Upper Colorado River Recreational Flow Assessment
Preliminary Report

Introduction

In the summer of 2007, the Kremmling and Glenwood Springs field offices for the Bureau of Land Management (BLM) published a Wild and Scenic Eligibilty Report for the Upper Colorado Basin as a part of their Resource Management Plan revision process mandated by the Federal Land Policy and Management Act (FLMPA) (43 U.S.C. 1701 et seq.). The study details which river and stream segments meet the criteria to be eligible for federal Wild and Scenic River designation.

Out of the 244 segments identified and evaluated, 27 segments were determined eligible for future study. Of these segments, American Whitewater identified at least 11 segments where whitewater paddling occurs and where recreation needs assessments were needed. Recreation assessments are crucial to the management of these resources as they are the best way to determine the instream flows needed to maintain the recreational quality of these river segments. In the fall of 2007, American Whitewater conducted an online instream flow study for the Upper Colorado Basin, which included the eleven whitewater segments under consideration for the Wild and Scenic designation. The BLM in 2008 narrowed the eligible segments down to the four most promising sections for Wild and Scenic designation. This report details the results of the American Whitewater online survey as they pertain to the four main stem segments of the Upper Colorado River under consideration, which include Gore Canyon, Pumphouse, State Bridge to Dotsero, and Glenwood Canyon.

Methods

Instream flow survey data and the structural norm approach, a technique used to graphically represent social norms, have been utilized to examine the acceptability of instream flows on river stretches across the United States and Canada for over twenty years (Whittaker & Shelby, 2002). The graphic representation, commonly referred to as an impact acceptability curve, is used to describe optimum flows, ranges of tolerable flows, norm intensity and level of norm agreement (Shelby, Vaske, &, Donnelly, 1996). The potential for conflict index (PCI) takes the graphic representation of social norms one step further by displaying information about their central tendency, dispersion and form (Vaske, Needham, Newman, Manfredo, & Petchenik, in press). In this study we combine these techniques to describe the instream flow-whitewater recreation relationship for four segments of the Upper Colorado River.

Instream Flows

Instream flow is the amount of water in a river at a given time, measured in cubic feet per second (cfs). Instream flow regimes effect fish habitat, fish food resources, fish populations and other ecological resources, influencing the entire riparian environment (Bovee, 1996; Covington & Hubert, 2003). Flow levels also affect the channel features of

river systems including beaches, pools, waves, riffles, banks, woody debris and rocks (Hill, Platts & Beschta, 1991). Channel features affect the riparian habitat and are also critical to specific types of river recreation (Whittaker & Shelby, 2002). Market and non-market benefits linked to river tourism are also strongly affected by instream flow (Douglas & Taylor, 1998).

Controlled dam releases and out-of-stream diversions are the two main ways that humans alter instream flows and therefore, on river stretches with hydrologic projects and where Wild and Scenic designation is under consideration, flow management is a central issue. Instream flow can affect the recreation experience in a number of ways from determining whether a stretch is runnable or fishable, to whether a stretch will provide a technical low water trip or a high water, high challenge trip. Understanding the relationship between instream flows and natural resource values can aid in the creation of standards for recreation use (Whittaker & Shelby, 2002).

Structural Norm Approach and the Potential for Conflict Index

Impact acceptability curves take acceptability ratings of specific instream flows, measured at the individual level and then aggregate them to describe social norms by plotting the averages of individual's response evaluations (Shelby et al.,1996). The set of specific instream flows measured are displayed on the horizontal axis. Average evaluations are displayed on the vertical axis, with negative evaluations on the bottom, a neutral line in the middle, and positive evaluations on top (Whittaker & Shelby, 2002).

The peak of the curve represents the optimum flow. The range of flows with average evaluations above the neutral line represents the range of tolerable flows. The points where the curve intersects with the neutral line define the standards to be associated with minimum and sometimes maximum flow. The variation among evaluations at each flow level constitutes the crystallization of the norm, but is typically not visually displayed. In this study we use the Potential for Conflict Index (PCI) and its associated bubbles to describe crystallization graphically on the curve.

Surveys gathering data for use in the structural norm approach commonly measure variables using response scales with an equal number of response options surrounding a neutral center point. Numerical ratings are assigned in ordinal fashion with the neutral point being 0 (e.g. -3, -2, -1, 0, 1, 2, 3 where -3 = highly unacceptable, 0 = neutral, and 3 = highly acceptable.). The use of the potential for conflict index requires this common form of measurement. The PCI describes the ratio of scoring on either side of a rating scale's center point. The greatest possibility for conflict (PCI = 1) occurs when there is a bimodal distribution between the two extreme values of the response scale (e.g., 50% strongly support, 50% strongly oppose, 0% neutral). A distribution with 100% at any one point yields a PCI of 0 (i.e., no conflict). Following computation of the index, the results are displayed as bubble graphs. The size of the bubble depicts the PCI value and indicates the degree of dispersion (e.g., the degree of potential conflict over the acceptability of a flow level). Small bubbles indicate less potential agreement over the acceptability of a

specific flow; larger bubbles reflect more potential agreement. The center of the bubble, which is plotted on the Y axis, represents the mean score (central tendency) for the variable.

Internet Survey

An internet specific instream flow survey for the Upper Colorado River was conducted between in the summer of 2007. The survey was advertised on the American Whitewater website through a number of online and print media outlets. Paddlers experienced in running the Upper Colorado River were invited to take part in the survey. The study asked respondents to evaluate a wide range of variables related to the management of the Upper Colorado River. Respondents evaluated the acceptability of specific flows for eleven different stretches. Each flow was evaluated on a 7-point scale: totally unacceptable (-3), moderately unacceptable (-2), slightly unacceptable (-1), neutral (0), slightly acceptable (1), marginally acceptable (2) and totally acceptable (3). Acceptable flows, optimal flows, and norm crystallization were determined for all respondents.

Respondents were asked to identify their primary preferred craft type for running each stretch of the Upper Colorado River and their skill level in terms of the highest difficulty of whitewater they confidently paddled in their preferred craft type. Respondents were also asked to identify whether they were private, commercial guides or commercial customer paddlers. A set of open ended flow questions were asked for all stretches including respondent's minimum, standard, technical, high challenge and highest safe flow for their craft type.

Results and Discussion

There was a strong response for the Upper Colorado internet study with over 200 respondents (n=242). Compared with other internet surveys conducted by American Whitewater, such as the Wild and Scenic Crooked River in Oregon (n=45, Stafford and O'keefe, 2008), this was considered a large number of respondents. Of all respondents were private boaters, 4% were commercial guides, 1% were commercial customers and 12% considered themselves to be both private boaters and commercial guides. A majority of respondents were advanced paddlers as 80% considered themselves to be class IV paddlers or better, while 16% considered themselves to be class III/IV and 4% considered themselves class III paddlers.

Gore Canyon

Gore Canyon is located southwest of Kremmling, below the confluence of the Blue River with the Upper Colorado River near highway 9. Gore Canyon is an advanced (class V) whitewater run that is popular with paddlers in Colorado and across the United States. It is commercially rafted by rafting operations out of the Arkansas Valley, Summit County, Vail, Glenwood Springs, Fort Collins and Idaho Springs. Paddlers from across the region flock to Gore Canyon in the second half of the summer due to late season outflows from Dillon Reservoir into the Blue River, providing Gore Canyon with reliable flows from

late July through August, a time when most other whitewater runs in the state have dried up.

Gore Canyon respondents (n=92) overall found the minimum acceptable instream flow to be 700 cfs and the range of acceptable flows for the canyon to be between 700 and 2500+ cfs. The optimum overall flow was 1300 cfs (Figure 1). The potential for conflict index shows the lowest level of agreement between respondents for Gore Canyon over the acceptability of 700 cfs (PCI = .39). Figure 2 displays a possible reason for this disagreement, with kayakers on average finding 700 cfs to be acceptable while, rafters on average found 700 cfs to be an unacceptable level. Gore is an advanced and technical run for rafters and it is possible that at lower levels there is simply not enough room in the riverbed to safely negotiate the rapids in a raft at 700 cfs. Kayaks were the preferred craft for 75% of respondents, 13% preffered a raft, shredder or cataraft, and 10% would paddle either. Other crafts were such as whitewater canoes or inflatable kayaks made up 2% of respondents.

Agreement levels are extremely high (PCI < .05) over the unacceptability of flows under 500 cfs and over the acceptability of flows between 1100 and 1300 cfs. The differences between kayakers and rafts again surfaces as a possible explanation for greater disagreement at the higher end of the flow spectrum. Kayakers found higher flows more acceptable than rafters, although both found all flows above 900 cfs, on average, to be acceptable. Mean acceptability scores, standard deviation and PCI for each specific instream flow measured in Gore Canyon are displayed in Table 1.

Figure 1

Gore Canyon Potential for Conflict Index Curve

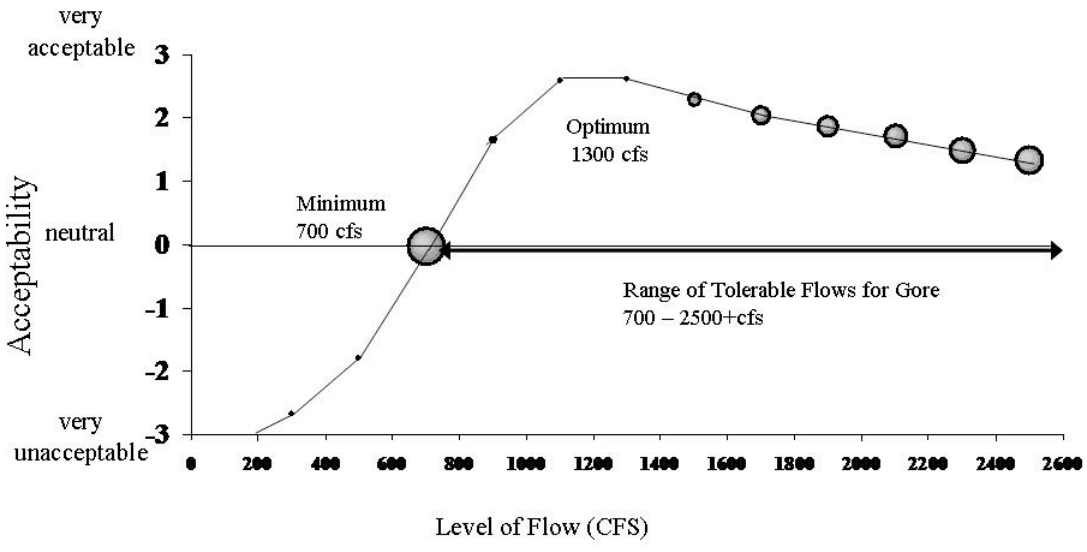
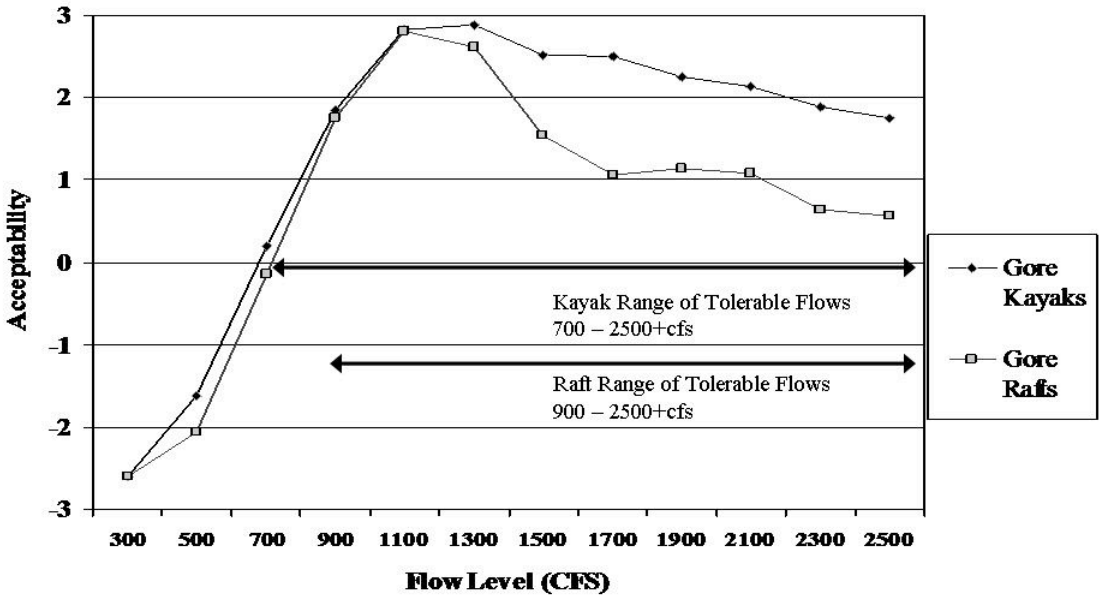


Table 1
Gore Canyon Mean Acceptability Scores, Standard Deviation and Potential for Conflict Index

Specific Flow CFS	Mean Acceptability	Standard Deviation	PCI
300	-2.68	0.72	0.00
500	-1.79	1.36	0.05
700	-0.02	1.61	0.39
900	1.66	1.35	0.07
1100	2.59	1.08	0.05
1300	2.62	1.00	0.04
1500	2.29	1.63	0.14
1700	2.05	1.80	0.19
1900	1.87	1.87	0.21
2100	1.71	1.90	0.23
2300	1.48	2.03	0.26
2500	1.34	2.09	0.30

Figure 2
Gore Canyon Impact Acceptability Curves for Kayaks vs. Rafts



Open ended flow related questions for Gore Canyon are displayed in Table 2. Open ended flow responses were consistent with the impact acceptability curve with a mean minimum acceptable flow of 714cfs, a mean standard whitewater trip flow of 1094 cfs, and a mean highest safe flow of 2402 cfs.

Table 2
Gore Canyon Open Response Instream Flow Results

	Minimum Acceptable Flow	Standard Whitewater Experience	Technical Whitewater Experience	High Challenge Whitewater	Highest Safe Flow
Mean cfs	**714**	**1094**	**759**	**1962**	**2402**
Low cfs Reported	300	750	300	1100	300
Max cfs Reported	1100	2000	1300	5000	20000

Pumphouse

Pumphouse begins downstream of Gore Canyon halfway between Kremmling and State Bridge. It shares a popular put-in/take-out with the Gore Canyon run and has a paddler friendly established campground there. Paddlers take-out at State Bridge, or upstream, a few miles at Yarmony Bridge. Pumphouse is a class III stretch of mellow and very scenic paddling suitable for almost any kind of watercraft. Pumphouse is used by a number of commercial recreation operations from all over state who provide guided float fishing, overnight rafting and kayak lessons. Like Gore, Pumphouse also benefits from the Blue River release season providing for reliable flows late into the summer.

Pumphouse respondents (n=85) overall found the minimum acceptable instream flow to be 900 cfs and the range of acceptable flows for the canyon to be between 900 and 2500+ cfs. Optimum flows were 1500+ cfs (Figure 3). The potential for conflict index shows the lowest level of agreement between respondents for Pumphouse over the acceptability of 700 cfs (PCI = .30). Kayaks were the preferred craft for 43% of respondents, 33% preffered a raft, shredder or cataraft, and 14% would paddle either. Other crafts were such as whitewater canoes or inflatable kayaks made up 6% of respondents.

Differences between kayaker and rafter flow preference did not factor into this disagreement as rafter and kayaker flow preferences for Pumphouse are nearly identical (Figure 4). It is possible that there is another variable involved that was not measured such as the differences between fisherman and general paddlers. Fisherman generally find lower flows more acceptable, even if they are floating the stretch (Whittaker & Shelby,

2002). Attributes of the fishing experience, such as defined eddy lines and pools, are better at lower flows, justifying the acceptability of slightly lower flows.

Agreement levels were high (PCI < .08) over the unacceptability of flows under 700 cfs and over the acceptability of flows over 1100 cfs. Paddlers were united over the strong acceptability of flows over 1100 cfs. Acceptability levels increased the higher the water level recorded, indicating that higher flows were optimum for paddling this stretch. This finding is consistent with other class III and below stretches where the degree of difficulty does not increase significantly with higher flows (Stafford and O'keefe, 2008; Whittaker & Shelby, 2002). Mean acceptability scores, standard deviation and PCI for each specific instream flow measured for Pumphouse are displayed in Table 3.

Figure 3

Pumphouse Potential for Conflict Index Curve

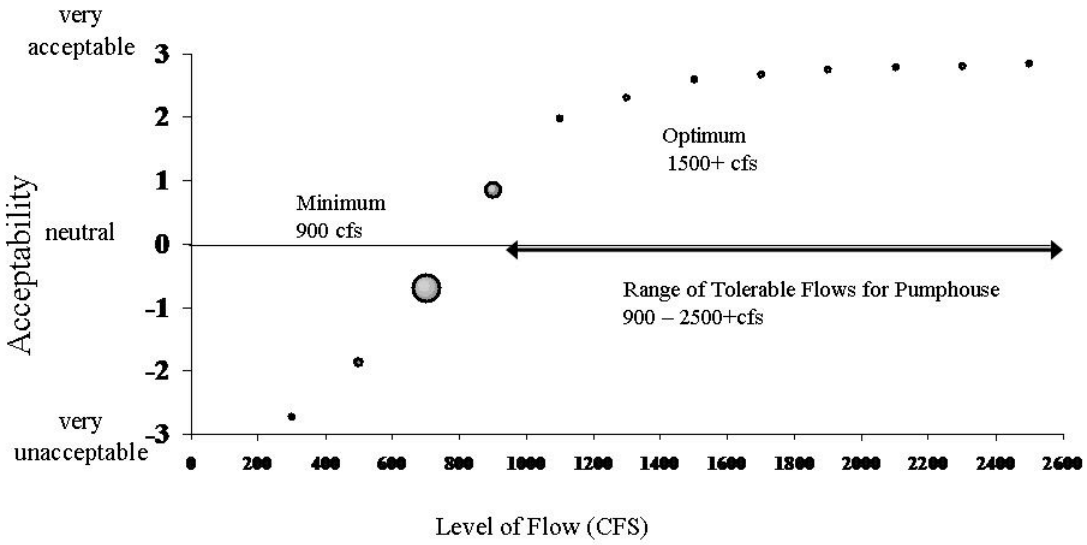
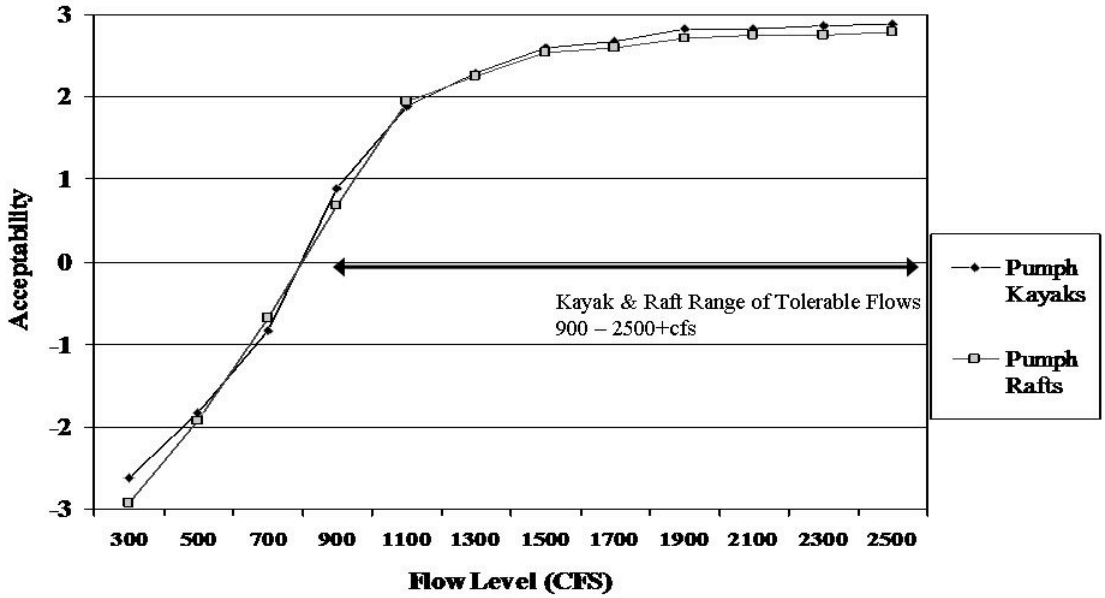


Table 3
Pumphouse Mean Acceptability Scores, Standard Deviation and Potential for Conflict Index

Specific Flow CFS	Mean Acceptability	Standard Deviation	PCI
300	-2.73	0.89	0.03
500	-1.87	1.45	0.08
700	-0.70	1.81	0.30
900	0.86	1.51	0.17
1100	1.98	1.34	0.05
1300	2.31	1.05	0.01
1500	2.60	0.89	0.01
1700	2.67	0.82	0.01
1900	2.76	0.80	0.02
2100	2.78	0.75	0.02
2300	2.81	0.74	0.02
2500	2.84	0.71	0.02

Figure 4
Pumphouse Impact Acceptability Curves for Kayaks vs. Rafts



Open ended flow related questions for Pumphouse are displayed in Table 4. Open ended flow responses were somewhat consistent with the impact acceptability curve. A mean minimum acceptable flow of 753 cfs was slightly lower than the curve, however where

the curve actually crosses the neutral line is approximately 800 cfs, a specific flow level which was not measured. The mean standard whitewater trip flow of 1297 cfs is consistent with the high acceptability of flows in that range. Around 1300 cfs is very commonly run flow level as this generally the reliable flow level during the late season releases. The mean highest safe flow of 7370 cfs indicates that this stretch can be paddled up to much higher water levels than were included in the impact acceptability portion of this survey.

Table 4
Pumphouse Open Response Instream Flow Results

	Minimum Acceptable Flow	Standard Whitewater Experience	Technical Whitewater Experience	High Challenge Whitewater	Highest Safe Flow
Mean cfs	**753**	**1297**	**808**	**3915**	**7370**
Low cfs Reported	300	650	350	900	850
Max cfs Reported	1500	2250	2250	25000	50000

State Bridge to Dotsero

The State Bridge to Dotsero segment of the Upper Colorado River is a nearly 40 mile stretch with mild whitewater and easy access. This stretch is great for car supported or boat supported overnight trips, has multiple access points and many different run options, many of which are suitable for beginners. Commercial fishing, rafting and kayaking operations utilize this segment for guided trips and lessons. From State Bridge to Burns is the most difficult section of whitewater in this segment, with class III difficulty for the majority of the run and one class IV rapid near the take-out. The class IV rapid is titled Burns Hole and is used as “playspot” for advanced paddlers to do tricks, similar to the features found at whitewater parks across the state. There is an upstream take-out, five miles above Burns, but the stretch below is one of the few along this segment where the river enters a canyon and leaves the road.

Below Burns there is little whitewater until the confluence with Sweetwater Creek. The stretch above Sweetwater is rarely run by whitewater paddlers, however float fisherman frequent this stretch for its serene pools and overhanging banks which provide ideal fish habitat. Below Sweetwater Creek there is a perfect stretch of beginner class II whitewater, with defined river features offering the novice paddler numerous opportunities to practice and fine tune their river running skills. Dotsero marks the confluence with Eagle River and also with Interstate 70.

Considering the variety of paddling stretches on this segment, American Whitewater broke up the State Bridge to Dotsero segment into two different study stretches, State Bridge to Burns and Burns to Dotsero. Respondents for both stretches overall found the minimum acceptable instream flow to be 900 cfs and the range of acceptable flows for the entire segment to be between 900 and 2500+ cfs. Optimum flows were 1300+ cfs (Figure 5). For State Bridge to Burns, kayaks were the preferred craft for 33% of respondents, 55% preferred a raft, shredder or cataraft, and 12% would paddle either. There was some disagreement between kayakers and rafters over the minimum acceptable flow levels, where kayakers found 1100 cfs to be the minimum acceptable flow, while rafters found 900 cfs to be acceptable. It is possible that the play features sought after by kayakers do not appear until the river reaches 1100 cfs.

For Burns to Dotsero, kayaks were the preferred craft for 37% of respondents, 49% preferred a raft, shredder or cataraft, and 14% would paddle either. The potential for conflict index shows the lowest level of agreement between respondents for Burns to Dotsero over the acceptability of 700 cfs (PCI = .38, Figure 7). Differences between kayaker and rafter flow preference did not factor into this disagreement as rafter and kayaker flow preferences for Burns to Dotsero are nearly identical (Figure 9). It is possible that other variables are involved or that 700 cfs is the cusp of acceptable flows and for some people it is barely acceptable, while for a slight majority it is barely unacceptable. Open ended flow responses support this idea, as the mean minimum flow reported was 838 cfs (Table 8).

For both stretches agreement levels were high (PCI < .08) over the unacceptability of flows under 700 cfs and over the acceptability of flows over 1100 cfs. Paddlers were united over the strong acceptability of flows over 1100 cfs. Acceptability levels increased for both stretches the higher the water level recorded, indicating that higher flows were optimum for paddling these stretches, similar to Pumphouse. Mean acceptability scores, standard deviation and PCI for each specific instream flow measured for State Bridge to Burns and Burns to Dotsero are displayed in Tables 5 and 6.

Figure 5

State Bridge to Burns and Burns to Dotsero Impact Acceptability Curves

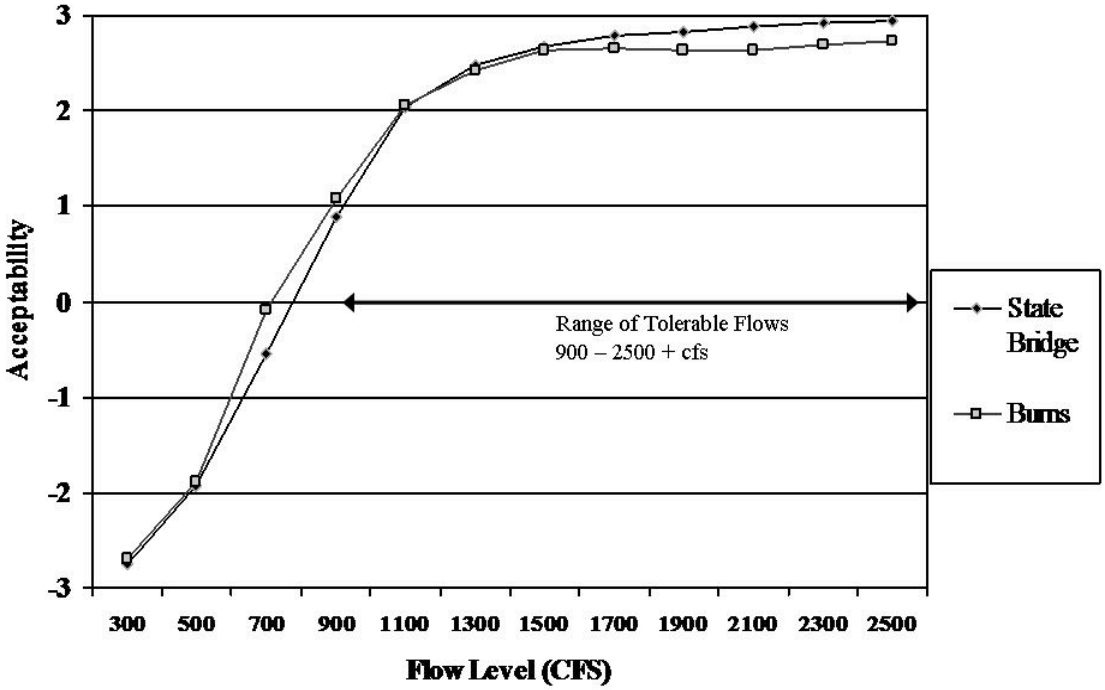


Figure 6

State Bridge to Burns Potential for Conflict Index

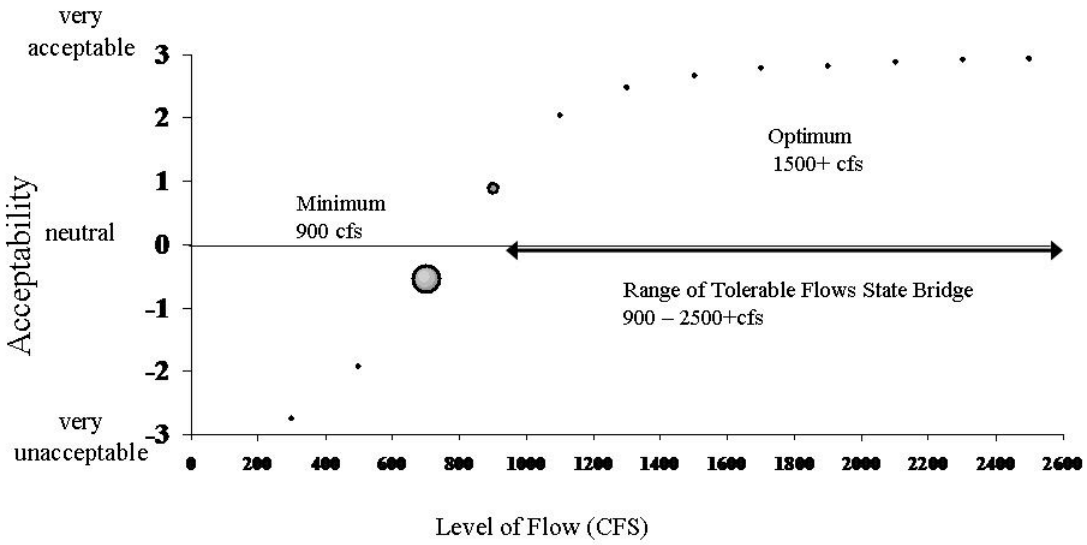


Table 5

State Bridge to Burns Mean Acceptability Scores, Standard Deviation and Potential for Conflict Index

Specific Flow CFS	Mean Acceptability	Standard Deviation	PCI
300	-2.76	0.68	0.00
500	-1.92	1.30	0.04
700	-0.55	1.69	0.28
900	0.89	1.39	0.11
1100	2.05	1.26	0.05
1300	2.49	1.02	0.03
1500	2.68	0.80	0.02
1700	2.78	0.63	0.00
1900	2.83	0.45	0.00
2100	2.89	0.32	0.00
2300	2.92	0.28	0.00
2500	2.94	0.24	0.00

Figure 7

Burns to Dotsero Potential for Conflict Index

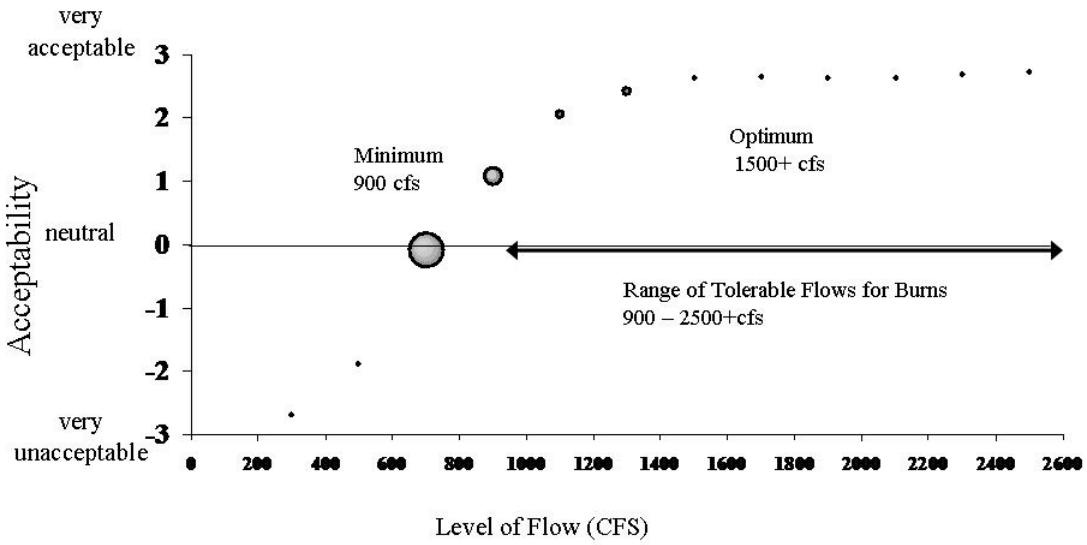


Table 6

Burns to Dotsero Mean Acceptability Scores, Standard Deviation and Potential for Conflict Index

Specific Flow CFS	Mean Acceptability	Standard Deviation	PCI
300	-2.69	0.82	0.00
500	-1.88	1.36	0.06
700	-0.09	1.65	0.38
900	1.09	1.75	0.20
1100	2.06	1.33	0.08
1300	2.43	1.24	0.08
1500	2.63	1.14	0.06
1700	2.65	1.12	0.06
1900	2.64	1.17	0.06
2100	2.64	1.11	0.06
2300	2.7	0.98	0.04
2500	2.73	0.88	0.02

Figure 8

State Bridge to Burns Impact Acceptability Curves for Kayaks vs. Rafts

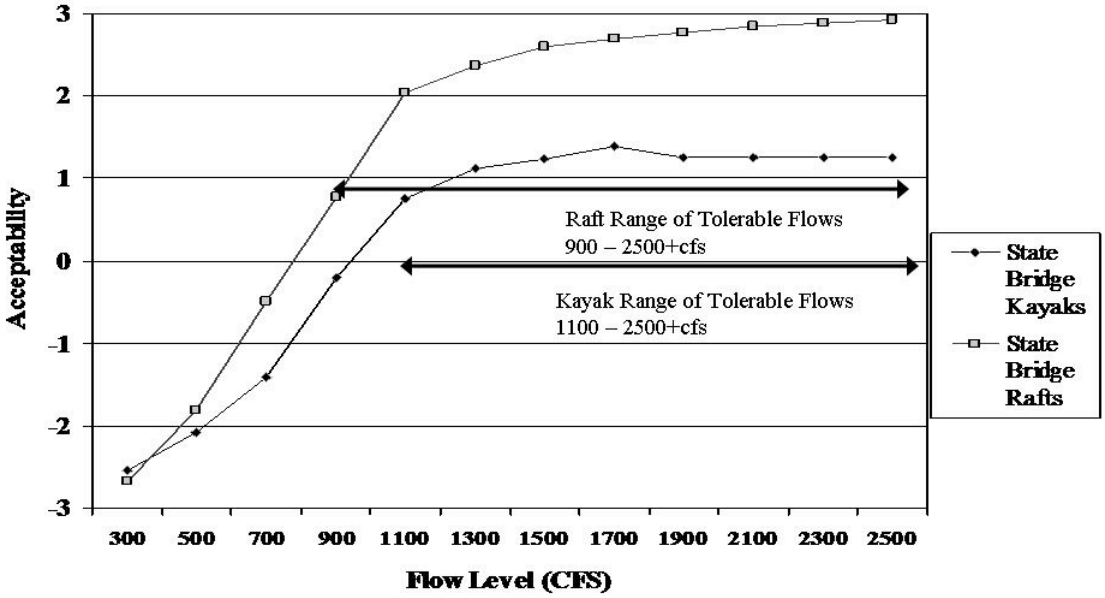
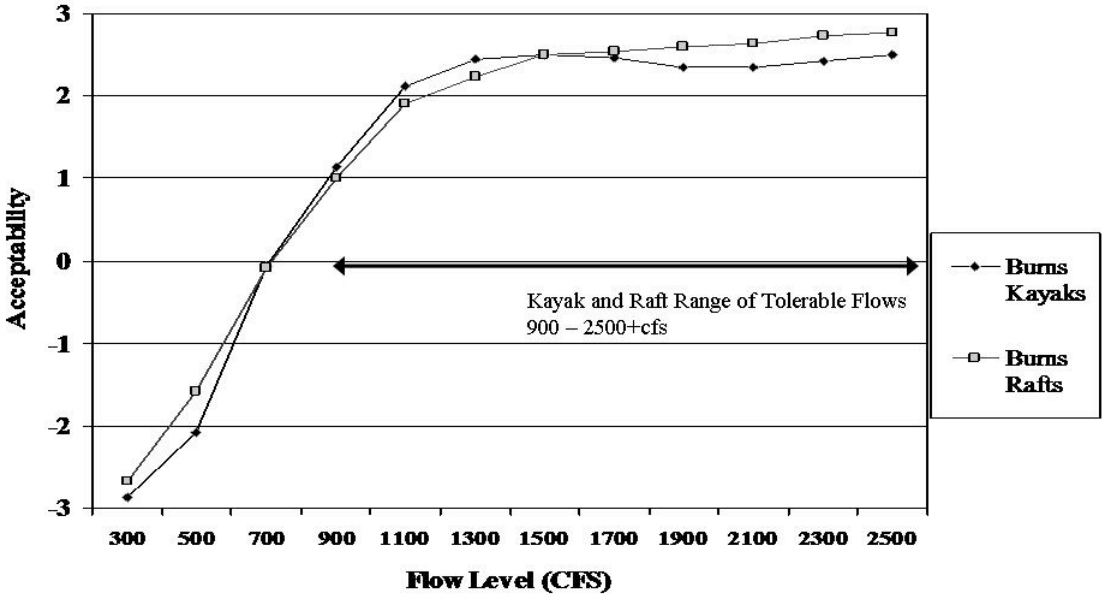


Figure 9

Burns to Dotsero Impact Acceptability Curves for Kayaks vs. Rafts



Open ended flow related questions for State Bridge to Burns and Burns to Dotsero are displayed in Tables 7 and 8. Open ended flow responses were consistent with the impact acceptability curve. Mean minimum acceptable flows of 798 and 838 cfs are slightly lower than acceptability curves measured, however both curves cross the neutral line between 700 and 900 cfs, supporting a minimum flow between those response points. Mean standard whitewater trip flows of 1348 and 1372 cfs are consistent with the high acceptability of flows in that range. Mean highest safe flows of 11,684 and 8840 cfs indicate that flows much greater than those found in this study would be acceptable to a number of river users.

Table 7

State Bridge to Burns Open Response Instream Flow Results

	Minimum Acceptable Flow	Standard Whitewater Experience	Technical Whitewater Experience	High Challenge Whitewater	Highest Safe Flow
Mean cfs	**798**	**1348**	**757**	**3686**	**11684**
Low cfs Reported	400	750	500	1500	1800
Max cfs Reported	1500	2300	1500	12000	100000

Table 8
Burns to Dotsero Open Response Instream Flow Results

	Minimum Acceptable Flow	Standard Whitewater Experience	Technical Whitewater Experience	High Challenge Whitewater	Highest Safe Flow
Mean cfs	**838**	**1372**	**759**	**4668**	**8840**
Low cfs Reported	400	1000	500	1500	1000
Max cfs Reported	2300	3500	1000	15000	30000

Glenwood Canyon

Glenwood Canyon is one of the most paddled stretches of whitewater in the state. With year round flows, ski and adventure communities in every direction and one of the most traveled sections of mountain interstate in the country, it is not hard to imagine why. With commercial rafting user days hovering around 70,000, only the Arkansas River

Valley sees more rafter user days across the entire state. Glenwood Canyon has multiple access points along the interstate and many different run options, from the class V of Upper Death rapid to the class II wave trains below the small burg of No Name, there is whitewater suitable for any level of paddler. For whitewater paddlers, the canyon is generally split into three different sections, Barrel Springs, Shoshone and Grizzly Creek. American Whitewater split the Glenwood Canyon segment into these three study stretches for separate analysis due to the different difficulty levels and water diversions for power production between the stretches.

Barrel Springs is a short stretch of advanced whitewater (class V at most levels) directly below the Shoshone Dam. This stretch is de-watered during a good portion of the year, when the flow below Shoshone Power Plant is less than 1300 cfs. This 1300 cfs is the amount diverted into the power plant and then pumped back into the river two miles downstream. The put-in for this run is at the Hanging Lake exit 125. The take-out and put-in for the Shoshone run, is the Shoshone exit 123.

Shoshone is quite possibly the most paddled 1.5 mile section of any river in the state. It is a class III section of whitewater with numerous waves, holes, rocks and eddy lines creating a natural playground for kayakers. Year round flow allows training for the most dedicated boaters in the area. Paddlers from the area and from as far as the Front Range come for an annual New Years paddle down Shoshone and on even the snowiest years you can still find them in the water. This stretch is the bread and butter for multiple commercial rafting operations hailing from communities on the east and west sides of the canyon. The take-out for Shoshone, at the Grizzly Creek exit 121, also serves as the put-in for the easiest section in the canyon, known as Grizzly Creek.

Grizzly is a big step down in difficulty from the Shoshone section, although at high flows it can provide great entertainment for novice paddlers. Many area paddlers take their first strokes on this run and at low flows there are undeveloped hot springs as you approach Glenwood. Two Rivers Park exit116 is the take-out for this 6 mile run and there is a whitewater park under construction here that is already being used by local paddlers.

Respondents for all stretches overall found the minimum acceptable instream flow to be 900 cfs and the range of acceptable flows for the entire segment to be between 900 and 2500+ cfs. Optimum flows were 1500+ cfs (Figure 10). Understanding the flow dynamics for Glenwood Canyon requires the awareness of the diversion at the Shoshone Dam of approximately 1100 - 1300 cfs. For the Barrel Springs stretch, the flow that respondents are referring to must be analyzed with more scrutiny. Generally respondents are asked to refer there acceptability ratings to the cfs reading on the most commonly used gauge for the run, however, the results from Barrel Springs indicate that many respondents referred there acceptability ratings to the actual cfs in the river for this particular stretch. This assumption is based on the flow data (Figure 10), which allows for 900 cfs to be an acceptable flow to the majority of Barrel Springs paddlers, when if they were referring their ratings to the flows measured at the Dotsero gauge, a 900 cfs reading would effectively mean that the Barrel Springs stretch was de-watered. Confusion over which flow level to rate in Barrel Springs is a possible reason for the relatively large PCI

value recorded for 900 cfs (PCI=.58). Flow levels up to 1700 had relatively high PCI values as well, supporting this idea (Figure 11).

For the Barrel Springs stretch, kayaks were the preferred craft for 93% of respondents, 5% preferred a raft, shredder or cataraft, and 2% paddled other crafts. True to the nature of the Barrel Springs run, there were not enough respondents using crafts other than kayaks to make any meaningful conclusions about different user groups. Kayakers are the main paddler of this stretch. For Shoshone, kayaks were the preferred craft for 79% of respondents, 14% preferred a raft, shredder or cataraft, 6% would paddle either a kayak or a raft, and 1% paddled other crafts. The potential for conflict index shows the lowest level of agreement between respondents for Shoshone over the acceptability of 900 cfs (PCI = .4, Figure 12). Differences between kayaker and rafter flow preference did not factor into this disagreement as rafter and kayaker flow preferences for Shoshone are nearly identical (Figure 13). It is possible that other variables are involved or that 900 cfs is barely on the edge of acceptable flows and for some people it is acceptable because they like to train on Shoshone during the off-season, while for others, who only paddle in the summer, it is unacceptable. For Grizzly Creek, kayaks were the preferred craft for 58% of respondents, 26% preferred a raft, shredder or cataraft, 12% would paddle either a kayak or a raft, and 4% paddled other crafts. Rafter and kayaker flow preferences for Grizzly Creek were also nearly identical.

For all stretches agreement levels were high (PCI < .08) over the unacceptability of flows under 700 cfs and over the acceptability of flows over 1900 cfs. Flows above 1800 cfs are when all three stretches of Glenwood Canyon are runnable. Paddlers were united over the strong acceptability of flows over 1900 cfs. Acceptability levels increased for all stretches the higher the water level recorded, indicating that higher flows were optimum for paddling these stretches. Mean acceptability scores, standard deviation and PCI for each specific instream flow measured for Glenwood Canyon are displayed in Tables 7, 8 and 9.

Figure 10

Barrel Springs, Shoshone and Grizzly Creek Impact Acceptability Curves

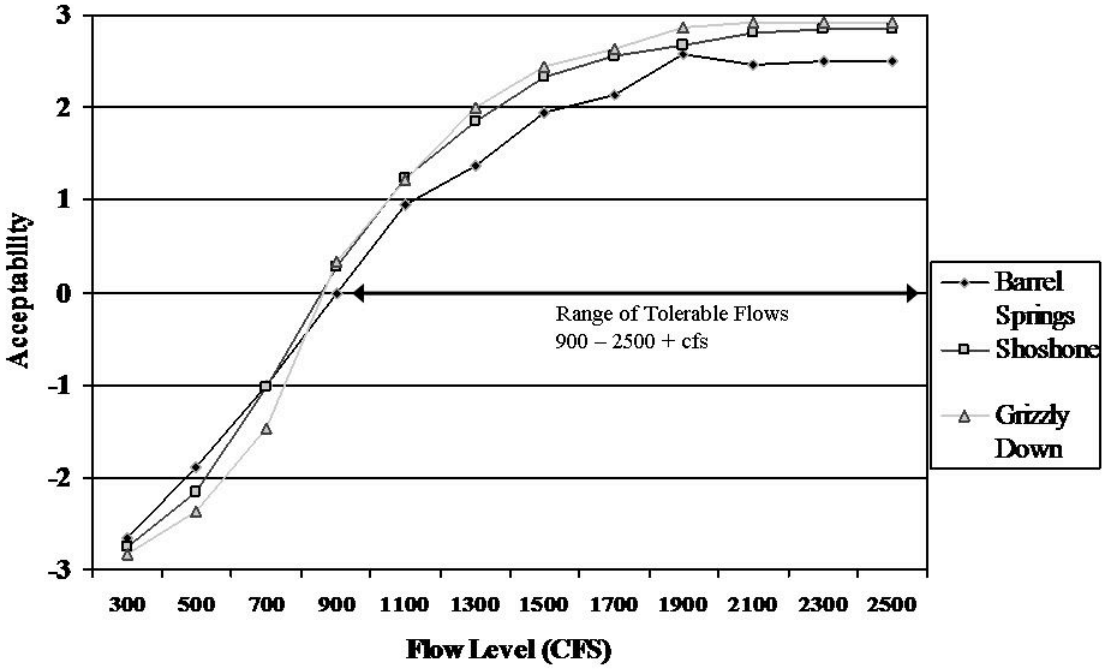


Figure 11
Barrel Springs Potential for Conflict Index

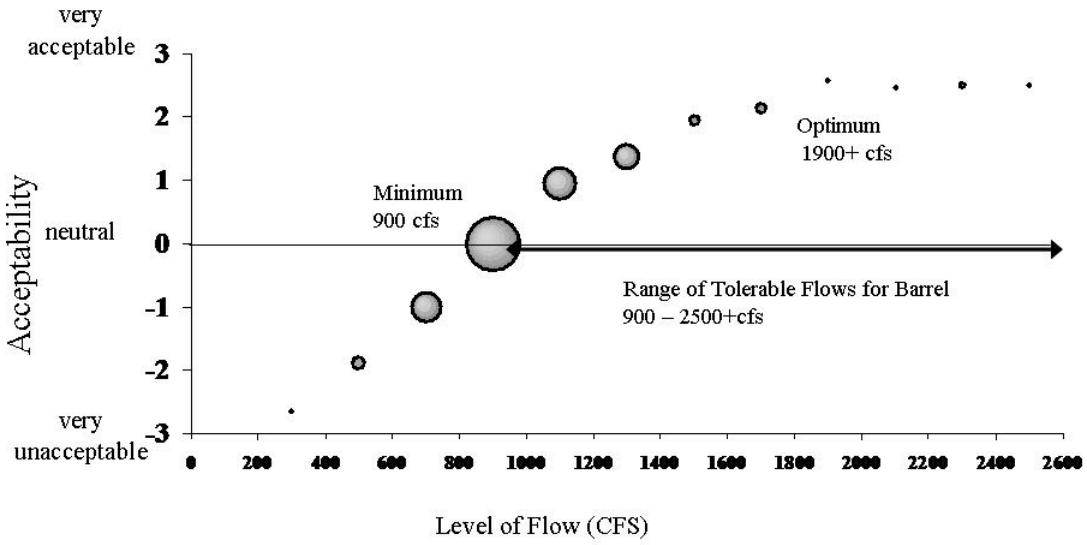


Table 9
Barrel Springs Mean Acceptability Scores, Standard Deviation and Potential for Conflict Index

Specific Flow CFS	Mean Acceptability	Standard Deviation	PCI

300	-2.66	0.80	0.00
500	-1.89	1.66	0.14
700	-1	2.04	0.32
900	0	2.09	0.58
1100	0.95	2.18	0.35
1300	1.37	2.03	0.26
1500	1.95	1.59	0.12
1700	2.13	1.49	0.11
1900	2.57	0.69	0.00
2100	2.46	1.14	0.05
2300	2.5	1.21	0.06
2500	2.51	1.19	0.04

Figure 12
Shoshone Potential for Conflict Index

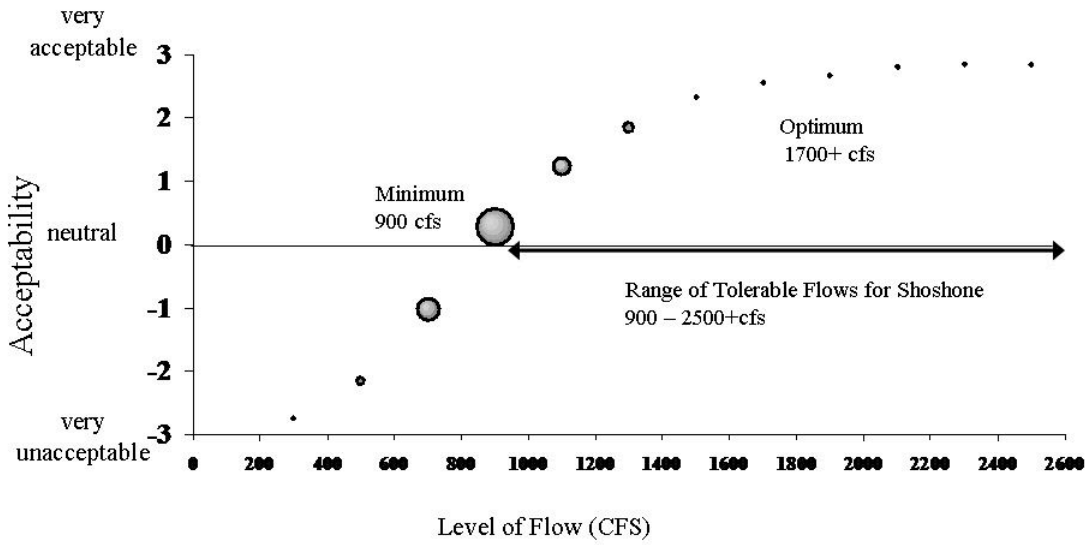


Table 10
Shoshone Mean Acceptability Scores, Standard Deviation and Potential for Conflict Index

Specific Flow CFS	Mean Acceptability	Standard Deviation	PCI
300	-2.76	0.70	0.00
500	-2.16	1.42	0.08
700	-1.03	1.85	0.25
900	0.27	1.84	0.40
1100	1.24	1.65	0.18
1300	1.85	1.54	0.12
1500	2.32	1.20	0.04

1700	2.56	0.99	0.03
1900	2.67	0.84	0.02
2100	2.81	0.59	0.00
2300	2.84	0.47	0.00
2500	2.84	0.52	0.00

Figure 13
Shoshone Impact Acceptability Curves for Kayaks vs. Rafts

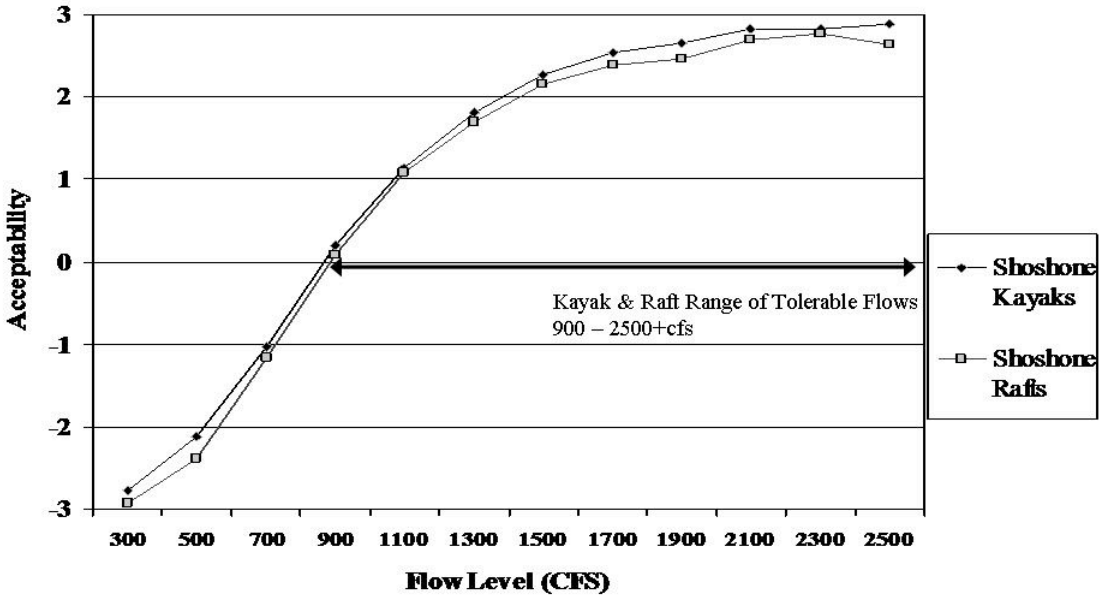


Figure 14
Grizzly Creek Potential for Conflict Index

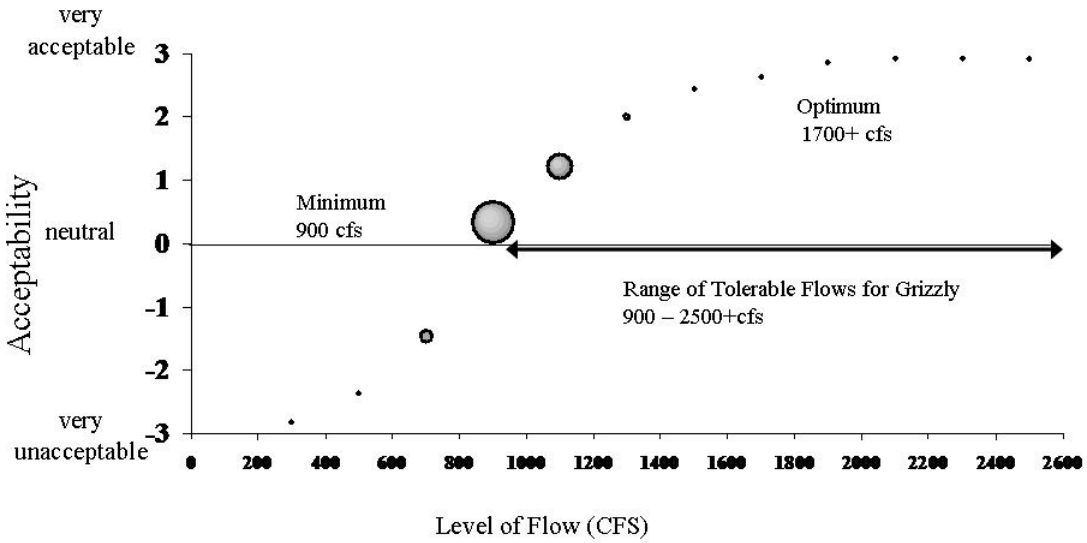


Table 11
Grizzly Creek Mean Acceptability Scores, Standard Deviation and Potential for Conflict Index

Specific Flow CFS	Mean Acceptability	Standard Deviation	PCI
300	-2.82	0.64	0.00
500	-2.37	1.28	0.05
700	-1.46	1.67	0.15
900	0.34	1.96	0.44
1100	1.21	1.99	0.26
1300	2	1.43	0.06
1500	2.44	0.93	0.00
1700	2.64	0.69	0.00
1900	2.86	0.42	0.00
2100	2.93	0.34	0.00
2300	2.93	0.34	0.00
2500	2.93	0.35	0.00

Open ended flow related questions for Glenwood Canyon are displayed in Tables 12, 13 and 14. Open ended flow responses were consistent with the impact acceptability curve. Mean minimum acceptable flows of 991, 1009 and 963 cfs are slightly higher than acceptability curves measured, however they are between 900 and 1100 cfs, the next recorded flow response point. Mean standard whitewater trip flows of 1,567, 1,909 and 1,724 cfs are consistent with the high acceptability of flows in that range. Mean highest safe flows of 6,636, 9,472 and 12,129 cfs indicate that flows much greater than those found in this study would be acceptable to a number of river users.

Table 12
Barrel Springs Open Response Instream Flow Results

	Minimum Acceptable Flow	Standard Whitewater Experience	Technical Whitewater Experience	High Challenge Whitewater	Highest Safe Flow
Mean cfs	**991**	**1567**	**989**	**5418**	**6363**
Low cfs Reported	300	500	300	1000	300
Max cfs Reported	2000	3500	2400	50000	50000

Table 13

Shoshone Open Response Instream Flow Results

	Minimum Acceptable Flow	Standard Whitewater Experience	Technical Whitewater Experience	High Challenge Whitewater	Highest Safe Flow
Mean cfs	**1009**	**1909**	**1007**	**4967**	**9472**
Low cfs Reported	500	900	400	1300	2000
Max cfs Reported	4000	15000	4000	20000	50000

Table 14

Grizzly Creek Open Response Instream Flow Results

	Minimum Acceptable Flow	Standard Whitewater Experience	Technical Whitewater Experience	High Challenge Whitewater	Highest Safe Flow
Mean cfs	**963**	**1724**	**1146**	**6109**	**12129**
Low cfs Reported	300	1100	300	1500	1500
Max cfs Reported	1700	3000	7000	20000	50000