RESEARCH NEEDS

MONITORING ACTION

The Forest Planning staff will maintain a list of research needs. The initial list of approved research needs appears in the Forest Plan (pages II-15, 16). As additional research needs are identified, they will be added to this list.

Item No. 24: Research Needs

Frequency of Measurement: Annual
Reporting Period: Five Years

FINDINGS

Lolo Pass Redevelopment Project: composed of multiple studies including, Impact of Hwy 12 on Fishers and Evaluating Wolverine and Lynx movements: USDA FS, Rocky Mountain Research Station: 2000-2005. Data is being collected to help understand populations, home ranges and movement patterns of fishers, wolverines and lynx in relation to the highway and other landscape features. The Selway-Bitterroot Wilderness is part of this study area. Contact: Mike K. Schwartz (406) 542-4161

Temperature Monitoring for Fish Bearing Streams*:* Clearwater National Forest: 1999-2005. Monitoring provides year-round temperature data on creeks within the S-BW to determine if the streams meet Cold Water Biota Standards. Streams monitored include Upper Storm Creek, North and South Forks of Storm Creek, and Maude were started for testing in 2002 and will go through 2005. Big Sand Creek had data collected in 1998, 1999, 2003 and will go through 2004. Dan, Fern, Pedro and Wind Lakes Creeks were collected from 1998 through 2003. Wag, Queen, Tom Beal, Dodge, Upper Warm Springs, and Hungry Creeks were started in 2003 and will continue through 2007. This monitoring information can be reviewed in the annual Clearwater NF Monitoring Plan. Contact: Pat Murphy (208) 476-4541

Idaho Department of Fish & Game (IDFG) surveys high mountain lakes on the Forest for location, size, depth, and fish/amphibian data. IDFG has a Fisheries Management Plan started in 2001 through 2006, and can be obtained from the Fisheries Bureau Headquarters in Boise, ID at (208) 334-3791.

IDFG also tagged Bull Trout last summer 2003 in the Lochsa River to see where the fish go to spawn. They were found in SBW locations. For more information, you can call Dan Schiff at IDFG in Lewiston as the primary contact at 208-799-5010.

Riparian Areas

Goal

Manage riparian areas under the principles of multiple use as areas of special consideration for distinctive values. Integrate riparian management with the management of adjacent areas to ensure the protection of the water resource and other dependent resources.

Strategy

Evaluate on-site and cumulative effects of proposed actions, resolving conflicts in favor of riparian-dependent resources. Define and identify riparian areas and their values. Develop direction and techniques to protect or enhance these values.

Item No. 10 Riparian Area Condition

Frequency of Measurement: Annual
Reporting Period: Five Years

Monitoring Action

Riparian monitoring stations have been established to determine baseline and current riparian conditions and also to determine the effects of road construction, timber harvest, site preparation and grazing.

Accomplishments/Findings

Baseline or current conditions, including channel characteristics, are monitored annually on several streams. This monitoring is repeated on a three to five-year cycle to determine trend in channel condition. Permanent channel cross sections are established in which gradient (channel slope), instream sediment concentration, channel substrate (rock size) composition and photo points are established. Channel type and stability are determined for each of the streams. An attempt is made to associate cause with effect when conditions do not appear as natural. Beginning in 2000 and continuing into 2002, much of the scheduled riparian monitoring could not be done due to inadequate funding for Forest Plan monitoring.

Instream sediment was analyzed using the Wolman pebble count technique. (A Wolman pebble count classifies the size of stream substrate.) Channel cross-sections were measured to determine changes in deposition (sediment deposits) or scour (removal of channel rock) over time.

In 2003, the Forest measured channel geometry and instream sediment at 13 streams across the Forest. Data collected at each site may be obtained by contacting the Forest Hydrologist at the Supervisor's Office.

Table 1. Channel Morphology Sites – 2003.

Basin	Stream	Beneficial Use	Activities	Year(s) Data Collected
Palouse River (17060108)				
Lochsa River (17060303)	Boulder Creek (Tributary)	Steelhead, Cutthroat, Brook trout	Baseline	1989, 1992, 1994, 1999, 2003
	Warm Springs Creek	Steelhead, Cutthroat trout	Baseline	1989, 1995, 2003
	Weir Creek	Steelhead, Cutthroat trout	Baseline	1989, 2003
	Postoffice Creek	Steelhead, Cutthroat, Bull trout	Road Obliteration	1989, 1997, 1998, 2003
	Badger Creek (below Trib CC)	Steelhead, Cutthroat, Bull trout	Road Obliteration	1989, 1994, 2001, 2002, 2003

Basin	Stream	Beneficial Use	Activities	Year(s) Data Collected
	Badger Creek (above Trib CC)	Steelhead, Cutthroat, Bull trout	Baseline	2001, 2002, 2003
	Badger Creek Trib CC	Steelhead, Cutthroat, Bull trout	Road Obliteration	2001, 2002, 2003
Clearwater River (17060306)				
Upper North Fork Clear-water River (17060307)	Upper North Fork Clear-water River (Above Long Creek)	Rainbow, Cutthroat, Bull trout, Mountain Whitefish	Baseline	1990, 1998, 2003
	Elizabeth Creek	Cutthroat, Brook trout	Baseline	1989, 1992, 1996, 2003
	Lake Creek	Rainbow, Cutthroat trout, Moun-tain Whitefish	Timber Harvest	1989, 2003
	4th of July Creek	Cutthroat Trout	Baseline	1988, 2003
	Weitas Creek	Kokanee, Rainbow, Cutthroat, Bull trout	Baseline	1990, 1998, 2003
	Hemlock Creek	Kokanee, Rainbow, Cutthroat	Baseline	1990, 1998, 2003

Table 2. Summary of Wolman Pebble Count Data Collected in 2003. Channel type, gradient, percent fine sediment, D50 (mean particle size), and D84 (two standard deviation from mean).

Stream	Channel Type	Gradient %	% Fines[1] 0-2mm	% Fines[2] 0-4mm	D50 in mm[3]	D84 in mm[4]
Boulder Creek (Trib of Lochsa)	A2/A3	4.1	3.2	3.4	256 (Large Cobble or Small Boulder)	866 (Medium Boulder)
Warm Springs Creek	B2	2.4	5.6	6.3	271 (Small Boulder)	489 (Small Boulder)
Weir Creek	A2	5.7	10.4	13.9	169 (Large Cobble)	465 (Small Boulder)
Postoffice Creek	B3	2.4	12.1	14.0	94 (Small Cobble)	350 (Small Boulder)
Badger Creek (below Trib CC)	A4	5.2	20.7	25.9	28 (Coarse Gravel)	128 (Large Cobble)
Badger Creek (above Trib CC)	B4	3.2	12.9	16.9	31 (Coarse Gravel)	108 (Small Cobble)
Badger Creek Trib CC	A4/A5	7.4	45.6	47.1	8 (Fine Gravel)	149 (Large Cobble)
Upper North Fork Clearwater River (Above Long Creek)	C3	1.4	4.8	4.9	125 (Large Cobble)	241 (Large Cobble)
Elizabeth Creek	A3	8.0	10.3	11.3	111 (Small Cobble)	333 (Small Boulder)
Lake Creek	B3	2.7	5.9	6.5	121 (Small Cobble)	256 (Small Boulder)
4th of July Creek	B3c	1.6	3.3	5.0	152 (Large Cobble)	441 (Small Boulder)
Weitas Creek	B3a	1.4	5.1	5.5	192 (Large Cobble)	528 (Medium Boulder)
Hemlock Creek	B3	2.8	8.3	9.0	115 (Small Cobble)	384 (Small Boulder)

SUBSTRATE MONITORING IN THE LOCHSA RIVER SUB-BASIN

Boulder Creek (Lochsa River Tributary): Wolman pebble count information was collected in Boulder Creek in 1989, 1992, 1994, 1999, and 2003. A complete channel survey was done in 1993.[5] The pebble count data has been collected in Reach BO-19, the lowest reach in the watershed.[6] The channel type is an A2/A3

[1] Clay, silt, and sand.

[2] Clay, silt, sand, and very fine gravel.

[3] The mean particle size. The stream classification is based on the D50.

[4] The diameter that is equal to 84% of the bed particles. The choice of 84% value is arbitrary; it is two standard deviations larger than the mean size, assuming a normal distribution. Experience has shown that particles larger than the median size play an important role in flow resistance, and therefore a singel parameter to describe bed particle size should be some size larger than the median.

[5] Clearwater BioStudies, Inc., Canby, Oregon. Habitat Conditions and Salmonid Abundance in Boulder and Huckleberry Creeks, Lochsa Ranger District, Summer 1993. February 1994.

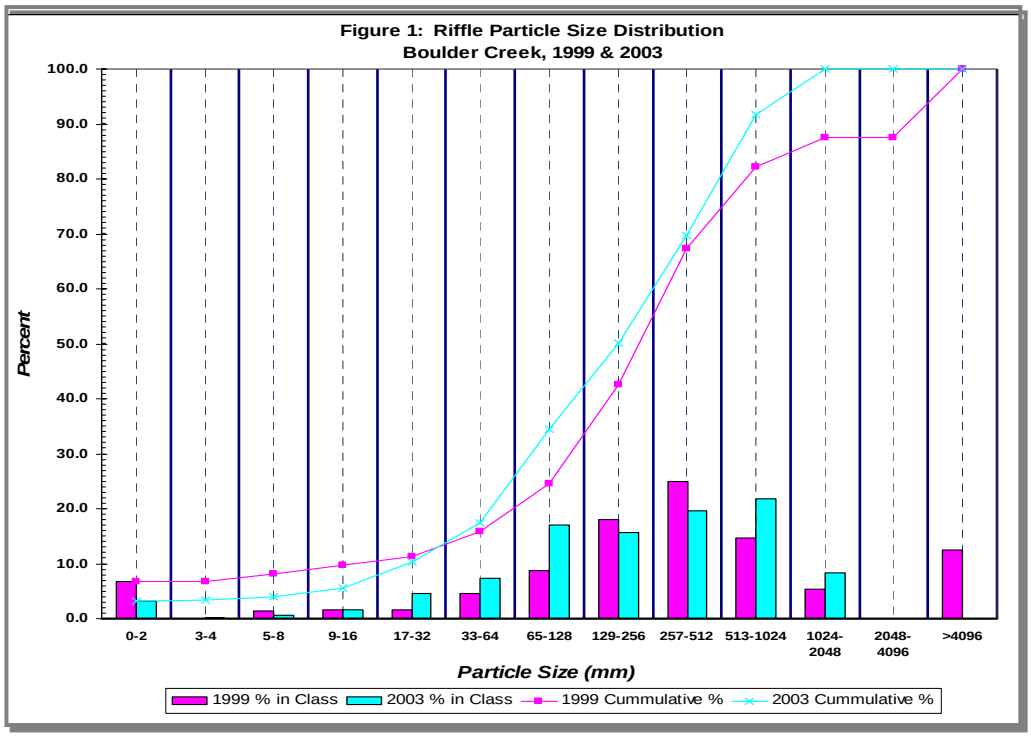
[6] The 1994 measurement was done above Surprise Creek, Reach BO-11.

(steep gradient, confined, boulder/cobble substrate stream) with a gradient of 4.1 percent. Bank stability was measured at 5.0 (no bank erosion) and cobble embeddedness was 14 percent. Boulder Creek is located within the Selway-Bitterroot Wilderness and is not roaded or logged. In 1999, higher levels of sand and boulders were measured with less gravel and cobble (see figure below). These channel changes may have been associated with the 1995-97 floods, with recovery occurring by the 2003 survey.

Table 3. Boulder Creek Wolman Pebble Count Data; 1989 – 2003.

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
1989	2.1	2.8	226 (Large Cobble)	482 (Small Boulder)
1992	3.4	4.8	159 (Large Cobble)	489 (Small Boulder)
1994	2.6	3.7	94 (Small Cobble)	216 (Large Cobble)
1999	6.7	6.7	330 (Small Boulder)	1,320 (Large Boulder)
2003	3.2	3.4	256 (Large Cobble)	866 (Medium Boulder)
Mean	3.6	4.3	213 (Large Cobble)	675 (Medium Boulder)

Additional channel stability testing was done in Boulder Creek using the Riffle Stability Index procedure.[7] With this procedure, the mobile fraction of the riffle can be estimated by comparing the relative abundance of various particle sizes present on the riffle with the dominant large particles on an adjacent bar. Riffle particles that are smaller than the dominant large particles on the bar are interpreted as being mobile. The mobile percentile of particles on the riffle is termed the "Riffle Stability Index" (RSI) and provides a useful estimate of the degree of increased sediment supply to riffles in mountain streams. The RSI procedure can also be used as an indicator of stream reach, water shed condition, and aquatic habitat quality. From RSI measurements in numerous streams in Northern Idaho and Virginia, Kappesser has determined that values less than 70 are indicative of watersheds in good condition. Values between 70 and 85 indicate watersheds in fair condition, and values greater than 85 indicate poor watershed condition.



The RSI was determined on two separate riffles in Boulder Creek in 1999 and repeated in 2003. On the first riffle (T1), the RSI was 23 in 1999 and 25 in 2003 (i.e. approximately 25% of the channel substrate is mobile during bankfull streamflows). On the second riffle (T2), the RSI was 13 in 1999 and 28 in 2003. These measurements and calculations indicate that the Boulder Creek watershed and stream reach are stable and in good condition.

[7] Gary B. Kappesser. A Rifle Stability Index to Evaluate Sediment Loading to Streams. In Journal of the American Water Resources Association, August 2002.

Warm Springs Creek: Wolman pebble count information was collected in Warm Springs Creek in 1989, 1995, and 2003. A complete channel survey was done in 1994 and 1995.[8] The pebble count data has been collected in Reach WSP-37, the lowest reach in the watershed. The channel type is a B2 (moderate gradient, moderately confined, boulder substrate stream) with a gradient of 2.4 percent. Bank stability was measured at 4.9 (20 meters of raw bank per kilometer) and cobble embeddedness was 10 percent. Channel stability rating was 52, or good. Warm Springs Creek is located within the Selway-Bitterroot Wilderness and is not roaded or logged. No apparent trends in the data have been observed to date.

Table 4. Warm Springs Creek Wolman Pebble Count Data; 1989 – 2003.

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
1989	11.2	12.6	155 (Large Cobble)	419 (Small Boulder)
1995	2.9	4.0	378 (Small Boulder)	886 (Medium Boulder)
2003	5.6	6.3	271 (Small Boulder)	489 (Small Boulder)
Mean	6.6	7.6	268 (Small Boulder)	598 (Medium Boulder)

Weir Creek: Wolman pebble count information was collected in Weir Creek in 1989 and 2003. A complete channel survey was done in 1991.[9] The pebble count data has been collected in Reach WE-7, the lowest reach in the watershed. The channel type is a B3a (steep gradient, moderately confined, cobble substrate stream) with a gradient of 5.7 percent. Bank stability was measured at 5.0 (20 meters of raw bank per kilometer) and cobble embeddedness was 26 percent. Weir Creek is roadless and there has been no logging in the watershed. No apparent trends in the data have been observed to date.

Table 5. Weir Creek Wolman Pebble Count Data; 1989 and 2003.

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
1989	11.8	12.7	80 (Small Cobble)	384 (Small Boulder)
2003	10.4	13.9	175 (Large Cobble)	445 (Small Boulder)
Mean	11.1	13.3	128 (Small Cobble)	415 (Small Boulder)

The Riffle Stability Index was determined on one riffle in Weir Creek in 2003. The RSI was 38 (i.e. approximately 38% of the channel substrate is mobile during bankfull streamflows). This measurement and calculation indicates that the Weir Creek watershed and stream reach are stable and in good condition.

Postoffice Creek: Wolman pebble count information was collected in Postoffice Creek in 1989, 1997, 1998, and 2003. A complete channel survey was done in 1992.[10] The pebble count data has been collected in Reach PO-12, the lowest reach in the watershed. The channel type is a B3 (moderate gradient, moderately confined, cobble substrate stream) with a gradient of 2.4 percent. Bank stability was measured at 5.0 and cobble embeddedness was 35 percent. Postoffice Creek has had minor timber harvest (3.2% of the watershed) and road construction (0.8 miles/sq. mi.). There appears to be a downward trend in sediment and an increase in the mean particle (D50) size indicating an improving trend from, perhaps, past timber management without adequate BMPs, landslides, or floods.

Table 6. Postoffice Creek Wolman Pebble Count Data; 1989 – 2003.

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
1989	27.7	27.7	42 (Very Coarse Gravel)	368 (Small Boulder)
1997	15.2	17.4	51 (Very Coarse Gravel)	155 (Large Cobble)
1998	20.6	21.5	70 (Small Coble)	250 (Large Cobble)
2003	12.1	14.0	94 (Small Cobble)	350 (Small Boulder)
Mean	18.9	20.2	64 (Very Coarse Gravel)	281 (Small Boulder)

[8] Clearwater BioStudies, Inc., Canby, Oregon. Habitat Conditions and Salmonid Abundance in the Warm Springs Drainage, Powell Ranger District, Summer 1994 and 1995. March 1996.

[9] Clearwater BioStudies, Inc., Canby, Oregon. Habitat Conditions and Salmonid Abundance in Selected Streams Within the Weir Creek Drainage, Powell Ranger District, Summer 1991. March 1992.

[10] Clearwater BioStudies, Inc., Canby, Oregon. Habitat Conditions and Salmonid Abundance in Postoffice and W. Fk. Postoffice Creeks, Powell Ranger District, August 1992. April 1993.

RSI was measured in Riffle T2 in Postoffice Creek in 1997 and repeated in 1998. No RSIs have been done since that date. In 1997, the RSI was measured at 195 mm and was moving approximately 86% of the channel substrate at bankfull flows. This high RSI indicated a channel that was unstable and moving large amounts of bed material. This measurement was taken immediately after the floods in 1995-1996 when Postoffice Creek experienced three landslides upstream from the study reach. The measurement was repeated in 1998, when the RSI was determined to be moving cobbles 76 mm in size, and 62% of the substrate. This measurement indicated the channel had stabilized. Measurements at T1 and T3 of 49% and 67%, respectively, validated this determination. We were unable to find sufficient channel bars in 2003 to do a RSI. This indicates the channel has scoured of excess depositional materials. In 2003, the channel appeared to be stable.

Badger Creek: Badger Creek is being studied to determine the effects of road decommissioning being done by the Nez Pierce Tribe and Clearwater National Forest. Prior to 2003, there were 85.2 miles of roads in this 5.6 square mile watershed. Road density was 15.3 miles/mile^2. This is the highest road density on the Clearwater National Forest. Two landslides occurred from these roads in the 1995-1996 flood event. In 2003, road decommissioning began. Forty-two miles of roads have been decommissioned with plans to obliterate another 20 miles in 2004 and 2005. Current road density has dropped to 7.7 miles/mile^2, with the goal of reducing road density to 4.1 miles/mile^2. The purpose of the study is to determine the level of short term bedload sediment increases from road decommissioning.

A complete channel survey was done in the summer of 1994.[11] The pebble count data has been collected in Reach BG-5, the lowest reach in the watershed. The channel type is an A4 (steep gradient, confined, gravel substrate) stream with a gradient of 5.2%. It is possible this channel type was historically an A3, with a natural cobble substrate. Bank stability was measured at 4.9, with 24 meters of raw streambank per kilometer. Cobble embeddedness was 44%, or higher than the DFC of 35%.

Table 7. Badger Creek Wolman Pebble Count Data; Badger above cc, trib cc, and Badger below cc; 1989 – 2003.

Stream	Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
Badger (Above CC)	2001	21.0	23.5	36 (Very Coarse Gravel)	108 (Small Cobble)
	2002	15.2	20.0	40 (Very Coarse Gravel)	114 (Small Cobble)
	2003	12.9	16.9	31 (Coarse Gravel)	108 (Small Cobble)
Tributary CC	2001	52.4	52.8	2 (Sand)	81 (Small Cobble)
	2002	48.1	49.6	5 (Fine Gravel)	113 (Small Cobble)
	2003	45.6	47.1	8 (Fine Gravel)	149 (Large Cobble)
Badger (Below CC)	1989	14.8	14.8	68 (Small Cobble)	248 (Large Cobble)
	1994	11.7	14.1	79 (Small Cobble)	143 (Large Cobble)
	2001	30.2	32.7	39 (Very Coarse Gravel)	239 (Large Cobble)
	2002	24.0	25.8	25 (Coarse Gravel)	158 (Large Cobble)
	2003	20.7	25.9	28 (Coarse Gravel)	128 (Large Cobble)

Wolman pebble count information was collected at three stations: Above Tributary CC, Tributary CC, and Below Tributary CC. The control station has little or no road decommissioning above the study reach. Tributary CC has numerous road fills being removed above the study reach. Badger Creek is the impact reach below all the activities. Trends in this reach will be compared to the control reach.

Creek shows a declining trend in sediment from 2001 to 2003. Tributary CC also shows a declining trend in sediment, with no apparent effects of the road decommissioning that has occurred to date. Wolman pebble counts in Badger Creek began in 1989 and continued through 2003. There appears to have been a spike in sediment after the 1994 measurement. This is most likely the result of the two landslides and 1995-1996 flood effects. There are no apparent increases in sediment as a result of the road decommissioning in this reach, as fine sediment has continued to decline.

[11] Clearwater BioStudies, Inc., Canby, Oregon. Habitat Conditions and Salmonid Abundance in the Wendover and Badger Creek Drainages, Powell Ranger District, Summer 19964. March 1995.

RSI monitoring has occurred at Badger Creek (Below CC) in 1994, 2001, 2002, and 2003. The data indicated the stream moved from a low of 51% of the substrate in 2001 to a high of 67% of the substrate at bank full flow in 2002. These measurements show a stable channel without an apparent trend.

Badger Creek Baer Survey: An 18 inch relief culvert in the headwaters of Badger Creek on Forest Road 5615 will be cleaned to handle increased peak flows.

Spruce Creek Baer Survey: A 24 inch culvert on Cost Share Road 373 (T38N, R16E, Sec. 25) will be upgraded to a 48 inch pipe to handle increased runoff from the fire. The new culvert will exceed the design storm peak flows. The Forest will also clean, replace, or repair six plastic culverts on cost share roads in Section 35 to handle increased runoff expected from the fire.

Crooked Fork Creek Baer Survey: Twin, misaligned and undersized 30 inch culverts on the 595 Road at T38N, R14E, Section 2, will be replaced (See Photo 1). The culvert will be designed to handle increased peak flows and accommodate fish passage. Removal of a 24 inch aluminum culvert on Road 75522, Spur 1 will be done to handle increased peak flows expected after the fire. A log culvert on Road 75222 at Station 40+25 will be removed before peak flows increase and the fill saturates and fails. At the head of an old debris torrent on Road 75226, the remainder of a previously failed log culvert will be removed before peak flows increase and a fill failure results.

Photo 1. Twin culverts proposed for replacement in Crooked Fork Creek tributary. September 3, 2003.

SUBSTRATE MONITORING IN THE NORTH FORK CLEARWATER RIVER SUB-BASIN

Upper North Fork Clearwater River (above Long Creek): Wolman pebble count information was collected in the Upper North Fork of the Clearwater River in 1990, 1998, and 2003. A complete channel survey was done in 1998.[12] The pebble count data has been collected in Reach UNF-20, immediately above Long Creek. The channel type is a C3 (low gradient, unconfined, cobble substrate stream) with a gradient of 1.4 percent. Bank stability was measured at 5.0 (3 meters of raw bank per kilometer) and cobble embeddedness was 22 percent. Channel Stability Index was 55 or "good." The North Fork Clearwater River has a very low harvest history and road density. 208 acres, or 0.4% of the watershed has been harvested and 34.9 miles of roads have been constructed in the 73.7 square mile watershed. The road density is 0.5 miles/mile^2. There are no known landslides within the North Fork Clearwater watershed. Table 11 shows the Wolman pebble count data for the three years. No apparent trends in the data have been observed to date.

Table 8. North Fork Clearwater River Wolman Pebble Count Data; 1990 to 2003.

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
1990	7.9	7.9	174 (Large Cobble)	414 (Small Boulder)
1998	0.4	1.6	75 (Small Cobble)	251 (Large Cobble)
2003	4.8	4.9	125 (Large Cobble)	241 (Large Cobble)
Mean	4.4	4.8	124 (Small Cobble)	302 (Small Boulder)

[12] Clearwater BioStudies, Inc., Canby, Oregon. Habitat Conditions and Salmonid Abundance in the Upper North Fork Clearwater River From Meadow Creek Downstream to Kelly Forks, North Fork Ranger District, Summer 1998. April 1999.

The Riffle Stability Index was determined on the North Fork Clearwater River in 1998 and 2003. In 1998, bankfull flow was moving a 158mm large cobble for a RSI of 74%. In 2003, RSI was measured at 54% and moving a 138mm cobble. This measurement and calculation indicates that the North Fork Clearwater River watershed and stream reach are stable and in good condition.

Elizabeth Creek: Wolman pebble count information was collected in Elizabeth Creek in 1989, 1992, 1996, and 2003. A complete channel survey was done in the summer of 1996.[13] The pebble count data has been collected in Reach ELI-10, the lowest reach in the watershed. The channel type is an A3 (steep gradient, confined, cobble substrate) stream with a gradient of 8.0 percent. Bank stability was measured at 4.9 (stable) and cobble embeddedness was 21 percent. Elizabeth Creek is essentially roadless. Less than 0.1% of the watershed has been harvested (4 acres) and road density is 0.2 miles/mile^2. Recent impacts in the watershed include two landslides that occurred during the 1995-1996 flood; a portion of the watershed was burned in the Elizabeth Fire in 2000; and sometime in the winter or spring of 2002-2003, a large debris jam failed near the mouth and above the study reach. Table 11 shows the Wolman pebble count data for the four years.

Table 9. Elizabeth Creek Wolman Pebble Count Data; 1989 – 2003.

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
1989	0.9	0.9	221 (Large Cobble)	467 (Small Boulder)
1992	3.5	3.5	198 (Large Cobble)	458 (Small Boulder)
1996	3.5	5.3	211 (Large Cobble)	768 (Medium Boulder)
2003	10.3	11.3	111 (Small Cobble)	333 (Small Boulder)
Mean	4.6	5.3	185 (Large Cobble)	507 (Small Boulder)

From 1989 through 1996, the channel remained stable and consistent with a small level of sediment. The flood and landslides appear to have had no effect on the mouth reach of Elizabeth Creek. However, the 2000 Elizabeth Fire resulted in increase peak flows and a subsequent debris jam failure in 2003 which has caused channel adjustments, at least in Reach ELI-10. Sediment in the reach has increased from approximately 5% to over 11% and the channel is scoured bright. Also, the D50 and D84 particle size has decreased by approximately 50%. Sediment behind the debris jam was 10 to 15 feet deep and backed up several yards upstream. It appeared that the debris jam pre existed the fire was probably weakened when one side partially burned. Much of this material would have been delivered to the North Fork of the Clearwater River.

RSI monitoring is recommended in 2005 to verify future recovery. We also failed to identify the debris jam hazard during the Elizabeth Fire Burned Area Emergency Response Survey. Future BAER surveys should identify large debris jams in mountain streams.

There were no depositional bars present in 1996, so a RSI was not done. With the new deposition in 2003 a RSI measurement was possible at two transects. Transect A was moving a 250 mm cobble at bankfull flows and Transect B was moving a 268 mm boulder. The calculated RSI for both transects indicates that 81% of the channel substrate is moving at bankfull flow. This is borderline instability.

Photo 2. Elizabeth Creek recent debris dam failure. August 14, 2003.

[13] Clearwater BioStudies, Inc., Canby, Oregon. Habitat Conditions and Salmonid Abundance in Selected Streams Within the Black Canyon Area, North Fork Ranger District, Summer 1996. March 1997.

Lake Creek: Wolman pebble count information was collected in Lake Creek in 1989 and 2003. A complete channel survey was done in 1990.[14] The pebble count data has been collected in Reach LK-13, near the mouth. The channel type is a B3 (moderate gradient, moderately confined, cobble substrate stream) with a gradient of 2.7 percent. Bank stability was measured at 3.5, indicating there were bank stability problems in 1990. Although bank stability was not measured during the 2003 Wolman pebble count measurements, we did not observe any bank erosion in the reach (See Photo 5). Cobble embeddedness was 23 percent. The Lake Creek watershed has a harvest density of 18.8% and a road density of 1.8 miles/mile^2. Timber harvest and road construction began in 1958 and continued until 1993. There was one landslide during the 1995-1996 flood event. There is insufficient data to determine if a trend in sediment exists.

Table 10. Lake Creek Wolman Pebble Count Data; 1989 to 2003.

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
1989	0.0	0.0	102 (Small Cobble)	419 (Small Boulder)
2003	5.9	6.5	121 (Small Cobble)	256 (Small Boulder)
Mean	3.0	3.3	112 (Small Cobble)	338 (Small Boulder)

The Riffle Stability Index was determined on Lake Creek in 2003. The RSI indicated that 67% or a 176mm large cobble was moving at bankfull streamflows. The RSI measurement indicates that the Lake Creek watershed and stream reach are stable and in good condition.

4th Of July Creek: Wolman pebble count information was collected in 4th of July Creek in 1988 and 2003. A channel survey was not been done. The pebble count data has been collected in the lowest reach, immediately upstream of the mouth. The channel type is a B3c (low gradient, moderately confined, cobble substrate stream) with a gradient of 1.6 percent. The 4th of July Creek watershed is unroaded and unlogged. There were two landslides in the watershed during the 1995-1996 flood event. There are an insufficient number of years of data to determine if a trend in sediment exists.

Table 11. 4th of July Creek Wolman Pebble Count Data; 1988 to 2003.

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
1988	0.0	0.0	76 (Small Cobble)	286 (Small Boulder)
2003	3.3	5.0	152 (Large Cobble)	441 (Small Boulder)
Mean	1.7	2.3	114 (Small Cobble)	364 (Small Boulder)

The Riffle Stability Index was determined on 4th of July Creek in 2003. The RSI indicated that 49%, or a 148mm large cobble was moving at bankfull streamflows. The RSI measurement indicates that the 4th of July Creek watershed and stream reach are stable and in good condition.

Weitas Creek: Wolman pebble count information was collected in Weitas Creek at the mouth in 1989, 1998, and 2003. A complete channel survey has not been done. The data was collected in the lowest reach, near the mouth. The channel type is a B3a (moderate gradient, moderately confined, cobble substrate stream) with a gradient of 1.4%. The Weitas Creek watershed is relatively unroaded and unlogged. Harvest density is 2.1% and road density is 0.7 miles/mile^2. There were 29 landslides during the 1995-1996 flood event giving a landslide density of 1 slide per 7.5 square miles. There appears to be a downward trend in sediment; there also appear to be no effects from the 1995-1996 flood event in this reach.

Table 12. Weitas Creek Wolman Pebble Count Data; 1989 to 2003.

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
1989	12.3	16.7	136 (Large Cobble)	444 (Small Boulder)
1998	5.2	10.3	129 (Large Cobble)	432 (Small Boulder)
2003	5.1	5.5	192 (Large Cobble)	528 (Medium Boulder)
Mean	3.0	3.3	152 (Large Cobble)	468 (Small Boulder)

[14] Clearwater BioStudies, Inc., Canby, Oregon. Habitat Conditions and Salmonid Abundance in Selected Streams Within the Lake Creek Drainage, North Fork Ranger District, Summer 1990. January 1991.

The Riffle Stability Index was determined on Weitas Creek in 1998. The 1998 RSI indicated that bankfull streamflows were moving 67% of the channel substrate, or a 206mm cobble. This measurement indicates that the Weitas Creek watershed and stream reach are stable and in good condition.

Hemlock Creek: Wolman pebble count information was collected in Hemlock Creek in 1990, 1998, and 2003. A complete channel survey was done in the summer of 1991.[15] The pebble count data has been collected in Reach HM-25, the lowest reach in the watershed. The channel type is a B3 (moderate gradient, moderately confined, cobble substrate) stream with a gradient of 2.8 percent. Bank stability was measured at 4.8 (minor bank erosion) and cobble embeddedness was 28 percent. Hemlock Creek is predominately roadless. Seven percent of the watershed has been harvested and road density is 1.5 miles/mile^2. Harvest took place between 1960 and 1997. Table 16 shows sediment in Hemlock Creek spiking in 1998 and recovering to 1990 conditions in 2003. The 1998 sediment levels are most likely the result of the 1995-1996 flood event. Three landslides occurred above the sample reach in those storms.

Table 13. Hemlock Creek Wolman Pebble Count Data; 1990 – 2003.

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D50 in mm	D84 in mm
1990	8.8	9.8	80 (Small Cobble)	224 (Large Cobble)
1998	18.5	21.0	67 (Small Cobble)	202 (Large Cobble)
2003	8.3	9.0	115 (Small Cobble)	384 (Small Boulder)
Mean	11.9	13.3	87 (Small Cobble)	270 (Small Boulder)

A RSI was measured in Hemlock Creek, Reach HM-25 at T1 and T2 in 1998 and in 2003. In 1998, the T1 RSI was 165 mm, moving approximately 75% of the channel substrate at bankfull flow. The T2 RSI was 282 mm and was moving approximately 95% of the substrate. T1 indicated borderline stability and the T2 transect was unstable. The effects of the flood and landslides above this reach are most likely the cause of the instability. In 2003, the same transects were re-measured. T1 was moving a 100 mm cobble, or 56% of the substrate and T2 was moving a 119 mm cobble, or 59% of the substrate at bankfull. These recent measurements indicate the channel has recovered from past flood and landslide effects.

Cayuse Creek Baer Survey: Seventeen undersized and plugged culverts, including everything from 12 inch relief pipes to fisheries crossings on Forest Road 581 will be replaced to handle increased peak runoff from the fire. These sites will all be monitored after construction is completed in August 2004. Photo 3 shows a plugged culvert on Road 581 that filled with ash during a fall rainstorm after the Pleasant Fire. This culvert was replaced immediately due to the risk of scouring or loosing the road fill if a large rainfall event occurred.

Photo 3. Plugged culvert with ash washed over road 581; September 17, 2003.

[15] Clearwater BioStudies, Inc., Canby, Oregon. Habitat Conditions and Salmonid Abundance in Selected Streams Within the Hemlock Creek Drainage, Pierce Ranger District, Summer 1991. March 1992.