

NASON CREEK RECREATION AND LARGE WOOD ASSESSMENT

For the Yakama Nation Upper Columbia Habitat Restoration Program

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Submitted to:
Yakama Nation Fisheries

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Notice

On-river assessments conducted for this project are designed to characterize recreation use and existing large wood or other river features. This study does not endorse specific boating/tubing, scouting, or portaging options for future river users. The assessments will not specifically endorse particular craft or skill levels for specific reaches or flows, nor are they intended to identify specific locations of potential natural or human-built obstacles or hazards for recreation or navigation purposes. All river users need to make their own decisions about whether or how to scout, run, and/or portage these reaches during any on-river boating or tubing activities. These decisions should be based on several sources of information, knowledge of their own skill and equipment, and direct observation of a river's conditions.

Rivers are inherently hazardous settings and may be physically, mentally, and emotionally stressful, or may aggravate existing physical, mental or emotional conditions. Boating or tubing on rivers may result in damage to or destruction of personal property; serious physical injury or even death arising from a variety of hazards including, but not limited to, (and by way of example only) rocks, hazardous terrain, trees, debris, powerful waves, waterfalls, hydraulics, and various man-made or natural hazards; and difficulty or improbability of rescue.

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Report Exhibits (Maps):

- Exhibit 1: Nason Creek Study Reach
- Exhibit 2: High Flow Large Wood Assessment Results
- Exhibit 3: Medium Flow Large Wood Assessment Results

I. Introduction

In support of the Upper Columbia Habitat Restoration Project, Yakama Nation Fisheries hired MIG, Inc. to conduct a detailed study of boating recreation and existing large wood along a series of rivers in north central Washington. This report presents the findings of the Nason Creek recreation assessment (see Exhibit I: Nason Creek Study Reach). The goal of this study is to support the work of the Yakama Nation and partners as they continue to seek ways to balance the ecological benefits of habitat restoration projects for salmonid species with the safety and recreation experience of river users.

This study employed a mix of qualitative and quantitative methods to achieve the following objectives:

- Characterize existing boating recreation use levels;
- Describe the “typical” skill level, preferences and behavior of Nason Creek boaters;
- Establish a baseline characterization of existing large woody material (LW) with respect to river navigability during the high-use season;
- Provide an overview of County search and rescue response capability; and
- Present boater perspectives on potential river hazards and related river management approaches.

Subsequent sections of this report are as follows:

- Overview of study methods and participants;
- Characterization of Nason Creek recreation use;
- Evaluation of existing large wood;
- River safety perspectives and swiftwater rescue response capacity; and
- Key findings.

II. Study Methods and Participants

A Dynamic, Mixed-Methods Approach

Formal data collection for Nason Creek began in February 2013 and was completed in July 2013. The study team gathered information via three primary activities:

- A series of informal discussions and in-depth interviews;
- An online questionnaire targeting boaters; and
- On-water assessment and characterization of existing large wood with respect to river navigability.

A brief discussion of each activity is provided below.

Boater and Expert Interviews

MIG, Inc. conducted seven in-depth telephone interviews with river users and others with first-hand knowledge of and experience boating Nason Creek. Interview questions were designed to obtain information related to the following:

- Recreation use levels;
- River access locations (i.e., put-ins and take-outs);
- Boater level of skill and common craft;
- Current and potential safety hazards in the study reach; and
- General impressions of habitat restoration actions and large wood placement from the boaters' perspective.

Nason Creek interviews targeted local boaters, primarily. Interviewees included recreational paddlers and professional guides, including one nearby resident with immediate knowledge of creek use and aquatic habitat restoration activities in the area. Nearly all interviewees identified themselves as expert Class V boaters, with one person a self-identified Class III/IV boater.

The information collected during interviews was used to help craft the study timeline, approach and questionnaire instrument, and directly informs findings presented in this report.

Boater Questionnaire

In winter and spring 2013, MIG administered an online questionnaire targeting Nason Creek boaters who had paddled or floated Nason Creek within the most recent two-year period. The questionnaire was designed to collect information related to the participants' most

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recent river trip. The questionnaire was online for approximately 2.5 months (Feb. 5 – May 20) leading into and corresponding with the high-use season for the study reach.

The goal of the questionnaire was to learn about the following:

- Boater characteristics, including level of skill and experience;
- Observable or identifiable behaviors that may play a role in determining relative on-water risk, such as type of watercraft, trip planning and preparedness;
- User experience with and perceptions of river hazards; and
- Management preferences related to safety-related information and on-river conditions.

The project team and partners conducted the following outreach to maximize participation in the online questionnaire.

- Yakama Nation Fisheries staff sent the survey link to a list of over 20 contacts, composed primarily of individuals known to have direct experience boating Nason Creek.
- Chelan County Natural Resources Department and American Whitewater shared the survey link via targeted email blasts to local stakeholders and recreation users region-wide.
- Partners announced and shared the survey link via the American Whitewater, Chelan County Natural Resources Department and Wenatchee Outdoors websites.

A total of 13 people with experience recreating on Nason Creek completed the questionnaire. Participants were self-selecting, and do not represent a statistically valid sample. All questions were optional, and so not every participant provided an answer to every question. This resulted in seven questionnaires completed in their entirety.

Seven questionnaire participants identified their place of residence, broken down as follows:

- King County (3)
- Klickitat County (1)
- Kitsap County (1)
- Chelan County (1)
- Marion County, Oregon (1)

Questionnaire findings are presented in Sections III and IV of this report: Characterization of Recreation Use and River Safety.

On-Water Assessment of Existing Large Wood

In spring 2013, MIG field staff completed two on-water evaluations to collect observational data for existing large woody material (LW) in Nason Creek. Assessments took place at high and medium flow levels, chosen based on defined target ranges for boatability. Target flow ranges were established based on review of American Whitewater and Bennett Guide recommended flows, and boatable flows reported by boaters via telephone interviews and the online questionnaire.

Each on-water evaluation occurred over the course of a single day, with each trip beginning at White Pine Road near river mile (RM) 14, and ending at the bridge below Nason Creek Campground (~RM 0.5). The on-water evaluation component of this study targeted a slightly shorter segment than that formally included the overall study (RM 0-19). At the time of this study, the Yakama Nation and partners were not studying Nason Creek above RM 14 for habitat restoration needs and opportunities. In addition, on-water panelist safety required eliminating this more challenging segment, and particularly the two-part Class V rapid referred to by boaters as “Trivial Pursuit” and “Royal Flush”.

All river trips were completed without incident, with the exception of minor damage to one of the watercraft used during the high flow assessment. Table 1 provides an overview of the two large-wood evaluations.

Table 1. Overview of Large Wood Evaluations

Event	Date	Flow (cfs)	Target Range (cfs)	Number of Boaters	Craft Used
Nason Creek High Flow	05/18/13	1,300	1,000-1,300	4	Two 14-ft rafts
Nason Creek Medium Flow	05/30/13	910	600-1,000	2	Hardshell kayak, inflatable kayak

Well established protocols exist for using boater panels to conduct on-water evaluations of boatability (Whittaker et al., 1993), and numerous studies reflect those protocols. For this project, however, the on-water evaluation focused specifically on one attribute with potential to affect boatability: the presence of large wood in the water.

Exhibits 2 and 3 (High and Medium Flow Large Wood Assessment Results) depict the locations and character of LW data collected during the assessment. Findings are discussed in Section IV: Evaluation of Existing Large Wood.

LW Assessment Boater Panel

Boater panels were comprised of skilled recreational whitewater boaters and river guides with professional experience in field data collection. Each panel recorded the location and defining characteristics of each qualifying occurrence of LW, assigning a GPS coordinate to

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each. The panel then classified LW based on relative potential risk to tubers and boaters using a pre-defined scoring system and set of criteria (described on the following page).

Panelists identified and evaluated LW pieces and clusters as a group, with the intent of characterizing each identified piece or cluster based on consensus opinion.

Table 2 provides a summary of on-water panelist skill and training, and identifies participant involvement in the two evaluations.

Table 2. Summary of Boater Panel

Name	Skill Level	Whitewater Rescue Trained	Flow Level Evaluated
Panelist 1	Class IV+	Yes	High
Panelist 2	Class IV	Yes	High
Panelist 3	Class V	Yes	High, medium
Panelist 4	Class IV	No	High, medium

LW Characterization and LW “Types”

The criteria and approach used to characterize LW was originally developed for a similar evaluation conducted for the Upper Wenatchee River in 2012. The specific criteria used to classify LW in Nason Creek reflect only minor modifications to the Wenatchee protocol (i.e., slightly less detail recorded) with the goal of simplifying on-water note-taking. The greater degree of boater attentiveness and active navigation required to run this reach safely, compared with the Upper Wenatchee, was the primary rationale for the changes made.

In this study, large woody material was classified using a scale of “A” thru “F”. This evaluation focused on recording observations for LW classified as “Type C” or greater. In general, routine navigation allows a floater to avoid physical contact with LW pieces or clusters classified as a Type C, but contact could occur if a floater is inattentive or unskilled, resulting in potentially serious consequences. At the highest end of the rating system, LW classified as a Type F is LW that spans the entire channel and/or requires boater portage.

Table 3 summarizes the LW categories with general definitions and instructions for classifying LW.

The criteria evaluated to help classify LW on Nason Creek included:

1. Location of LW in the channel;
2. LW projection into the channel (as a rough percentage of the boatable channel);
3. LW angle relative to current;
4. Roughness, or amount of “stickiness” (a result of rootballs, branches, etc.);
5. Complexity, defined simply as number of logs;

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6. Sight distance, or line of sight from a boater's perspective approaching LW from upstream; and
7. Current power at each LW occurrence.¹

The on-water panels took a conservative approach to classifying LW. Classifications are based on perceived risk inherent to boaters with only average skills in boating and on-water navigation. Where appropriate, the panel asked themselves the question, “Would a tuber hit this?”

At times, the panel perceived slight discrepancies between: a) the resulting classification of LW based on the strict application of the scoring method; and b) the general definition of a given LW type with respect to the level of consequence for a boater. In these cases, the panel ultimately classified LW based on its definition, relying on their own knowledge, experience and professionally conservative approach to evaluating risk in applying the scoring method.

Table 3. Large Wood Types (continued on next page)

LW Type and Definition	Description/Panelist Direction
Type A <i>(do not count)</i>	<ul style="list-style-type: none"> • Located below ordinary high water but dry or projecting into less than five percent of boatable current at this flow.
Type B <i>(do not count)</i> In general, it would take active navigation toward LW to make contact with a Type B.	<ul style="list-style-type: none"> • If contact occurs, consequences are generally low. • Located in water at this flow but generally has a small projection into boatable channel. • Located in side channels or on the inside of a bend, or is aligned parallel to current (so there is little current pressure against the obstacle). • Typically in a reach with lower current power and velocity. • Generally fewer logs in the cluster, little “roughness” or “complexity,” and easy to see from a distance upstream.
Type C In general, “routine navigation” allows a floater to avoid contacting a Type C, but this could occur if a floater is inattentive or unskilled.	<ul style="list-style-type: none"> • If contact occurs, consequences are uncertain and could be serious. • Compared with “B”, one or two characteristics increase the potential for interaction. • At least one characteristic is one level higher than “low” but none is at “high levels.”

¹ While not recorded, current power was routinely considered when evaluating risk and classifying LW.

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LW Type and Definition	Description/Panelist Direction
<p>Type D In general, these require boaters to engage in “active navigation” (at least one substantial positive maneuver) to avoid contact with a Type D (“routine navigation” may not be sufficient to avoid).</p>	<ul style="list-style-type: none"> • If contact occurs, consequences are uncertain and could be serious. • Three or more characteristics increase potential for interaction (at least one level higher than “low,”) or there is at least one characteristic that is at a “high” level. • Center piling bridges and similar man-made features also fall into this category.
<p>Type E A boatable channel may exist, but substantial “active and accurate navigation” is likely needed to avoid contact.</p>	<ul style="list-style-type: none"> • If contact occurs, consequences are uncertain and likely to be serious. • Multiple characteristics at “high” levels that substantially increase potential for contact.
<p>Type F Portage required.</p>	<ul style="list-style-type: none"> • Channel spanning LW or characteristics that prevent navigation.

III. Characterization of Recreation Use

Overview of Boating on Nason Creek

Boaters generally describe Nason Creek's two distinct whitewater segments. The reach from Berne to Merritt is known among boaters as Upper Nason Creek (Class IV-V), and is characterized by a series of Class IV-V rapids and a narrow canyon (i.e., the "Canyon section") and steep ravine with boulders, holes, pour-overs and ledges. The lower creek -- starting near or below Merritt -- is generally characterized as a Class II+-III river. Here, gradient decreases and, moving downstream, the creek gradually becomes more braided and the channel more dynamic on account of fewer physical constraints. Large woody debris also begins to accumulate at a greater rate, particularly downstream of Coles Corner (RM 4.6). On-water panelists noted two significant man-made hazards at both high and medium flow: irrigation pipes protruding into the boatable channel (~ RM 10.6) and a fish trap spanning the creek (~ RM 0.6).

Neither the American Whitewater website nor the Bennett Guide² provide boaters with information for the lower creek below Coles Corner, reflecting the reach's generally undesirable whitewater conditions.

Interviewees reported trips as early in the season as April, with most activity occurring in May and June. Interviewees characterized the boatable window as relatively short, lasting only 8-10 weeks a year, at most. The Bennett Guide identifies the periods just before and after snowmelt as the best times for whitewater boaters.

On-water assessment participants rated both the high and medium flow levels (1,300 and 910 cfs) as acceptable for boating in hardshell and inflatable kayaks, smaller rafts, and whitewater canoes. One long, flat section between rapids was identified as acceptable for tubes. On-water panelists rated the amount of large wood as unacceptable at all flows, particularly for larger craft (i.e., raft larger than 13 feet) and in lower reaches.

Despite its relatively low use, more than one study participant considers Nason a unique recreation resource. One interviewee shared the following: "Nason Creek is a valuable recreational resource. It doesn't see much use because there are so many other rivers in Washington. But if the run were to go away it would be a huge loss to the boating community." Another study participant simply said, "This is a great stretch of river. I loved it."

Swimming at local swimming holes (often adjacent to private lands) was reported as a common recreation activity; fishing and hiking along the creek, and hiking into the gravel bars for lunch and lounging, are also reported activities.

² Bennett, Jeff and Tonya. A Guide to the Whitewater Rivers of Washington. Second Edition. Referred to in text as the Bennett Guide.

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Exhibit 1, found at the end of this report, depicts the entire study reach (RM 0-19). Table 4 (next page) summarizes the upper and lower boating reaches as characterized by boaters and in popular river guide resources (i.e., Bennett Guide and American Whitewater and Wenatchee Outdoors websites).

Table 4. Nason Creek Boating Reaches

Creek Reach (river miles)	Usual Difficulty	Length	Ave Gradient (feet per minute)	Boatable Range (cubic feet per second)
Upper Nason: Berne to Merritt (RM 19-11)	IV-V (normal flows)	8 miles	84 fpm	400-800 cfs
Lower Nason: Below Merritt to Coles Corner (~RM 9-4.5)	II-III (normal flows)	4 miles	60 fpm	700-1,500 cfs

Source: Bennett, Jeff and Tonya. A Guide to the Whitewater Rivers of Washington. Second Edition.

River Access and Trips Reported

While Nason Creek runs along Highways 2 and 207, much of the creek sits far below the highway, and creek access is fairly limited. More than one interviewee expressed that the lack of boat put-ins and take-outs lends to the creek’s general feeling of remoteness, and results in few opportunities to turn back once a trip has begun. Anecdotally, the limited number of take-outs causes many users to take a relatively conservative approach when it comes to planning trips and on-water decision-making.

Study participants noted various put-in and take-out locations along Highway 2 and White Pine Road. The most commonly noted put-ins and take-outs within the study reach (RM 1-19), as identified by interviewees and questionnaire respondents, include the following locations:

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- Confluence with White Pine Creek (near and below);
- White Pine Road at Burlington Northern trestle;
- Highway pull-out near Mile Post 79 (~RM 12.5);
- Merritt;
- Highway 2 bridge and the “abandoned” or “washed out” bridge³
- The Butcher Creek area;
- Southeast end of Nason Ridge Road;
- Nason Creek Rest Area (DOT Station on Hwy 2);
- Kahlor Bridge;
- Coles Corner (Hwy 2 at SR 207); and
- Nason Creek Forest Service Campground.

Common river access points located along the on-water assessment reach (RM 0.5-14) are shown on Exhibits 2 and 3.

In addition, questionnaire participants reported the following discrete trips, start to end:

- From below the Cascade Tunnel to White Pine Road;
- From DOT Station (Hwy 2) to White Pine confluence;
- From the Slides to below the Canyon section;
- From Highway 2 above Canyon to below White Pine Creek;
- From Merritt to Coles Corner (3 individuals);
- From Merritt to Nason Creek Forest Service Campground; and
- From Nason Creek Rest Area (Highway 2) to confluence with the Wenatchee River (private land).

River User Profile

This section presents a profile of Nason Creek boaters based primarily on telephone interview and online questionnaire findings.

³ Participants noted potential access constraints due to land ownership surrounding the take-out near the abandoned bridge.

User Skill Level and Experience

Questionnaire results help paint the picture of the “typical” Nason Creek boater as skilled and well trained, with many years of on-water experience:

- Questionnaire respondents reported an average of 20.3 years of kayaking and rafting experience overall; the median level of experience reported was 15 years.
- The clear majority of those who participated in the questionnaire (10 of the 13 participants) are self-identified Class V boaters; two individuals characterized themselves as feeling most comfortable boating a Class III river, and two a Class II. Eleven of the 13 participants identified themselves as trained in swiftwater rescue.
- Respondents most frequently reported prior kayaking experience on Nason Creek, with rafting the second most frequently identified activity. Seven of 13 individuals reported only one prior trip on Nason Creek; three individuals reported more than ten previous trips, and one person reported more than 20 trips.
- With respect to their most recent experience boating the study reach, seven of the 12 questionnaire respondents reported flows below their skill level, and five people reported flows consistent with their level of boating skill. No respondents claimed that flows were above their skill level.
- Swimming and fishing were verified as Nason Creek activities. One respondent reported swimming in Nason Creek, and two reported fishing.

Nature of Trip and Group Characteristics

Study participants provided the following information about their most recent run, suggesting that trips are by and large independent (i.e., non-commercial), small group trips, with kayaks the preferred craft.

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- All reported trips were made by independent boaters in their own craft (i.e., no rentals or commercially guided trips).
- All groups were composed entirely of adults ages 18 and older. More than one interviewee noted that this reach is most appropriate for adults in relatively good physical condition.
- Table 5 summarizes questionnaire responses on craft type. Two-thirds of the questionnaire respondents who reported on craft type used a hardshell kayak on their last run. Two people used an inflatable kayak, and two used rafts. One person used a cataraft. Similarly, most interviewees reported kayaking trips; two reported trips in whitewater rafts.
- Ten of the 12 questionnaire respondents used single boats; two people reported running the creek in a double.
- Table 6 summarizes the number of boats reported per group. Participants most frequently reported running the creek in groups of two (5 of 12 total responses). Group sizes ranged from two to eight people. In general, participants most frequently stated that they go on whitewater trips in small groups (more than two people total).
- All respondents reported trips beginning 9am or after and ending by 5pm. Ten of 11 people noted that they saw no one else on the creek; only one person saw one other individual or small group.
- Boaters reported recent trips at flow levels as low as 450 cfs and as high as 1,500 cfs. Many boaters reported based on flow levels as gauged by Wenatchee River flow at Peshastin.

Table 5: Type of Craft Used on Most Recent Trip (Questionnaire Responses)

Craft Type	Response Percent	Response Count
Kayak (hardshell)	61.5%	8
Kayak (inflatable)	15.4%	2
Raft (multi-chamber)	15.4%	2
Canoe	0.0%	0
Inner-tube (covered, high quality manufactured)	0.0%	0
Inner-tube (cheap/vinyl)	0.0%	0
Catacraft	7.7%	1
<i>answered question</i>		<i>13</i>
<i>skipped question</i>		<i>1</i>

Table 6. Trip Characteristics: Number of Boats in Group (Questionnaire Responses)

Number of Boats	Response Percent	Response Count
1	0.0%	0
2	50.0%	6
3	16.7%	2
4	16.7%	2
5 or more	16.7%	2
<i>answered question</i>		<i>12</i>
<i>skipped question</i>		<i>2</i>

Note: Table 6 responses do not sum to 100 percent due to rounding.

Safety-Related Behavior

Questionnaire respondents’ generally high levels of experience are reflected in the research, precautions and measures they reported in planning and preparing for their most recent trip down Nason Creek. Questionnaire findings are as follows:

- Table 7 summarizes questionnaire responses regarding the sources consulted in trip planning. Seven of 11 (63.6%) question respondents obtained information about boating conditions prior to their trip. Of those who did, six individuals consulted a guidebook (the most frequently cited source of information used).
- Eight individuals reported that they always check stream gauge data before a whitewater trip. Two reported that they “sometimes” check river flow, and one person reported only checking flow levels when the reach is new to him/her.
- Five people consulted online sites prior to their trip. Two individuals reported using both the USGS and Department of Ecology river gauge sites. One person visited the

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American Whitewater website for information. The Bennett Guidebook is a frequently cited resource that many interviewees have used to identify creek access points.

- All question respondents came prepared with basic safety equipment: helmet, life jacket, and safety ropes, at a minimum. Ten of 11 respondents brought an extra paddle or oar. Use of a dry or wet suit was also noted.
- All respondents reported that every member of their group wore a personal flotation device (PFD) during their last Nason Creek boating trip.

Table 7: Sources Consulted in Trip Planning (Questionnaire Responses)

Information Sources	Response Percent	Response Count
Word of mouth	42.9%	3
River guidebook	85.7%	6
USGS website (Wenatchee River gauge)	42.9%	3
Department of Ecology website (Nason Creek gauge)	57.1%	4
Spoke with Forest Service or Washington State Parks staff	0.0%	0
Heard or saw a public service announcement	0.0%	0
Other (please specify)	0.0%	1
<i>Answered question</i>		7
<i>Skipped question</i>		7

Note: The online survey permitted multiple responses to this question.

IV. Evaluation of Existing Large Wood

As described in the methods section of this report (Section II), existing large woody material was systematically evaluated between RM 14 and RM 0.5 and classified with respect to its relative risk to boaters. Only LW with sufficient character to warrant a “Type C” rating or higher was counted and reported.

As presented in greater detail in Section II, routine navigation generally allows a floater to avoid physical contact with LW pieces or clusters classified as a Type C, but contact could occur if a floater is inattentive or unskilled, resulting in potentially serious consequences. At the highest end of the rating system, LW classified as a Type F is LW that spans the entire channel and/or requires boater portage.

This section presents the findings of the on-water large wood evaluation conducted for Nason Creek in May 2013.

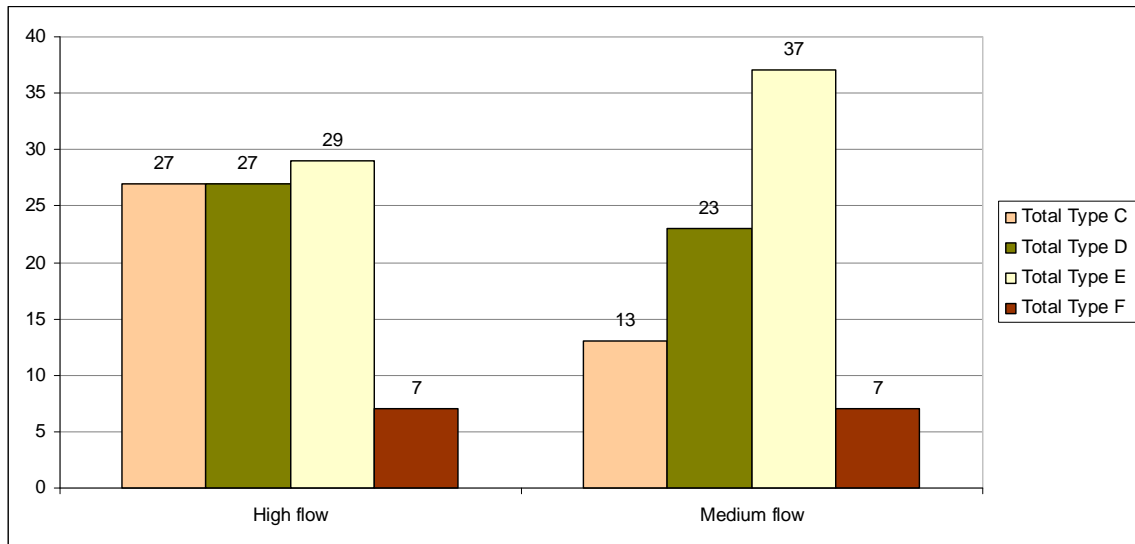
On-Water Assessment Findings

There are few consistent “rules” that determine whether a LW piece or cluster becomes Type C, D, or E. The specific characteristics and geometry of the existing large wood and channel are highly individual and cluster- or location-specific. Some LW rates higher because of size and a longer projection into the boatable channel, or because of greater approaching current power. Other reasons for rating LW as a potential Type C-E include a more perpendicular or upstream angle relative to the current, or because of greater roughness and complexity (as defined in Section II). Type E LW tends to exhibit more of these characteristics at levels that constitute potentially higher risk.

Overall Results

Exhibits 2 and 3 illustrate the general locations of recorded large wood clusters characterized as Type C-F relative to known river access points and other landmarks or features. Data points represent unique clusters or pieces of LW. Figure 1 illustrates the number of recorded LW occurrences by type for both high and medium flows.

Figure 1: LW Counts by Type and Flow Level



Analysis of overall numbers as shown in Figure 1 above results in the following observations:

- This study has recorded an average of 6.3 pieces or clusters of in-stream LW with the potential to affect boatability per mile over the 13.5 miles of river evaluated (average of two flow levels).
- From high to medium flow, the total number of recorded LW pieces or clusters decreased by roughly 11 percent, from 90 to 80 occurrences. Some LW was part of a larger complex for which additional data points are generally recorded and mapped.
- Most of the LW pieces or clusters identified were characterized as Type E at both high and medium flow levels. Type E LW is LW blocking a notable portion of the channel, and where substantial, active and accurate navigation is likely needed to avoid contact. Consequences of contact with Type E are more likely to be serious.
- At medium flow, the number of Type E LW increased by 24 percent from high flow levels (from 32% of all LW recorded at high flow to 46% of all LW recorded at medium flow). A corresponding decrease in the percentage of LW characterized as Type C was recorded (from 30% to 16%).⁴
- The number of channel-spanning logs (Type F) did not change between high and medium flow levels. However, Type F LW at medium flow increased as a percentage of total LW recorded.

⁴ Re-characterization of LW from Type E to Type C likely occurred due to changing characteristics of (and perceived risk associated with) exposed LW at different flows. However, this does not entirely explain the shift in Type C and E numbers from one flow event to the next.

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LW By Habitat Reach

Tables 8 and 9 present the number and type of LW pieces/clusters for the habitat reaches delineated in the Nason Creek Tributary Assessment, which was conducted by the Bureau of Reclamation (July 2008). The outlying portion of the study reach from the Nason Creek Forest Service Campground to Coles Corner is also included.

Table 8. LW Types by Reach at High Flow (1,300 cfs)

Reach	Length	High Flow LW Counts by Type					Totals by Reach (C-F only)
		Sweepers	C	D	E	F	
Campground to Coles Corner (RM 0.5 – 4.6)	3.9	5	9	7	13	6	35
Coles Corner to Rest Area (RM 4.6 – 8.9)	4.3	6	7	11	10	0	28
Rest Area (RM 8.9 – 9.4)	0.5	1	0	1	0	0	1
Rest Area to White Pine Road ⁵ (9.4 – 14.0)	4.9	7	11	8	6	1	26
Totals		<i>19</i>	<i>27</i>	<i>27</i>	<i>29</i>	<i>7</i>	<i>90</i>

⁵ The on-water LW assessment for this study began at approximately RM 14.0, covering most, but not all, of the habitat reach from the Nason Creek Rest Area to White Pine Road (RM 9.4-14.3) as defined by the Bureau of Reclamation.

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Table 9. LW Types by Reach at Medium Flow (910 cfs)

Reach	Length	Med. Flow LW Counts by Type					Totals by Reach (C-F only)
		Sweepers	C	D	E	F	
Campground to Coles Corner (RM 0.5 – 4.6)	3.9	1	6	8	18	6	38
Coles Corner to Rest Area (RM 4.6 – 8.9)	4.3	1	1	10	9	0	20
Rest Area (RM 8.9 – 9.4)	0.5	0	0	0	1	0	1
Rest Area to White Pine Road ⁶ (9.4 – 14.0)	4.9	2	6	5	9	1	20
Totals		<i>4</i>	<i>13</i>	<i>23</i>	<i>37</i>	<i>7</i>	<i>80</i>

- The LW evaluation helps to verify what is held as common knowledge among local boaters: recorded LW from the Forest Service Campground to Coles Corner accounts for the greatest amount of LW recorded overall, compared with the longer habitat reaches within the study area. During evaluations, this reach also required the vast majority of portages (6 of 7 for both high and medium flow levels).
- At high flow, nearly 42% of the in-stream LW recorded from the Nason Creek Rest Area to White Pine Road (RM 9.4-14.0) is characterized as wood of particular concern for the inattentive or unskilled (i.e., Type C). At medium flow, the proportion decreased to 30%.
- In comparison, at high flow, Type C LW accounts for only one-quarter of in-stream LW from the Forest Service Campground to Coles Corner, and from Coles Corner to the rest area. These proportions (relative to the total LW recorded by reach) drop notably at medium flow.

⁶ The on-water LW assessment for this study began at approximately RM 14.0, covering most, but not all, of the habitat reach from the Nason Creek Rest Area to White Pine Road (RM 9.4-14.3), as defined by the Bureau of Reclamation.

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- For each habitat reach, the percentage of Type E LW increased at the lower flow level evaluated. More accurate navigation and a generally higher level of skill are required to avoid Type E LW (compared with Types C and D). In addition, consequences of contact with Type E LW are likely to be serious.

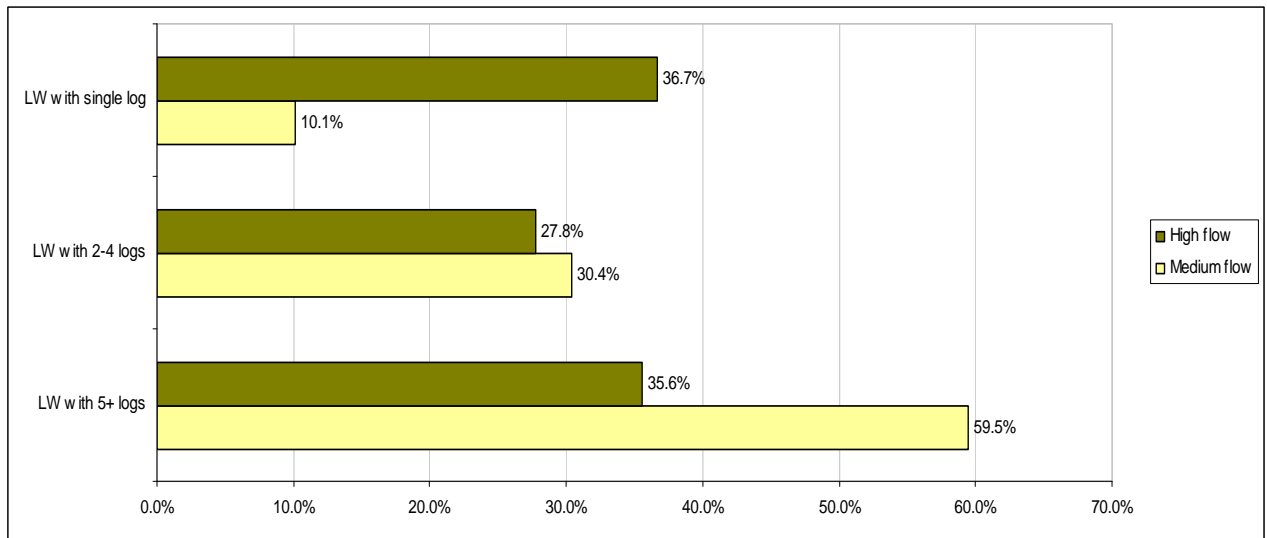
Key LW Characteristics

In review, the following characteristics were recorded for each LW occurrence recorded:

- LW projection into the channel;
- LW angle relative to current;
- Roughness (branches and entrapment spaces);
- Complexity, defined here as the number of logs; and
- Sight distance, or line of sight from a boater's perspective approaching LW from upstream.

The characteristics exhibited by typed LW vary by flow level. While the reality of recording LW data in a dynamic system over time likely accounts for some of this variation, changes between high and medium flow results are also a product of associated differences in bank-full width and LW exposure, and current power or direction at specific locations. Figure 2 demonstrates this variation using LW complexity, or number of logs, as an example.

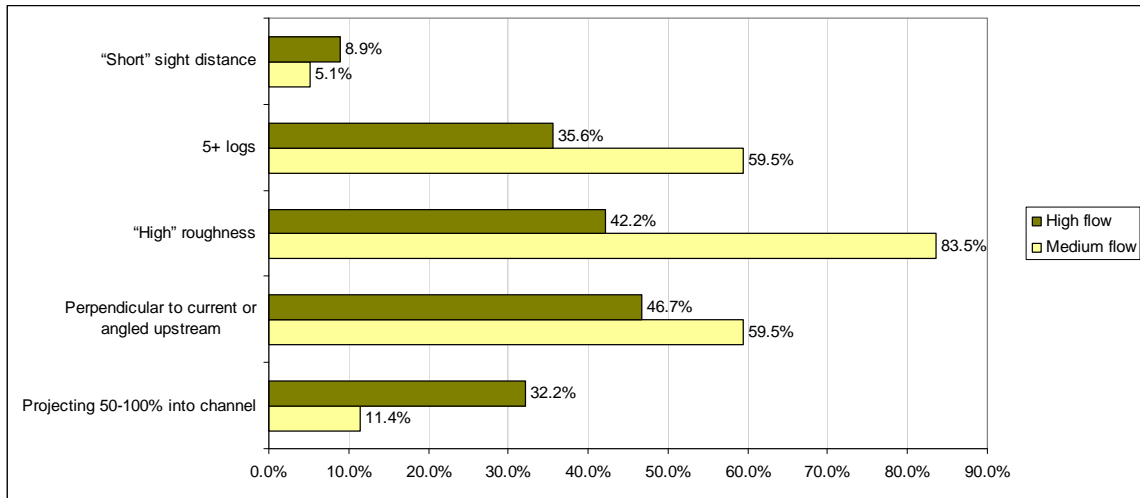
Figure 2: LW Complexity as a Percentage of Counts by Flow (RM 0.5-14)



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The LW characteristics recorded at “high” levels for this study are generally known to increase the potential for interaction and potential consequences for boaters. The following figure presents the percentage of recorded LW exhibiting individual high risk characteristics, irrespective of LW “type” or classification (i.e., designation as a type C, D, etc.).

Figure 3: Key characteristics of LW recorded for Nason Creek (RM 0.5-14)



- Per Figure 3 above, at medium flow, LW more frequently exhibited key risk characteristics at “high” levels, compared with high flow assessment findings. LW projection into the boatable channel is the one exception.
- This roughly corresponds with the greater severity of risk reflected in: a) the greater number of Type E LW pieces or clusters identified at medium flow (compared with high flow findings); and b) the high proportion of Type E LW at medium flow (vs. Types C and D at the same flow level).
- Between flow levels, LW exhibiting individual “high risk” characteristics demonstrated the greatest variation with respect to roughness (i.e., number of branches and entrapment spaces), and the least with respect to sight distance.

V. River Safety: Perspectives, Management and Response

This section describes Chelan County organizational response capabilities to boating-related emergencies, including search and rescue resources and general dispatch procedures for Nason Creek. It also describes survey respondents' perceptions of on-water conditions that may impact boater safety, and levels of participant support for different river management actions intended to mitigate risk.

County Search and Rescue Capabilities

The Sheriff's Office Department of Emergency Management provides the primary resources for all river-related safety incidents in Chelan County. This Department includes the Search and Rescue Unit, the Marine Patrol Unit and the Swiftwater Rescue Unit. These three units work in collaboration with a variety of on-call responders and volunteers throughout the county.

The following section outlines the search and rescue resources and general dispatch procedures for Nason Creek.

Initial Dispatch

Almost every safety incident report is called into the emergency 911 line, where dispatchers send the necessary resources to the area. For river-related safety incidents on Nason Creek, the following resources are automatically dispatched:

- Emergency responders, through the Sheriff's Department;
- A basic life support vehicle stationed at Lake Wenatchee and staffed with emergency medical technicians with advanced training;
- A Cascade Ambulance paramedic unit based out of Leavenworth; and
- Volunteer firefighters from District 9 Fire Department.

Department of Emergency Management Units

The Search and Rescue, Marine Patrol and Swiftwater Rescue Units are all Special Operations Units within the Department of Emergency Management. These resources are called upon by the Sheriff's Department if the situation requires their expertise.

The Search and Rescue (SAR) Unit is composed of full-time employees trained in SAR management, the use of specialized equipment and outdoor survival. The SAR Unit also coordinates efforts with the Chelan County Volunteer Services and other volunteer SAR groups.

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The Marine Patrol Unit, a component of the Chelan County Sheriff's Office, is responsible for performing rescue operations for any person or vessels in distress on Chelan County waters. The unit operates primarily on Lake Chelan, Columbia River and Lake Wenatchee. The Unit is comprised of 16 marine deputies with a fleet consisting of three patrol vessels and one available rescue boat. The Unit also assists other divisions and agencies as needed and provides support to the search and rescue missions of the Sheriff's Office. In addition, the Marine Patrol Unit provides boating safety and education classes to the public.

The Swiftwater Rescue Unit is supervised by Marine Patrol Sergeant Randy Foltz. Swiftwater Rescue deputies respond on call to swiftwater incidents, and use a variety of water craft and tools, depending on the circumstance.

If the incident does not escalate into a search and rescue situation, then the Sheriff's Department does not keep special reports on the event. Safety incidents are often called in more as information than as a response, and they are often resolved before responders can get to the scene.

Safety and Rescue Volunteers

Although Chelan County Sheriff's Department has overarching authority in emergency response, the volunteer Fire Department acts as support for staff and equipment resources. For safety incidents on the Upper Wenatchee River, the primary Volunteer Fire District is No. 9, which is based out of Lake Wenatchee. District 9 covers the Wenatchee River from Lake Wenatchee to Tumwater Bridge, with any incidents beyond this covered by District 3 out of Leavenworth. District 9 also covers the entirety of Nason Creek.

The District 9 Volunteer Fire Department is comprised of three fire stations located near Lake Wenatchee, in Plain and at Chiwawa Pines. There are 25 volunteers spread throughout the three stations, and the majority of volunteers are formally trained in swiftwater rescue..

User Risk and Safety Concerns

When asked, "When boating or floating this river, what are your primary safety concerns?" interviewees most frequently noted concerns about large woody material, including many log jams and sweepers requiring portage. Specific large wood concerns noted via both interviews and the questionnaire include:

- Shifting wood after high flows;
- Wood caught in the culvert bridge on the east side of Steven's Pass;
- Channel-spanning logs and LW that blocks most of the channel, including river-wide trees between below Merritt; and
- Channel-spanning LW (sometimes "massive"), in the lower section of the creek below Cole's Corner, where the gradient flattens notably (noted as particularly concerning for less experienced boaters).

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Table 10, below, presents responses to the survey question, “In your opinion, what were the greatest risks while you were boating today/during your most recent trip?”

Table 10: Perceived Levels of Risk Associated with Key Creek Characteristics
(Q: In your opinion, what were the greatest on-water risks during your most recent trip?)

	No risk at all	Slight level of risk	Some level of risk	High level of risk	Extreme level of risk	Don't know	Response Count
a) Fast water	2	3	4	3	0	0	12
b) Cold water	0	2	7	3	0	0	12
c) Large wood on sides of channel	0	3	5	3	0	0	11
d) Large wood blocking part of the channel	1	4	4	0	3	0	12
e) Channel spanning logs	1	0	7	2	2	0	12
f) Rocks and rapids	0	3	7	2	0	0	12
g) Mix of the above	0	1	8	3	0	0	12

- Consistent with interview findings, 11 of the 12 participants who answered this question reported that channel-spanning logs posed at least some level of risk.
- Of the seven possible items, “channel spanning logs” and “large wood blocking parts of the channel” were the only items noted to pose an extreme level of risk.
- Eleven of the 12 respondents identified a “mix of all” as posing either some level of risk or a high level of risk.
- In only four instances were creek characteristics (namely, fast water, large wood blocking part of the channel, and channel-spanning logs) characterized as posing “no risk at all”, reflective of respondents’ generally high level of confidence.

Other safety concerns identified include sharp rocks and railroad debris, the creek’s remote location, insufficient boating depth, landslide areas, and the rapids in the lower canyon, which most people portage.

Management Actions to Improve Boating Safety and Experiences

All questionnaire respondents were asked to express their level of support for, or opposition to, a series of potential management actions related to behavioral risk and river safety. Results are presented in Table 11. Key findings are bulleted below.

Table 11: Level of Support or Opposition to Potential Management Actions

Answer Options	Strongly oppose	Slightly oppose	Neutral	Slightly support	Strongly support	Don't know	Response Count
a) Require boaters/tubers to wear PFDs.	1	1	0	0	9	0	11
b) Require boaters to self-register before they float the river (to help agencies monitor use, skill levels, types of craft) and provide an opportunity to warn floaters of large wood hazards.	4	1	4	2	0	0	11
c) More large wood information at put-ins/take-outs.	1	2	4	4	0	0	11
d) Warning signs on site to identify large wood hazards.	1	3	3	2	2	0	11
e) Warning signs with directional suggestions (“go left”) at large wood hazards.	1	4	4	2	0	0	11
f) Websites with maps and photos of hazards.	2	1	3	3	2	0	11

- Of all management actions listed, participants most frequently expressed strong support for requiring that all boaters wear a PFD.
- Four of 11 respondents expressed strong opposition to requiring that boaters self-register before floating the river.
- Respondents more frequently expressed opposition or remained neutral on the topic of providing more large wood information at put-ins and take-outs, or posting warning or directional signs at (or approaching) large wood exhibiting high risk characteristics (as opposed to expressing support for these actions).

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Additional comments related to management of Nason Creek, as shared via the questionnaire, include the following:

- Rivers that are in a natural state should not have to be managed for the inexperienced boater. There are risks in anything we do.
- Wood is definitely a major concern on the section I ran, so any info posted at put-in, take-out or internet is always appreciated. The road being so close was also pretty scary.
- Manage the creek for trout fishing at lower flows, where the river becomes unboatable.
- Please keep the run wild.

When asked about his experience boating rivers with large woody material that has been placed in a river to improve habitat, one Nason Creek interviewee stated the following: “Engineered log jams are often found on runs that most people don’t regularly do...in these cases, there may be a lack of information available about them, and they will catch you by surprise.”

VI. Key Findings

In conclusion, the following key findings are offered:

- Compared to other runs in the area, Nason Creek is less frequently boated due to higher skill level required in certain areas, its remote location, lack of access points (“can’t back out”), and its limited use season and resulting difficulty tracking flow levels. For many of these same reasons, boaters who do run Nason Creek tend to be of higher skill level than the average whitewater boater. Decisions around trip planning and preparations, according to some, are made very conservatively.
- Local boaters are generally aware that a great deal of large woody debris accumulates below Coles Corner (~RM 4.5). One interviewee aptly characterized the large wood from Coles Corner to Wenatchee State Park as a “trip-ender.” According to more than one interviewee, most people generally do not float this portion.
- When asked of their primary boater-related safety concerns on Nason Creek, interviewees and questionnaire participants identified large wood most frequently. Overall, wood requiring active navigation and greater skill to avoid (i.e., Types D and E) accounted for the greatest proportion of LW with the potential to affect boater safety and navigability at both evaluated flows (1,300 cfs and 900 cfs).
- Continuing from the statement above, most of these LW pieces or clusters were characterized as “Type E”. Compared with Type D LW, Type E large wood often blocks more of the boatable channel, interacts with more powerful currents, is angled in more of an upstream position relative to the current, and/or has more branches and overall complexity.
- A number of Type E LW occurrences at both high and medium flows were characterized as LW complexes, or part of a large complex of wood accumulated on both banks and/or center-channel. LW assessment panelists noted at least three channel-spanning log jams consisting of roughly 300 pieces of wood or more.
- Study participants reported that they regularly portage when running Nason Creek, and generally expect to do so more than once in a given day. On-water panelists portaged no fewer than five times per run at both high and medium flow levels. One interviewee suggested that large wood in lower Nason Creek is easy to portage around, but noted that this could still pose significant risk for less experienced boaters.
- Compared to other suggested management actions, questionnaire participants expressed strong support for requiring that boaters/tubers to wear PFDs; roughly 45 percent (5 individuals) expressed some level of support for providing LW information online for boaters.

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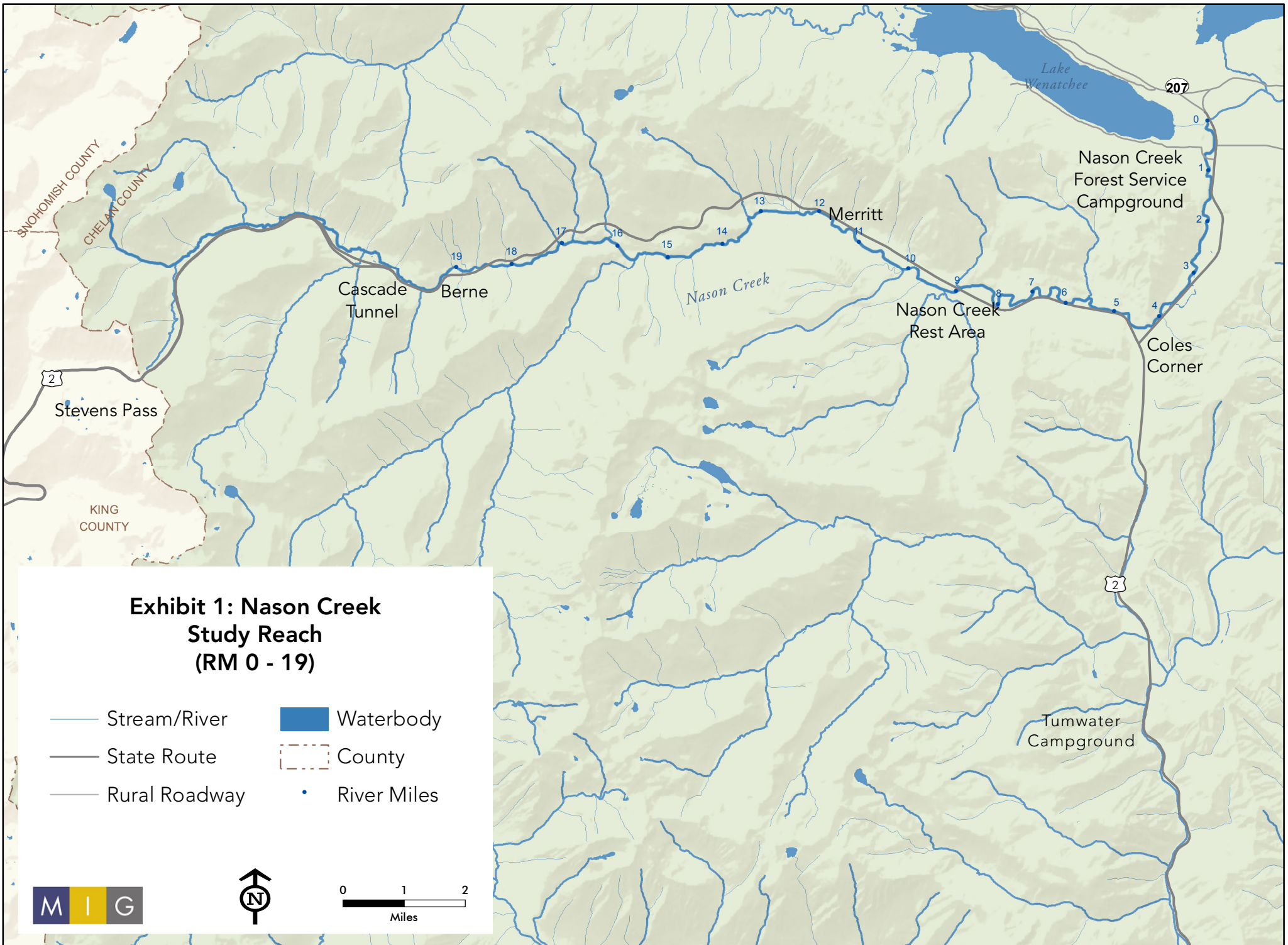


Exhibit 1: Nason Creek Study Reach (RM 0 - 19)

- Stream/River
- State Route
- Rural Roadway
- Waterbody
- County
- River Miles

