Year-End Report
2001-2002

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Implement Fisheries Enhancement on the Coeur d'Alene Indian Reservation: Hangman Creek

BPA Project # 2001-032-00

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1.0 INTRODUCTION

Historically, Hangman Creek produced Chinook salmon (*Oncorhynchus tshawytscha*) and Steelhead trout (*Oncorhynchus mykiss*) for the Upper Columbia Basin Tribes. One weir, located at the mouth of Hangman Creek was reported to catch 1,000 salmon a day for a period of 30 days a year (Scholz et al. 1985). The current town of Tekoa, Washington, near the state border with Idaho, was the location of one of the principle anadromous fisheries for the Coeur d'Alene Tribe (Scholz et al. 1985). The construction, in 1909, of Little Falls Dam, which was not equipped with a fish passage system, blocked anadromous fish access to the Hangman Watershed. The fisheries were further removed with the construction of Chief Joseph and Grand Coulee Dams. As a result, the Coeur d'Alene Indian Tribe was forced to rely more heavily on native fish stocks such as Redband trout (*Oncorhynchus mykiss gairdneri*), Westslope Cutthroat trout (*O. clarki lewisii*), Bull trout (*Salvelinus confluentus*) and other terrestrial wildlife. Historically, Redband and Cutthroat trout comprised a great deal of the Coeur d'Alene Tribe's diet (Power 1997).

The Redband trout, a subspecies of the rainbow trout (*Oncorhynchus mykiss*), historically occurred throughout the Columbia River basin east of the Cascade Mountains up to barrier falls created 10-15,000 years ago on the Kootenai, Pend Orielle, Spokane, and Snake Rivers (Behnke 1992). Cutthroat trout (*Oncorhynchus clarki lewisii*), on the other hand, were found above the barrier falls in the tributaries of the Columbia River (Behnke 1992). Since Hangman Creek is below the barrier falls on the Spokane River, the redband trout would have been the native fish to the watershed whereas all tributaries flowing into Lake Coeur d' Alene contained cutthroat trout. The Columbia River Redband trout evidently replaced the interior cutthroat trout in most areas where they came into contact. Widespread sympatric occurrence of both native redband trout and native cutthroat trout is known only in the Salmon ad Clearwater drainages of Idaho (Behnke 1992). Behnke explains this separation by stating, "the broad overlap of Rainbow and Cutthroat trout niches (particularly those of non-anadromous populations), which generally prevents these species from coexisting in the same habitat, suggests the ancestors of the two species evolved in isolation of each other). Although a great deal of the research done on redband trout has been done on the desert varieties from the Great Basin, more recent research has been done for the Upper Columbia redband trout. Summer habitat requirements were investigated by Mulfield et al. (2001a), which indicates Hangman Creek at one time, may have been ideal redband habitat. They described low gradient, medium elevation reaches flowing through alluvial valleys with a well-defined floodplain, along with an abundance of complex pools as ideal habitat. Age-0, juvenile, and adults strongly selected pool mesohabitats and avoided riffles. They found that as gradient reaches 4 percent, fish densities decreased and were not present at gradients over 10 percent. As temperatures drop in the fall and early winter adult Redband trout find suitable over wintering habitat in deep pools with extensive amounts of cover within a third order stream (Muhlfield et al. 2001b). They emphasized that resource managers should apply strategies that protect and enhance pool habitat and stream complexity. Muhlfield (2002) found that spawning occurred, in a 3rd-order stream in the Kootenai River drainage, as flow decreases after peak runoff and as mean daily temperatures exceeded 6.0 °C and as maximum daily temperature exceeded 7.0°C. Eighty percent of the redds were found in pool tailouts that contained substrate sizes 2-6mm and water velocities of 40-70 cm/s.

Historical salmonid distribution has been altered from extensive stocking by state fish and game agencies, as well as private citizens. Cross-breeding of native Redband with hatchery Rainbows and with Westslope Cutthroats have left few populations within the Columbia Basin genetically pure leading to a challenge when applying genetic analysis to fish populations (Shaklee 2002).

In addition to fish passage problems caused by the dams, there were rapid changes in land management practices that further altered the fish species composition in Hangman Creek and the availability of native terrestrial wildlife habitat (Edelen and Allen 1998). As a result of the Dawes Severalty Act of 1887, the Coeur d'Alene Tribal members were allotted lands and the Reservation was opened to white settlement early in the 20th century. This completely disrupted the Tribe's traditional relationship with the land and the Tribe itself underwent a period of disintegration (Ross and Dozer 1974). Early farming methods, which were used by the Coeur d'Alene Tribe, restricted tillage to small acreages, but as more mechanized methods became available the acreage of land under tillage increased (Black et al. 1998, Edelen and Allen 1998). Efforts were expended to straighten and channelize the streams to order to increase arable lands during the World War II era to the present, with the greatest efforts occurring during the 1950s and 1960s**.** By 1996, the predominant (65.1%) use of the land within the Hangman Watershed on the Coeur d'Alene Reservation was agriculture, followed by forest (37.9%), grassland (0.2%), developed (0.3%) and wetland (0.006%) (Redmond and Prather 1996).

Temperature is perhaps the single most altered habitat feature in Hangman Creek because of decreased flows and riparian cover. Temperature is a complex habitat variable in regards to trout production. Dickerson and Vinyard (1999) states, "the variety of responses to thermal stress is potentially large and no single set of values or estimates are appropriate for all species or situations." There are separate temperature requirements for each of the life history stages.

Cold temperatures must exist after high flows subside allowing eggs to develop. Shepard (1986) reported that for salmonids incubation occurred in the range of 4.4 –14.4° C. The upper and lower limits for Rainbow trout incubation were identified as 2-20° C. by Bell (1986) with temperatures remaining in the optimal range for the duration of incubation. We can expect that the incubation period to be approximately 31 days at 11° C. (Piper et al. 1992).

Juveniles and adults can withstand slightly higher temperatures than eggs. Lee and Rinne (1980) reported the critical thermal maximum (CTM) as 29-30° C at acclimation temperatures of 20° C over a short period. The CTM for Bull Trout was identified as 20.9° C after 60 days by Selong et al. (2001). Seventy-nine percent of the experimental fish survived at 20 ° C, but none survived at 22° C. Juveniles of different ages may show different CTM's. Age 0+ bull trout had slightly greater temperature tolerance than 1+ fish (Selong et al. 2001).

Another variable that plays a part in whether or not fish can survive in harsh thermal environments is diel temperature fluctuations. For example, it has been shown for rainbow trout (*Oncorhynchus mykiss)* that acclimation to diel temperature fluctuations can increase their upper temperature tolerance (Hokanson et al. 1977). In addition to acclimation temperature and age, genetics may influence CTM's. Carlene and Machung (2001) concluded that wild Brown, Rainbow and Brook trout showed higher CTM's because of genetic differences.

Merely staying below the CTM for Rainbow trout is not enough for survival as chronic high temperatures have proven to be detrimental.   Productivity may increase with temperatures above 19° C, but disease may increase and the food supply must keep up with the metabolism of the fish. Many trout will simply avoid areas in this temperature range (Beschta et al. 1987). The optimum growth rates were identified as 13.2 degrees C. for bull trout by Selong et al. (2001), and 17.2 degrees C. for Rainbow trout (Hokanson et al. 1977).

In summary, good redband trout habitat would be expected to have temperatures below 14° C until fry have emerged in early summer and stay below 20° C for the entire summer, preferably around 17° C. Availability of food sources for trout will dictate adjustment of the upper limits for temperature.

A second parameter that would likely limit salmonid distribution in Hangman Creek is suspended solids or TSS. Effects from TSS range from avoidance behaviors to reduction in feeding rates, increased coughing, impaired homing, delayed hatching, and finally mortality. Newcombe and Jensen (1996) compiled years of studies on effects of TSS on fish, which yielded six empirical formulas that predicts the response of fish to different combinations of concentration and exposure for six groups; (adult and juvenile salmonids; adult salmonids, juvenile salmonids, eggs and larvae; adult non-salmonids living in freshwater; and adult non-salmonids living in estuaries). Each sediment dose was classified into one of 14 effects ranging from no behavioral effects to 100% mortality.

In most streams suspended sediment concentration is strongly correlated with discharge. Large river systems show that the energy of water discharge is often a predictor of concentration. Numerous concentration/discharge pairs go into making up a good rating curve. However, small streams such as the tributaries of Hangman Creek often depend for their load on episodic contributions of fine materials from banks and upland areas, and so they tend to have poorer relationships between suspended sediment and discharge (Thomas 1985).

Little information is available on fish distribution throughout the watershed. The Coeur d' Alene Tribe electro-shocked the main stem of Hangman Creek and three of its tributaries, Indian Creek, the S. Fork of Hangman Creek, and Mission Creek. Salmonids were found in all tributaries and in the main stem of Hangman Creek at the town site of Sanders and above (Coeur d'Alene Tribe 1994). Other fish sampled by the tribe was Chiselmouth (*Acrocheilus alutaceus*), Northern Pikeminnow (*Ptychocheilus oregonensis*), Speckled Dace (*Rhinichys osculus*), Longnose Dace (*Rhinichys cataractae*), Tench (*Tinca tinca*), and Redside Shiner (*Richardsonious balteatus*) of the family of minnows and carp, Brown Bullhead (*Ictalurus nebulosus),* two suckers, the Longnose (*Catostomus catostomus*) and Bridgelip (*Catostomus columbianus*), Brook trout (*Salvelinus fontinalis*), and sculpin (*Cottus spp.*). Electro-shocking surveys in the 1990's by Idaho Dept of Lands yielded no salmonids in the S.F. Hangman area (Dupont 2002). There are personal accounts of local fisherman catching cutthroat trout in the upper reaches of Sheep and Squaw Creek, and large rainbows in the main stem of Hangman below Sanders as late as ten years ago. It is noteworthy that Idaho Dept of Lands records show these streams to be non-fish bearing except Indian Creek (Cuvala 2002). The Bull trout is thought to have been has been extirpated from the Hangman Creek watershed many years ago (Peters 2002).

Much more information is known about redband trout distribution in the Washington portion of Hangman Creek. Chuck Lee, of Eastern Washington University, found what is suspected to be native redband trout in California Creek, a tributary of Hangman Creek, or Latah Creek, as it is known in Washington (Lee 2002). No known stocking has been done in California creek. Lee also sampled rainbow trout in Marshall Creek, another tributary of Hangman Creek. This creek has been stocked with rainbows, brook, and brown trout as recently as 1982. Neither stream has had genetic samples taken, but it is widely accepted among area biologists that California Creek is the more likely site to have native redband trout. Washington Dept of Fish and Wildlife biologists found rainbow trout in tributaries of the Little Spokane River, and through genetic results from fin-clip samples, determined them to be native redband trout (McClellan 2002).

While the Hangman Watershed was once rich in resources that met the Coeur d'Alene Tribe's subsistence needs, little cover remains in the agricultural lands of the Hangman Watershed for the either native fish or native wildlife. The decrease in conifers and deciduous trees along Hangman Creek, because of land-use conversion, has decreased canopy and wood available for instream cover. The Hangman Watershed's reduced capability to support native fish and wildlife and its historical importance to the Coeur d'Alene Tribe prompted the Tribe to submit a proposal to the Northwest Power Planning Council. This proposal was to begin a coordinated effort to protect and restore fish and wildlife habitats along with the natural function of wetlands, riparian areas, and streams within the Project Area. The proposal was intended as an anadromous fish substitution action to provide alternate subsistence resources for extirpated salmon. The Fisheries Program's proposal titled *Implement Fisheries Enhancement on the Coeur d'Alene Indian Reservation: Hangman Creek* (BPA Project #2001-032-00) was submitted in conjunction with the Coeur d'Alene Tribe's 21017 *Implement Wildlife Habitat Protection and Restoration on the Coeur d'Alene Reservation: Hangman Watershed* (BPA Project #2001-033-00). These proposals were submitted during the fall of 2000 for inclusion in the FY2001 – FY2003 budget cycle for the Spokane River Sub-basin of the Intermountain Province. These projects were funded as part of the Bonneville Power

Administration's commitment "to rebuilding healthy, naturally producing fish and wildlife populations by protecting and restoring habitats and biological systems within them" (Northwest Power Planning Council 2000).

As part of BPA Project #2001-032-00, *Implement Fisheries Enhancement on the Coeur d'Alene Indian Reservation: Hangman Creek*, the Coeur d'Alene Tribe proposes to assess the fisheries enhancement opportunities for redband trout and other native fish species in that portion of Hangman Creek that lies within the Coeur d'Alene Reservation. Objectives are to 1) Identify if naturally reproducing rainbow trout in Hangman Creek and tributaries within the Coeur d'Alene Reservation are redband trout. 2) Determine areas that are in need of restoration to supply spawning and rearing habitat for redband and other naturally reproducing trout. 3) Develop an educational outreach program to facilitate a "holistic" watershed protection process. 4) Implement a habitat/in-stream restoration strategy that will provide self-sustaining, naturally reproducing, and harvestable populations of native trout in the Hangman Creek watershed. 5.) Implement a monitoring and evaluation program to determine the effectiveness of habitat/in-stream restoration projects

This newly contracted project will establish the historic and current distribution of Redband trout (*Oncorhynchus mykiss gairdeini)* and other native fish species throughout Hangman Creek and its tributaries. This project has been divided into three phases. Phase I (FY01-FY03) is an assessment of Hangman Creek and its tributaries to gather baseline data and identify sites for instream habitat restoration. Refer to the enclosed objectives and tasks for activities planned in FY01, along with an assessment of tasks completed in Section 5.0 (Assessment of Scope of Work). In FY02 a genetics study on redband trout will be performed to determine if the fish are native redband or a hybrid. Fisheries, water quality and erosion data will continue to be collected to establish background data. A macro invertebrate study will be performed in FY03 to identify species, numbers, diversity and biomass as another means to assess the health of Hangman Creek and its tributaries. The findings of the genetics analysis will be reported in FY03. This will determine if the native trout are redband and if they are recoverable. If not, then another native salmonid species may be pursued as an alternative for Tribal subsistence. Monitoring of the fisheries, water quality and erosion data will continue throughout the duration of this project. Based on the findings from FY 01-FY03, recommendations for instream habitat restoration sites will be outlined in an annual report, which will detail the work to be completed so there may be no delays in implementing restoration projects in FY04.

Phase II of the project deals with implementing instream habitat restoration projects at sites that were identified in FY03. The restoration projects are necessary to improve the spawning and rearing habitat along with stabilizing the stream banks and providing cover. The schedule for implementing restoration projects will last the duration of the project.

Phase III is to monitor the success of the habitat restoration projects and the recovery of harvestable native redband trout and other native fish species populations. Monitoring and evaluation begins in FY02 with the continued collection of baseline fisheries, water quality, and sediment data. Actual monitoring and evaluation of restoration projects will begin in FY05. Through monitoring and evaluation the success of the instream habitat restoration projects and population estimates will be evaluated so that any fine-tuning in methods or construction can be identified.

As part of the assessment phase a sediment abatement strategy will be developed. It will identify areas in which sediment enters Hangman Creek and its tributaries and make recommendations to decrease sediment loading. Prior to the implementation of restoration projects a monitoring and evaluation plan will be established along with the sister project # 21017 "*Implement Wildlife Habitat Protection and Restoration on the Coeur d'Alene Reservation: Hangman Watershed*". Although all restoration in this project will be confined within the Coeur d' Alene Reservation, the biosassessment protocols used in the initial phase of this project will need to be extended to headwaters areas that lie east of the reservation boundaries if we are to assess the entire watershed affecting tribal waters. Cooperative agreements with the state of Idaho to aid in the bioassesment of the watershed outside the reservation would contribute to an evaluation of the entire watershed. It is also the goal of the project to work with agencies downstream in Washington to develop a basin wide strategy for restoring Hangman Creek. The Washington Dept of Ecology and the Spokane Conservation District are both working on monitoring projects within the Washington portion of the watershed (Edelen 2002), and (McClellan 2002).

STUDY AREA

Hangman Creek is part of the Spokane River watershed, which is in the Intermountain Province of the Columbia River Basin. The Spokane River Sub-basin covers approximately 2,400 square miles and lies in four Washington counties, Pend Oreille, Stevens, Lincoln and Spokane and three Idaho counties, Benewah and Kootenai, and Shoshone. The upstream boundary is considered to be in Idaho at Post Falls Dam, which regulates Coeur d'Alene Lake. The Spokane River flows west through the City of Spokane where it is blocked by two dams, Upper Falls Dam at river mile (RM) 80 and the Monroe Street Dam at RM 74. As the River reaches the west side of the City of Spokane, Hangman Creek (also known as Latah Creek) is the first major tributary flowing in from the south at RM 72.4. Nine Mile Falls Dam lies at Spokane River RM58, the Little Spokane River enters at RM 56.5, Long Lake Dam lies at RM 34, and Little Falls Dam lies at RM 29. The lower 29 miles of the Spokane River is controlled by hydroelectric operations at Grand Coulee Dam and is considered part of Lake Roosevelt.

Hangman Creek drains 430,000 acres of northern Idaho and eastern Washington *(Draft: Spokane Sub basin Summary 2000)*. The study area consists of the portion of Hangman Creek watershed that lies within the Coeur d Alene Reservation and east into the headwaters outside of the reservation (Figure 1). The Washington-Idaho State border, which corresponds to the border of the Coeur d'Alene Indian Reservation, marks the western boundary of the project area. The divide between the Hangman Watershed and the Coeur d'Alene Basin runs east and south from the northwest corner of the Project Area. Figure 1 shows Hangman Creek watershed in relation to the Coeur d' Alene Reservation. The divide between Santa Creek and Hangman Creek runs north in the southeast portion of the project area. The divide between the Hangman Watershed and Palouse River Watershed marks the southern boundary. The total acreage is 156,601 (Green 2002), with 147,008 of that within the reservation. That is 43.9 % of the total reservation (Green and Matt, 2000). Elevations range from 754 meters in the northwest corner of the Project Area where Rock Creek flows west into Washington to 1,505 meters at the top of Moses Mountain on the southeastern end of the Hangman/Coeur d'Alene Basin watershed divide.

The climate and hydrology of the target watershed is influenced by the maritime air masses from the pacific coast, which are modified by continental air masses from Canada. A distinct precipitation season typically begins in October or November and continues through March. A seasonal snow pack generally covers the landscape at elevations above 4,500 feet (1,372 m) from late November to May. Snow pack between elevations of 3,000 and 4,500 feet (914 to 1,372 m) 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). Average total annual precipitation at Tensed, Idaho for the years 1963-1983 was 25.2 inches (64 cm; www.wrcc.dri.edu). Approximately two-thirds of annual precipitation occurred during this period of October through March (Bauer and Wilson 1983). The frequent rain on snow events and the fact that the entire watershed is strongly influenced by dry land agricultural practices contributes to significant flooding. Temperatures in the watershed are mild overall. The average daily maximum for August, of the 1963-1983 reporting period was 82.2° F (64.4° C). The average daily minimum for January, which was the coldest month of the year, was 20.9° F (-6.2°C).

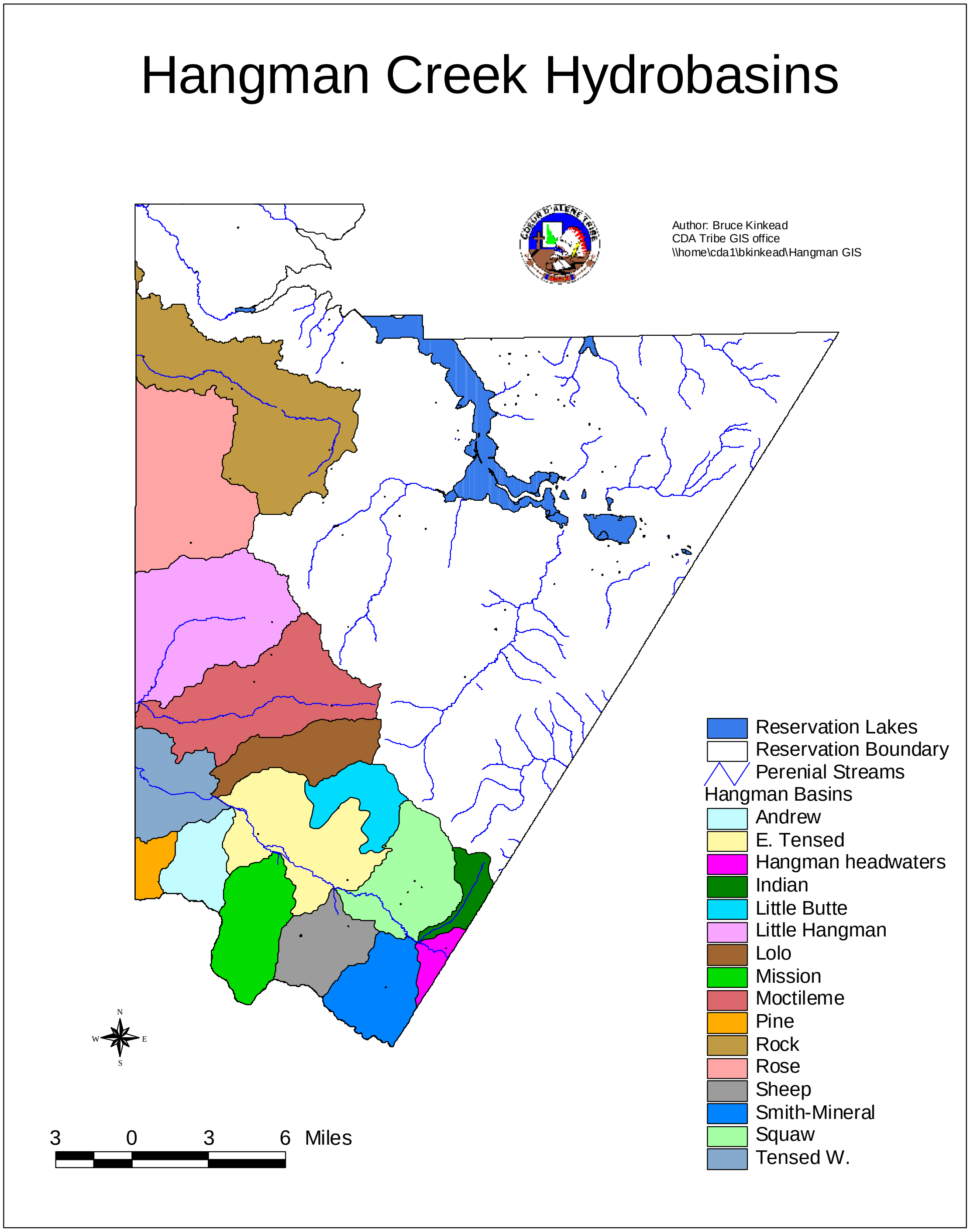

Figure 1. Hangman Creek hydrobasins within Coeur d' Alene Reservation, ID.

The original vegetation patterns within the Project Area included the eastern edge of the Palouse Steppe, mesic mountain forests, open woodland transition forests, (Bailey 1995, Lichthardt and Mosely 1997, Black et al. 1998) and wetland/riparian habitats (Jankovsky-Jones 1999). Currently the major vegetation coverage is agriculturally derived (Table 1) (Redmond and Prother 1996) and native habitats have been greatly altered to channel water off the landscape to facilitate agricultural production (Black et al. 1998, Jankovsky-Jones 1999). Tilling, tiling, grazing, riparian vegetation removal, stream channelization, logging, and road building have all contributed to stream sediment pollution and a flashy hydrologic cycle (Spokane County Conservation District 1994, Isaacson 1998). Rain-on-snow events in particular swell streams, contribute to the erosion of lands and cause a pulse of stream sediment pollutants (Bauer and Wilson 1983). The lack of an adequate wetland water storage capacity within the watershed results in little to no base flow during the dry season of August and September. During August of 2001, the Spokane County Conservation District documented no flow at five of nine sites sampled along Hangman Creek within the Project Area (Edelen 2002).

Hangman Creek was placed on the Coeur d'Alene Tribe's 303(d) list in 1998 as well as on the EPA's list in 1994 because measures of sediment, pH, nutrients and bacteria parameters did not meet accepted standards. Hangman Creek is currently 303d listed for sediment, nutrients and pathogens, and development of a TMDL is scheduled in 2005 (Fields). Little Hangman Creek, a tributary of Hangman Creek, is 303d listed for nutrients and it will have a TMDL developed in 2005 (Fields 2002).

Forest habitat series' within the Project Area include western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*) grand fir (*Abies grandis*) Douglas fir (*Pseudotsuga menziesii*), and ponderosa pine (*Pinus ponderosa*) (Cooper et al. 1991). These forest series' are found generally along a gradient from moist forests in the higher elevations to dry, lower elevation open woodlands. Western hemlock occurs in the upper elevations and is increasingly restricted to moist draws as elevation decreases. Western red cedar (*Thuja plicata*) is confined to poorly drained soils in wetland and riparian areas. The grand fir series is intermediate and is the most widely dispersed series in the Project Area with representation in both the moist and dry forest zones. The ponderosa pine series generally occurs below 4,000 ft and occupies a narrow environmental strip between more mesic Douglas-fir forests and the steppe vegetation. Many of the current ponderosa pine dominated stands are actually seral to Douglas fir. The dry forest types are increasingly restricted to south and west-oriented, convex slopes as elevation increases. Since settlement of this region, the white pine *(Pinus monticola)* cover type has been eliminated by a combination of harvest and white pine blister rust (Hagle et al. 1989, Maloy 1997) and the ponderosa pine and Douglas fir cover types have been greatly reduced, while grand fir, cedar and hemlock cover types have greatly increased (Gruell 1983).

Riparian/wetland plant communities within the Project Area can be divided into five general categories: coniferous forest, deciduous forest, deciduous shrub, graminoid wetlands (Jankovsky-Jones 1999) and camas marsh (Daubenmire 1988). The coniferous forest communities include mountainous riparian communities that are dominated by western red cedar, or mountain hemlock. In the lower elevations, coniferous forest riparian plant associations are dominated by ponderosa pine. Ponderosa pine can intergrade with the deciduous forest in much of the Project Area riparian zone but it can also be completely replaced where site conditions favor the deciduous forest. The deciduous forest riparian plant associations are dominated by aspen (*Populus tremuloides*) and black cottonwood (*Populus trichocarpa*). The deciduous shrub plant associations are dominated by red-osier dogwood (*Cornus sericea*), Douglas hawthorn (*Cretaegus douglasii*), alder (*Alnus incana*), and willow (*Salix sp*.). The graminoid wetlands are dominated by grasses (*Agropyron*), sedges (*Carex sp*.) and various rushes (*Eleocharis, Glyceria, Juncus, Scirpus, and Sparganium*). Extensive camas marshes were once present in the Project Area (Seltice 1990), however these plant communities may have been supported by Native American agricultural techniques (Lambert 2000). At this point, the possible distribution of the ponderosa pine, deciduous forest, deciduous shrub, graminoid, and camas marsh riparian plant associations within the Project Area is subject to conjecture because these communities were eliminated before their distribution was understood. In addition, the introduction of invasive weeds, such as hawkweed (*Hieracium sp.*),reed canarygrass (*Phalaris arundinacea*), and common tansy (*Tanacetum vulgare*), and landscape alterations have altered riparian wetland environments from their original form. Recent concern of landowners over the possibility of loosing valuable timber to forest pests may lead to additional changes in the landscape. The Tussock moth (*Orgyia psedotsugata*) infestation has lead to a great deal of harvesting of timber recently in the Mission Creek and Sheep Creek sub-watersheds.

2.0 MATERIALS AND METHODS

WATER QUALITY

Coeur d'Alene Tribe Fisheries and Water Resources Programs staff monitored 37 stations within the Hangman Creek watershed. Sample stations were chosen to get a complete spatial collection of sites with the watershed using the following variables as a guide; geomorphology; steam order changes; riparian and upland vegetation; fish presence/absence. Fisheries staff collected data at 11 primary sites and 20 secondary sites. Once fish were sampled in the upper portions of several sub-basins, separate sampling sites were located in the lower area where fish were absent and in the upper portion where fish were present. It is hoped that this will aid in identifying water quality conditions necessary in the future to restore native salmonids to the entire project area. Figure 2A shows locations of each sampling station in the Hangman Creek proper watershed, and Figure 2B shows the locations of sampling sites in the northern project area. The Coeur d'Alene Tribe's Water Resources Program collected data at four primary sites as part of an ongoing sampling regime. Hangman Creek at stateline is shown in Figure 2A. The other three sampling stations are Moctileme Creek, Little Hangman Creek, and NF Rock Creek, which are shown in Figure 2B. A complete list of sample site locations and parameters can be found in Appendix A.

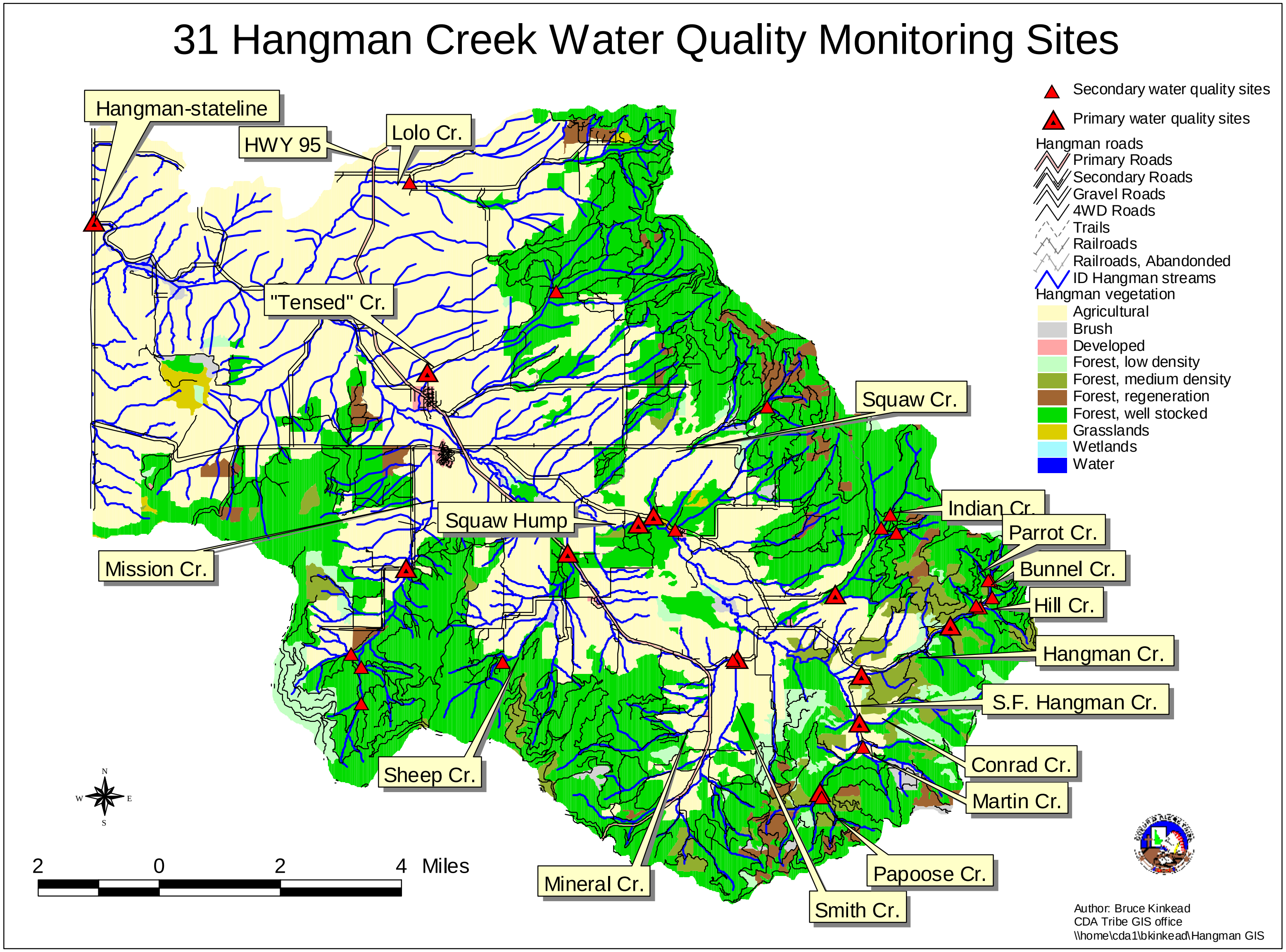

Figure 2A. Water quality sites located on Hangman Creek Proper, ID, 2002.

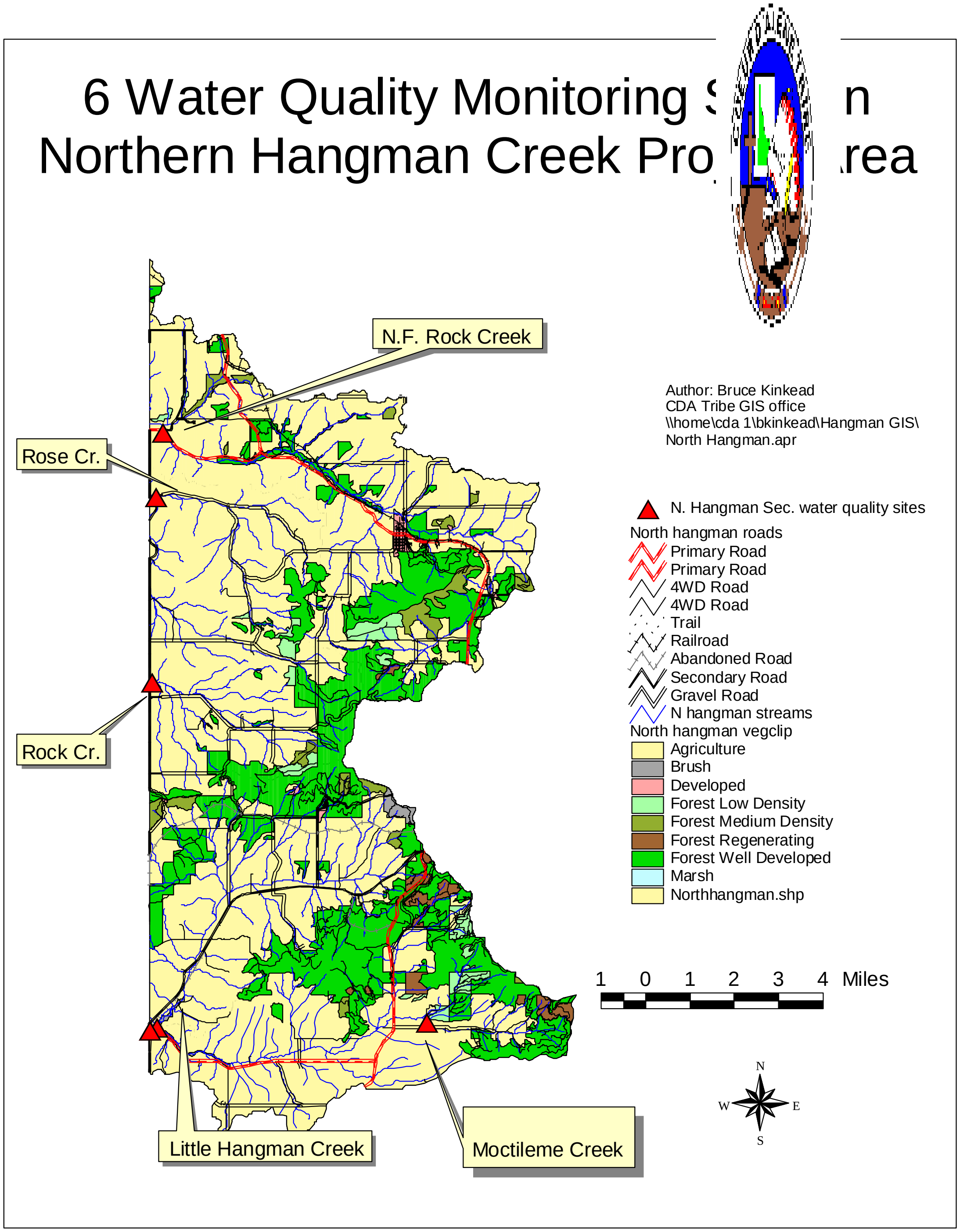

Figure 2B. Water Quality Sites located on tributaries of Hangman Creek, ID, in the northern project area, 2002.

Monitored Parameters

Bacteria data consisted of E-coli samples taken as part of Idaho DEQ's Beneficial Use Reconnaissance Project (BURP). Sampling and laboratory procedures can be found in 2001 Beneficial Use Reconnaisance Project: Workplan for Wadeable Streams (IDEQ 2002). Fecal coliform sampling done by the Coeur d'Alene Tribe's Water Resources Program used the following methods: Bacteria samples will be collected as close as practical to mid-stream and mid-depth. Grab samples will be collected using a clean sterile container provided by the analytical laboratory. All samples will be handled according to Standard methods for the examination of water and wastewater 18th Ed. (APHA) 1992 procedure 9060A collection and preservation of samples. Samples will be stored immediately in an ice bath for preservation and delivered to the contract laboratory within 6 hours of collection. All samples will follow strict chain of custody procedures as outlined in section 1060.B.1: Chain of custody procedures (APHA). Bacteria analysis will be completed by a qualified analytical laboratory in accordance with (APHA) standard method SM9213D for E.coli and SM9222D for fecal coliform.

Temperature, dissolved oxygen, pH, and conductivity were monitored at each station using a Hydrolab® DataSonde 4 multi-probe transmitter. Quality control was maintained through strict adherence to the standard operating procedures outlined in the Hydrolab® manual (Hydrolab Corporation 1997). Instrument calibration took place at the beginning of each day of monitoring. A calibration log was used to record the date and time of calibration, analyst performing calibration, calibration parameters, and other comments. At the end of the monitoring run, the instrument was checked for drift. All readings were recorded in the calibration log. All standards used for calibration were traceable to NIST Aqueous Electrolytic Conductivity Standard, or other comparable standards. Reagents used for calibration were accompanied by the following documentation: manufacturer, lot numbers, expiration dates, and date opened. A logbook was kept which contains all information related to preparation of reagents and standards.

Water samples submitted for laboratory analysis were collected using a certified water collection device and transferred to the appropriate containers for transportation to the contract laboratory. 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 chains of custody procedures were followed, as outlined in section 1060.B.1: Chain of custody procedures (APHA). All containers used were specially cleaned and prepared by the contract laboratory.

Total Suspended Solids was analyzed using EPA method 160.2: Gravimetric determination of Total Suspended Solids (USEPA 1993). TSS is defined as the residue left on a filter paper of 2μm or smaller pore size after a portion of sample has been filtered and dried. Results were compared to TSS models developed by Newcombe and Jensen (1996) to quantify the possible effects of TSS on adult, juvenile and egg/larvae stages of development for salmonids.

A qualified analytical laboratory completed turbidity analysis in accordance with standard method 2130B: Nephelmetric determination of turbidity (APHA, 1992) and/or 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). Turbidity in water is caused by suspended matter including clay, silt, and finely divided organic and inorganic matter. The clarity of a natural body of water is a major determinant of the condition and productivity of that system (APHA, 1992).

Discharge was taken at the time of water sampling whenever possible. A stage/discharge relationship is being developed at five sampling locations at this time, with more planned in the future. The rating curve will be used to determine the annual water budget for each stream sampled. Staff gauge heights were recorded to the nearest 0.002 of a foot. Discharge measurements are being taken at low, medium, and high flows in order to complete the rating curve. Discharge measurements were taken in accordance with standard IFIM methodologies (Bovee 1982). The wetted stream channel was divided into 20 equal cells and water velocity was measured in each cell using a Price model 622 digital flow meter. Discharge for each cell was calculated by multiplying the cell width by depth and velocity. All individual cell discharges were summed to determine total discharge in cubic feet per second.

Monitoring, Timing, and Schedule

The monitoring schedule was designed to capture data related to significant changes in the water quality throughout the year. This included physical and chemical characteristics. Sampling was done once a month at primary sites and at least three times per year for secondary sites. The three critical times of flood stage, spawning and incubation, and baseline flows were used to prioritize when the three samples would be taken. Sampling was initiated in May 2002, so flood stage occurring during rain on snow events was not sampled. June and August/September were sampled this past year.

Continuous Temperature Monitoring

Continuous temperature readings were taken every hour using RL 100's® made by Sensi Tech Inc in 19 locations. Locations of each of the RL 100's are shown in Figures 3A and 3B. Readings were taken from May until October. Some of the RL 100's were not purchased until summer when monitoring had already began. The additional sample sites were added to show differences between fish-bearing versus non fish-bearing locations. Data was collected at these additional sample sites in time to capture baseline conditions in August/September. Seven-day running averages for maximum and minimum temperatures were calculated and graphed.

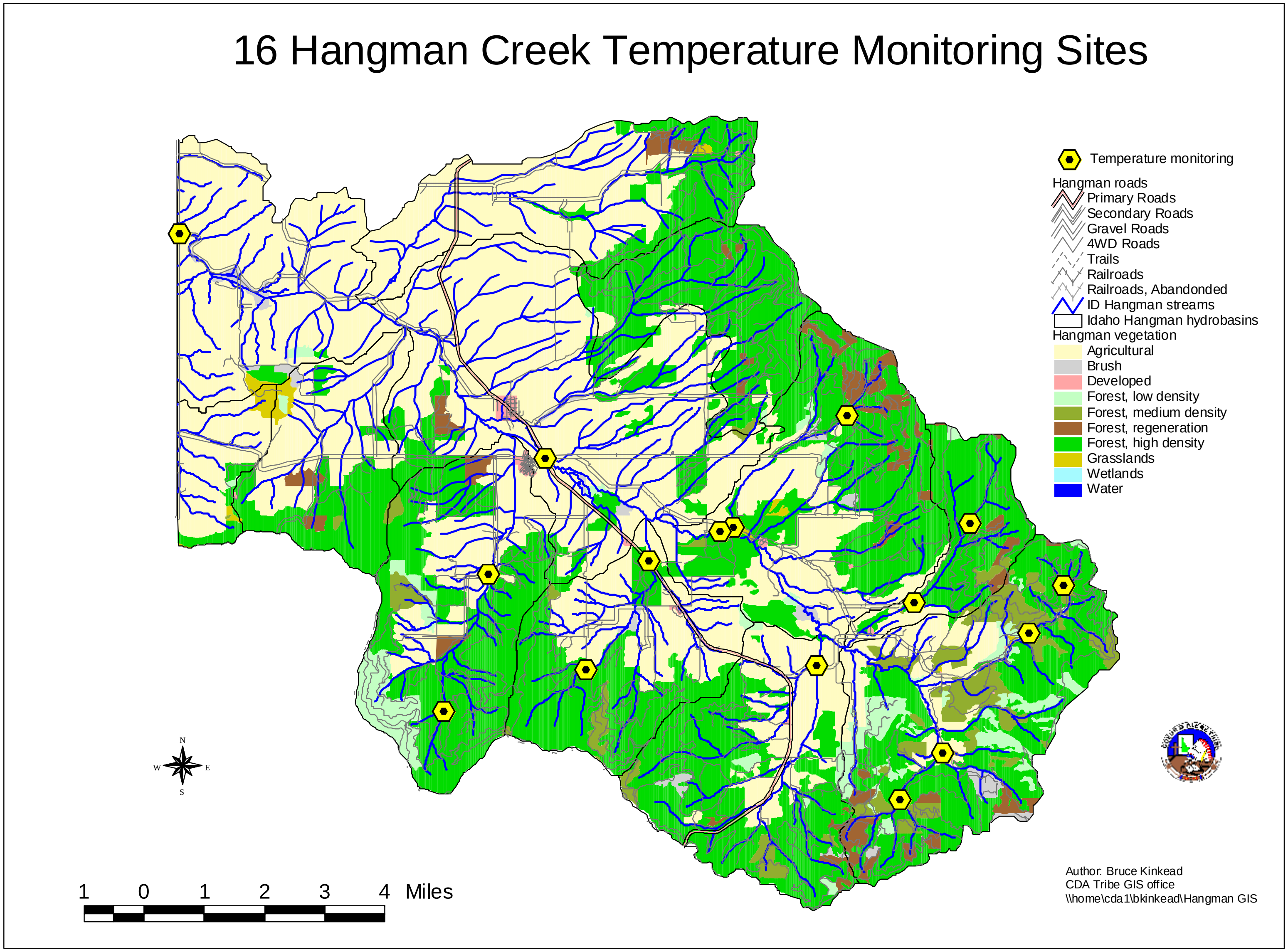

Figure 3A. Continuous temperature monitoring sites in Hangman Creek Proper, ID, 2002.

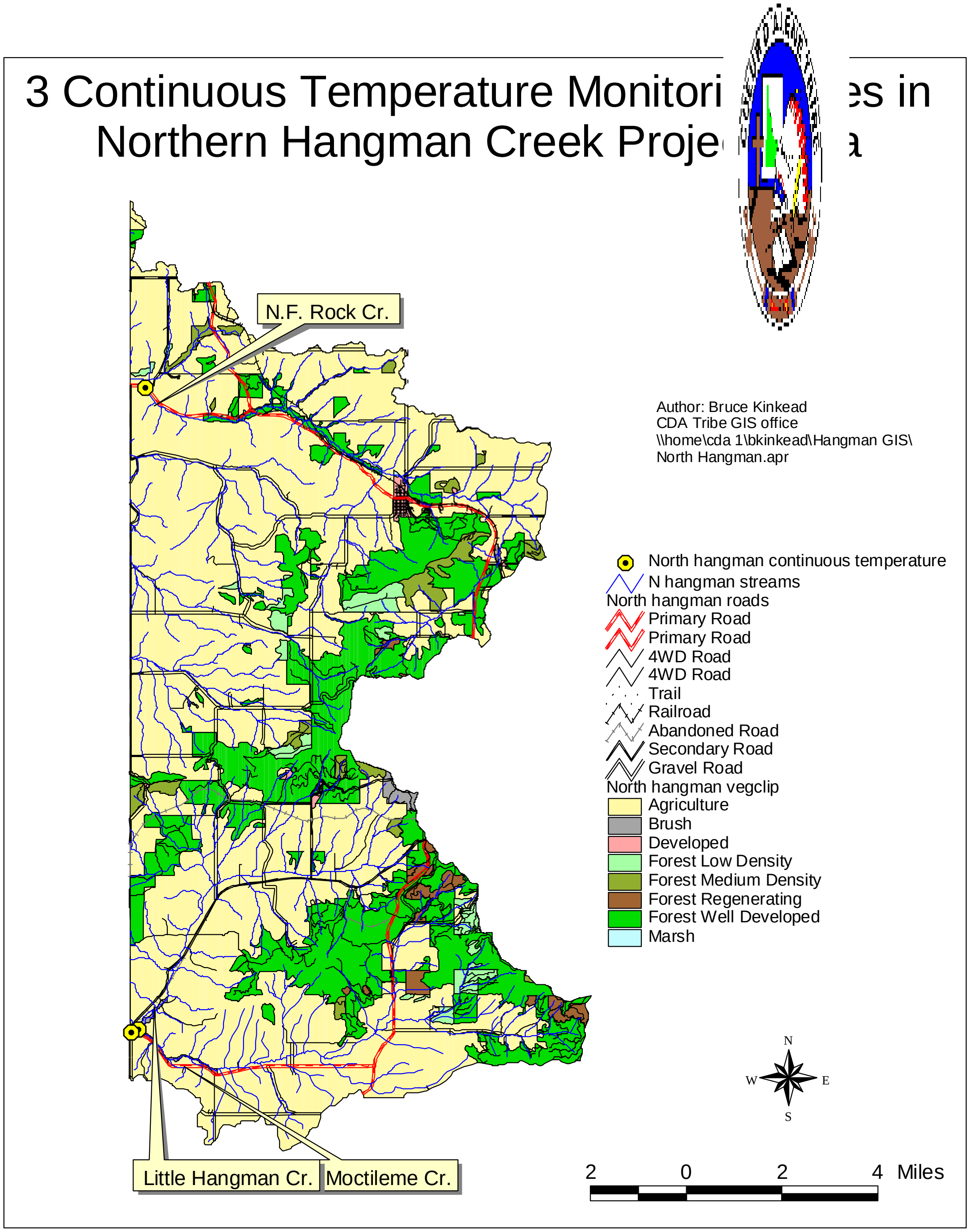

Figure 3B. Continuous Temperature Monitoring Sites located on tributaries of Hangman Creek, ID, in the northern project area, 2002.

FISHERIES

Thirty-seven sites were sampled in the summer to quantify the abundance and distribution of fishes during pre-base flow conditions (June –July). The Coeur d'Alene Tribe's Wildlife Program requested that current fish distribution maps be created as a first priority. Site selection was based on identification of distribution boundaries due to possible migration barriers and changes in hydrology with each input of discharge from tributaries. A single-pass method was used and no habitat measurements were made at the time of sampling. Therefore, no population estimates can be made with this data. The length of each sample unit was defined as twenty times the average stream width, with a minimum sample distance of 300 feet, so that all habitat types would be represented in the sample. Block-nets were placed at the upstream and downstream boundaries to prevent immigration and emigration. Each sample site was electro-fished using the standard guidelines and procedures described by Reynolds (1983). Fish were collected by spot shocking using a Smith-Root Type VII pulsed-DC backpack electro-fisher. Salmonid species, including cutthroat trout, redband rainbow trout, and bull trout, were the target species for this study. Fish identifications were made using Fishes of Idaho by Simpson and Wallace (1982) and Peterson Field Guides: Freshwater Fishes by Page and Burr (1991). Captured fish were identified, enumerated, measured (TL to nearest mm), and weighed. Other species such as Longnose Dace, Redside Shiner, Longnose Sucker, and sculpin (sp.) were also counted and a representative number weighed and measured in the same manner. The locations of shock sites are shown in Figures 4A and 4B. Appendix D contains detailed methods for electroshocking, along with the methods for population estimates that will be used in 2003-2004.

HABITAT SUITABILITY

Data taken from water quality sampling and continuous temperature monitoring was compared with salmonid presence in order to identify limiting factors for salmonid production at each of the water quality sampling sites. Limits were set for dissolved oxygen, maximum temperature, and Total Suspended Solids (TSS) at baseline flow. Perennial versus intermittent streams were also identified. The dissolved oxygen limit was set to 7.0 mg/L using Davis et al. (1963). TSS limits were set to 7.0 mg/L using the research compiled by Newcombe and Jensen (1996). The temperature limit was set to a somewhat arbitrary number, of a maximum of 20 degrees C. for an average weekly maximum, using a variety of references for thermal criteria for salmonids, (Bell 1986), (Selong et al. 2001), (Beschta et al. 1987), and (Hokanson et al. 1977).

IDAHO DEQ BURP SURVEYS

Nine total sites were selected to be surveyed for Hangman Creek, six within reservation boundaries, and three to the east of the reservation. Details can be found in 2001 Beneficial Use Reconnaisance Project: Workplan for Wadeable Streams (IDEQ 2002). The location of each BURP site within the watershed is shown in Figure 5. The following variables are part of the protocol: discharge; width and depth; shade; substrates; habitat types; bank stability; pool complexity; large woody debris; photo documentation and diagrammatic mapping; stream channel classification; conductivity; macroinvertebrates; fish; periphyton; fecal coliform/E coli; and amphibians. Data will be entered by IDEQ personel and all lab samples will be analyzed by subcontractors used by IDEQ. Lab samples will be analyzed early in 2003 and a full report from IDEQ is due during the fall of 2003.

EROSION MONITORING

Forty-one bank pins were installed during the fall of 2002. Steel rods (3/8”dia.) were driven horizontally into the stream banks above baseline water levels and below bankfull levels. Bank pins were installed at all water quality stations and an additional 15 locations. Data sheets are being maintained with the following information: location name; location description within the channel; and length of pin and date at the time it was installed/checked. Next year all locations will be downloaded onto GPS. Locations of the bank pins and the data sheets used to record locations are in Appendix C, Figures 1 and 2.

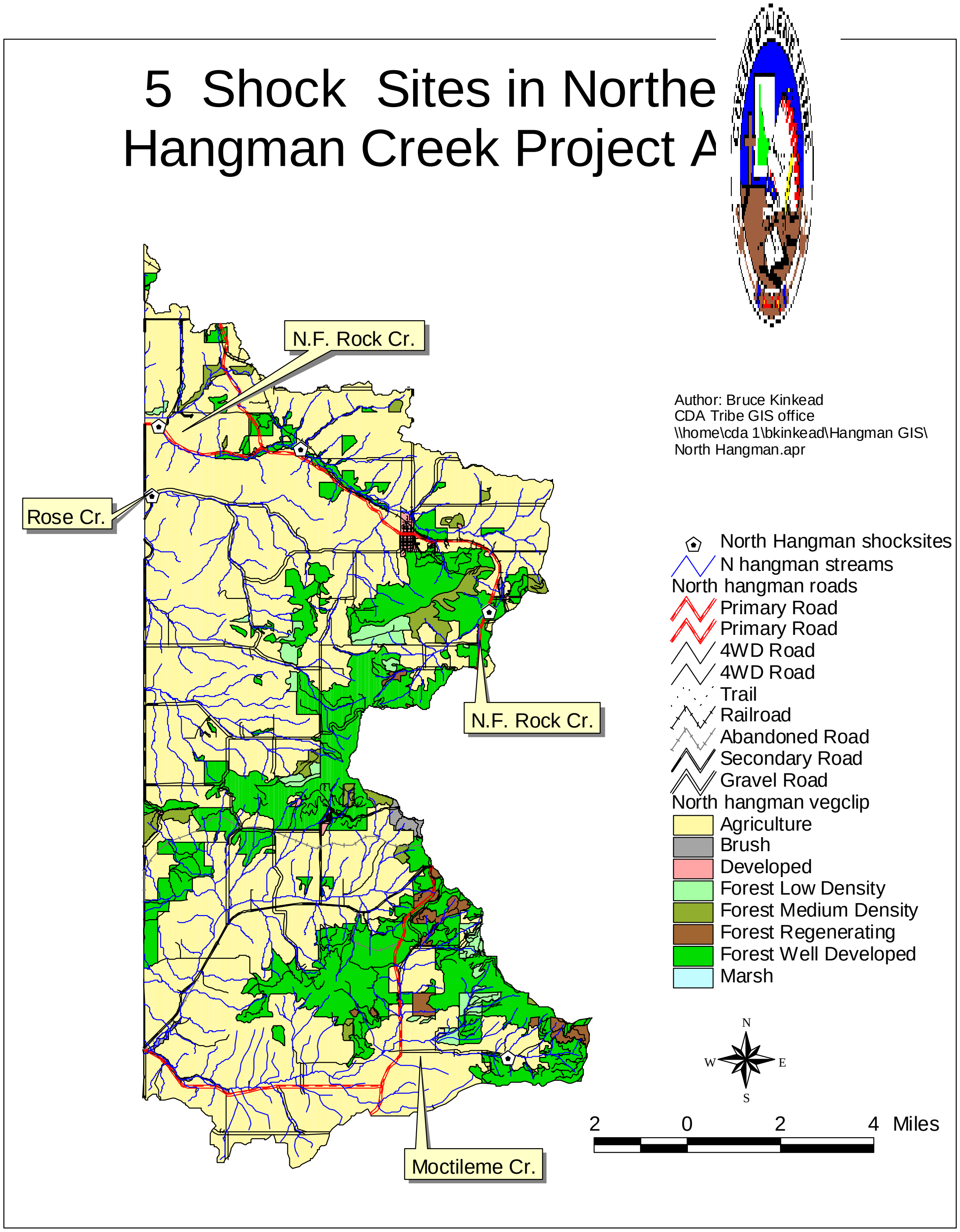

Figure 4A. Shock sites located on tributaries of Hangman Creek, ID, in the northern project area, 2002.

32 Shock Sites in Hangman Creek Proper

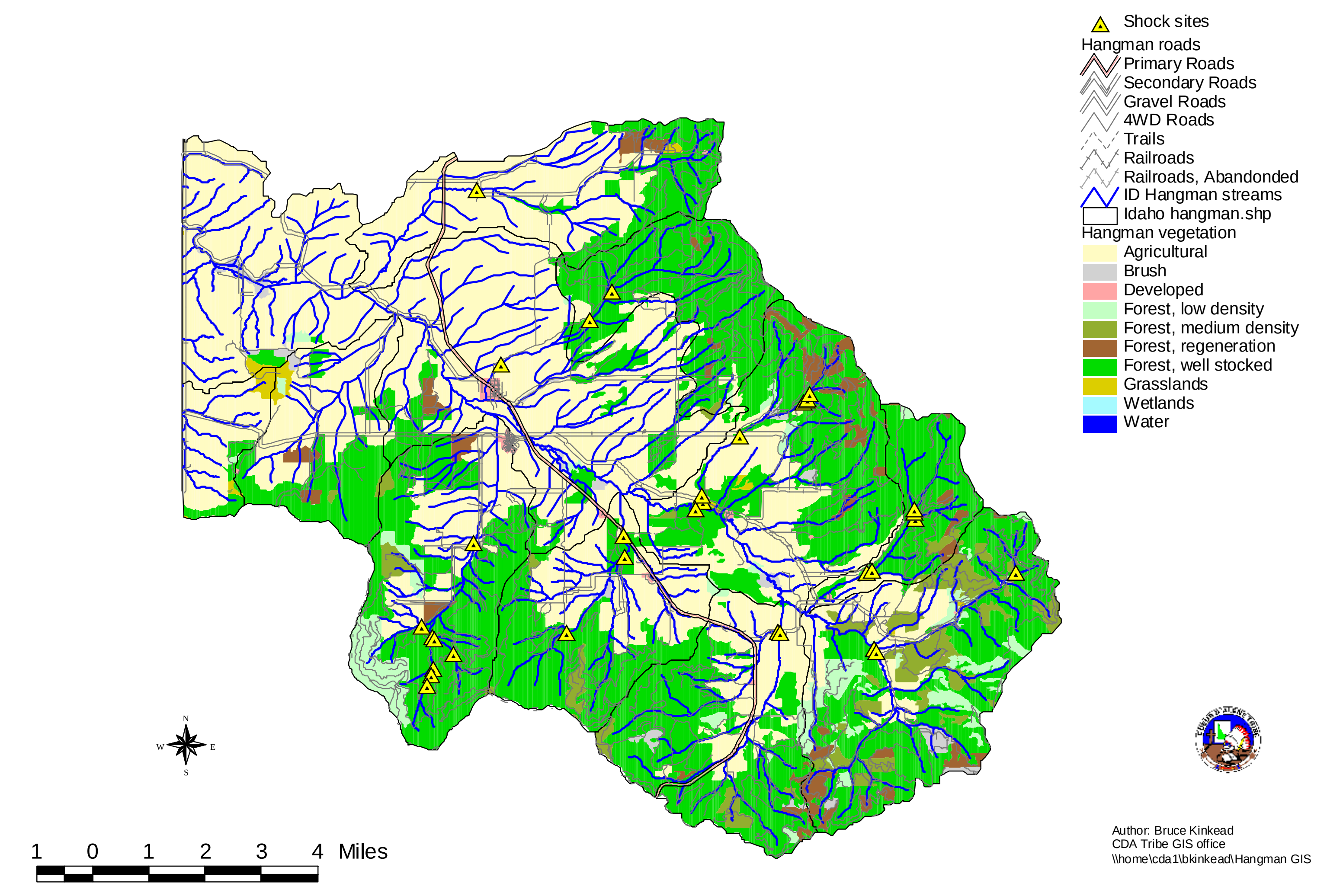

Figure 4B. Electroshocking sites in Hangman Creek proper, ID, 2002.

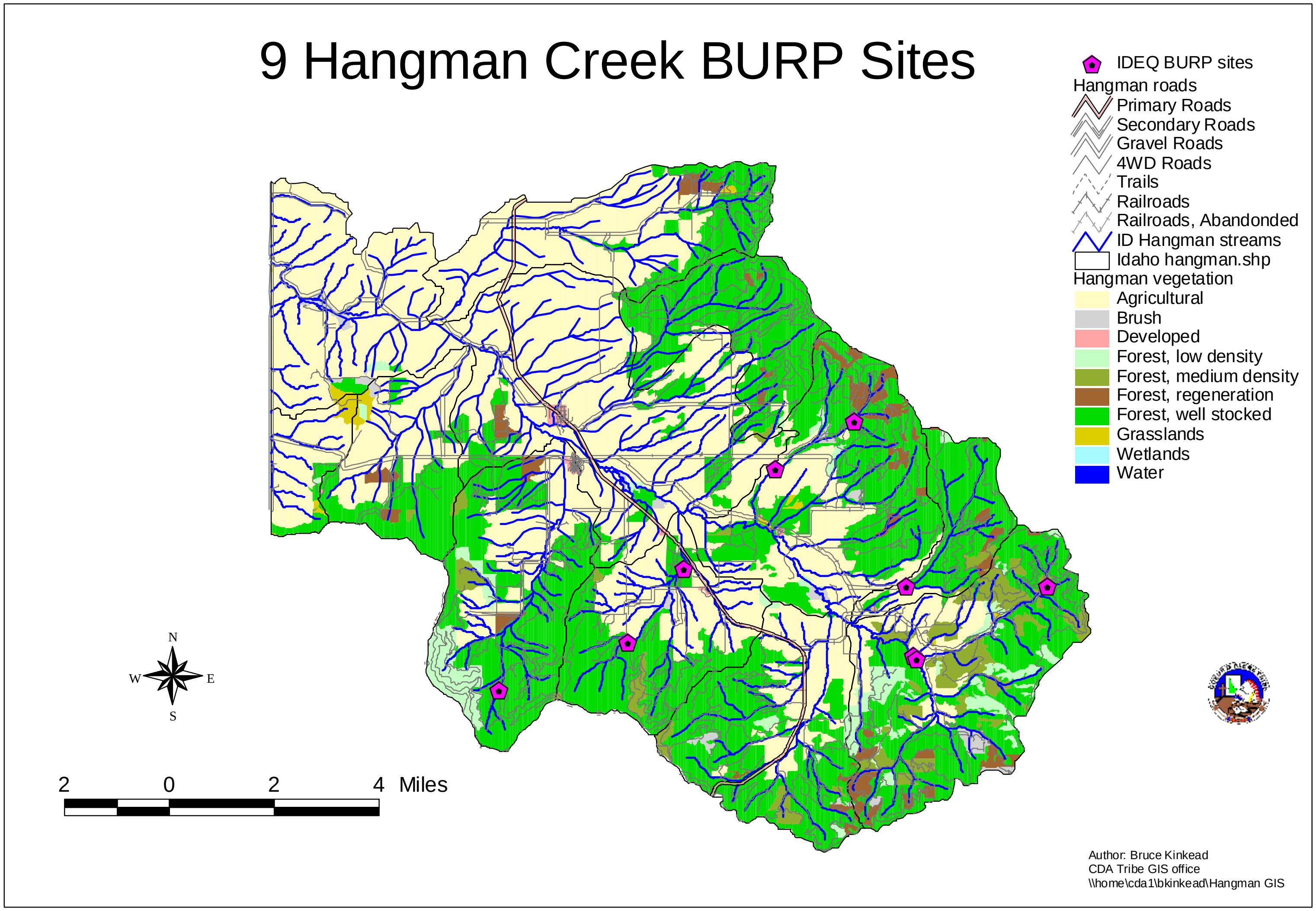

Figure 5. Idaho DEQ BURP (Beneficial Uses Reconnaisance Project) sites in Hangman Creek, Idaho, 2002.

FORESTRY AND ROAD CONDITIONS: METHODS AND SITE DESCRIPTIONS.

Roads were driven or walked and scouted for problems such as poor drainage, rutting, lack of culverts, blocked culverts, oil products entering streams, and a quick look at forestry practices as to whether buffer zone requirements were met. The initial work was intended to develop a more specific protocol that could be accomplished with the given resources but still cover the entire watershed. Problem spot locations were recorded using Global Positioning (GPS) equipment and downloaded onto a Geographic Information Systems (GIS) map to be later developed. Sites 1-6 were located using borrowed GPS equipment during the spring of 2002. The rest of the sites were plotted onto existing GIS maps using stream and road layers when GPS units were not available**.** Digital pictures of sites accompanied notes regarding problems. Most of the roads covered were access roads to sample sites. There were additional roads and timber cuts evaluated in the Mission Creek drainage. A great deal of logging by large timber operations has occurred recently in the drainage due to the tussock moth infestation. During the winter of 2002/2003 slash piles were burned and a portion of the new roads were tank trapped to limit access to vehicles. There was a lot of road condition and forestry practices survey work yet to be surveyed in the next two years, because of this amount of recent activity. Each of the sites will be revisited in 2003. Legal descriptions of each of the fifteen sites is as follows:

Site 1
Site description: T43N, R5W, S3, SW ¼. Haul road at a 0.2 miles south of bridge crossing of WF Mission.

Site 2
Site description: T43N, R5W, S3, SW ¼. Haul road following West Fork of Mission Creek 0.3 miles upstream of bridge crossing of the West Fork.

Site 3
Site description: T43N, R5W, S3, SE ¼. Skid road crossing EF Mission Creek 0.1 miles upstream of confluence with Mission Creek.

Site 4
Site description: T43N, R5W, S3, SE ¼. On road crossing of MF Mission located 0.1 miles west of site 3 on same skid road.

Site 5
Site description: T44N, R3W, S33, NW ¼. Hangman Creek Road at hairpin turn just prior to going over pass to Santa Creek drainage.

Site 6
Site description: 43N, R4W, S1, SE ¼. 43N, R4W, S1, SE ¼. Papoose Road at Hangman Creek crossing.

Site 7
Site description: T44N, R3W, S33, SE ¼.   Hangman Creek Road at hairpin turn just prior to going over pass to Santa Creek drainage.
Site 8
Site *description:* T43N, R5W, S4, SE ¼. Small haul road crossing the headwaters of WF Mission. It is the lowest of a series of roads on the ridge south of the WF Mission.

Site 9
Site description: T43N, R5W, S10, NE ¼. On Pole Camp Road at culvert crossing MF Mission Creek.

Site 10
Site description: T43N, R5W, S3, SE ¼. On small road crossing a tributary of East Fork Mission, 0.2 miles west of Pole Camp road.

Site 11
Site description: T43N, R5W, S3, SE ¼. On small road crossing East Fork Mission, 0.2 miles west of Pole Camp Road

Site 12
Site description: T43N, R5W, S2, SW ¼. Pole Camp Road at East Fork Mission Creek.

Site 13
Site description: T43N, R5W, S10, NE ¼. On Pole Camp Road 0.2 miles south of Site 9

Site 14
Site description: T44N, R4W, S4, NW ¼. On Johnson Road between the South Fork and main stem of Tensed Creek.

Site 15
Site description: T44N, R4W, S14, NW ¼. 0.2 miles behind Potlatch gate and upstream of the Apple Horse Farm.

3.0 RESULTS

WATER QUALITY

Bacteria levels were monitored by the Tribe's Water Resources Program, for Fecal coliforms, and for E-coli through IDEQ's BURP process. Table 1 summarizes E-coli sampling and Table 2 summarizes Fecal coliform sampling. Values shown in bold are considered bacteria "hits" that are above Idaho limits for E-coli. When a limit of 500/ml was exceeded, five more samples were taken. Based on this year's samples, there only appears to be a problem on the main stem of Hangman Creek and one tributary, Little Hangman. There was also a "hit" on S.F. Hangman and subsequent sampling was done to get a mean of five samples. That mean did not exceed water quality standards of 250/ml.

Table 1. Summary of E-Coli counts performed in conjunction with BURP surveys in the Hangman Creek watershed in 2002.

Hangman Creek, Sanders	Date	7/8/02	7/26/02	7/29/02	8/2/02	8/9/02	8/14/02	Mean
	E-coli (#/100ml)	**1100**	**730**	**2400**	**1000**	59	31	**887**
SF Hangman Cr.	Date	7/8/02	7/26/02	7/29/02	8/3/02	8/9/02	8/14/02	Mean
	E-coli (#/100ml)	**730**	64	26	24	21	370	206
Indian Creek	Date	7/8/02						
	E-coli (#/100ml)	86						
Bunnel Creek	Date	7/12/02						
	E-coli (#/100ml)	65						
Lower Mission Cr.	Date	7/10/02						
	E-coli (#/100ml)	120						
MF Mission Cr.	Date	6/27/02						
	E-coli (#/100ml)	3						
Lower Sheep Cr.	Date	7/10/02						
	E-coli (#/100ml)	18						
Upper Sheep Cr.	Date	7/10/02						
	E-coli (#/100ml)	51						
Lower Squaw Cr.	Date	7/10/02						
	E-coli (#/100ml)	4						
Upper Squaw Cr.	Date	7/10/02						
	E-coli (#/100ml)	29						

Fecal coliform levels shall both not exceed a geometric mean value of 100 colonies/100 ml, and not have more that 10 percent of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 ml per State of Washington Standards (Walt Edelen 2002). Large spikes in Fecal coliforms can be seen in Hangman Creek and especially Little Hangman Creek, above the Moctileme Creek confluence (Table 2).

Table 2. Summary of fecal coliform counts sampled by Coeur d' Alene Tribe's Water Resources Program in the Hangman Creek watershed in 2002.

Hangman-Stateline	Date	7/24/02		8/8/02	8/14/02	8/29/02	Mean
	Fecal coliform (#/100ml)	58		28	61	57	51
Hangman-HWY 95	Date	7/25/02	8/1/02	8/8/02	8/14/02	8/29/02	Mean
	Fecal coliform (#/100ml)	**1310**	170	110	94	63	**349**
Little Hangman-Stateline	Date		8/1/02	8/8/02		8/29/02	Mean
	Fecal coliform (#/100ml)		55	24		**450**	**176**
L. Hangman-Above Moctileme	Date	7/24/02	8/1/02	8/8/02	8/14/02	8/29/02	Mean
	Fecal coliform (#/100ml)	**4200**	20	91	97	**8200**	**2522**
Moctileme Creek	Date	7/24/02		8/8/02	8/14/02	8/29/02	Mean
	Fecal coliform (#/100ml)	97		25	51	180	88

Mainstem Hangman Creek

Water quality results are summarized in Tables 3 and 4. Dissolved oxygen levels remained below 7.0 mg/L from mid-late summer and made a recovery by October when temperatures dropped. Levels of pH remained in the range of 6.0-8.0 for the entire year at the stateline site, but were 5.45 on two different occasions upstream of HWY 95 at the Squaw Hump site. Levels of pH at the Upper Hangman Creek sites (Table 4) were within the range of 6.0 – 8.0. A storm event was sampled on March 11-13th that showed a typical early spike in TSS and TSS dropping before discharge did (Figure 6).
During this storm event, TSS concentrations were at levels greater than 450 mg/L over the course of the three days sampled, with a high of 1186 mg/L. Even the base flow conditions showed TSS levels in the range of 5.0-7.0 mg/L. Water quality improved proceeding upstream to sites 5 (above S.F. Hangman confluence) and 6 where dissolved oxygen, TSS and temperature were much improved. DO levels never dropped below 8.48 and TSS levels were at 5.0 mg/L or below.

Table 3. Summary of water quality parameters sampled by the Coeur d' Alene Water Resources Program at the Hangman-stateline site, Hangman Creek, ID.

Site 1, Stateline							
Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
1/25/02	6.35	88.0	13.62	0.40	808.9	554.00	357
2/14/02					59.6		
2/19/02	6.92	132.9	12.82	1.56	139	51.00	66
2/20/02	6.86	100.7	11.84	1.79	290.70	65.00	71
3/11/02	6.92	79.8	12.63	1.60	550.60	1186.00	554
3/12/02	6.13	37.4	12.94	2.03	1836.00	464.00	357
3/13/02					460.80	87.00	68.1
5/3/02	7.38	39.8	11.92	10.03	<1.55	30.70	11.4
5/17/02	7.23	42.4	10.11	12.31	<1.55	8.50	6.21
6/5/02	7.31	53.1	8.86	17.32	<1.55	7.30	4.55
6/11/02	7.30	86.3	9.31	13.55	<1.55	6.5	4.19
8/5/02	7.24	89.8	6.91	17.01	<1.55	5.00	2.26
8/20/02	7.21	101.3	5.74	16.53	<1.55	6.30	3.26
9/4/02	7.25	128.2	5.32	16.13	<1.55	5.00	2.42
10/22/02	7.65	248.3	10.80	5.88	<1.55		
11/13/02					56.13		

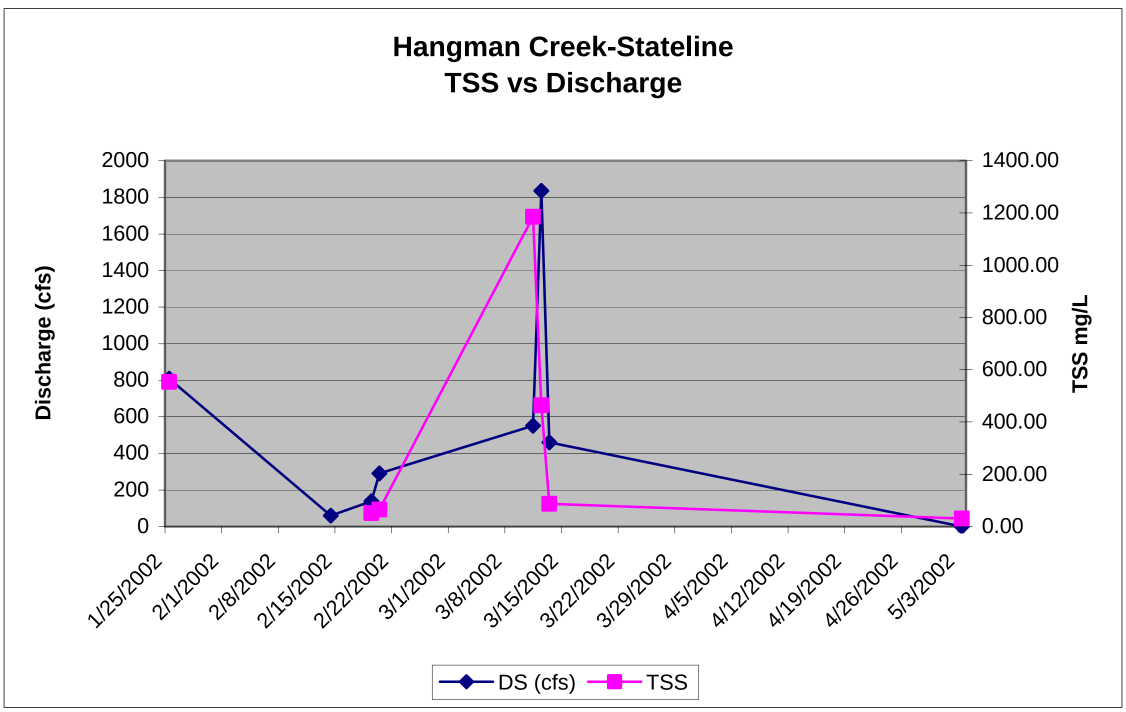

Figure 6. TSS and discharge at the Hangman Creek-stateline site as measured by the Coeur d'Alene Tribe's Water Resources Program in 2002.

Table 4. Summary of water quality parameters sampled at various sites, arranged downstream to upstream, on Hangman Creek, ID.

Site 3, Squaw Hump

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
7/3/02	5.45	39.9		14.38	5.401	25.7	9.81
8/2/02	5.45	39.9		13.38	0.094	24.5	6.23
9/24/02					0.349	7.50	4.01
10/8/02	6.76	34.7	8.78	8.12	0.274	3.8	4.12

Site 5, At SF Hangman Road

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/17/02	7.08	40	11.7	12.6	0.577	3	4
7/12/02	7.5	46	8.48	19.13	0.735	4.5	2.88
7/23/02							
9/4/02					0.113	1	2.82
9/24/02					0.025	5	2.47
10/10/02					0.113	1	1.92

Site 6, Forested Site

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/27/02	6.92	39.9	10.76	14.61	0.374	5.3	3.23
7/12/02	7.48	41.6	8.93	14.05	0.510	1	2.71
9/24/02					0.080	2.7	2.02
10/8/02	7.05	22.9	10.26	6.79	0.141	2.3	1.01

Site 7, Upper Hangman

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/27/02	6.41	39.1	11.23	11.77	0.018	42.2	7.56
8/1/02	7.15	52.8	9.77	11.33	0.032	3.5	2.29

Other Sites sampled by the CDA Tribe's Water Resources Program,

Tributaries of Hangman Creek that are heavily impacted from agriculture include Little Hangman Creek, Moctileme Creek, and NF Rock Creek. All three showed high levels of TSS (Tables 5-6). Little Hangman Creek had a maximum of 1,403 mg/L, and Moctileme had a max of 1,167 mg/L occurring on March 11, 2002. NF Rock creek does not have any data for this rain-on snow event but showed summer concentrations around 10.0 mg/L. Little Hangman Creek and NF Rock Creek had low DO levels (Tables 5-6), dropping below 6.0 mg/L and 4.0 mg/L respectively. NF Rock Creek had no surface flow by early July (Table 6).

Table 5. Summary of water quality parameters sampled in Little Hangman Creek, and Moctileme Creek, by the Water Resources Program in 2002.

Little Hangman Creek

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
1/7/02						593	343
1/25/02						896	296
2/19/02	6.68	166.8	13.14	0.72		92.0	81.2
2/20/02	6.96	168.6	11.32	2.88		168	89.3
2/22/02						347	168
2/26/02					117.865		
3/11/02	6.72	77.8	12.96	0.34		1,403	291
3/12/02	6.8	71.9	12.84	1.71		160	132
3/13/02	6.86	72.8	13.06	1.04	347.122	36.7	50.2
5/3/02	8.13	127.1	11.43	9.77	3.993	16.3	13.9
5/17/02	7.89	131.6	10.79	12.82	2.105	6.00	3.76
6/5/02	7.54	122.9	9.02	16.88	1	6.80	3.06
6/11/02	7.46	192.5	9.56	13.45	1.96	5.20	3.73
8/5/02	7.57	120.0	9.02	15.57	0.15		
8/8/02						1.0	1.04
8/20/02	7.29	122.7	6.54	13.87	0.25	5.30	2.72
9/4/02	7.26	148.7	5.96	13.95	0.22	3.8	1.82
10/22/02	7.6	264.0	10.67	4.97			

Moctileme

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
1/7/02						295	253
1/25/02						750	398
2/20/02						56.5	76.7
2/22/02						304	205
3/11/02	6.81	90.9	12.85	0.77		1,167	409
3/12/02	6.96	82.3	12.44	2.77		130	124
3/13/02						35.0	56.8
5/3/02	7.80	123.0	12.83	10.06	2.24	6.80	11.3
5/17/02	7.76	127.0	13.59	11.78	1.66	7.30	4.25
6/5/02	7.53	109.5	9.32	16.09	0.87	5.50	3.56
6/11/02	7.48	164.3	9.47	13.00	1.15	2.50	3.78
8/5/02	7.46	118.1	8.35	14.48	0.18		
8/8/02						7.70	1.70
8/20/02	7.54	118.6	9.01	13.26	0.2	2.70	0.980
9/4/02	7.48	142.7	8.21	12.65	0.219	13.3	1.71
10/22/02	7.72	255.0	11.67	5.17	0.192		

Table 6. Summary of water quality parameters sampled in the NF Rock Creek watershed by the Water Resources Program in 2002.

NF Rock Cr. Date	pH	Cond (µmhos/cm)	DO mg/L	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/1/02					0.353	11.3	9.36
5/16/02	6.98	74.3	8.52	13.75	0.102	20.8	5.65
6/10/02	7.13	128.4	8.88	11.48	0.107	13.2	4.83
7/9/02	6.91	287.0	3.50	24.66	0.000	13.3	4.86
7/30/02	7.45	354.0	4.22	15.17	0.000		
8/20/02	7.68	258.7	8.46	18.27	0.000	10.5	11.7
9/9/02	7.45	287.0	5.25	11.24	0.000	9.3	6.03
10/21/02	7.35	515.0	10.47	4.96	0.000		

Misc. Non-Fish Bearing Streams

Additional sites were sampled during 2002 in areas that were agriculture dominated. Tensed Creek which drains from the Little Butte area, upper Moctileme Creek, Rose Creek, Rock Creek, and Lolo Creek all show the water quality that is less than optimum for trout (Table 7). Only Moctileme Creek and Rose Creek flowed throughout the summer (Table 7). TSS levels were especially high at Moctileme Creek and Lolo Creek during the summer, showing concentrations of 57mg/L and 118 mg/L respectively. The upper Tensed Creek site is the only one that is not agriculture dominated. The area has had a lot of recent logging by Coeur d'Alene Tribal interests. It was all thinning operations and buffer zones around channels were more than adequate. It is not known what effect this logging may have had on baseline flow as there is no water quality data available for this stream. Slash piles have not been burned as of April 2003. The road leading into this area was gated but later the gate was removed.

Table 7. Summary of water quality parameters sampled in 2002 on miscellaneous tributaries within the Hangman watershed that are non-fish bearing: Lolo Creek, Moctileme Creek, Rose Creek, Rock Creek, and Tensed Creek (Little Butte area).

Lower Tensed Cr.

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/13/02					1.55	6.50	4.20
7/3/02	6.98	107	NA	14.78	0.028	12.30	4.57
8/1/02					0.0		
9/4/02					0.0		
10/10/03					0.0		

U. Tensed Cr.

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
8/2/02	6.92	29.7	NA	14.78	0.004	1.00	5.77
9/4/02					0.0		

Rose Creek

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
9/11/02					0.097	3.50	0.942

Rock Creek

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
9/11/02					0.051	5.3	2.12

U. Moctileme Cr.

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
7/16/02	6.96	62.2	8.62	10.91	0.057		
8/5/02					0.042	57.2	17.8

Lolo Creek

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/14/02					0.29		
7/16/02	6.77	24.8	4.38	15.33	0.002	118	68.6
8/1/02					0.0		
9/24/02					0.0		

Mission Creek

The Data Sonde 4 ® (Hydrolab) was unavailable on several occasions when water quality sampling was scheduled for Mission Creek. Therefore, dissolved oxygen data is minimal. Dissolved oxygen levels were around 9.0-10.0 mg/L in October. Dissolved oxygen was slightly lower at the lower station compared to the tributaries upstream on October 9, 2002. It is anticipated that DO readings for August/September would be less than readings taken in October, for temperature reasons alone.

PH levels did not appear to be an issue within the drainage based on the few Hydrolab® readings taken. All readings were in the range of 6.48-7.34.

Middle Fork Mission had the highest discharge during May and June compared to the other two tributaries, as well as concentrations relative to the other two forks (Table 8). MF Mission Creek also had the lowest water temperatures (7.5 C.) and highest dissolved oxygen (11.66 mg/L) of the three on June 11, 2002. EF Mission Creek had the highest levels of TSS (48.0mg/L) in June (Table 8). The relative amounts of TSS and discharge for the three tributaries changed as the summer proceeded. Despite discharge decreasing from June to August, the TSS levels increased from 5.7 to 13.5 mg/L at the M.F. site (Figure 8). By end of August, MF Mission and WF Mission Creek had TSS concentrations of 13.5mg/L and 13.7mg/L respectively. Baseline flows occurred in August and were less than 0.1 cfs for all three forks of Mission Creek (Table 8). The shift in relative discharge and TSS concentrations for the three forks is clearly seen in Figures 9 and 10. Baseline flow for the main stem was 0.016cfs and TSS concentrations were around 3.0 mg/L TSS.

There has been a lot of recent logging in the Mission Creek drainage. The WF Mission Drainage was logged around 5 years ago and the timber density is very thin at this time. Logging was done on EF Mission in 2001 near the confluence with the main stem on the Desmet Mission's land, and additional work was being done farther up the creek on Pole Camp Road on Stimson's land during June. The MF of Mission Creek was logged during July and August on a additional plot of Stimson's land. All work done in the area was done by Danielson Logging. A small logging operation was done in the West Fork drainage during August. This operation was done on Bennett Tree Farms land. Logging in the East Fork and Middle Fork drainages is not reflected in the Tribal GIS vegetation layers shown in Figure 7. It is suspected that logging was the reason for high TSS levels in the East Fork during June, and an increase in TSS in the West and Middle Fork drainages during logging operations in July and August.

Table 8. Summary of water quality parameters sampled in the Mission Creek watershed, 2002.

Lower Mission

Date	PH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/21/02					1.991	10.30	15.20
7/3/02					0.137	15.30	12.20
8/2/02					0.016	3.20	2.07
8/29/02					0.016		
9/25/02					0.035	3.00	1.63
10/9/02	6.75	70.5	7.92	9.05	0.035	2.00	1.75

EF Mission

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/21/02					0.399	40	11.1
6/11/02	6.82	37.4	9.2	11.4	0.152	48	17.3
8/21/02					0.064	4.3	5.53

MF Mission

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/21/02					0.976	38.3	11.40
6/11/02	6.76	27.1	11.66	7.5	1.059	5.7	8.93
6/27/02							
8/1/02					0.021		
8/21/02					0.070	13.5	6.54
10/9/02	6.48	16.1	805	9.1	0.012	1.0	3.55

WF Mission

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/21/02					0.141	7.7	11.4
6/11/02	7.34	45.6	10.81	11.53	0.310	4.2	9.86
8/1/02					0.025	3.3	3.16
8/21/02					0.035	13.7	6.59
10/9/02	6.68	26.9	8.06	10.12	0.017		

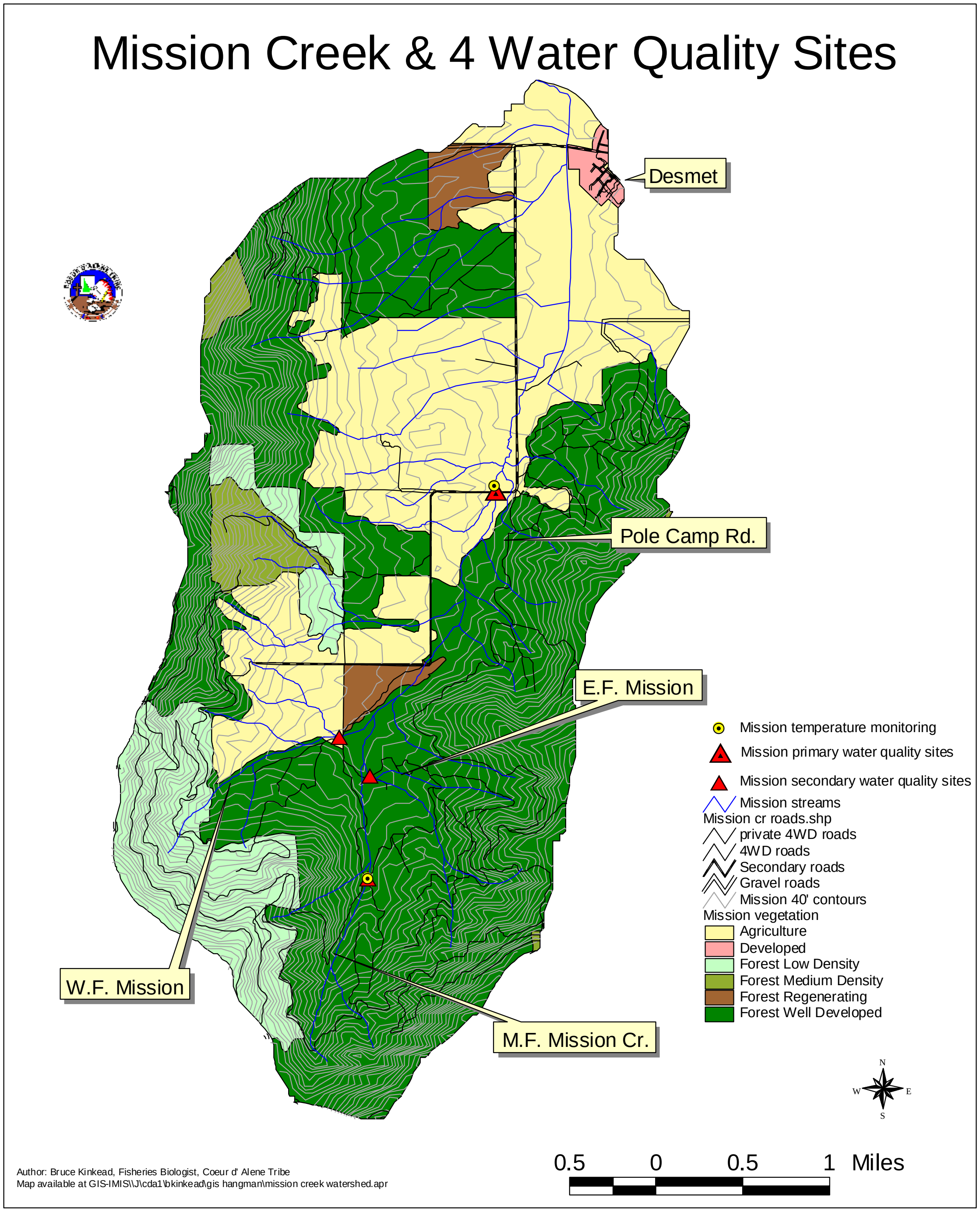

Figure 7. Water quality and continuous temperature monitoring in Mission Creek, Idaho, 2002.

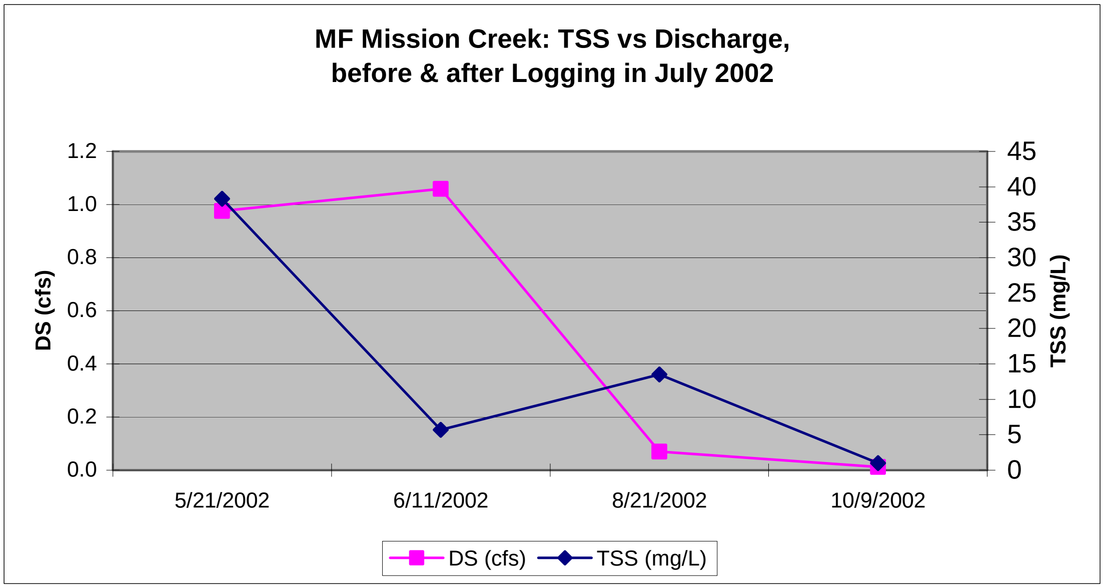

Figure 8. Discharge and TSS relationship on MF Mission Creek, ID, before and after logging operations in July, 2002.

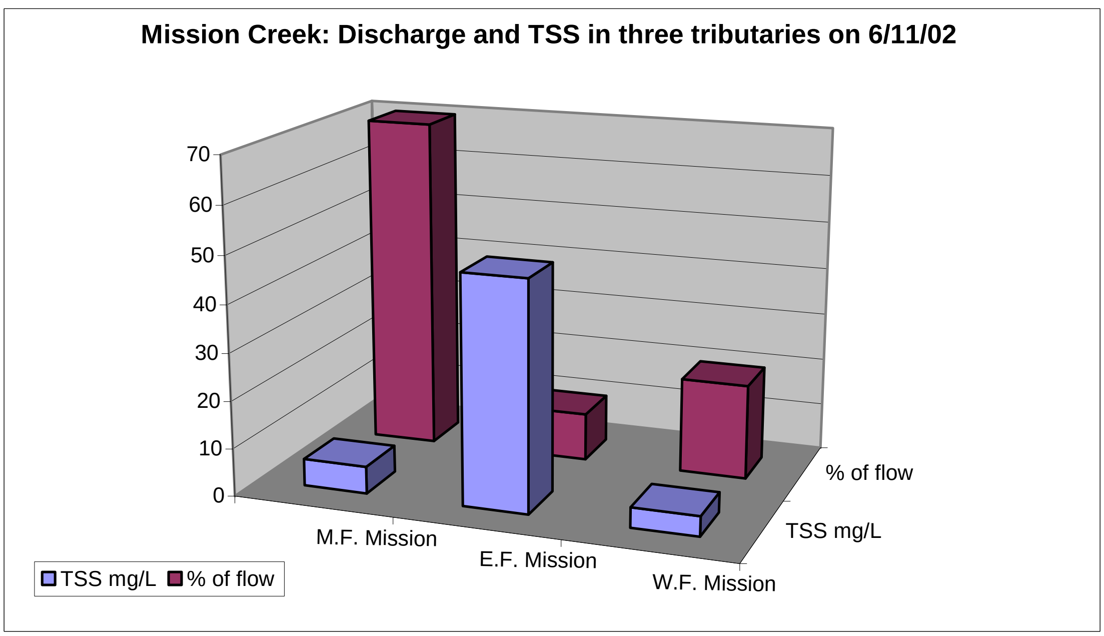

Figure 9. Discharge and TSS concentrations in three tributaries of Mission Creek on June 11, 2002.

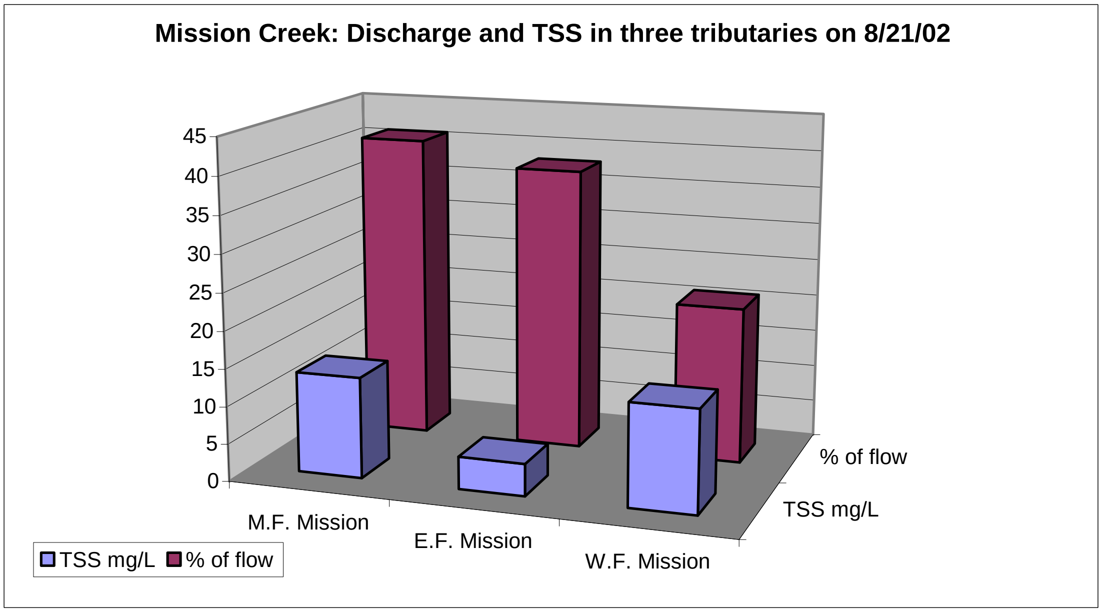

Figure 10. Comparison of discharge and TSS concentrations in three tributaries of Mission Creek, relative to each other on August 21, 2002.

Sheep Creek

As was the case in Mission Creek, Sheep Creek had ongoing disturbance during the summer, although not to the same degree. A pair of private trout ponds above the Upper Sheep Creek sampling site were being dug out during the summer. There was also logging in August/September downstream from the sample site. There was a lot of bank sloughing in the area above the lowest sample site according to field notes taken. This will be further described in IDEQ's BURP survey reports when they come out later this year. Sampling locations and differences in vegetation can be seen in Figure 11.

Discharge was less than 0.1 at both the upper site and lower (Table 9). The highest concentration of TSS sampled was 48.80 mg/L on July 3, 2002 at the lower site during a rainstorm. Other than that, TSS concentrations were at moderate levels (2.0-11.0g/L) for the remainder of the sampling period. Dissolved oxygen showed marked differences between the two sites. Base flow conditions existed on 8/1/02 and 9.67 mg/L of dissolved oxygen was recorded at the upper site and 5.52 mg/L DO was recorded at the lower site. Values for pH were all within the 6.46-7.12 range.

A tributary that goes along Larson Road (Figure 11) was scouted during the fall and the landowner was contacted. The landowner indicated the channel was perennial and that fish have been present in the last couple of years. We anticipate taking some Hydrolab® readings and water samples at this location in 2003 and 2004.

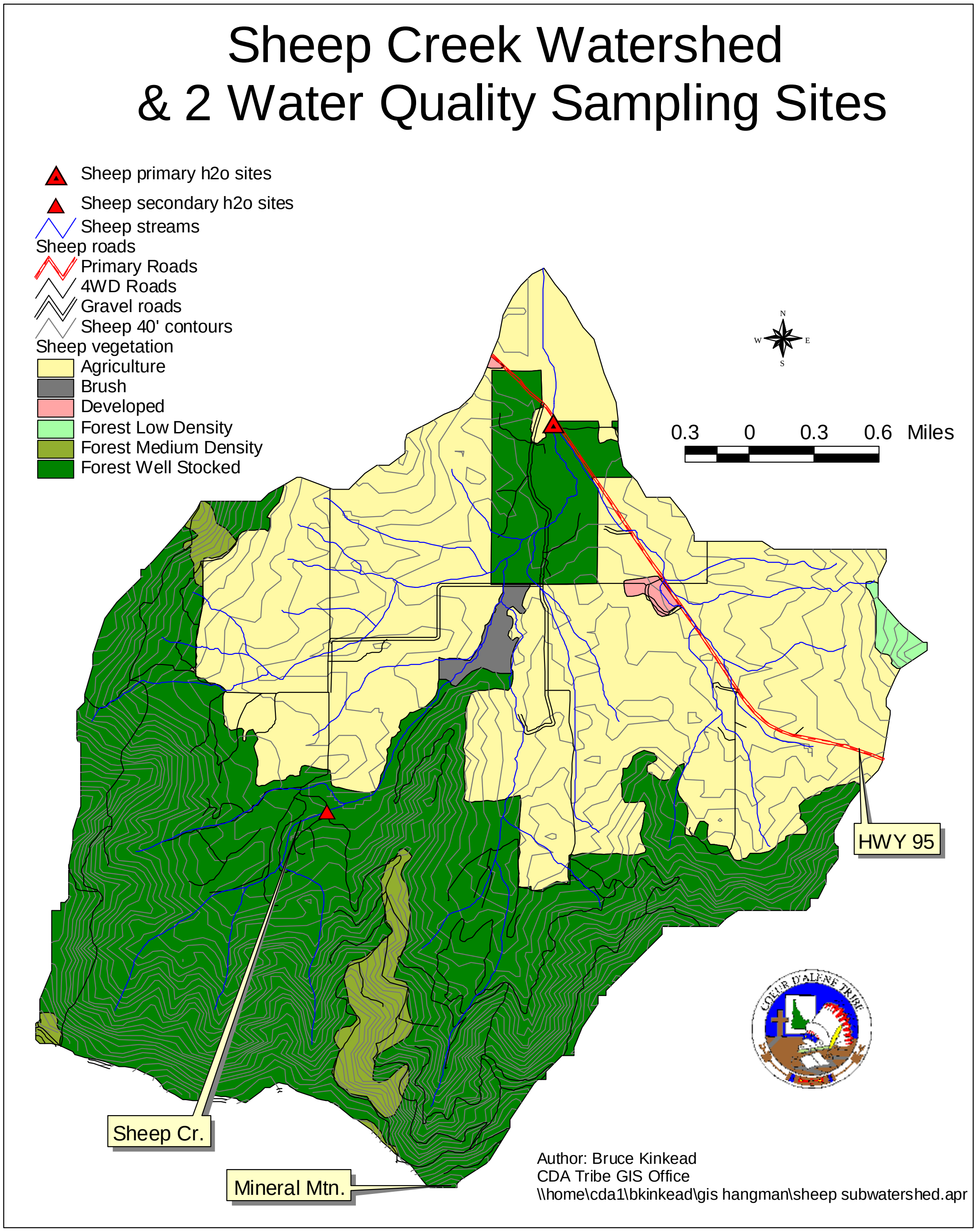

Figure 11. Water quality sampling locations in Sheep Creek, ID, 2002.

Table 9. Summary of water quality sampled in the Sheep Creek watershed, 2002.

L. Sheep Cr							
Date	PH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/22/02					2.805		
6/16/02					1.3332	10.7	11.4
7/3/02					0.378	48.80	10.8
7/12/02	7.12	62.4	6.18	19.1			
8/1/02	6.66	54.2	5.52	11.72	0.072	4.50	1.95
9/4/02					0.0033	2.30	1.53
9/24/02					0.065	2.80	1.82
10/9/02	6.48	50.6	6.47	9.21	0.065	2.00	1.37
Upper Sheep							
Date	PH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
7/10/02							
7/16/02	6.94	29.3	8.86	13.96	0.039	2.5	3.61
8/1/02	7.00	27.3	9.67	11.46	0.076	7.3	4.04
9/24/02					0.012		
10/10/02	6.46	13.9	8.46	7.82			

Smith Creek

Much of Smith Creek flows through agriculture land and exhibits the flashy hydrograph expected of such a stream. It was flowing at a rate of 1.547cfs on 6/13/02, but all surface flow ceased after the rainstorm on July 3rd, 2002. TSS concentrations were 239mg/L that day. Mineral Creek showed the same characteristics but dried up prior to July 3rd. TSS levels were similar on June 13, 2002 (Table10).

Table 10. Summary of water quality sampled in the Smith Creek watershed, 2002.

Smith Cr.							
Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/22/02					2.234		
6/13/02					1.547	10.8	4.18
7/3/02	6.67	96.9	8.44	13.73	0.028	239.00	41.7
8/1/02	7.18	28.5	6.65	14.78	0	13.00	6.89
10/8/02	7.59	72.2	9.95	12.57	0	41.00	11.10
Mineral Cr.							
Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/22/02					1.88		
6/13/02					1.455	11.8	12.1
7/3/02					0.000		
8/1/02					0.000		
10/8/02					0.000		

Squaw Creek

Squaw Creek is another stream that an upper sampling site was chosen to capture differences in water quality because of the obvious habitat differences (Figure 12). *Note, examination of Figure 12 reveals that the Squaw Creek sub-basin includes several small, unnamed channels that do not actually flow into Squaw Creek.* Two small tributaries empty into Squaw Creek below the upper sampling station. Despite this fact, the discharge was about the same (0.2cfs) at the two Squaw Creek sampling sites in late June. By July 10, 2002, the lower site no longer had any surface flow, whereas the upper site continued to flow. TSS concentrations were below detectable levels for all samples taken at the upper site. Concentrations at the lower site ranged between 7.0-14.0 mg/L TSS.

Table 11. Summary of water quality parameters sampled in the Squaw Creek watershed, 2002.

L. Squaw Cr.							
Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/12/02					0.734	7.5	4.84
6/21/02	6.56	24.9	11.17	10.86	0.226		
7/3/02	7.03	54.6		11.55	0.135	14.00	10.30
7/10/02					0.000		
8/1/02					0.000		
9/4/02					0.000		
9/24/02					0.000		
10/10/02					0.000		
U. Squaw Cr.							
Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/28/02					0.226	1	1.31
9/19/02					0.022	1	1.34
9/25/02					0.014		
10/10/02	6.00	15.0	8.13	10.9	0.021		

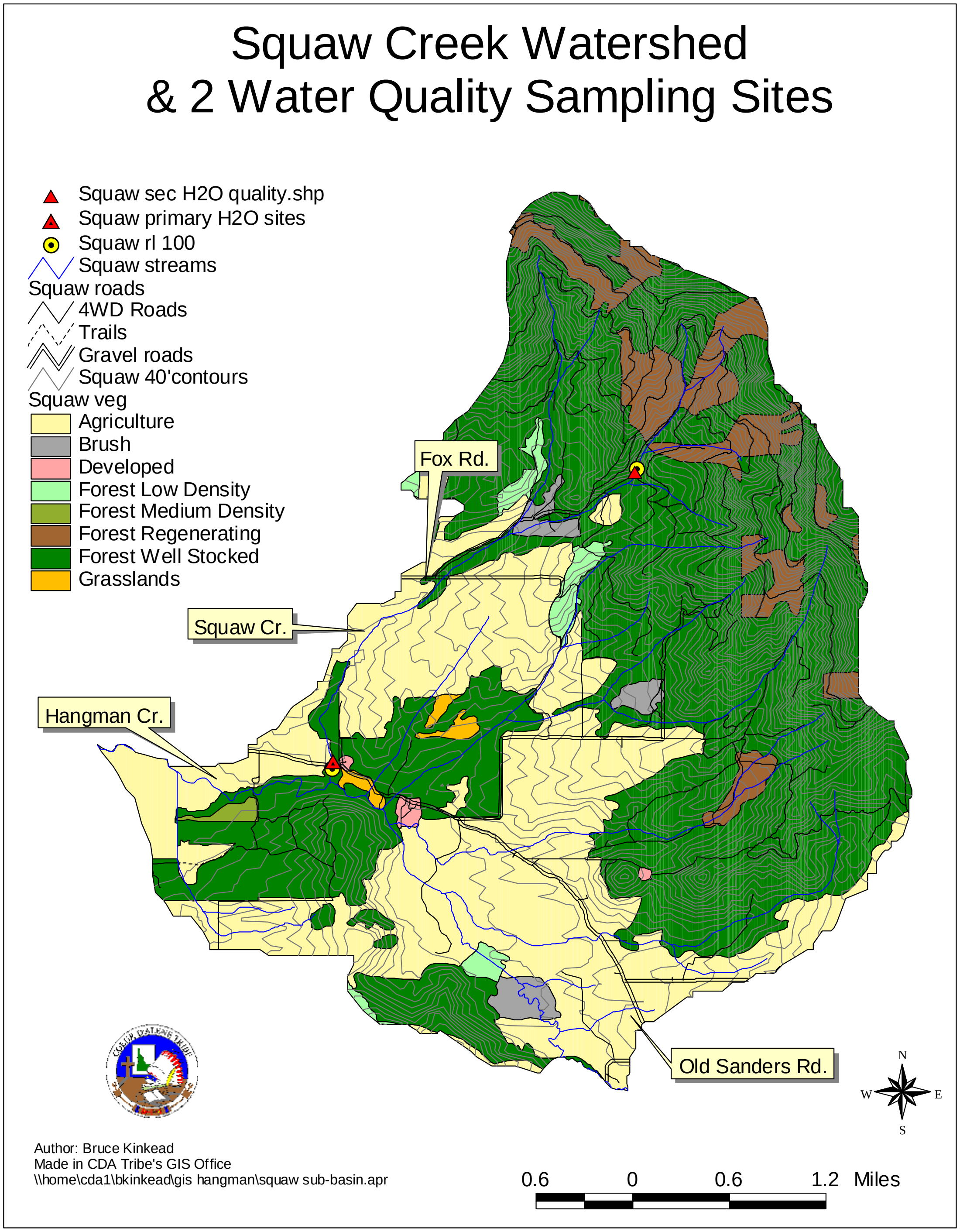

Figure 12. Water quality site locations in Squaw Creek, ID, 2002.

Indian Creek

Indian Creek water quality data showed cold temperatures, high oxygen and all pH values between 6.4- 7.2 (Table 12), except for one outlier on July 12. TSS values and turbidity were low throughout the summer except for a spike somewhere in mid-July to mid August. Despite flows dropping during July and August, TSS and turbidity rose at the lower Indian Creek site in late July (Figure 13), and did not subside until early September. It is clear that the source was EF Indian Creek as seen by an even larger spike during this time frame (Figure 14). The three contributing sub-basins that were monitored are shown in Figure 15. Differences in the relationship of TSS and discharge of the three contributing tributaries of Indian Creek (Figure 16) is evident during mid-summer. There has been more recent logging in the East Fork drainage as seen in the differences in vegetation types seen in Figure 17, which may explain the rising TSS concentrations in EF Indian (Figure 14)

Table 12. Summary of water quality parameters sampled in the Indian Creek watershed, 2002:

L. Indian Cr

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/3/02	6.65	17.13	11.9	5.3	15.065	6.80	4.80
5/17/02	6.63	14.6	10.49	5.57	6.843	3.50	2.78
5/23/02	6.67	14.3	10.73	5.41			
6/5/02	6.82	16.2	10.97	8.49	2.358	3.80	1.90
6/11/02	6.69	26.5	11.44	6.74	1.734	2.00	1.84
6/13/02					1.502	3.30	1.81
7/3/02	7.03	32.5	12.2	10.66	1.662	1.00	1.38
7/9/02							
7/12/02	8.55	22.7	9.38	16.04	0.571	2.00	1.35
8/1/02	7.22	35.2	12.2	10.66	0.267	14.5	3.16
9/4/02					0.233	2.00	1.09
9/20/02	7.12	17.5	9.52	9.0	0.154	1.00	0.749
9/24/02					0.096	1.00	0.713
10/8/02	7.04	18	10.16	7.75	0.154	1.00	0.841

EF Indian Cr.

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/15/02	6.77	37.9	12.11	9.27	0.146	2.2	1.85
7/16/02					0.058	111	19
8/14/02	7.01	120.1	8.91	10.51	0.034	47.5	9.44
9/20/02	6.91	20.5	9.52	9.0	0.016	1	0.564
10/8/02	6.75	20.8	9.65	8.59			

U. Indian Cr.

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L	Turbidity (NTU)
6/15/02	6.94	42.3	12.26	8.88	0.575	3	1.55
8/14/02	7.21	57.81	10.01	11.38	0.167	1	0.693
9/20/02	7.19	30.5	9.52	8.5	0.050	1	0.408
10/10/02	7.17	31.5	9.98	6.66			

NF Indian Cr.

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L	Turbidity (NTU)
6/18/02	6.52	20.4	12.75	8.12	0.96	2.2	1.61
8/14/02	6.9	20.9	9.84	11.54	0.082	3	0.404
9/20/02	6.4	16.1	10.56	8.5	0.099	1	0.561
10/8/02	6.84	10.7	10.19	8.07			

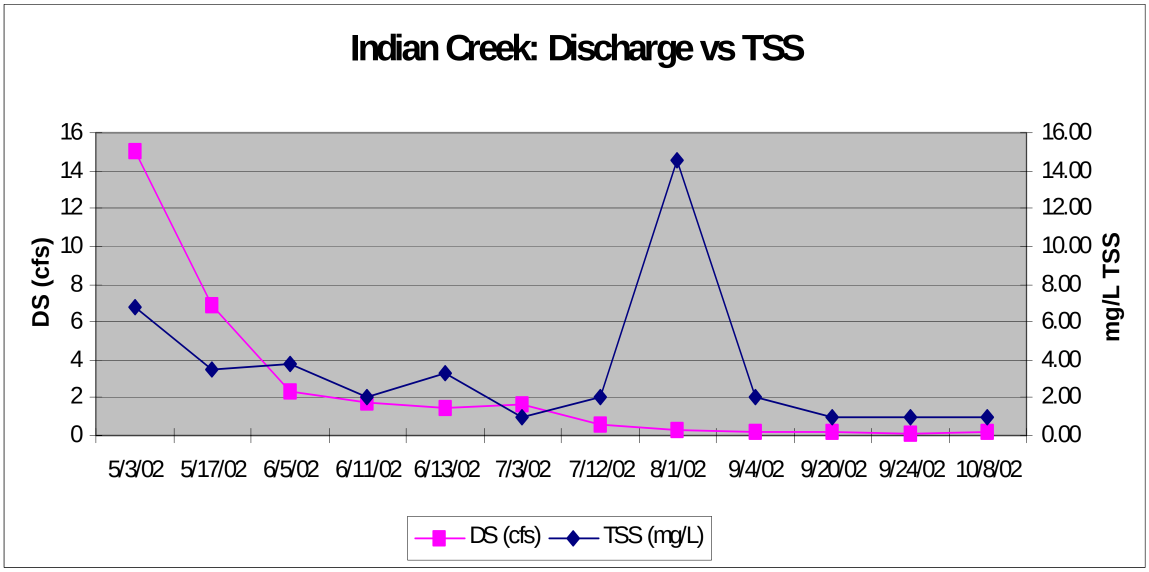

Figure 13. Discharge and TSS measurements taken on the main-stem of Indian Creek, ID, 2002.

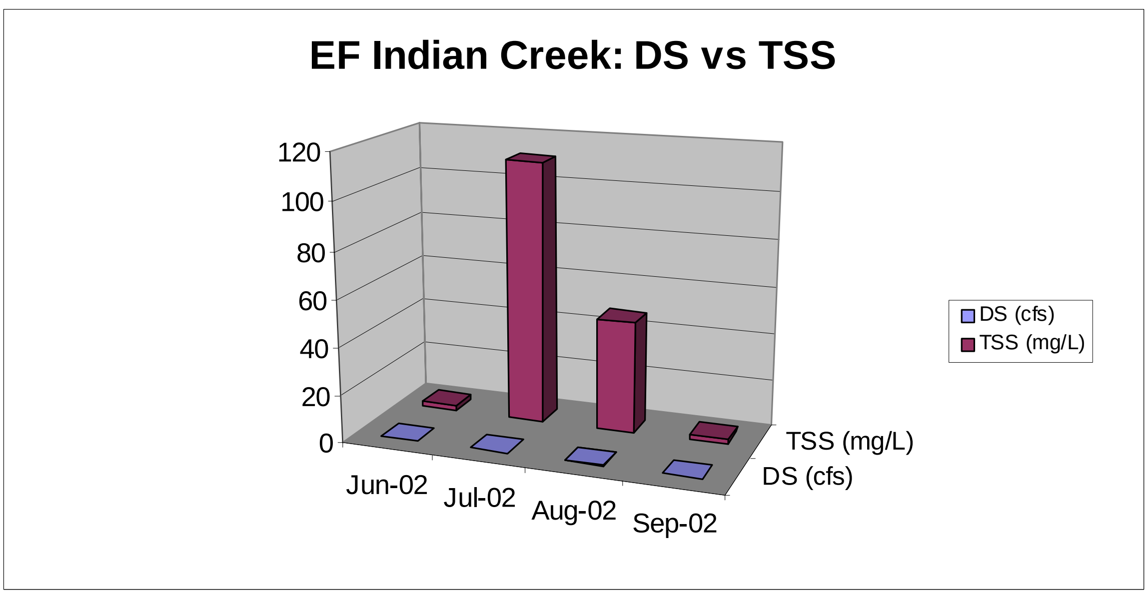

Figure 14. Discharge and TSS measurements taken on EF Indian Creek, ID, during 2002.

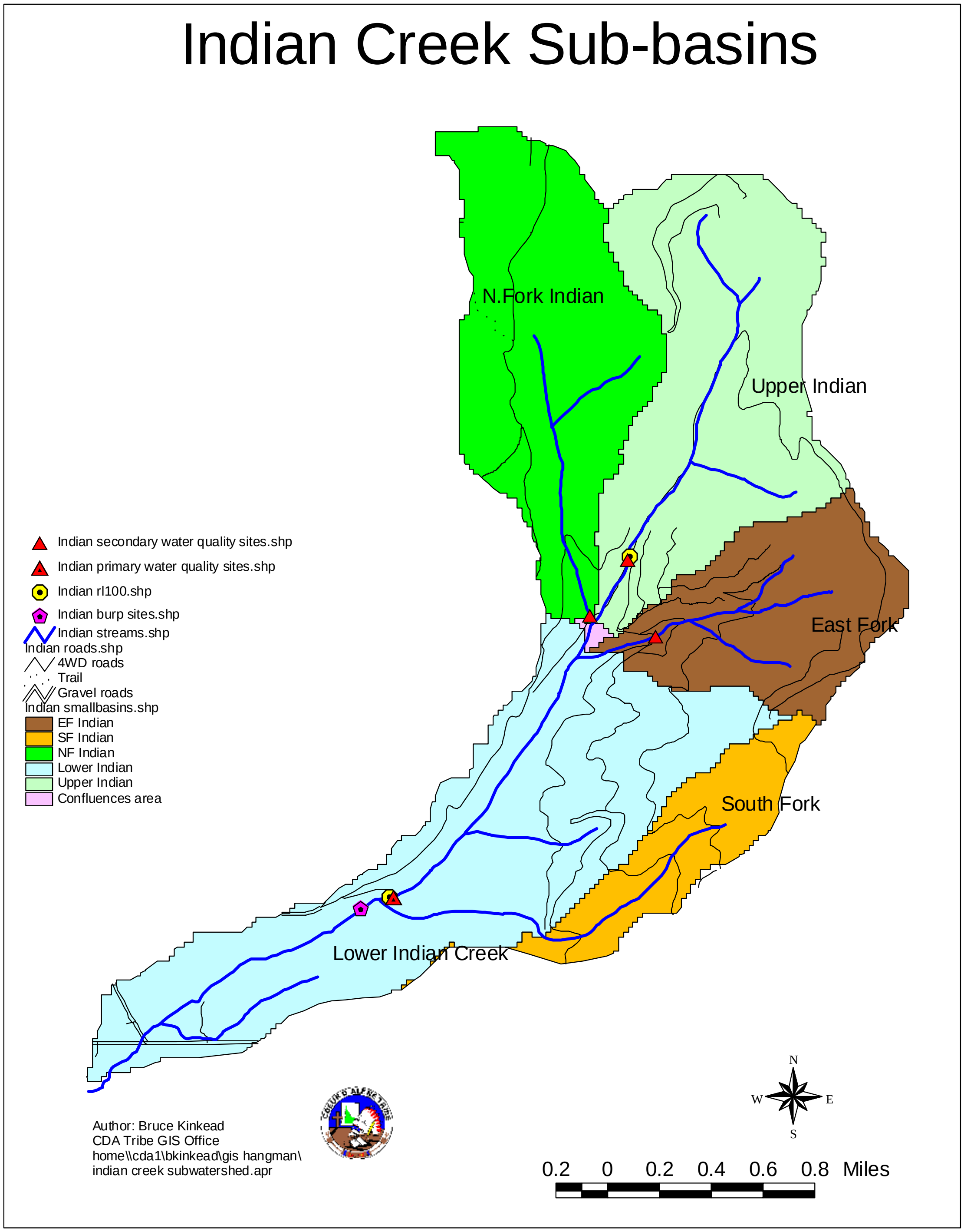

Figure 15. Indian Creek sub-basin boundaries and water quality stations within the watershed.

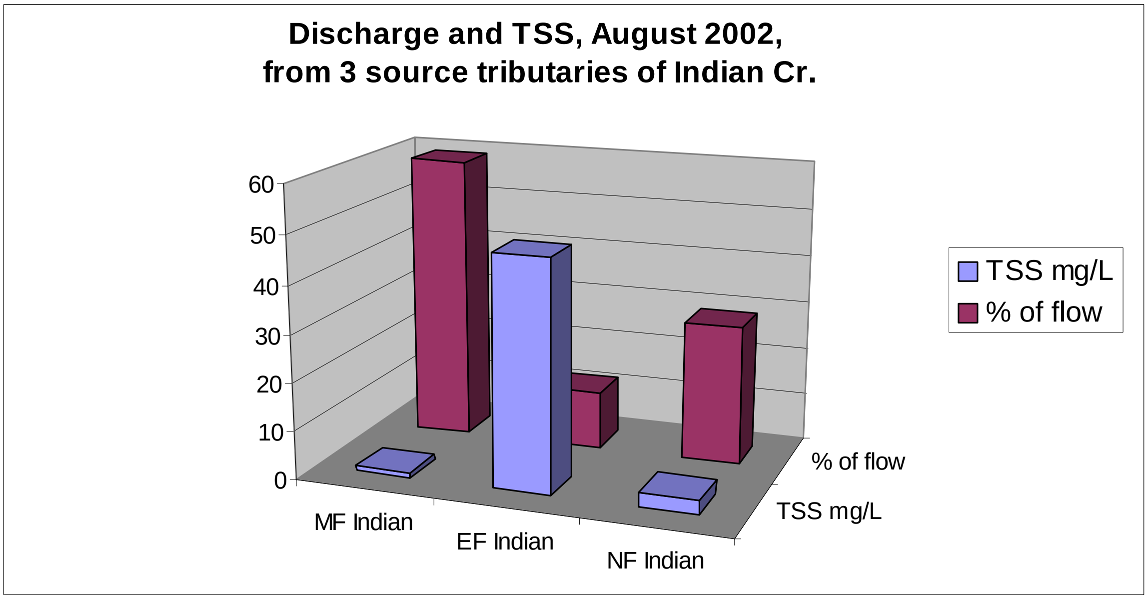

Figure 16. Discharge and TSS in three tributaries of Indian Creek on August 14, 2002.

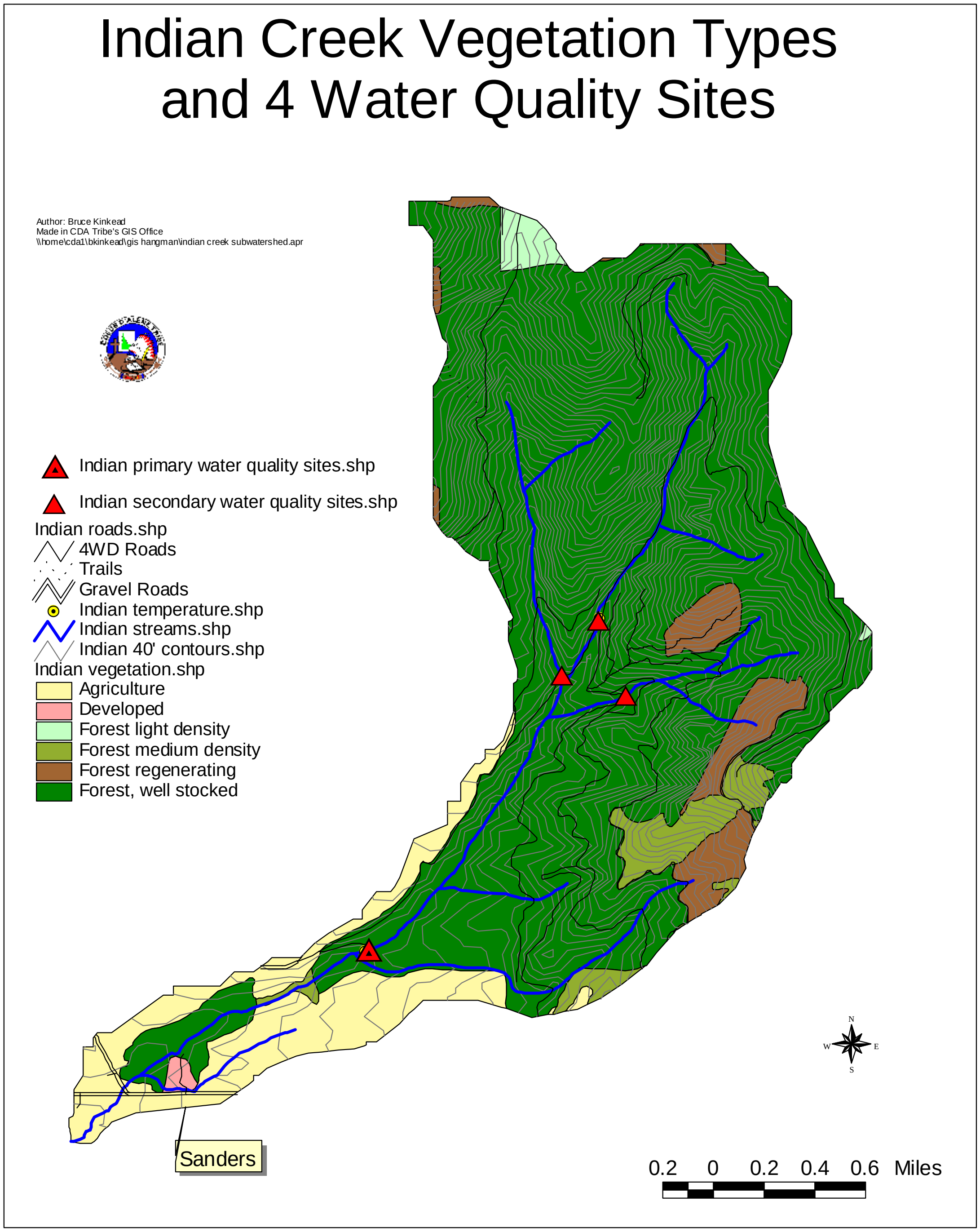

Figure 17. Vegetation types and locations of water quality sampling stations in Indian Creek, ID.

South Fork Hangman Creek

The entire South Fork Hangman drainage is outside of reservation boundaries and little information was known about the area. We were not able to sample the lower reaches of the SF Hangman because there was no public access to the site. All sampling sites were above any agricultural influences. Refer to Figure 18 for locations of sample sites. Of the three tributaries of the SF Hangman, only one (Martin Creek) turned out to be perennial. Papoose Creek and Conrad Creek were dry by August. Water quality was generally good in the SF drainage (Table 13). All pH values were between 6.38 and 7.62. TSS concentrations were all below 20mg/L in June and below 4.0 mg/L during baseline flows. Oxygen levels were high until flows approached zero.

Table 13. Summary of water quality parameters sampled in the SF Hangman Creek watershed, 2002.

Conrad Cr.							
Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/17/02	7.07	48.8	11.14	12.69	0.181	7.30	6.24
7/12/02	7.62	55.2	8.48	19.32	0.0235	2.70	2.64
9/4/02					0.000		
10/14/02					0.006		
Martin Cr.							
Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/17/02	7.15	72	11.36	11.4	0.699	16.20	8.02
7/12/02	7.66	76.6	9.84	16.01	0.567	3.5	1.78
8/1/02	7.43	81.7	9.84	12.07	0.024	1.00	0.78
9/24/02					0.024	1.00	0.969
10/8/02	7.66	25.9	9.87	7.21			
U. SF Hangman Cr.							
Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/23/02	6.87	24.8	10.39	6.39			
6/17/02	7.02	55.1	11.24	11.25	0.158	1	3.11
7/12/02	7.22	61.8	6.12	11.84	0.0425	1	2.67
8/1/02	6.87	69.7	7.34	10.53	0.02	3.2	2.06
9/24/02					0.008	2.8	7.84
10/8/02	6.38	34.7	7.08	5.61	0.0115	1	1.21
Papoose Creek		Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
5/23/02	6.75	21.4	10.17	5.83			
10/8/02					0		

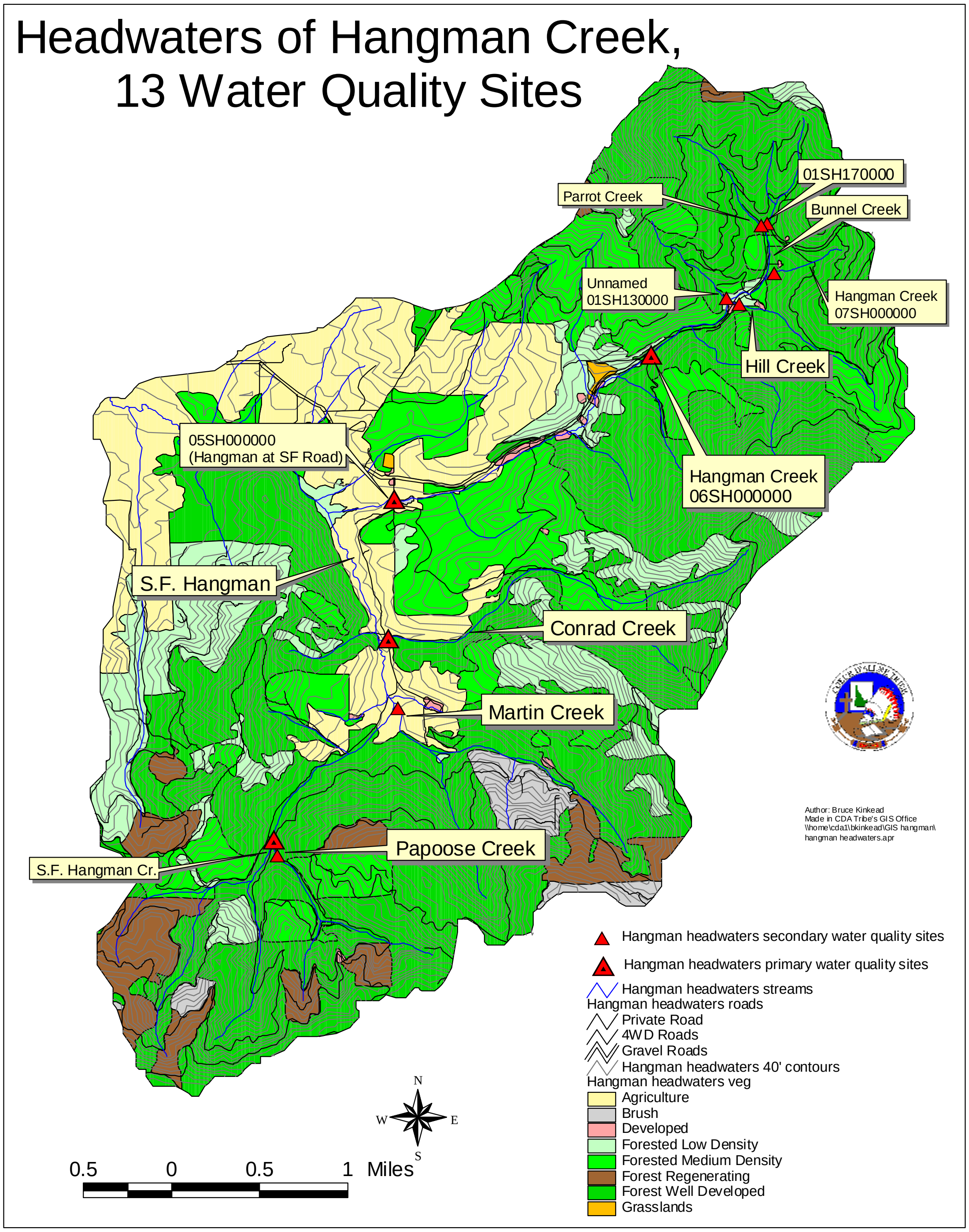

Figure 18. Water quality sites in the headwaters of Hangman Creek, ID, 2002.

Headwaters Tributaries of Hangman Creek

Much of the area is privately owned with small landowners along the road and larger landowners upslope running timber operations. When the area was first scouted for possible water quality stations, water was running down the road and into the stream at the site of sampling station 01SH170000. The source was an active logging road at this location. Across the road, Parrot Creek was running comparatively cleaner. For this reason separate sampling stations were set up. Figure 18 shows the locations of these sampling sites.

Conductivity, TSS, and turbidity were all higher for this unnamed channel compared to Parrot Creek (Table 14). Levels of pH for this headwaters area were all within the 6.5 – 7.3 range. Farther downstream a pair of tributaries enter, Hill Creek and the unnamed channel across from it (01SH130000). Hill Creek showed TSS levels increasing from 3.7 mg/L to 16.2 mg/L during the summer despite discharge dramatically decreasing, with conductivity also increasing. Hill Creek also had one Hydrolab® reading that showed pH at 5.86. Across the road from Hill Creek, Site (01SH130000) had a pH value at 8.68, and had a low TSS concentration of 2.8 mg/L.

Table 14. Summary of water quality parameters sampled in the tributaries of Hangman Creek watershed outside of the Coeur d' Alene reservation, 2002.

01SH130000, unnamed stream

Date	pH	Cond (µmhos/cm)	DO(mg/L)	Temp C	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
8/1/02	8.68	23.7	8.67	12.22	0.012	2.80	3.36

01SH140000 Hill Creek

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp C	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/27/02	6.54	28.2	10.74	14.75	1.145	3.70	3.58
8/1/02	5.86	55.9	5.27	10.47	0.028	16.20	4.15
9/24/02					0.046	12.00	2.33
10/8/02	6.84	27.4	9.48	8.07			

Bunnel Creek, 01SH150000

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
7/12/02	7.3	52.6	8.71	13.63	0.117	39.30	12.90
9/4/02					0.018	2.70	3.29

Parrot Creek

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/20/02	6.5	35.2	11.44	8.22	0.214	13.00	8.06
6/27/02	6.57	32.8	9.37	12.69	0.17	9.50	3.42
8/9/02	7.11	37.1	9.98	10.15	0.024	12.30	2.27
10/8/02	6.82	20.3	10.17	7.58	0.02	2.80	1.12

01SH170000, unnamed stream

Date	pH	Cond (µmhos/cm)	DO (mg/L)	Temp (°C)	DS (cfs)	TSS (mg/L)	Turbidity (NTU)
6/27/02	6.56	48.1	10.22	12.74	0.031		
8/9/02	7.02	69.7	9.62	9.89	0.026	26.50	11.20
9/24/02					0.021	2.30	2.87

Temperature

The seven-day running average for minimum and maximum temperatures is shown in Figures 19-36, which show three lines. The red line at 20° C is an estimate at which temperature becomes a limiting factor for Redband trout. It is also the CMT estimated by (Selong et al. 2001). The green line shows the State of Idaho limit for Bull trout temperatures. It can also be used as a preferred incubation temperature for salmonid eggs to develop. The orange line shows the minimum temperature at which we can expect redband trout to begin spawning (Muhlfeld 2002).

Cold temperatures can be found in the forested headwaters and tributaries of Hangman Creek, but temperatures are above optimum range in the lower areas managed for agricultural purposes. Temperatures at Hangman Creek sites 1-3 (Figures 19-21) illustrate temperatures reaching or exceeding 20° C. The temperature gage at Hangman Creek Site 5 just above the confluence with SF Hangman was lost. Temperatures above this confluence remained under 20° C the entire summer (Figures 22-23). Mission and Sheep Creeks showed a similar temperature profile to the main stem of Hangman Creek. The lower sites reached or exceeded 20°C in July, before dropping in early August (Figures 24 and 26). Upper sampling sites showed temperatures to be around 11-13° C (Figures 25 and 27). Lower Squaw Creek only had temperature data until July when surface flow dried up (Table 11, and Figure 28). However, Upper Squaw Creek flowed throughout the summer (Table 11) and never exceeded 14 degrees C (Figure 29). Indian Creek and its' tributaries never went above 17° C from either continuous temperature monitoring (RL 100's) (Figures30-31), or from Hydrolab® readings (Table 12). The Upper South Fork Hangman (Figure 32) and it's tributary, Martin Creek (Figure 33), did not exceed 20° C, although it is noteworthy that Martin Creek reaches 16° C in early July. A look at Figure 18 reveals the extent of logging in the watershed. Conrad Creek, another tributary of the SF Hangman, reached 19.3° C on July 12th before going dry later in July (Table13). This was recorded using a Hydrolab®. Moctileme Creek and Little Hangman Creek are predominantly within agriculture land and show temperatures out of range for salmonids (Figure 34 and 35). Little Hangman reached 24° C and Moctileme Creek reached 20° C. Figure 36 shows the temperature profile of Upper NF Rock Creek. Although this site never reached 20° C, it did go dry in July. The Hangman Creek, Site 1, recorded a temperature reading of 24.66° C using a Hydrolab® (Table 6).

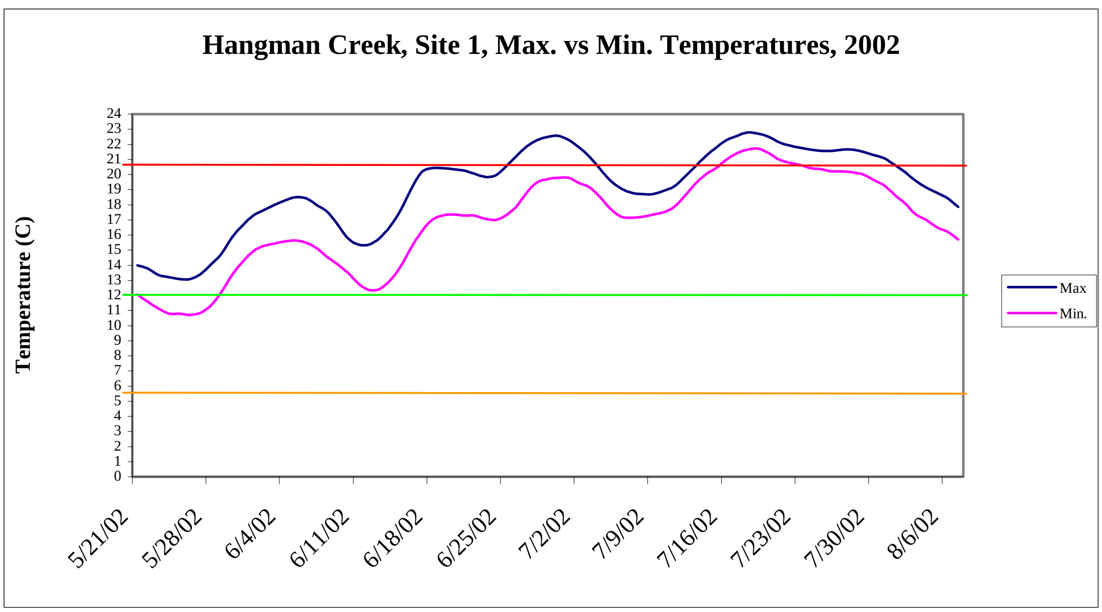

Figure 19. Hangman Cr at Stateline. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

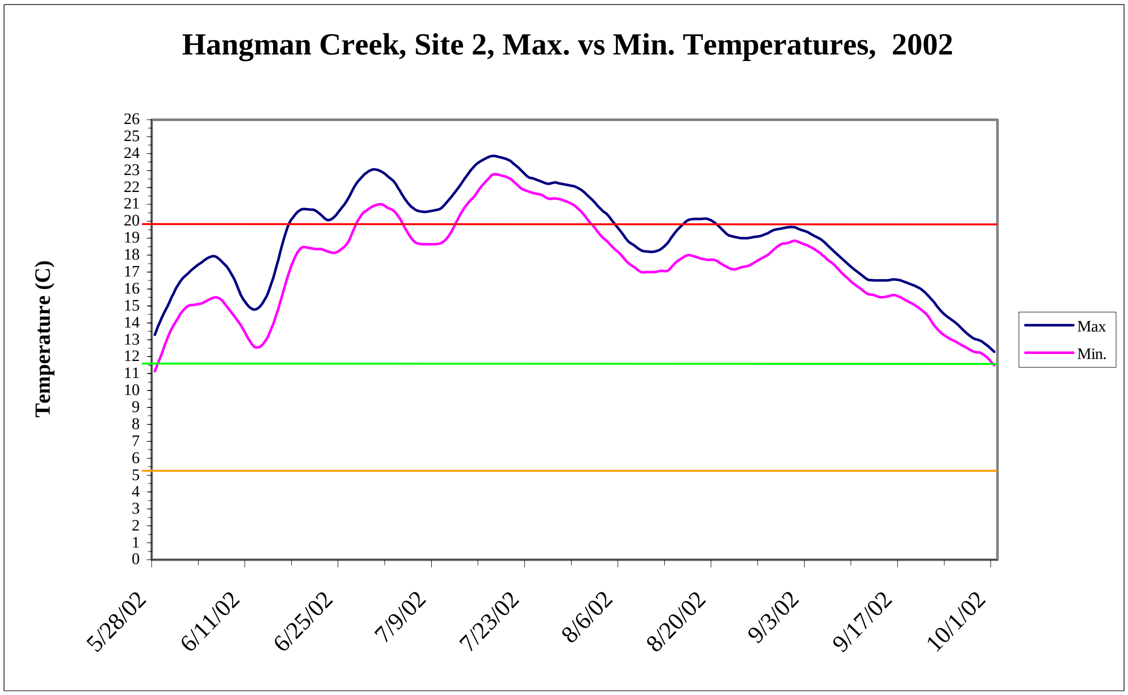

Figure 20. Hangman Creek at Hwy 95. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

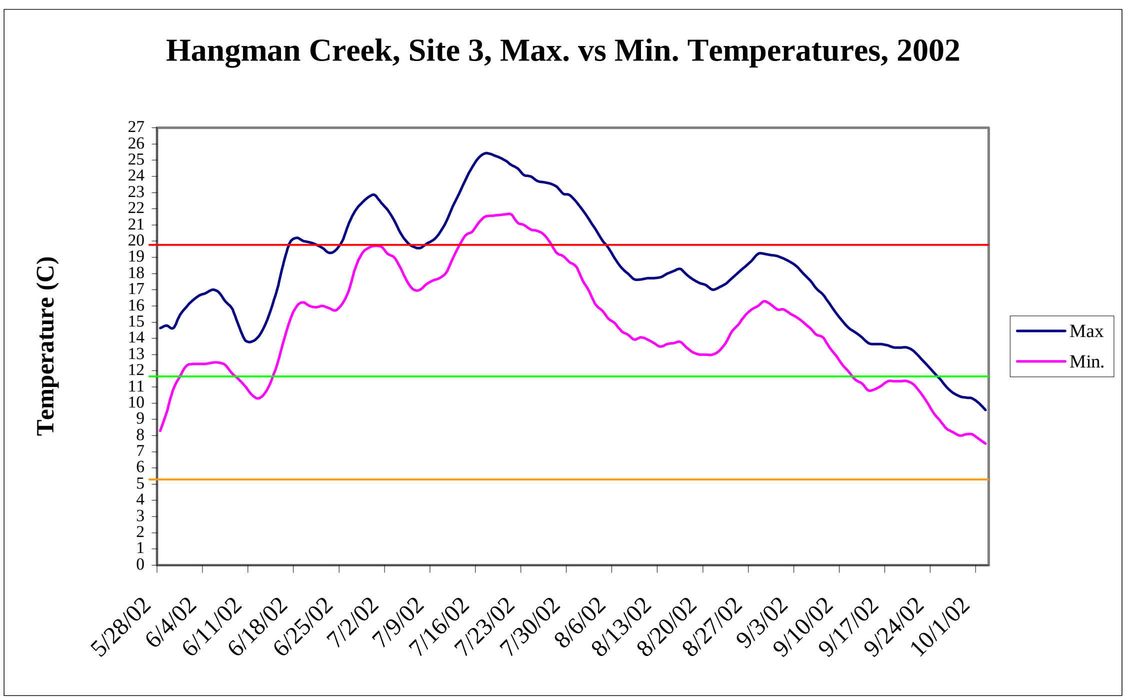

Figure 21. Hangman Creek at Squaw Hump. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

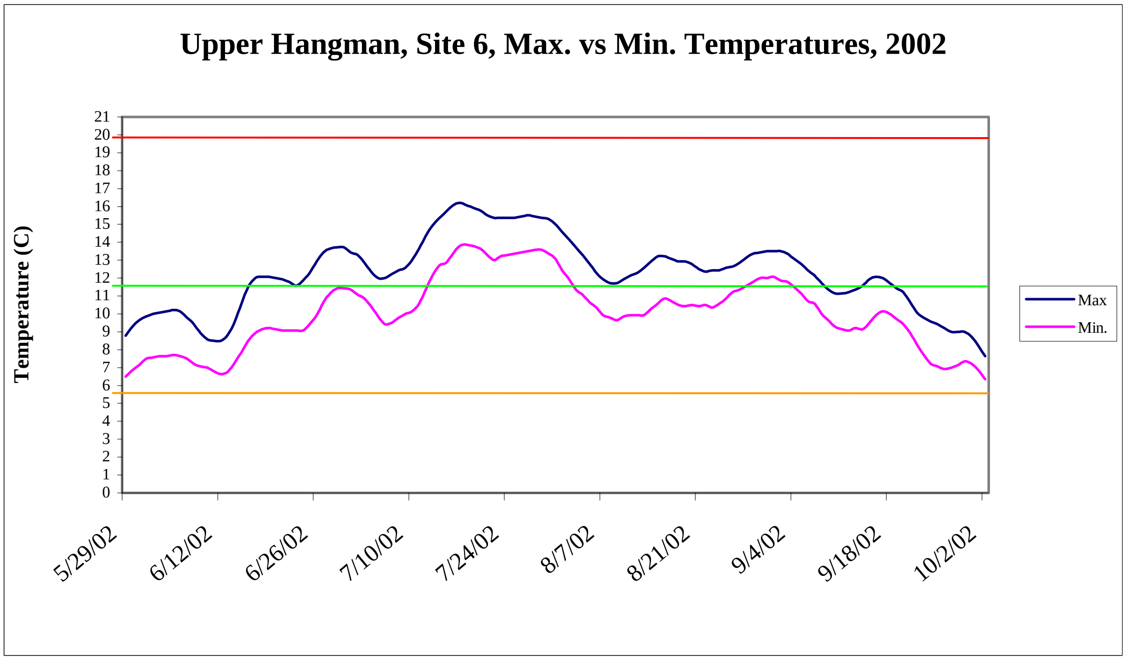

Figure 22. Upper Hangman Cr. Site 6. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

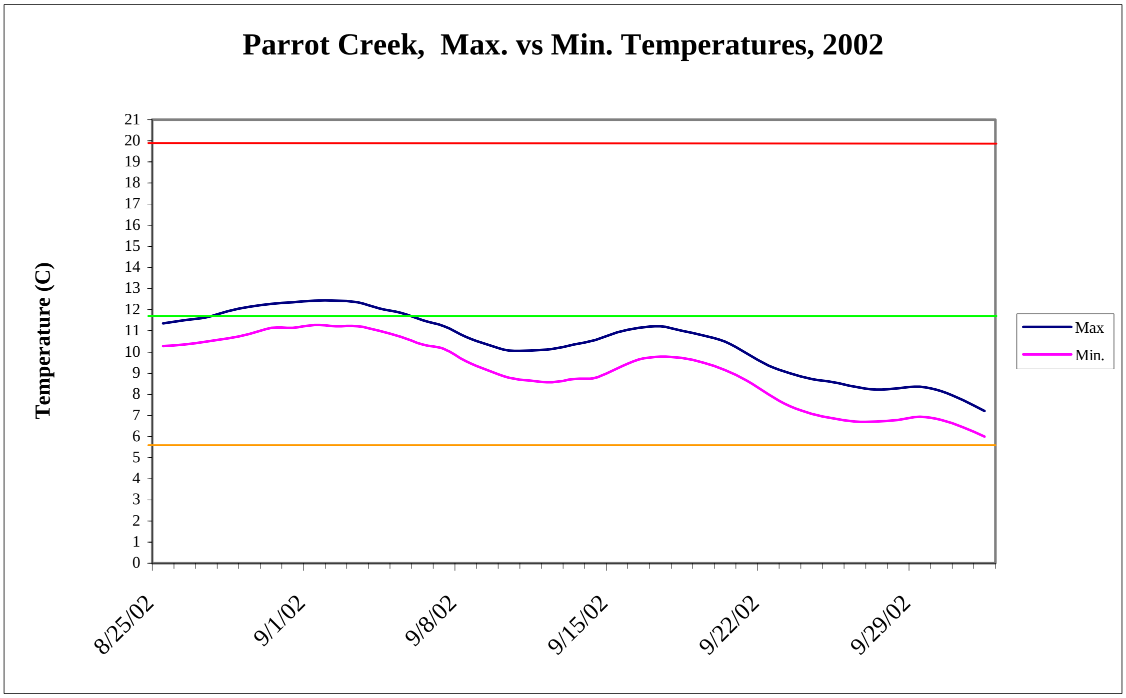

Figure 23. Parrot Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

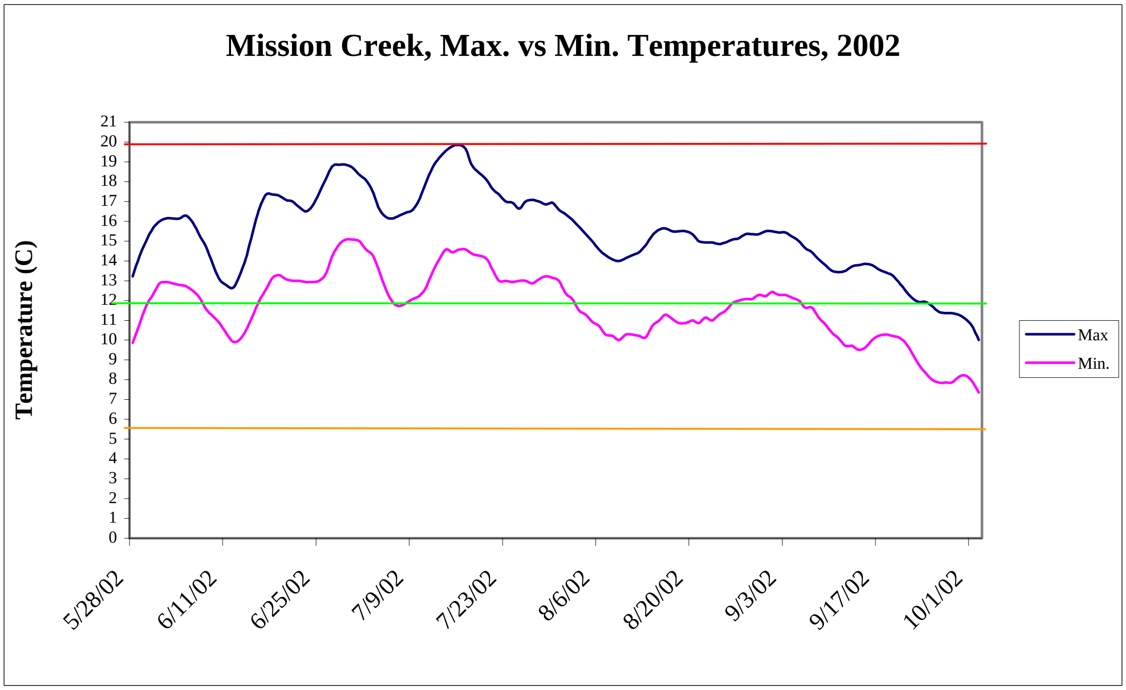

Figure 24. Lower Mission Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

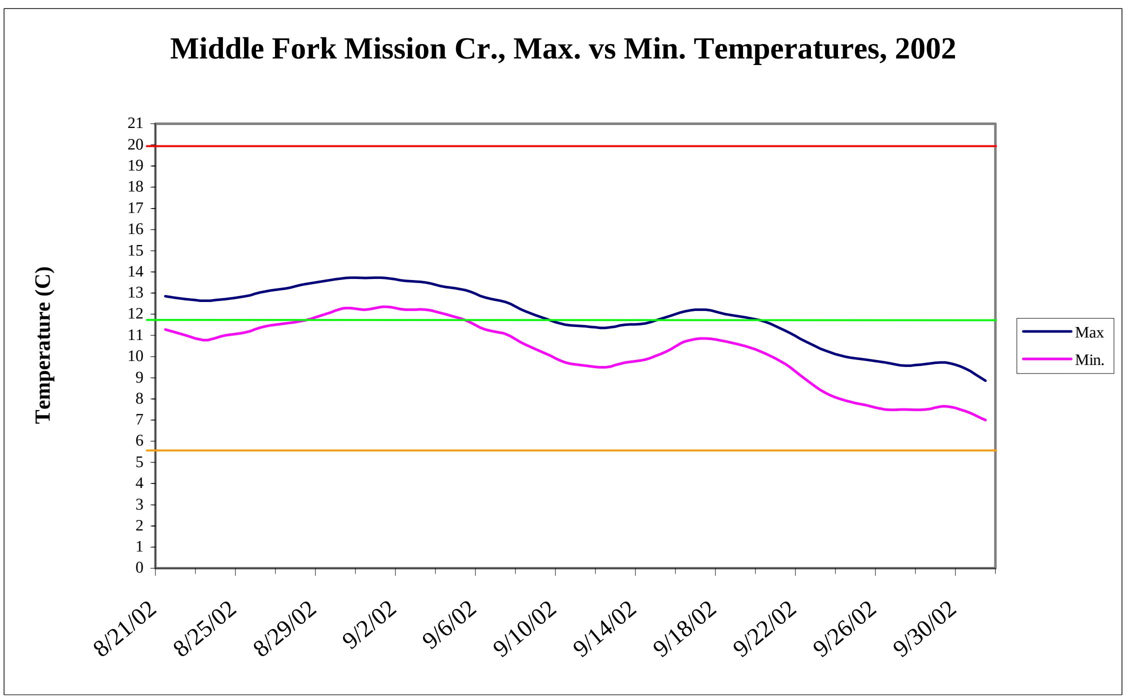

Figure 25. MF Mission Cr. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

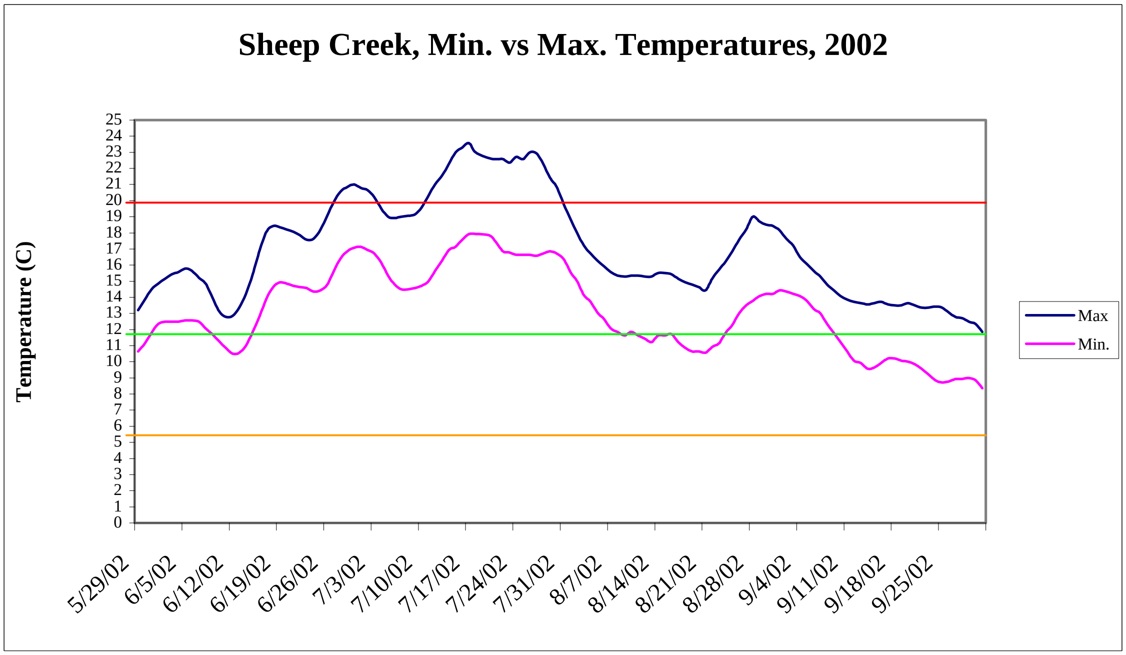

Figure 26. Lower Sheep Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

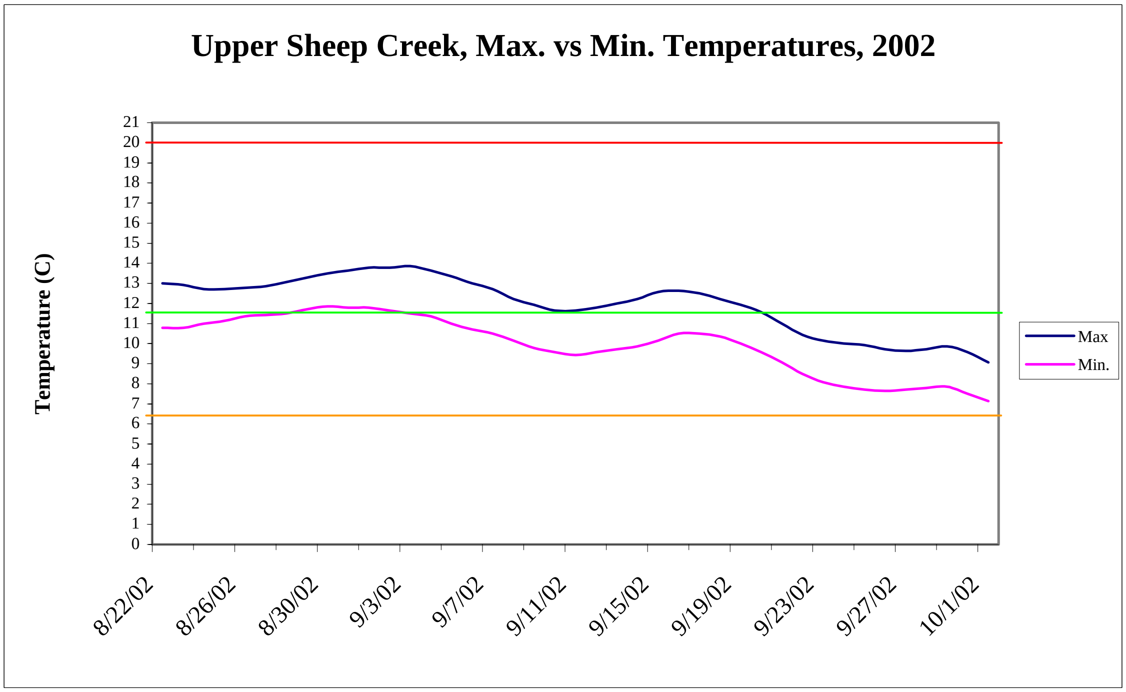

Figure 27. Upper Sheep Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

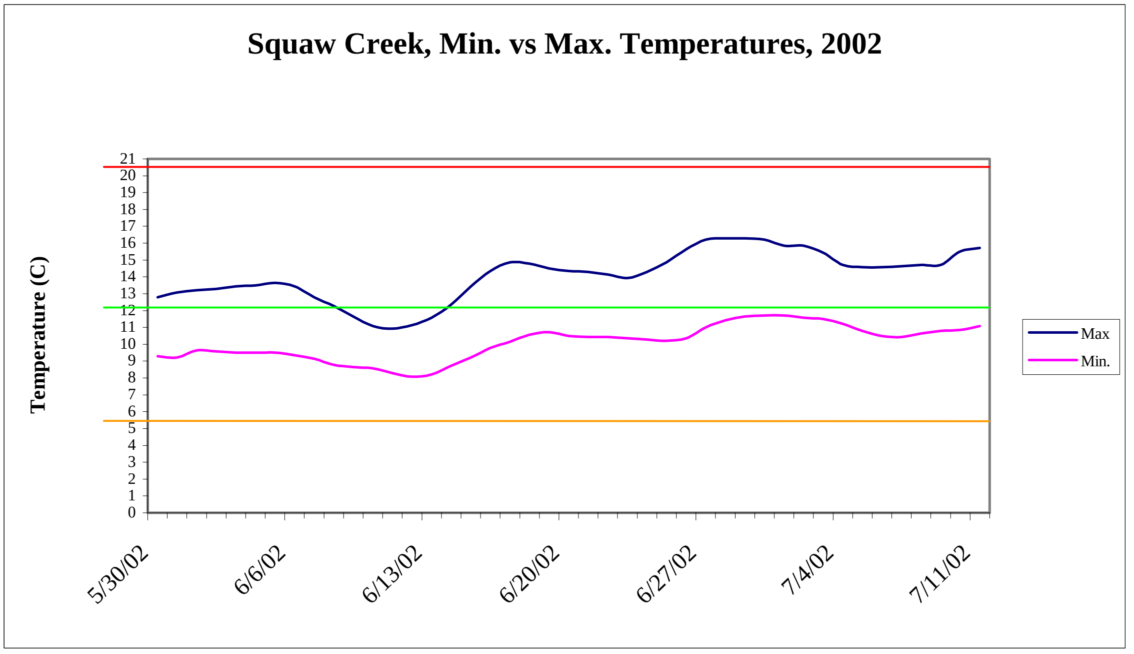

Figure 28. Lower Squaw Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

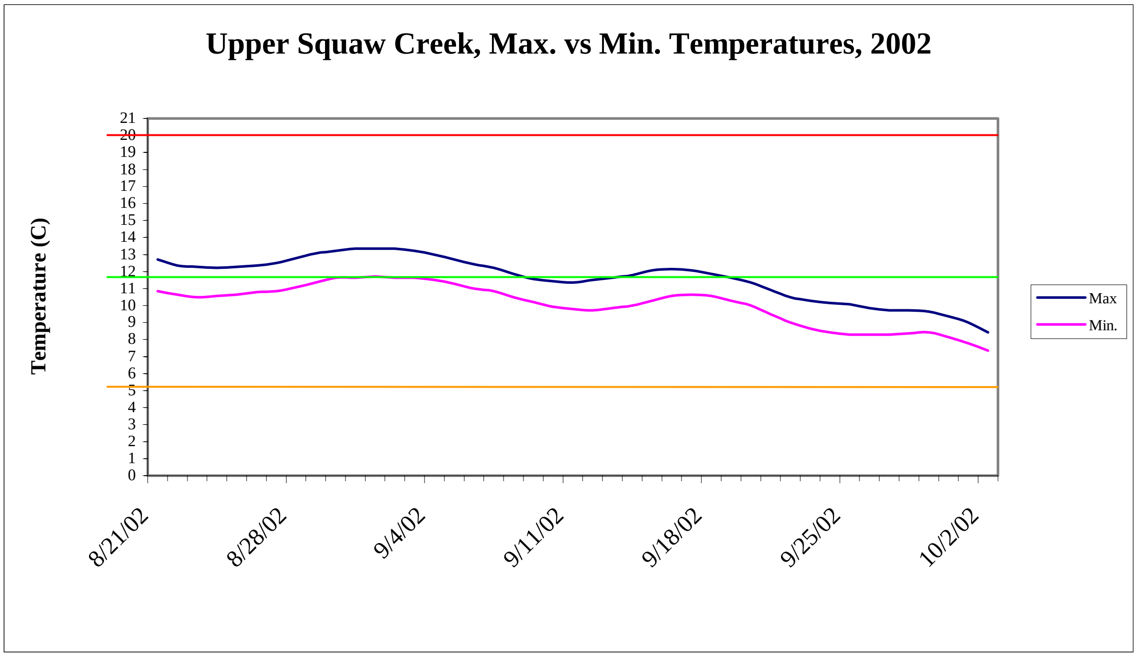

Figure 29. Upper Squaw Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

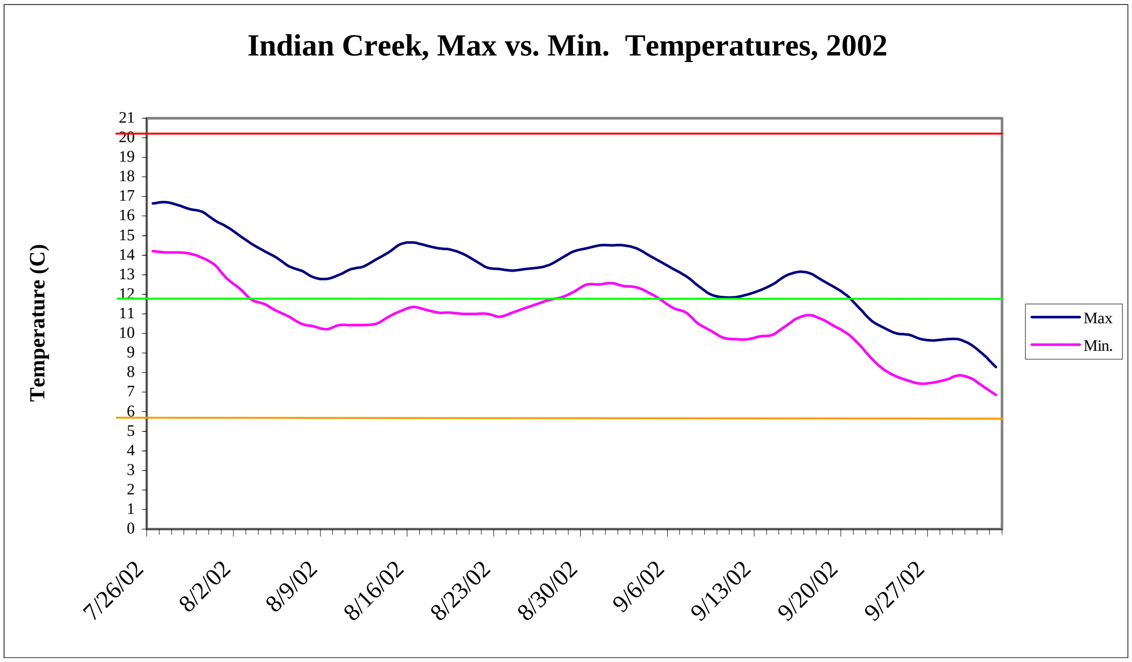

Figure 30. Lower Indian Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

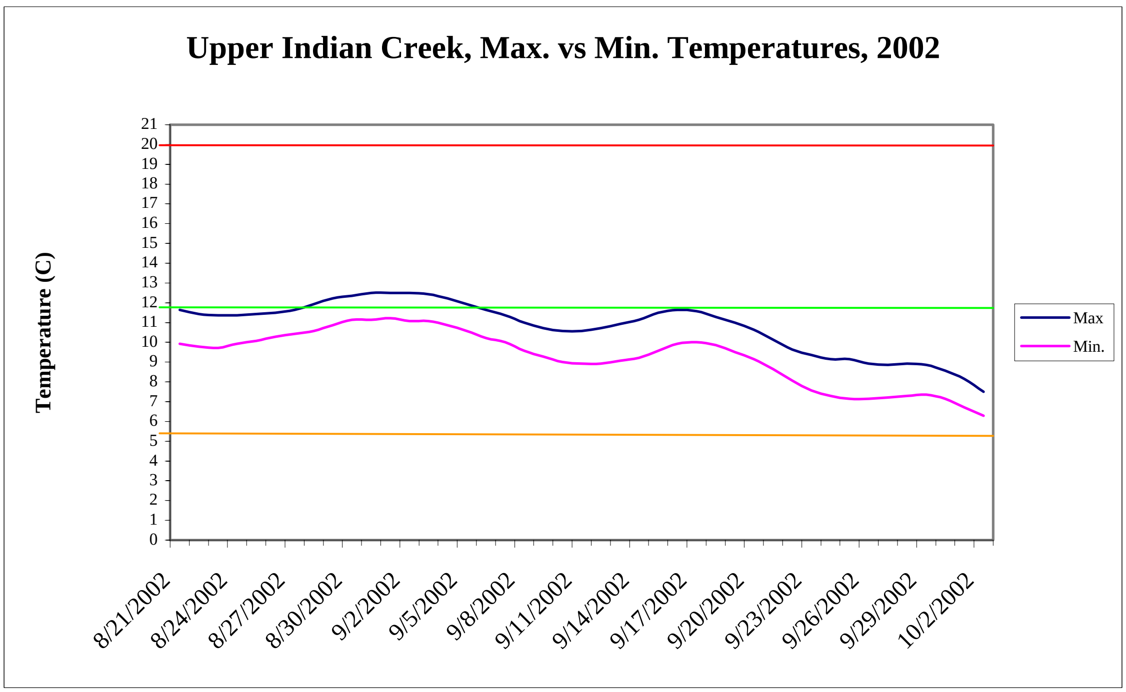

Figure 31. Upper Indian Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

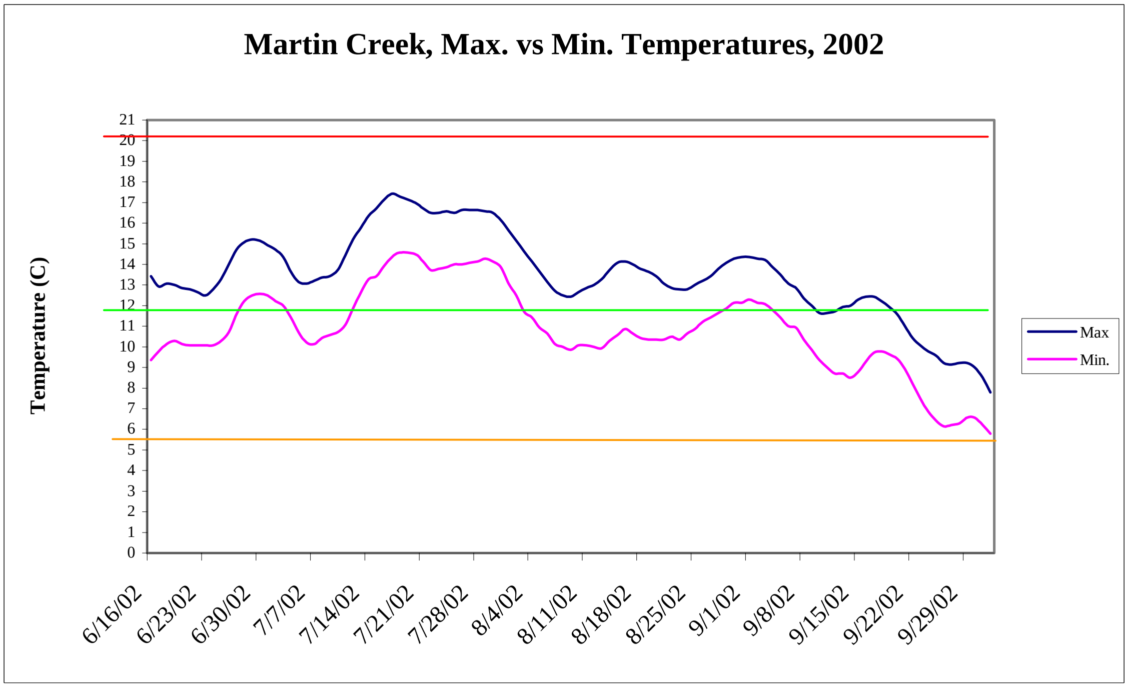

Figure 32. Martin Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

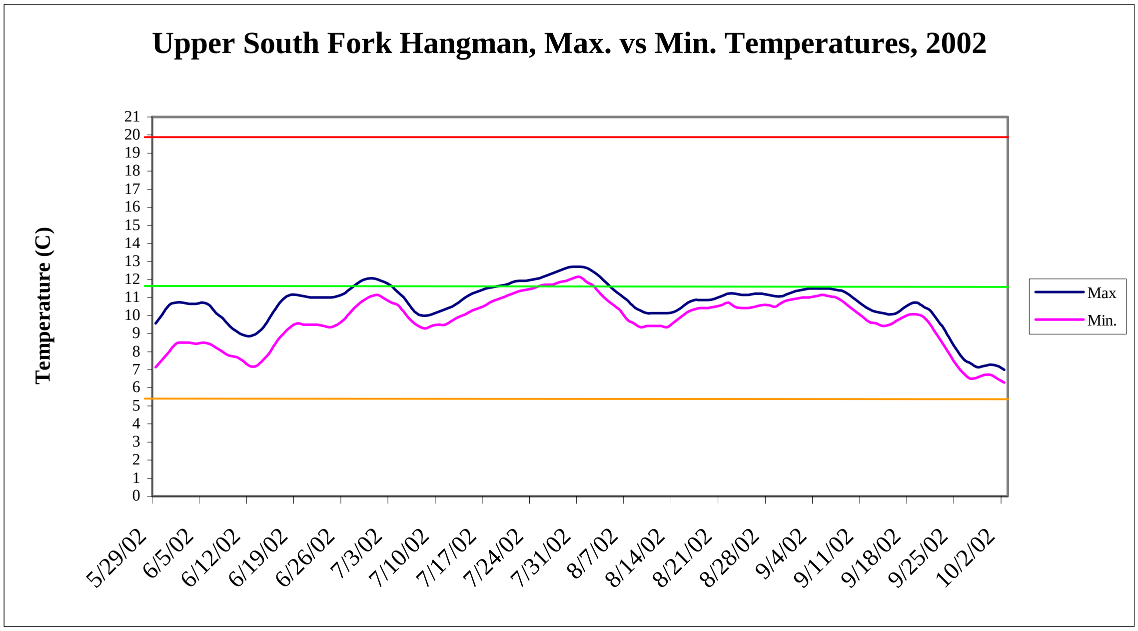

Figure 33. Upper S.F. Hangman. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

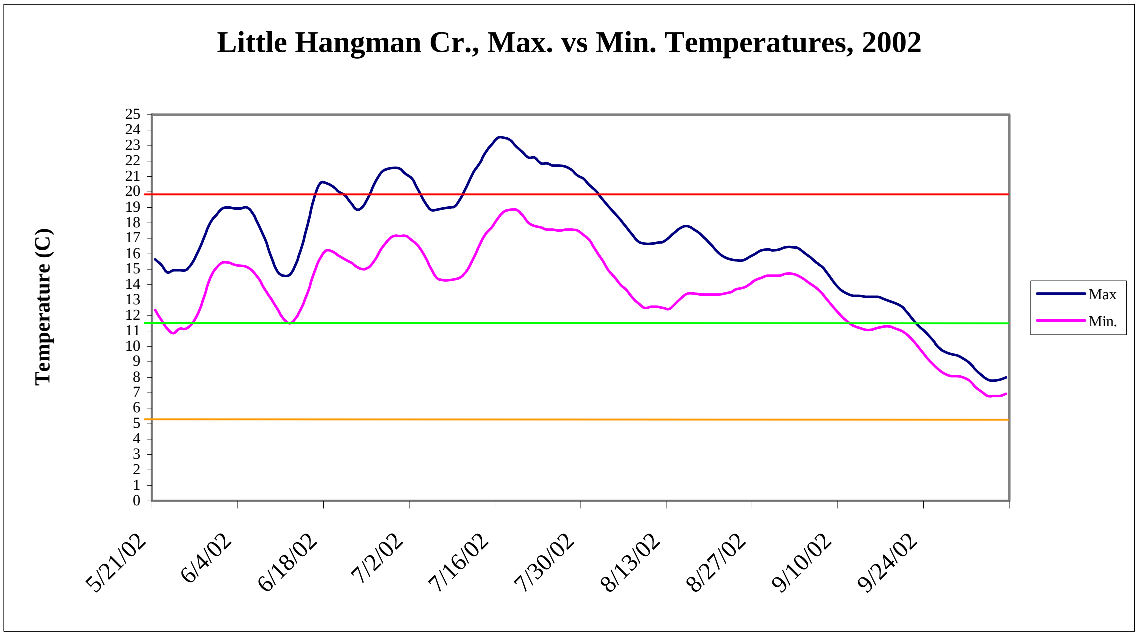

Figure 34. Little Hangman Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

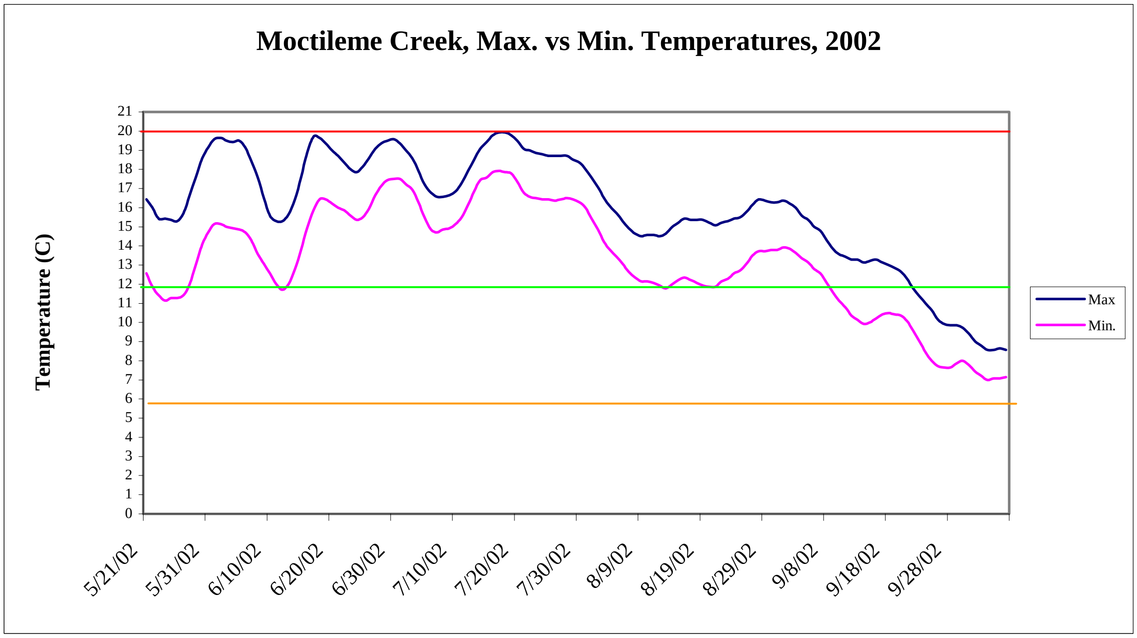

Figure 35. Moctileme Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

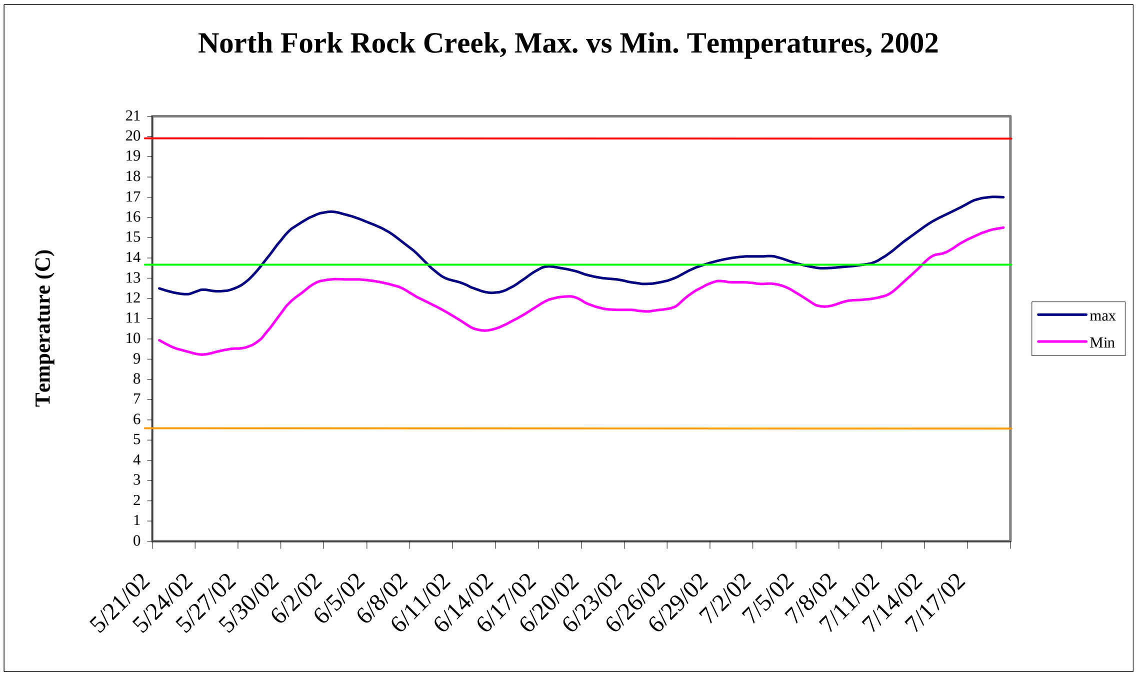

Figure 36. N.F. Rock Creek. Seven-day running averages for maximum and minimum temperatures as recorded in the Hangman Creek, ID, watershed in 2002.

Diel Temperature

A summary of the mean diel temperature fluctuations at each sample location is found in Table 15. Fluctuations were the greatest in the lower reaches of three tributaries where agriculture dominated and in several locations in the lower reaches of the main stem of Hangman Creek. Squaw Creek, Mission Creek, and Sheep Creek showed distinctive differences between lower and upper sampling locations. Indian Creek did not show these distinctive pattern between the upper and lower sampling sites. Vegetation differences are obvious in Squaw, Sheep, and Mission creeks (Figures 7, 11, and 12), whereas the Indian Creek sites show no obvious difference in vegetation (Figure 14).

Table15. Summary statistics of diel temperature fluctuations as recorded by RL 100's within Hangman Creek watershed, ID.

Sampling Station	Start Date	Finish Date	Mean	St. Dev.	Variance
Hangman-Stateline	5/15/02	8/7/02	2.21	1.09	1.19
Hangman-HWY 95	5/22/02	10/1/02	1.58	0.84	0.71
Hangman-Squaw Hump	5/22/02	10/2/02	3.50	1.70	2.89
Hangman-Forest site 6	5/23/02	10/2/02	2.16	0.83	0.69
Parrot Creek	8/19/02	10/2/02	1.30	0.46	0.21
Mission Creek	5/22/02	10/2/02	3.71	1.30	1.68
MF Mission Creek	8/15/02	10/1/02	1.67	0.52	0.27
Sheep Creek	5/23/02	10/1/02	3.82	1.51	2.28
Upper Sheep	8/16/02	10/1/02	2.05	0.60	0.37
Squaw Creek	5/24/02	7/11/02	4.02	1.71	2.92
Upper Squaw Creek	8/15/02	10/2/02	1.54	0.50	0.25
Indian Creek	7/20/02	10/2/02	2.31	0.78	0.61
Upper Indian Creek	8/15/02	10/2/02	1.53	0.51	0.26
SF Hangman Creek	5/23/02	10/2/02	0.99	0.79	0.62
Martin Creek	6/10/02	10/2/02	2.72	1.01	1.03
Moctileme Creek	5/15/02	10/7/02	2.68	1.19	1.41
Little Hangman Creek	5/15/02	10/7/02	3.21	1.62	2.62
NF Rock Creek	5/15/02	7/19/02	2.05	1.06	1.12

FISHERIES

Distribution

Fish sampling was done during June and early July by tribal personnel and personnel from Idaho DEQ. Salmonids were found in four tributaries within the Reservation, as well as in the headwaters area to the east of reservation boundaries (Figure 37). Other fish sampled in the lower reaches of tributaries and in the main stem of Hangman Creek were Speckled Dace (*Rhinichys osculus*), Redside Shiner (*Richardsonious balteatus*), Longnose Suckers (*Catostomus catostomus*), and Sculpin spp. Mission Creek had no fish within it's lowest reach, however small populations of trout were found in three of it's tributaries (Figure 38). Sheep Creek was dominated by dace and Redside Shiners in the lowest reach and rainbow trout upstream in the forested area (Figure 39). Squaw Creek had Rainbow trout, Speckled Dace and Long-nose suckers in the lowest reaches, and Cutthroat trout upstream where gradient was steeper (Figure 40). Indian Creek had

Rainbow trout in the lowest reach sampled and in NF Indian (Figure 41). Salmonids were sampled in two reaches of Hangman Creek, one just downstream of the SF Hangman confluence, and one 2 miles upstream in the conifer dominated area. Both sites were sampled by Idaho DEQ personnel during BURP surveys. Trout were also observed in Conrad Creek with species not determined. It is anticipated that fish are present in Martin Creek and Upper SF Hangman, so scheduling sampling with Idaho Fish and Game for next year will be a priority. Outside the main project area, fish sampling was done in the NF Rock Creek drainage as part of a bioassesment of NF Rock Creek. Redside Shiners and Speckled dace dominated the samples, with no salmonids sampled.

In summary, trout were not found within boundaries of agricultural land. No fish of any species were sampled at sites within agricultural land that was dominated by riffles such as Lolo Creek, Tensed Creek, and Moctileme Creek. The number of fish sampled and ages of salmonids is found in Table 16. Appendix D contains the raw fish sampling data with lengths and weights.

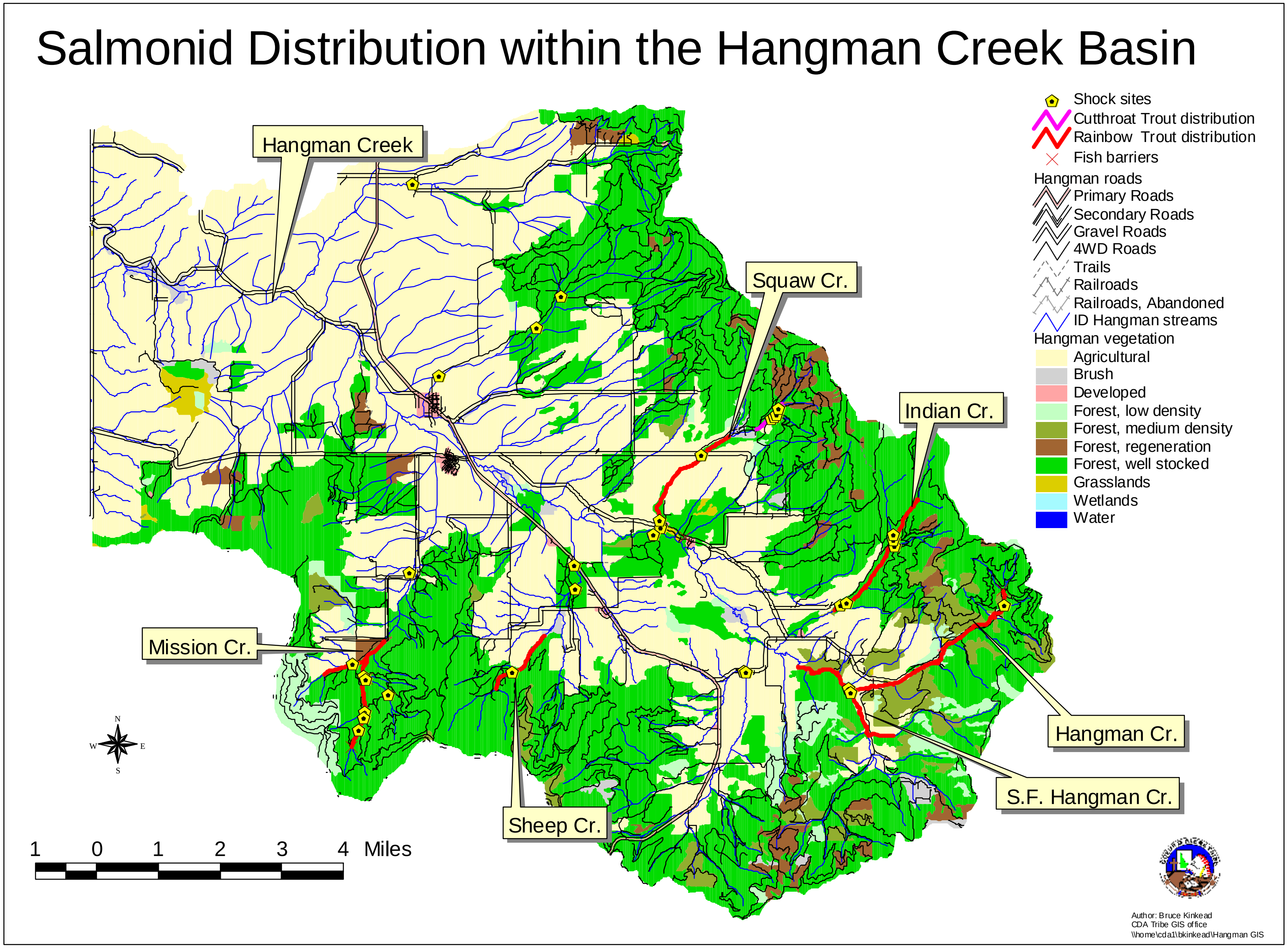

Figure 37. Salmonid distribution within the Hangman Creek Basin, ID, 2002.

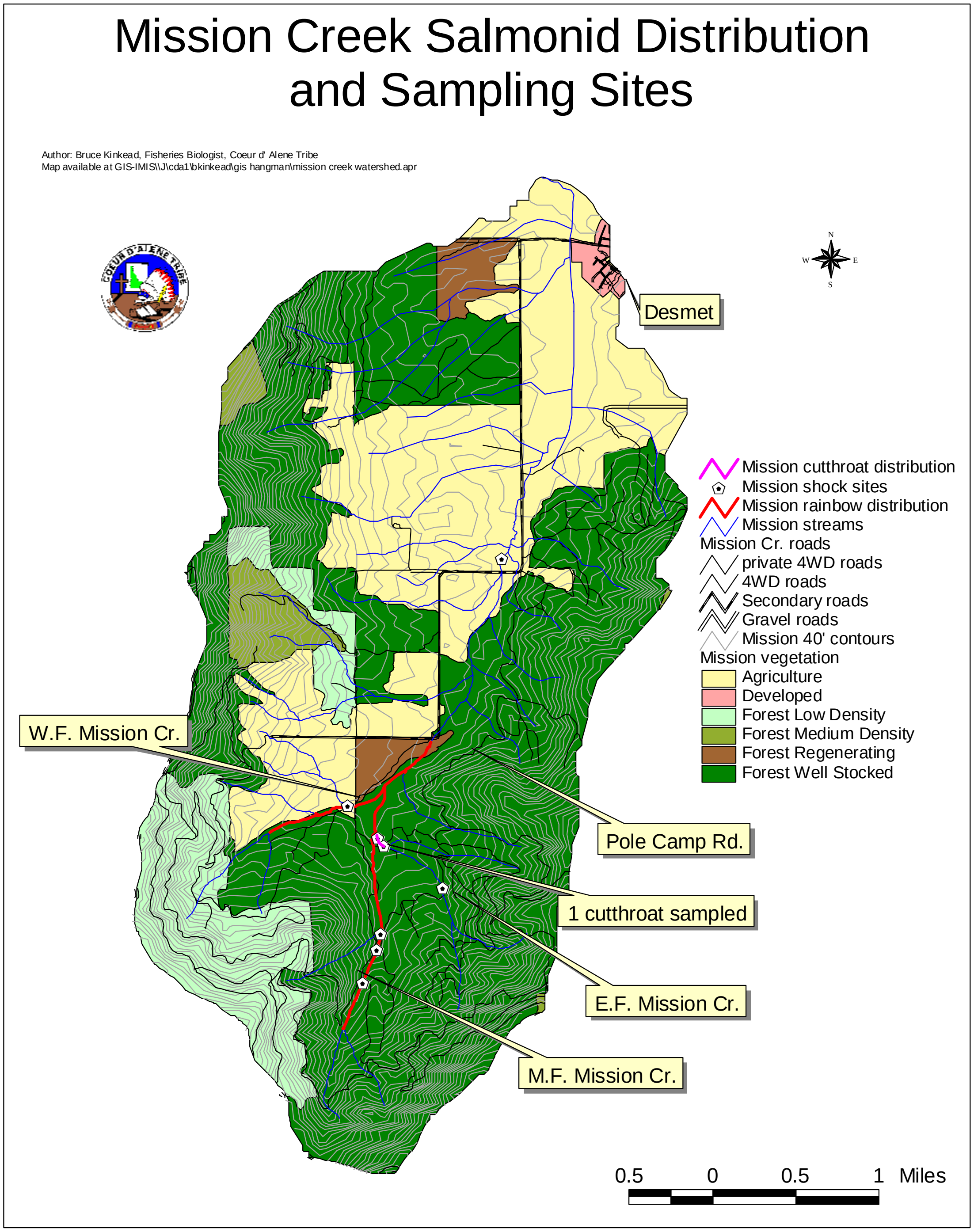

Figure 38. Salmonid distribution and shocking sites in Mission Creek, ID, 2002.

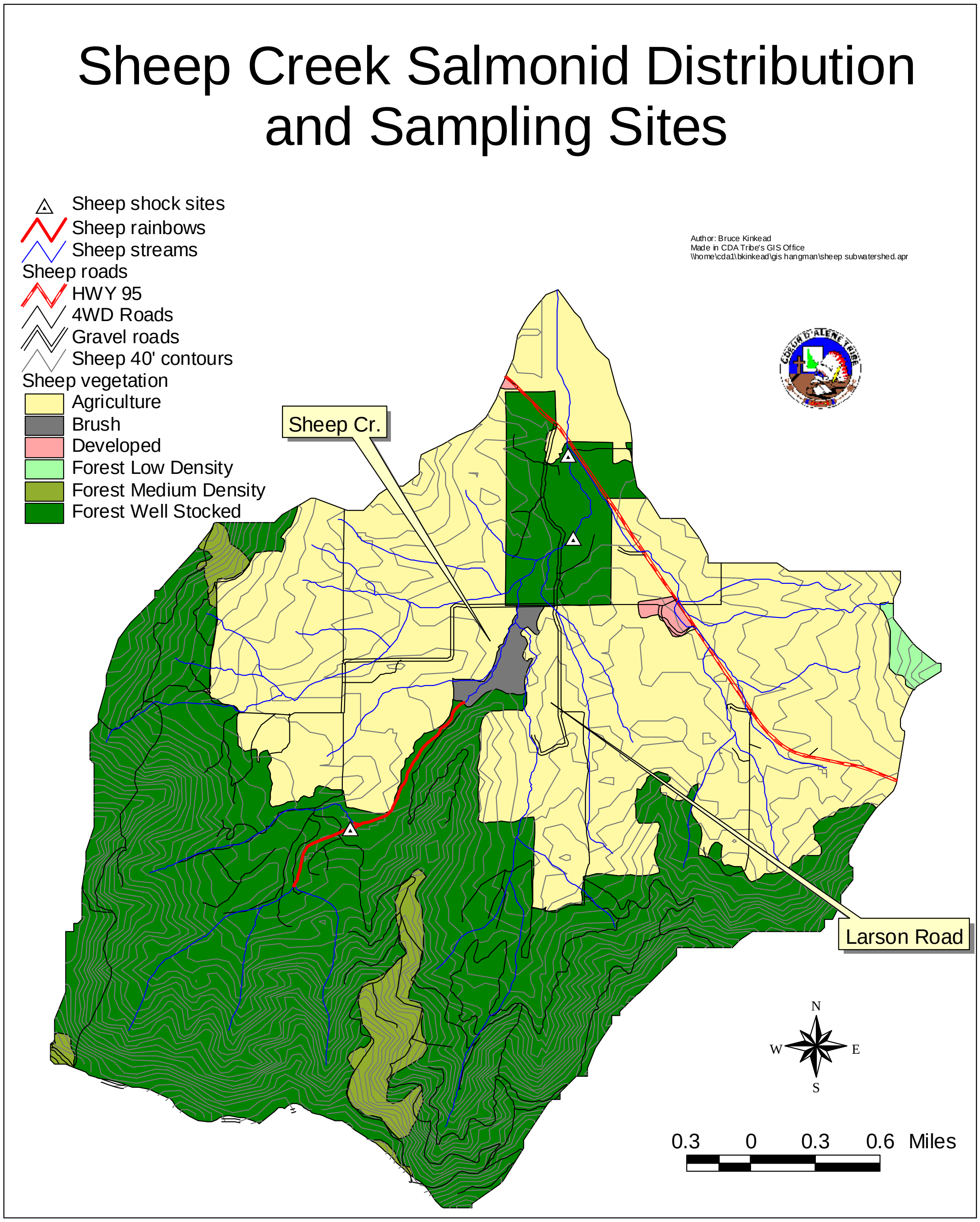

Figure 39. Sample site locations and salmonid distribution in Sheep Creek, ID, 2002.

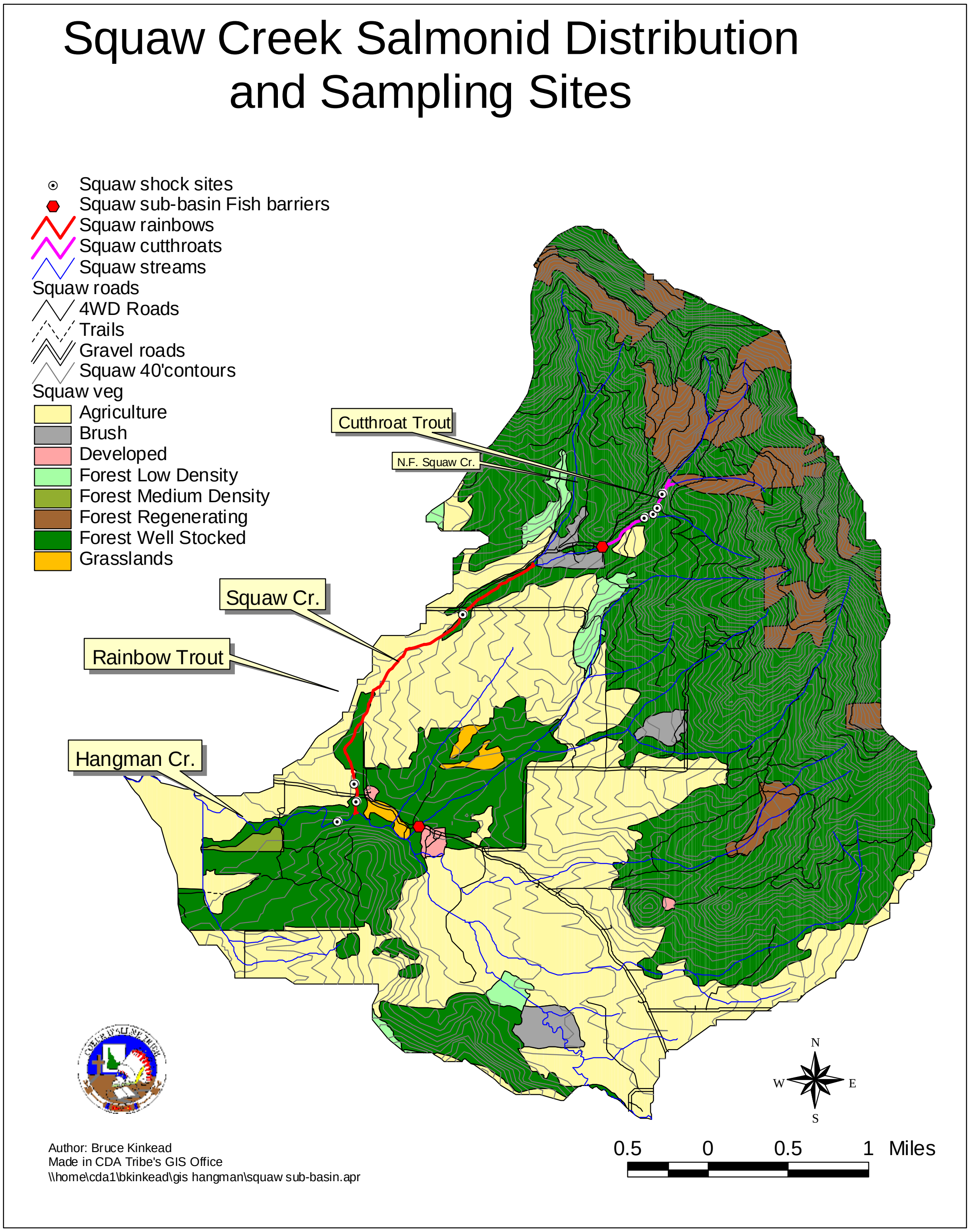

Figure 40. Fish sampling sites and salmonid distribution in Squaw Creek, ID, 2002.

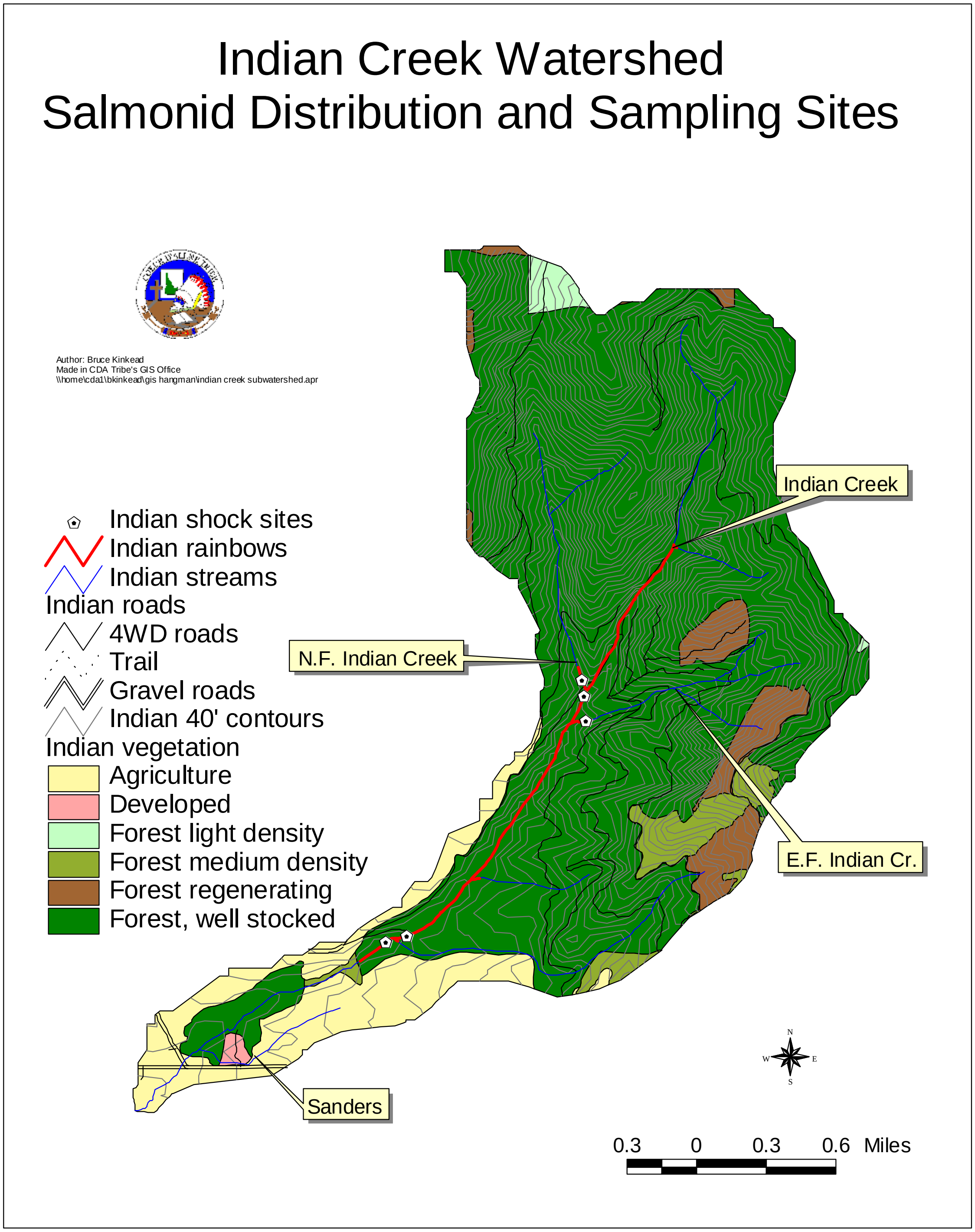

Figure 41. Salmonid distribution and sampling sites in Indian Creek, ID, 2002.

Age Analysis and Relative abundance

Eighty-eight salmonids were sampled during the summer of 2002. Of these, fifety-two were Rainbow trout, and 36 were Cutthroat trout, with one fish in Lower Squaw Creek identified by the biologist as a rainbow/cutthroat hybrid. Included in this total of 88 were 33 Rainbow trout that were sampled by IDEQ personnel. Abundance of non-salmonids All sub-watersheds showed low densities of Rainbow trout. Squaw Creek within the forested reaches showed a much denser population of Cutthroat trout relative to the other locations (Table 16). Large numbers of Speckled Dace and Redside Shiners were present in locations where large stagnant pools dominated such as Rose Creek, Smith Creek, Sheep Creek (Sites1-2), and Mineral Creek.

Age distribution was similar between cutthroat and rainbow populations (Table 16). One rainbow age 3+, ten Age 2+, and forty-one Age 1+ fish were sampled in 2002. The cutthroat population in Squaw Creek included one Age3+, six Age2+, and twenty-nine Age1+ were among the 36 fish sampled. The rainbow/cutthroat hybrid was Age 2+.

Average lengths and weights for Rainbow trout and Cutthroat trout, along with ranges for each, is found in Table 17. Scales were not taken by IDEQ for BURP sites off the reservation. Table 17 was used to age these salmonids.

Table 16. Summary of relative fish abundance and age distribution of salmonids for Hangman Creek watershed, 2002.

		Salmonids					Non Salmonids				
Stream	**Site #**	**Species**	**Total**	**Age 1+**	**Age 2+**	**Age 3+**	**Total**	**Speckled Dace**	**Redsided Shiner**	**Long-Nosed Sucker**	**Sculpin spp.**
N.F. Rock	1		0				5	5			
N.F. Rock	2		0				0				
N.F. Rock	3		0				10	9		1	
Tensed	1		0				0				
Tensed	2		0				0				
Tensed	3		0				0				
Lolo	1		0				0				
Moctileme	1		0				0				
Smith	1		0				7	5	1		1
Mineral	1		0				17	5	12		
Rose	1		0				8	1	4	3	
Hangman	1		0				11	10		1	
Lower Mission	1		0				0				
M.F. Mission	2	RBT	2	2			0				
M.F. Mission	3	RBT	2	2			0				
E.F. Mission	1	CTT	1	1			0				
E.F. Mission	2	No Fish	0				0				
E.F. Mission	3	No Fish	0				0				
W.F. Mission	1	RBT	2	2			0				
Sheep	1		0				5	4	1		
Sheep	2		0				25	24		1	
Sheep	3	RBT	2	2			0				
Squaw	1	RBT	2	1	1		2	1		1	
Squaw	2	Hybrid	1		1		0				
Squaw	3	RBT	1			1	0				
Squaw	4	CTT	2	1	1		0				
Squaw	5	No Fish	0				0				
Squaw	6	CTT	17	11	5	1	0				
Squaw	7	CTT	16	16							

Table 16 continued. Summary of relative fish abundance and age distribution of salmonids for Hangman Creek watershed, 2002.

			Salmonids				Non Salmonids				
Stream	**Site #**	**Species**	**Total**	**Age 1+**	**Age 2+**	**Age 3+**	**Total**	**Speckled Dace**	**Redsided Shiner**	**Long-Nosed Sucker**	**Sculpin spp.**
Indian	2	RBT	0								1
Indian	3	RBT	6	6							
N.F Indian	1	RBT	2	1	1						
E.F. Indian	1	No Fish	0				0				
DEQ Sites											
Hangman	2	RBT	8	7	1		137	112	25		
Bunnel Creek	1	RBT	5	3	2						
S.F. Hangman	1	RBT	19	15	4		49	35	14		
Indian	1	RBT	1	1			2				1
M.F. Mission	4	No Fish	0								

Total Rainbows	52
Total Cutthroats	36
Total Salmonids	88

RBT=Rainbow Trout
CTT=Cutthroat Trout

Table 17. Summary of lengths and weights of Cutthroat and Rainbow trout in Hangman Creek, ID, 2002.

Species/Age	Mean Length (mm)	Range of Lengths (mm)	Mean Weight (g)	Range of Weights (g)
Rainbow 1+	110	64 -130	14.4	4.0 - 33.9
Rainbow 2+	160	135 -199	52.4	25.6 - 57.9
Rainbow 3+	290	NA	260	NA
Cutthroat 1+	97.1	76-125	12.1	3.9 - 17.3
Cutthroat 2+	180	135-220	84.3	34.0 -144
Cutthroat 3+	323	NA	140	NA

Historical Salmonid Distribution

Very little is documented about historical distribution of salmonids, and changes to their habitat within the Hangman Watershed. At this point most of the information is derived from informal interviews of residents who were stopping by to ask questions about fieldwork that was being conducted. From these informal interviews a picture of declining fish distribution and decreasing flows has developed. As little as ten years ago salmonids were seen in the lower reaches of Mission Creek, Tensed Creek, Sheep Creek, Smith Creek, and Mineral Creeks. Flows have decreased in Squaw Creek, Sheep Creek, Tensed Creek, and Mission Creek. Trout up to 18' were caught in Sheep Creek, Mission Creek, and the mainstem of Hangman Creek down to the Squaw Hump area. However, sufficient information is lacking in order to construct a complete GIS map of historical distribution.

A decrease in flow has been dramatic in Mission Creek, and many smaller fish-bearing channels have become intermittent. Large Cutthroat trout were caught in a beaver pond downstream of the confluence with the West Fork and East Fork of Mission Creek two years ago. Fish once extended above Pole Camp Road in EF Mission Creek and far up the West Fork where the logging is shown on the GIS vegetation layer (Figure 7).

Trout once extended up into the three tributaries upstream of the current distribution in Sheep Creek (Figure (11). Trout were also known to inhabit South Fork Sheep below Mineral Mountain (Figure 11). Cutthroat and rainbow trout have both been caught by anglers in the Sheep Creek drainage.

Squaw Creek had very bad spring flooding at the base of the foothills and went dry during summer. Conditions have improved during the last 5 years to where flooding is no longer damaging property in Squaw Creek. Cutthroat trout from Benewah Creek were stocked around twenty years ago in Squaw Creek and into private trout ponds. Trout were routinely moved back and forth from stream to pond when fish were trapped in residual pools. It is perhaps for this reason that the trout population has survived the logging operations of ten years ago.

Off the reservation, many of the streams in the headwaters and the SF Hangman have had fish in them within the last 10 years. Papoose Creek in particular was a good fishing spot. However, the Idaho Dept of Lands sampled the upper SF Hangman and Martin Creek and found no fish (Dupont 2002).

HABITAT SUITABILITY

The main stem of Hangman Creek and lower reaches of tributaries impacted from agricultural practices (Figures 2, 7, 11, and 12) experienced water quality problems for most of the year exhibiting high TSS levels, low dissolved oxygen, and high temperatures. Because fish may be forced to move farther upstream, discharge becomes an issue as well. Marginal conditions exist in many of the forested tributaries due to intermittent flow. Table 18 summarizes the water quality parameters that are potentially limiting factors for salmonids. Designations of NA in Table 15 apply to sites that were intermittent, but did show DO or temperatures below limits at the time of sampling.

TSS levels and their effect upon fish are quantified by Newcombe and Jensen (1996). It is clear that TSS levels contribute to stress in fish year round for many of the sites within Hangman Creek by using their model for juvenile and adult salmonids to quantify the role of length of exposure and concentration. TSS levels were above 400 mg/L (Table 3) during a 3 day storm events in March at the Hangman Stateline site (Stress Level 8). and did not drop below 30 mg/L until May 17th, and remained above 5.0 mg/L for the entire year. Levels above 400 mg/L for 3 days, 20 mg/L lasting for four months or above 3.0 mg/L year round are all associated with Level 8 stress levels. For sites with TSS levels above 7.0 mg/L on a year round basis, a Stress Level 9 is reached. Hangman at the Squaw Hump site, Upper Moctileme Creek, and Hill Creek showed TSS levels at 7.0 mg/L during baseline flows. WF Mission and EF Indian also showed TSS levels above 7.0 mg/L at times during mid summer.

Sites identified as having problems with dissolved oxygen included the main stem of Hangman near stateline, Little Hangman Creek, Lower Sheep Creek, and Hill Creek. It is likely that Lower Mission Creek, Hangman Creek (Sites 3 and 5) would have also showed DO Levels below 7.0 mg/L if sampling was taken performed at base flows.

High temperatures at all main stem and tributary sites within agricultural impacted reaches are a concern. Those sites with continuous temperature monitoring devices (RL 100's) showed the most complete data. The main stem of Hangman Creek, Little Hangman Creek, Lower Moctileme Creek, and Lower Sheep Creek, all showed maximum temperatures above 20 degrees C. Because of a total lack of canopy for miles at Mineral and Smith Creek (Figure 2), it must be assumed that temperatures do exceed this temperature limit in the residual pools that do exist at base flow. Tensed Creek and Lolo Creek likely exceed 20 degrees C as well. Only Hydrolab® data was available for these four sites.

Intermittent flow is a limiting factor at several sampling sites, both in agricultural land, and within the upper-forested areas. All these sites are reported to have been perennial at one time, with all but Lolo Creek containing salmonids at one time as reported by long time residents and tribal members. Smith Creek, Mineral Creek, NF Rock Creek were intermittent with the occasional stagnant pool. Lower Squaw Creek, Lolo Creek, Tensed Creek, Papoose Creek, and Conrad Creek were completely dry by mid summer. Conrad Creek was the only intermittent channel that resumed surface flow in the fall of 2002.
Salmonids were not present during the sampling period at any sample sites that violated any of the three water quality parameters, temperature, DO, or TSS, at base flow (Table 18). Salmonids were sampled at two of the intermittent streams, Conrad Creek (visual), and Lower Squaw (electro-shocked).

Table 18. Summary of water quality at base-flow, compared to salmonid presence for the Hangman Creek watershed, 2002.

Location	Intermittant Flow?	Max Daily Temp >20° C	DO < 7.0mg/L	TSS > 7mg/L	Are trout present?
Hangman Creek-Stateline	No	Yes	Yes	No	No
Hangman Creek-Squaw Hump	No	Yes	?	Yes	No
Hangman Creek,Site 5	No	?	?	No	Yes
Hangman Creek, Site 6	No	No	No	No	Yes
Upper Hangman Creek, Site 7	No	No	No	No	?
Little Hangman Creek	No	Yes	Yes	No	No
Lower Moctileme Creek	No	Yes	No	No	No
Upper Moctileme Creek	No	No	No	Yes	No
Lower Mission Creek	No	Yes	?	No	No
EF Mission Creek	No	No	No	No	Yes
MF Mission Creek	No	No	No	No	Yes
WF Mission Creek	No	No	No	Yes	Yes
Lower Sheep Creek	No	Yes	Yes	No	No
Upper Sheep Creek	No	No	No	No	Yes
Upper Squaw Creek	No	No	No	No	Yes
Lower Indian Creek	No	No	No	No	Yes
N.F. Indian Creek	No	No	No	No	Yes
Upper Indian Creek	No	No	No	No	Yes
E.F. Indian Creek	No	No	No	Yes	No
Upper S.F. Hangman Cr.	No	No	No	No	?
Martin Creek	No	No	No	No	?
Hill Creek	?	No	Yes	Yes	?
01SH013000 across from Hill	?	No	No	No	?
Bunnel Creek	No	No	No	No	Yes
Parrot Creek	No	No	No	No	?

Table 18 continued. Summary of water quality at base-flow, compared to salmonid presence for the Hangman Creek watershed, 2002.

Location	Intermittant Flow?	Max Daily Temp >20° C	DO < 7.0mg/L	TSS > 7mg/L	Are trout present?
Smith Creek Creek	Yes	?	Yes	Yes	No
Lower Squaw Creek	Yes	NA	NA	No	Yes
N.F Rock Creek	Yes	Yes	Yes	Yes	No
Mineral Creek	Yes	NA	NA	NA	No
Lolo Creek	Yes	NA	Yes	Yes	No
Tensed Creek	Yes	NA	NA	Yes	No
Upper Tensed Creek	Yes	NA	NA	No	No
Papoose Creek	Yes	NA	NA	?	?
Conrad Creek	Yes	NA	NA	No	Yes

IDAHO DEQ BURP SURVEYS

Analysis of data by Idaho DEQ is ongoing. They have provided preliminary data for fish, which is found in Appendix D. Macro-invertebrates are currently being processed at EcoAnalysts, Inc and a report to IDEQ is due at the end of Febuary, 2003. A complete report from IDEQ will not be available until fall of 2003. Periphyton samples will be processed in March 2003 but complete BURP reports will not be completed by Idaho DEQ until fall 2003. All data will be reported in the 2003 Year-End report.

EROSION MONITORING

Bank pins were installed in the fall of 2002. The first measurements will be made next summer. Bank pin locations are shown in Appendix C.

ROAD SURVEYS

Ten of the total fifteen survey sites were located in a single sub-watershed (Figure 43). Many of the sites within the Mission Creek drainage can be more clearly seen in Figure 44. Some of these problems in Mission Creek were brought to the attention of the landowners and contracting logger. Three road crossings were fixed later in the summer and re-vegetated with alders and willows utilizing volunteers (Sites 2-4). Pictures were taken at time of survey and after road-crossings were fixed. The following is brief description of each site and the problems associated with the site.

Site 1
Problem: Skid trails are crossing the channel of a small tributary of MF Mission with oil seeping into water.
Pictures 1-9 in Appendix E.

Site 2
Problem: Small channel of water crossing road and into the WF Mission Creek. No culvert was installed. Water is pooling in the middle of the road.
See picture #10 in Appendix E.

Site 3 *Problem*: Culvert is plugged with sediment and small piece of wood. 1.5ft dia. pipe is too small for a channel that measures 5.0 ft. across. Water is running over top and washing out culvert.
See Pictures 11-16 in Appendix E.
The contracting logger, Bob Danielson Logging, was contacted and given suggestions for fixing the problem. The old culvert was taken out, and a new channel was dug across the road and blocked with debris. See Picture 17.

Site 4
Problem: Culvert is too small and was not installed in the same direction as channel. The result is that water is going over the road in one place, and over the top of the culvert causing the fill to erode away above the culvert.
See pictures 18-20 in Appendix E.
Solution: The contracting logger, Bob Danielson Logging, was contacted and given suggestions for fixing the problem. The old culvert was taken out, and a new channel was dug across the road and blocked with debris. See Picture 21 in Appendix E.

Site 5
Problem: Water and sediment is running down haul road above main road and onto both sides of the main road prior to entering Bunnel Creek. Gate blocked access to road.
See pictures 22-27 in Appendix E.

Site 6
Problem : Road is caving in at culvert. Benewah County replaced culvert during summer of 2002.
See pictures 28-29 in Appendix E.

Site 7
Problem : Shotgun covert. Drop from 2'dia.culvert is 24". Possible fish barrier.
No pictures taken, no camera available.

Site 8
Problem: Drainage problems along a mile stretch of road. Culverts are too small or non-existent where small pipes are needed. Camera not available at time of survey. Road is now tank trapped with problems not fixed.

Site 9
Problem : Old road reopened within 25 feet of MF Mission Creek (fish-bearing stream). Water is draining down road into channel above culvert on Pole Camp Rd. See pictures 30-32.

Site 10
Problem : Channel of a tributary of EF Mission crosses onto road without culvert, down road for 75 feet before re-entering forest. Water eventually reaches old channel.
Two foot pipe needs to be installed or channel re-contoured. Contracting logger agreed to dig channel across road and block road from both sides.
No pictures were taken.

Site 11
Problem: Logging road crossing EF Mission. No culvert installed and road is not blocked. Camera not available, no pictures taken.

Site 12

Problem : Skid trails within 20-40 feet of EF Mission on both sides of channel. Skid trails are paralleling channel. Huge slash piles are very close to channel. When they were burned cedars within 10 feet of channel were damaged.
See pictures 33-36 in Appendix E.

Site 13

Problem : New haul road constructed within 30 feet of fish-bearing reach on MF Mission after fish data was reported to Idaho Dept of Lands. See pictures 37-39.

Site 14

Problem : Deep rutting and drainage problems on Johnson road for approximately 0.2 miles. Needs water bars and 1.0' dia. drainage culverts. Camera not available. Revisit.

Site 15

Problem : Shotgun culvert. No pictures or measurements. Will revisit site later in the spring of 2003.

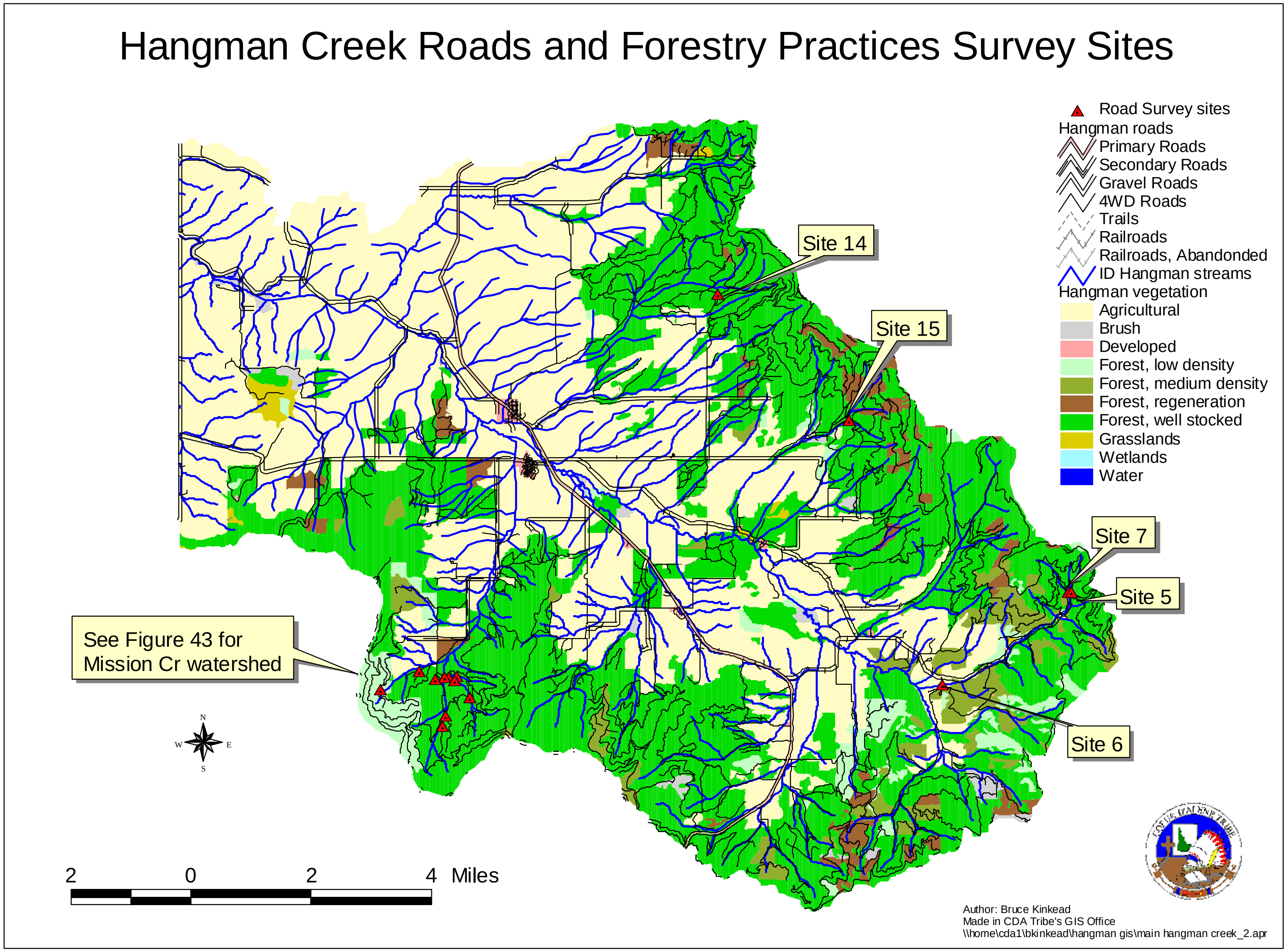

Figure 42. Roads and Forestry Practices survey sites in the Hangman Creek watershed, 2002.

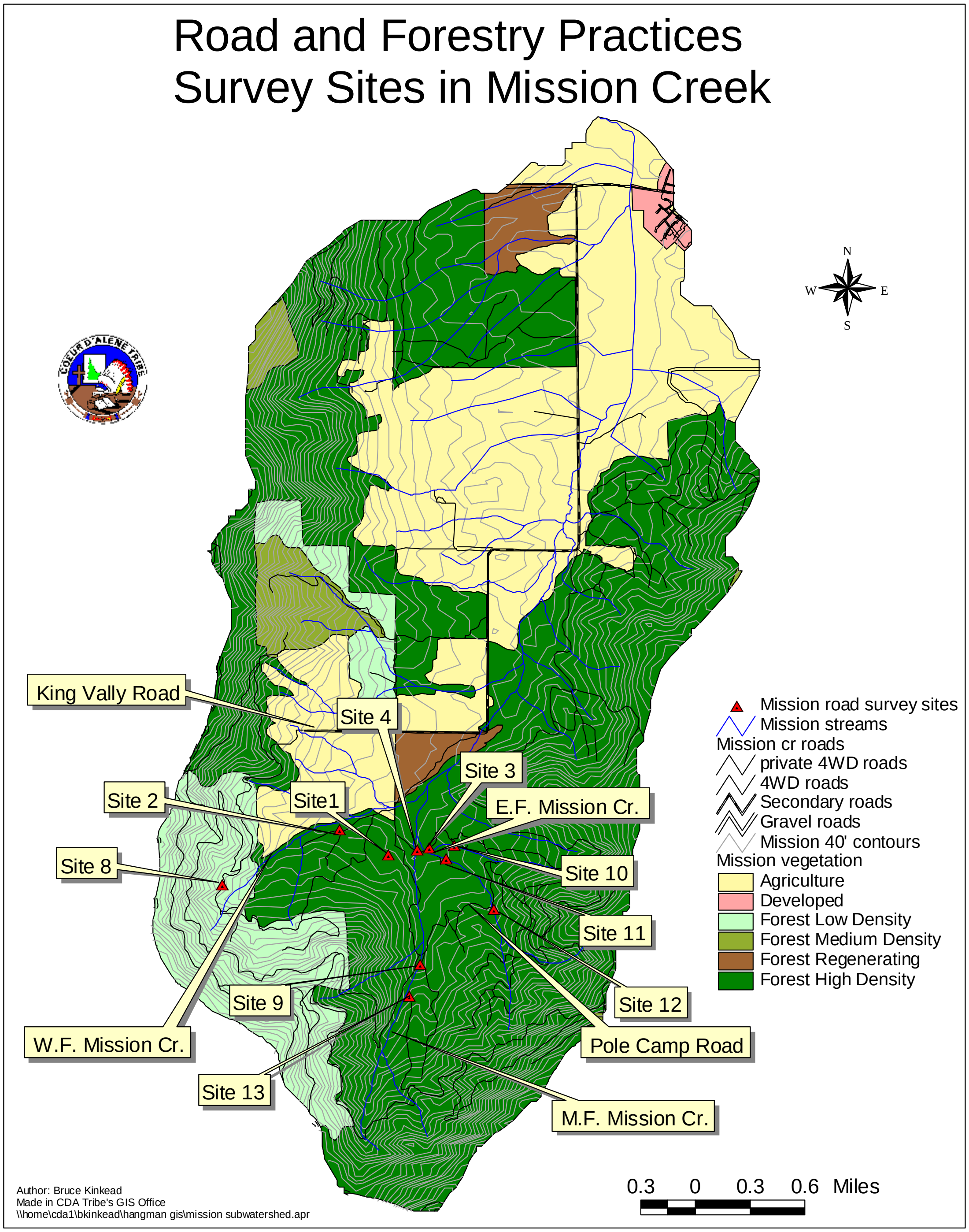

Figure 43. Road and forestry practices survey sites in Mission Creek, 2002.

4.0 DISCUSSION

WATER QUALITY

Historical data for water quality for the Hangman Creek watershed is comprised of four sample sites at locations along the Washington/Idaho border (Hangman Cr., Little Hangman Cr., Moctileme Cr., and NF Rock Cr.), and a fifth in the Indian Creek which is near the east boundary of the reservation. This data was collected from 1997 to present by the Coeur d’ Alene Tribe’s Water Resources Program. Of these five sites, only Indian Creek has not been severely impacted from agricultural practices (Coeur d’ Alene Tribe 2002).

Because of this lack of historical data, development of sample site locations was ongoing throughout the summer of 2002 as reaches were first scouted and conditions progressed toward baseline flow. Because this initial sampling in Hangman Creek placed an emphasis on a large number of sample sites, getting a large number of samples from each site was not possible. Because only a few samples were taken at each site, discharge sediment curves cannot be calculated. Instead, the purpose was to identify sources of sediment by making direct comparisons of sub-basins within the watershed. Distinctive differences among the sub-basins’ forest density in Mission Creek and Indian Creek prompted the creation of four sample sites within each of the two drainages. In cases of fish-bearing streams such as Sheep Creek and Squaw Creek, multiple sampling sites were monitored to show the effects of land use practices present within the drainage. Once more information is known about the entire watershed, certain sample sites can be monitored more closely to develop sediment/discharge curves. Since sampling began in late May, data from the highest flows will have to wait until next year. Rain on snow data is available from the stateline sites that were monitored by the Coeur d'Alene Tribe’s Water Resources Program.

A pattern of decreasing water quality occurs as streams leave forested areas and enter agricultural area. Many streams are losing surface flow as the channel reaches areas impacted by agriculture. Squaw Creek is perennial at the upper sample site but did not have surface flow at the lower sampling site (Table 11), despite two tributaries flowing into the main channel above the lower station. Streams with an upper and lower sampling site also showed a pattern of lower dissolved oxygen at the lower sampling site (Tables 8, 9, and 11). Both problems indicate that agriculture is adversely impacting flow regimes within the watershed. Continuous temperature monitoring reveals the same distinct differences in temperatures between reaches located in forested areas and those located in agriculture areas (Figures 19-36). Diel temperature fluctuations show a predictable pattern with the highest fluctuations occurring on the lower reaches of the tributaries where a lack of canopy occurs combined with lower discharges. Squaw, Sheep, and Mission Creek have the highest fluctuations in diel temperature fluctuations (Table 15).

Although the lower Mission Creek site never exceeded 20° C, it is strongly suspected that there is more of a problem with temperature than the data suggests. Figures 24 and 25 show only a difference of a couple of degrees C between the lower and upper Mission Creek sites. However, if the location of the lower sampling site (Figure 3) is taken into consideration, it should not be a surprise to see only a slight difference between the sites. Had a location closer to the confluence with Hangman Creek been monitored, a more dramatic difference between lower and upper sites would have likely been shown. Two miles of stream with almost no canopy would have raised the temperatures well beyond what is shown in the current data. This coming year a continuous temperature monitor will be placed near the confluence to record the full effects that the agricultural land has upon the stream temperatures.

The lowest temperature fluctuations were seen at Parrot Creek, SF Hangman Creek, Upper Indian Creek, and Upper Squaw Creek. All sites have near 100% canopy, which will be confirmed when IDEQ's BURP survey data is reported. The continuous temperature monitoring data point to the importance of canopy in determining temperature in tributaries with little flow. Discharge can also be impacted by a lack of cover. Evaporation in wide shallow channels with no canopy can be a factor. Conrad Creek began flowing again in September despite any rain occurring during the month of September. The only variable changing during the time span was the cooler air temperatures of fall. Canopy is lacking in Conrad Creek due to recent logging.

FISHERIES

Fisheries studies prior to 2002 have been limited to a few sample sites and some culvert surveys. There has been no attempt to delineate limits to salmonid distribution by the Coeur d'Alene Tribe or any state agency. Many fish bearing streams were not classified as Class 2 (fish-bearing) streams by Idaho Dept. of Lands, which would have given them the riparian buffer zone protection that come from a Class 2 designation. A comparison of current fish sampling data with the surveys done ten years ago by Tribe personnel shows a decreasing diversity. Brook trout, Tench, Chiselmouth, Longnose Dace, Brown Bullhead, and the Bridgelip sucker were not present in current sampling. The number of salmonids sampled is also of great concern in every area except Upper Squaw. The presence of non-native Cutthroat trout in Squaw Creek is not desirable.

HABITAT SUITABILITY

Marginal conditions exist for salmonids for much of the watershed, including Sheep Creek, Squaw Creek, and Mission Creek. Elsewhere in the watershed, salmonid habitat does not exist for any of the life history stages. It is obvious that one parameter cannot be singled out as the sole limiting factor for salmonid production. A combination of low dissolved oxygen, high TSS concentrations, and high temperatures (Table 15) from a combination of impacts from agriculture and forestry practices act in combination to create these marginal conditions. Many locations provide seasonal habitat that could be available for spawning before flows go sub-surface.

Water quality data from the sites sampled by the Water Resources Program in 2002 show conditions not conducive toward salmonid presence and perhaps, survival, during rain on snow events (Table 3). Data collected by the Fisheries Program show baseline conditions to be detrimental to salmonid presence as well. High TSS levels were present at all the sample sites located on agricultural impacted streams. These included Hangman Creek at Squaw Hump, Moctileme Creek, Little Hangman Creek, NF Rock Creek, Lolo Creek, Tensed Creek, and Smith Creek (Tables 4-7, 10, and 17). Any time concentrations remain above 400 mg/L TSS for 3 days, above 20 mg/L for two months, or 7.0 mg/L for the entire year, the stress levels for salmonids reach Level 8 or 9, using Newcombe and Jensen's (1996) TSS models. The effects of a Stress Level 8 would include the following: impaired homing, long-term reduction in feeding rate, long-term reduction in feeding success, and in general a poor condition. Fish are most likely showing avoidance as a behavioral response to these levels of TSS, either acute during storm events, or for chronic conditions. Newcombe and Jensen (1996) identified concentrations as low as 2.0 mg/L causing problems for salmonids if these concentrations were chronic.

Oxygen levels also appear to be limiting trout in the sites identified in Table 18 where dissolved oxygen was below 7.0 mg/L. The State of Idaho limit for DO is 6.0 mg/L at all times for cold water species. It should make sense to set a higher limit if only limited sampling of DO is performed, and the literature suggests modification of this limit. Swimming performance of trout is sharply reduced when DO levels reach 6.5-7.0 mg/L (Davis et al. 1963). This in turn affects feeding and predation avoidance. Unfortunately, oxygen data is missing for baseline flows at the Hangman Creek-Squaw Hump site and many other non-fish-bearing sites where it is suspected that DO levels dropped below 7.0mg/L during base flow. The available sampling device for DO determinations was a DataSonde® 4. This unit was very unreliable during mid summer and was eventually sent in for professional servicing. It will be critical to capture baseline conditions at sites that are suspected to be marginal for trout.

Temperatures also appear to be a potential factor for limiting salmonid production within most of the main stem of Hangman Creek and the lower reaches of tributaries despite favorable weather patterns during 2002. Air temperatures were relatively mild in August, and the snow pack was above normal the previous winter (Haynes 2003). All of the sites on agricultural land with the characteristic lack of canopy showed temperatures that exceeded optimum conditions for trout rearing. Ambient air temperature is the most critical variable in determining water temperature during baseline flows (Idaho DEQ 1998). It is anticipated that a drought year such as one in 2001 along with average August air temperatures would raise water temperatures even more. A complete assessment of temperatures is not possible at this time because continuous temperature monitors were not deployed in time to get running averages from April 1st when it is suspected that fish are spawning. There are many metrics in which to analyze continuous temperature data, and upper limits for these metrics are presently being researched and debated. Currently the State of Idaho uses 22° C as the maximum limit for temperature, and the daily average shall not exceed 19° C for more than 10% of the days within the critical period (Idaho Dept. of Environmental Quality) 2002). The State of Washington, Dept of Ecology (2002), has recently proposed to alter their own temperature requirements for salmonids that would include species and life stage specific limits for a seven-day average of daily maximum. This would include a limit for spawning and rearing of salmonids at 16° C, and Redband trout rearing at 18°. IDEQ sets a limit of 13° C for cold water species spawning with the critical period being the entire spawning and incubation period for a minimum of 45 days. Since the temperature monitors went out in May, sufficient data to assess spawning temperatures is lacking.

Sites such as Upper Tensed Creek, Lower Squaw Creek, Upper SF Hangman Creek, Conrad Creek, and Martin Creek may be marginal habitat for salmonids strictly based on a lack of flow. Temperature and TSS were not above limits (Table 18), but these streams are intermittent. At one time all these locations were perennial. Some of these locations could provide spawning habitat if substrate composition is favorable for Redband spawning. Pebble counts or other types of substrate analysis will provide better answers to this question. Additional continuous temperature monitors, more TSS samples, and more Hydrolab® readings will be needed to make any further conclusions about habitat suitability.

Indian Creek is the only tributary that has adequate water quality for it's entire course. Temperature (Figures 31-32) and oxygen (Table 12) do not appear to be an issue in Indian Creek. TSS levels in the East Fork drainage were high during summer months (Figures 13-14) and monitoring needs to be continued. Forestry practices within EF Indian Creek is strongly suspected as being the reason the stream is supplying more suspended sediment despite it's lower discharge during the summer. Upper Indian Creek and the NF Indian Creek show characteristics of pristine conditions with several TSS samples below detection limits (Table12).

TSS levels were very inconsistent at the EF Indian and Mission Creek sites a, and could be indicators of disturbance by logging operations that were ongoing during the summer. This is evidenced by TSS concentrations increasing after logging commenced, despite the fact that discharge had decreased during the same time frame (Mission Cr: Table 8, Figures 8-10, EF Indian: Table 12, Figures 13-14, 16). Continuous temperature monitoring in these three watersheds shows a distinctive difference between the forested upper portions of the watershed, and the lower portions that lie within agriculture lands (Figures 24-29). Low dissolved oxygen exists in the lower reaches of all three tributaries (Tables 8, 9,and 11).

Adequate cover and spawning substrate is also suspected for a lack of salmonid presence in many locations. Data from IDEQ BURP surveys, Rosgen (1996) channel typing and other hydrologic data collected from the hyrology study proposed with Hardin-Davis, Inc, will fill data gaps in order to further describe quality of fish habitat. Further details of the Hardin-Davis study can be found in this discussion under Watershed Coordination.

IDAHO DEQ BURP SURVEYS

Since results from IDEQ surveys have not been analyzed, no discussion is available at this time.

EROSION MONITORING

No discussion is available for erosion monitoring since bank pins have only been installed and monitoring will not begin until spring of 2003.

FORESTRY AND ROAD CONDITIONS

Surveys for forestry practices and road conditions are in the initial stages of development at this time. However, in scouting the watershed for water quality and fish sampling stations, it has become apparent that the Mission Creek watershed has more than it's share of problems. Some of the problems in Mission Creek include the following: poor drainage on haul roads (Road Survey Sites # 2, 5, 8 and 14), lack of culverts or improper sizing of culverts across perennial streams resulting in erosion and potential fish barriers (Road Survey Sites 3, 4, 10, and 11), potential violations of the Idaho Forest Practices Act (Sites 9, 12 and 13) in regards to buffer zones around fish-bearing streams, creation of fish barriers due to poor culvert installation resulting in a "shotgun" conditions, where fish need to jump up to get into culvert (Road Survey Sites 7, and 15). The problems seen elsewhere in the Hangman watershed were minor compared to Mission Creek. It will be a priority to identify all the problems with fish passage and road drainage so the watershed can recover from the effects of the recent activity in the watershed.

Coeur d' Alene Tribe fisheries personnel are apparently the first to do any audits in the Mission Creek watershed for the most recent activity. Idaho Dept of Lands (IDL) was contacted about forestry practices within the Mission Creek watershed that were bending, if not breaking, the laws under the Idaho Forest Practices Act of 1974. Issuing data to IDL in regards to salmonid distribution had little effect upon the buffer zones set on one timber cut (Road Survey Sites # 9, and 13). Getting salmonid distribution information to IDL must take place a year in advance of timber operations in order to set the proper buffers within the riparian zone. A much more thorough examination of buffer zones and installation of culverts is needed in the watershed in the final two years of the assessment phase of this project in order to determine if the Idaho Forestry Practices Act of 1974 was violated in past logging operations.

"Valuable as it may be, protection of streamside zones alone is not necessarily sufficient to insure maintenance of productive stream ecosystems in watersheds where timber is harvested. Particularly in steep terrain, debris avalanches and related mass movements of soil, timber, and debris from hill-slopes may adversely affect salmonid habitats" (Hicks et al. 1991). Maintaining forest density and decreasing road densities will decrease surface runoff allowing rainfall to penetrate soils. Decreasing high flows during spring runoff and rain-on-snow events and increasing base flows should be considered a primary goal in restoring aquatic ecosystems where adequate flows are not being maintained during the summer. Accurately measuring changes in vegetation types and density as well as road conditions and densities, along with discharge measurements, could provide a measure of predictability in a particular watershed for changes for how land use in the watershed changes the flow regime. Future forestry practices and road surveys should provide data to the Tribe's GIS office in order to maintain GIS vegetation and road layers. It would also be beneficial to seek out the help of large timber companies to accomplish this.

HISTORICAL TRENDS

With the lack of historical data, it is hard to show any trends in the water quality of these fish bearing streams. Despite this lack of scientific data, there are indications that the decline in water quality and fish populations in Hangman Creek is ongoing rather than something done 30 –100 years ago. Electro-shocking data reveals a less diverse fish assemblage today than in 1994. Many accounts by local residents say that trout up to 18 inches long were caught in different locations along the main stem of Hangman and in tributaries just 5 years ago. The common denominator when talking to residents was how much fishing has declined in the last 5-10 years. The key is to design samples methods that can detect such a trend. It is likely that the fish populations are becoming more fragmented and less productive. Within the Hangman Creek watershed, two sub-watersheds are suspected to have current trends in water quality or salmonid distribution that are in opposing directions.

Mission Creek, more than any other basin in the Hangman watershed, may be most vulnerable of loosing spawning and rearing habitat for trout within the near future. Recent logging in Mission Creek has altered the watershed just within the last 2 years. There have been several accounts of large fish being caught in Mission Creek just upstream of our lower sampling station just 2 years ago, as well as many perennial streams now being intermittent. GIS Vegetation layers showing forest density in the watershed are so inaccurate 5 years after they were created that it is easy to see how the watershed has dramatically changed. Finding corroborating accounts, and perhaps pictures, will be needed to confirm many "stories" told by these local residents in regards to fish distribution and changes in flow. A more formal interview of these residents will be necessary in the future to document their accounts of the changes in the watershed. Figures 43 and 44 show the impacts of forestry practices within the Mission Creek drainage.

In contrast to Mission Creek, the upper reaches of Squaw Creek may have improved during the last 5 years. Flooding in spring and dry channels in summer was common in the immediate years following a large timber operation completed within the watershed according to local residents. Now flooding has subsided and summer flows are recovering somewhat. If the presence of trout were the best indicator of stream health, one would have to conclude that Squaw Creek is in good shape compared to other tributaries of Hangman Creek. The best population of trout lies within these upper reaches of Squaw Creek (Table 16). Such speculation for either stream is difficult without the scientific data to back it up. Continuing with water quality and fisheries monitoring may show the suspected trends.

WATERSHED COORDINATION

Coordination with the Tribe and all agencies with interests in Hangman Creek is a primary goal of this project. Setting common management goals, gathering data to cover all areas of the watershed, and using common methods for data collection and analysis are the primary aspects of this coordination.

Coordination with Washington interests is being conducted with Washington Fish & Wildlife(WAF&W), Spokane Tribe, Eastern Washington University, and the Spokane County Conservation District who is acting as lead agency for a Redband trout group. Spokane County Conservation District is providing water quality data, as well as funding an Instream Flow analysis by Hardin-Davis, Inc. The tribe plans to hire Hardin-Davis to do a similar study on Hangman Creek within reservation boundaries. This data will provide HSI's (Habitat Suitability Index) for Redband trout. Fish distribution and population estimates within the Washington portion of Hangman Creek was first done by fish surveys done by Eastern Washington University's grad student, Charles Lee. Charles Lee now works for the Spokane Tribe. His thesis showed the need for genetic analysis in the Hangman Creek watershed to see if there are genetically-pure Redband trout present. Washington Dept. Fish & Wildlife plan to do genetics sampling in Hangman Creek in 2004. The Coeur d' Alene Tribe will be using WA F&W's sampling protocols for collection of DNA samples. Data provided by Washington natural resource agencies for Hangman Creek may reveal conditions that are necessary for healthy Redband populations to exist.

In Idaho this coordination has thus far consisted of IDEQ's *Beneficial Uses Reconnaisance Project* (BURP) surveys as described in the methods section of this report. Survey sites in 2002 were within tribal boundaries as well as east of the reservation. More BURP surveys are planned in 2003-2004 is contingent on funding. Future fisheries work with Idaho Dept of Lands and Fish & Game is also something the Coeur d'Alene Tribe will seek out in 2003 in order to locate salmonid populations in Hangman Creek upstream of the reservation.

RESTORATION PRIORITIES

Priorities need to be established in order to bring about the most beneficial effects for the limited resources. The philosophy of restoring the watershed from the top and working downstream should be applied, so as not to negate restoration efforts by impacts from upstream. Protecting existing salmonid habitat and expanding those habitat conditions in streams that currently contain trout should be considered a priority. Mission Creek, Sheep Creek, Squaw Creek, Indian Creek and the upper reaches of both the South Fork of Hangman and Hangman Creek all contain salmonid populations and are high in the Hangman Watershed (Figures 37-41). Lower nighttime temperatures theoretically raise the upper temperature tolerance of rainbow trout (Hokanson et al. 1977). Because of this, the conditions in the lower reaches of the previously identified streams show a greater potential to support trout than does the main stem of Hangman Creek (Figures 37-41). However, the potential for the main stem of Hangman Creek to provide connective habitat for those currently isolated fish populations warrants including it in among the priority streams (Green and Roberts 2002).

5.0 ASSESSMENT OF SCOPE OF WORK

SUMMARY

The project's specific objectives and tasks saw good progress during 2002 despite the late start of the project biologist and technician. A suitable candidate for project lead was not found in the interview process, and a biologist within the Fisheries Program was reassigned to the Hangman Creek project. The Fisheries Program manager provided guidance for project management, and many members of the Fisheries And Wildlife staff provided assistance GIS skills. A senior fisheries technician was not hired as outlined in the SOP due to the lack of a suitable candidate. Instead a seasonal technician was assigned to the Hangman project, and this person received a great deal of training during the first three months.

As with any new project, progress toward specific tasks was not as consistent as an ongoing project. Many of objectives and tasks were general in nature, and were refined during the course of fulfilling those objectives. During this initial year of bioassesment, efforts were made to become familiar with the entire watershed and the impacts of the many land uses of the watershed. Potential water quality and shock sites were scouted. The condition of some forest roads was determined during these initial scouting trips. As the summer progressed fieldwork involved electroshocking, water quality sampling, installation of bank pins, surveying using Rosgen protocols, monitoring continuous temperature monitors, and monitoring Forestry practices. After the field season, the technician was laid off and the project biologist took over duties for water quality. This data will be summarized in the 2004 year end report. Data entry, and creation of GIS projects took up a great deal of time prior to initiation of the year-end report.

While we did not complete all tasks scheduled, additional data was gathered that was not part of the original SOP. Because of the late start for the project biologist and the technician, migration studies *(Construction and Implementation, Task 1c)* were postponed until 2003. Also no rain-on-snow (ROS) events were sampled for water quality. Water quality data during this time period was restricted to sites sampled by the Water Resources Program with the tribe. Snorkeling *(Planning and Design, Task 1b, and Construction and Implementation Task 1b)* was determined to be a method not feasible in Hangman Creek.

Tasks that were slow to develop include installation of catch basins *(Planning and Design, Task 3b, and Construction and Implementation, Task 3a)*. No landowner agreements for restoration projects and installation of catch basins have been signed at this time. The newsletter *(Operation and Maintenance, Task 1b)* was impacted by budget constraints. The fall edition was delayed with a limited distribution. The winter edition was delayed until March. A more consistent publication of this newsletter will allow us to announce our meetings and summarize progress of the project.

Several tasks have received more attention in this first year and are ahead of schedule to be complete by the end of Phase I. The BURP surveys coordinated with IDEQ will provide a great deal of data relating to suitability of habitat for cold water species *(Planning and Design, Objective 2).* A report from IDEQ will be included in the 2003 Year-End report. A contract with Hardin-Davis Inc in 2003, for an IFIM (Instream Flow Incremental Methodology) study will yield quantified data for salmonid habitat. Forestry practices and road conditions were part of the Planning and Design Phase *(Task 3d)* of the SOW. Although nothing was in the scope of work for implementation of fieldwork in this area, some fieldwork was done. Some sites were actually repaired by contracting loggers using recommendations from the project biologist and volunteers were used to revegetate these sites (See Results: Road Surveys).

Conclusions
Progress was made during first year of Phase I (Bioassesment) toward the overall goal of the first three years. Because we accomplished more in the areas of assessment of suitable habitat and forestry practices, we feel confident that we can catch up with incomplete contracted deliverables outlined in the 2001 SOW.

The objectives and tasks along with details of progress for each task is as follows:

2.1 PLANNING and DESIGN PHASE

Objective 1. Assess the need to recover native redband trout and other native fish species in Hangman Creek and it's tributaries so they could support Tribal subsistence harvest.

Task 1.a Develop the protocol for electro shocking Hangman Creek and its tributaries.

Status: The complete protocol is in Appendix B. We have planned for 2003 to add an additional 10-15 electroshocking sites to the existing 37 sites. An evaluation of the current sites will be done to avoid redundancy. Some of the sites to be eliminated were very close to Idaho DEQ BURP sites. Determining range of salmonids will be a priority in adding or deleting sites, as well as conducting a population estimate.
We will again be working with Idaho DEQ to arrange BURP sampling both on the reservation and off. For sites that are off the reservation it will be an opportunity to gather fish data. There is a possibility we will use different methods to sample fish on the main stem of Hangman Creek using a drift boat in Year 2004. We

are assessing the feasibility for the Washington Dept. of Fish and Wildlife to work with us to electroshock the main stem of Hangman Creek next year using their protocols. Details will be worked out in the coming year.

Task 1.b Develop the snorkeling protocol for Hangman Creek and its tributaries.

Status: It has been determined that snorkeling the tributaries and main stem of Hangman Creek is not feasible. Therefore a protocol will not be developed.

Task 1.c Develop the methods for using migration traps.

Status: Complete. The methods for migration studies are in Appendix I. Four streams (Indian, Squaw, Sheep, Mission) have had upstream traps installed by the end of March 2003. Personnel have been trained in the proper sampling techniques from working on project (1990-044-00).

Task 1.d Outline the methods for collection of DNA samples.

Status: Complete. We will be using the protocol that Washington Dept. of Fish and Wildlife uses for collection of DNA samples including methods, paperwork, and analysis of samples. WDFW will supply the Coeur d' Alene Tribe with the protocol and provide training. They will also supply their collection kits. Personnel have not been trained in the proper sampling techniques. This will be done in the spring of 2003 when field crews report. Field and lab procedures that were provided by Washington Fish & Wildlife are in Appendix G.

Objective 2. Evaluate Hangman Creek and its tributaries based on current biological, chemical and physical data.

Task 2.a Develop sampling procedures to follow during the collection of water quality data.

Status: Complete. Procedures are outlined in methods section of this report. During the course of the summer two technicians were trained in the proper procedures for water quality sampling. This will be an ongoing process whether or not these two technicians return for this year. We are set to begin 2nd year sampling regime beginning in April with the additional parameters of nutrients (F, CL, SO4, nitrate, nitrite, and orthophosphate); alkalinity; total kjeldahl nitrogen; ammonia; total phosphorus; and bacteria.

Task 2.b Develop the guidelines to follow when channel typing Hangman Creek and it's tributaries.

Status: Complete: The complete protocol is outlined in Appendix H.

Personnel received some training for Rosgen's procedures in completing the fieldwork for the N.F. Rock Creek bioassesment.

An opportunity arose to collect additional physical, biological, and chemical data in a cost efficient manner. This is beyond what was written in the original scope of work. This was accomplished by habitat surveys done by Idaho's Div. of Environmental Quality. IDEQ conducted BURP (Beneficial Uses Reconnaissance Project) surveys at nine sites within the Hangman watershed. Six of these were on the reservation. An arrangement was developed where IDEQ will do 8 more sites over the next 2 years. The data will be compiled and analyzed by IDEQ. The Coeur d' Alene Tribe will pay for any lab fees incurred for sites within the reservation. IDEQ will pay for all lab fees incurred for sites outside the reservation. A service contract was drawn up with EcoAnalysts to do the macroinvertebrates analysis, and Hannaea to do the periphyton analysis.

Objective 3. Assess the effects of sediment loading on native redband trout and other native fish species production within the project area.

Task 3.a Quantify sediment delivery and abatement efforts and assess soil erosion and sources within Hangman Creek and its tributaries.

Status: Ongoing. Water quality data continued to be gathered which will lead to the production of a GIS layer that identifies sites with erosion problems. A draft sediment abatement strategy will be developed during 2003 and will be included in the final report.

Task 3.b Work with local landowners to determine the need to install catch basins that will assist in the modeling of sediment from agricultural fields.

Status: Ongoing. Efforts are being made to sign landowner agreements for installation of catch basins. A draft agreement will be created to draw upon when necessary. Our public meetings need to reach out to farmers better in order to attain better attendance.

Task 3.c Develop a means to measure bank erosion.

Status: Complete. Procedures for installing bank pins were developed and to detail site conditions. Procedures are outlined in the Methods section of this report. This will be used as baseline information to quantify erosion. These data will be compared to post restoration data to assess restoration efforts.

Task 3.d Examine forest road conditions and forestry practices to determine the effects on salmonid production.

Status: Ongoing. This task involved a lot more than what was originally anticipated. See Discussion section *Forestry and Road Conditions*. Forestry practices in the Mission Creek, and Sheep Creek watersheds were monitored during the 2^{nd} and 3^{rd} quarters of 2002. A few other sites were mapped out in Figure 43 that were in other areas of the Hangman Creek watershed. A great deal of roads is left to assess in the coming two years

Objective 4. Facilitate a "holistic" watershed approach to restoration to gain support for the project from local landowners as well as improving landowner involvement in the project.

Task 4.a Establish and oversee the Hangman Creek Watershed work group.

Status: Complete. The 1^{st} watershed work group meetings were held in October 2002, and a second held in February 2003. These meetings are scheduled to take place on a quarterly basis. This deviates from the scope of work that said we would hold meetings every 6 months. To garner interest in the project and maintain momentum it was determined that we should have, at the minimum, quarterly meetings. We feel that engaging the local landowners more frequently will allow more opportunity to get input from them.

A mailing list of all interested parties within the watershed is being maintained.

2.2 CONSTRUCTION and IMPLEMENTATION PHASE

Objective 1. Conduct a population estimate on native redband trout and other native fish species in Hangman Creek and its tributaries.

Task 1.a Implement electroshocking in Hangman Creek and its tributaries.

Status: Ongoing. Population estimates were scheduled for 2003. We performed single pass methods with block nets in 2002 to determine distribution of salmonids, which was a priority for Project 2001-033-00 (Implement Enhancement Wildlife Habitat on the Coeur d' Alene Reservation).

Task 1.b Implement snorkeling in Hangman Creek and its tributaries.

Status: No snorkeling was done during the last year. None is scheduled at this time. We feel that this type of sampling that it is not appropriate for this system, considering the bacteria levels and turbidity in the mainstem of Hangman and the lack of deep enough water in the tributaries to get a diving mask submerged.

Task 1.c Install migration traps in Hangman Creek and its tributaries.

Status: Complete. Installation of migration traps were not done in 2002 because there was no biologist or technicians assigned to this project until after migration was well under way. Traps have been installed in March of 2003. Length, weights and age data on native salmonids will be collected.

Task 1.d Implement the collection of DNA samples

Status: Ongoing. This task was scheduled to be done in 2003. Collection and preservation of genetic samples for future DNA analysis will commence in spring, 2003.

Task 1.e Identify current and historic distribution of native redband trout and other native fish species.

Status: Ongoing. A GIS layer and map illustrating existing rainbow trout and other salmonid distribution has been completed. Information is being gathered on historical distribution of trout from reliable long time residents of the area. A standard form for interviews wills to be used in future interviews. A complete map of historical distribution will be included in the final report.

Objective 2. Implement biological, chemical, and physical sampling parameters.

Task 2.a Establish and identify permanent water quality monitoring stations within Hangman Creek and its tributaries.

Status: Complete. Twenty-nine water quality sites were established in 2002; these sites are in addition to the 6 sites already established by the Coeur d'Alene Tribe's Department of Water Resources. The combined 35 sites have all been mapped and their site descriptions entered into our GIS system. Appendix A contains a site description for all water quality sites.

Task 2.b Characterize habitat suitability for native redband trout and other native fish species in Hangman Creek and its tributaries.

Status: Ongoing. Data is lacking at this time to develop a GIS layer for habitat suitability. Table 15 contains a summary of temperature, TSS, and dissolved oxygen, as it's relationship to salmonid distribution. A map will be created after habitat surveys (Rosgen channel typing, IDDEQ's BURP, and IFIM) and a full year of water quality data is analyzed.

Objective 3. Implement soil erosion and bank stability assessment measures in FY01.

Task 3.a Install catch basins in agricultural fields to monitor soil erosion.

Status: Incomplete. No landowner agreements have been signed to install catch basins. An increased effort will be made to reach out to farmers thru public meetings.

Task 3.b Install bank pins into the stream bank to measure bank erosion.

Status: Fifty bank pins were installed during the fall, 2002. All water quality sites have bank pins at this time. Additional bank pins were installed at sites where high potential for erosion existed, which would later become restoration priorities. A map of sites is in Appendix C. During the 2003 field season an additional 50 bank pins will be installed at priority sites.

2.3 OPERATION AND EVALUATION PHASE

Objective 1. Improve awareness of the Fisheries Program activities to encourage long-term support of restoration activities within the Reservation community.

Task 1.a Work with area schools, local communities and landowners to discuss restoration, cooperative and educational opportunities.

Status: Ongoing. Fish and Wildlife staff has been working towards making the public aware of the project in a variety of ways. Individual contacts were made during the course of the summer field season in order to gain access to land for water quality and fisheries sampling. Landowners were notified by mail and public notices were posted within the community regarding public meetings. Two public meetings were held in October 2002 to introduce the idea of a Hangman Creek watershed work group, and a second quarterly meeting was held in February. Contacts have been made to schools within reservation boundaries about the general concepts of restoration and the different projects the Coeur d'Alene Tribe has going. A primary tool of public outreach is the Tribe's Water Awareness week where 6th graders circulate through different stations learning about natural resource conservation. The event was held during the week of June 6-10, 2002. The Hangman Project Biologist taught at a similar event called the Silver Valley Water Awareness Week. He ran a classroom session on identifying macroinvertebrates and their significance to characterizing water quality.

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

Status: Ongoing. Newsletters were mailed out to landowners within the Hangman Watershed to coincide with the equinoxes. This will also be used as a means to educate the landowners. Due to funding shortfalls a limited distribution was released in Oct utilizing Tribal license vendors. A normal distribution was released in March 2003.

Objective 2: Review and coordinate fisheries activities with other Tribal departments and the Coeur d'Alene Tribal Council for consistency in management direction and to ensure compliance with all Tribal policies and procedures.

Task 2.a The Natural Resource Director will provide oversight, and facilitate coordination between fisheries staff, other Natural Resource staff, Natural Resources Committee, and Tribal Council, to ensure administrative approval of all activities.

Status: Ongoing. The Natural Resource Director, through monthly Program Manager meetings, coordinated between NR staff. He was kept abreast of progress on Scope of Work, financial status, and any changes conveyed between BPA and the Coeur d' Alene Tribe.

Task 2.b Coordination of all financial documents and fisheries activities with the Tribal Finance office to ensure accurate and efficient monitoring of fisheries budgets and timely and accurate invoicing of expenses.

Status: Ongoing. Monthly submission of reimbursable invoices to BPA was being handled in a timely manner.

2.4 MONITORING AND EVALUATION PHASE

Objective 1. Determine project effectiveness by monitoring changes in physical, chemical and biological conditions in Hangman Creek and its tributaries attributed to project implementation.

Task 1.a Compile baseline water quality parameters in Hangman Creek and its tributaries within the Coeur d'Alene Reservation to determine effectiveness of implementation measures.

Status: Ongoing. Discharge, pH, conductivity, dissolved oxygen, temperature, TSS, and turbidity data was gathered from late May until October 2003. This information is reported in the 2002 Year – End report. Spring runoff with rain on snow events were not captured during this initial year's sampling. Beginning in April

2003 data for the following parameters will be added to the sampling regime; nutrients (F, CL, SO_4, nitrate, nitrite, and orthophosphate); alkalinity; total kjeldahl nitrogen; ammonia; total phosphorus; metals; and bacteria. This data will be collected for the next 2 years to capture differences between annual precipitations.

Task 1.b Conduct periodic population estimates of redband trout in Hangman Creek and its tributaries within the Coeur d'Alene Reservation.

Status: Ongoing. This task was scheduled for 2003. Single pass electroshock sampling was done during early summer of 2002 to provide presence/absence data to show salmonid distribution within the watershed. Statistical methods for one-pass methods were not calculated. Multiple pass sampling will be done in 2003 to provide population estimates.

Task 1.c Monitor redband trout movement to determine if they use mainstem Hangman Creek to rear or if they rear in their natal stream. This will include daily monitoring of migration traps.

Status: Incomplete. Migration traps were not installed in the spring, 2002, but have been installed in March of 2003.

Task 1.d Establish current soil erosion conditions to compare future conditions after restoration activities have taken place.

Status: Ongoing. Bank pins were installed in September 2002. Monitoring of the bank pins will take place in late summer after flows have dropped and reporting will take place within each Year-End report. Rosgen's channel typing procedures (Rosgen 1996) were used to complete the N.F. Rock Creek Biological Assessment (Project 82-0255476) during this last quarter. Rosgen channel typing, level 2; will be done over the course of the next two field seasons (2004-2005), if training for the biologist is approved by BPA.

Objective 2. Determine effectiveness of educational efforts to raise awareness of natural resource issues in Hangman Creek and its tributaries within the Coeur d'Alene Reservation.

Task 2.a Conduct a public opinion survey so that it can be determined how effective the working group is.

Status: Ongoing. A brief satisfaction survey will be incorporated into the newsletter and distributed for completion at our 3rd public meeting and every meeting thereafter. The survey form is enclosed in Appendix I .

6.0 DISCUSSION of the NEXT STEPS OF BIOASSESSMENT

The field season of 2003 will include a continuation of tasks begun in 2002 and some additional tasks as outlined in the Scope of Work. Water Quality, fish sampling using traps and electro-shocking, road and forestry practices surveys, erosion monitoring, public outreach activities, and Rosgen channel typing will done in 2003. Collection of DNA samples will be part of the migration trapping and electroshocking. In addition to these tasks, subcontractors will be used to conduct a IFIM study which will provide a discharge and temperature model that will be used to determine restoration feasibility and priorities. Idaho Dept of Environmental quality will also conduct Beneficial Uses Reconnaisance Project (BURP) surveys both on and off the reservation.

Public outreach will take on greater importance now that some fisheries and water quality data is available. A natural resource fair is planned for the Hangman Watershed as our next public meeting. We will invite professionals from other natural resource agencies in Idaho and Washington who can help the residents of the watershed understand what they can do to help with the restoration process. Education of school age children will continue to be of importance thru the Coeur d'Alene Tribe’s Water Awareness Week and other opportunities to work with children. Signing agreements for restoration projects and installation of catch basins will need to be addressed in 2003.

Water quality will continue to play a major role in bioassessment, especially during spring when high flows will be sampled. It must be stressed that sampling must be done during rain on snow events and early spring to pick up data that was not obtained last year because of the late start to the program. With a freshly repaired hydrolab, some data gaps need to be addressed during baseline flows.

Conducting fish population surveys in order to estimate populations and to collect genetic samples for DNA analysis will begin in May to sample fish that may be using certain locations only during spawning season. Protocols and preservation kits will be supplied by Washington Dept of Fish & Wildlife to coincide with genetic studies being conducted on Hangman Creek within Washington (McLellan 2002).

Migration studies is planned for this year to include four upstream migrant traps. It is anticipated that additional traps may be built during the winter of 2003/2004 for the 2004 season and to replace damaged traps. Squaw Creek, Indian Creek, Sheep Creek, and Mission Creek will be the priorities for getting traps installed in 2003 because of the possibility that fish present in these watersheds originate from the Spokane River. Trapping during spawning induces a severe and prolonged stress response in wild rainbow trout (Clements et al. 2002). The potential harmful affects should be balanced against the need to accurately predict population densities and track migration patterns. In contrast, electroshocking poses less of a threat since it would occur after spawning, and studies have shown stress is minimal if done using the proper wavelength (Ainslie, et al. 1998). For these reasons, trapping will be restricted to only four locations, while electrofishing locations will more extensive. A great deal of effort will be made to avoid stress, injury, and mortalities associated with these sampling methods.

Idaho Dept of Environmental Quality's Beneficial Uses Reconnaissance Project (BURP) will continue to play a major role in the bioassesment of Hangman Creek. Six more sites are being considered for BURP surveys in June of 2003. Lower Mission, Upper Indian Creek, Rose Creek, Tensed Creek, and two locations east of the reservation, Martin Creek and Upper S.F. Hangman will be surveyed. We will have the same arrangement as last year, with the Coeur d'Alene Tribe paying for lab fees for sites within the Reservation. Funds to cover lab fees for these four sites will be part of the Scope of Work for 2003. These surveys will also allow us to get fish distribution for streams outside the reservation, as well as gain an understanding of the general health of the streams.

An Instream Flow study will also be done during 2003-2004 by Hardin-Davis, Inc. Temperature, discharge, and weather is being monitored by tribal personnel, while the habitat typing is being performed by Hardin-Davis personnel. This study will provide the Coeur d'Alene Tribe with a discharge and temperature model capable of determining restoration feasibility and priorites.

Road surveys and forestry audits will begin in earnest after initial tests of methods were conducted in 2002. Because of the large amount of logging occurring in the Mission and Squaw Creek watersheds, it is anticipated that more effort will be required than what the original scope of work called for. Linking water quality results to watershed vegetation differences and road densities will require that we update the GIS layers for vegetation and roads. The need for a dedicated GPS device for the project is critical in mapping new roads, identifying exact locations, and updating GIS vegetation layers.

Rosgen channel typing (1996) will commence in 2003. Level 1 surveys will be done in the office during 2003, but Level 2 surveys (fieldwork) will not begin until 2004 after the Project's biologist can attend Wildland Hydrology's training course entitled, *Fluvial Geomorphology*. Having properly trained personnel for this task is critical.

Continuous temperature monitoring will be expanded for 2003. Additional monitors will be purchased to cover baseline conditions, and the existing temperature monitors will be launched earlier to pick up initiation of spawning.

Because so much of the watershed is privately owned, an emphasis must be placed on involving everyone in the restoration process. A great deal of effort is needed to reach out to farmers in order to sign agreements for restoration projects, and to install catch basins. Our public meetings will play an integral part of accomplishing this goal. The Tribe also needs to get a working relationship with the major timber owners to assist us in developing management plans that seek to enhance flow and decrease suspended sediment.

Public Outreach activities planned include the Coeur d'Alene Tribe's Water Awareness Week and the Silver Valley Water Awareness Week. Our next meeting in July will incorporate a new format where information stations will be set up and attended by representatives of the Tribe and other natural resource agencies. This will allow more one-one type of interaction with attendees.

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8.0 APPENDICES

APPENDIX A: WATER QUALITY SAMPLING SITE DESCRIPTIONS

MAINSTEM OF HANGMAN CREEK

01-SH000000, Hangman, Stateline. T45N, R6W, Sec 36, NW $^1/_4$. River mile (RM) 0.0 on Hangman Creek Road. Located in Agriculture land.

02-SH000000, Hangman-HWY 95. T44N, R5W, Sec 24, NW $^1/_4$. Hangman Creek RM 13.8 at Hwy 95. Located in Agriculture land.

03-SH000000, Hangman Creek at Squaw Hump. T44N, R4W, Sec 28, NW $^1/_4$. RM 15.6 on Old Sanders Road. Mixed land use area.

05-SH000000, Hangman at confluence with SF Hangman. T43 N, R4W, Sec 1, SE $^1/_4$. RM 22.7 on Emida/Sanders Road. Mixed land use area.

06-SH000000, Hangman in Forest. T43N, R3W, Sec 5, NE $^1/_4$. RM 24.5 on Emida/Sanders Road. Forested area.

07-SH000000, Upper Hangman. T44N, R3W, Sec 33, SW $^1/_4$. RM 25.3 off Emida/Sanders Road. Forested area.

TRIBUTARIES

01-SH050000, Lolo Creek. T45N, R5W, Sec 26, SW $^1/_4$. Lolo Creek is at RM 4.0 on Hangman Creek. Sample site is at Benewah Creek Road crossing. Located in Agriculture land.

01-SH070000, Lower Tensed Creek. T44N, R5W, Sec 11, SE $^1/_4$. Confluence with Hangman Creek is RM 7.0. Sample site is at Old Tensed Road crossing. Located in Agriculture land.

02-SH070000, Upper Tensed Creek. T44N, R4W, Sec 6, NE ¼. Sample site is 100 yards SE of Little Butte Road. Forested area.

01-SH060000, Lower Mission Cr. T44N, R5W, Sec 35, NW . Confluence with Hangman Creek is RM 7.0, and sample site is at the second King Valley Road crossing at RM 2.5 of Mission Creek. Located in Agriculture land.

02-SH060000, M.F. Mission Cr. T43N, R5W, Sec 10, NE $^{1}/_{4}$. At Pole Camp Road crossing. Forested area.

01-SH060010, E.F. Mission Cr. T43N, R5W, Sec 3, SE $^{1}/_{4}$. $^{1}/_{4}$ mile west of Pole Camp Road on haul road. Lightly forested area.

01-SH060020, W.F. Mission Creek. T43N, R5W, Sec 3, NW $^{1}/_{4}$. At old bridge crossing that is tank-trapped, 1/3 mile west of Pole Camp Road. Mixed land uses in area

01-SH080000, Sheep Creek at HWY 95. Confluence with Hangman Creek is RM 7.0. Sample site under bridge at Hwy 95. Mixed land use area.

02-SH080000, Upper Sheep Creek. T43N, R5W, Sec 1 SE ¼. 1 mile south of end of Sheep Creek Road, at forestry gate. Forested area.

01-SH090000, Lower Squaw Creek. T44N, R4W, Sec 28, NW ¼.   RM 17.6 on Hangman Creek. Below culvert on Old Sanders Road. Located in Agriculture land.

02-SH090000, Upper Squaw. T44N, R4W, Sec 14, NW ¼. 1 mile behind Potlatch gate above Apple Horse Farm above culvert on logging road. Forested area.

01-SH100000, Unnamed creek upstream of Squaw. T44N, R4W, Sec 28, NE ¼. RM 17.9 on Hangman Creek. Sample site is below culvert on Old Sanders Road. Mixed land uses area.

01-SH110000, Lower Smith Creek.   T43N, R4W, Sec 3, SE ¼. RM 20.2 on Hangman Creek. Above culvert on Sanders Road. Located in Agriculture land.

01-SH110010, Mineral Creek. T43N, R4W, Sec 3, SE ¼. At confluence with Smith Creek on Sanders Road.   Located in Agriculture land.

02-SH120000, Upper S.F. Hangman Creek. T43N, R4W, Sec 13, SW ¼. SF Hangman Confluence with Hangman Creek is RM 22.3. At end of Papoose Road. Forested area.

01-SH120010, Conrad Creek. T43N, R4W, Sec 12, SE ¼. Above culvert on Papoose Road. Mixed land use area.

01-SH120020, Martin Creek. T43N, R3W, Sec 18, NW ¼. 50 yards east of Pappoose Road. Mixed land use area.

01-SH130000, Unnamed Cr. T44N, R3W, Sec 33, SW ¼. Across from Hill Cr on Elmida/Sanders Road on north side of Hangman Creek. Forested area.

01-SH140000, Hill Creek. T44N, R3W, Sec 33, SW ¼. RM 25.0 on Hangman Cr. Above culvert on Elmida/Sanders Road. Forested area.

01-SH160000, Parrot Creek. T44N, R3W, Sec 33, SW ¼. Above culvert on Elmida/Sanders Road. Forested area.

01-SH170000, Unnamed creek. T44N, R3W, Sec 33, SW ¼. Joins Parrot Cr to become Bunnel Creek at hairpin turn on Elmida/Sanders Road. Forested area.

03-SH020000, Lower Indian Creek. T44N, R4W, Sec 30, NW ¼. Confluence with Hangman Creek is RM 20.6. Sample site is at RM 1.4 on Indian Creek. Forested area.

04-SH020000, Upper Indian. T44N, R3W, Sec 30, NE ¼. RM 3.0 on Indian Creek. Behind gate on logging road above confluence with N.F. Indian. Forested area.

01-SH020010, E.F. Indian Creek T44N, R3W, Sec 30, SE ¼. RM 2.6 on Indian Cr. Opposite side of Indian Creek from road. Forested area.

01-SH020020, N.F. Indian Cr. T44N, R3W, Sec 30, SW ¼. RM 2.7 on Indian Cr. Above culvert on logging road. Forested area.

01-SH010000, Little Hangman Creek. T45N, R6W, Sec 12. At stateline with Washington. Agriculture area.

01-SH010010, Lower Moctileme Creek. T45N, R6W, Sec 12. On Hwy 60, 100 feet above confluence with Little Hangman. Agriculture area.

01-SH030000, NF Rock Creek. T47N, R6W, Sec 12. At Hwy 58 crossing near Washington border. Agriculture area.

No code. Rock Creek. T46N, R6W, Sec 1. At stateline with Washington. Agriculture area.

No code. Rose Creek. T47N, R6W, Sec 13. At stateline with Washington. Agriculture area.

APPENDIX B: METHODS FOR FISH SAMPLING USING ELECTROSHOCKING

The following protocol is taken from Peck et al., 2001 with additional equipment considerations from the electro-shocker manuals (Smith-Root, Inc. 1993).

To collect fish by electrical means it is necessary to establish an electrified zone in the water of sufficient strength to stun fish. To accomplish this, an electric current produced by a backpack generator is passed between submerged electrodes. When a fish is between these electrodes, it forms part of the closed circuit through which the current flows. This current can frighten, lead, stun or damage the fish. When a fish is exposed to an electrical current (DC or pulsed DC) it tends to turn toward the anode and will start to swim toward it until it reaches it or encounters an electrical field strong enough to stun it. Pulsed DC, which is obtained by interrupting a steady DC current with an electronically controlled switch, has a greater anode attraction than continuous DC. Fish stunned by the electro-shocker will usually float to the surface where they can be collected using dip nets and placed in buckets or a livewell for temporary storage until they can be measured and released.

The following protocol describes the basic operating procedure for using the Smith-Root Type VII-POW backpack electro-shocker; the complete operating instructions are described by Smith Root (1993). The units used by the Tribe are powered either by a battery or by gas driven generator that is also attached to a pack frame, the total unit weighing about 30 pounds. As a safety feature, these units must have a tilt switch to shut off the power if the unit is tipped more than 45 degrees from vertical. In addition, the backpack frame is constructed of an insulating material (fiberglass) and has an emergency release to quickly separate the operator from the equipment.

These electro-shocking units utilize two electrodes. The cathode is a wire that is insulated for four feet from the unit and then bare for four feet, that hangs off the back of the unit into the water. The anode is a circular metal ring attached to a six-foot long insulated pole, which is held out in front to the operator, and attracts the fish. The anode pole has a switch that must be pressed to allow electricity to flow to the anode.

The Type VII-POW electro-shocker contains the capability of generating a number of different electrical outputs (POW means "programmable output waveforms"). The results of controlled electro-shocking studies indicate that "current density" is the electrical parameter most directly related to the effects of electricity on fish. Current density is greatest near the anode and decreases rapidly with distance from the anode. High current densities will kill fish, moderate densities will stun them and low densities will allow them to escape. The objective of this effort is, as stated above, to stun and collect the fish.

Different species and sizes of fish have difference tolerances to electrical current. Because a fish has resistance, a given current density received at one end of its body will result in a lowered density at the other end, producing a voltage gradient in the fish.

Voltage gradients of 0.1 to 1.0 volts per centimeter are most effective for stunning fish and this range of gradients can be maintained in typical fresh waters (those having an electrical conductivity of 100 to 500 μmhos per cm) by adjusting circuit voltage to produce a current of three to six amperes (Reynolds, 1983). With these typical conditions, the voltage setting on the electro-shocker should be between 500 and 800 volts (Peck et al., 2001). In waters where strong-swimming fish are expected (that is, fish longer than about eight inches) use a pulse rate of 30 Hertz (Hz) with a pulse width (time) of two milliseconds (msec). If mostly smaller fish are expected, use a pulse rate of 60 to 70 Hz (Peck et al., 2001).

In addition to the electro-shocker operator, one or two people with long handled non-conductive dip nets are needed to collect stunned fish. NEVER ELECTROSHOCK ALONE AND ALWAYS WEAR INSULATED GLOVES AND WADERS! Other safety considerations are listed below.

The equipment needed for the fish collection by electro-shocking is:

- Backpack electro-shocker (either battery or gas powered) with 2 hand-held electrodes mounted on fiberglass poles, one positive (anode) and one negative (cathode)[Smith Root, Inc. Type VII-POW]
- Dip nets
- Block nets (2, 1 cm mesh)
- Elbow-length insulated waterproof gloves
- Chest waders (equipped with felt soled boots)
- Polarized sunglasses
- Buckets/livewells
- Fish identification key
- Measuring board (500 mm minimum, with 1 mm increments)
- Scale (battery powered, 1,200 gram capacity, 0.1 gram increments)
- Numbered 'Floy' tags and inserter
- Fish scale envelopes
- Tape measure (100 ft minimum)
- Thermometer with pocket case (0° to 50°C range, in 1°C increments)
- Survey notebook with **Data Form**, blank write-in-the-rain paper and pencil.
- First aid kit

Prior to starting fish collection set up the two block nets across the channel at the upstream and downstream ends of the sampling reach. These must be anchored securely to the channel bottom and be supported above the water surface as well.

Fish collection using electro-shocking begins with a "calibration run" downstream of the sample reach. With all safety gear on, the sampling crew enters the water, starts the electro-shocker, sets the timer and presses the switch on the anode pole to start shocking. As the operator walks slowly along the stream in an upstream direction, he/she swings the anode pole slowly from side to side bringing the anode within three feet of all areas of the sampled habitat unit. If fishing success is poor, increase the pulse width first and then the voltage. Increase the pulse rate last to minimize mortality or injury to large fish. If mortalities do occur, first decrease the pulse rate, then voltage then pulse width.

Once the settings of the electro-shocker are adjusted properly to sample effectively and minimize injury to the fish, begin the sampling at the downstream block net. With the anode power switch pressed, slowly sweep the anode pole from side to side while moving in an upstream direction, as described above. Shock close to (within three feet of) cut bank areas and snags found in the sampled habitat unit. Fish sampling using electro-shocking can be improved by using an intermittent process; it is better not to move through the water with the shocker power on continuously but rather to fish primarily in likely habitat. Fish can be extracted from areas of heavy cover by inserting the anode into the cover with the power off, pressing the power on switch and withdrawing the anode (and attracted fish) slowly towards a netter. In wide streams work from the middle of the channel towards the banks and in stretches with deep pools fish the margins as much as possible being careful not to step or slide into deep water. Keep the cathode wire near the anode if fish catch is low.

The netter(s), using short-handled (four foot, fiberglass) dip-nets, follow closely beside the operator with the net held within a foot or two of the downstream side of the anode. A bucket is carried by each netter for netted fish to be placed in with water.

Immediately after completing the first pass through the fish monitoring reach, all collected fish should be processed. The minimum processing for all captured fish includes measuring length (in millimeters), weight (in grams) and clipping the dorsal fin. For fish that are 200 mm or more in length a "dart" tag is attached near the dorsal fin, the code number for this tag recorded and scale samples are collected. After processing, all fish are released outside of the study reach enclosure.

The procedure for collecting fish scales is that presented by Jearld (1983). Only scales from particular areas on a fish are suitable for aging. The area generally used for bass and trout species is the middle of the side of the body just below the dorsal fin. Before collecting scales, mucus, dirt and epidermis must be removed from the sampling area by wiping or gently scraping in the direction of the tail with the blunt side of a knife. Then, scales are loosened by a quick, firm scraping motion in the direction of the head using the sharp side of a knife. Insert the knife blade with the collected scales on it into an opened and labeled paper scale envelope and press the envelope closed over the blade as it is withdrawn. Scale envelopes should be pre-stamped with a blank label so that date, fish length, weight, and species abbreviation and tag number can be recorded.

Fish population estimates require that a minimum of two shocks be made through the study reach. In addition, if the catch from the second pass is greater than 50% of the first pass a third and fourth pass must also be made. These additional passes ensure that all fish within the study reach are collected and documented.

Complete the Electro-shocking **Data Form** (see below) after each pass through the sampling reach:

- Ambient temperature (air and water)
- Weather conditions
- Total electro-shocking time and total shocking time
- Anode configuration (shape, diameter)
- Shocking details (wave form, volts, watts, amps, pulse rate and pulse width)
- Fish collected (species, length, weight, fin clipped/tagged, recapture fin clipping/tag number)

Additional safety considerations for electro-shocking: Considering the electrical current and voltage used in electro-shocking, and the fact the electricity is being transmitted throughout the water in which the sampling crew is standing, there are a number of important safety considerations that must be followed. The following key points are taken from the Smith-Root equipment manual that is included in Appendix A:

- There must be a minimum of two properly trained people for every stream electro-shocking crew.
- All electro-shocking personnel shall receive training in the fundamentals of electricity and safety.
- All crewmembers shall wear lineman's gloves, which are 5000-volt minimum rated.
- No crewmember shall reach into the water near either electrode ever if gloves are being worn.
- Hip boots or chest waders with non-skid soles must be worn by all crewmembers; and if any crewmember gets water in their boots/waders they shall immediately leave to stream and obtain dry gear.
- The electro-shocker operator shall make sure that all other personnel are clear of the anode before turning on the power and shall be constantly aware of netters in the anode area.
- All crewmembers shall be especially careful in turbid water where it is difficult to see the stream bottom and any obstacles or drop-offs.
- Operate slowly and carefully, most falls occur when crew members are hurrying …

COEUR D'ALENE TRIBE, FISHERIES PROGRAM

Restoration Project Monitoring

Date: ____________ Monitored Reach: ______________________________

Personnel: ___________________________ Weather: ___________________

Ambient temperature: air: _____°C water: _____°C
Total Shock time: _____ sec. Total fishing time: _____ min.
Wave Form (circle one): AC DC Pulsed DC
Anode shape: _____ Anode diameter: _____ in.
Shocker settings: Volts: _____ Watts: _____ Amps: _____
Pulse rate: _____ Pulse Width: _____

Fish species collected:

NOTE: Population estimates require a minimum of two shocks for each reach regardless if trout are captured in the first shock. If more than 50% fewer fish are captured during the second shock a third and fourth passes must be made.

Shock #1 Shock Time: _______

Species	Length (cm)	Weight (gm)	Tag #	Recapture?

Shock #2 Shock Time: _______

Species	Length (cm)	Weight (gm)	Tag #	Recapture ?

Population Estimates

The channel types to be delineated during Level I Rosgen channel typing procedures (1994) will serve as the basic geomorphic units for selecting sample sites for conducting fish population surveys. In the Level I survey, stream reaches are to be stratified into relatively homogeneous types according to broad geomorphologic characteristics of stream morphology, such as channel gradient, sinuosity, valley width, and vegetation types obtained from Coeur d'Alene Tribe GIS layers. Sample locations within each stratum are to be randomly selected in proportion to the total reach length. The length of each sample unit was defined as twenty times the average stream width, with a minimum sample distance of 65 meters, so that all representative habitat types would be included in the sample.

Sites were sampled 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). Blocknets were placed at the upstream and downstream boundaries to prevent immigration and emigration during sampling. Each sample site was electro-fished using the standard guidelines and procedures described by Reynolds (1983). Fish were collected by spot shocking using a Smith-Root Type VII pulsed-DC backpack electro-fisher. Two electro-fishing 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 fourth pass were generally made to increase the precision of the population estimate. Salmonid species, including cutthroat trout, brook trout, and bull trout, were the target species for this study. Captured fish were identified, enumerated, measured (TL to nearest mm), and weighed. 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 (sp.) were considered incidental catch and were only counted.

Population estimates were calculated using the following equation (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= $1 - \frac{U_2}{U_1}$.

The population estimates were converted into density values (# fish/100 square meters) for each sample site then extrapolated to the reach in which the samples were collected. The confidence intervals were converted in the same manner. Total reach lengths were obtained from the digital data layer maintained by the Tribal GIS Program.

Age Analysis

Raw scales were used for age determination and calculating growth rates. 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). Simultaneous to age determination, a measurement was made from the center of the focus to the furthest edge of the scale. Along this line, measurements were made to each annulus under a constant magnification. Annual growth was then back calculated using the Lee method as described by Carlander (1981). The formula used:

$$L_i = a + \left(\frac{L_c - a}{S_c} \right) S_i$$

where:

Li = Length of fish (in mm) at each annulus;
a = intercept of the body scale regression line;
Lc = length of fish (in mm) at time of capture;
Sc = distance (in mm) from the focus to the edge of the scale; and
Si = scale measurement to each annulus.

The intercept (a) was obtained from the linear regression of body length versus scale length at time of capture. The proportional method of back-calculation was used for species with small sample sizes due to poor regression results. The following equation was used:

$$L_i = \left(\frac{S_i}{S_c} \right) L_c$$

This formula does not take into account the size of fish at scale formation, as does the Lee method. A linear regression of body length versus age was calculated independently for fish from each subject watershed and the resulting equation was used to determine the age of fish for which scale samples were not taken.

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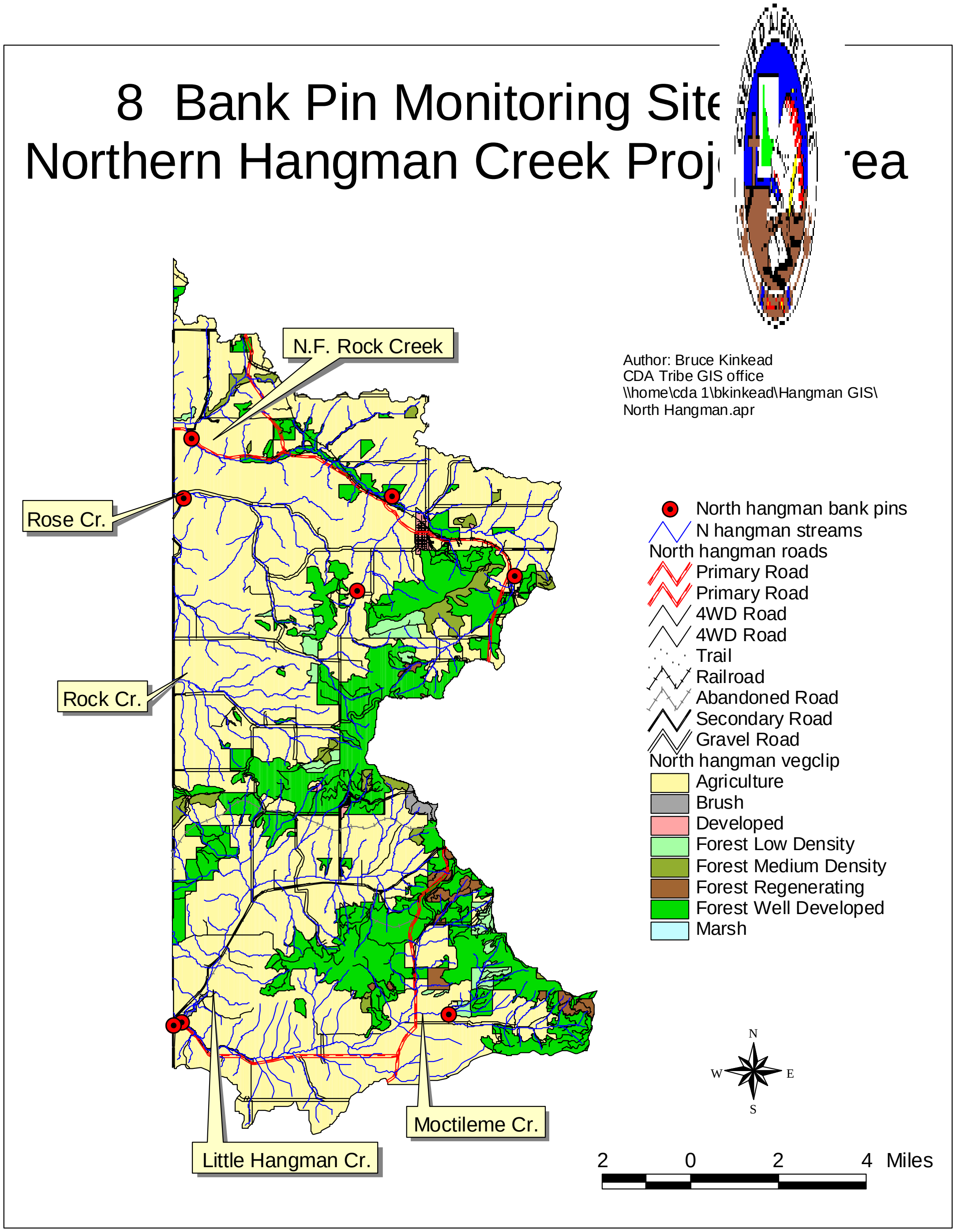
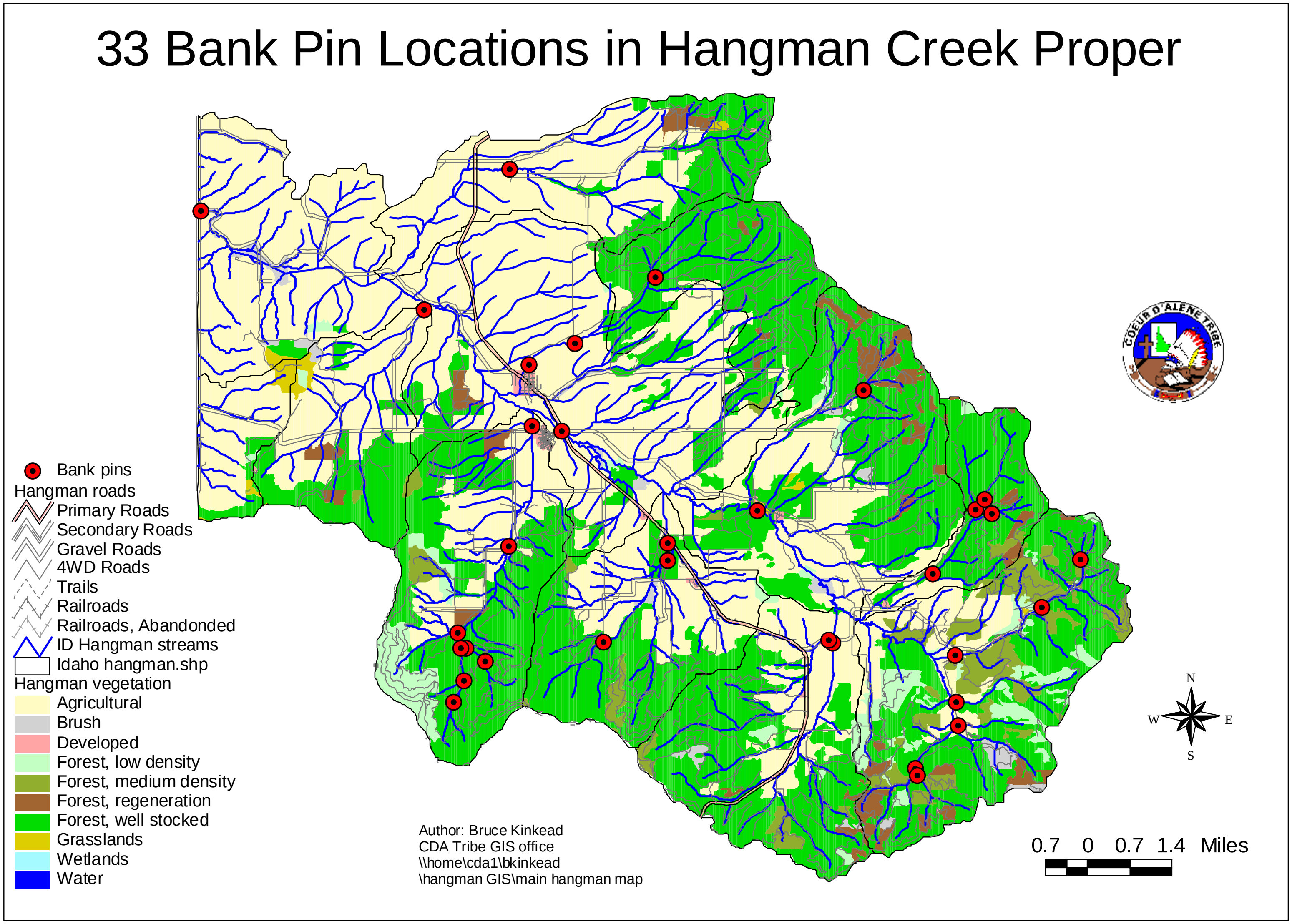


Appendix C, Figure 1. Bank pin locations in the northern project area, Hangman Creek, ID, 2002.



Appendix C, Figure 2: Bank pin locations in Hangman Creek proper, ID, 2002.

APPENDIX D: RAW FISHERIES DATA

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Hangman Cr	1	7/23/02	SD	81	5.4		No	RA PF	Squaw Hump area
Hangman Cr	1	7/23/02	SD	161	36		No	RA PF	Squaw Hump area
Hangman Cr	1	7/23/02	SD				No	RA PF	Squaw Hump area
Hangman Cr	1	7/23/02	SD				No	RA PF	Squaw Hump area
Hangman Cr	1	7/23/02	SD				No	RA PF	Squaw Hump area
Hangman Cr	1	7/23/02	SD				No	RA PF	Squaw Hump area
Hangman Cr	1	7/23/02	SD				No	RA PF	Squaw Hump area
Hangman Cr	1	7/23/02	SD				No	RA PF	Squaw Hump area
Hangman Cr	1	7/23/02	SD				No	RA PF	Squaw Hump area
Hangman Cr	1	7/23/02	SD				No	RA PF	Squaw Hump area
Hangman Cr	1	7/23/02	LNS	95	8.5		No	RA PF	Squaw Hump area
Hangman Cr.	2	7/3/02	RBT	110			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RBT	180			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RBT	105			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RBT	135			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RBT	131			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RBT	100			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	56			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	51			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	56			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	62			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	64			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	56			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	39			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	58			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	54			No	IDDEQ	BURP Site

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Hangman Cr.	2	7/3/02	RS	53			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	60			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	53			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	50			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	84			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	60			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	58			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	59			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	47			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	44			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	51			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	24			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	43			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	38			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	38			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	64			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	36			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RBT	140			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	34			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RBT	101			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	66			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	60			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	31			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	62			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	50			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	72			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	61			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	30			No	IDDEQ	BURP Site

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Hangman Cr.	2	7/3/02	SD	35			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	63			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	32			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	66			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	48			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	52			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	96			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	50			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	54			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	29			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	30			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	35			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	39			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	29			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	25			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	47			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	88			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	34			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	35			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	40			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	54			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	47			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	39			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	36			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	53			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	85			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	98			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	53			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	35			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	60			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	30			No	IDDEQ	BURP Site

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Hangman Cr.	2	7/3/02	SD	31			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	62			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	50			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	110			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	54			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	50			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	33			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	51			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	40			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	35			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	70			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	31			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	40			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	68			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	62			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	30			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	58			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	52			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	56			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	60			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	53			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	50			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	85			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	45			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	60			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	40			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	65			No	IDDEQ	BURP Site

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Hangman Cr.	2	7/3/02	SD	40			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	64			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	102			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	31			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	72			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	50			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	69			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	70			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	65			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	42			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	60			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	50			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	65			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	28			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	58			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	53			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	28			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	48			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	35			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	40			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	62			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	60			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	120			No	IDDEQ	BURP Site

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Hangman Cr.	2	7/3/02	SD	50			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	53			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	55			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	62			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	RS	74			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	48			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	50			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	65			No	IDDEQ	BURP Site
Hangman Cr.	2	7/3/02	SD	63			No	IDDEQ	BURP Site

Lower Mission	1	6/3/02	No fish					QB, RA	below water quality site
MF Mission	2	6/11/02	RBT	140			N	RA, PF	Below Pole Camp Road
MF Mission	2	6/11/02	RBT	140			N	RA, PF	Below Pole Camp Road
M.F. Mission	3	6/11/02	RBT	102			N	BK, RA	Above Pole Camp Road
M.F. Mission	3	6/11/02	RBT	98			N	BK, RA	Above Pole Camp Road
E.F. Mission	1	6/6/02	CTT	120			Yes	QB, RA	Below plugged culvert
E.F. Mission	2	6/6/02	No fish				N	QB, RA	Above plugged culvert
E.F. Mission	3	7/23/02	No fish				N	QB, BK, RA	Below Pole Camp Road
W.F Mission	1	6/11/02	RBT	101			Yes	PF, BK, RA	Above bridge
W.F Mission	1	6/11/02	RBT	126			Yes	PF, BK, RA	Above bridge

U. Moctileme	1	6/14/02						RA, NB	No fish
Lolo Creek	1	6/14/02						RA, NB	No fish
Tenced Cr	1	6/13/02						RA, NB	No fish
Tenced Cr	2	6/13/02						RA, NB	No fish
Tenced Cr	3	6/13/02						RA, NB	No fish

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Sheep Cr	1	6/14/02	SD	30			No	ra pf	site above Hwy 95
Sheep Cr	1	6/14/02	SD	20			No	ra pf	
Sheep Cr	1	6/14/02	SD	38			No	ra pf	
Sheep Cr	1	6/14/02	SD	25			No	ra pf	
Sheep Cr	1	6/14/02	RS	41			No	ra pf	RS= Red-sided Shiner
Sheep Cr	2	7/23/02	LNS				No		Long nosed sucker
Sheep Cr	2	7/23/02	SD				No	ra pf	no trout
Sheep Cr	2	7/23/02	SD				No	ra pf	SD=Speckled Dace
Sheep Cr	2	7/23/02	SD				No	ra pf	23 speckled dace
Sheep Cr	2	7/23/02	SD				No	ra pf	300 feet shocked below culvert on dirt road
Sheep Cr	2	7/23/02	SD				No	ra pf	same location as BURP site
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	2	7/23/02	SD				No	ra pf	
Sheep Cr	3	7/11/02	RBT	92	89		Yes	ra-pf	Upper Sheep Creek in forested area
Sheep Cr	3	7/11/02	RBT	94	118		Yes	ra-pf	Upper Sheep Creek in forested area

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Mineral Creek	1	6/1/02	SD	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	SD	NA	NA	NA		RA, NB	No lengths and weights
Mineral Creek	1	6/1/02	SD	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	SD	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	SD	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Mineral Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	

Smith Creek	1	6/1/02	SD	NA	NA	NA		RA, NB	
Smith Creek	1	6/1/02	SD	NA	NA	NA		RA, NB	
Smith Creek	1	6/1/02	SD	NA	NA	NA		RA, NB	
Smith Creek	1	6/1/02	SD	NA	NA	NA		RA, NB	
Smith Creek	1	6/1/02	SD	NA	NA	NA		RA, NB	
Smith Creek	1	6/1/02	RS	NA	NA	NA		RA, NB	
Smith Creek	1	6/1/02	Sculpin	NA	NA	NA		RA, NB	

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Squaw Creek	1	5/23/02	RBT	150	NA	2+	N	BK, RA	have pictures of all fish
Squaw Creek	1	5/23/02	RBT	64	NA	1+	N	BK, RA	site below culvert on road
Squaw Creek	1	5/23/02	SD	38	NA	NA	N	BK, RA	Speckled Dace
Squaw Creek	1	5/23/02	LNS	114	NA	NA	N	BK, RA	Long nosed sucker
Squaw Cr	2	6/12/02	RBT	199	75	2+	yes	ra pf	looks like a hybrid cuttbow, site above culvert
Squaw Cr	3	6/12/02	RBT	290	260	3+	yes	ra bk	site above BURP site
Upper Squaw	4	6/21/02	CTT	220	144	2+	yes	ra nb	that was a good day that day
Upper Squaw	4	6/21/02	CTT	105	52	1+	yes	ra nb	
Upper Squaw	5	6/21/02						ra nb	no fish, below culvert
Upper Squaw	6	6/21/02	CTT	125	20.1	1+	yes	ra nb	healthy looking fish
Upper Squaw	6	6/21/02	CTT	110	13.5	1+	yes	ra nb	Above culvert that is possible fish barrier at this time
Upper Squaw	6	6/21/02	CTT	85	10.2	1+	yes	ra nb	cleared debris from culvert at a later date
Upper Squaw	6	6/21/02	CTT	115	21.8	1+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	168	25.5	2+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	145	55	2+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	108	4.6	1+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	120	16.5	1+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	106	3.9	1+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	93	7.4	1+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	90	7.4	1+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	323	140	3+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	105	12.2	1+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	220	130	2+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	135	34	2+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	105	5.2	1+	yes	ra nb	
Upper Squaw	6	6/21/02	CTT	220	144	2+	yes	ra nb	

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Upper Squaw	7	6/28/02	CTT	155	57.6	2+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	85	10	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	105	17.8	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	95	12.9	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	105	17.5	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	110	14.1	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	105	15.3	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	85	9.1	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	90	9.7	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	82	6.9	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	85	7.1	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	78	5.3	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	76	4.6	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	86	7.4	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	88	8.6	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	92	8.9	1+	no	IDDEQ	BURP site
Upper Squaw	7	6/28/02	CTT	86	7.7	1+	no	IDDEQ	BURP site

Lower Indian	1	6/28/02	RBT	120	17.1			IDDEQ	DEQ BURP site
Lower Indian	2	6/18/02	sculpin	6.5				ra nb	At Water Quality site
Indian Cr.	3	6/18/02	RBT	115	13.9	1+	yes	ra nb	below confluence with N.F.Indian
Indian Cr.	3	6/18/02	RBT	112	10.9	1+	yes	ra nb	Very colorfull fish, wide red band, white fringe on fins
Indian Cr.	3	6/18/02	RBT	111	16.9	1+	yes	ra nb	Very colorfull fish, wide red band, white fringe on fins
Indian Cr.	3	6/18/02	RBT	107	4.29	1+	yes	ra nb	Very colorfull fish, wide red band, white fringe on fins
Indian Cr.	3	6/18/02	RBT	111	18.9	1+	yes	ra nb	Very colorfull fish, wide red band, white fringe on fins
Indian Cr.	3	6/18/02	RBT	125	16.8	1+	yes	ra nb	Very colorfull fish, wide red band, white fringe on fins
N.F Indian Cr.	1	6/19/02	RBT	111	4.0	1+	yes	ra nb	below culvert
N.F Indian Cr.	1	6/19/02	RBT	135	25.6	2+	yes	ra nb	Very colorfull fish, wide red band, white fringe on fins
E.F. Indian	1	6/19/02	No Fish					ra nb	No Fish

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
S.F. Hangman	1	7/3/02	RBT	95			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	72			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	56			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	142			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	58			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	94			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	66			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	180			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	125			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	172			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	141			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	122			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	107			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	195			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	103			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	156			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	130			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	58			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RBT	92			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	48			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	92			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	55			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	96			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	44			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	28			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	49			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	55			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	50			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	55			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	185			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	115			No	IDDEQ	BURP Site

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
S.F. Hangman	1	7/3/02	SD	111			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	138			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	94			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	94			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	84			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	67			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	65			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	58			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	56			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	69			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	52			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	36			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	46			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	34			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	58			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	46			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	39			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	103			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	60			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	50			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	51			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	61			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	42			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	52			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	57			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	69			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	54			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	57			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	49			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	24			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	40			No	IDDEQ	BURP Site

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
S.F. Hangman	1	7/3/02	SD	40			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	115			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	105			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	50			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	82			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	90			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	71			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	60			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	47			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	90			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	38			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	146			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	70			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	50			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	100			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	100			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	60			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	48			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	64			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	58			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	42			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	54			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	56			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	48			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	50			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	64			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	57			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	35			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	110			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	50			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	115			No	IDDEQ	BURP Site

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
S.F. Hangman	1	7/3/02	SD	97			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	62			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	84			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	128			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	170			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	70			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	72			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	65			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	62			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	47			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	47			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	132			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	64			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	79			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	53			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	62			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	47			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	50			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	62			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	RS	44			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	46			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	46			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	52			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	51			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	53			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	46			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	61			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	61			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	40			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	53			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	50			No	IDDEQ	BURP Site

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
S.F. Hangman	1	7/3/02	SD	145			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	58			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	70			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	56			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	54			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	72			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	51			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	55			No	IDDEQ	BURP Site
S.F. Hangman	1	7/3/02	SD	76			No	IDDEQ	BURP Site

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
Bunnel Cr.	1	7/10/02	RBT	150	51.1		no	DEQ	
Bunnel Cr.	1	7/10/02	RBT	99	8.3		no	DEQ	
Bunnel Cr.	1	7/10/02	RBT	130	23.1		no	DEQ	
Bunnel Cr.	1	7/10/02	RBT	164	57.9		no	DEQ	
Bunnel Cr.	1	7/10/02	RBT	103	12.7		no	DEQ	

Stream	Site#	Date	Species	L (mm)	Wt.(g)	Age	Scales	Shockers	Comments
N.F. Rock Cr	1	7/24/02	SD	71	4	NA	NA	ra pf	Shocked several pools on both sides of HWY 95
N.F. Rock Cr	1	7/24/02	SD	84	6.1	NA	NA	ra pf	
N.F. Rock Cr	1	7/24/02	SD	70	4.7	NA	NA	ra pf	
N.F. Rock Cr	1	7/24/02	SD	52	2.8	NA	NA	ra pf	
N.F. Rock Cr	1	7/24/02	SD	100	10.4	NA	NA	ra pf	
N.F. Rock Cr	2	7/25/02						ra pf	No fish sampled or seen
N.F. Rock Cr	3	7/25/02	SD	70	3	NA	NA	ra pf	
N.F. Rock Cr	3	7/25/02	SD	38	0.6	NA	NA	ra pf	shocked under bridge at hwy 95 on rock cr
N.F. Rock Cr	3	7/25/02	SD	83	5.7	NA	NA	ra pf	and on the wella grounds under the bridge
N.F. Rock Cr	3	7/25/02	SD	68	3.2	NA	NA	ra pf	and one long nose sucker
N.F. Rock Cr	3	7/25/02	SD	40	1.3	NA	NA	ra pf	
N.F. Rock Cr	3	7/25/02	SD	2.5	0.1	NA	NA	ra pf	
N.F. Rock Cr	3	7/25/02	SD	70	3.3	NA	NA	ra pf	
N.F. Rock Cr	3	7/25/02	SD	71	4.1	NA	NA	ra pf	
N.F. Rock Cr	3	7/25/02	SD	66	2.5	NA	NA	ra pf	
N.F. Rock Cr	3	7/25/02	LNS	47	1.4	NA	NA	ra pf	

Rose Creek	1	9/13/02	LNS	120	19	NA	NA	RA, PF	Bump on gills
Rose Creek	1	9/13/02	LNS	70	4	NA	NA	RA, PF	Bump on side
Rose Creek	1	9/13/02	RS	86	4	NA	NA	RA, PF	Lots of small fish not netted due to murky water
Rose Creek	1	9/13/02	LNS	70	1	NA	NA	RA, PF	
Rose Creek	1	9/13/02	RS	114	6	NA	NA	RA, PF	
Rose Creek	1	9/13/02	RS	106	6	NA	NA	RA, PF	
Rose Creek	1	9/13/02	SD	40	0.5	NA	NA	RA, PF	
Rose Creek	1	9/13/02	RS	30	0.4	NA	NA	RA, PF	

APPENDIX E: PICTURES TAKEN AT SURVEY SITES FOR ROAD CONDITIONS AND FORESTRY PRACTICES

Site 1

Road Survey 2002**:** Site 1, MF Mission Creek. Picture 1


Road Survey 2002**:** Site 1, MF Mission Creek. Picture 2.


Road Survey 2002**:** Site 1, MF Mission Creek. Picture 3.

Road Survey 2002**:** Site 1, MF Mission Creek. Picture 4.

Road Survey 2002**:** Site 1, MF Mission Creek. Picture 5.

Road Survey 2002**:** Site 1, MF Mission Creek. Picture 6.

Road Survey 2002**:** Site 1, MF Mission Creek. Picture 7.

Road Survey 2002**:** Site 1, MF Mission Creek. Picture 8.

Road Survey 2002**:** Site 1, MF Mission Creek. Picture 9.

Site 2


Road Survey Site#2: WF Mission Creek. Picture 10

Site 3

Road Survey Site #3. EF Mission Creek, 2002. Picture 11.

Road Survey Site #3. EF Mission Creek, 2002. Picture 12.

Road Survey Site #3. EF Mission Creek, 2002. Picture 13.

Road Survey Site #3. EF Mission Creek, 2002. Picture 14.

Road Survey Site #3. EF Mission Creek, 2002. Picture 15.

Road Survey Site #3. EF Mission Creek, 2002. Picture 16

Road Survey Site #3. EF Mission, October, 2002. Channel has been dug out after plugged culvert was removed. Picture 17

Site 4

Road Survey Site #4. MF Mission Creek, 2002. Picture 18.

Road Survey Site #4. MF Mission Creek, 2002. Picture 19.

Road Survey Site 4. MF Mission Creek, 2002. Picture 20.

Road Survey Site 4. MF Mission Creek, October, 2002. Culvert was removed and channel redug. Picture 21.

Site 5

Road Survey Site #5. Headwaters of Hangman Creek, 2002. Picture 22.

Road Survey Site #5. Headwaters of Hangman Creek, 2002. Picture 23.

Road Survey Site #5. Headwaters of Hangman Creek, 2002. Picture 24

Road Survey Site #5. Headwaters of Hangman Creek, 2002. Picture 25.

Road Survey Site #5. Headwaters of Hangman Creek, 2002. Picture 26.

Road Survey Site #5. Headwaters of Hangman Creek, 2002. Picture 27.

Site 6

Road Survey Site #6. Upper Hangman Creek at Papoose Creek Road, 2002. Pic 28.

Road Survey Site #6. Upper Hangman Creek at Papoose Creek Road, 2002. Pic 29.

Site 9

Road Survey Site #9. MF Mission Creek at Pole Camp Road, 2002. Picture 30.

Road Survey Site #9. MF Mission Creek at Pole Camp Road, 2002. Picture 31.

Road Survey Site #9. MF Mission Creek at Pole Camp Road, 2002. Picture 32.

Site 12

Road Survey Site #12. EF Mission Creek at Pole Camp Road, 2002. Picture 33.

Road Survey Site #12. EF Mission Creek at Pole Camp Road, 2002. Picture 34.

Road Survey Site #12. EF Mission Creek at Pole Camp Road, 2002. Picture 35.

Road Survey Site #12. EF Mission Creek at Pole Camp Road, 2002. Picture 36.

Site 13

Road Survey Site #13. MF Mission Creek near Pole Camp Road, 2002. Picture 37.

Road Survey Site #13. MF Mission Creek near Pole Camp Road, 2002. Picture 38.

Road Survey Site #13. MF Mission Creek near Pole Camp Road, 2002. Picture 39.

Camera was not available at sites 7-8, 10-11, and 14-15. Sites will be revisited in 2003 to obtain pictures and record current conditions.

APPENDIX F: PROTOCOLS FOR MIGRATION STUDIES

Trout Migration

Migration traps are to be installed in Mission Creek, Indian Creek, Squaw Creek, and Sheep Creek to assess migratory life history patterns, length and age frequency distribution, relative abundance and condition factors of adfluvial rainbow trout. The timing of installation and trapping effeciency has largely been determined by the runoff patterns of the respective watersheds. Typically traps need to be installed in March and monitored and maintained into June, except during periods of high stream flow. Traps will consist of a weir, runway and a holding box based on a modifed design of the juvenile downstream trap found in Conlin and Tuty (1979). Two traps are installed at each location to capture both fish moving upstream from Hangman Creek and fish moving downstream from the upper watershed. Paired traps were placed approximately 10 meters apart.

Traps are checked and cleaned at least once daily during peak spawning periods from April through mid-May and once daily afterwards until June, when traps are removed. Fish captured in the traps are to be identified, counted, measured, and weighed. A scale sample is to be taken to assess the age, growth, and condition of the fish. Catch per unit effort (CPUE), where one unit of effort was defined as one 24-hour period, is to be calculated to allow for relative comparisons of run size between trap locations and among years.

Mark-Recapture Method

The Coeur d'Alene Tribe performs a limited tagging program in conjunction with monitoring trout migration and stream electroshocking. The intent is to provide information on growth and basic life history information (e.g., migration timing, adult residence time, instance of repeat spawning, etc.) for adfluvial trout. Trout greater than 220 mm length and/or 300 grams weight are marked with a uniquely numbered floy tag. Tag numbers are recorded on a scale sample envelope as well as in a datalogger, along with date/species/length/weight and location information. The recapture data from tagged fish (from both the streams and lake) is then tabulated and graphed.

Construction of Traps

Traps boxes are made by welding rebar, chicken wire, and aluminum sheet metal for the cover. The barrier fences are made from a combination of rebar/chicken with rebar hammered into stream banks for support.

APPENDIX G: PROTOCOLS FOR COLLECTING DNA SAMPLES

APPENDIX G-1: SUMMARY OF METHODS USED FOR DNA SAMPLING

Appendix G was provided by Washington Dept of Fish & Wildlife

[DNA sampling summary.wpd]   rev 14 Mar 02

Tissue Sampling for DNA Analysis

Background:

As with any form of data collection, the statistical validity, quality, and documentation of the samples are of critical importance to the overall study. We will do our best to generate quality data in the laboratory analysis, but the overall success of each project is also dependent on the quality of the samples and the sampling design. For most of the work we do, the study designs require that we sample **unrelated individuals**. Thus, field sampling activities should minimize the chances for sampling family groups (e.g., fry from a single redd or one hatchery raceway or one production lot). In the case of non-lethal sampling, avoid repeated sampling of the same individuals at different times.

Our general procedure for DNA studies, is to collect fresh tissue directly into a special ethanol preservative. This preservative, which is a ***poison*** and is ***flammable***, should be obtained from the WDFW Genetics Lab. Once in this preservative, tissue samples can be stored at room temperature. The solution preserves the DNA by desiccating the tissue. Thus, **it is critical that the volume ratio of tissue:preservative not exceed 1:4 (20% tissue: 80% preservative)**. Note, an excess of preservative is okay. Sampling instruments, dissecting areas, and your hands should be kept clean (rinsed between specimens or as frequently as necessary) to avoid sample-to-sample contamination. Because all our DNA analyses involve PCR amplification of the DNA extracted from the tissue samples, sample-to-sample contamination can be a problem and must be avoided. Nevertheless, it is not necessary to wear gloves during the dissection process to avoid contamination of the samples -- just keep your hands, the sampling instruments, and the work area clean.

Tissue Sample Quality: *tissue samples should be obtained from live or freshly dead specimens; decomposed carcasses should not be sampled!*

Individuals separately IDed (to retain association of individual-specific genetic & biological data):

Wherever possible, samples should consist of a piece of fin or opercle tissue from each fish approximately 1 cm^2 if possible). *[Note that the tissue sample can either be a fin clip sample obtained with scissors or a series of 2-4 punches obtained using a standard 1/4" diameter paper punch]*. Because the DNA will actually be extracted primarily from the epithelial cells covering the fin or opercle, it is imperative that there is a reasonably intact layer of skin covering the tissue sample -- it should not be significantly abraded. If fin will be sampled and survival of the fish is not an issue, we recommend sampling the distal end of the caudal, dorsal, or pectoral fin. When it is not feasible to obtain samples as large as 1-2 cm^2 (e.g., non-lethal sampling of fry or pre-smolts), a smaller piece of fin (perhaps as small as 0.5 cm x 0.5cm) should be adequate. Because partial fin clips regenerate, whereas total fin amputations typically do not, we recommend obtaining partial fin clips from both pelvic fins (if necessary to get the desired amount of tissue) rather than complete removal of one fin, for non-lethal sampling of small fish.

The tissue sample from each specimen should be placed in a 2 mL screw-cap cryovial (filled with DNA preservative solution) immediately after dissection. Caps should be securely tightened on the vials (but not over tightened) and the sample vials should be stored upright at room temperature (do not freeze).

Each cryovial should contain a small laser-printed label on **write-in-the-rain paper** that gives the 4-digit WDFW collection code (e.g., "01CY") and the individual fish number [or, in an emergency, a pencil label identifying the sample]. Printed labels are provided by the WDFW Genetics Lab. **NOTE: DO NOT USE INK ON ANY LABELS; the preservative solution will dissolve the ink**.

Each set of tissue samples from a single locality/date should be accompanied by collection data (completed WDFW scale cards, WDFW Genetic Sampling Field Data Sheets, or another suitable form). Sampling data should be cross-referenced either to a map annotated with sampling locations or to GPS coordinates (for the site of collection of each fish, if possible) wherever possible.

Please store all vials containing DNA samples in the plastic sample storage boxes provided. Before placing vials containing tissue samples in the storage boxes, please verify that the vials are filled with
DNA preservative solution and that the caps are securely tightened; but do not over tighten.

Begin loading vials in the storage boxes in the back left corner cell (A1) and proceed from left to right and back to front to the front right corner cell (J10). Thus, for a collection of 100 fish, consecutively numbered from 1-100: sample #1 should be placed in cell A1, sample #2 should be in cell A2, ... sample #10 should be in cell A10, sample #11 should be in cell B1, ... sample #20 should be in cell B10 .... sample #91 should be in cell J1, ... sample #100 should be in cell J10). Note that one collection of up to 100 samples or two collections of up to 50 samples each (or several smaller collections) can be stored in a single box. The storage boxes should always be stored upright at room temperature until they are returned to the Genetics Lab in Olympia (as per instructions). Do not put tape on the boxes or on the individual vials or write on them. If you need to add a label, write it (in pencil) on a piece of paper and put it inside the top of the storage box.

Individuals treated as an aggregate group (when it is not necessary to retain the association of individual-specific genetic & biological data):

Opercle or fin samples from multiple individuals can be stored together in a single container provided:

1) only one tissue sample is taken from each individual

2) the tissue samples have enough structural integrity that they will remain intact during storage (*note: if even one sample falls apart, we won't know which fragments represent different individuals*)
3) the volume of preservative solution makes up at least 80% of the total final volume (preservative + tissue samples)
4) the tissues are dissected and handled in such a way as to minimize any cross-contamination of samples among individuals prior to, or during, immersion in the preservative

BEFORE BEGINNING SAMPLING, Please talk to:

Sewall Young (office phone: 360-902-2773; email: <youngsfy@dfw.wa.gov>)
Jim Shaklee (office phone: 360-902-2752; email: <shakljbs@dfw.wa.gov>)
Sewall and Jim can also be reached by phone in the lab at 360-902-2774 and by FAX at 360-902-2943.

Obtaining Sampling Supplies & Sampling Kits:

Supplies such as cryovials & screw-caps, sample boxes, paper punches, DNA preservative solution, labels, WDFW genetics style scale cards and/or WDFW Genetic Field Collection Data Sheets, and complete sampling kits can be obtained from the WDFW Genetics Laboratory (see below) by contacting Nathan Hyde. **Never use labels for a collection/stock different from the one the labels were originally assigned to. Do not retain labels for use in future years. Unused labels should be destroyed or returned to the Genetics Lab.**

Delivery of Samples to the WDFW Genetics Laboratory:

Whenever possible, it is best to hand deliver samples rather than ship them, both because this eliminates the possibility of loss of the samples and because there are restrictions on shipping the preservative solution. As collections are completed, or at the end of the sampling season, samples including accompanying scale cards, field collection data sheets, locality information appropriate to the samples, and **all unused sampling supplies** should be delivered or shipped to the lab at:

WDFW Genetics Laboratory
Natural Resources Building, Rm 665
1111 Washington Street SE
Olympia, WA 98504
attn. N. Hyde / J. Shaklee

Before shipping any samples to the lab, please contact Nathan or Jim so that they will expect the shipment and can initiate a search with the shipper if the samples do not arrive when expected.

APPENDIX G-2: METHODS FOR FIELD SAMPLING

non-lethal smolt-juvenile DNA sampling protocol.wpd] rev 14 Mar 02

Guidlines for Non-Lethal Fry and Smolt Sampling for DNA Analysis

The goal is to take a small enough piece of a non-critical tissue (e.g., fin) to have little or no impact on the subsequent survival of the fish but that is adequate to allow genetic analysis. DNA analysis is ideal for this for two reasons: 1) all living cells of an organism have essentially the same DNA composition (unlike the tissue specific expression characteristic of allozymes and other proteins), so that tissues such as fin and opercle can provide adequate samples, and 2) amplification of the resulting DNA from such samples via the PCR (polymerase chain reaction) provides the sensitivity of detection to enable working with very small pieces of tissue and small amounts of DNA. *[For mammals, this approach has be used successfully to characterize animals by analyzing DNA extracted from hair follicles, blot spatters, and scat samples.]*

The **minimum amount of tissue** that is needed is approximately the size of this circle: • (a piece of tissue with the same approximate surface area as a 1.5mm diameter disc). The recommended sources of such a tissue sample are any of the following:

1) A distal portion of the dorsal lobe of the caudal fin
2) A distal portion of one of the pelvic fins
3) Smaller distal portions of both pelvic fins
4) One entire pelvic fin

By sampling only the distal portion of a fin, we expect that the fish will successfully regenerate the entire fin over time. In contrast, removing an entire fin often results in little or no fin regeneration, presumably leaving the fish at a selective disadvantage.

When sampling larger fish, a larger sample is preferred (e.g., a piece of tissue the size of one of these circles: [approx. 3mm diameter] or [approx. approximately 4.5mm diameter]), because this will provide more material (DNA). The "extra" tissue provides a reserve that can be used to overcome some types of analytical problems in the lab by repeated analysis and/or it provides material that can be used for subsequent analyses (for example to examine additional loci at a future date) or can be shared with other laboratories/agencies.

Live fish should be handled appropriately before, during, and after sampling. This will probably involve: a) anesthetization prior to handling for tissue sampling (and taking of measurements or other biological samples such as scales), b) careful handling during sampling to avoid injury and scale/mucous loss, and c) holding fish in a recovery vessel after sampling (until the anesthetic has worn off) before releasing them in a way that minimizes immediate mortality due to predation of other effects.

Each tissue sample should be placed in a vial that contains DNA preservative solution (and an appropriate label -- preprinted by WDFW [preferred] or written in *pencil*) immediately after it is taken. We recommend using vials that are approximately 3/4 full of preservative solution and never adding more than 1/5 of this volume of tissue (to ensure adequate preservation). Please rinse forceps, scissors, etc. (with fresh water) and dry them between fish to minimize the chance of cross- contamination of samples. Such preserved samples should be stored at ambient temperatures (20-80^{o}F) until they are returned to the WDFW Genetics Laboratory in Olympia.

If you have questions or need additional information, please telephone Jim Shaklee (360-902-2752), Sewall Young (360-902-2773), or the Genetics Lab at 360-902-2775).

APPENDIX G-3: LABORATORY METHODS

Details regarding the proposed analysis of Hangman (Latah) Creek rainbow trout 3-Jan-03

Genetic markers to be screened:

Approximately 16 microsatellite DNA loci will be screened as the primary genetic markers in this investigation. Microsatellite DNA loci have high levels of variation (high allelic diversities and heterozygosities) that make them informative markers of populations. They exhibit Mendelian inheritance and are considered selectively neutral. If necessary, we may also screen some PINE markers to look for evidence of interspecific hybridization.

Proposed DNA extraction methods:

DNA will be extracted from fin tissues using a simple Chelex extraction protocol. A small fragment of fin will be incubated overnight at 70^{o}C in 180uL chelex solution (5% Chelex-100 [BioRad] in distilled water with 1.4 mg/mL proteinase-K [Sigma]). The extract will then be incubated at 95^{o}C for 5 min to inactivate proteins and then stored refrigerated or frozen until polymerase chain reaction (PCR) amplification is done.

Proposed PCR conditions:

Multiplex	Buffer	dNTP	$MgCl_2$ [mM]	Initial Denature	Cycle temps	# Cycles	Final Extension
OmyB	1X Promega PCR Buffer A	0.2mM each	1.5	92° 2min	92° 15s, 55° 30s, 72° 60s	32	72° 30min
OmyC	1X Promega PCR Buffer A	0.2mM each	1.5	92° 2min	92° 15s, 55° 30s, 72° 60s	32	72° 30min
OmyD	1X Promega PCR Buffer A	0.2mM each	1.5	92° 2min	92° 15s, 49° 30s, 72° 60s	42	72° 30min
OmyE	1X Promega PCR Buffer A	0.2mM each	1.5	92° 2min	92° 15s, 62° 30s, 72° 60s	35	72° 30min
OmyF	1X Promega PCR Buffer A	0.2mM each	1.5	92° 2min	92° 15s, 52° 30s, 72° 60s	35	72° 30min

Multiplex	Locus 1	conc 1 [uM]	Dye 1	Locus 2	conc 2 [uM]	Dye 2	Locus 3	conc 3 [uM]	Dye 3	Anneal T	Taq [units/rxn]
OmyB	One-102	0.12	6fam	One-114	0.20	hex	Ots-100	0.08	ned	55	0.05
OmyC	One-108	0.03	6fam	Ots-103	0.03	hex	One-101	0.04	ned	55	0.05
OmyD	Ots-1	0.07	6fam	Omy-77	0.08	hex	Ots-3M	0.04	ned	49	0.05
OmyE	Omm-1130	0.10	6fam	Omm-1070	0.07	hex	Omy-1011	0.06	ned	62	0.05
OmyF	Omy-1001	0.06	6fam	Omm-1128	0.08	hex	One-18	0.09	ned	52	0.05
OmyF				Oki-10	0.08	hex					

Stream Channel Typing

The classification of stream channel types will follow guidelines presented by Rosgen (1996) and includes both an office map review effort (Level I) and field inspection effort (Level II). The final determination of stream channel type will use data collected as described in the **Channel Gradient** and **Valley Cross Section** sections, below. The objective of classifying streams, based on channel morphology, is to use discrete categories of stream types so that consistent, reproducible descriptions can be developed. 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 **Table H-1**.

Table H-1. General stream type descriptions and delineative criteria for broad-level classification (from Rosgen 1996).

Stream Type	General description	Entrenchment ratio	W/D ratio	Sinuosity	Slope	Landform/soils/ features
Aa+	Very steep, deeply entrenched, debris transport streams.	< 1.4	< 12	1.0 to 1.1	> 0.10	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	>0.10	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	0.02 to 0.039	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	>12	<0.02	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	<0.04	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	<0.005	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	<0.02	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	>12	<0.02	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	0.02 to 0.039	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.

Level I Channel Type Determination: The Level I determination of channel type is an office procedure involving the use of topographic maps. Level I stream classifications serve several primary purposes; the primary purpose for this project is to provide an initial framework for organizing streams by 'geomorphic' characteristics. This, in turn, allows a logical placement of fish population monitoring sites. The 'geomorphic' characteristics pertinent to this analysis are shown in **Figure H-1**. The primary characteristics that are obtained from the map are valley slope, sinuosity and channel pattern (single versus multiple thread) and these in turn determines the channel type ("A" through "G").

The equipment needed for channel type determination using following Rosgen's Level I procedure is as follows:

- Topographic map
- Ruler and measuring wheel
- Calculator
- **Data Form 3a**

The procedure involves breaking a stream into segments (reaches) based on obvious valley form, vegetative cover (especially forest area versus agricultural areas) or other features. For each reach, the elevation of the stream channel at the top and bottom of the reach must be read off the map and the length of the channel within the reach must be measured using the measuring wheel. Use **Data form 3a** to indicate the elevation gain (top elevation minus bottom elevation) through the reach. The stream gradient (slope, in percent) is then calculated by dividing the elevation gain by the channel length. Enter the gradient on **Data Form 3a**:

- <u>Reach Gradient</u>

Sinuosity is determined by dividing the channel length within the reach by the valley length. Valley length is the straight-line distance between the top of the reach and the bottom. Enter the sinuosity on **Data Form 3a**:

- <u>Sinuosity</u>

Channel patterns can also be seen on the map and single thread versus multiple threads is the primary distinction. "Anastomosing" channels are multiple thread channels that are located in stable, well-vegetated, low-gradient areas. Enter the pattern on **Data Form 3a**:

- <u>Channel pattern</u>

The Rosgen channel type is determined by comparing the calculated channel gradient and pattern with the criteria presented in Figure H-1. Select the most appropriate channel type (closest match) should be entered on **Data Form 3a**:

- <u>Rosgen stream channel type for the reach</u>.

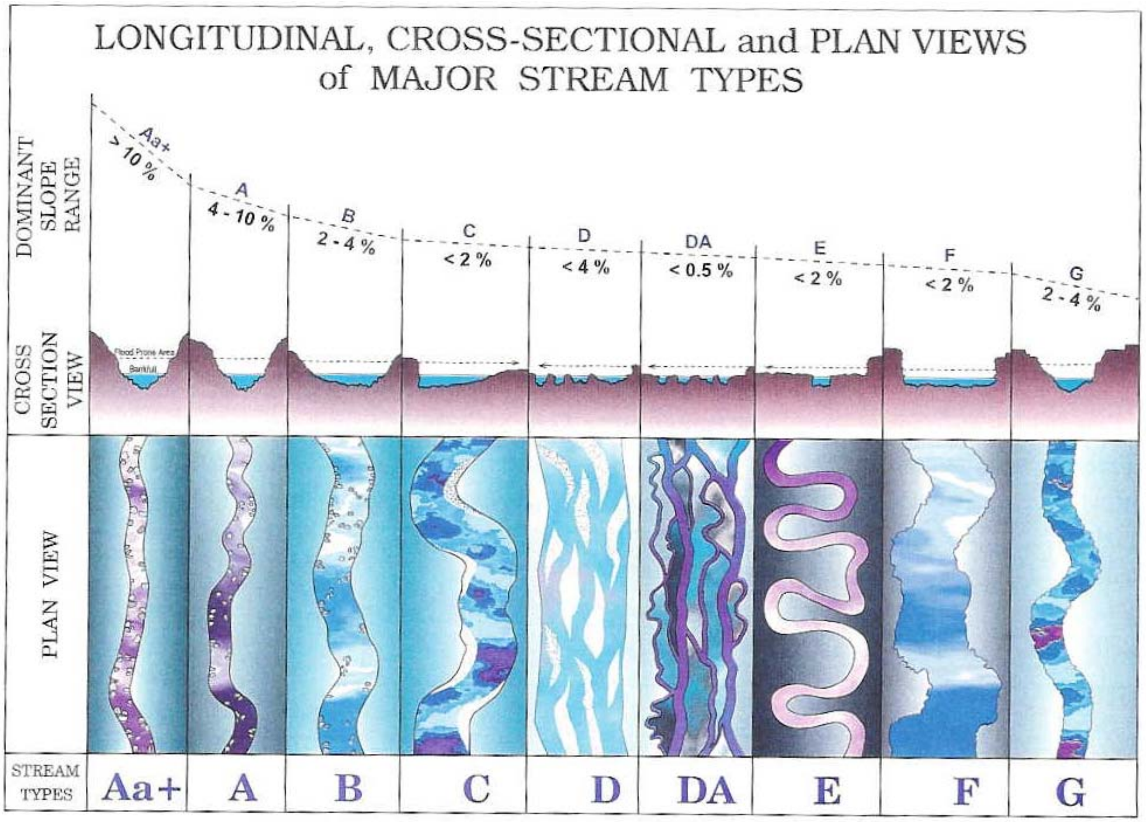


Figure H-1. Broad level stream classification delineation showing longitudinal, cross-sectional and plan views of major stream types (from Rosgen 1996).

Channel Gradient & Habitat Typing: This effort involves the measurement of the water surface elevation and width and stream channel bottom elevation along the entire study reach (modified from Peck et al., 2001). This involves the use of a surveyor's level and rod. Operating and note taking procedures for this equipment are described by Harrelson et al. 1994. Since the reach will most likely be longer than can be seen from a single level setup, it will also be necessary to use turning points as described below. Also included in this protocol is the determination and documentation of the various habitat types along the reach.

The channel profile is also referred to as the longitudinal "thalweg" profile. "Thalweg" refers to the flow path of the deepest water in a stream channel. The longitudinal thalweg profile is a survey of the stream bottom and water surface elevations along the entire monitoring reach. The optimum reach length for all stream longitudinal profiles has been determined to be 500 feet. With this length, there will be a series of 50 measurements collected every 10 feet along the stream, plus measurements at the boundaries between stream habitat types. Data from this survey will allow calculation of the proportion of all habitat types, channel sinuosity, and channel complexity. <u>This procedure will also establish the upstream end of the monitored reach as well as the locations of cross sections that will be used for monitoring other stream characteristics. It is advantageous to have GPS equipment available to document the location of the downstream and upstream ends of the stream reach.</u>

The equipment needed for channel gradient determination using the longitudinal "Thalweg" Profile procedure is as follows:

- Surveyors level and tripod
- Surveyors rod (in units of feet and tenths of a foot)
- Hip chain with string
- Two-way radios
- Two foot long wooden stakes and hammer
- Notebook with the **Data Form 3**, blank write in the rain paper and pencil
- Calculator
- Hip or chest waders

The level operator sets up and levels the level on the tripod next to the stream and within view of the downstream end of the reach (preferably within 200 feet). Then, starting at that downstream end of the reach, the rod carrier attaches the hip chain string to a rock or other stationary object at the downstream end of the study reach and resets the counter. The rod carrier then measures the "wetted width" of the stream, which is from waters edge to waters edge perpendicular to the channel. This can be done by placing the base of the rod at one waters edge and laying it down so that the distance to the opposite waters edge can be measured. This distance is reported to the level operator for recording in the survey notebook (it may be helpful to use two-way radios for these communications). The rod holder also reports what habitat type (riffle, pool, run/glide or side channel/shallows) is present at that location. Definitions of the habitat types are provided in **Table H-2**. The rod holder then holds the rod vertical and probes the stream to determine the deepest point across its' width (using the water surface as a guide). At the deepest point the rod holder holds the rod still for the level operator to take a reading. The level operator must acknowledge with a hand or voice signal that he/she has the reading before the rod holder moves the rod. The stream channel bottom elevation at this location (the downstream end of the reach) is assumed to be 100.00, unless the actual elevation is known, and the base elevation should be noted in the level operator's notes.

After the level operator has recorded the rod reading for the stream bottom, the rod holder raises the rod so that the base of the rod is at the water surface. As soon as the lever operator has taken this reading, he/she again acknowledges that the reading is taken and recorded. The rod holder then moves upstream until he/she reaches a boundary between habitat types, or 10 feet (whichever comes first), to the next reading location (cross section). The distance counter on the hip chain is used to determine distance along the thalweg.

Table H-2. Stream habitat type descriptions (from IDEQ 1999).

Habitat type	Description
Riffle	A portion of the stream with swiftly flowing, shallow water. The water surface in a riffle is turbulent and this is caused by completely or partially submerged obstructions. Cascades are one class of riffle characterized by swift current, exposed rocks and boulders, considerable turbulence and stepped drops over steep slopes. Riffle areas with standing waves are called rapids.
Pool	A portion of the stream with reduced current velocity (average velocity is generally less than 1 foot per second), and often, but not always, with water deeper than surrounding areas. Pools usually have flat-water surfaces with no surface agitation and often the bottom is concave such that it would hold water if there was no flow. Pools usually occur at outside bends in the channel and around large obstructions. Water impounded upstream of channel blockages, typically a logjam or beaver dam, is classed as a dammed pool. Pools end where the stream bottom approaches the water surface and this is known as a "pool tailout".
Run / glide	A portion of the stream with moderate to swift velocity and without surface agitation (runs display "laminar" or uniform flow patterns). Runs and glides typically occur immediately upstream and downstream of riffles. Pool tailouts are typically classed as runs in small high-gradient streams. Glides also occur where the channel widens allowing the stream to shallow and slow. Glides are most commonly found in low gradient streams associated with elongated pools.
Shallows or side channels	A portion of the stream where side channels enter or leave the main channel and shallow, border areas used by young fish.

At each 10-foot interval and each change in habitat type, a stream wetted width is measured, rod readings of the stream bottom deepest point and water surface are taken and notes are made of the observed habitat type (riffle, pool, run/glide, or shallow/side channel) or the presence of a boundary. Notes for boundaries should include the downstream habitat type and then the upstream type (for example "pool/run boundary"). Wetted width is measured across and over any mid-channel bars, boulders or other obstructions. If mid-channel bars are present, their width should also be measured and recorded. If there is a side channel entering the main channel at the cross section location, this should also be noted. The water at a cross section may be too deep to stand in and hold the rod vertical to get a direct depth measurement. If this is the case extent the rod to the deepest point and take a "depth measurement" (the reading where the water surface crosses the rod), and also estimate the angle that the rod is held to reach that point (using zero degrees as horizontal and 90 degrees as vertical). Both this "depth measurement" and rod angle must be provided to the level operator to be recorded. The rod reading of the water surface should then be taken as usual.

The level operator should maintain a running tally of the actual stream bottom and water surface elevations (in addition to the rod readings) as the rod holder moves along the stream. For the initial level setup, this involves adding the initial rod reading to 100.00, which is the assumed elevation of the bottom at the lower end of the reach, to obtain a "height of instrument" or "HI".

All subsequent rod readings at this setup location are subtracted from the HI to obtain the elevation of the base of the rod (either stream bottom or water surface). As the level is moved to continue to see the rod as it is moved up the channel, it will be necessary to establish a "turning point" so that the elevation base (100.00) can be used throughout the reach. The turning point is where the rod holder holds the rod on a fixed point after a level reading is taken so that the level can be moved and take a second reading on the same point. This serves to transfer the 100.00 base elevation to all other reading taken after the turning point. Either the stream bottom or a rock on the shoreline can be used for the turning point but not the water surface.

At six locations along the length of the reach the rod holder should place a temporary stake or surveyors flagging (or both) on each side of the stream above the wetted stream level to mark the approximate location of cross sections for follow-up monitoring. The temporary markers should be placed at 50 feet, 130 feet, 210 feet, 290 feet, 370 and 450 feet from the downstream end of the reach. These cross sections will later be adjusted so that they are located in habitat types proportionally to the percentage of habitat types seen in the entire reach (see **Valley Cross Section Profiles** section, below).

Add together all measured lengths and calculate the difference in water surface and stream bottom elevation from beginning to end and record on **Data Form 3**:

- Total stream length in reach (should be 500 feet),
- Overall water surface elevation difference (measured in feet or tenths of a foot),
- Overall channel bottom elevation difference.

The longitudinal profile slope is determined by dividing the "overall water surface elevation difference" by the "total stream length" and this calculated value should be entered on **Data Form 3**.

Add together the total length of each habitat type and indicate the totals on **Data Form 3**:

- Total of each habitat type.

Add together all wetted stream widths, and divide this total by the number of width measurements and indicate this on **Data Form 3**:

- Average wetted width (feet),
- Maximum wetted width,
- Minimum wetted width.

Valley Cross Section Profiles: This protocol will provide information on the shape and elevations of the stream channel "bankfull" area and the adjacent "flood prone area". This information is necessary to complete the determination of channel type for each monitoring reach. The cross section profile will be determined at (or near) the six locations that were staked and flagged during the "thalweg" profile work described in the previous protocol.

The term "bankfull" refers to the flow that fills the channel to the top of it's banks at that point where water begins to spill out onto floodplain (Rosgen, 1996). This generally corresponds to the US Army corps of Engineers field interpretation of "ordinary high water" which is expected to occur every one to two years. The "bankfull stage" refers to the elevation where overflow occurs. The bankfull stage and its corresponding flow are regular enough to serve as consistent indices that can be related to the formation, maintenance, and dimensions of the channel, as it currently exists. Unfortunately, the location of the bankfull level is not always evident; certainly not often can this be found on both sides of the channel. **Table H-3** presents some criteria for identifying the bankfull level.

Table H-3. Criteria for the identification of the bankfull level in the field (from Leopold, 1994).

1. The point bar is the sloping surface that extends into the cannel from the convex bank of a curve. The top of the point bar is at the level of the floodplain because floodplains generally result from the extension of point bars as a channel moves laterally by erosion and deposition through time.
2. The bankfull level is usually marked by a change in vegetation, such as the change from bare gravel bar to forbs, herbs or grass. Shrubs and willow clumps are sometimes useful but can be misleading. Willows may occur below bankfull stage but alders are above bankfull, in Idaho the lichens on rocks changes species and thus color at bankfull level. In ephemeral channels, the bankfull stage is marked by changes of plant species.
3. There is usually a topographic break at bankfull. The streambank may change from sloping bar to vertical bank. It may change from a to a horizontal plane on top of the floodplain. The change in topography may be as subtle as a change in the slope of the bank.
4. Bankfull is often registered by a change in the size distribution of materials at the surface, from gravel to fine cobbles, from sand to gravel or even finer material. It can change form fine to coarse or coarse to fine but a change is common.
5. Even more subtle is changes in the debris deposited between rocks, such as the amount of leaves, seeds, needles, or organic debris. Such indicators are confirmation rather than primary evidence. Flood-deposited debris alone should not be trusted.

Because of the importance that bankfull flow has in shaping and controlling the stream channel character, the stage or elevation of bankfull discharge (flow) is considered the single most important parameter used in stream type classifications (Rosgen 1996). The bankfull channel width is required to estimate two of the five primary criteria needed to determine stream type using the Rosgen process; that is width to depth ratio and entrenchment ratio. The bankfull elevation and width will be determined by surveying the six cross sections in each monitoring reach.

By comparison, "flood prone area" or "flood plain" is the widest extent that the stream channel gets and it is associated with the infrequent, high magnitude flood discharges (Rosgen 1996). While it is desirable to have the valley cross sections include the full extent of the flood prone area this will not be possible in all areas. The limits on the flood prone area surveying are described below.

The equipment needed for the Valley Cross Section Determination is as follows:

- Surveyors level and tripod.
- Surveyors rod (in units of feet and tenths of a foot),
- Hip chain and string
- Compass

- Calculator with memory function
- Two way radios
- Wooden survey stakes, rebar, surveyors ribbon and hammer
- Survey notebook with **Data Form 4**, blank write-in-the-rain paper, and pencil.
- GPS unit (optional).

The key to locating the cross sections is be sure that they are distributed as equally as possible to the proportion of all primary habitat types found in the reach. Thus, if there were found to be 50% riffles and 50% pools in the reach, three of the cross sections should be in riffle habitat and three in pool habitat. If the reach was comprised of 50% riffles, 30% pools and 20% runs or glides, the distribution of cross sections should be three in riffle habitat, two in pool habitat and one in run habitat. If a habitat type occupies less than 20% of the total, it should not have a cross section placed through it. Once the distribution of habitat types is known (and recorded on **Data Form 3**), the initial (temporary) cross section locations must be adjusted as necessary to match this distribution. This adjustment can be performed as the survey crew proceeds upstream during the cross section survey work. It may be that none of the cross section locations will need to be moved and it should not be necessary to move the first one or two cross sections as these can be used to meet the desired proportion no matter what habitat type they are in.

Once the permanent location of each cross section has been determined, a permanent "reference point" should be established on each cross section at a point above the bankfull stage height where the most bankfull area width can be seen. This point can be either on the right or left bank but must be described in the surveyor's field notes and monumented using a rebar driven into the ground, surveyor's flagging and, if possible, a coordinates reading using a GPS unit. It is from this reference point that the cross section profile will begin for this initial survey and all subsequent surveys.

The level and tripod should be set up and leveled on the reference point and the survey notebook should be set up according to the guidelines presented in Harrelson et al. 1994. It is important to have the level be above the bankfull stage height so that it will not have to be moved during the bankfull area surveying. When the level is ready, the alignment of the cross section must be determined using the compass. This involves standing facing the stream channel and estimating a line extending across the channel, perpendicular (90 degrees) to the stream channel alignment. It may help to hold your arms out straight to your sides parallel to the line of the stream and sight on an object that is straight ahead of you. Use the compass to determine the heading to that object (in degrees) and record this in the survey notebook. The level operator then uses the compass to set the level on the alignment of the cross section.

Starting at the reference point, the rod carrier ties the end of the hip chain string to the point marker (rebar) and resets the hip chain distance counter. The rod holder then follows the cross section compass heading as directed by the level operator, and gives the level operator shots on the rod to describe the channel cross section. This will include shots at all changes in the slope of the land surface across the stream channel as well as at both edges of the water in the stream and at the deepest spot in the wetted stream (that is, on the thalweg). The level operator's rod readings must be made while the rod is being held stationary and vertical on the ground surface, and the rod must be held in this manner until the level operator indicates that he/she is finished with that reading. The distance that the rod is from the level must be read from the hip chain counter at each reading point and told to the level operator so this can be recorded in the survey notebook.

The intersection of the stream thalweg and the cross section line is very important as the level reading at this point is used to establish the "height of instrument" (HI). As soon as this rod reading has been taken, the level operator can begin to calculate the heights of all other level readings by subtracting the other readings from the HI reading. The result of this calculation is the height (in feet) that the land surface is above the thalweg point. The level operator should calculate these heights as each shot is recorded and this can be done using the memory function on the calculator.

When the channel cross section is complete and the rod carrier has proceeded to a point that is above the bankfull level on the far side of the stream, a second reference point should be established on the cross section line. This, again, involves driving a rebar into the ground, attaching surveyors flagging and taking a GPS coordinates reading (if available).

The rod carrier may then continue with the survey along that same alignment across either the flood plain or return to survey the flood plain on the side of the channel that the level is located. In either case, the survey must include both sides of the channel with level shots on the ground surface at 10-foot intervals plus at all changes in the ground surface slope. In re-establishing the direction of the cross section on the side of the channel that the level was first set up on remember to add or subtract 180 degrees from the original compass reading to establish the opposite reading.

In areas of the cross section where an obstruction blocks the view of the level to the rest of the cross section, or when the ground surface rises above the view of the level, it will be necessary to use a turning point and relocate the level to the far side of the obstruction or higher up on the slope. As described in the longitudinal profile discussion, above, this involves taking a reading on the rod, moving the level while the rod is left in place, and taking a second reading on the rod. The new HI will reflect the original thalweg point when the turning point rod reading is subtracted from the original HI (which gives the height of the ground at the turning point) and then by adding the second rod reading. All subsequent rod readings are subtracted from the new HI to obtain the ground surface height as before.

The process of relocating the level is complicated on the cross sections by the need to remain on the cross section alignment. It may be possible for the rod carrier to use the compass to direct the level operator onto the cross section line from the turning point but the level operator may still not be able to see through (or above) the obstruction to take the second rod reading. It may therefore be necessary to make an additional offset turning point. This would involve taking the second rod reading from the level set up a measured distance to the side of the rod (90 degrees off the cross section alignment) and then moving the rod parallel to the cross section line until it is past the obstruction for a second turning point. The second rod reading from this second turning point could then be taken from the level set up back the measured distance onto the cross section alignment. If this procedure is followed, it will be necessary to record the offset distance and distance on the parallel line in addition to the level readings and calculated heights. Be sure not to move the rod from the turning points before the level operator has taken and recorded the second reading. When using the hip chain for measuring these offset distances be sure to attach the string to something (or have the level operator hold it after the level is set up) and to subtract each side move distance from the counter total that is recorded in the survey notebook as distance along the cross section.

Finally, surveyor's flagging should be attached to a stationary object or placed on the ground to mark the rod reading points.

One of the objectives of this cross section survey effort is to find the height of the flood prone depth and the total flood prone width. The flood prone height is calculated as two times the bankfull height as **Figure H-2**. The elevation of "flood-prone area" is defined as twice the maximum depth at bankfull; so the cross section survey must include both the maximum depth (which is the thalweg) and also the bankfull indicators, as described above. In situations where the bankfull height is apparent it will be possible to determine flood-prone area elevation precisely in the field and survey out to this elevation on both sides of the channel and thus measure the flood prone width. In narrow valleys where the flood-prone elevation can be found, this will be the outer end of the cross sections. In broad, relatively flat valleys, it may not be practical to survey out to the full flood prone width so this will have to be determined from a topographic map. In these cases, a maximum of 200 feet from the stream channel will be considered the end of the cross section.

Set up **Data Form 4** and use this for recording survey notes for the valley cross sections:

- Location (Monitored Reach)
- Reference elevation of Benchmark(s)
- Height of Instrument (HI)
- Foresights
- Backsights (for turning points)
- Elevations (relative to the Bench Mark)

Use the bottom part of the form to calculate the flood-prone elevation and width:

- Flood-prone area elevation
- Flood-prone area width

Following the completion of the survey of all six cross sections, it will be necessary to plot each in the office. This will be done using a computer and a copy of the Reference Reach Spreadsheet. This spreadsheet has many capabilities but the primary use is to produce a cross section plot and various channel dimensions using survey data. The plot will help expose the bankfull height (or confirm field observations) and allow calculation of the stream channel type criteria discussed in the next section.

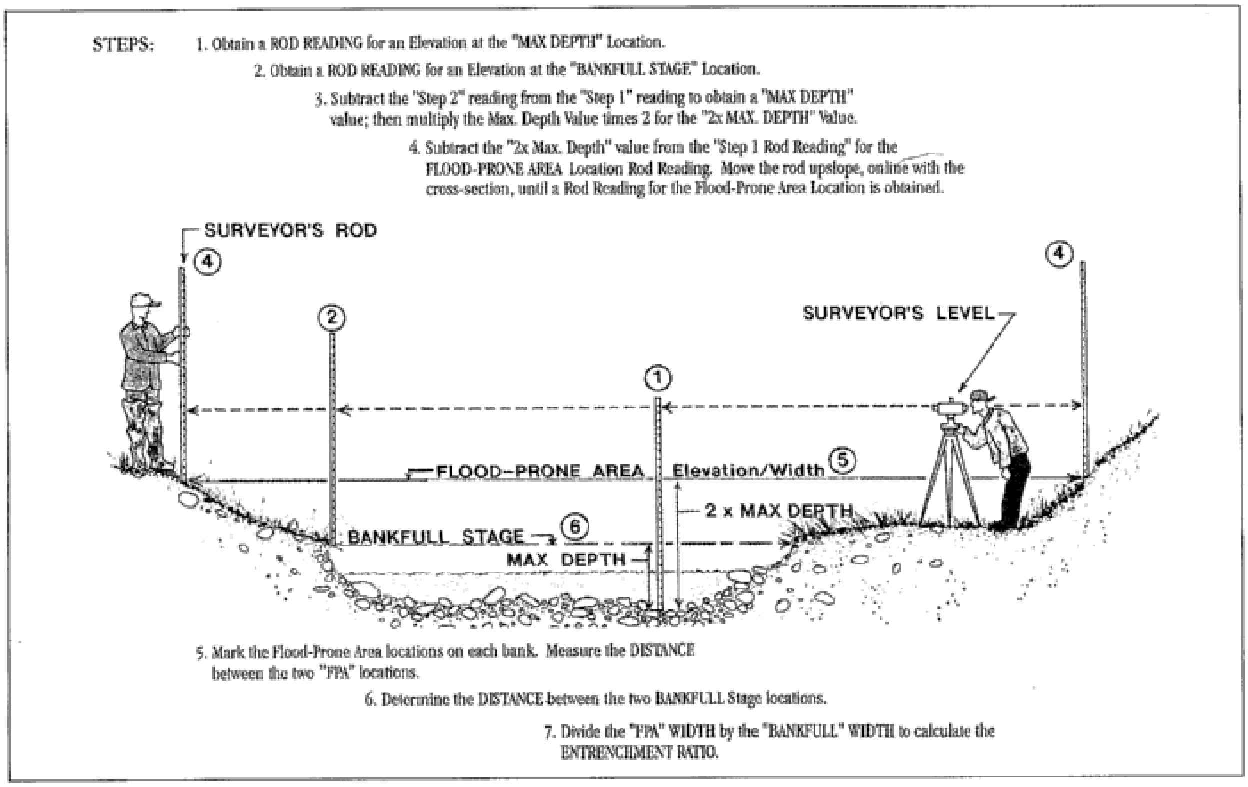


Figure H-2. Determination of "flood-prone area" elevation and width during channel cross-section surveys (from Rosgen 1996).

Entrenchment Ratio: Entrenchment ratio is estimated as the typical flood width divided by the bankfull channel width. Bankfull width, or the stream volume 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 break in the slope of the bank or a stain on rocks in the bank. The bankfull width may not be always evident but should be able to be identified somewhere within the reach, at least on one side of the channel. Flood width is frequently not evident, especially where floodplain features have been obscured by agriculture or other human activities. However, flood width has been defined by Rosgen as the width at the elevation that is twice the maximum bankfull depth.

Subtract the bankfull height reading from the maximum depth reading to obtain the estimated bankfull depth. Multiply the bankfull depth by 2 and subtract this value from the Maximum depth reading to obtain the flood depth reading. Record this on the **Data Form 5**:

- Entrenchment ratio for each cross section,
- Average entrenchment ratio for monitored reach.

Width to Depth Ratio: Stream channel width to depth ratio is determined for bankfull discharge condition. It is advantageous for permanent cross sections to be established for long term monitoring of this characteristic. Using the previously determined "bankfull width" and "bankfull depth", calculate width to depth ratio by dividing the width by the depth for the cross section and enter the result on **Data Form 5**:

- Width to depth ratio for each cross section,
- Average width to depth ratio for monitored reach.

Sinuosity: The sinuosity of a stream reach is estimated as the ratio of the stream channel length to the direct basin length. Rosgen (1996) describes this procedure for the entire stream basin but the procedure also applies to a monitored stream reach. Use a 1:24,000 map or orthophoto and a ruler, or GIS map in measure option or GPS 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.

Use the "total stream length" in the study reach that was measured for the longitudinal thalweg profile (this should be 500 feet) and calculate the sinuosity by dividing this length by the reach length. The result should be entered in **Data Form 5**:

- Sinuosity for the monitored reach,

Stream Classification: The Rosgen stream type classification is determined using the results of the longitudinal profile (slope), average entrenchment ratio, average width to depth ratio and sinuosity analyses described above. These calculated characteristics should be compared to the stream type descriptions presented in **Table H-1** and the most appropriate stream type (closest match) should be entered on **Data Form 5**:

- Rosgen stream channel type for the reach.

Bibliography for Stream Channel Typing Protocols

Harrelson, Cheryl C., C.L. Rawlins and J.P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. General Technical Report RM-245. Rocky Mountain Forest and Range Experiment Station, USDA Forest Service, Fort Collins, CO.

Peck, D.V., J.M. Lazorchak & D.J. Klemm (eds). 2001. Western Pilot Study DRAFT Field Operations Manual for Wadable Streams. Environmental Monitoring and Assessment Program - Surface Waters, Corvallis, OR.

Rosgen, Dave. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

DATA FORM 3a. Rosgen Level I
Channel Type Determination

Date: ________ Analyst(s): __________________________

Stream name: ________________ Reach #: __________________

Location: ____

Use USGS or other topographic map to determine the following:

Stream gradient:

Elevation at bottom of reach: _____

Elevation at top of reach: _____ Elevation gain: _____

Channel length: _____ Gradient (Elev. Gain / Chan. length): _____

Sinuosity:

Valley length: _____ Sinuosity (Chan. length / Valley length): _____
(straight line)

Channel Pattern:

Single thread: __ Multiple thread: __ Anastomosing: __

Rosgen Channel Type (Aa+, A, B, C, D, DA, E, F, or G): ____

Use Stream gradient (slope) and Channel Pattern with Figure H-1

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Restoration Project Monitoring

DATA FORM 3. Stream Gradient & Habitat Typing

Date: ________ Monitored Reach: ____________________

Personnel: _____________________ Weather: ______________

* Fill out this page using completed SURVEY NOTES (attached)

A. LONGITUDINAL "THALWEG" PROFILE

Total Water Surface Elevation Difference: ________ft.
(Between upstream and downstream ends of reach)

Total Stream Length: _________ft. } SLOPE : ____ft./ft.

B. HABITAT TYPE SUMMARY

Total length of each habitat type seen in reach and percent of total:

Riffle: ____ft. Pool: ____ft. Run/Glide: ____ft. Shallows: ____ft.
____% ____% ____% ____%

C. WETTED WIDTH SUMMARY

Maximum wetted width: _____ft. Minimum wetted width: ____ft.

Average wetted width: _____ft.

Page 1

Longitudinal Profile Survey Data Monitored Reach: ________

Reference elevation of Benchmark(s): _____ ft.

	Distance or Station **STATION** ft.	Back-Sight **BS** ft.	Height of Instrument **HI** ft.	Fore-Sight **FS** ft.	Height or **ELEVATION** ft.	Habitat Type	Wetted Width ft.	Notes
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Page 2

Longitudinal Profile Survey (continued) Monitored Reach: ________

Reference elevation of Benchmark(s): _____ ft.

	Distance or Station **STATION** ft.	Back-Sight **BS** ft.	Height of Instrument **HI** ft.	Fore-Sight **FS** ft.	Height or **ELEVATION** ft.	Habitat Type	Wetted Width ft.	Notes
37								
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COEUR D’ALENE TRIBE, FISHERIES PROGRAM

Restoration Project Monitoring

DATA FORM 4. Valley Cross Sections.

Date: _________ Monitored Reach: _____________________

Personnel: _____________________ Weather: ___________

Reference elevation of Benchmark(s): _____ ft.

	Distance or Station **STATION** ft.	Back-Sight **BS** ft.	Height of Instrument **HI** ft.	Fore-Sight **FS** ft.	Height or **ELEVATION** ft.	Notes
1						
2						
3						
4						
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26						
27						
28						

CROSS SECTION # (circle one): 1 2 3 4 5 6

Valley Cross Section Data (continued) Reach: _______________ Cross Section#: ___

Reference elevation of Benchmark(s): _____ ft.

	Distance or Station **STATION** ft.	Back-Sight **BS** ft.	Height of Instrument **HI** ft.	Fore-Sight **FS** ft.	Height or **ELEVATION** ft.	Notes
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Valley Cross Section Plot **Reach: ___** **Cross Sect.#: ___**

GRAPH CROSS SECTION AND FIND THE FOLLOWING:

Bankfull Elevation: _________ ft.Bankfull Width:________ ft.
Flood Prone Zone Elevation: _______ ft.
Flood Prone Width: _________ ft.

COEUR D'ALENE TRIBE, FISHERIES PROGRAM

Restoration Project Monitoring

DATA FORM 5. Channel Type Classifications.

Date: ________ Monitored Reach: _________________

Person completing this form: _________________________

** USE FIELD DATA FROM CROSS SECTION PROFILES, DATA FORM 3, FOR THIS MONITORED REACH

A. ENTRENCHMENT RATIOS

Cross Section #1: Flood Prone Zone Width: _____
Bankfull Width: _____ RATIO: _____

Cross Section #2: Flood Prone Zone Width: _____
Bankfull Width: _____ RATIO: _____

Cross Section #3: Flood Prone Zone Width: _____
Bankfull Width: _____ RATIO: _____

Cross Section #4: Flood Prone Zone Width: _____
Bankfull Width: _____ RATIO: _____

Cross Section #5: Flood Prone Zone Width: _____
Bankfull Width: _____ RATIO: _____

Cross Section #6: Flood Prone Zone Width: _____
Bankfull Width: _____ RATIO: _____

AVERAGE ENTRENCHMENT RATIO FOR REACH: _____

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B. WIDTH TO DEPTH RATIOS

Cross Section #1: Bankfull Width: _____
Bankfull Depth: _____ RATIO: _____

Cross Section #2: Bankfull Width: _____
Bankfull Depth: _____ RATIO: _____

Cross Section #3: Bankfull Width: _____
Bankfull Depth: _____ RATIO: _____

Cross Section #4: Bankfull Width: _____
Bankfull Depth: _____ RATIO: _____

Cross Section #5: Bankfull Width: _____
Bankfull Depth: _____ RATIO: _____

Cross Section #6: Bankfull Width: _____
Bankfull Depth: _____ RATIO: _____

AVERAGE WIDTH TO DEPTH RATIO FOR REACH: _____

C. STREAM CHANNEL TYPE

Use reach slope (from Data Form 3), average entrenchment ratio, average width to depth ratio and sinuosity to choose Channel Type from Table 4 in Technician Manual: _____

APPENDIX I: PUBLIC OUTREACH SURVEY FORM

Hangman Creek Public Outreach Opinion Survey

We are doing a small survey for all the people that have interests in the Hangman Creek Watershed (HCW). This survey will help us to better serve the needs of educating the public about our project, and to make partnerships for restoration. The Fish & Wildlife program will have the results of the survey at our next meeting.

	Yes	No
1. Do you get information on what is going on in the HCW?	___	___
2. Would you like to participate in the Quarterly meetings?	___	___
3. What is your main concern with the watershed?	___________	

____

	Yes	No
4. Do you have fish in your watershed?	___	___
5. Are you a landowner?	___	___
6. Would you like to see changes in the watershed?	___	___

If yes, what kind of changes? ____

____

	Yes	No
7. Do you get the Fish & Wildlife's Watershed Wrap newsletter?	___	___
8. Do you want any water quality samples collected from HCW, on your land, or other location of interest?	___	___
9. Do you have soil erosion conditions on your land?	___	___
10. Has the Cd'A Fish & Wildlife program done effective Educational efforts in teaching you about the HCW and its Tributaries?	___	___
11. Do you think this working group is effective?	___	___

If not, feel free to explain how you feel it might be improved in the space below for Comments.

____

____

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