Coeur d'Alene Tribe
Fisheries Program

Implementation of Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation

2004 ANNUAL REPORT

Coeur d'Alene Tribe Department of Natural Resources
Fisheries Program
401 Annie Antelope Road
Plummer, ID 83851-0408

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BPA PROJECT #1990-044-00

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INTRODUCTION

BACKGROUND

Historically, the Coeur d'Alene Indian Tribe depended on runs of anadromous salmon and steelhead along the Spokane River and Hangman Creek, as well as resident and adfluvial forms of trout and char in Coeur d'Alene Lake, for survival. Dams constructed in the early 1900s on the Spokane River in the City of Spokane and at Little Falls (further downstream) were the first dams that initially cut-off the anadromous fish runs from the Coeur d'Alene Tribe. These fisheries were further removed following the construction of Chief Joseph and Grand Coulee Dams on the Columbia River. Together, these actions forced the Tribe to rely solely on the resident fish resources of Coeur d'Alene Lake for their subsistence needs.

The Coeur d'Alene Tribe is estimated to have historically harvested around 42,000 westslope cutthroat trout (*Oncorhynchus clarki*) per year (Scholz et al. 1985). In 1967, Mallet (1969) reported that 3,329 cutthroat trout were harvested from the St. Joe River, and a catch of 887 was reported from Coeur d'Alene Lake. This catch is far less than the 42,000 fish per year the tribe harvested historically. Today, only limited opportunities exist to harvest cutthroat trout in the Coeur d'Alene Basin.

The declines in native salmonid fish populations, particularly cutthroat and bull trout (*Salvelinus confluentus*), in the Coeur d'Alene basin have been the focus of study by the Coeur d'Alene Tribe's Fisheries and Water Resources programs since 1990. It appears that there are a number of factors contributing to the decline of resident salmonid stocks within Coeur d'Alene Lake and its tributaries (Ellis 1932; Oien 1957; Mallet 1969; Scholz et. al. 1985, Lillengreen et. al. 1993). These factors include: construction of Post Falls Dam in 1906; major changes in land cover types, agricultural activities and introduction of exotic fish species.

In 1994, the Northwest Power Planning Council adopted the recommendations set forth by the Coeur d'Alene Tribe to improve the Reservation fishery (NWPPC Program Measures 10.8B.20). These recommended actions included: 1) Implement habitat restoration and enhancement measures in Alder, Benewah, Evans, and Lake Creeks; 2) Purchase critical watershed areas for protection of fisheries habitat; 3) Conduct an educational/outreach program for the general public within the Coeur d'Alene Reservation to facilitate a "holistic" watershed protection process; 4) Develop an interim fishery for tribal and non-tribal members of the reservation through construction, operation and maintenance of five trout ponds; 5) Design, construct, operate and maintain a trout production facility; and 6) Implement a five-year monitoring program to evaluate the effectiveness of the hatchery and habitat improvement projects.

Since that time, much of the mitigation activities occurring within the Coeur d'Alene sub-basin have had a connection to the project entitled "Implement of Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation", which is sponsored and implemented by the Coeur d'Alene Tribe Fisheries Program and is the subject of this report. These activities provide partial mitigation for the extirpation of anadromous fish resources from usual and accustomed harvest areas and Reservation lands.

STUDY AREA

The study area addressed by this report consists of the southern portion of Coeur d'Alene Lake and four 3rd – 4th order tributaries, which feed the lake (see *Figure 1*). These areas are part of the larger Coeur d'Alene sub-basin, which lies in three northern Idaho counties Shoshone, Kootenai and Benewah. The basin is approximately 9,946 square kilometers and extends from the Coeur d'Alene Lake upstream to the Bitterroot Divide along the Idaho-Montana border. Elevations range from 646 meters at the lake to over 2,130 meters along the divide. This area formed the heart of the Coeur d'Alene Tribe's aboriginal territory, and a portion of the sub-basin lies within the current boundaries of the Coeur d'Alene Indian Reservation.

Coeur d'Alene Lake is the principle water body in the sub-basin. The lake is the second largest in Idaho and is located in the northern panhandle section of the state. The lake lies in a naturally dammed river valley with the outflow currently controlled by Post Falls Dam. The lake covers 129 square kilometers at full pool with a mean depth of 22 meters and a maximum depth of 63.7 meters.

The four tributaries currently targeted by the Tribe for restoration are located almost exclusively on the Reservation (*Figure 1*) and have a combined basin area of 34,853 hectares and include 529 kilometers of intermittent and perennial stream channels. The climate and hydrology of the target watersheds are similar in that they are influenced by the maritime air masses from the pacific coast, which are modified by continental air masses from Canada. Summers are mild and relatively dry, while fall, winter, and spring brings abundant moisture in the form of both rain and snow. A seasonal snowpack generally covers the landscape at elevations above 1,372 meters from late November to May. Snowpack between elevations of 915 and 1,372 meters falls within the "rain-on-snow zone" and may accumulate and deplete several times during a given winter due to mild storms (US Forest Service 1998). The precipitation that often accompanies these mild storms is added directly to the runoff, since the soils are either saturated or frozen, causing significant flooding.

OBJECTIVES

This 2004 Annual Report summarizes previously unreported data collected to fulfill the contractual obligations for this project (BPA Project #1990-044-00) during the 2004 calendar year. The report is formatted into four primary sections that respectively describe: 1) status, trend and effectiveness monitoring of biological, chemical and physical habitat indicators; 2) implementation of restoration and enhancement projects; and 3) a discussion of education and outreach work performed during 2004. The study objectives and related tasks listed below are excerpted from the document titled: *2005 Scope of Work and Budget Request, June 2004 - May 2005. Implement Fisheries Enhancement Opportunities on the Coeur d'Alene Indian Reservation*.

Section 1: Monitoring and Evaluation

Objective 1: Conduct status and trend monitoring to quantify changes in biological and chemical attributes in target tributaries over time.

Task 1a: Measure abundance, distribution and other biological data related to cutthroat trout and other salmonids at 104 index sites in mainstem and tributary reaches within the four target watersheds.

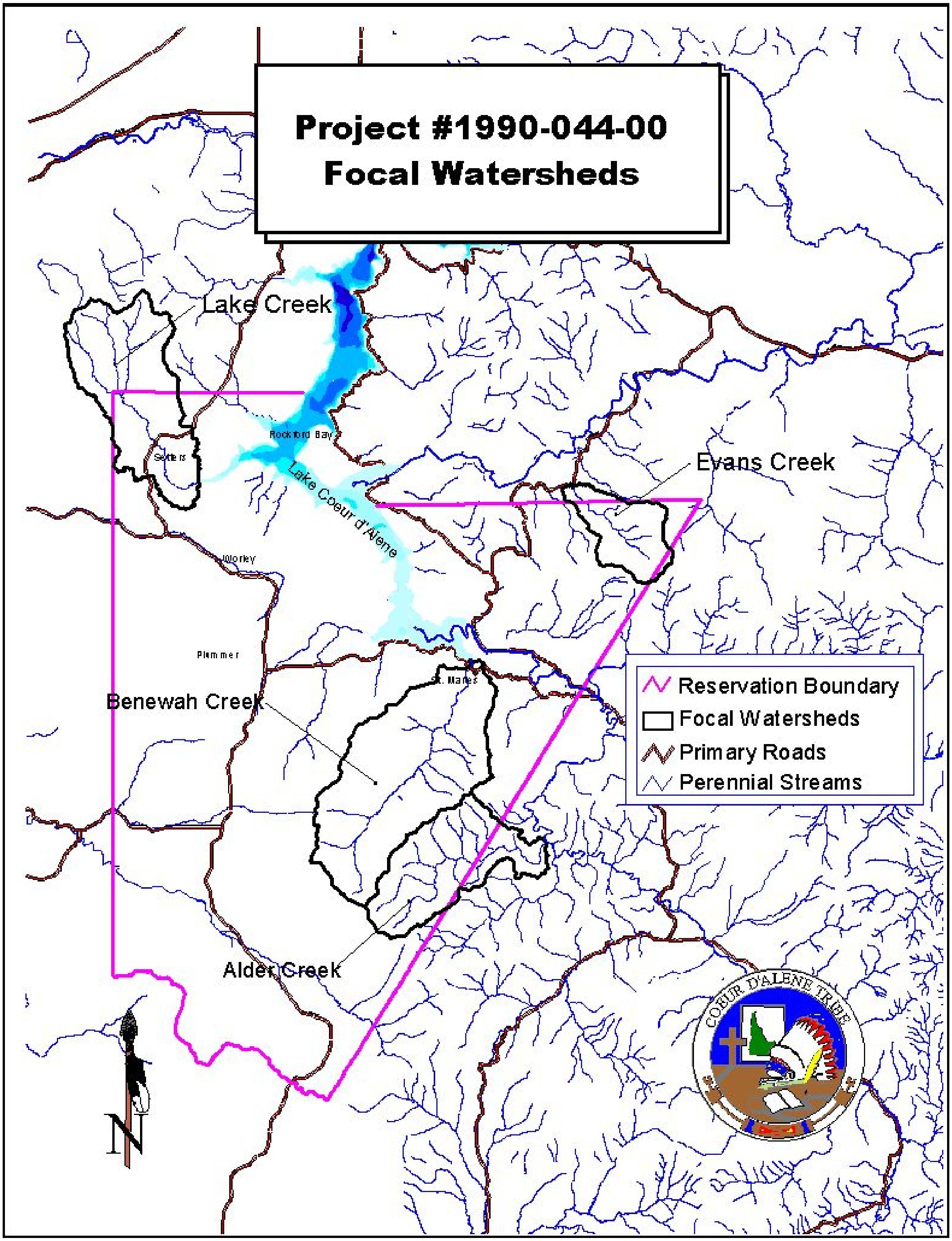

Figure 1. Locations of BPA Project 90-044-00 Focal Watersheds on the Coeur d'Alene Indian Reservation.

Task 1b: Monitor the movement of adfluvial fish within Benewah and Lake creeks.

Task 1c: Monitor stream flow, water temperature, nitrate and Hydrolab parameters at 21 sites in the restoration target drainages as described in the RM& E Plan.

Objective 2: Evaluate population responses to brook trout removal.

Task 2a: Calculate population estimates for brook trout at 35 index sites located throughout the Benewah watershed and track changes in abundance and distribution at the reach and watershed scales following annual removals.

Task 2b: Measure structural indices and indices of fecundity for brook trout removed from the Benewah Creek watershed.

Objective 3: Conduct effectiveness and statistical monitoring to provide inferences on fisheries/habitat relationships to larger areas and longer time periods.

Task 3a: Evaluate selection of control sites for each of the existing restoration/enhancement treatment sites.

Task 3b: Measure physical habitat indicators at paired treatment/control sites that are representative of each restoration/enhancement strategy to test the assumptions of habitat restoration and enhancement.

Section 2: Restoration and Enhancement Activities

Objective 1: Complete advanced project planning.

Task 1a: Complete NEPA requirements and obtain necessary permits and authorization to ensure compliance with federal laws and guidelines.

Task 1b: Complete detailed design work for channel filling and valley bottom wetland re-development in the Benewah Creek watershed.

Objective 2: Implement projects to improve instream habitat quality and quantity and restore watershed processes.

Task 2a: Restore native riparian forest plant communities within the 100-year floodplain of Benewah Creek.

Task 2b: Complete construction of 2.7 acres of side channel habitats to maximize wetland area and over winter rearing habitats for westslope cutthroat trout

Task 2c: Replace existing culvert at Windfall Creek to improve fish passage for westslope cutthroat trout consistent with NOAA fisheries standards and guidelines.

Task 2d: Increase floodplain roughness in areas with identified risk for channel avulsion adjacent to the upper mainstem of Benewah Creek.

Objective 3: Monitor the completion of tasks described in the construction and implementation phase for this project.

Task 3a: Conduct implementation monitoring for all new projects described in the construction and implementation phase of the project.

Section 3: Education and Outreach

Objective 1: Improve awareness of Program activities within the Reservation community.

Task 1a: Publish a quarterly newsletter that highlights Program activities, recognizes cooperative efforts and serves as a forum for discussing land management issues.

Task 1b: Continue meeting with watershed work groups comprised of private landowners, agency representatives and other interested parties to discuss restoration and cooperative opportunities.

Objective 2: Provide cultural and educational opportunities to improve student/teacher involvement in Program activities.

Task 2a: Continue to participate in and develop an educational forum for the local community regarding stream restoration opportunities on the Reservation and the need to provide for wild fish in the areas being restored.

Task 2b: Provide summer internships for high school students to assist with implementation of project activities.

Task 2c: Recruit four to seven school students to participate in the annual Natural Resources Camp sponsored by the US Forest service.

Task 2d: Work with the University of Idaho Extension Agent to develop and implement educational programs focusing on fish, water and wildlife resources and protection of Reservation watersheds.

SECTION 1: MONITORING AND EVALUATION

METHODS

Biological Monitoring

Trout Population Estimation

The channel types delineated during previous surveys (Lillengreen et al. 1996) served as the basic geomorphic units for selecting sample sites for conducting fish population surveys. In these early channel type surveys, stream reaches were stratified into relatively homogeneous types according to broad geomorphologic characteristics of stream morphology, such as channel slope and shape, channel patterns and channel materials, as defined by Rosgen (1994). Stream reaches were further stratified by basin area to ensure that both mainstem and tributary habitats were represented in the stratification scheme. Sample locations within each stratum were randomly selected in proportion to the total reach length. The length of each sample unit was defined 60 meters.

Sites were electrofished in the summer to quantify the abundance and distribution of fishes during base flow conditions occurring between July and September. Trout populations were estimated using the removal-depletion method (Seber and LeCren 1967, Zippen 1958). Block nets were placed at the upstream and downstream boundaries to prevent immigration and emigration during sampling. Each sample site was electrofished using the standard guidelines and procedures described by Reynolds (1983). Fish were collected using a Smith-Root Type VII pulsed-DC backpack electrofisher. Two electrofishing passes were made for each sample site as the standard procedure. If the capture probability during the initial passes was less than or equal to 50 percent, then a third and/or fourth pass were generally made to increase the precision of the population estimate. Salmonid species, including cutthroat trout, brook trout *(Salvelinus fontinalis)* and bull trout *(Salvelinus confluentus)* were the target species for this study. Captured fish were identified, enumerated, measured (TL to nearest mm), and weighed (g). Cutthroat trout greater than 200 mm in length were tagged with a Floy FD-6B numbered anchor tag. Other species such as longnose dace, redside shiner, longnose sucker, and sculpin (spp.) were considered incidental catch and were only counted.

Population estimates were calculated using the following equation for two pass removals (Armour et al. 1983):

$$N = \frac{U_1}{1 - (U_2 / U_1)}$$

where:
N = estimated population size;
U_1= number of fish collected in the first pass; and
U_2= number of fish collected in the second pass.
The standard error of the estimate was calculated as:

$$se(N) = \sqrt{\frac{M(1 - M / N)}{A - \left[(2p)^2 (U_2 / U_1)\right]}}$$

where:
se(N) = standard error of the population estimate;
M= $U_1 + U_2$;

A= $(M/N)^2$; and

p= $1 - \frac{U_2}{U_1}$.

Population estimates when more than two passes were necessary were calculated using the following equation (Armour et al. 1983):

$$N = \frac{M}{1-(1-p)^t}$$

where: N = estimated population size

M = sum of all removals ($U_1 + U_2 + \ldots U_t$)

t = the number of removal occasions

U_i = the number of fish in the i^{th} removal pass

$C = (1)U_1 + (2)U_2 + (3)U_3 + \ldots (t)U_t$

$R = (C-M)/M$

$p = (a_0)1 + (a_1)R + (a_2)R^2 + (a_3)R^3 + (a_4)R^4$

a_i = Polynomial coefficient from Table 8 (Armour et al. 1983).

The standard error was calculated as:

$$se(N) = \sqrt{\frac{N(N-M)M}{M^2 - \frac{N(N-M)(tp)^2}{(1-p)}}}$$

where: se(N) = standard error of population estimate. The approximate 95% confidence interval on the unknown population size was calculated as follows (Armour et al. 1983):

$$95\%CI = N \pm 2 * \sqrt{\text{var}(N)}$$

The population estimates were converted into density values (# fish/100 m^2) for each sample site then extrapolated to the reach in which the samples were collected to estimate the total number of fish in the reach. The confidence intervals were converted in the same manner (Johnson and Bhattacharyya 2001). Total reach areas were obtained from the digital data layer maintained by the Tribal GIS Program.

Brook Trout Removal from Benewah Creek

Beginning in August 2004, non-native brook trout were removed from the upper mainstem and two 2^{nd} and 3^{rd} order tributaries of Benewah Creek. Population estimate results from 1996-2003 revealed the highest brook trout densities were in the West and South Forks, Schoolhouse Creek and the upper mainstem above the confluence of Windfall Creek. The initial strategy in 2004 was to use a single-pass removal of brook trout with the goal to sample the entire longitudinal profile of the upper mainstem and tributaries mentioned above. The single pass method was used in lieu of multiple passes to reduce the stress on sympatric juvenile westslope cutthroat trout. All index sites associated with the population estimate sampling were sampled prior to brook trout removal. A sample of approximately 150-200 brook trout were euthanized and dissected to ascertain gender, reproductive maturity, and number of eggs, egg skein weight and testes weight. Scale samples were taken form each sacrificed fish. The brook trout population in Alder Creek is the control and a similar number of fish will be sacrificed to compare changes in density, production and potential changes in reproductive life history traits of brook trout following removal in Benewah Creek.

Trout Age and Size

Age composition was estimated by applying length-at-age proportion keys (Gulland and Rosenberg 1992) developed from scale analyses of fishes of known length from 1996-2004. The length-at-age proportion keys are stream and species-specific. Raw scales were used for age determination. Salmonid scales were taken from the side of the body just behind the dorsal fin and above the lateral line (Jearld 1983). Scale samples were sorted by watershed to allow for independent determination of age and growth rate. In the laboratory, several dried scales were mounted between two glass microscope slides and viewed using a Realist, Inc., Vantage 5 microfiche reader. Age was determined by counting the number of annuli (Lux 1971, Jearld 1983).

Trout Production

Annual production (kg/hectare/yr) and production to biomass (P:B) ratio and variances were estimated following methods of Newman and Martin 1983). Production and P:B ratios were estimated separately for 2nd and 3rd order tributaries, and 3rd and 4th order mainstems.

Trout Migration

Migration traps were installed in Lake and Benewah creeks in 2004 to assess migratory life history patterns, length and age frequency distribution, relative abundance and condition factors of adfluvial cutthroat trout. In the past, both the feasibility of installing and maintaining traps and the ultimate efficiency of trapping efforts have largely been determined by the runoff patterns of the respective watersheds. Traps consisted of a weir, runway and a holding box. The design was a modification of the juvenile downstream trap found in Conlin and Tuty (1979). Two traps were installed at each location to capture both fish moving upstream from the lake and fish moving downstream from the upper watershed. Paired traps were placed approximately 10 meters apart. Traps were checked and cleaned at least once daily during peak spawning periods from April through the early-June. Fish captured in the traps were identified, counted, measured, and weighed. A scale sample was taken to assess the age, growth, and condition of the fish.

Power Analysis

The program MONITOR (Gibbs 1995) was used to estimate the power to detect a positive or negative change of Westslope cutthroat and brook trout densities from annual population estimates in Alder, Benewah, Evans and Lake Creeks over a nine-year period from 1996-2004. The MONITOR program uses Monte Carlo simulations to model variation in count surveys over time. The program then generates detection rates produced from route-regression analysis. The density (mean ± 1 sd, n = 9 years) of westslope cutthroat and brook trout from each population estimate site was used as input for the power analysis. The results of the power analysis apply to detecting percentage of change at the stream scale. An alpha level of 0.10 and 1000 iterations were used for all Monte Carlo simulations. For results interpretation and discussion, detection ranges were broken into fine-scale (-4% to 4%) and coarse-scale (-10% to -4%, and 4% to 10%). Results were interpreted relative to past power analyses reported in (Vitale et al. 2002A).

Water Quality Monitoring

Stream Studies

Water quality monitoring was conducted at 17 stream sites during 2004. Table 1 lists these sites in order from mouth to headwaters for each of the four project watersheds. Nine of these sites had RL 100 continuous temperature monitoring devices placed during the March through October period (*Table 1*). The planned monitoring schedule was to visit all sites bi-weekly from March-October to perform discharge and field (Hydrolab) sampling. Samples for laboratory analyses were to be collected monthly from March-October and during rain-on-snow events during November-March. Due to staff changes and other conflicts, actual monitoring took place only during January, July, August and September.

Table 1. Stream water quality sites and monitoring variables.

Watershed	Stream	Discharge	Temperature[a]	Total Suspended Solids	Turbidity	Total Phosphorus	Total Kjeldahl Nitrogen
Alder	Alder	X	X	X	X	X	X
Alder	N Fk Alder	X	X	X	X	X	X
Benewah	Benewah 3 Mile	X	X	X	X	X	X
Benewah	Benewah 9 Mile	X	X	X	X	X	X
Benewah	Bull	X		X	X	X	
Benewah	Gore Creek	X		X	X	X	
Benewah	School House Creek	X	X	X	X	X	X
Benewah	Upper Benewah	X	X	X	X	X	X
Benewah	W Fk Benewah	X		X	X	X	X
Benewah	Whitetail Creek	X		X	X	X	X
Benewah	Windfall Creek	X		X	X	X	X
Evans	Evans	X	X	X	X		X
Evans	N Fk Evans	X	X	X	X		X
Evans	Upper Evans	X	X	X	X		X
Lake	Lower Lake	X	X	X	X		X
Lake	Upper Lake	X		X	X		X
Lake	Bozard	X	X	X	X		X

Monitored Parameters

Each stream site was monitored for discharge, temperature, dissolved oxygen (DO), pH, specific conductance, total suspended solids (TSS), turbidity and nutrients. Nutrients included nitrogen forms (nitrate, nitrite and total Kjeldahl nitrogen (TKN)), phosphorus forms (dissolved "ortho" and total phosphorus), sulfate, chloride and fluoride. The discharge, temperature, DO, pH and specific conductance were measured *in-situ*, while TSS, turbidity and nutrients were determined in samples collected and sent to a contract laboratory.

Sampling and Analysis Techniques

The devices used for the *in-situ* water analyses were the Price Model 625 velocity meter with a Teledyne Gurley Model 1100 digital flow velocity indicator Information on calibration and use of the velocity meter and flow velocity indicator is presented in Rantz 1983.
Stream discharge measurements were made following a "Velocity-Area Procedure" adapted from USEPA 2001.

Water samples submitted for laboratory analysis were collected using a DH-48 water sampler to obtain a depth-integrated sample, in most cases. Certain shallow stream sites (i.e. lass than six inches) were sampled by dipping the sample bottle into the flow to collect a simple grab sample. All samples were handled according to Standard Methods for the Examination of Water and Wastewater, 18th Ed. (APHA 1992), procedure 1060: *Collection and preservation of samples*. Strict chain of custody procedures was followed, as outlined in section 1060.B.1: *Chain of custody procedures* (APHA 1992). The contract laboratory prepared all containers used.

Total suspended solids (TSS) were analyzed using EPA method 160.2: *Gravimetric determination of Total Suspended Solids* (USEPA 1979).
A qualified contract laboratory completed turbidity analysis in accordance with EPA method 180.1 (USEPA 1993). Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines (APHA, 1992).

The contract laboratory analyzed certain nutrient samples with an ion chromatograph (IC) using EPA method 300.0 (USEPA 1993). The following nutrient compounds were tested for using this method: nitrate, nitrite chloride, fluoride and sulfate. Total and "ortho" phosphorus and TKN were analyzed using semi-automated colorimetry (EPA method 365.1 for phosphorus and EPA method 350.1 for nitrogen) (USEPA 1993).

Physical Habitat Evaluation

Following the Rolling Provincial Review in 2001, the project was tasked with producing a research, monitoring and evaluation plan that described the methods and evaluations to assess the effectiveness of habitat restoration on Tribal projects. In response project staff developed an RM&E plan, volume 1 (Vitale et al. 2003), that described a hierarchical stratification process to select control reaches for statistical comparison with restored (treatment reaches. Site selection for control reaches followed a hierarchical stratification of the target watersheds that incorporates both ultimate and proximate control, consistent with the guidelines provided by Paulsen et al. (2002) and Hillman and Giorgi (2002). Thirteen control sites were selected using the above-mentioned process and habitat indicators were measured according to the RM&E plan beginning in 2002. Our RM&E plan was being implemented at the same time the Collaborative, Systemwide Monitoring and Evaluation Project (CSMEP) was being developed. We have followed the evolving CSMEP and Pacific Northwest Aquatic Monitoring Partnership (PNAMP) and the habitat indicators and methods we use to collect them are consistent with those discussed in both forums.

Sites and Variables Monitored

An important aspect of the proposed monitoring and evaluation program is the study of certain physical, chemical and biological characteristics of select treated (i.e. restored or enhanced) sites and similar but untreated "control" sites. The comparison of treated and control site characteristics can provide an important measure of changes (improvements or lack thereof) brought about by the treatments. Table 2 provides a listing of the restoration / enhancement projects completed through 2002 that were selected to be monitored, along with the respective project category (treatment type) and the associated treatment and control monitoring sites. Restoration / enhancement project monitoring site locations are shown in *Figures 2 - 5*.

Table 2. Coeur d'Alene Tribe, BPA-funded restoration / enhancement project sites with associated preliminary treatment and control pairings.

Restoration / enhancement Project ID	Project Category / Treatment Type	Treatment Monitoring Site #	Control Monitoring Site #
B_6.5	Channel reconstruction	Benewah 12	Benewah 13
B_8.1	Streambank stabilization & riparian planting	Benewah 14L	Benewah 9
B_8.5	Streambank stabilization & riparian planting	Benewah 14U	Benewah 17
E_0.1/0.0	Riparian planting	Evans 1 *	Evans 2 *
E_1.3	Streambank stabilization	Evans 3	Alder 12
E_1.6	Streambank stabilization	Evans 5 *	Evans 4 *
L_6.0	Riparian planting	Lake 8	Lake 7
L_7.3	Riparian planting	Lake 9U	Lake 10
L_8.2	Instream structures & riparian planting	Lake 11	EF Bozard 1 *
L_8.2/0.0	Riparian planting	WF Lake 2	Bozard 3
L_8.5	Riparian planting	Lake 12	Bozard 2
L_8.8	Riparian planting	Lake 13 *	Bozard 1
*Site not monitored in 2004			

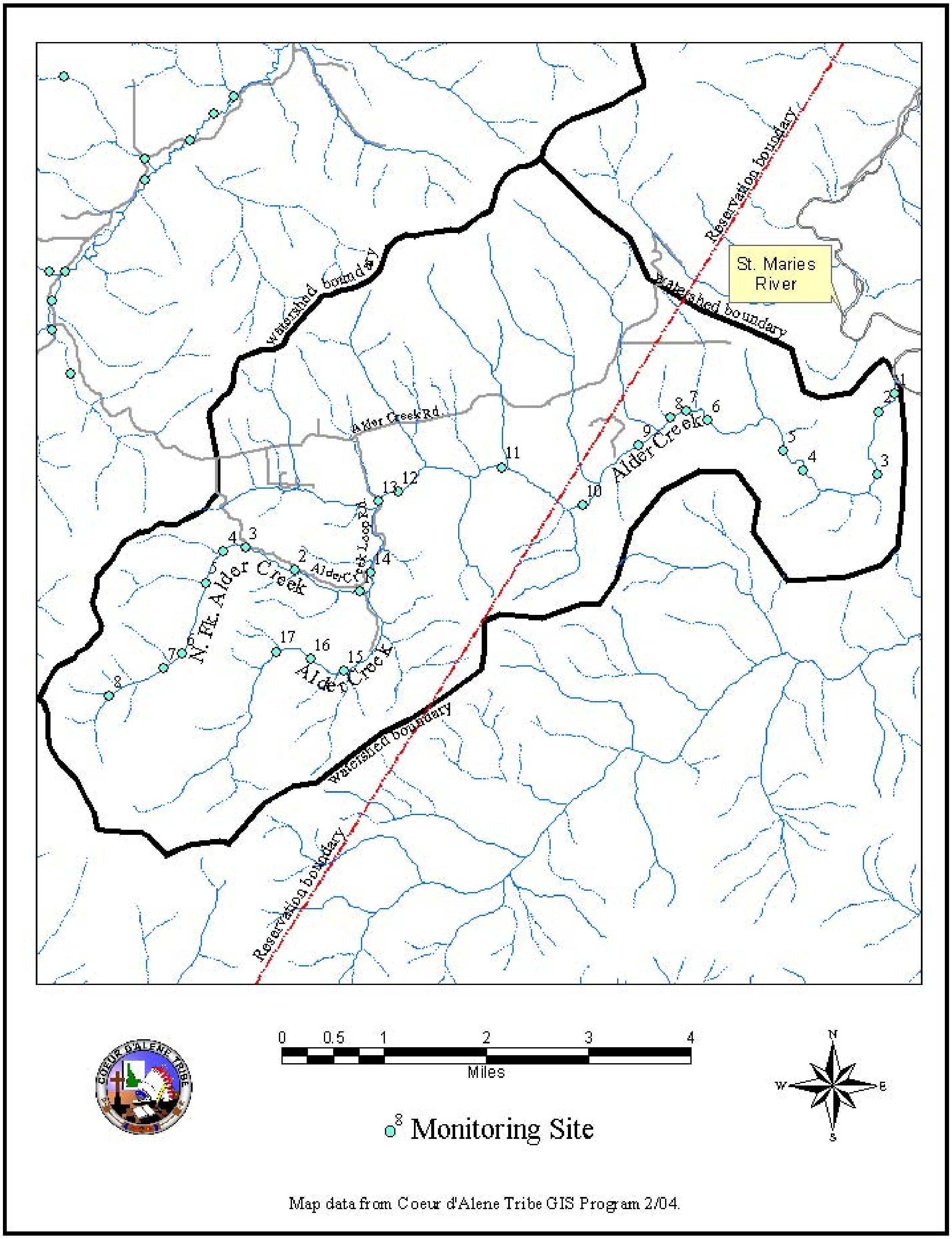

Figure 2. Map of Alder Creek watershed showing fish population and stream habitat monitoring sites.

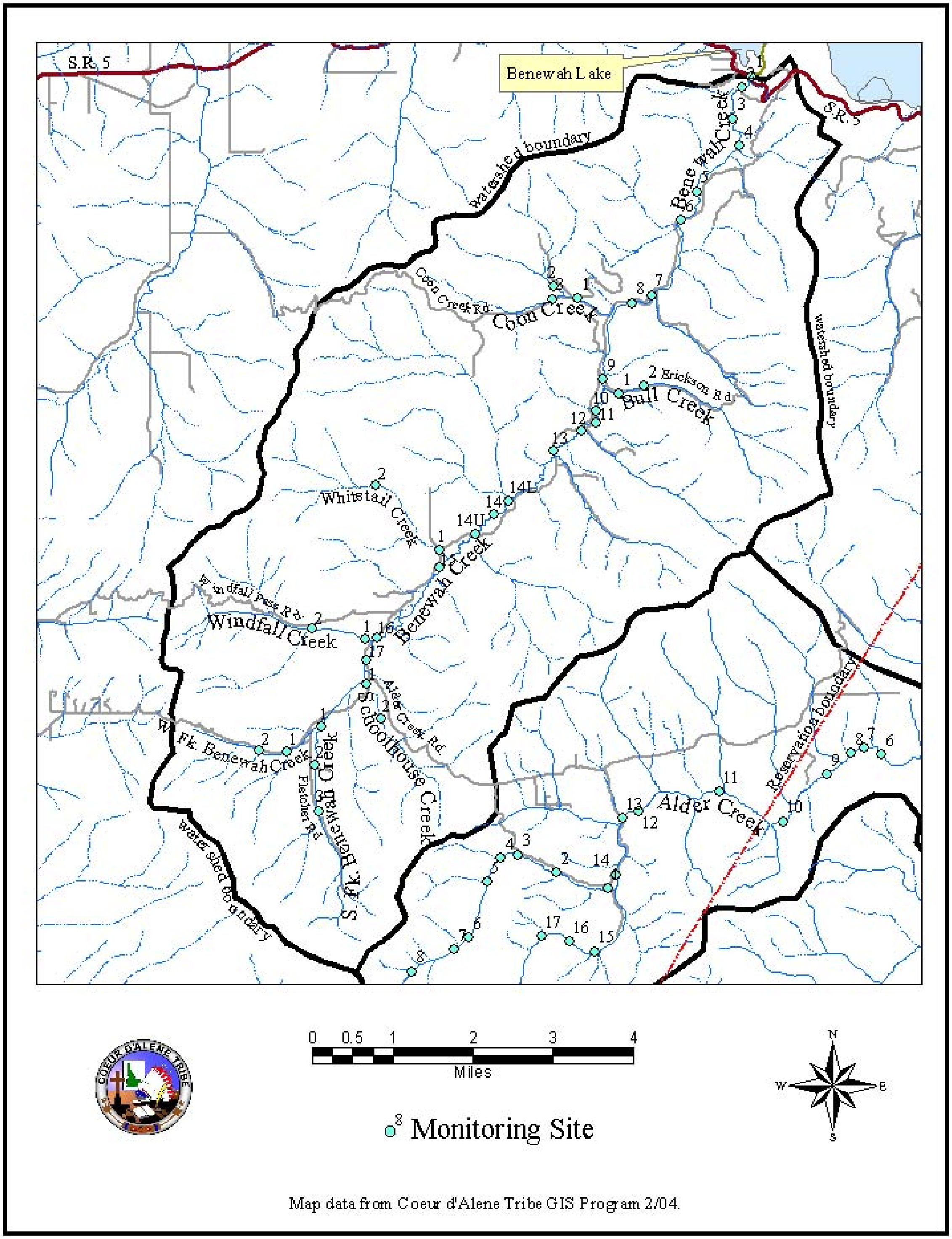

Figure 3. Map of Benewah Creek watershed showing fish population and stream habitat monitoring sites.

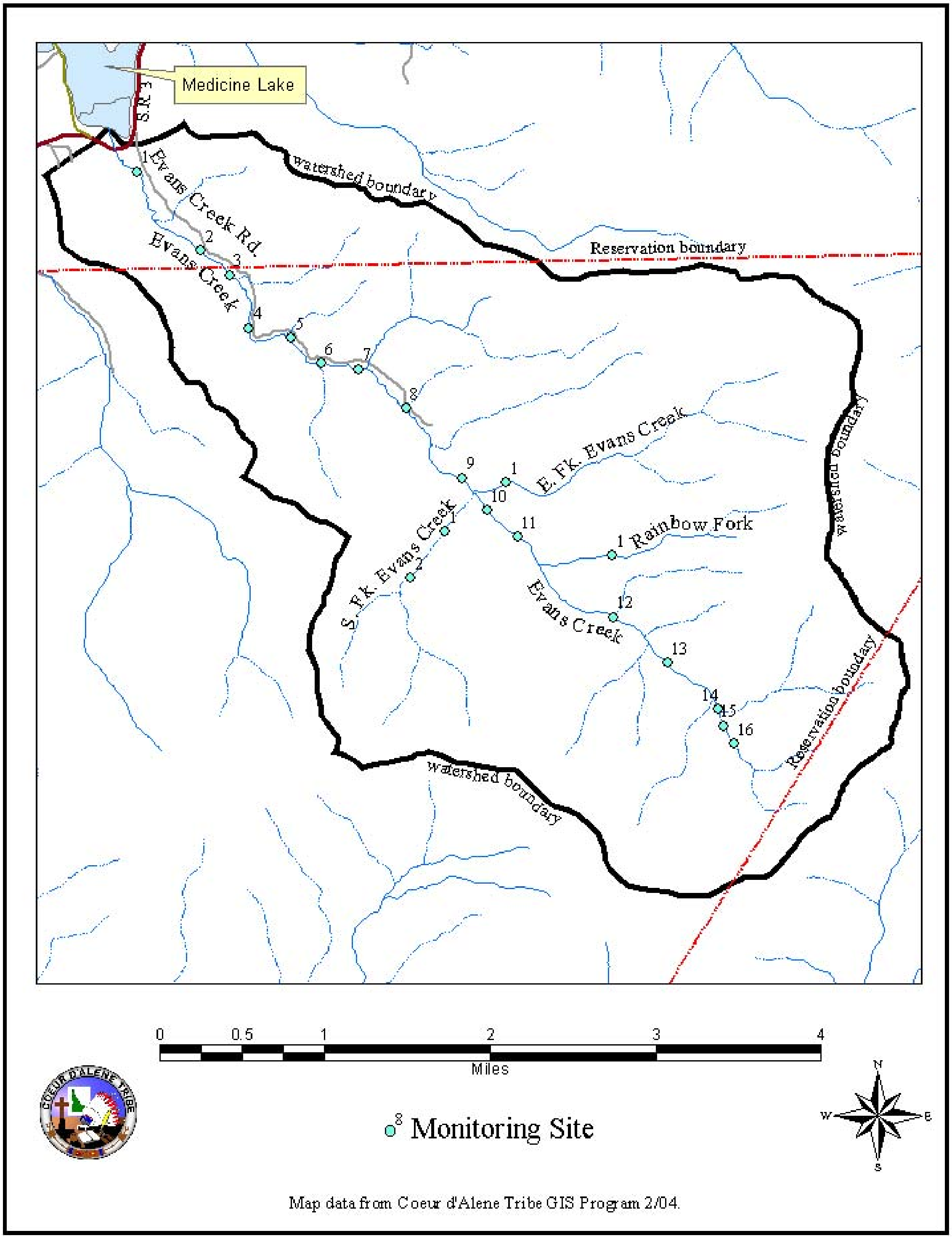

Figure 4. Map of Evans Creek watershed showing fish population and stream habitat monitoring sites.

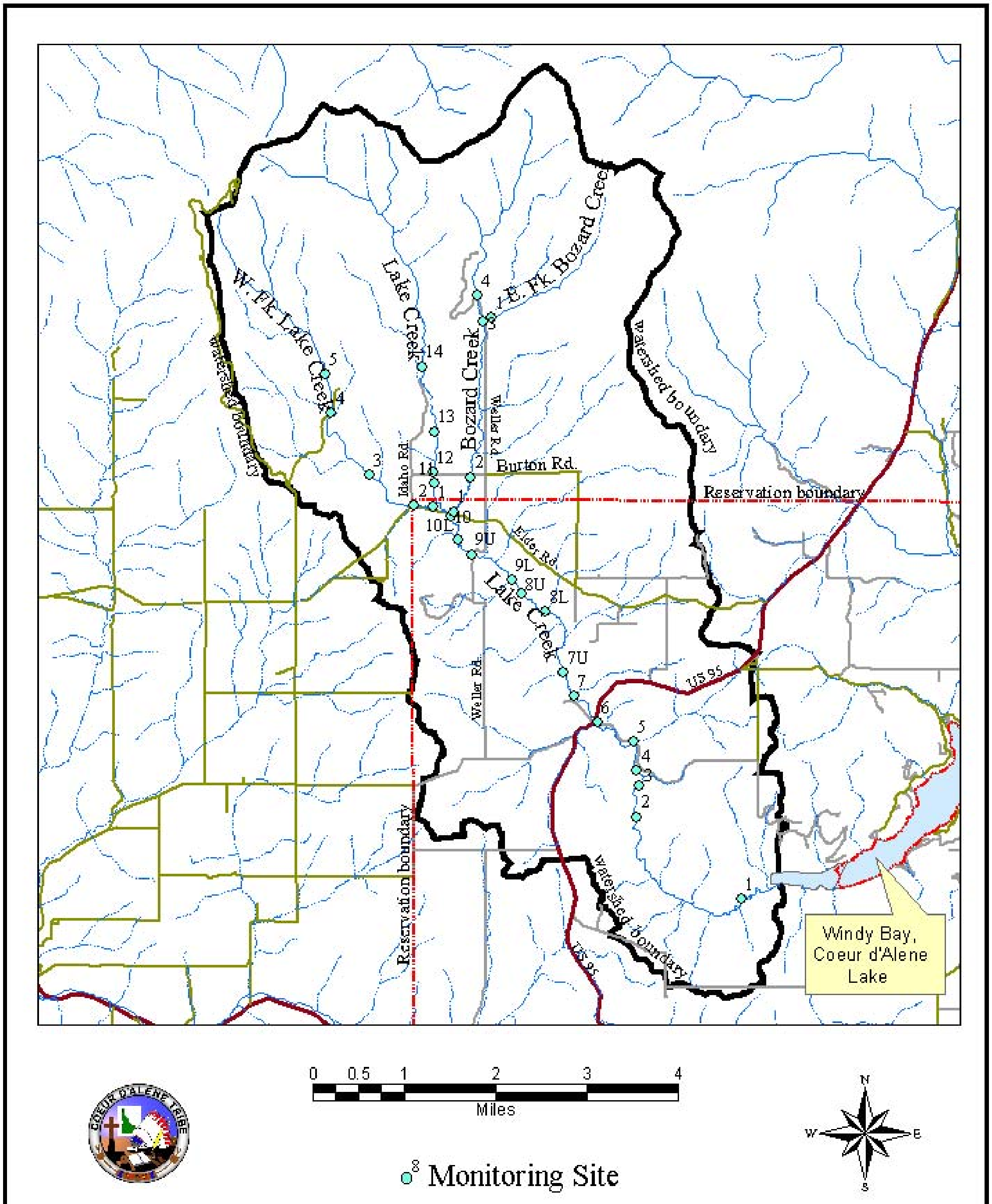

Figure 5. Map of Lake creek watershed showing fish population and stream habitat monitoring sites.

There were several basic physical characteristics measured at each of the paired treatment-control sites during 2004. These included: longitudinal (thalweg) profile of the site, six cross section profiles at each site, substrate materials ("pebble counts"), canopy cover, and amount of large woody debris (LWD) present. These parameters were measured and the data from each site was input into a single Reference Reach Spreadsheet (River4m, Ltd. 1999).

Habitat Typing

The first effort to be undertaken upon arrival at a monitoring site was to determine the location of the downstream end of the previously surveyed reach. Once this was found, the location was flagged with surveyor's ribbon. . A 500-foot tape (zero end) was then attached near the water surface and spooled out along the thalweg. Care was taken to keep the tape over the thalweg, especially around bends in the channel. This was accomplished by running the tape over or around existing woody debris or rocks. If no in-stream stationary items are found where needed, the tape was tied the appropriate distance from shoreline rocks or vegetation using surveyors ribbon. When the 500-foot mark was reached this was the end of the reach. This location was marked as was the start with flagging. For some sites, the starting or ending locations were different than the previous survey. This is further discussed later in this report.

Longitudinal "Thalweg" Profile

The slope of the water surface is a major determinant of river channel morphology, and of the related sediment, hydraulic, and biological functions (Leopold 1994). A longitudinal profile surveyed along a selected channel reach is recommended for slope and channel typing determinations (Rosgen 1996).

This effort (modified from Peck et al. 2001) involved the determination of the water surface and channel bottom elevations along the "thalweg" of each 500-foot study reach. "Thalweg" refers to the flow path of the deepest water in a stream channel. The longitudinal thalweg profile, therefore, is a survey of the lowest stream bottom elevations (and associated water depths) along the reach. Measurements require the use of a surveyor's level and rod, and the 500-foot measuring tape described above. Operating and note taking procedures for this equipment are described in the RM&E Plan. Since most reaches are longer than could be seen from a single level setup, it was necessary to use "turning points" to move the level through the reach.

Profile surveying was begun once a backsite shot to a previously established benchmark was completed. This permanent reference point (top of a section of one-inch rebar driven firmly into the ground) was given the assumed elevation of 100.00 feet. From the benchmark, the level was set up and shots taken along the thalweg. A sufficient number of shots were taken to capture all changes in channel bottom slope and habitat types along the reach, generally every 4 feet or so. Collected survey data was input into a "Reference Reach Spreadsheet" (Ohio Department of Natural Resources 1999) for each site, which automatically graphed the profiles and also calculated pertinent descriptive criteria such as water surface slope.

Bed Form Differencing

Identifying pool and riffle habitats is important in monitoring changes in bedform and fish habitat. A macrohabitat identification technique called the Bed Form Differencing was applied to each of the longitudinal profiles collected. This method was developed by O'Neill and Abrahams (1984) as a way to objectively identify bedforms in a survey reach. Four types of bedforms are identified: absolute maximums (riffles), absolute minimums (pools), local maximums, and local minimums. The tolerance value is determined by taking the standard deviation of all of the "differences" and multiplying it times a coefficient. If habitat units exceed this value they are classified as either a minimum or a maximum. If they do not exceed this value they are identified as not being a bedform. If a maximum is followed by a minimum then it is a absolute maximum (riffle). If a maximum is followed by another maximum, it is identified as a local maximum. If a minimum is followed by a maximum, it is defined as an absolute minimum (pool). A bed differencing program was developed in Microsoft Excel using Visual Basic following the relationships and terminology in Figure 6. Residual pool depths were calculated by running a program that sorts the bedforms that are either absolute maximums or absolute minimums, then identifies the first "riffle" and starts calculating residual pools by subtracting the elevation of the absolute minimum from the adjacent downstream absolute maximum. The sample spacing is assumed to be equal to channel width though shorter spacing can be used. The resolution of our data is at a much tighter interval. As a result, we have modified our data in order to achieve spacing closer to bankfull width.

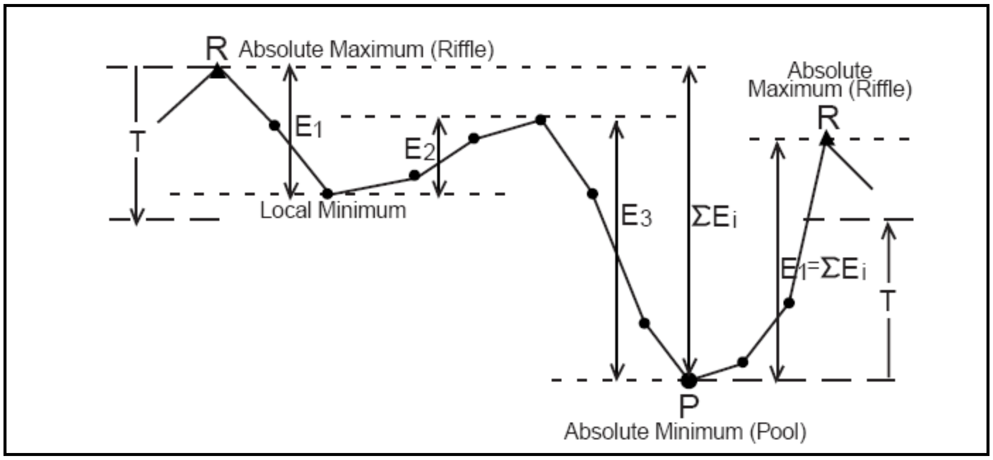

Figure 6. Hypothetical bed profile diagramming the terminology and method to calculate differences in streambed morphology (from O'Neill and Abrahams 1987).

Residual pool depth (RPD) is a particularly important habitat indicator because it can be accurately measured independent of discharge (Kershner et al 2004) and increasing RPD is generally associated with increased salmonid biomass (Hogel 1993; Binns 1994).   This technique was chosen to minimize the error in identifying pools and riffles due to acknowledged inconsistencies associated with field identification (Kershner et al 2004) and to facilitate comparisons across datasets (Arend 1999).

Cross Section Profiles

The cross section profiles were measured using a surveyor's level and rod at six locations along each studied reach. These cross-sections had been previously established and surveyed either in 2002 or 2003. All cross sections were monumented with permanent pins (rebar), stakes, lathe and flagging to allow for repeat surveying of the profiles in the future. In some cases, survey pins had to be reset because they had been moved or "lost". The Bench Mark established for the thalweg profile surveying was also used as the reference point for each of the six cross sections.

The cross section profiles were used to verify the bankfull depth and to calculate the bankfull cross sectional area, wetted perimeter, average and maximum depth and width-to-depth ratio. The flood-prone width, which is defined as the valley width at twice the maximum depth at bankfull, and entrenchment ratio, defined as the flood-prone width divided by the bankfull width, were not determined as part of this effort. The flood-prone width will be determined in the future to allow a verification of the channel type (see below). Collected cross section survey data, which included water depths where appropriate, was input into the "Reference Reach Spreadsheet" (Ohio Department of Natural Resources 1999), along with the longitudinal profile data, which automatically graphed the profiles and also calculated pertinent descriptive criteria such as bankfull elevation, cross sectional area, wetted perimeter and flood prone elevation.

Channel Substrate

Channel bed and bank materials influence the cross-sectional form, plan-view, and longitudinal profile of rivers; they also determine the extent of sediment transport and provide the means of resistance to hydraulic stress (Ritter 1967). Channel substrate was measured using a modified version of Wolman's (1954) pebble count method as described by Rosgen (1993). The modified method adjusts the material sampling locations so that streambed materials are sampled on a proportional basis along a given stream reach. This requires that the six cross sections be located as described above. The pebble count substrate analysis was performed along each of the six cross sections within the monitored reach. Following the original method, particle size was determined as the length of the "intermediate axis" of the particle; that is the middle dimension of its length, width and height. At each of these points a measuring stick or finger was placed on the substrate and the one particle the tip touched was picked up and the size measured. Substrate size classes that were recorded are shown in *Table 4*.

Collected pebble count data was input into the Reference Reach Spreadsheets (Ohio Department of Natural Resources 1999) which automatically graphed the distribution of particle sizes and calculated pertinent descriptive criteria such as percent by substrate class (size) and a particle size index (D value) for each habitat type for which data is indicated.

Canopy Cover

Vegetative canopy cover (or shade) was determined using a conical spherical densiometer, as described by Platts et al. (1987). The densiometer determines relative canopy "closure" or canopy density, depending on how the readings are taken. This monitoring was only for canopy density, which is the amount of the sky that is blocked within the closure by vegetation, and this is measured in percent. Canopy density can change drastically through the year if the canopy vegetation is deciduous.

Canopy cover over the stream was determined at each of the six cross sections established following the habitat typing survey. At each cross section, densiometer readings were taken one foot above the water surface at the following locations: once facing the left bank, once facing upstream at the middle of the channel, once facing downstream at the middle of the channel and once facing the right bank. Percent density was calculated by multiplying the sum of the four readings by 1.5. If the result was between 30 and 65%, 1.0 % was subtracted; if the result is greater than 65, 2% was subtracted. The adjusted density readings were then averaged for the entire reach.

Instream Organic Materials

Organic materials play an important role in the character and productivity of stream habitats. This survey of monitored stream reaches was an inventory of the number and size of individual pieces of woody material observed along a longitudinal transect through the reach. For the Large Woody Debris (LWD) these data were converted into volumes of material so it was necessary to collect data on the lengths and diameters of the material to allow this calculation. Tree root wads were tallied separately as these typically provide additional habitat benefits because of their size and complexity. For this protocol the definition of a root wad was that it was dead, that it was detached from its original position, that it has a diameter where the tree trunk meets the roots of at least eight inches and that it was less than six feet long from the base of the root ball to the farthest extent of the trunk (Schuett-Hames, 1999).

The organic materials survey transect was walked along the thalweg starting at the downstream end of the reach. All LWD (organic material that is greater than 4 inches in diameter at the small end) was tallied and measured whether or not it crossed the line of the transect. This included material that was suspended above the water surface and extended outside of the wetted stream width; it is not intended to include living trees or shrubs that hung over the water. For all observed LWD, orientation was noted by taking a compass heading (degrees) looking from the large end of the piece towards the small end. Other measurements taken of all LWD were the diameter at the large end, diameter at the small end and the length between these two ends. The large end diameter shall be measured immediately above the roots, if there are roots attached.Data handling included the tallying of all course material seen crossing the thalweg and calculation of the total volume and density of LWD found within the bankfull width of each studied reach. These calculations were performed in a spreadsheet worksheet added to the Reference Reach Spreadsheet.

Sinuosity

The sinuosity of a stream reach is estimated as the ratio of the stream channel length to the direct basin (valley) length. Rosgen (1996) describes the procedure for determining sinuosity of the entire stream basin but this also applies to a monitored stream reach. For a large scale determination of sinuosity, a 1:24,000 map or orthophoto and a ruler, or GIS map in measure option or GPS is used to measure the length of the basin as the straight line distance from the where the stream enters the study reach to where it leaves the reach. For the RM&E monitored stream segments, the "total stream length" in the study reach is that measured for the longitudinal thalweg profile (ie. 500 feet) and the valley length is measured (estimated) by pulling a hip chain as straight as possible between the upstream and downstream ends of the 500-foot (152.4 meters) reach. Sinuosity is calculated by dividing the stream length (500 feet) by the valley length.

Stream Typing

The classification of stream channel types followed guidelines presented by Rosgen (1996) and used data collected during the thalweg profile, cross section profile and sinuosity surveying efforts. The objective of classifying streams on the basis of channel morphology was to use discrete categories of stream types to develop consistent, reproducible descriptions of the stream reaches. These descriptions must provide a consistent frame of reference to document changes in the stream channels over time and to allow comparison between different streams. The different Rosgen classifications are described in Appendix *Table 4*. In addition to the parameters shown in Appendix *Table 4*, the dominant substrate type (ie. slit/clay, sand, gravel, cobble) was included as a modifier to the channel type. The numbering for this (from Rosgen 1996) is 1 for bedrock, 2 for boulder, 3 for cobble, 4 for gravel, 5 for sand and 6 for silt and clay.

The delineative criteria described by Rosgen (1996) are entrenchment ratio, width-to-depth (W/D) ratio, sinuosity and slope. Entrenchment ratio is estimated as the typical flood-prone width divided by the bankfull channel width. Bankfull width, or the stream width and depth at bankfull stage, is determined by the elevation of the top of the "highest depositional feature"; this could be a change in size distribution of substrate or bank particles, a stain on rocks in the bank, or, most frequently, a break in the slope of the bank. When the bankfull elevation was not evident in the field, this could usually be determined by looking at the plotted cross section profiles. Flood-prone width is frequently not evident, especially where floodplain features have been obscured by agriculture or other human activities. However, flood-prone width has been defined by Rosgen as the width at the elevation that is twice the bankfull max depth. That is, twice the distance between the thalweg and the bankfull height. The flood-prone widths were not determined in 2004 because the cross sections did not extend far enough from the stream to intersect the valley floor so the Entrenchment Ratio could not be calculated. This resulted in some uncertainty in the stream types identified; this uncertainty will be removed and channel types verified when cross section profiles are extended.

Width-to-depth ratio is the bankfull width divided by the bankfull mean depth in a riffle section. Other dimensionless ratios include pool area ratio, pool width ratio, pool max depth ratio,pool area ratio is the ratio of the cross-sectional area of a pool divided by the bankfull cross-sectional area in a riffle section. Pool width ratio is the ratio of the width of a pool divided by the riffle bankfull mean width. Pool max depth is the ratio of the max depth of a pool divided by the riffle bankfull mean depth. These relationships are also determined for run and glide habitat types.. Sinuosity is the length of reach divided by the straight-line distance between the upstream and downstream ends of the reach. Slope is the drop in elevation of the water surface divided by the length of the reach and was determined from the upstream end of one habitat type (preferably a riffle) near the upstream end of the study reach, to the upstream end of a like habitat type near the downstream end of the study reach.

RESULTS

Biological Monitoring

Trout Population Estimation

Westslope cutthroat trout were widely distributed in the Benewah, Evans, and Lake Creek watersheds during base flow conditions in the summer, with maximum densities in 2nd and 3rd order tributaries (Appendix Tables 1 and 2). In contrast, westslope cutthroat trout distribution in Alder Creek was limited to the mainstem (Appendix Table 1). In Alder Creek, only approximately 50% of the available habitat was occupied by cutthroat trout and much of the upper mainstem and North Fork contained no cutthroat in the sample. The highest mean densities at the watershed scale were 12.4/100m^2 and 8.8/100m^2 from Lake and Benewah creeks (Table 3). Maximum densities at the reach scale in each watershed were; 65.9/ 100m^2 in Bull Creek a tributary of Benewah Creek, 35.9/ 100m^2 in Bozard Creek a tributary of Lake Creek, (10.2/100m^2 in mainstem Evans Creek and 3.4/100m^2 in mainstem Alder Creek.

Non-native brook trout were found only in the Alder and Benewah creek watersheds (Appendix Table 3), but were dominant in Alder Creek. The mean density of brook trout at the watershed scale in Alder Creek was 10.9/ 100m^2 (Table 3). The highest density of brook trout at the reach scale was 30.4/100m^2 in North Fork Alder Creek. In Alder Creek brook trout were distributed throughout the North Fork and upper mainstem reaches with relatively little spatial overlap between brook trout and cutthroat trout. However, brook trout were found in higher densities where overlap did occur. In Benewah Creek, brook trout were distributed in the upper mainstem and associated tributaries with highest densities of 10.3/100m^2 and 29.7/100m^2 in the South and West forks respectively (Appendix Table 3).

The estimated total number of westslope cutthroat and brook trout at the watershed scale for the 9-year time series of data from 1996-2004 are presented in Figures 7 and 8. The westslope cutthroat trout population in Lake Creek increased from 2003 with a population of 8,238±1,831 (95%CI), the highest population of the four target watersheds in 2004 (Figure 7). The westslope cutthroat trout population in Benewah Creek has increased in the past two years with a population of 5,666±1,367 and 6,907±1,420 in 2003 and 2004 respectively (Figure 7). The westslope cutthroat trout population in Alder Creek was much lower than the other target watersheds and exhibits relatively low annual fluctuation (Figure 7). The population of brook trout in Alder Creek was 6,848±749 in 2004, an increase following two years of decreasing numbers (Figure 8). The population of brook trout in Benewah Creek increased in 2004 at 2,091±1,039, but also exhibited higher variance compared to past years (Figure 8). Generally, the brook trout population in Alder and Benewah creeks has increased since sampling began in 1996 (Figure 8).

A power analysis was done to evaluate the power to detect annual changes of cutthroat and brook trout populations at the watershed scale. The nine-year (1996-2004) population estimate data set was used for the power analysis. The power to detect changes in cutthroat trout populations is highest in Benewah and Evans creeks (Figure 9). However, the higher power is associated with only a coarse-scale detection range of (-10% to -4%, and 4% to 10%) and does not meet the criteria of detecting fine-scale changes (–3% to +3%) with 0.80 power at α 0.10 (Vitale et al. 2002A). The power to detect changes in the brook trout population of Alder Creek is nearly twice that of Benewah Creek (Figure 10).

Table 3. Density of westslope cutthroat trout and non-native brook trout, mean±standard error, at the watershed scale from the four target watersheds in 2004. Values in parentheses are the number of segments used for the estimate.

	Stream			
Species	Alder Creek	Benewah Creek	Evans Creek	Lake Creek
westslope cutthroat trout	0.8±0.3 (13)	8.8±4.3 (15)	6.6±0.9 (10)	12.4±3.6 (8)
brook trout	10.9±3.3 (13)	3.2±2.0 (15)		

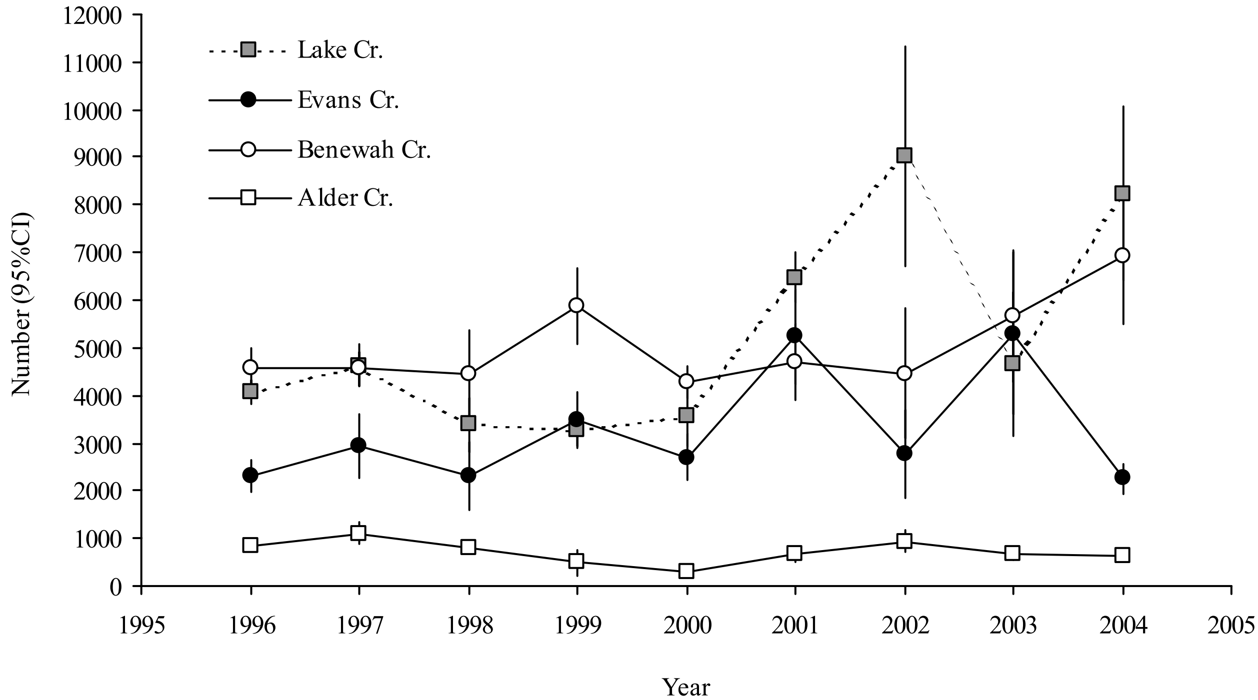

Figure 7. Total estimated cutthroat trout population by watershed, 1996-2004. Error bars indicate ±95% CI.

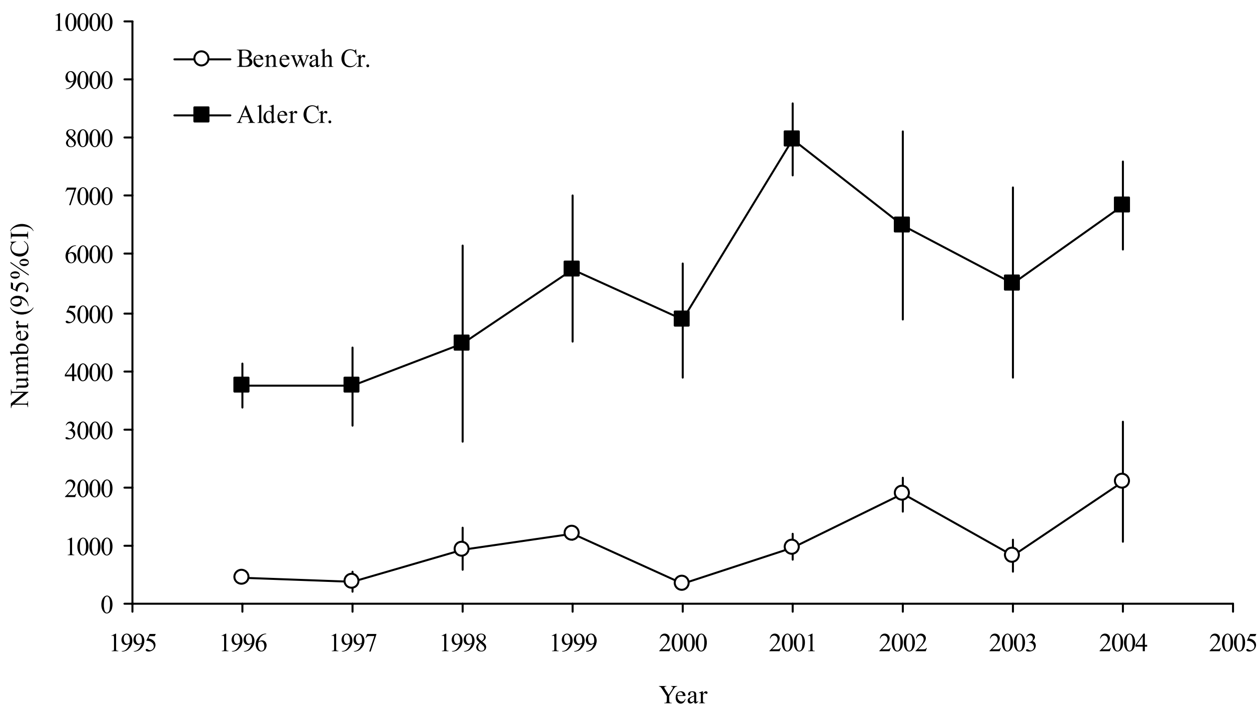

Figure 8. Total estimated brook trout population by watershed, 1996-2004. Error bars indicate ±95% CI.

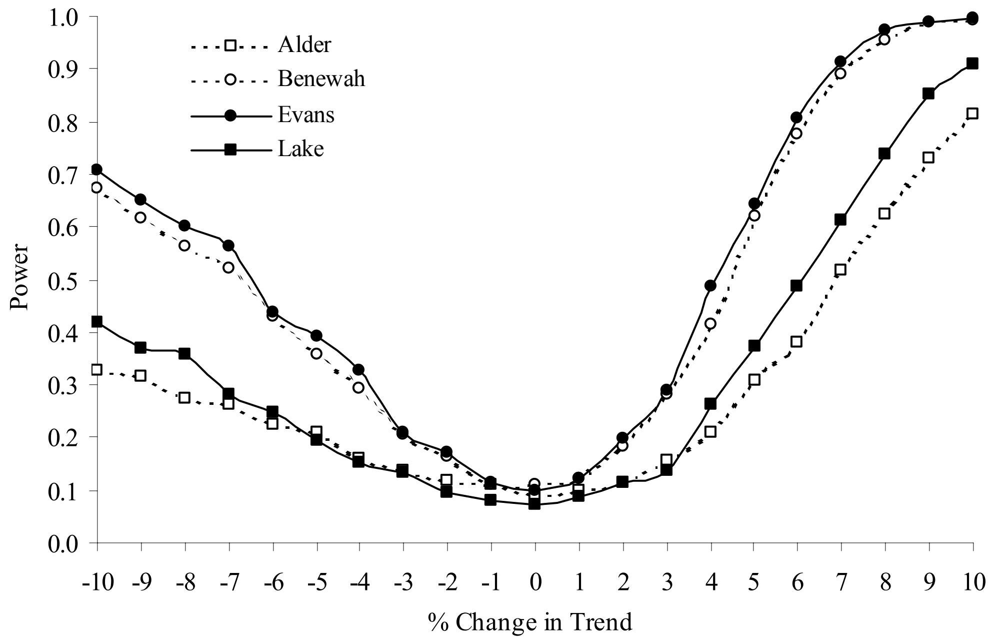

Figure 9. Power to detect annual changes in westslope cutthroat trout populations in four streams on the Coeurd' Alene Tribe Reservation (n=9 yrs, α level = 0.10).

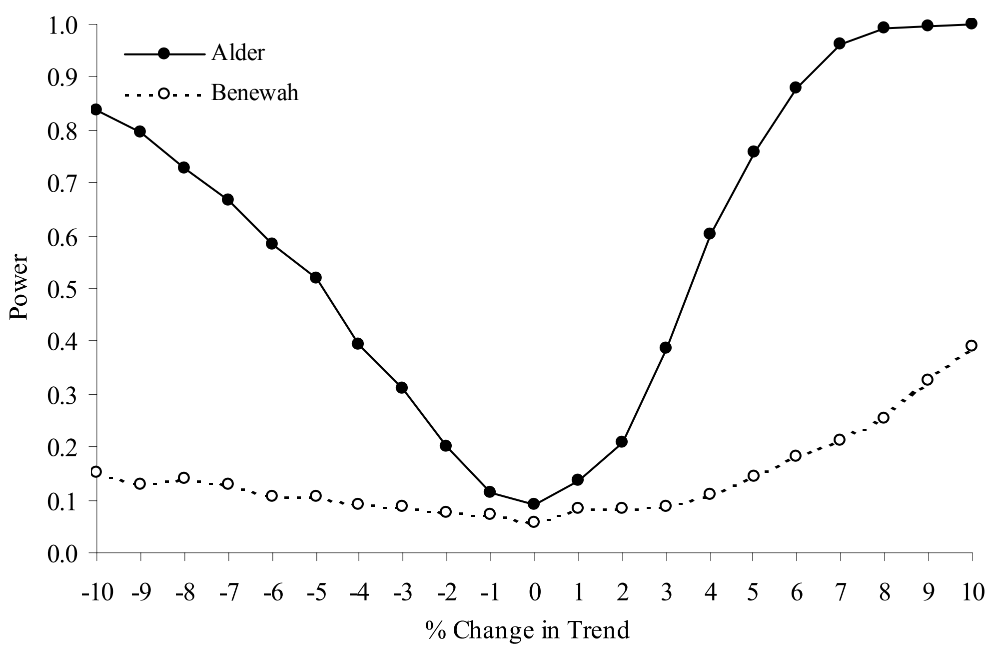

Figure 10. Power to detect annual changes in brook trout populations in two streams on the Coeurd' Alene Tribe Reservation (n=9 yrs, α level = 0.10).

Trout Production

Annual westslope cutthroat trout production in 2nd and 3rd order tributaries was 4.0 and 6.1 times greater than in 3rd and 4th order mainstems of Benewah and Lake creeks (*Table 3*). Westslope cutthroat trout production in Evans Creek was similar in 2nd and 3rd order tributaries compared to 3rd and 4th order mainstem reaches. Non-native brook trout production in 2nd order tributaries of Alder Creek was comparable to westslope cutthroat trout production in Benewah and Evans Creeks, and 1.5 times greater than brook trout production in Benewah Creek *(Table 9*). All density data by age class used for the following production results is presented in Appendix A, Tables 3-6.

The production/biomass (P:B) ratio of westslope cutthroat trout among the four streams from 1996-2005 was highest in Benewah Creek from both 2nd order tributaries and 3rd order mainstem of Benewah Creek *(Tables 9 and 10*). Lake Creek had the highest P:B ratio of 1.2±0.4 (95%CI) during the ten-year period in year 2001. The production/biomass (P:B) ratio of westslope cutthroat trout in the four target watersheds was similar to values from the literature for salmonids with a resident life history (*Table 11*). Production/biomass ratios of non-native brook trout in Alder and Benewah Creeks is in the lower range of P:B ratios from the literature (*Table 11*).

Table 4. Annual production ($kg \cdot ha^{-1} \cdot yr^{-1}$), biomass ($kg \cdot ha^{-1} \cdot yr^{-1}$), and production to biomass ratio(± 95% CI) for westslope cutthroat and brook trout from 2nd and 3rd order tributaries, and 3rd and 4th order mainstems of four target watersheds in the Coeur d'Alene Basin for 2004.

		Tributary			Mainstem		
Stream	Species	Production	Biomass	P:B	Production	Biomass	P:B
Alder[a]	WCT	-	-	-	6.6 (0.7)	7.7 (1.1)	0.9 (0.3)
Benewah	WCT	31.7 (2.5)	40.4 (1.9)	0.8 (0.1)	7.9 (0.4)	10.1 (0.6)	0.8 (0.1)
Evans	WCT	17.7 (0.8)	22.0 (0.7)	0.8 (0.1)	18.3 (0.6)	23.9 (0.5)	0.8 (0.1)
Lake	WCT	47.2 (3.1)	51.0 (3.3)	0.9 (0.2)	7.8 (0.4)	9.4 (0.4)	0.8 (0.1)
Alder[b]	EBT	34.4 (2.0)	54.0 (1.3)	0.6 (0.1)	-	-	-
Benewah[b]	EBT	27.0 (2.8)	31.3 (1.9)	0.9 (0.2)	-	-	-

[a] *Low numbers of westslope cutthroat trout precluded production estimates.*
[b] *Low numbers of brook trout precluded production estimates.*

Trout Age and Size

The length, weight and condition factor separated by age for westslope cutthroat and brook trout sampled during population estimates is presented in Tables 5 and 6. Length, weight and condition factor data was tested for normality prior to applying statistical tests. Most data sets were non-normal and the non-parametric Kruskall-Wallis test was selected to compare age classes between the four streams. A significant Kruskall-Wallis test was followed by a nonparametric multiple comparisons test (Zar 1984). A Mann-Whitney test was done for the comparison of brook trout in Alder and Benewah Creeks. For westslope cutthroat trout Sample size was low for age 5 fish and were excluded from the statistical analyses. Sample size was also low for Alder Creek westslope cutthroat trout and ages 0+, 1+ and 4+ fish were excluded from the analysis. Length and weight of age 1+ westslope cutthroat trout from Lake Creek were significantly lower than in the other streams (p=0.001), (Table 5). The length, weight and condition factor of age 2+ brook trout in Benewah Creek were significantly lower than in Alder Creek, with P values of 0.003, <0.001 and 0.020 respectively (Table 6).

Table 5. Total lengths, weights and Fulton type condition factors (K_{TL}) for age classes of westslope cutthroat trout from Alder, Benewah, Evans and Lake creeks sampled by electrofishing summer 2004. Bold type denotes the variable statistically different from the other streams (nonparametric multiple comparisons), alpha = 0.05.

			Length (mm)		Weight (g)		K_{TL}	
Stream	Age	n	mean±1SD	Range	mean±1SD	Range	mean±1SD	Range
Alder	0	3	80±2	(77-81)	4.5±0.3	(4.3-4.9)	0.90±0.06	(0.83-0.94)
	1	4	94±20	(78-121)	8.5±6.1	(4.2-17.4)	0.92±0.04	(0.89-0.98)
	2	16	135±9	(115-158)	22.8±5.8	(16.1-40.3)	0.91±0.09	(0.80-1.07)
	3	11	164±13	(147-186)	41.3±11	(30.7-62)	0.92±0.08	(0.71-0.99)
	4	4	228±3	(223-231)	119.2±13.2	(100.2-130.3)	1.01±0.13	(0.81-1.10)
Benewah	0	77	64±10	(44-82)	2.8±1.2	(0.8-5.2)	0.97±0.15	(0.66-1.34)
	1	53	96±14	(76-120)	8.6±3.5	(3.0-15.2)	0.94±0.14	(0.61-1.30)
	2	82	125±12	(97-155)	18.4±5.7	(8.4-38.9)	0.91±0.09	(0.74-1.15)
	3	30	166±15	(138-197)	43.7±13.9	(24.7-74.4)	0.93±0.07	(0.77-1.09)
	4	3	202±8	(194-210)	80.8±11.8	(72.2-94.2)	0.98±0.05	(0.92-1.02)
	5	1	256	-	143.0	-	0.85	-
Evans	0	54	61±10	(40-80)	2.5±1.3	(0.5-5.1)	1.12±0.26	(0.63-1.57)
	1	66	98±13	(77-124)	9.8±3.5	(3.9-19.3)	0.95±0.12	(0.70-1.24)
	2	56	131±10	(106-151)	21.2±5.9	(10.9-39.3)	0.91±0.09	(0.71-1.14)
	3	29	171±16	(140-195)	49.2±15.4	(4.4-79.2)	0.94±0.10	(0.72-1.12)
	4	19	220±15	(202-250)	105.1±22.1	(80.3-154.8)	0.98±0.08	(0.84-1.11)
	5	5	271±13	(249-285)	195.3±33.4	(160.6-240.4)	0.99±0.15	(0.84-1.17)
Lake	0	158	62±11	(32-85)	2.6±1.3	(0.4-6.2)	1.0±0.19	(0.66-1.5)
	1	130	**91±11**	**(70-120)**	**7.4±2.6**	**(3.2-15.1)**	0.95±0.11	(0.64-1.18)
	2	75	127±15	(97-155)	19.6±6.8	(8.7-34.9)	0.91±0.09	(0.67-1.13)
	3	38	167±14	(140-195)	45.8±12.2	(22.4-74.2)	0.97±0.08	(0.77-1.14)
	4	2	212±4	(209-215)	86±8.5	(80.0-92.0)	0.90±0.03	(0.88-0.93)
	5	1	259	-	152.8	-	0.88	-

Trout Migration

Migrant traps were installed in Lake and Benewah creeks beginning with upstream, adult traps being deployed March 18th and 20th in Lake and Benewah creeks respectively (Table 7). Downstream, juvenile migrant traps were deployed March 25th and 29th in Lake and Benewah creeks respectively (Table 7). Although the traps were fishing 88%-90% of the trapping period, 2004 was an extremely challenging year for trapping adult and juvenile westslope cutthroat trout. The extremely low snowpack and lack of early spring precipitation produced a hydrograph with very little fluctuation, until early May when a large rain event increased discharge dramatically (Figure 13). The traps could not be fished during the May rain and high flow event from May 12-May 19. During the low flow period from late March through April only 55 and 4 juveniles were captured in Lake and Benewah Creeks respectively. Trap avoidance by juveniles was observed with many more fish seen than captured. The upstream adult migrant traps were fishing one week earlier than the juvenile traps (Table 7). As with past years more post-spawn adults were captured in the downstream traps than in the upstream traps (Table 7). Post-spawn adults and were observed avoiding the downstream traps. Mean length and weight of post-spawners in Lake Creek was higher compared to post-spawners in Benewah Creek (Table 8).

Table 6. Total lengths, weights and Fulton type condition factors (K_{TL}) for age classes of non-native brook trout from Alder and Benewah creeks sampled by electrofishing summer 2004.

			Length (mm)		Weight (g)		K_{TL}	
Stream	Age	n	mean±1SD	Range	mean±1SD	Range	mean±1SD	Range
Alder	0	59	69±9	(45-80)	3.5±1.3	(1.0-5.6)	0.99±0.15	(0.63-1.29)
	1	117	97±14	(76-130)	9.0±4.2	(3.5-27.2)	0.94±0.13	(0.69-1.33)
	2	129	127±15	(86-158)	19.9±6.6	(5.5-42.0)	0.93±0.10	(0.73-1.25)
	3	72	159±20	(116-205)	41.5±16.3	(14.6-86.1)	0.99±0.11	0.77-1.21)
	4	21	207±9	(194-224)	89.6±16.8	(62.4-122)	1.01±0.11	0.76-1.14)
	5	5	231±24	(211-272)	131.8±51.5	(86.3-220.6)	1.03±0.07	0.92-1.10)
Benewah	0	26	73±8	(54-84)	3.7±1.0	(1.7-5.4)	0.93±0.09	0.72-1.11)
	1	15	90±10	(77-106)	6.8±1.9	(4.6-10.7)	0.93±0.11	0.78-1.12)
	2	47	122±11	(98-145)	16.5±5.0	(8.0-26.5)	0.89±0.08	0.72-1.08)
	3	16	163±13	(142-191)	43.6±13.1	(26.8-74.3)	0.97±0.06	0.85-1.07)
	4	1	178	-	59.8	-	1.06	-
	5	1	258	-	204.5	-	1.19	-

Table 7. Dates of trap deployment, trapping effort and number of adfluvial westslope cutthroat trout captured in Benewah and Lake creeks, 2004.

System	**Trap Type**	**Installed**	**Removed**	**Days Fishing (% of total)**	**Days Not Fishing (% of total)**	**Adults captured**	**Juveniles captured**
Benewah	Upstream	3/20/03	5/26/03	67 (88%)	7 (12%)	7	0
	Downstream	3/29/03	6/18/03	81 (90%)	7 (10%)	10	4
Lake	Upstream	3/18/03	5/26/03	69 (88%)	7 (12%)	1	0
	Downstream	3/25/03	6/17/03	84 (90%)	7 (10%)	65	55

Table 8. Length, weight and condition factor of adult lacustrine-adfluvial westslope cutthroat trout captured in migration traps from Lake and Benewah Creeks in 2004.

			Total Length (mm)	Weight (g)	Condition Factor
Stream	Trap	n	Mean±SD	Mean±SD	Mean±SD
Lake	Upstream	0			
Lake	downstream	65	363±25	376.3±81.4	0.77±0.08
Benewah	Upstream	7	334±32	344.5±106.2	0.90±0.13
Benewah	downstream	10	343±36	331.2±105.4	0.82±0.13

Brook Trout Removal

Beginning in August 2004, non-native brook trout *(Salvelinus fontinalis)* were removed from the upper mainstem and 2nd order tributaries of Benewah Creek. Results from ten-year population estimate efforts revealed the highest brook trout densities were in the West and South Forks, Schoolhouse Creek and the upper mainstem above the confluence of Windfall Creek. The initial strategy in 2004 was to use a single-pass removal of brook trout with the goal to sample the entire longitudinal profile of the upper mainstem and tributaries mentioned above. The single pass method was used in lieu of multiple passes to reduce the stress on sympatric juvenile westslope cutthroat trout. All index sites associated with the population estimate sampling were sampled prior to brook trout removal. In 2004 attention was focused on the West and South Forks and only a small distance of the upper mainstem below the confluence of the West and South Forks was sampled. Both tributaries were entirely shocked for a combined distance of 3,687 meters. A total of 563 brook trout were removed with an additional 56 removed from the upper mainstem *(Table 9).* Five age classes of were removed (Table 9). The estimated total number of mature males and females removed was 95 and 81 respectively (Table 10).

The brook trout population in Alder Creek is the control to compare changes in density, production and potential changes in reproductive life history traits of brook trout following removal in Benewah Creek. A subsample of 151 brook trout from Benewah Creek, and 102 brook trout from Alder Creek were dissected in 2004 to analyze reproductive life history traits Preliminary data suggests a significant difference in reproductive life history traits exists between female brook trout in Alder Creek and Benewah Creek. The relationship between number of eggs and total length does not differ between Alder Creek and Benewah Creek females (*Figure 11*). However, the relationship between egg skein weight and total length is significantly different (*Figure 12*) with females from Alder Creek producing larger eggs.

Table 9. Removal of brook trout (Salvelinus fontinalis) from Benewah Creek in 2004.

	Length of Stream Shocked (m)			Number of Brook Trout Removed			% Age Composition[a]					
							Age					
Year	Tributaries	Mainstem	Total	Tributaries	Mainstem	Total	0	1	2	3	4	5
2004	3,687	213	3,900	563	56	619	30.9	12.4	42.8	10.2	3.4	0.3

[a] *Age was estimated using an age-at-length proportion key (Gulland and Rosenberg 1992) from scale analysis of 130 brook trout from Benewah Creek, from 1996-2003.*

Table 10. Reduction of brook trout (Salvelinus fontinalis) production associated with the removal of brook trout from Benewah Creek in 2004.

Year	Mature males Removed[a]	Mature females Removed[a]	Male to Female Ratio	Number of Eggs Removed[b]	Total Biomass Removed (kg)[c]	Potential Production Removed ($kg \cdot ha^{-1} \cdot yr^{-1}$) ± 95% CI[d]
2004	95	81	1.17	14,392	13.7	21.8 ± 0.57

[a] *Estimated from logistic regression of maturity at length relationship from n=92 females and n=71 males dissected in 2004.*
[b] *Estimated from the number of eggs to total length relationship(#of eggs= 3.80*Total Length-439.31) multiplied by the number of mature females in each 5 mm length interval.*
[c] *Includes all brook trout removed from tributaries and mainstem.*
[d] *Based on the mean density of age 0 fish removed, and the densities of the subsequent five age classes estimated from the mean annual mortality rates from six cohorts from 1996-2001.*

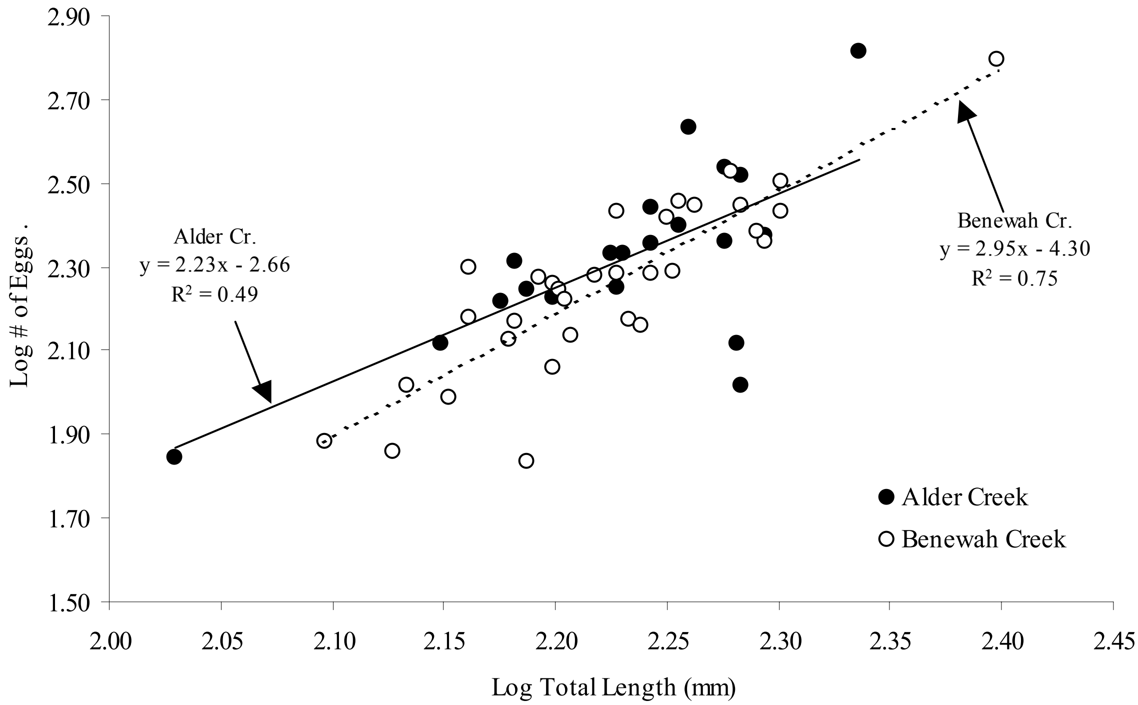

Figure 11. Comparison of log number of eggs and log total length relationship between Alder Creek and Benewah Creek from 2004. Elevations were significantly different (P 0.02<P<0.05), slopes were not significantly different (0.1<P<0.2).

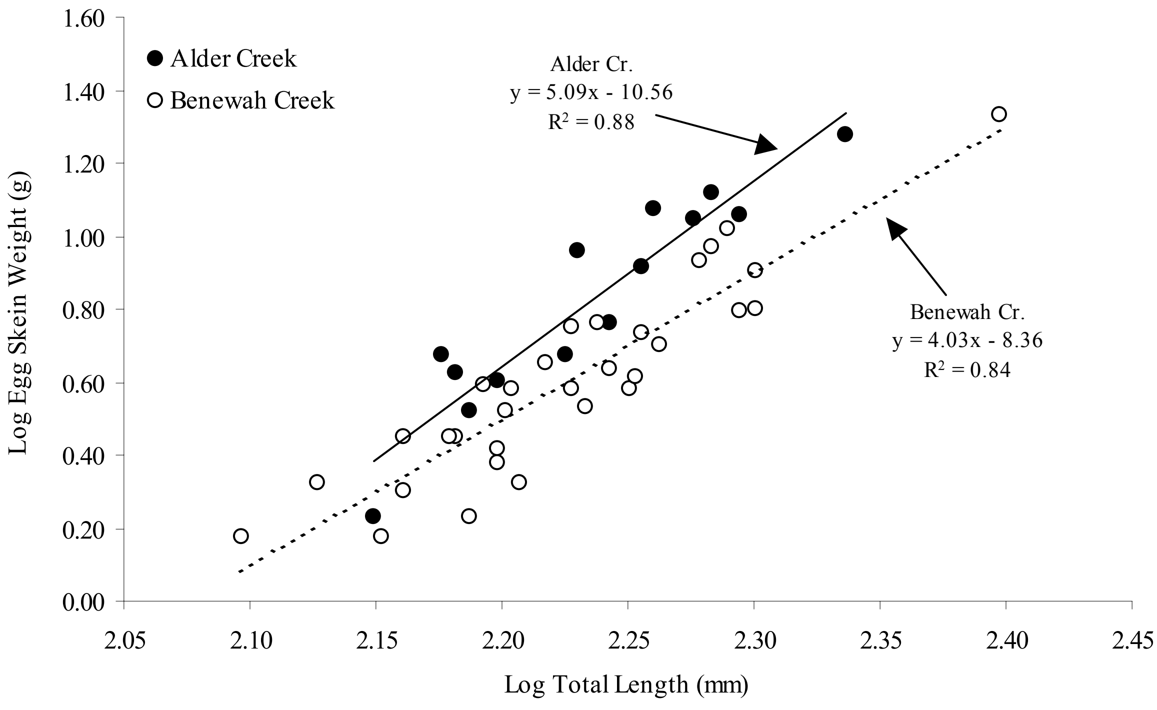

Figure 12. Comparison of log egg skein weight and log total length relationship between Alder Creek and Benewah Creek from 2004. Elevations and slopes were significantly different (0.01<P<0.02) and (P<0.001) respectively.

WATER QUALITY MONITORING

Stream Water Quality

Stream flow
A comparison of discharge measured in July 2004 in the four target watersheds with the 1997-2004 mean July discharge revealed 2004 as only 53 to 79 percent of the mean from 1997 through 2004. Little winter snow pack and limited rain between late March and early May produced a steady decline in discharge in both Lake and Benewah Creeks (Figure 13). The time periods between discharge measurements were characterized by no, or little precipitation, and thus little variation in flow.

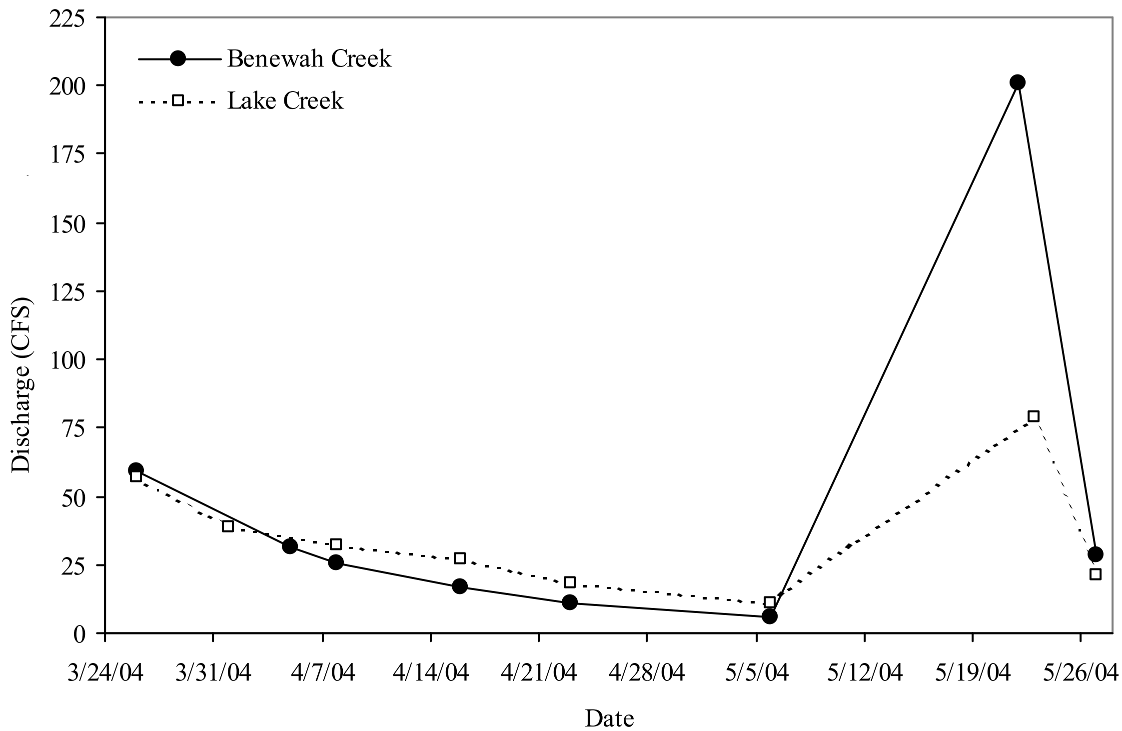

Figure 13. Dishcharge at the fish migration trap sites, during the trapping season in Lake and Benewah Creeks.

Temperature
The Coeur d'Alene Tribe water temperature standards were exceeded 17.4-27.4% of the time in fourth order, mainstem reaches of Alder, Lake and Benewah creeks (Table 11). The highest maximum temperature recorded was 26.3 ºC in Benewah Creek at the 3 Mile reach. Lower and upper Evans Creek mainstem reaches were within temperature standards the entire summer, with upper Evans Creek having the lowest maximum temperature of 14.5 ºC (Table 11).

Seston
The highest total suspended solids values of 17 and 12 mg/l were measured in to the mainstem Benewah Creek at 9 Mile on July 1st and Schoolhouse Creek on August 12th respectively. Neither of the above values were associated with high discharge events. The highest turbidity values of 12.5 and 8.0 NTUs were measured in Gore and Whitetail creeks respectively. The upper mainstem of Evans Creek consistently had the lowest TSS and turbidity compared to Alder, Lake and Benewah Creeks (Table 12).

Table 11. Exceedances of Tribal water temperature standards of days and percent time for selected subbasins in the target watersheds.

Watershed	Site	Stream Order	Hierarchy	Instantaneous maximum temp (°C)	Days and (%) in exceedance[1]
Alder	Alder	4	Mainstem	23.6	43 (22.6)
Alder	N. Fk. Alder	3	Tributary	20.5	39 (20.5)
Benewah	Benewah 3 Mile	4	Mainstem	26.3	51 (26.8)
Benewah	Benewah 9 Mile	4	Mainstem	24.9	45 (24.0)
Benewah	Upper Benewah	4	Mainstem	20.5	33 (17.4)
Benewah	School house Cr.	3	Tributary	18.0	0 (0.0)
Evans	Lower Evans	3	Mainstem	18.0	0 (0.0)
Evans	Upper Evans	3	Mainstem	14.5	0 (0.0)
Evans	N. Fk. Evans	2	Tributary	15.5	0 (0.0)
Lake	Lake	4	Mainstem	23.6	52 (27.4)
Lake	Bozard	3	Tributary	21.0	35 (18.4)

[1] Tribal Water Quality Standard: 7-day moving average of daily maximum temperature <18°C from July 1-January 31.

Table 12. Nutrient and seston variables sampled in Alder, Benewah, Evans and Lake creeks in 2004. All Variables expressed as (mean±1SD) mg/l, except turbidity which is expressed as Nephelometric units. Values in parentheses are sample numbers.

		Particulates				Nutrients			
System	Stream	Total Suspended Solids		Turbidity		Total Phosphorus		Total Kjeldahl Nitrogen	
Alder	Alder	2.0±0.0	(3)	2.1±0.2	(3)	0.023	(1)	0.147±0.040	(3)
Alder	N Fk Alder	2.3±0.6	(3)	4.3±0.3	(3)	0.030	(1)	0.180±0.062	(3)
Benewah	Benewah 3 Mile	2.3±0.6	(3)	1.5±0.6	(3)	0.017±0.01	(3)	0.130±0.046	(3)
Benewah	Benewah 9 Mile	6.0±4.6	(3)	2.5±0.6	(3)	0.026±0.001	(3)	0.123±0.025	(3)
Benewah	Bull	5.0	(2)	3.0	(2)	0.024	(2)		
Benewah	Gore Creek	3.0	(1)	12.5	(1)	0.072	(1)		
Benewah	School House Creek	9.0	(2)	3.8	(2)	0.042	(2)	0.183±0.060	(3)
Benewah	Upper Benewah	2.3±0.6	(3)	1.2±0.2	(3)	0.015±0.003	(3)	0.067±0.006	(3)
Benewah	W Fk Benewah	2.7±1.2	(3)	2.5±0.4	(3)	0.017±0.003	(3)	0.097±0.023	(3)
Benewah	Whitetail Creek	2.0	(2)	5.9	(2)	0.034	(2)	0.155	(2)
Benewah	Windfall Creek	2.3±0.6	(3)	3.9±1.0	(3)	0.035±0.004	(3)	0.137±0.051	(3)
Evans	Evans	2.3±0.6	(3)	0.8	(2)			0.057±0.012	(3)
Evans	N Fk Evans	3.3±2.3	(3)	2.0	(2)			0.057±0.012	(3)
Evans	Upper Evans	2.0±0.0	(3)	0.4	(2)			0.050±0009	(3)
Lake	Bozard	3.8±1.5	(4)	3.7±1.6	(3)			0.265±0.138	(4)
Lake	Lower Lake	2.3±0.5	(4)	2.4±0.3	(3)			0.443±0.109	(4)
Lake	Upper Lake	4.0±2.2	(4)	3.8±1.3	(3)			0.250±0.099	(4)

<u>Nutrients</u>

The highest total phosphorus values of 0.072 and 0.047 mg/l were measured in Schoolhouse and Gore Creeks, respectively. Both creeks are tributaries of Benewah Creek and had at least twice the concentration of total phosphorus compared to the mainstem Benewah Creek at 9 Mile (Table 12). Highest total Kjeldahl nitrogen values of 1.05 and 0.41 mg/l were measured in Lower Lake Creek and it's tributary Bozard Creek, respectively. In Comparison, the mainstem of Evans Creek had consistent total Kjeldahl nitrogen values of 0.05 mg/l.

Physical Habitat Monitoring

Twenty-one habitat sites were surveyed in 2004 from June through August. Only one site each was surveyed in the Evans and Alder Creek watersheds. The focus of monitoring, instead was on Benewah Creek and Lake Creek, where most of the majority of treatments have been implemented. There were 8 sites surveyed in the Benewah Creek watershed and 11 in the Lake Creek watershed including three in Bozard Creek and two in West Fork Lake Creek. Four sites were measured in 2004 that were not measured in 2003. Additionally, five sites measured in 2003 were not surveyed in 2004. Though there were not enough years of data to perform statistical analysis, the data was grouped together according to attribute to enable an initial qualitative comparison of the sites. All data will eventually be used to document the effectiveness of restoration measures implemented for the BPA project. The descriptions below, in tables 13, 14, and 15 provide an overview of the ranges of habitat indicator variables measured or calculated for initial treatment/control pairings from the 2004 data.

Table 13. Habitat indicator variables measured at treatment and control sites in the Benewah Creek watershed, 2004. Pairings are preliminary based on initial hierarchical stratification. T=treatment, C=Control.

	Site Comparison	***T***	***C***	***T***	***C***	***T***	***C***	***T***	***C***
		Benewah 12	Benewah 13	Benewah 14L	Benewah 9	Benewah 14U	Benewah 17	Benewah 16	Windfall 1
Morphology	Bankfull Width (m)	22.30	11.46	5.30	15.78	10.53	6.48	7.50	6.52
	Bankfull Wetted Perimeter (m)	22.92	12.43	6.07	16.36	11.55	7.48	8.81	7.01
	Bankfull Mean Depth (m)	0.59	0.67	0.49	0.65	0.82	0.64	0.67	0.39
	Cross Sectional Area (m^2)	14.16	7.63	2.53	10.22	8.40	4.41	4.93	2.80
	Length (m)	869.0	152.4	152.4	152.4	152.4	152.4	174.4	152.4
	Riffle w/d ratio	53.25	19.05	19.94	24.60	20.02	13.30	16.46	14.21
	Sinuosity	1.4	1.30	1.70	1.10	1.10	--	--	--
	Slope (%)	0.52	0.32	0.30	0.65	0.68	0.66	0.50	0.27
	Channel Type	C4	C4	C4	C4	C4	C4	C5	C5
Substrate	Channel Material (d50)	48.28	8.42	14.66	38.04	16.28	3.72	0.4	.14
Cover	Canopy Density (%)	0.50	21.00	35.00	6.75	21.75	35.50	34.8	59.0
Large Woody Debris	Total count	61	2	2	0.00	5	24	3	17
	Volume (m^3)	27.87	0.12	0.16	0.00	0.23	0.47	0.11	0.38
	Loading (m^3/100 m)	3.21	0.08	0.11	0.00	0.15	0.31	0.06	0.25
Residual Pools	Mean depth (m)	0.57	0.58	0.27	0.11	0.49	0.43	0.41	0.38
	min (m)	0.22	0.36	0.13	0.06	0.23	0.16	0.22	0.14
	max (m)	1.30	0.86	0.48	0.18	1.07	0.80	0.85	0.77
	number of pools	29	7	12	19	6	13	8	13

Table 14. Habitat indicator variables measured at treatment and control sites in the Lake Creek watershed, 2004. Pairings are preliminary based on initial hierarchical stratification. T=treatment, C=Control.

Site Comparison		T Lake 8	C Lake 7	T Lake 9U	C Lake 10	T Lake 12	C Bozard 2	T WF Lake 2	C Bozard 3	T Lake 11	C Bozard 1	C WF Lake 3
Morphology	Bankfull Width (m)	6.31	5.04	5.29	6.44	6.14	3.26	3.19	4.44	7.80	5.55	3.05
	Bankfull Wetted Perimeter (m)	7.45	5.47	6.73	8.27	8.23	4.69	4.03	4.97	8.58	6.86	3.69
	Bankfull Mean Depth (m)	0.74	0.38	0.95	1.18	0.71	0.76	0.42	0.32	0.36	0.81	0.40
	Cross Sectional Area (m^2)	4.93	2.07	4.84	7.79	4.22	2.44	1.43	1.37	2.95	4.59	1.34
	Length (m)	152.4	152.4	152.4	173.1	152.4	152.4	152.4	163.7	152.4	152.4	152.4
	Riffle w/d ratio	-	32.4	5.7	5.3	26.7	-	6.8	18.7	29.0	-	-
	Sinuosity	1.10	1.00	1.20	1.60	1.10	1.80	1.20	1.20	1.10	1.30	1.20
	Slope (%)	0.37	0.51	0.26	0.17	0.54	0.25	0.46	2.81	0.22	0.19	0.61
	Channel Type	E5	C4	E5	E5	C5	E5	E5	C4	C5	E5	C5
Substrate	Channel Material (d50)	0.62	17.91	1.14	.41	0.07	0.1	0.14	17.87	0.07	1.84	0.48
Cover	Canopy Density %	15.0	29.3	37.5	34.5	33.3	47.3	45.8	75.8	9.0	24.0	49.3
Large Woody Debris	Total count	15	3	23	17	7	15	18	10	22	31	10
	Volume (m^3)	3.05	0.05	0.71	1.97	0.26	0.42	0.41	0.24	8.16	3.43	0.98
	Loading (m^3/100 m)	2.00	0.03	0.47	1.14	0.17	0.28	0.27	0.14	5.35	2.25	0.64
Residual Pools	Mean depth (m)	0.39	0.29	0.47	0.66	0.48	0.50	0.35	0.15	0.33	0.43	0.30
	min (m)	0.22	0.12	0.20	0.23	0.17	0.19	0.16	0.07	0.13	0.14	0.14
	max (m)	0.55	0.53	0.83	1.19	0.99	0.95	1.04	0.33	0.63	1.09	0.62
	number of pools	6	8	8	12	21	12	20	16	17	12	19

Longitudinal Thalweg Profiles & residual pool depth

Four sites were measured in 2004 that were greater than152.4 m (500 ft) in length. These were Benewah 12, Benewah 16, Lake 10, and Bozard 3. Bozard 3 has the highest slope at 2.81%. Lake 10 the smallest slope at 0.17%. Only 3 sites had slopes greater than 1%: Evans 3, Bozard 3, and Alder 12. The average channel slope for Benewah Creek was 0.49% while the average channel slope for Lake Creek was 0.58%. Sinuosity ranged from 1.0 for Lake 7 to 1.8 for Bozard 2. Average sinuosity for 5 sites in Benewah Creek was 1.32. Average sinuosity for sites in Lake Creek was 1.25. There are currently three sampling sites on Bozard Creek. Sites 1 and 2 are impacted by beaver activity and have mean slopes of 0.25 and 0.19%. The beaver activity is easily identified by the large difference in elevation from the top of the dams to the pools below in relation to the rest of the profile (Figures 13 and 14). The third site has a slope of 2.8%, is bedrock controlled and has no beaver activity (Figure 15).

Table 15. Habitat indicator variables measured at treatment and control sites in the Evans and Alder creeks, 2004. Pairings are preliminary based on initial hierarchical stratification. T=treatment, C=Control.

Site Comparison		T	C
		Evans 3	Alder 12
Morphology	Bankfull Width (m)	15.94	8.28
	Bankfull Wetted Perimeter (m)	16.59	8.63
	Bankfull Mean Depth (m)	0.36	0.39
	Cross Sectional Area (m^2)	5.47	3.24
	Length (m)	152.4	152.4
	Riffle w/d ratio	40.96	22.87
	Sinuosity	1.10	1.20
	Slope (%)	1.10	1.34
	Channel Material (d50)	38.18	69.6
	Channel Type	C4	C3
Cover	Canopy Density %	15.0	29.3
Large Woody Debris	Total count	6	5
	Volume (m^3)	7.02	0.50
	Loading (m^3/100 m)	4.60	0.33
Residual Pools	Mean depth (m)	0.40	0.15
	min (m)	0.14	0.06
	max (m)	0.84	0.36
	number of pools	7	13

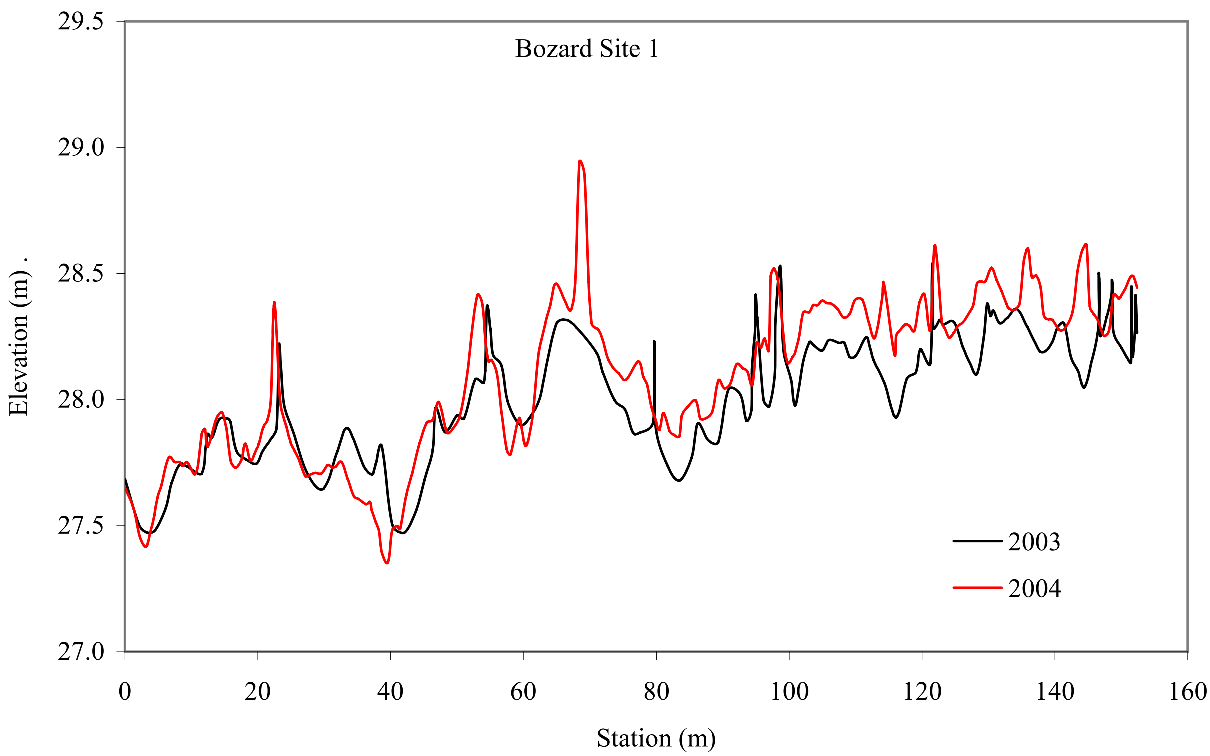

Figure 14. Longitudinal Profile of Bozard Creek Site 1 for 2003 and 2004.

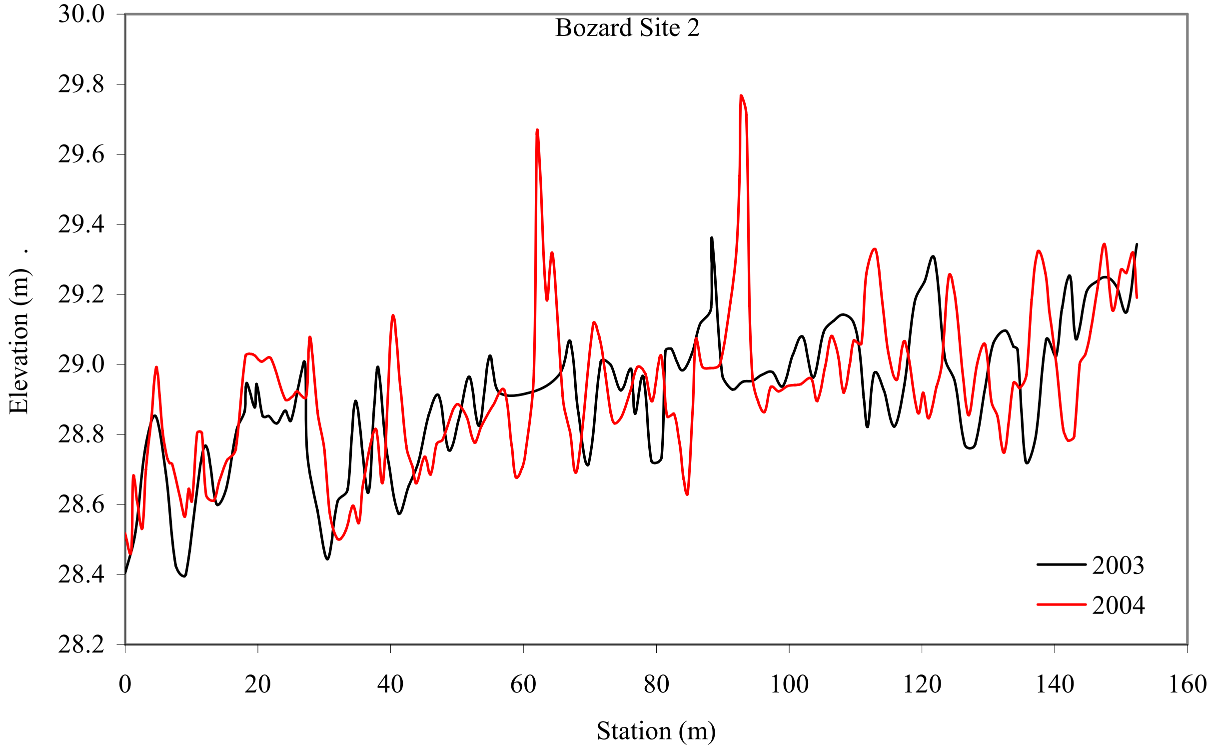

Figure 15. Longitudinal Profile of Bozard Creek Site 2 for 2003 and 2004.

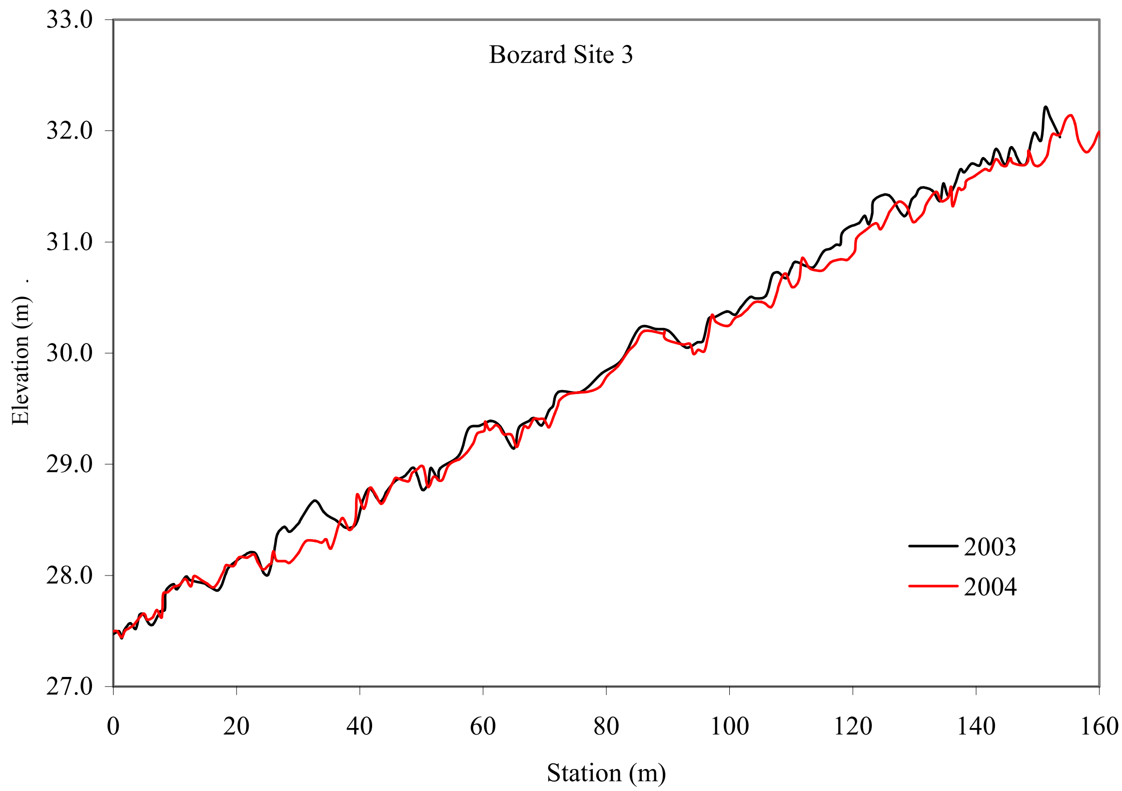

Figure 16. Longitudinal Profile of Bozard Creek Site 3 for 2003 and 2004.

Tables 13-15 show the average mean, min, max, and total number of pools within each sampling reach. Benewah 12 had a total of 29 pools over a length of 869 m. This is equivalent to 5 pools over 152.4 m making it the smallest pool density. Lake 12 had the most identified pools with 21. Lake 10 had the largest residual pool mean depth (0.66 m) while Benewah 9 had the lowest residual pool mean depth (0.11 m). Both Bozard 3 and Alder 12 had mean residual pool depth of 0.15 m. The site with the largest max residual pool was Benewah 12 (1.3 m). The maximum residual pool for Benewah 16 was 0.85, a pool that was a plunge pool at the downstream end of a culvert that was replaced later in 2004.

Table 16 shows changes in residual pool depth from 2003 to 2004 at select pools caused by beaver (Castor canadensis) dams from four sites in Lake Creek. An increase in the elevation of the top of a beaver dam from year-to-year indicates beaver activity. Six of the eleven beaver dams increased >0.20 meters, four were unchanged and one decreased in elevation between 2003 and 2004 (Table 16). Two beaver-formed pools in Bozard 2 changed in residual depth (measured manually from the top of the dam to the bottom of the pool on the longitudinal profile) by 0.47 and 0.60 meters. The three pools displayed for Lake 10 changed by less than 0.11 meter. The bed elevation increased above Bozard Creek site 1, evidence of significant sediment retention (Figure 14).

Cross Section Profiles

Six cross sections were surveyed at each of the monitoring sites. The area of the monitored cross sections was calculated based on the surveyed profile of bed and banks and the estimated bankfull elevation. Average bankfull widths for all cross sections ranged from 5.3 m to 22.3 m in mainstem Benewah Creek and from 5.04 m to 6.44 m for mainstem Lake Creek sites (excluding Lake 11 and 12). For 2004, WF Lake 3 had the smallest bankfull cross-sectional area (1.33 m^2) as well as the smallest bankfull width of 3.06 m. The average area for Lake Creek (including tributaries) was 3.5 m^2. Benewah Creek had an average cross-sectional area of 7.37 m^2.

Table 17 below displays dimensionless ratios developed for each cross-section based on habitat type and corresponding riffle characteristics. Bozard 1, Bozard 2, Lake 8, and WF Lake 3 had no riffle cross-sections. Benewah site 12 had the highest width/depth ratio of 53.25. The lowest width/depth ratio was 5.29 at Lake site 10. Pool Max Depth Ratios ranged from 2.0 for Lake 9U to 7.05 for Lake 7. Lake 10 also had the highest pool area ratio at 2.38.

Table 16. Comparison of residual pool depth produced by beaver (castor canadensis) dams and changes depth between 2003 and 2004 in mainstem Lake Creek and it's tributary Bozard Creek.

			Elevation (m)			
Site	Station (m)	Year	Top	Bottom	Difference (m)	Δ Depth (m)
Bozard Cr. 1	22	2003	28.21	27.47	0.74	0.29
		2004	28.39	27.36	1.03	
	52	2003	28.37	27.90	0.47	0.16
		2004	28.41	27.78	0.63	
	68	2003	28.32	27.87	0.45	0.61
		2004	28.94	27.88	1.06	
Bozard Cr. 2	62	2003	29.07	28.72	0.35	0.60
		2004	29.66	28.70	0.95	
	93	2003	29.36	28.93	0.43	0.47
		2004	29.77	28.86	0.90	
Lake Cr. 8	24	2003	28.48	27.94	0.54	0.01
		2004	28.58	28.03	0.55	
	70	2003	28.75	28.38	0.37	-0.30
		2004	28.46	28.39	0.07	
	109	2003	29.14	28.39	0.76	-0.46
		2004	28.68	28.39	0.30	
Lake Cr. 10	6	2003	28.52	27.62	0.90	0.03
		2004	28.71	27.79	0.92	
	78	2003	28.97	27.69	1.29	-0.09
		2004	28.87	27.68	1.19	
	125	2003	28.61	27.91	0.70	0.11
		2004	28.87	28.06	0.81	

Table 17. Dimensionless ratios for each site surveyed in 2004.

Site	Riffle Width/Depth Ratio	Riffle Max Depth Ratio	Pool Area Ratio	Pool Width Ratio	Pool Max Depth Ratio	Run Area Ratio	Run Width Ratio	Run Max Depth Ratio	Glide Area Ratio	Glide Width Ratio	Glide Max Depth Ratio
Alder 12	22.87	1.58	---	---	---	---	---	---	1.36	0.94	2.25
Benewah 9	24.60	1.55	---	---	---	0.91	0.90	1.83	0.73	0.88	1.37
Benewah 12	53.25	1.69	2.08	1.12	4.46	---	---	---	---	---	---
Benewah 13	19.05	2.07	1.96	1.18	3.01	1.63	1.06	2.44	2.05	2.01	2.07
Benewah 14 U	20.02	1.70	0.96	0.62	2.17	---	---	---	0.97	0.94	2.09
Benewah 14 L	19.94	2.23	1.99	0.72	3.28	1.08	0.73	2.40	---	---	---
Benewah 16	16.46	1.66	1.94	0.88	3.02	1.03	0.91	2.18	1.04	0.92	1.76
Benewah 17	13.30	1.63	1.65	1.02	2.46	---	---	---	---	---	---
Bozard 1	---	---	---	---	---	---	---	---	---	---	---
Bozard 2	---	---	---	---	---	---	---	---	---	---	---
Bozard 3	18.73	1.88	1.03	1.02	2.10	2.04	1.24	3.42	0.78	0.62	2.24
Evans 3	40.97	1.86	0.85	1.02	2.18	2.49	1.26	1.46	---	---	---
Lake 7	32.36	1.59	7.18	1.49	7.05	3.52	1.35	4.51	2.76	1.26	2.92
Lake 8	---	---	---	---	---	---	---	---	---	---	---
Lake 9U	5.70	1.52	1.66	1.24	2.00	---	---	---	1.19	1.15	1.44
Lake 10	5.29	1.34	2.38	1.70	2.03	---	---	---	1.26	0.83	2.05
Lake 11	28.95	1.63	1.16	0.78	2.90	0.81	0.57	2.12	---	---	---
Lake 12	26.72	2.99	1.31	0.58	4.21	0.98	0.50	4.39	---	---	---
WF Lake 2	6.76	1.73	---	---	---	1.71	1.39	2.50	0.63	0.85	1.38
WF Lake 3	---	---	---	---	---	---	---	---	---	---	---
Windfall 1	14.21	1.67	---	---	---	0.26	0.51	1.02	0.85	1.09	1.74

Stream Substrate (Pebble Counts)

Particle size distribution and substrate composition for 2004 survey sites are shown in table 5 and 6 for riffle and pool habitats. Benewah 9 was the only site that had bedrock present and this site also was the only site that had no pools present throughout the reach. Benewah 12 had the highest percentage of cobble in its riffle habitat at 58.7%. Lake 11 had 100% silt/clay in its pool habitat while Bozard 3 had no silt/clay in its pools. Tribal fisheries performance standards for fines, which are particles less than 4 mm, in riffle sections are <15%. Sites that exceeded this standard for riffle sections in 2004 were: Benewah 16, Benewah 17, Windfall 1, Lake 9U, Lake 10, and WF Lake 3. The highest d50 for pool habitats was 101.21mm for Alder 12. For the same site, the riffle d50 was only 58.14 mm. Benewah 12 had the highest d50, 71.7 mm, for riffle habitats. Composite d50 values, determined from composite pebble counts and shown in ranged from .14 mm to 48.28 mm for Benewah sites and from .07 mm to 17.91 mm for Lake Creek sites (Tables 13-15).

Table 18. Substrate composition for riffle habitats present in each cross-section.

Site	Percent by substrate type (%)						Size percent less than (mm)				
	silt/clay	sand	gravel	cobble	boulder	bedrock	D16	D35	D50	D84	D95
Alder, Site 12	0.00%	2.00%	51.00%	37.00%	10.00%	0.00%	16.00	29.95	58.14	207.23	317.89
Benewah, Site 9	0.00%	1.83%	45.87%	23.85%	0.92%	27.52%	6.87	35.83	49.40	102.07	125.18
Benewah, Site 13	0.00%	0.00%	94.34%	5.66%	0.00%	0.00%	7.26	11.03	16.00	49.48	66.60
Benewah, Site 14 U	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	10.32	23.05	26.53	40.63	53.67
Benewah, Site 14 L	0.00%	13.08%	86.92%	0.00%	0.00%	0.00%	2.72	6.23	8.64	16.92	27.94
Benewah, Site 12	0.00%	0.00%	41.23%	58.77%	0.00%	0.00%	32.24	55.70	71.70	113.03	143.17
Benewah, Site 16	11.76%	58.82%	29.41%	0.00%	0.00%	0.00%	0.07	0.16	0.30	5.27	12.66
Benewah, Site 17	4.95%	39.60%	52.48%	2.97%	0.00%	0.00%	0.53	1.28	2.42	25.40	50.31
Windfall, Site 1	20.00%	80.00%	0.00%	0.00%	0.00%	0.00%	NA	0.09	0.13	0.29	0.42
Evans, Site 3	0.00%	0.00%	62.62%	37.38%	0.00%	0.00%	10.57	28.77	41.56	96.30	126.95
Lake, Site 7	0.00%	10.26%	82.05%	7.69%	0.00%	0.00%	4.08	7.26	11.71	29.16	91.60
Lake 8	---	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Lake, Site 9U	9.62%	51.28%	39.10%	0.00%	0.00%	0.00%	0.10	0.34	1.43	4.32	6.18
Lake, Site 10	12.93%	78.45%	8.62%	0.00%	0.00%	0.00%	0.08	0.26	0.56	1.35	5.62
Lake, Site 11	---	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Lake, Site 12	---	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Bozard, Site 1	---	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Bozard, Site 2	---	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Bozard, Site 3	2.48%	12.40%	75.21%	9.92%	0.00%	0.00%	2.16	9.79	18.98	50.56	85.51
WF Lake, Site 2	---	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
WF Lake, Site 3	18.27%	60.58%	21.15%	0.00%	0.00%	0.00%	NA	0.26	0.41	2.56	5.76

Table 19. Substrate composition for pool habitats present in each cross-section.

Site	Percent by substrate type (%)						Size percent less than (mm)				
	silt/clay	sand	gravel	cobble	boulder	bedrock	D16	D35	D50	D84	D95
Alder, Site 12	0.00%	3.57%	37.50%	39.29%	19.64%	0.00%	15.92	47.44	101.21	281.30	588.13
Benewah, Site 9	---	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Benewah, Site 13	4.76%	44.76%	48.57%	1.90%	0.00%	0.00%	0.46	0.96	2.03	8.05	50.90
Benewah, Site 14 U	5.00%	15.00%	68.00%	12.00%	0.00%	0.00%	1.52	6.45	9.47	52.33	83.43
Benewah, Site 14 L	0.00%	7.02%	92.98%	0.00%	0.00%	0.00%	4.85	9.95	16.74	34.85	41.97
Benewah, Site 12	3.28%	3.28%	60.66%	28.69%	4.10%	0.00%	13.59	29.10	39.60	104.79	210.92
Benewah, Site 16	8.13%	63.41%	23.58%	4.88%	0.00%	0.00%	0.12	0.31	0.53	8.16	44.43
Benewah, Site 17	0.00%	25.21%	74.79%	0.00%	0.00%	0.00%	0.44	2.99	6.03	13.05	15.01
Windfall, Site 1	24.66%	49.78%	23.77%	1.79%	0.00%	0.00%	NA	0.09	0.19	5.44	31.64
Evans, Site 3	0.00%	5.21%	62.50%	32.29%	0.00%	0.00%	7.40	19.74	40.17	100.36	129.76
Lake, Site 7	0.00%	0.00%	81.48%	18.52%	0.00%	0.00%	6.42	13.18	33.39	74.70	134.72
Lake 8	23.76%	44.55%	29.70%	1.98%	0.00%	0.00%	NA	0.15	0.68	26.37	48.93
Lake, Site 9U	2.07%	57.93%	40.00%	0.00%	0.00%	0.00%	0.18	0.51	1.11	6.16	12.54
Lake, Site 10	19.80%	74.26%	5.94%	0.00%	0.00%	0.00%	NA	0.18	0.36	1.25	2.28
Lake, Site 11	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	NA	NA	NA	NA	NA
Lake, Site 12	50.00%	50.00%	0.00%	0.00%	0.00%	0.00%	NA	NA	0.06	0.10	0.12
Bozard, Site 1	14.66%	50.86%	34.48%	0.00%	0.00%	0.00%	0.07	0.18	0.55	5.12	7.85
Bozard, Site 2	55.56%	44.44%	0.00%	0.00%	0.00%	0.00%	NA	NA	NA	0.18	0.37
Bozard, Site 3	0.00%	23.58%	43.40%	33.02%	0.00%	0.00%	1.26	11.95	29.44	102.89	170.30
WF Lake, Site 2	28.24%	45.04%	12.98%	13.74%	0.00%	0.00%	NA	0.08	0.13	60.19	79.50
WF Lake, Site 3	8.74%	67.96%	23.30%	0.00%	0.00%	0.00%	0.17	0.35	0.62	2.63	3.98

Canopy Cover

Canopy density ranged from .5% for Benewah 12 to 75.8% for Bozard 3. The average canopy density for all treatment sites and control sites was 24.76% and 36.24% respectively. The average canopy density for sites in Benewah Creek was 26.78%. For all Lake Creek sites, this average is 36.4%.

Stream Typing

Rosgen channel types were estimated and found to be either C or E channel types. E channel types were found in both tributary and mainstem site in Lake Creek. C4 was the most common channel type for Benewah Creek. There are 9 sites classified as C4, 1 site as C3, 5 as C5, and 6 as E5.

Instream Organic Materials

Figure 19 shows the volume of large woody debris per 100 m for each site surveyed in 2004. Benewah 9 had no wood present. Lake 11 had the largest LWD loading with 5.35 m^3/100 m. Benewah 12 had a LWD loading of 3.21m^3/100 m, the third highest of all sitesFigure 6 shows the large woody debris loading in Lake and Benewah for mainstem and tributary sites. Treatment sites in tributaries of Lake Creek had the highest LWD loading with 2.81 m^3/100 m. Lake Creek mainstem treatment sites average 1.23 m^3/100 m. Benewah Creek mainstem treatment and control LWD loading were 0.88 m^3/100 m and 0.128 m^3/100 m respectively.
The site with the largest number of pieces of LWD per 100 m was Benewah 17 followed by Lake 9U.

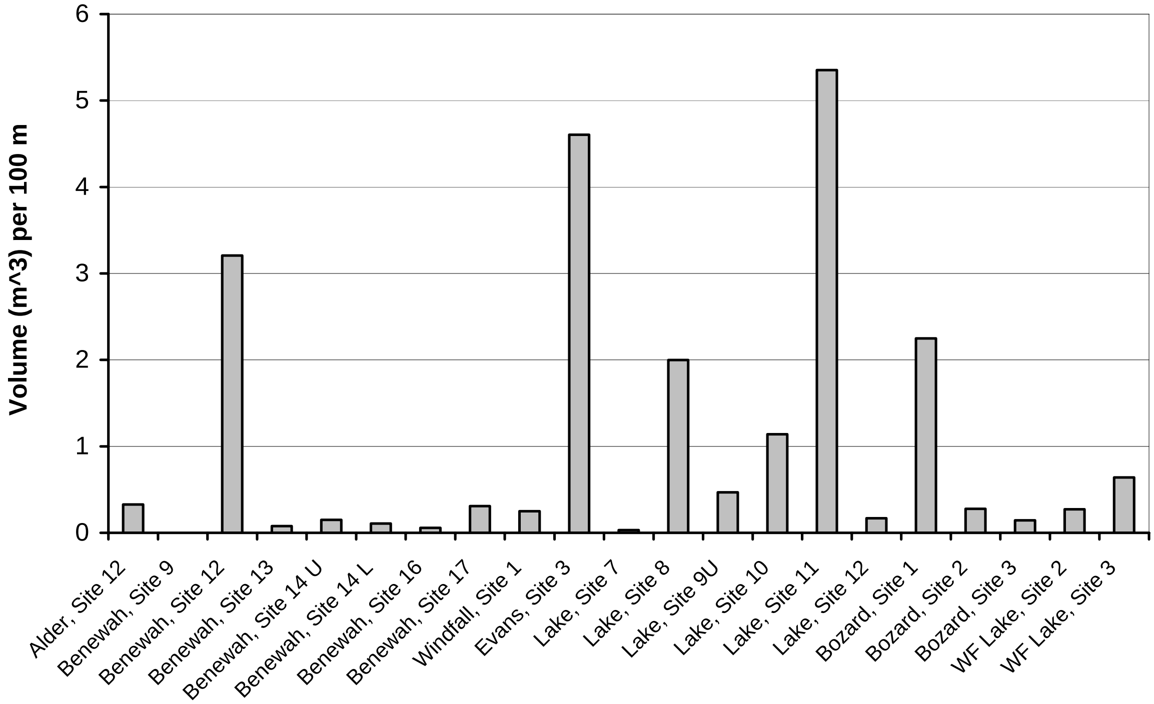

Figure 17. Large woody debris volume/100m for all sites surveyed in 2004.

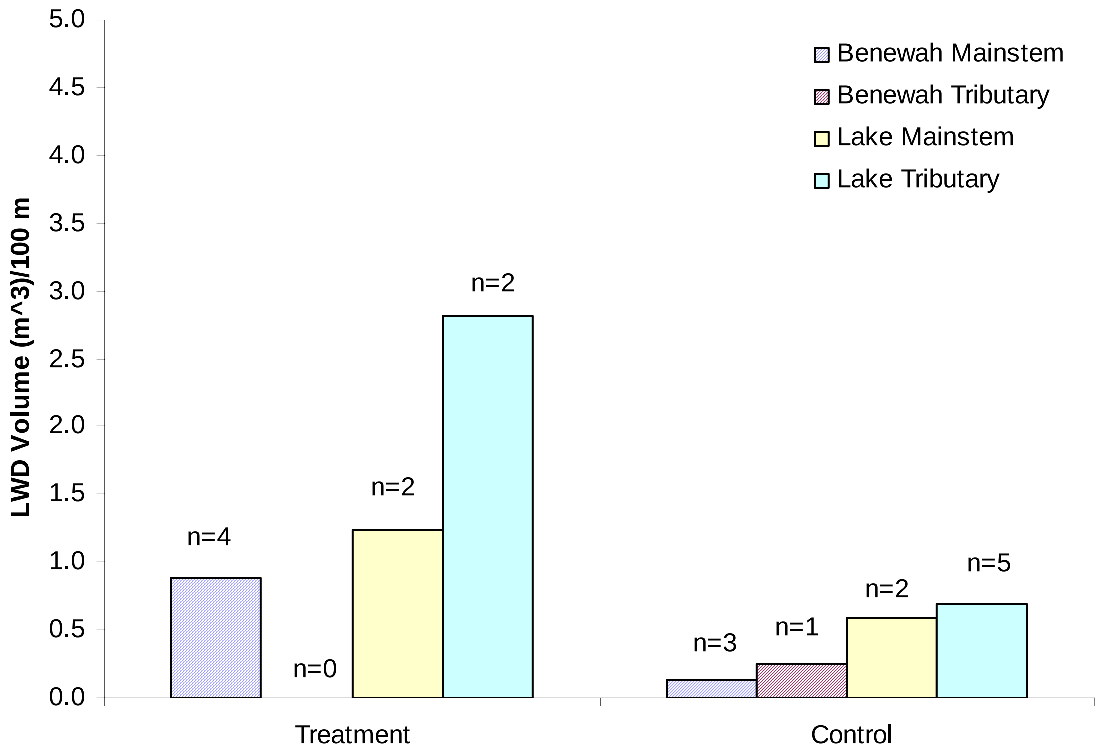

Figure 18. Average large wood volume per 100 meters for sites in Lake Creek and Benewah Creek Watersheds comparing treatment and control groups.

DISCUSSION

Population and Production

The nine-year population data set for westslope cutthroat trout indicates an increasing trend in Lake and Benewah creeks and a smaller increase in Evans Creek. The population of westslope cutthroat trout in Alder Creek is relatively unchanged and remains at a low level. The populations of non-native brook trout continue on an increasing trajectory in both Alder and Benewah creeks. We would expect the increasing population trends of westslope cutthroat trout in Lake and Benewah Creeks because of two primary factors. The first factor is that a harvest moratorium has been in place since 1993. The second factor is that most of the habitat restoration efforts have been focused in the Lake Creek and Benewah Creek watersheds. The trends for cutthroat provide evidence that management strategies are having a positive affect on the populations.

Although there is evidence of increasing population trends, production of westslope cutthroat trout in all four target streams remains in the lower range reported in the literature and much lower than the 100-300 (kg/hectare) proposed by Waters (1992) for salmonids in more productive stream systems. Past production studies have not included salmonids with, lacustrine-adfluvial life histories, but focused on production of resident life histories, in mostly headwater-type systems (Scarnecchia and Bergerson 1987; Waters 1992; Clarke and Scruton 1999). Mean annual production in 2nd order tributaries is generally 2-7 times greater than in 3rd

and 4th order mainstems of Lake, Benewah and Alder creeks, while production is more evenly distributed in Evans Creek.

The increasing population trends for non-native brook trout in Alder and Benewah creeks are not favorable because of the negative affects brook trout have on westslope cutthroat trout populations (Griffith 1988, Adams et al. 2001, Peterson and Fausch 2003). Brook trout negatively impact westslope cutthroat trout, displacing westslope cutthroat trout when they overlap (Griffith 1988, Adams et al. 2001, Peterson and Fausch 2003). Alder Creek provides an example of a system where the native cutthroat trout population is being affected by non-native brook trout. The brook trout population in Alder Creek is much larger than the suppressed cutthroat trout population. The large population and complete overlapping distribution of brook trout and cutthroat trout throughout Alder Creek indicate that brook trout have become well established and will continue to impact cutthroat trout. The growth rate of westslope cutthroat trout in Alder Creek is significantly different from the other three target streams, further evidence of the effects from brook trout.

We started a brook trout removal program in 2004 coupled with production and life history monitoring to evaluate the efficiency of the removal method used. Alder Creek sustains a large population of brook trout and serves as the non-exploited control to compare production and life history response to rigorous brook trout removal in Benewah Creek. The smaller population and lower density of brook trout in relation to cutthroat trout in the Benewah Creek system indicates that brook trout are still invading the Benewah Creek system. The distribution of brook trout in the upper watershed and upper lateral tributaries is consistent with the rapid upstream invasion behavior described by Peterson and Fausch (2003) and indicates that without intervention, brook trout in Benewah Creek may eventually become dominant as in Alder Creek. Hence, it was important to begin brook trout control in the Benewah Creek system to reduce the overlap and decrease the competition and predation on westslope cutthroat trout.

An aggressive brook trout control strategy was initiated in the late summer of 2004 in Benewah Creek. The upper mainstem and entire segments of West Fork, Southeast Fork and Schoolhouse Creek were electroshocked and all brook trout captured were removed. In addition to the 619 brook trout removed from August 16 to September 2, we verified that no fish captured during that period had spawned. Thus, in relation to removal timing, we are sampling the adults at the best time for maximizing the removal of production. In 2005 we will remove brook trout from the same segments as in 2004, but will electroshock the entire mainstem from the confluence of Windfall Creek to the South and West forks. This adds an additional 1,800 meters of mainstem for a total of over 5.5 km of continuous stream sampled for brook trout removal.

The effects of brook trout removal on the westslope cutthroat and brook trout populations will be measured using the summer population estimates, number of trapped adfluvial outmigrating westslope cutthroat trout juveniles and juveniles per spawner for the adfluvial life history. This will allow tracking of the effectiveness of the removal strategy and allow for modification of methods or adjustment of effort spent on brook trout removal in the future. We predict it will take several years to remove a large enough fraction of the brook trout population to reduce the negative impacts on cutthroat trout. However, after the brook trout population has been reduced, likely less effort will be needed to maintain the population at acceptable levels. The Alder Creek brook trout population will be used as a control to compare the effectiveness of the brook trout removal strategy.

Habitat

Temperature in 3rd and 4th order segments of Alder, Benewah and Lake creeks exceeds the tribal water quality standard, which is a 7-day moving average of daily maximum temperature <18°C. Alder, Benewah and Lake Creeks all had a maximum instantaneous water temperatures that exceeded 23°C. In contracts, the upper instantaneous water temperature in lower Evans Creek mainstem reached 18.0°C only once during the summer of 2004. The low flow conditions and lack of hyporheic water exchange likely had a major role in producing the high stream temperatures.

Elevated stream temperatures are an important physical effect resulting from land-use practices, with consequences for aquatic ecosystems. Human alterations to the landscape of the target watersheds have indirectly harmed the aquatic environment through alteration of stream thermal regimes through several mechanisms. Streamside riparian canopy closure has been reduced in each of the target watersheds and the older age riparian stands that have a moderating affect on stream temperature, provide large organic debris, and affect nutrient input and cycling (Beschta et al. 1987; Murphy and Meehan 1991) have been particularly affected. The extent of riparian harvest ranges from less than 13% in Evans Creek, between 13%-33% for Alder and Lake creeks, and greater than 33% in Benewah Creek.

In addition to riparian canopy cover, channel incision affects approximately 2.4 km and 8 km of mainstem habitats in Lake and Benewah creeks, respectively. Channel incision can effectively reduce the potential for hyporheic groundwater connectivity and exchange with the stream channel (Brunke and Gonser 1997). Increased hyporheic groundwater connectivity can produce thermal heterogeneity and cold-water refugia. Researchers have identified cold-water patch frequency and area as explanatory variables associated with increased salmonid densities (Torgersen et al 1999; Ebersole et al 2001 and 2003) and reductions in total energy expenditures (Berman and Quinn 1991). We believe reconnection of incised segments of the 3rd and 4th order mainstem reaches with the floodplain will increase hyporheic dynamics, reduce summer water temperature, and increase thermal heterogeneity in both summer and winter seasons. Restoring these conditions at the reach scale will increase westslope cutthroat trout production through use of mainstem habitats for rearing. Beginning in 2005, we will increase the number of continuous temperature loggers in the target watersheds along the longitudinal gradient to better understand temperature dynamics and assist with restoration priorities. In addition, in 2005 we will begin measuring thermal heterogeneity in the form of riffle/pool temperature differences in treated and control reaches in Benewah Creek.

Within the four target watersheds lack of large woody debris, both within the stream channel and the adjacent floodplain, has been identified as a contributor to poor habitat quantity and quality in low-order streams (Vitale et al. 2004). Researchers have attributed wood volume and/or frequency as influential in processes operating at the channel reach, valley bottom, and landscape scales. Buffington (1998) theorized that wood roughness can lead to the deposition of spawning gravels in steep drainages that otherwise would be inhospitable to salmonids because of high sheer stresses. Many studies indicate that most pools in moderate-gradient, cobble- and gravel-bed forest streams are either formed by or strongly influenced by wood (Andrus et al. 1988; Robison and Beschta 1990; Abbe and Montgomery 1996).

In the four target watersheds large woody debris (LWD) frequency and volume varied considerably among sites, and results of our habitat surveys were consistently indicative of stream reaches with altered or modified riparian plant communities. The treated sites where wood had been placed in the channel, including Lake 11 and Benewah 12, had more wood then sites where wood was not artificially added. The paucity of large woody debris is apparent in the sites surveyed in Benewah and Lake creeks. Large wood additions will continue to be a priority restoration technique used, especially in Lake and Benewah creeks.

In addition to LWD, the habitat created by beaver dams is important for rearing (Pollock et al. 2004) and overwinter habitat (Lindstrom and Hubert 2004). Beaver activity maintains habitat complexity by producing pools, and modifying stream hydrology and temperature through aquifer recharge (review by Pollock et al. 2003). The two-year comparison of beaver dams and channel morphology in reaches of Lake Creek shows that beavers are actively maintaining dams. In the future repeat measures of the reaches with beaver activity will provide estimates of the effects of beavers on stream morphology. Beaver activity is greatest in Lake and Benewah Creeks, but beaver density is likely well below historical levels. The composition, density and spatial distribution of riparian plant communities is also likely to be insufficient to support much higher densities of beaver than currently exist. Restoration of diverse, native riparian plant communities remains a high priority in the target watersheds, however trajectories for recovery are still decades away from supporting the full suite of wildlife species likely to use these areas.

Measuring Population Responses to Restoration

We predict increases in westslope cutthroat trout production, productivity and distribution in watersheds with habitat restoration. Production and productivity gains for lacustrine-adfluvial westslope cutthroat trout will be realized as juvenile rearing distribution expands into more suitable mainstem habitats and density increases in tributary habitats. Productivity increases will be estimated as juveniles per spawner, and in-stream production/biomass (P:B) ratio. Beginning in 2004, we added production and production:biomass ratio as additional metrics to analyze the biological response to management actions. We argue that production of lacustrine-adfluvial westslope cutthroat trout in Lake, Benewah and Evans Creeks should be 2-4 times higher than current, limited production, and production to biomass ratios (P:B ratios) should approach 2.0, similar to anadromous steelhead trout life histories. Anadromous salmonids have high P:B ratios in streams, the product of higher densities (from highly fecund spawners) and rapid annual turnover rates of emigrating age 0-1 salmon and age 1-3 steelhead smolts (Chapman 1968; Alexander and MacCrimmon 1974). The lacustrine-adfluvial life history includes trophic and reproductive migrations between tributary and lake environments (Northcote 1997), and by nature should exhibit higher production and productivity (P:B ratios) compared to the resident life history. The lacustrine-adfluvial life history is at least 50% larger at maturity and more fecund than the resident forms at the same age. In addition, production of westslope cutthroat trout juveniles (age 0-3) in natal streams is likely higher than in systems where westslope cutthroat trout compete with sympatric anadromous juveniles (e.g. coastal cutthroat trout or upper Snake River Basin habitats). Use of the anadromous life history as an analog to measure the production potential of lacustrine-adfluvial westslope cutthroat trout is realistic because they exhibit similar life history attributes to anadromous salmonids.

To accurately measure the response of westslope cutthroat trout from restoration and management actions it will be necessary to separate resident and adfluvial production in Benewah and Lake Creeks. This project has concentrated on estimating the population in late summer that includes juveniles with resident and adfluvial life histories in Benewah and Lake Creeks. The instream biotic and physical factors that have a greater influence on resident adults are likely fluctuating on different time and spatial scales compared to the lake food web dynamics and predation pressures that affect the adfluvial life histories.

The estimate of outmigrant juveniles per female spawner (smolts/spawner) is an important metric of the productivity and habitat capacity of tributaries. The trapping program has not been effective at capturing spawners as they migrate up Benewah and Lake Creeks. The past trap design did not allow the trap to be fished during high flows. Late winter rain–on-snow events produce higher flows and at this time trapping efficiency of spawners migrating into Benewah and Lake creeks is low, and at times the traps cannot be deployed. It is suspected that the spawners are actively migrating during high flows when the traps are not efficient or not deployed. This is evidenced by the fact that many more post-spawn fish are captured in downstream traps later in the season during low flows compared to upstream migrants caught earlier in the season during the higher flows. To improve the estimate of adult spawners, in 2005 flood–tolerant resistance-board weir traps (Tobin 1994, Stewart 2002) will be used to capture spawners migrating upstream. The resistance-board weir traps are designed to handle high flows and debris loading much better than the conventional, vertical weir design currently used. We will modify the juvenile outmigrant trap by incorporating "popout" panels that can be removed during high flows and loading events. The popout panels can be reinstalled as flows allow. The popout panel design reduces the potential for trap failure. These modifications to our trapping program will increase trapping efficiency providing better estimates of the adfluvial life history production and tributary productivity.

The monitoring and research program has mostly focused on in-stream westslope cutthroat trout production through population estimates. However, survival, growth and life history attributes of adfluvial cutthroat trout in Coeurd'Alene Lake have not been adequately studied. Results from fishery studies on Coeur d'Alene Lake reveal that non-native piscivorous species, especially northern pike prey on adfluvial westslope cutthroat trout (Rich 1992, Anders 2003). The in-lake survival of adfluvial westslope cutthroat trout is a critical knowledge gap that affects management decisions for recovery of the trout in the Coeur d'Alene system. Predators in Coeur d'Alene Lake may have a large impact on the adfluvial component and may be limiting production. As stated above, the use of resistance-board weir traps will increase trap efficiency and provide a better estimate of the number of returning spawners. To fill the survival estimate knowledge gap, a within lake survival study using PIT tag technology is being developed and will begin in 2005. The use of more efficient traps and PIT tag detection systems will dramatically increase the knowledge base of the adfluvial component of westslope cutthroat trout in Benewah and Lake creeks.

SECTION 2: RESTORATION AND ENHANCEMENT ACTIVITIES

OVERVIEW

Similar to the past several years, the focal point of restoration/enhancement activities during this contract period (June 2004-May 2005) was the property in the Benewah Creek watershed that was secured through the Albeni Falls Wildlife Mitigation Project (BPA project #9206100) in 2001. This purchase represented a significant development in the evolution of this project in several regards. First, the property is both large, encompassing 420 acres of critical habitat with nearly 3 miles of stream, and strategically located with regard to the production and enhancement opportunities for westslope cutthroat trout in the watershed. Two of the principle spawning tributaries, Windfall and Whitetail creeks, flow directly onto the property and its location effectively links several established enhancement sites with the most productive tributary reaches. Secondly, this property was identified as the highest priority for enhancement based on the limiting factor analysis presented in the Habitat Protection Plan, which was developed as a guidance document for this project (Vitale et al. 2002B).

An initial assessment of geomorphic and hydraulic processes on this property was conducted in 2002 and led to the development of several long-term restoration prescriptions for the property (Inter-Fluve, Inc. 2002). The goal of these prescriptions is to restore connectedness of stream habitats, improve stream channel stability, habitat complexity and stream/groundwater interaction through habitat restoration and enhancement. The strategies focus on addressing the factors limiting fish production, including: riparian function, stream channel stability, instream habitat complexity, and summer water temperature. We hypothesize that improving trends for key habitat indicators will increase production potential for early and juvenile rearing life stages of westslope cutthroat trout.

Additional design work was completed in 2004 to provide a 30% level of design appropriate for fit in the field construction for the lower 8,200 feet of stream channel (Inter-Fluve, Inc. 2005). The design outlines the methods and materials needed to fill the existing incised channel with imported gravel so the creek will flood the valley bottom on a more frequent basis, and keep the valley bottom wetter for longer periods. A design report summarizes analysis techniques and conclusions that support the design and provides drawings to depict the proposed channel alignment and profile, and describe construction materials, methods and cost estimates (Inter-Fluve 2005).

In 2004, the second year of implementing restoration prescriptions identified during the planning process, restoration and enhancement work was continued for riparian planting, side-channel habitat construction, and floodplain/terrace wood additions, as well as improvement of fish passage at Windfall Creek (*Table 20*). These implementation tasks are described in more detail in the summaries provided below.

Table 20. Summary of restoration/enhancement activities completed in 2004 for BPA Project #199004400.

Projects			Activity By Year			
Project ID	**Location**	**Treatments (Metrics)**	**2001**	**2002**	**2003**	**2004**
B_8.9	T45N, 4W, S13 & S24; T45N, 3W, S18	Riparian planting (46.3 hectares)	Property purchased through the Albeni Falls Mitigation Project.	Planted 8,957 trees (12 ha)	Planted 13,611 conifers and 2,013 deciduous trees (23 ha)	Planted 8,500 conifers, 3,650 deciduous trees, and 4,800 herbaceous plugs (11.3 ha)
B_10.2 B_10.4 B_10.7 B_11.6	T45N, R4W, S13 SE ¼	Side channel construction (770 meters)		Preliminary assessment and restoration prescriptions completed	Finalized design; NEPA completed; constructed 495m of side channel habitat; placed ~4MBF of LWD	Constructed 275m of side channel habitat; placed ~4MBF of LWD
B_11.0 B_11.3	T45N, R4W, S13 SE ¼	Floodplain stabilization (9.3 hectares)		Preliminary assessment and restoration prescriptions completed	Designs finalized; NEPA completed; placed and anchored ~50MBF LWD	Placed and anchored ~ 18 MBF of LWD
B_11.5	T45N, R4W, S24, NW ¼ NE ¼	Replaced passage barrier (opened 4,344 m of habitat); Channel construction (200 meters)		Preliminary assessment and restoration prescriptions completed	Finalized design; pre-treatment survey completed	NEPA completed; replaced culvert; constructed 200m of channel below culvert; placed ~12 MBF of instream LWD

SUMMARY OF RESTORATION PROJECTS

Project B_8.9: Riparian/Planting

Project Location:

Watershed: Benewah Sub Basin (River Mile): RM 8.9-11.9.	Legal: T45N, R4W, S24, NW¼ T45N, R4W, S13, SE¼ T45N, R3W, S18, N½

Site Characteristics:

Slope/gradient: <1%	Aspect: N	Elevations: 2,650-2,760
Valley/Channel type: B2/C4	Proximity to water: Floodplain	

Other: Project has treated 3,689 linear meters of stream channel and 46.3 hectares of associated floodplain from 2002 to 2005.

Problem Description: The Benewah valley has a history of anthropogenic disturbance by logging and agricultural activities that date to the early twentieth century. Logging removed many of the coniferous trees in the valley bottom between 1915-1930. Splash dams and flumes were developed in the creek to facilitate the movement of harvested logs to down valley mill sites. The combination of direct land clearing adjacent to the creek and the construction and operation of splash dams had a direct affect on channel form and function with negative implications for the productivity of habitats for juvenile rearing. In the most recent past, dating from approximately the 1940's through 2000, the property was managed for grazing and/or hay production, which has precluded the regeneration and establishment of a diverse native riparian plant community along much of the 3.2 miles of streams associated with this property.

Current riparian function is degraded as evidenced by low stream canopy closure, little overhanging vegetation, and low volumes of LWD. The wood that is present in the channel is mostly comprised of small pieces that generally do not function to shape channel morphology or maintain habitat diversity. Also, the existing riparian community offers little potential for providing recruitment of large wood in the future. Currently, discharges greater than the 5-year return interval flood begin to exit the existing channel in a non-uniform manner. As a result several avulsion channels have developed in portions of the floodplain as a direct result of low roughness and lack of root mass in floodplain soils. Active avulsions have the potential to cut-off remaining channel length and lead to abandonment of relatively high quality habitat.

This stream reach is located in a portion of the watershed that historically provided important summer rearing habitat for westslope cutthroat. Mainstem reaches of the property were likely utilized as over-winter habitat as well.

Description of Treatment: Riparian plantings have been undertaken to re-establish forest plant communities adjacent to the stream channel and provide long-term roughness across the valley bottom. Restoring a forested valley bottom will improve structural habitat conditions in the coming decades and is fundamental to the long-term restoration and enhancement of this site. An estimated 387 acres will be planted over the next several years as monies for implementation are secured.

A total of 8,957 deciduous and coniferous plants were installed in 2002, treating an area of approximately 12 hectares and a little more than 610 linear meters of stream channel. An additional

13,611 conifers and 2,013 deciduous trees and shrubs were planted in 2003 treating approximately 23 hectares and a little more than 1,200 linear meters of stream channel. Approximately 8,500 conifers, 3,650 deciduous trees, and 4,800 herbaceous plugs were planted in fall 2004 and spring 2005, treating 11.3 ha and 1,879 linear meters of stream channel (*Figure 19*). Portions of the 2004/2005 plantings were associated with side channel construction and the culvert replacement at Windfall Creek. Plantings have consisted of Engelmann spruce, western red cedar, western white pine, ponderosa pine, western larch, lodgepole pine, red-osier dogwood, alder, water birch, black cottonwood and willow (*sp*.), as well as 10 herbaceous species (*Juncus sp., Carex sp., Scirpus sp*.). Plant materials have generally been small tublings, containerized plants and live cuttings.

Project Timeline: Preliminary restoration prescriptions were developed for this project site following completion of a detailed stream channel assessment in October 2002. The prescriptions were outlined in a report entitled, Benewah Creek Assessment and Restoration Prescriptions (Inter-Fluve, Inc. 2002).

Plantings were completed in both spring and fall seasons between 2002 and 2005. Periodic inspections have been completed at several of the planting sites on the property. Conifer survival was estimated on October 6, 2003 in the Windfall Creek unit, at which time the overall survival was determined to be only 45 – 55%. Delays in planting and prolonged drought throughout the summer are thought to have been the primary cause for mortality. Survival estimates were also conducted in spring 2005 at the three units planted in 2003 and spring 2004 (*Figure 19*). Survival at these sites ranged from 75.9 - 86.5%. Detailed physical habitat surveys were also completed at three index sites on the property in 2002, 2003 and 2004 to look at instream LWD volumes and canopy density among other indicators. Ongoing annual monitoring is planned to identify areas to retreat in the event that project objectives cannot be met as a result of cumulative mortality and/or other factors.

Project Goals & Objectives: Goals for this project include 1) increase stream shading; 2) provide a long-term source of large woody debris for natural recruitment; 3) promote streambank and floodplain stabilization; 4) increase riparian species diversity and cover; and 5) enhance stream buffer capacity. Provide for significant increases in canopy density and overhanging vegetation over the next 20 years. Target canopy closure is 92%.

Relationship to Scope of Work: This project fulfills the Program commitments for implementation Objective 1, task 1a, sub-task 1.a.i in the FY 2005 Scope of Work and Budget Request (Inter-Governmental Contract #10885) for the contract period June 2004 - May 2005.

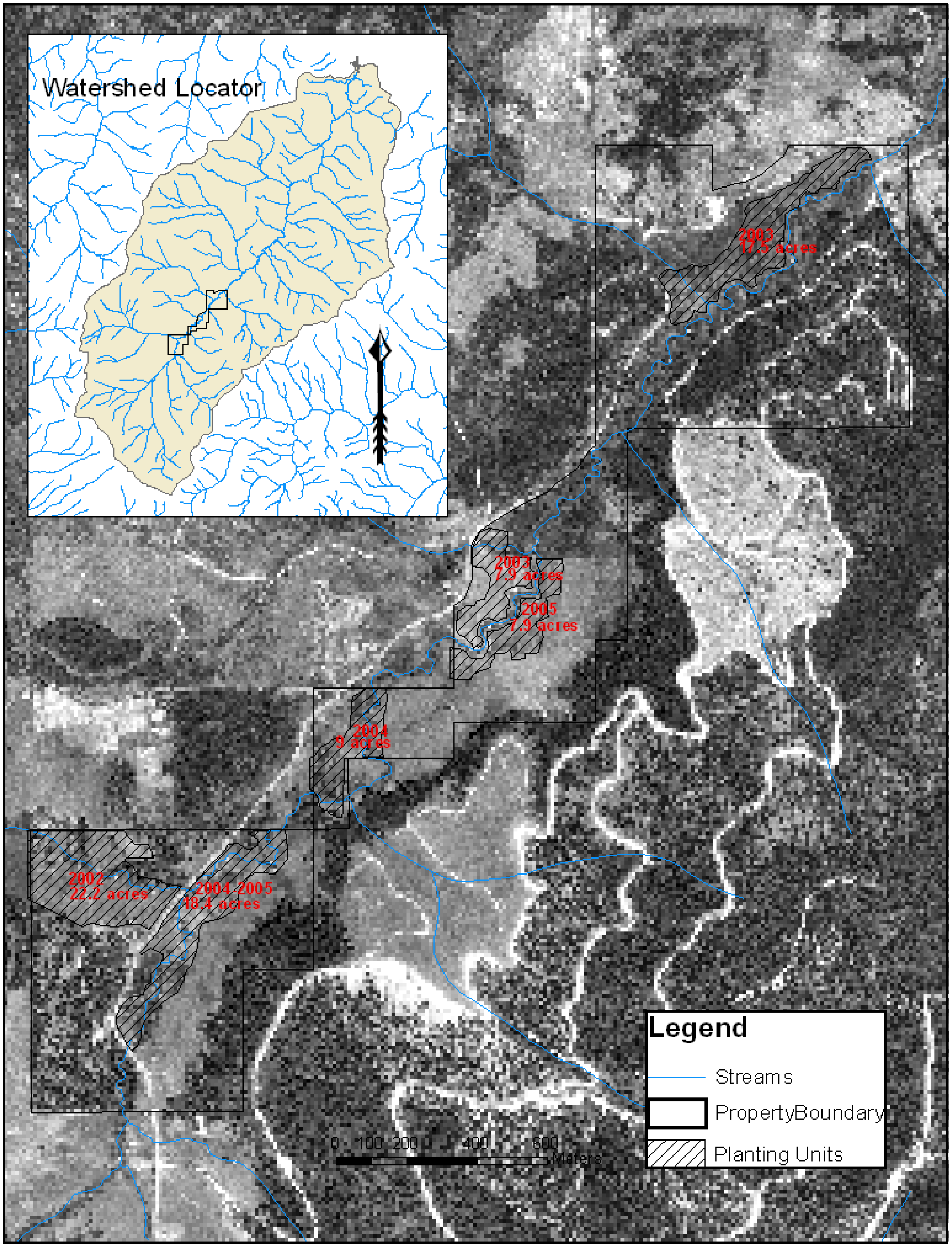

Figure 19. Locations of planting units in the Benewah valley, 2002-2005.

Project B_10.2, B_10.4, B_10.7, B_11.6: Instream/Channel construction

Project Location:

Watershed: Benewah | Legal: T45N, R4W, S13 & S24
Sub Basin (River Mile): RM 10.2-11.6

Site Characteristics:

Slope/Valley gradient: <1% | Aspect: N | Elevations: 2,650-2,760
Valley/Channel type: B2/C4 | Proximity to water: Floodplain
Other: Project created approximately 770 meters of side-channel habitats and 2.9 hecatres of palustrine emergent and scrub/shrub wetlands.

Problem Description: The Benewah valley between river miles 8.9 and 11.9 can be broken into three general reaches that relate to the level of sinuosity or the degree of channel avulsion activity that has taken place. The lower 1.4 miles and upper 0.5 miles have experienced more avulsions and channel straightening than the middle 1.3 miles. The valley slope is 0.007 throughout, however sinuosity in the lower and upper reaches is 1.38 and 1.3, respectively, compared to 1.8 in the middle reach. Downstream avulsions and head cutting have moved upstream through this middle reach causing it to be become entrenched within its historical alignment and substantially reducing the access to its old floodplain.

Hydraulic analysis of representative channel cross-sections show the overall level of entrenchment is approximately equivalent to the capacity of a 5-year return interval peak flow event with some areas exhibiting a level of entrenchment approaching the 10-year peak flow. Several avulsion channels and to a lesser extent, remnant historical channels have left portions of the valley bottom with some wetland habitat. However, it appears that groundwater tables have dropped along with the stream channel bed, as many of the wetland areas are only marginal in size. The entrenched channel is further characterized by unstable streambanks with high erosion potential.

This stream reach is located in a portion of the watershed that historically provided important summer and winter rearing habitats for westslope cutthroat trout. Existing conditions currently support low densities of cutthroat trout (<2 fish/100 sq. meters). Lack of habitat diversity, reduced infiltration of water from adjacent wetlands, and elevated water temperatures are all factors that limit the productivity of these reaches.

Description of Treatment: The project design calls for increasing instream and near-channel wetland habitats by utilizing several existing avulsion channels and upland or drier wetland sites and enlarging them to increase wetland and floodplain areas and provide backwater habitat for fish. These excavated areas are to be connected to the existing channel inverts and become inundated as stage increases in Benewah Creek. These areas are designed in part to emulate beaver activity.

Four backwater sites have been designed to create high-flow backwater habitat for westslope cutthroat trout (*Figure 20*). In many stable natural channels, floodplain and natural backwater habitat become active near the 2-year flood discharge. As the floodplain becomes wetted, juvenile fish can migrate from the lateral margins of the channel to the floodplain and backwater areas. These relatively low-velocity areas have been shown to provide important winter refuge and habitat capacity for salmonids and are used extensively by coastal cutthroat trout (Bustard and Narver

1975; Peterson 1982; Cederholm and Scarlett 1991). The design targets for backwater habitats were equated to the elevations associated with the 2-year discharge because these flows replicate the conditions that provide velocity-refuge habitat at a frequency that trout have evolved with in natural, undisturbed streams.

All NEPA analysis and permitting requirements, including CWA certification, 404 and 401 authorizations, NPDES permits and the supplemental analysis for the BPA Watershed Management Program EIS, were completed for the project in 2003. Construction at sites 1 and 2 was completed by the end of the 2003 field season. Approximately 12,200 cubic meters of material were excavated and moved to a stockpile area away from the valley bottom. Nearly 4MBF of large wood was placed in the excavated channels to provide habitat diversity and cover opportunities for fish and a total of 1,275 containerized plants, including a mix of dogwood, alder, water birch, cottonwood, willow and herbaceous plugs were planted at the completed sites. Construction of sites 3 and 4 were completed in 2004. At these sites, an additional 6,400 cubic meters of material was excavated and hauled; a total of 3,000 trees and shrubs and 3,500 herbaceous plugs were planted; and 4MBF of large wood was placed.

Project Timeline: Preliminary restoration prescriptions were developed for this project site following completion of a detailed stream channel assessment in October 2002. The prescriptions were outlined in a report entitled, "Benewah Creek Assessment and Restoration Prescriptions" (Inter-Fluve, Inc. 2002). Designs and specifications were finalized by July 2003 and permits for all activities were received by September 2003. Implementation of the full project design was completed as of October 2004. Monitoring of habitat conditions and utilization will be ongoing.

Project Goals & Objectives: Create a total of 770 meters of high-flow backwater habitat with 2.9 hectares of associated emergent wetlands accessible to cutthroat trout. Convert meadow plant communities dominated by grass and herb species to a more diverse array of tree, scrub/shrub, and emergent wetland plant types. Provide measurable increases in habitat diversity, wetland functions and values, and trout density within 5-7 years.

Relationship to Scope of Work: This project fulfills the Program commitments for implementation Objective 1, task 1a, sub-task 1.a.ii in the FY 2005 Scope of Work and Budget Request (Inter-Governmental Contract #10885) for the contract period June 2004 - May 2005.

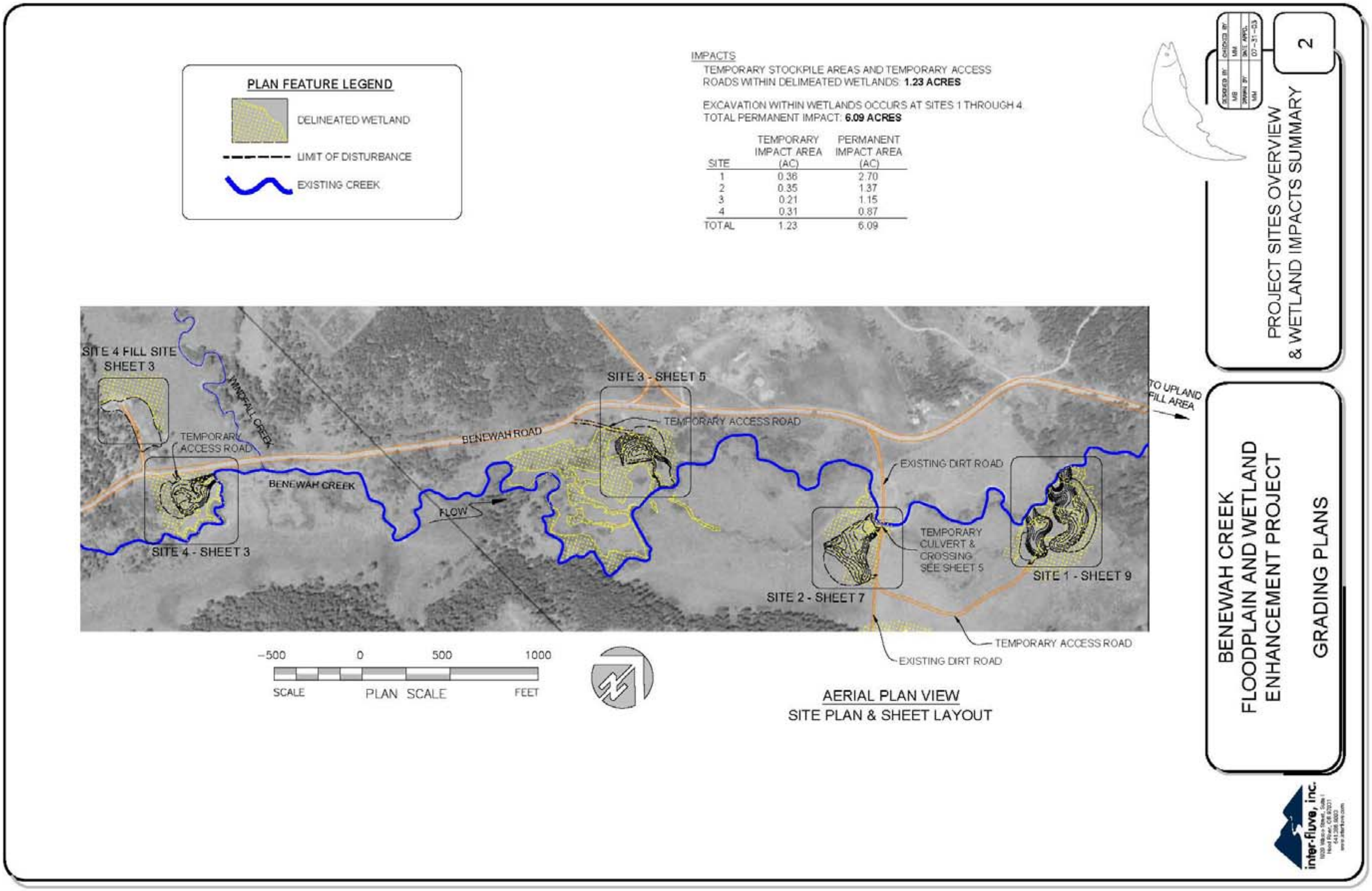

Figure 20. Locations of planned side-channel habitats in the Benewah Valley.

Project B_11.0, B_11.3: Riparian/Floodplain Stabilization

Project Location:

Watershed: Benewah	Legal: T45N, R4W, S13, SE ¼ & S24, NE ¼ ¼
Sub Basin (River Mile): RM 10.5-11.5	

Site Characteristics:

Slope/gradient: <1%	Aspect: N	Elevations: 2,650-2,760
Valley/Channel type: B2/C4	Proximity to water: Floodplain	

Other: Project treats 627 meters of active avulsion channels and 9.3 hectares of associated floodplain.

Problem Description: The reach targeted for this treatment has incised within its pre-disturbance channel alignment. Hydraulic analysis of representative channel cross-sections show the overall level of entrenchment is approximately equivalent to the capacity of a 5-year return interval peak flow event with some areas exhibiting a level of entrenchment approaching the 10-year peak flow. Within this reach, several avulsion channels have begun to develop on the floodplain during past out-of-bank floods. This development has been accelerated by past management practices that cleared forest and riparian plant communities and overgrazed the remaining vegetation. The relatively low root density of existing grass and forb species is insufficient to arrest floodplain erosion.

The avulsion channels are in the process of headward migration, which will ultimately short-circuit portions of the existing low-flow channel. Once an avulsion channel captures the active low-flow channel, the relatively good low-gradient habitat will be abandoned in place of a higher gradient and shorter channel with minimal riparian habitat and complexity.

Description of Treatment: The project design uses placement of natural wood accumulations to increase floodplain roughness near and within avulsion channels. The woody debris will help dissipate energy and reduce local scour, which will retard the headward migration of these features. Wood is to be placed above and below identified avulsion channel head cuts and across the valley in locations at high risk for avulsion (*Figure 21*). Many of the logs will be anchored following placement to keep them in place during flooding. Duckbill anchoring will be used to establish anchor points.

The placement of approximately 50,000 BF of large wood in channel avulsions and high-risk areas was completed by September 2003. Anchoring of all key pieces of wood was completed using Duckbill #88DB1 earth anchors. All disturbed areas were seeded and mulched according to specifications identified in the Storm Water Pollution Prevention Plan (SWPPP) prepared for this project (Coeur d'Alene Tribe 2003). An additional 18 MBF was placed in 2004 following negotiation of a contract with Potlatch Timber Corp. Distrubed areas were hand seeded and mulched as in the previous year. A total of 627 meters of active avulsion channel and 9.3 hectares of associated floodplain were treated.

Project Timeline: Preliminary restoration prescriptions were developed for this project site following completion of a detailed stream channel assessment in October 2002 (Inter-Fluve, Inc.

2002). Detailed designs and specifications were finalized by 7/2003 and permits for all activities were received by 9/2003. Implementation of the full project design was 90% completed as of 11/2003, and the remaining work was completed in summer 2004. Monitoring of erosion processes at active headcuts through photo documentation will be ongoing.

Project Goals & Objectives: Reduce headward migration of active avulsion channels and prevent capture of active low-flow stream channel. Increase floodplain roughness near and within avulsion channels and provide stable substrate for natural regeneration of plant materials and for active plantings.

Relationship to Scope of Work: This project fulfills the Program commitments for implementation Objective 1, task 1b in the FY 2005 Scope of Work and Budget Request (Inter-Governmental Contract #10885) for the contract period June 2004 - May 2005.

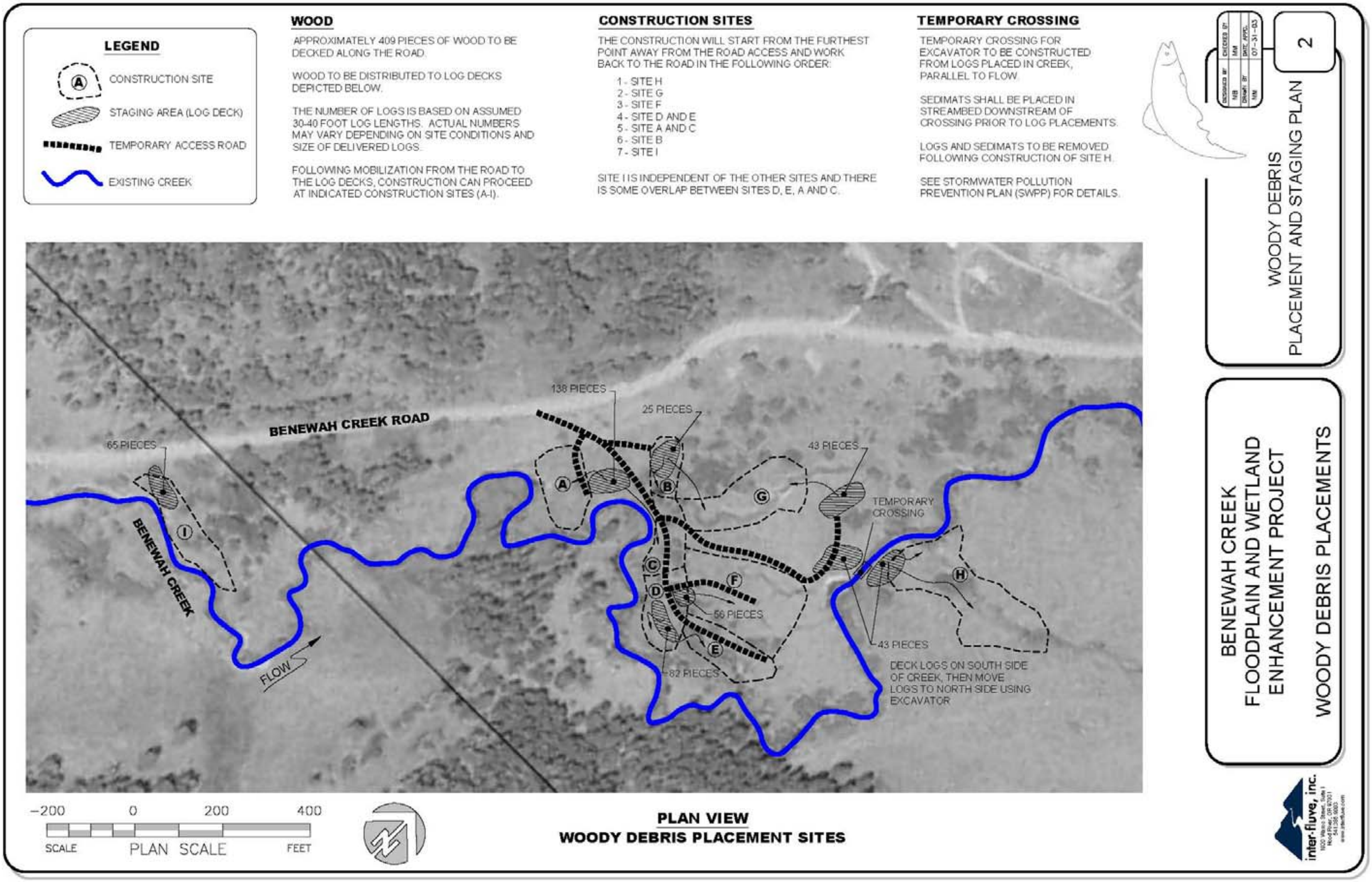

Figure 21. Plan view of floodplain wood placement sites in the Benewah Valley.

Project B_11.5: Instream/Fish Passage

Project Location:

Watershed: Benewah	Legal: T45N, R4W, S24, NW ¼ NE ¼ ¼
Sub Basin (River Mile): RM 11.5	

Site Characteristics:

Slope/gradient: <1%	Aspect: N	Elevation: 2,760
Valley/Channel type: B2/C5	Proximity to water: Instream	

Other: Project treats 200 meters of entrenched channel and opens 4,344 meters of spawning and rearing habitat in Windfall Creek to adfluvial trout.

Problem Description: An existing 48-inch diameter corrugated metal pipe (CMP) culvert conveys Windfall Creek flows under Benewah Road and discharges to Benewah Creek at river mile 11.5. The culvert is 31 feet long with 2.05 percent profile grade, and the culvert outlet has become perched 2 feet above low-flow tailwater following the gradual incision of mainstem Benewah Creek. The culvert is a passage barrier at high-flow for migrating adfluvial adult cutthroat trout trying to move to upstream spawning areas in Windfall Creek. It also is a low-flow passage barrier to resident and adfluvial juvenile salmonids that migrate between tributary and mainstem habitats in search of optimal rearing habitats.

Description of Treatment: Design for fish passage improvements to the Windfall Creek culvert included two major design features: 1) replacement of the existing culvert with a larger pipe-arch culvert lined with natural substrate, and 2) tailwater control at the outlet of the culvert, to be created by constructing a series of grade control riffles in Benewah Creek downstream of the outlet. Flood peak estimations and migration period flowrates were estimated using USGS regression analysis equations (Quillan and Hereberg 1982; Castro and Jackson 2001). Fish passage criteria were selected to be consistent with NOAA Fisheries recommendations for providing passage opportunity during a range of flowrates spanning the 95% and 5% exceedance levels. FishXing Version 2.2 was used to analyze culvert alternatives for high-flow and low-flow barriers occurring within the range of design flows consistent with these criteria. A series of five constructed riffles were designed for a reach extending approximately 200 meters downstream from the proposed culvert outlet. The constructed riffles would provide grade control at geomorphically appropriate locations and maintain a 1.1% average channel gradient consistent with the existing down valley slope. The U.S. Army Cops of Engineers' one-dimensional HEC-RAS model (ver. 3.1) was used to evaluate the conceptual design that incorporated these riffles (USACOE 2001).

The existing culvert was replaced with an 87"x63" pipe-arch set at a 1% profile grade to meet all the design criteria. The new culvert was sunk 2ft. below the existing grade, then refilled with 2 ft. of boulder/cobble substrate to provide a natural channel bottom. Baffles were welded at interval into the bottom of the pipe to provide additional grade control. Tailwater control at the outlet of the culvert was created by constructing a series of riffles in a 200 m reach of Benewah Creek downstream of the culvert outlet. Riffle material was hauled to the site and placed with an excavator. This had the effect of reducing channel entrenchment; restoring floodplain and side-channel interaction during high flows; raising local groundwater to promote and maintain wetland communities; and increasing rearing habitat capacity. Approximately 28 m^3 of large wood was placed in the treatment reach to increase roughness in overbank areas and provide instream habitat complexity. *Figure 22* shows the difference in longitudinal profile and wood frequency before and after restoration activities were completed. The LWD volume was increased from $0.057 m^3$/100 m to $5.59 m^3$/100 m. Mean residual pool depth increased from 0.41 m to 0.78 m. Bank height ratio (a measure of channel entrenchment) was reduced by 54% and estimated stream bank erosion rates and sediment yield were reduced by 47% and 69%, respectively (*Table 21*). Treated reaches, like this one, are expected to exhibit an initial high rate of variability and then stabilize over time.

Table 21. Pre- and Post treatment comparison of key habitat indicators at a restoration site in Benewah Creek (RM 11.5)

Habitat Variables	Pre-Treatment	Post-Treatment	%Change
Mean residual pool depth (feet)	2.1	4.9	+133%
Residual pool volume (cu. feet)	9,555	26,687	+279%
Bank height ratio	2.57	1.39	-54%
Est. Bank erosion rate (feet/year)	0.47	0.25	-47%
Est. Sediment yield (tons/year)	37.4	11.7	-69%

Project Timeline: Final designs were completed in November 2003. Permit authorizations and other NEPA compliance documentation was completed by August 2004. Pre-treatment surveys of channel form and function were completed in 2003 and 2004. Construction and site reclamation was completed by October 2004 (*Figure 23)*. Physical habitat monitoring and biological evaluations are ongoing.

Project Goals & Objectives: Provide fish passage for westslope cutthroat trout during a range of flows spanning the 95% (2.9 cfs) and 5% (34.1 cfs) exceedance levels.

Relationship to Scope of Work: This project fulfills the Program commitments for implementation Objective 1, task 1a, sub task 1.a.iii in the FY 2005 Scope of Work and Budget Request (Inter-Governmental Contract #10885) for the contract period June 2004 - May 2005.

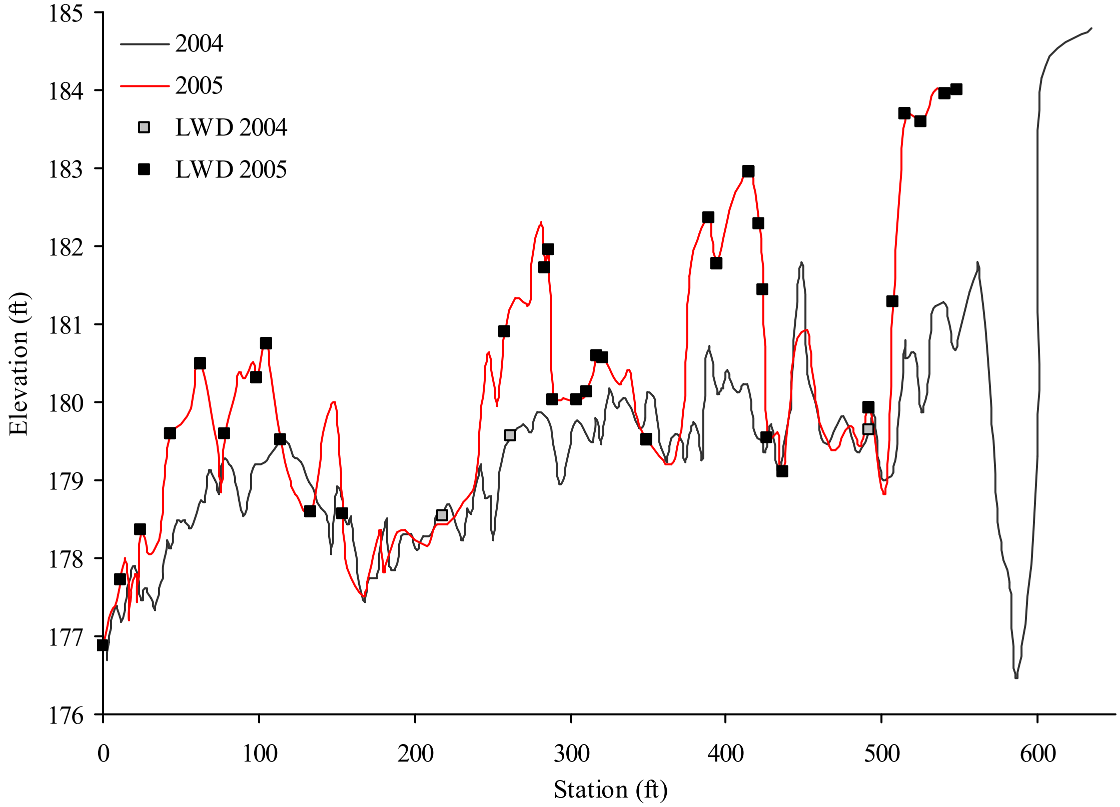

Figure 22. Comparison of channel bed form and large wood frequency before and after restoration for a site in Benewah Creek (RM 11.5).

Figure 23. Completed channel construction in Benewah Creek (RM 11.5), 2004.

SECTION 3: OUTREACH AND EDUCATION

OVERVIEW

Early in the planning stages of this project, Tribal staff envisioned the use of outreach to the general public and the development of educational opportunities related to the natural resources as a means to facilitate a holistic watershed protection process on the Reservation. The staff holds a common belief that responsible management must address the needs of the larger community that collectively affects the fisheries resource and critical habitats. By adopting Tribal recommendations, the Northwest Power Planning Council (NPPC) concurred with this concept and recognized public education and outreach to be a necessary and integral component of fisheries enhancement efforts on the Coeur d' Alene Reservation (NWPPC 1995).

Several related objectives and tasks were pursued in 2004 to address the general goals for the education and outreach portion of BPA project #1990-044-00, *Implement Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation*. The first objective is to coordinate project activities with affected and interested parties to improve awareness of and support for restoration within the Reservation community. This objective is accomplished through several strategies, including publishing a quarterly newsletter and through coordination and participation in watershed and inter-agency work groups. The second objective is to provide cultural and educational opportunities to increase student/teacher participation in restoration activities. This objective is accomplished through continual participation and development of an educational forum to share project related information, encouraging community participation in and garnering landowner support for stream restoration opportunities on Reservation lands, and providing opportunity for summer internships to local high school students. This report discusses accomplishments associated with each objective and task, and evaluates the overall effectiveness of education and outreach efforts using various performance criteria.

METHODS AND RESULTS

The text below presents details of the Outreach and Education work performed by the Fisheries Program and other cooperators during 2003. The methods and results are presented in a manner that is consistent with the outline found in the *2004 Scope of Work and Budget Request* for this project. *Table 22* presents a summary of the outreach efforts and associated completion dates.

Planning and Design Phase

<u>Objective 2: Coordinate restoration and management activities.</u>

<u>Task 2a: Coordinate and facilitate meetings with an Interagency Work Group.</u>

The Tribe's Fisheries Outreach Specialist arranged for meetings of the Interagency Work Group to be held three times during 2004, on April 28, September 29 and December 8. This year the group was still trying to work together on projects that are in their same watersheds. At each meeting, participants shared information on what had been accomplished on their projects and what additional resources might be needed to follow up. Through these meetings, the groups develop an understanding of how they can better manage the natural resources in the Reservation area and how they can promote education regarding land stewardship. Participation in this planning process is a critical step in applying uniform management standards in watersheds targeted by the BPA project and in forming partnerships that improve the cost-effectiveness of implementation efforts. Records were kept and minutes taken for each meeting along with a list of participants.

Task 2b: Participate in internal Tribal interdisciplinary team (IDT) processes during the development of Tribal management plans.

The Fisheries Outreach Specialist and Biologists participated in a series of meetings in support of the development of an Integrated Resource Management Plan (IRMP) for the Reservation. The initial work conducted at these meetings was to continue the development of a Draft Programmatic Environmental Impact Statement started during 2002. Project staff attended a series of meeting to finalize what had been written to date. Meetings were held on a monthly basis from January through September. The project sponsor, the Tribe's Environmental Program Office, then presented the document to the Tribal Council and to a Citizens Advisory Committee (CAC). Subsequent IDT meetings were held to review comments that the CAC and other outside agencies (US EPA, US Fish and Wildlife Service, Bureau of Indian Affairs) had on the IRMP.

Operation and Maintenance Phase

Objective 1: Improve awareness of Program activities within the Reservation community.

Task 1a: Publish a quarterly newsletter that highlights Program activities, recognizes cooperative efforts, and serves as a forum for discussing land management issues.

The *Watershed Wrap* newsletter was published every quarter of this past year. Publication dates correspond to the spring and fall equinox and the summer and winter solstice. The Fisheries Program printed between 1,700 and 2,200 copies of each issue. Approximately 1,100 to 1,300 were distributed by U.S. mail to all the local Tribes, landowners, and natural resources organizations, US Fish and Wildlife Service and US Forest Service. The remaining 500 newsletters were hand distributed for customer pick up at various local area businesses in Northern Idaho.

This last year's Newsletter described 1) on-the-ground projects to further fish and wildlife restoration and enhancement efforts, 2) various methods being used to help restore and protect target watersheds, and 3) natural resource educational efforts. The Fisheries Program made a concerted effort to explain to the local community the activities conducted by the Outreach & Education Specialist with local schools. Other features introduced new employees, provided profiles of fish and wildlife species, and described special research studies conducted in Reservation waters. Some examples of published articles include: "TMDL Development for Hangman Creek", "Fall Garbage and Recycling Survey", "Water Awareness Workshop (WAW) at Lake Creek", "Summer Interns Learning at Work and at Camp", "Brook Trout Removal Project", "Source Water Protection", "Fisheries Research, Monitoring and Evaluation Plan", "Tribe Purchases Mitigation Property at Windy Bay", and "Fisheries Habitat Survey Results".

Task 1b: Continue meeting with watershed work groups to discuss restoration efforts and cooperative opportunities.

Fisheries Program biologists and the Outreach Specialist met multiple times with different watershed working groups during this contract period. The Benewah Creek Watershed Working Group is a highly organized group with very active participants. They have their own regular meetings and the Tribe participated in two meetings during the past year to provide project updates, describe additional planned efforts and introduce new information to the group. The Tribe held one meeting with the Lake Creek Watershed Working Group during 2004 and provided additional information on projects through publication and distribution of the program newsletter. Three meetings were held with the Hangman Creek Watershed Working Group to discuss the

Table 22. Summary of outreach and education efforts of the Coeur d'Alene Tribe Fisheries Program for 2004.

Task	Description	Completion Dates (2004)	Status	
			Completed	Not Completed
Planning and Design Phase				
Objective 2:	***Coordinate restoration and management Activities.***			
Task 2a:	Coordinate and facilitate meetings with an Interagency Work Group.	2/18, 4/28, 9/29, 12/08,	X	
Task 2b:	Participate in the internal Tribal interdisciplinary team (IDT) processes during the development of Tribal management plans.	1/28, 3/23 4/20, 5/20, 9/22	X	
Operation and Maintenance Phase				
Objective 1:	***Improve Awareness of Program activities within the Reservation community.***			
Task 1a:	Publish a Quarterly Newsletter to coincide with the spring and fall equinoxes and the summer and winter solstices. Approximately 2000 newsletter sent out.	3/18, 6/15, 9/18, 12/17	X	
Task 1b:	Continue meeting with watershed working groups and provide a forum for local stakeholders to participate in restoration activities.	3/21, 4/18 Benewah Creek 3/15 Lake Creek	X	
Objective 2:	***Provide educational opportunities in the local schools to improve student/teacher involvement in Program activities.***			
Task 2a:	Continue to participate in and develop an education forum for the local community regarding stream restoration opportunities on the Reservation.	On-going throughout the school year.	X	
Task 2b:	Provide summer internships for high school students to assist with implementation of restoration projects. Attended Natural Resource Camp at Chewelah Peak Learning Center on the Colville National Forest.	4 students sponsored from 6/13 to 9/3 Planning meetings: 1/12, 3/16 and 5/26. Camp held 6/13 to 6/18	X	
Task 2c:	Work with the University of Idaho Extension Agent to develop and implement education programs.	Ongoing; numerous dates between 6/30/04 to 5/30/05	X	

results of watershed assessments and ongoing projects. Attendance for these meetings typically ranged from 12 to 25 residents with a total of 120 participants. Topics discussed at these meetings included: restoration project updates and planned activities, Idaho Department of Transportation highway realignment from Mica to Worley, Lake Creek TMDL issues, University of Idaho - USDA grants, soil erosion, NRCS/State funded programs, research activities, and identifying opportunities and concerns.

Direct mailing provided an additional opportunity to inform the public about what was going on in the project watersheds. This past year, the Outreach Specialist encouraged participation by local landowners through local advertising and the *Watershed Wrap*. Plans for the upcoming year include direct mailing of questionnaires to inquire how to better serve the needs of all who live in the target watersheds and to help better inform the public about our projects. These efforts are intended, in part, to facilitate new partnerships for restoration efforts on the Reservation.

Objective 2: Provide cultural and educational opportunities to improve student/teacher involvement in Program activities.

Task 2a: Continue to participate in and develop an educational forum for the local community.

The Fisheries Outreach Specialist worked closely with local schools and community organizations over the last year to provide a wide variety of educational opportunities that helped increase the exposure for program activities and provided information to improve the understanding of natural resource management issues on the Reservation. The venues for information exchange included field camps, classroom programs, miscellaneous lectures, and other activities related to natural resource management and environmental stewardship (*Table 23*).

Several large multi-day field camps were organized and attended by well over 1,100 students, teachers and members of the general public. Each of these events have become annual occurrences and include Water Awareness Week, the Rock n' the Rez Youth Camp, and Water Potato Day. Water Awareness Week was a big success and reached over 450 students and teachers during the weeklong workshops, which were held May 9-13. Participating schools represented 7 towns/cities and 3counties and included: Sandpoint (Sagle), Post Falls Middle School, Lakes Middle School (Coeur d'Alene), Southside (Coeur d'Alene), St. Maries Middle School, Kootenai Middle School (Harrison), and Coeur d'Alene Tribal school (DeSmet). Participants rotate through a series of stations, each presenting a different aspect of stream and wetland ecology, natural science disciplines, and resource management. The Rock n' the Rez Youth Program helped exposed a large number of local youth to Tribal natural resource programs and activities and provided leadership training over a seven day period in June. Attendance at WATER POTATO DAY exceeded all previous years with approximately 475 people attending. In order to accommodate the large number of students who wanted to attend, the celebration was held on three different days, October 18, 21 and 22. Participants experienced traditional subsistence practices first-hand, were exposed to native songs and stories (including "Simon Says" in the Coeur d'Alene language), tree/shrub identification, and wetland functions educational walks. Several additional one-day field outings were also organized to benefit students interested in natural resource issues (*Table 23*).

Table 23. Summary of education and outreach activities related to student/teacher programs (Objective 2, task 2a), 2004.

Category	Activity/Description	Location	Attendance	Dates
Field Camps	Water Awareness Week	Lake Creek watershed	>375 students/ teachers	5/9–13
	Native Plant ID/Collection	Turnbull Wildlife Refuge, Cheney, WA	23	5/14
	Youth Fishing Trips	Various, CDA Reservation	150	3/21, 4/11, 4/25, 5/9, 5/23
	Natural Resource Field Day	Woodland Middle School, Coeur d'Alene, ID	275 students/ teachers	6/3
	Natural Resource Field Camp	Farragut State Park	265 students/ teachers	6/4
	Rock n' the Rez Youth Camp	Plummer, ID	>165 students; >30 general public	6/29-8/13
	Water Potato Day	Chatcolet Lake	~ 475 students/ teachers	10/18,21-22
	Native American Fish & Wildlife Society Fisheries Camp	Inchelium, WA	25 students/10 teachers	8/2-6
Classroom Programs	After School Program	Plummer/Worley Middle School	19 per day	11/16 – 1/16
	Science Lecture Series	Kootenai High School, Harrison, ID	53 students	2 days bimonthly
	Environmental Education Workshop	Gonzaga High School, Spokane, WA	45 students	10/27
Miscellaneous Lectures	Indians and Fire	University of Idaho, Moscow, ID	45 students/ teachers	9/8
	Honoring the Heritage of the Plateau People	Washington State University, Pullman, WA	45 general public	9/29-30
	Native American Perspectives – Traditional Economies Past and Present	Gonzaga University, Spokane, WA	>55 students and general public	10/1
Other Activities	Environmental Education Booth	Kootenai County Fair, Coeur d'Alene, ID	>100 general public	8/25-29
	Antelope Run	DeSmet, ID	85	5/27
	Panel Moderator - Northwest Youth	Native American Fish and Wildlife Society Conference, Polsen, MT	~65-75 resource managers	10/31-11/2

Several classroom programs were arranged to help inject important fisheries and other natural resource issues into the curriculum of several local schools. The Outreach Specialist participated in a 9-week after school program for the Plummer/ Worley school District, beginning in November. Participating students, largely 4th, 5th, and 6th graders were taught traditional crafts and the relationship of traditional cultural practices to functioning natural ecosystems. A workshop was organized for a Gonzaga High school science class of 45 students interested in discussing environmental damages related to mining activity in the Coeur d'Alene Subbasin. Students were introduced to biological, physical and chemical data collected to support a Natural Resource Damage Assessment (NRDA) of Coeur d'Alene Lake and tributaries and to possible remediation scenarios. The Fisheries Program also worked closely with Kootenai High School (Harrison) to present a lecture series on natural resource management and environmental stewardship. Lectures and demonstrations were presented to the Science and Forestry classes on five different days. Topics included plant and tree identification, timber cruising/scaling, safety in the woods, fire fighting, and reforestation/ restoration techniques.

The Outreach Specialist was invited to participate in several lecture series that provided opportunities to introduce Program activities and Tribal cultural practices to a wider audience of university students, teachers and the general public. A lecture on Indians and Fire was presented to a University of Idaho class called “Fire, Myth and Mankind- Coming to Terms with Nature.” Participation in the conference entitled, Honoring the Heritage of the Plateau People: Past, Present, and Future, held at Washington State Univeristy, provided an opportunity to address approximately 45 people regarding the use and importance of native plants in traditional cultural practices and in ecological restoration. Native American perspectives were also provided in a lecture to Gonzaga University students regarding traditional natural resource based economies and their relevance to the economic realities of today.

Several additional activities were undertaken to address people and organizations not directly accessed with the preceding activities. An environmental education booth was setup and attended at the Kootenai County Fair in Coeur d’Alene. Posters depicting ongoing restoration work and program newsletters were on display and made available at the event. The Outreach Specialist also helped facilitate the Tribal schools’ Antelope run, which is a special part of Tribal history commemorating Morris Antelope’s run from Steptoe Butte, WA to DeSmet, ID in 1872. Tribal representation was also prominent at the Native American Fish and Wildlife Society, Pacific Region annual meeting held in Polson, Montana, October 21-November 2. the Outreach Specialist moderated a panel on the Northwest Youth.

Task 2b: Provide summer internships for high school students to assist with implementation of project activities.

During the summer of 2004 the Fisheries Program employed four summer youth and one college intern. The youth worked with biologists and technician staff from June 14 through September 3. The youth helped with T&E species surveys, built fences, assisted with fish population census and stream habitat monitoring, collected water quality data, assisted with data input into computer spreadsheets, assisted the Lake Management Department with an inventory of docks on the lake, and helped with maintenance activities related to the Rails-to-Trails project.

In addition to working with Tribal staff, the summer interns attended two natural resource camps to increase their exposure to other programs and opportunities. One such camp was hosted by the US Forest Service and held at Canyon Work Center in Pierce, Idaho on the Clearwater Ranger District, June 14 - 19. The Outreach Specialist played a big part in setting up the agenda for the weeklong camp and taught seminars on environmental ethics and the intrinsic value of fish and wildlife habitats. The youth learned different types of skills used in natural resource management and gained a better understanding of employment opportunities in natural resource related fields. The interns also attended the Native American Fish & Wildlife Pacific Region Youth Camp at Inchelium, Washington on the Colville Reservation, August 2-6. At this camp the interns learned about the job opportunities awaiting them in fisheries, wildlife and forestry programs after they finish college.

Task 2d: Work with the University of Idaho Extension Agent to develop and implement educational programs focusing on fish, water and wildlife resources and protection of Reservation watersheds.

The Outreach Specialist worked closely with the local University of Idaho Extension Offices to present various educational programs at the local schools and communities. The Outreach Specialist assisted Extension Office staff in presenting a 4-H curriculum for secondary students. Classes at several local schools (Kootenai, St. Maries, Worley, Plummer, Coeur d'Alene Tribal) were introduced to curriculum from the book titled *Project Wild*. Some of the topics included in this book are: 'Hooks and Ladders', 'How to catch a fish' and 'How do trees help fish'. The Outreach Specialist talked to students about the local fishery in the Rocky Point (Chatcolet Lake) area, and discussed the difference between native and non-native fish species. Presentations were given thought out the school year, September 2004 through May 2005. The Outreach Specialist also worked with Extension staff to prepare for giving the "Choices" curriculum to 8th grade students at Plummer/Worley Middle School. This curriculum was developed by an independent non-profit group to "empower students with vital tools that will increase their career and life opportunities". The Outreach Specialist/Extension Office team hosted a youth camp at the Benewah County fair grounds on July 8, 2004. This camp featured several fisheries related activities (Fish Ladder game, Fish Habitat game, Fish printing). The team also went to the Plummer preschool (Head Start) to talk to the youth about fish and wildlife habitat and tribal culture. Topics were presented from both the *Project Wild* and “Choices” curriculums. The team was also instrumental in planning the Natural Resources portion of the Tribe’s “Rockin’ the Rez” youth camp. The team was the primary organizers for that camp, held during the summer of 2004. They also worked together to recruit students for the Intertribal Natural Resources Camp in early June of 2005.

The Outreach Specialist worked with staff from the Extension Office to develop several grant opportunities. The first of these was developed for the Indian Land Tenure Foundation, an organization whose mission is to restore land within reservation boundaries to tribal management and ownership. The proposal was to adapt and teach the Foundation’s curriculum on the Reservation, with lesson plans for K-12, as well as an adult course that may be offered for college credit. The curriculum is designed to educate native people about land tenure issues so that they are better prepared to make proactive land decisions. We believe the curriculum could have a positive impact on our young people by giving them a greater understanding of the importance our land to our people. The grant application was accepted and funded, beginning in June of 2005. The first adult course will be offered in the fall 2005 in St. Maries, targeting a non-tribal audience. A second course will be offered in January 2006. A second grant application was developed in response to an EPA solicitation for Wetlands Education gants. The grant proposed to plan and develop a Wetlands Youth Leadership program. Unfortunately, the proposal was not funded for FY ’06. The grant was substantially changed and resubmitted for FY ’07 funding.

EVALUATION OF EFFECTIVENESS

There are several ways in which the effectiveness of outreach and education programs is traditionally evaluated. One such measure is the number of engagements that the Outreach Specialist accomplished, based on work dates available in the calendar year. A second measure is the variety of forums made available locally for education and outreach (i.e., K-12 and college students and teachers, Reservation communities and rural landowners, professionals from local/regional agencies and other stakeholders). Also, the number of participants in organized activities provides another measure of effectiveness. One additional measure that is perhaps more difficult to address is the individual participants' awareness, understanding and interest in the processes and needs of the habitat restoration, lake and stream studies, water quality, and other natural resource management activities undertaken by a particular project.

Performance criteria for the outreach/education component of this project were satisfied based on deliverables outlined in the 2004 Scope-of-Work, as described below. The measure of these criteria is primarily the documentation of the numbers of individuals contacted through mailings, attendance at events, and community participation in educational forums held on and around the Reservation. It is intended that effectiveness criteria for future activities also be based on questionnaires and/or surveys administered to the participants. The responses to these questionnaires and/or surveys will be used to develop activity-specific performance criteria so that all activities can be evaluated, modified as needed or deleted if found to be ineffective.

Planning and Design Phase

Objective 2: Coordinate restoration and management activities.

Task 2a: Coordinate and facilitate meetings with an Interagency Work Group.

Criteria: Are inter-agency work group meetings beneficial to the natural resources programs that participate?

Effectiveness: Three meetings held, 10 to 16 participants each meeting. Regular attendees included representatives of the following organizations: CDA Tribe Environmental, Fisheries, Wildlife, and Land Services Programs, NRCS, Farm Services Association, UI Extension, and the Benewah - Kootenai Soil, Spokane and Water conservation District. Participants agreed that these meetings met the effectiveness criteria. The future performance criteria will be documented in meeting sign-in sheets, agendas and written notes, by written letters of support, and executed memoranda of agreement.

Task 2b: Participate in internal Tribal interdisciplinary team (IDT) processes during the development of Tribal management plans.

Criteria: Is participation in IDT meetings by project staff beneficial to the overall planning process and specifically to the management of fisheries resources?

Effectiveness: The participation of the Fisheries Program staff was very effective in bringing awareness of fisheries and fish habitat protection issues to the IRMP process. Three Fisheries Program participants contributed important perspectives on habitat protection and other topics. Representatives of the following Tribal programs were typically also present: Environmental Program (responsible for the development of the IRMP), Forestry, Wildlife, Lake Management, TREO, Planning, Land Services, Development Corporation, and GIS.

Operation and Maintenance Phase

Objective 1: Improve awareness of Program activities within the Reservation community.

Task 1a: Publish a quarterly newsletter that highlights Program activities, recognizes cooperative efforts, and serves as a forum for discussing land management issues.

Criteria: Did the newsletter improve awareness within the local communities and businesses regarding fisheries habitat restoration?

Effectiveness: The Newsletter was effective in getting pertinent and interesting information out to the public on and off the Reservation. This conclusion was based on the number of newsletters mailed and delivered (1,800 to 2,200 per issue) and on oral feedback from participants at the different educational forums. In the future performance criteria for the newsletter will be supported by providing recipients an opportunity to comment on the newsletter in writing, via a postcard insert, back to the program.

Task 1b: Continue meeting with watershed work groups comprised of private landowners, agency representatives, and other interested parties to discuss restoration and cooperative opportunities.

Criteria: Are watershed working group meetings effective forums to educate and outreach to the Reservation community?

Effectiveness: These meetings were effective in bringing awareness of fish habitat improvement projects and needs to watershed landowners. The attendance logs kept with meeting minutes indicate that there are 15 to 20 landowners present at each of these meetings. The future effectiveness of these meetings will be measured through the use of questionnaires or survey forms that will be developed and made available at the Watershed Working Group meetings for participants to provide comments, suggestions, or questions regarding the activities of the program.

Objective 2: Provide cultural and educational opportunities to improve student/teacher involvement in Program activities.

Task 2a: Continue to participate in and develop an educational forum for the local community regarding stream restoration opportunities on the Reservation.

Criteria: Does the Outreach Specialist's sponsorship of and attendance to miscellaneous meetings and activities (as outlined above) promote the education and outreach cause?

Effectiveness: The Outreach Specialist's attendance at all workshops, classes, and events provided many opportunities to make presentations about fisheries program activities. The effectiveness of each of the primary activities that the Outreach Specialist was involved in is outlined below. In the future, performance of these or other educational forums will be measured by a questionnaire or survey to be made available at each workshop, class and event to measure the quality of the experience provided.

Water Awareness Week.

Criteria: Was the Water Awareness Workshop an effective educational forum to increase awareness?

Effectiveness: This is one of the most important events that the Tribal Natural Resource programs put on for the regional community. In 2004, 375 students, teachers and parents attended with each school having approximately one half day to work through the seven stations.

Kootenai High School Classroom Lecture Series

Criteria: Were these lecture sessions effective educational forums to increase awareness?

Effectiveness: Ten to twelve students attended each of the five lectures.

Coeur d'Alene Tribal School Classroom Teaching
Criteria: Was this an effective educational forum to increase awareness?
Effectiveness: Twelve to thirty students and their teachers attended.

Woodland Middle School
Criteria: Was this trip an effective educational forum to increase awareness?
Effectiveness: Approximately 275 students, parents and teachers attended.

Rock n' the Rez Youth Program
Criteria: Was the conference an effective educational forum to increase awareness?
Effectiveness: There were over 165 youth that attended and participated in all the activities.

Kootenai County Fair
Criteria: Was this trip an effective educational forum to increase awareness?
Effectiveness: Approximately 100 people visited our booth.

University of Idaho Lecture – Fire, Myth, Mankind
Criteria: Was this class an effective educational forum to increase awareness?
Effectiveness: Approximately 45 students attended the class.

Gonzaga University Lecture – Traditional Economies
Criteria: Was this class an effective educational forum to increase awareness?
Effectiveness: Approximately 65 students, businessmen, and teachers attended.

Water Potato Day
Criteria: Was this an effective educational forum to increase awareness?
Effectiveness: Water Potato Day is the largest event that is sponsored by the Fisheries Program and is particularly pertinent to Tribal culture. Approximately 475 students, teachers and others attended this year's event.

Elders, Youth and Culture in the Environment
Criteria: Was this workshop an effective educational forum to increase awareness?
Effectiveness: 104 community members participated in workshop.

Native American Fish & Wildlife Society Pacific Region Conference
Criteria: Was this trip an effective educational forum to increase awareness?
Effectiveness: Approximately 75 people attended this workshop.

Task 2b: Provide summer internships for high school students to assist with implementation of project activities.

Criteria: Were these internships an effective educational forum to increase awareness?
Effectiveness: Three students participated and each remained for the entire summer period.

Task 2c: Recruit 4-7 high school students to participate in the annual Natural Resource Camp sponsored by the US Forest Service.

Criteria: Was this camp an effective educational forum to increase awareness?

Effectiveness: 30 students attended. This year the Coeur d'Alene Tribe co-sponsored this years NR Camp. It was the first time the Tribe sponsored this event since it started 12 years ago.

Task 2d: Work with the University of Idaho Extension Agent to develop and implement educational programs focusing on fish, water and wildlife resources and protection of Reservation watersheds.

Criteria: Does the Outreach Specialist's work with University of Idaho extension staff promote the education and outreach cause?

Effectiveness: The UI Extension has a number of programs oriented to the understanding of natural resources issues and participation by the Outreach Specialist in these benefits both programs. Effectiveness of specific activities undertaken with the UI Extension is listed below. In the future, the effectiveness of these or other educational forums will be measured by a questionnaire or survey to be made available at each workshop, class or event to measure the quality of the experience provided.

Choices curriculum

Criteria: Was this curriculum an effective educational forum to increase awareness?

Effectiveness: 70 students attended.

4-H Workshops

Criteria: Were these workshops effective educational forums to increase awareness?

Effectiveness: 20 to 30 students attended each session

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APPENDIX TABLES 1-4

Appendix Table 1. Cutthroat trout population estimates for the Alder and Benewah Creek watersheds on the Coeur d'Alene Reservation, 2004

Alder Creek - Cutthroat Trout								**2004**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 m^2**	**Total N**	**±95 % CI**
Mainstem	1	7052	561	4		0.7	50	
	2	1825	360	2		0.6	10	
	3	9446	381	12	1	3.2	300	19
	4	4158	232	8		3.4	143	
	5	5064	645	0		0.0	0	
	6	1823	286	6		2.1	38	
	7	16860	990	4		0.4	68	
	8	4916	472	1		0.2	10	
	9	12635	279	0		0.0	0	
N.F. Alder	1	4475	360	1		0.3	12	
	2	1403	346	0		0.0	0	
	3	2058	221	0		0.0	0	
	4	2503	69	0		0.0	0	
Total		**74218**	**5203**	**38**	**1**		**633**	**19**

Benewah Creek – Cutthroat trout								**2004**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 m^2**	**Total N**	**±95 % CI**
Mainstem	1	7422	NS	NS				
	2	9419	1003	2		0.2	19	
	3	5588	557	6		1.1	60	
	4	16104	628	22	2	3.5	570	41
	5	2318	520	2		0.4	9	
	8	5656	818	1		0.1	7	
	9	5648	678	7		1.0	58	
	10	25981	1221	55	14	4.5	1164	296
	11	1399	526	3		0.6	8	
Bull	1	3685	136	89	27	65.9	2427	723
Coon	1	2149	204	11	1	5.5	118	13
School House	1	2741	193	14	2	7.5	204	25
SE Benewah	1	6915	282	38	3	13.3	923	70
WF Benewah	1, 2	3205	171	19	4	11.1	356	78
Whitetail	1	5204	143	4		2.8	145	
Windfall	1	5531	76	12	2	15.2	840	173
Total		**108965**	**7157**	**285**	**55**		**6907**	**1420**

Appendix Table 2. Cutthroat trout population estimates for the Evans and Lake Creek watersheds on the Coeur d'Alene Reservation, 2004.

Evans Creek – Cutthroat Trout								**2004**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 m^2**	**Total N**	**±95 % CI**
Mainstem	1	4977	373	1		0.3	13	0
	2	7227	595	36	5	6.0	435	65
	3	1970	266	18		6.8	133	0
	4	10127	1039	63	9	6.0	612	89
	5	2692	489	21	3	4.2	114	18
	6	1178	442	31	7	7.0	83	19
	7	2231	290	30	3	10.2	228	23
EF Evans	1	3990	121	12	2	9.6	382	79
RF Evans	1	2099	104	7	1	6.9	145	25
SF Evans	1, 2	1126	236	21	2	9.1	102	9
Total		**37617**	**3954**	**239**	**33**		**2248**	**327**

Lake Creek – Cutthroat Trout								**2004**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 m^2**	**Total N**	**±95 % CI**
Mainstem	1	5396	139	11	3	7.7	413	107
	4	2696	440	35	6	7.9	213	37
	5	2555	494	48	8	9.7	247	40
	6	11668	1000	76	11	7.6	882	134
	7	13284	1264	34	8	2.7	354	79
	8	9715	366	43	4	11.7	1134	110
WF Lake	1,2, 3	6270	388	63	25	16.1	1011	396
Bozard	1	11085	431	155	38	35.9	3983	978
Total		**62669**	**4523**	**463**	**102**		**8238**	**1881**

Appendix Table 3. Eastern brook trout population estimates for the Alder and Benewah Creek watersheds on the Coeur d'Alene Reservation, 2004.

Alder Creek - Eastern Brook Trout								**2004**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 m^2**	**Total N**	**±95 % CI**
Mainstem	1	7052	539	0		0.0	0	0
	2	1825	316	0		0.0	0	0
	3	9446	260	0		0.0	0	0
	4	4158	232	0		0.0	0	0
	5	5064	645	7	2	1.1	58	15
	6	1823	286	5	2	1.9	34	12
	7	16860	990	56	8	5.7	956	131
	8	4916	472	60	7	12.7	622	74
	9	12635	279	65	7	23.3	2938	296
N.F. Alder	1	4475	360	51	5	14.0	629	64
	2	1403	346	105	10	30.4	427	40
	3	2058	221	63	7	28.7	590	61
	4	2503	69	16	2	23.8	595	56
Total		**74218**	**5015**	**429**	**48**		**6848**	**749**

Appendix Table 3. Cont.

Benewah Creek - Eastern Brook Trout								2004
Tributary	Reach	Total Area (sq. m)	Area sampled (sq. m)	N	95% CI	#/100 m^2	Total N	±95 % CI
Mainstem	1	7422	N/S					
	2	9419	1003	0		0.0	0	0
	3	5588	557	0		0.0	0	0
	4	16104	628	0		0.0	0	0
	5	2318	520	0		0.0	0	0
	8	5656	818	0		0.0	0	0
	9	5648	325	0		0.0	0	0
	10	25981	1221	10	9	0.8	220	186
	11	1399	526	16	2	3.1	44	5
Bull	1	3685	136	0		0.0	0	0
Coon	1, 2	2149	204	0		0.0	0	0
School House	1	2741	193	6	2	3.2	89	21
SE Benewah	1	6915	282	29	29	10.3	714	709
WF Benewah	1,2	3205	171	51	6	29.7	952	119
Whitetail	1	5204	143	2		1.4	73	0
Windfall	1	5531	76	0		0.0	0	0
Total		**108965**	**6804**	**115**	**47**		**2091**	**1039**

Appendix Table 4. Discharge measurements in the mainstem and tributaries of Alder, Benewah, Evans and Lake creeks.

System	Hierarchy	Order	Site	Date	Discharge (CFS)
Alder	mainstem	4	mainstem	3/30/04	42.26
Alder	mainstem	4	mainstem	6/28/04	3.05
Alder	mainstem	4	mainstem	7/30/04	0.95
Alder	mainstem	4	mainstem	8/10/04	<1.0
Alder	mainstem	4	mainstem	8/18/04	<1.0
Alder	mainstem	4	mainstem	9/9/04	1.08
Alder	mainstem	4	mainstem	9/29/04	1.51
Alder	mainstem	4	mainstem	10/14/04	1.64
Alder	mainstem	4	mainstem	10/27/04	4.37
Alder	mainstem	4	mainstem	11/18/04	4.04
Alder	mainstem	4	mainstem	12/14/04	31.93
Alder	mainstem	4	mainstem	1/27/05	22.69
Alder	mainstem	4	mainstem	4/25/05	12.88
Alder	tributary	3	North Fork	3/30/04	16.53
Alder	tributary	3	North Fork	6/29/04	1.36
Alder	tributary	3	North Fork	7/30/04	0.53
Alder	tributary	3	North Fork	8/10/04	<1.0
Alder	tributary	3	North Fork	8/18/04	<1.0
Alder	tributary	3	North Fork	9/9/04	<1.0
Alder	tributary	3	North Fork	9/29/04	<1.0
Alder	tributary	3	North Fork	10/14/04	<1.0
Alder	tributary	3	North Fork	10/27/04	1.38
Benewah	mainstem	4	3 Mile	7/1/04	5.62
Benewah	mainstem	4	3 Mile	7/28/04	1.30
Benewah	mainstem	4	3 Mile	8/9/04	1.50
Benewah	mainstem	4	3 Mile	8/18/04	1.00
Benewah	mainstem	4	3 Mile	9/8/04	1.46
Benewah	mainstem	4	3 Mile	9/27/04	2.41
Benewah	mainstem	4	3 Mile	10/13/04	2.64
Benewah	mainstem	4	3 Mile	10/26/04	7.44
Benewah	mainstem	4	3 Mile	11/17/04	5.69
Benewah	mainstem	4	3 Mile	12/8/04	19.53
Benewah	mainstem	4	3 Mile	1/24/05	65.67
Benewah	mainstem	4	3 Mile	3/22/05	18.40
Benewah	mainstem	4	3 Mile	4/21/05	34.51
Benewah	mainstem	4	9 Mile	2/19/04	220.00
Benewah	mainstem	4	9 Mile	4/6/04	34.82
Benewah	mainstem	4	9 Mile	7/1/04	3.13
Benewah	mainstem	4	9 Mile	7/30/04	1.04

Appendix Table 4. Cont.

Benewah	mainstem	4	9 Mile	8/9/04	0.95
Benewah	mainstem	4	9 Mile	8/18/04	0.56
Benewah	mainstem	4	9 Mile	9/8/04	<0.5
Benewah	mainstem	4	9 Mile	9/27/04	<1.0
Benewah	mainstem	4	9 Mile	10/13/04	1.89
Benewah	mainstem	4	9 Mile	10/26/04	4.47
Benewah	mainstem	4	9 Mile	11/18/04	4.82
Benewah	mainstem	4	9 Mile	12/7/04	6.01
Benewah	mainstem	4	9 Mile	1/25/05	32.59
Benewah	mainstem	4	9 Mile	4/27/05	9.61
Benewah	tributary	3	Bull Creek	4/6/04	3.14
Benewah	tributary	3	Bull Creek	7/1/04	0.48
Benewah	tributary	3	Bull Creek	7/30/04	0.23
Benewah	tributary	3	Bull Creek	8/9/04	<0.5
Benewah	tributary	3	Bull Creek	8/18/04	<0.5
Benewah	tributary	3	Bull Creek	9/8/04	<0.5
Benewah	tributary	3	Bull Creek	9/27/04	<1.0
Benewah	tributary	3	Bull Creek	10/13/04	<0.5
Benewah	tributary	3	Bull Creek	10/26/04	0.39
Benewah	tributary	3	Schoolhouse Creek	3/30/04	6.20
Benewah	tributary	3	Schoolhouse Creek	6/28/04	0.38
Benewah	tributary	3	Schoolhouse Creek	7/27/04	<0.5
Benewah	tributary	3	Schoolhouse Creek	8/12/04	<0.5
Benewah	tributary	3	Schoolhouse Creek	8/18/04	<0.5
Benewah	tributary	3	Schoolhouse Creek	9/9/04	<0.5
Benewah	tributary	3	Schoolhouse Creek	9/27/04	<0.5
Benewah	tributary	3	Schoolhouse Creek	10/13/04	<0.5
Benewah	tributary	3	Schoolhouse Creek	10/26/04	<1.0
Benewah	tributary	3	West Fork	3/30/04	8.54
Benewah	tributary	3	West Fork	6/28/04	0.60
Benewah	tributary	3	West Fork	7/27/04	0.23
Benewah	tributary	3	West Fork	8/12/04	<0.5
Benewah	tributary	3	West Fork	8/20/04	<0.5
Benewah	tributary	3	West Fork	9/9/04	<0.5
Benewah	tributary	3	West Fork	9/27/04	<0.5
Benewah	tributary	3	West Fork	10/14/04	<0.5
Benewah	tributary	3	West Fork	10/27/04	0.43
Benewah	tributary	3	Whitetail Creek	4/6/04	1.68
Benewah	tributary	3	Whitetail Creek	6/29/04	0.12
Benewah	tributary	3	Whitetail Creek	7/30/04	0.00
Benewah	tributary	3	Whitetail Creek	8/9/04	0.00

Appendix Table 4. Cont.

Benewah	tributary	3	Whitetail Creek	8/18/04	0.00
Benewah	tributary	3	Whitetail Creek	9/9/04	<0.5
Benewah	tributary	3	Whitetail Creek	9/27/04	<0.5
Benewah	tributary	3	Whitetail Creek	10/13/04	<0.5
Benewah	tributary	3	Whitetail Creek	10/26/04	<1.0
Benewah	tributary	3	Windfall Creek	3/30/04	4.27
Benewah	tributary	3	Windfall Creek	6/29/04	0.39
Benewah	tributary	3	Windfall Creek	7/27/04	0.02
Benewah	tributary	3	Windfall Creek	8/9/04	0.02
Benewah	tributary	3	Windfall Creek	8/18/04	0.00
Benewah	tributary	3	Windfall Creek	9/9/04	<0.5
Benewah	tributary	3	Windfall Creek	9/27/04	<0.5
Benewah	tributary	3	Windfall Creek	10/13/04	<0.5
Benewah	tributary	3	Windfall Creek	10/26/04	<1.0
Evans	mainstem	3	mainstem	6/30/04	6.29
Evans	mainstem	3	mainstem	7/28/04	3.05
Evans	mainstem	3	mainstem	8/11/04	2.04
Evans	mainstem	3	mainstem	8/23/04	3.90
Evans	mainstem	3	mainstem	9/13/04	2.68
Evans	mainstem	3	mainstem	9/22/04	3.16
Evans	mainstem	3	mainstem	10/12/04	2.63
Evans	mainstem	3	mainstem	10/20/04	4.92
Evans	mainstem	3	mainstem	11/17/04	4.24
Evans	mainstem	3	mainstem	12/13/04	36.61
Evans	mainstem	3	mainstem	1/26/05	31.39
Evans	mainstem	3	mainstem	2/16/05	8.47
Evans	mainstem	3	mainstem	3/21/05	9.59
Evans	mainstem	3	mainstem	4/20/05	25.68
Evans	tributary	2	East Fork	6/30/04	0.78
Evans	tributary	2	East Fork	7/28/04	0.39
Evans	tributary	2	East Fork	8/11/04	<0.5
Evans	tributary	2	East Fork	8/23/04	<0.5
Evans	tributary	2	East Fork	9/13/04	<0.5
Evans	tributary	2	East Fork	9/22/04	<1.0
Evans	tributary	2	East Fork	10/15/04	<0.5
Evans	tributary	2	East Fork	10/20/04	<0.5
Evans	mainstem	3	mainstem	6/30/04	4.91
Evans	mainstem	3	mainstem	7/28/04	2.97
Evans	mainstem	3	mainstem	8/11/04	2.53
Evans	mainstem	3	mainstem	8/23/04	3.34
Evans	mainstem	3	mainstem	9/13/04	2.67

Appendix Table 4. Cont.

Evans	mainstem	3	mainstem	9/22/04	3.05
Evans	mainstem	3	mainstem	10/15/04	2.42
Evans	mainstem	3	mainstem	10/20/04	5.09
Lake	tributary	3	Bozard Creek	6/21/04	3.49
Lake	tributary	3	Bozard Creek	7/22/04	<1.0
Lake	tributary	3	Bozard Creek	8/4/04	<1.0
Lake	tributary	3	Bozard Creek	8/19/04	<1.0
Lake	tributary	3	Bozard Creek	9/10/04	<1.0
Lake	tributary	3	Bozard Creek	9/23/04	<1.0
Lake	tributary	3	Bozard Creek	10/6/04	<1.0
Lake	tributary	3	Bozard Creek	10/25/04	<1.0
Lake	mainstem	4	mainstem	2/19/04	252.00
Lake	mainstem	4	mainstem	6/17/04	9.25
Lake	mainstem	4	mainstem	7/26/04	<1.0
Lake	mainstem	4	mainstem	8/5/04	<1.0
Lake	mainstem	4	mainstem	8/19/04	<1.0
Lake	mainstem	4	mainstem	9/10/04	<1.0
Lake	mainstem	4	mainstem	10/25/04	4.17
Lake	mainstem	4	mainstem	11/15/04	2.82
Lake	mainstem	4	mainstem	12/9/04	20.51
Lake	mainstem	4	mainstem	3/16/05	4.97
Lake	mainstem	4	mainstem	4/19/05	19.90
Lake	mainstem	4	mainstem	5/17/05	34.68

Appendix Table 5. General stream type descriptions and delineative criteria for broad-level classification (from Rosgen 1996).

Stream	General	Entrenchment	W/D	Sinuosity	Slope	Landform/soils/
Type	description	ratio	ratio		%	features
Aa+	Very steep, deeply entrenched, debris transport streams.	< 1.4	< 12	1.0 to 1.1	>10	Very high relief. Erosional, bedrock or depositional features; debris flow potential. Deeply entrenched streams. Vertical steps with deep scour pools; waterfalls.
A	Steep, entrenched, cascading, step/pool streams. High energy/debris transport associated with depositional soils. Very stable if bedrock or boulder dominated channel.	< 1.4	< 12	1.0 to 1.2	>10	High relief. /erosional or depositional and bedrock forms. Entrenched and confined streams with cascading reaches. Frequently spaced, deep pools in associated step/pool bed morphology.
B	Moderately entrenched, moderate gradient, riffle dominated channel, with infrequently spaced pools. Very stable plan and profile. Stable banks.	1.4 to 2.2	>12	>1.2	2 to 3.9	Moderate relief, colluvial deposition, and/or structural. Moderate entrenchment and W/D ratio. Narrow, gently sloping valleys. Rapids predominate with scour pools.
C	Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplains.	>2.2	>12	>1.2	<2	Broad valleys with terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channels. Riffle/pool bed morphology.
D	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks.	n/a	>40	n/a	<4	Broad valleys with alluvium, steeper fans. Glacial debris and depositional features. Active lateral adjustment with abundance of sediment supply. Convergence/divergence bed features, aggradational processes, high bedload and bank erosion.

DA	Anastomosing (multiple channels) narrow and deep with extensive, well vegetated floodplains and associated wetlands. Very gentle relief with highly variable sinuosities and W/D ratios. Very stable streambanks.	>2.2	highly variable	highly variable	<0.5	Broad, low-gradient valleys with fine alluvium and/or lacustrine soils. Anastomosed geologic control creating fine deposition with well vegetated bars that are laterally stable with broad wetland floodplains. Very low bedload, high wash load sediment.
E	Low gradient, meandering riffle/pool stream with low W/D ratio and little deposition. Very efficient and stable. High meander width ratio.	>2.2	<12	>1.5	<2	Broad valley/meadows. Alluvial materials with floodplains. Highly sinuous with stable, well vegetated banks. Riffle/pool morphology with very low W/D ratios.
F	Entrenched meandering riffle/pool channel on low gradients with high W/D ratio.	<1.4	>12	>1.2	<2	Entrenched in highly weathered material. Gentle gradients with a high W/D ratio. Meandering laterally unstable with high bank erosion rates. Riffle/pool morphology.
G	Entrenched "gully" step/pool and low W/D ratio on moderate gradients	<1.4	<12	>1.2	2 to 3.9	Gullies, step/pool morphology with moderate slopes and low W/D ratio. Narrow valleys or deeply incised in alluvial or colluvial materials, I.e. fans or deltas. Unstable, with grade control problems and high bank erosion rates.