United States
Department
of Agriculture

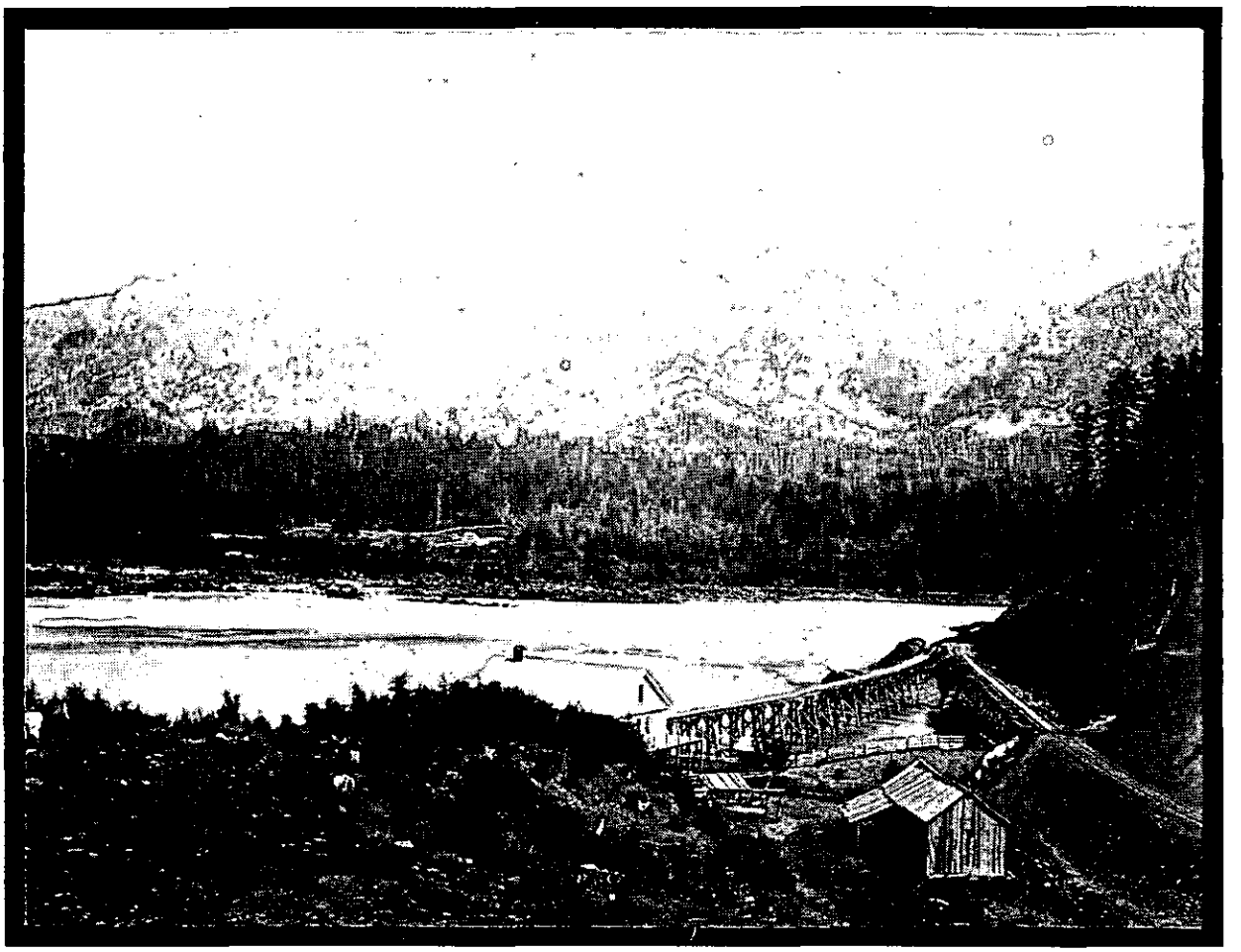
Forest
Service

**Pacific
Northwest
Region**

1998

Columbia Tributaries East Watershed Analysis

Hood River Ranger District
Mt. Hood National Forest
and
Columbia River Gorge National Scenic Area



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Hood River Ranger District

1998

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THIS WATERSHED ANALYSIS WILL SERVE AS THE OPEN SPACE PLAN FOR THE SPECIAL MANAGEMENT AREAS OF THE WATERSHED.

ARTHUR CARROLL
AREA MANAGER

6/1/98
DATE

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DOCUMENT ORGANIZATION

The Columbia Tributaries East watershed analysis describes the existing conditions in the area (Figure 1), for what reason the study area has changed over time, and how management or restoration can move the watershed toward the desired future condition. The document is organized into six chapters:

- Chapter I is a "Characterization" of the watershed that briefly describes location, physical features, natural processes and social significance. It is a summation of what makes the area unique.

- Chapter II contains the "Key Questions" developed by the watershed analysis team and from public comments.

- Chapter III explains in some detail "Current Conditions" of the watershed based on prevailing (1998) knowledge.

- Chapter IV describes the "Reference Conditions" for the period 350 to 1,500 years ago within the watershed. This chapter also presents the changes that happened since that period.

- Chapter V is a "Synthesis" of the separate ecological elements as they affect the entire ecosystem.

- Chapter VI provides the "Recommendations" that have been forthcoming from this analysis. In addition this chapter contains a discussion of data gaps, identification of additional analysis needs and identification of monitoring needs.

The Columbia East Tributaries Watershed Analysis format follows the Federal Guidelines for Watershed Analysis (version 2.2, August 1995). And the study was an integrated effort by resource specialists whose recommended actions establish a context for future projects. This watershed analysis, however, should not be considered a "decision" document, and any recommendations must undergo further analyses before implementation. The study should be thought of instead as a living document to guide resource specialists and land managers. Updates will occur periodically as new information becomes available.

Changes to the established Columbia Tributaries East watershed include the removal of Phelps Creek and the addition of Tanner Creek to the analysis area. These changes were made so lands of similar allocations and uses, and the remainder of the Mark O. Hatfield Wilderness, not in the West Fork Hood River, could be incorporated into the study area. It is recommended that Phelps Creek be analyzed with the main stem Hood River, because land uses and issues are similar.

The 1867 Watkin's cover photo "View of the Upper Cascades from the Blockhouse" (Negative No. Orlti 21110), is courtesy of the Oregon Historical Society.

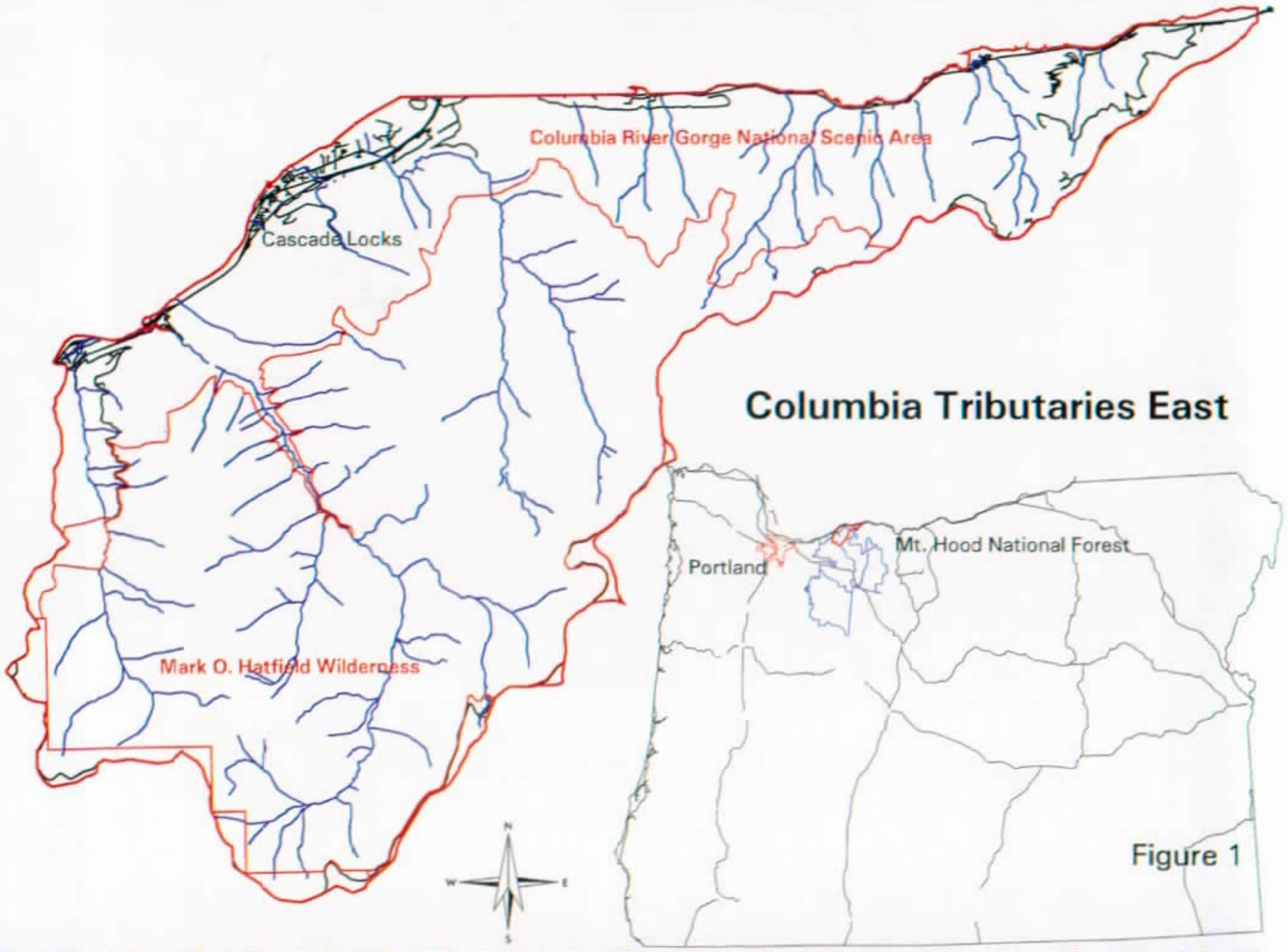
Columbia River Gorge National Scenic Area
Cascade Locks
Mark O. Hatfield Wilderness
Columbia Tributaries East
Portland
Mt. Hood National Forest
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Figure 1

I. CHARACTERIZATION

WATERSHED CHARACTERISTICS

The Columbia Tributaries East Watershed is a unique and complex area that consists of numerous short streams flowing directly into the Columbia River. Eastern interior and western marine climates meet here. Precipitation ranges from 40 inches to 125 inches annually. Elevations go from near sea level to 5,000 ft. The topographic and climatic conditions have resulted in different habitat types being much closer together than usual. Low elevation riparian forest, high mountain fir and hemlock, wet western hemlock, and dry Oregon oak/ ponderosa pine forests are all found within this watershed. This results in a mosaic of varied but spatially close habitats populated by a diversity of flora and fauna. Historically, the Columbia River corridor has been a travel and migration route for people, animals and plants. Today the Columbia River is dammed at Bonneville between Eagle and Tanner creeks. The unflooded lowlands are still used as a travel route, with two railroads, an interstate and state highway. Other human developments in the lowland area include urban areas, farms, parks and industrial sites. Whereas the river corridor has been highly modified, the walls of the Gorge and Mark O. Hatfield Wilderness remain largely undeveloped.

Table 1. Land Ownership

Land Owner or Managing Agency	Acreage	Percent of Watershed
National Forest	60,800	90.9 %
State of Oregon	2,093	3.1 %
Hood River County	1,039	1.6 %
City of Cascade Locks	79	0.1%
Private, Port	686	1.0 %
Urban Area	2,550	3.3 %

Located about 40 miles east of Portland, Oregon, this watershed contains the city of Cascade Locks and Bonneville Dam. Total watershed acreage equals 66,920 acres with about 25,185 acres in the Columbia River Gorge National Scenic Area (CRGNSA). Portions in the Mount Hood National Forest include 39,891 acres in the Mark O. Hatfield Wilderness, 1,441 acres in the Bull Run, and 402 acres in the Hood River Ranger District outside the Wilderness (Figure 2). Most of the study area is in the Willamette Province, with only a small portion, east of the Cascade Crest, located in the Deschutes Province. In addition, the majority of the watershed is located in Hood River County, with only a small section found in Multnomah County. The area of analysis is limited by Hood River Valley, the West Fork of Hood River Watershed to the east, the Bull Run Watershed to the southwest, the CRGNSA Open Space to the west, and the Columbia River to the north.

Management Direction

Land management agencies and property owners include the USDA Forest Service, state of Oregon, Hood River County, private citizens, along with the port and city of Cascade Locks. Direction for administration of the watershed is determined by the Northwest Forest Plan (Figure 3), the Mount Hood Forest Plan (Figure 4), the CRGNSA Management Plan (Figure 5) and Hood River County implementing ordinances, and the Oregon State Parks Master Plan. More information on land allocations and land ownership can be found in Appendix 3.

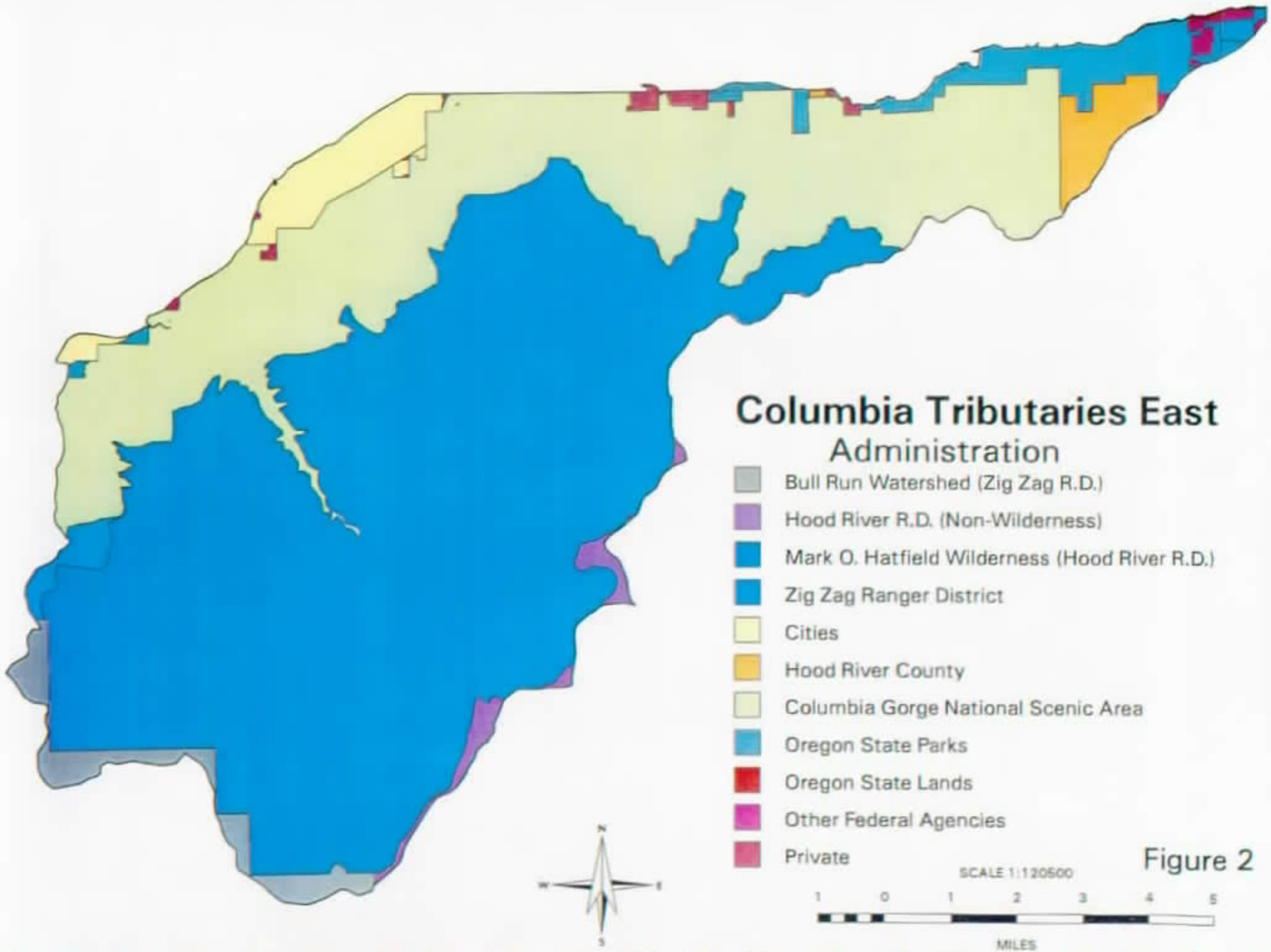
Columbia Tributaries East
Administration
Bull Run Watershed (Zig Zag R.D.)
Hood River R.D. (Non-Wilderness)
Mark O. Hatfield Wilderness (Hood River R.D.)
Zig Zag Ranger District
Cities
Hood River County
Columbia Gorge National Scenic Area
Oregon State Parks
Oregon State Lands
Other Federal Agencies
Private
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Figure 2

Allocations apply to Federal Lands Only

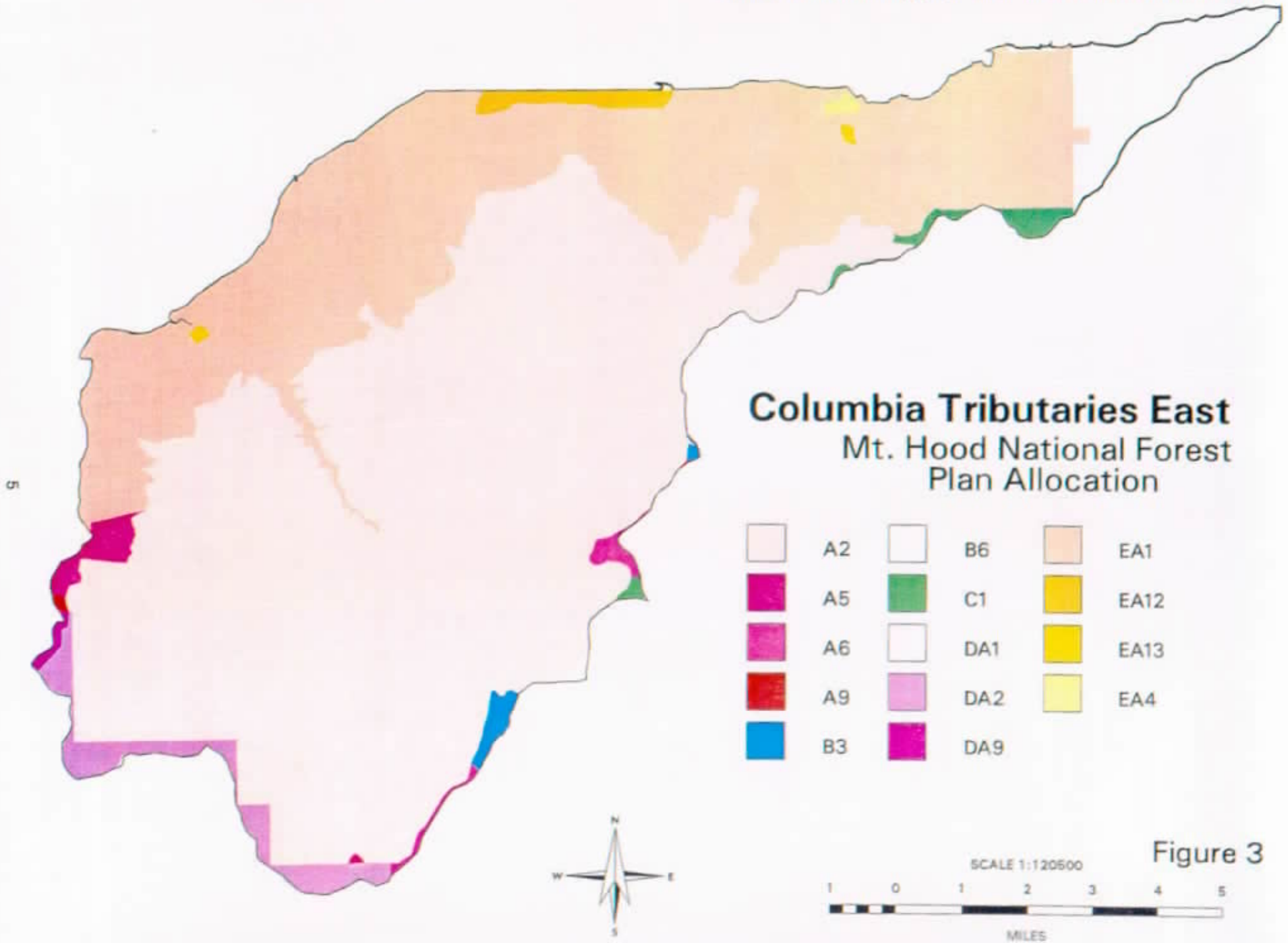


Figure 3

KEY TO FIGURE 3

- A2 Wilderness.
- A5 Unroaded Recreation.
- A6 Semi-primitive Roaded Recreation.
- A9 Key Site Riparian.
- B3 Roaded Recreation.
- B6 Special Emphasis Watershed.
- B12 Backcountry Lakes.
- C1 Timber Emphasis.
- DA1 Bull Run Physical Drainage.
- DA2 North Buffer-No Regulated Harvest.
- DA9 Key Site Riparian.
- EA1 Scenic Area.
- EA4 Special Interest Area.
- EA12 Outdoor Recreation Area.
- EA13 Bald Eagle Habitat Area

Allocations apply to Federal Lands Only

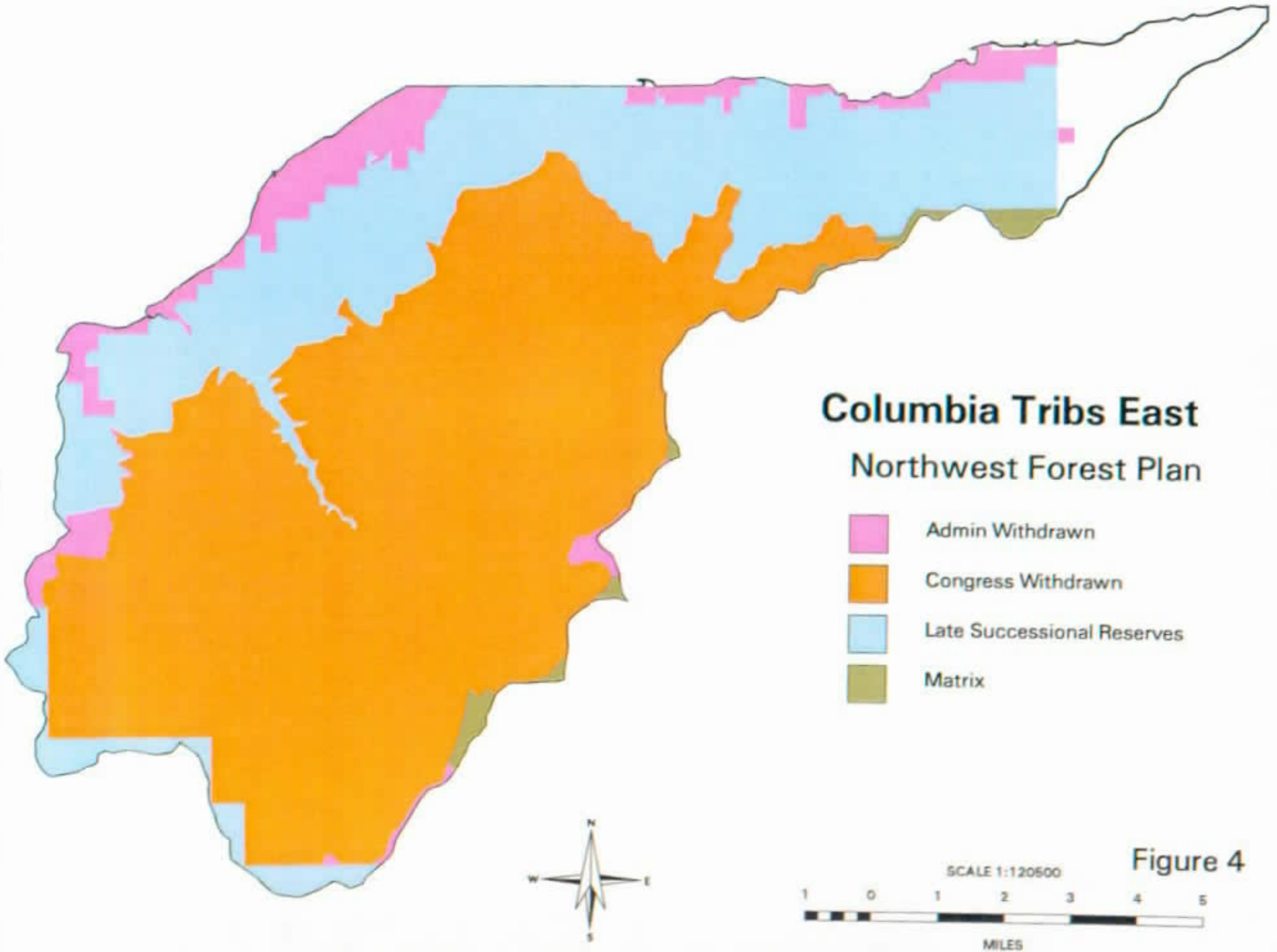
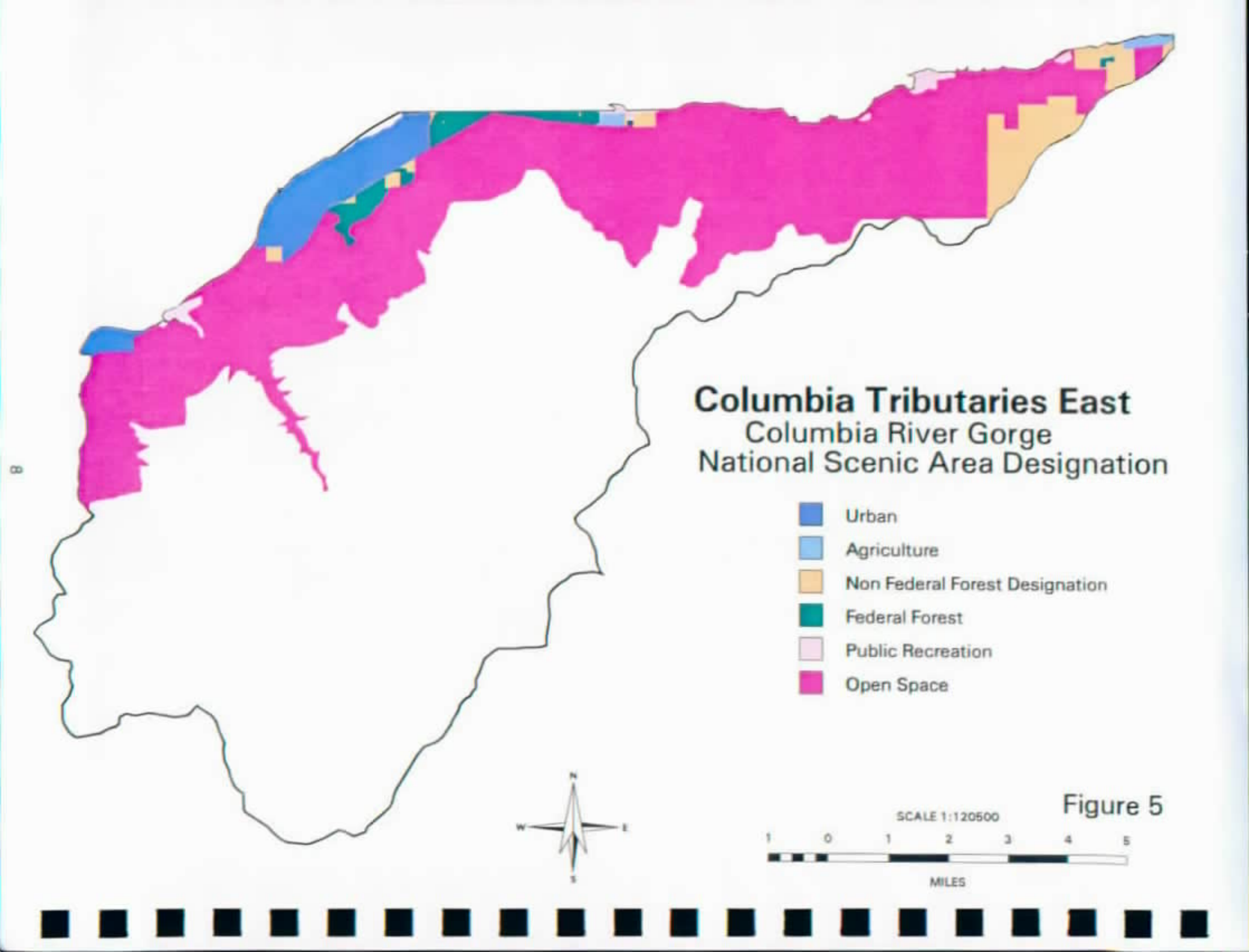


Figure 4


Columbia Tributaries East
Columbia River Gorge
National Scenic Area Designation
Urban
Agriculture
Non Federal Forest Designation
Federal Forest
Public Recreation
Open Space
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SCALE 1:120500
1 0 1 2 3 4 5
MILES

Figure 5

All of the Mount Hood National Forest watershed area is federally administrated, while the National Scenic Area allocations include federal, state, county and private lands. Mount Hood National Forest lands are governed by both the Mount Hood Forest Plan and the Northwest Forest Plan. Federal lands in the National Scenic Area are governed by the CRGNSA Management Plan, Mount Hood Forest Plan and Northwest Forest Plan, with the most protective guidelines taking precedence. Private lands in the watershed are regulated only by the CRGNSA Management Plan and Hood River County Ordinances. Table 2 portrays the land allocations found in the Northwest Forest Plan, that apply only to federal lands. Table 3 displays acreage in each land use designation found in the Mount Hood Forest Plan and the CRGNSA Management Plan. Table 4 displays ownership acreage in each Mount Hood and CRGNSA land use designation.

Table 2. Land Allocations from the Northwest Forest Plan

NW Forest Plan Allocation	Acres
Congressionally Withdrawn	39,891
Late Successional Reserve	20,295
Administratively Withdrawn	205
Matrix	322
Non-federal Land: unallocated	6,206
Total	*66,919*

Table 3. Land Use Designations from the Mount Hood Forest Plan and the CRGNSA Management Plan

Management Plan Designations	Acres
Mount Hood Forest Plan	
Wilderness (A2)	39,891
Bull Run Watershed (DA1, 2,9)	1,441
Hood River RD (A5, A6,A9)	80
Hood River RD (B3,B6,B12,C1)	322
CRGNSA Plan	
NSA Open Space	19,649
NSA Forest	2,846
NSA Public Recreation	328
NSA Agriculture	139
NSA Urban Areas	2,223
Total	*66,919*

Table 4. Land Stewardship by Mount Hood Forest Plan or CRGNSA Land Allocation

				Land	Allocation		Acres		
Land Owner	**Total Acres**	***Open Space**	***Forest**	***Public Recreation**	***Agri-culture**	***Urban Area**	**Wilder-ness**	**Bull Run**	**HRRD**
FS - Mt Hood	**41,734**	0	0	0	0	N/A	39,891	1,441	402
FS - NSA	**18,979**	17,831	1,023	125	0	N/A	0	0	0
Oregon State Parks	**2,035**	1,598	300	123	14	N/A	0	0	0
OR DOT	**56**	56							
OR DWF	**2**	2							
Hood River County	**1,039**	43	996	0	0	N/A	0	0	0
Cascade Locks City	**79**	2	77	0	0	N/A	0	0	0
Private (26 owners)	**772**	117	450	80	125	N/A	0	0	0
Cascade Locks UA	**1,673**	0	0	0	0	1,673	0	0	0
Bonneville UA	**550**	0	0	0	0	550	0	0	0
(Total Acres)	***66,919***	*19,649*	*2,846*	*328*	*139*	*2,223*	*39,891*	*1,441*	*402*

* National Scenic Area Plan allocation

GEOLOGY

Volcanic lava flows, followed much later by glaciation and flooding, are the major factors that formed the dramatic landscape of the Columbia River Gorge. Steep basalt cliffs, waterfalls, sharply-defined ridges and deep moist canyons characterize the watershed today. Initially the mountains of the Cascade Range began developing about 40 million years ago (MYA) as a series of low volcanoes. Around five MYA this older range rose and tilted creating a rain shadow to the east. The rise of the Cascade Arch completed the climatic division of the Pacific Northwest into western moist and eastern dry sections. A large volcanic eruption occurred around 7,000 years ago when Mount Mazama, which is located 150 miles to the south, exploded and spewed ash over the entire region. Mount Hood has had two eruptive phases in the last 15,000 years as well as minor ash, mud flows, and pumice emissions. Also, earthquakes, greater than 7.5 magnitude have occurred along the Pacific Coastline within the last 10,000 years, although no large quakes have been recorded during the historical period (Reese 1988; Lehman Turck 1996:A-1).

The Columbia River began flowing through the Columbia Plateau about 15 MYA. During the Tertiary Period (70 to 2 MYA), the river's down cutting action combined with the uplift of the Cascade Range to form the Columbia Gorge. Catastrophic events continued to shape the region. During the Pleistocene (2 MYA to 15,000 years ago), glaciers remained above 3,200 ft in the Gorge region. A large glacial lake was formed in present Montana when an ice dam blocked the passage of glacial melt. This dam repeatedly failed and rebuilt, causing over 40 episodes of cataclysmic flooding through the Columbia Gorge. These hydrological events, known as Bretz or Spokane floods, stripped away unconsolidated deposits, widened the canyon floor and created steep canyon walls. Origins of many of the Gorge waterfalls also date to this period. Through time, major landslides were initiated by the undercutting of the steep canyon walls by the Columbia River. Of particular note is the Bonneville Landslide that completely blocked the river approximately 800 years ago. This earthen dam created a 200-300 ft deep temporary lake (Beckham et al. 1988; Minor et al. 1986:5-8). In recent history, the most predominant type of erosional process has been mass wasting, also known as slope failure or landslide.

HYDROLOGY

The analysis area is comprised of over two dozen separate drainages that flow directly into the Columbia River. Deep canyons with oversteepened headwalls rising to the Cascade Crest, remain moist and cool throughout the year. Major topographic features include Tanner Creek, Eagle Creek, and Herman Creek, Benson Plateau, and the high peaks of Tanner Butte, Chinidere Mountain and Mount Defiance. Other prominent features include Wahtum, Hicks, and Mud lakes and several other named lakes. Large alluvial fan deposits, found at the mouths of major creeks where they join the Columbia River, are evidence of frequent routing of debris torrents down these channels. Upper headwaters areas contain around 100 small, shallow, glacially formed lakes. In contrast, tributaries with headwaters below the elevation of 3,200 ft have relatively small watersheds with short and steep mainstem lengths less than three miles long. The area has an overall north aspect which tends to be wetter than others due to shading. Precipitation amounts increase east to west as well as with elevation.

VEGETATION

Dramatic topographic and meterologic changes associated with a near sea-level passage through the Cascade Mountains have created a mosaic of relatively disparate habitats. Moisture-laden storms approach the Gorge from the Pacific, drop abundant rainfall on the west side of the Cascades as clouds rise over the crest, and then rapidly decrease in precipitation amounts inside the "rain shadow" east of the mountains. Within a 10 mile stretch along the Columbia River, moist western hemlock forests might dominate on the western end while dry Douglas-fir, grand fir and oak/pine communities might dominate the landscape just a few miles east. Similarly, the low elevation mixed hardwood/conifer communities quickly change into high elevation mountain hemlock communities within one to four miles.

Along the Columbia River are found riparian hardwood communities and a diversity of wetlands; these rapidly interfinger with the predominantly coniferous forested landscapes of the uplands. This marked variability in vegetation communities and topography has created a mosaic of relatively unique habitats in which live a great diversity of flora both rare and common. Although no federally listed threatened or endangered plants are known or suspected, many sensitive species are either documented or suspected to occur within the watershed. A complete list of sensitive plants known or suspected to occur is included in Appendix 7.

DISTURBANCE PROCESSES

Historically fire has been the most important disturbance factor to affect vegetation in this watershed. While landslides, floods, ice-flows, ice-storms and wind storms can be quite significant, they occur in limited areas. Of the latter events, landslides (excluding the Bretz floods) appear to be the most important. Flooding, while significant, has been limited to areas immediately adjacent to the Columbia River. More recently, introduction of noxious weeds into native plant communities by vectors such as vehicles, animals, and hikers, have caused dramatic changes to native vegetation.

WILDLIFE AND FISHERIES

Among endangered, rare or uncommon animals known to be present year round are cougar, bald eagle, peregrine falcon, northern spotted owl, pileated woodpecker, red-legged frog, Larch Mountain salamander and Cope's giant salamander. In addition, animals such as wolverine, fisher, marten, red fox, Vaux's swift, goshawk and harlequin duck may seasonally or permanently inhabit the watershed. Red-legged and Cascades frogs are both on the State sensitive species list and the red-legged is also on the Forest Service's Region 6 sensitive species list. Both are on a decline region wide, and have been extirpated in certain areas.

Because most of the fish migration routes are blocked by waterfalls within a mile or two of creek mouths, limited anadromous fish habitat exists. The Columbia River Gorge contains a mix of trout species due in part to the aforementioned steep topography and the various flood events that have swept through the region. Cutthroat trout and rainbow trout (predominant) are present in the watershed with bull trout potentially able to use the tributary mouths. Finally the watershed is within the range of four Region 6 sensitive species of caddisfly.

HUMAN USE

Archaeological evidence indicates the Native American Indians were present on the Columbia Plateau for at least the last 12,000 years. At the time of historic contact, they were living in dispersed, semi-permanent housepit villages along the banks of the Columbia River and its tributaries and using the Columbia as a major transportation route. Indians exploited both riverine and upland resources. In the Columbia River Gorge and elsewhere, their ranks were decimated by European diseases. The watershed falls within the ceded lands of the Confederated Tribes of Warm Springs. In the 1850s Governor Stevens, of Washington Territory, negotiated treaties with Columbia Basin Tribes. Most of the remaining Native Americans were moved to reservations, however, within the treaties the Tribes reserved the following provisions:

> . . ."the right to take fish at all their usual and accustomed fishing grounds and stations, is further secured to said Indians, in common with all citizens of the Territory, and of erecting temporary houses for the purpose of curing, together with the privilege of hunting, gathering roots and berries, and pasturing their horses on open and unclaimed land . . ." (Treaty of Medicine Creek 1854)

The above rights were negotiated in treaties were signed by United States officials and Tribal representatives and subsequently ratified by US Congress. The extent and nature of these reserved rights have been strongly contested at times by the state of Oregon. Disagreements usually resulted in court actions and decisions that serve to clarify and/or affirm portions of treaties and existing Indian law (McConnell 1991:21). Indian rights and privileges must be carefully considered in the future planning and management of the watershed.

Today the watershed is lightly populated with one city, Cascade Locks (pop 2,000), and the remainder largely uninhabited. Presently outdoor recreation is the major activity in the watershed. People are attracted to the Gorge because of its scenic beauty, and many recreation opportunities including trails, campgrounds and visitor centers. These facilities are located

within one hour of the greater Portland/Vancouver Metro area. Most of the use is confined to the I-84 corridor and developed recreation sites. Sightseeing and picnicking are the most popular form of recreation activity in the National Scenic Area. Fishing, wind surfing, nature study, and visiting historic sites are other significant uses.

Recreation

As of 1992, there were approximately 2 million acres of Wilderness in the National Forests in Oregon, and 2.6 million acres on National Forests in Washington. The Hatfield Wilderness is in close proximity to Portland, and somewhat unique because a portion is low elevation old-growth forest. Recreation experiences are distinct due to the relatively few visitors. In addition the large trail system provides for a variety of back country experiences. Abundant rainfall, and cool temperatures are probably the major reasons fewer people visit the Hatfield Wilderness than other areas of the Mount Hood National Forest. Many people prefer an alpine or sub-alpine experience, and are, therefore, drawn to Mount Hood because of its higher elevation. The Hatfield Wilderness has a 90 mile trail system, much of which is reached through trails originating in the CRGNSA. Most of the utilization in the Hatfield Wilderness takes place on the trail system, with the heaviest occurring in the Eagle Creek corridor, then Wahtum Lake followed by Rainy and North lakes. This Wilderness provides a variety of viewing experiences, from western redcedar rain forests, to 5,000 ft high windswept ridges. In order to access lakes and ridges, guests sometimes go off trail, or hike abandoned trails. Ice, steep slopes, the lack of plowed access to trailheads, and heavy forested conditions deter most visitors in the winter months.

AIR AND WATER QUALITY

Air

Air is an integral part of the forest environment. Its character directly affects plant, animal and human habitat and affects the many scenic and recreational opportunities available in the CRGNSA. The clarity and cleanliness of air quality varies seasonally in the National Scenic Area. Major sources of air pollution include vehicle emissions, dust from industrial operations, industrial and recreational vehicle traffic, as well as smoke particulates from the burning of unwanted vegetation and logging residues. Visibility is being monitored by federal and state agencies to determine the extent and causes of visibility impairment. Two of these IMPROVE (Interagency Monitoring of Protected Visual Environments) sites are located within the Scenic Area boundaries.

The Clean Air Act of 1963 (as amended) requires that all areas of the country be placed into one of the following classifications:

Class I: areas where anything but the smallest degradation of air quality would be socially unacceptable;
Class II: areas where moderate degradation of air quality would be socially acceptable;
Class III: areas where a considerable degradation of air quality would be socially acceptable.

The Columbia River Gorge National Scenic Area and Mark 0. Hatfield Wilderness are both designated Class II airsheds.

Water

Anadromous species as well as resident aquatic species are major beneficiaries of the water resources within the study area. Anadromous use generally occurs below 600 ft in elevation, downstream from the waterfalls. Alternatively, populations of resident aquatic species exist above the falls. Tanner Creek, Eagle Creek and Herman Creek provide water for hatcheries located near the Columbia River, and Dry Creek provides a backup of good clear water for Cascade Locks. The streams in this watershed have some of the cleanest water in the state.

II. KEY QUESTIONS

Key Questions were developed by the Watershed Analysis Team and from comments solicited from the public and other agencies.

RECREATION

1. How should overuse be managed at Eagle Creek and Wahtum Lake? (as defined by Wilderness policy and resource impacts)
   Indicators: encounters, campsites, resource impacts (lower trail)

2. What should be the role of Oregon State Parks, ODOT, and private landholders in supplying recreation opportunities?
   Indicators: inability to meet demand at existing and proposed sites on National Forest and other lands, acceptable resource impacts

3. Should any actions be taken regarding existing recreation facilities located in Riparian Reserves and floodplains? (includes campsites on lakes and streams)
   Indicators: Aquatic Conservation Strategy objectives, nutrients in high lakes

4. What recreation opportunities should be supplied by the Wyeth Bench area?
   Indicators: inability to meet demand elsewhere, acceptable resource impacts

SPECIES, ECOLOGICAL HABITATS AND DISTURBANCE

1. What role should fire play as a disturbance factor in this watershed?
   Indicators: acres, intensity, location, frequency, historical patterns

2. What disturbance processes are missing or altered that maintain special habitats, diversity and function of the ecosystem, and where should they be re-established?
   a. Columbia River flushing flows and riparian habitat
   b. Restriction of flows in lower tributaries
   c. Extirpated species and introduced species
   d. Mass wasting
   e. Fire
   Indicators: Same as #1

3. How can wildlife demographic and genetic exchanges across the Columbia River, and east-west along the corridor, be enhanced and maintained?
   Indicators: habitat linkages to other watersheds: avian, terrestrial, aquatic

4. What should the condition and location of anadromous fish habitat be in the future?
   Indicator: pools/mile, pieces large wood/mile, substrate, flow, barriers

5. How can we reduce damage caused to recreation facilities by natural events?
   Indicators: frequency, intensity, cost of damage, resource cost of actions taken

WATER RESOURCES

1. What is the level of water quality needed for hatcheries and domestic use?
   Indicators: turbidity, temperature, Ph, dissolved oxygen, bacteria, duration and concentration

2. Are there key areas where the riparian reserve boundaries should be altered from the standards of the Northwest Forest Plan?
   Indicators: meeting Aquatic Conservation Strategy objectives.

III. CURRENT CONDITIONS

EROSION PROCESSES

Dominant erosion processes relate to past geologic activities. Massive, deep seated, slumping occurs along the Gorge walls in the vicinity of Bonneville, Ruckle Ridge, and Wyeth, that were undercut by the Bretz Floods. Adjacent to the Columbia River, these areas are comprised of relatively flat ground along the river or on benches just above the river. The Columbia River Basalts and Troutdale Formations, that are exposed along the south cliff face of the Columbia River Gorge, are prone to rockfalls particularly during periods of repeated freezing and thawing temperatures. Water seeps into cracks of finely jointed basalt and freezing ultimately pries off sections of rock. Rockfall is more concentrated around the numerous waterfalls within the Gorge due to rapid erosion of the cliff faces by spray from the falls.

The level glaciated areas, above 3,200 feet, have deeper, finer soils that are prone to surface erosion and compaction. This higher elevation area also has weather extremes and tends to revegetate slowly after disturbance. The erosion process, however, that dominates the majority of the analysis area is that of mass wasting. This watershed contains many areas of steep, highly dissected, wet slopes that are conducive to landslides. Initially, relatively small, surface soil slope failures can develop into large debris flows or torrents as they are transported downslope, via, steep stream channels. Gaining in size, they scour additional material from channel bottoms and sideslopes, prior to depositing debris in channels with gentler slopes of less than 6%. These torrents commonly erode material one to two hundred feet upslope from the high water channel.

Debris slides, torrents, or avalanches made up of ice or snow are not uncommon in the area during the winter months. Ice concentrated along the area's steep slopes and stream channels is a highly erosive force. Ice and snow also accumulate and cause jams at channel constrictions. Blockages caused flows to back up with failure causing extensive and rapid downslope erosion along with denuding vegetation within riparian areas. Blockages and backup also results in much longer term erosion along side slopes and channels. Surface erosion from the undercut side slopes along channels is prevalent for years after routing of debris torrents. Freeze-thaw events in the winter and dry ravel of surface soils in the summer will occur until slopes are revegetated.

Vegetation plays the critical role in stabilizing the steep wet slopes common to the analysis area. Root strength appears to be the major element keeping soils on slopes that are greater than the natural angle of repose. After vegetation is removed from these soils, there is usually a period of 10 to 15 years (until vegetation growth is adequate to replace root strength) that these slopes would be more prone to failure. However, slides do still frequently occur on undisturbed slopes that are fully vegetated. The rate of mass failure and erosion is accelerated when the soils or vegetation is disturbed on these steep slopes (greater than 60%). Risk of slope failure after clearcutting or intensive burn may be three to ten times the rate of a forested slope fully vegetated with understory and overstory canopy.

HYDROLOGY

Most of the Columbia River tributaries in the watershed area are perennial, with relatively large base flows. During low flow periods, however, many of these tributaries have subsurface flows in the lower reach near the confluence with the Columbia. Streamflow percolates down through the vast amount of deposited and unconsolidated material of debris fans at stream mouths. Extensive areas of seeps and springs, probably concentrated at the numerous contact zones of the different geologic layers, feed these tributaries along with the numerous high elevation lakes and wetlands. The large amount of unvegetated talus slopes in the watershed also contribute, through the lack of transpiration, to these high base flows. As mentioned previously, the analysis area has precipitation that varies from about 40 to 125 inches annually. The watershed has an overall north aspect which tends to be wetter than other areas of the Gorge, due to shading. Precipitation amounts deviate on an east-west gradient as well as with elevation. At the near sea level elevations along the Columbia River, precipitation varies from about 70 inches per year near Bonneville to 40 inches at the eastern end of the area near Mitchell Point. The greatest amounts of precipitation (125 inches) occur at Chinidere Mountain, the highest point in the analysis area, located on the Cascade Mountains Crest.

Snowpack is transient in the winter months in most of the drainage area, between 1,000 to 4,000 ft in elevation. Normal high flows, in these tributaries to the Columbia, occur in the winter months between November and March. Major flood flows are a result of rain-on-snow events caused by the rapid melting of a heavy snowpack in this transient snow area in conjunction with a period of intense rainfall, and prior saturated conditions. These major winter ocean-dominated rainstorms normally have high, warm winds associated with them that increases the rate of snowmelt. Floods have historically occurred from December through February. Winter temperatures are low enough to have surface ice sometimes forming on the lower gradient channels of Tanner, Eagle, and Herman creeks along with the shallow and slow moving portions of the Columbia River (Figure 6).

The Columbia Gorge Tributaries East Watershed contains around 100 permanent lakes and ponds which cover a total of 110 surface acres, with about 10.5 miles of shoreline. Concentrated in the glaciated region above the 3,800 foot elevation, most of the lakes and ponds have surface areas of less than 10 acres and are shallow with depths of less than 12 feet. The exception is Whatum Lake, at the headwaters of Eagle Creek, which is the largest lake in the area. The lake has a surface area of about 60 acres and a maximum depth of 180 ft, and is the only lake deep enough to become stratified during the summer months. Bottom composition of these lakes is almost totally mud, with some scattered boulders, and scarce sand and gravels. Beaver dams and/or log jams are often seen at lake outlets.

STREAM CHANNEL MORPHOLOGY

Routing of the frequent debris torrents in the area varies with stream channel morphology. The shorter direct Columbia River tributaries normally are constricted and have adequate gradients to transport debris torrents down channel, until they start to deposit in areas of channel gradients of less than about 6%. This results in most of the debris torrents being routed to the mouths of these streams, and depositing near their confluence with the Columbia. The less constricted and lower gradient channels of Tanner, Herman and Eagle creeks tend not to transport debris torrents down the mainstem, as often as down the other steeper channels.

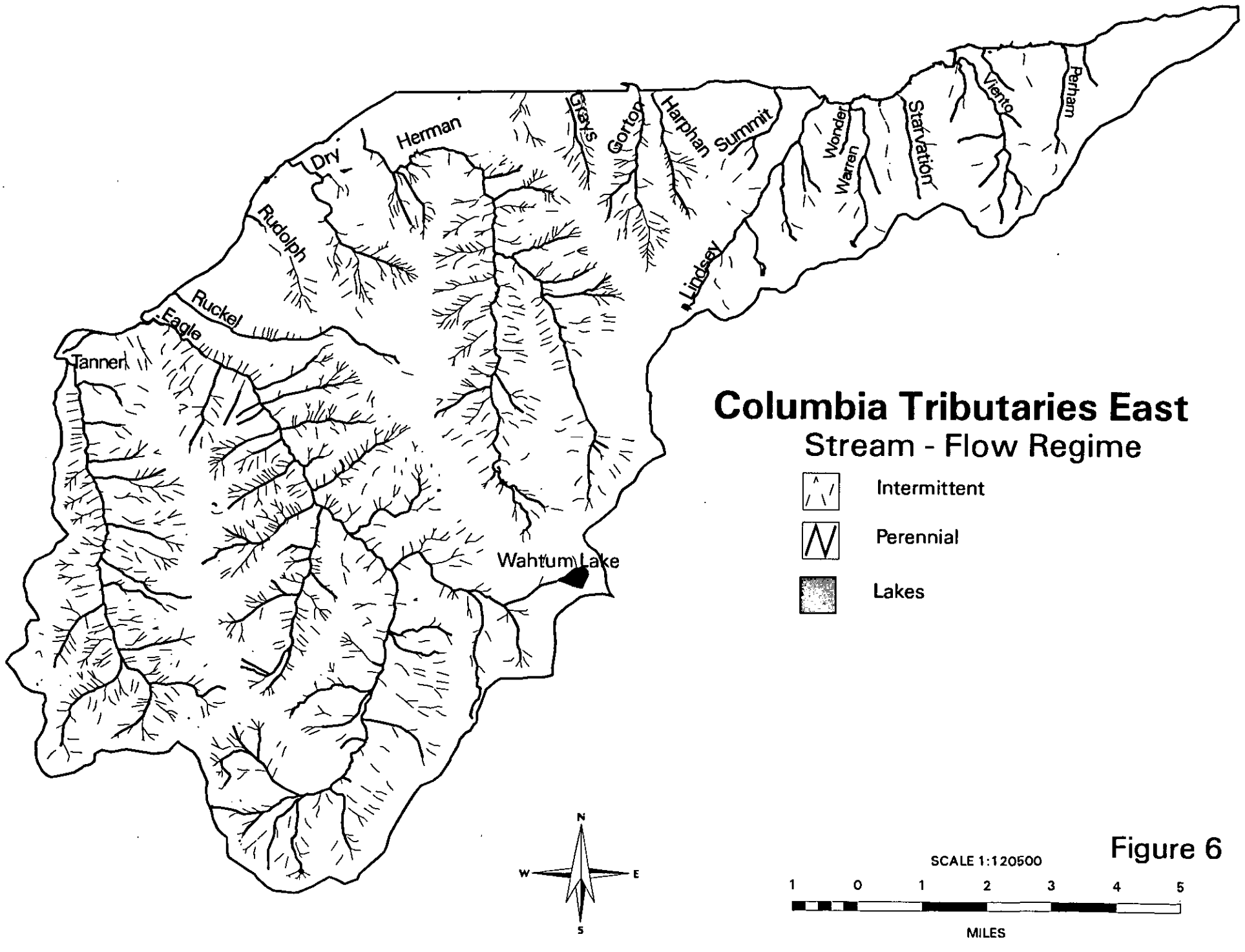

Columbia Tributaries East
Stream - Flow Regime
Intermittent
Perennial
Lakes
Dry
Herman
Gray's
Gorton
Harphan
Summit
Wonder
Warren
Starvation
Viento
Perham
Rudolph
Ruckel
Eagle
Tanner
Lindsey
Wahtum Lake
N
W
E
S
SCALE 1:120500
1 0 1 2 3 4 5
MILES

Figure 6

Typically, first and second order side drainages enter these mainstems at nearly right angles. Debris torrents routed down these side-draws, lodge at their sharp-angled confluences. When these debris flows deposit at the confluence of the larger ordered streams, a possibility exists of damming the larger stream. Flows then can back up behind debris dams. When dams break, they cause flood of water and debris to be carried downstream. Flood action scours the channel, strips away riparian vegetation, undercuts streams on adjacent slopes, and become hazards to downstream developments. Potential always exists for this type of debris dam failure. Generally, however, the broader valley bottoms streams of the three aforementioned creeks, will move laterally in the floodplain around the debris jams and not dam up streamflows.

The largest tributary, Eagle Creek, has a drainage area of a little less than 20,000 acres and a length of about 11.5 miles. Headwaters and channels of all the tributaries, above 3,000 ft, were carved out by glacial melt during the Ice Age. As a result, these lower gradient channels tend to have broader, "U" shaped valley bottoms, with fairly well-developed riparian and floodplain zones that contain overflow channels. The lower mile or so of these mainstem channels have gradients around 5%. The upper, glaciated, headwater area also has very low channel gradients with numerous lakes and wetlands located in these broad, glaciated valleys. These upper channels are entrenched and tend to migrate laterally through broad bottoms comprised of highly erodable, fine textured glacial soils. Lower channels below 3,000 ft have extremely sheer sideslopes (greater than 80%) and are contained in steep "V" shaped valleys. There is little floodplain and riparian development along the narrow valley bottoms. Channels are bedrock and boulder dominated with large woody debris (LWD) jams or accumulations concentrated at confluences which are near right-angles to higher order stream channels, as well as at plunge pools of the numerous falls and chutes in the stair-stepped mainstem channels. First and second order channels are extremely steep with gradients over 60%.

WATER QUALITY

The primary water quality concerns for fisheries are water temperature, dissolved oxygen, and suspended sediment. In addition, turbidity and bacteria/protozoa and dissolved organics occurrence is of major concern for drinking water use. Suspended sediment and bedload are of regard to irrigation users due to blocking of pipes and/or intake screens. Recreation use affects water turbidity, adds bacteria/protozoa, and for the high lakes, changes transparency and color. Typically, existing summer water temperatures, (between 55 and 60 degrees F) are considered ideal for salmonid production. Dissolved oxygen levels are really not a concern in these high gradient mountain streams with cold water temperatures. Most of the streams in the area contain dissolved oxygen at maximum saturation levels; this is because of their steepness and spring fed nature with fairly good shading on the narrow channel area. Suspended sediment, bedload, and turbidity tend to be high during specific events, but recover rapidly because of the generally coarse nature of the sediments in these drainages. The first flush events, which occur in the fall during the first storms, are a result of initial higher flows after a summer season of low flows. These initial events transport sediments that were stored in the channel bottoms during the drier summer months. Sediments accumulate in the channel as a result of raveling of soils down the steep channel sideslopes, common in the area. Elevated sediment loads also occur during major high flow events, but tend to settle out of the system within a matter of hours after the peak flow. According to the Eagle Creek Fish Hatchery manager, these

tributaries are considered to have some of the best water quality for supplying hatcheries within the state.

During the last two years, the city of Cascade Locks has relied entirely on its well water system. Dry Creek now provides only a supplemental and emergency source of water, but previously it was the primary supply for the city. The wells are shallow, about 100 feet deep, and have been used to some extent since 1969. These wells were not drilled through an impervious layer; this makes them susceptible to contamination. The Dry Creek system contains a reservoir that has about one and one-half days of water storage. The city of Cascade Locks chlorinates the Dry Creek surface water source. Some of the smaller tributaries in the area; Gorton, Grays, Viento, are used for domestic or irrigation water. Harmful bacteria/protozoa levels in drinking water comes primarily from organisms that are transmitted by humans and other warm-blooded species. Human activity close to water sources is, therefore, a concern for municipal or domestic drinking water. Dissolved organic material in drinking water sources can cause secondary problems if water is treated by chlorine, iodine, or another halogen. These organics form cancerous compounds when combined with chlorine.

The majority of higher lakes in the Cascades have low nutrient levels and little biological production (oligotrophic), along with low dissolved minerals. Most of these mountain lakes have a low buffering capability and are therefore susceptible to acid deposition. Due to the volcanic origin of the underlying rock in the area, Warren Lake is richer in phosphorus than nitrogen. Therefore, nitrates normally become the limiting factor for primary production (photosynthesis) in these high lakes. Transparency, or penetration of light, refers to the depth to which light can penetrate through water. Because photosynthesis can occur only to depths where sufficient light is available, transparency is one of the more important aspects that govern biological activity. Presently high elevation lakes and major tributaries are very clear and provide quality recreation.

VEGETATION

Vegetation Zones

The Columbia Tributaries East analysis area is predominantly an upland coniferous forest ecosystem. Also the watershed is distinctive in that the northern edge of the area borders the Columbia River. Overall, the hinterland area has seen fewer changes from human development than most Cascades localities. Vegetative diversity is especially high in the middle of the Columbia River Gorge. Substantial topographic variation and a collision of eastside and westside climatic influences combine here to create a large variety of habitat conditions within short distances. The majority of forest stands in the analysis area are currently mid-seral in their successional development; however, sizable areas of old-growth forest and early-seral forest are also present. Late-sucessional forest habitats tend to be located in canyon bottoms and at upper elevations. Early and mid-seral forests occupy flat, midslope and ridgetop sites at lower and mid-elevations.

Although the area is generally forested with conifers, hardwoods are an important component in the lowlands along the Columbia River, as well as along numerous ridge tops and basalt cliffs that are dominated with grasses, shrubs, and talus. Western hemlock dominates in upland areas under 3,000 ft in elevation, where rainfall exceeds 30 inches annually. Interspersed within the hemlock is Douglas-fir which in many locations is the predominant species. Drought prone areas are common within the steep, rocky faces of the Gorge; these areas are more

suitable for Douglas-fir than western hemlock. Above 3,000 ft, Pacific silver fir becomes the major species, and above 4,000 ft mountain hemlock dominates. These zones extensively interfinger depending on the soil, topography and aspect of the sites. Many of the ridge tops and mountain peaks are largely devoid of trees except for some subalpine firs and a few white bark pines.

The eastern portion of the watershed below 2,000 ft is much drier. Western hemlock is replaced by Douglas-fir and grand fir at lower elevations and by Oregon white oak/ponderosa pine, especially in areas of poor soils. The grand fir zone becomes more dominant at slightly higher elevations. The Pacific silver fir zone remains continuous above 3,000 ft. The shrub layer in the western portion is dominated by vinemaple, oceanspray, hazel, Rocky Mountain maple and Oregon grape, and at higher elevations huckleberries. In the drier eastern portions of the watershed, the shrub layer is similar with oceanspray, hazel, and snowberry being more dominant than huckleberry and Rocky Mountain maple (Figure 7; Figure 8).

Large-scale disturbances, primarily fire and to a lesser extent windstorms and insect outbreaks, have been the major forces shaping forest patterns in the Columbia East Tributaries analysis area. Fire likely plays a fundamental role in long-term persistence of younger forests within this region. These disturbances foster a continuing dynamic of forest decline followed by renewal and growth. In part, the present-day collection of snags, large woody debris, live trees and multiple tree ages are a legacy of habitat features formed by fire and other less obvious disturbances. To the degree that timing, duration or extent of these forces are now being altered under human influence, changed habitat conditions may emerge in the future. For an in-depth discussion of fire frequency and the alterations which changed fire regimes may have on this forest, refer to the section on fire in this chapter. Inside forested habitats, small to medium scale disturbance forces, such as landslides, snow avalanches, ice-storms, insect or disease infestations, and wind or snowbreak events (storm damage), appear to operate in most parts of the analysis area, largely unfettered by the actions of people.

Fire

Physical Processes

A number of variables are responsible for the recurrences of wildfires, and should be recognized for the roles they play in the shaping of the Columbia Tributaries East Watershed. Variables include long drainages running north to south from rivers; aspects of slopes, weather and wind patterns. South and southwest to western aspect slopes receive more sunlight, are dryer, and tend to hold less vegetation than the dominant stand types located on the north, northeast and eastern slopes. Southwest aspects burn more frequently and have a shorter fire return interval. Northeastern facing slopes have lusher vegetation, due to retained moisture, and burn less frequently. Ridge tops tend to burn more frequently, and often burn hotter (stand replacement) than riparian and valley bottom fires. They burn up an incline, then back down slope and then burn back up the ridges. Backing fires that burn into riparian areas and valleys produce an underburn effect. Storms pushing up against Mount Hood tend to drop lightning on the long ridge systems extending from the mountain to the north. This is the major area for lightning strikes.

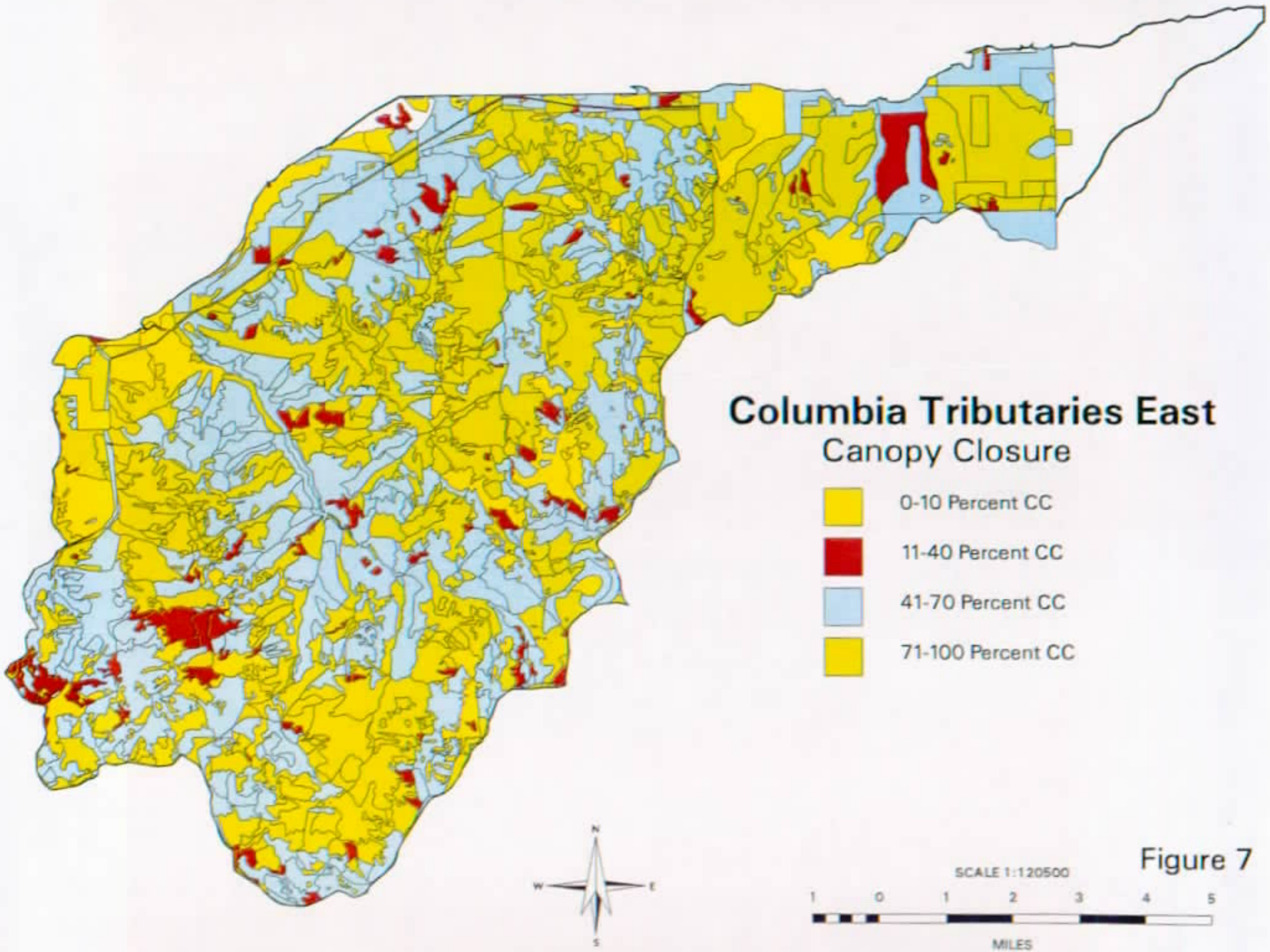

Columbia Tributaries East
Canopy Closure
0-10 Percent CC
11-40 Percent CC
41-70 Percent CC
71-100 Percent CC
N
W
E
S
SCALE 1:120500
1 0 1 2 3 4 5
MILES

Figure 7

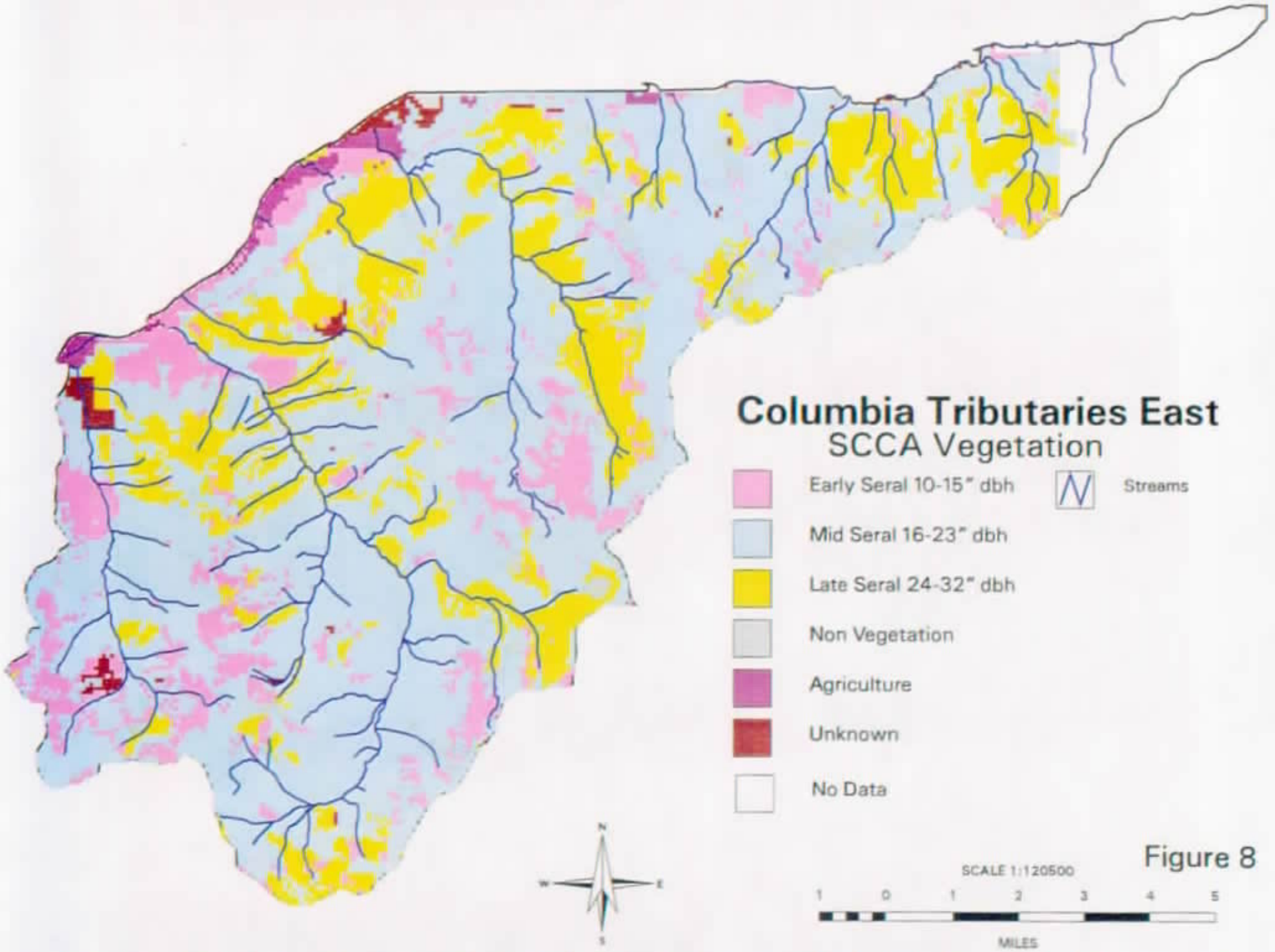

Columbia Tributaries East
SCCA Vegetation
Early Seral 10-15" dbh
Mid Seral 16-23" dbh
Late Seral 24-32" dbh
Non Vegetation
Agriculture
Unknown
No Data
Streams
N
W
E
S
SCALE 1:120500
1 0 1 2 3 4 5
MILES

Figure 8

Fire Regimes

The Mount Hood National Forest and CRGNSA have been divided into eleven fire ecology/fire regime groups based on vegetation, fire frequency, and fire behavior (Evers et al. 1994). The watershed contains three of these regime groups: six, eight and nine. Fire Group 6 incorporates the wetter, higher elevation portion of the transition zone on the eastside. Typically this zone has areas of heavy snowpacks, short growing seasons, frequent frost, and cold and moist soils. Return intervals are estimated at 170 to 430 years, but fire history information is scarce. Fire Group 8 includes most of the western hemlock and Pacific silver fir stands found in the mid-Columbia. This regime characteristically has warm, moist climate to the west, gradually shifting to a cooler and drier climate to the east. Fire frequencies range from 50 to over 200 years in western hemlock associations, and 170 to 300 years in Pacific silver fir. Fire Group 9, named for the dry western hemlock and westside Douglas-fir group, has a fire frequency of 25 to 150 years. Fire behavior consists of underburning with some crown fires, and is found in areas with rock outcrops and talus slopes. These areas are assumed to reburn frequently with below canopy ground fires. The stands have a different fire regime due to their steepness, wide spacing of trees, thin soils, and high percentage of exposed rock. Fires for these stands are thought to have a size potential of 10 acres to 20,000 acres, depending on weather pattern and stand conditions. Fires that range from 10 to 1,000 acres are the most frequent. The occurrence of underburn fires, depending on fire group, can range from 17 to 150 years or greater.

Across the region, the extent of fires differ considerably, and are categorized into *high, moderate* and *low* severity. These categories describe frequency, intensity, and environmental gradients of temperature and moisture. *High* severity fire regimes (more than 100 years between fires) are characterized by severe crown or surface fires that cause high tree mortality; or stand replacement fires. They typically result in total stand mortality, as well as moderate to high loss of the duff-litter layer. These fires are generally associated with drought years, east wind weather events with lower humidity, and an ignition source such as lightning. They are often of short duration, but of high intensity and severity. The *moderate* fire regime (25-100 years) is more difficult to characterize, because these fires often show a wide range of effects. They range from fires with some mortality occurring within the intermediate and overstory vegetation and light to moderate loss to the duff-litter layer, to light underburns with no loss to the intermediate vegetation, or a light loss to the duff-litter layer. Under *moderate* fire regimes, fires occur in areas with typically long, dry summers, and can be from weeks to months in duration. Periods of intense fire behavior are mixed with periods of moderate and low-intensity fire behavior. *Low-severity* regimes fires are low-intensity and frequent (1-25 years) with few, if any, overstory effects. These fires occur in areas where nearly continual summer drought exists, and fires are typically frequent and widespread. This fire regimes does not occur in the watershed area; it is characterized by drier forest types further east of the Cascades.

Current Fire Management Objectives

Fire and fuels management direction vary by land allocation. The overall fire suppression direction for National Forest lands, in order of priority, is to 1) protect life, 2) protect property, and 3) protect natural resources. The objective of fire and fuels management in the Wilderness is to permit lightning caused fires to play, as nearly as possible, their natural ecological role. The mission is also to reduce to an acceptable level the risks and consequences of fire escaping the Wilderness. Two types of prescribed fires may be approved for use within the its boundaries: those ignited by lightning and allowed to burn under prescribed conditions

and those ignited by qualified Forest Service fire/fuels managers. No wildfires will be allowed to burn without documented, preplanned, specified conditions. That is, all wildfires will be suppressed within the Wilderness unless an approved wildfire plan is in place prescribing the management of fire under those conditions. Forest Service fire/fuels managers may also ignite a prescribed fire to reduce unnatural buildups of fuels. Under such conditions, managers may use prescribed fire or other fuel treatment measures, if actions outside are not sufficient to achieve fire management objectives within the Wilderness. Outside the Wilderness lightning-caused fires that may pose serious threats to life and/or property, cannot be allowed to burn.

Noxious Weeds

Introduction of noxious weeds into native plant communities has caused dramatic disturbances to the native vegetation. Any disturbed ground can provide habitat for noxious weeds. This open door to noxious weeds allows them first to establish and populate the disturbed area, and then the surrounding areas. Buildup of a seedbank surrounding a noxious weed population allows the weed to be permanently present in the plant community. If soil later becomes exposed, seeds, which can be viable for up to 80 years, germinate. Consequently, once noxious weeds are introduced into an area, they have the ability to permanently change the vegetative conditions. Overall effect of these changes is not well studied, but some possible outcomes are loss of sensitive plant habitat, loss of unique plant communities, increased fire danger, and unsightly or inhospitable recreation areas.

The following noxious weed information has been gathered from incidental sightings in the watershed. Trails known to have such weeds include Tanner Creek, Herman Creek, and Eagle Creek. The species are Canada Thistle, *Cirsium arvense*; Bull thistle, *Cirsium vulgare*; Japanese knotweed, *Polygonum cuspidatum;* and St. John's Wort, *Hypericum perforatum*. St. John's Wort has been also found on trails leading from the Columbia River Gorge trailheads into the Hatfield Wilderness. Annual noxious weed surveys of National Forest roads located east of the Wilderness boundary show heavy populations of weeds on the following roads near or leading to the watershed: 2810, 2820, 2830, 1300, 1300-630, 1300-720, 1310, 1310-640, 1311, 1320. Noxious weeds found on these roads include the following species: Diffuse Knapweed *Centaurea diffusa*; Spotted Knapweed, *Centaurea maculosa*; Tansy Ragwort, *Senecio jacobaea*; St. John's Wort, *Hypericum perforatum*; and Bull Thistle, *Circium vulgare*. Other potential corridors for weeds to spread in this watershed include powerlines, campgrounds, quarries, highways and fire lookouts.

Plants

Vascular Plants

1. The mycotrophic candystick (*Allotropa virgata*), typically grows in closed canopy pole, mature and old-growth seral stages of Douglas-fir, western hemlock, grand fir, Pacific silver fir and lodgepole pine vegetation series, ranging from 1,500 ft to 5,000 ft elevation within the range of the northern spotted owl. Also, it appears to be substrate specific to decaying large woody debris. Assuming that the undocumented site is within the watershed, both sites of *A.virgata* are within a designated Wilderness area. The Wilderness designation should provide adequate protection for these species from intensive management activities such as logging. Threats to these sites include recreation since both are found along trails, and fire which may affect the woody substrate which this species requires. The draft management guidelines for this species of concern recommends conducting surveys within sites planned for prescribed burning

and establish monitoring sites to evaluate the effect of fire on establishment and survival. The Record of Decision survey strategy for this species is to manage known sites and survey prior to activities.

2. Cold-water corydalis (*Corydalis aquae-gelidae*) is restricted to cold, flowing, perennial seeps or streams with cobble or gravel bars, and found within the elevation range 1,220 ft to 4,260 ft in Oregon and Washington. Large areas of apparently suitable habitat are unoccupied within the known range of the species. The site of *C.aquae-gelidae* is within a designated Wilderness area and should be protected from timber management activities. Also damage to the riparian area, where the Tanner Creek Trail crosses the site, could occur with heavy recreational use. Fisheries projects, recreational development projects, hydroelectric projects, and any other activities likely to affect site's hydrology should be avoided. The Record of Decision survey strategy for this species is to manage known sites and survey prior to activities.

Fungi

The chanterelle group, consisting *of Gomphus bonarii, G. clavatus, G. floccosus,* and *G. kauffmanii*, occupy mature, late successional conifer forests. *G. floccosus* is the most common and widespread species in this grouping. The *Gomphus* species are edible for some people, poisonous for others and, therefore, are not likely to become commercially harvested. The known site is potentially subject to soil compaction from trampling since it is located on a trail. Habitat for *G. floccosus* is widespread in the watershed and it is unlikely that any management activities that happen within the Wilderness designation would negatively affect this species. Appendix J2-163 guidelines stress the need to identify and protect habitats, rather than specific sites for these species. The Record of Decision survey strategy is to conduct extensive surveys and manage sites.

Lichens

The rare rock lichen, *Pilophorus nigricaulis*, occurs on talus rock patches within old growth stands with low fire frequencies. This species may also occur on monoliths which emerge from the surrounding canopy, and rock piles which do not. These special habitats are critical to many wildlife species and bryophytes as well as lichen species. Potential adverse impacts to *P. nigricaulis* include hot fires, rock climbing, or reintroduction of mountain goats because each of these activities has the potential to remove the lichen from its substrate. Appendix J2-238 requires that old-growth stand fragments with rock outcrops or sheltered talus, including those 10-40 acres in size as distributed across the landscape, should be maintained as potential refuges for these rock lichen species. Managers should consider the abundance and distribution of this type of habitat in the watershed. The Record of Decision survey strategy for this species is to manage known sites and conduct extensive surveys.

Several knowledgeable specialists in the scientific community were consulted during research for watershed analyses (see personal communications in References). Without exception, these individuals stressed that the information currently available on habitat types, distribution

range, geographic extent, and ecology of fungi, lichens, and bryophytes (mosses and liverworts), is not at all conclusive. A paucity of information is available for these groups, due in part to the limited field surveys and expertise. Information in this document should, therefore, not be used exclusively to determine whether or not a species has potential to occur in other areas of the Hatfield Wilderness, Mount Hood National Forest or Columbia Gorge National Scenic Area.

Table 28 in the Appendix lists all plants, including non-vascular fungi, lichens, mosses, and liverworts, that are suspected to occur in the Columbia Tributaries East Watershed. The lists also includes a brief description of habitat and range/distribution of each species. The Survey and Manage lichen distribution maps prepared by Mark Boyll, lichenologist for the Mount Hood National Forest, were consulted to determine the likelihood of their presence and distribution in the watershed. A large percentage of Survey and Manage species are suspected to occur in the watershed because it contains many diverse habitat types such as high elevation subalpine fir forests to low elevation pine/oak associations. In addition to the large range of elevations present, there is a distinct moisture gradient from west to east in the Columbia River Gorge. The fog and moisture regime of the coast can even be detected as far inland the west end of the Gorge. All of these factors create an area rich with differing habitat types which increases the likelihood that many of the species occur in the watershed.

Threatened, Endangered or Sensitive Plant Species
No federally listed threatened or endangered plants are known or suspected to occur in the watershed; however, 37 species on the Oregon Natural Heritage Program (ONHP) list 1 and 2 are known or suspected to occur. An additional 27 species on the ONHP list 3 and 4 are documented or suspected. The Forest Service (Region 6) sensitive species list indicates that seven species are documented and eighteen species are suspected to occur within this watershed. See Appendix Table 29.

Survey and Manage Plant Species
The 1994 Record of Decision (ROD) identifies 354 species to be protected through Survey and Management standards and guidelines. Survey and Manage refers to vascular and non-vascular plant species, and includes rare species, locally endemic species, and at risk plants that are associated with late-successional and old-growth forests within the range of the northern spotted owl. The first and highest priority is to 'Manage Known Sites', which requires all activities that are scheduled for implementation in Fiscal Year 1995 and later to include management provisions for known sites. The ROD directs field surveys to be conducted in all projects proposed for implementation in cal Year 1999 and later. Any Survey and Manage species found incidentally within the planning area prior to 1996 will be protected according to Regional Ecosystem Office management provisions, (ROD 1994; FSEIS 1994: Appendix J2).

There are five known sites of Survey and Manage species in the watershed (Table 5), two of which have been formally documented. Three of these sites are vascular plants, one is a fungi, and one is a lichen. One site of the vascular plant, *Allotropa virgata*, is located in the same section as Scout Lake. This section is split between two watersheds and due to lack of site information, it is uncertain in which watershed the plant is located. No known locations of Survey and Manage moss or liverwort species exist in the watershed. The *Gomphus floccosus*, *Pilophorus nigricaulis*, and one of the *Allotropa virgata* sites have been reported by field personnel in recent years. Although these sites are not formally documented, mitigation

measures have been formulated because the sites have been observed by field biologists or qualified agency personnel. Eventually the sites must be reverified, and formally documented.

Table 5. Survey and Manage Species Located in the Study Area

Species	Survey Strategy	General Location	Documented	Observer if Undocumented
Vascular Plants				
Allotropa virgata	1,2	Only legal location, No other site information	Yes	
Allotropa virgata	1,2	Herman Creek Trail	No	Omar Sankari, USFS Wilderness Ranger
Corydalis aquae-gelidae	1,2	Tanner Creek Trail	Yes	
Fungi				
Gomphus floccosus	3	Wyeth Trail	No	Heather Laub USFS Botanist
Lichens				
Pilophorus nigricaulis	1,3	Wyeth Trail	No	John Davis USFWS Biologist

Specific site information for known sites is undocumented and therefore revisitation for all sites is recommended. Some information about habitat requirements, impacts, mitigation measures, and other information is discussed below.

WILDLIFE HABITATS AND ANIMAL PRESENCE

General Forest Habitat Conditions

Most of the Columbia Tributaries watershed area is forested in early and middle seral stands. Late-successional forests are present, too, but are predominantly a feature of areas sheltered from stand-replacing fires. Early and mid-seral plant community are typically dense in tree cover and their closed canopies shade the forest floor. As a consequence, understory shrub and herb layers are often sparse (or understory plants are completely absent) and so provide limited forage or cover for deer, bear, birds, elk and other animals. The complexity of canopy layering increases with stand age. Young stands tend toward simple, single-layer canopies while old-growth is nearly always multi-layered. It is complex multi-layered canopies that provides the most structural diversity for animal use.

The present-day collection of large snags and coarse woody debris (CWD) is generally on the wane in younger stands. Large snags and woody debris larger than 20 inches in diameter are remnant structures from former forests destroyed by large-scale fire or other disturbances. As these snags and CWD age within early and mid-seral stands, they decay and their abundance declines through time. Most stands are not yet to a stage of development where tree mortality is producing large size snags or CWD any significant numbers.

Special Non-Forest Habitats

Within the predominately forested landscape of this watershed are a number of special or noteworthy non-forest habitats. These special habitats provide living space for animals not

associated in forest environments. Pika, yellow-bellied marmot, great blue heron, numerous species of waterfowl and some bats are examples of animals requiring specialized habitats. The watershed includes the following special habitats: high basalt cliffs, upper elevation talus and scree slopes, fellfields (felsenmeer), lower elevation open or forested talus slopes, wet meadows, dryland balds, riparian woodlands (composed of mixed conifer and deciduous trees), and some subalpine parkland on high peaks (i.e., Mount Defiance). They occur in closer juxtaposition to one another in the analysis area than is typical of the Cascades Range in general.

These habitats add niche diversity to the watershed, and are largely responsible for the large number of sensitive species known to live within its boundaries. Many native flora and fauna species are associated with one or more of these special habitats. For example, Larch Mountain salamanders are found most commonly in forested talus areas, pikas inhabit treeless talus slopes and peregrine falcons require cliffs for nesting. A number of endemic flora are also associated with the special habitats of the Columbia River Gorge. Plants such as Oregon bolandra (*Bolandra oregana*), Howell's daisy (*Erigeron howellii*), Oregon sullivantia (*Sullivantia oregana)* grow only on moist basalt cliffs. Cold water corydalis (*Corydalis aquae-gelidae)* requires cold, flowing water. Long-beard hawkweed (*Hieracium longeberbe*) inhabits open balds on ridge tops, open slide areas or other open habitats.

At this time the specific acreage of these special habitats is unknown. Also this detail is beyond the scope of the present analysis.

Animals Present in the Watershed (partial listing)

The landscape mosaic of early, mid and late seral forests in this area provides the structural and spatial diversity to support many and varied wildlife species. Animals that inhabit Oregon Cascades forests generally are also common here. Black bear, coyote, bobcat, snowshoe hare, Douglas squirrel, northern flying squirrel, Townsend's chipmunk, mountain beaver, great horned owl, Cooper's hawk, Steller's jay, raven, gray jay, Swainson's thrush, chestnut-backed chickadee, brown creeper, garter snake, Cascades frog and Oregon rough-skinned newt are just a few of the animals that inhabit the watershed. Among uncommon animals known to be present in the area are cougar, pileated woodpecker, rubber boa, red-legged frog and purple martin (Brown 1985). Virtually nothing is known about current habitation or use by a number of animals including: wolverine, fisher, red fox, Vaux's swift, goshawk, red tree vole, most neotropical migrant song birds, most reptiles, many amphibians and nearly all mollusks. Overall, there is limited scientific understanding of the current population status of most individual species and their ecology within the analysis area. More thorough information on native wildlife habitation locally is likely to come only slowly and piecemeal rather than through any organized or purposeful study.

As is true in most Oregon localities, a number of non-native animal species have been introduced into the watershed since early settlement times. European starlings, rock doves (pigeons), house sparrows, bullfrogs, Norway rats, house mice, domestic cats, domestic dogs, and a variety of livestock animals are now occasional, seasonal or permanent inhabitants of the watershed. In addition, some native but non-endemic animals, such as opposum and brown-headed cowbird, have expanded their native North American range to include the watershed.

Threatened, Endangered and Sensitive Animals
The endangered peregrine falcon is a year-round resident of the Gorge. Two falcon nest sites (aeries) are known within the analysis area. Among threatened animals known to be present in the area are bald eagle and northern spotted owl. No bald eagle nests are known within the watershed area. A spotted owl inventory undertaken between 1992-1994 suggests that about 20 owls currently reside inside the Mark O. Hatfield Wilderness. It is documented that at least wo owl pairs fledged one young each during the summer of 1994.

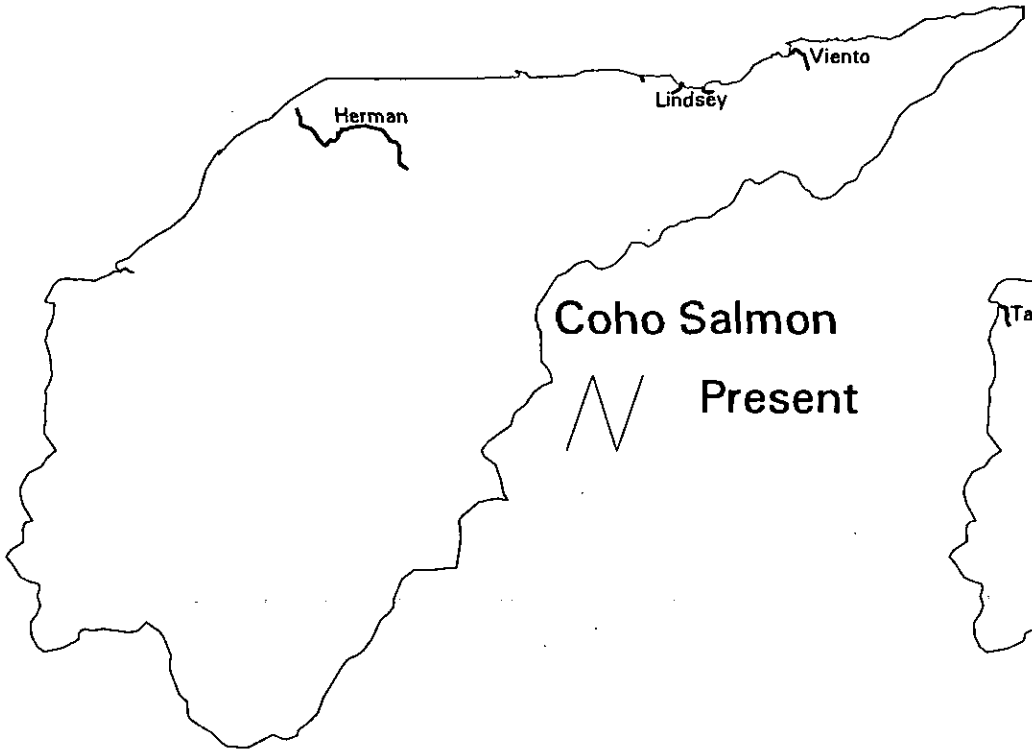
Of the animals listed by the Forest Service on the Pacific Northwest Region sensitive species list, four inhabit the watershed: western pond turtle, painted turtle, Larch Mountain salamander and Cope's giant salamander.

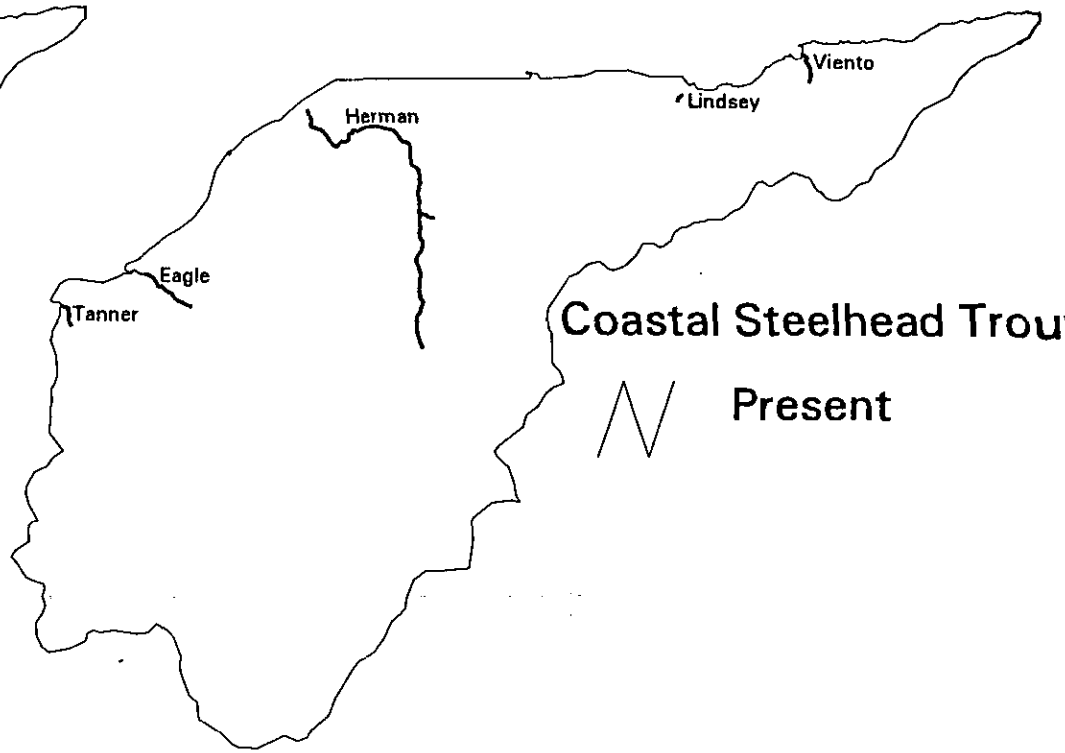
FISH HABITAT AND FISH PRESENCE

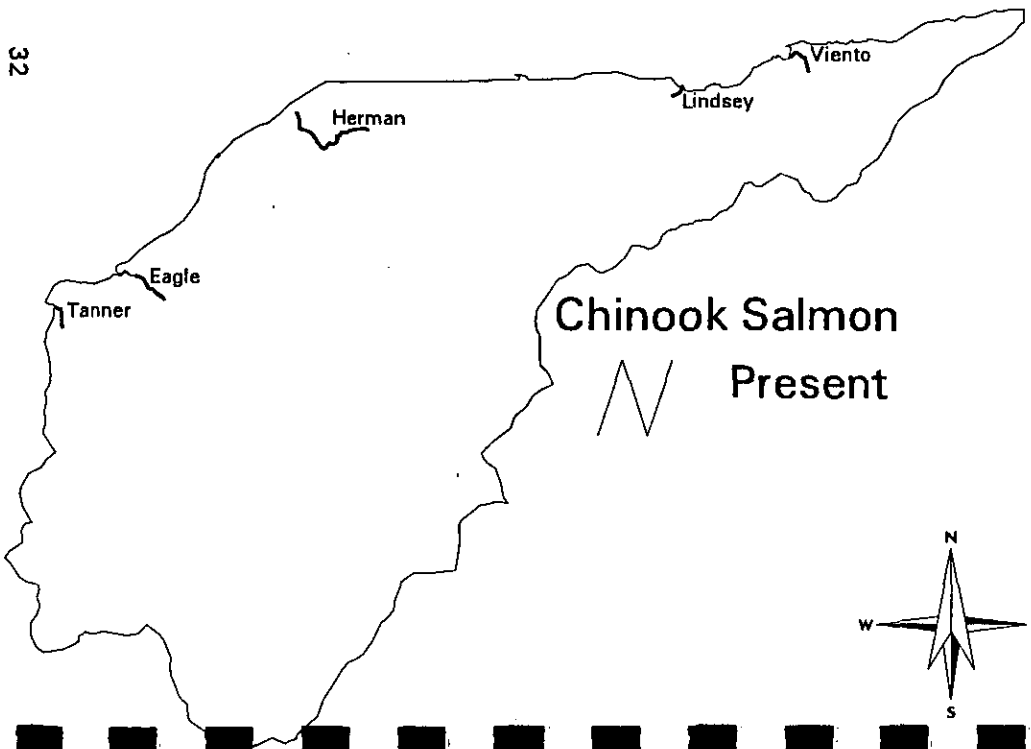
Anadromous Fish
Limited anadromous fish habitat exists within the analysis area (Figure 9). Most of the area's streams have the anadromous fish migration blocked by waterfalls, within a mile or two from their mouths. The only exception is Herman Creek, which has anadromous fish migration up to river mile 5.6. Tanner Creek has an electrified barrier near its mouth which prevents upstream migration of most anadromous fish all year round. The anadromous fish habitat in the lower reaches of all the streams has been highly impacted by human activities for many years. The lower Columbia River steelhead is listed as threatened, and the chinook salmon is proposed as threatened. Railroads, highways, fish hatcheries, logging, and other developments have changed fish habitat causing their environment to be in less than optimal condition. There are numerous stocks of anadromous fish found in this analysis area. Some of them are believed to be native while others are stocks derived from hatchery plantings. With little or no genetic analysis currently available for most of these stocks it would be impossible to determine which stocks are of hatchery or natural origin. It is expected that there are winter and summer run steelhead trout, fall coho salmon, and fall and spring chinook salmon in the analysis area. Further study is needed to determine the range and distribution of these stocks.

The following tables give information about the anadromous fish habitat found in streams within the analysis area. The condition of these streams is evaluated based upon the number of large woody debris (LWD) pieces found in the stream channel per mile, the number of pools per mile, and stream gradient. Reaches are specific lengths of streams which have like characteristics such as valley type, flow, gradient type, vegetation etc. The data indicates that the habitat areas for the reaches which are furthest downstream have been severely impacted by human activities, whereas the upper reaches are more or less their natural states.

Eagle Creek
Eagle Creek was surveyed in 1990 using Region 6 protocol. The stream was surveyed from river mile 0.5 to river mile 5.5. The survey shows that only one stream reach was surveyed. The anadromous barrier for this stream is located at river mile 2.0. The following conditions were present at the time of the survey.







Columbia Tributaries East
Anadromous
Fish Distribution

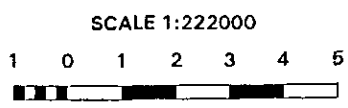


Figure 9

Table 6. Eagle Creek

	Reach 1 0.5-5.5 miles
Pools/Mile	10.2
LWD/Mile	1
Stream Gradient	5%

Tanner Creek

Tanner Creek was surveyed in 1991 using Region 6 protocol. The stream was surveyed from river mile 0.0 to river mile 5.6. Four stream reaches were identified in that survey. The anadromous barrier for this stream is located at river mile 1.6, which is the end of reach two, however anadromous fish are frequently prevented from moving upstream past the mouth of the stream due to an electrified barrier operated by the fish hatchery at the mouth of the creek. The following conditions were present at the time of the survey.

Table 7. Tanner Creek

	Reach 1 0.0-0.7	Reach 2 0.7-1.6
Pools/Mile	7.1	8.9
LWD/Mile	1.3	49.4
Gradient	5%	10%

Herman Creek

Herman Creek was surveyed in 1994 using Region 6 protocol. The stream was surveyed from river mile 0.0 to river mile 4.8. Four stream reaches were identified in that survey. The anadromous barrier for this stream is located at river mile 5.6. The following conditions were present at the time of the survey.

Table 8. Herman Creek

	Reach 1 0.0-0.8	Reach 2 0.8-2.8	Reach 3 2.8-4.3	Reach 4 4.3-4.8
Pools/Mile	2.4	9.5	8.1	14.6
LWD/Mile	0	26.9	29.8	12.5
Gradient	3%	5%	7%	8%

East Fork of Herman Creek

The East Fork of Herman Creek was surveyed in 1995 using Region 6 protocol. The stream was surveyed from river mile 0.0 to river mile 3.9. Four stream reaches were identified in that survey. The anadromous barrier for this stream is located at river mile 0.1. The following conditions were present at the time of the survey.

Table 9. East Fork of Herman Creek

	Reach 1 0.0-0.1
Pools/Mile	39
LWD/Mile	29
Stream Gradient	12%

Lindsey Creek

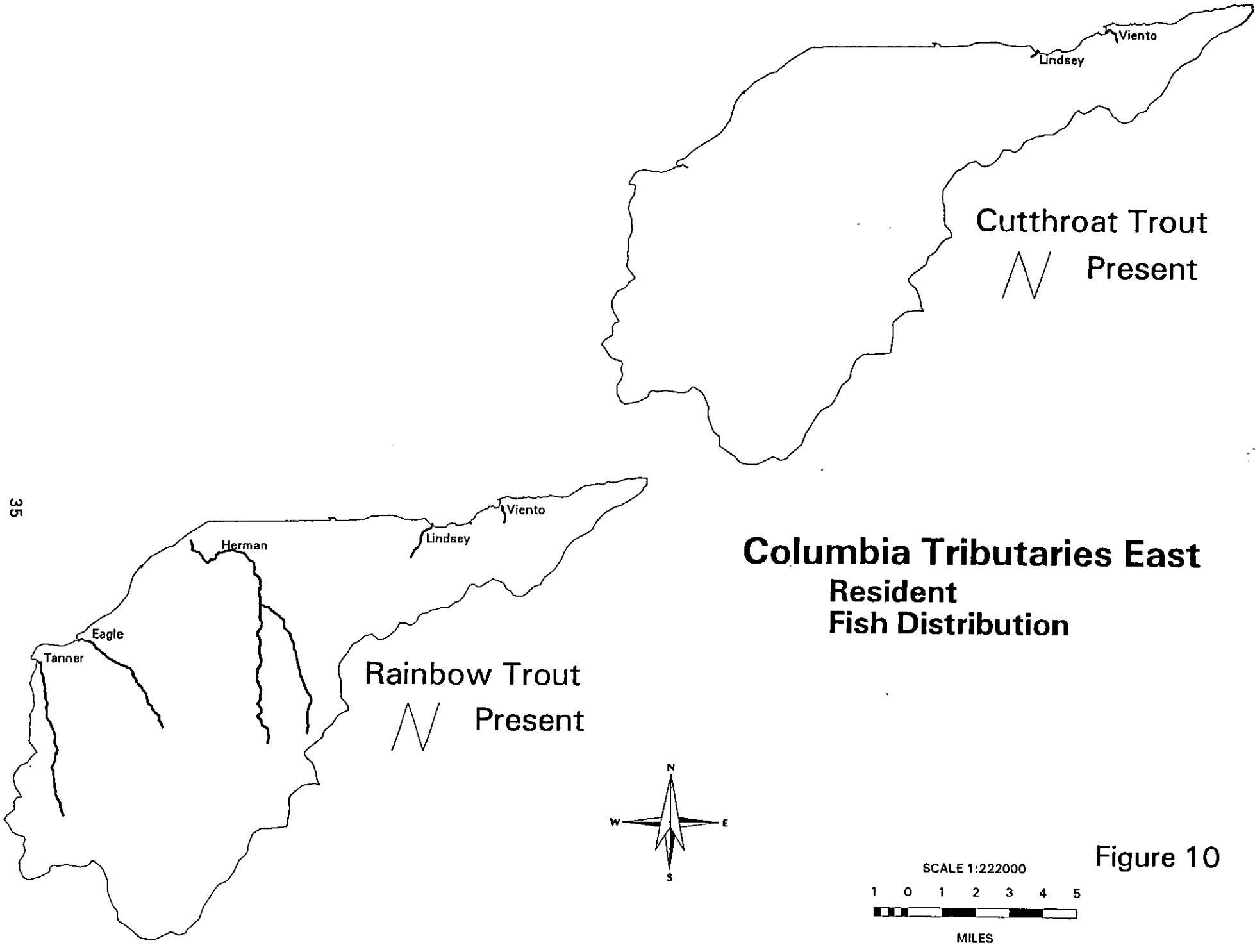
Lindsey Creek was surveyed in 1996 using Region 6 protocol. The stream was surveyed from river mile 0.0 to river mile 0.81. Two stream reaches were identified in that survey. The anadromous barrier for this stream is located at river mile 0.23. Pools per mile, large wood per mile, and stream gradient have not been summarized at this time, although it appears that the number of pools per mile in the anadromous reach is very low.

Resident Aquatic Species

The Columbia River Gorge has been known to contain a mix of trout species; this is due, in part, to the steep topography that allows isolation of populations and the various flood events that have swept through the area. Cutthroat trout and rainbow trout are known to be present in the Columbia Gorge with bull trout potentially present in the lower tributaries. West of the analysis area, streams contain a mixture of cutthroat (Figure 10) and/or rainbow trout species. It is possible that these fish could also be hybrids of the two species. To make matters more confusing, two subspecies of rainbow trout inhabit these stream systems, and this area of the Cascade Range is on the approximate dividing line between the two subspecies. Both Oregon and Region 6 list the inland rainbow trout as a sensitive species, but not the coastal rainbow trout. Sometimes it is difficult to recognize the differences (coloration mainly) between the two subspecies in this hybridization zone, and positive identification needs to be done by genetic analysis in a laboratory. Oregon Department of Fish and Wildlife has censused several populations of trout within streams of the Gorge, but the genetic analysis has not yet been completed by University of Montana.

Records indicate Tanner, Eagle, and Herman creeks were stocked with fingerling coastal rainbow trout annually in the 1940s, but fisheries personnel do not presently continue this practice. This further clouds the picture for fish dispersion within the Gorge, as it is unknown if present distribution was from hatchery stock or from wild origins. Current fish species surveyed within the analysis area tributaries are summarized in Table 30 of the Appendix. The evidence suggests that the present population consists predominantly of rainbow trout with no cutthroat trout present. In addition, Lindsey Creek and Tanner Creek may harbor an inland subspecies of rainbow trout, *Oncorhynchus mykiss gairdneri* above barrier falls (Greene 1995). This is a tentative assumption because laboratory verification has not been completed. Coastal rainbows, *Onchorynchus mykiss irideus* predominate in other tributaries. Bull trout may have entered the lower reaches of the tributaries; however, the evidence is minimal with only one of the species reportedly caught at the mouth of Tanner Creek. Bull trout have been listed as a sensitive species for many years by state and federal natural resource departments. Currently bull trout are proposed to be listed as a threatened species under authority of the Endangered Species Act. Concerns affecting anadromous fish are also germane to bull trout (i.e., I-84, passage problems, lack of gravels, and altered stream mouths).

In the analysis area, there are approximately 110 acres of permanent open water and 69 acres of constant wetland (Source: GIS layer, wetlands inventory and aerial photo interpretation). Permanent ponds and wetlands thus total to 179 acres. Presently 88 acres out of those 110 contain trout that have been stocked since early in the 1900s. Table 31 of the Appendix summarizes the present fish distribution as well as stocking and lake surveys data from 1940 to 1995. Lake stocking with brook trout, *Salvelinus fontinalis*, native to the Eastern United States, began in the early 1900s to allow for increased angling opportunities. They were used due to their tolerance for cold water and ability to grow and breed in lake situations, i.e., using areas of upwelling and atypical substrates. A beautiful trout in terms of coloration, they can



Columbia Tributaries East

Resident Fish Distribution

Figure 10

also attain a large size with sufficient food availability. Most of the smaller high lakes did not contain fish naturally, because they were carved and shaped by glacial ice and only later formed into ponds. Concern for high lakes stocking focuses on two topics. First, the change in trophic structure that may be altered by fish introduction (reductions or change in distribution of native species that had been present before fish stocking), and second, potential for escape of stocked fish into downstream tributaries (the possibility of predation, competition, and hybridization with native stocks). Anglers attracted to the fishing opportunities in the lakes may sometimes also cause environmental degradation.

Table 10 summarizes the acreage that may have been stocked with fish. It is difficult to determine if Wahtum Lake had fish originally. A former Native American trail that skirted the lake is several hundred years old. And Boy Scout troops have been going to the lake since 1914. No records, however, were found indicating if there were fish in the lake prior to 1900. In contrast, field notes from the 1880s show that Lost Lake definitely harbored fish. Lost Lake is considerably larger than Wahtum Lake, but has similar depths (Wahtum is 57 acres and 184 ft deep, while Lost Lake is 231 acres and 175 ft deep). With no recorded fish information for Wahtum Lake, the following table is calculated using both scenarios.

Table. 10 Estimated Acreage of High Lakes Stocked with Fish

	Total acres with fish	Percentage of pond acres that harbor fish	Percentage of permanent water (ponds and wetland combined) that harbor fish
Pre 1900s (Wahtum Lake naturally had fish)	57	52%	32%
Pre 1900s (Wahtum Lake naturally had no fish)	0	0%	0%
Present	88	80%	49%

As noted from Table 30, recent surveys have not located brook trout in tributaries below stocked lakes. This may largely be due to the steep topography as well as man made dams on the outflows of these lakes. These findings are in contrast to the adjacent West Fork of the Hood River Watershed, where brook trout have escaped downstream from several stocked lakes. Rainy Lake is within the analysis area, but its outflow Rainy Creek, is within the West Fork of the Hood River, a separate analysis area. Brook trout are in Rainy Creek and the lower systems; while noted, this will not have any further mention. Hypothetically if brook trout move downstream from stocked lakes, they could not hybridize with native fish (except bull trout), and would instead compete for habitat and/or prey on native stocks. The Oregon Department of Fish and Wildlife has tried to address this problem by changing the fishing regulation in 1997. They dropped all minimum size and catch limits for brook trout caught in streams, however, anglers are limited to catching five trout (eight inch minimum lengths) in lakes and ponds. The question of impacts to native species in stocked lakes is harder to discern. Fish have been stocked in a large percentage of available pond habitat. In the watershed, all permanent ponds over one and one half acres have been stocked. Stocking has taken place in other watersheds within the Pacific Northwest, so the effects on native species needing similar habitat have been wide spread and large scale. In contrast, the Bull Run Watershed has few stocked ponds. This watershed is an excellent control area in which to analyze the difference between stocked and unstocked lakes/ponds.

Earth/rock dams were built on North and Rainy lakes to increase water storage capability for eventual use in log fluming operations in the Hood River basin. North and Rainy lakes were connected to canals which diverted water into the Gate Creek system (West Fork Hood River Watershed Analysis 1996). The dams were constructed in 1923 and increased capacity of North Lake from 8 acres to 15 acres, and Rainy from 9 acres to 15 acres (Special Use Permit 1923). Both of these dams are now in disrepair and lake levels have dropped back to pre-dam levels. Timber around both lakes that was killed by the rising water was previously harvested. These dams may now help keep brook trout from migrating downstream into lower tributaries. Since none of the lakes have species other than what was stocked, the current assumption is that they were fishless before stocking.

Table 32 in the Appendix, describes the possible aquatic amphibians that could be within the analysis area. Terrestrials amphibians were excluded. Eleven species require aquatic conditions for part or all of their life stages. The last three columns of the table evaluate the impacts of trout to these species. The long-toed salamander, the red-legged frog and the Cascades frog and three pond-dependent species are most affected by fish introductions. The other three pond-dependent species, Northwestern, Roughskin, and Western toad, are either deadly poisonous or can produce mild toxins that repel attack. Longtoed salamanders are common, have a wide range and are able to use ephemeral ponds to breed and rear young. Stocked fish may eat them in a particular pond, but are not likely to effect the salamander's overall density or distribution. The Red-legged and Cascades frog are both on the state sensitive species list, and the red-legged is also on the Region 6 sensitive species list. Both are declining range wide and have been extirpated in certain areas. Effect on these two species from fish stocked in lakes could be significant, though both also use marsh habitat and shallow wetlands that do not contain fish. Other possible causes for their decline include the introduction of bull frogs into their habitat, pesticide/herbicide runoff, and shrinking wetland habitat. Table 33 in the Appendix, lists some recent known amphibian sightings/surveys within the analysis area. Formal amphibian survey data of lakes (and headwater streams) in the area is lacking.

Comparison of available data indicates that stocked lakes on average have approximately half the edible zooplankton per cubic meter of fishless (unstocked) lakes. This may be due to the grazing on zooplankton by stocked fish. Conversely, there are denser concentrations of phytoplankton in lakes with fish, which is perhaps due to the decreased zooplankton that feed on the phytoplankton. However, drawing conclusions from this data is premature because the information comes from a single sampling effort. Variables such as lake chemistry, and zooplankton/phytoplankton cycles were not taken into consideration. If each lake is looked at individually, the data shows a wide range of zooplankton/phytoplankton concentrations. Again, more intense sampling would have to be done to draw valid conclusions. These data may be found in Table 34 of the Appendix.

Four species of caddisfly on the Forest Service Region 6 sensitive species list are within range of this analysis area. They are: Cascades apatanian caddisfly, *Apatania taval*; Mount Hood Primitive brachycentrid caddisfly, *Eobrachycentrus gelidae;* One-spot rhyacophilan caddisfly, *Rhyacophila unipunctata;* and Mount Hood farulan caddisfly, *Farula jewetti*. All four species require cold, clear water and live above 4,000 ft elevation in springs, seeps and very small perennial streams. They are all associated with moss and cobble substrate in high gradient forested areas. Specimens must be collected and identified by specialists, because none of the

four are identifiable in the field. The Gorge and analysis area has much potential habitat for these caddisfly.

HUMAN USE

Social and Economic Characteristics of Local Communities

The population of Hood River County, the Portland Metro area and the Pacific Northwest is growing, aging, and becoming more ethnically diverse. Recreation and tourism are important and expanding sectors of the economy. Data for this analysis were drawn from *Demographic, Housing & Socioeconomic Characteristics of Oregon and Its Counties*, 1980 and 1990; *Demographic, Housing & Socioeconomic Characteristics* of *Multnomah County, Its Cities, and Census Tracts*, 1980 and 1990. The Center for Population Research and Census School of Urban and Public Affairs, Portland State University, Portland, Oregon, prepared the above mentioned documents. This section summarizes key social and economic data. A more detailed report is included in Appendix 3.

Population

- Most population increases have been from in-migration, rather than births.
- Oregon's growth rate was 4.6% between 1990 and 1992 (rest of US at 2.6%)
- The projected population increase for Hood River is an additional 3,000 to 4,000 persons every five years.
- Hood River County is estimated to have a population of 36,483 by the year 2040 (double the current population).
- The Portland-Vancouver Metro Area grows by more than seventy-five people every day.
- The Four-County Metro Region grew by 110,000 people from 1991-1995.
- The Metro Region is expected to have about 1,000,000 more people by the year 2040.

Sources for the following tables are the USDC Bureau of Census 1980 and 1990, Oregon Employment Division, 1996 and the Oregon Center for Population Research & Census, Portland State University.

Table 11. Demographic Data for Hood River County

	1995	1991	1986	1980
Total County Population	18,700	17,100	16,200	15,835
Cascade Locks	1,045	975	825	838
Hood River	4,940	4,715	4,520	4,329
Unincorporated	12,715	11,410	10,855	10,668

Aging

- Long-term population projections indicate an aging population for the Northwest and the Interior Basin.

Table 12. Age Groups in Hood River County

Age Bracket	Percent of Population
0-18	27.3
18-64	58.7
65 and over	14.0

Ethnic Distribution

- Population projections show an increasingly diverse population both nationally and in the Northwest.
- Asian and Pacific Islanders, and Hispanics are projected to be the fastest growing groups between 1993 and 2020 in the Northwest
- By 2020, these groups are projected to nearly double the population proportion of 1993.

Table 13. Ethnic Distribution in Hood River County

Ethnicity	Percent of Population
White	74.4
Hispanic	16.3
Black	0.3
American Indian	1.2
Asian or Pacific Islander	1.8
Other	6.0

Employment/Income

- Hood River County 1994 per capita income ($18,061) is 13% lower than the national average ($20,700).
- In 1995 there were 9,840 persons in the peak workforce.
- On average 820 people are unemployed in the county.
- The average annual unemployment rate in the county was 9.6 % over the last decade (higher than state average).

Table 14. Employment & Average Wages in Hood River County, Oregon

	Number Employed	Average Annual Wage (1994)
Total Jobs (1994)	9,113	$18,436
Agriculture	1,461	13,394
Services	1,910	14,651
Manufacturing (all)	1,349	23,349
(Wood Products Mfg.)	(479)	(28,879)
Government	1,177	27,765
Retail Trade	1,695	12,106
Communications	455	34,433

Poverty Rate

- Hood River County poverty rate in 1990 was 15.7%
- 2610 persons living below the poverty level and 14,056 persons living above the poverty level.

- 3061 persons or 18% of the population were considered economically disadvantaged in 1990.
- 4,130 persons or 21% of the population considered economically disadvantaged by 1995.

Job Growth

- The economy of Hood River County is anchored in tourism (services), agriculture and manufacturing.
- In the last 20 years, all job growth has been in the services sector.
- In the last two years, retail trade has contributed bigger share of job growth.

Recreation and Tourism Economic Impacts

- The outdoor experience seems to be one of the strongest tourist attractions in Oregon.
- Nearly half of all visitors engage in outdoor activities (47%), especially hiking (23%), wildlife viewing (17%), and visiting natural attractions (26%).
- Visitors to this area are generally recreationists, enjoying multi-sport, multi-day stays. In Hood River County, travelers spent $26,091,000 in 1992, or $1,482 per county resident (higher than the state average of $1,052 per capita spending).
- This spending generated a payroll of $4,890,000 which directly created 487 jobs in 1992.
- Day visitors from Portland spent about $2 million dollars in the county in 1992, supporting a payroll of $414,000 and forty three jobs.
- Spending by all travelers in the county increased by 17.6% from 1991 to 1992.

Transportation

Transportation corridors are concentrated along the Columbia River located on the northern boundary of the analysis area. People have followed this river route for thousands of years. Presently the watershed contains the following transportation corridors/systems: Columbia River, Historic Columbia River Highway (HCRH), Wyeth Bench Road, Herman Creek Road, Union Pacific railroad, including Amtrak, BPA Transmission lines and I-84 (Figure 11).

Recreation in the CRGNSA

In 1995 total visitation, which includes sightseeing from I-84, to the National Forest in the CRGNSA was estimated at 6.6 million visitors. Approximately 70% of the total activity occurred between June 1 and September 30, based on gross revenues at Multnomah Falls Lodge. The bulk of the public engage in such day activities as sight seeing, picnicking, day hiking, fishing etc. Generally recreation activity is confined to established trails and roads. Weather also plays a significant role in visitation to the Gorge. Use levels are significantly lower on rainy days. The majority of use is concentrated in the I-84 corridor, with low to moderate activity along trail corridors. All of the developed recreation sites in the CRGNSA are within one-half mile of I-84. Dispersed activity away from the travel routes is insignificant. This is mainly due to the physical constraints such as steep canyon walls and very little moderate to flat slopes in the Gorge. The Wyeth Bench is the only area along I-84 with a significant amount of flat ground; dispersed recreation activity in this area has steadily increased the past five years. Thirty-five percent of visitors participate in day hiking, which is somewhat lower than sightseeing and picnicking which accounts for over 50% of the recreational activities. As to be expected, this use occurs in trail corridors with some dispersed activity on user trails and cross country. By far, the Eagle Creek Trail System receives the

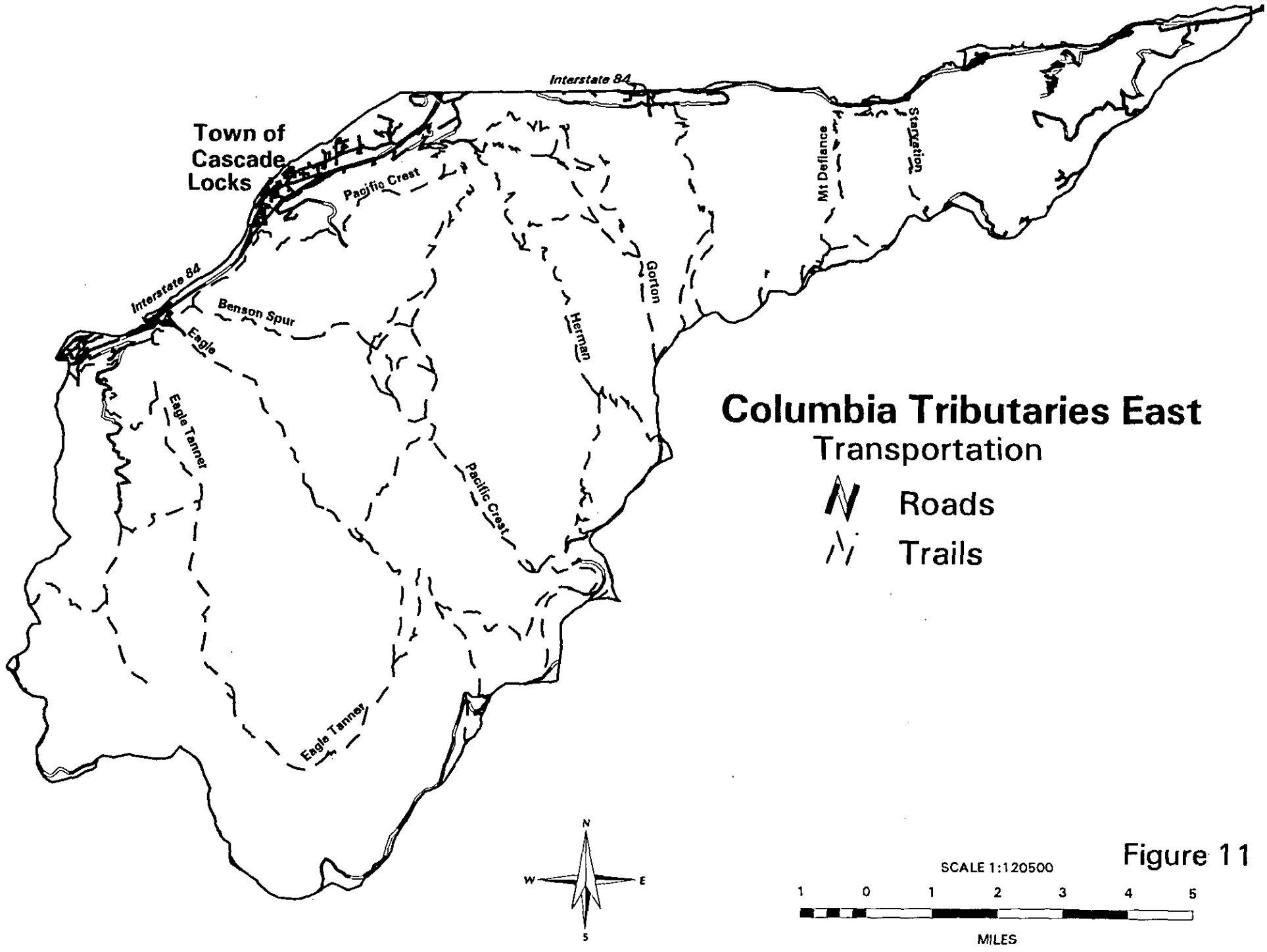

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Figure 11

highest use of all trails in the study area. Camping is also a significant with nearly 28% of all visitors engaging in the activity.

Respondents indicated that fishing (11%), wind surfing (17%), and nature study and visiting historic sites (40%), were other significant reasons for visiting the National Scenic Area.

Fishing tend to be concentrated at Bonneville Dam, Cascade Locks and scattered areas along the shoreline of the Columbia River. Herman and Eagle creeks also are very popular areas for stream fishing. Currently there are no recognized wind surfing sites in this segment of the Columbia River, although Viento State Park is commonly used as a launch. Wind surfing is relatively low because west winds tend to be stronger closer to Hood River, and east winds better closer to the mouth of the Gorge. Lack of public access to the river is also a factor. Historic site visitation and nature study occur throughout the area. Significant locations include the Historic Columbia River Highway (HCRH), Cascade Locks and Museum, Bonneville Dam Fish Hatchery and Visitor Center, Eagle Creek Campground and the Old Wagon Road Historic District. Researchers have identified that different ethnic groups have significant differences in recreation participation.. Although probably culturally based, scientists have yet to identify the root causes (Customer Demand Study 1992). For people participating in some type of recreation in the National Scenic Area, the 1992 Customer Demand Study revealed the following breakdown of ethnic composition:

Table 15. Use of the National Scenic Area by Ethnicity

Ethnic Origin	Percent
American Indian	0.38
Asian/Pacific Islander	1.69
Black	1.13
Hispanic	1.88
Anglo-American	94.54

People ages 45 to 64 are the ones who are most frequently sightseers and/or make use of the developed campsites, whereas, the 25 to 44 age group are the major users (hiking, backpacking etc.) of dispersed areas. The following table shows the National Scenic Area's activity by age distribution:

Table 16. Use of the National Scenic Area by Age

Age	Developed Camping	Dispersed Recreation	Sightseeing
25-44	35%	57%	32%
45-64	45%	27%	38%
+65	20%	20%	28%

The CRGNSA uses a modified version of the Recreation Opportunity Spectrum (ROS) called Recreation Intensity Class (RIC).

RIC I emphasizes providing semi-primitive recreation opportunities where people can realize experiences such as solitude, tension reduction and nature appreciation. Maximum capacity should not exceed 35 people at one time and parking for 10 vehicles.

RIC II encourages providing settings where people can participate in activities such as physical fitness, outdoor learning, relaxation and escape from noise and crowds. Maximum design capacity should not exceed 70 people at one time and a 25 car parking lot. RIC III emphasis is on facilities that are complementary to the natural landscape, yet accommodate a moderate number of people. In this environment, people will be able to participate in activities such as group socialization, nature appreciation, relaxation, cultural learning and physical activities. Maximum design capacity is 250 people at one time and parking for 50 vehicles.

RIC IV emphasis is on providing a roaded natural, rural, and suburban recreation opportunities with a high level of social interaction. Maximum design capacity is 1,000 people at one time and 250 automobiles. The majority of the watershed is in RIC I. RIC II tends to be along the I-84 corridor.

RIC III and IV are in areas where existing and proposed developed recreation sites are located. In this study area within the CRGNSA there are: Eagle Creek Recreation Area, Wyeth Bench (proposed), Wyeth Campground waterfront and campground expansion (proposed), Starvation Creek, Viento Campground waterfront (proposed) and Mitchell Point. Existing recreation facilities currently meet recreation demand throughout the tourist season. The exceptions is on weekends and holidays between June and August. At that time certain campgrounds tend to range between 85% and 100% capacity depending on the weather. Use is around 45% during the weekdays. This generally holds true for vista points, picnic areas and visitor centers. Trails and trailheads follow the same general trends. Only the Eagle Creek Trail and trailhead are not able to meet demand on typical sunny weekends. Other trails and trailheads tend to reach 80% to 100% of capacity on weekends, and approximately 40% during the weekdays.

Day hiking appears to be growing significantly during the past few years. For example, hiking on the Eagle Creek trail has increased 25% over the last three years. Interest shown by the number of phone calls, individual volunteers and hiking groups, supports this assertion. In contrast overnight camping has declined 37% at Viento State Park and 40% at Wyeth Campground, since 1992. State wide, camping declined approximately 12% over the same time period (State Parks only). Decline in RV camping at Cascade Locks appears to follow the trend. Since 1995, camping at Forest Service sites has climbed back to the pre-1992 levels (a 23% to 37% increase). While there appears to be no obvious reasons, weather and the economy could have been significant factors.

Generally camping seems to be transient in nature with the majority of the people staying one or two nights, while on their way to other destinations. Use at Bonneville Dam and Fish Hatchery has remained essentially stable over the last three years with approximately 750,000 visitors annually. In other areas, day use has increased slightly or remained static over the last few years. Day use at Cascade Locks has declined significantly during the same period. Demand for overall recreation opportunities are expected to continue to increase through year 2000. According to the State Comprehensive Outdoor Recreation Plan (SCORP), significant increases are projected for in State Regions 7, Multnomah County, and State Region 10, Hood River, Wasco, Sherman, Jefferson, Deschutes and Crook counties.

Table. 17 Projected Increase In Recreation Use

Survey	SCORP 1987-2000		Environsphere 1985-2000
Activity	Region 7 (State)	Region 10 (State)	CRGNSA
nature viewing	52%	145%	17%
day hiking	67%	94%	14%
RV camping	55%	64%	16%
tent camping	35%	33%	no data
picnicking	35%	48%	13%
sightseeing	58%	44%	20%
interp. centers	91%	51%	16%
fishing	21%	34%	17%
wind surfing	77%	8%	no projection

As indicated by the decline in use over the last four years, camping may not grow as fast as predictions in either SCORP or the CRGNSA Demand Studies. On the other hand, day use recreation, such as hiking, picnicking, sightseeing, nature/wildlife observation and visitor interpretation centers, should increase at a rate at least equal to the CRGNSA Demand Study projections. Overall projected annual recreation growth is about one percent annually, which is supported by a two percent annual increase in traffic volume along I-84, over the last five years. The Oregon Outdoor Recreation Plan 1994-1999 determined that the principle barriers which prohibit participation in recreation activities are time and distance. In the survey, 62.5% of the respondents stated that time restrictions deterred participation, and 48.5% indicated distance from home was a limiting factor. Community size or location was not a significant factor; both rural and urban dwellers gave similar answers (Oregon State Parks and Recreation Dept. 1994). The survey indicated that recreationist who prefer more natural or primitive settings are more likely to participate in a given activity such as backpacking. This is particularly true for hiking, nature study etc. These tendencies are related to the following factors: "1) many households now two wage earners which limits available leisure time; and 2) the growing urbanization is resulting in a decrease in the availability of desired opportunities close to home especially in more natural or semi-primitive settings" (SCORP 1988). These findings support the CRGNSA Demand Study projections for day use activities. In the future, the Gorge will provide major opportunities for many people when time and distance are limiting factors. The watershed provides recreation opportunities, in a natural setting, within an hours drive of major metropolitan areas.

Crime and vandalism at developed Forest Service recreation sites have remained static over the last five years. As recreation use increases there will probably be more crime, but it is difficult to predict. Reports of car clouting in the Eagle Creek-Multnomah Falls area has significantly decreased since 1995 (100 car burglaries) to 1997 (7 car burglaries). This decrease is due to more aggressive law enforcement activities. Overcrowding in the Eagle Creek area will become a significant problem, when the Eagle Creek to Cascade Locks Historic Columbia River Highway Connection Project is completed in 1998. Visitors will see this facility as a more desirable trailhead for the connection, because of the amenities provided (restroom, picnic area, etc.). Resource degradation in the trail corridors are becoming more evident. Impacts include numerous user trails, large unvegetated areas near vista points, sanitation problems and congestion near common rest stops. The Eagle Creek Trail is a major portal to

portal to the Hatfield Wilderness, and as trail use increases the visitor numbers will begin to exceed Wilderness Standard and Guidelines. Presently, the majority of day hikers do not seem to mind the large number of social encounters, but more people will increase the likelihood of conflicts between different user groups such the unauthorized use of mountain bikes and hikers. The new HCRH connection will attract more bike use to the area and exacerbate the problem.

In the last three years, we have received an increase in complaints regarding conflicts between off road vehicles and horses as well as indiscriminate target shooting and litter Wyeth Bench. This area must now be managed before illegal activity gets further out of hand. Additionally in the past five years, a series of natural events has caused significant damage to recreation facilities: the Wanua Point Fire in October 1991, flooding in February 1996 and ice/slush flows in December 1996. Cost of repairs are estimated at over $500,000.

Use in the Hatfield Wilderness

During 1994 and 1995 extensive data collection was done in the Hatfield Wilderness on encounter levels, numbers of users, and campsite conditions. The Hatfield Wilderness had about 11,600 visitors in 4,898 groups, with 78% on day trips. Eagle Creek received 42% of all visitors, and Wahtum Lake 13%. Nine trails had fewer than 100 users, and three quarters of all trails had fewer than 500 users. Most of the camping occurred along the Eagle Creek Trail, at Wahtum Lake, Benson Camp, North Lake, and Dublin Lake. Twenty seven camping destinations were identified in the study (Hall 1996).

Limits of Acceptable Change

The Limits of Acceptable Change (LAC) process, a public participation tool for Wilderness planning occurred in 1995 and 1996. Many interested persons participated in the workshops. They developed a proposal to modify the Wilderness Resource Spectrum (WRS) Forest Plan standards and guidelines, Wilderness Resource Spectrum descriptions, and map allocations. This proposal has been modified through study and discussion on the Forest, and is planned for public comment in 1998. The current Forest Plan-WRS mapped units are for semi-primitive trails along Eagle Creek, at Wahtum Lake, along the Pacific Crest Trail, and at the Benson Plateau. At this time, the Eagle Creek corridor does not meet standards for semi-primitive, but is in transition toward those standards. The remainder of the Wilderness is designated primitive trailed. LAC recommended changing the area around North Lake and Rainy Lake to semi-primitive, and designating portions of Eagle, Herman, and Tanner Creek Basins as primitive untrailed. The current standard is ten encounters or less in semi-primitive trailed, and six or less in primitive trailed. An encounter is any meeting with a group of people Encounters averaged less than five on weekends and less than two during the weekdays everywhere in the watershed, except Eagle to Wahtum Lake. Standards were exceeded 33% to 66% of the time in the aforementioned area, with lower Eagle Creek exceeding standards 83% of the time, and Wahtum Lake 11% of the time. Average group size is two to three persons and their lengths of stay is (61%) one night; (27%) two nights and 7% three nights.

Campsite Conditions

An inventory of 128 campsites in the Hatfield Wilderness in 1994-1995 revealed the following conditions:

Table 18. Conditions of Campsites

Percentage	Campsite Conditions
60	are within 100 ft of trails
66	are within 100 ft of water
61	have little or no screening from each other
66	are within 100 ft of each other
24	have 3 or more other campsites visible
67	are in forested settings
43	are greater than 500^2 ft in size
30	have a bare core area larger than 400^2 ft
33	have no mineral soil exposure
56	had one or more tree felled
73	had no badly scarred trees
60	had no exposed tree roots
10	had stock manure in the camp area
61	had litter present

Trends in Use

The Hatfield Wilderness was originally designated as the Columbia Wilderness in 1984. No known statistically valid use data exists prior to the 1994-1995 survey (Figure 12), so it is hard to compare use trends. Data does exist for 1980 for the Mount Hood Wilderness, and some comparison is valid. Use increased 58% over the 15 years, with a 78% growth in groups. These trends are consistent with Mount Washington, Mount Jefferson, and Three Sisters Wildernesses (Table 19; Table 20; Table 21). It is fair to conclude that use is increasing in the Hatfield Wilderness, although probably at a much lower rate than Wildernesses with alpine settings. Trend toward smaller groups will make meeting solitude standards more difficult, and demand for all types of recreation will grow as rural and metropolitan populations increase.

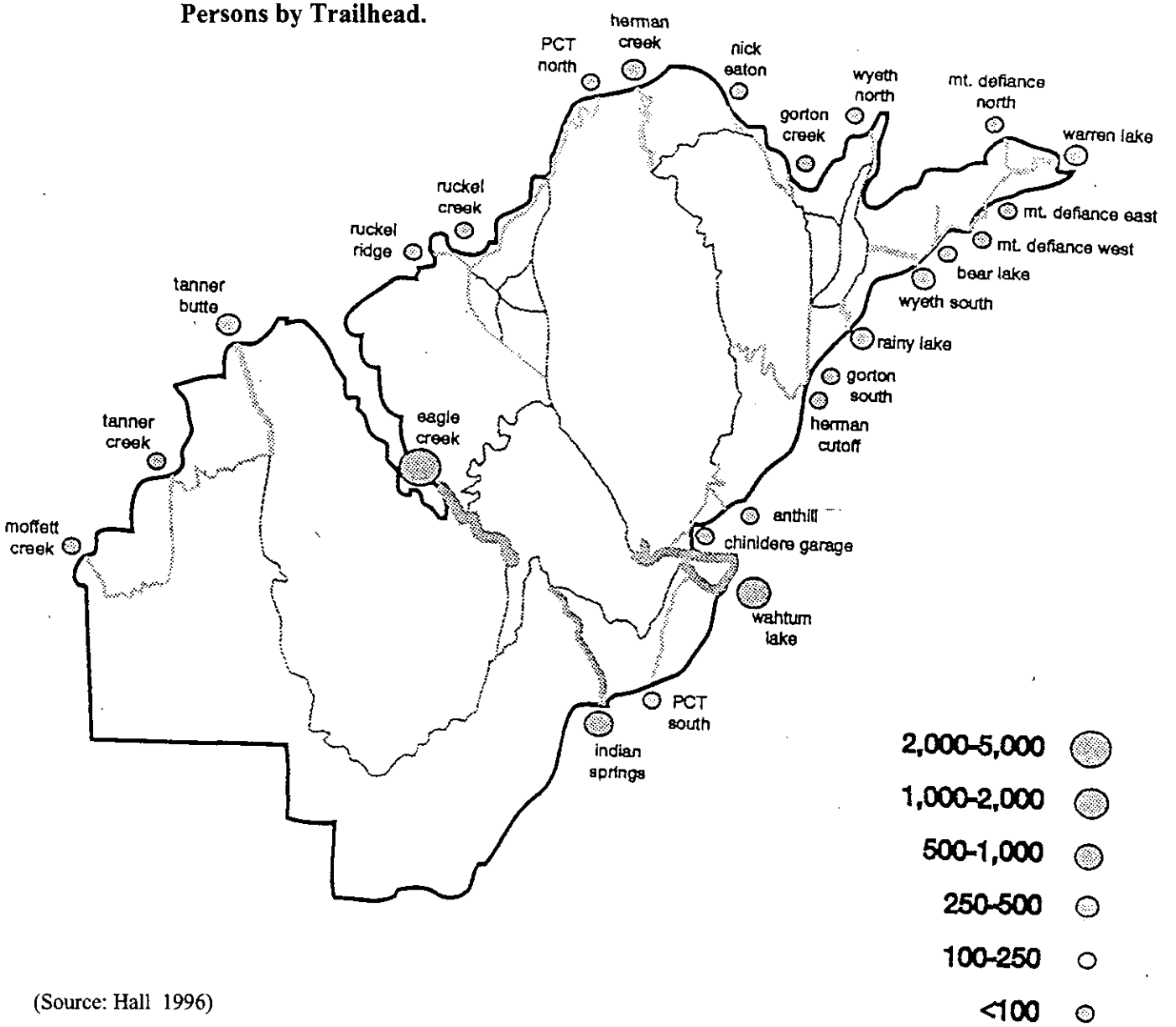
Recommendations from the Limits of Acceptable Change Study (Campsites)

Because of the steep terrain, out of necessity, camps are often close to water. Due to heavy vegetation growth in the Hatfield Wilderness, most persons use previously established campsites (personal observations, and observations of Wilderness rangers). It was the recommendation of the LAC team, that the only effective way to bring campsites into conformance with standards was to designate campsites. This would involve selecting campsite locations with an ID Team, then closing and moving some sites. Specialists would designate campsites further from water as desirable camping spots. Designated campsites would also allow minimizing damage to shoreline and lakes by reducing the percentage of lakeshore occupied by campers. The same is true for meadows. The study recommended standards be altered to allow campsites, in some instances, to be closer than 200 ft to the water when topography dictates. Current funding could require that designated campsites be phased in over many years. Regulatory permits and a user fees would hasten implementation.

SCENERY AND VIEWSCAPES

Except for the concentration of human developments near the Columbia River, the general forested landscape appears natural and unmodified thus meeting visual condition classes of

Figure 12. Use of the Hatfield Wilderness, 1994. Number of Persons by Trailhead.



(Source: Hall 1996)

Table 19. Use of the Cascades Wildernesses.

Wilderness	Acres	Year	# People	% Day Use
Three Sisters	283,402	1991	41,600	77
Mount Washington	46,655	1991	6,000	83
Mount Jefferson	100,208	1991	27,900	63
Mount Hood	47,100	1995	42,000	87
Salmon-Huckleberry	44,500	1995	6,500	89
Hatfield	39,000	1995	11,600	78

(1991 data from Shelby and Hall, 1992. 1996 data from Hall, 1996)

Table 20. Camping Use in the Hatfield Wilderness, 1995

	Destination	Groups
Untrailed Areas	Hicks Lake	5
	Mud Lake	8
Trailed Areas	Bear Lake	25
	Benson Camp	40
	Benson Plateau, lower	5
	Benson Plaueau, upper	13
	Big Cedar Springs	14
	Casey Creek (Herman Cr. Tr.)	21
	Cedar Swamp	6
	Dublin Lake	59
	Eagle-Benson	15
	Eagle Creek, Tunnel Falls	111
	Eagle Creek, 7.5 Mile Camp	278
	Eagle Creek, 8.5 Mile Camp	66
	Eagle Creek Trail Near Wahtum	2
	Green Point Mountain	2
	Herman Creek, lower	5
	Mount Defiance	3
	Noble Camp	21
	North Lake	36
	PCT-Indian Springs	3
	PCT-Benson Plateau	18
	Rainy Lake	32
	Ridge Camp	7
	Wahtum Lake	336
	Warren Lake	26

(Source: Hall, 1996)

Table 21. Average Encounter Rates By Location, 1994-5, Hatfield Wilderness

	Average # Groups per 8 hours		% of Time > 10 encounters/day	
Location	Weekday	Weekend	Weekday	Weekend
Benson Plateau	0.2	1.3	0	0
Dublin Lake-Tanner Butte		1.8		0
Eagle Creek, lower	10.2	28.3	83	86
Eagle Creek, upper		9.2		33
Herman Creek, South	0.6	1.7	0	0
North Lake	0.3	4.3	0	11
Rainy Lake	1.7	4.3	11	9
Wahtum Lake	6.0	14.6	11	60

(Source: Hall, 1996)

Preservation, except at campsites. Most campsites meet Retention, although a few heavily used areas near lakes only meet Partial Retention. All of the Gorge area is highly visible. Only in the large drainages (e.g., Eagle Creek, Viento Creek) are substantial areas not visible from Key Viewing Areas (KVA). KVAs are those portions of important public roads, parks or other vantage points within the National Scenic Area from which the public views Scenic Area landscapes.

Table 22. Key Viewing Areas

In Watershed	Outside Watershed
I-84	SR-14
Wyeth Bench Road	Beacon Rock
Pacific Crest Trail	Cook-Underwood Road
Historic Columbia River Highway	Bonneville Dam/Visitors Centers
	Panorama Point
	Larch Mountain
	Dog Mountain Trail
	Oregon Hwy. 35

AIR QUALITY

For centuries, the Pacific Northwest Region has had periods of poor air quality due to natural and man-caused forest fires. Diaries of early explorers and newspaper accounts of the last two centuries have commented to the problems of smoke from wildfire, burning of land clearing and logging slash, and the burning of woodstoves for home heating. Early twentieth (1910-1920) century legislation required the burning of logging slash. This practice became well established on private, state and federal lands. Early on, the accepted practice was to delay most slash burning until the fall season. With an enormous tonnage of logging slash being burned in a very short time period, smoke pollution episodes were not uncommon west of the Cascades. At that time, climatic conditions being traditionally poor for smoke dispersion in the fall season, slash fire smoke accumulated in the lower elevations of the forest and adjacent valleys (i.e., Puget Trough and the lower valleys). The practice of burning in the fall season continued until the early 1970s.

In the later part of the 1960s, Washington and Oregon inaugurated Smoke Management Programs (SMP). Since then air pollution problems in the Pacific Northwest Region significantly improved. A change implemented as a result of the new SMPs, was the move away from fall burning to more spring and summer burning. The burning time change to a period of better climatic conditions (spring and early summer) for improved dispersion of smoke pollutants has substantially reduced fall burn programs. The change to spring and summer burning periods with improved climatic conditions for smoke dispersion, has nearly eliminated fall broadcast burn programs.

The Federal Environmental Protection Agency had developed and promulgated National Ambient Air Quality Standards (NAAQS) for six pollutants: carbon monoxide, nitrogen dioxide, sulfur dioxide lead, ozone, and particulate matter. The standards were established to protect public health and welfare. Washington and Oregon Smoke Management Plans are now part of the State Implementation Plans for both states. They detail the procedures and lines of

authority for land management burning in the two states. Numerous areas in the Region are classified 'designated areas' in the Smoke Management Plan. Designated areas are typically the larger population centers. A 'smoke-sensitive area' is an area that would be negatively affected by smoke, but is not necessarily a designated area. Oregon's year 2000 goal is to reduce smoke particulates from prescribed burning by 50% of the level experienced during 1976-1979. Emissions from prescribed burning on Cascade Forests are now 30% of the level experienced during 1976-1979. During the 1976-1979 baseline period, biomass consumption averaged 60 tons per acre in western Oregon. In 1984, biomass consumption per acre had dropped to 44 tons per acre in Oregon (Sandberg 1986). On the Hood River Ranger District, the amount of slash planned for disposal through use of prescribed fire has decreased dramatically during the past decade. The primary factors contributing to this significant improvement are:

1) Unit managers program direction to reduce use of the prescribed fire;
2) Analysis of options and their applicability to meet planning objectives;
3) A reduction of timber sale volume

Air quality monitoring in the CRGNSA began in January 1993 with the installation of an IMPROVE-protocol visibility monitoring station near Wishram, Washington. This station includes a full IMPROVE aerosol monitoring system, two automatic cameras, an open-air integrating nephelometer, and associated meteorological and recording instruments. A continuous ozone analyzer operates April 1 through October 31. In October 1996, a second air quality station began operating in the Cape Horn area, near Mt. Pleasant, Washington. This station includes IMPROVE aerosol samplers, a Radiance M903 nephelometer, a tapered element oscillating membrane (TEOM) analyzer, and associated meteorological and recording instruments. A continuous ozone analyzer operates April 1 through October 31. The primary purpose of air quality monitoring is to assess the impact of pollution on the visual resource, as mandated by the Columbia River Gorge National Scenic Area Management Plan. Some baseline data exists to quantify visual quality in the west end of the CRGNSA, and data from future monitoring will add sufficient detail to determine if the visual resource is improving, degrading or not changing.

The CRGNSA experiences poor visibility when compared to other Northwest locations where the visual resource is an important part of recreational and scenic resources. The Forest Service used camera data collected at Vista House on Crown point in Oregon to establish "standard visual range" values of 70 km for poor, 130 km for medium and 291 km for good visibility conditions. Among the 17 camera locations in the Pacific Northwest, Vista House ranked near the bottom, 16th, 17th and 13th with respect to poor, medium and good visibility categories. Camera data from the Wishram site have not yet been analyzed for a standard visual range. Ozone data from the Wishram site shows concentrations at or above the injury threshold for sensitive lichens. This is a concern because several popular recreational sites in the Gorge owe their appearance and visual attraction to lichens. An example is Oneonta Gorge, where lichens color the sheer cliffs a peculiar shade of vibrant chartreuse. High ozone readings from the air quality stations support the initial results of a Forest Service study, which suggests a change in lichen distribution is a result of air pollution. Construction and operation of instrument stations using aerosol samplers, nephelometers and ozone analyzers is more recent than the camera-based program to monitor visibility. The advantage to the instrument sites is that they collect information 24 hours a day, while cameras take three photographs a day, and only during daylight hours. An instrument site can single out a particular type or source of pollution better than a camera site. Analysis of meteorological information and

instrument data will compare and contrast different pollution sources to determine if the contribution of each is growing, declining or staying the same. This is important knowledge for the Forest Service to fulfill its responsibilities under the Clean Air Act and the Columbia River Gorge National Scenic Area Management Plan.

The Forest Service monitoring strategy recommends a minimum five years worth of data to determine the nature of visibility impairment. Since the Cape Horn station started operating in late 1996, an accurate characterization of the visibility resource could be expected in 2001 at the earliest. Study of preliminary data should indicate, even after only two or three years of collection, some general patterns, such as seasonal variations in movement of urban pollution. This information will be useful to business and industry, and state and local governments. Changes in pollutant concentrations or distribution will prove useful to interpret other information gathered in performing watershed analysis. In considering acidification of a lake, for example, determining if air pollution as a factor becomes much easier when data are available to track the movement and intensity of particular pollutants. (Columbia River Gorge Commission; Air Resource Specialists 1994; USDA Forest Service 1994, 1996; CH2M Hill 1996).

IV. REFERENCE CONDITIONS

REFERENCE PERIOD

The period 350 to 1,500 years ago (100 AD to 1650 AD) was chosen as the Reference Period, because 1) it had similar geologic and climatic conditions as today, and 2) a stable aboriginal population whose level of technology was not as intrusive as Euro-Americans. After 1650 AD, environmental conditions including human populations and lifestyles changed quickly.

GEOLOGY/HYDROLOGY/WATER QUALITY

Watershed conditions during the Reference Period were probably highly variable. During this time, the Cascade or Bonneville slide occurred (1260 AD). This large slide blocked the entire Columbia River and raised the water level approximately 200 to 300 ft. Water was backed up to at least The Dalles by the slide debris, which gives some credence to 'The Bridge of the Gods' Indian legend. Water eroded away this blockage with the remaining material forming the rapids at the Cascades. This slide is believed to have re-routed the main Columbia River channel almost a mile to the south and constricted the channel to the extent that there was a permanent rise in upstream water levels of at least 30 feet.

Other major slumping activity presumably occurred along the Columbia in the Ruckle Ridge and Wyeth Bench areas. Apparently there were numerous unvegetated slopes adjacent to the Columbia that contributed sediment, rock, and large woody debris (LWD) directly into the river. Tributary streams probably funneled debris torrents down their channels to the Columbia River, at a 10 to 50 year frequency. Depositional debris fans formed at the mouths of the Columbia River tributaries, with finer materials being routed downstream during flood flows of the Columbia. At the mouths of each of these tributaries, creeks migrated over large areas of the debris fans. Typically, major storm events or debris torrents would carve out the most direct, straight path to the Columbia. Debris deposits that settled out in the lower gradient reaches of tributaries would tend to block channels with flows diverted around these depositions. Channel locations would have migrated along the Columbia for a mile or more, until the next flood or torrent eroded another high water channel (Appendix 1; Geology).

During the Reference Period, the Columbia River experienced frequent, large flood events. These spring flood events were characterized by large volumes. Annual high flows of spring freshets, between late April to August, probably averaged in the 600,000 cubic feet per second (cfs) range. Debris and sediment deposited in the stream deltas of the side tributaries would have been carried down river, during the Columbia's high water events. River levels dropped in the fall and winter. The resultant riparian landscape was a mosaic, with fingers of flood channels, side channels and backwater sloughs, and more stable higher ground of more mature vegetation. More recurrent and larger fires within tributary drainages resulted in landslides. It is estimated that major tributaries probably had debris slides routed down the channels every ten to twenty years. The Columbia River probably had higher overall sediment loading during the Reference Condition; however, low flows in the Columbia probably had clean, clear water. The high lakes were presumably clear with less primary production. Wetlands habitat presumably had significant beaver present. Lower reaches (one to two miles) of the side

tributaries, channels in all probability carried significant amounts of LWD, had many side channel pools, a developed and diverse riparian zone as well as floodplain channels.

Also during the Reference Period, fires frequently burned over areas. Denuded slopes caused mass wasting to deposit sediment, rock and LWD into tributaries as well as directly into the Columbia River. Ice dams created steep gradient scours, and later wood and debris jams diverted streams causing them to erode new channels. These continual channel migrations eventually created large debris fans or deltas, at the mouth of major tributaries. During this period, beaver dams also caused more meandering and shallow water conditions. Sediments and debris that deposited in stream deltas and side tributaries were carried away downstream, during the Columbia's annual spring freshets. In the fall and winter, river levels dropped and the shoreline became a mosaic of flood channels interspersed with backwater sloughs.

HUMAN USE

Prior to the Reference Period, the region had undergone a severe warming trend called the hypsithermal during the Archaic Cultural Period. Climatic conditions became cooler and more moist during the Reference Period. Plants and animals reoccupied areas that had been abandoned previously due to the severe arid conditions. In addition to exploiting riparian and riverine resources, Native Americans now hunted and gathered upland resources. An aboriginal trail once followed Herman Creek south to Wahtum and Lost lakes.

Improved environmental conditions apparently led to an expansion of the human population. Semi-permanent settlements along the Columbia River and its tributaries became larger and more numerous, with a concurrent expansion in technology, cultural complexity and trade networks. In the Gorge, most of the Indian winter villages were found on the north side of the Columbia River, however, a small winter village was located on the flat below Ruthton Point. Indians also had seasonal fish camps near the mouths of major creeks on both sides of the river. They traveled through the Gorge in dugout canoes and portaged around the Cascades Rapids and The Dalles area. The main portage at the Cascades was on the north side of the river. Various Indian trails also paralleled both sides of the Columbia River. The majority of trading occurred throughout the summer and fall.

During the Reference Period, Indians deliberately set fires to reduce the overstory. This was done to keep vegetation from encroaching on berry patches and perhaps also to create and maintain areas of open habitat in the forest, that in turn supported larger animal populations. Recent ethnographic accounts indicate that Natives burned berry bushes in the late fall, just before the first snow. Depending on the type of berry, the fields were burned every three to ten years. For huckleberries, it appears that a five year burning cycle produces maximum berry production (French et al. 1995). Native American campsites normally had smoldering fires used for drying fish, cooking, and warmth. Archeological evidence indicates that most of these fires were not banked, which suggests that some occasionally escaped and burned as wildfires (Appendix 2. Cultural History).

VEGETATION

This watershed is presumed to have been predominantly forested but strongly influenced by large-scale, periodic disturbances such as fire. The frequency of fire as a stand-replacing

disturbance is presumed to have been higher in the central and eastern Gorge than may have been common to the north and south within the Cascades as a whole. The result of a supposed higher fire frequency is that old-growth forests were likely less abundant on the landscape generally, perhaps commonly accounting for less than 50% of total watershed area in old-age (stands greater than 200 years old) forest condition. This percentage might vary considerably over time, being as low as 20% or as high as 80% depending on the frequency of fire during any given time period. Likewise, mid and early seral stages would have had a greater presence in this Gorge-influenced landscape than would have been seen in the Cascades just to the north and south of the Gorge. Increased frequency and intensity of disturbances (especially fire) in the Gorge combined with over-steepened relief may have produced a mosaic of stand age classes more complex and finely interlaced than is typical in the Cascades. The general pattern on the landscape of past forests might be characterized as follows:

> *High elevation forests* were dominated by mountain hemlock stands and isolated white bark pine groves along open ridges. Huckleberries were an important component in the understory.
>
> *Mid elevation forests,* when viewed from west to east, are presumed to have been dominated by western hemlock and Pacific silver fir stands which transitions into drier grand fir, ponderosa pine and Douglas-fir communities. Shrubs such as vine maple, ocean spray, California hazel and others were a dominant component of the understory.
>
> *Low elevation forests,* from west to east, were dominated by western hemlock communities which transitioned into grand fir forests. Oregon white oak stands occupied dry balds. Douglas-fir dominated forests may have been common in the eastern portion of the Gorge because of more drought prone soils, steep slopes, and more frequent fires. Along the Columbia River the vegetation was dominated by riparian hardwood communities (cottonwood, big-leaf maple, Oregon ash and alder) with a diverse system of wetlands, over-flow channels, and other flood plain related communities.

Upland forests within the watershed were probably much as they are today. Forests, as structurally and compositionally dynamic plant communities, vary considerably through time in the quality and quantity of habitat features provided. No evidence today suggests that former upland forests were different in their development on, or occupation of, the landscape.

Riparian woodlands, on the other hand, were hardwood communities of fairly complex compositional diversity that withstood regular and dynamic change during the Reference Period. Deciduous trees dominated in many areas along the Columbia River and adjacent to larger streams. Black cottonwood, big-leaf maple, red alder and Oregon ash were common trees in these woodlands. These trees were well-adapted to flood plain areas where high-water events eroded, abraded or broke existing stems. As trees that are adapted to water level changes and which sprout or quickly seed into newly worked bank edges, hardwoods dominated near-stream areas subjected to frequent flooding. Riparian hardwood communities provided, in turn, habitat niches (like nest sites) not available in upland coniferous forests.

Fire played a vital role in defining the ecology of this watershed. Historically, fires were caused both from lightning strikes and by Native Americans. Although it is not known how frequent and how large were these burn events, existing literature permits some speculation.

Large catastrophic fires probably occurred within this region at a fire interval of about 125 to 400 years. Large fires are those events that would have consumed 500 acres to well over 10,000 acres. Meanwhile, low or moderate intensity fires may have burned far more often, perhaps every 25-75 years in the western portions and every 10-30 years in the more eastern portion of the watershed. Clearly, in the drier eastern portion of the watershed, the likelihood of a fire start was far greater.

Regardless of how and where burns began, fire impacts on forests were sometimes dramatic. At higher elevations (in the Pacific silver fir and mountain hemlock zones), forest stands likely were destroyed and replaced by a new forest on an average of every 200 to 400 years. During most summers, fire that started at upper elevations may have been of rather small size, low intensity or both as heightened fuel moistures, rocky areas or a lingering snowpack on north slopes subdued burning and flame spread. However, when fuel loading became acute as stands grew to old age and weather conditions provided for active burning, fire behavior in a dry season changed tremendously. In a hot summer preceded by a winter of lower-than-normal snow accumulation, stand-replacing fire(s) might consume substantial upper-elevation forest. This area would then commence regeneration and its slow trajectory toward climax development. During the first 75 years of a new forest generation, lightning fires could be kindled by the tree debris left from the former forest, thus thinning out or completely destroying early seral growth and creating a structural mosaic.

At mid and lower elevations, the periodic cycle of fires is expected to have been more frequent than higher elevations due to the drier conditions, steep topography, constancy of Gorge winds and Native American habitation along the Columbia River. Stand-replacement fire frequencies were likely on the order of 125 to 250 years. Depending on local drying, slope aspect and wind conditions, hot fires may have erupted fairly often and ran up the steep walls of the Gorge in an all-consuming conflagration. At other times, fires may have been rather benign underburns which killed only understory trees and low vegetation. In any case, due to the regularity of burning along the lower canyon walls of the Gorge, the forest likely was dominated by second growth trees (0-200 years old). At any particular time, significantly-sized areas may have been in early seral condition with stands under 75 years of age.

Wet riparian areas were more likely to escape major fires and, consequently, the trees would have reached perhaps 600+years of age (as evidenced by today's old-growth redcedars in Herman Creek). Trees at mid-slope and on mountain tops, where soil moisture is typically lower and wind has greater influence, would have been more likely to have succumbed to fire than canyon-bottom trees. As a result, stream-side areas appear to be the localities where old-growth forests would have attained their oldest age and most complex development.

WILDLIFE AND HABITAT

The makeup of the terrestrial fauna was somewhat different during the Reference Period than today. Several wide-ranging animals that formerly inhabited the Columbia Gorge are no longer members of present-day fauna. The journals of Lewis and Clark confirm that two predators, the grizzly bear and gray wolf, and one scavenger, the California condor, were at least seasonal residents of the Columbia Gorge. These formerly endemic species were sympatric with other large predators and scavengers believed to inhabit the watershed, including cougar, coyote, bobcat, wolverine, and a number of raptors.

Although the extent of former mountain goat range is not known for certain, they probably once occupied suitable habitat in or near to the watershed. While it is generally accepted that mountain goats inhabited the Washington Cascades in suitable habitat, historic evidence of goats in Oregon is not clear. References on mountain goats (Ingles, 1965; Burt and Grossenheider 1980; Chapman and Feldhamer 1982), do not include the Oregon Cascades, or suggest the vicinity around Mt. Hood (Forest Service, 1930), as being within the species' native or introduced geographic range.

While the Columbia River certainly would not have been an insurmountable barrier to mountain goat movement into Oregon, long-term occupation by goats of low elevation cliff habitat within the Gorge seems unlikely for several reasons. Mountain goats would have had to regularly pass through thick forests to reach and move between the intermingled lower cliffs. These forests would have provided easy concealment for large predators, which included the now extirpated grizzly and wolf, to ambush unwary goats. Moreover, as the only mammal in the contiguous United States that retains white pelage year round, detection of goats by forest-dwelling predators is likely enhanced. Finally, American Indians,during their winter habitation along the Columbia, would likely have taken advantage of the forest concealment opportunity to hunt goats for meat and fur. The Gorge may be better suited today to sustaining mountain goats than it was in the pre-European past.

Probably all bird species and medium-to-large terrestrial mammals were able to cross the Columbia River. Birds would generally not be deterred from crossing the Columbia anytime during seasonal migrations or, for resident birds, during juvenile dispersal. Mammal crossings are more likely to have been constrained by the river's physical condition. Crossings may have been limited to times of low water levels (late summer and fall), and when the river froze over in winter (formerly about every five years). As it happens, physical capability for mammals to cross the river coincides with timing of juvenile dispersal in most species. Small mammals, such as red tree voles, gophers, moles, shrews, microtine mice and similar creatures were certain to have found the Columbia a complete barrier or to have made only infrequent or accidental crossings.

It is likely that the watershed was a key linkage for dispersing medium-to-large juvenile mammals moving between the Oregon and Washington shores of the Columbia. The value and extent that terrestrial animal crossings contributed to genetic interchange and overall population vitality can be inferred only from data collected elsewhere, and solely on a species by species basis. Today, the Bonneville Pool is an all but certain barrier to terrestrial mammal movements between Oregon and Washington.

Wolverine and fisher are believed to been have present within the analysis area. Remnant populations of these animals are known to persist elsewhere in Oregon today. Again, the overall role these animals had locally and their pattern of seasonal habitation in the watershed is uncertain.

ANADROMOUS AND RESIDENT AQUATIC SPECIES

The condition of anadromous fish habitat during the Reference Period can be estimated by comparing the relatively unmanaged upper reaches of each stream with the lower reaches, where railroads, highways, fish hatcheries, logging, and other developments may have changed the streams. In the upper reaches, the number of pieces of large wood per mile and pools per

mile are hypothesized to be close to what they were during the Reference Period. These unmanaged conditions may only exist above waterfalls impassable to anadromous fish where stream alterations were less likely to have occurred. Fire occurrence and intensity may also have affected fish habitat, however, it would be impossible to know the effects of fire without a detailed fire history. Low intensity fires may have added more large wood to streams, whereas, high intensity fires could have deprived the stream of sources for large woody input. Today the fish habitat in the upper reaches of the streams are probably within the range of natural variability found during the Reference Period.

Very little information exists on the relative abundance or distribution of resident fish or other aquatic species prior to 1900. An increase in human population and activities in the Gorge has led to a general decline in all native fish. Most lakes and ponds were likely fishless, with the possible exception of Wahtum Lake. Since none of the lakes have species other than what was stocked, the current thinking is that they were fishless before stocking.

AIR QUALITY

Wood smoke significantly affected air quality during the Reference Period. Natural disturbances such as lightning strikes caused forest fires in the watershed. In addition, Native Americans used fire as a primitive form of horticulture to clear and rejuvenate huckleberry fields. They also used fire to create openings for wildlife in the forest. Lush vegetation in the meadows supported more large animals that were in turn hunted by the Indians. Additional forest fires were probably caused by escapes from Native American's cooking, drying and warming fires. Many of these naturally and human caused fires burned for long time periods at low fire intensity. Smoke from these fires would have created air pollution in the watershed.

V. SYNTHESIS

The Columbia River Gorge lowlands have been altered from the Reference Period due to transportation as well as urban developments, damming of the river and suppression of natural fire. While fire has been routinely suppressed in this watershed during the last 75 years, it is likely still within the range of natural variability. Interestingly, the Benson Plateau and Hatfield Wilderness in general may have had more periodic human use during the Reference Period, because of the exploitation of huckleberry patches by Native Americans. The fish habitat in the upper reaches is probably still within the range of natural variability.

HYDROLOGY

The Bonneville Dam, The Dalles Dam and others along the Columbia have led to immense changes of the hydrological processes, and alteration of the entire natural disturbance pattern. Presently on the Columbia, large spring floods are less frequent, of shorter duration and drastically less volume. Events in the 200,000 cfs to 300,000 cfs range are very uncommon. Extreme low water levels also seldom occur. In the Reference Period, water volumes varied seasonally, while water volumes today are much more uniform seasonally, but can vary daily with 'power peaking' water control strategies. Tidal effect originally changed the water levels up to the Cascades Rapids. Today the Bonneville Dam is the limit of tidal currents which formerly went several miles further up river. Due to damming, sediment deposited by side tributaries is not carried away which results in an increased material buildup. Without the influence of scouring flood events, vegetation is more stable and side channels are not regularly inundated.

Damming of the Columbia River has led to a change in the function and timing of hydrological processes. Tidal effect is less, and the infrequent spring floods events have a diminished volume and much shorter duration. Resulting reduction in fluctuations has also highly altered the first downstream mile of the tributaries. Sediment in side channels is not carried away, which results in less side channel formation, and a more permanent shoreline. Stable vegetation results in less LWD entering stream channels which concomitantly has decreased fish habitat. Culverts prevent stream downcutting action and other man-made diversions limit the meanders of Eagle, Tanner, Herman and Dry creeks. Major debris jams are quickly cleared in lower stream channels. As far as the presence of LWD and mass wasting, the study area is probably near the lower limit of the range of variability for the Reference Period. Other problems include the powerline road near Tanner Creek, which frequently washes out and deposits material into the creek or across the highway.

Overall the Columbia River's hydrologic system has seen extraordinarily changes; the river's riparian system, and the first mile of the tributaries, are outside the range of natural variability. Fish migration has been seriously affected in the entire Columbia River system from dam blockages, and reduced spring flushing. Water level changes affected fish predation, and probably resulted in a different pattern of species competition and composition. Stream sediment is not a problem, it is coarse material and cleans up fast, within 24 hours, even after a major slide. The streams and tributaries of the watershed have some of the cleanest water of the entire region; dissolved oxygen contents are also high. At this time, water supplied to the hatcheries and Dry Creek is of high quality. The 100 or so upland lakes and ponds are not in as good condition. The high lakes have naturally low nutrient levels that are more susceptible

to nutrient inputs. Due to geologic conditions, the upland lakes elevated phosphorous levels are natural, but increases in nitrogen are probably due to lack of a vegetation buffer zone along their shorelines. Bacteria from the untreated human excrement is leaching into the lakes. Overuse by recreationalists has also exposed bare soil in many places around the lakes. Wahtum Lake may be showing signs of decreased transparency.

FIRE

Euro-American epidemics drastically reduced the Native American Indian population between the 1780s and 1830s. Theoretically fewer Indians in the area decreased small fire frequency, which caused a buildup of understory debris. This larger fuel load increased fire intensity and caused catastrophic fires that killed the larger trees. Tall snags seen in Watkin's 1867 photographs of the Gorge are witness to the existence of former old-growth stands (see cover page). In 1862 the first railroad went into service on the south side of the Cascades portage. Over the next 20 years, tracks were laid down in various other places. The line was completed and the first railroad began operation on the south side of the river in 1882. Railroads became a major source of catastrophic fire, especially during east winds and dry periods. In 1902 fires burned over 100,000 acres of old-growth stands in the Gorge. Riparian areas and those areas protected by cliffs remained old-growth. It is unknown if post-European period fires were part of the established fire cycle, but there were more chances of catastrophic fire after European settlement. The watershed is mid-way through the 200 year cycle for large burns. Lack of underburning has also resulted in an increase of hemlock and silver fir, and a reduction of vine maple.

The size of fires in recent years have tended to be small due to early detection and quick mobilization of the fire-fighting forces. An indication of potential fire behavior can be witnessed by examining the fast spread of burns like the Falls Fire during unfavorable weather patterns in 1991. Fire suppression and other human activities such as logging have altered the natural fire regime. This has resulted in increased fuel accumulation in stands, and greater susceptibility to insects and disease. Greater fuel load has also elevated the chances of fire occurrence. Herman Creek and the Columbia River Gorge are the most effected areas. Recent wildfires within the watershed have been minimal. Campers, hikers and hunters that abandon camp and warming fires are the most frequent source of human caused fires.

Due to the high moisture content that often accompanies storms within the watershed, lightning strikes are responsible for only a small percentage of fires. Lightning strikes occur on the ridges that run north from Mount Hood to the Gorge. Strikes also occur along the ridge tops and mid-way down slopes. Fire frequency, intensity and duration have changed from the Reference Period, but the system is still probably within the natural range of variability in the higher elevations, except for the absence of low intensity fires. At lower elevations and for the areas in the eastern portion of the watershed the system is marginally, if at all, within the range of natural conditions. In these areas fire suppression has been the primary reason for this discrepancy. The system could go outside the range of natural variability if management continues to suppress and exclude fire, especially in areas where logging has not occurred. Larger more catastrophic fires would most likely be the result.

NOXIOUS WEEDS

Another change from the Reference Condition has been the introduction of noxious weeds. Currently, they have gained strongholds throughout the Columbia River Gorge, I-84, railroad corridors, and along the forest roads to the east of the watershed. The Wilderness, however, is still largely free of noxious weeds. Without preventative action, these viable weed populations will penetrate the watershed through the many trail and road corridors frequently used by people and animals.

SPECIES AND HABITATS

Historical evidence (in the form of photos, documents and in-field clues), with the exception of riparian habitat, suggests that there has been little change within the watershed analysis area generally in types and amounts of wildlife habitats over the last 200 years. Roads, logging, mining, grazing, crop cultivation (row crops and orchards), settlements, water diversions, powerlines and other human developments or uses are localized or currently absent and have typically had only minor or no influence in changing the character of the Columbia Tributaries upland landscape. Difficult access and rugged terrain has afforded upland areas considerable isolation from most development and human intrusion. The most substantial and adverse change to wildlife habitat that has occurred since European settlement is the alteration of stream-side vegetation along the Columbia River. Former riparian hardwood communities (composed mainly of black cottonwood, red alder, big leaf maple and Oregon ash) are now largely reduced and perhaps functionally absent along the Columbia River in this area.

Compared to pre-settlement conditions, Columbia River riparian hardwood communities are now almost entirely gone. The Bonneville Reservoir (pool) has inundated the natural riverine shoreline and replaced it with a year-round water level that is much above the former river height. What was formerly upland conifer forest now substitutes for the riparian hardwood vegetation that had grown along the free-flowing river's edge. As a consequence, the yellow-billed cuckoo, one bird species absent from the present-day Gorge habitats, may be a direct casualty of the changes to riparian hardwood communities. The river bottomlands also provided habitat important to waterfowl (migratory and resident), neotropical song birds, amphibians and reptiles (turtles), but used as well by a variety of insects, mammals, raptors (eagles, hawks, owls and vultures) and other birds. River bottomlands provide habitat for many species which are now of concern. For example, serious declines in the Northwest's only native turtles (painted and western pond turtles) have occurred due to predation on hatchlings by introduced bullfrogs and loss of quality habitat.

Restoration of riparian hardwood communities is problematic since homes, businesses, railroad tracks and the Interstate 84 right-of-way often crowd the current shoreline. Even where there is potential for restoration, other considerations, such as Columbia River views enjoyed by property owners, will complicate re-establishment of riparian hardwoods. The most substantial remnant of riparian woodland on the Oregon side of the Columbia (upstream of Bonneville Dam) likely exists just outside the analysis area on Wells Island. This island currently supports willow, black cottonwood and other hardwood trees that provide suitable habitat for a great blue heron rookery.

Although upland forests structure and composition in today's forest has not changed appreciably, natural lightning strikes and fires caused by Native Americans probably combined to create a more robust and healthy forest environment during the Reference Condition. More frequent but less intense fires created a greater diversity of plant species, as well as retarded the buildup of insect populations and disease. The indigenous Native American Indian population was all but wiped out by European diseases and external and internal conflict. Initially this caused a reduction in the number of man made fires from 1800 to the 1860s. Euro-American presence most likely changed the ecological balance of the region. Originally the reference forest grew down to the Columbia shoreline, and included a much larger region of floodplain and hardwood riparian zone. Unlike the Indians, Euro-Americans viewed the forest as a nuisance or a commodity. Many of the first settlers made a living by logging cordwood along the Columbia River, and selling it to the steamboat captains for fuel. The riparian zone suffered when settlers logged the hardwood in the backwaters, wetlands and sloughs. Many sensitive plants are riparian zone dependent.

This shoreline was also part of the natural transportation corridor, and railroad construction in the 1880s further diminished the size of the riparian area. Because the reduction of small fires, over the previous 50 years, had caused a buildup of the fuel load, railroads began to cause catastrophic fires. Commercial logging along with splash damming and logging roads further disrupted the watershed's ecological system. Later, highways, urbanization, fire detection and fire suppression continued to change the region. After 1930, fire suppression reduced the number of early seral plant communities, but increased the number of exotics. Soil disturbances gave exotic plant species, particularly noxious weeds, a foothold and invited their proliferation. Cultivation and grazing near the riverbank caused erosion.

When the Lewis and Clark expedition passed through the Gorge in 1805 and on their return in 1806, they reported seeing mountain goats in the cliffs on the north side of the river, and purchased a mountain goat pelt from the local Indians. Although historically no sightings of mountain goats have been reported on the south side of the Columbia, Warm Spring Indian elders recently said they at one time hunted them, on the south side of Mount Hood. Ten goats were introduced in Tanner Creek area in early 1970s, but all eventually died or were killed by poachers. Since the time of Lewis and Clark, the grizzly bear, wolf, and the California condor, have become locally extinct. Changes that have occurred to the upland forest faunal community, such as the extirpation of the grizzly, are generally not a result of local habitat alteration, but have been driven by larger trends associated with settlement of the region. Several wide-ranging animals that formerly inhabited the Columbia Gorge are no longer members of present-day fauna. Historic records confirm that grizzly bear, gray wolf and California condor were removed from the Columbia Gorge by early-day hunting and trapping. These formerly endemic species are no longer found anywhere in the Gorge, in the Oregon Cascades or in Oregon generally. Suitable mountain goat habitat exists in or near the Gorge. If mountain goats, lynx or both were present within the watershed, prior to Euro-American settlement, they to are now extirpated. Due to the same, larger pressures of civilization, wolverine and fisher are also believed to be absent from the analysis area even though remnant populations of these animals are known to persist elsewhere in Oregon.

Another change in present day conditions from Reference Period is the result of construction of Bonneville Dam. Prior to formation of the Bonneville pool, medium to large terrestrial mammals and probably all bird species were able to cross the Columbia River during low water levels and when the river froze over (formerly about every five years). With creation of the

Bonneville pool, it is likely that terrestrial mammal crossings between Oregon and Washington are exceedingly rare or perhaps impossible. Creation of this water barrier undoubtedly affects genetic interchange and isolates formerly linked mammal populations into separate sub-populations. Higher water levels also resulted in less wildlife habitat, because of the smaller flood plain and riparian zones.

Reduction in the riparian zone and bare soil around the high lakes has decreased the number of neotropical song birds, turtles and frogs. The large decline in Indian population probably reduced fishing pressure on the Columbia. Anadromous fish populations may have peaked on the river between 1830 and the introduction of commercial fishing and gill netting. Native Americans retain treaty rights to hunt, gather and fish in the watershed. Cannery processing was introduced in the 1860s and fish wheels in the 1880s. Commercial fishing, construction of hydroelectric dams, logging drastically reduced numbers of salmon. Today, although the catch is greatly reduced, gill netting and sport fishing have a greater impact, because fishermen are taking a larger percentage of the salmon population. Because gill nets cause the death of all fish trapped in them, it is impossible to protect the native stocks of fish in the river while keeping the hatchery fish. After 1900 trout were artificially stocked into most of the high lakes of the watershed. Resource specialists and managers are concerned that these fish will escape from the stocked lakes, enter the tributaries and eventually replace the resident species. Class I, II and Fish Bearing Class III streams in the watershed will be managed to meet the Mount Hood National Forest "Standards and Guidelines" found in Chapter Four, page 59, of the 1990 Land and Resource Management Plan, Mt. Hood National Forest.

CURRENT HUMAN USE/RECREATION

A growing regional population is having an effect on the watershed. Recent demographic studies indicate that the population of Hood River County, the greater Portland Metropolitan Area and the Pacific Northwest is growing, aging and becoming more ethnically diverse. Several factors including increased leisure time, have led to an increase in outdoor recreation nationally. For over 100 years, outdoor recreationists have been attracted to the scenic beauty of the Columbia River Gorge. The close proximity to Portland gives a large population easy access to the watershed. Some areas, particularly Eagle Creek-Wahtum Lake corridor, are beginning to feel the stress of too many visitors. This has resulted in some environmental degradation and loss of solitude.

The national population is changing to a greater proportion of older citizens. Generally, physical abilities decline with age. And as this trend continues, the emphasis in the distribution of recreational facilities will probably be more toward the developed end of the recreational opportunity spectrum. Site seeing, developed camping and nature/historic studies should continue to increase, but dispersed recreation such as hiking may plateau and then decrease. Existing and new developed facilities will carry the brunt of public recreation demands. Most of the developed facilities are located completely or partially in riparian zones in the lower reaches of side tributaries. These facilities will continue to contribute to confining in stream flows, sediment regimes and degradation of riparian vegetation. Human disturbance upslope will be mostly confined to travel corridors such as trails. Activity in these travel corridors should not have a significant effect on the environment, except in areas of high use such as the Eagle Creek Trail. Concentrated recreational use in these corridors may erode soil and degrade riparian vegetation, as well as act as connectivity barriers within the watershed. Asians, Pacific Islanders and Hispanics are expected to be the fastest growing segment of the

population between 1993 and 2020. This demographic change should not have a significant effect on the watershed in terms of recreation, but may dictate future design needs that take into account these particular cultural groups. Because of the unique recreational opportunities and nearness to the Portland Metropolitan area, recreation will continue to be one of the most significant uses of the study area.

AIR AND WATER QUALITY

Slash burning, wood stoves, industrial pollution and automobile exhaust emissions has increased air pollution in the transportation corridor and watershed. Inland from the river, air quality may occasionally be somewhat better seasonally because of fire suppression and the absence of smoke from many small fires. Agricultural burning, burning to clear land and logging debris fires have created air quality problems since the mid 1800s. With the inauguration of Smoke Management Programs (SMP), by Washington and Oregon in the latter part of the 1960s, air pollution problems in the Pacific Northwest were significantly improved. A change implemented as a result of the new SMPs, was the move away from fall burning to more spring and summer burning. The change in burning to a period of better climatic conditions, substantially improved dispersion of smoke pollutants, and has nearly eliminated fall broadcast burn programs.

Instrumented air quality monitoring began recently, with installation of the Wishram station in 1993 and the Cape Horn station in 1996. Data collection at the Wishram station was interrupted for nearly a year when the shelter burned down in 1994. A nearly continuous, five year data set will be available for analysis in 2001. Data analysis and interpretation will indicate initial air quality, as well as preliminary trends. County, state and federal agencies, the Columbia River Gorge Commission, and business and industry will use air quality data to manage their activities to protect and enhance public health, fisheries, plant and animal communities, and scenic resources.

AQUATIC CONSERVATION STRATEGY

The team evaluated how well the Aquatic Conservation Strategy (ACS) Objectives were currently being met and the potential for meeting them in the future. The watershed is divided into three major zones for the purpose of this evaluation. The fist zone includes the Hatfield Wilderness, and the upper portions of the Scenic area. This zone is in a largely natural condition and is mostly National Forest. The second zone is the lower one to two miles of the stream reaches within the National Scenic Area. It is a mix of National Forest, state, county, private, and other federal administrated lands. Major transportation corridors, urban developments, hatcheries, and other improvements exist in this zone. It varies from highly altered to nearly natural conditions. The third zone is the Columbia River and it's immediate environs. This zone is highly altered through influence of the Bonneville Dam and pool, urban and industrial areas, recreation facilities, and other developments.

USDA Forest Service Regional policy, the Wilderness Act, the Scenic Area Management Plan and Late Successional Reserve (LSR) guidelines limits options such as fire, logging etc. LSR regulations protect late seral habitat and allow fire to play a natural role in the Wilderness environment. The Wilderness Policy is very restrictive as to use of fire to achieve objectives of vegetation and wildlife habitat management. While management efforts in the future should

focus on the dams, transportation corridor and riverine system, most options such as moving the freeway, removing the railroad and removing the dams to allow streams to wander about the flood plain and allow anadromous fish easier passage, are impractical. The Aquatic Conservation Strategy (ACS) objectives cannot be achieved in the Columbia transportation corridor, but the Forest Service can meet ACS objectives on federally managed land, except the lower stream reaches of Eagle Creek and Tanner Creek. High lakes also have a potential to meet Aquatic Conservation Strategy objectives. The current condition and potential for meeting the ACS objectives are first summarized in the tables below and then discussed by objective. The Northwest Forest Plan defines the following ACS Objectives:

Table 23. Team Assessment of the Status of ACS Objectives in Watershed

ACS Objective	Hatfield Wilderness Upper Scenic Area	Lower 1-2 miles Stream Reaches	Columbia River Environs
1. Landscape	Meets	Not Meeting	Not Meeting
2. Connectivity	Meets (except east)	Not Meeting	Not Meeting
3. Physical Integrity	Meets	Not Meeting	Not Meeting
4. Water Quality	Meets	Meets	Not Meeting
5. Sediment Regime	Meets	Meets	Not Meeting
6. In-Stream Flows	Meets	Not Meeting	Not Meeting
7. Floodplain	Meets	Not Meeting	Not Meeting
8. Riparian Plants	Meets	Not Meeting	Not Meeting
9. Species Habitat	Meets	Not Meeting	Not Meeting

Table 24. Team Assessment of Future Potential for Meeting ACS Objectives

ACS Objective	Hatfield Wilderness Upper Scenic Area	Lower 1-2 miles Stream Reaches	Columbia River Environs
1. Landscape	High	Very Low	Very Low
2. Connectivity	High, low to East	Some Improvement	Very Low
3. Physical Integrity	High	Some Improvement	Very Low
4. Water Quality	High	High	Some Improvement
5. Sediment Regime	Moderately High	Some Improvement	Very Low
6. In-Stream Flows	Moderately High	Some Improvement	Very Low
7. Floodplain	High	Some Improvement	Very Low
8. Riparian Plants	High	Some Improvement	Some Improvement
9. Species Habitat	High	Some Improvement	Some Improvement

Objective 1: *Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to insure the protection of the aquatic systems to which species populations and communities are uniquely adapted.*

The upper elevations of the watershed are well within the natural range of variability in terms of the distribution, diversity and complexity of the landscape scale features. Although fire has not effected much of the area in the last 90 years, enough was burned early this century to provide bald ridges, and mid seral areas. Adequate late seral patches remain. Disturbance from fire in the Wilderness, and fire and other management in the Scenic Area will be needed to provide early seral and other habitat in the future. The watershed could meet this objective for the next hundred years without significant disturbance from fire.

The lower stream reaches and the Columbia environs are heavily altered by the dam, transportation corridors, and other developments. The lower stream reaches and the Columbia will not meet the objectives in the foreseeable future, due to the presence of the dam, transportation corridors, and other improvements.

Objective 2: *Maintain and restore the spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.*

Fair connectivity is provided to the south and west of the study area, from the Wilderness, and upper Scenic Area. To the east, connectivity is hampered by Hood River Valley urban areas and agriculture. Connectivity should improve through time to the South and West as the Northwest Forest Plan takes effect and no harvest occurs in the Bull Run (if no large scale fires occur). Connectivity to the east may improve if a corridor is provided through cooperative efforts of county and private land managers in the Middle Mountain Area. Another corridor is proposed across the lower slopes of Mount Hood on National Forest Land. Terrestrial connectivity to the north is cut off by the Bonneville Pool, and is not likely to change in the near future. Avian connectivity is still fair, and can be maintained or improved in the future through cooperative management.

Connectivity in the lower stream reaches is blocked by culverts, bridges, channel restrictions, and the absence of fluctuating Columbia flows. Migration in the Columbia is blocked for sturgeon, and hampered for other aquatic species. The situation on the Columbia will change little in the foreseeable future. The lower stream reaches could be improved by improving passage, habitat, etc.

Objective 3: *Maintain and restore the physical integrity of the aquatic system, including shorelines, banks and bottom configurations.*

Upper stream elevations are in a natural condition, and are likely to remain so over time. The upper elevations could be improved by moving recreation activities back from lake and stream shores.

Lower stream elevations, and the Columbia are highly altered. Banks, shorelines, and bottoms are outside the range of natural conditions and likely to remain so. The lower stream reaches could be improved by adding shade and vertical structure with vegetation, and adding multiple channels. Existing transportation facilities severely restrict opportunities.

Objective 4: *Maintain and restore water quality necessary to support healthy riparian, aquatic and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival growth, reproduction and migration of individuals composing aquatic and riparian communities.*

Water in the upper elevations and lower stream reaches is excellent now, considered to be the best hatchery water in the state. Water quality should remain excellent over time, with minor flows of sediment due to mass wasting.

Water quality in the Columbia River has heavy metals and pesticides above the natural range. Current flows have much more standing water due to the dams. Water temperature may be higher in shallows and on the surface. The situation in the Columbia may improve slightly over time if pesticides and heavy metals are regulated.

Objective 5: *Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate and character of sediment input, storage and transport.*

Sediment regime is normal everywhere except the Columbia River. To remain in the range of natural conditions, disturbance must occur in the upper reaches to initiate mass wasting. No large scale mass wasting is likely to occur as a "planned" event, but smaller scale events as a result of natural or management ignition fire could occur. Moving campsites and other recreation activities back from lakes and streams in the watershed will help reduce chronic sediment input.

Sediment flows in the Columbia have been stopped by the dam system, and will likely not change in the near future.

Objective 6: *Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic and wetland habitats and to retain patterns of sediment, nutrient and wood routing. The timing, magnitude, duration and spatial distribution of peak, high and low flows must be protected.*

In-stream flows are meeting the objective in the upper elevations, but disturbance must be an active player to maintain natural conditions in the future. Flows in the lower stream elevations have been highly altered by diversions, channelization, culverts, and cleaning to maintain improvements. Some improvement could be achieved through cooperative efforts with ODOT, the hatcheries, and other land managers to allow for more bedload and large wood transport. The Columbia Dam system has altered the entire transport regime, and reduced the fluctuations of flows as well as altered timing. No change is anticipated for the Columbia System in the near future, other than flow timing, duration, and magnitude of the reservoir system. Some improvement could be realized from this possibility.

Objective 7: *Maintain and restore the timing, variability and duration of floodplain inundation and water table elevation in meadows and wetlands.*

The upper elevations meet the objectives, and are likely to over time. The lower stream reaches were channelized to eliminate frequent flooding. Some improvement could be realized by moving developments out of the flood plain and reducing the channelization. The floodplain of the Columbia has been eliminated by the dam. There will likely be little change to the situation on the Columbia.

Objective 8: *Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion and channel migration, and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.*

Upper reaches are meeting the objectives for plant communities. Over time they could be improved by reducing the impacts of recreation activities on riparian vegetation. Lower stream reaches currently have the wood removed to protect improvements, and have highly altered riparian plant communities. Most riparian vegetation along the Columbia has been eliminated. There can be some improvement in the future in the lower reaches and the Columbia by planting and protecting riparian areas, and working with other land managers to place, recruit, and retain large wood.

Objective 9: *Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.*

Habitat in the upper reaches currently meets the objective. Beaver introduction into streams where they are absent might increase wetlands and better reflect historic levels.

The lower reaches currently lack pools, side channels, and large wood. As previously discussed there could be some improvement here. The Columbia River is highly altered. One riparian dependent species that may have been eliminated due to alteration of this habitat is the Yellow Billed Cuckoo.

REVIEW OF INTERIM WIDTHS FOR RIPARIAN RESERVES

Riparian reserves, defined in detail in the Northwest Forest Plan, are one component of a four-pronged agency ACS action framework. The ACS was developed to "restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands", (Northwest Forest Plan, 1994: B-9). Riparian reserves are those lands along streams and other water bodies (including wetlands) where special standards and guidelines direct land use. The purpose of riparian reserves is to enable the Forest Service to manage "riparian-dependent resources to maintain the existing condition or implement actions to restore conditions", (Northwest Forest Plan, 1994: B-10). Basically, riparian reserves are intended as a barrier zone to development and extractive uses near waterways. The standards and guidelines prescribed for these reserves prohibit or regulate activities that retard or prevent attainment of ACS objectives. Within the ACS are defined interim widths for determining riparian reserve areas in the field; however, as part of watershed analysis, the ACS stipulates that adjustments to these interim widths may be recommended. Final consideration to act on implementing a newly recommended width would come during site-specific project planning. In deliberating about adjustments to reserve widths, the ACS cautions that "[w]atershed analysis should take into account all species that were intended to be benefited by the prescribed Riparian Reserve widths", (Northwest Forest Plan, 1992: B-13). Furthermore, adjustments to interim widths are seen as more likely to be considered for intermittent streams rather than permanently-flowing streams.

For the Columbia Tributaries East area, two aspects of the watershed itself are important in considering whether an adjustment to reserve widths is to be recommended. The first aspect evaluated was the designation of land uses within the analysis area since land use allocations are sometimes more restrictive than riparian reserve standards. About 60 percent of total watershed area is designated Mark O. Hatfield Wilderness. Most of the watershed's headwater streams are included inside this Wilderness boundary or are within the Bull Run Watershed. As a consequence, no extractive management (logging, mining, grazing) is foreseen or

appropriate along riparian areas in the Wilderness or Bull Run. In another 28% of the watershed, many extractive uses are highly regulated by land use designations promulgated under the Columbia River Gorge National Scenic Area Act. The second aspect of the watershed that bears on consideration of riparian reserve width is the physical character of stream segments where extractive activities might be permitted to take place. Those intermittent (headwater) streams not fully inside Wilderness or the Bull Run are typically inaccessible to most human activities, other than back-country recreation, by precipitous, impassable terrain. As it happens, nearly all water bodies away from steeply pitched gorges (and outside of protected National Scenic Area land allocations) are perennial streams which are significant for their fish-bearing potential, domestic water diversion or both uses.

Most of the lower reaches of these permanently-flowing named streams have already been changed for human benefit. Human alterations to in-stream flows and channel morphologies of near-Columbia creeks have degraded natural processes and functions of the stream environment (described elsewhere in this report). On public lands, therefore, restoration would be the primary objective of future riparian zone activities. Considering the aspects discussed above, watershed analysis team members see no compelling evidence for changing riparian reserve widths from the interim standards. Greater widths do not appear necessary as the interim widths were designed by scientists to meet ACS objectives and "to provide a high level of fish habitat and riparian protection...", (Northwest Forest Plan, 1994: B-13). The stream reaches where future human activities are likely to occur are perennial and significant for several human benefits; therefore, they are deserving of the substantial protection provided by the current (interim) standards. On the other hand, few intermittent streams are in locations or land use allocations where human influences would much affect riparian structure, processes and function; so, there seems little need to recommend any adjustment of riparian widths there. The team also found no evidence to suggest making the riparian widths narrower than current standards, given Northwest Forest Plan ACS objectives. As described elsewhere in this watershed analysis, the diversity of the landscape itself and the variety of plants, animals and habitats that occur make maintenance or restoration of hydrologic, geomorphic and ecological processes in riparian areas a priority for action.

In summary, the three major changes that have impacted the watershed since the Reference Period has been the development of the Columbia River Gorge as a major transportation route, the suppression of the natural wildfire regime and the damming of the Columbia River. This analysis has observed the following trends: the region is becoming more populated; outdoor recreation, particularly day hiking, is increasing; anadramous fish species are headed toward extinction; and noxious weeds are spreading and beginning to crowd out native plant species that are dependent on openings. Processes related to vegetation disturbance, such as fire or its equivalent, need to be reestablished. Major human developments have influenced some aspects of the ecological functioning of the Gorge. The existing forest landscape, while not much changed at present, may be headed for more structural and compositional alteration in the years ahead. Continued interruption of disturbances such as wildfire would be a major factor in changing the character. One positive note is that the water quality in the downstream creeks is getting better.

VI. RECOMMENDATIONS

VEGETATION

Desired Future Condition

The management goal is a watershed that eventually mimics the healthy ecological conditions present during the Reference Period (100 AD to 1650 AD). The Desired Future Condition (DFC) would include the following conditions: older stands (up to 600 years) along riparian zones and other moist areas; Douglas-fir stands with low fire and ladder fuels on the face of the Gorge; and riparian hardwood communities that dominate the Columbia River. About 50% to 60% of the total area should be in 'old growth' stands over 200 years in age. The remaining 20% to 50% should consist of bare ridges and younger stands. Natural actors such as fires, insects and other diseases will create these conditions in the wilderness, whereas, fires and/or silvicultural treatments may be used in the CRGNSA. Existing CRGNSA forest practices guidelines should be examined to integrate long-term ecosystem health.

The current Forest Service Scenery Management System does not speak to large-scale ecological disturbances such as fire. Therefore, there may be some professional debate whether the defined DFC is consistent with present scenic resource guidelines.

Recommendations

Wilderness and Special Management Area

- Limit stand replacement fires to 25% of any major drainage.
- Limit the acres of stand replacement fires in 350+year late serial forest to range of reference condition (further evaluation needed).
- Limit the acres of stand replacing fires in riparian reserves to reduce instance of mass wasting and debris flows (and subsequent downstream effects on water quality, hatcheries, transportation facilities, and other structures), and to preserve long term species refugia.
- Increase incidence of low intensity fires (these were more prevalent in reference period and usually took place outside of the true fir zone).
- Reduce fuels in areas of high recreation use and on the Wilderness boundary.
- Address noxious weeds in fire rehabilitation and prescribed burn plans.
- Prevent the spread of noxious weeds into the planning area.

Wilderness only:

- Allow natural fire processes take place, as much as possible.

Maintain present ridge tops and meadow openings (where encroachment is happening) for sensitive plant habitat and animals, and allow fire to create new openings.

Special Management Area only:

- Review CRGNSA forest practices guidelines to integrate the recommended DFC and long-term ecosystem health at the landscape scale.

- Use silvicultural treatments and fire to hasten stand evolution toward 50% to 60% 'old growth', particularly in riparian areas, and to maintain a diversity of stand ages and openings to mimic the reference condition.

- Reduce fire fuels through a regular treatment program (fire and other), to reduce occurrence of catastrophic wildfire, and to mimic the presumed conditions of the Reference Period.

- Focus on fine fuels reduction, treatment of high risk areas, lands adjoining private lands, lands adjoining Wilderness, hotter and drier south aspects, areas that have high fire occurrence, steeper headwalls that are more prone to mass wasting and riparian reserves.

- Incorporate the long term role of fire or silviculture when developing the Late Successional Reserve (LSR) assessment.

Restoration Projects

1. Prepare Wilderness prescribed natural fire management plan.

2. Prepare Special Management Area fire management plan (preferably concurrently with an LSR assessment).

STREAMS AND LAKES

Desired Future Condition

The Desired Future Condition is described separately for the lakes and upper stream reaches, lower stream reaches, and Columbia River. The overall objective is to reduce effects of human use on riparian vegetation and to restore to a healthy condition.

Lakes and Upper stream reaches (resident fish habitat)
Maintain the condition of the lakes and upper stream reaches.

Lower stream reaches (anadromous portions of streams)
Recognizing stream restoration must be within the framework of existing transportation and other facilities, and must be compatible with their viability, the desired future condition is improved fish passage, improved stream flow, improved riparian habitat functioning, improved in stream habitat diversity (large woody debris, pools, etc.), and improved floodplain functioning.

Columbia River
Recognizing the existing dam situation, the desired future condition is a healthy hardwood riparian community. A healthy riparian community would improve habitat for riparian

dependent species, and enhance both east-west connectivity along the Columbia River, and north-south connectivity across the river.

Recommendations

- Preserve hardwood riparian habitat on all ownerships.
- Work with Oregon state to provide passage around human-made barriers up to the waterfalls on Herman, Tanner and Eagle creeks.
- Work with Oregon state to examine water diversions on Eagle, Tanner and Herman creeks and their effect on the summer fish run.
- Widen flow channels by constructing more culverts (bottomless, larger), more bridges and overflow channels.
- Reduce sedimentation from road that accesses Tanner Butte by closing the road and constructing a new connector trail to Eagle Creek Trailhead or new ODOT Trailhead.
- As opportunities arise, work with other agencies and landowners to eliminate or reduce flow restrictions at stream mouths.
- Support other agencies to re-introduce flushing flows to carry sediment and vary water level.
- Add large wood to anadromous portions of all streams where they are currently below standards. Facilitate an interagency effort where necessary.
- Increase the number of ponds in the lowlands like those existing near I-84 and the railroad.
- Increase the amount of pool habitat in the anadromous streams where it is below standards.
- Create riparian hardwood habitat by placing dredging spoils along shoreline (mimic existing conditions at MP 29 of I-84, or the system below the Columbia Gorge Hotel).

Restoration Projects

1. Recreate hardwood riparian habitat wherever possible i.e., Bridge of the Gods, along railroad tracks, Viento, Starvation Creek, Wyeth, and Point of Cascade Locks (use dredging spoils where possible). Facilitate an interagency effort where necessary.
2. Negotiate with Oregon State to open 1.6 miles of habitat passage on Tanner Creek by removing electro-shocker and diversion barriers.
3. Add large wood to anadromous portions of streams to provide more fish cover and pool habitat for juvenile rearing on both federal and non-federal lands.
4. Consider closing Tanner Butte Road and construct a connector trail to Eagle Creek Trailhead or new ODOT Trailhead.

FLORA AND FAUNA

Desired Future Condition

Maintain a noxious weed free habitat for naturally occurring species by remaining within the Vegetation Desired Future Condition. Maintain or enhance demographic and genetic exchanges both east/west, and north/south across the Columbia River.

Recommendations

- Work cooperatively with Washington's Gifford Pinchot National Forest to insure long-term maintenance of diverse upland forest communities near the Columbia River, to facilitate avian connectivity across the river.

- Encourage retention of a forested connection across county and private lands located in the Hood River Valley at Middle Mountain, for genetic and demographic interchange of wildlife.

- Focus noxious weed prevention and eradication efforts on burn areas and new invaders such as Japanese Knotweed.

- Require that any heavy equipment and fill used on projects be weed free; i.e., pick-ups, trailers, bulldozers, dirt fill, tools, and trail equipment.

- Ensure the proper ecosystems studies are completed, if a state or federal wildlife agency proposes mountain goat reintroduction. Evidence of previous occupation is not conclusive. In addition, introduction of mountain goats to this area must be approached with caution, because of the potential for these introduced animals to further damage the environment by removing the lichen from the substrate of rocky areas.

- Consider reintroducing beaver into upper reaches of Tanner and Eagle creeks because the areas may be lacking historic wetlands (beaver are presently in Herman Creek).

- Reduce road kill by improving passages for small and medium sized animals across I-84 (i.e., larger culverts, fencing).

Restoration Projects

1. Eliminate noxious weeds along travel corridors that enter the Wilderness (weed free, grooming for horses).

2. Eliminate noxious weeds from north side Trailheads.

3. Eliminate all noxious weed populations in the study area.

4. Provide barrier fencing and under-highway passage for mammals and other animals to reduce road kill.

5. Coordinate efforts with State Fish and Wildlife for the reintroduction of beaver into Tanner and Eagle creeks.

AIR AND WATER QUALITY

Desired Future Condition (Water Quality)
High water quality on streams in the long term, recognizing short, recurrent periods of high sedimentation from large storm events, mass wasting and fire.

Desired Future Condition (Air Quality)
Maintain current air quality in Wilderness and CRGNSA, recognizing short, recurrent periods of smoke from fires. (Note: most air quality problems are generated outside of the watershed)

RECREATION

Desired Future Condition
Human encounters are within the prescribed Wilderness use standard. Recreation use levels are within the National Scenic Area Recreation Intensity Class limits. The more developed recreation opportunities are located on lands in the lower reaches managed by Oregon State Park, Oregon Department of Transportation, private landowners and National Forest lands at Wyeth Bench.

Recommendations

- Do not expand Eagle Trailhead parking, and sign to prevent parking along the road.
- Keep the developed site at Eagle Creek, including the campground trail, at 250 visitors maximum (RIC IV). Above the campground, activity stays at low to moderate use (RIC I).
- Use existing and collected information to route people to other trails, and develop trails in other areas.
- Consider connecting Tanner Butte and Tanner Creek trails to Eagle Creek Trailhead with a new trail.
- Oregon State Parks, ODOT and private landowners supply the more developed recreation experiences in the lower reaches, i.e., parking lots, bicycle and handicapped trails, Historic Columbia River Highway reconnection projects, road access, RV camping, Columbia River access, interpretive program for riparian impacts, etc. and complete sections of 400 Trail in the Shellrock area.
- Consider not rebuilding Eagle Creek Trailhead and road if washed out by future flooding.

Restoration Projects

1. Develop one good side trail at a safe location to Punch Bowl Falls and close the remaining unsafe trails.
2. Implement regulatory permit system on Eagle Creek Trail in the Wilderness.
3. Reduce the number of campsites and their size, as well as increase setbacks at Wahtum, Rainy and North lakes.

4. Consider constructing a new trail tying Tanner Butte and Tanner Creek trails to Eagle Creek Trailhead or new ODOT Trailhead.

5. Consider removal or relocation of the Wahclella Falls Trailhead. Consider moving parking to the new ODOT lot. Consider moving the present fish intake access road at Tanner Creek to the east edge of flood plain.

6. Prevent off highway vehicles (OHV) use at Wyeth Bench through road closures and signing.

7. Prevent Wyeth Bench shooting and dumping.

8. Install more toilets along route at back country camps along Eagle Creek trail (possibly a pumper station).

9. Consider changing the overlook and picnic shelter uses at Eagle Creek.

10. Complete site specific Wyeth Bench plan.

11. Develop Wyeth Bench horse trail facilities and tie trail to Herman Creek to fill recreation gap.

12. Consider changing Wyeth Bench gate at campground to allow trail access.

13. Preserve option for construction of a Wyeth Bench Environmental Education Center.

14. Initiate a designated campsite program in the Wilderness.

Proposed Recreation Developments in the CRGNSA Management Plan
Since the watershed analysis also serves as the CRGNSA Open Space Plan, this section is included to address proposed developments in the CRGNSA Management Plan. Open Space plans typically address whether proposed developments in the Recreation Development Plan should remain in that document as projects under consideration. The following projects were analyzed and all were recommended to remain in the Recreation Development Plan.

No. 36 Historic Columbia River Highway (HCRH)
- Reconstruction and reconnection of abandoned portions of the HCRH.

No. 37 Viento Waterfront
- Beach access and day use facilities.

No. 38 Wyeth Waterfront
- River access and day use facilities.

No. 39 Wyeth Campground Expansion
- Expansion of Wyeth Campground to up to 350 people at one time (paot) and provision of a direct link with the Wyeth waterfront.

No. 40 Eagle Creek Historic Recreation District

- Continued rehabilitation of the campground, bridge and day use areas. Work completed in 1992 and 1993 did not meet the full intent of the original proposal.

No. T19 Viento to Mitchell Point Trail

- Five trail miles connecting Viento State Park to the Mitchell Point Trail (Wygant).

No. T20 Wyeth to Starvation Creek Trail

- Six new trail miles connecting Wyeth Campground/Trailhead to Starvation Creek.

No. T22 Eagle Creek to Bridge of the Gods Trail

- One and one-half new trail miles paralleling the Columbia River shoreline to link Cascade Locks and Bonneville Dam.

PRIORITIZED LIST OF RESTORATION PROJECTS

This section consolidates the restoration projects listed in the Recommendations section, and prioritizes them into High, Medium and Low categories. Listing order within each category confers no hierarchy.

High

1. Prepare Wilderness prescribed natural fire plan.
2. Prepare Special Management Area fire management plan (preferably concurrently with a Late Successional Reserve assessment).
3. Add large wood to anadromous streams to provide fish cover and additional pools for juvenile fish rearing.
4. Eliminate noxious weeds along travel corridors that enter the Wilderness and identify primary sites that need treatment.
5. Eliminate noxious weeds from north side trailheads.
6. Develop one good side trail at a safe location to Punch Bowl Falls and close the remaining unsafe trails.
7. Reduce the number of campsites and increase setbacks at Wahtum, Rainy and North lakes.
8. Consider removal or relocation of the Wahclella Falls trail head. Consider moving parking to the new ODOT lot. Consider moving the present fish intake access road at Tanner Creek to the east edge of flood plain.
9. Prevent Wyeth Bench OHV use through road closures and signing.
10. Prevent Wyeth Bench shooting and dumping.

11. Close Tanner Butte Road and build connector trail to Eagle Creek Trailhead or the new ODOT Trailhead, from the Tanner Butte and Tanner Creek trails.

Medium

1. Recreate hardwood riparian habitat wherever possible i.e., Bridge of the Gods, west along railroad tracks, Viento, Starvation Creek, Wyeth, and Point of Cascade Locks (use dredging spoils where possible).

2. Install more toilets along route at back country camps along Eagle Creek trail (possibly a pumper station).

3. Complete site specific Wyeth Bench plan.

4. Develop Wyeth Bench horse trail facilities; tie trail to Herman Creek to fill recreation gap.

5. Change Wyeth Bench gate at campground to allow trail access.

6. *Initiate a designated campsite program in the Wilderness.*

Low

1. Preserve option for construction of a Wyeth Bench Environmental Education Center.

DATA GAPS

- Vegetation layer ISAT is not accurate (develop accurate vegetation layer for Wilderness and Scenic area)

- What is the current genetic condition for trout and anadromous fish populations?

- How do fish impact and alter other species in high lakes?

- Air quality data

FURTHER RESEARCH

- Extent of logging in the area

- Former existence of mountain goats on the south side of the Columbia River

- Access the effects of acid rain

- Application of the Scenery Management System to large-scale ecological disturbance.

- Compare fish in high lakes to non-fish lakes in Bull Run to note any difference in zoophyte, protozoa, and amphibians (trophic structure).

- Look at feasibility of closing and restoring Tanner Butte Road. (an alternative trail access up Tanner Creek past Wahclella Falls or a connector trail to Eagle Creek Trailhead may be possible).

- Monitor transparency at Wahtum Lake and nutrients at Warren Lake.

- Inventory acres of 'special habitat' along with vegetation.

- Study effects of fire on Bull Run LSR (access in LSR plan, Hatfield Wilderness fire plan, and CRGNSA fire plan)

- Investigate the occurrence of wolverines in the watershed.

- Monitor air quality in the CRGNSA and Hatfield Wilderness, as well as lichen populations.

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Appendices

APPENDIX 1. GEOLOGY

For at least the last 20 to 15 million years, the Columbia River has routed flows westerly through the Cascades Mountain Range to a retreating saltwater sea. During this time the Columbia River channel has migrated northward to its present location from an area just north of where Mount Jefferson now stands. Great basalt floods, originating from fissure volcanoes in the earth's crust within central and eastern Washington and Oregon, repeatedly covered more than 50,000 square miles of the Pacific Northwest. These fissures extruded large volumes of fluid molten material, flowing at speeds up to 30 miles per hour, with individual flows ranging from 50 to 400 feet deep. Lava flows or floods, that averaged about 3,000 ft in thickness, eventually covered the area. Now known as the Columbia River Basalts, they flowed westward to the sea down the broad ancestral Columbia River Valley. This river valley was repeatedly displaced to the north edge of the basalt flows. By 14 MYA the Columbia River lay just south of its present day location. Most of the lavas from the Columbia River Basalts form the great black cliffs in the present Gorge.

Following these basaltic flows, the High Cascades begin to fold up into a great arch, with the rising mountain barrier causing a dryer climate east of the Cascades and shallow basins on both sides of the crest. There was a relative quiet period in the Gorge region for about a million years after the last of the Columbia River Basalt flows. This period was dominated by deep weathering, erosional, and depositional processes in the Columbia River Valley. The ancient river valley and basins on either side of the Cascades filled with up to 1,000 feet of coarse gravels and sands transported by the river. These deposits, in and around the Gorge area, are now known as the Troutdale formation or Satsop Gravels. They sit on top of the older Columbia River basalts and are more erodable than the adjacent lavas. This layer is exposed along the present day Gorge cliffs and may be a causative factor in maintaining an oversteepened face in these areas.

Around four to two million years ago (MYA), lava and mudflows from the High Cascades began to fill the ancient Columbia River channel. South of the river, dozens of small volcanoes in the nearby Cascades, built up large shields of gray basaltic lava and finally diverted the Columbia River northward to its present location. These volcanoes include a number of the present day peaks within and adjacent to the analysis area; Larch, Talapus, Tanner, Chinidere, Green Point, Defiance, etc. These volcanoes extruded lava that was deposited above the Troutdale Formation and are currently known as the Boring or Cascade lavas. These lava flows comprise the exposed surface layers of most of the analysis area today. Uplifting of the Cascades and the Troutdale Formation, the depositional layer of the old Columbia River valley, occurred again, while the adjacent basins continued downfolding. This latest rise of the Cascade arch completed the climatic division of the Pacific Northwest into a western moist, and an eastern dry section, controlled by an almost continuous mile high north to south crest of the Cascades.

Nearly two MYA, the cooling of the climate accelerated ushering in the Ice Age. This Period had more to do with the shaping of the present day Columbia River Gorge than all the past events occurring during the preceding tens of millions of years. From about 2 million to 12,000 years ago, great ice sheets covered up to a third of the earth's present land area. The amount of water stored in these ice sheets was sufficient to lower the sea level by at least 300 feet. This steepened the gradient of the Lower Columbia River through the Gorge, and

resulted in a speeded up the rate of flows through the Gorge and greatly increased the erosive power of the river, with the Gorge cutting deep below the present day sea level. There were at least four major advances and retreats of these ice sheets during the 2 million years of the Ice Age. In addition to these vast ice sheets covering the northern part of the Columbia River basin, hundreds of smaller mountain glaciers accumulated on the slopes of the higher peaks of the Cascades.

On at least 20 of these mountain peaks, above 4,000 feet, glaciers formed immediately south of the Columbia River Gorge. These glaciers carved small cirques on the cooler north and east sides of these peaks, now occupied by glacial formed lakes. Glaciers formed on the northern side of Larch Mountain., Palmer Mountain, Mount Talapus, Chinidere Mountain and Tanner Butte etc. It has been estimated that there were at least five glaciers around Mount Defiance and on Green Point Mountain. These smaller glaciers remained above the 3,200 foot level. Repeated advancing and retreating of these glaciers carved the main Columbia River valley as well as tributary valleys whose headwaters were above this elevation. The larger Columbia River tributaries in the area; Eagle, Tanner, and Herman creeks were all carved by the erosive powers of these smaller mountain glaciers, with headwater areas formed by glaciation.

Towards the end of the Ice Age, around 15,000 to 12,000 years ago, a series of at least 40 cataclysmic floods scoured the Columbia River Gorge. During the later Ice Age, a large glacial lake was created in the current day Missoula, Montana area. Huge 2,000 ft high ice dams formed this 3,000 square mile lake. Water built up behind and eventually undermined these ice dams. The unimpeded water swept away ice and debris within a span of less than two days. This series of massive floods resulting from the repeated formation and destruction of these ice jams are often referred to as the Spokane, Missoula, or the Bretz Floods named after Professor J. H. Bretz who first described these floods. Elevation of these floodwaters ranged from about 1,000 feet in the eastside of the Gorge and dropping to about 600 ft on the westside. These floods carved out the existing walls of the Columbia River Gorge and left behind a series of hanging valleys, by cutting away the lower portions of Gorge tributaries. This resulted in a series of waterfalls on these tributary streams, located around the 400 ft in elevation. Flows eroded most of the soils on the Gorge walls up to the crest of these flood waters (1,000 ft to 600 ft). In addition, these massive floods undercut the toe of many unstable slopes within the Gorge (Allen 1973; Bretz et al. 1956). These large unstable slump areas still exist near Bonneville, Ruckle Ridge, and the Fountain slide at Wyeth Bench.

APPENDIX 2: CULTURAL HISTORY

PREHISTORIC

Occasional surface finds of early artifacts indicate the presence of Native Americans on the Columbia Plateau at least by 12,000 years before present (BP). This low density population known as Paleoindians subsisted largely by hunting North American megafauna. Having little control over the environment these nomadic hunters remained flexible and extremely mobile. As glaciers receded the climate warmed, and the growing season became longer and plants more diversified. Regions became both forested and open grassland. This vegetation supported many of the same species found in the area today. Around 10,000 BP, the Native American's original subsistence pattern evolved into a less specialized hunting and gathering lifeway called broad spectrum foraging. Because the same campsites were not necessarily used from season to season, food storage was still impractical. On the Columbia Plateau, subsistence patterns became more concentrated as people focused on resources found in riverine settings (Draper 1992:2.9; Lehman Turck 1996:2.2).

A severe climatic warming trend began about 8,500 years ago. Called the Hypsthermal or Altithermal, the event ushered in the Archaic Cultural Period. Forests receded creating more open park land conditions. This environmental change and human predation caused megafauna such as camel, mammoth, and giant bison to become extinct. Hunters now began to stalk deer and elk into the expanding grasslands, as well as taking smaller game. Much harsher environmental conditions occurred between 5,500 BP and 3,000 BP, and very likely caused a major shift in subsistence activity. Some archaeologists believe the region could not support additional people, and the landscape had reached its carrying capacity. The preceding nomadic and unspecialized hunting and gathering lifestyle gave way to a more semi-sedentary foraging and collecting strategy. In some areas, people relied heavily on salmon and other riverine resources, in others, plant resources, and s till in others, combinations. These subsistence patterns resulted in more permanent pit house residences probably starting to appear around 3,500 to 3,000 years ago. The climate changed once again becoming cooler and more moist. Plants and animals reoccupied areas abandoned during earlier periods of severe draught. These improved environmental conditions apparently led to an expansion of the human population between 2,500 BP and 500 BP. Semi-permanent settlements became larger and more numerous, with a concomitant expansion in cultural complexity, technology, and trade networks (Beckham et al. 1988:76; Draper 1992:2.9; Lehman Turck 1996:2.3-2.4).

PROTOHISTORIC PERIOD (just before European contact)

The effects of European expansion in North America were experienced by Columbia River Indians long before actual contact. Horses were acquired and Euro-American material goods filtered into the region. European diseases also preceded the first explorers and devastated aboriginal populations (French et al. 1995:46). Indeed the Hood River and Cascade Chinookan Indians living along the banks of the Columbia River (within the study area), at the time of historic contact, may have been recent immigrants. Rick Minor and Linda Walker (1993) propose that a major population shift took place in the late prehistoric. Chinookans, living in the Portland Basin, expanded to the east into the Gorge after epidemics drastically reduced the numbers of existing peoples. The previously mentioned Bonneville Landslide, which occurred

around 1,100 AD, also must have taken its toll on the resident human, animal, and plant populations, as well as making the area uninhabitable for a protracted period.

The Tenino or Warm Springs also occupied portions of the watershed, however, this report will concentrate on the river Indians. The Chinook Indians established their semi-permanent villages in strategically favorable areas along the banks of the Columbia River, where they subsisted primarily by fishing and root-and-berry gathering. They moved in annual seasonal rounds from resource to resource. The Chinookans also maintained a complex system of trade and interconnections with other regions. Their three main riverine subsistence resources were eulachon, salmon, and white sturgeon. From semipermanent villages, they moved to prime fishing locations during the spring and fall runs. Interior Indians also moved to the Columbia River during times of peak salmon migrations, and temporarily increased populations along the banks of the river. Salmon fishing places, which varied seasonally, usually, were controlled by specific groups. They processed the fish by smoking or pounding the flesh into small pieces, and then drying them in the sun and the wind. After drying, salmon were packed into bundles that would keep for up to three years. In 1805, on their trip through the Long Narrows of The Dalles, Lewis and Clark estimated seeing 10,000 pounds of fish contained in stacks of these bundles (Moulton 1988:335). During fishing season, these resourceful peoples subsisted largely on salmon heads and roe, the remains of the fish processing.

Hunting territories and plant gathering areas were not as well defined. Chinookans hunted large and small game during the fishing off-season and used the animals for food and clothing. Groups also made annual excursions to the high country to gather berries, and used fire to eliminate encroaching vegetation from berry patches. Also, they gathered root crops which locations seemed to have been freely accessible to other groups. Roots provided a major source of food. Early travelers observed females harvesting over 90 pounds of camas apiece, in half a day (Lee and Frost 1844, Wilkes 1851; Boyd and Hadja 1987:310-316; Silverstein 1991:536-538; French et al. 1995). Native American archaeological sites found in the study area include former village sites, probable spirit questing sites located on some of the talus slopes, and lithic scatters.

HISTORIC PERIOD

In 1803, President Thomas Jefferson initiated a major expedition of exploration across North America. He directed captains Meriwether Lewis and William Clark to seek routes of commerce, map the land and establish locations of major landmarks, collect ethnographic information on the Indians, and the record scientific information on geology, botany, and zoology, of western North America. This information was to be recorded in daily journals and field notes. Leading the Corps of Discovery, Lewis and Clark traversed the Columbia Gorge on both their western and eastern journeys of passage. They noticed stumps from drowned forests that resulted from the Bonneville Landslide. And, also volcanic ash and volcaniclastic fragments, or sand, in the Hood River and the Sandy River, which was the result of a minor eruption of Mount Hood in the 1790s (Moulton 1991:118).

They did not see any horses west of the White Salmon River. Clark believed that this area was too thickly forested for horses to travel. At an Indian village on the north side of the river, Lewis and Clark observed the skin of a mountain goat, which the Indians said were found in great abundance on the adjacent mountains. Later they obtained a second mountain goat skin to use as a sail (Moulton 1988:101). There a question if mountain goats ever lived on the south side of the Columbia. In recent ethnographic accounts, Warm Springs Native elders reported that, at some

unspecified time, mountain goats were hunted on the west side of Mount Hood (Reese et al 1991). In this stretch of the Gorge, the expedition observed the following animals or skins of animals: elk, blacktailed deer, wolf, fox, badger, skunk, and bobcat or lynx, northern fur seal, and otter. When the group camped on an island for the night, Captain Clark wrote that, "I slept but very little last night for the noise Kept during the whole of the night by the Swans, Geese, white & Gray Brant Ducks &c . . . they were emensely noumerous, and their noise horid" (Moulton 1989:22-23). The expedition also observed the following birds and waterfowl: California condor, turkey vulture, wood stork, mountain quail, "pheasant", grouse, Sand Hill crane, Canadian geese, ducks, trumpeter swan and whistling swan (Moulton 1988:356-359; Moulton 1991:87-122).

Near Hood River, the Corps of Discovery saw their first Ponderosa Pine, as well as a small Indian village of four houses, on the flat below Ruthton Point. They described the area as a thickly timbered bottom, above and in back of the village. Further downstream the crew obtained rosin to reseal canoes from fir trees that had been recently injured by fire, and had discharged considerable quantities of sap. The Corps recorded the following vegetation: Sitka Spruce, Western white pine, white cedar, Oregon oak, cottonwood, Oregon ash, big leaf maple, sweet willow, broad leaf ash, vine maple, black hawthorn, Oregon crabapple, bitter cherry, gooseberry, honeysuckle, snowberry, hazel nut, Oregon grape, huckleberry, salmonberry, raspberry, seviceberry and thimbleberry (Moulton 1989:15-23; Moulton 1988:352).

Four years after the Lewis and Clark expedition, a land-based fur trade emerged at the mouth of the Columbia River. To access the interior, trading parties had to pass through the Gorge. The Cascades Indians living at the Cascades portage were in a strategic position, on the line of travel between the interior and the coast. Outnumbering intruders, they harassed, leveled tribute, and occasionally plundered fur trading parties that passed through their territory. Traders were especially vulnerable while portaging their goods around the Cascade rapids. In order to traverse the region safely, the fur companies began to use heavily armed fur brigades (Ross 1904; Minor et al. 1986:51-53). Ross Cox led such a party through the Gorge in 1812. He recalled, "The islands in the distance are crowded with great numbers of seals which afforded excellent sport for our marksmen." (Cox 1957:80) . The fur companies also fought among themselves. In order to discourage Americans fur traders from entering the region, the Hudson's Bay Company, under the leadership of governor George Simpson, established a policy of *cordon sanitaire* or "fur desert" for the area south of the Columbia River. The company tried to trap most of the beaver out of this part of Oregon Country, which altered the entire ecology of the region. By contrast, conservation was the rule north of the Columbia River in the British sector. Here the Hudson's Bay Company encouraged Indians to take only winter beaver, and quotas were imposed on the district managers to further protect these animals (Merk 1968:xxiii)

Traders also introduced new waves of epidemics. In the 1830s, smallpox and malaria swept through the Cascade Indian villages, further decimating their ranks (Minor et al. 1986:54-55). Epidemics caused a massive overall reduction in the Indian population of the Columbia River Basin. Because there were fewer Indians, fishing pressure was reduced on the river. Most probably, salmon populations peaked sometime between the 1830s and the 1860s when commercial fishing was introduced. Cannery processing began in the 1860s. Fish wheels were introduced in the 1880s, and outlawed between 1926 and 1934 (Donaldson and Cramer 1971; Cramer 1994). In testimony concerning the effects of Bonneville Dam, Indians said that they originally had fishing sites at the mouths of Herman Creek and Eagle Creek, as well as the upstream and downstream entrances to Cascade Locks (French et al.:1995:8).

Early transportation routes included an Indian trail from Cascade Locks to Lost Lake, through the Herman Creek-Green Point Creek divide. Indians discontinued using this trail to the huckleberry fields, after it was blocked as consequence of "white man's fire" (Langille 1903:43; Surveyors Generals Office Map 1898) . The major transportation route through the Gorge, however, continued to be the Columbia River. Pioneers, who crossed the continent on the Oregon Trail, rafted down the Columbia from The Dalles to the rapids at the Cascades. In 1836 the first steamboat, a side-wheeler called the Beaver, was put into service at Fort Vancouver. By the 1850s, sternwheelers began to replace side-wheelers on the river. The fireboxes, of these boats, required four cords of wood per hour. This voracious appetite for firewood created a profitable industry for the settlers living along the banks of the Columbia. It was the first "cash crop" in this remote area, and a forerunner to the timber industry (McCoy 1995). Some towns emerged initially as fueling stops where woodcutters brought their cordwood to sell to the steamboat captains. Over the entire steamboat era, there was a constant demand for wood, at about $1.00 a cord (Beckham et al. 1988:154-158).

Because of the heavy shade and steep terrain, the pace of settlement initially moved slower on the Oregon of the river, than in Washington. Early immigrants settled around Hood River and The Dalles. In 1862, tracks were laid on the Oregon side of the Cascade portage. Later that year the 'Oregon Pony', the regions first locomotive, went into service at the Cascades. A photograph taken of the Upper Cascades area in 1867 by C. E. Watkins show the area south of the portage was heavily burned over. The city of Cascade Locks owed its development to the building of a 3,000 ft canal and two 500 ft locks as a water passageway around the Upper Cascades. The construction took place between 1878 and 1896, and created first a community of workers, and then operators. The Oregon Railway and Navigation Company (O.R.&N.) built a railroad along the Oregon shoreline in 1882. This linked the communities to Portland as well as points east across the Columbia Plateau, and ultimately the rest of the nation. Development now shifted to the Oregon shoreline. The O.R.&N. went bankrupt in 1887, but was succeeded by the Union Pacific. In 1908 the Great Northern and Northern Pacific laid tracks along the north bank of the Columbia to Vancouver. Because the railroad was completed later, community development was retarded. The smaller size of the present day communities, on the north bank, are witness to this occurrence (Beckham et al 1988:154-158,172).

The proximity of virgin timber to transportation facilities attracted several lumber companies to the Gorge. An 1882 Watkin's photograph shows that timber is being harvested along the shoreline. In a short period, these companies evolved from essentially small operations of oxen and skid roads to large enterprises. Fluming operations were especially attractive, because the steep mountainsides and rugged terrain. The Stanley Smith Lumber Company operated a flume at the Greenpoint Mill in Hood River County. The company also created reservoirs called North, Rainy, and Black lakes, which were used to supplement the flume during low water periods. The log flume was partially destroyed in a fire in 1918. North and Rainy lakes were connected to canals which diverted water into the Gate Creek system (West Fork Hood River). The dams were constructed in 1923 and increased capacity of North Lake from eight to fifteen acres, and Rainy Lake from nine to fifteen acres. Both of these dams are now in disrepair and lake levels have dropped back to pre-dam levels. Timber around both lakes that was killed by the rising water was previously harvested. These dams may now help keep brook trout from migrating downstream into lower tributaries (Special Use Permit 1923; Forest Service Cultural Resource Report 1991; Beckham et al 1988:172; Carr 1983).

Wagon roads also passed through the area. An "Old Wagon Road District" is presently found near the mouth of Lindsey Creek. Segments of the original Columbia River Highway are also present between Troutdale and The Dalles. This highway was built over a ten year period between 1913 and 1922. Samuel C. Lancaster (1864-1941) was the highway engineer, who used European road building styles and applied a variety of technological and engineering responses to the geographic obstacles posed by the Columbia River Gorge. Lancaster's design was also sympathetic to the natural environment. The highway served as a major transportation route and opened the Gorge to further tourism and recreation. In the late 1940s and early 1950s, a more efficient water-grade freeway was built. This highway was upgraded to interstate standards (I-84) in the 1960s. In 1983, the Columbia River Highway was placed on the National Register of Historic Places as a linear historic district (Smith 1983; Connolly 1995). Presently, the Historic Columbia River Highway is in the process of being nominated as a National Historic Landmark.

In 1933 the federal government, under direction of the Army Corps of Engineers, began construction of the Bonneville Dam. When completed the pool flooded shoreline areas along the Columbia. The Bonneville Power Administration began to construct electrical distribution facilities in the Gorge in 1938 (Beckham et al. 1988:172). Also, the aluminum industry, which was attracted to the area by cheap and abundant electricity, caused major air pollution in the Gorge, by introducing fluoride into the atmosphere. Later scrubbers were installed on the smoke stacks.

Early on, the Gorge was recognized for its scenic beauty. Since the late 1800s tourists visited the Gorge by means of steamboat or railroad. In 1915, the Secretary of Agriculture declared the 22 mile strip of the Oregon National Forest, between Warrendale and Viento, the Columbia Gorge Park. Logging and agriculture were not permitted. He declared the park to be a public playground dedicated to the "use and enjoyment of the general public for recreation purposes". This appears to be the first time the Forest Service dedicated an area for purely recreational use. In 1915 the Gorge was finally made accessible to automobiles when the Historic Columbia River Highway was constructed. It also ushered in a new era of recreation use. In the summer of 1916, Eagle Creek Campground became the first "modern" campground in the Forest Service system. Construction on the Eagle Creek trail also started that summer. The trail was built specifically for recreation use (Tour Guide 1923).

APPENDIX 3. SOCIAL ECONOMICS

Due to the similarity in social economic data, the following report has been taken largely from the 1996, *Social and Economic Assessment for the East and Middle Forks of the Hood River Watershed Analysis* by Monica Burke.

Social Economics

Hood River County Landbase

For Hood River County, only 24% (88,320 acres or 138 square miles) of the county landbase is in private ownership. The population of roughly 20,000 people equals a density of 122 people per square mile. This is a much higher population than traditionally found in rural areas and is important in the political complexion of the county--people and issues are more concentrated. Sixty-seven percent of the population lives outside the urban growth boundary in single-family dwellings, and zoning is in place to accommodate another 10,000 people in the valley. The county is surrounded by federal land and federal authority, and 50 square miles of the county landbase is in the CRGNSA. Three population centers exist in the county, Hood River, the Hood River Valley (with the communities of Mount Hood, Parkdale and Odell) and Cascade Locks. The population of Hood River is about 5,000 people, and the combined population of the Mount Hood/Parkdale area is roughly 2,500 people. And the city of Cascade Locks, located in western Hood River County, has a population of roughly 1,000.

Social Assessment

Historical Overview

Prior to Euro-American settlement, the Dog River band of Wasco Indians and Chinookan speaking tribe known as the Cascade Indians lived in the Hood River area. They subsisted by salmon fishing and seasonally migrating into the surrounding mountains harvesting root foods, berries and game. The Indian population, already decimated from introduced disease, faced inevitable change as settlers arrived in the Gorge. The town of Hood River spread along the riverfront, and the settlement of the Upper Hood River Valley began to fill the traditional summer camping sites. Most of the Native people either migrated across the Columbia River or were moved to reservations. The 1910 census listed only 15 Indians living in Hood River County. Today, most of the descendants of the Wasco and Cascade people are enrolled on either the Yakama Reservation and the Confederated Tribes of Warm Springs Reservation. The Warm Springs enrollees have access rights for hunting and gathering on the Mount Hood National Forest, and continue those activities today.

Settlement

Railroads were central to the settlement of the Columbia River Gorge and Hood River Valley. National advertising by the Union Pacific Railroad brought people on scenic excursions to this area. The 1908 Lewis & Clark exposition in Portland drew thousands of people. Tourists came on scenic excursions to the valley, and many bought land. These links between tourism and development continue today.

Early Characterizations

Scenery and natural beauty were prime reasons that people settled here. Agriculture has been prized since the early days. Open land was highly valued because of the amount of work it took to clear and work it. Geographic isolation lends itself to independent natures, and "obstinacy" and "pride" are words used to describe early residents.

Current Population

The current population of Hood River County (1995) is 18,700 with a seasonal fluctuation of about 2,000 agricultural workers. Since 1980, the population of the county has grown slowly, but steadily, with most new residents have settled in the unincorporated areas. The population of the city of Hood River has grown by only 600 in the 15 year period 1980-1995, in contrast to the unincorporated rural areas which grew by 2,000 people during the same period. This population growth is part of a larger, national trend of growth in the West. Between 1960 and 1990, the United States population grew by over 69 million people and much of this growth occurred in the South Census Region and the West Census Region. In each of the last three decades, the West had the greatest rate of change from one census to the next of all the regions in the US.

Age and Gender in Hood River County

The age distribution of the population of Hood River County is directly linked to the size and composition of the current and future labor force. It may also be important in consideration of a variety of other economic and social issues such as demand for recreation, provision of social services, and economic development opportunities. The 1990 census shows an almost equal distribution of males and females in the county, with 27.3% of the population under age 18. Fourteen percent of the population is 65 or older. Seventy four per cent of the population is white, 16.3% is of Hispanic origin; 0.3% is Black; 1.2% is American Indian, Eskimo or Aleut; 1.8% of the population is Asian or Pacific Islander, and 5.95% other races. The survey found that 71.4% of county residents age 25 and older are high school graduates. Of these, 18% have attended at least four years of college. This rate of education is somewhat lower than other counties, perhaps reflecting the lower educational attainment levels of some seasonal agricultural workers.

Recent National Population Trends: 1990 to 1992

Trends continue to show strong population growth in the West and the Northwest in particular. Between the 1990 census and the 1992 (July 1 estimate), Nevada led the nation with an 11.1% increase in population, and Idaho (5.9%), Washington (5.7 percent), Utah (5.1%), and Oregon (4.6 %) all grew at rates well above California's rate of 3.8% and the US rate of 2.6%. The Portland-Vancouver Metro Area grows by more than seventy-five people every day. And during the last four years has had an increase of 110,000 people. The metro region is expected to have about 1,000,000 more people by the year 2040. Hood River County lies on the cusp of Eastern Oregon and Western Oregon. Eastern Oregon also experienced increased growth rates in the late 1980s, which continued into the early 1990s. Eastside growth in Oregon accounted for about 13 percent of Oregon's population gain between 1990 and 1992 as opposed to five percent between 1980 and 1990. Hood River County's population is projected to increase by 3,000 to 4,000 persons every five years, and reach an estimated 36,483 by the year 2040. Population forecasts vary, and although these increases appear high; they are based on the most current estimates available at this time.

Changes In Population

Hood River County's natural rate of increase is 0.76% (1990 census). Births and deaths have long-term effects but slowly-felt impacts in terms of local markets and services. Migration, on the other hand, tends to have immediate and more broadly distributed impacts to the landscape. Because the majority of new residents are/will be in-migrants, migration is an important variable in understanding social and economic change.

Migration in the West - Reasons for Moving

The sport of windsurfing draws participants to Hood River County. The social organization developed around windsurfmg and the developing technology has contributed to economic diversification, and is changing the socio-cultural complexion of the valley. Windsurfers getting housing and jobs (whether seasonal or year-round) add to the mix of values in the community. People are not moving to Hood River County for jobs, but rather for improved quality of life, which could be thought of as a higher level of amenities. For those not drawn by the sport of windsurfing, other recreation and "quality of life" amenities are overwhelmingly cited as the reason for relocation. Most often cited are the natural environment (scenery), abundance of year-round recreation, good drinking water and clean air. Being a tourist destination, the city of Hood River has a higher level of restaurants. micro-breweries. galleries, retail shops etc. than other towns of its size. These businesses contribute to the livability of the area, and its economic fabric. The same things that attract windsurfers and other in-migrants to this area also attract retirees. While retirees are a small but growing segment of the population of the valley now, this potential is important to note in light of some national population trends.

The aging of the "baby boomers" will be one of the most significant demographic changes in the future to affect both metro and non-metro areas in all regions of the country. The Census Bureau projections show the percent of the population over 65 in the Northwest growing from 12% in 1993 to 16 percent in 2020. This represents a gain of over a million people in this age class (as opposed to a gain of 3.5 million in all other age classes combined). Long term projections by the Census Bureau show the percentage of the population that is 65 years and over rising from 12.5% in 1990 to 20.2% by 2030. When and where "baby boomers" decide to retire, how much income they have, and how they choose to spend it will be important to regional and local economies. Long-term projections also indicate for the Northwest and the Interior Basin, an aging population, and a more racially and ethnically diverse population. Between 1993 and 2020, Asians, Pacific Islanders and Hispanics are projected to be the fastest growing groups in the Northwest. By 2020, these groups are likely to make up nearly twice the proportion of the population that they made up in 1993 in the four-state area.

Hispanic Population

Hispanic seasonal workers have become an important part of the agricultural industry since migrant farm workers first came to this area from Mexico, during World War 11. They harvested the fruit while local men were away fighting the war. Not all of the migrant workers continue to be transients. Workers have been offered citizenship several times since the 1940's, and many have settled. About 2,400 workers relocate here seasonally to harvest the fruit and work in the orchards of the Hood River Valley.

Japanese-American Population

The Japanese-American people who live in Hood River county comprise 1.8% of the population (1990 census), but make a much more significant social contribution. They hold an

important chapter in the history of the area, and today are among the community's most esteemed citizens. The city of Hood River has an active sister-city relationship with the town of Tsuruta in Japan. Local Japanese-American people have a specific cultural connection to the Hood River valley, having settled in the upper valley as early as 1908. Harvesting and sharing forest mushrooms is an important tradition in many Japanese-American families. The Matsutake mushrooms are prized, and are often given as gifts between family members.

Native Americans
Lands in the watershed are within the ceded lands of the Confederated Tribes of the Warm Springs. People from the reservation come to these watersheds to harvest huckleberries, wild edibles, medicinal and useful plants.

Values and Beliefs
Fallout From In-Migration
A large influx of new people to the area can produce a "rootless" population, with limited attachments or commitments to the local community. This coupled with increased tendencies toward environmentalism among urban migrants can lead to a radical shift in the values of an area. Hood River County may now be experiencing such a phenomenon. Values of the new residents are likely to be different from those of long-term residents. On the surface, Hood River County may appear to be rural. The majority of the population lives in single-family homes outside the urban growth boundaries, and the economy has strong ties to agriculture. Population density and the diversity of population, however, suggest that this county is neither rural nor urban, but somewhere in between. New residents are bringing more "urban" values. Long-term residents are dealing with global economic change, and shifts in public policy that do not seem to their economic benefit, or challenge "rural" values.

Oregon Values and Beliefs Survey
The 1993 Oregon Business Council survey of values and beliefs in Oregon revealed more commonalties than differences between the core values of urban and rural residents. Given a choice of ten personal values, all surveyed groups identified, "participation in family" as their most important value, followed by "career or job opportunity" and then a concern for the environment". The FEMAT team reviewed a number of surveys that focused specifically on environmental values. These surveys showed the following results:
1) Environmental concern has been increasing in all parts of the world in the past 20 years, including among rural residents of the Pacific Northwest.
2) Urban residents in the Pacific Northwest generally express stronger environmental values and concerns than rural residents, but this is a matter of degree, not of presence or absence of concern.
3) At present, generational differences in environmental values and concerns appear much greater than urban-rural differences; the younger the age, the greater the concern.

Economic Assessment
Economy and Employment
Hood River is not a wealthy county with the 1994 per capita income ($18,061) considerably lower than the national average ($20,700). Likewise the state per capita income level is about 10% below the national average. In Hood River County, the average unemployment rate has remained higher than the state average for the last twenty years. Also the average annual unemployment rate in the county was 9.6 % over the last decade. Due to the seasonal nature of agricultural and recreation-service work, there are major fluctuations in the rates of

unemployment in the county throughout any given year. In 1995 there were 9,840 persons in the peak workforce. On average 820 people are unemployed in the county. For the last 20 years, all job growth has been in the services sector. In the last two years, the retail trade has contributed bigger share of job growth.

Table 25. Unemployment Rate in Hood River County Compared to Oregon

		UNEMPLO	YMENT	PER	CAPITA	INCOME
Year	Hood River	Oregon	Difference	Hood River	Oregon	Difference
1978	11.2	6.0	5.2	7.9	8.2	-0.3
1980	9.4	8.3	1.1	10.1	9.9	0.2
1982	14.8	11.5	3.3	10.2	10.6	-0.4
1984	12.9	9.4	3.5	11.0	12.3	-1.3
1986	13.6	8.5	5.1	11.9	13.5	-1.6
1988	8.6	5.8	2.8	13.7	15.1	-1.4
1990	8.1	5.5	2.6	15.5	17.2	-1.7
1992	10.3	7.5	2.8	16.8	18.7	-1.9
1994	7.7	5.4	2.3			
1995	8.3	5.0				

(Source: Oregon Employment Division, 1996)

The 1990 census shows the county has a 15.7%, poverty rate which translates to 2,610 persons living below and 14,056 persons living above the poverty level. In 1990, 3,061 persons (18%) of the population were considered economically disadvantaged. And by 1995, this number grew to 4,130 persons or 21% of the population. Generally speaking, the county does not mirror national economic trends, going into recessions sooner and coming out later than the rest of the country. Also generally speaking, the gap between the "haves" and the "have-nots" is widening in this county as it is nationally.

The Economy of Tourism and Recreation

Visitor Volume

In 1994, 26.1 million people traveled in Oregon with 1,560,000 people visiting Mount Hood and the Columbia Gorge. The 1994 Oregon Visitor Profile suggests that the Mount Hood/Columbia Gorge region attracts mainly nature-oriented outdoor enthusiasts, with a large majority engaging in outdoor activities. Of all the visitors to the state, 6% are most likely to stay in a campground or an RV park. Statewide, about 14% of visitors stay in campgrounds. In-state visitors (residents) are also more likely to stay in campgrounds. About 1/3 of the visitor volume is from out-of-state, and 2/3 are from in-state. Out-of-state visitors account for half of all spending. Twenty three percent of the out-of-state visitors come from Washington and 22% come from California. International guests make up one tenth of the total number of travelers with 40% of the overseas visitors are from Pacific Rim countries, with Japan sending more visitors than any other country in the world. Hood River may have a higher than average number of Japanese visitors due to the strong cross-cultural ties between some people here and places in Japan.

Although in-state and out-of-state visitors seem to engage in the same kinds of activities, out-of-staters are more likely to participate in more activities than their in-state counterparts. The outdoor experience seems to be one of the strongest tourist attractions in Oregon. Nearly half

of all visitors engage in outdoor activities (47%), especially hiking (23%), wildlife viewing (17%), and visiting natural attractions (26%).

Economic Impacts

The Gorge Region (Hood River and Wasco counties) has shown substantial growth in lodging. In 1992-1993, revenues from transient lodging taxes grew 25.6% to $414,467 following a similar increase of 21.4 percent the previous year. Hood River County received $153,653 in 1992-1993 from lodging tax receipts, and anticipated receipts of $170,000 in 1996. In Hood River County, about half of this money is put into the general fund, and most of the rest goes to promote tourism.

Travel and tourism spending in Oregon totaled over $3.13 billion in 1992, up 5.6% from 1991. Every $1000 spent by visitors in Oregon generated $190 in wage and salary income in 1992. In Hood River County, travelers spent $26,091,000 in 1992, or $1,482 per county resident. This is higher than the state average of $1,052 per capita spending, suggesting a more affluent group of visitors, and a slightly higher level of economic dependence on the visitor industry. This spending generated a payroll of $4,890,000 which directly created 487 jobs in 1992.

In Hood River County, 60% of visitor expenditures went to commercial accommodations. Many of these people come from Portland. They spent about $2 million dollars in the county in 1992, supporting a payroll of $414,000 and forty three jobs. Spending by all travelers in the county increased by 17.6 % from 1991 to 1992.

Generally speaking, a community economy based in tourism is somewhat vulnerable to fluctuations in the outside economy.

Hood River County Visitors

In general the visitors to this area are recreationists, enjoying multi-sport, multi-day stays. The same people who windsurf also mountain bike, climb, hike, ski, and snowboard. They come for the scenery, the unique outdoor experiences. This watershed holds some very popular destinations: Eagle Creek, Wahckekka Falls, Viento State Park etc.

Future Trends In Tourism

The Oregon Tourism Division in its 1995-1997 marketing plan identifies these niche markets for development:

- Agri- and Nature-based Tourism
- Cultural and Heritage Tourism
- Adventure Travel

The Eastern Oregon Visitors Association identifies these niche markets for development in 1995-1998:

- Heritage and History
- Culture
- Eco-tourism and Natural Resources
- Experiential & Participatory

If these represent future trends in tourism this area may hold even greater tourism potential.

Tourism and In-Migration

Tourism and in-migration are related, either because tourists discover areas and move there or because economic opportunities in tourism attract migrants.

Economy Summary

The economy of Hood River County is anchored in tourism (services), agriculture and manufacturing. All three sectors of the economy have significant ties to these watersheds. Water for agriculture, wood for industry and recreation/scenic amenities for tourists are among the most predominant links between the economy and the watersheds. A major transportation corridor physically links people and the forest. Residents value the same forest amenities as tourists, along with good drinking water, valuable Open Space and cultural experiences (berry, mushroom harvest) within the watershed. Maintenance of a high quality environment has become a critical component of this area's economic development. Economic contributions of federal lands in these watersheds go far beyond commodities yielded.

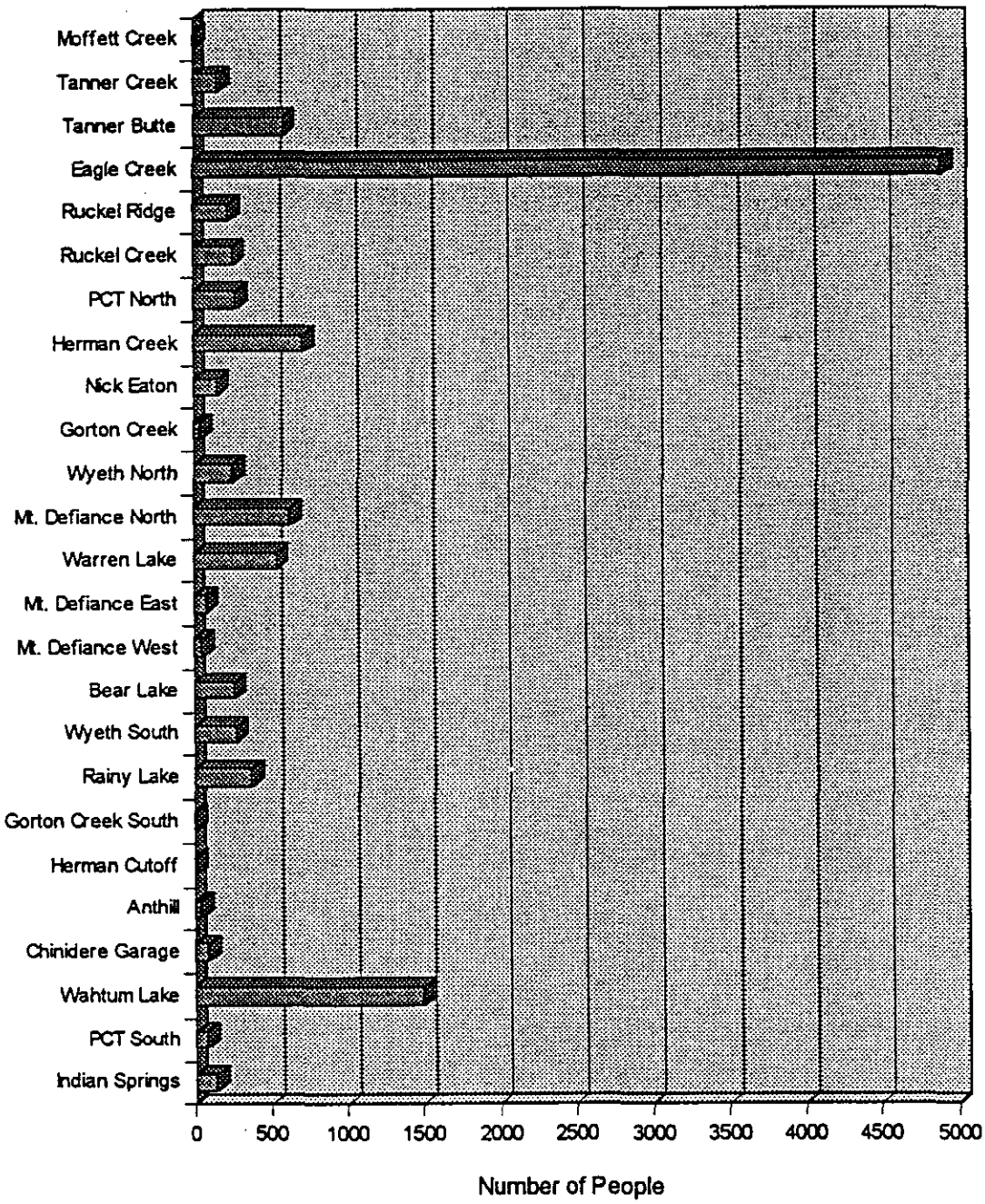
APPENDIX 4. RECREATION

Table 26. Day and Overnight Use by Trailhead in Hatfield Wilderness May 15 to October 15, 1995

		Groups			People			
Trailhead	No.	Day	Over	Total	Day	Over	Total	% Day
Indian Springs	1	34	26	60	56	78	134	41.9
PCT South	2	18	21	39	37	40	77	48.0
Wahtum Lake	3	392	182	574	926	574	1500	61.7
Chimdere Garage	4	27	3	30	73	15	88	82.9
Anthill	5	18	1	19	35	1	36	96.9
Herman Cutoff	6	3	2	5	3	8	11	28.6
Gorton Creek South	7	5	0	5	8	0	8	100.0
Rainy Lake	8	131	21	152	300	71	371	80.8
Wyeth South	9	87	11	98	229	41	270	84.7
Bear Lake	10	79	26	105	185	74	259	71.6
Mt. Defiance West	11	8	1	9	48	2	50	95.5
Mt Defiance East	12	35	0	35	79	0	79	100.0
Warren Lake	13	211	18	229	489	54	543	90.0
Mt. Defiance North	14	276	10	286	608	25	633	96.0
Wyeth North	15	127	17	144	208	45	253	82.3
Gorton Creek	16	21	6	27	29	10	39	73.7
Nick Eaton	17	74	2	76	147	7	154	95.5
Herman Creek	18	229	61	290	582	131	713	81.6
PCT North	19	94	44	138	198	80	278	71.1
Ruckel Creek	20	116	18	134	208	48	256	81.2
Ruckel Ridge	21	113	6	119	219	10	229	95.5
Eagle Creek	22	1534	455	1989	3784	1119	4903	77.2
Tanner Butte	23	194	57	251	453	138	591	76.7
Tanner Creek	24	69	10	79	137	18	155	88.2
Moffett Creek	25	3	2	5	3	2	5	58.4
Total		3898	1000	4898	9044	2591	11635	77.7

(Source: Hall 1996)

Table 27. Number of People by Trailhead Entering Hatfield Wilderness, 1995.



(Source: Hall 1996)

APPENDIX 5. AIR QUALITY

Air is an integral part of the forest environment. Its character directly affects plant, animal and human habitat, and affects the many scenic and recreational opportunities available in our National Forest. A description and understanding of air and "air quality-related values" (AQRVIS) is not limited to the boundaries of the project area. A larger area (Mount Hood National Forest and adjacent rural and urban air-sheds) of consideration is appropriate in describing the environmental element. Increased concern for air quality in the 1960s led to passage of the Amended Clean Air Act of 1970, The provisions of this Act were written to reduce the emissions of major pollutants, including small suspended particles called particulates, into the air. Pollutant-carrying smoke from the summer and early fall burnings is often trapped by air inversions, which aggravate the problem. An air inversion lid forms when the air in upper levels is warmer than air that is close to the ground. The warm air 'lid' keeps ground-level air from rising and dispersing its load of pollutants. The polluted air just sits still.

Historical Trends

For centuries, the Pacific Northwest (PNW) Region has had periods of poor air quality due to natural and man-caused forest fires. Diaries of early explorers and newspaper accounts of the last two centuries have commented to the problems of smoke from wildfire, burning of land clearing and logging slash, and the burning of woodstoves for home heating. Early twentieth (1910-1920) century legislation required the burning of logging slash. This practice became well established on private, state and federal lands. Early on, the accepted practice was to delay most slash burning until the fall season. With an enormous tonnage of logging slash being burned in a very short time period; smoke pollution episodes were not uncommon west of the Cascades. With climatic conditions being traditionally poor for smoke dispersion in the fall season, slash fire smoke accumulated in the lower elevations of the forest and adjacent valleys (i.e., Puget Trough and the lower valleys). The practice of burning in the fall season continued until the early 1970s.

With the inauguration of Smoke Management Programs (SMP) by both Washington and Oregon in the later part of the 1960s, air pollution problems in the Pacific Northwest Region were significantly improved. A change implemented as a result of the new SMPs, was the move away from fall burning to more spring and summer burning. The burning time change to a period of better climatic conditions (spring and early summer) for improved dispersion of smoke pollutants has substantially reduced fall burn programs. The change to spring and summer burning periods with improved climatic conditions for smoke dispersion, has nearly eliminated fall broadcast burn programs.

Laws and Regulations

A concern for urban and rural air quality in the 1960s led to passage of the Clean Air Act (CAA) of 1963 which was amended seven times; the last amendment to the CAA was 1977. Part C of the CAA, sections 160-169 (Prevention of Significant Deterioration, or PSD) required that all areas of the country be placed into one of the following classifications:

Class I: areas where anything but the smallest degradation of air quality would be socially unacceptable;

Class II: areas where moderate degradation of air quality would be socially acceptable;

Class III: areas where a considerable degradation of air quality would be socially acceptable;

All National Parks larger than 6,000 acres and Wilderness larger than 5,000 acres, and certain other preserves existing on August 7, 1977 were designated Class I areas. The remainder of the country was designated Class II. Additions to Wilderness and National Parks after that date are Class II until and unless redesignated Class I by the states. Congress also directed all federal land managers to comply with all federal, state, and local air quality regulations and to protect the 'air quality-related values' of Class I areas. An air quality-related value is a feature or property of an area that is affected in some way be in some way by air contaminates. The only air quality-related value specifically identified in the Clean Air Act is visibility.

The Federal Environmental Protection Agency had developed and promulgated National Ambient Air Quality Standards (NAAQS) for six pollutants: carbon monoxide, nitrogen dioxide, sulfur dioxin lead, ozone, and particulate matter. The standards were established to protect public health and welfare.

The states are responsible for developing and implementing programs to assure that the NAAQS and any other standards (visibility) are met. A State Implementation Plan (SIP) consist of a state's program to assure the timely clean up of excessively polluted areas. Clean areas are called "attainment" areas; excessively polluted areas are called 'non-attainment' areas. An area may be an attainment area for several criteria pollutants, but classified as non-attainment for others. States may adopt standards more stringent than NAAQS. Currently, the Portland-Vancouver area is 'non-attainment' due to the level of total suspended particulates (TSP) (Oregon Department of Environmental Quality, 1985).

Washington and Oregon Smoke Management Plans are now part of the State Implementation Plans for both states. They detail the procedures and lines of authority for land management burning in the two states. Numerous areas in the Region are classified 'designated areas' in the Smoke Management Plan. Designated areas are typically the larger population centers. A 'smoke-sensitive area' is an area that would be negatively affected by smoke, but is not necessarily a designated area.

Current Conditions

Visibility in the state of Oregon is being monitored by federal and state agencies to determine the extent and causes of visibility impairment in some Class I, some Class II, and a few high recreational use areas (i.e., Columbia Gorge National Scenic Area).

In 1986, Oregon amended their State Implementation Plan to include programs to comply with the visibility protection requirements of the CAA. A significant provision limited prescribed burning during the summer to protect the visibility in Class I areas and to reduce smoke from forestry burning. As a result thereof, and some exceptions, prescribed burning is restricted in the Oregon Cascades during the high visitor and recreation use period of Independence Day through Labor Day. Oregon's 'Year 2000' goal is to reduce smoke particulates from prescribed burning by 50 percent of the level experienced during 1976-1979. Emissions from

prescribed burning on Cascade Forests are now 30 percent of the level experienced during 1976-1979. During the 1976-1979 baseline period, biomass consumption averaged 60 tons per acre in Western Oregon. In 1984, biomass consumption per acre had dropped to 44 tons per acre in Oregon.

On the Hood River Ranger District, the amount of slash planned for disposal through use of prescribed fire has decreased dramatically during the past decade. The primary factors contributing to this significant improvement are:

1) Unit managers program direction to reduce use of the prescribed fire;
2) Analysis of options and their applicability to meet planning objectives;
3) A reduction of timber sale volume

Future Trends

The Environmental Protection Agency will no doubt lower the National Air Quality Standards for particulate matter. The new standards will probably focus on the health and welfare of rural residents and the forest visitors, and on the regional haze problem, all of which could be affected by smoke from prescribed burning. With more attention to improving these health concerns and extending Class I status to some of the 1984 Wilderness additions in Washington and Oregon states, Pacific Northwest air quality will unquestionably benefit. The Hood River Ranger District can be expected to contribute towards improvement of PNW air quality through continued management program that advocates reduced use of prescribed fire to meet vegetative management objectives.

Important Interactions of Fuels Treatment with Air Quality

Treatment of slash can generate a considerable amount of smoke. The problems created by Air pollution are discussed in Chapter III of the Forest Plan. Fire managers plan the dispersal of smoke away from Designated Areas in accordance with Washington's Smoke Management Plan. These designated areas include Goat Rocks and Mount Adams Wildernesses (Class I), Trapper Creek Wilderness (Class II), and urban areas such as Portland, Vancouver, and the I-5 corridor.

All of the vegetation management methods considered may temporarily affect local air duality, but prescribed burning has the potential to significantly degrade air quality over large areas for extended (2-3 days) periods. For that reason, the focus of this element is on prescribed burning. The criteria used to assess the effects of prescribed burning on air quality for methods used are attainment of the NAAQS for fine particulates protection of Class I area visibility; and compliance with state air quality and visibility enhancement strategies. Previously compiled inventories of total suspended particulates (TSP) from prescribed burning in western Oregon and western Washington. The periods inventoried were: 1) 1976 through 1979 and 2) 1984. Similar baseline data for the Hood River Ranger District is incomplete at this time.

Projected Prescribed Fire Emissions

The average particulate emissions (from prescribed burning) for the Hood River Ranger District are expected to decline at 50 percent by the year 2000 compared to 1983-1985 period. This reduction is a conservation estimate and may highly underestimate district accomplishments to date. The decrease is primarily due to decline in acres burned, better utilization, and burning at higher fuel moisture.

Wildfire Emissions

Wildfire typically may consume up to three times as much fuel per acre as prescribed fires. They may produce two to ten times as much fire particulates as prescribed fires because wildfire combustion efficiency is typically lower.

However, wildfire emissions were not included in the FEIS analysis for two reasons:

1) there are no federal or state emissions standards for uncontrolled sources such as wildfires; and
2) there is no basis for projecting differences in wildfire acres among the alternatives for the FEIS.

Prevention of Significant Deterioration (PSD) Increments

The Clean Air Act requires total suspended particulates and sulfur dioxide will not exceed annual increments published for Class I, II, and III areas. Since the annual prescribed burn program on the Hood River Ranger District is projected to be substantially below baseline levels and goals for the year 2000, particulate emissions from prescribed burning is not expected to significantly affect any portion of the PSD increment of adjacent rural and urban areas.

National Ambient Air Quality Standards

Annual particulate emissions from prescribed burns conducted on the Hood River Ranger District are expected to decrease below current levels. Therefore, air quality as measured against published annual particulate standards, will be maintained or improved.

Visibility Protection of Class I Areas

Washington State Implementation Plan contains short and long term strategies for improving Pacific Northwest visibility. With the exception of cloudy days, the short term strategy restricts prescribed burning in order to produce immediate improvement in the Class 1 area visibility during peak summer recreation period July 4 through Labor Day. The long-term strategies are designed to assure reasonable progress toward the national goal of improving visibility by reducing particulate emissions from prescribed burning. Oregon long-term strategies include the previously mentioned goal of 50 percent emissions reduction, compared to 1976-1979 levels by year 2000. Despite the favorable projections of reduced annual particulate emissions, particulate standards may be violated, and Class 1 area visibility could be affected by an individual prescribed fire. Care will be taken to burn only when smoke advection and dispersion conditions are favorable; compliance with state smoke management direction will assure best possible decisions. Occasionally forecast of meteorological factors that affect smoke behavior may fail; hence such forecast do not guarantee that smoke incursions into Class 1 areas or communities will not occur. However, the projected annual particulate emissions from prescribed burning on the Wind River Ranger District does indicate that Pacific Northwest air quality will improve.

APPENDIX 6. MANAGEMENT DIRECTION AND GOALS

Northwest Forest Plan

Management direction outlined within the Northwest Forest Plan is divided into seven Land Designations. Further, Tier I Key Watersheds, Tier 2 Key Watersheds, and non-Key Watersheds overlay portions of all six categories of designations and matrix. This watershed is classified as a non-Key Watersheds. It includes three Northwest Forest Plan Land Designations. Management Goals for these Land Designations are briefly described as follows:

Congressionally Reserved Areas

These lands have been reserved by Congress for specific land allocation purposes. The Columbia Wilderness is a Congressionally Reserved Areas. The Management Goals contained in the Mount Hood National Forest's Land and Resource Management Plan for A2 Wilderness are consistent with the objectives of this land allocation.

Late Successional Reserves (LSR)

LSR are identified with an objective to protect and enhance conditions of late-successional and old growth forest ecosystems, which serve as habitat for late-successional and old-growth forest related species including the northern spotted owl. Limited stand management is permitted, subject to review by the Regional Ecosystem Office. National Scenic Area lands designated Open Space and forest are LSR.

Administratively Withdrawn Areas

Administratively Withdrawn Areas include recreation and visual areas, back country and other areas where management emphasis precludes scheduled timber harvest. National Scenic Area lands designated Public Recreation and Agriculture are Administratively Withdrawn.

Riparian Reserves

As a key element of the Aquatic Conservation Strategy, the Riparian Reserves provide an area along all streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystem as well, serving, for example, as dispersal habitat for certain terrestrial species.

Mount Hood National Forest

Direction for the Mount Hood National Forest is found in the Mount Hood Land and Resource Management Plan.

Bull Run Watershed

Forest Plan prescription D Series, Bull Run Watershed Management Unit (DA1, DA2, DA9) apply to the Bull Run Watershed Management Unit. The management goal is to serve as the main water supply for the city of Portland, and to protect and manage renewable resources within the Unit.

Hatfield Wilderness

Forest Plan prescription A2 applies to the Hatfield Wilderness (formerly Columbia Wilderness). The Forest Plan defines a Desired Future Condition for the Wilderness, and sets management standards and guidelines. Wilderness attributes and resources will be maintained,

in accordance with the 1964 Wilderness Act. The Columbia Wilderness Implementation Schedule sets direction to move the Wilderness from the existing condition to the Desired Future Condition.

Unroaded Recreation
Forest Plan prescription A5: Dispersed recreation opportunities are provided in an undeveloped environment.

Semi-primitive Roaded Recreation
Forest Plan prescription A6: Dispersed recreation opportunities are provided; motorized activities predominate.

Key Site Riparian.
Forest Plan prescription A9: The diversity, high quality, and key role of selected riparian areas are maintained and approved.

Roaded Recreation
Forest Plan prescription B3: A range of dispersed, predominantly motorized recreation uses are provided.

Special Emphasis Watershed
Forest Plan prescription B6: Management emphasis is placed on the watershed stability and water related values.

Backcountry Lakes
Forest Plan prescription B12: Recreation, fish and wildlife habitat, and scenic values are emphasized at selected lakes.

Timber Emphasis
Forest Plan prescription C1: Lumber, wood fiber and other forest products are provided on a regular basis.

National Scenic Area
National Scenic Area direction is established in the Columbia River Gorge National Scenic Area Management Plan. In addition, Mount Hood National Forest Plan prescriptions EA1 (Scenic Area), EA4 (Special Interest Area), EA12 (Outdoor Recreation Area) and EA13 (Bald Eagle Habitat Area) also apply to the National Scenic Area. The plan with the more protective guidelines applies. The watershed is located within a Special Management Area. The following National Scenic Area land use designations apply within the watershed.

Open Space
Goal: Protect and enhance open space values. The most sensitive resource lands are designated Open Space, and lands are managed to protect these sensitive resources. Most new land uses and developments are not allowed. Low intensity recreation, utility services, and resource enhancement are allowed. About 75% of the National Scenic Area in the analysis area is designated Open Space. It includes the steep Gorge walls. Most of the Open Space is National Forest land (90%). The remainder is owned by Oregon, Hood River County, the city of Cascade Locks and private landowners. Most of the Open Space is Recreation Intensity Class (RIC) I, with some RIC II near transportation corridors. The Landscape Setting is

primarily Gorge Walls, Canyonlands and Wildlands, with some Conifer Woodlands and River Bottomlands nearer the Columbia River

Forest

Goal: Protect and enhance forest lands for forest uses. Lands suitable for production of commercial forest products are designated Forest. Forest practices are allowed subject to resource protection guidelines. Utilities, resource enhancement, recreation developments are allowed. Dwellings and quarry operations are allowed in certain circumstances. In the analysis area, 2,846 acres are designated Forest. About 1/3 (1,023 acres) are National Forest lands, and almost 1,000 acres are managed by Hood River County. The remainder is owned by the state of Oregon, the city of Cascade Locks and private landowners. Recreation Intensity Classes include RIC I-IV. Landscape Settings are primarily Conifer Forest, and a small amount of Pastoral.

Agriculture

Goal: Protect and enhance lands that are used or suitable for agricultural uses. Lands suitable for agricultural purposes are designated Agriculture. Agriculture use is allowed. Forest practices, utilities, resource enhancement, recreation developments are allowed. Dwellings and quarry operations are allowed in certain circumstances. In the analysis area, 139 acres are designated Agriculture. Most is owned by private landowners, with a few acres owned by Oregon State Parks. RIC classes I-IV. Landscape Settings are either Pastoral or Conifer Forest

Public Recreation

Goal: Protect and enhance lands that are suitable for public recreation. Lands suitable for moderate and high recreation are designated Public Recreation. Recreation facilities, agriculture, forest practices, utilities, resource enhancement, recreation developments are allowed. Dwellings are allowed in certain circumstances. About 328 acres in the analysis area is designated Public Recreation. About 125 acres are National Forest and include Eagle Creek, Herman Creek and Wyeth recreation facilities. In addition, Starvation Creek, Viento, Mitchell Point state parks are designated Public Recreation. Most of the Public Recreation land is RIC IV, although there is a small amount of RIC II. Landscape Settings include River Bottomlands and Coniferous Woodlands.

Urban Areas

Urban Areas are entirely exempt from National Scenic Area land use regulations. The entire Cascade Locks Urban Area (1,673 acres) is within the analysis area. The Oregon portion of the North Bonneville Urban Area is in the analysis area (550 acres).

Oregon State Parks

The analysis area includes part or all of ten Oregon State Parks: John Yeon, Bonneville, Sheridan, Lane, Lindsay Creek, Senaca Fouts (Mitchell Point), Starvation Creek, Viento, Vinzenz Lausmann and Wygant. Oregon State Parks and Recreation has developed a *Columbia Gorge District Master Plan* which includes site specific development plans. State Park developments must be consistent with the National Scenic Area Management Plan or county implementing ordinances.

APPENDIX 7. SURVEY & MANAGE PLANT SPECIES

CODES USED IN THE FOLLOWING TABLE

The attached table format is similar to the ROD Table C-3 on pages 49 to 61, with fungi groups listed first, lichen groups second, bryophytes third, and vascular plants last. Additional columns were added to incorporate habitat information and known range and/or geographic extent. Appendix J2, pages 83-247, provided a large percent of the information available regarding species range and geographic extent. The following key identifies codes used to expedite and condense this document.

Survey Strategies

1 = Manage Known Sites

2 = Survey Prior round Disturbing Activities

3 = Conduct Extensive Surveys and Manage Sites

4 = Conduct General Regional Surveys

Occurrence

D = Documented sites on MHNF
S = Suspected to occur, habitat present
N = Not likely to occur
? = Unknown, inadequate information
R = Reported but not formally documented
X = Added after Appendix J2

Trees and Shrubs

ABAM - Abies amabilis (Pacific silver fir)
ABCO - Abies concolor (White fir)
ABGR - Abies grandis (Grand fir)
ABLA2 - Abies lasiocarpa (Subalpine fir)
ABPR - Abies procera (Noble fir)
ACCI - Acer circinatum (Vine maple)
ARsp.- Arctostaphylos (Manzanita)
CACH - Castanopsis chrisophylla (Chinquapin)
PIAL - Pinus albicaulis (Whitebark pine)
PICO - Pinus contorta (Lodgepole pine)
PIEN - Picea engelmannii (Engelmann spruce)
PILA - Pinus lambertiana (Sugar pine)
PIMO - Pinus monticola (Western white pine)
PISI - Picea sitchensis (Sitka spruce)
PIPO - Pinus ponderosa (Ponderosa pine)
PSME - Pseudotsuga menziesii (Douglas-fir)
QUGA - Quercus garryana (Oregon white oak)
TABR - Taxus brevifolia (Pacific yew)
THPL - Thuja plicata (Western redcedar)
TSHE - Tsuga heterophylla (Western hemlock)
TSME - Tsuga mertensiana (Mountain hemlock)

Table 28. East Tributaries Suspected Survey and Manage Species

SPECIES	SURV. STRAT.	ET CR	HABITAT	KNOWN GEOGR. RANGE or EXTENT
FUNGI				
MYCORRHIZAL FUNGI				
BOLETES				
Gastroboletus subalpinus	1, 3	S	above 4500', ecto-michorrizal w/pines	Endemic Ore. Casc. & N. Sierras
Gastroboletus turbinatus	3	S	mid-high elev. w/true firs, PIEN/PISI, TSHE/ TSME, w/abundant large woody debris, humus	WA to N. CA, WA/OR Coast Range, Sisk. Mts., Klam. Mts., N. ID, MI, Mexico
BOLETES LOW ELEVATION				
Boletus piperatus	3	S	low-mid elev forests, requires course woody debris in Douglas-fir	Unknown
Tylopilus pseudoscaber	1, 3	S	low elev, moist hab., often w/Sitka spruce.	PNW coast endemic
RARE BOLETES				
Boletus haematinus	1, 3	S	high elev silver fir	Cal. north to Wash
Boletus pulcherrimus	1, 3	S	low-mid elev conifer	Cal. to Canada, north to Olympics
Gastroboletus imbellus	1,3	S	upper mid elev (5000') w/ABAM, ABGR, PSME, TSHE, TSME, possibly ectomycorrhizal w/pine	locally endemic to Willamette NF(WNF) Ollalie Trail & Lamb Butte Scenic
Gastroboletus rubra	1, 3	S	upper mid-high elev. w/mature TSME and developed humus layer.	endemic to WA N. Casc. south to Willamette Pass OR
FALSE TRUFFLES				
Nivatogastrium nubigenium	1, 3	S	mid-high elev. in mature forests w/abundant lg. coarse woody (relies on mammals for dispersal)	Casc. Mts. of CA, N. to Mt. Adams, & north ID.

Rhizopogon abietis **R. atroviolaceus** **R. truncatus**	3 3 3	S S S	high elev. mixed conifer (true firs, pines, PSME, TSME), in moderate to dry sites.	E. Canada, E. USA N. Rockies, Strawberry Mts. OR, Casc. & Klam. Mts.
Thaxterogaster pinque	3	S	only mid-high elev. true firs, w/ thick humus, lg. crs. woody	Casc. Mts. S. of Canada border to N Sierras, Sisk. Mts OR, Klam. Mts. CA
UNCOMMON FALSE TRUFFLES				
Macowanites chlorinosmus	1, 3	S	low elev. PISI, PSME, TSHE w/lg. crs. woody	endemic OR coast & Coast Ranges
RARE FALSE TRUFFLES				
Alpova alexsmithii	1, 3	S	mid to upper mid elev. w/true firs, TSHE, and possibly pines.	endemic to Casc. Mts. & British Columbia Coast Rng
Alpova olivaceotinctus	1, 3	N	a single site known in the range of N. Spotted owl w/Shasta fir	Unknown
Arcangeliella crassa **A. lactarioides**	1, 3 1, 3	S S	mid to high elev. montane forests w/ Abies spp. and /or TSME.	Western OR, N. CA Mts. Shasta/Lassen
Destuntzia fusca **D. rubra**	1, 3 1, 3	S S	low to lower-mid elev. in variously mixed true firs, TSHE, PSME, oaks, pines, redwood	Mendocino Cnty. CA & Willamette N.F. (WNF), Linn Cnty.
Gautieria magnicellaris	1, 3	S	high elev. w/TSME and true firs	WNF, Klamath NF, Mt. Wash. Wildns., NE USA, Germany, Czechoslovakia
Gautieria otthii	1, 3	S	mid to upper-mid elev. ectomychorrizal w/ Pinaceae	N. CA, Sisk. Mts, OR Centr. Cascades Europe, Alaska
Leucogaster citrinus	1, 3	S	low to high elev. w/ PSME, TSHE, CACH, manzanita, tanoak, or in stands w/lg. woody	Mendocino Cnty. CA north to Linn & Benton Counties

Leucogaster microsporus	1, 3	S	mid elev. w/PSME or in stands w/abundant legacy of crs. woody	Slopes of W. Casc. Mts., N. Casc. & Coast Range OR, to S. Casc. of WA
Macowanites lymanensis	1, 3	S	mid elev. old-growth TSME/ABPR forest	Lyman Lake, Wenatchee NF
Macowanites mollis	1, 3	S	mid elev. mature to old-growth PSME, Pines	Mt. Rainier NP, Larch Mt., MHNF
Martellia fragrans	1, 3	S	mid-high elev. old-growth TSME/Abies spp	S. OR, N. CA, & ID
Martellia idahoensis	1, 3	S	mid-upper mid elev. w/ true firs & Pinacea	Coast Range SNF, Cascade Range, WNF N. ID
Martellia monticola	1, 3	S	mid-high elev. old-growth TSME/Abies spp.	Central to North Oregon Cascades
Octavianina macrospora	1, 3	S	Mt. foothills in PSME/ TSME old-growth forest	former Twin Brdgs. forest Camp
Octavianina papyracea	1, 3	N	coastal mixed PSME/ TSME/PISI forest in a fog belt	Humboldt Co, CA
Rhizopogon brunneiniger	1, 3	S	low-high elev. dry old growth PSME/TSME/fir/ pine forest	N. OR Cascades & coast ranges, & N. CA
Rhizopogon evadens var. subalpinus	1, 3	N	upper mid elev. TSME/ fir/pine forest near timberline	N. CA to WA & ID
Rhizopogon exiguus	1, 3	S	moist-dry mature to old-growth PSME/TSME low-mid elev. forest	Cascade Mt., WA & coast ranges of Or
Rhizopogon flavofibrillosus	1, 3	S	mid-upper mid elev. mature to old-growth mixed conifer forest	N. CA, Siskiyou Mts, & central Cascades of OR
Rhizopogon inquinatus	1, 3	S	mid-upper mid elev. mature to old-growth PSME forest	S. Santiam River, WNF, & ID

Sedecula pulvinata	1, 3	S	mid-high elev. old-growth TSME/Abies	Smt. Shasta to Yuba Pass, CA& CO

UNDESCRIBED TAXA, RARE TRUFFLES & FALSE TRUFFLES				
Alpova sp. nov. Trappe #9730 **Trappe #1966** **Arcangeliella sp. nov. #Trappe 12382**	1,3 1, 3	N N	mid-high elev. mature to old-growth PSME/ PILA/ARsp/PIAl/ ABMASH forest	Siskiyou Mts. of southwestern OR
Arcangeliella sp. nov. #Trappe 12359	1, 3	S	mature to old-growth PISI/TSME/PSME coastal fog belt forest	Lane, Lincoln, & Tillamook counties OR
Chamonixia pacifica sp. nov. #Trappe 12768	1, 3	S	upper mid elev. old-growth PSME/TSME/PISI/ ABAM forest	N. coastal OR & N. Cascades of WA
***Elaphomyces sp. nov.* #Trappe 1038**	1, 3	S	mature to old-growth PISI/TSME/PSME coastal fog belt forest	Lane, Lincoln, & Tillamook counties OR
Gastroboletus sp. nov. #Trappe 2897	1, 3	N	mid-high elev. mature to old-growth PSME/ PILA/ARsp/PIAT/ Shasta fir	Siskiyou Mts. of southwestern OR
Gastroboletussp. nov. #Trappe 7515	1, 3	S	high elev. old-growth TSME forest	Crater Lake National Park
+Gastrosuillus sp. nov. #Trappe 7516	1, 3	S	high elev. mature to old-growth true fir & coniferous forest	Klamath NF, OR
+Gastrosuillus sp. nov. #Trappe 9608	1, 3	N	upper mid elev. mature mixed conifer forest w/ PILA	Lassen NF, CA
Gymnomyces sp. nov. #Trappe 4703 & #5576	1, 3	S	upper mid elev mature ABPR forest.	Siuslaw NF, OR Coast range of OR
***Gymnomyces sp. nov.* #Trappe 5052**	1, 3	S	*high elev. mature to* old-growth TSME/ABAM forest	*Phlox Pt., Mt.Hood NF,* OR
Gymnomyces sp. nov. #Trappe 1690 & #1706, 1710	1, 3	S	upper mid elev. mature to old-growth ABGR/ ABPR/ABAM/TSME forest	W. OR Cascades, Willamette NF (WNF)
Gymnomyces sp. nov. #Trappe 7545	1, 3	S	high elev. mature to old-growth true fir & coniferous forest	Klamath NF, OR

Hydnotrya sp. nov. #Trappe 787, 792	1, 3	S	upper mid elev. old-growth ABAM/TSME *forest*	Mt. Jefferson, WNF

Hydnotrya subnix sp. nov. #Trappe 1861	1, 3	S	old-growth ABAM forest	Gifford Pinchot NF WA
Martellia sp. nov. #Trappe 311, 649	1, 3	S	high elev. mature to *old-growth* TSME/ABAM forest	Phlox Pt., Mt.Hood NF, OR
Martellia sp. nov. #Trappe 1700	1, 3	S	upper mid elev. mature to old-growth ABGR/ ABAM/PSME/TSME forest	Willamette NF, OR
Martellia sp. nov. #Trappe 5903	1, 3	S	upper mid elev. old-growth ABAM/TSME forest	Mt. Jefferson, WNF
Octavianina sp. nov. #Trappe 7502	1, 3	S	upper mid elev. mature to old-growth ABGR/ ABAM/PSME/TSME forest	Willamette NF, OR
Rhizopogon sp. nov. #Trappe 9432	1, 3	N	mid-high elev. mature to old-growth PSME/ PILA/ARsp/PIAT/Shasta pine) forest	Siskiyou Mts. of southwestern OR
Rhizopogon sp. nov. #Trappe 1692, 1698	1, 3	S	upper mid elev. mature to old-growth ABGR/ ABAM/PSME/ TSME *forest*	Willamette NF, OR
Thaxterogaster sp. nov. #Trappe 4867, 6242 & #7427, 7962, 8520	1, 3	S	mature to old-growth PISI/PSME/TSME coastal fog belt forest	Lane, Lincoln, & Tillamook counties OR
Tuber sp. nov. #Trappe 2302, 12493	1, 3	S	same as above	same as above
RARE TRUFFLES				
Balsamia nigra	1, 3	S	low elev. mature xeric pine/oak forest	Sierra Nevada Mts, CA to Yamhill Co, OR
Choiromyces alveolatus	1, 3	S	mid-high elev. old-growth TSME/Abies spp. forest	Mt. Hood, OR to Yuba Pass, CA
Choiromyces venosus	1, 3	S	low elev. w/coniferous deciduous or mature PSME forest	Springfield, OR & Europe

Elaphomyces anthracinus	1, 3	N	mature PIPO forest	W. Europe, E. North America, & E. OR Cascades
Elaphomycep subviscidus	1, 3	?	mid elev, mature to old-growth pine forest	Ce tral to S. OR Cascades
RARE CHANTERELLE				
Cantharellus formosus	1, 3	S	coniferous & mixed forest	N. CA, OR, & WA
Polyozellus multiplex	1, 3	S	intermittent streams montane fir forest	N Sierras, CA & Cascades, OR & WA
CHANTERELLE				
Cantharellus cibarius **C. subalbidus** **C. tubaeformis**	3,4	S S S	coniferous & mixed forest late-successional forest	N. CA, OR, & WA

CHANTERELLES - GOMPHUS				
Gomphus bonarii **G. clavatus** **G. floccosus** **G. kauffmanii**	3 3 3 3	S S R S	late successional west conifer forests " (& w/hemlock in east " N. America)	throughout region especially N. CA
UNCOMMON & RARE CORAL FUNGI (App. J2, pp 163, 164)				
(Ramaria spp.)	(1,3) & (3)	S	w/TSHE, Abies, Picea, Pinus, Pseudotsuga, & Taxus	N. CA, OR, WA Overall distribution of individual spp., unknown.
PHAEOCOLLYBIA (App. J2, p. 166)				
(Phaeocollybia spp)	(1,3)	S	low elev. to montane, w/conifers, moist hab. (prefers low elev.)	Distribution and frequency currently under study.
UNCOMMON GILLED MUSHROOMS (App. J2, p. 168)				
(Catathelasma sp., **Cortinarius spp.,** **Dermocybe sp.,** **Hebeloma sp.,** **Hygrophorus spp.,** **Russula sp.)**	(1,3) & (3)	S	ectomycorrhizal in low elev. to montane, w/conifers	Distribution and range of individual species is unknown. Some may be PNW endemics.

RARE GILLED MUSHROOMS				
Chroogomphus loculatus	1, 3	S	upper mid-elev (5000') w/ABAM, ABGR, PSME, TSHE, TSME.	local endemic, type locality Ollalie Trail, WNF
Cortinarius canabarba **C. rainierensis** **C. variipes** **Tricholoma venenatum**	1, 3 1, 3 1, 3 1, 3	? ? ? ?	The range of elev. and host species are unknown. All require diverse coniferous forests w/heavy hummus layer and crs. woody.	Overall ecology and distribution are not well known for these species.
Cortinarius verrucisporus	1, 3	S	high elev. montane, w/ conifers & true firs, hypogeous (fruits underground)	CA and OR
Cortinarius wiebeae	1, 3	S	(same as above)	Local endemic/MHNF only known site
UNCOMMON ECTO-POLYPORES				
Albatrellus ellisii **A. flettii**	3	S S	coastal old-growth & mixed hardwood forest	WA, OR, N. CA, Rocky Mts., NE. US & Europe
RARE ECTO-POLYPORES				
Albatrellus avellaneus **A. caeruleoporus**	1, 3	S S	coastal old-growth & mixed hardwood forest	WA, OR, N. CA, Rocky Mts., NE. US & Europe
TOOTH FUNGI				
Hydnum repandum **H. umbilicatum** **Phellodon atratum** **Sarcodon fuscoindicum** **S. imbricatus**	3	S S S S S	late-successional & second growth conifer & hardwood forest	Widespread in N. America & Europe
RARE ZYGOMYCETES				
Endogone acrogena	1, 3	S	low elev. mesic old-growth PSME/TSME forest	W. Cascades from Mt. Rainier to Whitechuck Rv.
Endogone oregonensis	1, 3	S	low elev. old-growth PSME/PIPI/TSME coastal forest	Suislaw NF, OR

Glomus radiatum	1, 3	S	mature to old-growth Coastal Redwood/Alaska cedar mesic wet forest	OR & WA Cascades, N. CA, & NE. US
SAPROBES (DECOMPOSERS)				
UNCOMMON GILLED MUSHROOMS (App. J2 p. 179)				
Species are collectively grouped. See App. J2 p. 179	(1,3) & (3)	S	low-mid elev. conifer ecosystems; on PISI, recently fallen logs, or decomposed logs	N. CA, OR, & WA
RARE GILLED MUSHROOMS				
Clitocybe subditopoda **C. senilis**	1, 3	S S	low-mid elev. moist late successional forest, large logs in later stages of decay	WA, OR, & CA
Neolentinus adherens	1, 3	S	low-mid elev. moist late successional forest, large logs in later stages of decay	Olympic Natl. Park
Rhodocybe nitida	1, 3	S	low-mid elev. moist late successional forest, large logs in later stages of decay	WA, OR, & CA
Rhodocybe speciosa	1, 3	S	low-mid elev. moist late successional forest, large logs in later stages of decay	Mt. Rainier Natl. Park to Barlow Pass
Tricholomopsis fulvescens	1, 3	S	low-mid elev. moist late successional forest, large logs in later stages of decay	Mt. Hood area, Mt. Rainier Natl. park Mt. Baker-Snoq. NF
NOBLE POLYPORE (Rare and Endangered)				
Oxyporus nobilissimus	1, 2, 3	S	late-successional forest on Abies spp. esp. A. procera	OR & WA Cascades

BONDARZEWIA POLYPORE				
Bondarzewia montana	1, 2, 3	S	late-successional high elev. forest on associate w/Abies	Pacific Northwest, W. NV, & ID

RARE RESUPINATES AND POLYPORES				
Aleurodiscus farlowii	1, 3	S	on wood, humus, litter stumps, & dead roots	WA, OR, & N. CA
Dichostereum granulosum	1, 3	S	(same as above)	(same as above)
Cudonia monticola	3	S	duff layer of mature conifer forest	WA, OR, & N. CA
Gyromitra californica **G. esculenta** **G. infula** **G. melaleucoides** **G. montana (syn. G. gigas)**	3,4	S S S S S	decaying matter in soil & rotten wood in older forest (except G. esculenta which prefers second growth)	Northwestern N. America & Europe
Otidea leporina **O. onotica** **O. smithii**	3	S S S	conifer duff in moist-wet late-successional mid-low elev. conifer forest	Unknown
Plectania melastoma	3	S	late-successional to old-growth conifer forest duff	NE. & NW. North America & Europe
Podostroma alutaceum	3	S	mature conifer & mixed conifer/hardwood forest duff	Pacific Northwest
Sarcosoma mexicana	3	S	late-successional & old-growth high elev. forest	Coastal OR & CA
Sarcosphaera eximia	3	S	conifers & Fagaceae pp on chalky soils	Pacific Northwest, CA, Rockies, NE. U.p. & Europe
Spathularia flavida	3	S	duff layer of mature conifer forest	OR, WA, & N. CA

RARE CUP FUNGI				
+Aleuria rhenana	1, 3	S	late successional conifer forest liter	San Francisco to Mt. Rainier
+Bryoglossum gracile		N	mossy, wet, alpine / Subalpine montane conifer forest	artic & alpine N. America & Europe
Gelatinodiscus flavidus	1, 3	S	needles, cones, & twig of high elev. Alaska Yellow cedar	BC, Olympic Penn., OR & WA Cascades, & Central OR
Helvella compressa **H. crassitunicata** **H. elastica** **H. maculata**	1, 3	S S S S	low-mid elev. riparian & wet late succession forest	temperate forested area of N. America

Neournula pouchetii	1, 3	S	late-successional Thuja & Tsuga forest	N. OR & WA

Pithya vulgaris	1, 3	S	high elev. Abies forest	BC, WA, ID, & OR
Plectania latahensis	1, 3	S	upper montane, subalpine conifer forest	OR, WA, ID, & BC
Plectania milleri	1, 3	S	montane, subalpine conifer forest	OR, WA, ID, & BC
Pseudaleuria quinaultiana	1, 3	S	low elev. wet late-successional conifer forest on wood or soil	Olympic Peninsula, coastal WA & OR
CLUB CORAL FUNGI				
Clavariadelphus ligula **C. pistilaris** **C. truncatus** **C. borealis** **C. lovejoyae** **C. sachalinensis** **C. subfastigiatus**	3,4 3,4 3,4 3,4 3,4 3,4 3,4	S S S S S S S	cool/cold moist late-successional hardwood or conifer forest, increases in frequency w/increasing lat. & elev., need well-developed litter layer	Pacific Northwest BC, AK, Midwest, & eastern N. America

JELLY MUSHROOM				
Phlogoitis helvelloides	3,4	S	riparian zones, upper headwater seeps, & intermittent streams w/large woody debris	Pacific Northwest, Northwest, Midwest & Rockies
BRANCHED CORAL FUNGI				
Clavulina cinerea **C. criptata** **C. ornatipes**	3,4	S S S	late-successional forest w/well-developed liter layer	Pacific Northwest & elsewhere
MUSHROOM LICHEN				
Phytoconis ericetorum	3,4	S	large woody debris in well lit forest w/alt. high/low moisture, increases northward	CA to artic, coast to subalpine elev.
PARASITIC FUNGI (App. J2 p. 212)				
SPECIES are collectively grouped. pee App. J2 p. 212.	3	?	late-successional moist forest on a host fungus	Pacific Northwest, distribution and ecology unknown.
CAULIFLOWER MUSHROOM				
Sparassis crispa	3	S	low-mid elev. old-growth conifer forest on large roots, esp. PSME	Pacific Northwest & N. CA

MOSS DWELLING MUSHROOM

Neournula pouchetii	1, 3	S	late-successional Thuja and Tsuga forest	N. OR & WA

CORAL FUNGI				
Clavicorona avellanea	3	S	low-mid elev. moist *late-successional forest* on large roots	Pacific Northwest

LICHENS

RARE FORAGE LICHENS				
Bryoria tortuosa	1, 3	N	*low-mid elev, coastal* on conifers, inland in pine/oak wet regimes	Central Cal. to Brit. Col., Cascades
RARE LEAFY LICHENS				
Hypogymnia duplicata	1, 2, 3	S	low elev wet, foggy, windy coast & maritime sites on conifers	Ore. to Alaska
Tholurna dissimilis	1, 3	N	subalpine fog zone on stunted TSME, canopy of old-growth PSME	Montane areas of Ore. & Wash.
RARE NITROGEN FIXING LICHENS				
***Dendriscocaulon* intricatulum**	1, 3	S	low-mid elev wet, boreal, riparian, late-successional forest	Southern Wash. to southeast Alaska
Lobaria hallii	1, 3	S	low-mid elev wet, foggy forest on large dia. hardwoods & on shrubs	*Central Coast* Cal. to N. Alaska
Lobaria linita	1, 3	S	old-growth PSME & moist fir forest	N. Ore. to southeast Alaska, Idaho
Nephroma occultum	1, 3	?	pristine old-growth approx. 400 yrs old	Willamette NF to Brit. Col.
Pannaria rubiginosa	1, 3	S	bases of trees in mature forest	Salem, Ore. & Mt. Rainier, Wash.
***Pseudocyphellaria* rainierensis**	1, 3	S	old-growth forest on trunks of PSME	Cascades of Wash. and Ore.
NITROGEN FIXING LICHENS				
Lobaria oregana	4	S	open 200 yr. old-growth & Coast forests on conifers	Pacific Northwest Cascades

Lobaria pulmonaria	4	S	moist, hardwood, old-growth forest & swamps	Pacific Northwest Cascades

Lobaria scrobiculata	4	S	old-growth forest from 140-200 yrs old	Pacific Northwest Cascades
Nephroma bellum	4	S	open old-growth & along roadsides	Pacific Northwest Cascades
Nephroma helveticum	4	S	N. Coast, montane forests & foothill woodlands & valleys	Pacific Northwest Cascades
Nephroma laevigatum	4	S	low elev. Coast & old-growth forests	Pacific Northwest Cascades
Nephroma parile	4	N	moist coniferous & deciduous old-growth forests	Pacific Northwest Cascades
Nephroma resupinatum	4	S	low-mid elev. Coast & montane coniferous shady forests	Pacific Northwest Cascades
Pannaria leucoptictoides	4	S	low-elev. open Coast & old-growth forest	Pacific Northwest Cascades
Pannaria mediterranea	4	S	old-growth forest from 140-200 yrs old	Pacific Northwest Cascades
Pannaria saubinetii	4	S	old-growth forest from 140-200 yrs old	Pacific Northwest Cascades
Peltigera collina	4	S	low-mid elev. Coast, montane, & old-growth forests	Pacific Northwest Cascades
Peltigera neckeri	4	S	old-growth forest from 140-200 yrs old	Pacific Northwest Cascades
Peltigera Pacifica	4	S	old-growth forest from 140-200 yrs old	Pacific Northwest Cascades
Pseudocyphellaria anomala	4	S	low-mid elev. Coast, montane, & old-growth forests	Pacific Northwest Cascades
Pseudocyphellaria anthrapsis	4	S	low-mid elev. open, coniferous old-growth forest	Pacific Northwest Cascades
Pseudocyphellaria crocata	4	S	old-growth forest from 140-200 yrs old	Pacific Northwest Cascades
Sticta beauvoisii	4	N	old-growth forest from 140-200 yrs old	Pacific Northwest Cascades
Sticta fuliginosa	4	S	low elev. Coast & moist coniferous old-growth forests	Pacific Northwest Cascades

Sticta limbata	4	S	low-mid elev. Coast & old-growth forests	Pacific Northwest Cascades

PIN LICHENS (See App. J2, pp 234, 235)				
SPECIES grouped collectively; all not mentioned have potential to occur in MHNF watersheds. The species listed below, from the pin Lichen group, are documented.				
Calcicium abietinum	4	D	all species within this group need sheltered microsites w/high atmospheric humidity provided by old-growth forest conditions, substrate and texture specific	Pacific Northwest & N. Europe Endemic to the Pacific Northwest
C. glaucellum	4	D		
C. viride	4	D		
Chaenotheca brunneola	4	D		
C. ferruginea	4	D		
C. furfuracea	4	D		
Cyphelium inquinans	4	D		
RARE ROCK LICHENS				
Pilophorus nigricaulis	1, 3	R	talus rock patches w/in old-growth forest w/ low fire frequency	coastal Ore., Wash. & Brit. Col.
Sticta arctica	1, 3	S	rock outcrop in foggy wet Coast forest	coast range of Ore
RIPARIAN LICHENS				
Cetrelia cetrarioides	4	S	low-mid elev. foggy, riparian forest on older hardwood trees	coastal Ore. to Alaska
Collema nigrescens	4	S	low-mid elev. foggy riparian forest mostly on QUGA	Pacific Northwest to Alaska (to Equador)
Leptogium burnetiae var. hirsutum	4	S	low-mid elev. foggy riparian forest on older hardwood trees	Pacific Northwest & N. Europe
Leptogium cyanescens	4	S	low-mid elev. foggy riparian forest on older hardwood trees	Equador to Alaska including Ore.
Leptogium saturninum	4	S	low-mid elev. boreal riparian forest on older hardwood trees	Pacific Northwest (mostly Canada)
Leptogium teretiusculum	4	S	low-mid elev. foggy riparian forest on older hardwood trees	Pacific Northwest & Montana
Ramalina thrausta	4	S	low-mid elev. boreal forest on hardwood & coniferous trees	Ore., Wash., Idaho Mont., Cal., & Brit. Col.

Usnea longissima	4	S	low-mid elev. wet coniferous/hardwood forests and swamps	Northwest Cal. to Alaska

AQUATIC LICHENS				
Dermatocarpon luridum	1, 3	S	low-mid elev. streams	Ore., Brit. Col., Colo., & Virginia
Hydrothyria venosa	1, 3	S	mid-high elev. clear, cold streams in pristine old-growth	Central Cal. to central Brit. Col.
Leptogium rivale	1, 3	S	low-mid elev. streams	Oregon & Montana
RARE OCEANIC INFLUENCED LICHENS				
Bryoria Pseudocapillaris	1, 3	N	PISI forests, open sand dunes on coast	Oregon coast
Bryoria spiralifera	1, 3	N	pantropical areas, on peninsulas & headlands	Northern Cal.
Bryoria subcana	1, 3	S	coastal bays & streams	Ore., Cal., Alaska
Buellia oidalea	1, 3	S	low-elev. dry coastal oak forest	Mexico to Brit. Col.
Erioderma sorediatum	1, 3	N	stabilized dunes in old PISI & PICO forest	Oregon coast
Hypogymnia oceanica	1, 3	S	coast & maritime microclimates in old-growth forest	Inland & Coast Oregon
Leioderma sorediatum	1, 3	N	stabilized dunes in old PISI & PICO forest	Oregon coast
Leptogium brebissonii	1, 3	N	stabilized dunes in old PISI & PICO forest	Oregon coast
Niebla cephalota	1, 3	N	promontories of land along windswept coasts	coastal p. Cal. to maritime N. Wash.
Pseudocyphellaria mougeotiana	1, 3	N	coastal old-growth PISI forest	Oregon coast
Telopchiptes flavicans	1, 3	N	dry uplands & prairies, on coast shrubs	Equador to Oregon coasts
Usnea hesperina	1, 3	N	broken dune PICO forest	Oregon coast
OCEANIC INFLUENCED LICHENS				
Cetraria californica	1, 3	N	scrubby dune areas on old-growth PICO	S. Cal. to southeast Alaska coasts
Heterodermia leucomelos	1, 3	N	on large PISI in forested headlands	p. Cal. to N. Wash. coasts
Loxospora sp nov "corallifera"	1, 3	S	old-growth conifers on immediate coast	Pacific Northwest coasts

Pyrrhospora quernea	1, 3	N	old-growth conifers on immediate coast	p. Cal. to N. Wash. coasts

ADDITIONAL LICHENS (Added after Appendix J2)				
Cladonia norvegica	1, 3	N	unknown (inadequate info.)	unknown

Heterodermia sitchensis	3	N	unknown (inadequate info.)	unknown
Hygomnia vittiata	3	?	unknown (inadequate info.)	unknown
Hypotrachyna revoluta	3	S	high elev. open forest	N. Cal., W. Ore. & W. Wash.
Ramalina pollinaria	3	S	low elev. N. Coast forest with sandstone outcroppings	W. Ore. & W. Wash.
Nephroma isidiosum	3	?	unknown (inadequate info.)	unknown
BRYOPHYTES (mosses and liverworts)				
Antitrichia curtipendula	4	D	low-mid elev. old-growth forest canopies	N. Cal. to N. Ore. west of Cascades
Bartramiopsis lepcurii X	1, 3	S	old-growth forest	Pacific Northwest, esp. Wash.
Brotherella roellii X	1, 3	S	low-mid elev. old-growth forest on rotting logs	Wash. Cascades
Diplophyllum albicans X	1, 3	S	coastal old-growth TSME/PISI forest	unknown
Diplophyllum plicatum	1, 2	S	coastal PISI forest	W. Ore. & W. Wash.
Douinia ovata	4	D	low-mid elev. foggy old-growth forest w/ ridges & rock outcrops	Pacific Northwest Cascades and coast
Encalypta brevicolla var. crumiana X	1, 3	S	foggy rock outcropping shaded by old-growth forest	Mountains of Ore. & Wash.
Herbertus aduncus X	1, 3	S	high elev. old-growth forest	N. coast & Cascade of Ore. & W. Wash.
Herbertus sakurali X	1, 3	S	foggy rock faces in old-growth forest	N. coast range of Ore.
Iwatsukella leucotricha X	1, 3	S	bark in old-growth forest	N. coast range of Ore.
Kurzia makinoana	1, 2	S	low-elev. old-growth forest	Ore. & Wash. old-growth

Marsupella emarginata var aquatica	1, 2	S	mid-high elev. stream splash zones	Oregon Cascades
Orthodontium gracile X	1, 3	?	old-growth redwood forest	N. Cal. & southwestern Ore.

Plagiochila satol X	1, 3	S	old-growth forest on cliffs, rocks, & bark	Pacific Northwest
Plagiochila semidecurrens var. crumniana X	1, 3	S	foggy cliffs & shaded rocks	Oregon coast range

Pleuroziopsis ruthenica X	1, 3	S	low-elev. shrub thickets, old-growth swamps, stream edges	Wash.
Ptilidium californicum	1, 2	D	conifers in old-growth forest	N. Cal. to Wash.
Racomitrium aquaticum X	1, 3	S	shaded moist rocks & streambanks of old-growth forest	unknown
Radula brunnea X	1. 3	S	foggy rock walls in old-growth forest	N. coast range of Ore.
Scouleria marginata	4	S	splash zone of streams	Pacific Northwest endemic
Tetraphis geniculata X	1, 3	S	low-mid elev. old-growth forest on shaded, moist wood	N. Cal. to W. Wash
Tritomaria expectiformis	1, 2	S	old-growth forest on moist shaded rocks	Ore. & Wash. old-growth
Tritomaria quinquedentata X	1, 3	S	old-growth forest on moist shaded rocks	Ore. & Wash. old-growth
VASCULAR PLANTS				
Allotropa virgata	1,2	D	1500'-5000' elev. under closed canopy ABAM, ABGR, PICO, PSME requires association w/fungus & vasc. plnts(saprophytic)	east slopes Casc. range to coast, BC to CA, disjunct in ID & MO.
Arceuthobium tsugense	The Regional Ecosystem Office removed this species from the Survey and Manage List in 1995			
Aster vialis	1, 2	N	low elev. w/mid-successional conifers, thriving in edge habs. or in canopy openings	endemic to OR, Lane, Linn, & Douglas Counties (Willamette Valley)

Bensoniella oregana	1, 2	N	3000'-5000' elev. w/ mixed evergreen & white fir, meadow/strm	coast Range OR, CA Douglas, Josephine, Curry, Roseburg Counties, (Sisk.NF)
Botrychium minganense	1, 2	S	variable elev. w/THPL and/or ACCI, ACMA variable moist habs.	Endemic to North America, difficult taxonomically
Botrychium montanum	1, 2	S	between 3200' & 4100' (MHNF) in deep shade old-growth THPL, seeps	Endemic to western North America
Clintonia andrewsiana	1, 2	N	coastal redwood forest	California coast
Coptis asplenifolia	1, 2	S	from 360'-3600' w/ABAM TSHE, THPL, in cool, wet, shady habitats	OR coast Rng., WA Cascades, Olympic peninsula
Coptis trifolia	1, 2	S	perimeters of small wetlands/swamps w/PSME	Disjunct in OR (MHNF), East. OR (Geographic Extent)

Corydalis aquae-gelidae	1, 2	D	1220'-4260' on gravel bars in cold perennial streams w/high canopy	Gifford Pinchot NF Mt. Hood NF, Salem BLM
Cypripedium fasciculatum	1, 2	S	1300'-5300' in 60-100% shade by numerous plnt communities	Western US
Cypripedium montanum	1, 2	S	broad range of habs., presence of specific symbiotic fungi	All Cascade provinces, (Hood River, Wasco Cnty)
Galium kamtschaticum	1, 2	S	Seeps w/conifers and west Cascades riparian associated species	Circumboreal Olympic & West. WA Casc. provinces
Habenaria orbiculata	1, 2	S	mesic-dry mossy forest w/deep litter in TSHE and lower ABAM zones	uncommon, wide-spread, W. WA Casc. provinces (Geographic extent)
Pedicularis howellii	1, 2	N	4200'-6300' in mixed conifer/shrub, edge of openings or damp shade	Endemic to the Siskiyou Mts.
Scoliopus bigelovei	1, 2	N	low elevation Redwood forest	Endemic to CA, Sisk. NF, Six Rivers NF

R6 SENSITIVE PLANT SPECIES REPORT
EAST TRIBUTARIES OF THE COLUMBIA RIVER
WATERSHED ANALYSIS

Attached is a table of R6 Sensitive Plants, and other species of concern, that are known or suspected to occur in the East Tributaries of the Columbia River watershed.

FS SENSITIVE SPECIES POLICY AND MANAGEMENT DIRECTION

A. "Habitat for threatened, endangered, and sensitive plants and animals shall be protected and/or improved", (FW-175).

B. "Avoid actions which may cause a species to become threatened or endangered.", (FSM 2670.12-3)

C. "Avoid or minimize impacts to species whose viability has been identified as a concern.", (FSM 2670.32-2)

D. "If impacts cannot be avoided, analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole. (The line officer, with project approval authority, makes the decision to allow or disallow impact, but the decision must not result in loss of species viability or create significant trends toward Federal listing.), (FSM 2670.32-4)

DEFINITIONS AND CRITERIA

The following are acronyms and ranking criteria used in the attached table:

USFS - Regional Forester's List of Region 6 Sensitive plants, specific to the Mt. Hood National Forest (1994 list). Includes species on the Oregon Natural Heritage Data Base List of Rare, Threatened, and Endangered Plants of Oregon (ONHDB).

ONHDB - Oregon Natural Heritage Data Base, December 1995. Although many of the species on the ONHDB list are not included in the Regional Forester's List of Sensitive Plants, the USFS is encouraged to inventory for ONHDB species in order to keep track of population trends and threats to habitat.

List Categories:

1 Taxa that are threatened with extinction or presumed extinct throughout their entire range.

2 Taxa that are threatened with extirpation or presumed extirpated from the state of Oregon.

3 Species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.

4 Taxa which are of conservation concern, but are not currently threatened or endangered. This includes taxa which are very rare but are currently secure, as well as taxa which are declining in numbers or habitat but are still too common to be proposed as threatened or endangered.

Table 29. Vascular Plants

Documented (D) and Suspected (S) to occur in the East Tributaries of the

Plants listed in **bold** are endemic to the Columbia River Gorge.

	SPECIES	USFS	ONHDB 95
S	Agoseris elata	R6 Sens.	2
D	**Agrostis howellii**		1
S	Allium campanulatum		4
S	Ammannia robusta (= A. coccinea)		3
S	Arabis furcata		4
S	Arabis sparsiflora var. atrorubens	R6 Sens.	2
D	**Bolandra oregana**		1
S	Botrychium lanceolatum	R6 Sens.	2
S	Botrychium lunaria	R6 Sens.	2
S	Botrychium minganense	R6 Sens.	2
S	Botrychium montanum	R6 Sens.	2
S	Botrychium pinnatum	R6 Sens	2
S	**Calamagrostis howellii**		
S	Carex livida	R6 Sens.	2
S	Carex macrochaeta		2
D	Castilleja levisecta		1-ex
D	Castilleja rupicola		3
D	Cimicifuga elata	R6 Sens.	1
S	Chaenactis nevii		4
S	Collomia larsenii		4
S	Coptis trifolia	R6 Sens.	2
D	Corydalis aquae-gelidae	R6 Sens.	1
S	Cyperus bipartitus (= c. rivularis)		3
S	Cypripedium fasciculatum		1
S	Cypripedium montanum		4
S	Delphinium nuttallii		3
S	Diphasiastrum complanatum	R6 Sens.	2
D	**Douglasia laevigata**		3
D	Erigeron howellii	R6 Sens.	1
D	Erigeron oreganus		1
S	Fritillaria camschatensis	R6 Sens.	2

S	Hackelia diffusa var. cottoni		4
S	Hackelia diffusa var. diffusa		1
D	**Hieracium longiberbe**		4
S	Howellia aquatilis		1-ex
S	Huperzia occidentalis	R6 Sens.	2
D	Lewisia columbiana var. columbiana	R6 Sens.	2
S	**Lupinus latifolius var. thompsonianus**		4
S	Lycopodiella inundata	R6 Sens.	2
S	Lycopodium annotinum		4
S	Montia diffusa		4
S	Ophioglossum pusillum	R6 Sens.	2
D	Penstemon barrettiae	R6 Sens.	1
S	**Poa gracillima var. multnomae**		
S	Potentilla villosa var. parviflora	R6 Sens.	2-ex
S	Rorippa columbiae		1
S	Scheuchzeria palustris var. americana	R6 Sens.	2
S	Scirpus cyperinus		4
S	Streptopus streptopoides	R6 Sens.	2
D	Sullivantia oregana		1
D	Suskdorfia violacea	R6 Sens.	2
S	Synthyris stellata		4
D	Tauschia stricklandii	R6 Sens.	2
S	Vaccinium oxycocus		4
S	Utricularia minor	R6 Sens.	2

Liverworts, Mosses, and Lichens

Documented (D) and suspected (S) to occur in the East Tributaries of the Columbia River watershed.

	SPECIES	USFS	ONHDB 95
Liverworts:			
S	Anastrophyllum minutum		3
S	Chiloscyphus gemniparus		1
S	Gymnomitrion concinnatum		3
S	Herbertus aduncus		3
S	Marsupella concinnatum		3
S	Marsupella condensata		3
S	Nardia japonica		3
Mosses:			
S	Conostomum tetragonum		3
S	Polytricum sphaerothecium		3
Lichens:			
S	*Lecanora pringlei*		3
S	Usnea sphacelata		2

APPENDIX 8. AQUATIC SPECIES

Table 30. Known Fish Species and Locations

Ct = cutthroat RB = rainbow Ch = chinook St = steelhead

	Forest Service Surveys	Chet Green's Report	Upper limit anadromy	Comments
Tanner Creek	1991: RB up to rm 5.0 where flow becomes intermittent	Above falls (rm 1.5) look like redbands, below falls look like coastal rainbow.	rm 0.1, Historic 1.6? Ch, St, coho	Stocked RB fingerlings annually in 40's, packed in "1 mile by man". Til when? Barrier Falls at r.m. 1.6
Eagle Creek	1990: RB at least up to rm 5.5	RB, look like coastals subsp.	rm 2.0, Ch, St	Stocked RB fingerlings annually in 40's, packed in "5 miles by man". Til when?
East Fk Eagle			No anad.	Little info.
Opal Creek	1990: Dry trib. in summer		No anad.	Several small discrete ponds in headwaters
Herman Creek	1994: RB up to just below Hicks Lk	RB	rm 5.6 St, coho, Ch	Stocked RB fingerlings annually in 40's, packed in "5 miles by man". Til when?
East Fk Herman	1994: no fish? when electroshocked		rm 0.1	potential for stellhead to rm 0.1
Lindsey Creek	1979: RB up to rm 0.06,electroshock, also coho, cottids. 1963 (OR Game Comm): Rb, Ct, Ch, Coho, St present	RB, potential redband	rm 0.25 St, Coho	No record of stocking Falls at r.m. 0.25, impassable
Warren Creek	1979: no fish found, electroshocked up to rm 0.2 (50' falls)		?rm 0.05?	Flow subterranean from rm 0.05 to 0.15 (1979)
Smaller Creeks:				
Ruckel	1979: highway culvert a barrier, no resident fish noted.			'79 channel dry except for short section between RR & hiqhway (many coho fingerling)
Rudolph, Dry, Grays				
Gorton	1979: unidentified fry at rm 0.5			Mouth is dry, but some flow above rm 0.4
Harphan	1979: Highway culvert barrier			
Summit	1979: Dry at mouth			
Cabin	1990: No fish			200' falls near mouth, lower 0.8 miles watered.

Starvation	1979: no fish noted near mouth			
Viento	1979: rm 0.15 electroshocked RB and cutthroat up to 20 cm., also coho and sculpin.		Rm 0.2? coho, St	Creek drains into lagoon formed by RR trestle aggregate. Stocked with RB in 40's, til when?

No brook trout noted in any tributary of the Columbia Gorge East. Streams just west of this area (Bridal Veil, McCord, Multnomah) contain cutthroat trout. It will be interesting to get the genetics results back to be more certain which species or subspecies resides within these streams. Bridal Veil and Multnomah were stocked with rainbow trout for at least a period in the 1940's, but the streams seem to presently contain cuthroat trout.

Table 31: Lakes Fisheries Surveys Summary

All surveys and subsequent data reflect midsummer conditions

NAME ELEVATION	ACRES Max. Depth	OUTFLOW cfs & name	FISH INFO RB = rainbow EB = brook	Fish Sizes (ave size)	Natural Reprod?	AQUATIC VEG?	AMPHIBIAN NOTED?	NOTES N = Nymph, A = adult
Warren 3700'	4.5 8'	Seep # Dry + Warren Cr	stocked EB since at least the 40's **Present EB**	≤8" (7.5") * ≤15" (7.1") +	NO, *+ potential	many sedges *+	Newt and unidentified salamander +	Cond. Range 1.097-1.474 mean condition factor 1.26 + Stomach content: stonefly N, caddis N, Damselfy A + Fair to Good fish cover from wood, sedge, undercut bank + 3 campsites around lake +
North 4000'	8.0 6'	0.5 *# Lindsey Cr	stocked EB since at least the 40's **Present EB**	≤17" (9.2") * ≤9" (5.5") +	YES * but low	some sedges *+	2 cascade frogs + 3 Cascade frogs $	Cond. Range 1.08-1.92 mean condition factor 1.42 + Stomach content: (+crayfish, damselfly N/A, mayfly N/A), (*flying ant, crayfish, mosquito) Dirt/rock dam leaking water, losing 5-6' of depth with seepage 7 campsites around lake +
Bear 3,900'	3.5 12'	Dry + Etrib Lindsey	stocked EB since at least the 40's **Present EB**	≤11" (8.5") * ≤12" (8.5") +	Questionable * See note Fry not noted+	sedge, rush, cattail +	Many newts, lambystoma+ 1 Cascade frog, >150 newts $	Cond. Range 0.95-1.34 mean condition range 1.11 + Stomach content: (+50%zooplankton, the rest caddisfly N and dragonfly N), (* beetle, flying ant, stonefly N, caddisfly N, true bugs) 1955 reports natural production but data does not seem to support this. 3 campsites around lake +
Hicks 3,900'	2.3 6'	aprox 0.5 * Herman Cr	stocked EB, stopped in 60's **Present EB**	≤8" (6.5") * ≤12"	YES, * fry noted -Not stocked since 60's	sedges, moss, marsh marigold *	?	Brook trout look in good condition ^ Stomach content: *damselfly, mayfly N, beetle and fly larvae Slow continous spring along south shore * **Pond actively maintained by beaver dam. A series of ponds/dams downstream of this lake support rainbow trout.** ^
Mud 3,700'	1.5 5'	seep * EF Herman	stocked EB and RB, stopped RB in 1946, EB in 60's **Present RB**	≤9" (8.3") * ≤10" RB	YES, * many RB fingerling noted	water lily sedge etc *	?	RB in good condition^, stocking of EB not successful* Stomach content: caddis N, fly N, flying ant **Pond actively maintained by beaver dam, lodge present on edge.**^
Wahtum 3,700'	57.0 184'	Seep # EF Eagle Cr	stocked EB and RB since the 40's stopped RB in 1946 **Present EB,**	≤17" (8.2")EB* ≤7" (6.4") RB*	YES, + fry noted, sp. not identified	Sedges + Attached veg *	unidentified frogs +	Cond. Range EB 0.65-1.28 (mean 1.09), RB 1.02-1.4 (mean 1.23) + Stomach content: beetle, crayfish, **brook trout**, fly larvae. * Below average condition factor (1.13) for brook trout on Mt Hood NF, appearance of large head as compared to length. + Only lake with light to heavy tapeworm infestation. * Only lake that may have had natural population of trout, similiar to Lost lake,

			RB	≤8" (6.4") EB+ ≤8" (6.8") RB+				due to size/depth. No records.
Rainy 4,100'	9.6 6'	seep # Rainy Cr	stocked EB since 40's **Present EB**	≤10" (6.2") * Dead15.5" found also	YES, * Fry noted	No aquatics # *	?	Stomach content: flying ant, crayfish, beetle * Boulder dam on NE side of lake about 10' in height.
Dublin 3500'	2.0 9'	Seep trib to Eagle Cr	stocked EB since 80's? **Present EB?**	?	?	?	?	Surveyed only in 1940, at time, no fish Has been stocked since then but no surveys completed

o 1940 Survey
* 1955 Survey (gill net)
# 1975 Survey (physical only)
+ 1991-1994 Survey (gill net)
^ 1994 survey by col Gorge Scenic Area (physical survey with fish data by hook/line)
$ 1995 (8/31) surveys by private wildlife consultant, Char Corkran

Table 32. Aquatic Amphibians Species and Their Potential Vulnerability to Stocked Fish

	BREEDING SITE REQUIRED	ADULT HABITAT	DIET (JUVENILE / adult)	REMARKS	Affected by stocked fish?	HOW?	SIGNIFICANT?
Northwestern salamander *Ambystoma gracile*	POND slow stream	*terrestrial or neotene	ZOOPLANKTON invertebrates	Produces mild iritant/ toxin as larvae and adult	marginally, see remarks	competition for food	probably not
Long-toed salamander *Ambystoma macrodactylum*	POND slow stream	*terrestrial	ZOOPLANKTON, COPEPOD, OTHER SAL/ invertebrates	specifically use temp and small ponds that wouldn't naturally harbor fish.	Yes	Predation, competition	probably not, a common sp., widespread
Roughskin salamander *Taricha granulosa*	POND slow stream	terrestrial or aquatic	AQUATIC INVERTEBRATE amphib egg/juv, inverts, slug etc	Produces extremely deadly poison	No, see remarks	poisonous at all stages	No
Cope's Giant salamander *Dicamptodon copei*	STREAMS alpine pond	aquatic/ neotene	AQUATIC INVERT, TAILED FROG EGG/JUV, CANNIBAL	Strongly neotenic, remain instream throughout life	potentially in some localized areas	coexist with fish naturally	probably Not
Pacific Giant salamander *Dicamptodon tenebrosus*	STREAMS alpine pond	*terrestrial or neotene	JUV SAME AS COPE'S insects, inverts, amphibs, mice	can be neotenic but more more likely to transform into terrestrial fom then Cope's	same as Cope's	present popul. Coexist with fish	probably Not
Cascade Torrent salamander *Rhyacotriton cascadae*	SEEP, SM STREAM	seep-side, wet areas	CADDIS, INVERTS/ springtails, sm insects, spiders, amphipods	Preyed on by Pacific Giants	prob. Not	lives in very shallow habitat, seeps, spray area	No
Tailed frog *Ascaphus truei*	STREAMS	streamside and aquatic	DIATOMS, MICROSCOPIC ALGAE, insects	Preyed extensively by Giant salamanders	prob. Not	fast streams, coexist now with fish	No
Western toad *Bufo boreas*	PONDS/ MARSH	*terrestrial	FILAMENTOUS ALGAE, CARRION/ inverts, insects	Can produce mild toxin	marginally, see remarks	competition	probably Not
Pacific treefrog *Hyla (Pseudacris) regilla*	TEMP POND, MARSH	terrestrial	ALGAE, DETRITUS/ insects, spiders	almost exclusively uses shallow marsh/swamps/ ephemeral areas	No		No
Red-legged frog *Rana aurora*	PONDS MARSH	terrestrial	ALGAE, VEG MATTER?/ Inverts, insects, oppurtunistic	eggs/tadpole stage have few defenses, adult has mild toxin in dorsolateral folds	Yes	predation of egg and juv. in stocked ponds	localized significance, ie. Marsh area unaffected
Cascades frog *Rana cascadae*	PONDS, MARSH, streamside	*terrestrial	same as red-legged frog	same as red-legged frog	Yes	"	"

Table 33. Amphibian Surveys within the Columbia Gorge East

Surveys by Char Corkran (wildlife consultant), unless otherwise noted.

LOCATION	FROGS	SALAMANDERS
Gorton Creek (near Wyeth)	red-legged frog	Dunn's
Talus west of Wyeth Campground		Larch Mountain, Dunn's
Herman Cr mouth, intermittent	red-legged frog	
Cedar Swamp (1.5 miles below Mud Lake, east slope) FS crew	red-legged frog	
Starvation Creek Park		Larch Mountain, Ensantina, Oegon Slender
Starvation Creek below falls, rm 0.2	Tailed frog	Pacific Giant, Cascade Torrent

*moist areas, ie seeps, logs on forest floor, streamside, marsh

Table 34: Comparison of Zooplankton and Phytoplankton Rates Between Fishless Lakes and Lakes with Fish

Data from 1991 to 1994 lake survey program by Mt. Hood National Forest

	LAKE DATA		ZOOPLANKTON DATA			PHYTOPLANKTON DATA			
	Acres	Depth	# per	Edible sp.per	%edible sp	#/ml	microM/ml	Trophic	Diversity
Lakes draining into the Columbia River			cubic m.	cubic m.			(biovolume)	state	index
Warren	5	8	13,961	1,056	8	456	333,854	41.9	3.9
North	8	6	7,779	46	1	2,058	213,343	38.7	1.2
Bear	3	10	17,398	14,466	83	11,270	225,500	39.3	0.1
Wahtum	60	160	2,040	376	18	137	8,116	15.9	2.1
Lakes in adjacent watershed (Hood River)									
Laurance	125	105	36,609	8,687	24	451	160,176	36.7	2.8
Ottertail	3	8	47,709	31,162	65	565	33,013	25.4	1.5
Scout	2	7	34,829	609	2	4,156	1,980,297	54.8	0.6
Lakes in adjacent watershed (Sandy and Little Sandy)									
L Goodfellows	10	9	19,169	1,439	8	790	100,912	33.4	2.5
M Goodfellows	9	12	6,882	2,855	41	357	92,380	32.7	3.5
U Goodfellows	21	40	1,274	549	43	811	28,624	24.4	0.9
Burnt	6	26	26,913	8,377	31				
Cast	4	21	31,290	16,189	52				
Dumbell	3	4	72,481	46,221	64				
AVERAGE			**24,487**	**10,156**	**34**	**2,105**	**317,622**	**34.3**	**1.9**
Fishless Lakes within Bull Run Watershed *									
Hickman	11	15	44,986	3,086	7	632	72,000	30.9	2.0
Big Bend M	6	9	14,871	1,040	7	158	55,238	29.1	2.9
Dickey	2	4	98,027	21,744	22	1,185	236,236	39.5	2.0
Ol Baldy	2	5	60,617	32,769	54	684	108,626	33.9	2.2
Triangle	2	5	72,402	42,142	58				
AVERAGE			**58,181**	**20,156**	**29.6**	**665**	**118,025**	**33.4**	**2.3**

* No record of lake having been stocked, and no fish noted during survey

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