Appendix D

Gifford Pinchot
National Forest
and

Columbia River Gorge
National Scenic Area

Environmental Baselines

Appendix A – Environmental Baseline

Environmental baselines of the following fifth- fields are discrete documents, with their own tables and references. Styles, headings, and matrix tables may have slight variations due to differences in authorship. Conditions were determined by scoring environmental baselines from earlier fifth-field analyses.

The intent of environmental baselines is to consider effects of the invasive plant treatments individually and cumulatively at the fifth field watershed scale. The anticipated effects of the GPNF and CRGNSA Invasive Plant Treatments forecasted were reviewed by 5th and 6th field watersheds in relationship to the existing environmental baseline, unique watershed conditions, and their spatial and temporal distribution. This resulted in effects being analyzed at a finer scale, which helped to support the analysis in Chapter IV of this BA. The analysis concluded that the anticipated effects of forecasted invasive plant treatments were within the range of expected effects described in Chapter IV of this BA.

Clearfork Cowlitz River (HUC # 1708000401)

The Clearfork Cowlitz River watershed is a 216.3 square mile drainage area between the Muddy Fork of the Cowlitz River and headwaters of the Clearfork Cowlitz River. The Clearfork Cowlitz watershed includes four 6th field sub-watersheds; Ohanapecosh, Summit, Clearfork Cowlitz, and Muddy Fork Cowlitz river. Clearfork Cowlitz River watershed contains approximately 53.1 miles of Proposed, Threatened, Endangered or Sensitive (PETS) fish species habitat. Anadromous fish species found in Clearfork Cowlitz are chinook salmon (*Oncorhynchus tsywatscha*), coho salmon (*Oncorhynchus kisutch*), steelhead (*Oncorhynchus mykiss*), and sea-run and resident coastal cutthroat (*Oncorhynchus clarki clarki*) (Figure 1).

Several sources of information were used to determine the environmental baseline conditions for the Clear Fork (Table 2):

- The Clearfork Cowlitz Watershed Assessment, Gifford Pinchot National Forest, Randle and Packwood Ranger Districts, September 1998.
- Stream Surveys by the Gifford Pinchot National Forest from 1977 through 2000, (Table 1).
- Stream temperature monitoring from 1994 through 2000.
- Field observations from 1990 through 2001 by employees of the Gifford Pinchot National Forest. These employees included a number of Hydrologists and Fisheries Biologists employed by the Forest Service during that time period.

Table 1. Level II Stream Surveys in the Clearfork Cowlitz River watershed.

Watershed #	Stream name	Years Surveyed [1]
170800040101	Ohanapecosh River	1992
170800040102	Carlton Creek	1980, 1982
170800040102	Cyreneus Creek	1979
170800040102	Summit Creek	1979, 1980, 1983, 1997
170800040103	Clear Fork	1982, 1987, 1992
170800040103	Cortright Creek	1980, 1982, 1984, 1989
170800040103	Lava Creek	1984
170800040103	Little Lava Creek	1984
170800040103	Millridge Creek	1983
170800040103	Purcell Creek	1983

[1] Stream surveys prior to 1991 did not conform to regional guidelines for stream surveys. Guidelines for fish surveys did not exist prior to 1991

Table 2. Environmental baseline conditions in 2001 for the Clearfork Cowlitz River watershed.

		Environmental Baseline Rating[1]		
Pathway	**Indicator(s)**	**Properly Functioning**	**Functioning at Risk**	**Functioning at Unacceptable Risk**
WATER QUALITY	Temperature Other Species	X		
	Sediment		X	
	Chemical Contaminants/Nutrients		X	
HABITAT ACCESS	Physical barriers		X	
HABITAT ELEMENTS	Substrate in rearing areas		X	
	Large Woody Debris		X	
	Pool Frequency and Quality USFWS		X	
	Pool Frequency and Quality NMFS		X	
	Large pools		X	
	Off-channel habitat		X	
	Refugia		X	
CHANNEL DYNAMICS and CONDITION	Width / Depth Ratio		X	
			X	
	Streambank condition		X	
	Floodplain connectivity		X	
FLOW / HYDROLOGY	Peak/base flows		X	
	Drainage network	X		
WATERSHED CONDITIONS	Road density and location		X	
	Disturbance regime		X	
	Disturbance history		X	
	Riparian reserves		X	
SUBPOPULATION CHARACTERISTICS / SPECIES AND HABITAT	Subpopulation size, Growth and survival, Life history Diversity and isolation, Persistence and genetic integrity, Integration of species and habitat conditions	No Rating. (The Forest Service has insufficient data in order to rate these indicators).		

Water Quality

Temperature – There is very little water temperature data for this watershed. Existing data show cold water temperatures, but we have few if any afternoon or evening temperatures for the Clear or Ohanapecosh rivers (Table 3). Given the position in the watershed, altitude, relatively unmanaged condition of the watersheds and glacial source of these streams it is unlikely that water temperatures exceed 14 ^{o}C.

Table 3. Temperature monitoring in the Clearfork Cowlitz River watershed.

Watershed #	Stream	Location	Years Monitored	7 Day Ave Max
170800040102	Carlton Creek	at Summit Creek confluence	1997	12.7
170800040103	Cortright Creek	~ River Mile 2	1997, 2000	12.7

Sediment/Turbidity – Many of the streams were rated for fine sediments under the Clear Fork watershed analysis in 1998. None of the streams were rated as being 100% good. Best habitat conditions were in the Ohanapecosh River (96% good) and (Clear Fork Cowlitz River 68% Good), Summit Creek (100% Good where data existed). The worst areas were Lava Creek (100 % Poor), Little Lava Creek (100 % Poor), and Cortright Creek (50% Poor).

Chemical Conc./Nutrients - On April 25, 2002 a small oil spill was detected at Jody's bridge. The source of this pollution was undetermined until April 29, 2002. Clearly there is the potential for spills from other developed areas within the Clearfork watershed.

Habitat Access

Physical Barriers - The one barrier to PETS fish found by the 2001 culvert survey is on an intermittent tributary to the Ohanapecosh River. Because we have observed adult coho salmon above this culvert, it is not considered a barrier to all life stages at all flows. Additional barrier culverts are above natural barriers to PETS fish.

Habitat Elements

Substrate/Sediment - Many of the streams were rated for fine sediments under the Clear Fork watershed analysis in 1998. None of the streams were rated as being 100% good. Best habitat conditions were in the Ohanapecosh River (96% good) and (Clear Fork Cowlitz River 68% Good), Summit Creek (100% Good where data existed). The worst areas were Lava Creek (100 % Poor), Little Lava Creek (100 % Poor), and Cortright Creek (50% Poor).

Large Woody Debris – Level II stream survey data indicate that some reaches of Clear Fork and Ohanapecosh River meet the criteria. However, we feel numbers from early surveys may be inflated because survey crews may have been instructed to use smaller sizes when assigning pieces of wood to size categories. The Level II stream survey protocol does not record the actual size of a piece of wood but places them in three different size categories. Several reaches, particularly on the relatively managed tributaries of Summit Creek, Carlton Creek and Cortright Creek do not meet the criteria for functioning properly.

Pool Character and Quality - Pool Frequency standards are met in the lower Ohanapecosh and Clear Fork, but number of pools decrease upstream in the Clear Fork and frequency standards are not met in tributary streams. Lower Clear Fork and Ohanapecosh have many large pools. However, pool size decreases in the upper Clear Fork and its tributaries have few large pools.

Off Channel Habitat - The valley types in this watershed are narrow and not conducive to the formation of off channel habitats. Some side channels do exist between the Clear Fork/Ohanapecosh confluence and the confluence of the Muddy Fork. However, these side channels are not particularly stable. Ohanapecosh River appears to have some side channels within the unsurveyed sections on Mt Rainier National Park.

Refugia - Clear Fork Cowlitz and Ohanapecosh rivers do provide refugia for resident populations of fish. However, they are not accessible to anadromous or downstream resident fish populations. Upper Summit and Carlton Creeks are also potential refugia for resident populations.

Channel Condition and Dynamics

Width/Depth Ratios - Clear Fork Cowlitz, Ohanapecosh, and Muddy Fork Cowlitz rivers all have short sections that were interpreted to have gotten wider since 1973.

Streambank Condition – No information currently exists to address streambank condition. Based on professional judgment, 50 to 80% of any stream reach in Clear Fork watershed has greater than 90% stability.

Floodplain Connectivity - Based on field observations and post-flood assessment, some stream reaches do have noticeable channel downcutting (i.e., floodplain abandonment). Road density within the riparian zone is very high in major campground areas, such as La Wis Wis and Ohanapecosh, and moderate in the developed portions of other sub-watersheds. A dike was constructed along side Purcell Creek in La Wis Wis campground.

Flow/Hydrology

Changes in Peak/Base Flows - Clear Fork watershed has an Aggregate Recovered Percentage (ARP) value of 96%. This is close to natural conditions. However, the Clear Fork watershed analysis reported that some of the 1999 sub-watersheds had lower ARP values and Water Available for Run-off (WAR) greater than 10%.

Drainage Network Increase - Drainage network increase was estimated by counting the number of stream crossings by roads, multiplying the number of stream by an average distance between the crossing and the nearest drainage structure and dividing by the total miles of stream in the watershed. The overall value was 1.7% and none of the sub-watershed values exceeded 3%.

Watershed Conditions

Road Density and Location - Overall, road density was 0.77 miles per square mile and riparian reserve road density was 0.62 miles per square mile. Only in the Clear Fork sub-watershed did the road density exceed 1 mile per square mile (1.14 Miles per square mile).

Disturbance History/Regime – Approximately 15 ten-year or greater flood events have occurred on the Cowlitz River since 1970. Effects from these flood events are low in the headwaters compared to the lower portion of the watershed. At least one major channel changing land slide event was observed in the Clear Fork sub-watershed after the 1996 flood.

The ARP values are all above 92.5%. However, there is a slight concentration of activities in the riparian zones of the non-wilderness portions of Summit Creek, Carlton Creek, and Cortright Creek Drainages.

Riparian Reserves - There is very little fragmentation due to management activities. The non-wilderness portions of Summit Creek, Cortright Creek, Carlton Creek, and Clear Fork drainages do have some fragmentation.

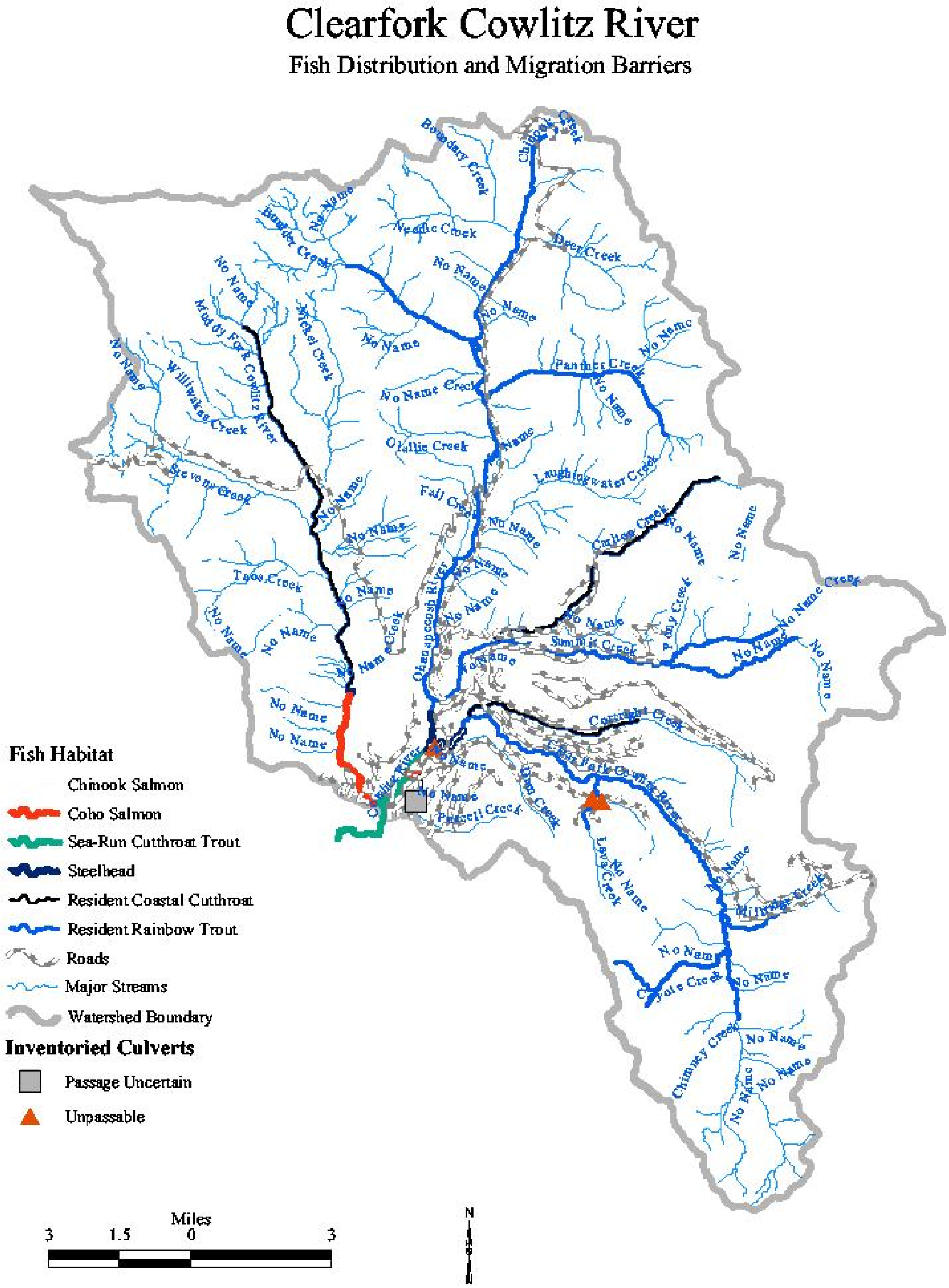


Figure 1. Fish distribution in the Clearfork Cowlitz River watershed.

Middle Cowlitz River (HUC #1708000403)

The Middle Cowlitz River is a 207 square mile drainage area between Smith Creek and the confluence with the Cispus River. Middle Cowlitz River watershed includes a portion of the former Upper Cowlitz watershed and all of former Middle Cowlitz River watershed.

The Middle Cowlitz River watershed includes eight 6th field sub-watersheds. Only those 6th field sub-watersheds that contain ground disturbing activities be evaluated individually in this document.

The Middle Cowlitz River watershed contains approximately 78.5 miles of Proposed, Endangered, Threatened, and Sensitive (PETS) fish species (Figure 1). The streams containing number of miles of PETS habitat for each stream are listed in Table 1.

Table 1. Summary of Threatened, Proposed and Candidate fish habitat in the Middle Cowlitz River Watershed.

6th Field Watershed Number	Stream	Common Name	Habitat Length (mi)
170800040301	Smith Creek	Coho Salmon	1.2
		Resident Coastal Cutthroat	3.6
		Sea-Run Cutthroat Trout	1.2
		Steelhead	1.2
170800040302	Willame Creek	Coho Salmon	1.2
		Sea-Run Cutthroat Trout	1.2
		Resident Coastal Cutthroat	1.2
		Steelhead	1.2
	North Fork Willame Creek	Resident Coastal Cutthroat	2.4
	West Fork Willame Creek	Resident Coastal Cutthroat	2.2
	Headwater Tributary to West Fork Willame	Resident Coastal Cutthroat	0.2
170800040303	Burton Creek	Chinook Salmon	2.0
		Coho Salmon	2.0
		Resident Coastal Cutthroat	2.0
		Sea-Run Cutthroat Trout	2.0
		Steelhead	2.0
	Cowlitz River	Chinook Salmon	7.4
		Coho Salmon	7.4
		Resident Coastal Cutthroat	7.4
		Sea-Run Cutthroat Trout	7.4
		Steelhead	7.4
	Dry Creek	Coho Salmon	0.8
		Resident Coastal Cutthroat	0.8
	Garrett Creek	Coho Salmon	1.3
		Resident Coastal Cutthroat	1.3
		Sea-Run Cutthroat Trout	1.3
	Kilborn Creek	Coho Salmon	1.0
		Resident Coastal Cutthroat	1.0
		Sea-Run Cutthroat Trout	1.0
170800040304	Cowlitz River	Chinook Salmon	7.9
		Coho Salmon	7.9
		Resident Coastal Cutthroat	7.9

6th Field Watershed Number	Stream	Common Name	Habitat Length (mi)
		Sea-Run Cutthroat Trout	7.9
		Steelhead	7.9
	Cunningham Creek	Coho Salmon	2.2
		Resident Coastal Cutthroat	2.6
		Sea-Run Cutthroat Trout	2.2
	Davis Creek	Coho Salmon	1.9
		Resident Coastal Cutthroat	2.3
		Steelhead	2.3
	Hopkin creek	Coho Salmon	0.3
		Resident Coastal Cutthroat	0.3
		Sea-Run Cutthroat Trout	0.3
	Sethe Creek	Coho Salmon	1.6
		Resident Coastal Cutthroat	1.9
		Sea-Run Cutthroat Trout	1.9
	Surrey Creek	Coho Salmon	2.0
		Sea-Run Cutthroat Trout	2.0
170800040305	Silver Creek	Chinook Salmon	2.7
		Coho Salmon	2.7
		Resident Coastal Cutthroat	11.5
		Sea-Run Cutthroat Trout	5.4
		Steelhead	5.4
	East Fork Silver Creek	Resident Coastal Cutthroat	2.7
	Lake Creek	Resident Coastal Cutthroat	2.6
		Steelhead	0.1
	Lynx Creek	Resident Coastal Cutthroat	3.5
	Martin Creek	Resident Coastal Cutthroat	0.3
	Unnamed Trib to Upper Silver Creek	Resident Coastal Cutthroat	0.8
170800040306	Cowlitz River	Chinook Salmon	6.4
		Coho Salmon	6.4
		Resident Coastal Cutthroat	6.4
		Sea-Run Cutthroat Trout	6.4
		Steelhead	6.4
	Hampton Creek	Coho Salmon	0.9
		Resident Coastal Cutthroat	0.9
		Sea-Run Cutthroat Trout	0.9
	Miller Creek	Coho Salmon	0.5
	Kiona Creek	Coho Salmon	7.1
		Resident Coastal Cutthroat	7.1
		Steelhead	7.1
	Peters Creek	Coho Salmon	1.4
		Resident Coastal Cutthroat	2.9
		Sea-Run Cutthroat Trout	1.4
		Steelhead	1.4
	East Fork Peters Creek Sec 7	Resident Coastal Cutthroat	0.6
	Unnamed Trib to Peters Sec 6	Resident Coastal Cutthroat	0.3
	Oliver Creek	Chinook Salmon	0.2
		Coho Salmon	1.2
		Resident Cutthroat Trout	3.7
		Sea-Run Cutthroat Trout	1.7
		Steelhead	1.7
170800040307	Siler Creek	Coho Salmon	4.1
		Resident Coastal Cutthroat	5.9

6th Field Watershed Number	Stream	Common Name	Habitat Length (mi)
		Sea-Run Cutthroat Trout	4.1
		Steelhead	4.1
	Squire Creek	Resident Coastal Cutthroat	1.4
		Sea-Run Cutthroat Trout	1.4
170800040308	Cowlitz River	Chinook Salmon	9.7
		Coho Salmon	9.7
		Resident Coastal Cutthroat	9.7
		Sea-Run Cutthroat Trout	9.7
		Steelhead	9.7
	Schooley Creek	Coho Salmon	1.2
		Resident Coastal Cutthroat	1.2
		Sea-Run Cutthroat Trout	1.2

Several sources of information were used to determine the environmental baseline conditions of the Middle Cowlitz River watershed (Table 3):

- Middle and Upper Cowlitz River watershed analyses, 1997, Gifford Pinchot National Forest, Randle and Packwood Ranger Districts.
- Stream Surveys by the Gifford Pinchot National Forest from 1979 through 2000 (Table 4).
- Stream temperature monitoring from 1994 through 2000.
- Field observations from 1990 through 2002 by employees of the Gifford Pinchot National Forest. These employees included a number of Hydrologists and Fisheries Biologists employed by the Forest Service during that time period.

Table 3. Environmental baseline conditions in 2002 for the Middle Cowlitz River Watershed.

Environmental Baseline Rating				
Pathway	**Indicator(s)**	**Properly Functioning**	**Functioning at Risk**	**Functioning at Unacceptable Risk**
SUBPOPULATION CHARACTERISTICS	Subpopulation Size	No Rating (The Forest Service has insufficient data in order to rate these indicators)		
	Growth and Survival			
	Life History			
	Persistence and Genetic Integrity			
WATER QUALITY	Temperature – (Bull Trout)			
	Temperature – (Coho, Chin, STH,CCT)		X	
	Sediment		X	
	Chemical Contaminants/Nutrients	X		
HABITAT ACCESS	Physical barriers – (Coho)		X	
	Physical Barriers – (Chin, STL, CCT,BT)	X		
HABITAT ELEMENTS	Substrate in rearing areas			X
	Large Woody Debris			X
	Pool Frequency & Quality (BT, CCT)			X
	Pool Frequency & Quality (Coho, Chin, STH)			X
	Large Pools		X	
	Off-channel Habitat			X
	Refugia – (All Species)			X
CHANNEL DYNAMICS and CONDITION	Width / Depth Ratio	X		
	Streambank Condition		X	
	Streambank Condition		X	
	Floodplain Connectivity			X
FLOW / HYDROLOGY	Peak/base Flows		X	
	Drainage Network		X	
WATERSHED CONDITIONS	Road Density and Location			X
	Disturbance Regime			X
	Disturbance History			X
	Riparian Reserves		X	
	Integration of Species & Habitat Condition – (All Species)			X

Table 4. List of Stream Surveys[1] for Middle Cowlitz River Watershed

Sub-Watershed #	Stream Name	Stream Survey Year(s)
170800040301	Castle Butte	1984
	Smith Creek	1981, 1986, 1988, 1991, 1994
170800040302	Willame Creek	1990, 1994, 1998
	North Fork Willame Creek	1979, 1998
	South Fork Willame Creek	1979, 1998
	West Fork Willame Creek	1998
	Lillian Creek	1983, 1998
170800040303	Garret Creek	1994
	Kilborn Creek	1993
	Burton Creek	1983, 1994
170800040304	Davis Creek	1980, 1984, 1994
	Owens Creek	1983
	Hopkins Creek	1994
170800040305	Silver Creek	1980, 1982, 1989, 1996
	Lynx Creek	1987
	Willie Creek	1988
170800040306	Oliver Creek	1995
	Miller Creek	1995
	Kiona Creek	1995
170800040307	Siler Creek	1994
	Squire Creek	1991

[1] Stream surveys prior to 1991 did not conform to regional guidelines for stream surveys. Guidelines for fish surveys did not exist prior to 1991.

Water Quality

Temperature – A number of streams in the watershed have exceeded the state standard of 16.0^{o} C in the summer of more than one year: Oliver Ck., Peters Ck., Lake Ck., North Fork Martin Ck., Lynx Ck., Silver Ck., and Kiona Ck. Willame Ck. is currently on the 303 (d) list for temperature (Table 5).

Table 5. - Temperature monitoring in the Middle Cowlitz River Watershed.

Sub-Watershed #	Stream Name	Location	Year(s) of Stream Temperature Monitoring Data	Maximum 7 day average temperature in degrees Celsius/year
170800040301	Castle Butte Creek	At Smith Ck. Confluence	1986	12.2 / 1986
	Smith Creek	At 2nd Crossing, Rd 20	1994-1998	12.4 / 1995
	Smith Creek	Above Castle Butte Ck.	1986	12.6 / 1986
	Smith Creek	Below Castle Butte Ck.	1986	11 / 1986
170800040302	Willame Creek	At Forest Boundary	1999-2001	15.9 / 2001
	Willame Creek	At Cowlitz Confluence	1998	18.7 / 1998
	N.F. Willame Creek	Above Rd. 47	1983-1984, 1987, 1996, 1998-	14.4 / 1987
	N.F. Willame Creek	At Willame Ck. Confluence	1996, 1998-2001	15.9 / 1996
	S.F. Willame Creek	NR end Rd 4715	1977, 1981-82, 1984-88, 1994	14.2 / 1994
	S.F. Willame Creek	At Willame Ck. Confluence	1998, 2000-2001	15.6 / 1998
	W. F. Willame Creek	At Willame Ck. Confluence	1996, 1998	13.8 / 1996
	Lillian Creek	At Willame Ck. Confluence	1998-2001	16.1 / 1998
170800040304	Davis Creek	River Mile 1.5	2001	15.5 / 2001
170800040305	Silver Creek	T.13N. R.7E, Sec 7	1999	12.3 / 1999
	Silver Creek	T.13N. R.7E, Sec 23	1999	15 / 1999
	Silver Creek	Just above Confluence Lynx	1999	13.1 / 1999
	Silver Creek	Just below Lake Ck.	1999, 2001	16.0 / 2001
	Silver Creek	Above East Fork Ck.	2001	16.8 / 2001
	Silver Creek	At East Fork Ck.	2001	14.3 / 2001
	Silver Creek	Between Mary Kiona and	2001	16.5 / 2001
	Silver Creek	At Forest Boundary	1992, 1995-2001	18.3 / 1998
	Lynx Creek	At Confluence Silver CK.	1999	17.0 / 1999
	Willie Creek	½ mile above Confluence	1999	13.7 / 1999
	Lake Creek	At Confluence Silver Ck.	1999	15.7 / 1999
	East Fork Silver Creek	T.13N. R.7E, Sec 35	1999	11.7 / 1999
170800040307	Siler Creek	Near Forest Boundary	1996	15.3 / 1996

Sediment/Turbidity – A number of streams have segments with gravel deposits that are filled in with fine-grained sediment (and therefore their gravel deposits were rated as "poor"): Kiona Cr., Peters, Miller Cr., Lake Cr., Lynx Cr., Silver Cr., Siler Cr., Squire Cr., Schooley Cr, Davis Cr.

Chemical Conc./Nutrients - There are no known water quality problems outside of stream temperature; however, the potential exists for chemical/nutrient contamination of streams because of the presence of development along the Cowlitz River. Development in the floodplain of the Cowlitz River includes the town of Randle, ranches, and lumber mills.

Habitat Access

Physical Barriers - The 2001 culvert survey found 8 culverts that maybe a migration barrier in Smith Creek, Siler Creek, North Fork Willame Creek, Squire Creek, and West Fork Willame Creek.

Habitat Elements

Substrate/Sediment - Stream surveys have not measured sediment in fashion suggested by the NMFS matrix. Estimates made during Field observations, suggest that the substrate is moderately embedded and the interstitial spaces were reduce by fine sediments.

Large Woody Debris - None of the streams in the watershed that have a stream survey meets the 80-piece/mile requirement. These streams make up approximately 60% of total stream miles in the basin.

Pool Character and Quality - None of the streams in the watershed that have a stream survey meets the “wetted width:pools/mile ratio. This is approximately 60% of the stream miles in this 5th field. Stream surveys for the watershed show that all of streams have a few large pools.

Off Channel Habitat - Cowlitz Mainstem has some quality side channels. The tributaries generally have too high of gradient for good off-channel habitat, however there is some off-channel in the response reaches but they lack side channels near the confluences with the Cowlitz River.

Refugia - Refugia do not exist at the 6th field watershed scale

Channel Condition and Dynamics

Width/Depth Ratios - With the exception of the Cowlitz River that makes up approximately 14% of the stream miles in the watershed most of the other stream types are “B” with the headwalls being “A”. The stream surveys indicate the W/D ratios within the excepted limits

Streambank Condition – There are some stability problems in the watershed, however these are confined to a relative small area.

Floodplain Connectivity - Highway 12 bisects the floodplain of the Cowlitz River. The floodplain contains extensive home development and conversion to pasture. Many of the tributaries to the Cowlitz River on private land have been channelized in the Cowlitz River floodplain.

Flow/Hydrology

Changes in Peak/Base Flows - Approximately half (48%) of the 5th field watershed has an ARP level of less than 70%, an indicator of the potential for an increase in peak flows. However, the 6th field that contributes the most to the 48% (Silver) is very close to moving ARP levels from below 50% to above 85% based on timber stand age.

Drainage Network Increase - There is a 3% increase in the drainage network.

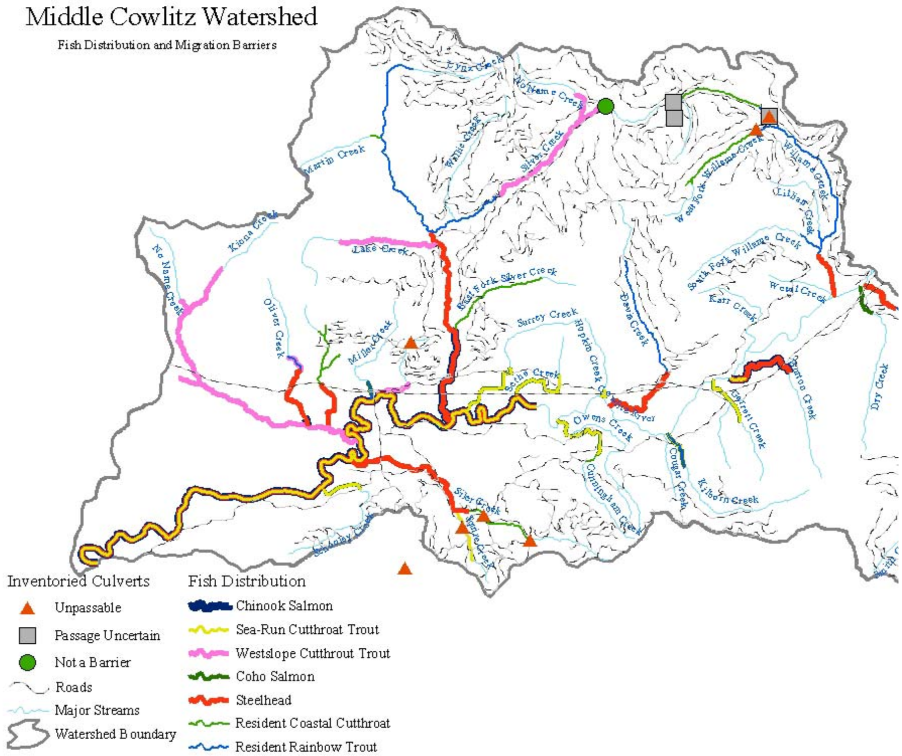
Watershed Conditions

Road Density and Location - Road density averages 3.8 miles per square mile in the old Middle Cowlitz watershed, and there are a number of roads in the floodplain of the Cowlitz River.

Disturbance History/Regime – Hydrologic Recovery values of most 6th field watersheds are less than 85%, and there has been a substantial amount of human development (roads, houses, pastures, towns) in the floodplain of the Cowlitz River. There has been a lot of activities in this 5th field; floods, heavy ash fall, road construction, timber harvest, on the Cowlitz Valley floor: home construction, lumber production, and dam construction. All of these items have added up to a reduction and quality of fish habitat.

There have been approximately 15 ten-year or greater flood events since 1970 on the Cowlitz River. Resulting in pronounced stream channel erosion, channel widening, increasing channel instability, and reducing hydrologic complexity.

Riparian Reserves - Years of timber harvesting and road construction have left the riparian reserves badly fragmented in this 5th field. Most of the timber on private lands in this watershed has been harvested and replanted. It will be many years before the replanted timber is available for LWD recruitment.


Middle Cowlitz Watershed
Fish Distribution and Migration Barriers
Inventoried Culverts
Unpassable
Passage Uncertain
Not a Barrier
Roads
Major Streams
Watershed Boundary
Fish Distribution
Chinook Salmon
Sea-Run Cutthroat Trout
Westslope Cutthrout Trout
Coho Salmon
Steelhead
Resident Coastal Cutthroat
Resident Rainbow Trout
Martin Creek
Kiona Creek
Lake Creek
Oliver Creek
Surrey Creek
Hopkins Creek
Davis Creek
Kilborn Creek
Dry Creek
Karr Creek
Cougar Creek
Cunningham Creek
South Fork Willame Creek
Willame Creek

Upper Cowlitz River (HUC #1708000402)

The Upper Cowlitz River watershed is a 5th field watershed, Hydrologic Unit Code 1708000402. The watershed is located in the Gifford Pinchot National Forest of southwest Washington. The watershed is defined as the 167 square mile drainage area between Johnson Creek in the west and Coal Creek in the east. The current delineation of the Upper Cowlitz River watershed includes only a portion of the former Upper Cowlitz River watershed. The re-delineation of the watershed boundaries occurred in December 2000. The Upper Cowlitz River watershed includes six 6th field sub-watersheds. These 6th field sub-watersheds will *not* be evaluated individually in this document.

Below is list of sources used to develop baseline information for Upper Cowlitz River:

- The Upper Cowltiz River Watershed Assessment, Gifford Pinchot National Forest, Randle and Packwood Ranger Districts, July 1, 1997.
- Stream Surveys by the Gifford Pinchot National Forest from 1977 through 2000.
- Stream temperature monitoring from 1994 through 2000.
- Field observations from 1990 through 2001 by employees of the Gifford Pinchot National Forest. These employees included a number of Hydrologists and Fisheries Biologists employed by the Forest Service during that time period.

The Upper Cowlitz watershed contains approximately 174 miles of Proposed, Threatened, Endangered or Sensitive (PETS) fish species habitat. The streams containing PETS fish species habitat and the number of miles of habitat for each stream are listed in Table 1.

Anadromous fish species listed that occur in the Upper Cowlitz River watershed are chinook salmon (*Oncorhynchus tsywatscha*), coho salmon (*Oncorhynchus kisutch*), steelhead (*Oncorhynchus mykiss*), and sea-run coastal cutthroat (*Oncorhynchus clarki clarki*). Resident fish includes coastal cutthroat (*Oncorhynchus clarki clarki*) and rainbow trout (Figure 1).

Table 1. Summary of PETS fish habitat in the Upper Cowlitz River watershed.

Watershed Number	Location	Common Name	Habitat Length
170800040201	Cowlitz River	Chinook Salmon	3.7
		Coho Salmon	3.7
		Resident Coastal Cutthroat	3.7
		Sea-Run Cutthroat Trout	3.7
		Steelhead	3.7
	Coal Creek	Coho Salmon	0.7
		Resident Coastal Cutthroat	4.7
		Sea-Run Cutthroat Trout	0.7
		Steelhead	0.7
	Unnamed Trib Cowlitz E 1/2 T13N 9E Sec 1 (Gun Club)	Coho Salmon	0.4
		Resident Coastal Cutthroat	0.4
		Sea-Run Cutthroat Trout	0.4
	Unnamed Trib Cowlitz 1 W1/2 sec 1	Coho Salmon	0.6
	Unnamed Trib Cowlitz 2 T13N R9E	Coho Salmon	0.4
	Hinkle Tinkle Creek	Coho Salmon	0.6
	Unnamed Trib Cowlitz sec 11 T13N	Coho Salmon	0.5
170800040202	Lake Creek	Coho Salmon	2.3

		Resident Coastal Cutthroat	5.5
		Sea-Run Cutthroat Trout	2.3
		Steelhead	2.3
170800040203	Butter Creek	Coho Salmon	1.7
		Resident Coastal Cutthroat	8.0
		Sea-Run Cutthroat Trout	1.7
		Steelhead	1.7
170800040204	Cowlitz River	Chinook Salmon	5.5
		Coho Salmon	5.5
		Resident Coastal Cutthroat	5.5
		Sea-Run Cutthroat Trout	5.5
		Steelhead	5.5
	Hall Creek	Coho Salmon	3.8
		Resident Coastal Cutthroat	3.8
		Sea-Run Cutthroat Trout	3.8
		Steelhead	3.8
	Hager Creek	Resident Coastal Cutthroat	2.1
	Unnamed Trib Cowlitz sec 15 T13N R9E (FS Bone Yard)	Coho Salmon	0.9
		Resident Coastal Cutthroat	0.9
		Sea-Run Cutthroat Trout	0.9
170800040205	Skate Creek	Chinook Salmon	10.9
		Coho Salmon	10.9
		Resident Coastal Cutthroat	12.1
		Sea-Run Cutthroat Trout	10.9
		Steelhead	10.9
	Bear Prarie Creek	Coho Salmon	0.4
		Resident Coastal Cutthroat	0.4
		Sea-Run Cutthroat Trout	0.4
		Steelhead	0.4
	Johnson Creek	Resident Coastal Cutthroat	3.6
170800040206	Johnson Creek	Coho Salmon	4.1
		Resident Coastal Cutthroat	0.5
		Sea-Run Cutthroat Trout	4.1
		Steelhead	4.1
	Glacier Creek	Resident Coastal Cutthroat	1.0
	Deception Creek	Resident Coastal Cutthroat	2.6
	Jordan Creek	Resident Coastal Cutthroat	0.3

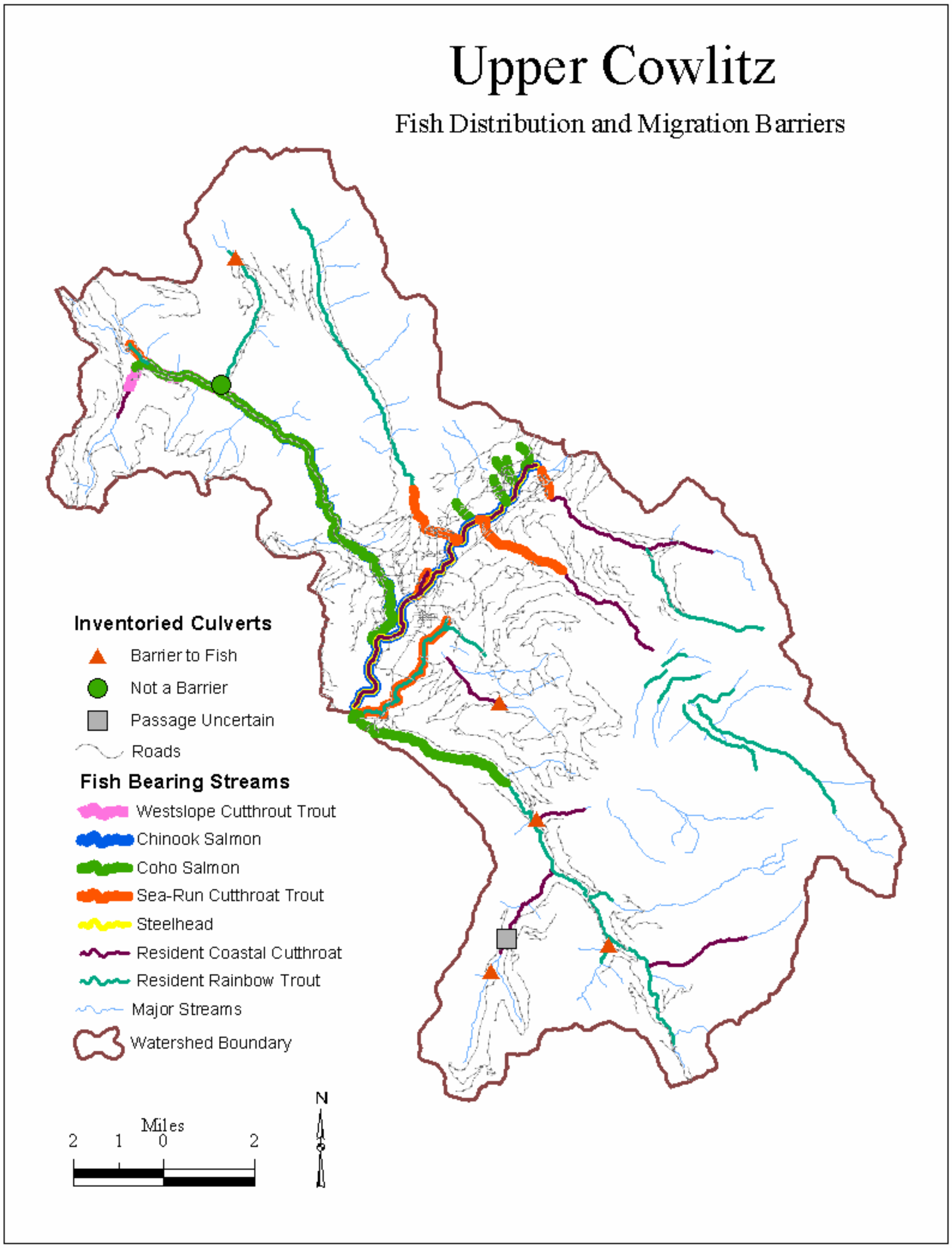


Figure 1. Fish distributions within the Upper Cowlitz River Watershed (2002).

Table 2. Environmental baseline conditions in 2001 for the Upper Cowlitz River watershed.

		Environmental Baseline Rating[1]		
Pathway	**Indicator(s)**	**Properly Functioning**	**Functioning at Risk**	**Functioning at Unacceptable Risk**
	Temperature	X		
	Sediment		X	
	Chemical Contaminants/Nutrients		X	
HABITAT ACCESS	Physical barriers	X		
HABITAT ELEMENTS	Substrate in rearing areas		X	
	Large Woody Debris			X
	Pool Frequency and Quality USFWS		X	
	Pool Frequency and Quality NMFS		X	
	Large pools		X	
	Off-channel habitat		X	
	Refugia			X
CHANNEL DYNAMICS and CONDITION	Width / Depth Ratio		X	
	Streambank condition (USFWS)		X	
	Streambank condition (NMFS)		X	
	Floodplain connectivity			X
FLOW / HYDROLOGY	Peak/base flows		X	
	Drainage network		X	
WATERSHED CONDITIONS	Road density and location		X	
	Disturbance regime			X
	Disturbance history			X
	Riparian reserves		X	
SUBPOPULATION CHARACTERISTICS / SPECIES AND HABITAT	Subpopulation size, Growth and survival, Life history Diversity and isolation, Persistence and genetic integrity, Integration of species and habitat conditions	No Rating. (The Forest Service has insufficient data in order to rate these indicators).		

Supporting information to the environmental baseline for the Upper Cowlitz River watershed is presented in a different format. Environmenatl baseline information is shown below in Table 5. Temperature and stream survey information is provided below in Tables 3 and 4 to give the reader some content while going through the environmental baseline conditions.

Table 3. Temperature monitoring in the Upper Cowlitz River watershed.

6th field Sub Watershed	Stream Name	Locatation	Years Monitored	Max 7-day Ave
170800040202	Lake Creek	Above County Rd	1995	13.4
170800040203	Butter Creek	At Rd 5270066	1995	12.5
170800040204	Hager Creek	Above Hager Lk	1995	9.1
170800040205	Skate Creek	½ mile below Little Johnson	1994 – 1998	14.2
170800040206	Jordan Creek	At confluence	1999	11.1
	Middle Fork Johnson	At confluence with Johnson Cr.	1999	11.3
	Deception Creek	At confluence with Johnson Cr.	1999	11.1
	Glacier Creek	At confluence with Johnson Cr.	1999	9.8
	Johnson Creek	Near Forest Boundary	1982-88, 1994-99	13.7

Table 4. Stream surveys collected in the Upper Cowlitz River.

6th field Sub-watershed #	Stream name	Years Surveyed [1]
170800040201	Coal Creek	1982
	Lost Creek	1984
	Hinkle Tinkle Creek	1983, 1994
170800040202	Lake Creek	1982, 1993
170800040203	Butter Creek	1979, 1987, 2001
170800040204	Hager Creek	1983, 1994
	Hall Creek	1994
	Snyder Creek	1983, 1994
170800040205	Skate Creek	1979, 1980, 1995
	Dixon Creek	1984
	Little Johnson Creek	1979
170800040206	John Bob Creek	1984
	Jordan Creek	1983, 1999
	Johnson Creek	1981, 1987, 1999
	Mission Creek	1987, 1999
	Glacier Creek	1983, 1999
	Deception Creek	1980. 1981,1982,1999
	Middle Fork Johnson	1982, 1999

[1] Stream surveys prior to 1991 did not conform to regional guidelines for stream surveys. Guidelines for fish surveys did not exist prior to 1991.

Table 5. Details for documenting anadromous fish habitat environmental baseline conditions in the Upper Cowlitz Rive

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
WATER QUALITY	Temperature Bull Trout	Functioning at Risk	Not Pertainent	The Level 1 team has agreed that it is highly unlikely that bull trout occur in this watershed and no further consultation is needed.	
	Temperature Other Species	Functioning Appropriately	7 day average maximum temperature in a reach during the following life history stages: [1, 3] rearing: 10 – 14 °C	Water temperatures in most of tributaries manage by the National meet the criteria for properly functioning, however, water temperatures in a couple of the key tributaries Skate Creek and Lake Creek are slightly higher than the criteria of 13 °C. We have no data for the Cowlitz River Itself, because of its width and exposure to sunlight it is probably above slightly warmer than 13 °C. Because this watershed is just down stream from the glacially fed Muddy Fork of the Cowlitz River, it is unlikely that water temperatures exceed 14°C.	Watershe Appendix
	Sediment (in spawning areas)	Functioning At Risk	12-17% fines (<0.85mm) in gravel	We have no data to address the condition of spawning gravels directly. Road failures, landslides, and avalanche chutes are contributing sediment to some streams. In addition, spawning areas of some streams have elevated levels of fine-grained sediment.	Watershe 5-16, 5-18 Stream Su
	Chemical Contaminatio n/ Nutrients	Functioning At Risk	Moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one CWA 303d designated reach	The town of Packwood, which is located in the middle of the watershed, contains septic tanks and lawns that are located near the Cowlitz River. With the exception of stream temperature, there is no water quality data for streams in the watershed. A fuel oil spill originating a storage tank outside of the watershed, enterd the watershed on or about April 26, 2002. In addition, this spill points out the potential for such spills to occur in a developed setting.	Field Obs
HABITAT ACCESS	Physical barriers	Functioning Appropriately	Human-made barriers allow upstream and downstream fish passage at all flows for all life history stages.	The 2001 culvert survey found two barrier and one partial barrier in the watershed.	Stream Su Field obse Table 1)
	Substrate character and embedded-ness (in rearing areas)	Functioning at Risk	Gravel and cobble are subdominant, or if dominant, reach embeddedness 20-30%.	We have no data to address the condition of spawning gravels directly. Road failures, landslides, and avalanche chutes are contributing sediment to some streams. In addition, spawning areas of some streams have elevated levels of fine-grained sediment.	Watershe 16, 5-18, . Stream Su

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
HABITAT ELEMENTS	Large Woody Debris (LWD)	Functioning at Unacceptable Risk	Current levels are being maintained at minimum levels desired for "Func. Appr." but potential sources are lacking to maintain these minimum values.	Most streams segments are lacking in large woody debris when compared to the values listed in "Functioning Appropriately."	Watershe Survey Field Obs table 2)
	Pool Frequency and Quality FWS	Functioning at Risk	Pool frequency is similar to values in "functioning appropriately", but pools have inadequate cover/temperature, and/or there has been a moderate reduction of pool volume by fine sediment	Some stream reaches do not meet the "Functioning Appropriately" criteria for number of pools per mile. In addition, there has been some reduction in the volume of some pools by coarse-grained sediment. Stream Surveys; Watershed Analysis 3-115 to 3-117, 3-121, 3-122..	Stream Su Watershe 121, 3-12 (Baseline
HABITAT ELEMENTS (continued)	Pool Frequency and Quality NMFS	Functioning at Risk	Pool frequency is similar to values in "functioning appropriately", but pools have inadequate cover/temperature, and/or there has been a moderate reduction of pool volume by fine sediment	Some stream reaches do not meet the "Functioning Appropriately" criteria for number of pools per mile. In addition, there has been some reduction in the volume of some pools by coarse-grained sediment. Stream Surveys; Watershed Analysis 3-115 to 3-117, 3-121, 3-122..	Stream Su Watershe 121, 3-12 (Baseline
	Large Pools (in streams with > 3m in wetted width at baseflow)	Functioning at Risk	Reaches have few pools greater than 1 meter in depth.	Tributaries of the Cowlitz River generally have few pools greater than one meter in depth. In addition, there has been some reduction in the volume of some pools by coarse-grained sediment. Sources	Stream Su Field Obs Watershe (baseline
	Off-channel habitat	Functioning at Risk	Some high water velocity refugia such as ponds, oxbows, backwaters …	Off-channel habitat is abundant in the Cowlitz River, but there are few side channels near the mouths of tributaries of the Cowlitz River.	Field Obs Aerial ph in 1999.
	Refugia (at 6th to 7th field watershed scale)	Functioning at Unacceptable Risk	adequate habitat refugia do not exist	Intact watersheds are too small and disconnected from anadromous habitat to support a strong population of anadromous species.	Field obse

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
CHANNEL CONDITION AND DYNAMICS	Width/Depth Ratio in riffles	Functioning at Risk	W/D ratios and/or channel types in portions of watershed are outside historic ranges and/or site potentials.	Width/depth ratios of streams are rated as "poor" for segments of Butter Creek, and Skate Creek, and Little Johnson Creek.	Watershe (Baseline
	Streambank Condition	Function At Risk	50 – 80% of any stream reach has greater than 90% stability.	The flood of 1996 resulted in a large amount of erosion along the Cowlitz River. Lower Butter Creek contains unstable reaches. Johnson Creek and Lake Creek contains fairly stable stream channels.	Watershe Observati
	Streambank Condition	Function At Risk	80-90% stable	The flood of 1996 resulted in a large amount of erosion along the Cowlitz River. Lower Butter Creek contains unstable reaches. Johnson Creek and Lake Creek contains fairly stable stream channels.	Watershe Observati
	Floodplain Connectivitiy	Functioning at unacceptable Risk	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly	The presence of roads, homes, and a town in the floodplain of the Cowlitz River has resulted in a reduction in hydrologic connectivity between off-channel, wetland, floodplain, and riparian areas. In addition, the overall function of the floodplain has been altered.	Watershe 5-22 Field Obs
FLOW / HYDROLOGY	Change in Peak/Base Flows	Functioning at Risk	Some evidence of altered peak flow, baseflow and /or flow timing relative to an undisturbed watershed of similar size, geology, and geography.	Values for Hydrologic Recovery (ARP) and Water Available for Runoff indicate an alteration of peak flows of some streams from undisturbed watershed conditions.	Watershe Appendix (Baseline
	Drainage Network Increase	Functioning at Risk	Low to moderate increase in active channel length correlated with human caused disturbance.	Given that the road density is approximately 1.9 miles per square mile, it is assumed that the increase in drainage network is low to moderate.	Watershe (Baseline

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
WATERSHED CONDITIONS	Road Density and Location	Functioning at Risk	1 – 2.4 miles per square mile; some valley bottom roads.	Road density is approximately 1.8 miles per square mile over the entire watershed, and there are roads in the riparian reserves containing the Cowlitz River, Skate Creek, and Deception Creek. These roads are particularly close to the streams The stream associated riparian reserve road densities in these the watershed range from 1.4 to 3.30 miles per square mile.	Watershe (Baseline
WATERSHED CONDITIONS (continued)	Disturbance Regime	Functioning at Unacceptable Risk	Frequent flood or drought producing highly variable flows …. Channel is simplified … little hydrologic complexity … Natural processes are unstable.	Since 1800, a number of natural events have affected the watershed. A number of flood events have occurred in the past 30 years; four floods occurred in the 1970's alone. The flood of 1996 caused channel erosion of the Cowlitz River. Peak flow events are expected to occur at 3-50 year intervals over the entire watershed. Before active fire suppression started in the 1930's, a number of fires occurred in the watershed between 1800 and 1910. The largest fire burned 27,000 acres over the Middle and Upper Cowlitz Watersheds, and included parts of Skate Creek and Butter Creek. 15 ten-year flood events since 1970. In addition, mudflows from Mount Rainier have inundated the floodplain of the Cowlitz River since the retreat of the last glaciation. This will likely occur again at an unknown time in the future.	Watershe 20, USGS Ga
	Disturbance History	Functioning at Unacceptable Risk	15% ECA (< 85% ARP/HRP) of entire watershed and some disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area;	Hydrologic Recovery (ARP) varies between 83.8 and 94.5 percent for four of the five watershed stratification units contained in the watershed. In addition, there is considerable land disturbance from human activity in the floodplain of the Cowlitz River.	Watershe Observati (Baseline
	Riparian Reserves	Functioning at Risk	Moderate loss of connectivity or function (shade, LWD, etc.) …	Fragmentation of riparian areas has occurred in the mainstem of Johnson Creek (Glacier Creek to Wright Lake), and Deception Creek (river miles 1.2 – 4.0). Approximately 15% of riparian areas in the watershed are in the grass/pole structural stage. In addition, there has been considerable development in the valley containing the Cowlitz River, which the lower reaches of Johnson Creek, Hall Creek, Butter Creek, and Lake Creek.	Watershe (Baseline
	Subpopulation Size	No Rating		**The Forest Service has insufficient data in order to rate these indicators. The existing records of fish passage on the Cowlitz**	

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
SUBPOPULA-TION CHARACTER-ISTICS	Growth and Survival	No Rating		**River dams cannot be used to evaluate this watershed because they collect fish from all five 5th field watersheds upstream.**	
	Life History Diversity and Isolation	No Rating			
	Persistence and Genetic Integrity	No Rating			
SPECIES and HABITAT	Integration of Species and Habitat Conditions	No Rating			

Upper Cispus River (HUC #1708000404)

The Upper Cispus River watershed is a 5th field watershed, Hydrologic Unit Code 1708000404. The watershed is located in the Gifford Pinchot National Forest of southwest Washington. The watershed is defined as the 242.5 square mile drainage area downstream from the confluence of the Cispus River and North Fork Cispus River and includes all of the tributaries to the Cispus River in that area. Upper Cispus River watershed includes nine 6th field sub-watersheds. The conditions of all 9 sub-watershed were rated in the Upper Cispus Watershed Analysis. Because this rating was done in a watershed analysis the format of the summary is slightly different from the format in the other 5th watersheds.

All of the species listed below currently occur in the Upper Cispus River watershed and are on the Proposed, Endagered, Threatened, or Sensitive (PETS) species list .

- chinook salmon (*Oncorhynchus tshawytscha*)
- coho salmon (*Oncorhynchus kisutch*)
- steelhead (*Oncorhynchus mykiss*)
- coastal cutthroat trout (*Oncorhynchus clarki clarki)*

The Matrix of Pathways and Indicators was used to evaluate habitat conditions for existing Threatened and Sensitive fish species in the Upper Cispus watershed (Table 1). This section also serves as a discussion for habitat conditions for other aquatic species. We define the ratings categories used in the Matrix of Pathways and Indicators as follows:

Functioning Appropriately – The existing conditions would allow for a large persistent population of fish.

Functioning At Risk - The existing conditions would allow for persistent population of fish, but further declines in these habitat conditions may lead to a decline in the fish population.

Functioning At Unacceptable Risk – The existing conditions are likely contributing in a cumulative way to decreased fish populations.

Table 1. Summary of the matrix of pathway indicators by 6th field sub-watershed for the Upper Cispus Watershed.

Pathway	Indicator	Functioning Appropriately	Functioning At Risk	Functioning At Unacceptable Risk
WATER QUALITY	Temperature Bull Trout	Muddy Fork, Adams Fork	Cat	Headwaters, Walupt Lake, Chambers, East Canyon, Blue Lake, North Fork
	Temperature Cutthroat and Anadromous Species		Headwaters, Walupt Lake, Chambers, Muddy Fork, Cat, Adams Fork, Blue Lake, North Fork,	East Canyon
	Sediment (in spawning areas)	Muddy Fork	Headwaters, Walupt Lake, Chambers, Cat, Blue Lake, North Fork, East Canyon	Adams Fork
	Chemical Contamination/ Nutrients	All sub-watersheds		
HABITAT ACCESS	Physical barriers	Headwaters, Walupt Lake,	Adams Fork, Blue Lake, Muddy Fork, Cat, East Canyon.	Chambers, North Fork
HABITAT ELEMENTS	Substrate character and embeddedness (in rearing areas)	Muddy Fork,	Headwaters, Walupt Lake, Chambers, Cat, Blue Lake, North Fork, East Canyon	Adams Fork

Pathway	Indicator	Functioning Appropriately	Functioning At Risk	Functioning At Unacceptable Risk
	Large Woody Debris (LWD)	Walupt Lake	Muddy Fork, Adams Fork, Blue Lake, North Fork	Headwaters, Chambers, Cat, East Canyon
	Pool Frequency and Quality	Walupt Lake, Muddy Fork	Chambers, Cat	Headwaters, Adams, East Canyon, Blue Lake, North Fork
	Large Pools (in streams with > 3m in wetted width at baseflow)	Headwaters, Walupt Lake, Muddy Fork	Chambers, Cat, Adams Fork, East Canyon, Blue Lake, North Fork	
	Off-channel habitat	Walupt Lake, Chambers, Muddy Fork, North Fork	Headwaters, Cat, Adams Fork, East Canyon, Blue Lake,	
	Refugia (at 6th to 7th field watershed scale)		Headwaters, Walupt Lake, Muddy Fork, Adams Fork,	Chambers, Cat, East Canyon, Blue Lake, North Fork
CHANNEL CONDITION AND DYNAMICS	Width/Depth Ratio in riffles	Walupt Lake, Muddy Fork, Adams Fork	Headwaters, Chambers, Cat, East Canyon, North Fork	Blue Lake
	Streambank Condition	Headwaters, Walupt Lake, Muddy Fork. Adams Fork	Chambers Creek, Cat, Blue Lake, North Fork	East Canyon Creek
	Floodplain Connectivitiy	Headwaters, Walupt Lake, Chambers, Muddy Fork, Adams Fork, Blue Lake	Cat, East Canyon, North Fork	
FLOW / HYDROLOGY	Change in Peak/Base Flows	Headwaters,	Walupt Lake, Chambers, Muddy Fork, Cat, Adams Fork, East Canyon, Blue Lake, North Fork	
	Drainage Network Increase	Headwaters, Walupt Lake, Muddy Fork, Adams Fork,	Chambers, Cat, East Canyon, Blue Lake, North Fork	
WATERSHED CONDITIONS	Road Density and Location	Headwaters, Walupt Lake, Muddy Fork, Adams Fork,	Chambers, Cat, Blue Lake, North Fork	East Canyon
	Riparian Reserves	Headwaters, Walupt Lake,	Chambers, Muddy Fork, Cat, Adams Fork, East Canyon, Blue Lake, North Fork	
	Disturbance Regime	Headwaters, Walupt Lake,		Chambers, Muddy Fork, Cat, Adams Fork, East Canyon, Blue Lake, North Fork
	Disturbance History	Headwaters, Walupt Lake,	Muddy Fork, Adams Fork, Blue Lake	Chambers, Cat, East Canyon, North Fork
SUBPOPULATION CHARACTERISTICS	Subpopulation Size other species not rated	Coho Salmon	Resident Coastal Cutthroat	Steelhead, Chinook Salmon, Sea-Run Coastal Cutthroat, Bull Trout
	Growth and Survival	No Rating	No Rating	No Rating
	Life History Diversity and Isolation No rating for Bull trout or other species.		Steelhead, Chinook Salmon, Coho Salmon	Coastal Cutthroat
	Persistence and Genetic Integrity		Coho Salmon and Costal Cutthroat	Steelhead, Chinook Salmon, Bull Trout
SPECIES and HABITAT	Integration of Species and Habitat Conditions			All Spcies

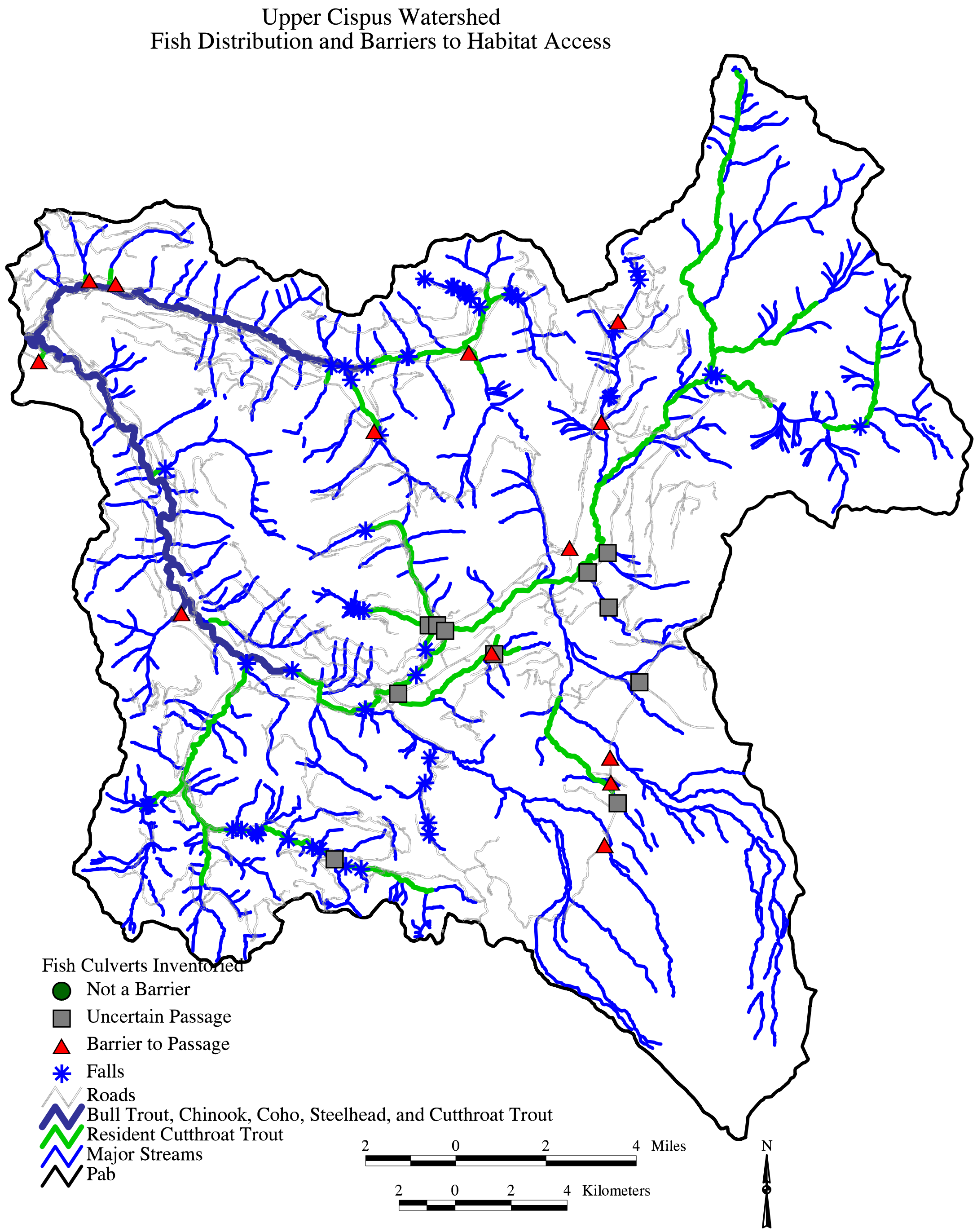


Figure 1. Known fish distribution within the Upper Cispus Watershed. Note error in bull trout distribution.

The Matrix of Pathways and Indicators groups 19 indicators into somewhat related pathways. In this section we discuss each indicator under four subheadings.
Under *Background* we briefly discuss how the indicator is related to aquatic species and their habitat. The *Analysis Tools* briefly discussed the tools we used to analyze the current condition. The *Data Gaps* section discusses missing data information and weaknesses in the analysis. And finally the results section summarizes the condition for the watershed. Detailed information about the condition can be found in the Upper Cispus Watershed Analysis 2002.

Water Quality

Water Temperature
Background-Water temperature is an important component of fish habitat. Elevated water temperature decreases the amount of oxygen contained in the water (Bjornn and Reiser, 1991), increases the vulnerability of fish to resist diseases and parasites (Bjornn and Reiser,), and decreases the ability of fish to compete for food and territory (Bjornn and Reiser,).

Analysis Tools- We use the results of the water temperature monitoring in the Hydrology Section to evaluate habitat conditions. The Hydrology Report thoroughly discusses the temperature monitoring results.

Data Gaps – We generally lack stream long –term temperature data. We have only recently (1991) started temperature monitoring on many of the streams in the watershed. Temperature monitoring does not cover the spawning and incubation period of most of the species.

Results -We rate stream temperature for the entire watershed as Functioning At Unacceptable Risk for Bull Trout and Functioning At Risk for the other species. Water temperatures generally are warm enough that they would impair all life stages of bull trout. The worst areas are East Canyon Creek, the Blue Lake 6th field sub-watersheds. The exceptions are found in the Adams Fork and Muddy Fork watersheds, where glaciers or ground water feed the streams and water temperature is rated as Functioning Appropriately.

The rating is less severe for the other species, only because they are adapted to warmer water temperatures. Water in the Adams Fork and Muddy Fork may be slightly cold for these species and inhibit their ability to feed.

Sediment (sediment in spawning gravel)

Background - It is well documented in laboratory studies (Bjornn and Reiser, 1991; Hicks *et al*. 1991) that fine-grained sediments (< 8 mm) impair spawning success. These finer particles block the flow of water through (salmon and trout) nests, thus limiting the amount of oxygen reaching the eggs and developing fry. To put it simply, these fine sediments smoother the eggs.

Analysis Tools- We use data collected in level II stream surveys and observations by aquatic personnel over the last decade.

Data Gaps -We lack data that directly addresses this indicator. None of our surveys measured this indicator. Early surveys did make a visual estimate of embeddedness. The surveyors recorded whether or not the estimated embeddednes was greater than 35%. This is a highly subjective rating, but it is the best available information. Appendix 1 in the watershed analysis is a table that summaries the level II stream survey data.

Where we did not collect this data we are limited to observations by aquatics personnel made over the past five years (Blue Lake, Cat, Muddy Fork, Walupt Lake, East Canyon, North Fork Watersheds and Chambers Creek).

Results – We rate sediment rated sediment as Functioning At Risk for the watershed as a whole. The Stream Survey Data Appendix displays the cobble embeddedness ratings. In addition, we also have observations and indications from previous reports. The Middle and Upper Cispus Watershed Analysis, 1995 reported that fine sediments impaired spawning habitats in the Cispus and North Fork Cispus rivers. This rating is consistent with recent observations on these streams. Fine-grained sediment in the Muddy Fork islargely derived from the glacial flour and represents the potential for this system. Likewise, the sediments observed in Walupt Creek originate in the wilderness and represent the natural potential. The level of harvest activity in the Chambers Creek drainage is likely to have increased fine sediment levels.

Sediments in Adams Fork are also likely derived from glaciers, but the sediments in Sheep Creek portion are more likely to be derived from a combination of management actions (the 5601 road and older timber harvest units); therefore we rate this sub-watershed as functioning at unacceptable risk.

Chemical Contamination/Nutrients

Background – Chemicals or acid rock drainage can literally position streams. Excessive nutrients from human or domestic animal waste can create algal blooms, which use most of the available oxygen.

Analysis Tools – We evaluated the area occupied by homes, factories, agricultural use and cities. We also used field observations of algal levels. We also examined records for stream or lakes on the 303(d) list for pollutants.

Data Gaps – We have no data on chemical contamination or excess nutrients for streams in the watershed.

Results -We rated this indicator as Functioning Appropriately for all 6th field sub-watersheds. There are no 303(d) listed water bodies in the watershed that listed for parameters other than temperature. The potential sources of pollution in the watershed are limited to campgrounds, dispersed sites, and occasional spills from automobile or heavy machinery accidents. Given the presence of out houses and manure control measures at all of the developed campsites, and the relatively low levels of pollution observed at dispersed sites, we consider these to present a low pollution hazard.

Habitat Access

Physical Barriers

Background – Dams, and culverts can block access to potential habitats.

Analysis Tools – Anadromous salmonids are being reintroduced to the upper Cowlitz River system including the Upper Cispus Watershed. We report some of the results from the last couple of years of the reintroduction program. In addition, the Gifford Pinchot National Forest is conducting a fish passage at culvert survey. We use the preliminary results to evaluate the culverts in the watershed.

Data Gaps – Several of the culverts identified in the survey require further analysis to determine if they are migration barriers. Many of these do not appear to be barriers at low flows, but they do constrict the channel and may be barriers during higher flows. We identify these as seasonal migration barriers. The exact distribution of fish is unknown on several of the small steep stream (ex Timonium Creek), so the culverts that are shown as barriers may actually be upstream of the upper limit of fish distribution.

Results -Three dams on the Cowlitz River block volitional passage of anadromous fish to the Upper Cispus watershed. A two way trap and haul system currently provides passage around these dams. Adult Chinook salmon, coho salmon, steelhead, and sea-run coastal cutthroat trout are captured at the Barrier Dam and transported to several places upstream from Cowlitz Falls Dam. Smolts (juvenile anadromous fish heading to the ocean) are captured at Colwitz Falls dam at transported to near the barrier dam.

During the last spawning season over 30,000 (personal communication, Mark Larivier, Tacoma Power, 2000) adult coho salmon, over 500 steelhead, and around 200 chinook salmon were placed above the dams. The vast majority of the Chinook salmon were placed in the Cispus River. Some of these chinook salmon were radio tracked to where they spawned in the Upper Cispus watershed (John Serl, WDFW, presentation at Cowlitz River TAC Meeting, 2000). We do not know the distribution of the coho or steelhead.

Research plans are in the works to study the feasibility of providing volitional passage these dams. The biggest obstacle is volitional passage at Mossyrock Dam and riffe Lake. Juvenile fish (particularly Chinook salmon and coho salmon) rarely successfully navigate this 20 plus mile long reservoir.

Within the Upper Cispus watershed the only potential man-made barriers are culverts at road crossings. A fish passage culvert inventory completed in 2001 identified several culverts as seasonal barriers to fish passage (Table2). Results are displayed in Map 1.

Table 2. Culvert/Fish Passage survey

Sixth field sub-watershed Hydrologic Unit Code 1708000404 _ _	**Stream name** (downstream order)	**Location of culvert - road number and routed distance**	**Barrier to upstream fish passage?**	**Stream miles that could be restored to upstream fish passage**	**Comments**
01 Headwaters	None				
02 Walupt Lake	None				
03 Cispus R. – Chambers Cr.	Pimlico Creek	2100000 mp 19.6	ND[1]	None	Pipe Arch Vert Leap Dist = 4.59
	Wesley Creek	5600000 mp 6.38	Seasonal[2]	0.2	Pipe Arch Vert Leap Dist = 1.20'
	Midway Creek	5600000 mp 5.77	Seasonal	3.5	Twin Culverts Vert Leap Dist = 1.48' and 2.60'
	Midway Creek	5600059 mp 1.98	Seasonal	2.6	Box Culvert-channel gradient = 43%
	Midway Creek	2329000 mp 10.28	Seasonal	1.1	Vert Leap Dist = 0.79'

	Chambers Ck	2150000 mp 0.95	Yes	None	Fish barrier: 30' falls located downstream from pipe. Vert Leap Dist = 3.44
	Chambers Ck	2160000 mp 0.28	Yes	3.7	Twin Culverts Vert Leap Dist = 1.8' and 4.1'
04 Muddy Fork	Muddy Fork	5600000 mp 4.9	ND		No survey to date
	Muddy Fork	5603000 mp 3.4	ND		No survey to date
	Muddy Fork	2329000 mp 8.45	Yes	An assumption of 2.0 mi. was made from District Map. No survey data available.	Twin Culverts – Vert Leap Dist = 2.39' and 3.02'
	N. Fk.Spring Creek	2329000 mp 7.39	Seasonal	0.2	Pipe Arch Vert Leap Dist = 0.66'
	S. Fk. Spring Ck	2329000 mp 7.89	Yes	0.5	Twin Culverts Vert Leap Dist = 0.5' and 0.3'
05 Cat Cr.	Cat Creek	2100000 mp 22.5	Seasonal	3.8	Pipe Arch = Vert Leap Dist = 1.02'
	Cat Creek	7812000 mp 0.14	Seasonal	3.1	Twin Culverts Vert Leap Dist = 0.05' and 0.04'
	Mouse Creek	7812000 mp 0.20	Seasonal	1.4	Pipe Arch = Vert Leap Dist = 0.69'
	Orr Creek	5600000 mp 0.79	Seasonal	3.2	Pipe Arch – twin culverts Vert Leap Dist = 0.60' and 0.49'
	Orr Creek Trib.	5603000 mp 0.32	Seasonal	0.3	Beaver dam at inlet Vert Leap Dist = 1.18'
	Orr Creek	5603000 mp 0.39	Seasonal	0.6	Pipe Arch Vert Leap Dist = 1.01'
06 Adams Fork	Killen Creek	2329000 mp 6.41	Yes	1.1	Twin Culverts Vert. Leap Dist = 4.51' and 4.86'
07 East Canyon Cr.	East Canyon Cr	2300292 mp 0.1	Seasonal	2.4	Pipe Arch Vert Leap Dist = 0.31
08 Blue Lake	Unnamed Creek	2801000 mp 2.56	Yes	0.1	Vert. Leap Dist. 8.55'
	Prospect Creek	2801000 mp 9.60	Yes	0.2	Box Culvert (Concrete) Vert Leap Dist = 2.29'
09 North Fork	Irish Creek	2200000 mp 2.06	Yes	0.08	Concrete Vented Ford Vert Leap Dist = 1.29'
	Swede Creek	Road 2200000 mp 2.67	Yes	0.2	3 ft. vertical drop at outlet. Vert Leap Dist = 0.54'
	Timonium Creek	7800060 mp 0.10	Yes	None	Pipe Arch Vert Leap Dist = 1.79'
	Wobbly Creek	2208000 mp 2.60	Yes	0.4	Vert Leap Dist = 4.26' (resident fish)

1 ND = Not documented – the survey has not been completed for this culvert.
2 Seasonal = Further evaluation is needed to determine if this culvert is a barrier. These culverts maybe barriers to fish migration at stream flows, which are greater or less than the stream flows observed during the survey.

Culverts block only 0.3 miles of potential anadromous habitat. This habitat is of marginal quality, because it is in high gradient section of streams with small pools. At most culverts definitely block 9.0 miles of resident habitat on a year around basis. In addition, there 22.4 miles of habitat that may be blocked on a seasonal only basis. Both the year around and seasonal blockages culverts may not prevent the habitation of upstream habitats, but they do prevent the complete interaction between fish upstream and down stream.

Habitat Elements

Gifford Pinchot National Forest has conducted (or contracted out) Level II stream surveys over the past 13 years. There are several data gaps with this set of data.

1) We do not have data for several key sections of stream—Cispus River, below the Muddy Fork, the Muddy of the Cispus River, Walupt Lake Creek, and Chambers Creek. Evaluation of these sections of streams in the watershed depend on very limited observations, and notes gathered from other documents.
2) The surveys rarely collected data concerning the amount of fine sediment in streams, and when they did collect this information it was somewhat subjective.
3) The surveys rarely quantified bank stability. When surveyors did quantify bank stability, they did so only in a fraction of the areas sampled and may have missed many eroding areas.

Substrate Character and Embeddedness

Background - This indicator is slightly different from sediment in that it examines the amount of spaces between rocks (interstitial spaces) available for juvenile hiding and an macroinvertebrates (crayfish, stream insects, worms, ect.) habitat. Juvenile fish and many macroinvertebrates also use the interstitial spaces to get protection of high flows and predators (Bjornn and Reiser, 1991; Furniss *et al*., 1991). When the interstitial spaces are filled with fine sediments or the substrate is bedrock these spaces are absent and the quality of habitat is low.

Analysis Tools – We use the cobble embeddedness ratings from level II stream surveys (Stream Survey Data Appendix 1). In the absence of these ratings we use observations from various other trips to the stream. As a last resort we use professional judgment based on the knowledge of the watershed.

Data Gaps -We have very little information about substrate embeddedness. The information we have is reported in the Stream Survey Data Appendix 1.

Results - We rated most of the 6th field sub-watersheds as Functioning At Risk.
The ratings are the same as for the sediment indicator, because the same sediments that impair the quality of spawning habitat fill interstitial spaces and degrade the quality of juvenile and invertebrate habitats.

Large Woody Debris

Background -Woody debris provides several functions in terms of fish habitat. Wood provides hiding cover, creates pools and pool-like habitats, helps to stabilize banks and is a source of food for some invertebrates, which in turn are food for fish and other aquatic and riparian species (Bjornn and Reiser, 1991; Chamberlin *et al*., 1991). Habitat quality increases with amount of large and stable pieces of wood in a stream.

Analysis Tools – We use the counts of pieces of wood from the level II stream surveys (Stream Survey Data Appendix 1). In the absence of these counts we use observations from various other trips to the stream. As a last resort we use professional judgment based on the knowledge of the watershed.

Data Gaps -We have very little information about woody debris. The information we have is reported Stream Survey Data Appendix 1. We have no counts of wood for the Cispus River below the Muddy Fork, Muddy Fork sub-watershed, Chambers Creek, Midway Creek, Wesley Creek, and Walupt Creek. Several of the pre-1990 surveys did not contain information about the size of the wood.

Results - We rated, only one stream system (Walupt Lake and Walupt Creek) rated as Functioning Appropriately. Fires and past stream side regeneration harvest and past salvage have reduced level of wood in streams below the potential. Levels of wood are the lowest in the Headwaters, Chambers, Cat, and East Canyon 6th subwatersheds.

<u>Pool Frequency and Quality</u>

Background - Pools provide slow water where fish do not have to fight the current (Bjornn and Reiser, 1991). The quality of pools is dependent on the size (depth) and cover in the pools.

Analysis Tools- We use the counts of pools from the level II stream surveys (Stream Survey Data Appendix 1). In addition, to the pool frequency we rated quality of pools. The quality of a pool depends on its size relative the stream and cover in the pool. The only item the level II survey provides for rating cover is woody debris. We rated a pool as a quality if it had one or more pieces of wood or its wetted width-to-depth-ratio was less than 7. The latter is based on unpublished analysis of differences in pools located in managed streams and relatively unmanaged streams in Idaho.

In the absence of level II data we use observations from various other trips to the stream. As a last resort we use professional judgment based on the knowledge of the watershed.

Data Gaps -We have very little information about pool frequency and quality. The information we have is reported Appendix 1. We have no counts of pools for the Cispus River below the Muddy Fork, Muddy Fork sub-watershed, Chambers Creek, Midway Creek, Wesley Creek, and Walupt Creek.

Results – Overall we rated this indicator as Functioning at Unacceptable Risk. Few of the stream reaches meet the criteria for pool frequency (See Stream Survey Data and individual rating summaries). In addition the quality of the pools was generally fair. The exception to the general rule was Walupt Creek and the Muddy Fork.

In addition to the data from Level II surveys we have some observations The Middle and Upper Cispus watershed analysis rated pool frequency as poor citing unpublished data showing a 38% decrease in pools, between 1935 and 1991, for the Cispus River from the Cowlitz River confluence to Blue Lake Creek. The assumption is that the general decrease in pool habitat occurred evenly throughout the study area.

<u>Large Pools</u>

Background - Large pools provide a large amount of space for holding fish. This is particularly important to anadromous fish prior to spawning. They can also provide thermal refuges in streams that otherwise have higher water temperatures.

Analysis Tools- We use the counts of pools and pool depths from the level II stream surveys to evaluate this indicator (Stream Survey Data Appendix 1). Only pools greater than 3 feet were rated as quality pools.

In the absence of level II data we use observations from various other trips to the stream. As a last resort we use professional judgment based on the knowledge of the watershed.

Data Gaps -We have very little information about pool size. The information we have is reported Appendix 1. We have no counts of pools for the Cispus River below the Muddy Fork, Muddy Fork sub-watershed, Chambers Creek, Midway Creek, Wesley Creek, and Walupt Creek.

Results - Overall we rated large pools as At Risk. There are many pools in the Cispus River that would qualify as a large pool (> 3 feet deep), however, a river the size of the Cispus River is expected to have many pools deeper than 3 feet. We rated Headwaters, Walupt Lake, and Muddy Fork as Functioning Appropriately because they are nearly at there potential. The other streams have fewer large pools that expected based on comparisons to relatively unmanaged streams.

Off Channel Habitats

Background - Off channel habitat provide spawning and juvenile habitats for coho salmon, cutthroat and bull trout. Chinook salmon and steelhead will also off channel habitats but are more often found in the main channel.

Analysis Tools – We used observations from level II surveys, aerial photo analysis of the Cispus River downstream form Adams Fork and other stream studies.

Data Gaps - We have no data for Muddy Fork Creek, Chambers Creek, Midway Creek, Wesley Creek, and Walupt Creek.

Results -We rated off channel habitats as Functioning At risk. Off channel habitats are generally, abundant where the valley type is conducive to the formation of these habitats. The At Risk rating comes from low quality and low stability of these habitats.

Refugia (at 6^{th} and 7^{th} field scales)

Background -Refugia are defined as areas of functioning habitat that would provide a refuge for a fully functional population of fish at least until habitat conditions improve elsewhere.

Analysis Tools – We used compilations of the stream data previously rated along with observations from less formal stream surveys to evaluated this indicator.

Data Gaps - We have no data for Muddy Fork Creek, Chambers Creek, Midway Creek, Wesley Creek, and Walupt Creek.

Results - None of the 6^{th} fields or 7^{th} field sub-watersheds meet this definition. The sub-watersheds that are nearly at their potential are isolated from the rest of watershed by natural barriers. The other sub-watershed are lack the habitat quality to qualify as refugia.

Channel Conditions and Dynamics

Width/Depth Ratio

Background –Width-to-depth ratio is a measure of balance in the sediment transport regime (Rosgen, 1996). Low width-to-depth-ratios are generally considered to be better than high width to depth ratios. Streams with low width to depth generally have deep pools and have cool water temperatures.
The exception to the rule of the smaller width-to-depth ratio the better, occurs when streams are down cutting and disconnected from the floodplain.

Analysis Tools – We examined the width-to-depth-ratios as reported by level II stream surveys and other studies of channel width. We compared the observed channel width with those expected based on the geology and stream gradient. Where we had data we also examined how channel width changed over time.

Data Gaps– We have many data gaps for this indicator.
Level II surveys collected very few measurements of bankfull width and depth.
Using channel type to evaluate width-to-depth-ratio is difficult, because there are no standard criteria for bankfull width-to-depth ratios.

Results - Overall we rated width-to-depth-ratios as Functioning At Risk. The width-to-depth-ratios on a few streams are nearly at their potential (Walupt Lake, Adams Fork, and Muddy Fork).

We considered these ratios on the other streams to be slightly to greatly modified. The previous watershed analysis (Middle and Upper Cispus WA, 1995) reported on stream channel widening in the Blue Lake. The hydrology section also discusses channel widening.

Streambank Condition

Background - Streambank stability is a measure of the sediment/stream flow balance in a stream. Streams with large areas of unstable bank are thought to be out of balance. Streams that are out of balance often are wide and shallow and deep and quality pool habitats. They often have elevated levels of sediment.

Analysis Tools – We quantify the amount of unstable or potentially unstable bank.

Data Gaps We lack information about stream bank condition. The level II surveys at best collected this information for only sub-samples of the reaches. Therefore it is not possible to quantify the amount of stable streambank. The ratings are thus based upon observations made by aquatics professionals (hydrology and fisheries personnel, ex., stream survey note are just one source of these observations) over the last two decades and professional judgment based the amount of stream side disturbance. In addition the Middle and Upper Cispus Watershed Analysis, 1995 also mentions areas of unstable streambanks.

The Headwaters, Walupt Lake, Muddy Fork, and Adams Fork 6^{th} field sub-watersheds are thought to be nearly at the potential for these areas, because areas are relatively unmanaged. The Chambers, Cat, Blue Lake, and North Fork 6^{th} field sub-watersheds were rated as Functioning At Risk, because of observed areas of instability, wider than expected channels, or relatively high levels of streamside activities when compared to other 6^{th} field sub-watersheds. The East Canyon sub-watershed was rated as Functioning At Unacceptable Risk, because of a large number of unstable areas we reported in the stream survey notes.

Floodplain Connectivity

<u>*Background*</u> - Modifications along the streambanks, such as road building, bank revetments and other developments, can affect the function of floodplain as pressure relief valve during floods and disconnect streams from wetlands and other off-channel habitats.

Analysis Tools - As an initial evaluation we examined the density of roads within riparian reserves (Table 3), we then refined this with observations of road location from the field.

Table 3 - Road Information as it relates to streams in the Upper Cispus Watershed.

Sub-Watershed	Total Road Density	Riparian Road Density	Stream Crossing Density	Drainage Extension
	Miles of Road/Square Miles of Watershed	Miles of Road/Square Miles of Riparian Reserve	Number of Crossing /linear mile of stream	% of linear stream length
Headwaters	0.02	0.00	0.00	0.0
Walupt	0.07	1.17	0.06	0.2
Chambers	1.22	14.7	1.32	5.0
Muddy Fork	0.32	6.63	0.15	0.6
Cat	1.40	21.81	1.60	6.0
Adams	0.31	8.41	0.28	1.0
East Canyon	1.05	14.94	1.03	4.3
Blue Lake	0.87	14.26	1.29	4.9
North Fork	1.26	17.80	1.57	5.7

We rated only the Cat, North Fork, and East Canyon 6th field sub-watersheds as Functioning At Risk. Roads are located on the banks of Cat Creek and East Canyon Creek for substantial portions of these streams. At least one wetland has been affected in the North Fork sub-watershed.

We rated the rest of the sub-watersheds as Functioning Appropriately. Although there are roads in the riparian reserves, the roads are for the most part outside of the floodplains.

Flow/Hydrology

<u>Change in Peak and Base Flows</u>

Background -When the magnitude or frequency of peak flows is increased they can change pool frequency and quality. They can also erode banks leaving stream channels wider and shallower than before or create gullies, both result in the reduction of the quality of fish habitat.

We use a combination of a conservative Aggregate Recovered Percentage (ARP) value, drainage network increase (a separate indicator), and observed channel changes and observed flow records to evaluate this indicator.

Stands of larger trees outside of riparian areas are also important for aquatic habitats. Relatively dense stands of trees intercept snowfall before it hit ground and contributes to peak flows. The degree to which this occurs is dependent on the size and density of a stand. Stands with an average diameter of 8 inches and canopy closure of 70% are rated as being hydrologically mature. Stands with average diameters smaller than 8 inches or canopy closures of less than 70% intercept less snow and allow this snow to contribute to peak flows when it melts. These stands are rated as hydrologically immature.

Analysis Tools - We use the combination of average tree size in stands, drainage network extension, and evidence from stream channels to predict the risk of increased in peak flow.

Stand size - Because the Aggregate Recovered Percentage Wizard (ARP) is not working, we queried the vegetation database for stands with an average diameter of greater than 8 inches and then calculated the percentage of the potentially forested occupied by these stands.

Evidence from channels – We examined channels for evidence of debris flows and flow records. Although the stream gauge with the longest history is slightly below this watershed it would be a mistake to ignore this data.

Data Gaps - The tool Aggregate Recovered Percentage Wizard (ARP) is not working so, we used queries of the GIS forest vegetation database to approximate this value. We did not use canopy closure as part of the query, because this data is of questionable quality. This value is different from standard ARP in that it does not consider canopy closure nor does assign partial value of recovery hydrologically immature stands.

For this conservative ARP values of 70% or less warrant further interpretation, values of 85% or represent a moderate of increased peak flow particularly when drainage extension is higher represent only minor changes and a value of 95% is considered undisturbed. The values for the Cat, East Canyon, Chambers, and North Fork are indicative of moderate potential for elevated peak flows magnitude and frequency. The lower ARP values in these watersheds correspond with relatively high levels of regeneration harvest.

The low value for Muddy Fork sub-watersheds is of lesser concern. This value is low primarily because this sub-watersheds has large areas of naturally disturb stands that are slowly recovering from fires 80 years or more ago. Further investigation showed many of these stands are near (6-7 inches dbh and >70% crown closure) if not actually the potential conditions for the high elevation stands.

Evidence From Stream Channels - In addition to the lower ARP values, stream channel in parts of the Cat (Cat Creek and Mouse Creek), East Canyon Creek, Cispus River and the North Fork Cispus River show signs of increased peak flows. The Middle and Upper Cispus Watershed Analysis reported that channel of the Cispus River and North Fork Cispus River had increased in width since 1959. Evidence of channel scouring flows observed during the 1998 stream surveys of Cat Creek and Mouse Creeks. There were numerous episode of bank erosion in East Canyon Creek. Examination of peak flow records show at least flow 20 year plus floods occurring the last 30 years. It would be mistake to totally ascribe these floods to the one major drainage between the stream gage and this watershed.

Drainage Network Increase

Road drainage ditches and road surfaces capture surface runoff and surface flows. Where roads cross streams, they route the captured water flows to streams. In other words the roads act like extensions of the stream channels. This has two effects. First, it decreases the time it takes water to reach streams and increases peak flows. Secondly, water captured by the road's surface and ditches sometimes carries fine grained sediments to the streams and increases the amount of fine grained sediments in the streams.

Analysis Tool – We model drainage network increase by using the GIS data to map roads and streams. We add 200 feet to the stream for each stream crossing. The 200 feet of additional stream is based on earlier investigations of the average distance from the last drainage ditch relief culvert to the stream crossing. The later is nearly impossible to model. To scale this to the size of the existing drainage network, we divide the increase in stream length by the existing length of streams in the sub-watershed. The resulting value is a percent increase in the length of streams. We rated values of between 0 and 5% as Functioning Appropriately, values between 5% and 10% as Functioning At Risk and values greater 10% as Functioning At Unacceptable Risk.

Data Gaps – We are dependent upon the accuracy of the GIS data in identifying stream crossing. The limitation of this method is that it does not account for ditch relief culverts that lead directly to streams. These situations are most likely to occur where roads parallel streams within 100 to 200 of the stream.

Results – Overall we would rate the condition as Functioning At Risk. Drainage network increases are fairly low throughout the watershed is fairly low. They never exceeded 10% and equaled or exceeded 5% in 5 of the sub-watersheds.

Watershed Conditions

Road Density and Location

Background- Roads have been demonstrated to affect both stream flows and sediment delivery (Furniss *et al*., 1991). We have previously evaluated the potential for effects to stream flow (Flow and Hydrology) and leaves sediment delivery. Sediment is delivered in two forms, fine-grained sediments, which clog spawning gravels and juvenile habitats and coarse-grained sediments, which fill pools and make streams more shallow than normal. Coarse-grained sediments are delivered to streams by roads, when stream crossing fail and when road fill materials give way and create small landslides. Fine-grained sediments are delivered to streams by roads via surface runoff and when roads fail either at culvert or in the small landslides.

Analysis Tools -The potential for roads to affect streams increases with road density. Since the delivery of sediment is most often associated with stream crossings, roads near streams, and roads in otherwise unstable areas, we refine our analysis by concentrating on stream crossings, roads within the riparian reserves (near stream areas and unstable areas). We used the GIS database to map and quantify the areas of concern for roads. The Geology report further refines areas of concern.

Data Gaps – We are dependent on the accuracy of the GIS data used to make these maps. Some streams may not actually exist on the ground while other streams are do not exist in the database.

Results- Overall we rated the condition as Functioning At Risk.

Riparian Reserves

Background - Riparian connectivity is also a key habitat feature for aquatic species (particularly fish). Vegetation within the riparian reserves provide shade to the streams cool, root masses to stabilize banks and reduce sedimentation, and eventually down woody material creates current breaks and hiding cover. The general rule is that stands with larger trees and tight canopy closure are the most beneficial, where as the grass/shrub stands provide the least of the important characteristics. The large tree sands are most important along the mainstems of streams, but also provide key habitat features in other sub-watersheds as well.

A GIS analysis was done for riparian reserves in the watershed (Table 3). Vegetation was classified into grass/pole, hardwoods, small tree and large tree forested habitats, as well as non-forest. The following table displays the results of this analysis, in acres, by category:

Table 3 – Seral classes within riparian reserves of the Upper Cispus Watershed.					
Sub-basin	Non-Forest[1]	Early Open	Early Closed	Mid Successional	Late Successional
Headwaters	52	0	3	7	38
Walupt	58	0	1	34	7
Chambers	30	3	12	32	23
Muddy Fork	27	6	32	31	2
Cat	4	10	8	45	33
Adams Fork	12	6	9	66	8
East Canyon	20	5	12	40	23
Blue Lake	16	2	3	69	11
North Fork	10	14	19	26	32

Ratings- Unlike many of the other criteria we did not apply a one-size-fits-all-ratings curve to riparian reserves. The unique rating is based on the proportion of potentially forested area in the late successional condition class, the amount of riparian harvest, and the size of the principle streams in the sub-watershed. Sub-watersheds with large streams (ex, Cispus-Blue Lake, Cispus – Cat Creek) required a larger proportion of late sucessional habitat for a good or rating of functioning appropriately habitat than sub-watersheds with smaller streams. The reason for this difference is because larger streams require larger trees to shade the stream and small woody debris is less stable in large streams than in small streams. We rate sub-watershed with little riparian harvest higher than sub-watersheds with more riparian harvest. The reason for this difference that riparian harvest removes potential woody debris from the system and the case of regeneration harvest substantially reduces stream shading.

Disturbance Regime

Background -This indicator examines the frequency and magnitude of disturbances is the watershed. The focus is mainly on "natural disturbance" (ex., floods, fires, volcanic eruptions). Smaller and less frequent disturbances allow for refuges and the watershed more time for the watershed to recover.

Analysis Tool - We examined the fire history of the watershed and frequency of other disturbances such as volcanic eruptions and floods.

Results – Overall the watershed rated as Functioning At Unacceptable Risk. Disturbances were widespread and included large fires in late 1800s through the early 1900s, the eruption of Mt St Helens dumping volcanic ash throughout the watershed, and frequently large magnitude over last 30 years.

Disturbance History

Background – This indicator is very close to the previous one (Disturbance Regime). The chief difference is that disturbance history focuses on "Human Caused" disturbances (timber harvest, road building, ect) and their location.

Analysis Tool - We examined the size and location of past timber harvest, road building and recreational uses.

Results – The overall rating is Functioning At Unacceptable Risk. Table 6 and maps display the magnitude and location of the disturbances. The disturbances are not particularly large, but they do occur in the riparian reserves, and unstable areas. These disturbances are not spread throughout the entire watershed. The Walupt Lake and Headwaters sub-watershed are largely unharvested, roadless or wilderness areas. The Adams Fork, Muddy Fork, and Blue Lake sub-watersheds also have relatively roadless or wilderness areas and that are relatively undisturbed by human activities, but do have some harvested and roaded areas. The remaining sub-watershed are relatively heavily roaded and or harvested.

Subpopulation Characteristics

We address this pathway and its indicators only at the 5th field watershed level. We do not have the necessary information to begin to rate the associated indicators at a 6th field sub-watershed scale. The conditions of the indicators vary by species.

<u>Subpopulation Size</u>

Background – Population size is the most key indicator for risk of extinction. The smaller a population become that greater the chance it will become extinct. Small population are at great risk, because natural environmental fluctuations such as floods, fires and droughts can wipe out a population(). In addition, small population generally have low genetic variability making them vulnerable to disease().

Analysis Tools **–** We use catch and transport records from the and reintroduction of anadromous salmonids in the upper Cowlitz River system.

Data Gaps - The only solid population data we have available are the catch transport records from the reintroduction effort. Because these records cover the entire upper Cowlitz River, they are not specific to this watershed. Counts of fish in the level II surveys are old and not rigorous enough to provide meaningful measures of population size. In addition to lack of rigorous sampling it is impossible to tell steelhead and sea-run cutthroat trout fry from the resident form without laboratory analysis.

Results **–** The population of anadromous runs are entirely dependent upon how many fish are passed around the dams in the Cowlitz River. The number of fish transported above the dams are still heavily dependent on the number of fish perceived to be needed the run the hatchery program and the success of capturing smolt at Cowlitz Dam. Until recently only adult fish that were surplus to the hatchery needs were transported above the dams.

> Steelhead – We rate the Steelhead population as Functioning At Unnaccptable Risk. Approximately 500 adult steelhead were placed in upper Cowlitz River. Base on professional experience, this number of fish would barely be enough to occupy the available habitats in the Upper Cispus River let alone the entire upper Cowlitz River watershed.
>
> Chinook Salmon- We rate the Steelhead population as Functioning At Unacceptable Risk. Fewer than 500 adult Chinook salmon were transported the upper watershed. The transport of adult Chinook salmon has been limited the catch rate of Chinook salmon smolts at Cowlitz Falls dam is low. Washington Department of Fish and Wildlife officials and other regulatory officials are reluctant to place adult in the upper Cowlitz watershed when fewer than 50% of their have a chance of making it past the Cowlitz River dams.

Experimental efforts with designs at the Cowlitz Falls fish facility are showing promising results.

Sea-Run Coastal Cutthroat Trout - We rate the sea-run coastal cutthroat population as Functioning At Unacceptable Risk. Fewer than 50 adult sea-run coastal cutthroat were transported to the upper Cowlitz River watershed.

Resident Coastal Cutthroat Trout – We rate the resident coastal cutthroat trout population as Functioning At Risk. Coastal cutthroat trout are spread throughout the Upper Cispus watershed, however, they seemed to have disappeared or greatly declined in numbers in several areas (Personal Communication, Terry Lawson, Fisheries Technician and 20 plus year resident of the area).

Bull Trout - We rate the bull trout population as Functioning At Unacceptable Risk. Despite wide ranging surveys and reports from anglers we have only one confirmed report of a bull trout in Cowlitz River and that was from Yellowjacket Creek which is not in the Upper Cispus watershed.

Coho Salmon – We rated this coho salmon as Functioning Appropriately. Over 30,000 adult coho salmon were transported to the upper Cowlitz River watershed. Although monitoring efforts for these adults have been focused on the lower Cispus River and Cowlitz River, coho salmon seem to be spreading throughout the available habitats.

Other Species – We do not have enough information to address the other species in a meaningful manor. The only other population monitoring in the watershed is at Walupt Lake. The spawning records from Washington Department of Fish and Wildlife seem to indicate stable populations of these species. The remaining lakes are not tracked except to evaluate the need for planting fish.

<u>Growth and Survival</u>

Background – Populations need to have the size and genetic variation to weather environmental disasters such as floods.

Analysis Tools – Population numbers before and after events.

Data Gaps - We do not have the information to confidently address this indicator.

Results – We do not have enough information to evaluate this indicator.

<u>Life History Diversity and Isolation</u>

Background- The existence of all migratory types and ages is the key to recovering quickly from disturbances.

Analysis Tools – We reviewed the life history forms and ages of fish existing the watershed.

Data Gaps- We do not have good population structure information on any of the species. This condition is most evident in bull trout, where we have record of one fish.

Results-

Steelhead, Chinook salmon, and coho salmon- We rate these species as Functioning At Risk. The diversity of run timing has been reduced the combination of the Cowlitz dams and assignment to various runs by hatchery practices. Hatchery practices have separated out runs, which may have overlapped in timing. The effect is potential greatest on steelhead. Only steelhead arriving between certain dates are transported to the upper Cowlitz River. The thought at this time is that "late winter run" is most representative the native stock, the potential for problems exist when these fish arrive either early or late because of environmental fluctuations. In addition, few if any fall Chinook salmon are transported to the upper Cowlitz River.

Coastal Cutthroat – We rate this species as Functioning At Unacceptable Risk. The sea-run life history is barely hanging on. Fewer than 50 adults have transported to the upper Cowlitz River watershed.

Bull Trout – We have no information to begin to make a rating for this species.

Persistence and Genetic Integrity

Background – Sub-populations of animals need to be large and well connected with other to avoid problems associated with a lack of genetic variability.

Analysis Tools – We examined the sub-population size and its connection to other sub-populations.

Data Gaps – We have very little information about population size.

Results-

Steelhead and Chinook salmon- We rate these species as Functioning At Unacceptable Risk. The sub-population in the Upper Cispus Watershed is well under 1000 (transport records) and the Cowlitz River Dams cut this sub-population off from the lower Cowlitz River sub-populations.

Coho Salmon-We rate this species as Functioning At Risk. The over 30,000 adults coho transported to upper Cowlitz River is certainly large enough to maintain genetic variability, however, stock has been heavily influence by hatcheries, and the Cowlitz River Dams cut the this sub-population off from the lower Cowlitz River populations.

Coastal Cutthroat – We rate this species as Functioning At Risk. The sub-population size is unknown and some parts maybe isolated in the headwaters.
Like the other species there is very little connection to the lower Cowlitz River.

Bull Trout – We rate this species as Functioning At Unacceptable Risk. If a bull trout population exist it is extremely small and isolated.

Integration of Species and Habitat

The title of this indicator is self-explanatory; this is combination of the previous ratings. All of the previously mentioned analysis tools and data gaps also apply for this rating. Given the lack of crucial data confidence in the rating is low.

Results -We rate this indicator as Functioning At Unaceptable Risk. Habitats have definitely been altered, and fish populations seem to be in a slow downward trend.

Lower Cispus River (HUC #1708000405)

The Lower Cispus watershed encompasses about 123,500 acres in the Cispus River drainage of the Gifford Pinchot National Forest. Most of the watershed is National Forest land, with some private land inclusions also. The northern portion of the watershed is bounded by the ridges forming the boundary between the Cispus and Cowlitz River watersheds while the southern boundary is defined by the break between the Cispus and Lewis River watersheds. To the east is the boundary between the Lower Cispus and Upper Cispus watersheds (primarily Juniper Ridge). To the west is the boundary between the Lower Cispus and Lower Cowlitz watersheds (primarily the ridge that runs between Goat Mountain and Tumwater Mountain). Table 1 lists the eight subwatersheds and associated aquatic features within the Lower Cispus watershed.

Table 1 : General Location of subwatersheds

Sixth-field	Acres	Name	Other Aquatic Features
170800040501	29,706	Yellowjacket Creek	Pinto Creek
170800040502	12,838	McCoy Creek	Sunrise Creek, Jumbo Creek
170800040503	11,612	Cispus River - Camp Creek	Dry Creek, Covel Creek
170800040504	9,994	Greenhorn Creek	1918 Creek, Soldier Creek
170800040505	23,128	Iron Creek	Ferrous Creek, Big Creek, Wakepish Creek
170800040506	8,025	Woods Creek	Ames Creek
170800040507	13,490	Quartz Creek	Red Springs Creek, Deep Lake
170800040508	14,728	Lower Cispus River Frontal	Crystal Creek, Copper Canyon

The Lower Cispus River watershed contains approximately 84.45 miles of Proposed, Endangered, Threatened and Sensitive (PETS) fish species. Fish species of concern that occur in the Lower Cispus River watershed are chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), steelhead (*Oncorhynchus mykiss*), and coastal cutthroat trout (*Oncorhynchus clarki clarki)* (Figure 1).

Supporting information to the environmental baseline (Table 2) for the Lower Cispus watershed was taken from the following resources:

- Lower Cispus East and Lower Cispus West watershed analyses, Gifford Pinchot National Forest, Randle Ranger Districts.
- Stream Surveys by the Gifford Pinchot National Forest from 1987 through 2000.
- Stream temperature monitoring from 1994 through 2000.
- Field observations from 1990 through 2002 by employees of the Gifford Pinchot National Forest. These employees included a number of Hydrologists and Fisheries Biologists employed by the Forest Service during that time period

Lower Cispus Watershed
Fish Distribution and Barriers to Habitat Access

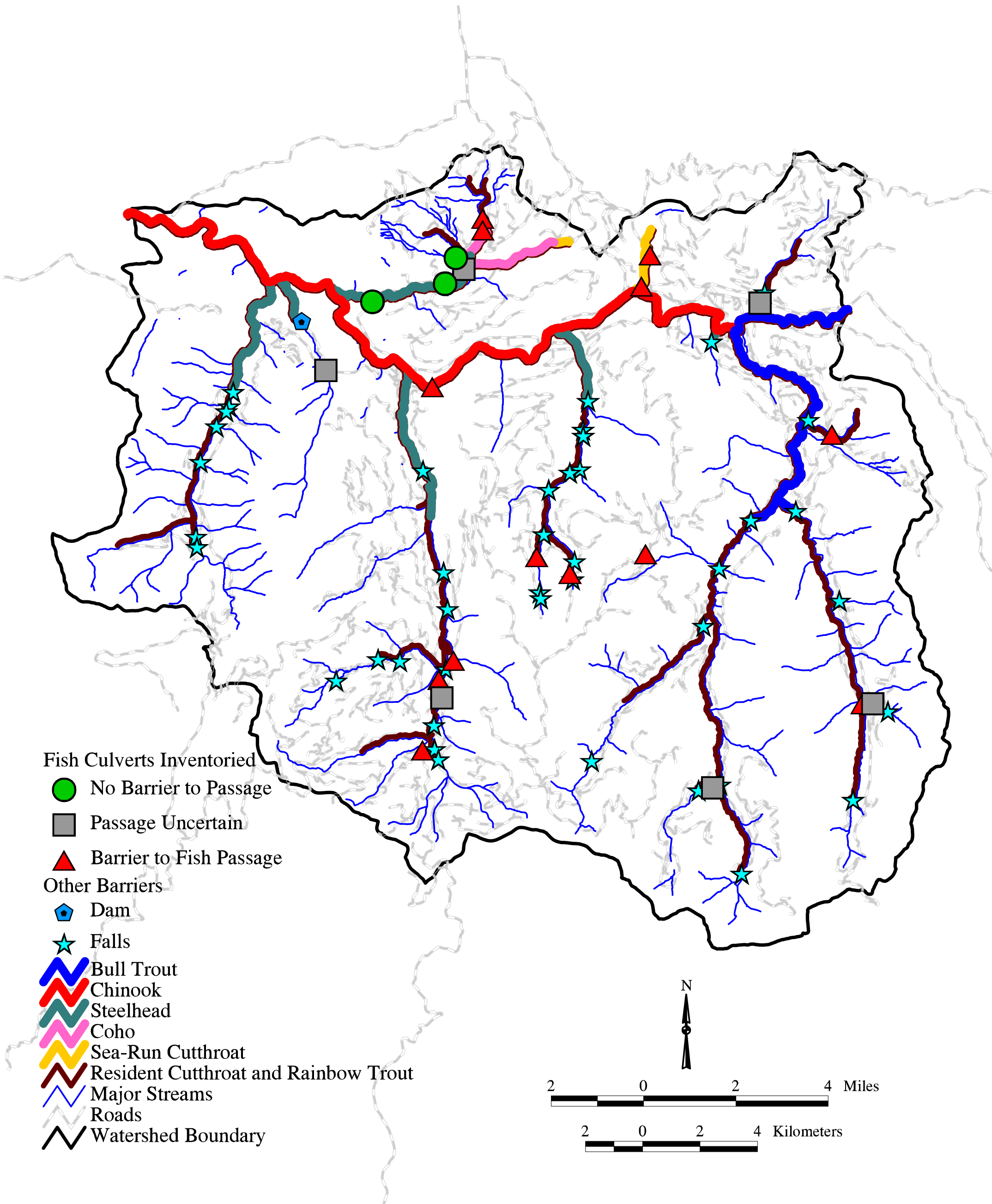


Figure 1. Known fish distribution within the Lower Cispus Watershed. Note error in bull trout distribution. There are no records of bull trout present in the Lower Cispus Watershed.

Table 2. Environmental baseline conditions in 2001 for the Lower Cispus River watershed.

		Environmental Baseline Rating[1]		
Pathway	**Indicator(s)**	**Properly Functioning**	**Functioning at Risk**	**Functioning at Unacceptable Risk**
WATER QUALITY	Temperature Bull trout			All Sub-watersheds
	Temperature Other Species		All Sub-watersheds	
	Sediment		All Sub-watersheds	
	Chemical Contaminants/Nutrients	All Sub-watersheds		
HABITAT ACCESS	Physical barriers		Woods Creek, Yellowjacket creek	Iron Creek, Greenhorn Creek, Lower Cispus River Frontal, Cispus River Camp Creek,
HABITAT ELEMENTS	Substrate in rearing areas		All Sub-watersheds	
	Large Woody Debris		Greenhorn Creek	Iron Creek, Lower Cispus River Frontal,Woods Creek,Yellowjacket Creek,Cispus River Camp Creek
	Pool Frequency and Quality FWS		Iron Creek, Woods Creek	Greenhorn Creek, Lower Cispus River Frontal, Yellowjacket Creek, Cispus River Camp Creek.
	Pool Frequency and Quality NMFS		Iron Creek, Woods Creek	Greenhorn Creek, Lower Cispus River Frontal, Yellowjacket Creek, Cispus River Camp Creek.
	Large pools		All Sub-watersheds	
	Off-channel habitat	Woods Creek	Iron Creek, Greenhorn Creek, Lower Cispus River Frontal, Yellowjacket Creek, Cispus River Camp Creek.	
	Refugia			All Sub-watersheds
CHANNEL DYNAMICS and CONDITION	Width / Depth Ratio		Woods Creek	Iron Creek, Greenhorn Creek, Lower Cispus River Frontal, Yellowjacket Creek, Cispus River Camp Creek.
	Streambank condition FWS	Woods Creek	Iron Creek, Greenhorn Creek, Lower Cispus River Frontal, Yellowjacket Creek, Cispus River Camp Creek.	
	Streambank condition NMFS	Woods Creek	Iron Creek, Greenhorn Creek, Lower Cispus River Frontal, Yellowjacket Creek, Cispus River Camp Creek.	
	Floodplain connectivity	Yellowjacket Creek	Woods Creek, Cispus River Camp Creek	Lower Cispus River Frontal, Greenhorn Creek, Iron Creek,
FLOW / HYDROLOGY	Peak/base flows		Yellowjacket Creek, Lower Cispus River Frontal, Greenhorn Creek, Iron Creek, Cispus River Camp Creek	Woods Creek
	Drainage network		All Sub-watersheds	
WATERSHED CONDITIONS	Road density and location		Yellowjacket Creek, Greenhorn Creek	Woods Creek, Lower Cispus River Frontal, Iron Creek, Cispus River Camp Creek
	Disturbance regime			All Sub-watersheds
	Disturbance history			All Sub-watersheds
	Riparian reserves		Woods Creek, Yellowjacket Creek, Greenhorn Creek, Iron Creek, Cispus River Camp Creek	Lower Cispus River Frontal
SUBPOPULATION CHARACTERISTICS / SPECIES AND HABITAT	Subpopulation size, Growth and survival, Life history Diversity and isolation, Persistence and genetic integrity, Integration of species and habitat conditions	No Rating. (The Forest Service has insufficient data in order to rate these indicators).		

Water Quality

<u>Temperature</u> - The natural range of summer maximum stream temperatures in the Lower Cispus watershed is estimated to range from 11.0 to 19.0 °C. The temperatures of all streams monitored to date have fallen within this range with the exception of three streams; Cispus River (at river mile 6.5), Greenhorn Creek and 1918 Creek (Table 2). Lethal levels for salmonids are generally 20 °C or higher. Elevated temperature increases fish vulnerability to disease and parasites, and decreases fish ability to compete for food and territory (Bjornn and Reiser, 1991).

Table 2- A comparison of stream temperatures at three sites, Lower Cispus Watershed Analysis (2003).

Cispus River at RM 6.5	Greenhorn Creek	1918 Creek
21.9 (1996)	20.2 (2000)	19.6 (2001)
20.6 (1997)	19.9 (2002)	20.5 (2002)

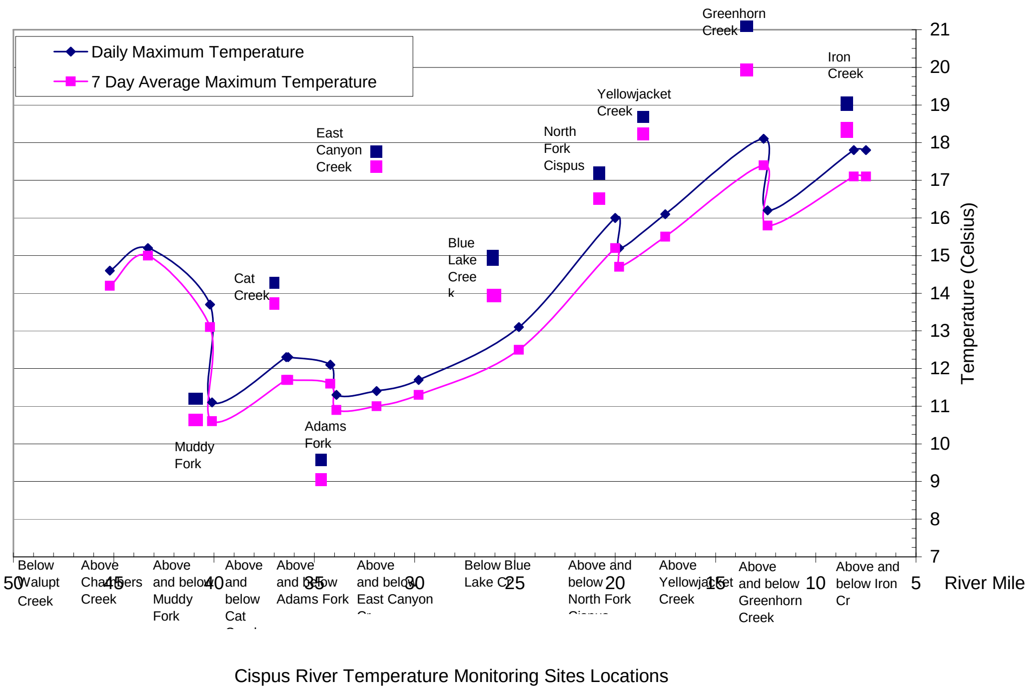
The state temperature standard states: "temperatures shall not exceed 16.0°C due to human activities. When natural conditions exceed 16.0°C, no temperature increases will be allowed which raise the receiving water temperature by more than 0.3°C". Stream temperatures exceed 16.0 °C throughout the Lower Cispus River watershed. Previous management activities such as riparian harvest and removal of large wood from streams probably resulted in increases to the temperatures of some of the streams within the Lower Cispus River watershed, although to what degree is uncertain.

Several of the major tributaries (Yellowjacket Creek, Iron Creek, Greenhorn Creek, Woods Creek, and the lower portion of the Cispus River regularly exceed 16°C during the summer rearing period. Only chinook salmon spawn during the monitoring period. Of the streams listed only the Cispus River and Yellowjacket Creek contain the typical spawning habitats of chinook salmon. Both of these streams have cooler water refuges upstream from the monitoring sites. Therefore I chose the Functioning At Risk Rating.

<u>Mainstem Cispus River</u>

The mainstem of the Cispus River is at its coolest temperature just below the confluence with the Muddy Fork, a glacial fed subwatershed within the Upper Cispus River Watershed. The Cispus River's rate of heating between this coolest site and the furthest downstream site is about 0.2 °C/mile, representing 33 miles of monitored river in 2000 (Figure 2, 3). Three major tributaries cool the mainstem, Muddy Fork, Adams Fork, and the North Fork Cispus River, all of which are within the Upper Cispus River watershed. A decrease in temperatures of the mainstem Cispus River is detected between the sampling sites above and below the confluence with Greenhorn Creek. This temperature decrease is not considered to be from the influence of Greenhorn Creek, but rather the shade afforded by the canyon-like mainstem reach

Figure 2. Stream temperatures in the mainstem Cispus River and tributaries during 2000.



The mainstem Cispus River temperatures increased about 1.7 °C in the 12 monitored miles (0.3 °C/mile) within the Lower Cispus River watershed during 2000. The furthest downstream sampling site along the mainstem Cispus River is about 7 miles from the confluence with the Cowlitz River. The Cispus River probably reached 19 °C as it entered the Cowlitz River in 2000, assuming a similar rate of heating in the reach below the lowest monitoring site.

The entire mainstem Cispus River within the Lower Cispus River watershed has anadromous and resident fish habitat. The anadromous fish use the mainstem for spawning and rearing.
Greenhorn Creek, Yellowjacket Creek and Iron Creek subwatersheds have the warmest waters flowing into the Cispus River (Map 3.1) within the Lower Cispus River watershed and exceed 16 °C for prolonged periods during the summer. All the subwatersheds flowing into the mainstem within the Lower Cispus River have small relative flow contributions (10% or less) and so their stream temperatures are a limited influence on the temperatures of the mainstem.

Yellowjacket Creek Subwatershed

Yellowjacket Creek temperatures exceed 16 °C from its confluence with the Cispus River to above Mc Coy Creek confluence, and coincides with the extent of anadromous habitat (6.1 miles). McCoy Creek does not exceed 16 °C. Pumice Creek, a tributary to Pinto Creek, and Pinto Creek stream temperatures exceed 16°C. Pinto Creek has 2.7 miles of resident fish habitat.

Greenhorn Creek Subwatershed

Greenhorn Creek exceeds 16°C from above 1918 Creek to its confluence with the Cispus River, about 3 miles. 1918 Creek is the only known Greenhorn Creek tributary to have stream temperatures that exceed 16 °C. 1918 Creek is a wide shallow stream in a bedrock canyon and has only 0.1 miles of resident habitat. Greenhorn Creek has only 1.8 miles of anadromous habitat but 5.5 miles of resident habitat, including 1.2 miles of Soldier Creek.

Iron Creek Subwatershed

Iron Creek stream temperatures exceeded 16 °C in the lower one mile of stream. No monitored tributaries of Iron Creek had stream temperatures exceeding 16 °C. Iron Creek has 3.3 miles of anadromous habitat.

Woods Creek Subwatershed

Woods Creek stream temperatures measured 1.5 miles from the confluence with the Cispus River remained below 16 °C during the three years it was monitored (1995, 1997, 1999) although one temperature recorded during a stream survey within the lowest half mile of Woods Creek was 20 °C during the summer of 1999. Woods Creek has 3.6 miles of anadromous habitat.

Quartz Creek Subwatershed

Quartz Creek's maximum water temperatures was approximately 16 °C during 2000-2002, as measured 1.5 miles from confluence with the Cispus River. Quartz Creek has 2.8 miles of anadromous habitat.

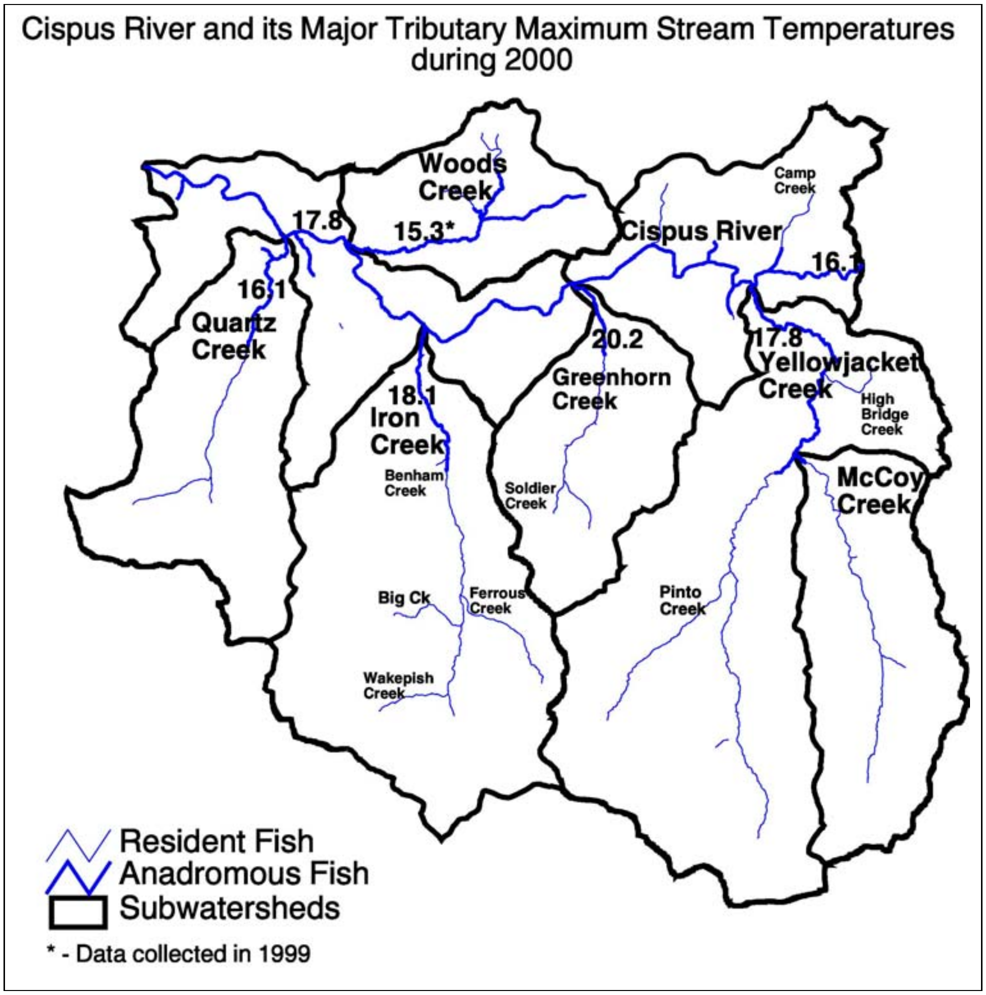


Figure 3. Maximum stream temperatures, Cispus River and major tributaries, 2000

Sediment/Turbidity - Sediment delivery from roads and management-related landslides has changed the natural sediment regime by increasing the amount of sediment that streams must process. Roads with sediment delivery of 20 tons or greater per mile were designated as "high risk" in the Gifford Pinchot NF Roads Analysis. Landslides were reviewed and designated based on proximity to roads or harvest units, through either and professional judgement by a geologist/soil scientist.

The three subwatersheds where the most sediment delivery from roads is occurring are Iron Creek, Cispus River-Camp Creek, and Lower Cispus River Frontal (Table 3). The three subwatersheds with the most acres of management related landslides are Yellowjacket Creek, Quartz Creek, and Iron Creek.

Table 3- Total length of roads delivering high amounts of sediment, and total area of management-related landslides delivering sediment, in the Lower Cispus River watershed.

Subwatershed	Total length of road in the high category of sediment delivery (miles)	Landslide from management related causes (acres)
Yellowjacket Creek	8.9	140
McCoy Creek	2.7	18
Cispus River-Camp Creek	10.4	85
Greenhorn Creek	1.2	14
Iron Creek	38.0	104
Woods Creek	5.3	0
Quartz Creek	3.6	128
Lower Cispus River Frontal	9.5	43

Yellowjacket Creek Subwatershed

Fine sediment delivery to stream channels and transport to depositional reaches within the subwatershed can alter substrate composition is important to aquatic species (invertebrates, amphibians, fish and plants). Fine sediments were estimated as 13% fines within the depositional reach of Yellowjacket located above the confluence with Badger Creek. Harvest and road-related landslides occur within this area. Recent sediment deposition caused braided channel and subsurface flows according to a 2001 stream survey.

Evidence of excessive sediment delivery was apparent in the reach between Veta Creek and Pinto Creek where recent channel widening was attributed to the 1996 flood. Long stretches of raw bank, recently formed log jams and deposits of alluvial material were observed in this reach. The lowest 1.8 miles of Yellowjacket Creek has floodplain deposits of coarse alluvium and dramatic shifts in channel position.

Pinto Creek depositional reach (RM 3-4) has high sedimentation where numerous road- and harvest- related landslides are located.

Iron Creek Subwatershed

Iron Creek has high sediment contribution from roads and management-related landslides. The depositional reaches within the Iron Creek subwatershed are located on Big Creek and Wakepish Creek, and the mainstem Iron Creek (RM 7.3-8.2) in the vicinity of those tributaries in the upper section of the subwatershed and the lowest 0.8 miles of the mainstem Iron Creek. All of the reaches of the mainstem Iron Creek have high width to depth ratios and lack large wood. Large wood was added and redistributed along the lowest mile of Iron Creek in 1999.

Quartz Creek Subwatershed

The high sediment load from the blast zone is working its way down through the subwatershed as sedimentation levels decrease in a downstream direction. This is also evident as moderate bank cutting in the middle reaches, with excessive bank cutting further upstream in reaches nearer the blast zone. Management related sediment contributed from roads and harvest units is also delivered to Quartz Creek.

Quartz Creek does not have any significant depositional reaches, so management related sediment from roads and landslides are transported through the subwatershed and enter the mainstem Cispus River at about river mile 4.

We have no data that directly addresses the condition of spawning gravels.
Both watershed analyses, however, indicate that there is an influx of sediments from roads on Yellowjacket Creek, McCoy Creek, Pinto Creek, Greenhorn Creek, the upper portion of Iron Creek, and Crystal Creek. The large amount of fines sediment in Woods and Ames creeks is typical of low gradient streams and naturally limits the quality of spawning gravels in these streams.
Observations along the Cispus River and its tributaries indicate that the condition of spawning gravel ranges from functioning appropriately to functioning at unacceptable risk.

Chemical Contaminants/Nutrients - We have no data with which to address this indicator. Previous watershed analyses indicated concerns in only two streams, Red Springs Creek (a trib to Quartz Creek) and Camp Creek (a trib to McCoy Creek). The problems appear to be isolated in these particular streams. There are many residences, a couple of ranches in watershed but no towns, mills, or factories.

Habitat Access

Physical Barriers - There are several culverts that are likely preventing the free movement of all species and age class up and down the stream.

Habitat Elements

Substrate – See section above on sediment/turbidity.

Large Woody Debris – Forest structural stage was used to evaluate future large wood recruitment potential. Recruitment potential is considered to be currently available for large tree structural stage and near-term recruitment potential (1-7 decades) is considered from the small tree structural stage.

All the subwatersheds have lower percentage of large tree structure than the reference condition with Iron Creek, Lower Cipsus River Frontal and Woods Creek subwatersheds experiencing the largest decline from the historic condition (Table 4). These subwatersheds also have higher percentages (greater than 25% higher) of small tree structure than the reference condition. The lower ratio of large tree and higher ratio of small tree indicates that less large wood recruitment is currently available within the subwatersheds.

Table 4. Current and reference percentage of large and small tree structural class within riparian reserves for each subwatershed in the Lower Cispus River watershed.

Subwatershed	Current Large Tree (%)	Historic Large Tree (%)	Difference	Current Small Tree (%)	Historic Small Tree (%)	Difference
Yellowjacket Creek	30	55	25	41	34	7
McCoy Creek	18	44	26	38	30	8
Cispus River-Camp Creek	34	39	5	38	36	2
Greenhorn Creek	18	38	20	62	42	20
Iron Creek	38	94	56	31	2	29
Woods Creek	29	94	65	31	0	31
Quartz Creek	43	37	6	24	9	15
Lower Cispus River Frontal	30	85	55	31	5	26

The stream surveys rarely show woody debris approaching 80 pieces per mile. Most of the woody debris does not meet the criteria for large wood. The high number of pieces of wood in Camp Creek and Quartz Creek are mainly due to differences in how wood was counted. The size classes were much smaller for the Camp Creek survey and the Quartz Creek Survey estimated the number of pieces of wood in logjams. Niether of these methods are consistent with the protocol on which the criteria is based. The 1996 flood did increase the amount of wood on bar in the Cispus River. This wood however is not particularly stable.

Pool Character, Frequency, and Quality - For the surveyed streams the number of pools rarely meets the criteria for pool frequency, and the pools are generally shallower than expected given the size of the streams. Post 1996 flood surveys found a decrease in pool number and pool depth on Yellowjacket Creek. Only Yellowjacket Creek, Iron Creek and the Main Cispus River have substantial numbers of pools greater than 3> feet deep. The pools in the main river appear to be shallower than one would expect for a river of its size.

Off-Channel Habitat - Some backwaters and side channels are present. They are mainly located the Cispus River upstream from Yellowjacket Creek. These side channels generally lack stability and cover. Woods Creek and Ames Creek contain many beaver ponds, which provide good refuge from high flows.

Refugia - Some streams have small areas of fully functioning habitat but they small and disconnected and would not support large populations of fish.

Channel Condition & Dynamics

Width/Depth Ratios/Streambank Condition/Floodplain Connectivity – Stream width is a major influence on the amount of solar radiation reaching a stream. Stream instability can result in increased stream widths. Past management, such as removal of large wood from streams and excessive sediment from road construction has resulted in stream instability. Recent floods in November 1995 and February 1996 caused unstable streams to widen or shift channel position. The Cispus River flow was estimated at 31,600 cfs on February 6, 1996- the largest recorded flood on record- with the next highest flow event in 1933, which was estimated as 20,000 cfs.

The Yellowjacket Creek floodplain is 300-600 feet wide for the last 1.5 miles before it joins the Cispus River. During the recent (1996) flood, the floodplain vegetation was stripped, the stream widened, and sections of the river shifted channel position. Similar processes occurred during an earlier flood as seen in the aeriel photos of 1939. Widening of the stream channel is also evident in 1973, presumably the result of excessive sediment from road construction in the late-1960s and early-1970s.

Similarly, Iron Creek was stripped of its floodplain vegetation and widened during the 1996 flood. Stream surveys suggest high width-to-depth ratios for two of the nine miles surveyed in 1993.

Greenhorn Creek experienced less disturbance during the 1996 flood.

We do not have direct measurements of streambank stability. Numerous streambanks experienced a high degree of erosion during the 95-96 floods. Many of these are still unstable because of a lack of root strength (Lower portions of Yellowjacket Creek, Iron Creek and Greenhorn Creek and several portions of the Cispus River especially above the 2306 rd.). Some stability is slowly returning naturally (lower section of Greenhorn Creek) and other places have been strengthened by human made structures (engineered log jams upstream from the Tom Music Bridge and rock work along the 76 road, channel work in Iron Creek).

Flow/Hydrology

Change in Peak/Base Flows/Increase in Drainage Network - Peak flows affect stream channel morphology, sediment transport and bed material size. Peak streamflows affect channel morphology through bank erosion, channel migration, riparian vegetation alteration, and deposition of material on floodplains. Most sediment transport occurs during peakflows as sediment transport capacity increases with discharge. The ability of a stream to transport incoming sediment will determine whether there is deposition or erosion within the active stream channel. The relationship between sediment load and sediment transport capacity will affect the distribution of aquatic habitat types. Increases in peak flows can potentially change channel morphology, sediment transport rates and bed material size, and consequently change aquatic habitat.

Increases in bankfull flow (flows with a recurrence interval of 1.5 years) can potentially change the stream morphology and/or cause excessive scour. Stream morphology, in particular the shape of a channel, is formed during bankfull flows which determine the bankfull height and width. Increases in bankfull flow can potentially cause channel instability resulting in various conditions depending upon channel type, sediment regime, and substrate. Conditions that could indicate increased peak flows causing channel instability include incision, excessive bank erosion, loss of mature vegetation, excessive floodplain deposition, or excessive scour.

Excessive scour has the potential to scour and mobilize stream bed sediments and redds. Salmonids generally bury most of their eggs at depths exceeding the mobile stream layer for the 2-year flood. Evolutionary strategy would suggest advantage to burying eggs at depths below the 2-year storm mobile layer, since scour frequency at shallower depths could affect population on a nearly annual basis. Larger floods with greater volumes and duration of flow may cause deeper scour of the gravel, however, these storms occur less frequently, have a lower probability of affecting the entire population, but could have significant effects on the brood in the years they do occur (DNR 1993).

The Aquatic Conservation Strategy gives clear direction that "the distribution of land use activities, such as timber harvest or roads, must minimize increases in peak streamflows" in order to create and sustain riparian, aquatic and wetland habitats and to retain patterns of sediment nutrient and wood routing.

Changes in peak flows were estimated using both Water Available Runoff (WAR) and Aggregate Recovery Percentage (ARP). Both methods assume that the greatest likelihood for causing significant, long-term cumulative effects on forest hydrologic processes is through the influence of created openings from timber harvest and roads on snow accumulation and melt. The effect of vegetation change on peakflows during rain-on-snow events is the focus of the assessment. Although results from both methodologies are presented, the WAR model results are presumed to present a more accurate synopsis of the conditions, as this model has more variables representing the various affects to the rain-on-snow process, i.e. ranges in precipitation, temperature and wind speeds, in addition to created openings. The WAR methodology is documented in the Washington Department of Natural Resources Standard Methodology for Completing Watershed Analysis (DNR 1993). 1996 vegetation data was used in this analysis and therefore, estimated increases in Water Available Runoff are currently incrementally less. Little regeneration harvesting has been completed in this watershed on Forest Service lands since 1996. Therefore natural growth is considered to have more than offset any reductions to hydrologic maturity from regeneration harvest.

The WAR increase of 10% or greater are considered to indicate that increased peak flows are affecting stream channels with the potential to cause excessive stream bank erosion and/or scour redds (see WAR/ARP map).

<u>Yellowjacket Creek Subwatershed</u>

Yellowjacket Creek subwatershed analysis units R and Y had WAR of 11% and 10% respectively (see WAR and ARP map). These analysis units comprise the furthest downstream section of Yellowjacket Creek and High Bridge Creek, which coincides with the anadromous habitat section of Yellowjacket Creek subwatershed. Excessive widening occurred during the flood of 1996 in Yellowjacket Creek. The 1996 flood affected

Yellowjacket Creek channel conditions including dramatic shifts in channel position and excessive floodplain deposits of coarse alluvium. Increased runoff conditions and associated mass wasting and sediment delivery, as a result of this subwatershed's vegetation status, may have resulted in worsened affects to the channel. Past removal of instream large wood also made the channel more vulnerable to channel perturbations. The 1996 flood was the largest one experienced since 1934 and therefore, insufficient evidence exists that would ascertain how much the theoretical increased peak flows during this event worsened the channel disturbance.

Camp Creek – Cispus River Subwatershed

Camp Creek drainage of the Cispus River-Camp Creek subwatershed had WAR of 13%**.** Camp Creek runs subsurface for 250 feet at the confluence with the Cispus River. Signs of channel migration, scouring and dry channels are prevalent within the lower reach below the 40 foot waterfall. Landslides in the upper reaches exist. These conditions may or may not be a result of increased peak flows causing excessive sediment deposition.

Iron Creek Subwatershed

Iron Creek has two drainages (Big Creek and Wakepish Creek) in the upper section of the subwatershed with WAR at 10%. Wakepish Creek and Big Creek have only resident fish species. Stream surveys of 1987 suggest scoured bedrock areas exist within low gradient reaches, possibly the effect of increased peak flows in both these drainages. The uppermost portions of these drainages are within the Mt. St. Helens blast zone.

Woods Creek Subwatershed

Woods Creek WAR is 16% where 6.8 miles of anadromous habitat exists. Woods Creek has 1,255 acres of privately-managed land (16% of the subwatershed). A Woods Creek stream survey in 1999 documented stream conditions that are indicative of increased peak flows; bank undercutting and erosion are prevalent. Stream reaches are characterized as Rosgen Channel Type "E" with over 5 feet, up to 15 feet high, stream banks. Large wood deposited only above bankfull level indicate the stream has downcut and is unable to utilize its floodplain during all but extreme high flows.

Quartz Creek Subwatershed

Quartz Creek WAR is 16% where 2.8 miles of anadromous habitat exists. Quartz Creek was impacted by the volcanic eruption of Mt. St. Helens. The blast zone comprises about one-third of the area within the Quartz Creek Subwatershed resulting in high WAR increases. Stands within the blast zone will develop at a natural rate for a forest recovering from the effects of a volcanic eruption.

Lower Cispus River Frontal Subwatershed

Within the Lower Cispus Frontal subwatershed, Copper Canyon Creek has the highest WAR (24%) within the entire Lower Cispsus watershed. Copper Canyon Creek contains about two-thirds of its land in private ownership. The Crystal Creek WAR increase was 15%, and contains 1.1 miles of anadromous habitat. The 1994 stream survey of Crystal Creek suggests the channel is incised in the valley bottom with 3-10 feet high banks. The Crystal Creek drainage contains about one-third privately-managed lands.

Watershed Condition

Road Density and Location – Average road density is 2.63 miles/square mile and road density in the riparian reserves associated with streams is 2.19 miles/square mile. Although several roads have been decommissioned in the last 5 years the resulting road densities are still relatively high. The worst areas are Cispus-Camp Creek, Cispus-Woods Creek, Lower Cispus river Frontal, Iron Creek, and Greenhorn Creek sub-watersheds. The only sub-watershed with road density under 2 miles per square mile is the McCoy Creek sub-watershed.
In addition, there are about 1.5 stream crossings per mile of stream. Many of these are sources of fine sediment during winter storms. Most of these alter the transport of sediment during floods. Most of the culverts do not drain the floodplain, thus the back up water sediment and accelerate flows downstream increasing stream energy.

Subwatersheds with a high density of roads within the riparian corridors and a high number of stream crossings have affected riparian connectivity. The Gifford Pinchot NF Roads Analysis rated roads in terms of road density in riparian areas within drainages (7th field HUC). Roads were rated high risk in terms of riparian road density if the road was within a drainage that had greater than 3.5 road miles per sq. mile of drainage area. Roads where more than 25% of the road was within a riparian reserve, and the road was within a drainage that had greater than 2.5 road miles per sq. mile were also rated high risk. The Roads Analysis rated roads in terms of number of stream crossings as high risk if a road had more than 2.5 crossings per mile within a drainage. The three subwatersheds with the greatest affects from road density in riparian areas and number of stream crossings are Iron Creek, Yellowjacket Creek and Cispus River-Camp Creek – Cispus River (Table 5).

Table 5. Total length of road contributing to high road densities and to high number of stream crossings for each subwatershed.

Subwatershed	Total length of road contributing to high road densities in riparian corridor	Total length of road with greater than 2.5 crossings per mile
Yellowjacket Creek	75.2	62.1
McCoy Creek	5.0	7.3
Cispus River-Camp Creek	45.8	34.1
Greenhorn Creek	28.3	22.1
Iron Creek	95.3	81.3
Woods Creek	29.7	5.2
Quartz Creek	15.6	21.1
Lower Cispus River Frontal	33.2	28.4

Disturbance Regime/History - A review of the USGS stream gauge data at the Cispus Near Randle (14232500) there have been seven ten year plus floods in since 1970. Although it is not possible to conclude that this represents an elevated frequency of flooding, it does show that relatively large number of substantial floods have occurred in the last 32 years. The floods in 1995 and 1996 certainly dramatically modified the habitat in Yellowjacket Creek, Greenhorn Creek, Iron Creek, Quartz Creek, Camp Creek and the Cispus River. In addition a relatively small flood (2 to 5 Year) in 2002 modified the location of channel in the lower mile of Yellowjacket Creek. The 1980 eruption of Mt St Helens denuded the upper ¼ of the Quartz Creek sub-watershed. It also dumped tons of ash into the streams in the other sub-watersheds.

As a whole the Forest Service lands 5th field watershed are near the 74% for Aggregate Recovered Percentage (ARP). The worst sub-watershed is Iron Creek and best sub-watershed is Cispus River Camp Creek.
There is too much missing GIS data to estimate ARP values for the sub-watersheds with substantial portions of private land (Quartz Creek, Lower Cispus River Frontal, and Woods Creek). Observations and aerial photo analysis show more disturbances in these sub-watersheds than in Forest Service managed sub-watersheds. In addition the 1980 eruption of Mt St Helens practically denuded the upper 1/3 of the Quartz Creek sub-watershed. There have been some activities in the riparian reserves and unstable areas for example a road density 2.19 miles/square mile in the riparian reserves. The harvest and activities on the private lands primarily in Cispus - Woods Creek, Lower Cispus River Frontal, and Quartz Creek Sub-watersheds tip the balance toward the Functioning at Unacceptable Risk side of the scale. There are no large refugia remaining.

Riparian Reserves – Riparian vegetation can provide shade to stream surfaces, thus reducing the amount of solar radiation reaching a stream. Vegetation height determines the length of shadow, while stand density influences the amount of light that passes through a stand. The orientation of the stream and the channel width also influence how much solar radiation reaches a stream each day. These influences were modeled as described in *Chapter VII Temperature* of the EPA publication "An Approach to Water Resources Evaluation of Non-point Silvicultural Sources" (Environmental Protection Agency, 1980) to obtain current stream shade for each subwatershed.

By modeling current and site potential vegetation conditions, the reduction in shade caused by past riparian harvest or development can be estimated. Only Class I and II streams were modeled. Shade from tree height and topography was estimated from the GIS analysis.

Woods Creek and Yellowjacket Creek subwatersheds had the lowest existing shade levels, 49% and 68%, respectively. Camp Creek drainage and Quartz Creek subwatersheds had 70% existing shade, while Iron Creek subwatershed had 71% existing shade (Table 6).

Table 6.- Existing shade, potential shade and current shade loss for subwatersheds within the Lower Cispus River watershed.

Subwatershed	Percent of Stream Federally Managed	Existing Shade (%)	Potential Shade when trees reach 160 feet (%)	Current Shade Loss (%)
Yellowjacket Creek	100	68	81	13
McCoy Creek	100	84	87	3
Camp Creek*	100	70	82	12
Greenhorn Creek	100	79	89	10
Iron Creek	100	71	79	8
Woods Creek	84	49	51	2
Quartz Creek	90	70	76	6

* Only the Camp Creek drainage of the Cispus River – Camp Creek subwatershed was modeled.

Modeling the subwatershed shade summaries for Cispus River-Camp Creek subwatershed and the Lower Cispus River Frontal subwatershed was not considered appropriate with the GIS analysis due to the large width of the Cispus River. Alternative analysis involving aerial photo interpretaton will be accomplished during the Summer of 2003.

Approximately 17% of the stream-side riparian on the forest on in the early seral classes. When one adjusts for flood damage (25% of non-forest) and harvest on private lands (50% of private) this figure jumps 25%. Adding in historic stream salvage operations, and residences (the community of Cispus) the riparian reserves are moderately fragmented. The worst area are the Iron Creek and the Lower Cispus River Frontal sub-watersheds and the best is the Cispus River-Camp Creek sub-watershed.

Wind River (HUC # 1707010512)

This fisheries assessment generally follows the NOAA Fisheries ***Matrix of Pathways and Indicators***. The format includes major headings identified in the Matrix. Where necessary to provide a more cohesive and logical report, some topics were combined and are presented in a different order than they are found in the Matrix. The tables below are summaries of 5th and 6th field watershed conditions relative to the NOAA FISHERIES criteria.

Table 1. Fifth field watershed condition summary based on the NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species, Wind River, Skamania County, Washington.

NMFS Matrix and Pathways Criteria	Wind River 5th Field Watershed	Sources and Comments
Water Quality		
Maximum Water Temperature	17	The average of all maximum temperatures for all major tributaries is 17.5 degrees celsius (USFS water quality baseline station data 1977-present & USFS water quality monitoring data 1995-present) maximum temperature recorded near the mouth of the Wind River was 17 degrees Celsius (Underwood Conservation District 1999 to present)
Substrate (% fines < 1.6mm)	13%	Average fines <1.6mm found in spawning gravel of major tributaries was 13% (USFS sediment core data 1988-present)
Turbidity (Max NTU)	107	Maximum turbidity recorded at the mouth of the Wind River was 107 NTU (11/28/95 USFS turbidity monitoring)
Chemical contamination	PF	There has been no toxic chemical analysis however agriculture and mining within the basin are limited; Underwood Conservation District water quality monitoring found only trace elements of fecal coliform, nitrate and nitrite.
Habitat Access		
Migration barriers	Dam and Culverts	Hemlock Dam has a fish ladder but is thought to create a thermal block for adult steelhead in summer months and a serious impediment to Parr emigration. At this time Oldman Creek and Youngman Creek have culverts that block adult and juvenile steelhead migration. A culvert analysis is in progress and will provide detailed list of culverts impeding migration of all life stages.
Habitat Elements		
Substrate (% fines < 1.6mm)	13%	Average fines <1.6mm found in spawning gravel of major tributaries was 13% (USFS sediment core data 1988-present)
LWD Pieces/River Mile	55	Average LWD for all surveyed streams (USFS stream survey data 1990-present)
Pools/Mile	34	Average pools per mile for all surveyed streams (USFS stream survey data 1990-present)
Pool Surface Area/Volume Ratio	51	Average pool surface area/volume ratio for all surveyed streams (USFS stream survey data 1990-present)
Off channel habitat	5%	Average percent off-channel habitat for all surveyed streams (USFS stream survey data 1990-present)
% Riparian area within Early Seral	17%	Average percent of early seral vegetation within riparian areas (USFS Vegetation data 2000)
% Riparian Area within Late Seral	30%	Average percent of early seral vegetation within riparian areas (USFS Vegetation data 2000)
Channel Conditions & Dynamics		
W/D Ratio (Low Flow)	9	Average Width/Depth ratios for all surveyed streams (USFS stream survey data 1990-present)
Streambank condition	NPF	The alluvial reaches within the Wind River are very unstable due to riparian timber harvest and stream clean-outs. Bank stability within these reaches is poor (Pfanchuk stream survey data 1983-present and professional judgment)
Floodplain Connectivity	FAR	The alluvial reaches within the Wind River are very unstable due to riparian timber harvest and stream clean-outs. Channelization due to down-cutting is the predominant process associated with the loss of flood plain function within the Wind River (Pfanchuk stream survey data 1983-present, bank stability monitoring 1998 and professional judgment)
Flow/Hydrology & Watershed Conditions		
Increased Peakflows	FAR	Peakflow conditions were evaluated against the percentage of watershed within the rain on snow zone, Aggregate Recovery Percentage (ARP) and Drainage Network increase. The Wind River watershed is recovering from regeneration harvest in the rain on snow zone. In addition, approximately 100 road miles have been decommissioned and will in the long term assist with recovery of the hydraulic regime (2001 USFS Hydrology Assessment)
% Watershed in Rain on Snow	33%	The Upper 33% of the watershed exist within the rain of snow zone.
ARP	92	An ARP value of >70 is considered hydrologically recovered (2001 USFS Hydrology Assessment)
Drainage network Increase	41%	Drainage network increase due to road construction is 41% (2001 Hydrology Assessment) Increases above 25% impact the timing and magnitude of peakflows (Wemple, 1994 & Siskyou 1995)
Road density	2.9	Road densities within the basin are 2.9 mi/mi^2 (2001 Hydrology Assessment) Road densities >2mi/mi^2 impact the timing and magnitude of peakflows (USFS 1993)
PF = Properly Functioning		
FAR = Functioning at Risk		
NPF = Not Properly Functioning		
ND = NO DATA		

Table 2. Sixth field watershed condition summary based on the NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species, Wind River, Skamania County, Washington.

NMFS Matrix and Pathways Criteria	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
Water Quality								
Maximum Water Temperature	16	17	25	21	17	16	16	12
Substrate (% fines < 1.6mm)	ND	ND	11%	14%	11%	ND	15%	14%
Turbidity (Max NTU)	107	26	46	39	25	4	35	46
Chemical contamination	PF	PF	PF	PF	PF	PF	PF	PF
Habitat Access								
Migration barriers	None	Falls/	Dam	None	Falls	Falls	Culverts	None
Habitat Elements								
Substrate (% fines < 1.6mm)	ND	ND	11%	14%	11%	ND	15%	14%
LWD Pieces/River Mile	ND	ND	26	40	55	81	51	78
Pools/Mile	ND	ND	25	23	31	31	35	56
Pool Surface Area/Volume Ratio	ND	ND	52	38	49	54	67	46
Off channel habitat	ND	ND	3%	3%	7%	6%	5%	ND
% Riparian area within Early Seral	17%	9%	40%	24%	16%	22%	15%	15%
% Riparian Area within Late Seral	30%	40%	27%	33%	37%	34%	22%	47%
Channel Conditions & Dynamics								
W/D Ratio (Low Flow)	ND	ND	14	11	7	ND	8	7
Streambank condition	PF	ND	NPF	NPF	NPF	PF	NPF	FAR
Floodplain Connectivity	PF	ND	NPF	NPF	FAR	PF	FAR	ND
Flow/Hydrology & Watershed Conditions								
Increased Peakflows	PF	PF	NPF	FAR	PF	FAR	NPF	NPF
% Watershed in Rain on Snow	33%	71%	85%	59%	78%	70%	84%	72%
ARP	92	95	85	87	94	82	82	85
Drainage network Increase	41%	12%	31%	30%	10%	24%	29%	23%
Road density	2.9	1.4	2.4	2.6	1.1	1.6	2.2	2.2
Landslide Risk								
PF = Properly Functioning								
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Water Quality

Water Temperature **-** The Wind River watershed has been severely impacted by both natural and human caused disturbances. Riparian timber harvest, splash dams, stream clean-outs, and floods have removed stream shade, in-stream large woody debris, and reduced channel stability. The cumulative effects have led to extreme width to depth ratios and bank erosion within Trout Creek, Dry Creek, Middle and Upper Wind River 6th field watersheds. Many salmonids tolerate temperatures exceeding 18°C, but higher temperatures increase stress and mortality usually occurs around 25°C (Jobling 1981). The poor channel conditions (large width/depth low flow ratios) combined with low summer flows and poor stream shade have produced lethal maximum water temperatures for salmonids ($\geq$ 24° C) within the Trout Creek watershed. Bell (1987) demonstrated that 50% steelhead mortality occurs after 17 hours of exposure at 24°C.
Maximum water temperatures do not negatively affect Spawning and incubation. The Wind River steelhead spawn from March to late May/early June with maximum water temperatures during this period below 45-50°F, which are near optimal conditions for spawning. Maximum water temperatures negatively affect adult steelhead migration and juvenile rearing. Adult steelhead enter the watershed every month of the year and the majority of juvenile steelhead rear in tributaries and the main-stem Wind River for two years.

NOAA Fisheries Criteria for water temperature are: 50-57°F = *Properly Functioning,* 57-64°F = *Functioning at Risk,* >64°F = *Not Properly Functioning.*
Maximum water temperatures have exceeded the lethal limits for steelhead (25°C or 75°F) during recent years (1987, 1990, 1991, 1992, 1994 and 1998) in Trout Creek and sub-lethal temperatures (21°C) have been recorded in the Middle Wind River and are therefore categorized as *Not Properly Functioning* for migration and rearing. Bear and Dry Creek sub-watersheds have recorded maximum water temperatures above 16°C, which exceeds both the NOAA FISHERIES criteria and State of Washington water quality standards and therefore was categorized as *Functioning at Risk.* The Lower Wind River, Upper Wind River, Falls Creek and Panther Creek 6th field watershed meet both the NOAA FISHERIES criteria and state water quality standard of 16°C and are categorized as *Properly Functioning.*

Table 3. Maximum water temperature matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
Maximum Water Temperature (Main Stem)	16	17	25	21	17	16	16	12
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning (Max Temp.<17)								Mouse
FAR = Functioning at Risk (Max Temp. 17-19)								
NPF = Not Properly Functioning (Max Temp. >19)								
ND = NO DATA								

Sediment and Turbidity-Sediment and sediment transport are natural processes that provide streams with a source of substrate and nutrients. Sediment is naturally delivered to streams by a variety of mechanisms such as landslides and bank erosion. All streams and their associated aquatic organisms evolved to a natural “sediment load” or regime. The sediment load is the quantity and size of the material a stream typically transports. The sediment regime and composition determines the quantity and quality of aquatic habitat. When streams or watersheds are disturbed by fire, logging, or road construction, excess sediment can be delivered to the stream altering both the quantity and composition of the substrate. This shift in the sediment composition can directly and indirectly affect aquatic organisms by altering water quality, incubation, larval development, and juvenile rearing habitat (WTFW, 1993).

Turbidity is the visible suspension of smaller particles of sediment typically carried by all streams. Turbidity meters measure the clarity of the water by passing a beam of light through a sample. A sensor assigns a NTU (nephelometric turbidity units) value for the amount of light that passes though the sample. Turbidity levels are typically tied to stream flow levels. At higher flow levels, sediment inputs are usually greater, and streams have greater capacity to entrain and maintain finer sediments in suspension. High turbidities / suspended sediment can affect aquatic organisms by killing them directly, by reducing growth rates and resistance to disease, by preventing successful development of eggs or larvae, by modifying natural movement or migration patterns, or by reducing the natural availability of food (EPA, 1986).

Landslides and accelerated bank erosion have altered the sediment budgets of Panther Creek, Trout Creek, Dry Creek, Upper and Middle Wind River 6th field watersheds. The majority of sediment within the alluvial valleys of Trout Creek, Dry Creek, Upper and Middle Wind River watersheds comes directly from bank erosion and within stream sources such as eroding, unconsolidated bank erosion and exposed point gravel bars. This erosion is caused by: LWD removal, lack of vegetative roots and peak flows. Roots from trees and shrubs are needed to hold soil and rock together along the stream/bank interface. In-stream LWD protects banks and gravel bars by reducing and dampening water velocities along them. Large streamside trees are needed for self-maintaining / potential in-stream LWD.

Trout Creek, Panther Creek and Lower Wind River 6th field watersheds has the highest turbidity and potential for sediment delivery. Grab samples of turbidity were taken along major tributaries and the main-stem Wind River at three stream stages in 1995 to evaluate suspended sediment/turbidity. Results are presented in the following table along with turbidity levels found in the Wind River during the same sampling period.

Table 4. Turbidity (NTU's) for the Wind River and tributaries during low, medium and high flows [11/28/95, 11/20/95 and 12/9/96], Skamania County, Washington.

Turbidity in Wind River, 1995 (rising limb), 1996 (falling limb).				
	Estimated Streamflow (1)			
Location	Medium	Low	Medium	High
	(12/9/96)	(11/20/95)	(11/24/95)	(11/28/95)
Bear	6.4	1.73	3.43	26.70
Dry		1.66	3.10	25.34
Falls		1.68	2.36	4.97
Martha	3.7		3.03	21.35
Mouse	11.1	2.21		41.65
Ninemile		1.78		14.07
Panther, Lower	9	2.18		46.25
Panther, Upper	5	1.57	3.31	18.93
Paradise	3.8	2.52	4.67	23.36
Tenmile		1.46		12.18
Trapper	1.7	1.34	2.26	9.38
Trout	2.2	2.42	6.26	46.69
Wind, Lower	8.3	3.57	10.03	107.20
Wind, Middle	4.1	1.88	4.81	39.02
Wind, Upper	2	2.34	6.00	35.38
Trout, Lower	3.6			
(1) Field estimate of streamflow based on bankfull channel				
where: High is equivalent to 2/3 bankfull to bankfull; Medium				
is equivalent to approximately 1/3 to 2/3 bankfull; and Low				
is equivalent to 1/3 bankfull or less.				

turbidity in Wind River, 1995-96.

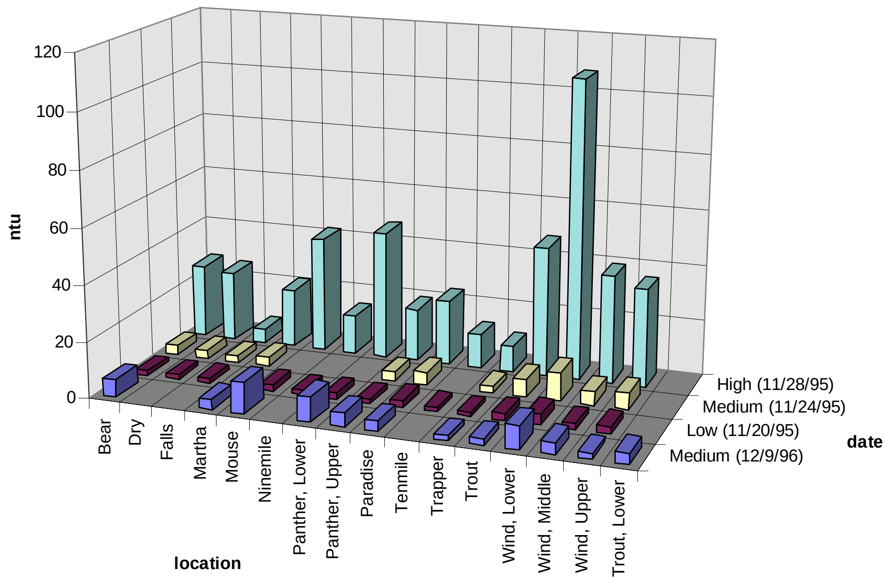


Figure 1. Turbidity (NTU's) for the Wind River and tributaries during low, medium and high flows [11/28/95, 11/20/95 and 12/9/96], Skamania County, Washington.

State water quality standards do not define maximum levels of turbidity, but allow for 5% increases above "background" turbidity levels. The data presented here are primarily used to index turbidity levels during a range of flow conditions across major tributaries in the Wind River watershed, not to compare against state standards.

The data shows that during the high flow sampling period, Trout Creek, Panther Creek and Lower Wind River turbidity was 21, 23 and 30 times greater than the respective low flow turbidities. The average increase in turbidity for all measured tributaries at high flow was 15 times greater than low flow. The lowest increase in turbidity was recorded at Falls Creek with an increase of only three times greater than low flow. Because of the limited number of samples collected, it is important to note that this data may be more a reflection of very localized or short term inputs of sediment or disturbances in the stream channel than of broader scale or chronic erosion/sediment processes in the sub-watersheds where they were taken. Continued collection of turbidity data will hopefully begin to reinforce or discount the apparent spatial patterns in turbidity across the watershed and through a range of flows, and may help in establishing "background levels" for the watershed. Sediment sources in the sub-watersheds of interest appear to be a combination of natural and human-induced.

Substrate **-** Substrate composition determines the quantity and quality of aquatic habitat. When streams or watersheds are disturbed by fire, logging, or road construction, excess sediment can be delivered to the stream altering both the quantity and composition of the substrate. This shift in the sediment composition can directly and indirectly affect aquatic organisms by altering water quality, incubation, larval development, and juvenile rearing habitat.

McNeil Core Sediment samples were taken from the Wind River and seven tributaries to evaluate the quality of steelhead spawning habitat. Sediment cores were taken in areas where steelhead have historically spawned. To avoid risk of accidentally disturbing incubating eggs samples were taken in late summer or approximately six weeks after emergence. Samples were taken in reach one of Layout Creek and reach five of Trout Creek. Table XB provides a summary of the data.

Table 5. 1998 spawning substrate composition for the Wind River and tributaries, Skamania County, Washington.

Stream	***(>76.1-25mm) "Large"***	***(25.1-6.4mm) "Medium"***	***(6.3-1.7mm) "Small"***	***(<1.6mm) "Fines"***
Dry Cr.	41%	25%	20%	15%
Middle Wind R.	46%	22%	17%	14%
Panther Cr.	48%	23%	15%	14%
Trout Cr.	***46%***	***24%***	***16%***	***14%***
Martha Cr.	45%	24%	18%	12%
Upper Wind R.	42%	24%	20%	16%
Layout Cr.	***54%***	***27%***	***13%***	***7%***
Trapper Cr.	41%	32%	20%	7%
Paradise Cr.	46%	23%	18%	13%
Average	**45%**	**25%**	**17%**	**12%**

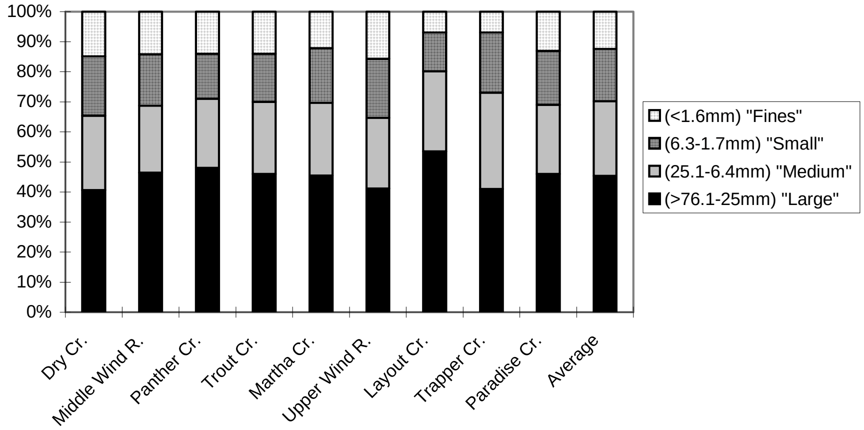


Figure 2. 1998 spawning substrate composition for the Wind River and tributaries, Skamania County Washington.

Layout Creek a heavily managed watershed and Trapper Creek a wilderness watershed contained the lowest percentage of fines (both 7%) of sampled tributaries. The Upper Wind River and Dry Creek contained the highest percentage of fines in spawning substrate; 16% and 15% respectively. This data consist of one year of sampling and is intended to be a reference relative to conditions found in other tributaries.

Based on substrate and water quality monitoring, baseline conditions for the sediment and substrate are: <10% fines (<1.6mm) and or Turbidity <20 NTU = Properly Functioning, 10-17% fines and or 20-30 NTU = Functioning at Risk, >17% fines and or >30 NTU = Not Properly Functioning.

Trout and Panther Creek, the Lower, Middle and Upper Wind all have relatively high turbidities and moderate percentages of fines found in spawning substrate and are therefore classified as Not Properly Functioning. Bear and Dry Creek have moderate turbidities and are classified as functioning at Risk. Falls Creek has extremely low turbidities and is characterized as Properly Functioning.

Table 6. Sediment and turbidity matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington.

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
Substrate (% fines < 1.6mm)	ND	ND	11%	14%	11%	ND	15%	14%
Turbidity (Max NTU)	107	26	46	39	25	4	35	46
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Chemical Contamination and Nutrients -The majority of agriculture within the Wind River has been in the form of timber management. The Wind River Nursery located along Trout Creek, farmed trees for reforestation from the early 1900's to 1997. There has been no known water quality monitoring within the watershed to detect pesticides or herbicides. Underwood Conservation District has evaluated the watershed for nitrate +, nitrite +, nitrogen, total phosphorus, fecal and total coliform. All test were barley above detection limits and could only be considered as "trace".

All sub-watersheds are considered to be ***Properly Functioning*** with respect to chemical and nutrient contamination.

Table 7. Chemical contamination and nutrients matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
Chemical contamination	PF	PF	PF	PF	PF	PF	PF	PF
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Habitat Access

Migration Barriers - The known migration impediments and barriers to fish passage are: Hemlock Dam on Trout Creek, Bear Creek municipal water diversion and culverts on Oldman and Youngman Creeks. Trout Creek and the Upper Wind, which contains Oldman and Youngman Creek, are considered *Not Properly Functioning.* Bear Creek is considered *Functioning at Risk* due to a waterfall at the mouth blocks anadromous access to the watershed. The municipal water diversion blocks resident rainbow up-stream migration in the lower two river miles above the falls.

Table 8. Migration barriers matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
Migration barriers	None	Falls/ Diversion	Dam	None	Falls	Falls	Culverts/ Falls	None
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Habitat Elements

Substrate - Refer to previous Water Quality, Sediment and Turbidity section for discussion. Baseline conditions for the substrate conditions within the Wind River are: <10% fines (<1.6mm) = ***Properly Functioning,*** 10-17% fines = ***Functioning at Risk,*** >17% fines = ***Not Properly Functioning.***

Table 6. Sediment and turbidity matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington.

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
Substrate (% fines < 1.6mm)	ND	ND	11%	14%	11%	ND	15%	14%
Turbidity (Max NTU)	107	26	46	39	25	4	35	46
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Large Woody Debris - Large woody debris, is defined in the PACFISH standards and guidelines as wood >12" in diameter, >50' in length. Large wood within a stream has both physical and biotic impacts on salmonid streams. The physical effect LWD has on streams includes changes in stability of stream banks and channels, storage of sediment, dissipation of stream energy, and alteration of channel flows (Bryant, 1983, Everest and Meehan 1981, Harmon et al 1986).

Large woody debris within undisturbed reaches of the Wind River watershed was evaluated to set the baseline conditions for properly functioning streams. Undisturbed reaches were evaluated with respect to Rosgen channel types to further refine criteria and are presented below:

Table 9. Range of LWD/mile by Rosgen Channel type for undisturbed reaches within the Wind River, Skamania County, Washington.

Rosgen Channel Type	Maximum LWD/Mile	Average LWD/Mile	Minimum LWD/Mile
A (N=13)	134	106	75
B (N=8)	124	101	76
C (N=11)	308	130	75

Table 10. Baseline conditions by channel type for LWD within the Wind River, Skamania County, Washington.

Rosgen Channel Type	Properly ***Functioning (Pieces/mile)***	Functioning ***At Risk (Pieces/mile)***	Not Properly ***Functioning (Pieces/mile)***
A	>106	75-106	<75
B	>101	76-101	<76
C	>130	75-130	<75

Stream clean-outs, riparian timber harvest have negatively impacted LWD within the majority of watersheds within the Wind River. Trout Creek, Dry Creek, Middle and Upper Wind River 6th field watersheds are ***Not Properly Functioning.*** Falls and Panther Creek watersheds fall within the lower range of natural variability and are ranked as ***Functioning at Risk.***

Table 11. In-stream large woody debris (LWD) matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington. (ranked via *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
LWD Pieces/River Mile	ND	ND	26	40	55	81	51	78
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Table 12. Large woody debris stream survey data for the Wind River and tributaries, Skamania County, Washington. (ranked via *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

Stream Name	River Miles	7th Field H20shed	LWD Condition Rating	LWD /mile >12" Diameter	Rosgen Channel Type
Trout Creek 6th field Watershed					
COMPASS CREEK, rm 1.7-2.1, 09 93	0.4	Crtr/Cmps	-1	36	A
CRATER CREEK, rm 1.5-1.8, 09 93	0.3	Crtr/Cmps	1	123	A
COMPASS CREEK, rm 1.1-1.7, 09 93	0.6	Crtr/Cmps	-1	29	A
CRATER CREEK, rm 1.1-1.5, 09 89	0.4	Crtr/Cmps	-1	35	A
CRATER CREEK, rm 1.5-1.9, 09 89	0.4	Crtr/Cmps	-1	42	A
CRATER CREEK, rm 0.8-1.1, 09 89	0.3	Crtr/Cmps	0	76	B
CRATER CREEK, rm 0.5-0.8, 09 89	0.3	Crtr/Cmps	-1	14	C
COMPASS CREEK, rm 1.5-2.4, 07 97	0.9	Crtr/Cmps	-1	65	B
CRATER CREEK, rm 0.0-0.3, 09 89	0.3	Crtr/Cmps	-1	61	C
COMPASS CREEK, rm 0.0-1.5, 07 97	1.5	Crtr/Cmps	-1	62	B
CRATER CREEK, rm 0.0-1.6, 07 96	1.6	Crtr/Cmps	0	78	D
CRATER CREEK, rm 0.3-0.5, 09 89	0.2	Crtr/Cmps	-1	54	C
CRATER CREEK, rm 0.0-1.5, 09 93	1.5	Crtr/Cmps	-1	63	A
COMPASS CREEK, rm 0.0-1.1, 09 93	1.1	Crtr/Cmps	-1	19	C
LAYOUT CK, rm 2.3-2.5, 09 91	0.2	Layout	0	87	A
LAYOUT CK, rm 0.0-1.9, 07 98	1.9	Layout	0	123	C
LAYOUT CK, rm 1.1-2.3, 09 91	1.2	Layout	0	99	B
LAYOUT CK, rm 1.9-2.5, 07 98	1.6	Layout	-1	42	B
LAYOUT CK, rm 0.0-1.1, 09 91	1.1	Layout	-1	51	C
LAYOUT CK, rm 1.9-2.5, 07 98	1.6	Layout	-1	38	C
SF PLANTING CK 09 92	0.5	Lower Trt	-1	62	A
PLANTING CK, rm 0.4-0.9, 09 92	0.5	Lower Trt	-1	25	A
TROUT CK, rm 2.8-4.6, 09 95	1.8	Lower Trt	-1	12	A
TROUT CK, rm 2.4-2.8, 09 95	0.4	Lower Trt	-1	31	B
SF PLANTING CK 09 92	0.5	Lower Trt	-1	0	B
PLANTING CK, rm 0.9-1.1, 09 92	0.2	Lower Trt	-1	11	A
TROUT CK, rm 1.8-2.4, 09 95	0.6	Lower Trt	-1	42	B
PLANTING CK, rm 0.0-0.4 09 92	0.4	Lower Trt	-1	71	B
PLANTING CK, rm 1.1-2.0, 09 92	0.9	Lower Trt	-1	70	B
TROUT CK, rm 8.7-9.4, 09 95	0.7	Lower Trt	-1	0	B
E FK TROUT CK, rm 0.6-0.8, 09 92	0.2	Upper Trt	1	227	G
E FK TROUT CK, rm 0.3-0.6, 09 92	0.3	Upper Trt	1	308	C
E FK TROUT CK, rm 0-0.3 09 92	0.3	Upper Trt	1	258	E
E FK TROUT CK, rm 0.0-0.8, 09 92	0.8	Upper Trt	-1	0	B
TROUT CK, rm 5.4-6.7, 07 96	1.3	Upper Trt	-1	4	B
TROUT CK, rm 6.8-8.7, 09 95	1.9	Upper Trt	-1	16	C
TROUT CK, rm 6.7-7.9, 07 96	1.2	Upper Trt	-1	38	C
TROUT CK, rm 7.9-9.4, 07 96	1.5	Upper Trt	-1	62	C
TROUT CK, rm 4.6-6.8, 09 95	2.2	Upper Trt	-1	9	C
		Average	*-1*	*63*	
Panther Creek 6th Field watershed					
MOUSE CK, rm 0.0-0.6, 09 94	0.6	Mouse	0	78	B
12 MILE CK, rm 0.0-0.5, 09 94	0.5	Upper Pnt	1	287	B
10 MILE, rm 0.0-0.8, 09 94	0.8	Upper Pnt	-1	63	C
PANTHER CK, rm 9.2-10.0, 09 94	0.8	Lower Pnt	1	108	A
PANTHER CK, rm 5.7-6.3, 09 94	0.6	Lower Pnt	-1	28	B
PANTHER CK, rm 6.3-6.9, 09 94	0.6	Lower Pnt	-1	32	C
PANTHER CK, rm 7.7-9.2, 09 94	1.5	Lower Pnt	0	77	B
PANTHER CK, rm 0.0-4.6, 09 94	4.6	Lower Pnt	-1	0	A
PANTHER CK, rm 6.9-7.7, 09 94	0.8	Lower Pnt	-1	14	B
PANTHER CK, rm 4.6-5.7, 09 94	1.1	Lower Pnt	-1	42	B
CEDAR CK, rm 1.3-2.5, 09 94	1.2	Cedar	1	122	A
CEDAR CK, rm 0.4-1.3, 09 94	0.9	Cedar			B
8 MILE CK, rm 0.0-0.8, 09 94	0.8	8 mile	-1	62	E
8 MILE CK, rm 0.8-1.3, 09 94	0.5	8 Mile	0	101	A
		Average	*0*	*78*	

Stream Name	River Miles	7th Field H20shed	LWD Condition Rating	LWD /mile >12" Diameter	Rosgen Channel Type
Dry Creek 6th Field watershed					
TRAPPER	4	Trapper	0	96	B
TRAPPER	5	Trapper	-1	39	B
TRAPPER	3	Trapper	-1	56	B
TRAPPER	1	Trapper	-1	53	C
TRAPPER	2	Trapper	-1	40	C
DRY CREEK, rm 3.4-3.8, 09 92	2	Dry Cr	0	110	C
DRY CREEK, rm 3.8-4.4, 09 92	3	Dry Cr	-1	1	G
DRY CREEK, rm 1.6-3.4, 09 92	1	Dry Cr	-1	48	C
		Average	*-1*	*55*	
Falls Creek 6th Field watershed					
FALLS CREEK, rm 6.0-9.5, 09 98	3.5	Upper Flls	-1	50	C
FALLS CREEK, rm 9.5-11.4, 09 98	1.9	Upper Flls	-1	42	B
FALLS CREEK, rm 2.9-6.0, 09 98	3.1	Lower Flls	1	156	B
FALLS CREEK, rm 1.6-2.9, 09 98	1.3	Lower Flls	1	180	B
FALLS CREEK, rm 0.6-1.6, 09 98	1	Lower Flls	-1	37	B
FALLS CREEK, rm 0.0-0.6, 09 98	0.6	Lower Flls	-1	22	B
		Average	*0*	*81*	
Upper Wind River 6th Field waters!					
OLDMAN CK, rm 0.0-1.1, 09 93	1.1	'Headwater	-1	18	B
YOUNGMAN CK, rm 0.0-0.9, 09 93	0.9	'Headwater	-1	71	B
YOUNGMAN CK, rm 0.9-1.7, 09 93	0.8	'Headwater	-1	54	A
OLDMAN CK, rm 1.6-2.1, 09 93	0.5	'Headwater	-1	2	B
OLDMAN CK, rm 1.1-1.6, 09 93	0.5	'Headwater	-1	2	A
UPPER WIND R, rm 27.9-28.5, 09 9	0.6	Headwater	1	156	A
UPPER WIND R, rm 25.3-27.0, 09 9	1.7	Headwater	1	167	A
UPPER WIND R, rm 28.5-29.0, 09 9	0.5	Headwater	0	122	A
UPPER WIND R, rm 27.0-27.9, 09 9	0.9	Headwater	-1	73	A
UPPER WIND R, rm 27.4-28.4, 07 9	1	Hdwtrs Wind	0	79	B
UPPER WIND R, rm 28.4-28.9, 07 9	0.5	Hdwtrs Wind	0	143	A
UPPER WIND R, rm 25.3-27.4, 07 9	2.1	Hdwtrs Wind	-1	71	B
UPPER WIND R, rm 28.9-29.7, 07 9	0.8	Hdwtrs Wind	-1	36	D
PETES GULCH CK II, rm 0.5-0.6, 09	0.1	Pete's	-1	0	E
PETES GULCH CK, rm 0.0-0.8, 09 9	0.8	Pete's	-1	11	A
PETES GULCH CK, rm 0.8-1.6, 09 9	0.8	Pete's	-1	7	A
PETES GULCH CK II, rm 0.0-0.5, 09	0.5	Pete's	-1	7	A
PARADISE CK, rm 1.0-2.3, 09 93	1.3	Paradise	0	75	B
PROVERBIAL CK, rm 0.0-1.5, 09 95	1.5	Paradise	-1	15	A
PROVERBIAL CK, rm 1.5-3.5, 09 95	2	Paradise	-1	11	B
PARADISE CK, rm 0.0-1.0, 09 93	1	Paradise	-1	63	C
UPPER WIND R, rm 22.0-25.3, 07 9	3.3	Upper Wind	-1	36	D
MIDDLE WIND, rm 22.0-24.4 09 93	2.4	Upper Wd	-1	2	B
MIDDLE WIND, rm 20.4-22.0, 09 93	1.6	Upper Wd	-1	8	C
		Average	*-1*	*51*	
Middle Wind River 6th Field waters					
MIDDLE WIND, rm 18.9-20.4, 09 93	1.4	Mid Wind	-1	4	D
UPPER WIND R, rm 23.7-25.3, 09 9	1.6	Mid Wind	0	111	C
MIDDLE WIND, rm 16.7-18.9, 09 93	1.2	Mid Wind	-1	6	D
		Average	*-1*	*40*	

NMFS Criteria	A Channels	B Channels	C Channels
PF = Properly Functioning	>106	>101	>130
FAR = Functioning at Risk	75-106	76-101	75-130
NPF = Not Properly Functioning	<75	<76	<75

Pool Character and Quality - Pool quantity (pools/mile) was based on the USDA Forest Service, Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin. The protocol evaluates pools per mile on a stream width basis. Pool quality was evaluated in the 1995 Wind River watershed analysis by analyzing pool surface area/maximum pool depth ratios by Rosgen Channel type and will be used here to establish the baseline criteria for this analysis.

Table 13. Pool Quantity criteria; USDA Forest Service, 1994. Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin.

Channel Width (feet)	Pools/Mile
5	184
10	96
15	70
20	56
25	47
50	26
75	23
100	18

Table 14. Range of pool quality (pool surface area/maximum pool depth) by Rosgen Channel type for undisturbed reaches within the Wind River, Skamania County, Washington.

Rosgen Channel Type	Maximum Pool Quality Ratio	Average Pool Quality Ratio
A (N=23)	58	51
B (N=24)	58	49
C (N=11)	69	57

Table 15. Baseline conditions by channel type for pool quality (pool surface area/maximum pool depth) within the Wind River, Skamania County, Washington.

Rosgen Channel Type	**Properly Functioning (Pool Quality Ratio)**	**Functioning At Risk (Pool Quality Ratio)**	**Not Properly Functioning (Pool Quality Ratio)**
A	<51	51-58	>58
B	<49	49-58	>58
C	<57	57-69	>57

The averages for pools/mile of all 6th field watersheds fell below the Forest Service criteria and were ranked *Not Properly Functioning* except Panther Creek, which on average met the pools/mile standard and was classified as *Properly Functioning*. When all pool quality ratios by stream reach were averaged, Trout, Dry, Falls, Upper Wind and Panther 6th field watersheds had moderate values and were ranked *Functioning at Risk.* While the numbers of pools per mile was low in the Middle Wind River watershed, the pools that did exist contained high quality habitat and were ranked as *Properly Functioning.*

Table 16. Average Pools/mile and pool quality (pool surface area/maximum pool depth) matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
Pool Surface Area/Volume Ratio	ND	ND	52	38	49	54	67	46
Pools/Mile	ND	ND	25	23	31	31	35	56
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Table 17. Pools/mile and pool quality (pool surface area/maximum pool depth) stream survey data, Wind River, Skamania County, Washington. (*NOAA Fisheries Pathways and Indicators Criteria)*

Trout Creek 6th field Watershed

Stream Name	River Miles	7th Field H20shed	PNW Standard Pools/Mile	Pools/Mile	Pool Quality Rating	Pool Area/ Volume Ratio	Rosgen Channel Type
COMPASS CREEK, rm 1.7-2.1, 09 93	0.4	Crtr/Cmps	75	17	1	30	A
CRATER CREEK, rm 1.5-1.8, 09 93	0.3	Crtr/Cmps	70	13	1	34	A
COMPASS CREEK, rm 1.1-1.7, 09 93	0.6	Crtr/Cmps	75	21	1	35	A
CRATER CREEK, rm 1.1-1.5, 09 89	0.4	Crtr/Cmps	70	25	1	36	A
CRATER CREEK, rm 1.5-1.9, 09 89	0.4	Crtr/Cmps	70	27	-1	67	A
CRATER CREEK, rm 0.8-1.1, 09 89	0.3	Crtr/Cmps	70	43	1	36	B
CRATER CREEK, rm 0.5-0.8, 09 89	0.3	Crtr/Cmps	70	32	1	33	C
COMPASS CREEK, rm 1.5-2.4, 07 97	0.9	Crtr/Cmps	75	23	-1	69	B
CRATER CREEK, rm 0.0-0.3, 09 89	0.3	Crtr/Cmps	70	34	0	67	C
COMPASS CREEK, rm 0.0-1.5, 07 97	1.5	Crtr/Cmps	75	46	-1	61	B
CRATER CREEK, rm 0.0-1.6, 07 96	1.6	Crtr/Cmps	70	49	0	45	D
CRATER CREEK, rm 0.3-0.5, 09 89	0.2	Crtr/Cmps	70	46	-1	95	C
CRATER CREEK, rm 0.0-1.5, 09 93	1.5	Crtr/Cmps	70	22	-1	71	A
COMPASS CREEK, rm 0.0-1.1, 09 93	1.1	Crtr/Cmps	75	38	0	65	C
LAYOUT CK, rm 2.3-2.5, 09 91	0.2	Layout	91	14	-1	65	A
LAYOUT CK, rm 0.0-1.9, 07 98	1.9	Layout	91	40	1		C
LAYOUT CK, rm 1.1-2.3, 09 91	1.2	Layout	91	45	-1	63	B
LAYOUT CK, rm 1.9-2.5, 07 98	1.6	Layout	91	49	-1	86	B
LAYOUT CK, rm 0.0-1.1, 09 91	1.1	Layout	91	33	0	67	C
LAYOUT CK, rm 1.9-2.5, 07 98	1.6	Layout	91	38	0	64	C
SF PLANTING CK 09 92	0.5	Lower Trt	114	0	1	23	A
PLANTING CK, rm 0.4-0.9, 09 92	0.5	Lower Trt	96	60	0	48	A
TROUT CK, rm 2.8-4.6, 09 95	1.8	Lower Trt	31	18	1	23	A
TROUT CK, rm 2.4-2.8, 09 95	0.4	Lower Trt	31	11			B
SF PLANTING CK 09 92	0.5	Lower Trt	114	0	0	45	B
PLANTING CK, rm 0.9-1.1, 09 92	0.2	Lower Trt	96	70	-1	91	A
TROUT CK, rm 1.8-2.4, 09 95	0.6	Lower Trt	31	29	1	25	B
PLANTING CK, rm 0.0-0.4 09 92	0.4	Lower Trt	96	47	0	49	B
PLANTING CK, rm 1.1-2.0, 09 92	0.9	Lower Trt	96	82	-1	63	B
TROUT CK, rm 8.7-9.4, 09 95	0.7	Lower Trt	39	28	1	37	B
E FK TROUT CK, rm 0.6-0.8, 09 92	0.2	Upper Trt	91	70	1	37	G
E FK TROUT CK, rm 0.3-0.6, 09 92	0.3	Upper Trt	91	30	0	64	C
E FK TROUT CK, rm 0-0.3 09 92	0.3	Upper Trt	91	63	0	58	E
E FK TROUT CK, rm 0.0-0.8, 09 92	0.8	Upper Trt	91	0			B
TROUT CK, rm 5.4-6.7, 07 96	1.3	Upper Trt	45	31	-1		B
TROUT CK, rm 6.8-8.7, 09 95	1.9	Upper Trt	52	24	1	34	C
TROUT CK, rm 6.7-7.9, 07 96	1.2	Upper Trt	52	25	-1		C
TROUT CK, rm 7.9-9.4, 07 96	1.5	Upper Trt	52	24	0	47	C
TROUT CK, rm 4.6-6.8, 09 95	2.2	Upper Trt	45	22	0	50	C
		Average	*74*	*33*	*0*	*52*	
Panther Creek 6th Field watershed							
MOUSE CK, rm 0.0-0.6, 09 94	0.6	Mouse	75	110	-1	63	B
12 MILE CK, rm 0.0-0.5, 09 94	0.5	Upper Pnt	80	53	0	42	B
10 MILE, rm 0.0-0.8, 09 94	0.8	Upper Pnt	91	112	0	52	C
PANTHER CK, rm 9.2-10.0, 09 94	0.8	Lower Pnt	44	36	1	27	A
PANTHER CK, rm 5.7-6.3, 09 94	0.6	Lower Pnt	43	21	1	25	B
PANTHER CK, rm 6.3-6.9, 09 94	0.6	Lower Pnt	38	30	1	22	C
PANTHER CK, rm 7.7-9.2, 09 94	1.5	Lower Pnt	34	34	1	28	B
PANTHER CK, rm 0.0-4.6, 09 94	4.6	Lower Pnt					A
PANTHER CK, rm 6.9-7.7, 09 94	0.8	Lower Pnt	44	33	1	34	B
PANTHER CK, rm 4.6-5.7, 09 94	1.1	Lower Pnt	43	18	1	26	B
CEDAR CK, rm 1.3-2.5, 09 94	1.2	Cedar	86	98	-1	72	A
CEDAR CK, rm 0.4-1.3, 09 94	0.9	Cedar	86	51	-1	73	B
8 MILE CK, rm 0.0-0.8, 09 94	0.8	8 mile	91	52	0	51	E
8 MILE CK, rm 0.8-1.3, 09 94	0.5	8 Mile	91	83	-1	79	A
		Average	*65*	*56*	*0*	*46*	

Dry Creek 6th Field watershed

Stream Name	River Miles	7th Field H20shed	PNW Standard Pools/Mile	Pools/Mile	Pool Quality Rating	Pool Area/ Volume Ratio	Rosgen Channel Type
TRAPPER	4	Trapper	56	7	1	36	B
TRAPPER	5	Trapper	56	4	1	36	B
TRAPPER	3	Trapper	70	15	0	49	B
TRAPPER	1	Trapper	70	17	0	57	C
TRAPPER	2	Trapper	75	23	0	57	C
DRY CREEK, rm 3.4-3.8, 09 92	2	Dry Cr	75	45	1	40	C
DRY CREEK, rm 3.8-4.4, 09 92	3	Dry Cr	91	50	0	56	G
DRY CREEK, rm 1.6-3.4, 09 92	1	Dry Cr	91	31	0	59	C
		Average	*73*	*24*	*0*	*49*	
Falls Creek 6th Field watershed							
FALLS CREEK, rm 6.0-9.5, 09 98	3.5	Upper Flls	64	29	0	63	C
FALLS CREEK, rm 9.5-11.4, 09 98	1.9	Upper Flls	62	34	-1	66	B
FALLS CREEK, rm 2.9-6.0, 09 98	3.1	Lower Flls	59	31	1		B
FALLS CREEK, rm 1.6-2.9, 09 98	1.3	Lower Flls	56	28	1		B
FALLS CREEK, rm 0.6-1.6, 09 98	1	Lower Flls	43	30	1	38	B
FALLS CREEK, rm 0.0-0.6, 09 98	0.6	Lower Flls	35	32	0	51	B
		Average	53	*31*	*0*	*54*	
Upper Wind River 6th Field watershed							
OLDMAN CK, rm 0.0-1.1, 09 93	1.1	'Headwate	114	18	0	49	B
YOUNGMAN CK, rm 0.0-0.9, 09 93	0.9	'Headwate	131	37	-1	80	B
YOUNGMAN CK, rm 0.9-1.7, 09 93	0.8	'Headwate	131	50	-1	89	A
OLDMAN CK, rm 1.6-2.1, 09 93	0.5	'Headwate	131	20	-1	120	B
OLDMAN CK, rm 1.1-1.6, 09 93	0.5	'Headwate	131	22	-1	89	A
UPPER WIND R, rm 27.9-28.5, 09 91	0.6	Headwate	47	14	-1	143	A
UPPER WIND R, rm 25.3-27.0, 09 91	1.7	Headwate	45	22	-1	95	A
UPPER WIND R, rm 28.5-29.0, 09 91	0.5	Headwate	44	12			A
UPPER WIND R, rm 27.0-27.9, 09 91	0.9	Headwate	43	25	-1	85	A
UPPER WIND R, rm 27.4-28.4, 07 96	1	Hdwtrs W	42	41	0	53	B
UPPER WIND R, rm 28.4-28.9, 07 96	0.5	Hdwtrs W	40	97	-1	81	A
UPPER WIND R, rm 25.3-27.4, 07 96	2.1	Hdwtrs W	35	39	0	49	B
UPPER WIND R, rm 28.9-29.7, 07 96	0.8	Hdwtrs W	35	42	1	44	D
PETES GULCH CK II, rm 0.5-0.6, 09 95	0.1	Pete's	91	75			E
PETES GULCH CK, rm 0.0-0.8, 09 95	0.8	Pete's	91	36	0	43	A
PETES GULCH CK, rm 0.8-1.6, 09 95	0.8	Pete's	91	31	1	24	A
PETES GULCH CK II, rm 0.0-0.5, 09 95	0.5	Pete's	91	26	0	51	A
PARADISE CK, rm 1.0-2.3, 09 93	1.3	Paradise	70	22	1	34	B
PROVERBIAL CK, rm 0.0-1.5, 09 95	1.5	Paradise	91	43	0	56	A
PROVERBIAL CK, rm 1.5-3.5, 09 95	2	Paradise	91	44	-1	87	B
PARADISE CK, rm 0.0-1.0, 09 93	1	Paradise	70	20	-1	83	C
UPPER WIND R, rm 22.0-25.3, 07 96	3.3	Upper Wi	32	25	-1		D
MIDDLE WIND, rm 22.0-24.4 09 93	2.4	Upper Wc	32	38	1	30	B
MIDDLE WIND, rm 20.4-22.0, 09 93	1.6	Upper Wc	32	34	1	33	C
		Average	*73*	*35*	*0*	*67*	
Middle Wind River 6th Field watershed							
MIDDLE WIND, rm 18.9-20.4, 09 93	1.4	Mid Wind	34	26	1	23	D
UPPER WIND R, rm 23.7-25.3, 09 91	1.6	Mid Wind	33	28	0	56	C
MIDDLE WIND, rm 16.7-18.9, 09 93	1.2	Mid Wind	31	15	1	35	D
		Average	*33*	*23*	1	*38*	

Pool Quality (Pool Area/Maximum pool Depth)

NMFS Criteria	A Channe	B Channe	C Channels
PF = Properly Functioning	<51	<49	<57
FAR = Functioning at Risk	51-58	49-58	57-69
NPF = Not Properly Functioning	>58	>58	>69

** PNW= Pacific Northwest Regional Standards for pools/mile based on low flow width.*

Off –channel Habitat - Off channel habitat provides juvenile salmonids with refuge from peak flows and predators and can compose a significant of juvenile rearing and foraging habitat for some species such as coho salmon use side channels and braids extensively for rearing. When logjams were removed in the mid to late 1970's channels "down-cut" or degraded dropping out of their flood plain and losing connectivity with many side channels and wetlands. Because streamside riparian zones along the main-stem of the Wind River and its major tributaries were readily accessible and often contained large, high value timber, many of these areas were logged over the past 40 years. Early logging of the watershed included development of railroads along much of valley following the main-stem of the Wind River, and subsequent roads, campgrounds, and other facilities have been constructed along streams, in valley bottoms, and through riparian areas.

Gifford Pinchot, Level II Stream Habitat Survey data (1990-1999), channel type and professional judgment were used to establish off channel habitat baseline criteria for this analysis. Watersheds with averages greater than 5% side channels were considered to be ***Properly Functioning,*** those with 4-5% side channels were ranked as ***Functioning at Risk,*** and those with less than 4% side channels were ranked ***Not Properly Functioning.*** Trout Creek and the Middle Wind River ranked ***Not Properly Functioning,*** The Upper Wind River and Panther Creek ranked out as ***Functioning at Risk*** and Dry and Falls Creek 6th field watersheds were characterized as ***Properly Functioning.***

Table 18. Off channel habitat and flood plain connectivity matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
Off channel habitat	ND	ND	3%	3%	7%	6%	5%	ND
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Refugia - Healthy riparian vegetation provides streams with shade, bank stability and LWD. The Regional Ecosystem Assessment Process (REAP) identified the "range of natural variability" for seral conditions in riparian areas across the Pacific Northwest. For the area including the Wind River watershed, the natural range of conditions in riparian areas is 5-30% for early seral vegetation and is 23-92% in late serial vegetation.
Refugia baseline criteria was based on the REAP criteria; riparian vegetation conditions; % riparian in early and late seral stages.

Table 19. Baseline conditions by channel type for riparian conditions (percent riparian within early and late seral stages) within the Wind River, Skamania County, Washington.

	Properly Functioning	**Functioning At Risk**	**Not Properly Functioning**
(% Riparian in Early seral)	<23%	23-33%	>33%
(% Riparian in Late seral)	≥40%	30-39%	<30%

The Lower Wind River, Bear, Dry, Falls and Panther were considered ***Properly Functioning,*** Middle and Upper Wind River were ranked as ***Functioning at Risk*** and Trout Creek was the only watershed that rated ***Not Properly Functioning.***

Table 20. Refugia matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
Disturbance history/ Refugia Rating	PF	PF	NPF	FAR	PF	PF	FAR	PF
% Riparian area within Early Seral	17%	9%	40%	24%	16%	22%	15%	15%
% Riparian Area within Late Seral	30%	40%	27%	33%	37%	34%	22%	47%
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Channel Conditions & Dynamics

Stream Width to Depth Ratios - When timber is harvested from riparian corridors, the stability of stream banks is decreased. This can substantially increase sediment delivery to streams and result in streams becoming wide and shallow (increased width to depth ratios). As width to depth ratios increase pools fill in with sediment. Fish depend on for foraging and refuge Increased width to depth ratios can indirectly affect fish and their habitat by fill. Bank sloughing or landslides deliver both coarse and fine particles of soil which increase suspended sediments and bed load. Bed load consists of the larger particles that roll or slide across the bottom of the stream bed. Each stream has evolved to transport a certain amount of sediment. If excess sediment enters a stream the channel must compensate or adjust to the new sediment load

Stream width to depth ratios are calculated by taking the bankfull or low channel widths divided by the average bankfull or low flow depths. These measurements are taken to evaluate the health of a stream. . Without adequate large living root wads and large in-stream woody debris, streams that contain banks composed of unconsolidated soil and gravel have little lateral resistance. An increase in sediment load displaces water within the channel placing even more pressure on the banks. This accelerates erosion, increases channel width, and reduces the depth. These actions produce a wide, shallow channel that has a large surface area exposed to the sun and can increase maximum water temperatures.

Width to depth ratios were evaluated and segregated by Rosgen Channel type in the 1995 Wind River watershed and will be used here to establish the baseline criteria for this analysis.

Table 21. Baseline conditions by channel type stream width to depth ratios within the Wind River, Skamania County, Washington.

NMFS Criteria	A Channels	B Channels	C Channels
PF = Properly Functioning	<8	<6	<7
FAR = Functioning at Risk	8-10	6-8	7-9
NPF = Not Properly Functioning	>10	>8	>9
ND = NO DATA			

Trout Creek and the middle Wind River were ranked as *Not Properly Functioning* and Dry, Panther and Upper Wind watersheds were rated as *Functioning at Risk.*

Table 22. Stream width to depth ratio matrix matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
W/D Ratio (Low Flow)	ND	ND	14	11	7	ND	8	7
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Table 23. Width to depth ratio stream survey data for the Wind River and tributaries, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

Stream Name	River Miles	7th Field H20shed	Low Flow W/D Ratio Condition Rating	Low Flow W/D Ratio	Rosgen Channel Type
Trout Creek 6th field Watershed					
COMPASS CREEK, rm 1.7-2.1, 09 93	0.4	Crtr/Cmps	1	2	A
CRATER CREEK, rm 1.5-1.8, 09 93	0.3	Crtr/Cmps	1	2	A
COMPASS CREEK, rm 1.1-1.7, 09 93	0.6	Crtr/Cmps	1	4	A
CRATER CREEK, rm 1.1-1.5, 09 89	0.4	Crtr/Cmps	0	9	A
CRATER CREEK, rm 1.5-1.9, 09 89	0.4	Crtr/Cmps	1	4	A
CRATER CREEK, rm 0.8-1.1, 09 89	0.3	Crtr/Cmps	1	5	B
CRATER CREEK, rm 0.5-0.8, 09 89	0.3	Crtr/Cmps	1	5	C
COMPASS CREEK, rm 1.5-2.4, 07 97	0.9	Crtr/Cmps			B
CRATER CREEK, rm 0.0-0.3, 09 89	0.3	Crtr/Cmps	-1	13	C
COMPASS CREEK, rm 0.0-1.5, 07 97	1.5	Crtr/Cmps	-1	18	B
CRATER CREEK, rm 0.0-1.6, 07 96	1.6	Crtr/Cmps	-1	15	D
CRATER CREEK, rm 0.3-0.5, 09 89	0.2	Crtr/Cmps	0	9	C
CRATER CREEK, rm 0.0-1.5, 09 93	1.5	Crtr/Cmps	0	9	A
COMPASS CREEK, rm 0.0-1.1, 09 93	1.1	Crtr/Cmps	0	9	C
LAYOUT CK, rm 2.3-2.5, 09 91	0.2	Layout			A
LAYOUT CK, rm 0.0-1.9, 07 98	1.9	Layout	-1	23	C
LAYOUT CK, rm 1.1-2.3, 09 91	1.2	Layout	-1	10	B
LAYOUT CK, rm 1.9-2.5, 07 98	1.6	Layout	-1	11	B
LAYOUT CK, rm 0.0-1.1, 09 91	1.1	Layout	-1	11	C
LAYOUT CK, rm 1.9-2.5, 07 98	1.6	Layout	-1	17	C
SF PLANTING CK 09 92	0.5	Lower Trt	1	1	A
PLANTING CK, rm 0.4-0.9, 09 92	0.5	Lower Trt	1	4	A
TROUT CK, rm 2.8-4.6, 09 95	1.8	Lower Trt	1	7	A
TROUT CK, rm 2.4-2.8, 09 95	0.4	Lower Trt			B
SF PLANTING CK 09 92	0.5	Lower Trt	1	3	B
PLANTING CK, rm 0.9-1.1, 09 92	0.2	Lower Trt	-1	10	A
TROUT CK, rm 1.8-2.4, 09 95	0.6	Lower Trt	0	8	B
PLANTING CK, rm 0.0-0.4 09 92	0.4	Lower Trt	1	5	B
PLANTING CK, rm 1.1-2.0, 09 92	0.9	Lower Trt	1	4	B
TROUT CK, rm 8.7-9.4, 09 95	0.7	Lower Trt	-1	10	B
E FK TROUT CK, rm 0.6-0.8, 09 92	0.2	Upper Trt	1	4	G
E FK TROUT CK, rm 0.3-0.6, 09 92	0.3	Upper Trt	1	4	C
E FK TROUT CK, rm 0-0.3 09 92	0.3	Upper Trt	0	7	E
E FK TROUT CK, rm 0.0-0.8, 09 92	0.8	Upper Trt			B
TROUT CK, rm 5.4-6.7, 07 96	1.3	Upper Trt	-1	17	B
TROUT CK, rm 6.8-8.7, 09 95	1.9	Upper Trt	1	6	C
TROUT CK, rm 6.7-7.9, 07 96	1.2	Upper Trt	-1	17	C
TROUT CK, rm 7.9-9.4, 07 96	1.5	Upper Trt	-1	19	C
TROUT CK, rm 4.6-6.8, 09 95	2.2	Upper Trt	-1	13	C
		Average	*0*	*9*	
Panther Creek 6th Field watershed					
MOUSE CK, rm 0.0-0.6, 09 94	0.6	Mouse	0	8	B
12 MILE CK, rm 0.0-0.5, 09 94	0.5	Upper Pnt	1	3	B
10 MILE, rm 0.0-0.8, 09 94	0.8	Upper Pnt	0	5	C
PANTHER CK, rm 9.2-10.0, 09 94	0.8	Lower Pnt	0	6	A
PANTHER CK, rm 5.7-6.3, 09 94	0.6	Lower Pnt	-1	11	B
PANTHER CK, rm 6.3-6.9, 09 94	0.6	Lower Pnt	0	8	C
PANTHER CK, rm 7.7-9.2, 09 94	1.5	Lower Pnt	0	8	B
PANTHER CK, rm 0.0-4.6, 09 94	4.6	Lower Pnt	1	0	A
PANTHER CK, rm 6.9-7.7, 09 94	0.8	Lower Pnt	-1	10	B
PANTHER CK, rm 4.6-5.7, 09 94	1.1	Lower Pnt	0	9	B
CEDAR CK, rm 1.3-2.5, 09 94	1.2	Cedar	0	8	A
CEDAR CK, rm 0.4-1.3, 09 94	0.9	Cedar	-1	9	B
8 MILE CK, rm 0.0-0.8, 09 94	0.8	8 mile	0	4	E
8 MILE CK, rm 0.8-1.3, 09 94	0.5	8 Mile	-1	9	A
		Average	*0*	*7*	

Stream Name	River Miles	7th Field H20shed	Low Flow W/D Ratio Condition Rating	Low Flow W/D Ratio	Rosgen Channel Type
Dry Creek 6th Field watershed					
TRAPPER	4	Trapper	0	5	B
TRAPPER	5	Trapper	0	5	B
TRAPPER	3	Trapper	0	9	B
TRAPPER	1	Trapper	0	8	C
TRAPPER	2	Trapper	-1	16	C
DRY CREEK, rm 3.4-3.8, 09 92	2	Dry Cr	0	7	C
DRY CREEK, rm 3.8-4.4, 09 92	3	Dry Cr	1	1	G
DRY CREEK, rm 1.6-3.4, 09 92	1	Dry Cr	-1	10	C
		Average	*1*	*7*	
Falls Creek 6th Field watershed					
FALLS CREEK, rm 6.0-9.5, 09 98	3.5	Upper Flls			C
FALLS CREEK, rm 9.5-11.4, 09 98	1.9	Upper Flls			B
FALLS CREEK, rm 2.9-6.0, 09 98	3.1	Lower Flls			B
FALLS CREEK, rm 1.6-2.9, 09 98	1.3	Lower Flls			B
FALLS CREEK, rm 0.6-1.6, 09 98	1	Lower Flls			B
FALLS CREEK, rm 0.0-0.6, 09 98	0.6	Lower Flls			B
		Average			
Upper Wind River 6th Field waters!					
OLDMAN CK, rm 0.0-1.1, 09 93	1.1	'Headwater	1	3	B
YOUNGMAN CK, rm 0.0-0.9, 09 93	0.9	'Headwater	0	6	B
YOUNGMAN CK, rm 0.9-1.7, 09 93	0.8	'Headwater	1	4	A
OLDMAN CK, rm 1.6-2.1, 09 93	0.5	'Headwater	0	4	B
OLDMAN CK, rm 1.1-1.6, 09 93	0.5	'Headwater	0	4	A
UPPER WIND R, rm 27.9-28.5, 09 9	0.6	Headwater	-1	15	A
UPPER WIND R, rm 25.3-27.0, 09 9	1.7	Headwater	-1	15	A
UPPER WIND R, rm 28.5-29.0, 09 9	0.5	Headwater			A
UPPER WIND R, rm 27.0-27.9, 09 9	0.9	Headwater	-1	14	A
UPPER WIND R, rm 27.4-28.4, 07 9	1	Hdwtrs Wind	0	9	B
UPPER WIND R, rm 28.4-28.9, 07 9	0.5	Hdwtrs Wind	0	5	A
UPPER WIND R, rm 25.3-27.4, 07 9	2.1	Hdwtrs Wind	-1	14	B
UPPER WIND R, rm 28.9-29.7, 07 9	0.8	Hdwtrs Wind	0	9	D
PETES GULCH CK II, rm 0.5-0.6, 09	0.1	Pete's			E
PETES GULCH CK, rm 0.0-0.8, 09 9	0.8	Pete's	1	4	A
PETES GULCH CK, rm 0.8-1.6, 09 9	0.8	Pete's	0	5	A
PETES GULCH CK II, rm 0.0-0.5, 09	0.5	Pete's	0	7	A
PARADISE CK, rm 1.0-2.3, 09 93	1.3	Paradise	0	6	B
PROVERBIAL CK, rm 0.0-1.5, 09 95	1.5	Paradise	0	7	A
PROVERBIAL CK, rm 1.5-3.5, 09 95	2	Paradise	0	7	B
PARADISE CK, rm 0.0-1.0, 09 93	1	Paradise	-1	16	C
UPPER WIND R, rm 22.0-25.3, 07 9	3.3	Upper Wind	-1	19	D
MIDDLE WIND, rm 22.0-24.4 09 93	2.4	Upper Wd	0	6	B
MIDDLE WIND, rm 20.4-22.0, 09 93	1.6	Upper Wd	0	7	C
		Average	*0*	*8*	
Middle Wind River 6th Field waters					
MIDDLE WIND, rm 18.9-20.4, 09 93	1.4	Mid Wind	-1	10	D
UPPER WIND R, rm 23.7-25.3, 09 9	1.6	Mid Wind	-1	11	C
MIDDLE WIND, rm 16.7-18.9, 09 93	1.2	Mid Wind	-1	13	D
		Average	-1	11	

NMFS Criteria	A Channels	B Channels	C Channels
PF = Properly Functioning	<8	<6	<7
FAR = Functioning at Risk	8-10	6-8	7-9
NPF = Not Properly Functioning	>10	>8	>9
ND = NO DATA			

<u>Channel Stability, Stream Bank Conditions and Floodplain Connectivity</u> - Bank erosion and channel stability can significantly affect fish habitat and water quality by filling in pools with fine and coarse sediment, increasing the stream width and decreasing depth, increasing turbidity and fine sediment deposition in substrates.

The Pfankuch stability rating has been used in part to evaluate channel and bank stability. This systematic procedure developed by Pfankuch was used to evaluate the resistive capacity of stream channels to the detachment of bed and bank materials and provides information about the streams capacity to adjust and recover from changes in flows and increases in sediment production. The variables associated with evaluating channel stability are: land form, mass wasting, LWD, vegetative bank protection, width to depth ratios, bank erosion, substrate type and aquatic vegetation (Pfankuch, 1978).

Accurate flood plain and bank stability data was not available for most streams within the Wind River therefore qualitative Pfankuch surveys were used as a surrogate. Table 24 established baseline criteria for channel and bank stability.

Table 24. Baseline conditions for floodplain connectivity, bank and channel stability by channel type within the Wind River, Skamania County, Washington.

NMFS Criteria	A Channels	B Channels	C Channels
PF = Properly Functioning	<76	<73	<90
FAR = Functioning at Risk	76-85	73-68	90-98
NPF = Not Properly Functioning	>85	>73	>98
ND = NO DATA			

The Lower Wind River and Falls Creek are generally bedrock controlled systems and were considered *Properly Functioning,* The alluvial reaches of Panther Creek produced moderate Pfanchuck ratings and was therefore ranked as *Functioning at Risk.* Trout, Middle Wind, Dry and Upper Wind alluvial reaches have poor bank and channel stability and were rated *Not Properly Functioning.*

Table 25. Channel Stability, stream bank conditions and floodplain connectivity matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

6th Field Watershed	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
Channel Stability and Streambank conditions	PF	ND	NPF	NPF	NPF	PF	NPF	FAR
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

Table 26. Pfankuch channel Stability and stream bank conditions stream survey data for the Wind River and tributaries, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

Stream Name	River Miles	7th Field H20shed	Channel Stability Rating	Phanchuk Channel Stability	Rosgen Channel Type
Trout Creek 6th field Watershed					
COMPASS CREEK, rm 1.7-2.1, 09 93	0.4	Crtr/Cmps	0	70	A
CRATER CREEK, rm 1.5-1.8, 09 93	0.3	Crtr/Cmps			A
COMPASS CREEK, rm 1.1-1.7, 09 93	0.6	Crtr/Cmps	0	75	A
CRATER CREEK, rm 1.1-1.5, 09 89	0.4	Crtr/Cmps	1	53	A
CRATER CREEK, rm 1.5-1.9, 09 89	0.4	Crtr/Cmps	0	73	A
CRATER CREEK, rm 0.8-1.1, 09 89	0.3	Crtr/Cmps	-1	83	B
CRATER CREEK, rm 0.5-0.8, 09 89	0.3	Crtr/Cmps	0	83	C
COMPASS CREEK, rm 1.5-2.4, 07 97	0.9	Crtr/Cmps			B
CRATER CREEK, rm 0.0-0.3, 09 89	0.3	Crtr/Cmps	0	91	C
COMPASS CREEK, rm 0.0-1.5, 07 97	1.5	Crtr/Cmps			B
CRATER CREEK, rm 0.0-1.6, 07 96	1.6	Crtr/Cmps	-1	76	D
CRATER CREEK, rm 0.3-0.5, 09 89	0.2	Crtr/Cmps	-1	115	C
CRATER CREEK, rm 0.0-1.5, 09 93	1.5	Crtr/Cmps			A
COMPASS CREEK, rm 0.0-1.1, 09 93	1.1	Crtr/Cmps	-1	100	C
LAYOUT CK, rm 2.3-2.5, 09 91	0.2	Layout	1	62	A
LAYOUT CK, rm 0.0-1.9, 07 98	1.9	Layout	0	83	C
LAYOUT CK, rm 1.1-2.3, 09 91	1.2	Layout	1	55	B
LAYOUT CK, rm 1.9-2.5, 07 98	1.6	Layout	0	66	B
LAYOUT CK, rm 0.0-1.1, 09 91	1.1	Layout	-1	124	C
LAYOUT CK, rm 1.9-2.5, 07 98	1.6	Layout	1	62	C
SF PLANTING CK 09 92	0.5	Lower Trt			A
PLANTING CK, rm 0.4-0.9, 09 92	0.5	Lower Trt	1	58	A
TROUT CK, rm 2.8-4.6, 09 95	1.8	Lower Trt	1	48	A
TROUT CK, rm 2.4-2.8, 09 95	0.4	Lower Trt	1	51	B
SF PLANTING CK 09 92	0.5	Lower Trt			B
PLANTING CK, rm 0.9-1.1, 09 92	0.2	Lower Trt	1	58	A
TROUT CK, rm 1.8-2.4, 09 95	0.6	Lower Trt	-1	75	B
PLANTING CK, rm 0.0-0.4 09 92	0.4	Lower Trt	0	72	B
PLANTING CK, rm 1.1-2.0, 09 92	0.9	Lower Trt	-1	104	B
TROUT CK, rm 8.7-9.4, 09 95	0.7	Lower Trt	-1	74	B
E FK TROUT CK, rm 0.6-0.8, 09 92	0.2	Upper Trt	1	77	G
E FK TROUT CK, rm 0.3-0.6, 09 92	0.3	Upper Trt	1	75	C
E FK TROUT CK, rm 0-0.3 09 92	0.3	Upper Trt	1	67	E
E FK TROUT CK, rm 0.0-0.8, 09 92	0.8	Upper Trt	1	62	B
TROUT CK, rm 5.4-6.7, 07 96	1.3	Upper Trt	1	65	B
TROUT CK, rm 6.8-8.7, 09 95	1.9	Upper Trt	-1	113	C
TROUT CK, rm 6.7-7.9, 07 96	1.2	Upper Trt	-1	117	C
TROUT CK, rm 7.9-9.4, 07 96	1.5	Upper Trt	-1	122	C
TROUT CK, rm 4.6-6.8, 09 95	2.2	Upper Trt	-1	108	C
		Average	*0*	*79*	
Panther Creek 6th Field watershed					
MOUSE CK, rm 0.0-0.6, 09 94	0.6	Mouse	0	70	B
12 MILE CK, rm 0.0-0.5, 09 94	0.5	Upper Pnt	1	74	B
10 MILE, rm 0.0-0.8, 09 94	0.8	Upper Pnt	1	96	C
PANTHER CK, rm 9.2-10.0, 09 94	0.8	Lower Pnt	1	44	A
PANTHER CK, rm 5.7-6.3, 09 94	0.6	Lower Pnt	1	91	B
PANTHER CK, rm 6.3-6.9, 09 94	0.6	Lower Pnt	0	90	C
PANTHER CK, rm 7.7-9.2, 09 94	1.5	Lower Pnt	-1	77	B
PANTHER CK, rm 0.0-4.6, 09 94	4.6	Lower Pnt			A
PANTHER CK, rm 6.9-7.7, 09 94	0.8	Lower Pnt	-1	84	B
PANTHER CK, rm 4.6-5.7, 09 94	1.1	Lower Pnt	-1	97	B
CEDAR CK, rm 1.3-2.5, 09 94	1.2	Cedar	0	79	A
CEDAR CK, rm 0.4-1.3, 09 94	0.9	Cedar	-1	78	B
8 MILE CK, rm 0.0-0.8, 09 94	0.8	8 mile	1	77	E
8 MILE CK, rm 0.8-1.3, 09 94	0.5	8 Mile	1	52	A
		Average	*0*	*78*	

Stream Name	River Miles	7th Field H20shed	Channel Stability Rating	Phanchuk Channel Stability	Rosgen Channel Type
Dry Creek 6th Field watershed					
TRAPPER	4	Trapper	1	51	B
TRAPPER	5	Trapper	1	51	B
TRAPPER	3	Trapper	1	58	B
TRAPPER	1	Trapper	1	61	C
TRAPPER	2	Trapper	1	53	C
DRY CREEK, rm 3.4-3.8, 09 92	2	Dry Cr	0	81	C
DRY CREEK, rm 3.8-4.4, 09 92	3	Dry Cr	0	76	G
DRY CREEK, rm 1.6-3.4, 09 92	1	Dry Cr	0	87	C
		Average	*1*	*65*	
Falls Creek 6th Field watershed					
FALLS CREEK, rm 6.0-9.5, 09 98	3.5	Upper Flls	0	50	C
FALLS CREEK, rm 9.5-11.4, 09 98	1.9	Upper Flls	1	44	B
FALLS CREEK, rm 2.9-6.0, 09 98	3.1	Lower Flls	1	69	B
FALLS CREEK, rm 1.6-2.9, 09 98	1.3	Lower Flls	1	71	B
FALLS CREEK, rm 0.6-1.6, 09 98	1	Lower Flls	1	63	B
FALLS CREEK, rm 0.0-0.6, 09 98	0.6	Lower Flls	1	66	B
		Average	*1*	*61*	
Upper Wind River 6th Field waters!					
OLDMAN CK, rm 0.0-1.1, 09 93	1.1	'Headwater	0		B
YOUNGMAN CK, rm 0.0-0.9, 09 93	0.9	'Headwater	-1	91	B
YOUNGMAN CK, rm 0.9-1.7, 09 93	0.8	'Headwater	-1	85	A
OLDMAN CK, rm 1.6-2.1, 09 93	0.5	'Headwater	-1		B
OLDMAN CK, rm 1.1-1.6, 09 93	0.5	'Headwater	-1		A
UPPER WIND R, rm 27.9-28.5, 09 9	0.6	Headwater	1	59	A
UPPER WIND R, rm 25.3-27.0, 09 9	1.7	Headwater	1	69	A
UPPER WIND R, rm 28.5-29.0, 09 9	0.5	Headwater	-1	83	A
UPPER WIND R, rm 27.0-27.9, 09 9	0.9	Headwater	1	66	A
UPPER WIND R, rm 27.4-28.4, 07 9	1	Hdwtrs Wind	0	52	B
UPPER WIND R, rm 28.4-28.9, 07 9	0.5	Hdwtrs Wind	0	46	A
UPPER WIND R, rm 25.3-27.4, 07 9	2.1	Hdwtrs Wind	-1	100	B
UPPER WIND R, rm 28.9-29.7, 07 9	0.8	Hdwtrs Wind	-1	87	D
PETES GULCH CK II, rm 0.5-0.6, 09	0.1	Pete's	1	85	E
PETES GULCH CK, rm 0.0-0.8, 09 9	0.8	Pete's	-1	86	A
PETES GULCH CK, rm 0.8-1.6, 09 9	0.8	Pete's	0	79	A
PETES GULCH CK II, rm 0.0-0.5, 09	0.5	Pete's	0	83	A
PARADISE CK, rm 1.0-2.3, 09 93	1.3	Paradise	1	53	B
PROVERBIAL CK, rm 0.0-1.5, 09 95	1.5	Paradise	0	67	A
PROVERBIAL CK, rm 1.5-3.5, 09 95	2	Paradise	-1	103	B
PARADISE CK, rm 0.0-1.0, 09 93	1	Paradise	0	82	C
UPPER WIND R, rm 22.0-25.3, 07 9	3.3	Upper Wind	-1	122	D
MIDDLE WIND, rm 22.0-24.4 09 93	2.4	Upper Wd	-1	134	B
MIDDLE WIND, rm 20.4-22.0, 09 93	1.6	Upper Wd	-1	103	C
		Average	*0*	*83*	
Middle Wind River 6th Field waters					
MIDDLE WIND, rm 18.9-20.4, 09 93	1.4	Mid Wind	0	87	D
UPPER WIND R, rm 23.7-25.3, 09 9	1.6	Mid Wind	-1	141	C
MIDDLE WIND, rm 16.7-18.9, 09 93	1.2	Mid Wind	-1	98	D
		Average	-1	*109*	

NMFS Criteria	A Channels	B Channels	C Channels
PF = Properly Functioning	<76	<73	<90
FAR = Functioning at Risk	76-85	73-68	90-98
NPF = Not Properly Functioning	>85	>73	>98
ND = NO DATA			

Flow/Hydrology and Watershed Condtions

Peak flows, Road Density, Drainage Network and Riparian Reserves - Changes in peak flows can have significant impacts on salmonid habitat and life histories.
Up-slope timber harvest within the rain on snow zone can indirectly affect stream channels and fish habitat by increasing peak flows, erosion and sedimentation.

The following table details the criteria used to establish baseline values for **Aggregate Recovery Percentage *ARP,* Drainage Network Increase, Road Density and Riparian conditions.**

Table 27. Baseline criteria for Flow/Hydrology and Watershed Condtions (Aggregate Recovery Percentage *ARP,* Drainage Network Increase, Road Density and Riparian conditions), Wind River, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

NMFS Matrix and Pathways Criteria	*Properly Functioning*	*Functioning at Risk*	*Not Properly Functioning*
ARP	>80	70-80	<70
Drainage network Increase	<10%	10-20%	>20%
Road density (Mile/Mile^2)	<2	2-3	>3
% Riparian area within Early Seral	<23%	23-33%	>33%
% Riparian Area within Late Seral	>40	30-40%	<30%

Due to the high percentage of drainage network increases, road densities, Aggregate Recovery Percentages, percentage of watershed in rain-on-snow and riparian conditions, Trout Creek was ranked as *Not Properly Functioning.* Panther Creek and the Lower, Middle and Upper Wind River sub-watersheds were ranked as *Functioning at Risk* and Dry, Bear and Falls Creek were rated as *Properly Functioning.*

Table 28. Peak Flow matrix for 6th and 7th field watersheds, Wind River, Skamania County, Washington. (Based on: *NOAA Fisheries Pathways and Indicators Criteria for threatened and endangered species)*

NMFS Matrix and Pathways Criteria	Lower Wind	Bear	Trout	Middle Wind	Dry	Falls	Upper Wind	Panther
% Watershed in Rain on Snow	33%	71%	85%	59%	78%	70%	84%	72%
ARP	92	95	85	87	94	82	82	85
Drainage network Increase	41%	12%	31%	30%	10%	24%	29%	23%
Road density	2.9	1.4	2.4	2.6	1.1	1.6	2.2	2.2
% Riparian area within Early Seral	17%	9%	40%	24%	16%	22%	15%	15%
% Riparian Area within Late Seral	30%	40%	27%	33%	37%	34%	22%	47%
	Little Wind	L Bear	L Trout	Middle Wind	Dry	U Falls	Upper Wind	L Panther
7th Field Sub-watersheds	Brush	NF Bear	Layout	Nine Mile	Trapper	L Falls	Paradise	Eight-Mile
	L Wind	EF Bear	Upper Trout				Pete's Gulch	U Panther
			Compass / Crater				Headwaters Wind	Cedar
PF = Properly Functioning								Mouse
FAR = Functioning at Risk								
NPF = Not Properly Functioning								
ND = NO DATA								

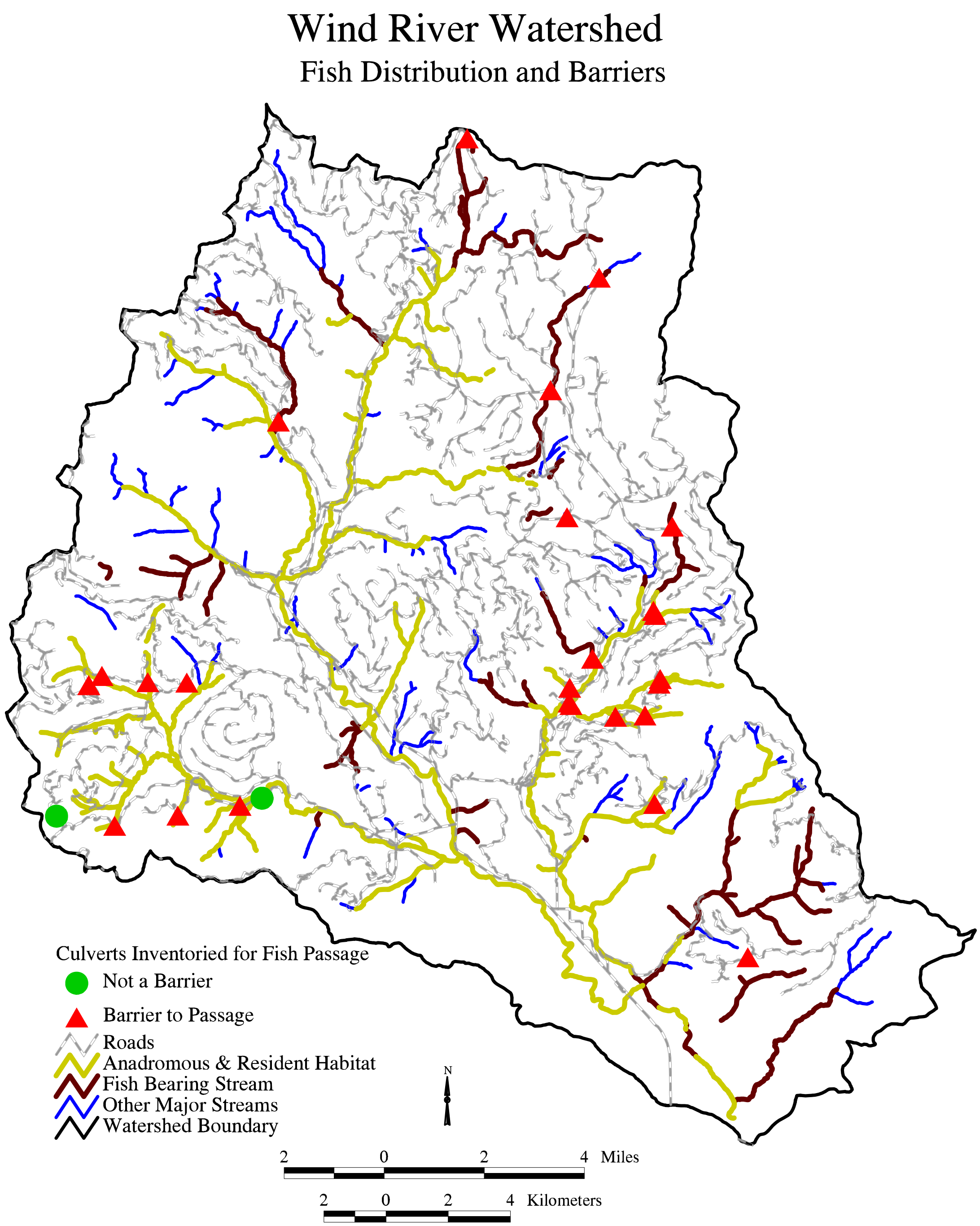


Figure 3. Known fish distribution in Wind River Watershed.

Little White Salmon River (HUC#1707010511)

Effects Analysis

The Little White Salmon River (LWSR) watershed encompasses 86,460 acres of which the Forest Service manages 68,660 acres. The watershed area includes all tributary drainages to the Little White Salmon River, plus the area that drains into the Big Lava Bed. The Big Lava Bed is a relatively young flow (8000 years old), runs a length of approximately 10 miles, and covers 16,000 acres of the watershed. Subwatersheds that drain into the Big Lava Bed include: 11 01 and 11 02. All the streams from these subwatersheds go subterranean at the Lava Bed, have no above surface connection to the Little White Salmon River, and have had none for at least the past 8000 years. Due to this 10 mile migration block, anadromous forms of coastal cutthroat or steelhead have not been physically able to migrate into the subwatersheds above the Lava Bed for at least the past 8000 years. Subwatershed 05 and part of 04 are not included in this assessment since they lie private land.

Historically fall and spring chinook, chum salmon, and coho were all present in the first 1.9 miles of the river up to a 38-foot barrier falls. Hatchery reared spring and fall chinook, coho, steelhead, and other strays from the Columbia River are present in Drano Lake, which lies adjacent to the Columbia River. In 1896 the Little White Salmon National Fish Hatchery was established at river mile 1.6 to supplement the run of tule fall chinook salmon. A migration barrier dam currently exists at the hatchery (at Drano Lake), and the 38-foot waterfall barrier is located just upstream at river mile 1.9. These barriers make it impassible for all upstream anadromous fish migration. The Forest boundary is located approximately 6.6 miles upstream from Drano Lake, 5 miles from the first migration barrier.

The Little White Salmon River is stocked every year with legal size rainbow and eastern brook trout. Records show this river has been stocked since 1914. Cutthroat trout were also stocked intermittently in the past. Most of the tributaries to the river are fish bearing due to low stream gradients that allow for upstream migration from the river, although several culvert migration barriers exist on tributary streams today. Rainbow, eastern brook, cutthroat, and brown trout are stocked in lakes in the watershed. All of the lake tributaries eventually drain into the Lava Bed, therefore fish stocked in these lakes which out migrate never reach the Little White Salmon River. No steelhead are present in the watershed due to the migration barriers mentioned above. This watershed is considered a "*No Effect*" area for steelhead.

No cutthroat trout have been found in the recent past in the Little White Salmon River. A presence/absence population survey was conducted in 1994 on the mainstem Little White Salmon River. Only rainbow and brook trout were captured. Extensive fish sampling which included auger trapping, electroshocking, minnow trapping, and seining, was done by the USGS Western Fisheries Research Center in 1997, 1998, 2000, and 2001 in the Little White Salmon River from Willard to the Okalahoma campground. During this sampling effort only rainbow and brook trout were found.

Although no coastal cutthroat are known to inhabit the watershed, population surveys to date have not been comprehensive enough to rule out the possibility a remnant resident population may exist. In the event coastal cutthroat are determined to be absent only in the subwatersheds above the Lava Bed (11 01 and 11 02), these subwatersheds would also be considered "*No Effect*" areas for coastal cutthroat since no downstream effects would occur due to the buffering of the Lava Bed.

Fish species known to currently inhabit the watershed include rainbow and eastern brook trout. Fish-bearing streams include: Goose Lake tributaries (Goose Lake Creek, Spring Creek), Lost Creek, South Prairie Lake tributaries, Lava Creek, Lusk Creek, West Fork Lusk Creek, the Little White Salmon River, Beetle Creek, Homes Creek, Berry Creek, Lava Creek, Moss Creek, and Cabbage Creek.

The environmental baseline for the **Little White Salmon River 5th Field Watershed** is summarized in Table 1. The baseline condition is determined for the entire 5th field watershed. Stream survey data is used to determine the ratings for several indicators. Streams which have been surveyed include: Berry Creek, North Fork Berry Creek, Goose Lake Creek tributaries, Homes Creek, Lava Creek, the Little White Salmon River, Lost Creek, Lusk Creek, Moss Creek, and South Prairie Lake tributaries. The major fish bearing streams which have not been surveyed include: West Fork Lusk Creek, Beetle Creek, and Cabbage Creek.

Baseline determinations for specific indicators were determined using findings from watershed analysis (with 2002 data updates), stream survey and monitoring data, practical knowledge of conditions of the ground from field reconnaissance, and professional judgment as needed. Rational for determinations of individual indicators is provided.

Table 1. Environmental Baseline Summary the Little White Salmon River Watershed.

DIAGNOSTICS/PATHWAYS: INDICATORS	ENVIRONMENTAL BASELINE		
	Functioning Appropriately	Functioning At Risk	Functioning at Unacceptable Risk
Subpopulation Characteristics: Subpopulation Size	unknown	unknown	unknown
Growth and Survival	unknown	unknown	unknown
Life History Diversity and Isolation	unknown	unknown	unknown
Persistence and Genetic Integrity	unknown	unknown	unknown
Water Quality: Temperature (cutthroat and bull trout)			*MON, WA*
Sediment			*WA*
Chem. Contam./Nutrients	*WA, MON*		
Habitat Access: Physical Barriers			*SS, WA*
Habitat Elements: Substrate Embeddedness			*SS, WA*
Large Woody Debris			*SS*
Pool Frequency and Quality (cutthroat and bull trout)			*SS*
Large Pools			*SS*
Off-Channel Habitat		*FO, WA, SS*	
Refugia (bull trout and cutthroat trout)			*WA SS, PJ, MON*
Channel Cond. & Dyn.: Width/Depth Ratio	*SS*		
Streambank Condition (cutthroat and bull trout)			*SS*
Floodplain Connectivity		*FO,WA, SS*	
Flow/Hydrology: Change in Peak/base flows			*WA*
Drainage Network Increase			*WA*
Watershed Condition: Road Density & Location			*WA*
Disturbance History			*WA*
Riparian Reserves		*WA, PJ*	
Disturbance Regime			*WA, PJ*
Integration of Species and Habitat Conditions	unknown	unknown	unknown

Abbreviations: WA = watershed analysis; SS = stream surveys; PJ = professional judgment; MON = monitoring; FO = field observations

Subpopulation Characteristics within Subpopulation Watersheds

Subpopulation Size — Unknown.

Currently there are no known populations of coastal cutthroat trout, bull trout, or steelhead trout in the Little White Salmon River Watershed. It is unknown if coastal cutthroat were there historically. The waterfall migration barrier 5 miles downstream of the Forest boundary make the possibility of steelhead and the migrating forms of coastal cutthroat and bull trout inhabiting the watershed impossible. Today a hatchery dam barrier is also present at the mouth of the Little White Salmon River at Drano Lake.

No cutthroat trout have been found in the recent past in the Little White Salmon River. A presence/absence population survey was conducted in 1994 on the mainstem Little White Salmon River. Only rainbow and brook trout were captured. Extensive fish sampling which included auger trapping, electroshocking, minnow trapping, and seining, was done by the USGS Western Fisheries Research Center in 1997, 1998, 2000, and 2001 in the Little White Salmon River. The sections sampled were from Willard to the Okalahoma campground. During this sampling effort only rainbow and brook trout were found. There are no records indicating bull trout ever inhabited the watershed.

Growth and Survival — Unknown.

Life History Diversity and Isolation— Unknown.

Persistence and Genetic Integrity— Unknown.

Water Quality

Temperature— Functioning at Unacceptable Risk

Summer water temperatures have been monitored by the Forest Service from 1976-1985, 1991, and from 1995-2001. Additional long-term data have been collected by the USFWS at the Little White Salmon Fish Hatchery (1974-1994). Data from both these long-term stations indicates that maximum water temperatures in the lower Little White Salmon River (below the confluence of Moss and Lava Creeks) have consistently remained below the maximum allowable level established in the state water quality regulations. Maximum-recorded water temperature at the fish hatchery was 9.4 c in August, 1992.

Lava and Moss Creeks have very cold temperatures (approx. 5°c). It is suspected that this is due to the influence of the Big Lava Bed. These two streams play an important role in maintaining cool water temperatures in the lower LWSR. Upstream of these tributary confluences the LWSR commonly has temperatures that no not meet the state standard of 16° c. From 1995 – 2000 maximum stream temperatures in the LWSR above Moss Creek ranged from 17.6 - 20.2° c. In 1998 stream temperatures exceeded the state standard of 16°c on 74 days. Maximum temperatures of tributary streams with recent monitoring include: Berry Creek, 1995 – 1997, 13.9°; Cabbage Creek, 1998, 14°; and Lusk Creek, 1995- 1997, 14.9°.

Seven day maximum water temperatures are 18.5°c for subwatershed 01, 16.4°c for subwatershed 03, and 19.6°c for subwatershed 04 (table 2). These temperatures are *Functioning at Unacceptable Risk* for all life stages of bull trout. For cutthroat and steelhead, subwatershed 03 is *Functioning at Unacceptable Risk* for spawning, and subwatersheds 01 and 04 are *Functioning at Unacceptable Risk* for rearing and spawning. No monitoring has been done in subwatersheds 02 and 05.

Table 2. Seven day maximum water temperatures, ARP's, peakflow increases, and percent of early seral vegetation in riparian areas in the Little White Salmon Watershed.

WS #	NAME	ARP	PEAKFLOW 2 YR INCR.	EARLY SERAL IN RIP. AREAS	7-DAY MAX AVE. TEMP	
01	Dry Creek	74.2	0.13	31.0	18.5	(1 yr of data)
02	Big Lava Bed Frontal	89.7	0.05	11.9	No Data	
03	Upper LWSR	74.4	0.11	23.8	16.4	4 yrs of data)
04*	Middle LWSR	73.4	0.06	20.7	19.6	7 yrs of data)
05*	Lower LWSR	77.3	No Data	16.2	No Data	
17070105 11	**LWSR**	**80.8**		**18.3**		

*Data from these two watersheds is not entirely accurate because the old sixth field 10S was split between these two sixth fields. For this report, the entire 10S was put into 05, the new sixth field subwatershed.

For tributary streams lacking water quality data, seral condition of riparian vegetation can be used to indicate specific areas of the watershed that may have temperature concerns due to a lack of shade. Early seral vegetation includes the grass/forb, shrub/seedling, open sapling/pole, and light forest vegetation classes. The total percent of riparian area in an early seral condition is 18.3 (table 2).

Based on water temperature monitoring, this indicator is determined to be *Functioning at Unacceptable Risk.*

<u>Sediment in Areas of Spawning and Incubation</u> - Functioning at Unacceptable Risk

Standard U.S. Forest Service Region 6 Level II stream surveys do not include collection of data for directly evaluating spawning gravel quality (e.g., percentage of fines, etc.). Wolman Pebble Counts (Wolman 1954) are conducted as part of the Level II stream surveys, however, these data do not provide a reliable indicator of spawning gravel quality. Pebble counts attempt to characterize the streambed composition across the bankfull channel width in riffle habitats only.

Remobilization of sediments stored in streambeds, on bars, and in streambanks is largely a factor of stream channel type and condition. The mainstem of the LWSR begins in steep terrain at its headwaters, then flows through very low gradient reaches (C channels) along the valley bottom to Willard. From Willard to the mouth of Drano Lake, the gradient increases again as the stream drops into a steep-walled canyon. Sediment produced in the steep headwaters of the LWSR and its tributaries is rapidly transported to the low gradient reaches above Willard. Once in this part of the system, it can take many years for sediment to be routed through to the lower channel. Because the stream is flowing through alluvial deposits in these lower reaches, much of the channel stability throughout this segment is provided by the riparian vegetation growing along the banks, making a late seral riparian condition especially important (Watershed Analysis, page 64).

Turbidity and suspended sediment have been identified as a problem on the LWSR since at least as early as the late 1960's. During a rain-on-snow driven flood event in 1968, the settling basin at the Willard Fish Hatchery was filled with 300 cubic yards of sediment over a five-day period. The storm producing the event was at the time estimated to be a 50-year storm, but the streamflow event had a recurrence interval of approximately 10 years. In 1968 the Forest Service conducted a storm damage assessment of the watershed. They noted that Moss, Lava, and Lost Creek were clear during the storm, but that most of the other tributaries had some turbidity. They concluded that some sediment was coming from roads, but the majority of the sediment was coming from stream bank cutting on the lower White Salmon River (Watershed Analysis, page 68).

Water quality monitoring began in the watershed in late 1974 at five stations on the LWSR, and six stations on major tributaries including Lusk, Homes, Berry, Cabbage, Moss, and Lava Creeks. Turbidity levels ranged from 0.17 to 160 NTU's. Road systems continue to be a source of sediment in the watershed. The number of road crossings per subwatershed is used to index the relative potential for sediment introduction from stream crossings. The road density in the watershed is 2.8 miles/sq. mile and the total number of stream crossings is 732 (5.41 mi/square mile) (table 3).

Table 3. Road densities and number of stream crossings in the Little White Salmon Watershed.

WS #	NAME	ACRES	SQ. MI.	ROAD MILES	ROAD DENSITY	# FISH BEARING STREAM CROSSINGS	# PERRENIAL NON FISH BEARING STREAM CROSSINGS	# INTERM. STREAM XINGS	TOTAL # STREAM XINGS
01	Dry Creek	12126	18.95	47.2	2.5	5	2	42	49
02	Big Lava Bed Frontal	34132	53.33	102.8	1.9	9	23	149	181
03	Upper LWSR	13989	21.85	66.1	3.0	27	10	143	180
04*	Middle LWSR	10594	16.55	48.2	2.9	18	13	117	148
05*	Lower LWSR	15620	24.4	107.9	4.4	30	12	132	174
1707010511	LWSR	86462	135.08	372.1	2.8	89	60	583	732 (5.41mi/sq. mi)

*Data from these two watersheds is not entirely accurate because the old sixth field 10S was split between these two sixth fields. For this report, the entire 10S was put into 05, the new sixth field subwatershed.

Based on this information, this indicator is determined to be *Functioning At Unacceptable Risk.*

Chemical Contamination/Nutrients— Functioning Appropriately

From 1976 to 1980, a total of ten water samples were sampled for fecal coliform from the LWSR. The average coliform count in these samples was 28.7 colonies per 100 ml of sample, and the maximum was 43. This is below the established maximum allowable levels in state water quality regulations. In 1992 the statewide water quality assessment done by WDOE identified the LWSR on the 303 (d) list as water quality limited for pH. The data used for this is suspect (Watershed Analysis page 72). Since 1992, the State has published another statewide water quality assessment and the LWSR has been removed form the 303(d) list.

Based on this information found in the Watershed Analysis, this indicator is determined to be *Functioning Appropriately.*

Habitat Access

Physical Barriers— Functioning At Unacceptable Risk

An inventory of culvert barriers was conducted in most of the fish bearing streams in the watershed in July, 1995. Fifteen of the 26 culverts inventoried in the basin were determined barriers to fish. There are 89 fish bearing steam crossings and 5.41 stream crossings/square mile (table 3).

Therefore this indicator is determined to be *Functioning At Unacceptable Risk.*

Habitat Elements

Substrate Embeddedness in Rearing Areas— Functioning At Unacceptable Risk

Substrate embeddedness data are not collected as part of the U.S. Forest Service Region 6 Level II stream survey protocol, although it is noted by surveyors if observed. Based on stream survey and channel stability narratives, road densities, and number of stream crossings which sets the context for past watershed disturbances and current channel conditions, this indicator is determined to be *Functioning At Unacceptable Risk.*

Large Woody Debris— Functioning At Unacceptable Risk

Sixteen streams (a total of 38.6 miles) in the analysis area have been surveyed and compared to the Matrix of Diagnostics/Pathways and Indicators criteria for functioning appropriately (80 LW pieces/mile). Only two streams in the watershed, Homes and Moss Creek (3 miles total length, 8% of total miles surveyed), contained more than 80 pieces of wood/mile >24 inch diameter and > 50 ft length (table 4). Therefore, *this indicator is determined to be Functioning At Unacceptable Risk.* It should be noted that the LWSR was surveyed in 1994. Field observations have observed abundant quantities of large wood deposited in the C channel areas of the LWSR during the 1996 flood, therefore the number of pieces of wood/mile likely has increased significantly in the LWSR since the time of survey.

Table 4. Stream survey data for the Little White Salmon River Watershed.

STREAM NAME	SUBWS #	SURVEY DATE	KNOWN FISH SPECIES	STREAM LENGTH SURVEYED	AVE. RIFFLE WIDTH	#POOLS/ MILE	# LARGE POOLS/MI	# LARGE & MED WOOD	DOM. ROSGEN TYPE	WIDTH/ DEPTH RATIO	CHANNEL STABILITY
LOST	2	1996	RB, EB	2.92	7.2	40.1	2.7	5.7	B	unk	Good
EF GOOSE	2	1997	EB	1.43	10.5	45.4	5.5	19.6	C	20.1	Good
EF GOOSE TR. 1	2	1997	EB	0.86	8.6	44.2	3	16	B	11.3	Good
GOOSE LAKE	2	1997	EB	1.09	13.3	48.5	7.2	40	A, C	15.4	Good
GOOSE LAKE W T2	2	1997	EB	0.92	3.8	1.1	1	17	A	6.3	Good
LAVA	2	1997	RB, EB	3.23	27.6	14.6	11.5	24	B	17.9	Fair
SO. PRAIRIE E	2	2001	EB	1.76	5.1	32.4	0	27.8	B, C	7	Fair
SO. PRAIRIE S	2	2001	EB	0.66	3.6	30.5	0	16.7	B	6	Fair
SPRING CREEK T1	2	1997	UNK	0.26	12.5	7.6	0	61	B	4.2	
SPRING CR	2	1991	EB	1.17	5.2	54	0	25.6	A	10.5	
HOMES	3	1989	UNK	1.59	6.3	28.2	0	112	C	unk	Good/Fair
NF BERRY	3	1995	RB, EB	1.4	6.5	73.4	0	5.4	A	11.3	Good
BERRY	3	1995	RB, EB	2.76	8.9	71.3	1.1	11.5	C	12.3	Good
LUSK	3	2000	RB	3.34	10.9	21	1.8	9.4	B, C	51.3	Fair
LITTLE WHITE SALMON	3, 4	1994	RB, EB	13.86	20.2	40.7	8.8	15.8	C	22.3	Poor
MOSS	4	2001	RB, EB	1.34	55.1	5.2	2.9	97.6	B	35	Good
TOTAL OR PERCENT MEETING CRITERIA				38.59		53% of survey miles meets criteria		8% of survey miles meets criteria		72% of survey miles meet criteria	35% of survey miles rated Good

* Shaded values meet *Functioning Appropriately* criteria in the Matrix of Diagnostics/Pathways and Indicators.

Pool Frequency and Quality - Functioning At Unacceptable Risk.

The pool frequency criteria for bull trout and cutthroat trout was met in five streams totaling 20.28 miles. This equals 53% of the total miles surveyed (table 4). Since only slightly over half of the surveyed streams met the criteria, this indicator is determined to be *Functioning at Unacceptable Risk.*
The pool frequency criteria for steelhead, Chinook, coho, and chum were not met in any stream in the watershed.

Large Pools— Functioning At Unacceptable Risk

As expected, the smaller stream reaches had few large pools/mile with the larger stream reaches having a greater number of large pools/mile. The mainstem LWSR averaged 8.8 large pools/mile (table 4), with 18.6 large pools/mile in the most downstream reach and no large pools/mile in the headwater reach. Of the 37 stream reaches surveyed, four reaches had more than 10 large pools/mile. This indicator is determined to be *Functioning At Unacceptable Risk.*

Off-Channel Habitat—Functioning At Risk

Lava and Lost Creek stream surveys show fourteen side channels, two braids, and one marsh were present in Lava Creek, and five braids and two marshes exist on Lost Creek. Little other quantitative information on off-channel habitat is quantified for other streams. "Response" reaches (Rosgen "C" and "E" channels) provide channel types that commonly offer very good lateral connections to floodplains and off-channel features. "Transport" reaches (A and B) are typically higher gradient and more laterally confined, thus offering less opportunity for off-channel habitat features. The dominant Rosgen channel types found in the watershed are A, B and C. Channel types A and B generally do not naturally have many off-channel areas. Some off-channel habitat is present along the mainstem alluvial (Rosgen "C") reaches of the LWSR. However due to the presence of the 86 and 18 roads which run parallel to the LWSR, and the high road densities in many subwatersheds in the basin which limit lateral movement of streams, this indicator is determined to be *Functioning At Risk.*

Refugia— Functioning At Unacceptable Risk.

Suitable habitat areas (i.e., reaches of stream with cool water temperatures, sufficient woody debris, high quality pools, properly functioning riparian ecosystems, etc.) are present in some areas of the Little White Salmon River watershed. High stream temperatures and excessive bank cutting are problems found along the mainstem of the river. Many of the streams in this watershed area have impassable culvert barriers limiting the total habitat available. For these reasons this indicator is determined to be *Functioning At Unacceptable Risk* for all fish species.

Channel Condition and Dynamics

Mean Bankfull Width/Mean Bankfull Depth Ratio - Functioning Appropriately

Of the streams surveyed in the watershed, 72% meet the width/depth criteria by Rosgen type (table 4). Therefore, this indicator is determined to be *Functioning Appropriately*.

Streambank Condition— Functioning At Unacceptable Risk

Pfankuch stream channel stability evaluation forms were completed for the surveyed reaches of the Little White Salmon River and several tributaries (table 4). Thirty-five of the stream survey miles rated good. The Little White Salmon River itself rated poor. For this reason this indicator is determined to be *Functioning At Unacceptable Risk* for all fish species.

Floodplain Connectivity— Functioning At Risk

For the same reasons described in Off-Channel Habitat, this indicator is determined to be *Functioning at Risk.*

Flow/Hydrology

Change in Peak/Base Flow— Functioning At Unacceptable Risk

The Aggregate Recovery Percentage (ARP) and Department of Natural Resources (DNR) 2-Year Peak Flow models were run as indicators of changes in peak flows from natural conditions. The average ARP for analysis subwatersheds is 80.8%, and the average 2-year peak flow increase is <1% (table 4). Much of the watershed below the Lava Bed lies in the Rain on Snow zone, making peak flow increases a greater probability. Most large peak flow events in the Lower LWSR are associated with Rain-on-snow conditions (LWSR Watershed Analysis pg. 53). Three events in 1972, 1974, and 1978 resulted in dramatic changes to some stream reaches in the watershed (Watershed Analysis page 55). Peak flows for the entire LWSR are predicted to have increased 8% under current conditions, but increases of greater than 10% were found in several seventh field subwatersheds (Watershed Analysis page 58). Based on this information, this indicator is determined to be *Functioning At Unacceptable Risk.*

Increase in Drainage Network— Functioning At Unacceptable Risk

The road density in this watershed is 2.8 mi./sq. mi. Road densities are actually higher than this as road surveys have identified numerous roads in the watershed that are not mapped, and are therefore not included in this calculation (Watershed Analysis page 57). As road density increases, so does the drainage density in the watershed. There are currently 5.41 known stream crossings/square mile (table 3). Based on road densities, this indicator is determined to be *Functioning At Unacceptable Risk.*

Watershed Conditions

Road Density & Location— Functioning At Unacceptable Risk

The road density in the analysis subwatersheds is greater than 2.4 mi/sq.mi. There are many road miles on the valley bottom. For these reasons, this indicator is determined to be *Functioning At Unacceptable Risk.*

Disturbance History— Functioning At Unacceptable Risk

The Gifford Pinchot National Forest uses the Aggregate Recovery Percentage (ARP) Model to assess a watershed's disturbance history. This model is different than the Equivalent Clear up Area (ECA) Model most commonly used by the Bureau of Land Management in Oregon. The ARP Model is a tool used to index the proportion of a watershed in a hydrologically "mature" condition. The model is based on the premise that large trees have a greater capacity to intercept and retain snow in the forest canopy, and are more effective at limiting snowmelt during rain-on-snow by impeding wind movement across the snowpack. An ARP of 100 indicates that nearly all of the forest vegetation in the watershed is in a hydrologically mature condition, whereas and ARP of 0 indicates that all forest vegetation in the watershed is hydrologically immature. As the ARP for a watershed decreases, the risk of increased flows becomes greater. The model assumes that a natural forest stand has a 70 percent or greater crown closure. Further, it is assumed that a well stocked stand (natural or reforested) 37 years old has a crown closure of 70 percent and is hydrologically recovered.

ARP values for a given watershed need to be evaluated based on the watershed's landform, geology, and soil types to determine a watershed's inherent sensitivity to disturbances. A simple translation from the ARP Model to the ECA Model is: 100 - ARP value = ECA

The ARP value is for the analysis watershed is 80.8% (table 2) and the ECA value is 19.2%. Because the ECA value is >15%, it is determined that *this indicator is Functioning At Unacceptable Risk.*

Riparian Reserves— Functioning At Risk

The percent of riparian reserve in the analysis subwatersheds in an early seral condition is 18.3% (table 2), and approximately 20% is in a late seral condition. These values fall within the Hood-Wind subbasin Range of Natural Conditions (USDA-FS, 1993). Because of the lack of fire over the recent past, the amount of riparian area in an early-successional condition indicates the amount of timber harvest that has occurred in the last 35 years in the riparian area (Watershed Analysis, page 62). Based on large wood counts and temperature monitoring, there is likely a moderate loss of riparian function, making this indicator *Functioning At Risk.*

Disturbance Regime— Functioning At Unacceptable Risk.

The LWSR showed some effects to the stream channel from the 1996 flood, and dramatic changes in stream reaches occurred from several floods in the 1970's (Watershed Analysis, page 55). Most large peak flow events in the Lower LWSR are associated with rain-on-snow conditions (Watershed Analysis pg. 53). Much of the river is an alluviated valley and is highly susceptible to scour events. Headwater streams are more resilient. Based on past observations in the analysis area, this indicator is determined to be *Functioning At Unacceptable Risk.*

White Salmon River (HUC #1707010510)

The portion of the White Salmon River Watershed covered in this analysis is 144,541 acres and 226 square miles. The mainstem of the Upper White Salmon River is approximately 23 miles long from its headwaters on Mt. Adams to it's confluence with Trout Lake Creek near the town of Trout Lake. Trout Lake Creek is the major tributary to the river. Cave Creek, which enters the White Salmon River just below the Trout Lake Creek confluence, is the lowest point for the delineation of this analysis area. Drainages below the Cave Creek confluence are not part of the Gifford Pinchot National Forest. The White Salmon River flows another 26 miles past this point before reaching the Columbia River.

The White Salmon River is fed by the White Salmon and Avalanche Glaciers which lie above 7,000 feet elevation on Mt. Adams, and is a relatively high gradient river. All of the tributaries which drain the south slopes of Mt. Adams and enter the mainstem from the east are directly fed by glaciers and have substantial flow throughout most of the year. Ninefoot Creek, Green Canyon Creek, Cave Creek, and Trout Lake Creek all enter the White Salmon River from the west and are fed by springs and numerous wetlands, meadows, and lakes. Elevations in Trout Lake Creek range from 5400 feet at Steamboat Mountain to 2000 feet at the mouth of Trout Lake Creek.

There are no anadromous fish in this analysis area. Condit Dam is located at river mile 3.3 miles and has blocked upstream migration of salmonids since 1913. A 21 foot waterfall is located at river mile 16.2 and is a barrier to most salmonids, although it is uncertain if steelhead could have passed this barrier in the past before Condit Dam was built.

Currently there are no known populations of bull trout in the upper White Salmon River watershed, nor were any known historically. In the lower White Salmon River (approx. 23 miles downstream of the analysis area) two sightings of bull trout were reported above Condit Dam at Northwestern Lake, both by Washington Department of Fish and Wildlife biologists. One fish was captured in a gill net set in the spring of 1986 in Northwestern Lake, and the other was checked on the opening day creel census in April 1989 (Weinheimer, 1996). Bull trout have been found in the river below the dam, but these are believed to be strays from the Hood River in Oregon. If a bull trout population does currently exist above Northwestern Lake, they would be limited to the White Salmon River mainstem and tributaries between the lake and the falls at river mile 16.2.

It is unknown if coastal cutthroat trout are present in the watershed. Cutthroat were found in Trout Lake Creek in the 1980's but have not been found since then. Cutthroat trout were stocked intermittently in the past in the watershed.

Known fish species in the watershed include rainbow and brook trout. Known fish bearing tributaries to the White Salmon River include Ninefoot Creek, Green Canyon Creek, Cascade Creek, Beaver Creek, and Cave Creek. Wicky and Morrison Creeks were surveyed and found to have no fish, and it is unknown if Buck Creek contains fish. Fish bearing tributaries to Trout Lake Creek include Mosquito Creek, North Fork Trout Lake Creek, Smokey Creek, Steamboat Lake Creek, Little Goose Creek, Meadow Creek, Grand Meadows Creek, Skull Creek, and Cultus Creek.

The environmental baseline for the **Upper White Salmon River 5th Field Watershed** is summarized in Table 1, below. The baseline condition is determined for the entire fifth field watershed which lies on Forest land. Baseline determinations for specific indicators were determined using findings from three watershed analyses (the White Salmon River, 1998, Trout Lake Creek, 1996, and Cave/Bear Creek, 1997), data from stream surveys and monitoring, practical knowledge of conditions on the ground from field reconnaissance, and professional judgment as needed. All the data used in this report has been updated from the Watershed Analyses. Stream survey data is used to determine ratings for several indicators. Streams which have survey data include: the White Salmon River, Buck Creek, Wicky Creek, Ninefoot Creek (and tributaries), Green Canyon Creek, Morrison Creek, Mosquito Creek, North Fork Trout Lake Creek, Smokey Creek, Steamboat Lake Creek, Little Goose Creek, Meadow Creek, Grand Meadows Creek, Cultus Creek, Trout Lake Creek, Skull Creek, Beaver Creek, and Cave Creek. Rational for determinations of individual indicators is provided.

Table 1. Environmental Baseline Summary for the White Salmon River 5th Field Watershed.

DIAGNOSTICS/PATHWAYS: INDICATORS	ENVIRONMENTAL BASELINE		
	Functioning Appropriately	Functioning At Risk	Functioning at Unacceptable Risk
Subpopulation Characteristics: Subpopulation Size	UNK	UNK	UNK
Growth and Survival	UNK	UNK	UNK
Life History Diversity and Isolation	UNK	UNK	UNK
Persistence and Genetic Integrity	UNK	UNK	UNK
Water Quality: Temperature			MON
Sediment		MON, WA, SS	
Chem. Contam./Nutrients		MON, WA	
Habitat Access: Physical Barriers	SS, WA		
Habitat Elements: Substrate Embeddedness		SS, WA , PJ	
Large Woody Debris			SS
Pool Frequency and Quality			SS
Large Pools			SS
Off-Channel Habitat	FO, SS		
Refugia	SS, MON, PJ for cutthroat trout	SS, MON, PJ for bull trout	
Channel Cond. & Dyn.: Width/Depth Ratio	SS		
Streambank Condition	SS		
Floodplain Connectivity		SS, PJ	
Flow/Hydrology: Peak/base flows		WA	
Drainage Network Increase			WA
Watershed Condition: Road Density & Location			WA
Disturbance History			WA
Riparian Reserves		WA, PJ	
Disturbance Regime		WA, PJ	
Integration of Species and Habitat Conditions	UNK	UNK	UNK

Abbreviations: WA = watershed analysis (with data updates completed); SS = stream surveys; PJ = professional judgement; MON = monitoring; FO = field observations; UNK = unknown

Subpopulation Characteristics within Subpopulation Watersheds

Subpopulation Size— Unknown.

Currently there are no known populations of bull trout or coastal cutthroat trout in the Upper White Salmon River Watershed, nor were any known historically. In 1993 bull trout presence/absence surveys were conducted in the watershed by the Forest Service and Washington Department of Fish and Wildlife. Electrofishing and day snorkeling sampling sites included the White Salmon River above Cascade Creek, Cascade Creek, Ninefoot Creek, and Morrison Creek. No bull trout or cutthroat trout were found during this sampling effort. The streams sampled were considered to be the optimal bull trout habitat areas. These streams had all been previously electrofished one or more times, and no bull trout or cutthroat trout have ever been found. Other bull trout surveys were completed in year 2000 following the US Fish and Wildlife protocol. Survey sites included the White Salmon River, and Wicky, Morrison, Ninefoot, and Cascade Creeks. No bull trout or cutthroat trout were found.

There are no records that indicate bull trout ever inhabited the analysis area. Impassable barriers are present at many of the tributary streams. An impassable waterfall barrier is present on the White Salmon River (river mile 16.2) downstream of this analysis area, limiting any upstream migration. It is uncertain if coastal cutthroat are present in the watershed. Cutthroat trout have been observed in the past (1980's) in the Trout Lake Creek drainage, but it is not known if these are coastal or westslope cutthroat, or if they are hatchery stock origin since past stocking of cutthroat trout has occurred in the watershed.

Growth and Survival— Unknown.

Life History Diversity and Isolation— Unknown.

Persistence and Genetic Integrity— Unknown.

Water Quality

Temperature—Functioning at Unacceptable Risk

Seven day maximum water temperatures are 8.9˚c in the White Salmon River (subwatershed 01), and 12.2˚c in the Gotchen Creek subwatershed (# 03). The Gotchen Creek monitoring was actually done in the White Salmon River part of the subwatershed. These values are *Functioning Appropriately* for all life stages of bull trout and coastal cutthroat trout.

In Upper Trout Lake Creek (subwatershed 04) the 7-day maximum stream temperature is 17.3˚c, and for Lower Trout Lake Creek (subwatershed 05) the 7-day max. temperature is 23.3˚c. These values are *Functioning at Unacceptable Risk* for all life stages of bull trout. In Upper Trout Lake Creek temperatures are *Functioning at Risk* for cutthroat trout rearing, and *Functioning at Unacceptable Risk* for spawning. In the Lower Trout Lake Creek subwatershed, 7-day maximum temperatures are *Functioning at Unacceptable Risk* for all life stages of coastal cutthroat trout according to the Matrix of Diagnostics/ Pathways and Indicators.

For tributary streams lacking water quality data, seral condition of riparian vegetation can be used to indicate specific areas of the watershed that may have temperature concerns due to a lack of shade. Early seral vegetation includes the grass/forb, shrub/seedling, open sapling/pole, and light forest vegetation classes. The total percent of riparian area in early seral vegetation is 21% and the total percent of riparian area late seral vegetation in the watershed is 36%. This percent of later seral would actually be a slighter higher percentage if age rather than tree size were used, as much of the acreage in the Upper White salmon subwatershed lies in the high elevation Mt. Adams Wilderness area. Because of the short growing season and difficult growing conditions at this elevation, many trees that are old enough to be called "late seral" actually fall into the "small tree" size classes.

Based on water temperature monitoring this indicator is determined to be *Functioning at Unacceptable Risk.*

Sediment in Areas of Spawning and Incubation— Functioning At Risk

Standard U.S. Forest Service Region 6 Level II stream surveys do not include collection of data for directly evaluating spawning gravel quality (e.g., percentage of fines, etc.). Wolman Pebble Counts (Wolman, 1954) are conducted as part of the Level II stream surveys, however, these data do not provide a reliable indicator of spawning gravel quality. Pebble counts attempt to characterize the streambed composition across the bankfull channel width in riffle habitats only.

Remobilization of sediments stored in streambeds, on bars, and in streambanks is largely a factor of stream channel type and condition. This watershed is dominated by Rosgen A and B channel types (table 2), with substrates of predominantly cobble, boulder, and bedrock. Because these channel types are sediment transport-dominated systems, they typically do not store a great deal of fine sediment, and therefore are probably not a large source of stored instream sediment. Lower gradient C and degraded E channels may be greater sources for turbidity associated with in-channel stored sediments, but these types of channels are limited in this watershed.

Limited turbidity monitoring has been done in this watershed. Turbidity monitoring was done downstream of the analysis area in the White Salmon River from 1992 to 1994. With the exception of one very high turbidity reading taken during a December flood, average turbidity during the period of monitoring peaked in the summer months, with a maximum value of 46 occurring in July of 1993. The late spring and summer turbidity peaks (Upper White Salmon River Watershed Analysis, 1998, pg. IV-63) are due to a combination of high flows associated with spring snowmelt, and glacial processes that continue to provide fine glacial flour through the summer months. In the Trout Lake Creek drainage some low flow monitoring was done during the summer months. These levels were generally low (Trout Lake Creek Watershed Analysis, 1996, pg. 47), but high flow turbidity levels are not known.

Sediment inputs in the watershed are partically a result of sediment contributions from roads, harvest units, and other areas where soils and vegetation have been disturbed. The number of road crossings per subwatershed is used to index the relative potential for sediment introduction from stream crossings. Table 4 shows the number of road crossings and road density per subwatershed. The road density in the watershed is 2.9 mi/sq. mi. and the number of total stream crossings is 3.3 mi/sq.mi.

Channel stability surveys are also indicators of the amount of fine sediment entering streamcourses from bank erosion. Bank erosion apparently is not prevalent in this watershed as the majority of channel stability surveys for the streams in this watershed rated "good" (table 2).

Based on low turbidity readings and "good" channel stability, but relatively high road densities and number of stream crossings/square mile, this indicator is determined to be *Functioning At Risk.*

Table 2. Stream survey data for the White Salmon River watershed.

STREAM NAME	SUBWS #	SURVEY DATE	KNOWN FISH SPECIES	STREAM LENGTH SURVEYED	AVE. RIFFLE WIDTH	#POOLS/ MILE	# PRIM. POOLS/MI	# LARGE & MED. WOOD/MI	DOM. ROSGEN TYPE	WIDTH/ DEPTH RATIO	CHANNEL STABILITY RATING
WHITE SALMON	1,2	1998	RB, EB	6.06	31.82	13.76	6.79	8.05	A, B	19.75	Good
BUCK	2	2000	UNK	1.84	4.65	10.8	0	1.6	C	7.8	Good
WICKY	2	2000	NONE	2.52	9.56	0.4	0	8.27	B	18.9	Good
NINEFOOT	2	2001	RB	2.3	6.34	18.16	0.26	7.75	A, B	11.15	Good
E.F. NINEFOOT	2	1991	RB	0.87	2.17	no data	0	75.69	A, B	no data	Good
GREEN CANYON	2	1991	RB	5.83	9.3	29.3	3.32	63.57	A, B	3.1	no data
M.F. NINEFOOT	2	1991	RB	2.03	2	no data	0	43.66	A, B	no data	Good
MORRISON	2	2000	NONE	3.55	14.6	0.05	0.05	10.89	A, B	11.22	Good
MOSQUITO	4	1991	RB, EB	6.3	17.6	15.94	7.3	45.33	A, B	7.66	Good/Fair
N.F. TROUT LAKE	4	1996	RB, EB	2.95	5	73.95	1.76	25.03	A	9.71	no data
SMOKEY	4	1995	EB	3.17	11.18	51.99	3.06	9.07	A, C	18.64	Fair
STEAMBOAT LAKE	4	1997	RB, EB	3.18	10.03	46.77	1.8	4.3	A	15.53	no data
LITTLE GOOSE	4	1989	EB, CT?	2.63	13.2	43.8	14.3	37.61	A, C	no data	Good
MEADOW	4	1993	RB	1.23	16.77	33.2	8.3	103.17	A, C	14.8	Fair
GRAND MEADOWS	4	1996	RB, EB	2.91	7.45	66.8	2.13	12.58	B	12.3	Fair
CULTUS	4	1997	RB, CT?	2.92	15.53	26.6	1.77	7.05	B, C	19.4	Good
TROUT LAKE	4,5	1995	RB, EB	10.88	26.65	19.82	7.94	9.11	B, C	18.29	Good
SKULL	5	1992	RB, EB	1.98	7.48	45.6	0.05	509.37	A	8.38	no data
BEAVER	6	1996	RB, EB	1.32	4.74	107.1	0.76	3.62	F	9.4	Fair
CAVE	6	1993	RB, EB	4.35	5.05	18.8	2.07	18.38	C, D	7.7	Fair
TOTAL OR PERCENT MEETING CRITERIA				68.82		15% of survey miles meets criteria		0.05% of survey miles meets criteria		76% of survey miles meets criteria	65% of survey miles are Good

* Shaded values meet *Functioning Appropriately* criteria in the Matrix of Diagnostics/Pathways and Indicators.

Table 3. Road densities and number of stream crossings in the White Salmon River watershed.

6th Field Subwshed Number	6th Field Subwshed Name	Subwshed (Acres)	Subwshed (Sq. Miles)	% of wshed	Road Density (Mi./Sq mile)	Stream Xings (#/Sq Mile)
1	Headwaters WSR	18822	29.4	0.13	1.3	2.0
2	Upper WSR	19867	31.0	0.14	2.5	3.1
3	Gotchen Creek	27819	43.5	0.19	2.9	2.6
4	Upper TLC	28114	43.9	0.19	2.7	3.3
5	Lower TLC	16480	25.7	0.11	3.4	4.0
6	Cave/Bear Creek	33438	52.2	0.23	3.8	4.4
	Subtotal	144541	225.8	1	2.9	3.3

Chemical Contamination/Nutrients— Functioning At Risk

There is no known chemical contamination, nutrient enrichment, or active mining activities occurring within the watershed. Cattle and sheep grazing is occurring in portions of the watershed. In 1992 fecal coliform was monitored monthly in the White Salmon River just above the town of Trout Lake throughout the period cattle were on the Mt. Adams allotment. Peak coliform levels measured 40 colonies/100ml, which is within the state water quality standard for fecal coliform which is 50 colonies/100ml for class AA streams. The highest level of coliform was found in May, 1993 when 45 colonies/100 ml was found. This peak occurred prior to cattle entering the allotment, suggesting that other sources are responsible for coliform levels found there. Over the 18 years of fecal coliform monitoring, the coliform levels ranged from 2 - 45.

In Trout Lake Creek fecal coliform levels were collected from 1976 to 1995 on Forest Service land and all were within state standards. However, levels downstream of Forest lands have far exceeded the state standard due to runoff into irrigation ditches (Trout Lake Creek Watershed Analysis, 1996). There are no chemical contamination CWA 303d designated reaches on Forest Service land in the watershed.

Since coliform levels in the White Salmon River were close to not meeting the state standard, this indicator is determined to be *Functioning At Risk.*

Habitat Access

Physical Barriers— Functioning Appropriately

Past stream surveys and field reviews done in the upper White Salmon watershed did not detect any man made barriers present with the exception of the 23 road culvert on Ninefoot Creek. In 1990 a parasitic copepod was found in high numbers on the rainbow trout sampled below the culvert on Ninefoot Creek, but none were found on the fish above the culvert. For this reason passage at this culvert was not recommended in the past to protect the rainbow trout population above the culvert from infestation of this parasite. This was the only man-made barrier found during a subsequent culvert inventory done for the White Salmon River Watershed Analysis.

In the Trout Lake Creek portion of the watershed twenty-one culverts were inventoried for fish passage in the drainage, and three of these were considered migration barriers. Two of these, Cultus and Little Goose creeks have impassable culverts on the 88 road, yet they do not warrant passage improvement since impassable waterfalls are present just upstream of these culverts. The third barrier identified, Steamboat Creek crossing on the 88 road, is also questionable if improvement is worthy due to possible gradient barriers at this site. Therefore, this indicator is determined to be *Functioning Appropriately.*

Habitat Elements

Substrate Embeddedness in Rearing Areas— Functioning At Risk

Substrate embeddedness data are not collected as part of the U.S. Forest Service Region 6 Level II stream survey protocol, although it is noted by surveyors if observed. Based on stream survey narratives, professional judgment, information presented in the Watershed Analysis reports, and tables 2, 3, and 4 above which sets the context for past watershed disturbances and current channel conditions, *this indicator is determined to be Functioning At Risk.*

Large Woody Debris— Functioning At Unacceptable Risk

Twenty steams (a total of 68.8 miles) in the analysis area have been surveyed and compared to the Matrix of Diagnostics/Pathways and Indicators criteria for functioning appropriately (80 pieces of large wood/mile). Only two streams in the watershed, Meadow and Skull Creek (0.05% of surveyed miles), meet the matrix criteria of 80 pieces of wood/mile >24 inch diameter and >50 foot length.

Historically the White Salmon River and it's glacial fed tributaries most likely never met the Matrix of Diagnostics/Pathways and Indicators for large wood due to the steady high velocity flows from glacial run-off creating riffle/cascade habitat and flushing most wood downstream. However, because of the low numbers of large wood in the tributaries which also flow from the west side of the White Salmon River, this indicator is determined to be *Functioning At Unacceptable Risk.*

Pool Frequency and Quality—Functioning At Unacceptable Risk.

The pool frequency criteria for bull trout and cutthroat trout was met in four streams totaling 15% (10.35 miles) of the surveyed miles. Because of this low percentage, this indicator is determined to be *Functioning At Unacceptable Risk.*

Large Pools— Functioning At Unacceptable Risk

As expected, the smaller stream reaches had fewer large pools/mile than the larger stream reaches. Ten out of the 58 reaches surveyed had more than 10 pools >3 meters deep. Most of these reaches were the downstream reaches where the stream was larger, with the exception of Trout Lake Creek. The middle reaches of Trout Lake Creek are a bedrock canyon and contained between 18 and 34 large pools/reach. Because the majority of reaches had few large pools, and the greatest number of large pools/mile/stream was 14.3 in Little Goose Creek this indicator is determined to be *Functioning At Unacceptable Risk.*

Off-Channel Habitat—Functioning Appropriately

U.S. Forest Service Region 6 Level II stream surveys do not quantify or evaluate off-channel habitat conditions. Ponds and side channels are prevalent in Cave, Beaver, North Fork Trout Lake, and Meadow Creeks. "Response" reaches (Rosgen "C" and "E" channels) provide channel types that commonly offer very good lateral connections to floodplains and off-channel features. "Transport" reaches (A and B) are typically higher gradient and more laterally confined, thus offering less opportunity for off-channel habitat features. The majority of Rosgen channel types in this watershed are A and B, and therefore do not naturally have many off-channel areas. For these reasons, this indicator is determined to be *Functioning Appropriately.*

Refugia— Functioning At Risk for Bull Trout, Functioning Appropriately for cutthroat trout.

Suitable habitat areas (i.e., reaches of stream with cool water temperatures, sufficient woody debris, high quality pools, properly functioning riparian ecosystems, etc.) are present in some areas of the watershed, although habitat is not optimal in many areas. Many of the tributaries to the White Salmon River have impassable waterfall barriers near their confluences with the White Salmon River, thus limiting the total habitat available. Cold water habitat is prevalent in the White Salmon River and it's eastern tributaries making this drainage optimal habitat for bull trout. High stream temperatures in the Trout Lake drainage make this area not suitable bull trout habitat. Coastal cutthroat habitat is present in much of the watershed. This indicator is determined to be *Functioning At Risk* for bull trout, and *Functioning Appropriately* for cutthroat trout.

Channel Condition and Dynamics

Avg. Wetted Width/Max. Depth Ratio — Functioning Appropriately

Of the streams surveyed in the watershed, 75% meet the width/depth criteria by Rosgen stream type. Therefore this indicator is determined to be *Functioning Appropriately.*

Streambank Condition— Functioning Appropriately

Pfankuch stream channel stability evaluation forms were completed for the surveyed stream reaches in the watershed. Sixty-five percent of the surveyed miles rated "good", and no streams were rated poor. For this reason this indicator is determined to be *Functioning Appropriately.*

Floodplain Connectivity— Functioning At Risk

Very little floodplain is possible in the steep, narrowly confined streams that characterize the White Salmon River and it's tributaries. The majority of stream channels were observed to be well connected to their adjacent floodplains given the landform and geologic constraints. In the Trout Lake Creek and Cave/Bear Creeks drainages many streams are not as narrowly confined as those tributaries to the White Salmon, and road densities and number of stream crossings are higher. Higher road densities limit lateral movement of streams. The determination for the entire watershed is *Functioning At Risk.*

Flow/Hydrology

Change in Peak/Base Flows— Functioning At Risk

The Aggregate Recovery Percentage (ARP) and Department of Natural Resources (DNR) 2-Year Peak Flow models were run as indicators of changes in peak flows from natural conditions. The average ARP for this subwatershed is 81%, and the average 2-year peak flow increase for watersheds 4, 5, and 6 varied between 3 and 7%. Forty-seven percent of the watershed lies in the rain-on-snow zone. The Watershed Analyses assigned a relative risk rating to identify those subwatersheds with the highest potential for increased peak streamflows based on the vegetation age classes present, the elevations of the subwatershed, and the degree of roading that has occurred. The increased peak flow risk for the White Salmon River watershed analysis area is rated moderate, Cave/Bear is rated high, and in the Trout Lake Creek drainage approximately half of the area is rated high. Although the ARP level is relatively high in the upper White Salmon River, much of the past management disturbance has been concentrated in the lower elevation, non-Wilderness subwatersheds. Based on this concentration of impacts, data from the watershed analysis, and the overall rating, this indicator is determined to be *Functioning At Risk.*

Increase in Drainage Network— Functioning At Unacceptable Risk

The road density in this watershed averages 2.9 mi./sq.mi., and the number of stream crossings averages 3.3 crossings/sq. mile (table 3). In the White Salmon River Watershed Analysis Report the drainage density has been increased by 46% due to road systems in this area. For the Cave/Bear analysis it has increased by 87%, and was not calculated for Trout Lake Creek WA report. Since these values are greater than 20%, this indicator *Functioning At Unacceptable Risk.*

Watershed Conditions

Road Density & Location— Functioning At Unacceptable Risk

The road density in this subwatershed is 2.9 mi./sq.mi in this watershed and many of the roads are in mid-slope positions, making this indicator *Functioning At Unacceptable Risk.*

Disturbance History— Functioning At Unacceptable Risk

The Gifford Pinchot National Forest uses the Aggregate Recovery Percentage (ARP) Model to assess a watershed's disturbance history. This model is different than the Equivalent Clear Cut Area (ECA) Model most commonly used by the Bureau of Land Management in Oregon. The ARP Model is a tool used to index the proportion of a watershed in a hydrologically "mature" condition. The model is based on the premise that large trees have a greater capacity to intercept and retain snow in the forest canopy, and are more effective at limiting snowmelt during rain-on-snow by impeding wind movement across the snowpack. An ARP of 100 indicates that nearly all of the forest vegetation in the watershed is in a hydrologically mature condition, whereas an ARP of 0 indicates that all forest vegetation in the watershed is hydrologically immature. As the ARP for a watershed decreases, the risk of increased flows becomes greater. The model assumes that a natural forest stand has a 70 percent or greater crown closure. Further, it is assumed that a well stocked stand (natural or reforested) 37 years old has a crown closure of 70 percent and is hydrologically recovered.

ARP values for a given watershed need to be evaluated based on the watershed's landform, geology, and soil types. All of these factors derive a watershed's inherent sensitivity to disturbance. A very simple translation from the ARP Model to the ECA Model is: 100 - ARP value = ECA value.

The ARP value is for this watershed is 81% (table 2) and the ECA value is 19%. Because the ECA value is > 15% this indicator is *Functioning At Unacceptable Risk.*

Riparian Reserves— Functioning At Risk

The percent of riparian reserve in this watershed in an early seral condition is 21%, and 36% is late seral. These values fall within the Hood-Wind subbasin Range of Natural Conditions (USDA-FS, 1993). On a course level, the amount of early seral vegetation indicates the amount of timber harvest that has occurred in the watershed (since fires have been suppressed) and the amount of future large wood input and channel stability. Based on stream survey large wood counts and temperature monitoring, there is likely a moderate loss of riparian function and therefore this indicator is determined to be *Functioning At Risk.*

Disturbance Regime— Functioning At Risk.

The headwaters of the White Salmon River and it's east tributaries originate on the glaciers of Mt. Adams. Due to glacial melt, flows in this area are fairly predictable during the year and retain a relatively high velocity even in the summer months. The Trout Lake and Cave Creek drainages have flows which widely fluctuate based on the precipitation input. Aside from a few road problems, this watershed did not show many effects from the 1996 flood. Due to fire suppression efforts, the risk of a large-scale fire does exist in this watershed, as well as on the forest as a whole. There is a relatively large area of dead and dying trees due to insect infestation in the Upper White Salmon Watershed. However, this area is in the dryer areas where only intermittent streams are present. This indicator is determined to *Functioning At Risk.*

Integration of Species and Habitat Conditions— Unknown.

East Fork Lewis (HUC #1708000205)

This environmental baseline focuses on three sub-watersheds: the East Fork Lewis River Headwaters (170800020501), the Upper East Fork Lewis River (170800020502) and Copper Creek (170800020503). These three sub-watersheds contain most of the National Forest System Lands that drain into the East Fork Lewis River Watershed (1708000205). The Middle East Fork Lewis River sub-watershed (170800020504) and the Rock Creek sub-watershed (170800020505) contain small amounts of NFSL, but were not considered in this analysis because the Forest Service has limited control of management activities off-forest, and because these areas lie within the Silver Star Special Interest Area, which is withdrawn from timber harvest. Limited data on non-federal lands within East Fork Lewis River sub-watersheds downstream of Copper Creek (170800020504, -05, -06) preclude discussion in this management plan.

There are a total of 288 stream miles in the upper East Fork Lewis River watershed, including all Forest Service System Lands within the five sixth-field sub-watersheds considered in this analysis. Eight miles (four percent of total stream miles on NFSL) of the East Fork, all of which is on National Forest within the Upper East Fork sub-watershed (170800020501) is considered Class I. This portion of the East Fork is considered Class I because of domestic water uses downstream of Forest System Lands. There are no water withdrawals on National Forest; however, a well supplies water to the Forest Service housing unit at Sunset Falls. This segment of the river also provides the most important habitat for summer and winter steelhead in the entire watershed (Limiting factors analysis, 1999).

The Northwest Forest Plan (USDA, 1994) designated the Upper East Fork Lewis River Watershed as a Tier 1 Key Watershed. Tier 1 Key Watersheds were selected for their direct contribution to anadromous salmonid and bull trout stocks. They serve as refugia for maintaining and recovering habitat for at-risk stocks of anadromous and resident fish species. The two primary beneficial uses within the Upper East Fork Lewis River Watershed are fish habitat and domestic water supply. Upper East Fork Lewis River steelhead, listed as threatened under the Endangered Species Act on May 18th, 1998, has the highest priority for habitat restoration in the State of Washington's Lower Columbia Steelhead Conservation Initiative.

Based on observations in run timing and adult distributions, it is believed that summer run steelhead enter the river above Sunset Falls (D. Rawding, WDFW, personal communication). The summer run are native to the drainage and classified as a distinct stock based on the geographical isolation of the spawning population (WDFW, 1993). Winter run steelhead on the East Fork Lewis River are supplemented with hatchery stock, whereas the summer run are predominately wild fish. Immature adult fish are present in the East Fork Lewis River above Sunset Falls through the summer, fall, and winter periods. The Upper East Fork Lewis River (170800020502) and East Fork Lewis River Headwaters (170800020501) sub-watersheds, including the Green Fork, have anadromous fish habitat. Copper Creek sub-watershed (170800020503) has an anadromous barrier (20 ft waterfall) 1.2 miles upstream of its confluence with the East Fork Lewis River.

The migration range for steelhead in the East Fork Lewis River Watershed ends at a waterfall located at river mile (RM) 42.0 on the upper East Fork, at a debris jam near RM 1.6 on Slide Creek and at a waterfall and associated valley spanning debris jam at RM 2.5 on the Green Fork. Minor use also occurs in Little Creek, below the waterfall and debris jam at RM 0.1 and the unnamed tributary to Slide Creek at RM 1.3. Steelhead were definitively observed on McKinley Creek, and may occur in Poison Gulch (unconfirmed).

According to the Washington Department of Fish and Wildlife (WDFW) fish surveys, fishermen and other anecdotal accounts, adult steelhead migrants were reaching the upper watershed prior to "notching" of Sunset Falls in the early 1980's. At the time, it was believed that notching of the falls was necessary to increase the number the number of adult steelhead reaching the upper watershed; however, the effects of this on adult population is unknown.

Stream habitat surveys have been completed on approximately 25 miles of stream, including the East Fork Lewis River, Green Fork, Copper Creek, Slide Creek, Snass Creek, McKinley Creek, Little Creek, Poison Gulch and Bolin Creek. Surveys were conducted in Miner's Creek and Fish currently occupy approximately 50 miles of stream in the Upper East Fork Lewis River Watershed. Snass Creek and Bolin Creek were surveyed in 2002, but data were not available for this analysis. Copper Creek has not been surveyed since 1995, so effects of the 1996 flood are not known.
Forest Service stream surveys conducted in 1983, 1993, 1995, 1998 and 2001, together with report findings from the Pacific Watershed Institute (Shaw, et al. 1999), all point to four habitat components that limit or are issues for steelhead in the Upper East Fork Lewis River. These habitat components include:

- Adult spawning sites and incubation success: low amounts and quality of spawning gravel areas.
- Juvenile rearing and off-channel habitat or refuge areas: very little side channel and connected floodplain areas and complex channels near spawning sites.
- Adult holding/ security cover: lack of large pools with overhead cover and adequate depth to protect adult fish from predation during summer low flow periods, especially near spawning areas.
- Elevated water temperatures: water temperatures in the mainstem of the East Fork have exceeded State water quality standards on numerous occasions, sometimes falling within the sub-lethal range for juvenile trout.

The environmental baseline for the **Upper East Fork Lewis River 5th Field Watershed** is summarized in Table 1. The baseline condition is determined for the entire 5th field watershed. Stream survey data is used to determine the ratings for several indicators. Baseline determinations for specific indicators were determined using findings from watershed analysis (with 2002 data updates), stream survey and monitoring data, practical knowledge of conditions of the ground from field reconnaissance, and professional judgment as needed. Rational for determinations of individual indicators is provided.

Table 1. Environmental Baseline Summary for Steelhead in the East Fork Lewis River Watershed on National Forest lands.

Baseline/Diagnostics/Pathways			
Indicators	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Subpopulation Characteristics			
Subpopulation Size	unknown	unknown	unknown
Growth and Survival	unknown	unknown	unknown
Life History Diversity and Isolation	unknown	unknown	unknown
Persistence and Genetic Integrity	unknown	unknown	unknown
Water Quality			
Temperature			*MON, WA*
Sediment		*WA, EFEA*	
Chem. Contam./Nutrients		*WA, PJ*	
Habitat Access			
Physical Barriers		*SS, WA, EFEA*	
Habitat Elements			
Substrate Embeddedness	*SS, EFEA, PJ*		
Large Woody Debris			*SS, WA, EFEA*
Pool Frequency and Quality		*SS, WA, EFEA*	
Large Pools		*SS, WA, EFEA*	
Off-Channel Habitat		*WA, SS, EFEA*	
Refugia (cutthroat trout)			*WA SS, PJ, MON, EFEA*
Channel Condition & Dynamics			
Width/Depth Ratio		*SS*	
Streambank Condition	*SS, EFWA*		
Floodplain Connectivity		*WA, EFWA*	
Flow/Hydrology			
Change in Peak/base flows		*WA*	
Drainage Network Increase			*WA*
Watershed Condition:			
Road Density & Location			*WA*
Disturbance History			*WA*
Riparian Reserves			*WA*
Disturbance Regime		*WA*	
Integration of Species and Habitat Conditions	unknown	unknown	unknown

Abbreviations: WA = watershed analysis; SS = stream surveys; PJ = professional judgment; MON = monitoring; FO = field observations; EFEA = East Fork Lewis River Fish Habitat Rehabilitation Project Environmental Assessment (USDA 1999)

Following are descriptions of various pathway indicators that are used to determine environmental baselines for the Upper East Fork Lewis River Watershed. Fish and other aquatic organisms are sensitive to a variety of disturbance factors and have specific habitat requirements for their life stages. The optimum habitat factors for the species that are present in this watershed are displayed in Table 1.

Subpopulation Characteristics within Subpopulation Watersheds

Subpopulation Size, Growth and Survival, Life History Diversity and Isolation, Persistence and Genetic Integrity — Unknown.

Winter and Summer run steelhead trout (*Oncorhynchus mykiss)* are currently considered present upstream of Sunset Falls in the East Fork Lewis River, although most fish above the falls are believed to be summer run. Winter run steelhead on the East Fork Lewis River are supplemented with hatchery stock, whereas the summer run are predominately wild fish.

The migration range for steelhead in the East Fork Lewis River Watershed ends at a waterfall located at river mile (RM) 42.0 on the upper East Fork, at a debris jam near RM 1.6 on Slide Creek and at a waterfall and associated valley spanning debris jam at RM 2.5 on the Green Fork. Minor use also occurs in Little Creek, below the waterfall and debris jam at RM 0.1 and the unnamed tributary to Slide Creek at RM 1.3. Steelhead were observed in McKinley Creek during 2002 presence-absence surveys; Poison Gulch may also be used, which is not confirmed.

Redd surveys have been conducted by the WDFW between 1992 and 1999. Redd densities appeared to decline following the winter flood of 1996, which was attributed to a loss in habitat complexity in the 1999 East Fork Lewis River Restoration EA. However, 1999 densities increased, demonstrating the complexity of factors responsible for salmon population trends. For example, the 1996 floods may have resulted in an indirect loss of existing spawning habitat. However flood conditions may have resulted in a net increase in spawning habitat, which would result in increase spawning opportunities during years following the flood. Additional survey years are recommended to apply a statistically valid trend analysis.

Snorkel surveys, which began in 1995, are conducted annually by the WDFW. Adult wild and hatchery steelhead are counted in the surveys and are performed during July. While the numbers do not estimate total population values for steelhead in the East Fork Lewis River and its tributaries, it does provide a minimum count, and a basis for comparing trends between years. The total wild steelhead count was 393, the highest count since the surveys were initiated during 1995. The apparent decline following the 1996 flood event was temporary, indicating that salmon population dynamics are complex and difficult to characterize.

Water Quality

Temperature — Functioning at Unacceptable Risk

High water temperatures during summer months represent the most important water quality concern in the upper East Fork Lewis River. The Washington State Department of Ecology (DOE) temperature standard is 16°C; excursions beyond 16°C are considered “water temperature exceedances.” Because the East Fork Lewis River exceeds WDOE water quality standards, the river is listed at two locations downstream in the Washington 1998 §303(d) list (WAC 173-201-080). The mainstem of the East Fork Lewis River has the highest stream temperatures of all major streams in the Upper East Fork Lewis River Watershed, within the National Forest boundary. The maximum 7-day average temperature was 18.0° C in 2001 in the mainstem of the East Fork, downstream of Sunset Falls Campground near the Gifford Pinchot National Forest boundary (Table 2). River temperatures downstream of Slide Creek exceeded 16°C for extended periods in 2001. Historical data are limited in the Upper East Fork Lewis River Watershed.

Table 2 contains a summary of current temperature conditions within the East Fork Lewis River Watershed. Temperatures of most streams within the watershed meet WDOE temperature criteria. The total number of days exceeding a temperature of 16°C decreased in the East Fork of the Lewis River and Canyon Creek during 2001.

Table 2. East Fork Lewis River watersheds stream temperature from June 15 through September 15, 2001. Canyon Creek (Yale Reservoir – Lewis River Sub-watershed) is provided for comparison.

Streams In downstream order	Monitoring location	**Maximum (°C)**	**Days >16.0°C**	**7-day average maximum(°C)**
Canyon Creek	Above Jake's Creek	12.6	0	12.3
Canyon Creek	Above Big Rock Creek	15.2	0	14.8
East Fork Lewis River	Above Green Fork	**17.0**	**7**	**16.5**
Green Fork	One mile above East Fork	15.0	0	14.4
Green Fork	0.5 mile above East Fork	15.3	0	14.9
East Fork Lewis River	Below Green Fork	**16.2**	**3**	15.8
East Fork Lewis River	Below Little Creek	**16.2**	**3**	15.8
East Fork Lewis River	Above Slide Creek	**17.1**	**7**	**16.5**
Slide Creek	0.25 mile above East Fork	**16.2**	**2**	15.6
East Fork Lewis River	Below Slide Creek	**18.1**	**17**	**17.6**
East Fork Lewis River	Below Sunset Falls Campground	**18.5**	**29**	**18.0**
Copper Creek	Above Bolin Creek	15.8	0	15.4
East Fork Lewis River (downstream of NFSL)	Above Niccolls Creek and below Horseshoe Falls	**19.2**	**35**	**18.8**

Bold – Monitoring Station with Temperatures above 16° C

The mainstem of the East Fork has the highest water temperatures and most frequent excursions beyond the WDOE temperature criterion of 16°C within the watershed. Temperatures are highest downstream of Slide Creek and continue to rise downstream of Sunset Falls. Temperatures upstream of Green Fork are higher than the East Fork tributaries and mainstem between the Green Fork and Slide Creek. Cool temperatures contributed by the Green Fork and other tributaries appear to moderate temperatures downstream. One monitoring station along the East Fork Lewis River is located on private property downstream of Horseshoe Falls and Copper Creek. The largest heat input to the East Fork Lewis River on National Forest System Lands appears to occur downstream of Slide Creek; the highest number of temperature violations occur at Sunset Falls and downstream. Green Fork, Copper Creek and Canyon Creek did not exceed 16°C during 2001. All three systems have a history of exceeding the maximum temperature standard of 16°C (Table 3). Based on this analysis, this indicator is considered to be functioning at an unacceptable risk.

Table 3. Historical summary of streams exceeding the state temperature standards within the Yale Reservoir – Lewis River, and East Fork Lewis River watersheds. Canyon Creek (Yale Reservoir – Lewis River Sub-watershed, 170800020s) and Siouxon Creek (Swift Reservoir – Lewis River sub-watershed, 1708000204) are provided for comparison.

Stream Name	Monitoring location	Years monitored	Number of years temperature exceeded 16.0°C	Maximum temperature (°C) during monitoring period (Year)
Siouxon Creek	Below West Creek	1996-2000	**5**	**22.0 (1997)**
Canyon Creek	Above Big Rock Creek	1997-1998, 2001	**2**	**16.9 (1998)**
East Fork Lewis River	Above Green Fork	1999-2001	**2**	**17.5 (2000)**
Green Fork	Near confluence w/ East Fork Lewis River	1996-2001	**2**	**22.0 (1997)**
East Fork Lewis River	Below Green Fork	2001	**1**	**16.2 (2001)**
East Fork Lewis River	Below Little Creek	1999-2001	**1**	**17.9 (2000)**
East Fork Lewis River	Above Slide Creek	2001	**1**	**17.1 (2001)**
East Fork Lewis River	Below Slide Creek	2001	**1**	**18.1 (2001)**
East Fork Lewis River	Below Sunset Falls	2001	**1**	**18.5 (2001)**
Copper Creek	Above Bolin Creek	1977-1981, 1996-2001	**7**	**20.8 (1997)**
East Fork Lewis River	Above Niccolls Creek	1997, 1999-2001	**4**	**20.1 (2000)**

<u>Sediment in Areas of Spawning and Incubation</u> — Functioning at Risk

The Pacific Watershed Institute conducted a sediment budget and landslide analysis in the East Fork Lewis River watershed during 1998 (PWI 1998). The Upper East Fork Lewis River Watershed is considered to be sediment supply-limited due to various factors including depletion of sediment sources due to fire and subsequent salvage-related landslides, naturally thin soils, recent low landslide rates, and the observation that gravels are not plentiful naturally.

Of the various surface erosional processes at work in the watershed, sediment delivery via roads is the most prevalent. Principal mechanisms for sediment delivery to streams from roads in the East Fork Lewis River Watershed were identified: surface ravel from exposed cut-and fill-slopes, sidecast and fillslope failures, and undermining of roadbeds due to gully erosion associated with insufficient drainage. Unlike the composition of landslide sediments, finer materials including sand and silts are believed to dominate the largest fraction of sediments delivered via roads to stream channels. Most fines are transported along road surfaces during high intensity and/or long duration storms when water is conveyed to streams along road treads. Because the Upper East Fork Lewis River and its tributaries are transport reaches, most sediment from National Forest System Lands are transported downstream, off-forest.

Road density, stream crossings, stream channel network increase are used to indicate potential for road derived sedimentation. Tables 4 and 5 list these values for the East Fork Lewis River Watershed. Another effect of roads in the East Fork is to block downstream passage of desirable sediment and organic matter. This effect has not been quantified, but has been observed in the watershed.

Table 4. Road summary data by sub-watershed within the EF Lewis River watershed.

Sub-watershed	Road mileage	Stream crossings	Area (mi^2)	Road density (mi/mi^2)
East Fork Lewis River Headwaters 170800020501	35.0	68	14.9	2.3
Upper East Fork Lewis River 170800020502	51.8	121	15.2	3.4
Copper Creek 170800020503	33.9	56	14.0	2.4
Middle East Fork Lewis River (King Creek) 170800020504	1.9	0	0.6	3.2
Rock Creek 170800020505	0	0	1.8	0.0
Total Upper East Fork Watershed	**122.6**	**245**	**46.5**	**2.6**

Table 5. Drainage network increase based on culvert spacing, number of crossings and stream channel lengths within the EF Lewis River watershed.

Sub-watershed	Area (mi^2)	Drainage network length, miles		Drainage density, mi/mi^2		Percent change
		Streams (L_S)	Road-related extension (L_{RC})	Streams (D_d)	Total (D'_d)	
East Fork Lewis River Headwaters 170800020501	14.9	80.8	13.8	5.4	6.4	14.6%
Upper East Fork Lewis River 170800020502	15.2	83.0	24.6	5.5	7.1	22.9%
Copper Creek 170800020503	14.0	54.1	11.4	3.9	4.7	17.4%
Middle East Fork Lewis River (King Creek) 170800020504	0.6	1.1	0	1.8	1.8	0.0%
Rock Creek 170800020505	1.8	9.4	0	5.2	5.2	0.0%
Total	**46.5**	**228.3**	**49.8**	**4.9**	**6.0**	**17.9%**

While the Upper East Fork Lewis River Watershed is considered sediment-supply limited, factors contributing to this condition include blockage of sediment delivery by undersized or lack of culverts, and the lack of large wood within the watershed that would function to retain sediment within stream channels. Additionally, the aging nature of the road system in the drainage, the absence of adequate drainage on unmaintained roads, the high road density within riparian reserves and the high number of stream crossings increases the potential risk of delivery of finer sediments to streams. Based on this analysis, this indicator is considered to be functioning at risk.

<u>Chemical Contamination/Nutrients</u> – Functioning at Risk

An analysis of the chemical constituents within waters of the East Fork Lewis River Watershed has not been performed. However, based on professional knowledge regarding uses in the watershed and the biological condition of waters in the East Fork Lewis River, chemical water pollution is not likely. It is likely that the waters in the Upper East Fork Lewis River are actually *nutrient limited* based on the lack of instream wood or low frequency of holding pools that would allow the accumulation of organic material that would contribute to the productivity of the system. Turbidity from sediment delivery via roads has not been measured in the watershed. Some riparian road systems do contribute sediment to the East Fork Lewis River and its tributaries. Spring road maintenance (including blading) along the 42 Road is only permitted after July 1 due to observed turbidity in the East Fork Lewis River, which occurred during a rainstorm that immediately followed surface blading activities. Turbid water has also been observed entering Copper Creek near the 4109 Road, flowing directly from a small channel linking the muddy road surface to the stream. A resource concern in the Copper Creek drainage includes an abandoned system of copper mines near the Miner's Creek and Copper Creek confluence. Several spur roads (4107 system) lead to and radiate from the abandoned site, and lie entirely within riparian reserves. The abandoned road system, which has drainage problems, is recommended for decommissioning in the Gifford Pinchot National Forest Roads Analysis (2002) and the 2nd Iteration Upper East Fork Lewis River Watershed Analysis.

Water samples are collected monthly at the Sunset Campground well and tested for the presence of fecal coliform. Some past tests have indicated unacceptable levels of fecal coliform for consumption (WDOE standard; L. Walker, personal communication). It is unclear how the subsurface water becomes contaminated, and it is recommended that instream monitoring occur in the future up and downstream of the site, which is located approximately 100 feet from the East Fork Lewis River. The river is listed (CWA 303(d)) for fecal coliform exceedances on private lands, downstream of National Forest.

Because of the high density of riparian roads in the Upper East Fork Lewis River, observed turbidity and concerns regarding abandoned mines in the Copper Creek sub-watershed, this indicator is considered to be functioning at risk until planned drainage and surface repairs on the 42 road and proposed road decommissioning, weatherization and maintenance occurs, and an evaluation of the abandoned mining operations at Miner's Creek is made.

Habitat Access

<u>Physical Barriers</u> — Functioning at Risk

An inventory of culvert barriers was conducted in the anadromous fish bearing streams in the watershed during 2002. Two culverts inventoried in the basin were determined to be barriers to anadromous fish. There are also 8 possible culvert barriers (one confirmed on Bolin Creek) in the Copper Creek sub-watershed that are considered to be barriers to resident fish, including cutthroat trout (Figure 1). Therefore, this indicator is determined to be Functioning at risk.

East Fork Lewis River

Fish Distribution and Migration Barriers

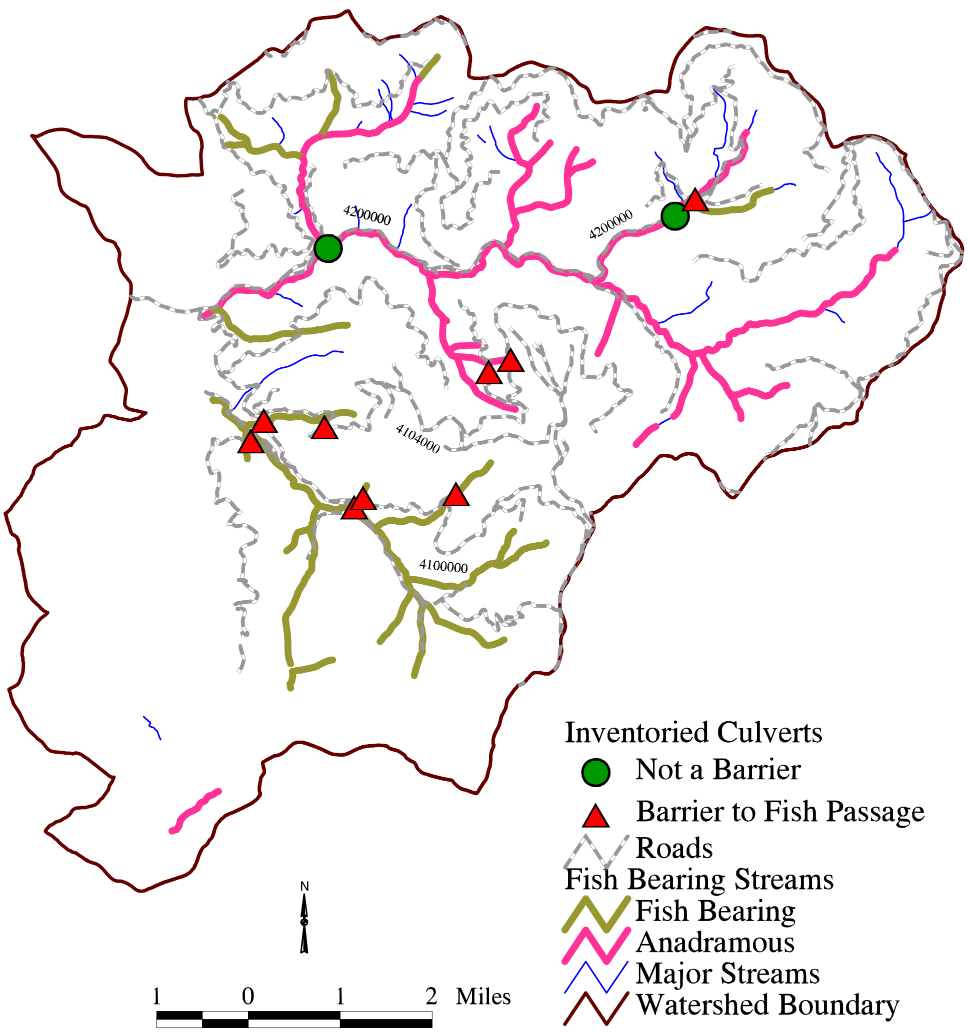


Figure 1. Fish distribution and location of culvert barriers to fish passage in East Fork Lewis River watershed on National Forest lands.

Habitat Elements

<u>Substrate Embeddedness in Rearing Areas</u> **-** Functioning Appropriately

Substrate embeddedness data are not collected as part of the U.S. Forest Service Region 6 Level II stream survey protocol, however it is noted in stream survey narratives if it is observed. Based on stream survey and channel stability narratives, substrate embeddedness is not a problem in the East Fork Lewis River on National Forest Lands. High road densities (particularly within riparian areas) and the high number of stream crossings may contribute to downstream sedimentation, although the contribution is believed to be minor relative to other land uses in the sub-basin. This risk may increase as unmaintanied roads age beyond their design life.

<u>Large Woody Debris</u> **-** Functioning at Unacceptable Risk

Table 6 lists a summary of stream survey data from the SMART database. In the East Fork Lewis River watershed, the most current data indicates all surveyed streams are rated poor. The East Fork Lewis River Restoration Project (USFS 1999) was implemented during summer 2000 and 2001, which included the installation of several log structures and some instream Rosgen-style rock structures (Rosgen 1994). All structures were constructed and placed according to the Environmental Assessment and Risk Hazard Analysis (USFS 1999). Structures were placed in locations above the ordinary high waterline to provide high flow refugia for steelhead and coastal cutthroat. The structures were not placed below high water because of safety issues related to kayak use (USFS 1999). Several structures were placed at historical side channel inlets to encourage diversion of mainstem flow into the side channels. Large wood concentrations in the East Fork Lewis River have declined continuously since stream surveys began in the watershed in the 1980's (USFS 2002). All stream reaches within the Upper East Fork Lewis River Watershed are rated as poor according to the Columbia River Basin Anadromous Policy Implementation Guidelines (PIG); therefore, this indicator is determined to be Functioning at unacceptable risk.

<u>Pool Frequency and Quality</u> - Functioning at Unacceptable Risk.

See Table 6 for a summary of Level II stream survey data. Large holding pools provide resting places for adult steelhead after their upstream migration and provide thermal refuge and cover from predation. The East Fork has several large pools below the Green Fork confluence; however, many of these are not close to spawning sites or lack cover from predators. Quality holding pools are rare on Slide Creek, the Green Fork, and the East Fork Lewis River above the Green Fork confluence. This is generally due to low summer base flows, which substantially reduces the pool sizes. This is a critical factor for summer run steelhead since they inhabit these areas during the summer and fall seasons. There are existing holding pools upstream of Slide Creek; however their proximity to dispersed campsites along the river is suspected to result in an increase in adult displacement due to harassment, poaching, and other human-caused stress factors.

The majority of spawning fish within the Upper East Fork Lewis River Watershed on National Forest System Lands utilize the mainstem of the East Fork Lewis River from Sunset Falls to McKinley Creek, with much less spawning occurring in Slide Creek, Green Fork, and the upper East Fork upstream of the Green Fork confluence. Use patterns may correspond to the amount of available gravel and proximity to large adult holding pools that are not found in upper reaches. During snorkel surveys conducted by PWI and the Forest Service in 1998, adult steelhead were found utilizing large pools in the East Fork below the Green Fork confluence; however, no adults were found in pools in Slide Creek, the Green Fork or the upper East Fork above the Green Fork confluence, yet juvenile steelhead are abundant in these reaches. While spawning is apparently occurring there, pools of sufficient quality may be lacking in these upper reaches and tributaries. Adult fish may be falling back to larger pools along the mainstem of the East Fork during summer low flow periods. The formation of pools is limited due to channel morphology, although some instream opportunities exist, including the placement of large wood or boulders to improve habitat. This indicator is determined to be Functioning at risk.

Large Pools - Functioning at Risk

Juvenile rearing is influenced by channel complexity in the form of structures where juveniles can establish feeding stations, find refuge from high velocity flows and escape predation. Structures consist of riffles with interspersed boulders, boulder forced pools on channel margins, overhanging vegetation, and large wood accumulations and side channels for high flow refuge. It is preferable that these features are close to and just downstream of spawning sites. Improving stream complexity in areas downstream of spawning sites can enhance rearing success. Table 6 lists large pool frequencies that have been observed in the Upper East Fork Lewis River watershed. This indicator is determined to be Functioning at risk for the same reasons described above.

Off-Channel Habitat **-** Functioning at Risk

Off-channel or high flow refuge in the form of side channels are rare but do exist, particularly in areas of lateral and mid-channel gravel bars. However, these side channels are either unavailable to fish due to channel incision or have water velocities that are too fast for use by juveniles, except during the highest flows. Because of the confined nature of the Upper East Fork Lewis River and its tributaries, there are limited opportunities for the development of side channels. Most reaches in the Upper East Fork are considered Rosgen channel types A and B, which are typically higher gradient and more laterally confined, offering less opportunity for off-channel habitat features. Off-channel habitat opportunities occur in areas of sediment accumulation, where debris fans occur at stream confluences. Because of the limited opportunity for the formation of off-channel habitat, the potential for improving it is limited to a few areas along the Green Fork and East Fork where channel incision down to bedrock has occurred. Stream channel restoration activities were designed to improve off-channel habitat by encouraging the diversion of mainstem flow into side channels, but have had limited success. Instream structures were not placed below ordinary high water due to safety concerns for recreational kayakers. (USFS 1999). Although there are few opportunities to improve off-channel habitat, it is very important habitat because of its relative rare occurrence. Because of this and the limited quality of these few areas, this indicator is determined to be Functioning at risk.

Refugia - Functioning at Unacceptable Risk.

Juvenile rearing is influenced by channel complexity in the form of structures where juveniles can establish feeding stations, find refuge from high velocity flows and escape predation. Structures consist of riffles with interspersed boulders, boulder forced pools on channel margins, overhanging vegetation, and large wood accumulations and side channels for high flow refuge. It is preferable that these features are close to and just downstream of spawning sites. Improving stream complexity in areas downstream of spawning sites can enhance rearing success.

While some natural conditions preclude the development of various refugia components, the lack of large wood, high stream temperatures in some locations, passage barriers and interception of bedload and debris by roads in the watershed limit the potential opportunities for the development of refugia. Because of this, this indicator is determined to be Functioning at unacceptable risk for all fish species.

Channel Condition and Dynamics

Mean Bankfull Width/Mean Bankfull Depth Ratio in riffles in a reach - Functioning Appropriately

Of the streams surveyed in the watershed, most Rosgen A meet the width/depth criteria by Rosgen type (Table 6). Most reaches are "B" channels with some "C" in "response" type reaches where debris fans are located at stream channel confluences. Channel characterized as Rosgen B channels have width to depth ratios greater than 12, reflecting channel incision to bedrock, which is attributed to fires and subsequent salvage operations. Therefore, this indicator is determined to be Functioning Appropriately.

Streambank Condition - Functioning Appropriately

Stream channel stability analysis has not been performed in the Upper East Fork Lewis River Watershed. However, based on field observations and discussions by Shaw et al (1998), much of the Upper East Fork consists of bedrock controlled, confined channels. Channel segments prone to streambank erosion occur at debris fans where third and fourth-order tributaries enter the mainstem. The largest debris fan deposits occur at Slide Creek, Little Creek and Green Fork.

A large landslide feature on the north side of the mainstem channel (RM 35) appears to have been active during and prior to the 1902 fires, and reactivated during 1958 based on aerial photo interpretation. The landslide is bisected by the 42 Road, and is deposited in the river as a debris fan that has been reworked by the river, and appears as a point bar. With the exception of this one location, streambank condition has been observed to be good due to bedrock channels and armored streambanks that only deliver sediment during the highest flows. The latter factor is considered to contribute to the limited transport of gravels downstream. For these reasons this indicator is determined to be Functioning Appropriately for all fish species.

Floodplain Connectivity - Functioning at Risk

Because of the confined nature of the Upper East Fork Lewis River and its tributaries, there are limited opportunities for the development of floodplains. Most reaches in the Upper East Fork are considered Rosgen channel types A and B, which are typically higher gradient and more laterally confined, offering less opportunity for the development of floodplains. However, there are a few locations along the East Fork and Green Fork where the channel is entrenched to bedrock, and disconnected from flood plains, as few as there may be. For this reason, this indicator is determined to be Functioning at risk.

Flow/Hydrology

Change in Peak/Base Flows - Functioning at Risk

East Fork Headwaters upstream of Green Fork (8.2%), McKinley Creek (8.5%), Slide Creek (9.6%) and Copper Creek (8.4%) had the highest peak flow predictions based on methods described in the State of Washington "Standard Methodology for Conducting Watershed Analysis" (1997), Hydrologic Change Module. The sub-watershed with the highest potential for increased peak flows was Copper Creek (8.4%). Stands are believed to be recovering, and peak flow values are expected to improve over time. Planned harvest activities, which would affect peak flow predictions, include commercial thinning, which would be designed to increase growth, and not increase peak flows. Table 7 lists peak flow calculations. Based on this information, this indicator is determined to be Functioning at risk.

Increase in Drainage Network - Functioning at Unacceptable Risk

Stream channel network extensions were highest in the Upper East Fork Lewis River Watershed (170800020502) at 22.9%, and relatively moderate in the East Fork Lewis River Headwaters (170800020501) and Copper Creek (170800020503) at 14.6% and 17.4%, respectively. Slide Creek, Little Creek and McKinley Creek have the highest road densities within the Upper East Fork; the Green Fork has the highest road densities in the East Fork Headwaters. Table 6 lists road and stream crossing data, Table 5 lists stream channel network increase estimates.

Stream channel network extensions are lowest within the King Creek and Rock Creek sub-watersheds (170800020504 and 170800020505). The data are only a reflection of GIS stream and road data available for National Forest System Lands. Most roads on National Forest System Lands within the King Creek and Rock Creek sub-watersheds have been converted to trails, except for the 4109 road, which is largely constructed along a ridge where it exits the Copper Creek drainage. Based on road densities and stream channel network increases, this indicator is determined to be Functioning at unacceptable risk.

Watershed Conditions

Road Density & Location **-** Functioning At Unacceptable Risk

Table 4 displays road density and number of stream crossings within the Upper East Fork Lewis River Watershed. The highest road densities (3.4 miles per square mile) and number of stream crossings (121) were found in the Upper East Fork Lewis River Sub-watershed, which includes Slide Creek, McKinley Creek and Little Creek. Road density in the entire Upper East Fork Lewis River Watershed (on National Forest System Lands) was 2.6 miles per square mile. Road densities within Riparian Reserves in the Upper East Fork Lewis River Watershed totaled 8.7 miles per square mile (Table 8). For these reasons, this indicator is determined to be Functioning at unacceptable risk.

Disturbance History **-** Functioning at Unacceptable Risk

Using the peak flow analysis as and indicator of disturbance, relatively high road densities and because of the lack of large instream wood and historical practices of stream cleaning in the watershed and the lasting impacts of large stand replacement fires that occurred in the early part of the 20th century, this indicator is considered to be Functioning at unacceptable risk.

Riparian Reserves - Functioning at Unacceptable Risk

Table 9 lists vegetation structure for the entire watershed, Table 10 lists vegetation structure in riparian reserves. The percent of riparian reserve within analysis area sub-watersheds that are characterized as seedling/sapling/small tree (poles) is 61.8%; mature stands including single and multiple story is 3.0%, and approximately 27.1% is mapped as hardwood. Because of the fire history within the watershed, historic fires, the lack of instream large wood, high road densities in Riparian Reserves and high temperatures in the mainstem of the East Fork, there is a significant loss of riparian function. Based on this information, this indicator is considered to be Functioning at unacceptable risk.

<u>Disturbance Regime</u> - Functioning at Risk.

Most instream disturbance occurred following massive fire and subsequent salvage logging operations that occurred mid- 20th century. Landslide occurrence was at a peak during this time period (PWI 1998). Most landslide events appear to have coincided with management and salvage activities that occurred during the 1950's, with a smaller pulse sometime between 1975 and 1995. This information is limited to available aerial photo flight years 1958, 1959, 1975, 1995 and 1997. The prevalence of 45 to 50 year-old red alder (*Alnus rubra*) is an indicator of the last major disturbances that disrupted riparian stands.

PWI (1998) surmised that most areas prone to fail have already done so with the exception of road-related failures that are expected to occur as unmaintained roads and roads built on sidecast continue to age beyond their design life. Harvest activity since salvage operations following fires has been limited to 5% of the watershed area (Table 11).

Objectives including restoration of riparian areas that include activities such as road weatherization, decommissioning and increased maintenance are expected to reduce the potential recurrence of a severe perturbation of the stream channels and associated riparian areas. Establishment of Riparian Reserves will further the objective of restoring the condition of the watershed. However, the Upper East Fork Lewis River Watershed is at risk from increased public use due to its close proximity to the Portland-Vancouver metropolitan area. A lack of Recreation Management in the area is expected to continue to threaten the watershed. Placer mining continues to occur in Copper Creek and just downstream of Green Fork in the mainstem. Some dredging activities occur with this "small scale mining" (see Watershed Analysis, 2002). Because of these factors, this indicator is considered to be Functioning at risk.

Muddy River Watershed (HUC# 1708000202)

The new 5th Field Muddy River Watershed (1708000202) covers 86,913 acres (85,666 of National forest and 1,247 of private ownership), and ranges in elevation form 1,008 feet at Swift Reservoir to 8,298 feet at the crater rim of Mount St. Helens. The Muddy River includes lands drained by Smith Creek, Clearwater Creek, Clear Creek, Elk Creek, and the reaches of Muddy River. The Muddy River is a relatively small watershed that drains into a portion of the Upper Lewis River.

The Muddy River watershed primarily developed from volcanic and glacial geologic processes and has been shaped by recent wind and rain erosional processes working on the surficial deposits. The majority of the area is composed of Tertiary bedrock overlain by glacial till, lahars, tephra and alluvial deposits. The 1980 eruption of Mount St. Helens clearly demonstrated the effects of volcanism on shaping the landscape. The lahars that moved down the Muddy River and Smith Creek and the blast area in the northwestern part of the watershed will have long lasting effects on processes occurring in the watershed. Tephra deposits laid down in Clearwater, Bean, and Smith Creeks have created a large area that is highly susceptible to surface erosion, shallow mantle failures and debris torrents in many of the steep sideslopes and drainages.

Large Fires have been a major agent of natural change in the forest landscape of the Muddy River watershed. Fire has been an integral part of the forest ecosystem, affecting wildlife habitat, vegetation dynamics, soil properties and water.

The Muddy River Watershed has approximately 736 miles of stream. Rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), mountain whitefish (*Prosopium williamsoni*), largescale suckers (*Catastomus macrocheilus*), and sculpins (*Cottus* sp.) are the most common fishes found in the streams. Bull trout (Salvelinus confluentus) are found below the watershed boundary.

There are two large reservoirs created by the dams on the Lewis River.TheYale Lake and Swift Reservoir, which are approximately 3,800 and 4,580 acres, respectively. No anadromous fish currently access the Muddy River watershed because upstream fish passage is blocked by the dams at both Yale Lake and Swift Reservoir. Both reservoirs contain rainbow trout, cutthroat trout, bull trout, mountain whitefish, and largescale suckers. However, experimental populations of coho salmon fry were released upstream of Yale and Swift Dam as part of a FERC re-introduction study in the Lewis River. Juvenile Coho salmon have been observed in the Muddy River and its tributary.

Mean stream water temperatures meet the State Water Quality standard of 68° F (20 ° C); however, maximum temperatures exceed this standard for short periods of time. This could affect optimum spawning and rearing behavior for salmonids.

Culverts and road crossings can fragment aquatic habitat by interfering with fish migration, as well as the flow pattern of LWD and sediment through the system. The watershed contains 565 road/stream crossings, which, when divided by 736 stream miles equates to 0.77 crossings per mile of stream. Thirty percent of the riparian reserves along streams have undergone timber harvest in the past 50 years.

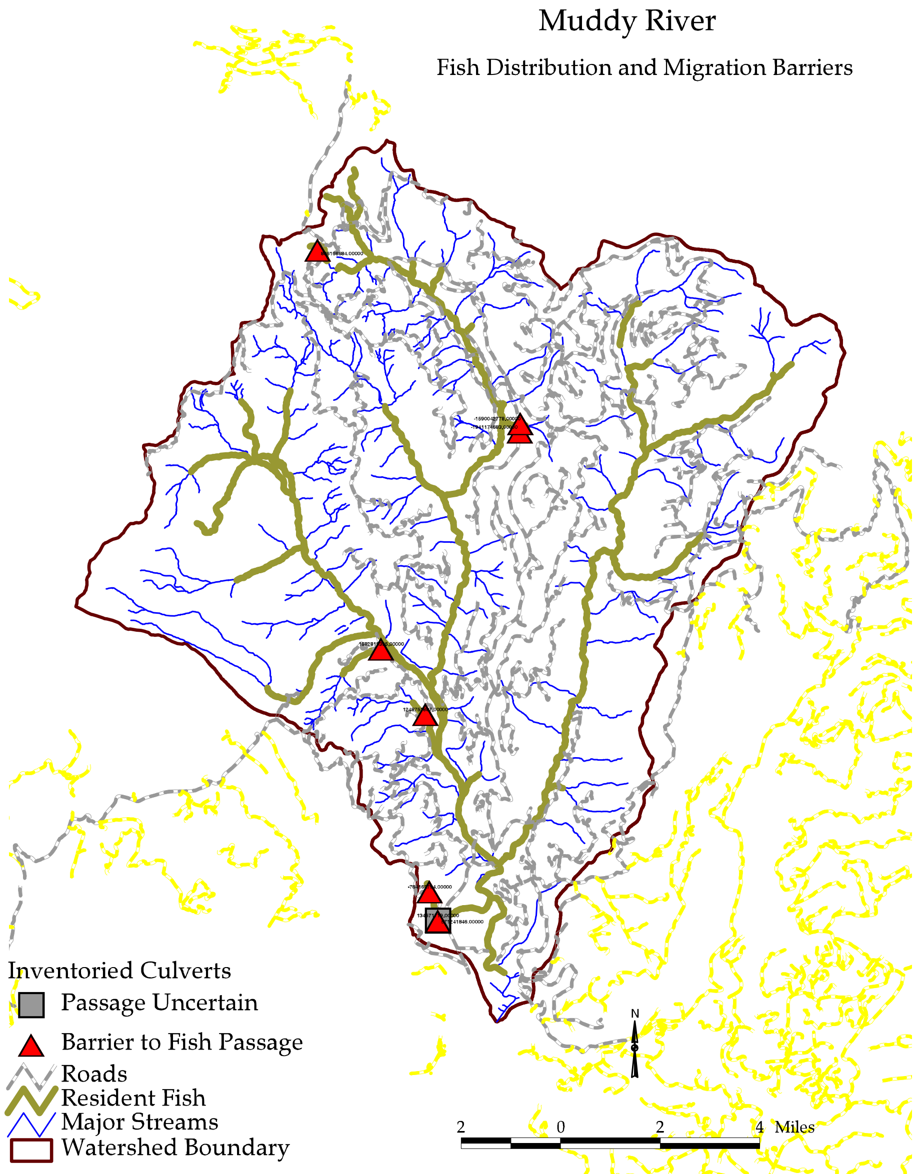


Figure 1. Current fish distribution in Muddy River watershed.

The environmental baselines for the Muddy River 5th Field Watershed is summarized in Table 1. The baseline condition is determined for the 5th field watershed. Stream survey data is used to determine the ratings for several indicators. Streams which have been surveyed for this analysis are; Muddy River, Smith Creek, Clearwater Creek, Clear Creek, and Elk Creek

Baseline determinations for specific indicators were determined using findings from watershed analysis (with 2002 updates of data), data from stream surveys and monitoring data, practical knowledge of conditions of the ground from field reconnaissance, and professional judgment as needed. Rational for determinations of individual indicators is provided.

Table 1. Environmental Baseline Summary for the Muddy River Watershed

DIAGNOSTICS/PATHWAYS: INDICATORS	ENVIRONMENTAL BASELINE		
	Functioning Appropriately	Functioning At Risk	Functioning at Unacceptable Risk
Subpopulation Characteristics: Subpopulation Size	unknown	unknown	unknown
Growth and Survival	unknown	unknown	unknown
Life History Diversity and Isolation	unknown	unknown	unknown
Persistence and Genetic Integrity	unknown	unknown	unknown
Water Quality: Temperature			MON, WA
Sediment			WA
Chem. Contam./Nutrients	WA, PJ		
Habitat Access: Physical Barriers			SS, WA
Habitat Elements: Substrate Embeddedness		SS, WA, PJ	
Large Woody Debris			WA
Pool Frequency and Quality			SS, PJ
Large Pools		SS, PJ	
Off-Channel Habitat		FO, WA	
Refugia		PJ, WA	
Channel Cond. & Dyn.: Width/Depth Ratio		SS	
Streambank Condition			WA
Floodplain Connectivity		WA	
Flow/Hydrology: Peak/base flows		WA	
Drainage Network Increase		WA	
Watershed Condition: Road Density & Location			WA
Disturbance History			WA
Riparian Conservation Areas		WA, PJ	
Disturbance Regime		WA	
Integration of Species and Habitat Conditions	unknown	unknown	unknown

Abbreviations: WA = watershed analysis; SS = stream surveys; PJ = professional judgment; MON = monitoring; FO = field observations

Following are descriptions of various pathway indicators that are used to determine environmental baselines for the Muddy River Watershed. Fish and other aquatic organisms are sensitive to a variety of disturbance factors and have specific habitat requirements for their life stages. The optimum habitat factors for the species that are present in this watershed are displayed in Table 1.

Subpopulation Size — Unknown.

Region 6 Level II stream surveys are conducted annually in the Muddy River watershed to collect stream habitat and fish presence/absence data. Stream habitat inventory records and fisheries surveys indicate that streams in the Muddy River watershed support resident populations of the following species: cutthroat trout (Onchorynchus clarki), brook trout (Salvelinus fontinalus), rainbow trout (Onchorynchus mykiss), unidentified sculpin (cottus sp.), and mountain whitefish (Prosopium williamsoni). These species inhabit Clear Creek, Clearwater Creek, Elk Creek, Smith Creek, and their tributaries. Information on the abundance of these populations is not available.

A bull trout (Salvelinus confluentus) population exist in the Lewis river below "Lower Falls" river mile 73. This population inhabits Swift reservoir and it's tributaries. Information being collected on these populations has included habitat attributes, distribution and spawning counts.

Coho salmon does not occur in the Lewis River above 3 major dams along the Lewis River. However, experimental populations of coho salmon fry were released upstream of Yale and Swift Dams as part of a FERC re-introduction study in the Lewis River. Substantial coho spawning habitat has been blocked or passage substantially imparied in the Lewis River as a result of dams. Juvenile Coho salmon have been observed in the Muddy River and its tributary.

Growth and Survival, Life History Diversity and Isolation, Persistence and Genetic Integrity — Unknown.

Water Quality

Temperature - Functioning at Unacceptable Risk

Stream water temperature is a major factor influencing the composition and productivity of aquatic ecosystems. Fish, aquatic macroinvertebrates, and other aquatic organisms are affected directly and indirectly by changes in water temperatures. Specifically for salmonids, stream temperature influences the timing of migration, spawning, incubation rates, growth, distribution, resistance to parasites, food supply and quality, and tolerances to diseases and pollutants (Bjornn and Reiser 1991). Aquatic organisms are often able to withstand short- term increases in stream temperature and adjust by moving to optimum habitat within the channel. Long term changes or peaks in water temperature may directly alter the established patterns of the salmonid populations.

Maximum temperatures in the Muddy River exceeded 16°C more than 200 occurrences during 2001 than in 2000. Gauging stations above and below Clear Creek confluence, Clearwater 8 miles above Muddy River, and Clear Creek near confluence with Muddy River exceeded 16°C during 2000. The Washington State Department of Ecology temperature standard is 16°C; excursions beyond 16°C are considered "water temperature exceedances." The Muddy River maximum 7-day average temperature was above the Clear Creek confluence was 21.1^{o} C in 2001 (Tables 2 and 3). The maximum 7-day average temperature in the Muddy River below the Clear Creek confluence was 20.1°C.

Loss riparian vegetation from the 1980 eruption caused increased stream temperatures in Clearwater Creek. Maximum stream temperatures are decreasing and recovery is continuing as canopy begins to close back in over smaller and intermediate sized tributaries to Clearwater Creek.

Table 3, contains a summary of current temperature conditions within the Muddy River Watershed. Temperatures at all gauging stations exceeded the WDOE temperature criteria. Therefore this indicator is determined to be Functioning at Unacceptable Risk.

Table 2. Muddy River Watershed Stream Temperatures from *June 15 through September 15, 2000*.

Streams In downstream order	Monitoring location	Maximum temperature (°C)	Number of days above 16.0°C	Maximum 7-day average temperature (°C)
Muddy River	**Above Clear Creek confluence**	**20.1**	**64**	**20.1**
Muddy River	**Below Clear Creek confluence**	**21.5**	**66**	**21.1**
Clearwater Creek	**8 miles above Muddy River**	**18.4**	**39**	**18.1**
Clear Creek	**Near confluence with Muddy R.**	**17.9**	**35**	**17.7**

Bold – Monitoring Station with Temperatures above 16° C

*Note: 18 days during September were omitted because of anomalous measurements (stowaway was most likely out of the water).

Table 3. Historical Summary of Streams Exceeding the State Temperature Standards Within the Muddy River Watersheds.

Stream Name	Monitoring location	Years monitored	Number of years temperature exceeded 16.0°C	Maximum temperature (°C) during monitoring period (Year)
Muddy River	Above Clear Creek	1991, 1996-2001	7	24.4 (1991)
Clearwater Creek	8 miles above confluence w/ Muddy River	1998-1999, 2001	3	18.8 (1998)
Clearwater Creek	Above confluence w/ Muddy River	1996-1998	3	21.2 (1998)
Clear Creek	Near confluence w/ Muddy River	1991, 1997-2001	5	22.9 (1991)

Sediment in Areas of Spawning and Incubation — Functioning at Unacceptable Risk

Increased levels of sediment can adversely affect fish habitat and riparian ecosystems. Spawning gravels can be filled in by fine sediment reducing survival of eggs and developing small salmonids (Everest et al. 1987), food availability can be reduced (Cordone and Kelley 1961), and important habitat such as pools may be filled in by excess sediment (Megahan 1982). The majority of stream channels in the analysis area are characterized as "erosion" and "transport" reaches, having relatively high gradients and confined channels that tend to move input variables such as wood, water, and sediment through quickly. Changes to the amounts of these input variables are most noticeable in low gradient, less confined sections (called "response" reaches) in the Lewis Basin.

All response reaches in the Lewis River are currently in some phase of recovery and adjustment to sediment pulses from past flood events in the 1970's and 1990's. They are adjusting primarily by channel narrowing, riparian vegetation encroachment, and/or downcutting. The Lewis River is recovering very slowly from a large pulse of sediment that occurred in the 1970's and 1990's. Average channel width increased 27% from these events. Therefore this indicator is determined to be Functioning at Unacceptable Risk.

Chemical Contamination/Nutrients - Functioning Appropriately

No known sources of chemical or nutrient contamination are known to exist. No problems were noted in the watershed analysis nor during field observations, therefore this indicator is determined to be Functioning Appropriately.

Habitat Access

Physical Barriers — Functioning at Unacceptable Risk

The Lewis River has 3 major dams along the Lewis River. These dams block the migration of anadromous salmon to the upper reaches of the watershed where they once spawned. The dams have also altered the available habitat in the system by converting over 25 miles of stream to lake habitat. In addition to the dams on the mainstem of the river, road building without adequate facilities for passage of fish has increased aquatic habitat fragmentation. Culverts and road crossings can fragment aquatic habitat by interfering with fish migration, as well as the flow pattern of LWD and sediment through the system. The watershed contains 565 road/stream crossings, which, when divided *by* 736 stream miles equates to 0.77 crossings per mile of stream. Therefore this indicator is determined to be Functioning at risk.

Habitat Elements

Substrate Embeddedness in Rearing Areas - Functioning at Risk

Substrate embeddedness data are not collected as part of the U.S. Forest Service Region 6 Level II stream survey protocol, however it is noted in stream survey narratives if it is observed. High road densities (particularly within riparian areas) and the high number of stream crossings may contribute to downstream sedimentation although the contribution is believed to be minor relative to other land uses in the sub-basin. Tephra deposits laid down in Clearwater, Bean, and Smith Creeks have created a large area that is highly susceptible to surface erosion. Roads constructed on native surfaces also deliver additional sediment to the stream channels that can alter in-channel conditions decreasing quality habitat (i.e., filling in pools, silting in spawning beds, etc.).This risk may increase as unmaintanied roads age beyond their design life.

Large Woody Debris — Functioning at Unacceptable Risk

Large woody debris is a critical component of aquatic habitats for a variety of organisms. It influences channel morphology, the storage and routing of sediment, and the amount and complexity of habitat for aquatic organisms (Hicks et. al 1991). Wood is delivered to the stream channel through a variety of mechanisms (i.e., landslides, transport from upstream areas, and direct entry from adjacent sideslopes). Management activities alter the effectiveness of these delivery mechanisms and the longevity of wood in the system. For example harvest within the riparian zone reduces the available wood supply for direct entry from adjacent slopes.

The USDA Columbia River Policy Implementation Guide of 1991 (PIG) identified standards for quantities of (LWD) in western cascade streams to provide quality salmonid habitat. The existing condition identified in stream surveys is evaluated against this standard, to determine a rating of good, fair or poor. Streams in good condition meet or exceed the standard of 80 pieces per mile. Streams in fair condition contain 40-79 pieces of LWD/mile, and streams in poor condition contain less than 40 pieces of LWD per stream mile. Stream survey data indicate, approximately 59 percent of the surveyed stream segments are rated as poor, approximately 31 percent are rated as fair, and 10 percent are rated as good.

Sub-basins 17800020201, 17800020203, and 17800020205 were given the rating of poor. The Muddy River Watershed is rated as poor according to the Columbia River Basin Anadromous Policy Implementation Guidelines; therefore, this indicator is determined to be, Functioning at unacceptable risk.

Pool Frequency and Quality —Functioning at Unacceptable Risk.

The Columbia River Policy Implementation Guide identified standards for quantities of pools/mi. in streams based on stream width to provide quality salmonid habitat. This standard is what the existing condition identified in stream surveys is evaluated against, to determine a rating of good, fair or poor. Streams in good shape meet or exceed the quantity of pools based on width, streams in fair condition contain 50-99 percent of the desired number of pools, and streams in poor condition contain fewer than 50 percent of the desired pools per mile in sub-basins 17800020201, 17800020202, 17800020203, and 17800020205. Stream survey data indicate similar results, approximately over 50% of the surveyed streams are rated as poor. Therefore, this indicator is determined to be, Functioning at unacceptable risk.

Large Pools - Functioning at Risk

Pools provide thermal refuge for aquatic organisms dependent on cool stream temperatures; protective cover for rearing; and act as holding areas for LWD flowing through the stream system. The quality of habitat formed by pools is based on several factors including: pool depth, stream width, amount of LWD in place, and the complexity of sub-habitats within the pool. The number of pools increases as the stream size decreases. Channel morphology influences where pools are formed in the stream channel, and determines the hydraulic controls that create the pools.

Juvenile rearing is influenced by channel complexity in the form of structures where juveniles can establish feeding stations, find refuge from high velocity flows and escape predation. Structures consist of riffles with interspersed boulders, boulder forced pools on channel margins, overhanging vegetation, and large wood accumulations and side channels for high flow refuge. It is preferable that these features are close to and just downstream of spawning sites. Improving stream complexity in areas downstream of spawning sites can enhance rearing success. This indicator is determined to be, Functioning at risk for the same reasons described above.

Off-Channel Habitat - Functioning at Risk

Off-channel or high flow refuge in the form of side channels are rare but do exist, particularly in areas of lateral and mid-channel gravel bars. However, these side channels are either unavailable to fish due to channel disturbance from the 1980 eruption and channel migration between C and D type channel configuration. The lack of intack riparian areas contributes to the lack of channel

stability. Off channel habitat in some areas are wide and shallow which contribute to high stream temperatures that does not promote suitable aquatic habitat. Off channel habitat opportunities occur in areas of sediment accumulation, where debris fans occur at stream confluences. The lack of available large woody debris and structure prevents the ability to create off channel habitat. This system is still in the process of trying to find its stream equilibrium and opportunities to improve off-channel habitat may arise once the stream reaches this point.
Therefore, this indicator is determined to be Functioning at risk.

Refugia - Functioning at Risk.

Juvenile rearing is influenced by channel complexity in the form of structures where juveniles can establish feeding stations, find refuge from high velocity flows and escape predation. Structures consist of riffles with interspersed boulders, boulder forced pools on channel margins, overhanging vegetation, and large wood accumulations and side channels for high flow refuge. It is preferable that these features are close to and just downstream of spawning sites. Improving stream complexity in areas downstream of spawning sites can enhance rearing success.

While some natural conditions preclude the development of various refugia components, the lack of large wood, high stream temperatures in some locations, passage barriers and interception of bedload and debris by roads in the watershed limit the potential opportunities for the development of refugia. Also due to the natural disturbance caused by Mount St. Helens this, this indicator is determined to be Functioning at unacceptable risk for all fish species.

Channel Condition and Dynamics

Mean Bankfull Width/Mean Bankfull Depth Ratio - Functioning At Risk

High width/depth ratio can be an indicator of unstable bank conditions. When stream reaches become wide and shallow, it can cause erosion to occur.

Streams surveyed in the Muddy River watershed are classified as Rosgen C and D types. The Muddy River is mostly composed of D type braided channels as a result of the 1980 eruption of Mount St. Helens with a width/depth ratio at 34. This system consists of wide C channels with D channels intermittently dispersed through out the stream makeup. Therefore, this indicator is determined to be Functioning At Risk.

Streambank Condition — Functioning At Unacceptable Risk

Reaches on major streams were classified based on similar physical characteristics and placed into three major groups: erosion, transport and response. "Response" reaches have low gradients and are less confined sections that tend to be more sensitive to changes in the amount of input variables such as wood, water, and sediment. Consequently, these response reaches tend to degrade easily and take longer to recover from disturbances than erosion and transport reaches. Almost half of the length of named streams in the analysis area are characterized as "response" reaches.

The rest of the length of named streams are characterized as "erosion" and "transport" reaches. Erosion-type channels usually have relatively steep gradients and are actively down cutting at various rates due to underlying geology and other physical characteristics. They are also travel paths for up slope mass wasting events (debris torrent areas). Some channels with more gentle gradients can be defined as erosional reaches if they have high rates of bank cutting. Transport reaches, on the other hand, have moderate gradients and are less confined than erosion-type channels. Both erosional and transport channels tend to move input variables such as wood, water, and sediment through relatively quickly

Response reaches in the upper reaches of Bean Creek and lower reaches of Smith Creek are in the blast zone of the 1980 eruption of Mount St. Helens. Most vegetation was blown down and varying depths of blast deposits covered these watersheds. The eruption changed the channel types for both of these reaches from a meandering single "C" type channel to a braided "D" type channel. The eruption increased the width of these reaches 229 percent and 685 percent respectively, in the period 1978-1989. The February 1996 flood increased the width of these reaches 52 percent and 14 percent respectively.

The Muddy River carried a mudflow from the eruption of Mount St. Helens. In the period 1959-1978, the lower reach increased in width 49 percent and the upper reach increased by 108 percent. The Muddy River was noticeably widened from the confluence of Smith Creek to the confluence with the Lewis River. The lower reach width remained unchanged in periods' 1978-1989 and 1989-1996 (post-eruption) while upper reach increased in width 76 percent after the 1980 eruption.

Clear Creek was outside the blast zone and not subject to mudflows. Flood events in the 1970's changed the stream from a meandering single "C" type channel in some areas to a braided "D" type channel and increased in width 81 percent during this period. The reach readjusted to a meandering single "C" type channel and decreased in width 56 percent as the channel downcut and vegetation grew on the flood plain in the period 1978-1989. This reach reverted to a braided "D" type channel and increased in width 149 percent due to an influx of sediment and wood from the 1996 flood. For these reasons this indicator is determined to be Functioning At Unacceptable Risk.

<u>Floodplain Connectivity</u> - Functioning at Risk

Floodplain Connectivity in the form of braids and side channels exist, particularly in areas of lateral and mid-channel gravel bars. The valley floor in the Muddy River Watershed is wide in some areas with little riparian vegetation to have a suitable floodplain fish and aquatic species. In some areas of the basinroad densities exceed 3 miles per square mile which fragment the aquatic habitat. For this reason, this indicator is determined to be Functioning at risk.

Flow/Hydrology

<u>Change in Peak/Base Flows</u> - Functioning at Risk

Pepper Creek (4.9-10.0%), Clearwater Creek (6.7-13.5%), Elk Creek (3.5-7.4%), Clear Creek (4.1-8.3%) and Smith Creek (8.6-13.5%) had the highest peak flow predictions based on methods described in the State of Washington "Standard Methodology for Conducting Watershed Analysis" (1997), Hydrologic Change Module. The sub-watershed with the highest potential for increased peak flows was Smith Creek (8.6-13.5%). Table 4 lists peak flow calculations. Based on this information, this indicator is determined to be Functioning at risk.

Table 4. Peak flow data for 2 year and extreme events..

Sub-watershed	Acres	Peakflow, Fully Forested 2 yr Event (cfs)	Peakflow, Existing 2 yr Event (cfs)	Peakflow, Fully Forested, Event (cfs)	Peakflow, Existing Extreme Event (cfs)	Percent % Increase Peak Flow
Smith Creek 170800020201	18100	2632	2858	3458	4004	8.6-15.8
Clearwater 170800020202	25395	3144	3353	3768	4275	6.7-13.5
Elk Creek 170800020203	22881	2735	2830	3259	3501	3.5-7.4
Clear Creek 170800020204	7493	1121	1167	1324	1434	4.1-8.3
Muddy 170800020205	13044	2161	2267	2633	2895	4.9-10.0

Increase in Drainage Network — Functioning at Unacceptable Risk

Stream channel network extensions were highest in the Muddy River Watershed (1708000202??) and Clearwater Creek and relatively moderate in Smith Creek (170800020201) and Elk Creek (170800020203). The Muddy River and Elk Creek have the highest road densities within the Muddy River watershed. Table 5 lists road and stream crossing data. Based on road densities and stream channel network increases, this indicator is determined to be Functioning at unacceptable risk.

Table 5. Road summary data by sub-watershed

Sub-watershed	Road Mileage	Stream Crossings	Area (mi²)	Road Density (mi/mi²)
Smith Creek 170800020201	12.6	36	28.3	0.4
Clearwater 170800020202	92.2	229	37.4	2.5
Elk Creek 170800020203	75.0	110	28.2	2.7
Clear Creek 170800020204	22.8	42	11.7	1.9
Muddy 170800020205	58.8	148	20.4	2.9
Total Muddy River Watershed	**261.4**	**591**	**126**	**2.1**

Watershed Conditions

Road Density & Location **-** Functioning At Unacceptable Risk

Table 5 displays road density and number of stream crossings within the Muddy River Watershed. The highest road densities (2.9 miles per square mile) and number of stream crossings (229) were found in the Muddy River Sub-watershed, which includes Smith Creek, Clearwater Creek, Elk Creek, and Clear Creek. Road density in the entire Muddy River Watershed was 2.9 miles per square mile. For these reasons, this indicator is determined to be Functioning at Unacceptable risk.

Disturbance History — Functioning at Unacceptable Risk

Using the peak flow analysis as and indicator of disturbance, relatively high road densities, the 1980 eruption, lack of large instream wood and past forest practices. This indicator is considered to be Functioning at unacceptable risk.

Riparian Reserves — Functioning at Risk

Riparian harvest and LWD removal from stream channels has resulted in a limited supply of large woody debris that is available to the stream channel. Lack of LWD in the channels could be contributing to a lack of pools in the channels as well, which results in a lack of quality habitat for the salmonid species that use this watershed.

Many acres of riparian ecosystem, especially stream riparian areas, have been harvested. The removal of riparian vegetation has left streams vulnerable to erosion and aquatic habitat degradation, has reduced or eliminated migration corridors for animals and plants, and impairs connectivity between areas of old growth habitat. Riparian reserves are intended to provide a network of habitat to serve as migration corridors across larger landscapes for both plants and animals. For the most part, these reserves should be dominated by older forest with younger forest accruing as the result of natural disturbances. Management activities are allowed if they conserve, protect, or enhance riparian habitat and other aquatic resources. Table 4 identifies Riparian Reserves in 2 sub-basins that are greater than 25 percent that has been harvested in the Muddy River Watershed. This indicator is considered to be Functioning at Unacceptable risk.

Table 4**.** Seral classes represented within riparian reserves, expressed in terms of a percentage of total riparian reserve area within each sub-watershed. Data is only available for Forest Service Lands.

New 6th fields	Non Forest	Early Open	Early Closed	Large Tree Single-Story	Large Tree Multi-Story	Hardwoods	Total FS Acres	Harvested Stream Riparian
170800020201	27	55	13	2	2	0	8104	16
170800020202	3	65	13	1	17	0	10575	43
170800020203	5	19	27	2	47	0	5325	17
170800020204	8	25	57	1	10	1	1998	17
170800020205	17	25	42	1	14	1	4794	43

Disturbance Regime **-** Functioning at Risk

Mass wasting within the Muddy River Watershed is characterized by three main processes: large, slow moving, deep-seated landslides, debris torrents, and shallow rapid mantle failures. These have occurred bith in managed and natural areas. Since the 1980 erupton of Mount St. Helens, the number of debris torrents and shallow mantle have increased significantly in the blast area. Much of the Muddy River Watershed is unstable. Erosional processes have been a major contributor to sediment routing since the 1908 eruption of Mount St. Helens. Loose ash and tephra on steep slopes of the watershed have continually been influenced by precipitation and wind. As new vegetation gains a foothold these erosional processes will ease. The tephra deposits from the 1980 eruption have been a much larger contributor of sediment to the aquatic system than the erosion from roads. High intensity stand replacement fires occurred in the watershed during the early 20th century which, included two large fires in 1902 totaling 34,500 acres. This indicator is considered to be Functioning at Risk.

Upper Lewis River Watershed (HUC# 1708000201)

The new 5th Field Upper Lewis River (1708000201) has been combined to include the old Middle Lewis River Watershed (06) and old Upper Lewis Watershed (23). The 177,587-acre Upper Lewis River Watershed is comprised of National Forest (160,549 acres) and State and private (17,038 acres) ownership. The elevation ranges from 1,008 feet at Swift Reservoir to 11,800 feet at the summit of Mount Adams.

Volcanic and glacial processes along with erosional processes of wind and rain formed the Upper Lewis Watershed; the eastern portion of the watershed has been greatly influenced by volcanic and glacial activity from Mount Adams. The flows in this area date to about 250,000 to 400,000 years of age. The area north of the Lewis River is characterized by steep and relatively old andesitic and pyroclastic flow depositis while the area south of the Upper Lewis area consists of more gentle unstable sedimentary deposits with numerous wetlands. Glaciers coming from Mount Adams and out of the Indian Heaven area scoured and smoothed the landscape until it reached defined channels such as the Upper Lewis River. Past glacial activity has over-steepened the terrain making it susceptible to deep-seated landslides. This is more prevalent downstream in the former Middle Lewis Watershed area (06).

Historical aquatic habitat and fish population information in this basin is poorly documented. However, rainbow trout and cutthroat trout are known to have been quite abundant in the Lewis River and its tributaries and ranged in size from up to 18 inches with a 12 inch average (WDG, 1957). Bull trout is present in the Upper Lewis Watershed and use Rush Creek as spawning habitat. However, they have not been found above lower falls. The distribution of fish was probably altered by road construction, the construction of dams on the mainstem of the North Fork Lewis River, and presence of non-native fish.

Anadromous fish populations including coho, steelhead, and chinook spawned in the North Fork Lewis River and its tributaries upstream to the barrier at Lower Falls located at river mile 73, prior to the construction of Merwin Dam in 1931. When the dam was first constructed approximately 53 miles of mainstem habitat and numerous miles of tributary habitat was blocked. This dramatically altered the distribution and abundance of these species in the watershed. However, experimental populations of coho salmon fry were released upstream of Merwin Dam as part of a FERC re-introduction study in the Lewis River.

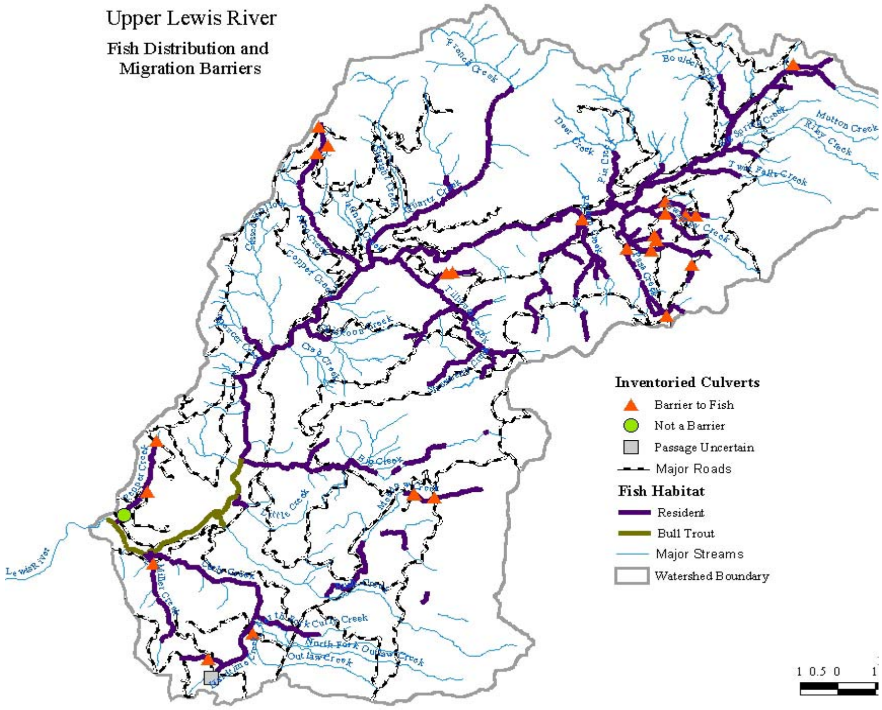
Fish species known to currently inhabit the watershed include cutthroat, rainbow, brook trout, and coho salmon. Rush Creek is the only stream in the Upper Lewis watershed that is inhabited by bull trout. Fish bearing streams that are inhabited by all other resident species are Pass, Strawberry, Spencer, Rush, Boulder, Swampy, Pin, Platinum, Poison, Steamboat, Tillicum, Quartz, Snagtooth, Strait, Alec, Chickoon, Crab, Cussed Hollow, Big Creek, Meadow, Curly, Hardtime, North Curly, Little Creek, and the Upper Lewis River. Coho salmon are found in the Upper Lewis due to the reintroduction process.

The environmental baseline for the Upper Lewis 5th Field Watershed is summarized below in Table 1. The baseline condition is determined at the 5th field watershed scale. Stream survey data is used to determine the ratings for several indicators. Streams which have been surveyed for this analysis are; Alec, Big, Copper, Cussed Hollow, Little Creek, Meadow, Rush, Boulder, Curly, NF Swampy, Pass, Pin, Quartz, Snagtooth, Steamboat, Swampy, and Tillicum Creek.

Table 1. Environmental Baseline Summary for the Upper Lewis Watershed

DIAGNOSTICS/PATHWAYS: INDICATORS	ENVIRONMENTAL BASELINE		
	Functioning Appropriately	Functioning At Risk	Functioning at Unacceptable Risk
Subpopulation Characteristics: Subpopulation Size	unknown	unknown	unknown
Growth and Survival	unknown	unknown	unknown
Life History Diversity and Isolation	unknown	unknown	unknown
Persistence and Genetic Integrity	unknown	unknown	unknown
Water Quality: Temperature		MON, WA	
Sediment		WA,	
Chem. Contam./Nutrients	WA, PJ		
Habitat Access: Physical Barriers			SS, WA
Habitat Elements: Substrate Embeddedness		SS, WA, PJ	
Large Woody Debris		WA	
Pool Frequency and Quality			SS, PJ
Large Pools		SS, PJ	
Off-Channel Habitat	FO, WA		
Refugia	PJ, WA		
Channel Cond. & Dyn.: Width/Depth Ratio		SS	
Streambank Condition		WA	
Floodplain Connectivity		WA	
Flow/Hydrology: Peak/base flows		WA	
Drainage Network Increase		WA	
Watershed Condition: Road Density & Location			WA
Disturbance History		WA	
Riparian Conservation Areas		WA, PJ	
Disturbance Regime	WA		
Integration of Species and Habitat Conditions	unknown	unknown	unknown

Abbreviations: WA = watershed analysis; SS = stream surveys; PJ = professional judgment; MON = monitoring; FO = field observations


Upper Lewis River
Fish Distribution and Migration Barriers
Inventoried Culverts
Barrier to Fish
Not a Barrier
Passage Uncertain
Major Roads
Fish Habitat
Resident
Bull Trout
Major Streams
Watershed Boundary
Lewis River
Mutton Creek
Riley Creek
Twin Falls Creek
French Creek
Boulder Creek
Deer Creek
Copper Creek
Big Creek
North Fork Outlaw Creek
Outlaw Creek
1 0.5 0 1

Baseline determinations for specific indicators were determined using findings from watershed analysis (with 2002 updates of data), data from stream surveys and monitoring data, practical knowledge of conditions of the ground from field reconnaissance, and professional judgment as needed. Rational for determinations of individual indicators is provided.

Subpopulation Characteristics

Subpopulation Size - Unknown

Region 6 Level II stream surveys are conducted annually in the Upper Lewis watershed to collect stream habitat and fish presence/absence data. Stream habitat inventory records and fisheries surveys indicate that streams in the upper lewis river watershed support resident populations of the following species: cutthroat trout (Onchorynchus clarki), brook trout (Salvelinus fontinalus), rainbow trout (Onchorynchus mykiss), unidentified sculpin (cottus sp.), and mountain whitefish (Prosopium williamsoni). Information on the abundance of these populations is not available.

A bull trout (Salvelinus confluentus) population exist in the Lewis river below "Lower Falls" river mile 73. This population inhabits Swift reservoir and it's tributaries. Information being collected on these populations has included habitat attributes, distribution and spawning counts.

Coho salmon do not occur in the Lewis River above 3 major dams along the Lewis River. However, experimental populations of coho salmon fry were released upstream of Merwin Dam (year) as part of a FERC re-introduction study in the Lewis River. Substantial spawning habitat has been blocked or passage substantially imparied in the Lewis River as a result of dams.

Growth and Survival— Unknown.

Life History Diversity and Isolation— Unknown.

Persistence and Genetic Integrity— Unknown.

Water Quality

Temperature – Functioning at Risk

Stream water temperature is a major factor influencing the composition and productivity of aquatic ecosystems. Fish, aquatic macroinvertebrates, and other aquatic organisms are affected directly and indirectly by changes in water temperatures. Specifically for salmonids, stream temperature influences the timing of migration, spawning, incubation rates, growth, distribution, resistance to parasites, food supply and quality, and tolerances to diseases and pollutants (Bjornn and Reiser 1991). Aquatic organisms are often able to withstand short- term increases in stream temperature and adjust by moving to optimum habitat within the channel. Long term changes or peaks in water temperature may directly alter the established patterns of the salmonid populations. Maximum temperatures in the Upper Lewis River were generally higher and exceeded 16°C more frequently during 2001 than in 2000. Quartz Creek and Clear Creek exceeded 16°C two to three more frequently in 2000. The Washington State Department of Ecology (WDOE) temperature standard is 16°C; excursions beyond 16°C are considered "water temperature exceedances." Stream temperatures in the Upper Lewis River watershed exceeded 16°C on 50 individual days.

The Upper Lewis River maximum 7-day average temperature was 17.8° C in 2001 above Big Creek (Table 2). The maximum 7-day average temperatures in the Upper Lewis River above Quartz Creek River were 15.2°C

Table 2. Upper Lewis River Watershed Stream Temperatures from June 15 through September 15, 2000.

Streams **In downstream order**	**Monitoring location**	**Maximum temperature (°C)**	**Number of days above 16.0°C**	**Maximum 7-day average temperature (°C)**
Lewis River	Above Quartz Creek	15.7	0	15.2
Quartz Creek	Above Platinum Creek	17.6	16	17.0
Quartz Creek	Below Platinum Creek	17.5	12	16.9
Lewis River	Above Big Creek	18.5	31	17.8
Big Creek Tributary	Above Skookum Meadows	14.1	0	13.5
Big Creek	Big Creek Gaging Station	15.5	0	15.0

*Note: 18 days during September were omitted because of anomalous measurements (stowaway was most likely out of the water).

Table 3 contains a summary of current temperature conditions within the Upper Lewis River Watershed. Temperatures at three gauging stations exceeded the WDOE temperature criteria.

Table 3. Historical Summary of Streams Exceeding the State Temperature Standards Within the Upper Lewis River Watersheds.

Stream Name	**Monitoring location**	**Years monitored**	**Number of years temperature exceeded 16.0°C**	**Maximum temperature (°C) during monitoring period (Year)**
Quartz Creek	Above Platinum Creek	1999-2001	2	17.6 (2000, 2001)
Quartz Creek	Below Platinum Creek	1977-1979, 1982, 1984, 1988, 1997-2001	8	19.0 (1997)
Lewis River	Above Big Creek	2001	1	18.5 (2001)
Lewis River	Above Curly Creek	1975-1988, 1991, 1996-2000	10	22.7 (1997)

Sediment in Areas of Spawning and Incubation - Functioning at Risk

Increased levels of sediment can adversely affect fish habitat and riparian ecosystems. Spawning gravels can be filled in by fine sediment reducing survival of eggs and developing small salmonids (Everest et al. 1987), food availability can be reduced (Cordone and Kelley 1961), and important habitat such as pools may be filled in by excess sediment (Megahan 1982). The majority of stream channels in the analysis area are characterized as "erosion" and "transport" reaches, having relatively high gradients and confined channels that tend to move input variables such as wood, water, and sediment through quickly. Changes to the amounts of these input variables are most noticeable in low gradient, less confined sections (called "response" reaches) in the Lewis Basin.

All response reaches in the Lewis River are currently in some phase of recovery and adjustment to sediment pulses from past flood events in the 1970's and 1990's. They are adjusting primarily by channel narrowing, riparian vegetation encroachment, and/or downcutting. The Lewis River is recovering very slowly from a large pulse of sediment that occurred in the 1970's and 1990's. Average channel width increased 27% from these events. Therefore this indicator is determined to be Functioning at Risk.

Chemical Contamination/Nutrients - Functioning Appropriately

No known sources of chemical or nutrient contamination are known to exist. No problems were noted in the watershed analysis nor during field observations, therefore this indicator is determined to be Functioning Appropriately.

Habitat Access

Physical Barriers - Functioning at Unacceptable Risk

The Lewis river has 3 major dams along the Lewis River. These dams block the migration of anadromous salmon to the upper reaches of the watershed where they once spawned. The dams have also altered the available habitat in the system by converting over 25 miles of stream to lake habitat. In addition to the dams on the mainstem of the river, road building without adequate facilities for passage of fish has increased aquatic habitat fragmentation. Therefore this indicator is determined to be Functioning at Unacceptable Risk.

Habitat Elements

Substrate Embeddedness – Functioning at Risk

Substrate embeddedness data are not collected as part of the U.S. Forest Service Region 6 Level II stream survey protocol, however it is noted in stream survey narratives if it is observed. Based on stream survey and channel stability narratives, substrate embeddedness is not a problem in the Upper Lewis River. High road densities (particularly within riparian areas) and the high number of stream crossings may contribute to downstream sedimentation, although the contribution is believed to be minor relative to other land uses in the sub-basin. This risk may increase as unmaintanied roads age beyond their design life.

Large Woody Debris – Functioning at Risk

Large woody debris is a critical component of aquatic habitats for a variety of organisms. It influences channel morphology, the storage and routing of sediment, and the amount and complexity of habitat for aquatic organisms (Hicks et. al 1991). Wood is delivered to the stream channel through a variety of mechanisms (i.e., landslides, transport from upstream areas, and direct entry from adjacent sideslopes). Management activities alter the effectiveness of these delivery mechanisms and the longevity of wood in the system. For example harvest within the riparian zone reduces the available wood supply for direct entry from adjacent slopes.

The Columbia River Policy Implementation Guide identified standards for quantities of LWD in streams to provide quality salmonid habitat. Sub-basins 170800020106 and 170800020108 meet the standard of 80 pieces of LWD/mi and 90 percent of 3 other sub-basins are rated poor (170800020104, 170800020101, 170800020107and 170800020109). The remaining 11 surveyed sub-basins have a mixture of segments ranging from poor to good. Overall a total of 51 percent of surveyed segments are rated poor and have < 40 pieces of LWD/mi. that meet the size standard, 15 percent are rated fair and have 41-79 pieces of LWD/mi., and 34 percent are rated good and meet or exceed the standard.

Timber harvest in the basin has been increasing since access to the area was developed in the early 1900's. Although harvest management techniques have substantially improved through time, the impacts from early management decisions are still present. Four of the sub-basins have greater than 25 percent of the stream riparian reserve area harvested. Future LWD recruitment in these sub-basins may be a concern due to lack of buffer strips left along the streams during past harvest activities. Across the watershed approximately 10 percent of the riparian reserve has been harvested in the past. The Upper Lewis River Watershed is rated as poor according to the Columbia River Basin Anadromous Policy Implementation Guidelines; therefore, this indicator is determined to be, Functioning at Risk.

Pool Frequency and Quality - Functioning at Unacceptable Risk.

The Columbia River Policy Implementation Guide identified standards for quantities of pools/mi. in streams based on stream width to provide quality salmonid habitat (Table 4). This standard is what the existing condition identified in stream surveys is evaluated against, to determine a rating of good, fair or poor. Streams in good shape meet or exceed the quantity of pools based on width, streams in fair condition contain 50-99 percent of the desired number of pools, and streams in poor condition contain fewer than 50 percent of the desired pools per mile in sub-basins 170800020108, 170800020109, 170800020107, 170800020104, 170800020102, and 170800020103. Stream survey data indicate similar results, approximately over 50% of the surveyed streams are rated as poor. Therefore, this indicator is determined to be, Functioning at unacceptable risk.

Table 4. Stream survey data for the Upper Lewis River Watershed.

STREAM NAME	6th FIELD CODE	SURVEY DATE	KNOWN FISH SPECIES	STREAM LENGTH SURVEYED MI	AVE. BANK FULL WIDTH	#POOLS/ MILE	# PRIMARY POOLS/MI	# LARGE & MED WOOD	WIDTH/ DEPTH RATIO	CHANNEL STABILITY
Boulder Creek	0101	1992	unknown	2.2		68		313.81		
Twin Falls Creek	0102	1997	No Fish	2.6		48		8.68		
Pass Creek	0103	1989	CT, BRT, RB	1.2		53		114.18		
Swampy Creek	0103	1989	BRT	2.3		73		720.30		
Pin Creek	0104	1991	BRT	4.4		96		265.03		
Platinum Creek	0104	1990	RB, BRT	.84		8		17		
Poison creek	0105	1986	RB							
Steamboat Creek	0105	2001	unknown	5.8		214		141.34		
Pepper Creek	0113	1989	CT					70.30		
Tillicum Creek	0106	1992	unknown	5.7		213		3311.36		
Strawberry Creek	0106	1992	RB, CT, unknown	1.7		108		594.99		
French Creek	0107	1983	No Fish Sighted							
Quartz Creek	0107	2000	RB	8.9		158		160		
Snagtooth Creek	0107	1989	RB	.9		17		256.41		
Straight Creek	0107	1989	Unknown trout	2.7		95		718.07		
Alec Creek	0108	1992	BRT	5.2		249		500.10		
Spencer Creek	0109	1984	RB, CT,							
Chickoon Creek	0109	1989	RB, RHXX							
Crab Creek	0109	1989	Unknown trout							
Cussed Hollow Creek	0109	2001	Unknown trout, coho					75.00		
Big Creek	0110	2001	RB, BRT	8.3		153		484.04		
Lower Rush Creek	0111	1994	CT, BLT,RBT,WF	1.5		47		127.01		
Curly Creek	0112	2000	BRT	5.2		137		72.50		
Hardtime Creek	0112	1988	Unknown trout, BRT							
North Curly Creek	0112	1989	SAFO	-						
Outlaw Creek	0112	1985	No Fish Sighted							
South Curly Creek	0112	1989	RB, BRT							
Miller Creek	0113	1988	CT							
Little Creek	0113	1984 1990	No Fish Sighted	.5		18		93.51		

Large Pools – Functioning at Risk

Pools provide thermal refuge for aquatic organisms dependent on cool stream temperatures; protective cover for rearing; and act as holding areas for LWD flowing through the stream system. The quality of habitat formed by pools is based on several factors including: pool depth, stream width, amount of LWD in place, and the complexity of sub-habitats within the pool. The number of pools increases as the stream size decreases. Channel morphology influences where pools are formed in the stream channel, and determines the hydraulic controls that create the pools.

The Columbia River Policy Implementation Guide identified standards for quantities of pools/mi. in streams based on stream width to provide quality salmonid habitat. Four of the surveyed segments meet the standards for pools/mi. in sub-basin 170800020108,. Each of these segments is in a separate sub-basin indicating that unlike the LWD component there is not a single sub-basin that meets the standard for pools in this analysis area. All of the surveyed segments in four of the sub-basins totaling 13 miles of habitat, rated poor (10070800020107).

Juvenile rearing is influenced by channel complexity in the form of structures where juveniles can establish feeding stations, find refuge from high velocity flows and escape predation. Structures consist of riffles with interspersed boulders, boulder forced pools on channel margins, overhanging vegetation, and large wood accumulations and side channels for high flow refuge. It is preferable that these features are close to and just downstream of spawning sites. Improving stream complexity in areas downstream of spawning sites can enhance rearing success. This indicator is determined to be, Functioning at risk for the same reasons described above.

Off-Channel Habitat – Functioning at risk

Off-channel or high flow refuge in the form of side channels are rare but do exist, particularly in areas of lateral and mid-channel gravel bars. However, these side channels are either unavailable to fish due to channel disturbances consisting of flood events, road fragmentation, channel narrowing and down cutting from sediment pulses, and unstable landforms. The Lewis River currently has low amounts of in-channel large woody debris due to channel downcutting that has perched the wood on terraces above the channel. The lack of intact riparian areas contributes to the lack of channel stability. Off channel habitat opportunities occur in areas of sediment accumulation, where debris fans occur at stream confluences. The lack of available large woody debris and structure prevents the ability to create off channel habitat. Therefore, this indicator is determined to be Functioning at risk.

Refugia - Functioning Appropriately.

Juvenile rearing is influenced by channel complexity in the form of structures where juveniles can establish feeding stations, find refuge from high velocity flows and escape predation. Structures consist of riffles with interspersed boulders, boulder forced pools on channel margins, overhanging vegetation, and large wood accumulations and side channels for high flow refuge. It is preferable that these features are close to and just downstream of spawning sites. Improving stream complexity in areas downstream of spawning sites can enhance rearing success.

While some natural conditions preclude the development of various refugia components, the lack of large wood, high stream temperatures in some locations, passage barriers and interception of bedload and debris by roads in the watershed limit the potential opportunities for the development of refugia. Because of this, this indicator is determined to be Functioning at unacceptable risk for all fish species.

Channel Condition and Dynamics

Width to Depth Ratio - Functioning Appropriately

Of the streams surveyed in the watershed, most Rosgen A meet the width/depth criteria by Rosgen type. Most reaches are "B" channels with some "C" in "response" type reaches where debris fans are located at stream channel confluences. Channel characterized as Rosgen B channels have width to depth ratios greater than 12, reflecting channel incision to bedrock, which is attributed to fires and subsequent salvage operations and Therefore, this indicator is determined to be Functioning Appropriately.

Streambank Condition - Functioning At Risk

Stream reaches in the Upper Lewis River can be classified based on similar physical characteristics and placed into three major groups: erosion, transport and response. “Response” reaches have low gradients and are less confined sections that tend to be more sensitive to changes in the amount of input variables such as wood, water, and sediment. Consequently, these response reaches tend to degrade easily and take longer to recover from disturbances than erosion and transport reaches.

Erosion-type channels usually have relatively steep gradients and are actively down cutting at various rates due to underlying geology and other physical characteristics. They are also travel paths for up slope mass wasting events (debris torrent areas). Some channels with more gentle gradients can be defined as erosional reaches if they have high rates of bank cutting. Transport reaches, on the other hand, have moderate gradients and are less confined than erosion-type channels. Both erosional and transport channels tend to move input variables such as wood, water, and sediment through relatively quickly. Many of the sidewall and headwall streams in the Upper Lewis area are erosional or transport reaches, while the Lewis River is composed primarily of transport and response reaches.

All response reaches in the Lewis River are currently in some phase of recovery and adjustment to sediment pulses from past flood events. They are adjusting primarily by channel narrowing, riparian vegetation encroachment, and/or downcutting. The Lewis River is recovering very slowly from a large pulse of sediment that occurred in the 1970's and 1990’s. This slow recovery may be due in part to continued sediment contribution from roads in the Steamboat Creek, Poison Creek, Pass Creek, and Swampy Creek areas.
The Lewis River currently has low amounts of in-channel LWD compared to pre-1959 conditions due to channel downcutting that has perched the wood on terraces above the channel. Due to a variety of natural physical characteristics including unstable landforms, some stream channels south of the Lewis River are very unstable. Selected reaches on Poison Creek, Steamboat Creek, Pass Creek, North and South Fork Swampy Creek are some of the most unstable channel on the Forest, due mostly to unstable lower and upper streambanks. For these reasons this indicator is determined to be Functioning At Risk for all fish species.

Floodplain Connectivity – Functioning at Risk.

Floodplain Connectivity is limited in some areas due road densities and amount of stream crosses within the watershed. Due to past management practices some riparian vegetation has been altered that has disconnected the floodplain from the stream system in the form of harvesting and road building. In some areas of the basin road densities approach 2.9 miles per square mile, which is an indicator of fragmentation within aquatic habitats. For this reason, this indicator is determined to be Functioning at risk.

Flow and Hydrology

<u>Change in Peak/Base Flows</u> – Functioning at Risk.

Lewis River Headwaters (3.7-5.6%), Twin Falls Creek (3.2-6.4%), and Swampy Creek (2.7-5-9%), Pin Creek (1.0-5.5%), Steamboat Creek (2.4-5.0%), Tillicum Creek (3.2-6.7%), Quartz Creek (2.5-5.7%), Alec Creek (4.5-10.8%), Cussed Hollow Creek (3.4-7.4%), Big Creek (1.4-4.4%), Rush Creek (3.1-8.6%), Curly Creek (3.3-9.9%), and Little Creek (5.8-11.6%) had the highest peak flow predictions based on methods described in the State of Washington "Standard Methodology for Conducting Watershed Analysis" (1997), Hydrologic Change Module. The sub-watershed with the highest potential for increased peak flows was Alec Creek (4.5-10.8%). Table 5 lists peak flow calculations. Based on this information, this indicator is determined to be Functioning at risk.

<u>Drainage Network Increase</u> – Functioning at Risk

Stream channel network extensions were highest in the Steamboat Creek (170800020103) and Curly Creek and relatively moderate in Lewis River Headwaters (170800020101) and Little Creek (170800020113). The Swampy Creek and Steamboat Creek have the highest road densities within the Upper Lewis River watershed. Table 6 lists road and stream crossing data. Based on road densities and stream channel network increases, this indicator is determined to be Functioning at risk.

Watershed Condition

<u>Road Density and Location</u> – Functioning at Unacceptable Risk

Within the upper Lewis watershed the aquatic habitat has been fragmented and altered by management activities such as road building. Management activities have increased each decade since the 1950's with a peak in 1988. The amount of harvest is being used as an indicator of the number of roads constructed by decade. Some sub-basins now have road densities that exceed 5.0 miles per square mile (Table 5). Roads and culverts can not only block upstream migration of resident fish, they can alter the flow pattern of LWD through the system, and increase sediment input (Furniss et. al. 1991). The number of road crossings over perennial streams was normalized by perennial stream length in each basin. Sub-basins 170800020105, 170800020102, 170800020103 170800020106, and 17080002017 were within the highest one-third of the values. Which indicates they have received the most intense degree of habitat fragmentation caused by roads.
Functioning at unacceptable risk.

Table 5. Road summary data by sub-watershed. Upper Lewis

Sub-watershed	**Road mileage**	**Stream crossings**	**Area (mi^2)**	**Road density (mi/mi^2)**
170800020101	29	56	-	1.18
170800020102	9.1	15	8.5	2.6
170800020103	55.8	77	15.7	2.68
170800020104	6.5	5	-	0.76
170800020105	50.2	100	17.8	2.82
170800020106	41.6	82	12.8	3.25
170800020107	40.2	61	30.1	1.51

Disturbance History – Functioning at Unacceptable Risk

Using the peak flow analysis as and indicator of disturbance, relatively high road densities and because of the lack of large instream wood and historical practices of stream cleaning in the watershed, this indicator is considered to be Functioning at unacceptable risk.

Riparian Reserves – Functioning at Risk

Many acres of riparian ecosystem, especially stream riparian areas, have been harvested. The removal of riparian vegetation has left streams vulnerable to erosion and aquatic habitat degradation, has reduced or eliminated migration corridors for animals and plants, and impairs connectivity between areas of old growth habitat. Riparian reserves are intended to provide a network of habitat to serve as migration corridors across larger landscapes for both plants and animals. For the most part, these reserves should be dominated by older forest with younger forest accruing as the result of natural disturbances. Management activities are allowed if they conserve, protect, or enhance riparian habitat and other aquatic resources. This indicator is considered to be functioning at risk.

Disturbance Regime –

Integration of Species and Habitat Conditions - Unknown

Tilton River Watershed (HUC# 1708000502)

The Titlton watershed is a 5th field watershed, Hydrologic Unit Code 1708000502, located in the Gifford Pinchot National Forest of southwest Washington. The watershed is a 161.3 square mile drainage area. The Titlton watershed includes five 6th field sub-watersheds. These 6th field sub-watersheds will not be evaluated individually in this document.

Several sources of information were used to determine the environmental baseline conditions for the Tilton River watershed (Table 1):

- Tilton Watershed Analysis, Gifford Pinchot National Forest, Cowlitz ValleyRanger Districts, September 1999. Connelly, West Fork Tilton and Niniteen Creek Analysis and East Fork Tilton watershed Anlyses contracted by Murray Pacific.
- Tumble Creek Stream Survey 1993 by the Gifford Pinchot National Forest
- Stream temperature monitoring from 1996.

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The Tilton River watershed contains approximately 102.7 miles of Proposed, Threatened, Endangered or Sensitive (PETS) fish species habitat. Fish species known to occur in the Tilton River watershed are chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), steelhead (*Oncorhynchus mykiss*), and coastal cutthroat trout (*Oncorhynchus clarki clarki).*

Table 1. Environmental baseline conditions in 2001 for the Tilton River watershed.

		Environmental Baseline Rating		
Pathway	**Indicator(s)**	**Properly Functioning**	**Functioning at Risk**	**Functioning at Unacceptable Risk**
WATER QUALITY	Temperature			X
	Sediment		X	
	Chemical Contaminants/Nutrients		X	
HABITAT ACCESS	Physical barriers		X	
HABITAT ELEMENTS	Substrate in rearing areas		X	
	Large Woody Debris			X
	Pool Frequency and Quality USFWS			X
	Pool Frequency and Quality NMFS			X
	Large pools		X	
	Off-channel habitat		X	
	Refugia			X
CHANNEL DYNAMICS and CONDITION	Width / Depth Ratio			X
	Streambank condition USFWS			X
	Streamban k condition NMFS			X
	Floodplain connectivity		X	
FLOW / HYDROLOGY	Peak/base flows		X	
	Drainage network			X
WATERSHED CONDITIONS	Road density and location			X
	Disturbance regime			X
	Disturbance history			X
	Riparian reserves			X
SUBPOPULATION CHARACTERISTICS / SPECIES AND HABITAT	Subpopulation size, Growth and survival, Life history Diversity and isolation, Persistence and genetic integrity, Integration of species and habitat conditions	No Rating. (The Forest Service has insufficient data in order to rate these indicators).		

Supporting information for the environmental baseline is presented in a table format below in Table 2.

Table 2. Environmental baseline conditions for the Tilton River Watershed 2002.

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
WATER QUALITY	Temperature Other Species	Functioning At Unacceptable Risk	7 day average maximum temperature in a reach during the following life history stages:[1, 3] rearing: > 18□C spawning: > 16□C	Because most of the watershed is managed by private entities we have almost no water temperature data. The watershed analyses prepared for Muarray Pacific report temperatures exceeding 16 □C and the Forest Service monitoring of Tumble Creek found the same in 1995 and 1996. Water temperatures in Tumble Creek did not exceed 16 □C in the period from 199 through 2001. The West Fork Tilton and Tilton Rivers ranged above 18 □C	Connelly East Fork West Fork WA Chap
	Sediment (in spawning areas)	Functioning At Risk	12-17% fines (<0.85mm) in gravel[4];	We have no information with which to address this question of Forest Service managed lands. Many of the values reported in the watershed analyses prepared for Murray Pacific are under 12%. A few of the values fall into the 12 to 17% range and there are many unknowns for the North Fork Tilton and Tilton Rivers	Connelly West Fork WA Table East Fork
	Chemical Contamination/ Nutrients	Functioning At Risk	moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one CWA 303d designated reach[8]	Parts of the Tilton River and West Fork Tilton had low values for dissolved oxygen. In addition The Tilton River flows by the City of Morton and there are many houses and ranches near the banks of the river.	Connelly West Fork WA chap. East Fork
HABITAT ACCESS	Physical barriers	Functioning At Risk	one or more human-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows for at least one life history stage	The watershed analyses prepared for Murray Pacific indicate that there are a couple of human made barriers. It is unclear if these would affect the listed species. The Forest Service has to conduct the fish passage survey on the land it manages.	Connelly West Fork WA chap. East Fork
	Substrate character and embedded-ness (in rearing areas)	Functioning At Risk	gravel and cobble are subdominant, or if dominant, reach embeddedness 20-30%[9,10]	The data in the watershed analyses do not directly address this measure. The data for fine sediment would suggest that there may be some loss of interstitial spaces. In addition there is general lack of information about the North Fork Tilton and Tilton Rivers.	Connelly West Fork WA chap. East Fork

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
HABITAT ELEMENTS	Large Woody Debris (LWD)	Functioning At Unacceptable Risk	current levels are not at those desired values for "functioning appropriately",	The watershed analyses prepared for Murray Pacific do not report the amount of wood in the a way that is comparable to the criteria. Given the history of timber harvest in the watershed it is highly likely woody debris level have been reduced.	Professio
	Pool Frequency and Quality FWS	Functioning At Unacceptable Risk	pool frequency is considerably lower than values desired for "functioning appropriately"; also cover/temperature is inadequate[4], and there has been a major reduction of pool volume by fine sediment	The watershed analyses prepared for Murray Pacific do not report the amount of pool habitat in the a way that is comparable to the criteria. They do however discuss the filling of pools and general lack of pool habitat.	Connelly West For WA chap East Fork Professio
	Pool Frequency and Quality NMFS	Functioning At Unacceptable Risk	does not meet pool frequency standards.	The watershed analyses prepared for Murray Pacific do not report the amount of pool habitat in the a way that is comparable to the criteria. They do however discuss the filling of pools and general lack of pool habitat.	Connelly West For WA chap East Fork Professio
	Large Pools (in streams with > 3m in wetted width at baseflow)	Functioning At Risk	reaches have few large pools (>1 meter) present[4]	The watershed analyses prepared for Murray Pacific do report many large pools in the Tilton River and Lower West Fork Tilton River, but they lacking the in the other streams and these reports also report pool filling.	Connelly West For WA chap East Fork Professio
	Off-channel habitat	Function at Risk	watershed has some functional high water velocity refugia such as ponds, oxbows, backwaters, and other off-channel areas with cover; but side-channels are generally high energy areas[4]	The watershed analyses prepared for Murray Pacific do report many of channel type habitat in the Tilton River and Lower west Fork Tilton River, but they reported to be unstable.	Connelly West For WA chap East Fork Professio
	Refugia (at 6th to 7th field watershed scale)	Functioning at Unacceptable Risk	adequate habitat refugia do not exist[12]	The Tilton River watershed has been and continues to be a highly disturbed watershed.	Proffesio

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
CHANNEL CONDITION AND DYNAMICS	Width/Depth Ratio in riffles	Functioning At Unacceptable Risk	W/D ratios and channel types throughout much of the watershed are outside of historic ranges and/or site potentials.	We have no data with which to assess the width to depth ratios. The watershed analyses prepared for Murray pacific all indicated some degree of channel aggradation or channel widening.	Connelly West Fork WA chap. East Fork
	Streambank Condition FWS	Functioning At Unacceptable Risk	<50% of any stream reach has ≥90% stability[5]	Past logging that removed riparian vegetation destabilized the banks. There are extensive culvert failures that resulted in tributaries being sluiced out to bedrockm Failure of large landings and sidecast resulted in sever impacts to stream banks. The 1995-96 floods increased the extent of bank erosion.	Field obse Tumble C Professior
	Streambank Condition NMFS	Functioning At Unacceptable Risk	<80% stable	Past logging that removed riparian vegetation destabilized the banks. There are extensive culvert failures that resulted in tributaries being sluiced out to bedrockm Failure of large landings and sidecast resulted in sever impacts to stream banks. The 1995-96 floods increased the extent of bank erosion.	Field obse Tumble C Professior
	Floodplain Connectivitiy	Functioning At Risk	reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	The raod density in the stream associated riparian reserves is high at 3.25 miles/miles per square mile. However, the floodplains are very narrow because of the steep valley side walls.	GIS Anal Reserves.
FLOW / HYDROLOGY	Change in Peak/Base Flows	Functioning At Risk	some evidence of altered peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	The watershed analyses prepared for Murray Pacific all model increases in peak flow of greater than 10% for at least one sub-watershed. The drainage extension created by the roads would also lead to increased peak flows.	Connelly West Fork WA chap. East Fork

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
	Drainage Network Increase	Functioning At Unaccpetable Risk	low to moderate increase in active channel length correlated with human caused disturbance (e.g. ~5%)	We estimated drainage extension by multiplying the number of stream crossing by 200 feet (the average distance between a crossing and the nearest ditch relief structure) and dividing by the number of miles of stream in the watershed. There is a moderate drainage extension in the watershed 7.6%.	GIS analy
WATERSHED CONDITIONS	Road Density and Location	Functioning At Unacceptable Risk	>2.4 mi/mi² [13]; some to many valley bottom roads	Road densities are high at 4.52 miles per square mile overall and 3.25 miles per square mile in the stream associated riparian reserves.	GIS analy
	Disturbance Regime	Functioning At Unacceptable Risk	Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents, or high probability of catastrophic fire exists throughout a major part of the watershed. Stream channels are simplified, providing little hydraulic complexity in the form of pools or side channels. [1] Natural processes are unstable.	Like the rest of the watersheds in the Cowlitz River Basin the Tilton river has experience many substantial floods in the past two decades which have been partially responsible for simplifying the channels of the streams.	Connelly West Fork WA East Fork

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
	Disturbance History	Functioning at Unacceptable Risk	>15% ECA (< 85% Aggregate Recovery Percentage [ARP] or Hydrologic Recovery Percentage [HRP]) of entire watershed and some disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; ≤15% LSOG in watershed	Because of all of the privately managed land in this watershed is it not practical to calculate % ECA (< 85% Aggregate Recovery Percentage [ARP] or Hydrologic Recovery Percentage [HRP]). Casual observations, however, suggest that the Tilton Watershed is the most heavily harvested watershed associated with the Cowlitz Valley Ranger District. A total road density of 4.5 miles/square mile and 3.25 miles/ square mile within the stream associated riparian reserve are also indicative of a lot disturbance	GiS Analy causual ol
	Riparian Reserves	Functioning at Unacceptable Risk	riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitats for sensitive aquatic species (<70% previously unmanaged), including from grazing impacts; percent similarity of riparian vegetation to the potential natural community/composition and structure <25%[15]	Because of the small portion of land managed by the Forest Service the Forest Service has very little data on riparian condition. The watershed analyses prepared for Murray Pacific focus on the riparian reserves of the fish bearing streams and only briefly discuss the non-fish bearing streams. Given the harvest history and causal observations I concluded that the riparian reserve especially those on non-fish bearing streams are fragmented.	Tilton Wa West Forl WA Chap East Fork Connelly
SUBPOPULA-	Subpopulation Size	No Rating			
	Growth and Survival	No Rating			

Pathway	Indicator	Rating	Definition of Rating	Information used to make rating	Sources o
TION CHARACTER-ISTICS	Life History Diversity and Isolation	No Rating			
	Persistence and Genetic Integrity	No Rating			
SPECIES and HABITAT	Integration of Species and Habitat Conditions	No Rating			

Upper Nisqually Watershed (HUC# 1711001501)

The Upper Nisqually watershed is a 5th field watershed, Hydrologic Unit Code 1711001501, located in the Gifford Pinchot National Forest of southwest Washington. The watershed is defined as the 289.6 square mile drainage area between Alder Reservoir and headwaters of the Nisqually River. The Upper Nisqually watershed includes 11 6th field sub-watersheds. These 6th field sub-watersheds will not be evaluated individually in this document.

The Forest Service manages substantial portions of land only in the Nisqually Headwaters, Berry Creek, Big Creek, Copper, East Creek, and Little Nisqually River sub-watershed. Mt Rainier National Park Manages all of the Tahoma Creek and the vast majority of the Nisqually Headwaters sub-watersheds. Private interest manage nearly all the Nisqually River- Reese Creek, Mineral Creek, North Fork Mineral Creek, and Roundtop Creek sub-watersheds and substantial portions of the Big Creek, Copper Creek, Nisqually River East Creek sub-watersheds.

Several sources of information were used to determine the environmental baseline:

- The Nisqually and Little Nisqually watershed assessments, Gifford Pinchot National Forest, Cowlitz ValleyRanger Districts, September 1999.
- Stream Surveys by the Gifford Pinchot National Forest from 1987 through 1997, listed in Table 1.
- Stream temperature monitoring from 1996 through 2001, listed in Table 2.
- Field observations from 1990 through 2001 by employees of the Gifford Pinchot National Forest. These employees included a number of Hydrologists and Fisheries Biologists employed by the Forest Service during that time period

Table 1. Level II Stream Surveys in the Upper NisquallyRiver watershed from 1987 through 1997.

Watershed	Stream name	Years Surveyed[1]
171100150101	Horse Creek	1988
171100150103	Berry Creek	1980, 1989, 1997
171100150104	Copper Creek	1981, 1988
171100150104	Goat Creek	1979, 1988
171100150105	Catt Creek	1984, 1987
1711001501051	Big Creek	1997

[1] Stream surveys prior to 1991 did not conform to regional guidelines for stream surveys. Guidelines for fish surveys did not exist prior to 1991

Table 2. Temperature monitoring in the Upper NisquallyRiver watershed from 1996 through 2001.

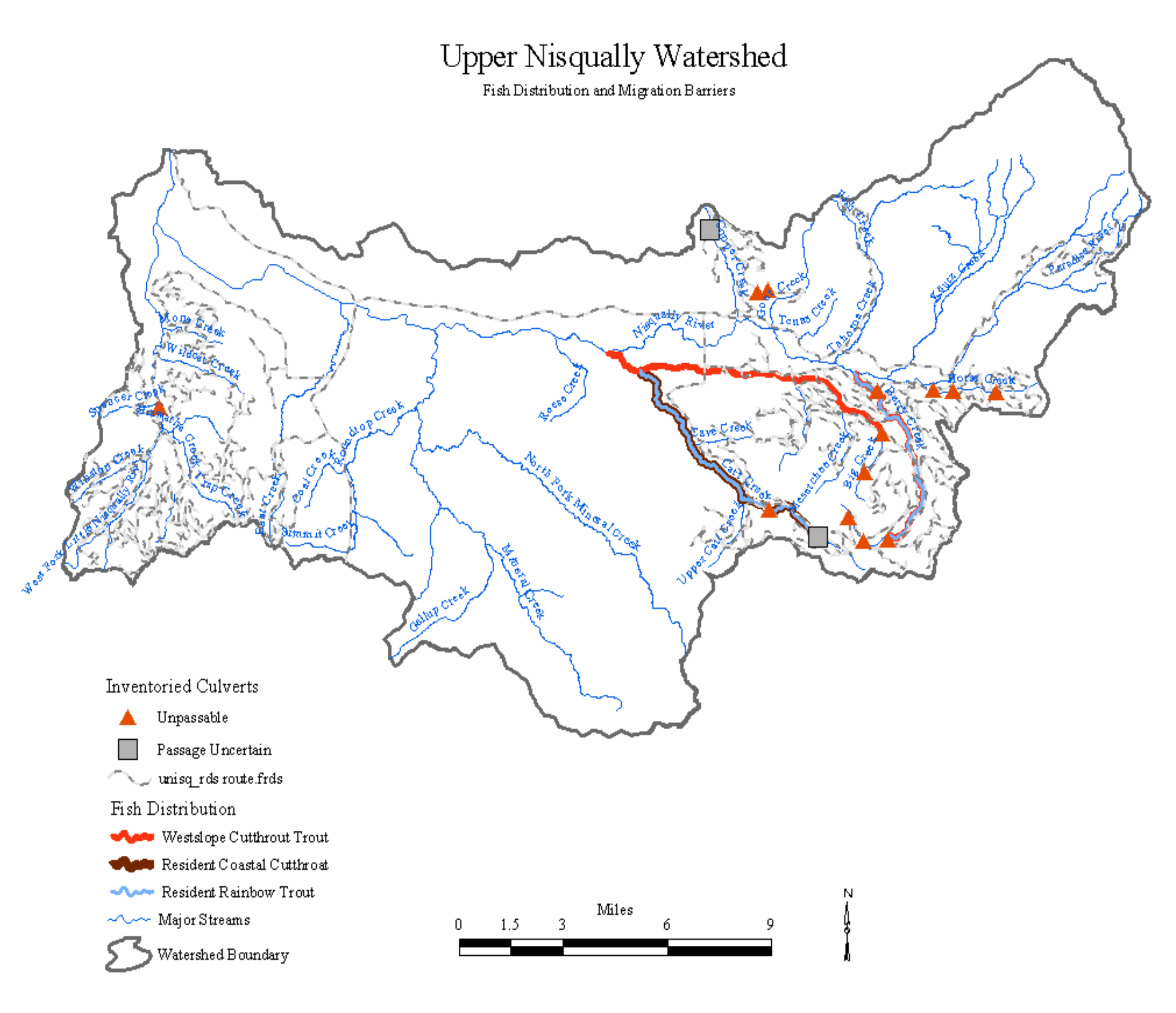
Sub-Watershed #	Stream name	Location	Years Monitored	7-day Average Max
171100150101	Horse Creek	T 14N R8 Sec 5 SW1/4	1997	12.0
171100150103	Berry Creek	At Mouth	1997	13.8
		T 14 N R7 sec 12 NW 1/4	1997	11.7
171100150104	Copper Creek	T15N R7 Sec 30 NE 1/4	1997	12.6
171100150105	Big Creek	At Mouth	1997	16.6
		T14 N R7 Sec 3 NW 1/2	1997	12.2
	Catt Creek	Near Forest Bnd	1999, 2001	15.1
		At Cave Creek	1996	15.3
		At 8440054	2000	12.2
		At 85 road	2000	12.5
	South Fork Catt Creek		2000	12.5
	Mesatchee Creek	at 8415 road	2000	11.1
		Sec 10 NW 1/4	1997, 2000	11.7
	Teeley Creek		1997	12.2
171100150111	Hiawatha Creek	At Mouth	2001	15.4

The Upper Cowlitz watershed contains approximately 108.2 miles of fish species habitat. There are no anadromous species in the upper part of this watershed. Bull trout was suspected of occurring in the Upper Nisqually River. Despite numerous surveys bull trout have never been reported in this 5th watershed, therefore we do not report any mile of habitat for this species. There are no records of bull trout in the Upper Nisqually River watershed.

Table 3. Fish habitat environmental baseline conditions in 2001 for the Upper Nisqually River watershed.

		Environmental Baseline Rating		
Pathway	**Indicator(s)**	**Properly Functioning**	**Functioning at Risk**	**Functioning at Unacceptable Risk**
WATER QUALITY	Temperature		X	
	Sediment		X	
	Chemical Contaminants/Nutrients		X	
HABITAT ACCESS	Physical barriers	X		
HABITAT ELEMENTS	Substrate in rearing areas		X	
	Large Woody Debris			X
	Pool Frequency and Quality			X
	Large pools		X	
	Off-channel habitat		X	
	Refugia		X	
CHANNEL DYNAMICS and CONDITION	Width / Depth Ratio		X	
	Streambank condition		X	
	Floodplain connectivity		X	
FLOW / HYDROLOGY	Peak/base flows		X	
	Drainage network		X	
WATERSHED CONDITIONS	Road density and location			X
	Disturbance regime		X	
	Disturbance history			X
	Riparian reserves		X	
SUBPOPULATION CHARACTERISTICS / SPECIES AND HABITAT	Subpopulation size, Growth and survival, Life history Diversity and isolation, Persistence and genetic integrity, Integration of species and habitat conditions	No Rating. (The Forest Service has insufficient data in order to rate these indicators).		

Although there are no anadromous fish within National Forest lands in the Upper Nisqually River watershed, there is fish habitat availability and the presence of resident fish. The health of the upper watershed should not be overlooked for the mere reason that anadromous fish are not present.


Upper Nisqually Watershed
Fish Distribution and Migration Barriers
Nisqually River
Mineral Creek
North Fork Mineral Creek
Gallup Creek
Reese Creek
Cave Creek
Big Creek
Upper Cat Creek
Summit Creek
Coal Creek
Tenas Creek
Tahoma Creek
Horse Creek
Paradise River
Wilson Creek
Spencer Creek
Inventoried Culverts
Unpassable
Passage Uncertain
unisq_rds route.frds
Fish Distribution
Westslope Cutthrout Trout
Resident Coastal Cutthroat
Resident Rainbow Trout
Major Streams
Watershed Boundary
Miles
0
1.5
3
6
9
N