed bedrock in the area creates a quarter-mile stretch of rapids used by whitewater boaters as the river drops 7 vertical feet over the short distance. According to Lessels (1998), Sumner Falls is runnable at almost any water level and interesting enough to occupy the better part of a day at most levels. While Sumner Falls is not a river run, it is a reliable (often daily) and well-liked summer play spot (Lessels, 1998). Open-faced boats and canoes typically portage the ledges.

About 12 miles downstream of TransCanada's Vernon project, FirstLight operates the Turners Falls project which has a bypassed reach at which a similar whitewater opportunity study was conducted as part of their FERC relicensing process. The 2.7-mile bypassed reach is available for whitewater boating during periods of spill at the Turners Falls dam, typically during high river flows when the hydraulic capacity of the power canal is exceeded. Boaters in the FirstLight Turners Falls whitewater boating study rated the reach as a Class I to a Class IV whitewater run; however the Class IV rating was attributed to a single feature (FirstLight, 2015).

The Wave-O-Saurus is another park-and-play area on the Connecticut River (Riverbreak, 2014) located near Holyoke, Massachusetts. The wave gets its name from a series of dinosaur footprints located adjacent to the area. At this location, flows are normally around 12,000 cfs; however, two to three times per year, the river can reach flows between 75,000 and 90,000 cfs at which time the wave forms and becomes boatable.

3.0 STUDY AREA

The focus of the Sumner Falls evaluation is the rocky complex in North Hartland, Vermont, about 9 miles downstream from Wilder dam (Figure 3-1). The exposed bedrock in the area creates a quarter-mile stretch of rapids used by whitewater boaters as the river drops 7 vertical feet over the short distance (Figure 3-2).

The focus of the Bellows Falls bypassed reach study is the upper 0.4 mile portion of the entire 0.7 mile bypassed reach, extending from near the base of the spillway to a few hundred feet upstream of the fish barrier dam. Figure 3-3 shows the Bellows Falls bypassed reach evaluated as part of this study.

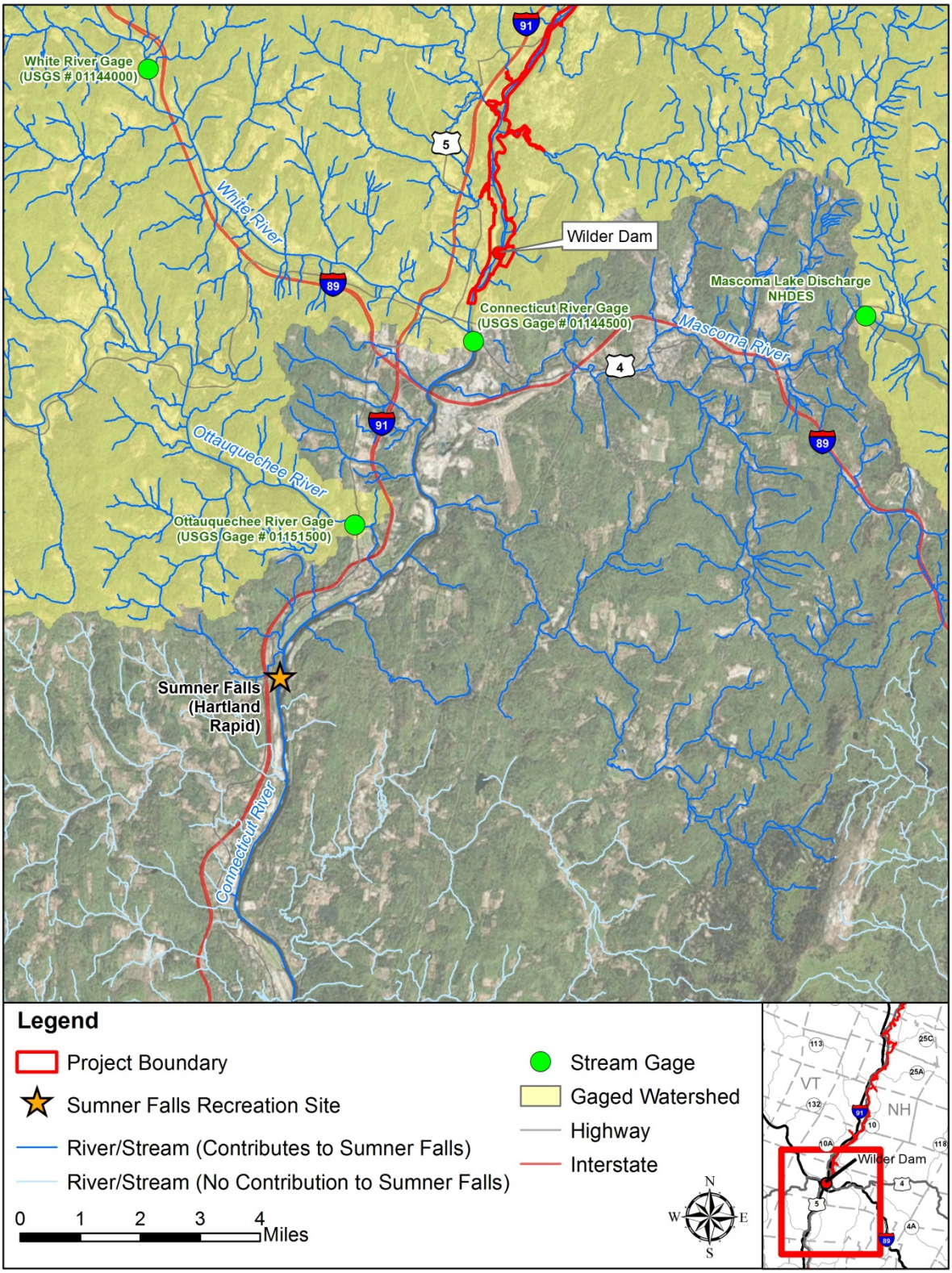

Figure 3-1. Sumner Falls and surrounding watershed.

Figure 3-2. Sumner Falls rapids and features.

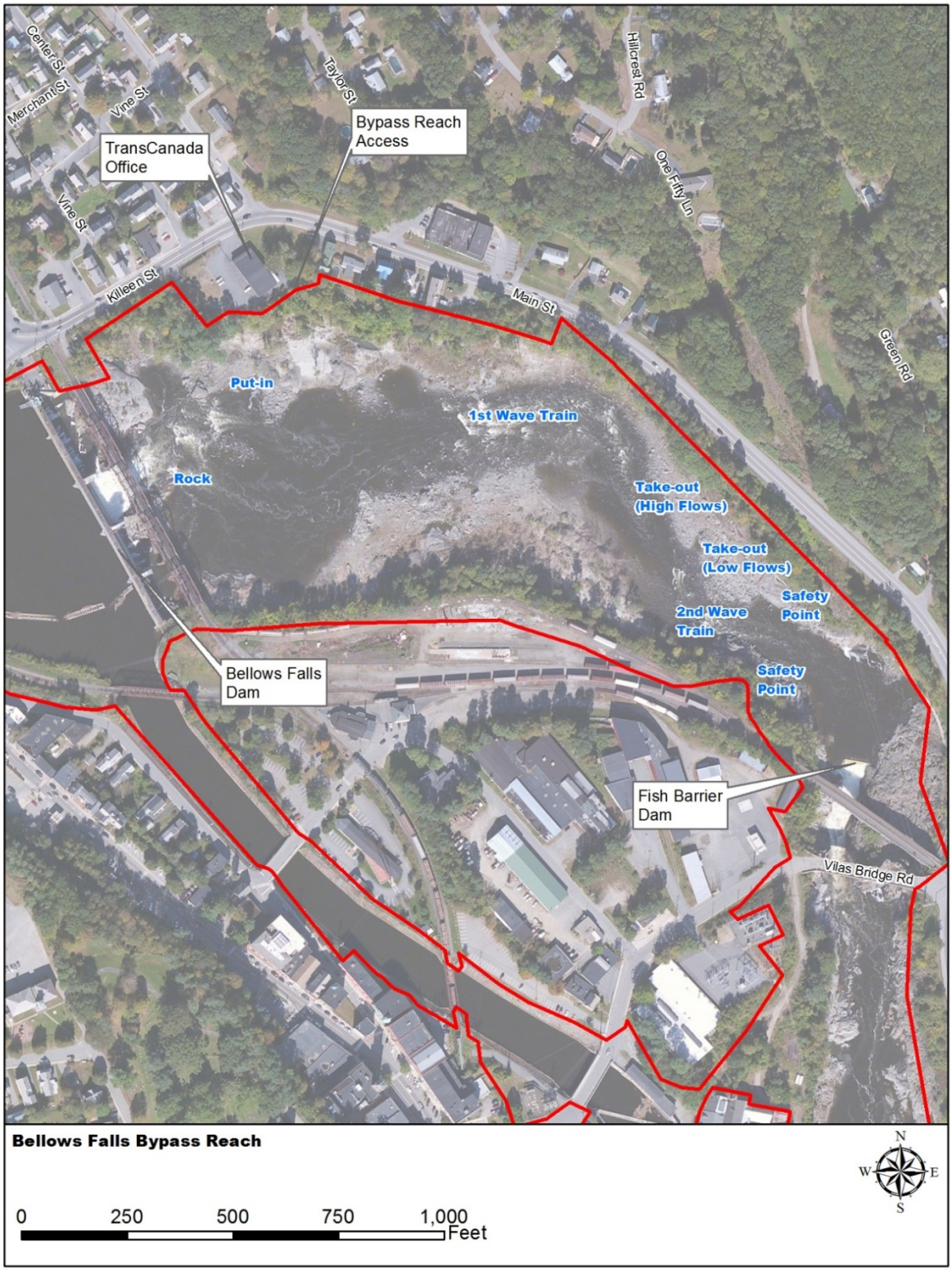

Figure 3-3. Bellows Falls bypassed reach.

4.0 CONTROLLED FLOW STUDY

In an attempt to quantify the minimum and optimum flows for whitewater paddling, TransCanada collaborated with American Whitewater, New England Flow, the Appalachian Mountain Club, and FERC staff (study group) to develop the details of the controlled flow study for Sumner Falls and the Bellows Falls bypassed reach. Once the study group identified the features and flows to be studied, TransCanada consulted with the study group and hydro operations personnel for providing controlled, demonstration flows and the timing of conducting the flow study. TransCanada determined that it would be best to conduct the Sumner Falls study during the end of the spring freshet, when higher flows are typically available throughout the watershed, and flows are sufficient for providing target study flows while maintaining upstream reservoir elevations.

Target flows at Sumner Falls were developed based generally around the capacity of the generating units at Wilder dam, recognizing that the ability to provide higher flows was limited by current license project operating procedures that limit reservoir drawdown rate. Local boaters frequently time their trips to Sumner Falls based on the West Lebanon US Geological Survey (USGS) gage (01144500) which measures releases from Wilder dam as well as the White River (see Figure 3-1). Table 4-1 summarizes the four target flows and the five estimated flows that occurred at Sumner Falls during the demonstration on Saturday June 28 – Sunday June 29, 2014. The variance in the targeted flow and the calculated flows arriving at Sumner Falls are due to a rain event in the watershed during the week before the demonstration that resulted in notable contributions to the Connecticut River from other sources downstream of the West Lebanon gage—specifically, the Mascoma and Ottauquechee rivers. Figure 3-1 shows the locations of these gages and their watersheds as well as other non-gaged rivers contributing to the flows reaching Sumner Falls during the demonstration. Under typical summer conditions and absent recent precipitation, the West Lebanon gage captures the majority of the flow into Sumner Falls with negligible contributions from the Mascoma and Ottauquechee rivers. Interestingly, during the demonstration flow portion of this study, these rivers were higher than normal and contributed an almost 900 and 600 cfs on Saturday and Sunday, respectively. Local boaters familiar with gaged flows as related to the West Lebanon, Mascoma, and Ottauquechee gages suggested that the “low target” flow on Saturday was actually closer to flow No. 2 because of the additional water. TransCanada operators provided the low flow on Sunday morning and it was closer to the “target” as a result of declining flows from the Mascoma and Ottauquechee.

Because of the complexities of boating in the Bellows Falls bypassed reach, the on-water component of the flow study was developed in a phased approach. Study group members met at TransCanada’s North Walpole office on May 28, 2014, to finalize the study plan, which laid out the approach. Study group members assessed access to the Bellows Falls bypassed reach, viewed video of late winter and spring spills through the spillway at flows up to 20,000 cfs, and evaluated controlled spills from the shoreline and Vilas Bridge at flows ranging from 2,500 to 7,500 cfs. After viewing these flows, study group members concluded that the

reach was boatable at more than one flow so the single flow assessment was expanded to a multi-flow assessment.

TransCanada operators were able to provide flows approximating the desired target flows. The main challenge with providing flows closer to the targets lies in the size of the dam's roller gates and the chain links or gear sizes that open them do not have fine enough resolution to increase the accuracy of the estimated delivered flow. In all cases, the measured flow was within a few hundred cfs of the target flow with sufficient differences between flows to make determinations related to the boating experience at different levels. The on-water assessment for the Bellows Falls bypassed reach occurred on the weekend of May 30 and 31, 2015.

Tables 4-1 and 4-2 describe the dates, and target and actual or estimated flows during the study at Sumner Falls and Bellows Falls bypassed reach. For the remainder of the report, flows are referenced to the estimated flow at Sumner Falls and the measured flows in the Bellows Falls bypassed reach rather than the target flows.

Table 4-1. Whitewater paddling study flows and schedule for Sumner Falls.

Date	Flow No.	Target Flows as Measured at West Lebanon gage (cfs)	Estimated Flow at Sumner Falls Using the West Lebanon, Ottauquechee, and Mascoma Gages (cfs)[a]
6/28/2014	1	3,000-3,500	4,700
	2	5,000	6,700
6/29/2014	3	n/a	3,750
	4	7,500-8,000	7,800
	5	11,000-11,500	13,000

a. Estimates were made using information from the West Lebanon and Ottauquechee River gages, and real-time Mascoma dam discharge.

Table 4-2. Whitewater paddling study flows and schedule for Bellows Falls bypassed reach.

Date	Flow No.	Target Flow (cfs)	Actual Flow (cfs; measured by TransCanada at the spillway gate)
5/30/2015	1	2,200	2,370
	2	3,500	3,300
	3	4,500	4,370
	4	5,500	5,560
5/31/2015	5	1,500	1,580
	6	2,000	2,020
	7	3,000	2,900

Date	Flow No.	Target Flow (cfs)	Actual Flow (cfs; measured by TransCanada at the spillway gate)
	8	7,500	7,400
	9	10,000	9,660

4.1 Methods

The study group collaborated to engage local paddlers with intermediate or higher experience to volunteer for the Sumner Falls controlled flow study and boaters with advanced or higher experience for the Bellows Falls bypassed reach study. The invitation is included as Appendix A. Study participants were briefed on safety and their responsibilities related to the study prior to entering the water each day. For each flow, the demonstration was recorded with digital video and photography at a number of points along the Sumner Falls complex and along the Bellows Falls bypassed reach.

Because the study took place at two different boating sites, different numbers and experience levels of boaters participated on the various days. In all cases, a sufficient number of boaters with a variety of skills at Sumner Falls and with sufficient experience at Bellows Falls bypassed reach volunteered for each of the study flows. Appendix B provides the breakdown of the number of participants and the types of boats used in the study for each location. Participants in the Sumner Falls portion of the study used a wide variety of watercraft (e.g., hard-shell kayak, cataraft, open canoe [with flotation], and stand-up paddleboard) on each of the study days. Participants in the Bellows Falls bypassed reach portion of the study used hard-shell kayaks, and a few runs were made with open canoes. As the tables in Appendix B show, participants with a wide variety of skill levels were represented throughout the study.

Figure 4-1 summarizes the estimated flow arriving at Sumner Falls during the demonstration period based on the West Lebanon gage (blue line), measured discharges from Mascoma dam (NHDES) and Ottauquechee River gage (USGS), and estimates of the observed flow at Sumner Falls (red dashed circles). Estimating flow at Sumner Falls was complicated by flows associated with a rain event that passed through the region the day and evening prior to the demonstration. Figure 4-2 summarizes the flow recorded by TransCanada's Supervisory Control and Data Acquisition (SCADA) system for the releases into the Bellows Falls bypassed reach and boated by the study participants. Because this reach is immediately downstream of the spillway gates, there was little wait time for flows to adjust compared to Sumner Falls, and spill levels were easier to report.[1]

[1] A SCADA system is a computer-based system used to monitor and control various types of processes.

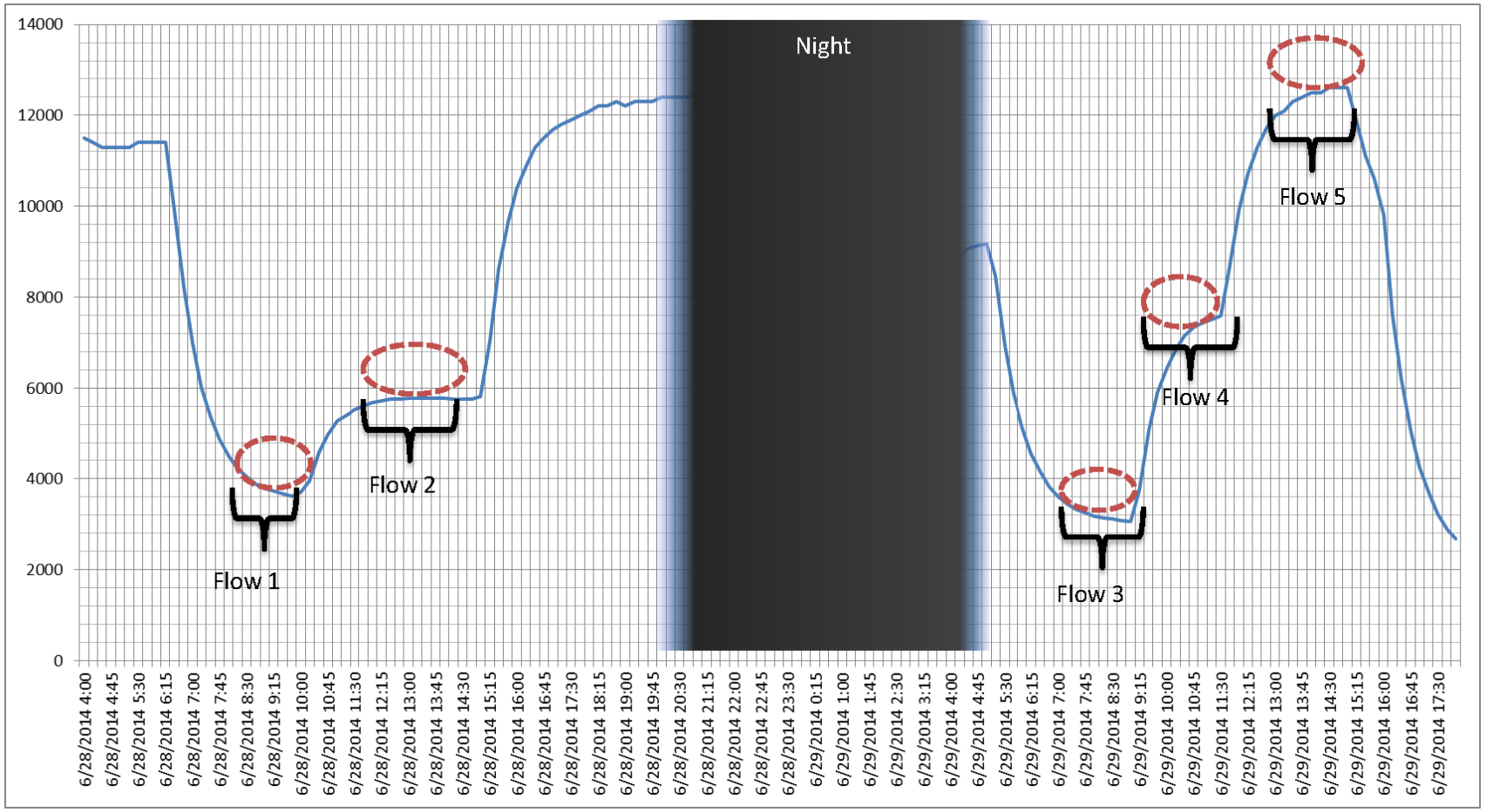

Figure 4-1. Summarized demonstration flow data for Sumner Falls.

Note: boaters were actually on the water about 2 hours after these gage readings to account for the travel time of the water.

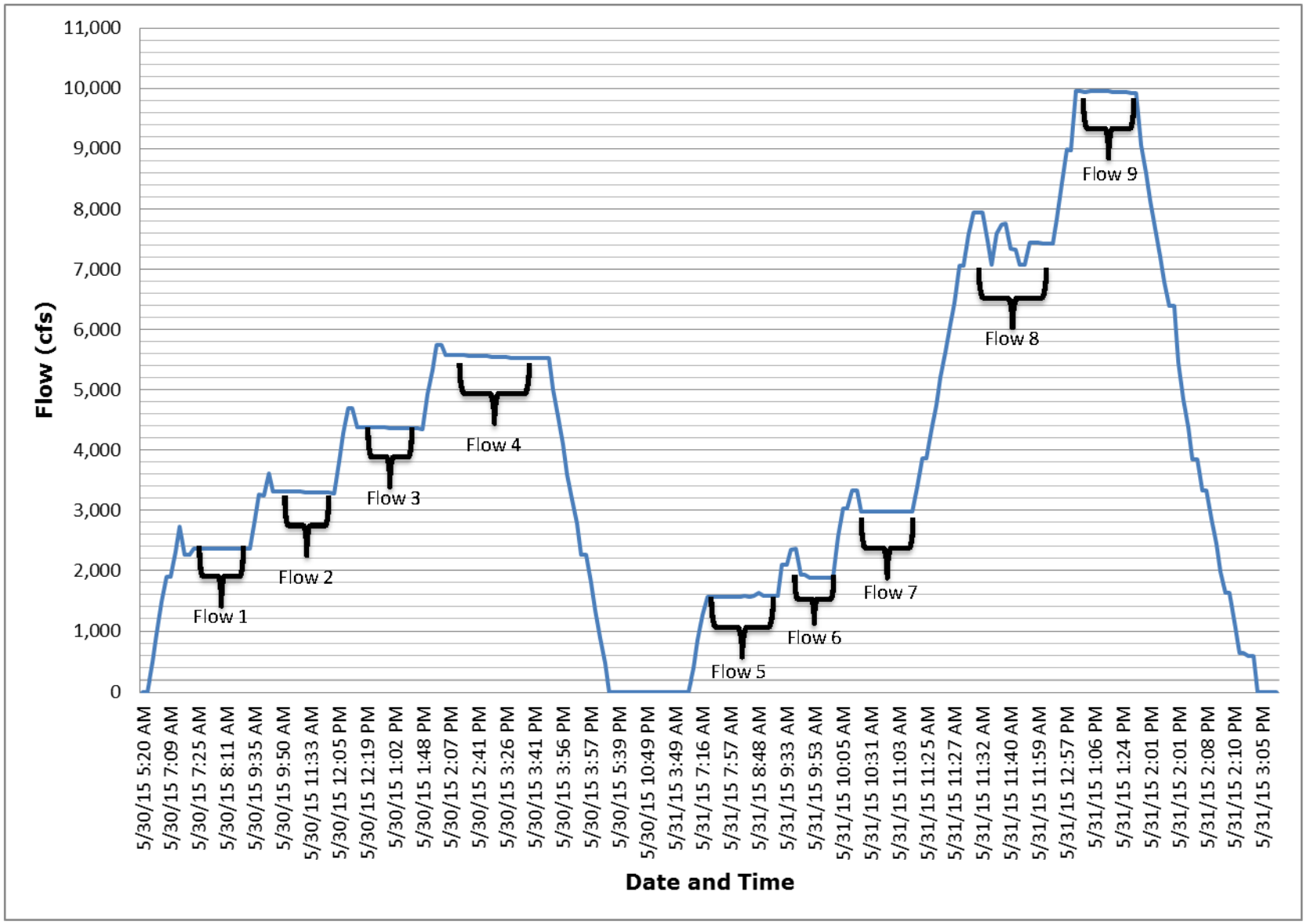

Figure 4-2. Summarized demonstration flow data for Bellows Falls bypassed reach.

4.2 Surveys

For each of the whitewater study locations, participants were asked to complete two types of surveys: (1) single flow survey, and (2) a flow comparison survey. These survey tools, which are provided in Appendix C, were developed independently in consultation with the study group and approved by FERC in the SPD. The single flow survey was completed after each flow level that a given participant experienced, and was designed to capture individual impressions of specific flows. Participants responded to questions only about the particular flow that they had just experienced. The flow comparison survey was completed once by each participant after boating multiple flows at a given study location and was designed for participants to compare flows and specific attributes within the study reach.

Participants in the study were asked to evaluate each individual flow on its characteristics such as navigability, whitewater challenge, safety, and aesthetics. In addition, participants were asked to indicate their preferred whitewater boating flow and to evaluate the access sites to the boating locations on the river. The Sumner Falls surveys were refined to address the potential for scheduled releases from Wilder dam. For example, participants were asked to indicate how likely they would be to use a scheduled release of specific flows.

In addition to the surveys, boaters participated in a close-out discussion at the conclusion of the Bellows Falls demonstration to come to consensus on issues related to their experiences during the field work and preferred and optimal flow ranges. Discussion notes as well as recordings were taken for use during the study analysis phase.

5.0 RESULTS

5.1 Sumner Falls

American Whitewater's website describes Sumner Falls as a series of ledges sprawled out across a wide section of the Connecticut River and runnable from 700 to 60,000 cfs (American Whitewater, 2015c). The website is based on the perspective of a downriver trip more typical of a river trip (e.g., creek boating, canoe) than on the site's attributes as a park-and-play surf wave. The website states "The simplest route down the Sumner Falls rapids is to stay river left the entire time, while in higher water, boaters can drop down several of the small falls/chutes on river right. The wave is the first significant drop on river left and is situated next to a large, swirling eddy" (American Whitewater, 2015c). The "wave" referred to on the website is also known as the "Summer" wave due to its frequent presence at this location during the low flow season when most other naturally fed rivers are too low to boat. The opportunity is a direct result of the inflows into and discharges out of Wilder upstream.

The website reports that the New Hampshire side of the river (river left) is Class II+, and the Vermont side (river right) is rated Class III, and describes the New Hampshire side as "everything to the left of the large rock island" which includes a

long Class II rapid with many surf waves. The island is an outcrop of rocks that becomes cut off from the parking area when flows are above about 700 cfs and the river creates a river left and river right path around the outcropping. On Figure 3-2, the island would be the large central outcropping just upstream of the 'right center slot'. The last part of the island can be bypassed via a chute just to the left of the island; on Figure 3-2 this would be the 'right center slot'. At levels less than 5,000 cfs, the last section of the rapid diverges. The far left route is somewhat technical, whereas the route that makes a sharp right turn is easier (American Whitewater, 2015c). On the Vermont side (Class III), the ledge to the right of the large island drops suddenly and is shorter but more difficult, and at certain flows, can either be "sticky" or provide "good boof spots" (American Whitewater, 2015c; areas a boater can try and launch their craft into the air such as off a large submerged rock).

Study participants included volunteers that were interested in downriver kayak experiences, play spot boating/wave surfing, squirt boating,[2] and general water-based fun (e.g., stand-up paddle boarding into waves). In general, the Connecticut River receives downriver canoe camping boaters that either portage or run the Sumner Falls rapid. Sumner Falls is also used as a park-and-play location that is generally acknowledged to provide boating opportunities throughout the summer when flows in other rivers or creeks may be too low for boating.

Not all boaters boated all flows as some arrived late, left early, conserved energy for other flows, or didn't feel comfortable paddling a specific flow. Over the course of the weekend, between 13 and 16 boaters completed surveys for each study flow. One person only participated on a cataraft (a type of boat where the user is seated upon a support structure that sits on two typically inflated pontoons) while another used a stand-up paddle board and yet another participated in their open canoe. The rest of the participants used hard-shell kayaks of multiple types (creek boats, play boats, and a squirt boat).

The Sumner Falls ledge complex offers a range of opportunities across a wide range of flows with some features coming into optimal conditions at certain levels and not at others. Generally, at flows between 3,800 to 5,000 cfs, "Main Wave", or "Summer Wave", as it is known locally, is the preferred feature due to its shape and consistency, and it has good eddy service. Main Wave is so-named because this is the primary feature when river flow is approximately 3,800 cfs to 5,000 cfs. This flow is within the range of operations of one of Wilder's two larger generating units. The name also refers to its consistency and the fact that other locations in relative proximity to the Connecticut River often do not have enough water for boaters to play during summer in the local rivers or creeks in the absence of substantial precipitation, although through boating is still available. During this

[2] Squirt boating is a form of whitewater kayaking where the boat is designed to be as low in volume as possible while still allowing the paddler to float, enabling a wider array of maneuvers in the river currents with maneuver names like "mystery move", "cartwheels", "double enders", "clean wheel", and "loop".

study, Main Wave was very popular at all flows below 13,000 cfs and very user-friendly. Figure 3-2 shows some of the named features within the Sumner Falls complex that were referenced during the study in the surveys or discussions. In addition to Main Wave, Sumner Falls is well known for another wave feature named Sign Wave, which develops at the head of the rapid complex on the New Hampshire side of the river. Sign Wave typically doesn't take shape until at least 11,500 cfs (Wilder's maximum nominal generating capacity) and becomes surfable at around 13,000 cfs. Flow in this range requires all Wilder units to be generating with additional flows either from spill or contributing tributaries downstream of Wilder. During the whitewater boating study, participants also explored other areas throughout the Sumner Falls complex and generated names for describing these places during the survey portions of the study. Boaters of all types and abilities made runs through or attempted to surf in various waves and features throughout the area (Figure 3-2).

Whitewater Class and Boater Skill Level

For each test flow, participants were asked what they thought the whitewater difficulty level was for their watercraft (Table 5.1-1). Responses varied ranging from Class II at 4,000 cfs to Class IV- at 13,000 cfs. In general, the lower flows received less challenging whitewater class ratings, and higher flows received higher ratings. The wide spread in responses is likely due to the wide range of abilities, the wide range of crafts used during the study and the variety of play spots that differ with varying flow levels. Paddling a stand-up paddle board into a wave is a much different experience than paddling a hard-shell playboat for surfing, which is a much different experience than paddling a cataraft down the rapids, and they all influence opinions of the whitewater rating from the user.

Table 5.1-1. Participant whitewater class difficulty ratings for Sumner Falls.

Watercraft	3,750 cfs	4,700 cfs	6,700 cfs	7,800 cfs	13,000 cfs
Canoe	n/a	II+	III	III	III
Cataraft	II	II+	II+	III	III+
Kayak - creek boat	II to III	II to III+	II to III	II to III+	III to IV-
Kayak - hybrid	n/a	n/a	n/a	n/a	III+
Kayak - play boat	II	II to III	II to III	II to III	II to III
Kayak - river boat	II	II+ to III-	II+ to III-	III-	III-
Squirt Boat	II+ to III-	II+ to III-	II+ to III-	II to III	III
Stand up paddleboard	II	II to III	II to III	III	II to III

Participants were also asked to report the minimum skill level they thought necessary to successfully run this segment at each flow. Table 5.1-2 shows the results which are similar to the whitewater ratings above in that lower flows support novice and beginner boaters while the higher flows require more whitewater experience. Very few boaters thought the Sumner Falls complex was so difficult

that only advanced and expert boaters could make it through; in fact the minimum skill level that received the most responses was 'Intermediate' at the 7,800 cfs and 13,000 cfs flow levels which underscores the area's popularity and broad appeal among boaters.

Table 5.1-2. Participant skill level ratings required to successfully boat Sumner Falls.

Skill level required	3,700 cfs	4,700 cfs	6,750 cfs	7,800 cfs	13,000 cfs
Novice	5	2	1		
Beginner	7	12	10	7	4
Intermediate	1	1	4	8	9
Advanced			1	1	1
Expert			1		1

Whitewater Characteristic Ratings

Participants were asked to rate nine characteristics of boating Sumner Falls for each flow including: its boatability, the availability of technical rapids, the availability of powerful hydraulics, the availability of play boating areas, the overall whitewater challenge, boater safety (due to flow levels), the amount of potential hazards present in the river, the aesthetics of river/channel, and an overall rating. Participant scores varied by boat type which dictates the type of experience available to the boater.

All boaters rated the 'boatability' of the Sumner Falls complex as higher than 'acceptable' across all flows, with most scores closer to '7-totally acceptable' than closer to 'acceptable'. In fact, the lowest boatability scores were reported for canoes (score of 5) at the 4,800 cfs level and kayaks (score of 5.5) at the 4,000 cfs level. This further confirms the Sumner Falls complex has broad appeal across a wide range of flows and boater types.

Kayaker Ratings

Table 5.1-3 presents kayaker ratings for the nine characteristics of boating Sumner Falls. All characteristics averaged above 'marginal' for kayak boats which includes creek boats, play boats and river boats. In general, scores for characteristics like 'boatability', 'technical rapids', 'powerful hydraulics', and 'overall whitewater challenge' increased with flow. Results for the characteristic 'play boating areas' showed a double peak in preferred flows: one at the 4,700 cfs and the other at 13,000 cfs. Not surprisingly, scores for 'safety' decreased with increasing flows.

Table 5.1-3. Average whitewater flow characteristic scores by flow – Kayak.[a]

Characteristic	3,750 cfs (n=10)	4,700 cfs (n=11)	6,700 cfs (n=15)	7,800 cfs (n=10)	13,000 cfs (n=11)
Boatability	5.5	6.5	6.4	6.7	6.7
Technical Rapids	4.5	5.2	5.3	5.5	6.0
Powerful Hydraulics	4.3	4.3	5.2	5.0	5.9
Playboating Areas	5.2	6.0	5.3	5.2	6.2
Overall Whitewater Challenge	4.6	4.8	5.4	5.5	5.9
Safety	6.6	6.9	6.4	6.1	6.4
Hazards present	5.4	5.9	5.9	5.4	6.0
Aesthetics	6.2	6.7	6.3	6.5	6.2
Overall Rating	5.4	6.5	5.8	5.8	6.5

a. Key to rating scale:
1 = Totally unacceptable
4 = Marginal
7 = Totally acceptable

All Other Boat Types

Tables 5.1-4 through 5.1-7 summarize participant responses for the non-kayak type watercrafts including canoe, cataraft, stand-up paddle board, and squirt boat participants. Not all boat types participated in all flows and some flows received responses from multiple participants interested in using more than one watercraft during the test flow. It is important to note that boater experience can strongly influence responses. For example, participants that used canoes were interested in playing in the waves, an advanced technique, and do not represent a downriver canoe trip which is often paddled by much more beginner to intermediate paddlers. Evidence of this can be seen in responses from the canoe participants responding to the 'safety' characteristic which did not change across flow levels while it did with boaters response to 'whitewater rating' level, and within the kayak boater group above (Table 5.1-3). This indicates that canoe participants boating skills and reporting are solely for Sumner Falls and should not represent conditions for downriver paddlers. Canoe users reported 'boatability', 'powerful hydraulics', 'overall whitewater challenge', 'aesthetics', and the 'overall rating' scores all increased with flow. 'Playboating areas' and 'safety' scores were the same across all flows and 'technical rapids' and 'hazards present' whitewater boating characteristic scores were relatively constant with minor differences at the 6,700 cfs flow (table 5.1-4).

Table 5.1-4. Whitewater flow characteristics by flow – Canoe.[a]

Characteristic	3,750 (n=0)	4,700 (n=1)	6,700 (n=1)	7,800 (n=0)	13,000 (n=1)
Boatability	-	5	6	7	7
Technical Rapids	-	4	6	5	5
Powerful Hydraulics	-	6	6	6	7
Playboating Areas	-	6	6	6	6
Overall Whitewater Challenge	-	5	5	6	7
Safety	-	6	6	6	6
Hazards present	-	6	5	6	6
Aesthetics	-	5	6	6	7
Overall Rating	-	5	6	6	7

a. Key to rating scale:
1 = Totally unacceptable
4 = Marginal
7 = Totally acceptable

Cataraft users reported the lowest scores (a score of 3 which is below 'acceptable') for 'technical rapids', and 'overall whitewater challenge' (Table 5.1-5) at the 3,750 cfs flow level. This user group also reported 'acceptable' ratings for 'powerful hydraulics' at the 3,750 cfs flow and 'overall whitewater challenge' at the 4,700 flow. All other characteristics received scores of 5 or higher at all other flow levels with six of the nine characteristics receiving scores of '7-totally acceptable' at the 13,000 cfs flow.

Table 5.1-5. Whitewater flow characteristics by flow – Cataraft.[a,b]

Characteristic	3,700 (n=1)	4,700 (n=1)	6,700 (n=1)	7,800 (n=1)	13,000 (n=1)
Boatability	6	7	7	7	7
Technical Rapids	3	5	5	6	7
Powerful Hydraulics	4	6	6	5	7
Playboating Areas	5	6	6	-	7
Overall Whitewater Challenge	3	4	-	6	6
Safety	6	6	7	7	5
Hazards present	6	6	7	7	6
Aesthetics	7	7	7	7	7
Overall Rating	5	6	6	6	7.0

a. Key to rating scale:
   1 = Totally unacceptable
   4 = Marginal
   7 = Totally acceptable
b. Catarafts require two boaters at the same time; one member reported scores for the cataraft trips while the other submitted responses to their experience in a kayak.

Stand-up paddle board whitewater boater characteristic scores (Table 5.1-6) were generally favorable across all characteristics and flows with many of the characteristics scored at the highest rating level '7-totally acceptable'. The 3,750 cfs flow received a single score below 'acceptable' (a score of 3) for 'play boating areas'. The 3,750 cfs score also received 'acceptable' scores (a score of 4) for 'technical rapids', 'powerful hydraulics', and 'overall whitewater challenge'. The 4,700 cfs flow also received a score of 'acceptable' for the 'technical rapids'. Lower flows within the Sumner Falls complex result in more exposed rocks which, from the perspective of a stand-up paddleboard, would seem less desirable given the increased potential for falling onto them while trying to paddle downstream or when trying to paddle into a wave to surf.

Table 5.1-6. Whitewater flow characteristics by flow – Stand-up Paddle Board.[a]

Characteristic	3,750 (n=1)	4,700 (n=1)	6,700 (n=1)	7,800 (n=2)	13,000 (n=1)
Boatability	6	7	7	6.5	7
Technical Rapids	4	4	6	6	6
Powerful Hydraulics	4	7	6	6	7
Playboating Areas	3	7	7	5.5	6
Overall Whitewater Challenge	4	6	6	6	7
Safety	5	7	7	6	6
Hazards present	6	6	6	7	6
Aesthetics	7	7	7	7	7
Overall Rating	6	6	7	6.5	7

a. Key to rating scale:
1 = Totally unacceptable
4 = Marginal
7 = Totally acceptable

Squirt boat participant whitewater characteristic scores (Table 5.1-7) were generally all rated higher than 'acceptable' for all flows. The exception were scores of '4-acceptable' for 'powerful hydraulics' at the 4,700 cfs flow, and the 13,000 cfs flow was scored 'acceptable' for 'playboating areas'. This last score is not surprising for this boat type which relies on the presence of eddies and underwater hydraulics to utilize the boat design to perform specific moves, which at high flows were likely non-existent or difficult to find throughout the Sumner Falls complex.

Table 5.1-7. Whitewater flow characteristics by flow – Squirt Boat.[a]

Characteristic	3,700 (n=1)	4,700 (n=1)	6,700 (n=1)	7,800 (n=1)	13,000 (n=1)
Boatability	7	7	7	7	7
Technical Rapids	6	6	6	6	7
Powerful Hydraulics	5	4	6	6	7
Playboating Areas	7	7	6	5	4
Overall Whitewater Challenge	5	7	6	6	7
Safety	6	6	6	6	7
Hazards present	6	6	6.5	6	5
Aesthetics	7	6	6	7	7
Overall Rating	6	7	6	7	7

a. Key to rating scale:
1 = Totally unacceptable
4 = Marginal
7 = Totally acceptable

At the 13,000 cfs flow level, most boaters reported that the minimum skill level necessary to successfully run this segment was intermediate or higher. Three respondents indicated beginners could boat at 13,000 cfs citing the size of Sumner Falls boating area and the large complex of ledges which allows beginners to find areas that match their ability and comfort level. At 13,000 cfs, beginners could improve their boating skills and techniques and as they get more experience, and could work their way into more challenging rapids. All participants that considered themselves intermediate and above reported Sign Wave as a "Class A[3]" feature, and they noted that it was the site's big attraction, which would keep them coming back if flows were consistently at this level. They also noted that Sign Wave was the only feature worth boating at this level. This was confirmed by boaters with less experience, those uninterested in surfing, and those inexperienced with the eddy service into the wave; these boaters reported preferences for lower flows that provided opportunities at other features.

Flow Preferences

After each flow release, boaters were asked to indicate whether they would prefer a higher, lower, or similar flow to the one that they had just experienced (Table 5.1-3). Results are organized by boat type which influences the type of experience on the water during each flow.

[3] In this context this is not an official whitewater rating term but a metaphor for meaning the wave is top notch or best in class.

Interestingly, the results from the kayak users were very diverse, most likely a reflection of the variety in boat types and skill levels (Table 5.1-8). Generally, the results suggest a larger convergence between the 4,700 cfs and 6,700 cfs flows based on the number of scores preferring higher flows at 4,700 cfs and below, and the number of scores preferring lower flows at 6,700 cfs and above (Table 5.1-8). There is a smaller group of boaters that also identified the 13,000 cfs flow as their preferred flow. Table 5.1-9 shows the variability in scores by types of kayaks.

The single canoe user reported the 7,800 cfs and 13,000 cfs should remain "about the same; this was close to the best flow" while the 4,700 cfs and 6,700 cfs flows received a "slightly higher" score indicating this participant preferred the higher flows (Table 5.1-8). Based on results from the single cataraft user, the preferred flows were the 6,700 cfs and 13,000 cfs flows (Table 5.1-8). The cataraft scores converged around the 6,700 cfs flow indicating lower flows should be higher and higher flows should be lower around the 6,700 cfs flow level.

The single squirt boater did not identify any of the flows as "about the same; this was close to the best flow". Responses to the 3,750, 4,700, and 7,800 cfs flows received 'slightly higher' flow preference scores while the 6,700 cfs flow received a 'much higher'. It is not clear from these results if there was a possible preferred flow within this range. The 13,000 cfs flow received a 'much lower' flow score consistent with their scoring of whitewater boating characteristics score for playboating areas (Table 5.1-8). The single stand-up paddle board user scored the 6,700 and 7,800 cfs as "about the same; this was close to the best flow" (Table 5.1-8). This was consistent with their scores for the other flows which resulted in a convergence toward this upper-middle range study flow levels.

Table 5.1-8. Participant scores of flow preferences for Sumner Falls by boat type.

Boat Type and Flow Preference	3,700 cfs	4,700 cfs	6,700 cfs	7,800 cfs	13,000 cfs
Kayak					
Much higher flow	3	2	1	1	
Slightly higher flow	4	6		2	1
About the same; this was close to the best flow	3	2	4	4	7
Slightly lower flow			7	3	3
Much lower flow				1	
Canoe					
About the same; this was close to the best flow				1	1
Slightly higher flow		1	1		
Cataraft					
Much higher flow	1	1			
About the same; this was close to the best flow			1		1
Slightly lower flow				1	
Squirt Boat					
Slightly higher flow	1	1		1	
Much higher flow			1		
Much lower flow					1
Stand-up Paddle Board					
Slightly higher flow	1	1			
About the same; this was close to the best flow			1	1	
Slightly lower flow				1	1

Table 5.1-9. Kayaker scores of flow preferences for Sumner Falls by kayak type.

Kayak Type and Flow Preference	3,700 cfs	4,700 cfs	6,700 cfs	7,800 cfs	13,000 cfs
Kayak - creek boat					
Slightly lower flow			3		2
About the same; this was close to the best flow		1	2	1	
Slightly higher flow	1	1		1	
Much higher flow	2				
Kayak - hybrid					
About the same; this was close to the best flow					1
Kayak - play boat					
Much lower flow				1	
Slightly lower flow			3	3	
About the same; this was close to the best flow	3	1	2	2	6
Slightly higher flow	2	3		1	1
Much higher flow	1	2	1	1	
Kayak - river boat					
Slightly lower flow			1		1
About the same; this was close to the best flow				1	
Slightly higher flow	1	2			

For each flow, participants were asked whether or not they would plan to boat Sumner Falls if the flow were provided 'periodically' (qualitatively, as a periodicity was not defined in the survey). As indicated by the responses summarized in Table 5.1-9, all five flows would provide opportunities that the participants would plan to boat. Nine of the 15 participants that experienced the 13,000 cfs flow indicated they would definitely plan to boat that flow again in the future. The second-most popular flow was 4,700 cfs, where seven of the 15 participants indicated that they definitely would return and another seven indicated it was probable they would return for that flow. The two responses of 'definitely no' were reported from kayakers.

Table 5.1-9. Participants' plan to boat Sumner Falls at various flows if those specific flows were provided periodically.

Response	3,700 cfs	4,700 cfs	6,700 cfs	7,800 cfs	13,000 cfs
Possibly	6	1	5	7	1
Probably	2	7	8	6	5
Definitely yes	3	7	4	3	9
Definitely no	2				

As a part of the flow comparison survey, participants were asked to compare the Sumner Falls play spot with other play spots within 2 hours of Sumner Falls and throughout New England (Table 5.1-10). Participants rated Sumner Falls as a desirable play spot in the region and above average. Discussions with boaters about this question yielded few alternative park-and-play wave spots in proximity. The closest wave is Wave-O-Saurus near Holyoke, Massachusetts; however, Wave-O-Saurus requires flows greater than 70,000 cfs, which only occur a few times each year.

Table 5.1-10. Participants' comparison of Sumner Falls with other boating play spots.

Comparison	Average Rating[a]	Minimum Rating[a]	Maximum Rating[a]	Standard Deviation
Compared to other play spots within a two-hour drive of Sumner Falls	4.4	3	5	0.3
Compared to other play spots in New England	3.9	3	5	0.3

a. Key to rating scale:
   1 = Worse than average
   2 = Below average
   3 = Average
   4 = Above average
   5 = Much better than average

As part of the close-out survey that focused on flow comparison, participants were asked to provide overall evaluations for the Sumner Falls area for a range of flows for their craft and skill level, including flows they did not boat during the study. Responses relied on boaters to make estimates as to how the features within the area would change as the flows changed based on their experience with the flows they did evaluate. In general, all participants reported all flows boated as part of the study as 'marginal' or higher with multiple preferred flow levels. The average score from kayakers rated flows less than 2,000 cfs less than 'marginal', which were below the levels directly observed during the study. Figure 5-1 shows the overall evaluation scores for each flow by boater types. Kayak scores were

averaged and include standard deviation error bars. The figure shows non-kayak boaters scored lower test flows closer to 'marginal' and as flows increased so did the overall acceptability; however, the stand-up paddle board scores decreased slightly at the 13,000 cfs level. Within the kayak group, reported scores show acceptability steadily rising with flow up to about 5,500 cfs before dipping and rising again to a second peak at 13,000 cfs. Within the kayak group there is a relatively wide spread in scores as shown by the error bars; however, the scores and error bars converge around the mid-flows between 5,000 and 6,000 cfs.

Comments supplied as part of the close-out discussion confirm these findings in that the Sumner Falls area is large enough and diverse enough to accommodate a wide range of flows allowing boaters of various skill levels and craft types to find boatable features that result in positive experiences. Overall, kayak boater enjoyment remained fairly high at all flows over 5,500 cfs except for a dip in acceptability scores at the 11,000 cfs range when all the features in the complex were washed out, the river was too pushy for boaters not interested in surfing, and Sign Wave had yet to form. It should be noted that many of the kayakers self-reported as advanced and/or expert boaters, as did the canoe participant. This experience level presents a bias clearly visible in the results for the canoe flow range of totally acceptable at 13,000 cfs; which is not representative of a downriver canoe trip. Incidentally, it may be easier to navigate down river through the rapids in a canoe at this flow; however, the risk of capsizing is also much greater resulting in a much higher risk to the boater. As such, these results should be considered as outliers.

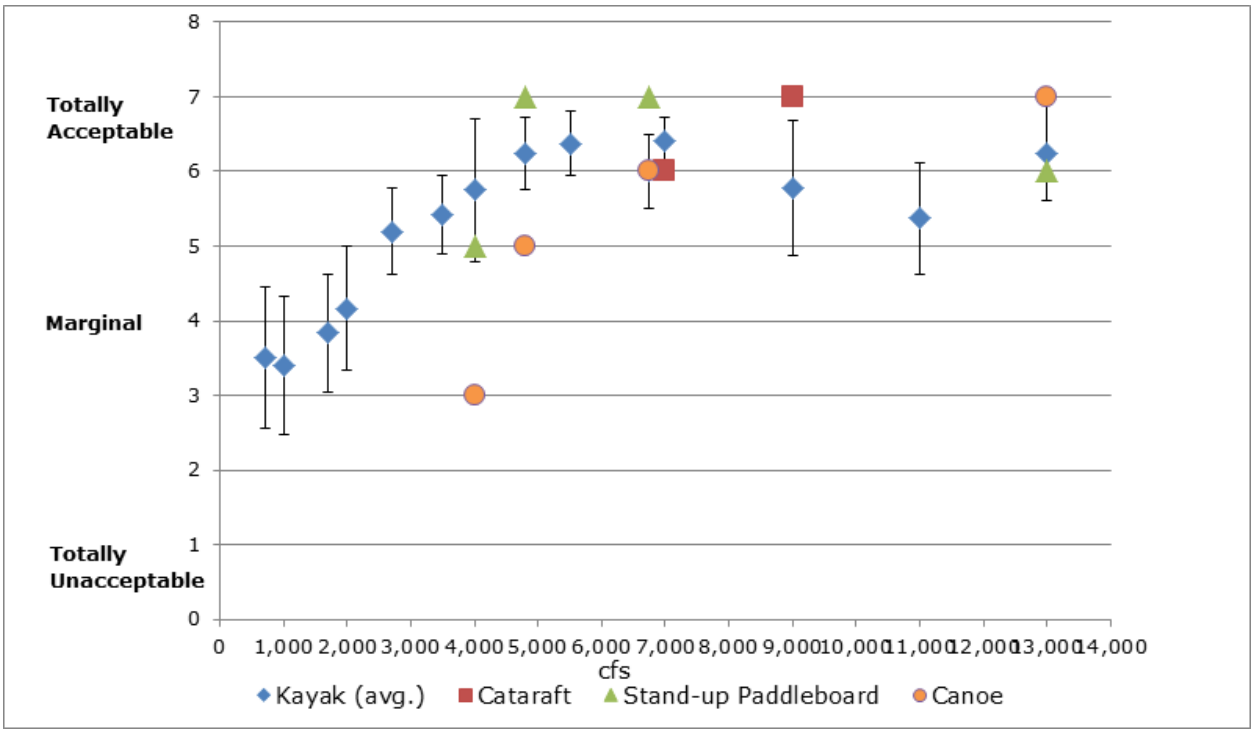

Figure 5-1. Average participants' rating for multiple flows at Sumner Falls.

In addition to the average ratings for various flow levels, boaters were asked to identify other types of experiences in the comparison survey. Table 5.1-11 shows the averaged flow levels reported for metrics such as the highest level that canoe through-boaters would run the rapids, the lowest flow that provides an acceptable experience for boating at this location, lowest flows for standard whitewater trips, and lowest flow levels for big water trips. The spread in reported flows among the participants was quite large, reflective of the wide boating interests in participants (e.g., interests in running rapids, wave surfing, paddle boarding).

Table 5.1-12 summarizes the ideal flows for the three main features within the Sumner Falls rapid complex: Sign Wave, Main Wave, and the Right Center slot. Main Wave was scored over a broad range while Sign Wave's ideal flow level was scored within a narrower band. The Right Center slot was run numerous times as a downriver run but cataraft boaters were successful in finding short surf waves at the bottom of the run during the middle afternoon on Sunday which corresponded to the rising flows and the 7,800 cfs target flow period. Table 5.1-13 summarizes additional comments recorded by boating participants at the conclusion of the comparison study. Additional comments about each flow are presented in Appendix D with photos documenting the main features at each flow presented in Appendix E.

Table 5.1-11. Averaged flow levels, based on participants' responses, for providing specific types of experiences.

Types of Experiences	N	Average Flow (cfs)	Min Flow (cfs)	Max Flow (cfs)
What is the highest water level that a through canoe boater would run (above this they would portage) Note: a through canoe boater is considered someone making a downriver trip and may be packing provisions and gear for overnight stays along the river and not visiting the rapids solely to boat the Sumner Falls.	12	~ 7,000	1,000	15,000
Some people are interested in a more open experience at lower flows. Think of this lower flow experience in your craft.	15	~ 4,000	700	5,000
What is the lowest flow that provides an acceptable experience at this location?	15	~ 4,000	700	5,000
What is the best or optimal range of flows for a more open experience at this location?	14	varies	3,500	13,000
Some people are interested in taking trips at somewhat higher flows that have stronger hydraulics but may offer less technical routes through rapids. Think of this "standard trip" in your craft. What is the lowest flow that provides an acceptable experience for a standard trip at this location?	13	~ 6,600	4,000	13,000
What is the best or optimal range of flows for a standard trip at this location?	13	varies	3,000	17,000
Some people are interested in taking trips at much higher flows that have more powerful hydraulics and larger waves. Think of this as "big water use" in your craft. What is the lowest flow that provides an acceptable experience for a "big water" type of trip?	13	~ 10,600	5,500	16,000
What is the best or optimal range of flows for this big water use type of trip?	15	varies	5,500	14,000
If TransCanada were to provide boating releases, what flows would you prefer?	13	varies	3,500	18,000

Table 5.1-12. Ideal flows for Sumner Falls features.

Feature	Flow Range (cfs)
Sign Wave	11,000 – 13,500
Main Wave (Summer Wave)	3,000 – 8,100, with a focus near 5,000
Right Center slot	6,700 – 9,000

Table 5.1-13. Additional participant survey comments for Sumner Falls.

Additional Comments
This section of river was a lot of fun. If there were scheduled releases a few weekends at a few levels, a lot of boaters would want to come for a weekend
Any water is great in the summer; more is better. Any flow above 5,000/5,500 cfs is fun and worth the drive. 7,800 cfs is my preference
Any water is great in the summer!!
Enjoyed the weekend; thanks. Good group of people and fun park-and-play experience.
There are clearly a range of flows that can provide an optimal paddling experience. In order to entice boaters for a larger geographic area, there needs to be multiple flows on the same day ranging from 4,700 cfs to 13,000 cfs.
I would be willing to make day trips at lower flows (e.g., 3,750 cfs to 6,700 cfs) or high flows (10,500 cfs to 13,000 cfs). Sumner Falls is a great spot and can easily be a full day experience. I'd have no problem bringing beginners down this and would use it for training.
Think our middle ranges of 6,000 cfs to 9,000 cfs may offer the best set of mixed features for entire river. Above that lots wash-out, but the play goes up (e.g., Sign Wave). Below that, it starts to loose features, and total boatability drops off.
This survey was well thought out, and I was glad to be a part of it.
There used to be a group of boaters that called Sign Wave on the Vermont side, and then the sign and boaters disappeared or changed and now the 'Sign Wave' is considered on the opposite bank in New Hampshire, but both are boatable at the right flow levels

5.2 Bellows Falls Bypassed Reach

The Bellows Falls bypassed reach is a relatively short stretch (0.7 mi total) of the Connecticut River between the Village of Bellows Falls, Vermont and North Walpole, New Hampshire. The reach is characterized by a boulder strewn channel immediately below Bellows Falls dam, exiting through a narrow gorge beneath the now-closed Vilas Bridge, then re-joining the outflow from the Bellows Falls powerhouse. The land adjacent to the bypassed reach is in large part owned by others, upon a portion thereof, TransCanada holds flowage rights. Signs are posted throughout the reach warning of sudden changes in water levels (due to spill) and no boating, swimming or fishing is allowed. A fish barrier dam is located 0.4 miles

downstream of Bellows Falls dam and was installed to block upstream migrating Atlantic Salmon from entering the bypassed reach and thus diverting fish passage via the fish ladder at the powerhouse.

As indicated above, boating has never been sanctioned or encouraged in the bypassed reach due to high flow danger concerns and lack of suitable ingress and egress. Under normal operating conditions, the reach would not have any flow in it other than leakage through the gates or flashboards at the dam or when gates are opened to pass water in excess of powerhouse capacity. During spring freshet, when the river is at its highest, the spill gates are opened, and flows in the reach can be in excess of 11,000-90,000 cfs. A 17,000 cfs spill claimed the life of an inexperienced boater in the past. Complicating matters is the presence of the fish barrier dam just upstream of the Vilas Bridge. The dam, with portions of the crest about 9 feet above the downstream channel bedrock and two 18-inch diameter tubes under the surface to pass flow, was given the highest safety risk potential during the on-water portion of the study, and all boaters successfully stayed clear of this hazard dam.

Study participants included volunteers that were interested in kayaking heavy water, play spot boating/wave surfing and general assessment of the bypassed reach for whitewater boating potential. The participants boated 9 different flows over a single weekend, but not all boaters boated all flows as some arrived late, left early, or didn't feel comfortable boating a specific flow. Over the course of the demonstration, between 4 and 11 boaters completed surveys at each flow. Nine of the 11 participants used hard-shell kayaks of multiple types (creek boats, play boats, and a river boat). Two participants used either open or decked canoes. Nine of the participants self-reported as being advanced boaters (meaning comfortable boating Class IV whitewater) and three were expert boaters (meaning comfortable boating Class V whitewater).

The Bellows Falls bypassed reach has four notable features that participants boated during the course of the demonstration. The first, near the spillway, is a large, dome-shaped rock that water pours over into a very large pool across the river not far from the base of the dam. About 200 yards downstream is the beginning of a stretch of river where the main channel narrows resulting in a series of waves (wave train) before the channel bends to the right (river right) through a similar but smaller series of wave heights. This is the first curve in the large 'S' turn in the reach above the fish barrier dam. Downstream of the first turn, the river bends back toward river left and forms another wave train along the island side of the bank where the New Hampshire shoreline pinches toward the Vermont side. Farther downstream the reach forms a moderate-sized pool behind the fish barrier dam before passing under the railroad and Vilas bridges.

Exiting the river downstream of the second wave train feature was easy at most flows under 5,560 cfs. Three participants worked as safety personnel along the New Hampshire side of the reach downstream of the second wave train; two from shore near the end of the wave train and another in a boat ready to assist anyone swimming or out of control going into the pool upstream of the fish barrier dam. At

flows above 5,560 cfs, the second wave train became washed out, and boaters exited the channel above this feature. During the second day when flows were scheduled to be higher, volunteer safety personnel were stationed on the shore on both sides of the channel immediately below the second wave train before the fish barrier dam with two on the New Hampshire side and one on the Vermont side. There was no boater providing safety help from the water on the second day due to high flows.

Access to the bypassed reach was provided by TransCanada through its chain link fence behind its offices in North Walpole, New Hampshire. TransCanada provided two knotted ropes and a 30-foot aluminum extension ladder to assist participants and their boats down the steep slopes to the river channel. Similarly, at the downstream take-out, TransCanada staff created an informal trail along the steep bank immediately adjacent to New Hampshire State Route 12 and provided a knotted rope to assist boaters up the steep slope. Boaters were required to carry their own boat to a passenger van with trailer to shuttle people and gear back to TransCanada's offices and the put-in. Boaters were also free to walk the shoreline back to the top or any spot where they wanted to put in during a flow. Participants tired from having to carry their gear up the steep slope, and the number of boaters participating in flows diminished as the study progressed toward higher flows.

Whitewater Class and Boater Skill Level

For each flow, participants were asked what they thought the whitewater difficulty was (Table 5.2-1). Responses were varied ranging from Class II at 1,580 cfs to Class IV at 9,660 cfs with the majority of boaters reporting the difficulty as Class III across most flows within the range evaluated in this study. In general, the lower flows received less challenging whitewater class ratings, and higher flows received higher ratings.

Table 5.2-1. Participant whitewater class difficulty ratings for Bellows Falls bypassed reach.

Flow (cfs)	Participant Whitewater Class Ratings for Bellows Falls Bypassed Reach									
	II	II+	II – III	III-	III	III+	III – IV	III+ – IV-	IV-	IV
1,580	3	1	1		3					
2,020	1	1			2					
2,370		1	3		7					
2,900		1	1		2					
3,300		1	2		6	1				
4,370	1			1	3	4		1		
5,560				1	2	3	1			1
7,400				1	1	1				3
9,660				1					1	4

Participants were also asked to report the minimum skill level necessary to successfully run this segment at each flow. Table 5.2-2 shows the results which are similar to the whitewater ratings above in that participants rated lower flows as boatable by novice and beginner boaters, while higher flows would require more whitewater experience. Very few boaters thought the Bellows Falls complex was so difficult that only advanced boaters could make it through the reach below 3,500 cfs; however above this, boaters should be at least an intermediate to advanced whitewater boater. These ratings are subjective as these are reported from boaters that self-reported as advanced to expert and may overestimate the abilities of new boaters at the lower end of the experience level.

Table 5.2-2. Participant skill level ratings required to successfully boat Bellows Falls bypassed reach.

Minimum Experience Level	1,580 cfs	2,020 cfs	2,370 cfs	2,900 cfs	3,300 cfs	4,370 cfs	5,560 cfs	7,400 cfs	9,660 cfs
Novice (no previous boating experience)			1		1				
Beginner (some previous boating experience)	4	3	1	2	1	2	2		
Intermediate	3	1	8	2	8	6	3	2	
Advanced			1			2	3	4	6

Whitewater Characteristic Ratings

Tables 5.2-3 and 5.2-4 summarize the single flow survey results from kayak and canoe participants, respectively, for such characteristics as 'navigability', 'availability of challenging rapids', 'availability of powerful hydraulics', 'aesthetics', 'safety', 'hazards', 'length of run', and an 'overall rating'. Not surprisingly, many of the ratings generally increased with the flow (e.g., 'rapids', 'navigability', and 'powerful hydraulics') or decreased with the flow (e.g., 'safety' due to flow, 'boating instruction potential'). Some characteristics did not exhibit much difference across flows (e.g., 'length of run').

Kayaker Ratings

'Length of run' scores were rated lowest of all the characteristics across all flows which is not surprising given the short length of the bypassed reach and avoidance of the fish barrier dam (Table 5.2-3). Given that the length of the run was short and the majority of boaters were advanced or higher, there was general interest by the kayakers to find waves to surf and play spots during the study. There were two flows that kayak participants scored highest for the 'availability of play boating areas': 2,020 cfs and 4,370 cfs. 'Navigability' was rated high across all flows while 'overall ratings' were all higher than 'acceptable' but more flows rated closer to the mid-five score range. The highest flow received the highest overall score (of six). This flow was the last flow of the day and generated a lot of adrenaline among the six expert boaters that experienced this flow which may have resulted in more positive ratings after many hours of lower flows and few opportunities for exhilaration.

Canoe Ratings

Canoe users reported ratings below 'acceptable' for the 'length of run' across all flows with decreasing ratings at higher flows. In general, canoe users scored the boating characteristics highest at the lowest flows with decreasing acceptability scores as flows increased (Table 5.2-4). Only one canoe participant boated the 5,560 cfs flow and there were no runs taken at the two highest flows.

Table 5.2-3. Average participant ratings of flow characteristics of Bellows Falls bypassed reach - Kayak[a]

Characteristic	Test Flow Level								
	1,580 cfs	**2,020 cfs**	**2,370 cfs**	**2,900 cfs**	**3,300 cfs**	**4,370 cfs**	**5,560 cfs**	**7,400 cfs**	**9,660 cfs**
Number of participants	6	4	9	4	8	8	7	5	6
Navigability	6.2	6.0	7.0	5.8	6.8	6.6	6.6	6.6	6.7
Availability of challenging technical rapids	4.2	5.0	5.0	4.8	5.0	5.3	5.9	6.2	6.3
Availability of powerful hydraulics	3.7	4.0	4.6	4.3	4.9	5.9	5.7	5.8	6.0
Availability of play boating areas	4.0	5.3	5.0	3.5	4.3	6.0	5.1	4.2	4.0
Overall whitewater challenge	4.7	4.5	5.1	4.5	4.8	5.6	5.7	5.8	5.8
Safety (due to flow levels)	5.3	6.0	6.6	5.8	5.6	5.6	4.9	5.2	5.3
Safety (due to debris or other in-channel physical hazards)	5.3	5.8	6.0	5.5	5.9	6.1	6.3	5.2	5.0
Number of hazards present in river	6.0	5.8	6.0	5.8	6.4	5.4	6.0	5.0	5.2

Characteristic	Test Flow Level								
	1,580 cfs	**2,020 cfs**	**2,370 cfs**	**2,900 cfs**	**3,300 cfs**	**4,370 cfs**	**5,560 cfs**	**7,400 cfs**	**9,660 cfs**
Aesthetics of river/channel	5.5	5.8	5.8	5.8	5.3	5.6	5.2	5.8	6.0
Length of run	4.2	4.0	4.4	4.3	4.6	4.6	4.7	4.6	4.5
Boating instruction potential	5.7	5.8	6.1	5.3	4.4	4.8	5.2	3.6	3.5
Overall rating	4.7	5.5	5.6	4.8	4.8	5.6	5.5	5.4	6.2

a. Key to rating scale:
1 = Totally unacceptable
4 = Marginal
7 = Totally acceptable

Table 5.2-4. Average participant ratings of flow characteristics of Bellows Falls bypassed reach – Canoe.

Characteristic	Test Flow Level						
	1,580 cfs	2,020 cfs	2,370 cfs	2,900 cfs	3,300 cfs	4,370 cfs	5,560 cfs
Number of participants	2	-	2	-	2	2	1
Navigability	6.0	-	6.5	-	6.5	6.5	5.0
Availability of challenging technical rapids	6.0	-	4.5	-	5.0	4.5	4.0
Availability of powerful hydraulics	6.0	-	4.0	-	5.0	5.5	5.0
Availability of play boating areas	6.0	-	4.0	-	5.5	5.0	5.0
Overall whitewater challenge	6.0	-	5.0	-	5.5	5.5	5.0
Safety (due to flow levels)	6.0	-	6.0	-	6.0	5.5	5.0
Safety (due to debris or other in-channel physical hazards)	6.5	-	6.5	-	6.5	6.5	6.0
Number of hazards present in river	6.5	-	6.5	-	6.5	6.5	6.0
Aesthetics of river/channel	5.0	-	5.0	-	5.0	5.5	5.0
Length of run	3.5	-	2.5	-	3.0	3.5	2.0
Boating instruction potential	5.5	-	4.0	-	4.5	4.0	4.0
Overall rating	6.0	-	5.0	-	5.5	4.5	5.0

a. Key to rating scale:
1 = Totally unacceptable
4 = Marginal
7 = Totally acceptable

Flow Preferences

Boaters were asked to indicate what they consider the minimum acceptable flow (enough flow for an enjoyable recreation experience) and optimal flows relative to the flows they had just experienced. Both minimum and optimal flow ranges were different between canoe and kayak user groups. Canoe user scores for the minimum flow showed a convergence in scores at 2,370 cfs and below (Table 5.2-5). For kayakers, scores for the minimum acceptable flow for their experience converged in two areas; the first between 2,020 and 3,300 cfs and a second, weaker overall response that the minimum flow was 4,370 cfs. This wide spread in responses with two convergences for a minimum acceptable boating flow stems from the diversity in the boater interests with some looking for more challenge and others looking for more play spots with easy eddy service into standing waves for surfing.

Boater responses to the optimal flow relative to the flow they just boated were similarly diverse with both canoer and kayaker results showing a spread in flows with a double convergence among the kayakers similar to the minimum flow responses. The greatest number of kayakers indicated that the flow that came closest to their preferred flow was somewhere between 2,370 cfs or slightly higher and 3,300 cfs and slightly lower (Table 5.2-6). Interestingly, only four kayakers boated the 2,900 cfs flow, and only one reported their preferred flow to be about the same. The flow level just above this level, 3,300 cfs was boated by eight kayakers and six of them indicated the optimal flow would be slightly lower suggesting the 2,900 cfs level is relatively close to one of the optimal flows. Kayak participant scores also converged between 4,370 cfs and 5,560 cfs with a majority indicating slightly higher flow than 4,370 cfs, and a majority wanted slightly lower than 5,560 cfs suggesting an optimal flow around 5,000 cfs.

Table 5.2-5. Participants' minimum acceptable flow preferences for Bellows Falls bypassed reach.

Craft and flow	Much higher flow	Slightly higher flow	About the same; this was the minimum flow	Slightly lower flow	Much lower flow
Canoe					
1,580			1	1	
2,370			1		1
3,300				1	1
4,370					2
5,560		1			
Kayak					
1,580	1	3		2	
2,020		2	1	1	
2,370		2	5	2	
2,900			1	1	2
3,300		1		6	1
4,370		2	1	1	4
5,560				3	4
7,400				1	5
9,660					6

Table 5.2-6. Participants' optimal flow preferences for Bellows Falls bypassed reach.

Craft and flow	Much higher flow	Slightly higher flow	About the same; this was the minimum flow	Slightly lower flow	Much lower flow
Canoe					
1,580			1	1	
2,370		1		1	
3,300				1	1
4,370					2
5,560		1			
Kayak					
1,580	3	3			
2,020		3	1		
2,370		5	4		
2,900			1	2	1
3,300		1		6	1
4,370		5	3		
5,560		1		5	1
7,400	1			1	4
9,660	1	1		1	3

As part of the flow comparison survey, participants were asked to compare the Bellows Falls bypassed reach with other reaches within 2 hours of the reach and throughout New England (Table 5.2-7). Overall, kayakers rated the Bellows Falls bypassed reach as above average to average compared to other reaches in the region while canoers rated it average to below average.

Table 5.2-7. Participants' comparison of Bellows Falls bypassed reach with other boating reaches.

Comparison	Average Rating[a]	Minimum Rating[a]	Maximum Rating[a]	Standard Deviation
Kayaks				
Compared to other reaches within a two-hour drive of Bellows Falls bypassed reach	4	2	5	0.7
Compared to other reaches in New England	3.1	2	5	1.0
Canoes				
Compared to other reaches within a two-hour drive of Bellows Falls bypassed reach	3	2	3	0.9
Compared to other reaches in New England	2	2	2	0

a. Key to rating scale:
1 = Worse than average
2 = Below average
3 = Average
4 = Above average
5 = Much better than average

As a part of the flow comparison survey, participants were asked to indicate the approximate minimum flow that they could (but not necessarily would) boat at the Bellows Falls bypassed reach (Table 5.2-8). Nine of the 10 respondents indicated minimum boatable flows of 2,500 cfs or less, with 7 of the respondents noting a minimum boatable flow 2,000 cfs or less with canoe users reporting slightly lower flows than kayakers.

Table 5.2-8. Participants' approximate minimum flows for boating Bellows Falls bypassed reach by craft type.

Craft and flow	Minimum
Canoe	
1,000 cfs	1
1,500 cfs or less	1
Kayak	
1,000 cfs	2
2,000 cfs	3
2,500 cfs	2
4,500 cfs	1

As part of the flow comparison survey, participants were asked to provide overall evaluations for the Bellows Falls bypassed reach for a range of flows for their craft and skill level. Ten of the 11 participants reported all flows boated as part of the study as 'marginal' or higher with multiple preferred flow levels. Less than marginal rankings were provided by a single boater at flows of 1,580 cfs, 2,900 cfs, and 3,300 cfs. Figure 5-2 shows the average overall evaluation for each flow with standard deviation error bars. The figure shows two peaks around 2,370 cfs and 4,370 cfs, with a third increase in boater acceptability at the highest flow but not quite as high as the other two peaks.

At lower flows, features are not as interesting or powerful and there are no play waves. The two wave trains develop their best shape for surfing at the 2,370 cfs level with specific waves within the trains as the interesting features. As the flow increases, these features become less interesting but underlying rock structures within the trains start to develop waves again as the flow continues to increase to 4,370 cfs. As flows increase again, the river becomes pushy and washes out play spots. At the highest flow level, the river appears full and wild with whitewater; however, the challenge to surf and play is increased dramatically and so too is the risk of exiting before the fish barrier dam with boaters exercising caution and taking out upstream of the second wave train. Comments provided as part of the close-out survey and discussion confirm these findings in that participants reported that the Bellows Falls bypassed reach is interesting at two levels and that, although boating the 2,370 cfs flow is good, it would be a shame to not have the opportunity for the higher (4,370 cfs) flows as well. Boaters indicated the fish barrier dam was a significant impediment to the study and to boating in the reach and that the area downstream of the barrier dam to the confluence with the main river appeared to have boating potential with waves visible from the Vilas Bridge.

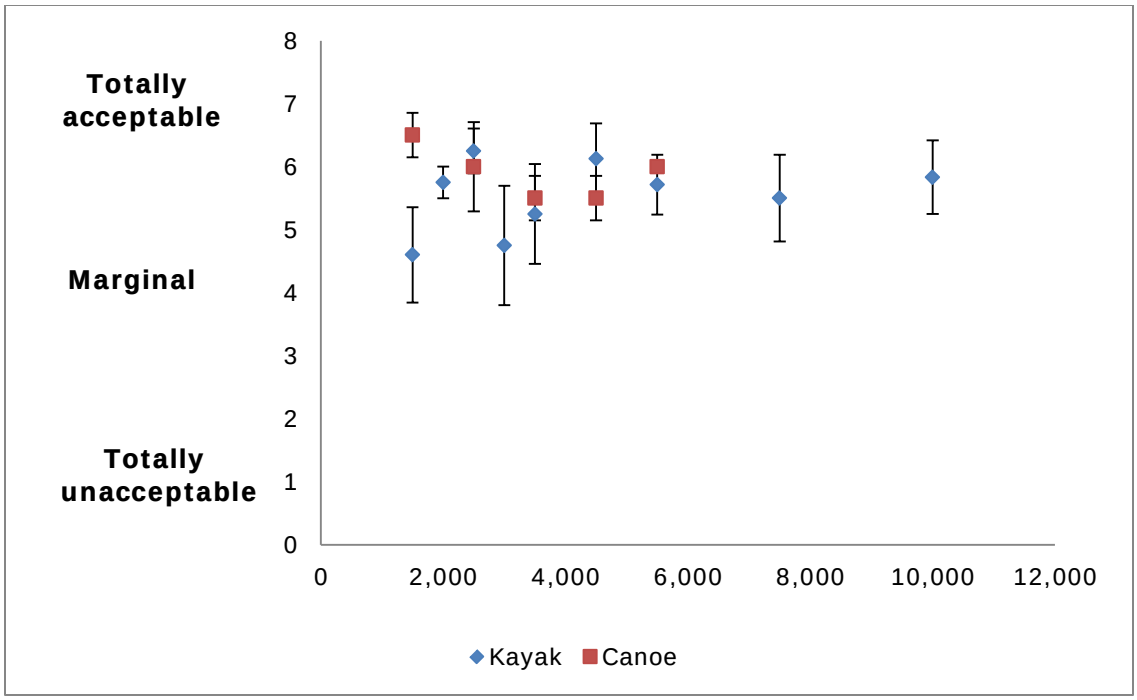

Figure 5-2. Average participants' acceptability rating for multiple flows at Bellows Falls bypassed reach.

Close-out survey questions asked participants to consider the flows boated and a corresponding type of experience (e.g., minimum quality whitewater experience, highest quality whitewater experience [optimal flow], lowest flow that provides a safe run, the highest flow they would consider running) as well as a series of questions that investigated parking and trail access into and out of the reach. Table 5.2-9 summarizes the lowest flow that provides a quality whitewater experience by number of responses (not necessarily a flow the participants boated), while Table 5.2-10 summarizes the responses to what participants consider the flow that provides the highest quality whitewater experience. Results show a wide spread in responses for both the lowest flow that provides a quality experience and the highest quality experience. Participants were also asked to indicate their preferred flow if only one flow were provided. The most common response from kayakers for the preferred flow was 4,500 cfs with participants reporting preferred flows at flows greater than 2,500 cfs and none above 5,500 cfs. The single canoe response for preferred flow was reported as 7,500+ cfs; however this is inconsistent with all the other flow preference data received from the participants using canoes described above and should be considered an outlier.

Table 5.2-9. Lowest flow that provides a quality whitewater experience.

Flow	Kayak Responses	Canoe Responses
1,000 cfs	2	1
1,500 cfs or less		1
2,000 cfs	3	
2,500 cfs	2	
4,500 cfs	1	

Table 5.2-10. Flow that provides the highest quality whitewater experience.

Flow	Kayak Responses	Canoe Responses
2,500 cfs	2	
2,500/5,000 cfs[a]	1	
3,500 cfs	1	
4,500 cfs	3	
5,500 cfs	1	
7,500 + cfs		1

a. One participant indicated preferred flows of both 2,500 cfs and 5,000 cfs because different features were available at different flows.

Tables 5.2-11 and 5.2-12 summarize boater responses related to boating safety in the bypassed reach. In general, all flows less than approximately 2,500 cfs were scored as providing a safe run with the majority of responses at flows of approximately 1,500 cfs or lower (Table 5.2-11). On the opposite end of the safety spectrum, boaters reported the highest flow that provides a safe run. The highest number of responses (3) reported 10,000 cfs as safe to run; however, again, there was a wide spread in responses. It is important to remember the boater group self-identified as expert and advanced boaters only to ensure the highest safety during the study, and boating higher flows is typically interesting for this skill level boater. This is evident by the nature of the responses to the follow-up question, 'what is the highest flow you would consider running,' which elicited responses of 15,000 and 35,000 cfs even though the majority of responders capped their personal highest runnable flow at approximately 10,000 cfs (Table 5.2-13).

Table 5.2-11. Lowest flow that provides a safe run in the Bellows Falls bypassed reach.

Flow	Kayak Responses	Canoe Responses
1,000 cfs	1	1
1,500 cfs or less	3	
2,000 cfs	1	
2,300 cfs	1	
2,500 cfs or less	2	
No lowest flow		1

Table 5.2-12. Highest flow that provides a safe run in the Bellows Falls bypassed reach.

Flow	Kayak Responses	Canoe Responses
5,500 cfs	2	
6,500 cfs	1	
7,500 cfs		1
10,000 cfs	3	
Unknown	1	
All levels	1	
“Higher than I’ve seen it”		1

Table 5.2-13. Highest flow that you would consider running in the Bellows Falls bypassed reach.

Flow	Kayak Responses	Canoe Responses
7,500 cfs		1
10,000 cfs	4	1
15,000 cfs	2	
35,000 cfs	1	
Unknown	1	

6.0 DISCUSSION

This section includes a discussion of the data results, including minimum and optimum flows, safety, and access, in the context of qualitative comments by participants written on the survey forms and other observations during the study.

6.1 Sumner Falls

Results are presented as the estimated flow arriving at Sumner Falls calculated as the sum of the West Lebanon, Ottauquechee, and Mascoma River gages during the demonstration period and accounting for estimated water travel times (approximately 2 hours for water to reach Sumner Falls from the West Lebanon gage).

Survey results indicate there are two preferred surfing flows with some range within the two. The first related to Main Wave, which becomes surfable between 4,700 cfs and 6,700 cfs based on survey responders requesting slightly more than the 4,700 cfs and slightly less than the 6,700 cfs observed. Boaters not interested in surfing found this range less interesting, yet still enjoyable. The second preferred flow was reported at the highest flow of 13,000 cfs, which resulted from full generation at Wilder and contributions from tributaries downstream of Wilder. The surveys did not ask to identify an optimal flow level at Sumner Falls because that level is likely above TransCanada's generation capabilities at Wilder; however, based on the feedback provided on the surveys and discussions with boaters, 13,000 cfs is as close to optimal conditions reported over the course of all demonstration flows for the intermediate to advanced boaters. Interestingly, the flow level of 7,800 cfs received the highest number of responses for participant's preference to remain 'about the same' which captured the broader experience of beginners and non-kayak boat types. At this flow, neither Main Wave or Sign Wave are formed for surfing; however, all boaters found interesting features and challenges to boat: squirt boaters found eddy lines and numerous cataraft trips were taken down various channels. This flow level provided enough water across the wide complex to create the impression of turbulence and rapids with very easy and safe conditions throughout the larger falls. Downriver enthusiasts enjoyed shooting various sections, practicing eskimo rolls, and easy swims with all rapids emptying into the large pool at the bottom, rendering the entire complex good for beginners and teaching opportunities. The high concentration of responders reporting preference for the 13,000 cfs flow is likely related to there being more play boaters in the study group than downriver whitewater boaters.

Local boaters represented a small percentage of study participants; however, all of the local boaters were familiar with the size and timing of Wilder's operational discharge levels and resulting boating opportunities at Sumner Falls. Boaters indicated in the close-out surveys that they would boat flows as low as 700 cfs, which is the maximum flow passed through the minimum flow generating unit at Wilder and disregards contributions from tributaries including the White River; however, at this level there would be numerous exposed rocks and no waves for play boating. Canoes and downriver boats could easily navigate to river left and

run the rapids with low risk of any consequence at this level; however this result is based on anecdotal discussions with local boaters and in discussions during the study since 700 cfs is much lower than the flows utilized in this study and is speculation of the lowest flow they would boat at Sumner Falls. Flow passing through one of the two larger units at full generation and the minimum flow unit discharges about 5,700 cfs, which is within the preferred range for surfing Main Wave. Full utilization of all three Wilder generating turbines results in discharge of about 10,700 cfs from Wilder. Boaters reading the West Lebanon gage would read higher flow levels accounting for inflows from the White River. Additional tributary inputs would increase the flow arriving at Sumner Falls.

Discharge at Wilder is in response to inflow, regional electric demand and associated energy prices. Discharges above station capacity are managed to the extent possible for flood control via spill. In all cases, the project operates within the FERC licensed range of impoundment elevation, as well as operational protocols that limit the rate of elevation change. Figure 6-1 shows the New England Independent System Operator (ISO) regional electric load forecast (blue) and real time (orange) for a summer day during 2015, illustrating the typical afternoon peak in electrical demand. Under normal summer conditions, this results in TransCanada typically generating electricity at Wilder during those same time periods in response to forecasted ISO demand.

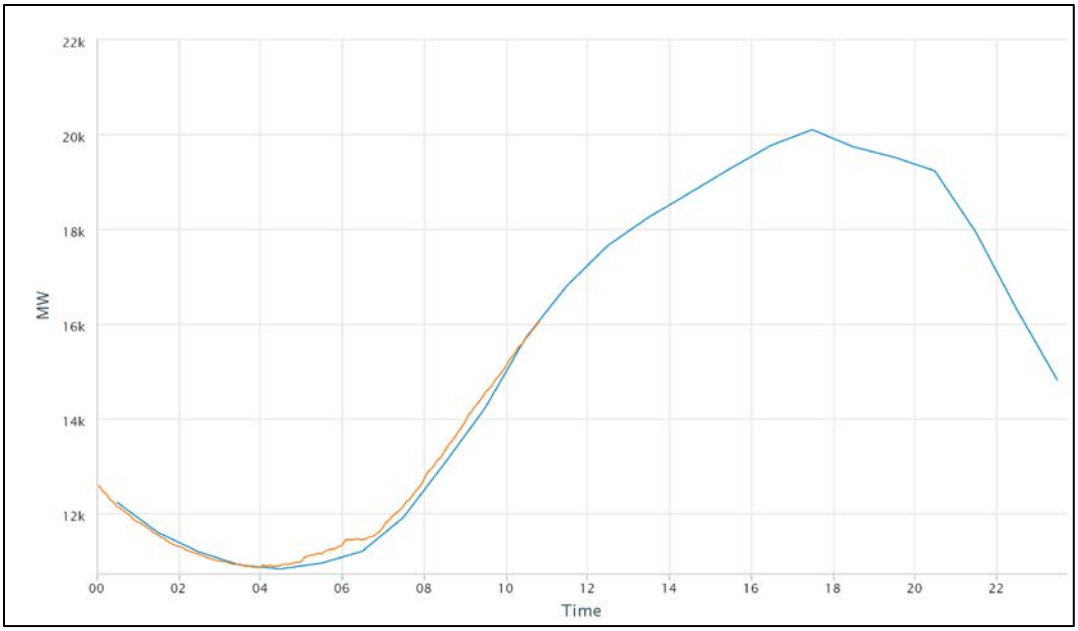

Figure 6-1. New England ISO real time (orange) and forecast (blue) electrical demand for a typical summer day, 2015.

Figure 6-2 shows the West Lebanon gage for a week in July 2015 highlighting typical Wilder operations and resulting flows in the Connecticut River, peaking every afternoon to respond to the higher demand. Because Sumner Falls is about nine miles downstream, it takes about two hours for these flows to reach the park and play spot.

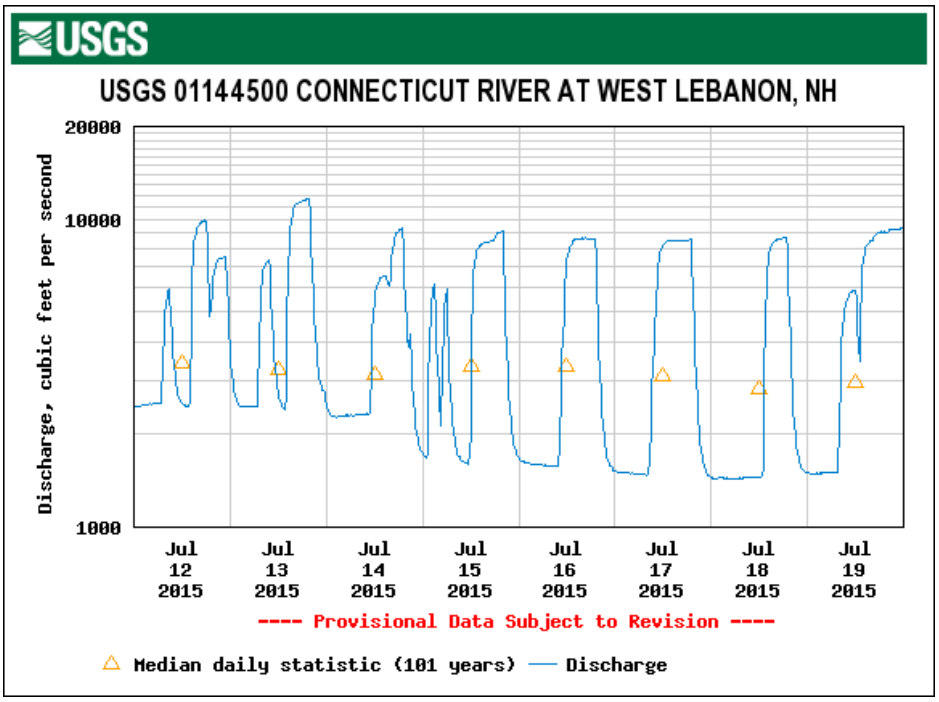

Figure 6-2. USGS West Lebanon gage (01144500) for period July 12-19, 2015.

Figure 6-3 shows a typical weekend day, Saturday July 18, and the timing of the Wilder operational discharge relative to the West Lebanon gage Located about a mile and half downstream. Shifting this 2 hours to account for travel time to Sumner Falls moves the peak start from about 2 pm to about 4 pm and lasting until around 9 pm when the pulse of water recedes after Wilder generation decreases in the evening. The White River was releasing about 580 cfs during this same time and the peak on the West Lebanon gage was about 1,200 cfs more than the Wilder discharge. On this day, Wilder's peak generation discharge ranged from approximately 7,170 – 7,550 cfs or about 70% of full generation capacity.

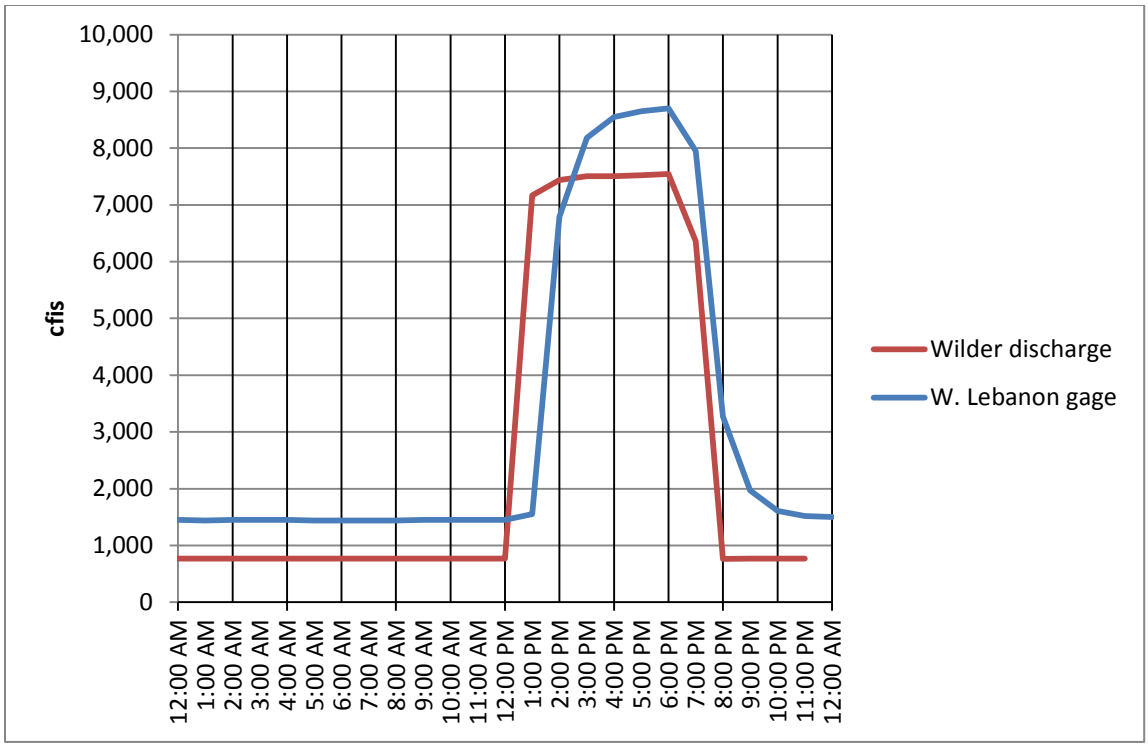

Figure 6-3. Characteristic summer weekend flows (cfs) for Saturday, July 18, 2015.

Unless there is sufficient contribution from other rivers downstream of the West Lebanon gage, Sumner Falls receives essentially the same flow as the West Lebanon gage during the summer months. Results from the survey indicate whitewater boating opportunities are marginal or better in the 3,750 - 8,500 cfs range and again around 11,000-13,000 cfs (above Wilder's generation capacity). With respect to play spots, participants found flows just under 9,000 cfs to be well below the preferred levels for Sign Wave and above the preferred levels for Main Wave.

Under typical project operations, boaters would have about a half hour every day to boat the rising limb of the hydrograph in the 4,000-6,000 cfs range to surf the Main Wave, based on 2015 flow data which on July 18 (shown in Figure 6-3) would be between 3:30 and 4 pm (adjusted for the 2-hour time lag). The same flow range would also occur during the falling limb of the hydrograph which would occur after dark (between 10-10:30 pm). Figure 6-4 shows the flow exceedance curve for the West Lebanon gage for data between June 1 and October 31, 2015 (typical of the general summer boating season) between the hours of 6 am and 6 pm, which is assumed to be the daylight hours for boating Sumner Falls. This figure shows flows for Main Wave (assumed broadly to be between 4,000 and 6,000 cfs) would occur between roughly 30 to 40 percent of those daylight summer-fall hours and flows between 11,000 and 13,500 cfs (preferred range for Sign Wave) would occur between about approximately 1 and 7 percent of the same period. As described above, these preferred flow ranges typically occur during the afternoon and evening hours. Primary factors that could result in deviations from these generalized trends

during the warmer months addressed here include large precipitation events, changes in economic drivers from the ISO New England due to regional electric supply or demand, or outages at Wilder (e.g., rewinding a turbine, replacing runners). However, the data suggests that boating opportunities at the preferred levels for the two primary play spots at Sumner Falls occur regularly under current project operations during the summer-fall daylight hours.

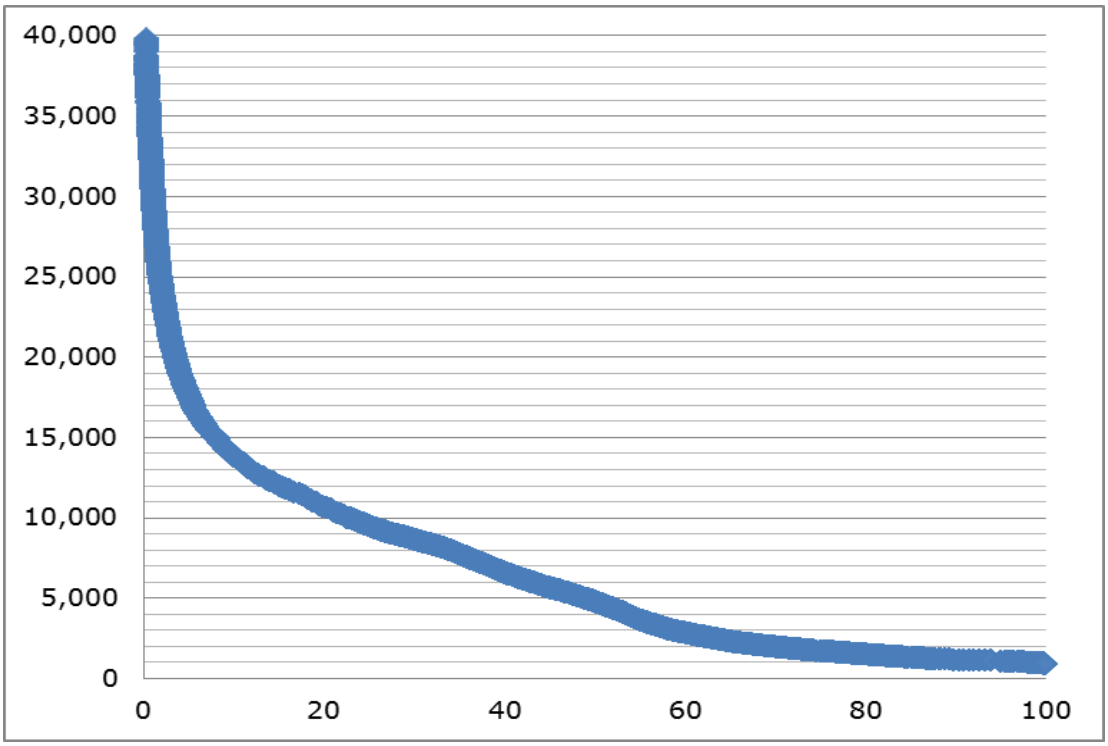

Figure 6-4. Flow exceedance curve for West Lebanon gage for the period from June 1 to October 31, 2008-2015, for the hours between 6 am and 6 pm.

6.2 Bellows Falls Bypassed Reach

Overall, Bellows Falls bypassed reach boating participants rated several characteristics (e.g., navigability, aesthetics) of the boating reach as better than marginal at multiple flows (Tables 5.2-3 and 5.2-4), thus suggesting that there is potential for this area to provide whitewater opportunities. But in comparison with other opportunities within two hours and throughout New England as a whole, the reach was rated as average and below average for canoes. Furthermore, there are some key factors that limit the potential of the reach as a significant boating opportunity. These factors include: shortness of length and dynamic play spots, public access, and safety concerns, which include not only the fish barrier dam at the downstream end of the reach but whether or not boaters of a novice or intermediate level could find themselves over their ability in many of the flows that were evaluated.

Under normal conditions, the Bellows Falls bypassed reach does not offer any boatable flow. The Bellows Falls project has a required minimum flow under the current FERC license of 1,083 cfs or inflow if lower, which is currently provided by generation from the powerhouse. Higher flows into the bypassed reach only occur during high river flows that exceed station capacity.

Study participants using canoes indicated that minimum flows of 1,500 cfs or less are needed to provide quality boatable conditions while the weighted average of flows kayakers reported as a minimum flow level was about 2,000 cfs.

Preferred flows for the Bellows Falls bypassed reach as stated by canoe users were also 1,500 cfs, while preferred flows stated by kayak users were typically in the range of 2,370 cfs to 5,560 cfs. The highest number of kayak responders reported 4,370 cfs as the flow that provides the highest quality whitewater experience (weighted average of 3,800 cfs). Interestingly, kayakers reported the 2,370 cfs flow created decent waves in both wave trains.

Bellows Falls discharges in response to inflow and regional electric demand and associated energy prices, and as upstream flow from Wilder and tributary flows dictate. Discharges above station capacity are passed as spill at the dam but are not predictable beyond a window of a day or so and are based upon weather forecasting. In all cases, the project operates in accordance within the FERC licensed range of impoundment elevation, as well as operational protocols that limit the rate of elevation change. In order to provide scheduled whitewater in the bypass, generation would typically need to be curtailed in order to utilize the inflow and maintain reservoir operating restrictions.

Public access to the bypassed reach presents another obstacle to formal boating opportunities. There are various informal trails, typically down steep embankments. Most cross privately owned land or are adjacent to roads and railroad property. Private property lines Route 12 in New Hampshire, the railroad owns the property along the Vermont side, and access would require crossing working train tracks. For this study, boaters were provided access via TransCanada property that is used for official business, not open to the public. Similarly, take-out access for the study used a steep trail out of the reach immediately onto Route 12 with the assistance of knotted ropes temporarily installed by TransCanada for the study. The take-out used a narrow cut between the end of private residences on Route 12 and the highway retaining wall and was essentially straight up the hillslope.

A third factor that limits the Bellows Falls bypassed reach as a suitable whitewater boating reach is the presence of the fish barrier dam located about two-thirds of the way down the bypassed reach just upstream of the Vilas Bridge. Like many other low-head dams, this dam presents a serious and potentially fatal human health and safety hazard due to intense hydraulics that can lead to drowning. Unless the dam is removed, public use of the Bellows Falls bypassed reach for boating should not be considered.

7.0 CONCLUSIONS

7.1 Sumner Falls

- Sumner Falls is a popular park and play location due to its dependable flow levels throughout the summer months when other rivers are too low for boating.

- Sumner Falls is a large rapid complex with a variety of features that become available depending on the flow. The prominent surfing features are Main Wave, which study participants consider ideal between 4,700 cfs and about 5,500 cfs, and Sign Wave, which doesn't begin to form until about 11,000 cfs until surfable at 13,000 cfs.

- Other features include Right-Center Slot, Duck Pond, Boiling-eddies, Washing Machine and A-hole; all of which were of varying interest to different boaters at various flows as these were not all surf spots but features one could run down river through, look for special squirt boat maneuvers, or enjoy practicing whitewater skill improvement.

- Participant boat types in the study included an open canoe (expert), a stand-up paddleboard (intermediate), a cataraft (beginner), a squirt boat (expert), and more than 12 kayaks. Of the kayakers, five identified their skill level as intermediate, three advanced, and three expert. Boating waves and higher flows is typically more interesting for expert and advanced boaters than for downriver trips through Sumner Falls.

- Frequent summer flows in the class II-III range are well suited for teaching/training opportunities and for a broad range of boater types and experiences looking to improve in a non-threatening, diverse section of river.

- Boater survey results indicated varying levels of enjoyment at different flows. The 7,800 cfs level received high scores across all boat types and skill levels as running the rapids became interesting (most notably right center slot) and some eddies for squirt boats became active resulting in very positive scores across more than one boat type (or user group in response to a single feature).

- Flows in the preferred range for playboating the Main Wave (4,700-5,500 cfs) occur briefly almost daily during daylight hours between June 1 and October 31, while flows for Sign Wave occur less frequently since those flows (11,000 - 13,000 cfs) are greater than Wilder's generation capacity.

- Overall, Sumner Falls is large offering diverse opportunities across a wide range of flows. The fact that it frequently has adequate flow during the summer solidifies its place as a whitewater destination where there is often 'something for everyone'. The site has parking, easy put-in and take-out access, a small beach for non-boaters, and other amenities such as picnic

tables and a port-a-john, offering a complete 'park-and-play' experience for boaters.

- Wilder is operated based on upstream inflow, precipitation events, and New England ISO regional electricity demand, which during the summer typically peaks from about noon until about 8 pm. Travel time for releases from Wilder to Sumner Falls is about 2 hours.

- Full generation output from Wilder is about 10,700 cfs, which is above the ideal flow level for Main Wave and below the ideal flow for Sign Wave. USGS gage information show levels that are typically lower than this during peak generation periods. Local boaters familiar with the USGS West Lebanon gage showed up to boat Sumner Falls during the study when flows were rising to 13,000 cfs, indicating the local boater population is very familiar with the gaged rivers in the area and resulting whitewater boating characteristics and opportunities at Sumner Falls.

- Information from the aquatics and modeling studies will be required in order to evaluate impacts to aquatic resources as well as economic impacts of providing whitewater flows at Sumner Falls.

7.2 Bellows Falls Bypassed Reach

- Expert and advanced boaters identified three whitewater boating features in the Bellows Falls bypassed reach between the spillway and the fish barrier dam.

- Preferred playboating flows in the bypassed reach were identified using survey questions. One set of survey questions indicated two optimal flows: one in the 2,020 cfs to 2,900 cfs range and another in the 4,370 to 5,560 cfs range. The weighted average of the flow that provides the highest quality whitewater experience was 3,880 cfs with responses confirming a lower and midlevel flow (2,500 and 4,500 cfs respectively).The lowest flow evaluated, 1,580 cfs, represents Class II-III rapids which could present a safety issue and challenge for novice to beginner boaters.

- Boating is not currently encouraged in the bypassed reach, and the area only receives flows during spring freshet, large precipitation events, and outages at the powerhouse requiring water to be diverted to the dam and spilled.

- Boaters did not investigate the short reach below the fish barrier dam or any features potentially inundated by the presence of the dam.

- Access is very limited due to private non-TransCanada ownership and control. The significant ingress and egress challenges would need to be addressed to support whitewater boating and public safety.

- Information from the aquatics and modeling studies will be required in order to evaluate impacts to aquatic resources.

- Economic impacts of providing whitewater flows at the Bellows Falls bypassed reach have not been evaluated but scheduled releases would reduce station generation.

8.0 LITERATURE CITED

American Whitewater. 2015a. National Whitewater Inventory. Available at: http://www.americanwhitewater.org/content/River/detail/id/682. Accessed on September 4, 2015.

American Whitewater. 2015b. Concord River, City of Lowell to Merrimack River webpage. Available at: http://www.americanwhitewater.org/content/River/detail/id/680. Accessed on: September 4, 2015.

American Whitewater. 2015c. Sumner Falls (Hartland Rapids) webpage. Available at: http://www.americanwhitewater.org/content/River/detail/id/3606/. Accessed on: September 3, 2015.

American Whitewater. 1998. Safety Code of American Whitewater. Available at: http://www.americanwhitewater.org/archive/safety/safety.html#rating%20scale. Accessed on: September 3, 2015.

First Light. 2015. Whitewater Boating Evaluation, Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889). March 2015.

Lessels, Bruce. 1998. Classic Northeastern Whitewater Guide: the best whitewater runs in New England and New York – novice to expert, 3rd edition. Published by the Appalachian Mountain Club.

Riverbreak. 2014. Wave O Saurus. Available at: http://riverbreak.com/spots/wave-o-saurus/. Accessed on: September 4, 2015.

Whitewater Rafting New England. 2015. Whitewater Rafting New England webpage. Available at: http://www.whitewaterraftingnewengland.com/. Accessed on: September 4, 2015.

Appendix A: Invitation Letter

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AMERICAN WHITEWATER

AMC

NEW ENGLAND *FLOW*

CONTROLLED FLOW STUDY INVITATION

Dear Whitewater Controlled Flow Study Participant:

We are seeking paddlers for a Whitewater Controlled Flow Study on the Connecticut River on June 28 & 29th as part of a FERC relicensing. The section in question is Sumner Falls/Hartland Rapids in Hartland, VT, close to Route 91.

Purpose of the Study

The purpose of the Whitewater Controlled Flow Study is to identify minimum acceptable and optimum flows for whitewater paddling on the Sumner Falls section of the Connecticut River. Flows on this reach of the Connecticut River fluctuate under normal conditions principally as a result of the hydropower operation of the Wilder dam by TransCanada.

Sumner Falls/Hartland Rapids is a series of ledges sprawled out across a wide section of the Connecticut River. This section includes a several drops, waves, chutes and swirling eddies that provide opportunities for playboating, squirt boating, skill building and instruction with rapids ranging from Class I-III.

This study is one of a series of studies undertaken by TransCanada as part of the relicensing of their facilities on the Connecticut River. TransCanada will also be conducting a flow study in the fall at Bellows Falls

The study is being conducted by Louis Berger Group for TransCanada in collaboration with American Whitewater, the Appalachian Mountain Club, and New England *FLOW*. We will use this study to develop environmental and recreational proposals for an annual schedule of whitewater releases that balances hydropower generation with environmental and recreational needs.

Schedule and Commitment

The Whitewater Controlled Flow Study will take place on June 28th & 29th in Hartland, VT. We will be evaluating various flows throughout the weekend. We expect to arrange for a group campsite for those participating in the study, and food (or a food allowance) will be provided.

Please note that the study requires a commitment from you for **2 full days**, and it is necessary that you commit to both days in order to participate in the study. (If the flow levels exceed your abilities, of course you can skip those tests.) If for any reason the study needs to be cancelled due to unexpected flows, it will be rescheduled.

Prior to the start of each day, there will be a **mandatory** orientation meeting in which we will discuss the planned flows, the responsibility of each participant, and the safety plan. These meetings will consist of a detailed review and orientation to the questionnaires and the detailed logistics for each day.

All study participants will be required to sign a liability waiver.

PLEASE NOTE: Only those boaters who have completed the attached Boating Participation Survey will be allowed to participate in the flow study.

Study Plan and Logistics

The Whitewater Controlled Flow Study will involve paddling Sumner Falls/Hartland Rapids at several flow levels. After each flow level, you will be asked to evaluate specific characteristics of the river, as well as the quality of your experience using a standard survey questionnaire. At the end of the 2-day evaluation period, or after you have experienced several different flows, you will be asked to complete a comparative survey questionnaire allowing you to identify your preferred flow for the respective runs. The intent of the study is to collect information about experiences in the flows being tested, so it is important that your responses to the survey questions be as accurate as possible.

If you decide that progressively higher flows are beyond your ability you may withdraw from that test; however, we expect you to remain as part of the study to complete the day's study forms and assist your fellow boaters.

Responsibilities

Boaters will be selected based on their whitewater experience, type of craft, and most importantly, their judgment, ability to work as a team member and ability to represent the interests of the paddling public.

We are asking you to join this select group because you;

1) Have a skill set and experience that ranges from beginner (Class I) up to and including expert (Class V+) and can represent paddlers and river recreationists in one of the following categories: kayaks, canoes, SUP's, rafts, duckies, or riverboards.

2) Belong to regional organizations whose members and the paddling public at large are key resource constituents and beneficiaries of paddling opportunities on the Connecticut River;

3) Have a strong history of conservation volunteerism and/or other support for American Whitewater, the Appalachian Mountain Club, and New England *FLOW*;

4) Will be committed to communicate your test participation by sharing your experience on this study with your local paddling community or organization (writing articles, speaking, etc.);

Most importantly, have the sense to know when to follow as well as lead when called upon.

RSVP by June 16, 2014, by filling out the attached Sumner Falls Boating Participant Survey

Mail or email the completed Boater Information Form To:

Bob Nasdor
65 Blueberry Hill Lane
Sudbury, MA 01776

Tel: (617) 584-4566
Email: bob@americanwhitewater.org

If you have any questions about the study or need further clarification, please contact me @ (508) 331-4889 or (978) 728-4544, AW's Bob Nasdor @ (617) 584-4566, or AMC's Norman Sims @ (413) 774-2970.

We appreciate your participation in this important study.

Sincerely,

Tom Christopher	Bob Nasdor	Norman Sims
New England FLOW	American Whitewater	Appalachian Mountain Club

Sumner Falls (Hartland Rapids) Boating Study
Boating Participant Survey

Your name: _____

Part I

1. How many years have you been taking trips to this location? _____ years

2. Are you an outfitter, guide, or private river user?
- ☐ Outfitter
- ☐ Guide
- ☐ Private User
- ☐ Other_____

3. How would you rate your own skill level?
- ☐ Beginner (some previous boating experience)
- ☐ Intermediate
- ☐ Advanced
- ☐ Expert

4. Do flow levels influence whether or not you take a trip?
- ☐ Yes
- ☐ No

5. Do flow levels influence how you take trips (when you go, what craft you use, which rapid you run, how much gear you take, etc.)? If yes, please describe below.

_____
_____

Part II

How would you describe yourself as a boater (what type of boater are you?):_____
_____
_____
_____
_____
_____
_____
_____

What type of watercraft do you generally use for whitewater paddling?

Hard shell kayak	Stand up paddle board
Inflatable kayak	C2

OC1	Raft
OC2	Cataraft
C1	Other (describe):_____

How many years have you been using this type of watercraft? Years

How would you rate your skill level with this type of watercraft? *(Circle one – whitewater classifications defined on next page)*

Novice (comfortable running Class II whitewater)

Intermediate (comfortable running Class III whitewater)

Advanced (comfortable running Class IV whitewater)

Expert (comfortable running Class V whitewater)

In general, how many days per year do you spend whitewater boating?

What is your age?

Are you □ male or □ female?

Have you boated at Sumner Falls on the Connecticut River before? Yes_____ No_____

Please respond to each of the following statements about your river-running preferences.

	Strongly disagree	Moderately disagree	Slightly disagree	No Opinion	Slightly agree	Moderately agree	Strongly agree
I often run rivers with Class II and III rapids.	1	2	3	4	5	6	7
I often run rivers with difficult rapids (Class IV-V).	1	2	3	4	5	6	7
Running challenging whitewater is the most important part of my boating trips.	1	2	3	4	5	6	7
I often boat short river sections (under 4 miles) to take advantage of whitewater play areas.	1	2	3	4	5	6	7

	Strongly disagree	Moderately disagree	Slightly disagree	No Opinion	Slightly agree	Moderately agree	Strongly agree
I often boat river segments to experience a unique and interesting place.	1	2	3	4	5	6	7
I often boat short river segments to run challenging rapids.	1	2	3	4	5	6	7
I select boating opportunities based on length and experience regardless of difficulty.	1	2	3	4	5	6	7
I am willing to tolerate difficult put-ins and portages (boat carries in excess of 1,000 feet over unimproved footpaths) in order to run interesting reaches of whitewater.	1	2	3	4	5	6	7
I often boat rivers that feature large waves and powerful hydraulics.	1	2	3	4	5	6	7
I often boat steep technical rivers.	1	2	3	4	5	6	7
I enjoy boating both difficult and easy rivers.	1	2	3	4	5	6	7

Class I – Fast moving water with riffles and small waves. Few obstructions, all obvious and easily missed with little training. Risk to swimmers is slight; self-rescue is easy.
Class II – Straightforward rapids with wide, clear channels which are evident without scouting. Occasional maneuvering may be required, but rocks and medium-sized waves are easily missed by trained paddlers. Swimmers are seldom injured and group assistance, while helpful, is seldom needed.
Class III – Rapids with moderate, irregular waves which may be difficult to avoid and which can swamp an open canoe. Complex maneuvers in fast current and good boat control in tight passages or around ledges are often required; large waves or strainers may be present but are easily avoided. Strong eddies and powerful current effects can be found, particularly on large-volume rivers. Scouting is advisable for inexperienced parties. Injuries while swimming are rare; self-rescue is usually easy but group assistance may be required to avoid long swims.

Class IV – Intense, powerful but predictable rapids requiring precise boat handling in turbulent water. Depending on the character of the river, it may feature large, unavoidable waves and holes or constricted passages demanding fast maneuvers under pressure. A fast, reliable eddy turn may be needed to initiate maneuvers, scout rapids, or rest. Rapids may require "must" moves above dangerous hazards. Scouting may be necessary the first time down. Risk of injury to swimmers is moderate to high, and water conditions may make self-rescue difficult. Group assistance for rescue is often essential but requires practiced skills. A strong eskimo roll is highly recommended.
Class V – Extremely obstructed, or very violent rapids which expose a paddler to added risk. Drops may contain large, unavoidable waves and holes or steep, congested chutes with complex demanding routes. Rapids may continue for long distances between pools, demanding a high level of fitness. What eddies exist may be small, turbulent, or difficult to reach. At the high end of the scale, several of these factors may be combined. Scouting is recommended but may be difficult. Swims are dangerous, and rescue is often difficult even for experts. A very reliable eskimo roll, proper equipment, extensive experience, and practiced rescue skills are essential.

RSVP by June 16, 2014, by filling out the attached Sumner Falls Boating Participant Survey

Mail the completed Boater Information Form To:

Bob Nasdor
65 Blueberry Hill Lane
Sudbury, MA 01776

Tel: (617) 584-4566
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AMERICAN WHITEWATER

NEW ENGLAND *FLOW*~~~~~~~~

CONTROLLED FLOW STUDY INVITATION

Dear Whitewater Controlled Flow Study Participant:

We are seeking paddlers for a Whitewater Controlled Flow Study on the Connecticut River on May 30th & 31st as part of a FERC relicensing. The section in question is located at Bellows Falls, VT, close to Route 91.

Purpose of the Study

The purpose of the Whitewater Controlled Flow Study is to identify minimum acceptable and optimum flows for whitewater paddling on the Bellows Falls section of the Connecticut River. Flows on this reach of the Connecticut River fluctuate under normal conditions principally as a result of the hydropower operation of the Bellows dam by TransCanada. Under normal operating conditions, all of the water that would otherwise flow through the .7-mile natural river channel is instead diverted through a canal to TransCanada's powerhouse before flows rejoin the river. As a result, the natural river channel, or bypassed reach, is left dewatered except for leakage and when high flows on the Connecticut River exceed the generating capacity of the hydropower project. This study is one of a series of studies undertaken by TransCanada as part of the relicensing of their facilities on the Connecticut River. Flow studies were also conducted at Sumners Falls and Turners Falls on the Connecticut River last year.

With water restored to the natural river channel, Bellows Falls contains a series of rapids and play features. This section includes a several drops, waves, chutes and swirling eddies that provide opportunities for playboating, possibly squirt boating, skill building and instruction. The difficulty level of these rapids has not been determined, but we believe that individuals who are capable of boating rivers up to Class IV and have a solid roll are qualified to participate in the flow study. Participants will be asked to evaluate the quality of the play features at various flow levels as part of the flow study.

At the lower portion of the bypassed reach, there is a low-head fish stopper dam that was built to divert fish from the bypassed reach and into a fish ladder in the power canal. We will not be evaluating the recreational benefits of the low-head dam as part of this study, and will be seeking to remove this dam through the relicensing process. Study participants will not be running the dam during the flow study.

The study is being conducted by Louis Berger Group for TransCanada in collaboration with American Whitewater, the Appalachian Mountain Club, and New England *FLOW*. We will use this study to develop environmental and recreational proposals for an annual schedule of

whitewater releases that balances hydropower generation with environmental and recreational needs.

Schedule and Commitment

The Whitewater Controlled Flow Study will take place on May 30th & 31th in Bellows Falls, VT. We will be evaluating various flows throughout the weekend. TransCanada will be providing hotel lodging for the study on Friday and Saturday nights, and food (or a food allowance) will be provided.

Please note that the study requires a commitment from you for **2 full days**, and it is necessary that you commit to both days in order to participate in the study. (If the flow levels exceed your abilities, of course you can skip those tests.) If for any reason the study needs to be cancelled due to unexpected flows, it will be rescheduled.

Prior to the start of each day, there will be a **mandatory** orientation meeting in which we will discuss the planned flows, the responsibility of each participant, and the safety plan. These meetings will consist of a detailed review and orientation to the questionnaires and the detailed logistics for each day.

All study participants will be required to sign a liability waiver.

PLEASE NOTE: Only those boaters who have completed the attached Boating Participation Survey will be allowed to participate in the flow study.

Study Plan and Logistics

The Whitewater Controlled Flow Study will involve paddling the Bellows Falls Bypassed Reach at several flow levels. After each flow level, you will be asked to evaluate specific characteristics of the river, as well as the quality of your experience using a standard survey questionnaire. At the end of the 2-day evaluation period, or after you have experienced several different flows, you will be asked to complete a comparative survey questionnaire allowing you to identify your preferred flow for the respective runs. The intent of the study is to collect information about experiences in the flows being tested, so it is important that your responses to the survey questions be as accurate as possible.

If you decide that progressively higher flows are beyond your ability you may withdraw from that test; however, we expect you to remain as part of the study to complete the day's study forms and assist your fellow boaters.

Responsibilities

Boaters will be selected based on their whitewater experience, type of craft, and most importantly, their judgment, ability to work as a team member and ability to represent the interests of the paddling public.

We are asking you to join this select group because you;

5) Have a skill set and experience that ranges from beginner (Class I) up to and including expert (Class V+) and can represent paddlers and river recreationists in one of the following categories: kayaks, canoes.

6) Belong to regional organizations whose members and the paddling public at large are key resource constituents and beneficiaries of paddling opportunities on the Connecticut River;

7) Have a strong history of conservation volunteerism and/or other support for American Whitewater, the Appalachian Mountain Club, and New England *FLOW*;

8) Will be committed to communicate your test participation by sharing your experience on this study with your local paddling community or organization (writing articles, speaking, etc.);

Most importantly, have the sense to know when to follow as well as lead when called upon.

RSVP by May 22, 2015, by filling out the attached Sumner Falls Boating Participant Survey

Mail or email the completed Boater Information Form To:

Bob Nasdor
65 Blueberry Hill Lane
Sudbury, MA 01776

Tel: (617) 584-4566
Email: bob@americanwhitewater.org

If you have any questions about the study or need further clarification, please contact me @ (508) 331-4889 or (978) 728-4544, AW's Bob Nasdor @ (617) 584-4566, or AMC's Norman Sims @ (413) 774-2970.

We appreciate your participation in this important study.

Sincerely,

Tom Christopher
New England FLOW

Bob Nasdor
American Whitewater

Norman Sims
Appalachian Mountain Club

Bellows Falls Boating Study
Boating Participant Survey

Your name: _____

Part I

1. How many years have you been taking trips to this location? _____ years

2. Are you an outfitter, guide, or private river user?
- ☐ Outfitter
- ☐ Guide
- ☐ Private User
- ☐ Other_____

3. How would you rate your own skill level?
- ☐ Beginner (some previous boating experience)
- ☐ Intermediate
- ☐ Advanced
- ☐ Expert

4. Do flow levels influence whether or not you take a trip?
- ☐ Yes
- ☐ No

5. Do flow levels influence how you take trips (when you go, what craft you use, which rapid you run, how much gear you take, etc.)? If yes, please describe below.

_____
_____

Part II

How would you describe yourself as a boater (what type of boater are you?):_____
_____
_____
_____
_____
_____
_____
_____

What type of watercraft do you generally use for whitewater paddling?

Hard shell kayak	Stand up paddle board
Inflatable kayak	C2

OC1	Raft
OC2	Cataraft
C1	Other (describe):_____

How many years have you been using this type of watercraft? Years

How would you rate your skill level with this type of watercraft? *(Circle one – whitewater classifications defined on next page)*

Novice (comfortable running Class II whitewater)

Intermediate (comfortable running Class III whitewater)

Advanced (comfortable running Class IV whitewater)

Expert (comfortable running Class V whitewater)

In general, how many days per year do you spend whitewater boating?

What is your age?

Are you □ male or □ female?

Have you boated at Sumner Falls on the Connecticut River before? Yes_____ No_____

Please respond to each of the following statements about your river-running preferences.

	Strongly disagree	Moderately disagree	Slightly disagree	No Opinion	Slightly agree	Moderately agree	Strongly agree
I often run rivers with Class II and III rapids.	1	2	3	4	5	6	7
I often run rivers with difficult rapids (Class IV-V).	1	2	3	4	5	6	7
Running challenging whitewater is the most important part of my boating trips.	1	2	3	4	5	6	7
I often boat short river sections (under 4 miles) to take advantage of whitewater play areas.	1	2	3	4	5	6	7

	Strongly disagree	Moderately disagree	Slightly disagree	No Opinion	Slightly agree	Moderately agree	Strongly agree
I often boat river segments to experience a unique and interesting place.	1	2	3	4	5	6	7
I often boat short river segments to run challenging rapids.	1	2	3	4	5	6	7
I select boating opportunities based on length and experience regardless of difficulty.	1	2	3	4	5	6	7
I am willing to tolerate difficult put-ins and portages (boat carries in excess of 1,000 feet over unimproved footpaths) in order to run interesting reaches of whitewater.	1	2	3	4	5	6	7
I often boat rivers that feature large waves and powerful hydraulics.	1	2	3	4	5	6	7
I often boat steep technical rivers.	1	2	3	4	5	6	7
I enjoy boating both difficult and easy rivers.	1	2	3	4	5	6	7

Class I – Fast moving water with riffles and small waves. Few obstructions, all obvious and easily missed with little training. Risk to swimmers is slight; self-rescue is easy.
Class II – Straightforward rapids with wide, clear channels which are evident without scouting. Occasional maneuvering may be required, but rocks and medium-sized waves are easily missed by trained paddlers. Swimmers are seldom injured and group assistance, while helpful, is seldom needed.
Class III – Rapids with moderate, irregular waves which may be difficult to avoid and which can swamp an open canoe. Complex maneuvers in fast current and good boat control in tight passages or around ledges are often required; large waves or strainers may be present but are easily avoided. Strong eddies and powerful current effects can be found, particularly on large-volume rivers. Scouting is advisable for inexperienced parties. Injuries while swimming are rare; self-rescue is usually easy but group assistance may be required to avoid long swims.

Class IV – Intense, powerful but predictable rapids requiring precise boat handling in turbulent water. Depending on the character of the river, it may feature large, unavoidable waves and holes or constricted passages demanding fast maneuvers under pressure. A fast, reliable eddy turn may be needed to initiate maneuvers, scout rapids, or rest. Rapids may require "must" moves above dangerous hazards. Scouting may be necessary the first time down. Risk of injury to swimmers is moderate to high, and water conditions may make self-rescue difficult. Group assistance for rescue is often essential but requires practiced skills. A strong eskimo roll is highly recommended.
Class V – Extremely obstructed, or very violent rapids which expose a paddler to added risk. Drops may contain large, unavoidable waves and holes or steep, congested chutes with complex demanding routes. Rapids may continue for long distances between pools, demanding a high level of fitness. What eddies exist may be small, turbulent, or difficult to reach. At the high end of the scale, several of these factors may be combined. Scouting is recommended but may be difficult. Swims are dangerous, and rescue is often difficult even for experts. A very reliable eskimo roll, proper equipment, extensive experience, and practiced rescue skills are essential.

RSVP by May 22, 2015, by filling out the attached Sumner Falls Boating Participant Survey

Mail the completed Boater Information Form To:

Bob Nasdor
65 Blueberry Hill Lane
Sudbury, MA 01776

Tel: (617) 584-4566
Email: bob@americanwhitewater.org

If you have any questions about the study or need further clarification, please contact me @ (508) 331-4889 or (978) 728-4544, AW's Bob Nasdor @ (617) 584-4566, or AMC's Norman Sims @ (413) 774-2970.

Appendix B: Study Participants

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Table B-1. Sumner Falls participant profile

Name	Age	Skill level	Years' experience	Days per year boating	Type of watercraft for paddling
Andrew Fournier	27	Advanced	7	50	Hard shell kayak
Art Keating		Expert			Hard shell kayak
Bob Nasdor	54	Intermediate	11	20	Hard shell kayak
David McElwain	50	Expert	24+	60+	Squirtboat
David Su	61	Expert	33	120	Everything but inflatable kayak
Jesse Nicola		Intermediate			Hard shell kayak
Mike Beers	41	Intermediate	6	20+	Hard shell kayak
Orli Gottlieb	24	Advanced	5	20	Hard shell kayak
Paula Townsend		Intermediate			Hard shell kayak
Pauline Boyce	36	Intermediate	6	12	Hard shell kayak
Rob Schafsteck		Intermediate			Hard shell kayak
Robert Breau	30	Intermediate	3	10	Stand up paddle board
Seth Kallman	58	Advanced	25	30+	Hard shell kayak
Skip Morris	59	Advanced	39	50-75	OC1
Tad Martin	52	Advanced	20+	60+	Hard shell kayak
Tom Christopher	70	Expert	30	20-60	Hard shell kayak
Tracy Kallman	58	Intermediate	1	30+	Cataraft
Tracy Wilson	45	Intermediate	17	20+	Hard shell kayak

Note: blank cells indicate missing information from the pre-run survey

Table B-2. Sumner Falls pre-run boater questionnaire river running preferences (7=Strongly Agree, 4=No opinion, 1=Strongly disagree)

Name	I often run rivers with Class II and III rapids	I often run rivers with difficult rapids (Class IV-V)	Running challenging whitewater is the most important part of my boating trips	I often boat short river section (<4mi) to take advantage of play areas	I often boat river segments to experience a unique and interesting place	I often boat short river segments to run challenging rapids	I select boating opportunities based on length and experience regardless of difficulty	I'm willing to tolerate difficult put-ins and portages in order to run interesting reaches	I often boat rivers that feature large waves and powerful hydraulics	I often boat steep technical rivers	I enjoy boating both difficult and easy rivers
Andrew Fournier	6	7	6	6	7	7	6	6	6	6	7
Bob Nasdor	7	2	3	6	4	5	3	5	5	4	7
David McElwain	7	6	4	6	7	5	5	7	7	3	5
David Su	7	7	7	7	7	7	1	7	7	7	7
Mike Beers	7	5	3	5	6	5	5	5	3	5	6
Pauline Boyce	7	2	2	5	7	5	3	7	2	2	6
Robert Breau	7	2	5	5	7	4	5	5	5	2	7
Seth Kallman	7	2	6	7	7	5	5	7	6	1	7
Skip Morris	6	7	6	5	5	6	3	blank	7	blank	4
Tad Martin	7	6	3	5	7	3	2	5	5	3	6
Tom Christopher	6	7	5	6	6	6	6	7	7	7	7
Tracy Kallman	7	1	1	5	7	1	5	7	4	1	5
Tracy Wilson	7	5	3	3	6	5	5	3	2	5	6
AVERAGE	**7**	**4**	**4**	**5**	**6**	**5**	**4**	**6**	**5**	**4**	**6**

Note: Participants who did not completely filled out the pre-run survey are not included here.

Table B-3. Bellows Falls boater participant profile.

Name	Age	Skill level	Years' experience	Days per year boating	Type of watercraft for paddling
Bob Nasdor	54	Intermediate	11	20	Hard shell kayak
Chris Ingram	36	Expert	18	15	Hard shell kayak
Clay Murphy	28	Expert	8	60	Hard shell kayak
David Su	61	Expert	33	120	Hard shell kayak, OC1
Jim Dowd	67	Advanced	35	30	Hard shell kayak
Jim Michard	76	Advanced	48	60	OC1
Kevin Lindberg	52	Advanced	12		Hard shell kayak
Mark Stevens	56	Advanced	24	70-100	Hard shell kayak
Seth Kallman	59	Advanced	25	30+	Hard shell kayak
Skip Morris	60	Advanced	40	40-75	OC1
Tad Martin	52	Advanced	20+	60+	Hard shell kayak

Notes: Tom Christopher and Norm Sims were safety at bottom of run on land; Seth Kallman was safety in the water from his boat on the first day and from land on the Vermont side the second day.

Table B-4. Bellows Falls pre-run boater questionnaire river running preferences (7=Strongly Agree, 4=No opinion, 1=Strongly disagree)

Name	I often run rivers with Class II and III rapids	I often run rivers with difficult rapids (Class IV-V)	Running challenging whitewater is the most important part of my boating trips	I often boat short river section (<4mi) to take advantage of play areas	I often boat river segments to experience a unique and interesting place	I often boat short river segments to run challenging rapids	I select boating opportunities based on length and experience regardless of difficulty	I'm willing to tolerate difficult put-ins and portages in order to run interesting reaches	I often boat rivers that feature large waves and powerful hydraulics	I often boat steep technical rivers	I enjoy boating both difficult and easy rivers
Bob Nasdor	6	6	6	7	5	6	2	3	6	2	5
Chris Ingram	6	7	6	5	6	6	5	7	6	7	7
Clay Murphy	7	7	6	3	6	7	1	7	7	7	7
David Su	7	7	7	7	7	7	1	7	7	7	7
Jim Dowd	7	6	5	6	7	7	7	7	7	7	7
Jim Michard	7	5	2	6	6	7	2	3	6	6	6
Kevin Lindburg	5	7	7	6	5	6	3	3	6	4	6
Mark Stevens	5	5	2	5	5	4	5	6	5	5	7
Seth Kallman	7	5	3	7	6	3	4	4	6	4	7
Skip Morris	7	7	6	2	5	5	4	1	6	6	6
AVERAGE	6	6	5	5	6	6	3	5	6	6	7

Table B-5. Bellows Falls bypassed reach boater participation by flow.

Name	Flow 1	Flow 2	Flow 3	Flow 4	Flow 5	Flow 6	Flow 7	Flow 8	Flow 9
	2,370	3,300	4,370	5,560	1,580	2,020	2,900	7,400	9,660
Bob Nasdor	x	x	x		x				
Chris Ingram	x	x	x	x	x	x	x	x	x
Clay Murphy	x	x	x	x	x	x	x	x	x
David Su	x	x	x	x	x	x	x	x	x
Jim Dowd	x	x	x	x					
Jim Michard	x	x	x		x				
Kevin Lindberg	x	x	x	x	x	x	x	x	x
Mark Stevens	x	x	x	x	x			x	x
Seth Kallman	x								
Skip Morris	x	x	x	x	x				
Tad Martin	x	x	x	x				x	x
Count	**11**	**10**	**10**	**8**	**8**	**4**	**4**	**6**	**6**

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Appendix C: Survey Tools

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SUMNER FALLS (HARTLAND RAPIDS) BOATING STUDY

Date: ____/ ___/ 2014 Your name: _____

Section A: General

1. How many years have you been taking trips to this location? _____years

2. Are you an outfitter, guide, or private river user? (circle one)
   - Outfitter
   - Guide
   - Private User
   - Other_____

3. How would you rate your own skill level? (circle one)
   - Intermediate
   - Advanced
   - Expert

4. Do flow levels influence whether or not you take a trip? (circle one)
   - Yes
   - No

5. Do flow levels influence ***how*** you take trips (when you go, what craft you use, which rapid you run, how much gear you take, etc.)? If yes, please describe below.

SUMNER FALLS (HARTLAND RAPIDS) BOATING STUDY

Date:_____/ ____/ 2014 Morning/Afternoon Flow: _____ cfs Your name: _____

Section B: Post-run Questions

1. What type of craft did you use for this run? *(Circle one)*
   Kayak: (hybrid · play boat · creek boat · river boat) Inflatable kayak Canoe (open decked)
   Other: _____

2. In general, what class (example: I–III+) was the whitewater difficulty at this flow? _____

3. Did you have any significant problems (e.g., had to swim, pinned, or wrapped a boat) during your run? Please provide a brief description and location of any incident (continue on back if needed).

4. Please evaluate the flow on this trip for your craft and skill level for each of the following characteristics. *(Circle one number for each item).*

	Totally Unacceptable			Marginal			Totally Acceptable
Boatability	1	2	3	4	5	6	7
Availability of technical rapids	1	2	3	4	5	6	7
Availability of powerful hydraulics	1	2	3	4	5	6	7
Availability of play boating areas	1	2	3	4	5	6	7
Overall whitewater challenge	1	2	3	4	5	6	7
Safety (due to flow levels)	1	2	3	4	5	6	7
Hazards present in river	1	2	3	4	5	6	7
Aesthetics of river/channel	1	2	3	4	5	6	7
Overall Rating	1	2	3	4	5	6	7

5. In general, would you prefer a generation release flow that was higher, lower, or about the same as this flow for the features you like? *(Circle one)*.
   a. Much lower flow
   b. Slightly lower flow
   c. About the same; this was close to the best flow
   d. Slightly higher flow
   e. Much higher flow

6. What is the minimum skill level necessary to successfully run this segment at this flow level? *(Circle one)*
   a. Novice (no previous boating experience)
   b. Beginner (some previous boating experience)
   c. Intermediate
   d. Advanced
   e. Expert

7. If this flow were provided periodically, are you likely to return for future boating? *(Circle one)*
   a. Definitely no
   b. Possibly
   c. Probably
   d. Definitely yes

SUMNER FALLS (HARTLAND RAPIDS) BOATING STUDY

Section B: Post-run questions continued

8. Which features in this rapid were best at this flow (list):

Sign Wave: _____

Main Wave:_____

A-hole:_____

Washing Machine:_____

Other(s):*name*_____

9. Additional comments for this flow:

SUMNER FALLS (HARTLAND RAPIDS) BOATING STUDY

Date:_____/ ____/ 2014 Your name: _____

Section C: Close-out Questions

1. Compared to other ***play spots***, how would you rate the boating opportunity at this location (assume optimal flows). *(Circle one number for each; if you are unsure about a comparison, leave that item blank).*

Compared to….	This play spot is……				
	Worse than average	Below Average	Average	Above Average	Much better than average
Other play spots within 2 hours of Sumner Falls (Hartland Rapid)	1	2	3	4	5
….other play spots in New England	1	2	3	4	5

2. Please provide overall evaluations for the Sumner Falls Rapid for the following flows for your craft and skill level. Please consider all the flow-dependent characteristics that contribute to high quality trips (e.g., boatability, whitewater challenge, safety, availability of surfing or other play areas, and aesthetics).*(If you do not feel comfortable evaluating a flow you have not seen, don't circle a number for that flow).*

Sumner Falls	Totally Unacceptable			Marginal		Totally Acceptable	
700	1	2	3	4	5	6	7
1000	1	2	3	4	5	6	7
1700	1	2	3	4	5	6	7
2000	1	2	3	4	5	6	7
2700	1	2	3	4	5	6	7
3500	1	2	3	4	5	6	7
5500	1	2	3	4	5	6	7
7000	1	2	3	4	5	6	7
9000	1	2	3	4	5	6	7
11000	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

SUMNER FALLS (HARTLAND RAPIDS) BOATING STUDY

Section C: Close-out Questions continued

3. Please specify the flows that you think would provide the following types of experiences on the reach.
(Note: It's okay to specify flows you have not observed, but which you think would provide the type of experience specified).

	Flow in cfs
What is the highest water level that a through canoe boater would run (above this they would portage) Note: a through canoe boater is considered someone making a downriver trip and may be packing provisions and gear for overnight stays along the river and not visiting the rapids solely to boat the Sumner Falls.	
Some people are interested in a more open experience at lower flows. Think of this lower flow experience in your craft.	
What is the lowest flow that provides an acceptable experience at this location?	
What is the best or optimal range of flows for a more open experience at this location?	_____to_____
Some people are interested in taking trips at somewhat higher flows that have stronger hydraulics but may offer less technical routes through rapids. Think of this "standard trip" in your craft. **What is the lowest flow that provides an acceptable experience for a standard trip at this location?**	
What is the best or optimal range of flows for this type of use at this location?	_____to_____
Some people are interested in taking trips at much higher flows that have more powerful hydraulics and larger waves. Think of this as "big water use" in your craft. **What is the lowest flow that provides an acceptable experience for a "big water" type of trip?**	
What is the best or optimal range of flows for this type of trip?	_____to_____
If TransCanada were to provide boating releases, what flows would you prefer?	

4. What are the best flows for each feature (list):

   a. Sign Wave_____

   b. Main Wave_____

   c. A-hole_____

   d. Washing Macine_____

   e. Others (name):_____

5. Additional comments:

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BELLOWS FALLS BYPASSED REACH BOATING STUDY

Bellows Falls Bypassed Reach Boating Study

Section A: Pre-Run Boater Information

1. Date: _____
2. Name:_____

3. What is your age?

4. Are you…
   - □ Male
   - □ Female

5. How would you describe yourself as a boater (what type of boater are you?):

6. What type of watercraft do you generally use for whitewater paddling? (Circle one)

Hard shell kayak	C2
Inflatable kayak	Raft
OC1	Cataraft
OC2	Other (describe):_____
C1	

7. How many years have you been using this type of watercraft? _____ Years

8. How would you rate your skill level with this type of watercraft? *(Circle one)*
   - □ Novice (comfortable running Class II whitewater)
   - □ Intermediate (comfortable running Class III whitewater)
   - □ Advanced (comfortable running Class IV whitewater)
   - □ Expert (comfortable running Class V whitewater)

9. In general, how many days per year do you spend whitewater boating?_____

10. Have you boated the Bellows Falls Bypassed Reach on the Connecticut River before? Yes_____ No_____

BELLOWS FALLS BYPASSED REACH BOATING STUDY

11. Please respond to each of the following statements about your river-running preferences.

	Strongly disagree	Moderately disagree	Slightly disagree	No Opinion	Slightly agree	Moderately agree	Strongly agree
I often run rivers with Class II and III rapids.	1	2	3	4	5	6	7
I often run rivers with difficult rapids (Class IV-V).	1	2	3	4	5	6	7
Running challenging whitewater is the most important part of my boating trips.	1	2	3	4	5	6	7
I often boat short river sections (under 4 miles) to take advantage of whitewater play areas.	1	2	3	4	5	6	7
I often boat river segments to experience a unique and interesting place.	1	2	3	4	5	6	7
I often boat short river segments to run challenging rapids.	1	2	3	4	5	6	7
I select boating opportunities based on length and experience regardless of difficulty.	1	2	3	4	5	6	7
I am willing to tolerate difficult put-ins and portages (boat carries in excess of 1,000 feet over unimproved footpaths) in order to run interesting reaches of whitewater.	1	2	3	4	5	6	7
I often boat rivers that feature large waves and powerful hydraulics.	1	2	3	4	5	6	7
I often boat steep technical rivers.	1	2	3	4	5	6	7
I enjoy boating both difficult and easy rivers.	1	2	3	4	5	6	7

12. Do flow levels influence ***how*** you take trips (whether or not to take a trip, when you should go, what craft you use, which rapid you run, how much gear you take, etc.)? If yes, please describe below.

BELLOWS FALLS BYPASSED REACH BOATING STUDY

Bellows Falls Bypassed Reach Boating Study

Section B: Post-run Questions

Date: ___/ ___/ 2015 Flow Number: _____ Flow _____ cfs Your name: _____

1. What type of craft did you use for this run? *(Circle one)*
   Kayak: (hybrid · play boat · creek boat · river boat) Canoe (open decked)
   Other: _____

2. Your whitewater skill level for the type of watercraft used?
   - □ Novice (comfortable running Class II whitewater)
   - □ Intermediate (comfortable running Class III whitewater)
   - □ Advanced (comfortable running Class IV whitewater)
   - □ Expert (comfortable running Class V whitewater)

3. In general, what class (example: II–V) was the whitewater difficulty at this flow? _____

4.(a) Did you have any significant problems (e.g., pinned, or wrapped a boat) during your run? Please provide a brief description and location of any incident.

4(b) Did you have any swims during your run? Please provide a brief description and location of any incident.

5. Please evaluate the flow on this trip for your craft and skill level for each of the following characteristics. *(Circle one number for each item).*

	Totally Unacceptable			Marginal			Totally Acceptable
Navigability	1	2	3	4	5	6	7
Availability of challenging technical rapids	1	2	3	4	5	6	7
Availability of powerful hydraulics	1	2	3	4	5	6	7
Availability of play boating areas	1	2	3	4	5	6	7
Overall whitewater challenge	1	2	3	4	5	6	7
Safety (due to flow levels)	1	2	3	4	5	6	7
Safety (due to debris or other in-channel physical hazards)	1	2	3	4	5	6	7
Number of hazards present in river	1	2	3	4	5	6	7
Aesthetics of river/channel	1	2	3	4	5	6	7
Length of run	1	2	3	4	5	6	7
Boating instruction potential	1	2	3	4	5	6	7
Overall Rating	1	2	3	4	5	6	7

BELLOWS FALLS BYPASSED REACH BOATING STUDY

6. In general, would you consider the minimum acceptable flow (enough flow for an enjoyable recreation experience) to be higher, lower, or about the same as this flow for the features you like? *(Circle one).*

□ Much lower flow
□ Slightly lower flow
□ About the same; this was the minimum flow
□ Slightly higher flow
□ Much higher flow

7. Relative to this flow, would you consider the optimum flow for this type of trip to be higher, lower, or about the same as this flow for the features you like? *(Circle one).*

□ Much lower flow
□ Slightly lower flow
□ About the same; this was the best flow
□ Slightly higher flow
□ Much higher flow

8. What is the minimum skill level necessary to successfully run this segment at this flow level?

□ Novice (no previous boating experience)
□ Beginner (some previous boating experience)
□ Intermediate
□ Advanced
□ Expert

9. What features or characteristics in this segment, at this flow, contributed to the score in question 8?

10. List the primary advantages of this flow…..

11. List the primary disadvantages of this flow…

BELLOWS FALLS BYPASSED REACH BOATING STUDY

Section C: Close-out Questions

Name _____

1. Please provide overall evaluations for Bellows Falls Bypassed Reach for the following flows for your craft and skill level. Please consider all the flow-dependent characteristics that contribute to high quality trips (e.g., boatability, whitewater challenge, safety, availability of surfing or other play areas, and aesthetics).

Bellows Falls	Totally Unacceptable			Marginal		Totally Acceptable	
2,500	1	2	3	4	5	6	7
3,500	1	2	3	4	5	6	7
4,500	1	2	3	4	5	6	7
5,500	1	2	3	4	5	6	7
7,500	1	2	3	4	5	6	7
10,000	1	2	3	4	5	6	7

2. Compared to other *river reaches of similar difficulty*, how would you rate the boating opportunity at this location (assume optimal flows). *(Circle one number for each; if you are unsure about a comparison, leave that item blank).*

Compared to river reaches of similar difficulty to….	This reach is……..				
	Worse than average	Below Average	Average	Above Average	Much better than average
Other reaches within 2 hour drive, this reach is….	1	2	3	4	5
….other reaches in New England, this reach is….	1	2	3	4	5

3. Please specify the flows that you think would provide the following types of experiences on the bypassed reach.
(Note: It's okay to specify flows you have not observed, but which you think would provide the type of experience specified).

	Flow in cfs
What is the lowest flow that you consider acceptable for a minimum quality whitewater experience?	
What flow provides the highest quality (i.e., optimal flow) whitewater experience?	
What is the lowest flow level that provides a safe run?	
What is the highest flow level that provides a safe run?	
What is the highest flow level you would consider running?	

4. Please evaluate the boating access for this segment of the bypassed reach (circle one):

	Totally Unacceptable			**Marginal**			**Totally Acceptable**
Put-in/take out							
Amount of parking	1	2	3	4	5	6	7
Parking proximity to put-in	1	2	3	4	5	6	7
Trail:							
Slope	1	2	3	4	5	6	7
Temporary amenities	1	2	3	4	5	6	7
Ease of reaching put-in from parking	1	2	3	4	5	6	7

5. Interest in variability in flows and its importance

	Totally Unacceptable			**Marginal**			**Totally Acceptable**
Interest in variability in flows in this segment:	1	2	3	4	5	6	7
Importance in variability in flows in this segment	1	2	3	4	5	6	7

Section D: End of Study Focus Group Discussion Topics

1. Identify challenging features, play areas, rapids or sections and rate their difficulty (use aerial)
2. Discuss advantages and disadvantages of each flow
3. Preferred flow ranges
4. Access
5. Who is the potential typical user
6. Highest and lowest flows that provide safe runs
7. Overall evaluation on the range of water flows available

Appendix D: Boater Comments

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Boater comments

Sumner Falls

Other comparable play spots:

- Wave-o-saurous park and play wave on the Connecticut River near Holyoke, Massachusetts.
- T-ville park and play spot – on the Farmington River near East Granby, Connecticut at Tariffville Park (Simsbury) to Highway 187 (Tariffville Gorge) run.
- Pemigewasset (Pemi park & play spot) – on the Pemigewasset River near Bristol, New Hampshire at the end of the Ayers Island dam (Bristol) to Coolidge (Bristol Gorge) run.

Other general notes:

- During our break on the first day as the river was rising for the afternoon test session a group of through paddlers in canoes portaged the rapids (4 canoes loaded with gear)
- Gate typically locked until Memorial Day missing the spring shoulder season
- Good place to keep skills seasoned
- No shuttle, predictable, info readily available

Specific flow notes:

3,750 cfs

- Harder for beginners because there are less eddies and more rocks and more swirly water
- Little more water would be better
- Squirt boat found lots of swirly water at this level for mystery moves
- Island shows up above the Main Wave which makes it easier to walk up to top and put in again
- Top of Main Wave was glass and best at this level
- Safety was an issue as more exposed and shallow rocks – especially of note from the paddleboarder
- Too scratchy for a raft and open boats.
- At this level, boating Main Wave is not so good, but it gets interesting in other places. New waves show up at the top; Main Wave is not as deep and can't surf it but there are micro eddies that show up.
- Main Wave at this level starts breaking on one side but as the river rises from here, the transition up produces some real good conditions at Main Wave.
- As a new person to this spot this was a good starting level to explore the area

4,700 cfs

- Best for novices/beginners/really favorable for beginners
- Great location for teaching new boaters on the main wave as its pretty safe with large pool immediately downstream if boaters swim

- Great surfing rides on Main Wave at this level, clean, consistent wave
- Good eddy service into Main Wave
- Very satisfied with this flow
- Anything a touch lower than 5,000 cfs here is what I really like
- Lots of beach/rest areas near Main wave
- Good viewing areas/island easy to access
- Only 1 main feature to surf for the better boaters (Main wave)
- Rocky, shallow, only 1 wave; not interesting for downriver running
- Other features are for advanced boaters (e.g., A-hole, washing machine) as they are retentive
- A-hole and washing machine are real sticky and tough for beginners
- Very good at this level for many features
- Very good training area for multiple levels and good surfing wave on Main Wave

6,700 cfs

- More limited waves at this flow; better for longer boats on the main wave
- Sign wave didn't come in
- Features were easier to obtain at the 4,700 cfs flow than this level
- More available runs through the rapid at this flow; this was my favorite flow level; there were lots of good options for play and lines to run
- Faster, harder waves to get to
- 8-9 clean lines at this level, Right-Center slot next to Main Wave really opened up
- Faster, more clean lines over ledges downstream of Main Wave/different features opened up and more features above Main Wave
- Below Main Wave the Bottom Section Area is a great teaching spot for beginners with little consequences; rest of rapid not good for beginners
- Better open boat level, bigger surface area can be supported
- Of all the flows I felt this was my least favorite. My favorite wave was washed out and the big water waves were not present. I would not travel for this level.
- This level not very good for whitewater recreation. Would be good for teaching beginners and newer paddlers and instructors.
- The open canoe does better with the higher flows compared to the kayak.

7,800 cfs

- Little pushy in spots for canoes, but I liked it.
- Washing machine slot was nice and runnable for a canoe at this level
- Less rocks for paddle boarder and canoe to hit.
- Squirt boat – pushier at this level but not terrible
- Main Wave flushes out at around 7,000 cfs, still fun waves below ledges – always fun spots for boaters if Main Wave isn't in.
- Sign Wave isn't in at this flow
- Duck Pond washed out, gets meaty and ledges aren't big enough to get in there
- Still no safety issues – all easy swims if needed

- Great fun for the cataraft, bigger and more interesting run through the Right Center slot
- Cataraft users paddled into a small surfing wave at the bottom of Right Center slot.
- From here and rising, broadest spectrum of spots where boaters could pick their fun. Although Main Wave washed out there are plenty of other features to boat and have fun. Collectively, looked and felt this was the most fun level without Main Wave or Sign Wave.

13,000 cfs

- All features washed out below Sign Wave, this is the main attraction on the New Hampshire side of the river near the big warning sign.
- As the water came up it got pushy and moved boaters off the wave; at 13,000 it was the ideal wave with good retentive properties.
- Nice big water feel at this level, loved it
- Canoeing was fun at this level; not much play in the large OC1 but good on the fly surfing
- No problems, just fun
- There are so many features here that I think folks with a range of abilities can safely enjoy whitewater here. Novices and beginners can practice basic skills at the bottom and work their way into some of the more challenging rapids here. The quality of challenging, safe, sun whitewater here would be incredible to have regular access to. I would defiantly come here to surf at the Sign Wave in the summer.
- More water might wash out Sign Wave, good eddy service at this level. Overall fun park and play
- I really like the high flow a lot
- This was one of my less than favorite flows, it was fine but the technical features were gone so it wasn't as much fun.
- The play feature at Sign Wave is the big attraction at this level. This is a class A feature.
- This is a one feature level.
- Cataraft can run anywhere at this level.
- Lots of really fun channels open up. Some creek lines, big waves and holes. I really enjoyed this level.

Boater Comments

Bellows Falls bypassed reach

1,580 cfs

Advantages

- Above put-in would be great for beginner whitewater instruction.
- Better chance of zipping around the river, especially if the rocks were rearranged (Whitewater park).
- Great level for instruction, mellow enough for students, but enough interesting features to make it worthwhile.
- More technical boating because there are more rocks and features from shallow rocks.
- No other decent play
- Slow flows = friendly to newer boaters
- Slower current flow.

Disadvantages

- A swimmer is more likely to bash themselves on rocks if they swim.
- Bony for swims
- No powerful features
- None
- Not a lot of water covering rocks.
- Too lame for advanced boaters.

2,020 cfs

Advantages

- The play features started improving in both rapids.
- This seems to be the level that has most play.
- Top play hole, middle surf wave, bottom surf wave.
- Waves + Holes

Disadvantages

- If the top wave was at its best from yesterday at this flow, combined with the other features this would actually be something to get excited about.
- It needs a bit more flow, 2500ish to optimize the most amount of features.
- Middle beginner surf - previously omitted from surveys at head of the big river L staging eddy - not yet present.

2,370 cfs

Advantages

- 2-3 good features, two up top in "right turn" one at the bottom
- Easy paddling. For every skill level - good for teaching beginners & Intermediates.
- Good beach access when you arrive at the river. Depth of pool suitable for many and rollable…easy to see rapid below. At least two good play features. This section would be an excellent whitewater play park at this level if more features were installed.

- Good play features, flow was slow so easy to read
- Good surfing opportunities
- Nice wave train
- Real nice surf wave, near take-out!
- Surf waves
- There are some waves that have definition for surfing.
- Very nice play feature at that level

Disadvantages

- Carry to the put-in was horrendous. Take-out was worse. Suggest improve access. Low head dam below the place we took out should be removed (a) because it is an extreme safety hazard and (b) to take advantage of one existing public access on river left below low head dam and (c) create "additional" features.
- I found none other than the portage out
- Lack of features
- Little playability because of a limited number of surfing waves & playholes.
- Beyond teaching, this level would not attract many recreational boaters unless there were "no" other options, e.g. during droughts.
- Looks like many nice features are washed out
- None, I liked it.
- River access
- Sticky hole at top not playable
- The "boof" rock in the main rapid is not covered with water yet. (turn rapid)

2,900 cfs

Advantages

- Beginner surf at top. Beginner surf at middle staging eddy
- Can't think of any advantages.
- Good wave hole at top of rapid. Good wave at bottom rapid.
- The river is deep so a swim would be safer.

Disadvantages

- All features become less interesting.
- Bottom surf gone. Rocky walking at all levels.
- There were less eddies to catch. The waves were flushed out some so surfing was not good. Less definition over rocks.

3,300 cfs

Advantages

- Better surf wave at top of middle section, at bottom, and top/dam.
- Hard to identify and advantages at this flow
- Interesting right channel boatable in first rapid, Unboatable at 2,500 cfs
- Nice friendly waves
- None
- Smooth run, covering most rocks.
- There was one decent wave at the top of turn rapid. Less exposed rock.
- Very playable, was excellent in "long" Dagger RFM-MAX Kayak, surfed several waves, especially at the bottom. Shorter play boats seemed to have less fun.

- Wave trains, some play features.

Disadvantages

- boring
- Large play feature at bottom, hard to stay on. Eddy service could be better. Need to carry back up above feature.
- Less play features
- Lost some minor waves in middle section
- Lots of shallow long waves suited for boats longer than my 7 ft boat.
- Low head dam is seriously dangerous hazard because the rapids are big, powerful + pushy, a swimmer could be swept a long way downstream. Play features were enhanced at 3500 from 2500. Would be an even better "whitewater play park" with additional man-made features installed.
- Not high enough to be a big water run, to high to be interesting.
- Swift moving water could carry a swimmer over the dam.
- The wave trains are flushing out with less definition. There is less potential for catching waves on the fly. A faster boat would be more fun.
- Too short

4,370 cfs

Advantages

- Big waves, fast current
- Features are improving
- Good play level.
- Great surfing similar to 2500. A wider river allowing different moves to be made.
- Most playable features seem so far today. Multiple surf waves that were excellent. Several were easy to access via "elevator eddies" that permit one to paddle back up to play the same wave.
- Not much. The rapids were starting to wash out.
- Really, really nice wave-hole just downstream of put-in
- Surf wave at the top of first rapid
- The beginning wave of the main rapid was good surf. The boof rock is clean to hit.
- Very good teaching level. Can accommodate two good play spots. Beginners-experts. Safe swimming.

Disadvantages

- Low head dam - dangerous. 2) Put-in was difficult. Take-out was extremely hazardous. 3) Although existing natural features are very good, additional structures (man-made) would potentially create an outstanding section of river.
- A swim may be scary due to the close proximity of the dam under the bridge.
- Currents beaming, choppy, and pushy.
- Eddy service only to the small wave in the top section. Best wave, middle section, has no eddy service or walking path.
- Lack of playable features.
- Miserable death-chute after take-down
- None
- The flow is still flushing the bottom rapid.

- The river moves quickly towards the bottom dam now. The top ledge is getting nasty and people should avoid paddling near it.
- Too pushy

5,560 cfs

Advantages

- Big pushy waves & currents, a fun ride.
- Great surf wave just downstream of put-in. Spinning hole upstream of put-in.
- Lots of play spots, but 4500 was better.
- Provided juice for a big water feel those interested in that experience.
- Surf one wave
- Surfs were good at top and middle.
- The first feature (wave) in the first main rapid is fantastic.
- Top wave in main rapid still in

Disadvantages

- Getting pushy at take-out above terminal death slot.
- No other play features
- Not applicable for lesser skill boaters/paddlers. A swim at this level may take one a long way.
- Not too much in the way of interesting rapids, just a big wash.
- Several pour overs became boily at 5500 and now. More likely to flip boaters, steeper.
- The boof rock has turned into a powerful hole. The top ledge hole is more powerful. The water moves towards the bottom dam faster.
- The rest of the run is not very interesting.
- Tough to catch waves + play features unless one carries the boat up above the feature.

7,400 cfs

Advantages

- Big water play.
- Big water practice.
- Good depth.
- Good, hard, technical paddling & holes for advanced paddlers.
- It was fun to see the river at this flow.
- Starting to feel like genuine big water river

Disadvantages

- A swimmer would have difficulty & wash over dam.
- All features are fast and flat.
- Not many play features
- Short run. Area above put-in washed out. Chaotic.
- Shortness of run.
- Top ledge bad. No bottom surfs.

9,660 cfs

Advantages

- Big Water!
- Good last chance eddy on river right above 2nd dam. Roller coaster waves. No bad recirculating holes except top ledges.
- Large volume
- River fills in so one can run the wave train repeatedly without getting out of boat.
- Seal launch at top (above put-in). Launching off the waves. Huge eddy on left, fun wave trains, more water can be fun!
- Very fun to be on that much water, large wave trains.

Disadvantages

- 2 top ledges at 10K cfs. Short run (all flows). Mediocre ingress & egress (all flows).
- No major singular features.
- Safety of swimmers
- Scary for swimmer! May go a long way.
- Short run.
- Too short, features are washed out with lack of definition, no play, big holes, poor for instruction.

Appendix E: Photographs

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Sumner Falls Photographs

3,750 cfs – surfing Main Wave

3,750 cfs – Right center slot

Sumner Falls Photographs

3,700 cfs over ledges, Washing Machine in middle ground

4,700 cfs - Right Center slot wave

Sumner Falls Photographs

4,700 cfs – Washing machine

4,700 cfs – Main Wave surf

Sumner Falls Photographs

6,750 cfs – Right center slot washed over

6,700 cfs – Main Wave surf

Sumner Falls Photographs

6,700 cfs – Washing machine on right looking back to access area

7,800 cfs – Right center slot in foreground

Sumner Falls Photographs

7,800 cfs – Right center slot

7,800 cfs – Main Wave

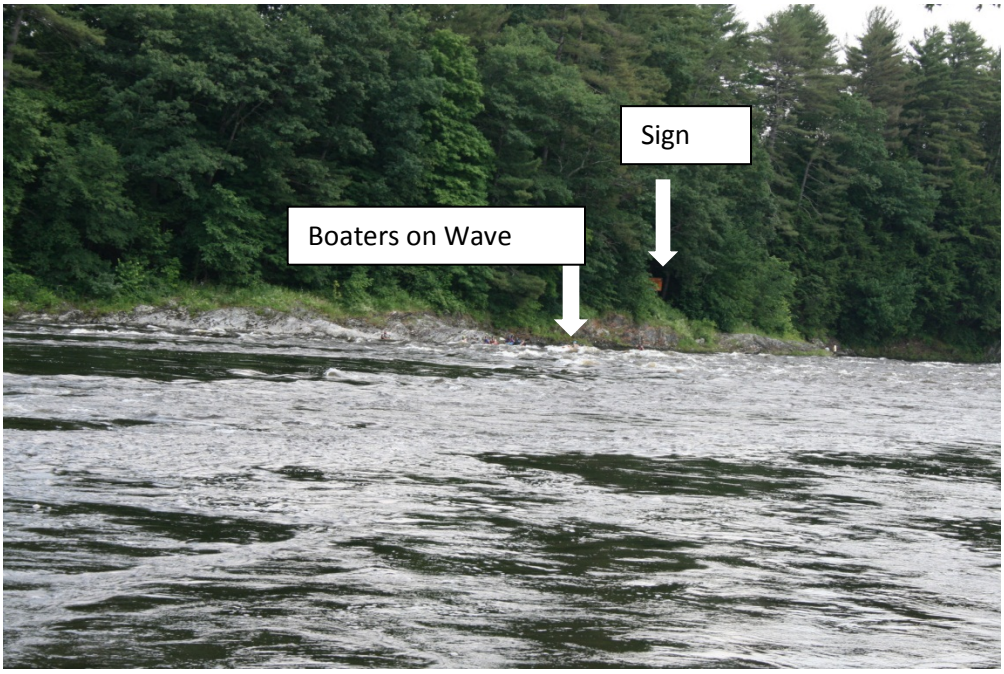
Sumner Falls Photographs

13,000 cfs – Right center slot

13,000 cfs – Right Center slot area

Sumner Falls Photographs

13,000 cfs – area near where Main Wave used to be



13,000 cfs – Sign wave

Sumner Falls Photographs

Close out surveys

Sumner Falls Photographs

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Bellows Falls Photographs

Put in Trail with hand rope

Second put-in trail with ladder, ropes and landscape cloth for boats

Bellows Falls Photographs

View up the put-in trail

1,580 cfs – Dome rock

Bellows Falls Photographs

1,580 cfs – First wave train

1,580 cfs – Second wave train

Bellows Falls Photographs

2,020 cfs – surfing in first wave train

2,020 cfs – surfing in second wave train

Bellows Falls Photographs

2,370 cfs – First wave train

2,370 cfs – Second wave train

Bellows Falls Photographs

2,900 cfs – surfing first wave train

2,900 cfs – surfing second wave train with first wave train in foreground

Bellows Falls Photographs

3,300 cfs – Dome rock feature near spillway

3,300 cfs – Top of wave train

Bellows Falls Photographs

3,300 cfs – Looking down at first wave train

3,300 cfs – OC1 (open canoe) through first wave train

Bellows Falls Photographs

3,300 cfs - Surfing second wave train

Bellows Falls Photographs

4,370 cfs – Dome rock near spillway

4,370 cfs – Surfing top of first wave train

Bellows Falls Photographs

4,370 cfs – First wave train

4,370 cfs – Second wave train

Bellows Falls Photographs

5,555 cfs – Dome Rock

5,555 cfs – Looking towards first wave train and beyond

Bellows Falls Photographs

5,555 cfs – First wave train

5,555 cfs – Top wave on first wave train

Bellows Falls Photographs

5,555 cfs – Second wave train washed out

7,400 cfs – Dome rock

Bellows Falls Photographs

7,400 cfs – surfing very top of first wave train

7,400 cfs – First wave train

Bellows Falls Photographs

9,660 cfs – Dome rock

9,660 cfs – First wave train

Bellows Falls Photographs

9,660 cfs – In first wave train

9,660 cfs – First wave train; note take out on left bank and safety on right shore

Bellows Falls Photographs

Completing surveys

Take out trail

Bellows Falls Photographs

Take out trail near top of trail at road