Lake Ozette Tributary Habitat Conditions

A summary of Ozette Watershed Baseline Habitat Inventory Data
Collected with funding from FY1999 BIA Watershed Projects/Jobs in the Woods Program

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Prepared For:
Makah Indian Tribe
Makah Fisheries Management
PO Box 115
Neah Bay, WA 98357

Prepared By:

Mike Haggerty
Fisheries Hydrologist
95 Hoare Road
Port Angeles, WA 98363

and

Andy Ritchie
Fisheries Ecologist
49 Heather Park Road
Port Angeles, WA 98362

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LIST OF ACRONYMS/ABBREVIATIONS USED

AC	Across Channel
BFD	Bankfull Depth
BFW	Bankfull Width
BIA	Bureau of Indian Affairs
CP	Crown Pacific
CW	Channel Width
DBH	Diameter at Breast Height
DEM	Digital Elevation Model
EOS	EOS
ESA	Endangered Species Act
GIS	Geographic Information System
IS	In-Stream (flowing or standing water)
LB	Left Bank
LBT	Left Bank Tributary
LWD	Large Woody Debris
O/A	Open and Accessible
ONP	Olympic National Park
MFM	Makah Fisheries Management
NMFS	National Marine Fisheries Service
N/A	Not Open and Accessible
RPD	Residual Pool Depth
RBT	Right Bank Tributary
RM	River Mile
RW	Rootwad
S/G	Spawning Gravel
SOS	SOS
TFW	Timber, Fish, and Wildlife
WAU	Watershed Administrative Unit
WFPB	Washington Forest Practice Board
WRIA	Water Resource Inventory Area

1.0 INTRODUCTION

1.1 BACKGROUND

The Ozette River, Lake Ozette, and its tributaries have long been the source of one of the Makah Tribe's most important fisheries: the Ozette sockeye fishery. Ozette sockeye run sizes have decreased significantly from those reported in the late 1940's and 50's. Several factors though to have contributed to the decline of Lake Ozette sockeye include: 1) decreased quantity and quality of spawning and rearing habitat, 2) predation and disruption of natural predator-prey relationships, 3) decreased ocean productivity and survival, 4) past over-fishing, 5) introduction of non-native plant and fish species, and 6) a combination of these factors (Makah Fisheries Management 2000). Extensive road building, timber harvesting, and agricultural development are thought to have degraded freshwater habitat productivity for all salmonids species throughout the basin.

On March 25, 1999 the National Marine Fisheries Service (NMFS) listed Lake Ozette sockeye as threatened under the Endangered Species Act (ESA). In an effort to help understand the spatial distribution of anadromous fish and the habitat limiting factors in the tributaries to Lake Ozette the Makah Tribe implemented a detailed field investigation of baseline habitat conditions. The primary objective of this report is to summarize and analyze the field data collected by the Tribe in 1999 and 2000. Where possible data from previous studies and habitat inventories will be integrated with data collected as part of this project to assess habitat conditions. The specific products in this report and accompanying datasets include: edited and formatted data for each stream surveyed, channel dataset including 51.6 miles (83.1 km) of summarized channel data, LWD dataset including 30,326 pieces of LWD, integrated LWD-habitat dataset summarizing LWD and pool conditions for 38.3 miles (61.6 km) of stream. GIS products include: a routed stream survey layer, linked habitat and channel attribute data tables, a segment level summary layer, and miscellaneous data layers used for this report.

1.2 WATERSHED CHARACTERISTICS

The Lake Ozette watershed is located on the northwestern edge of the Olympic Peninsula, Washington State. The 7,300 acre Lake Ozette is the third largest natural lake in Washington State (Bortleson and Dion 1979) and has a drainage area of 77mi^2 (199.4km^2; Figure 1). The lake has an average depth of approximately 130 feet (40 meters) and a maximum depth of 320 feet (98 meters) (Dlugokenski et al. 1981). The Ozette River drains the lake from the North End, falling about 29 vertical feet along its 4.7 mile course to the Pacific Ocean. The total drainage area of the Ozette watershed at the confluence with the Pacific Ocean is 88.4mi^2 (229km^2). Coal Creek, which enters just downstream from the lake outlet, is the largest tributary to the Ozette River. Several significant tributaries drain into Lake Ozette and the largest include: Umbrella Creek, Big River, Crooked Creek, Siwash Creek, and South Creek. Data for this study was collected in Coal, Palmquist, Umbrella, Crooked, and Siwash Creeks and their largest tributaries, as well as in Big River and several of its tributaries.

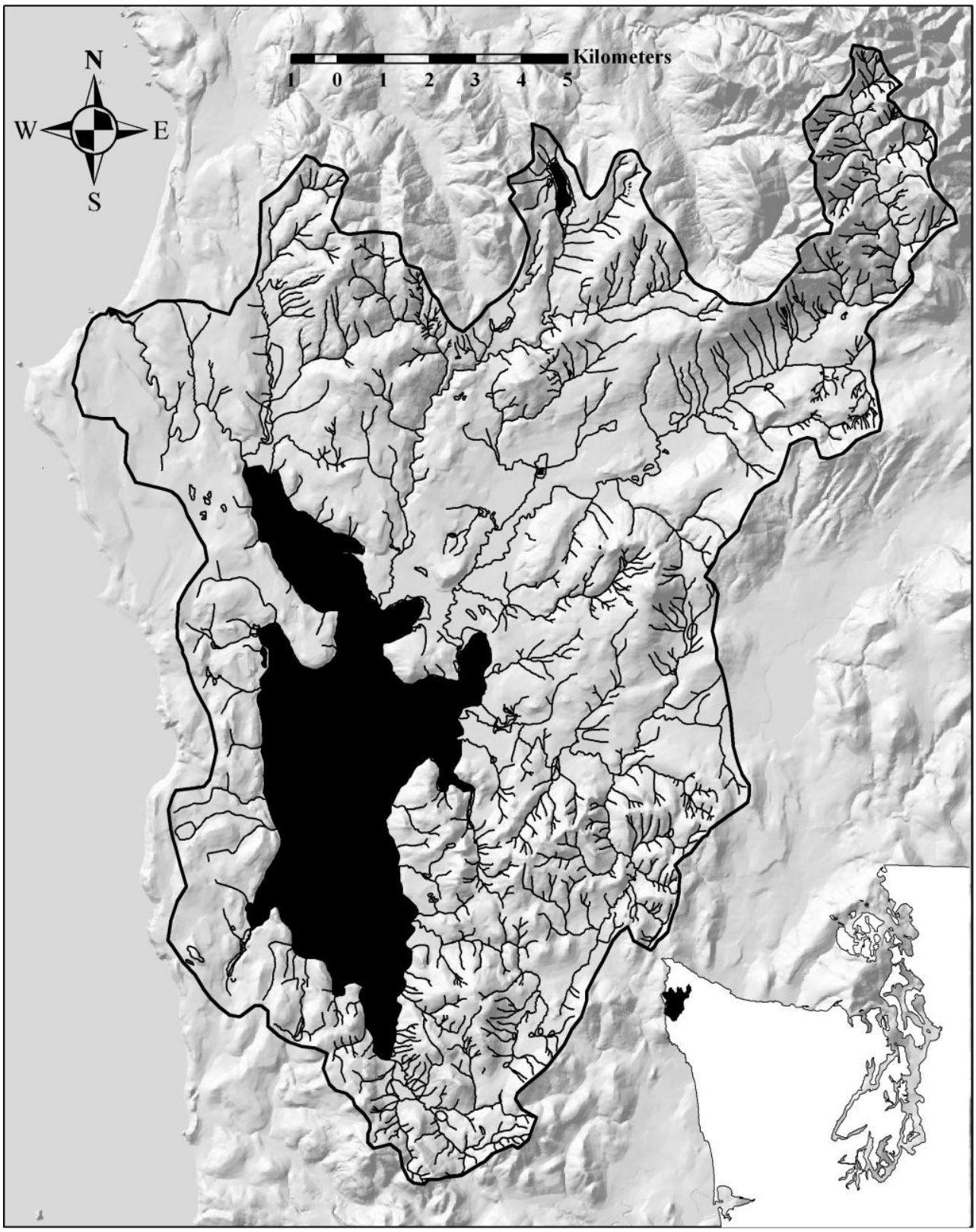

Figure 1. Ozette Watershed.

The geology of the Ozette watershed is an interesting mix of flat and gently sloping glacial and glacio-fluvial deposits situated between resistant knobs and small hills composed of Tertiary marine sedimentary rock units (mechanically weak silt- and sandstones). Some glacial landforms extend for several square miles while others only occupy small valleys. Much of the land within the watershed is low-relief and contains numerous swamps, bogs, and wetlands. Other portions of the watershed (ex. upper Big River) are steep and rugged and are underlain by Eocene age volcanic flows and breccias. Detailed watershed characteristics are described for each stream system surveyed in Section 3.0. The climate of the northwest Olympic Peninsula can be characterized as temperate coastal-marine, with mild winters and cool summers. No long-term weather stations are located in the Ozette watershed (a new weather station was recently installed at the Ozette Ranger Station). Most researchers (Bortleson and Dion 1979, Dlugokenski et al. 1981, Blum 1998, Jacobs et al. 1996) have used Forks, Washington climate data when describing Ozette. Mean annual precipitation in Forks is 117 inches, with 77% falling as rain between October and March (Bortleson and Dion 1979).

2.0 METHODS

2.1 FIELD METHODS

Field data were collected in two separate field surveys: a channel and a habitat survey. This was done because many of the TFW Ambient Monitoring habitat unit definitions are defined based upon the bankfull width (BFW) of a stream. In order to know the minimum pool habitat dimensions prior to conducting habitat surveys, BFW measurements were taken as part of the channel survey prior to habitat data collection.

2.1.1 CHANNEL DATA COLLECTION

For each stream surveyed the first step was to identify the SOS (SOS), which was usually at a confluence, bridge, or other prominent feature. From the SOS point a hip chain was used to measure stream length along the stream thalweg. Flagging marked with the distance from the SOS was hung at 50 or 100 foot (~15 or ~30 meters) intervals depending on stream width. The flags were used to record distance, as well as to note the location of channel attribute measurements. When channel measurements where made at points other than flagged positions, the stream location was noted. At each flag BFW was measured using a fiberglass tape or two handheld Sonin® Distance Measurers following methods outlined in Pleus and Schuett-Hames (1998A). Stream gradient between flags was measured along the water surface using a handheld clinometer. During the low-flow season (June to early-October) wetted width across the channel was also measured at each flag. At each wetted width measurement the habitat type was noted (C-cascade, P-pool, PT-pool tail, and R-riffle). Channel confinement at each flag was estimated and recorded using the standards established in Pleus and Schuett-Hames (1998B). Within a 50 or 100 foot stream reach confinement was recorded as one of three categories: Confined (floodplain width < 2 BFW), Moderately confined (floodplain width > 2 < 4 BFW), or Unconfined (floodplain width > 4 BFW). Additional data on other

features, such as tributaries, landslides, bridges, substrate size and composition, logjams, cascades, and potential fish barriers were collected during channel surveys and recorded in the comments section of the field form. Channel surveys typically encompassed the entire anadromous stream length but in some cases the surveys ended prior to a 100% barrier. Data on the length of surveyed and un-surveyed anadromous habitat is included in the watershed and channel description in the results section of this report.

2.1.2 HABITAT DATA COLLECTION

Habitat data collection typically began at the same SOS as the channel data collection. The survey team moved from downstream up using the flagging from the channel surveys to note stream position. Each piece of large woody debris (LWD) encountered within the stream channel was categorized by size, type, position, and pool forming attributes. Once a piece of LWD was identified as being within the BFW it was given a LWD "Piece Number" and the distance from the SOS to the midpoint of the log was measured or estimated, and then recorded. The piece was then examined and classified by size (Table 1). The initial classification identified the LWD category as either: L+, L/L-, M, or S; L and L- were used interchangeable throughout the surveys. Where rootwads (RW) were attached to a LWD bole the code RW was added to the LWD size category; note this is the only significant deviation from the protocols outlined in the TFW Method Manual for Large Woody Debris Surveys (Schuett-Hames et al. 1999). Often additional data on the pieces position were recorded, such as right bank (RB), left bank (LB), in-flowing stream (IS), across channel (AC), and bridged (B). However, these data were not recorded for all pieces of LWD, so no systematic analysis of these data were conducted at the watershed scale.

Table 1. LWD Categories and Size Requirements.

LWD CATEGORY	LWD SIZE REQUIREMENTS
L+	Large plus is defined as greater than 0.5m diameter at the midpoint of the piece and longer than 5m.
L	Large is defined as greater than 0.5m diameter at the midpoint of the piece and longer than 2m. Typically these pieces were shorter than 5m.
L-	Large minus is defined as greater than 0.5m diameter at the midpoint of the piece and longer than 2m but less than 5m.
M	Medium is defined as 0.2-0.5m diameter at the midpoint of the piece and length exceeding 2m.
S	Small is defined as 0.1-0.2m diameter at the midpoint of the piece and longer than 2m.
KEY/K	Key piece is defined as (1) independently stable in the stream bankfull width (not functionally held by another factor, i.e., pinned by another log, buried, trapped against a rock or bedform, etc.), and (2) is retaining (or has the potential to retain) other pieces of organic debris. Without the Key Piece, the retained organic debris will likely become mobilized in a high flow (approximately equal to or greater than a 10 year event). (From WADNR Watershed Analysis Fish Habitat Module Version 4.0 (1997).
RW	Rootwad, where rootwads were attached to the LWD piece RW was recorded at the end of the piece size: example-Lrw=large piece with rootwad attached.

Key pieces were recorded independent from the LWD size categorization because in the smallest streams surveyed pieces less than 0.5 meters in diameter could qualify as key pieces (i.e. a very large medium piece could qualify as a key piece). When a piece of LWD was encountered that had the potential to qualify as a key piece its length and diameter were measured and recorded (no systematic recording system was used for all pieces so piece volume data were not analyzed for all streams). If the piece met the criteria for a key piece (Table 1) it was recorded as a yes under the key piece column on the data form. For pieces of LWD that qualified as key pieces additional information on decay class was collected. Decay class was recorded as 1-4, with 1 denoting the freshest LWD and 4 being the most decayed (1-bark intact, surface texture firm, round shape, and original wood color; 2 traces of bark, surface texture smooth, round shape, originally or darkening wood color; 3 bark is absent, surface is abraded with some small holes, shape is round to oval, and wood color is dark; 4 bark is absent, surface is vesicular with many small holes and openings, shape is irregular, and wood color is dark).

Pool forming function was recorded for each piece of LWD using a yes or no in the pool forming column on the habitat field worksheet. For each piece that was considered a pool forming piece, the number (ID) of the pool it was acting to form was recorded in the habitat field notes. In order for the piece to be considered "pool forming" the pool needed to meet the standards defined in the TFW Monitoring Program Method Manual for the Habitat Unit Survey (Pleus et al. 1999; Table 2). Once a habitat unit was identified that appeared to be a pool, the downstream and upstream ends of the unit were identified and the distance from the SOS was measured and recorded at the downstream end of the pool; typically this occurred at the riffle crest. For each pool, the maximum pool depth was measured and recorded. The depth at the pool outlet was then measured. The difference between the two measurements, defined as the residual pool depth, was calculated and recorded in the field. The length of each pool was measured along the longitudinal axis (along the stream's thalweg), from the pool outlet to the upstream boundary of the pool. Where unit boundaries were complex, such as where the upstream end of the pool was oriented diagonally across the channel, the midpoint of the upstream end of the pool was used to measure pool length.

Table 2. Minimum Qualifying Pool Unit Dimensions**.**

AVERAGE BFW of SEGMENT (METERS)	MINIMUM SURFACE AREA OF POOL ($METER^2$)	MINIMUM RESIDUAL POOL DEPTH (METERS)
0-2.5	0.5	0.10
2.5-5.0	1.0	0.20
5.0-10.0	2.0	0.25
10.0-15.0	3.0	0.30
15.0-20.0	4.0	0.35
>20	5.0	0.40

Large woody debris cover in each pool was visually estimated and recorded as one of three categories: 0-5%, 6-20%, and >20% woody cover. Data on the factors or agents acting to form the pool were also recorded for each pool. The categories used to define pool forming agents included: LWD, logjams, roots of standing trees, bedrock, boulders, channel bedform, resistant bank, riprap, and beaver dams. In general, only pools within the primary/core habitat zone were measured. In some cases pools in side channels were recorded but noted as secondary habitat units. In situations with multiple pools or scour pockets connected by a common pool outlet (or outlets) the entire channel length connected by the common outlet was defined as a single pool.

2.2 DATA PROCESSING and ANALYSIS METHODS

2.2.1 CHANNEL DATA

Initially channel data from field forms for each stream survey were entered into separate Excel workbooks in 1999 and 2000. When data analysis started in 2003, all channel data within a workbook were checked for data entry accuracy by comparing against the original field forms. All channel data for a given stream were then placed in a single worksheet in a new Excel workbook. A channel summary template was created to uniformly summarize all channel data. The channel summary template summarized BFW, gradient, confinement, and wetted width by averaging the values within 100 meter channel bands from the channel data worksheet. Typically there were 3 or 4 measurements for each parameter within a given 100 meter band. Gradient, BFW, and wetted width measurements were simple to average because they were all numerical values. On the other hand channel confinement was more complex to average. Often the confinement was the same throughout a 100 meter band, but in some cases two different confinement categories were found within a 100 meter band. In these cases the confinement category represented by the greatest number of observations within the band was recorded first, followed by the other confinement category (ex. 3 moderates and 1 confined would be recorded as M-C). Where there were an equal number of observations for both categories, the first category recorded in the band summary was the primary confinement category from the preceding band. Where there were both unconfined and confined channel conditions within a band, the band confinement was typically defined as moderate.

Each 100 meter channel band was given a numeric band ID starting with 1 followed by 2, 3, 4… Once BFW, gradient, confinement, and wetted width data were summarized for a stream, the notes were reviewed from the comments section of the field forms. Features such as road crossings, tributary confluences, logjams, side channels, and permanent reference markers were added to a summary of important features for each stream (Appendix C). These features, along with the channel summary data, were used to identify channel segments based upon BFW, gradient, confinement, and significant tributary confluences using methods described in Pleus and Schuett-Hames (1998B). Once channel segments were identified, they were plotted on a 1:24,000 watershed base map using stream features and distances noted in the field forms. Streams without names or water resource inventory area (WRIA) numbers were named using a common

convention. Each tributary stream was given a unique name based upon the side of the stream it entered and the cumulative distance from the SOS (ex. the left bank tributary (LBT) that enters Coal Creek at 22,772 feet above the SOS was named "LBT 22,772 to Coal Creek").

Additional field notes on channel and riparian conditions, such as substrate size and channel instability were incorporated into the watershed and channel description for each stream surveyed. Basin area(s) for each stream system surveyed were delineated using the 10-meter digital elevation model (DEM) contours included in the 1:24,000 Ozette basemap. After each watershed boundary was plotted on the basemap a planimeter was used to measure watershed area. Each polygon was measured a minimum of two times to ensure minimal errors in measuring. The values from each acceptable measurement were averaged and the basin area was calculated and converted to square miles. Watershed scale geologic descriptions were written for each stream system surveyed using a combination of field notes, personal observations, and the Cape Flattery digital 1:100,000 geologic map (Schasse 2003).

2.2.2 HABITAT DATA

Habitat data processing was fairly complex and involved several steps. Initially habitat data from field forms for each stream survey were entered into separate Excel workbooks in 1999 and 2000. The initial data processing steps included data formatting and error checking. Data formatting consisted of ensuring that each dataset contained a common header and that all data were entered consistently. Each dataset was error checked against the original field forms. In many cases not all pool forming pieces of LWD had the associated pool number entered. In these cases the associated pool was determined by comparing the LWD position versus the position of the pool(s). In some cases, not all pools had data associated with the pool forming agent. When pool forming LWD debris was associated with these pools, the pool forming agent was defined as LWD. In cases where no pool forming agent could be linked to a pool it was defined as bedformed or free-formed. Additional notes on important features from habitat survey forms were added to the summary of important features worksheet (Appendix C). Once the habitat data were formatted consistently and error checked, LWD data processing began.

LWD data processing started by using a copy of the full habitat dataset to filter out only LWD data. Once a dataset of only LWD data was constructed, it was sorted by distance from SOS. Each stream surveyed used the 100 meter channel bands established in the channel data processing work to define LWD bands. Each LWD band was given a unique LWD Band ID. LWD data within each 100 meter band was then summarized by species type (C-conifer, D-deciduous, and U-unknown), piece size (Key, L+, L/L-, M, or S), and pool forming function (Y/N). This was done by summing the number of occurrences in each of the categories. During this process numerous typos, errors, and pool numbering omissions were discovered. Each time a data error issue arose it was fixed within the LWD dataset and in the full habitat dataset. The goal was to ensure that

both the LWD data and the full habitat dataset were fully error checked on at least two occasions.

After the LWD data were summarized within each LWD band, the pool habitat data were then processed. Within each full habitat dataset, the pool data were copied and sorted by length from SOS. Pool data were error checked once again and then formatted into a separate dataset. This dataset contained the following pool attributes: cumulative distance, pool number, maximum and residual pool depth, pool length, and percent woody cover (0-5%, 6-20%, and >20%). These data formed the base for creating the main pool dataset. Each pool in the main pool dataset consisted of the data attributes described above plus the channel band ID and habitat segment values for BFW, gradient, and confinement. After each pool was linked and formatted with channel segment data a review of LWD and pool forming factors was conducted. This was done using the full habitat dataset for each stream. Each pool and pool forming piece of LWD was sorted by cumulative distance from SOS. Each pool was then examined for pool forming attributes; three separate fields were used to record pool forming attributes. Each pool which had LWD listed as a pool forming agent was then examined for the largest piece of pool forming LWD and the total number of pieces of pool forming LWD.

Habitat segments were defined during the pool dataset construction. Habitat segments corresponded with the channel segments developed earlier but were partitioned into 500 meter segments. When channel segments were less than 1,000 meters, the habitat and channel segments were identical. When channel segments exceeded 1,000 meters, the segment was divided into 500 meter habitat segments; habitat segment lengths in excess of 500 meters typically occur in the last habitat segment within a channel segment. In cases where segment breaks occur at discrete features, such as a large tributary, the first habitat segment within a channel segment is between 500-600 meters in order to allow for the next habitat segment to fall at the start of a channel and LWD band.

The resulting pool dataset consisted of every pool inventoried and a wide range of attributes including: stream name, WRIA number, channel segment ID, habitat segment ID, gradient, confinement, BFW, cumulative distance, analysis pool number, field recorded pool number, maximum and residual pool depth, pool length, percent woody cover, habitat band ID, three levels of pool forming attributes, number of pool forming pieces, largest piece of pool forming LWD, length in habitat band, and length in next habitat band. The pool dataset was then summarized at the habitat segment level. The summary consisted of an extensive dataset including the following attributes: stream name, WRIA number, channel segment ID, habitat segment ID, lower band ID, upper band ID, cumulative downstream start and end distances, segment length, gradient, confinement, BFW, number of BFWs (within habitat segment), number of pools, pool frequency, percent of segment in pool habitat, number of pools >1 m deep, length of segment in pool habitat, number of pools with primary LWD pool forming attributes, and percent of pools formed by LWD. After the pool dataset was summarized at the habitat segment level and edits to the main habitat dataset were complete, a final LWD dataset was developed.

The final LWD dataset was constructed in a similar manner to the pool dataset. Each piece of LWD was given a unique piece ID and associated with its respective channel and LWD Band ID. All LWD attribute data from the main habitat dataset were included for each piece of LWD. The final LWD dataset consists of the following attributes: stream name, WRIA number, channel band ID, and channel band attributes (BFW, gradient, confinement, wetted width, date of survey, and length of channel band), habitat segment ID (one non-unique field and one unique field), analysis piece distance from SOS, recorded distance from SOS, recorded piece ID, LWD piece ID, piece size, piece type, key piece (Y/N), key piece decay class, pool forming (Y/N), pool number, and piece position.

The LWD band summary and pool datasets were then integrated in a single summarized dataset, the "pool and LWD summary dataset". This was done so that LWD data and pool forming agents and their associated pool attributes could be summarized at the segment level. The LWD band summary calculations simply added the values of each category at the segment level. Where LWD bands crossed segment breaks, the data were partitioned between the two segments using the ratio of band length within each segment. Each pool within the pool dataset was grouped based upon the primary factor/agent forming the pool. Pools were grouped based upon the largest piece of pool forming LWD (key, L+, L/L-, M, or S) or into two other categories: free-formed pools and free-formed pools with LWD. Free-formed pools were defined as pools formed by: boulders, bedrock, resistant banks, artificial banks, or channel bedform. Free-formed pools with LWD were defined as pools primarily free-formed but contained LWD as a secondary pool forming agent. Within each segment, each pool was placed into one of these seven categories. Pool attributes were then summarized in each of the seven categories. The attributes summarized included: number of pools, average maximum and residual pool depth, average pool length, average no of pieces of LWD forming pools, LWD cover (3 categories-0-5%, 6-20%, >20%), and the number of LWD cover observations.

2.2.3 HABITAT TARGETS and RATINGS

2.2.3.1 LWD TARGETS

Evaluation of habitat data can be complex; there is no single set of standards that can be used to classify habitat data as good or bad. When considering LWD conditions in a stream or stream segment, several different LWD attributes need to be examined to understand the LWD conditions. The most common LWD attribute used to express LWD condition is frequency (LWD/CW or LWD/BFW). Within this region the most common LWD frequency standards used are those found in the WFPB Manual for Conducting a Watershed Analysis (WFPB 1997), where 2 pieces per channel width (CW) are considered good conditions and < 1 piece per CW is considered poor. McHenry (1999) cautions the use of this standard in the nearby Hoh watershed for two separate reasons: a) LWD frequencies in old growth stands within the Hoh Watershed averaged nearly 6 pieces/CW and b) at least two studies have shown that LWD frequencies may not be sensitive to the effects of timber harvesting (Ralph et al. 1994; McHenry et al.

1998). In a study of Hoh River tributaries Cederholm and Scarlett (1997) used a mean piece frequency of 60 pieces/100 meters as an indicator of intact/target piece frequency.

Ralph et al. (1994) present the hypothesis that wood volume is more sensitive to timber harvest than simple piece count. They found that an average of 60% of all LWD in unlogged basins were >50 cm diameter (range 27-95%; calculated by piece count). The percent of LWD >50cm is an important metric used throughout this report because LWD volumes were not measured and the number, frequency, and proportion of LWD > 50 cm are the only indicators of LWD volume within the dataset. Key piece frequency targets (pieces/BFW) defined in WFPB Indices of Resource Condition (1997) define habitat quality conditions based on piece frequency as: poor (<0.15 key pieces/CW), moderate (0.15-0.30 key pieces/CW), and good (>0.30 key pieces/CW) for channels < 10m BFW and poor (<0.20 key pieces/CW), moderate (0.20-0.50 key pieces/CW), and good (>0.50 key pieces/CW) for channels 10-20m BFW. Table 3 defines the default LWD habitat condition ratings made for LWD conditions throughout this report. Several other LWD metrics are used throughout the report to describe and evaluate LWD conditions. These include: percent of pieces pool forming, pool forming pieces/CW, large pool forming pieces per 100 meters, etc. LWD ratings for each channel segment surveyed can be found in Appendix B.

Table 3. LWD Habitat Condition Ratings.

LWD Attributes	Habitat Condition Rating		
	Poor	**Fair**	**Good**
Pieces/100 meters	<40	40-60	>60
Pieces/BFW	<2	2-4	>4
Large pieces/BFW (10-20m BFW)	<1	1-2	>2
Large pieces/BFW (<10m BFW)	<0.5	0.5-1.0	>1.0
Key Pieces/BFW (BFW<10m)	<0.15	0.15-0.30	>0.3
Key Pieces/BFW (BFW10-20m)	<0.2	0.2-0.5	>0.5
Percent of Pieces > 50 cm diameter	<25%	25%-50%	>50%

2.2.3.2 POOL HABITAT TARGETS

In past studies and assessments several different metrics have been used to describe pool characteristics including: surface area in pools, maximum pool depth, holding pool frequency, residual pool depth, average pool length, percent woody cover in pools, pool frequency, and percent pools formed by LWD. No single pool attribute alone can accurately reflect pool conditions for a stream. Many of the widely used pool habitat targets and rating systems only use the quantity of pool habitat as a measure of pool conditions. Within this report the main rating standards used are those found in the WFPB Manual for Conducting a Watershed Analysis, Indices of Resource Conditions (WFPB 1997; Table 4). In addition to percent pool, pool frequency, and wood cover in pools, this analysis uses several other pool quality factors to describe and rate pool habitat. Each pool surveyed was classified by the primary pool forming agent, and

evaluated based on the depth, length, cover, etc. to determine the quality of pools at the segment and watershed scale. This assessment of pool habitat weighs both the quantity and the quality of pools to describe the condition of pool habitat.

Table 4. Pool Habitat Condition Ratings.

Habitat Parameter	Channel Type	Habitat Quality Rating		
		Poor	Fair	Good
Percent Pool	<2%; < 15m BFW	<40%	40 - 55%	>55%
	2-5%; < 15m BFW	< 30%	30-40%	> 40%
	>5%; < 15m BFW	< 20%	20 - 30%	> 30%
Pool Frequency	BFW < 15m	> 4 CW/Pool	2-4 CW/Pool	<2 CW/Pool
Percent Wood Cover in pools	<5%; < 15m BFW	Most pools in low category 0-5%	Most pools in moderate category 6-20%	Most pools in high category > 20%
Holding Pools	0-5%; <20m BFW	<5 Pools/km	6-9 Pools/km	>10 Pools/km

3.0 RESULTS and DISCUSSION

3.1 STREAMS SURVEYED

During the summer of 1999 and 2000 channel and habitat surveys were conducted in tributaries to Lake Ozette (Figure 2; Appendix A). The first surveys were conducted in Coal Creek, and additional surveys in other tributaries were conducted in clockwise order around the lake. Within the Coal Creek watershed, 7,804 meters of channel and habitat data were collected in Coal Creek mainstem. Two tributaries (20.0050 and LBT 22,772) were also surveyed and 2,439 meters of channel and habitat data were collected. Surveys in Palmquist Creek collected a total of 2,865 meters of channel data and 1,625 meters of habitat data.

Surveys in Umbrella Creek mainstem collected 10,972 meters of channel and habitat data. An additional 7,541 meters of channel and habitat data were collected in five tributaries (RBT 15,663, W.B. Umbrella Creek, E.B. Umbrella Creek, LBT 5,210 to E.B. Umbrella, and LBT 8,100 to E.B. Umbrella). Another 2,571 meters of channel data were collected in three tributaries where no habitat surveys were completed (LBT 9,400, unnamed tributary 20.0056, and Elk Creek). A total of 17,221 meters of channel and habitat data were collected in the mainstem of Big River. . An additional 5,149 meters of channel data and 4,069 meters of habitat data were collected in unnamed tributary 20.0065 and Solberg, Stony, and Boe Creeks. Five surveys encompassing 11,127 meters of channel were conducted in Big River tributaries where only channel data were collected (Dunham Creek, Trout Creek, RBT 2,092 to Trout, RBT 825 to RBT 2,092 to Trout, and RBT 5,149 to Trout). A total of 6,874 meters of channel data and 2,947 meters of habitat data were collected in the mainstem of Crooked Creek. Surveys in the

South and North Forks provided 765 and 3,206 meters of channel and habitat data respectively. Siwash Creek channel surveys encompassed 4,595 meters of stream and habitat surveys examined 3,071 meters of channel.

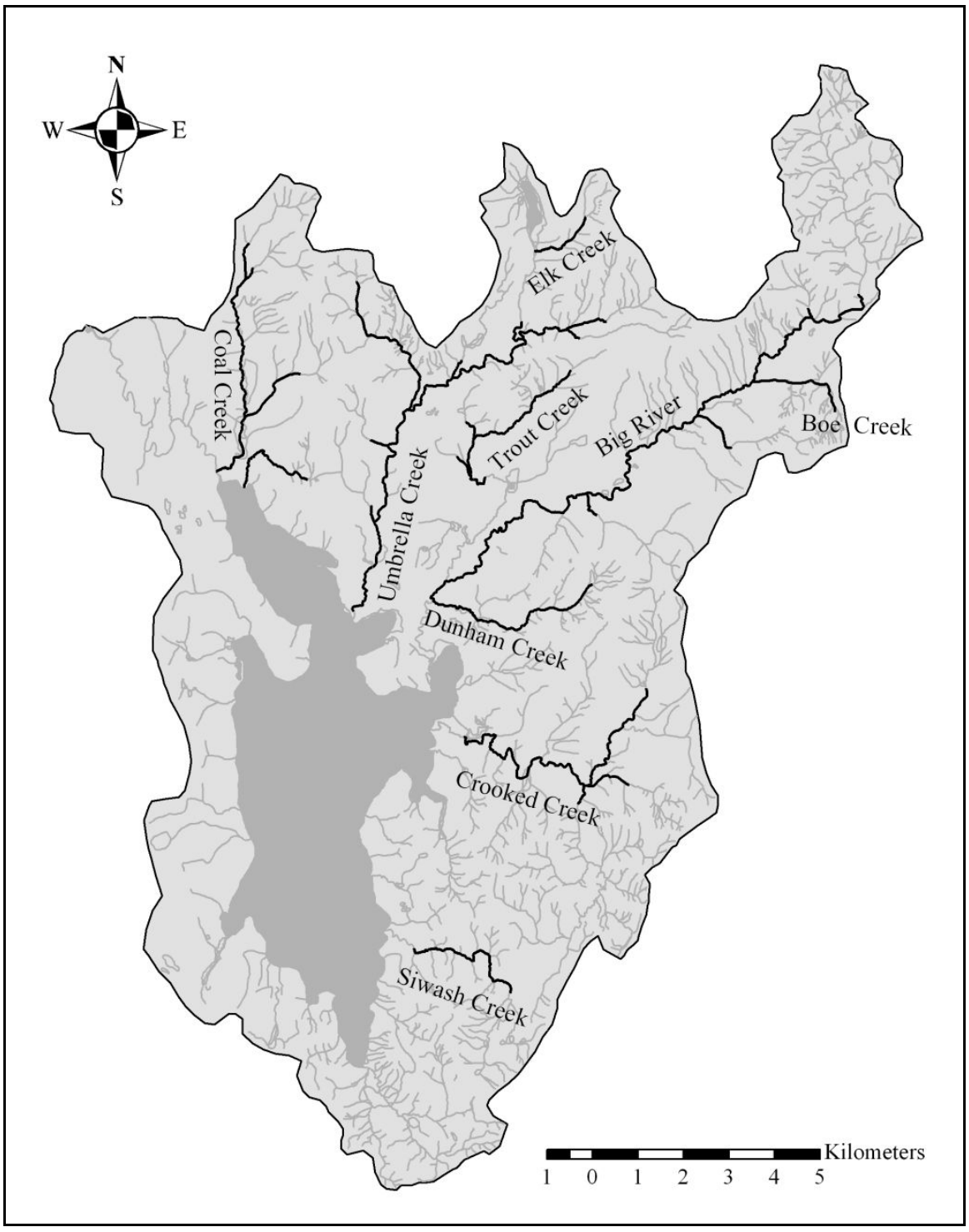

Figure 2. Extent of Channel and Habitat Stream Surveys.

3.2 COAL CREEK

3.2.1 COAL CREEK WATERSHED AND CHANNEL DESCRIPTION

Coal Creek is a right bank tributary to the Ozette River that enters just downstream from the lake outlet. The Coal Creek watershed drains approximately 4.57mi^2 (11.84km^2) and consists of the mainstem of Coal Creek, two main tributaries (20.0050 and LBT22,772), and several smaller tributaries. The mainstem is a predominately south flowing stream. The western and southern portions of the watershed are underlain with Pleistocene age glacial till and drift deposits with very low relief (maximum elevations of about 200-300 feet above sea-level). The headwaters of Coal Creek are located in the northeastern portion of the watershed and are underlain by Oligocene-Eocene aged marine sedimentary rock units.

The mainstem of Coal Creek was surveyed in 1999 and 2000 from the confluence with the Ozette River upstream 7,804 meters. The surveyed stream was divided into five main channel segments with 14 habitat segments (Figure 3; Table 5). The first segment of Coal Creek is low gradient averaging <1%, BFW averaged 10-12 meters, and wetted width averaged 7 meters (mid-September 1999). Substrate conditions were quite variable throughout segment 1, the first 175 meters of channel were described as mud, silt, and sand bottomed. The next 100 meters had several locations with spawning gravel. Spawning gravel was found in small sections throughout the rest of segment 1 but many locations were dominated by silt and sand. Segment 2 and 3 are very similar to one another, both are low gradient (<1%), and average 8-9 meters BFW; wetted width measurements averaged 4-5 meters. Channel confinement classifications in segments 1 and 2 are difficult to explain, unless it is assumed that the survey crew was classifying confinement based upon apparent channel entrenchment and lack of floodplain connectivity. This issue should be further investigated. Segments 2 and 3 are very similar to one another, both are low gradient (<1%), and average 8-9 meters BFW; wetted width measurements averaged 4-5 meters. Substrate conditions in segment 2 were also dominated by fine-grained materials. Gravel bars and spawning gravel were present in many locations but field notes indicate that many were covered in silt and sand. Channel confinement in channel segment 3 was classified as unconfined. No substrate observations were recorded in channel segment 3.

Channel segment 4 extended upstream from segment 3, to an area to just upstream of LBT 22,772. Stream gradient averaged 1-2% and the channel was classified as unconfined. Bankfull width measurements ranged from 4 to 16 meters, averaging 7.4 meters. Wetted width measurements taken during mid-July 2000 ranged from 0.5 to 9.4 meters, averaging 3.7 meters. Segment 5 averaged 2-4% gradient and was classified as confined. Bankfull width measurements ranged from 4 to 8 meters, averaging 5.5 meters. Wetted width measurements taken on July 13, 2000 ranged from 0.6 to 7.2 meters, averaging 2.8 meters. Substrate was noted as changing from gravel to cobble near the segment 4/5 break. Field notes also describe the presence of step-pools and boulders. Interestingly, two beaver dams were also noted in the middle of segment 5. The survey ended where the contributing basin area had diminished to 0.45mi^2 (1.17km^2), stream

gradient had increased to 4%, and BFW had decreased to less than 5 meters. Some additional anadromous fish habitat exists upstream from the EOS (EOS) but channel gradient increases above 8% within 400 meters of the EOS. The mapped position of segment breaks could be greatly improved by obtaining the GPS position for several Green Crow reference points which are documented in the field notes (Appendix C).

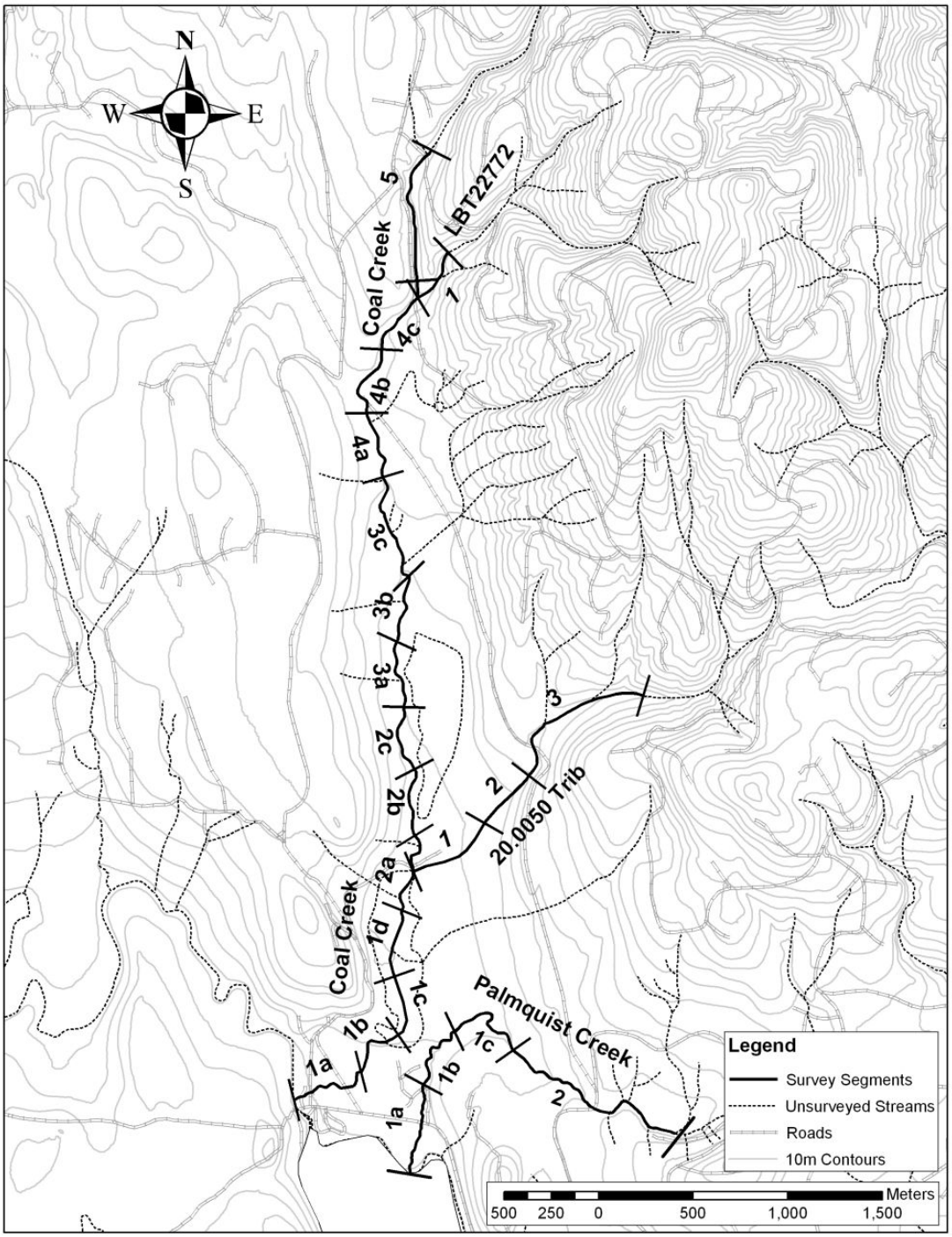

Figure 3. Coal and Palmquist Creek Channel and Habitat Segments.

Table 5. Coal Creek Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Coal Creek	1a	PS-1	500	500	<1%	C-M	12.0	41.6
Coal Creek	1b	PS-2	1,000	500	<1%	M-C	10.3	48.5
Coal Creek	1c	PS-3	1,500	500	<1%	M-C	10.2	48.8
Coal Creek	1d	PS-4	2,042	542	<1%	M-C	11.0	49.3
Coal Creek	2a	PS-5	2,700	658	<1%	C-M	7.8	83.9
Coal Creek	2b	PS-6	3,200	500	<1%	M	8.5	58.5
Coal Creek	2c	PS-7	3,700	500	<1%	M	8.7	57.2
Coal Creek	3a	PS-8	4,200	500	<1%	U	8.0	62.4
Coal Creek	3b	PS-9	4,700	500	<1%	U	8.6	58.0
Coal Creek	3c	PS-10	5,500	800	<1%	U	8.0	99.8
Coal Creek	4a	PS-11	6,000	500	1-2%	U	7.2	69.7
Coal Creek	4b	PS-12	6,500	500	1-2%	U	8.2	61.2
Coal Creek	4c	PS-13	7,000	500	1-2%	U	6.9	72.5
Coal Creek	5	PS-14	7,803	804	2-4%	C	5.5	145.8

3.2.2 COAL CREEK HABITAT CONDITIONS

3.2.2.1 LWD CONDITIONS

Coal Creek habitat data were collected in all 14 habitat segments described in Section 3.2.1. LWD data were summarized at the watershed scale and in 100 meter LWD bands and at the habitat segment level. In the mainstem of Coal Creek a total of 5,488 pieces of LWD were inventoried, of which 73%, 26%, and 1% were categorized as conifer, deciduous, or unknown respectively. Of the 5,488 pieces inventoried only 1% of the pieces were categorized as key pieces. Large and L+ pieces accounted for 10% of the LWD count, while small (37%) and medium (52%) pieces made up the remaining 89% of the LWD inventoried. At the band level only 9% of the bands had LWD piece counts below 40. Just over 33% of the bands had 41-60 pieces per 100 meters, 28% had LWD levels between 61-80 pieces per 100 meters, and 30% of the bands had > 80 pieces per 100m (Figure 4). Within the entire Ozette watershed surveyed, Coal Creek had the highest proportion of LWD bands with >80 pieces/100 meters. The LWD bands with the lowest LWD piece counts included: LWD bands 45, 46, 68, 70 and 78; LWD bands 8, 9, 10, and 52 had the highest piece counts.

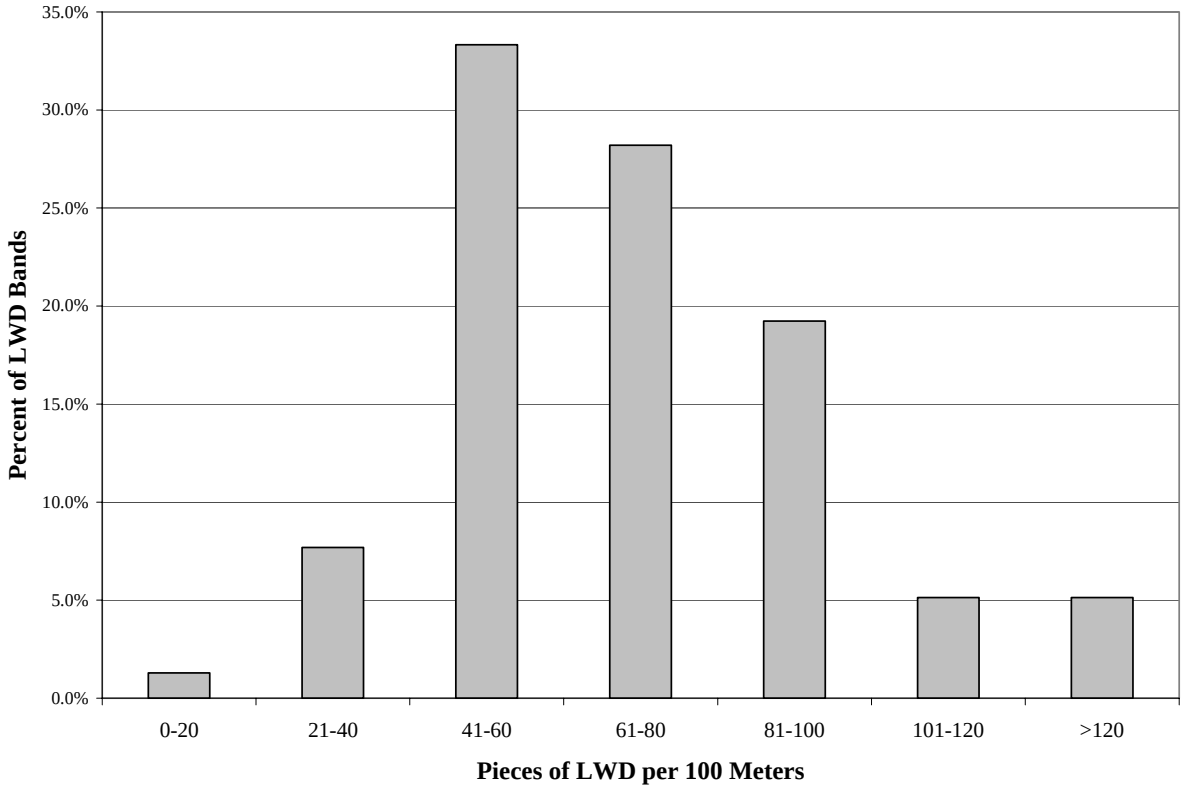

Figure 4. Coal Creek LWD Bands within Specified LWD Count Categories**.**

At the segment level, LWD data were evaluated based upon LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 6). LWD pieces/100 meters rated good in segments 1a-2a, 2c, 3a, 3c, 4a, and 4b, and fair in segments 2b, 3b, and 5 (Figure 5). Only segment 4c rated poor for LWD pieces/100 meters. Pieces/BFW rated good for segments 1a-4b and fair in segments 4c and 5. Key pieces/BFW rated poor in all segments except segment 1d. Large pieces/BFW rated good in segment 1a and 1d, and fair segments 1b, 1c, 2a-2c, 4a, and 4b. All other segments rated poor in large pieces/BFW. Pool forming pieces/BFW exceeded 2 pieces/BFW in segments 1a, 1d, 2a, 2c, 3a, and 4b. Pool forming pieces/BFW ranged from 1-2 pieces/BFW in the remaining segments with the exception of segments 4c and 5 which were 0.9 and 0.7 pieces/BFW respectively. The percent of pieces classified as large rated poor in all habitat segments and ranged from 23.7% to 5.5%. The LWD conditions in Coal Creek are interesting since most habitat segments had a high piece frequency but only 2 segments had a high frequency of large pieces and no segments had a good rating for key piece frequency. This illustrates how the size structure of LWD in Coal Creek has been degraded (many pieces but insufficient large pieces). Overall, the LWD conditions were the best in segments 1a-1d and poorest in segments 4c and 5.

Table 6. LWD Data for Coal Creek Habitat Segments.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces per 100 M	LWD Pieces per BFW	Key Pieces per BFW	Percent of Pieces Large (>50cm)	Large Pieces per BFW	Pool Forming Pieces per BFW	Percent of Pieces Pool Forming
1a	PS-1	389	77.8	9.4	0.12	23.7%	2.2	2.3	24.7%
1b	PS-2	615	123.0	12.7	0.08	8.3%	1.1	1.5	11.5%
1c	PS-3	377	75.4	7.7	0.02	10.1%	0.8	1.7	22.3%
1d	PS-4	475	87.7	9.6	0.22	12.6%	1.2	2.6	27.3%
2a	PS-5	487	74.0	5.8	0.05	12.2%	0.7	2.1	35.6%
2b	PS-6	280	56.0	4.8	0.05	12.1%	0.6	1.6	34.3%
2c	PS-7	323	64.6	5.7	0.03	11.5%	0.6	2.4	42.4%
3a	PS-8	398	79.6	6.4	0.10	5.5%	0.4	2.1	32.9%
3b	PS-9	263	52.6	4.5	0.02	6.8%	0.3	1.5	32.3%
3c	PS-10	650	81.3	6.5	0.03	7.5%	0.5	1.6	24.8%
4a	PS-11	334	66.8	4.8	0.04	10.8%	0.5	1.9	39.2%
4b	PS-12	311	62.2	5.1	0.08	13.8%	0.7	2.3	45.0%
4c	PS-13	191	38.2	2.6	0.01	6.8%	0.2	0.9	33.5%
5	PS-14	395	49.4	2.7	0.02	13.7%	0.4	0.7	26.6%

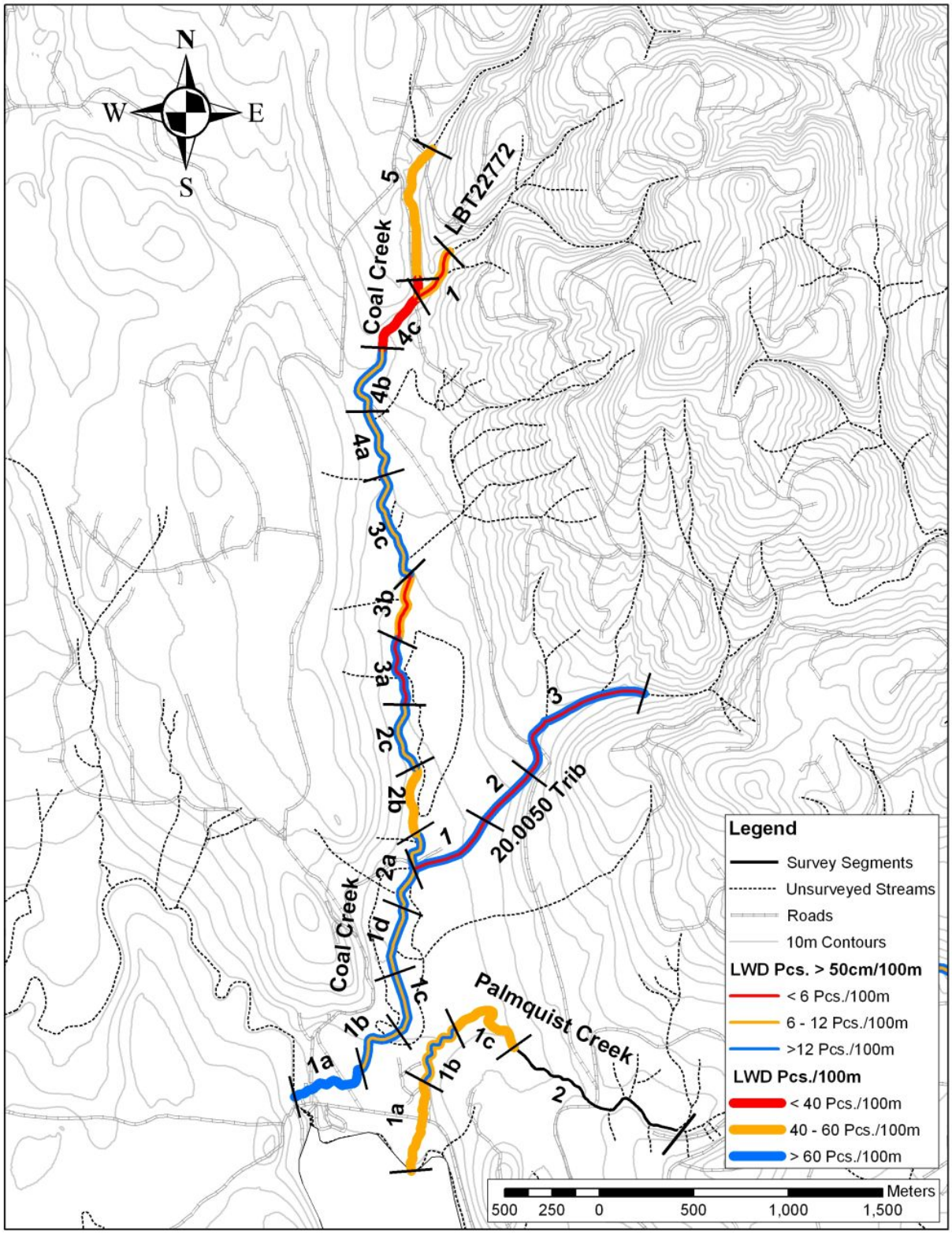

Figure 5. Coal and Palmquist Creek LWD > 50cm and Total Piece Counts/100m by Segment.

3.2.2.2 POOL CONDITIONS

Pool habitat data for the 14 habitat segments described above were summarized and evaluated at the habitat segment level. Attributes used in the evaluation included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 7). Pool frequency rated as fair in all of the segments except for 1d and 5 where pool frequency rated good and poor respectively (Figure 6). Percent pool rated good in all segments except for segments 4c and 5 which rated fair. Percent of pools with adequate woody cover rated fair in segments 1a, 1b, 1d, 2a, and 5 and poor in all other segments. Holding pools deeper than 1 meter rated good in habitat segments 1a-3b, and fair in segments 3c, 4a, and 4b. Segments 4c and 5 rated poor for holding pools. The percent of pools formed by LWD ranged between 52%-100% in the 14 habitat segments surveyed. The best pool habitat conditions were found in segments 1a-2b and the poorest conditions were found in segments 4c and 5.

In the mainstem of Coal Creek a total of 348 pools were inventoried. The average maximum pool depth was 0.76 meters and the average pool length was 15.5 meters. LWD clearly affected pool habitat quality within Coal Creek. On average, pools formed by largest LWD were the deepest, longest, and had the highest percent of woody cover (Table 8). Key piece sized LWD made up only 1% of the total LWD abundance and had a frequency of only 0.07 pieces/CW but formed 15% of the total pool habitat (by length). Large (Key, L+, and L/L-) LWD made up 11% of the total LWD abundance and had a frequency of about 0.63 pieces/CW and formed 51% of the total pool habitat.

Table 7. Pool Data for Coal Creek Habitat Segments.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1a	PS-1	<1%	12.0	3.2	65%	1.09	0.93	26.8	14	69%
1b	PS-2	<1%	10.3	2.9	67%	0.97	0.87	18.4	18	94%
1c	PS-3	<1%	10.2	2.0	75%	0.80	0.68	15.7	14	96%
1d	PS-4	<1%	11.0	1.8	83%	0.84	0.74	16.0	15	86%
2a	PS-5	<1%	7.8	2.4	71%	0.75	0.66	17.4	14	74%
2b	PS-6	<1%	8.5	2.3	75%	0.79	0.69	15.0	14	88%
2c	PS-7	<1%	8.7	3.0	68%	0.81	0.73	17.4	10	74%
3a	PS-8	<1%	8.0	3.3	79%	0.90	0.83	20.1	16	100%
3b	PS-9	<1%	8.6	2.3	74%	0.76	0.68	16.1	10	64%
3c	PS-10	<1%	8.0	2.6	75%	0.73	0.63	15.3	6	71%
4a	PS-11	1-2%	7.2	3.0	70%	0.67	0.60	14.8	6	70%
4b	PS-12	1-2%	8.2	2.7	71%	0.74	0.66	15.4	8	83%
4c	PS-13	1-2%	6.9	2.9	52%	0.55	0.47	10.5	0	52%
5	PS-14	2-4%	5.5	4.3	38%	0.54	0.49	8.9	0	74%

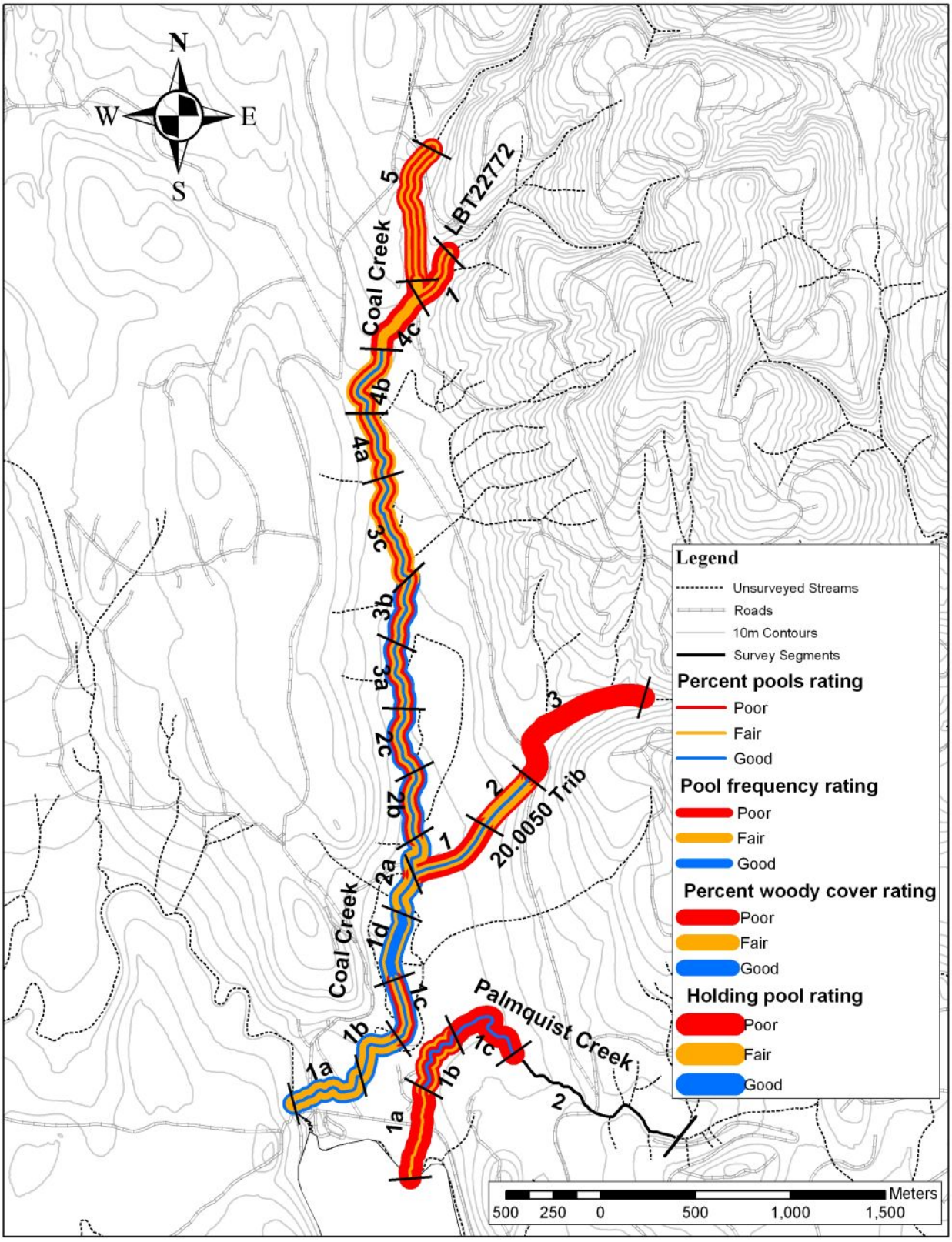

Figure 6. Coal and Palmquist Creek Pool Habitat Condition Ratings.

Table 8. Coal Creek Pool Conditions Grouped by Primary Pool Forming Attributes.

Pool Forming Agent	Number of Pools	Avg Max Pool Depth	Avg Res. Pool Depth	Avg Pool Length	Avg No. of Pieces of LWD Forming Pools	0-5% Woody Cover in Pool	6-20% Woody Cover in Pool	>20% Woody Cover in Pool
Key	41	0.97	0.88	19.5	8.1	28%	35%	38%
L+	38	0.89	0.78	19.4	5.3	28%	36%	36%
L/L-	76	0.80	0.71	16.3	5.7	50%	32%	18%
Medium	99	0.70	0.61	13.1	3.9	66%	22%	12%
Small	13	0.63	0.53	9.3	2.1	69%	23%	8%
Free-formed	30	0.59	0.52	11.5	0.0	90%	0%	10%
Free-formed w/LWD	51	0.71	0.59	16.9	3.2	76%	18%	6%

As described in the LWD condition section, most habitat segments ranked poor for key piece frequency and nearly 79% ranked fair or poor for large piece frequency. The loss of large and key piece size LWD has reduced pool quality throughout most of Coal Creek by reducing the number of high quality habitats. Figure 7 illustrates the role of the largest LWD in forming deep pools with sufficient cover. Also note how the average number of LWD pieces forming pools decreases as size piece decreases (Table 8).

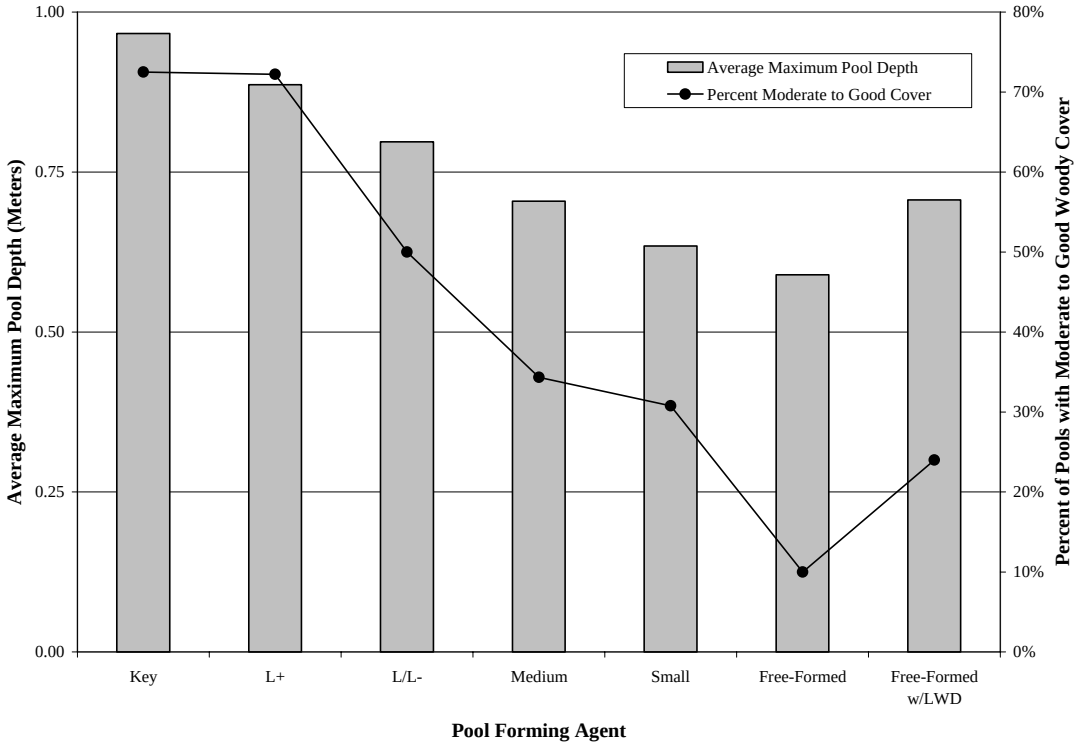

Figure 7. Relationship Between Primary Pool Forming Agent and Pool Depth and Percent Pool Cover for Coal Creek.

3.2.3 COAL CREEK TRIBUTARIES

During the Coal Creek channel survey several streams were identified as containing potential anadromous fish habitat; only two were surveyed in detail. The streams which were not surveyed likely provide only short reaches which are accessible to anadromous fish. Adult coho have been observed in at least two of the larger unsurveyed left bank tributaries. Additional low gradient channels that provide off channel rearing habitat are abundant throughout the lower 6,200 meters of Coal Creek.

3.2.3.1 UNNAMED TRIB 20.0050 WATERSHED AND CHANNEL DESCRIPTION

Unnamed tributary 20.0050 is a left bank tributary to Coal Creek that enters approximately 2,040 meters upstream from the mouth of Coal Creek (Figure 3). The predominately southwest flowing stream drains just slightly more than 1 square mile of land. The lower half of the watershed is underlain by Pleistocene age glacial till and drift deposits with low relief. The headwaters drain steeper topography and are underlain by Oligocene-Eocene age marine sedimentary rock units. A total of 2,134 meters of channel were surveyed in the summer of 2000. The surveyed stream channel was divided into three main channel segments (Table 9). The first channel segment is low gradient and unconfined with an average BFW of 6.3 meters and an average wetted width of about 4 meters (late-July, 2000). The gradient increased to 1-2% in segment 2 but other channel characteristics remain very similar to those found in segment 1. Bankfull width ranged from 4-12 meters, averaging 6.3 meters. Wetted width measurements taken during late-July 2000, ranged from 0.5 to 6.5 meters, averaging 3.2 meters. Spawning gravel was present throughout segments 1 and 2 but was noted as changing to mostly cobble at the segment 2/3 break.

Table 9. Unnamed Tributary 20.0050 Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
20.0050	1	PS-15	700	700	<1%	U	6.3	111.3
20.0050	2	PS-16	1,200	500	1-2%	U	6.3	78.9
20.0050	3	PS-17	2,134	934	2-4%	M	5.7	163.6

Segment 3 was steeper. Gradient averaged 2-4% and channel confinement was classified as moderate. Bankfull and wetted width averaged 5.7 and 3.4 meters respectively. The survey ended where gradient increased above 4% and the channel became confined and was flowing through bedrock cascades. Field notes indicate a likely fish barrier at the end of the segment 3. Watershed area upstream from the EOS was calculated to be $0.49mi^2$ ($1.27km^2$). Two tributaries to 20.0050 appeared to contain additional anadromous fish habitat. The right bank tributary that entered 1,600 meters upstream of the SOS was noted as being 3-4m BFW with good spawning gravels. The larger right bank tributary that enters at 2,025m also appeared to have some habitat although it appears to be higher gradient habitat. Mapped segment break accuracy could be greatly

increased by getting the GPS points for the Green Crow reference points which were documented in the field notes (Appendix C).

3.2.3.2 UNNAMED TRIB 20.0050 HABITAT CONDITIONS

3.2.3.2.1 LWD Conditions

Habitat data were collected in all 3 channel segments described in Section 3.2.3.1. Large woody debris data were collected for a total of 1,416 pieces of LWD. Conifer LWD made up nearly 68% of the total LWD while deciduous LWD made up just over 32% of all LWD inventoried. Of the 1,416 pieces of LWD inventoried just over 1% were classified as key pieces. Large and L+ pieces accounted for only about 6% of the LWD count, while medium(60%) and small (32%) pieces made up the remaining 92%. Only 9% of the LWD bands had piece counts below 40 pieces/100m, 68% of the bands had 41-80 pieces/100m and 23% had LWD levels above 80 pieces/100m (Figure 8). The LWD bands with the lowest LWD piece counts included: LWD bands 18, 19, and 21. Bands 9, 12, 15, and 16 had the highest piece counts.

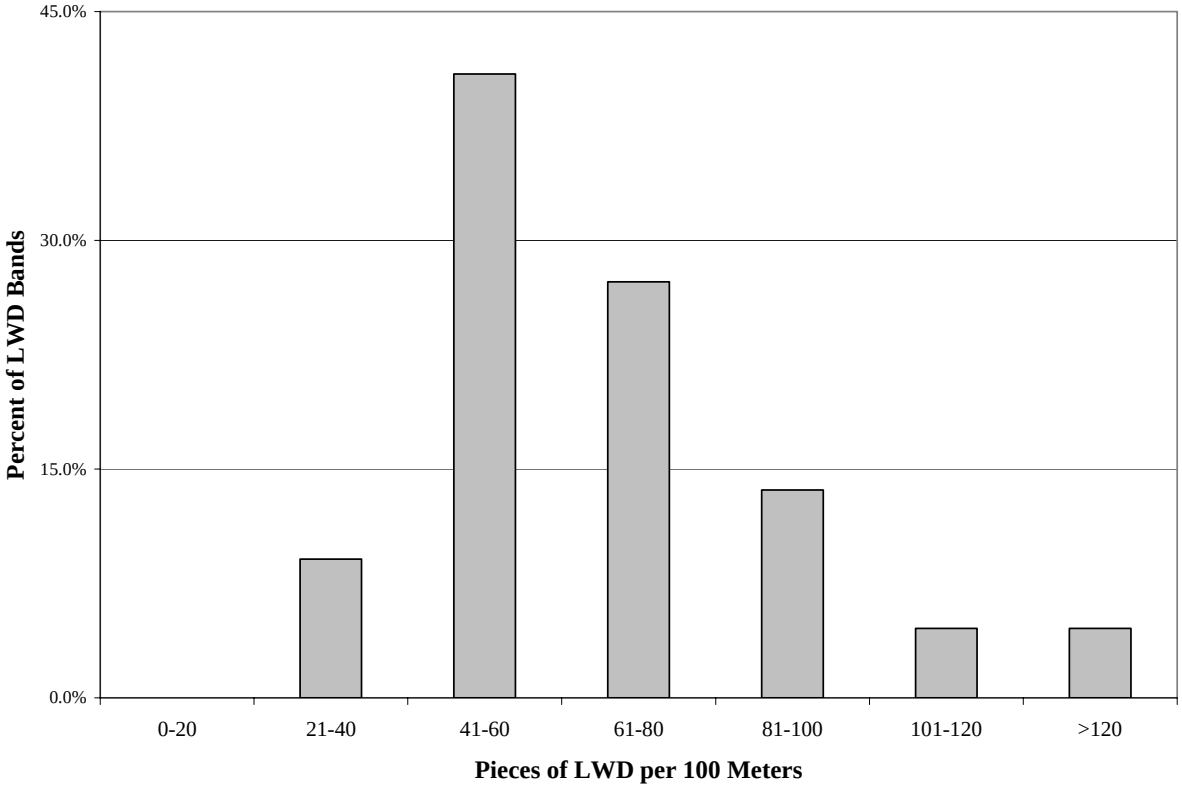

Figure 8. Tributary 20.0050 LWD Bands within Specified LWD Count Categories.

At the segment level, LWD data were evaluated based upon total LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming

pieces/BFW, and percent of pieces pool forming (Table 10; Figure 5). LWD/100 meters rated good in all three segments. LWD/BFW rated fair in segments 1 and 3, and good in segment 2. Key and large pieces per channel width rated poor in all segments. The average number of large pieces per 100 meters averaged approximately 5. Pool forming pieces per BFW ranged from 1-2 pieces/BFW in each of the segments. Approximately 30-36% of LWD was classified as pool forming. Low levels of large LWD were evident throughout the entire stream network; only 5-9% of the LWD was classified as greater than 50 cm diameter.

Table 10. LWD Data for Unnamed Tributary 20.0050.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-15	423	60.4	3.8	0.10	9.5%	0.4	1.2	30.3%
2	PS-16	405	81.0	5.1	0.03	5.4%	0.3	1.8	35.8%
3	PS-17	588	63.0	3.6	0.04	8.2%	0.3	1.1	31.6%

3.2.3.2.2 Pool Conditions

Pool habitat data for the 3 habitat segments described above were summarized and evaluated at the habitat segment level. Attributes used in the evaluation included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 11). Pool frequency rated fair in segments 1 and 2 and poor in segment 3 (Figure 6). Percent pool rated good in segments 1 and 2 and poor in segment 3. Percent of pools with adequate woody cover rated fair in segment 2 and poor in segments 1 and 3. Holding pools deeper than 1 meter rated poor in all three segments. All holding pools inventoried were formed by LWD except one, which was formed by a resistant bank. The best pool habitat conditions were found in segments 1 and 2, and segment 3 was considered to have poor pool habitat conditions.

Table 11. Habitat Segment Level Pool Data for Unnamed Tributary 20.0050.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1	PS-15	<1%	6.3	3.3	62%	0.66	0.61	12.9	4	65%
2	PS-16	1-2%	6.3	2.7	56%	0.62	0.56	9.7	4	79%
3	PS-17	2-4%	5.7	6.1	26%	0.60	0.55	8.8	3	70%

The largest LWD clearly influenced the best pool habitats. Key piece sized LWD only made up about 1% of the total LWD abundance but formed 38% of the pools > 1 meter deep. A total of 90 pools were inventoried and only 14% were formed independent of

LWD (Table 12). Pools formed by key pieces were 63% deeper than pools formed independent of LWD. Pools formed by key, large, and medium LWD comprised almost 99% of the pools with >20% woody cover. Only 2% of pools were formed by small LWD and these pools had the lowest measured habitat qualities. Loss of large and key piece sized LWD has decreased the number of high quality pools throughout the stream system.

Table 12. Tributary 20.0050 Pool Conditions Grouped by Primary Pool Forming Attribute.

Pool Forming Agent	Number of Pools	Avg Max Pool Depth	Avg Res. Pool Depth	Avg Pool Length	Avg No. of Pieces of LWD Forming Pools	0-5% Woody Cover in Pool	6-20% Woody Cover in Pool	>20% Woody Cover in Pool
Key	7	0.80	0.74	9.5	6.6	43%	14%	43%
Large	25	0.68	0.63	12.1	7.1	36%	16%	48%
Medium	30	0.65	0.59	10.1	6.3	55%	24%	21%
Small	2	0.38	0.34	8.6	2.5	100%	0%	0%
Free-formed	13	0.49	0.44	8.2	0.0	92%	0%	8%
Free-formed w/LWD	13	0.58	0.54	12.4	3.2	75%	17%	8%

3.2.3.3 UNNAMED LBT 22,772 WATERSHED AND CHANNEL DESCRIPTION

Unnamed LBT 22,772 is the name that was used to identify this tributary to Coal Creek. The stream drains a very small basin with an area of only 0.58mi^2 (1.5km^2) and flows towards the southwest. The majority of the watershed is moderately steep and underlain with Oligocene-Eocene age marine sedimentary rock types. Only 305 meters of stream were surveyed (Figure 3). Near the confluence with Coal Creek the stream remained unconfined and low gradient (1-2%), but within 100 meters the stream became mostly confined and stream gradient averaged 2-4%. There were occasional sections of moderate confinement throughout the confined sections and therefore confinement for the segment was defined as C-M (Table 13). Wetted width measurements taken on August 3, 2000 averaged 3.4 meters; BFW averaged 5.5 meters. A five foot high logjam was noted 180 meters upstream from the confluence and another 6 foot high logjam was located at the end of the stream section surveyed. Another even larger jam was located 30 meters upstream from the EOS. The lower 100 meters of the channel provided the most suitable spawning habitat. Areas upstream were mostly cobble and bedrock with scoured banks.

Table 13. LBT 22,772 Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
LBT 22,772	1	PS-18	305	305	2-4%	C-M	5.5	55.3

3.2.3.4 UNNAMED LBT 22,772 LWD and POOL HABITAT CONDITIONS

A total of 156 pieces of LWD were inventoried in the 305 meters of surveyed channel. Conifer LWD made up just over 64% of the total LWD while deciduous LWD made up just less than 36% of all LWD inventoried. Of the 156 pieces of LWD inventoried just less than 3% were classified as key pieces. Large and L+ pieces accounted for only 9% of the LWD count, while medium (74%) and small (14%) pieces made up the remaining 88%. At the segment level, LWD data were evaluated based upon total LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 14; Figure 5). LWD/100 meters and LWD/BFW rated fair. Key and large pieces per channel width rated poor. Only 11.5% of LWD was >50 cm diameter but 30.1% of LWD formed pools.

Table 14. Segment Level LWD Data for Unnamed LBT 22,772.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-18	156	51.1	2.8	0.07	11.5%	0.3	0.8	30.1%

Pool habitat data were evaluated at the segment level using the following attributes: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 15; Figure 6). Pool frequency rated as fair, but percent pool rated poor. The pools with adequate woody cover rated poor, as did holding pool frequency. A total of 16 pools were inventoried and maximum pool depth averaged only 0.43 meters. Only two pools deeper than 0.6 meters were identified and both were formed by LWD. Only 2 pools were formed independent of LWD (free-formed w/out LWD). Pools classified as being formed primarily with LWD averaged 32% greater depths than free-formed pools and free-formed pools with secondary LWD. No pools were formed independently by LWD classified as small. Loss of pool quantity and quality within this stream reach is likely associated with decreased levels of LWD >50 cm diameter, as well as decreased levels of coniferous LWD (currently < 2 pieces/BFW).

Table 15. Segment Level Pool Data for LBT 22,772.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1	PS-18	2-4%	5.5	3.5	28%	0.43	0.38	5.4	0	63%

3.3 PALMQUIST CREEK

3.3.1 PALMQUIST CREEK WATERSHED AND CHANNEL DESCRIPTION

Palmquist Creek is an independent tributary to Lake Ozette which enters the lake approximately 600 meters east of the lake outlet. The Palmquist Creek watershed has a basin size of approximately 1.1mi^2 (2.85km^2). The headwaters drain from low hills of moderate steepness underlain by Oligocene-Eocene age marine sedimentary rock types. The headwater streams quickly reach the flatter topography influenced by Pleistocene age glacial till and drift deposits. The stream's course is quite sinuous as it meanders across the flat topography. In fact during high flows, a portion Palmquist Creek appears to flow into Coal Creek.

The mainstem of Palmquist Creek was surveyed during the summer of 2000 from the confluence with Lake Ozette to a distance upstream 2,865 meters. The surveyed stream was divided into two channel segments. The lower channel segment was further divided into 3 habitat segments (Table 16; Figure 3). The lower end of segment 1 was very low gradient (<0.1%) near the confluence with Lake Ozette. As a whole, segment 1 was low gradient 0-2%, unconfined, and averaged approximately 5 meters BFW. During the initial channel survey, a large, well established log jam was thought to be a barrier to anadromous fish and the survey was ended. Later during the same summer, additional channel data were collected upstream of the potential barrier. Segment 2 is slightly higher in gradient (1-2%), with moderate confinement and an average BFW of 5-6 meters. The survey in segment 2 ended where the stream forked into two streams of similar size. Total basin area at the confluence was approximately 0.6mi^2 (1.55km^2). If fish can pass over the jam located at the segment 1/2 break, then there is likely some additional habitat upstream of the EOS. No wetted width data were collected during channel surveys.

Table 16. Palmquist Creek Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Palmquist Creek	1a	PS-19	500	500	<1%	U	4.6	108.5
Palmquist Creek	1b	PS-20	1,000	500	1-2%	U	4.8	103.2
Palmquist Creek	1c	PS-21	1,625	625	1-2%	U	6.0	104.3
Palmquist Creek	2	na	2,900	1,275	1-2%	M	5.8	221.4

3.3.2 PALMQUIST CREEK HABITAT CONDITIONS

3.3.2.1 LWD CONDITIONS

Habitat data were only collected in the first three habitat segments: 1a, 1b, and 1c. A total of 908 pieces of LWD were inventoried in the three segments. Conifer made up just over 84% of all LWD inventoried while deciduous LWD accounted for over 11% and the remaining LWD (5%) was classified as unknown. Less than 1% of the LWD inventoried

by size was classified as key. Large and L+ accounted for just over 19% of all LWD in Palmquist Creek. At the 100 meter LWD band level, nearly 19% of the bands had LWD piece counts below 40 per 100 meters; 25% and 56% of the bands contained 41-60 and 61-80 pieces/100 meters respectively (Figure 9). The lowest LWD counts were in bands 1, 3, and 8; the highest counts were in bands 4, 5, 10 and 11.

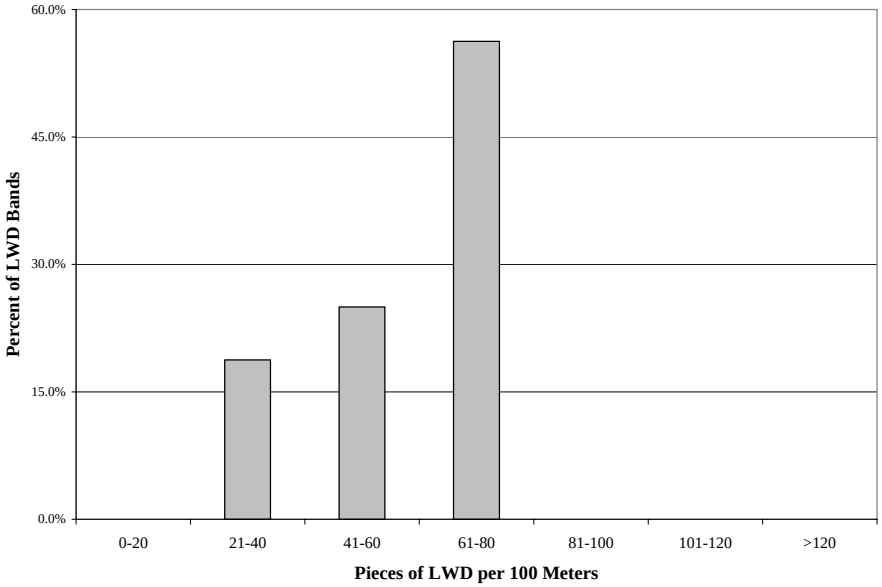

Figure 9. Palmquist Creek LWD Bands within Specified LWD Count Categories

At the segment level, LWD data were evaluated based upon total LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 17; Figure 5). Piece frequency rated fair for both pieces/100 meters and pieces/BFW in all three segments. Key pieces/BFW rated poor for all three segments but large LWD/BFW rated fair in all segments. Pool forming pieces/BFW was low in all three segments, averaging 0.5-0.6 pool forming pieces/BFW. The percent of pieces pool forming ranged from 15-23%. Larger LWD were classified as pool forming at a higher rate than smaller sized LWD. In fact, over 83% of the key pieces were pool forming while only 3% of LWD classified as small was pool forming. Approximately, 54%, 39%, and 21% of L+, L/L-, and medium sized pieces were pool forming respectively.

Table 17. Palmquist Creek LWD Data.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1a	PS-19	257	51.4	2.4	0.01	21.4%	0.5	0.5	20.2%
1b	PS-20	282	56.4	2.7	0.02	24.5%	0.7	0.6	22.7%
1c	PS-21	369	59.0	3.5	0.03	15.7%	0.6	0.5	15.4%

3.3.2.2 POOL CONDITIONS

Pool habitat conditions were analyzed within the three segments described above using the following attributes: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 18). Pool frequency rated poor in segments 1a and 1b and right on the edge between fair and poor is segment 1c (Figure 6). Percent pool rated good in segments 1b and 1c but only fair in segment 1a. The percent of pools with adequate woody cover rated fair in segments 1b and poor in segments 1a and 1c. Holding pools deeper than 1 meter/km rated poor in all habitat segments. Pool habitat conditions were fairly similar between the three habitat segments. Conditions in segment 1b may have been slightly better than in the other two segments.

Table 18. Palmquist Creek Pool Habitat Data.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Freq.	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/ km	Percent of Pools Formed by LWD
1a	PS-19	<1%	4.6	5.7	54%	0.68	0.58	14.9	4	68%
1b	PS-20	1-2%	4.8	5.4	70%	0.71	0.61	18.0	2	74%
1c	PS-21	1-2%	6.0	4.0	59%	0.62	0.51	13.7	3	46%

A total of 64 pools were inventoried in Palmquist Creek. Maximum pool depth and pool length averaged 0.66 and 15.3 meters respectively. LWD influenced several aspects of pool habitat conditions including: maximum and residual pool depth, pool length, and percent woody cover in pools (Table 19). Pools formed by key piece sized LWD averaged 61% deeper than free-formed pools without LWD. On average pools formed by LWD > 50 cm diameter were deeper, longer, and had more woody cover than pools formed by other agents (Figure 10). Reduced numbers of key pieces of LWD have likely reduced the number of high quality pool habitats throughout Palmquist Creek.

Table 19. Palmquist Creek Pool Conditions Grouped by Primary Pool Forming Agent.

Pool Forming Agent	No. of Pools	Avg Max Pool Depth	Avg Res. Pool Depth	Average Pool Length	Avg No. of Pieces of LWD Forming Pools	0-5% Woody Cover in Pool	6-20% Woody Cover in Pool	>20% Woody Cover in Pool
Key	4	0.85	0.77	17.6	3.0	0%	50%	50%
L+	8	0.70	0.60	15.4	3.3	50%	38%	13%
L/L-	17	0.71	0.61	17.6	4.9	35%	41%	24%
Medium	9	0.59	0.51	10.5	1.9	56%	44%	0%
Small	1	0.36	0.25	6.3	0.0	100%	0%	0%
Free-formed	8	0.53	0.42	12.8	0.0	75%	25%	0%
Free-formed w/LWD	17	0.67	0.57	17.1	2.4	59%	29%	12%

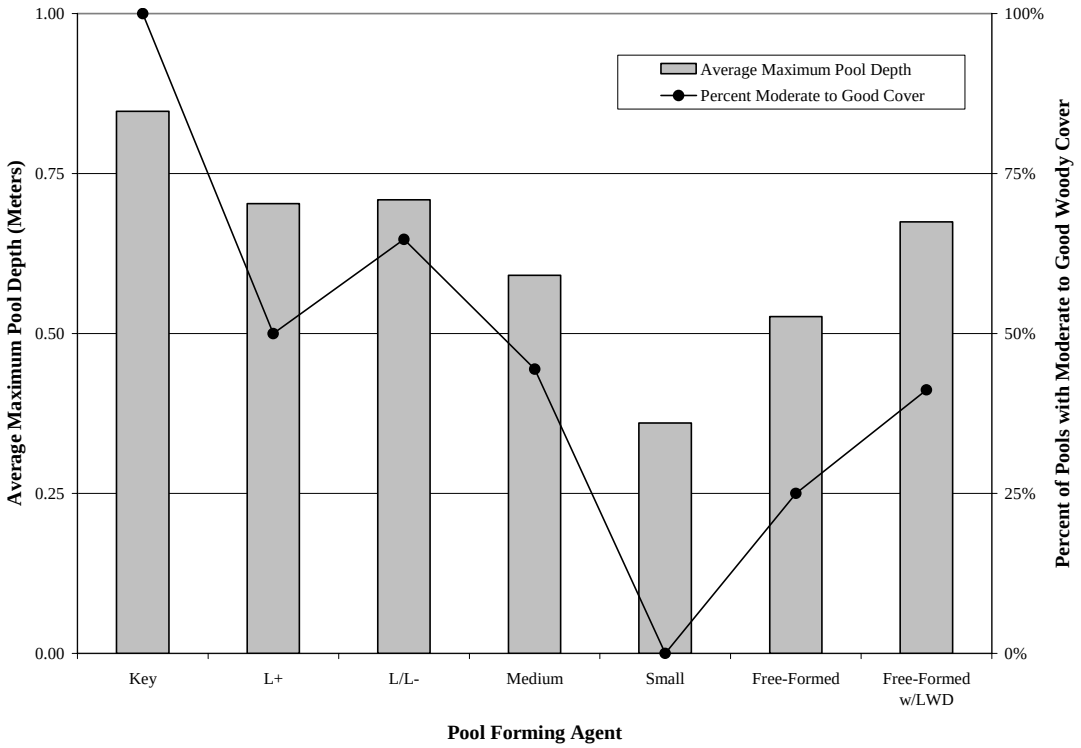

Figure 10. Pool Depth and Woody Cover by Primary Pool Forming Agent for Palmquist Creek.

3.4 UMBRELLA CREEK

3.4.1 UMBRELLA CREEK WATERSHED AND CHANNEL DESCRIPTION

Umbrella Creek is the third largest tributary to Lake Ozette. Umbrella Creek enters the lake at the northwest edge of Deer Bay (northeast end of Lake Ozette). The Umbrella Creek watershed drains approximately 10.6mi^2 (27.45km^2; Table 20) and has several significant tributaries. The two largest tributaries are the East and West Branches of Umbrella Creek, followed by the Hatchery Creek (20.0056), Elk Creek, and unnamed RBT 15,663 and RBT 9,400. There are also numerous smaller tributaries to Umbrella Creek. The mainstem flows predominately south-southwest from its headwaters at Elk Lake. The course of the mainstem is almost exclusively underlain by Pleistocene age glacial till, drift, and outwash deposits. The major tributaries drain moderate steep low hills. Headwater streams draining the steeper topography are typically underlain by Eocene-Miocene age marine sedimentary rock types. The majority of the main channel networks of large tributaries to Umbrella Creek are associated with broad, low relief glacial deposits.

Table 20. Umbrella Creek Watershed Areas.

Watershed/Sub-basin	Watershed Area	
	Mile^2	**km^2**
Unnamed RBT 15,663	0.39	1.01
West Branch Umbrella	1.98	5.13
Hatchery Creek	0.68	1.76
Umbrella- Upstream from Hatchery Creek	5.00	12.95
East Branch Umbrella Creek	2.15	5.57
Elk Creek	0.66	1.71
Entire Umbrella Creek Watershed	10.64	27.56

The Umbrella Creek mainstem was surveyed during the summer of 1999 from the upper extent of the backwatering effect of the lake to a point approximately 800 meters upstream of the East Branch of Umbrella Creek, and downstream of Elk Lake. The surveyed channel was divided into 6 main channel segments with 20 habitat segments (Table 21; Figure 11).

The first channel segment of Umbrella Creek is unconfined and low gradient (<1%). BFW averaged 16-19 meters, and wetted widths averaged 9-10 meters on June 22, 1999. The break between segment 1 and 2 is at the Hoko-Ozette Road Bridge. Segment 2 extends upstream to the confluence with the West Branch Umbrella Creek and remains unconfined for its entire length. The stream gradient remains below 1% throughout segment 2. BFW ranged from 10-30 meters averaging about 16 meters. Wetted width measurements taken from June 22-29, 1999 averaged 11 meters.

Segment 3 of Umbrella Creek extends upstream from the confluence with the West Branch Umbrella Creek to Hatchery Creek (WRIA 20.0056). Channel confinement oscillates between confined and moderately confined with small sections exhibiting unconfined conditions. Stream gradient averaged between 1-2% and BFW measurements ranged from 8 to 30 meters, averaging 13 meters. Wetted width measurements taken in late-June through early-July 1999 averaged 9 meters. Segment 4 extends 1,000 meters upstream from the Hatchery Creek. Channel confinement varied from unconfined to moderately confined. Stream gradient averaged 1-2% and BFW ranged from 8-26 meters, averaging 14 meters. Wetted width measurements taken in July 1999 averaged 8 meters.

Segment 5 extends upstream from segment 4 to the confluence with the East Branch Umbrella Creek. Channel confinement was classified as confined with small sections of moderate confinement. Stream gradient averaged between 1-2% and BFW averaged 11 meters. Wetted width averaged 7 meters. Segment 6 extends 722 meters upstream from the East Branch Umbrella Creek, and ends where channel characteristics change to that of a regime channel (a channel in which sediment input and transport are at “equilibrium” regime channels lack evidence of scour and deposition and are typically sand bottomed with ripples or dunes in the low-flow portion of the channel). Channel confinement was constrained at the bottom end of the segment, then became moderately confined, and at the end of the segment was unconfined. Stream gradient averaged 1-2% and BFW

averaged 7 meters; although a section of segment 6 included channel measurements taken from the transition into the regime channel (reducing the average BFW).

Table 21. Umbrella Creek Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Umbrella Creek	1a	PS-22	500	500	<1%	U	15.9	31.4
Umbrella Creek	1b	PS-23	1,300	800	<1%	U	18.4	43.4
Umbrella Creek	2a	PS-24	1,800	500	<1%	U	14.7	34.1
Umbrella Creek	2b	PS-25	2,300	500	<1%	U	18.6	26.9
Umbrella Creek	2c	PS-26	2,800	500	<1%	U	16.7	29.9
Umbrella Creek	2d	PS-27	3,300	500	<1%	U	15.8	31.7
Umbrella Creek	2e	PS-28	3,800	500	<1%	U	17.1	29.3
Umbrella Creek	2f	PS-29	4,300	500	<1%	U-M	16.4	30.4
Umbrella Creek	2g	PS-30	4,800	500	<1%	U	16.5	30.4
Umbrella Creek	2h	PS-31	5,300	500	<1%	U	17.1	29.3
Umbrella Creek	2i	PS-32	6,000	700	<1%	U-M	13.6	51.5
Umbrella Creek	3a	PS-33	6,500	500	1-2%	M	12.7	39.4
Umbrella Creek	3b	PS-34	7,000	500	1-2%	M-C	12.8	39.2
Umbrella Creek	3c	PS-35	7,500	500	1-2%	M-C	11.4	43.7
Umbrella Creek	4a	PS-36	8,000	500	1-2%	U-M	13.5	37.2
Umbrella Creek	4b	PS-37	8,500	500	1-2%	U-M	15.7	31.9
Umbrella Creek	5a	PS-38	9,000	500	1-2%	C	13.0	38.5
Umbrella Creek	5b	PS-39	9,500	500	1-2%	C	10.1	49.5
Umbrella Creek	5c	PS-40	10,200	700	1-2%	C	9.5	73.4
Umbrella Creek	6	PS-41	10,972	772	1-2%	M-C	6.7	116.0

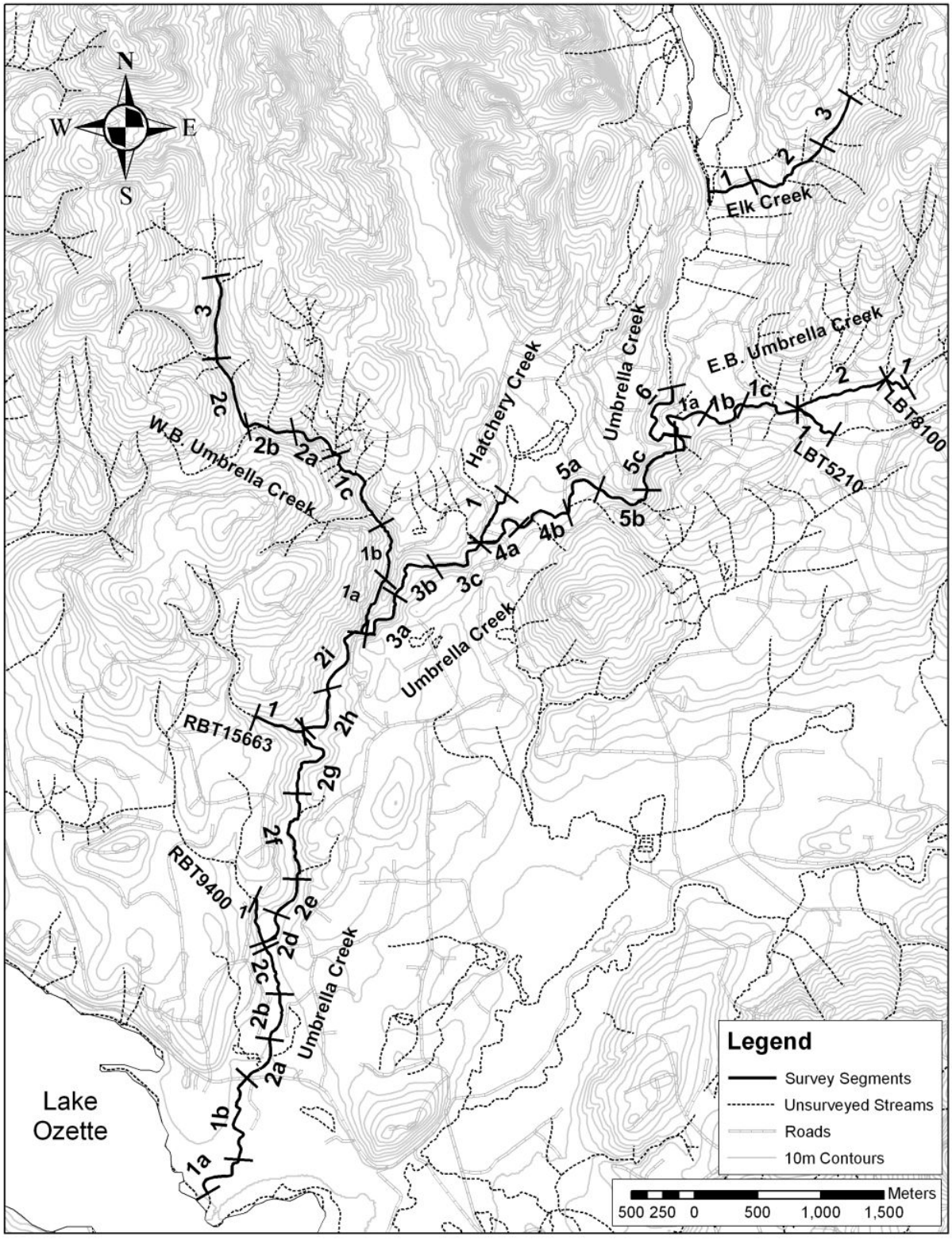

Figure 11. Umbrella Creek Watershed Channel and Habitat Segments.

3.4.2 UMBRELLA CREEK HABITAT CONDITIONS

3.4.2.1 LWD CONDITIONS

Habitat data were collected in all 6 channel segments and 20 habitat segments described in Section 3.4.1. LWD data were summarized at the watershed scale, as well as at the habitat segment and 100 meter LWD band level. In the Umbrella Creek mainstem a total of 4,734 pieces of LWD were inventoried, of which 77%, 21%, and 2% were categorized as conifer, deciduous, and unknown respectively. Only 1% of the 4,724 pieces of LWD inventoried were classified as being key pieces. Large and L+ pieces accounted for 18% of the LWD inventoried, while medium (53%) and small (28%) pieces made up the remaining 81%. At the band level 60% of the bands had LWD piece counts below 40. Just over 17% of the bands had 41-60 pieces per 100 meters, 14% had LWD levels between 61-80 pieces per 100 meters, and only 9% of the bands had > 80 pieces per 100m (Figure 12). The LWD bands with the lowest LWD counts included: LWD Bands 33, 48, 78, 89, 102, and 105. LWD bands 4, 6, 7, 37, and 46 had the highest piece counts.

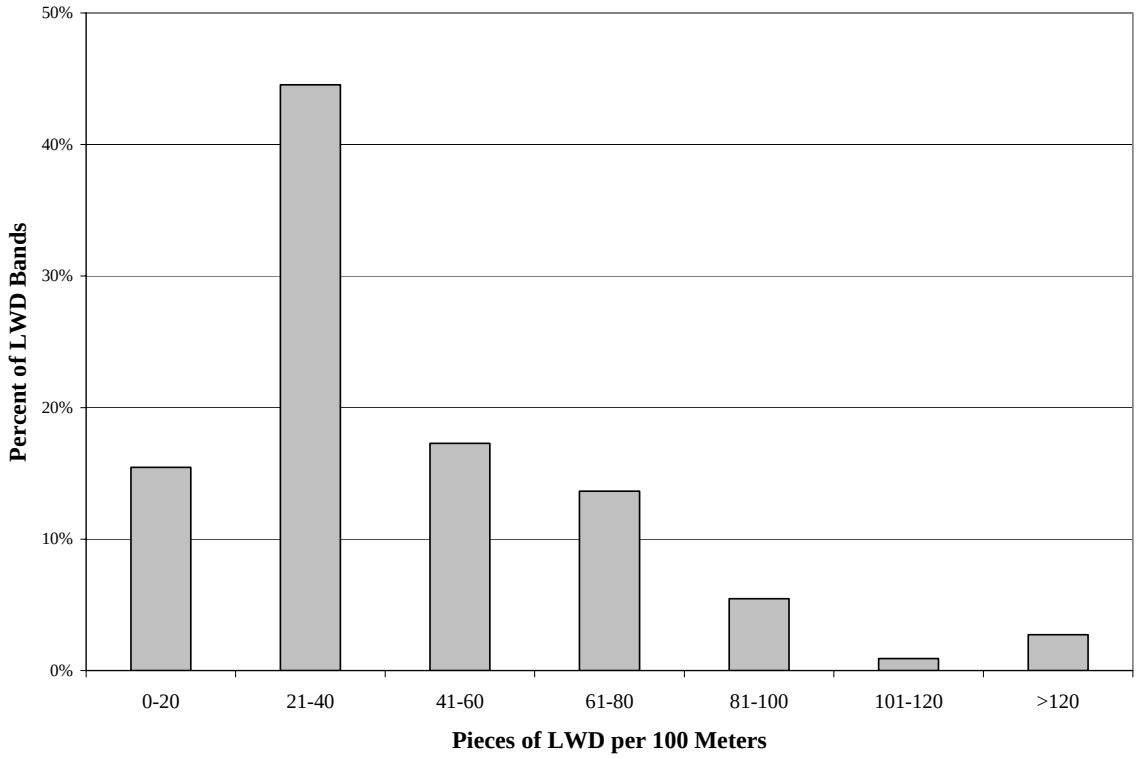

Figure 12. Umbrella Creek LWD Bands within Specified LWD Count Categories.

At the segment level LWD data were evaluated based upon LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 22; Figure 13). Pieces per 100

meters rated good in segments 1a, 1b, and 2e and fair in segments 2a-2d, 2g, 2h, 3b, and 4b, and poor in the other segments. Pieces per BFW rated in good in segments 1a-2i and 3b-4b, and fair in segments 3a and 5a-5c. Segment 6 rated poor for pieces/BFW. Key pieces/BFW rated poor in all segments except segment 2b, 2c, and 2e where segments rated fair. Large pieces/BFW rated good in segment 1a-2c and segment 2e. Large pieces/BFW rated fair in segments 2d, and 2f-2h and poor in the remaining segments. Pool forming pieces/BFW exceeded 2 pieces/BFW in segments 1a, 1b, and 2e. Pool forming pieces/BFW ranged from 1-2 pieces/BFW in segments 2a-2d, 2h, and 4b, the remaining habitat segments had less than one pool forming piece/BFW. LWD conditions were best in segments 1a-2e and poorest in segments 2i, 3a, and 5a-6.

Table 22. LWD Data for Umbrella Creek Habitat Segments**.**

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces per 100 M	LWD Pieces per BFW	Key Pieces per BFW	Percent of Pieces Large (>50cm)	Large Pieces per BFW	Pool Forming Pieces per BFW	Percent of Pieces Pool Forming
1a	PS-22	354	70.8	11.3	0.06	18.1%	2.0	4.3	38.1%
1b	PS-23	607	75.9	14.0	0.07	22.5%	2.9	4.7	33.6%
2a	PS-24	229	45.8	6.7	0.12	36.7%	2.5	1.5	21.8%
2b	PS-25	261	52.2	9.7	0.30	28.4%	2.8	1.6	16.5%
2c	PS-26	218	43.6	7.3	0.27	28.4%	2.1	1.4	19.7%
2d	PS-27	222	44.4	7.0	0.19	22.1%	1.5	1.1	15.3%
2e	PS-28	345	69.0	11.8	0.24	23.2%	2.7	2.1	17.7%
2f	PS-29	142	28.4	4.7	0.13	27.5%	1.3	0.9	18.3%
2g	PS-30	262	52.4	8.6	0.10	22.9%	2.0	0.9	10.7%
2h	PS-31	226	45.2	7.7	0.00	21.7%	1.7	1.5	19.5%
2i	PS-32	209	29.9	4.1	0.04	12.4%	0.5	0.4	10.5%
3a	PS-33	151	30.2	3.8	0.05	15.2%	0.6	0.5	13.2%
3b	PS-34	238	47.6	6.1	0.08	11.8%	0.7	0.9	15.5%
3c	PS-35	180	36.0	4.1	0.02	15.6%	0.6	0.2	3.9%
4a	PS-36	190	38.0	5.1	0.05	4.7%	0.2	0.8	15.3%
4b	PS-37	249	49.8	7.8	0.03	8.8%	0.7	1.8	22.9%
5a	PS-38	126	25.2	3.3	0.00	20.6%	0.7	0.6	18.3%
5b	PS-39	125	25.0	2.5	0.08	13.6%	0.3	0.4	15.2%
5c	PS-40	212	30.3	2.9	0.04	12.3%	0.4	0.3	9.9%
6	PS-41	188	24.4	1.6	0.02	10.6%	0.2	0.3	20.7%

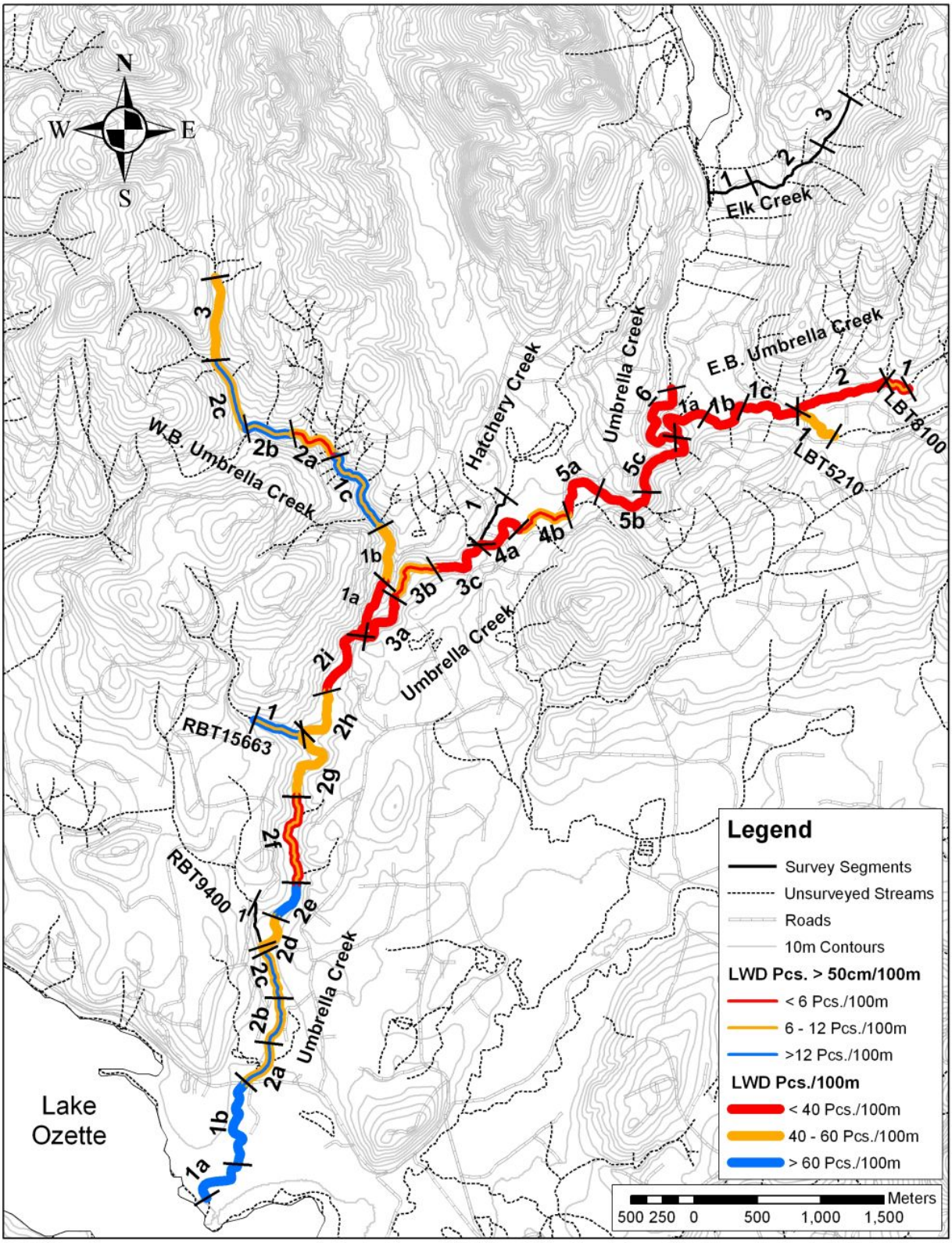

Figure 13. Umbrella Creek Watershed LWD > 50cm and Total Piece Counts/100m by Segment.

3.4.2.2 POOL CONDITIONS

Pool habitat data for the 6 channel segments and 20 habitat segments described above were summarized and evaluated at the habitat segment level. Attributes used in the evaluation included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, pool cover, and percent of pools formed by LWD (Table 23;Figure 14). Pool frequency rated good in habitat segments 2b and 2c and poor in segments 2i, 3c, 5b, and 5c; all other segments rated fair. Pool frequency was between 2.0 to 2.4 in segments 1a, 1b, 2d, 2e, and 4b, nearly qualifying for a good pool frequency rating. Percent pool rated good in segments 1a-2h and 3b, while segments 2i-3a, and 4b rated as fair. All other segments rated poor. Percent of pools with adequate woody cover rated good in segments 1a and 1b, and fair in segments 2a-2d, 3b, 3c, 4b, and 5a; all other segments rated poor. Holding pools deeper than 1 meter rated good in habitat segments 1a-2h, 3a, and 4b, and fair in segments 4a, 5a, and 5b; all other segments rated as poor. The best pool habitat conditions were found in segments 1a-2h and 4b, the poorest conditions were found in segments 2i, 3c, 4a, 5b, 5c, and 6.

Table 23. Umbrella Creek Pool Habitat Data.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Freq.	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/ km	Percent of Pools Formed by LWD
1a	PS-22	<1%	15.9	2.1	87%	1.20	0.85	29.2	18	100%
1b	PS-23	<1%	18.4	2.1	73%	1.27	0.96	28.8	19	100%
2a	PS-24	<1%	14.7	2.8	72%	1.16	0.89	28.4	12	92%
2b	PS-25	<1%	18.6	1.8	71%	1.02	0.81	24.5	14	100%
2c	PS-26	<1%	16.7	1.6	74%	1.01	0.85	20.6	18	74%
2d	PS-27	<1%	15.8	2.4	66%	1.01	0.82	26.5	12	85%
2e	PS-28	<1%	17.1	2.0	72%	0.86	0.76	21.0	12	93%
2f	PS-29	<1%	16.4	3.0	81%	1.11	1.00	40.1	18	80%
2g	PS-30	<1%	16.5	2.5	79%	1.12	0.91	33.0	12	50%
2h	PS-31	<1%	17.1	2.7	62%	0.99	0.77	29.3	10	91%
2i	PS-32	<1%	13.6	4.7	50%	0.73	0.63	31.0	1	55%
3a	PS-33	1-2%	12.7	4.4	46%	0.95	0.78	29.2	8	67%
3b	PS-34	1-2%	12.8	2.8	59%	0.73	0.56	18.8	4	93%
3c	PS-35	1-2%	11.4	4.4	28%	0.75	0.57	15.0	2	30%
4a	PS-36	1-2%	13.5	2.9	37%	0.82	0.65	13.3	6	62%
4b	PS-37	1-2%	15.7	2.1	43%	0.88	0.73	14.1	10	80%
5a	PS-38	1-2%	13.0	3.8	25%	0.93	0.75	13.2	8	60%
5b	PS-39	1-2%	10.1	6.2	22%	0.92	0.76	13.9	6	75%
5c	PS-40	1-2%	9.5	4.3	27%	0.70	0.55	11.5	1	35%
6	PS-41	1-2%	6.7	4.0	36%	0.52	0.43	9.6	0	69%

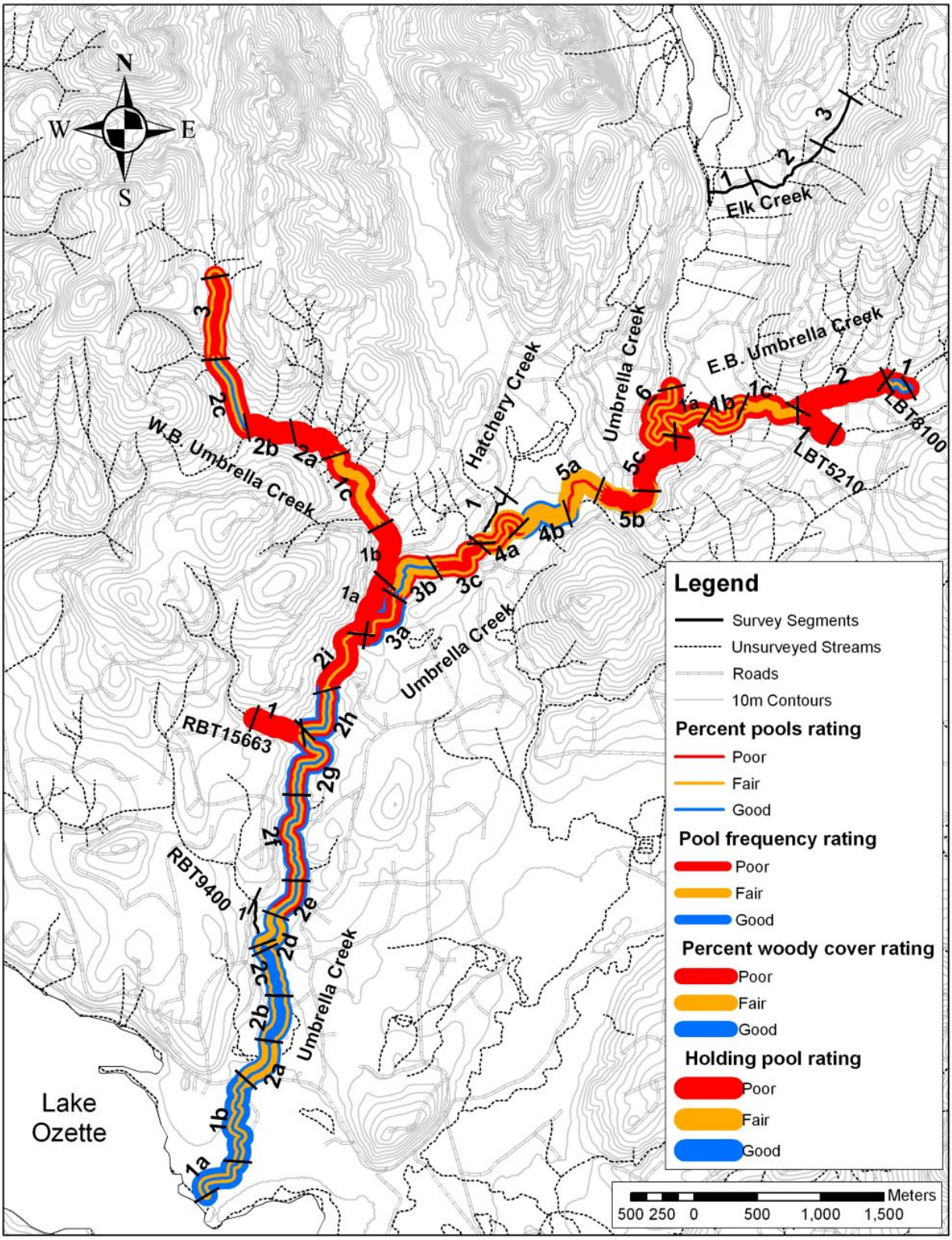

Figure 14. Umbrella Creek Watershed Pool Habitat Condition Ratings.

A total of 279 pools were inventoried in the Umbrella Creek mainstem. The average maximum pool depth was 0.92 meters and the average pool length was 21.7m. The quality of pool habitat appears to be directly correlated with LWD conditions. The best pool conditions were typically found where LWD conditions rated the highest. LWD pieces formed pools with increasing frequency as piece size increased. Nearly 57% of key-sized LWD formed pools while only 13% of small LWD were considered pool forming. Key LWD made up only 1% of the total LWD abundance and had a frequency of only 0.08 pieces/CW but formed 17% of the total pool habitat (by length). Small LWD independent of larger LWD formed only 1% of the total pool habitat. LWD >50 cm diameter made up 19% of the total LWD count but formed 65% of the total pool habitat by length.

A finer analysis of individual pool attributes revealed that on average pools formed by the largest LWD were the deepest, longest, and had the highest percent of woody cover (Table 24). Pools formed by key piece size LWD averaged nearly 1.8 times deeper than pools formed by medium or small LWD and free-formed pools without LWD. Key piece formed pools were typically twice as long as pools formed by medium or small LWD and free-formed pools without LWD. The quality of individual pools within Umbrella Creek appears to be directly linked to pool forming agents. Figure 15, illustrates the role of large wood in forming deep pools with good cover conditions. The loss of large and key piece sized LWD has significantly reduced the number of pools throughout large sections of Umbrella Creek. Furthermore, the quantity of high quality pool habitats has been reduced throughout the entire mainstem.

Table 24. Umbrella Creek Pool Conditions Grouped by Primary Pool Forming Agent.

Pool Forming Agent	Number of Pools	Avg Max Pool Depth	Avg Res. Pool Depth	Avg Pool Length	Avg No. of Pieces of LWD Forming Pools	0-5% Woody Cover in Pool	6-20% Woody Cover in Pool	>20% Woody Cover in Pool
Key	35	1.24	1.08	29.1	6.3	35%	29%	35%
L+	59	1.12	0.89	27.8	5.7	33%	23%	44%
L/L-	49	1.00	0.79	25.9	4.6	48%	33%	19%
Medium	61	0.70	0.55	15.8	2.2	53%	31%	16%
Small	6	0.69	0.56	9.8	2.5	60%	20%	20%
Free-formed	63	0.71	0.54	16.8	0.0	88%	5%	7%
Free-formed w/LWD	4	1.16	0.97	12.6	2.5	50%	25%	25%

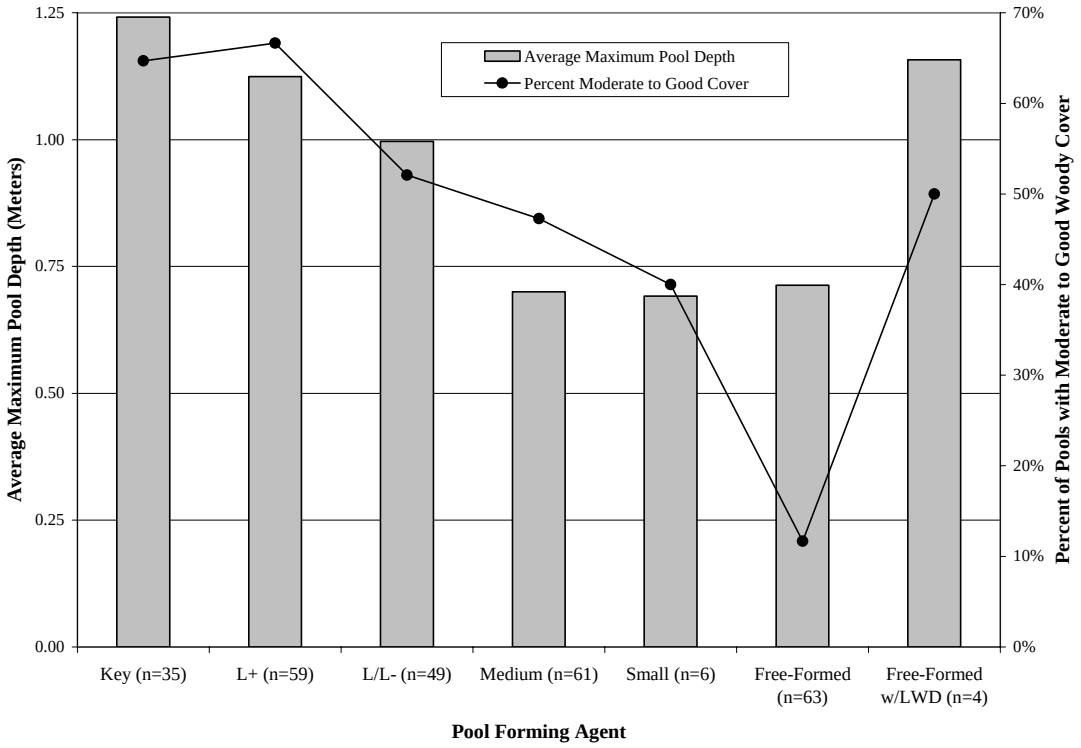

Figure 15. Relationship between Primary Pool Forming Agent and Pool Depth and Cover for Umbrella Creek.

3.4.3 UMBRELLA CREEK TRIBUTARIES

During channel and habitat surveys in the mainstem of Umbrella Creek, numerous tributaries were identified as containing anadromous fish habitat. Six stream systems contain the majority of anadromous fish habitat found in the tributaries to Umbrella Creek. All six stream systems were included in the channel surveys (Figure 11). A total of 10,182 meters of channel data were collected in the six stream systems surveyed. Extensive habitat data were collected in the two largest stream systems (East and West Branch Umbrella Creek). Additional habitat data were collected in RBT 15,663. No habitat data were collected in RBT 9,400, the Hatchery Creek (20.0056), or Elk Creek. Two examples of stream systems that provide off-channel rearing habitat in wetland complexes, including forested wetlands, are located near the Hoko-Ozette Road Bridge. The smaller of the two is a right bank tributary just downstream of the bridge. The other is a right bank tributary just upstream of the bridge. No channel or habitat data were collected in either of these streams. Another unsurveyed tributary that is known to provide coho, steelhead, and sockeye spawning habitat is the first right bank tributary downstream of the Hatchery Creek.

3.4.3.1 UNNAMED RBT 9,400 WATERSHED AND CHANNEL DESCRIPTION

A right bank tributary located 2,865 meters (9,400 ft) upstream from the SOS was given the identity RBT 9,400 (Figure 11). This stream drains a small basin less than 0.5 square miles (1.3km^2) in area. The stream flows from the north-northwest and is underlain by gentle sloping Pleistocene age glacial till and drift deposits. Delineation of the basin area was difficult because of the low relief between adjacent watersheds. Only 366 meters of stream channel were surveyed. The first 300 meters of the stream were moderately confined and 1-2% gradient (Table 25). The gradient increased slightly upstream of 300 meters and the channel became confined. Upstream of the EOS the gradient continued to increase and the stream flow went subsurface. Stream width averaged about 3.7 meters in the channel segment surveyed. Wetted width measurements were taken on August 26, 1999 and averaged 1.7 meters. The survey was ended early because of very brushy conditions and the fact that the stream bed was mostly dry. Additional habitat exists upstream of the EOS but stream gradient appears to increase to >8% for a few hundred meters before decreasing again.

Table 25. RBT 9,400 Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
RBT 9,400	na	na	366	366	1-2%	M	3.7	98.3

3.4.3.2 UNNAMED RBT 15,663 WATERSHED AND CHANNEL DESCRIPTION

The right bank tributary located 4,774 meters (15,663 ft) upstream from the SOS was given the identity, RBT 15,663 (Figure 11). This stream drains a small basin approximately 0.39mi^2 (1.01km^2) in area. The stream flows from the northwest and the lower half of the watershed is underlain by Pleistocene age glacial till and drift deposits. The upper watershed is underlain by Oligocene-Eocene age marine sedimentary rock units. Only 409 meters of stream channel were surveyed (Table 26). The first 50 meters of the stream were moderately confined and the rest of the channel was confined. Stream gradient increased from 1-2% at the confluence to 2-4% upstream. Bankfull width averaged about 4.3 meters in the channel segment surveyed. Wetted width measurements were taken on August 23, 1999 and averaged 2.3 meters. The survey ended at the second large potential fish-blocking logjam located 409 meters upstream from the SOS. This jam was 2.4 meters high by 6.1 meters wide by 4.6 meters long. The first jam was located 26 meters downstream and measured 2.1 meters high by 7.6 meters wide by 2.4 meters long. Substrate was noted as being mostly cobble and boulder throughout the channel segment, but from 250-350 meters small patches of spawning gravel were also present.

Table 26. RBT 15,663 Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
RBT 15,663	1	PS-55	409	409	2-4%	C	4.3	101.4

3.4.3.3 UNNAMED RBT 15,663 LWD and POOL HABITAT CONDITIONS

A total of 280 pieces were inventoried of which 79%, 16%, and 5% were categorized as conifer, deciduous, and unknown respectively. Just over 3% of the 280 pieces inventoried were classified as key pieces. Large and L+ pieces accounted for only 14% of the LWD count, while medium (57%) and small (26%) pieces made up the remaining 83%. At the segment level LWD data were evaluated based upon LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 27; Figure 13). LWD/100 meters and LWD/BFW rated good and fair respectively. Key and large pieces per channel width rated poor but this could partially be a function of the small channel width. There were just over 11 pieces of LWD > 50 cm diameter per 100 meters. Channel confinement and gradient likely decreased the influence of LWD in this stream; just over 38% of the LWD > 50 cm diameter were either bridged across the channel or part of the two large logjams described above. Pool forming pieces per BFW and percent of pieces pool forming were quite low, 0.1 and 3.6% respectively.

Table 27. Segment Level LWD Data for Unnamed RBT 15,663.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-55	280	68.5	2.8	0.09	16.8%	0.5	0.1	3.6%

Pool habitat data were evaluated at the segment level using the following attributes: pool frequency, percent pools (by length), average maximum pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 28; Figure 14). Pool frequency, percent pool, and holding pools all rated poor. Pool cover rated fair since half of the pools had > 5% woody cover. A total of only 8 pools were inventoried and maximum pool depth averaged only 0.49 meters. Only two pools deeper than 0.6 meters were identified and both were formed by LWD > 50 cm diameter. Only 2 pools were formed independent of LWD (free-formed w/out LWD). Only 3.6% of LWD formed pools. The poor pool conditions found in this stream are difficult to explain. Poor pool conditions may be a function of the physical habitat potential in this stream, or from the results of past management activities. Additional stream surveys are necessary in order to fully understand the potential habitat qualities of this stream.

Table 28. Segment Level Pool Data for RBT 15,663.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1	PS-55	2-4%	4.0	9.2	16%	0.49	0.44	6.1	0	64%

3.4.3.4 WEST BRANCH UMBRELLA CREEK WATERSHED AND CHANNEL DESCRIPTION

The West Branch Umbrella Creek is the second largest tributary to Umbrella Creek. The West Branch enters Umbrella Creek 5,964 meters upstream from the SOS. The watershed drains approximately 1.98mi^2 (5.13km^2) of land and has two large tributaries, as well as several smaller fish bearing streams and numerous feeder tributaries. The largest two tributaries are both unnamed but have WRIA numbers (20.0054 and 20.0055). No surveys were conducted in any of the tributaries to the West Branch. There is likely about 1 mile of anadromous fish habitat in four tributaries that were identified during channel surveys. Each of the four streams (LBT 5,954, 20.0054, RBT 8,780, and 20.0055) has a short length of 300-600 meters of lower gradient habitat (2-5%) before gradients increase as the streams ascend into steeper topography.

The mainstem of the West Branch flows predominately south-southeast from its headwaters. The course of the mainstem is almost exclusively underlain by Pleistocene age glacial till and drift deposits. The stream has downcut through glacial deposits over the last several thousand years, leaving a well defined gully. This same course of incision is also apparent in the major tributaries to the West Branch. Headwater tributaries draining the upper third of the basin and a large portion of the west side drain topography of moderate steepness underlain by Oligocene-Eocene age marine sedimentary rock units.

The mainstem of the West Branch was surveyed during the summer of 1999 from the confluence with Umbrella Creek upstream 4,054 meters. The surveyed channel was divided into 3 main channel segments with 7 habitat segments (Table 29; Figure 11). The first channel segment of the West Branch Umbrella Creek is confined with small areas of moderate confinement and maintains a 1-2% gradient. BFW ranged from 6-13 meters, averaging 9 meters. Wetted width measurements were recorded from August 3-4, 1999 and averaged 3.7 meters. The break between segment 1 and 2 is 1,800 meters upstream from the confluence near LBT 5,954. Segment 2 extends from segment 1 to an area just upstream of unnamed tributary 20.0055. The channel is confined throughout the segment. Gradient averaged 2-4% with localized areas (<50m) of 6-8% gradient and BFW averaged 7.1 meters. Wetted width measurements ranged from 0.7 to 7.2 meters, averaging 2.6 meters. Segment 3 extends from segment 2 to point were stream width decreases to about 3 meters and the contributing basin size is quite small. Stream gradient averaged 2-4% with localized areas (<50m) of 6-8% gradient. The channel remained confined and BFW diminished to an average of only 4 meters. Wetted widths averaged 1.5 meters in segment 3. Very little if any habitat is upstream of the EOS.

Table 29. West Branch Umbrella Creek Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment length	Gradient	Confine-ment	BFW	Number of BFWs
W.B. Umbrella Creek	1a	PS-42	500	500	1-2%	C	9.8	51.2
W.B. Umbrella Creek	1b	PS-43	1,000	500	1-2%	C-M	8.4	59.5
W.B. Umbrella Creek	1c	PS-44	1,800	800	1-2%	C-M	8.5	93.6
W.B. Umbrella Creek	2a	PS-45	2,300	500	2-4%	C	7.8	64.3
W.B. Umbrella Creek	2b	PS-46	2,800	500	2-4%	C	6.8	73.1
W.B. Umbrella Creek	2c	PS-47	3,400	600	2-4%	C-M	6.8	88.3
W.B. Umbrella Creek	3	PS-48	4,054	654	2-4%	C	4.0	165.4

3.4.3.5 WEST BRANCH UMBRELLA CREEK HABITAT CONDITIONS

3.4.3.5.1 LWD Conditions

Habitat data were collected in all of the 3 channel segments and 7 habitat segments described in Section 3.4.3.4. LWD data were summarized at the watershed scale, as well as at the habitat segment and 100 meter LWD band level. In the mainstem of the West Branch, a total of 2,362 pieces of LWD were inventoried, of which 75%, 24%, and 1% were categorized as conifer, deciduous, and unknown respectively. Almost 3% of the 2,362 pieces of LWD inventoried were classified as being key pieces. Large and L+ pieces accounted for 14% of the LWD inventoried, while medium (52%) and small (31%) pieces made up the remaining 83%. At the LWD band level, only 18% of the bands had 40 or fewer pieces, while 52% had 41-60 pieces, 15% had 61-80 pieces per 100 meters, and 15% of the LWD Bands had greater than 80 pieces per 100 meters. (Figure 16). The LWD bands with the lowest LWD counts included: LWD Bands 3, 20, and 24. LWD bands 13, 26, and 29 had the highest piece counts.

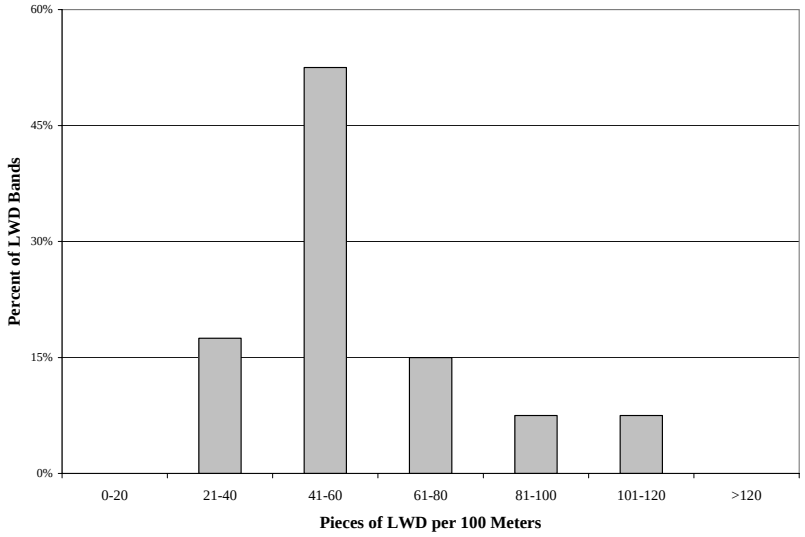

Figure 16. W.B. Umbrella Creek LWD Bands within Specified LWD Count Categories.

At the segment level, LWD data were evaluated based upon LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 30; Figure 13). Pieces per 100 meters rated good in segments 1c and 2b, fair in segments 1b, 2a, 2c, and 3, and poor in segment 1a. Pieces per BFW rated good in segments 1b, 1c, 2b, and 2c, and fair in segments 1a, 2a, and 3. No segments rated poor for pieces/BFW. Key pieces/BFW rated poor in all segments except segments 2c and 3 where the rating was fair. Large pieces/BFW rated fair in segments 1a-1c, 2b, 2c, and 3. Large pieces/BFW rated poor in segment 2a (0.46 pieces/BFW). Segment 3 contained more large pieces per 100 meters than segment 1a and 1b. Pool forming pieces/BFW was very low throughout the entire stream, ranging from 0.2-0.4 pieces/BFW. The percent of LWD that was classified as pool forming was also low throughout the stream system, ranging from a low of 3.4% in segment 1b to 13.4% in segment 3. The overall LWD conditions were rated fair to good in all segments except 1a and 2a where the overall conditions were poor. Larger LWD were classified as pool forming at a higher rate than smaller sized LWD. Over 27% of the key pieces were pool-forming while only 2% of LWD classified as small were pool forming. Approximately, 27%, 22%, and 18% of L+, L/L-, and medium sized pieces were pool forming respectively.

Table 30. LWD Data for W.B. Umbrella Creek Habitat Segments**.**

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces per 100 M	LWD Pieces per BFW	Key Pieces per BFW	Percent of Pieces Large (>50cm)	Large Pieces per BFW	Pool Forming Pieces per BFW	Percent of Pieces Pool Forming
1a	PS-42	196	39.2	3.8	0.04	13.3%	0.5	0.3	8.7%
1b	PS-43	291	58.2	4.9	0.10	15.5%	0.8	0.2	3.4%
1c	PS-44	528	66.0	5.6	0.05	15.5%	0.9	0.4	7.4%
2a	PS-45	244	48.8	3.8	0.11	12.3%	0.5	0.2	4.9%
2b	PS-46	401	80.2	5.5	0.07	12.0%	0.7	0.3	6.2%
2c	PS-47	356	59.3	4.0	0.24	23.0%	0.9	0.4	8.7%
3	PS-48	346	52.9	2.3	0.16	22.0%	0.5	0.3	13.0%

3.4.3.5.2 Pool Conditions

Pool habitat data for the 7 segments described above were summarized and evaluated at the segment level. Pool attributes used in the evaluation included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, pool cover, and percent of pools formed by LWD (Table 31; Figure 14). Pool frequency rated fair in habitat segments 1c and 2c and poor in all other segments. Percent pools rated good in segment 2c, and fair in segment 1c, and poor in all the other segments. Percent of pools with adequate woody cover rated fair in segment 3 and poor in all the other segments. Holding pools deeper than 1 meter rated poor in all habitat segments. There were 4 and 3 pools deeper than 1 meter/km in segments 1a and

1c respectively. The best pool habitat conditions were found in segments 1c and 2c and the other segments were all rated as having poor overall pool conditions.

Table 31. W.B. Umbrella Creek Pool Habitat Data.

Habitat Segment	Pool Segment ID	Gradient	BFW	Pool Freq	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1a	PS-42	1-2%	9.8	4.3	29%	0.68	0.58	12.0	4	67%
1b	PS-43	1-2%	8.4	5.4	27%	0.60	0.51	12.2	0	45%
1c	PS-44	1-2%	8.5	3.0	43%	0.63	0.54	11.2	3	71%
2a	PS-45	3.2%	7.8	7.1	17%	0.58	0.44	9.2	0	67%
2b	PS-46	3.3%	6.8	4.1	27%	0.59	0.46	7.4	0	67%
2c	PS-47	3.3%	6.8	2.7	48%	0.50	0.44	8.6	0	45%
3	PS-48	3.0%	4.4	5.0	20%	0.49	0.41	4.4	0	80%

Pool conditions appear to be less influenced by the quantity and quality of LWD in the West Branch Umbrella Creek than in other streams surveyed within the Ozette Basin. This is likely a function of the confined channel conditions found throughout this stream system. Natural physical channel and valley conditions likely influence the pool habitat potential in this stream. Nonetheless, LWD still significantly affected pool habitat conditions throughout the watershed. A total of 144 pools were inventoried in the mainstem. The average maximum pool depth was 0.56 meters and the average pool length was 8.6 meters. The best pool conditions were found where LWD conditions rated the highest. However, not all of the habitat segments with the highest LWD condition ratings had fair or good pool habitat conditions. A finer analysis of individual pool attributes showed that 15 pools were greater than or equal to 0.85 meters deep. All 15 pools were formed by LWD and 80% of these pools were formed by LWD > 50 cm diameter. Pool attributes grouped by pool forming agent are depicted in Table 32.

Table 32. W.B. Umbrella Creek Pool Conditions Grouped by Primary Pool Forming Agent.

Pool Forming Agent	Number of Pools	Avg Max Pool Depth	Avg Res. Pool Depth	Avg Pool Length	Avg No. of Pieces of LWD Forming Pools	0-5% Woody Cover in Pool	6-20% Woody Cover in Pool	>20% Woody Cover in Pool
Key	17	0.70	0.62	7.8	2.5	20%	33%	47%
L+	9	0.69	0.58	7.1	1.6	50%	50%	0%
L/L-	30	0.65	0.56	9.0	2.2	52%	33%	15%
Medium	33	0.53	0.44	8.2	1.5	66%	28%	6%
Small	3	0.43	0.36	5.4	1.0	67%	33%	0%
Free-formed	52	0.48	0.39	9.5	0.0	81%	17%	2%

3.4.3.6 HATCHERY CREEK (20.0056) WATERSHED AND CHANNEL DESCRIPTION

Unnamed tributary 20.0056 is locally known as the Hatchery Creek. This stream is the water supply for the Makah Tribe's Umbrella Creek hatchery facility. The stream is a right bank tributary located 7,520 meters upstream from the SOS on Umbrella Creek. Hatchery Creek is the third largest independent tributary to Umbrella Creek and has a basin area of 0.68mi^2 (1.76km^2). The stream flows from north to south. The mainstem and its associated valley are underlain by gently sloping Pleistocene age glacial till and drift deposits. The current stream channel shares a very low elevation and nearly flat divide with Pilchuck Creek (Sooes River tributary) providing further evidence of the influence past glaciations have had on the channel network. The extreme upper end of the channel network is underlain by Miocene-Eocene age sheared silt and sandstones which compose a part of the Elk Lake Block. Only 457 meters of stream channel were surveyed (Table 33). The first 100 meters of the stream are totally confined and quite steep with an average gradient of 8-10%. Stream gradient quickly decreases to 1-3% upstream of the road crossing (about 100 meters upstream from the confluence with Umbrella Creek). Bankfull width averaged about 5.5 meters in the channel segment surveyed. Wetted width measurements were taken on August 3, 1999 and averaged 2.5 meters. The survey ended due to extremely brushy conditions. However a significant amount of habitat exists upstream from the end of the survey. No habitat data were collected in this stream system.

Table 33. Hatchery Creek Channel Segment Attributes

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Hatchery Creek	na	na	457	457	1-3%	M-C	5.5	83.5

3.4.3.7 EAST BRANCH UMBRELLA CREEK WATERSHED AND CHANNEL DESCRIPTION

The East Branch Umbrella Creek is the largest tributary to Umbrella Creek. The confluence of the two streams is located at the segment break between segment 5 and 6 (10,187m upstream from the SOS) of Umbrella Creek. The East Branch drains approximately 2.15mi^2 (2.57km^2; Table 34) and has a wide variety of channel types. There are several noteworthy tributaries and at least three that provide anadromous fish habitat: RBT 621, LBT 5,210, and LBT 8,100. The mainstem flows predominately from east to west. The lower 2,500 meters of the mainstem and valley are exclusively underlain by Pleistocene age glacial drift and till deposits. The tributaries entering the lower half of the mainstem drain hills of moderate to low relief. Headwater streams entering from the north drain steeper topography which is underlain by Eocene-Miocene age tectonic breccias, and marine derived silt- and sandstone rock units.

Table 34. East Branch Umbrella Creek Watershed Areas.

Watershed/Sub-basin	Watershed Area	
	Mi^2	km^2
E.B. Umbrella Creek Watershed	2.15	5.57
LBT 5210	0.56	1.45
East Branch upstream of LBT 5210	1.24	3.21

The East Branch was surveyed during the summer of 1999 from the confluence with Umbrella Creek upstream to the confluence with an unnamed left bank tributary (LBT 8,100) 2,469 meters (8,100ft) upstream of Umbrella Creek. The surveyed channel was divided into 2 main channel segments with 4 habitat segments (Table 35; Figure 11). The first channel segment is low gradient (0-2%) and is moderately confined with small confined sections. Bankfull width averaged 7.8 meters and wetted width measurements taken July 26, 1999 averaged 4.1 meters. The break between segment 1 and 2 is at the confluence with a large left bank tributary 1,600 meters upstream from the confluence with Umbrella Creek (LBT 5,210). Segment 2 extends upstream to the confluence with the LBT 8,100 at 2,469meters. Segment 2 remains low gradient (1-2%) and channel confinement opens up into mostly unconfined conditions. BFW averaged 5.8 meters and wetted width averaged 3 meters. The survey of the mainstem ended at segment 2 because as the mainstem turns to the north it gains approximately 200 meters elevation in less than 2 km (~10% gradient).

Table 35. East Branch Umbrella Creek Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment length	Gradient	Confine-ment	BFW	Number of BFWs
E.B. Umbrella Creek	1a	PS-49	500	500	0-2%	M-C	7.8	64.4
E.B. Umbrella Creek	1b	PS-50	1,000	500	0-2%	M-C	7.3	68.9
E.B. Umbrella Creek	1c	PS-51	1,600	600	0-2%	M	8.2	73.4
E.B. Umbrella Creek	2	PS-52	2,469	869	1-2%	U-M	5.8	150.0

3.4.3.8 EAST BRANCH UMBRELLA CREEK HABITAT CONDITIONS

3.4.3.8.1 LWD Conditions

Habitat data were collected in all four habitat segments described above. LWD data were summarized at the watershed scale, as well as at the habitat segment and 100 meter LWD band level. In the East Branch a total of 578 pieces of LWD were inventoried of which 96% and 4% were categorized as conifer and deciduous respectively. A little more than 3% of the pieces were classified as key pieces. Large and L+ pieces accounted for 14% of the LWD inventoried, while medium (63%) and small (19%) pieces made up the remainder. At the LWD band level 82% of the bands had 40 or fewer pieces, while 8% had 41-60 pieces; no LWD bands had greater than 48 pieces/100 meters (Figure 17). The

LWD bands with the lowest LWD counts included: LWD Bands 5, 16, and 20. LWD bands 9, 10, and 24 had the highest piece counts.

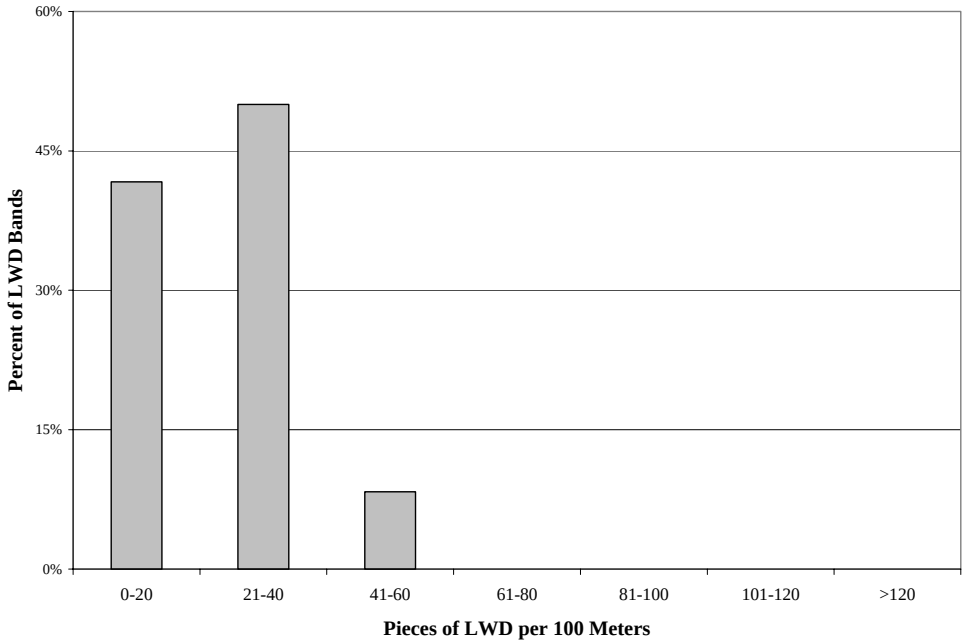

Figure 17. E.B. Umbrella Creek LWD Bands within Specified LWD Count Categories.

At the segment level, LWD data were evaluated based upon LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 36; Figure 13). Pieces per 100 meters rated poor in all segments. Pieces per BFW rated poor in segments 1a, 1c, and 2, and fair is segment 1b. Key and large pieces/BFW rated poor in all segments. Pool forming pieces/BFW ranged from 0.2-0.4 and was considered poor in all segments. The percent of LWD forming pools was very low in segment 1a; this may be an error in data recording (LWD data often lacked complete data records for pool forming attributes within this dataset.). Other segments ranged from 12-18% of the pieces acting to form pools. In general, LWD conditions were poor throughout the entire stream system.

Table 36. LWD Data for E.B. Umbrella Creek Habitat Segments.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces per 100 M	LWD Pieces per BFW	Key Pieces per BFW	Percent of Pieces Large (>50cm)	Large Pieces per BFW	Pool Forming Pieces per BFW	Percent of Pieces Pool Forming
1a	PS-49	90	18.0	1.4	0.00	22.2%	0.3	0.0	1.1%
1b	PS-50	160	32.0	2.3	0.13	16.9%	0.4	0.4	18.1%
1c	PS-51	135	22.5	1.8	0.05	17.0%	0.3	0.2	11.9%
2	PS-52	193	22.2	1.3	0.05	16.6%	0.2	0.2	13.0%

3.4.3.8.2 Pool Conditions

Pool habitat data for the 4 habitat segments described above were summarized and evaluated at the habitat segment level. Attributes used in the evaluation included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and pool cover (Table 37; Figure 14). Pool frequency rated fair in habitat segments 1a and 1c, and poor in segments 1b and 2. Pool frequency was 4.1 in segment 1b, nearly qualifying it for a fair pool frequency rating. Percent pool rated fair in segments 1b and 1c and poor in segments 1a and 2. Percent of pools with adequate woody cover rated fair in segment 1b and poor in segments 1a, 1c, and 2. Holding pools deeper than 1 meter/km rated poor in all habitat segments. The best pool habitat conditions were found habitat segments 1b and 1c, the poorest conditions were found in segments 1a and 2.

Table 37. E.B. Umbrella Creek Pool Habitat Data.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Freq.	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/ km	Percent of Pools Formed by LWD
1a	PS-49	0-2%	7.8	4.0	28%	0.53	0.42	8.8	2	19%
1b	PS-50	0-2%	7.3	4.1	42%	0.71	0.61	12.7	4	65%
1c	PS-51	0-2%	8.2	2.7	48%	0.63	0.50	10.6	3	48%
2	PS-52	1-2%	5.8	5.0	33%	0.54	0.42	9.5	0	50%

A total of 90 pools were inventoried in the East Branch. Maximum pool depth and pool length averaged 0.6 and 10.3 meters respectively. A finer scale analysis of LWD and pool conditions could not be done because the E.B. Umbrella Creek data were not consistently collected. A large portion of the data didn't include pool forming agents or link LWD pieces to individual pools.

3.4.3.9 EAST BRANCH UMBRELLA CREEK TRIBUTARIES

3.4.3.9.1 Unnamed LBT 5,210 Watershed and Channel Description

A left bank tributary located 1,588 meters (5,210ft) upstream from the SOS was given the identity, LBT 5,210. This stream drains a small basin approximately 0.56mi^2 (1.45km^2) in area. The stream flows from east to west and is underlain by gentle sloping Pleistocene age glacial till and drift deposits. The main headwater tributaries drain from the south and are underlain by Oligocene-Eocene age marine sedimentary rock units. Only 396 meters of stream channel were surveyed (Table 38; Figure 11). The stream channel was moderately confined and maintained a gradient of 1-2%. Evidence of beaver activity was noted along the stream. Substrate conditions were noted as being mostly small cobble and spawning gravel was present in low quantities. Bankfull width averaged 5.1 meters. Wetted width measurements were taken on August 11, 1999 and averaged 3.7 meters. The survey ended before any obvious barrier to fish. Additional

habitat exists upstream of the EOS and stream gradient appears to remain <4% for several hundred meters.

Table 38. LBT 5,210 Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
LBT 5,210	1	PS-53	396	396	1-2%	M	5.1	76.9

3.4.3.9.2 Unnamed LBT 5,210 LWD and Pool Habitat Conditions

A total of 215 pieces of LWD were inventoried in the 396 meters of surveyed channel. Conifer composed 97% of the total LWD while deciduous and unknown LWD made up the remaining 3%. Of the 215 pieces inventoried, just less than 2% were classified as key pieces. Large and L+ pieces accounted for only 10% of the LWD count, while medium (55%) and small (33%) pieces made up the remaining 88%. At the segment level LWD data were evaluated based upon total LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 39; Figure 13). LWD/100 meters and LWD/BFW rated fair. Key and large pieces per channel width and percent of pieces > 50 cm diameter all rated poor. Only 7% of pieces were classified as pool forming.

Table 39. Segment Level LWD Data for Unnamed LBT 5,210.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-53	215	54.3	2.8	0.05	11.6%	0.3	0.2	7.0%

Pool habitat data were evaluated at the segment level using the following attributes: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 40; Figure 14). Pool frequency and percent pools both rated poor. The pools with adequate woody cover category also rated poor, as did holding pool frequency. A total of 15 pools were inventoried and maximum pool depth averaged 0.60 meters. Only 3 of the 15 pools were formed independent of LWD (free-formed w/out LWD). The relatively poor pool conditions found in this channel segment are likely related to the low number of LWD pieces > 50 cm diameter. The percent of pools formed by LWD suggests that LWD is an important factor contributing to pool formation. The low percentage of LWD pieces which were actually pool forming and the large substrate size may indicate that channel instability (current or past), such as channel incision, has affected pool conditions in this section. Channel incision/entrenchment was noted during data collection but further field

review of this stream would help to better understand current versus potential habitat conditions.

Table 40. Segment Level Pool Data for Unnamed LBT 5,210.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1	PS-53	1-2%	5.1	5.1	35%	0.60	0.48	9.1	0	73%

3.4.3.9.3 Unnamed LBT 8,100 Watershed and Channel Description

A left bank tributary located 2,469 meters (8,100ft) upstream from the SOS in the E.B. Umbrella Creek was given the identity, LBT 8,100. This stream drains a small basin approximately 0.61mi^2 (1.58km^2) in area. The stream flows from the east to the west and is underlain by gentle sloping Pleistocene age glacial till and drift deposits. The main headwater tributaries drain from the north and are underlain by Eocene-Miocene age marine sedimentary rock units. Only 213 meters of stream channel were surveyed (Table 41; Figure 11). The stream channel was moderately confined and maintained a gradient of 1-2%. Substrate conditions were not examined in detail but spawning gravel was noted as being fair in this stream. Bankfull width averaged 5.8 meters and wetted width measurements were taken on August 10, 1999 and averaged 4.2 meters. The survey ended where the channel entered into a large wetland complex which appeared to be influenced by the local beaver population. Additional habitat exists upstream of the EOS and stream gradient appears to remain low for 800-1,000 meters. This channel should be further explored because it has the potential to provide some high quality coho habitat.

Table 41. LBT 8,100 Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
LBT 8,100	1	PS-54	213	213	1-2%	M	5.8	36.4

3.4.3.9.4 Unnamed LBT 8,100 LWD and Pool Habitat Conditions

A total of 79 pieces of LWD were inventoried in the 213 meters of channel that were surveyed. Conifer pieces composed 91% of the total LWD while deciduous LWD made up the remaining 9%. Of the 79 pieces inventoried none were classified as key pieces. Large and L+ pieces accounted for 19% of the LWD count, while medium (38%) and small (43%) pieces made up the remaining 81%. At the segment level, LWD data were evaluated based upon total LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table

42; Figure 13). LWD/100 meters rated poor and LWD/BFW rated fair. Key and large pieces per channel width and percent of pieces > 50 cm diameter all rated poor. The percent of pieces that were classified as pool forming equaled 14%.

Table 42. Segment Level LWD Data for Unnamed LBT 8,100.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-54	79	37.1	2.2	0.00	19.0%	0.4	0.3	13.9%

Pool habitat data were evaluated at the segment level using the following attributes: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 43; Figure 14). Percent pools rated good but pool frequency rated poor. The pools with adequate woody cover category rated as poor, as did holding pool frequency. A total of 14 pools were inventoried and maximum pool depth averaged 0.53 meters. The short survey length in this stream makes it difficult to accurately describe pool and LWD habitat conditions. In general, percent of channel in pool habitat appeared to be relatively high but the quality of pool habitats was mostly poor; pools were relatively shallow with little cover.

Table 43. Segment Level Pool Data for Unnamed LBT 8,100.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1	PS-54	1-2%	5.8	2.6	75%	0.53	0.42	11.4	0	64%

3.4.3.10 ELK CREEK WATERSHED AND CHANNEL DESCRIPTION

Elk Creek (local name) is a left bank tributary located ~12,800 meters (42,000ft) upstream from the SOS on Umbrella Creek. Elk Creek is the fourth largest independent tributary to Umbrella Creek and has a basin area of 0.66mi^2 (1.71km^2). The stream flows from the north in the headwaters and then swings in an almost perfect arc to flow from east to west at the confluence with Umbrella Creek. The lower section of the watershed is underlain by Pleistocene age glacial drift deposits. The upper portion of the watershed is underlain by a mix of Miocene-Eocene age tectonic breccias, sandstone, conglomerate, and sheared silt and sandstone rock units, which compose a part of the Elk Lake Geologic Block. A total of 1,748 meters of channel were surveyed and the channel system was broken into three discrete channel segments (Figure 11). Channel segment 1 started at the confluence with Umbrella Creek and continued upstream for 400 meters. Stream gradient was <1% and channel confinement was classified as unconfined (Table 44).

Bankfull width averaged 4.6 meters and wetted width measurements taken on July 19, 1999 averaged 0.7 meters. No surface water was observed in the upper 250 meters of segment 1, but where the channel became more confined near the segment break, surface flow was present. Several large salmon or steelhead redds were still visible in the section of channel with subsurface flow.

Segment 2 continued upstream from segment 1 and ended about 70 meters upstream of CZ-9000 Road. Stream gradient averaged 1-2% and channel confinement was classified as moderate. Bankfull width averaged 5.7 meters and wetted widths averaged 3.2 meters. Segment 3 ended at a large right bank tributary 1,748 meters upstream from the SOS. Stream gradient averaged 1-3% and the channel was mostly confined with small sections of moderate confinement. Bankfull width averaged 4.9 meters and wetted widths averaged 2.6 meters. The survey ended without locating an anadromous barrier and potential habitat exists upstream of the end of survey, as well as in the tributary at the end of the survey. No habitat data were collected in Elk Creek.

Table 44. Elk Creek Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Elk Creek	1	na	400	400	<1%	U	4.6	86.4
Elk Creek	2	na	1200	800	1-2%	M	5.7	139.2
Elk Creek	3	na	1818	618	1-3%	C	4.9	101.7

3.5 BIG RIVER

3.5.1 BIG RIVER WATERSHED AND CHANNEL DESCRIPTION

Big River is the largest tributary to Lake Ozette. Big River enters the lake at the north end of Swan Bay (west-northwest end of Lake Ozette). The Big River watershed drains approximately 22.8mi^2 (59.1km^2; Table 45) and has several significant tributaries. The largest tributary is Trout Creek followed by Dunham Creek, Solberg Creek, Boe Creek, Stony Creek, LBT 17,400, and unnamed tributary 20.0065. Additionally, several small to medium sized streams enter Big River upstream of the falls, and were not included in this assessment. The unsurveyed portion of the upper mainstem of Big River (upstream of the falls) is located in the most rugged terrain within the Ozette Watershed. The upper mainstem flows to the south-southeast across a relatively wide valley underlain by Pleistocene age glacial drift deposits. The northeast side of the valley is bound by topographically steep, Eocene age volcanic flows and breccias (Crescent Formation). The southwest side of the valley is bound by slightly less steep Oligocene-Eocene age marine sedimentary rock types. As the river exits this unique valley it plunges over the falls shortly before it turns nearly 90 degrees and begins to flow to the west-southwest. Below the falls, the mainstem meanders across a wide (~0.5 mi) valley composed of Pleistocene age glacial till and drift deposits before entering Lake Ozette.

Table 45. Big River Watershed Areas.

Watershed/Sub-basin	Watershed Areas	
	Mi^2	**km^2**
Dunham Creek	2.07	5.36
Trout Creek- entire watershed	5.14	13.31
LBT 17,400	0.59	1.53
Solberg Creek	1.44	3.73
Stony Creek	0.81	2.10
Boe Creek	1.09	2.82
Unnamed tributary 20.0065	0.44	1.14
Big River- entire watershed	22.79	59.02

The mainstem of Big River was surveyed during the summer of 1999 from Swan Bay Road upstream to the falls, a distance of 17,221 meters. The surveyed channel was divided into 5 main channel segments with 33 habitat segments (Table 46; Figure 18). Below Swan Bay Road, Big River is influenced by backwater effects from Lake Ozette during winter lake levels. This section, comprising approximately 2,500 meters of very low gradient channel between Swan Bay road and Lake Ozette, was not surveyed. The first surveyed channel segment of Big River is unconfined and very low gradient (<0.2%). BFW averaged 17 meters, and wetted width measurements taken on July 21, 1999, averaged 10 meters. The substrate in segment 1 was mostly composed of sand and small pebbles. Typically, the banks were high and steep, indicative of channel incision.

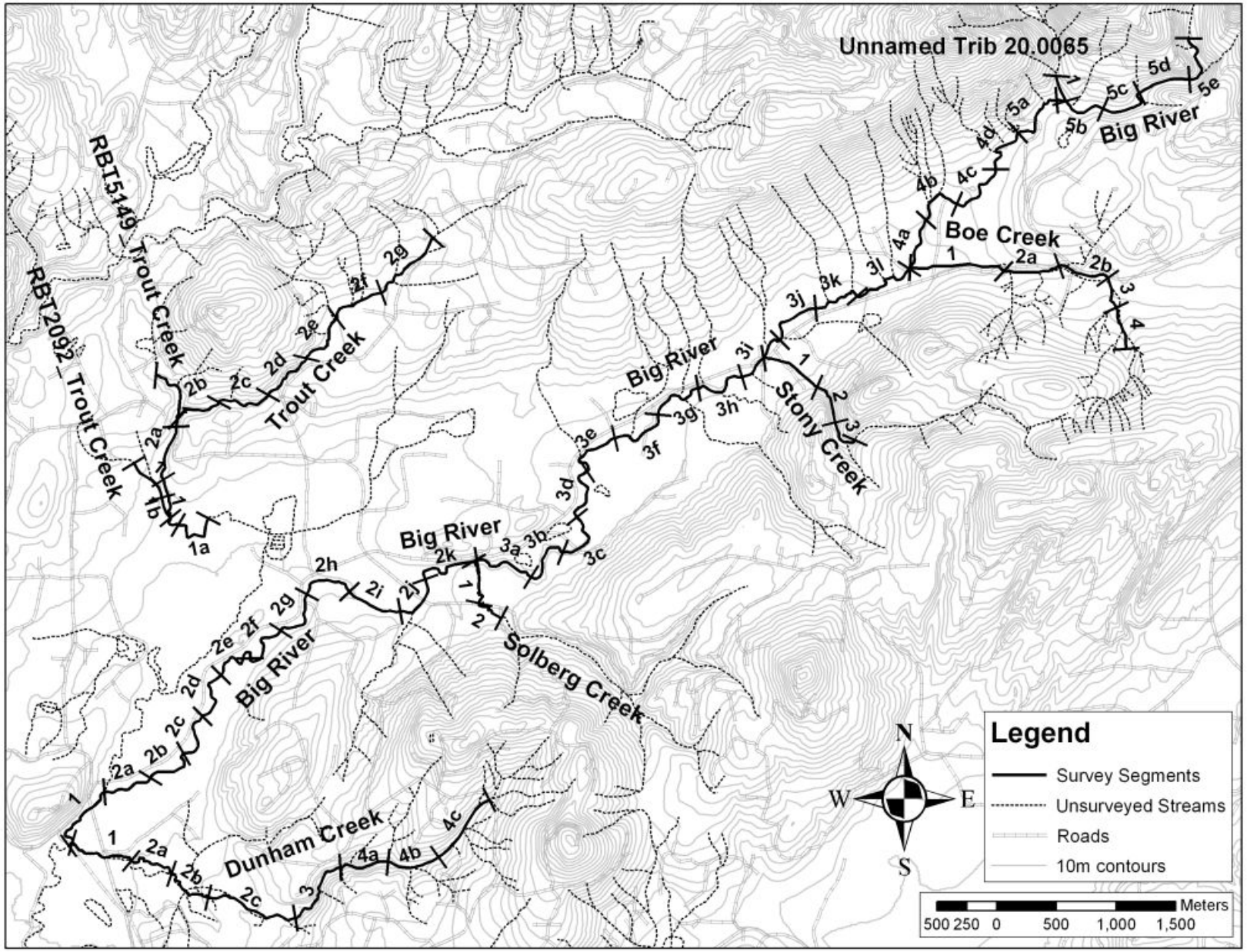

Figure 18. Big River Watershed Channel and Habitat Segments

The break between segment 1 and 2 is at the confluence with Trout Creek. Segment 2 extends upstream to the confluence with the Solberg Creek and remains unconfined throughout. Stream gradient remains below 1% throughout segment 2, and BFW ranged from 11-37 meters, averaging about 19 meters. Wetted width measurements taken during July 1999 averaged 9 meters. Substrate in segment 2 consisted of mostly sand and pebbles with occasional gravel patches in the lower half, with gravel becoming common in most pool tails and steeper glides in the upper half. Most of segments 1 and 2 lacked side channel complexes and well developed sand and gravel bars, which is likely an effect of the low width to depth ratio found throughout most of the stream length, and its proximity to the lake inundation zone.

Segment 3 extends upstream from Solberg Creek to the confluence with Boe Creek. Channel confinement remained unconfined and stream gradient was mostly <1%, with occasional sections approaching 2%. BFW measurements ranged from 12 to 45 meters, averaging 24 meters. Wetted width measurements taken in late-July 1999 ranged from 2.1 to 19.7 meters, averaging 12 meters. Gravel substrate dominated most pool tails and riffles but sand and pebble substrate was also common in the lower sections of segment 3. Cobble substrate was also present in significant quantities in the upper reaches of segment 3. Gravel bars and side channels occurred at much higher frequency in segment 3 than in the lower two segments. Nearly 600 meters of side channel habitat were inventoried in segment 3. Logjams were also present at a higher frequency in segment 3 (See Appendix C).

Segment 4 extends upstream from the confluence with Boe Creek to an area where the channel becomes confined. The lower two-thirds of the channel were mostly unconfined, but channel incision has rendered the lower 600 meters of floodplain dysfunctional. Channel confinement changes from unconfined to moderately confined in the upper 500 meters. Channel gradient ranges from 0.2-2% and increases in the upstream direction. BFW measurements ranged from 13 to 35 meters, averaging 24 meters. Wetted width measurements taken in September 1999 ranged from 3.2 to 14.6 meters, averaging 7 meters. Gravel substrate dominated pool tails, glides, and riffles in the lower two-thirds of segment 4 but cobble and boulders became more dominant in the upper 500 meters of the segment. Gravel bars and side channels are prevalent throughout the upper two-thirds of segment 4. Over 700 meters of side channel habitat were inventoried in a 1,400 meter section of segment 4 (See Appendix C).

Segment 5 extends from the segment 4/5 break upstream to a set of impassible waterfalls located 2,260 meters upstream of the CP 7402 Road. The channel remained mostly confined throughout the segment but small reaches of moderate confinement were also present. Stream gradient ranged from 1-3% and BFW ranged from 9 to 35 meters, averaging 17 meters. Wetted width measurements taken in September 1999 ranged from 3.4 to 13.7 meters, averaging 7 meters. The stream bed was chiefly composed of cobble and boulders with isolated patches of gravel, although there was a 150 meter section with gravel as the dominant substrate about 300 meters upstream from the CP 7402 bridge. Side channel habitat was infrequent in segment 5 although two side channel complexes were documented. The survey ended at a large two-stage waterfall. The first section of

the falls consists of a very steep slide/falls that drops about 4 vertical meters. Just upstream there is a large pool bound by a 6 meter vertical waterfall.

Table 46. Big River Channel Segment Attributes.

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Big River	1	PS-56	671	671	<1%	U	16.3	41.1
Big River	2a	PS-57	1,200	529	<1%	U	17.0	31.1
Big River	2b	PS-58	1,700	500	<1%	U	17.3	28.8
Big River	2c	PS-59	2,200	500	<1%	U	16.5	30.3
Big River	2d	PS-60	2,700	500	<1%	U	15.8	31.7
Big River	2e	PS-61	3,200	500	<1%	U	17.8	28.1
Big River	2f	PS-62	3,700	500	<1%	U	20.8	24.0
Big River	2g	PS-63	4,200	500	<1%	U	18.1	27.6
Big River	2h	PS-64	4,700	500	<1%	U	19.2	26.0
Big River	2i	PS-65	5,200	500	<1%	U	20.6	24.3
Big River	2j	PS-66	5,700	500	<1%	U	22.1	22.7
Big River	2k	PS-67	6,444	744	<1%	U	20.9	35.5
Big River	3a	PS-68	7,000	556	0.1-2%	U	20.7	26.9
Big River	3b	PS-69	7,500	500	0.1-2%	U	20.6	24.3
Big River	3c	PS-70	8,000	500	0.1-2%	U	20.0	24.9
Big River	3d	PS-71	8,500	500	0.1-2%	U	25.0	20.0
Big River	3e	PS-72	9,000	500	0.1-2%	U	20.0	25.0
Big River	3f	PS-73	9,500	500	0.1-2%	U	18.5	27.0
Big River	3g	PS-74	10,000	500	0.1-2%	U	23.7	21.1
Big River	3h	PS-75	10,500	500	0.1-2%	U	32.4	15.4
Big River	3i	PS-76	11,000	500	0.1-2%	U	23.0	21.7
Big River	3j	PS-77	11,500	500	0.1-2%	U	20.5	24.4
Big River	3k	PS-78	12,000	500	0.1-2%	U	27.4	18.3
Big River	3l	PS-79	12,680	680	0.1-2%	U	25.4	26.7
Big River	4a	PS-80	13,200	520	0.1-2%	U	19.5	26.6
Big River	4b	PS-81	13,700	500	0.1-2%	U	26.2	19.1
Big River	4c	PS-82	14,200	500	0.1-2%	U	26.1	19.2
Big River	4d	PS-83	14,700	500	0.1-2%	M	23.8	21.0
Big River	5a	PS-84	15,200	500	1-3%	C	18.8	26.5
Big River	5b	PS-85	15,700	500	1-3%	C	17.9	28.0
Big River	5c	PS-86	16,200	500	1-3%	C	16.8	29.8
Big River	5d	PS-87	16,700	500	1-3%	C	13.3	37.5
Big River	5e	PS-88	17,221	521	1-3%	C	20.4	25.5

3.5.2 BIG RIVER HABITAT CONDITIONS

3.5.2.1 LWD CONDITIONS

Habitat data were collected in all of the 5 channel segments and 33 habitat segments described in Section 3.5.1. LWD data were summarized at the watershed scale, as well as at the habitat segment and 100 meter LWD band level. In the mainstem of Big River a total of 6,756 pieces of LWD were inventoried of which 69%, 24%, and 7% were categorized as conifer, deciduous, and unknown respectively. Slightly more than 1% of the 6,756 pieces of LWD inventoried were classified as key pieces. Large and L+ pieces accounted for 24% of the LWD inventoried, while medium (55%) and small (20%) pieces made up the remaining 75%. At the LWD band level, 58% of the bands had 40 or fewer pieces, while 27% had 41-60 pieces and 12% had 61-80 pieces; only 3% of the bands had greater than 80 pieces per 100 meters (Figure 19). The LWD bands with the lowest LWD counts included: LWD Bands 107, 111, 115, 130 and 151; LWD bands 58, 122, 170, 171, and 172 had the highest piece counts.

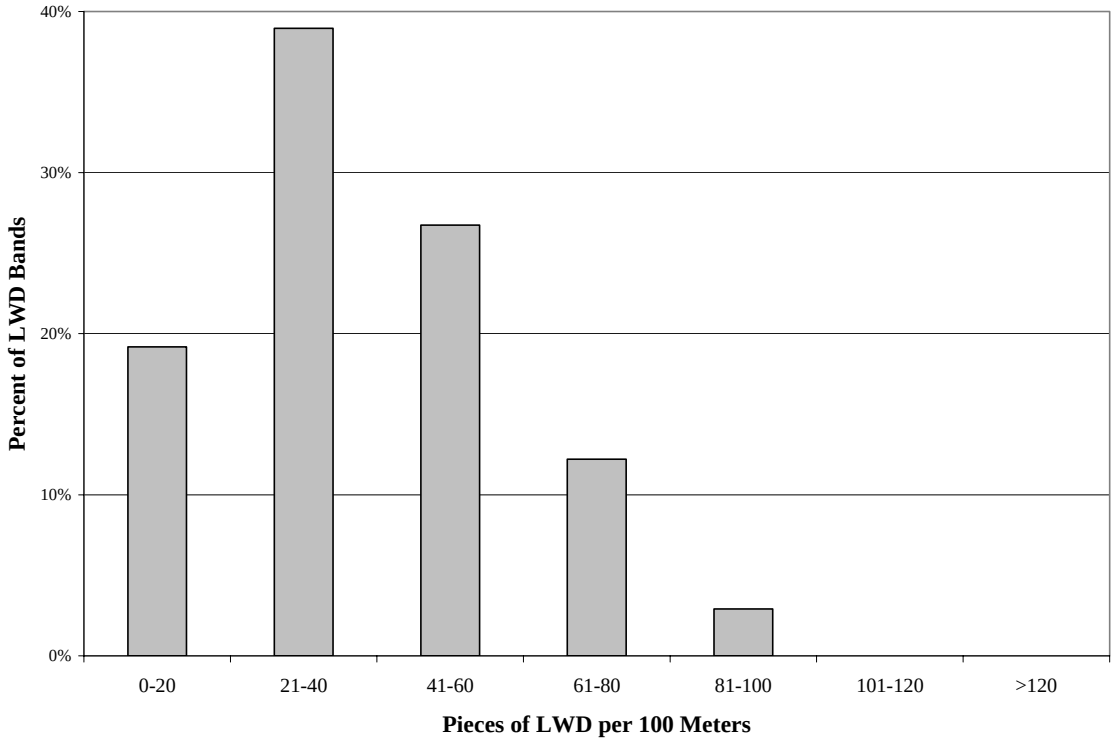

Figure 19. Big River LWD Bands within Specified LWD Count Categories.

At the habitat segment level LWD data were evaluated based upon LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 47). Pieces of LWD/100 meters

rated good in segment 5e and fair in segments 1, 2a, 2b, 2d, 2e, 2h, 2i, 2j, 3a, 3b, 3c, 3d, 3k, 3l, 4b, 5c, and 5d, and poor in the other segments. Pieces per BFW rated fair in segments 3f, 3i, 3j, 4a, 5a, and 5b, and good in all other segments. However, the majority of the LWD data collected were in channels > 20 meters BFW and comparisons and characterization of LWD frequencies/BFW should be used with caution!

Table 47. LWD Data for Big River Habitat Segments.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-56	273.7	40.8	6.7	0.21	17.9%	1.2	1.8	27.2%
2a	PS-57	264.3	50.0	8.5	0.20	17.0%	1.5	1.9	22.8%
2b	PS-58	219	43.8	7.6	0.07	12.3%	0.9	0.9	12.3%
2c	PS-59	141	28.2	4.7	0.00	9.9%	0.5	0.8	16.3%
2d	PS-60	209	41.8	6.6	0.00	12.4%	0.8	1.1	16.7%
2e	PS-61	212	42.4	7.5	0.04	11.3%	0.9	2.0	26.9%
2f	PS-62	195	39.0	8.1	0.37	16.4%	1.3	1.9	23.6%
2g	PS-63	143	28.6	5.2	0.07	6.3%	0.3	1.3	24.5%
2h	PS-64	238	47.6	9.1	0.12	21.0%	1.9	2.0	21.8%
2i	PS-65	251	50.2	10.3	0.16	18.7%	1.9	1.6	15.1%
2j	PS-66	264	52.8	11.6	0.18	7.6%	0.9	2.1	18.2%
2k	PS-67	284.5	38.2	8.0	0.17	17.2%	1.4	1.4	18.1%
3a	PS-68	292.5	52.6	10.9	0.07	39.7%	4.3	1.2	11.5%
3b	PS-69	275	55.0	11.3	0.21	45.1%	5.1	2.4	21.5%
3c	PS-70	207	41.4	8.3	0.36	38.6%	3.2	0.8	9.7%
3d	PS-71	295	59.0	14.8	0.20	38.6%	5.7	1.2	8.1%
3e	PS-72	179	35.8	7.2	0.04	29.6%	2.1	1.2	17.3%
3f	PS-73	96	19.2	3.6	0.04	56.3%	2.0	1.1	32.3%
3g	PS-74	151	30.2	7.2	0.14	39.7%	2.8	1.5	21.2%
3h	PS-75	151	30.2	9.8	0.00	36.4%	3.6	1.8	18.5%
3i	PS-76	82	16.4	3.8	0.00	29.3%	1.1	1.1	28.0%
3j	PS-77	94	18.8	3.8	0.04	38.3%	1.5	0.7	17.0%
3k	PS-78	273	54.6	15.0	0.05	29.3%	4.4	1.5	10.3%
3l	PS-79	341.4	50.2	12.8	0.11	31.9%	4.1	1.3	10.1%
4a	PS-80	79.6	15.3	3.0	0.04	17.6%	0.5	0.3	9.3%
4b	PS-81	226	45.2	11.9	0.05	13.3%	1.6	0.6	5.3%
4c	PS-82	197	39.4	10.3	0.00	16.8%	1.7	0.6	6.1%
4d	PS-83	130	26.0	6.2	0.10	18.5%	1.1	0.8	12.3%
5a	PS-84	87	17.4	3.3	0.04	27.6%	0.9	0.3	10.3%
5b	PS-85	108	21.6	3.9	0.04	25.0%	1.0	0.1	1.9%
5c	PS-86	214	42.8	7.2	0.13	29.9%	2.1	0.2	3.3%
5d	PS-87	201	40.2	5.4	0.11	39.3%	2.1	0.1	2.0%
5e	PS-88	382	73.3	15.0	0.51	30.4%	4.6	0.3	2.1%

Key pieces/BFW rated good in segment 5e, fair segments 1, 2a, 2f, 3b, 3c, and 3d, and poor in all other habitat segments. Large pieces/BFW rated good in segment 3a, 3b, 3c, 3d, 3e, 3g, 3h, 3k, 3l, 5c, 5d, and 5e. Large pieces/BFW rated fair in segments 1, 2a, 2f, 2h, 2i, 2k, 3f, 3i, 3j, 4b, 4c, and 4d; all other habitat segments rated poor for large pieces/BFW. Figure 20 and Figure 21 illustrate the relative abundance of all LWD and LWD > 50 CM diameter between habitat segments.

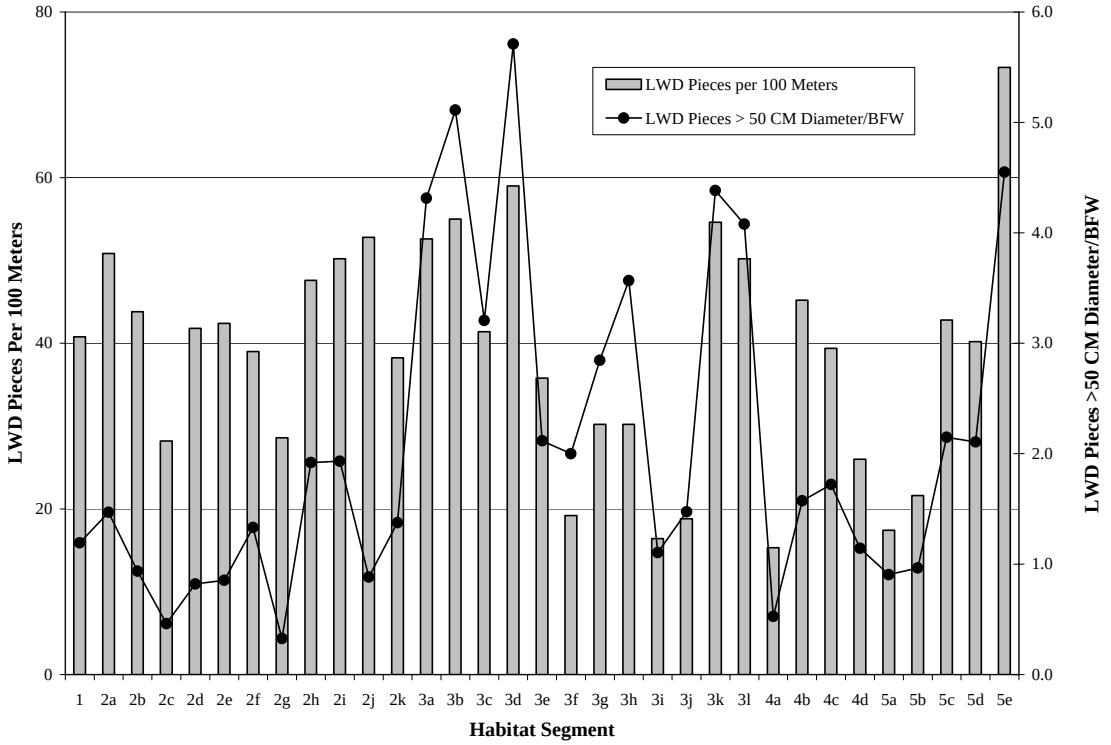

Figure 20. Relative Abundance of LWD in Big River Habitat Segments.

Pool forming pieces/BFW equaled or exceeded two pieces/BFW in segments 2a, 2e, 2h, 2j, and 3b. Pool forming pieces/BFW ranged from 1-1.9 pieces/BFW in segments 1, 2d, 2f, 2g, 2i, 2k, 3a, 3d, 3e, 3f, 3g, 3h, 3i, 3k, and 3l; all other habitat segments had less than one pool forming piece/BFW. Over 56% of the LWD in habitat segment 3f was classified as large (>50 cm diameter) LWD. Twenty-five to fifty percent of all LWD in habitat segments 3a-3e, 3g-3l, and 5a-5e was classified as large. Less than 25% of the LWD in the remaining segments was classified as large. The percent of LWD which was classified as pool forming ranged from 32% in segment 3f to 2% in segment 5b. Segments 1, 2e, 3i, and 3f had the highest proportion of LWD classified as pool forming, while habitat segments 5b-5e had the lowest (likely a function of gradient and confinement). The LWD conditions were the best in segments 3b, 3c, 3d, and 5e. The LWD conditions were the poorest in segments 2c, 2g, 4a, 5a, and 5b.

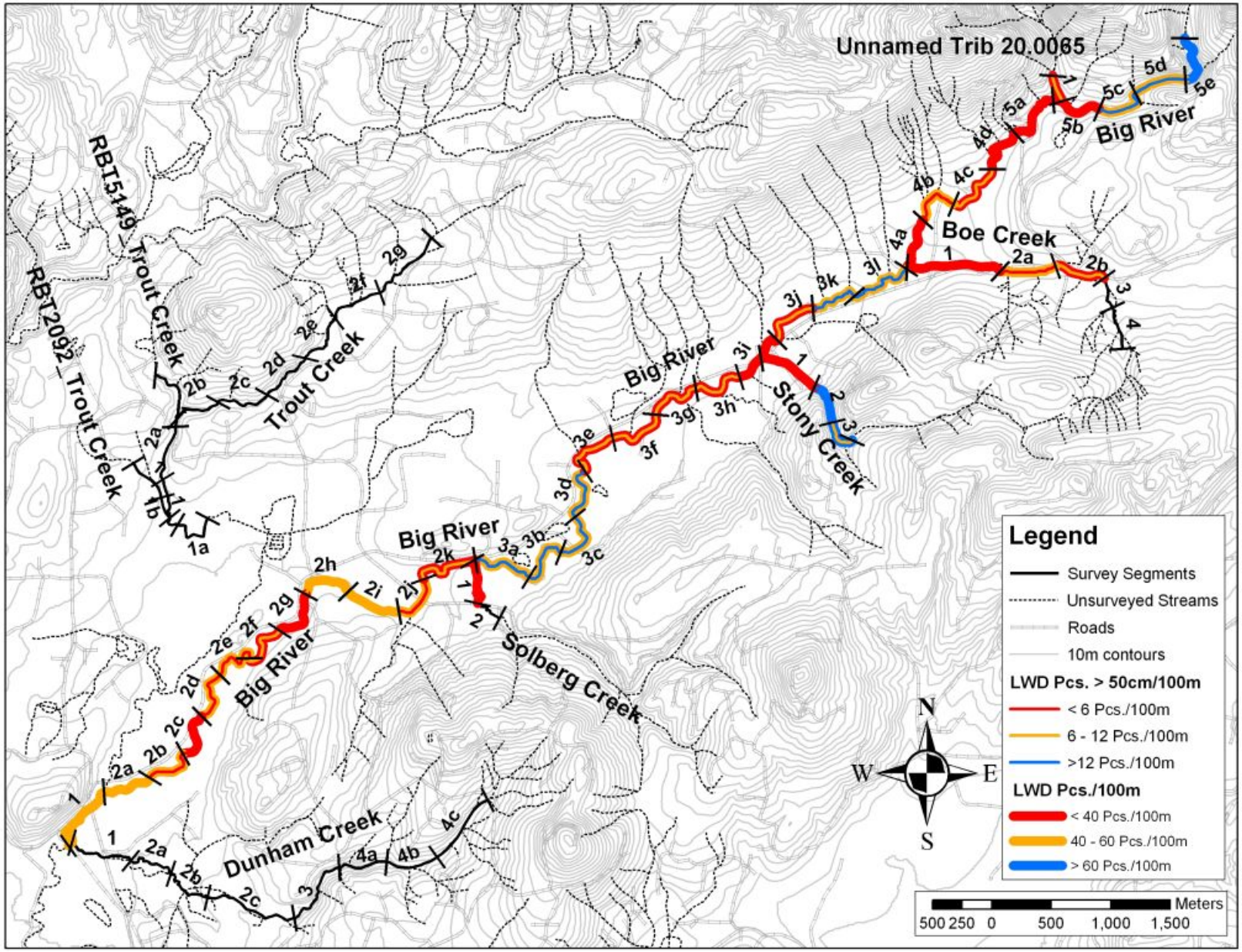

Figure 21. Big River Watershed LWD > 50cm and Total Piece Counts/100m by Segment.

3.5.2.2 POOL CONDITIONS

Pool data for the 33 Big River habitat segments described above were summarized and evaluated at the habitat segment level. Attributes used in the evaluation included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, pool cover, and percent of pools formed by LWD (Table 48; Figure 22).

Table 48. Pool Data for Big River Habitat Segments.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Freq.	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/ km	Percent of Pools Formed by LWD
1	PS-56	<1%	16.3	2.7	88%	1.52	1.15	42.1	22	100%
2a	PS-57	<1%	17.0	1.7	72%	1.03	0.71	19.7	17	100%
2b	PS-58	<1%	17.3	2.4	66%	1.32	1.00	30.8	16	83%
2c	PS-59	<1%	16.5	3.4	75%	1.28	1.04	37.3	16	78%
2d	PS-60	<1%	15.8	2.3	77%	0.97	0.72	28.1	10	79%
2e	PS-61	<1%	17.8	1.5	80%	1.16	0.97	21.8	20	79%
2f	PS-62	<1%	20.8	1.5	58%	0.96	0.80	17.0	14	88%
2g	PS-63	<1%	18.1	2.5	85%	0.96	0.79	38.6	10	82%
2h	PS-64	<1%	19.2	1.9	86%	1.19	0.94	31.7	22	86%
2i	PS-65	<1%	20.6	1.4	77%	0.90	0.70	23.2	10	71%
2j	PS-66	<1%	22.1	1.4	95%	1.11	0.88	29.4	10	81%
2k	PS-67	<1%	20.9	2.0	82%	0.95	0.69	34.1	9	44%
3a	PS-68	0.1-2%	20.7	2.1	74%	1.17	0.91	33.4	9	85%
3b	PS-69	0.1-2%	20.6	1.9	81%	1.01	0.82	31.0	8	85%
3c	PS-70	0.1-2%	20.0	4.2	43%	1.08	0.86	35.2	8	67%
3d	PS-71	0.1-2%	25.0	1.8	76%	1.19	1.01	33.3	16	100%
3e	PS-72	0.1-2%	20.0	2.8	68%	1.04	0.88	35.5	12	67%
3f	PS-73	0.1-2%	18.5	3.0	72%	0.93	0.80	40.1	10	89%
3g	PS-74	0.1-2%	23.7	1.9	71%	1.22	1.02	36.9	14	73%
3h	PS-75	0.1-2%	32.4	2.6	57%	1.02	0.85	41.9	8	100%
3i	PS-76	0.1-2%	23.0	2.4	79%	1.00	0.87	44.2	8	56%
3j	PS-77	0.1-2%	20.5	2.2	69%	0.83	0.69	31.9	2	55%
3k	PS-78	0.1-2%	27.4	1.3	64%	0.85	0.72	21.0	8	79%
3l	PS-79	0.1-2%	25.4	1.3	61%	1.04	0.88	19.9	15	86%
4a	PS-80	0.1-2%	19.5	3.0	40%	1.24	1.09	22.7	12	33%
4b	PS-81	0.1-2%	26.2	1.9	47%	0.91	0.75	23.4	10	40%
4c	PS-82	0.1-2%	26.1	1.7	55%	1.04	0.88	25.4	12	55%
4d	PS-83	0.1-2%	23.8	2.3	46%	0.95	0.71	28.4	6	67%
5a	PS-84	1-3%	18.8	3.8	47%	0.75	0.63	30.1	2	29%
5b	PS-85	1-3%	17.9	3.5	51%	0.85	0.72	30.7	2	13%
5c	PS-86	1-3%	16.8	2.1	69%	0.72	0.59	26.1	6	21%
5d	PS-87	1-3%	13.3	4.2	45%	0.84	0.72	23.0	6	22%
5e	PS-88	1-3%	20.4	2.5	43%	0.88	0.75	24.8	6	50%

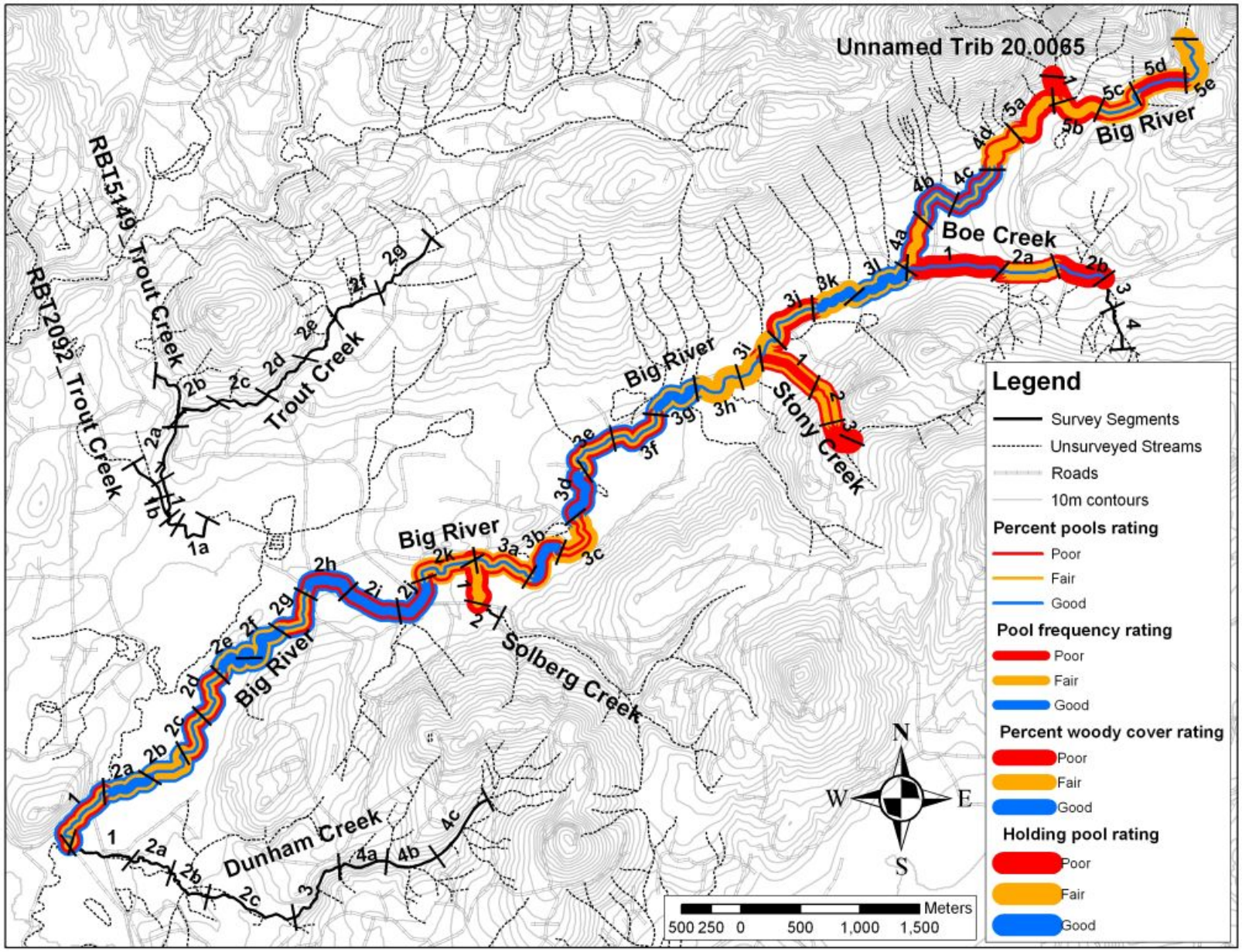

Figure 22. Big River Watershed Pool Habitat Condition Ratings.

Pool frequency rated good in habitat segments 2a, 2e, 2f, 2h, 2i, 2j, 3b, 3d, 3g, 3k, 3l, 4b, and 4c, and poor in segments 3c and 5d; all other segments rated fair. Pool frequency was between 2.0-2.4 in segments 2b, 2d, 2k, 3a, 3i, 3j, and 4d nearly qualifying for a good pool frequency rating. Percent pool rated good in segments 1-3b, 3d-3l, and 5c-5e; all other segments rated as fair. Percent of pools with adequate woody cover rated fair in segments 2a, 2b, 2e, 2f, 3c, 3g, 3h, 3i, 3k, 3l, and 5e; all other segments rated as poor and no segments rated as good. Holding pools deeper than 1 meter/km rated good in habitat segments 1-2j, 3d-3g, 3l and 4a-4c, and poor in segments 5a, and 5b; all other segments rated as fair. In general pool conditions were good throughout most of the mainstem, but complex pools with cover were lacking in most of the habitat segments. The poorest pool conditions were found in segments 3c, 3j, 5a, 5b, and 5d.

A total of 399 pools were inventoried in the mainstem of Big River. The average maximum pool depth was 1.03 meters and the average pool length was 29 meters. The quality of pool habitat appears to be correlated with LWD conditions. On average the best pool habitats were associated with LWD. LWD pieces formed pools with increasing frequency as piece size increased. An analysis of individual pool attributes revealed that on average pools formed by the largest LWD were the deepest, longest, and had the highest percent of woody cover. Pools formed by key piece sized LWD averaged nearly 1.5 times deeper than pools formed by medium or small LWD and free-formed pools without LWD (Figure 23).

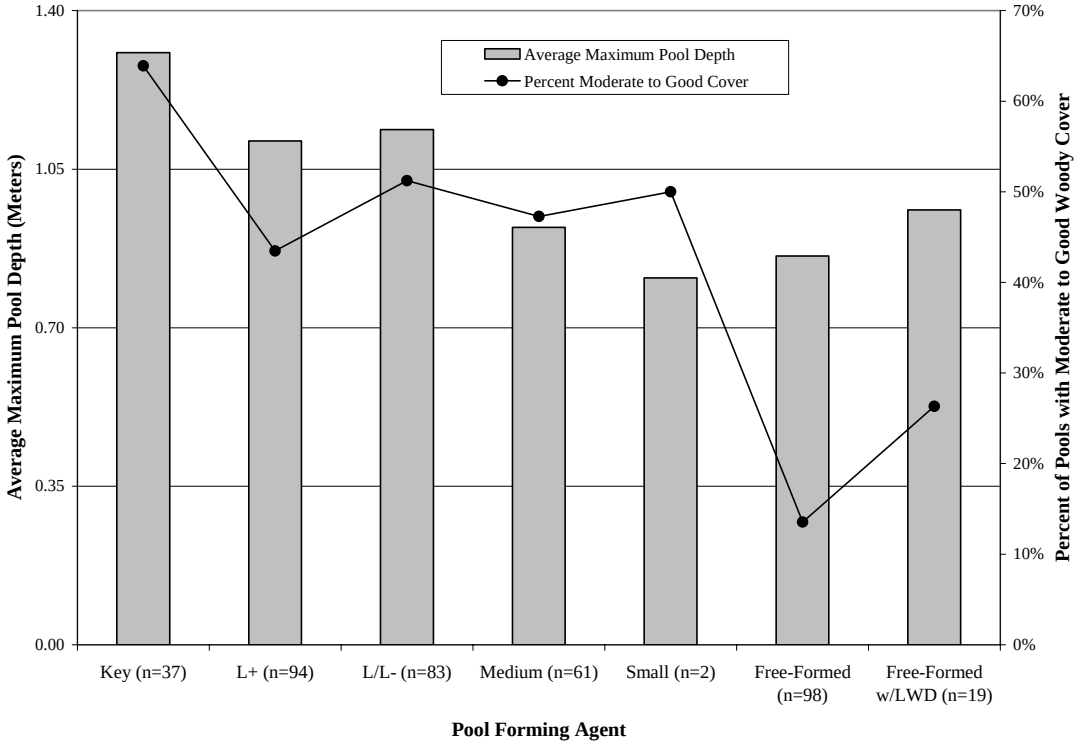

Figure 23. Relationship between Primary Pool Forming Agent and Pool Depth and Cover for Big River.

Key piece formed pools were typically twice as long as pools formed by medium or small LWD and free-formed pools without LWD, essentially doubling the pool habitat per habitat unit (Table 49). LWD > 50 cm diameter formed more than 62% of the pool habitat inventoried. In fact, key piece size LWD formed 14% of the total pool habitat even though the frequency of key LWD was only 0.12 pieces/BFW. LWD plays an important role in forming high quality pool habitats and the rate at which LWD acts to form pool habitat is directly linked to the size of the LWD. Just over 53% of key pieces formed pools while only 3% of small LWD were considered pool forming (Figure 24).

Table 49. Big River Pool Conditions Grouped by Primary Pool Forming Agent.

Pool Forming Agent	Number of Pools	Avg Max Pool Depth	Avg Res. Pool Depth	Avg Pool Length	Avg No. of Pieces of LWD Forming Pools	0-5% Woody Cover in Pool	6-20% Woody Cover in Pool	>20% Woody Cover in Pool
Key	37	1.31	1.08	41.7	5.1	36%	28%	36%
L+	94	1.11	0.93	32.0	3.8	57%	30%	13%
L/L-	83	1.14	0.90	31.4	3.3	49%	38%	13%
Medium	63	0.92	0.70	22.6	2.1	53%	31%	16%
Small	2	0.81	0.58	15.45	2.0	50%	50%	0%
Free-formed	98	0.86	0.70	22.5	0.0	86%	13%	1%
Free-formed w/LWD	19	0.96	0.79	33.8	1.4	74%	16%	11%

The low gradient and unconfined nature of the lower 15,000 meters of Big River provides for a naturally robust pool population despite low LWD volumes. However, the quality, stability, and complexity of the pool habitats suffer from the loss of historically abundant large LWD. Other factors, such as bank armoring, channelization, forest conversion, riparian logging, and non-native invasive riparian vegetation have decreased near- and long- term recruitment potential for large LWD for the entire Big River mainstem.

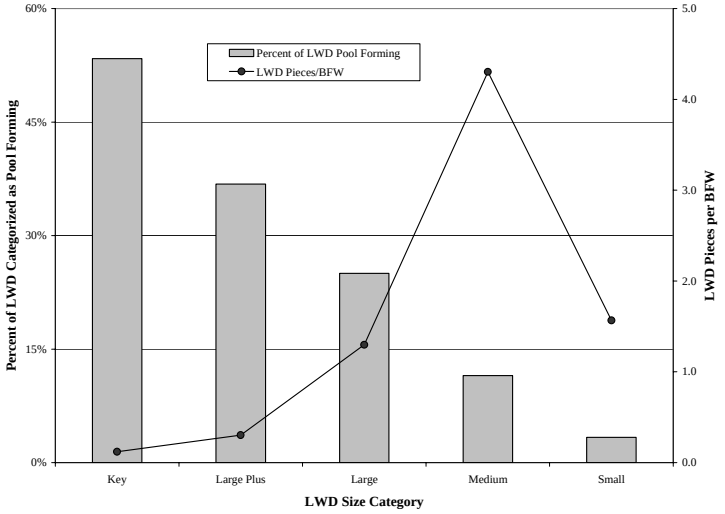

Figure 24. Percent of LWD Pool Forming and LWD/BFW by Size Class for Big River.

3.5.3 BIG RIVER TRIBUTARIES

During channel and habitat surveys in the mainstem of Big River, many streams were identified as containing anadromous fish habitat. Dunham, Trout, Solberg, Stony, and Boe Creeks contain the majority of anadromous fish habitat in tributaries to Big River. All five stream systems were included in the channel surveys and approximately 16,000 meters of channel data were collected in these tributaries. Extensive habitat data collection occurred in the Solberg, Stony and Boe Creeks. Additional habitat data were collected in unnamed tributary 20.0065. No habitat data were collected in Dunham or Trout Creeks but channel data were collected. No channel or habitat data were collected in several other streams which provide important spawning and rearing habitat to salmon and steelhead. These include: LBT 17,400, RBT 32,740, RBT 32,990, unnamed tributary 20.0062, LBT 36,215, RBT 39,005, RBT 44,160, LBT 46,785, RBT 47,230, RBT 49,700, and RBT 50,365.

There be some additional small streams that provide further spawning and rearing habitat to anadromous salmonids that were not inventoried during channel and habitat surveys. The Big River system also contains several small to medium size stream/wetland complexes that provide ideal off-channel habitat to over-wintering salmonids. Several examples of accessible tributaries draining wetland complexes enter Big River in habitat segments 3a-3f. Several spring-fed wall-based channels are located on the Big River floodplain in this same section of the river. The habitat inventory portion of this project was not designed to identify all off-channel habitats within the watershed. Many undocumented off-channel habitats are yet to be described. Habitat segments 3a-3f are noted here based on the casual observation that their density appeared to be higher here then else where in the watershed.

3.5.3.1 DUNHAM CREEK WATERSHED AND CHANNEL DESCRIPTION

Dunham Creek (local name) is a left bank tributary located 53 meters (175ft) upstream from the SOS on Big River. Dunham Creek is the second largest independent tributary to Big River and has a basin area of 2.07mi^2 (5.36km^2). The stream flows from the northeast at its headwaters and swings around to flow mostly to the west or northwest. The lower three-quarters of the watershed are underlain by Pleistocene age glacial drift deposits. The upper portion of the watershed is underlain by Oligocene-Eocene age marine sedimentary rock units. A total of 5,060 meters of channel were surveyed (Figure 18). The surveyed channel system was broken into four discrete channel segments. Channel segment 1 started at the confluence with Big River and continued upstream for 700 meters. Stream gradient was <1% and channel confinement was classified as unconfined (Table 50). Bankfull width ranged from 6 to 18 meters, averaging 10.2 meters. Wetted width measurements taken in September 1999, ranged from 0.6 to 8.5 meters averaging 3.7 meters. No other significant observations were recorded in segment 1.

Segment 2 continued upstream from segment 1 and ended about 840 meters upstream of the new bridge. Stream gradient averaged 0-2% and channel confinement remained unconfined. One large beaver dam was noted as backing up water for 160 meters. Bankfull width ranged from 5 to 19 meters, averaging 12.1. Wetted width measurements ranged from 0.6 to 7.4 meters, averaging 3.5 meters. No other channel observations were documented for segment 2.

Segment 3 starts at the downstream end of a long gully and ends 700 meters upstream, where channel confinement changes from moderate to confined. Stream gradient averaged 2-3% and BFW ranged from 7 to 18 meters, averaging 11.5 meters. Wetted width measurements ranged from 1.2 to 6.5 meters and averaged 2.7 meters. Segment 4 extended upstream and ended at the confluence with LBT 16,600. Stream gradient averaged 2-4% and the channel was confined throughout the segment. Bankfull width ranged from 4 to 18 meters, averaging 8 meters. Wetted width measurements ranged from 0.4 to 5.5 meters, averaging 2.1 meters. The survey ended without encountering an anadromous barrier and potential habitat exists upstream of the EOS. However, gradient increases drastically and watershed area is only 0.24mi^2 (0.62km^2) upstream of the EOS.

Table 50. Dunham Creek Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Dunham Creek	1	na	700	700	0-1%	U	10.1	69.2
Dunham Creek	2	na	2,600	1,900	0.1-2%	U	12.1	157.0
Dunham Creek	3	na	3,300	700	2-3%	M	11.5	61.1
Dunham Creek	4	na	5,061	1,760	2-4%	C	7.7	228.6

No habitat data were collected in Dunham Creek, but wetted width measurements were taken at 30 meter intervals and the habitat unit the measurement was taken in was recorded as a pool, pool tailout, riffle, or cascade. A simple comparison of the percent of measurements taken at pools revealed that the percent of habitat in pools was 74%, 63%, 43%, and 38% for segments 1-4 respectively. No surveys were conducted in any of the tributaries to Dunham Creek but several tributaries were inventoried as containing potential anadromous fish habitat. Based upon field notes, basin size, topography, and stream length RBT 1,535, RBT 3,490, and LBT 4,900 likely contain the most tributary habitat. Based upon field notes, basin size, topography, and stream length the following streams are thought to contain 50-300 meters of anadromous fish habitat each: RBT 11,200, LBT 11,660, RBT 12,450, LBT 13,200, and LBT 15,280.

3.5.3.2 TROUT CREEK WATERSHED AND CHANNEL DESCRIPTION

Trout Creek is the largest tributary to Big River and enters along the right bank 670 meters upstream from the Swan Bay Road Bridge. The Trout Creek watershed drains approximately 5.14mi^2 (13.3km^2) and has several significant tributaries, as well as numerous smaller tributaries. The vast majority of the watershed is underlain by Pleistocene age glacial drift and till deposits which are of very low relief. The upper

watershed is topographically divided by a moderately sloping, resistant knob of Oligocene-Miocene age marine sedimentary rock, which rises to an elevation of over 200 meters. The Trout Creek sub-watershed is unique with respect to all other systems in the Ozette Watershed in the fact the it shares an extensive, very low relief floodplain surface with another large stream and several tributaries. During large bankfull flood events the surface waters of Big River and Trout Creek mix 2,000 meters upstream from their confluence in a forested wetland complex. Channel incision, LWD removal, road construction, and bank armoring have reduced the frequency, magnitude, and duration of large scale flooding on these surfaces.

The very low stream gradient of Trout Creek and extensive floodplain and associated wetland complexes provide a unique system of side channels and distributaries for which there are no local comparisons. The complexity of lower Trout Creek's secondary channels and regularly inundated forested wetlands is difficult to comprehend. The role these flood complexes serve in providing fish habitat is unclear, but coho salmon have been documented in channels and flooded forests several hundred meters away from channels that connect through channelized flow to Trout Creek. A few distributary channels of Trout Creek have been followed for 1,000 or more meters to find them entering streams which eventually flow back into Trout Creek further downstream.

The lower 3,900 meters of Trout Creek were not surveyed mostly because of the unique channel type and conditions that are present in the lower section of the stream. This lower section of Trout Creek can be characterized as having a low width-to-depth ratio with almost no bar development. Substrate conditions are almost exclusively silt, sand, and small pebbles. Small sections of gravel bedded stream channel exist in a 1,000 meter section downstream from the SOS. The survey started 2,600 meters downstream from the 27E Road and continued upstream 4,695 meters. The contributing basin area upstream of the SOS was 2.0mi^2 (5.2km^2). The surveyed channel was divided into 2 main channel segments with 9 habitat segments (Table 51; Figure 18). The first channel segment of Trout Creek is unconfined and low gradient (<1%). Bankfull width ranged from 5 to 15 meters and averaged 8.6 meters. Wetted width measurements taken on September 10, 2000, ranged from 1 to 9 meters, averaging 3.7 meters. Segment 2 extends upstream from segment 1 for 3,695 meters to the EOS. The stream gradient averages 1-3% and channel confinement ranges from moderately confined to confined with small sections classified as unconfined. Bankfull width ranged from 3 to 17 meters, averaging 7 meters. Wetted width measurements taken in late-September, 2000, ranged from 0 to 8 meters, averaging 2.7 meters.

Table 51. Trout Creek Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment	Upstream End (M)	Segment Length	Gradient	Confine-ment	BFW	Number of BFWs
Trout Creek	1a	na	500	500	1-2%	U	7.9	63.2
Trout Creek	1b	na	1,000	500	1-2%	U	9.0	55.3
Trout Creek	2a	na	1,500	500	1-3%	M-C	8.9	56.4
Trout Creek	2b	na	2,000	500	1-3%	M-C	7.9	63.1
Trout Creek	2c	na	2,500	500	1-3%	C	7.5	66.7
Trout Creek	2d	na	3,000	500	1-3%	C-M	8.4	59.2
Trout Creek	2e	na	3,500	500	1-3%	M	8.0	62.8
Trout Creek	2f	na	4,000	500	1-3%	C-M	6.2	81.1
Trout Creek	2g	na	4,695	695	1-3%	C-M	5.7	121.0

Substrate size was variable throughout the reach surveyed with sections of cobble and boulder in the most confined sections and gravel in other sections. During the summer of 1992 gravel samples were collected in upper Trout Creek and the mean percent fines in spawning gravel (< 0.85mm) were 7.9% (13.9% wet-sieve equivalent; McHenry et al. 1994). No additional habitat data were collected in Trout Creek but wetted width measurements were taken at 30 meter intervals and the habitat unit the measurement was taken in was recorded as a pool, pool tailout, riffle, or cascade. A comparison of the percent of measurements taken at pools revealed that 69% and 38% of the measurements were taken in pool habitats in segments1 and 2. The survey ended where BFW was averaging < 5 meters and the contributing basin area was < 0.25mi^2 (0.65km^2)

3.2.3.2.1 Trout Creek Tributaries

During channel surveys and miscellaneous investigations in the mainstem of Trout Creek several streams were identified as containing anadromous fish habitat. Two of the largest tributaries are located downstream of the SOS on Trout Creek. The lowest downstream tributary enters Trout Creek about 1,300 meters upstream from the confluence with Big River. This stream system drains a large open water wetland complex which is connected to several fish bearing forested wetlands and small wetland channels. The largest tributary to Trout Creek also enters downstream of the SOS. This stream's confluence is located in the vicinity of a cranberry bog. The stream is very low gradient and drains extensive wetlands.

Two other interesting streams enter Trout Creek downstream of the SOS. These streams start on the low hill that divides lower and upper Trout Creek. In their upper reaches, these streams are typical of other small, low to moderate gradient forested streams with pool-riffle and step-pool morphologies. When they reach the very flat topography around the 27E Road, the streams character changes drastically. The stream channels begin to lose their defined channels through a series of distributaries which end in forested wetlands with almost no channel defining characteristics. Interestingly, coho par and smolts have been observed throughout this channel network and within the forested

wetlands when water is present. Two stream systems upstream of the SOS, RBT 2,092 and RBT 5,150, were surveyed for channel conditions. Information for these streams is included in the following two sections of this report. In addition to these two stream systems surveyed, additional anadromous fish habitat is contained in the following streams: RBT 6,810, RBT 11,393, RBT 12,500, and RBT 13, 542. Most of these streams likely only contain a short reach of usable habitat; RBT 11,393 likely contains the most habitat.

3.2.3.2.2 Unnamed RBT 2,092 Watershed and Channel Description

A right bank tributary located 638 meters (2,092ft) upstream from the SOS (Trout Creek) was given the identity, RBT 2,092. This stream drains a small basin (< 0.5 sq. mi.), and flows out of a narrow gully from the northwest. The majority of the watershed is underlain by gently sloping Pleistocene age glacial drift deposits. A total of 617 meters of stream channel were surveyed (Table 52; Figure 18). The stream channel was mostly confined but the lower 100 meters near the confluence with Trout Creek was unconfined. Additional small sections of moderate confinement were also found within the surveyed reach. Stream gradient averaged 2-4% but small sections of lower gradients were also observed. Bankfull width ranged from 3 to 10 meters, averaging 4.7. Wetted width measurements were taken in late-September 2000 and ranged from 0.5 to 4.4 meters, averaging 2.3 meters. The survey ended without encountering an obvious fish barrier and at least some habitat exists upstream of the EOS. Two tributaries were identified while conducting the channel survey. The first stream was a right bank tributary (RBT 825) located 251 meters upstream from the confluence with Trout Creek. Channel data were collected for 206 meters in this stream (Table 52). The survey up this tributary ended where the channel narrowed to < 2 meters and substrate composition became high in organic content. Bankfull width averaged 4 meters and wetted width averaged 2.0 meters. The second tributary was located 395 meters upstream from the SOS and fish passage into this stream wasn't considered possible.

Table 52. Unnamed RBT 2,092 and RBT 825 Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
RBT 2,092	1	na	617	617	2-4%	C-M	4.7	130.2
RBT 825	1	na	206	207	2-5%	C	4.1	50.2

3.2.3.2.2 Unnamed RBT 5,149 Watershed and Channel Description

A right bank tributary located 1,569 meters (5,149ft) upstream from the SOS (Trout Creek) was given the identity, RBT 5,149. This stream has a contributing basin of 0.41mi^2 (1.06km^2) and flows from the west side of the resistant knob of siltstone and sandstone described earlier. The small valley the channel flows through is underlain by Pleistocene age glacial deposits. A total of 549 meters of stream channel were surveyed (

Figure 18). The stream channel was mostly confined but the lower 100 meters near the confluence with Trout Creek was unconfined. Stream gradient averaged 1-3% and BFW ranged from 3 to 9 meters, averaging 4.2 meters. Wetted width measurements were taken in late-September 2000 and ranged from 0.6 to 3.9 meters, averaging 1.8 meters. The survey ended when the channel entered into a wetland complex. Two tributaries were encountered during the survey but no additional information on these streams was recorded.

3.5.3.3 SOLBERG CREEK WATERSHED AND CHANNEL DESCRIPTION

Solberg Creek is the third largest tributary to Big River. The confluence of the two streams is located at the segment break between segment 3 and 4 (6,414 meters upstream from the SOS) of Big River. Solberg Creek drains approximately 1.44mi^2 (3.73km^2). The headwaters are located on northeast side of the headwaters of Dunham Creek. The topography is moderately steep and the hillsides are underlain by Oligocene-Eocene age marine sedimentary rock units and patches of glacial till and drift deposits. Solberg Creek flows out of a steep sided canyon about 800 meters upstream from the confluence with Big River. The upper watershed is sediment rich and high energy, capable of transporting impressive quantities sediment downstream. The lower end of the canyon is a depositional zone containing evidence of past channel disturbance across a wide area. The location where Solberg Creek meets the 27E Road also has an interesting history of channel disturbance and avulsion.

Sometime in the mid-1990's, debris blocked the Solberg Creek culverts on the old 27-E Road, causing the stream to jump its banks and create a new channel. The new channel initially flowed down the 27-E ditch line, and eventually incised through the roadbed, in some places as much as 3 meters. Channel downcutting along the roadbed triggered an upstream response to the localized downcutting, which eventually caused the channel to incise an additional 250 meters upstream of the original culverts to a maximum depth of 1.5 meters. The large volumes of sediment (~3,800m^3) resulting from the channel downcutting, coupled with background sediment transport and the lack of an efficient channel to transport sediment, resulted in the formation of a large alluvial fan on State land near the junction of the 27-E Road and the old 5800 Road. This in turn caused the formation of seven distributaries and chronic channel instability in the lower half mile of Solberg Creek. During the summer of 1999 a project was conducted to return Solberg Creek back to its original channel. This is important to know because the stream channel and habitat data in this report were collected prior to moving the stream back into its original channel. Detailed maps and cross section measurements were made prior to the implementation of the project and provide an additional source of data for Solberg Creek.

A total of 701 meters of channel data were collected in Solberg Creek (Figure 18). The channel was divided into 2 separate channel segments. Stream gradient averaged 1.2% in segment 1 and was measured using an optical level on a tripod. Channel confinement was mostly unconfined, although near the confluence with Big River the floodplain in quite high relative to the bed level in Solberg Creek. Bankfull width ranged from 5 to 13

meters, averaging 9 meters (Table 53). A deep, narrow side channel 120 meters long is present in the middle of segment 1. No wetted width measurements were taken because the stream was only flowing in the lower 150 meters due to the upstream diversion. It was difficult to take measurements in segment 2 because as the stream incised upstream of the 27E Road, the banks were destabilized and dozens of trees had recently fallen in, making the survey nearly impossible. Channel confinement was classified as moderate and gradient averaged 1-2%. Bankfull width ranged from 7 to 20 meters, averaging 9 meters. A significant amount of habitat is present upstream from the EOS. Areas upstream should be further investigated. A few small streams enter Solberg Creek in the reach that was surveyed, and one stream may provide possible off-channel habitat where as the other stream is likely non-fish bearing.

Table 53. Solberg Creek Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Solberg Creek	1	PS 89	462	462	1.2%	U	9.0	51.5
Solberg Creek	2	na	701	239	1-3%	M	9.1	26.2

3.5.3.4 SOLBERG CREEK LWD and POOL HABITAT CONDITIONS

It is important to note that LWD and pool habitat data were collected prior to LWD placement in the summer of 1999. A total of 143 pieces of LWD were inventoried in the 462 meters of channel that were surveyed. Large woody debris classified as conifer composed only 31% of the total LWD while deciduous LWD made up the remaining 69%. Of the 143 pieces of LWD inventoried only one piece (<1%) was classified as a key piece. Large and L+ pieces accounted for only 11% of the LWD count, while medium and small pieces made up the remaining 88%. At the segment level LWD data were evaluated based upon total LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 54; Figure 21). LWD/100 meters rated poor and LWD/BFW rated fair. Key and large pieces per channel width and percent of pieces > 50 cm diameter all rated poor. The percent of pieces that were classified as pool forming was 21%. Overall, the LWD conditions in segment 1 of Solberg Creek were considered poor. No habitat data were collected in segment 2.

Table 54. Segment Level LWD Data for Solberg Creek.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-89	143	31.0	2.8	0.02	11.9%	0.3	0.6	21.0%

Pool habitat data were evaluated at the segment level using the following attributes: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 55; Figure 22). Pool frequency and percent pools both rated fair. The pools with adequate woody cover category rated as poor, as did holding pool frequency. A total of 26 pools were inventoried, but because of the lack of flow in most of the survey reach, pool attributes such as maximum and residual pool depth became difficult to measure and interpret. Pool and LWD conditions were less than optimal prior to LWD placement in the summer of 1999.

Table 55. Segment Level Pool Data for Solberg Creek.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1	PS-89	1.2%	9.0	2.0	45%	0.50	0.40	8.0	0	62%

3.5.3.5 STONY CREEK WATERSHED AND CHANNEL DESCRIPTION

Stony Creek (local name) is the fifth largest tributary system to Big River and has a contributing basin size of 0.81mi^2 (2.10km^2). The confluence with Big River is located along the left bank, about 60 meters upstream of the Hoko-Ozette Road Bridge. The stream flows to the southwest in the upper watershed and then makes a 90-degree turn and flows to the northwest for about 1,000 meters before entering Big River. The lower section of the watershed is underlain by Pleistocene age glacial drift and till deposits. The upper portion of the watershed is composed of Oligocene-Miocene age marine sedimentary rock units. A total of 1,323 meters of channel were surveyed and the channel system was broken into three discrete channel segments.

Channel segment 1 started at the confluence with Big River and continued upstream for 600 meters. Stream gradient ranged from around 1% near the confluence to 3% or more near the segment break (Table 56; Figure 18). The channel remained relatively confined throughout segment 1. Bankfull width ranged from 3.5 to 7.2 meters, averaging 5.1 meters. Wetted width measurements taken on June 21, 2000 ranged from 2.0 to 5.8 meters, averaging 3.1 meters. There are three stream crossings in this short reach, two are small bridges and one is an 80 foot long culvert at the Hoko-Ozette Road crossing.

Segment 2 continued upstream from segment 1 and ended about 400 meters upstream. Stream gradient averaged 3-5% with some steeper cascades approaching 8%. The channel remained confined throughout segment 2. Segment 2 has a step-pool morphology and flows through a narrow canyon with exposed bedrock along the right bank. Bankfull width ranged from 3.4 to 7.1 meters, averaging 5.9 meters. Wetted width measurements taken on June 21, 2000 ranged from 2.0 to 5.0 meters, averaging 3.3 meters. A perched logjam near the upper end of segment 2 may pose a passage problem for some fish at lower flows. Segment 3 ended 323 meters upstream from segment 2 at a

log jam that field technicians believed was a fish barrier. The segment break between segments 2 and 3 was based solely on a change in gradient, as the channel remained confined. Stream gradient decreased in segment 3, averaging 2-4%. Bedrock was noted as being present in at least one location in segment 3. Bankfull width ranged from 4.8 to 7.7 meters, averaging 6.3 meters. Wetted width measurements taken on June 21, 2000 ranged from 2.1 to 4.2 meters, averaging 2.9 meters. A review of field forms showed that observations of juvenile salmonids were made throughout the survey area, indicating at least fair numbers of fish in this system. Two tributaries were noted during the channel survey. The first tributary, LBT 3,389 is not accessible to fish. The other tributary, LBT 4,010 is accessible to fish. The stream averaged 3-4 meters BFW and had a wetted width of 2 meters.

Table 56. Stony Creek Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Stony Creek	1	PS-90	600	600	1-3%	C	5.1	118.2
Stony Creek	2	PS-91	1000	400	3-5%	C	5.9	68.2
Stony Creek	3	PS-92	1323	323	2-4%	C	6.3	51.2

3.5.3.6 STONY CREEK HABITAT CONDITIONS

3.5.3.6.1 LWD Conditions

Habitat data were collected in all 3 channel segments described in Section 3.5.3.5. Large woody debris data were collected for a total of 595 pieces of LWD. Conifer LWD made up 64% of the total LWD while deciduous and unknown LWD composed the remaining 36% of all LWD inventoried. Of the 595 pieces of LWD inventoried, just less than 3% were classified as key pieces. Large and L+ pieces accounted for almost 18% of the LWD count, while medium (38%) and small (41%) pieces made up the remaining 79%. Over 60% of the of LWD bands had piece counts below 40 pieces/100m , 23% of the bands had 41-80 pieces/100m, and 15% had LWD levels above 80 pieces/100m (Figure 25). The LWD bands with the lowest LWD piece counts included: LWD bands 3, 4, and 5, bands 8, 10, and 11 had the highest piece counts.

At the segment level, LWD data were evaluated based upon total LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 57; Figure 21). LWD/100 meters rated good in segments 2 and 3, and poor in segment 1. LWD/BFW rated poor in segment 1, and good in segments 2 and 3. Key pieces per channel width rated poor in all segments. However, segment 2 was close to meeting the fair requirement, with 0.13 key pieces/BFW. Large pieces/BFW rated poor in segments 1 and 3, and good in segment 2. In fact segment 2 averaged > 20 large pieces per 100 meters and this factor alone indicates good levels of large LWD. Pool forming pieces per BFW ranged from 0.1-0.3

pieces/BFW across the three segments. Low levels of large LWD were evident throughout segments 1 and 3.

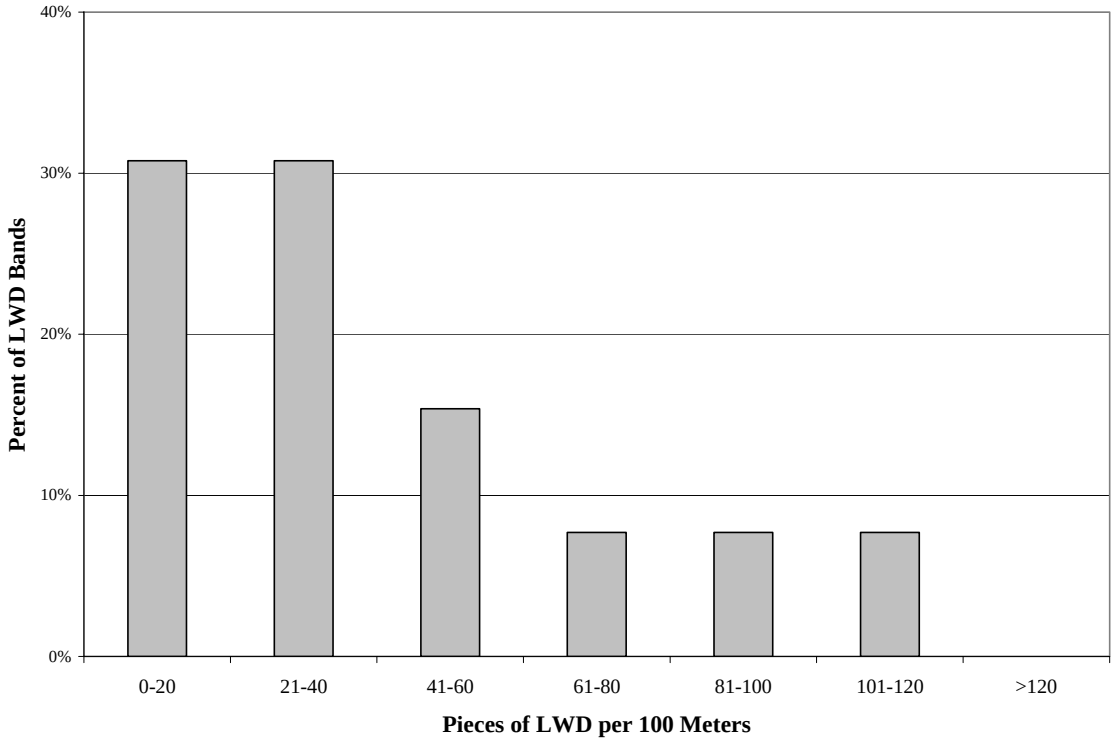

Figure 25. Stony Creek LWD Bands within Specified LWD Count Categories.

Table 57. LWD Data for Stony Creek Habitat Segments.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-90	100	16.7	0.8	0.02	16.0%	0.1	0.1	14.0%
2	PS-91	285	71.3	4.2	0.13	30.2%	1.3	0.3	6.3%
3	PS-92	210	65.0	4.1	0.10	9.5%	0.4	0.3	6.7%

3.5.3.6.2 Pool Conditions

Pool habitat data for the 3 habitat segments described above were summarized and evaluated at the habitat segment level. Attributes used in the evaluation included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 58; Figure 22). Pool frequency rated poor in all three segments. Percent pools rated poor in segments 1 and 3, and fair in segment 2. Percent of pools with adequate woody cover

rated fair in segment 1 and 2, and poor in segment 3. Holding pools deeper than 1 meter/km rated poor in all three segments; maximum and residual pool depths were also shallow on average. Large woody debris was the primary pool forming agent in all habitat segments. A total of 40 pools were inventoried. Only 27% were formed independent of LWD and nearly half of those pools were associated with the root systems of live trees. Pools formed by large LWD were 25% deeper than pools formed independent of LWD. Pools formed by large LWD were also 3 times more likely to contain fair to good pool cover habitat than free-formed pools.

Table 58. Habitat Segment Level Pool Data for Stony Creek.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1	PS-90	1-3%	5.1	8.4	14%	0.45	0.35	6.1	0	57%
2	PS-91	3-5%	5.9	4.5	36%	0.55	0.46	9.8	3	73%
3	PS-92	2-4%	6.3	4.7	27%	0.42	0.30	7.6	0	73%

3.5.3.7 BOE CREEK WATERSHED AND CHANNEL DESCRIPTION

Boe Creek is the fourth largest tributary system to Big River and has a contributing basin size of 1.09mi^2 (2.82km^2). The confluence with Big River is located just upstream of the Nicholas Road Bridge. The stream flows to the north in the upper watershed and then makes a 90-degree turn and flows to the west for about 2,000 meters before entering Big River. The lower section of the watershed is underlain by Pleistocene age glacial till deposits. The upper portion of the watershed is underlain by Oligocene-Miocene age marine sedimentary rock units and localized glacial till deposits. A total of 2,400 meters of channel were surveyed and the channel system was broken into four discrete channel segments (Table 59; Figure 18).

Channel segment 1 started at the confluence with Big River and continued upstream for 945 meters to the confluence with unnamed LBT 3,096 (just upstream of the Hoko-Ozette Road). The lower 300 meters of channel were classified as unconfined, but the channel is essentially in a large ditch, flowing through an open pasture. The streambed is incised and floodplain connectivity is poor. Stream gradient ranged from 1-3%. Bankfull width ranged from 3.5 to 9 meters, averaging 6.1 meters. No wetted width measurements were taken in Boe Creek. Substrate in segment 1 was mostly made up of gravel and some sand. Two tributaries enter Boe Creek in segment 1, LBT 1,850 and LBT 3,096. Both streams provide at least some anadromous fish habitat. Several spawning coho have been observed in LBT 3,096.

Segment 2 continued upstream from segment 1 and ended at the confluence with unnamed LBT 6,744. Stream gradient averaged 1-3% and channel confinement varied from unconfined to confined; the segment was classified as moderately confined. The

Hoko-Ozette Road was constructed on a large portion of the floodplain of Boe Creek and rip-rap armoring along the road acts to confine the channel in areas of segment 2. Bankfull width ranged from 3 to 12 meters, averaging 5.3 meters. Substrate in segment 2 was mostly made up of small to medium sized gravel. One section of cobble and bedrock was also noted. During the summer of 1992, gravel samples were collected in segment 2 of Boe Creek and the mean percent fines in spawning gravel (<0.85mm) were 8.0% (14.4% wet-sieve equivalent; McHenry et al. 1994). Several tributaries enter Boe Creek in segment 2, RBT 3,395, LBT 4,640, RBT 5,168, LBT 5,702, LBT 6,050, and LBT 6,744. All tributaries except RBT 3,395 provide at least some potential anadromous fish habitat; LBT 6,744 has the most potential habitat and spawning coho have been observed in this stream on several occasions. Some of the smaller tributaries drain low-relief land and provide access to small wetland habitats. Segment 2 of Boe Creek has consistently been observed to contain the highest density of spawning coho in the Ozette watershed.

Segment 3 continued upstream from segment 2 and ended 344 meters upstream at a change in channel confinement. Stream gradient averaged 1-3% and channel confinement was mostly classified as unconfined, although small sections of moderate confinement were also recorded. Bankfull width ranged from 2.4 to 5.1 meters, averaging 3.7 meters. Substrate in segment 3 was almost completely composed of small to medium size gravel. The contributing basin size is < 0.3mi^2 (0.78km^2) upstream of a wetland complex 30 meters upstream from the segment 2-3 break. The channel is quite small; nonetheless, coho salmon spawn in this stream reach in impressive numbers. Only one tributary was inventoried in segment 3, RBT 6,840. This stream drains a large open water wetland complex and provides an over-wintering haven for juvenile coho.

Segment 4 continued upstream from the segment 3-4 break for 496 meters. Stream gradient averaged 3-6% and channel confinement was mostly confined, although sections of moderate confinement were also present. Bankfull width ranged from 1.9 to 4.0 meters, averaging 2.8 meters. The survey ended at a large patch of blowdown which made the channel survey impossible to complete. One LBT was identified as containing potential habitat, LBT 8,421. No habitat data were collected in segments 3 and 4.

Table 59. Boe Creek Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Boe Creek	1	PS-93	945	945	1-3%	U	6.1	155.9
Boe Creek	2a	PS-94	1,500	555	1-3%	M	5.3	104.7
Boe Creek	2b	PS-95	2,056	556	1-3%	M	4.6	120.7
Boe Creek	3	na	2,400	344	2-3%	U	3.7	92.3
Boe Creek	4	na	2,896	496	3-6%	C	2.8	176.1

3.5.3.8 BOE CREEK HABITAT CONDITIONS

3.5.3.8.1 LWD Conditions

Habitat data were collected in channel segments 1 and 2 (habitat segments 1, 2a, and 2b) but not in segments 3 or 4. Large woody debris data were collected for a total of 749 pieces of LWD. Conifer made up 74% of the total LWD while deciduous and unknown LWD composed the remaining 26%. Of the 749 pieces inventoried just less than 1% were classified as key pieces. Large and L+ pieces accounted for only 13% of the LWD count, while medium (54%) and small (32%) pieces made up the remaining 86%. Sixty percent of the of LWD bands had piece counts below 40 pieces/100m , and 35% of the bands had 41-60 pieces/100m and 5% had 61-80 pieces/100m (Figure 26). The LWD bands with the lowest LWD piece counts included: LWD bands 2, 3, and 20. Bands 8, 11, and 14 had the highest piece counts.

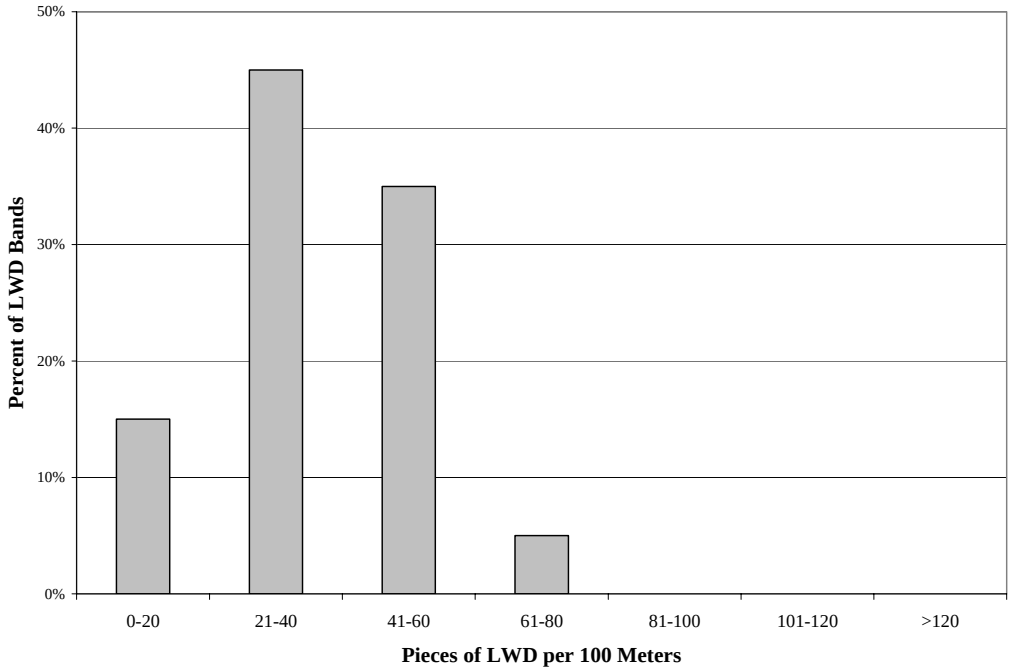

Figure 26. Boe Creek LWD Bands within Specified LWD Count Categories.

At the segment level, LWD data were evaluated based upon total LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 60; Figure 21). LWD/100 meters rated poor in habitat segments 1 and 2b, and fair in segment 2a. LWD/BFW rated poor in segments 1 and 2b, and fair in segment 2a and 3. Key and large pieces per channel width rated poor in all segments. Pool forming pieces per BFW averaged 0.4 pieces/BFW in all three habitat segments. The percent of pieces classified as large rated poor in all channel segments. The percent of LWD pieces pool forming ranged from 14-28%. Sixty-seven

percent of the key pieces were pool forming; 50%, 36%, 22%, and 6% of large plus, large, medium, and small pieces were pool forming respectively. LWD conditions in Boe Creek are poor overall and future LWD recruitment is limited in several areas by pasture land, riparian adjacent roads, frequent stream crossings, and very narrow riparian buffers.

Table 60. LWD Data for Boe Creek Habitat Segments.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-93	298.5	31.6	1.9	0.01	11.7%	0.2	0.4	19.5%
2a	PS-94	262.5	47.3	2.5	0.01	10.7%	0.3	0.4	14.3%
2b	PS-95	188	33.8	1.6	0.02	22.3%	0.3	0.4	27.7%

3.5.3.8.2 Pool Conditions

Pool habitat data for the 3 habitat segments described above were summarized and evaluated at the habitat segment level. Attributes used in the evaluation included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 61; Figure 22). Pool frequency rated poor in segments 1 and 2b, and fair in segment 2a. Percent pools rated good in all segments. Percent of pools with adequate woody cover rated poor in segments 1 and 2b, and fair in segment 2a. Holding pools deeper than 1 meter rated poor in all three segments, but there were at least some pools deeper than 1 meter. Large woody debris was the primary pool forming agent in all habitat segments. A total of 92 pools were inventoried and only 24% were formed independent of LWD. Pools formed by large LWD were 39% deeper than pools formed independent of LWD. A total of 22 pools were > 0.75 meters deep; only 9% of these pools were formed independent of LWD. Approximately 80% of the pools ≥0.9 meters deep were associated with LWD > 50 cm diameter. Pools formed by LWD > 50 cm were also 3 times more likely to contain fair to good pool cover habitat than free-formed pools. The quality of pool habitat has been reduced throughout the entire stream, but overall pool conditions still rated fair in Boe Creek. An opportunity to enhance a whole suite of channel and floodplain characteristics exists in the lower half of segment 1.

Table 61. Habitat Segment Level Pool Data for Boe Creek.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1	PS-93	1-3%	6.1	4.1	58%	0.71	0.55	14.3	3	61%
2a	PS-94	1-3%	5.3	3.7	45%	0.57	0.42	9.8	0	61%
2b	PS-95	1-3%	4.6	4.6	52%	0.60	0.48	10.0	4	54%

3.5.3.9 UNNAMED TRIBUTARY 20.0065 WATERSHED AND CHANNEL DESCRIPTION

Unnamed tributary 20.0065 is the smallest stream system tributary to Big River that was inventoried as part of this project. The stream is located at the confluence with Big River 15,453 meters upstream from the SOS on Big River. This stream drains a small watershed of 0.44mi^2 (1.14km^2). The stream flows from the north and drains relatively steep topography underlain by marine sedimentary rock units. Only 229 meters of stream channel were surveyed (Table 62; Figure 18). The channel was classified as confined and stream gradient ranged from 2-10%, averaging 4-8%. Bankfull width averaged 6.7 meters and wetted width averaged 2.6 meters (measurements were taken on June 19, 2000). The survey ended 15 meters downstream from what was described as a salmon blockage; no specifics were included in the field notes.

Table 62. Unnamed Tributary 20.0065 Channel Segment Attributes

Stream Name	Habitat Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
20.0065	1	PS-96	229	229	4-8%	C	6.7	34

3.5.3.10 UNNAMED TRIB 20.0065 LWD and POOL HABITAT CONDITIONS

A total of 87 pieces LWD were inventoried, of which 61%, 38%, and 1% were categorized as conifer, deciduous, and unknown respectively. Of the 87 pieces inventoried none were classified as key pieces. Large and L+ pieces accounted for 19% of the LWD count, while medium and small pieces comprised 24% and 56% respectively. At the segment level, LWD data were evaluated based upon LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 63; Figure 21). LWD/100 meters and LWD/BFW rated poor. Key pieces per channel width rated poor, but large pieces/BFW rated fair. Total large pieces per 100 meters averaged 7.4. Channel confinement and gradient likely decreased the influence of LWD in this stream, but the low number of large pieces, lack of key pieces, and the high percent of pieces in the small category also affected the frequency at which LWD formed pools. Pool forming pieces per BFW and the percent of pieces pool forming were quite low 0.1 and 5.7%. Overall, LWD conditions in this stream were rated as poor.

Table 63. Segment Level LWD Data for Unnamed Tributary 20.0065.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-96	87	38.0	2.6	0.00	19.5%	0.5	0.1	5.7%

Pool habitat data were evaluated at the segment level using the following attributes: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 64; Figure 22). Pool frequency, percent pool, and holding pools all rated poor. Pool cover rated fair since 60% of the pools had > 5% woody cover. A total of only 6 pools were inventoried and maximum pool depth averaged only 0.41 meters. Only one pool deeper than 0.5 meters was identified and it was formed by LWD > 50 cm diameter. Only 2 pools were formed independent of LWD (free-formed w/out LWD). The four deepest pools were all formed by LWD and the two shallowest pools were free-formed without LWD. The poor pool conditions found in this stream are likely a function of the poor LWD conditions, as well as the physical habitat potential of this stream.

Table 64. Segment Level Pool Data for Unnamed Tributary 20.0065.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1	PS-96	4-8%	6.7	5.7	9%	0.41	0.31	3.4	0	67%

3.6 CROOKED CREEK

3.6.1 CROOKED CREEK WATERSHED AND CHANNEL DESCRIPTION

Crooked Creek is the second largest tributary to Lake Ozette. Crooked Creek enters the lake on the east shore between Swan Bay and Boot Bay. The Crooked Creek watershed drains approximately 12.2mi^2 (31.6km^2; Table 65) and has several significant tributaries. The largest tributary is the South Fork followed by the North Fork, RBT 12,390 and LBT 10,325. Crooked Creek flows from the east and drains mostly low relief terrain underlain by Pleistocene age glacial drift and till deposits. From the confluence with the South Fork the mainstem only drops about 20 meters in elevation over of a distance of more than 6 kilometers. This results in a very sinuous channel (i.e. crooked). Just upstream from the South Fork is the confluence with the mainstem and the North Fork. The mainstem upstream from the North Fork becomes quite small with a basin area < 0.8mi^2 (2.07km^2).

Table 65. Crooked Creek Watershed Areas.

Watershed/Sub-basin	Watershed Area	
	Miles^2	km^2
LBT 10,325	0.78	2.02
RBT 12,390	0.95	2.46
South Fork Crooked Creek	4.46	11.55
North Fork Crooked Creek	3.26	8.44
Mainstem upstream of N.F. Crooked Creek	0.79	2.05
Entire North Fork	3.26	8.44
Entire Crooked Creek System	**12.21**	**31.62**

The mainstem of Crooked Creek was surveyed during the summer of 1999 from the lowest downstream bridge upstream to a large slide blocking fish passage, a total distance of 6,874 meters. Habitat surveys conducted in the summer of 2000 ended 66 meters upstream of the slide. The surveyed channel was divided into 6 main channel segments with 5 habitat segments (note habitat data were not collected in segments 1 and 2; Table 66; Figure 27). Approximately, 1,200 meters or more of very low gradient channel are located downstream of the SOS in segment 1. No habitat or channel surveys were conducted in segment 1. Segment 2 of Crooked Creek is unconfined and very low gradient (<.3%). BFW ranged from 10-34 meters, averaging 15.2 meters. Wetted width measurements taken in late-August and early-September 1999 ranged from 2-26 meters, averaging 10.1 meters. The substrate in the lower 2,200 meters was primarily composed of small cobble with minor amounts of gravel, sand, and small boulders. Substrate in the upper half of segment 2 was primarily coarse sand and gravel with occasional patches of small cobble. At least 10 significant logjams were identified in segment 2; at least five of these jams were over 20 meters long. The break between segment 2 and 3 is at the middle bridge.

Segment 3 extends upstream to the confluence with the South Fork Crooked Creek and remains unconfined throughout the segment. The stream gradient remains well below

1% throughout segment 3. BFW ranged from 12-20 meters averaging 14.9 meters. Wetted width measurements taken in early-September 1999 ranged from 4.6 -18.5 meters, averaging 10.1 meters. Substrate consisted of mostly gravel with sections of sand mixed with gravel, as well as some small reaches dominated by small cobble. One small jam and two side-channels were identified in segment 3. Segment 4 extends upstream from the South Fork to the confluence with the North Fork. Channel confinement remained unconfined and stream gradient was <1%. BFW measurements ranged from 6 to 15 meters, averaging 10.1 meters. Wetted width measurements taken in early-September 1999 ranged from 3.6 to 13.3 meters, averaging 7.4 meters. Gravel substrate dominated most pool tails and riffles but sand and pebble substrate was also common in segment 4.

Segment 5 extends upstream from the confluence with the North Fork to an area where the channel becomes confined. Stream gradient averaged 1-2% and channel confinement was mostly unconfined with sections classified as moderately confined. BFW measurements ranged from 3.8 to 7.2 meters, averaging 5.4 meters. Wetted width measurements taken in September 1999 ranged from 0.7 to 5.9 meters, averaging 3.3 meters. Gravel substrate was noted in small patches throughout segment 5. Segment 6 extends upstream of segment 5 for a distance of 540 meters. Channel confinement was classified as confined and gradient averaged 1-3%. BFW ranged from 2.4 to 10.4 meters, averaging 5.5 meters. Wetted width measurements taken in September 1999 ranged from 0.6 to 5.4 meters, averaging 2.6 meters. The survey ended where a large left bank slide covered the channel and was thought to be a fish passage barrier. Additional notes on side channel habitats, logjams, and other features can be found Appendix C.

Table 66. Crooked Creek Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Crooked Creek	1	na	na	~1,200	<1%	U	na	na
Crooked Creek	2	na	3993	3993	<1%	U	15.2	263.0
Crooked Creek	3a	PS-97	4,500	507	<1%	U	15.2	33.4
Crooked Creek	3b	PS-98	5,309	809	<1%	U	14.7	55.0
Crooked Creek	4	PS-99	5,642	333	<1%	U	10.1	33.0
Crooked Creek	5	PS-100	6,400	758	1-2%	U-M	5.4	141.5
Crooked Creek	6	PS-101	6,940	540	1-3%	C	5.5	98.7

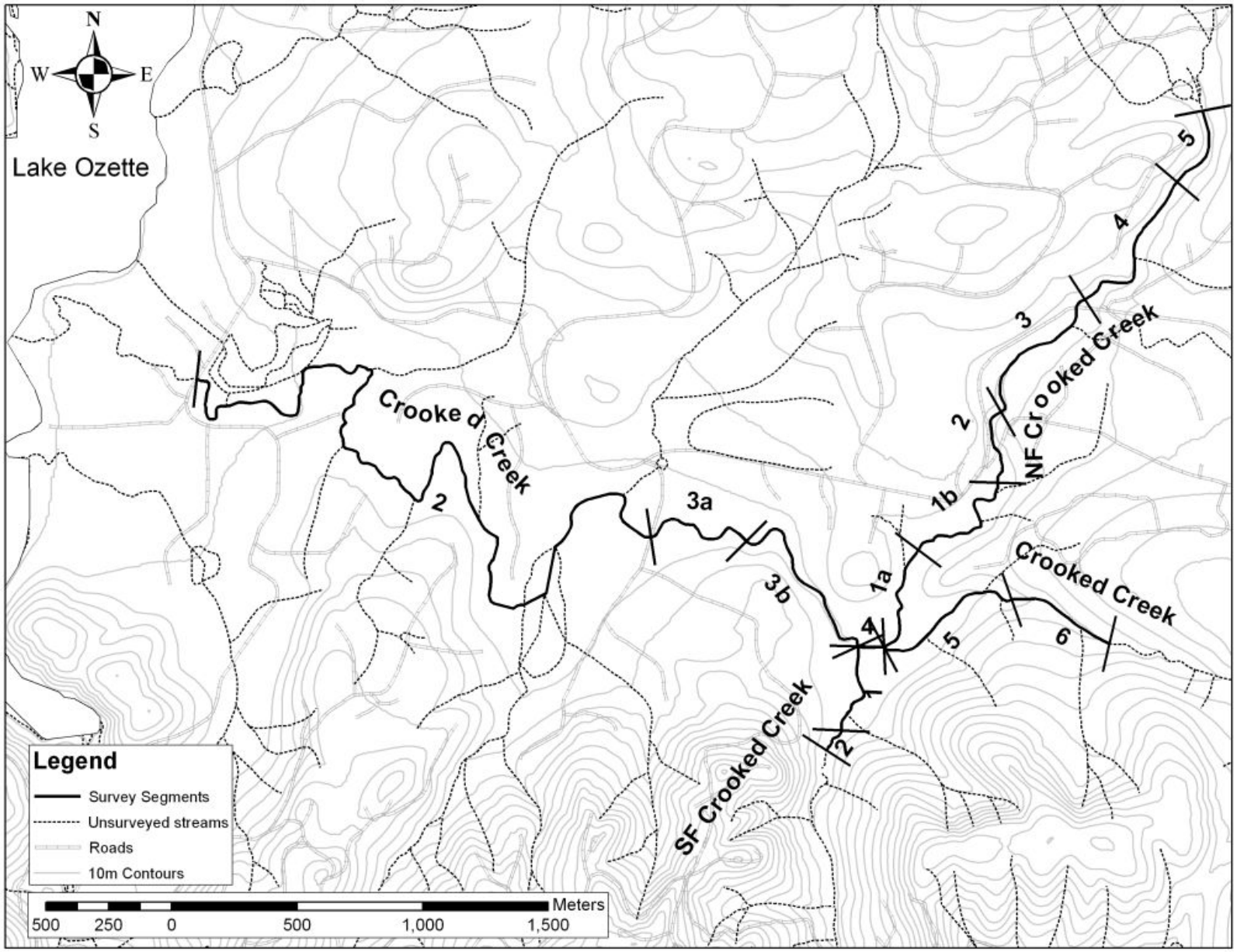

Figure 27. Crooked Creek Watershed Channel and Habitat Segments

3.6.2 CROOKED CREEK HABITAT CONDITIONS

3.6.2.1 LWD CONDITIONS

Habitat data were collected in 4 of the 6 channel segments described in Section 3.6.1 and a total of 5 habitat segments were surveyed over a distance of 2,974 meters. LWD data were summarized at the watershed scale, as well as at the habitat segment and at the 100 meter LWD band level. In the mainstem of Crooked Creek, a total of 1,453 pieces of LWD were inventoried of which 84%, 11%, and 5% were categorized as conifer, deciduous, and unknown respectively. Nearly 4% of the 1,453 pieces inventoried were classified as being key pieces. Large and L+ pieces accounted for 16% of the LWD inventoried, while medium (55%) and small (25%) pieces made up the remaining 80%. At the LWD band level, 21% of the bands had 40 or fewer pieces, while 62% had 41-60 pieces; 17% had greater than 60 pieces per 100 meters (Figure 28). The LWD bands with the lowest LWD counts included: LWD Bands 51, 53, and 57. LWD bands 43, 52, 61, and 67 had the highest piece counts.

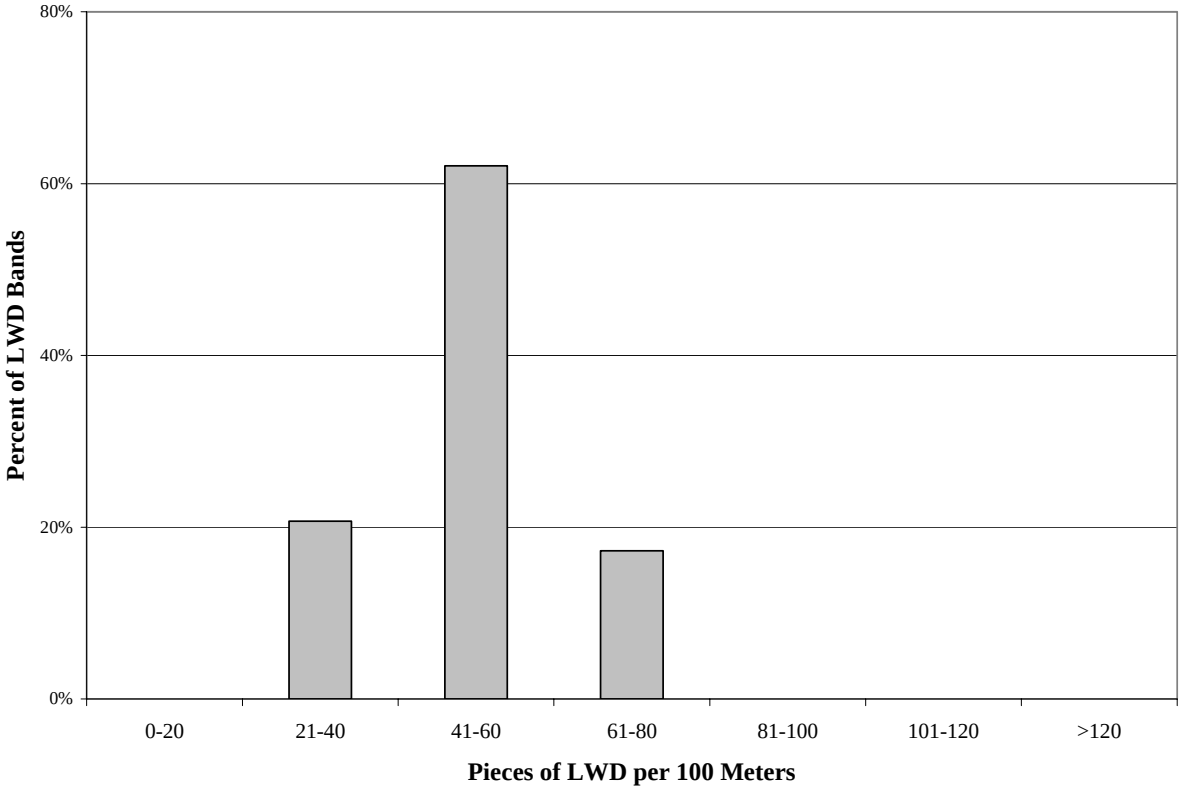

Figure 28. Crooked Creek LWD Bands within Specified LWD Count Categories.

At the segment level LWD data were evaluated based upon LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming

pieces/BFW, and percent of pieces pool forming (Table 67; Figure 29). Pieces per 100 meters rated fair in all five habitat segments. Pieces per BFW rated in good in segments 3a, 3b, and 4, and fair in segments 5 and 6. Key pieces/BFW rated poor in segments 3a, 3b, and 4, and fair in segments 5 and 6. Large pieces/BFW rated fair in segments 3a, 3b, 5, and 6, and poor in segment 4. Pool forming pieces/BFW exceeded 2 pieces/BFW in segments: 1a, 1b, and 2e. Pool forming pieces/BFW ranged from 0.7 to 1.0 pieces/BFW in segments 3a, 3b, 4, and 6. Segment 5 contained 1.7 pool forming pieces/BFW, the highest value observed throughout the Ozette basin in a channel < 7 meters BFW. The frequency of LWD formed pools appeared to be directly related to the width of the channel, the wider the channel the lower the proportion of LWD that formed pools. The LWD conditions were the best in segment 5, although the overall LWD conditions were fair to good in all segments inventoried. Loss of key pieces of LWD appears to be a more significant factor in segments 3a, 3b, and 4, than in segments 5 and 6.

Table 67. LWD Data for Crooked Creek Habitat Segments.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces per 100 M	LWD Pieces per BFW	Key Pieces per BFW	Percent of Pieces Large (>50cm)	Large Pieces per BFW	Pool Forming Pieces per BFW	Percent of Pieces Pool Forming
3a	PS-97	265	52.3	7.9	0.03	15.1%	1.2	0.7	8.3%
3b	PS-98	377.23	46.6	6.9	0.09	26.2%	1.8	0.7	9.7%
4	PS-99	156.95	47.1	4.8	0.09	16.8%	0.8	0.7	14.2%
5	PS-100	368.82	48.7	2.9	0.17	19.8%	0.6	1.7	57.0%
6	PS-101	285	52.8	2.9	0.24	18.2%	0.5	1.0	36.1%

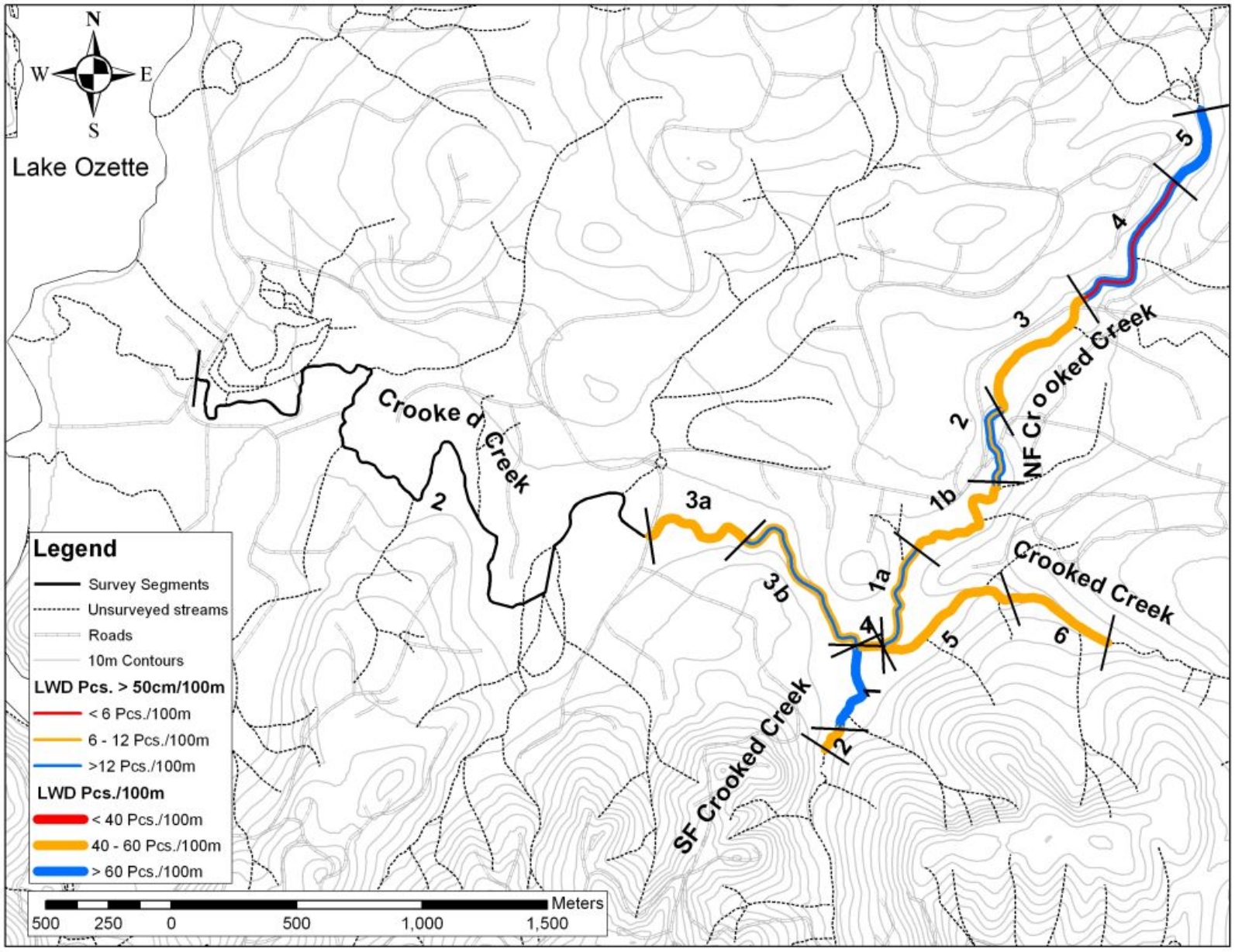

Figure 29. Crooked Creek Watershed LWD > 50cm and Total Piece Counts/100m by Segment.

3.6.2.2 POOL CONDITIONS

As described earlier, habitat data were not collected in channel segment 2 but wetted width measurements were taken at 30 meter intervals and the habitat unit the measurement was taken in was recorded as a pool, pool tailout, riffle, or cascade. A simple comparison of the percent of measurements taken at pools revealed that 69% of the measurements were taken in pools. Pool habitat data for habitat segments 3-6 were summarized and evaluated at the habitat segment level. Attributes used in the detailed evaluation included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, pool cover, and percent of pools formed by LWD (Table 68;Figure 30). Pool frequency rated poor in habitat segments 3a and 3b, and fair in segments 4, 5, and 6. Percent pools rated good in all habitat segments. Percent of pools with adequate woody cover rated fair in segments 3a, 3b, 4, and 6; segment 5 rated poor. Although segment 5 had the highest number of pools with >20% woody cover and had numerous pools with 6-20% cover, there were simply more pools with 0-5% woody cover than pools with >5% in this segment. Holding pools deeper than 1 meter rated good in habitat segment 4 and fair in segments 3a, and 3b; segments 5 and 6 rated as poor. Fair or good pool conditions exist in all habitat segments surveyed.

Table 68. Crooked Creek Pool Habitat Data.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Freq.	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/ km	Percent of Pools Formed by LWD
3a	PS-97	<1%	15.2	5.6	76%	1.01	0.78	70.6	6	67%
3b	PS-98	<1%	14.7	5.0	84%	1.08	0.88	57.5	9	82%
4	PS-99	<1%	10.1	2.5	74%	0.93	0.81	18.0	15	69%
5	PS-100	1-2%	6.0	2.9	67%	0.53	0.49	11.5	3	89%
6	PS-101	1-3%	5.5	3.0	56%	0.44	0.41	9.1	0	82%

A total of 107 pools were inventoried in the mainstem of Crooked Creek. The average maximum pool depth was 0.64 meters and the average pool length was 19.6. The quality of individual pool habitats appears to be directly correlated with LWD conditions. The best pool conditions were typically found where LWD conditions rated the highest. The proportion of LWD pieces which formed pools increased as piece size increased. Just over 58% of key pieces formed pools while only 17% of small LWD were considered pool forming (Figure 31). Key LWD made up only 4% of the total LWD abundance and had a frequency of 0.15 pieces/CW but formed 30% of the total pool habitat (by length). Small LWD independent of larger LWD formed only 1 pool. LWD >50 cm diameter made up 20% of the total LWD count but formed >82% (70% of all pools) of the pools formed by LWD.

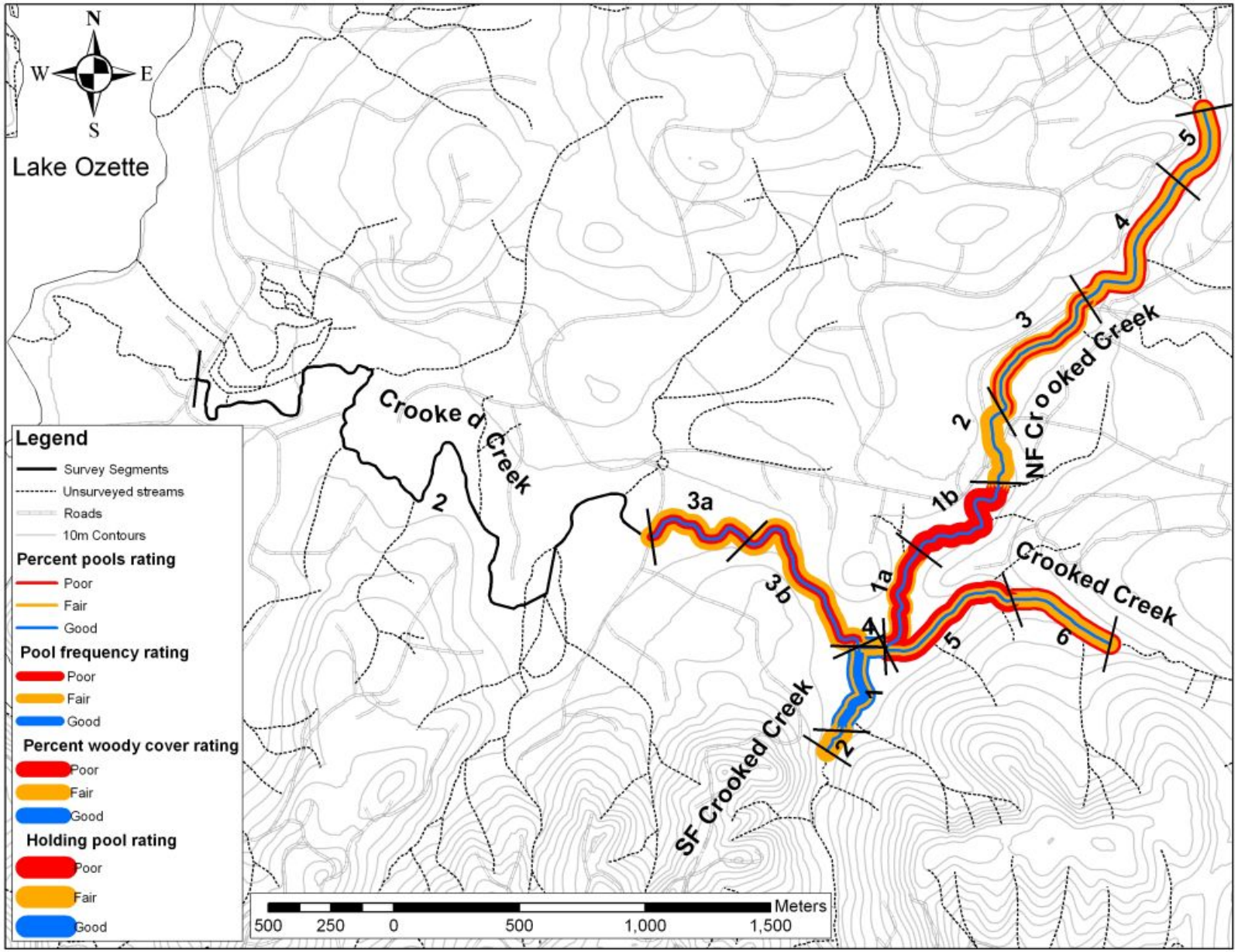

Figure 30. Crooked Creek Watershed Pool Habitat Condition Ratings.

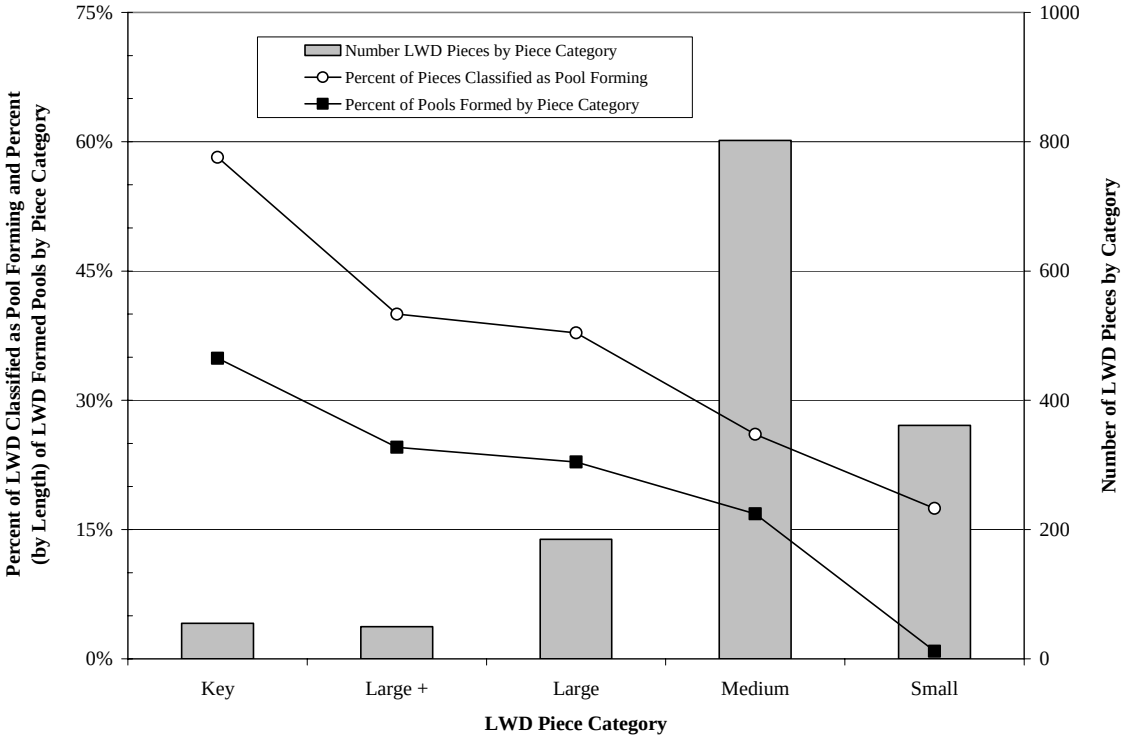

Figure 31. Crooked Creek LWD Piece Counts by Size and Pool Forming Relationships.

Not only did large LWD form pools at a higher frequency but it also formed deeper, longer, and more complex pool habitats with greater cover than pools formed by smaller LWD or independent of LWD (Table 69). Pools formed by key pieces were 68% deeper than pools formed by medium or small LWD and free-formed pools without LWD. Key piece formed pools were typically twice as long as pools formed by medium or small LWD and free-formed pools without LWD. The quality of individual pools within Crooked Creek appears to be directly linked to pool forming agents. Figure 32 illustrates the role of large wood in forming deep pools with good cover conditions.

Table 69. Crooked Creek Pool Conditions Grouped by Primary Pool Forming Agent.

Pool Forming Agent	Number of Pools	Avg Max Pool Depth	Avg Res. Pool Depth	Avg Pool Length	Avg No. of Pieces of LWD Forming Pools	0-5% Woody Cover in Pool	6-20% Woody Cover in Pool	>20% Woody Cover in Pool
Key	25	0.74	0.67	24.8	5.0	12%	32%	56%
L+	11	0.88	0.79	39.6	6.5	18%	55%	27%
L/L-	23	0.72	0.63	17.6	4.0	43%	43%	13%
Medium	27	0.44	0.38	11.1	3.6	56%	19%	26%
Small	1	0.35	0.34	16	1	100%	0%	0%
Free-formed	15	0.47	0.40	11.9	0.0	71%	14%	14%
Free-formed w/LWD	5	0.8	0.644	28.54	1.6	80%	20%	0%

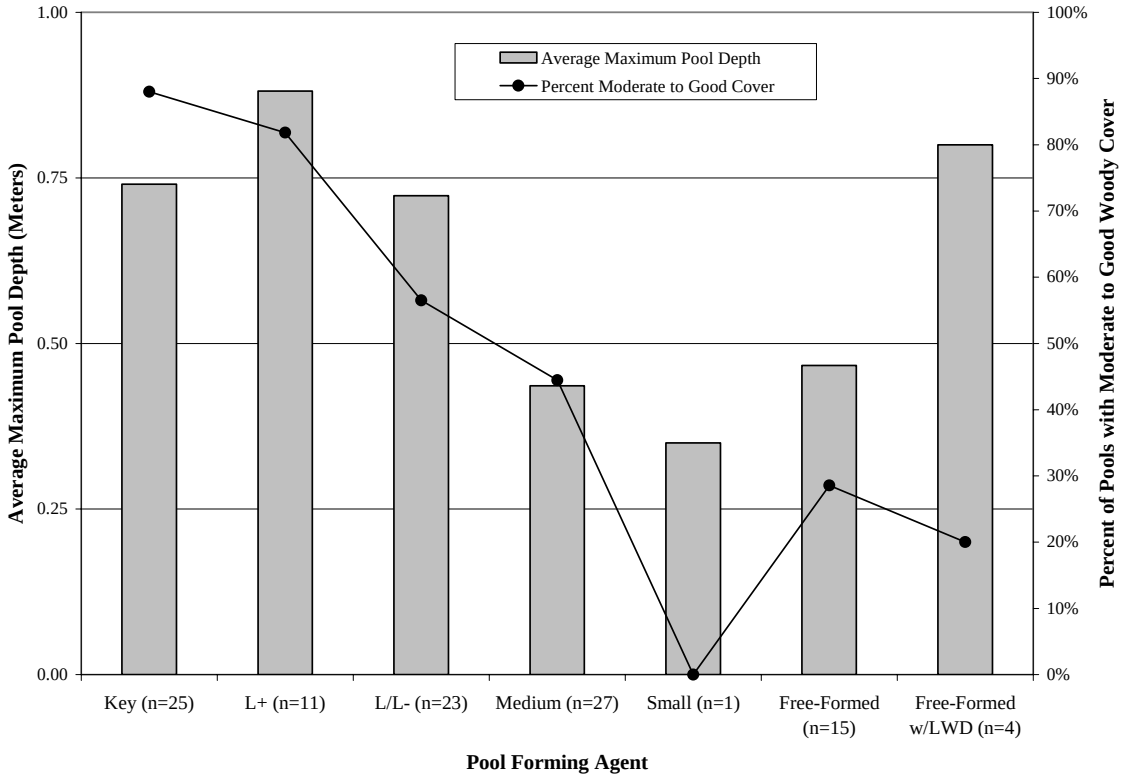

Figure 32. Relationship between Primary Pool Forming Agent and Pool Depth and Cover for Crooked Creek.

3.6.3 CROOKED CREEK TRIBUTARIES

During channel and habitat surveys in the mainstem of Crooked Creek five streams were identified as containing anadromous fish habitat. These streams included: South and North Fork Crooked Creek, RBT 3,791, LBT 10,325, and RBT 12,390. Channel and habitat data were collected in 3,871 meters of channel in the North and South Fork Crooked Creeks. No habitat or channel data were collected in RBT 3,791, LBT 10,325, or RBT 12,390. Very little information exists about these three streams, but based on mapped channel gradient, watershed area, and a review of aerial photos, all three have the potential to contain some very productive habitat. The 5800 Road may block fish passage in RBT 3,791. RBT 12,390 appears to be connected to a large open water wetland complex, but access is unknown. There may be additional small streams that provide further spawning and rearing habitat to anadromous salmonids that were not inventoried during channel and habitat surveys

3.6.3.1 SOUTH FORK CROOKED CREEK WATERSHED AND CHANNEL DESCRIPTION

South Fork Crooked Creek is the largest tributary to Crooked Creek. The South Fork drains a 4.46 square mile (11.55km^2) watershed. The confluence between the mainstem and the South Fork is located approximately 1,300 meters upstream from the "middle" bridge. The stream flows to the north throughout its entire length. The lower portion of the watershed is situated on gentle topography underlain by glacial till deposits. The middle watershed is much steeper and underlain by marine sedimentary silt- and sandstone. The upper watershed is underlain by glacial till and outwash deposits and is situated on relatively flat topography similar to the lower watershed. A total of 765 meters of channel were surveyed and channel system was broken into two discrete channel segments (Figure 27).

Channel segment 1 started at the confluence with Crooked Creek and continued upstream for 600 meters. Stream gradient ranged averaged 1-2% and channel confinement was unconfined (Table 70). Bankfull width ranged from 7 to 26 meters, averaging 16.4 meters. Wetted width measurements taken on June 20, 2000, ranged from 5.5 to 17 meters, averaging 10.6 meters. Gravel bars were noted as present in several locations in segment 1. A large jam containing at least 75 logs was identified 450 meters upstream from the SOS. Segment 2 ended 165 meters upstream from segment 1 at a large barrier falls.

Segment 2 is confined and low gradient, stream gradient averaged 1-2%. Bankfull width averaged 14.5 meters and no wetted width measurements were taken in segment 2. The water fall at the end of segment 2 is 5.5 meters high and 11 meters long. No additional notes on channel conditions were recorded in the South Fork.

Table 70. South Fork Crooked Creek Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
SF Crooked Creek	1	PS-102	600	600	1-2%	U	16.4	36.5
SF Crooked Creek	2	PS-103	765	165	1-2%	C	14.5	11.4

3.6.3.2 SOUTH FORK CROOKED CREEK HABITAT CONDITIONS

3.6.3.2.1 LWD and Pool Conditions

A total of 602 pieces of LWD were inventoried in the 765 meters of channel that were surveyed. Conifer composed 80% of the total LWD while deciduous LWD made up the remaining 20%. Of the 602 pieces inventoried, just less than 2% were classified as key

pieces. Large and L+ pieces accounted for 14% of the LWD count, while medium (55%) and small (29%) pieces made up the remaining 84%. At the segment level, LWD data were evaluated based upon total LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 71; Figure 29). LWD/100 meters rated good in segment 1 and fair in segment 2. LWD/BFW rated good in both segments 1 and 2. Key pieces per BFW rated fair in segment 1 and poor in segment 2. Large pieces per channel width rated good in segment 1 and fair in segment 2. The percent of pieces > 50 cm diameter ranged from 15-19%; this range was considered poor for rating purposes but the high number of large pieces was encouraging overall. Segment 1 contained 3.7 pool forming pieces per BFW, the second highest observed value for any habitat segment in the Ozette watershed. The overall LWD conditions in the S.F. Crooked Creek were considered good.

Table 71. Segment Level LWD Data for S.F. Crooked Creek.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces/ 100 M	LWD Pieces/ BFW	Key Pieces/ BFW	Percent of Pieces Large (>50cm)	Large Pieces/ BFW	Pool Forming Pieces/ BFW	Percent of Pieces Pool Forming
1	PS-102	528	88.0	14.5	0.30	15.2%	2.2	3.7	25.8%
2	PS-103	74	44.8	6.5	0.09	18.9%	1.2	0.7	10.8%

Pool habitat data were evaluated at the segment level using the following attributes: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, and percent of pools formed by LWD (Table 72; Figure 30). Pool frequency rated good in segment 1 and fair in segment 2. Percent pools rated good in both segments. The pools with adequate woody cover category rated as fair for both segments and holding pool frequency rated good in segment 1 and fair in segment 2. A total of 32 pools were inventoried and maximum pool depth averaged 0.94 meters. Only 5 of the 32 pools (16%) were formed independent of LWD (free-formed w/out LWD). The relatively good pool conditions found in the South Fork are likely related to the high number of LWD pieces > 50 cm diameter, as well as the generally high abundance of all LWD. LWD formed 81% of all pools and LWD pieces > 50 cm diameter formed 64% of all pools found in the South Fork.

Table 72. Segment Level Pool Data for S.F. Crooked Creek.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Frequency	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/km	Percent of Pools Formed by LWD
1	PS-102	1-2%	16.4	1.3	70%	0.95	0.76	15.5	20	90%
2	PS-103	1-2%	14.5	3.8	64%	0.94	0.86	24.9	6	33%

3.6.3.3 NORTH FORK CROOKED CREEK WATERSHED AND CHANNEL DESCRIPTION

The North Fork of Crooked Creek is the second largest tributary to Crooked Creek. The North Fork drains a 3.26 square mile watershed. The confluence between the mainstem and the North Fork is located approximately 332 meters upstream from the confluence with the South Fork Crooked Creek. The stream flows from the north-northeast throughout its entire length. The vast majority of the watershed is situated on gentle topography underlain by glacial drift and minor till deposits. Headwater tributaries in the upper portion of the watershed drain steeper topography, underlain by glacial till deposits in the lower reaches and marine derived silt and sandstones in the upper reaches. A total of 3,206 meters of channel were surveyed and channel system was broken into 5 discrete channel segments with 6 habitat segments (Figure 27).

Channel segment 1 started at the confluence with Crooked Creek and continued upstream for 1,100 meters. Stream gradient averaged <1% and channel confinement was classified as unconfined (Table 73). Bankfull width ranged from 6 to 15 meters, averaging 9.5 meters. Wetted width measurements taken on September 9, 1999 ranged from 2.3 to 13.4 meters, averaging 6.8 meters. Substrate conditions in the lower 500 meters were mostly fine-grained sand, silt, and small pebbles, with occasional patches of spawning gravel. In the upper half of segment 1, spawning gravel was much more prevalent, although small reaches of silt and sand were also still present, as were reaches containing cobble.

Segment 2 extends 400 meters upstream from segment 1. Channel confinement was classified as moderate and stream gradient averaged 1-2%. Bankfull width ranged from 6 to 14 meters, averaging 9.4 meters. Wetted width measurements taken on September 9, 1999 ranged from 4.2 to 12.0 meters, averaging 8.2 meters. Substrate conditions in the lower 200 meters were composed mostly of gravel and pebbles and the upper 200 meters were mostly fine grained sand, silt, and small pebbles. The segment break between segment 2 and 3 occurred where the channel was downcutting and had become functionally confined.

Segment 3 stream gradient averaged 1-2% and BFW ranged 5 to 11 meters, averaging 8.0 meters. Wetted width measurements taken from September 9-10, 1999 ranged from 1.8 to 11 meters, averaging 5.8 meters. Substrate conditions consisted of sections of gravel separated by reaches of fines and pea-gravel and occasional sections dominated by cobble. Field notes indicate that the channel has downcut significantly in the lower reaches, but notes are unclear on whether these conditions continued throughout the segment.

The lower end of segment 4 is located 44 meters upstream from the old bridge (Figure 27; Appendix C). Channel confinement was classified as moderate and stream gradient averaged 2-3%. Bankfull width ranged from 4.5 to 9.0 meters, averaging 6.3 meters. Wetted width measurements recorded on September 10, 1999 ranged from 0.9 to 6.8 meters, averaging 3.3 meters. Spawning gravel was noted throughout segment 4, but the

lower half had consistently more fine-grained materials than the upper half of the segment. Coho fry were noted in the middle of segment 4.

Segment 5 is short, only 306 meters. Channel confinement was classified as confined and stream gradient averaged 2-4%. Bankfull and wetted width averaged 6.2 and 3.4 meters respectively. The channel was described as unstable and downcutting, substrate was mostly large cobble and boulders. No clear rationale was used in ending the survey at the end of segment 5. The contributing basin area upstream of the EOS is 1.22mi^2 (3.16km^2) and based upon topographic maps and aerial photos up to 2,000 meters of anadromous fish habitat likely exists upstream of the EOS.

Table 73. North Fork Crooked Creek Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
N.F. Crooked	1a	PS-104	500	500	<1%	U	10.1	49.3
N.F. Crooked	1b	PS-105	1,100	600	<1%	U	9.1	66.3
N.F. Crooked	2	PS-106	1,500	400	1-2%	M	9.4	42.5
N.F. Crooked	3	PS-107	2,300	800	1-2%	C	8.0	100.0
N.F. Crooked	4	PS-108	2,900	600	2-3%	M	6.3	95.2
N.F. Crooked	5	PS-109	3,206	306	2-4%	C	6.2	49.2

3.6.3.4 NORTH FORK CROOKED CREEK HABITAT CONDITIONS

3.6.3.4.1 LWD Conditions

Habitat data were collected in all of the 5 channel segments and 6 habitat segments described in Section 3.6.3.3 above. LWD data were summarized at the watershed scale, as well as at the habitat segment and 100 meter LWD band level. In the mainstem of the North Fork Crooked Creek, a total of 1,931 pieces of LWD were inventoried of which 77%, 19%, and 4% were categorized as conifer, deciduous, or unknown respectively. Nearly 3% of the 1,931 pieces inventoried were classified as being key pieces. Large and L+ pieces accounted for 13% of the LWD inventoried, while medium (65%) and small (19%) pieces made up the remaining 84%. At the LWD band level 28% of the bands had 40 or fewer pieces, while 22% had 41-60 pieces, 31% had 61-80 pieces; impressively 19% had greater than 80 pieces per 100 meters (Figure 33). The LWD bands with the lowest LWD counts included: LWD Bands 1, 11, 20, and 22. LWD bands 13, 14, 15, and 32 had the highest piece counts.

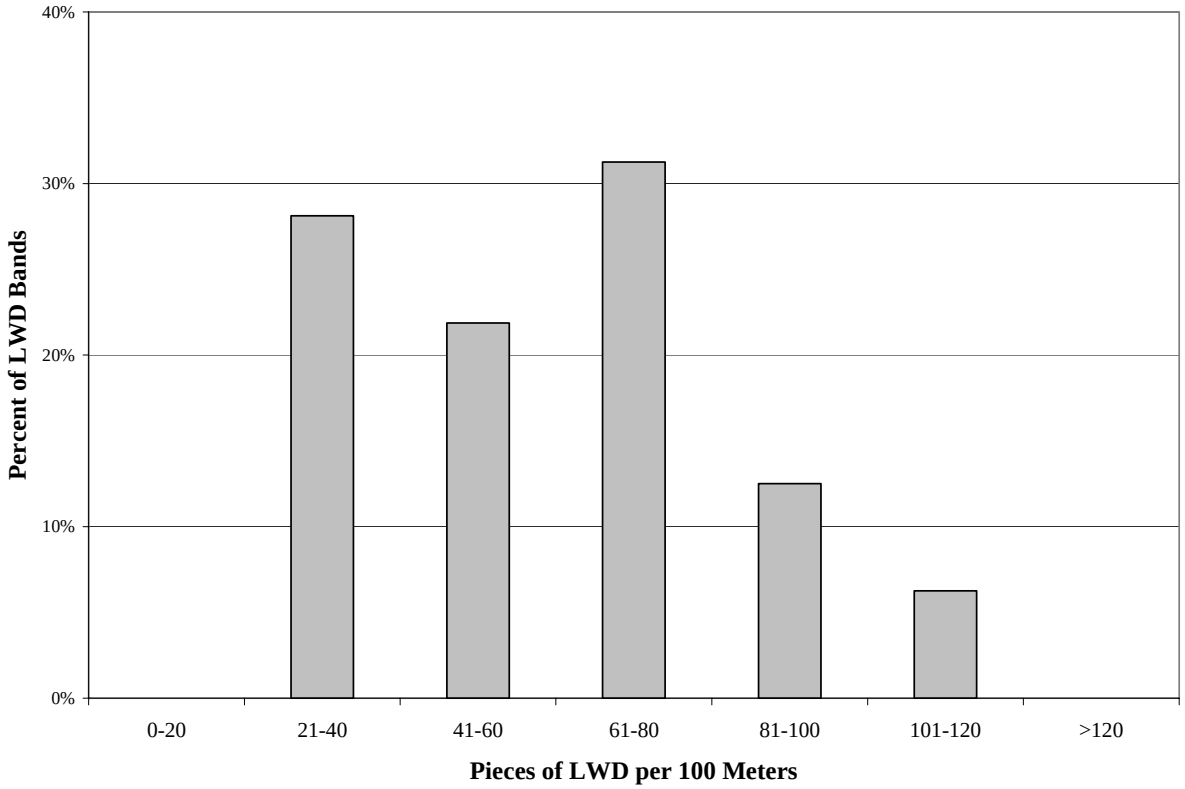

Figure 33. N.F. Crooked Creek LWD Bands within Specified LWD Count Categories.

At the habitat segment level LWD data were evaluated based upon LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 74; Figure 29). Pieces per 100 meters rated good in segments 2, 4, and 5 and fair in segments 1a, 1b, and 3; no segment rated poor. Pieces per BFW rated good in segments 1a, 2, 3, and 5, and fair in segments 1b and 4; segment 4 nearly qualified as good (4.0 pieces/BFW). Key pieces/BFW rated fair in segments 2, 3, and 5, and poor in segments 1a, 1b, and 4. Large pieces/BFW rated good in segment 2, and fair in segments 1a, 1b, 3, and 5. Segment 4 rated as poor for large pieces/BFW.

Pool forming pieces/BFW ranged from 0.4 to 4.5 pieces/BFW; the lowest and highest values were found in segments 1b and 2 respectively. Segment 2 had the highest number of pool forming pieces per BFW observed in any habitat segment surveyed in the Ozette watershed. The percent of LWD pieces classified as large ranged from 9-24%. The highest and lowest percent were found in segments 1a and 4, which also had the corresponding highest and lowest number of large pieces/100m (13.0 and 5.7). The percent of LWD pieces forming pools ranged from 11% to 72%; the highest percentages were found in segments 2 and 3. The LWD conditions were the best in segment 2, the poorest conditions were found in segment 1b.

Table 74. LWD Conditions for N.F. Crooked Creek Habitat Segments.

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces per 100 M	LWD Pieces per BFW	Key Pieces per BFW	Percent of Pieces Large (>50cm)	Large Pieces per BFW	Pool Forming Pieces per BFW	Percent of Pieces Pool Forming
1a	PS-104	273	54.6	5.5	0.10	23.8%	1.3	0.7	12.1%
1b	PS-105	246	41.0	3.7	0.06	16.7%	0.6	0.4	11.0%
2	PS-106	350	87.5	8.2	0.16	12.9%	1.1	4.5	54.9%
3	PS-107	402	50.2	4.0	0.17	18.7%	0.75	2.9	71.8%
4	PS-108	382	63.7	4.0	0.09	8.9%	0.4	2.1	52.4%
5	PS-109	278	90.8	5.6	0.20	15.1%	0.9	1.2	21.2%

3.6.3.4.2 Pool Habitat Conditions

Pool habitat data for the 6 habitat segments described above were summarized and evaluated at the habitat segment level. Attributes used in the evaluation included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, pool cover, and percent of pools formed by LWD (Table 75; Figure 30). Pool frequency rated fair in habitat segments 2, 3, 4, and 5, and poor in habitat segments 1a and 1b. Percent pools rated good in all habitat segments. Percent of pools with adequate woody cover rated fair in segments 2, 4, and 5, and poor in segments 1a, 1b, and 3. Holding pools deeper than 1 meter rated fair in habitat segments 1a, 2, and 3, and poor in segments 1b, 4, and 5. The percent of pools formed by LWD ranged from 75-100%, with the highest and lowest percentages in segments 2 and 1b respectively. The segments with the best LWD conditions also had the best pool habitat conditions; the segment with the worst LWD conditions also had the poorest pool habitat conditions.

Table 75. N.F. Crooked Creek Pool Habitat Data.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Freq.	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/ km	Percent of Pools Formed by LWD
1a	PS-104	<1%	10.1	4.1	60%	0.86	0.75	26.3	8	100%
1b	PS-105	<1%	9.1	5.5	71%	0.84	0.73	35.0	3	75%
2	PS-106	1-2%	9.4	3.3	84%	0.81	0.75	27.7	8	100%
3	PS-107	1-2%	8.0	3.7	84%	0.74	0.67	23.4	6	96%
4	PS-108	2-3%	6.3	3.5	61%	0.56	0.50	13.5	2	96%
5	PS-109	2-4%	6.2	2.6	53%	0.54	0.47	8.5	3	84%

A total of 110 pools were inventoried in the N.F. Crooked Creek. The average maximum pool depth was 0.70 meters and the average pool length was 20.5 meters. The quality of pool habitat appears to be directly correlated with LWD conditions. The best pool conditions were found where LWD conditions rated the highest. The proportion of LWD pieces that formed pools increased as piece size increased. Nearly 60% of key piece

sized LWD formed pools while only 28% of small LWD were considered pool forming. Key LWD made up <3% of the total LWD abundance and had a frequency of only 0.13 pieces/CW but formed 27% of the total pool habitat (by length). Small LWD independent of larger LWD formed only 1% of the total pool habitat. LWD >50 cm diameter made up 16% of the total LWD count but formed 71% of the total pool habitat by length. Pools formed by large LWD were typically deeper, longer, and more complex and contained higher LWD counts and greater pool cover (Table 76). Pools formed by key piece size LWD averaged nearly 1.8 times deeper than pools formed by small LWD and free-formed pools without LWD. The quality of individual pools within the North Fork appears to be directly linked to pool forming agents. Figure 34, illustrates the role of large wood in forming deep pools with good cover conditions.

Table 76. N.F. Crooked Ck Pool Conditions Grouped by Primary Pool Forming Agent.

Pool Forming Agent	Number of Pools	Avg Max Pool Depth	Avg Res. Pool Depth	Avg Pool Length	Avg No. of Pieces of LWD Forming Pools	0-5% Woody Cover in Pool	6-20% Woody Cover in Pool	>20% Woody Cover in Pool
Key	25	0.78	0.72	24.7	13.8	13%	35%	52%
L+	21	0.82	0.73	26.5	8.0	43%	29%	29%
L/L-	22	0.67	0.60	19.2	6.5	59%	14%	27%
Medium	32	0.61	0.54	16.3	4.3	65%	26%	10%
Small	2	0.44	0.37	7.9	1.0	50%	50%	0%
Free-formed	5	0.43	0.37	7.8	na	60%	0%	40%
Free-formed w/LWD	3	0.73	0.65	28.2	1.0	100%	0%	0%

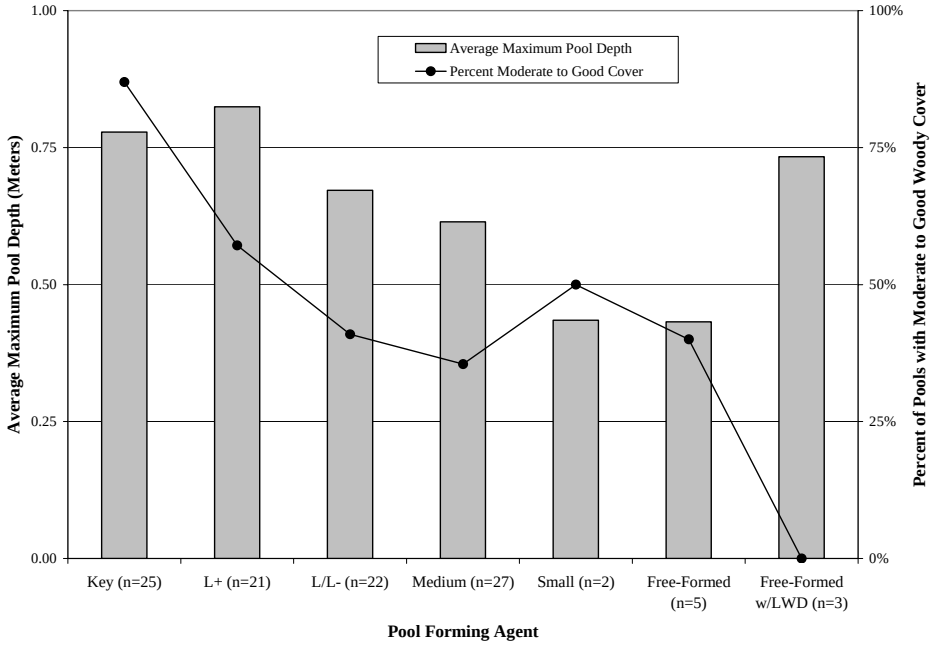

Figure 34. Relationship between Primary Pool Forming Agent and Pool Depth and Cover for N.F. Crooked Creek.

3.7 SIWASH CREEK

3.7.1 SIWASH CREEK WATERSHED AND CHANNEL DESCRIPTION

Siwash Creek drains 2.87mi^2 (7.43km^2) of land and is the fifth largest tributary to Lake Ozette (South Creek is the fourth largest; 3.26mi^2). Siwash Creek enters the lake along the south end of the eastern shoreline of the lake along a point just south of Olsen's Beach. The lower 3,500 meters (channel segments 1, 2, and 3) of Siwash Creek flow to the west in a valley confined by small hills underlain by Pleistocene age glacial till deposits. Side tributaries draining from the south originate in moderately steep low hills underlain by Eocene-Miocene aged marine sedimentary rock units. The stream winds around a resistant bedrock knob in a narrow ravine through segments 4 and 5. Upstream of segment 5 the channel flows through a wide unconfined valley underlain by Pleistocene age glacial till and outwash deposits. The vast majority of channels in this area are wetland-type channels, which typically were not surveyed in this project.

The mainstem of Siwash Creek was surveyed during the summer of 2000 from the first significant left bank tributary upstream from the lake to point 4,595 meters upstream where the channel took on the characteristics of a wetland-type channel. The surveyed channel was divided into 4 main channel segments with 5 habitat segments (Table 77; Figure 35). The first channel segment of Siwash Creek was not surveyed; it is the section of channel between Lake Ozette and segment 2. A portion of this segment was walked but the channel characteristics were mostly that of a wetland channel. Segment 2 is unconfined and low gradient (<1%). BFW ranged from 4 to 13 meters, averaging 7.3 meters. Wetted width measurements taken during late-August 2000 ranged from 3.8 to 11.3 meters, averaging 6.2 meters. The break between segment 2 and 3 is located 1,000 meters upstream from the SOS. Channel confinement remained unconfined but stream gradient increased and averaged 1-2%. Bankfull width ranged from 4 to 15 meters, averaging 8.3. Wetted width measurements taken in late-August and early-September 2000 ranged from 2.3 to 13.6 meters, averaging 6.4 meters. The break between channel segment 3 and 4 occurred 1,400 meters upstream from segment 2 at a location where the channel became moderately confined. Both stream gradient and confinement increased in the upstream direction throughout segment 4 until the channel became totally confined. Bankfull width and wetted width averaged 8.5 and 6.0 meters respectively. Segment 4 ends at the confluence with a right bank tributary (RBT10,075) at the lower end of a narrow ravine.

Segment 5 extends upstream through the ravine described above; the channel remains confined throughout the small canyon section. Stream gradient varied drastically through the segment. Overall the gradient averaged 2-4% but the middle 700 meters of the segment contained numerous cascades and sections where gradients were between 5-10%. Bankfull and wetted widths averaged 7.4 and 4.6 meters respectively. Substrate conditions in segment 5 were much different from those observed downstream. Segments 2, 3, and 4 were primarily gravel dominated with sections of pebbles, fines, and small cobble. Substrate in segment 5 on the other hand was dominated by cobble, boulders, and bedrock in the lower and middle sections, but transitioned into gravel in the

upper 300 meters of channel above the last set of cascades. Anadromous fish passage through the cascade section of segment 5 is assumed based on observations of fry upstream of the cascades. The small reach of gravel bed channel between the cascades and the wetland may provide extremely important spawning habitat for coho salmon since most of the channels upstream are mud and silt bottomed channels. Only a few tributaries enter Siwash Creek that have the potential to provide anadromous fish habitat and none of these streams were surveyed. Tributaries that may provide anadromous fish habitat likely only contain short reaches of habitat (<500 meters).

Table 77. Siwash Creek Channel Segment Attributes.

Stream Name	Channel Segment	Habitat Segment ID	Upstream End (Meter)	Segment Length	Gradient	Channel Confine-ment	BFW	Number of BFWs
Siwash Creek	2a	PS-110	500	500	<1%	U	7.3	68.6
Siwash Creek	2b	PS-111	1,000	500	<1%	U	7.2	69.1
Siwash Creek	3a	PS-112	1,500	500	1-2%	U	8.0	62.7
Siwash Creek	3b	PS-113	2,400	900	1-2%	U	8.5	106.1
Siwash Creek	4	PS-114	3,071	671	1-3%	M	8.5	78.5
Siwash Creek	5	na	4,595	1,524	2-4%	C	7.4	205.9

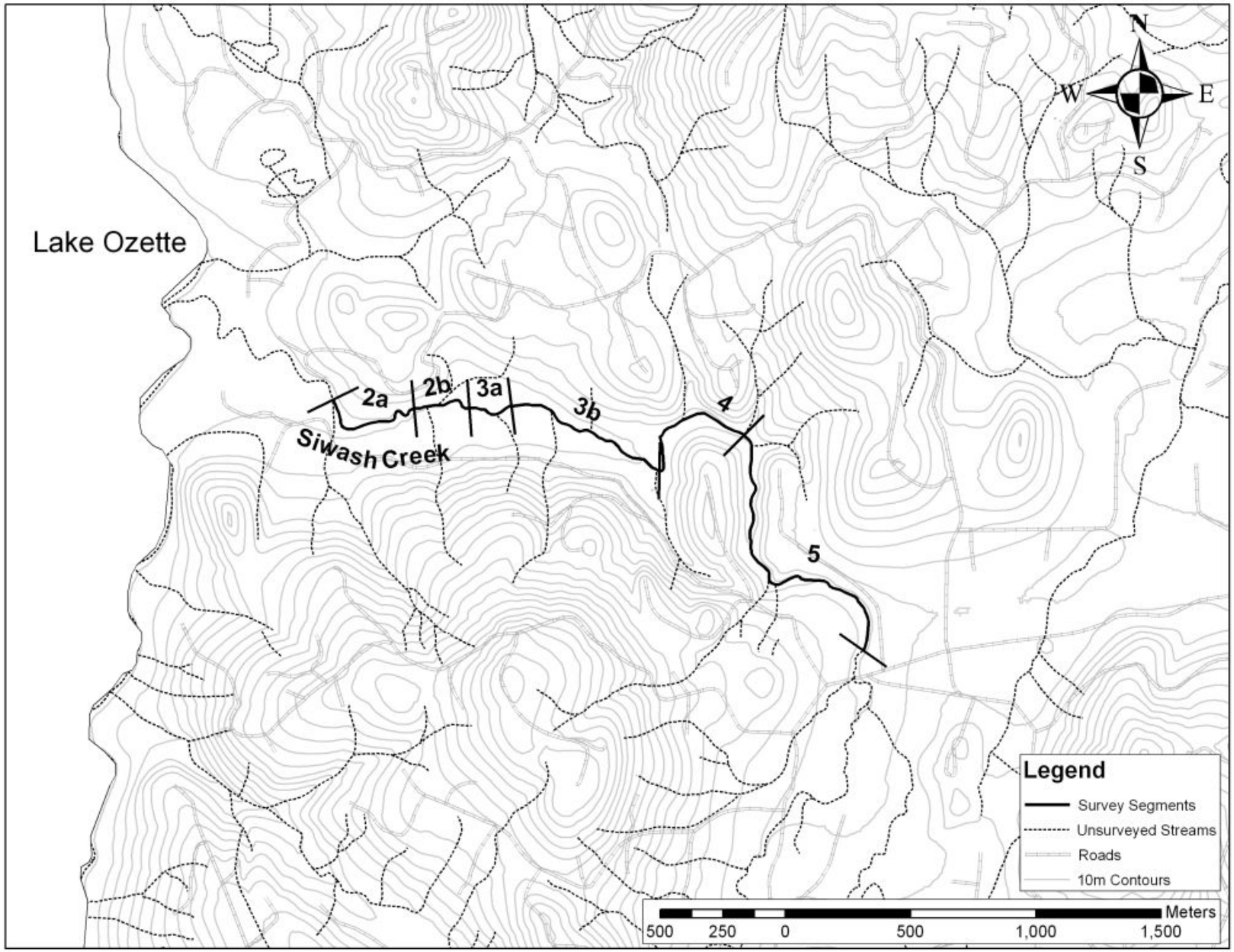

Figure 35. Siwash Creek Channel and Habitat Segments.

3.7.2 SIWASH CREEK HABITAT CONDITIONS

3.7.2.1 LWD CONDITIONS

Habitat data were collected in 5 habitat segments found in channel segments 2, 3, and 4; no habitat data were collected in segment 5. LWD data were summarized at the watershed scale, as well as at the habitat segment and 100 meter LWD band level. In the mainstem of Siwash Creek a total of 1,757 pieces of LWD were inventoried of which 69%, 25%, and 6% were categorized as conifer, deciduous, or unknown respectively. Just over 4% of the 1,757 pieces inventoried were classified as being key pieces. Large and L+ pieces accounted for an additional 22% of the LWD inventoried, while medium (43%) and small (31%) pieces made up the remaining 74%. LWD > 50 cm diameter was well distributed throughout the stream system; pieces per 100 meters ranged from 7 to 25 pieces/100 meters, averaging 14.8 (median=14). At the LWD band level, only 13% of the bands had 40 or fewer pieces, while 50% had 41-60 pieces; nearly 37% had greater than 60 pieces per 100 meters (Figure 36). The LWD bands with the lowest LWD counts included: LWD Bands 21, 23, 29, and 30. LWD bands 2, 5, 7, and 22 had the highest piece counts.

At the segment level, LWD data were evaluated based upon LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, the percent of pieces of LWD classified as large (>50cm diameter), pool forming pieces/BFW, and percent of pieces pool forming (Table 78; Figure 37). Pieces per 100 meters rated good in segments 2a and 2b and fair in segments 3a, 3b, and 4. Pieces per BFW rated in good in segments 2a-3, and fair in habitat segment 4. Key pieces/BFW rated fair in segments 2a, 3a, 3b, and 4, and poor in habitat segment 2b (0.12 key pieces/BFW). Large pieces/BFW rated good in segments 2a, 3a, 3b, and 4, and fair in habitat segment 2b. Pool forming pieces/BFW ranged from 0.6 in segment 4, to 1.1 in segment 3a. The percent of pieces classified as large ranged from 20.7% in segment 2a to 31.1% in segment 3b. The percentage of pieces classified as large was rated fair in segments 3a-4, and poor in segments 2a and 2b.The LWD conditions were fair or good in all habitat segments surveyed. The best LWD conditions were found in habitat segments 2a, 3a, and 3b. High deciduous piece counts in some LWD bands may be cause for concern about future riparian conditions and in-channel wood loading. Decay class (1-4; see Section 2.1.2) was recorded for 70 of the key pieces of LWD in Siwash Creek and only 16% of the pieces were in decay class 1 and 2; 54% were in decay class 4.

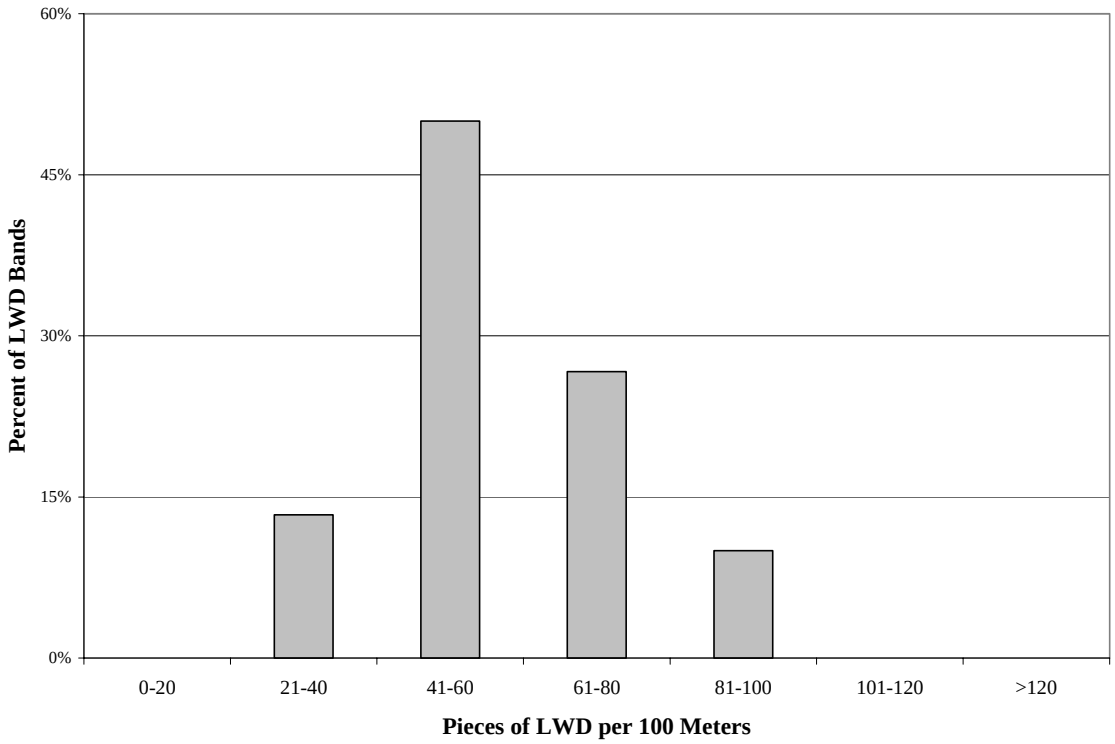

Figure 36 Siwash Creek LWD Bands within Specified LWD Count Categories.

Table 78. LWD Data for Siwash Creek Habitat Segments**.**

Habitat Segment	Habitat Segment ID	Total Number of LWD	LWD Pieces per 100 M	LWD Pieces per BFW	Key Pieces per BFW	Percent of Pieces Large (>50cm)	Large Pieces per BFW	Pool Forming Pieces per BFW	Percent of Pieces Pool Forming
2a	PS-110	391	78.2	5.7	0.25	20.7%	1.2	0.8	13.6%
2b	PS-111	313	62.6	4.5	0.12	20.8%	0.9	0.9	20.8%
3a	PS-112	285	57.0	4.5	0.16	28.1%	1.3	1.1	24.6%
3b	PS-113	466	51.8	4.4	0.23	31.1%	1.4	0.7	15.9%
4	PS-114	302	45.0	3.8	0.24	29.1%	1.1	0.6	16.2%

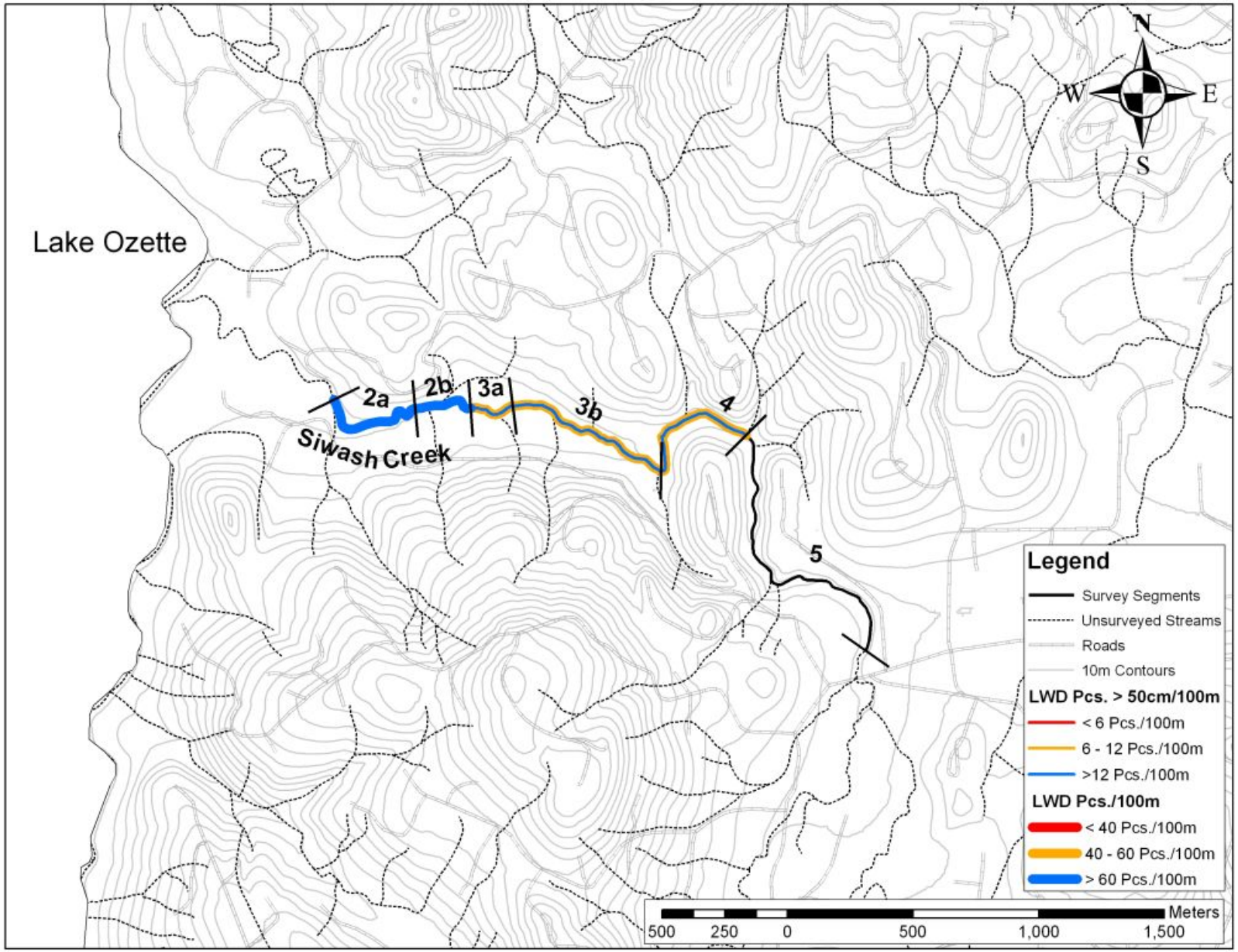

Figure 37. Siwash Creek LWD > 50cm and Total Piece Counts/100m by Segments.

3.4.2.2 POOL CONDITIONS

Pool habitat data for the 5 habitat segments described above were summarized and evaluated at the watershed and habitat segment level. Attributes used in the evaluations included: pool frequency, percent pools (by length), average maximum and residual pool depth, average pool length, pools >1m deep/km, pool cover, and percent of pools formed by LWD (Table 79; Figure 38). At the segment level pool frequency rated fair in segment 4 and poor in all other habitat segments. This may be a function of complex/multiple pools being lumped into a single pool unit. The ratio of pool length to channel width was examined for the 114 habitat segments surveyed in Ozette watershed; Siwash Creek habitat segments ranked 1st, 4th, 6th, 7th, and 12th highest. Percent pools rated good in all habitat segments. Percent of pools with adequate woody cover rated fair in segments 2a, 3b, and 4, and poor in segments 2b and 3a. Holding pools deeper than 1 meter/km rated good in habitat segments 2a, 2b, 3a, and 3b, and fair in segment 4. Segments 2a, 2b, and 3a had the lowest maximum pool depth to channel width ratio of any habitat segments in the Ozette watershed. The percent of pools formed by LWD ranged from 85-100%. Overall pool conditions rated fair or good in all habitat segments.

Table 79. Siwash Creek Pool Habitat Data.

Habitat Segment	Habitat Segment ID	Gradient	BFW	Pool Freq.	Percent Pools (by length)	Average Maximum Pool Depth	Average Residual Pool Depth	Average Pool Length	Pools >1m Deep/ km	Percent of Pools Formed by LWD
2a	PS-110	<1%	7.3	4.3	80%	1.10	0.98	28.1	18	94%
2b	PS-111	<1%	7.2	7.7	86%	1.10	0.92	46.2	12	100%
3a	PS-112	1-2%	8.0	4.8	74%	1.20	1.06	31.1	18	92%
3b	PS-113	1-2%	8.5	5.3	74%	0.98	0.86	32.2	13	85%
4	PS-114	1-3%	8.5	3.6	85%	0.87	0.72	24.9	7	86%

A total of 80 pools were inventoried in the mainstem of Siwash Creek. The average maximum pool depth was 1.02 meters (residual pool depth=0.88m) and the average pool length was 30.8 meters. The quality of pool habitat appears to be directly correlated with LWD conditions. The best pool conditions were typically associated with the largest LWD. The proportion of LWD pieces that formed pools increased as piece size increased. Nearly 57% of key piece sized LWD formed pools while only 5% of small LWD were considered pool forming. Key LWD made up only 4% of the total LWD abundance and had a frequency of 0.20 pieces/CW but formed 44% the total pool habitat (by length). No pools were formed by small LWD independent of larger LWD. Large LWD (diameter > 50 cm) made up 26% of the total LWD piece count but formed 83% of all pools; the highest observed percentage in any stream system surveyed in the Ozette watershed. Approximately, 93% of pool habitat was formed by LWD, only 5% of the total pool habitat was formed independent of LWD (2% of the pool habitat was classified as free-formed w/LWD).

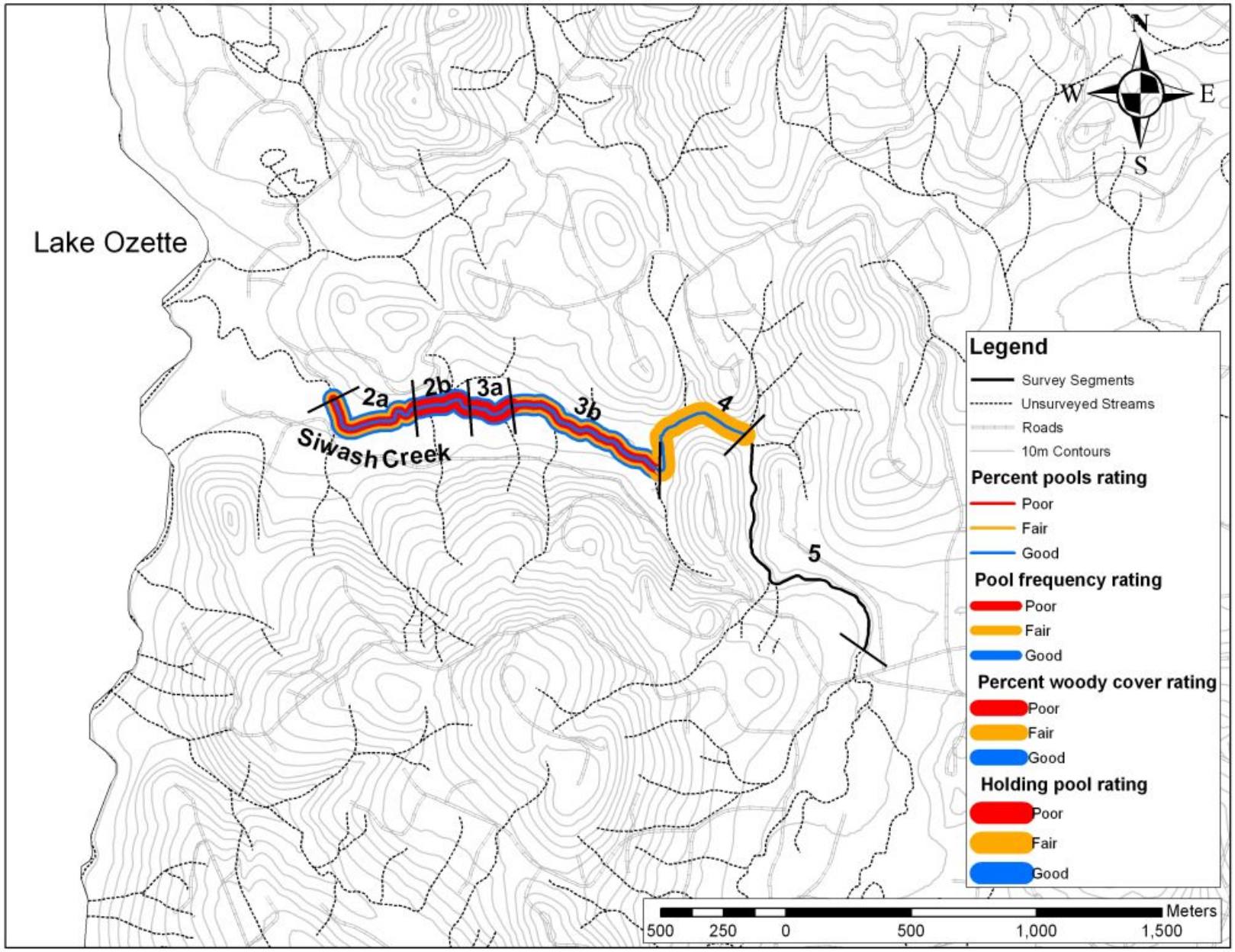

Figure 38. Siwash Creek Pool Habitat Condition Ratings.

An analysis of individual pool attributes revealed that on average, pools formed by the largest LWD were the deepest and longest. They also contained the highest number of pool forming pieces/pool and had the highest percent of woody cover (Table 80). Pools formed by key piece size LWD averaged nearly 1.4 times deeper than pools formed by medium LWD and free-formed pools without LWD. Key piece formed pools were 1.8 times as long as pools formed by medium LWD and free-formed pools without LWD. The quality and complexity of individual pools within Siwash Creek is directly linked to pool forming agents. Figure 39, illustrates the role of large wood in forming deep pools with good cover conditions. Currently a significant number of large and key piece sized LWD exists in Siwash Creek and pool conditions are rather good. But the future recruitment potential for large LWD in most of Siwash Creek is bleak due to riparian stand conditions.

Table 80. Siwash Creek Pool Conditions Grouped by Primary Pool Forming Agent.

Pool Forming Agent	Number of Pools	Avg Max Pool Depth	Avg Res. Pool Depth	Avg Pool Length	Avg No. of Pieces of LWD Forming Pools	0-5% Woody Cover in Pool	6-20% Woody Cover in Pool	>20% Woody Cover in Pool
Key	30	1.14	1.01	36.1	5.4	34%	45%	21%
L+	15	1.07	0.92	34.1	4.5	53%	40%	7%
L/L-	16	0.99	0.84	28.3	3.6	63%	38%	0%
Medium	11	0.84	0.73	22.7	2.2	64%	36%	0%
Small	0	na	na	na	na	na	na	na
Free-formed	6	0.83	0.69	19.4	na	50%	0%	33%
Free-formed w/LWD	2	0.72	0.58	23.2	1.5	50%	50%	0%

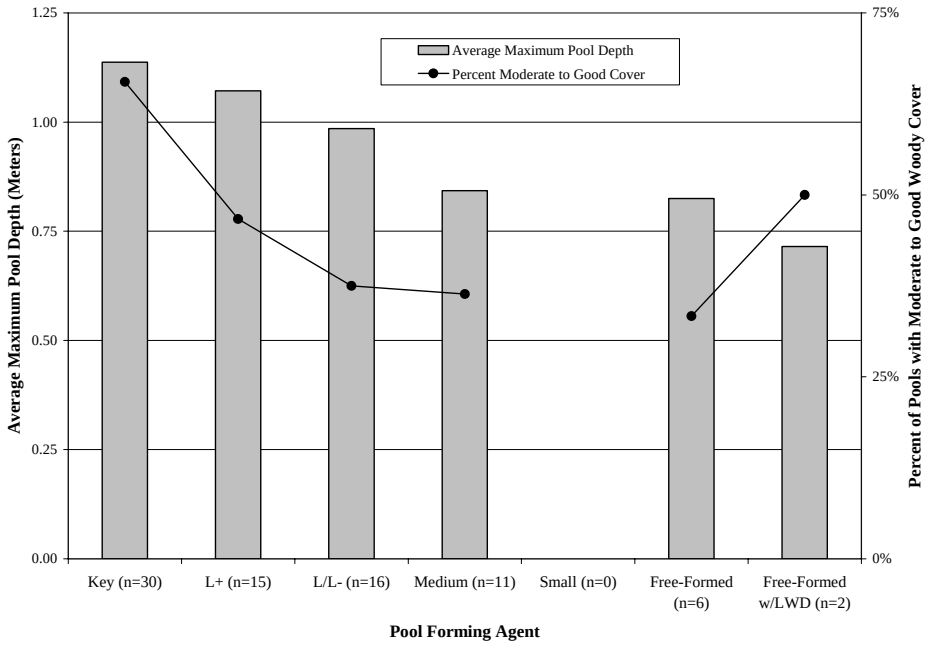

Figure 39. Relationship between Primary Pool Forming Agent and Pool Depth and Cover for Siwash Creek

3.8 WATERSHED SCALE HABITAT SUMMARY

LWD data were collected in 628 LWD bands distributed throughout the 114 habitat segments surveyed within the watershed. A total of 30,289 LWD pieces were inventoried of which 74%, 23%, and 3% were categorized as conifer, deciduous, or unknown respectively. At the segment level, the proportion of LWD classified as conifer varied from a low of 31.5% (Solberg Creek segment 1) to a high of 100% (E.B. Umbrella Creek segments 1a and 1b). Nearly 32% of the habitat segments surveyed were classified as containing > 80% conifer LWD by piece count; 54% of the habitat segments had only 60-80% of the pieces classified as conifer.

Approximately 2% of the LWD pieces inventoried were classified as key pieces. Large and L+ pieces accounted for 16% of the LWD inventoried, while medium (54%) and small (28%) pieces made up the remaining 82%. At the LWD band level, 43% of the bands had 40 or fewer pieces, while 30% had 41-60 pieces, 17% had 61-80 pieces, and 11% had greater than 80 pieces per 100 meters (Figure 40). The LWD bands with the lowest LWD counts included: LWD Bands 107, 111, 115, 130 and 151 (Big River). LWD bands 144, 162, and 168 (Coal Creek) had the highest piece counts.

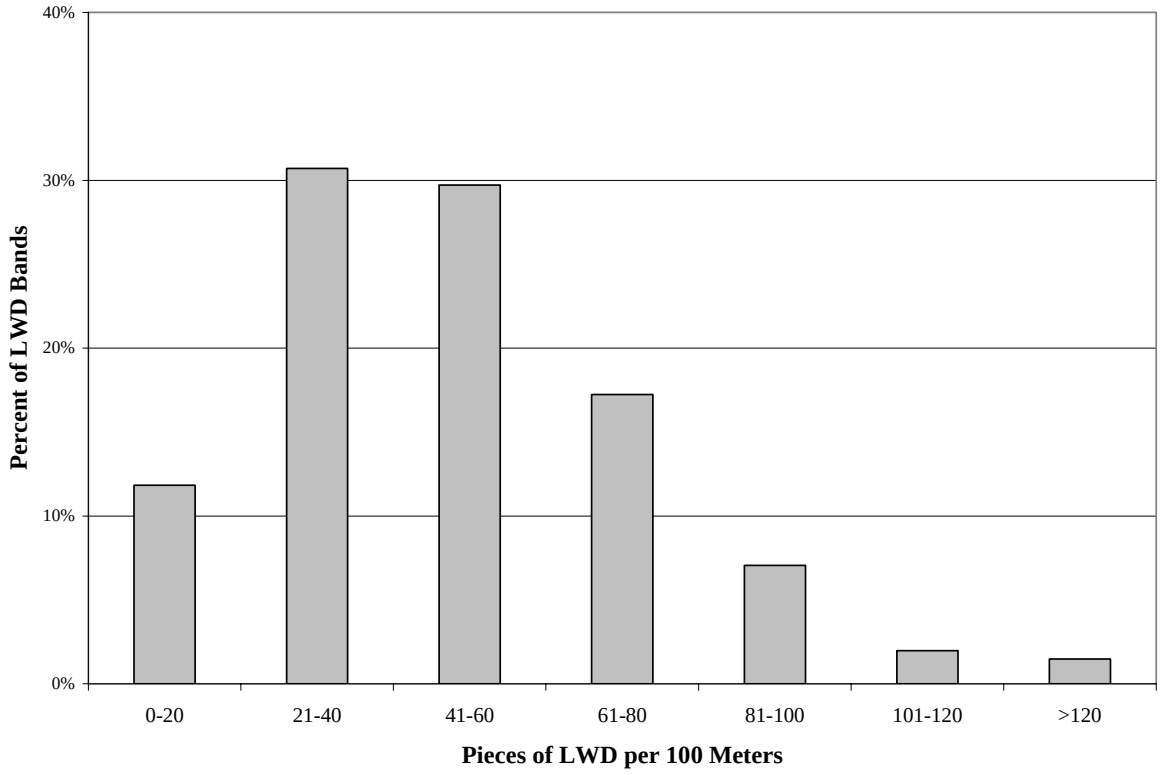

Figure 40. LWD Bands by Specified Piece Count Category for Lake Ozette Tributaries.

At the segment level, at the watershed scale, LWD data were evaluated based upon total LWD frequency (pieces/100m and pieces/BFW), key and large (>50cm diameter) piece frequency, and the percent of pieces of LWD classified as large (Appendix B; Figure 41). Pieces per 100m rated good in 25% of the habitat segments surveyed. Approximately 44% and 32% of the segments rated fair and poor for LWD/100m. Approximately 66%, 29%, and 5% of the habitat segments rated good, fair, and poor for LWD/BFW respectively. Key pieces/BFW rated good in 1% of the segments and fair in 19%; just over 80% of the segments rated poor. LWD > 50cm diameter/100m rated good in 23% of the segments and fair in 39%, the remaining 38% of segments rated poor. The percent of pieces classified as large rated good in only 1% of the segments surveyed and fair in 22% of the segments. The remaining 77% of habitat segments rated poor for percent of LWD > 50 cm.

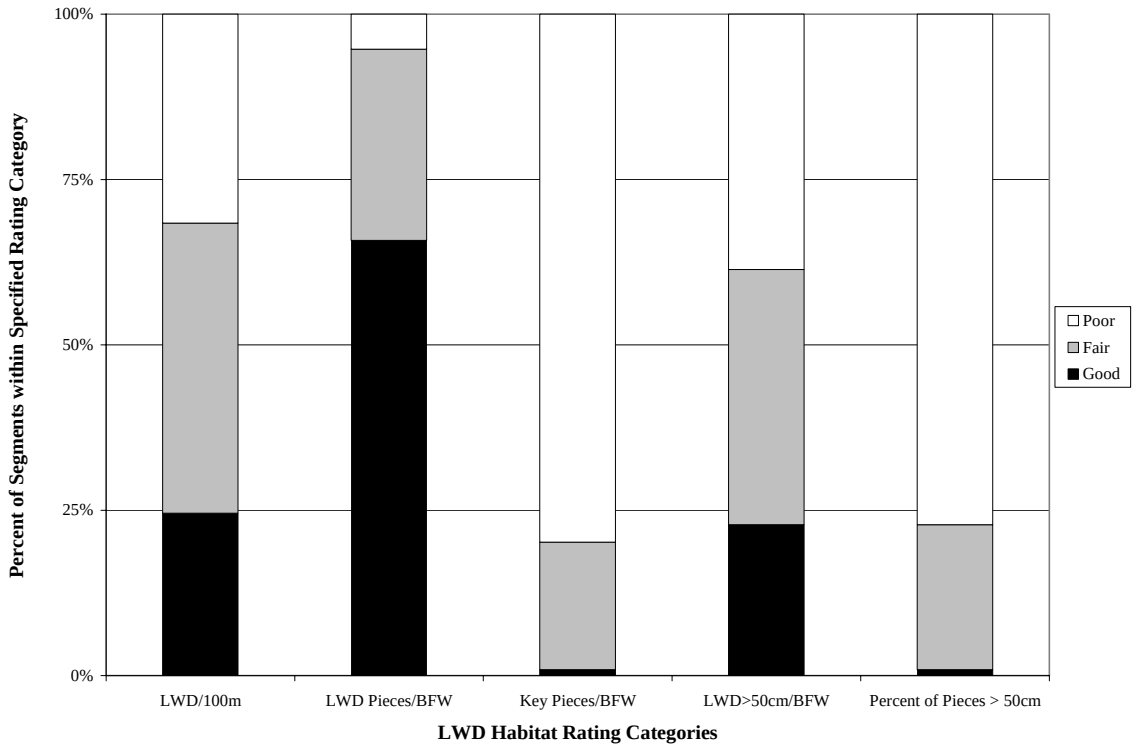

Figure 41. Ozette Tributary Segment Level LWD Habitat Ratings.

Segment-level LWD habitat rating categories also display interesting spatial relationships. (Figure 42). For example, several segments of the Big River mainstem have > 12 pieces of LWD > 50cm per 100m. These nine segments (3a-3d, 3k, 3l, and 5c-5e) occur in three discrete reaches of the river which are separated by agriculturally developed valley bottom. Exploring this aspect of the data is beyond the scope of this report, but it should be noted that GIS datasets and data summary files developed in this report can be a useful tool in watershed- and stream-scale planning and restoration activities.

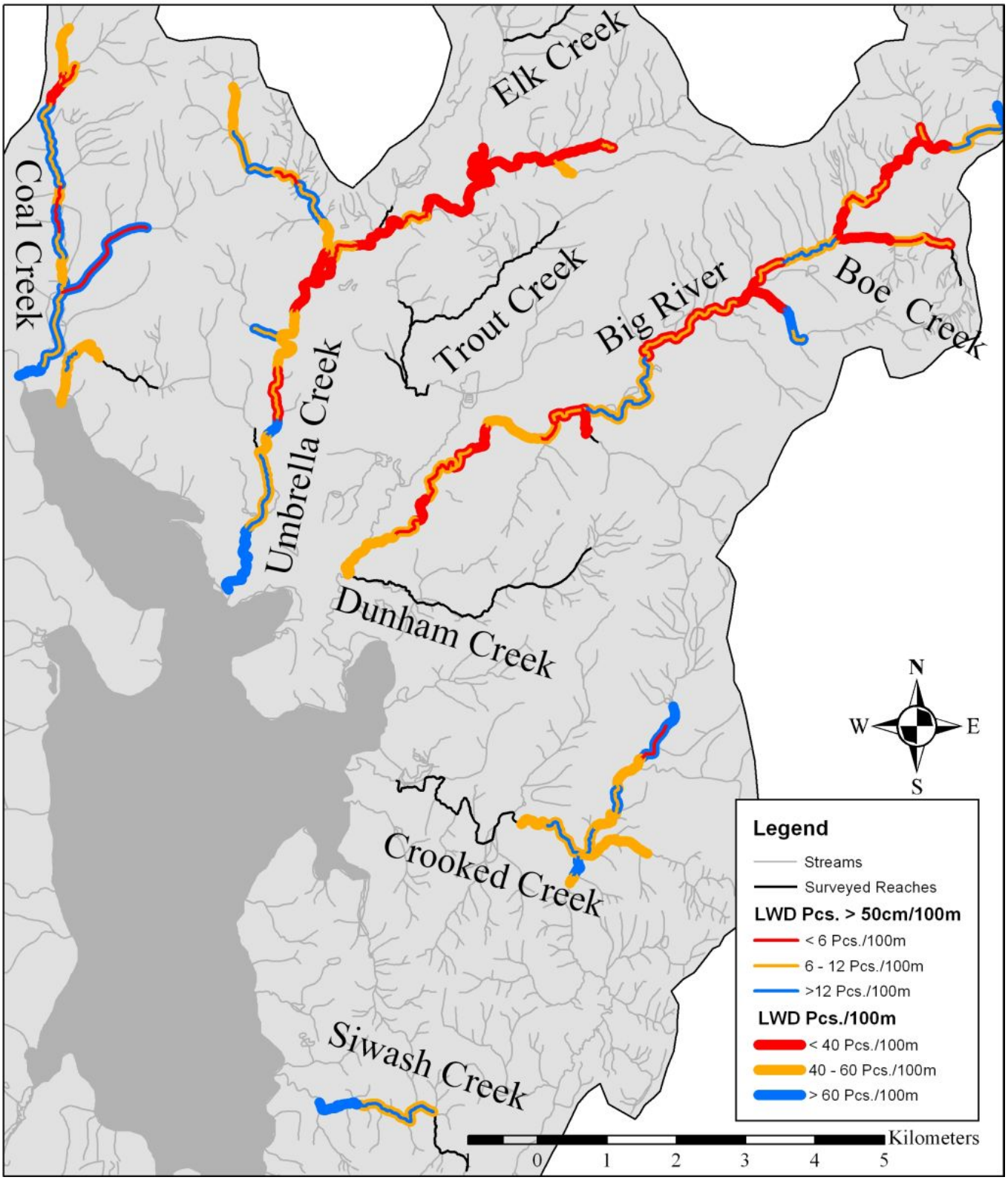

Figure 42. Ozette Watershed LWD > 50cm and Total Piece Counts/100m by Segment.

The frequency of LWD varied by segment but there was also considerable variation at the stream level. Figure 43, illustrates the distribution of all size classes of LWD, as well as the distribution of LWD > 50cm diameter for the major tributaries to Lake Ozette. Interestingly Coal Creek has the highest overall LWD frequency but the frequency of LWD > 50cm is lower than Umbrella Creek and approximately the same as Big River.

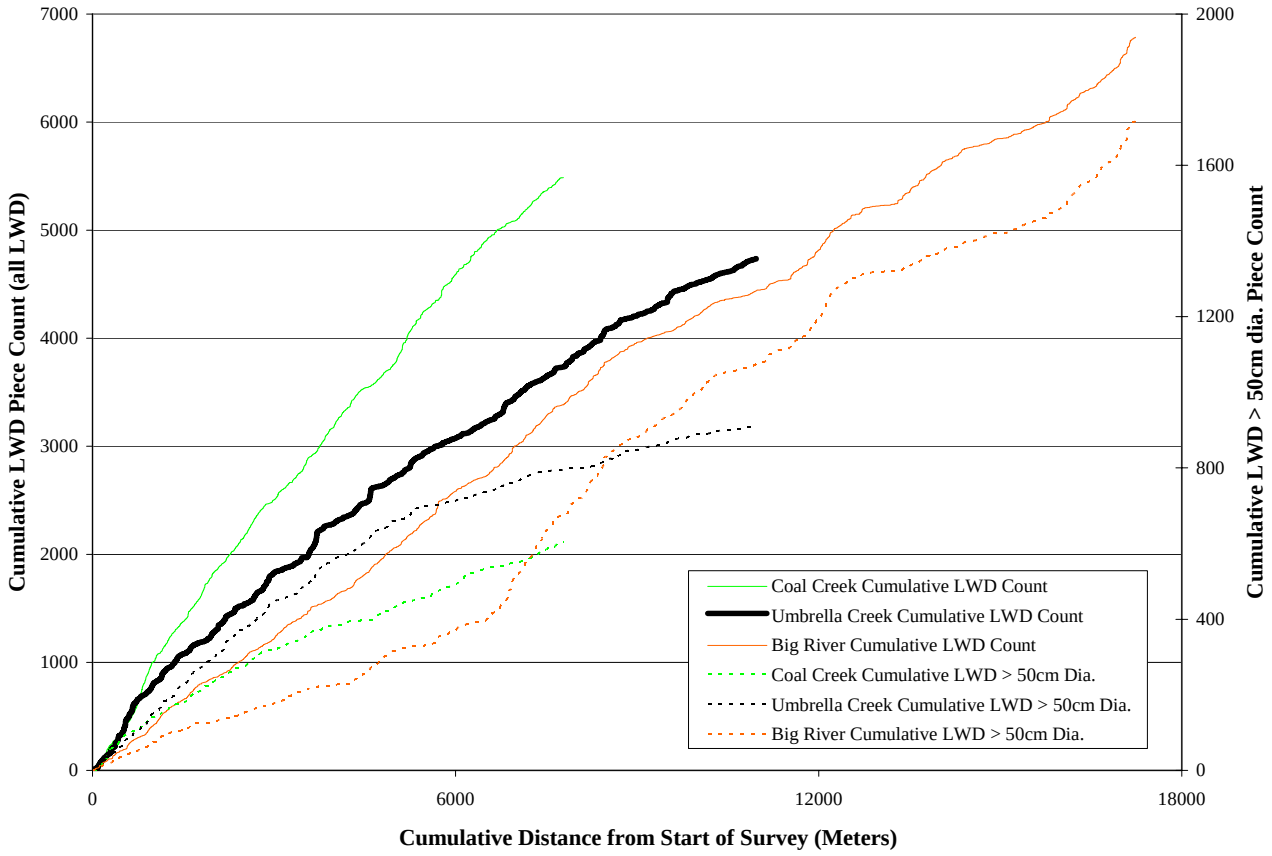

Figure 43. Cumulative LWD and LWD>50cm/100m Counts for Major Tributaries to Lake Ozette.

Figure 44, depicts the distribution of all size classes of LWD, as well as the distribution of LWD > 50cm diameter for the major secondary tributaries to Lake Ozette. Siwash Creek and West Branch Umbrella Creek have nearly the same frequency of total LWD/100m but Siwash Creek contains nearly twice the number of LWD > 50cm diameter.

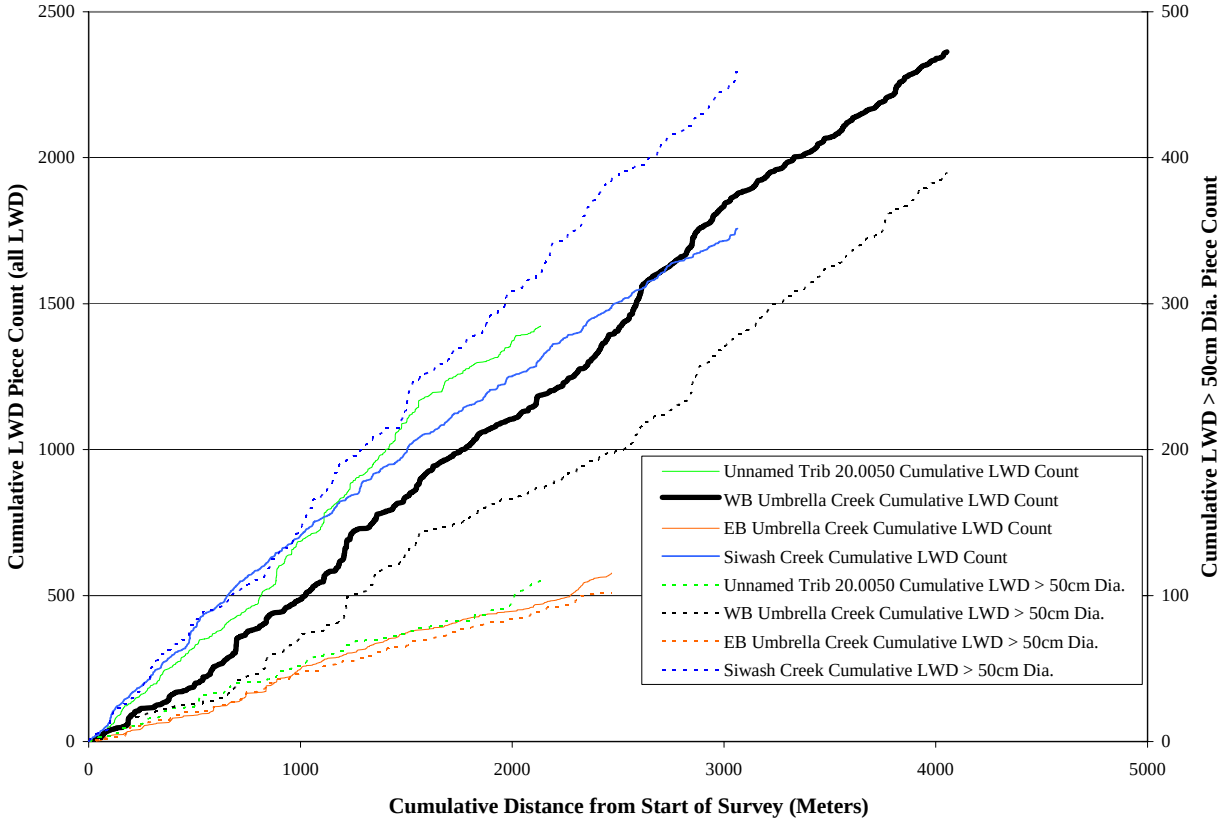

Figure 44. Cumulative LWD and LWD>50cm/100m Counts for Major Secondary Tributaries to Lake Ozette.

Pool forming pieces/BFW ranged from a high of 4.72 pieces/BFW (Umbrella Creek 1b), to a low of 0.02 pieces/BFW (E.B. Umbrella Creek segment 1a), averaging 0.87 pieces/BFW. Larger LWD were classified as pool forming at a higher rate than smaller sized LWD. In fact, over 52% of the key pieces were pool forming while only 11% of LWD classified as small was pool forming. Approximately, 40%, 31%, and 21% of L+, L/L-, and medium sized pieces were pool forming respectively.

Pool habitat data were evaluated based upon pool frequency, percent pools, percent woody cover, and holding pools/km for the 114 habitat segments described above (Figure 45), using the ratings established in Table 4. Pool frequency rated good in 16% of the habitat segments, fair in 54%, and poor in the remaining 40% of segments. Percent pools rated good in 66% of the habitat segments, fair in 16%, and poor in 18%. Percent of pools with adequate woody cover rated good in only 2% of the habitat segments, fair in 38%, and poor in the remaining 61%. Holding pools deeper than 1 meter/km rated good in 40% of the habitat segments, fair in 21%, and poor in 39

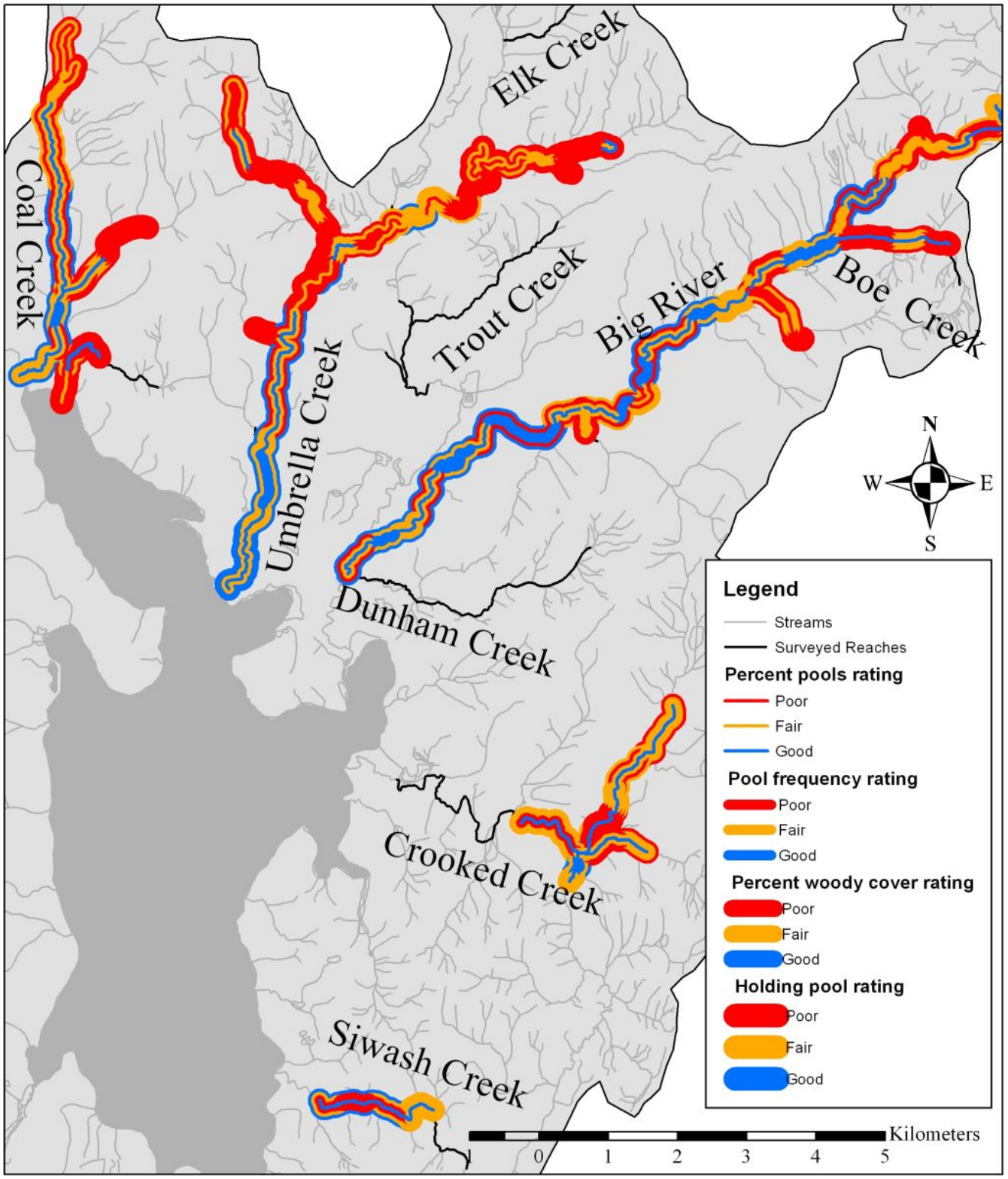

Figure 45. Ozette Watershed Pool Habitat Condition Ratings.

The relationship between LWD piece size and quality and quantity of pool habitat has been discussed throughout this report in the context of specific streams and habitat segments, but nowhere is the importance of large LWD more clearly expressed than in a watershed-scale summary of pool attributes and pool forming agents. Average maximum pool depth in 1,963 pools surveyed during the course of this study was strongly correlated with key piece size category, for LWD-formed pools, as was the percent by length of pools with moderate to good woody cover (Figure 46). Key and large+ piece-formed pools are 53% deeper than medium, small, and free formed pools. The relationship between piece size and pool depth and cover illustrates the important influence of large LWD (> 50cm diameter) on pool quality.

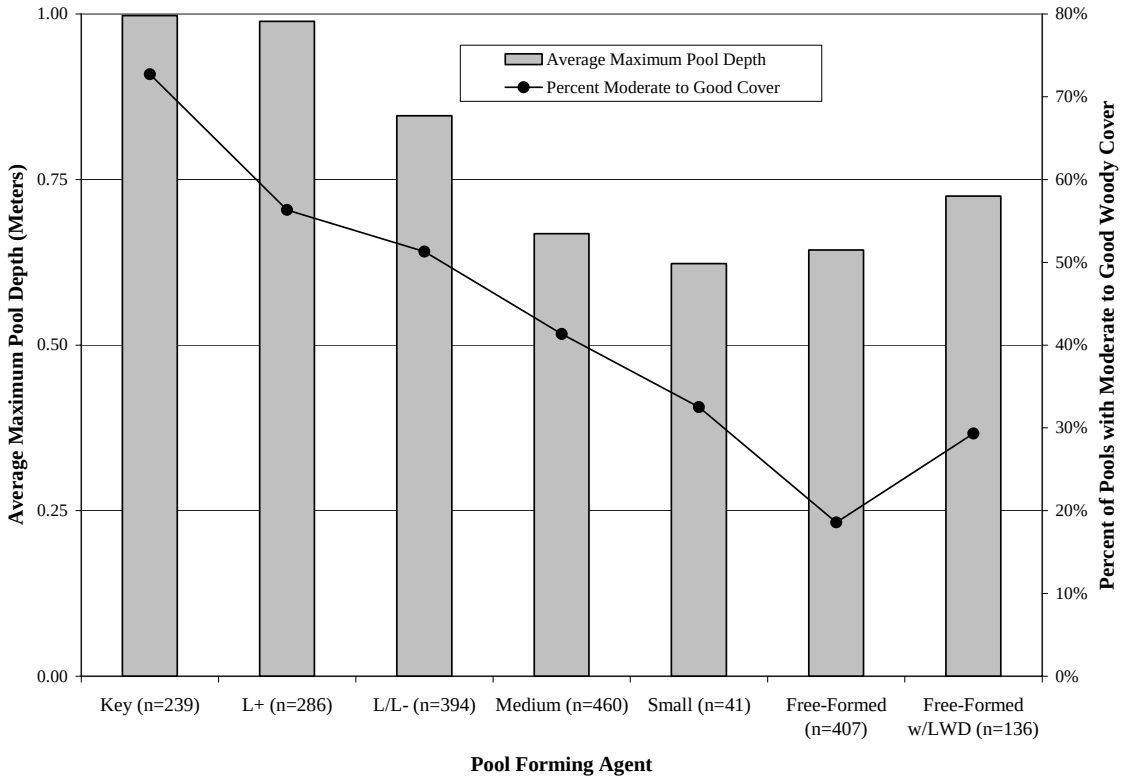

Figure 46. Relationship between Primary Pool Forming Agent and Pool Depth and Cover for Ozette Watershed Tributaries.

The quantity of pool habitat is also strongly influenced by LWD piece size (Figure 47). Even though key-sized LWD comprised only 593 of 30,289 inventoried pieces of LWD (2%), it formed 17% of the inventoried pool habitat by length. LWD pieces > 50 cm in diameter formed 76% of the LWD-formed pool habitat, even though these combined size classes represent only 18% (5520 pieces) of the inventoried LWD. Conversely, small and medium-sized LWD make up 82% of the inventoried LWD (24,769 pieces), but form only 24% of the LWD-formed pool habitat.

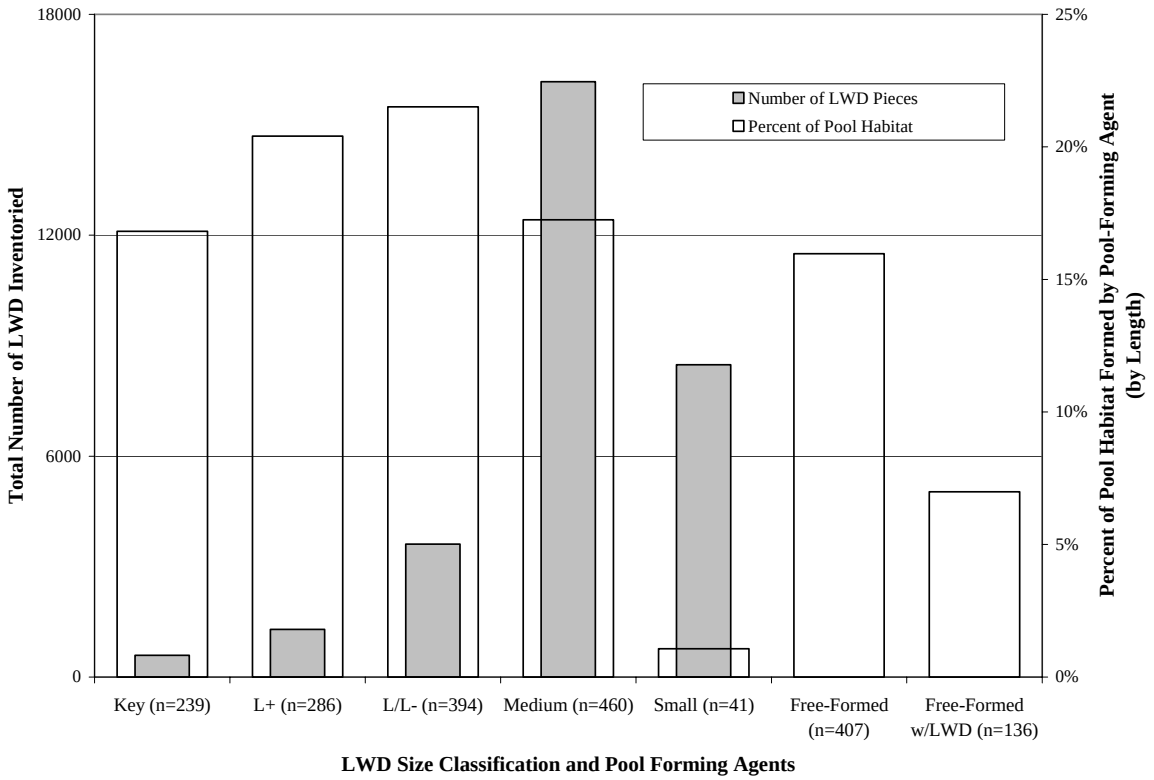

Figure 47. LWD Piece Count and Percent Pool Habitat Formed by Pool Forming Agent for Ozette Watershed Tributaries.

Habitat data collected in the Ozette watershed at a watershed, stream, and segment level provide insight into the relationship between LWD frequency and piece size, and the quality and quantity of pool habitat. Many portions of the watershed have low levels of large woody debris, and in many cases, poor quality and quantity of pool habitat. This report and the associated GIS and summary datasets will provide useful tools for identifying and understanding habitat limiting factors to Ozette sockeye and other salmonid species at a variety of scales within the Ozette watershed.

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APPENDIX A: Inventory of Channel and Habitat Surveys

Stream System	Stream Name	Number of Segments	Number of Habitat Bands	Channel Data Length (M)	Habitat Data Length (M)
	Coal Creek	5	79	7,804	7,804
	LBT 20.0050	3	22	2,134	2,134
	LBT 22,772	1	4	305	305
Coal Creek	TOTALS	9	105	10,243	10,243
Palmquist Creek	Palmquist Creek	1	29	2,865	1,625
	Umbrella Creek	6	110	10,972	10,972
	Trib to Umbrella@9400	1	4	366	0
	Trib to Umbrella@15663	5	5	409	409
	W. Branch Umbrella	3	41	4,054	4,054
	Hatchery Creek 20.0056	1	5	457	0
	E. Branch Umbrella	2	25	2,469	2,469
	Trib to EB Umb@5210	1	4	396	396
	Trib to EB Umb@8100	1	3	213	213
	LBT to Umbrella@42,000	1	19	1,748	0
Umbrella Creek	TOTALS	21	216	21,084	18,513
	Big River	5	173	17,221	17,221
	Dunham Creek	4	51	5,060	0
	Trout Creek	2	47	4,695	0
	RBT Trib to Trout@2092	1	7	617	0
	RBT Trib@ 825 to RBT2092_Trout	1	3	206	0
	RBT Trib to Trout@5149	1	6	549	0
	Solberg Creek	2	8	701	462
	Stony Creek	3	14	1,323	1,323
	Boe Creek	4	29	2,896	2,055
	Unnamed Trib 20.0065	1	3	229	229
Big River	TOTALS	24	341	33,497	21,290
	Crooked Creek	5	69	6,874	2,947
	S.F. Crooked Creek	2	8	765	765
	N.F. Crooked Creek	5	33	3,206	3,206
Crooked Creek	TOTALS	12	110	10,845	6,918
Siwash Creek	Siwash Creek	5	46	4,595	3,071
GRAND TOTAL		72	847	83,129	61,660

APPENDIX B: LWD and Pool Habitat Condition Ratings

APPENDIX B- LWD and Pool Habitat Ratings

Stream	Habitat Segment	Pool Segment ID	LWD Pieces per 100 M	LWD Pieces per BFW	Key Pieces per BFW	Large Pieces per BFW	Percent of Pieces Large (>50cm)	Pool Frequency	Percent Pool	Percent woody cover	Holding Pools
Coal Creek	1a	PS-1	Good	Good	Poor	Good	Poor	Fair	Good	Fair	Good
Coal Creek	1b	PS-2	Good	Good	Poor	Fair	Poor	Fair	Good	Fair	Good
Coal Creek	1c	PS-3	Good	Good	Poor	Poor	Poor	Fair	Good	Poor	Good
Coal Creek	1d	PS-4	Good	Good	Fair	Fair	Poor	Good	Good	Fair	Good
Coal Creek	2a	PS-5	Good	Good	Poor	Fair	Poor	Fair	Good	Fair	Good
Coal Creek	2b	PS-6	Fair	Good	Poor	Fair	Poor	Fair	Good	Poor	Good
Coal Creek	2c	PS-7	Good	Good	Poor	Fair	Poor	Fair	Good	Poor	Good
Coal Creek	3a	PS-8	Good	Good	Poor	Poor	Poor	Fair	Good	Poor	Good
Coal Creek	3b	PS-9	Fair	Good	Poor	Poor	Poor	Fair	Good	Poor	Good
Coal Creek	3c	PS-10	Good	Good	Poor	Poor	Poor	Fair	Good	Poor	Fair
Coal Creek	4a	PS-11	Good	Good	Poor	Fair	Poor	Fair	Good	Poor	Fair
Coal Creek	4b	PS-12	Good	Good	Poor	Fair	Poor	Fair	Good	Poor	Fair
Coal Creek	4c	PS-13	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor	Poor
Coal Creek	5	PS-14	Fair	Fair	Poor	Poor	Poor	Poor	Fair	Fair	Poor
20.0050 Trib	1	PS-15	Good	Fair	Poor	Poor	Poor	Fair	Good	Poor	Poor
20.0050 Trib	2	PS-16	Good	Good	Poor	Poor	Poor	Fair	Good	Fair	Poor
20.0050 Trib	3	PS-17	Good	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor
LBT22772coal	1	PS-18	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Poor	Poor
Palmquist Creek	1a	PS-19	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Poor	Poor
Palmquist Creek	1b	PS-20	Fair	Fair	Poor	Fair	Poor	Poor	Good	Fair	Poor
Palmquist Creek	1c	PS-21	Fair	Fair	Poor	Fair	Poor	Poor	Good	Poor	Poor
Umbrella Creek	1a	PS-22	Good	Good	Poor	Good	Poor	Fair	Good	Good	Good
Umbrella Creek	1b	PS-23	Good	Good	Poor	Good	Poor	Fair	Good	Good	Good
Umbrella Creek	2a	PS-24	Fair	Good	Poor	Good	Fair	Fair	Good	Fair	Good
Umbrella Creek	2b	PS-25	Fair	Good	Fair	Good	Fair	Good	Good	Fair	Good
Umbrella Creek	2c	PS-26	Fair	Good	Fair	Good	Fair	Good	Good	Fair	Good
Umbrella Creek	2d	PS-27	Fair	Good	Poor	Fair	Poor	Fair	Good	Fair	Good
Umbrella Creek	2e	PS-28	Good	Good	Fair	Good	Poor	Fair	Good	Poor	Good
Umbrella Creek	2f	PS-29	Poor	Good	Poor	Fair	Poor	Fair	Good	Poor	Good
Umbrella Creek	2g	PS-30	Fair	Good	Poor	Fair	Poor	Fair	Good	Poor	Good
Umbrella Creek	2h	PS-31	Fair	Good	Poor	Fair	Poor	Fair	Good	Poor	Good
Umbrella Creek	2i	PS-32	Poor	Good	Poor	Poor	Poor	Poor	Fair	Poor	Poor
Umbrella Creek	3a	PS-33	Poor	Fair	Poor	Poor	Poor	Poor	Fair	Poor	Good
Umbrella Creek	3b	PS-34	Fair	Good	Poor	Poor	Poor	Fair	Good	Fair	Poor
Umbrella Creek	3c	PS-35	Poor	Good	Poor	Poor	Poor	Poor	Poor	Fair	Poor
Umbrella Creek	4a	PS-36	Poor	Good	Poor	Poor	Poor	Fair	Poor	Poor	Fair
Umbrella Creek	4b	PS-37	Fair	Good	Poor	Poor	Poor	Fair	Fair	Fair	Good
Umbrella Creek	5a	PS-38	Poor	Fair	Poor	Poor	Poor	Fair	Poor	Fair	Fair
Umbrella Creek	5b	PS-39	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Fair
Umbrella Creek	5c	PS-40	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Umbrella Creek	6	PS-41	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor
W.B. Umbrella Creek	1a	PS-42	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Poor	Poor
W.B. Umbrella Creek	1b	PS-43	Fair	Good	Poor	Fair	Poor	Poor	Poor	Poor	Poor
W.B. Umbrella Creek	1c	PS-44	Good	Good	Poor	Fair	Poor	Fair	Fair	Poor	Poor
W.B. Umbrella Creek	2a	PS-45	Fair	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor
W.B. Umbrella Creek	2b	PS-46	Good	Good	Poor	Fair	Poor	Poor	Poor	Poor	Poor
W.B. Umbrella Creek	2c	PS-47	Fair	Good	Fair	Fair	Poor	Fair	Good	Poor	Poor
W.B. Umbrella Creek	3	PS-48	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor
E.B. Umbrella Creek	1a	PS-49	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor
E.B. Umbrella Creek	1b	PS-50	Poor	Fair	Poor	Poor	Poor	Poor	Fair	Fair	Poor
E.B. Umbrella Creek	1c	PS-51	Poor	Poor	Poor	Poor	Poor	Fair	Fair	Poor	Poor
E.B. Umbrella Creek	2	PS-52	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor
LBT5210_EB Umbr	1	PS-53	Fair	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor
LBT8100_EB Umbr	1	PS-54	Poor	Fair	Poor	Poor	Poor	Good	Fair	Poor	Poor
RBT15663_Umbr Creek	1	PS-55	Good	Fair	Poor	Fair	Poor	Poor	Poor	Poor	Poor
Big River	1	PS-56	Fair	Good	Fair	Fair	Poor	Fair	Good	Poor	Good
Big River	2a	PS-57	Fair	Good	Fair	Fair	Poor	Good	Good	Fair	Good
Big River	2b	PS-58	Fair	Good	Poor	Poor	Poor	Fair	Good	Fair	Good

APPENDIX B- LWD and Pool Habitat Ratings

Stream	Habitat Segment	Pool Segment ID	LWD Pieces per 100 M	LWD Pieces per BFW	Key Pieces per BFW	Large Pieces per BFW	Percent of Pieces Large (>50cm)	Pool Frequency	Percent Pool	Percent woody cover	Holding Pools
Big River	2c	PS-59	Poor	Good	Poor	Poor	Poor	Fair	Good	Poor	Good
Big River	2d	PS-60	Fair	Good	Poor	Poor	Poor	Fair	Good	Poor	Good
Big River	2e	PS-61	Fair	Good	Poor	Poor	Poor	Good	Good	Fair	Good
Big River	2f	PS-62	Poor	Good	Fair	Fair	Poor	Good	Good	Fair	Good
Big River	2g	PS-63	Poor	Good	Poor	Poor	Poor	Fair	Good	Poor	Good
Big River	2h	PS-64	Fair	Good	Poor	Fair	Poor	Good	Good	Poor	Good
Big River	2i	PS-65	Fair	Good	Poor	Fair	Poor	Good	Good	Poor	Good
Big River	2j	PS-66	Fair	Good	Poor	Poor	Poor	Good	Good	Poor	Good
Big River	2k	PS-67	Poor	Good	Poor	Fair	Poor	Fair	Good	Poor	Fair
Big River	3a	PS-68	Fair	Good	Poor	Good	Fair	Fair	Good	Poor	Fair
Big River	3b	PS-69	Fair	Good	Fair	Good	Fair	Good	Good	Poor	Fair
Big River	3c	PS-70	Fair	Good	Fair	Good	Fair	Poor	Fair	Fair	Fair
Big River	3d	PS-71	Fair	Good	Fair	Good	Fair	Good	Good	Poor	Good
Big River	3e	PS-72	Poor	Good	Poor	Good	Fair	Fair	Good	Poor	Good
Big River	3f	PS-73	Poor	Fair	Poor	Fair	Good	Fair	Good	Poor	Good
Big River	3g	PS-74	Poor	Good	Poor	Good	Fair	Good	Good	Fair	Good
Big River	3h	PS-75	Poor	Good	Poor	Good	Fair	Fair	Good	Fair	Fair
Big River	3i	PS-76	Poor	Fair	Poor	Fair	Fair	Fair	Good	Fair	Fair
Big River	3j	PS-77	Poor	Fair	Poor	Fair	Fair	Fair	Good	Poor	Poor
Big River	3k	PS-78	Fair	Good	Poor	Good	Fair	Good	Good	Fair	Fair
Big River	3l	PS-79	Fair	Good	Poor	Good	Fair	Good	Good	Fair	Good
Big River	4a	PS-80	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor	Good
Big River	4b	PS-81	Fair	Good	Poor	Fair	Poor	Good	Fair	Poor	Good
Big River	4c	PS-82	Poor	Good	Poor	Fair	Poor	Good	Fair	Poor	Good
Big River	4d	PS-83	Poor	Good	Poor	Fair	Poor	Fair	Fair	Poor	Fair
Big River	5a	PS-84	Poor	Fair	Poor	Poor	Fair	Fair	Fair	Poor	Poor
Big River	5b	PS-85	Poor	Fair	Poor	Poor	Fair	Fair	Fair	Poor	Poor
Big River	5c	PS-86	Fair	Good	Poor	Good	Fair	Fair	Good	Poor	Fair
Big River	5d	PS-87	Fair	Good	Poor	Good	Fair	Poor	Good	Poor	Fair
Big River	5e	PS-88	Good	Good	Good	Good	Fair	Fair	Good	Fair	Fair
Solberg Creek	1	PS-89	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor	Poor
Stony Creek	1	PS-90	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Fair	Poor
Stony Creek	2	PS-91	Good	Good	Poor	Good	Fair	Fair	Poor	Fair	Poor
Stony Creek	3	PS-92	Good	Good	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Boe Creek	1	PS-93	Poor	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor
Boe Creek	2a	PS-94	Fair	Fair	Poor	Poor	Poor	Fair	Good	Fair	Poor
Boe Creek	2b	PS-95	Poor	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor
Unnamed Trib 20.0065	1	PS-96	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Poor	Poor
Crooked Creek	3a	PS-97	Fair	Good	Poor	Fair	Poor	Poor	Good	Fair	Fair
Crooked Creek	3b	PS-98	Fair	Good	Poor	Fair	Fair	Poor	Good	Fair	Fair
Crooked Creek	4	PS-99	Fair	Good	Poor	Poor	Poor	Fair	Good	Fair	Good
Crooked Creek	5	PS-100	Fair	Fair	Fair	Fair	Poor	Fair	Good	Poor	Poor
Crooked Creek	6	PS-101	Fair	Fair	Fair	Fair	Fair	Fair	Good	Fair	Poor
SF Crooked Creek	1	PS-102	Good	Good	Fair	Good	Poor	Good	Good	Fair	Good
SF Crooked Creek	2	PS-103	Fair	Good	Poor	Fair	Poor	Fair	Good	Fair	Fair
NF Crooked Creek	1a	PS-104	Fair	Good	Poor	Fair	Poor	Poor	Good	Poor	Fair
NF Crooked Creek	1b	PS-105	Fair	Fair	Poor	Fair	Poor	Poor	Good	Poor	Poor
NF Crooked Creek	2	PS-106	Good	Good	Fair	Good	Poor	Fair	Good	Fair	Fair
NF Crooked Creek	3	PS-107	Fair	Good	Fair	Fair	Poor	Fair	Good	Poor	Fair
NF Crooked Creek	4	PS-108	Good	Fair	Poor	Poor	Poor	Fair	Good	Fair	Poor
NF Crooked Creek	5	PS-109	Good	Good	Fair	Fair	Poor	Fair	Good	Fair	Poor
Siwash Creek	2a	PS-110	Good	Good	Fair	Good	Poor	Poor	Good	Fair	Good
Siwash Creek	2b	PS-111	Good	Good	Fair	Fair	Poor	Poor	Good	Poor	Good
Siwash Creek	3a	PS-112	Fair	Good	Poor	Good	Fair	Poor	Good	Poor	Good
Siwash Creek	3b	PS-113	Fair	Good	Fair	Good	Fair	Poor	Good	Fair	Good
Siwash Creek	4	PS-114	Fair	Fair	Fair	Good	Fair	Fair	Good	Fair	Fair

APPENDIX C: Summary of Important Stream Features

Appendix C. Important Stream Features

Stream Name	Feature	Distance from Start (Ft)	Distance from Start (M)	Notes
Coal Creek	Start of Survey	0	0	Started at confluence w/Ozette River
Coal Creek	Bridge	297	91	Road that leads to ONP trailhead parking lot
Coal Creek	ONP X-sec 1-2	500	152	ONP cross sections
Coal Creek	Sockeye Head found	750	229	Sockeye head reported in habitat notes from 9-23-99
Coal Creek	ONP Reference Tag	800	244	from fish remap project
Coal Creek	Bridge	968	295	Seafield-Coal Creek Mainline
Coal Creek	LBT-O&A	1,982	604	Habitat data states stream is 4M+ BFW
Coal Creek	ONP Boundary	3,066	935	-
Coal Creek	1997 Thermograph Site	3,440	1,049	1997 Thermograph Site
Coal Creek	RP#7	5,400	1,646	Green Crow
Coal Creek	RBT O&A	5,500	1,676	2-3 BFW Low gradient, O/A
Coal Creek	RP#8	5,730	1,747	Green Crow
Coal Creek	RP#9	6,110	1,862	Green Crow
Coal Creek	RP#10	6,475	1,974	Green Crow
Coal Creek	LBT	6,730	2,051	No additional info in notes- stream presumed to be 20.0050
Coal Creek	Center of Road	7,977	2,431	No additional info
Coal Creek	RBT O&A	8,270	2,521	<2% gradient, stream splits 300' up into 2 streams 3M BFW
Coal Creek	RP#18	9,120	2,780	Green Crow
Coal Creek	RP#24	11,200	3,414	Green Crow
Coal Creek	LBT-O&A	11,310	3,447	BFW=2.5M, mud bottom
Coal Creek	RP#25	11,500	3,505	Green Crow
Coal Creek	RP#26	11,830	3,606	Green Crow
Coal Creek	RP#28	12,500	3,810	Green Crow
Coal Creek	LBT	12,800	3,901	LBT- Flows out of wetland complex
Coal Creek	RP#29	12,800	3,901	Green Crow
Coal Creek	RP#30	13,200	4,023	Green Crow
Coal Creek	RP#32	13,900	4,237	Green Crow
Coal Creek	RP#33	14,200	4,328	Green Crow
Coal Creek	LBT	15,185	4,628	Flagged by green crow as their stream No. 7
Coal Creek	LBT	16,020	4,883	LB Feeder trib- Green Crow stream No. 9
Coal Creek	LBT	16,212	4,941	Green Crow trib 10- good flow about 1m BFW
Coal Creek	LBT	19,815	6,040	Dry- Green Crow #15
Coal Creek	LBT	19,935	6,076	Dry- Green Crow #16
Coal Creek	LBT	20,100	6,127	Flowing- Green Crow #17
Coal Creek	BRIDGE	20,115	6,131	Bridge forms pool
Coal Creek	BRIDGE	20,779	6,334	
Coal Creek	BRIDGE	22,562	6,877	
Coal Creek	LBT	22,766	6,939	Stream was surveyed -LBT 22,766
Coal Creek	Substrate change	24,900	7,590	Substrate changed from gravel to small cobble
Coal Creek	RBT	25,067	7,641	RBT No habitat, Green Crow#19
Coal Creek	RP#65	25,200	7,681	Green Crow
Coal Creek	Bridge	25,440	7,754	Bridge
Coal Creek	End of Survey	25,600	7,803	End of survey, no data for this band
20.0050	Start of survey	0	0	LBT 6700 on Coal Creek
20.0050	Old road crossing	700	213	Old road crossing
20.0050	RP#4	1,400	427	Green Crow Reference Point
20.0050	LBT-O&A	1,523	464	LBT #1, Avg 3 M BFW, steeper gradient
20.0050	RP#6	2,127	648	Green Crow Reference Point
20.0050	LBT	2,160	658	LBT#2, not flowing during hab survey 8-7-00
20.0050	RP#7	2,472	753	Green Crow Reference Point
20.0050	RP#8	2,730	832	Green Crow Reference Point
20.0050	LBT-NOT O&A	2,845	867	LBT#3, not flowing
20.0050	RP#10	3,555	1,084	Green Crow Reference Point
20.0050	LBT- no habitat	4,490	1,369	No habitat?
20.0050	Old RR Crossing	4,755	1,449	Old RR Crossing
20.0050	RP#?	5,045	1,538	RP# not recorded
20.0050	5 ft high logjam	5,110	1,558	5 ft high logjam
20.0050	RBT-O&A	5,225	1,593	RBT#4, good flow, good spawning gravel, 3-4m wide
20.0050	RP#17	6,120	1,865	Green Crow Reference Point
20.0050	RP#18	6,455	1,968	Green Crow Reference Point

Appendix C. Important Stream Features

Stream Name	Feature	Distance from Start (Ft)	Distance from Start (M)	Notes
20.0050	RBT#5	6,643	2,025	RBT O&A
20.0050	LBT#6	6,717	2,047	Type 5?
20.0050	End of Survey	7,000	2,134	End of survey, potential barrier to anadromous fish
LBT 22,772	Start of survey	0	0	Start of survey at confluence w/Coal Creek
LBT 22,772	Logjam	630	192	5 ft high log jam
LBT 22,772	LBT	750	229	No additional info
LBT 22,772	Logjam	975	297	6 ft high log jam
LBT 22,772	End of survey	1,000	305	End of survey
LBT 22,772	Logjam	1,100	335	"98% confident this is a blockage" quote T.P.
Palmquist Creek	Start of survey	0	0	Start of Survey, 708 ft downstream of culvert
Palmquist Creek	Arch Culvert	708	216	Hoko Ozette road crossing
Palmquist Creek	Bridge	1,558	475	Bridge leading past Lost Resort
Palmquist Creek	Foot Bridge	1,808	551	Fred Rennenbaums bridge?
Palmquist Creek	Foot Bridge	2,400	732	???
Palmquist Creek	RBT O&A	3,890	1,186	No flow
Palmquist Creek	LBT	5,286	1,611	No additional info
Palmquist Creek	Large Logjam	5,331	1,625	Potential fish blockage- large log jam
Palmquist Creek	Start of new survey	5,350	1,631	No habitat data collected in this section.
Palmquist Creek	Green Crow RP	5,815	1,772	No RP# recorded
Palmquist Creek	Green Crow RP	6,156	1,876	No RP# recorded
Palmquist Creek	Green Crow RP#10	6,570	2,003	Green Crow RP#10
Palmquist Creek	Tributary	6,885	2,099	No additional info
Palmquist Creek	Green Crow RP	6,915	2,108	No RP# recorded
Palmquist Creek	Green Crow RP	7,285	2,220	No RP# recorded
Palmquist Creek	Old RR crossing	7,585	2,312	Old RR crossing supports in creek
Palmquist Creek	RBT	8,220	2,505	No additional info
Palmquist Creek	LBT	9,192	2,802	No additional info
Palmquist Creek	End of Survey	9,483	2,890	Major confluence
Umbrella Creek	Start of Survey	0	0	Start of survey about 600-700 feet above lake
Umbrella Creek	Thermograph	3,510	1,070	XTI unit with tie down found here
Umbrella Creek	Old RR Xing	3,700	1,128	Old RR Bridge
Umbrella Creek	Fyke Net	4,150	1,265	Lowest fyke net site
Umbrella Creek	Bridge	4,253	1,296	Center of Hoko-Ozette Road bridge
Umbrella Creek	RBT-O&A	4,550	1,387	RBT excellent wetland complex
Umbrella Creek	Fyke Net Site	6,115	1,864	Main upper fyke net site
Umbrella Creek	RBT-O&A	9,401	2,865	Channel data collected for this stream
Umbrella Creek	LBT- O&A	10,575	3,223	Type 3 stream
Umbrella Creek	Small trib	10,800	3,292	Small feeder trib
Umbrella Creek	LBT- O&A	12,753	3,887	No additional info
Umbrella Creek	LBT- O&A	13,685	4,171	No additional info
Umbrella Creek	RBT-Not O&A	13,935	4,247	Gradient was estimated to be 14-18%
Umbrella Creek	LBT	14,635	4,461	Not accessible to fish
Umbrella Creek	LBT-O&A	14,830	4,520	No additional info
Umbrella Creek	RBT-O&A	15,663	4,774	Stream surveyed
Umbrella Creek	LBT	16,485	5,025	Wetland complex
Umbrella Creek	RBT	19,085	5,817	Feeder trib, non-fish
Umbrella Creek	RBT	19,120	5,828	Feeder trib, non-fish
Umbrella Creek	RBT	19,332	5,892	Feeder trib, non-fish
Umbrella Creek	Bridge	19,459	5,931	Middle of bridge, RY7000Rd
Umbrella Creek	RBT-O&A	19,567	5,964	Stream 20.0053 West Branch Umbrella Creek
Umbrella Creek	RBT	22,350	6,812	No additional info
Umbrella Creek	RBT?	22,790	6,946	No additional info- not 100% sure on right bank part
Umbrella Creek	Clearcut	23,500	7,163	Top end of clearcut with very poor buffer
Umbrella Creek	Thermograph	24,070	7,337	Thermograph observed attached to Large Alder Rtw- 7-14-99
Umbrella Creek	RBT-O&A	24,306	7,409	Stream receives some spawning fish, small creek
Umbrella Creek	RBT-O&A	24,668	7,519	Umbrella Creek Hatchery Stream
Umbrella Creek	Bridge	25,239	7,693	Center of Bridge, CZ9100/27E
Umbrella Creek	LBT- O&A	26,700	8,138	No additional info
Umbrella Creek	RBT	27,400	8,352	Right bank feeder trib, non-fish? Drains wetlands
Umbrella Creek	LBT	28,095	8,563	Feeder trib, non-fish

Appendix C. Important Stream Features

Stream Name	Feature	Distance from Start (Ft)	Distance from Start (M)	Notes
Umbrella Creek	LBT- O&A	28,338	8,638	Stream is about 7 ft wide at confluence
Umbrella Creek	RBT	29,375	8,954	No additional info
Umbrella Creek	LBT	29,480	8,986	Dry feeder trib, non-fish
Umbrella Creek	RBT	30,021	9,151	Right bank feeder trib, non-fish
Umbrella Creek	LBT- O&A	33,425	10,188	East Branch of Umbrella Creek
Umbrella Creek	End of Survey	36,000	10,973	End of survey
RBT 9,400	Start of Survey	0	0	Start of survey at confluence w/Umbrella Creek
RBT 9,400	End of Survey	1,200	366	No important features noted- survey stopped due to brush
RBT 15,663	Start of Survey	0	0	Start of survey at confluence w/Umbrella Creek
RBT 15,663	Potential Fish Blockage	1,256	383	8' high logjam, 25 feet wide
RBT 15,663	Potential Fish Blockage	1,341	409	End of survey; 7 foot high log jam
W.B Umbrella Creek	Start of Survey	0	0	Started at confluence w/Umbrella Creek
W.B Umbrella Creek	RBT	588	179	No additional info
W.B Umbrella Creek	RBT	1,555	474	Dried up rbt
W.B Umbrella Creek	RBT	3,650	1,113	Not open or accessible
W.B Umbrella Creek	Thermographs	3,800	1,158	Both water and air thermographs
W.B Umbrella Creek	RBT	5,360	1,634	Not open or accessible
W.B Umbrella Creek	RBT	5,465	1,666	RB Feeder
W.B Umbrella Creek	LBT	5,954	1,815	Open and Accessible
W.B Umbrella Creek	LBT	6,580	2,006	Open and Accessible; 20.0054
W.B Umbrella Creek	RBT	6,980	2,128	N/A NO FLOW
W.B Umbrella Creek	LBT	8,300	2,530	Not open or accessible
W.B Umbrella Creek	RBT	8,780	2,676	Open and Accessible
W.B Umbrella Creek	LBT	9,540	2,908	No additional info
W.B Umbrella Creek	RBT	10,690	3,258	Not open or accessible
W.B Umbrella Creek	RBT	11,060	3,371	Open and Accessible- w/fish; 20.0055
W.B Umbrella Creek	RB spring	11,400	3,475	No additional info
W.B Umbrella Creek	Small waterfall	11,690	3,563	Small waterfall 3.5 ft
W.B Umbrella Creek	LBT NA	12,250	3,734	No additional info
W.B Umbrella Creek	Possible barrier	12,430	3,789	Possible fish barrier 5.5 ft high
W.B Umbrella Creek	EOS	13,300	4,054	End of survey
E.B Umbrella Creek	Start of Survey	0	0	Start of Survey
E.B Umbrella Creek	RBT O/A	621	189	RBT open and accessible
E.B Umbrella Creek	LBT O/A	5,210	1,588	LBT open and accessible- Habitat data collected
E.B Umbrella Creek	RBT O/A	8,100	2,469	RBT open and accessible- Habitat data collected
E.B Umbrella Creek	End of Survey	8,100	2,469	End of Survey
EB LBT 5,210	Start of Survey	0	0	No important features described
EB LBT 5,210	End of Survey	1,300	396	No important features described
EB LBT 8,100	Start of Survey	0	0	Start of Survey
EB LBT 8,100	LBT	250	76	Feeder Trib
EB LBT 8,100	End of Survey	700	213	No additional notes
Elk Creek	Start of Survey	0	0	Start of Survey
Elk Creek	Stream goes sub-surface	400	122	Stream goes sub-surface
Elk Creek	Flowing water	1,300	396	Flowing water
Elk Creek	Road Crossing	3,936	1,200	Culvert-was a partial blockage and has been replaced.
Elk Creek	RBT O/A	5,736	1,748	Fish stream- open and accessible
Elk Creek	End of Survey	5,963	1,818	End of Survey
Big River	Start of Survey	0	0	Survey started at the Swan Bay Road Bridge Crossing
Big River	LBT	175	53	Dunham Creek
Big River	LBT	1,900	579	Small stream but no other info
Big River	RBT	2,200	671	Trout Creek
Big River	Rip-Rap	4,150	1,265	Start of rip-rap
Big River	Rip-Rap	4,250	1,295	End of rip-rap
Big River	LBT	5,050	1,539	2-3 ft wide
Big River	LBT	5,290	1,612	2-3 ft wide
Big River	Water intake	6,043	1,842	Private water intake
Big River	Rip-Rap	6,725	2,050	Start of rip-rap
Big River	Rip-Rap	6,920	2,109	End of rip-rap
Big River	Clay Bank	7,420	2,262	No additional info
Big River	Blowdown	8,350	2,545	50 feet of blowdown from RB Clearcut

Appendix C. Important Stream Features

Stream Name	Feature	Distance from Start (Ft)	Distance from Start (M)	Notes
Big River	Blowdown	10,500	3,200	70 feet of blowdown
Big River	Side Channel	11,450	3,490	Lower end: 250' distance between top and bottom
Big River	Side Channel	14,000	4,267	Lower end: 200' distance between top and bottom
Big River	Water intake	14,800	4,511	Private water intake
Big River	RBT	15,100	4,603	2 M BFW- N/A downcutt 2M
Big River	LBT	17,422	5,310	LBT O/A
Big River	LBT	17,445	5,317	LBT O/A- Part of solberg creek distrib complex
Big River	Bridge	17,900	5,456	27 E south bridge
Big River	LBT	17,965	5,476	LBT O/A- Likely Solberg distribs
Big River	LBT	18,040	5,499	LBT O/A- Likely Solberg distribs
Big River	LBT	18,260	5,566	LBT O/A- Likely Solberg distribs
Big River	Large Logjam	18,695	5,698	Large jam-approx 60 feet long
Big River	Side Channel	19,625	5,982	Lower end: 110' distance between top and bottom
Big River	LBT	21,043	6,414	Solberg Creek (historic and current)
Big River	Side Channel	22,700	6,919	Lower end: 75' distance between top and bottom
Big River	Logjam	22,760	6,937	About 35 logs in jam
Big River	LBT	23,035	7,021	N/A no additional info
Big River	Logjam	24,930	7,599	40 ft long, about 25 logs
Big River	Old bridge crossing	25,040	7,632	No additional info
Big River	LBT	25,190	7,678	O/A wall based feeder
Big River	LBT	25,605	7,804	No flow
Big River	LBT	25,625	7,811	Some flow
Big River	Logjam	26,830	8,178	60 ft long, 35 logs
Big River	Side Channel	27,000	8,230	Lower end: 135' distance between top and bottom
Big River	Logjam	27,735	8,454	small jam 22 logs
Big River	RBT	27,840	8,486	No additional info
Big River	Side Channel	28,285	8,621	Lower end: 685' distance between top and bottom- old mainstem
Big River	Off-channel slough	28,634	8,728	No additional info
Big River	Old bridge crossing	30,515	9,301	No additional info
Big River	LBT	30,840	9,400	Access blocked by rootwad
Big River	RBT	32,740	9,979	2-3 M BFW, O/A
Big River	RBT	32,990	10,055	No additional info
Big River	LBT	33,550	10,226	3+ M BFW, O/A 20.0062
Big River	Junk Car	33,770	10,293	Junk car along RB
Big River	Bridge	35,040	10,680	Hoko Ozette Rd
Big River	LBT	35,275	10,752	Stony Creek- Sockeye RSI Stream
Big River	Rip-Rap	36,017	10,978	Start of rip-rap
Big River	Rip-Rap	36,200	11,034	End of rip-rap
Big River	LBT	36,215	11,038	> 2M BFW, leads to wetland complex
Big River	Junk Car	36,725	11,194	No additional info
Big River	Bridge	37,480	11,424	Bridge to private residence
Big River	Braided Channel	38,365	11,694	160 ft long
Big River	Side Channel	38,540	11,747	Lower end: 270' distance between top and bottom
Big River	Logjam	38,760	11,814	Logjam 50 ft long, about 50 logs
Big River	RBT	39,005	11,889	2-3 M BFW, no additional info
Big River	Side Channel	39,400	12,009	Lower end: 250' distance between top and bottom
Big River	Side Channel	39,830	12,140	Lower end: 240' distance between top and bottom
Big River	Logjam	41,115	12,532	Small logjam 23 logs
Big River	Bridge	41,500	12,649	Nicholas Rd bridge, exact distance not recorded
Big River	LBT	41,650	12,695	Boe Creek
Big River	Side Channel	43,350	13,213	Lower end: 305' distance between top and bottom
Big River	Side Channel	44,125	13,449	Lower end: 235' distance between top and bottom
Big River	RBT	44,160	13,460	BFW 2-3 m
Big River	RBT	44,575	13,587	No additional info
Big River	Side Channel	44,700	13,625	Lower end: 365' distance between top and bottom
Big River	Bridge	44,950	13,701	Boe family bridge
Big River	Side Channel	45,235	13,788	Lower end: 150' distance between top and bottom
Big River	Side Channel	45,355	13,824	Lower end: 115' distance between top and bottom
Big River	Side Channel	45,780	13,954	Lower end: 335' distance between top and bottom
Big River	LBT	46,785	14,260	LBT O/A w/fish; 3m wide

Appendix C. Important Stream Features

Stream Name	Feature	Distance from Start (Ft)	Distance from Start (M)	Notes
Big River	Side Channel	46,790	14,262	Lower end: 340' distance between top and bottom
Big River	RBT	47,230	14,396	RBT T3 2-3m BFW
Big River	Side Channel	47,630	14,518	Lower end: 195' distance between top and bottom
Big River	Side Channel	47,675	14,532	Lower end: 95' distance between top and bottom
Big River	Side Channel	47,900	14,600	Lower end: 190' distance between top and bottom
Big River	Side Channel	48,470	14,774	Lower end: 355' distance between top and bottom
Big River	LBT	48,800	14,874	LBT 2m+ BFW, questionable habitat above road.
Big River	Bridge	49,085	14,961	7402 RD Bridge
Big River	RBT	49,700	15,149	RBT 2-3m BFW, probably only accessible for 500'.
Big River	RBT	50,070	15,262	RBT 3-5m BFW, large tributary (20.0065).
Big River	RBT	50,365	15,351	RBT 2-3m BFW
Big River	Logjam	51,880	15,813	25 feet long, 26 logs
Big River	Logjam	52,830	16,103	30 feet long, 37 logs
Big River	RBT	53,340	16,258	T-4
Big River	LBT	55,120	16,801	T-4
Big River	Logjam	55,700	16,978	75 feet long, 53 logs
Big River	Logjam	56,045	17,083	70 feet long, 58 logs
Big River	Logjam	56,185	17,125	85 feet long, 59 logs
Big River	Side Channel	56,160	17,118	Lower end: 150' distance between top and bottom
Big River	EOS	56,500	17,221	End of survey, two stage waterfall 12 ft falls followed by 20' vertical drop
Dunham Creek	SOS	0	0	Start of Survey
Dunham Creek	Old Bridge	1,430	436	No additional info
Dunham Creek	RBT	1,535	468	RBT 1-2m BFW T4/T3?
Dunham Creek	Logjam	2,200	671	Small logjam
Dunham Creek	RBT	3,490	1,064	RBT 2-3m BFW
Dunham Creek	Beaver Dam	3,580	1,091	Beaver Dam
Dunham Creek	Upper end of Backwater	4,100	1,250	Upper end of backwater from beaver dam
Dunham Creek	Clearcut	4,160	1,268	Edge of clearcut
Dunham Creek	LBT	4,900	1,494	LBT 2m+ BFW, stagnant. Beaver dam at confluence with mainstem.
Dunham Creek	Bridge	5,780	1,762	Bridge
Dunham Creek	LBT	10,235	3,120	LBT T5 1-2' OHWM
Dunham Creek	LBT	10,610	3,234	LBT T4 high gradient 2-3' OHWM.
Dunham Creek	LBT	10,810	3,295	LBT 5'-6' OHWM, T4 due to high gradient.
Dunham Creek	RBT	11,200	3,414	RBT 3'-5' OHWM, possible T3
Dunham Creek	LBT	11,500	3,505	LBT 2'-3' OHWM, T4 due to high gradient.
Dunham Creek	LBT	11,660	3,554	LBT 5' OHWM T3/T4?
Dunham Creek	LBT	11,870	3,618	LBT T5 1-2' OHWM
Dunham Creek	RBT	12,450	3,795	RBT 5'-6' OHWM, flat and dry. Prob. T3 when water is flowing.
Dunham Creek	LBT	13,200	4,023	LBT 6'-8' OHWM T3
Dunham Creek	LBT	14,300	4,359	LBT 1'-2' OHWM, T5.
Dunham Creek	LBT	15,280	4,657	LBT 5'-7' OHWM T3.
Dunham Creek	LBT	15,295	4,662	LBT 2'-3' OHWM, T4/T3?
Dunham Creek	RBT	15,740	4,798	RBT 1'-2' OHWM, T5.
Dunham Creek	RBT	15,970	4,868	RBT 1'-2' OHWM, T5.
Dunham Creek	RBT	16,220	4,944	RBT 3'-4' OHWM, T4.
Dunham Creek	EOS	16,600	5,060	Confluence of two tribs., and end of survey.
Trout Creek	SOS	0	0	Start of survey
Trout Creek	LBT	178	54	No additional info
Trout Creek	RBT	2,092	638	O/A- Channel data collected
Trout Creek	RBT	5,149	1,569	O/A- Channel data collected
Trout Creek	RBT	6,810	2,076	No additional info
Trout Creek	Bridge	8,563	2,610	Bridge
Trout Creek	RBT	11,393	3,473	Open and accessible
Trout Creek	RBT	12,500	3,810	Open and accessible
Trout Creek	RBT???	13,542	4,128	No additional info; this stream plots on the map as a LBT
Trout Creek	RBT	13,866	4,226	Not accessible
Trout Creek	Stream subs out	14,180	4,322	Stream subs out
Trout Creek	Stream subs out	14,485	4,415	Stream subs out for 65 feet
Trout Creek	LBT	14,940	4,554	Not accessible
Trout Creek	EOS	15,400	4,695	End of survey- unclear how much habitat is upstream

Appendix C. Important Stream Features

Stream Name	Feature	Distance from Start (Ft)	Distance from Start (M)	Notes
Trout RBT 2,092	SOS	0	0	Start of survey at confluence w/Trout Creek
Trout RBT 2,092	RBT	825	251	RBT channel data collected (RBT825_RBT2092_Trout CRK)
Trout RBT 2,092	LBT	1,295	395	Not accessible
Trout RBT 2,092	EOS	2,025	617	End of survey; unclear why survey ended at this point
Trt RBT 825_2092	Start of Survey	0	0	Started at confluence w/RBT2092_Trout Creek
Trt RBT 825_2092	LBT	581	177	LBT not accessible
Trt RBT 825_2092	EOS	675	206	End of Survey, at least a few hundered more feet of habitat
Trout RBT 5,149	Start of Survey	0	0	Started at confluence w/Trout Creek
Trout RBT 5,149	LBT	1,010	308	No additional info
Trout RBT 5,149	LBT	1,422	433	No additional info
Trout RBT 5,149	EOS	1,800	549	EOS at bottom end of wetland complex
Solberg Creek	Start of Survey	0	0	Started at confluence w/Big River
Solberg Creek	LBT	270	82	No additional info
Solberg Creek	Side channel	719	219	Lower end of side channel 381 feet long
Solberg Creek	RBT	935	285	Might be a T-3
Solberg Creek	Culverts	1,533	467	Downstream end of culverts
Solberg Creek	EOS	2,300	701	End of survey; near old stringer bridge.
Stony Creek	SOS	0	0	Start of Survey at confluence w/Big River
Stony Creek	Culvert	162	49	Hoko Ozette Road-culvert is 80 feet long
Stony Creek	Bridge	656	200	Small suspension bridge
Stony Creek	Foot Bridge	1,650	503	No additional info
Stony Creek	Logjam	3,084	940	4' high jam, about 20 logs
Stony Creek	Logjam	3,529	1,076	Logjam, about 25 logs
Stony Creek	LBT	3,839	1,170	Not accessible
Stony Creek	LBT	4,010	1,222	O/A, BFW 3-4M, WW 2.5M
Stony Creek	EOS-Logjam	4,341	1,323	Logjam, potential fish blocking jam-EOS
Boe Creek	SOS	0	0	Start of survey at confluence w/Big River
Boe Creek	LBT	1,850	564	LBT O/A
Boe Creek	Culvert	2,967	904	Culvert at Hoko Ozette Road
Boe Creek	LBT	3,096	944	LBT O/A-some adult coho have been observed and even caught
Boe Creek	Segment Break	3,100	945	Segment Break
Boe Creek	RBT	3,395	1,035	RBT not accessible
Boe Creek	LBT	4,640	1,414	LBT O/A 1-2M BFW
Boe Creek	RBT	5,168	1,575	RBT O/A
Boe Creek	Culvert	5,433	1,656	CP 650 Rd. Culvert
Boe Creek	LBT	5,702	1,738	LBT O/A
Boe Creek	LBT	6,050	1,844	LBT O/A, subs out 75 ft upstream
Boe Creek	Side channel	6,190	1,887	Lower end of side channel w/flow
Boe Creek	Bridge	6,685	2,038	Small bridge; small landowner's
Boe Creek	LBT	6,744	2,056	LBT O/A- Stream has doumented coho spawning
Boe Creek	RBT	6,840	2,085	RBT-Outlet to large open water wetland complex!!!!!!!!!
Boe Creek	LBT	8,421	2,567	LBT O/A
Boe Creek	Plunge	8,578	2,615	4-4.5 ft plunge
Boe Creek	EOS	9,500	2,896	End of survey
20.0065	Start of Survey	0	0	Start of survey
20.0065	LBT	104	32	LBT partially accessible, flows under LWD piece 2
20.0065	End of Survey	750	229	End of survey at undefined fish blockage
Crooked Creek	SOS	0	0	Start of survey at lower bridge
Crooked Creek	Side Channel	380	116	Lower end of RB side channel, length 120 ft
Crooked Creek	Side Channel	778	237	Lower end of RB side channel, length 30 ft
Crooked Creek	Small Jam	900	274	No additional notes
Crooked Creek	Logjam	2,300	701	log jam 4 key pieces
Crooked Creek	Clay bottom	3,300	1,006	No additional notes
Crooked Creek	Logjam	3,700	1,128	Small logjam
Crooked Creek	RBT	3,791	1,156	RBT O/A
Crooked Creek	Side Channel	3,882	1,183	Lower end of side channel
Crooked Creek	Logjam	3,890	1,186	Large logjam, 86 ft long
Crooked Creek	Logjam	5,335	1,626	Logjam, 36ft long
Crooked Creek	Logjam	5,968	1,819	Logjam, 77ft long
Crooked Creek	Logjam	7,494	2,284	Small logjam
Crooked Creek	Logjam	8,041	2,451	Large logjam, 100 ft long
Crooked Creek	Logjam	8,472	2,582	Large logjam, 100 ft long
Crooked Creek	Logjam	9,587	2,922	Large logjam, 75 ft long
Crooked Creek	Logjam	10,238	3,121	No additional notes
Crooked Creek	LBT	10,325	3,147	LBT O/A
Crooked Creek	RBT	12,390	3,777	RBT O/A
Crooked Creek	Bridge	13,100	3,993	"Middle" Bridge
Crooked Creek	Logjam	15,286	4,659	Small logjam

Appendix C. Important Stream Features

Stream Name	Feature	Distance from Start (Ft)	Distance from Start (M)	Notes
Crooked Creek	Side Channel	16,354	4,985	Lower end of side channel, 70ft long
Crooked Creek	Side Channel	16,910	5,154	Lower end of side channel, 100ft long
Crooked Creek	LBT	17,420	5,310	LBT O/A- S.F. Crooked Creek
Crooked Creek	LBT	17,990	5,483	17990 LBT feeder N/A
Crooked Creek	RBT	18,510	5,642	RBT O/A- N.F. Crooked Creek
Crooked Creek	LBT	18,648	5,684	LBT N/A
Crooked Creek	Logjam	19,975	6,088	Logjam 5FT high, partial barrier
Crooked Creek	Huge Tree	20,186	6,153	Huge tree, 11'4" AT BASE
Crooked Creek	LBT	20,285	6,183	LBT N/A-Low flow and high gradient
Crooked Creek	LBT	21,510	6,556	LBT- Very low flow
Crooked Creek	RBT	21,980	6,700	RBT N/A
Crooked Creek	LBT	22,300	6,797	LBT- N/A Good flow
Crooked Creek	EOS	22,552	6,874	EOS- Large failure in channel creates barrier
S.F. Crooked	Start of Survey	0	0	Started at confluence w/Crooked Creek
S.F. Crooked	Side channel	1,080	329	RB Side channel- 65 Ft.
S.F. Crooked	LOGJAM	1,505	459	Approximately 75 pieces
S.F. Crooked	RBT	1,656	505	RBT- Feeder trib, na?
S.F. Crooked	Waterfall-EOS	2,510	765	Waterfall 5.5 M tall and 11 m long, Eos at 765 M
N.F. Crooked	SOS	0	0	SOS at confluence with Crooked Creek
N.F. Crooked	Logjam	540	165	19040 Logjam approx. 15 logs
N.F. Crooked	RBT	1,250	381	19750 RBT N/A
N.F. Crooked	Side Channel	1,780	543	20280 RB Sidechannel
N.F. Crooked	RBT	1,993	607	20493 RBT- dried up feeder trib
N.F. Crooked	LBT	2,265	690	20765 LBT- dried up feeder trib
N.F. Crooked	Bridge	4,100	1,250	22600 Bridge
N.F. Crooked	Dry channel	6,175	1,882	10 feet of subsurface flow-8/30/00
N.F. Crooked	Large Boulder	6,353	1,936	Large boulder
N.F. Crooked	Bedrock	7,100	2,164	Bedrock along LB
N.F. Crooked	LBT	7,175	2,187	25675 LBT
N.F. Crooked	Old bridge	7,400	2,256	25900 Old Bridge
N.F. Crooked	RBT	7,820	2,384	26320 RBT N/A
N.F. Crooked	Dry channel	8,835	2,693	5 M of subsurface flow
N.F. Crooked	Large Boulder	9,060	2,762	Large boulder
N.F. Crooked	Braided Channel	10,080	3,072	Approx. 180 ft of braided channel
N.F. Crooked	EOS	10,500	3,206	EOS- likely more habitat upstream
Siwash Creek	SOS-LBT	0	0	Start of survey at LBT approx 0.75 miles upstream of lake
Siwash Creek	RBT	1,985	605	RBT- no additional info
Siwash Creek	RBT	5,130	1,564	RBT- no additional info
Siwash Creek	LBT	6,380	1,945	No additional info
Siwash Creek	Logjam	6,475	1,974	No additional info
Siwash Creek	LBT	7,819	2,383	No additional info
Siwash Creek	RBT	8,961	2,731	RBT- O/A fair flow
Siwash Creek	RBT	10,075	3,071	RBT- no additional info
Siwash Creek	RBT	10,875	3,315	RBT- O/A and Type 4???
Siwash Creek	RBT	13,098	3,992	RBT- feeder trib
Siwash Creek	LBT	13,150	4,008	No additional info
Siwash Creek	Cascades	13,440	4,097	Cascades
Siwash Creek	RBT	13,750	4,191	RBT- feeder trib
Siwash Creek	RBT	14,363	4,378	RBT- feeder trib
Siwash Creek	EOS- Wetland Complex	15,075	4,595	End of Survey at wetland complex

APPENDIX D: Inventory of Watershed Areas

Watershed	Watershed Description	Basin Area (miles^2)
Coal Creek	Coal Creek Upstream of Segment PS 14	0.45
	LBT 22,772	0.58
	Unnamed tributary 20.0050	1.01
	Coal Creek excluding areas listed above	2.53
	Entire Coal Creek system	**4.57**
Palmquist Creek	RBT at EOS	0.18
	Main above EOS	0.42
	Total area above EOS	0.6
	Palmquist Creek	**1.1**
Umbrella Creek	Unnamed RBT 15,663	0.39
	West Branch Umbrella	1.98
	Hatchery Creek	0.68
	Elk Creek	0.66
	East Branch Umbrella Creek	2.15
	East Branch Upstream of LBT 5,210	1.24
	LBT 5,210 (E.B. Umbrella trib)	0.56
	LBT 8,100 (E.B. Umbrella trib)	0.61
	Lower Umbrella Sub-basin	2.59
	Upper Umbrella Sub-basin	2.19
	Entire Umbrella Creek System	**10.64**
Big River	Dunham Creek	2.07
	Dunham Creek-upstream of EOS	0.24
	Lower Trout Sub-basin	3.26
	Upper Trout Sub-basin	1.88
	RBT 5150 Trout Creek	0.41
	Trout Creek upstream of EOS	0.24
	Trout Creek entire watershed	5.14
	LBT 17,400	0.59
	Solberg Creek	1.44
	Stony Creek	0.81
	Stony Creek- upstream of EOS	0.57
	Boe Creek	1.09
	Boe Above wetland complex	0.3
	Unnamed 20.0065	0.44
	Lower Big River Sub-basin	1.65
	Lower Mid Big River Sub-basin	4.5
	Middle Big River Sub-basin	1.38
	Upper Big River Sub-basin	3.68
	Entire Big River System	**22.79**

Watershed	Watershed Description	Basin Area (miles^2)
Lake Ozette Trib	**Unnamed Tributary between Crooked & Dunham**	**0.9**
Crooked Creek	Lower Crooked Creek	1.92
	LBT 10,325	0.78
	RBT 12,390	0.95
	South Fork Crooked Creek	4.46
	Wedge between Forks	0.05
	Mainstem upstream of N.F. Crooked Creek	0.79
	Lower North Fork	2.04
	Upper North Fork- upstream of EOS	1.22
	Entire North Fork	3.26
	Entire Crooked Creek System	**12.21**
Lake Ozette Trib	**Unnamed Tributary between Crooked & Quinn**	**0.65**
Quinn Creek	**Quinn Creek**	**0.9**
Unnamed Tributary 20.0073	**Unnamed Tributary 20.0073**	**0.36**
Elk Creek	**Elk Creek**	**0.3**
Siwash Creek	Lower Siwash	1.57
	Upper Siwash- upstream from EOS	1.3
	Entire Siwash Creek System	**2.87**
Lake Ozette Trib	**Unnamed Tributary between Siwash and South**	**0.46**
South Creek	**Entire South Creek System**	**3.26**