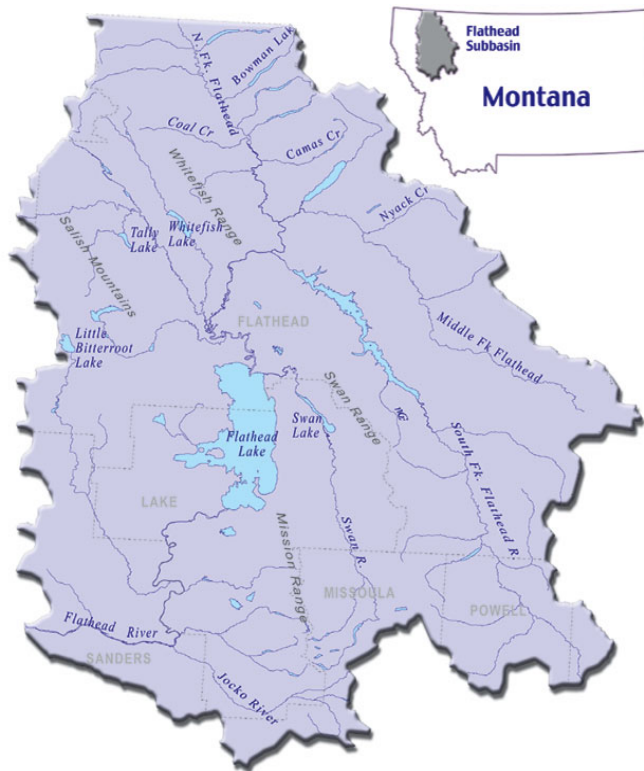


# Hungry Horse Mitigation Flathead Lake

Annual Progress Report 2008  
Project 9101901



by:

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Confederated Salish and Kootenai Tribes

## INTRODUCTION

The Confederated Salish and Kootenai Tribes (CSKT) and Montana Fish Wildlife and Parks (MFWP) wrote the “Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam” in March 1991 to define the fisheries losses, mitigation alternatives and recommendations to protect, mitigate and enhance resident fish and aquatic habitat affected by Hungry Horse Dam. On November 12, 1991, the Northwest Power Planning Council (NPPC) approved the mitigation plan with minor modifications, called for a detailed implementation plan, and amended measures 903(h)(1) through (7). A long-term mitigation plan was submitted in August 1992, was approved by the Council in 1993, and the first contract for this project was signed on November 11, 1993.

The problem this project addresses is the loss of habitat, both in quality and quantity, in the Flathead Lake and River basin resulting from the construction and operation of Hungry Horse Dam. The purpose of the project is to both implement mitigation measures and monitor the biological responses to those measures including those implemented by Project Numbers 9101903 and 9101904.

Goals and objectives of the 1994 Fish and Wildlife Program (Section 10.1) addressed by this project are the rebuilding to sustainable levels weak, but recoverable, native populations injured by the hydropower system. The project mitigates the blockage of spawning runs by Hungry Horse Dam by restoring and even creating spawning habitats within direct drainages to Flathead Lake. The project also addresses the altered habitat within Flathead Lake resulting from species shifts and consequent dominance of new species that restricts the potential success of mitigation measures. Specific goals of this project are to create and restore habitat and quantitatively monitor changes in fish populations to verify the efficacy of our mitigation measures. The project consists of three components: monitoring, restoration and research. Monitoring, for example, includes a spring gillnetting series conducted annually in Flathead Lake and builds on an existing data set initiated in 1981. Monitoring of the experimental kokanee reintroduction was a primary activity of this project between 1992 and 1997. Lake trout, whose high densities have precluded successful mitigation of losses of other species in Flathead Lake, have been monitored since 1996 to measure several biological parameters. Results of this work have utility in determining the population status of this key predator in Flathead Lake. The project has also defined the baseline condition of the Flathead Lake fishery in 1992-1993 and has conducted annual lakewide surveys since 1998. The restoration component of the project has addressed several stream channel, riparian, and fish passage problems, and suppression of non-native fish. The research component of the project began in FY 2000 and measured trophic linkages between *M. relictus* and other species to assist in predicting the results of our efforts to suppress lake trout. Only Work Element A in the Statement of Work is funded entirely by Hungry Horse Mitigation funds. Additional funds are drawn from other sources to assist in completion of all remaining Work Elements.

### **WE B: Quantify relative abundance of bull trout and westslope cutthroat trout**

We set six floating and six sinking gillnets in Flathead Lake in cooperation with Montana Fish, Wildlife and Parks during spring 2008. The data generated by this sampling program contributes to a long-term monitoring index of abundance of westslope cutthroat trout (Figure 1) and bull trout (Figure 2) in the Flathead system. This monitoring tool is intended to be one measure of the effect on native adfluvial trout of mitigation projects taking place throughout the basin. Capture rates during the period of sampling are highly variable and provide no clear evidence of a trend in abundance of either species since sampling began.

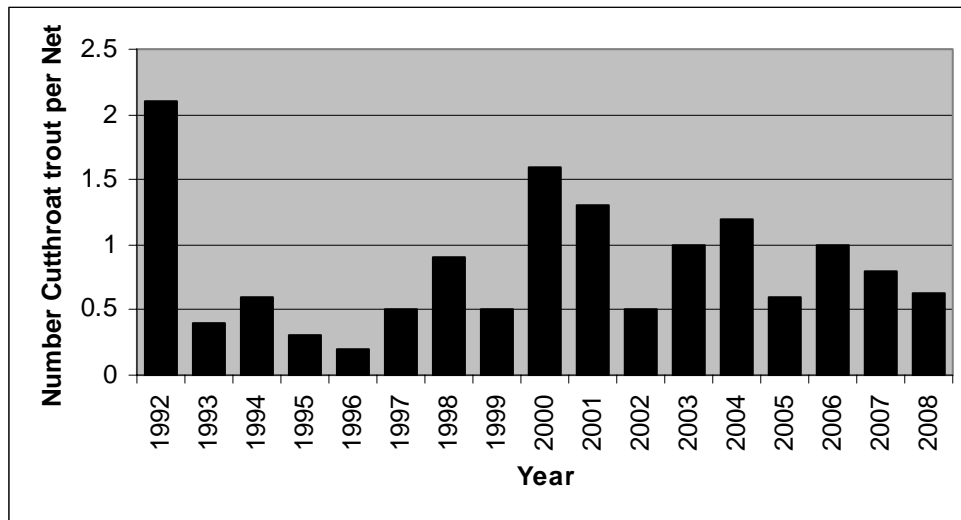


Figure 1. Number of westslope cutthroat trout caught per floating net during spring in Flathead Lake, 1992-2008.

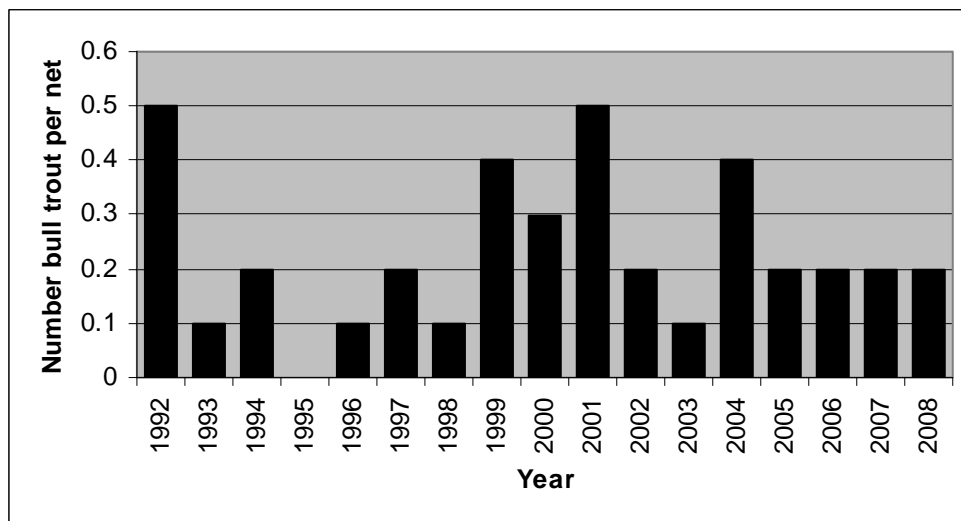


Figure 2. Number of bull trout caught per sinking net during spring in Flathead Lake, 1992-2008.

### **WE C: Quantify Flathead Lake Fishery**

The creel survey is another tool to measure the effect on native adfluvial trout of mitigation projects throughout the basin. Its primary use though has been to monitor the harvest of lake trout which currently exert the greatest control over native adfluvial trout abundance. During 2008 we interviewed 1289 parties of anglers and conducted 206 aerial and ground counts of anglers. The average length of lake trout caught by anglers was 526 mm TL (Figure 1) and age 7 fish were the most abundant year class in the catch (Figure 2).

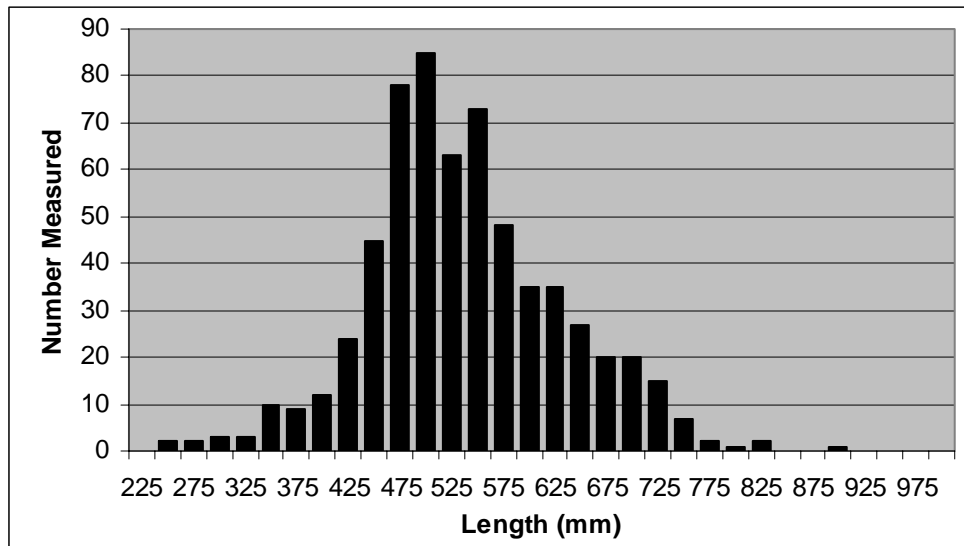


Figure 1. Lengths of lake trout measured during creel survey, 2008.

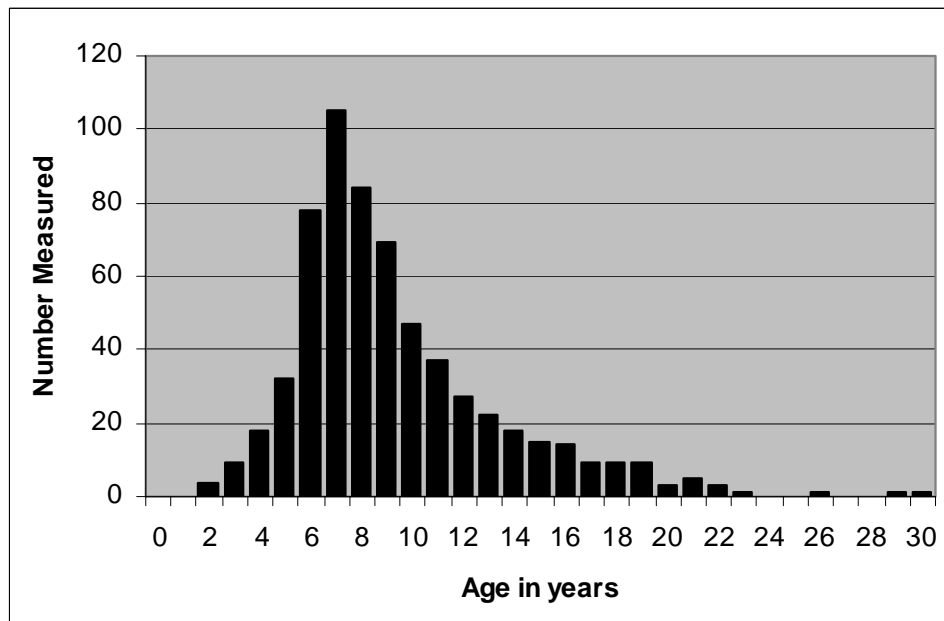


Figure 2. Ages of lake trout measured during creel survey, 2008.

We estimated that 22,437 lake trout were harvested in 2008 during the general harvest, and that 22,759 lake trout were harvested in the spring and fall fishing events for a grand

total harvest of 45,196 lake trout. We estimated that total pressure equaled 163,867 angler hours during 2008. We also estimated the harvest during 2008 of 19,435 lake whitefish, and 38,953 yellow perch. Annual harvest of lake trout is trending upward slightly, but has not increased sufficiently to reach the desired management target for harvest (Figure 3).

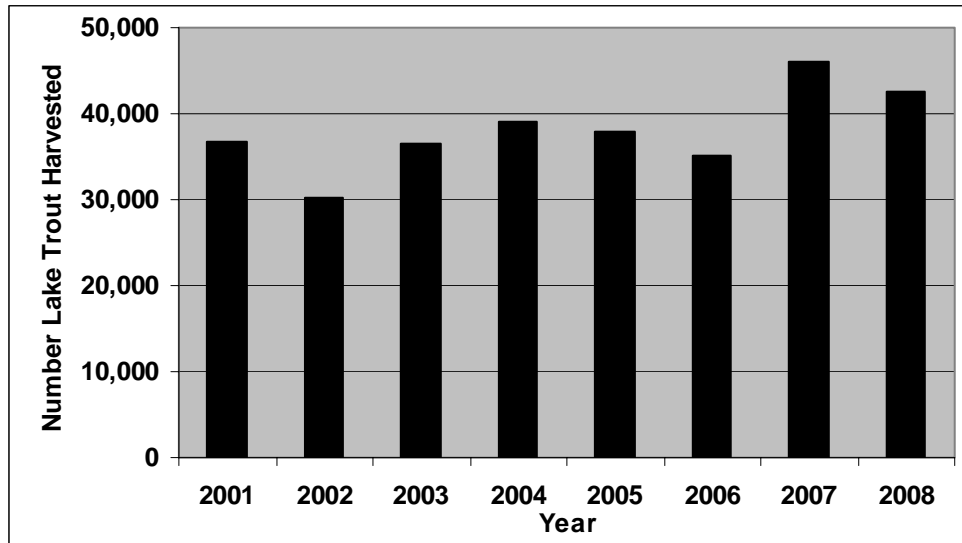


Figure 3. Estimates of annual harvest of lake trout, Flathead Lake, 2001 to 2008.

#### **WE D: Quantify parameters of lake trout biology**

Under an entirely separate funding source we set 72 gillnets (consisting of 12 panels of differing mesh sizes) in a stratified random pattern throughout Flathead Lake during fall 2008. Nets were distributed in five geographic strata and five depth strata proportional to their occurrence in the lake. These data are analyzed and described under WE E.

#### **WE E: Analyze biological parameters of lake trout**

We assigned the catch to age classes based on an age key developed from scales read in 2005. A fairly uniform decline in survival between age 9 and 20 is evident, representing a mortality rate of 0.30 as computed by the Robson Chapman method (Figure 1). This mortality rate has been very consistent over the last ten years and is substantially below the 0.50 target level identified by many researchers as necessary to reduce the lake trout population (Healey 1978, Nieland et al. 2008). Length-at-maturity for male lake trout has been trending upward since 1996, indicating that the population has reached or is near carrying capacity based on the supposition that the population requires increasingly more time to accumulate the resources necessary to reach maturity (Figure 2). A parallel trend has been quantified for growth rates in which decreasing growth has been measured over the period from 1986 to 2005 (Figure 3). These growth data were developed from a technique under development in which age is determined from the weight of the otolith based on a comparison with the total length to otolith mass relationship derived from fish collected in 2005. Increasing otolith weights relative to length indicate decreasing growth rates.

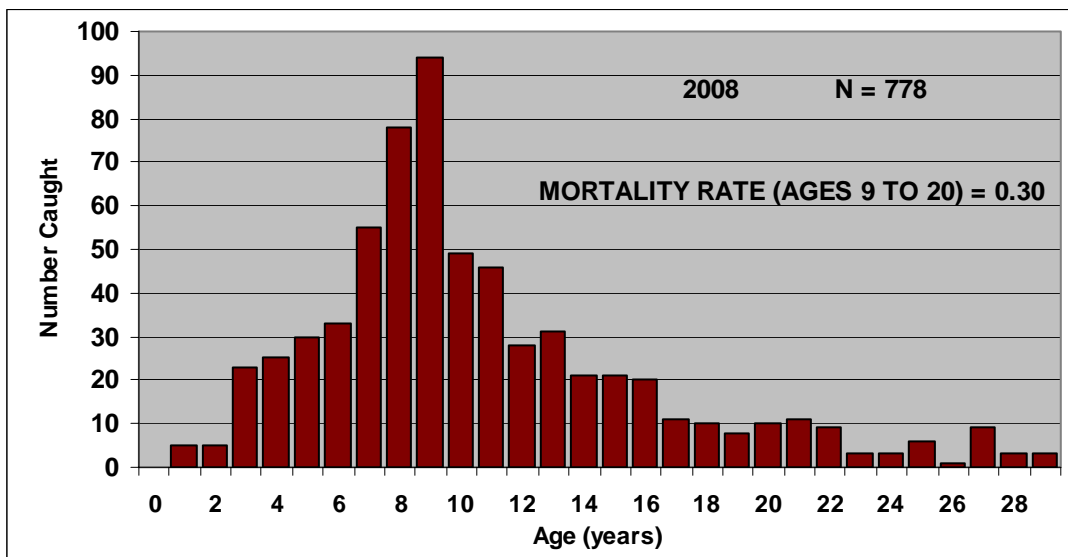


Figure 1. Estimated age structure of Flathead Lake lake trout derived from gillnetting samples, 2008.

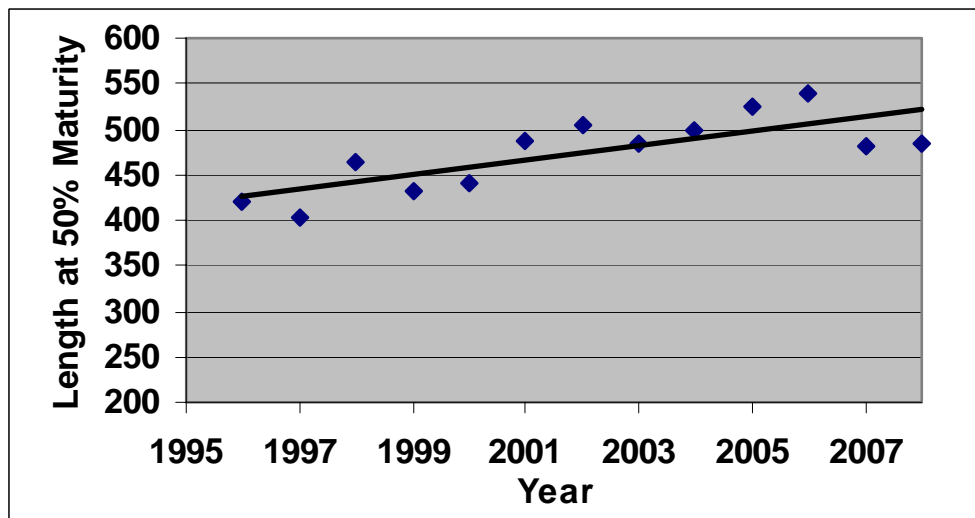


Figure 2. Lengths of male lake trout at 50% maturity in Flathead Lake, 1996 to 2008.

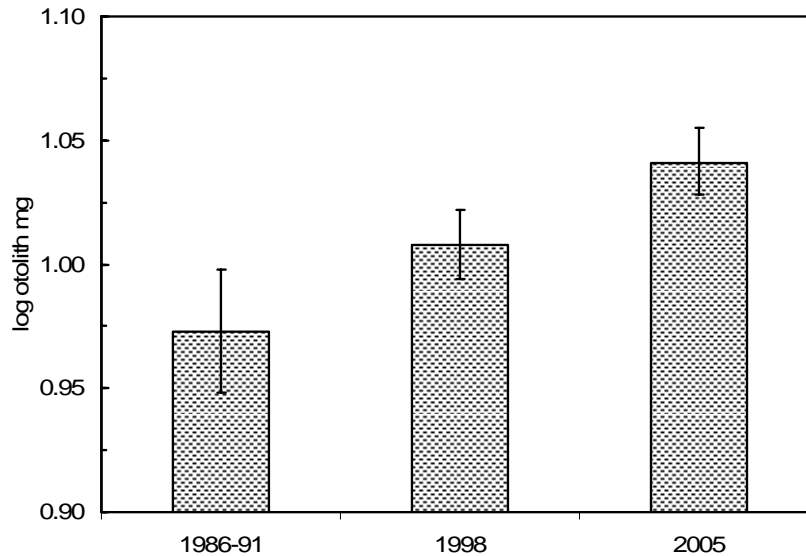


Figure 3. Marginal means of log otolith mg (at log TL mm = 2.636) from 1986-91, 1998, and 2005 for lake trout with TL ranges = 294-538 mm. Bars denote 95% confidence intervals.

All the standard metrics that we monitor indicate that the current harvest of lake trout is insufficient to reduce the population and that the population continues to be large enough that it is clearly limited by available resources (declining condition and growth rate and increasing length at maturity).

### References Cited

- Healey, M.C., 1978. The dynamics of exploited lake trout populations and implications for management. *J. Wildlife Manage.* 42, 307–328.
- Nieland, J. M. Hansen, M. Seider, J. Deroba. 2008. Modeling the sustainability of lake trout fisheries in eastern Wisconsin waters of Lake Superior. *Fisheries Research* 94: 304-314.

### WE F: Collect pre-treatment data for Skidoo Creek

During 2008 we conducted several activities in preparation for treating Skidoo Creek with piscicides. We continued to define the upstream extent of brook trout distribution, and collected additional supportive information for preparation of the Environmental Assessment.

### WE G: Monitor success of fish planting program

We maintained our program of interviewing a pre-selected group of anglers to confirm their satisfaction with the planting program. The Rainbow Pond program continues to

receive unanimous approval, while the Pablo Reservoir program continues to receive mixed ratings from the anglers.

We sampled Rainbow Pond by angling in June 2008, and collected eight fish for otolith analysis. We thin-sectioned the otoliths and will complete the growth analysis in FY2009.

#### **WE H: Research shoreline erosion processes.**

During 2008 we set up a baseline monitoring protocol for the Salish Point site. Future monitoring of this site will be used to identify problems with stability of the constructed beach and will provide a data set to verify the success of the technology applied there.

#### **WE I: Design beach restoration at Salish Point**

This project was completed in 2007 and was reported in the 2007 Annual Report.

#### **WE J: Operate radio advisory broadcast**

We completed installation of the radio equipment in a building at the southern entrance to the Flathead Indian Reservation and began broadcasting in 2008. The program is not fully functional at this time though, because of highway construction at the site that does not allow us to post a traveler's notice along the highway. We will fully implement the program as soon as the necessary signage can be placed following completion of the highway construction.

#### **WE K: Hell Roaring Creek restoration**

Hell Roaring Creek is a direct tributary to Flathead Lake entering in East Bay. This Work Element was successfully completed in 2007. Post-construction monitoring began in 2008 during which there was only moderate rather than severe runoff to test the integrity of the channel. We observed a high level of survival of the willow sprigs planted along the banks, and did not observe any points of channel failure within the construction zone.

#### **WE L: Timber road removal in Camas and Mill watersheds**

We continued the programs of road-removal during 2008 to address the seriously altered watershed condition in Camas and Mill creeks. Both streams support important and isolated populations of westslope cutthroat trout. The watersheds are characterized by high densities of legacy roads dating back to the mid-1900's. We conducted coordination activities with the Tribal Forestry Department for both watersheds and identified for removal over the next five years a total of 32 miles in the Camas Creek watershed and slightly over 100 miles in the Mill Creek watershed. During 2008 we removed, by full recontouring, multiple road segments within the Mill Creek watershed. Removal of a total of 10.9 miles of road was funded by BPA while the remainder were funded by the



Tribal Forestry Department (Figure 1). The costs of recontouring and revegetating averaged about \$3,500 per mile.

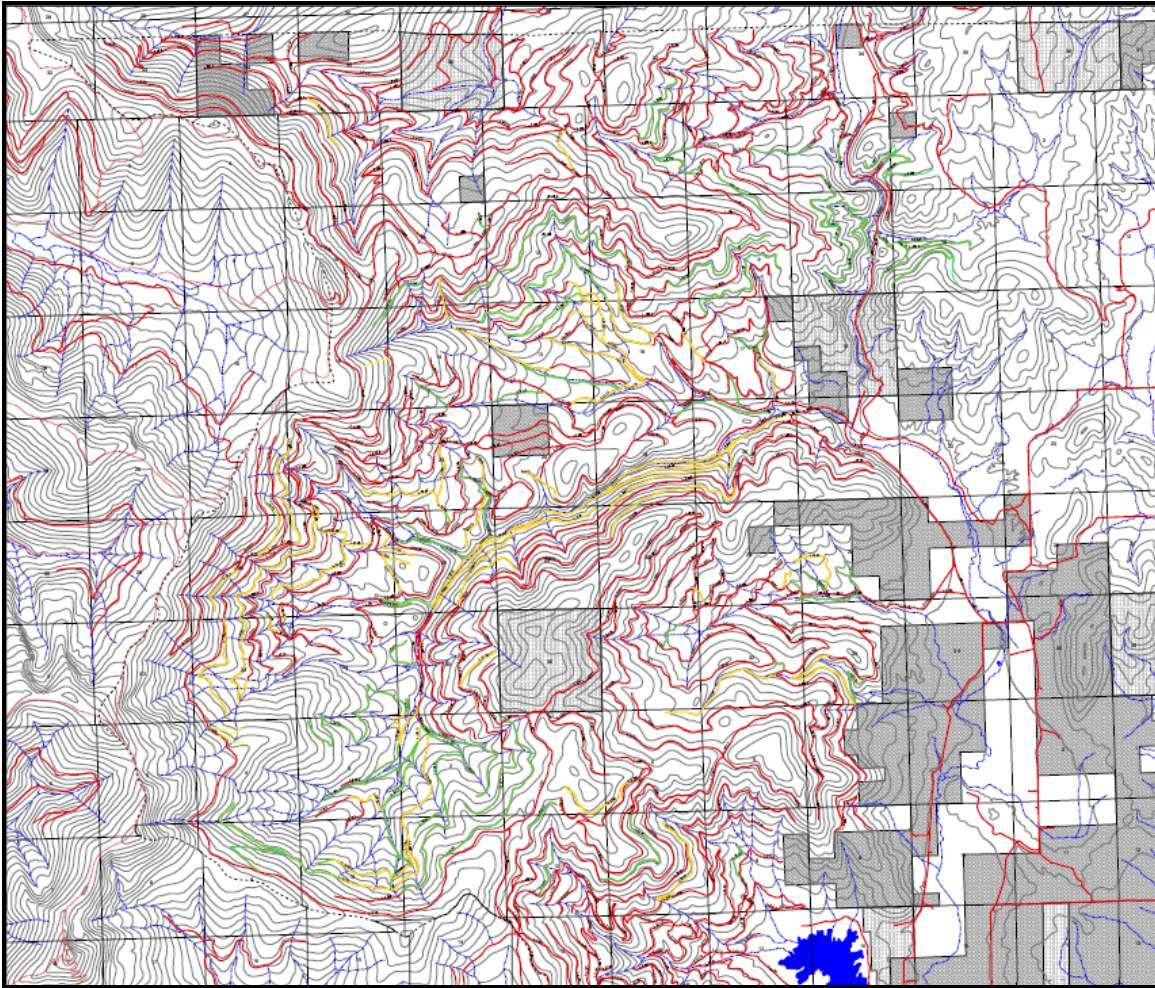


Figure 1. Mill Creek watershed and location of roads. The green lines represent roads that were recontoured during 2008, and the yellow lines represent roads that are scheduled to be recontoured in 2009.

#### **WE M: Jocko River riparian fence**

We were not able to finalize any of our on-going coordination efforts with landowners during 2008 for fencing of riparian areas.

#### **WE N: Conduct mark/recapture estimate**

In 2008 we continued our efforts to develop a cost-effective method to estimate the size of the lake trout population in Flathead Lake. By quantifying the size of the population we will be able to determine the scale of effort that will be required to reduce the population. We incorporated the marking process in the ongoing fall gillnetting schedule and also collected fish from anglers during the Fall Mack Days event for marking. Marked fish also served double-duty of providing additional interest in the fishing contests as we awarded from \$100 to \$500 (non-BPA funding) for recaptured fish with

tags. By utilizing the fishing contests we completely eliminated the cost of recapturing fish and were able to generate a recapture sample size that would have been unreasonably expensive to obtain by conventional means. Lengths of fish tagged were restricted to those targeted in the contest and under the slot limit length of 750 mm TL (Figure 1). Tribal staff conducted the tagging process and recovery process, and the analysis of the data generation of a population estimate that follows was conducted by Dr. Michael Hansen, University of Wisconsin.

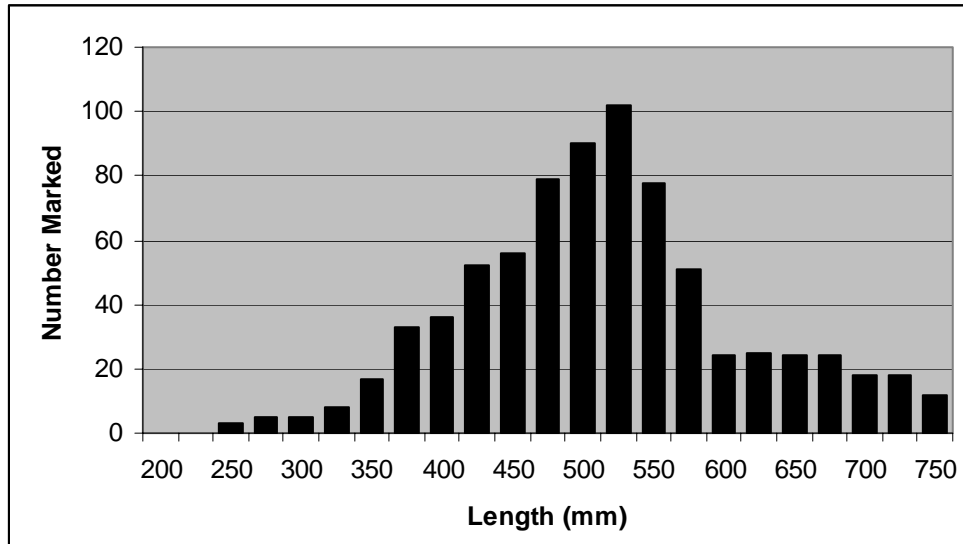


Figure 1. Lengths of lake trout marked for recapture during fall 2007.

**Methods** – Mark-recapture sampling was completed in 2007–2008, with angling and gillnetting for capturing, marking, and releasing fish from 5 October 2007 through 10 March 2008 and angling during a tournament for recapture sampling during 3 October through November 16, 2008. The number of marked fish at large was established on 10 March 2008, so the mark-recapture estimate of abundance applies to that date. The recapture sample was obtained through a fishing derby in which all lake trout were removed from the population, so sampling was without replacement (i.e. the same fish could not be observed more than once during recapture sampling), thereby making Chapman’s modification of the Petersen estimator applicable (Ricker 1975):

$$\hat{N} = \frac{(M + 1)(C + 1)}{(R + 1)} - 1$$

A relatively small recapture sample requires that confidence limits on  $N$  be estimated using the binomial distribution for  $R/C$ , the Poisson distribution for  $R$  (rather than the normal distribution, which is only appropriate when  $R$  is large, say larger than 50), or maximum likelihood. Therefore, 95% confidence limits for  $N$ ,  $LL(N)$  and  $UL(N)$ , were computed from exact binomial confidence limits for  $R/C$  ( $L_1$  and  $L_2$ ):

$$LL(\hat{N}) = \frac{(M+1)(C+1)}{(L_2C+1)} - 1$$

$$UL(\hat{N}) = \frac{(M+1)(C+1)}{(L_1C+1)} - 1$$

Where  $L_1$  and  $L_2$  are computed from the relationship between the  $F$ -distribution and the binomial distribution (equations 24.28 and 24.29 in Zar 1999):

$$L_1 = \frac{R}{R + (C - R + 1)F_{\alpha(2), V1, V2}}$$

$$V1 = 2(C - R + 1)$$

$$V2 = 2R$$

$$L_2 = \frac{(R+1)F_{\alpha(2), V1', V2'}}{C - R + (R+1)F_{\alpha(2), V1', V2'}}$$

$$V1' = 2(R+1) = V2 + 2$$

$$V2' = 2(C - R) = V1 - 2$$

Last, the standard error ( $SE$ ) and the associated coefficient of variation ( $CV$ ) of the estimate of  $N$  were estimated from the variance ( $V$ ) of  $N$ :

$$CV(\hat{N}) = \frac{SE(\hat{N})}{N}$$

$$SE(\hat{N}) = \sqrt{V(\hat{N})}$$

$$V(\hat{N}) = \frac{(M+1)^2(C+1)(C-R)}{(R+1)^2(R+2)}$$

Estimates of abundance and associated statistics were generated for the pooled sample of all sizes of lake trout sampled and for size groupings based on RSD length classes (Stock < 50 cm; Quality = 50–65 cm; and Preferred  $\geq$  65 cm; Piccolo et al. 1993).

**Mark-Recapture Assumptions** – Assumptions of all closed-population mark-recapture models are: (1) the population is closed to additions and deletions (constant  $N$  assumption); (2) marked and unmarked animals are equally vulnerable to capture (constant catchability assumption); and (3) marked individuals do not lose their marks and are all recognized upon recapture (no tag loss assumption; Pollock et al. 1990). The constant  $N$  assumption is relaxed if: (1) mortality or emigration occurs equally for marked and unmarked individuals, the estimate is unbiased; or (2) recruitment or immigration occurs, the estimate of  $N$  includes all animals present at the time of marking and new individuals that entered the population.

The constant catchability assumption must be differentiated into two types of potential biases: (1) the probability of capture cannot vary among animals via differences in age, sex, social status, or territoriality (heterogeneity assumption); and (2) marking cannot alter behavior of animals via trap happy or trap shy response (trap response assumption). To overcome the first problem, sampling effort must be distributed

randomly throughout the population during either marking or recapture or individuals must be given time to mix randomly between marking and recapture. To overcome the second problem, different capture methods should be used for marking and recapture.

The no tag loss assumption requires that tags are not lost or that tag loss is estimated and that all tags are observed during recapture sampling. To address the first problem, double tagging is often used to estimate tag loss so the number of recaptures can be adjusted upward to account for lost tags. The assumption of double tagging is that an individual is exceedingly unlikely to lose both tags (likelihood = 0), so loss of one tag will always be observed. To address the second problem, tags or marks should be used that are not easily missed by observers and observers should be trained to observe tags.

**Results** – Angling and gillnetting from 5 October 2007 through 10 March 2008 resulted in a sample of 856 lake trout marked ( $M$ ), while angling in a derby during 3–16 October 2008 resulted in a sample of 10,108 lake trout examined for marks ( $C$ ), of which 21 were previously marked ( $R$ ). The length frequency of lake trout in samples of fish marked and recaptured were quite similar, though the overall length frequency of the recapture sample ( $C$ ) was shifted slightly to the right in relation to the marked sample ( $M$ ; Figure 2), likely because fish grew between the spring marking period and the autumn recapture period. The fraction of fish marked in the recapture sample ( $R/C$ ) was constant across size classes (Figure 3), which indicated that size selectivity of sampling was nearly the same between marking and recapture. The mark-recapture estimate of lake trout abundance was nearly 400,000 fish in Flathead Lake on 10 March 2008, whether based on pooled samples of all size classes or separate estimates for different size classes (Table 1), which reflects the relatively constant vulnerability to capture of all sizes of lake trout during marking and recapture (Figure 2). Population density for lake trout in Flathead Lake was relatively high, compared to Lake Pend Oreille, Idaho, Wisconsin waters of Lake Superior, and other North American lake trout populations (Figure 4).

**Discussion** – The lake trout population in Flathead Lake is likely near carrying capacity, based on the estimated population density in spring 2008. For example, the lake trout population in eastern Wisconsin waters of Lake Superior (i.e. the Apostle Islands region), when recovered to carrying capacity, was simulated to be at a similar density as in Flathead Lake. In contrast, the lake trout population in Lake Pend Oreille, Idaho was much lower at its peak in autumn 2005, before targeted netting and angling suppressed the population since 2006. In Lake Superior and Lake Pend Oreille, 45% annual fishing mortality was the primary cause of lake trout population declines. In comparison, a harvest of 10,108 lake trout from a population of nearly 400,000 lake trout represents an exploitation rate of only 2.6% in Flathead Lake in 2008.

## References

- Hansen, M. J., N. J. Horner, M. Liter, M. P. Peterson, and M. A. Maiolie. 2008. Dynamics of an increasing lake trout population in Lake Pend Oreille, Idaho, USA. *North American Journal of Fisheries Management* 28:1160–1171.
- Healey, M. C. 1978. The dynamics of exploited lake trout populations and implications for management. *Journal of Wildlife Management* 42:307–328.

- Martin, N. V., and C. H. Olver. 1980. The lake charr, *Salvelinus namaycush*. Pages 205–277 in E. Balon, editor. Charrs: salmonid fishes of the genus *Salvelinus*. Dr W. Junk, The Hague, the Netherlands.
- Nieland, J. L., M. J. Hansen, M. J. Seider, and J. J. Deroba. 2008. Modeling the sustainability of lake trout fisheries in eastern Wisconsin waters of Lake Superior. *Fisheries Research* 94:304–314.
- Piccolo, J. J., W. A. Hubert, and R. A. Whaley. 1993. Standard weight equation for lake trout. *North American Journal of Fisheries Management* 13:401–404.
- Pollock, K. H., J. D. Nichols, C. Brownie, and J. E. Hines. 1990. Statistical inference for capture-recapture experiments. *Wildlife Monographs* 54(1):1–97.
- Ricker, W. E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Bulletin 191 of the Fisheries Research of Canada, Ottawa, Ontario.
- Zar, J. H. 1999. Biostatistical Analysis, Fourth Edition. Prentice Hall, Upper Saddle River, New Jersey.

TABLE 1.—Mark-recapture estimates of abundance (N), 95% confidence limits for N (LL and UL), standard error of N (SE), and coefficient of variation for N (CV) for all size groups and three different size groups of lake trout, based on marking by angling and gill netting from 5 October 2007 through 10 March 2008 and examined for marks during an angling tournament during 3–16 October 2008 in Flathead Lake, Montana.

Group	<i>N</i>	<i>LL(N)</i>	<i>UL(N)</i>	<i>SE(N)</i>	<i>CV(N)</i>
Pooled	393,791	261,867	618,645	82,022	0.208
<50	192,375	106,462	375,943	57,940	0.301
50-65	147,564	83,782	279,982	42,548	0.288
>65	26,024	9,517	62,846	12,990	0.499
Sum	365,962	199,762	718,771	113,478	0.310

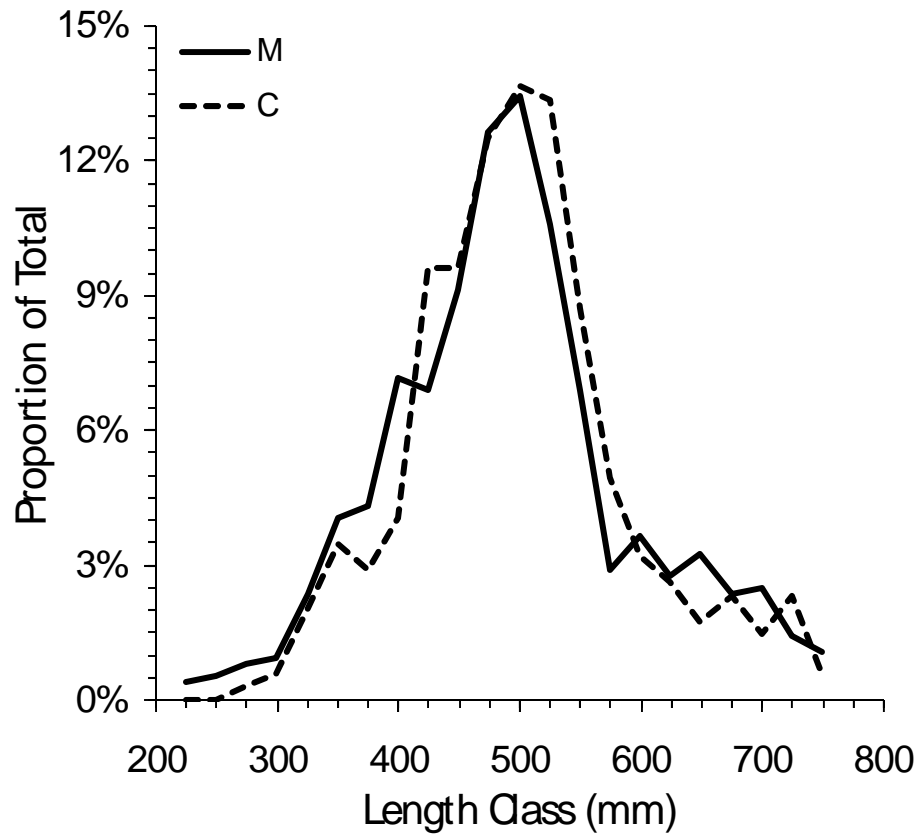


FIGURE 1.—Length-frequency of lake trout captured for marking by angling and gill netting from 5 October 2007 through 10 March 2008 (M) and examined for marks by angling during 3–16 October 2008 (C) in Flathead Lake, Montana.

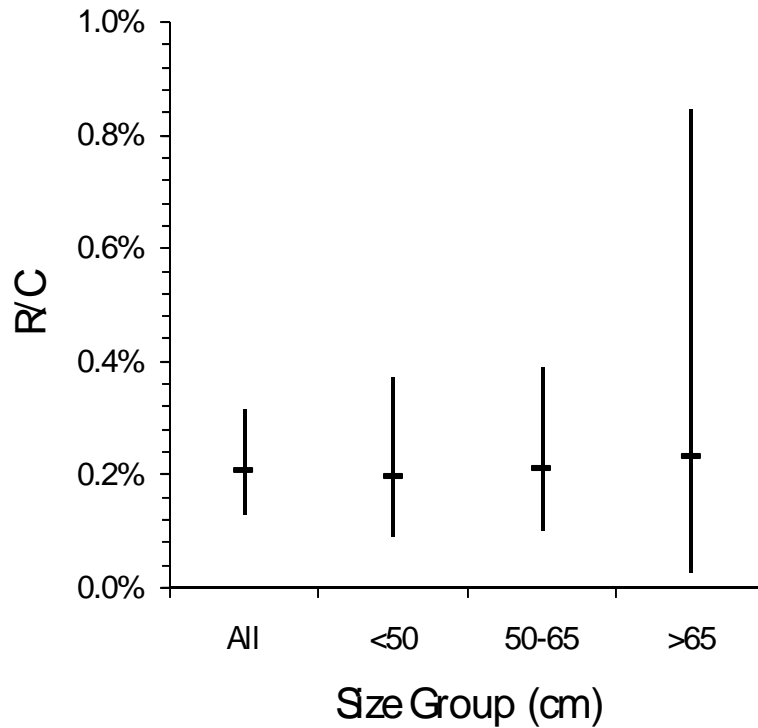


FIGURE 2.—Proportion of marked individuals ( $R$ ) in samples examined for marks ( $C$ ) in an angling tournament for all size groups and three different size groups of lake trout in Flathead Lake, Montana during 3–16 October 2008.

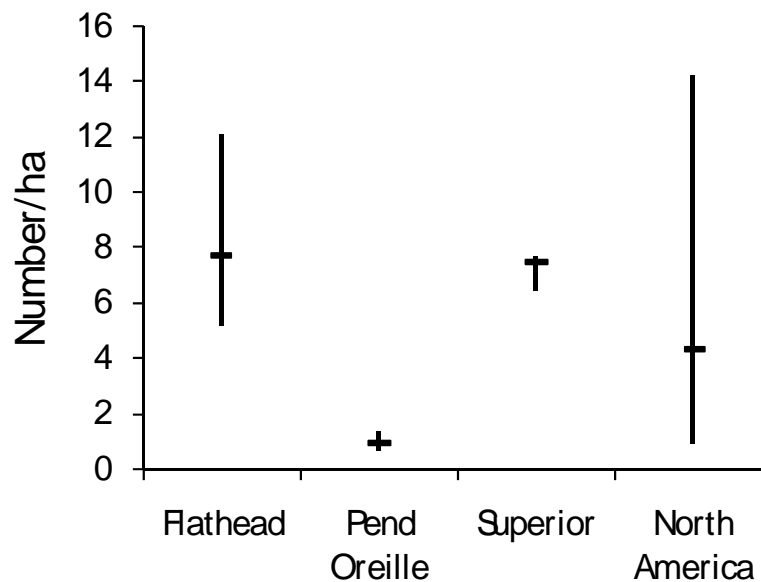


FIGURE 3.—Population density (number/ha) of lake trout in Flathead Lake, Montana, on 10 March 2008 (this study;  $\pm$  95% confidence limits), Lake Pend Oreille, Idaho, on 15 December 2005 (Hansen et al. 2008;  $\pm$  95% confidence limits), eastern Wisconsin waters of Lake Superior at carrying capacity (Nielland et al. 2008;  $\pm$  95% simulation error), and in North American lake trout lakes (Healey 1978; Martin and Olver 1980;  $\pm$  range of estimates).



**WE O: Construct perimeter fence on Adams property**

We decided that the Adams property did not require a perimeter fence because the risk from trespass cattle was too low to warrant the investment at this time.

**WE P: Construct perimeter fence on Bogage property**

We constructed a new fence along the perimeter of the Bogage property (2900 ft in length) to protect this acquisition from trespass cattle (Figure 1). This project will ensure that the habitat quality of this acquisition will not be diminished by unauthorized grazing.



Figure 1. Perimeter fence on Bogage property. The coiled wire hanging from the post is stretched across the Jocko River after peak flows have receded to prevent cattle from entering the property via the river channel.

**WE Q: Construct perimeter fence on Vulles property**

We constructed a new fence along the perimeter of the Vulles property (1,900 feet in length) to protect this acquisition from trespass cattle. This project will ensure that the habitat quality of this acquisition will not be diminished by unauthorized grazing.

**WE R: Remove road on Vulles property**

We have reconsidered the necessity of removing the road and have therefore postponed this project for future consideration.

**WE S: Complete design of passage barrier on Magpie and Seepay creeks**



Magpie Creek and Seepay Creek are two direct third-order tributaries to the lower Flathead River. Both streams maintain perennial flow in their upper reaches, but after spring runoff they infiltrate into stream substrates as they flow across large alluvial fans near their confluences with the Flathead River. Both streams have westslope cutthroat trout *Oncorhynchus clarki lewisi* populations that are threatened by invasion of introduced species, particularly congeneric taxa, from the lower Flathead River. We concluded that the best opportunity for preventing the loss of these populations from hybridization with rainbow trout *O. mykiss* or competitive interactions and replacement by brook trout *Salvelinus fontinalis* is to construct barriers on the streams.

In past years we identified potential barrier locations, developed a scope of work, and hired a contractor to conduct a feasibility study to determine if barriers could be constructed in the downstream ends of the systems. The contractor evaluated our proposed barrier locations, determined that they were suitable for fish barriers, and then undertook conceptual designs of a barrier at one preferred location in each stream. During 2008 we used the conceptual designs and flow modeling to conduct public outreach and complete a NEPA process. We also started work on obtaining necessary permits (ALCO and ACOE) and we met onsite with staff from the Montana Department of Transportation (MDT) because one barrier, which will be constructed at an old highway crossing, will require an encroachment permit from the MDT. In the upcoming year we will work with the contractor to finalize designs. Our goal is to build at least one of the barriers in 2009.

#### **WE T: West Magpie Creek perched culvert removal**

Again in 2008 we were unable to complete coordination with the Tribal Forestry Program to be able to complete this project. The expected implementation date is postponed until August 2009.

#### **WE U: Complete survey of Jocko River westslope cutthroat trout**

We continued work on the study to assess the distribution and amount of hybridization in westslope cutthroat trout (*Oncorhynchus clarki lewis*) populations in the Jocko River drainage. Field work during 2008 consisted of the collection of 895 tissue samples of westslope cutthroat trout with the Jocko River watershed.

#### **WE V: Analyze results of genetic survey of Jocko River**

During 2008 we completed genetic analyses at seven diagnostic variable microsatellite loci and four additional variable microsatellite loci for 882 tissue samples from fish (*Oncorhynchus* spp.) collected in the upper Jocko River from 2005-2007. Tissue samples (median = 29; range = 5-38) were collected from fish at 33 sample locations. We have also begun collection of microsatellite genotypes from 57 migratory *Oncorhynchus* spp. collected during 2007 and 2008 at ladders on two main-stem Jocko River diversions (K-Canal and S-Canal) and on 239 fish collected from five tributaries of the Jocko River. Completion of these analyses is pending. The objectives of this study were to (1)

determine the geographic distribution of hybrid individuals throughout the Jocko River catchment and (2) to determine the population genetic structure of trout in the Jocko River basin. Information from this work will be used to guide WCT management decisions for the drainage. The two most likely sources of rainbow trout (*O. mykiss*) alleles to the upper Jocko River are Liberty Creek, a tributary to the South Fork Jocko River, and dispersers from populations in the lower Jocko River, where RBT and early generation hybrids of RBT and WCT are abundant.

We calculated hybrid index scores (HIS) for each individual as the total number of RBT alleles amplified across seven the diagnostic loci, divided by the total number of alleles amplified for that individual. For each population sample, we calculated the sample frequency of RBT alleles as the total number of RBT alleles detected at a sample location divided by the total number of amplified alleles; thus, scores could range from 0 to 1, with a HIS of 0 indicating that no RBT alleles were detected at the seven diagnostic loci. Hybrids were detected in 28 of 33 sample sites. Of these samples, two (K-Canal and S-Canal) consisted of migratory fish collected at irrigation diversion ladders and one (Demo Reach) consisted of individuals collected in a mixed stock fishery in the main-stem Jocko River. These locations were eliminated from the data set used to assess the population genetic structure of the upper Jocko River basin because they represented special sampling cases where little inference could be made at the population level. While hybrids were detected at most sample locations, the sample frequency of RBT alleles was very low (0.0 – 0.036) at all sites with the exception of Liberty Creek and the Demonstration Reach. As expected, Liberty Creek appears to be a likely source of RBT alleles with a sample frequency of RBT alleles of 0.76. Samples collected at the Demonstration Reach, in the main-stem Jocko River, had an average RBT allele sample frequency of 0.53, confirming that the lower Jocko River system is also a potential source of hybridization for the upper river.

We tested for population genetic structure in 29 of the 33 population samples in the upper Jocko River. Eight of 29 population samples collected in the upper Jocko River were out of Hardy-Weinberg equilibrium (HWE), a test to determine if a population is at genetic equilibrium with respect to mutation, random mating, and natural selection. Based on location in the stream network, there was not a striking geographic pattern to those samples that were out of HWE. In general, adjacent sites had non-significant allele frequency differences. Pairwise  $F_{st}$  values ranged from 0 to 0.29 and mean pairwise  $F_{st}$  was 0.078. Pairwise  $F_{st}$  is a test of population divergence that scales from 0 to 1 where 0 represents two populations with identical allele frequencies and 1 represents two populations with totally divergent allele frequencies. Tests for isolation by distance were significant both within (correlation coefficients ( $r$ ): South Fork Jocko without tributaries = 0.52, North Fork Jocko = 0.75) and among all drainages ( $r$  = 0.51). Isolation by distance (IBD) is an assertion that  $F_{st}$  will increase as fluvial distance between two populations increases. Tributaries to the South Fork Jocko River had exceptionally high pairwise  $F_{st}$  values between geographically proximate sample sites, indicating substantial population structure exists at the tributary level. Tests for IBD, along with tests for allelic differentiation indicate statistically significant population structure at the fork level as well.

As part of ongoing genetic analyses, we are establishing a basin-wide population genetic baseline for the Jocko River system. Such a baseline consists of population samples from all or nearly all of the breeding populations in the Jocko River system. Using this information, we should be able to assign individuals from anywhere in the system to the population they were most likely from. From this baseline, we should also be able to identify fine-scale population genetic structure, which gives us information about relative rates of genetic migration between populations. These data will assist CSKT with making several management decisions regarding enhancement of habitat connections, prioritizing conservation populations, and fish passage management to minimize problems with hybridization.

**WE W: Install pipeline in diversion ditch adjacent to Valley Creek**

We completed this project during 2007 and reported it in the 2007 Annual Report.

**WE X: Write plan for irrigation siphon on Finley Creek**

This project has been dropped from consideration with BPA funding and will be implemented with other funds.

**WE Y: Publish lake trout growth rate article**

Completion of this project was delayed by the acquisition of a large sample of known-age otoliths provided by a collaborator in Michigan. This new information allows the accuracy of the work upon which the article is based to be verified to the highest degree possible. Completion of the article is anticipated in 2009.

**WE AB: Work with Project 200200300 on acquisitions and easements**

In addition to conducting numerous land owner contacts during 2008 for future acquisitions and land protection, we completed negotiations and closed on three properties totaling 210 acres. The properties we protected in 2008 include the acquisition of 33 acres along the Jocko River, 56 acres along Mission Creek, and the easement of 122 acres along Post Creek.

**WE AF: Restore a segment of the Jocko River and floodplain.**

Restoration of the Jocko River channel and floodplain began in 2004 and it will likely require until 2012 to fully meet the Tribe's restoration objectives. BPA funding of this restoration work began in 2008 and was roughly equivalent to five percent of the total project costs. CSKT has succeeded in acquiring much of the riparian lands along the Jocko River, and that combined with the extensive restoration work constitutes a very successful and significant river restoration program. The following description is the full report of the project for activities conducted during 2008.

# JOCKO RIVER DEMONSTRATION REACH PHASE II

## As-built Report

June 2009



### Prepared for:

Confederated Salish and Kootenai Tribes  
Natural Resources Department  
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## Introduction

This document describes restoration work completed as part of the Demonstration Reach Phase II restoration project. The work completed in Phase II is a component of the Confederated Salish and Kootenai Tribes' (Tribes) watershed-scale aquatic restoration efforts in the Jocko Drainage. These efforts reflect the Tribes endeavor to implement the Natural Resources Damage consent decree for mining-related impacts in the Upper Clark Fork River basin. The Tribes have prepared a document titled *The Jocko River Master Plan* (Master Plan) to guide restoration activities in the lower 22 miles of the Jocko River (CSKT, 2009). This segment of the river is an alluvial reach, often with a wide and potentially accessible floodplain. There is extensive overlap between bull trout restoration potential and riparian and wetland restoration potential in the lower river. However, land use impacts have been concentrated in the lower 22 miles of the river, and there are several river sections where natural fluvial processes have been disrupted. In these sections, active restoration is identified as a critical tool to restore fluvial and ecological floodplain processes. The Master Plan outlines the existing condition for the alluvial sections of the river, restoration strategies, and restoration proposals completed to approximately a conceptual level. The Jocko River restoration project, including project goals and objectives, is described in more detail in the Master Plan.

The Demonstration Reach project is located near Arlee, Montana on a reach of stream that was channelized and diked approximately sixty years ago. This area was identified early on as a priority reach for restoration because it was a significant sediment source located near the upstream end of the 22 mile restoration reach identified in the Master Plan. This area was also identified as a restoration priority because stream temperatures are generally suitable year round for all life stages of bull trout. Because the Demonstration Reach project is approximately 2 miles long, it was split into two phases -- Phase I and Phase II. Phase I of the Demonstration Reach restoration project was completed in fall 2004 and various restoration maintenance activities have been completed in the Phase I reach since then. Work completed in the Demonstration Reach prior to 2008 is described in previous reports, and monitoring results are described in the *Demonstration Reach Phase I Monitoring Plan and Report* and associated addendums and River Design Group's *Jocko River Geomorphic Data Summary Report*. Phase II of the Demonstration Reach (described in this report) was implemented during summer and fall 2008. Restoration work included removal of levees, channel reconstruction, installation of grade control structures, installation of temporary bank stabilization structures including bioengineering, incorporation of floodplain microtopography, and floodplain revegetation and seeding. Designs and plans for the Demonstration reach Phase II restoration project are described in *Permit Support Document: Jocko River Demonstration Reach Phase Two* (CSKT 2008) and other internal documents.

Specific objectives of this project include:

- Restore connectivity with the historical floodplain;
- Reduce sediment inputs to the lower watershed;
- Reduce channel width to increase mean depth and improve sediment transport;
- Restore channel length;
- Remove levees;
- Provide fish passage;
- Create conditions that provide cooler water temperatures within the project area;

- Restore riparian and floodplain plant communities and increase floodplain width;
- Provide short-term channel stability as vegetation establishes in the near channel and floodplain environment;
- Improve instream and floodplain habitat diversity and complexity both short-term and long-term;
- Achieve wetland and riparian credits as stipulated in the guiding consent decree; and
- Implement and evaluate a suite of restoration tools that will have applicability for future work in the Jocko River watershed.

To achieve these objectives, the following restoration strategies were implemented during summer and fall 2008:

- Constructed 5,375 feet of C4 stream type (meandering, pool-riffle, gravel bed channel).
- Elevated the channel bed between 1 and 6 feet to restore connection with abandoned meanders and the pre-disturbance floodplain surface.
- Constructed secondary channels to convey portions of flood flows, provide diverse stream macro-habitats in proportions similar to those found in less disturbed sections of the Jocko river and enhance floodplain functions such as flood water retention and sediment storage.
- Constructed cobble and boulder grade control structures to provide short-term channel bed stability in the 5 to 10 years immediately following restoration.
- Constructed log vanes and engineered log jams to provide energy dissipation, reduce short-term lateral channel migration, maintain lateral pools and provide fish habitat.
- Installed streambank bioengineering to provide short-term stability while desired woody vegetation communities establish.
- Installed vegetated sills to provide short-term and long-term stability of constructed point bars.
- Enhanced and restored riparian and floodplain plant communities using a variety of treatments including: mature shrub and sod salvage and transplant, seeding, containerized planting, soil amendments, and diverse floodplain topography.
- Continued an integrated pest management program to suppress weeds and encourage establishment of native riparian vegetation in the floodplain and along the channel.



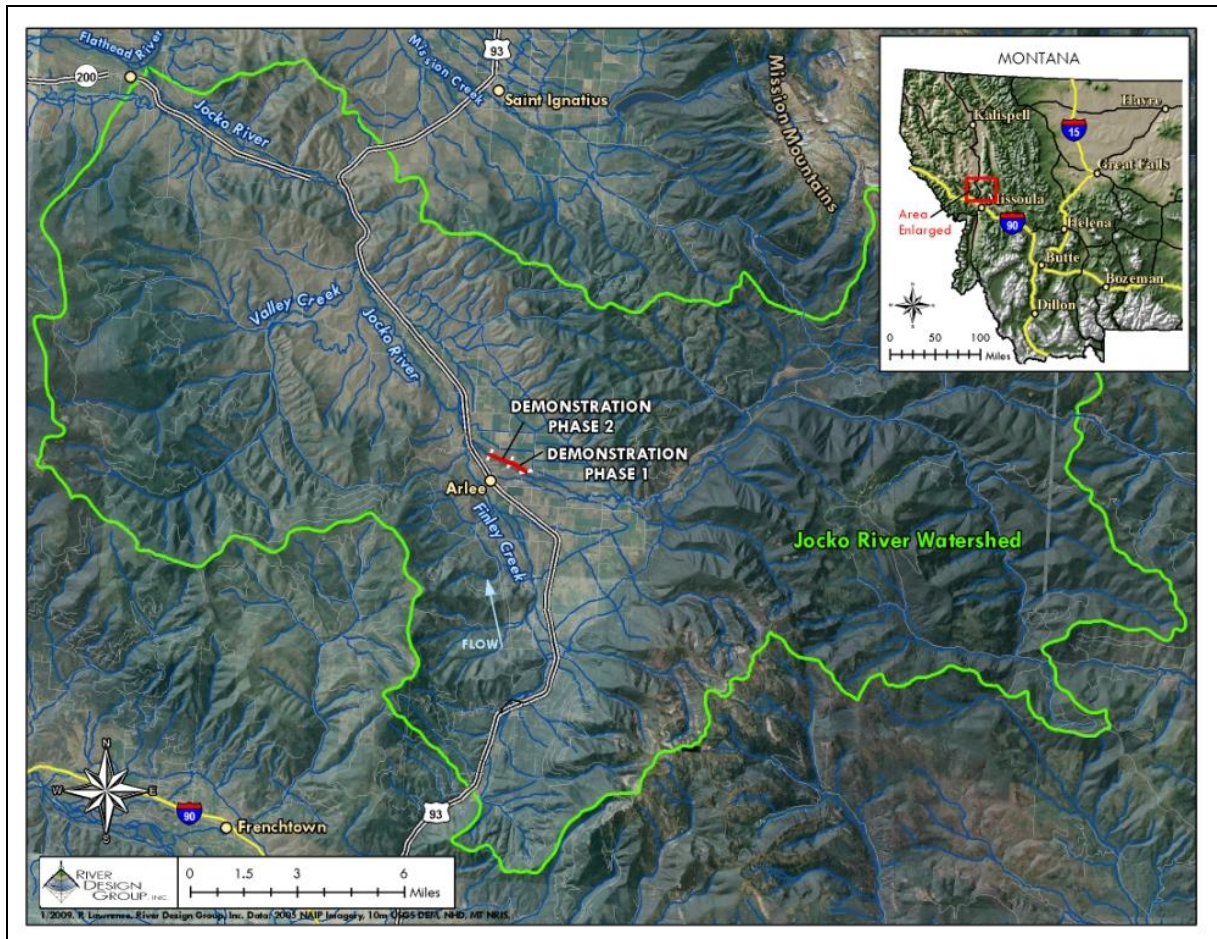
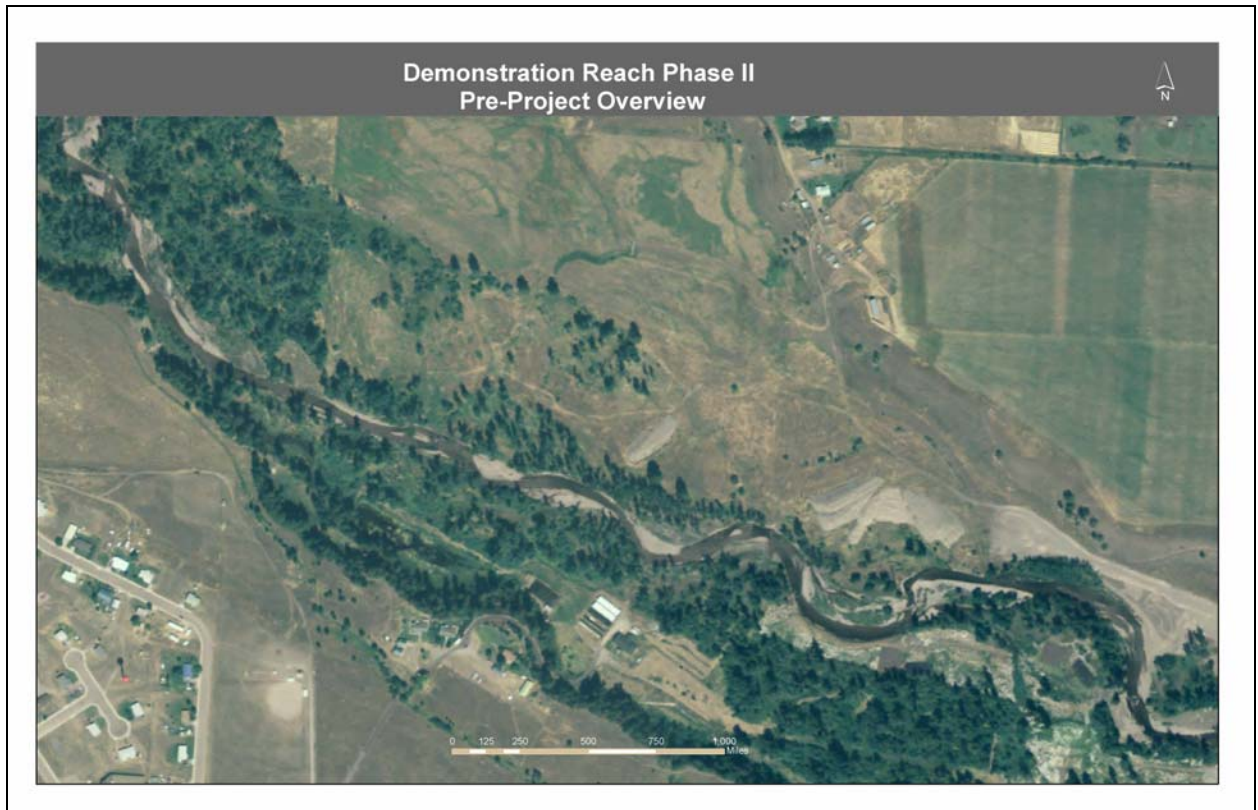


Figure 1. **Demonstration Reach Phase II project area and vicinity.**  
**Restoration Treatment Descriptions**

This section includes descriptions of restoration treatments installed as part of the Jocko River Demonstration Reach Phase II restoration project. Treatment descriptions are organized according to the following categories: channel construction; grade control; bank protection; streambank and floodplain bioengineering; and riparian and wetland plant community enhancement.

### **Channel Construction**

Throughout the Demonstration Reach Phase II project area, the pre-disturbance morphology was reconstructed to achieve project objectives described above. Design dimensions are shown in Table 1. Figure 2 shows a pre-project overview of the channelized and diked river channel. Figure 3 shows the constructed channel center line and stationing superimposed on an aerial photo from late May 2009.



**Figure 2. Figure shows an overview of the Phase II project area prior to channel construction and floodplain revegetation.**



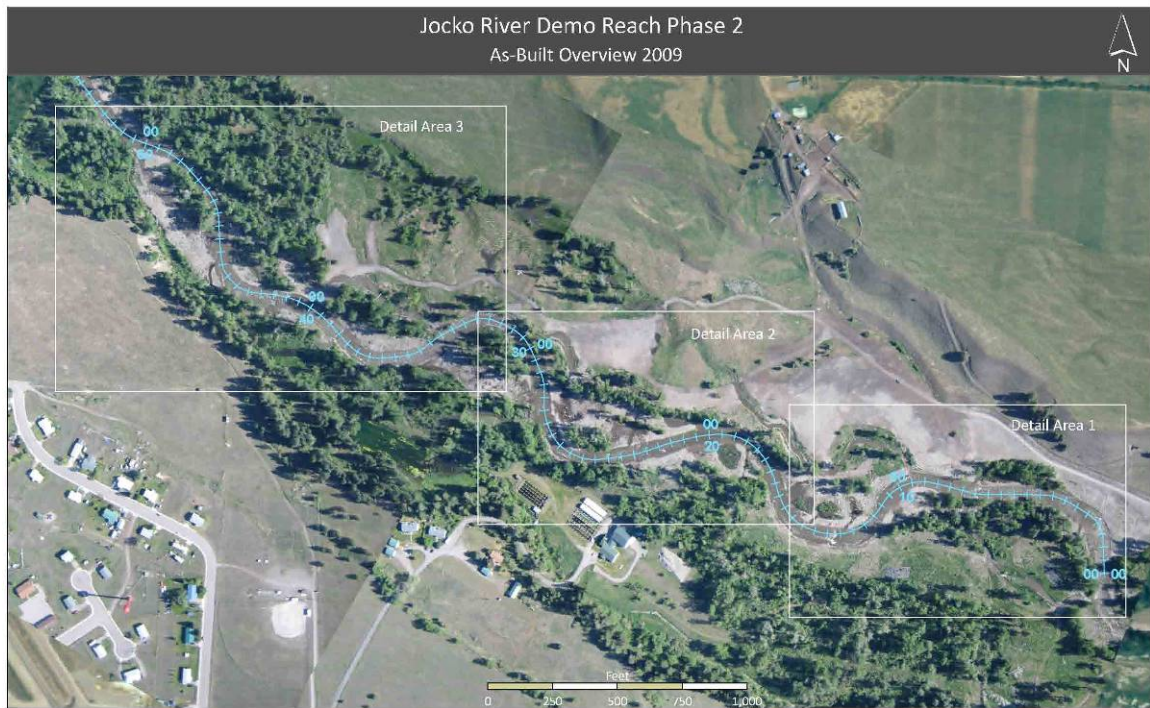


Figure 3. Jocko River Demonstration Reach Phase II reconstructed channel alignment. Detail areas are shown in Figures 16, 17, and 18 below.

Table 1. Bankfull channel design dimensions by feature.

Parameter	Riffle	Pool	Run	Glide
Discharge	650 cfs	650 cfs	650 cfs	650 cfs
Width	60 ft +/- 2 ft	78 ft +/- 6 ft	54 ft +/- 6 ft	72 ft +/- 6 ft
Mean Depth	1.9-2.1 ft	2.0-2.3 ft	2.1-2.6 ft	1.8-2.2 ft
Max. Depth	2.6-3.4 ft	6.0-8.0 ft	3.4-4.6 ft	2.4-3.2 ft
Scour Depth	4.0 ft	8.4 ft	5.0 ft	4.0 ft
XS Area	120 sq ft	168 sq ft	126 sq ft	144 sq ft
Width-Depth Ratio	28-32	31-42	18-29	30-42

In addition to the main channel, secondary channels (approximately 20-40 ft wide and 0.5 to 1.5 ft deep) were constructed in the floodplain to convey portions of flows at various higher discharge levels. Different secondary channels were designed to convey flows at different discharge levels. Figure 4 shows the Jocko River before and after channel reconstruction. The “after” photo shows secondary channels flowing during high water in late May 2009.



**Figure 4. Aerial photo of the Jocko River through the Demonstration Reach Phase II project area prior to channel re-construction (left) and after channel reconstruction (right). In the post-construction photo, secondary channels are visible in the floodplain.**

## **Grade Control**

Because construction equipment is not able to establish a channel configuration and sorting in the same manner as a natural fluvial system, the raw, post-construction condition of the river following construction would not be sustainable without temporary measures that provide interim protection of constructed features. Grade control structures are intended to maintain the channel bed elevation during the first few years after construction while natural channel bed sorting and armoring processes begin functioning. Two kinds of grade control structures were installed as part of the project. Submerged boulder energy dissipaters were installed to reduce flow energy approaching meanders and concentrate flow into pools. Submerged boulder grade control structures were installed to increase roughness, maintain the channel bed elevation at top of riffle locations and maintain connection to the floodplain along straighter reaches between meanders.

### **Submerged Boulder Energy Dissipaters**

Eleven submerged boulder energy dissipaters were installed along approximately 550 feet of channel bed as part of the Demonstration Reach Phase II restoration project. The intent of the submerged boulder energy dissipater is to maintain the grade at the transition between riffle and run features, reduce flow energy in meanders and concentrate flow into pools. A matrix of large, irregularly-placed boulders forms the backbone of the structure. Gaps between boulders are filled with smaller, mobile cobble, thus maintaining bedload transport through the structure. The structure is designed to provide interim stream bed grade control in run features until natural armoring/sorting processes develop and control long-term vertical stability. Pools typically form downstream of the structure. The structure is designed to be natural in appearance and shall be submerged at all flow levels. It should have no abrupt effect on the water surface profile and maintains fish passage at all flow levels. Figure 5 shows a submerged boulder energy dissipater during project construction.

### **Submerged Boulder Grade Control**

Thirteen submerged boulder grade control structures were installed along approximately 930 feet of channel bed as part of the Demonstration Reach Phase II restoration project. The intent of the submerged boulder/cobble grade control structure is to ensure that flood waters access the floodplain at or near the design bankfull discharge and fish passage is maintained. The structure is designed to maintain interim streambed grade control in riffle, run and glide features until natural armoring/sorting processes develop and control long-term vertical stability. The structure is similar in appearance to the submerged boulder energy dissipater, but is typically constructed over a longer length of channel.





**Figure 5. Submerged boulder energy dissipater during construction**  
**Bank Protection**

Bank protection treatments are intended to limit lateral channel movement during the first 10 to 15 years after the restoration project has been completed. Bank protection treatments include engineered log jams and log vanes (described below) and are combined with streambank bioengineering and grade control treatments as a way to provide short term bank protection while woody vegetation becomes established on banks. These structures also provide aquatic habitat in the form of cover and pools, although this is not their primary purpose.

### **Engineered log jams**

Nineteen engineered log jams were installed on meander bends to provide temporary bank stabilization by reducing near-bank stress and redirecting flow away from the bank. Engineered log jams were installed in association with bioengineering structures (described below) and other grade control and bank stabilizing structures. These structures were placed in pool features and each extends approximately 20 feet along the bank and 5-10 feet into the channel. Over time, these structures will degrade and the bank protection function will be replaced by native woody vegetation. Figure 6 shows an example of an engineered log jam installed as part of the Demonstration Reach Phase II restoration project.



Figure 6. **Engineered log jam tied in with streambank bioengineering.**

### **Log vanes**

Fifteen log vanes were installed at run-pool or riffle-run transitions with the intent of providing bank protection by reducing near-bank stress and redirecting flow away from the bank and into engineered log jams. These structures also function to dissipate energy because they typically form a scour pool on their downstream side. Log vanes are set low in the water to minimize abrupt affects on the water surface. They extend approximately 20 feet into the channel, leaving about 60 percent of the channel unobstructed for bedload transport and recreational passage. Figure 7 shows an example of a log vane installed at the Demonstration Reach phase II project.





Figure 7. **Log vane after channel construction.**

### **Streambank and Floodplain Bioengineering**

Five bioengineering treatments were installed within the Demonstration Reach Phase II project area (Table 2). Bioengineering treatments integrate living vegetation with natural, structural materials such as logs, rocks and natural fiber fabric to create stable areas where mature vegetation can become established. Table 2 provides a summary of bioengineering treatment lengths and each treatment is described below. Figures 16, 17 and 18 at the end of this document show locations of bioengineering treatments in the project area.

Table 2. **Summary of bioengineering treatment lengths within the Demonstration Reach Phase II.**

<b>Treatment</b>	<b>Total Feet of Treated Streambank</b>
Vegetated Soil Lift	2,850
Wrapped Coir Log	2,260
Anchored Coir Log	540
Brush Trench	120
Floodplain sill	40

#### **Vegetated Soil Lift**

Vegetated soil lifts were installed along outer meander bends to promote the establishment of woody vegetation that will provide bank roughness, contribute to

aquatic habitat, and help sustain balanced channel morphology over time. All vegetated soil lifts were constructed with cobble and wood toes to prevent scour and slumping in the short term while vegetation becomes established. Willow cuttings were installed between lifts and in some locations under the bottom lift and above the top lift where conditions appeared conducive to willow growth. A combination of four pound per cubic foot density, ten foot by twelve inch diameter coir wattles, aspen excelsior logs, and seven pound per cubic foot density, ten foot by twelve inch diameter coir logs were used to face the vegetated soil lifts. In some locations, containerized plants, primarily sandbar willow (*Salix exigua*) and black cottonwood (*Populus balsamifera*) were installed behind and on top of structures. Plants were installed using the Stinger attachment mounted on an excavator to allow planting through woven coir fabric. Figure 8 shows a typical vegetation soil lift sequence in the project area.



**Figure 8. Photograph showing a typical vegetated soil lift sequence on an outer meander bend. Vegetated soil lifts were installed in conjunction with other bank protection treatments such as engineered log jams.**

### **Wrapped Coir Log**

Wrapped coir logs were installed along riffle-run features to provide temporary protection and retain moisture along cobble dominated channel margins while native woody vegetation with deep binding root mass develops. Wrapped coir logs were installed primarily along the banks of the new channel at the upstream and downstream ends of abandoned sections of the channel. Wrapped coir logs were installed using nine pound per cubic foot density, ten foot by sixteen or twelve inch diameter coir logs and wrapped with a single layer of woven coir fabric. The coir logs were placed on narrow cobble benches that sloped away from the channel. Various plant materials were incorporated in wrapped coir log structures including stinger installed container plants (cottonwoods and willows) and willow cuttings placed both vertically and horizontally. Figure 9 shows a wrapped coir log installation within the project area.





Figure 9. **Completed wrapped coir log with vertically installed willow cuttings.**

### **Anchored Coir Log**

Anchored coir logs were installed along riffle-run sections to provide temporary protection and retain moisture along cobble dominated channel margins while native woody vegetation with deep binding root mass develops. Anchored coir logs were constructed on cobble benches using nine pound per cubic foot density sixteen or twelve inch diameter, ten foot long coir logs. Coir logs were secured in place using duckbill earth anchors and wire cable. Both single and double layer anchored coir logs were constructed. Willow cuttings were installed vertically behind and between the coir logs. Figure 10 shows an anchored coir log installation within the project area.



Figure 10. **Photograph shows double layer anchored coir log tying into existing vegetation at the downstream end (at photo right).**

### **Brush Trench**

Brush trenches were installed in some areas at the transition between riffles and point bar features to provide roughness on newly constructed floodplain surfaces. Brush trenches are intended to establish woody vegetation that will provide seed sources, habitat and other riparian function such as trapping of fine sediment. This treatment encourages



plant community succession on newly constructed floodplain surfaces. This treatment includes excavating a trench parallel to the channel approximately to the depth of baseflow or slightly lower. Willow cuttings, woody debris and low density coir logs are placed in the trench and the trench is back-filled with alluvium. Willow cuttings placed in the trench extend between 1 and 3 feet beyond the finished grade surface. Figure 11 shows a brush trench constructed in the project area.



**Figure 11. Brush trench incorporates woody debris, willow cuttings and mature plant material to create floodplain roughness and microsites for woody vegetation establishment.**

### **Vegetated Sill**

Vegetated sills are similar to brush trenches, except they are constructed perpendicular to the channel rather than parallel along the channel. Vegetated sills were constructed in the newly constructed floodplain along one riffle feature in the project reach.

### **Other Revegetation Activities**

In addition to bioengineering, other revegetation treatments focused on preserving existing vegetation, establishing new vegetation, and creating conditions where natural vegetation recruitment could occur. These treatments are described below and Figures 16, 17 and 18 at the end of this document show locations of revegetation treatments in the project area.

### **Existing Shrub and Tree Preservation**

Several islands of existing shrubs and trees (primarily willows and cottonwoods) were preserved within point bar and floodplain features (Figure 12). Most of this vegetation had become established during the five years prior to this project, mostly in response to the elimination of livestock grazing from the project area. These preservation areas were left at the lower pre-project floodplain elevation, and in some cases soil fill material was added around the edges to create surfaces at an appropriate elevation where willows and cottonwoods could become established and expand these areas. Where possible, the floodplain was shaped to allow surface water to drain from these areas, limiting ponding

that might cause young cottonwoods and willows to drown. Over time, these areas are expected to fill with sediment to match the surrounding floodplain elevation.



Figure 12. **Vegetation preservation area within the constructed floodplain.**

### **Floodplain microtopography**

Floodplain microtopography included construction of swales features, placement of woody debris and leaving finished surfaces with undulating topography (Figure 13). Swale features were incorporated into all constructed floodplain surfaces and were generally perpendicular to the channel and with the following approximate dimensions: 25 feet long, eight to ten feet wide, 3:1 side slopes, and bottom elevation at baseflow or slightly above (approximately two feet below bankfull). Swales are irregularly shaped to mimic natural depressions. Small to large diameter woody debris was placed in swales and on or partially buried in the floodplain surface. Rough graded floodplain surfaces vary between 0.5 feet above and 0.5 feet below the design floodplain surface elevation. Topsoil was placed on some constructed floodplain surfaces, primarily outer meanders and some filled sections of abandoned channel to facilitate seed establishment.



Figure 13. Floodplain microtopography including swales, woody debris and a rough, finished surface.

#### **Containerized planting (stinger)**

In some areas, particularly behind bioengineering structures, containerized, native woody plants were installed using an excavator-mounted stinger attachment. Species planted included cottonwoods, willows and other riparian shrubs. Figure 14 shows stinger plantings behind a wrapped coir log.





Figure 14. **Stinger planted riparian tree and shrub seedlings behind a wrapped coir log.**

### **Seeding**

Newly constructed floodplain surfaces and other construction related bare surfaces were seeded in spring 2009. Seed mixes are shown in Table 3. Figure 15 shows seeding areas.

Table 3. Seed mixes applied at the Demonstration Reach Phase II in spring 2009.

Scientific Name	Common Name	Seeding Areas
<b>River Low Terrace Mix:</b>		
<i>Bromus marginatus</i>	mountain brome	Demo Reach FP-E
<i>Elymus canadensis</i>	Canada wildrye	Demo Reach FP-F1
<i>Elymus lanceolatus ssp. psammophilus</i> Sodar	streambank wheatgrass	Demo Reach FP-G
<i>Elymus trachycaulus</i> Revenue	slender wheatgrass	Demo Reach FP-J
<i>Pseudoroegneria spicata</i> Goldar	bluebunch wheatgrass	Demo Reach FP-K
		Demo Reach FP-L
		Demo Reach FP-M
<b>30 acres</b>		Demo Reach FP-1

<b>River Floodplain Mix:</b>		
<i>Elymus canadensis</i>	Canada wildrye	Demo Reach FP-A
<i>Elymus lanceolatus ssp. psammophilus</i> Sodar	streambank wheatgrass	Demo Reach FP-B
<i>Glyceria grandis</i>	America mannagrass	Demo Reach FP-C
<i>Carex nebraskensis</i>	Nebraska sedge	Demo Reach FP-D
<i>Carex stipata</i>	sawbeak sedge	Demo Reach FP-F
<i>Juncus balticus</i>	Baltic rush	Demo Reach FP-H
<i>Carex microptera</i>	small winged sedge	Demo Reach FP-I
		Demo Reach FP-N
		Demo Reach FP-O
<b>25 acres</b>		Demo Reach FP-P

<b>Upland Mix #1:</b>		
<i>Bromus marginatus</i>	mountain brome	Demo Reach FP-2 Demo Reach FP-4
<i>Elymus lanceolatus ssp. lanceolatus</i> Bannock	thickspike wheatgrass	
<i>Elymus trachycaulus</i>	slender wheatgrass	
<i>Festuca idahoensis</i>	Idaho fescue	
<i>Poa sandbergii</i>	Sandberg bluegrass	
<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	
<b>20 acres</b>		

<b>Upland Mix #2:</b>		
<i>Bromus marginatus</i>	mountain brome	Demo Reach FP-2 Demo Reach FP-4
<i>Elymus trachycaulus</i>	slender wheatgrass	
<i>Triticum aestivum x Secale cereale</i>	triticale	
<b>60 acres</b>		

<b>Triticale:</b>		
<i>Triticum aestivum x Secale cereale</i>	Quickguard' triticale	
<b>20 acres</b>		

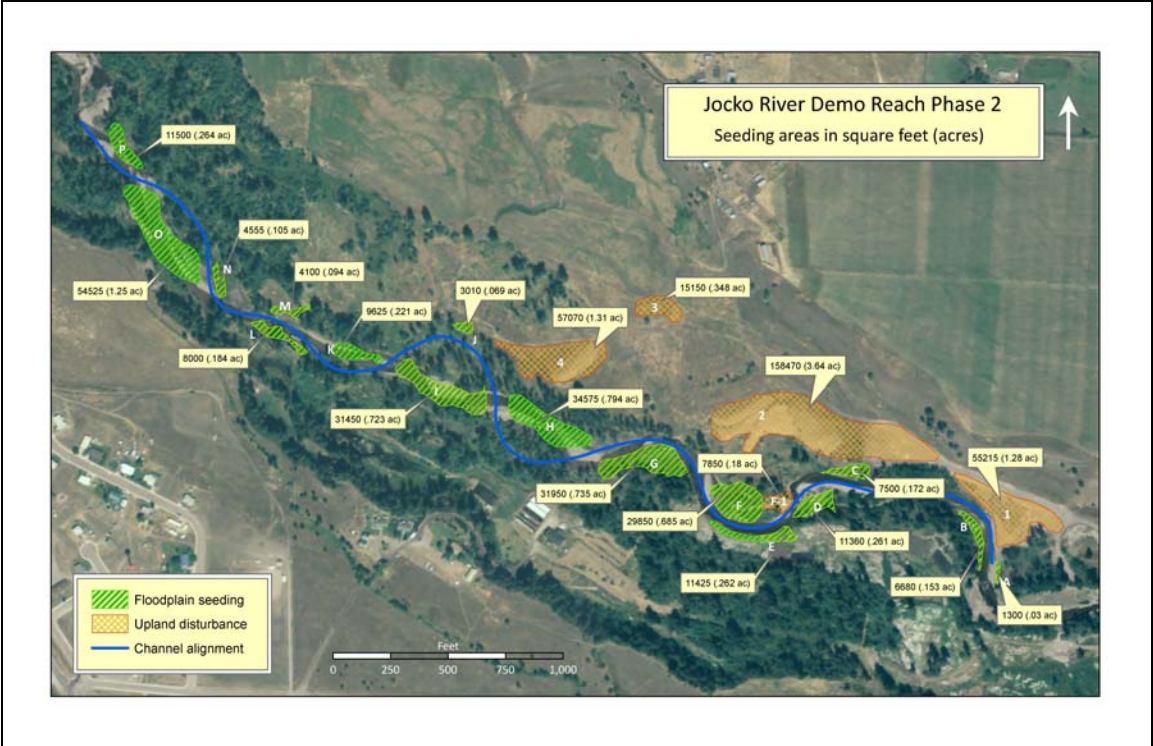


Figure 15. Seeding locations within the Demonstration Reach Phase II. Table 3 shows the various seed mixes used within the labeled seeding areas.



Figure 16. Detail figure of as-built conditions at the upstream end of the Demonstration Reach Phase II.





Figure 17. Detail figure of as-built conditions in the middle section of the Demonstration Reach Phase II.



Figure 18. Detail figure of as-built conditions at the downstream section of the Demonstration Reach Phase II.

Maintenance and monitoring will begin in summer 2009 according to methods described in the Jocko River Master Plan. Baseline geomorphic data was collected immediately after project completion in fall 2009. Figure 19 shows the locations of geomorphic monitoring. Details of the geomorphic monitoring effort are in Appendix C of the *Geomorphic Data Summary Report—Jocko River near Arlee Montana* (River Design Group 2009).



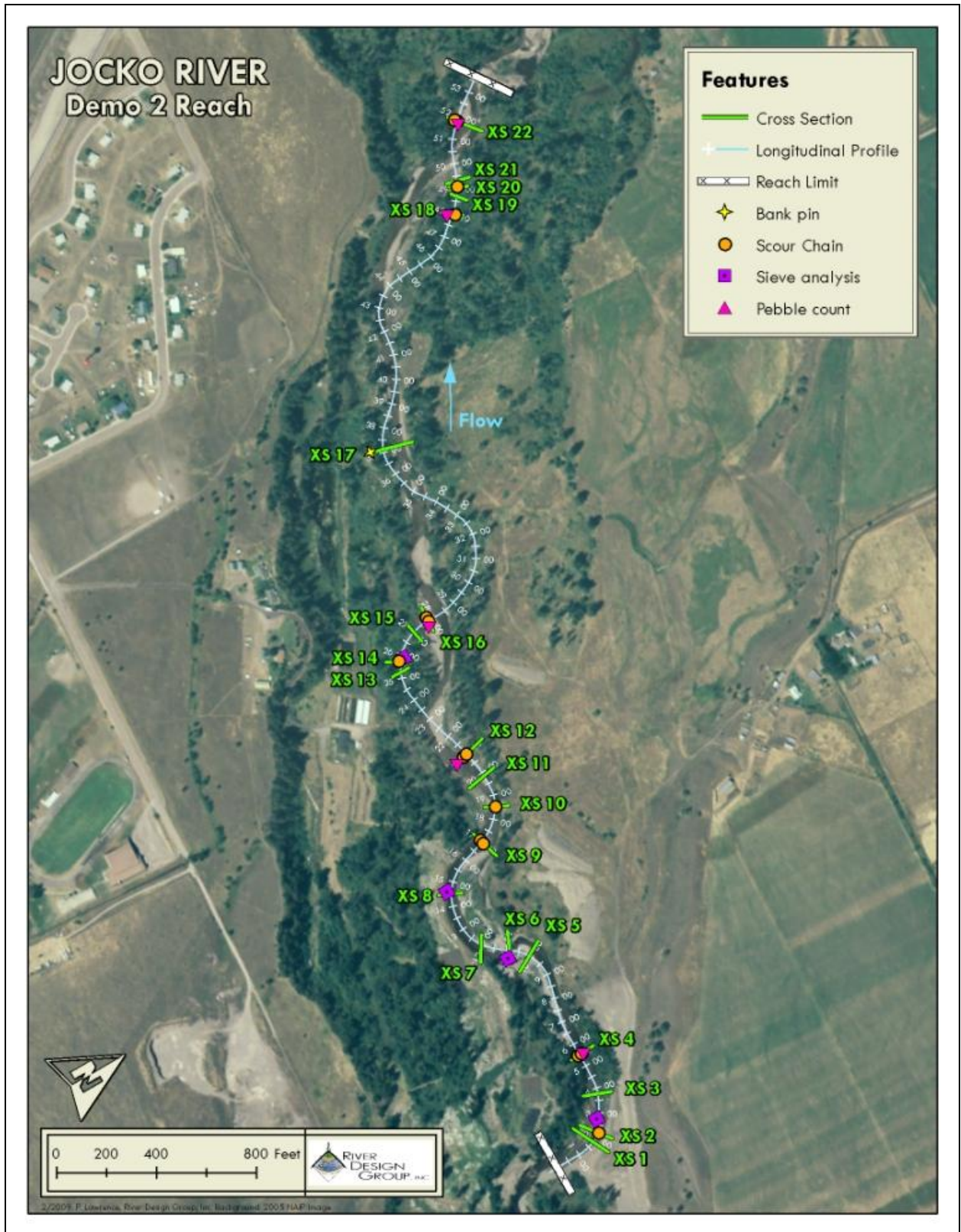


Figure 19. Figure depicting the locations of geomorphic monitoring points along the Jocko River in the Demonstration Reach Phase II.

## **References**

CSKT. 2006. Jocko River Demonstration Reach Phase I Monitoring Plan and Report. Confederated Salish and Kootenai Tribes, Natural Resources Department, Pablo, MT.

CSKT. 2008. Permit Support Document: Jocko River Demonstration Reach Phase Two. Confederated Salish and Kootenai Tribes, Natural Resources Department, Pablo, MT. Prepared by CSKT, Geum Environmental Consulting, Inc., River Design Group, Inc., WestWater Consultants, Inc.

CSKT. March 2009. Jocko River Master Plan. Confederated Salish and Kootenai Tribes, Natural Resources Department, Pablo, MT. Prepared by CSKT, Geum Environmental Consulting, Inc., River Design Group, Inc., WestWater Consultants, Inc.

River Design Group, Inc. 2009. Jocko River Geomorphic Data Summary Report. River Design Group, Inc, Whitefish, MT.

### **WE AG: Remove fish passage barrier in Dayton Creek.**

We did not complete this project during 2008 because the owner of this private road and culvert continues to vacillate over whether or not he can adjust his operation to the changes we are proposing. We will continue to work with the landowner to resolve this issue.

### **WE AF: Initiate process for writing a plan to treat 15 creeks with piscicide**

We began the process of writing an Environmental Assessment to address the use of piscicides on the Flathead Indian Reservation. There are 15 known candidate streams for treatment based on quantified threats to populations of westslope cutthroat trout. This document will resolve issues raised by the public and address general issues associated with the use of piscicides. Additional and more specific documentation will be required for each individual stream project.

### **WE AJ: Construct barrier to non-native brook trout in Skidoo Creek**

Skidoo Creek is a tributary to Flathead Lake that supports a population of purestrain westslope cutthroat trout that are being competitively excluded by brook trout. We currently plan to remove brook trout from Skidoo Creek in 2010 to save the westslope cutthroat population. In order to ensure that brook trout cannot recolonize Skidoo Creek by immigrating from Flathead Lake, we constructed a passage barrier in the stream in 2008 (Figure 1). The barrier is located about 600 feet upstream from Flathead Lake, and consists of a 32" drop onto a flat, outslipping rock surface. Completion of this project was a necessary prerequisite to the treatment project planned for 2010.



Figure 1. Constructed passage barrier near the mouth of Skidoo Creek, 2008.