Watershed Analysis

Canton Creek

Roseburg District BLM

Updated as of

May 12, 1995

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To: Lowell Hayes, CANTON CREEK WA (iteration 2)

Frm: Dan Couch

Subj: June 1998 Update of Activities in **Canton Creek 5th Field Watershed**
(As related to **Christopher Folly** Regen Harvest & ACS Analysis at the 5TH Field)

LAND USE ALLOCATIONS FOR HARVESTING UNDER NFP

Under the NFP land use allocations approximately 1,062 acres are available for Matrix type regeneration harvest (Canton Creek WA, pg 13). Of those lands approximately 508 acres are currently at the age and land use for GFMA type regeneration harvest to take place. It is estimated that approximately 255 acres are currently at the age and land use for Connectivity type of harvest to take place.

PASSIVE RESTORATION

There is approximately 30,783 acres of federal lands (both BLM and USFS) within the Canton Creek WA (Canton Creek WA, pg 10). Of that land approximately 96.5% (29,721 acres) is in some type of reserve (eg. Late Successional Reserve, Riparian Reserve, etc.).

The Canton Creek WA considered full hydrologic recovery to have taken place when forested stands reach 40 years of age. A major amount of the recovery is considered to take place within the first 25 to 30 years (Canton Creek WA, pg 42-44). As of 1995 approximately 6,580 acres of forests were less than 25 years of age (Canton Creek WA, pg 21). Within 40 years all of these stands, except those that may be harvested again in Matrix lands, will be hydrologically recovered. Even if all of the Matrix lands (1,062 acres) were harvested within the next 40 years, it would only represent 3.5% of federal lands in the Canton Creek 5th field Watershed. All reserves (29,721 acres) would be in a hydrologically recovered state.

Thus over time as a result of the reserve land use allocations the overall change in federal lands hydrologically recovered would increase as represented by the following **Table 1**:

Federal forest lands in stages of recovery over time **Table 1**

Year	Hydrologically Unrecovered (acres)	%	Hydrologically Recovered (acres)	%
1995	6580	22%	24203	78%
2035	1062*	3%	29721**	97%

* Note this amount would actually be somewhat less because portions of the Matrix lands will have grown into hyrdrologic recovery from growth in the planted trees.
** Note this amount is based only on reserves. Additional recovery will have occured in Matrix lands in various stages of forest growth as noted above.

ACTIVE RESTORATION

In addition to the passive restoration noted above, the following active restoration activities will have been completed by the end of FY 98.

BLM	Road Actively Decommissioned:	3.7 miles
	Roads Passively Decommissioned (Re-vegetated): (EA OR-104-98-01, Canton Creek Restoration)	1.3 miles
	Road Improvement/Renovation: (EA OR-104-97-15, Christopher Folly TS)	16.7 miles
	Road Stormproofing (Joker Cr Road# 23-1-35.0):	4.6 miles
USFS	Road Decommissioning: (Canton Road Decommissioning Project EA, June 6, 1997)	14.4 miles
	Road Stormproofing:	14.7 miles

HARVEST ACTIVITIES ON FEDERAL LANDS

Christopher Folly TS

Total Regeneration Harvest Acres	215 acres
Road Const.	0.1 miles (temporary road)

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EXECUTIVE SUMMARY

Key concerns and questions were first developed in the original assessment and further expanded in this analysis to focus on the most needed information. Past, present, and desired future conditions were analyzed by key concern. This information was used to suggest restoration opportunities. The following summarizes the major findings resulting from watershed analysis followed by a list of potential restoration opportunities.

Key Concerns

- Canton Creek is within a Tier 1 Key watershed, and a Late Successional Reserve.
- Canton Creek supports populations of Federally proposed fish species (Umpqua Basin cutthroat trout) and Federally petitioned fish species (Oregon coastal steelhead) and is a key refuge for anadromous fish stocks within the Steamboat Creek basin.
- Water quality is related to and influences the quality of fish habitat as well as the water quality going into the North Umpqua Wild and Scenic River.

Findings

- Channel conditions within the basin are strongly tied to fire history, land management activities, and basin geology. These 3 categories most influence debris flow frequencies within the basin.
- Past land management (i.e., roading, timber harvest, and stream cleanout) has impacted riparian and aquatic conditions within the basin. These impacts are seen in the form of increased debris flow frequencies, simplified fish habitat conditions, alteration of riparian vegetation, and alteration of flow regimes within the basin.
- Aquatic conditions within the Canton Creek basin are below desired levels and improvements will occur on a much slower time line unless there are specific restoration efforts.

Restoration Opportunities

The concept of protecting areas with the highest values and least previous impacts was used to prioritize compartments. For this iteration of watershed analysis restoration opportunities were listed only for the highest priority compartments realizing there would be limited money. Four criteria were used for categorizing compartments for restoration. The highest criteria was preventing road related landslides which all of the prioritized compartments have potential roads to treat. Restoration opportunities are outlined below by priority.

1) Upper Pass Creek

This compartment was identified by Dambacher (1991) as a stronghold for steelhead because of its high quality habitat and low impacts to the drainage. Since this compartment has few stream impacts, it needs to be protected by treating roads to prevent future landslides and potential damage by large storm events. Treatments may include: replacing undersized culverts, pulling out culverts and replacing with drain dips, pulling back road fills, and ripping compacted areas. Potential road to treat: 24-1-22.1

2) East Pass Creek

Impacts to this compartment have resulted primarily from debris torrents which has widened the channel and removed shade. To narrow the channel and provide better future shade treatments should include converting some of the alder dominated riparian areas to conifers and narrowing the upper channels by adding large woody debris.
Potential roads to treat: 23-1-35.0, 24-1-11.0, 24-1-11.4

3) Francis Creek

This compartment is an historic stronghold for cutthroat trout. Projects for this compartment include monitoring stream temperatures and adding large woody debris in areas it is lacking. Potential roads to treat: 24-1-12.1, 24-1-12.0, 24-1-1.1

4) Mellow Moon

This compartment is a contributor of cool water for Pass and Canton Creeks and is extensively used by fish. It has a high road density, low amounts of vegetation, and currently has few minor debris torrents. Restoration should aim at speeding up the tree growth process so that younger stands will more quickly develop older growth characteristics. Road densities should also be reduced as much as possible. Potential roads to treat: 24-1-22.1, 24-1-20.0

5) Other Potential Roads to Treat: 24-1-14.0, 24-1-1.0, 24-1-24.0, 24-1-24.1, 24-1-23.1

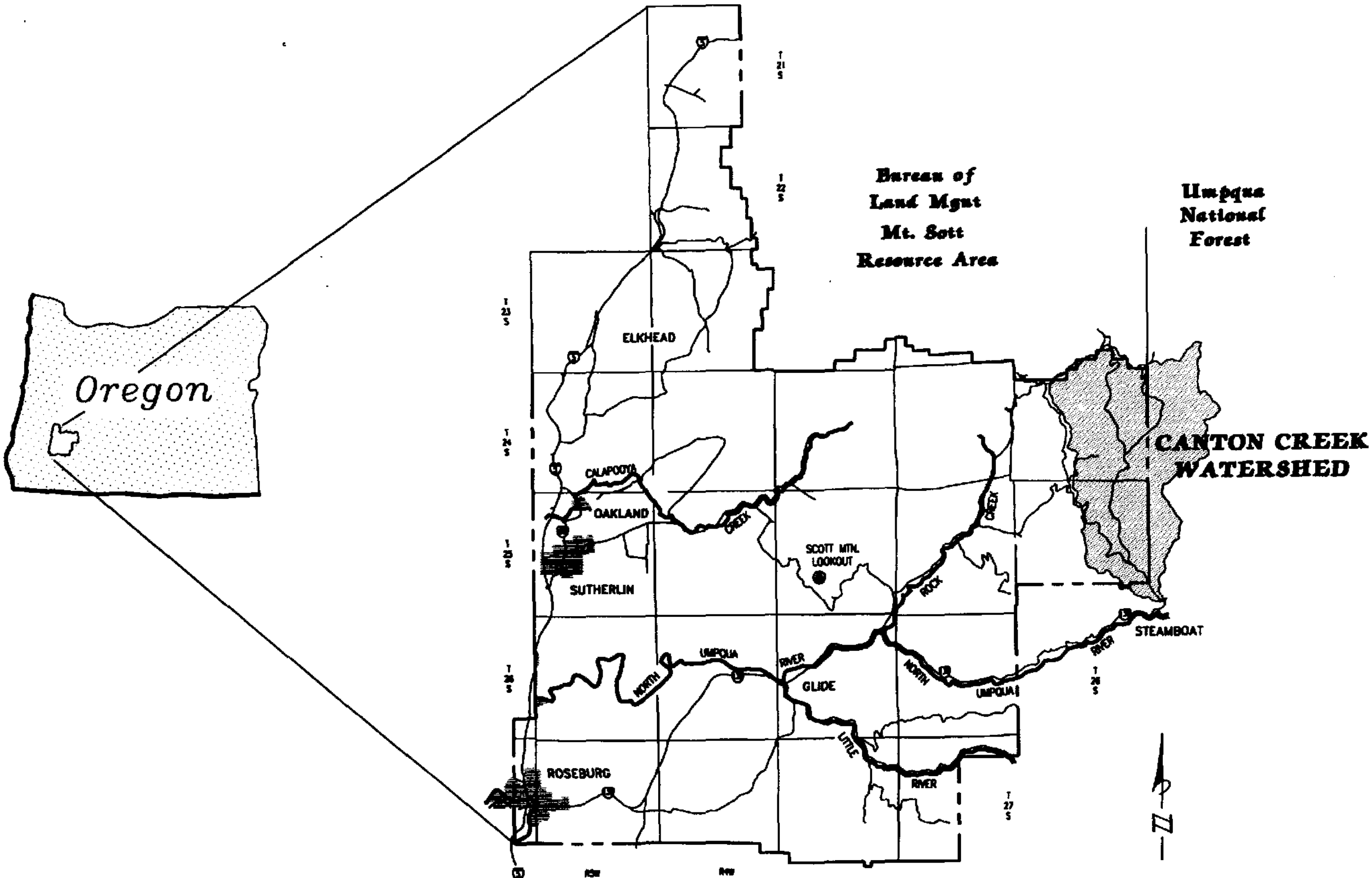

Oregon
Bureau of
Land Mgmt
Mt. Sott
Resource Area
Umpqua
National
Forest
CANTON CREEK
WATERSHED
ELKHEAD
CALAPOOYA
OAKLAND
SUTHERLIN
CREEK
SCOTT MTN.
LOOKOUT
ROCK
CREEK
NORTH
UMPQUA
RIVER
GLIDE
NORTH
UMPQUA
RIVER
STEAMBOAT
LITTLE
RIVER
ROSEBURG
T 21 S
T 22 S
T 23 S
T 24 S
T 25 S
T 26 S
T 27 S
T 26 S
N

Figure 1

CANTON CREEK WATERSHED ANALYSIS

A. WATERSHED ANALYSIS INTRODUCTION

The Umpqua National Forest (USFS), the Roseburg District Bureau of Land Management (BLM), and the Oregon Department of Fish and Wildlife cooperated in a preliminary watershed assessment on Canton Creek which was completed in March, 1994. Restoration projects for 1994 were planned from this analysis. Canton Creek watershed analysis is a continuation of that work. The Roseburg District BLM is taking the lead role in analyzing this watershed in cooperation with the Umpqua National Forest. The core interdisciplinary team (TEAM) consists mostly of BLM employees with two USFS employees who were on the original assessment. Much of the information from the first watershed assessment has been improved and incorporated into this analysis. Canton Creek is a high priority for watershed analysis because it is a Tier I Key Watershed in the Forest Plan, federally petitioned fish and State listed sensitive species of fish are present in the watershed, and this watershed is highly regarded by the public for its scenic, recreation, and fish values.

This analysis is not offered as an end product. As conditions, assumptions, and goals evolve, the analysis and projects will be updated. To promote flexibility, track new information, and measure progress, the resource area has developed a Canton Creek watershed folder which can be updated with new information as it becomes available. In this way watershed analysis will remain an ongoing process.

How the federal lands within Canton Creek watershed will be managed are governed by the guiding principles outlined in the Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. This document as well as BLM and USFS planning documents will be referred to throughout this watershed analysis.

B. AREA DESCRIPTION

General Location: Canton Creek is a watershed containing approximately 40,573 acres of land. This 60 square miles of drainage located on the Western slopes of the Cascade mountains drains into the North Umpqua river system. The largest tributary to Steamboat Creek (see vicinity map), Canton Creek joins this famous summer steelhead stream just upstream from its confluence with the North Umpqua River. The North Umpqua and the South Umpqua join to form the 1300 square mile river system that flows 200 miles from the Cascade crest through the Oregon Coast Range to the Pacific Ocean. This coastal river system supports fish and aquatic life adapted to both a low gradient riverine habitat, as well as steep boulder-step channels common to Coast Range sedimentary mountains and the Cascade volcanics.

Specific Description: Canton Creek stretches 13 miles south to north, from an elevation of 1200 feet at its mouth, to 4800 feet above sea level at Canton Point. The watershed is made up of 3 major drainages, Lower Canton Creek, Pass Creek, and Upper Canton Creek. These drainages are also divided into 24 sub-drainages (Figure 2, 2A, and Table 1). Pass Creek and Upper Canton Creek are the main tributaries, joining about 8 miles upstream. Canton Creek is a 6th order stream, and the largest tributary of the 227-square mile Steamboat Creek watershed.

Climate: About 54 inches of rain and snow fall yearly at the mouth, increasing to 80 inches or more at the top of the watershed. Snow persists only at the highest elevations in winter, with rain melting snow in flood peaks from November to April storms. Approximately 36,699 acres or 90% of the watershed have elevations between 2000 and 5000 feet. This zone typically will have periods of snow followed by rain (transient snow zone).

Geology: The land has been formed over a long period of time as a result of volcanos and erosional processes. Approximately 31% of the Canton Creek watershed is formed by a harder geological base (Tub basalt) while the other 69% of the watershed is formed by a softer type geology more prone to erosion. This affects how the stream systems have formed as well as the rates of erosion.

Vegetation: Douglas-fir is the dominant tree species over the landscape. Grand fir, western hemlock and western redcedar are common associates.

People and Recreation: This watershed is well known for its scenic qualities as well as its production of fish. Scaredman campground, which is on Canton Creek, receives moderate use during the summer and the watershed's proximity to the North Umpqua Wild and Scenic River attracts traffic on the main Canton Creek access road. Logging and timber products have been the major use of the area in the last 50 years.

CANTON CREEK ANALYTICAL WATERSHED

(Sub-Watersheds & Major Streams)

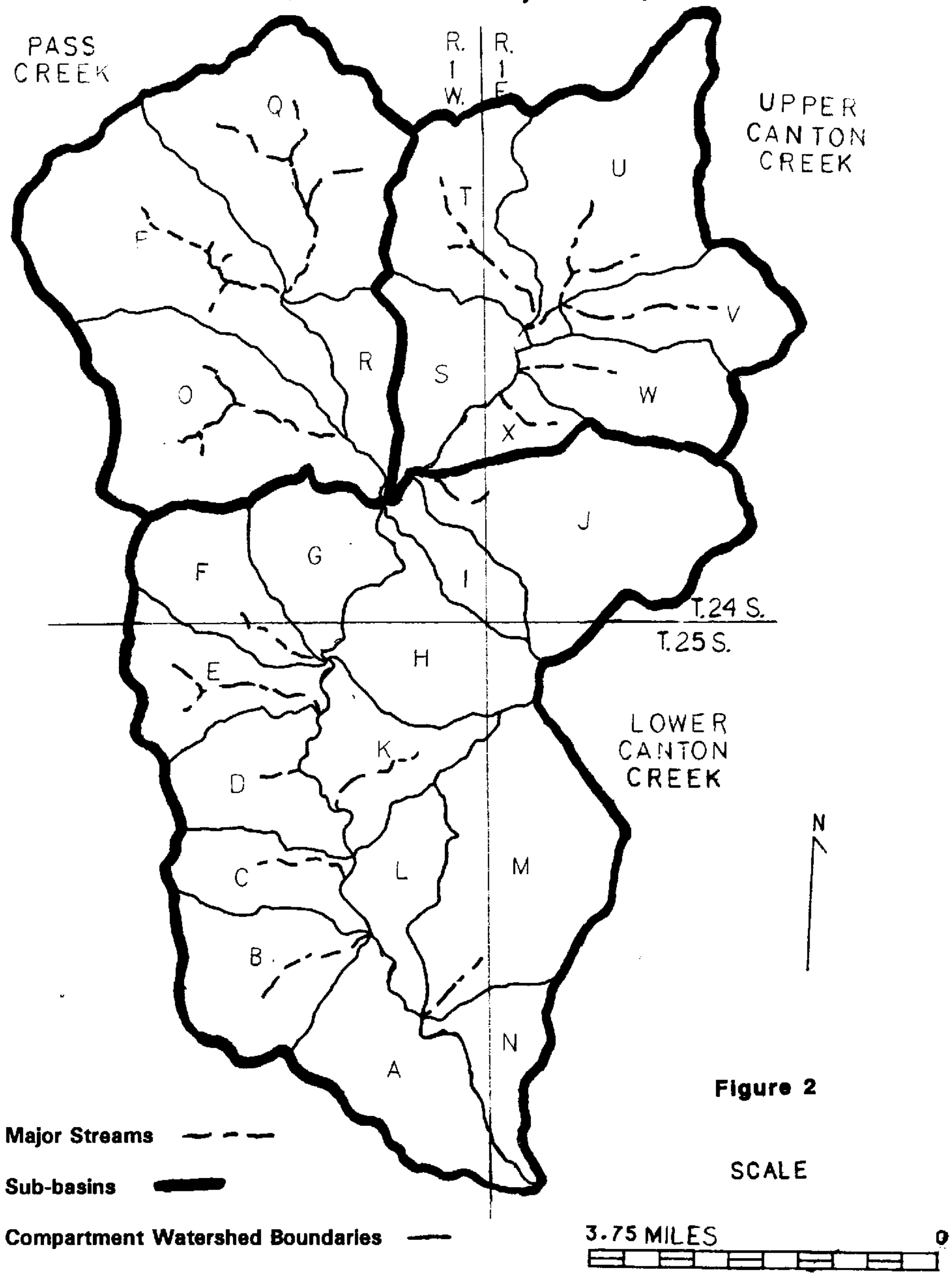


Figure 2

CANTON CREEK SUB-WATERSHEDS

Table 1

Map Letters, Sub-basins	Compartment Names	Acreage (acres)	BLM, GIS#	USFS, GIS#
Lower Canton Cr		21,135		
A	Coon Creek	1,892	17100301_1350 101F	18 G
B	Scaredman Creek	1,591	" " 102W	18 I
C	Camp Creek	964	" " 103F	
D	Wolverine Creek	1,309	" " 104F	
E	Trapper Creek	1,273	" " 105W	
F	Grizzly Creek	1,235	" " 106W	
G	Ring Tail Creek	1,263	" " 107F	
H	Buck Creek	1,702	" " 108F	18 E
I	Salmon Creek	637	" " 109F	18 D
J	Chilcoot Creek	3,226	" " 110W	18 C
K	Brouse Creek	1,184	" " 111F	18 L
L	Lower Canton Creek	936	" " 112F	
M	HiPower Creek	3,081	" " 113W	18 F
N	Bloody Point	842	" " 114F	18 P
Pass Cr		10,214		
O	Mellow Moon Creek	2,904	17100301_1350 201W	
P	Upper Pass Creek	3,199	" " 202F	
Q	East Pass Creek	3,287	" " 203W	18 Q
R	Lower Pass Creek	824	" " 204F	
Upper Canton Cr		9,224		
S	Lost Bucket Creek	1,317	17100301_1350 301F	18 M
T	Francis Creek	1,694	" " 302W	18 N
U	Upper Canton Creek	2,990	" " 303F	18 O
V	McKinley Creek	1,296	" " 304W	18 A
W	No Man Creek	1,350	" " 305W	18 B
X	Middle Canton Creek	577	" " 306F	18 U

CANTON_CREEK

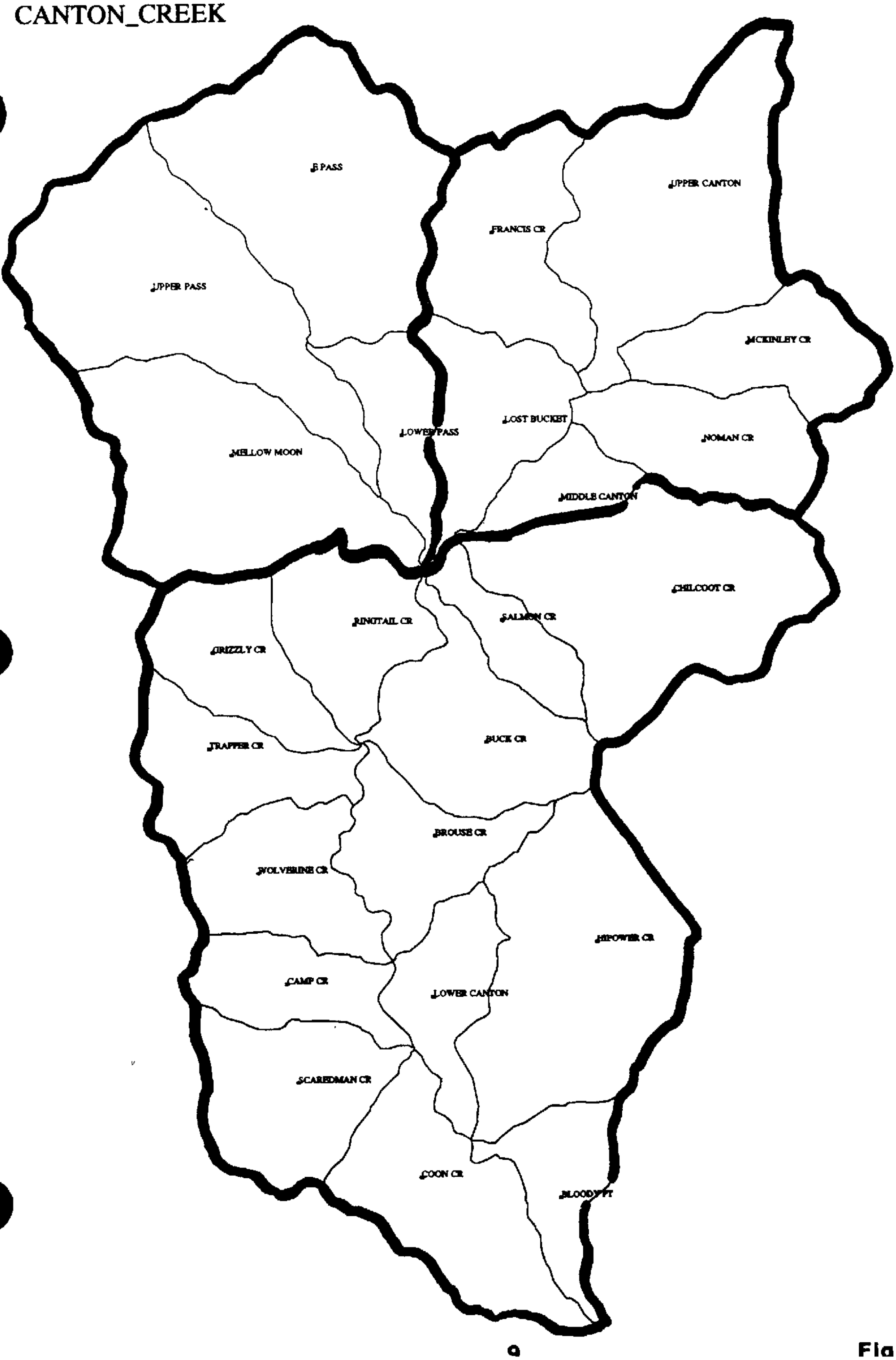


Figure 2A

C. OWNERSHIP AND FEDERAL LAND USE ALLOCATIONS

Figure 3 shows the general ownership patterns within this watershed. This figure does not delineate private ownership. The following breakdown of ownership shows that Federal agencies administer approximately 76% of the watershed.

Land Owner	Acres	Percent of Watershed
Government (BLM)	17,726	44%
Government (USFS)	13,057	32%
Private Landowners	9,800	24%

For federally managed lands within Canton Creek (totaling 30,773 acres), the land use allocations (Figure 4) in accordance with the ROD and PRMP fall into the following categories (note: these acreages are estimates based on calculated acres from computer generated maps):

	Acres, Fed Lands	% Fed Lands	% of Watershed
Late Successional Reserve	27,466 ac	90%	68%
Riparian Reserves	2,244 ac	7%	6%
Matrix Lands (Outside Riparian Reserves)			
- Connectivity	404 ac	1%	1%
- General Forest Management Area (GFMA)	658 ac	2%	2%

1. Late Successional Reserves

The management objectives for the Late Successional Reserves (LSR) are to protect and enhance old-growth forest conditions and include unmapped pre-1994 Northern Spotted Owl (NSO) designated core areas. Of the 27,466 acres of LSR in Canton Creek it is estimated that 20,818 acres (76% of LSR) are currently in late-successional type forests (80+ years). There are a total of 22 NSO core nesting areas (pre 1994 owl activity centers) in Canton Creek 2 of which are located outside mapped LSR.

Page A-7 of the Standards and Guides attached to the ROD states that "Projects and activities within LSRs . . . may proceed in fiscal years 1994-96 using initial LSR Assessments. An initial LSR assessment will be completed to determine if proposed projects are in conformance with the Aquatic Conservation Strategy Objectives."

2. Riparian Reserves

The riparian reserves were established for federal lands as one component of the Aquatic Conservation Strategy to protect the health of the aquatic system and its dependent species and provide incidental benefits to upland species. The reserves were designated to help maintain and restore riparian structures and functions, benefit fish and riparian-dependent non-fish species, enhance habitat conservation for organisms dependent on the transition zone between uplands and riparian areas, improve travel and dispersal corridors for terrestrial animals and plants, and provide for greater connectivity of late-successional forest habitat (ROD, B-13).

In Canton Creek, Riparian Reserves are only located over the matrix land use allocation. There are approximately 874 acres of riparian reserves on Connectivity lands and approximately 1,370 acres on GFMA lands. The riparian reserves were estimated from the stream network characterized by the Geographic Information System (GIS) computer database as well as on the ground verification and mapping of intermittent (1st and 2nd order) streams. The following computer generated riparian reserve widths were measured in horizontal distances: 178 feet for intermittent, non-fish bearing streams and 358 feet for fish bearing streams. These horizontal distances compensate for the average side slopes in the watershed for a slope distance of approximately 200 feet.

CANTON CREEK ANALYTICAL WATERSHED

(Land Ownership)

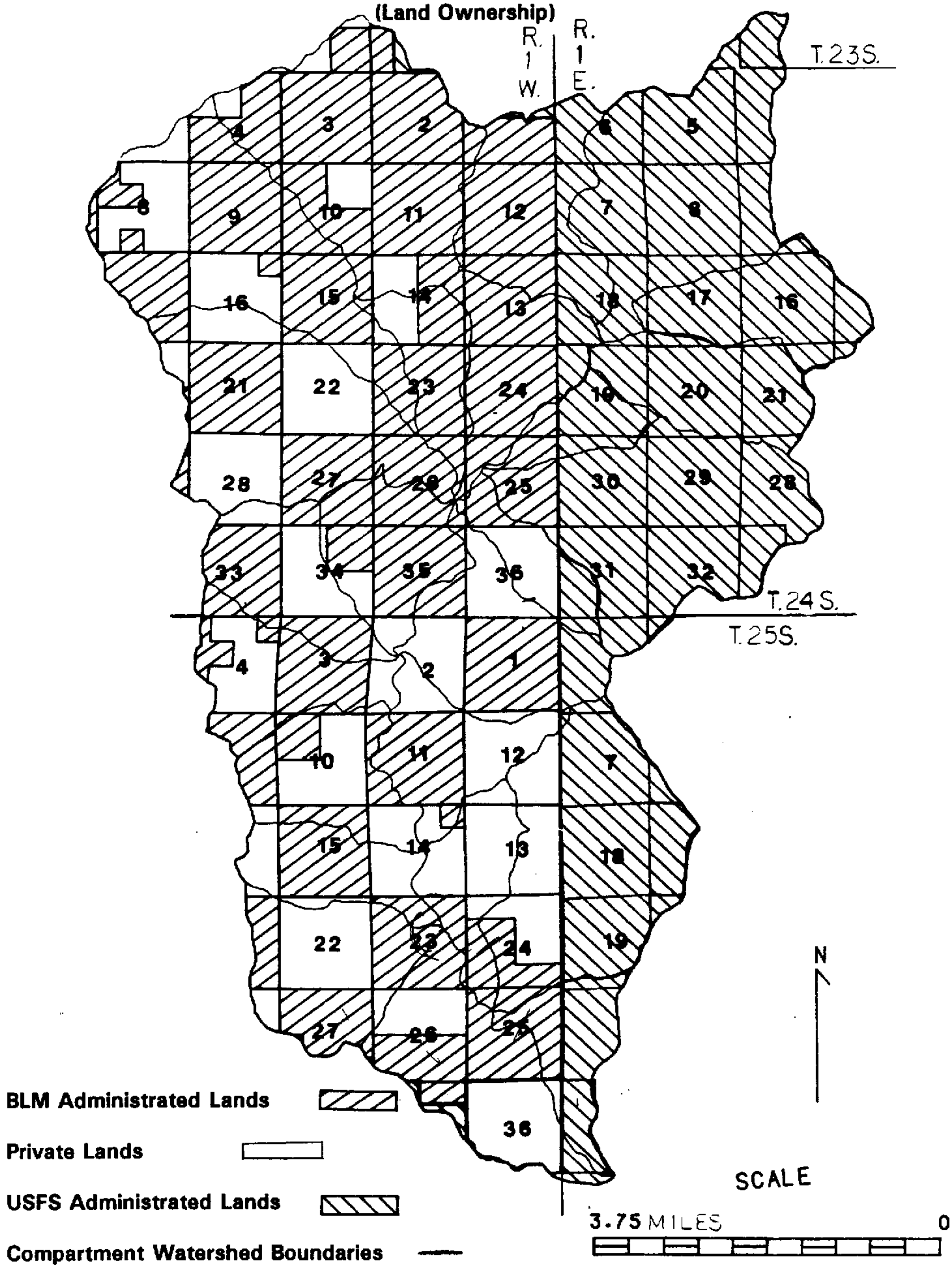


Figure 3

CANTON CREEK WATERSHED
(Land Use Designations)

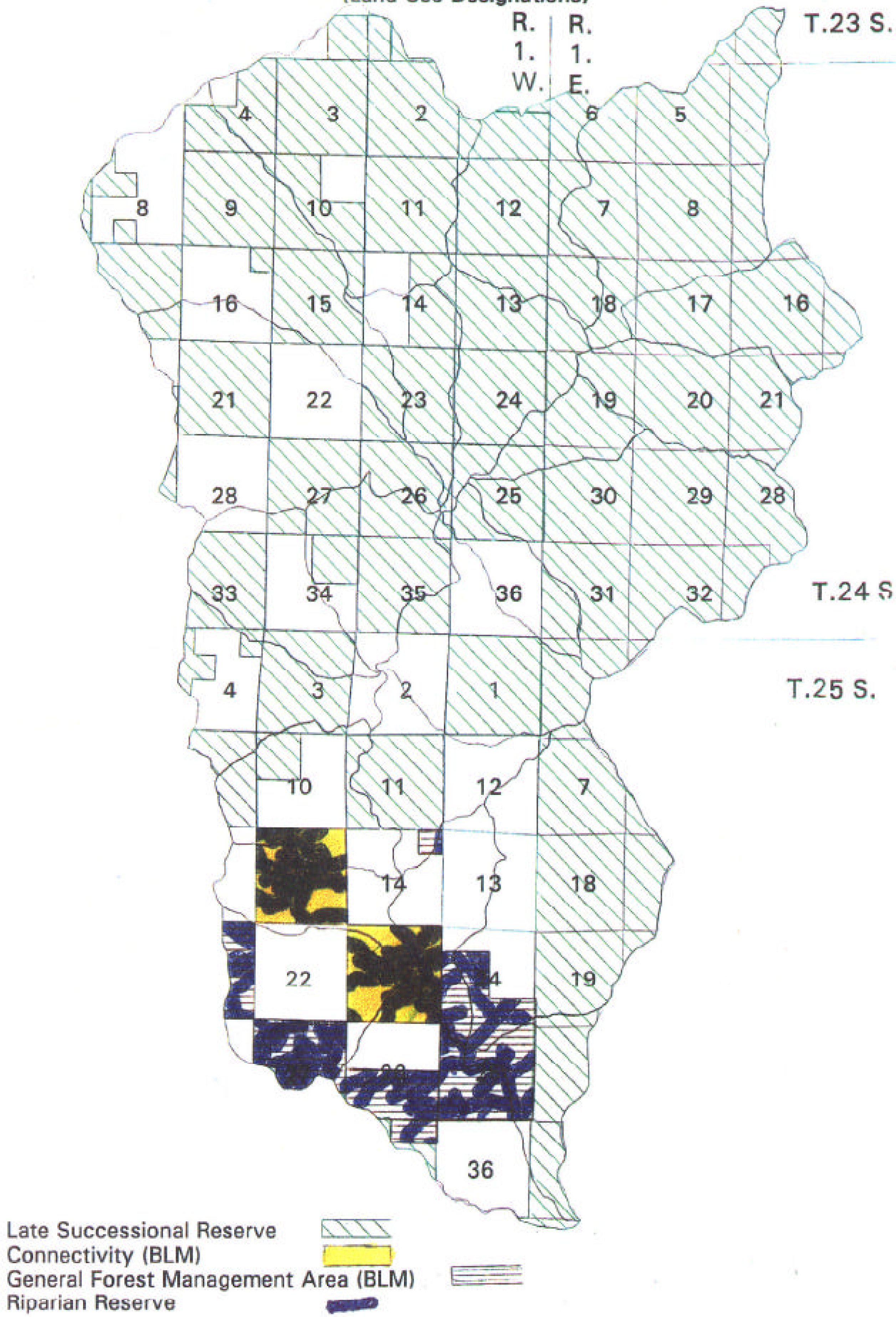


Figure 4

When actual projects are developed in the field, a slope distance of approximately 160 feet will be used as representing the average site-potential tree height of the area (ROD, pg. 9). The site-potential tree height of 160 feet was determined from 4 plots taken on the lower one-third of the hill slopes in the Canton creek drainage. Field studies have shown that GIS underestimates the number of streams on the ground. Even though the site potential tree height is 160 feet in this drainage, 200 feet was used for analysis to compensate for on the ground conditions.

3. Matrix Lands
Matrix lands as designated in the ROD are composed of federal lands not withdrawn as congressionally reserved areas, LSR, Adaptive Management Areas, administrative withdrawn areas or Riparian Reserves. Most timber harvest and other silvicultural activities will be conducted on these lands (ROD, p. 7). Standards and guides for overall management of the matrix are included in the ROD on pages C-39 through C-43.

In the ROD matrix lands were delineated into two separate categories on BLM lands. Management is slightly different for each of these separate categories.

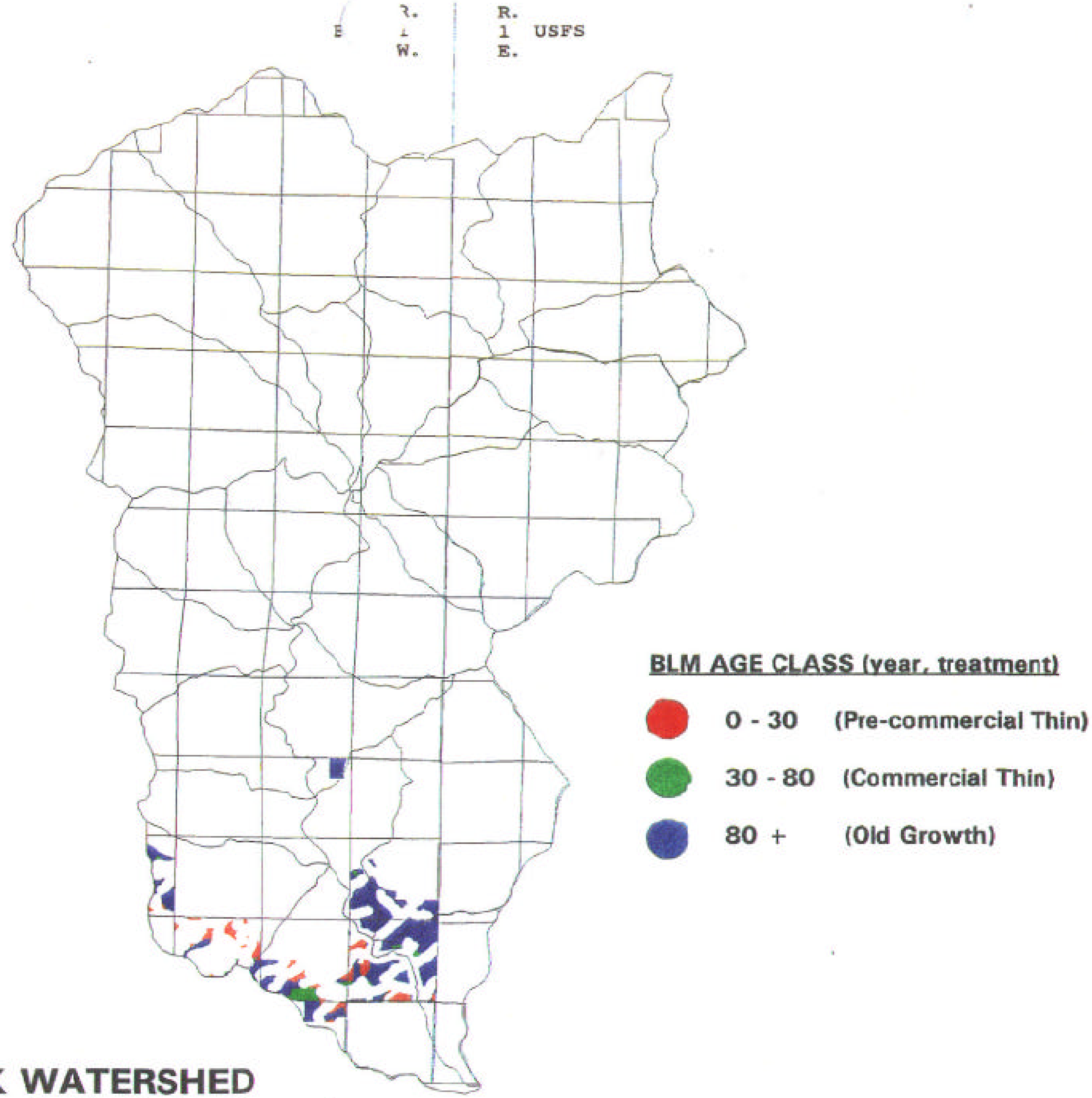
-Connectivity
The objective of these lands on the overall landscape is to provide a bridge between larger blocks of old growth stands and Riparian Reserves (PRMP, p. ix, Vol I). This provides habitat for breeding, feeding, dispersal, and movement of old growth-associated wildlife and fish species (PRMP, Glossary-3, Vol I). In Canton Creek approximately 874 acres of Riparian Reserves overlay the Connectivity lands leaving 404 acres available for silvicultural practices.

-General Forest Management Area (GFMA)
The objective of these lands is to manage on a regeneration harvest cycle of 70 to 110 years, leaving a biological legacy of 6 to 8 trees per acre to assure forest health (PRMP, Glossary-6, Vol. I). In Canton Creek approximately 1,370 acres of Riparian Reserves overlay GFMA lands leaving 658 acres available for silvicultural practices. Within this land designation there are approximately 111 acres in young pre-commercial age class (0 to 30 years), 39 acres potentially available for a commercial thinning (30 to 80 years), and 508 acres available for regeneration harvest (80+ years) (**Figure 5**).

D. LAND EXCHANGE CONSIDERATIONS
Because of the fish values Canton Creek contributes to Steamboat Creek and the North Umpqua Wild and Scenic River corridor, private lands along Canton Creek were considered for exchange in May, 1992. Approximately 2400 acres were considered for exchange with Seneca Timber Company as well as another 920 acres from two other timber companies. The desire was to acquire the riparian lands to protect the recovering second growth forests.

After analyzing Canton Creek the TEAM felt that if private lands were managed according to the Oregon Forest Practices Act adequate protection would be provided for fish values. The specified riparian management areas would provide shade for the stream system as well as larger diameter trees and snags which will later fall into the stream for fish habitat. The management objectives on federal lands in this watershed, especially with 68% of the watershed in LSR, would compensate for the harvesting on private lands. Moreover it was assumed that the 34% of private lands would remain in some aspect of early seral stage, thus providing habitat for species adapted to such an environment. This amount of young forests is estimated to be within natural variation.

Therefore in terms of protection and restoration, a land exchange opportunity did not seem a high priority for this watershed.



CANTON CREEK WATERSHED
(General Forest Management Area Outside Riparian Reserves)

Figure 5

NON-KEY CONCERNS

A. Air Resources

Under guidance from the State Implementation Plan smoke produced from prescribed fire is managed by the Oregon Department of Forestry. Prescribed burns would be planned to prevent nearby communities from receiving higher levels of smoke than given under the State Implementation Plan.

B. Archaeological Sites

The BLM and USFS archaeologists keep an updated list of inventoried cultural sites. How any sites would be impacted depends on the type and extent of a particular project. Cultural sites do not affect the overall management of this watershed. The need for cultural evaluation and mitigation would be evaluated with each project. Any impacts would be addressed in the project environmental analysis.

C. Recreation and Rural Interface

The Canton Creek watershed is not particularly remarkable in terms of recreation use. There is one primitive, non-fee campground in this watershed (Scaredman Recreation site). Scaredman recreation site has 9 campsites and two picnic sites located along Canton Creek. This recreation site does not receive heavy use and what use it does receive is primarily from persons wanting to get more off the beaten path. On hotter days there is some swimming use of Canton Creek by users of the campground. There is also occasional dispersed recreation use of this watershed by hunters and back country drivers. There is no fishing since it is illegal to fish in Canton Creek. Currently there are no plans to expand the recreation program in this drainage.

It should be noted that Canton Creek is an important tributary of Steamboat Creek which is an important tributary of the North Umpqua River. The North Umpqua is a part of the National Wild and Scenic River System, with water quality and fishery being two of its five identified outstandingly remarkable values. Because of its prominent influence to the North Umpqua River, these two values are particularly important in the Canton Creek drainage as well.

D. Special Forest Products

Inventories of Special Forest Products have not been completed but they will probably only have a minor influence in this watershed.

E. Special Status Plants

A significant portion of BLM lands has previously been surveyed although some surveys are older than 10 years. The importance of some species has changed since that time. Additional surveys would be needed before conducting any ground disturbing activities. Much of the habitat that would represent suitable areas for special status plants that has not had previous surveys are currently in exclusion areas. Surveys would need to occur during the blooming periods of any special status plant.

The following is a list of survey and manage plants that may occur in this watershed. The number beside the plant name refers to the ROD page number and the survey strategies required:

		Page No.	Strategy
Fungi:	Oxyporus nobilossimus	C54	1,2,&3
	Rhizopogon truncatus	C49	3
	Cantharellus cibarius	C51	3&4
	Cantharellus subalbidus	C51	3&4
	Cantharellus tubaeformis	C51	3&4
	Gautieria otthii	C49	3
	Otidea leporina	C54	3
	Otidea onotica	C54	3
	Otidea smithii	C54	1&3
	Aleuria rhenana	C54	1&3
Liverworts:	Marsupella emarinata (var. aquatica)	C59	1&2
	Ptilidium californicum	C59	1&2
Lichens:	Pseudocyphellaria rainierensis	C56	1,2,&3
	Hypogymnia duplicata	C56	1,2,&3
	Nephroma occultum	C56	1&3
	Usnea longissima	C57	4
Vascular Plants:			
	Allotropa virgata	C60	1&2
	Cypripedium montanum	C61	1&2
	Cypripedium fasciculatum	C61	1&2
	Aster vialis	C60	1&2
	Bensoniella oregana	C60	1&2
Bryophytes:	Buxbaumia piperi	C58	1&3
	Buxbaumia virdis	C58	1&3
	Rhizomnium nudum	C58	1&3
	Ulota meglospora	C58	1&2
	Tetraphis geniculata	C59	1&3
	Brotherella roelli	C58	1&3
	Ptilidium californicum	C58	1&2

No data on special status plants has been obtained on private lands but could be obtained at a future date from the Oregon Natural Heritage program database.

Species of concern (noxious weeds) data has been obtained from the Department of Agriculture but it is very broad based. The most likely areas to have infestations of noxious weeds occur along heavily traveled roads, river and stream corridors. Their significance, distribution, and location may become of greater concern and importance.

KEY WATERSHED PROCESSES

A. FIRE

Wildland fire in Oregon has been well documented by European settlers (Journals of David Douglas and other Oregon pioneers) from the early 1800s to the present. Fire events were a combination of underburning and partial stand to total stand replacement. Fire has traditionally provided the landscape with a mosaic of different timber types and age classes (Agee 1981, 1991, Franklin and Hemstrom 1981). Fire also created different seral stages of plant and animal species. Timber harvest has replaced the mosaic effects of fire with more uniform age classes.

Historically, fire is the most common disturbance affecting both upland and riparian vegetation in Canton Creek. The moderate fire regime shows a wide variation in fire intensity, severity and return interval. The return interval is 20 to 120 years. Approximately two-thirds of the acres burned at low to moderate intensities resulting in a landscape of 45 to 75 percent late successional vegetation, 10 to 15 percent mid successional vegetation and 10 to 40 percent early successional vegetation. In the low to moderate fires, extensive numbers of live and dead trees remained standing partly because there were few reburns. This resulted in multilayered stands and stands with many snags. In the Western Cascades late successional dependent species evolved with this type of habitat across the landscape.

State of Oregon records from 1914 (**Figure 6**) show that 2793 acres had been burned over along the west side of the Canton Creek watershed. Of this figure 1741 acres or 62% occurred on BLM owned lands, 1017 or 37% on private, and 34 acres or 1% on Forest Service lands. BLM records show 12 lightning caused fires have occurred over the past 15 years on BLM and private lands. These lightning fires were all caught at less than 1 acre in size. These two sets of records support the literature cited above in that fire has played a key role in establishing the present stands and by continuing to exclude fire increases the risk of altering the fire regime.

In the past, federal agencies have used prescribed fire as a site preparation and fuels reduction tool. Private industrial landowners and other public landowners have used prescribed fire in the same fashion. In the last ten years the use of prescribed fire has declined on private lands. This is a result of more material being removed from the site during logging operations with less debris remaining.

In keeping with historical fire occurrence, prescribed fire may be a viable alternative to wildfire. Location, intensity, size, time of year and scorch height can be planned and utilized with prescribed fire. It is impossible to control the same factors with a wildfire. Plants and animals have adapted to frequent fires in this watershed. The long term health of these plants, animals and the watershed could benefit from the use of prescribed burns to alter vegetative patterns.

Wild fires will continue to be suppressed under the current trends. This will protect the younger uniform plantations and allow them to eventually restore late successional vegetation. Without restoration of the natural mix of species in some plantations, these stands may not produce the range of functions that fire-created old growth stands produce.

Fire History

Canton Creek Watershed

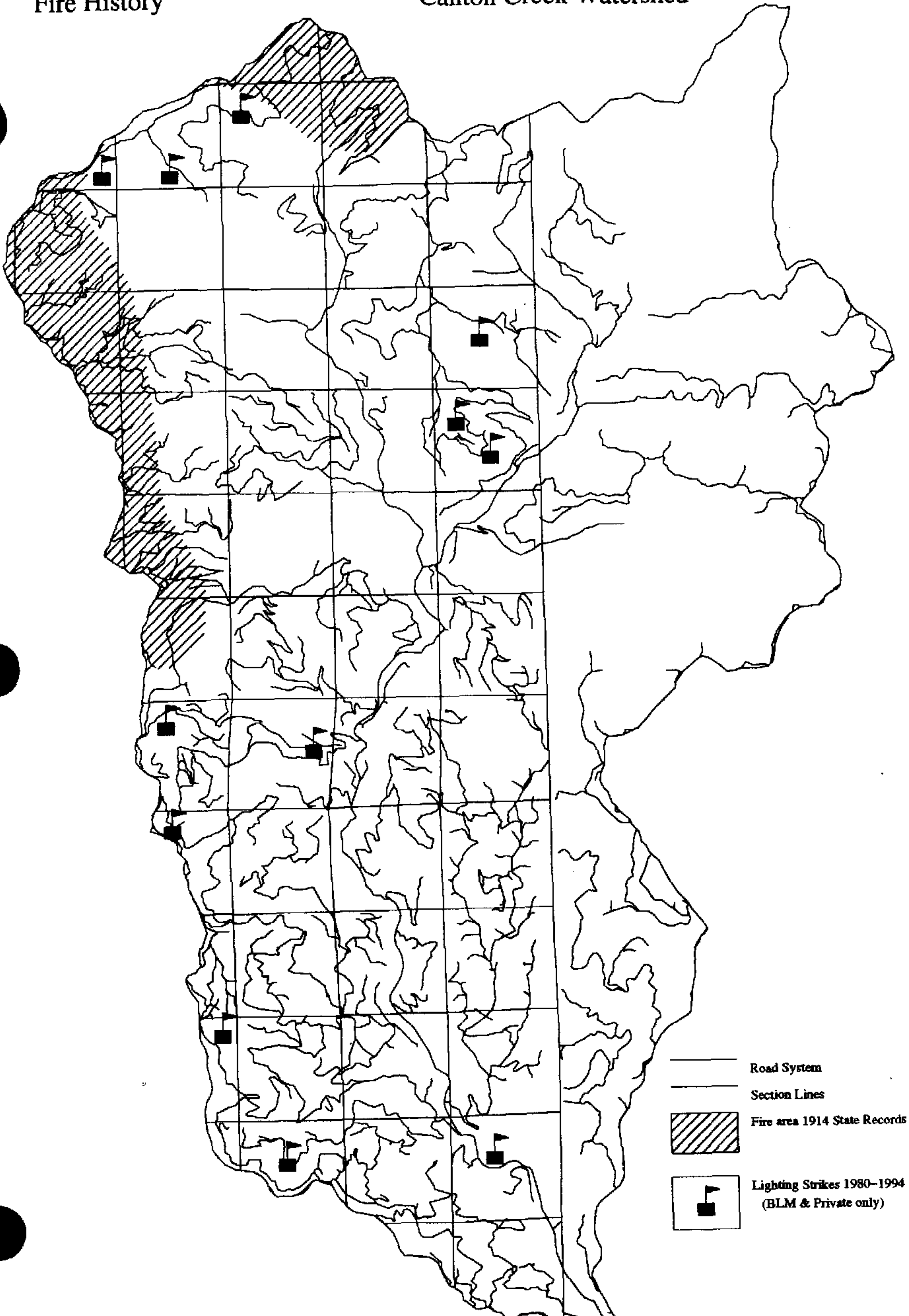


Figure 6

B. HISTORICAL INFLUENCES TO VEGETATIVE CHANGE

A brief look at the cultural history as well as laws and regulations over the past 200 years will help explain the current vegetative patterns. Of what is known about the native Americans who lived in this area there is ample evidence that they used fire to modify the landscape. Fire was used for hunting, maintenance of small meadows and collection of foods such as hazelnuts, acorns, berries, and root crops (Agee 1993).

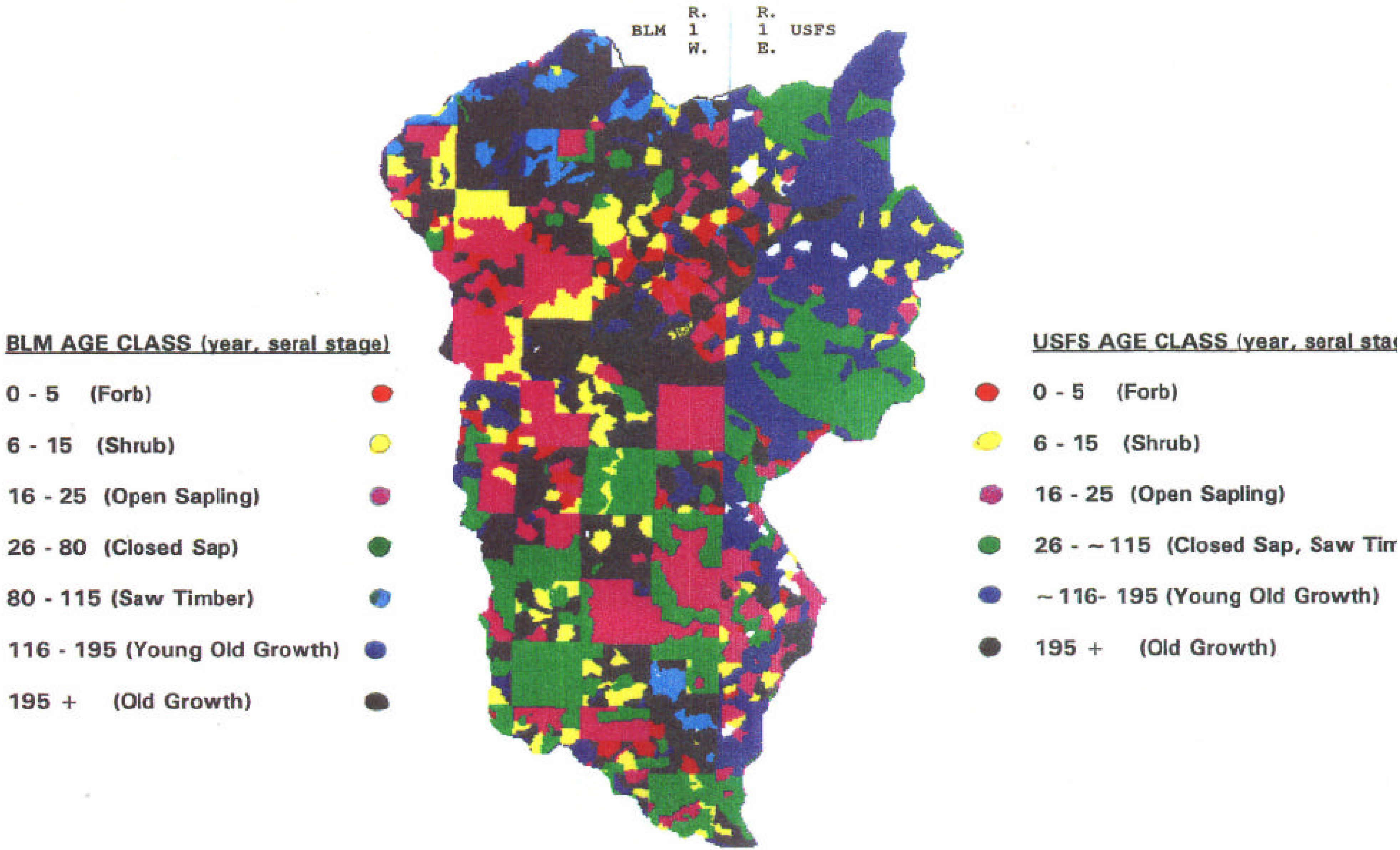
The series of laws enacted between 1850 and 1878 (Donation Land Law, Homestead Law and Timber and Stove Law) encouraged the settlement of Native American lands and extraction of timber. To encourage a railroad connecting Oregon and California for lumber trade, the Oregon & California (O&C) Act was passed in 1869. The alternating sections of land within 30 miles of the railroad were given to the railroad company as the incentive to complete the Oregon segment. The company did not carry out the terms of the Act however. The lands were then surveyed and the timber cruised for resale. The alternating patterns of public and private ownership probably helped create some of the greatest changes to the vegetation in the watershed.

The North Umpqua Ranger District, Umpqua National Forest has aerial photos that were flown in 1949. These photos show that Canton Creek had no major industrial entries up to that point. At that time there was only a small road along the creek. Since the 1960's most if not all of private lands and approximately 40% of federal lands have been harvested and planted back to conifer seedlings.

Between 1966 and 1968 particular attention was focused on the logging practices in the Pass Creek drainage. A film was produced called Pass Creek which showed logging through the creek, skid trails that delivered sediment to the stream and the removal of riparian shading to the stream. Although there are no scientific records to show changes in these particular areas, these management activities probably resulted in warmer stream temperatures and higher amounts of sediment in the stream. Logging practices have changed since that time and the vegetation in these particular stream reaches is now adequately shading the streams as shown in a photo point series taken during a 10 year period after the above incident.

The following **Figure 7 and Table 2** show the overall vegetative patterns. There are 7 general age classes that represent habitat types for wildlife. (Note: Only 6 age classes could be represented on USFS lands because the GIS database could not be analyzed in this manner. Efforts are being made to standardize databases with USFS and other agencies.) The 7 age classes tend to represent the age at which stands reach different seral stage conditions, as described in Brown (1985: Appendix 8). The use of this habitat relationship reference allows wildlife biologists to estimate the suitability of a given landscape for a species of wildlife based on the amount and distribution of seral stages used by that species. It is also useful for analyzing potential hydrologic processes in response to past, present, and future timber management activities.

It is assumed that the 9,800 acres on private lands (24% of the watershed) will be managed primarily for timber production which traditionally has been a rotation schedule from 40 to 65 years. Harvesting would follow the Oregon Forest Practices Act which provides protective buffers along fish bearing streams. The remaining stands would probably remain in early to mid seral vegetative stages.



CANTON CREEK WATERSHED
(Age Classes on Federal & Private Ownership)

Figure 7

CANTON CREEK WATERSHED AGE CLASSES (by acres, % Federal, & % Total Watershed)

TABLE 2

AGE CLASSES

SUB-WATERSHEDS	Acreage	Early [illegible] Federal Acres	% of Federal	Private Acres	% Total of Watershed	Mid [illegible] Federal Acres	% of Federal	Private Acres	% Total of Watershed
LOWER CANTON CREEK									
Coon Creek	[illegible]	149	7.8%	0	7.8%	[illegible]	8.4%	[illegible]	11.7%
Screamer Creek	[illegible]	0	0.0%	3	0.2%	167	10.6%	0	10.6%
Camp Creek	[illegible]	0	0.0%	0	0.0%	107	13.2%	0	13.2%
Wolverine Creek	1308	0	0.0%	0	0.0%	54	4.1%	0	4.1%
Trapper Creek	1273	56	4.4%	0	4.4%	41	3.2%	31	5.7%
Grizzly Creek	1236	111	9.0%	0	9.0%	88	7.0%	84	13.9%
Ring Tail Creek	1260	0	0.0%	0	0.0%	274	21.7%	3	21.9%
Buck Creek	1702	72	4.2%	0	4.2%	21	1.2%	16	2.3%
Salmon Creek	637	7	1.1%	0	1.1%	0	0.0%	0	0.0%
Chilcoot Creek	3226	151	4.7%	0	4.7%	136	4.2%	0	4.2%
Brouse Creek	1184	1	0.1%	0	0.1%	100	8.7%	27	11.0%
Lower Canton Creek	[illegible]	0	0.0%	0	0.0%	0	0.0%	0	0.0%
HiPower Creek	3081	133	4.3%	0	4.3%	231	7.5%	3	7.6%
Bloody Point	842	0	0.0%	0	0.0%	23	2.7%	0	2.7%
SUB-TOTAL	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PASS CREEK									
Mellow Moon Creek	2804	137	4.7%	[illegible]	4.7%	18	0.6%	286	10.4%
Upper Pass Creek	3180	125	3.9%	0	3.9%	76	2.4%	482	18.0%
East Pass Creek	3287	0	0.0%	0	0.0%	131	4.0%	79	6.4%
Lower Pass Creek	824	93	11.3%	0	11.3%	116	14.1%	95	25.6%
SUB-TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12.4%
UPPER CANTON CREEK									
Lost Bucket Creek	1317	259	19.7%	0	19.7%	49	3.6%	0	3.6%
Francis Creek	1694	87	5.1%	0	5.1%	99	5.7%	0	5.7%
Upper Canton Creek	2980	0	0.0%	0	0.0%	131	4.4%	0	4.4%
McKinley Creek	[illegible]	0	0.0%	0	0.0%	203	15.7%	0	15.7%
No Man Creek	1350	1	0.1%	0	0.1%	78	5.9%	0	5.9%
Middle Canton Creek	577	46	8.0%	0	8.0%	44	7.6%	0	7.6%
SUB-TOTAL	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	0	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SUB-WATERSHEDS	Open Sap [illegible] Federal Acres	% of Federal	Private Acres	% Total of Watershed	Closed Sap [illegible] BLM Acres	% of Federal	Private Acres	% Total of Watershed	USFS Close Sap/Saw Timber (26–115 yrs) USFS Acres	% Total of Watershed
LOWER CANTON CREEK										
Coon Creek	47	2.8%	281	15.6%	137	8.7%	642	36.4%	13	0.7%
Screamer Creek	139	8.4%	49	11.4%	259	16.0%	871	67.9%	0	0.0%
Camp Creek	35	3.4%	177	21.6%	95	9.6%	223	33.0%	0	0.0%
Wolverine Creek	60	4.6%	287	26.0%	120	9.6%	411	41.0%	0	0.0%
Trapper Creek	[illegible]	4.6%	271	25.9%	108	8.3%	188	23.1%	0	0.0%
Grizzly Creek	34	2.8%	378	33.3%	3	0.2%	27	2.4%	0	0.0%
Ring Tail Creek	60	5.0%	122	14.5%	83	6.6%	77	12.7%	0	0.0%
Buck Creek	37	2.2%	284	18.4%	146	8.6%	309	26.7%	108	6.3%
Salmon Creek	0	0.0%	314	49.3%	0	0.0%	0	0.0%	160	25.1%
Chilcoot Creek	80	2.5%	16	3.0%	0	0.0%	0	0.0%	[illegible]	61.3%
Brouse Creek	16	1.4%	226	20.4%	1	0.1%	348	28.2%	0	0.0%
Lower Canton Creek	0	0.0%	417	44.6%	0	0.0%	241	25.7%	0	0.0%
HiPower Creek	714	23.2%	299	32.9%	0	0.0%	507	16.5%	185	6.0%
Bloody Point	113	13.4%	0	13.4%	0	0.0%	30	3.6%	147	17.5%
SUB-TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PASS CREEK										
Mellow Moon Creek	302	10.4%	1036	47.1%	44	1.6%	0	1.6%	0	0.0%
Upper Pass Creek	120	3.8%	333	14.3%	41	1.3%	29	2.2%	0	0.0%
East Pass Creek	24	0.7%	88	3.4%	54	1.6%	66	4.6%	0	0.0%
Lower Pass Creek	7	0.8%	49	6.8%	0	0.0%	3	0.4%	0	0.0%
SUB-TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.4%	[illegible]	[illegible]	[illegible]	[illegible]
UPPER CANTON CREEK										
Lost Bucket Creek	251	19.0%	0	19.0%	0	0.0%	0	0.0%	0	0.0%
Francis Creek	246	14.6%	0	14.6%	56	3.3%	0	3.3%	39	2.3%
Upper Canton Creek	128	4.3%	0	4.3%	0	0.0%	0	0.0%	702	23.6%
McKinley Creek	5	0.4%	0	0.4%	0	0.0%	0	0.0%	54	4.2%
No Man Creek	190	14.1%	0	14.1%	0	0.0%	0	0.0%	79	5.9%
Middle Canton Creek	156	27.0%	0	27.0%	0	0.0%	0	0.0%	43	7.5%
SUB-TOTAL	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SUB-WATERSHEDS	Saw Timber [illegible] BLM Acres	% of Federal	Private Acres	% Total of Watershed	Young Old Growth [illegible] Federal Acres	% of Federal	Private Acres	% of Total Watershed	Old Growth [illegible] Federal Acres	% of Federal	Private Acres	% Total of Watershed
LOWER CANTON CREEK												
Coon Creek	0	0.0%	21	1.1%	127	6.7%	[illegible]	7.0%	[illegible]	[illegible]	[illegible]	[illegible]
Screamer Creek	0	0.0%	0	0.0%	60	3.6%	[illegible]	3.9%	284	16.8%	0	16.6%
Camp Creek	0	0.0%	0	0.0%	0	0.0%	0	0.0%	305	31.6%	0	31.6%
Wolverine Creek	0	0.0%	0	0.0%	10	0.8%	0	0.8%	367	28.0%	1	28.1%
Trapper Creek	0	0.0%	0	0.0%	87	6.8%	0	6.8%	424	33.3%	[illegible]	33.6%
Grizzly Creek	0	0.0%	0	0.0%	270	21.8%	0	21.8%	243	19.7%	0	19.7%
Ring Tail Creek	0	0.0%	0	0.0%	24	1.9%	0	1.9%	605	47.9%	7	48.6%
Buck Creek	0	0.0%	0	0.0%	220	12.9%	0	12.9%	485	28.7%	2	28.9%
Salmon Creek	0	0.0%	0	0.0%	18	2.8%	0	2.8%	142	22.3%	0	22.3%
Chilcoot Creek	0	0.0%	0	0.0%	975	30.2%	0	30.2%	242	7.5%	0	7.5%
Brouse Creek	0	0.0%	0	0.0%	21	1.8%	0	1.8%	434	36.7%	4	37.0%
Lower Canton Creek	63	6.7%	0	6.7%	4	0.4%	0	0.4%	199	21.2%	0	21.2%
HiPower Creek	80	2.6%	0	2.6%	496	16.1%	0	16.1%	402	13.0%	0	13.0%
Bloody Point	53	6.3%	0	6.3%	257	30.5%	0	30.6%	185	22.0%	0	22.0%
SUB-TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PASS CREEK												
Mellow Moon Creek	0	0.0%	0	0.0%	54	1.8%	0	1.8%	993	34.2%	0	34.2%
Upper Pass Creek	221	6.9%	0	6.9%	139	4.3%	24	5.1%	1526	48.1%	76	50.4%
East Pass Creek	418	12.7%	0	12.7%	427	13.0%	0	13.0%	1901	57.8%	31	58.8%
Lower Pass Creek	0	0.0%	0	0.0%	65	7.8%	0	7.8%	401	48.7%	2	48.9%
SUB-TOTAL	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
UPPER CANTON CREEK												
Lost Bucket Creek	12	0.9%	0	0.9%	152	11.5%	0	11.5%	629	47.8%	0	47.8%
Francis Creek	43	2.5%	0	2.5%	308	18.2%	0	18.2%	780	46.0%	0	46.0%
Upper Canton Creek	0	0.0%	0	0.0%	1734	[illegible]	0	[illegible]	[illegible]	6.1%	0	6.1%
McKinley Creek	0	0.0%	0	0.0%	959	74.3%	0	74.3%	2	0.2%	0	0.2%
No Man Creek	0	0.0%	0	0.0%	946	70.1%	0	70.1%	6	0.4%	0	0.4%
Middle Canton Creek	0	0.0%	0	0.0%	225	39.0%	0	39.0%	65	11.3%	0	11.3%
SUB-TOTAL	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.[illegible]	[illegible]	17.[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1426 2362 2792 1120 3154 7581 11170

63%

6580ac

74%

C. PRECIP. PATTERNS, GEOLOGY, & EFFECTS ON STREAM TEMPERATURE & EROSION

1. Precipitation

As stated in the introduction this watershed averages 54 to 80 inches in annual precipitation. Most of this precipitation occurs from the months of November to April in the form of rain or snow. Approximately 36,699 acres or 90% of the watershed is in the transient snow zone (TSZ). The TSZ is characterized by elevations between 2000 and 5000 feet and precipitation comes in the form of rain or snow (**Figure 8**). Increasing amounts of snow accumulate on the ground in areas where the forest canopy has been removed. Rain on snow events can cause a rapid melt of the snowpack creating a large influx of water into the watershed in a short period of time. This creates higher peak flows in the streams and higher pore water pressures in soils (Harr 1981, 1986). Higher peak flows can result in: greater streambank erosion, greater sediment and large woody debris transport, increased flooding, and degradation of fish habitat. Higher pore water pressure in soils can trigger landslides in unstable areas.

2. Geologic Environment

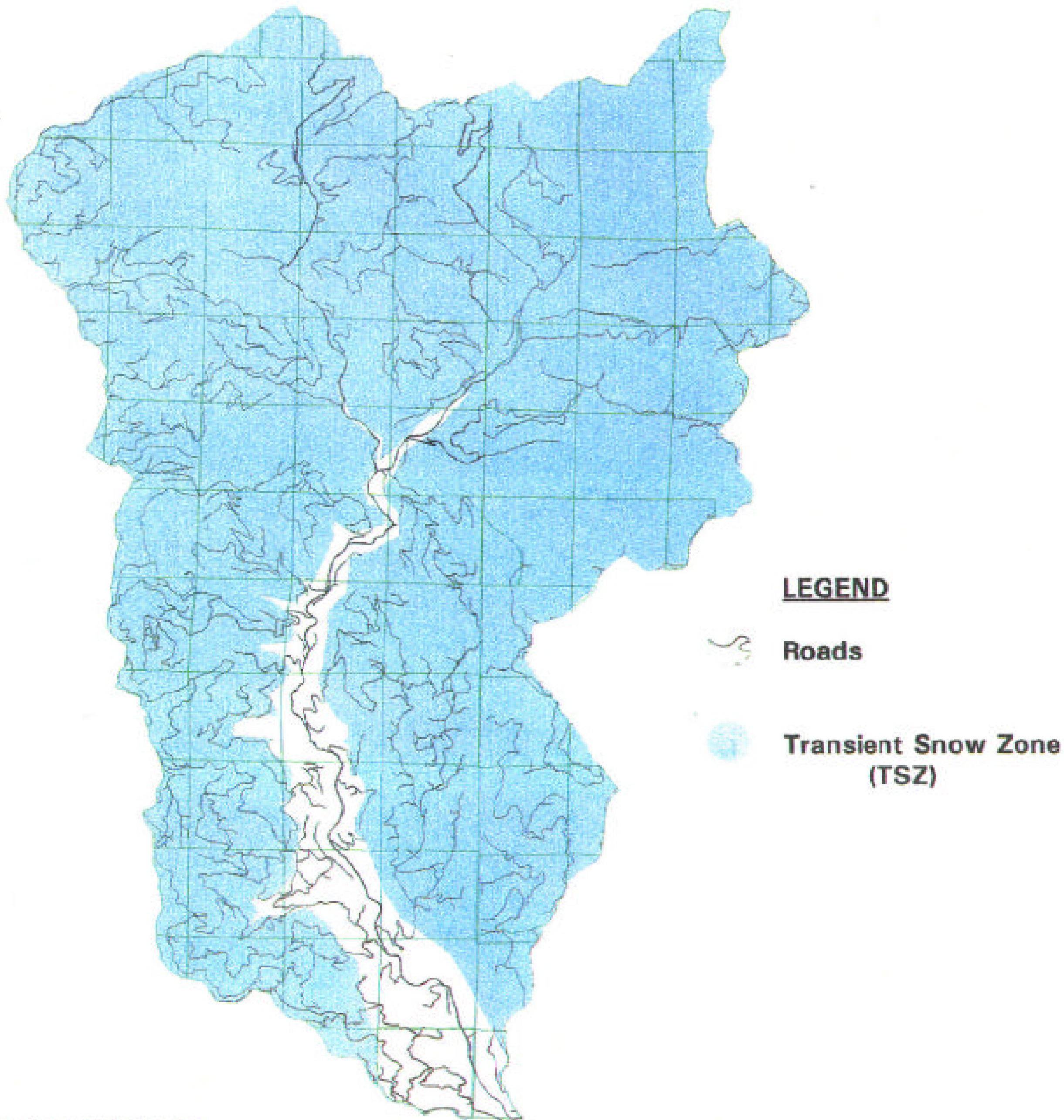
The Canton Creek watershed is considered to be within the Western Cascades physiographic province. The Western Cascades physiographic province is characterized by rock units that vary in age from 45 million years old to recent deposits. The vast majority, however are volcanic and volcaniclastic rocks that include basalts, andesites, dacites, ash-flow tuffs and flow breccias. This assemblage of rocks its commonly referred to as the Little Butte Volcanic Group (Sherrod, 1986). Within the Canton Creek watershed, bedrock exposures are associated with ridgecrest outcrops, crowns of landslide scarps, along existing road cuts and inner gorges associated with stream channels. The following **Table 3 and Figure 9** show the general characteristics of Canton Creek watershed.

Table 3 Geologic Units in Canton Creek Watershed

ROCK UNIT	Private	BLM	USFS	TOTAL
Tub basalt	5,163 ac	6,385 ac	840 ac	12,389 ac
Tus brecia	4,476 ac	9,736 ac	5,798 ac	20,011 ac
Tsv dacite	180 ac	133 ac	251 ac	564 ac
Tut tuff	32 ac	797 ac	6,118 ac	6,947 ac
Q1s slides		599 ac	48 ac	647 ac

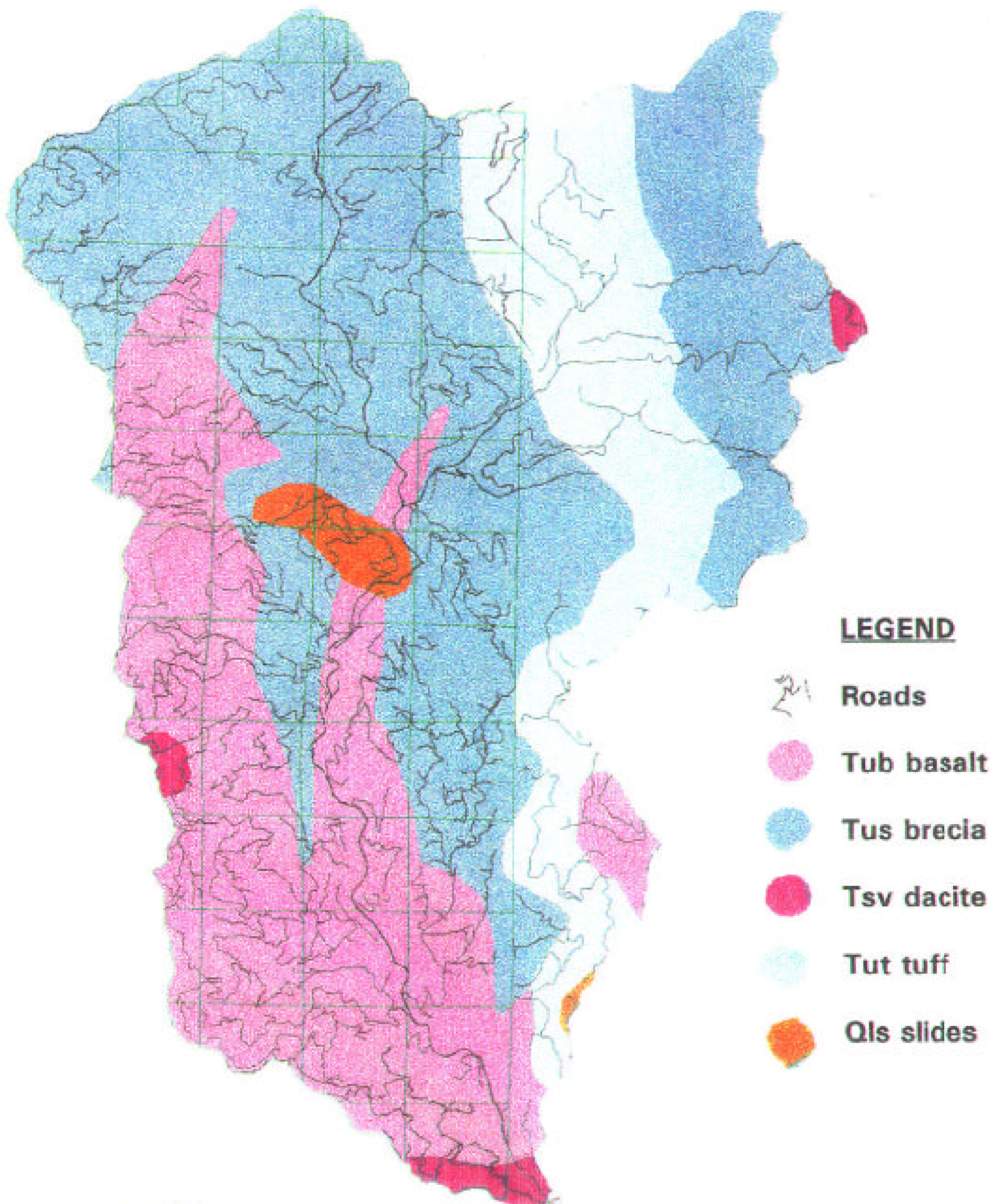
3. Geomorphic Landforms

Landforms in Canton Creek include alluvial terraces, bedrock terrain, landslide terrain (including landslide and landslide deposits) and debris slide terrain. Recent alluvial terraces and floodplains include small deposits along Canton Creek and tributaries such as Pass Creek and Chilcoot Creek. These deposits represent material that has been transported and reworked, primarily under large storm flows. In addition, a number of depositional features are found that are downstream of prominent swales and are usually composed of coarse-grained poorly sorted colluvial material. These are often associated with debris slide and torrent deposits.



CANTON CREEK WATERSHED
(Transient Snow Zone, 2000 ft to 5000 ft)

Figure 8



CANTON CREEK WATERSHED
(Geologic Units on Federal & Private Ownership)

Figure 9

The configuration of the drainage pattern in Canton Creek appears to be controlled by geologic units. The lower reaches of Canton Creek is associated with a competent basalt unit (Tub) that has controlled the development of the canyon, resulting in a narrow confined bedrock system. This basalt has also influenced the pattern of tributaries that join Canton Creek. The tributaries intersect the main stream at, or near right angles, reminiscent of the 90 degree fracture pattern characteristic of basaltic weathering.

The upper reaches of Canton Creek, particularly associated with the East Fork and Pass Creek are controlled by an assemblage of volcanic sediments, breccias tuffs and mudflow deposits (Tus, Tut). These rock units, particularly in an altered state are much more susceptible to weathering and erosional processes than basalts and hard tuff deposits. This has resulted in an extensive drainage development that is dendritic in character.

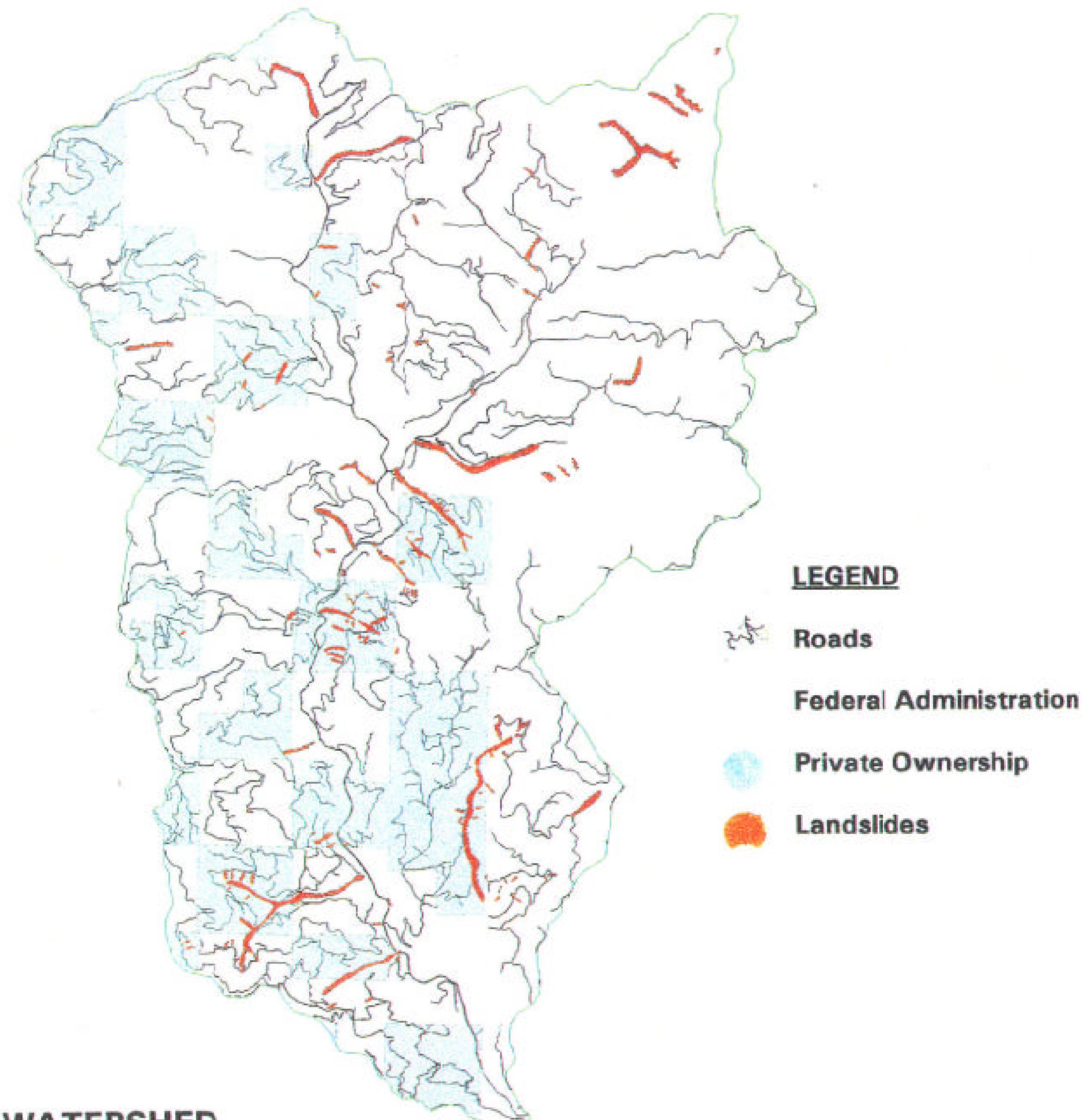
The Canton Creek drainage also has several large ancient landslide deposits that have developed in association with weathering of pyroclastic material over basaltic flow rock (Qls). These features are usually associated with relatively gentle slopes and deep fine textured soils. Within these deposits, subsurface flow and surface flow are important in developing drainage patterns and influencing slope stability.

The initial scoping process and previous knowledge of the Canton Creek basin supported the analysis team in the identification of debris slides and debris torrents as significant mechanisms that have impacted the beneficial uses. As a result, the available information (air photos, project files) was compiled and a map was developed that portrayed the approximate location of landslides for the watershed (**Figure 10**). This map identified several compartments to field sample in order to calibrate and validate the photo interpretation. **Table 4** represents the distribution of landslides by rock unit, by compartment as well as estimate of channels impacted by debris torrents.

Based on the interpretation and limited sampling in the watershed, several trends were identified in this review of the existing condition. The number of landslides occurring in association with the Tus (breccia) landscape was significantly larger than the other 2 major rock units combined. While this appears to be proportional to the acreage, there is a disproportionate relationship between the landslide occurrence and management impacts. Several factors appear to be contributing to this occurrence. The strength of the rock, combined with associated physical and chemical weathering properties result in a steep and dissected landscape that is naturally prone to mass wasting (debris slides) when subject to disturbance, either natural or induced. In addition to the inherent weakness of the rock, management activities (roads and timber harvest) were identified or associated with 125 slide features (94%). While there was limited opportunity to validate these features, a sample of 5 compartments (Scaredman, Buck, HiPower, Salmon, and East Pass Creeks) was conducted. These samples confirmed that what was identified on the photos were landslide features.

4. Stream Temperature

Stream temperature is biologically of most concern during the lower flow period of the summer months. Before road building and timber harvesting occurred in the Canton Creek watershed, wildfire and mass wasting had the greatest effect on summer stream temperatures. Both processes removed stream shade from perennial streams allowing solar radiation to heat the streams during the seasonally lower flow period. The actual occurrence of these two processes were seasonally different; that is, the wildfire occurred during the more critical low flow period and mass wasting during the wetter winter period. In addition to shade removal, mass wasting also widened the channels while impacting the adjacent channel growing sites, removed channel bed material often to bedrock creating more efficient channels with less complexity, reduced or eliminated inter-gravel flow, and impacted the ground water interface and exchange. The wider channels with shallow summer flow in less complex condition warmed more



CANTON CREEK WATERSHED
(Roads & Landslides on Federal & Private Ownership)

Figure 10

Canton Creek Watershed Analysis Landslide/Debris Torrent Table
Number of Slides by Rock Unit
Miles of Channels Associated With Debris Flows

Table 4

	Numbers of Slides			
COMPARTMENT	basalt	breccia	tuff	Debris Flows (miles)
(W) No Man			1	0.4 No Man Cr
(J) Chilcoot		4		1.5 Chilcoot Cr
(I) Salmon		6		1.6 Salmon Ck
(H) Buck		27		1.7 Buck Ck
(M) HiPower	1	12	12	3.4 HiPower Ck
(A) Coon	5			1.0 Coon Ck
(B) Scaredman	20			2.7 Scaredman Ck
(K) Brouse	4			
(S) Lost Bucket		2		
(T) Francis	1	1		0.3 Francis Ck
(U) Upper Canton		13		2.3 Upper Canton Ck
(P) East Pass		3		2.2 East Pass Ck
(C) Camp	3			0.2 Camp Ck
(D) Wolverine	1			0.4 Unnamed Ck
(E) Trapper	1			
(F) Grizzly		2		
(O) Mellow Moon	3	3		0.5 Mellow Moon
(R) Lower Pass		6		
TOTAL	38 (29%)	80 (61%)	14 (11%)	18.2 miles

efficiently.

The summer stream temperatures have been affected by road building and timber harvesting. These activities removed riparian trees either by harvesting (in units or road location) or accelerating mass wasting as debris torrents in the channels. Holaday (1992) found a significant decreasing trend of the maximum summer temperature in Canton Creek for the 1969-1990 period. This study determined that the "regrowth of riparian vegetation that was previously removed by flooding, debris torrents, or streamside harvesting appears to be the major cause of trends in the decreasing maximum summer stream temperature." Road locations in riparian areas have shown the least shade recovery. The amount of debris torrents has been accelerated in frequency. This has simplified more of the stream channels and allowed more efficient stream heating. The recovery of the stream bed through depositional processes will take many decades which limits recovering temperatures. The vegetation and geology/roads sections of this report provide addition process detail for riparian vegetation and mass wasting.

5. Erosion

Several natural processes appear to be important in the Canton Creek watershed, specifically the natural erosion that is occurring and its relationship to the sediment regime. A primary erosion process that has developed the landscape in Canton Creek is associated with mass wasting (debris slides). There is abundant evidence that debris slides have occurred throughout the landscape, although there appears to be a disproportionate number associated with the Tus (volcaniclastic material). Historically, it appears that these debris slides were triggered in association with natural disturbances such as intense fires and major storm events. This is based on observations of similar age classes on debris deposits in channels relative to the surrounding slopes.

In conjunction with debris slides influencing the landscape on the slopes, they have also resulted in the development of many of the stream channels in the drainage. Specifically, a number of channels observed suggest that historic debris flows have occurred and contributed to the channel condition. These flows have transported large volumes of material, with the end result being some reaches of channel that are scoured to bedrock and extremely simplified. Other stream channels are aggraded to the point of being filled and in some cases only sub-surface flow occurs. In these cases surface flow is minimized to the highest stream flows.

While landslides have played an important part in the development of the landscape and contributed to the natural sediment regime, other sources of sediment are factors in the development of the ecosystem. Specifically surface erosion from upslope areas as well as the natural erosive forces of concentrated flowing water act as removal and transport agents in the system.

An important factor with regards to sedimentation is the size and availability of sediment in the system. In Canton Creek, the inherent geologic units are volcanic in nature and with few exceptions tend to weather and erode to boulder to cobble material (based on limited observations). This appears to either limit the amount of fines available, or support the concept that the energy of the systems does not allow wide scale deposition.

Under the natural condition, sediment can be displaced and removed through a variety of disturbance mechanism's such as weathering of rock, wind throw, frost heave, or removal of cover by fire or animal trails. Removal of sediment can occur as a result of overland flow, rill and gully erosion. Sediment associated with stream channels occurs in a variety of ways, including undercutting of stream banks, reworking of alluvial or colluvial deposits and deposition of sediments as stream energy allows.

D. PROCESSES ASSOCIATED WITH MANAGEMENT ACTIVITIES

1. Hydrological

This analysis identified that there were about 18 miles of valley bottom road along Canton Creek and Pass Creek (within 200 feet of creek). Casual observations suggested that a number of road segments were immediately adjacent to the streams and the road fill had encroached on the flood plain. This encroachment has contributed to a loss of useable flood plain and reduced the area available for storage and deposition of wood and sediment. Confinement of the channel by embankments increases energy and in several areas forced the channel into the opposite bank resulting in increased bank cutting. This confinement also increases the potential for stream side landslides where the creek hits the toe of the fill.

2. Timber Harvest

The harvest of timber can be broken into several components, felling of the trees and yarding of the trees to a landing. While the felling of the trees is an impact that could contribute to the sediment regime, the erosional processes associated with yarding can be significant. In Canton Creek the two primary yarding techniques identified were ground skidding (tractors) and cable yarding.

Ground skidding operations require the use of tractors or skidders operating on skid roads. While these skid roads vary in character, in general they result in surface disturbance such as compaction and soil displacement that has the potential to modify erosional processes. Skid roads also have a tendency to collect and concentrate surface water which disrupts the natural flow regime.

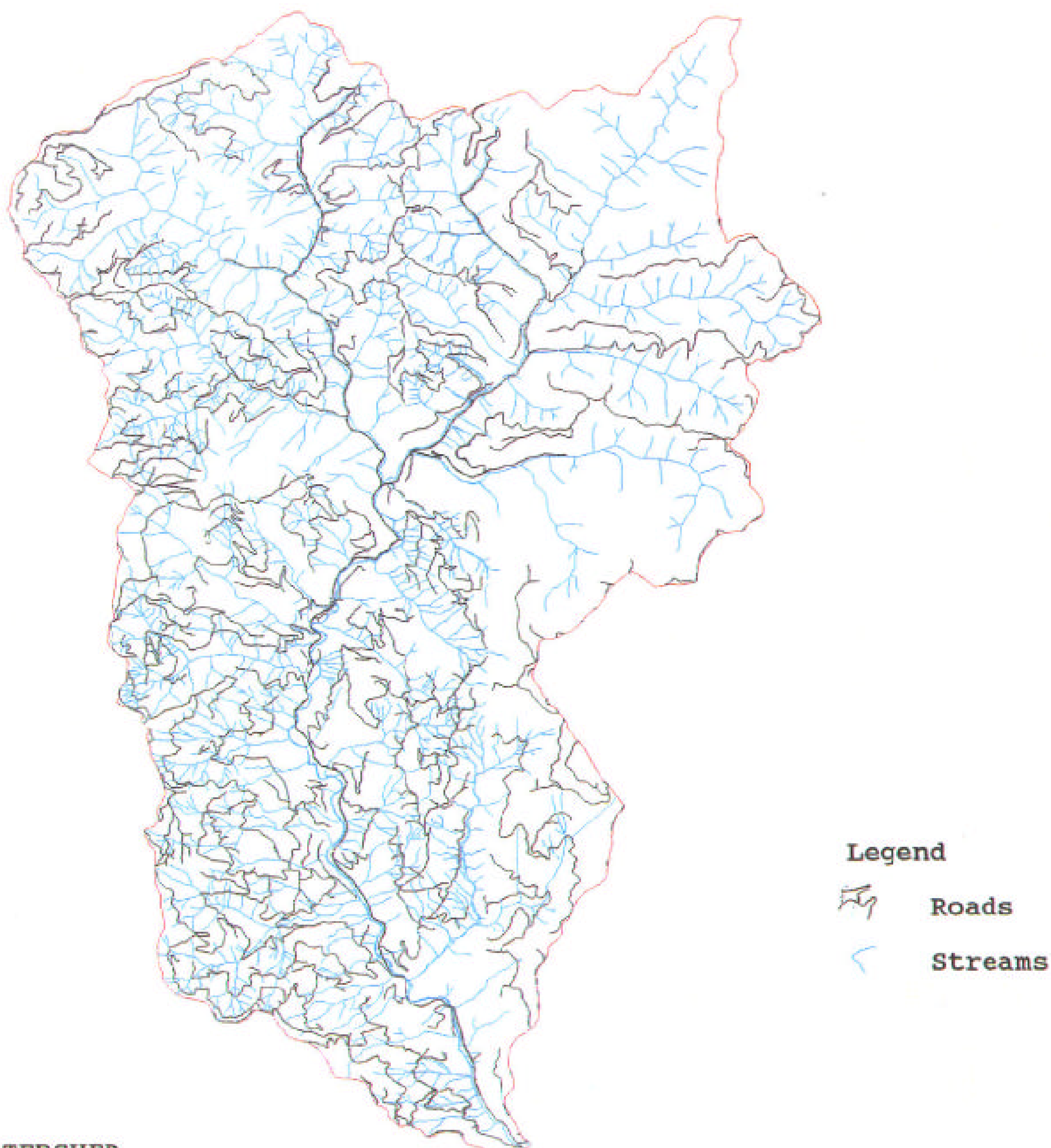
Cable yarding has undergone an evolution in the last several decades from high-lead to full suspension. The age of plantations in Canton Creek suggest that the full spectrum of cable yarding has occurred in this area. While not as impacting as ground skidding, cable yarding has resulted in numerous yarding corridors. These corridors are subject to increased erosion due to loss of surface cover. The nature of cable yarding suggest activity on steep slopes which when combined with linear exposed surfaces lead to the development of rill and gully erosion. In addition, certain situations have developed that concentrate surface runoff into colluvial hollows, where slides are likely to develop.

3. Transportation

The transportation network in Canton Creek has developed over the past several decades utilizing a wide variety of construction practices and techniques. As a result, road related sedimentation has been identified as a process that is affecting the beneficial uses. **Figure 11** shows the road and stream system in Canton Creek and **Table 5** shows road and stream lengths and densities. The road and stream lengths came from databases in the Geographical Information System (GIS). The GIS road inventory came from both BLM and USFS data using satellite imagery and previous road records.

The stream lengths were measured from BLM map inventories (7½ minute quadrangle maps based on contour elevations) for private and BLM lands, USFS inventoried perennial streams, and estimates of intermittent stream drainage densities on USFS lands. In this analysis two distinct sedimentation processes are addressed, mass wasting (landslides and debris flows) and surface erosion.

Mass wasting in Canton Creek appears to be associated with stream crossings, road drainage structures and sidecast fills and landings that are oversteepened and/or contain organic debris. A preliminary landslide inventory on the drainage suggests that a number of stream crossings have failed as a result of debris slides initiated upslope from roads and drainage features which resulted in debris flows in the channel. While these crossing were designed to handle streamflow, in many cases the crossings were plugged by slide



CANTON CREEK WATERSHED

Figure 11

CANTON CREEK

Table 5

Stream and Road Densities Compared by Compartment

Compartment Names	Total acres	Stream Length (miles)	Stream Density (mi/mi²)	Road Length (miles)	Road Density (mi/mi²)
Coon Creek*	1,892	19.8	6.7	17.8	6.0
Scaredman Creek	1,591	18.3	7.4	17.9	7.2
Camp Creek	964	9.9	6.6	10.7	7.1
Wolverine Creek	1,309	18.6	9.1	11.8	5.8
Trapper Creek	1,273	17.7	8.9	15.1	7.6
Grizzly Creek	1,235	11.2	5.8	9.9	5.1
Ring Tail Creek	1,263	14.0	7.1	11.5	5.8
Buck Creek*	1,702	18.8	7.1	12.3	4.6
Salmon Creek*	637	6.4	6.4	5.3	5.3
Chilcoot Creek*	3,226	12.4	2.5	6.9	1.4
Brouse Creek*	1,184	12.8	6.9	11.2	6.1
Lower Canton Creek	936	13.0	8.9	9.5	6.5
HiPower Creek*	3,081	41.7	8.7	21.1	4.4
Bloody Point*	842	9.8	7.4	4.9	3.7
Lower Canton Cr	**21,135**	**224.4**	**6.8**	**165.9**	**5.0**
Mellow Moon Creek	2,904	35.8	7.9	22.9	5.0
Upper Pass Creek	3,199	32.3	6.5	18.9	3.8
East Pass Creek	3,287	31.0	6.0	18.0	3.5
Lower Pass Creek	824	11.3	8.8	5.0	3.9
Pass Cr	**10,214**	**110.4**	**6.9**	**64.8**	**4.1**
Lost Bucket Creek*	1,317	14.5	7.0	9.8	4.8
Francis Creek*	1,694	18.9	7.1	10.6	4.0
Upper Canton Creek*	2,990	28.0	6.0	5.7	1.2
McKinley Creek*	1,296	12.2	6.0	4.8	2.4
No Man Creek*	1,350	12.7	6.0	7.2	3.4
Middle Canton Creek*	577	8.5	9.4	4.7	5.2
Upper Canton Cr	**9,224**	**94.8**	**6.6**	**42.8**	**3.0**
TOTAL	**40,573**	**429.6**	**6.8**	**273.5**	**4.3**

* Stream lengths were estimated based on projections from similar geology.

debris and subsequently acted as debris dams that eventually failed and scoured the channels downstream.

Road drainage structures, including ditches, cross drains and culverts have also resulted in a large number of failures in the drainage. In a field sample of the slide features, a number of sites were identified where these structures failed to contain the runoff and water was diverted to areas not designed to receive it, making the material saturated and unstable. Specifically, failures were identified with plugged ditches and culverts and unprotected outlets that saturated otherwise stable fill slopes.

Sidecast fills and landings built either as self balanced roads or disposal sites were also associated with a number of failures. There appeared to be 2 causal mechanisms that initiated these failures. The placement of uncompacted material on slopes that exceed the angle of repose (60-70%) on steep slopes allow for gravity to initiate movement, particularly when this material becomes saturated.

The other factor identified was the incorporation of large organic material (logs and stumps) into the fill. While this material originally served to anchor the surrounding material, over time it decays and the fill is left with large voids. In some cases these voids are large enough that with the addition of moisture (snow and rain) the fill cannot support its weight and collapses, triggering a debris slide.

The landslide inventory and assessment was done using historic photos as well as recent flights in an effort to bracket when these slides occurred. While a number of slides are visible in photos after the 1964 floods, it appears that there has been a significant number of slides that become apparent sometime after 1974. This suggests that these slides are associated with more frequent storm intervals, not necessarily just big storms.

4. Surface Erosion and Sedimentation

Due to time constraints, a formal road sediment delivery analysis was not done. However, reasonable statements and assumptions can be made from previous research and local erosional process studies. Numerous studies have found that the amount of sediment production from road prisms depends primarily on proximity to streams, road surfacing, maintenance levels, road traffic, and the condition of the cutbanks.

Results of the referenced study indicates the relative importance of sediment production from various sources (Ref. L.M. Reid, T.Dune - Sediment Production From Forest Roads):

Sediment Source		Av. Sediment Yield % of Total
Surface of Roads (Gravel)	- Heavy Use	70.8
	- Moderate Use	9.8
	- Light Use	3.8
Cutbanks, ditches of active roads		4.5
Other		11.1

The proximity of the sediment source to the stream plays an important role in the delivery of the eroded sediment material into the stream. Research has established that transport distances of sediment below fill slopes is less than 100 feet and less than 200 feet for sediment associated with culvert flows.

Potential sediment delivery from graveled and native surfaces depends on the amount of use and time of use. Timber haul during wet periods on these surfaces cause most of the sediment yield.

Paved roads have approximately 85 to 90% less sediment production than graveled roads.

The estimated length of roads within 200 feet of the following streams:

Pass Creek	6.0 mi.
Upper Canton	6.0 mi.
Lower Canton	6.4 mi.
Total	18.4mi.

Length of roads within 100 feet of stream crossings (upper drainage culverts) is 16.6 miles. This is in addition to the miles identified above in the major drainages. These figures suggest that 35 miles of road are in close proximity to flowing water and subject to road induced sediment sources with a potential for delivery.

KEY CONCERNS ANALYZED

Analysis was more narrowly focused by developing the key concerns for this particular watershed. Other issues are briefly discussed but are not considered as major recipients or influences of the processes within this watershed. The non-key concerns and their related information could still be used for project level environmental analysis. The major management issues or concerns for Canton Creek identified by the TEAM include the following:

1. Water Quality
2. Fish
3. Special Status Animal Species

WATERSHED: PAST, PRESENT, & FUTURE CONDITIONS BY KEY CONCERNS

A. WATER QUALITY

Key Questions:

1. What is the extent and condition of the water quality within Canton Creek?
   (Past and present overall stream water quality conditions.)

2. What are the past and present stream temperatures?
   (Summer stream temperature distribution. Summer stream temperatures influence on aquatic habitat. How land management activities have influenced summer stream temperatures.)

3. What are the flow regimes?
   (Influences of the summer and winter streamflows on the aquatic habitat. How land management activities have influenced the flow regimes.)

4. How have roads and stream crossings effected stream sedimentation?
   (Road surface type and road crossings effects on sedimentation.)

1. Past and Present Water Quality Conditions

Standards by Law

The Clean Water Act provides direction "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters". The Act empowers the States to set water quality standards, which are a combination of numerical criteria (ie. temperature or turbidity), designated beneficial uses, and an antidegradation policy to protect water quality conditions needed for the beneficial uses. To achieve the standards, conservation practices are implemented to control and reduce pollution from non-point sources such as forest management activities.

The State Antidegradation Policy found in the Department of Environmental Quality (DEQ) Oregon Administrative Rules (OAR) under Chapter 340-41-026, is intended "to maintain the quality of waters" in Oregon. The specific purpose of this policy is "to guide decisions that affect water quality such that unnecessary degradation from point and non-point sources of pollution is prevented, and to protect, maintain, and enhance existing surface water quality to protect all existing beneficial uses". The rules and appropriate criteria provide the consistency in the identification of water quality concerns and needs and was used where applicable in the evaluation of Canton Creek's water quality.

As part of the Antidegradation Policy, waterbodies are classified as either High Quality Waters, Water Quality Limited Waters, or Outstanding Resource Waters. Within the Canton Creek watershed, all streams are in the High Quality Waters category. Although water quality conditions of concern have been initially identified in this watershed, the State assessment process directed by the Clean Water Act has not listed these conditions as water quality limited. The High Quality Waters category only allows lowering of the water quality condition if standards are met and beneficial uses are protected where economic or social development benefits are high and no reasonable alternatives exist.

National Wild and Scenic Rivers are priority waterbodies for nomination to the Outstanding Resource Waters category. Specific water quality values "shall be maintain and protected" under this category and not lowered. The North Umpqua Wild and Scenic River is a potential nomination. If selected, the potential accumulative contribution from Canton Creek to the North Umpqua water quality would be an additional concern.

Umpqua Basin Standards list salmonids and resident fish, aesthetic quality, and water contact recreation as beneficial uses, and these same values are among the Outstandingly Remarkable Values of the North Umpqua Wild and Scenic River. Simply put, any activity in Canton Creek which interferes with or injures fish, scenic, recreation, or water quality values is also prohibited under this river designation.

Existing Stream Network

There are approximately 430 miles of streams (Table 5, pg 31) in the 63 square mile Canton Creek watershed. The stream density is 6.8 miles per square mile. There are an estimated 126 miles of streams on Umpqua National Forest administered lands, 180 miles on Roseburg District BLM administered lands, and 124 miles on private lands. This stream inventory comes from a data base which has varying levels of completeness for land ownership and stream order. The smaller first and second order intermittent streams have the highest density but are not as well identified in the current inventory. Canton Creek is a 6th order stream, and the largest tributary of the 227 square mile Steamboat Creek watershed.

General Water Quality

The DEQ conducted a statewide assessment of stream quality conditions for certain beneficial uses and published the results in 1988. Water quality for fisheries support and the physical aquatic habitat were two of the beneficial uses that were rated. Canton Creek was stratified into two segments. From the mouth to the confluence with Pass Creek, Canton Creek was rated severe, with supportive data, because of insufficient stream structure. A moderate sedimentation problem was also observed without data. From the Pass Creek confluence to the upper aquatic reach, the rating was moderate because of insufficient stream structure. The assessment identified mass wasting, surface erosion, vegetative removal, and road location as the "probable cause" for these conditions.

Sedimentation and Turbidity

Sedimentation was identified as a concern by the Oregon Department of Fish and Wildlife in the aquatic inventory report for Canton Creek which was done during the summer of 1993. In Reach #2 from Hipower Creek to Brouse Creek, sand, silt, and organic matter occupied 18% of the wetted area in riffles. For the five reaches evaluated, this fine texture material occupied only 5% of the total wetted area.

Turbidity, which is "the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample" (APHA, AWWA, and WPFC, 1985), has been monitored in Canton Creek at the mouth since 1972. Turbidity is caused by the finer texture matter in suspension such as clay, silt, finely divided organic and inorganic matter. Turbidity is a good indicator of how well fish can see to feed or how a waterfall appears; that is, the clarity of water.

An analysis of the turbidity record which was flow generated by winter storms shows Canton Creek turbidity per unit of flow declining through the 1970's and increasing in 1991 and 1992. **Figure 12** displays the 1972-1992 results. The more recent higher response may be explained by the milder winters with below normal runoff events. If this true, future analysis of more normal winters, such as 1993, should show a similar response as the 1980's. For the period of record, Canton Creek has been more turbid per unit of flow than Steamboat Creek.

The monitoring results have shown relatively low turbidity compared to other streams but a higher presence of coarser sediments, which have lesser affect on turbidity. In comparison with Elk Creek on the South Umpqua River and Layng Creek to the north, Canton Creek turbidities appear relatively low. A study of suspended sediment (that is, turbidity suspension and the more coarser sediment such as sand) in Southwestern Oregon (Curtiss, 1975) found that Steamboat Creek, which includes Canton Creek, had higher annual sediment yields (770 tons per square mile) than the South Umpqua River at Tiller (310 tons per sq. mi.), or Cow Creek near Azalea, Oregon (290 tons per sq. mi.). Because of the present lack of stream structure in Cánton Creek and the tributaries, aquatic life is more easily subject to scour from the coarser sediments and experience a more harsh winter environment.

2. Stream Temperatures

The summer stream temperatures of Canton Creek and tributaries are often above the Umpqua Basin criteria of 58 degrees Fahrenheit (°F) which is identified by DEQ in the Oregon Administrative Rules, Chapter 340 (DEQ, 1992), for the protection of the aquatic environment. This water quality criteria does not allow measurable temperature increases as the result of land management activities when stream temperatures are 58°F or greater. The maximum summer stream temperature in the main stem of Canton Creek has frequently equaled or exceeded 70°F for the record of stream temperature monitoring.

Stream temperature has been monitored the longest at the mouth (1969-71, 1975, 1977-82, 1985-93) and the Douglas County gaging station (1981 to 1990), which is approximately 2 miles upstream of the mouth. Holaday (1992) evaluated the water temperature at the mouth of Canton Creek for the 1969 to 1990 period and found a significant trend of decreasing maximum summer temperature. He associated the decreasing temperature trend with recovering riparian vegetation which had been removed by flooding, debris torrents, or timber harvest.

An expansion of the summer temperature monitoring was done in 1992 and 1994. During both of these summers, low flow was below average providing the potential for high stream temperatures. The new stations in 1992 included Pass Creek near the confluence with Canton Creek, Mellow Moon (Call) Creek which is a tributary of Pass Creek, and upper Canton Creek below Pass Creek. **Table 6** displays the 1992 results:

Steamboat & Canton Creeks
Late Season
Turbidity per Unit of Flow
1972-1992

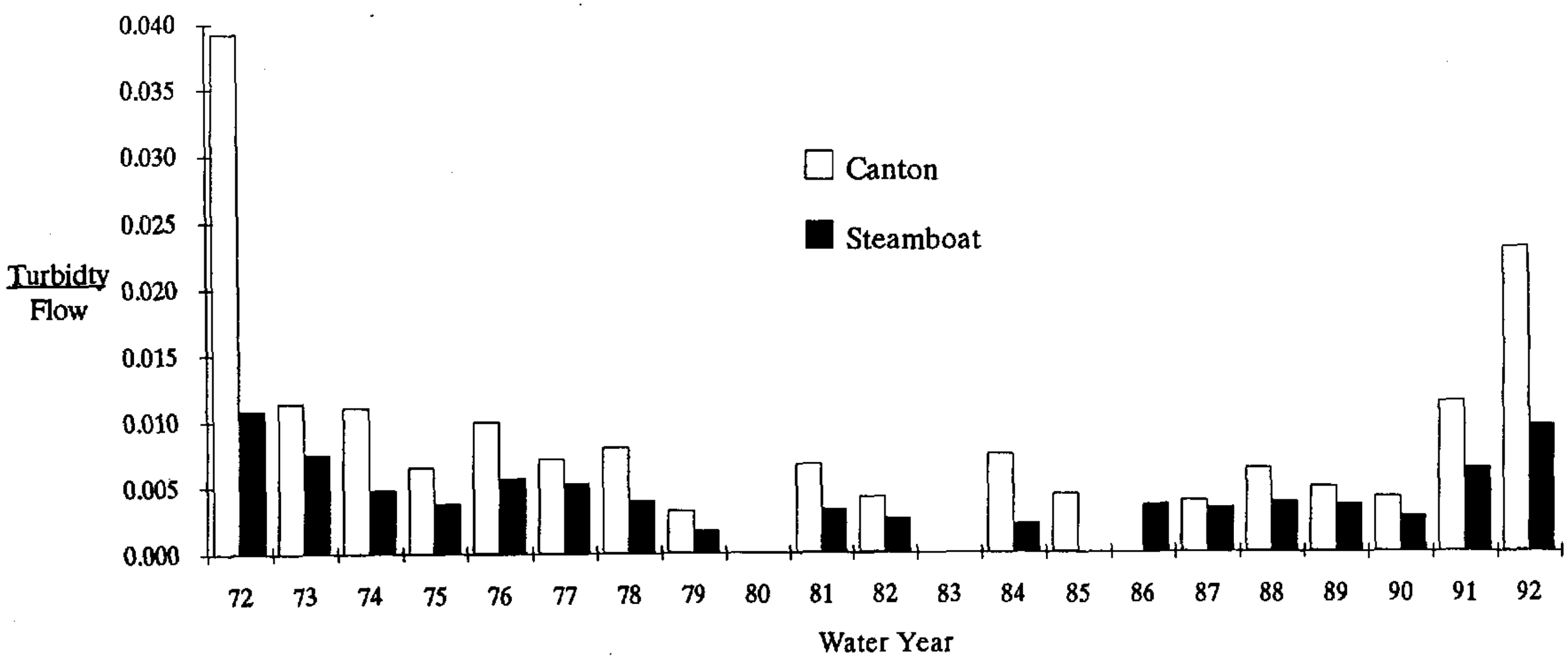


Figure 12

Table 6 **1992 Summer Stream Temperatures**

Site Location	Watershed Area (mi²)	Max. Temp.	1992 Dates	14-Day Mean Max. Temp.	1992 Dates
Canton Creek @ mouth	63.50	73.6°F	8/14,18	71.6°F	8/7-20
Canton Creek above Pass Creek	20.44	68.7°F	8/18	66.1°F	8/7-20
Mellow Moon (Call) Creek	4.29	61.9°F	7/31	60.8°F	7/10-31
Pass Creek below Mellow Moon Cr	20.44	69.8°F	8/14,18	67.3°F	8/7-20

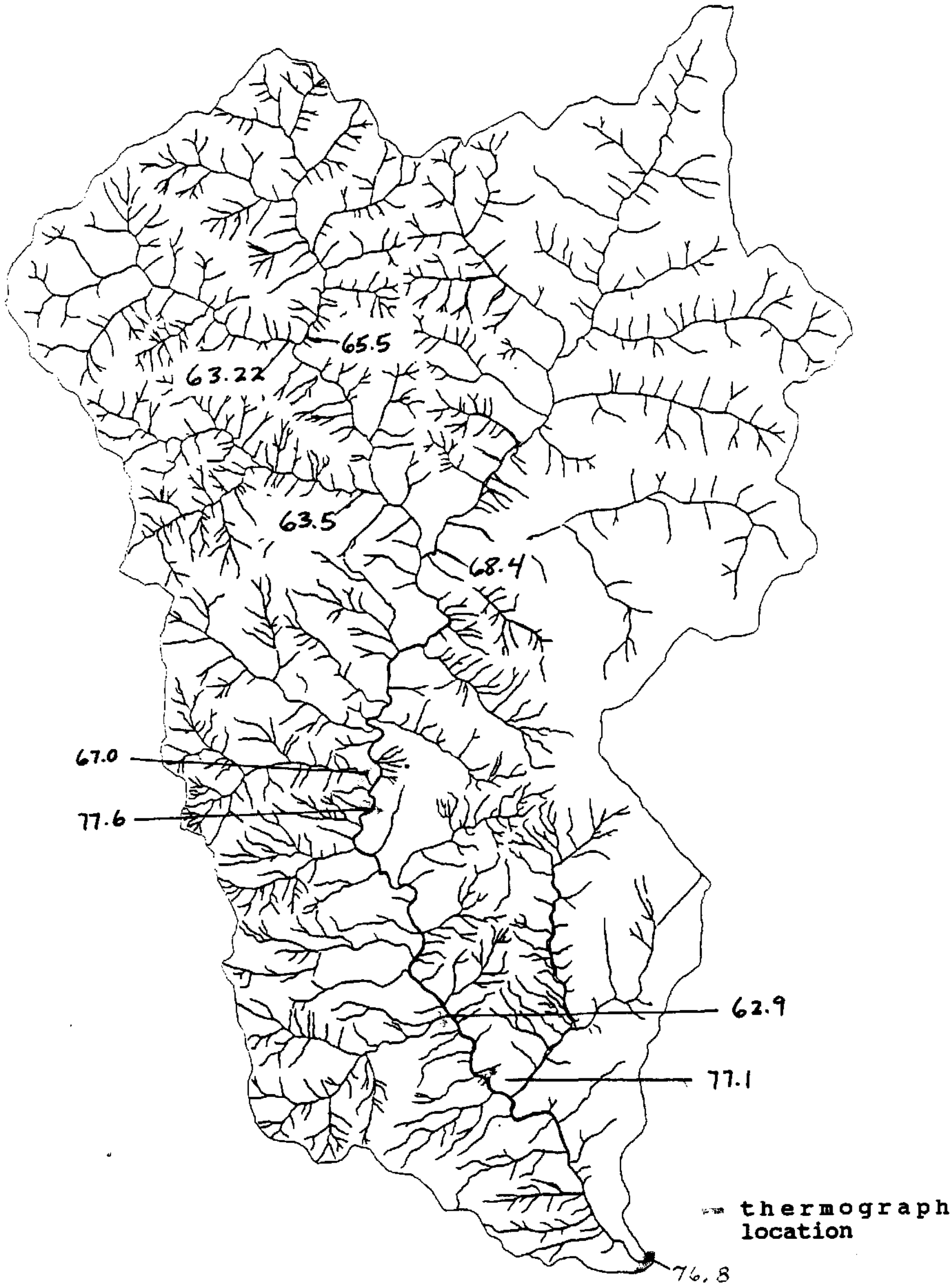
During 1994, Scaredman Creek, Canton below Trapper Creek, Trapper Creek, East Fork Pass Creek, and Upper Pass Creek were added to the 1992 monitoring network. The Pass Creek above Mellow Moon Creek site has no data for 1994 because the temperature monitor was stolen. The 1994 monitoring sites and maximum temperatures are shown on **Figure 13 and in Table 7** (additional monitoring sites for 1994 are marked with "*").

Table 7 **1994 Summer Stream Temperatures**

Site Location	Max. Temp.	Date 1994	14-Day Mean Max. Temp.	Date 1994
Canton Creek @ mouth (USFS)	76.8°F	7/21	73.2°F	7/16 - 7/29
* Canton Creek @ gaging sta.	77.1°F	7/21	68.2°F	7/16 - 7/29
* Scaredman Creek	62.9°F	7/21	60.9°F	7/16 - 7/29
* Canton Creek	77.6°F	7/23	74.0°F	7/16 - 7/29
* Trapper Creek	67.0°F	7/21	64.2°F	7/16 - 7/29
Canton Creek above Pass Creek	68.4°F	7/21	65.5°F	7/16 - 7/29
Mellow Moon (Call) Creek	63.5°F	7/21	61.7°F	7/17 - 7/30
Pass Creek above Mellow Moon Cr	No Data	—	No Data	—
* East Fork Pass Creek	65.5°F	7/21	63.3°F	7/17 - 7/30
* Upper Pass Creek	63.2°F	7/21	61.4°F	7/17 - 7/30

The maximum stream temperatures in lower Canton Creek during 1992 and 1994 were warm for continuous periods of time. The lower reach of Canton Creek at the mouth exceeded 70°F on 41 days or 45% of the 1992 three month monitoring period. During 1994, this same site had 30 days or 30% exceeding 70°F. When compared to the Umpqua Basin criteria of 58°F, only on three days was the 1992 maximum temperatures below this criteria. During 1994, all days of the monitoring period were above the basin criteria.

Minimum stream temperatures may represent the only time that the aquatic environment is under less heating stress and is allowed time to recover from warm days. During 1992, the daily minimums at the mouth exceeded 58°F on 81 days or 88% of the time. Daily minimums in 1994 exceeded 58°F on 80 days or 80% of the time.



Maximum water temperatures in the Canton Creek watershed, 1994.

In comparison, Boulder Creek, which is a 38 square mile wilderness watershed that is a tributary to the North Umpqua River, maximum temperature in 1992 was 70°F and occurred twice. The 14-day mean maximum temperature was 67.4°F for the same period. The daily maximum temperatures were usually above the basin criteria except for six days. Daily minimums were equal to or greater than 58°F on 66 days or 73% of the time.

The duration that maximum temperature exceeds a level of concern is critical compared to the single maximum value. The maximum temperature at the mouth of Canton Creek was 6.8°F warmer than Boulder Creek. Canton was greater than 70°F for 45% of the time while Boulder equaled 70°F for 2% of the same period. Boulder minimums were below the 58°F level 14 days more than Canton.

The maximum temperature distribution for 1994 is displayed in **Figure 13**. The mid and lower main stem peaked at about 77°F. However, upper Canton peaked about 8° cooler. From the upper site to the mouth of Canton Creek, the 14-day mean maximum stream temperature increased 7.7°F (5.5°F in 1992) over a distance of approximately 10 stream miles. The tributaries maximums ranged from 62.9°F (Scaredman) to 67°F (Trapper). All of the sites measured maximums and minimums greater than the basin criteria. The greatest heating occurred from the mid main stem to the mouth. This is where the channel is wide and bedrock with shallow streamflow and reduced shade from harvesting and road location. The cooler temperatures in Pass Creek and upper Canton provide the better thermal aquatic habitat.

3. Streamflow

Streamflow plays an important role in the water quality of Canton Creek. Forest management activities in the watershed have influenced changes in the present volume and timing of runoff. Peakflows have affected the channel stability and is reflected in the aquatic habitat condition and measured in the sedimentation and turbidity levels. Summer low flow has influenced maximum stream temperatures.

Steamboat Creek along with Canton Creek may provide half or more of the flood peak in the 800-square mile North Umpqua River below their confluence. In late summer, Steamboat and Canton Creek combined flow has been less than 40 cfs of warm (over 70°F) water entering 60-65°F water of the North Umpqua, where flow is 600-1000 cfs. Canton Creek makes up about 24 percent of Steamboat's low flows and about 35 percent of Steamboat's floods.

A Canton Creek gaging station (No. 143117530) operated by Douglas County is located approximately 2 miles upstream of the Canton and Steamboat confluence. Immediately downstream of this confluence there is a U.S. Geologic Survey (USGS) station on Steamboat (No. 14316700). A second county station is located approximately 5 miles downstream of the Steamboat Creek and North Umpqua River confluence. Flood and low flow frequency analyses are currently only available for the USGS station on Steamboat Creek. During the period of record (1980 to present) for the Canton Creek gaging station, the major floods in Canton Creek compared to the Steamboat flows and flood return periods were:

Table 8 Canton and Steamboat Stream Flow Comparison

DATE	CANTON CR (cfs)	STEAMBOAT CR (cfs)	FLOOD RETURN PERIOD (yr)*
Dec 6, 1981	8,450	23,900	6
Feb 23, 1986	No Data	21,750	5
Jan 10, 1989	7,670	22,470	5
Jan 7, 1990	6,700	19,700	4

cfs - cubic feet per second

* Flood Return Periods extrapolated from USGS, Statistical Summaries of Streamflow Data in Oregon: Volume 2: Open-File Report 93-63.

Drainage Area at stream gaging station:

Steamboat 227 square miles
Canton 54.6 square miles

This period of record reveals that Canton Creek has experienced four peak flows averaging a 5-year event in a recent 10-year period. The smaller Canton Creek watershed appears to more efficiently route runoff as reflected in the average peak flow per area of 139 cfs per square mile (CFSM) compared to an average 97 CFSM for Steamboat. These four storms included runoff driven by warm air and rain on melting snow (rain-on-snow).

Canton Creek flood peaks are among the highest in the Western Cascade mountains. Existing and discontinued streamgages on Steamboat Creek and downstream on the North Umpqua show that the biggest floods occurred in the first half of this century, with only 1 large peak since 1955. There were peaks with return periods greater than 10 years (many were 25-year floods) in 1909, 1927, 1942, 1945, 1950, and 1955 on the North Umpqua River. After streamgages were installed on Steamboat Creek in 1956 and a small tributary of Little Rock Creek in 1964, a flood larger than a 100-year event occurred on December 22, 1964. Since then, the 8 largest floods have had return periods of only about 5 years.

Landslides and debris flows often accompany large floods, and together they dramatically shape the stream network and aquatic life in it. In 1964, Steamboat Creek watershed including Canton, with a mean annual flow of about 740 cubic feet per second (cfs), reached 51,000 cfs. That resulted in overbank flooding, headwater and main channel shifts in Steamboat and Canton, and many plugged culverts failed including road fills and caused debris torrents throughout their watersheds. Estimates based on the relationship between the Canton and Steamboat gaging stations show it is likely that Canton flowed almost 18,000 cfs during that flood. Small drainages, like the 2.01 square mile Little Rock Creek tributary with a crest (peak) gage on it, flood more efficiently from their small areas. Flows from this gage show that 100-year floods on similar small streams in Canton reach 280 cfs per square mile. Flood peaks throughout Steamboat and Canton are roughly 60 percent higher than similar watersheds on the South Umpqua.

A cumulative plot of each year's highest flood peak on Steamboat Creek from 1956-1991 showed that floods may have increased about 5% after the 1964 flood. When debris torrents and overbank flows remove the wood and pools that absorb and delay flood peaks (and when such debris was removed from streams before and after the flood), floods in Steamboat and Canton would be expected to peak sooner and higher. Although that is consistent with observations of some scoured and widened channels, this increase hasn't been tested for statistical significance (Umpqua National Forest, 1993). Theoretical calculations for a 12-year frequency flood show that canopy removal may be responsible for more than a 5 percent increase in Steamboat/Canton flood peaks, if flood peaks are proportional to accelerated snowmelt from openings during rain-on-snow floods (Umpqua National Forest, 1990). Flood peaks may have been increased more than this in larger floods, as a result of combined canopy removal, channel extension by road drainage, stream simplification, and as a result of more disturbance in the Canton Creek basin than in Steamboat.

Flood peaks, especially the largest floods caused by warm air and rain on melting snow, have accompanied landslides and debris flows in Canton Creek. These large accelerated sediment pulses have impacted the watershed aquatic habitat, water quality, and created chronic winter sediment sources.

Where canopy has been removed or altered by timber harvesting in Canton Creek, snow pack accumulation is expected to be greater with loss of interception and heat transfer to the snow would be more efficient which accelerates melt during a warm rain-on-snow event. This condition has the potential to produce greater water delivery to the soil which could contribute to increased peakflow.

The present hydrological recovery condition for rain-on-snow events was evaluated by estimating stand structure and canopy cover from stand age. An area was assumed to be hydrologically recovered when the trees are older than 40 years (Coffin and Harr, 1992). This assumption implies that the stand canopy would be at least 70% closed and capable of snow interception and buffering heat transfer during a rain-on-snow event. Plantations that were 10 years or younger were considered unrecovered. Silvicultural activities that accelerate growth were not factored. This approach was used to identify the areas in Canton Creek that would be potentially less responsive to this rain-on-snow process and more likely not experiencing peakflow increases. This condition would help to identify refugia where possible restoration would protect or improve the aquatic habitat.

The hydrological recovery condition was determined for the compartments and also grouped into the three sub-basins Upper Canton Creek, Pass Creek, and Lower Canton Creek (refer to **Figure 2, 2A and Table 1**, *pgs 7-9). **Figure 14 and Table 9** shows the potential hydrological recovery condition for each* compartment in Canton and the three sub-basins. Of the 3 sub-basins, Upper Canton Creek has the highest current potential hydrological recovery condition and Pass Creek is next. Lower Canton Creek is considerably lower than the other two.

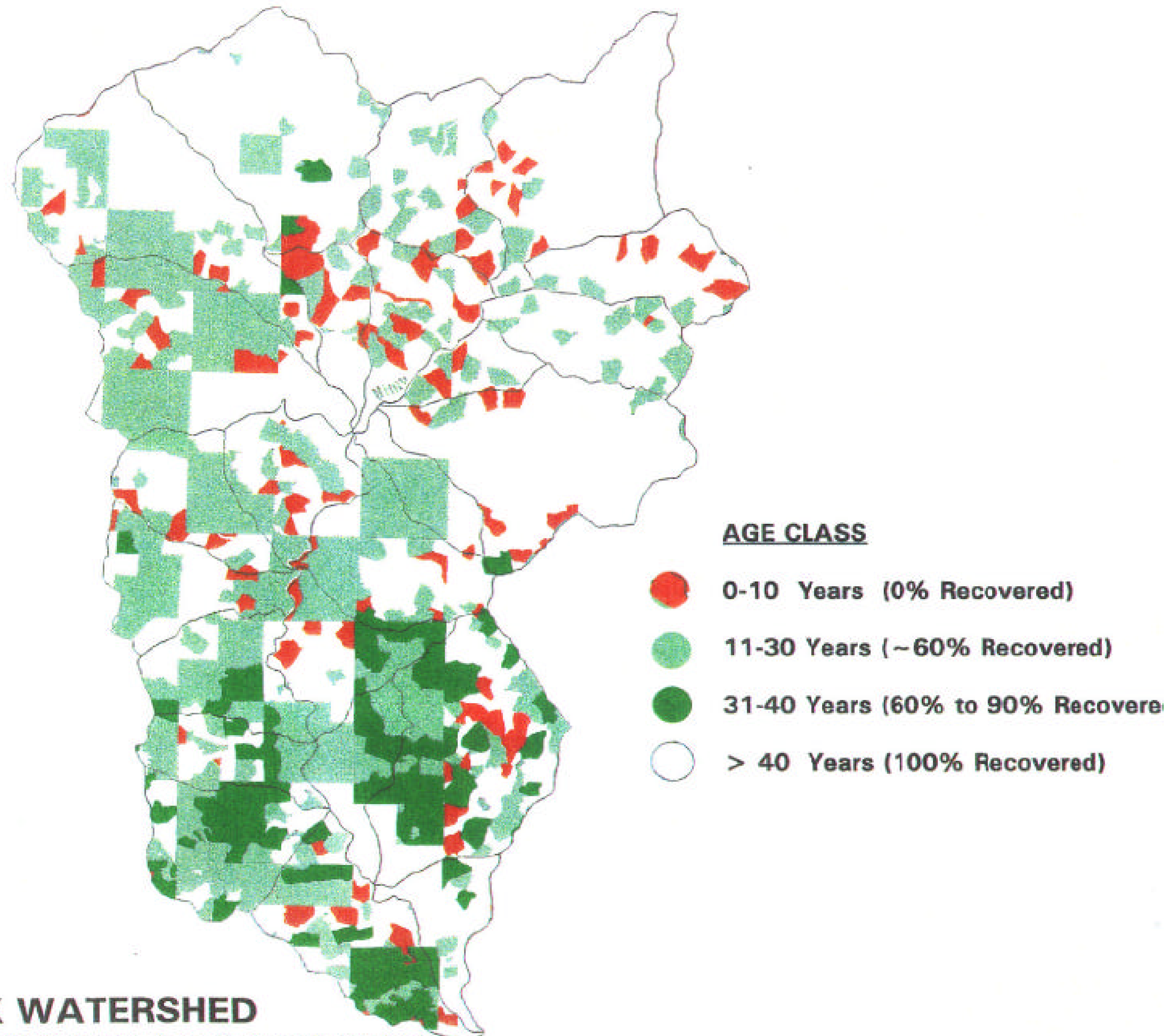
Summer low flow in Canton Creek and most tributaries is typically less than 0.2 CFSM. However, four tributaries have been identified with greater flow. During the low flow period of September, 1981, Scaredman, Trapper, Grizzly, and Mellow Moon (Call) Creeks were contributing higher flows per area compared to other tributaries and the combined flows at the gaging station or at the mouth of Canton Creek. **Figure 15 and Table 10** display this low flow distribution.

The influence of these four tributaries on Canton low flow aquatic habitat and indirectly the summer temperatures is not apparent. For example, the 1994 maximum stream temperatures during a near record low flow summer in the main stem of Canton below Trapper Creek was 77.6°F while Trapper was 67.0°F. However, the greater and cooler low flow in these tributaries may provide site specific refuge both in the tributary and the immediate area of the confluence with Canton. Further aquatic habitat evaluation would help define the influence of these tributaries.

For the Canton Creek gaging station period of record (water year 1980-1993), the extreme instantaneous low flow was 6.1 cfs on October 10-21, 1992 or 0.11 CFSM. The low flow typically occurs in September. However, the wetter fall seasons in water years 1983 and 1985 resulted in August low flow period. The 1994 flows were not available for this analysis.

Channel Extension by Roads and Effect on Peak Flows

The routing of surface flow through road drainage has been identified as a contributor to shortened stormflow response and increased peakflow. Wemple (1994) showed that road ditches leading to streams and gullies added to the stream length effecting the peak flow. Her study suggested that the stream



CANTON CREEK WATERSHED

(Hydrologic Recovery, Stands < 40 Years of Age, Federal & Private)

Figure 14

Table 9

CANTON CREEK WATERSHED
Hydrologic Recovery for Average Site IV Growth

Compartment Names	Total acres	HYDROLOGIC RECOVERY BY AGE CLASS							
		0-10	%	11-30	%	31-40	%	>40	%
Coon Cr	1,892	211	11%	475	25%	649	34%	557	29%
Scaredman Cr	1,591	3	0%	685	43%	572	36%	331	21%
Camp Cr	964	15	2%	448	46%	179	19%	322	33%
Wolverine Cr	1,309	0	0%	694	53%	224	17%	391	30%
Trapper Cr	1,273	59	5%	654	51%	32	3%	528	41%
Grizzly Cr	1,235	111	9%	608	49%	0	0%	516	42%
Ring Tail Cr	1,263	132	10%	490	39%	0	0%	641	51%
Buck Cr	1,702	91	5%	765	45%	66	4%	780	46%
Salmon Cr	637	7	1%	314	49%	0	0%	316	50%
Chilcoot Cr	3,226	207	6%	133	4%	43	1%	2,843	88%
Brouse Cr	1,184	131	11%	376	32%	212	18%	465	39%
Lower Canton Cr	936	0	0%	417	45%	241	26%	278	30%
HiPower Cr	3,081	294	10%	706	23%	1022	33%	1,059	34%
Bloody Point	842	1	0%	72	9%	98	12%	671	80%
Canton Cr	**21,135**	**1,262**	**6%**	**6,837**	**32%**	**3,338**	**16%**	**9,698**	**46%**
Mellow Moon Cr	2,904	213	7%	1637	56%	0	0%	1,054	36%
Upper Pass Cr	3,199	131	4%	1026	32%	29	1%	2,013	63%
East Pass Cr	3,287	79	2%	311	9%	82	2%	2,815	86%
Lower Pass Cr	824	199	24%	153	19%	3	0%	469	57%
Pass Cr	**10,214**	**622**	**6%**	**3,127**	**31%**	**114**	**1%**	**6,351**	**62%**
Lost Bucket Cr	1,317	260	20%	267	20%	0	0%	790	60%
Francis Cr	1,694	126	7%	358	21%	0	0%	1,210	71%
Upper Canton Cr	2,990	122	4%	163	5%	0	0%	2,705	90%
McKinley Cr	1,296	154	12%	120	9%	0	0%	1,022	79%
No Man Cr	1,350	8	1%	311	23%	0	0%	1,031	76%
Middle Canton Cr	577	86	15%	160	28%	0	0%	331	57%
Upper Canton Cr	**9,224**	**756**	**8%**	**1,379**	**15%**	**0**	**0%**	**7,089**	**77%**
TOTAL	**40,573**	**2,640**	**7%**	**11,343**	**28%**	**3,452**	**9%**	**23,138**	**57%**

CANTON CREEK AND TRIBUTARY LOW FLOW DISTRIBUTION
(September, 1981)

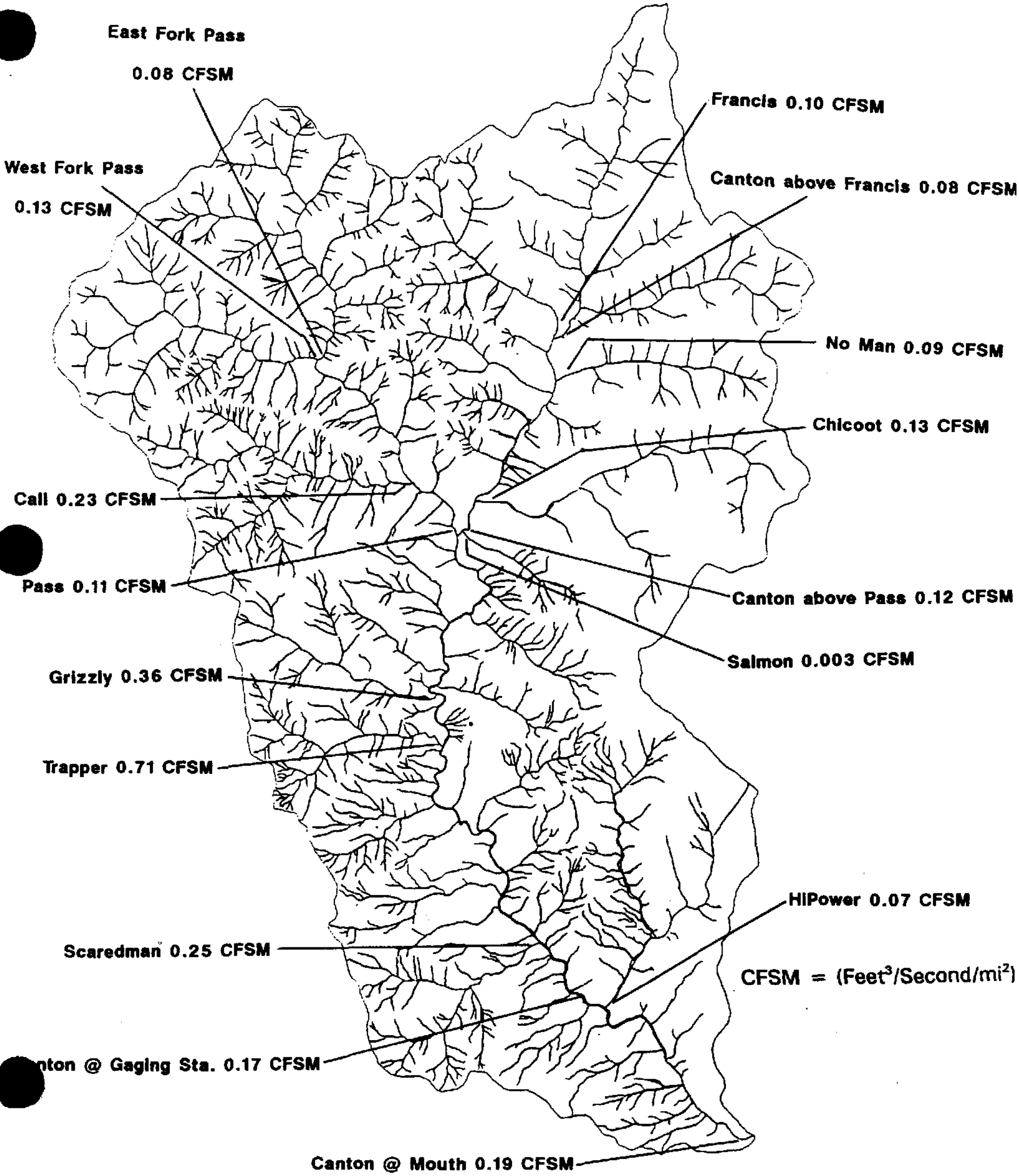


Figure 15

CANTON CREEK
LOW FLOW DISTRIBUTION
(September, 1981)

Table 10

DATE 1981	STREAM LOCATION	FLOW (CFS)	AREA (SQ MI)	FLOW/AREA (CFSM)
9/18	CANTON AT MOUTH	11.8	63.47	.19
9/18	HIPOWER	.367	5.01	.07
9/18	CANTON AT GAGING STATION	9.2	54.6	.17
9/17	SCAREDMAN	.622	2.5	.25
9/17	TRAPPER	1.29	1.82	.71
9/17	GRIZZLY	.702	1.96	.36
9/15	CANTON ABOVE PASS	2.55	20.44	.12
9/15	SALMON	.003	.89	.003
9/15	CHILCOOT	.63	5.03	.13
9/17	PASS	1.78	15.96	.11
9/16	MELLOW MOON (CALL)	.986	4.29	.23
9/16	WEST FORK PASS	.539	4.27	.13
9/16	EAST FORK PASS	.408	5.05	.08
9/17	CANTON ABOVE PASS	2.55	20.44	.12
9/15	NO MAN	.186	2.08	.09
9/15	CANTON ABOVE FRANCIS	.538	6.68	.08
9/15	FRANCIS	.252	2.64	.01

network might be extended by as much as 40% during storm events because of road drainage.

In Canton Creek, the number of stream crossings was used to estimate the risk of effecting peakflow from potential channel extension. Where the density of crossings was the greatest, the risk was also assumed the highest. The highest risk appears to be in Pass Creek where 228 stream crossings (or 3.5 crossings per road mile) were identified from the existing GIS road and stream inventory. Mellow Moon (Call) and East Pass Creeks have the highest densities in Pass Creek at 4.4 and 4.6, respectively. Opportunities to improve road drainage and reduce channel extension appears to greatest in Pass Creek considering the available aquatic habitat in this watershed. Although Lower Canton Creek also has high crossing densities, the immediate aquatic habitat is not considered as good. **Table 12** displays a summary of the number of stream crossings in the compartments and sub-basins and **Table 4** summarizes the stream and road densities.

4. Roads and Effects on Sedimentation

Road Surfacing and Ownership

Figure 10 shows the existing road system in Canton Creek as well as landslides. The majority of the existing road system in the Canton Creek watershed is managed by the BLM and Forest Service. In addition, several road networks exist that are associated with private holdings. Current data on road length and surface type combines the BLM and private systems. Road lengths and surface types are estimated in the following **Table 11**:

Table 11

Road Surface Type and Length
(Length unit is mile)

OWNER	NATIVE	GRAVEL[1/]	PAVED[2/]	TOTAL
BLM/Private (miles)	25.3	156.8	31.4	213.5
Forest Service (miles)	9.5	31.6	0	41.1
TOTALS	34.8 (14%)	188.4 (74%)	31.4 (12%)	254.6

[1/] Includes any type of rocked surface (pit run, crushed, etc.).
[2/] Any type of bituminous surfacing (hot mix, emulsion, etc.) which includes:
17.9 mi. Canton Creek Road, 25-1E-31.0
3.0 mi. Upper Canton Creek Road, 24-1-26
4.0 mi. Francis Creek Road, 24-1-1.1
6.5 mi. Mellow Moon Road, 25-1-18.0

Paved Roads

The existing paved roads in the Canton Creek Watershed were paved 20+ years ago. A review of the existing surfaces showed a large amount of surface cracking within 4 to 6 feet of the outer (fill) edge. Most of the roads were constructed +40 years ago using the "self balance" approach with little if any effort put into fill compaction. Over the years this side cast and fill material has continually settled. This settlement has caused cracking that extends through the base and pavement and longitudinally along the road shoulder. Water invades and saturates the base and fills through these cracks causing instability and additional settlement.

Table 12 **CANTON CREEK ROAD/STREAM CROSSINGS By Sub-Watersheds**

Map Letters, Sub-basins	Compartment Names	Acreage (acres)	Number of Road/Stream Crossings
Lower Canton Cr		21,135	513
A	Coon Creek	1,892	50
B	Scaredman Creek	1,591	57
C	Camp Creek	964	30
D	Wolverine Creek	1,309	53
E	Trapper Creek	1,273	68
F	Grizzly Creek	1,235	31
G	Ring Tail Creek	1,263	32
H	Buck Creek	1,702	38
I	Salmon Creek	637	17
J	Chilcoot Creek	3,226	10
K	Brouse Creek	1,184	30
L	Lower Canton Creek	936	41
M	HiPower Creek	3,081	49
N	Bloody Point	842	7
Pass Cr		10,214	228
O	Mellow Moon Creek	2,904	101
P	Upper Pass Creek	3,199	29
Q	East Pass Creek	3,287	83
R	Lower Pass Creek	824	15
Upper Canton Cr		9,224	70
S	Lost Bucket Creek	1,317	32
T	Francis Creek	1,694	14
U	Upper Canton Creek	2,990	5
V	McKinley Creek	1,296	3
W	No Man Creek	1,350	5
X	Middle Canton Creek	577	11
Total Canton Cr		40,547	811

Maintenance of these paved roads has consisted of sealing the cracks and leveling of the uneven road surface by patching every few years. Also, some chip sealing has been done within the watershed. Widths of the paved roads vary from 16 to 24 feet. Most have a crown section providing positive drainage away from the running surface into ditches. There is little superelevation on curves.

The number of cross and ditch relief culverts appear to be sufficient, but many appear to be undersized (not able to withstand a 100 year flood event) because the original criteria for sizing culverts was 30 year flood events. Scour and erosion from culvert misalignment was noted in some locations.

A significant failure is occurring on Road No. 24-1-1.1 where a large rocky road fill toes itself into Francis Creek. This failure is approximately 1/2 mile in length. The outside edge of the paved surface along this fill has cracks up to 3 to 4 inches wide and settlements of up to 6 inches. This settlement is caused by a combination of consolidation of the fill and by degradation of the rocky side cast material making up the fill. The toe of the fill is failing into the creek.

Gravel and Native Surfaced Roads

The roads are single lane with turnouts. Grades generally do not exceed -10% to +10%. Gravel surfacing is generally crushed aggregate,and is dense graded. Culverts are located in most stream crossings. Ditch relief culverts are spaced 200 to 300 feet apart. Most culverts were probably installed after the 1964 flood event, therefore many culverts may be undersized to accommodate at least the 100 year flood, including associated bedload and debris.

Stream Crossings

The number of stream crossings was identified by the existing GIS road and stream inventory. **Table 12** summarizes the number of stream crossings by compartment. As discussed earlier, Pass Creek has the highest crossing density. Crossing density can be used to identify the potential for plugged culverts during a 100-year flood event. Considering the potential impacts to aquatic habitat, Pass Creek would have more at risk than Lower Canton. Upper Canton also has more aquatic habitat but overall fewer crossings.

B. FISH

Key Questions:
1. What is the current fish distribution?

2. What is the current condition and trend of the aquatic habitat? What is the condition of the riparian habitat? Are they contributing large woody debris to the stream system? When will they be able to contribute large woody debris naturally? How have natural processes and land management activities affected the riparian areas and streams.

3. How have stream temperatures affected fish populations?

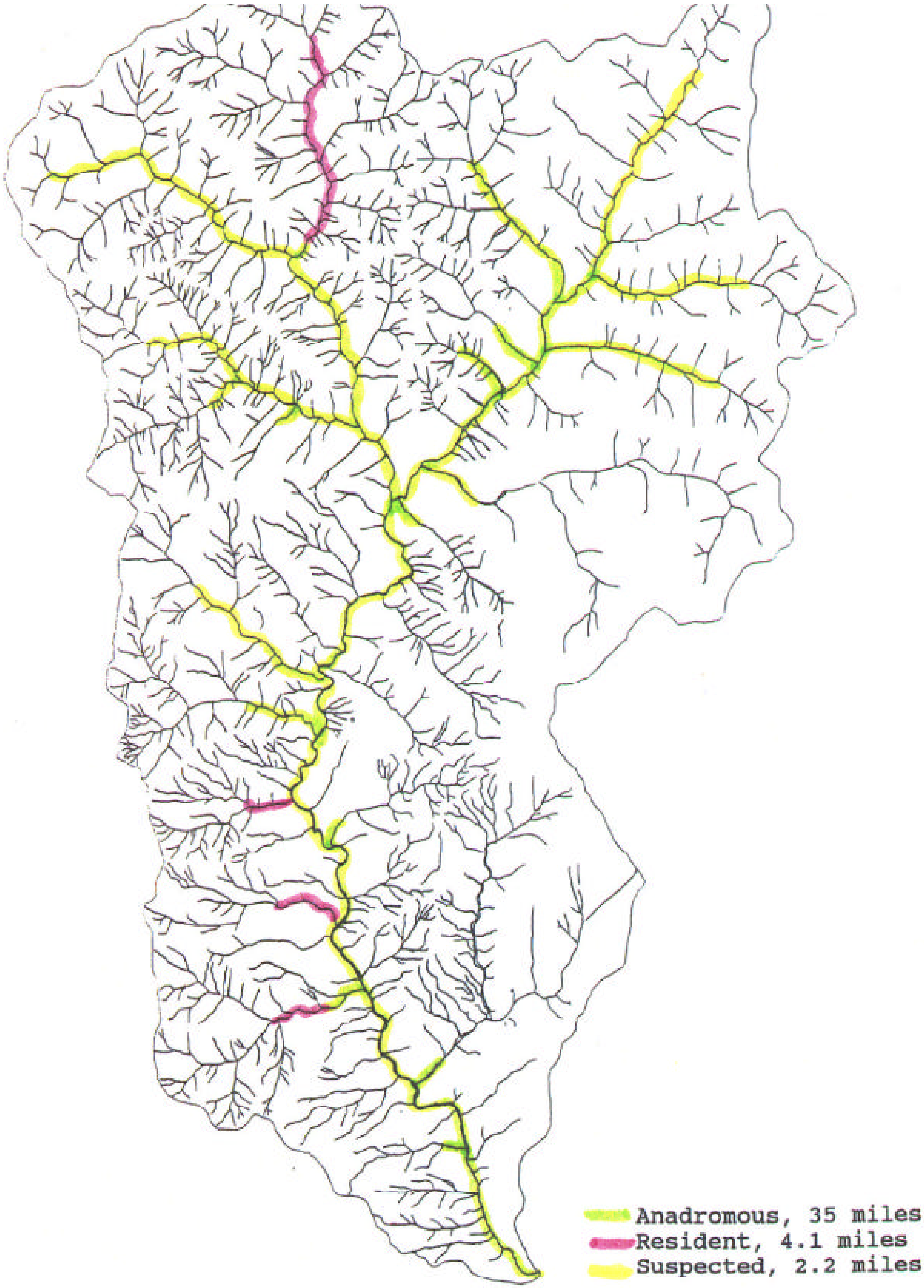
4. What information is relevant to restoration opportunities for fish? What is the existing aquatic habitat by prioritized compartments?

1. Fish Distribution and Current Condition/Trends

Canton Creek supports populations of summer and winter steelhead trout (Oncorhynchus mykiss), resident and migratory cutthroat trout (Oncorhynchus clarki), sculpins (Cottus spp.), speckled dace (Rhinichthys osculus), and Umpqua longnose dace (Rhinichthys evermanni). The stream is also at least seasonally or occasionally used in its lower reaches (lower 1-2 miles) by Umpqua squawfish (Pteichocheilus umpquae), Pacific lamprey (Lampetra tridentata), largescale sucker (Catostomus macrocheilus), coho salmon (Oncorhynchus kisutch), and spring chinook salmon (Oncorhynchus tschawytscha). Of these stocks, coho salmon have been petitioned for a federal threatened listing and coastal cutthroat trout have been proposed by the National Marine Fisheries Service to be listed as endangered. Coastwide, winter steelhead are undergoing a stock status review by National Marine Fisheries Service. Migratory cutthroat trout, including fluvial (migratory within river system) and sea-run cutthroat, have been placed on the Oregon state sensitive list. Summer and winter steelhead, Pacific lamprey, and migratory cutthroat trout (sea-run and fluvial) are considered "stocks of concern" by the Oregon Department of Fish and Wildlife. Umpqua basin coho salmon and sea-run cutthroat trout are considered "stocks at risk" by the American Fisheries Society.

Figure 16 shows the general distribution of fish in Canton Creek. This map was assembled from samples taken throughout the watershed, known barriers to fish, and ODFW stream habitat surveys. Anadromous fish distributions are pretty well defined and encompass about 35 miles of stream in the watershed. Resident trout distributions are less well defined with a tentative total of 4.1 miles of stream delineated above anadromous distributions (see **Figure 16**). Most of the small tributaries to main stem Canton Creek are considered too steep to support anadromous fish but many of them likely contain limited distributions of resident trout and may be used seasonally by juvenile anadromous fish. The tributaries of Canton Creek that receive extensive anadromous fish use are Pass Creek, Mellow Moon Creek (Call Creek), McKinley Creek, Francis Creek, and No Man Creek. The flows from Mellow Moon (Call) Creek, Grizzly Creek, Trapper Creek, and Scaredman Creek (**Figure 15**, pg 45) are likely cooler than other tributaries and may represent unique habitat for fish near their mouths in Canton Creek.

Of the stocks discussed above, the salmonid portion of the fish community in Canton Creek is dominated by summer and winter steelhead. Canton Creek has been found to be a major summer rearing stronghold for steelhead in the Steamboat Creek watershed. Dambacher (1991) found that the main stem of Canton Creek (up to the mouth of Pass Creek) made up 21% of the summer habitat by area in the Steamboat basin but held 32% of the age 1 and older steelhead juveniles. Upper Canton Creek (above mouth of Pass Creek) made up 4.3% of the habitat area and reared 2.4% of the juveniles while Pass Creek made up 4.5% of the habitat and reared 6% of the juveniles. Overall, the Canton Creek basin was found to make up about 31% of the habitat and rear 41% of the age 1 and older steelhead in the Steamboat Creek watershed.



Fish distribution in Canton Creek.

Figure 16

The Oregon Department of Fish and Wildlife estimates that the Steamboat Creek watershed, including Canton Creek produces 70% of the summer steelhead in the North Umpqua River basin. Based on snorkel counts of index pools, ODFW estimates that Canton Creek supports 15% of the holding adult summer steelhead in the Steamboat basin during summer. Upper Canton Creek (above the mouth of Pass Creek) has been found to support high spawning densities of summer and winter steelhead. The two miles of stream above the mouth of Pass Creek supported spawning densities of at least 43 steelhead redds/mile (La Marr, 1992). The next mile above that supported spawning densities of at least 25 steelhead redds/mile. Although this portion of the stream dwindles in size as flows recede to support very few juveniles during summer, this area likely serves as a spawning refuge to "seed" larger downstream rearing areas which may lack high quality spawning habitat.

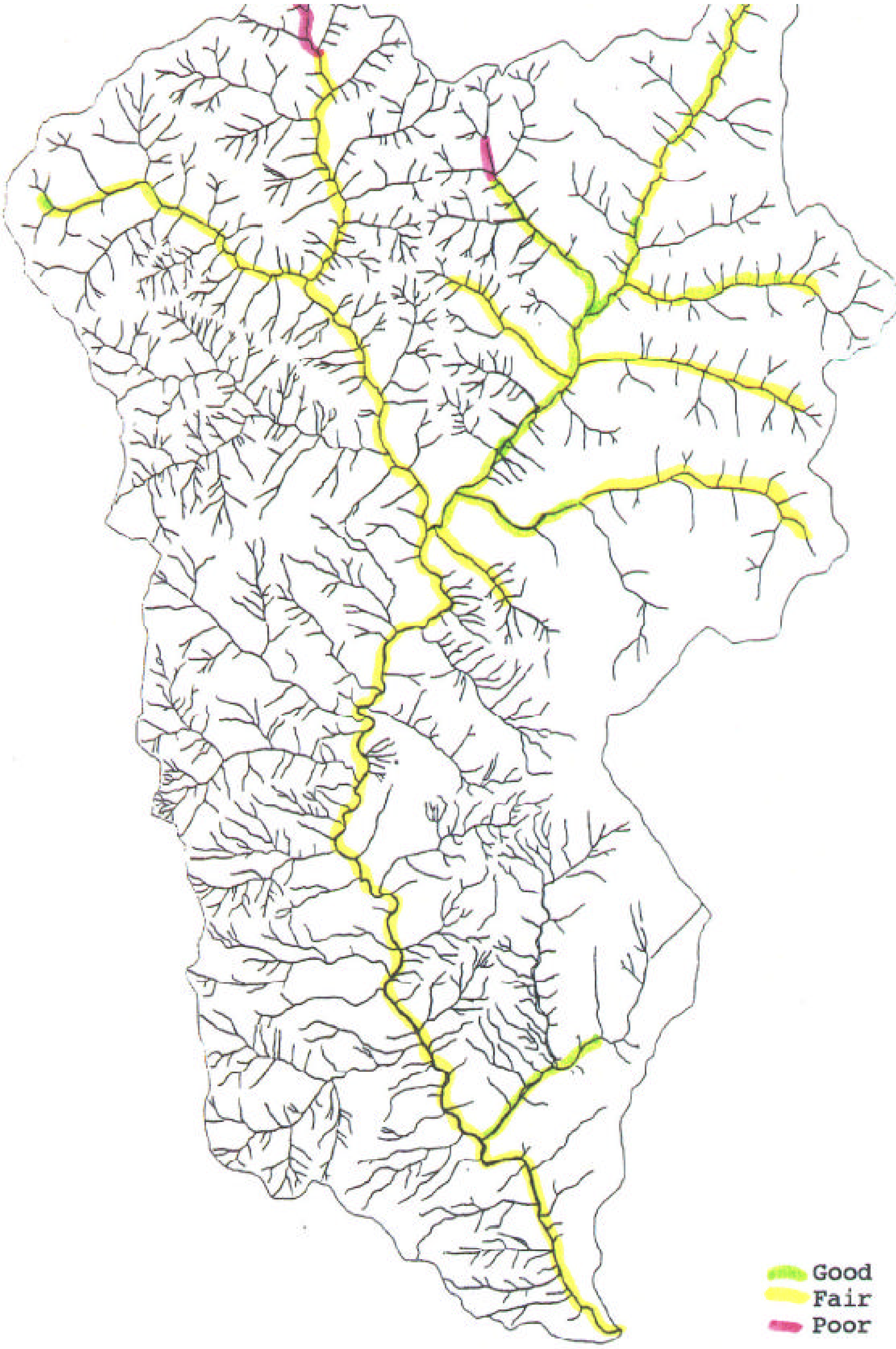
Canton Creek is also an important stream for cutthroat trout. This includes fish with a fluvial life history (spawn and rear in tributaries, outmigrate to river to mature, return to tributaries to spawn) as well as potential for sea-run cutthroat. ODFW snorkel counts index pools in the drainage for migratory cutthroat trout. Currently, an average index number of cutthroat seen in these pools is 30 fish (in two pools). ODFW believes that migratory cutthroat populations are severely depressed so this number is low relative to historic conditions. Many of the headwater streams also support populations of resident cutthroat trout. The upper main stem of Canton Creek itself above the mouth of McKinley Creek, McKinley Creek, No Man Creek, Francis Creek, Ring Tail Creek, Upper Pass Creek, East Fork Pass Creek, Mellow Moon Creek, Call Creek, Buck Creek, Salmon Creek, Chilcoot Creek, Hipower Creek, Wolverine Creek, Brouse Creek, Scaredman Creek, Grizzly Creek, Trapper Creek, and at least one unnamed tributary of the Canton Roadless Area all are confirmed to support cutthroat trout populations. Other streams in the basin undoubtedly also support resident cutthroat populations.

2. Aquatic Habitat

One indication of aquatic biological health is the aquatic macroinvertebrate community. The existing conditions of the macroinvertebrate community in lower Canton Creek (down near the mouth) reflects moderate impairment of the aquatic environment. Insect species tolerant of warmer water, fine sediment, and filamentous algae dominate the community. Species requiring stable crevice space beneath cobble and boulder substrate are absent. Species sensitive to high winter scour are rare (indicating that winter scour is severe). Species categorized as shredders (those which shred leaf litter and other organics) are few and found in low numbers. Overall, habitat complexity is low, and disturbance is high, leading to a depauperate benthic invertebrate community (Wisemann, 1994).

Stream survey data are available for Canton Creek, Pass Creek, and several of the main tributaries to Canton and Pass Creeks (**Figure 17**). Stream conditions in Canton Creek vary considerably with location in the drainage. An evaluation of aquatic habitat conditions in Canton Creek conducted by the Department of Environmental Quality showed that the main stem of Canton Creek (from the mouth up to the confluence with Pass Creek) was in a severely degraded condition due to sedimentation and lack of structural components in the channel. As the probable causes for these conditions, DEQ lists landslides, surface erosion, vegetation removal (logging), and road location (valley bottom road) (DEQ, 1988). The DEQ evaluation also states that upper Canton Creek, above the mouth of Pass Creek is moderately degraded due to lack of structure in the stream brought on by landslides and road location (stream cleanout facilitated by the valley bottom road).

Generally, the lower 5.5 miles of Canton Creek (see ODFW Aquatic Habitat Inventory) are dominated by bedrock substrate with a severe lack of gravel (poor condition) and large wood. There is an average of 4.6 pieces of wood (greater than 15cm diameter, greater than 3 meters in length) per 100 meters of stream, and only 5.7 cubic meters of wood per 100 meters of stream (both poor conditions) (**Table 13**).



Aquatic habitat rating in the Canton Creek watershed based on ODFW aquatic habitat inventories, 1992-94. No color = no survey data.

Figure 17

Table 13

FISH HABITAT INVENTORIES FOR CANTON CREEK BASIN

	Pool Area	Residual Pool Depth	W/D Ratio	% Fines in Riffles	% Gravel	Riparian Veg.	Riparian Conifer Size	% Shade	LWD pieces/100m	LWD vol/100m
Canton Creek Reach 1	39	1.7	16	2	11	con/hdwd	small	57	3	4.5
Reach 2	44	1.3	16.3	11	22	con/hdwd	small	68	5	6
Reach 3	28.7	1.0	23.9	3	23	con/hdwd	small	65	11.6	17
Reach 4	26.6	0.8	27.2	3	38	con/hdwd	small	84	13.1	25
Reach 5	8.3	0.7	33.8	10	28	con/hdwd	small	92	20.8	59.7
Reach 6	7.5	0.5	15.4	3	57	con/hdwd	medium	93	19.9	44.5
Pass Cr. Reach 1	16.6	0.6	19.7	11	27	con/hdwd	small	85	7.9	28.9
Reach 2	16.3	0.5	17.2	11	27	con/hdwd	small	88	9.2	26.2
Reach 3	16.3	0.5	13	13	33	con/hdwd	small	93	19.3	69.3
Reach 4	9.7	0.5	20.7	33	30	con/hdwd	small	53	42.1	49
E. Fk. Pass Cr. Reach 1	23.6	0.5	17.2	6	38	con/hdwd	small	87	13.1	24.7
Reach 2	11.5	0.6	22.4	4	30	con/hdwd	small	92	7.1	9
Reach 3	8.6	0.3	11.1	13	52	-	-	94	16	26.5
Reach 4	3.3	0.4	-	-	-	-	-	93	13.3	21
Chilcoot Cr. Reach 1	27	0.6	14.4	10	40	con/hdwd	small	98	35.2	45.4
Reach 2	31.6	1.0	33.1	15	48	con/hdwd	small	94	50.3	102.8
Reach 3	10.4	0.4	25.2	14	31	con/hdwd	small	98	40.6	52
Reach 4	-	-	-	-	-	con/hdwd	small	87	38.4	48.5
McKinley Cr. Reach 1	33.4	0.4	30.3	5	32	con/hdwd	small	89	11.8	32.8
Reach 2	40.6	0.3	14.7	10	45	con/hdwd	small	92	13.3	67.3
Reach 3	30.5	0.3	10	10	60	con/hdwd	small	95	15.5	115
Reach 4	7.5	0.4	-	-	-	con/hdwd	small	98	11	47.5
Hipower Cr. Reach 1	33.4	0.8	9	10	22	con/hdwd	small	87	15.8	39.1
Reach 2	5.7	0.8	10.3	19	33	hdwd/con	small	93	25.3	62.7
No Man Cr. Reach 1	25	0.4	21	12	33	con/hdwd	small	90	20.2	67.7
Reach 2	10.2	0.4	19	6	28	con/hdwd	small	100	12.2	79.2
Lost Bucket Cr. Reach 1	9.8	0.4	15	4	25	con/hdwd	small	95	27.3	59.3
Francis Cr. Reach 1	28.9	0.3	18.8	12	41	con/hdwd	small	89	26.5	54.6
Reach 2	37.1	0.3	11.4	7	65	con/hdwd	small	90	15.6	32.5
Reach 3	2.4	0.2	-	-	-	con/hdwd	small	98	17.9	53.7
Salmon Cr. Reach 1	12.4	0.6	-	-	-	con/hdwd	small	86	30.4	32.4
Reach 2	9.7	0.8	-	-	-	con/hdwd	small	92	12.3	14.1

The stream is constrained by bedrock as well as terraces. Pools make up 43% of the habitat by area (good condition). The average wetted width/depth ratio is 16.4 (good condition).

There is a road within 200 feet of the stream throughout much of this lower 5.5 miles. The stream has undergone large wood removal and riparian timber harvest which has contributed to its simplified bedrock nature and lack of large wood. In this context, it is of high concern that from river mile 2.7 to approximately river mile 5.5, sand and silt make up 18% of the streambed substrate in riffle habitats (poor condition). This is a poor condition for aquatic biological production which would not be expected in a scoured out, simplified stream that is highly efficient for sediment transport. Given the lack of large wood and dominance of bedrock substrate in this portion of the stream, most or all fine sediment (sand and silt) would be expected to be flushed out of the system at high flows because there are so few obstructions in the channel which would cause fine sediment to be deposited. The inordinately high presence of fines in-channel suggests an inordinate supply of fines entering the stream relative to the stream's ability to transport this material. This may be due to the lack of "flushing" flows over the past several years to flush out fine sediment that has worked its way into the channel.

Overall, the 3.9 mile reach of Canton Creek from Brouse Creek up to the mouth of Pass Creek is in slightly better condition than the lower main stem. The stream is considered unconstrained. Although pools only make up 29% of the habitat by area (fair condition), the habitat is generally more complex with the streambed substrate being dominated by cobble and gravel (good condition). Large wood amounts increase to 11.6 pieces of wood (>15cm in diameter, >3 meters in length) per 100 meters of stream (fair condition). Wood volume is 17 cubic meters per 100 meters of stream (poor condition). The wetted width/depth ratio is 23.9 (fair condition). Many of the influences of the stream-side road remain in this reach in the form of floodplain interruption as well as lack of large wood due to past stream cleanout.

In general, fish habitat conditions are better in upper Canton Creek from above the mouth of Pass Creek up to two miles above Canton Falls than in previously discussed reaches. The channel is constrained by hillslopes and terraces throughout this portion of the stream. Pools make up only about 20% of the habitat (fair condition) but this is to be expected as the channel gradient increases sharply in the headwaters. Streambed substrate is dominated by gravel (good condition) and large wood amounts increase to 15.8 pieces (>15cm diameter, >3 meters in length) per 100 meters of stream (fair condition) over previous areas discussed. Wood volume averages 34.3 cubic meters per 100 meters of stream (good condition). Wetted width/depth ratio is 25.5 (fair condition). This portion of the basin supports high steelhead spawning densities and likely serves to "seed" rearing habitat in downstream areas that lack good spawning habitat.

McKinley Creek, an unnamed tributary that enters Canton Creek just upstream from McKinley Creek, and upper Canton Creek above the unnamed tributary are relatively not impacted by recent human activity. All these streams have > 60 pieces of wood (>24" diameter, >50' in length) per mile (good condition). Two of the three reaches have at least 35% pool habitat by area (the upper Canton reach has only 21% pools), which indicates a good condition. Bankfull width/depth ratios range from 15-17 (fair). However, based on the presence of large quantities of large wood, the fact that the riparian vegetation along these streams is in a moderate (50-150 years old) or late seral stage, and that in-stream substrate (cobble and gravel) is highly complex, these stream reaches provide the best refuge habitat for resident cutthroat trout (and possibly migratory cutthroat trout) in the Canton Creek basin.

Pass Creek also supports summer and winter steelhead as well as fluvial and resident cutthroat trout. Habitat conditions have been assessed in about 6.5 miles of Pass Creek. The lower 3.6 miles are dominated by riffle habitat and contain only about 16-17% pool habitat (fair condition) by surface area. The dominant substrates are boulder and cobble (fair condition). The average large wood levels are 8.5 pieces (>15cm diameter, >3 meters in length) per 100 meters of stream (poor condition). The wood volume is 27.7 cubic meters per 100 meters (fair condition). As with much of Canton Creek, there is a stream-side road which has facilitated riparian timber harvest and stream cleanout which has thereby reduced the amounts of large wood in the stream. The wetted width/depth ratio is 18.4 (good condition).

The upper portion of Pass Creek is also dominated by riffle habitat with pools making up only about 15% of the habitat (poor condition). Dominant substrates are gravel and boulders (good condition). Large wood levels are 30.7 pieces (>15cm diameter, >3 meters in length - excellent condition) and 59.2 cubic meters per 100 meters of stream (excellent condition). These higher levels of wood are to be expected in the headwaters of streams because there is less stream power in the headwaters to transport wood downstream. In addition, this portion of Pass Creek is not under the influence of a stream-side road. The average wetted width/depth ratio is 17 (good condition).

In summary, fish habitat in Canton Creek is in fair to good overall condition. However, habitat in the main stem of Canton Creek suffers from a lack of large wood and substrate complexity. These two structural factors, combined with altered sediment regimes (accelerated landslide rates), appear to be the main factors limiting fish production in the main stem. The presence of large amounts of fine sediment in reach 2 of main stem Canton Creek may suggest that inordinate amounts of fine sediment are being transported into the stream at this time. Pass Creek also lacks large wood, pool habitat, and substrate complexity.

The trend of the aquatic habitat condition is not easily determined. Most of the Canton Creek watershed is a late successional reserve. Therefore, it is safe to assume that over the very long-term the aquatic habitat will improve. However, in the short-term (<20 years), the habitat may worsen before it gets better. Stream habitat is relatively stable for long periods of time, and is usually shaped by major events. The resulting habitat is merely a reflection of all of the activities that have occurred since the last major event. Currently, there are lots of untested management activities in the Canton Creek watershed. Only by removing the unknown threats can we be sure that the aquatic habitat will improve over the short-term.

Large woody debris (LWD) has been recognized for some time as being a key piece in aquatic habitats. Incidentally, a lack of LWD is often cited as a limiting factor in aquatic habitat surveys, including surveys in Canton Creek. Of the 39 miles of known fish-bearing stream in Canton Creek, approximately 24 miles have a road parallel to them (distances determined by a map wheel). Normal road maintenance activities, such as salvage removal of downed trees in the road prism, preclude these stream reaches from ever reaching their full potential for large wood recruitment. LWD additions should be considered in these stream reaches to maintain and restore their full fish habitat potential.

3. Stream Temperatures and Fish

Stream temperatures affect fish life cycles in several ways. Stream temperatures affect the migration timing, time of spawning, egg development, and habitat use patterns of the fish. The preferred temperature for salmonids is 58°F. Temperatures over 73°F begin to be life threatening for most salmonids. Past research has shown that fish can withstand temperatures above 70°F without any negative impacts as long as it is for a short period of time and as long as the temperature drops to below 58°F for a significant portion of the day.

Stream temperatures are available for selected locations for 1992 and 1994. In 1994, seven locations were monitored every 30 minutes for the duration of the summer. Maximum summer water temperatures varied widely depending on location (**Figure 13, Tables 6 & 7, pgs 38-39**). In 1992 and 1994, daily temperatures in lower to mid-Canton Creek were well above 70°F for extended periods of time. For a seven week period including this two weeks, daily minimums in lower Canton Creek did not drop below 58°F. This could have significant implications for fish. Temperatures in this range could create a complete thermal barrier to fish moving upstream or downstream. This comes at a peak migration time for summer steelhead. Dambacher (1991) documented a steelhead parr (pre-smolt) outmigration in the Steamboat Creek Basin. One possible explanation for this could be that the fish outgrow their habitat in the upper reaches of Canton Creek. As the water drops in summer, the amount of habitat shrinks and the fish are forced downstream to find available habitat. The outmigrating parr could be fish that are being forced out of their preferred rearing areas due to high water temperatures. The high water temperatures in the mid to lower portions of Canton Creek essentially render some of the best rearing habitat useless in drought years.

Canton Creek above the confluence with Pass Creek was warmer than Pass Creek. This stresses the importance of Pass Creek to fish populations both as a refuge area as well as providing cooler water to Canton Creek. The high temperatures in mid-Canton Creek most likely stress fish during the hottest periods of drought years. Cool water tributaries, although they may be non-fish bearing, appear to be extremely important for over-summering fish in Canton Creek.

Additional temperature monitoring is needed to determine if the high temperatures in Canton Creek are consistent from year to year and also to determine if the differences in temperature in various locations are natural or a result of management activities. Also, specific cool water tributaries need to be determined to see if these tributaries correlate to adult fish summer holding pools.

Additional Data Needs for Fish

Additional data is needed before any other restoration priorities are set for other compartments. Specifically, more temperature data and fish habitat use is needed. Coolwater tributaries need to be located and protected to maintain and restore cool water temperatures in the lower reaches of Canton Creek. Also, fish habitat utilization data and population data are needed to determine areas where the habitat is not fully seeded.

C. SPECIAL STATUS ANIMAL SPECIES

Key Questions:

1. How much late successional habitat (80+ years) exists in the Riparian Reserves? What species in this watershed will be dependent on late successional (80+ years) riparian habitat?

2. What special status species are known or suspected within the watershed?

1. Distribution of Late Successional Habitat

The age class distribution for Canton Creek (see **Table 2 and Figure 7**, pgs 20-21) shows between 49% and 57% of Federal land currently in forest habitat 80 years of age or older. The reason for this range of percentages is the lack of specific stand age information between 26 to 115 years on USFS. Due to the weather patterns, high elevation, and soil conditions found in this watershed, vegetation growth potential is only moderate in the valley bottoms of Lower Canton Creek and poor in the Upper Canton and Pass Creek areas. Considering the low site class potential of the majority of this watershed, it may take a longer period of time for older forest characteristics to develop.

Stands measured at 80 years of age may still be relatively immature and have not developed late successional characteristics. It may be appropriate to consider only those stands older than 120 years of age as actually providing late successional habitat for wildlife in this drainage. Currently 40% of the streams in this watershed are located in this habitat type. These stream systems are illustrated in **Figure 18**. Silvilcultural treatments of stands less than 80 years of age could accelerate the development of larger tree sizes, however attention to creation or maintenance of other structural components such as thick layers of organic duff over non-compacted soil, large amounts of down wood, a variety of tree, shrub and ground cover species, snags and multiple canopy layers should be viewed as equal in importance to the creation of large trees.

Terrestrial Riparian Wildlife

The following is a list of terrestrial wildlife species known or suspected to occur in this watershed which need older forest riparian habitat for their life cycle requirements. An asterisk represents a special status species. Other species listed in Table C-3 of the Record of Decision such as plants, fungi and mollusks also benefit from this type of habitat.

Northwestern salamander
Olympic salamander
Cascade frog*
Townsends warbler
Hermit warbler
Varied thrush
Winter wren
Pine grosbeak
Red crossbill
Western tananger
Western flycatcher
Chestnut-backed chickadee
Wood duck
Saw-whet owl*
Redbreasted nuthatch
Townsend's big-eared bat*
Pine marten*
Red-legged frog*
Long-eared myotis
Yuma myotis
Long-legged myotis
Little brown myotis
Trowbridge shrew
Silver-haired bat
California myotis
Dusky shrew
Bald eagle*
Golden eagle
Northern spotted owl*
Western screech owl
Brown creeper
Barred owl
Red-backed vole*
Fringed bat*
Tailed frog*
Harlequin duck*(possible)

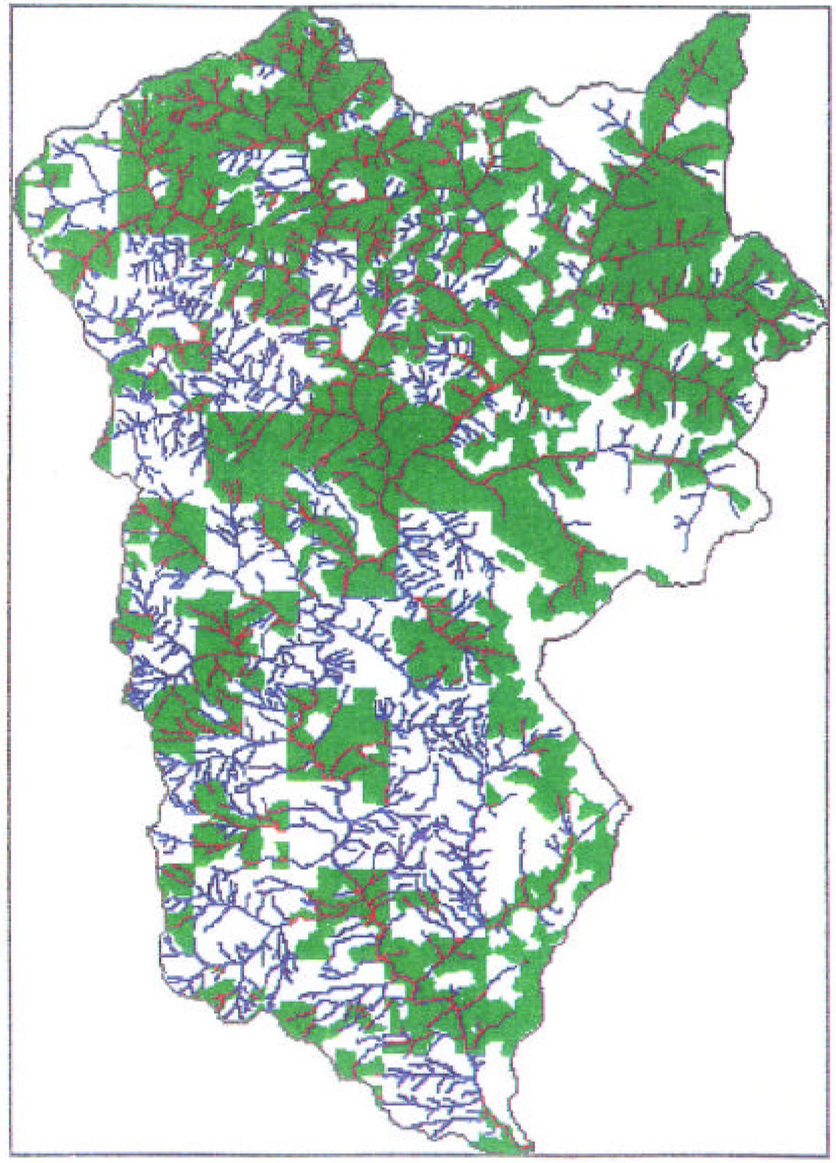

Late Successional Habitat
(120+ years)
Streams in LSH (120+ yrs.)
Streams in habitat < 120 yrs.

Figure 18

Any riparian enhancement projects that involve vegetation manipulation or streamside activities should take these species into account. Of special concern are disturbance to nesting northern spotted owls and other raptors as well as habitat loss for tailed frogs, bat species and nesting songbirds in riparian areas.

Figure 19 illustrates areas within one quarter mile of known NSO site centers in the watershed. Several federal candidate species of bats have been documented in this watershed. Although little is known about their habitat requirements, it is acknowledged that riparian conditions that provide large, decadent live trees with deep, grooved bark and standing snags provide opportunities for roosting close to or adjacent to foraging areas over water. Tailed frogs are known to occur in the upper reaches of Canton Creek past its junction with Pass Creek.

2. Known or Suspected Special Status Species

Refer to the following **Table 14** for a list of all special status species known or suspected to occur in this watershed, together with their status.

Table 14 Special Status Species - Canton Creek Watershed

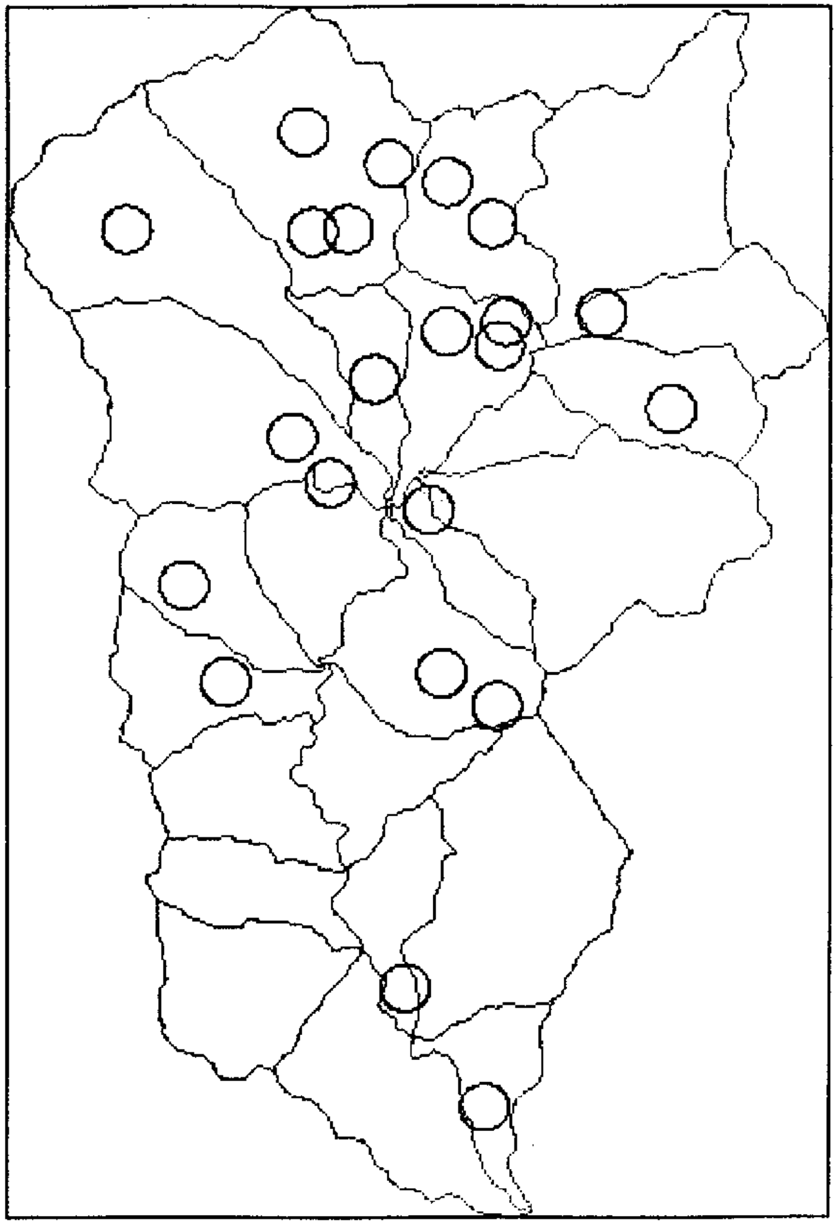
Species	Status	Presence	Inventory
Peregrine Falcon	FE, ST	S	3
Bald Eagle	FT, ST	S	3
Northern Spotted Owl	FT, ST	D	4
Western Pond Turtle	FC, SC	D	3
Cascades Frog	FC, AS, SC	U	1
Long-eared Bat	FC	D	2
Red-legged Frog, Oregon Species	FC	D	3
Spotted Frog	FC, SU	U	1
Northern Goshawk	FC, AS, SC	D	3
Pileated Woodpecker	AS, SC	D	3
Mountain Quail	FC	D	3
Western Bluebird	AS, SV	S	1
Northern Pygmy Owl	SU	D	3
Northern Saw-whet Owl	AS	D	3
Flammulated Owl	AS, SC	U	1
Purple Martin	AS, SV	U	1
Townsend's Big-eared Bat	FC, SC	D	2
Yuma Myotis Bat	FC, SC	D	2
Fringed Myotis Bat	FC, SV	D	2
Pine Martin	AS, SC	U	1
Ringtail	SU	D	3
Clouded Salamander	AS, SC	D	3

Tailed Frog	FC, SV	D	3
Long-legged Bat	FC, SC	D	2
California Mountain Kingsnake	AS, SP	D	2
Common Kingsnake	AS, SP	D	2
Sharptailed Snake	AS, SV	D	3
Vertree's Ceraclean Caddisfly	FC	U	1
Vertree's Ochotrichian Microcaddisfly	FC	U	1
Mt. Hood Primative Brachycentrid Caddisfly	FC	U	1
Oregon Snail	FC	U	1
Oregon pearly mussel	FC	U	1
Coho salmon	FP	D	3
Sea-run coastal cutthroat	FP	D	3
Winter steelhead	FP	D	3

Status:
FE - Federal Endangered
FT - Federal Threatened
FP - Federal Proposed
FC - Federal Candidate
BS - Bureau Sensitive
AS - Assessment Species (BLM)
SE - State Endangered
ST - State Threatened
SC - State Critical
SP - State Peripheral or naturally rare
SV - State Vulnerable
SU - State Undetermined

Presence:
D - Documented
S - Suspected
U - Uncertain
A - Absent

Inventory:
N - No surveys done
1 - Literature search only
2 - One field search done
3 - Limited field surveys done
4 - Protocol completed



Northern Spotted Owl
Disturbance Zones
(.25 mi.)

Figure 19

DESIRED FUTURE CONDITIONS

A. Private and Federal Land Management Guidance

Private Lands

The 9600 acres of private lands will most likely be managed primarily for timber production which traditionally has had rotation schedules of between 40 and 65 years. Oregon Forest Practice Act would guide how these lands will be protected.

Late Successional Reserves (LSRs)

The objective of LSRs is to protect and enhance late successional and old-growth forest conditions by protecting refuge areas with management activities that would enhance old-growth characteristics or by restoring areas that have been previously damaged. More specifics as to how this objective will be implemented is addressed below.

Riparian Reserves

Riparian reserve widths will approximate the distances listed in **Table 15** (site potential tree height estimates in Canton Creek) or to ecological breaks as defined in the ROD.

Table 15 ROD Riparian Widths

Stream Type	Slope Distance
Perennial Fish Bearing	~320 feet
Perennial Non-Fish	~160 feet
Intermittent	~160 feet
Ponds/Wetlands > 1 acre	~160 feet
Wetlands < 1 acre	Outer edge of wetland vegetation

Connectivity

The main objective of Connectivity areas (also called Diversity Blocks) on the landscape is to provide blocks of land in the checkerboard ownership that maintain old growth characteristics for the dispersal of Northern Spotted Owls from one Late Successional Reserve to another. Connectivity areas outside of Riparian Reserves would provide a limited amount of timber production. These areas are managed on 150-year rotations. When these areas are cut, 12 to 18 trees per acre would be retained while also retaining coarse woody debris and snags to benefit those plant and animal species utilizing those habitats.

General Forest Management Area

GFMA areas outside of Riparian Reserves would provide production of forest products while retaining 6 to 8 trees per acre, coarse woody debris, and snags to benefit plant and animal species.

B. Water and Riparian Quality

Erosion

The desired future condition for sediment is a reduction in its delivery to streams from mass wasting and surface erosion processes. The specific sources of sedimentation from these erosional processes include accelerated debris torrents, stream banks, roads, and secondary erosion from mass wasting scarps and depositional sites. Because of the many miles of impacted streams compared to road mileage, the effort toward a desired future condition must recognize the greater potential of chronic sediment from stream banks than roads. The overall vision is a reduction in the chronic surface erosion from stream banks, roads, and bare ground, and a reduction in the frequency of accelerated mass wasting, especially debris torrents.

While erosional processes are a natural part of a functioning ecosystem, alteration of these processes can lead to disproportionate increases in the kinds and amounts of sediment. In the Canton Creek watershed, the construction of roads and associated drainage features have contributed to the existing condition. Because Canton Creek is so efficient in its stream flow and soils are shallow and rocky, sediment from erosion is not considered as major a problem in this drainage as some of the other processes described below.

Landslides & Debris Flows

The analysis suggests that the rate and distribution of landslides has increased relative to the disturbance patterns in the watershed. The information available indicates that aquatic habitat has been significantly impacted in a number of locations throughout the watershed by the debris slides and debris flows in the channels.

Stream Flows

In the transient snow zone (TSZ), peak flows are normalized (returned to a pre-harvest level and interval) when forest stands reach a closed canopy condition. On site IV lands, which is most common in this watershed, fully recovered forest stands with closed canopies would generally be expected to occur after 40 years of growth. The desired future condition would be to manage the forest stands so that 60 to 75% of the watershed, within the TSZ, would maintain a closed canopy condition. This goal may not be compatible with objectives of private landowners.

Additional needs would include the following:

- Adequate woody debris in streams to protect channel stability and biotic health (see under Fish below).

- An adequate supply of standing conifers of varying age and size to provide long term recruitment of large woody debris.

Stream Temperatures

The desired future condition for stream temperature in the Canton Creek watershed recognizes the main stem of Canton, Pass Creek and upper Canton, and the smaller perennial tributaries of the watershed. For the main stem of Canton Creek, a stream temperature range of 65-70°F is desirable. The desirable stream temperature range for Pass Creek and upper Canton Creek is 60-65°F and less than 60°F for the perennial tributaries. These stream temperature ranges represent vegetative shade recovery where debris torrents and harvest/road activity have removed historic shade as well as channel aggradation caused by scour down to bedrock.

C. Fish

Channel Condition

The Aquatic Conservation Strategy within the ROD sets forth a number of general objectives pertaining to fish habitat. One key goal that is pertinent to Canton Creek is to restore spatial and temporal connectivity within and between watersheds. An important measure to achieve this goal is to re-establish connectivity between stream channels and their floodplains. It is also vital to re-establish healthy biotic conditions within floodplains themselves in order to re-establish natural processes. Interaction between a stream channel and its floodplain is vital to large wood recruitment as well as high flow relief during storm events. As part of re-establishing floodplains it is also crucial to re-establish down large wood and the species composition and structural diversity of riparian plant communities to reflect a late successional condition in floodplains across a representative proportion of the landscape. In Canton Creek, specific objectives to meet these goals are:

- re-establishing connectivity between stream channels and fully functioning floodplains. .

- a riparian zone dominated by large, old growth conifers with a multi-storied canopy consisting of a representative diversity of plant species and age classes.

Another major goal to reach for desired future condition is to restore the physical integrity of the stream channel(s) in the watershed. Meeting the following objectives with the following parameters in fish-bearing streams would indicate that this goal has been met:

- Greater than 70 pieces of large wood (greater than 24" diameter at small end, greater than 50' in length) per mile, OR, greater than 30 pieces of wood (greater than 15cm in diameter, greater than 3 meters long) per 100 meters and greater than 40 cubic meters of wood/100 meters of stream.

- Bankfull width/depth ratio of less than 10, OR, wetted width/depth ratio of less than 10.

- Percent area of pool habitat: greater than 45% in main stem, greater than 35% in tributaries.

- Substrate (in riffles) - to have gravel make up 30-80% of substrate by area, sand/silt/organics to make up less than 1% of substrate by area. OR, to have gravel dominate streambed substrate.

Another desired future condition pertains to restoring sediment regimes to natural conditions. The desired future condition is restoration and maintenance to natural conditions of the timing, volume, rate, and character of sediment input, storage, and transport. Although landslides and debris torrents are natural phenomena in the Canton Creek landscape, landslide rates have been substantially increased over natural levels (see existing condition of geology in this report) and this has had a profound effect on fish habitat conditions. As they occur naturally, landslides and debris torrents are a major source of large wood and sediment of all sizes to streams in Canton Creek. Another aspect of the desired future condition for sediment regimes is to restore vegetation in landslide-prone areas to the old growth condition so that when slides occur naturally in the future, large wood in the form of old growth conifers will be transported into streams to eventually serve as structural components for the aquatic environment.

Aquatic Habitat

While the above stated desired future conditions are important as measures of aquatic habitat quality and complexity, the ultimate indication of a healthy aquatic system is a healthy biological community. Two potential indicators of aquatic biological health include the fish community as well as the macroinvertebrate community. A general desired future condition for fish would include a diverse assemblage of species and age classes of all fishes indigenous to the basin within their historic distributions. In the case of Canton Creek the species include summer and winter steelhead, resident and migratory cutthroat trout, sculpins, speckled dace, Umpqua longnose dace, and, in the lower portion of the basin, coho salmon (occasionally in lower 1.5-2 miles), spring chinook salmon (occasionally in lower 1.5-2 miles), largescale sucker, Umpqua squawfish, and Pacific lamprey. Existing and historic distributions of the non-salmonid fishes in the watershed are not well known at this time. As they are the dominant salmonids in Canton Creek, more specific desired conditions can be designated for cutthroat and steelhead trout. The desired condition for juvenile cutthroat and steelhead trout is for these fish to be abundant with representative percentages of each age class throughout the portions of the watershed historically accessible to them. A monitoring program for outmigrants should be continued and related to the work done by Dambacher (1991). Objectives for numbers of outmigrants of steelhead and cutthroat trout should be determined upon further, more in-depth analysis of stream survey as well as upslope data in the watershed to assess fish habitat capability. The Oregon Department of Fish and Wildlife has a desired future condition to increase the number of full-term smolts outmigrating from Canton Creek.

The Oregon Department of Fish and Wildlife also has desired future conditions for numbers of adult steelhead and migratory cutthroat to hold through summer in index snorkeling pools. The goal for steelhead is to have over 100 adult summer steelhead holding in Canton Creek index pools before the autumn rains and for at least 30% of these fish to be located above river mile 5. The desired condition for migratory cutthroat trout is to have at least 30 migratory cutthroat trout adults holding in the pools through the summer. Overall the desired future condition is to have the Canton Creek watershed support a diverse and abundant fish community throughout the year.

As mentioned earlier, another indication of a healthy aquatic ecosystem is a healthy macroinvertebrate community. For macroinvertebrates, the desired future condition is for the lower Canton Creek sampling site to reflect a more diverse assemblage of taxa than what currently exists. More specifically, it is desired that the community contains more species that are less tolerant to warm water temperatures, sedimentation, and scour in high flows. These types of macroinvertebrates would be an indication of colder water temperatures, less sedimentation, and less scour from high flows. It is also desired that target macroinvertebrate index values be determined for riffle, margin, and coarse particulate organic matter samples as described by Wisseman (1991).

RESTORATION OPPORTUNITIES

A. Overall Watershed Restoration

In the original assessment, several types of restoration activities were identified with a focus on transportation systems. The inventory, identification, and analysis of stream crossings to determine the potential for failure was identified as a high priority. Identification and analysis of oversteepened and side cast fills to determine the need for removal or stabilization was also considered a high priority.

Road systems need to be storm proofed so that they require low level maintenance and minimize impacts to natural drainage. This could include things like outsloping roads and replacing culverts with drain dips. Other opportunities include improving road drainages with improperly designed culverts. This might include changing undersized culverts and excavating road fill that is eroding into streams. Roads no longer needed could be closed and/or reclaimed (decommissioned), if they are causing erosion or stream degradation. Preliminary Transportation Management Objectives for Canton Creek watershed are being developed through an interdisciplinary team and has targeted those roads listed in this analysis. Some specific recommendations are listed below. Any projects would be examined in greater detail in an environmental analysis to make final recommendations.

To protect stream channel and biotic health in upper reaches, the following may be needed:
- An adequate supply of standing conifers of varying age and size to provide long term recruitment of large woody debris.
- Adequate woody debris in streams to protect channel stability.

B. Background Information for Restoration Specific to Fish

Restoration opportunities in Canton Creek are different in the various compartments. The Canton Creek preliminary assessment recommended that restoration begin in the headwaters and work down. Stream restoration guidance from the ROD is to take care of road related problems, riparian and upslope problems, and stream structure problems in that order. The ROD also recognizes the refugia concept, that of protecting the best remaining habitats before trying to restore degraded ones. Protecting the best remaining habitats is more than simply preventing further activities that cause additional impacts. The health and current condition of aquatic habitats is not an accurate indicator of the threats that may be present. Many years of threats and impacts may manifest themselves in a single event such as the 1964 flood. Protecting the best is a process where the "unseen" threats to the current condition are identified and removed, often referred to as stormproofing the watershed.

As a result of the analysis in Canton Creek four criteria were used for categorizing compartments for restoration. The greatest need was to reduce the potential of road failures and resulting landslides in the event of a large flood event. This is particularly true in the upper reaches of Canton Creek since most of the roads have been constructed since the 1964 flood (a 100 year event). Storms since that time have produced approximately 8 floods with return periods of 5 years. Preventing road related landslides would protect downstream values which include riparian vegetation, stream channel complexity which effect stream shading, temperature, fish spawning and rearing as well as other aspects.

A) To prevent road related landslides, specific roads will need to be evaluated and rated on the following:
- those having highest risk to fish habitat
- construction type & slope
  - -Road types with high potential failure and high risk to fish habitat
  - -Road location

-Crossing function
- landform location
- geology
- stream crossing type

In addition to reducing potential road related landslides, the analysis also focused restoration opportunities on the following aspects of riparian and stream habitat.

B) The need to speed recovery of riparian habitat that was harvested or impacted by debris torrents.
C) Road densities and drainage and how they extend stream channels and influence stream flows.
D) Large woody debris (LWD) needs for the stream channel.

Using the guidelines from the original assessment, the ROD, and from the above criteria, four specific compartments within Canton Creek were identified as the highest priorities based on their values and needs.

1. Upper Pass Creek
2. East Fork Pass Creek
3. Francis Creek
4. Mellow Moon (Call) Creek

C. Existing Aquatic Conditions by Prioritized Compartment

Specific information was assembled in the prioritized compartments to verify stream and riparian conditions. Attempts were made to assemble information in the other compartments but because of time constraints, the time consuming aspect of computing this information by riparian area and because of differences in databases between BLM and USFS, this information will need to wait until the next iteration of watershed analysis. The TEAM thought this would be valuable information in the future but did not think it was crucial for restoration projects. **Table 16** below shows an estimate of the current stream and riparian conditions. The estimate was completed with a combination of aerial photo interpretation and GIS. For Mellow Moon (Call) Creek compartment, after an initial review with aerial photos, a better estimate was developed of aquatic habitat by fully using GIS generated percentages.

Table 16 Existing Aquatic Conditions by Prioritized Compartment

Compartments Names	Alder Dominated		Road Parallel (1/2 Riparian)		Young Conifer (< 40 yrs)		Old Conifer (80+ yrs)		TOTAL
	miles	%	miles	%	miles	%	miles	%	miles
East Pass Cr	2.2	7%	1.6	5%	3.7	12%	24.4	76%	31.9
Upper Pass Cr	0.6	2%	1.3	4%	12.4	38%	18.0	56%	32.3
Francis Cr	0.1	<1%	1.3	7%	4.5	24%	13.0	69%	18.9
Mellow Moon (Call) Cr	0.0	0%	0.0	0%	26.9	75%	8.9	25%	35.8

The category of conifer stands between 41 and 80 years of age was not included in this table because there are no stands in this age class since harvesting in these compartments has occurred within the last 30 years.

D. Restoration Opportunities by Prioritized Compartment

The following describes the criteria driving restoration in each of the prioritized compartments. In all of these compartments one of the driving criteria was potential road related landslides. The listed roads are only preliminary assessments and will need more detailed review to weigh management objectives. These roads can be used as a starting list for restoration.

1. Upper Pass Creek

Dambacher (1991) recognized the importance of Canton Creek to steelhead. Also, the ODFW stream habitat surveys have determined that Pass Creek is some of the best stream habitat. It has a relatively low gradient (6.4%) and has some of the lowest summer temperatures in the basin (63.2°F maximum). On an overall basis, management activities have increased the frequency of debris torrents in Canton Creek. Currently, no debris torrents were identified in Upper Pass Creek (above the mouth of East Fork Pass). Some road construction has taken place in this compartment in the 1970's but the road system has not been tested by 100 year type flood events since being constructed.

Currently Upper Pass Creek has a relatively low road density (3.8 mi/sq mi) and a moderate hydrologic recovery percentage (63%). Much of the road system is untested by major storm events and it is likely that a storm event of a ten year magnitude or larger, with resulting landslides, could have significant impacts on the aquatic habitat.

Possible Road to Treat
24-1-22.1

2. East Fork Pass Creek

This was second priority because of it's potential impacts to Upper Pass Creek. Restoration opportunities in this basin should focus on removing the road related threats. Settling of road fill material on some roads has the potential of reaching stream channels. Interception of groundwater on some roads has also created unnatural surface water. Roads with these conditions should be considered for decommissioning if they dead-end in the middle of a Late Successional Reserve.

Stream temperatures in East Fork Pass are higher than in Pass Creek (see **Table 7, pg 38**). This could be a result of past debris torrents that have widened the stream channel and removed the shade. Seven percent of the riparian reaches are currently dominated by alder (see **Table 16**) which appear to be associated with debris torrents. Riparian treatment should target conversion of the alder dominated reaches back to conifers. Instream projects such as adding large woody debris in these upper reaches would benefit the stream by narrowing the channel and adding stream complexity. This would target lowering stream temperatures and increased diversity for fish.

Possible Roads to Treat
23-1-35.0, 24-1-11.0, 24-1-11.4

3. Francis Creek

Old ODFW records show a high population of cutthroat trout in Francis Creek. Also, current habitat inventories show Francis Creek to be some of the best habitat and the low gradient (3.6%) make it particularly important for fish. Stream temperature data is needed for Francis Creek. Considering Canton Creeks high temperatures, if temperatures are lower in Francis Creek then it could be more of a refuge area for salmonids. Francis Creek has debris torrents and a moderate road density (4 mi/sq mi). Some roads could be reviewed for their potential downstream threats.

Certain areas of the stream are lacking channel complexity in the form of large wood. This is potentially a result of stream cleaning or minor debris torrents. The adjacent riparian areas are of an age and condition that they could contribute LWD to the stream channel. Future restoration projects could selectively fall trees from the riparian reserves into the stream channel or add LWD from other areas to the stream channels.

Possible Roads to Treat
24-1-12.1, 24-1-12.0, 24-1-1.1

4. Mellow Moon (Call) Creek
This stream has extensive fish use, due possibly to the relatively low gradient, cooler water, and higher summer flow per area. The easy accessibility to fish from Canton Creek makes the stream even more important to fish in Canton Creek. This compartment contributes cool water to Pass Creek but it is in the Transient Snow Zone, has a low hydrologic recovery percentage (36%), and high road density (5 mi/sq mi). Research has shown that watersheds with these conditions have higher more intense peak flows. These type of flows increase the scour rate of fish eggs and also make juvenile fish more susceptible to down stream displacement.

Restoration should focus on reducing the road density of the basin and use sivilcultural treatments to speed the hydrologic recovery both of the riparian areas as well as the upslope forests.

Possible Roads to Treat
24-1-22.1, 24-1-20.0

5. Other Potential Road Threats
Other roads that are known to be potential threats in the watershed include the following:
24-1-14.0, 24-1-1.0, 24-1-24.0, 24-1-24.1, 24-1-23.1

E. Wildlife Concerns Related to Restoration Opportunities

As a part of wildlife restoration it is desirable to promote growth of riparian early seral stages through pre-commercial and commercial thinnings to more quickly develop functional late successional forest habitat. Riparian enhancement projects which may be considered in this watershed that involve vegetation manipulation or streamside activities should be designed so that minimum impacts to these species result. Of special concern are disturbance to nesting northern spotted owls and other raptors as well as habitat loss for tailed frogs, bat species and nesting songbirds in riparian areas.

For known NSO site centers (**Figure 19**), activities planned within one quarter mile of a site should be scheduled to occur outside of the nesting season (March 15 through September 1) to avoid possible nest failure due to disturbance.

The several federal candidate species of bats documented in this watershed use riparian conditions that provide large, decadent live trees with deep, grooved bark and standing snags provide opportunities for roosting close to or adjacent to foraging areas over water. Creation or preservation of any existing snags located near riparian areas should be a major objective of any riparian enhancement to provide habitat for roosting cavity dwellers including sensitive bat species known to occur in this watershed.

Tailed frogs are known to occur in the upper reaches of Canton Creek past its junction with Pass Creek. Any activities planned in this section of Canton Creek or its tributaries should consider impacts to the habitat requirements of this species, including stream substrate disturbance, water quality (especially silt and temperature), algae and micro-organism growth and chemical pollution. Inventories for this species should be a regular part of planning any projects which could impact this species throughout the watershed.

MONITORING

With realization that money and resources are limited, monitoring within the Canton Creek watershed has been separated into two areas of need; realistic low cost monitoring and monitoring needs that will require a greater outlay of resources. Monitoring below has been prioritized from greatest needs to moderate needs.

Realistic, Lower Cost Monitoring

1. Stream temperatures will continue to be monitored.
2. Tributary contribution to low stream flows and temperature.
3. Continue turbidity and suspended sediment monitoring.
4. Complete analysis of turbidity/flow ratio for 1993 and 1994.
5. Improve intermittent stream mapping on USFS lands.

Higher Cost, More Labor Intensive Needs

Water Quality
1. Seasonal monitoring of other water quality parameters. (High cost, low labor intensity) (ie. pH and dissolved oxygen)
2. Analysis on existing gaging station data. (Medium cost, medium labor intensity)

Fish
1. Distribution and abundance of summer juvenile fish populations. (Low cost, high labor intensity)
2. Fish spawning surveys. (Low cost, medium labor intensity)
3. Outmigrant trapping of smolts. (High cost, high labor intensity)

PUBLIC PARTICIPATION

Letters were sent out to various interest groups and landowners. Some input was received from Mark Powell that directed a small portion of this analysis. Bill Moore from Seneca Timber Company also provided some valuable input on hydrologic recovery that helped direct how the information would be analyzed as well as presented.

REFERENCES

Agee, J.K. "Fire Ecology of Pacific Northwest Forests", Island Press, Covelo, CA, 1993

BLM, USFS, April 1994, *Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl.*

Brown, E.R., editor, 1985- Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington, Part 2 - Appendices. USDA Forest Serv. Publ. No. R6-F2WL-192-1985. Portland, Oreg. 302 pp.

Coffin, B.A. and R.D. Harr. 1992. Effects of forest cover on volume of water delivery to soil during rain-on-snow. Pacific Northwest Research Station. Final Report for Project SH-1.

Dambacher, J. M. 1991. Distribution, abundance, and emigration of juvenile steelhead (Oncorhynchus mykiss), and analysis of stream habitat in the Steamboat Creek basin, Oregon. Master Thesis, Oregon State University.

Department of Environmental Quality. 1988. 1988 Oregon statewide assessment of nonpoint sources of water pollution. Oregon State Department of Environmental Quality, Portland, Oregon.

Harr, R.D. 1981. Some Characteristics and Consequences of Snowmelt During Rainfall in Western Oregon. J. Hydroi. 53:277-304.

Harr, R.D. 1986. Effects of Clearcutting on Rain-on-snow Runoff in Western Oregon: A New Look at Old Studies. Water Res. Res. 22:7. pp 1095-1100.

Holaday, Steve. 1992. Summertime Water Temperatures in Steamboat Creek Basin, Umpqua National Forest. Oregon State University, M.S. Thesis.

La Marr, T. J. 1992. Summer and winter steelhead spawning ground survey results from the North Umpqua Ranger District, 1992. Progress Report on file at the North Umpqua Ranger District, Glide, Oregon.

Mellen, T.K., E.C. Meslow, and R.W. Mannan. 1992. Summertime Home range and Habitat Use of Pileated Woodpeckers in Western Oregon. J. Wildl. Manage. 56:96-103.

Swanston, D.N., and F.J. Swanson. 1976. Timber Harvesting, Mass Erosion, and Steepland Forest Geomorphology in the Pacific Northwest. Pages 199-221 in D.R. Coates, editor. Geomorphology and Engineering. Hutchinson and Ross, Inc., Stroudsburg, Penn.

Umpqua National Forest. 1990. Land and Resource Management Plan and Final Environmental Impact Statement.

Umpqua National Forest. 1993. Wild and Scenic River Suitability Study for Steamboat Creek, Draft Legislative Environmental Impact Statement.

U.S. Geological Survey. 1993. Statistical Summaries of Streamflow data in Oregon: Volume 2-- Annual low and high flow, and instantaneous peak flow. Portland, Oregon. U.S. Geological Survey open-file report 93-63.

Wemple, B.C. 1994. Hydrologic integration of forest roads with stream networks in two basins, Western Cascades, Oregon. Master's thesis. Department of Geosciences, Oregon State University.

Wisseman, B. 1994. Memo to Umpqua National Forest on macroinvertebrate indices in lower Canton Creek. Aquatic Biology Associates, Corvallis, Oregon.

Wisseman, B. 1991. Benthic invertebrate biomonitoring - Umpqua National Forest, Oregon, 1989, 1990, 1991. Aquatic Biology Associates, Corvallis, Oregon.