ASSESSMENT OF STREAMFLOW PREFERENCES FOR SUPPORTING RECREATIONAL WATER USES ON THE TAYLOR AND UPPER GUNNISON RIVERS

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Whitewater rafters enjoying the first feature in the Gunnison Whitewater Park. *Photo by Carly Donk.*

Executive Summary

The recreational use assessment presented in this report provides important baseline information relating streamflow and recreational use. This work directly supports the Upper Gunnison River Basin Watershed Management Planning efforts on the Taylor and Gunnison Rivers near Gunnison, Colorado. Methods used to collect and analyze streamflow preference information from recreational users, flow preference results, and quantification of existing river recreation opportunities are presented in this report. Many of the graphical and tabular results are sorted in appendices to improve readability.

In 2013, American Whitewater conducted a web-based survey of flow preferences on 17 different river segments in the Gunnison River Basin. There were 329 total respondents to the 2013 flow preference survey and between 64 to 110 respondents for the Gunnison and Taylor River segments. Results from the 2013 survey were further refined in 2020 to define navigable, acceptable, and optimal flow preferences on the Taylor and Gunnison Rivers for aggregate respondents and different user groups (e.g., kayakers, locals, beginners). Due to the low number of commercial rafting outfitters that operate on these segments and the lack of commercial float fishing user responses to the 2013 survey, additional work was done to define streamflow preferences for these user groups. One-on-one interviews and group discussions were conducted with commercial rafting and fishing outfitters during the 2020 season to determine the full range of streamflows that support commercial operations on the Taylor and upper Gunnison Rivers.

Flow preference thresholds for aggregate survey respondents and commercial outfitters are presented in Table ES.1. Flow threshold identification supported quantification of the Boatable Days metric for each assessment reach under wet, wet-typical, dry-typical, and dry hydrological year types. The assessment followed recommendations in the State of Colorado's Basin Implementation Plan guidance documents for quantifying non-consumptive recreational needs and provided a basis for analysis to meet the unique needs of the Upper Gunnison River Basin (CWCB, 2013). The Boatable Days metric was

used to quantify existing opportunities for aggregate (or public) users based on the 2013 survey data and a similar analysis was completed to determine Commercial Rafting Days and Commercial Float Fishing Days.

Respondent numbers for the flow preference study conducted in 2013 are robust for a remote or sparsely populated region of western Colorado. The large number of responses to flow related questions for the Taylor and Gunnison River segments led to high confidence in the flow acceptability thresholds for aggregate respondents. However, relatively low response rates among specific user groups may cause some uncertainty for sub-group flow preferences. These sub-group flow preferences are presented in this report, however only aggregate flow preferences were used to inform the Boatable Days analysis.

Table ES.1. User-defined flow preferences for reaches included in the Boatable Days assessment.

User	River	Reach Description	Min. Navigable	Min. Acceptable	Min. Optimal	Max. Optimal	Max. Acceptable
Aggregate Users	Taylor	New Generation to Almont	250	350	600	900	1200+
	Gunnison	Almont to McCabes	300	500	1000	1800	5000+
	Gunnison	Whitewater Park	400	550	1200	1600	5000+
Commercial Float Fishing	Gunnison	Almont to North Bridge	250	300	400	1000	1800
	Gunnison	North Bridge to WW Park	250	300	400	1000	1750
	Gunnison	WW Park to McCabes	250	300	400	1000	1500
Commercial Rafting	Taylor	Todd's Slot to South Bank	200	300	400	600	1000*
	Taylor	South Bank to Five Mile	200	300	400	600	1000*
	Taylor	Five Mile to Almont	200	300	400	600	1000*
	Gunnison	Almont to North Bridge	300	400	400	2500	2800
	Gunnison	North Bridge to WW Park	300	400	600	2500	4,000
	Gunnison	WW Park to McCabes	300	400	600	2500	5,000+

**For commercial rafting on the upper and lower Taylor River acceptable flows are exceeded above 1,000 cfs, however flows above 1,000 cfs are still navigable and rafting outfitters continue to run modified trips during these higher flows. On the middle Taylor River, the river becomes unnavigable for commercial rafting at Harmel's Bridge above 1,250 cfs.*

Variable streamflow conditions were found to impact use opportunities on all reaches and for all user groups. The total number of Boatable Days, Commercial Rafting Days, and Commercial Float Fishing Days, generally increase throughout the assessment area as hydrological conditions transition from dry to wet. For aggregate users and commercial rafting users on most reaches, daily streamflows rarely exceed the maximum flow acceptability threshold. Commercial float fishing has a relatively lower acceptable flow maximum and acceptable flows are exceeded in all year types except dry years. As an example, Figure ES.1 summarizes the hydrological analysis results for Commercial Rafting Days on the Taylor River between Todd's Slot and South Bank. Quantifying existing river recreation opportunities (e.g., number of Boatable Days) establishes an important baseline and can be used to assess how changes to streamflow conditions due to reservoir operations and climate change may impact Boatable Days or Commercial Rafting and Float Fishing Days. The results from this study were used to develop a web-based tool that allows users to input projected or actual hydrological time series to assess the associated impacts to recreational opportunities.

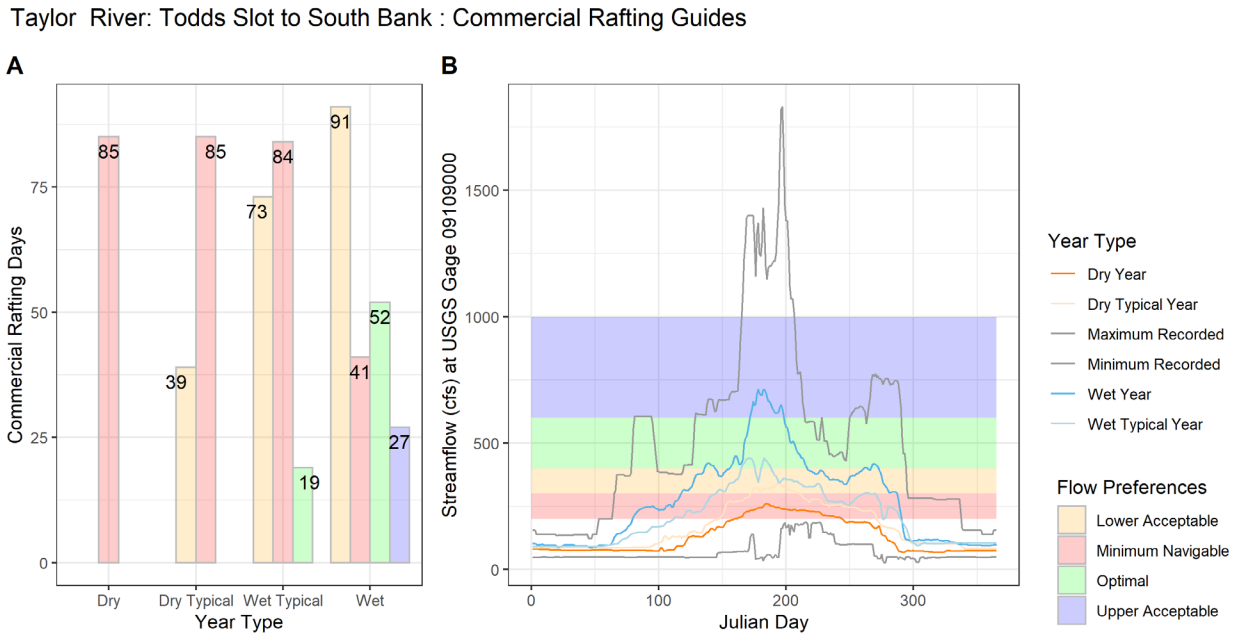

Figure ES.1. Commercial rafting results for the Taylor River between the commercial put-in at Todd's Slot and South Bank Access. A) Boatable Days results by year type and B) Year type hydrographs overlaid with identified flow preferences. Grey hydrograph lines represent the minimum and maximum flow recorded over the 43-year period of record and do not represent a single annual hydrograph.

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1. Introduction

Considerable work evaluating relationships between streamflow and recreational use opportunities has occurred in recent decades (Brown et al., 1991; Shelby, Brown, & Taylor, 1992; Whittaker and Shelby, 2002; Stafford et al., 2016). Many flow-recreation studies focus on whitewater boating and float fishing as flow often determines whether people have the opportunity to successfully complete a trip. Flow level often contributes to the risk, challenge, and aesthetic attributes of river based recreation (Whittaker & Shelby, 2002). Natural and man-made changes in streamflow can have direct and indirect impacts on recreational boating experiences. Direct effects include navigation, safety and difficulty, travel times, quality of whitewater stretches, and beach and camp access (Brown, Taylor, & Shelby, 1991; Whittaker et al., 1993; Whittaker & Shelby, 2002). Indirectly, variability in streamflow affects wildlife viewing, scenery, fish habitat, and riparian vegetation over the long term as a result of changes in flow regime (Bovey, 1996; Richter et al., 1997; Jackson & Beschta, 1992; Hill et al., 1991).

Streamflow is often manipulated through releases from dams and reservoirs, pipelines, and diversions. Additional scenarios, such as climate change, can impact flows and recreation quality over both the short and long-term. Decision-makers at the local, state, and federal level are increasingly interested in the extent that flow regimes can be managed to provide desirable recreational resource conditions. As population and climate change continue to stress water resources, water management strategies that have multiple use benefits need to be better understood and prioritized. Methodologies developed by American Whitewater are regularly used to delineate user-defined streamflow preferences and subsequently quantify recreation opportunities under different hydrological conditions. Implementation of these assessment methodologies aims to support water management decision-making and the design of multi-use projects and processes. American Whitewater's flow preference and Boatable Days assessment methodology is recognized as a best practice for defining recreation flow needs and opportunities and is included in the Colorado Water Conservation Board's Non-Consumptive Toolbox (Stafford et al., 2016; CWCB, 2013).

The Upper Gunnison River Water Conservancy District (UGRWCD) in Gunnison, Colorado is leading a local effort to develop a Watershed Management Plan (WMP) for the upper Gunnison River Basin. The current phase, Phase 2, focuses on Cebolla Creek, Tomichi Creek, Taylor River, and the Gunnison River. The overarching goal of the WMP is "the protection and sustainable continuity of existing water uses (agricultural, municipal, ecological, and recreational) that are the foundation of our local economic and cultural lives, in a time of diminishing water supply and increasing demand."[1] Other WMP goals include the improvement of relationships between consumptive and non-consumptive water users and the improvement of efficiency among all users. To help meet these WMP goals, American Whitewater was invited to work with the WMP team to conduct a recreational flow study on the Taylor and Gunnison Rivers to define flow preferences for different user groups and to quantify how often those flows are met in different hydrological year types (wet, wet-typical, dry-typical, dry). Comparing user-defined flow preferences to historical hydrology provides a baseline of existing opportunities and will allow for future analyses of how snow pack and runoff projections, water projects (e.g. Taylor Park Operations or irrigation infrastructure projects), climate change and other hydrologic scenarios will impact recreation

[1] https://ugrwcd.org/watershed-mgmt/

opportunities, positively or negatively. This report describes the methodologies used and presents the results of the study for consideration in the WMP process and future water planning efforts.

2. Background

In 2013, AW completed an assessment of river recreation flow preferences on 17 different river segments in the upper and lower Gunnison Basins (Menges, et al., 2013). The 2013 assessment used a web-based survey approach to interview 329 different respondents on their flow preferences. Respondents represented a broad range of skill levels and craft types. The analysis and report completed in 2013 provided a broad overview of identified 'acceptable' and 'optimal' flow preferences for 17 different river segments. While this analysis provided important information describing flow-recreation relationships in the Gunnison River Basin, it was determined that an in-depth analysis of specific segments and user groups would be helpful for local water managers. Thus, to inform Phase 2 of the WMP process, this current study focused on flow dependent recreation on the Taylor and Gunnison Rivers between Taylor Park Reservoir and Blue Mesa Reservoir.

The results from the 2013 survey were determined to still have relevance for current river and recreation use conditions. Response rates to the 2013 web survey for the Taylor and Gunnison River segments were exceptionally robust and achieving the same or an increased response rate with a new survey would be difficult and unnecessary. Excluding minor manmade changes to the Gunnison Whitewater Park and the Psychedelic Falls rapid, the geomorphology of the river segments has not changed significantly since 2013. Additionally, operations at Taylor Park Reservoir have not significantly changed since 2013 and continue to depend on downstream water rights, varied annual snowpack, and natural hydrological conditions in the watershed.

In addition to defining flow preferences based on 2013 flow survey data, American Whitewater worked directly with Colorado Trout Unlimited, commercial rafting outfitters, and commercial float fishing outfitters to define navigable, acceptable, and optimal flow ranges for commercial rafting and float fishing on the Taylor and Gunnison Rivers. Local outfitters have been operating in the valley for many decades and have developed strong knowledge of the range of flow conditions that support their operations on the Taylor and Gunnison Rivers. In other regions where there are a greater number of commercial outfitters a survey-based approach would be preferred, using the survey-based flow preference analysis described in this report.

3. Study Area

This study focused on the Taylor River and the Gunnison River in the upper Gunnison River Basin. Segments included the Taylor River between the New Generation access area and Almont and the Gunnison River between Almont and Wilson's Landing (Figures 1 and 2).

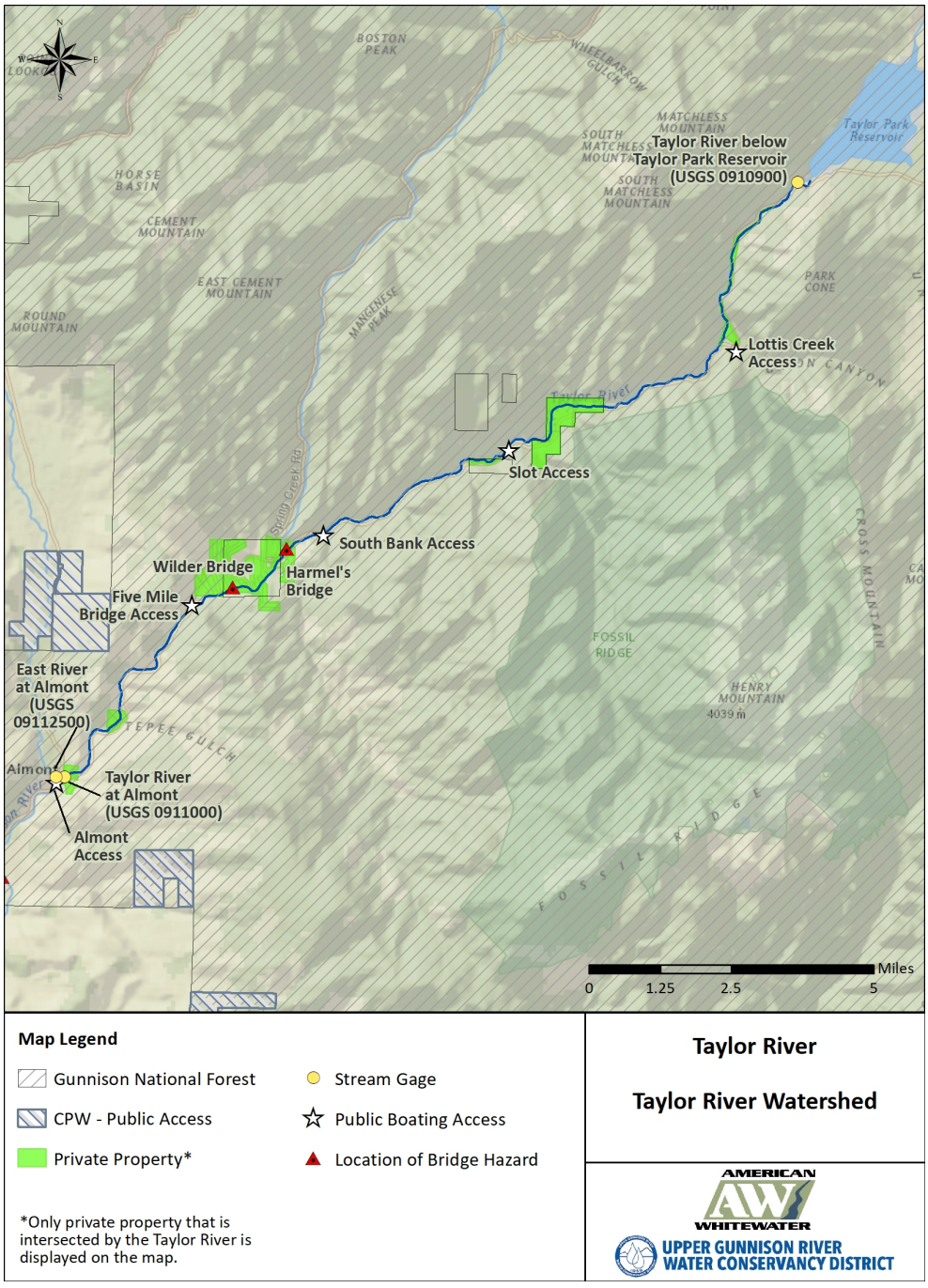


Figure 1. Map of Taylor River including access points, USGS stream gages, and river hazards that were included in this study.

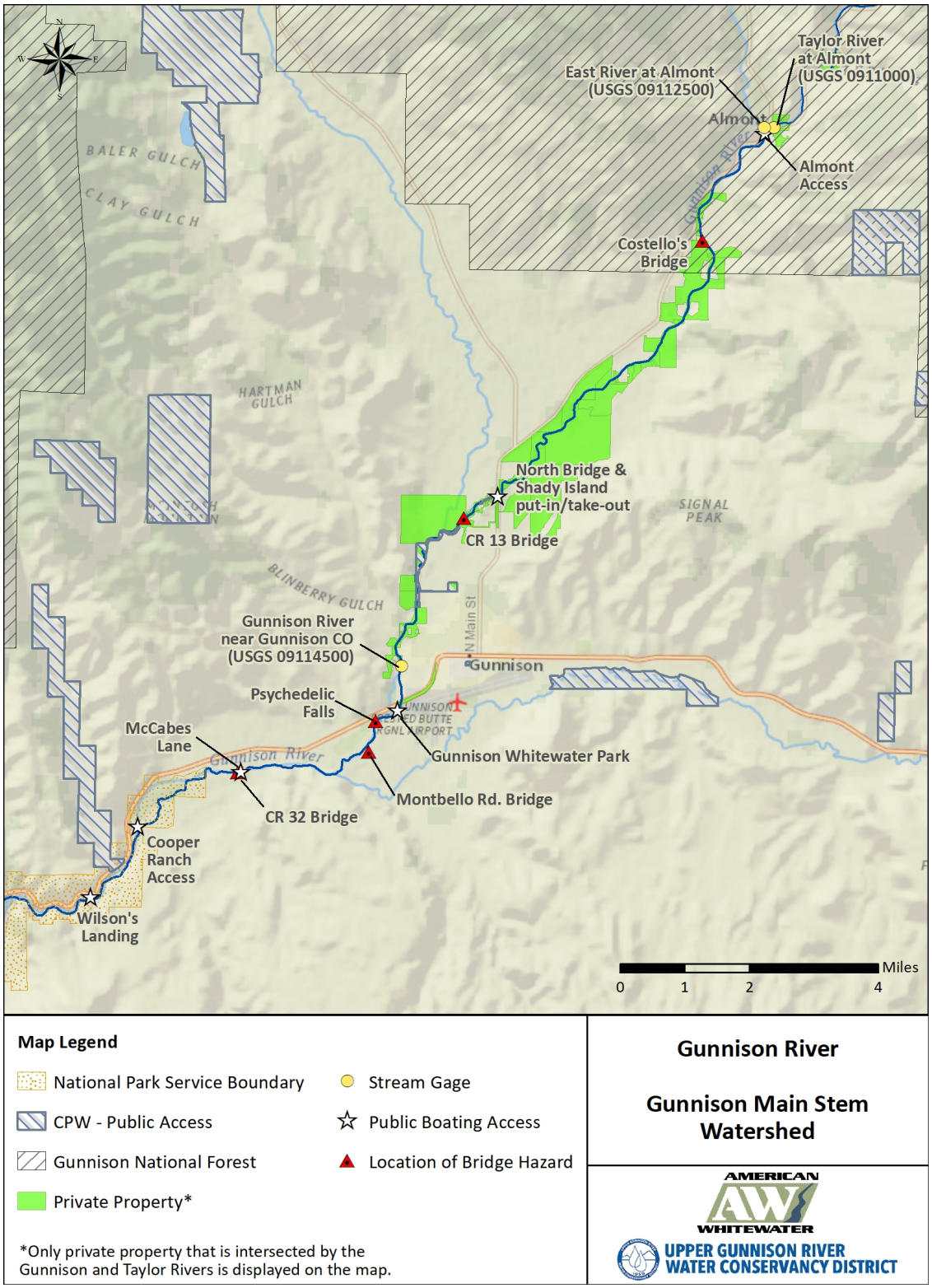


Figure 2. Map of the Gunnison River including river access points, USGS stream gages, and river hazards that were included in this study.

River segments used in American Whitewater's flow preference analysis were based on the segments included in the 2013 Flow Survey and included in AW's National Whitewater Inventory. Additional segments were identified in coordination with commercial rafting and fishing outfitters based on their permits, typical operations, and the availability of historical stream gage data. See Table 1 for a list of river segments and corresponding stream gages that were used in this study.

Corresponding United States Geological Survey (USGS) stream gages were chosen based on proximity to the river segment, historical period of record, and commonality of use among recreationists. It is common practice among both self-guided users and commercial outfitters to check stream flows before deciding whether or not to float a river. By using specific stream gages to check flow conditions regularly, boaters become experienced at assessing stream flows relative to different gages and the recreational experience they provide. With more experience, recreationists are capable of assessing the acceptability of flows both within and outside of the range of flows that they may have directly experienced.

Sometimes multiple stream gages are used by boaters to assess flow conditions on the same segment, such as on the Taylor River. The Taylor River has one stream gage located directly below the Taylor Reservoir outflow and one in Almont above the confluence with the East River. There are multiple tributaries to the Taylor River between these stream gages, including Lottis Creek and Spring Creek, which can contribute significant stream flows to the river during spring runoff. Because of this, sometimes boaters use the Almont gage during spring runoff to inform their river trip in addition to the upstream gage. Neither stream gage represents the precise flows that support river recreation at specific points as the paddler is traveling downstream, but they provide important estimates that can inform management decisions. For the purposes of this study, the stream gage below Taylor Park Reservoir (USGS 0910900) was used to assess stream flows for the Taylor River between New Generation and Almont. This was clearly communicated to respondents in the 2013 Flow Survey prior to flow-related survey questions for each segment. The use of the Taylor Park Reservoir gage in this study is further validated by the use of this same gage by commercial outfitters and by the University of Western Colorado's Wilderness Pursuit Program (Appendix G). Nonetheless, it is important to acknowledge that some recreation users may reference the Almont USGS gage to inform their trip on the Taylor River at certain times of year. This anecdotal information on stream gage use should complement the findings of this report and is another factor that can inform flow-related management decisions.

Table 1. River segments and corresponding USGS streamflow gages considered in this study.

User Group	River	Segment Description	Corresponding Stream Gage
Aggregate Users	Taylor	New Generation to Almont	Taylor River below Taylor Park Reservoir (USGS 0910900)
	Gunnison	Almont to McCabes	Gunnison River near Gunnison, CO (USGS 09114500)
	Gunnison	Whitewater Park	Gunnison River near Gunnison, CO (USGS 09114500)
Commercial Float Fishing	Gunnison	Almont to North Bridge	Combined flows at Taylor River at Almont (USGS 0911000) and East River at Almont (USGS 09112500)
	Gunnison	North Bridge to WW Park	Gunnison River near Gunnison, CO (USGS 09114500

	Gunnison	WW Park to McCabes	Gunnison River near Gunnison, CO (USGS 09114500)

Commercial Rafting	Taylor	Todd's Slot to South Bank	Taylor River below Taylor Park Reservoir (USGS 0910900)
	Taylor	South Bank to Five Mile	Taylor River below Taylor Park Reservoir (USGS 0910900)
	Taylor	Five Mile to Almont	Taylor River below Taylor Park Reservoir (USGS 0910900)
	Gunnison	Almont to North Bridge	Combined flows at Taylor River at Almont (USGS 0911000) and East River at Almont (USGS 09112500)
	Gunnison	North Bridge to WW Park	Gunnison River near Gunnison, CO (USGS 09114500)
	Gunnison	WW Park to McCabes	Gunnison River near Gunnison, CO (USGS 09114500)

A kayaker navigating the most challenging rapid on the Taylor River, Todd's Slot. *Photo by Dave Bumgarner.*

4. Methods

4.1. Flow Preferences

Two approaches were employed to determine flow preferences for river based recreation on the Taylor and Gunnison Rivers. Using results from the 2013 web survey and peer reviewed analytical methods, American Whitewater defined flow preferences for aggregate survey respondents as well as for sub-groups, including beginners, experts, kayakers, rafts, commercial users, and local residents. Defining flow preferences for sub-groups allows for a comparison between different user groups and further illustrates the results for aggregate respondents, especially where increased conflict exists. Flow preferences for aggregate users were used to inform the Boatable Days analysis and additional flow preferences are reported for each user group in Appendix D.

The 2013 web survey collected data from a diversity of recreationists, including respondents that identified as commercial guides and outfitters. However, we determined that preferred flows identified by commercial guides are not always representative of flows that support commercial operations. While these survey-based results provide helpful context, it was necessary to determine more realistic navigable, acceptable, and optimal flow conditions that support both commercial rafting and float fishing outfitters. Between June and September 2020, one on one interviews and group discussions with commercial outfitters were conducted to determine the full range of streamflow that support commercial operations on the identified river segments. The approach used to determine commercial flow preferences are further described below in Section 4.1.2.

4.1.1. Survey-Based Flow Preferences

Researchers collecting and organizing survey-based evaluative information often employ a normative approach for analyzing results. This approach is particularly useful for natural resource management where developing thresholds that define minimum, acceptable, and optimal resource conditions are crucial for informing decision-making (Shelby et al. 1992). The normative approach considers each individual's evaluation (personal norms) of a range of potential conditions. Aggregation of many individuals' personal norms describe a group's collective evaluation (social norms) of the resource condition (e.g., streamflow). This technique was employed to understand user preferences for various streamflows on the Grand Canyon (Shelby et al. 1992) and on several other rivers in Colorado (Vandas et al. 1990, Shelby & Whittaker 1995, Fey & Stafford 2009, Fey & Stafford 2010). The normative approach is the basis for American Whitewater's flow preference and Boatable Days assessment methodology.

To inform this assessment, American Whitewater used existing recreational user feedback from the web-based survey that was conducted in the Gunnison River Basin in 2013 (Appendix A). The 2013 web survey had an exceptionally robust response rate and it was determined that factors influencing flow preferences on the Taylor and Gunnison Rivers had not substantially changed since 2013. Three types of questions were included in the survey. The first type of question captured demographic information about each participant's skill level, frequency of participation in river-related recreation, etc. The second type of question allowed users to assign use-acceptability rankings to various stream flows. Finally, the third question type asked users to identify flows associated with different trip types (technical low-water, standard, challenging high-flow, etc.). These questions were organized around each assessment reach and were supported with general mapping and narrative information about that reach from American Whitewater's website. The survey also clearly defined which streamflow gage to reference

when assigning acceptability rankings and single-flow judgements for streamflows on each reach. Distribution of the 2013 web survey was extensive and successful. An announcement of the survey was emailed to American Whitewater's members, posted on the AW website, and distributed via AW's online newsletter. The survey was also shared directly with local commercial outfitters and press releases announcing the survey were published in the Montrose Press, Gunnison Country Times, Crested Butte News, and Telluride Watch during the spring and summer of 2013.

The flow acceptability questions included in the 2013 survey are the principal focus of this assessment. These questions asked respondents to evaluate the acceptability for a range of streamflows on each study segment using a five-point scale that included the following rankings: Unacceptable, Slightly Unacceptable, Marginal, Slightly Acceptable, and Acceptable. Each ranking in the scale was mapped to an integer value between -2 and 2 where an 'Unacceptable' ranking mapped to a value of -2, a 'Marginal' ranking mapped to a value of 0, and an 'Acceptable' ranking mapped to a value of 2. To further explore and characterize the relationship between flows and recreational use opportunities, the survey posed a series of single-flow judgement questions about streamflow associated with distinct niche experiences. These niche experiences included: lowest navigable flow, minimum acceptable flow, technical but navigable, standard trip, challenging high-water, and highest safe[2] flow. Flow-acceptability rankings provided through the survey were used to describe norms (evaluative standards) through statistical characterizations and use of graphic tools called impact acceptability curves. This approach has been applied extensively in natural resource management settings, often with respect to instream flows for recreation (Shelby and Whittaker, 1995; Shelby et al., 1992a; Vandas et al., 1990; Whittaker and Shelby, 2002b).

Defining management standards is often more efficient if there is a high degree of norm crystallization, or consensus, regarding acceptable and unacceptable resource conditions. Traditional measures of norm crystallization have included the standard deviation, coefficient of variation, and interquartile range of survey responses (Krymkowski et al., 2009; Manning, 2011; Shelby and Vaske, 1991). The Potential for Conflict Index-2 (PCI2) was developed to help address some of the shortcomings associated with traditional measures of norm crystallization. A detailed description of the PCI2 statistic is provided by Vaske et al. (2010). Briefly, PCI2 ranges from 0 to 1.0 where the least amount of consensus (PCI2 = 1.0) occurs when responses are equally divided between two extreme values on a response scale (e.g. 50% Highly Unacceptable and 50% Highly Acceptable). A set of responses with unanimous consensus among respondents yields a PCI2 of 0. PCI2 scores were computed for each set of streamflow ranking survey question results for each of the study reaches.

The principal graphical tool employed in this assessment incorporated both the central tendency of survey responses and the PCI2 scores (Figure 2). These curves display attributes of social norms associated with streamflow acceptability rankings, including the intensity or strength of the norm, and the crystallization or level of agreement about the norm (Vaske et al., 1986; Shelby et al., 1996). Plotted curves and tabular outputs of PCI2 scores and responses to open-ended questions about niche streamflow conditions were used to delineate various normative characteristics, including the minimum navigable streamflow, and the range of acceptable and optimal streamflow.

Integrating single-flow judgements can help further refine flow acceptability ranges where boundaries are not clearly identified by the impact acceptability curve and the PCI2 metric. By the nature of the flow-acceptability rankings, there sometimes exists a need for interpolation between data points on the

[2] The use of the term "safe" does not imply that any other particular stream flows provide safe conditions and it should be acknowledged that river recreation has inherent risk regardless of the resource condition.

curve. For example, in Figure 2, 500 cfs is identified as acceptable and 400 cfs is unacceptable, however purely based on the impact acceptability curve it is unclear if 550 cfs is acceptable or not. The single flow judgements can alleviate some of these uncertainties by providing additional data to define the outer-boundaries of the flow acceptability curves, as well as niche conditions along the curve. This level of integration was incorporated into the flow preference analysis and further supports the results.

Additionally, it was determined that a greater level of detail was needed to understand how lower stream flows support river recreation opportunities. Using the single-flow judgement responses, an additional threshold range was created to define flows that are navigable but not quite acceptable. Navigable flows are defined as the lowest flow required to navigate your craft on a segment and acceptable flows are flows where the respondent would return to paddle again. This additional flow threshold range will provide useful insights on a range of flows that may support a lower quality recreational opportunity, but one that still exists. Defined streamflow conditions were then compared to historical hydrological conditions in order to complete the Boatable Days analysis.

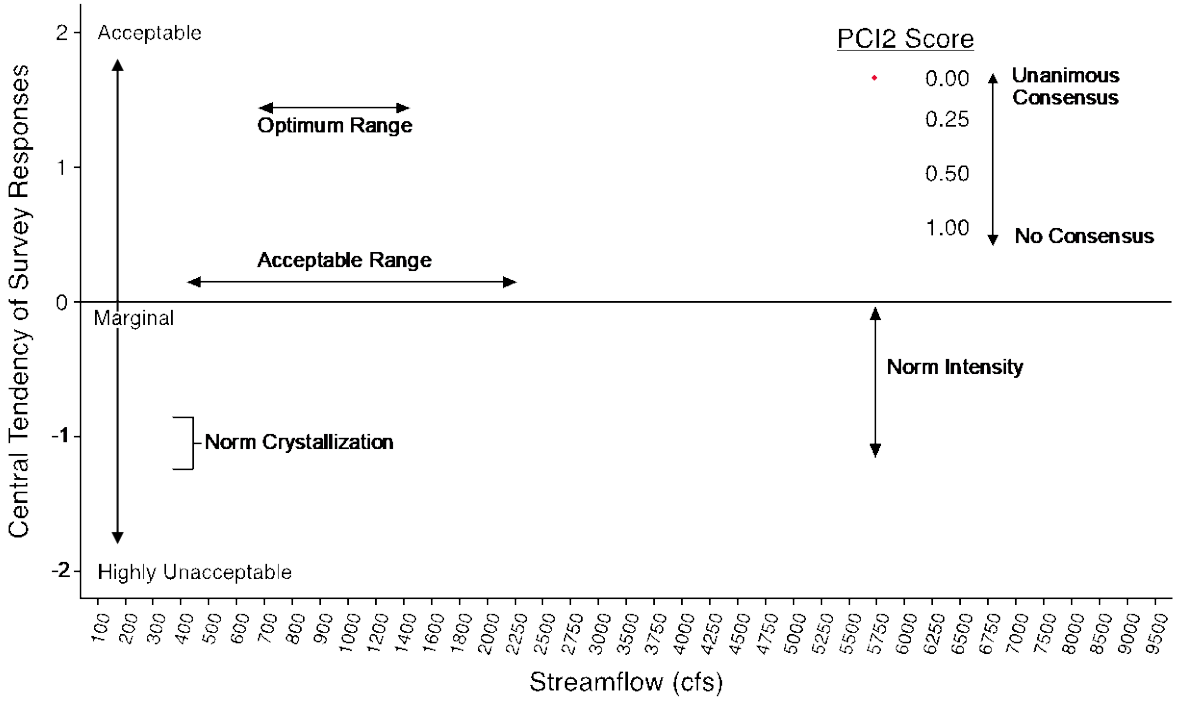


Figure 3. An example impact acceptability curve where the position of each dot corresponds to the central tendency of survey responses and the relative size of the dot corresponds to the PCI2 score. Smaller dots indicate a higher degree of agreement or crystallization among survey respondents. The distance of each dot from the neutral line (0) indicates norms of higher or lower intensity. Generally, the plateau of the curve reflects optimum streamflow conditions and points that lie above the neutral line (0) reflect the range of acceptable resource conditions.

4.1.2. Commercial Rafting and Float Fishing

One-on-one interviews were conducted with commercial rafting and commercial fishing outfitters by American Whitewater and Colorado Trout Unlimited, respectively. Interviews were conducted between

June and October of 2020. Rafting and float fishing outfitters were asked to define the minimum navigable, minimum acceptable, minimum optimal, maximum optimal, maximum acceptable flows, and in some cases maximum navigable flows that support their operations. Discrepancies in preferred flows that arose between outfitters were discussed further and finalized based on consensus. Common factors that influence preferred flows for commercial operations may include, but are not limited to, timing of trips, customer safety, age restrictions required for higher flows, low bridge hazards, and flows that provide a high challenge or excitement. Defined commercial rafting and float fishing flow preferences were used to determine a baseline of Commercial Rafting Days and Commercial Fishing Days, respectively. These metrics were determined using the Boatable Days framework described below.

4.2. Boatable Days Analysis

The computation of Boatable Days is the dominant quantitative approach used to characterize recreational use opportunities on rivers (Fey and Stafford, 2009; Shelby and Whittaker, 1995; Whittaker et al., 1993). The metric itself reflects the number of days in a given year that fall within certain defined flow ranges (e.g., lower acceptable flows, optimal flows, upper acceptable flows). The Boatable Days analysis performed on reaches within the assessment area responded to the inter-annual natural and management-induced variability in streamflow by computing the number of Boatable Days that occur in each of four hydrological year types: wet, wet-typical, dry-typical, and dry. Boatable Days were additionally computed for three different individual representative years that have commonly been used as example hydrological years in the Gunnison Watershed Management Planning process. Representative years include 2010, 2011, and 2012, representing average, wet, and dry conditions, respectively. The three hydrological year examples are illustrative and are not meant to replace the four defined hydrological year types used in this analysis (Appendix E).

Wilson Water Group, LLC. and Lotic Hydrological provided streamflow time series data for the four hydrological year types defined here. The period of record used for this analysis was from 1975 to 2018. Representative streamflow time series for each year type were created by first ordering the 43-year period of streamflow time series by total annual flow (Figure 3). Average daily streamflows across all years in the ordered list below the 25th percentile were computed to produce a representative dry year streamflow time series. The same approach was used to create representative streamflow series for dry-typical, wet-typical, and wet years where dry-typical year types fell between the 25th and 50th percentiles of total annual flow, wet-typical year types were between 50th and 75th percentiles, and wet year types were those years above the 75th percentile in the ordered list.

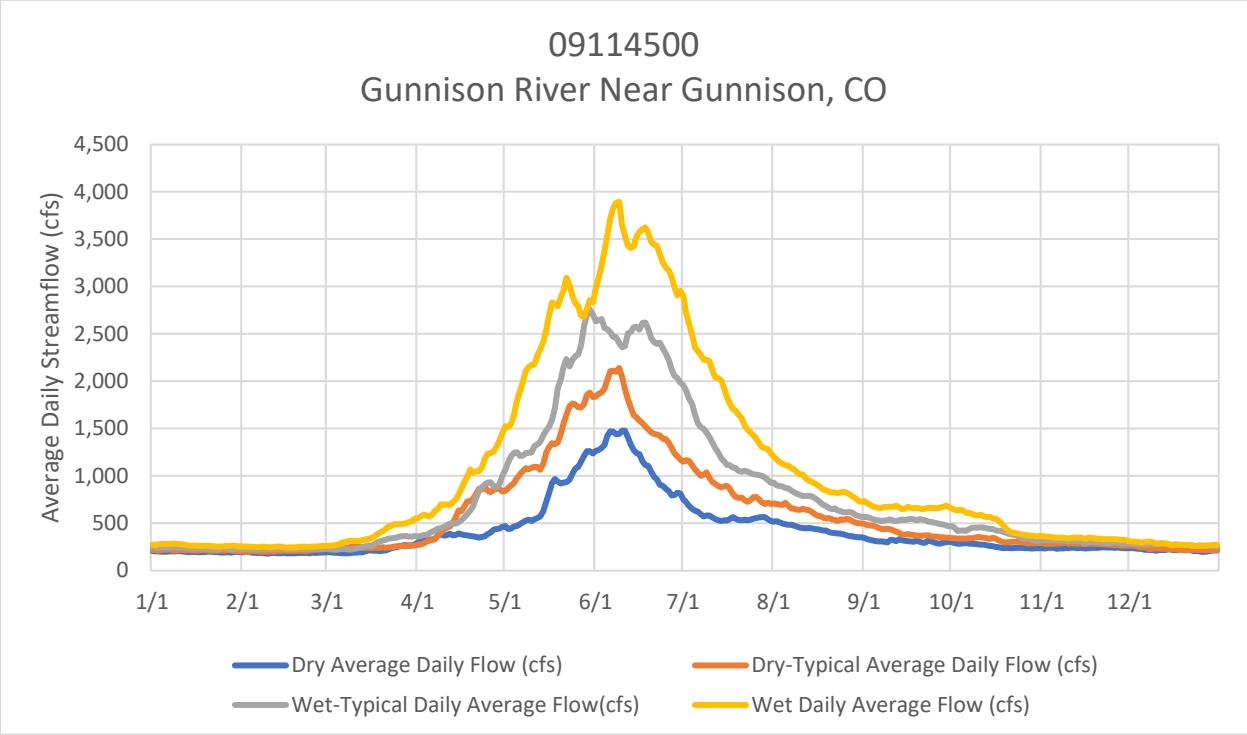


Figure 4. Example hydrograph of the Gunnison River characterizing representative hydrological year types based on USGS gage 09114500. These streamflow time series were used in the Boatable Days analysis.

5. Results and Discussion

5.1. Survey-based Flow Preferences

The 2013 web-survey captured responses from 329 total recreational users. The Taylor River had 110 respondents and the Gunnison River and Gunnison River Whitewater Park had 64 and 57 respondents, respectively. Eighty-four percent of overall respondents indicated they were somewhat comfortable or very comfortable reporting flows, 78.1% of respondents identified themselves as advanced or expert paddlers, and 71.5% recreate on streams and rivers at least 20 days per season (Figure 2). A wide range of preferred craft types were indicated, including oar frame rafts, kayaks, catarafts, canoes, paddle rafts, stand up paddle boards, and river surf boards. The majority of respondents indicated their preferred craft type as a kayak (66%), with rafts and canoes having 31% and 3% representation, respectively.

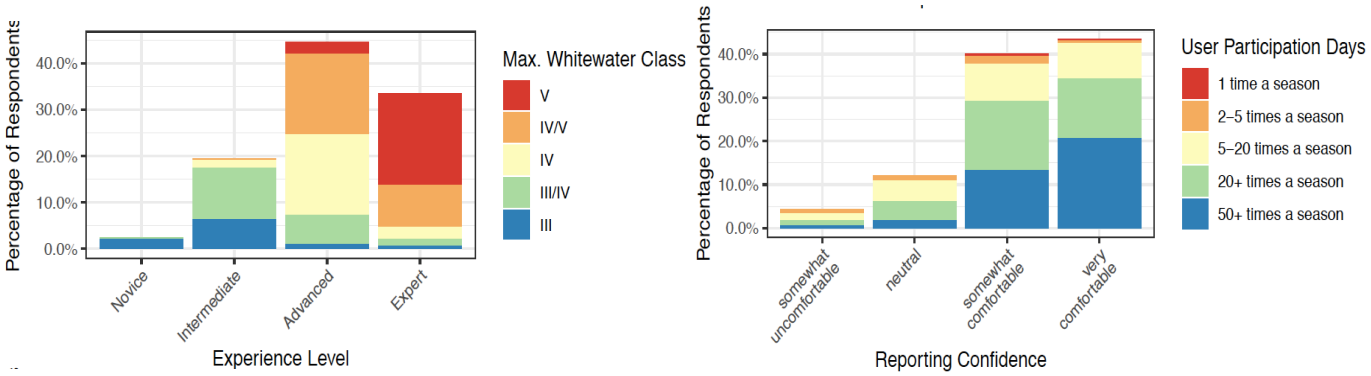


Figure 4. Survey responses from 329 users indicating (left) experience level and maximum comfortable whitewater class and (right) participant confidence in providing flow acceptability rankings and the number of days respondents typically participate in paddling activities annually.

Disproportionate kayaker responses had the potential to skew aggregate flow preferences to be weighted to kayaks compared to other craft types, however, overall PCI2 scores were low indicating a high level of agreement amongst all respondents. The majority of respondents also identified as advanced or expert paddlers, which increases the confidence of the results. More skilled paddlers tend to have more experience reporting flows that support river recreation, increasing the confidence of the aggregate results. While more advanced paddlers are capable of navigating higher flows, they are also capable of and interested in technical, low-flow opportunities. The limited response rate for beginner and intermediate paddlers combined with their limited experience reporting flows reduces the confidence of that specific user group. Overall, aggregate responses for the majority of flow value rankings presented with low PCI2 scores, indicating a high level of agreement across craft types, skill levels, and other user groups (Table 3).

Table 2. Survey-based flow preferences for aggregate users

User	River	Reach Description	Min. Navigable	Min. Acceptable	Min. Optimal	Max. Optimal	Max. Acceptable
Aggregate Users	Taylor	New Generation to Almont	250	350	600	900	1200+
	Gunnison	Almont to McCabes	300	500	1000	1800	5000+
	Gunnison	Whitewater Park	400	550	1200	1600	5000+

Computed PCI2 statistics and mean flow acceptability scores for each user group on each reach are reported in Appendix C. Output from the PCI2 and flow acceptability computations were then used to create streamflow acceptability curves. Tabular and graphical output from the PCI2 computation along with survey responses to open ended flow preference questions were used to delineate 'Minimum Navigable', 'Minimum Acceptable', 'Minimum Optimal', 'Maximum Optimal', and 'Maximum Acceptable' streamflow thresholds for both aggregate users (Table 2) and individual user groups (Appendix D).

Aggregate-respondent flow acceptability rankings provided for the Taylor River and the two reaches on the Gunnison River did not indicate an upper bound for the maximum acceptable flow. The majority of the Taylor River does not have hazards that become considerably dangerous at higher flows. The Gunnison River has multiple low bridges that are known to have varying flow thresholds between 1800 cfs and 4,000 cfs, however sub-segments such as the Whitewater Park do not have navigational hazards at high flows and could account for the lack of a determined maximum acceptable flow. Other than the identified hazards, the Gunnison River is relatively low-gradient and does not significantly change with additional flow compared to steeper, more channelized streams in the region.

Responses to single-flow judgment questions complimented mean acceptability rankings and were used to further refine streamflow thresholds. 25th percentile, median, and 75th percentile responses are reported in graphical summaries for each of the three segments below (Figures 4 through 6).

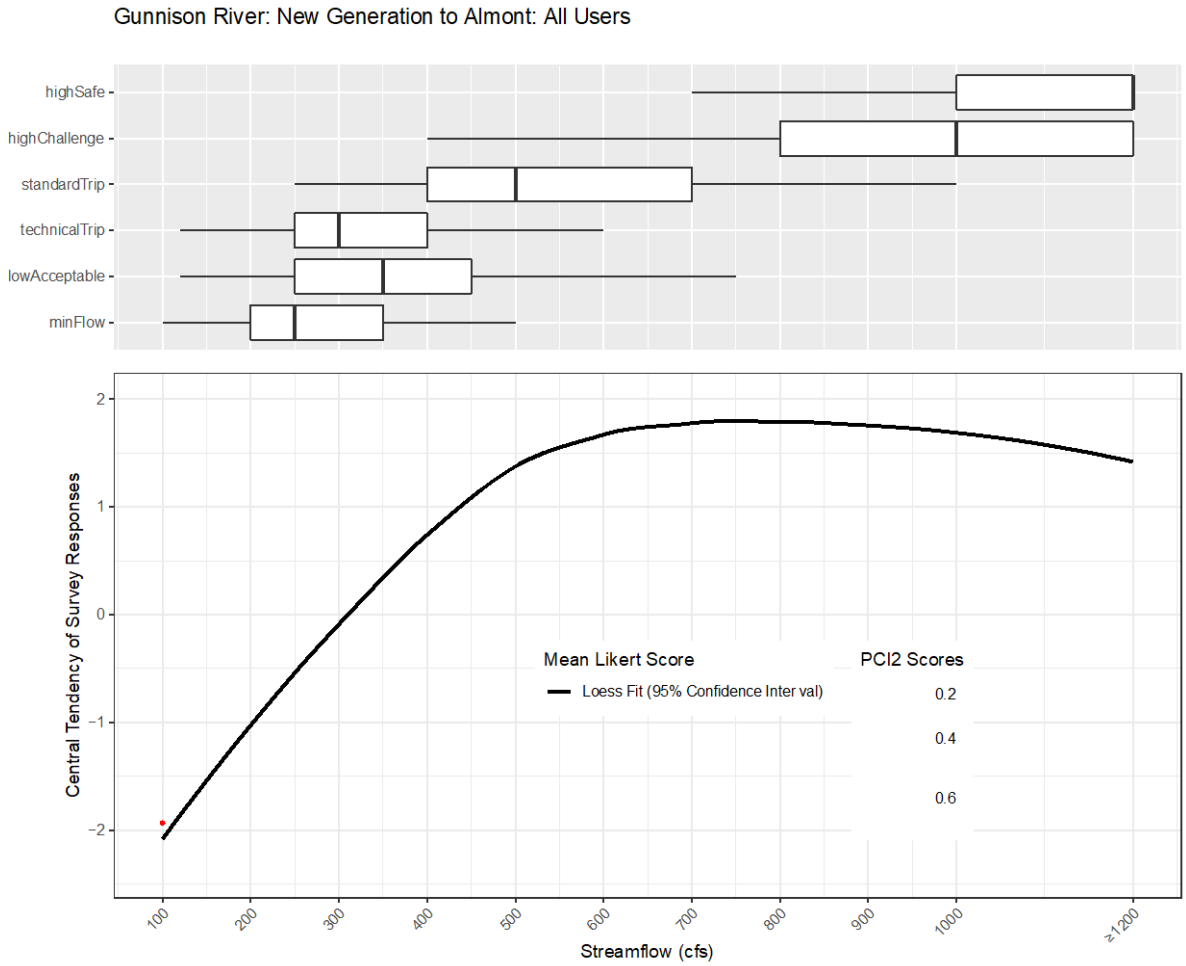
On the Taylor River between New Generation and Almont, flows with positive acceptability rankings ranged from 400 to 1200 cfs and above (Figure 4). High flows never fell below the neutral line and thus no maximum acceptable flow was determined for the Taylor River. 1200+ cfs was used to represent the maximum acceptable flow because flows above 1200 cfs were rarely observed at the stream gage over the 43 period of record. No maximum acceptable flow is consistent with observed use patterns in high water years. While high flows may not be suited for all user groups (e.g., beginners or inflatable kayaks), the majority of users still choose to paddle the Taylor at high flows. Additionally, while high flows become less acceptable for commercial rafting, outfitters noted that there is not a maximum high flow at which their trips on the upper and lower Taylor River segments become unnavigable.

Using a combination of flow acceptability rankings and single-flow judgements, 350 cfs was determined to be the minimum acceptable flow for the Taylor River. 400 cfs had a mean acceptability ranking of 0.839 and 300 cfs had a mean ranking of -0.125 (Table 3). The median single-flow judgement response for lowest acceptable flow was 350 cfs. In this case, the single-flow judgement response was used to interpolate between acceptability rankings and the minimum acceptable flow was determined to be 350 cfs.

Optimal flows for the Taylor River were found to be 600 to 900 cfs. Optimal flows were defined as flows that had a minimum of a 1.5 acceptability ranking and less than a 0.3 PCI2 score, indicating high acceptability and low conflict. Finally, a minimum navigable flow of 250 cfs was determined using the single-flow judgement responses (Figure 4).

This lower flow threshold was defined in order to assess the range of flows that may be less than acceptable to the majority of users, but are still navigable and could support some level of recreation

opportunities.

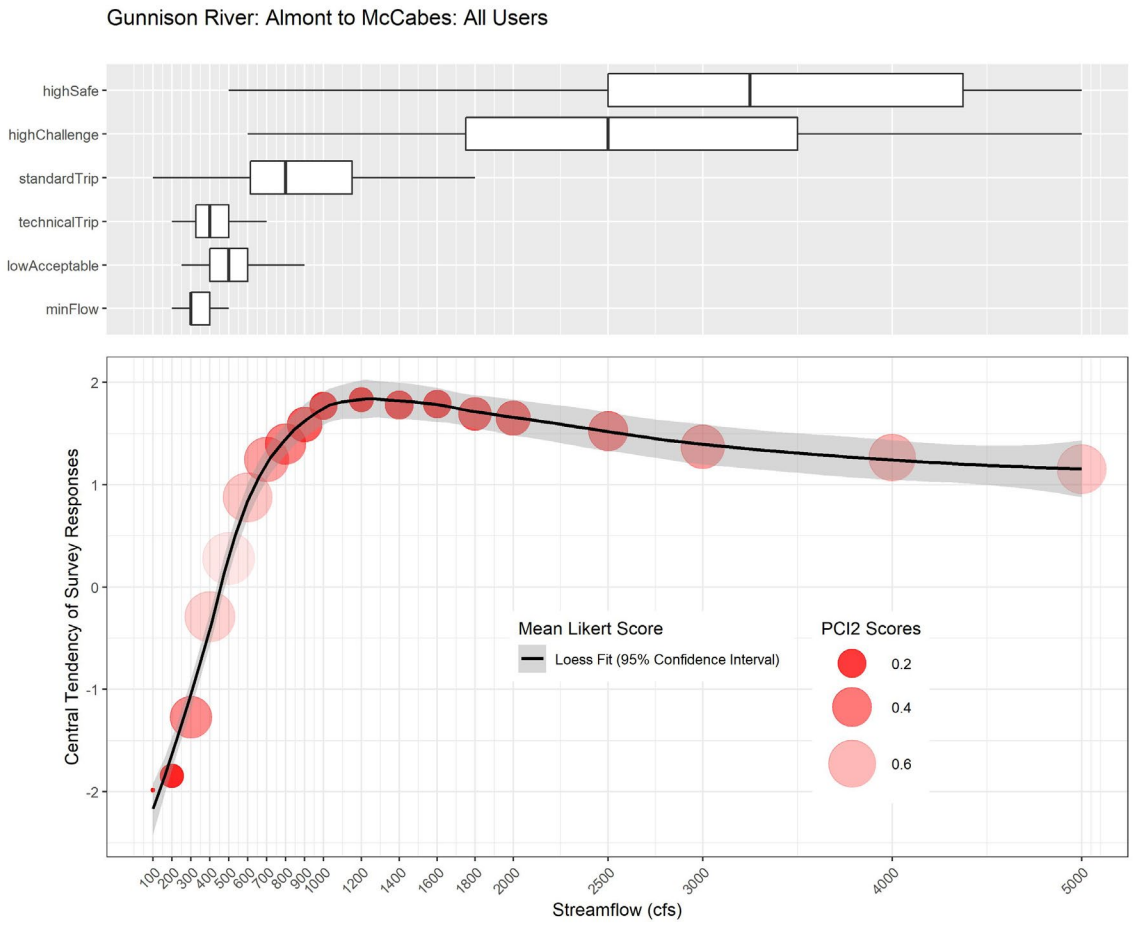


Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	200	250	338	110
Low Acceptable Flow (cfs)	250	350	450	108
Technical Flow (cfs)	250	300	400	107
Standard Trip Flow (cfs)	400	500	700	107
Challenging High Flow (cfs)	800	1000	1500	101
Highest Safe Flow (cfs)	1000	1600	2000	93

Figure 5. Summary of aggregate flow preference results for the Taylor River: New Generation to Almont. 5-point acceptability rankings (y-axis) and streamflow (x-axis) make up the impact acceptability curve with PCI2 scores shown in red bubbles. Single-flow judgement responses are represented in the box plot overlaid on the impact acceptability curve x-axis (top) and in tabular form (bottom). Survey responses are correlated to the USGS gage below Taylor Park Reservoir (USGS 0910900).

Acceptable flows on the Gunnison River between Almont and McCabes were found to range from 500 cfs to 5,000 cfs and above, with a lowest navigable flow of 300 cfs (Figure 5). 500 cfs was the lowest flow with a positive mean acceptability ranking and was also the median lowest acceptable flow identified in the single-flow judgement questions. Similar to the Taylor River, no maximum acceptable flow was determined on this river segment. While there are multiple low bridge hazards that exist between Almont and McCabes, there are also sub-segments on the river where low bridge hazards do not exist, such as from the Whitewater Park downstream to McCabes. See Section 5.3 for more information on

low bridge hazards. While the PCI2 scores (i.e., level of conflict) increase with higher flows, the mean acceptability ranking remains above 1 at 5,000 cfs (Figure 5). Optimal flows for this segment ranged from 1000 cfs to 1800 cfs and were correlated to PCI2 scores of 0.3 and lower and mean acceptability rankings of 1.5 and higher.

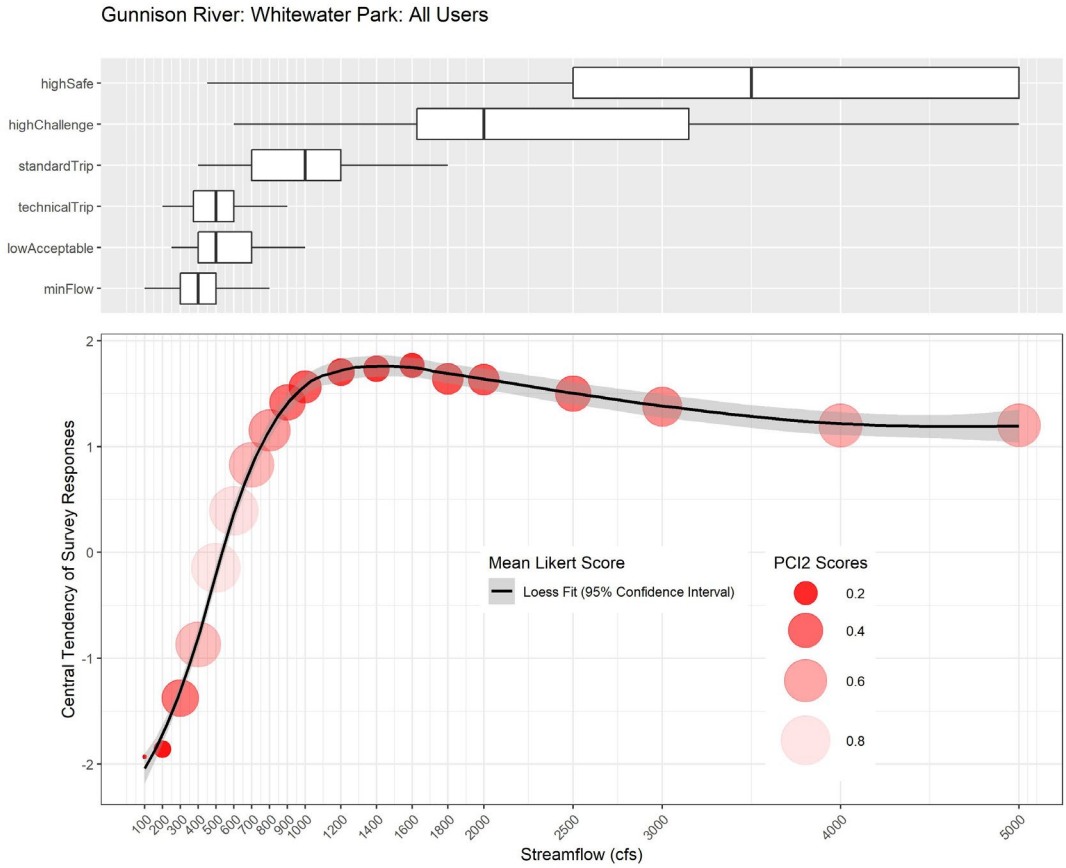


Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	300	400	64
Low Acceptable Flow (cfs)	400	500	600	63
Technical Flow (cfs)	325	400	500	62
Standard Trip Flow (cfs)	612	800	1150	62
Challenging High Flow (cfs)	1800	2500	3500	61
Highest Safe Flow (cfs)	2500	4000	5000	59

Figure 6. Summary of aggregate flow preference results for the Gunnison River: Almont to McCabes. 5-point acceptability rankings (y-axis) and streamflow (x-axis) make up the impact acceptability curve with PCI2 scores shown in red bubbles. Single-flow judgement responses are represented in the box plot overlaid on the impact acceptability curve x-axis (top) and in tabular form (bottom).

Acceptable flows for the Gunnison River Whitewater Park were found to range from 550 cfs to 5,000 cfs and above, with a lowest navigable flow of 400 cfs (Figure 6). 600 cfs had a 0.393 acceptability ranking and 500 cfs had a -0.145 ranking. Single-flow judgement results indicated that 500 cfs was the lowest acceptable flow for this segment and using this result in combination with the flow acceptability rankings, 550 cfs was determined to be the overall lowest acceptable flow. Similar to other segments in this study, no maximum acceptable flow was determined. There are no low bridges on this short

segment or other specific hazards at high flows. While the Whitewater Park becomes more challenging at high flows, it still provides an acceptable user experience for most users at high flows. Optimal flows for this segment ranged from 1200 cfs to 1600 cfs and were correlated to PCI2 scores of 0.3 and lower and mean acceptability rankings of 1.5 and higher. While this range was the overall identified optimal flow range, it is commonly understood that different features at the Whitewater Park provide a better experience at different flow levels. A feature-specific assessment for the Whitewater Park was outside the scope of this study.



Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	400	500	57
Low Acceptable Flow (cfs)	400	500	700	57
Technical Flow (cfs)	372	500	600	56
Standard Trip Flow (cfs)	700	1000	1200	57
Challenging High Flow (cfs)	2000	2500	3600	57
Highest Safe Flow (cfs)	2500	4000	5000	56

Figure 7. Summary of aggregate flow preference results for the Gunnison River: Whitewater Park. 5-point acceptability rankings (y-axis) and streamflow (x-axis) make up the impact acceptability curve with PCI2 scores shown in red bubbles. Single-flow judgement responses are represented in the box plot overlaid on the impact acceptability curve x-axis (top) and in tabular form (bottom).

Table 3. Potential for Conflict Index-2 (PCI2) and mean acceptability scores for the Taylor and Gunnison Rivers. Mean Acceptability values reflect the -2:0:2 numerical mapping assigned to the 5-point scale of acceptability rankings where negative values reflect unfavorable rankings and positive values reflect favorable rankings.

	Taylor River: New Generation to Almont		Gunnison River: Almont to McCabes		Gunnison River: Whitewater Park	
Flow (CFS)	PCI2	Mean Acceptability	PCI2	Mean Acceptability	PCI2	Mean Acceptability
100	0.065	-1.933	0.015	-1.98	0.067	-1.930
200	0.465	-1.303	0.134	-1.846	0.128	-1.860
300	0.715	-0.125	0.463	-1.269	0.450	-1.377
400	0.665	0.839	0.685	-0.288	0.677	-0.869
500	0.469	1.360	0.746	0.279	0.803	-0.145
600	0.267	1.694	0.647	0.877	0.784	0.393
700	0.216	1.760	0.527	1.246	0.661	0.828
800	0.224	1.755	0.434	1.397	0.574	1.154
900	0.213	1.768	0.309	1.591	0.430	1.419
1000	0.303	1.663	0.1875	1.773	0.357	1.562
1200	0.472	1.425	0.145	1.831	0.255	1.705
1400	0.574	1.271	0.198	1.778	0.238	1.733
1600	0.643	1.157	0.190	1.790	0.216	1.767
1800	-	-	0.275	1.694	0.325	1.638
2000	-	-	0.306	1.651	0.331	1.632
2500	-	-	0.404	1.525	0.429	1.500
3000	-	-	0.508	1.371	0.516	1.375
4000	-	-	0.583	1.267	0.619	1.196
5000	-	-	0.650	1.150	0.612	1.2

Variability in flow thresholds between rivers and different segments on the same river can be attributed to the unique geomorphic or hydraulic characteristics of each reach, and/or variability in the sample size of respondents providing flow rankings on each reach and for each listed streamflow. Flow preference thresholds were used to compute the number of Boatable Days associated with different hydrological conditions on each reach in the assessment area (Section 5.4).

5.2. Commercial Rafting and Float Fishing Flow Preferences

Compared to aggregate users, flow preferences for commercial rafting and commercial fishing operations had lower minimum navigable and acceptable flow thresholds and lower maximum acceptable and maximum navigable thresholds. Commercial outfitters are financially motivated to run river trips and may be willing to run trips at lower flows than self-guided users. Outfitters also have operational concerns at higher flows and often reduce the age of their trip participants at higher flows. Fishing outfitters have lower preferred flows compared to both rafting outfitters and aggregate users. Fishing conditions can be better at lower flows and lower flows are also conducive to a longer, more optimal trip length.

For both fishing and rafting outfitters, preferred flows were very similar on all segments of the Taylor River and for all segments on the Gunnison River, with the only variation occurring in the maximum acceptable flows due to different low bridge hazards. While there is variation in the difficulty of the segments on the Taylor and Gunnison Rivers, the character of the two rivers does not significantly change between segments. Preferred flows for commercial fishing were not identified on the Taylor River for the purposes of the hydrological analysis because fishing outfitters do not hold permits on the Taylor River. Additional commercial float fishing flow preferences for the Lower Taylor and the Lower Gunnison between McCabe's and Wilson's Landing are included in Appendix G.

Table 4. Flow preferences for commercial rafting and float fishing based on interviews during the summer of 2020.

User	River	Reach Description	Min. Navigable	Min. Acceptable	Min. Optimal	Max. Optimal	Max. Acceptable
Commercial Float Fishing	Gunnison	Almont to North Bridge	250	300	400	1000	1800
	Gunnison	North Bridge to WW Park	250	300	400	1000	1750
	Gunnison	WW Park to McCabes	250	300	400	1000	1500
Commercial Rafting	Taylor	Todd's Slot to South Bank	200	300	400	600	1000*
	Taylor	South Bank to Five Mile	200	300	400	600	1000*
	Taylor	Five Mile to Almont	200	300	400	600	1000*
	Gunnison	Almont to North Bridge	300	400	400	2500	2800
	Gunnison	North Bridge to WW Park	300	400	600	2500	4,000
	Gunnison	WW Park to McCabes	300	400	600	2500	5,000+

**For commercial rafting on the upper and lower Taylor River acceptable flows are exceeded above 1,000 cfs, however flows above 1,000 cfs are still navigable and rafting outfitters continue to run modified trips during these higher flows. On the middle Taylor River, the river becomes unnavigable for commercial rafting at Harmel's Bridge above 1,250 cfs.*

5.3. Navigational Hazards

Additional constraints or hazards limit recreational use on several segments of the Taylor and Gunnison Rivers. Low bridges are the most common type of navigational hazard. These bridges can make passage extremely dangerous or impossible at certain high flows depending on the craft type. Navigational hazards and other limitations were not used to modify Boatable Days calculations because they are expected to apply differently to various craft types. However, it is likely that knowledge of these hazards impacted survey respondents' flow preferences and identification of high safe flow levels. On the Gunnison River between Almont and McCabes, the highest safe flow (4,000 cfs @ USGS 09114500) corresponds with the CR 13 bridge thresholds outlined in Table 5. However, on this same segment no

maximum acceptable flow was determined. This could be due to the fact that there are multiple access points and sub-segments within the Almont to McCabes section of the Gunnison River. For example, sub-segments such as the Whitewater Park do not have low bridges that limit maximum acceptable flows.

Flow preferences for commercial rafting and fishing outfitters are more closely aligned with navigational hazards. This can be attributed to multiple factors including an increased need to manage risks for commercial operations, limited craft types with more established bridge thresholds for each craft, and more consistent users (guides) and abilities. On most river segments, flows do not exceed bridge thresholds even in 'wet' years. This is further discussed in subsequent sections of this report.

Table 5. Known navigation hazards on segments of the Taylor and Gunnison Rivers. Identified flow thresholds are based on flow estimates using the most appropriate stream gage(s).

River	Reach	Hazard Name	Notes
Taylor	South Bank to Five Mile	Harmel's Bridge	Harmel's Bridge is located below the South Bank access on the Taylor River and is impassable paddle rafts at roughly 1,250 cfs based on either the Taylor River below Taylor Reservoir gage or the Taylor River at Almont gage, depending on spring runoff.
Taylor	South Bank to Five Mile	Wilder Bridge	The Wilder Bridge becomes impassable to paddle rafts at 1,080 cfs, however some commercial operators have permission to portage around the bridge at high flows. The flows at this bridge are determined using both the Taylor River below Taylor Reservoir gage and the Taylor River at Almont gage, depending on spring runoff.
Gunnison	Almont to North Bridge	Costello's Bridge	Costello's bridge has been identified as the most problematic bridge hazard in the Upper Gunnison Basin. Depending on craft type, this bridge begins to be impassable at flows between 2,000 and 2,800 cfs (combined flows on East and Taylor Rivers at Almont).
Gunnison	North Bridge to Whitewater Park	CR 13 Bridge	CR 13 Bridge directly upstream from the WW Park obstructs the river at flows ranging from 3,700 – 4,000 cfs depending on the craft type.
Gunnison	Whitewater Park to McCabes	Psychedelic Falls	Psychedelic Falls has varying levels of perceived risk at higher flows. Some user groups consider the rapid to have a maximum acceptable flow of 1500 cfs, while other user groups have not identified a maximum acceptable flow.
Gunnison	Whitewater Park to McCabes	Montbello Rd. Bridge	This bridge crosses the river near the Dos Rios golf course on Montbello Rd. Possible obstruction at extremely high flows, but there have been no issues in recent years.
Gunnison	McCabes to Wilson's Landing	CR 32 Bridge	CR 32 bridge is located just below the McCabes river access area and at high flows can obstruct passage between McCabes and Wilson's Landing. While some users have not reported any issues, it is known to obstruct fishing rafts at flows as low as 5,700 cfs (Gunnison at Riverway gage).

5.4. Boatable Days Results

Boatable Days, Commercial Rafting Days, and Commercial Float Fishing Days were calculated for each respective user group to determine a baseline of existing river recreation opportunities on each reach. The number of opportunities varied greatly across hydrological year types and user groups, with opportunities consistently increasing as hydrological conditions change from dry to wet. Opportunities for aggregate respondents range from 8 Boatable Days on the Taylor River in dry years to 276 days on the Gunnison River in wet years (Table 6).

In certain years, a high number of river recreation opportunities occur during typical winter months when there is little to no use on these segments due to weather conditions and ice hazards on the river. When using the hydrological analysis results for management decisions it will be necessary to consider the monthly numbers in addition to annual totals in order to look at the number of opportunities that exist during the typical use-season. While ice coverage will greatly vary depending on the year and the river segment, ice has the potential to impact user days between November 1 and March 31 under current weather patterns. It is also important to note the difference between a Boatable Day, Commercial Rafting Day, or a Commercial Float Fishing Day and a user-day. For example, a Boatable Day describes when acceptable flows are met, providing an *opportunity* for recreation for the majority of users and a user-day is when people are taking advantage of that opportunity. User-days are affected by numerous factors including weather, unexpected hazards, limited access, and personal plans, while Boatable Days are solely affected by flow conditions.

Totals for Boatable Days, Commercial Rafting Days, and Commercial Float Fishing Days are summarized in Table 6 for each acceptability category and each year type. Additionally, the results are summarized graphically for an example reach for each user group (Figures 7 through 9). The remaining summary graphics and monthly totals are included in Appendices E, F, and H.

Table 6. Boatable Days falling within each navigable and acceptability category calculated for reaches within the assessment area for dry, dry-typical, wet-typical, and wet hydrological year types.

Users	River	Reach	Acceptability Category	Dry Year	Dry Typical Year	Wet Typical Year	Wet Year
Aggregate Users	Taylor	New Generation to Almont	Navigable	8	95	95	41
			Acceptable	0	0	43	114
			Optimal	0	0	0	27
			Total	8	95	138	182
	Gunnison	Almont to McCabes	Navigable	86	34	82	71
			Acceptable	61	119	122	162
			Optimal	28	50	43	43
			Total	175	203	247	276
	Gunnison	Whitewater Park	Navigable	51	28	57	20
			Acceptable	46	108	117	178
			Optimal	20	21	23	20
			Total	117	157	197	218
Commercial Float Fishing	Gunnison	Almont to North Bridge	Navigable	20	31	36	35
			Acceptable	89	81	68	61
			Optimal	86	102	107	113
			Total	195	214	211	209

	Gunnison	North Bridge to WW Park	Navigable	31	57	46	79
			Acceptable	86	97	91	99
			Optimal	89	88	108	103
			Total	206	242	245	281
	Gunnison	WW Park to McCabes	Navigable	31	57	46	79
			Acceptable	86	82	85	90
			Optimal	89	92	108	103
			Total	206	231	239	272
Commercial Rafting	Taylor	Todd's Slot to South Bank	Navigable	85	85	84	41
			Acceptable	0	39	73	118
			Optimal	0	0	19	52
			Total	85	124	176	211
	Taylor	South Bank to Five Mile	Navigable	85	85	84	41
			Acceptable	0	39	73	118
			Optimal	0	0	19	52
			Total	85	124	176	211
	Taylor	South Bank to Five Mile	Navigable	85	85	84	41
			Acceptable	0	39	73	118
			Optimal	0	0	19	52
			Total	85	124	176	211
	Gunnison	Almont to North Bridge	Navigable	60	34	33	28
			Acceptable	0	0	1	32
			Optimal	115	157	184	152
			Total	175	191	218	212
	Gunnison	North Bridge to WW Park	Navigable	58	46	50	58
			Acceptable	63	34	83	83
			Optimal	54	123	114	135
			Total	175	203	247	276
	Gunnison	WW Park to McCabes	Navigable	58	46	50	58
			Acceptable	63	34	83	83
			Optimal	54	123	114	135
			Total	175	203	247	276

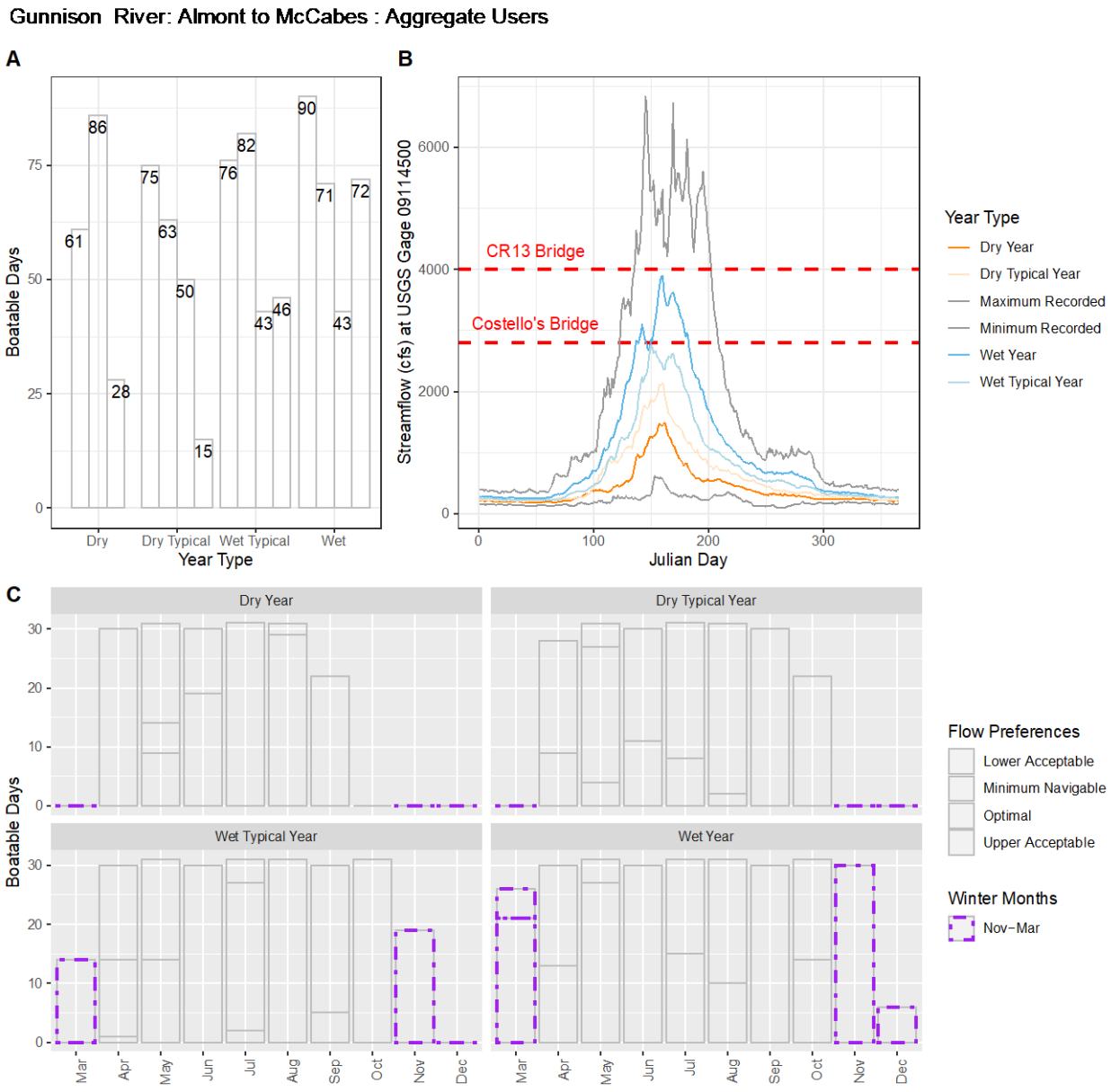


Figure 8. Boatable Day totals for the Gunnison River: Almont to McCabes for aggregate users. (A) Annual Boatable Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Boatable Day totals summarized by hydrological year type.

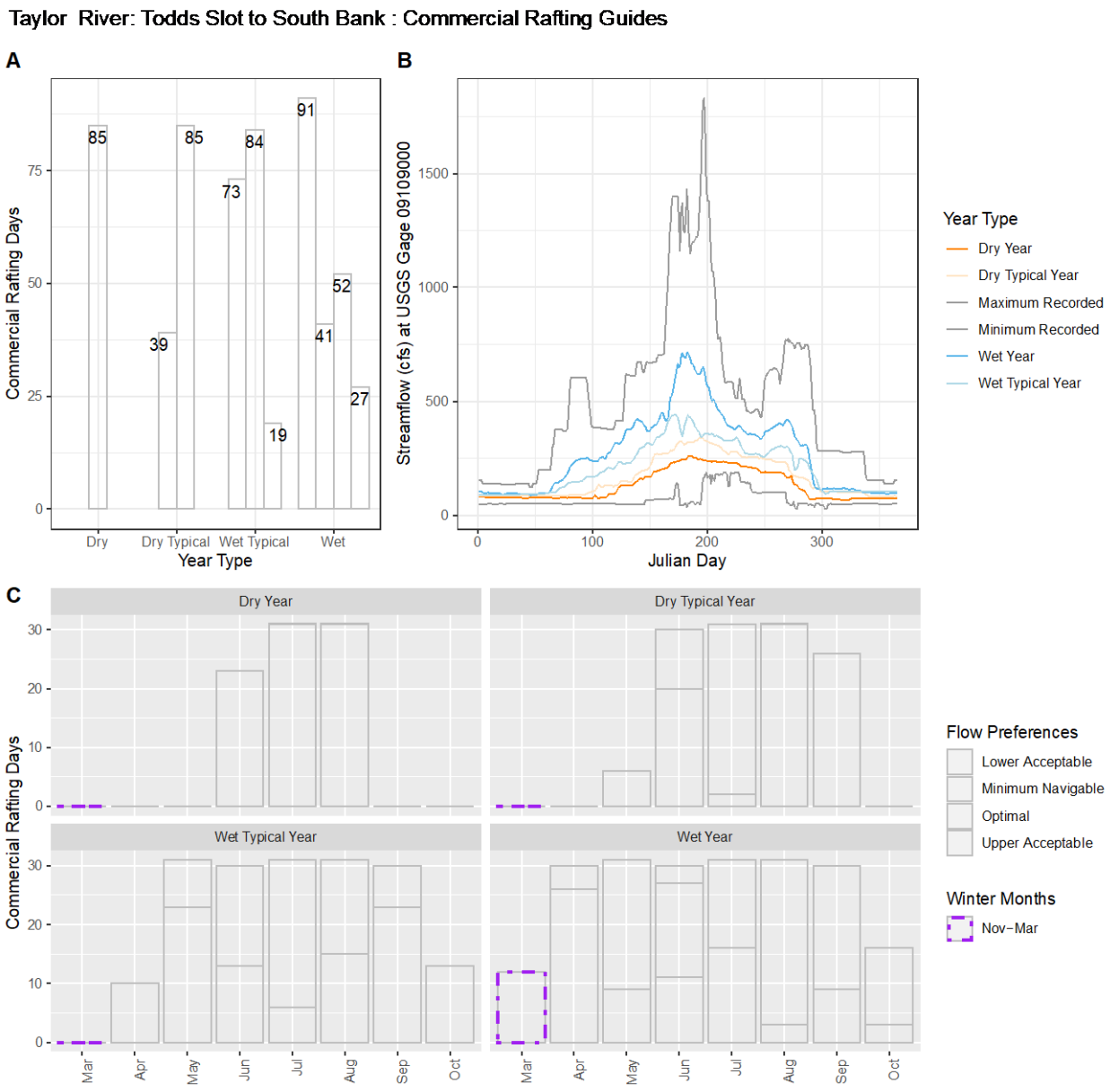


Figure 9. Commercial Rafting Day totals for the Taylor River: Todd's Slot to South Bank. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

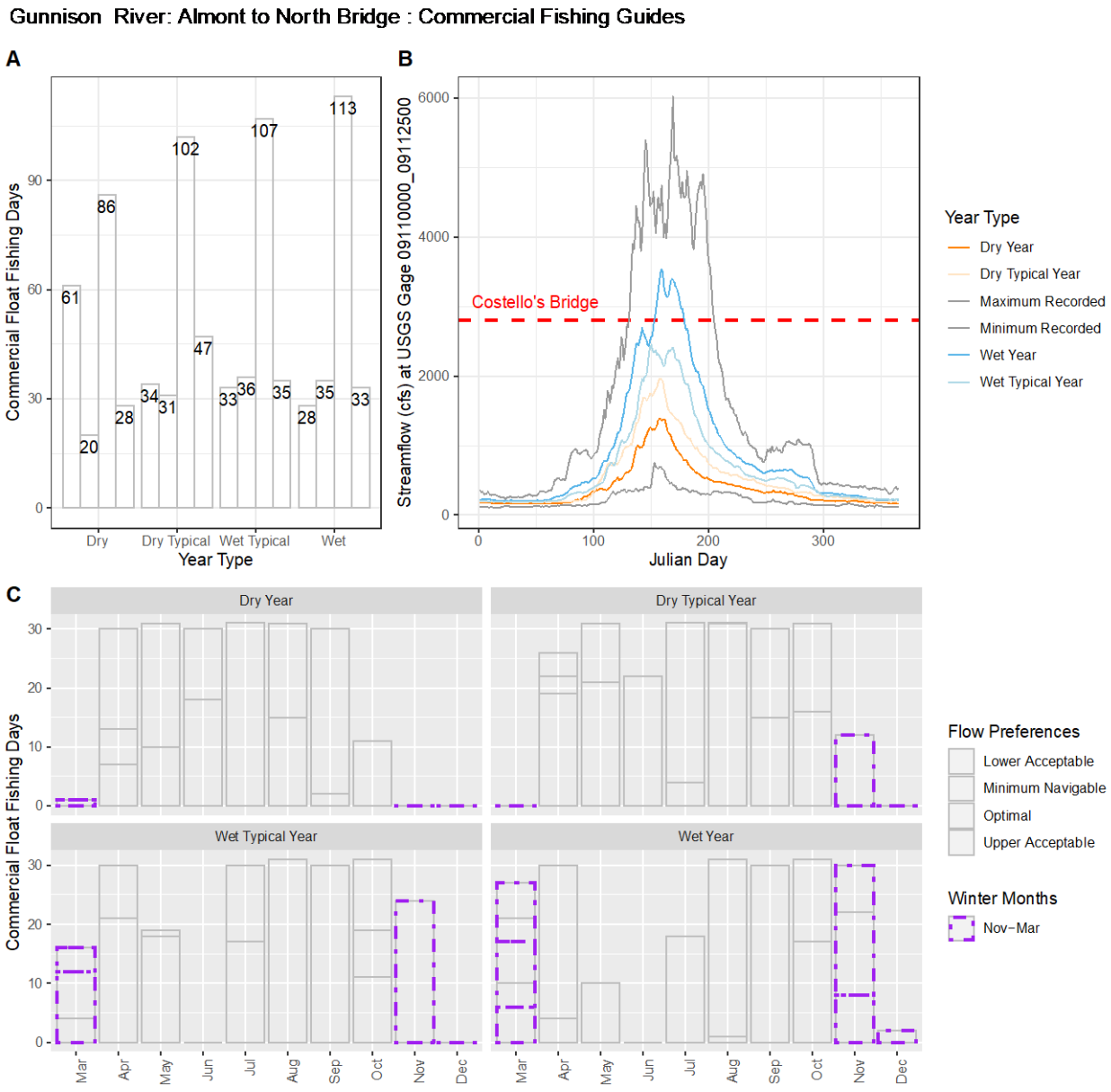


Figure 10. Commercial Fishing Day totals for the Gunnison River: Almont to North Bridge. (A) Annual Commercial Fishing Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Fishing Day totals summarized by hydrological year type.

6. Summary and Conclusions

This report discusses the study locations, and methods used to collect and analyze streamflow preference information from recreational users. Responses to American Whitewater's streamflow survey in 2013 were used to delineate navigable, acceptable and optimal streamflow thresholds for supporting recreational use activities on Taylor and Gunnison Rivers. Additional work was done to define streamflow thresholds for commercial rafting and float fishing through one-on-one interviews with outfitters during the summer and fall of 2020. Streamflow threshold identification through aggregate survey responses supported quantification of the Boatable Days metric for each assessment reach under dry, dry-typical, wet-typical and wet hydrological year types. A similar analysis was completed to quantify Commercial Rafting and Commercial Float Fishing Days. The assessment followed recommendations in the State of Colorado's Basin Implementation Plan guidance documents for quantifying non-consumptive recreational needs (CWCB, 2013).

Respondent numbers for the flow preference study conducted in 2013 are robust for a remote or sparsely populated region of Colorado's western slope. The large number of responses to flow related questions for the Taylor and Gunnison Rivers made delineation of flow acceptability thresholds for aggregate users straightforward. Flow preferences were also determined for individual user groups based on skill level, craft type, and residency. Some response rates for individual user groups were low and may have led to less reliable results. The relatively low number of commercial outfitters that operate on the Taylor and Gunnison was not conducive to using a survey-based approach and instead one-on-one interviews were conducted with commercial rafting and fishing outfitters during the 2020 river reason.

User-defined stream flow preferences differed between user groups, with commercial float fishing having the greatest difference in preferred flows compared to aggregate users and commercial rafting. Aggregate flow preferences represent the greatest diversity of users, while commercial rafting and fishing flow preferences provide recreational opportunities for more specific types of users. Flow preferences for all three user groups can be used in combination to inform management decisions. For example, 600 cfs on the Taylor River provides optimal stream flows for both aggregate users and rafting outfitters and 1000 cfs on the Gunnison River between North Bridge and Almont provides optimal stream flows for all three user groups. The overall differences in user group flow preferences are further illustrated through a comparison with historical hydrology.

Variable streamflow conditions were found to impact use opportunities on all reaches. The total number of Boatable Days generally increases on each river segment as hydrological conditions transition from dry to wet. For aggregate users, year-type hydrology never exceeded acceptable flows and for commercial rafting, acceptable flows were only exceeded in wet years on the Gunnison between Almont and North Bridge. Alternatively, acceptable flows were exceeded on every reach for commercial fishing in most year-types. Optimal flows for aggregate users on the Taylor River are only achieved in wet years, while the greatest number of optimal flow days on the Gunnison River segments occur in dry-typical and wet-typical years. Overall, flow preferences and opportunities are similar between commercial rafting and aggregate users, while commercial fishing outfitters have greater opportunities at lower flows and lose overall opportunities in wetter years.

The results presented in this report represent important baseline data characterizing the relationships between flows and recreational use. As such, this body of work directly supports the Upper Gunnison Watershed Management Plan process. Future efforts may choose to build upon this assessment by calculating the number of Boatable Days available in a greater diversity of hydrological year types, under

various water management scenarios, or in anticipation of altered future hydrology due to climate change. The information in this report was used to develop a user-friendly, web-based tool to assess the impact of future hydrological scenarios on Boatable Days and Commercial Days. The use of the web-based tool should be complemented by this report in order to provide appropriate context for the tool's use. Step-by-step instructions for using the Boatable Days Web Tool are provided in Appendix I.

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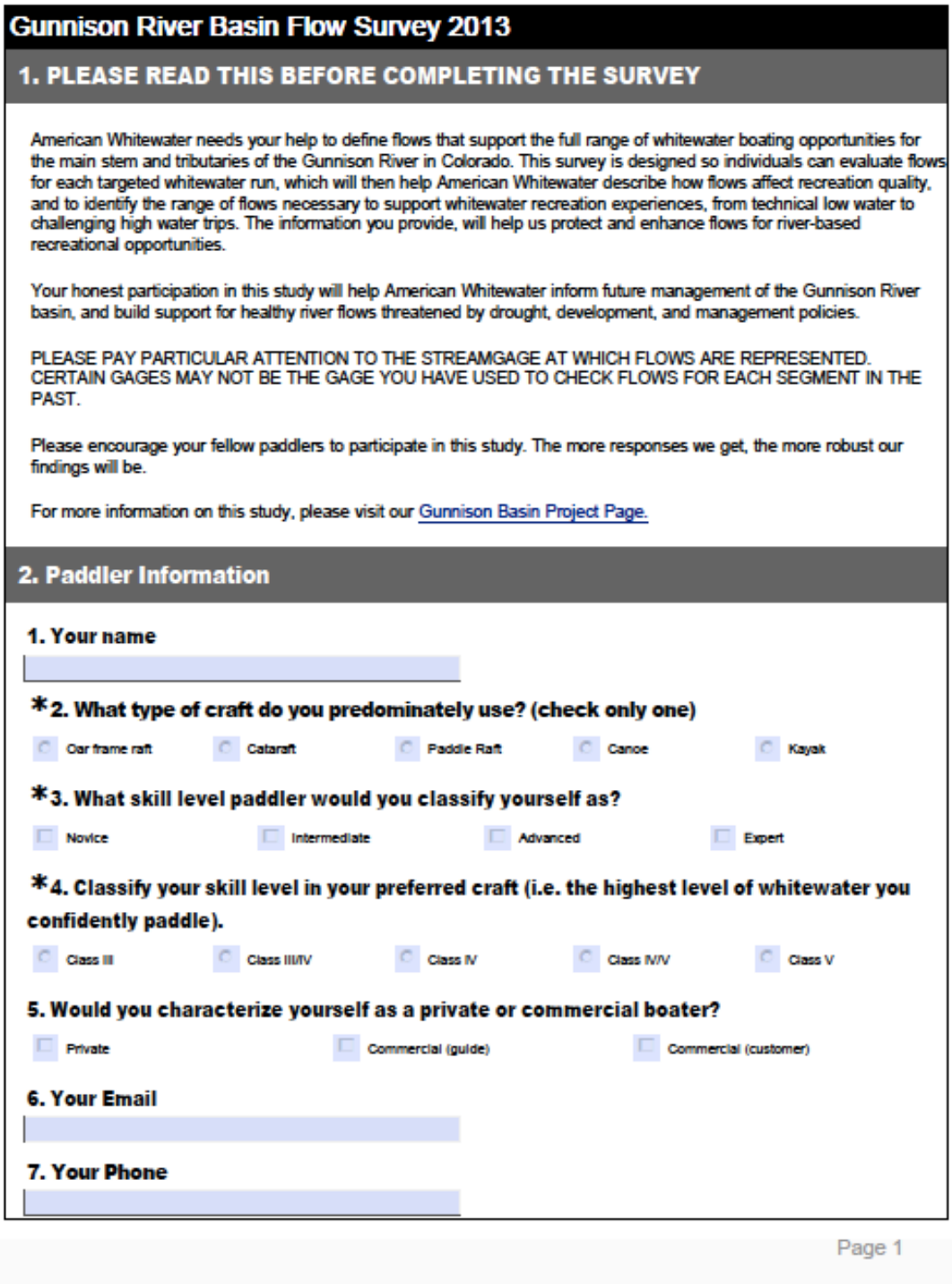
APPENDIX A: 2013 Web Survey



Gunnison River Basin Flow Survey 2013

1. PLEASE READ THIS BEFORE COMPLETING THE SURVEY

American Whitewater needs your help to define flows that support the full range of whitewater boating opportunities for the main stem and tributaries of the Gunnison River in Colorado. This survey is designed so individuals can evaluate flows for each targeted whitewater run, which will then help American Whitewater describe how flows affect recreation quality, and to identify the range of flows necessary to support whitewater recreation experiences, from technical low water to challenging high water trips. The information you provide, will help us protect and enhance flows for river-based recreational opportunities.

Your honest participation in this study will help American Whitewater inform future management of the Gunnison River basin, and build support for healthy river flows threatened by drought, development, and management policies.

PLEASE PAY PARTICULAR ATTENTION TO THE STREAMGAGE AT WHICH FLOWS ARE REPRESENTED. CERTAIN GAGES MAY NOT BE THE GAGE YOU HAVE USED TO CHECK FLOWS FOR EACH SEGMENT IN THE PAST.

Please encourage your fellow paddlers to participate in this study. The more responses we get, the more robust our findings will be.

For more information on this study, please visit our Gunnison Basin Project Page.

2. Paddler Information

1. Your name

***2. What type of craft do you predominately use? (check only one)**

Oar frame raft | Cataraft | Paddle Raft | Canoe | Kayak

***3. What skill level paddler would you classify yourself as?**

Novice | Intermediate | Advanced | Expert

***4. Classify your skill level in your preferred craft (i.e. the highest level of whitewater you confidently paddle).**

Class III | Class III/IV | Class IV | Class IV/V | Class V

5. Would you characterize yourself as a private or commercial boater?

Private | Commercial (guide) | Commercial (customer)

6. Your Email

7. Your Phone

Page 1

Gunnison River Basin Flow Survey 2013

8. Your Street Address

9. Your City

***10. Your State**

***11. Your Zip Code**

***12. How often do you go boating? (check only one)**

- 1 time a season
- 2-5 times a season
- 5-20 times a season
- 20+ times a season
- 50+ times a season

***13. How comfortable are you with estimating the flow in cfs on your favorite stretch for paddling?**

- Not comfortable at all
- somewhat uncomfortable
- neutral
- somewhat comfortable
- very comfortable

***14. How often do you check for the most current cfs level on the relevant in-stream flow gage before or after you go paddling?**

- Never
- Sometimes
- Most of the time
- Always

***15. How many years have you been paddling?**

- 1
- 2-5
- 5-10
- 10+

11. Taylor River

Gunnison River Basin Flow Survey 2013

*56. Have you ever paddled the Taylor River, between New Generation and Almont?

- Yes
- No

12. Comparing Whitewater Flows for the Taylor River

For the questions on this page please rate the quality of the run and/or play features, in your particular craft, at each flow. Please pay particular attention to the gage referred to and respond with acceptable flows for that gage only.

57. Please report the quality of the following flows on the Taylor River for your craft and skill level. Consider all the flow-dependent characteristics that contribute to the quality of your trip (e.g., boatability, whitewater challenge, safety, availability of surfing or other play areas, aesthetics, and length of run).

Taylor River sections include: 1) New Generation to South Bank (upper Taylor); 2) South Bank to Five Mile (middle Taylor); 3) Five Mile to Almont (lower Taylor)

For more information on this stretch of river visit:
http://www.americanwhitewater.org/content/River/detail/id/428/

Flows represented are flow levels at the USGS Taylor River Below Taylor Park Reservoir, CO Gage.

	Unacceptable	Slightly Unacceptable	Marginal	Slightly Acceptable	Acceptable
100					
200					
300					
400					
500					
600					
700					
800					
900					
1000					
1200					
1400					
1600					
1800					
2000					

2500					
3000					

58. From a recreational perspective what is the lowest flow required to navigate this stretch? (please specify in cfs)

59. From a recreational perspective what is the lowest acceptable flow that provides a reasonable experience on this run? The lowest acceptable is the lowest flow you would return to boat in your preferred craft, not the minimum flow that allows you to navigate. (please specify in cfs)

60. Some people are interested in taking trips at lower flows for a technical trip. Think of this "technical trip" in your craft. What is the best or optimal flow for a technical trip? (please specify in cfs)

61. Many people are interested in a "standard" whitewater trip at medium flows. Think of this "standard trip" in your craft. What is the best or optimal flow for a standard trip? (please specify in cfs)

62. Some people are interested in taking trips at higher flows for increased whitewater challenge. Think of this "high challenge trip" in your craft. What is the best or optimal flow for a high challenge trip? (please specify in cfs)

63. What is the highest safe flow for your craft and skill level? (please specify in cfs)

64. What is your preferred craft for running the Taylor River? (Choose one)

- Hard shell kayak/canoe
- Raft/Shredder
- Inflatable kayak/canoe
- Open canoe
- Other (please specify)

Gunnison River Basin Flow Survey 2013

65. Do you have any general comments on flows that you feel have not been addressed in the questions we've asked? Specifically if you do not have a good record of flows or dates from when you have run the river please include any qualitative observations on flows needs.

13. Gunnison River Town Runs

***66. Have you ever paddled any of the Gunnison River Town Runs anywhere between Almont to McCabes?**

- Yes
- No

14. Comparing Whitewater Flows for the Gunnison River Town Runs

For the questions on this page please rate the quality of the run and/or play features, in your particular craft, at each flow. Please pay particular attention to the gage referred to and respond with acceptable flows for that gage only.

Gunnison River Basin Flow Survey 2013

67. For comparative purposes please estimate the quality of the following flows for the Gunnison River Town Runs for your craft and skill level. These include the Almont to North Bridge; North Bridge to WW Park; and WW Park to McCabes sections of the Gunnison River. Please consider all the flow-dependent characteristics that contribute to a high quality trip (e.g., boatability, whitewater challenge, safety, availability of surfing or other play areas, aesthetics, and length of run)

Flows represented are flow levels at the USGS Gunnison River Above Blue Mesa Reservoir, CO Gage.

	Unacceptable	Slightly Unacceptable	Marginal	Slightly Acceptable	Acceptable
100	○	○	○	○	○
200	○	○	○	○	○
300	○	○	○	○	○
400	○	○	○	○	○
500	○	○	○	○	○
600	○	○	○	○	○
700	○	○	○	○	○
800	○	○	○	○	○
900	○	○	○	○	○
1000	○	○	○	○	○
1200	○	○	○	○	○
1400	○	○	○	○	○
1600	○	○	○	○	○
1800	○	○	○	○	○
2000	○	○	○	○	○
2500	○	○	○	○	○
3000	○	○	○	○	○
4000	○	○	○	○	○
5000	○	○	○	○	○

68. From a recreational perspective what is the lowest flow required to navigate this stretch? (please specify in cfs)

Gunnison River Basin Flow Survey 2013

69. From a recreational perspective what is the lowest acceptable flow that provides a reasonable experience on this run? The lowest acceptable is the lowest flow you would return to boat in your preferred craft, not the minimum flow that allows you to navigate. (please specify in cfs)

70. Some people are interested in taking trips at lower flows for a technical trip. Think of this "technical trip" in your craft. What is the best or optimal flow for a technical trip? (please specify in cfs)

71. Many people are interested in a "standard" whitewater trip at medium flows. Think of this "standard trip" in your craft. What is the best or optimal flow for a standard trip? (please specify in cfs)

72. Some people are interested in taking trips at higher flows for increased whitewater challenge. Think of this "high challenge trip" in your craft. What is the best or optimal flow for a high challenge trip? (please specify in cfs)

73. What is the highest safe flow for your craft and skill level? (please specify in cfs)

74. What is your preferred craft for paddling the Gunnison River Town Runs? (Choose one)

- Hard shell kayak/canoe
- Raft/Shredder
- Inflatable kayak/canoe
- Open canoe
- Other (please specify)

75. Do you have any general comments on flows that you feel have not been addressed in the questions we've asked? Specifically if you do not have a good record of flows or dates from when you have run the river please include any qualitative observations on flows needs.

15. Gunnison Whitewater Park

Gunnison River Basin Flow Survey 2013

***76. Have you ever paddled at the Gunnison River Whitewater Park?**

- Yes
- No

16. Comparing Whitewater Flows for the Gunnison Whitewater Park

For the questions on this page please rate the quality of the run and/or play features, in your particular craft, at each flow. Please pay particular attention to the gage referred to and respond with acceptable flows for that gage only.

77. For comparative purposes please estimate the quality of the following flows for the Gunnison Whitewater Park. Please consider all the flow-dependent characteristics that contribute to a high quality Whitewater Park experience for the man made features on the Gunnison River.

Flows represented are flow levels at the USGS Gunnison River Above Blue Mesa Reservoir, CO Gage.

	Unacceptable	Slightly Unacceptable	Marginal	Slightly Acceptable	Acceptable
100					
200					
300					
400					
500					
600					
700					
800					
900					
1000					
1200					
1400					
1600					
1800					
2000					
2500					
3000					
4000					
5000					

Gunnison River Basin Flow Survey 2013

78. From a recreational perspective what is the lowest flow required to navigate this stretch? (please specify in cfs)

79. From a recreational perspective what is the lowest acceptable flow that provides a reasonable experience on this run? The lowest acceptable is the lowest flow you would return to boat in your preferred craft, not the minimum flow that allows you to navigate. (please specify in cfs)

80. Some people are interested in taking trips at lower flows for a technical trip. Think of this "technical trip" in your craft. What is the best or optimal flow for a technical trip? (please specify in cfs)

81. Many people are interested in a "standard" whitewater trip at medium flows. Think of this "standard trip" in your craft. What is the best or optimal flow for a standard trip? (please specify in cfs)

82. Some people are interested in taking trips at higher flows for increased whitewater challenge. Think of this "high challenge trip" in your craft. What is the best or optimal flow for a high challenge trip? (please specify in cfs)

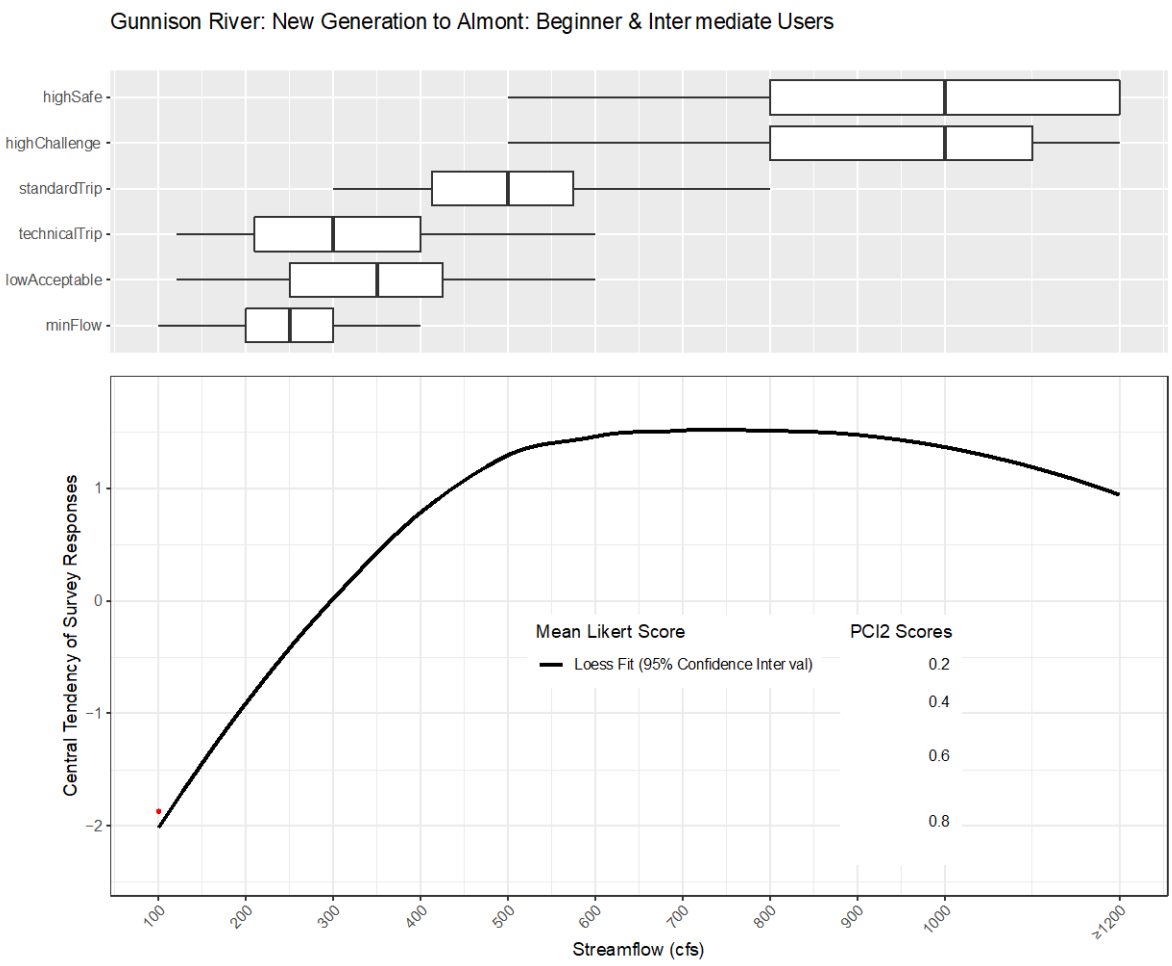
83. What is the highest safe flow for your craft and skill level? (please specify in cfs)

84. What is your preferred craft for paddling the Gunnison Whitewater Park? (Choose one)

- ☐ Hard shell kayak/canoe
- ☐ Raft/Shredder
- ☐ Inflatable kayak/canoe
- ☐ Open canoe
- ☐ Other (please specify)

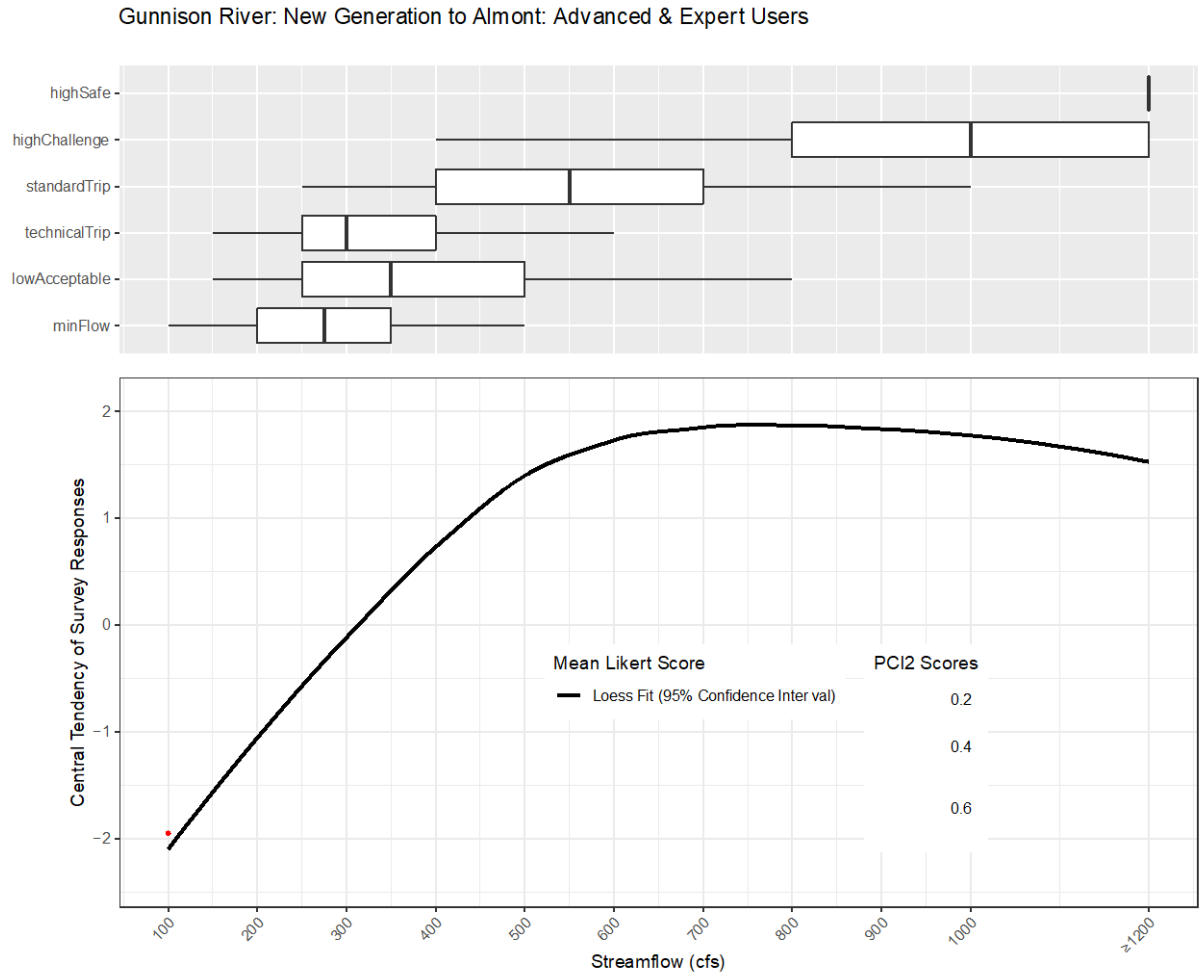
85. Do you have any general comments on flows that you feel have not been addressed in the questions we've asked? Specifically if you do not have a good record of flows or dates from when you have run the river please include any qualitative observations on flows needs.

APPENDIX B: User Group Flow Preference Results



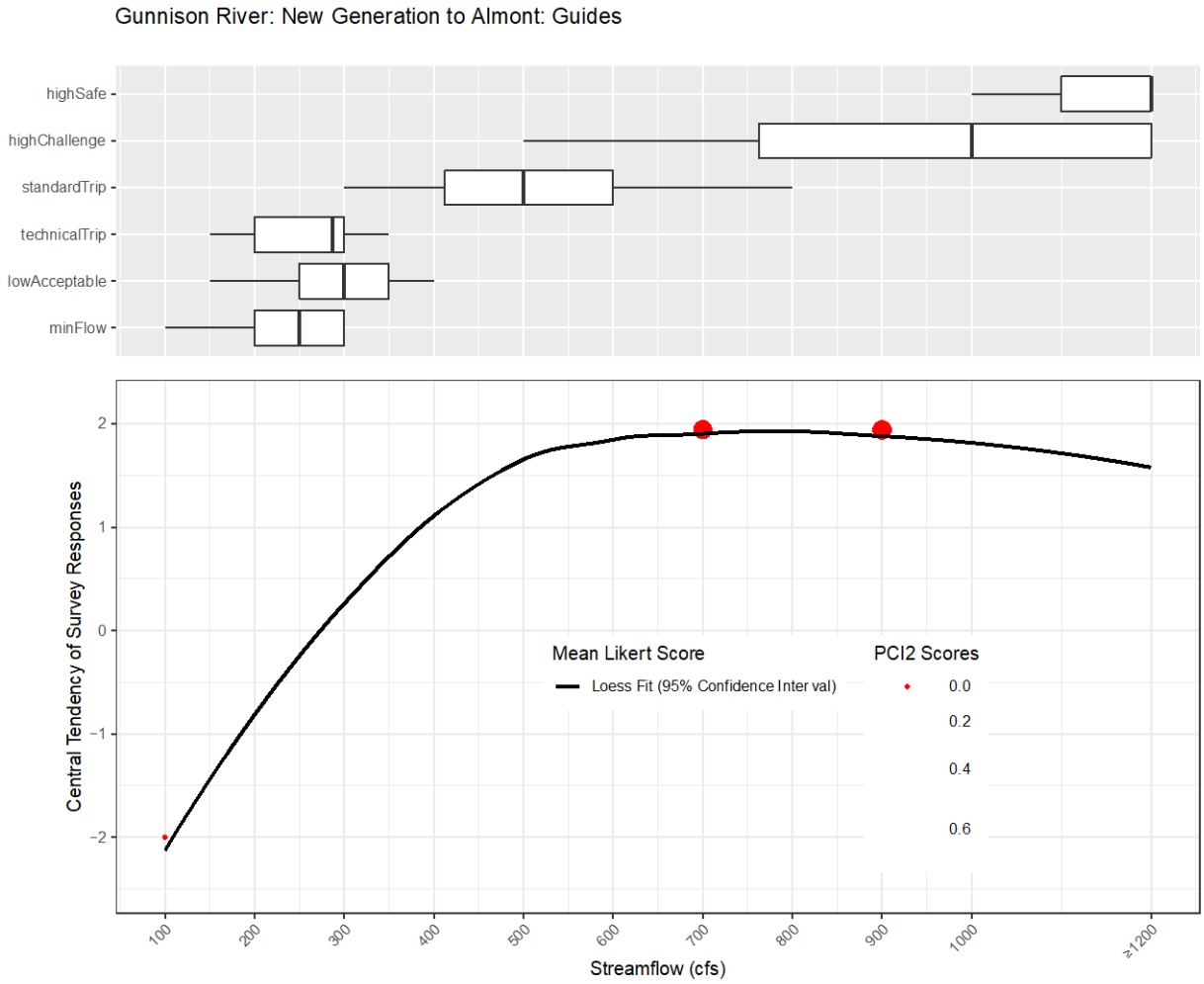
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	190	250	300	23
Low Acceptable Flow (cfs)	250	350	425	23
Technical Flow (cfs)	210	300	400	23
Standard Trip Flow (cfs)	412	500	575	22
Challenging High Flow (cfs)	800	1000	1100	19
Highest Safe Flow (cfs)	800	1000	1800	17

Figure 11. Beginner and intermediate survey responses for the Taylor River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



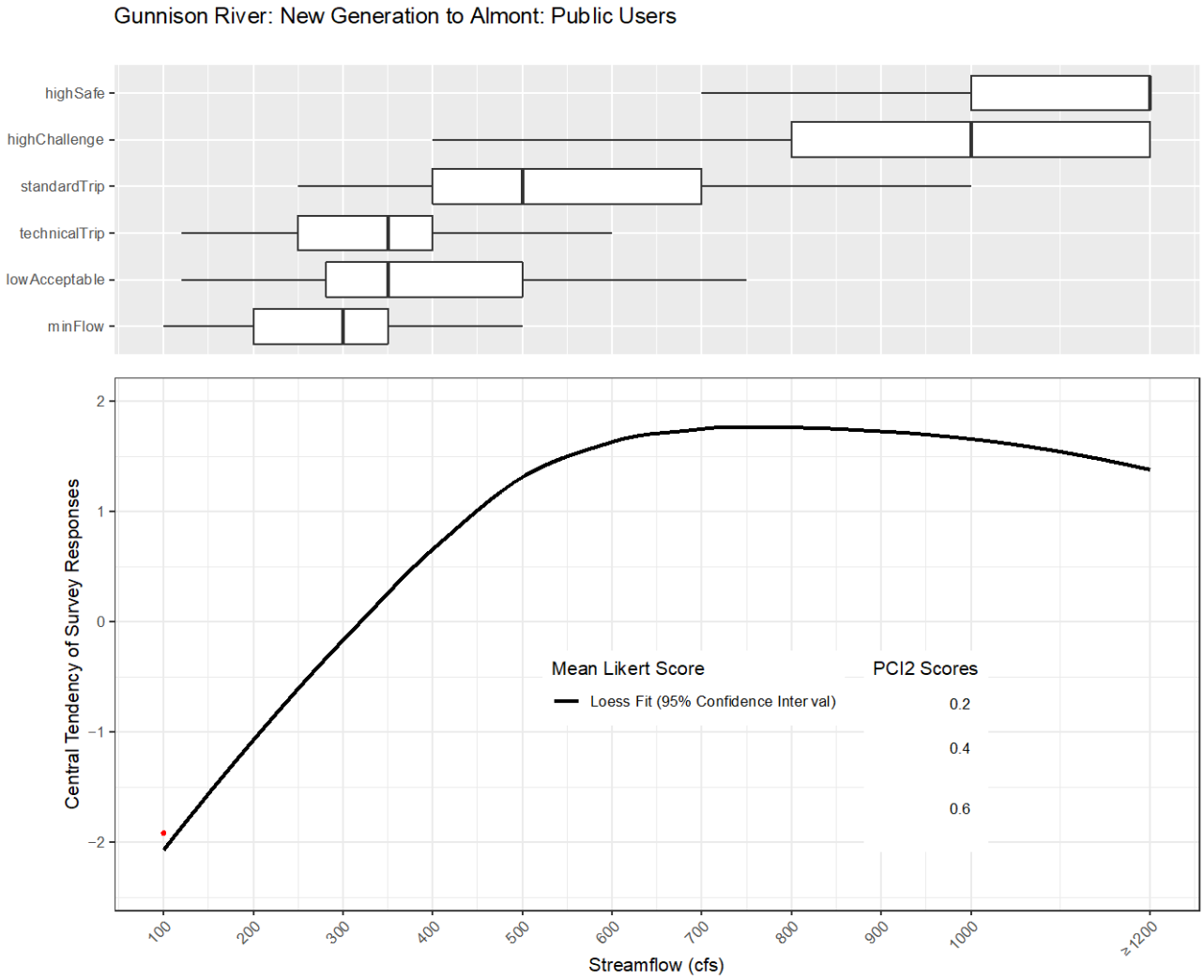
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	200	250	350	87
Low Acceptable Flow (cfs)	250	350	500	85
Technical Flow (cfs)	250	300	400	84
Standard Trip Flow (cfs)	400	600	700	85
Challenging High Flow (cfs)	800	1000	1500	82
Highest Safe Flow (cfs)	1200	1800	2500	76

Figure 12. Advanced and expert survey responses for the Taylor River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



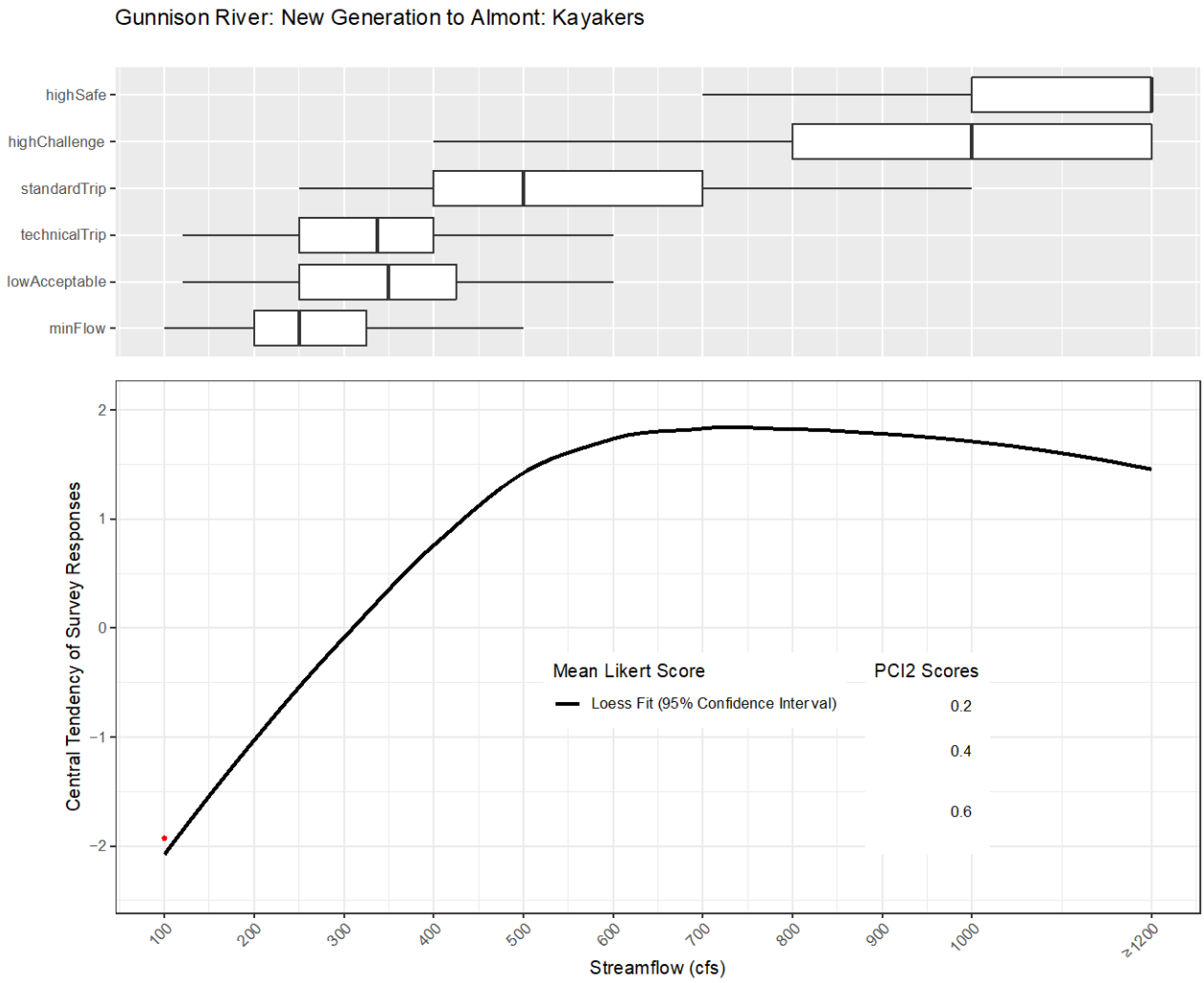
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	200	250	300	19
Low Acceptable Flow (cfs)	250	300	350	18
Technical Flow (cfs)	200	288	300	18
Standard Trip Flow (cfs)	412	500	600	18
Challenging High Flow (cfs)	762	1000	1200	18
Highest Safe Flow (cfs)	1100	1800	2000	15

Figure 13. Guides and outfitter survey responses for the Taylor River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



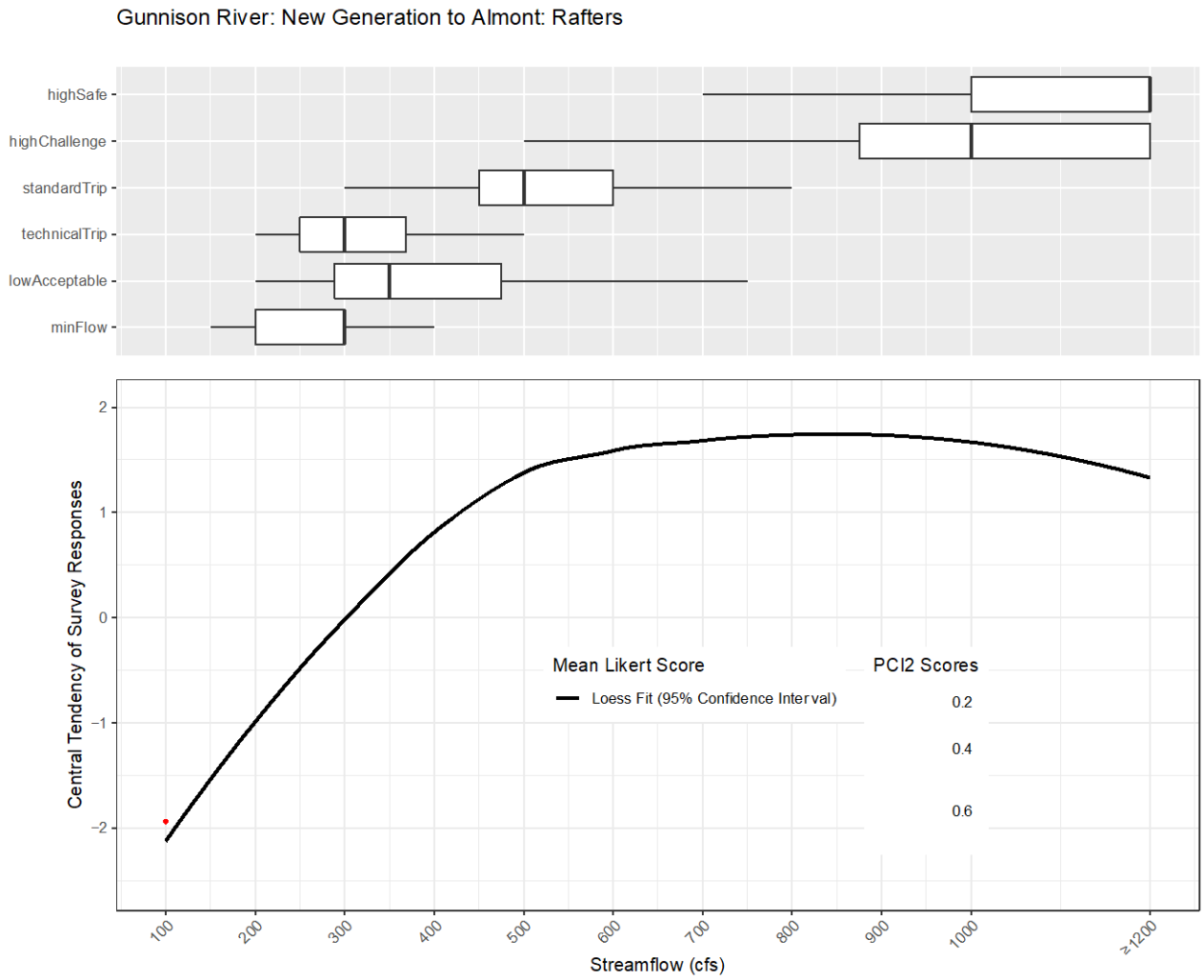
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	200	300	350	91
Low Acceptable Flow (cfs)	281	350	500	90
Technical Flow (cfs)	250	350	400	89
Standard Trip Flow (cfs)	400	500	700	89
Challenging High Flow (cfs)	800	1000	1500	83
Highest Safe Flow (cfs)	1000	1550	2500	78

Figure 14. Public (non-guided) survey responses for the Taylor River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



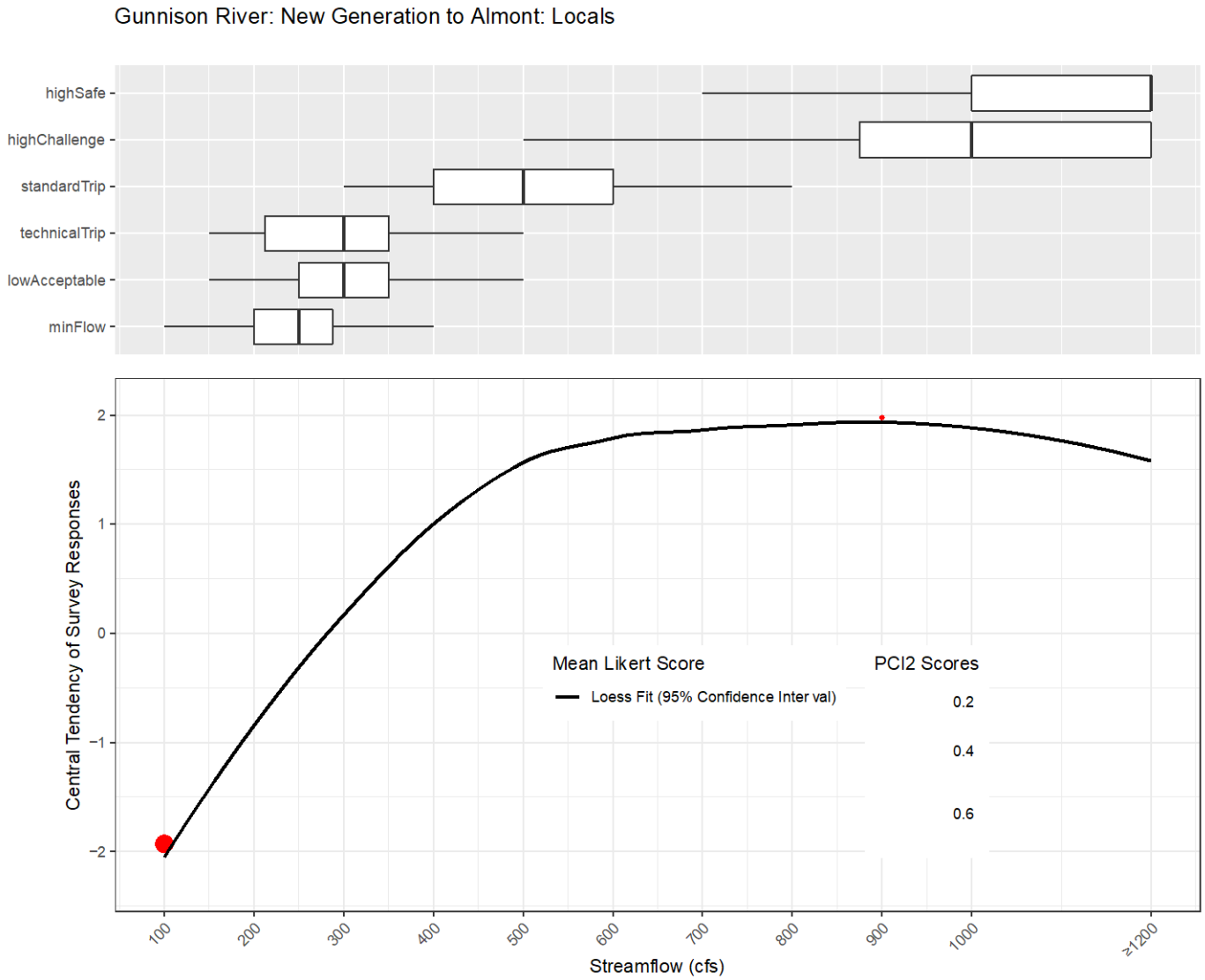
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	200	250	300	77
Low Acceptable Flow (cfs)	250	350	425	75
Technical Flow (cfs)	250	338	400	74
Standard Trip Flow (cfs)	400	500	700	75
Challenging High Flow (cfs)	800	1000	1500	70
Highest Safe Flow (cfs)	1000	1900	2625	64

Figure 15. Kayaker survey responses for the Taylor River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



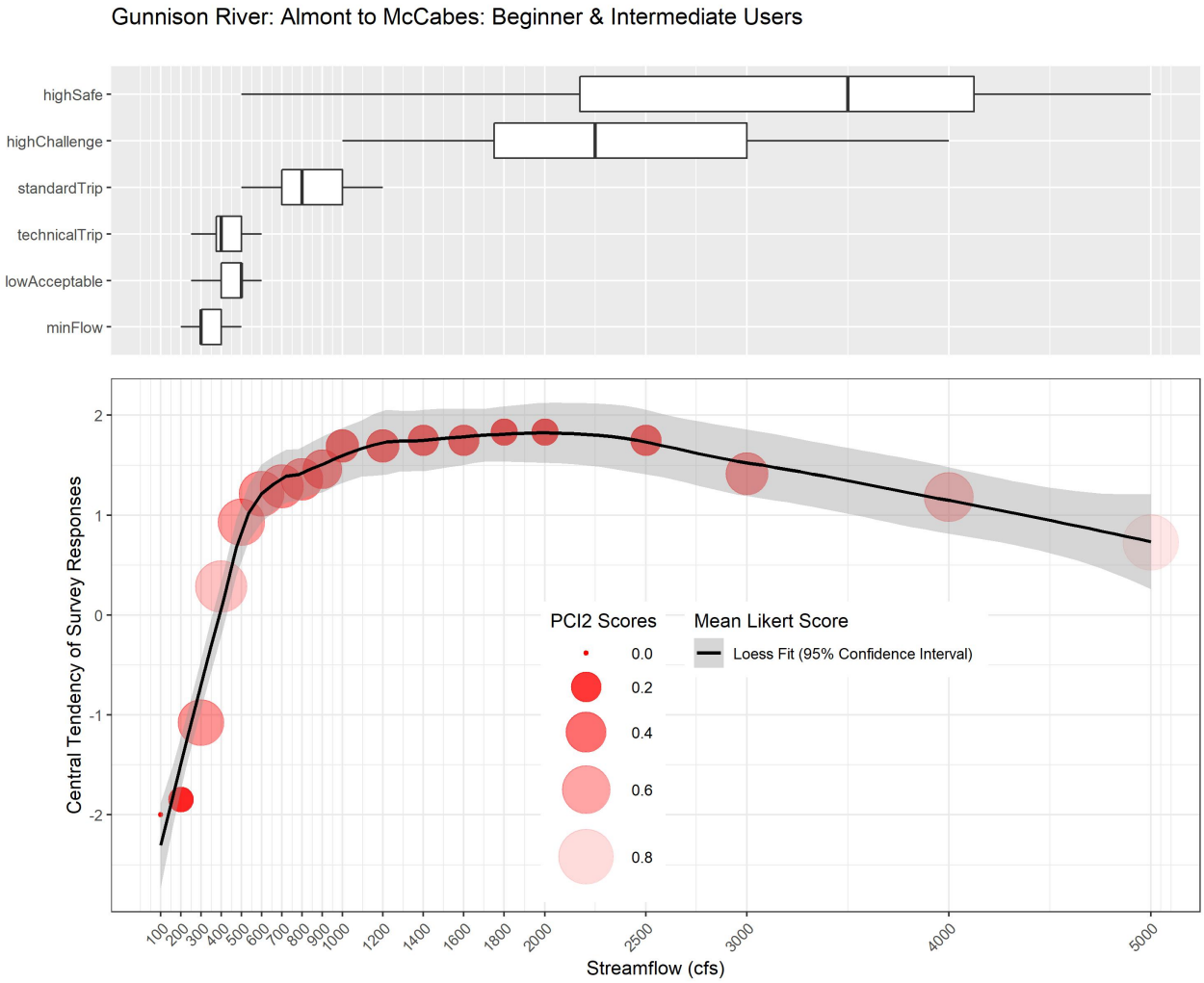
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	200	300	300	34
Low Acceptable Flow (cfs)	289	350	475	34
Technical Flow (cfs)	250	300	369	34
Standard Trip Flow (cfs)	450	500	600	33
Challenging High Flow (cfs)	875	1000	1350	32
Highest Safe Flow (cfs)	1000	1550	2000	30

Figure 16. Rafter survey responses for the Taylor River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



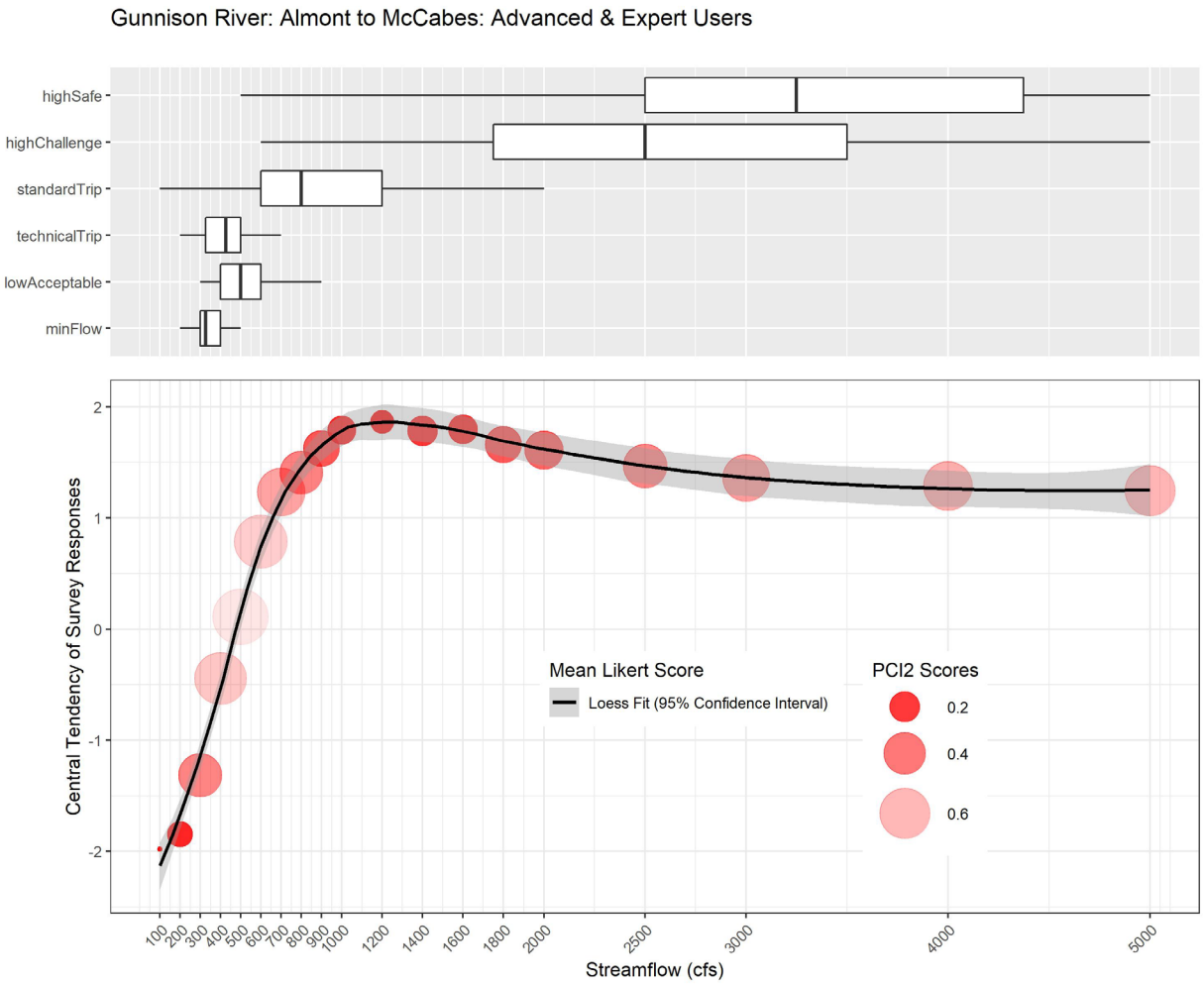
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	188	250	275	43
Low Acceptable Flow (cfs)	250	300	350	42
Technical Flow (cfs)	212	300	350	42
Standard Trip Flow (cfs)	400	500	600	41
Challenging High Flow (cfs)	875	1000	1275	40
Highest Safe Flow (cfs)	1000	2000	3000	39

Figure 17. Local resident survey responses for the Taylor River. Whisker plot for single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgement responses (bottom). Local residents were defined as respondents living in the zip codes: 81210, 81224, 81225, 81230, and 81231.



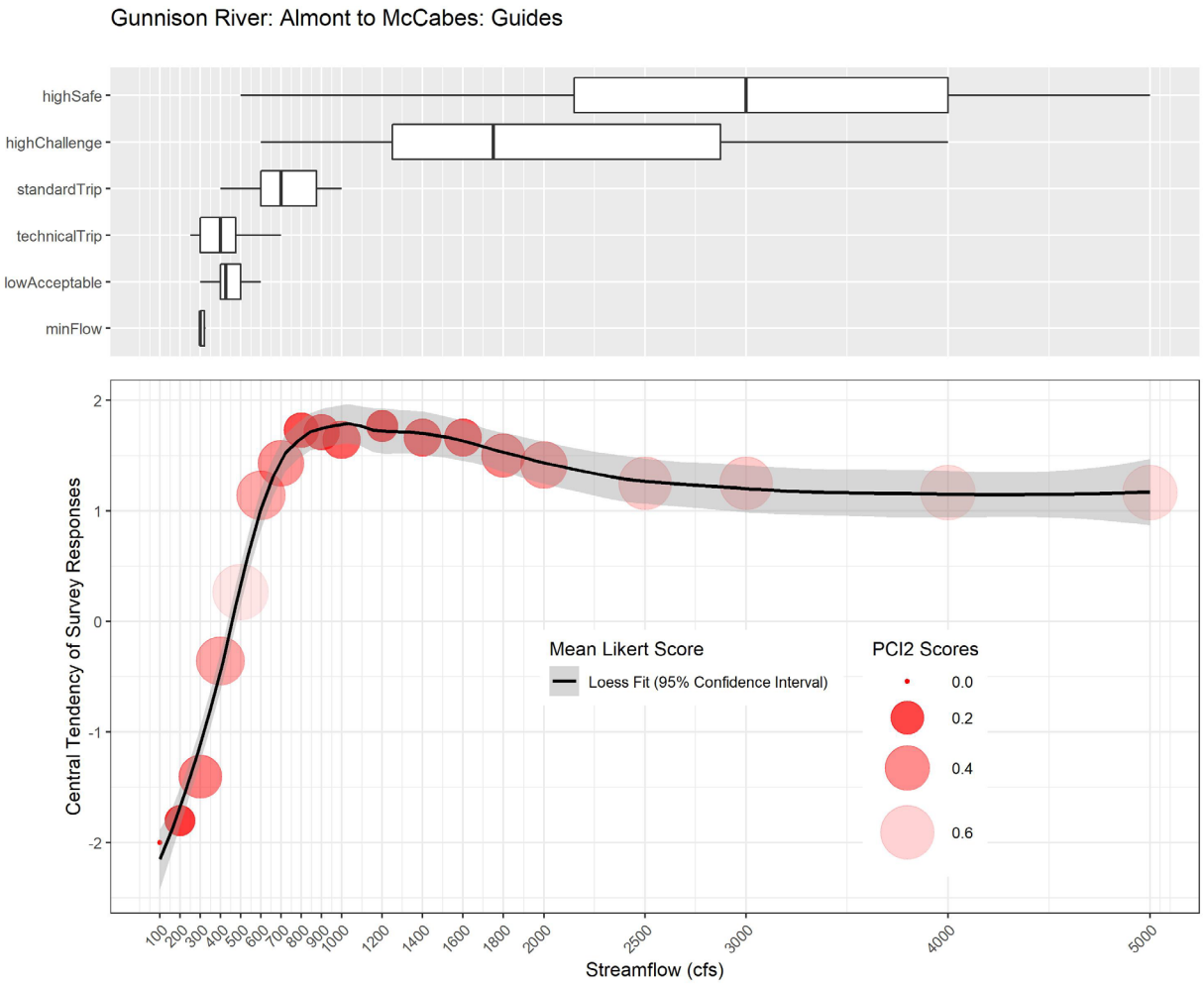
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	300	400	13
Low Acceptable Flow (cfs)	400	500	500	13
Technical Flow (cfs)	375	400	500	12
Standard Trip Flow (cfs)	700	800	1000	13
Challenging High Flow (cfs)	1750	2250	3000	12
Highest Safe Flow (cfs)	2175	3500	4125	12

Figure 18. Beginner and intermediate survey responses for the Gunnison River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



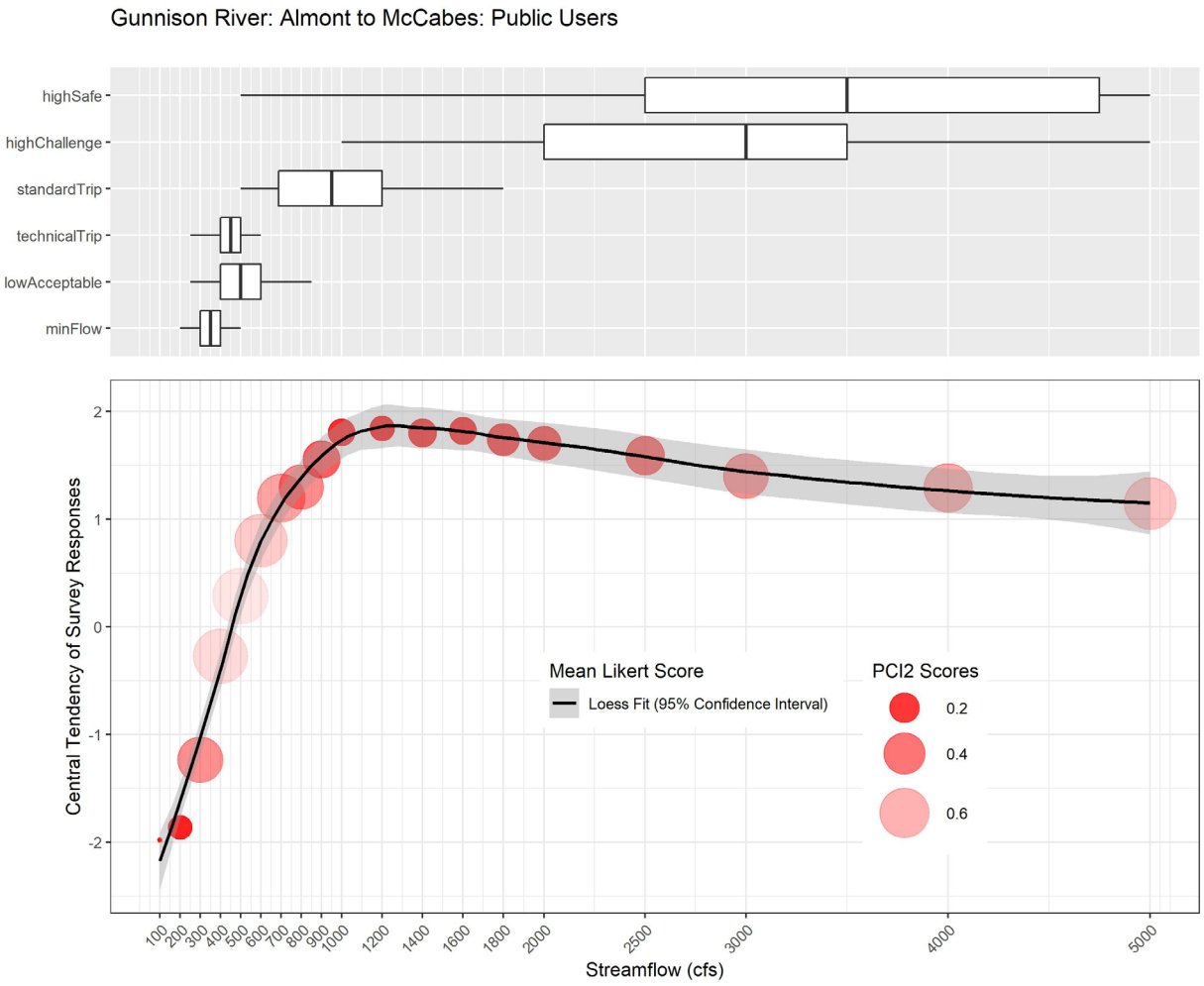
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	325	400	51
Low Acceptable Flow (cfs)	400	500	600	50
Technical Flow (cfs)	325	425	500	50
Standard Trip Flow (cfs)	600	800	1200	49
Challenging High Flow (cfs)	1800	2500	3500	49
Highest Safe Flow (cfs)	2500	4000	5000	47

Figure 19. Advanced and expert survey responses for the Gunnison River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



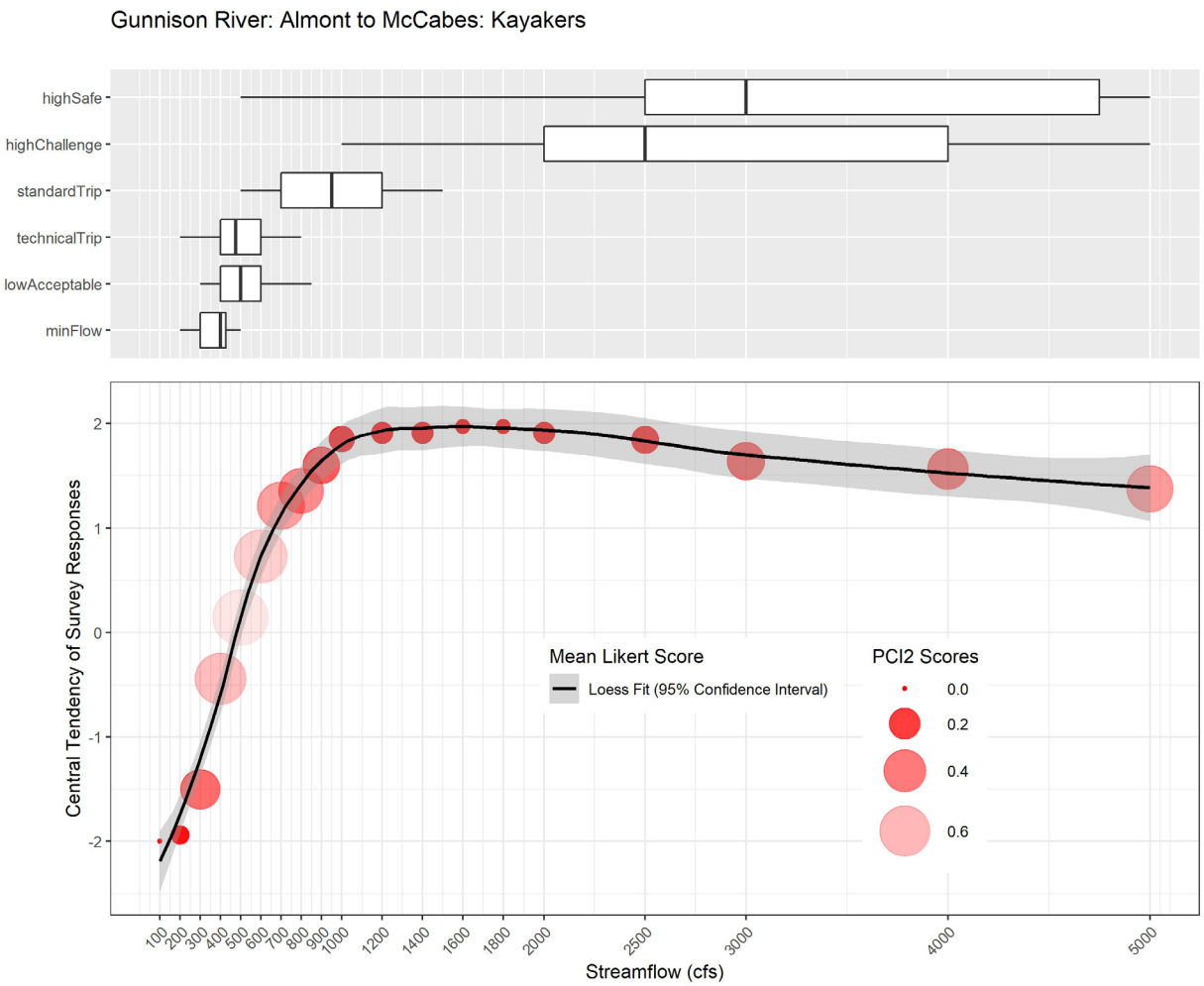
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	300	319	14
Low Acceptable Flow (cfs)	400	425	500	14
Technical Flow (cfs)	300	400	475	14
Standard Trip Flow (cfs)	600	700	875	14
Challenging High Flow (cfs)	1250	1750	2875	14
Highest Safe Flow (cfs)	2500	4000	4500	13

Figure 20. Guides and outfitter survey responses for the Gunnison River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



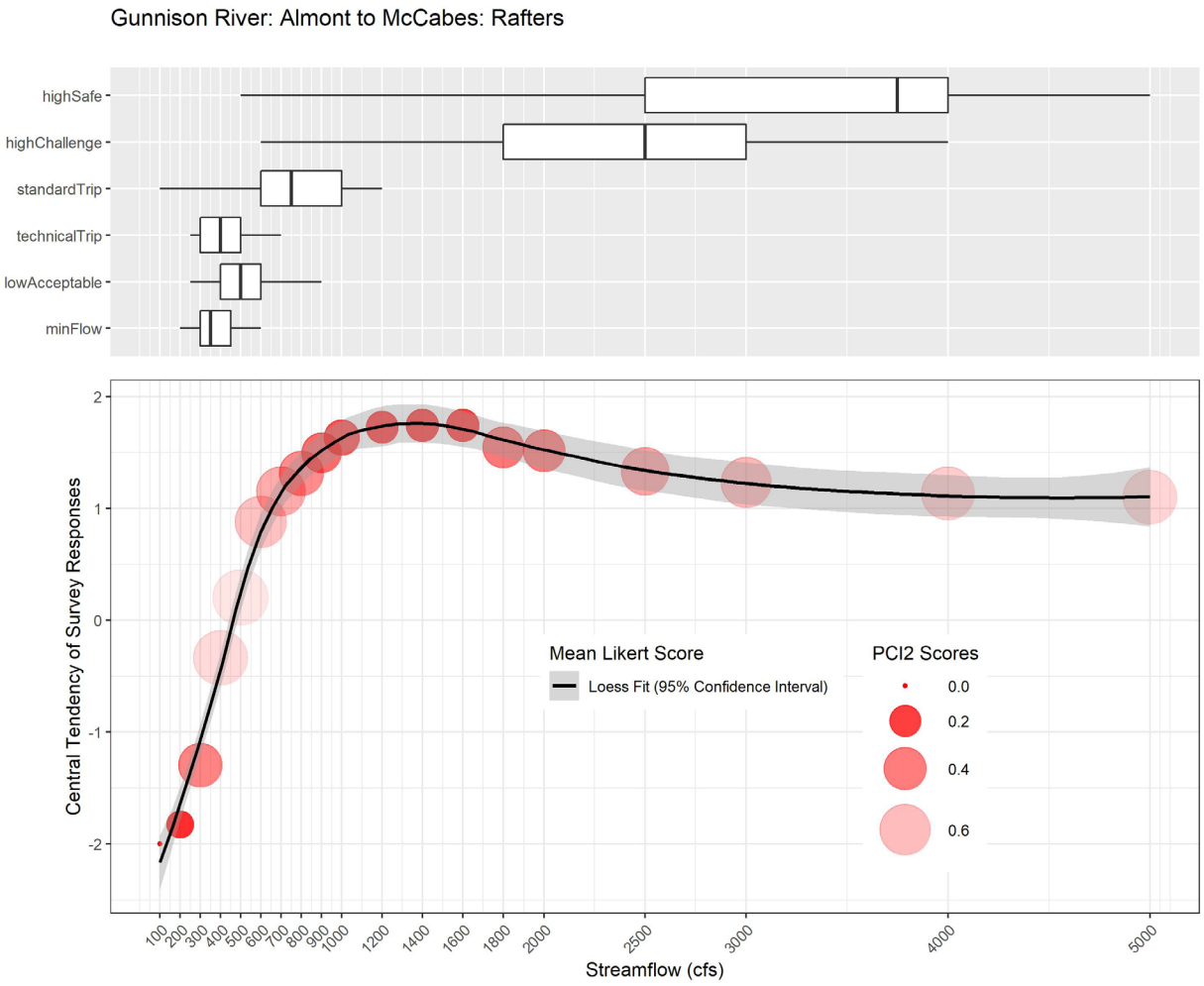
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	350	400	50
Low Acceptable Flow (cfs)	400	500	600	49
Technical Flow (cfs)	400	450	500	48
Standard Trip Flow (cfs)	688	950	1200	48
Challenging High Flow (cfs)	2000	3000	3550	47
Highest Safe Flow (cfs)	2500	4000	5000	46

Figure 21. Public (non-guided) survey responses for the Gunnison River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



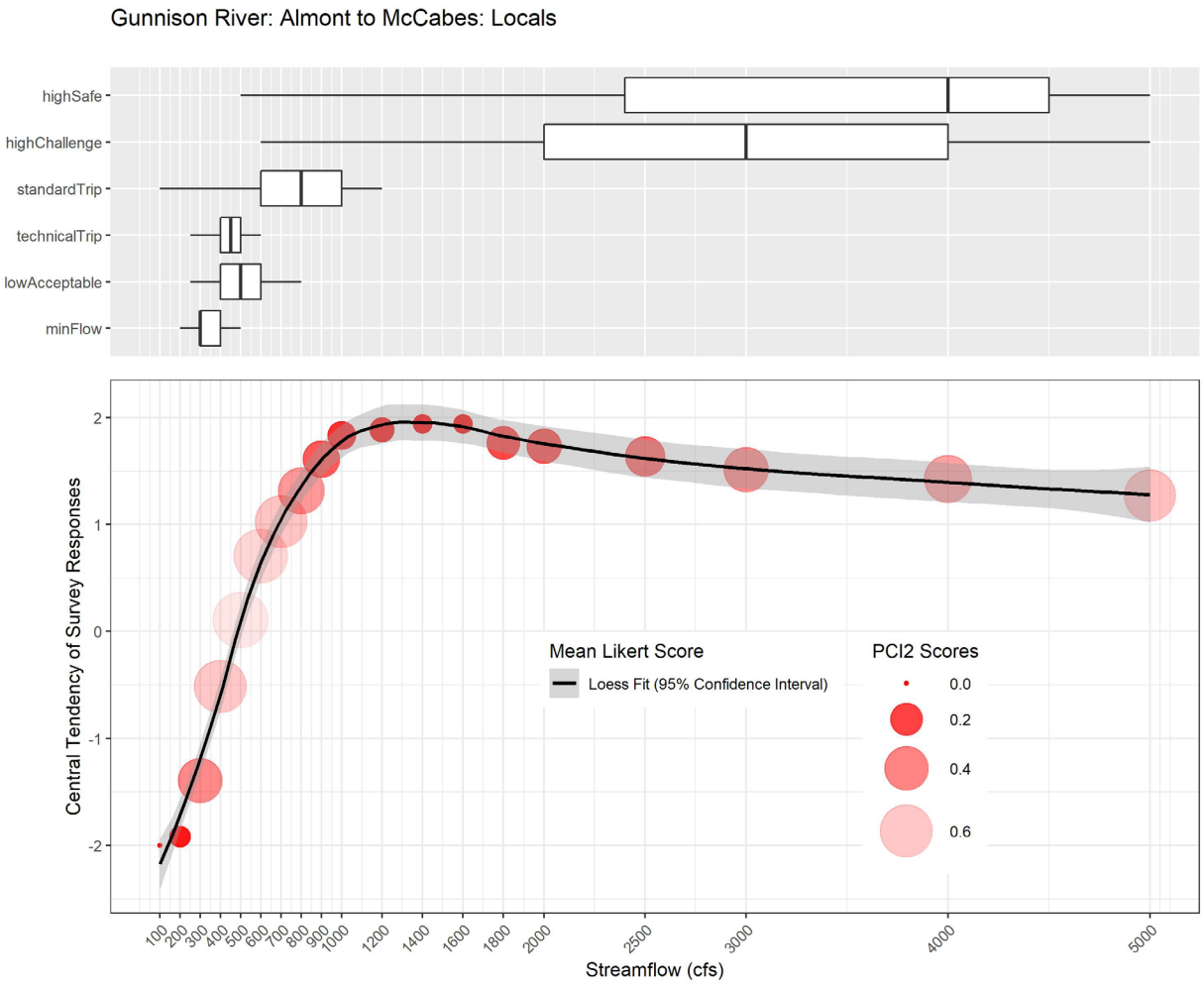
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	400	425	32
Low Acceptable Flow (cfs)	400	500	600	32
Technical Flow (cfs)	400	475	600	32
Standard Trip Flow (cfs)	700	950	1200	32
Challenging High Flow (cfs)	2000	2750	4000	32
Highest Safe Flow (cfs)	2500	4000	5000	29

Figure 22. Kayaker survey responses for the Gunnison River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



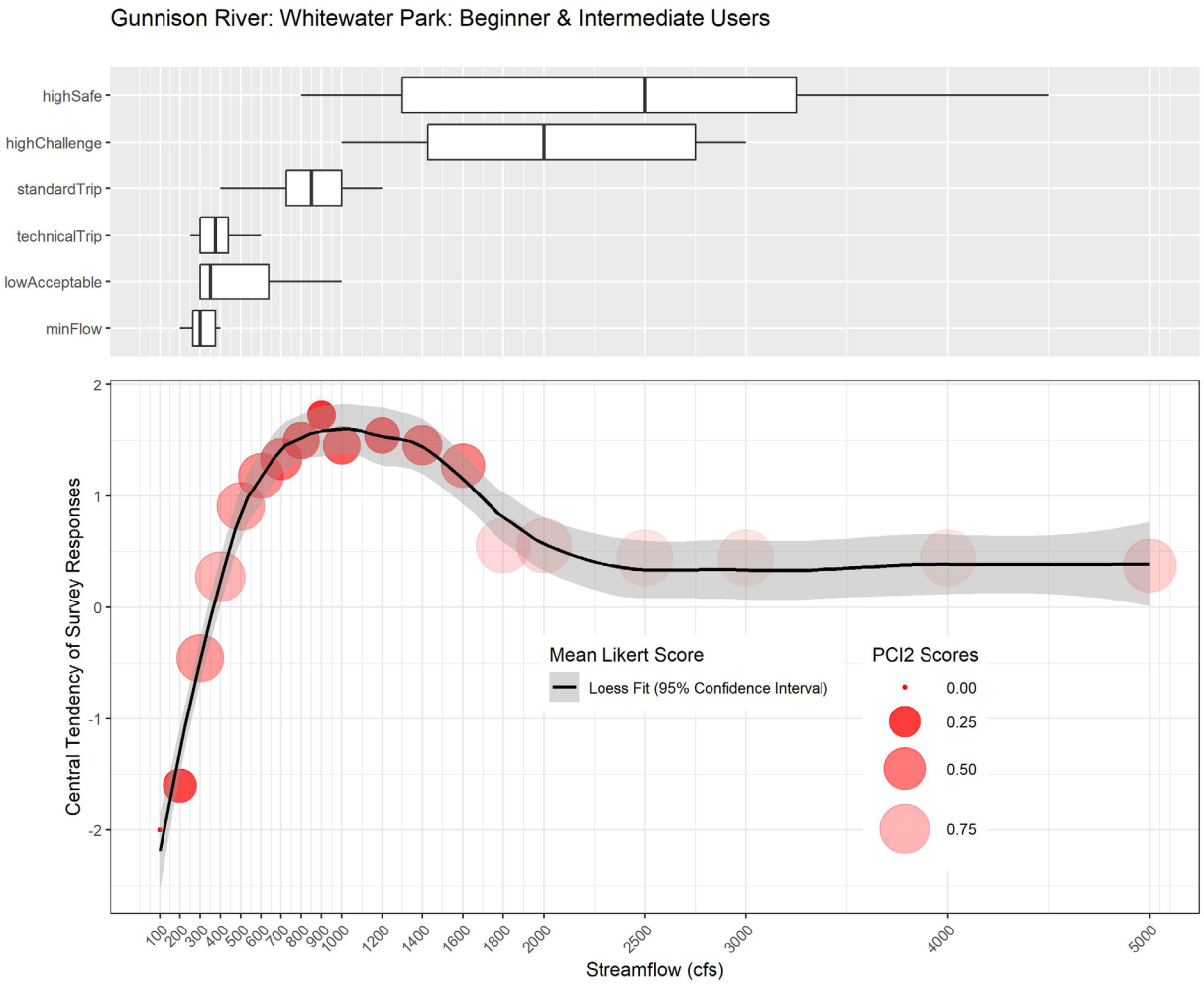
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	350	450	35
Low Acceptable Flow (cfs)	400	500	600	35
Technical Flow (cfs)	300	400	500	34
Standard Trip Flow (cfs)	600	750	1000	34
Challenging High Flow (cfs)	1800	2500	3000	33
Highest Safe Flow (cfs)	2500	4000	5000	34

Figure 23. Rafter survey responses for the Gunnison River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



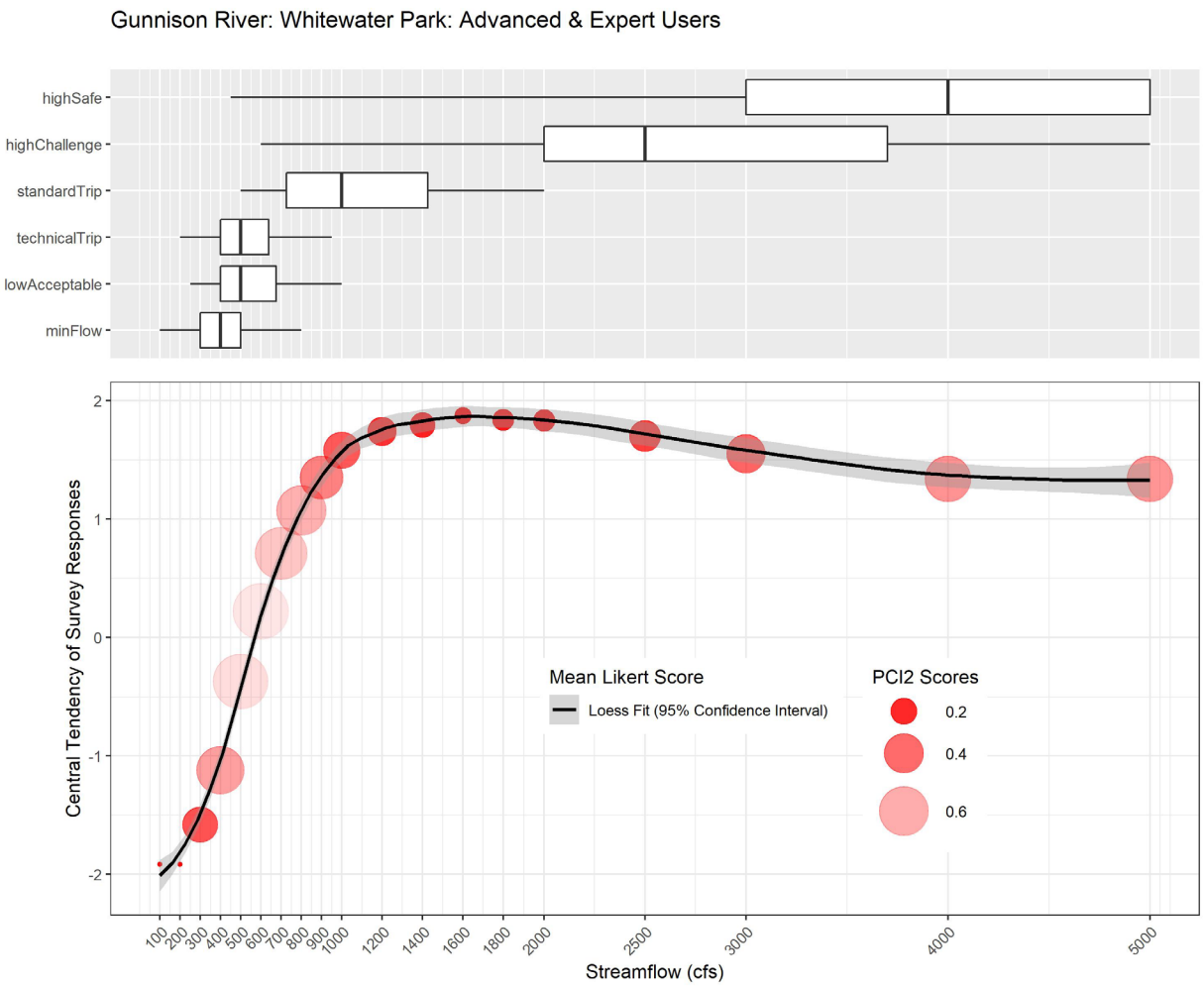
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	300	400	35
Low Acceptable Flow (cfs)	400	500	600	35
Technical Flow (cfs)	400	450	500	34
Standard Trip Flow (cfs)	600	800	1000	34
Challenging High Flow (cfs)	2000	3000	4000	33
Highest Safe Flow (cfs)	2500	4000	5000	32

Figure 24. Local resident survey responses for the Gunnison River. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom). Local residents were defined as respondents living in the following zip codes: 81210, 81224, 81225, 81230, 81231.



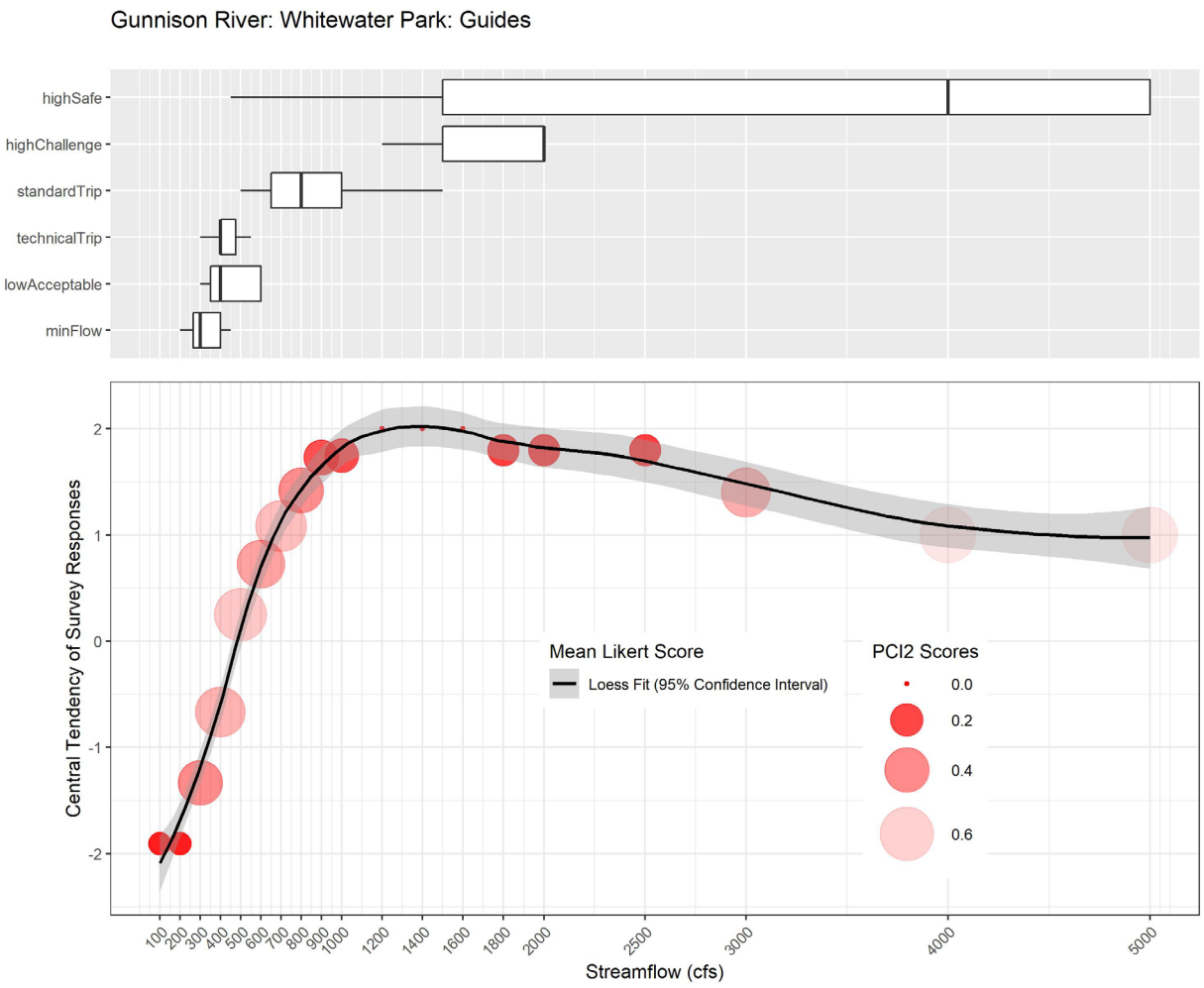
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	262	300	375	10
Low Acceptable Flow (cfs)	300	350	638	10
Technical Flow (cfs)	300	375	438	10
Standard Trip Flow (cfs)	725	850	1000	10
Challenging High Flow (cfs)	1425	2000	2750	10
Highest Safe Flow (cfs)	1300	2500	3250	11

Figure 25. Beginner and intermediate survey responses for the Gunnison River Whitewater Park. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



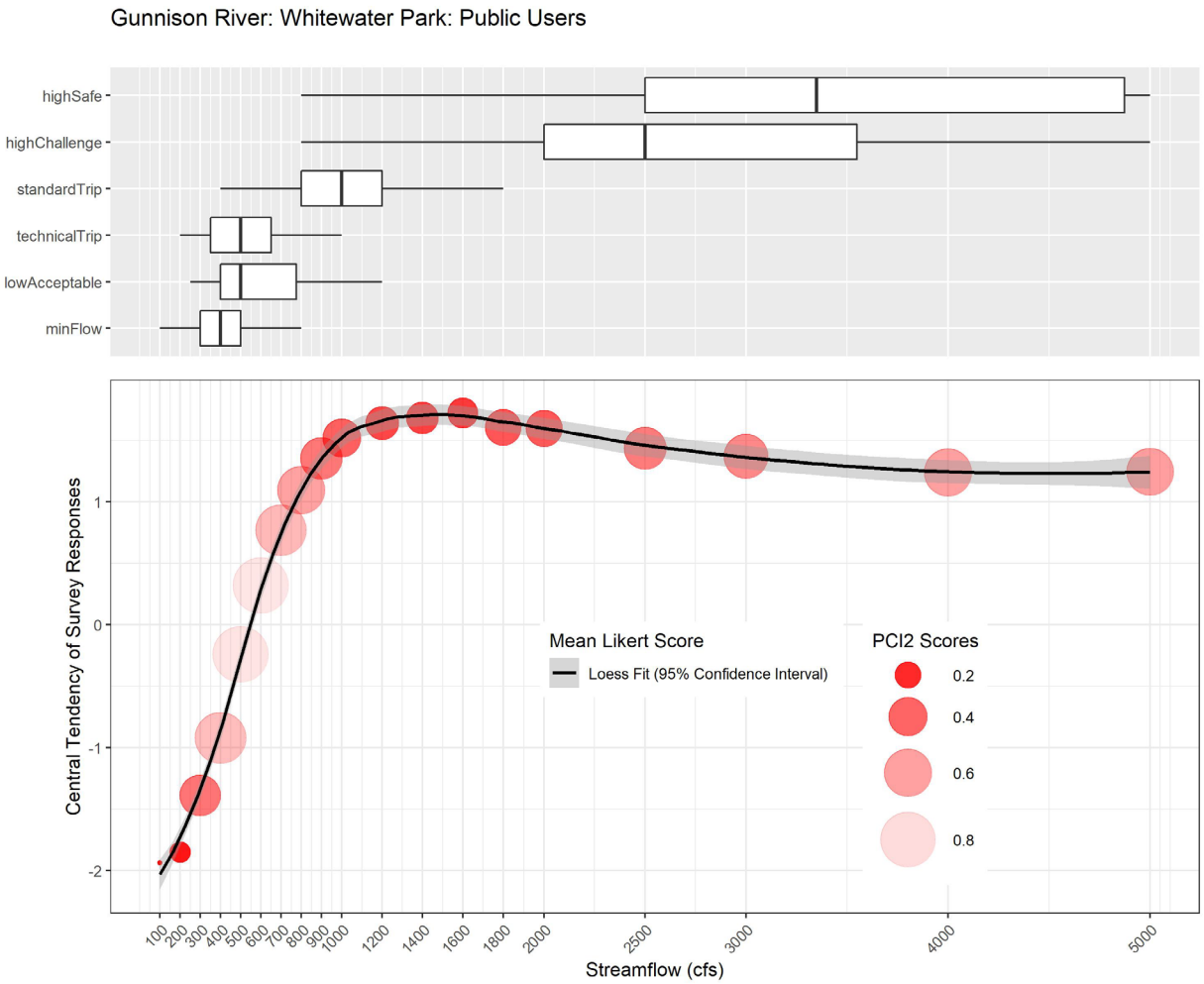
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	400	500	47
Low Acceptable Flow (cfs)	400	500	675	47
Technical Flow (cfs)	400	500	638	46
Standard Trip Flow (cfs)	750	1000	1500	47
Challenging High Flow (cfs)	2000	2500	4000	47
Highest Safe Flow (cfs)	3000	4500	5000	45

Figure 26. Advanced and expert survey responses for the Gunnison River Whitewater Park. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



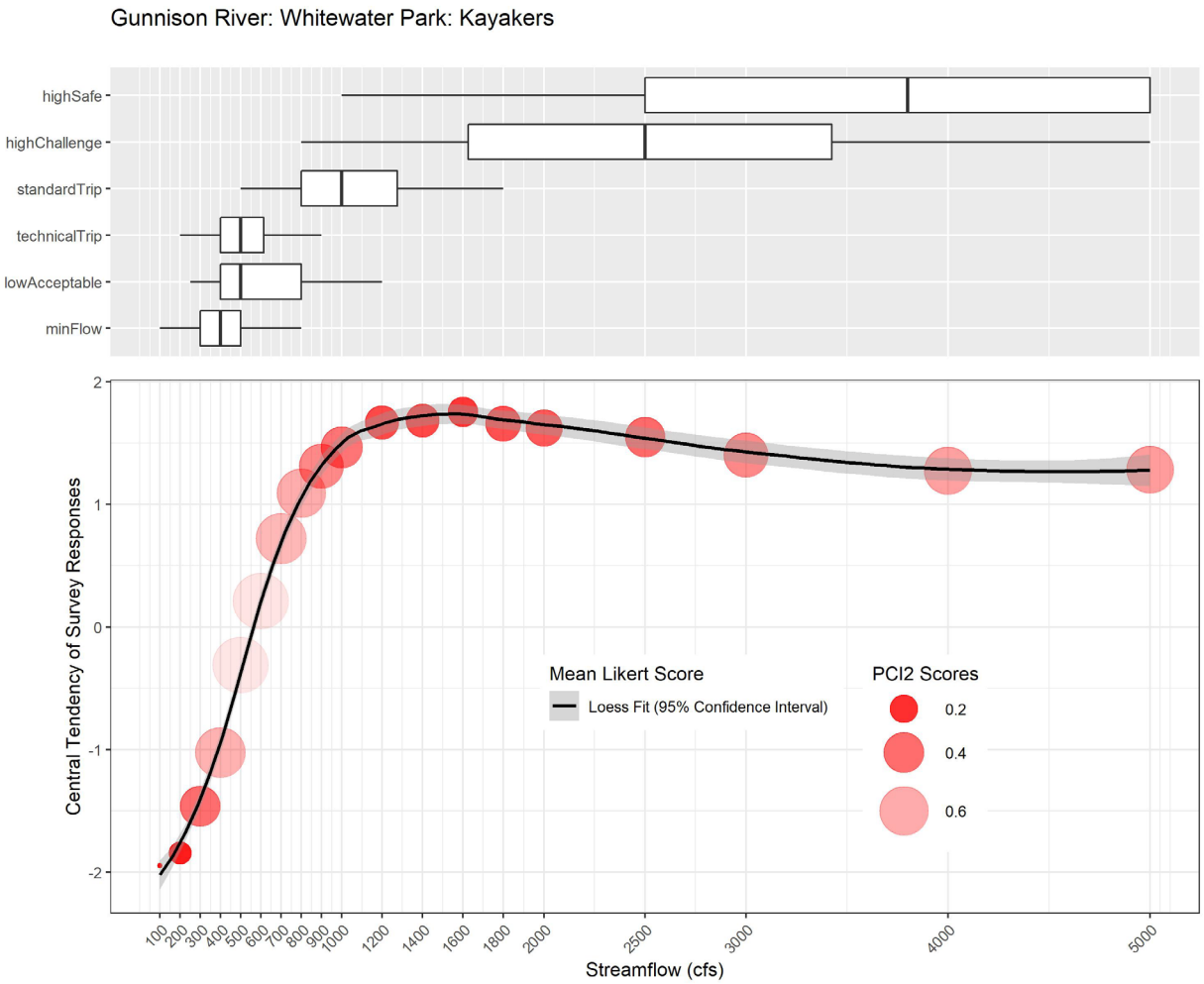
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	265	300	400	11
Low Acceptable Flow (cfs)	350	400	600	11
Technical Flow (cfs)	400	400	475	11
Standard Trip Flow (cfs)	650	800	1000	11
Challenging High Flow (cfs)	1500	2000	2000	11
Highest Safe Flow (cfs)	2000	4500	5000	11

Figure 27. Guides and outfitter survey responses for the Gunnison River Whitewater Park. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



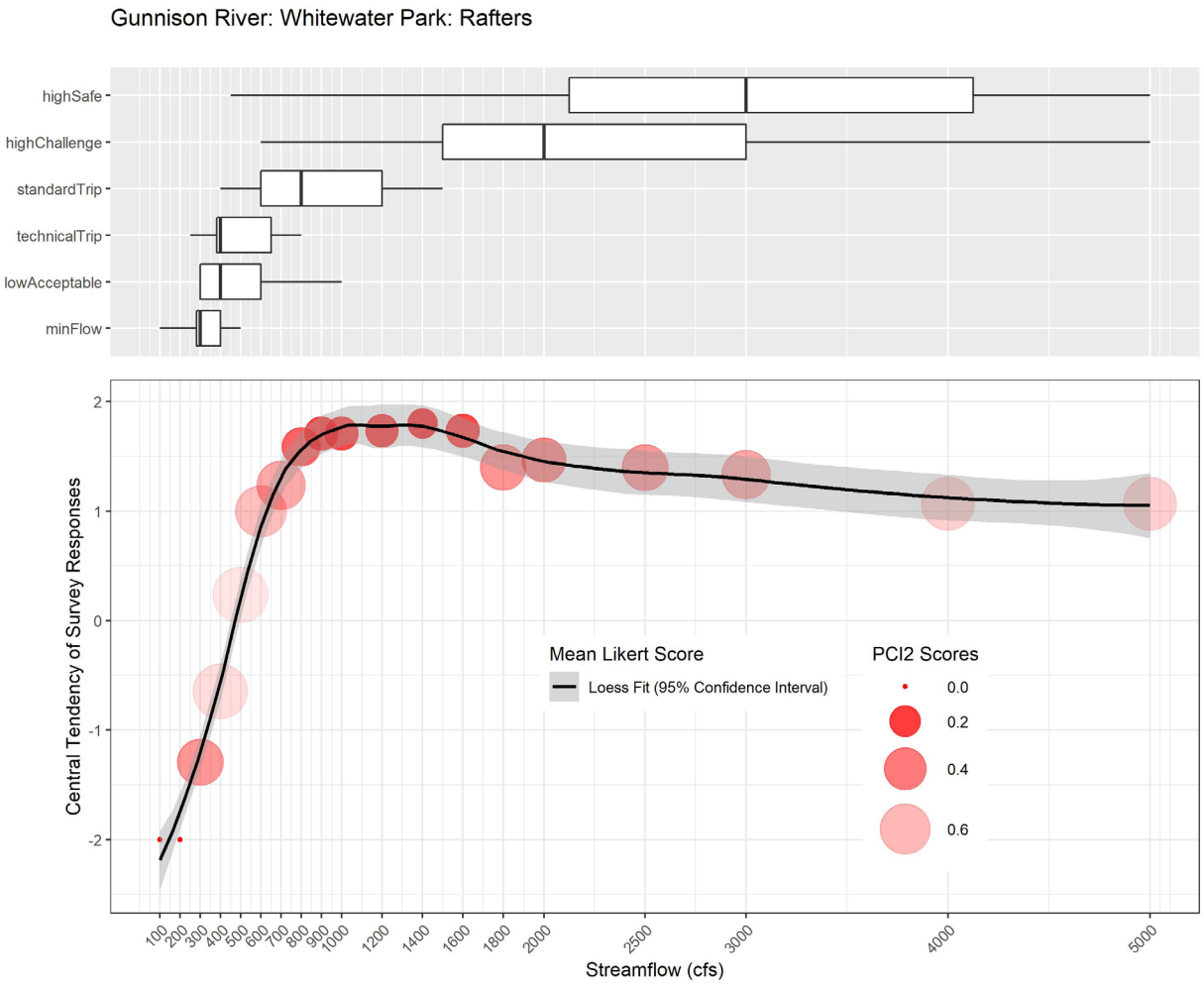
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	400	500	46
Low Acceptable Flow (cfs)	400	500	775	46
Technical Flow (cfs)	350	500	650	45
Standard Trip Flow (cfs)	800	1000	1425	46
Challenging High Flow (cfs)	2000	2750	4000	46
Highest Safe Flow (cfs)	2500	4000	5000	45

Figure 28. Public (non-guided) survey responses for the Gunnison River Whitewater Park. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



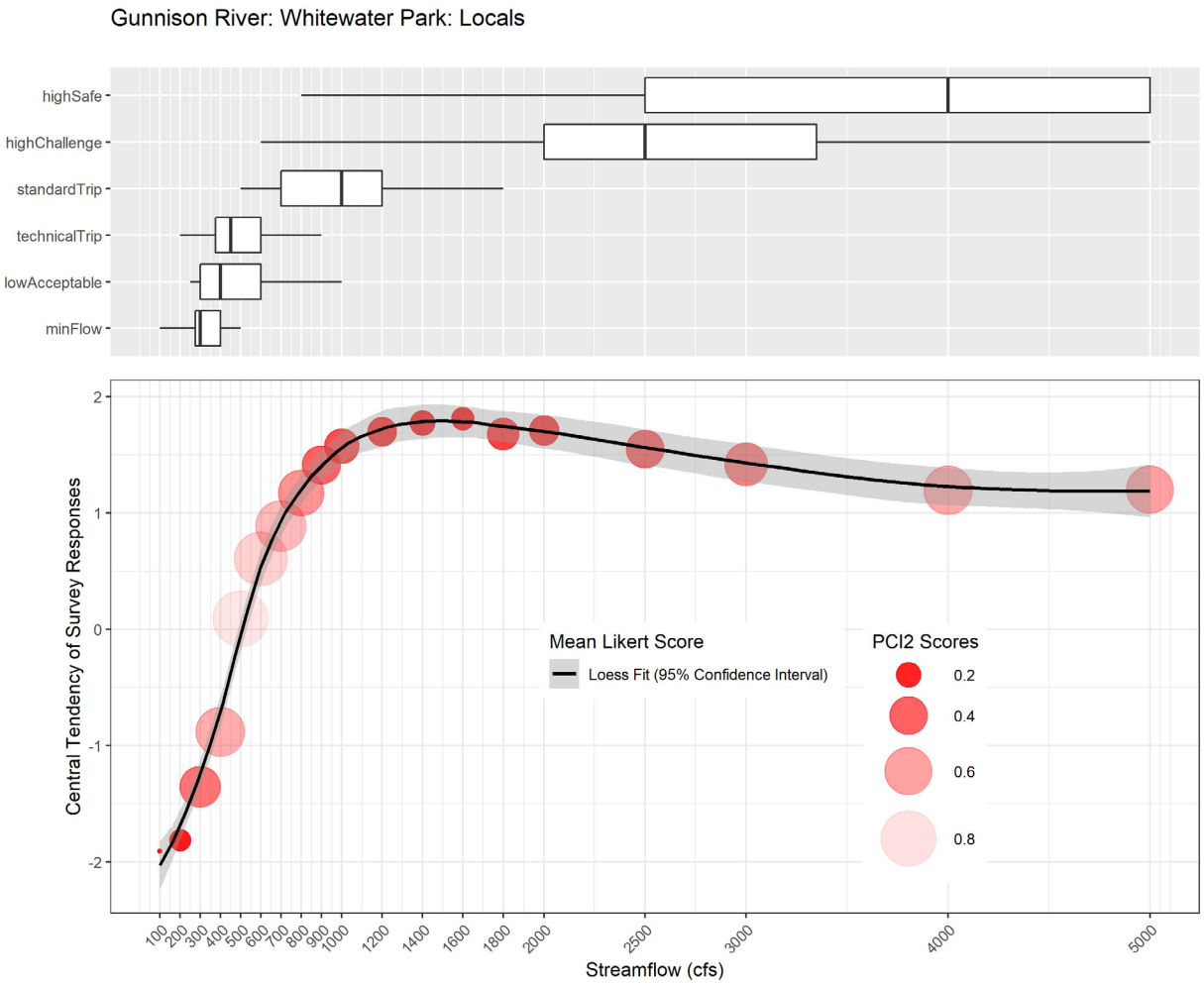
Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	300	400	500	41
Low Acceptable Flow (cfs)	400	500	800	41
Technical Flow (cfs)	400	500	612	40
Standard Trip Flow (cfs)	800	1000	1500	41
Challenging High Flow (cfs)	2000	3000	4000	41
Highest Safe Flow (cfs)	2500	4000	5000	41

Figure 29. Kayaker survey responses for the Gunnison River Whitewater Park. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	280	300	400	17
Low Acceptable Flow (cfs)	300	400	600	17
Technical Flow (cfs)	380	400	650	17
Standard Trip Flow (cfs)	600	800	1200	17
Challenging High Flow (cfs)	1500	2000	3000	17
Highest Safe Flow (cfs)	2500	3000	4500	17

Figure 30. Rafter survey responses for the Gunnison River Whitewater Park. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom).



Survey Question	25th Percentile	Median Response	75th Percentile	Response Count
Minimum Flow (cfs)	275	300	400	31
Low Acceptable Flow (cfs)	300	400	600	31
Technical Flow (cfs)	375	450	600	31
Standard Trip Flow (cfs)	700	1000	1200	31
Challenging High Flow (cfs)	2000	2500	3350	31
Highest Safe Flow (cfs)	2500	4500	5000	29

Figure 31. Local resident survey responses for the Gunnison River Whitewater Park. Whisker plot of single flow judgement responses (top), impact acceptability curve (middle), and tabular single flow judgment responses (bottom). Local residents were defined as respondents living in the following zip codes: 81210, 81224, 81225, 81230, 81231.

APPENDIX C: Subgroup PCI2 and Mean Acceptability Summary Tables

Table 7. Potential for Conflict Index 2 (PCI2) and mean acceptability for seven different user group categories on the Taylor River between New Generation and Almont using the USGS gage below Taylor Reservoir.

	Guides		Public		Beginners		Experts		Rafters		Kayakers		Locals	
Flow (CFS)	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.
100	0.000	-2.000	0.080	-1.916	0.114	-1.870	0.048	-1.951	0.057	-1.939	0.069	-1.929	0.067	-1.930
200	0.514	-1.048	0.443	-1.364	0.432	-1.217	0.467	-1.326	0.403	-1.353	0.467	-1.297	0.524	-1.067
300	0.745	0.200	0.699	-0.196	0.816	0.083	0.675	-0.182	0.667	-0.030	0.710	-0.141	0.665	0.111
400	0.473	1.333	0.688	0.725	0.752	0.875	0.629	0.830	0.650	0.971	0.656	0.844	0.592	1.111
500	0.348	1.550	0.493	1.319	0.609	1.208	0.423	1.402	0.511	1.333	0.430	1.421	0.356	1.581
600	0.144	1.842	0.291	1.663	0.379	1.565	0.234	1.729	0.351	1.588	0.212	1.764	0.205	1.767
700	0.052	1.944	0.248	1.721	0.462	1.435	0.135	1.852	0.300	1.656	0.171	1.814	0.153	1.837
800	0.151	1.833	0.239	1.738	0.450	1.455	0.152	1.838	0.263	1.710	0.201	1.783	0.115	1.881
900	0.056	1.941	0.245	1.731	0.364	1.571	0.165	1.824	0.190	1.793	0.204	1.781	0.024	1.976
1000	0.181	1.765	0.324	1.640	0.528	1.350	0.230	1.750	0.311	1.643	0.275	1.698	0.096	1.897
1200	0.340	1.588	0.501	1.386	0.699	0.938	0.398	1.535	0.527	1.333	0.448	1.459	0.368	1.571
1400	0.491	1.400	0.591	1.243	0.839	0.533	0.476	1.429	0.614	1.192	0.555	1.305	0.473	1.441
1600	0.589	1.267	0.654	1.132	0.888	0.429	0.558	1.304	0.667	1.120	0.633	1.172	0.507	1.394
1800	0.000	-2.000	0.080	-1.916	0.114	-1.870	0.048	-1.951	0.057	-1.939	0.069	-1.929	0.067	-1.930
2000	0.514	-1.048	0.443	-1.364	0.432	-1.217	0.467	-1.326	0.403	-1.353	0.467	-1.297	0.524	-1.067
2500	0.745	0.200	0.699	-0.196	0.816	0.083	0.675	-0.182	0.667	-0.030	0.710	-0.141	0.665	0.111
3000	0.473	1.333	0.688	0.725	0.752	0.875	0.629	0.830	0.650	0.971	0.656	0.844	0.592	1.111
4000	0.348	1.550	0.493	1.319	0.609	1.208	0.423	1.402	0.511	1.333	0.430	1.421	0.356	1.581
5000	0.144	1.842	0.291	1.663	0.379	1.565	0.234	1.729	0.351	1.588	0.212	1.764	0.205	1.767

Table 8. Potential for Conflict Index 2 (PCI2) and mean acceptability for seven different user group categories on the Gunnison River between Almont and McCabes using the USGS gage near Gunnison, CO.

	Guides		Public		Beginners		Experts		Rafters		Kayakers		Locals	
Flow (CFS)	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.
100	0.000	-2.000	0.020	-1.980	0.000	-2.000	0.019	-1.981	0.000	-2.000	0.000	-2.000	0.000	-2.000
200	0.161	-1.800	0.125	-1.860	0.131	-1.846	0.135	-1.846	0.145	-1.824	0.057	-1.939	0.073	-1.921
300	0.366	-1.400	0.490	-1.231	0.536	-1.077	0.441	-1.315	0.424	-1.294	0.354	-1.500	0.415	-1.395
400	0.474	-0.357	0.732	-0.269	0.704	0.286	0.648	-0.442	0.695	-0.333	0.622	-0.441	0.599	-0.514
500	0.652	0.267	0.768	0.283	0.566	0.929	0.750	0.111	0.733	0.206	0.753	0.143	0.691	0.105
600	0.480	1.143	0.681	0.804	0.515	1.214	0.672	0.784	0.619	0.879	0.680	0.727	0.645	0.703
700	0.418	1.429	0.552	1.196	0.480	1.286	0.538	1.235	0.550	1.152	0.528	1.212	0.592	1.027
800	0.223	1.733	0.478	1.302	0.434	1.357	0.431	1.407	0.449	1.314	0.464	1.353	0.460	1.316
900	0.235	1.714	0.326	1.558	0.369	1.462	0.291	1.623	0.344	1.500	0.297	1.600	0.275	1.611
1000	0.270	1.643	0.162	1.808	0.250	1.692	0.172	1.792	0.268	1.636	0.125	1.853	0.147	1.833
1200	0.179	1.769	0.135	1.846	0.250	1.692	0.116	1.865	0.213	1.727	0.080	1.912	0.101	1.886
1400	0.264	1.667	0.178	1.804	0.215	1.750	0.193	1.784	0.217	1.742	0.084	1.912	0.055	1.941
1600	0.264	1.667	0.168	1.820	0.215	1.750	0.183	1.800	0.217	1.742	0.029	1.970	0.055	1.941
1800	0.375	1.500	0.240	1.740	0.153	1.833	0.303	1.660	0.379	1.548	0.029	1.970	0.216	1.765
2000	0.438	1.417	0.266	1.706	0.153	1.833	0.339	1.608	0.396	1.516	0.084	1.912	0.241	1.735
2500	0.576	1.250	0.354	1.592	0.215	1.750	0.446	1.469	0.522	1.333	0.146	1.844	0.324	1.636
3000	0.576	1.250	0.489	1.400	0.451	1.417	0.519	1.360	0.588	1.233	0.314	1.636	0.417	1.515
4000	0.625	1.167	0.570	1.292	0.633	1.182	0.572	1.286	0.656	1.133	0.379	1.563	0.487	1.424
5000	0.625	1.167	0.655	1.146	0.833	0.727	0.597	1.245	0.679	1.100	0.508	1.375	0.577	1.273

Table 9. Potential for Conflict Index 2 (PCI2) and Flow Acceptability Agreement Index (FAAI) scores for seven different user group categories at the Gunnison River Whitewater Park using the USGS gage near Gunnison, CO.

	Guides		Public		Beginners		Experts		Rafters		Kayakers		Locals	
Flow (CFS)	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.	PCI2	Mean Accept.
100	0.083	-1.909	0.063	-1.935	0.000	-2.000	0.081	-1.915	0.000	-2.000	0.050	-1.947	0.089	-1.906
200	0.083	-1.909	0.138	-1.848	0.300	-1.600	0.081	-1.915	0.000	-2.000	0.140	-1.842	0.168	-1.813
300	0.403	-1.333	0.452	-1.388	0.650	-0.455	0.327	-1.580	0.493	-1.294	0.405	-1.463	0.455	-1.353
400	0.514	-0.667	0.695	-0.918	0.750	0.273	0.563	-1.120	0.722	-0.647	0.623	-1.024	0.637	-0.882
500	0.576	0.250	0.826	-0.240	0.683	0.909	0.748	-0.373	0.750	0.235	0.787	-0.310	0.814	0.088
600	0.467	0.727	0.830	0.320	0.600	1.182	0.773	0.220	0.625	1.000	0.781	0.209	0.750	0.606
700	0.549	1.083	0.683	0.769	0.486	1.333	0.677	0.712	0.556	1.235	0.642	0.721	0.680	0.886
800	0.410	1.417	0.605	1.094	0.361	1.500	0.614	1.075	0.326	1.588	0.601	1.091	0.557	1.171
900	0.233	1.727	0.464	1.353	0.200	1.727	0.472	1.353	0.236	1.706	0.491	1.310	0.403	1.412
1000	0.215	1.750	0.387	1.519	0.383	1.455	0.348	1.585	0.236	1.706	0.426	1.465	0.340	1.576
1200	0.000	2.000	0.301	1.640	0.350	1.545	0.230	1.740	0.223	1.733	0.287	1.667	0.250	1.697
1400	0.000	2.000	0.279	1.680	0.433	1.455	0.187	1.796	0.179	1.800	0.280	1.683	0.204	1.774
1600	0.000	2.000	0.255	1.720	0.550	1.273	0.118	1.878	0.241	1.733	0.226	1.756	0.179	1.806
1800	0.180	1.800	0.353	1.604	0.900	0.556	0.154	1.837	0.482	1.400	0.310	1.659	0.292	1.677
2000	0.180	1.800	0.361	1.596	0.900	0.556	0.158	1.833	0.446	1.467	0.336	1.625	0.267	1.710
2500	0.180	1.800	0.476	1.435	0.950	0.444	0.267	1.702	0.500	1.400	0.391	1.550	0.396	1.548
3000	0.500	1.400	0.518	1.370	0.950	0.444	0.385	1.553	0.554	1.333	0.491	1.400	0.492	1.419
4000	0.660	1.000	0.602	1.239	0.950	0.444	0.525	1.340	0.679	1.067	0.567	1.275	0.623	1.194
5000	0.660	1.000	0.593	1.244	0.859	0.375	0.531	1.340	0.679	1.067	0.554	1.282	0.598	1.200

APPENDIX D: Subgroup Flow Preferences

Table 10. Subgroup flow preferences determined for the Taylor and Gunnison Rivers.

User	River	Reach Description	Min. Navigable	Min. Acceptable	Min. Optimal	Max. Optimal	Max. Acceptable
Guides	Taylor	New Generation to Almont	250	350	600	1000	1200+
	Gunnison	Almont to McCabes	300	450	800	1600	5000+
	Gunnison	Whitewater Park	300	500	900	2500	5000+
Public	Taylor	New Generation to Almont	300	350	600	900	1200+
	Gunnison	Almont to McCabes	350	500	1000	2000	5000+
	Gunnison	Whitewater Park	400	550	1400	1600	5000+
Beginners	Taylor	New Generation to Almont	250	300	600*	900*	1200+
	Gunnison	Almont to McCabes	300	400	1000	2500	5000+

	Gunnison	Whitewater Park	300	350	1200	1600	5000+
Experts	Taylor	New Generation to Almont	250	350	600	1000	1200+
	Gunnison	Almont to McCabes	325	500	900	1600	5000+
	Gunnison	Whitewater Park	400	600	1200	2500	5000+
Rafters	Taylor	New Generation to Almont	300	350	700	900	1200+
	Gunnison	Almont to McCabes	350	500	1000	1600	5000+
	Gunnison	Whitewater Park	300	500	900	1600	5000+
Kayakers	Taylor	New Generation to Almont	250	350	600	1000	1200+
	Gunnison	Almont to McCabes	400	500	900	2500	5000+
	Gunnison	Whitewater Park	400	550	1200	1600	5000+
Locals	Taylor	New Generation to Almont	250	300	600	1000	1200+
	Gunnison	Almont to McCabes	300	500	900	2000	5000+
	Gunnison	Whitewater Park	300	500	1200	2000	5000+

*Optimal flows could not be determined for the beginner sub-group due to higher PCI-2 scores, indicating a greater level of disagreement. Optimal flows presented here are estimates based on PCI-2 scores and mean acceptability rankings relative to other surveyed flow levels.

APPENDIX E: Four Year-Type Hydrological Results

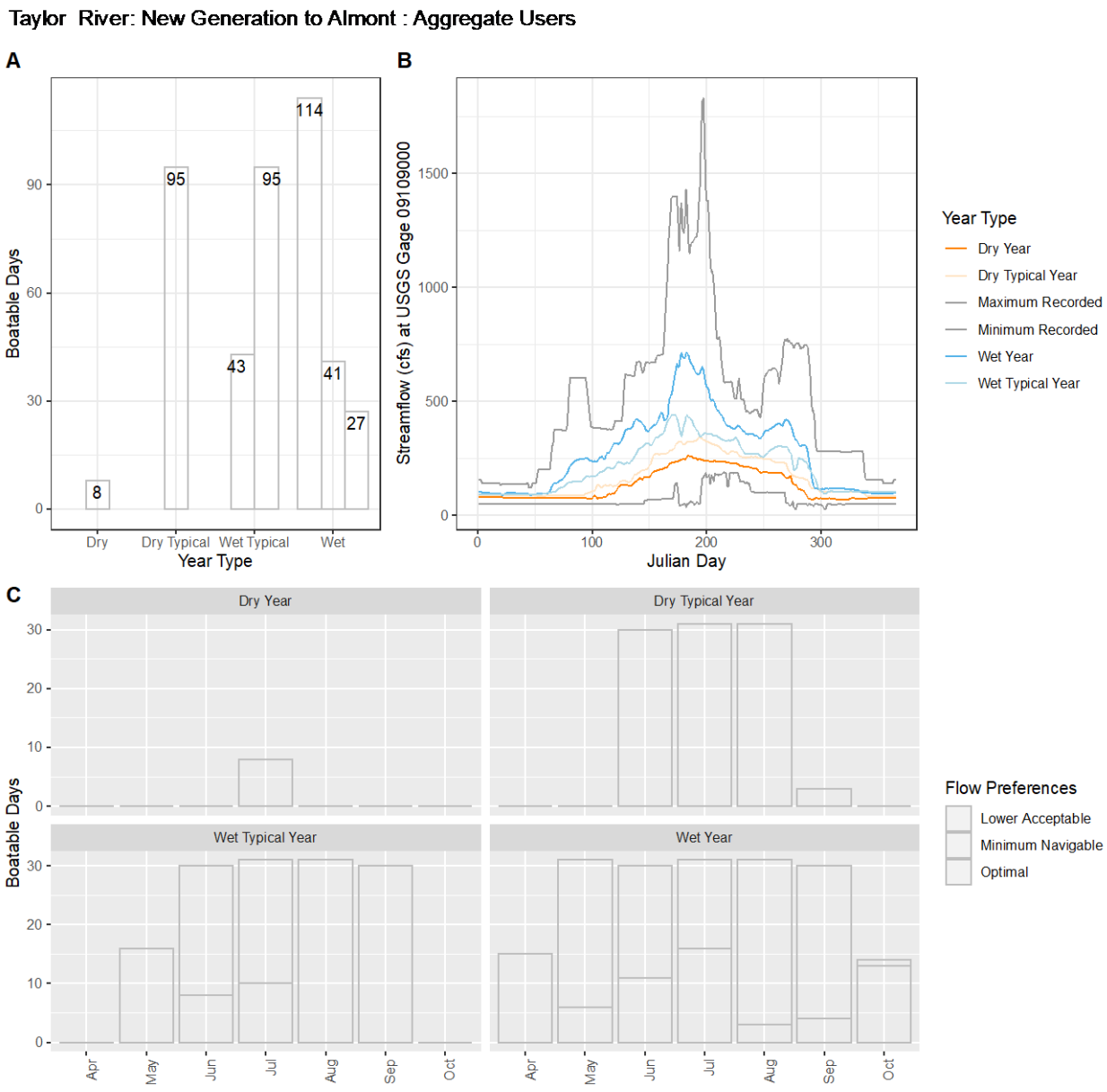


Figure 32. Boatable Day totals for the Taylor River: New Generation to Almont. (A) Annual Boatable Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Boatable Day totals summarized by hydrological year type.

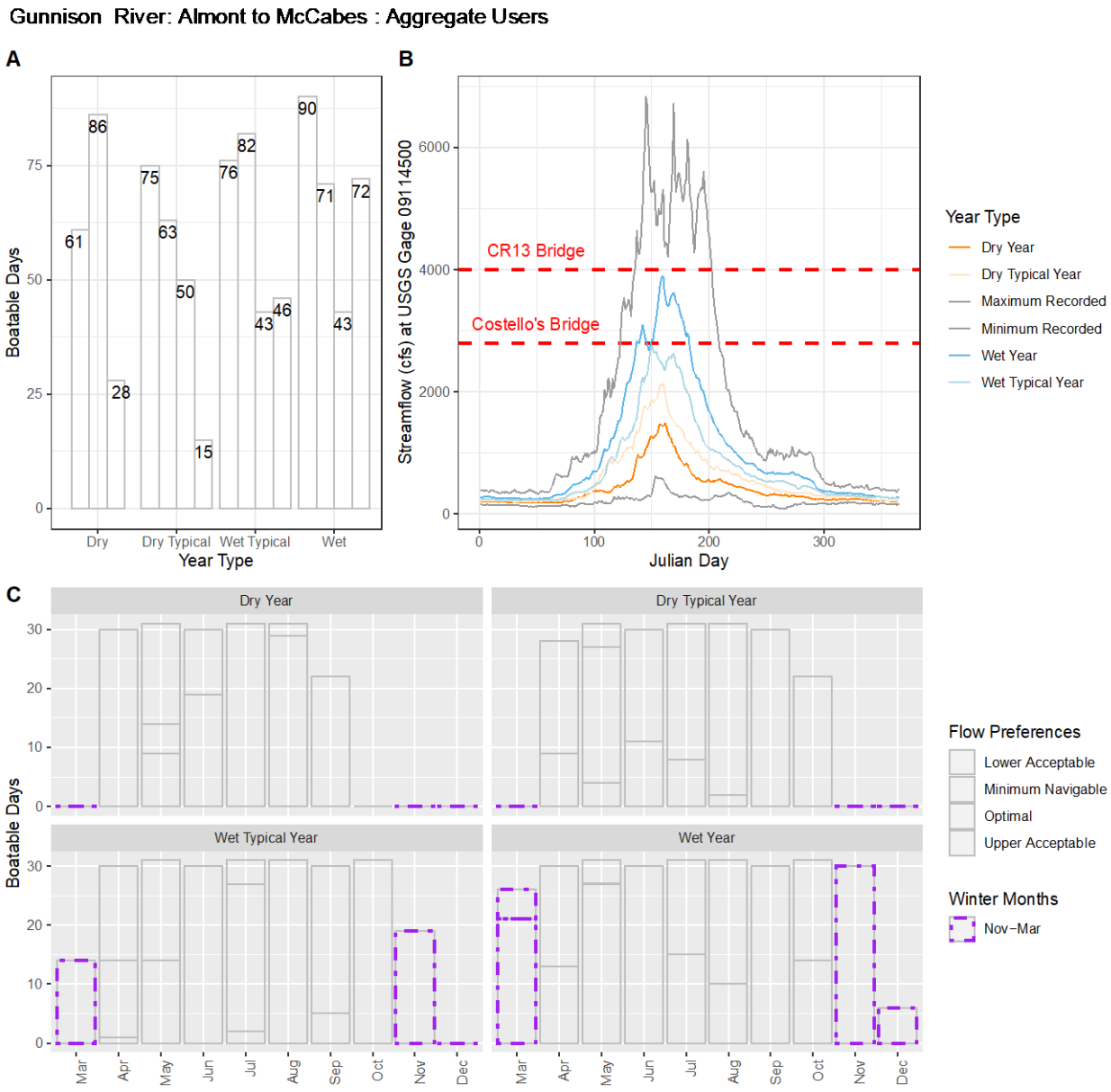


Figure 33. Boatable Days total for the Gunnison River: Almont to McCabes. (A) Annual Boatable Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Boatable Day totals summarized by hydrological year type.

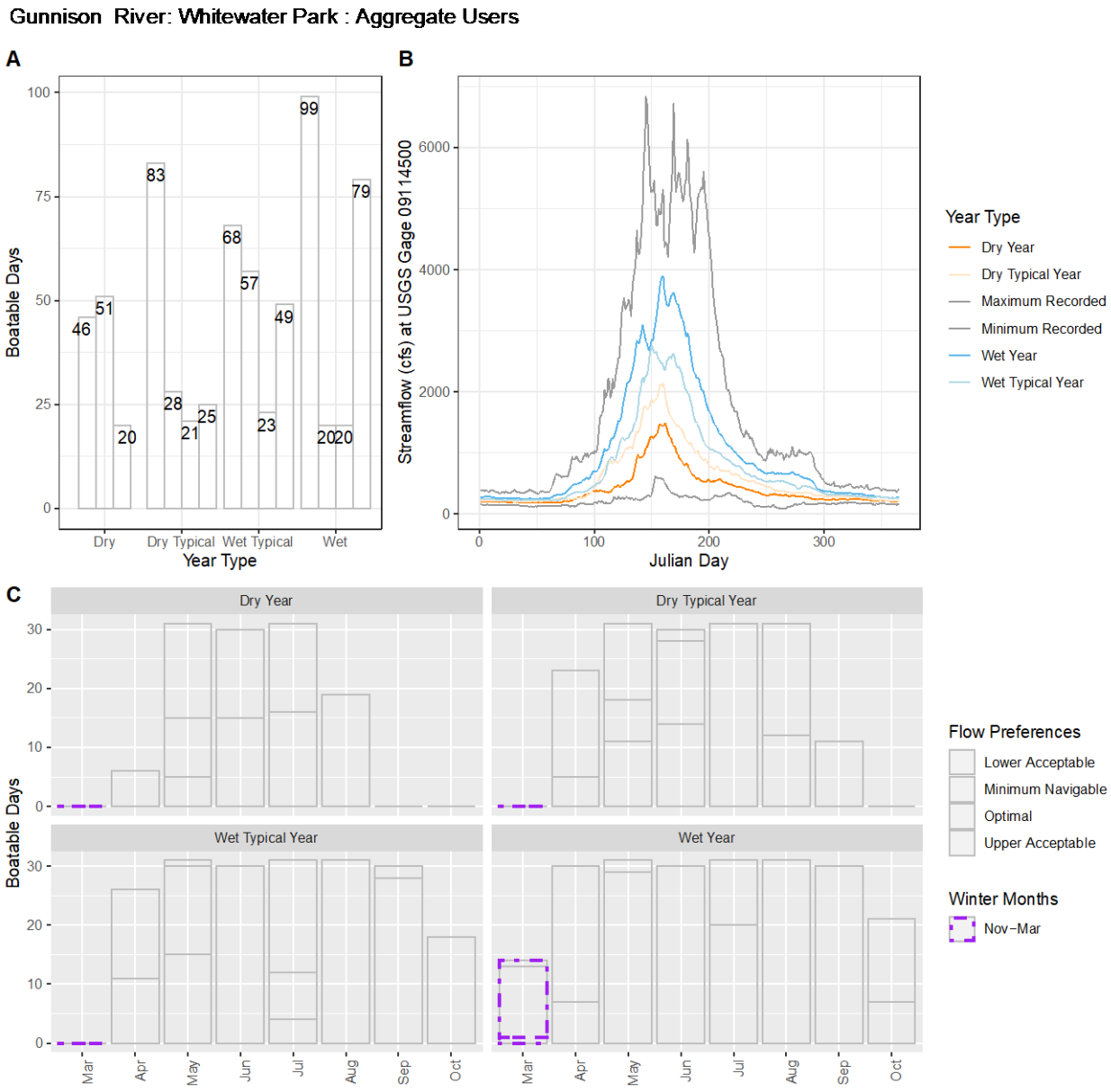


Figure 34. Boatable Day totals for the Gunnison River: Whitewater Park. (A) Annual Boatable Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Boatable Day totals summarized by hydrological year type.

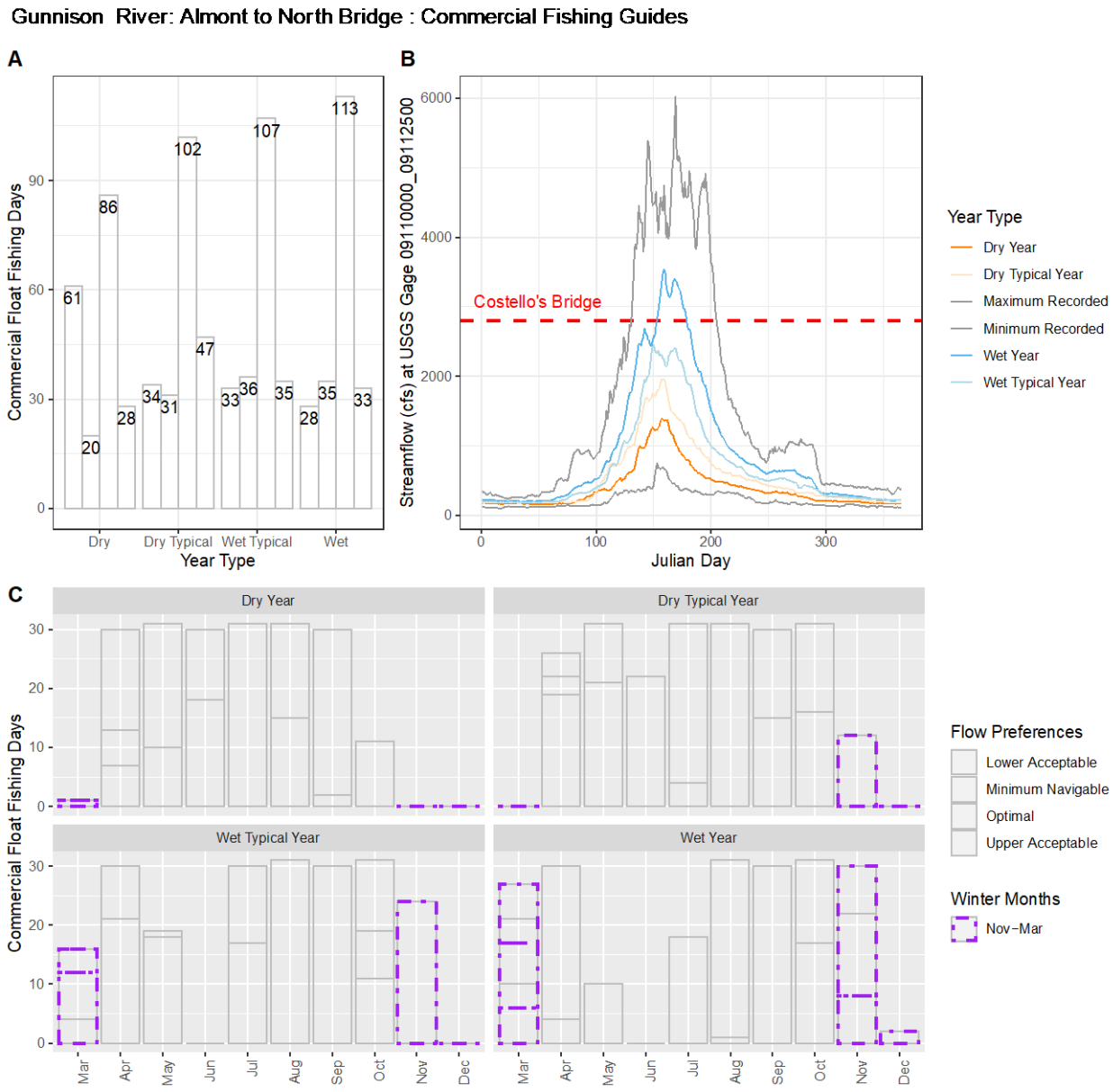


Figure 35. Commercial Float Fishing Day totals for the Gunnison River: Almont to North Bridge. (A) Annual Commercial Float Fishing Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Float Fishing Day totals summarized by hydrological year type.

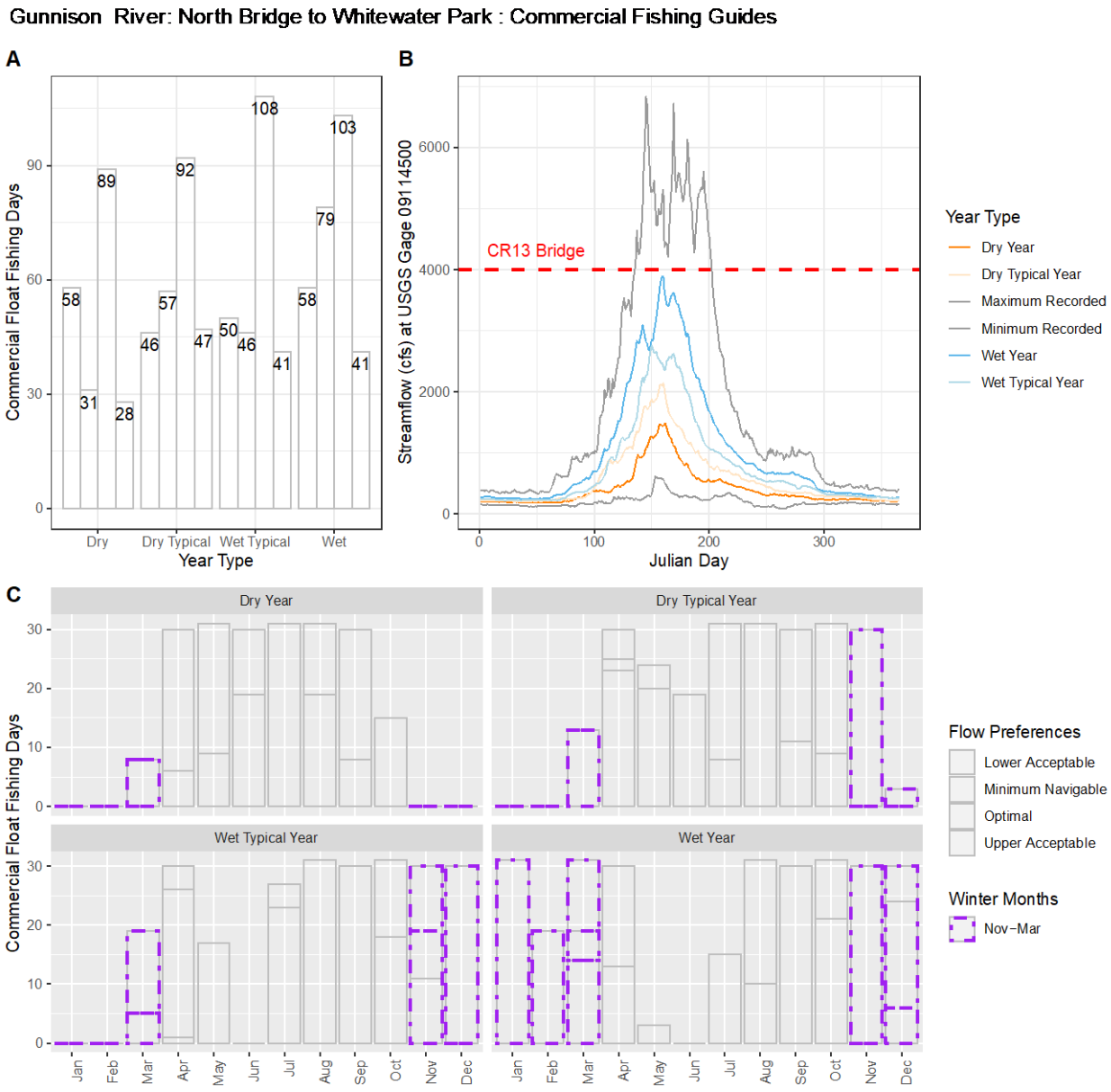


Figure 36. Commercial Float Fishing Day totals for the Gunnison River: North Bridge to Whitewater Park. (A) Annual Commercial Float Fishing Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Float Fishing Day totals summarized by hydrological year type.

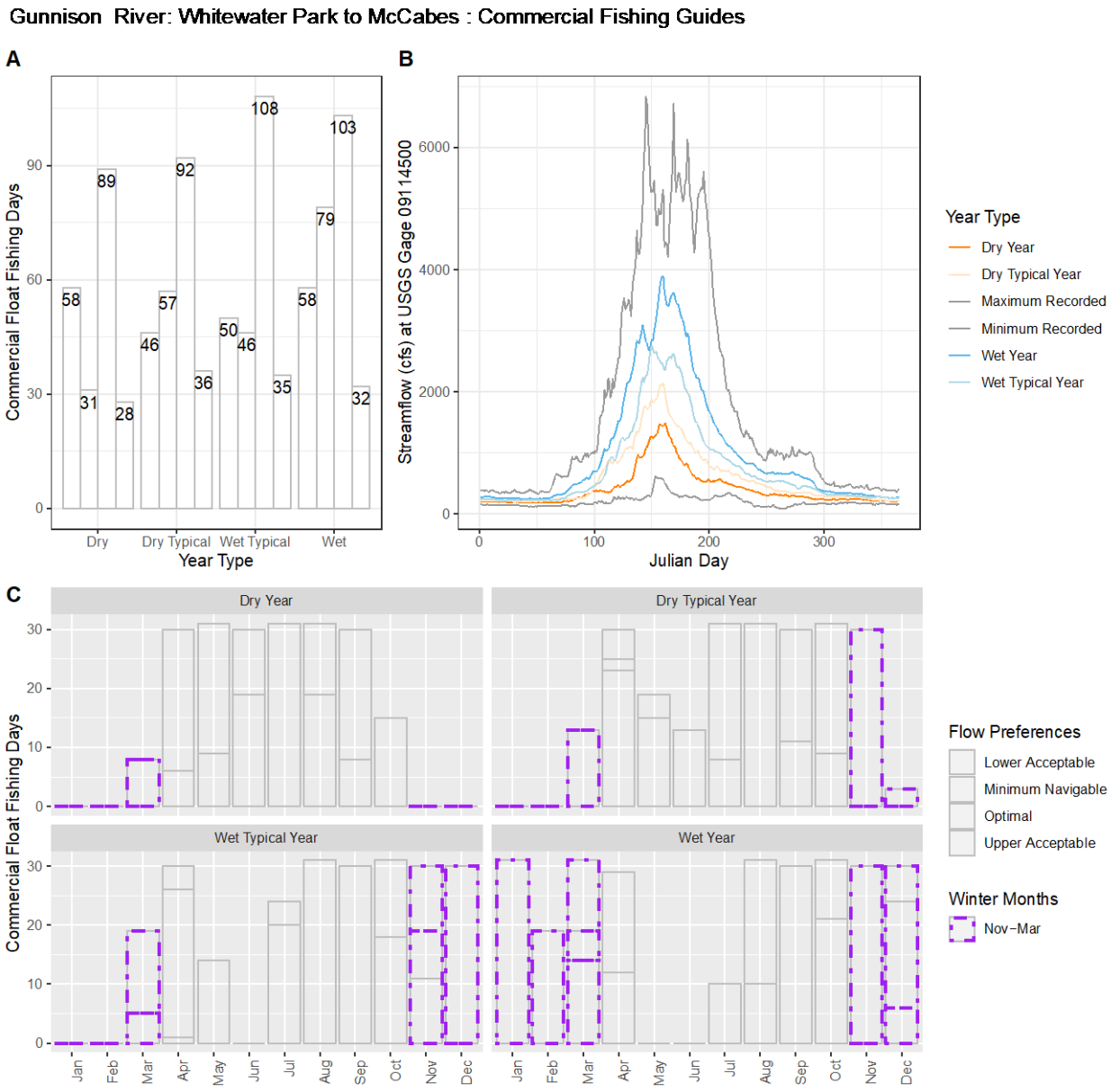


Figure 37. Commercial Float Fishing Day totals for the Gunnison River: Whitewater Park to McCabes. (A) Annual Commercial Float Fishing Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Float Fishing Day totals summarized by hydrological year type.

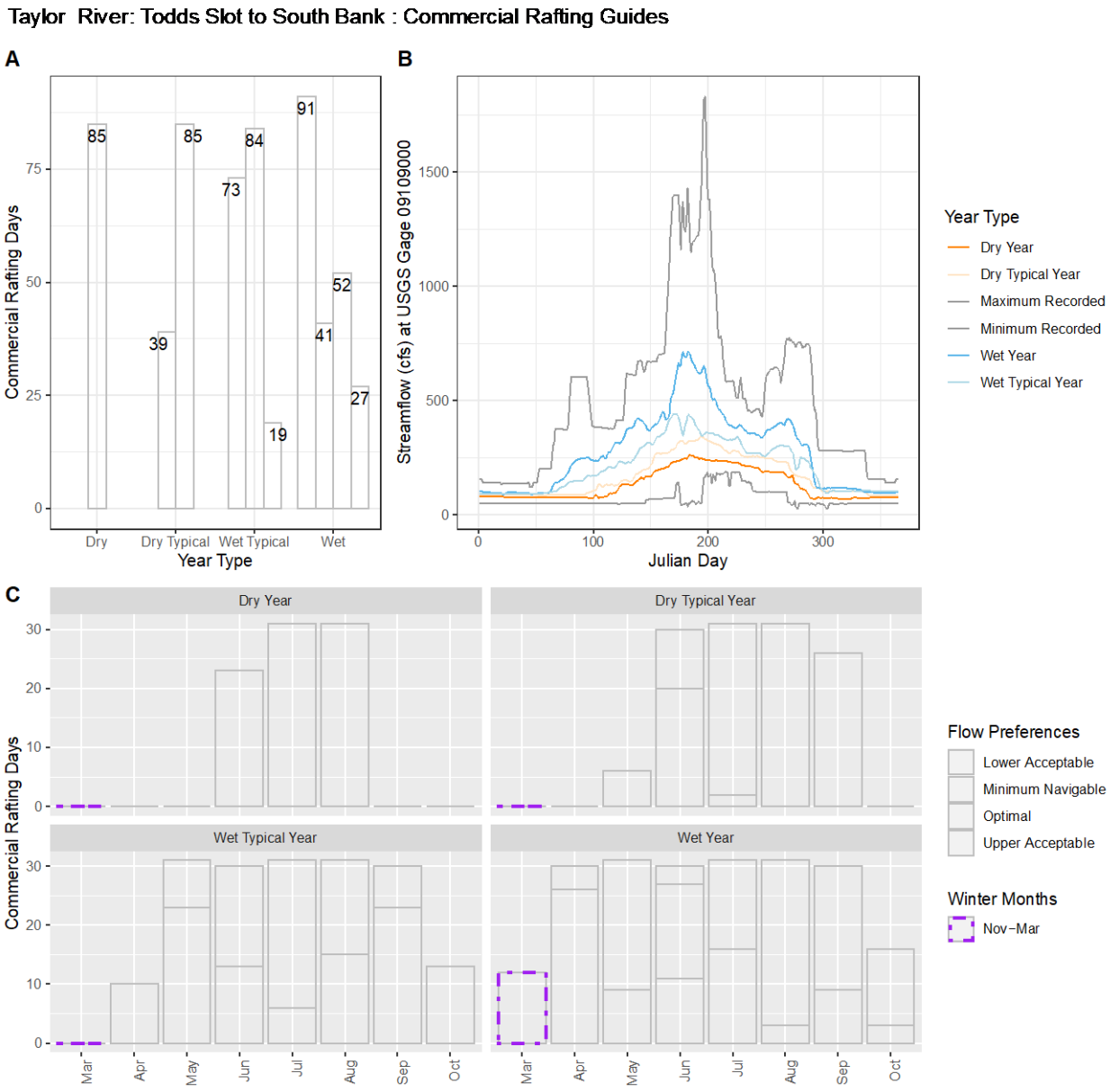


Figure 38. Commercial Rafting Day totals for the Taylor River: Todd's Slot to South Bank. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

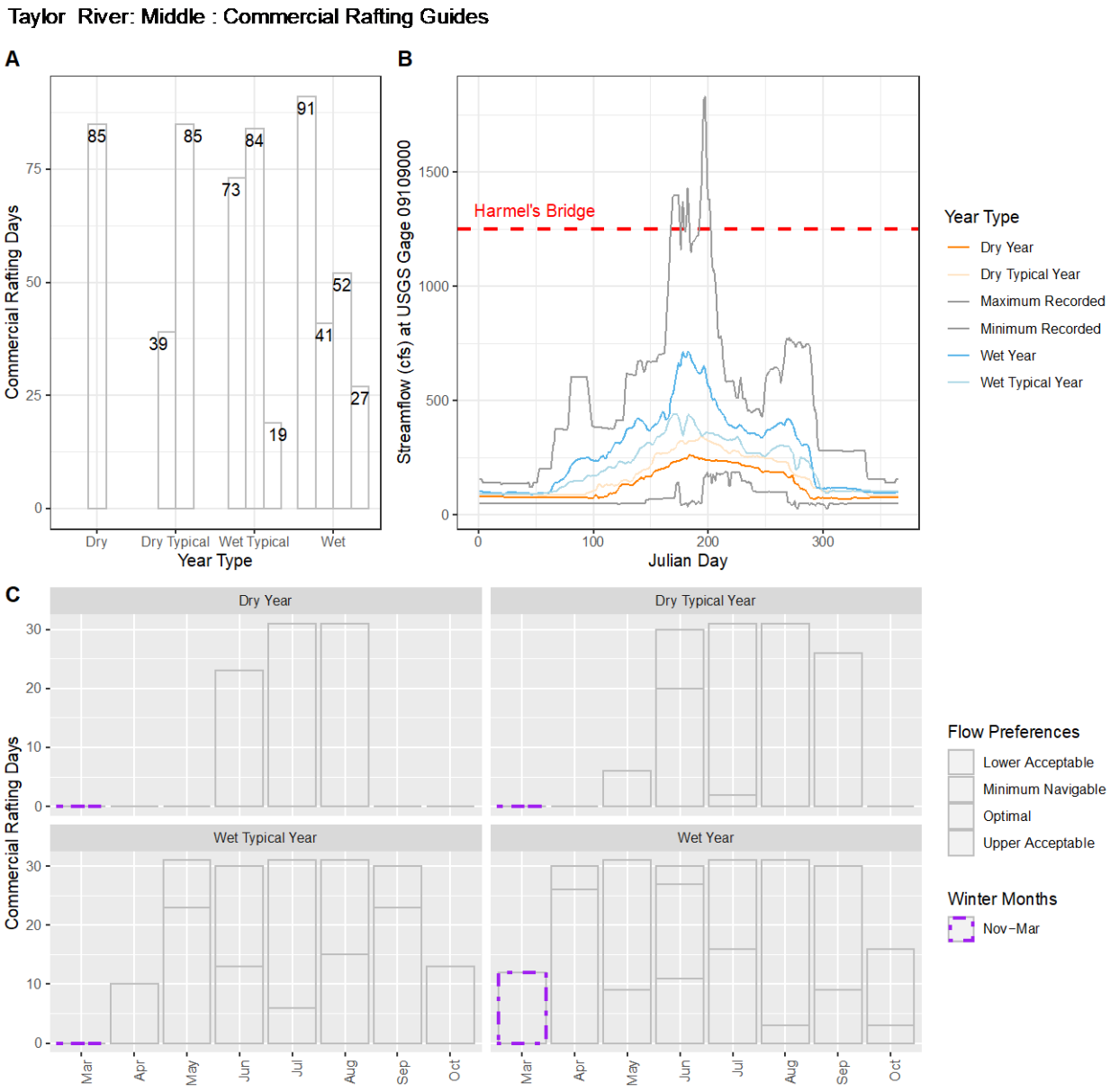


Figure 39. Commercial Rafting Day totals for the Taylor River: South Bank to Five Mile. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

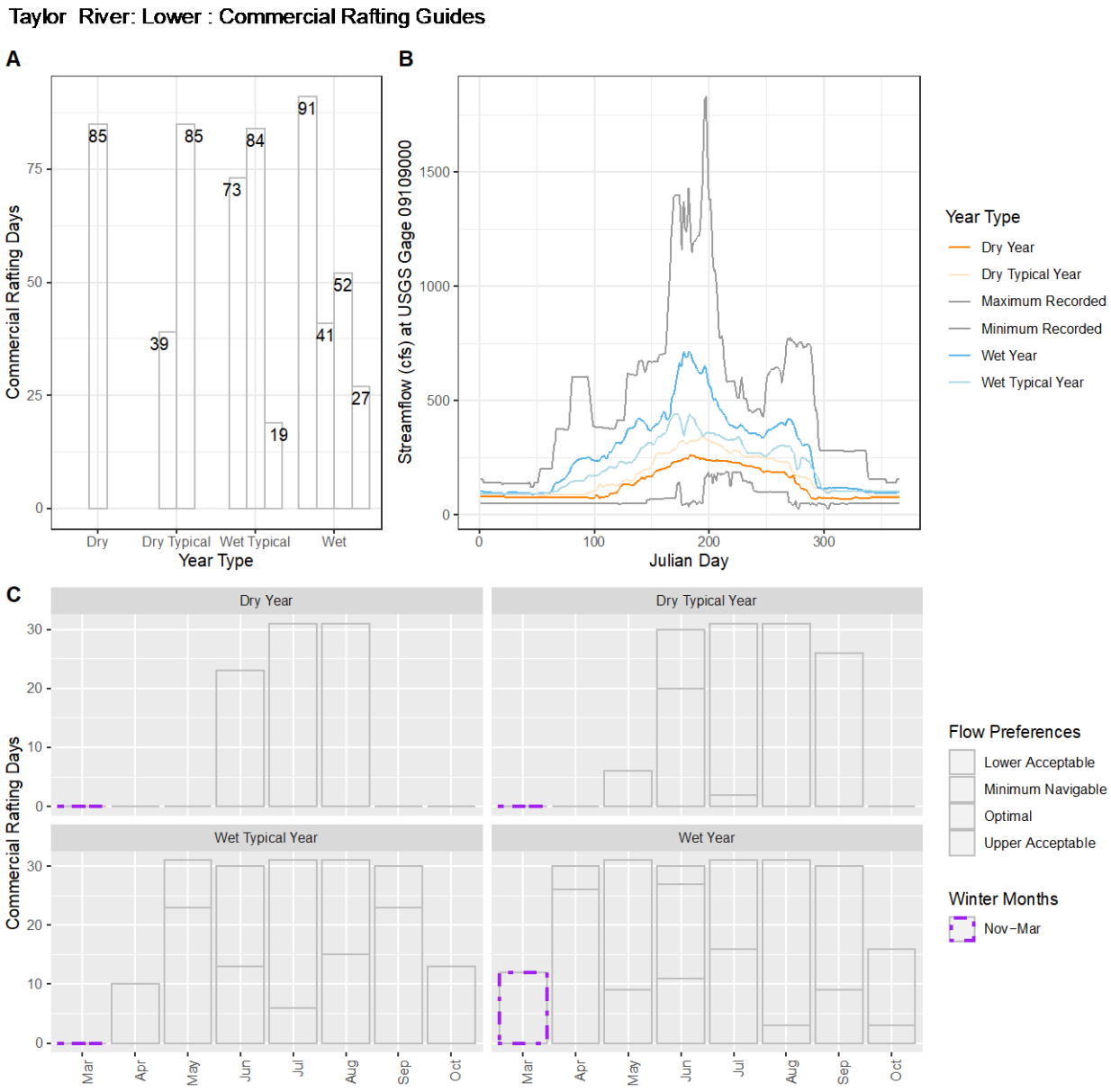


Figure 40. Commercial Rafting Day totals for the Taylor River: Five Mile to Almont. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

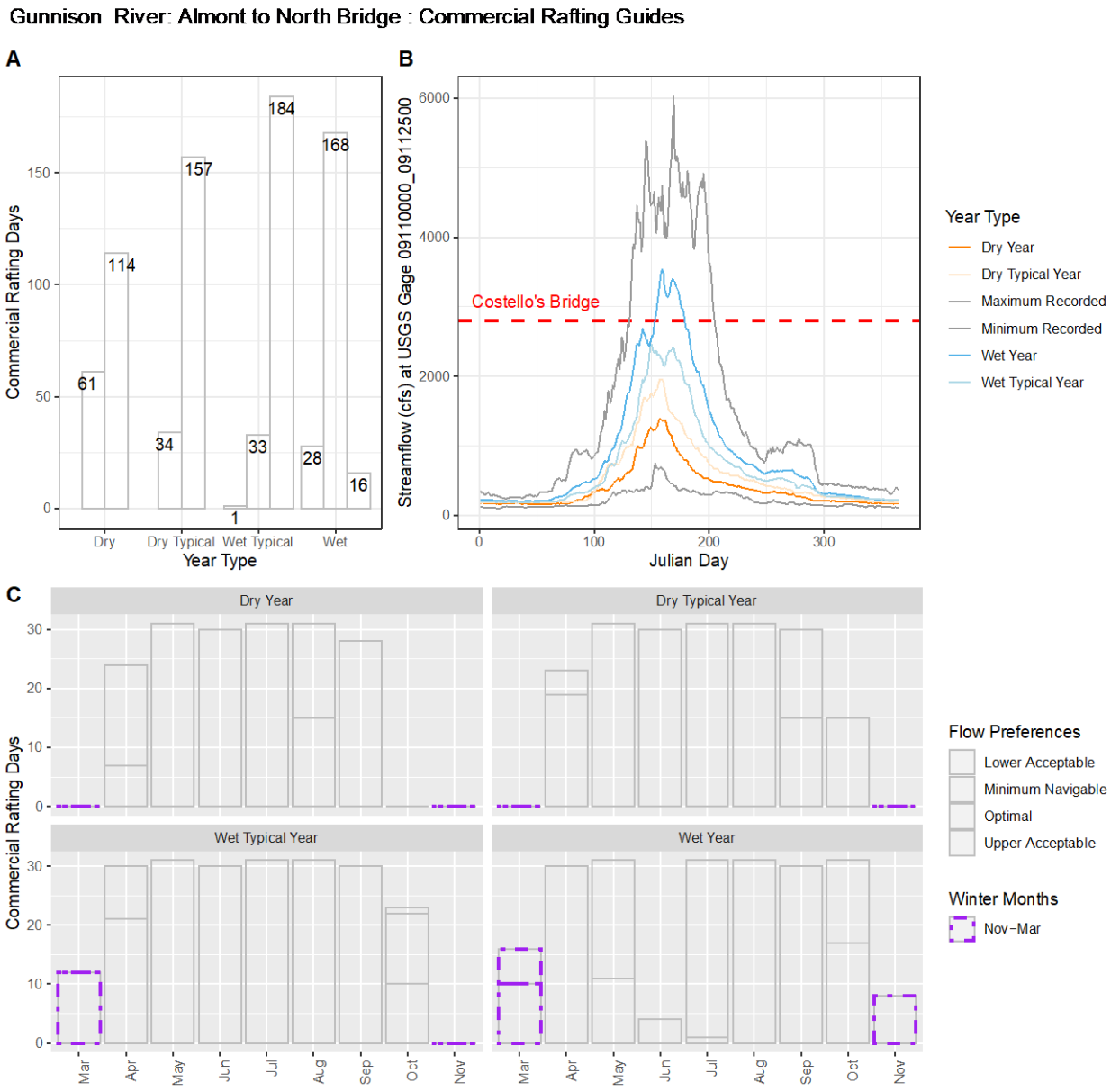


Figure 41. Commercial Rafting Day totals for the Gunnison River: Almont to North Bridge. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

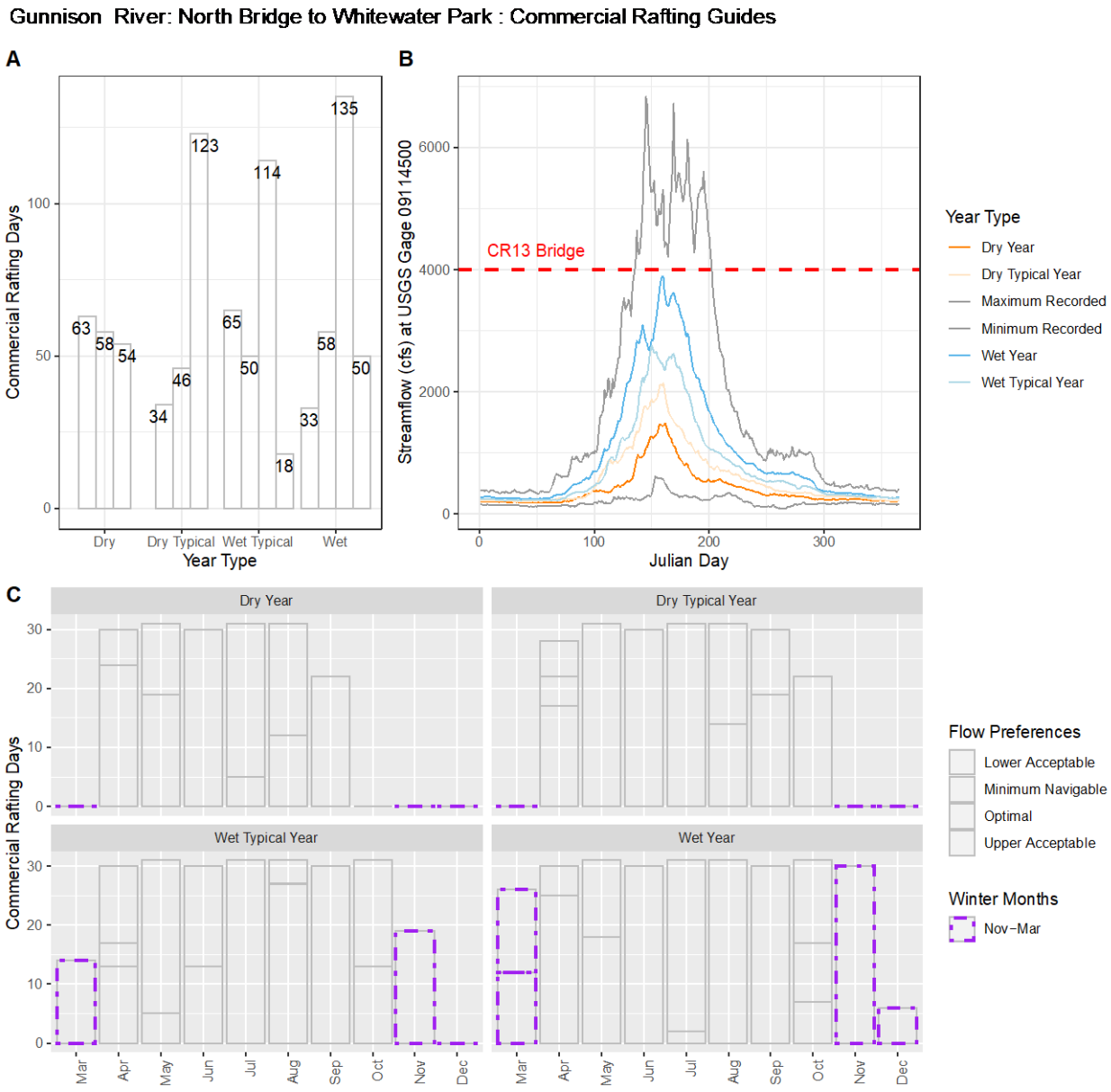


Figure 42. Commercial Rafting Day totals for the Gunnison River: North Bridge to Whitewater Park. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

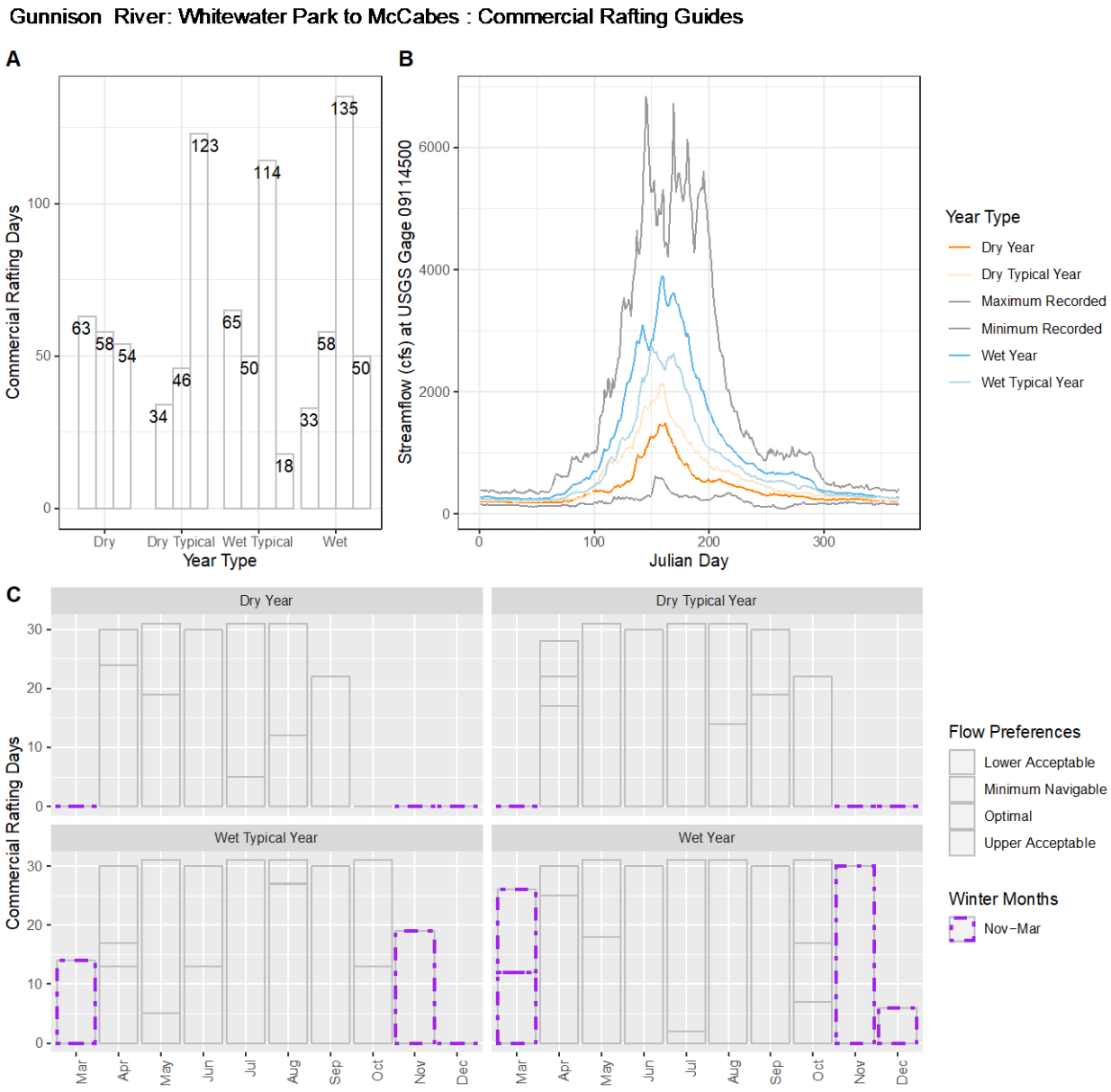


Figure 43. Commercial Rafting Day totals for the Gunnison River: Whitewater Park to McCabes. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for dry, dry-typical, wet-typical, and wet years. (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

APPENDIX F: Three Representative Year-Type Hydrological Results

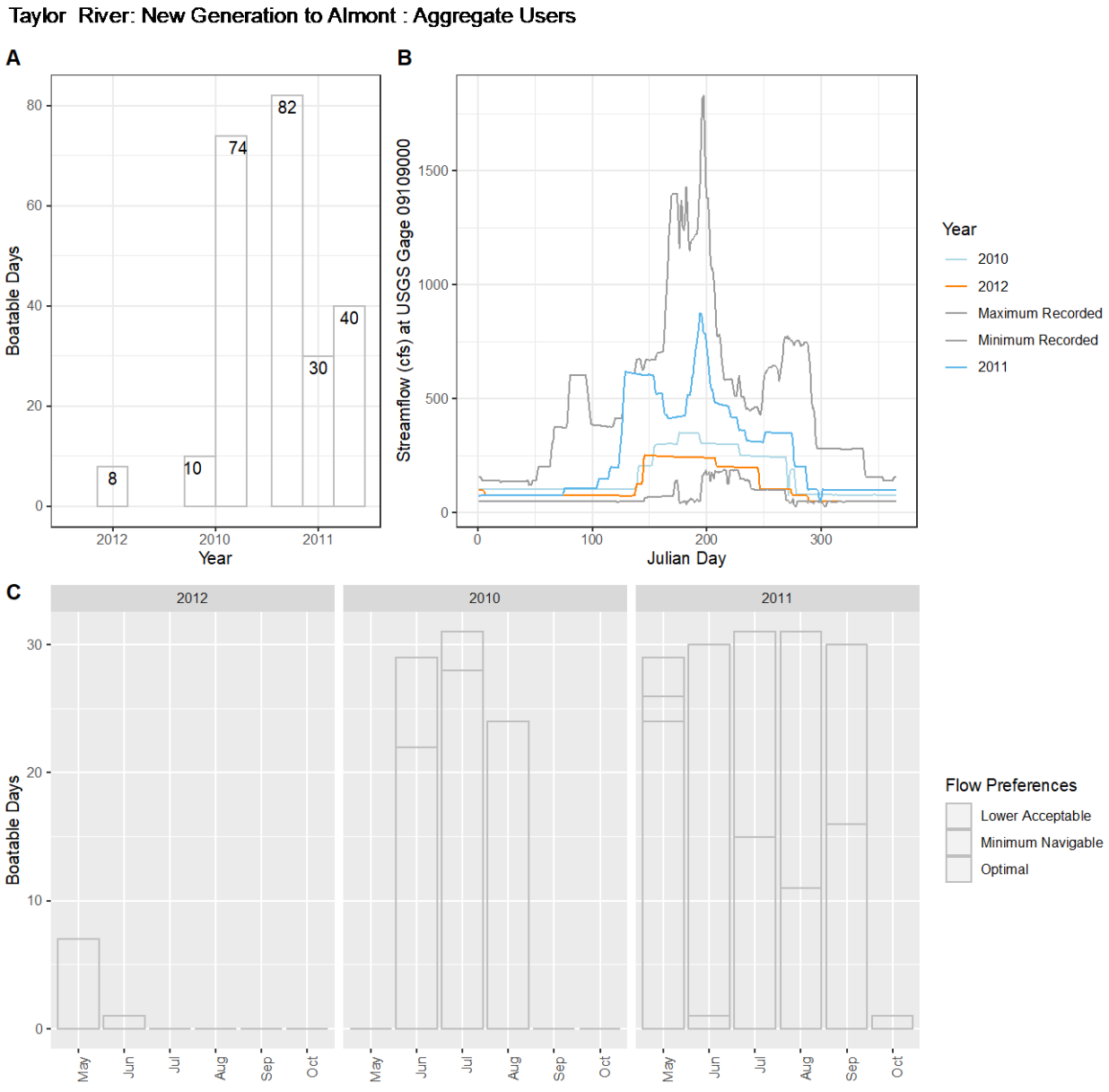


Figure 44. Boatable Day totals for the Taylor River: New Generation to Almont. (A) Annual Boatable Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Boatable Day totals summarized by hydrological year type.

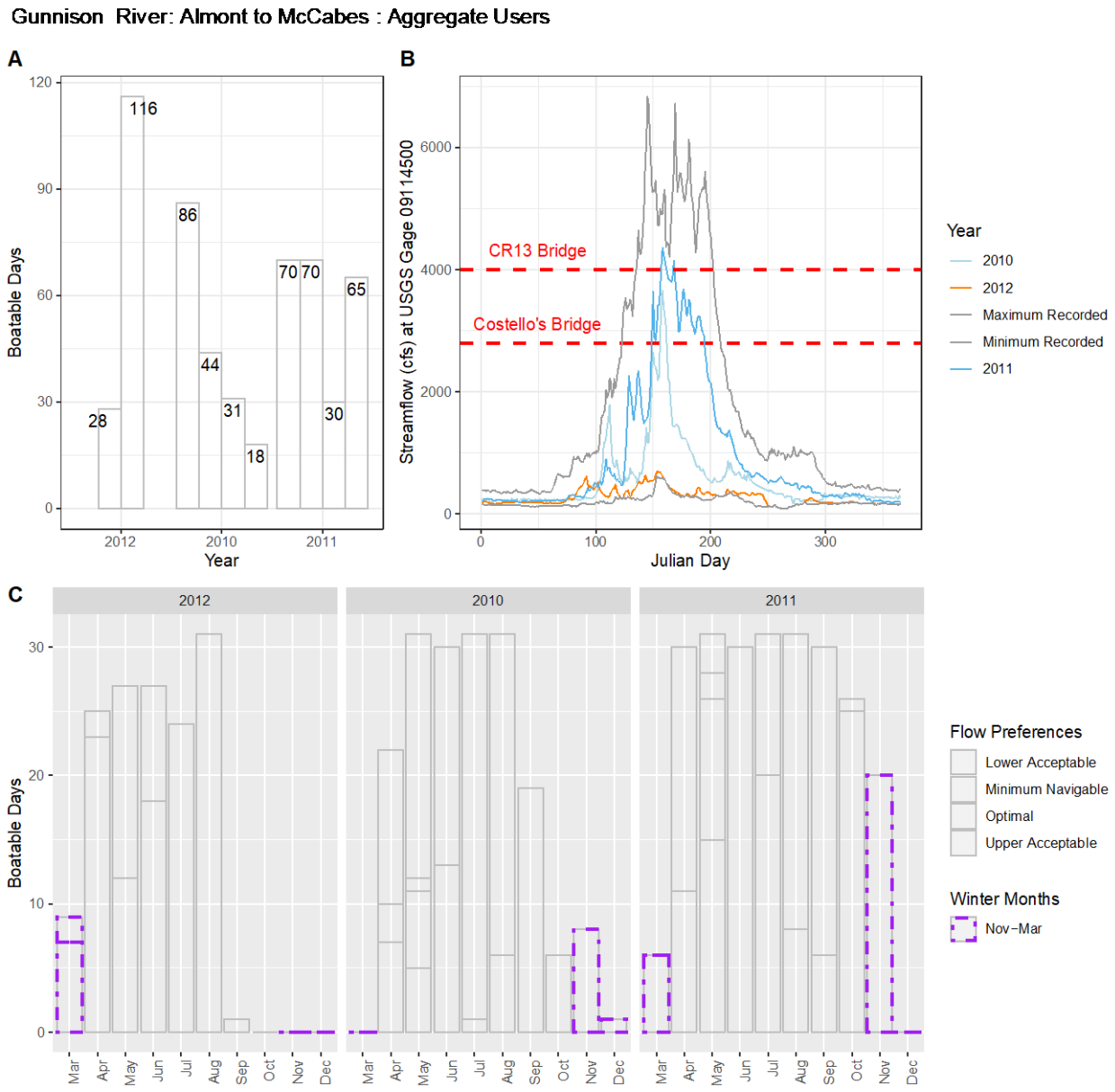


Figure 45. Boatable Day totals for the Gunnison River: Almont to McCabes. (A) Annual Boatable Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Boatable Day totals summarized by hydrological year type.

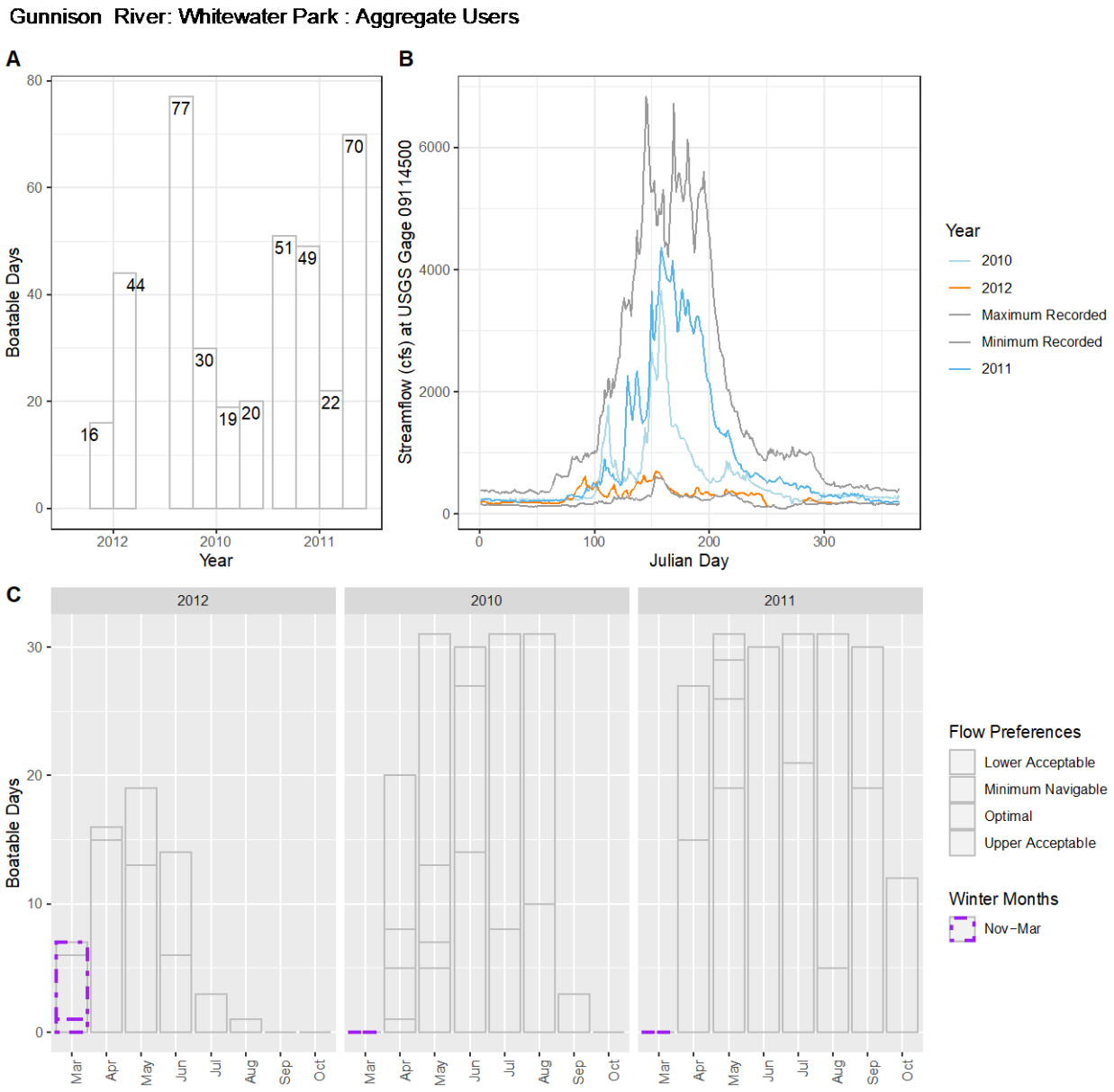


Figure 46. Boatable Day totals for the Gunnison River: Whitewater Park. (A) Annual Boatable Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Boatable Day totals summarized by hydrological year type.

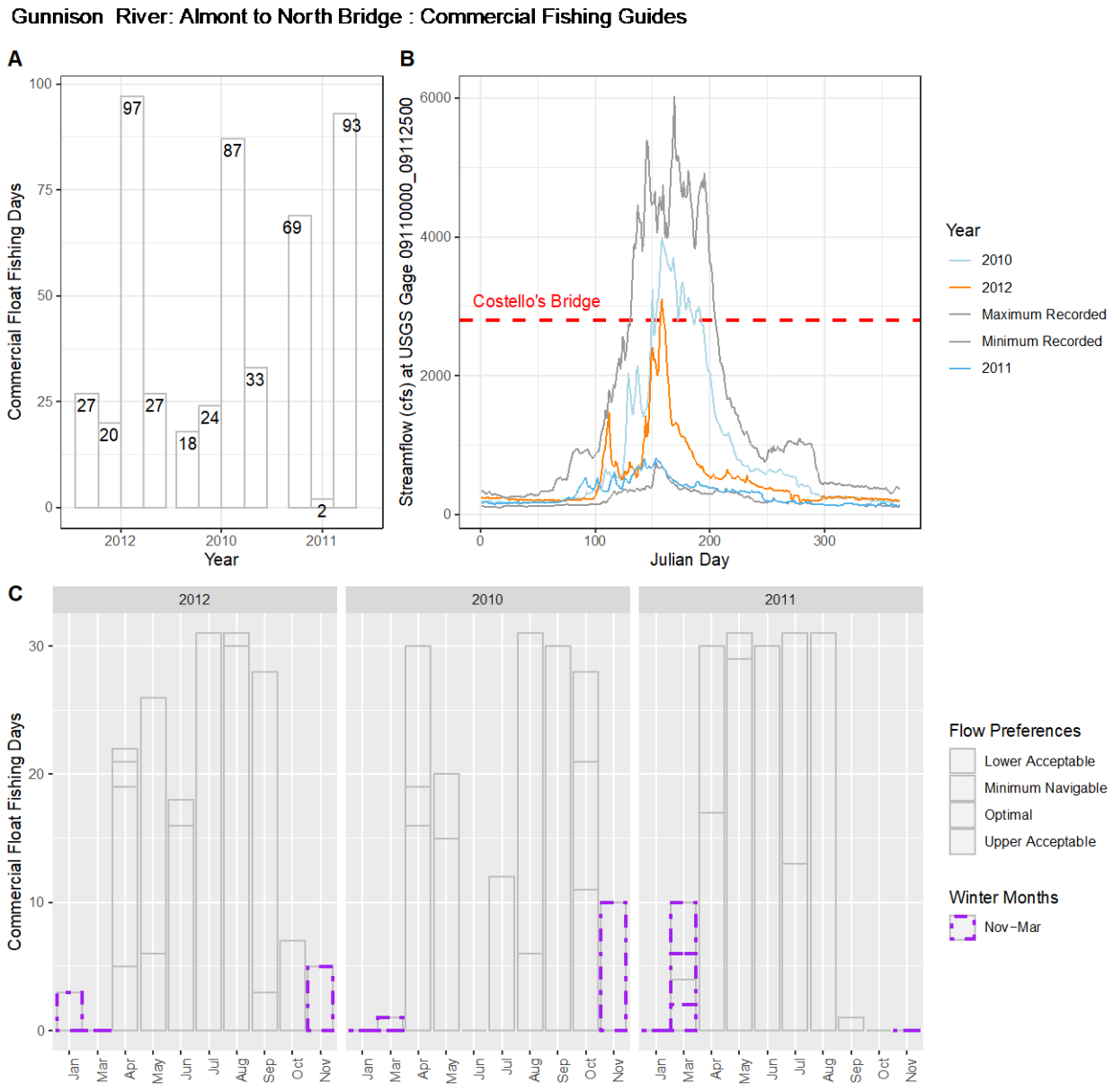


Figure 47. Commercial Float Fishing Day totals for the Gunnison River: Almont to North Bridge. (A) Annual Commercial Float Fishing Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Commercial Float Fishing Day totals summarized by hydrological year type.

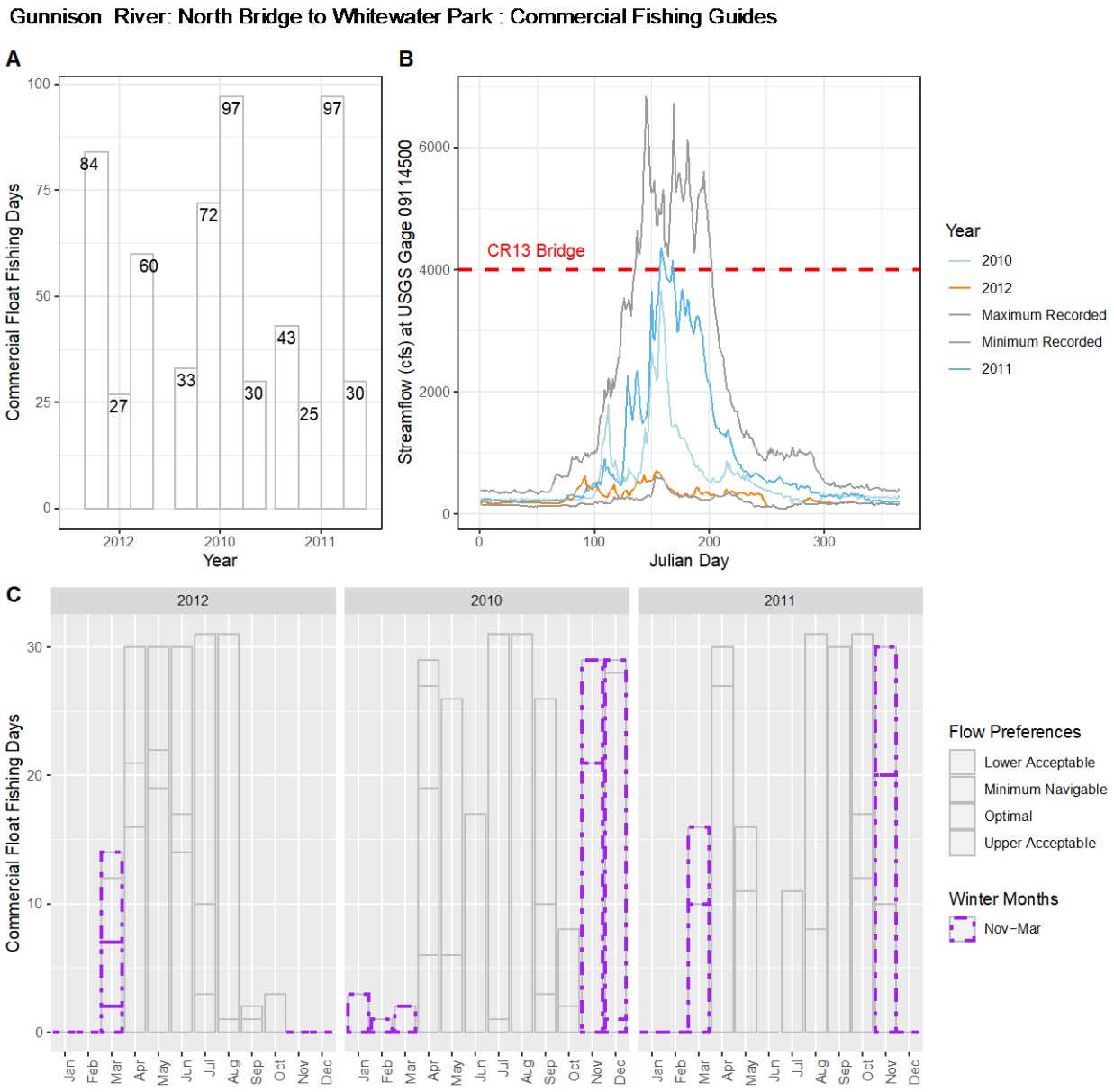


Figure 48. Commercial Float Fishing Day totals for the Gunnison River: North Bridge to Whitewater Park. (A) Annual Commercial Float Fishing Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Commercial Float Fishing Day totals summarized by hydrological year type.

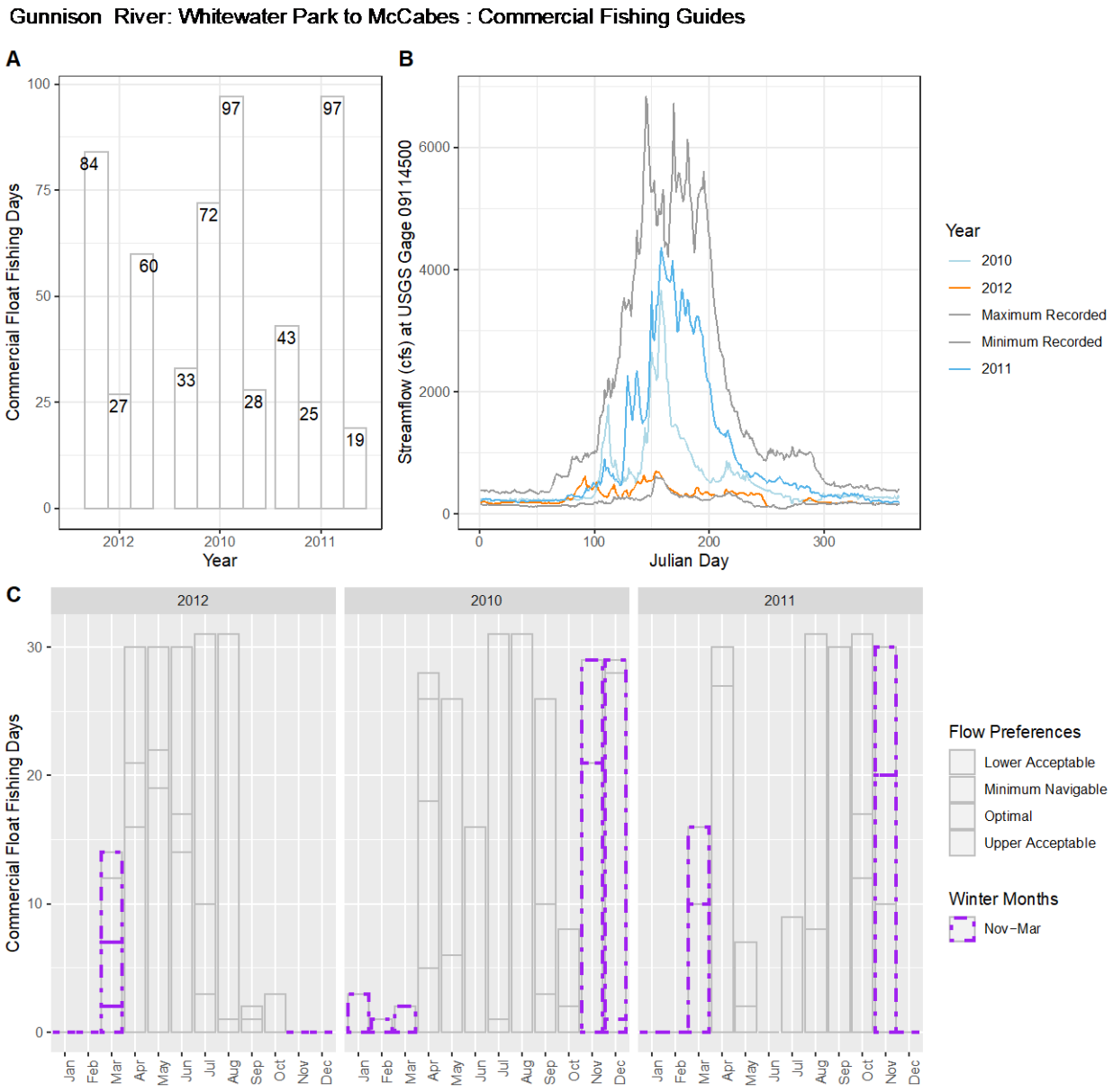


Figure 49. Commercial Float Fishing Day totals for the Gunnison River: Whitewater Park to McCabes. (A) Annual Commercial Float Fishing Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Commercial Float Fishing Day totals summarized by hydrological year type.

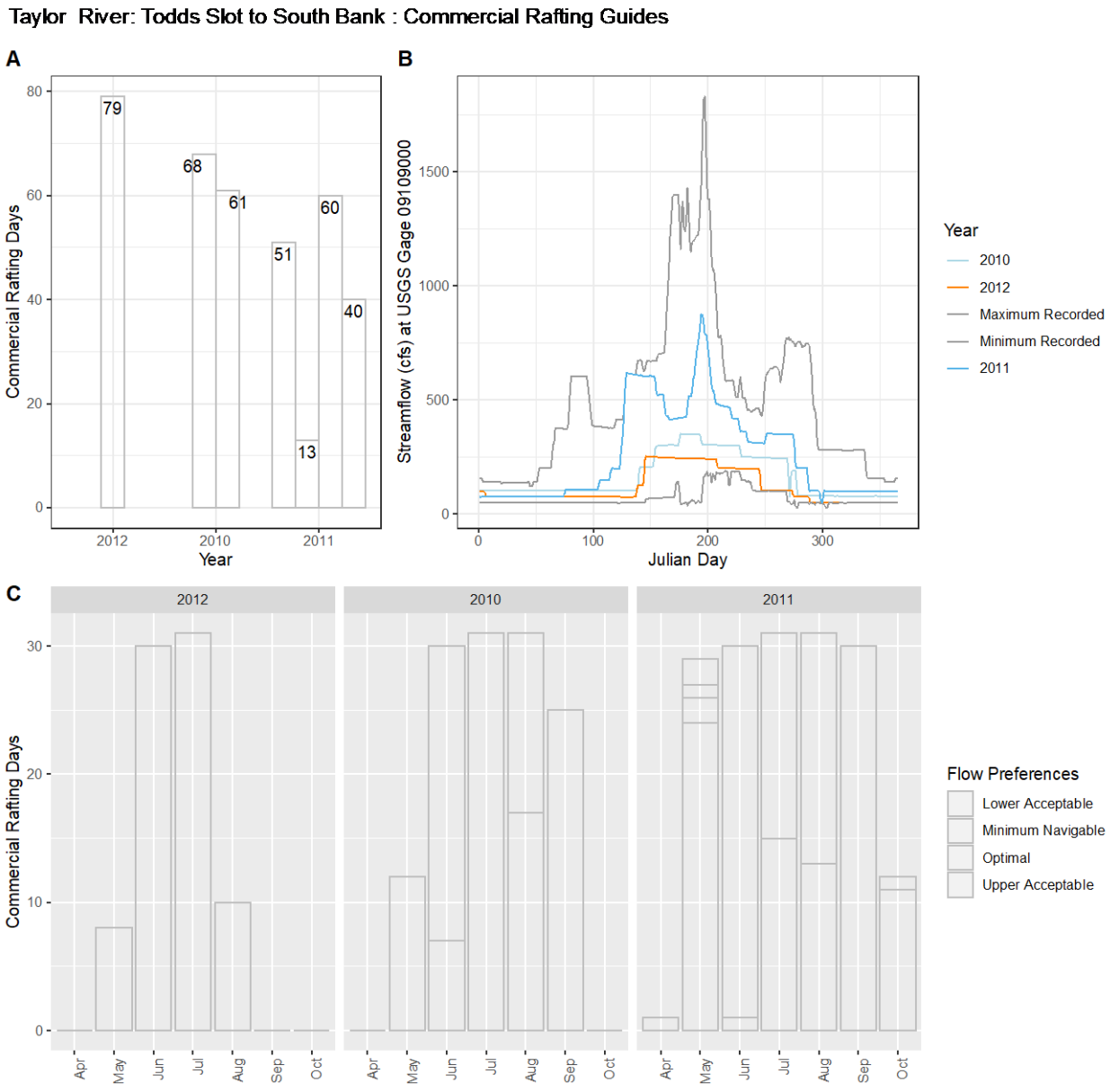


Figure 50. Commercial Rafting Day totals for the Taylor River: Todd's Slot to South Bank. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

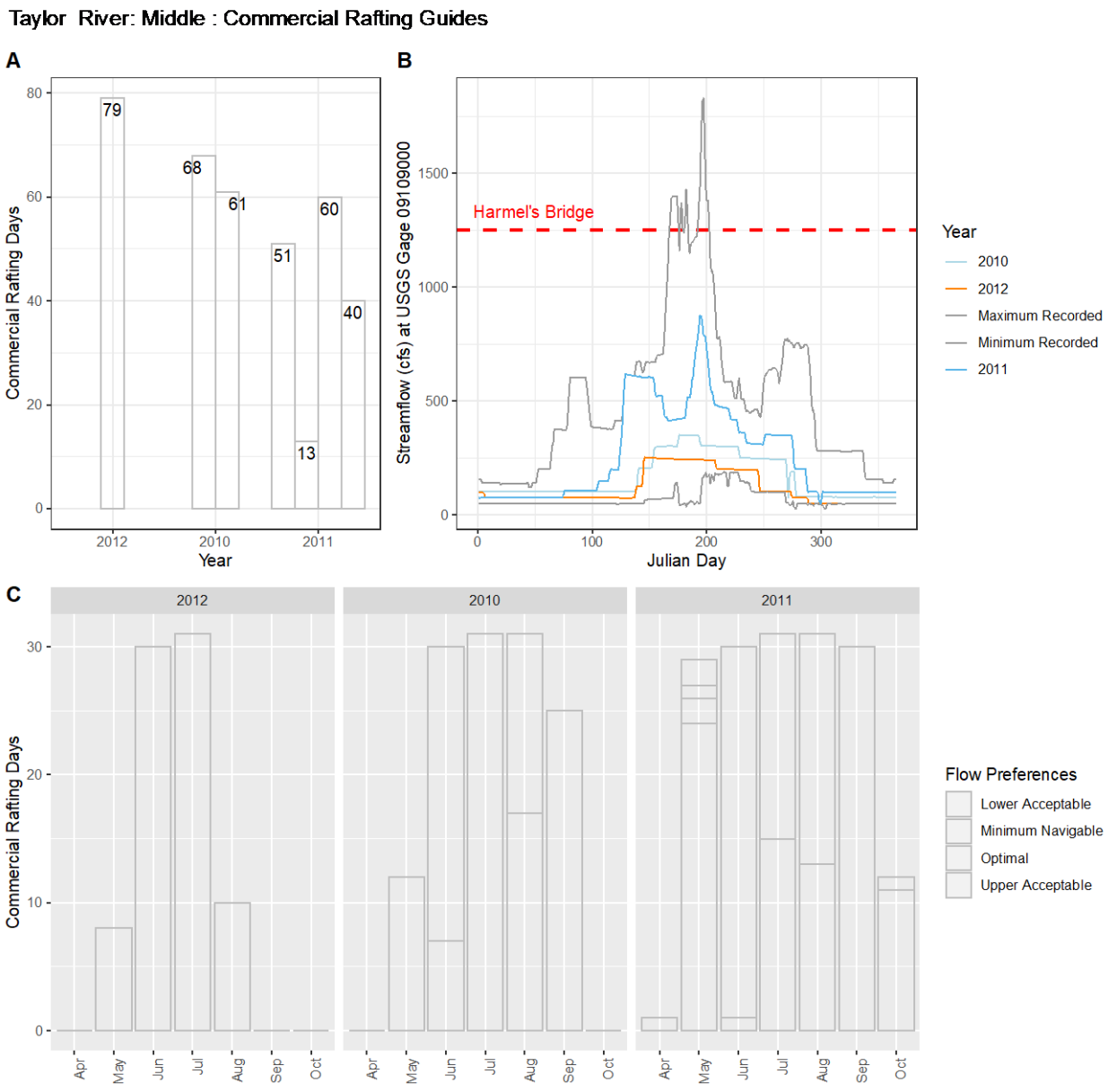


Figure 51. Commercial Rafting Day totals for the Taylor River: South Bank to Five Mile. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

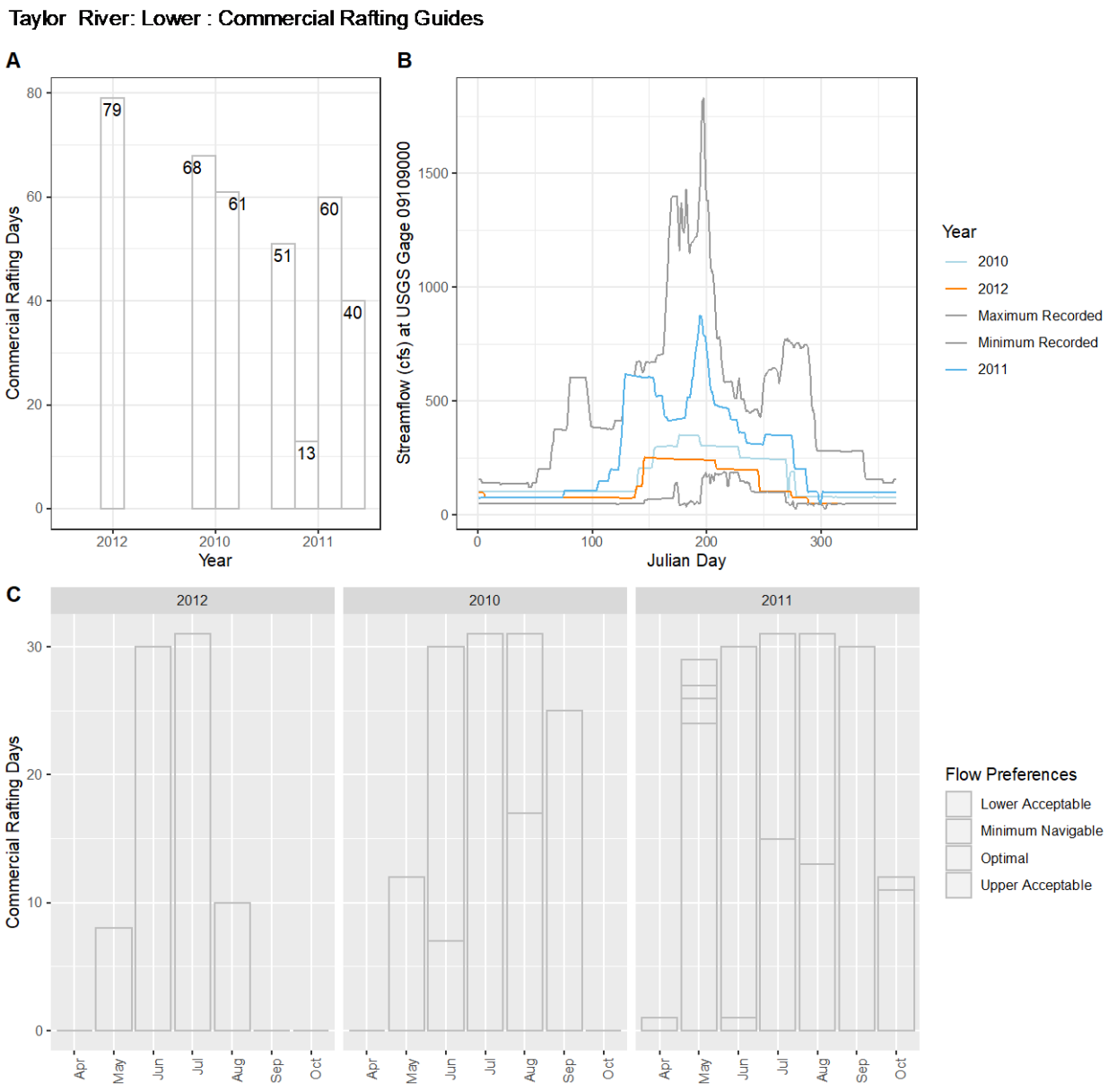


Figure 52. Commercial Rafting Day totals for the Taylor River: Five Mile to Almont. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

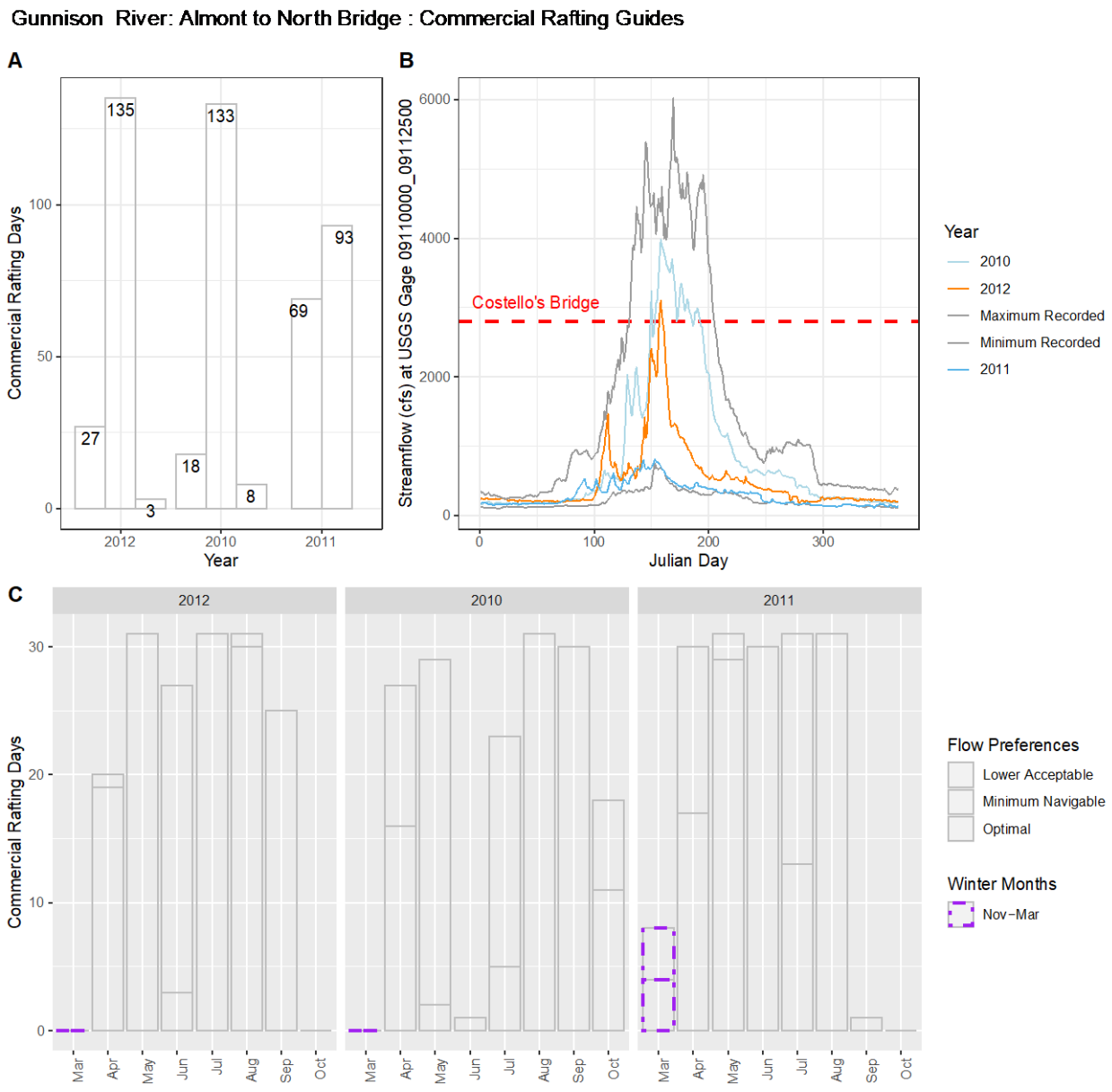


Figure 53. Commercial Rafting Day totals for the Gunnison River: Almont to North Bridge. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

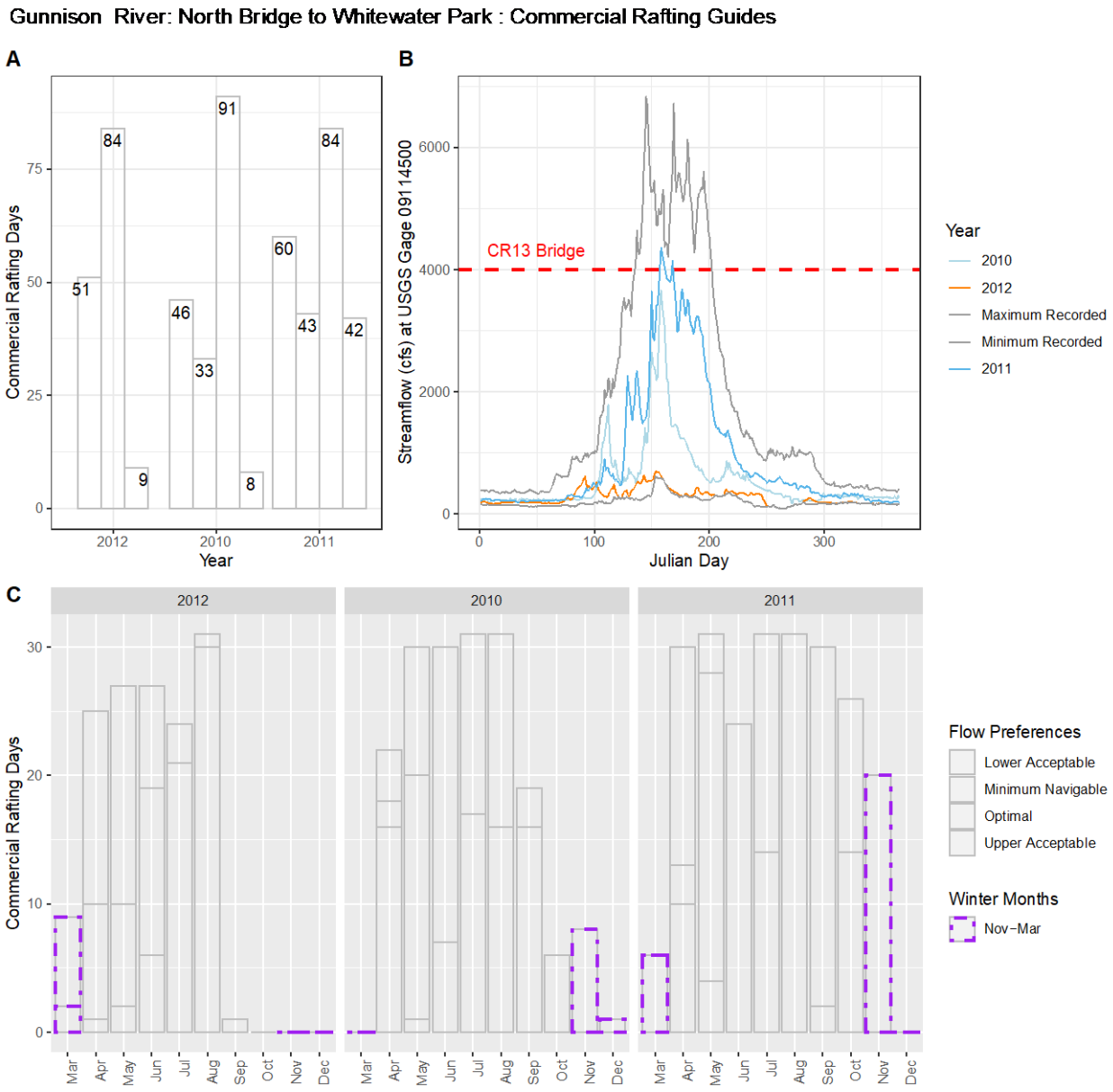


Figure 54. Commercial Rafting Day totals for the Gunnison River: North Bridge to Whitewater Park. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

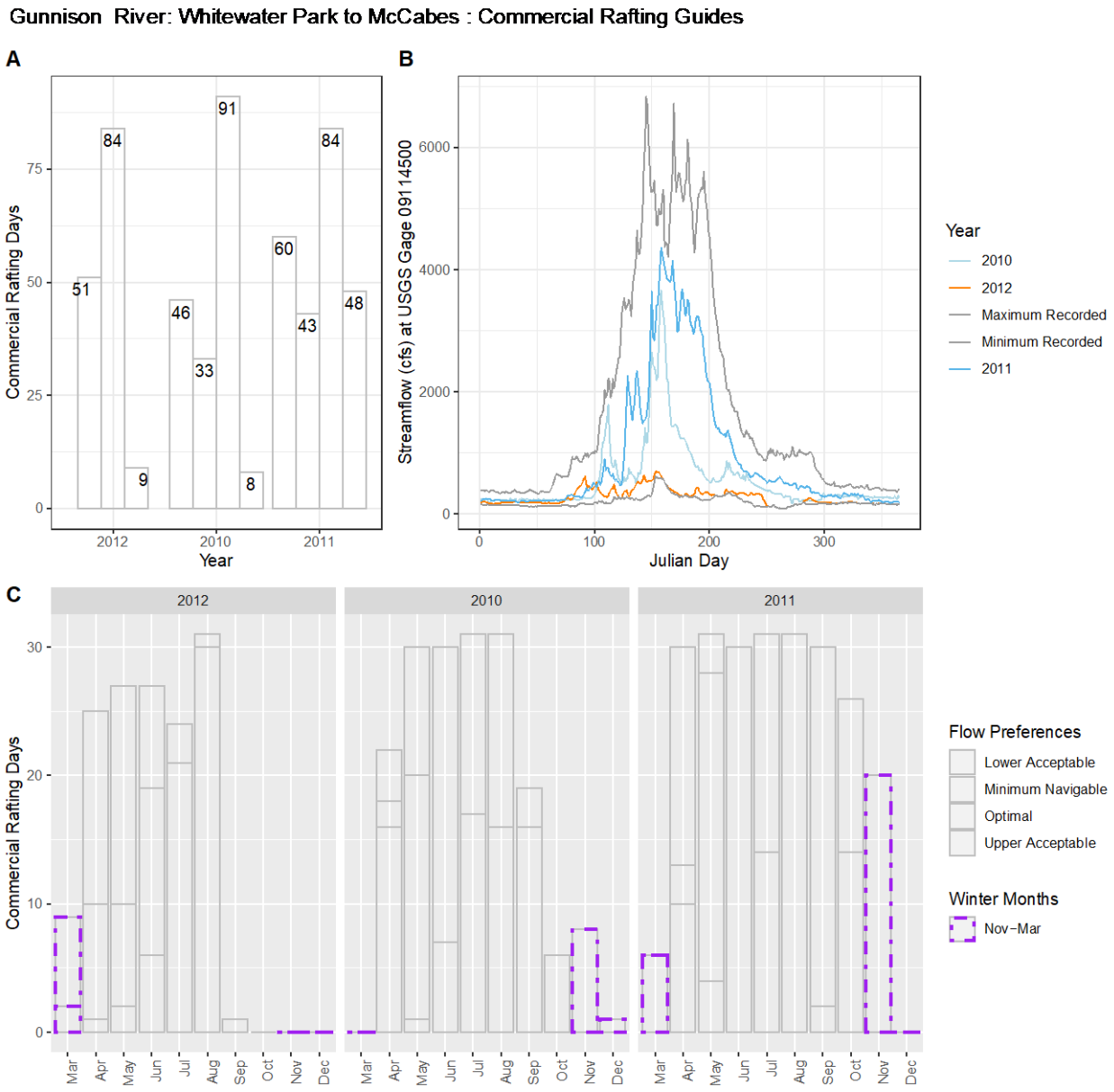


Figure 55. Commercial Rafting Day totals for the Gunnison River: Whitewater Park to McCabes. (A) Annual Commercial Rafting Day totals summarized by hydrological year type. (B) Flow preference ranges mapped to representative streamflow time series for 2012 (dry), 2010 (average), and 2011 (wet). (C) Monthly Commercial Rafting Day totals summarized by hydrological year type.

APPENDIX G: Additional Flow Preferences Not Included in Hydrological Analysis

Western Colorado University's Wilderness Pursuits Program organizes a variety of student river trips and has a gear rental program where students can rent rafts, inflatable kayaks (IKs), and other necessary equipment for self-organized river trips. Wilderness Pursuits' rental program defines minimum and maximum flow thresholds for river rentals and uses these flow thresholds as a guideline for their program trips (See Table 11). These flow thresholds are intentionally conservative on the low and high end to minimize damage to rental equipment and to cater to beginner users. Flows outside of these ranges are often still used for Wilderness Pursuits trips when needed.

Table 11. Flow Guidelines for Western Colorado University's Wilderness Pursuits Programs and Rental Program.

River	Reach Description	Stream Gage	Craft	Minimum (cfs)	Maximum (cfs)
Taylor	Todd's Slot to South Bank	Taylor River Below Taylor Park Reservoir (USGS Gage 09109000)	Rafts & Cats	300	800
			IKs	300	500
	South Bank to Five Mile	Taylor River Below Taylor Park Reservoir (USGS Gage 09109000)	Rafts & Cats	300	800
			IKs	300	500
	Five Mile to Almont	Taylor River Below Taylor Park Reservoir (USGS Gage 09109000)	Rafts & Cats	300	800
			IKs	300	500
Gunnison	Almont to North Bridge	Combined flows at Taylor River at Almont (USGS 0911000) and East River at Almont (USGS 09112500))	Rafts & Cats	400	2800
			IKs	400	1800
			Mini-me & Storm	400	1800
Gunnison	North Bridge to WW Park	Gunnison River near Gunnison, CO (USGS 09114500)	Rafts & Cats	400	3000
			IKs	400	1800
			Mini-me & Storm	400	1800
Gunnison	WW Park to McCabes	Gunnison river near Gunnison, CO (USGS 09114500)	Rafts & Cats	400	3000
			IKs	400	2500

Float fishing companies that operate in the Upper Gunnison River Basin do not have permits to operate on the Taylor River. However, the companies and their fishing guides have a robust understanding of flows that support non-commercial float fishing opportunities on the Lower Taylor. In addition, float fishing companies will operate between McCabes and Wilsons at higher water when conditions are less ideal upstream. These float fishing segments were not included in the hydrological analysis, but are included in Table 12 below for reference.

Table 12. Float Fishing Flow Preferences on the Lower Taylor and Lower Gunnison River segments that were not included in the hydrological analysis. Flows are based on the USGS Gage near Gunnison (USGS 09114500).

River	Reach Description	Stream Gage	Minimum Navigable (cfs)	Minimum Acceptable (cfs)	Minimum Optimal (cfs)	Maximum Optimal (cfs)	Maximum Acceptable (cfs)
Taylor	Five Mile to Almont	Taylor River at Almont (USGS 0911000)	300	350	400	700	800
Gunnison	McCabes to Wilsons	Gunnison River near Gunnison, CO (USGS 09114500)	200	250	300	2500	3000

APPENDIX H: Monthly Statistics

Monthly statistics can be explored further and calculated using the web tool that was built in partnership between Lotic Hydrological and American Whitewater. Using the web tool, monthly statistics for Boatable Days, Commercial Rafting Days, and Commercial Float Fishing Days can be compared between different year-types for each river segment included in this study. Additionally, monthly statistics can be calculated for a user-defined hydrograph and the output can be compared to one of the pre-defined year-types. Table 13 provides tabular monthly Boatable Days results (for aggregate users) for the Almont to McCabes section of the Gunnison River. Additional monthly statistics can be calculated for each user group and river segment using the web tool.

Table 13. Boatable Days analysis results broken out by month for the Gunnison River: Almont to McCabes. Where an Acceptability Category (e.g. 'Upper Acceptable') is missing for a given month, zero days were observed to fall within that category and the row was left out of the table for brevity. Additional monthly statistics can be calculated using the Web Tool.

Month	Acceptability Category	Dry Year	Dry-Typical Year	Wet-Typical Year	Wet year
Mar	Minimum Navigable	0	0	14	21
	Lower Acceptable	0	0	0	5
Apr	Minimum Navigable	30	9	13	0
	Lower Acceptable	0	19	16	17

Month	Acceptability Category	Dry Year	Dry-Typical Year	Wet-Typical Year	Wet year
	Optimal	0	0	1	13
	Minimum Navigable	5	0	0	0
	Lower Acceptable	17	4	0	0
	Optimal	9	23	17	4
May	Upper Acceptable	0	4	14	27
	Lower Acceptable	11	0	0	0
	Optimal	19	19	0	0
Jun	Upper Acceptable	0	11	30	30
	Lower Acceptable	31	23	4	0
	Optimal	0	8	25	16
Jul	Upper Acceptable	0	0	2	15
	Lower Acceptable	2	29	31	21
	Minimum Navigable	29	2	0	0
Aug	Optimal	0	0	0	10
	Lower Acceptable	0	0	25	30
Sep	Minimum Navigable	22	30	5	0
	Lower Acceptable	0	0	0	17
Oct	Minimum Navigable	0	22	31	14
Nov	Minimum Navigable	0	0	19	30
Dec	Minimum Navigable	0	0	0	6

APPENDIX I: Boatable Days Web-Tool Instructions

Upper Gunnison Basin Boatable Days Web Tool Step-by-Step Instruction Guide

This Boatable Days Web Tool is an open-access resource owned by the Upper Gunnison River Water Conservancy District (Upper Gunnison District) developed in partnership with American Whitewater, Lotic Hydrologic, and the Upper Gunnison District Watershed Management Planning Team. This tool is available to water managers, river outfitters, recreational enthusiasts, and other interested stakeholders to assess how historical, current, and future flow conditions impact river recreation opportunities on the Taylor and Upper Gunnison Rivers. This project was made possible through the generous support of the Colorado Water Conservation

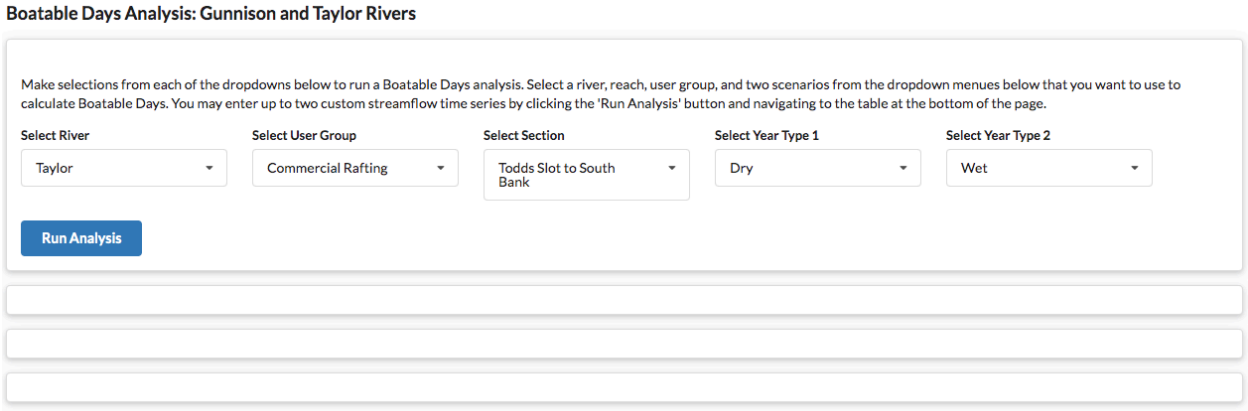
Board's Colorado Watershed Restoration Program and Stream Management Planning Grant, the Upper Gunnison District, and American Whitewater.

Note that nothing in this Web Tool guarantees the safety or navigability of any particular river segment. Rivers are inherently dangerous and unexpected changes to the natural and manmade environment can occur at any time.

Section 1: Instructions for Analyzing Boatable Days Using Pre-Defined Year Types

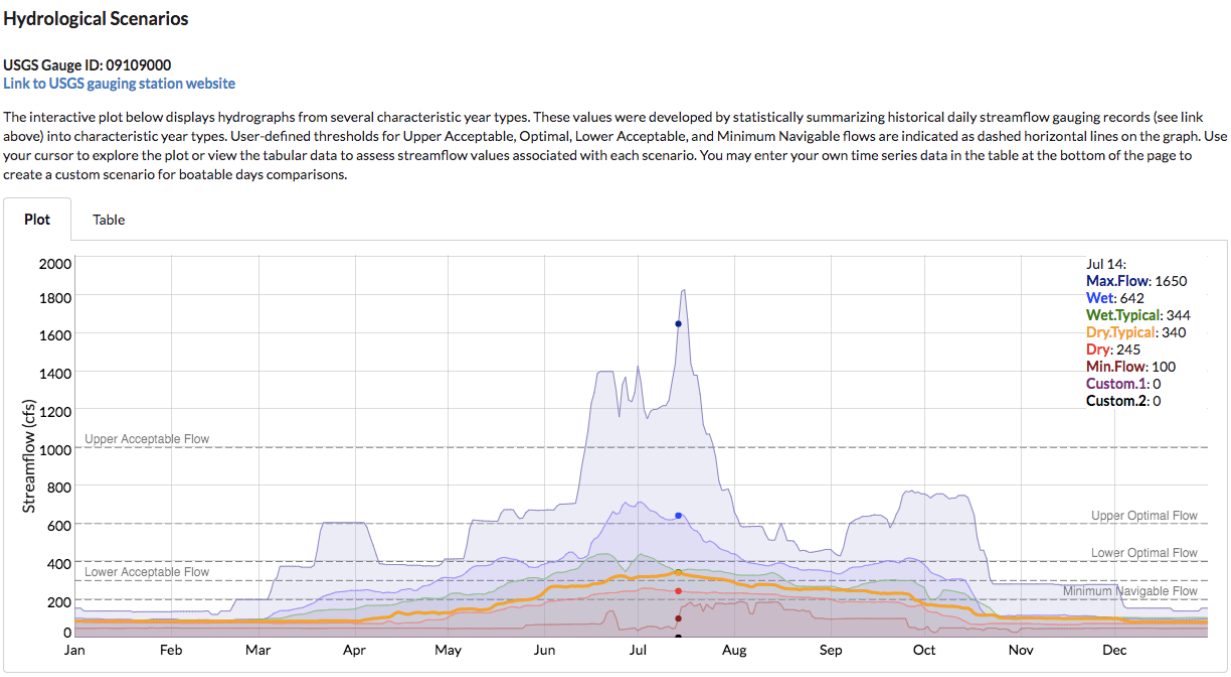
1. Launch the Boatable Days Web Tool directly from the **Upper Gunnison River Water Conservancy District's webpage.**

2. The Web Tool's home page displays the parameters that need to be identified to analyze Boatable Days. Select the river, user group, and river segment of interest. Next, select the two year-types (Year Type 1 and Year Type 2) or hydrologic scenarios to assess, such as dry year versus wet year. If you select the pre-defined year type you do not need to input any custom streamflow time series data. See page 4 for instructions on evaluating a custom flow time series. When all the parameters are selected, click the "Run Analysis" button as demonstrated below.

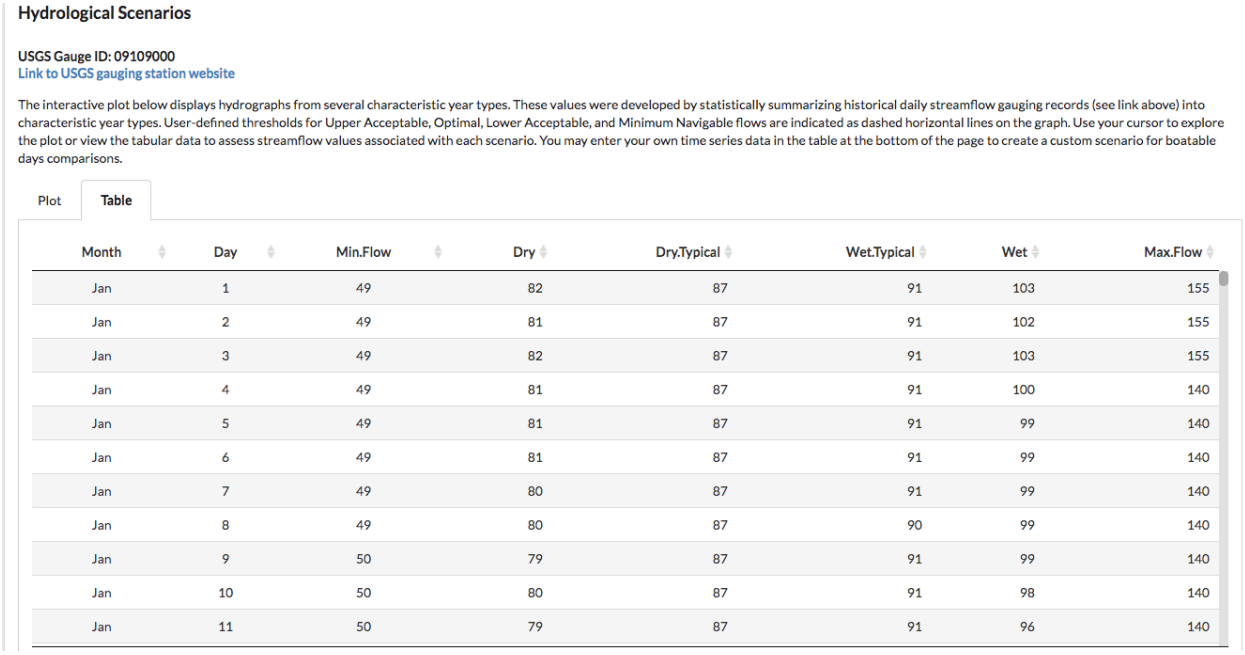


The first set of results will be the hydrologic output displayed in two separate tabs as a graphical "Plot" and "Table".

3. Review the hydrographical outputs in the "Plot" tab. The output will include a flow time series for each year-type in addition to the minimum and maximum flows recorded each day over the 43-year period of record (1975-2018). Flow preference thresholds for the chosen river recreation user group, river segment, and the range from Minimum Navigable to Upper Acceptable flows will be displayed. Using your cursor, hover above the streamflow line on the graph in order to see average daily flow values for each time series as shown in the screenshot. As you scroll across the hydrographs, flow values will display in the top right corner of the chart.

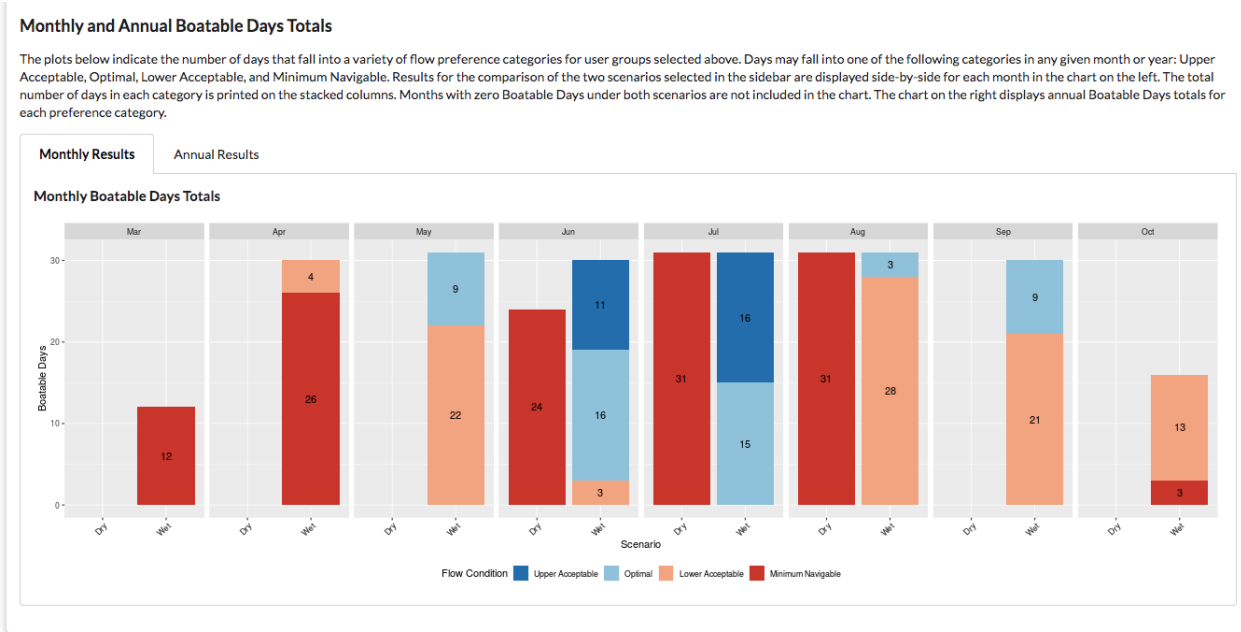


4. Review the tabular outputs for each pre-defined time series by clicking on the second “Table” tab. Daily average flows are shown for each year-type along with minimum and maximum flows.

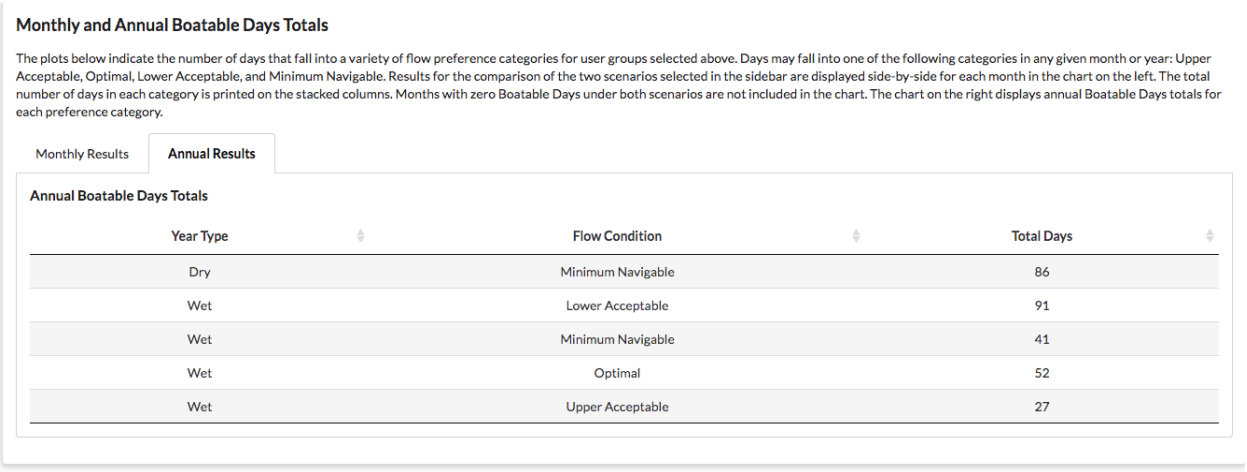


Month	Day	Min.Flow	Dry	Dry.Typical	Wet.Typical	Wet	Max.Flow
Jan	1	49	82	87	91	103	155
Jan	2	49	81	87	91	102	155
Jan	3	49	82	87	91	103	155
Jan	4	49	81	87	91	100	140
Jan	5	49	81	87	91	99	140
Jan	6	49	81	87	91	99	140
Jan	7	49	80	87	91	99	140
Jan	8	49	80	87	90	99	140
Jan	9	50	79	87	91	99	140
Jan	10	50	80	87	91	98	140
Jan	11	50	79	87	91	96	140

5. Scroll down and click on the “Monthly Results” tab to view the monthly Boatable Days results for your selected river segment, user group, and flow scenario. Flow preferences are noted in the legend below the plots (e.g., navigable, acceptable, optimal).



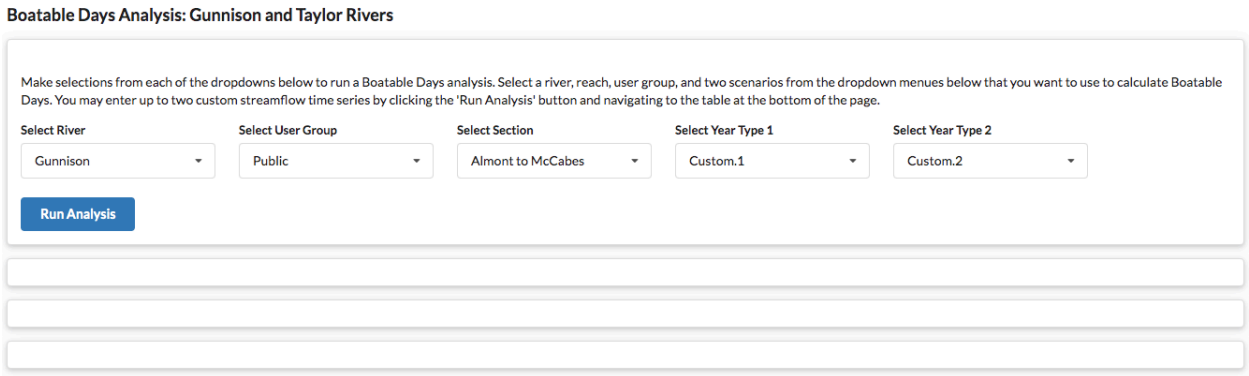
6. Click on the “Annual Results” tab to view annual Boatable Days totals for the two selected scenarios. Use the monthly Boatable Days results in conjunction with the annual totals to get the most accurate information.



Section 2: Instructions for Analyzing Boatable Days Using a Custom Flow Time Series

1. Analyzing one or two custom time series: Using the custom time series feature, the Web Tool analyzes the Boatable Days results for a specific year or for future projected flows. A custom time series can be compared to a pre-defined year-type or to a second custom time series. As

shown below, use the **"Select Year Type"** dropdown menus to select one or two custom inputs. Then, click the "Run Analysis" button. *Note: If you need help generating a custom time series, please email Beverly Richards at* ***beverly@ugrwcd.org****.*



2. After clicking the "Run Analysis" button, scroll down to the "User Defined Time Series" table. The custom time series can be copied and pasted directly into the appropriate column. If only one custom time series is input, ensure that the column matches the selected scenario (Custom.1 vs. Custom.2). Important: You must click "Run Analysis" again for the results to appear.

User Defined Time Series

You may enter your own streamflow time series data in one or more of the 'Custom' columns below. These time series can then be used as a basis for comparison to other year types or to each other for the purposes of Boatable Days caluculations. Values can be entered into the table clicking and editing one cell at a time. Alternatively, multiple values can be copied from a spreadsheet (Ctrl + C) and pasted into a column by clicking a starting cell and then using a keystroke shortcut (Ctrl + V) to enter values into the selected cell and the cells below it.

Reset Table

	Month	Day	Custom.1	Custom.2
1	Jan	1	500.0	1000.0
2	Jan	2	500.0	1000.0
3	Jan	3	500.0	1000.0
4	Jan	4	500.0	1000.0
5	Jan	5	500.0	1000.0
6	Jan	6	500.0	1000.0
7	Jan	7	500.0	1000.0
8	Jan	8	500.0	1000.0
9	Jan	9	500.0	1000.0
10	Jan	10	500.0	1000.0
11	Jan	11	500.0	1000.0
12	Jan	12	500.0	1000.0
13	Jan	13	500.0	1000.0
14	Jan	14	500.0	1000.0
15	Jan	15	500.0	1000.0
16	Jan	16	500.0	1000.0
17	Jan	17	500.0	1000.0
18	Jan	18	500.0	1000.0
19	Jan	19	500.0	1000.0