Mt. Hood National Forest

White

Rock-Threemile

Badger-Tygh

WHITE RIVER WATERSHED ANALYSIS

White River from Bonney Butte

AUGUST 1995

Pine-Oak in Lower Threemile

Eastside Watershed Analysis Team

18 August 1995

Dear Watershed Analysis User,

Enclosed for your use is a copy of the first iteration of Watershed Analysis for White River subbasin. The subbasin covers approximately 270,000 acres. The analysis primarily focuses on lands within the National Forest boundary, so covers approximately 158,000 acres. We ask that you keep the in mind that this analysis is largely qualitative, rather than quantitative.

As the Forest Service and other users apply the suggestions, recommendations, and concepts to the watershed, we expect to find out whether the watershed analysis leads us in the appropriate direction or not. As we discover new things about the watershed, gain new information and understanding, and monitor the results of what we try, we expect changes in the analysis results. To further emphasize that we expect things to change, this analysis has been placed in a 3-ring binder so we can amend and add to the document.

At some point, we will accumulate enough changes to warrant the second iteration. At present, we do not know at what point that would happen. By the second iteration, we expect to also include the results of the Columbia Basin analysis currently on-going in Walla Walla, WA. Our potential partners in White River subbasin are also waiting these results in order to guide their planning and management efforts.

We hope you find this watershed analysis useful. Please feel free contact the 1995 Eastside Watershed Analysis Team at the locations below after September 30, 1995. Before September 30, you may contact us at Hood River Ranger District (503-352-6002). We also encourage you to contact either Di Ross, the White River Steward (Bear Springs: 503-328-6211), or Becky Nelson, the Badger Steward (Barlow: 503-467-2291). Di Ross' stewardship area includes the White River watershed within White River subbasin. Becky Nelson's stewardship area includes the Rock-Threemile and Badger-Tygh watersheds.

Sincerely,

The Eastside Watershed Analysis Team

Ron Boehm--Team Leader (R.BOEHM:R06F06D05A)
503-630-6861

Linda Batten (L.BATTEN:R06F06D02A)
503-328-6211

Louisa Evers (L.EVERS:R06F06D01A)
503-467-2291

White River Subbasin Watershed Analysis

FIRST ITERATION

EASTSIDE WATERSHED ANALYSIS TEAM

AUGUST 1995

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EXECUTIVE SUMMARY

Introduction

White River subbasin is a Tier 2 Key Watershed under the Northwest Forest Plan. Tier 2 Key Watersheds were selected as sources of high water quality and a Watershed Analysis is required prior to all management activities except minor activities such as those Catagorically Excluded under the National Environmental Policy Act (ROD p. B-19). This subbasin covers approximately 268,000 acres between Mt. Hood and the Deschutes River. Approximately 60% of the subbasin, or 156,000 acres, lies within the National Forest boundary. White River subbasin is comprised of three fifth field watersheds as defined by the Northwest Forest Plan:

- White River
- Rock-Threemile
- Badger-Tygh

We chose 1855 as our breakpoint year for evaluating the range of natural conditions (RNC). In 1855, the treaty with the Middle Tribes of Oregon was signed, transferring most of the subbasin into the ownership of the US Federal government and opening the way for legal settlement by Euro-Americans.

We used diary entries, General Land Office survey notes, a survey of the Cascade Range Forest Reserve, and similar information to describe the past conditions in as much detail as we could. We also used this information along with hints from the present condition to speculate on probable past conditions where we did not have much detail. We used a variety of databases and personal information to describe the current conditions.

In analyzing this subbasin, we found we needed to break it into smaller segments than the three fifth field watersheds. We developed three climatic zones (Crest, Transition, and Eastside) to divide the subbasin on a vegetative basis and ten subwatersheds (White, Barlow, Clear, McCubbins, Boulder, Gate, Rock-Threemile, Badger-Tygh, Jordan, and Butler) on a physical basis. Most analyses use these two subdivisions to describe conditions, events, processes, and so forth.

We developed Diagnostic Stand Types for the vegetation. These stand types do not cover every stand type that may occur. Instead, we used them as key indicators of landscape condition in the past and present. We were particularly interested in what may have been the typical Old Growth structure types in each climatic zone. We decided that a stand type called Late Seral Tolerant Multistory, which approximates that Old Growth stand type described in the Northwest Forest Plan, occurred in the Crest Zone. The typical Old Growth structure in the Transition Zone was a Cathedral Forest, usually dominated by ponderosa pine and Douglas-fir. Late Seral Parklike stands dominated by ponderosa pine and Oregon white oak were the Old Growth of the Eastside Zone.

We repeatedly returned to the Mt. Hood Forest Plan, the Northwest Forest Plan and the FEMAT report to keep the intent of these documents in mind when the details did not seem to make sense. We also tried to follow a parallel track with the Columbia Basin assessment effort, since the lands east of the Forest boundary will be "covered" by that document, and the National Forest lands within this subbasin may be partially or fully covered by that plan.

We received many comments on the draft watershed analysis. We reviewed all the comments, incorporated some of the suggested changes but not all. This final document differs little in substance from the draft. The review comments resulted in the addition of new information, correction of mistakes caught by others, and the clarification of some ideas. The main thrust and recommendations of the analysis remain unchanged between draft and final versions of this iteration.

Appendices to the document provide supporting material to many of the answers and conclusions. In some cases, the conclusions reached by a particular resource specialist may differ from the conclusions reached during synthesis. Readers are encouraged to review all appendices for supporting information and for opinions which differ from those presented in the main document.

Public Involvement

Direct public involvement primarily consisted of one public meeting held in Tygh Valley on February 16, 1995, and personal contacts with other governmental agencies. Indirect public involvement occurred through the numerous recent planning documents covering projects within the subbasin, such as the White River Wild and Scenic River Plan and Environmental Assessment. Other agencies contacted included:

- US Fish and Wildlife Service,
- Natural Resource Conservation Service,
- Prineville District of the BLM,
- the Confederated Tribes of the Warm Springs Reservation of Oregon,
- Oregon Department of Forestry,
- Oregon Department of Fish and Wildlife,
- Oregon Natural Heritage Program,
- Wasco County Planning Office, and
- Wasco County Water Master.

Stewardship Involvement

Both the White River and Badger stewardship teams were heavily involved in the entire analysis process. Much of the personal information on conditions came from these people. Both teams were very involved in the synthesis process, which took about three months of the time allotted for this analysis.

Constraints on Analysis

This iteration of the White River Watershed Analysis suffered from time and data constraints. Much of the FY95 timber sale program lies within the subbasin. In order to meet the deadlines for advertising these sales in FY95, we had to complete our analysis by June 1. Analysis began in February, allowing four months to cover such a large area. Another major constraint was the lack of data or lack of data in an easily usable format. In some cases, we lacked the data needed for the National Forest lands. In many cases, data was available for the non-National Forest lands but not in a format that we could use quickly. We felt we did not have the time to devote to translating the data into a usable format.

The time and data constraints caused two things to happen. First, we did little or no analysis on non-National Forest lands. In most cases, the other ownerships are mentioned briefly, if at all. Because we could not examine the other ownerships, White River Watershed Analysis is not a complete watershed analysis as described in the watershed analysis guide. This analysis is as complete as the available data allows for lands within the National Forest boundary. Second, much of the analysis is qualitative instead of quantitative. We did not have time to completely "clean up" many of our existing data and databases, use very many models, or collect new information. Because the analysis is largely qualitative, the useful lifespan of this document may be much shorter than other watershed analyses.

Issues and Results

The Watershed Team, in conjunction with the stewardship teams developed eleven main issues. Each issue had a dominant theme and several key questions which we attempted to answer. Questions were phrased in a "yes" or "no" answer format with explanation following. Not all questions were answered, and Issue 4 was dropped from this iteration due to lack of time and information.

Issue 1--Standards and Guidelines. Initially we doubted whether all or parts of the three Late-Successional Reserves (LSRs) in the subbasin could meet the intent of the Northwest Forest Plan. After re-examining the Northwest Forest Plan and the FEMAT report, we concluded that all LSRs could meet the *intent* of the Plan assuming that the intent is *to provide habitat for species dependent on forests dominated by large trees*. We defined what type of forest this intent represented in each climate zone and each LSR:

- White River LSR--Late Seral Tolerant Multistory in the Crest Zone, Cathedral in the Transition Zone, and Late Seral Parklike in the Eastside Zone.
- Douglas Cabin LSR--Cathedral near Gordan Butte and in sheltered areas, Late Seral Parklike elsewhere.
- Triangles LSR--Late Seral Parklike.

We proposed changes to the Mt. Hood Forest Plan standards and guidelines for downed wood, sediment, pools, thermal cover, and forage enhancement on big game summer range. In general, the standards for bank stability, water temperature, and turbidity appear to be appropriate. For in-channel large wood, we found that FW-092, FW-093, and FW-096 were appropriate while the other standards were not. In some cases, the existing numeric standards still serve a purpose, such as guidance for restoration efforts. Our conclusion for specific standards and guidelines revolved around whether the standard and guideline recognized natural variation or used a "one size fits all" approach. We also developed additional recommendations which could either take the form of a standard and guideline or simply serve as general management strategies towards meeting standards and guidelines.

Issue 2--Compaction. Based on the limited data and time available to analyze it, we concluded that compaction is a significant problem in Rock-Threemile, Gate, Clear, and the southern half of Boulder subwatersheds. Compaction may be significant along the southern edge of McCubbins and southeastern corner of White subwatersheds. Restoration related in these subwatersheds may need to be staged in order to not over-stress the systems in the short-term. In general, management practices and on-going restoration efforts within the subbasin have already begun to have significant effects on compaction levels.

Issue 3--Aquatic/Riparian Ecosystems. The most far-reaching result under this issue are the recommendations on Riparian Reserve widths. We developed a list of guidelines for adjusting Riparian Reserves on-the-ground and created a preliminary map of adjusted Riparian Reserves. Further, *these are **not** "hands-off" Riparian Reserves.* In order to replace natural processes that have not been allowed to operate freely and probably will not be allowed to operate freely in the future, we must actively manage these reserves, particularly on intermittent streams and on all streams of the Transition and Eastside Zones.

Additional conclusions under this issue include:

- Management activities have reduced riparian and in-channel downed wood potential in several subwatersheds and creeks.
- Additional water temperature monitoring is needed to better determine the range of natural conditions for water temperature and to better understand what effects irrigation withdrawals have on stream temperature.
- It is very difficult to separate the effects of climate changes, drought cycles, irrigation withdrawals, and land uses on the current and past peakflow regimes. We were unable to determine if peakflows have been significantly altered compared to pre-1855 conditions. We did conclude that peakflow has probably increased relative to an unmanaged forest condition under the same climate regime. It also appears that we have significantly increased potential peakflows resulting from smaller rain-on-snow events, but not on larger events.

- The National Forest lands do contain species dependent on the continued presence of riparian hardwood communities, a community type that has all but vanished within the Forest boundary. Four such species are yellow warbler, red-eyed vireo, black phoebe, and downy woodpecker.

Issue 4–Private lands. This issue was dropped from this analysis.

Issue 5–Grazing on National Forest lands. In general, we lacked sufficient data to conclude whether grazing on National Forest lands would prevent attainment of the Aquatic Conservation Strategy objectives. We did conclude that the utilization standards in the Mt. Hood Forest Plan did not present a problem. We also concluded that the real potential problem with grazing was the physical damage caused by cattle in riparian areas. However, we lack sufficient data on the extent of damage, how much damage would be tolerated under the Aquatic Conservation Strategy, and of the damage known, how much was caused by past grazing and how much by present. We believe there may be a significant amount of cattle damage caused by past grazing that has never recovered adequately. We recommended a monitoring program to try and answer some of the questions noted above.

Issue 6–Introduced Plants and Animals. We found several native/non-native species interactions within the subbasin. In some cases, the non-native species involved are considered desirable or at least acceptable, but are not consistent with the emphasis of the Northwest Forest Plan on native species. Examples of these types of species are cattle and wild turkey. In other cases, the non-native species are considered desirable by other agencies or landowners but not desirable by the Mt. Hood National Forest. Examples of these types of species are cheatgrass and brook trout.

Noxious weeds do not present a serious problem for native plants at present, but the potential exists for problems in the future. Of particular concern are houndstongue, scotch broom, and knapweeds. At present, a more serious problem for native plants are non-native species used in wildlife forage, range improvement, and erosion control seed mixes. The species planted are highly palatable and generally do not spread far beyond the area planted, but occupy habitat that native species might otherwise use. Of particular concern are orchard grass and intermediate wheatgrass, since these species are so widely used.

We made several recommendations on noxious weed management and control. We believe fish stocking should end in all natural lakes, with the possible exceptions of Badger Lake and Clear Lake. Stocking might continue in Badger Lake and Clear Lake provided no native fish remain in either lake and measures are taken to keep the non-native fish in the lakes and the native fish in the outlet streams from interacting. We believe fish stocking could continue in Rock Creek Reservoir and Pine Hollow Reservior provided measures are taken to keep the non-native fish in the reservoir and the native fish in the streams from interacting. Fish stocking has changed fish species compositions in many of the lakes and several streams.

Issue 7–Disturbance Processes. We found several areas where the risk of catastrophic wildfire and epidemic levels of insects have increased beyond the range of natural conditions, primarily in the Eastside and Transition Zones. In these same zones, both the upland and riparian ecosystems have become less resilient to natural events. Many of the upland stands are over-stocked and dominated by the climatic climax species. Irrigation withdrawals appear to have narrowed the riparian communities below the diversion points. No culverts allow large wood to pass from the Transition Zone to the Eastside Zone; we believe that before 1855, the Transition Zone was a significant source of large conifer logs for the Eastside Zone.

The changes in vegetation communities and landscape patterns have also driven changes in how different species use the landscape. Deer and elk population levels are much higher than pre-1855 conditions. The northern spotted owl was able to expand eastward. Open ditches flowing in otherwise dry areas have dispersed wildlife and fishes over a larger area than they might have been before 1855.

We made several recommendations for amending the Mt. Hood Forest Plan to better incorporate natural processes and recognize natural variation in habitat elements. We only suggested changes to the Forestwide standards and guidelines and did not examine specific land allocations. We did not undergo the same analysis for the Northwest Forest Plan since we have not had a chance to apply these standards and guidelines to any great degree to test their "goodness of fit."

Issue 8–Species Viability. In general, we lacked sufficient information to discuss species viability to any great detail or with any confidence. We did evaluate which species, both within and outside the range of the northern spotted owl and not discussed in any detail in other plans, should receive additional consideration when changing Riparian Reserve widths or evaluating projects. Species of particular concern include:

- spotted frogs–isolated population in Camas Prairie,
- redband trout–genetically unique endemic threatened by cross-breeding with hatchery rainbow trout and habitat degradation,
- *Cortinarius wiebeae* - (a rare gillled mushroom) only known location is Camas Prairie, and
- *Rhizopogon brunneiniger* - (a rare false truffle) type locality is around Devil's Half Acre Campground,

Further, the National Forest lands cannot provide for all ecosystem components in the subbasin. Three native plant communities are found only on private lands. These communities are limited in White River subbasin, but not limited within the Deschutes Province or Columbia Basin.

Issue 9–Recreation Uses. Recreation demand is increasing on the whole, particularly for sites and activities in association with water. Recreational use has had detrimental effects on soil, water, vegetation, wildlife, and fish, primarily due to poor design of facilities and/or lack of adequate control measures. Both of these factors are driven by the lack of adequate budgets, especially for dispersed recreation management. We recommend against additional developed recreation facilities within LSRs and Riparian Reserves. We suggest that new trail construction should not proceed unless the design results in a low maintenance trail that does not prevent attainment of the Aquatic Conservation Strategy objectives, or an alternative maintenance strategy assures that the trail does not prevent attainment of aquatic objectives due to lack of proper maintenance. We proposed several restoration projects on recreational facilities.

Issue 10–Access and Travel. This issue was winnowed down to only two key questions. The first question is of most concern for recreation travel within the subbasin. We were asked to quickly evaluate whether an off-road vehicle trail crossing was feasible within the White River Wild and Scenic River corridor using nine criteria. We did not find any potential crossings that met all nine criteria. A trail crossing may still be feasible by examining the corridor using more site-specific information. Otherwise it appears that either all off-road vehicles will need to be street-legal or that we will need to work with the State to designate selected roads for dual use.

We found that almost none of the existing stream crossings met the 100-year flood requirement in the Northwest Forest Plan. We assumed that any stream crossing that could not pass a 100-year flood event would probably fail and cause significant resource damage downstream. We even found some stream crossings that did not meet the Mt. Hood Forest Plan's standard for a 50-year flood event. We could not find any coherent method to prioritize restoration work on these crossings. When combined with the analysis results of other key questions, we created a list of crossings that we recommend should be able to pass large wood and a list of crossings that are currently migration barriers for fish and salamanders.

Issue 11–Commodity Production. This issue covered a wide variety of forest products including timber, water, game animals and fish, rock, rural development, and tribal treaty rights. Livestock forage concerns were covered by Issue 5 and not repeated here. We expect to provide timber over the short-term out of all Northwest Forest Plan land allocations except Wilderness and 100-acre LSRs. Over the long-term, timber production on a regular basis is questionable in LSRs and Riparian Reserves.

Water within the subbasin is not over-allocated according to state water law but is over-allocated in an ecological sense. Oregon State Parks has applied for an in-stream water right to provide for relatively high levels of flow over White River Falls. If granted this right, White River subbasin will be closed to additional surface water right applications. The Forest may wish to acquire water rights for instream flows on selected streams to improve aquatic habitat conditions. If so, they will need to buy or lease water rights from current holders, or apply for abandoned rights.

We can meet state management objectives for elk and game fish, but might not for deer. At the highest population levels, the White River Wildlife Management Unit, which includes additional lands beyond White River subbasin, has only reached 80% of the goal. We recommend that ODFW reassess this goal and consider lowering population expectations. We also recommend that stocking of non-native game fish end on National Forest lands, with the possible exception of Rock Creek Reservoir, Badger Lake, and Clear Lake.

Three to five rock pits are located on sites within or potentially within Riparian Reserves. All three pits known to fall within Riparian Reserves--Stockton, Jakey, and White River--appear to prevent attainment of the Aquatic Conservation Strategy objectives. We have recommended restoration on Stockton and Jakey pits, but do not know what to recommend for White River pit. Two other pits may lie within Riparian Reserves--Maxine and Green Lake. The status of these pits in relation to the aquatic objectives is unknown. In addition, the reclamation attempt at Forest Creek Pit has apparently failed. High levels of sediment and erosion were noted in this pit in Spring of 1995.

We believe that many opportunities exist for rural development and "jobs in the woods." Rural development efforts should focus on opportunities that both diversify the economy of this portion of Wasco County and that provide year-round employment, preferably at a so-called family wage.

The Treaty with the Middle Tribes of Oregon listed several rights provided to the signatory tribes and bands. We may best meet our treaty obligations by working with the CTWS to coordinate management of cultural plants and gathering sites and to discuss potential impacts of grazing or other projects on cultural plants, and by assuring that State Water Quality standards are meet within the National Forest lands.

Recommendations

Chapter 6 consolidates the recommendations generated by this analysis. Chapter 5 contains the background information that accompanies these recommendations.

Restoration Projects

The analysis pointed out several potential restoration projects. Initially we had hoped to develop an extensive list and prioritize the work on the basis of documented resource damage (High priority), suspected resource damage or damage expected within 5-10 years (Medium priority), and resource enhancement (Low priority). Instead, we developed such a large list based on resource damage that we felt that listing projects of Medium and Low priority was rather pointless. The existing list of restoration projects in Chapter 7 is much larger than any expected funding over the next several years. Instead, project funding will likely be driven more by funding for emphasis items from the Washington Office and Regional Office.

Data and Analysis Gaps

The team identified several data and analysis gaps. Most gaps were due to lack of time to either consolidate or acquire existing data stored in forms not readily accessible or to analyze what data was available in the time allotted. We also identified some additional data needs. In many cases, the next iteration of analysis on this watershed should proceed smoother and more completely since by that time the entire subbasin should be covered by an overall guiding document similar to the Northwest Forest Plan, local databases should be more complete and up to standard, and the analyzers should have a better idea of what is needed to complete the analysis.

Old Growth

Using the Diagnostic Stand Type definitions, we mapped the existing Old Growth in each fifth field watershed. *The Northwest Forest Plan requires that we protect **all** existing old growth in watersheds with 15% or less on federal lands* (ROD p. C-44). Our results are:

- White River watershed--approximately **15%** Old Growth concentrated in the upper elevations of the Crest Zone.
- Rock-Threemile--**0%** Old Growth.
- Badger-Tygh--**less than 5%** Old Growth, consists of one large stand with some remnant Cathedral characteristics in the "thumb" of Badger Wilderness between Badger Creek and the south wilderness boundary.

However, the situation is not as grim as it initially appears. Both Rock-Threemile and Badger-Tygh watersheds contain many stands that we believe could be manipulated back towards the typical Old Growth structure type relatively quickly. Both the Cathedral type and Late Seral Parklike type are dependent on frequent, low intensity disturbance. The lack of Old Growth in these two watersheds is primarily due to the lack of this type of disturbance. Both watersheds have stands dominated by older trees, but the structure type is not one considered stable over the long-term for the Transition and Eastside Zones.

CHAPTER 1: INTRODUCTION

White River subbasin is a Tier 2 Key Watershed under the Northwest Forest Plan. Tier 2 watersheds were selected on the basis of high water quality and a Watershed Analysis is required before management activities can proceed. Minor activities normally Categorically Excluded under the National Environmental Policy Act (NEPA) may proceed without a watershed shed analysis with the exception of timber sales (ROD p. B-19). White River subbasin lies in the Deschutes River Province (Figure 1.1). The subbasin includes three fifth field watersheds as defined by the Northwest Forest Plan: White River, Rock-Threemile, and Badger-Tygh (Figure 1.2). It consists of the mainstem of the White River plus all its tributaries. Throughout the report, the term White River refers to the entire subbasin unless otherwise specified.

As a convenient shorthand, land locations are sometimes described by GRID. A GRID consists of township and range numbers run together like so: GRID 312. The first number refers to the township, in this example 3 South. The next one or two numbers refer to the range, in this example 12 East. All townships and ranges are East and South of the Willamette Meridian and baseline. To distinguish between a land location GRID and any other type, the land location reference will always appear with all letters capitalized.

Other common shorthand names and abbreviations include:

FS	USDA Forest Service
BLM	Bureau of Land Management
ODFW	Oregon Department of Fish and Wildlife
CTWS	Confederated Tribes of the Warm Springs Reservation of Oregon
NRCS	Natural Resources Conservation Service
USFWS	US Fish and Wildlife Service
ODF	Oregon Department of Forestry
GLO	General Land Office
LSR	Late-Successional Reserve
RR	Riparian Reserve
ACS	Aquatic Conservation Strategy
RNC	Range of Natural Conditions
SCORP	State Comprehensive Outdoor Recreation Plan

Due to lack of time and resources, this watershed analysis focuses on lands within the National Forest boundary. Lands outside the boundary are mentioned only briefly, if at all.

SETTING

White River originates on the south flank of Mt. Hood in the White River Glacier and flows into the Deschutes River just above Shearer Falls. White River is the northernmost large tributary of the Deschutes River. The subbasin lies approximately 40 miles east-southeast of the Portland metropolitan area, 26 miles south of The Dalles, 15 miles south of Dufur, and 4 miles north of Maupin. It lies wholly east of the Cascade crest and covers approximately 268,146 acres. The primary road accesses into and through the subbasin are Oregon State Highways 35 and 216, US Highways 26 and 197, and Forest Roads 48, 43, and 27.

The ownership of the subbasin is very mixed (Table 1.1). Approximately 60% of the land, 157,995 acres, lies within the National Forest Boundary. The FS recently purchased 1,280 acres in seven parcels from the Rocky Mountain Elk Foundation. This land was owned by Mountain Fir Timber Company and harvested before selling it to the Elk Foundation. Most of White River lies in Wasco County and a portion in Hood River County.

Table 1.1 Ownership of White River subbasin.

Owner	Approximate Acres
National Forest	149,625
ODFW[1]	25,350
BLM	3,680
CTWS	6,480
Oregon State Parks	540
Other	82,471

[1] Includes land currently owned by Rocky Mountain Elk Foundation

Over 90% of the National Forest lands lie in Barlow and Bear Springs Ranger Districts. A small portion of the headwaters area lies on Hood River and Zigzag Ranger Districts. The BLM lands are managed by the Prineville District; these federal lands lie east of the area covered by the Northwest Forest Plan. Local offices for the state lands are in The Dalles while the agencies' regional offices are in Bend. The Oregon Department of Fish and Wildlife manages the Rocky Mountain Elk Foundation lands through the White River Wildlife Area. The Confederated Tribes of the Warm Springs Reservation in Oregon own various portions of the subbasin along its southern edge, primarily along Clear Creek.

White River includes several small natural lakes and several large and small impoundments. Badger Lake and Clear Lake were small natural lakes that dams increased in size. Other significant features in White River include:

- Barlow Road,
- Pacific Crest National Scenic Trail,
- Camp Cody youth camp,
- A portion of Mt. Hood Meadows Ski Area,
- Badger Creek Wilderness,
- White River National Wild and Scenic River,
- Graveyard Butte,
- White River Falls,
- Pine Hollow Reservoir,
- Wasco County Fairgrounds, and
- Tygh Valley State Park, better known by its local name--White River Falls State Park.

Several small communities lie within and adjacent to White River. Communities within the subbasin include Tygh Valley, Wamic, Pine Hollow, and Pine Grove. Maupin and Wapinitia lie just outside White River to the south. Friend lies just outside to the north.

The National Forest lands are allocated into several dominant uses by the Mt. Hood Forest Plan and the Northwest Forest Plan (Table 1.2). Allocated LSRs in the Northwest Forest Plan changed allocations under the Mt. Hood Forest Plan.

Table 1.2. Land allocations for FS lands in White River subbasin.

Northwest Forest Plan	
Late Successional Reserves	White River
	Douglas Cabin
	Triangles
Riparian Reserves	See Figure 5.2 (not shown in Figure 1.3)
Congressional Reserves	Badger Creek Wilderness (A2)
	White River National Wild and Scenic River (A1)
Administratively Reserved	Gumjuwac-Tolo Research Natural Area[1] (A3)
	Barlow Road Special Interest Area (A4)
	Unroaded Recreation (A5)
	Semi-Primitive Roaded Receration (A6)
	Special Old Growth (A7)
	Key Site Riparian (A9)
	Winter Recreation (A11)
	Bald Eagle Habitat Areas (A13)
Matrix	All lands not covered above with the exception of 100 acre LSRs and great gray owl protection buffers
Mt. Hood Forest Plan	Scenic Viewshed (B2)
	Pine-Oak Habitat (B4)
	Pine Marten/Pileated Woodpecker Habitat Areas (B5)
	Deer-Elk Winter Range (B10)
	Timber Emphasis (C1)

[1] Proposed, wholly within Badger Creek Wilderness

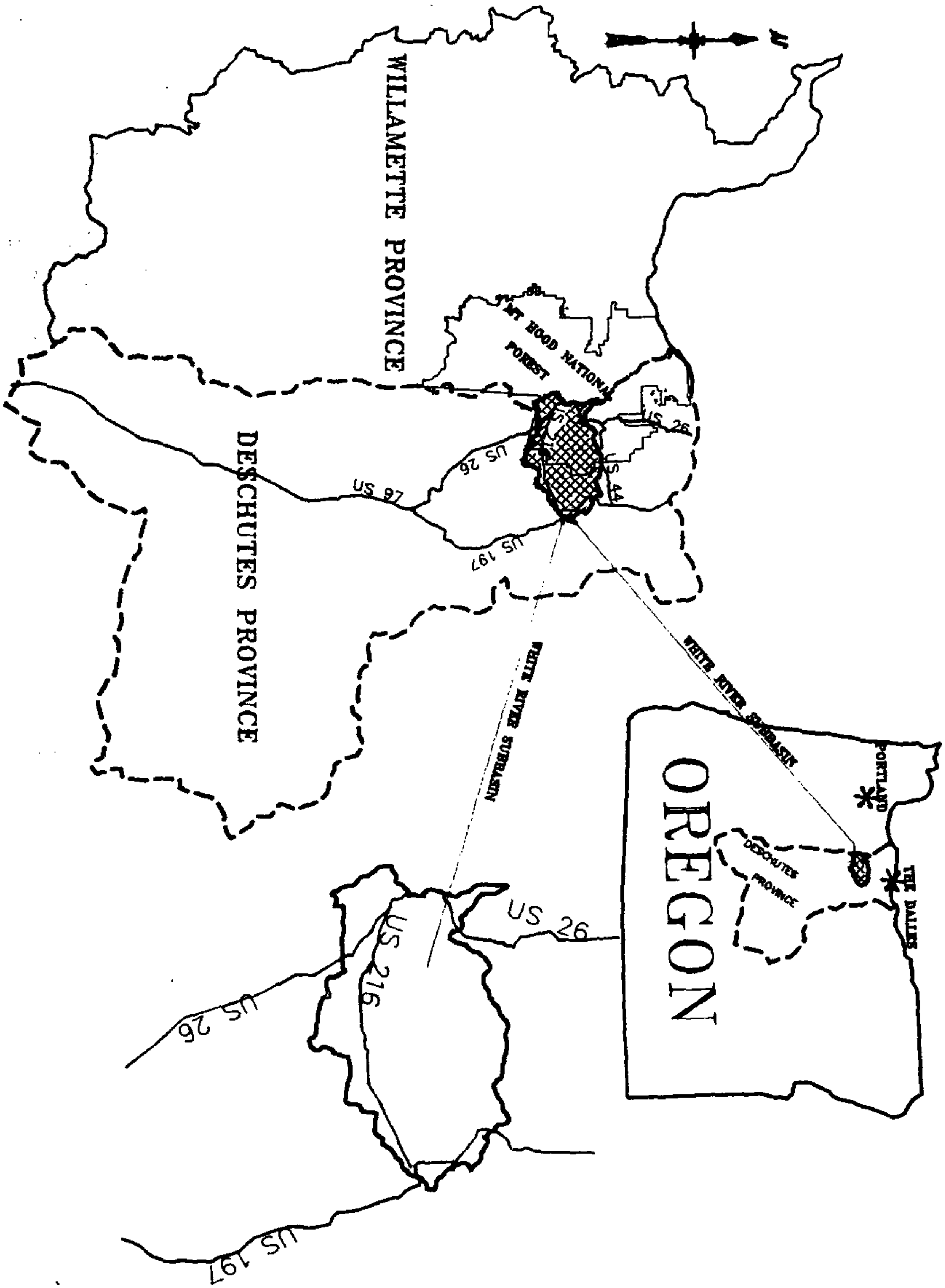


Figure 1.1. Vicinity Map for White River subbasin.

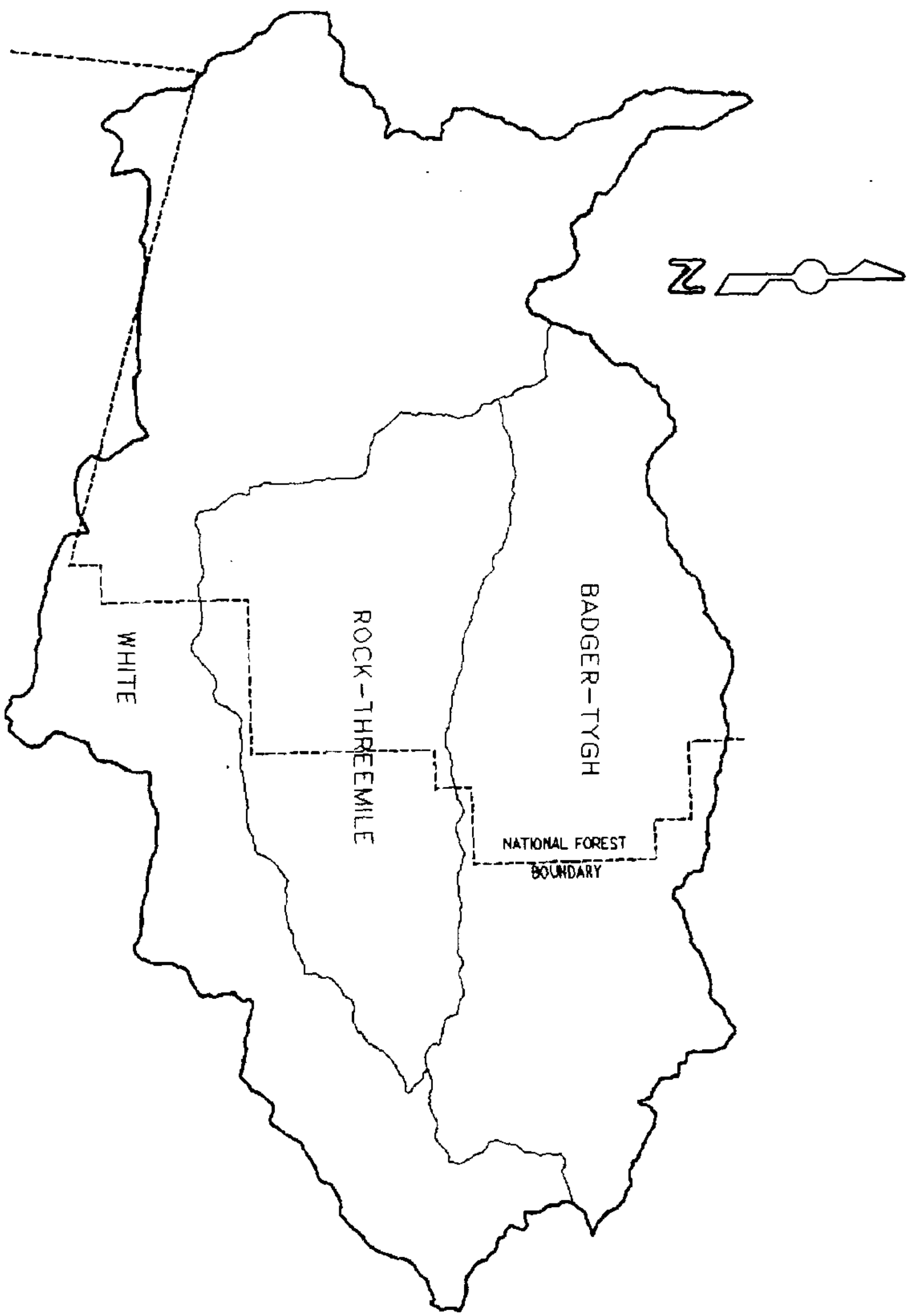


Figure 1.2. White River watersheds.

CHAPTER 2: A BRIEF HISTORY OF WHITE RIVER SUBBASIN

Introduction

This chapter provides an overview of human use in the White River subbasin and discusses how these uses have reflected changing human wants, needs, desires, and concerns over the course of time. It begins with a very short review of the geologic and climatic processes which influenced the White River landscape, continues with a discussion of cultural resource management in the area, and concludes with a breakdown of human use into prehistoric and historic periods.

Geologic Processes. Mt. Hood (and the White River subbasin) is part of the Cascade Range and falls within the region called the Central High Cascades. The High Cascades overlie the eastern portion of the older Western Cascades and developed from vulcanism, flows, and uplift during the late Pliocene and Pleistocene mountain-building period approximately 4.5 to 2 million years ago. Glacial activity during the late Pleistocene and the Holocene, along with subsequent erosion from wind and water, further shaped the area. Rock types such as cryptocrystalline silicates, basalts, andesites, and volcanic glass resulted from the formation of the area and can be used for stone tool formation. Overall, the basic landform of the Northwest and the White River subbasin is the same today as it was when humans first arrived in the area.

Climatic Processes. The climate in the White River subbasin has changed over time, and this has contributed to different land-use patterns by humans. There were preglacial and glacial conditions during the late Pleistocene, a warming to cool and moist conditions during the early Holocene, warmer and drier conditions during the mid-Holocene, and a return to cool and moist conditions during the late Holocene. Local variations and changes in climate probably occurred during these times.

The climate changes influenced the vegetation in the subbasin, and thus also influenced the fauna. In turn, these fluctuations influenced how humans used the land to obtain the most productive food and material resources. In general, during cooler and moister climates the vegetation tended to be more dense and supported relatively high populations of big game. Mobile people were better able to take advantage of the available resources. During warmer and drier climates the vegetation tended to be more open, with more plant resources available, and lower, but adequate, game populations. At these times semi-sedentary people were best able to utilize the environment.

Cultural Resource Management - Lack of Knowledge and Recorded Sites

The White River subbasin includes portions of the Barlow, Bear Springs, Hood River, and Zigzag Ranger Districts of the Mt. Hood National Forest. A large percentage of the subbasin lies to the east outside the Forest boundary.

Although required by legislation and Executive Order to identify, conserve, and manage cultural resources, heritage work in the National Forest is usually related to other resource projects. As a result, most of the White River subbasin within the National Forest has not been surveyed for cultural resources. In addition, little heritage work has been done on the other ownerships within the subbasin. Therefore, we have a gap in our scientific knowledge of the area.

We have records on 51 American Indian sites and 103 European American (Euro-American) sites within the National Forest area of the subbasin (totals include isolate sites). American Indian sites include seasonal camps, lithic scatters, rock features, peeled cedar trees, and isolated tools. Euro-American sites include those related to themes such as government (administrative sites and lookouts), transportation (roads, trails, and a railroad), communication (telephone lines), settlement (cabins and small farms), waterworks (ditches and dams), the Civilian Conservation Corps (CCC) (Bear Springs compound and Timberline Trail), hunting (marten sets), logging (mills), and mining (small mines). As we survey more land within the subbasin, we will undoubtedly locate additional cultural resource sites.

Limiting public knowledge is sometimes necessary to protect sites from pothunting and destruction. There is potential for additional site interpretation in the subbasin, which would benefit both the Forest and the public. Interpretation often depends upon a site's condition, accessibility, and potential for development. A site should show some uniqueness, reflect a theme of the area, and have educational value. For example, the Barlow Road Historic Corridor has National Register status and offers interpretation of this important use of the Forest. Various signs and exhibits along the Road show the dangers, difficulties, and commonplace occurrences of early overland travelers. In addition, a planned Passport in Time project at a prehistoric site on the Barlow Ranger District will provide additional public information and participation.

Human Use

Human use within the White River subbasin can be broken into two periods--prehistoric and historic. The prehistoric period covers uses by American Indians before Euro-American settlement. The historic period covers early contact between American Indians and Euro-Americans and Euro-American uses. Cultural resource sites located within the subbasin reflect the various uses during these eras.

Prehistoric (American Indian). The Mt. Hood National Forest is a meeting place for the Columbia Plateau, Northwest Coast, and Great Basin culture areas. Although characteristics of all three cultural areas are likely visible in White River, the subbasin probably fits best with the Columbia Plateau culture area. Prehistoric sites in the subbasin reflect the various aspects and types of culture use and include probable seasonal camps, lithic scatters, large dart points, small and delicate arrow points, peeled cedar trees, and berry hearths.

Although there were not many people in the area, humans probably used the White River subbasin as early as 10,000 to 6,050 BC. During this time the climate in the area was cool and moist, and people probably practiced a mobile lifestyle emphasizing big-game hunting and foraging for the various resources available throughout the year at different elevations. Only one possible paleoindian projectile point base (Windust Phase) has been found in the subbasin, so little evidence of early human use has been located.

Around 6050 to 2550 BC, people began to adapt to more localized environments, although probably still practicing a mobile lifestyle. In the White River subbasin people probably hunted large and small animals, fished, and gathered indigenous plants such as camas, nuts, seeds, and berries. During the early part of this period, the climate became warmer and drier, then began to resemble today's climate around 4500 years ago. A few later Cascade Willowleaf and Northern Side Notch projectile points in association with other lithic debris have been located in the subbasin, suggesting a more obvious human presence in the area. The lack of cultural resource excavation has made it difficult to determine any possible effects on human uses from the eruption of Mt. Mazama approximately 6800 years ago.

Around 2550 to 550 BC a change in available resources due to climatic changes (primarily a loss of big game) and larger human populations led to a stronger emphasis on fish and roots such as camas and wappato. With long-term food storage and increasingly predictable labor-intensive gathering taking place, people began to practice a semi-sedentary lifestyle utilizing winter villages. A number of side- and corner-notch projectile points from this time period have been found in the subbasin.

From 550 BC, people continued to lead semi-sedentary lives. With additional population growth, subsistence became more resource specific. People utilized their territory and began to place an intensive emphasis on salmon. Roots continued to be a staple food source. Adoption of the bow and arrow appeared at the same time as an increase in the hunting of small game. A number of small arrow points have been found in the subbasin.

Many people lived and fished along salmon-bearing rivers and streams, including the lower White River and the Deschutes River. As they had in the past, rivers and streams continued to serve as travel routes for trading, hunting, and gathering. People maintained large winter villages near dependable water and firewood sources at lower elevations, such as Tygh Valley. Smaller temporary sites existed for hunting, fishing, and gathering along streams and in the foothills and mountains.

People practiced a seasonal round of resource gathering which differed by elevation. Important resources included plants and animals for food, medicinal, and material purposes. In spring, some people moved to seasonal camps in the foothills to hunt, while others went to fishing stations for the salmon run in March and April. In summer, families would often go upland to gather roots and hunt, returning to the fishing stations for the second salmon run in June and July. Late summer and early fall were often spent gathering plants, drying meat and berries, and gathering supplies for winter. Berry fields were also occasionally burned in the fall to maintain production. In late fall people began to move back to winter villages, and during the winter many people would repair or make material objects.

In the Northwest, contact between American Indians and Euro-Americans began primarily in the 1700s. The horse was reintroduced shortly after 1700 and provided a probable ease and increase in long distance and regional trade and travel. In the late 1700s contact was made with Europeans along the coast, with contact from overland Euro-American explorers following in the early 1800s. Although American Indians in the White River subbasin may not at first have had direct contact, influence was felt through the exchange of trade items and through depopulation resulting from the introduction of diseases, such as smallpox and measles, from which they had no immunity. These combined factors led to a change in the American Indian lifestyle and a partial return to a mobile existence. The American Indian lifestyle and mobility conflicted with Euro-American ideals and settlement. A treaty in 1855 between the United States government and the Deschutes, Wasco, and Walla Walla tribes resulted in the creation of the Warm Springs Reservation and the moving of American Indians to that area.

Historic (Euro-American). Early Euro-American emphasis in the Northwest was based on exploration and fur trade. The Lewis and Clark expedition passed along the Columbia River in 1805, with other explorers and fur traders following shortly thereafter. However, there was little Euro-American use of the subbasin before the 1840s.

Emigration started around 1840, with the greatest number of people coming to the west and passing over the Oregon Trail in 1843. In the Northwest, the emigrants were primarily bound for the Willamette Valley, and their activities as they passed through the area were usually limited to those related to survival, such as hunting. These activities left little trace on the land. In 1845, Samuel K. Barlow explored and blazed the Barlow Road route which passed through the White River subbasin. This overland route was the only alternative for emigrants to finishing the journey via rafts down the Columbia River from present-day The Dalles. In the White River subbasin much of the Barlow Road follows along the edge of the White River. In 1846 the Barlow Road route was improved and became a toll road, and over the next few years thousands of people and their animals and belongings passed over the road. During the 1850s emigration began to slow down. In 1854 and 1855, Lt. Abbot completed an exploration and survey for a possible railroad route through the subbasin. Sites for this era include the Barlow Road, which is a National Historic District, and associated sites such as the Gate Creek Toll Station and White River Station.

The roads in the White River subbasin determined its early use as a transition area and helped establish early settlement patterns. The upland forest was a rough area and generally not used as it was steep, rocky, and difficult to clear for crops. There was, however, limited grazing use for sheep and cattle, and a few cabins were built by trappers and prospectors.

By 1860 there was movement back and forth across the National Forest as people continued to move to the west and some of the early emigrants moved back to the east to settle in the more arid regions of eastern Oregon and Idaho. The Donation Land Act of 1850, the Homestead Act of 1863, and the Railroad Land Grants of 1868 provided legal ownership of land to the people. As had the American Indians before them, Euro-Americans first settled and built towns in the valleys as they provided milder weather and easier access to necessary resources. As lower elevation lands were taken, though, people began to move into the foothills, and use of the upland areas increased.

Timber was first used for houses and fences, and close-by areas fulfilled needs. Commercial timber was also kept to a small scale as transportation difficulties for the product made large-scale production uneconomical. Small, portable five-man milling operations and small-scale permanent mills were present in the lower elevations and foothills of the subbasin.

In the 1880s the Northwest was still fairly isolated, with most contact coming from the sea. However, the coming of trains opened up transportation and eased problems in shipping goods, and more people began to move to the interior to practice agriculture such as wheat farming. With easier movement over the rails, sheep and cattle grazing also increased.

By the 1890s large logging companies had formed and bought or controlled land in the subbasin, and the small logging operators in the lowlands and foothills could not compete and began to shut down. The National Forest area of the subbasin was originally under the jurisdiction of the General Land Office. However, Forest Reserves were established in 1891 and this restricted use of the upland timber areas and controlled logging activity.

Fish stocking via agreements between the State game agency and the Forest Reserve is documented just north of the subbasin in 1902; stocking probably occurred within White River subbasin probable occurred at the same time. In 1905 the Forest Service was created as part of the Department of Agriculture, and the Cascade Range Forest Reserve became the Cascade Forest Reserve in 1907. In 1908 the area was renamed the Oregon National Forest, and in 1924 was finally named as the Mt. Hood National Forest.

Early rangers in the Forest and subbasin went about on horseback and were primarily concerned with trail construction, trespass, grazing, and timber theft. They also constructed a number of small log guard stations. To preserve timber and other resources, fire suppression was also a large part of the early rangers' duties. Both natural and human-caused fires were suppressed, and Forest Service policy at the time was to discourage and prevent the seasonal burning which had been practiced by American Indians and early settlers to maintain travel routes and some food and resource areas.

In 1915 the Barlow Road became a free travel route, and in 1919 the Highway Commission modernized it for auto traffic. The Mt. Hood Loop Highway opened in 1925, allowing much easier access to the National Forest and to the higher elevations of the White River subbasin. With easier access to the area, use of the White River subbasin increased, although most users were still from local communities. Around this time a number of ditches were excavated in the mid-elevations of the subbasin to bring water to the lower elevations for agricultural purposes.

By the 1920s and '30s additional roads, telephone lines, ranger stations, and lookouts were being constructed in the National Forest and in the White River subbasin. Grazing of both sheep and cattle was intensive during this time, and many tin-can dumps of the herders are found in the subbasin. World War I brought about an increase in the demand for wheat and lumber for war industries, but throughout the war, the Depression, and the following stabilization of the economy, timber harvest remained a minor activity in the Forest as lower elevations and private lands provided enough wood. After World War II the demand for timber increased, but logging was still not a dominant factor in the Forest.

The CCC and other work groups were present in the subbasin in the 1930s and '40s and helped string telephone lines, plant trees, fight fires, stock fish in lakes and streams, and build trails, various structures, and campgrounds. In an effort to prevent vandalism, possible injury, and other resource damage, the Forest Service in the 1950s and early '60s destroyed many unused cabins, lookouts, and structures within the Forest.

By the 1960s grazing in the area was much reduced. Lowland timber could no longer meet demands, especially for non-local markets, and intensive logging activities began to move into the upland National Forest portion of the White River subbasin. Until the mid-1980s, timber harvest was a dominant feature of National Forest activities, and as a consequence much road building took place. Also during this era there was a large change in American lifestyles and activities such as hiking, camping, hunting, and fishing, (necessary for the survival of the American Indians and early emigrants) were more frequently done for recreation purposes. Additional recreation activities such as mountain biking and cross-country skiing are also now enjoyed in the subbasin. There is a strong emphasis in the National Forest on maintaining trails, roads, and recreation facilities, and many users of the subbasin are from non-local areas.

Although there has always been controversy over the various uses of the Forest, during the 1980s the rise of "environmentalism" brought about changes in Forest procedures and management. Commodity extraction is still a primary concern, but experiential use has become an important factor to be considered in National Forest and subbasin management. Timber harvest has slowed; roads are being closed rather than constructed; more emphasis has been placed upon resources such as wildlife, botany, fisheries, heritage, and visuals; and commodities such as firewood and mushrooms have become more regulated as demand increases. These changes have affected the local communities, as well as the National Forest. Two examples are the closing of the Tygh Valley and Maupin mills and the rise in use of the National Forest by Asian Americans for mushroom picking.

Conclusion

In the White River subbasin human-use patterns have changed and will continue to change through time in response to different environmental factors and to human wants, needs, desires, and concerns. Important factors for American Indians have been food resources and experiential use; and important factors for European Americans have been range, agriculture, timber and other forest products, recreation, and experiential use.

CHAPTER 3: ISSUES

Introduction

This section contains the issues and key questions that this analysis will address. The issues and key questions follow the scientific method. In other words, we have observed several items and effects in the White River subbasin. Based on these observations we formed a *preliminary hypothesis* to explain what we think we see. This broad scale hypothesis is what we call an *issue*. We defined an issue as a clear statement of a perceived problem or conflict. The paragraphs that follow each issue statement record what we see and what we think is going on regarding the issue. *Key questions* are the specific hypotheses around the issue and that this analysis will test. As such, they are phrased as "yes" or "no" questions.

Implicit in each issue statement and key question is the *null hypothesis*. The null hypothesis states that what we see or think is going on is not true. For example, in Issue 1 (see below) the null hypothesis is that the standards and guidelines for the governing plans **do not** result in ecosystems that are outside the range of natural conditions and, thus, are **not** contrary to ecosystem management objectives. In following the scientific method, evidence in the analysis must show that the null hypothesis is wrong and what we see or think is going on is true.

Like any other scientific analysis, a "yes" answer to a key question also includes discussing causal factors, displaying where the problems occur as specifically as possible, and listing what corrective measures or actions might be appropriate. A "no" answer includes discussing where our perceptions are in error and what is really going on regarding a particular issue. If we cannot answer the key question, then we have an obvious data gap or analysis need. The issues and questions were developed jointly by the Watershed Analysis Team and Stewardship Teams but are focused at the watershed scale. Site-specific concerns raised by the stewards are rephrased as resource-integrated, broader scale issues or questions.

1. ***Issue: The Mt. Hood Forest Plan, Northwest Forest Plan, State Water Quality, and Columbia River Policy Implementation Guide standards and guidelines for several habitat elements appear to result in forest, riparian, and aquatic ecosystems that are outside the range of natural conditions and are thus contrary to ecosystem management objectives for several portions of the subbasin.***

The Forest Service recently changed its land management emphasis from producing individual goods and services to managing for ecosystem sustainability. Included in this goal is an emphasis on providing healthy ecosystems to best meet societal demands over the long-term and at sustainable levels. The Forest Service is also charged with meeting several other specific resource objectives related to providing habitat for selected species. Typically, standards and guidelines for the higher level plans were developed under a "one size fits all" strategy and assumed that the various vegetation zones and stream systems did not differ significantly from each other. White River subbasin is characterized by steep environmental gradient (changing from alpine communities to perennial grassland communities in approximately 17 miles) and, thus rapid changes in land and stream productivity.

Tied in with this issue are the following key questions:

A. Can the Douglas Cabin and Triangles LSRs meet LSR Objectives over both the short-term (next 5 years) and the long-term (greater than 5 years)?

B. Can the White River LSR between Deep Creek and the National Forest boundary meet LSR objectives over both the short-term and the long-term?

C. Can the dry forest zones provide stable nesting, roosting, and foraging habitat for the northern spotted owl over the long-term?

D. Can we return to a more open ponderosa pine-Oregon white oak dominated community and still provide adequate dispersal habitat for northern spotted owls?

E. Can we continue to provide habitat for known northern spotted owl pairs in the dry forest zones long enough to develop needed habitat in the LSRs?

F. Has the shift in plant communities reduced the habitat for other species, potentially reducing their viability in White River subbasin?

G. Has the shift in forested plant communities increased respiration rates and reduced the soil moisture reserve, thus creating drought stress in upland forests and detrimentally altering the magnitude, duration, and timing of low summer baseflows? *Dropped from further analysis. Tjhis question is too technical to effectively address in this iteration. We believe it is a question that Research needs to address before we can evaluate it in White River plant community types.*

H. Are the current standards for downed wood appropriate within the dry grand fir, Douglas-fir, and ponderosa pine forest zones?

I. Should the desired loadings vary between terrestrial and riparian/aquatic ecosystems and between perennial and intermittent streams? *This question refers to downed wood. Downed wood is one of the aquatic habitat elements refered to in Question J. Therefore we dropped this particular question with the understanding that Question J would provide an answer.*

J. Are the current standards for water quality and aquatic habitat elements appropriate for all streams in White River subbasin?

K. Should the standards vary between streams or stream segments with irrigation withdrawals and those without?

L. Should they apply to natural channels being used as water transmission corridors?

M. Are the current standards and guidelines for big game winter range thermal cover the best method to provide that habitat element?

N. Does current management direction provide sufficient forage to meet deer and elk herd management objectives over the long-term?

2. *Issue: Past management activities and practices may limit our ability to effectively treat forest health problems on slopes of 30% or less. This problem occurs primarily on National Forest lands.*

Slopes of 30% and less are usually harvested using ground-based logging systems. Machine piling is also the most cost-effective fuel treatment method on this same ground. Most of this ground lies in the eastern portion of the National Forest lands and was closest to human population centers and lumber mills. It has been the most heavily cut portion of the National Forest lands within the subbasin.

Until the mid-1970s, most entries were partial cuts where the largest and most valuable trees and species were removed. Beginning in the 1970s, regeneration harvests (mostly clearcuts and shelterwoods cuts) became more prevalent. Only in the late 1980s did these harvests begin to use designated skid trails with the trails mapped using the Global Positioning System (GPS) and the information stored in a Geographic Information System (GIS). Harvesting intensified beginning in the mid-1960s.

Fuel treatment often consisted of machine piling and burning the slash. In many early sales only the landings were machine piled, however these landings were widely scattered throughout the forest. In other sales, some spot machine piling occurred in the heavier concentrations of slash, but the exact locations are not known within sale areas that covered several hundred to several thousand acres. In areas, or units, receiving regeneration harvesting, the entire unit was machine piled. Until 1987, standard procedure was to pile all or 90% of the slash, including the large cull logs. Further, machine piling with a bulldozer is not feasible using a designated skid trail system, resulting in "broadcast" travel by the equipment.

Compacted soils have many effects on soil productivity, insect and disease risk, tree growth and yield, percolation rates, peakflow, erosion, and instream sedimentation. Since compacted soils lack pore space, trees other plants, and aquatic species have less available water, thus magnifying both seasonal and climatic drought periods. Beneficial fungi and microbes, such as mychorrhizae, do not grow as well, reducing soil organic matter and nutrient cycling. Trees are less able to fight off insect and disease attack due to the drought stress. Lack of water also slows growth rates. The soils cannot absorb as much water during rainfall and snowmelt, more water runs off, and erosion rates increase.

Past selective harvesting and failure to treat the understory have created forests dominated by the late successional tree species, such as grand fir and Douglas-fir. These forests are generally unhealthy with epidemic or near-epidemic levels of dwarf mistletoe, fir engraver beetles, spruce budworm, western pine beetle, and various root diseases. While underburning could help address some of these forest health problems, we cannot safely underburn many stands. However, the cumulative effects of harvesting and fuel treatments using heavy equipment means that much of the dry forest area does not meet Forest Plan standards and guidelines.

Tied in with this issue are the following key questions:

A. Is compaction a significant problem in LSRs, Riparian Reserves, or Matrix lands?

B. Should the standard methods for stand management change where compaction is an identified problem?

C. Do we have soils at very high risk of compaction from past and potential use of mechanized equipment?

D. Can we restore compacted areas without further degrading the riparian and aquatic ecosystems?

3. *Issue:* ***Past management activities may have significantly reduced the large wood potential and riparian cottonwood communities and increased runoff rates and peakflow, placing aquatic and riparian resources and human property at increased risk of damage from erosion, instream sedimentation, and flooding. This concern occurs throughout the subbasin and the increased risk of property damage occurs primarily in Wamic and Tygh Valley.***

Timber harvests conducted in the 1970s and early 1980s did not always leave enough trees in the riparian zone. The Rocky Fire and subsequent salvage left no trees in the riparian zone for several miles in Gate, Rock, and Threemile Creeks. In the late 1960s through most of the 1970s biologists considered large wood in the streams as a barrier to fish passage. Timber sales containing harvest units extending to the stream often required the purchaser to remove all logs within the stream segments next to the unit. Further, stream clean-out projects removed large logs from most perennial streams on National Forest lands.

Parts of many streams and wet areas formerly supported cottonwood dominated communities. Conifers can quickly invade a cottonwood stand and replace the hardwoods unless some mechanism, such as beaver ponding, favors the cottonwood over the conifers. Where cottonwoods are still reproducing in cattle allotments, grazing can keep the trees brushy and prevents successful regeneration. Riparian cottonwood communities support a mix of animal species, particularly birds and amphibians. Some species may be dependent on the riparian hardwoods to provide one or more critical habitat elements.

No mechanized equipment buffers or inadequate buffers were provided around streams before the mid-1980s. Both logging and piling equipment moved across and up and down intermittent stream channels regularly. These practices and repeated entries often create high levels of compacted ground, increase sediment delivery to the streams, increase erosion, erode streambanks, increase drainage densities, and alter channel morphology, hydrologic function, and downstream sediment deposition. Riparian habitat was degraded in some areas and eliminated in others. The riparian zone may no longer act as a filter for sediment originating from the uplands.

Timber harvest, roading, and the Rocky Burn have created a large number of canopy openings in a forest matrix. As the number of canopy openings increases, more snow accumulates rather than being intercepted and lost to sublimation and evaporation. Snow in openings melts more quickly than snow under a forest canopy. During snowmelt, more water is available to reach the streams. Total flow increases, peak discharge rates change, and the frequency of flood events may change. In turn, these changes in the peakflow regime and flood control efforts can change the sediment transporting capability of the stream, channel morphology, and aquatic habitat capability.

Runoff rates are directly related to the drainage density of a particular watershed, subwatershed, or subbasin and infiltration capability across the landscape. Natural channels, human-made structures such as roadside ditches and irrigation ditches, and gullies comprise the drainage density. The human-made structures in particular concentrate water in different ways than the landscape "evolved" under. Different driving surfaces, such as asphalt and gravel, and compaction reduce infiltration. Lastly, roads can intercept subsurface flow and cause it to become surface flow. Together these factors reduce the time that water spends on the land so that less soaks in and more runs off. Increased run off rates and drainage densities also change the frequency and duration of flows of differing intensities, alter the sediment transporting capability of the stream, and can increase the risk of flood damage to homes and other structures in the floodplain.

Riparian Reserves on National Forest lands are to maintain and restore riparian structures and functions of perennial and intermittent streams, provide habitat for riparian-dependent and associated species other than fish, enhance habitat conservation for organisms that depend on the ecotone between riparian areas and uplands, improve dispersal and travel corridors for many terrestrial species, and provide connections between riparian areas and Late-Successional Reserves. Riparian Reserves are to help maintain or enhance both riparian and aquatic function, including regulating peakflow and flooding. The interim reserve widths are designed to protect these functions until analysis can recommend more appropriate widths based on ecologic and geomorphic factors.

Tied to this issue are the following key questions:

A. Are there streams or stream reaches where the riparian large woody debris levels or recruitment potential is low and outside the range of natural conditions?

B. Are there streams or stream reaches where the instream large woody debris levels or recruitment potential, stream temperature, or predicted peakflow is low and outside the range of natural conditions?

C. Are there any species in White River subbasin whose viability depends on the continued presence of cottonwood or cottonwood-conifer riparian communities? *Viability not addressed, only the continued presence of such species discussed.*

D. Are any streams or stream reaches and aquatic resources at a significantly higher risk of degradation or damage from increased peakflows, bedscour, and instream sedimentation due to soil compaction, increased drainage densities, and created openings? *Dropped from further analysis. As with Issue 1, key question G, this question requires a research project to answer.*

E. Has the change in peakflow regime placed homes and other structures at increased risk of flood damage? *Dropped from further analysis. We did not have enough time to examine this question in enough detail to answer it.*

F. Does the system of irrigation ditches mitigate some of the potential for flood-related damage? *Dropped from further analysis. We did not have enough time to examine this question in enough detail to answer it.*

G. Should the interim Riparian Reserve widths be modified to better reflect local processes and conditions?

4. Issue: Farming methods may be degrading the cold water habitat and resulting in streams that may not meet state water quality standards. This problem is restricted to private lands east of the National Forest boundary.

The agriculture lands lie in the vegetation zones that receive less than 20 inches of annual precipitation. Most of this precipitation falls as rain or snow between October and March. In recent years, snow has not lasted very long (less than one month), exposing the fallow fields to the processes that cause sheet and rill erosion throughout the main precipitation season. As fields erode, the most productive soils leave first, reducing land productivity over time. New wheat varieties and some changes in farming practices have partially offset these losses but erosion rates still exceed those recommended by the National Resource Conservation Service (formerly the Soil Conservation Service).

Due to low precipitation, farmers either irrigate or use a summer fallow method of farming. Many farmers irrigate to increase crop yield and to obtain a crop every year. Water for irrigation is diverted out of perennial streams and delivered via ditches, pumped from wells, or captured in intermittent stream channels and stored in ponds. None of the ditches are lined or otherwise sealed against leakage. In turn, removal of the water for irrigation reduces instream flows and may affect water temperature. Water captured in ponds on intermittent streams is water no longer available for instream flow further down in the watershed. The reduced flow reduces the quantity and quality of aquatic habitat and may be a migration barrier for fishes. The irrigation diversions are not screened against fish passage, potentially allowing many fish to become stranded fields or in ditches when the flow is shut off.

Due to cost, farmers in this area limit the use of chemicals. However, they do use a variety of fertilizers, pesticides, and herbicides to increase crop productivity. Some chemicals leach into the streams during rain events and during the irrigation season. Soil particles carry others. As lands erode, soil and associated farm chemicals eventually wind up in perennial, fish-bearing streams. Agricultural chemicals can reduce stream productivity by killing streambed vegetation and macroinvertebrates, thus reducing instream productivity. High enough levels of sediment can clog spawning gravels and fill pools.

Agriculture provides many benefits beyond the obvious. The ponds, irrigation ditches, and crops have created habitat for many species of birds, warm water fish, and amphibians. The ditches and ponds also disperse wildlife use over a greater portion of the landscape than may otherwise occur. Agriculture retains open space in an area that may otherwise convert to residential development for the fine views of Mt. Hood.

Tied into this issue are the following key questions:

A. Are the available incentive programs adequate to promote sustainable farming methods?

B. Do any incentive programs promote the creation, retention, or maintenance of functioning riparian zones and floodplains?

C. Are current farming methods or practices adequate to control erosion to acceptable levels?

D. Are stream shade and stream flow adequate to meet state water quality standards and to provide for functional cold water ecosystems?

E. Is the viability of any fish species at risk from reduced water quality and quantity?

We dropped this entire issue from further analysis. We believe the issue and key questions are valid. However, the proper agency to address this issue and set of key questions is the NRCS in conjunction with the private landowners.

5. ***Issue: Current Forest Plan standards and guidelines for grazing may not be adequate to meet Aquatic Conservation Strategy Objectives and may be inconsistent with Late Successional Reserve objectives on National Forest lands and grazing practices may conflict with meeting State Water Quality standards on other lands.***

The Aquatic Conservation Strategy objectives apply only to federal lands within the range of the northern spotted owl, which ends at the National Forest boundary. White River subbasin contains three entire Forest Service grazing allotments and part of a fourth. State Water Quality standards apply to all lands in the subbasin. Grazing occurs on the White River Wildlife Management Area, owned and managed by the Oregon Department of Fish and Wildlife, lands managed by the Bureau of Land Management, and on many ranches and farms.

On National Forest lands, Grasshopper allotment is fenced into many separate pastures. The remaining allotments contain drift fences. Within all allotments, several springs have been fenced, along with a few stream segments and meadows, to protect riparian and aquatic values. Other livestock control methods include salting, riding, herding, and the grazing systems incorporated in each annual operating plan. Much of the damage seen today is the result of uncontrolled and poorly controlled grazing of cattle, sheep, and horses prior to World War II. Merely removing livestock will not restore the native plant communities or riparian and stream channel conditions.

In summer, cattle seek out the riparian areas for shade, forage, and water. Little grazing occurs in the steep-sided narrow canyons, such as Badger Creek and White River, and along streams with little forage, such as Boulder Creek and Frog Creek. Mt. Hood Forest Plan standards and guidelines limit forage utilization levels in riparian areas to 35% or less; however, these riparian zones may differ from the interim or recommended Riparian Reserve widths. There are no grazing standards and guidelines that directly address physical damage to streams and riparian areas. The areas of most concern are Rocky Burn and around Clear Lake.

Parts of Badger, Grasshopper, and White River allotments lie within an LSR. The objectives for LSRs do not appear to provide for much transitory range. However, if all or part of an LSR were managed for early or mid-successional old-growth communities, some opportunity for grazing may remain.

On non-National Forest lands, State Water Quality standards regulate all activities. Within White River subbasin, grazing is concentrated on the uplands, intermittent streams, and irrigation ditches. Little grazing occurs along most perennial streams since these streams typically lie in steep-sided narrow canyons. Grazing does occur in the riparian zone of perennial streams in Tygh Valley and on Smock Prairie.

Tied in with this issue are the following key questions:

A. Do Forest Plan standards and guidelines provide adequate grazing restrictions to allow attainment of the Aquatic Conservation Strategy objectives on National Forest lands?

B. Does the amount of riparian area detrimentally affected by grazing prevent attainment of the Aquatic Conservation Strategy objectives or State Water Quality standards?

C. Can the problem areas be treated in a manner that allows continued grazing while meeting the Aquatic Conservation Strategy objectives and/or State Water Quality standards? *Dropped from further analysis. This question more properly belongs under the venue of grazing allotment planning and annual operating plans.*

D. Is continued grazing appropriate in LSRs, Riparian Reserves, and meadows?

E. Are range allotment management plan revisions on schedule to meet Salmon Summit agreements for protection of salmonid fishes? *Dropped, this question does not apply to any allotments within White River subbasin.*

6. ***Issue: Introduced plants and animals may be successfully competing against native plants and animals and continual disturbance from human activities often favors the introduced species over the native species. This problem exists throughout the subbasin.***

The Northwest Forest Plan emphasizes management of native plant and animal species over non-native species (ROD p. B-11 #9 and p. C-19). Many species have been accidentally or purposefully introduced within the subbasin. The Oregon State Department of Agriculture has classified some plants as noxious weeds. Other plants are not classified as noxious weeds but are very aggressive invaders and able to spread easily. These plants succeed since they are adapted to frequent disturbance and can quickly take advantage of bare ground created by human activities. A third class of plants are those deliberately introduced as a commercial crop or to accomplish a natural resource management goal such as improving big game forage or stabilizing cutbanks and other eroding sites. Some of these plants form sods that both spread and prevent native plant species from establishing.

Most of the animal species that have been introduced are fish and amphibians and game species. Oregon Department of Fish and Wildlife used to stock most lakes, all reservoirs, and many streams with hatchery rainbow trout and other game fish species. Fish stocking has ended in streams, but continues in reservoirs, ponds, and some lakes. Hatchery fish have interbred with the native redband rainbow trout, a genetically distinct stock isolated by White River Falls.

Oregon Department of Fish and Wildlife has also introduced wild turkey, red-legged partridge, Hungarian partridge, ring-necked pheasant, and chukar into the subbasin. The races of wild turkey introduced are Merriam's and Rio Grande. The Department is considering introducing more of the Rio Grande race, a more prolific breeder and able to use more open areas than the Merriam's race. The effects of these introductions on native upland birds and other terrestrial wildlife species and plant communities are unknown.

Tied in with this issue are the following key questions:

A. Are noxious weeds, as identified by the Oregon State Department of Agriculture, crowding out native plants?

B. Are other non-native plant species crowding out native plants? Are these species spreading? Will problems develop in other areas if no control actions are taken?

C. Are additional control actions needed to control existing or potential problems with noxious weeds and invasive non-native plants?

D. Are introduced animal species crowding out or preying on native species or diluting the purity of the gene pool?

E. Will stocking of non-native fish continue? Are these fish likely to escape and interbreed with the native fish?

F. Are the introduced species affecting the viability of any threatened, endangered, sensitive, or at-risk species? *Species viability not addressed in this iteration, only the continued presence of such species addressed.*

7. ***Issue: Disturbance processes create a dynamic landscape and dynamic habitat; however, land management plans and the Northwest Forest Plan tend to try to create a fixed landscape through land allocations and the associated objectives and standards and guidelines. This problem occurs across the landscape and primarily is a problem on federal lands.***

All federal lands in White River subbasin are managed for multiple uses but many land allocations partition these uses into given parcels of land. To emphasize a given use, standards and guidelines are written to "protect" that use from other uses. These standards and guidelines often to not recognize or do not adequately recognize the disturbance processes, such as fire and flood, which operate in a given ecosystem and that many of these disturbance processes operate at larger scales than a particular land allocation.

These processes created a dynamic landscape with constantly shifting vegetation patterns and habitat conditions. All ecosystems need these disturbances to remain healthy and productive. The standards and guidelines can force areas outside their range of natural conditions such that when a disturbance does happen it has unforeseen impacts. Often the system is not adapted to the increased severity of the disturbance. This concept applies to all types of biological ecosystems--terrestrial, aquatic, and riparian.

The land allocations tend to isolate species into islands, such as what was probable with the B5 (Pileated Woodpecker/Pine Marten Habitat Areas) and A8 (Spotted Owl Habitat Areas) land allocations in the Mt. Hood Forest Plan. The Late-Successional Reserves in the President's Forest Plan provide for larger islands, but do not allow certain disturbance processes to operate that are necessary to maintain ecosystem functioning.

This failure to adequately recognize dynamic processes does not promote landscape stability or resiliency. Ecosystems have an inherent ability to absorb and recover from catastrophic events, a concept often called ecosystem resiliency. Land management practices can alter ecosystem resiliency to the point where the land can no longer adequately deal with catastrophic events, thus degrading the ability to meet societal demands. Stable ecosystems are considered both harder to disturb significantly and return to a more-or-less stable condition more quickly than unstable ecosystems. Conventional wisdom is that the typical landscapes found before 1855 were healthier, more stable, and more resilient than the current landscapes. The vegetation communities, including species composition and structure, and other ecosystem processes and conditions typical of the pre-1855 landscape define the range of natural conditions.

Tied in with this issue are the following key questions:

A. Has the risk of catastrophic events increased over the pre-1855 risk level? What events are specific to a given location, and what are the expected consequences?

B. Have management actions simplified the vegetative community (excluding agricultural lands)? What are the expected consequences? *Dropped as analysis indicated the question was not significant. Even though we have planted many monocultures of ponderosa pine and Douglas-fir and have planted from off-site seed sources, natural processes are replacing monocultures with a diversity of species. Many off-site plantations, which never involved a significant number of acres, are dying or showing signs of poor health. We expect to either replace these plantations or natural processes have already begun the replacement process.*

C. Are landscapes and ecosystems becoming less stable and resilient?

D. Do the different landscape patterns (pre-1855 and current direction) affect species viability?

E. Should we better incorporate dynamic processes that cross land allocations and landscape features into standards and guidelines and management activities? How might we do this?

8. *Issue: Current direction and information may not be adequate to assure the viability of species on the C3 Table and certain threatened, endangered, sensitive, at-risk, and unique species in White River subbasin that are outside the range of the northern spotted owl.*

The Northwest Forest Plan in particular attempts to address viability of these species in the FSEIS and the C-3 Table. In some cases we cannot identify the species in question without destructive sampling. In other cases, sampling methodologies have not been developed. The habitat needs are unclear or unknown for many species. We have not looked for some of the more easily identified species. For migratory species, particularly the neotropical migratory birds, we do not know if the real problem lies within the National Forest lands or somewhere else. In cases where we have a fair to good understanding of the habitat needs we are unsure if the current direction is adequate.

Regulations associated with the National Forest Management Act (NFMA) and Federal Land and Policy Management Act (FLPMA) require that management of federal lands assure viability of all the species that occur within the boundaries of those lands (36 CFR 219.19, ROD p. 43). The Mt. Hood Forest Plan and Northwest Forest Plan emphasize certain species that are federally listed, may become listed, are rare in the state, or are considered indicators of certain habitat conditions. The Eastside Columbia River Basin assessment currently under way will likely contain similar direction. While much information exists on popular megafauna, such as bald eagles and deer, little information exists on less charismatic species and plants not considered commercially important.

Lastly, a debate is emerging over whether single species management is desirable or even feasible, given the large number of species in question. The problem is particularly acute when addressing species with limited mobility, such as mollusks and arthropods. Ecosystems are more complex than we can hope to understand. The interrelationships between species and their environment quickly become overwhelming and impossible to deal with in any coherent fashion as the number of species under consideration increases.

Tied in with this issue are the following key questions:

A. Do we have adequate information to assess the viability of all relevant species listed in the FSEIS and C-3 Table should we decide to recommend changes in the Riparian Reserve width or if the FSEIS suggested that further viability analysis was appropriate during watershed analysis?

B. Are there additional or unique species within the range of the northern spotted owl that are not dealt with in existing direction?

C. Should management focus on protecting individual species or should it focus on providing habitat within the range of natural conditions? *Dropped as watershed analysis is not the appropriate level to address this question.*

D. Are there species beyond the range of the northern spotted owl that are unique, rare, or at-risk?

E. Does current direction provide sufficient habitat to assure viability of primary and secondary cavity nesters in Matrix lands? *Viability not addressed, only the continued presence of such species is discussed.*

F. Are connectivity and dispersal habitat sufficient to allow gene flow at the metapopulation scale?

G. Does the White River subbasin provide important habitat for species when considered at the metapopulation scale?

H. Can the public lands provide for ecosystem conservation and species viability for all ecosystem components in White River subbasin? *Viability not addressed, only the continued presence of such species is discussed.*

9. ***Issue: The demand for recreation opportunities is rising faster than management's ability to handle the demand and to provide, protect, or maintain the desired recreational experiences, and to protect other resources affected by recreation use.***

Many recreational users in White River subbasin come from the Portland metropolitan area, which is projected to continue to grow rapidly for several decades. The Mt. Hood National Forest is classified as an urban forest due to the current and projected population levels. The Mt. Hood Forest Plan emphasizes dispersed recreation in White River subbasin and the Northwest Forest Plan emphasizes dispersed recreation in Late Successional Reserves and Riparian Reserves. As the population on the westside increases, the pressure on eastside recreational opportunities will increase, yet recreation budgets on the eastside continue to decline. Use exceeds capacity in the most popular sites and many facilities do not meet maintenance standards. The number of encounters between users is increasing, changing the availability of certain recreational experiences. The more primitive recreation experiences are becoming increasingly harder to find on the Mt. Hood National Forest.

The land is only able to handle a certain level and certain types of recreation use before degradation begins. High recreation use often results in bare, compacted soil; loss of screening vegetation; and depleted levels of downed wood. Many high use areas also lie in riparian zones so that these impacts also affect stream channel structure, contribute to declines in water quality and aquatic habitat elements, and disturb or displace some wildlife or fish species that may depend on the riparian zones.

Conflicts exist or are developing between different types of recreation users. Some examples include conflicts between motorized and nonmotorized recreation users, between nordic skiers and downhill skiers, and between off-road vehicles and snowmobilers in early and late winter. The White River Stewardship Area contains the transition between an emphasis on nonmotorized and motorized recreation. Motorcycle and ATV users conflict with campers, anglers, and other nonmotorized users at several locations. Nordic skiers conflict with snowmobilers and dogsledders.

Other land management practices also conflict with recreation uses. Snowplowing for timber harvest or tree planting and road obliteration can conflict with snowmobiling, dog sledding, and skiing. Managing the Barlow Road as a National Historic Site may conflict with the management objectives for the White River LSR and the Riparian Reserves.

The private landowners are also concerned that the trend of increasing recreation use will push more people onto the private lands, which many do not want. Some parcels of private land may be converted from agriculture to recreational uses, such as duck hunting, angling, and overnight accommodations. The numbers of farmers and ranchers are decreasing and the numbers of retirees and "snow birds" are increasing in the local communities. Oregon Department of Fish and Wildlife is considering expanding nonhunting recreation opportunities on the White River Wildlife Management Area. Wasco County is struggling with how to accommodate increased demand for recreation and is searching for opportunities to link the various public lands with trail systems.

Tied in with this issue are the following key questions:

A. Are the trends for the various types of recreation uses increasing or decreasing?

B. Have high levels of recreation use created detrimental impacts to soil, water, vegetation, wildlife, and fish?

C. Does the White River subbasin provide any unique recreational experiences or opportunities not readily available elsewhere?

D. What level of developed recreation is appropriate in LSRs and Riparian Reserves?

E. Do any of the current dispersed recreation activities conflict with the Aquatic Conservation Strategy and LSR objectives? Might any conflicts develop in the future?

F. Can the public land owners better protect the private landowners from undesired recreation uses/trespass?

10. ***Issue: The need to provide for and manage administrative, commodity extraction, and recreation access on public lands may conflict with standards and guidelines for Late-Successional Reserves and Riparian Reserves and with Aquatic Conservation Strategy, fish, and wildlife management objectives. This problem is restricted to National Forest lands.***

Providing recreational opportunities is a main purpose of National Forest lands. We also have the responsibility to balance recreational demands and uses with other uses, such as providing habitat for fish and wildlife. The Mt. Hood Forest Plan established road densities for the various land allocations designed to provide access while protecting other values. The Northwest Forest Plan contains additional standards and guidelines relating to road densities, particularly in LSRs and Riparian Reserves. There are no guidelines in either plan concerning trail densities.

Much of the Barlow Road, a part of the Oregon Trail, lies within White River LSR and it crosses several Riparian Reserves. Managing this road as a National Historic site may conflict with the Aquatic Conservation Strategy Objectives, LSR objectives, and Riparian Reserve objectives. As roads are closed to meet other objectives, motorized based recreation becomes more concentrated into a smaller area, as do the attendant impacts. The Highway 26 and 35 corridors have several sno-parks with more proposed. There is no sno-park plan to address how many sno-parks are needed and where. Sno-parks serve as winter recreation trailheads. Currently Road 48 is allowed to snow shut in the winter and melt out more-or-less at its own pace in spring. However, if this road were plowed all winter, it might allow employees of Mt. Hood Meadows to live in Pine Hollow, Wamic, or Tygh Valley and commute to work. It may provide a new opportunity for winter driving for pleasure. Road 48 runs through the White River LSR.

The Northwest Forest Plan requires that all stream crossings within the range of the northern spotted owl handle 100 year storm events if failure of the crossing would cause significant resource damage downstream. Any stream crossing which cannot meet that specification must be identified and altered to comply. Nearly all stream crossings in White River do not exceed 50 year interval storm specifications. Stream surveys identified many culverts that are barriers to fish passage during low flows. Some of these culverts may also be barriers to fish passage at higher flows and peakflows. The Highway 35 bridge across White River, a major east-west thoroughfare linking Hood River and Government Camp, lies in the White River floodplain. Natural, episodic mudflows have severely damaged this bridge in the past and it remains at-risk.

Off-road vehicles can use both roads and trails. Bear Springs Ranger District has a designated off-road vehicle use area at McCubbins Gulch. The users complain that the area is too small. Oregon Department of Fish and Wildlife does not want the McCubbins Gulch area increased but is willing to support a designated route across White River that connects this area to an off-road vehicle network on Barlow Ranger District. The Department prefers area closures and establishment of designated routes to other management methods. Further, they want the off-road system recognized as having the same impacts to wildlife as an open road and, therefore, counted as part of the open road density. Barlow Ranger District is working on an off-road vehicle plan. Many users want a connection across the White River corridor.

While both Barlow and Bear Springs have trail systems with designated uses, until very recently the two districts did not coordinate their trail systems to provide networks over a large area. Barlow has not examined their trail system comprehensively to design networks, with the exception of off-road vehicles. Most trails lie in Riparian Reserves with little opportunity to relocate them. Many trails are not maintained to current regional standards.

Tied in with this issue are the following key questions:

A. Is a north-south connection for off-road vehicles feasible across the White River corridor?

B. Are the Forest Plan road densities appropriate for the LSRs? *Dropped, this question is better addressed through Access and Travel Management Planning.*

C. Should any stream crossings be modified to meet the 100-year flood event specifications?

D. Are the designated use types appropriate for the trails in the LSRs and Riparian Reserves?

E. Are certain roads key to providing the appropriate level of access for administrative, commodity extraction, and recreation use? *Dropped, this question is better addressed through Access and Travel Management Planning.*

F. Does the trail system in White River subbasin provide for coherent use patterns, meet the needs of the users, and protect other resources? *Dropped, this question is better addressed through Access and Travel Management Planning.*

G. Do the current road and trail maintenance levels provide the appropriate surface and adequately protect the other resources? *Dropped, this question is better addressed through Access and Travel Management Planning.*

H. Are road and trail locations and densities appropriate to meet the Aquatic Conservation Strategy objectives? *Dropped, this question is better addressed through Access and Travel Management Planning.*

11. *Issue: We do not know what levels of commodities are appropriate or sustainable from National Forest lands in White River subbasin or where we should be obtaining those outputs.*

The Northwest Forest Plan reduces the probable level of commodities from the National Forests, but the estimates, primarily timber volume, are based on a regional scale. These estimates have been disaggregated down to the ranger district level but no further. Ecosystem management also assumes that we will produce commodities; however, the level of commodities produced is based on preserving the health of forestlands and protecting the long-term health of our forests (ROD p. 3).

Other commodities produced in the White River subbasin include livestock forage, cattle, water, game animals and fish, and rock, along with agricultural crops on the other ownerships. Grazing is discussed in Issue 5. Most perennial streams in the subbasin have at least one irrigation diversion. Some perennial streams have been converted to intermittent streams below some diversions. Water is moved around the subbasin according to established water rights and can result in transferring water from one subwatershed to another or, in the case of Clear Creek Ditch, from one watershed (White River) to another (Wapinitia Creek).

White River subbasin lies in the White River Game Unit. Hunting seasons have been established for many species. A limited amount of trapping may occur for furbearers. Oregon Department of Fish and Wildlife stocks many reservoirs and ponds in the subbasin with catchable rainbow trout and other game fishes. Stocking in streams ended recently with adoption of the Department's Native Fish Policy. The perennial streams and some irrigation ditches are important angler destinations.

Several rock and sand pits lie scattered throughout the subbasin. White River does not have any known deposits of locatable minerals and very limited opportunity for leasible minerals (primarily geothermal energy sources). The rock pits on National Forest lands are intended for Forest use, but special use permits can be issued for small loads of gravel and landscaping rock. The other rock pits in the subbasin are primarily used by Wasco County Road Department, although rock may be sold to other agencies or companies. White River Management Plan discusses management of White River sand pit.

Besides commodity production, the Forest Service has made a commitment to aid in rural development. Wasco County is considered a timber dependent community eligible for assistance under the President's Forest Plan and Rural Development. Reductions in federal harvest levels coupled with the loss of the Maupin and Tygh Valley mills eroded the income base for Wasco County services. The President's Forest Plan seeks to address some recent employment losses by creating new jobs related to watershed restoration.

White River subbasin lies within the ceded lands of the Confederated Tribes of the Warm Springs Reservation of Oregon. The Forest Service has the responsibility to provide for rights and resources established in the Treaty of 1855.

Tied in with this issue are the following key questions:

A. Do we expect to continue to provide timber out of LSRs, Riparian Reserves, and Matrix lands?

B. Is water currently over-allocated to provide for instream beneficial uses in any streams?

C. Can we meet the state management objectives for deer, elk, and game fish?

D. Are mining areas on National Forest lands sited in appropriate locations to meet the Aquatic Conservation Strategy objectives?

E. Are mining areas on other ownerships sites in appropriate locations to meet state water quality standards? *Dropped, the proper agency to deal with this question is Oregon DEQ in conjunction with the mine owners.*

F. Do additional rural development and "jobs in the woods" opportunities exist in White River subbasin?

G. Is current direction adequate to provide for protection of tribal treaty rights and trust resources?

CHAPTER 4: PAST AND PRESENT CONDITIONS

Introduction

We divided the subbasin and watershed into smaller analysis units. The primary units used are based on climate and geomorphology. The *climatic division separates the subbasin into three zones known as* Crest, Transition, and Eastside (Table 4.1 and Figure 4.1). We grouped the sixth field watersheds into ten larger subwatersheds based on similar geomorphology (Table 4.2 and Figure 4.2). All discussions use one or both of these analysis units.

Table 4.1. *Climatic zones and descriptors for* White River subbasin.

Zone	Description	Climax Species	Major Early Seral Species	Coniferous Riparian Associates	*Fire Groups*
Crest	Cold, moist winters with consistent snowpack; warm, dry summers. Forest conditions greatly resemble those west of the Cascade crest.	western hemlock mountain hemlock Pacific silver fir whitebark pine subalpine fir	Douglas-fir western larch western white pine noble fir lodgepole pine Engelmann spruce western redcedar	Pacific yew	5, 6, 7, 8, 10
Transition	Cool, moist winters with inconsistent snowpack. Forest conditions are a mix of Crest and Eastside zones.	grand fir western hemlock-Douglas-fir	Douglas-fir ponderosa pine western larch western white pine incense-cedar	Pacific yew western redcedar Engelmann spruce western hemlock north of White River	3, 4, 9
Eastside	*Cool, semi-dry winters where* snowpack often does not last all winter; hot, dry summers.	Douglas-fir ponderosa pine Oregon white oak	ponderosa pine Oregon white oak incense-cedar	western redcedar western larch grand fir	1, 2, 11

Table 4.2. Major subwatersheds in White River subbasin.

Subwatershed	Sixth field watersheds
White River	252, 256, 259
Barlow	251
Clear	253, 255, 260
McCubbins	254, 261, 262
Boulder	257, 258
Gate	269, 299, 300, 301
Rock-Threemile	295, 297, 298, 302
Badger-Tygh	246, 247, 248, 249, 250
Jordan	245
Butler	N/A

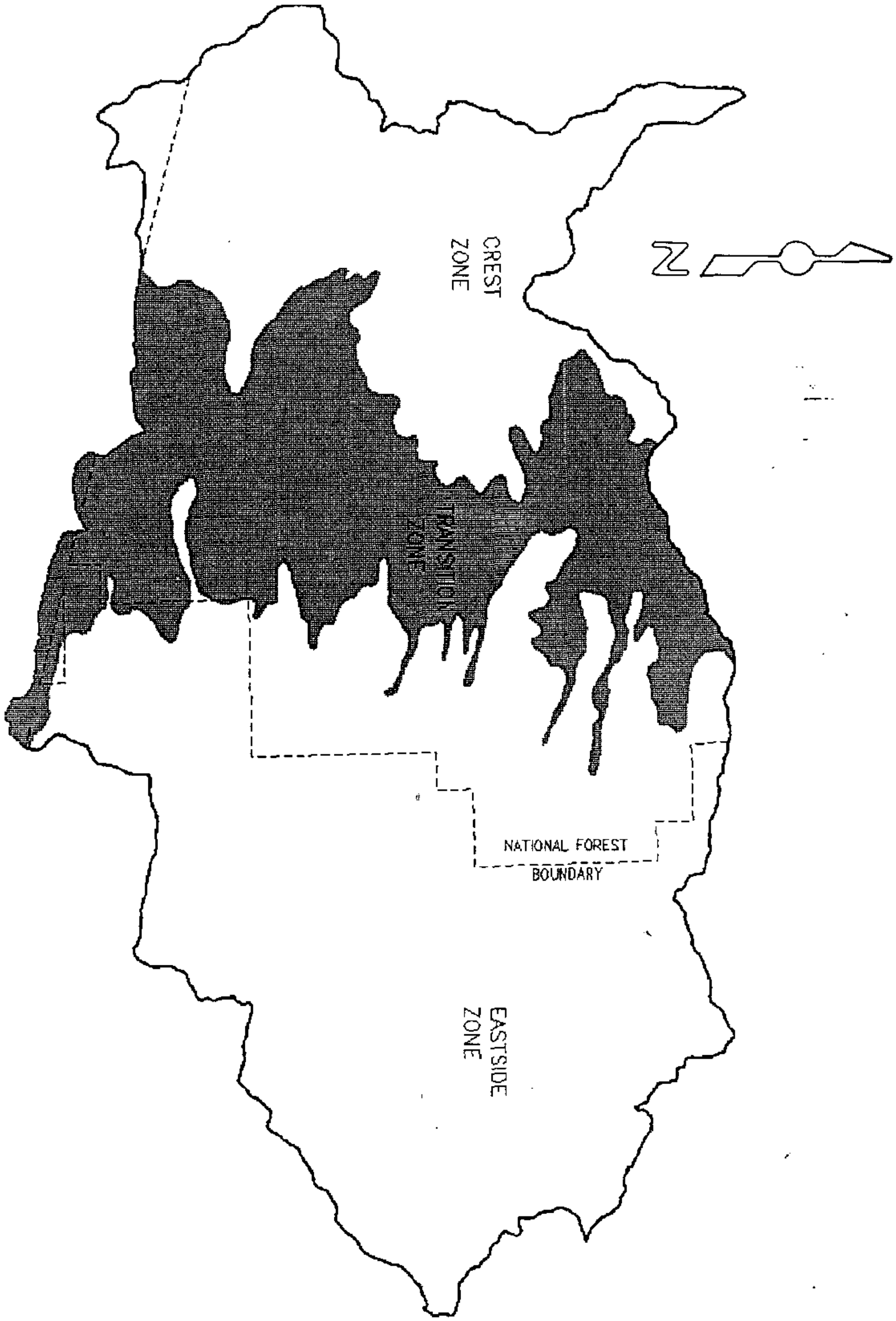


Figure 4.1. Climate zones in White River subbasin.

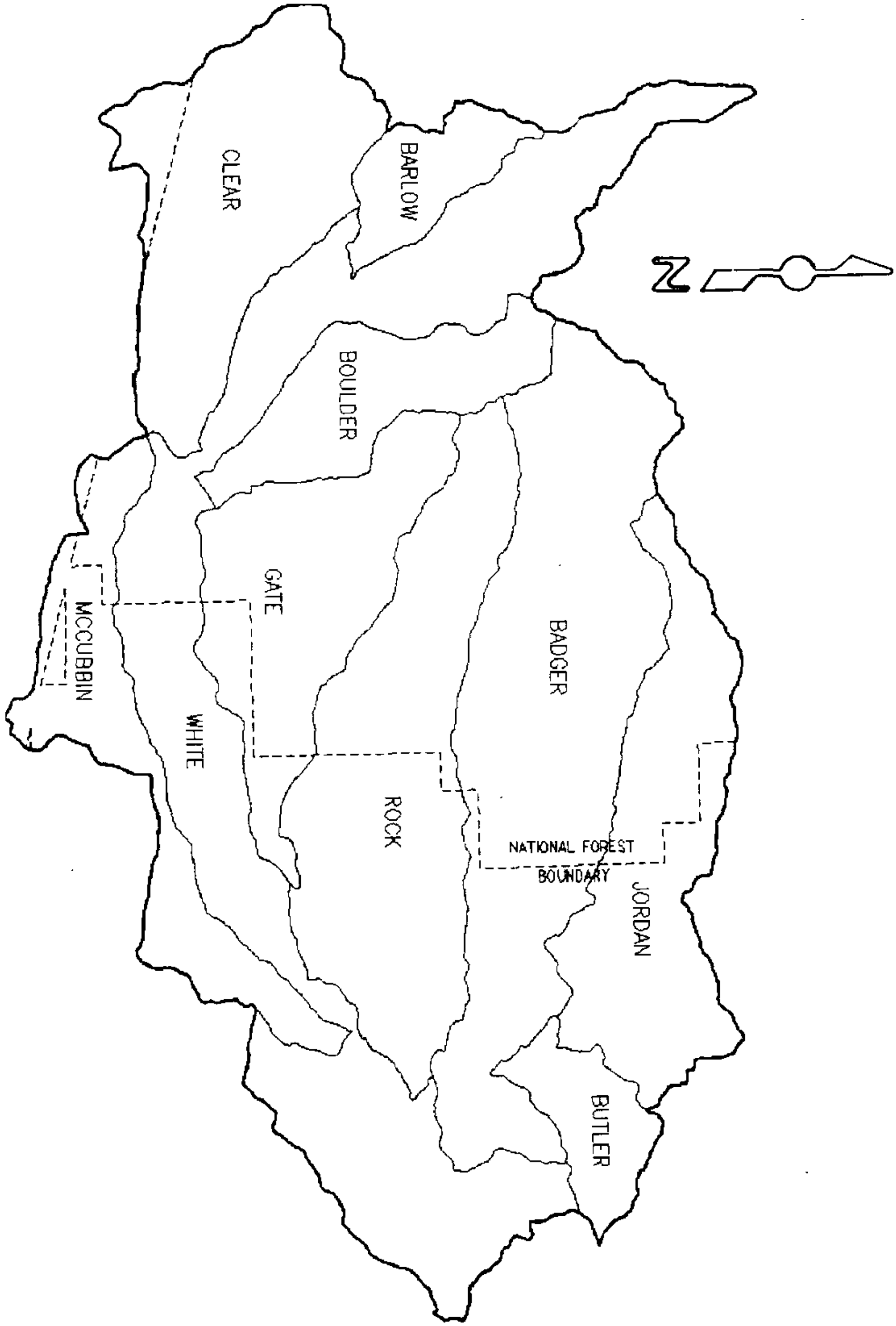


Figure 4.2. Subwatersheds in White River subbasin.

To describe the past and present forest conditions in a manner that was easily comparable we developed diagnostic stand types. *These types do not describe every potential stand or existing stand on the landscape.* Instead they are meant to describe key indicator stands that tell us something about the difference between stand conditions before 1855 and today. Stands not specifically described are informally known as "wannabe" stands. That is they are transitional between diagnostic stand types or the result of lack of the "proper" kind of disturbance.

Figure 4.3 displays the range of natural conditions and existing condition of each diagnostic stand type by climatic zone within the Forest bounda, y. We used several sources of information and professional judgment to develop the ranges:

- GLO survey notes,
- 1901 survey of the conditions of the Cascade Range Forest Reserve,
- 1916 map of forest types and fire occurrence, and
- Diary and journal notes from Joel Palmer (pioneered Barlow Road with Sam Barlow in 1845 and '46), Lt. Abbot (surveyed for railroad route across the northern Cascades in 1855), and members of Sam Barlow's family.

In the text below, we will describe many stand types, including the diagnostic types. When a diagnostic stand type is used, its name will appear with initial capital letters such as Late Seral Parklike. Other stand types are not named. Complete definitions of the diagnostic stand types are in the Glossary.

Pre-1855 Landscape

Vegetation

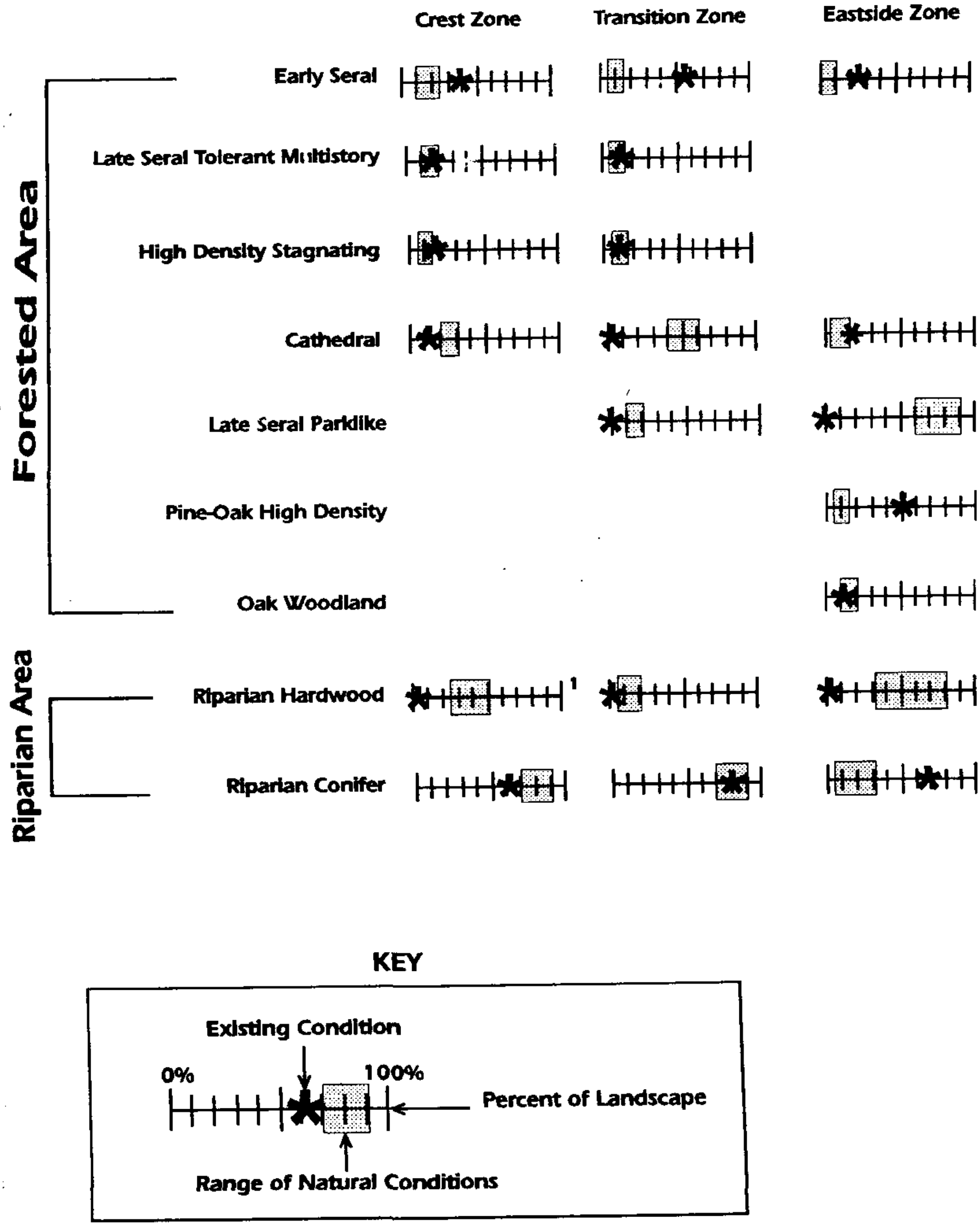
Eastside Zone. Three basic stand types dominated the Eastside zone on National Forest lands. Open, parklike stands of ponderosa pine and Oregon white oak covered the uplands, intermittent streams, and south aspects of perennial streams. Overall, the structure was multicohort consisting of single cohort patches of varying sizes. Tree size ranged from large ponderosa pines averaging over 24 inches DBH to dense or relatively dense patches of pine and oak regeneration. The understory was primarily native bunchgrasses and forbs with scattered shrubs. Antelope bitterbrush appeared in the lower portions of Gate and Rock-Threemile subwatersheds. Downed woody fuel loadings were very light and consisted mostly of widely scattered large logs, approximately 1-2 per acre. Evidence of low-intensity fire was everywhere. We have named this stand type Late Seral Parklike.

More closed to closed canopy stands dominated by large ponderosa pine and Douglas-fir dominated the north aspects along perennial streams. The even-aged patches were larger and often of a size to be readily mapped as individual stands, rather than just patches. Older stands tended to dominate due to frequent underburning. The understory was much more shrubby, consisting of species like hazel, ceanothus, oceanspray, and so forth. Downed woody loadings were still generally light, but heavier than on the adjacent uplands. The more moist conditions associated with these sites allowed for less frequent underburning than the adjacent uplands. In turn, the north aspects probably had more large logs present. We call this stand type Cathedral. Edge contrast was very low between Cathedral and Late Seral Parklike.

The third major stand type was riparian associates. The riparian areas showed mostly influence by seasonal flooding and beaver ponding with some influence by fire and insects. Stands tended to be more even-aged but were structurally and biologically the most diverse stands in the Zone. Three main types appear to occur. The first type is hardwood dominated. These stands differ from the typical hardwood stand described for most forests within the range of the spotted owl in that they were dominated by hardwood trees rather than hardwood brush. Black cottonwood was the largest tree and probably the most common species, followed by various species of willow and alder. Patches of quaking aspen were present in Jordan Creek. Conifers were present in these stands, but hardwood trees dominated. This appears to be an early seral stand type in the riparian zone. We believe beaver

Diagnostic Stand Types: Within National Forest Boundary

Range of Natural Conditions and Existing Conditions



1 - Barlow, Boulder, Mineral, and lower Iron Creeks, and White River

Figure 4.3. Diagnostic stand types for each climate zone in White River subbasin.

ponding was a significant factor in allowing hardwood dominated stands to persist longer that we might otherwise expect.

A second riparian stand type was more mid-seral. The typical disturbance types were not sufficient to keep conifers limited. In the mid-seral stage, hardwood trees and conifers were co-dominant; neither appeared to be more prominent than the other. The third riparian stand was conifer dominated and a late successional stage. Hardwood trees were still present, mostly black cottonwood, but not dominant. Typical conifers in the riparian zone were Douglas-fir, ponderosa pine, western larch, and western redcedar. The early seral stage is called Riparian Hardwood and the third stage Riparian Conifer.

In all stand types, hardwood brush dominated much of the understory. Riparian Conifer stands could be dominated by forbs or lack much of an understory if the canopy closure exceeded 70%. Edge contrast was low between the riparian stand types and Cathedral but relatively high between riparian stands and Late Seral Parklike.

Other stand types were also present, though they did not cover a large percentage of the landscape. Some south aspects and very dry ridges supported only oak woodlands. Oak woodlands were very open stands of short, scrubby Oregon white oak with a grass and forb understory. Shrubs were rare in that stand type. Occasionally an area of Late Seral Parklike escaped burning for an extended period of time. Additional conifer regeneration would establish and stand densities would become quite high. If no additional disturbance occurred, these Pine-Oak High Density patches could stagnate. Early Seral patches were scattered throughout the zone. These areas dominated by new regeneration were often too small to map as individual stands. Early Seral patches could be large enough to map as distinct stands on north aspects within a Cathedral stand.

Transition Zone. The Transition Zone was more diverse than the eastside zone. It contained stand types typical of both the Crest and Eastside zones. Late Seral Parklike stands could be found on south aspects near the eastern edge of the Zone. These stands differed from the more typical Late Seral Parklike stands of the Eastside Zone by having less Oregon white oak and more Douglas-fir. The understory was still grassy, although the species may have differed from the Eastside Zone.

Cathedral stands dominated the uplands and intermittent streams. Transition Zone Cathedral stands were very similar to Eastside Cathedral stands in both species mix and stand structure. Ponderosa pine and Douglas-fir were the most common species. Western larch was scattered throughout the stand type. Western hemlock, grand fir, western white pine, and other conifer species began appearing towards the western half of the zone, particularly around White River. The understory was often brushy with such species as vine maple, hazel, ceanothus, and manzanita. Ponderosa pine and Douglas-fir regeneration was also common in the understory. The understory vegetation was apparently both clumpy and well distributed, depending on the disturbance history and most recent disturbance type in each stand.

The western edge of the Transition Zone would frequently escape major disturbances long enough to allow the climatic climax species to begin dominating the stand. These stands typically have two or more canopy layers with scattered snags and snag patches and "emergent" trees such as very old ponderosa pine, Douglas-fir, and western larch. Downed logs could become quite thick, making travel through the forest very difficult even on foot. Downed logs would typically be thickest in streams, both intermittent and perennial. This old growth stand type is known as Late Seral Tolerant Multistory and appeared more frequently and in larger stands in Boulder and Clear subwatersheds.

North aspects along perennial streams were different from south aspects and uplands. Stands were generally denser, with more closed canopies, and a greater number of species more typical of the Crest Zone. Intermittent streams were probably slighter denser than the adjacent uplands and more likely to contain species such as Engelmann spruce, grand fir, and western hemlock.

Disturbances such as fire and insect outbreaks occasionally created larger openings of several tens to several hundred acres (Early Seral). These large openings provided greater landscape diversity to the Transition Zone as a whole and created large snag patches that favored certain bats and cavity nesters.

These openings appear to not be very common at any one point in time. Further, the disturbance was of a type that effectively "ignored" riparian areas as barriers to spread. Thus, small drainages could be entirely converted to Early Seral. Species such as ponderosa pine, Douglas-fir, western larch, and other species generally intolerant of shade would establish dominance quickly in Early Seral openings. If a fire burned particularly "hot" (moderate to high severity), brush species such as snowbrush ceanothus could dominate the new opening for several years to over a decade. In general, there was low to moderate contrast between the edges of Early Seral and the adjacent stand type.

The Riparian Hardwood stand type was found only on the eastern fringe of the Transition Zone. Instead most riparian areas had a strong conifer component in virtually all early seral stands. Evidence today strongly suggests that riparian hardwood trees were present in most early seral riparian stands, particularly black cottonwood in all subwatersheds, and quaking aspen in segments of Rock-Threemile, Gate, and Clear subwatersheds. The Riparian Conifer stand type dominated the riparian areas and the successional stages were very similar to those of the uplands. Engelmann spruce, western hemlock, western redcedar, and Pacific yew were important riparian associates.

Crest Zone. The Crest Zone is the most productive and biologically diverse climatic zone in the subbasin. Abundant moisture and a favorable temperature regime provide an environment capable of supporting a high diversity of plant and animal species in all successional stages. The strong glacial influence is most evident in this portion of mainstem White River, providing many unique habitats within the floodplain.

The large-scale disturbances were infrequent and created large mosaics on the landscape. The fire and insect regime would result in landscapes where either very young or very old forests seemed to dominate. Some stands would approach near-climax conditions between resetting disturbances, a condition virtually unknown in the Eastside and Transition zones. Some American Indian burning for huckleberries created large, persistent brushfields at selected locations, primarily in upper White River and the Camp Windy-Barlow Butte area.

Late Seral Tolerant Multistory stands were the "classic" old growth described in so many papers and articles on spotted owls and westside old growth. Stands were dense, multi-canopied, and usually highly diverse in plant species. Abundant snags and snag patches combined with large numbers of downed logs created high quality habitat for species associated with these forms of dead trees. Once a stand or portion of the landscape reached this condition, it could persist for many decades due to the "speed" at which this structure developed and the infrequent nature of resetting disturbances. However, resetting disturbances were more frequent than in similar stands on the westside such that the Late Seral Tolerant Multistory stand type did not cover as much area as we originally expected.

The Crest Zone had other stand types that also provided habitat for species dependent on older, closed-canopy forests. The Cathedral stand type was also present, although comprised of mixed conifers rather than predominantly ponderosa pine and Douglas-fir. Several disturbance types would create Cathedral stands, but unlike the other zones, this stand type did not persist. Instead, it moved to either Late Seral Tolerant Multistoried or to another stand type intermediate between Cathedral and Late Seral.

Early seral stands typically covered very large areas. Fire and insects and disease were very closely tied together with all three disturbance types interacting to create large openings and fairly elaborate vegetative mosaics. When a stand-replacing fire burned, it usually covered several hundred to several thousand acres. Reburns were common. There was high edge contrast between Early Seral stands and the undisturbed or lightly disturbed adjacent stands. After a certain point fires, insects, and disease outbreaks apparently subsided over the entire zone and a long period ensued in which little or no new openings were created.

Brushfields often developed after a large fire and various brush species would dominate the site for 10-20 years. After 20 years, conifers would begin to dominate. Usually conifer regeneration was abundant and stands had a high number of trees per acre. If a stand escaped the small scale disturbances or lodgepole pine dominated the regeneration then the stand might stagnate. It does not seem that such High Density Stagnating stands developed very often or covered a large percentage of the landscape. Usually species diversity was high enough that species-specific differential growth rates prevented most stands from stagnating. Most of the Crest Zone stands also appeared to have been self-pruning and self-thinning.

Riparian areas, with a few exceptions were very similar to the uplands. The perennial streams tended to have a larger percentage of unburned and lightly burned areas than the intermittent streams. The Riparian Conifer stand type was the most common with hardwood brush in the understory. Resetting disturbances were infrequent enough and forest canopy continuous enough that riparian areas did not serve as a significant barrier to fire spread. White River sand flats is a very unique area with its own unique ecology and disturbance regime. Black cottonwood was a very important species in large portions of the sand flats.

Other streams where the Riparian Hardwood stand type seems to have been significant are upper Boulder Creek, lower Barlow Creek, lower Iron Creek, and Mineral Creek. Of these four streams, the last three lie in the White River floodplain so are under the same hydrologic, microclimatic, and soil conditions. Upper Boulder Creek lies in an area of many springs and wet areas, such that it appears to have burned very infrequently. When it did burn, we believe the fire was of higher severity than elsewhere in the Crest Zone, creating less of a mosaic on the landscape. Black cottonwood and quaking aspen would quickly exploit this new opening. Slower than average recovery rates and beaver ponding allowed the Riparian Hardwood stand type to persist for much longer than might otherwise be expected.

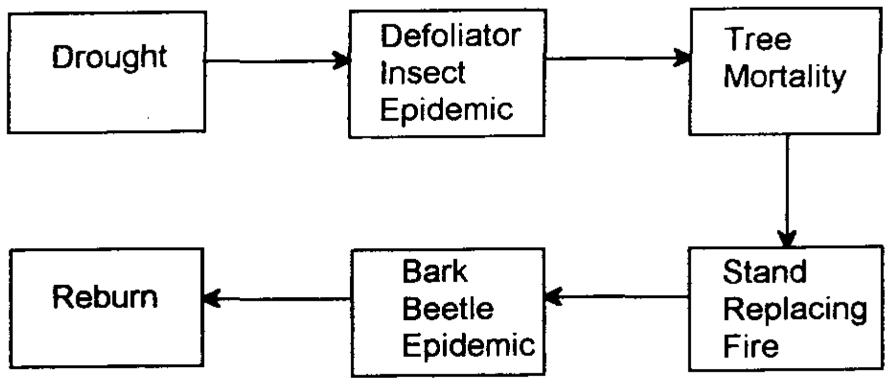
Any streams where the Riparian Hardwood stand type was present also have evidence of beaver ponding. We believe in the Crest Zone that the combination of conditions which created generally open stand conditions also promoted both hardwood trees and beaver activity in an elevation zone where we normally would not expect to find either.

Disturbance Processes

Table 4.3 lists the primary disturbance types for each zone along with its approximate scale. The scales are relative and based mostly on professional opinion. Disturbances rated "High" are those that typically have result in major changes in wildlife or fish habitat and ecologic functioning. Low disturbances result in minor changes in habitat or functioning. Moderate disturbances are intermediate in effects on habitat and functioning. Generally, events with return intervals of more than 100 years or highly irregular events are rare. Those with intervals of 25-100 years are semi-common; those with intervals of less than 25 years are common. Appendix A discusses the main disturbance processes we believe had the greatest effects on White River subbasin before 1855.

We do not have a good understanding of some disturbance types within the subbasin. For example, we believe than American Indian burning was widespread in the Eastside Zone due to evidence from similar ecosystems in the Intermountain West. We have little confirmation from the CTWS of what burning may have actually occurred in White River subbasin.

Many of the disturbance types interacted. For example, stand-replacing fire, drought, and insect epidemics are closely tied together in the Crest Zone. A typical scenario might be:



Root disease can also enter this scenario.

Often of equal importance is what happened after a disturbance event, particularly in terms of downed logs and sediment. Most of the information on downed wood and sediment potential is related to fire and most of that is oriented toward stand-replacing fire. Stand-replacing fires create a large number of snags as well as burn up a large proportion of the downed wood on site. Approximately 5-10 years after the fire, many snags of species subject to so-called white rots begin to fall. These species are usually true firs, Engelmann spruce, western hemlock, and trees of any species less than 15 inches DBH.

Approximately 20-50 years after the fire, fuel loadings are sufficient to allow a reburn. The reburn creates some new snags, leaves some existing snags, and removes some of the recent fallen downed logs. A long period follows in which there is little or no new input of sound downed wood. This period can last over 100 years. What remains begins to decay and moves into the rotten log categories. Few snags are created during this period as the forest is generally healthy. The conclusion we came to is that it is natural in the Crest Zone to have no sound logs for an extended period of time and that both snag creation and wood input is more episodic than continual. In much of the Transition Zone and all the Eastside Zone, snag creation and wood input was more continual than episodic and occurred at much lower levels than in the Crest Zone.

Similar scenarios as described for the Crest Zone occurred in all riparian areas and streams. Further, periodic floods and debris torrents removed wood from the steeper stream reaches and deposited the wood in gentler reaches, often in logjams. Logjams typically formed at constrictions in the stream channel, gradient changes, beaver dams, and similar stream features. Therefore, the range of natural conditions would include no or very few logs in the riparian area and stream for a period of time. If this natural stream clean-out occurred when the forest was relatively healthy and growing well, then it could be many years to decades before high levels of downed wood began to accumulate.

The riparian vegetation also suggests that flooding and debris torrents were a primary method of moving conifer logs into the Eastside Zone. We believe that conifers were naturally fewer along perennial streams in the Eastside Zone and that hardwood trees played a significant role. Hardwood trees do not necessarily die when uprooted. As long as some roots remain buried, the tree will live. One result may be a partially living logjam.

Table 4.3. Major disturbance types for each climate zone and approximate scale and frequency.

Zone	Disturbance	Scale	Frequency
Crest	Stand-replacing fire	High	Rare
	American Indian burning	Low-Moderate	Common
	Mudflows[1]	High	Rare
	1-25 year floods	Low	Common
	25-100 year floods	Low-Moderate	Semi-common
	100+ year floods	Moderate-High	Rare
	Rain-on-snow	Low	Semi-common
	Insect epidemics	Moderate-High	Semi-common-Rare
Transition	Stand-replacing fire	Moderate	Semi-common-Rare
	Underburning	High	Semi-common-Common
	American Indian burning	High	Common
	1-25 year floods	Low-Moderate	Common
	25-100 year floods	Moderate-High	Semi-common
	100+ year floods	High	Rare
	Rain-on-snow	Moderate-High	Semi-common
	Mudflows/Debris torrents	High	Rare
	Beaver ponding	Low	Semi-common
	Insect epidemics	Moderate	Semi-common
	Disease epidemics	Moderate	Rare
Eastside	Stand-replacing fire[2]	Low	Rare
	Underburning	Low	Common
	American Indian burning	Low	Common
	1-25 year floods	Moderate-High	Common
	25-100 year floods	High	Semi-common
	100+ year floods	High	Rare
	Rain-on-snow	High	Semi-common-Rare
	Mudflows/Debris torrents	High	Rare
	Beaver ponding	Low	Common
	Insect epidemics	High	Rare

1 Limited to White River mainstem in all zones

2 Limited to Cathedral stands

Sediment input to streams also appears to have been more episodic than continual. Rain-on-snow events could result in high levels of erosion and rockfall on steeper slopes in the Transition and Eastside Zones. The Crest Zone would occasionally see similar effects, but at much more infrequent intervals due to the more consistent snowpack. High intensity rainstorms shortly after a high severity stand-replacing fire would also generate large sediment input. If what we believe about potential fire severity in upper Boulder Creek is true, then significant levels of sediment input to Boulder Creek and White River probably occurred 1-5 years after this portion of the subwatershed burned.

Wildlife and Fish

Wildlife habitat in this analysis refers to all terrestrial, riparian, and aquatic species, both vertebrates and invertebrates. The combination of vegetation and disturbance processes are what provide and alter habitat for animals. Most of the information available pertains to megafauna with little or no information on invertebrates, reptiles, amphibians, most birds, bats, and small mammals. Presence of some of these animals can be assumed by their presence today. Appendix B lists species currently found within White River subbasin.

Wolves, grizzly bears, lynx, and wolverine were probably present in the subbasin. Pronghorn antelope were relatively abundant in the eastern third of the subbasin. Mule deer, black-tailed deer, and elk were relatively scarce and scattered throughout White River. Bald eagles probably nested in Tygh Valley. Certain related species probably differed in their abundance by climatic zone. For example, pine martens were probably concentrated in the Transition and Crest zones while fishers were concentrated in the Eastside zone.

Species more dependent on old closed canopy forest, such as the northern spotted owl, were concentrated more in the Crest Zone. Species more dependent on old open canopy forest, such as the white-headed woodpecker, were concentrated more in the Eastside Zone. Both species groups intermingled in the Transition Zone. During wetter periods, habitat conditions probably favored a higher percentage of closed canopy forests and the species associated with them. Drier periods favored a higher percentage of open canopy forests and those associated species.

Fish and other aquatic organisms were genetically isolated from other populations by White River Falls. All the aquatic organisms in White River mainstem evolved under a naturally high sediment regime. Both the subbasin as a whole and White River mainstem in particular contained many species that were genetically unique. Beaver were present throughout the subbasin although abundance varied widely. They were probably least abundant in the Transition Zone and most abundant in the Eastside Zone.

Social Uses

American Indians were the main users of the subbasin until the 1840s. The various tribes present mostly fished for salmon and steelhead in the Columbia and Deschutes rivers and in White River below the Falls. They may have fished for redband trout during hunting and gathering expeditions in the forest and while traveling over the Cascades. It appears that American Indians mostly used the subbasin as a source of basket material; building materials; medicinal and edible roots, herbs, and berries; hides; furs; and spiritual renewal. Apparently, the Tygh Valley people grew melons in Tygh Valley. Several trails crossed over the Cascades south of White River, and into the Hood River valley north of White River.

Beginning in the mid-1840s Euro-Americans began entering the subbasin in large numbers. Initially these were emigrants on their way to the Willamette Valley. However, they also brought large herds of cattle, horses, and sheep with them. These herds would have had a major impact on grass production along the main travel route, particularly in Tygh Valley and at the Gate Creek tollgate. Shortly after Euro-Americans begin passing through, some began to stay and establish permanent farms in Tygh Valley, Wamic Flat, Smock Prairie, and Juniper Flat. Before 1855, this settlement was illegal.

The Transition Period

In 1855, the United States government gained title to most of the land in White River subbasin. Legal Euro-American settlement began in earnest shortly thereafter. Initially the settlers had unrestricted use of the forest lands to the west. A common practice was to cut what timber was needed and either mill it on site or take to one of the newly built local mills. Many trees were cut into apparently to test them for some quality, such as ease of splitting, and then left unfelled. Another common practice was to turn cattle out in spring near the edge of unclaimed land and allow the cattle to wander at will until fall. Sheep were herded into the high country and a herder stayed with the animals until returning to the low country in fall. Most settlers initially copied the American Indian burning practices. Sheepmen routinely burned the high country to maintain pasturage. Travelers in the forest burned the trails to keep them clear. Annual maintenance on the Barlow Road consisted of burning up as far as Immigrant Spring and possibly further. Evidence suggests the portion of the road into and out of White River was burned periodically.

The Cascade Range Forest Reserve was created in 1893. Additional townships or portions of townships were added in 1901 and 1907. The Forest Reserves were created to protect water supplies and provide for grazing, timber, and fire protection. The 1901 survey of forest conditions suggests that these functions were not well met in the subbasin. A grazing prohibition north of Barlow Road and west of the eastern boundary of GRID 410 was regularly violated by cattle. Cutting by locals continued with little control. Some irrigation had begun, but demand already exceeded supply. Four sawmills were in operation in the subbasin, with at least one having already cut all the timber it had under contract (Frailey Mill). Information from long-time residents of the subbasin indicate that little fire control occurred. Much of the upper elevations within the subbasin burned around 1900 and portions of it reburned as late as 1917.

In 1906 the Forest Service was created with much the same mission as the Forest Reserves. The Forest Reserves were split into National Forests. Management of the National Forest became more active than under the Forest Reserve system. Settlement continued within the subbasin east of the Forest boundary. These changes began to have profound effects on vegetation, water, and wildlife in White River.

Fire exclusion quickly became a reality due to ease of initial attack and fire control, particularly in the Eastside and Transition zones. Abundant grass encouraged high levels of grazing. High levels of grazing reduced the understory vegetation. Grassland soils are very fertile. Thus the combination of significant reduction in fire and competition, fertile soil, and favorable soil moisture regime due to an open canopy and relatively little competition allowed a veritable explosion in successful conifer regeneration. Various documents dated 1939 indicate a 60% loss in available grazing lands, primarily due to tree encroachment, and a dramatic increase in conifer regeneration throughout the forest .

Timber harvest prior to 1940 was generally at low levels although harvest was focused on the largest trees. Most timber went to supply local needs. Grazing levels fluctuated and consisted of sheep in the southwest corner of the subbasin and cattle elsewhere. Most allotments were small in size and the subbasin contained many allotments. Diversion for irrigation purposes continued with many new diversions and miles of irrigation ditches constructed. Most irrigation was via the flood method. A dam was proposed on Rock Creek and construction began.

Grazing levels reached their peak during World War II to provide meat and wool for the war effort. After World War II grazing levels began to fall and small allotments began to consolidate into larger ones. Timber harvest began accelerating in the late 1940s and 1950s to meet the demands of a burgeoning middle class and baby boom. Timber was cut for shipment outside the local area. Stocking levels in the lower elevations began to result in bark beetle epidemics in ponderosa pine. White pine blister rust began causing mortality in western white pine. Large salvage operations began for ponderosa pine in the Eastside and Transition zones and for western white pine in the Transition and Crest zones. The largest trees were cut first since they were rated as the highest risk for loss from bark beetles or white pine blister rust. Recreation use of the forest; camping, hiking, and so forth; was generally low but began increasing after World War II. Clear Lake dam was constructed in the 1950s.

By the 1960s, the Forest began accelerating timber harvesting. Clearcutting was used in the upper elevations and south of White River. Salvaging of insect and disease-threatened large trees continued. By the mid-1970s, both Barlow and Bear Springs Ranger Districts came under intensive pressure to halt selective harvesting in the lower elevations and switch entirely to even-aged management. Both did so, using clearcutting as the primary tool. Road construction proceeded at rapid rates with many roads paved.

In 1973, the Rocky Fire burned 7400 acres of public and private land, primarily in the Rock-Threemile subwatershed. A contributing factor to the fire size and severity was many acres of untreated logging slash. The burn area was fertilized and seeded with orchard grass and non-native fescues. Stream banks were planted with willow cuttings. Fuel breaks were constructed along both sides of the major roads by machine piling all woody material and burning it. All but 33 acres of the burn area on National Forest lands was intensively salvaged. Few trees were available to leave as wildlife snags, less than two per acre. All those trees plus all trees under 9 inches DBH were left. Three years after the burn virtually all these trees had fallen. Snowbrush ceanothus sprouted from stored seed and quickly dominated the burn area. The first two reforestation efforts largely failed due to lack of appropriate species and drought.

By the 1980s, root disease began to become a significant tree mortality factor in western hemlock, grand fir, and Douglas-fir dominated stands in the Transition Zone. Fire exclusion and failure to adequately manage the understory allowed grand fir and western hemlock to begin dominating many stands in the Transition Zone. Douglas-fir became dominant in many stands of the Eastside Zone. These stand conditions evidently created a refuge for northern spotted owls. The species expanded its range to the east at the same time harvesting constricted habitat availability within the pre-1855 range.

Beaver had virtually disappeared from streams on the National Forest due to loss of riparian hardwoods. Species dependent on open pine-oak stands lost habitat with the encroachment of Douglas-fir, grand fir, and western hemlock. Sheep grazing in the upper elevations ended and the remaining four active allotments were allocated to cattle.

Irrigation methods started to become more efficient with the decline of flood irrigation and the advent of sprinkler irrigation. Some farmers began drilling wells to provide irrigation water. Advances in crop genetics created wheat varieties that needed less water to maintain yields. The 1985 Farm Bill, which included the CRP program, resulted in many acres of marginal land being taken out of production.

Recreation use continued to accelerate with the most rapid expansion coming in winter sports and any activity around water. Badger Wilderness was created in 1984. White River was designated as a National Wild and Scenic River in 1988. The Barlow Road Historic District was established in 1990. The Mt. Hood Forest Plan was released in 1989 and the northern spotted owl was federally listed as a threatened species. Several species on non-native fish and wildlife were introduced in the subbasin, mostly to increase opportunities for hunting and fishing.

Current Landscape

Vegetation

The current vegetation differs quite significantly from the typical pre-1855 vegetation, in terms of species compositions, percent area covered, and landscape pattern (Table 4.4 and Figure 4.3). These changes began before 1855 and we cannot expect to readjust quickly.

Eastside Zone. No old growth forest remains in this zone. Fire exclusion and failure to manage the understory allowed for dense conifer regeneration to establish and grow up to a certain point. Many stands consist of a remnant overstory of scattered ponderosa pine over 200 years old and a thicket of ponderosa pine less than 10 inches DBH and over 80 years old. Many of these small ponderosa pines essentially stopped growing approximately 40 years ago. We do not know what to call this stand in terms of successional name since it does not function as old growth and is not a typical late-successional stand even though the trees within it are considered old. The diagnostic stand name is Pine-Oak High Density, many of these stands are also stagnant. Both mountain and western pine beetle are present in many stands and causing increasing mortality in all size classes of ponderosa pine.

Stands on north aspects have become denser and are now transitional between Cathedral and Late Seral Tolerant Multistory. We do not expect these stands will reach Late Seral Tolerant Multistory before a resetting disturbance occurs. The most probable scenario is an insect epidemic and a fire. Rocky Burn did create a stand that has a Cathedral structure near Bonney Crossing. The trees are somewhat smaller in diameter than envisioned in a true Cathedral stand. Harvesting has created some Cathedral or near-Cathedral stands on the uplands, primarily in the Doughty and Cabin timber sales.

Harvesting by both the Forest Service and Mountain Fir Timber Company and the Rocky Burn created many Early Seral stands. The Mountain Fir harvesting created very large Early Seral stands in Badger-Tygh subwatershed. The combination of Forest Service and Mountain Fir harvesting created large areas of Early Seral in Jordan subwatershed. Rocky Burn created a large Early Seral stand in Rock-Threemile subwatershed. Both the Forest Service and Mountain Fir used clearcutting on the uplands where it probably was not appropriate. Mountain Fir usually left the unmerchantable small trees standing whereas the Forest Service cut them down (whipfelling).

Oak woodlands within the Forest boundary appear to remain relatively unchanged. This stand type is found on the harshest sites that can support trees. There may have been some conversion from oak woodland to pine-oak, but this change is much harder to detect without early photos to compare with current stands. Comparing photos taken in 1933 from Postage Stamp Butte with photos taken in 1993 reveals a change from oak woodland to pine-oak forest on ODFW lands near Friend.

Except in Oak Woodlands, recent harvest units, and recent prescribed underburns, the understory has changed from a dominance of native bunchgrasses to a dominance of litter, duff, and downed wood. Even in harvest units, non-native grasses and forbs dominate due to forage seeding. Antelope bitterbrush dominates understories east of Road 48 in the Gate subwatershed.

The Riparian Hardwood stand type is virtually absent within the Forest boundary, primarily due to past grazing and fire exclusion. The Riparian Conifer stand type now dominates perennial streams. Riparian stands are now more multistoried with very few single storied stands. The edge contrast between north aspects and south aspects and uplands is now very low. The edge contrast between Early Seral areas and the surrounding stands is now very high to extreme.

Transition Zone. Cathedral stands are very rare. Grand fir and western hemlock encroachment have greatly increased stand densities. Many stands will begin to stagnate within 10 years if not thinned either naturally or through management. Insects such as spruce budworm and fir engraver beetle and several root diseases are very active within these high density stands. The understories in many of these stands are less brushy. Some have little or no understory vegetation at all. Shelterwood harvest has left some stands with Cathedral qualities where the final removal cut has not occurred, for example in several Sputterbird units.

Late Seral Parklike stands no longer occur in the Transition Zone. These stands have also filled in with grand fir and Douglas-fir. The understory now supports scattered shrubs and forbs, or mostly litter and downed wood. Both Late Seral Parklike and Cathedral were the dominant type of old growth in the Transition Zone. Some Late Seral Tolerant Multistory old growth used to occur along the western edge of the zone. The only remaining patch of old growth lies on the south side of Badger Creek in the thumb of the Badger Wilderness; a large stand that still retains many Cathedral qualities. Fire exclusion is converting this stand into a high density stand.

Harvesting has fragmented most of the Transition Zone and converted it to Early Seral. Most early plantations were planted as monocultures of ponderosa pine north of White River and Douglas-fir south of White River. The Transition Zone has been the most heavily clearcut portion of the subbasin. Edge contrast between the Early Seral stands and the surrounding stands is high to extreme.

Table 4.4. Differences between range of natural conditions and current vegetation.

Zone	Diagnostic Stand Type	Species Composition Pre-1855	Species Composition Current	Landscape Pattern Pre-1855	Landscape Pattern Current
Eastside	Early Seral	PP, OWO	PP, DF	Small patches, ameboid shapes	Large blocks, geometric shapes
	Cathedral	PP, DF	PP, DF, GF	North aspects	Scattered
	Late Seral Parklike	PP, OWO	PP, little OWO	Dominated uplands	N/A
	Pine-Oak High Density	PP, OWO	PP	Small patches	Large blocks
	Oak Woodland	OWO	OWO	Small blocks, south aspects and ridgetops	Same
	Riparian Hardwood	BC, willow, alder	N/A	Short to moderate stretches	N/A
	Riparian Conifer	PP, DF, WL, WRC	PP, DF, GF, WRC	Short to moderate stretches	Long stretches
Transition	Early Seral	PP, DF, WL	PP, DF	Small patches or moderate blocks, ameboid shapes	Small blocks, geometric shapes
	Late Seral Tolerant Multistory	Mixed conifer	DF, GF, WH	Moderate blocks	Small blocks
	High Density Stagnating	Early or late seral species	Mostly late seral species	Small blocks	Moderate to large blocks
	Cathedral	PP, DF, WL	Late seral	Large blocks	Small to moderate blocks
	Late Seral Parklike	PP, OWO	N/A	South aspects, moderate blocks	N/A
	Riparian Hardwood	BC, willow, alder	N/A	Short to moderate stretches east edge of zone	N/A
	Riparian Conifer	Mixed conifer	DF, GF, ES, WRC, WH	Long stretches	Moderate to long stretches, fragmented in some streams
Crest	Early Seral	Mixed conifer	PP, DF	Very large blocks, ameboid shapes	Small blocks, geometric shapes
	Late Seral Tolerant Multistory	GF, WH, MH, mixed conifer	Same	Large blocks	Moderate to large blocks
	High Density Stagnating	Mixed conifer, LPP	Same	Small to moderate blocks	Moderate to large blocks
	Cathedral	Mixed conifer	Same	Moderate blocks	Small blocks
	Riparian Hardwood	BC, willow, alder	Same	Moderate stretches	Small patches to short stretches
	Riparian Conifer	Mixed conifer	Same	Long stretches	Moderate to long stretches, fragmented

The Riparian Hardwood stand type has almost disappeared, primarily due to fire exclusion, irrigation diversions, and past grazing. These three factors allowed conifer regeneration to establish at higher rates, reduced flood-related bank and bed scour, and prevented successful sprouting and seeding which in turn greatly reduced suitable habitat for beavers. Hardwood trees now appear as isolated individuals rather than short stretches along the perennial streams.

The Riparian Conifer stand type has spread but has also been fragmented by harvesting. Many of the large conifers have been removed in Gate subwatershed, resulting in denser and smaller diameter stands than would be expected under natural conditions. Most of Rock-Threemile subwatershed is strongly influenced by the Rocky Burn and resulting ceanothus brushfield. Rocky Burn is showing accelerating signs of reforestation, mostly through natural regeneration. Protection buffers were placed on most perennial streams, although not as wide as recommended in the Northwest Forest Plan. We clearcut the riparian area itself only from the mid-1970s through mid-1980s.

Intermittent streams were not well recognized by earlier timber sale planning; protection buffers are very narrow and well less than the 100 foot interim width specified in the Northwest Forest Plan. Within the Badger Wilderness in Badger-Tygh subwatershed, stand densities in the intermittent streams are higher than the range of natural conditions. Intermittent streams were not protected during ground-based salvage operations, particularly in Clear and Gate subwatersheds and in the Rocky Burn. Skidder operators simply took the most direct route to the tree.

Crest Zone. The Crest Zone still contains a wide variety of stand types and many stand types cover about the same percentage of land area as before 1855. However, the landscape pattern is very different. The Late Seral Tolerant Multistory stands are smaller than typically expected under natural conditions and concentrated in the very upper end of White River mainstem. We have harvested many stands that either were Late Seral Tolerant Multistory or approaching that stage. Many of these stands lay in areas that were not yet to the condition where we would expect a resetting disturbance to occur within a short period of time.

There are more Early Seral stands than expected under natural conditions and the pattern created is a highly fragmented one instead of a highly concentrated one. Edge contrast between Early Seral and the surrounding stands is extreme. The Crest Zone has fewer Cathedral stands than expected, although some shelterwood harvest units, particularly in Clear subwatershed, have Cathedral qualities where the final removal cut has not occurred.

The Hardwood Riparian stand type is all but gone from White River, lower Barlow Creek, lower Iron Creek, and upper Boulder Creek. The condition in upper Boulder Creek is probably within the range of natural conditions. The condition in the other streams probably is below the range of natural conditions. The loss in White River, Barlow Creek, and Iron Creek is not as easy to decipher as in the Eastside Zone. We believe that loss of beaver, past grazing, timber harvest, recreation use, and fire exclusion all play a role in the steep decline in black cottonwood in particular.

The Riparian Conifer type is either within the range of natural conditions or slightly below. Harvesting has fragmented this stand type. As in the Transition Zone, intermittent streams were not well buffered and were not well protected during salvage operations. Most perennials were buffered, but not to the level recommended in the Northwest Forest Plan.

Disturbance Processes

In addition to the natural disturbance processes listed under the pre-1855 conditions, we have added many new ones (see Appendix A for more details). Among these are:

- timber harvest and salvage
- grazing
- ditch failures

- roading
- recreation

In addition, we have altered the frequency, intensity, and/or severity of many processes. Fire exclusion has reduced the frequency and increased the intensity and severity of fires in the Eastside and Transition zones. If current trend continues, we will begin to see similar effects in the Crest Zone. We have changed the typical season of burning by focusing on spring prescribed burning to meet other resource objectives and reduce emissions. Timber harvesting along the higher ridges in the western half of the subbasin has increased the frequency of blowdown. Insect and disease levels have increased greatly in the Transition Zone. Insect epidemics now occur in the Eastside Zone. Irrigation diversions have reduced stream power and we do not have a good understanding of how they have changed riparian and aquatic ecosystem functioning. Since some ditches flow year-round we believe they may have reduced the magnitude and frequency of 10-25 year flood events in Clear, Boulder, Gate, and Rock-Threemile subwatersheds.

Beaver ponding is no longer significant within the Forest boundary. Erosion and sediment delivery to streams occurs at higher levels and much more frequently. The causes of erosion have also changed. Now it is due more to compaction, ditch blow outs, roading, recreation use, and grazing.

White River ecosystems did not evolve under high grazing pressure by large herds of ungulates. Intensive grazing did not occur until Euro-American settlement began. Records are spotty, but do give an indication of grazing levels over the historic period (Figure 4.4). Since the Forest Plan was issued, more personnel have been hired to administer the existing grazing permits. Short- and long-term monitoring plots were reestablished, permittees are slowly improving the fences, and grazing systems have been altered. Under the current system, range readiness monitoring occurs before the livestock are turned out. Permitted numbers were reduced on Grasshopper Allotment in 1989 and in Wapinitia Allotment in 1993 and increased in White River Allotment in 1991 (Table 4.5).

The high levels of past grazing resulted in many changes in vegetation and damage to streams, springs, wet meadows, and riparian areas. We believe some of the problems in streambank stability and erosion are at least partly due to unrecovered past damage. However, some continuing damage has been noted, primarily in Grasshopper Allotment.

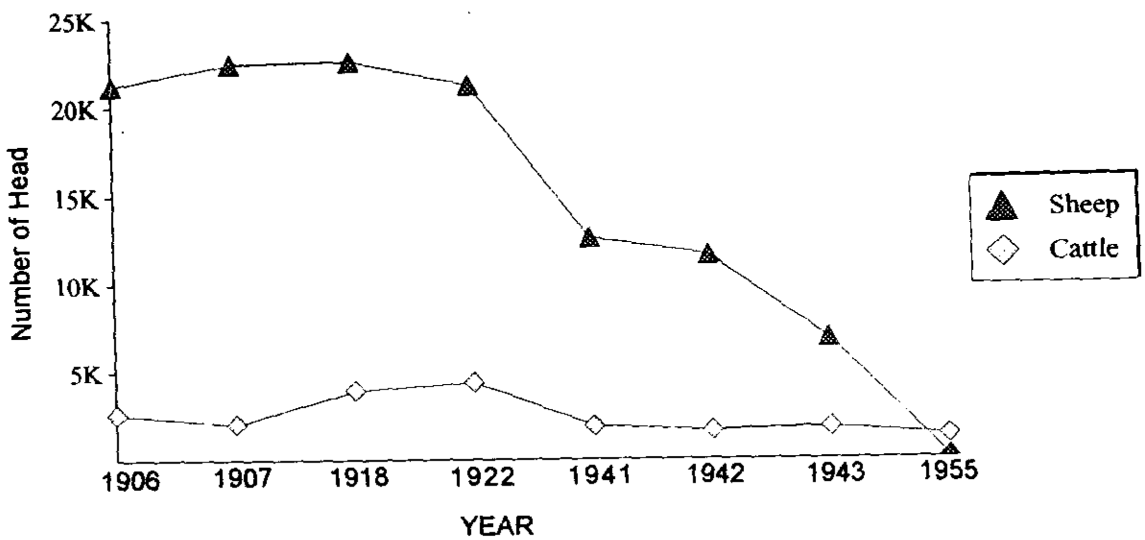


Figure 4.4. Livestock use levels for Barlow and Bear Springs Ranger Districts. Note: unknown if "number of head" in cattle equals actual number or number of cow-calf pairs.

Table 4.5. Permitted use levels for all allotments on Barlow and Bear Springs Ranger Districts by allotment. Note: numbers are for cow-calf pairs.

Allotment	1990	1991	1992	1993	1994	1995
Wapinitia	130	130	130	100	100	100
White River	195[1]	250	250	250	250	250
Grasshopper	400	400	400	400	400	0
Badger	80	80	0[2]	0	80	80
Total	805	860	780	750	830	430

[1] One permittee took non-use on a permit for 55 cow-calf pairs

[2] 0 = Rested from grazing

Roading increases the drainage network due to the drainage ditches along each road. Road surfaces and maintenance levels are intended to remove water quickly. The higher the number of road miles, the more runoff increases. Native surface roads are much more prone to erosion than gravel or paved roads. Further, culverts or bridges must be provided to cross streams if fords are not used. Only one ford remains in general use (Road 2700-120 at Tygh Creek). Culverts may present migration barriers to fish and other aquatic species and may not be large enough to handle floods beyond a certain size. Occasionally culverts do plug up, causing ponding, road wash-outs, and a major influx of sediment.

Wildlife and Fish

Wolves and grizzly bears no longer exist in the subbasin. Lynx and wolverine are probably absent. Pronghorn antelope were wiped out and recently reintroduced on Postage Stamp Butte. We believe mule deer, black-tailed deer, and elk are populations far exceed the range of natural conditions. Scattered individual bald eagles only winter in the subbasin, primarily in White River, Tygh Valley, Clear Lake, Rock Creek Reservoir, and Pine Hollow Reservoir. With the reduction of the anadromous fish runs up the Deschutes River, the eagles have little to feed on since White River subbasin does not support large flocks of winter waterfowl. Pine martens have declined and fishers may be absent.

Species more dependent on old closed canopy forest, such as the northern spotted owl, were able to expand their range into the Eastside Zone. Species more dependent on old open canopy forest, such as the white-headed woodpecker, have lost a significant amount of habitat with the loss of Late Seral Parklike forests. Several birds have been introduced or expanded their range:

- wild turkey, both Rio Grande and Merriams' races
- chukar
- ring-necked pheasant
- red-legged partridge
- Hungarian partridge
- brown-headed cowbird
- starling
- barred owl

Fish stocking of non-native hatchery rainbow and brook trout included many streams and all lakes. In 1994, ODFW ended stocking of streams under the new Native Fish policy. Fish stocking continues in many lakes and both reservoirs. As stock and farm ponds were constructed on private lands, warm-water fishes such as bass, bullhead, and bluegill were introduced. Goldfish have even been introduced into some stock ponds on private lands and wildlife guzzlers on federal lands. Bullfrogs have made their way into the Eastside Zone. Beaver are virtually non-existent within the Forest boundary, but relatively abundant farther east.

Social Uses

The National Forest lands in White River subbasin provide a variety of both consumptive and nonconsumptive uses. Commodities include timber, forage for commercial livestock, common variety minerals, and water for irrigation. The two districts issue a variety of permits for firewood collection, Christmas trees, boughs, mushrooms, and beehives to name a few. People also hunt and fish on the National Forest lands, and collect beargrass, huckleberries and a variety of other plants and plant materials.

Recreation use occurs year-round in much of the subbasin. Winter use is concentrated in the Crest Zone. The subbasin has several unique experiences possible such as renting a lookout in the winter, traveling a large section of the Oregon Trail, or kayaking down a highly technical river. This subbasin is one of the few areas to have a relatively primitive experience yet be close to a road for relatively easy entry and exit. There are 18 developed campgrounds and numerous dispersed camp sites. Visitors have 12 lakes or reservoirs on National Forest lands or one reservoir on private lands from which to choose. Most trails provide for several different user groups such as hikers, horseback riders, horse or llama packers, and mountain bikers. McCubbins Gulch offers an off-road vehicle riding area and Barlow Ranger District is in the processes of designing a trail system for off-road vehicles.

The Forest has been divided into a variety of Recreational Opportunity Spectrum (ROS) Classes based on land allocations in the Forest Plan. In many cases we have difficulty understanding what ROS Class we are supposed to meet in a given area since no maps were prepared and some land allocations permit multiple ROS Classes depending on location in the Forest. Often we are unsure which ROS Class applies to a given area in a particular land allocation. A prime example of this confusion is found in the southwest quadrant of GRID 410. A hand map of ROS Classes is at Barlow Ranger District.

Semi-Primitive Nonmotorized:

- Twin Lakes--generally meets ROS Class except right around Lower Twin Lake; too much bare ground and the shoreline is degraded.
- Bonney Meadows/Echo Point--generally meets the ROS Class.
- Boulder Lake--generally meets the ROS Class; too much bare ground along the south and east shore; non-native materials used in picnic table bases but is weathered enough not to be noticeable.
- White River Canyon--meets the ROS Class.

Semi-Primitive Motorized:

- Upper White River corridor--does not meet ROS Class due to geometric clearcuts, industrial outhouses in White River West Sno-park; industrial appearance to both White River sno-parks, and Road 48 roadcuts.
- Barlow Road--generally does not meet ROS Class due to too much bare ground in the dispersed sites (i.e. 4800-170 and Barlow Road junction); use of inappropriate materials in the allotment fences; and the Gordan Site. The special use permit area at the Gordan Site is more typical of a Rural or Urban ROS Class due to the number of structures, general condition of the site, and the use levels.
- Upper Boulder Creek west--generally meets the ROS class except for the geometric clearcuts. The ROS Class should be Semi-Primitive Non-Motorized to match the land allocation of Unroaded Recreation.

Roaded Natural:

- GRID 312--exceeds ROS Class, generally meets Semi-Primitive Motorized and Non-motorized except for the Mountain Fir clearcuts.

- Jordan subwatershed in the Eastside Zone--does not meet ROS Class due to the number and shape of cutting units and cable corridors. Experience is closer to Roaded Modified.
- Rock-Threemile and Gate subwatersheds in the Eastside Zone--meets ROS Class.
- Hazel Hollow and McCubbins subwatershed in the Transition Zone--do not meet ROS Class. Hazel Hollow does not meet due to number of clearcuts and the "T"; borderline Roaded Modified. McCubbins subwatershed does not meet due to off-road vehicle use levels and current vegetation management practices.
- Clear and Barlow subwatersheds in the Crest Zone--meets ROS Class in general although specific sites do not, such as Frog Lake Buttes and Clear Lake Campground. Frog Lake Sno-park and Campground meets the ROS Class but does not meet Visual Quality Objectives.
- Upper Boulder Creek east--exceeds ROS Class, actually meets Semi-Primitive Non-motorized except near Kane and Whooping units.

Roaded Modified:

- Douglas Cabin LSR--meets ROS Class.
- Rock-Threemile and Gate subwatersheds in the Transition Zone--meets ROS Class.
- Wildhorse/Camas area--meets ROS Class.
- Road 4850 area--meets ROS Class.
- Abbott Burn--exceeds ROS Class, actually meets Roaded Natural ROS Class.
- Lower Boulder Creek/Section 16--meets ROS Class.

Land management practices are also expected to result in a certain level of scenic quality, known as Visual Quality Objectives (VQOSs). Table 4.6 compares VQOs with terms that describe the actual scenic condition. The viewsheds from Timberline Lodge, US Highway 26, Oregon Highway 35, Forest Road 48, and the White River Wild and Scenic River greatly influence VQOs in the Crest Zone. Since most of the Crest Zone is allocated to LSR and B2-Scenic Viewsheds we are mostly trying to meet Retention and Partial Retention. In the Transition Zone, the White River Plan changed some VQOs to Partial Retention. In both the Transition and Eastside zones we are mostly trying to meet Modification and Partial Retention, with the wilderness having Preservation as its goal.

Table 4.6. Comparison between VQOs and existing condition terms.

VQOs	Existing Condition
Maximum Modification[1]	Heavily Modified
Modification	Moderately Altered
Partial Retention	Slightly Altered
Retention	Natural Appearing
Preservation	Natural Appearing

[1] Not an actual VQO in the Mt. Hood Forest Plan

A hand map of the existing scenic condition is at Barlow Ranger District. The evaluation of existing condition is based on a combination of aerial photo interpretation and professional opinion.

Crest Zone:

- Heavily Modified in areas of concentrated timber sales such as along 2660 and 2630 north of Clear Lake, much of the Frog Creek drainage, and the east side of Boulder Creek.
- Moderately Altered in areas of scattered timber sales such as along White River floodplain, upper Frog Creek drainage, west side of Boulder Creek below Bonney Meadows and Boulder Lake, and Road 48 near Highway 35.

- Slightly Altered in areas of very few timber sales or no sales but poorly designed roads such as the road to Badger Lake.
- Natural Appearing in four main areas:
  1. between Frog Lake Buttes and Barlow Butte,
  2. the roadless portions of upper Boulder and Threemile Creeks, and Badger Wilderness,
  3. White River floodplain, and
  4. upper Clear Creek drainage.

Transition Zone:

- Virtually all Heavily Modified with some large patches of Moderately Altered.
- Natural Appearing in two areas:
  1. White River canyon and
  2. Badger Wilderness.

Eastside Zone:

- Virtually all Moderately Altered.
- Slightly Altered along Barlow Road and Barlow Road meadows complex.
- Natural Appearing in Badger Wilderness.

Critical Trends

Vegetation

- The Forest has done a poor job on controlling certain noxious weeds, primarily knapweeds and thistles. Both genera are widespread on National Forest lands and may be a source of reinfestation on adjacent landowners who have attempted to control these weeds.
- Forest health continues to decline in the Transition and Eastside zones. The recent drought has increased tree stress, particularly in old trees and in the climatic climax species.
- No mechanism is currently in place to reverse the loss of riparian hardwood trees on National Forest lands, particularly black cottonwood.
- The most recent timber sales and planning efforts are using uneven-aged management prescriptions with area level fuel treatments. Prescriptions and management strategies address both the overstory and understory. Logging technology and an aggressive decompaction program on unneeded skid trails are both reducing detrimental soil impacts and restoring site productivity. While it is too soon to establish a clear trend, early results on Gate Timber Sale look very promising for moving towards the desired conditions and minimizing detrimental impacts on all resources. Lessons learned from Gate have been applied to sales planned for FY95 and 96.
- Both Barlow and Bear Springs Ranger Districts have started native plant propagation programs. Seed zones have been established for various plant groups; native seed collection and sprouting are underway using local growers. Sprouts from the first year of collection are being used in restoration efforts in FY95. Seeds have been collected from a variety of native grasses, forbs, and shrubs.

Disturbance Processes

- Most or all natural disturbance processes appear to operating within the range of natural conditions in the Crest Zone. If the current policy of fire exclusion continues, we may begin to see unnatural levels of fuel buildup even in the Crest Zone.

- The risks of insects, disease, and stand replacing fire are outside the range of natural conditions in the Transition and Eastside zones.
- Irrigation diversions in the Transition Zone appear to have detrimentally affected riparian and aquatic ecosystem functioning in the Transition and Eastside zones. Diversions may have significantly altered the magnitude and timing of floods, and sediment and wood transport and deposition, particularly on those streams where the diversions flow year-round (Frog, Clear, Boulder, Cedar, Lost, Gate, and Threemile creeks).
- Prescribed burning of natural fuels has reduced hazardous fuel loadings on several thousand acres in the Eastside zone. The natural fuels program began in the early 1980s and strove to burn approximately 1000 acres per year. In addition to reducing fuels, the burns thinned some stands and stimulated browse and forage. In 1993, the program lost stable funding and is struggling to continue under a variety of uncertain funds. A natural fuels underburning analysis indicated the need to burn 1000-1200 acres annually on Barlow Ranger District alone in order to meet Mt. Hood Forest Plan and ecosystem management objectives.

Wildlife and Fish

- As insects, disease, and fire increase tree mortality, habitat quality and quantity for those species that depend in closed canopy forest will continue to decline in the Transition and Eastside zones. The quality and quantity of deer and elk thermal cover in winter range will continue to decline.
- As surface water withdrawal opportunities end, irrigators will increase ground water withdrawals. The state does not have a mechanism to determine when to stop ground water withdrawals. As ground water withdrawals increase, domestic use wells, springs, and seeps east of the Forest boundary may begin to dry up.
- We know very little about the aquifer supplying irrigation and domestic use wells, but there is a high probability that the recharge area for that aquifer lies on National Forest lands. As pressure on ground water increases, the National Forest lands may come under increasing pressure to identify and better manage the ground water recharge areas. We do not yet know what the consequences on other resources and land uses may be.
- Fish habitat improvements have been on-going for several years, particularly in the Rocky Burn. In-channel improvements include debris loading and placing a variety of structures to increase habitat complexity in stream reaches degraded from human activities.
- Erosion control and road closures/obliteration programs have accelerated since FY93. Efforts have been concentrated on high steep cutbanks and native surface roads. Erosion control results have been mixed, in part due to drought conditions. The most successful measure has been to use coconut netting with seeding. Success is greater if watering occurs during the summer. At present, watering depends on the availability of fire prevention patrols and engines. Several miles of unneeded native surface road have been obliterated and reseeded, primarily in Badger-Tygh and McCubbins subwatersheds.
- Range exclosures around springs and sensitive stream reaches have reduced grazing impacts around these water sources. Fence maintenance and repair has been a problem in some locations, but most exclosures work well.
- Blasting the tops of live trees to create snags in snag-deficient areas has begun to pay off. Cavities begin to appear in these trees 5-10 years after blasting. Snag creation has been most critical in lower elevations where an early 1970s felling program removed virtually all large snags in an effort to reduce wildfire risks.
- Grazing management practices began changing after release of the Mt. Hood Forest Plan. Funding increased sufficiently in the Range Program to allow hiring one full-time range conservationist and one part-time person. Although much work is still needed, fence repair is proceeding along with water developments and salting patterns to better control cattle use.

- Bird and bat boxes have been placed, primarily south of White River and in the Rocky Burn, to provide nesting and roosting sites for secondary cavity nesters. Use levels of these boxes is unknown.

Social Uses

- Important demographic changes that affect recreational demands include increasing urbanization of the state's population, an aging population, declining economic conditions, growing minority populations, and dramatic increase in the number of working mothers.
- The Mt. Hood National Forest is classified as an urban forest due to its proximity to the Portland metropolitan area. Most of White River subbasin, however may be too far away to be considered a significant part of recreational opportunity for most lower income households in the Portland area. Of more significance to recreation management would be providing recreational opportunities for the lower income households in Wasco and Hood River counties.
- The only organized community based opportunity offered on National Forest lands in White River subbasin is the annual Fishing Clinic. However, the Fishing Clinic does not happen in White River subbasin every year. In recent years, the location moved much closer to The Dalles. Community based recreational opportunities east of the Forest boundary include Tygh Valley All Indian Rodeo (Tygh Valley), the Wasco County Fair (Tygh Valley), and Barlow Road Rendezvous (Wamic).
- Major barriers to participating in community based recreation include lack of time, crowded areas or facilities, distance from home, and not knowing where the facilities are.
- Statewide, the five most popular dispersed recreational activities are:

  1. Sightseeing, driving for pleasure (69.3%)
  2. Swimming, wading at ocean, lake, or river (58.7%)
  3. Boat fishing (40.6%)
  4. Tent camping (39.1%)
  5. Nature study and wildlife viewing (38.5%)

  White River subbasin provides all these opportunities. Opportunities for swimming and wading and boat fishing are limited and occur mostly at crowded facilities. The Forest Service has only very recently begun to promote opportunities for nature study and wildlife viewing through the Watchable Wildlife program.
- In households where no one participated but would like to, the top five desired activities are:

  1. Non-motorized boating (canoeing, rafting) (35.1%)
  2. Horseback riding on trials (34.3%)
  3. Cross country skiing (31.1%)
  4. Hiking, backpacking on trails (30.7%)
  5. Nature study and wildlife viewing (29.2%)

  The most recent trend in recreation management in White River subbasin has been to promote motorized recreation and more developed facilities. White River Wild and Scenic River Plan emphasizes dispersed and less developed recreational activities and facilities, such as horseback riding, cross-country skiing, and hiking.
- The main barriers to participation in dispersed recreational activities are lack of time, distance from home, equipment expense and fees, and crowded areas and facilities.
- There is a marked preference for more natural or primitive settings. In many cases, people are using facilities and settings more developed than they would prefer.
- Barriers to using the preferred setting are lack of time, over crowding, and travel expense. Lack of knowledge is also significant. Opportunities for the settings may be provided but not identified.

- Important conclusions in the 1994 SCORP report that may affect White River subbasin include:
  1. Increased provisions for wildlife and nature education, community sponsored programs in hiking, boating, and wildlife viewing, and opportunities to enjoy outdoor theater and plays, and park concerts and music festivals seems warranted.
  2. Greater planning and management emphasis is warranted to protect scenic qualities and those natural resource areas providing opportunities for such activities as camping, boating, fishing, trail use, and wildlife observation.
  3. There is a pronounced preference for more semi-primitive and primitive settings, especially for dispersed activities and there are substantial shortages of these settings to meet future demand on National Forest lands.
  4. Cost factors and fees are barriers to many. With the recent trend towards greater reliance on user fees, financial barriers may become more acute. The issue of economic accessibility to recreation should be given major consideration.
  5. Greater focus should be placed on the number and location of facilities and design and management of facilities to alleviate crowding.
  6. Greater attention should be given to educating the public on location of resources and to increasing knowledge and skill levels to expand opportunities for people to participate in outdoor activities.
- Wasco County and local communities lost a significant portion of the economic base with the closure of the Tygh Valley and Maupin sawmills and the selling of Mountain Fir Timber Company's land base. Most of it was sold to Rocky Mountain Elk Foundation, a non-profit wildlife organization, who intends to sell the land to either the federal or state government, thus removing the land from the property tax roles. Property taxes are the primary source of county income to pay for such services as law enforcement, schools, road maintenance and plowing, and so forth. The county and local communities have begun to struggle financially to provide these services.
- Wasco County is in the process of trying to expand its economic base and promote tourism and recreation. The area around Pine Hollow Reservoir is currently undergoing increased recreation-related development.
- Firewood availability is a concern in the local area. Many residents depend on wood as a primary heat source in winter. As timber sale levels have declined and restrictions to protect wildlife habitat have increased, firewood availability has declined. Fees for firewood are increasing. Firewood theft appears to be increasing.
- During periods of high fire danger the eastside of the Mt. Hood often remains open for firewood cutting due to use of an inappropriate fuel model to calculate fire danger indices. In 1992, the eastside had firewood cutters coming from as far away as Bend. These non-local firewood cutters may compete with local residents for an increasingly scarce supply.

CHAPTER 5: RESULTS

Introduction

In Issue 10 the main issue statement questions commodity production levels as well as locations; however, the key questions only ask about locations. Therefore, we reworded the main issue statement to delete any references to commodity production levels.

We have reworded a few key questions to either broaden or narrow their focus based on what we found during analysis and synthesis. The wording in the questions below better reflect the question we were actually able to answer. Also note some key questions have new designations; the old designation is listed in parentheses following the question so that you may cross-reference with the original wording in Chapter 3.

Appendices to this document provide supporting material to many answers in this chapter. In some cases, the conclusions reached by a particular resource specialist may differ from the conclusions reached during synthesis. For example, one specialist felt that current conditions within the Badger Creek Wilderness are representative of the range of natural conditions before 1855. The synthesized conclusion was that current conditions in wilderness represent the range of conditions in the absence of timber harvesting, roads, and fire. Wilderness conditions were not considered representative of the pre-1855 range of natural conditions due to the large influence fire exclusion has played on stand structures, densities, and species compositions. Readers are encouraged to review all appendices for supporting information and opinions which differ from those presented in this chapter.

Answers to Key Questions

1. **Issue: The Forest Plan, Northwest Forest Plan, State Water Quality, and Columbia River Policy Implementation Guide standards and guidelines for several habitat elements appear to result in forest, riparian, and aquatic ecosystems that are outside the range of natural conditions and are thus contrary to ecosystem management objectives for several portions of the subbasin.**

A. *Can the Douglas Cabin and Triangles LSRs meet LSR Objectives over both the short-term (next 5 years) and the long-term (greater than 5 years)?*

Yes, with the assumption that the intent of the Northwest Forest Plan is to provide habitat for species dependent on stands dominated by large trees. In both LSRs, the typical old growth structure is primarily Late Seral Parklike (ponderosa pine-Oregon white oak dominated) with significant amounts of Cathedral (ponderosa pine-Douglas-fir dominated). The key in both these LSRs is that the typical Old Growth structure is disturbance-dependent. Both types require frequent, low intensity disturbance to both create and maintain the Old Growth structure and function. The disturbance needs to be large or widespread.

Before 1855, the primary disturbance that created both Old Growth structures was fire. As best we can determine, these fires burned several hundred to several thousand acres at a time over a period of several weeks to months. American Indians started many of these fires. The time of burning is less clear. In the Blue Mountains, most American Indian burning occurred in fall. In California oak woodlands, most of the burning occurred in early spring as soon as possible after snowmelt. Either case is possible and the burning occurred either before or after the active growing season for most native plants.

Under present conditions, neither LSR contains either Late Seral Parklike or Cathedral forests. Douglas Cabin LSR is providing some spotted owl nesting, roosting, and foraging habitat. However, this LSR is also experiencing relatively high levels of insect attack, both spruce budworm and bark beetles, and is at relatively high risk of stand replacing fire. We have conducted some prescribed underburning in the LSR to both reduce the risk of fire and promote spotted owl nesting habitat. The burning has not been extensive enough to reduce the fire risk on the western half of the LSR. It is too early to know if the burning actually promoted spotted owl habitat. The health and risk status of the Triangles LSR is unknown.

It appears that Douglas Cabin LSR can continue to provide low quality spotted owl habitat for about another 20 years if we do not have either another spruce budworm outbreak, a bark beetle outbreak, or a large fire. It cannot provide spotted owl habitat for much longer than that.

To promote ecologically sustainable Old Growth forests in these two LSRs, we need to begin moving them toward their more stable Old Growth structures. That portion of both LSRs that we move into a Cathedral Structure will likely continue to provide spotted owl nesting, roosting, and foraging habitat and at a higher quality of habitat than is present currently. That portion of the LSRs that we move into Late Seral Parklike will provide habitat for species such as flammulated owls, great gray owls, pygmy nuthatches, Lewis woodpeckers, and white-headed woodpeckers.

B. Can the White River LSR between Deep Creek and the National Forest boundary meet LSR objectives over both the short-term and the long-term?

Yes, with the same assumption as used in Question A. Below Deep Creek, the typical Old Growth structure is Cathedral on the south side of the river (north aspect) and Late Seral Parklike on the north side (south aspect). The considerations apply to White River LSR as apply to Douglas Cabin and Triangles LSRs. Further, that portion of White River LSR lies within the Wild and Scenic River boundary. See the Wild and Scenic River Plan for the vegetation management strategy within White River canyon.

C. Can the dry forest zones provide stable nesting, roosting, and foraging habitat for the northern spotted owl over the long-term?

No. The Eastside Zone is capable of providing stable spotted owl nesting, roosting, and foraging (NFR) habitat only on the more moist areas, typically north aspects along perennial streams, and in the riparian zones of third order and larger streams. Within these areas, we can probably maintain NFR habitat over the long-term (greater than 50 years) provided no stand-replacing fires burn. If we manage the adjacent uplands to produce Late Seral Parklike stands dominated with ponderosa pine and Oregon white oak, including using frequent, low intensity burning, we would reduce the probability of a stand-replacing fire in the NFR habitat. Under natural conditions, stands suitable for providing NFR habitat probably covered 5-25% of the land area within the Eastside Zone.

The upland portions of the Eastside Zone are not capable of supporting NFR habitat over the long-term. Most of the existing habitat is the result of fire exclusion, which has allowed development of more closed stands than would have naturally occurred. High stocking levels have created significant moisture stress and increased all trees' susceptibility to insect, disease, drought, and fire-related mortality. We expect many of these stands to succumb to one or more of these factors within the next 50 years if we do not reduce stocking levels.

The Crest and Transitions Zones are capable of providing NFR habitat on about 50% or more of each zone's land area over time. Stand structures and diagnostic stand types that provide NFR habitat are Cathedral; Mature Stem Exclusion, providing the stand is not so dense that it is stagnating; and Late Seral Tolerant Multistory as well as most structures that are intermediate among these three. The stable Old Growth structure in the Transition Zone is a Cathedral forest. Even though it depends on low intensity semi-frequent disturbance to maintain itself, Cathedral forest provides the stocking levels and crown closures at the levels needed for those habitat elements. Habitat quality would probably be higher in the western portion of the zone.

Habitat quality within the Transition Zone would tend to fluctuate with the climate cycle. During dry periods of the cycle, habitat quality would be lower and suitable habitat quantity may decrease as drought conditions encourage a more open stand structure. During wet periods of the cycle, habitat quality and quantity would be higher as moist conditions would support a more closed stand structure. The difficulty comes in recognizing what portion of the cycle we are in and manage accordingly. We cannot detect the change in cycle until we are well into it. For example, a dry period probably began in the mid- to late 1970s, but we have only detected it in the mid-1990s. Each phase of the cycle averages 40 years in duration.

D. *Can we return to a more open ponderosa pine-Oregon white oak dominated community and still provide adequate dispersal habitat for northern spotted owls?*

Yes. When pine-oak stands also include Douglas-fir, canopy closure typically equals or slightly exceeds 40% for the conifer component. With tree sizes generally greater than 20 inches DBH for the conifers, these stands can easily achieve the 11 inch DBH/40% crown closure guideline. This type of stand would develop most often in the western portion of the Eastside Zone. That portion of the zone where only ponderosa pine and Oregon white oak would grow (pine-oak plant associations) would not provide 40% canopy closure year-round when managed within the range of natural conditions.

E. *Can we continue to provide habitat for known northern spotted owl pairs in the dry forest zones long enough to develop needed habitat in the LSRs?*

Uncertain in the Eastside Zone. Some portions of the Eastside zone may be able to provide NFR habitat for the next 20-40 years if some management occurs to reduce susceptibility to epidemic levels of insect attack and stand-replacing wildfire. We recommend thinning many stands in the following priority:

1. Thin stands currently overstocked and which do not meet NFR habitat conditions. The primary objectives would be to reduce susceptibility to stand-replacing wildfire, maintaining or improving vertical diversity in a somewhat clumpy manner, and maintaining dispersal characteristics or promoting the rapid development of dispersal habitat. Thinning these stands would reduce the overall risk of stand-replacing wildfire within this zone.

2. Thin stands meeting NFR characteristics which have a high likelihood of not maintaining those characteristics over the next 20-40 years due to risk of wildfire or stress related mortality. Thinning such stands would reduce moisture stress, greatly increase stand longevity, and still maintain NFR characteristics. Increasing the potential longevity of these stands would more than offset potential losses in NFR quality.

3. Thin stands on north aspects along perennial streams and other moister sites that currently provide higher quality NFR habitat to reduce moisture stress and risk of stand-replacing wildfire while retaining the necessary numbers of large trees, structure, crown closure, and other stand components needed for nesting, roosting, and foraging.

In all cases we recommend that thinning prescriptions focus on retaining or promoting large diameter ponderosa pine and Douglas-fir. Large diameter grand fir should be retained only when needed to provide the needed numbers of large trees or crown closure. We also recommend a regular underburning program to keep the risk of stand-replacing wildfire as low as feasible. Burning should occur in late winter or early spring, before spotted owl mating activity begins, or in fall after young birds have fledged and begun dispersing to other areas.

Burning during late winter/early spring and fall would also minimize negative effects on native plants which evolved under a summer/fall burning regime (e.g. perennial bunchgrasses, buckwheats, wild onions, and lomatiums). Some plant species will likely benefit from fall or winter underburns. Burning after plant growth begins often harms many species by destroying the above-ground parts (leaves, flowers, and fruits) at a time when root reserves are depleted. The plants cannot recover quickly and become more susceptible to displacement by non-native species.

Yes. We can provide habitat in the Transition Zone until habitat develops in the White River LSR. The Transition Zone is capable of providing spotted owl NFR habitat over about 50% of its area. Analysis indicates that such habitat is provided by the Cathedral forest which used to dominate the zone. Much of the current habitat is of lower quality than it could be due to the transformation of Cathedral forest into High Density stands.

Continuing to stay out of these stands could result in the loss of NFR habitat to disease, insects, fire, or drought-related mortality. Careful harvesting should move much of the Transition Zone back towards the Cathedral stand structure and improve spotted owl habitat. However, the management needed may result in stands that do not provide suitable owl habitat immediately. Given the current status of many stands and of the spotted owl as a species, we will need to assure that there is no net loss of suitable spotted owl habitat between the Crest and Transition Zones as we manipulate the vegetation to restore the desired stand structures.

We do have a concern in the scheduling and intensity stand treatments in the Eastside and Transition Zones. Even in priority 1 and 2 stands, we believe there is a 20-40 year window in which to apply these treatments to gradually move stands towards the desired condition. Since many of the concepts discussed in this watershed analysis are relatively untried, and success is highly dependent upon final results as envisioned, new thinnings should be applied cautiously, for example on less than 30% of a subwatershed. Moving slowly, particularly initially, will allow for adjustments in prescriptions, harvest techniques, administration, and so forth, and allow for easier incorporation of new information on both forest and spotted owl ecology. We can be more sure that the resulting landscape patterns, stand conditions, and associated effects are either within acceptable tolerance of the predicted condition or more readily adjusted to reflect new information that affects desired conditions.

F. *Has the shift in plant communities reduced the habitat for other species in White River subbasin?*

Yes, primarily in the Eastside Zone and lower fringes of the Transition Zone. Some species which have less suitable habitat currently than before 1855 are:

Group	Species
Birds	flammulated owl, great gray owl, white-headed woodpecker, pygmy nuthatch, loggerhead shrike
Mammals	fisher, long-eared myotis, pallid bat
Plants	Tygh Valley milkvetch, Howell's milkvetch, bluebunch wheatgrass, Idaho fescue, northern buckwheat, daggerpod, other species native to perennial grasslands and biscuit scabland

These species are more dependent on open parklike stands of ponderosa pine and Oregon white oak or ponderosa pine and Douglas-fir, perennial grasslands, or biscuit scablands. Loss of these types has reduced the viability of these species in the subbasin. Little is known about the presence or absence of flammulated owls. We have not looked for this nocturnal species in this area, but believe it probably was present since suitable habitat was present. Great gray owls are still present, but at reduced populations. White-headed woodpecker, a readily recognizable species active in the daytime, is no longer known to be present within the subbasin. Pygmy nuthatch is considered a rarity. Loggerhead shrike was not recognized as a potential species of concern until recently; we do not know anything about its presence and population levels. Areas formerly dominated by native bunchgrasses and forbs now contain many introduced grasses and forbs or have been converted to agriculture.

In general, the loss of spotted owl NFR habitat in the Crest and Transition Zones due to harvest and fire exclusion has increased the need for and value of non-typical NFR habitat in the lower fringes of the Transition Zone and in the Eastside Zone. Management activities which will tend to change the lower portions of the Transition Zone and the Eastside Zone towards more parklike stands would benefit species such as those listed above. However, it would reduce habitat suitability for the northern spotted owl.

G. *Are the current standards for downed wood appropriate for the terrestrial and riparian ecosystems? (formerly question H)*

No. The aquatic standards are discussed under Key Question 1H. The standards use a "one size fits all" approach and do not recognize that downed wood loadings vary across the landscape and through time. The Northwest Forest Plan requires that we use Forest Plan standards and guidelines if they provide more downed wood. The applicable standards and guidelines are:

- FW-033 At least 15 tons per acre of dead and down woody material in east side vegetation communities . . . should be maintained and evenly distributed across managed sites.
- FW-036 On sites which naturally produce less dead and down woody material than 15 tons per acre on the east side . . . , at least 80% of naturally occurring levels should be maintained.
- FW-038 When prescribed fire is used for site preparation, consumption of surface organic horizons (i.e. litter and duff layer) should not exceed 50% of natural depths within the fire area.

The loadings above are intended to include material needed for wildlife habitat. The wildlife standards and guidelines require that we leave an average total of six logs per acre in decay classes 1, 2, and 3 that are at least 20 inches in diameter on the small end and at least 40 cubic feet in volume (FW-219 through FW-223). The wildlife requirements calculate out as a maximum of four tons per acre using the specific gravity of Douglas-fir.

We are not certain what the range of natural conditions is for downed wood, but used information collected from Ecology plots on the Mt. Hood and from forest inventory plots taken in similar climatic zones from Idaho and Montana. We also examined photo guides to approximate what we thought might have been typical before 1855. Using this information we developed the following recommendations:

- Within harvest units these loadings should remain after fuels treatment is complete--

1. Eastside Zone: 3-13 tons per acre, at least one tree-length log per acre.
2. Transition Zone: 10-20 tons per acre, at least three tree-length logs per acre.
3. Crest Zone: 25-50 tons per acre, at least five tree-length logs per acre.

- At least 75% of the loading should be in material larger than 3 inches in diameter. In the Eastside Zone, at the low end of the range, all loading should be in large logs (greater than 12 inches average diameter).
- At the subwatershed level, manage for the following percentages of the above tonnages of large woody material within each size class:

	ZONE		
Size Classes[1]	Crest	Transition	Eastside
3-6 inches	10-15%	10-15%	5-10%
6-12 inches	10-20%	15-25%	20-30%
12-20 inches	35-40%	40-50%	45-50%
20+ inches	25-45%	20-25%	15-25%

[1] Average diameter of log

- Within the Crest Zone, no more than 25% of each subwatershed should fall below 30 tons per acre.

- Within the Transition Zone, no more than 15% of each watershed should fall below 12 tons per acre.
- Within the Eastside Zone, no more than 10% of the forested area should fall below 5 tons per acre.
- The 15% green tree retention guidelines in the Northwest Forest Plan should provide an adequate input of twigs, branches, and needles to quickly rebuild and/or maintain sufficient duff and 0-3 inch material to meet short-term nutrient needs. The current guidelines in the Forest Plan for 0-3 inch material and litter and duff may no longer be needed in units harvested under the standards and guidelines of the Northwest Forest Plan. Exceptions may exist to protect rare or sensitive fungi, lichens, bryophytes, and vascular plants.
- Silvicultural prescriptions and fuel treatments should assure that downed wood potential remains across harvested units. One method might be to make sure the spacing between dispersed individual trees should not exceed 90% of the combined heights. For example, if two leave trees were each 100 feet tall, the spacing between these two trees should not exceed 180 feet.
- Woody material left after harvesting and fuel treatment should be more-or-less evenly distributed across the unit.

We do not know how downed wood loadings should vary between the riparian areas and the uplands. In the interim, we recommend using the above guidelines across the landscape. We also recommend establishing a study that examines large wood loading in riparian areas. The study should try to determine how loadings may vary both between different riparian plant communities and a different times since disturbance.

H. Are the current standards for water quality and aquatic habitat elements appropriate for all streams in White River subbasin? (formerly question J)

No. The current standards for water quality are appropriate while many of the standards for aquatic habitat elements are not. We believe that the standards and guidelines for water quality and aquatic habitat elements should reflect the range of natural conditions. Unfortunately, we do not know what those ranges are. Land uses should have a minimal impact on streams, riparian areas, and water quality and in that sense we can examine the current standards and guidelines to decide if they adequately reflect what we do know about White River subbasin and its ecological functioning.

- In general, we recommend that numeric standards for aquatic habitat elements be tied to the range of natural conditions. Additional research and/or monitoring will be needed to develop probable ranges of natural conditions. Data sources could include local monitoring or survey results and/or data from other areas of the intermountain West with similar stream types and ecological conditions. Existing numeric standards are useful defaults to guide management activities and restoration efforts until probable ranges are developed.

<u>Sediment</u>. The current standard is that 20% or less of the fine sediment in spawning areas should average 1 mm and smaller (FW-097). Bjornn and Rieser (1991) demonstrated that the survival of salmon and trout embryos decreases rapidly when fine sediment < 6 mm diameter exceeds 20% due to lack of sufficient oxygen during development. Available data suggests sediment problems in spawning areas of many streams in White River subbasin (Table 5.1).

White River subbasin within the Forest boundary supports resident fishes, primarily redband trout. White River mainstem is a glacially influenced river and naturally carries a very high sediment load in summer and fall. This glacial milk gave the river its name and is one of the Wild and Scenic River's outstandingly remarkable values. According to a recent study by Bonneville Power Administriation (1985) redband trout in White River mainstem have adapted to glacial sediment regime. Rain-on-snow events from mid-December through mid-January usually result in the largest annual peakflows and serve to scour out much of the fine sediment deposited every year before

Table 5.1. Fine sediment levels in selected streams in White River subbasin.

Stream	Location	Rivermile[1]	Percent Surface Fines <6 mm[2]	Percent Surface Fines <1 mm[2]
Mineral	below confluence with SF and NF Mineral	0.5	11	6
South Fork Mineral	below Road 3560-224	1	16	13
North Fork Mineral	mouth	0	20	15
Green Lake	below Road 3530-220	0.3	13	3
	mouth	0	85	75
Buck	mouth	0	18	12
Bonney	below Road 48	0.3	45	36
Red	below Road 48	0.3	42	28
North Fork Iron	mouth	0.3	36	22
Clear	below Clear Creek CG	3	19	11
	mouth	0.3	19	12
Frog	mouth	0.25	66	45
Camas	below Road 2130-241	0.8	36	25
Barlow	mouth	0	54	35
	upstream from Grindstone CG	3.5	15	5
Deep	below Road 4885-140	0.5	31	12
Lost	above Road 48	0.5	55	47
Cedar	mouth	0	33	19
Swamp	above Road 4880	0.75	60	45
Boulder	end of Road 4880	8.75	54	43
	below Road 3530	2	18	9
	mouth	0.75	60	45
Souva	below Road 4820-120	0.75	25	18
South Fork Gate	below Road 4830	0.25	53	31
Gate	below Road 4811	13.25	22	13
	below Road 48	7	71	61
Pup	below Road 4811	0.3	34	27
Rock	staff gage site	6.25	33	21
	below Road 48	4.75	21	14
North Fork Rock	mouth	0	23	12
Threemile	below Road 4811	11.5	14	11
Badger	below Bonney Crossing CG	9.75	15	5
Little Badger	below Little Badger CG	1.5	25	7
Tygh	above Road 2730	12.25	6	4
Jordan	above Road 2730	6.75	19	7

[1] As measured either from Forest Boundary or from stream mouth.

[2] Any value larger than 20 indicates excessive sediment

redband trout begin spawning. By the time White River Glacier starts melting and producing the fine white sediment, young-of-the-year fish have moved out of the substrate.

We recommend that a sediment standard more reflective of the spawning needs of resident salmonids be used-- ≤20% surface fines <6 mm--in the streams other than White River mainstem. A standard will need to be developed for White River mainstem that also protects the outstandingly remarkable value (see White River National Wild and Scenic River Plan).

Sediment can come from both natural and human-related sources. Natural sources may include landslides, severe wildfires, and White River Glacier. Human-related sources may include roads, trails, skid trails and firelines, excessive recreational use on a site near water, uncontrolled cross-country vehicle use, over-grazing either past or current, and so forth. Road erosion has been noted on several native surface roads, some cinder-surface roads, and a few gravel surface roads. Recreation related erosion is discussed under Issue 9, key question B. Grazing is discussed under Issue 5.

We recommend that all stream reaches where sediment levels for material <6 mm is greater than 20% receive additional evaluation to determine the cause or causes. For example, Green Lake Creek may have excessive sediment at its mouth simply because it ends in the White River floodplain since there are very few roads in the drainage. Excessive sediment in Boulder Creek at the end of Road 4880 may be from natural sources whereas the excessive sediment in Boulder Creek at the mouth may be from road or timber-related erosion. Excessive sediment in Gate Creek below Road 48 may be related to the off-road vehicle activity just above Road 48.

Bank Stability. We have seven standards that refer to bank erosion:

- FW-081: No more than 5% of a project activity area (within a riparian area) shall be in a compacted, puddled, or displaced soil condition.
- FW-082: At least 95% ground cover (e.g. vegetation, duff, or litter) shall be maintained within all project activity areas (within riparian areas).
- FW-102: Streambank and/or shoreline stability of the riparian management area shall be maintained in its natural condition (on Class I, II, and Fish Bearing Class III Streams).
- FW-103: If the existing streambank condition is degraded due to past management activities, the natural condition should be restored (on Class I, II, and Fish Bearing Class III Streams).
- FW-126: Trees necessary for sideslope stability, channel stability, long-term large wood input, and wildlife habitat diversity shall be maintained (on Non-Fish Bearing Class III Streams).
- FW-132: Channel and bank stability should not be deteriorated beyond existing conditions and should be restored to natural conditions (on Class IV Streams, Seeps, Springs and Headwaters).
- FW-133: Activities and practices which could result in ground disturbance such as rills, furrows, erosion, compaction, puddling, etc., should be minimized (on Class IV Streams, Seeps, Springs and Headwaters).

Natural compaction is rare. The existing compaction is from management activities and recreation so FW-081 is an appropriate standard. The percent ground cover is highly variable through time, particularly in the Crest Zone. Applying FW-082 to areas not directly affected by management activities is not appropriate. It is a useful standard to keep management activities from contributing to the effects of natural events. The combination of management activities and natural events could result in conditions outside the range of natural conditions if we do not constrain the effects related to management.

We only have limited data on streambank erosion (Table 5.2). In the streams where we have data, it appears we meet the intent of FW-081 and FW-082 except in reach 3 of Gate Creek and reaches 1 and 5 of Souva Creek. Spot problems have been identified on Camas, Clear, Rock, and Threemile creeks, but we do not have sufficient data to know if we meet the standard in FW-082.

FW-082 is not appropriate in streams with broader floodplains and that can and do shift channels through natural events. White River mainstem above Deep Creek is subject to mudflows originating on Mt. Hood. These mudflows can cause the river to shift channel quite dramatically, and have a similar effect on all stream reaches that flow into the White River floodplain: portions of Iron, Mineral, Barlow, Bonney, Palmateer, Green Lake, and numerous small unnamed streams. Little Badger Creek within the Badger Wilderness shifted channels during the spring floods in 1995.

Assuming all other standards listed allow for natural variation in the amount of ground cover and bank stability, then these standards are appropriate. In other words, if natural events operating within the range of natural conditions, as best as we can determine, result in temporarily unstable banks or effective ground cover of less than 95% of a given reach or stream segment then those conditions should be accepted as part of the natural condition. Such events would provide opportunities to monitor recovery rates in order to better predict effects of similar natural events and, possibly, the effects of management activities as well as help to design restoration efforts that are both more efficient and effective. If management activities, either past or present, result in detrimental impacts outside the expected range, then restoration of more natural conditions should occur.

<u>Large Wood.</u> This element has nine standards. The standard from the Policy Implementation Guide (PIG) is greater than or equal to 20 pieces per mile. The Forest Plan has eight standards:

- FW-092: At least 90% of potential and naturally occurring in-channel large woody debris (LWD) shall be maintained (on Class I, II, and Fish Bearing Class III Streams).
- FW-093: Retention of multi-piece accumulations of LWD and fallen trees with attached root wads should be emphasized (on Class I, II, and Fish Bearing Class III Streams).
- FW-094: At least 20 pieces of LWD per 1,000 lineal feet of stream shall be present (on Class I, II, and Fish Bearing Class III Streams).
- FW-095: Suitable LWD should meet the following dimensions (on Class I, II, and Fish Bearing Class III Streams)--minimum length of 35 feet, minimum mean diameter of ≥ 12 inches (80%) and ≥20 inches (20%). *Note: these are the standards for streams east of the Cascade crest on the Mt. Hood National Forest.*
- FW-096: Effective in-stream cover (e.g. boulders and floating material) should be maintained at natural levels on at least 90% of the riparian area that is providing or influencing fish habitat (on Class I, II, and Fish Bearing Class III Streams).
- FW-120: In-channel large wood Standards and Guidelines (for Non-Fish Bearing Class III streams) shall be the same as for Class I, II, and fish bearing Class III streams except:
- FW-121: The minimum piece length of LWD should be two bankfull widths.
- FW-122: The number requirements (e.g. percentages) should be applied as average conditions for all non-fish bearing, perennial streams (versus required for each stream).
- FW-135: Conifer trees and hardwood trees necessary for stream bank stability, long-term wood input, and diversity of wildlife and plant communities should be maintained (for Class IV Streams, Seeps, Springs, and Headwaters).
- FW-136: At least 100% of potential and naturally occuring large woody material (both quality and quantity) within seeps and springs or lying within or across the channels of Class IV streams should be maintained.

FW-092 is an appropriate standard since it is tied to the range of natural conditions. Large wood in the riparian area and stream is a function of species present, site potential, stand age, stream gradient, flow volume, and valley entrenchment ratio. FW-093 simply recognizes the value and

Table 5.2. Percent eroding banks by reach in White River subbasin.

Stream	Reach	Length	% Eroding Bank
Bonney Creek	1	0.1 miles	2.3
	2	0.2 miles	0.2
	3-10	3.6 miles	0
NF Iron Creek	1	0.6 miles	1.5
	2	1.4 miles	0.8
	3	0.6 miles	1
	4	0.5 miles	0
Green Lake Creek	1-2	1.7 miles	0
Jordan Creek	1	1.1 miles	0
	2	11 miles	0.2
	3	1.0 miles	0
Gate Creek	1	2.8 miles	1.8
	2	1.2 miles	4.5
	3	0.4 miles	5.1
	4	5.9 miles	1.5
	5	1.0 miles	0
Pup Creek	1	1.1 miles	2.4
SF Gate Creek	1	0.7 miles	0.1
	2	1.1 miles	0.7
SF Gate tributary	1	1.4 miles	0.6
Souva Creek	1	0.4 miles	6
	2	1.6 miles	0.4
	3	1.8 miles	4
	4	0.4 miles	5
	5	2.4 miles	9.3
Green Lake Creek	1	0.1 miles	0
	2	1.6 miles	0

function of log jams and whole trees with root wads and is appropriate. FW-094 and 095 require at least 106 pieces per mile, of which 21 should be ≥ 20 inches in average diameter. These standards are not appropriate since they rely on a "one size fits all" strategy that does not recognize natural variations in downed wood levels due to differences in stand conditions and the effects of natural disturbance processes. FW-096 is tied to the range of natural conditions and is appropriate.

For non-fish bearing streams, the standards generally fall back on FW-094 and 095 with some modifications. FW-122 is a much less strict standard than stated in the Northwest Forest Plan's ACS objectives (ROD p. B-11 #8). The ACS objectives do not distinquish among fish bearing, non-fish bearing, and intermittent streams in terms of the riparian and aquatic habitat elements except to recognize that the probable width of reserves can vary and still meet the objectives. FW-135 appears to be both appropriate and fits the ACS objectives. FW-136 could result in unnaturally high levels of large wood material where fire exclusion has resulted in increased stand densities.

Trees die and fall into the floodplain and stream and a flood may move the log further downstream. In general, higher order, large volume streams retain less wood than lower order, low volume streams due to the differences in hydraulic power. Floods typically move wood out of entrenched and steep reaches and deposit it in less entrenched and lower gradient reaches. Analysis found no statistically significant relationship between downed wood and stream gradient. This result may be due to the time since the last event which redistributed wood, to differences in the data sets used resulting from changes in survey protocal, and/or counting "live and leaning" trees as part of the in-channel wood amounts. Floods must exceed the average annual discharge in order to have enough power to move large logs. The debris jams formed by flushing events collect smaller wood, sediment, and vegetative debris; increase pool volume; and provide complex habitat for aquatic animals.

Before 1855, the riparian community in the Eastside Zone contained many stands dominated by hardwood trees. Rates of large wood recruitment were more rapid in these hardwood stands than in conifer stands--approximately 80 year rotation versus 200 years--and the length of time cottonwoods last in the stream is less than a comparably sized conifer log. Hardwood logs are lighter than similar sized conifer logs, so tend to move out of certain reaches more frequently than conifer logs would. Conversely, a toppled hardwood that retains some roots in the ground may continue to live, potentially resulting in a partially living debris jam that would tend to last longer than one formed exclusively of dead material. Fire exclusion and, to a limited extent, timber harvest has resulted in a conversion from hardwood dominated stands to conifer dominated stands. One result may be a large gap in the downed wood recruitment cycle, from shorter to longer rotations of longer lasting wood.

In addition to the above physical effects, hardwoods differ chemically from conifers, which could have a significant effect on macroinvertebrate species compositions and population levels. Hardwood trees contribute a large input of leaves every year and tend to shed large branches more frequently than conifers. Hardwood tree communities provide habitat for certian species that may not be present or as prevalent otherwise, such as downy woodpeckers. Hardwoods are a primary production area for butterflies. Beavers are dependent on riparian hardwood communities.

In general, intermittent streams are considered an important source area for large wood in perennial streams. There are some areas in White River subbasin where little or no downed wood transport seems to occur. These are large areas of gentle slopes with no naturally perennial streams:

- the uplands between Badger and Little Badger creeks
- Hazel Hollow drainage
- McCubbins subwatershed

We do not know the range of natural conditions for downed wood in most stream reaches. Stream survey data found a wide range of existing downed wood loadings for pieces 12 inches in diameter and larger, from 0 to well over 300 pieces per mile equivalent (Appendix C). Reaches within meadows, such as upper Camas and Bonney creeks and reaches with a gradient of 10% or more normally contain few or no large logs. Upper White River floodplain periodically flushes all streams within the floodplain. However, between mudflow events, downed wood can accumulate in the reaches of Iron, Mineral, Bonney, Palmateer, Barlow, and Green Lake creeks that lie in White River's floodplain. Due to a combination of disturbances, such as fire and flood, all stream reaches have time periods where they are devoid of large wood.

We recommend the following:

- FW-092, 093, and 135 should be applied to all stream types. An analysis is needed to determine what detrimental effects, if any, may occur as a result of lowering the standard for actual and potential downed wood in seeps and springs and actual wood in Class IV (or intermittent) streams from 100% to at least 90%. The analysis should also examine whether lowering this standard remains within the intent of the ACS objectives.

- Standards FW-094 through 096, 120, and 121 are not appropriate in general but do provide useful guidance for restoration efforts and until a more complete analysis of the probable range of natural conditions can occur. FW-122 is not appropriate and should be dropped. FW-136 probably is not appropriate where fire exclusion has increased stand densities and, thus, actual and potential downed wood above the probable range of natural conditions.
- No stream reach should be devoid of large wood as a result of human activities such as timber harvest, firewood collection, and recreation. Do not remove any in-channel large wood unless a clear danger is identified for personal injury or death to people, or damage to uses downstream (i.e. campgrounds, bridges, etc.)
- Monitor streams relatively unaffected by timber harvest more intensively to determine how downed wood loadings change over time and how various disturbance factors affect downed wood levels. Prime candidates for such monitoring include White River, Barlow Creek, Boulder Creek above Section 16, Badger Creek, Little Badger Creek, Pen Creek, and Tygh Creek. Streams within Badger Wilderness and Badger Creek for its entire length within the Forest boundary may be outside the range of natural conditions due to the effects of fire exclusion on stand densities and species compositions.
- In general, timber harvesting in Riparian Reserves should not remove any trees larger than 15 inches DBH, regardless of species, unless the prescription clearly provides for both immediate and long-term in-channel large wood needs and riparian and aquatic ecosystem functioning.
- Consider placing in-stream large wood only in those streams and stream reaches where management activities have significantly reduced downed wood potential (i.e. the average diameter of dominant and co-dominant trees in the Riparian Reserve is less than 15 inches DBH as calculated on a minimum 1/2 mile basis). Use the recommendations in FW-094 for the number of pieces to place as calculated on a minimum of 1/2 mile basis. In other words, we should find low in-channel wood conditions on at least 1/2 mile of stream before adding the equivalent of 106 pieces per mile. Reevaluate stream and riparian stand conditions every five years for the amount of large wood still in the stream and whether the riparian stand is in a condition to begin contributing large downed wood on its own.
- If a smaller Riparian Reserve burns (i.e. 300 feet each side or narrower), do not salvage any dead or dying trees. Monitor the changes in snag levels and downed wood in the terrestrial, riparian, and aquatic ecosystems and other aquatic elements within the Reserve. Results of monitoring should help refine standards and guidelines.
- Develop a standard and guideline for downed wood that recognizes that wood levels vary naturally. The standard should probably be based on an entire stream basis, rather than on a reach basis.

<u>Pools.</u> The PIG and Mt. Hood Forest Plan use an over-simplified "one size fits all" approach to standards for pools per mile. The Mt. Hood Forest Plan standard is based on gradient while the PIG standard is based on stream width. Research indicates stream width, gradient, and geomorphology influence the size and number of pools per mile and the range of natural conditions is very wide (Overton et al. In Press, Rosgen 1994, Montgomery and Buffington 1993).

The Mt. Hood Forest Plan defines a primary pool as one that occupies at least 50% of the low flow channel and is at least 3 feet deep. The number of pools that meet this description is well below the Mt. Hood Forest Plan standards (FW-090, 091). Pools of this size are uncommon in White River subbasin and appear to be associated primarily with stream reaches having a cobble substrate and low gradient (see stream survey data at Barlow and Bear Springs Ranger Districts), although the correlation was not statistically significant. When all pools are considered, residual pool depth rarely averages over 2 feet deep.

We recommend the following:

- Develop standards based on pool quality rather than quantity. The standards should consider pool forming structures, fish cover, residual pool depth, and substrates for biological activity.
- Pool filling and loss of complex substrates should not occur as a result of excessive sedimentation originating from land uses, such as erosion related to timber harvest, grazing, or recreation use; erosion from native surface roads and unreclaimed or inadequately reclaimed rock pits; and erosion resulting from ditch failures.

Water Temperature. Water quality standards in the Mt. Hood Forest Plan are tied to State water quality standards (Oregon Administrative Rules, Chapter 340-410; FW-109, FW-110, and FW-111). To paraphrase, these state that forest management activities should not cause water temperatures to:

- increase more than 2°F if the stream temperature is <56°F,
- exceed 58°F if stream temperature is between 56-57.9°F, or
- cause any measurable increase in maximum water temperature where stream temperatures exceed 58°F.

These standards recognize natural variation between streams so are appropriate. Some streams in White River subbasin may be naturally warmer than 58°F (see data for Badger and Tygh Creeks in Table 5.3, Issue 3). Grazing and water withdrawals have affected riparian areas and streams for over a century. Logging, road building, and recreation have removed vegetation. Disturbance processes, such as fire and flooding, have changed in pattern, intensity, severity, and duration due to fire exclusion and beaver population decline within the Forest boundary. Until temperature changes from these activities can be separated from background or natural temperatures, it would be prudent to use 58°F as the standard. Results of temperature monitoring to date are discussed in more detail in Issue 3, Key Question B.

Turbidity. The Mt. Hood Forest Plan also restates the State water quality standards for turbidity: "No more than a 10% cumulative increase in natural in-stream turbidity shall be allowed to result from forest management activities (Oregon Administrative Rules 340, Div. 1; FW-113, FW-114). This standard recognizes that there is natural variation in streams and holds each stream to its natural condition. At present, we have a general idea for the natural level of turbidity for White River mainstem.

I. *Should the water quality and aquatic habitat elements standards vary between streams or stream segments with irrigation withdrawals and those without? (formerly question K)*

No. The standards should remain the same for all stream segments. Rather than change the standard, we should clearly state that irrigation withdrawals have altered the hydrologic regime of the stream and the withdrawal may mean that the stream will not meet standards. We should change standards only when meeting them would place a stream or stream segment outside the range of natural conditions. Further, some ditches only flow part of the year and, in rare cases, water rights and ditches can be abandoned. By striving to meet standards, we will maintain channels and riparian areas in a condition that would help provide clean, cool water when it does flow and that riparian and aquatic ecosystems have a chance to function normally.

J. *Should the water quality and aquatic habitat elements standards apply to natural channels being used as water transmission corridors? (formerly question L)*

Yes, for water quality elements. By meeting state standards for water temperature and turbidity we will reduce unnecessary sedimentation that could cause problems for the downstream irrigators. Augmenting streamflow in otherwise intermittent channels does provide some replacement riparian and aquatic habitat that has been lost in the upstream channel due to the withdrawal.

However, the Forest needs to decide clearly how to manage McCubbins Gulch. Presently, management is somewhat contradictory with simultaneous proposals to manage for fish habitat in that portion of McCubbins Gulch which has been converted from intermittent to perennial and to screen Clear Creek Ditch at the diversion point in Clear Creek. The two obvious alternatives are:

1. Recognize McCubbins Gulch as a fish-bearing stream where the natural channel is used. Apply the appropriate Riparian Reserve width and provide for the appropriate aquatic habitat elements (in-channel wood, pools, bank stability, and sediment). Screen the ditch at the Forest boundary.
2. Manage McCubbins Gulch strictly as a water transmission corridor. Meet only state water quality standards for the reasons stated above. Apply the Riparian Reserve width for intermittent streams on McCubbins Gulch. Screen the ditch at both diversions (Frog Creek and Clear Creek).

Regardless of which alternative is selected we must recognize that water transmission is the primary use of McCubbins Gulch and that the streamflow has a water right attached to it that prevents unauthorized withdrawals. Both Forest Creek and Lost Boulder ditches have converted unnamed intermittent streams to perennial; management strategy on these natural stream segments should be the same as on McCubbins Gulch.

K. *Are the current standards and guidelines for big game winter range thermal cover the best method to provide that habitat element? (formerly question M)*

No. The current Forest Plan standards and guidelines for winter range thermal cover cannot be achieved through time. All of the winter range area lies within the Eastside Zone and eastern half of the Transition Zone (Figure 5.1). Thermal cover is defined as a stand of coniferous trees 40 feet or more tall with an average crown closure of 70% or more. The current standards call for 50% thermal cover on winter range. While less difficult to achieve than spotted owl NFR habitat, thermal cover generally has many of the same characteristics as NFR habitat, except in the youngest stands.

The high tree density needed to achieve 70% crown closure exceeds the long-term site capability of most of the Eastside Zone and some of the lower elevation portions of the Transition Zone. Long-term site capability is tied to the combination of soil, microclimate, and typical disturbance regime that permits a target stand structure to persist in a more-or-less stable condition for several decades. Probably no more than 25% of the Eastside Zone is capable of maintaining thermal cover characteristics through time. The lower portion of the Transition Zone are capable of maintaining higher than 25% of the area in long-term thermal cover, but still less than 50%. The likelihood of maintaining thermal cover as described above through time is highest on north aspects of perennial streams and in riparian zones.

Observations from similar winter ranges throughout eastern Oregon suggest that open parklike stands dominated by large ponderosa pine or ponderosa pine and Douglas-fir can provide most of the winter thermal needs of deer and elk (Late Seral Parklike). Crown closures for the conifers typically vary from 30-60% with many in the 40-50% range. Such stands appear to meet both the day and night thermal needs of both deer and elk during most weather conditions (70-80% of the time).

Late Seral Parklike stands are dense enough to reduce wind velocities and snow depths while also allowing more sun light (heat) to reach the forest floor. A grassy or grassy and brushy understory provides high levels of forage without requiring the animals to move around much, thus conserving energy, and the large boles provide long-wave radiation well into the night, also conserving energy. These stands also have small patches of conifer regeneration, which acts as hiding cover.

Deer and elk appear to be able to maintain all life functions (feeding, bedding, etc.) within such stands during most winter weather conditions. Feeding occurs throughout the day whereas open forage areas become unavailable due to lack of cover. During winter deer and elk often do use very open, exposed areas, such as farm fields, for feeding even during the day, but evidence indicates

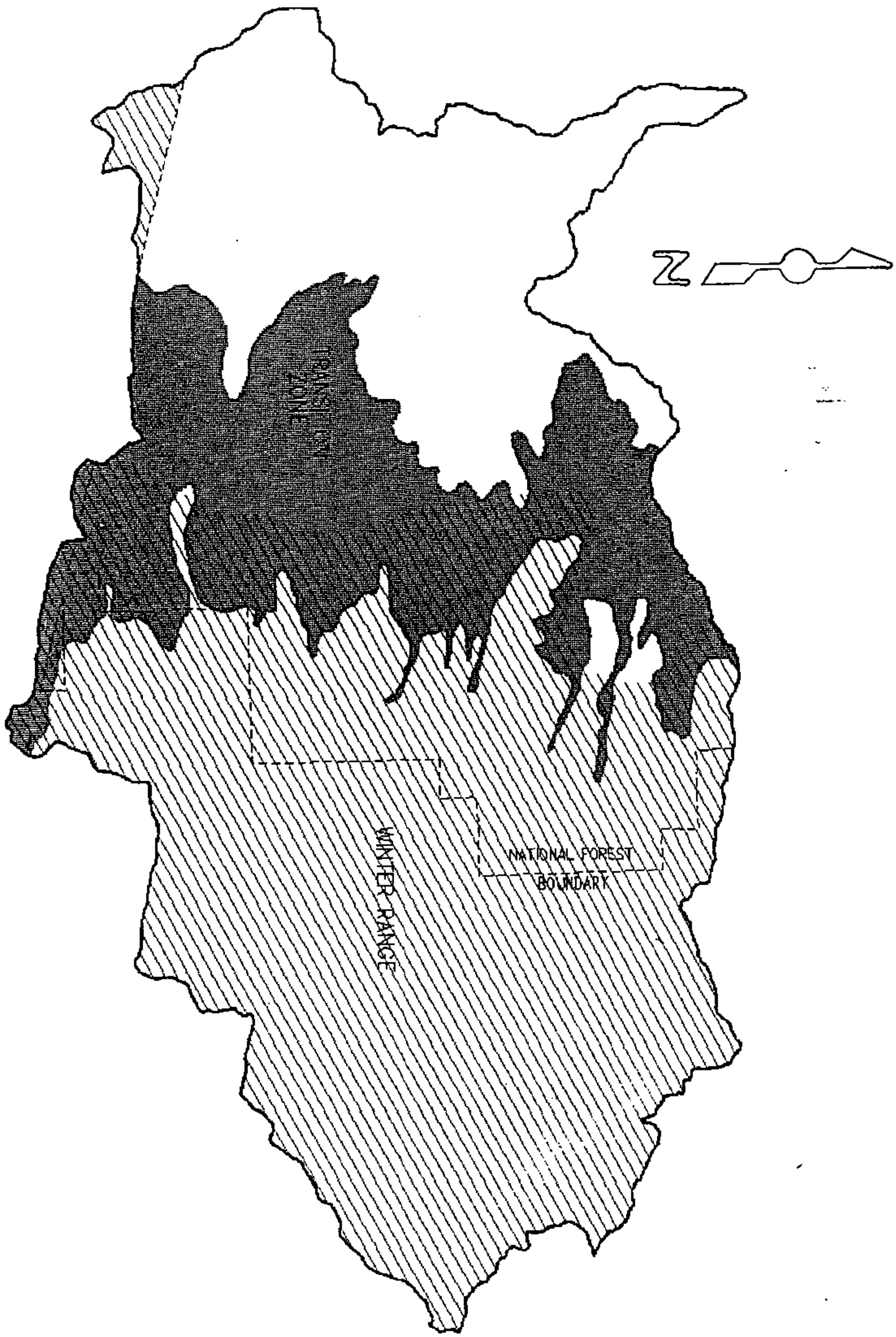


Figure 5.1. Big game winter range by climate zone in White River subbasin.

the animals are under significant stress in such conditions. Stress increases heart rate and overall metabolic rate, which burns energy that could better be used to reduce fat loss, prevent resorption or abortion of fetuses, and generally maintaining the animal's health.

During short-term (1-3 day) storm events deer and elk will move to the typical thermal stands to "weather the storm." Usually this is strictly a conservation of energy strategy, although older thermal cover stands can provide significant forage from hanging lichens for short periods of time. During extended storm events or when snow depths significantly exceed average conditions over extended periods of time deer and elk appear to move to lower elevations where snow depths are lower and forage from agricultural lands is available.

We recommend that the Forest develop new standards and guidelines for Eastside Zone winter range in cooperation with ODFW. These standards should address thermal cover levels in terms of site capabilities to support dense stands over the long-term (i.e. north aspects along perennial streams, riparian areas, etc.). We also suggest that this type of thermal cover be referred to as "severe weather cover."

- The expected range of severe weather cover varies between 10-50% of a sixth field watershed. Allowance should be made for treatment of a portion of these stands per decade to maintain healthy stand conditions and to allow regeneration in stands where insects, disease, or other factors have or will result in the loss of or significant reduction in thermal value.
- Eighty to ninety percent of the areas capable of providing severe weather cover should be in that condition at any point in time.
- Severe weather cover should be recognized in stands or patches as small as 1 acre. Small patches that provide severe weather protection become more critical as the capability of a given sixth field watershed to provide that habitat element decreases. For example, it is more important to recognize small thermal patches in a sixth field watershed that can provide that habitat element on only 25% of its area than in one that can provide severe weather cover on 50% of its area.
- Recognize that multi-layered stands over 40 feet tall on average and with 60% canopy closure often provide more effective severe weather cover than a single-layered stand that is over 40 feet tall with 70% or more canopy closure.
- Late Seral Parklike and Cathedral stands in the Eastside Zone and lower portion of the Transition Zone should include small patches of relatively dense conifer regeneration on 5-10% of the prescription area. When coupled with the winter range road closure standards, this standard should provide adequate security for deer and elk.

L. *Does current management direction provide sufficient forage to meet deer and elk herd management objectives over the long-term? (formerly question N)*

Yes on winter range. Current direction requires 80% of all regeneration harvests and commercial thinning units within the B10 allocated winter range and B4 Pine-Oak Habitat and that 40% of such units elsewhere in winter range receive forage enhancement. Either this standard or the proposed switch to a dominance of Late Seral Parklike stands in the Eastside Zone and Cathedral stands in the Transition Zone should meet the forage requirements of deer and elk herds that winter within the National Forest boundary. We believe we can meet ODFW's management objectives in winter range.

No on summer range. Summer range areas will likely not meet the forage needs of the deer and elk that summer within the National Forest boundary within about 20 years with the current required forage enhancement (20% of regeneration and commercial thinning units). This condition is the result of reducing regeneration harvests which reduce the amount of open areas needed to produce forage. Further, future commercial thinnings are not expected to produce additional forage even when seeded or planted.

We may be able to meet forage needs at the management objective levels if forage enhancement was required on a high number of regeneration and commercial thinning units. We recommend forage enhancement on 80% of regeneration units and 40% of commercial thinning units in the Transition Zone. Much of the Crest Zone lies in LSR, which would have little forage enhancement opportunity. If Cathedral stands provide the level of forage envisioned, then losses in the Crest Zone probably would not impact the management objective herd levels.

2. Issue: Past management activities and practices may limit our ability to effectively treat forest health problems on slopes of 30% or less. This problem occurs primarily on National Forest lands.

A. Is compaction a significant problem in LSRs, Riparian Reserves, or Matrix lands?

Uncertain. We did not have enough time to conduct this analysis to the detail needed to fully answer this question. It appears that compaction is not a significant problem in the allocated LSRs. The highest potential for significant compaction is along the southern edge and northwestern corner of Douglas Cabin LSR and just above Section 16 in White River LSR.

We were not able to separately analyze Riparian Reserves and Matrix lands or include the effects of older multiple entries, harvesting on private in-holdings, and salvaging. It appears that compaction may be significant on National Forest lands in the following subwatersheds:

- Rock-Threemile
- Gate
- Boulder--southern half
- Clear

Fuel treatments records for a significant portion of Clear subwatershed were not readily available. If many of the units with an unknown fuel treatment were not machine piled, then compaction probably is not significant in Clear subwatershed. There may also be significant levels of compaction in the southeast corner of White River subwatershed and the southern edge of McCubbins subwatershed. Compaction exists in all subwatersheds but does not appear to be significant on National Forest lands in Badger-Tygh, Jordan, Barlow, or most of White River subwatersheds.

B. Should the standard methods for stand management change where compaction is an identified problem?

Yes. We have already started to change management practices since compaction was identified as a problem several years ago. Some changes made include:

- using different types of logging equipment,
- using different types of slash disposal contracts,
- less dozer piling of residue,
- digitizing new and existing skid trails by using the Global Positioning System (GPS), and
- making a greater effort to reuse existing skid trails.

These efforts should continue. As logging and slash treatment technology changes, we should continue to experiment and assess the results.

C. *Do we have soils at very high risk of compaction from potential use of mechanized equipment?*

Yes. Most soils in the mid and low elevations of the subbasin can be easily compacted (Appendix D). These soils have a moderate texture and weak structure, are somewhat low in organic matter, and are located on easily accessible terrain. Most higher elevation soils formed from glacial material tend to have a higher rock content, which reduces the compaction risk.

D. *Can we restore compacted areas without further degrading the riparian and aquatic ecosystems?*

No. However, it is accepted practice to allow some short-term degradation of riparian and aquatic ecosystems to attain long-term benefits for chronic or catastrophic sediment prevention; increased site productivity, downed wood potential, and stream canopy cover; decreased peakflow; and increased infiltration. We have some experience with such projects, such as the successful decommissioning of roads in the Little Badger area in 1993. Occassionally restoration efforts do result in additional sediment reaching streams, but it does not happen on every project and usually does not last very long before sufficient vegetation has reestablished on the site.

There are limits to what the various stream systems can absorb. Therefore, we recommend that no more than 20-25% of compacted areas within a subwatershed with an identified significant compaction problem undergo restoration at any one time (see Question 2A). Some evidence of recovery or stabilization, such as reestablished vegetation or lack of noticeable erosion, should be present before undertaking additional restoration in those subwatersheds.

3. Issue: Past management activities may have significantly reduced the large wood potential and riparian cottonwood communities and increased runoff rates and peakflow, placing aquatic and riparian resources and human property at increased risk of damage from erosion, instream sedimentation, and flooding. This concern occurs throughout the subbasin and the increased risk of property damage occurs primarily in Wamic and Tygh Valley.

A. *Are there streams or stream reaches where the riparian or instream large woody debris levels or recruitment potential is low and outside the range of natural conditions?*

Yes. Although we do not know what the range of natural conditions is, we do know that management activities have removed potential downed wood from the riparian areas:

Drainage or Subwatershed	Cause
Rock-Threemile subwatershed	Rocky Burn salvage, timber harvest
Gate subwatershed	Rocky Burn salvage, timber harvest
Jordan subwatershed	Timber harvest
McCubbins subwatershed	Timber harvest
Clear subwatershed	Timber harvest
Boulder subwatershed	Timber harvest
Cedar Creek	Timber harvest
Swamp Creek	Timber harvest

Timber harvest has affected downed wood potential in all other subwatersheds but the effects are more limited and may not be significant. The south aspects along perennial streams in the Badger-Tygh watershed typically have naturally low downed wood recruitment potential. Some restoration work has already occurred in some streams with low levels of downed wood and potential downed wood (Appendix C). Similar restoration work is planned in others.

The downed wood recruitment potential model used in the state of Washington was used to evaluate large wood potential within the interim riparian reserves (Appendix C). The results of this model were not used for several reasons. First, and most important, the model only considers trees larger than 21 inches DBH as "large" while the Mt. Hood Forest Plan standard for the eastside considers trees between 12 and 21 inches DBH as "large" also. After discussions with fisheries biologists on the eastside, we did not change this definition of large for the eastside. Therefore, the model does not provide an accurate assessment of large wood potential based on eastside standards.

Second, the vegetation database used to evaluate stand structure and tree size is based on remote sensing. While the information has utility for forest-level analyses, district silviculturists felt that the errors in the database became significant at the subbasin scale and smaller. Unfortunately, the districts do not have databases describing current stand conditions for every stand within the subbasin, so could not provide a suitable substitute.

Third, during discussions of the pre-1855 vegetation condition, synthesis concluded that the disturbance levels in the Eastside and Transition Zones often resulted in "normal" canopy closures of less than 50% in the pine-oak community type and less than 70% in other forest types. There was insufficient time to adjust the model to account for these three factors. In the case of the third factor, canopy closure, we are unsure if the model can be adequately adjusted.

B. Are there streams or stream reaches where the stream temperature or predicted peakflow is outside the range of natural conditions?

Uncertain. We do not know the range of natural conditions for stream temperature in White River subbasin. Water temperature monitoring has occurred only on a few streams and for a very limited time period. The readings have not been correlated to drainage condition or weather conditions during the monitoring period. (State water quality standards for stream temperatures are stated in Key Question 1G.) Table 5.3 displays the results of stream temperature monitoring to date.

Rocky Burn and the subsequent management activities probably have dramatically affected stream temperatures in Rock and Threemile creeks. Badger and Gate creeks have major water diversions upstream from the monitoring sites. Other than the diversion, Badger Creek has not been greatly affected by timber harvesting and roading. Rock and Gate creeks stop flowing just below the monitoring sites at the Forest boundary. White River was monitored only in 1992, one of the hottest and driest years within the period covered by 1985-1994.

If what we believe about the range of natural conditions for vegetation and disturbance processes is true, then it is likely that stream temperatures fluctuated quite a bit over the long-term. For example, the 1901 map of vegetation indicates that over 50% of the immediate slopes above White River were burned in stand-replacing fires. The temperature of White River was probably relatively high during the recovery period. The temperatures shown for Badger and Tygh creeks were taken as the streams left Badger Wilderness. We believe that the extent of vegetative cover along both creeks is higher than normal, thus the temperatures seen may represent lower than normal temperatures.

White River stocks of redband trout may be capable of tolerating much higher water temperatures than other salmonids. Eastern basin stocks of this species have been observed feeding in water as warm as 77° F (Behnke 1992). Even though such high temperatures may not be lethal, they still decrease growth rates and increase metabolic stress on the fish.

Table 5.3. Stream temperatures in White River subbasin.

Stream	Monitoring Site	Year Monitored	7 Day Average High	Total Days > 58°F	Annual Maximum
Threemile Creek	Road 4811 (GRID 410 sec. 36)	1993, 1994	53°F, 55°F	0, 0	54°F, 57°F
Threemile Creek	Road 4811 (GRID 411 sec. 3)	1993, 1994	64°F, 68°F	43, 73	66°F, 70°F
Gate Creek	Forest Boundary	1993, 1994	69°F, 75°F	NA, 105	71°F, 79°F
Rock Creek	Road 4811	1993, 1994	56°F, 62°F	1, NA	59°F, 65°F
Rock Creek	Forest Boundary	1993, 1994	73°F, 79°F	114, 146	79°F, 83°F
Badger Creek	Bonney Crossing CG	1994	67°F	61	69°F
Jordan Creek	Road 27	1994	64°F	37	66°F
Tygh Creek	Road 27	1994	60°F	12	62°F
Cedar Creek	Forest Creek CG	1994	49°F	0	50°F
White River	Forest boundary	1992	71°F	83	75°F
White River	Below White River Falls	1992	75°F	145	77°F

The available data are too limited to draw any conclusions, but they do suggest interesting trends. It appears that many streams in White River subbasin may be naturally warmer than 58°F. In order to better get at the natural stream temperatures we recommend temperature monitoring at the following locations:

- *Camas Creek as it leaves Camas Prairie*
- Bonney Creek as it leaves Bonney Meadows
- At least 6 springs in headwater areas
- At least 4 springs in mid-drainage areas
- Outlet to Clear Lake
- Outlet to Badger Lake
- Just below the diversion in Clear Creek
- Just below the diversion on Badger Creek

Spring temperature monitoring stations should be evenly divided between springs north and south of White River. All of these monitoring stations would be in addition to the ones already in place. We recommend working with Oregon DEQ to decide how long monitoring should last in order to adequately describe the probable natural range of stream temperatures. We also recommend attempting to model the natural range of stream temperatures based on current climate data and the probable pre-1855 canopy closures.

Predicted peakflows are higher in some streams, but whether they are outside the range of natural conditions is a very complex question (see Appendix H). Predicted peakflow is higher in some streams, but lower in others. For example, peakflow is higher in Rock Creek above the reservoir due to the Rocky Burn and subsequent salvage, but lower below the reservoir due to the impoundment. Peakflow is higher in McCubbins Gulch since year-round diversion of water via Clear Creek Ditch has turned this naturally intermittent stream into a perennial stream for at least part of its length. Peakflow is lower in all streams with year-round diversions and reflective of current climate and stand conditions in streams with seasonal diversions.

When the subbasin was analyzed using the Aggregated Recovery Percentage (ARP) model, we found no significant difference in the state of hydrologic recovery of watershed vegetation between pre-1855 and the current condition. All other things equal, peakflow should be the same between the two conditions. However, climate has changed since 1855. In 1855, the so-called "Little Ice Age" was just ending. Conditions were cooler and more humid before 1855 than currently. Snowpacks and annual precipitation were higher. Wetter cycles and larger snowpacks most likely result in higher peakflows. The western United States was in a drought cycle from 1880-1920. It appears that we may be currently in a similar drought period, although we will only know for certain in hindsight.

Based on the processes examined, we believe that current management in the subbasin has caused an increase in peakflows relative to likely flows in the absence of such management. Climatic changes are most likely the greatest influence on peakflows relative to typical pre-1855 conditions, especially since the range of annual precipitation within the subbasin varies from about 12 inches at the Deschutes River to over 120 inches on Mt. Hood.

When modeling the difference in peakflows between existing watershed condition and a more naturally forested condition through the Water Available for Runoff (WAR) hydrologic model, it appears there is no significant difference in peakflows resulting from an "average" rainstorm. However, it appears there are significant differences between peakflows resulting from rain-on-snow events. The greatest differrences are seen in the smaller storms. As storm size increases, the difference between peakflows in the current condition relative to the "fully forested" condition decreases.

C. *Are there any species in White River subbasin dependent on the continued presence of cottonwood or cottonwood-conifer riparian communities?*

Yes. Several species in White River subbasin depend on the riparian hardwood ecosystem, especially hardwood trees. Five such species are beaver, yellow warbler, red-eyed vireo, black phoebe, and downy woodpecker. Of these, the downy woodpecker is heavily dependent on black cottonwood for cavity excavation. The scarity of beaver within the Forest boundary appears to be tied to the lack of large cottonwood and alder, particularly in the Eastside Zone. Assessment of actual viability of these species within White River subbasin is outside the scope of this analysis.

We do not know if there are any species of fungi, bryophytes, vascular plants, or insects present in the subbasin that are more dependent on hardwoods than conifers, but it seems likely. Hardwoods are usually a primary production area for butterflies. However, the apparent decline, and near loss on National Forest lands, of the cottonwood and cottonwood-conifer riparian community has undoubtedly reduced the populations of these species within the subbasin.

D. *Should the interim Riparian Reserve widths be modified to better reflect local processes and conditions? (formerly question G)*

Yes. Figure 5.2 displays the recommended riparian reserve widths as best as we could determine from using a 1:24,000 map scale, local knowledge of broad-scale needs, and aerial photography interpretation. In White River subbasin, we expect active management within the Riparian Reserves, particularly in all intermittent streams, and in all streams in the Transition and Eastside zones. Active management is needed to replace or partially replace disturbance processes that are not allowed to operate freely. In particular, fire is currently not permitted and will likely not be allowed to play its full role within the Riparian Reserves at any time in the foreseeable future. Based on our understanding of the role of fire and other disturbances in riparian and aquatic ecosystem functioning in this subbasin, these systems will become unhealthy and "dysfunctional" without disturbance. Management activities within the Riparian Reserves should, as closely as possible, mimic the typical disturbance regime for the individual site.

We developed a list of criteria for adjusting Riparian Reserve widths where on-the-ground information is needed:

1. Area has a high density of mapped and unmapped springs, and/or many wet area indicator species (see proposed Riparian Reserve for upper Boulder Creek and White River mainstem).
2. Consolidate complexes of meadows, rocky slopes and talus patches, and intermittent streams (see proposed Riparian Reserve for Frog Lake Buttes area).
3. Connect wet meadows to nearby intermittent streams where not directly connected to a perennial stream.
4. Consolidate headwall areas where many intermittent streams originate.
5. Protect wet meadows, Key Site Riparian areas identified in the Mt. Hood Forest Plan, and other wetlands larger than one acre, insuring that the Riparian Reserve width provides adequate protection to meet the management objectives of these sites.
6. Protect microclimate for *Botrychium* spp. in cedar swamps regardless of swamp size (Reserve boundary approximately 200 feet wide).

Specific guidelines include:

1. Within well defined canyons, the Riparian Reserve should run rim-to-rim. Purpose is to incorporate primary large wood and sediment sources.
2. Incorporate all of White River floodplain above Deep Creek into one continuous reserve. Purpose is to recognize channel shifting and high levels of subsurface flow (see White River Wild and Scenic River EA and Management Plan for more details on hydrology of upper White River floodplain).
3. On reservoirs with large drawdown zones, use interim widths for constructed ponds and reservoirs as measured on horizontal distance from the maximum pool elevation. Purpose is to reduce recreation uses that prevent development of riparian vegetation within the drawdown zone and to reduce sediment input from recreation use of drawdown zone.
4. In Badger Wilderness, use the interim widths as described (slope distance) for the various stream types and lakes. Purpose is to better guide recreation management and development of wilderness fire plan.
5. If Riparian Reserve crosses a large paved road paralleling a stream, evaluate whether the riparian processes and functions can be met by shifting the Reserve to one side of the road. If they cannot, the Riparian Reserve should cross the road. Determine what impacts the drainage ditch network, culvert locations, and drainage flows have on the stream to which the Reserve is assigned. If the water from the ditch opposite the stream eventually flows into that stream, then the Reserve should incorporate that ditch network. Examine whether the road has created an unstable area above the road. If so, expand the Reserve to incorporate the unstable area. Purpose is to address atypical sediment source.
6. Where ditches use natural stream channels but are not fish-bearing, establish a Riparian Reserve using the guidelines appropriate for the type the stream would be if it was not used as a water transmission corridor (usually intermittent). Purpose is to protect water quality consistent with state standards.
7. Establish a perennial fish bearing Riparian Reserve on any ditches that use natural channels and are fish-bearing. The purpose of such reserves is to maintain suitable water temperatures for fish using the natural stream channels. The Reserve along the constructed portion of such ditches is not intended to prohibit maintenance to protect its function as a water transmission corridor. This Reserve is intended to be consistent with the management

strategy of the Mt. Hood Forest Plan (see FW-085, FW-086, FW-706, FW-707, FW-708, B7-049, and B7-050)

8. On south aspects of perennial streams in very dry areas, the Riparian Reserve may be narrowed where there is little or no riparian vegetation beyond the immediate stream channel AND the slope immediately above the stream contains few large trees (naturally low downed wood potential). The Riparian Reserve must include all riparian vegetation or the 100 year floodplain, whichever is greater. The purpose is to recognize that certain aspects do not contribute very much to riparian functioning.

9. On north aspects of perennial streams in the Eastside Zone, the Riparian Reserve width should include all the potential area that will support stable Cathedral forests. The purpose is to provide connectivity and dispersal for species dependent on more closed canopy forests and big game severe weather, or thermal, cover.

10. On intermittent streams in relatively flat terrain, the Riparian Reserve should not extend beyond the sideslope gradient break that defines the actual riparian area. Consider soil type, slope, and aspect in defining these reserve widths for downed wood and sediment potential. The purpose is to only include that area which contributes to riparian functioning of a given intermittent stream.

11. In flatter areas with substantial subsurface flow, consider establishing Riparian Reserves on ephemerals. The purpose is to recognize the importance of subsurface flow in areas with little surface flow. Examples of such areas include Gate subwatershed, the Douglas Cabin area in Badger-Tygh subwatershed, and Owl Hollow in Jordan subwatershed.

12. Riparian Reserve widths may need to be widened where harvest has greatly narrowed or severed links within what would normally be considered the riparian area. The purpose would be to provide connectivity for dispersal of late-successional species. The Reserve would return to its "normal" location once the harvested areas have recovered sufficiently to provide for dispersal of those species.

We expect vegetation management to occur within Riparian Reserves to meet Reserve objectives. On areas otherwise suited for ground-based harvesting systems we suggest the following guidelines:

1. In previously harvested areas, avoid constructing or designating any new skid trails within a Riparian Reserve.

2. Where equipment must enter a Riparian Reserve to remove felled trees, use existing skid trails and roads.

3. Directionally fell trees away from the stream within a Riparian Reserve.

4. Do not use bulldozers to pile slash within a Riparian Reserve. Instead use a grapple piler or other equipment that can operate from the designated skid system.

5. Avoid crushing slash within a Riparian Reserve in the Eastside Zone.

On areas otherwise suited for aerial harvesting systems we suggest the following guidelines:

1. Keep cable corridors as narrow as possible.

2. Evaluate the feasibility of harvesting systems that do not create straight corridors. Examples of such systems to consider are zig-zag yarding systems and helicopter yarding.

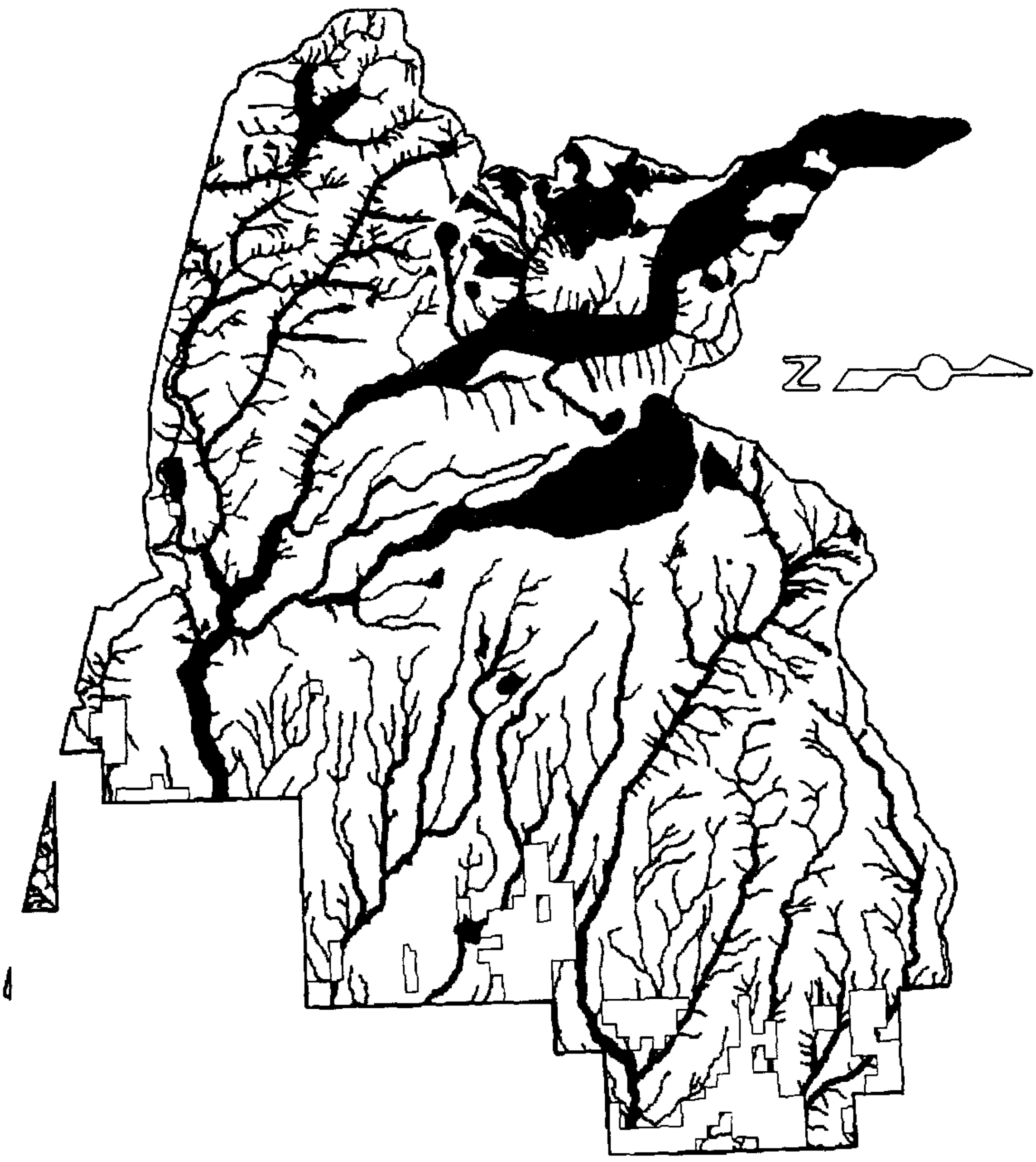


Figure 5.2. Recommended Riparian Reserve widths.

5. Issue: Current Mt. Hood Forest Plan standards and guidelines for grazing may not be adequate to meet Aquatic Conservation Strategy Objectives and may be inconsistent with Late Successional Reserve objectives on National Forest lands and grazing practices may conflict with meeting State Water Quality standards on other lands.

A. *Do Mt. Hood Forest Plan standards and guidelines provide adequate grazing restrictions to allow attainment of the Aquatic Conservation Strategy objectives on National Forest lands?*

No. The Forest Plan standards and guidelines directly address only vegetation utilization. Based on monitoring results to date, forage utilization standards do not prevent attainment of the ACS objectives in terms of vegetated levels in riparian areas. In any given year cattle may use more forage than allowed at one or more monitoring site, but on the whole current management prevents excessive grazing in most riparian areas.

Utilization level is used as a proxy for physical damage. Utilization standards in the Mt. Hood Forest Plan differ between range allotments or pastures in satisfactory and unsatisfactory condition. Satisfactory range condition is defined as:

". . . forage condition is at least fair, with stable trend, and allotment is not classified PC (basic resource damage) or PD (other resource damage)."

Both PC and PD classifications include considerations of water temperature, streambank stability, gullying, and soil condition. However, these conditions are measured during stream surveys, not range allotment status. Range allotment monitoring focuses on vegetation utilization, condition, and trend. Stream surveys are not specific enough as to cause of the conditions observed. It does not seem possible under the current monitoring plan to ever determine actual range classification (PC or PD or Satisfactory) with regard to riparian area damage.

Currently, actual utilization standards in the annual operating plans are geared towards limiting utilization in riparian areas. Riparian areas are managed as though they were in Unsatisfactory Condition even though they have not been rated as such. Utilization levels are not supposed to exceed 30-35% in the riparian areas of all allotments.

We recommend the Forest develop a monitoring program more specific to livestock damage in riparian areas (see Question B below). Not only is such a program needed to better determine if continued grazing will not prevent attainment of the ACS objectives and State Water Quality Standards, it appears to be needed to better assess actual allotment condition. Allotment standards and management strategies should be aimed at creating, enhancing, or maintaining the desired conditions listed under the Recommendations section of this chapter.

B. *Does the amount of riparian area detrimentally affected by grazing prevent attainment of the Aquatic Conservation Strategy objectives or State Water Quality standards?*

Uncertain. The primary difficulty with grazing in Riparian Reserves does not arise from the utilization standard currently in the Forest Plan. The problem with grazing in the Riparian Reserves arises from physical damage caused by cattle entering and leaving a riparian area and trampling within the riparian area. Long-term channel morphology changes recover very slowly. Vegetation recovery is usually quick but may or may not be dominated by native species. Physical damage from cattle has not been well monitored. We do not know how much of the damage seen is from cattle, elk, recreation use, or a combination of the three. We do not know how much is from past grazing levels and how much is from the present grazing levels.

The physical damage caused by cattle results in increased sediment delivery to the streams. However, we also have increased sediment delivery from roads, timber harvest, and recreation use. We cannot presently separate out the causes of the sediment in order to recommend adjustments to either grazing levels or grazing practices.

We recommend that a monitoring program that specifically measures physical damage from cattle be developed. This program could be incorporated into the current stream survey program or the allotment condition survey over the long-term, but with more specific parameters for identifying recent and old cattle damage and for assessing recovery rates. Over the next five years, in order to better assess actual damage and cause, we recommend an annual survey program specifically for cattle damage. Surveys should focus on Clear, Camas, Gate, Rock, Threemile, Tygh, and Jordan creeks, and Owl and Hazel hollows. Surveyors should identify current cattle-created bare paths, damaged streambanks, and wallows, older areas that do not appear to be used now, and areas needing restoration work.

C. *Is continued grazing appropriate in LSRs, Riparian Reserves, and meadows? (formerly question D)*

Yes, in LSRs, Riparian Reserves and dry meadows. **No**, in wet meadows. At present, the only wet meadow within the subbasin grazed commercially is a portion of Camas Prairie. Camas Prairie contains vegetation assemblage unique to that area. Grazing occurs mostly along the edge where conditions are drier, but the edge also needs protection for its unique values. In addition, *Cortinarius wiebeae*, a C-3 rare gilled mushroom, occurs in Camas Corral. We do not know what effects grazing has on this species. As a Strategy 1 species under the Northwest Forest Plan we must manage the site to ensure the species persists. Camas Corral is the only known location for this species.

Grazing in White River LSR should be able to continue over the short-term. White River and a small portion of Grasshopper allotments fall within its boundaries. However, the management strategy within that LSR, if followed as recommended, will result in little new forage creation. Thus, grazing can continue as long as the presently available forage holds out. As trees reestablish and grow in the current clearcuts, forage levels will fall and grazing levels will need to fall also. A similar "fate" awaits that portion of Wapinitia allotment within the White River subbasin and the upper portions of Grasshopper Allotment. Even though these areas do not fall within an LSR, we do not expect to create many new openings.

The grazing potential in Douglas Cabin LSR, and that portion of Badger Allotment, should increase over the long-term as stand structures shift from the current High Density structure to Late Seral Parklike. One of the key features in Late Seral Parklike is a grassy understory. Although grazing potential should increase, grazing levels may not. The preferred understory is composed of native bunchgrasses, which did not evolve under the type of grazing pressure created by large herds of ungulates. High grazing pressure results in loss of vigor of the native species and favors weedy species and non-native species. Thus, we may not increase grazing levels above the current 80 cow-calf pairs in Badger allotment. The forage quality, however, should be higher. We also hope that increasing forage quantity and quality will help distribute the cattle better through the allotment.

No grazing allotments lie within Triangles LSR. We do not anticipate creating an allotment due to the small size of the Triangles, the lack of surface water in summer, and poor position on the landscape (generally midslope) with no clear topographic breaks between the National Forest lands, the Warm Springs Reservation, and other private landowners. Grazing does not appear to pose significant problems in the dry meadows as long as utilization standards are met and grazing does not occur when soil water is too high in the vernally wet meadows. Grazing should be excluded from around young cottonwood and aspen until sprouts and seedlings reach a size that protects them from cattle, if cattle are a significant factor in keeping these species shrubby.

6. Issue: Introduced plants and animals may be successfully competing against native plants and animals and continual disturbance from human activities often favors the introduced species over the native species. This problem exists throughout the subbasin.

A. *Are noxious weeds, as identified by the Oregon State Department of Agriculture, crowding out native plants?*

No. It appears that none of the noxious weeds are responsible for reductions in native plant species. Instead, reductions in native plants are tied to introduced plants not classified as noxious, fire exclusion, compaction, past grazing, and intensive recreation use.

If left unchecked, noxious weed species such as houndstongue (*Cynoglossum officinale*), scotch broom (*Cytisus scoparius*) and knapweeds (*Centaurea* spp.) could begin to displace native species. Knapweeds and scotch broom, along with most other noxious weeds, are most abundant along roadsides and have not spread into the centers of openings. Houndstongue has velcro-like seeds that are easily picked up and carried by any large animal, such as cattle, deer, and humans, and is found far from roadways.

B. *Are other non-native plant species crowding out native plants? Are these species spreading? Will problems develop in other areas if no control actions are taken?*

Yes. Of highest concern is the spread of cheatgrass (*Bromus tectorum*), voodoo grass (*Ventenata dubia*), and bulbous bluegrass (*Poa bulbosa*). Cheatgrass and voodoo grass are winter annuals that readily invade sites with bare soil. Any land uses that create bare soil encourages both species as well as bulbous bluegrass and knapweeds. All these species can compete with native bunchgrasses, particularly under heavy grazing pressure. Past high levels of grazing in the subbasin allowed cheatgrass and bulbous bluegrass to establish many decades ago. Bulbous bluegrass, a weedy perennial from Europe, may now be the most common grass species in the Eastside Zone.

Orchard grass (*Dactylis glomerata*), timothy (*Phleum pratense*), and intermediate wheatgrass (*Agropyron intermedium*) are common species in the subbasin. These species have long been used in forage enhancement and erosion control seed mixes and have been planted throughout the National Forest lands and on ODFW lands. Range improvement seedings have included timothy and intermediate wheatgrass. While they do not spread out from the areas intentionally seeded, they do persist indefinitely, lessening available habitat for native species. Orchard grass tends to form a sod and also retards or, in extreme cases, prevents tree reestablishment. Orchard grass is considered a highly desirable forage enhancement species by ODFW.

Once established, winter annuals have a competitive advantage over the native bunchgrasses. Winter annuals sprout in fall of the previous year and begin growing again very early in spring. This strategy coupled with a shallow root system allows these species to, in essence, grab most of the available water in the upper soil layer before the native species begin growing. The native species do not grow well due to lack of sufficient moisture, particularly during dry years and dry periods. Winter annuals usually complete their lifecycles and set seed before the native species sprout flowers. Burning in mid- to late spring also favors winter annuals since they are no longer vulnerable to fire while the natives are in an extremely sensitive period in their life cycles.

Both species are spreading. While the Forest Service considers cheatgrass and bulbous bluegrass as weeds, local farmers and ODFW consider them valuable early spring forage for cattle, deer, and elk. Before developing seeds, both species are very palatable and nutritious. Since winter annuals are shallow-rooted, die early, and consist of single stems, they also increase the erosion potential of any site they dominate. Both species are present only on the eastern edge of the Eastside Zone within the Forest boundary and more widespread east of the Forest boundary. No open, grassy areas within the Forest boundary are free of cheatgrass, bulbous bluegrass, orchard grass, or knapweeds.

We recommend that several patches of the most weed-free grasslands dominated by native plants be protected from further grazing, off-road vehicles and other land uses that disturb the soil, and further weed encroachment. These patches would preserve examples of native plant communities, serve as "control" communities to compare with other management areas, and provide a base from which to collect seeds to restore degraded areas.

We recommend that wildlife forage, range improvement, and erosion control seed mixes switch over to native species or use sterile non-native plants on National Forest lands. All seed mixes should meet all the state's noxious weed free seed certification tests or come from locally established native plant nurseries with certified weed free growing areas.

C. *Are additional control actions needed to control existing or potential problems with noxious weeds and invasive non-native plants?*

Yes. The Mt. Hood Noxious Weed Management Plan (Helliwell et al. 1990) lists three different ratings for noxious weeds. "A" rated weeds should be controlled or eradicated at the ranger district level. "B" rated weeds are more widespread and should be controlled or contained at the ranger district level in cooperation with Oregon Department of Agriculture. Detection weeds generally include species with small isolated populations which should be eradicated as they are discovered. Top priority under the noxious weed plan is to prevent establishment of Detection weeds. Table 5.4 lists the noxious weeds known or suspected within White River subbasin.

In addition, noxious weed detection on the National Forest currently is opportunistic within the agency rather than systematic. That is, no regular surveys of noxious weeds using FS employees occur or are planned. Instead, the Forest contracts with Oregon Department of Agriculture for noxious weed surveys. In turn, Oregon Department of Agriculture subcontracts the surveys to the local counties and, occassionally, other individuals such as member of the Native Plant Society of Oregon.

Noxious weed control is accomplished by both FS employees and by contractors. In recent years, the only control action taken by FS employees has been hand pulling of isolated populations. The Forest contracts with the counties for other noxious weed control actions. We contract with the counties for hand pulling of isolated populations, biocontrol methods, and chemical control methods. Herbicides have been used only once in the last seven years to control an isolated population of tansy ragwort. Currently, Wasco County Department of Agriculture is evaluating several different methods of knapweed control on Barlow Ranger District.

We recommend the following noxious weed control actions:

> Teach all field-going employees to recognize and report noxious weeds. Encourage employees to uproot any small, isolated weed population and report it as soon as possible to the Noxious Weed Coordinators (Linda Cartwright or Lance Holmberg).
>
> Eradicate all detection weeds found in the subbasin. Manually remove potential invaders including scotch broom and houndstongue.
>
> Promptly reseed bare ground at landings, skid trails, and so forth with certified noxious weed-free native seed or sterile non-native seed, or native shrubs.
>
> Monitor noxious weed sites in the subbasin and regularly update GIS and database records of noxious weed populations.
>
> Develop and maintain a standardized database for tracking noxious weed populations. The database should include fields for observation date, population size, and treatments used. The database should link with a GIS data layer with a unique polygon assigned to each population of each species. Coordinate database development with other landowners in the subbasin and Oregon Department of Agriculture.
>
> Road construction, logging equipment, and fire suppression equipment from areas with infestations of scotch broom, houndstongue, tansy ragwort, or any Detection weeds should be cleaned before entering any project area within the subbasin.
>
> Use integrated pest management techniques to contain established infestations of knapweed, St. Johnswort, and Canada thistle.
>
> All seed purchased for revegetation must meet all state noxious weed-free certification tests.

Table 5.4. Noxious weed species known or suspected to occur in White River subbasin.

Rating	Species	Zone
A	tansy ragwort--*Senecio jacobea*	Crest, Transition
	spotted knapweed--*Centaurea maculosa*	All
B	Canada thistle--*Cirisium arvense*	All
	diffuse knapweed--*Centaurea diffusa*	All
	St. Johnswort--*Hypericum perforatum*	Eastside, Transition
	houndstongue--*Cynoglossum officinale*	Crest
Detection	dalmation toadflax--*Linaria dalmatica*	Eastside
	musk thistle--*Carduus nutans*	Eastside
	yellowstar thistle--*Centaurea solstitialis*	Eastside
	white top--*Cardaria* spp.	Eastside
	yellow toadflax--*Linaria vulgaris*	Transition, Eastside
	brown/meadow knapweed--*Centaurea jacea/C. pratensis*	Eastside
	poison hemlock--*Conium maculatum*	Eastside
	perennial pepperweed--*Lepidium latifolium*	Eastside

D. *Are introduced animal species crowding out or preying on native species or diluting the purity of the gene pool?*

Yes. Nine main introduced/native species interactions are known in the White River subbasin. Non-native fish species have been introduced in all lakes and many streams. In some cases, the non-natives are breeding with the endemic redband trout. In other cases the non-native species are preying on native species. Bullfrogs have been introduced into many constructed ponds, mostly east of the Forest boundary.

<u>Turkey/Gray squirrel.</u> Wild turkey, both Merriam's and Rio Grande subspecies, have been introduced into the subbasin. Merriam's seems to be the dominant race and the most successful breeder. Acorns and ponderosa pine seeds are major food sources for both adult turkeys and the native western gray squirrel, also known as the silver-gray squirrel. Competition for food does not appear to be limiting the gray squirrel's populations at this time. The potential exists for food competition in the future if turkey populations increase significantly.

Fire exclusion, which has increased stand densities, has probably favored gray squirrels. The ability to travel from crown to crown is a very important characteristic of gray squirrel nesting habitat. However, increasing stand densities has also reduced acorn production by both reducing the number of oak trees and by reducing crown size in many of the remaining trees.

Existing and proposed management direction protects adequate dense pine for nesting gray squirrels. Under the proposed management direction, about 25% of the Eastside Zone would be managed as thermal cover, or severe weather cover. The addition of some thickets associated with known concentrations of gray squirrels should assure adequate nesting habitat, adequately protecting gray squirrels and reducing the potential of significant competition from turkeys. Proposed management direction would increase acorn production potential by increasing the number of oak trees and promoting development of larger tree crowns.

<u>Cattle/Native plants.</u> Cattle often have a preference for some native plants over other species. Studies elsewhere have shown that cattle will preferentially graze many native bunchgrasses, such as Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Agropyron spicatum*), as well as certain other species. In White River subbasin, examples of these preferred species are Howell's

milkvetch (*Astragalus howellii*) and Sitka willow (*Salix sitchensis*) on National Forest lands. Under the Forest's summer grazing system, Howell's milkvetch does not appear to be at risk since the plant usually has completed seeding before the cattle are turned out (Elmore 1995).

Our forage utilization sampling protocol may miss scattered or scarcer native species which are highly palatable and preferentially grazed. Utilization of these preferred species may exceed allowable amounts, yet we do not move livestock out of an area until the more common species are consumed to the allowable amount. We have a method to measure shrub consumption, but have not used it. Current monitoring focuses on herbaceous vegetation; shrub consumption had not been identified as a area of concern.

We recommend developing sampling protocols or monitoring strategies that indicate better trends in native plant species populations for those species which may be preferentially grazed, particularly in Grasshopper and Badger allotments. These two allotments contain the highest number of species of concern. Results from these surveys should be used to evaluate trends in plant populations within the allotments. We also recommend monitoring shrub utilization in shrub and hardwood dominated riparian areas. Of particular importance would be to devise a monitoring strategy that attempts to separate cattle utilization from elk utilization.

Turkey/Ponderosa pine. Evidence in Idaho suggests that turkey may be responsible for the lack of natural ponderosa pine regeneration (Neuenschwander 1994). Ponderosa pine seeds are a preferred food. More study is needed to determine if turkeys have or could have a significant effect on natural regeneration of ponderosa pine.

Barred owl/Northern spotted owl. Habitat fragmentation throughout the western United States and Canada has allowed the barred owl to spread from it's original range in the east and Rockies to habitat in the Cascades. The barred owl, a close relative of the spotted owl, appears to be better adapted to fragmented old growth and late successional habitat than the northern spotted owl. The northern spotted owl appears capable of surviving and reproducing in relatively fragmented habitat as long as a sufficient total quantity is present. However, in the presence of barred owls, northern spotted owls do not appear to compete except where late successional and old growth habitat remains in relatively large, unfragmented blocks. Whether this competition is for space, prey changes, resistance to predators, or some other factor is unknown. The "take-over" of habitat by barred owls does not appear to be from predation on spotted owls. The Northwest Forest Plan recognized the impact of fragmentation and the relationship between barred owls and spotted owls as one reason for designated relatively large LSRs.

Brown-headed cowbird/Other birds, especially neotropical migrants. The brown-headed cowbird was native to the Great Plains and Midwest. Relatively recent fragmentation of forested habitats in the west has contributed to the cowbird expanding its range to include the western United States. The brown-headed cowbird is a parasite on other bird species, using other birds' nests to lay their eggs. Usually one egg is laid in each parasitized nest. Often the female cowbird will remove or eat some of the host bird's eggs prior to laying her single egg. Cowbird eggs have the ability to synchronize their hatching with the remaining host egg(s) such that they typically hatch one day before the host species egg(s).

Cowbird nestlings are usually larger than the host nestlings and more aggressive at obtaining food from the host adults. The host young usually starve to death or are knocked from the nest by the cowbird nestling. The result is a failed nesting year for the host species. Female cowbirds do not appear to seek host nests much more than a few hundred feet into a timber stand. Fragmentation from regeneration harvests, particularly in the Transition and Crest zones has greatly increased the amount of edge habitat, thus increasing nesting habitat for the brown-headed cowbird.

The extent and depth of this threat to native bird species within White River subbasin is unknown. The cowbird is present. We do not believe it poses a major threat to host species at this time. Moving towards the proposed conditions on National Forest lands would reduce any threats to native species within the Transition and Crest zones due to decreased level of regeneration harvest. We do not know what effects the proposed condition in the Eastside Zone may have on the extent of cowbird parasitism.

Starling/Cavity nesting species. The imported starling is a very aggressive cavity nesting species which is known to take over cavities from less aggressive species, especially bluebirds. The extent of impacts from starlings in White River subbasin is unknown. Managing for higher levels of snags than the minimum needed for viability (40% of biological potential) for primary cavity excavators would provide additional cavities for displaced cavity nesters. At present, it appears that the lack of cavities, due to a lack of snags, is a more limiting factor than competition for other resources.

Non-native fish/Redband trout. Oregon Department of Fish and Wildlife has introduced hatchery rainbow trout and brook trout to all lakes within the subbasin. Stocking of these fish in streams ended only recently with adoption of the State's Native Fish Policy. Stocking of rainbow trout continues in the lakes. The redband trout found in White River subbasin has evolved in isolation from other populations of redband trout since White River Falls was created. The hatchery rainbow trout interbreed with the endemic redband trout, reducing genetic purity. Brook trout feed on the young of the native redband trout. Streams that contain redband trout, but not hatchery rainbow trout include Gate, South Fork Gate, Souva, Rock, Threemile, Little Badger, Tygh, Pen, and Jordan creeks (Figure 5.3).

In addition, warmwater fishes, such as bluegill, brown bullhead, largemouth bass, and smallmouth bass, have been introduced into Rock Creek and Pine Hollow reservoirs. A natural lake did not exist in either location prior to construction of the reservoirs.

Non-native fish/Native amphibians. Many of the smaller lakes, such as Jean, Boulder, Little Boulder, Upper Twin, Lower Twin, Catalpa, Frog, and Green lakes, may have been fishless. Research in North Cascades National Park found that salamanders are the top predators in many naturally fishless lakes (Liss et al. 1995). Stocking fish into otherwise fishless lakes introduces a new predator that can feed on the salamanders as well as many of the salamanders' prey species. Northwestern salamander and rough-skinned newts are toxic in both the larval and adults forms, so can co-exist with the introduced fish (Leonard et al. 1993). Rough-skinned newts and Northwestern salamanders may gain a competitive advantage when introduced fish prey on the competitors of these two species.

Non-native amphibians/Native amphibians. Bullfrogs can prey on native amphibians, such as Pacific chorus frogs. Both Pacific chorus frogs and bullfrogs have been sighted within constructed ponds in the Eastside Zone.

E. *Should stocking of non-native fish continue? Are these fish likely to escape and interbreed with the native fish?*

Yes. Stocking could continue with no adverse effects on native fish if the stocked species cannot escape and either interbreed or prey on native fish, amphibians, or macroinvertebrates. Stocking could continue in Pine Hollow and Rock Creek reservoirs with little risk to native species if the stocked fish were prevented from escaping into perennial streams. If no native fish remain in Badger and Clear lakes then stocking could probably continue in those lakes provided the stocked fish could not escape into Badger or Clear creeks. We recommend that stocking end at all other natural lakes to protect native species either present in the lake or downstream of the outlets.

Of additional concern is that none of the lakes and only one irrigation diversion is screened to prevent fish passage. State law requires that all diversions be screened against fish passage at the diversion point (Oregon Revised Statute 509-615). This law was intended to prevent the loss of fish into fields via the irrigation network. The lack of screening has both allowed fish stocked into the lakes to escape into the streams and provided a refuge for all fish by allowing them to retreat to the ditches during periods of low flow in the streams. The ditches often provide better fish habitat in August and September than the creek below the diversion points simply because the ditches contain more water and cooler water.

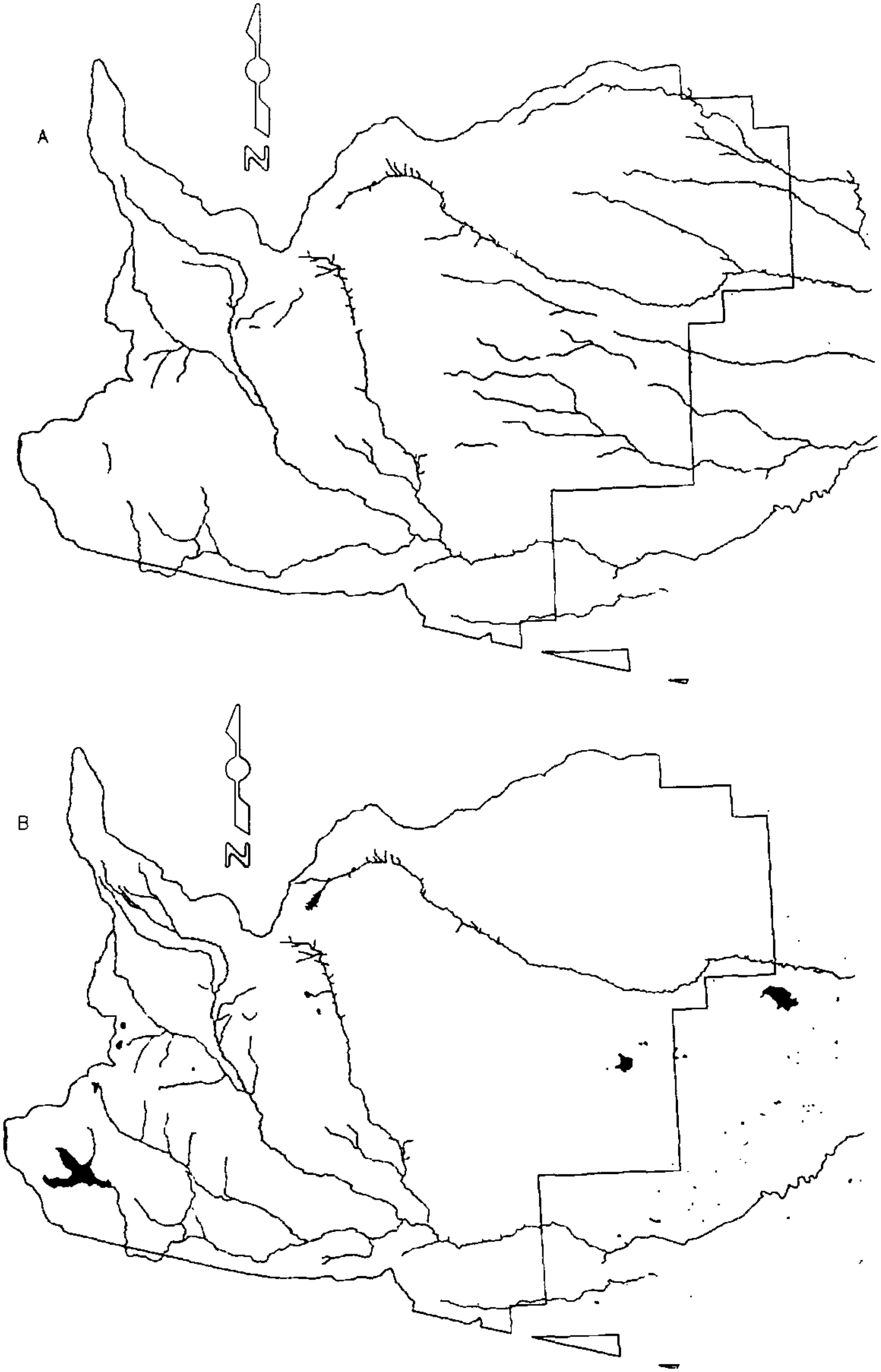


Figure 5.3. Redband trout distribution (A) verses non-native fish distribution (B).

In order to meet the intent of the state law and to better protect the current population levels of fish, we recommend that the irrigators be allowed to screen the ditches against fish passage at the Forest boundary rather than at the diversion points. In some cases, we believe this recommendation would make both construction and maintenance of fish screens less costly.

F. *Are the introduced species affecting any threatened, endangered, sensitive, or at-risk species?*

Yes. The barred owl is reducing the viability of the northern spotted owl throughout the fragmented late successional and old growth forests of the west, including White River subbasin. Interbreeding with hatchery trout is reducing the genetic purity of the White River population of redband trout. All the introduced fish are competing with or preying on redband trout, native sculpins, aquatic amphibians, and zooplankton within the Forest boundary plus whitefish and long-nosed dace east of the Forest boundary. See the answer to 6D for more complete descriptions of the interactions. In addition, cattle are contributing to habitat damage in Camas Prairie, potentially affecting the only population of spotted frogs documented on the Mt. Hood National Forest and the only known location of *Cortinarius wiebeae*.

7. Issue: Disturbance processes create a dynamic landscape and dynamic habitat; however, land management plans and the Northwest Forest Plan tend to try to create a fixed landscape through land allocations and the associated objectives and standards and guidelines. This problem occurs across the landscape and primarily is a problem on federal lands.

A. *Has the risk of catastrophic events increased over the pre-1855 risk level? What events are specific to a given location, and what are the expected consequences?*

Yes. The risk of catastrophic fire, insect attacks, and disease levels is significantly higher in the Transition and Eastside zones. In both zones, fire exclusion and failure to adequately manage tree understories has greatly increased stocking levels and favored late successional species. Grand fir in particular seems prone to attack by many different insect and disease species (see Appendix A on the role of disturbances). While the risk of catastrophic fire is within the range of natural conditions in the Crest Zone, the consequences of such a fire are not socially acceptable.

Specifics include:

- High risk of stand replacing fire in mixed conifer stands on Frog Lake Buttes due to spruce budworm related mortality of true firs in dense, stagnated stands; last burned around 1900.
- High risk of stand-replacing fire in Fire Groups 1 and 2, portions of Groups 3 and 9 due to increased stocking levels, increased presence of fire susceptible species, increased ladder fuels, increased risk and incidence of mortality from insects and disease, increased drought stress (Figure 5.4). Last ecologically significant burns probably occurred before 1910.
- Increased risk of stand-replacing fire in Badger-Tygh subwatershed due to high levels of tree mortality from recent spruce budworm epidemic within the Badger Creek Wilderness. Last burned in mid-1800s.
- Higher risk of bark beetle outbreaks affecting ponderosa pine in the Eastside Zone due to drought and overstocking.
- Higher risk of fir engraver beetle, spruce budworm, Douglas-fir bark beetle, and root diseases affecting Douglas-fir, grand fir, and western hemlock in the Transition Zone due to drought and overstocking.

Insect and disease outbreaks are of concern not only for their immediate impacts on wildlife and riparian habitat but because they often create or exacerbate conditions suitable for a large, stand-replacing fire. The wildlife habitat elements which either a major insect/disease outbreak or a large, stand-replacing wildfire would detrimentally affect include:

- northern spotted owl nesting, roosting, and foraging habitat on Frog Lake Buttes, much of Badger-Tygh subwatershed, and the grand fir/starflower, grand fir/twinflower, western hemlock/dwarf Oregongrape, and western hemlock-Douglas-fir/oceanspray plant associations in Fire Groups 3 and 9,

- critical northern spotted owl dispersal habitat in Fire Groups 2 and 3, particularly south of White River,
- the only remaining patch of Old Growth in Badger-Tygh Watershed,
- big game thermal, marginal thermal, and hiding cover in the lower portions of Badger-Tygh subwatershed and in Fire Groups 1, 2, 3, and 9,
- possibly pine marten denning habitat in Fire Groups 3 and 9, and
- potential great gray owl nesting habitat and habitat for flammulated owls, white headed woodpeckers, and other species dependent on open canopy forests in Fire Groups 1 and 2.

Assuming a stand-replacing fire started on Frog Lake Buttes under the typical burning conditions associated with similar past fires, the fire would be pushed by strong westerly winds. Under these conditions, riparian areas and even White River would not pose a significant barrier to fire spread since a main method of spread is long-range spotting (spot fires starting over 1/2 mile from the main fire). Such a fire could reach the large old growth stand in upper Boulder Creek. This stand is the largest single patch of old growth in the entire White River subbasin.

Also of concern is the potential for a stand-replacing fire originating in the Badger-Tygh subwatershed to detrimentally affect ownerships east of the Forest boundary. The stream canyons in this subwatershed act to funnel and strengthen winds, particularly in Badger Creek. Under worse-case conditions a fire beginning in Badger Creek could threaten the communities of Wamic, Pine Hollow, or Tygh Valley.

B. *Are landscapes and ecosystems becoming less stable and resilient? (formerly question C)*

Yes, in the Transition and Eastside zones and in riparian areas below irrigation diversions. Fire exclusion, past over-grazing, failure to manage the understory, and dominance of many stands by the climatic climax species have made the uplands and Eastside Zone riparian areas both less stable and less resilient. All areas are experiencing increased incidents of insect and disease outbreaks and an increased risk of stand-replacing fire in a system not adapted to it. Continuing succession in the Eastside Zone has also contributed to the loss of beaver.

Irrigation withdrawals have reduced low flows and probably have reduced peakflows in streams with year-round diversions. The aquatic ecosystem is less resilient below the diversion points and the riparian ecosystem has probably narrowed. We are not certain if these systems are less stable. We do not know what effects changing the water table in riparian areas has had on riparian species compositions, bank stability, and so forth.

Culverts in most streams are unable to pass woody debris and, in some cases, the higher floods. Floodplains in the Eastside Zone may not be fully functioning due to the lack of downed wood formally transmitted from the Transition Zone. Culvert and bridge crossings can restrict the stream flow, accelerating water velocity and potentially promoting downcutting and scouring immediately downstream of the crossing. Some crossings may have changed the angle of the stream, casuing additional bank scouring.

Streams disconnected from their floodplains are less resilient to flood effects. Vegetated floodplains slow water velocity, allowing better infiltration and allowing sediment to drop out. Within the National Forest, a portion of Rock Creek is downcut and straighter than normal due to management activities upstream from Rock Creek Reservior; most likely due to activities associated with the Rocky Burn. East of the Forest boundary portions of some floodplains on Jordan, Tygh, and Threemile creeks are somewhat channelized with minor diking. These actions have had more effect on lower peakflows than higher peakflows.

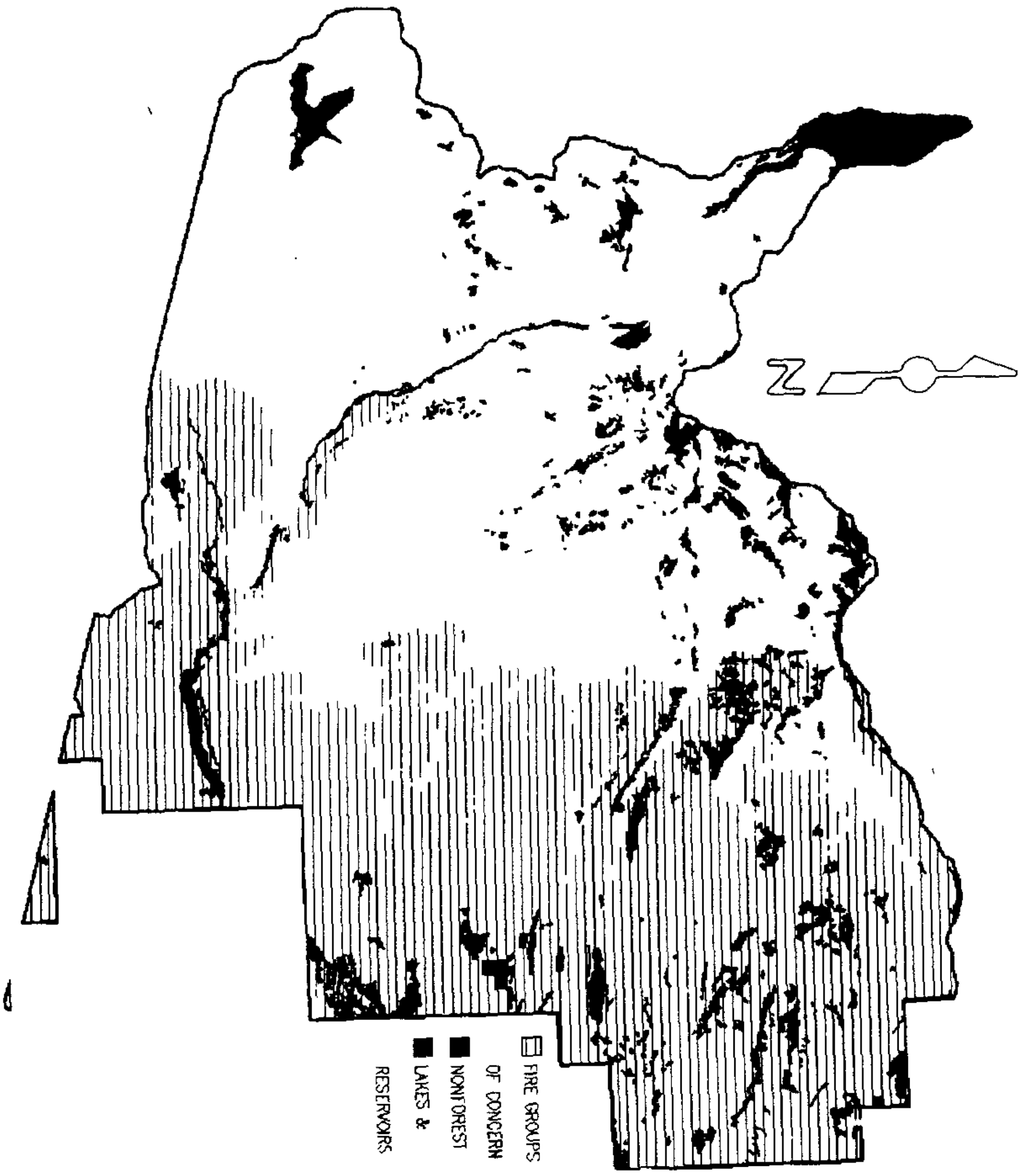


Figure 5.4. Fire groups of concern in White River subbasin.

Sediment excessive to natural levels can overwhelm a channel's capabilty to move sediment further downstream. As pools fill, channels become wider and shallower and larger rocks (cobble-sized and larger) become buried, stream channels may begin to shift that did not shift before, or they may migrate more frequently. Stream reaches where the material less than or equal to 6 mm in diameter comprises more than 20% of the surface fines (see Table 5.1) may be less stable. We recommend evaluting these streams in more detail to determine the causes of the high surface fine levels (natural or artifical sources) and decide what corrective actions, if any, are needed.

C. *Have the different landscape patterns (pre-1855 and current direction) affected species use patterns and levels of use? (formerly question D)*

Yes. Deer and elk populations are much higher than pre-1855 conditions in part due to management activities that have favored habitat development for these species. Fire exclusion has created stand conditions that provided nesting, roosting, and foraging habitat for northern spotted owls in the Eastside Zone. Before 1855, such habitat conditions appeared only on steep north aspects and topographically sheltered areas along perennial streams. Now this habitat appears on the uplands, though it is of low quality. This habitat is partly responsible for allowing the spotted owl to persist where harvesting has greatly reduced suitable habitat in the Transition and Crest zones. Conversely, species that depend on more open stands and old growth ponderosa pine have lost habitat. These species occur only at reduced population levels within the National Forest boundary and some, such as beaver, are now virtually absent.

Ditches that flow overland move water out of stream canyons and onto flat ridges in the Eastside Zone. The ditches are much more accessible than the streams and water is present in otherwise dry areas. Further, many ditches do offer some riparian values, such as willow and alder brush in areas normally devoid of these species. The ditches often have higher flows in August and September than do the associated creeks, but lack the habitat complexity of streams. These factors help disperse wildlife over a larger area than may have been typical before 1855 and at least partially replace riparian and aquatic habitat lost due to the diversion. Irrigation diversions and culverts often pose migration barriers to fish and amphibians.

The combination and cummulative effects of management actions in the subbasin have created large changes in aquatic and riparian ecosystems and ecosystem functioning. Fire exclusion has dramatically increased riparian stand densities in some areas while timber harvesting has dramatically reduced or eliminated stands. Constructed reservoirs and ponds have severed connections for some species, such as spotted frogs, and created new habitat for other species, such as Pacific chorus frogs. Introductions of non-native fish and amphibians have resulted in the redistribution of native species due to predation or competition for food and spawning and living space.

Beaver-created wetlands were common throughout the Eastside Zone and distributed through the Transition and Crest Zone streams. Beaver activity creates highly productive complex, slowwater habitats for fish, helps to moderate both baseflows and peakflows, provides resting areas for migrating fish, traps sediment and nutrients, and helps maintain riparian hardwood plant communities. The near loss of beaver in much of the Crest and Transition Zones and in that portion of the Eastside Zone west of the Forest boundary has also resulted in the reduction of these aquatic and riparian habitat features.

D. *Should we better incorporate dynamic processes that cross land allocations and landscape features into standards and guidelines and management activities? How might we do this? (formerly question E)*

Yes. Natural disturbance processes vary in scale and effects and create wide variation in landscape and habitat elements. We have had little or no effect in our attempts to control many of these processes. We have had the most success in attempting to control fire but now realize that often these efforts were misguided and have created as many or more problems than they solved. Standards and guidelines need to recognize our lack of power over most disturbance processes and work to have management actions and land uses either work within the constraints established by natural disturbance processes or complement them. In other words, standards and guidelines should not work to constrain natural processes. Instead, they should constrain management actions and some land uses, such as collecting special forest products and grazing, towards mimicking and complementing natural processes.

One difficulty we have not been able to resolve is how best to recognize the management actions taken by American Indians prior to the arrival of Euro-Americans. American Indians manipulated the White River subbasin for many thousands of years and had a major influence on the assemblage of plants and animals present in the subbasin. Since the landscape created by their actions is what most envision when discussing the "natural" environment, we should consider the actions they took as part of the "natural" disturbance regime. Yet, the actions they took are ones that we can strongly influence, so do not fall in the same category as a drought, flood, or lightning ignited fires.

In this light we recommend the following actions:

- Base standards and guidelines on climatic zones and the associated disturbance processes first, then on land allocation. The Northwest Forest Plan does this to some extent, but is too broad.
- Recognize that the quantity of various habitat elements varies from zero to some level. Analyze the quality of a given habitat element over a larger unit. For example, average in-channel large wood and pools per mile for an entire stream rather than by reach. This strategy would recognize that some reaches may have zero while others may have an "excess."
- No habitat element should go to zero as the result of management actions or land uses. Natural processes can manage for the minimums, but we need to recognize that minimums exist naturally. This strategy would also require that we understand why a habitat element is missing in a given location. For example, is a given stream reach devoid of in-channel large wood because of a management action or because of a recent flood?
- Standards and guidelines must clearly state what management activities or land uses they address. For example, timber sales can be an overwhelming influence on downed wood and snag levels. We recommend that we be upfront and write the standard to address timber sales and not use vague terms like "management activities" unless the intent is to constrain <u>all</u> management activities.
- Standards and guidelines should clearly state what is considered a management activity and what is not. Is Prescribed Natural Fire a management action or a natural event? Is recreation a management action or is the action any steps we take to constrain or control recreation?
- The Forest should consider reevaluating the following Forestwide standards and guidelines:

1. FW-004--natural events will change the present stands; we cannot maintain the present stands without taking action.
2. FW-010--clearly state whether this standard applies only to management actions.
3. FW-015 and 016--stablization should only be required if we did something to increase instability or caused the area to begin moving. Earthflows are a natural sediment source.
4. FW-025--reevaluate whether this standard is still needed under the Northwest Forest Plan standards (15% green tree retention guideline).
5. FW-032 through FW-038--see Question 1G on downed wood.
6. FW-035--calculate into a bigger landscape. We may be at the low end of the range of natural conditions, but we believe that level is wiser than being outside the range.

7. FW-061 through FW-065--should just constrain management activities and land uses, not natural events. The crown closure level should reflect the range of natural conditions for a given climate zone or diagnostic stand type, not an arbitrary level. Better define "watershed stability."

8. FW-069--stabilization should be required only when management actions have destabilized an area. This standard should consider that the "stable peak flow" is generally unknown for a given watershed and may be very difficult to determine where the data are confounded by such influences as irrigation withdrawals. In general, watershed restoration should not occur on natural events unless that event occurred outside the range of natural conditions. For example, restoration should occur on a stand-replacing fire in the Eastside Zone since this zone did not evolve under a high intensity fire regime. Restoration should not occur on a stand-replacing fire in the Crest Zone since this zone did evolve under a high intensity fire regime. Restoration should occur on all impacts related to the fire suppression effort. This standard should also not preclude actions taken to prevent or control noxious weed or non-native plant invasion of a burned area.

9. Riparian Area Section--all standards and guidelines should be rewritten to constrain management actions from degrading aquatic and riparian habitat elements and to restore degraded areas caused by past or present management actions. Changes caused by natural events occurring within the range of natural conditions should be allowed. We should monitor such changes to gain a better understanding of riparian and aquatic ecosystem functioning. The highest impact activities in White River subbasin were past over-grazing, roading, and timber harvest. Restoration efforts to correct problems caused by these land uses are appropriate. See the answers to Issue 1, Key Question H for some specific recommended changes.

10. FW-137--fish habitat capability changes with time, fluctuates with disturbances, such as fire, and with drought cycles. Fish habitat capability should not be reduced as the result of land uses over which the agency has some control.

11. FW-139--rehabilitate or enhance fish habitat degraded only as the result of management actions or land uses, either past or present, such as past over-grazing and timber harvesting.

12. FW-143 and 144--in the White River subbasin, it would be more appropriate to screen diversions at the Forest boundary so the ditches can continue to serve as refugia during low flows.

13. FW-158 through FW-160--replaced by the Northwest Forest Plan?

14. FW-162--viable populations of native species should be managed on the basis of their historic range. For example, northern spotted owls have expanded their range into the Eastside Zone and possibly the lower Transition Zone due to fire exclusion. The current habitat conditions are not stable and we cannot continue to provide habitat over the long-term (see Questions 1C and 1E).

15. FW-163 through FW-168--forest diversity elements should be based on the range of natural conditions for a given climate zone or stand type, not based on a "one size fits all" approach.

16. FW-175--see the discussion for FW-162.

17. FW-192 and 193--does not apply well to the Crest Zone where the range of natural conditions is for very large openings.

18. Wildlife Section--the Forest should talk with ODFW about the new management paradigm under the Northwest Forest Plan, including what levels of habitat elements we expect the range of natural conditions to provide and what population levels they can support. Everyone should recognize that populations fluctuate and set population goals on the basis of the range of natural conditions. No habitat element should drop to zero as the result of

management actions or land uses, but natural events and processes may result in areas devoid of a given habitat element.

19. Forest Protection and Safety--the Forest Fire Management Action Plan (FMAP) should be updated to reflect the findings in this and other watershed analyses, assuming the recommendations are accepted. Regardless, a copy of the FMAP should be available on each district to guide preparation of Escaped Fire Situation Analyses. We recommend the FMAP include a decision matrix on the appropriate suppression response by Northwest Forest Plan land allocation and based on time of year and level of fire danger indices. We also suggest using Energy Release Component (ERC) or a combination of ERC and the Ignition Component (IC) as the appropriate indices, and recommend that the appropriate fuel models are used to reflect actual fuels.

20. Range Section--develop physical damage standards and guidelines (see Questions 5A and 5B).

21. Timber Section--standards and guidelines should address desired outcomes and not specific methods. Outcomes should reflect the range of natural conditions. For example, opening size guidelines in the Crest Zone should not encourage fragmentation. It would probably be appropriate to constrain how quickly a large opening could be created to protect certain social desires, but the end result should be a large area of more-or-less one age class as the area approaches a late successional condition. Standards and guidelines should emphasize natural regeneration and genetic diversity over artificial regeneration, particularly in areas of uneven-aged management. Recognize up front that herbicides are only appropriate for controlling noxious weeds and are not politically acceptable for managing brush. Recognize that areas of dense brush are part of the natural condition and serve a purpose that we may not understand very well. Fertilizing should be limited and we should manage for nitrogen-fixing plants, such as legumes, ceanothus, and alder. These species will provide available N over a much longer period of time than chemical fertilizers and add diversity to the forest.

We recognize that incorporating dynamic processes cannot happen immediately due to past actions whose consequences we must now mitigate. In the interim, we may need to take restoration actions on some natural events operating within the range of natural conditions until we have adequately reduced the impacts of land management activities.

8. Issue: Current direction and information may not be adequate to assure the viability of species on the C3 Table and certain threatened, endangered, sensitive, at-risk, and unique species in White River subbasin that are outside the range of the northern spotted owl.

A. Do we have adequate information to assess the viability of all relevant species listed in the FSEIS and C-3 Table should we decide to recommend changes in the Riparian Reserve width or if the FSEIS suggested that further viability analysis was appropriate during watershed analysis?

No, we cannot adequately assess species viability for any species listed on the C-3 Table. Of the species listed, the following have been documented in White River subbasin:

Species Group	Species	Survey Strategy	Habitat
Mychorrhizal Fungi: Boletes	*Gastroboletus subalpinus*	3[1]	Above 4500 ft; ectomychorrizal with pines
	Gastroboletus turbinatus	3	mid to high elevation with true firs, spruce, hemlock; with abundant LWD[2] and thick duff
Mychorrhizal Fungi: Boletes Low Elevation	*Boletus pipratus*	3	low to mid elevation forests; requires LWD in Douglas-fir
False Truffles	*Thaxterogaster pinque*	3	only mid to high elevation true firs with thick duff and LWD
Rare False Truffles	*Rhizopogon brunneiniger*	1[3], 3	low to high elevation dry old growth forests; Douglas-fir, mountain hemlock, true fir, pine
Rare Gilled Mushrooms	*Cortinarius wiebeae*	1, 3	montane late-successional forest with true firs and other conifers
Uncommon Ecto-Polypores	*Albatrellus ellisii*	3	old growth forests
Vascular Plants	*Botrychium minganense*	1, 2[4]	usually associated with western hemlock, vine maple, and big leaf maple
	Allotropa virgata	1, 2	high elevation forests in the western hemlock and Pacific silver fir series, possibly mountain hemlock series

[1] Conduct extensive surveys and manage sites

[2] Large woody debris, or downed logs

[3] Manage known sites

[4] Survey prior to activities and manage sites

The subbasin contains potential habitat for many other species of fungi, lichens, and bryophytes on the C-3 Table. We have not surveyed for mollusks. Potential habitat exists around springs, seeps, talus slopes, and riparian areas for a number of slugs, land snails, and freshwater snails. Threemile Creek has a population of small, "fingernail" clams in the upper part of the stream. These clams are probably in the genus *Pisidium*, but are not believed to be *Pisidium ultramontanum* (montane peaclam) listed in the C-3 Table (Furnish 1995, Frest and Johannes 1993). There is no potential habitat for the amphibians listed. There may be habitat for the red tree vole in the Crest Zone.

B. Are there additional or unique species within the range of the northern spotted owl that are not dealt with in existing direction?

Yes, there are several plant species associated with the Eastside Zone and with special habitats within the designated range of the northern spotted owl that are not specifically covered in current direction:

Species	Zone	Habitat	Status
Agoseris elata (susp.) tall agoseris	Crest	vernally moist to wet montane meadows	state sensitive, R6 sensitive
Allium campanulatum Sierra onion	Crest	dry soils at medium to high elevation, only known location is Barlow Butte	locally rare, at edge of distribution
Arabis furcata Cascade rockcress	Crest, Transition	High ridges, locally uncommon	probably genetically isolated
Arabis sparsiflora var. *atrorubens* sickle-pod rockcress	Eastside	open, rocky areas in pine-oak woodlands, locally rare	state sensitive, R6 sensitive
Astragalus howellii Howell's milkvetch	Eastside	open, grassy pine-oak woodlands, endemic to Sherman and Wasco counties	state candidate, R6 sensitive
Calamagrostis brewerii Brewer's reedgrass	Crest	streambanks, lake margins, moist subalpine and alpine meadows	state threatened, R6 sensitive
Chaenactis nevii (susp.) John Day chaenactis	Transition	high rocky ridges in the Badger Wilderness	state concern, populations declining but still common
Collomia larsenii (susp.) collomia	Transition	high rocky ridges in the Badger Wilderness	state concern, populations declining but still common
Delphinium nuttallii Nuttall's larkspur	Crest	basalt talus, only known location is Barlow Butte	state sensitive
Hackellia diffusa var. *cottoni* diffuse stickseed	Eastside, Transition	White River at forest boundary, shaded cliffs and talus	state concern, populations declining but still common
Huperzia occidentalis fir club-moss	Transition	wet areas, found only in White River and Clear Creek; formerly *Lycopodium selago*	state sensitive, R6 sensitive; probably genetically isolated
Lewisia columbiana var. *columbiana* (susp.) Columbia lewisia	Crest	exposed gravel banks and rocky slopes; tentative sighting above Badger Lake	state sensitive, R6 sensitive
Lomatium watsonii (susp.) Watson's desert-parsley	Eastside	rocky, open hillsides	state sensitive, R6 sensitive
Lycopodium annotinum stiff club-moss	Transition	wet areas, relatively common	state concern, may be dropped from future concern lists
Scribnaria bolanderi Scribner's grass	Eastside	vernally moist swales, scablands, other poorly drained sites; Wasco County has only known populations in Deschutes Province	state sensitive, R6 sensitive
Vaccinium oxycocus wild cranberry	Transition	sphagnum bogs; only known location is Camas Prairie	state concern
Utricularia minor (susp.) lesser bladderwort		standing or slowly moving water	R6 sensitive

We did not consider the species on the R6 Sensitive list as having adequate direction since the majority of these species do not have individual management plans. Current direction requires that we survey for these species and, if present, adjust the activity to maintain or enhance the species. However, since the life cycles and requirements of these species are not well known, the action usually taken is to simply avoid the species.

Of the species listed above, the following should be considered when managing or adjusting the widths of Riparian Reserves:

- tall agoseris
- fir club-moss
- wild cranberry

Of the remaining species, the following are considered secure and additional conservation measures are not needed at this time:

- Sierra onion
- Cascade rockcress
- John Day chaenactis
- collomia
- Nuttall's larkspur
- diffuse stickseed
- Columbia lewisia
- stiff club-moss

The subbasin also contains native sculpins of one or more unknown species, four species of rare caddisflies, four species of at-risk amphibians, and crayfish within the range of the northern spotted owl. Native sculpins are the second most common fish in White River subbasin and may be prey for redband trout and Cope's giant salamander. Existing direction focuses on salmonids and generally ignores other fishes. The species present might be torrent or shorthead sculpins or both species. The habitat for both species is present. Both species spawn in coarse substrates and feed on benthic invertebrates, so are sensitive to fine sediment levels. As such, sculpins could be better indicators of aquatic habitat conditions than salmonids and giant salamanders. The sculpins in White River subbasin have also been reproductively isolated from sculpins in other watersheds, so may be endemic in the same manner as the redband trout in White River.

All four species of rare caddisflies (Mt. Hood primitive brachycentrid caddisfly, Cascades apatanian caddisfly, Mt. Hood farulan caddisfly, and one-spot rhycophilan caddisfly) have been found in the North Fork of Iron Creek above Highway 35. The Mt. Hood farulan caddisfly has been found in the South Fork of Iron Creek above Highway 35. These species are all listed as C2 species by the US Fish and Wildlife Service. Since the habitat needs are not well documented for all life stages, existing direction may not be adequate.

The four species of at-risk amphibians include spotted frog, tailed frog, Cascades frog, and Cope's giant salamander. The spotted frog population in Camas Prairie is genetically isolated and the only known location of this species on the Mt. Hood National Forest. Table 5.5 lists where these species have been found. All species should be considered when adjusting Riparian Reserve widths. Habitat for the Cascades torrent salamander (State vulnerable) exists in the subbasin, but presence of the species has not been documented.

Crayfish are apparently abundant in Badger Lake and upper Badger Creek. Some harvesting of crayfish occurs each summer, although we do not know how many are taken. We have also found crayfish in Frog Lake and Rock Creek and they may occur in Clear Lake and Rock Creek Reservior.

Crayfish distribution is not well documented and the populations are not monitored. We are not even sure if the crayfish are native or introduced. We do not know what interactions occur between crayfish and other aquatic species or what the habitat needs are for this species. No management direction exists for this species even though there is documented demand for harvestable levels.

Table 5.5. Occurrence of rare and at-risk amphibians in White River subbasin.

Species	Locations	Status
Spotted frog	Camas Prairie	Federal candidate State Concern
Tailed frog	Alpine Creek Boulder Creek Buck Creek Clear Creek tributary to Iron Creek Jordan Creek Gate Creek	Federal candidate State Vulnerable
Cascades frog	Alpine Creek Bonney Creek Bonney Meadows Boulder Lake Camas Creek Camas Prairie Clear Creek Clear Lake tributaries to Clear Lake Devil's Half Acre meadow Frog Creek tributary to Frog Creek Frog Lake Green Lake SF Iron Creek White River Spinning Lake Jordan Creek	Federal candidate State Vulnerable
Cope's giant salamander	Alpine Creek Bonney Creek Bonney Meadows Boulder Creek Buck Creek tributaries to Buck Creek Clear Creek tributary to Iron Creek SF Iron Creek tributary to SF Iron Creek Gate Creek	R6 Sensitive

Although the current direction for management associated with fisher is considered adequate, the Northwest Forest Plan found that outcome B was the best we could expect even with additional mitigation measures. Outcome B states that the population is expected to stabilize but with significant gaps on federal land. The gaps may cause some limitations in interactions between local populations.

Tracks that may be fisher have been observed over the last two years in White River subbasin. These tracks were larger than normal for a pine marten, although pine marten cannot be completely ruled out. Management of White River subbasin within the range of natural conditions will provide a substantial increase in closed canopy forests at lower elevations (Cathedral stands) that would benefit the fisher. The long-term result would be that White River subbasin would not be one of the gaps limiting interactions between local populations. White River subbasin may be large enough to support a sustainable population of fishers capable of providing individuals for recolonization of adjacent portions of it's range.

C. *Are there species beyond the range of the northern spotted owl that are unique, rare, or at-risk? (formerly question D)*

Yes, some plant species listed in question B above grow or potentially grow beyond the range of the northern spotted owl. These species include:

- sickle-pod rockcress
- Howell's milk-vetch
- diffuse stickseed
- Watson's desert parsley
- Scribner's grass

In addition, the following species appear in White River subbasin wholly east of the range of the northern spotted owl:

Species	Habitat	Status
Allium douglasii var. *nevii* Douglas' onion	shallow rocky soils, vernally wet but very dry remainder of the year; documented on BLM lands and state owned land	state concern
Allium macrum rock onion	very dry, rocky, shallow soils; smallest FS triangle, private land, and likely Warm Springs Reservation	state, concern, genetically isolated
Astragalus tyghnesis Tygh Valley milk-vetch	biscuit scabland, bunchgrass slopes below rimrock, woodlands below rimrock; endemic to Wasco County	federal candidate, state candidate
Claytonia umbellata springbeauty	dry talus; found on smallest FS triangle and likely on Warm Springs Reservation	at northernmost limits of range
Linanthus bakeri Baker's linanthus	biscuit scabland; found on Hunter Prairie and likely through Juniper Flats	more information needed

Of these species either no additional management action is needed due to low risks from human activities or current management direction is considered adequate. A species management plan is in place for Tygh Valley milk-vetch.

Adult summer steelhead and spring chinook salmon use the lower two miles of White River, below White River Falls. Whether these fish rest, feed, or spawn in White River is unknown. The falls are a natural barrier to migration further upstream. The long-nose dace and mountain whitefish found above White River Falls have been isolated like the redband trout, and may differ genetically from populations elsewhere. Genetic work-ups are needed on the other fish species present above White River Falls to confirm if they are genetically unique.

D. *Does current direction provide sufficient habitat for primary and secondary cavity nesters in Matrix lands? (formerly question E)*

Yes. Direction in the Northwest Forest Plan and the Mt. Hood Forest Plan provides sufficient habitat to maintain populations of all primary and secondary cavity nesters on Matrix lands. Further monitoring is needed to assure that the applicable standards are being met. Standard operating procedures have been to recommend retention of snags, green replacement trees, and the creation of snags from the replacement trees at close to the minimum levels specified in current direction.

Monitoring indicates significant loss of snags and green replacement trees after timber sale layout due to logging damage, fuels treatment, and post sale blowdown. **Units often do not retain enough snags and green trees to meet the direction.** Future prescriptions are likely to leave more trees than in the past. The Northwest Forest Plan standard of 15% green tree retention with 70% in patches should alleviate many of the past problems in achieving the recommended levels. We will continue to need monitoring to assure that direction is met and to recommend additional leave trees if standards are not being met for any reason.

E. *Are connectivity and dispersal habitat sufficient to allow gene flow at the metapopulation scale? (formerly question F)*

No for redband trout, Cope's giant salamander, and spotted frogs. The metapopulation for the redband trout in White River subbasin is the subbasin. Impassable irrigation diversions prevent low flow upstream migrations of redband trout and Cope's giant salamander in Tygh and Badger creeks and White River east of the Forest boundary. Within the Forest boundary, irrigation diversions may be migration barriers in Badger, Threemile, Gate, Boulder, Cedar, Frog, and Clear creeks. Fish can populate downstream areas by washing over the diversions during high flows, but cannot migrate back up. Clear Lake and Rock Creek dams prevent upstream migration also. Road culverts that are too steep, too long, too small, too high above the water's surface, or lacking a large jump pool at the outlets are upstream barriers to fish and Cope's giant salamander at several locations (Appendix C).

The isolated spotted frog population at Camas Prairie was once part of a larger metapopulation connected by the Big Meadow system (Camas Prairie, Clear Lake, Timothy Lake, Little Crater Meadows, and Clackamas Lake) as late as the 1930s (Hayes et al. 1994). The Big Meadow ecosystem was fragmented by damming at Clear and Timothy lakes. Uses in and around Camas Prairie may be affecting local habitat connectivity. Spotted frogs are warm water marsh specialists that need periods of 3 or more months in warm standing water greater than 77°F (25°C) to complete the reproductive cycle and mature into frogs. At 86 acres, Camas Prairie currently provides abundant suitable habitat. If the available suitable habitat drops to less than 11 acres, then this isolated population probably would not persist (Hayes et al. 1994).

Yes for many other species. Sufficient habitat for breeding, rearing, and dispersal would remain for other species for which we have information on life cycle needs under either current direction or under the recommendations listed in Chapter 6.

Uncertain for white-headed woodpeckers, pygmy nuthatch, and flammulated owl. Little breeding habitat remains for white-headed woodpeckers and pygmy nuthatches under the current condition and trend. Possibly little breeding habitat remains for flammulated owls. If that condition is allowed to persist, a gap could develop in breeding habitat causing a potential restriction of gene flow. Rather than gene intermixing occurring across a relatively continuous breeding range, the populations could become more isolated. Individuals breeding north of White River subbasin would have opportunity for gene mixing only if individuals did not have a high fidelity for returning to the same general nesting locales each year. Managing the subbasin for conditions within the range of natural conditions should eliminate or prevent the breeding range gap for these species while not creating a gap for other terrestrial species.

Unknown for species on which we lack sufficient information may or may not have sufficient connectivity or dispersal habitat to allow gene flow at the metapopulation scale. These species primarily consist of smaller species, such as mollusks, some fish and amphibians, most reptiles, and all invertebrates. We also have little or no information on fungi, lichens, bryophytes, and many vascular plants.

All the plant species from the C-3 Table documented in White River subbasin (see Question 8A) consist of only widely scattered populations (Appendix E). *Cortinarius wiebeae*, a rare gilled mushroom, is known only from the type locality in Camas Prairie. We know nothing about its ecology, life history, range, or abundance. The type locality for *Rhizopogon brunneiniger*, a rare false truffle, is Devil's Half Acre Campground. Only five populations are known throughout the Cascades and northern Sierras. Several other rare and unique species are genetically isolated (see Questions 8B and 8C)

F. Does the White River subbasin provide important habitat for species when considered at the metapopulation scale? (formerly question G)

Yes. White River provides, or potentially provides important habitat for the following species:

Class	Species
Mammals	wolverine, fisher
Birds	northern spotted owl, white-headed woodpecker, pygmy nuthatch, flammulated owl, great gray owl, sandhill crane
Fish	redband trout, one or more unidentified species of sculpin, long-nosed dace, mountain whitefish (all species genetically isolated by White River Falls)
Amphibians	spotted frog, tailed frog, Cascades frog, Cope's giant salamander, Pacific giant salamander
Invertebrates	Mt. Hood primitive brachycentrid caddisfly, Cascades apatanian caddisfly, Mt. Hood farulan caddisfly, one-spot rhyacophilan caddisfly
Fungi	*Albatrellus ellisii, Boletus peperatus, Cortinarius wiebeae, Gastroboletus subalpinus, Gastroboletus turbinatus, Rhizopogon brunneiniger, Thaxterogaster pingue*
Bryophytes	fir club-moss
Vascular Plants	Cascade rockcress, sickle-pod rockcress, Howell's milk-vetch, Tygh Valley milk-vetch, wild cranberry, rock onion, candy stick

White River subbasin has some of the few recent sightings of wolverine within Oregon. The subbasin may be acting as a major habitat link east of Mt. Hood with wolverine populations in Washington. The subbasin may be functioning in the same manner for fisher. Managing within the range of natural conditions would maintain or enhance these values.

The subbasin also provides an important north-south link for northern spotted owl. The USFWS recognized this link when they designated the critical habitat in Gate, McCubbins, and Clear subwatersheds. Management within the range of natural conditions would maintain that corridor along with the corridor associated with White River LSR and Frog Lake Buttes. Northern spotted owl nesting habitat would decline over the long-term in the Eastside Zone and easternmost portion of the Transition Zone, but habitat quality and quantity would increase in the remainder of the subbasin. During the transition period, spotted owl habitat within the Eastside Zone can decline only as the habitat is rebuilt in the Transition and Crest Zones.

As stated in the previous question, the Eastside Zone of the subbasin has the potential to provide important habitat for the white-headed woodpecker, pygmy nuthatch, and flammulated owl. That habitat could be important at the metapopulation scale. Sandhill cranes use Camas Prairie as a rest stop during migration and a limited amount of nesting is currently happening.

Several fish species may be genetically unique to White River subbasin above White River Falls. Genetic work-ups have occurred only on some subpopulations of redband trout in the subbasin. The sculpin species have not been identified. The greatest risks to these species include excessive sedimentation filling spawning and rearing areas, stream temperatures above lethal limits for at least part of the year, loss of habitat complexity in some stream reaches, and insufficient baseflows to maintain connectivity and habitat quality. Cross-breeding with hatchery rainbow trout may be diluting the genetic purity of the endemic redband trout.

Spotted frogs have declined across their range. Only remnant populations remain on public lands at the upper end of the suitable elevation range (Hayes et al. 1994). There are only 6 known locations west of the Cascades (3 each in Oregon and Washington), 1 known location east of the Cascades (Camas Prairie), and 23 potential locations east of the Cascades and in the Klamath Basin. British Columbia populations are extinct. The spotted frogs will be split into three species in the near future based on genetic testing. If the Camas Prairie population is determined to be the western spotted frog, it will warrant listing under the Endangered Species Act (Corkran 1995).

The amphibians and invertebrates listed above are at higher risk from natural events and land uses rather than from limited gene pools. Actions that minimize risks associated with population dynamics also minimize genetic risks. The same is true for many of the plants listed above. Most of the plants occur in special habitats that are fairly well protected. No additional actions are needed. The two fungi, whose type localities are in the subbasin are exceptions.

In order to better protect important habitat for selected species we recommend the following:

- Maintain existing spotted owl NFR and dispersal habitat in the Eastside Zone until increases in such habitat have been achieved in the Transition and Crest Zones. Habitat quality may be degraded to prevent catastrophic loss, but functioning must be maintained.
- Designate Camas Prairie as a Special Interest Area to protect habitat for spotted frogs, sandhill cranes, and wild cranberry and to protect the type locality for *Cortinarius wiebeae*. The Special Interest Area should be large enough to include the lodgepole pine/meadow edge dynamics. Survey suitable habitat in the vicinity to incorporate all known populations of *Cortinarius wiebeae* and to determine if additional populations exist. Investigate the relationships between *Cortinarius wiebeae*, mycophagous animals, and cattle use.
- Designate a Mycological Special Interest Area at Barlow Creek Campground to protect the type locality for *Rhizopogon brunneiniger*. Inventory the type locality to delineate the boundary of the population and determine the habitat needed. Adopt management guidelines to insure that the known population persist.
- Work with ODFW to protect and maintian the genetic integrity of redband trout in streams without non-native trout: Gate, Rock-Threemile, and Jordan subwatersheds, Little Badger Creek, and Tygh Creek.

G. *Can the public lands provide for all ecosystem components in White River subbasin? (formerly question H)*

No, the public lands cannot provide for all ecosystem components present or potentially present in White River subbasin. The following native plant communities are found primarily on private lands:

- Cottonwood gallery forest
- Juniper woodland
- Sagebrush grassland

Public lands can provide the remaining ecosystem components to some degree. If we manage within the range of natural conditions, then all habitat elements should be present that would normally occur within the subbasin. We would not jeopardize viability on the larger scale and habitat for all terrestrial species evaluated in the Northwest Forest Plan and the Mt. Hood Forest Plan would be present at or above the levels directed in those documents.

Habitat components for some species, such as big game thermal cover on winter range, may be at lower levels than directed in the Mt. Hood Forest Plan, but they will be at the highest levels the land is capable of maintaining. The viability of deer and elk are not in doubt, however.

Aquatic habitat would retain all critical components but quality and quantity have been permanently reduced from pre-1855 levels. These permanent losses are due to irrigation withdrawals and damming. Other habitat changes caused by grazing, fish stocking, reductions in large wood potential, activities that increase sediment delivery, roading, and other management activities could be ameliorated by changes in management direction and restoration. Chapter 6 lists recommended changes and Chapter 7 lists restoration projects.

9. Issue: The demand for recreation opportunities is rising faster than management's ability to handle the demand and to provide, protect, or maintain the desired recreational experiences, and to protect other resources affected by recreation use.

A. Are the trends for the various types of recreation uses increasing?

Yes, use levels are increasing for many types of recreation uses (Table 5.6). The highest demands are in the Crest Zone and on all sites near water. The Crest Zone provides a consistent snowpack to support all the winter sports, such as snowmobiling, cross country skiing, downhill skiing, dog sledding, and snow play. There is a high demand among off-road vehicle users for a trail system that will disperse use over a large area and provide a connection across White River. Since the release of the White River Wild and Scenic River Plan, interest in both commercial and noncommercial use has accelerated. Any site near water is in high demand for developed and dispersed camping and picnicking. Interest is increasing for kayaking/rafting and outfitter/guide services although use levels have not changed as yet.

Most campgrounds are not designed to handle modern day equipment and vehicles. No trails are specifically designed for either mountain bikes or off-road vehicles. Most campsites can only accomodate 20-22 foot RVs; only Rock Creek Campground has sites (2) large enough to park a 40 foot RV. Demand for sites to handle the larger RVs is increasing.

Elsewhere on National Forests in Region 6, homeless people have used recreation sites as temporary homes. In a few cases, special sites have been set up on either a permanent or temporary basis to meet this demand. The subbasin has little apparent use or demand for sites for homeless people. White River is probably too far from the other needed social services such as banks, health care facilities, employment offices, and so forth.

B. Have high levels of recreation use created detrimental impacts to soil, water, vegetation, wildlife, and fish?

Yes, particularly on sites near water and along the Barlow Road. Only Rock Creek, Frog Lake, and Clear Lake campgrounds are fee sites, allowing some control over use levels. We have no real control over use levels in all other developed campgrounds, forest camps, and dispersed camp sites. Impacts appear to be especially high around lakes and reservoirs, even those with fee sites. Only Little Boulder, Spinning, Upper Twin, and Catalpa lakes seem relatively unaffected. Boulder and Jean lakes are not as affected as the other lakes. Even the industrial camp sites receive high levels of use by recreationists. Most campgrounds were not designed for the current use levels.

Table 5.6. Trends in recreation use within White River subbasin.

Use Type	Trend	Zone
Tent camping	Stable to Decreasing	All
Hiking	Stable to Decreasing	All
Dog sledding	Increasing	Crest
Nordic skiing	Increasing	Crest
Downhill skiing	Currently consists of out-of-bounds skiing; proposal to expand ski run into subbasin	Crest
Motorized recreation[1]	Increasing	All
Fishing	Increasing	All
Hunting	Increasing	Primarily Eastside and Transition
Horse riding	Stable	Primarily Transition and Crest
Kayaking/Rafting	Stable	Transition and Eastside
Foraging/Gathering[2]	Increasing	Primarily Transition and Crest
Mountain biking	Increasing	All

[1] Includes such activities as driving for pleasure, car/truck/RV camping, off-road driving, snowmobiling, etc.

[2] Includes such activities as picking mushrooms and huckleberries

The main direct impacts include widespread compaction from uncontrolled vehicles; large areas of bare ground; lack of riparian, ground, and screening vegetation; and lack of downed wood. We have not specifically monitored for erosion rates on any developed or dispersed sites, although the extent of bare ground suggests a high probability of sheet erosion.

Off road vehicle use is having major impacts on all resources, particularly where that use is concentrated. Until 1994, off road vehicle use in the McCubbins Gulch area severely limited deer and elk use on about ten square miles west and north of the Forest boundary and south of White River. About four square miles of this area lies in winter range, where off road vehicle use in early spring conflicted with deer and elk use. The McCubbins Gulch OHV Plan eliminated the use in winter range. Summer use by deer, elk, bear, cougar, and bobcat remains severely limited in the designated six square miles.

Planning for an off road vehicle trail system is not complete north of White River. Standards and guidelines for B4 Pine-Oak Habitat restricts winter recreation use between December 1 and April 1 (B4-003); however, the restriction is not well enforced. Gate and Rock-Threemile subwatersheds near Road 48 and Rock Creek Reservoir are popular off road vehicle play areas. This use interferes with wintering wildlife, such as deer and elk, and has created large mudholes. Use on the 80 acre parcel at Gate Creek and Road 48 has been unrestricted. Some off road vehicle users have been using the site as a short hill climb, contributing to erosion, loss of vegetation, decreased water quality, and loss of aquatic habitat. Controlling winter and early spring recreation use in this area is virtually impossible due to the high level of access, flat topograghy, close proximity of private lands with year-round residents, and lack of law enforcement resources.

Recreation use between Bonney Creek and Faith Spring on White River may be limiting reproduction use by harlequin ducks (see White River Wild and Scenic River EA). A brood successfully hatched in that segment in 1993 and we believe that it fledged. Increased recreation use could prevent successful reproduction if not carefully monitored and/or controlled.

Spring through fall recreation use on all lands south and east of roads 43 and 48 east of the 43 junction probably prevents significant wolverine use during those times. Winter recreation use of roads 42, 43, 48, 2610, and 2630 reduces habitat suitability for wolverine within 1/2 mile of the roads. Summer recreation and other uses limits this species to the roadless area between Frog Lake Buttes and Barlow Butte and to the Badger Wilderness.

We have very little knowledge of the vegetation within the Badger Wilderness and have no information on the effects of recreation on sensitive plants and the C-3 species. Only a small portion of the wilderness has been surveyed for sensitive species. We recommend that the wilderness be surveyed for sensitive plants, C-3 species, and general forest conditions.

C. *Does the White River subbasin provide any unique recreational experiences or opportunities not readily available elsewhere?*

Yes. Table 5.7 lists the recreational facilities and events of international, national, and regional significance. Examples of unique opportunities include:

- Nordic skiing in upper White River floodplain area. No other areas on the eastside of the Mt. Hood National Forest provides a primitive experience opportunity for beginner skiers and many intermediate skiers. Badger Wilderness is generally not accessible in winter and the terrain is not conducive to skiing by other than expert skiers. The nordic skiing associated with nearby ski areas and other sno-parks includes very high levels of use. The Twin Lakes area is small and suitable only for some intermediate skiers and advanced skiers. Barlow Ranger District does not have any sno-parks. The next closest opportunity for a similar experience for beginner skiers is around Bend.

- Flag Point Lookout and Valley View Cabin winter rental program. Both sites are unique to the Deschutes Province to the best of our knowledge. Since its inception four years ago, the winter lookout rental program has proven enormously popular. Flag Point is generally booked throughout the entire rental season and weekends are typically booked within two weeks after the district begins accepting reservations. Valley View Cabin rental program started two years ago and the cabin is occupied most weekends. Even though both sites lie within the Badger Wilderness the road access does not, so both are accessible to snowmobilers and skiers. There is opportunity to expand the program to include Clear Lake Butte Lookout.

- White River Falls in Tygh Valley State Park. These falls are one of the largest in the Deschutes Province. The location of the falls is also unique, sitting on the east end of Tygh Valley in a shrub-steppe community. The park also includes the remains of a powerhouse constructed in the 1920s which is popular with visitors. The park generally receives lower visitation that might occur if the name of the park were more distinctive, it was signed better, and the park was open in winter.

- Barlow Road. This section of the Oregon Trail is the longest driveable section and the longest section remaining in its original general location. Wasco County is actively promoting the Road as a tourist attraction.

- Earlier recreation season. Recreational opportunities that do not depend on snow open earlier in the year and last longer in the year that similar opportunities on the rest of the Forest. This longer recreation season is due to the warmer, drier climate and low elevations of White River subbasin compared to the rest of the Forest.

- Vegetation change. For those looking to see a wide variety of vegetation within a short distance, White River subbasin changes from shrub-steppe/grassland plant communities to alpine plant communities within approximately 17 miles. Visitors can see these vegetation changes driving along either Road 48 or along Highways 216 and 26. Both routes take approximately 25 miles to travel between grassland and alpine communities.

Table 5.7. Significant recreational opportunities in White River subbasin.

Zone	Significance[1]	Sites or Events
Crest	International	Barlow Road, Pacific Crest Trail, part of view from Timberline Lodge
	National	White River Lodge Organization Camp
	Regional	Mt. Hood Meadows Ski Area, Mt. Hood Loop, Clear Lake, Twin Lakes, Frog Lake Sno-park, White River, old growth stand along Crane Creek Trail
Transition	International	Barlow Road
	National	Flag Point Lookout winter rental
	Regional	White River, Camas Prairie, Badger Lake
Eastside	International	Barlow Road
	National	Tygh Valley All Indian Rodeo
	Regional	White River, White River Falls, Rock Creek Reservoir, Pine Hollow Reservoir

[1] Significance based on consistent use by visitors from other countries (International), states other than Oregon and Washington (National), and outside Wasco and Hood River counties (Regional).

D. *What level of developed recreation is appropriate in LSRs and Riparian Reserves?*

The Northwest Forest Plan assumes the continued existence of current developed recreation sites within LSRs and Riparian Reserves. It does recommend relocation of facilities within Riparian Reserves when feasible and as needed to reduce resource damage to meet the ACS objectives. In both allocations, the Northwest Forest Plan does not prohibit constructing new facilities, but it does emphasize dispersed recreation over developed recreation. New facilities in Riparian Reserves must not prevent attainment of ACS objectives.

At present, there are no plans to develop new campgrounds anywhere in White River subbasin. Some new trail construction may occur in White River LSR under the Wild and Scenic River Plan. In general, construction funds for new recreation projects are readily available and may become unavailable in the near future. Given the continuing decline in both recreation construction and recreation maintenance budgets we recommend against constructing any new developed recreation facilities in any LSRs or Riparian Reserves. Construction of new trails should not proceed unless the design results in a low maintenance trail that does not prevent attainment of the ACS objectives or an alternative maintenance strategy can be used to assure the trail does not prevent attainment of ACS objectives due to inadequate maintenance.

E. *Do any of the current dispersed recreation activities conflict with the Aquatic Conservation Strategy and LSR objectives? Might any conflicts develop in the future?*

Yes. We combined this question with key question 10C and added discussion on developed recreation. Some conflicts exist with use levels where use has degraded shorelines and streambanks. As use levels increase and if problems with design of many current facilities are not corrected the conflicts will likely intensify. Other conflicts are related to poor design or no design of facilities.

Potential conflicts may develop between ACS and LSR objectives and recreation tied to motorized vehicles, mountain bikes, and heavy horse use. Present use levels do not appear to cause a significant conflict, except in localized areas. However, no trails exist that have been specifically designed to accommodate off-road vehicles and mountain bikes. These uses are causing increased sediment input to streams for two reasons. Off-road vehicles currently use trails that were user created, not designed. Mountain bikers use designated trails but many trails were designed and constructed before the advent of mountain bikes. The first eight miles of trail designed specifically for off-road vehicles is scheduled for construction in summer of 1995 at the McCubbins Gulch OHV area. Trails suitable for wheeled vehicles need to avoid long downhill runs and avoid powdery or mucky soils.

Horse use is generally light at present. If use increases then a potential exists for increased sediment input to streams from wear on trails, lack of facilities, and more use during wetter portions of the year and for increased spread of noxious weeds and increased water pollution from feces. In the entire subbasin, only Bonney Crossing Campground has horse facilities (corrals, loading ramps, and hitch rails). However, users must water their horses in Badger Creek. Horse users also stay at Bonney Meadows Campground and all the campgrounds along White River. Horse camps appear during the fall hunting seasons at many dispersed sites, such as Little Badger and School Canyon trailheads.

The real problem in attaining ACS and LSR objectives while providing for recreation use lies in the condition of the facilities. All the developed recreation sites, most of the dispersed camping sites, and many trails lie within Riparian Reserves. Nearly all the developed sites suffer from bare soil, lack of screening vegetation, high compaction, increased bank erosion, and increased sediment input to streams and lakes. The White River Wild and Scenic River Plan discusses restoration/rehabilitation needs for the recreation facilities within the river corridor. Examples of other specific problems are:

- Little Badger Trail (469) between about milepost 2 and Kinsel Cabin has severe and continuing erosion problems. The trail crosses Little Badger Creek eight times and generally travels within the immediate floodplain. The creek periodically shifts channels and runs over the trail. Damage from runoff in late winter and early spring 1995 was severe enough to render the trail unsafe for horse use. A proposal to the Capital Investment Program was made several years ago to relocate the trail, eliminate the middle four crossings, and design the remaining four crossings to better handle flood events. This proposal was not funded.
- The middle portion of Crane Creek Trail (478) along Boulder Creek and the lower portion of Crane Prairie Trail suffer from similar problems as Little Badger Trail, although the erosion problems are not quite as severe. Mountain bikers use Crane Creek Trail. Again, proposals to relocate the trails to drier soils have not been funded.
- Trail 487T below Clear Creek Campground and along Clear Creek is swampy and eroding. Motorcyclists occasionally use this trail. The trail needs to be relocated away from the mucky soils and the streambank.
- McCubbins Gulch Campground and Industrial Camp suffer from compaction, severe erosion, lack of vegetation, and severe streambank damage. This portion of McCubbins Gulch holds Clear Creek Ditch so that the stream is perennial. The stream is becoming wider and shallower where off-road vehicle users cross the stream. Neither area was designed. McCubbins Gulch Campground was a dispersed site that motorcycle riders turned into a campground. The FS added toilets and fire rings to mitigate some damage and sanitation problems.
- Gate Creek Industrial Camp was not designed but it is functioning as a campground. The area suffers from bare soil, compaction, erosion, vandalism to the outhouse, and damage to the ditch banks.
- Keeps Mill Campground has a sanitation problem due to the presence of a pit toilet rather than a vault toilet. One campsite has standing water in the spring.
- Little Badger Trailhead dispersed site was not designed but is receiving heavy use. It lies in the floodplain of Little Badger Creek and suffers from large areas of bare ground and erosion.

- Gate/Road 48 off-road vehicle trails are user created and used as a play area. The area suffers from severe erosion, compaction, and large mudholes.
- Badger Lake and Campground has use levels that exceed the designed capacity. Some campsites lie right along the creek. The area south and east of the dam has high levels of dispersed camping. The back end of the trail around the lake was never completed. Users have created a trail connecting the two ends through a swampy area containing many of the springs that feed the lake. The entire area suffers from excessive amounts of bare soil and erosion. A proposal to relocate the campground to a better site was never funded.
- The intersection of Road 42 and Clear Creek is a designated engine fill site for wildfire suppression, prescribed burning, and road maintenance. As such the site extends to the edge of the stream. It is also one of the most popular dispersed campsites on the Bear Springs district. The lack of a toilet has created a sanitation problem.
- Clear Lake has extensive dispersed camping in the draw-down zone. People often drive in the draw-down zone to reach a particular spot. The high levels of dispersed camping, plus the condition of Clear Lake Campground has resulted in high sediment levels entering the lake.

Generally all developed campgrounds, major dispersed camp sites, and trails require some restoration work to meet ACS and LSR objectives. Based on these examples, we developed a list of criteria to use for setting priorities for restoration:

1. Length or area of high impact (i.e. bare ground, standing water, eroding bank, compaction, devegetation, etc.)
2. Sanitation problem exists
3. Sedimentation problem exists
4. Proximity to threatened, endangered, sensitive, or at-risk plant, invertebrate, or vertebrate species
5. Popularity of site or trail (use levels, use season)
6. Proximity to water

In addition, we recommend that the following facilities receive immediate attention due to the scope and scale of problems identified:

- Little Badger Trail
- Badger Lake
- Clear Lake
- McCubbins Gulch Campground
- Crane Creek Trail

F. *Can the public land owners better protect the private landowners from undesired recreation uses/trespass?*

Yes. We can discourage undesired uses near the Forest boundary. We can better post the National Forest boundary. We can use stricter law enforcement to halt prohibited uses or control restricted uses on National Forest lands under the Code of Federal Regulations. Where uses persist that result in trespass, we should be more willing to cite violators and take advantage of cooperative law enforcement agreements with the Wasco County Sheriff's Department and Oregon State Police.

10. **Issue: The need to provide for and manage administrative, commodity extraction, and recreation access on public lands may conflict with standards and guidelines for Late-Successional Reserves and Riparian Reserves and with Aquatic Conservation Strategy, fish, and wildlife management objectives. This problem is restricted to National Forest lands.**

A. *Is a north-south connection for off-road vehicles feasible across the White River corridor?*

Uncertain, but unlikely. To address this question we looked at several criteria related to both public desires on the type of crossing and the ACS objectives that are most relevant to such a crossing. The ACS objectives require that we do not knowingly permit additional resource damage from land uses. This requirement does not automatically preclude a crossing or any other activity as long as we make a good faith effort to avoid and mitigate resource damage. However, if we cannot design a use or activity without avoiding or mitigating any expected damage, then we would not meet the intent of the ACS objectives by proceeding with the use or activity.

We used the following criteria to look for any potential off-road vehicle crossings in the White River Wild and Scenic River corridor:

- Suitable for non-street legal vehicles.
- Connects McCubbins Gulch off-road vehicle area with Barlow's potential off-road vehicle trail network.
- Does not promote development of a campsite near White River.
- Keeps users on the designated trail.
- Does not result in additional sediment entering White River.
- Allows for passage of a 100 year flood with associated debris (logs, rocks, etc.).
- Does not change the character of the existing campgrounds.
- Does not cause additional damage to riverbanks and bottom configurations, or reductions in native plant, invertebrate, or vertebrate riparian- and aquatic-dependent species, water quality, or water chemistry.
- Does not alter the timing, volume, rate, and character of sediment and wood input, storage, and transport.

Sources for these criteria include public input, the White River National Wild and Scenic River Plan, and the ACS objectives from the Northwest Forest Plan.

Preliminary analysis suggests that no feasible crossings exist based on these criteria. At the very least it appears that any crossings would have to use an existing road. In order to use any roads, we would either need to require that all off-road vehicles be street-legal or work with the State to designate one or more roads or road segments for dual use (both street legal and non-street legal vehicles). Further analysis with the above criteria using more site-specific information and more consultation with design engineers may find a potential trail crossing. Additionally, if a feasible trail crossing exists, it could be found only between Highway 35 and Deep Creek (see White River Wild and Scenic River Plan).

B. *Should any existing stream crossings be modified to meet the 100-year flood event specifications? (formerly question C)*

Yes, all but a few stream crossings do not meet the 100-year flood event specifications. We assumed that if the crossing could not pass a 100 year flood event, then bridge or culvert failure was highly probable and that significant reosurce damage downstream would result. A few stream crossings do not even meet the former 50-year flood event specifications. Chapter 6 lists the recommended restoration work.

Of more concern is the need to provide for wood passage on perennial streams between the Transition and Eastside Zones on streams selected for conversion back to hardwood tree domination. We believe that many of the conifer logs in the Eastside Zone riparian areas originated in the Transition Zone. The larger flood events would carry the wood down and deposit them in log jams at beaver ponds, channel constrictions, and gradient changes. All culvert specifications currently in use are designed to pass a certain volume of water but do not consider wood, fish, or other aquatic organisms. For those streams selected for reconversion back to hardwoods, we should reconstruct the stream crossings between the Transition Zone and the forest boundary to allow for wood passage.

C. *Are the designated use types appropriate for the trails in the LSRs and Riparian Reserves? (formerly question D)*

We combined the answer to this question with 9E to discuss recreation use in LSRs and Riparian Reserves in general.

11. **Issue: We do not know where we should be obtaining commodity outputs from National Forest lands in White River subbasin over the next five to ten years.**

A. *Do we expect to continue to provide timber out of LSRs, Riparian Reserves, and Matrix lands?*

Yes. We can expect to provide timber out of all three land allocations over the next five to ten years. Marketable timber will come from a variety of restoration projects. Examples include:

- moving toward the desired conditions in both uplands and riparian areas,
- promoting more rapid development of large trees,
- "defragmenting" the Crest and Transition zones,
- protecting the existing Old Growth from catastrophic fire until more natural landscape patterns are restored,
- visually rehabilitating existing harvest units by feathering edges and reshaping geometric units, and
- reducing conifers in riparian areas in the Eastside Zone to promote hardwoods.

Much of the material will be small diameter. Some large trees will likely come from the Crest Zone from defragmentation and visual rehabilitation efforts. The timber suitability of the Eastside Zone should be reexamined. This zone contains much unsuitable ground and large areas of marginal suitability. However, timber harvest may be a valuable method on unsuitable ground in order to meet the management objectives of the land allocation and to move towards the desired conditions.

Promoting recovery of the northern spotted owl will probably require no net loss of owl habitat between the Transition and Crest Zones over the next five to ten years. Timber harvest in Riparian Reserves should occur only to protect riparian values and promote attainment of ACS objectives. Harvesting methods and prescriptions may need to change from current "standard" procedures.

We do not expect to provide any timber over the short-term from the 100-acre LSRs. We probably would provide timber from the great gray owl protection buffers. The intent of any harvest in the protection buffer would be to develop or enhance great gray owl habitat.

Timber availability from LSRs and Riparian Reserves is more uncertain over the long-term. To meet the intent of the Northwest Forest Plan, harvest levels may drop from that provided over the short-term. On the other hand, we may also be perpetually playing "catch-up." We did not have the personnel or budgets to adequately manage smaller diameter trees and stands, even in the 1970s when the agency was quite "fat." Both budgets and personnel levels have dropped considerably over the last five years and are expected to continue to do so over the next five years.

Silvicultural prescriptions, harvest methods, and other vegetation management activities will likely produce a landscape that looks very different than today. In the Crest Zone we need to recreate the large fire mosaics typical of the pre-1855 landscape. Stand structures would be very different with a shift in emphasis to large trees and maintaining some level of canopy cover or shelter at all times. Harvest units would probably be more aggregated on the landscape rather than the current dispersed pattern. Clearcutting in the traditional sense would be rare and mostly the tool of last resort.

During the transitional period between current conditions and desired conditions, we may need to utilize regeneration harvests and even-aged management strategies more than anticipated under the desired conditions. Some stands in the Eastside and Transition zones have deteriorated to the point that even staged entries cannot move the stand in the desired direction. In these cases, the only option may be to remove most of the existing stand and essentially start over with the desired species compositions.

In the future, only the Crest Zone would have predominately even-aged management strategies. Prescriptions would likely focus on thinnings, heavy seed tree cuts, and shelterwood cuts with uncut patches and variable spacing between the trees. The Transition Zone would probably have a mix of even-aged and uneven-aged strategies while the Eastside Zone would be predominantly uneven-aged. Uneven-aged prescriptions would likely focus on thinnings and group selections. Staged entries are more likely, especially in the short-term, to maintain certain existing values such as spotted owl habitat, pine marten and pileated woodpecker habitat, and big game thermal cover in winter range.

B. Is water currently over-allocated to provide for instream beneficial uses in any streams?

No, in a legal sense; **Yes**, in an ecological sense. The original water right allocation process in Oregon did not recognize instream flow as a beneficial use. All the currently active water rights were awarded under those rules. The current water right allocation process does recognize instream flows as a legitimate use. Throughout the history of state water law only 80% of the available water was to be allocated within a given basin. Under state water regulations White River is a basin, instead of just a subbasin. Even under current regulations it is permissible for individual streams to be dewatered as long as 20% of the basin's flow remains in the streams. During drought periods water use follows the typical "first in time, first in right" process.

Due to irrigation diversions, parts of five streams are dewatered within the National Forest boundary: Frog, Lost, Gate, Rock, and Threemile creeks. Flow is significantly reduced in Clear, Cedar, Boulder, Souva, and Badger creeks within the National Forest boundary. During low flows, the ditches which are unscreened can provide higher quality fish habitat than the streams below the diversion points. At present only the diversion on Tygh Creek is screened to prevent fish passage into the ditch. During drought periods, more streams could be dewatered and streams could be dewatered for a longer length than currently. In 1992, some junior water right holders did not receive their full allocation due to lack of flow.

Water rights can be sold, leased, terminated or abandoned. In 1994, Northern Wasco PUD abandoned its right to White River when it found that rebuilding a hydroelectric power plant at White River Falls was not economically feasible. Oregon State Parks has applied for a water right on the mean monthly flow for each month at Tygh Valley State Park. The purpose of the application is to provide for water over White River Falls. If this right is awarded, then White River basin will be closed to additional new surface water right applications.

As current water rights are transferred, canceled, or abandoned, others may apply for those rights. The date assigned to the right is the same as the original awarding of the right where rights are leased or sold. For example, if a 1920 water right is sold or leased to another applicant, that right remains a 1920 right and is senior to rights awarded after that date.

If the Forest Service wishes to provide for more instream flow to improve ecological functioning within a stream, we will need to work through another agency and have them apply for an existing right as it comes open or lease available rights form the current holders. We recommend that efforts first go towards acquiring rights for instream flows on Boulder, Cedar, Souva, Badger, Frog, and

Clear creeks as first priority. These streams would benefit most from increasing instream flows within the National Forest boundary. Lower priority would be to acquire water rights for instream flows on Lost, Gate, Rock, and Threemile creeks.

C. *Can we meet the state management objectives for deer, elk, and game fish?*

Uncertain for deer. At the highest population levels, White River management unit only reached 80% of the goal. We do not know what effects on deer populations the recommended desired stand conditions would have, particularly in the Eastside Zone. The recommended conditions would result in higher forage production in the Eastside and Transition zones than would be provided under the Forest Plan direction. Under the Forest Plan direction, forage would become limited sometime between 2010 and 2030. We believe the recommended conditions will provide sufficient thermal cover to meet habitat needs, but this strategy needs to be tested and validated. We recommend that ODFW reassess the deer management objectives and consider reducing the expected population levels.

Yes for elk. The current population in the White River management unit exceeds the management objectives by 10%. Managing under the recommended conditions and strategy would produce high quality elk habitat over time on the National Forest lands.

Yes for game fish. At present we meet the state's management objectives for catchable trout fisheries at the stocked lakes. However, stocking non-native fish into lakes where the fish can escape and detrimentally affect native species is not consistent with management direction in the Northwest Forest Plan.

D. *Are mining areas on National Forest lands sited in appropriate locations to meet the Aquatic Conservation Strategy objectives? (formerly question D)*

Yes, with three to five exceptions. White River subbasin has no active locatable or leasable mineral sites. The potential for leasable mineral development, in the form of geothermal development, exists on Mt. Hood within the White River Wild and Scenic River corridor. However, the actual potential is considered low and probably not economical to develop (see White River Wild and Scenic River EA).

Five common variety mineral pits lie within or on the edge of Riparian Reserves. Three pits lie partly or wholly within a Riparian Reserve and appear to prevent attainment of ACS objectives:

- Stockton Pit - sediment source to Threemile Creek, streambank degraded, riparian vegetation reduced. The south edge of the pit lies very close to an unnamed fish-bearing tributary to Threemile Creek.
- Jakey Pit - sediment source to Frog Creek, streambank stability reduced, riparian vegetation reduced. Access to pit may also have a significant effect on erosion and bank stability.
- White River Pit - significantly reduced bank integrity. The pit lies on the outside bend of White River above Highway 35. A large glacial outburst flood or mudflow could breach the outer wall where mining has removed or weakened the wall. The resulting debris torrent would likely destroy White River Boy Scout Camp and Highway 35 and White River could shift to capture Mineral Creek above the Highway 35 bridge. Currently when the river shifts, it captures either Mineral Creek or Iron Creek below the Highway 35 bridge. Additional mining would only weaken bank integrity further. This pit has been ODOT's source of sanding material for highways 26, 35, and 216, roads in and around Government Camp, and the access roads to Timberline Lodge and other ski areas.

Two pits lie near the edge of a Riparian Reserve and may prevent attainment of ACS objectives:

- Maxine Pit - the east and west edges of the pit may enter a Riparian Reserve along either of two intermittent streams connected to Byzandine Gulch. This pit may be an indirect sediment source. The sediment might reach an intermittent stream by leaving the pit and washing down the access road. Otherwise this pit does not appear to prevent attainment of ACS objectives.

- Green Lake Pit - the southern tip of this pit may enter a Riparian Reserve along an intermittent stream that feeds into White River. It may be an indirect sediment source for White River. Otherwise this pit does not appear to prevent attainment of ACS objectives.

We recommend the following actions be taken:

1. Restore or stabilize Stockton and Jakey pits to reduce sediment, stabilize streambanks, and encourage regrowth of riparian vegetation.
2. Evaluate Maxine and Green Lake pits for their potential as sediment sources. If the potential exists, restore or stabilize the pits to reduce or eliminate erosion.
3. Reclaim Forest Creek Pit to reduce existing erosion. The existing reclamation effort has not succeeded.

We do not know what to recommend on White River Pit. Bank integrity depends on the sheer volume of material present in the wall. The wall naturally does not support much vegetation due to the type of material comprising it, so does not depend on root strength to maintain bank integrity. No vegetation should be planted to provide additional stability since high levels of vegetation are unnatural and would take tremendous effort to maintain.

Regardless of location, the Forest needs to determine which pits need to remain open for future use and which pits are no longer needed. We recommend that all pits no longer needed, such as Post Point Pit, be fully reclaimed. Pits still needed should be stabilized to reduce potential erosion into streams and isolate, neutralize, or remove toxic or potentially toxic materials, such as spilled fuel. We also recommend that the level of target shooting be monitored. If the level of spent bullets appears excessive (i.e. completely covers the pit floor) we recommend removal of the lead and recycling or disposal in an appropriate facility.

E. *Do additional rural development and "jobs in the woods" opportunities exist in White River subbasin? (formerly question F)*

Yes, ample opportunities exist for additional rural development and "jobs in the woods". Many of the restoration projects listed in Chapter 6 could be fully or partially completed by contractors. Several options appear to exist for rural development. Some examples may include:

- Promoting outfitter/guide services (anything associated with the Barlow Road, horse or llama pack trips, mountain biking, hiking, rafting/kayaking White River, scenic tours, eco-tours, environmental education camping at Camp Cody, etc.)
- Destination resorts
- RV Parks
- Scenic By-ways on Road 48 and/or US 197
- Multi-use trail connecting the National Forest and the Deschutes River
- Off-road vehicle trail network, play area, and camping east of the Forest boundary
- Value-added forest products mill/maufacturing center
- Other light industry or manufacturing
- Game farms
- Specialty farms (garlic farms, emu/ostrich ranching, etc.)
- Native plant propagation for ecosystem restoration and burned area rehabilitation

Rural development should focus on developing year-round employment opportunities rather than on seasonal employment. On National Forest lands use of the available recreational facilities is near, at, or over designed capacity. The trend is for less recreation maintenance funding and capital investments rather than more. Most of the potential for new recreational facilities and experiences is on other ownerships east of the Forest boundary.

Another potential area for "jobs in the woods" besides restoration is environmental monitoring. With the demand to reduce the number of federal employees, we will have greater and greater difficulty conducting the monitoring required by both the Forest Plan and the Northwest Forest Plan. Provided we can secure the needed funding, it would probably be more efficient to contract much of the monitoring and the surveys for C-3 species (once protocols are developed) than to conduct the monitoring in-house with a shrinking workforce.

F. *Is current direction adequate to provide for protection of tribal treaty rights and trust resources? (formerly question G)*

Yes. The National Forest lands within White River subbasin are ceded land as defined in the Treaty of 1855. Rights specifically stated in the Treaty with The Tribes of Middle Oregon (1855) include:

"*Provided, also,* That the exclusive right of taking fish in the streams running through and bordering said reservation is hereby secured to said Indians; and at all other usual and accustomed stations, in common with citizens of the United States, and of erecting suitable houses for curing the same; also the privilege of hunting, gathering roots and berries, and pasturing their stock on unclaimed lands, in common with citizens, is secured to them."

The CTWS identified many resources within the subbasin used for ceremonial, traditional, and other purposes. These include a wide variety of food plants, animals for clothing and shelter, medicinal plants, and weaving materials. White River subbasin was not identified as a usual or accustomed place for anadromous fishing.

Few specific sites for gathering plants have been identified in White River subbasin. The Northwest Forest Plan provides a higher level of protection for such resources than the Forest Plan. We suggest contacting the Tribal Council to ask whether they would like to coordinate management plans for their cultural plants and gathering grounds in the subbasin. We should also consider managing cultural gathering grounds for that primary purpose. At minimum, we should assure that ACS objectives are met in moist/wet meadows and riparian areas since these areas typically support a large percentage of root foods. Five root plants are currently important cultural foods (Helliwell 1987):

- camas *Cammassia quamish*
- bitterroot *Lewisia rediviva*
- biscuit root *Lomatium cous*
- Canby's desert parsley *Lomatium canbyi*
- Indian carrot *Perideridia gairdneri*

We should consult with the Tribal Council on possible impacts of range management on cultural plants. Potential topics of discussion might be:

Adjusting grazing practices to protect cultural plants.

Use of non-native plant species in range improvement seed mixes.

Noxious weed control.

The tribes have also identified the importance of water quality, particularly water temperature, in White River. Members of the Tribal Council stated that Mt. Hood is known as "Water Giver" for its importance in providing abundant, cool water in summer to help trigger anadromous fish runs in the

Deschutes River. Temperature data taken below White River Falls suggests that water temperatures are quite warm, but we are unsure what the range of natural conditions for water temperatures was before 1855. The primary factors affecting water temperature are irrigation withdrawals and timber harvest. We do not have enough data to know how much irrigation withdrawals have affected water temperature. The little data available strongly suggests that the Rocky Burn and subsequent salvage significantly raised the temperatures of Rock and Threemile creeks.

The Forest can do nothing about irrigation withdrawals. Water rights are controlled by the State. Following the recommended conditions should result in a higher level of closed canopy forest than is currently present in the Crest and Transition zones, helping to maintain water temperatures in the tributaries of White River. The best way we can address the water quality concern is to assure that State Water Quality Standards are met on National Forest lands.

CHAPTER 6: RECOMMENDATIONS

Desired Conditions.

After much discussion, we concluded that we have the best chance of providing for long-term ecosystem health and stability, high quality wildlife habitat, and social needs for wood, water, wildlife, recreation, and range by managing within the range of natural conditions. In cases where we do not know what the range of natural conditions was, we either have a recommended list of standards or recommend following the current standards in the Mt. Hood Forest Plan as amended.

In general, land management activities and land uses on National Forest lands, such as timber harvest, should manage for the higher end of any ranges. Natural events are expected to "manage" for the lower end of the ranges. On exception to this though is stream temperature--in this case we should manage for the low end and natural events can "manage" for the high end.

These recommendations are intended to incorporate the majority of situations within the subbasin. As always, site-specific details may reveal that a given recommendation is not appropriate at that place or at that time. We expect adjustments as we attempt to use these recommendations as intended. When the appropriateness of a given recommendation is in doubt, we urge the ID Team to review the Northwest Forest Plan, FEMAT report, and Mt. Hood Forest Plan for the intent behind those guiding documents and to pose questions to the Supervisor's Office, Deschutes Province RIEC, and Regional Ecosystem Office.

We believe we have the best information on the range of natural conditions when it comes to terrestrial vegetation, although what information we have refers most specifically to the trees. In general, we should use the information displayed in Figure 4.3 to determine how much of a given diagnostic stand type should be present on the landscape over the long-term. It will take several decades to move significantly in that direction. We did not have time to develop suggestions for interim landscapes. However, the Badger and White River stewardship teams should be able to take on that role.

We lack good information on the range of natural conditions for the following elements:

- downed wood in the terrestrial, riparian, and aquatic ecosystems,
- snags,
- water temperature,
- pools per stream mile,
- sediment input to streams,
- streambank stability, and
- riparian plant communities.

Therefore we suggest the following standards should apply to each of the above elements.

Downed Wood (Key Questions 1G and 1H).

- Within harvest units these loadings should remain after fuels treatment is complete--
    1. Eastside Zone: 3-13 tons per acre, at least one tree-length log per acre.
    2. Transition Zone: 10-20 tons per acre, at least three tree-length logs per acre.
    3. Crest Zone: 25-50 tons per acre, at least five tree-length logs per acre.
- At least 75% of the loading should be in material larger than 3 inches in diameter. In the Eastside Zone, at the low end of the range, all loading should be in large logs (greater than 12 inches average diameter).

- At the subwatershed level, manage for the following percentages of the above tonnages of large woody material within each size class:

Size Classes[1]	ZONE Crest	Transition	Eastside
3-6 inches	10-15%	10-15%	5-10%
6-12 inches	10-20%	15-25%	20-30%
12-20 inches	35-40%	40-50%	45-50%
20+ inches	25-45%	20-25%	15-25%

[1] Average diameter of log

- Within the Crest Zone, no more than 25% of the managed acres in each subwatershed should fall below 30 tons per acre.
- Within the Transition Zone, no more than 15% of the managed acres in each subwatershed should fall below 12 tons per acre.
- Within the Eastside Zone, no more than 10% of the managed acres in the forested area of each subwatershed should fall below 5 tons per acre.
- The 15% green tree retention guidelines in the Northwest Forest Plan should provide an adequate input of twigs, branches, and needles to quickly rebuild and/or maintain sufficient duff and 0-3 inch material to meet short-term nutrient needs. The current guidelines in the Forest Plan for 0-3 inch material and litter and duff may no longer be needed in units harvested under the standards and guidelines of the Northwest Forest Plan. Exceptions may exist to protect rare or sensitive fungi, lichens, bryophytes, and vascular plants.
- Silvicultural prescriptions and fuel treatments should assure downed wood potential remains across harvested units. One method might be to ensure the spacing between dispersed individual trees does not exceed 90% of the combined heights. For example, if two leave trees were each 100 feet tall, the spacing between these two trees should not exceed 180 feet.
- Woody material left after harvesting and fuel treatment should be more-or-less evenly distributed across the unit.
- No stream reach should be devoid of large wood as a result of human activities such as timber harvest, firewood collection, and recreation. Do not remove any in-channel large wood unless a clear danger is identified for personal injury or death to people, or damage to uses downstream (i.e. campgrounds, bridges, etc.)
- Monitor streams relatively unaffected by timber harvest more intensively to determine how downed wood loadings change over time and how various disturbance factors affect downed wood levels. Prime candidates for such monitoring include White River, Barlow Creek, Boulder Creek above Section 16, Badger Creek, Little Badger Creek, Pen Creek, and Tygh Creek. Streams within Badger Wilderness and Badger Creek for its entire length within the Forest boundary may be outside the range of natural conditions due to the effects of fire exclusion on stand densities and species compositions.
- In general, timber harvesting in Riparian Reserves should not remove any trees larger than 15 inches DBH, regardless of species, unless the prescription clearly provides for both immediate and long-term in-channel large wood needs and riparian and aquatic ecosystem functioning.
- Consider placing in-stream large wood only in those streams and stream reaches where management activities have significantly reduced downed wood potential (i.e. the average stand diameter in the Riparian Reserve is less than 15 inches DBH as calculated on a minimum 1/2 mile basis). Use the recommendations in FW-094 for the number of pieces to place as calculated on a minimum of 1/2 mile basis. In other words, we should find low in-channel wood conditions on at

least 1/2 mile of stream before adding the equivalent of 106 pieces per mile. Reevaluate stream and riparian stand conditions every five years for the amount of large wood still in the stream and whether the riparian stand is in a condition to begin contributing large downed wood on its own.

- If a smaller Riparian Reserve burns (i.e. 300 feet each side or narrower), do not salvage any dead or dying trees. Monitor the changes in snag levels and downed wood in the terrestrial, riparian, and aquatic ecosystems and other aquatic elements within the Reserve. Results of monitoring should help refine standards and guidelines.
- Develop a standard and guideline for in-channel and riparian downed wood that recognizes that wood levels vary naturally. The standard should probably be based on an entire stream basis, rather than on a reach basis.

Snags (Key Question 8D).

- Follow the snag guidelines in the Northwest Forest Plan and the Mt. Hood Forest Plan.
- Place bird and bat boxes in snag deficient areas not expected to provide suitable snags within the next 10 years.

Water Temperature (Key Questions 1H and 3B).

- Follow state water quality standards for temperature until we have collected sufficient data to establish the actual "natural" baseline temperature of these streams.
- In order to better get at RNC monitor water temperature at the following locations:
  1. Camas Creek as it leaves Camas Prairie
  2. Bonney Creek as it leaves Bonney Meadows
  3. At least 6 springs in headwater areas
  4. At least 4 springs in mid-drainage areas
  5. Outlet to Clear Lake
  6. Outlet to Badger Lake
  7. Just below the diversion in Clear Creek
  8. Just below the diversion on Badger Creek
- Spring temperature monitoring stations should be evenly divided between springs north and south of White River. The monitoring stations above would be in addition to the ones already in place.
- Work with Oregon DEQ to decide how long temperature monitoring should last in order to adequately describe the probable range of stream temperatures.
- Attempt to model the natural range of stream temperatures based on current climate data and the probable pre-1855 canopy closures.

Pools (Key Question 1H)

- Develop standards based on pool quality rather than quantity. The standards should consider pool forming structures, fish cover, residual pool depth, and substrates for biological activity.
- Pool filling should not occur as a result of excessive sedimentation originating from land uses, such as erosion related to timber harvest, grazing, or recreation use; erosion from native surface roads and unreclaimed or inadequately reclaimed rock pits; and erosion resulting from ditch failures.

Sediment (Key Question 1H)

- Use a sediment standard more reflective of the spawning needs of resident fish (i.e. $\leq$20% surface fines <6 mm) in the streams other than White River mainstem. Develop a standard for White

River mainstem that also protects the outstandingly remarkable value (see White River National Wild and Scenic River Plan).

Streambank Stability (Key Question 1H)

- Use the Forest Plan standards within activity areas. Develop a standard for broader floodplains that recognizes natural variability and the role natural events play on streambank stability.
- When using management ignited prescribed fire, do not allow ignition within the immediate floodplain except when designed to meet specific ACS objectives. Fire should be allowed to back or creep into floodplains.

Riparian Plant Communities

- Eastside Zone:
  - The range of natural conditions in the immediate floodplain of perennial streams probably is 20-30% hardwood tree dominated, 40-60% mix of hardwood and conifer, and 20-30% conifer dominated.
  - The range of natural conditions just outside the immediate floodplain on south aspects probably is 50-80% hardwood dominated, 20-30% hardwood-conifer mix, and 5-20% conifer dominated.
  - Intermittent streams probably are very similar to the uplands.
- Transition Zone:
  - The range of natural conditions along perennial streams probably is 5-25% Early Seral, and 15-30% Late Seral Tolerant Multistory. The remainder of the stands were of a variety of stand types.
  - The range of natural conditions in intermittent streams probably was very similar to the uplands.
- Crest Zone:
  - The range of natural conditions probably was very similar to the uplands in all streams.

In addition, there are certain elements that do not have a range of natural conditions, such as scenic quality and potential recreation experiences.

- In general, the VQO for White River subbasin should be Partial Retention. Modification and Retention VQOs do not fit with the recommended desired conditions and management strategy for vegetation. Retention may be consistent with management goals for allocated LSRs and Riparian Reserves. A Retention VQO does not preclude timber harvesting. Instead, it points to harvesting on a smaller scale and with a lighter hand than we typically use. An example would be the harvest practices within the The Dalles City Watershed on city-owned lands.

  We recognize that many areas currently do not meet these VQOs. Rehabilitation and restoration efforts may also result in areas that do not meet these VQOs over the short-term. However, we feel that these VQOs better reflect both the demands of the public for a certain visual quality setting and the probable future condition of the vegetation.

- In general, the following ROS Classes should be provided:

Location or Allocation	ROS Class
Matrix Lands	Semi-Primitive Non-motorized in GRID 312[1], Semi-Primitive Motorized in Barlow Road Historic District, Roaded Natural elsewhere
Riparian Reserves	Semi-Primitive Non-motorized[2]
White River LSR	See Wild and Scenic River Plan for river corridor
	Semi-Primitive Non-motorized in Twin Lakes roadless area and upper Boulder Creek roadless area, Semi-Primitive Motorized elsewhere
Douglas Cabin LSR	Semi-Primitive Motorized
Triangles LSR	Semi-Primitive Motorized
Badger Wilderness	Primitive

[1] Semi-Primitive Motorized along old North-South road and motorized trails

[2] Semi-Primitive Motorized where roads and motorized trails cross through

We realize that many areas do not meet these ROS Classes under existing conditions. However, we feel that these ROS Classes better reflect both the demands of the public for a certain recreational setting and the future condition of the vegetation.

Management Strategy

Assuming that the recommendation to move back within the range of natural conditions is acceptable, we recommend the following changes in management strategy.

- Reevaluate plans for planting, gopher baiting, and Final Removals in all shelterwoods in the Transition and Crest Zones. Focus on stands with canopy closures of 40% or more and with a dominance of early seral tree species (ponderosa pine, Douglas-fir, western larch, western white pine, and so forth) and with an average diameter nearing or over 21 inches DBH. These stands would be prime candidates to manage as Cathedral stands.

- Develop a plan to protect all old growth in the Crest Zone from a stand-replacing wildfire. At highest risk is the old growth area in upper Boulder Creek. This area is at risk of a large fire originating in the dense stands currently on Frog Lake Buttes under a strong west wind scenario. The strategy might consist of developing Cathedral stands along Roads 48, 4890, and 4891 and on Bonney Butte to act as a fuel break while simultaneously thinning the stands on Frog Lake Buttes to reduce stand densities and promote more rapid development of Late Seral Tolerant Multistory stands (Key Question 7A).

- Reevaluate the Natural Fuels Underburning IRA for Barlow to incorporate new information and strategies and to include the lower Transition Zone on Bear Springs. Pursue a stable funding source or sources to accomplish ecosystem management objectives (Key Question 7A).

- Develop a Prescribed Natural Fire Plan for Badger Wilderness that also incorporates Douglas Cabin LSR, White River LSR, Fifteenmile LSR, and other Matrix lands as appropriate to allow the greatest possibility of fire playing its natural role throughout the Badger Wilderness and the LSRs. The plan should include a strong element of management-ignited prescribed fire to reflect the importance of American Indian burning before 1855 (Key Question 7A).

- In the Badger-Tygh and Jordan subwatersheds in the Eastside Zone, to maintain dispersal habitat for species more dependent on closed canopy forest and to provide for big game thermal cover, thinning in the old B5 areas should not occur until we have tried the prescriptions in less critical areas (see B5 analysis below). Thinning should follow the same priorities as discussed in Key Question 1E, but the goal would be to create Cathedral stands on north aspects of perennial streams. We recommend trying prescriptions first in Tygh and Pen creeks and in Little Badger Creek between the wilderness and ODFW lands and evaluating the results after 5 years. If the results look promising, then begin trying them in Jordan, Badger, and the rest of Little Badger creeks.

- Manage for the following late successional forest types in each LSR (Key Question 1A):

  1. White River--Late Seral Tolerant Multistory in the Crest Zone (mixed conifer), Cathedral in the Transition Zone (ponderosa pine-Douglas-fir dominated), Late Seral Parklike in the Eastside Zone (ponderosa pine-Oregon white oak dominated).
  2. Douglas Cabin--Cathedral near Gordan Butte and in sheltered areas, Late Seral Parklike elsewhere.
  3. Triangles--Late Seral Parklike.

- Manage for landscape patterns more typical of the characteristic pre-1855 landscape. For example, openings in the Crest Zone should be consolidated to create large areas (i.e. several hundread acres in size) of stands in more-or-less the same age class or cohort. Openings in the Transition Zone should vary over a wide range and be more dispersed over the landscape than in the Crest Zone. Openings in the Eastside Zone should be very small and widely scattered.

- Manage the Eastside Zone to favor wildlife species dependent on open, parklike stands of ponderosa pine and Oregon white oak. Manage the Transition and Crest zones to favor wildlife species dependent on more closed canopy forests (Key Questions 1C and 1F).

- Begin thinning stands in the Eastside Zone using the following priority system (Key Question 1E):

  1. Thin stands currently overstocked and which do not meet spotted owl NFR habitat conditions. The primary objectives would be to reduce susceptibility to stand-replacing wildfire, maintaining or improving vertical diversity in a somewhat clumpy manner, and maintaining dispersal characteristics or promoting the rapid development of dispersal habitat.
  2. Thin stands meeting NFR characteristics which have a high likelihood of not maintaining those characteristics over the next 20-40 years due to risk of wildfire or stress related mortality.
  3. Thin stands on north aspects along perennial streams and other moister sites that currently provide higher quality NFR habitat to reduce moisture stress and risk of stand-replacing wildfire while retaining the necessary numbers of large trees, structure, crown closure, and other stand components needed for nesting, roosting, and foraging.

- Thinning prescriptions in Riparian Reserves should focus on retaining large diameter ponderosa pine and Douglas-fir in the Eastside Zone (Key Question 1E).

- A regular program of underburning should occur in Late Seral Parklike and Cathedral stands in the Eastside and Transition zones, particularly in the LSRs. Initial burns may occur in seasons less favorable for native plant species and northern spotted owl lifecycles in order to increase probability of successfully reducing wildfire risk without unacceptable risk of escaped fires. Subsequent burning should occur in late winter or early spring or in late fall to avoid negative impacts on native plants and northern spotted owl nesting and rearing (Key Question 1E).

- In cooperation with ODFW develop new standards and guidelines for winter range (Key Question 1K). We suggest the following:

  1. The expected range of severe weather cover varies between 10-50% of a sixth field watershed. Allowance should be made for treatment of a portion of these stands per decade to maintain healthy stand conditions and to allow regeneration in stands where insects,

disease, or other factors have or will result in the loss of or significant reduction in thermal value.

2. Eighty to ninety percent of the areas capable of providing severe weather cover should be in that condition at any point in time.

3. Severe weather cover should be recognized in stands or patches as small as 1 acre. Small patches that provide severe weather protection become more critical as the capability of a given sixth field watershed to provide that habitat element decreases. For example, it is more importnat to recognize small thermal patches in a sixth field watershed that can only provide such habitat on 25% of its area than in one that can provide severe weather cover on 50% of its area.

4. Recognize that multi-layered stands over 40 feet tall on average and with 60% canopy closure often provide more effective severe weather cover than a single-layered stand that is over 40 feet tall with 70% or more canopy closure.

5. Late Seral Parklike and Cathedral stands in the Eastside Zone and lower portion of the Transition Zone should include small patches of relatively dense conifer regeneration on 5-10% of the prescription area. When coupled with the winter range road closure standards, this standard should provide adequate security for deer and elk.

- Forage enhancement should occur on 80% of regeneration units and 40% of commercial thinning units in the Transition Zone (Key Question 1L).
- No more than 20-25% of compacted areas within a subwatershed with identified significant levels of compaction should undergo restoration at any one time in order to allow some recovery between restoration efforts. Some evidence of recovery or stabilization, such as reestablished vegetation or lack of noticeable erosion, should be present before undertaking additional restoration in those subwatersheds (Key Question 2D).
- Develop a monitoring program that specifically assesses physical damage caused by cattle grazing in Riparian Reserves. The program should attempt to separate unrecovered past damage from current, on-going damage and recommend restoration work and changes in allotment management strategies. Consider using the monitoring protocols developed by EPA (Bauer and Burton 1993) (Key Question 5A).
- Over the next five years, in order to better assess actual damage and cause, conduct an annual survey specifically for cattle damage. Surveys should focus on Clear, Camas, Gate, Rock, Threemile, Tygh, and Jordan creeks, and Owl and Hazel hollows. Surveyors should identify current cattle-created bare paths, damaged streambanks, and wallows, older areas that do not appear to be used now, and areas needing restoration work (Key Question 5B).
- If identified as a signifcant factor, exclude cattle grazing around young cottonwood and aspen until seedlings and sprouts reach a size that protects them from browsing (Key Question 5C).
- Protect the most weed-free grasslands dominated by native plants from grazing, off-road vehicles, and other land uses that disturb the soil, and from further weed encroachment. These patches would preserve examples of native communities, serve as control communities to compare with other management areas, and provide a seed source for use in restoration (Key Question 6B).
- Select well defined areas in which to allow permits for harvesting commerically desired roots such as valerian. These areas should be free of sensitive plants and should not include fragile habitats, such as wetlands, that may be damaged by root digging. Monitor harvest areas to determine harvest impacts on target plant populations (Appendix E).
- Attempt to propagate commerically harvested medicinal plants from seeds or cuttings and use these species to revegetate decommissioned roads. Once populations are established, issue permits to collect from these areas rather than from general forest lands (Appendix E).

- Switch all wildlife forage, range improvement, and erosion control seed mixes to native species or use sterile non-native plants on National Forest lands. All seed mixes should meet all the state's noxious weed free seed certification tests or come from locally established native plant nurseries with certified weed free growing areas (Key Question 6B).
- The following noxious weed control actions should occur (Key Question 6C):
  1. Teach all field-going employees to recognize and report noxious weeds. Encourage employees to uproot any small, isolated weed population and report it as soon as possible to the Noxious Weed Coordinators (Linda Cartwright or Lance Holmberg).
  2. Eradicate all detection weeds found in the subbasin. Manually remove potential invaders including scotch broom and houndstongue.
  3. Promptly reseed bare ground at landings, skid trails, and so forth with certified weed-free seed or native shrubs.
  4. Monitor noxious weed sites in the subbasin and regularly update GIS and database records of noxious weed populations.
  5. Develop and maintain a standardized database for tracking noxious weed populations. The database should include fields for observation date, population size, and treatments used. The database should link with a GIS data layer with a unique polygon assigned to each population of each species. Coordinate database development with other landowners in the subbasin and Oregon Department of Agriculture.
  6. Road construction, logging equipment, and fire suppression equipment from areas with infestations of scotch broom, houndstongue, tansy ragwort, or any Detection weeds should be cleaned before entering any project area within the subbasin.
  7. Use integrated pest management techniques to contain established infestations of knapweed, St. Johns-wort, and Canada thistle.
  8. All seed purchased for revegetation must meet all state noxious weed-free certification tests.
- In the Eastside Zone retain some denser clumps of ponderosa pine in areas where silver gray squirrels are concentrated to provide high quality nesting habitat (Key Question 6D).
- Develop sampling protocols or monitoring strategies that better indicate trends in native plant species populations for those species which may be preferentially grazed, particularly in Grasshopper and Badger allotments (Key Question 6D).
- Monitor utilization in shrub and hardwood dominated riparian areas. The monitoring strategy should attempt to separate cattle utilization from elk utilization (Key Question 6D).
- If no native fish remain in Badger and Clear lakes, then fish stocking could continue provided the stocked fish could not escape into Badger or Clear creeks. Fish stocking should end at all other natural lakes to protect native species either present in the lake or downstream of the outlets. Fish stocking could continue in Rock Creek and Pine Hollow reservoirs with no adverse effects on native fish where the stocked species cannot escape and either interbreed or prey on native fish, amphibians, or macroinvertebrates (Key Question 6E).
- In order to meet the intent of the state law and to better protect the current population levels of fish, the irrigators should be allowed to screen the ditches against fish passage at the Forest boundary rather than at the diversion points (Key Question 6E).
- Further evaluate streams and stream segments with high fine sediment levels in more detail to discover the probable causes of the sediment levels (natural or artifical sources) and decide what corrective actions, if any, are needed (Key Question 7B).
- In addition to the C-3 species, the following should be considered when managing or adjusting the widths of Riparian Reserves: tall agoseris, fir club-moss, wild cranberry, spotted frogs, tailed

frogs, Cascades frog, Cope's giant salamander, harlequin duck, Mt. Hood primitive brachycentrid caddisfly, Cascades apatanian caddisfly, Mt. Hood farulan caddisfly, and one-spot rhycophilan caddisfly (Key Question 8B).

- Encourage ODFW to consider active management of crayfish. Develop strategy or processes for permitting commercial harvest if demand exists and supply is available (Key Question 8B).
- Maintain existing spotted owl NFR and dispersal habitat in the Eastside Zone until increases in such habitat have been achieved in the Transition and Crest Zones. Habitat quality may be degraded to prevent catastrophic loss, but functioning must be maintained. As habitat in the Crest and Transition zones is rebuilt, habitat in the Eastside Zone may decline and be eliminated in areas not capable of providing stable habitat over the long-term (Key Question 8F).
- Designate Camas Prairie as a Special Interest Area to protect habitat for spotted frogs, sandhill cranes, and wild cranberry and to protect the type locality for *Cortinarius wiebeae*. The Special Interest Area should be large enough to include the lodgepole pine/meadow edge dynamics. Survey suitable habitat in the vicinity to incorporate all known populations of *Cortinarius wiebeae* and to determine if additional populations exist. Investigate the relationships between *Cortinarius wiebeae*, mycophagous animals, and cattle use (Key Question 8F).
- Designate a Mycological Special Interest Area at Devil's Half Acre Campground to protect the type locality for *Rhizopogon brunneiniger*. Inventory the type locality to delineate the boundary of the population and determine the habitat needed. Adopt management guidelines to insure that the known population persist (Key Question 8F).
- Work with ODFW to protect and maintain the genetic integrity of redband trout in streams withoout non-native trout: Gate, Rock-Threemile, and Jordan subwatersheds, Little Badger Creek, and Tygh Creek (Key Question 8F).
- Survey Badger Creek Wilderness for sensitive plants, C-3 species, and general forest conditions (Key Question 9B).
- Given the continuing decline in both recreation construction and recreation maintenance budgets, forego constructing any new developed recreation facilities in any LSRs or Riparian Reserves. Construction of new trails should not proceed unless the design results in a low maintenance trail that does not prevent attainment of the ACS objectives or an alternative maintenance strategy can be used to assure the trail does not prevent attainment of ACS objectives due to inadequate maintenance (Key Question 9D).
- Trails suitable for wheeled vehicles should avoid long downhill runs and avoid powdery or mucky soils (Key Question 9E).
- Work with State ATV Committee, off-road vehicle user groups, and others to design a motorized trail system, including reconstruction of road or trail segments to handle use. Provide user education and enforcement of relevant rules and laws (Review Comment).
- To better protect adjacent landowners from unwanted recreation uses and trespass discourage undesired uses near the Forest boundary, post the National Forest boundary better, and use stricter law enforcement to halt prohibited uses or control restricted uses under the Code of Federal Regulations. Where uses persist that result in trespass, we should be more willing to cite violators and take advantage of cooperative law enforcement agreements with the Wasco County Sheriff's Department and Oregon State Police (Key Question 9F).
- In the Crest Zone recreate the large fire mosaics typical of the pre-1855 landscape. Harvest units should be more aggregated on the landscape rather than the current dispersed pattern. As much as is feasible, prescriptions should consist primarily of thinnings, heavy seed tree cuts, and shelterwood cuts with uncut patches and variable spacing between the trees. The Transition Zone should have a mix of even-aged and uneven-aged strategies while the Eastside Zone should be predominantly uneven-aged. Uneven-aged prescriptions should focus on thinnings and group selections. Staged entries are more likely, especially in the short-term, to maintain certain existing

values such as spotted owl habitat, habitat for the guilds of species represented by pine marten and pileated woodpecker, and big game thermal cover in winter range (Key Question 11A).

- If we wish to provide for more instream flow to improve ecological functioning, work through another agency to have them apply for an existing right as it comes open, or lease or buy available rights from the current holders. First effortst should go towards acquiring rights on Boulder, Cedar, Souva, Badger, Frog, and Clear creeks as first priority. These streams would benefit most from increasing instream flows within the National Forest boundary. Lower priority would be to acquire water rights for instream flows on Lost, Gate, Rock, and Threemile creeks (Key Question 11B).
- ODFW should reassess the deer management objectives and consider reducing the expected population levels (Key Question 11C).
- All rock pits on National Forest lands that are no longer needed should be fully reclaimed. Pits still needed should be stabilized to reduce erosion potential into streams and isolate, neutralize, or remove toxic or potentially toxic materials, such as spilled fuel (Key Question 11D).
- Monitor target shooting levels in all rock pits used for this purpose. If the level of spent bullets appears excessive (i.e. completely covers the pit floor), remove the lead and send it to either a recycling facility or an appropriate disposal facility (Key Question 11D).
- Encourage local landowners to convert some land formerly under the CRP program to native plant propagation for ecosystem restoration and burned area rehabilitation (Key Question 11E).
- Rural development should focus on developing year-round employment opportunities rather than on seasonal employment (Key Question 11E).
- Contact the CTWS to inquire on the possibilities of coordinating management for important cultural plants and gathering grounds (Key Question 11F).
- Consult with the CWTS on the possible impacts of grazing on cultural plants (Key Question 11F).

Riparian Reserve Widths (Key Question 3D)

Figure 5.2 displays the recommended Riparian Reserves for White River subbasin. These recommendations require ground-truthing. We developed a list of criteria for adjusting Riparian Reserve widths where on-the-ground information is needed:

1. Area has a high density of mapped and unmapped springs, and/or many wet area indicator species (see proposed Riparian Reserve for upper Boulder Creek).
2. Consolidate complexes of meadows, rocky slopes and talus patches, and intermittent streams.
3. Connect wet meadows to nearby intermittent streams where not directly connected to a perennial stream.
4. Consolidate headwall areas where many intermittent streams originate.
5. Protect wet meadows, Key Site Riparian areas identified in the Mt. Hood Forest Plan, and other wetlands larger than one acre, insuring that the Riparian Reserve width provides adequate protection to meet the management objectives of these sites.
6. Protect microclimate for *Botrychium* spp. in cedar swamps regardless of swamp size (Reserve boundary approximately 200 feet wide).

Specific guidelines include:

1. Within well defined canyons, the Riparian Reserve should run rim-to-rim. Purpose is to incorporate primary large wood and sediment sources.

2. Incorporate all of White River floodplain above Deep Creek into one continuous reserve. Purpose is to recognize channel shifting and high levels of subsurface flow (see White River Wild and Scenic River EA and Management Plan for more details on hydrology of upper White River floodplain).

3. On reservoirs with large drawdown zones, use interim widths for constructed ponds and reservoirs as measured on horizontal distance. Purpose is to reduce recreation uses that prevent development of riparian vegetation within the drawdown zone and to reduce sediment input from recreation use of drawdown zone.

4. In Badger Wilderness, use the interim widths as described (slope distance) for the various stream types and lakes. Purpose is to better guide recreation management and development of wilderness fire plan.

5. If Riparian Reserve crosses a large paved road paralleling a stream, evaluate whether the riparian processes and functions can be met by shifting the Reserve to one side of the road. If they cannot, the Riparian Reserve should cross the road. Determine what impacts the drainage ditch network, culvert locations, and drainage flows have on the stream to which the Reserve is assigned. If the water from the ditch opposite the stream eventually flows into that stream, then the Reserve should incorporate that ditch network. Examine whether the road has created an unstable area above the road. If so, expand the Reserve to incorporate the unstable area. Purpose is to address atypical sediment source.

6. Where ditches use natural streams channels but are not fish-bearing, establish a Riparian Reserve using the guidelines appropriate for the type the stream would be if it was not used as a water transmission corridor (usually intermittent). Purpose is to protect water quality consistent with state standards.

7. Establish a perennial fish bearing Riparian Reserve on any ditches that use natural channels and are fish-bearing. The purpose of such a reserve is to maintain a suitable water temperature for fish using the natural channels. This Reserve along the constructed portion of the ditch is not intended to prohibit maintenance to protect its function as a water transmission corridor. This Reserve is intended to be consistent with the management strategy of the Mt. Hood Forest Plan (see FW-085, FW-086, FW-706, FW-707, FW-708, B7-049, and B7-050).

8. On south aspects of perennial streams in very dry areas, the Riparian Reserve may be narrowed where there is little or no riparian vegetation beyond the immediate stream channel AND the slope immediately above the stream contains few large trees (naturally low downed wood potential). The Riparian Reserve must include all riparian vegetation or the 100 year floodplain, whichever is greater. The purpose is to recognize that certain aspects do not contribute very much to riparian functioning beyond topographic shading.

9. On north aspects of perennial streams in the Eastside Zone, the Riparian Reserve width should include all the potential area that will support stable Cathedral forests. The purpose is to provide connectivity and dispersal for species dependent on more closed canopy forests and big game severe weather, or thermal, cover.

10. On intermittent streams the Riparian Reserve should not extend beyond the sideslope gradient that defines the actual riparian area. Consider soil type, slope, and aspect in defining these reserve widths for downed wood and sediment potential. The purpose is to only include that area which contributes to riparian functioning of a given intermittent stream.

11. In flatter areas with substantial subsurface flow, consider establishing Riparian Reserves on ephemerals. The purpose is to recognize the importance of subsurface flow in areas with little surface flow. Examples of such areas include Gate subwatershed, the Douglas Cabin area in Badger-Tygh subwatershed, and Owl Hollow in Jordan subwatershed.

12. Riparian Reserve widths may need to be adjusted where harvest has greatly narrowed or severed links within what would normally be considered the riparian area. The purpose would be to provide connectivity for dispersal of late-successional species. The Reserve would return to its "normal" location once the harvested areas have recovered sufficiently to provide for dispersal of those species.

We expect vegetation management to occur within Riparian Reserves to meet Reserve objectives. On areas otherwise suited for ground-based harvesting systems we suggest the following guidelines:

1. In previously harvested areas, avoid constructing or designating any new skid trails within a Riparian Reserve.
2. Where equipment must enter a Riparian Reserve to remove felled trees, use existing skid trails and roads.
3. Directionally fell trees away from the stream within a Riparian Reserve.
4. Do not use bulldozers to pile slash within a Riparian Reserve. Instead use a grapple piler or other equipment that can operate from the designated skid system.
5. Avoid crushing slash within a Riparian Reserve in the Eastside Zone.

On areas otherwise suited for aerial harvesting systems we suggest the following guidelines:

1. Keep cable corridors as narrow as possible.
2. Evaluate the feasibility of harvesting systems that do not create straight corridors. Examples of such systems to consider are zig-zag yarding systems and helicopter yarding.

B5 Pine Marten/Pileated Woodpecker Areas

The Northwest Forest Plan directs the B5 areas to return to their underlying land allocation in Matrix lands except where needed to assure habitat and dispersal for the guilds of species represented by pine martens and pileated woodpeckers. The Mt. Hood National Forest assessed the relative importance of individual B5 areas in contributing to late seral forest conditions at the watershed landscape level. Based on this assessment, they recommended that certain B5 areas be returned to the underlying land allocation and watershed analysis take a closer look at the remaining B5 areas.

The Forest recommended dropping all B5 areas in the Badger Wilderness and in Badger-Tygh Watershed. They recommended a more detailed analysis of the following areas:

Watershed	Pine Marten Code	Pileated Woodpecker Code
Rock-Threemile	1131M	
White River	1071M, 2011M, 2151M, 2191M, 2231M, 2021M, 2131M	2021W, 2151W, 2061W

In the White River watershed analysis, we looked at all individual B5 areas again to validate the results of the Forest level analysis and to make a recommendation on which areas to retain. In general, we did not find a need to retain any areas set aside for pileated woodpeckers. We did not retain any B5 areas in Badger Wilderness and allocated LSRs. We recommend the following (Figures 6.1 and 6.2):

- Return all B5 areas in Badger-Tygh watershed to the underlying land allocations. The B5 area in Badger and Little Badger canyons should be the last priority for harvest entry due to its importance in big game thermal cover and dispersal of a variety of species. The underlying land allocation is A9--Key Site Riparian. The B5 area in Owl Hollow appears to present opportunity to focus on providing high quality silver gray squirrel nesting habitat.
- Return 1081W and 1161M in the Rocky Burn to the underlying land allocation. It would be several decades before this area actually provides the intended habitat conditions. Assuming the

recommended desired conditions are adopted and that strategy continues for several decades, there will be no need to provide special allocations for late successional dependent species.

- Return 1151M in Gate Creek to the underlying land allocation. The Riparian Reserve should provide Cathedral forest on both sides of Gate Creek due to the narrowness of the canyon. Further, a 100 acre LSR includes the southern tip of this area.
- Use the Barlow Road Historic District as a connecting link. Return all B5 areas in close proximity (1021M, 1061M, 1051M, and 1011W) to the underlying land allocations.
- Return 1191M in Hazel Hollow to the underlying land allocation. The site is not ecologically capable of providing long-term stable forest conditions of the type needed to provide for species dependent on old closed-canopy forest.
- Return 1051M in Boulder Creek to the underlying land allocation. This B5 area lies in a Riparian Reserve.
- Retain a B5 area in the vicinity of 1071M. Most of this pine marten area lies in a Riparian Reserve but a connecting link is still needed around the east side of Section 16. Retain the east portion of 1071M between the Riparian Reserve and road 4870-120. We recommend a connection that follows road 4870-120 to the north until the end of the road and thereafter along the 4400 foot contour until the White River LSR boundary.
- Retain 1031M, 1141M, and 1131M. All three pine marten areas are needed to provide a dispersal corridor that runs north-south and east-west through a heavily fragmented landscape. Many of the riparian areas are in poor condition and do not provide the needed habitat by themselves. The Rocky Burn lies north and east of these three areas.
- Retain 2151M and 2011W. These areas are needed to provide a connecting link in a fragmented landscape and are part of the mitigation measures for McCubbins Gulch off-road vehicle area. Otherwise a large migration barrier exists between Clear Creek and White River both down Clear Creek and across the uplands north of the creek.
- Return 2231M to the underlying land allocation. The combination of White River LSR, 100-acre LSRs, and retaining 2151M and 2011W provides good connections.
- Retain 2131M. This area is already marginal for spotted owl dispersal and the landscape is fragmented. This area would also protect osprey nesting habitat.
- Retain 2111W. This area is not needed for pileated woodpeckers; rather it provides a connecting corridor between Clear Creek, Salmon River watershed, and the Oak Grove portions of the Clackamas River watersheds for pine martens. It also would protect potential osprey and bald eagle nesting habitat. Abbott Burn area west of Clear Lake provides poor quality habitat for late-successional dependent species.
- Retain 2191M. This area offsets existing harvested areas in the adjoining Riparian Reserve, providing a link for between areas to the south across US Highway 26 and Frog Lake Buttes.

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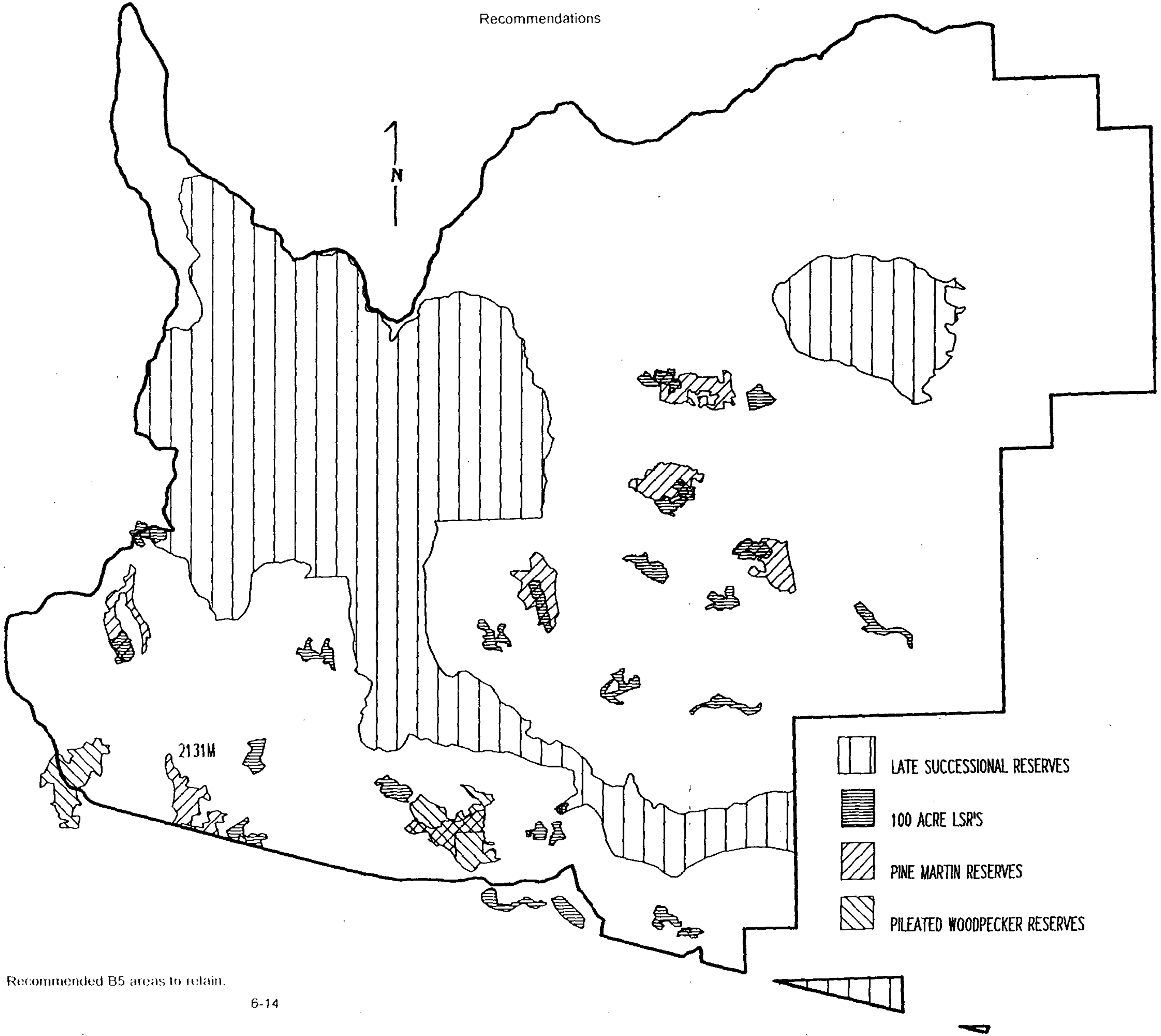

Figure 6.1. Recommended B5 areas to retain.

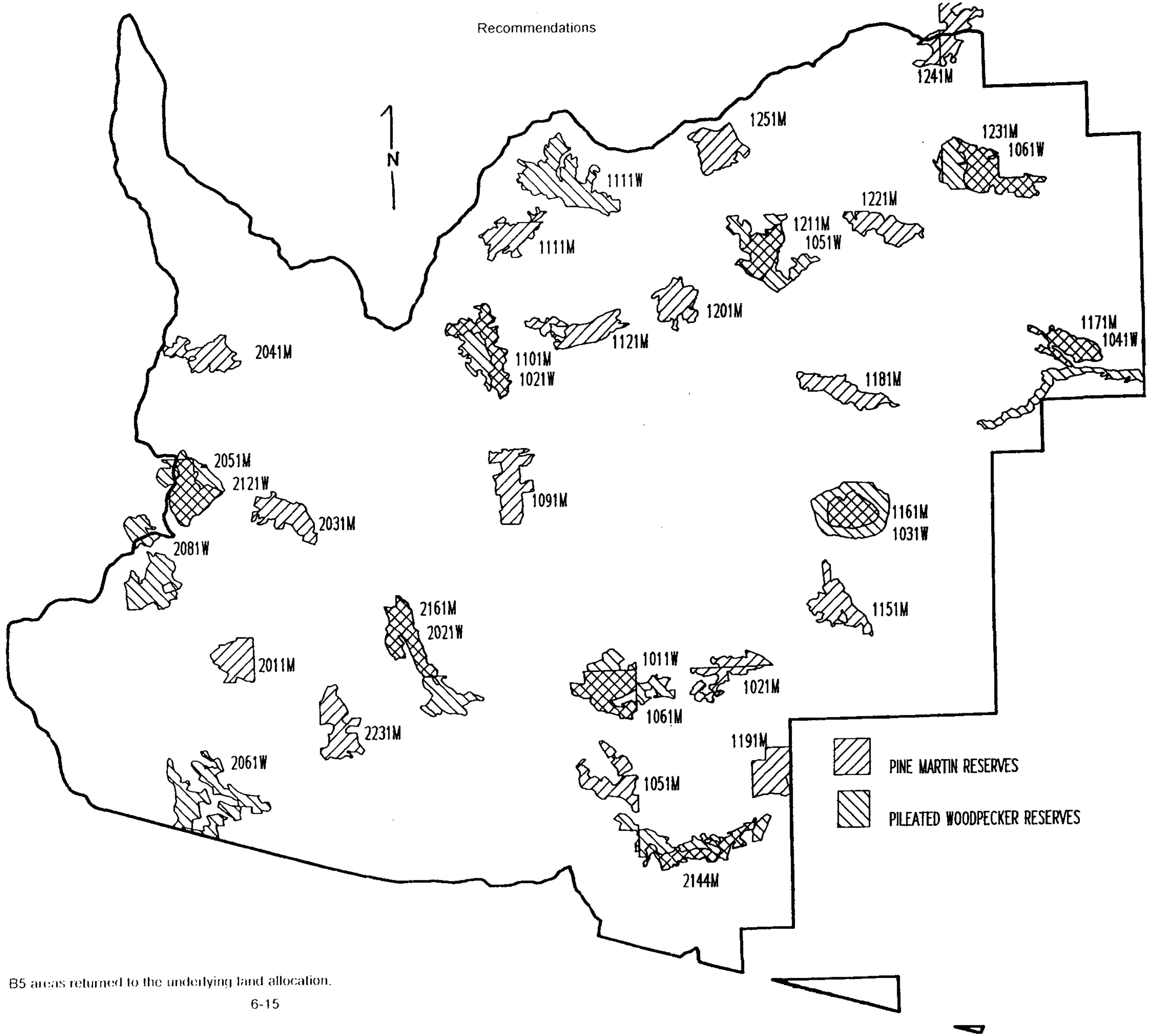

Figure 6.2. B5 areas returned to the underlying land allocation.

Conflicts

I. The Forest needs to decide clearly how to manage McCubbins Gulch (Key Question 1J). Presently, management is somewhat contradictory with simultaneous proposals to manage for fish habitat in that portion of McCubbins Gulch which has been converted from intermittent to perennial and to screen Clear Creek Ditch at the diversion point in Clear Creek. The two obvious alternatives are:

1. Recognize McCubbins Gulch as a fish-bearing stream where the natural channel is used. Apply the appropriate Riparian Reserve width and provide for the appropriate aquatic habitat elements (in-channel wood, pools, bank stability, and sediment). Screen the ditch at the Forest boundary (see Riparian Reserve recommendations).
2. Manage McCubbins Gulch strictly as a water transmission corridor. Meet only state water quality standards for the reasons stated above. Apply the Riparian Reserve width for intermittent streams to McCubbins Gulch. Screen the ditch at both diversions (Frog Creek and Clear Creek).

Regardless of which alternative is selected we must recognize that water transmission is the primary use of McCubbins Gulch and that the streamflow has a water right attached to it that prevents unauthorized withdrawals. Similar contradictions may be present on other ditches that alternate between contructed ditch and natural channel.

II. Many standards and guidelines in the Mt. Hood Forest Plan provide what we consider as inappropriate direction or unnecessarily restrictive direction that does not adequately recognize dynamic processes and climatic differences on the Forest or in White River subbasin (Key Question 7D). We recommend amending the Mt. Hood Forest Plan with the following considerations:

- Base standards and guidelines on climatic zones and the associated disturbance processes first, then on land allocation. The Northwest Forest Plan does this to some extent, but is too broad.
- Recognize that the quantity of various habitat elements varies from zero to some level. Analyze the quality of a given habitat element over a larger unit. For example, average in-channel large wood and pools per mile for an entire stream rather than by reach. This strategy would recognize that some reaches may have zero while others may have an "excess."
- No habitat element should go to zero as the result of management actions or land uses. Natural processes can manage for the minimums, but we do need to recognize that minimums exist naturally. This strategy would also require that we understand why a habitat element is missing in a given location. For example, is a given stream reach devoid of in-channel large wood because of a management action or because of a recent flood?
- Standards and guidelines must clearly state what management activities or land uses they address. For example, timber sales can be an overwhelming influence on downed wood and snag levels. We recommend that we be up front and write the standard to address timber sales specifically and not use vague terms like "management activities" unless the intent is to constrain <u>all</u> management activities.
- Standards and guidelines should clearly state what is considered a management activity and what is not. Is Prescribed Natural Fire a management action or a natural event? Is recreation a management action or is the action any steps we take to constrain or control recreation?
- The Forest should consider reevaluating the following Forestwide standards and guidelines:
    1. FW-004--natural events will change the present stands; we cannot maintain the present stands without taking action.
    2. FW-010--clearly state whether this standard applies only to management actions.
    3. FW-015 and 016--stablization should only be required if we did something to increase instability or caused the area to begin moving. Earthflows are a natural sediment source.

4. FW-025--reevaluate whether this standard is still needed under the Northwest Forest Plan standards (15% green tree retention guideline).
5. FW-032 through FW-038--see Question 1G on downed wood.
6. FW-035--calculate into a bigger landscape. We may be at the low end of the range of natural conditions, but we believe that level is wiser that being outside the range.
7. FW-061 through FW-065--should just constrain management activities and land uses, not natural events. The crown closure level should reflect the range of natural conditions for a given climate zone or diagnostic stand type, not an arbitrary level. Better define "watershed stability."
8. FW-069--stabilization should be required only when management actions have destabilized an area. This standard should consider that the "stable peak flow" is generally unknown for a given watershed and may be very difficult to determine where the data are confounded by such influences as irrigation withdrawals. In general, watershed restoration should not occur on natural events unless that event occurred outside the range of natural conditions. For example, restoration should occur on a stand-replacing fire in the Eastside Zone since this zone did not evolve under a high intensity fire regime. Restoration should not occur on a stand-replacing fire in the Crest Zone since this zone did evolve under a high intensity fire regime. Restoration should occur on all impacts related to the fire suppression effort. This standard should also not preclude actions taken to prevent or control noxious weed or non-native plant invasion of a burned area.
9. Riparian Area Section--all standards and guidelines should be rewritten to constrain management actions from degrading aquatic and riparian habitat elements and to restore degraded areas caused by past or present management actions. Changes caused by natural events occurring within the range of natural conditions should be allowed. We should monitor such changes to gain a better understanding of riparian and aquatic ecosystem functioning. The highest impact activities in White River subbasin were past over-grazing and timber harvest. Restoration efforts to correct problems caused by these land uses are appropriate. See also the discussion under Key Question 1H.
10. FW-137--fish habitat capability changes with time, fluctuates with disturbances, such as fire, and with drought cycles. Fish habitat capability should not be reduced as the result of land uses over which the agency has some control.
11. FW-139--rehabilitate or enhance fish habitat degraded only as the result of management actions or land uses, either past or present, such as past over-grazing and timber harvesting.
12. FW-143 and 144--in the White River subbasin, it would be more appropriate to screen diversions at the Forest boundary so the ditches can continue to serve as refugia during low flows.
13. FW-158 through FW-160--replaced by the Northwest Forest Plan?
14. FW-162--viable populations of native species should be managed on the basis of their historic range. For example, northern spotted owls have expanded their range into the Eastside Zone and possibly the lower Transition Zone due to fire exclusion. The current habitat conditions are not stable and we cannot continue to provide habitat over the long-term (see Questions 1C and 1E).
15. FW-163 through FW-168--forest diversity elements should be based on the range of natural conditions for a given climate zone or stand type, not based on a "one size fits all" approach.
16. FW-175--see the discussion for FW-162.
17. FW-192 and 193--does not apply well to the Crest Zone where the range of natural conditions is for very large openings.

18. Wildlife Section--the Forest should talk with ODFW about the new management paradigm under the Northwest Forest Plan, including what levels of habitat elements we expect the range of natural conditions to provide and what population levels they can support. Everyone should recognize that populations fluctuate and set population goals on the basis of the range of natural conditions. No habitat element should drop to zero as the result of management actions or land uses, but natural events and processes may result in areas devoid of a given habitat element.

19. Forest Protection and Safety--the Forest Fire Management Action Plan (FMAP) should be updated to reflect the findings in this and other watershed analyses, assuming the recommendations are accepted. Regardless, a copy of the FMAP should be available on each district to guide preparation of Escaped Fire Situation Analyses. We recommend the FMAP include a decision matrix on the appropriate suppression response by Northwest Forest Plan land allocation and based on time of year and level of fire danger indices. We also suggest using Energy Release Component (ERC) or a combination of ERC and the Ignition Component (IC) as the appropriate indices, and recommend that the appropriate fuel models are used to reflect actual fuels.

20. Range Section--develop physical damage standards and guidelines (see Questions 5A and 5B).

21. Timber Section--standards and guidelines should address desired outcomes and not specific methods. Outcomes should reflect the range of natural conditions. For example, opening size guidelines in the Crest Zone should not encourage fragmentation. It would probably be appropriate to constrain how quickly a large opening could be created to protect certain social desires, but the end result should be a large area of more-or-less one age class as the area approaches a late successional condition. Standards and guidelines should emphasize natural regeneration over artificial regeneration, particularly in areas of uneven-aged management, and genetic diversity. Recognize that herbicides are only appropriate for controlling noxious weeds and not for managing brush. Recognize that areas of dense brush are part of the natural condition and serve a purpose that we may not understand very well. Fertilizing should be limited and we should manage for nitrogen-fixing plants, such as legumes, ceanothus, and alder. These species will provide available N over a much longer period of time than chemical fertilizers and add diversity to the forest.

We recognize that incorporating all dynamic processes cannot happen immediately due to past actions whose consequences we must now mitigate. However, we can begin to make some changes now.

III. The goals of the National Forest and the goals of ODFW lands conflict at present. On National Forest lands, the FS is charged with managing for healthy ecosystems in order to best meet social demands. On State wildlife lands, Oregon Department of Fish and Wildlife is charged with managing for high quality habitat for wildlife to reduce depredation on private lands. These goals come into the highest level of conflict in GRID 312 and portions of GRIDS 311 and 411 where National Forest and State wildlife lands intermingle. Also contentious has been management of stands that provide thermal cover. The potential exists to have very different stand structures adjacent to each other where the two lands meet.

In addition to the recommendations on changing the strategy associated with thermal cover (see Key Question 1K) we recommend that the Forest and ODFW pursue one or more of the following options:

- Develop a joint management strategy for the intermingled lands. Both agencies would manage their own lands but projects and activities would be coordinated between the two.
- Turn management of intermingled lands over to one or the other agency under a Memorandum of Understanding over management goals. This alternative does not mean that one or the other agency should manage all intermingled lands but that management responsibilities should be shared.

- Pursue land exchanges to consolidate ownerships of intermingled lands and allow each agency to pursue separate goals on their own lands. The Mt. Hood National Forest and ODFW should continue to cooperate to benefit both agencies.

IV. The goals of managing the Barlow Road as a National Historic District may conflict with the goals of the Northwest Forest Plan. The goals of the National Historic District include maintaining a primitive atmosphere within the district and protecting all actual sites dating from the original use of the corridor. As such, the roadbed can be stabilized against erosion but cannot be obliterated and must remain a native surface road. No restoration work to reduce erosion can occur on actual wagon ruts if such work would damage or destroy the ruts.

A significant portion of the Barlow Road lies within White River LSR and in Riparian Reserves. All measures designed to control access and use must maintain the characteristic landscape of the National Historic District. The emigrants typically encountered dusty conditions and muddy, rutted road segments, all of which are indicative of the potential for excessive sedimentation. Such conditions are in keeping with the goals of the Historic District, but may not be in keeping with the Aquatic Conservation Strategy objectives.

We identified two major immediate concerns where the goals of the National Historic District and the goals of the Northwest Forest Plan may conflict and attempted to resolve them:

- Erosion off the Barlow Road--potential solutions include
    1. Construct settling ponds away from the road.
    2. Construct drivable dips under the proper soil moisture condition so that they hold.
    3. Increase enforcement on the existing seasonal closure.
    4. Extend the seasonal closure during wet springs or falls.
- Barlow Creek cutting towards the Barlow Road between Barlow Crossing and Barlow Creek campgrounds--potential solutions include
    1. Use logs to redirect the stream flow rather than armoring the streambank.
    2. Develop a contingency plan to address the situation of Barlow Creek were to take out the Barlow Road.

In this second case it appears that if the creek shifting was caused by unnatural disturbances (i.e. direct or indirect effects of roading and timber harvesting in Barlow subwatershed), then it would be appropriate to expend more effort to protect the Barlow Road and still meet the intent of the Northwest Forest Plan. If the creek shifting is caused by natural forces, then our options are less clear.

We expect the goals of the Barlow Road National Historic District and the goals of the Northwest Forest Plan will conflict in the future. It would help if steps could be taken now to reconcile the two sets of goals. We suggest that the Mt. Hood National Forest contact both the Regional Ecosystem Office (REO) and the State Historic Preservation Office (SHPO) and begin a process to address conflicting goals.

CHAPTER 7: RESTORATION PROJECTS

This section lists restoration projects on National Forest lands derived from the recommendations in Chapter 6 and results in Chapter 5. We intended to show the projects with a priority ranking. However, we developed an extensive list based solely on documented resource damage. This list contains far more projects than we can expect funding to implement in any one year. The stewards will need to develop a method to prioritize this list over several years. This list is not intended to be inclusive or restrictive.

Road Management (ACS Objectives)

- The Mt. Hood Forest Plan requires that we reduce open road densities to 2.5 miles per square mile in big game summer range, 2.0 miles per square mile in inventoried winter range, 1.5 miles per square mile in A1 (White River National Wild and Scenic River), B2 (Scenic Viewshed), and B10 (Deer and Elk Winter Range) land allocations. Evaluate all native surface roads for obliteration, closure, or erosion control in the following priority order by subwatershed:

  1. Clear
  2. Badger-Tygh
  3. Boulder
  4. Gate
  5. Jordan
  6. White River
  7. McCubbins
  8. Rock-Threemile
  9. Barlow

  The priority order is based on number of miles of road, number of native surface roads relative to other surface types, number of unnumbered spurs, and subwatershed sensitivity to erosion. Exception: Road 3530 (Barlow Road)--evaluate only for erosion control consistent with management as a National Historic District.

  Closures may be seasonal or year-round, depending on current and future need for road and which method will best control erosion.

- Evaluate all aggregate surface roads to be retained with a cinder surface for erosion control needs.
- Evaluate all aggregate surface roads to be retained with a rock surface for erosion control needs.
- Stabilize cutbanks and fillslopes on all roads to remain open. Examples include Roads 48, 4820, 27, 2710, and 2110-220.

Recreation

- Little Badger Trail Reconstruction and Bridge Relocation--relocate trail between milepost 2 and Kinsel Cabin and reconstruct four creek crossings to better handle spring flood events (Key Question 9E). Top Priority
- Clear Lake Recreation Management and Restoration Plan--develop and implement plan to reduce sediment delivery into lake from high levels of dispersed and developed recreation use and to protect potential bald eagle nesting habitat (Key Question 9E). Top Priority

- Badger Lake Recreation Management and Restoration Plan--develop and implement plan to reduce sediment delivery into lake, relocate campsites, and to restore riparian and screening vegetation along lake and Badger Creek (Key Question 9E). Top Priority
- McCubbins Gulch Campground Restoration--redesign campground to handle and control use levels, reduce erosion, rehabilitate streambank damage, and restore riparian and screening vegetation (Key Question 9E). Top Priority
- Crane Creek Trail Reconstruction--relocate middle portion of trail and lower end of Crane Prairie Trail away from immediate floodplain of Boulder Creek (Key Question 9E). Top Priority
- Gate Creek Industrial Camp Restoration--redesign camp to handle and control use levels, reduce erosion, and rehabilitate ditchbank damage (Key Question 9E)
- Clear Creek Trail Reconstruction--relocate trail below Clear Creek Campground away from wet soils along Clear Creek (Key Question 9E).
- White River Campgrounds Restoration--redesign 4 campgrounds located in the wild and scenic river corridor to reduce erosion, rehabilitate streambank damage, restore riparian and screening vegetation, and to meet wild and scenic river management objectives (White River Wild and Scenic River Plan).
- Bonney Crossing Campground Restoration--restore and close specific campsites, provide drinking water for people and horses away from Badger Creek, and restore riparian vegetation.
- Badger Creek Trail Restoration--restore/relocate 1 mile of trail away from a wet meadow and wet area within Badger Wilderness.
- Sanitation Improvement--replace pit toilets with vault toilets at Upper Twin Lake and Keeps Mill Campground (Key Question 9E).
- Little Badger Trailhead Dispersed Site Restoration--redesign to move campsite away from streambank, control use area, reduce erosion, and restore ground vegetation (Key Question 9E).
- Road 42 Dispersed Site Restoration--redesign dispersed site at water source on Clear Creek at Road 42 to move campsite away from streambank, control use area, reduce erosion, and restore ground vegetation (Key Question 9E).
- Gate Creek/Road 48 Use Area Restoration--restore off road vehicle user created hill climbs, mudholes, and unneeded trails to reduce erosion and restore vegetation (Key Question 9E).
- Use these criteria to set priorities for additional restoration (Key Question 9E):
    1. Length or area of high impact (i.e. bare ground, standing water, eroding bank, compaction, devegetation, etc.)
    2. Sanitation problem exists
    3. Sedimentation problem exists
    4. Proximity to threatened, endangered, sensitive, or at-risk plant, invertebrate, or vertebrate species
    5. Popularity of site or trail (use levels, use season)
    6. Proximity to water

Vegetation Manipulation

- Promote development of Cathedral stands or similar stand structure types along Road 4891 between Bonney Meadows and junction of Road 4890 to help protect old growth stand in upper Boulder Creek from stand-replacing fire originating to the west (Key Question 7A).

- Thin overstocked stands on Frog Lake Buttes to promote more rapid development of northern spotted owl NFR habitat and to reduce the risk of stand-replacing fire (Key Question 7A).
- Thin and underburn overstocked stands to promote development or restoration of Late Seral Parklike or Cathedral stands in Douglas Cabin and Triangles LSRs. Focus treatments first on stands that do not provide spotted owl NFR habitat or thermal cover, second on stands with NFR habitat or thermal cover that is not expected to persist another 20 years. Thinning in stands that provide NFR habitat or thermal cover should retain those values but may degrade them slightly to improve stand health. Consider using staged entry approach (Key Questions 1A , 1E, and 8C).
- Thin and underburn overstocked pine and pine-oak stands in Badger-Tygh subwatershed to promote development of or restore Late Seral Parklike stand structure. Focus on stands which currently do not provide spotted owl NFR habitat and stands which provide NFR habitat but are not expected to persist for another 20 years. Consider using staged entry approach (Key Question 1E).
- On a trial basis, thin and underburn potential Cathedral stands on north aspects of Pen Creek or Tygh Creek and potential Riparian Hardwood stands in riparian zone. Focus on stands which are not expected to persist another 20 years. Consider using staged entry approach to protect any existing thermal cover or NFR habitat (B5 Recommendations)
- Thin and underburn High Density stands in the Transition Zone of Clear and/or McCubbins subwatersheds to restore or promote more rapid development of Cathedral stands. Focus on stands not expected to persist another 20 years. Consider using staged entry approach to protect any existing thermal cover or NFR habitat (Key Questions 1A , 1E, and 8C).

Aquatic Habitat Improvement (ACS Objectives)

- Water Source Rehabilitation--install dry hydrants, remove existing water retaining structures, scarify soil and close unimproved roads, move dispersed campsites away from stream, restore riparian vegetation, and place large downed logs for fish cover as needed. Priority sites are:

  1. Tygh Creek at 2700-120
  2. Gate Creek at 4813
  3. Gate Creek at 4811
  4. Clear Creek at 42
  5. Little Badger Creek at 2710
  6. McCubbins Gulch at 2110 (Industrial camp site)
  7. Boulder Creek at 48
  8. Boulder Creek at 4800-037
  9. Boulder Creek at 4885

- Irrigation Ditch Stabilization--assist irrigation companies in acquiring sufficient funding to pipe irrigation ditches located on sideslopes to reduce risk of blowouts and to line irrigation ditches across uplands to reduce leakage.
- Large Wood Restoration--add large downed logs to stream segments low in large wood and large wood potential. Project covers several segments of Threemile, Rock, and North Fork Rock creeks in the Rocky Burn and clearcuts that included the riparian zone.
- Road 4810-170 Culvert Removal--remove plugged culvert on a closed road, regrade the stream channel to its original gradient, and stabilize the bed and bank above and below the culvert.

- Forest Creek Campground Riparian Exclosure and Cattleguard--fence portions of campground with a buck and pole fence to exclude cattle from riparian areas and allow riparian vegetation and streambank to recover, and install cattleguard.
- Rock Creek Reservoir Riparian Exclosure--fence riparian areas associated with natural inlets with a buck and pole fence to allow riparian vegetation and streambank recovery.
- Rock Creek Riparian Exclosure--fence 0.25 miles of stream with a minimum 4 strand barbed wire fence to protect riparian area from grazing. Site is intended for use as a control to compare with other exclosures and non-exclosed areas that have other treatments, such as riparian planting or instream structures.
- Souva Creek Riparian Exclosure--fence heavily used segment of creek with minimum 4 strand barbed wire fence to allow riparian vegetation and streambank recovery.
- Gate Creek LWD Barrier--use large logs strategically placed in Gate Creek in GRID 311 Section 16 to restrict cattle access to stream and to allow riparian vegetation and streambank recovery.
- Threemile Creek Riparian Exclosure Maintenance--repair existing exclosure along 0.5 miles of stream with a minimum 4 strand barbed wire fence to continue protection of riparian area from grazing.
- Threemile Spring Development--fence unnamed spring in GRID 310 Section 25 to exclude cattle, pipe water to trough outside of wet area.
- Gate Creek Spring Exclosure Maintenance--rebuild fence around unnamed spring in GRID 411 Section 22 to continue to exclude cattle from wet area and riparian vegetation.
- Riparian Planting--plant hardwood and conifer trees along specified sections of Rock Creek, North Fork Rock Creek, and Threemile Creek in the Rocky Burn.
- Camas Prairie Exclosure and Restoration--fence Camas Prairie with buck and pole fence to exclude cattle and protect spotted frog habitat. Move livestock holding corrals away from Camas Prairie. Remove unused and abandoned fencing, non-historic buildings, and old car bodies from the area.
- Clear Creek Riparian Exclosure--fence degraded portion of Clear Creek with minimum 4 strand barbed wire fence to exclude cattle from heavily used area and promote restoration of riparian vegetation and streambank stability.

Ecosystem Underburning (Recommended Desired Conditions)

- South Corner Underburn--complete required surveys and consultation with SHPO and burn approximately 634 acres along Barlow Road.
- Gate Creek Riparian Underburn--on trial basis, burn approximately 20 acres within a Riparian Reserve to determine the utility of fire as a restoration tool.
- Hazel Underburn--burn approximately 1000 acres between Road 48 and Barlow Road in conjunction with activity fuels treatment associated with Haze, Hazelet, and Hazel II timber sales.
- Badger-Tygh Underburn--burn approximately 1000 acres in Badger-Tygh subwatershed east of Badger Wilderness. Project may occur in conjunction with timber sale to reduce stocking. Project area yet to be determined.
- Bear Springs Underburn--burn approximately 1000 acres in either McCubbins or lower Clear subwatershed in the vicinity of Bear Springs Ranger Station. Project may occur in conjunction with timber sale to reduce stocking. Project area yet to be determined.

Culvert and Bridge Replacement (Key Questions 8F and 10B)

- Wood Migration Barrier Removal--rebuild stream crossings at selected locations to allow large wood passage between Transition and Eastside Zones, upstream passage of fish and salamanders, and to meet 100 year flood requirement.

  1. Gate Creek at Road 48
  2. South Fork Gate Creek at Road 4830
  3. Little Badger Creek at Road 2710
  4. Little Badger Creek at Road 2710-130 (entrance to Little Badger Campground)
  5. Tygh Creek at Road 27
  6. Pen Creek at Road 27
  7. Pen Creek at Road 2700-120
  8. Jordan Creek at Road 27
  9. Jordan Creek at Road 2700-120

- Fish and Salamander Migration Barrier Removal--replace culverts that prevent upstream migration of redband rainbow trout and various species of giant salamanders and do not meet the 100 year flood requirement.

  1. Bonney Creek at Road 48
  2. Bonney Creek at Road 4891
  3. 2 Iron Creek tributaries at Road 4890
  4. North Fork Iron Creek at Road 48
  5. Red Creek at Road 48
  6. Red Creek at Road 4890-120
  7. Gate Creek at Road 4813
  8. Gate Creek at Road 4811
  9. Threemile Creek at Road 4810

- 100 Year Flood Replacement--replace all culverts and bridges that do not meet the 100 year flood requirement in the Northwest Forest Plan and are not already listed above.

Rock Pit Restoration (Key Question 11D)

- Restore or stabilize Stockton and Jakey pits to reduce sediment, stabilize streambanks, and encourage regrowth of riparian vegetation.
- Evaluate Maxine and Green Lake pits for their potential as sediment sources. If the potential exists, restore or stabilize the pits to reduce or eliminate erosion.
- Reclaim Forest Creek Pit to reduce existing erosion. The existing reclamation effort has not succeeded.

Miscellaneous Other Projects

- Work with ODOT to reduce impacts to creeks from sanding US 26 and Highway 35 (ACS Objectives).
- Through rural development support "fledging" native plant propagation business beginning to appear in local communities. Develop contracts for collection, storage, and propagation of native plant species to support watershed restoration and burned area emergency rehabilitation (BAER) efforts. Initially focus efforts on high value species for watershed restoration, such as nitrogen fixers, wildlife forage, and native bunchgrasses (Key Question 11E).
- Through rural development, contract vegetation surveys for Badger Wilderness. The contractor would map all sensitive and C-3 species locations, identify and map rare plant communities, survey general forest conditions using R6 stand exam procedures or equivalent, and maintain a comprehensive species list (Key Question 11E).
- Through rural development, contract surveying and monitoring for C-3 species (once protocols are developed) (Key Question 11E).

CHAPTER 8: DATA GAPS AND ANALYSIS NEEDS

This chapter lists additional information needed to strengthen both the analysis and results. A data gap results when insufficient or, in some cases, no data was available to conduct the analysis needed. An analysis gap results when there is insufficient time or resources to examine the data available or to examine the available data in the needed detail.

Item	Data Gap	Analysis Gap
Streambank stability	Limited data available	No analysis on non-NF ownerships
Aquatic Habitat--large wood recruitment potential	Vegetative composition, seral stage, canopy closure, and structure within the Riparian Reserves or the riparian zones of the lower third of the subbasin	Complete causal effect analysis of large wood recruitment potential based on vegetative potential No analysis on non-NF ownerships
Aquatic Habitat--Range of Natural Conditions (RNC)		Multiple correlation analyses of aquatic habitat elements and causal effects to correlate unmanaged conditions with probable RNC
Peakflow	Weather data from sources more complete and reliable than RAWS, such as Sno-tel, Agri-met, National Weather Service Cooperators Network, National Weather Service stations, etc.	
Baseflow	Continuous baseflow data to assess baseflow regime above and below irrigation withdrawal diversion points	
Water temperature	Current and pre-1855 vegetative composition, seral stage, canopy closure, and structure within Riparian Reserves; temperature data from springs, lakes, and above and below irrigation withdrawals	RNC analysis
Water chemistry	No data	Water chemistry analysis
Stream substrate	Sediment data for other ownerships Limited embeddedness and pebble count data for NF lands Limited point source sediment data	No analysis for non-NF ownerships No causal effects analysis for current sediment conditions on NF lands RNC for embeddedness
Channel morphology	Channel morphology data for non-NF ownerships	Rosgen channel classification for non-NF lands

Population assessment for at-risk aquatic species	Redband population and recruitment information At-risk amphibian population assessment Distribution of at-risk aquatic macroinvertebrates Native sculpin species identification and distribution Genetic information for Cope's salamanders and other fish species isolated above White River Falls	Quantitative viability modeling Index of aquatic vertebrate biological integrity Genetic analysis of Cope's salamanders identified by phenotypic characters Genetic analysis of other fish species isolated above White River Falls
Potential effects of shift in plant communities on hydrologic cycle	Literature search	PNW Research?
Downstream flood risks	Miles of irrigation ditch, miles of irrigation ditch with year-round flow, firmer estimates of the extent of various vegetation types pre-1855.	
Viability of various terrestrial wildlife and plant species	Existing population levels and population dynamics, importance of White River populations relative to Deschutes Province and range of species	Viability modeling
Compaction	Complete clean-up of existing database, incorporate earlier partial cuts, salvage, and harvesting on other ownerships within NF boundaries	
RNC for downed wood and snags	Literature search for existing information, snag and downed wood levels from unmanaged areas, snag and downed wood levels from areas considered representative of pre-1855 conditions Large downed wood loadings in riparian and upland plant communities at various times since the last major disturbance	Relationship between unmanaged conditions with pre-1855 conditions, particularly in disturbance-dependent plant community types Large downed wood loading variations through time--PNW Research?
Standards for in-channel downed wood		Implications to aquatic and riparian functioning of changing standards and guidelines to FW-092 and FW-093 for all stream types

Possible impacts of summer flash floods	Frequency and precipitation amounts of high intensity summer rainstorms	Potential impacts to aquatic and riparian resources from summer flash floods caused by high intensity rainstorms similar to 9 July 1995 event that struck Fifteenmile Creek east of Dufur. Subwatersheds at highest risk of excessive erosion from such events include Butler, Jordan, and Badger-Tygh

LIST OF PREPARERS

Eastside Watershed Analysis Team

Ron Boehm--Team Leader

Linda Batten--Riparian Ecologist, Hydrologist

Louisa Evers--Terrestrial Ecologist, Writer/Editor

Contributors

Becky Nelson--Lead Steward, Badger Stewardship Area

Artis Holmquist--Fisheries (Eastside)

Chris Brun--Fisheries (Eastside)

Duane Bishop--Fisheries (Eastside)

Bill Wall--Fisheries (SO)

Danalyn Loitz--Fisheries (SO)

Katie Serres--Fisheries (SO)

Mark Pittsenberger--Fisheries (SO)

Dale Wondercheck--Wildlife (Eastside)

Caitlan Cray--Botany (Barlow RD)

Lance Holmberg--Botany (Bear Springs RD)

Sue Nugent--Botany (Hood River RD)

Pat Haley--Silviculture (Barlow RD)

Tamara Shannon--Silviculture (Bear Springs RD)

Dan Fissell--Range (Eastside)

Linda Cartwright--Range (Eastside)

Ryan Bissette--Range (Eastside)

Sarah Crump--Cultural Resources (Barlow RD)

Jack Archer--Recreation (Barlow RD)

Dennis Beechler--Recreation (Bear Springs RD)

Di Ross--Lead Steward, White River Stewardship Area

Jeannie Blackmore--GIS (Barlow RD)

Luisa Suarez--GIS (Bear Springs RD)

Karen Hale--GIS (Hood River RD)

Chris Highfield--GIS (Eastside)

Cheryl Johnson--GIS (SO)

Rich Hagestedt--GIS (SO)

Dave Radetich--GIS (SO)

Dan Newberry--Hydrology (Hood River RD)

John Dodd--Soils (Barlow/Hood River RD)

Dave Peterson--Soils (Hood River RD)

Doug Jones--Barlow Road Wagonmaster[1]

Larry Robertson--GIS (SO)

Larry Bryant--Hydrology (SO)

Nancy Diaz--Ecology (SO)

Jeff Reis--Ecology (SO)

Chris Schulte--Fire (Bear Springs RD)

Doug Smith--Geology (SO)

Anna Clark--Database Manager (SO)

Lucy Wold--Fisheries (SO)

---

[1] Position no longer filled

Consultants

Ray Johnson--White River Wildlife Area Manager, ODFW
Jim Torland--Wildlife Biologist, ODFW
Jim Newton--Fisheries Biologist, ODFW
John Buckman--State Forest Practices Forester, ODF
Oregon Natural Heritage Program
State Historic Preservation Office
Wasco County Planning Commission
Larry Tolle--Wasco County Water Master
Tribal Council--CTWS
Oregon Water Resources Department
Prineville District--BLM
Pam Repp--US Fish and Wildlife Service
Char Corkran--Herpetologist, Mt. Hood Study Group
Marc Hayes--Herpetologist, Portland State University
John Kelley--Fisheries Biologist, CTWS

REFERENCES

Abbot, H.L. 1857. Reports of explorations and surveys, Vol. VI. Senate Ex. Doc. No. 78. Beverly Tucker, Washington, DC [incomplete copy].

Aikens, C. M. 1986. Archaeology of Oregon. USDI Bureau of Land Management, Oregon State Office.

Bailey, W. 1912. The Barlow Road. The Quarterly of the Oregon Historical Society 13: 287-296.

Barlow, M.S. 1902. History of the Barlow Road. The Quarterly of the Oregon Historical Society 3: 71-81.

Barlow Ranger District. 1992. (unpub.) Natural fuels underburning integrated resource analysis. USDA Forest Service, Mt. Hood National Forest, Gresham, OR. 62 p.

Barlow Ranger District. 1992. (unpub.) Rocky Burn integrated resource analysis. USDA Forest Service, Barlow Ranger District, Dufur, OR.

Barlow, W. 1912. Reminiscences of seventy years. The Quarterly of the Oregon Historical Society 13: 240-286.

Bauer, S.B. and T.A. Burton. 1993. Monitoring protocols to evaluate water quality effects of grazing management on western rangeland streams. EPA 910/R-93-017. US Environmental Protection Agency, Region 10, Water Division, Surface Water Branch, Seattle, WA. 203 p.

Behnke, R.J. 1992. Native trout of Western North America. Amer. Fish Soc. Monograph 6. 275 p.

Blaustin, A., D.B. Wake, and W.P. Sousa. 1994. Amphibian declines: judging stability, persistence and susceptibility to local and global extinction. Conservation Biology 8: 60-71.

Bonneville Power Company, Oregon Department of Fish and Wildlife, and Mt. Hood National Forest. 1985. White River Falls fish passage project: final technical report. 101 p.

Brown, J.K. and T.E. See. 1981. Downed dead woody fuel and biomass in the northern Rocky Mountains. Gen. Tech. Rep. INT-117. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 48 p.

Bryant, R. L., L. Conton, R.E. Hurlbett, and J.P. Nelson. 1978. Cultural resource overview of the Mt. Hood National Forest, Oregon: vol. 1. USDA Forest Service, Mt. Hood National Forest, Gresham, OR.

Burtchard, G.C. 1994. Posy archaeological project: upland use of the central Cascades; Mt. Hood National Forest, Oregon. USDA Forest Service, Mt. Hood National Forest, Gresham, OR.

Burtchard, G.C. and R.W. Wheeler. 1991. Mt. Hood cultural resource reevaluation project. USDA Forest Service, Mt. Hood National Forest, Gresham, OR.

Bury, R.B. 1988. Habitat relationships and ecological importance of amphibians and reptiles. Contribution #74 of the old growth wildlife habitat program. USDA Forest Service, Olympia, WA.

Castleman, M. 1991. The healing herbs. Rodale Press, Emmaus, PA.

Cooper, L. 1993. White River Wildlife Area long range management plan. Oregon Department of Fish and Wildlife, Portland, OR. 54 p.

Corkran, C. 1995. Herpetologist, Mt. Hood study group. Personal communication.

Corkran, C. and C. Thoms. 1994. Field manual of Oregon Amphibians (draft). Northwest Eco. Res. Int. 92 p.

Corn, P.S. and R.B. Bury. 1990. Sampling methods for terrestrial amphibians and reptiles. Gen. Tech. Rep. PNW-GTR-256. USDA Forest Service, Pacific Northwest Research Station, Portland , OR. 34 p.

Christner, J. 1981. Changes in peak streamflows from managed areas of the Willamette National Forest. USDA Forest Service, Willamette National Forest, Eugene, OR.

Dore, J. and L. Wold. unpub. Mt. Hood National Forest Stream Survey Handbook.

Dumond, D.E. 1983. Alaska and the Northwest Coast. In Ancient North Americans. J.D. Jennings, ed. W.H. Freeman and Co., New York, NY.

Dunne, T. and L. Leopold. 1978. Water in environmental planning. W.H. Freeman & Co., New York, NY.

Elmore, W. 1995. Riparian Ecologist, USDI Bureau of Land Management, Prineville District, Prineville, OR. Personnal communication.

Evers, L., J. Colby, R. Crump, R. Dobson, and H. Hubbs. In Press. Fire ecology of the mid-Columbia area. USDA Forest Service, Pacific Northwest Region, Portland, OR.

Forest Service. 1989. Rural development opportunities in special forest products. USDA Forest Service, Washington Office, Washington, DC.

Forest Service and Bureau of Land Management. 1994a. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl. Seattle, WA. [218 p.]

Forest Service and Bureau of Land Management. 1994b. Final supplemental Environmental Impact Statement on management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl: Appendix J2. Seattle, WA.

Forest Service. 1994 (unpub.) Miles Creek Watershed Analysis. USDA Forest Service, Mt. Hood National Forest, Gresham, OR.

Forest Service. 1994c. White River National Wild and Scenic River management plan. USDA Forest Service, Pacific Northwest Region, Portland, OR. [114 p.]

Forest Service. 1990. Land and resource management plan: Mt. Hood National Forest. USDA Forest Service, Pacific Northwest Region, Portland, OR. [587 p.]

Franklin, J.F. and C.T. Dryness. Natural vegetation of Oregon and Washington. Oregon State University Press, Corvallis, OR. 452 p.

French, D. and K. French. 1989. Warm Springs Sahaptin medicinal plants: a summary (preliminary version). Reed College, Portland, OR.

Graham, R.T., A.E. Harvey, M.F. Jurgensen, T.B. Jain, J.R. Tonn, and D.S. Page-Dumroese. 1994. Managing coarse woody debris in forests of the Rocky Mountains. Res. Paper INT-RP-477. USDA Forest Service, Intermountain Research Station, Ogden, UT. 12 p.

Habeck, J.R. 1994. Using General Land Office records to assess forest succession in ponderosa pine/Douglas-fir forests in western Montana. Northwest Science 68(2): 69-78.

Hagle, S. K., S. Tunnock, and C.J. Gilligan. 1987. Field guide to diseases and insect pests of Idaho and Montana forests. R1-89-54. USDA Forest Service, Northern Region, Missoula, MT. 123 p.

Halverson, N.M., C. Topik, and R. Van Vickle. 1986. Plant association and management guide for the western hemlock zone: Mt. Hood National Forest. R6-ECOL-232A-1986. USDA Forest Service, Pacific Northwest Region, Portland, OR. 111 p.

Harris, D.D. and L.E. Hubbard. 1983. Magnitude and frequency of floods in eastern Oregon. Water Investigations Report 82-4078. US Geological Survey, Portland, OR.

Hayes, M. P. 1994. The spotted frog (*Rana pretiosa*) in western Oregon. Oregon Department of Fish and Wildlife Tech. Rep. 94-1-01.

Hayes, M. P. 1995. Herpetologist, Portland State University, Portland, OR. Personal communication

Hayer et al., ed. 1994. Measuring and monitoring biological diversity: standard methods for amphibians. Smithsonian Institution, Washington, D.C.

Helliwell, R. 1987. The preservation and management of cultural plants on the Warm Springs Indian Reservation: a proposal.

Helliwell, R. 1988a. Forest plants of the Warm Springs Indian Reservation.

Helliwell, R. 1988b. Preliminary plant term list: Warm Springs Sahaptin, Wasco, and Paiute.

Helliwell, R. 1989. Important traditional plants of the Warm Springs Indian Reservation. Warm Springs Culture and Heritage Program, Warm Springs, OR.

Helliwell, R., L. Cartwright, T. Butler, B. Otani, and L. Kemp. 1990. Mt. Hood National Forest Noxious Weed Management Plan. USDA Forest Service, Mt. Hood National Forest, Gresham, OR.

Hemstrom, M.A., W.H. Emmingham, N.M. Halverson, S.E. Logan, and C. Topik. 1982. Plant association and management guide for the Pacific silver fir zone: Mt. Hood and Willamette National Forests. R6-ECOL-100-1982a. USDA Forest Service, Pacific Northwest Region, Portland, OR. 104 p.

Hickman, J.C. 1993. The Jepson manual. University of California Press, Berkeley, CA.

Hitchcock, C. L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle, WA. 730 p.

Hitchcock, C.L., A. Cronquist, M. Owenby, and J.W. Thompsen. 1969. Vascular plants of the Pacific Northwest. University of Washington Press, Seattle, WA.

Hopkins, W. E. and R. C. Rawlings. 1985. Major indicator shrubs and herbs on National Forests of eastern Oregon. R-6-TM-190-1985. USDA Forest Service, Pacific Northwest Region, Portland, OR.

Hunn, E. S. 1990. Nch'i-Wana, "The Big River": mid-Columbia Indians and their land. University of Washington Press, Seattle, WA.

Hunn, E. S. and D. H. French. 1981. Lomatium: a key resource for Columbia Plateau native subsistence. Northwest Science 55(2): 87-94.

Hutchins, A. R. 1991. Indian herbology of North America. Shambhala, Boston, MA.

Johnson, D.M., R.R. Peterson, D.R. Lycan, J.W. Sweet, and M.E. Neuhaus. 1985. Atlas of Oregon lakes. Oregon State University Press, Corvallis, OR.

Kaye, T., and K. Kuykendall. 1992. Status report for *Astragalus tyghensis*. Oregon Department of Agriculture, Natural Resources Division, Plant Conservation, Biology Program, Salem, OR.

Kirk, D. R. 1970. Wild edible plants of western North America. Naturegraph Publishers, Happy Camp, CA.

Kostow, K. et al. In Press. Oregon Department of Fish and Wildlife 1994 annual report: rainbow/redband/steelhead trout (*Onchorrhynchus mykiss*).

Land, R. 1987. Extinction thresholds in demographic models of terrestrial populations. American Naturalist 130: 624-635.

Langille, H.D., F.G. Plummer, A. Dodwell, T.F. Rixon, and J.B. Leiberg. 1903. Forest conditions in the Cascade Range Forest Reserve, Oregon. Professional Paper No. 9. US Geological Survey, Washington, DC. 298 p.

Leonard, et al. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle, WA.

Leonhardy, F.C. and D.G. Rice. 1970. A proposed cultural typology for the lower Snake River region, southeastern Washington. Northwest Anthropological Research Notes 4: 1-29.

Lesher, R.D. and H.R. McClure, Jr. 1986. Major indicator shrubs and herbs on National Forests of western Oregon. R6-TM-229-1986. USDA Forest Service, Pacific Northwest Region, Portland, OR.

Lewis, W.H. and M.P.H. Elvin-Lewis. 1977. Medical botany: plants affecting man's health. Wiley Interscience Publication, New York, NY.

Liss, W.J., G.L. Larson, E. Deimling, L. Ganio, R. Gresswell, R. Hoffman, M. Kiss, G. Lomnicky, C.D. McIntire, R. Truitt, and T. Tyler. 1995. Ecological effects of stocked trout on naturally fishless high mountain lakes, North Cascades National Park Service Complex, USA. USDI Tech. Rep. NPS/PNROSU/NRTR-95-03.

Mahar, M.J. 1953. Ethnobotany of the Oregon Paiutes of the Warm Springs Reservation. Master's Thesis. Reed College, Portland, OR.

Martin, G.J. 1995. Ethnobotany: a people and plants conservation manual. Chapman and Hall, London, England.

Moffatt, R., R.E. Wellman, and J.M. Gordon. 1990. Statistical summaries of streamflow data in Oregon: vol. I and II. US Geological Survey, Portland, OR.

Moore, M. 1993. Medicinal plants of the Pacific west. Red Crane Books, Sante Fe, NM.

Murdock, G.P. 1980. The Tenino Indians. Ethnology 19: 129-149.

Neuenschwander, L. 1995. Fire ecologist, College of Forestry, Wildlife, and Range, University of Idaho, Moscow, ID. Personal communication.

Oliver, C.D. and B.C. Larson. 1990. Forest stand dynamics. McGraw-Hill, Inc., New York, NY. 467 p.

Oregon National Heritage Program. 1993. Rare, threatened, and endangered plants and animals of Oregon. Oregon National Heritage Program, Portland, OR.

Oregon Water Resources Department. 1995a. Public access on-line water allocation database. Salem, OR.

Oregon Water Resources Department. 1995b. Electronic water rights database. Salem, OR.

Palmer, J. 1847. Journal of travels over the Rocky Mountains to the mouth of the Columbia River, made during the years 1845 and 1846. Ye Galleon Press, Fairfield, WA. 186 p.

Raphael, M.G. 1988. Long-term trends in abundance of amphibians, reptiles, and mammals in Douglas-fir forests of northwestern California. In Symposium for management of amphibians, reptiles, and small mammals in North America. R.C. Szaro, K.E. Severson, and D.R. Patton, tech. coords.

Ray, V.F. 1939. Cultural relationships in the plateau of northwestern North America. Frederick W. Hodge Publication No. 3. Southwestern Museum, Los Angeles, CA.

Sawyer, R.W. 1932. Abbot railroad surveys, 1855. The Quarterly of the Oregon Historical Society 23: 1-24, 115-135.

Scharpf, R.F., tech. coord. 1993. Diseases of Pacific coast conifers. Ag. Handbook 521. USDA Forest Service, Pacific Southwest Research Station, Albany, CA. 197 p.

Topik, C., N.M. Halverson, and T. High. 1988. Plant association and management guide for the ponderosa pine, Douglas-fir, and grand fir zones: Mt. Hood National Forest. R6-ECOL-TP-004-88. USDA Forest Service, Pacific Northwest Region, Portland, OR. 136 p.

Turner, N. J. et al. XXXX. Thompson ethnobotany: knowledge and uses of plants by the Thompson Indians of British Columbia. Memoir No. 3. Royal British Columbia Museum, Vancouver, BC. P. 70-76.

Wall, W.R. 1995 (unpub.) White River subbasin lakes report within the Mt. Hood National Forest. USDA Forest Service, Mt. Hood National Forest, Gresham, OR.

Washington Forest Practices Board. 1993. Board manual: standard methodology for conducting watershed analysis. Version 2.0. Washington State Department of Natural Resources, Olympia, WA.

Washington National Heritage Program. 1994. Endangered, threatened and sensitive vascular plants of Washington. Department of Natural Resources, Olympia, WA.

Zukar, Hummel, Hogfoss. 1983. Oregon Indians: culture, history, and current affairs. Western Imprints,

GLOSSARY

Acute - a disturbance regime where several decades typically pass between events on the same piece of ground or feature.

Chronic - a disturbance regime where few decades or years typically pass between events on the same piece of ground or feature.

Cohort - a group of trees developing after a single major or minor disturbance with a range in ages of individuals; an age class of trees.

Diagnostic Stand Types

Cathedral - semi-open to closed stands dominated by widely spaced, large diameter trees usually greater than 20" DBH. Tree crowns touch or overlap somewhat. Understory is brush, brush and grass, grass, and scattered conifer regeneration. Obvious understory tree canopy covers less than 25% of the area. Canopy closure 40-80% in Transition and Eastside zones, 60-90% in Crest Zone. UNDERSTORY REINITIATION (Crest Zone), OLD GROWTH (Transition Zone).

Cottonwood Gallery - riparian stands dominated by large diameter, "wolfy" black cottonwood. Other species present include willows, alders, occasionally aspen, and an occasional ponderosa pine. Hardwoods have tree form. Occurs in Tygh Valley and Butler Canyon.

Early Seral - created openings of small diameter trees (generally less than 5 inches DBH) where the canopy has not closed (canopy closure less than 50%). A remnant overstory may be present but the canopy closure of that overstory does not exceed 25% in the Eastside Zone, 30% in the Transition Zone. Includes regeneration harvests and stand-replacing events. STEM INITIATION

High Density, Stagnating - single layer, stands either single-aged or multi-aged that require disturbance to move into the next stage. Stands are either closed canopy dense stands dominated by early seral species (intolerants) OR stands with early seral species occupying the dominant and co-dominant stand positions and late seral species (tolerants) in the co-dominant and intermediate positions. Transition and Crest Zones. STEM EXCLUSION, MATURE STEM EXCLUSION

Juniper Woodland - open canopy stands dominated by western juniper. No other tree species present. Occurs only in Juniper Flats.

Late Seral Parklike - Open canopy stands maintained by frequent, low intensity disturbance (usually fire). Understory tree canopy covers less than 20% of the area. Overstory consists of Oregon white oak and ponderosa pine greater than 20 inches DBH and with yellow/orange bark. Canopy closure ranges from 25-50%. OLD GROWTH

Late Seral Tolerant Multistory - stands with two or more canopy layers where true firs or hemlock is climax. Lowest canopy layer is composed of tolerant species. Upper canopy layer(s) composed of a mix of tolerant, semi-tolerant, and intolerant conifer species. Stand is growing at acceptable/desirable rates and density is at acceptable/desireable levels. Transition and Crest Zone. OLD GROWTH

Oak Woodland - open canopy stands dominated by Oregon white oak. Other tree species either absent of widely scattered individuals.

Perennial Bunchgrass - grasslands dominated by native bunchgrasses and forbs. Occasional tree or tree patch of Oregon white oak, western juniper, or ponderosa pine may be present.

Pine-Oak High Density - single-aged or multi-aged dense stands of ponderosa pine or ponderosa pine-Oregon white oak greater than 5 inches DBH OR ponderosa pine or ponderosa pine-Oregon white oak larger than 12 inches DBH with a dense understory. Stands are either stagnant or will stagnate without further disturbance. Eastside Zone only. STEM EXCLUSION, UNDERSTORY REINITIATION, MATURE STEM EXCLUSION

Riparian Hardwood Trees - stands dominated by tree-form hardwoods, primarily black cottonwood, alders, and willows with occasional conifer species and maintained by fire, beaver activity and flood scouring of streambanks. Canopy closure from conifers less than 50%. Early Seral.

Riparian Conifer Trees - stands dominated by conifers with an occasional cottonwood tree or cottonwood tree patch. Dense shrub layer of willow, alder, and a high diversity of other species. Late Seral.

Sagebrush Grassland - shrub steppe dominated by big sagebrush and grass. Other brush species may be present; Brush cover varies. Primarily occurs east of US Highway 197 and south of White River.

Disturbance Process - events which cause changes in landscape features which are readily visible and measurable. The events usually occur over a brief period of time and usually can be viewed. We do not consider drought, dry-wet cycles, and other climatic changes as disturbance processes under this definition; these items are considered separately. In this analysis, only events which operate at the landscape or watershed level are considered. Examples of events are fires, epidemic insect outbreaks, beaver ponding, and erosion.

Duration - how long a disturbance event typically lasts, **not** how long the effects associated with an event typically last.

Features - items on the landscape which can be visited and are measurable, including both natural and human-made or altered items. Examples of features are created openings, roads, stand structures, ponds, and stream channels.

Frequency - how often a particular disturbance process is likely to happen at a given intensity and severity within the subbasin. Frequency is not necessarily tied to the event happening on a particular piece of ground.

Intensity - aeral extent of a given disturbance event, such as acres or miles; how many features are affected. This definition differs from the term *fire intensity*.

Megafauna - generally, large animals, usually mammals and birds, that are easily seen and recognized such as elk, deer, red-tailed hawks, and so forth.

Metapopulation - a relatively discrete collection of individuals that interact on a genetic basis; the potential gene pool for a given population of a species, such as Snake River sockeye salmon.

Multicohort Stands - stands where component trees arose after two or more disturbances, of which only the first disturbance was major and the others minor.

Severity - how drastically a disturbance event changes a given feature or series of features. This definition differs from the term *fire severity*.

Single Cohort Stand - a group of trees regenerating after a single major disturbance.

Stand Structures

Mature Stem Exclusion - a dense single layer, single cohort or two-cohort stand similar in structure as in Stem Exclusion but comprised of large trees. If comprised of at least two cohorts, the dominant trees are usually early seral species, the co-dominant trees are usually a mix of early and late seral species, and the intermediate tree are usually of late seral species.

Old Growth - a stand of multiple cohorts and size classes, dominated by large, old trees. If relatively disturbance independent, then comprised mostly of late seral species, such as the climate climax species. If relatively disturbance dependent, then comprised mostly of early seral species.

Stand Initiation - after a disturbance which kills most of the previous stand, new individuals and species appear.

Stem Exclusion - new individuals no longer appear and members of the existing stand begin to die. Stand density is usually quite high. Surviving individuals grow larger and begin to express differences in height and diameter.

Understory Reinitiation - advanced tree regeneration appears and survives in the understory of the current stand; two or more distinct canopy layers appear. Advanced regeneration is often of shade tolerant species while overstory is often shade intolerant species.

APPENDIX A: RANGE OF NATURAL CONDITIONS AND DESIRED CONDITIONS WORKING NOTES

Summary of Historical Information on Vegetation within the White River Subbasin

Joel Palmer's Journals

Joel Palmer traveled through the subbasin in 1845 and 1846 while scouting out the feasibility of moving his family west on the Oregon Trail and Barlow Road. He joined Sam Barlow's party south of The Dalles on the original expedition to find a usable pass around Mt. Hood. Leaving The Dalles, his party traveled south across a grassland on rolling hills. He noted a few Indian families farming in Tygh Valley; the farm plots were fenced to keep wildlife out. Climbing out of Tygh Valley, they entered Wamic Flats, a "level grassy plain." The first trees noted were scattered ponderosa pine on Rock Creek.

After crossing Rock Creek, the vegetation alternated between prairie and ponderosa pine. They climbed a ridge which ran west and gradually ascended for the next "ten miles." After crossing a "little brushy bottom" they noted the next ridge was heavily timbered with dense undergrowth. It is not clear if Palmer traveled on that ridge. His journal notes that they descended a ridge and traveled on a level bench "covered by very large and tall fir timber" for four miles. They then descended a "mountain", traveled west for 1 1/2 miles and came upon a small stream which they named "Rock Creek."

The distances listed in Palmer's journals are suspect since the current terrain does not match the description above for the distances listed. It appears that the alternating prairie and pine carried him well into the current National Forest west of Gate Creek. The "little brushy bottom" is either Hazel Hollow or one of its tributaries. We believe that Palmer climbed his ridge to the level bench near Immigrant Spring and that this level bench carried him as far as Boulder Point, the "mountain" they descended. "Rock Creek" is probably Boulder Creek.

Palmer crossed Boulder Creek, climbed another hill and encountered a "dense forest of spruce pine." He then dropped into Forest Creek and found a large cedar swamp. They had difficulty finding a good crossing. He described the channel as "strewn with moss covered logs and roots," and the water as extremely clear and cold. The next obstacle was Deep Creek. Palmer apparently turned north, found a crossing, and then dropped into White River. White River, at that point, had a sandy bottom with scrubby pines (lodgepole pine) and side channels with dense alder brush. He found little grass and some rushes. In order to get the remainder of the party, gear, and livestock down to White River the party burned the "laurel brush" (snowbrush ceanothus) on the side of the mountain.

Palmer's party traveled more-or-less north on the White River floodplain. At one point, they entered a cedar swamp covered with extremely dense brush, probably alder. It took them one hour to cover about 1/2 mile. Eventually they reached a point on the White River Sand Flats where they could see Mt. Hood and the surrounding country. He describes Barlow Butte as timbered on the lower 2/3s followed by a "space of over 2 miles covered with grass; then a space of more than a mile destitute of vegetation," then a snow covered top. On the other side of the river was a snow topped timbered ridge where the forest was dead near the snow.

Lt. Abbot's Journals

Lt. Abbot was second in command of a party commissioned in 1854 to survey a railroad route to connect the Mississippi River with the Pacific Ocean. Lt. Abbot crossed the subbasin twice; once on a trip to The Dalles to get fresh supplies and again while attempting to avoid a rumored Indian uprising. On the resupply trip he made several notes of the Juniper Flat area and Tygh Ridge. He described Juniper Flat as a prairie of thin soil over basalt with oak and little bunchgrass. Tygh Ridge had few to no trees but "tolerably good grass." Abbot noted that no pine grew north of Juniper Flat or oak south of Juniper Flat and no sage grew north of Warm Springs River.

When the survey party reached the area near present-day Kah-Nee-Ta in 1855 they received word of an Indian uprising around The Dalles and elected to find a route over the Cascades south of White River. The route was based on rumors of an old Indian trail. Lt. Abbot's party entered the subbasin near the current location of Bear Springs Ranger Station. The survey party was using a two wheeled cart to haul their equipment and were driving cattle for fresh meat. They traveled through "a fine forest of pine nearly level, no fallen timber."

Near Camas Prairie they encountered heavy fallen timber and ". . . tangled forest of spruce, yew, fir, and pine, with many fallen logs crossing, and sometimes even piled up on the trail." Abbot's party camped at Camas Prairie, originally named for the abundant "cranberries" common in the area, and decided to dismantle the two wheeled cart due to the level of downed logs. At this point, the bunchgrasses were replaced by a very coarse, deep green grass species which the horses and cattle would not eat. His description suggests elk sedge.

The next day the party traveled as far as Clear Lake. The amount of fallen logs increased and travel became quite arduous. Lt. Abbot had hoped to keep his party together to better protect against Indian attack, but the number of logs encountered resulted in the party spreading out over one half mile. They had great difficulty in herding the cattle. The fallen timber was not quite as thick on the ridgetops.

Abbot noted scattered huckleberries present in the forest. One species was large and black and growing on bushes about six feet tall, possibly big huckleberry. The other species was smaller and blue and growing on bushes about three feet tall, possibly oval leaf huckleberry. Clear Lake was bordered by grass and surrounded by thick forest. The lake banks were deep mud and difficult for the livestock to cross to reach water. The following day the party left the subbasin headed towards Dry Meadow and Fryingpan Lake.

Sam Barlow's Family

Most descriptions of what Sam Barlow's party found were recorded or remembered by others in the family, such as his son and daughter. Mary Barlow noted that the eastside of the Cascades was "slightly timbered" and teams "passed around and under the pine and hemlock trees with ease." William Barlow also remembered travel being fairly easy until they reached the White River Sand Flats. Since the party's cutting tools were broken, dull, or otherwise in poor shape they could not have made rapid progress if the underbrush or fallen wood was very heavy. Barlow's party did burn some underbrush to make travel easier.

William Barlow also recalled conditions at the toll gate on Gate Creek. They placed the toll gate there, approximately 10 miles west of Tygh Valley, due to the presence of plenty of wood, water, and grass. The emigrants typically rested at Gate Creek for one or two days before starting over the Cascades.

General Land Office Survey Notes

Information on the overstory and understory is plotted on a 1:24,000 clear acetate overlay for the subbasin. Survey information dates from 1860 for most of the township boundaries and from 1887 to 1901 for the township interiors. Copies of the survey notes are found at Bear Springs and Barlow Ranger Districts. We did not use any information from surveys conducted after 1901. We have notes for Grids 312, 311, 411, 410, 511, 510, and 59.

Surveyors for the General Land Office had instructions regarding selection of witness trees and how they were to characterize the land surveyed. Each section corner was supposed to have four bearing trees, one for each quadrant. The surveyors were to select sound, healthy trees which were expected to live for some time. Trees were to be within 300 links (198 feet) of the corner. Two trees, one on each side of the survey line, were to be marked at the half-mile point of each line. In the set of notes available, the surveyors noted the dominant tree species, soil quality, and understory characteristics. For the overstory and the understory, the species are listed in order of dominance. The overstory and understory were often described as "dense", "heavily timbered", "scattering timber" and similar phrases. The term "heavily timbered" does not necessarily mean densely stocked. Studies elsewhere found the term more often described relatively open forests of large diameter trees. The survey notes also include topographic descriptions, widths of streams crossed, roads crossed, and entry into and exit from burns, prairies or meadows, and swamps.

Survey of the Cascade Range Forest Reserve

The Cascade Range Forest Reserve was created on 28 September 1893 and was the largest of the forest reserves at that time. White River subbasin falls within both the northern and central portion of the Reserve, so were surveyed by two different groups. The northern portion covers Grids 210, 211, 39, 310, 311, 49, 410, and 411. The southern portion includes grids 59, 510, and 511. Grid 411 was added to the reserve on 1 July 1901. We do not know when the portions of Grid 312 that are currently National Forest lands were added. The survey was conducted in 1901 and the results published in 1903. Since most of Grids 210 and 211 lie within Miles Creek Watershed, they are not discussed here.

The survey includes a set of maps on the forest conditions. Polygons are based on available timber volume although the cruising rules used are not included. The maps were originally ink on linen paper. We obtained color copies of the maps, however yellowing of the linen makes interpretation difficult.

General Information: Approximately 1/4 of the timber found on the Cascade Range Forest Reserve grew on the eastside. Ponderosa pine was the most common species followed by western hemlock and Douglas-fir on the eastside overall. Within White River subbasin Douglas-fir was the most common species (787,739 MBF) followed by ponderosa pine (388,126 MBF) and noble fir (225,343 MBF).

White River Glacier covered about 170 acres. Only the Little Sandy Glacier was smaller; all other glaciers were significantly larger. Western white pine was undergoing rapid decline but the cause was not apparent. In the summer of 1894 an epidemic level infestation of *Neophasia menapia* (pine butterfly) had devastated whitebark pine. A large percentage of the grand fir was dead in the northern portion.

Timber: Wood cut on the reserve was mostly used by people living within 50 miles of the reserve. Uses were lumber, shingles, fencing, and so forth. The report mentions five sawmills within or adjacent to the Reserve boundaries:

Mill	Location	Years of Operation	Season of Operation	Capacity
Lakes	411 SW section 26	9	summer	12-15 MBF/day
Frailey	211 section 27	4	shut down for lack of timber	10-12 MBF/day
Jordan Creek	212 section 16	2	not stated	5 MMBF in 1900 7 MMBF in 1901
Fryer's	510 section 8	17	as needed to supply Wapinitia area	Not stated
Unnamed	510 section 22	destroyed before began operations		

The report states that the timber around Lakes Mill was almost all ponderosa pine in two size classes--averaging 30 inches DBH and 18 inches DBH. The report also laments to large volume of waste associated with timber harvest. The largest trees were cut first but only about 2/5s or less of the tree was used. Only the clear bole was taken to the mill. Often the bottom 4-10 feet was left due to fire scars or decay. In Township 4 South, virtually every large tree had been cut or cut upon to test the splitting quality of the wood. Many of the younger trees were also already cut.

Regeneration: The surveyors stated that conifer reproduction was abundant everywhere in the northern portion although less was found in the higher elevation , closed canopy forests. Pacific silver fir and hemlock were reproducing well at the higher elevations but noble fir was not. In the ponderosa pine forests, most of the regeneration was Douglas-fir and grand fir. In the Douglas-fir forests most of the regeneration was hemlock and Pacific silver fir. Western larch and lodgepole pine were the major species in burns at upper elevations. In the lodgepole pine forests regeneration was lodgepole pine along the ridge crests; western larch, lodgepole pine, ponderosa pine, Engelmann spruce, and several other species in burns; and grand fir, Douglas-fir, and ponderosa pine in the woods. The central portion report did not discuss regeneration.

Grazing: Sheep grazed the high elevation meadows and old burns. Cattle grazed mostly in the lower elevations from April or early May to late September. Grazing was supposed to be excluded north of Barlow Road and west of the eastern boundary of Range 10 East. The reason for this restriction was not stated. The restriction only served to keep sheep out since they had to be actively herded. Local farmers and ranchers simply turned their cattle loose further east and allowed them to roam at will. The surveyors found an estimated 600-700 head of cattle in the restricted area. They also noted wetland and riparian damage from cattle trampling and churning, polluted water from feces, and increased sediment. Sheep tended to strip the lodgepole pine of needles and bark if insufficient forage was available, killing the trees.

Water: The northern portion survey noted that demand for water exceeded the supply. One cause was the power company at White River Falls. This company obtained an injunction against any more diversions from White River and its tributaries. The accompanying map shows the Lost Boulder Ditch, but no others. An attempt was made to construct an irrigation ditch from Clear Lake prior to 1901. This effort failed when the irrigation district ran out of money before completing construction. A cash patent was given in Grid 49, section 32, SW quarter which controlled the outlet of Clear Lake. An irrigation ditch served Juniper Flat but the source was not stated.

Fire: Human caused fires were widespread. Fires were started deliberately by sheepman to improve grazing and either deliberately or accidentally by hunters, anglers, and campers. Almost 21% of the northern portion was burned and not restocking. The most destructive fires were along the Barlow Road and into the Salmon River. Only 10% of the central portion was burned recently although 90% of it showed evidence of fire.

Litter: This element was only discussed in the central portion report. Litter, which included all downed woody material, was considered light in the ponderosa pine region. Only scattered downed trees were present. Downed wood became thick approaching the high summits. Most commonly it consisted of limbs and snow broken or wind thrown saplings.

Specific Townships:

- GRID 39: remains of old forest in White River, otherwise mostly barren. Whitebark pine, subalpine fir, and mountain hemlock below timberline mixed with grassy meadows. Good timber south of White River where not burned.
- GRID 49: timber generally poor quality. Mountain hemlock and Douglas-fir dominant. Large percentage of trees defective in southern half of township. Several burns but no one burn considered extensive.
- GRID 59: Averages 8.9 MBF/acre; 5% diseased.
- GRID 310: small trees of little value on ridge crests above Hood River, Boulder Creek and Badger Creek. Quickly switches to excellent timber. Grazed by cattle. Extensively burned.
- GRID 410: timber spotty and curiously intermingled; ponderosa pine, western larch, noble fir, and western hemlock found in the same stand. Much of west side of Boulder Creek drainage burned; poor timber. Mostly western hemlock and Douglas-fir with patches of western redcedar along the streams. East side of Boulder Creek "very fine" timber of Engelmann spruce,

Douglas-fir, and noble fir. Lodgepole pine dominant in the bottom of White River. Signs of extensive lethal underburning. Extensive burns on slopes above White River.

- GRID 510: Averages 11.7 MBF/acre; 2% diseased.
- GRID 311: western larch, lodgepole pine, Pacific silver fir, Engelmann spruce on the ridgetops, ponderosa pine below. Extensively burned but good reforestation. 90% of forest in head of Jordan Creek is young western larch. Badger Creek contains very little timber; bluffs and "shell rock" slides along steep sidewalls. Lower portion of Tygh Creek contains very light timber in places, mostly oak.
- GRID 411: eastern side has timber of little value. Some narrow timberless tracts penetrate a short distance into the Reserve. Rocky depressions with vernal pools. Much erosion on ridgetops; narrow canyons contain small tracts of fertile land from where eroded soil deposited. Areas of poor drainage can result in loss of cattle and horses to miring in the spring. Northwest sections contain dense brush in old burns. Heavily cut over or damaged by cuttings. 2760 acres homesteaded and 280 acres purchased by settlers.
- GRID 511: Averages 2.5 MBF/acre.

LAND CLASSIFICATION
(acres)

	39	49	59	310	410	510	311	411	511
Timbered	14,900	18,855	17,979	19,050	19,205	22,470	21,580	22,299	18,145
Burned	4,255	3,015	3,980	3,815	3,770	350	1,225	455	670
Grazing	600			175			35	155	4,140
Barren	3,285		1,050			140			
Cut						80	200	4,270	
Other		360[1]			65[2]				

[1] Water surface

[2] Restocked

STOCKING BY SPECIES
(MBF)

	39	49	59	310	410	510	311	411	511
ponderosa pine			3,186	18,790	48,569	104,914	78,289	103,662	30,716
western white pine	5,989	7,510	3,186	5,480	1,150			25	
lodgepole pine	4,951	13,840	1,593	1,569	2,689		1,001		
whitebark pine	582			349					
Douglas-fir	108,771	170,969	103,562	69,570	137,495	131,142	14,823	40,437	10,970
grand fir	2,401	2,356	4,780	3,108	26,894	13,114	7,569	8,180	1,316
noble fir	88,733	25,867	1,593	89,941	18,106		1,000	13	
Pacific silver fir	46,046	5,779	1,593	17,394	8,374		441		
subalpine fir	3,343			905			315		
western hemlock	31,577	130,386	31,865	5,317	10,603	7,868		463	
mountain hemlock	46,393	4,779		24,341	11,589		189		
western redcedar	4,184	11,318	1,593	1,477	7,754		81	162	
Engelmann spruce	11,119	812	1,593	40,181	7,525		449	27	
western larch	3,435	9,445	4,780	23,779	10,253	5,246	3,051	726	878
Other[1]					86		36	358	

[1] incense-cedar, Oregon white oak, black cottonwood

Stand Exams

We tried to verify and gain a better understanding of the descriptions in the 1903 condition report by using district stand exams and essentially "degrowing" the stands by 100 years. The stands selected had all been harvested at least once but we tried to select stands with a minimum of known entries. We plotted the number of trees by diameter class, species, and age class. We then removed all trees less than 100 years old and compared that theoretical stand with the present stand.

We also estimated the probable basal area associated with the volume classes shown in the 1901 map. We assumed the 1901 volume only represented trees 15 inches DBH and larger. This assumption is based on our knowledge of the mill technology of the time and the timbering practices mentioned in the 1903 report. Since the descriptions of the stands are sketchy, the estimates for 1901 probably underestimate the real basal area. We do not have a good understanding of the amount of regeneration present. Degrowing the stands removes all regeneration.

Stand	Series	Basal Area per Acre: 15"+ DBH 1901	Basal Area per Acre: 15"+ DBH Present	Basal Area per Acre: Entire Stand[1]	Trees per Acre: 15"+DBH 1901	Trees per Acre: 15"+DBH Present	Trees per Acre: Entire Stand[1]
Rock Cr. 12	PP	33	14	119	30-3	10	274
Rock Cr. 38	DF	23	52	132	22-2	20	714
Rock Cr. 5	DF	23	22	119	22-2	13	415
Rock Cr. 4	PP	11	30	122	9-3	8	464
ULB 43	PP	33	54	102	30-3	21	527
ULB 1	PP	11	16	82	9-3	8	499
Gate 241	MH	72	220	260	67-15	78	379
Gate 230	GF	18	315	350	18-1	116	313
Hazel 47	GF	90	131	214	90-5	48	459
Hazel 150[2]	DF	39	103	133	53-4	34	699
Gate 8	DF	117	137	167	106-8	17	699

1 Current value

2 Includes a riparian zone

Disturbance Processes In White River Subbasin

Introduction

Watershed analysis requires that we understand disturbance processes, their role in White River subbasin, and how management has influenced them. We need to analyze disturbance processes since these processes leave features. In turn, the features provide or serve different ecosystem functions, such as wildlife habitat, sediment filtering, and so forth. If we can better understand the interactions between disturbance processes and the resulting features, we can better understand how the ecosystem(s) work and what effects human actions may have on the system.

We approached this task by defining some terms, listing the various disturbance processes for White River subbasin along with their frequencies and typical locations, and describing the regime around a particular disturbance process. We tried to figure out what processes and regimes were typical of the pre-1855 landscape and what is typical in today's landscape. We then tried to estimate which processes or regimes have changed, which have essentially vanished, and which have been added. Lastly we tried to describe what roles a disturbance process usually plays in an ecosystem. We did not analyze natural and human-caused events separately. Instead, we felt it more holistic to look at all processes, regardless of the cause. In some cases, most notably fire, separating natural from human virtually impossible since humans have been burning the landscape for millennia.

Definitions

Disturbance Process - events which cause changes in landscape features which are readily visible and measurable. The events usually occur over a brief period of time and usually can be viewed. We do not consider drought, dry-wet cycles, and other climatic changes as disturbance processes under this definition; these items are considered separately. In this analysis, only events which operate at the landscape or watershed level are considered. Examples of events are fires, epidemic insect outbreaks, beaver ponding, and erosion.

Features - items on the landscape which can be visited and are measurable, including both natural and human-made or altered items. Examples of features are created openings, roads, stand structures, ponds, and stream channels.

Frequency - how often a particular process is likely to happen at a given intensity and severity within the subbasin. Frequency is not necessarily tied to the event happening on a particular piece of ground.

Duration - how long an event typically lasts, **not** how long the effects associated with an event typically last.

Intensity - aeral extent of a given event, such as acres or miles; how many features are affected. This definition differs from the term *fire intensity.*

Severity - how drastically an event changes a given feature or series of features. This definition differs from the term *fire severity.*

Acute - a disturbance regime where several decades typically pass between events on the same piece of ground or feature.

Chronic - a disturbance regime where few decades or years typically pass between events on the same piece of ground or feature.

Disturbance Process	General Frequency	Typical Duration	Typical Location	Features Affected[1]
Fire	Various	1 day to several months	Entire subbasin	Plant communities, stand structures, seral stages, buildings
Epidemic Insect Outbreaks	Periods of high stress and where host species dominate	2-10 years	Forested lands	Plant communities, stand structures, seral stages
Epidemic Disease Levels	Periods of high stress and where host species dominate	2 year - several decades	Entire subbasin	Plant communities, stand structures, seral stages
Floods, including rain-on-snow events	Various	1-5 days	Primarily lower elevations	Stream channels, ditches, ponds and reservoirs, buildings, roads communities, plant communities, stand structures, seral stages
Mudflows/Debris Torrents	Highly irregular	1-5 days	Upper White River for mudflows, all streams for debris torrents	Stream channels, plant communities, stand structures, seral stages, roads, trails, campgrounds, picnic areas
Pyroclastic Flows	Highly irregular	1-5 days	White River	Stream channels, buildings, roads, trails, communities, plant communities, stand structures, seral stages
Lateral Blasts	Highly irregular	Minutes	Within 6 miles of Mt. Hood	Stream channels, buildings, roads, trails, communities, plant communities, stand structures, seral stages
Ashfall	Highly irregular	1 day to several weeks	Entire subbasin	All features in the subbasin
Timber Harvest	Annually	Mostly spring, summer, and fall over 1-5 year period	Forested lands	Plant communities, stand structures, seral stages, roads, trails, stream channels

Grazing	Annually		Primarily mid- and lower elevations of subbasin	Plant communities, stand structures, seral stages, trails, ditches, ponds, stream channels
Ditch Failures	Highly irregular	1-5 days	Hillslopes between diversion point and National Forest boundary	Plant communities, stand structures, seral stages, roads, trails, ditches, stream channels
Wind	Highly irregular	1-2 days	New openings along exposed ridges and points along the west edge of Barlow and western 1/2 of Bear Springs	Created openings, stand structures
Mass Wasting	Highly irregular	1-5 days	Slopes >60%, north and south aspects	Stream channels, plant communities, stand structures, seral stages, roads, trails
Avalanches	Highly irregular	1 day	Mt. Hood, Barlow Butte, Bonney Butte, Lookout Mountain	Stream channels, plant communities, stand structures, seral stages, talus
Beaver Ponding	Irregular	N/A	Perennial streams and ditches	Stream channels, plant communities, stand structures, seral stages
Erosion	Annually	Primarily during snowmelt and high intensity storm events	Entire subbasin, mostly from unpaved roads, past and current grazing, some rock pits, other human activities	Stream channels, ditches, ponds, reservoirs
Rockfall/Slides	Highly irregular	Unknown	Barlow Butte, Bonney Butte, Lookout Mountain, White River canyon, Badger canyon, Little Badger canyon, Tygh canyon	Talus, cliffs

[1] Primary or direct effects only; does not include secondary or indirect effects

We attempted to classify the disturbance regime for each process. A disturbance was considered Acute when several decades would typically lapse before that particular disturbance would occur again. A disturbance was Chronic if it typically occurred fairly frequently, such as annually to less than 5 decades. This time span relates more to the "typical" lifespan of the various landscape elements, rather than is typically considered "frequent" from a human perspective. A disturbance was considered as High in intensity and severity if it usually covered more than 100 acres or 5 miles of stream, or was likely to affect human communities. Disturbances rated Low in intensity and severity typically cover less than 100 acres or less than 1 mile of stream.

Disturbances rated as Mixed in intensity and severity consist of those where the effects are highly dependent on conditions at the time of the disturbance or the size of the disturbance. For example, the initial ponding of an area by beavers usually has dramatic effects, but subsequent ponding in the same area (such as dam repairs or raising the level of the dam) usually has little additional effect. As another example, one year an avalanche may run out in the existing chute while an avalanche in another year may enlarge the chute.

In our rating system, we came up with disturbance processes that were Acute/High, Acute/Mixed, Chronic/High, Chronic/Mixed, and Chronic/Low. We could not think of a process where the regime was Acute/Low. The table on the following page displays what we believe the pre-1855 regime was and the current regime. Those disturbances not present at the landscape scale prior to 1855 are not rated for that period. In some cases, the disturbance regime is broken out by climate zone.

Disturbance Process	Pre-1855 Regime	Current Regime
Fire	Acute/High in Crest Zone	Acute/High in all elevations
	Chronic/Mixed in Transition Zone	
	Chronic/Low in Eastside Zone	
Epidemic Insect Outbreaks	Acute/High in Crest Zone	Acute/High in Crest and Transition zones, possibly in Eastside Zone
	Chronic/Low in Transition and Eastside zones	
Epidemic Disease Levels	Chronic/Low in all elevations	Chronic/Low in Crest and Eastside zones
		Chronic/Mixed in Transition Zone
Floods	Acute/High	Acute/High but may have altered magnitude or frequency of 10-25 year events
Mudflows/Debris Torrents	Acute/High	Acute/High
Pyroclastic Flows	Acute/High	Acute/High
Lateral Blasts	Acute/High	Acute/High
Ashfall	Acute/High	Acute/High
Timber Harvest	Not Applicable	Chronic/High
Grazing	Not Applicable	Chronic/Mixed
Ditch Failures	Not Applicable	Acute/Mixed
Wind	Insignificant	Chronic/Low
Mass Wasting	Acute/High	Acute/High
Avalanches	Acute/High on Mt. Hood	Acute/High on Mt. Hood
	Acute/Mixed other locations	Acute/Mixed other locations
Beaver Ponding	Chronic/Mixed	Insignificant
Erosion	Acute/Mixed	Chronic/Mixed
Rockfall/Slides	Acute/Mixed	Acute/Mixed

Due to their highly irregular nature, lack of evidence of significance at the landscape and watershed level, or the lack of evidence that management has had any impact on the process, the following disturbance processes were not analyzed further: wind, pyroclastic flows, lateral blasts, ashfall, mass wasting, ditch failures, and rockfall/slides.

Roles of Disturbance Processes

Many disturbances play similar roles in ecosystem functioning. The roles listed below are not intended to include any judgment on the desirability or acceptability of each set of roles. It is simply an attempt to objectively state how a given process acts on the environment.

Process	Type	Role in Ecosystem Functioning
Fire	Natural and Human Caused	Recycle nutrients; reduce stocking levels, ladder fuels, fuel loadings; favor fire-adapted/dependent plant and animal species; scarify seeds; create snags and snag patches; create canopy gaps; begin secondary succession; alter levels of insect and disease activity
Insect Epidemic	Natural	Reduce stocking levels of host species, create snags and snag patches, recycle nutrients, create canopy gaps, begin secondary succession (often in conjunction with fire)
Disease Epidemic	Natural	Reduce stocking levels of host species, create snags and snag patches, recycle nutrients, create canopy gaps, begin secondary succession (often in conjunction with fire)
Mudflows/Debris Torrents	Natural	Redistribute downed woody material, change stream channel, scour streambanks, create new pools, fill in pools, begin secondary succession in floodplain, create frost pockets
Floods	Natural	Redistribute downed woody material, scour streambanks, clean out and create pools, fill in pools, begin secondary succession in riparian zone. Rain-on-snow events rarely have direct impacts in the Crest Zone.
Timber Harvest	Human Caused	Commodity production, reduce stocking levels, create canopy gaps or openings, favor selected species, reduce risk of insect or disease epidemic, begin secondary succession in regeneration cuts
Grazing	Human Caused	Commodity production, encourage vigorous regrowth of selected forage species
Beaver Ponding and Activity	Natural	Create pools for fish rearing habitat and water storage, favor species adapted/dependent on high water tables, favor riparian hardwoods
Erosion	Natural and Human Caused	Redistribute nutrients, provide fish spawning material, slowly change landform

American Indian burning was probably widespread within the subbasin. We know that the local tribes burned to manage huckleberry fields and clear trails. Research elsewhere has documented many other reasons that American Indians set fires (Pyne 1982; Gruell 1985a, 1985b; Arno 1985; Reed and Sugihara 1987). The most probable reasons for burning White River subbasin were to improve pasturage for wild ungulates and tribal horses, reduce cover for enemies, and expose acorns. In addition, most individuals and groups did not extinguish their campfires; they simply abandoned them. Occasionally these campfires would have flared into larger fires.

Undesirable Effects

All disturbance processes have undesirable effects on the environment in terms of human desires or beliefs on what the ecosystem should produce and how it should function. How long an given undesirable effect lasts depends on the intensity and severity of the disturbance.

Process	Undesirable Effects
Fire	Smoke and other emissions, reduced visibility, loss of economically valuable trees, loss of critical wildlife habitat, loss of fire sensitive plant species and/or habitat, increased risk of erosion, increased risk of epidemic bark beetle levels, possible decrease in site productivity, visually unattractive, create habitat for invasive non-native plants
Insect Epidemic	Loss of economically valuable trees, increased risk of large wildfire
Disease Epidemic	Loss of economically valuable trees, increased risk of large wildfire
Mudflows/Debris Torrents	Damage human structures and infrastructure, increased sediment delivery further downstream, loss of fish habitat, possible loss of sensitive or rare aquatic and riparian species unique to White River, possible flooding further downstream
Floods	Damage to human structures and infrastructure, potentially loss of critical aquatic or riparian habitat, bank erosion, sedimentation, crop loss in floodplain fields
Timber Harvest	Loss of critical wildlife habitat, loss of sensitive species and/or habitat, soil compaction on slopes less than 30%, increased forest and wildlife habitat fragmentation, increased erosion associated with roads and improper logging methods, visually unattractive, introduction of non-native plants, create habitat for invasive non-native plants, loss of biodiversity
Grazing	Increased sediment delivery to streams, streambank cutting, creation of "wallows" in wet areas and stream edges, loss of highly palatable species, introduction of non-native plants, feces in streams
Beaver Ponding and Activity	Damage to human infrastructure, drowning of crops or economically desirable trees
Erosion	Increased sediment delivery to streams, loss of fish spawning and rearing habitat, road damage

Risks of Undesirable Effects

The risks of undesirable effects are increased over pre-1855 risks in many cases. The risk levels have not necessarily changed everywhere in the subbasin. In some cases, the greatest damage was done before the recent past. Where possible, the following table indicates when the greatest damage occurred or the period of the most negative effects. Only those areas that are outside the range of natural *conditions (RNC) are shown.*

Process	Areas Outside RNV	Causes	Risk Rating
Fire	Frog Lake Buttes	High fuel hazard, high probability of escaped wildfire due to overstocked stands, spruce budworm epidemic, and poor access (roadless area in LSR)	High
	Badger-Tygh subwatershed	High fuel hazard, high to extreme probability of escaped wildfire due to spruce budwom epidemic and related mortality and poor access (Badger Creek Wilderness)	Extreme
	Fire Groups 1, 2, 3, and 9 in Eastside and Transition Zones	*High fuel hazard, moderate* probability of escaped wildfire due to ladder fuels, fuel loadings, dominance of fire sensitive tree species	*Moderate to High*
Insect Epidemic	Eastside Zone--bark beetles	Overstocked stands, drought stress	High
	Transition Zone--defoliaters	Overstocked stands, drought stress, dominance of host species	Very High
Disease Epidemic	Transition Zone	Overstocked stands, drought stress, dominance of host species	Moderate
Timber Harvest	All zones	Inappropriate prescriptions for environmental conditions (primarily a problem of the recent past), multiple entries, 40 acre limitation, social pressure to provide logs for local and regional economies	Moderate
Grazing	All zones, primarily Eastside and Transition Zones	Overgrazing (problem of past), forage not adequately distributed across the allotment, lack of water away from sensitive streams and wetlands, inadequate fencing and fences in poor repair, social pressure to provide for a traditional use	Moderate to High
Erosion	All zones	Social pressure to provide *commodity outputs at rates that* may not be sustainable, social pressure to provide high levels of roaded access for motorized recreation, inadequate road maintenance (primarily native surface roads)	High

Role and Risk of Fire in White River Subbasin

Role of Fire. Fire serves many roles within the White River subbasin. Among these are reducing fuels, reducing stocking levels, favoring selected plant species and habitat conditions, recycling nutrients, and "resetting" the successional clock. The role of fire has changed considerably since 1855 due to reduced numbers of ignitions, aggressive wildfire suppression (fire exclusion), timber harvesting, grazing, introduction of non-native plants, introduction of intensive agriculture, and changing the typical season of burning (prescribed fire).

Prior to fire exclusion all of the Eastside Zone and mucn of the Transition Zone experienced frequent low intensity fire (Fire Groups 1, 2, 9, 11 and portions of 3). The remainder of Fire Group 3 saw a mix of low intensity underburning and higher intensity stand replacing fire. Fire Groups 4, 5, 6, and 7 experienced infrequent high intensity crown fire or moderate intensity lethal underburning. Fire Group 10 rarely burned, other disturbance factors probably played a more important role in stand dynamics. Table Fire 1 displays the typical structural components of the vegetation prior to 1855. Table Fire 2 displays how each of the human influences have affected the timing, frequency, and severity of fire and the associated fire effects.

We can partially restore the role of fire through several management actions. Where fire normally burned as a stand replacing event (Fire Groups 4, 5, 6, and 7), the changes in fire frequency, timing, and severity are essentially permanent since the socio-political costs of restoring fire are considered unacceptable at either the local, regional, and national scale. Restoring fire to Fire Groups 1, 2, 3, and portions of 9 are generally considered acceptable on National Forest lands, although site-specific exceptions exist. Restoring fire on other ownerships within the subbasin is considered controversial. In most cases, we cannot simply begin burning. Instead we must use other tools, such as timber harvest to reduce stocking levels, ladder fuels, and fire susceptible species in order keep the fire effects within acceptable ranges.

Due to lack of time, an emissions trade-off analysis was not conducted. Cumulative effects of restoring fire to the landscape are listed in the Integrated Resource Analysis for Natural Fuels Underburning (Barlow Ranger District), Hazel EA analysis file (Barlow), Upper Boulder EA analysis file (Barlow) and White River Wild and Scenic River EA analysis file (Bear Springs).

Table Fire 1. Natural structural components of vegetation prior to 1855.

Vegetation Zone	Dominant Structure	Fuel Components	Fuel Load (tons/ac)	Fire Group
Perennial bunchgrass	grassland with scattered oak, pine, juniper	cured grass	0.5-.075	11
Sagebrush grassland	scattered shrubs and clumps of shrubs with grass/forb understory	cured grass, dead crowns in shrubs	2-4	11
Cottonwood Galleries	Semi-open to dense stands of large riparian hardwoods and hardwood sprouts, scattered ponderosa pine	scattered logs and log jams	3-30	Not described
Pine-oak	Open stands of large ponderosa pine, single and multistemmed Oregon white oak, scattered concentrations of regeneration that do not exceed 20% canopy closure. Overstory canopy closure 20-40%. Bunchgrass/forb understory	cured grass, needles, oak leaves, widely scattered large logs	4-8	1, 2
Pine-fir	Semi-open stands of large diameter ponderosa pine and Douglas-fir, scattered openings with conifer regeneration, forb/shrub/grass or graminoid understory. Canopy closure 30-60%	needles, twigs, branches, downed logs, patches of cured graminoids and dead crowns in shrubs	4-25	2, 3
Mixed Conifer	Closed stands of several conifer species usually dominated by intolerant or semitolerant species in the overstory. Understory of forbs, brush, and conifer regeneration mostly of semitolerant or tolerant species. Canopy closure 50-80%	twigs, branches downed logs	5-50	4, 8
Subalpine	Closed to semi-open stands of conifers dominated by either lodgepole pine, Pacific silver fir, mountain hemlock, or whitebark pine. Understory of conifer regeneration, huckleberries, and beargrass. Canopy closure 40-70%	twigs, branches, downed logs, live plants	5-40	5,6,7,10
Alpine	Cushion plants or krummholtz	live plants, twigs, branches, downed logs	3-30	N/A

Table Fire 2. Changes in fire timing, frequency, and severity due to human influences.

Influence	Change	Effect on Fire Timing	Effect on Fire Frequency	Effect on Fire Severity
Euro-American Diseases	Reduced number of ignitions	None identified	Reduced	Uncertain
Grazing	Increase in brush and annual grasses, decrease in perennial bunchgrasses	None identified	Reduced	Increased where shrub cover increased, decreased where annual grasses reduce fuel continuity
Intensive Agriculture	Altered plant communities, irrigation, fire control at field edges	Partial shift to spring burning, elimination of summer burning	Reduced to nearly eliminated in some natural communities	Uncertain
Timber Management + Fire Exclusion Policy	Shift toward tolerant species, increased stocking levels, increased fuel ladders, increased fuel loadings, loss of large logs, loss of open stands	Virtual elimination of summer and fall burning	Decreased	Increased--when fires escape initial attack, more likely to become a large, stand replacing fire in all forest zones
Non-native Plants	Increased fuel discontinuity in dry meadows, grasslands	Cheatgrass favors spring and early summer burning	Decreased	Decreased
Clean Air Act	Reduced emissions goals both particulates and other chemicals	Shift to spring prescribed burning, burning under moister fuel conditions	Uncertain	Decreased during prescribed burning

Risk of Fire. Wildfire risk and hazard have specific meanings in fire management. **Risk** refers to the probability of fire starts. In this analysis, risk also refers to a qualitative assessment of the probability of escaped fires. **Hazard** refers to the available fuel loading. The areas of high fuel hazard include:

- Mixed conifer stands on Frog Lake Buttes: spruce budworm related mortality of true firs; dense, stagnated stands, last burned around 1900.
- Fire Groups 1 and 2, portions of Groups 3 and 9: increased stocking levels, increased presence of fire susceptible species, increased ladder fuels, increased risk and incidence of mortality from insects and disease, increased drought stress. Last ecologically significant burns probably occurred before 1910.
- Badger-Tygh subwatershed: high levels of tree mortality from recent spruce budworm epidemic within the Badger Creek Wilderness. Last burned in mid- to early 1800s.

All other areas have low to moderate fuel hazards. Overall the subbasin rates out as a moderate risk due to the low number of annual fire starts but the increasing probability of escaped fires within the high hazard areas. Badger-Tygh subwatershed has both the highest hazard and the highest probability of an escaped fire within the subbasin. The fuel hazard on Frog Lakes Butte is lower than Badger-Tygh subwatershed but the risk of an escaped fire is probably very similar. Both areas have very limited access (Badger-Tygh is a designated wilderness and Frog Lakes Butte is in a roadless area) which greatly increases initial attack time and both are fully exposed to strong westerly winds.

The Fire Groups at high hazard currently have a lower probability of an escaped fire due to the level of access and the favorable terrain for use of dozers and engines in initial and extended attack. Much of this area is still fully exposed to strong westerly winds.

The weather factors that most often leads to large-scale, stand replacing fire are prolonged drying under stable high pressure systems followed by strong westerly winds. Humans cause more fires within the subbasin than lightning, so storms are not considered as important. Strong westerly winds occur when intense thermal lows develop in the Columbia Basin east of the Deschutes River. Intense thermal lows develop from prolonged surface heating and high temperatures, creating strong convective air currents over a large area. The strongest winds typically occur between mid-July and early September and can exceed 40 mph at eye-level. Analysis of recent and past fire patterns reveals that the largest fires in the subbasin burned under strong westerly winds.

The wildlife habitat elements which a large-scale stand replacing wildfire would detrimentally affect include:

- Northern spotted owl nesting, roosting, and foraging habitat: Frog Lake Buttes, much of Badger-Tygh subwatershed, and the grand fir/starflower, grand fir/twinflower, western hemlock/dwarf Oregongrape, and western hemlock-Douglas-fir/oceanspray plant associations in Fire Groups 3 and 9.
- Critical Northern spotted owl dispersal habitat in Fire Groups 2 and 3, particularly south of White River.
- Big game thermal, marginal thermal, and hiding cover in the lower portions of Badger-Tygh subwatershed and in Fire Groups 1, 2, 3, and 9.
- Possibly pine marten denning habitat in Fire Groups 3 and 9.
- Potential great gray owl nesting habitat and habitat for flammulated owls, white headed woodpeckers, and other species dependent on open canopy forests in Fire Groups 1 and 2.

Measures to improve the likelihood of maintaining late-successional habitat are limited on Frog Lake Buttes and in the Badger-Tygh subwatershed since the former lies in a roadless area in a Late-Successional Reserve and the latter lies in a designated Wilderness. The lower elevations of the Badger-Tygh subbasin would benefit from a program of management-ignited prescribed burning to reduce fuel loadings, ladder fuels, and stocking levels and recreate open parklike stands of pine-oak and pine-fir. However, the wilderness does not have an approved fire management plan and permission for management-ignited prescribed fire in the wilderness must come from the Chief of the Forest Service, a step the agency has been reluctant to take. A possible measure to reduce the hazard on Frog Lake Buttes may be helicopter timber sales coupled with prescribed burning. We can think of no viable options to reduce the hazard in the upper elevations of the Badger-Tygh subwatershed.

Measures to improve the likelihood of maintaining late-successional habitat are possible in much of Fire Groups 1, 2, 3, and 9 provided the acceptable habitat is open stands of pine-oak and pine-fir. Measures include timber harvest to reduce stocking levels, ladder fuels, and fire susceptible species coupled with prescribed burning. However, hazard reduction faces the same problems with great gray owl protection buffers discussed under the role of fire in White River subbasin. Further, analysis has identified a need to retain high hazard stands south of White River until suitable spotted owl nesting, roosting, and foraging habitat develops or is stabilized on Frog Lake Buttes.

Socio-political concerns affecting wildfire protection, fire use, and fuel treatment programs include:

- Proximity of a Class 1 Airshed: Mt. Hood Wilderness
- Proximity of a designated non-attainment area: Portland-Vancouver approximately 40 miles northwest
- Additional emissions restrictions in the 1990 Clean Air Act
- Smoke input into smoke sensitive areas and during high recreation use periods
- Need to protect the little remaining old growth in all watersheds
- Risk or perceived risk of an escaped burn onto other ownerships
- Conflicting land management objectives between the Forest Service (healthy ecosystems) and ODFW (big game thermal cover in winter range)
- Conflicting standards and guidelines in the Forest Plan (big game thermal cover requirements, scenic resource objectives in Retention and Partial Retention areas)
- Protection of some cultural resource sites
- Protection of sensitive plant species habitat
- Existing soil compaction levels in portions of Fire Groups 1, 2, 3, and 9
- Restrictions on road building in roadless portions of LSRs (Frog Lake Buttes)

In theory, we can manage fuels through manual, biological, or mechanical treatments, and/or prescribed burning. The biological method available is grazing, which raises many issues in and of itself (see Issue 5). The primary manual methods are pruning and thinning to reduce ladder fuels and remove small diameter fire sensitive species, and hand piling fuel. The primary mechanical methods are timber harvest to reduce stocking and favor selected species, tree sizes, and canopy closure, and machine piling of woody fuel. In reality manual and mechanical methods alone do not accomplish all the social and resource goals. Both methods should also include prescribed burning in many cases.

Another difficulty with relying solely on biological, manual, and mechanical methods is that they cannot restore the thermal effects of fire in the ecosystem. Through heating, fire scarifies seedbanks and alters soil chemistry. Failing to adequately scarify the seedbank may result in a reduction of biodiversity over the long-term through the reduction or loss of species that depend on thermal scarification to sprout. We do not fully understand the roles that many of the species play in ecosystem functioning, therefore it seems short-sighted to simply ignore them. One species group that we understand better are the ceanothus species. Ceanothus seeds can last many decades in the seedbank and require a heat treatment to sprout. Ceanothus is an important nitrogen-fixing species group that aids in wildfire recovery over the long-term.

The fire has numerous effects on soil chemistry. While not fully understand, we do know that fire can alter the amount of total nutrients and available nutrients and soil pH. Merely altering soil pH has far-reaching effects on subsequent soil chemical reactions and soil microorganisms, both populations and species compositions. Research into this aspect of fire effects is not very advanced but does suggest that these effects play very important roles on ecosystem functioning. We cannot duplicate these effects through any other means. See Fire Ecology of the Mid-Columbia Area (Evers et al, In Press) for a more thorough discussion of this concern.

The Northwest Forest Plan requires that we use Forest Plan standards and guidelines for woody debris, litter, duff, and snag retention goals where they provide greater levels. The Mt. Hood Forest Plan requires greater levels that the Northwest Forest Plan. In the Crest Zone, the guidelines are compatible with managing wildfire risk. In portions of the Transition Zone (Fire Group 3) and in all the Eastside Zone, the coarse woody debris, litter, and duff retention guidelines are too high to successfully manage the wildfire risk. The snag guidelines require higher levels of snags than may have naturally occurred in the Eastside Zone.

Data and Analysis Gaps:

- Particulate emissions analysis trade-off on prescribed vs wildfire in Fire Groups 1, 2, 3, and 9.
- Cumulative effects of harvesting coupled with burning.

Restoration Projects:

- Redo Natural Fuels IRA to encompass Bear Springs and establish a program to restore fire to all or part of Fire Groups 1, 2, 3, and 9, including within the Badger Wilderness.
- Establish a cooperative prescribed burning program with ODFW for state owned and managed inholdings within the National Forest boundary in Fire Groups 1, 2, 3, and 9.

Roles and Risks of Insects and Disease

Roles of Insects and Disease. Insects and disease serve to create snags and snag patches, reduce stocking levels, favor non-host species, cycle nutrients, and start secondary succession. In the Crest and portions of the Transition Zones, epidemic levels of insects and disease are often closely tied to fire. A major outbreak of either or both results in more open canopies and a sudden and dramatic increase in fuel loadings. The fuels dry earlier in the season and fuel moisture levels drop below critical thresholds earlier in the season. A large fire eventually burns through an area and may involve a larger area than that affected by the insect or disease outbreak. In turn, fire-damaged trees become more susceptible to insect and disease attack.

Research has shown that bark beetles and disease attack both healthy and susceptible trees with equal frequency. The healthy trees are usually able to eliminate the attackers. During an epidemic outbreak, however, high population levels of bark beetles or disease can overcome the defenses of even healthy trees. Bark beetles often serve as a vector for stem rots and stains.

Outbreaks of defoliating insects are closely tied to population levels of host species. As long as the foliage levels remain above a critical threshold, the defoliator species population levels will remain high. Defoliators are subject to viruses once their population levels reach a critical threshold. The viruses work on either digestive tracts of the larvae, causing them to starve to death, or on the pupae, causing them to not mature or rot.

Diseases operate in a similar fashion as insects. During periods of stress due to lack of moisture or nutrients, diseases are more successful in attacking and killing trees. Some diseases have an affinity for certain species, although most diseases are not as species-specific as insects. Diseases which are more species-specific, such as white pine blister rust, tend to remain at high levels as long as the host species remains at high levels. Root diseases and dwarf mistletoe appear to be the most wide-spread of the diseases present. Some stem diseases are present, but do not appear to be significant.

Only certain insects and disease are of concern in White River subbasin:

Species	Host	Zone	Damage
western pine beetle *Dendroctonus brevicomis*	ponderosa pine	Eastside	Successfully attacking large diameter trees, usually over 15" DBH; introduces blue stain fungi
mountain pine beetle *Dendroctonus ponderosae*	all pines	Eastside	Successfully attacking ponderosa pine, usually trees 5-15" DBH; introduces blue stain fungi
Douglas-fir beetle *Dendroctonus pseudotsugae*	Douglas-fir	Eastside and Transition	Minor species thus far. Attacks trees over 12" DBH, introduces blue stain fungi
fir engraver beetle *Scolytus ventralis*	grand fir, occasionally Douglas-fir and western hemlock	Transition	Usually top kills tree; killing entire trees north of White River. Root disease a precursor
western spruce budworm *Choristoneura occidentalis*	true firs	Crest and Transition	Widespread mortality in Badger Creek Wilderness and Frog Lake Buttes. Scattered mortality elsewhere, primarily below subalpine zone
armillaria root rot *Armillaria ostoyae*	primarily Douglas-fir and grand fir, but all conifers may be attacked	Transition	Scattered mortality, increases susceptibility to fir engraver beetle, trees less windfirm
laminated root rot *Phellinus weirii*	Primarily Douglas-fir, grand fir, and western hemlock	Transition	Mortality and windthrow, increases susceptibility to fir engraver beetle; major root disease south of White River
annosus root rot *Fomes annosus*	Douglas-fir, grand fir, ponderosa pine	Transition	Mortality and windthrow, increases susceptibility to fir engraver; major root disease north of White River
white pine blister rust *Cronartium ribicola*	western white pine, whitebark pine	Transition and Crest	Mortality; significant only in western white pine south of White River
comandra blister rust *Cronartium comandrae*	ponderosa pine and lodgepole pine	Transition	Top kill or mortality; found in one off-site plantation in Lower Boulder POA but spreading into adjacent stand
dwarf mistletoe *Arceuthobium* spp.	primarily grand fir, Douglas-fir, western larch, and ponderosa pine	Transition and Eastside	witches brooms, deformed trees, poor self-pruning

Downed Wood

Information on pre-1855 levels of downed wood is non-existent. We essentially have no information on historic levels for any size classes, cover types, plant associations, or structural stages of stands that have not been affected by management activity, including fire exclusion. We evaluated several sources of information on downed wood in general from elsewhere in the Intermountain West and from the plant association guide for the Mt. Hood National Forest that covers the ponderosa pine, Douglas-fir, and grand fir series. From this information we used expert opinion to decide on what the range of natural conditions for down wood may have been in the Eastside, Crest, and Transition Zones.

Northern Rocky Mountains. The most detailed information on down wood is described by Brown and See (1981) for the northern Rocky Mountains (northern Idaho and Montana). Data from forests west of the Continental Divide are more indicative of conditions in the White River subbasin. These forests include the Colville (now part of Region 6), Kaniksu, Nez Perce, Clearwater, Kootenai, Flathead, Bitterroot, and Lolo. We also used data from the Forest Inventory since the sample points were taken on a grid pattern in randomly chosen management subcompartments. As such they should represent forest-wide conditions. Data from stand exams was not used since this data was taken in stands rated as "high risk" and where the district or forest expected to schedule timber harvest. These high risk stands often contained dead and dying trees, so that the down wood levels were above "normal" amounts.

In general, we assumed the following relationships between cover types in the northern Rockies and climate zones in White River subbasin:

- Ponderosa pine = Eastside Zone
- Larch-grand fir and Douglas-fir = Transition Zone
- Cedar-hemlock and Spruce-fir = Crest Zone

These relationships are based on knowledge of what these cover types typically look like and where they occur in the northern Rockies and how similar they are to the climate zones described for White River subbasin. We used the mean loadings (tons/acre) plus and minus one standard deviation to develop a range of potential loadings. Where two cover types are used, the low end of the range equals the lowest loading between the two cover types and the high end equals the highest.

Mean loadings

Zone	1/4 - 1 inches	1 - 3 inches	>3 inches	Total	Duff Depth
	----------tons/acre----------				inches
Eastside	0.9	1.6	10.4	13	0.6
Transition	1.0 - 1.3	1.8 - 2.3	12.9 - 17.7	16 - 21	0.9 - 1.2
Crest	1.0 - 1.3	1.9 - 2.7	23.8 - 29.4	27 - 38	1.4

Range of loadings

Zone	1/4 - 1 inches	1 - 3 inches	>3 inches	Total	Duff Depth
	----------tons/acre----------				inches
Eastside	0 - 2.3	0 - 5.5	0 - 33.7	0 - 38	0 - 1.7
Transition	0 - 2.5	0 - 6.1	0 - 46.1	0 - 50	0 - 2.6
Crest	0 - 2.5	0 - 7.1	0 - 78.2	0 - 83	0 - 3.3

Of the greater than 3 inch material, approximately 50-65% of it was rated as rotten. Rotten logs only had to show visible signs of rot to be classified as such. The report provided percentage breakdowns by additional size classes for the larger material for cover types considered representative of the Crest and Transition Zones:

- 3-6 inches: 9-14%
- 6-10 inches: 21-28%
- 10-20 inches: 45-47%
- 20+ inches: 13-23%

Plant Association Guide for the Ponderosa Pine, Douglas-fir, and Grand Fir Zones. This plant association guide includes downed woody inventories for the Douglas-fir and grand fir plant associations. However, this is the only guide for the Mt. Hood National Forest that includes this information. The associations in the guide fall within the Eastside Zone (Douglas-fir associations) and part of the Transition Zone (grand fir associations). As such the data available applies only to a portion of White River subbasin. The data were taken in the 1980s. The loadings shown are from relatively unmanaged stands. In this regard, little or no timber harvest has occurred or occurred recently.

Mean loadings

Zone	1/4 - 1 inches	1 - 3 inches	>3 inches	Total
	tons/acre			
Eastside	1.1-2.2	1.0-2.3	1.0-7.0	3.4-11.5
Transition	1.0-3.1	0.8-4.7	4.4-35.7	8.8-39.2

Recent research on the Olympic National Forest revealed the importance of leaving live trees over much of the harvested area. This study examined a clearcut where all trees were removed and the resulting opening seeded to a non-native grass. The grass took over the site and soil biological activity shifted from fungi-dominated to bacteria-dominated. Reforestation efforts did not begin until after the grass dominated the opening. Reforestation failed even after several attempts. One attempt involved growing seedling plugs in soil inoculated with mycorrhizal fungi. These trees also died after the roots grew out of the fungi-dominated soil and into the bacteria-dominated soil.

This study plus others by Alan Harvey, Russell Graham, Martin Jurgensen, and others strongly suggest that green trees and large logs need to remain at the number and distribution that maintains an active root system with mychorrizal fungi throughout the soil. Once the mycorrhizae have been removed from the area, reinnoculation must occur from the edges of the unit. This process can take many years.

Recommended Range of Conditions

In general the range of natural conditions equals the desired conditions. The ranges apply at the landscape level. That is, on average over that portion of a given subwatershed within the Crest Zone, large wood loading should range between 20-50 tons per acre. This range should provide for the needed levels to sustain long-term site productivity and wildlife habitat for log dependent species. We recognize that under natural conditions some areas could fall below the lower limit since we do not know the true full range.

We recommend the following guidelines:

- At the subwatershed level manage for the following percentages within each size class:

Size Classes[1]	Crest	Zone Transition	Eastside
3-6 inches	10-15%	10-15%	5-10%
6-12 inches	10-20%	15-25%	20-30%
12-20 inches	35-40%	40-50%	45-50%
20+ inches	25-45%	20-25%	15-25%

[1] Average diameter of log

- Within the Crest Zone, no more than 25% of each subwatershed should fall below 2X tons/acre.
- Within the Transition Zone no more than 15% of each subwatershed should fall below 1X tons/acre.
- Within the Eastside Zone no more than 10% of the forested area of each subwatershed should fall below 1X tons/acre.
- The 15% green tree retention guidelines in the Northwest Forest Plan should provide an adequate annual input of twigs, branches, and needles to quickly rebuild and/or maintain sufficient duff and 0-3 inch material to meet short-term nutrient needs. Therefore, the current guidelines in the Forest Plan may no longer be needed in units harvested under the standards and guidelines of the Northwest Forest Plan.
- In order to assure downed wood potential across harvested units the spacing between dispersed individual trees should not exceed 90% of the combined heights of the trees. For example, if two leave trees were each 100 feet tall, the spacing between these two trees should not exceed 180 feet.

REFERENCES

Abbot, H.L. 1857. Reports of explorations and surveys, Vol. VI. Senate Ex. Doc. No. 78. Beverly Tucker, Washington, DC [incomplete copy].

Bailey, W. 1912. The Barlow Road. The Quarterly of the Oregon Historical Society 13: 287-296.

Barlow, M.S. 1902. History of the Barlow Road. The Quarterly of the Oregon Historical Society 3: 71-81.

Barlow, W. 1912. Reminiscences of seventy years. The Quarterly of the Oregon Historical Society 13: 240-286.

Brown, J.K. and T.E. See. 1981. Downed dead woody fuel and biomass in the norther Rocky Mountains. Gen. Tech. Rep. INT-117. USDA Forest Service, Intermoutain Forest and Range Experiment Station, Ogden, UT. 48 p.

Evers, L., J. COlby, R. Crump, R. Dobson, and H. Hubbs. In Press. Fire ecology of the mid-Columbia area. USDA Forest Service, Pacific Northwest Region, Portland, OR.

Habeck, J.R. 1994. Using General Land Office records to assess forest succession in ponderosa pine/Douglas-fir forests in western Montana. Northwest Science 68(2): 69-78.

Langille, H.D., F.G. Plummer, A. Dodwell, T.F. Rixon, and J.B. Leiberg. 1903. Forest conditions in the Cascade Range Forest Reserve, Oregon. Professional Paper No. 9. USDI United States Geological Survey, Washington, DC. 298 p.

Palmer, J. 1847. Journal of travels over the Rocky Mountains to the mouth of the Columbia River; made during the years 1845 and 1846. Ye galleon Press, Fairfield, Washington. 186 p.

Sawyer, R.W. 1932. Abbot railroad surveys, 1855. The Quarterly of the Oregon Historical Society 23: 1-24, 115-135.

APPENDIX B--SPECIES PRESENT IN WHITE RIVER SUBBASIN

Animals

Common Name	Species	Comments
	BIRDS	
osprey	*Pandion haliaetus*	Rare, has nested
bald eagle	*Haliaceetus eucocephalus*	Threatened, winter
northern harrier	*Circus cyaneus*	
sharp-shinned hawk	*Accipiter striatus*	
Cooper's hawk	*Accipiter cooperii*	
northern goshawk	*Accipiter gentilis*	State sensitive
Swainson's hawk	*Buteo swainsoni*	State sensitive, summer
red-tailed hawk	*Buteo jamaicensis*	
ferriginous hawk	*Buteo regalis*	State sensitive, winter
rough-legged hawk	*Buteo lagopus*	Winter
golden eagle	*Aquila chrysaetus*	Uncommon
American kestrel	*Falco sparverius*	
peregrine falcon	*Falco peregrinus*	Endangered, off-NF lands
prairie falcon	*Falco mexicanus*	Rare, summer
turkey vulture	*Cathartes aura*	Summer
gray partridge	*Perdix perdix*	Uncommon, introduced, Postage Stamp Butte area
chukar	*Alectoris chukar*	Uncommon, introduced
French red-legged partidge	*Alectoris rufa*	Rare, introduced
ring-necked pheasant	*Phesianus colchicus*	Introduced
blue grouse	*Dendragapus obscurus*	Uncommon
ruffed grouse	*Bonasa umbellus*	Uncommon
wild turkey	*Meleagris gallopavo*	Introduced
California quail	*Callipepla californica*	
mountain quail	*Oreortyx pictus*	Uncommon
Sora rail	*Porzana carolina*	Uncommon, summer
American coot	*Fulica americana*	
sandhill crane	*Grus canadensis*	State sensitive, migration
killdeer	*Charadrius vociferus*	Summer
spotted sandpiper	*Actitis macularia*	Rare, summer
common snipe	*Gallinago gallinago*	
Wilson's phalarope	*Phalaropus tricolor*	Uncommon, spring
ring-billed gull	*Larus delawarensis*	Summer
California gull	*Larus californicus*	Summer
band-tailed pigeon	*Columba fasciata*	Uncommon, spring and fall

Common Name	Species	Comments
mourning dove	*Zenaida macroura*	Summer
barn owl	*Tyto alba*	Summer
flammulated owl	*Otus flammeolus*	State sensitive
western screech owl	*Otus kennicottii*	Uncommon
great horned owl	*Bubo virginianus*	
snowy owl	*Nyctea scandiaca*	Rare, winter
northern pygmy owl	*Glaucidium gnoma*	State sensitive
northern spotted owl	*Strix occidentalis*	Threatened
barred owl	*Strix varia*	
great gray owl	*Strix nebulosa*	State sensitive
northern saw-whet owl	*Aegolius acadicus*	Uncommon
common nighthawk	*Chordeiles minor*	Summer
poorwill	*Phalaenoptilus nutallii*	Summer
Vaux's swift	*Chaetura vauxi*	Rare, summer
black chinned hummingbird	*Archilochus alexandri*	Summer
calliope hummingbird	*Stellula calliope*	Summer
rufous hummingbird	*Selasphorus rufus*	Summer
belted kingfisher	*Ceryle alcyon*	
Lewis' woodpecker	*Melanerpus lewis*	State sensitive, drastic fluctuation
red-breasted sapsucker	*Sphyrapicus ruber*	Rare, summer
red-naped sapsucker	*Sphyrapicus nuchalis*	
Williamson's sapsucker	*Sphyrapicus thyroideus*	State sensitive
downy woodpecker	*Picoides pubescens*	Uncommon
hairy woodpecker	*Picoides villosus*	
white-headed woodpecker	*Picoides albolarvatus*	State sensitive, summer
three-toed woodpecker	*Picoides tridactylus*	State sensitive
black-backed woodpecker	*Picoides arcticus*	State sensitive
northern flicker	*Colaptes auratus*	
pileated woodpecker	*Dryocopus pileatus*	State sensitive
olive-sided flycatcher	*Contopus borealis*	Summer
western wood-pewee	*Contopus sordidulus*	Summer
willow flycatcher	*Empidonax traillii*	Summer
Hammond's flycatcher	*Empidonax hammondii*	Summer
dusky flycatcher	*Empidonax oberholseri*	Summer
Pacific slope flycatcher	*Empidonax difficilis*	Summer
Say's phoebe	*Sayornis saya*	Summer
ash-throated flycatcher	*Myiarchus cinerascens*	Uncommon, summer
western kingbird	*Tyrannus verticalis*	Summer
eastern kingbird	*Tyrannus tryannus*	Uncommon, summer

Common Name	Species	Comments
horned lark	*Ermophila alpestris*	
tree swallow	*Tachycineta bicolor*	Summer
violet-green swallow	*Tachycineta thalassina*	Summer
barn swallow	*Hirundo rustica*	Summer
gray jay	*Perisoreus canadensis*	Uncommon
steller's jay	*Cyanocitta stelleri*	
scrub jay	*Aphelocoma coerulescens*	
Clark's nutcracker	*Nucifraga columbiana*	Uncommon
black-billed magpie	*Pica pica*	
American crow	*Corvus brachyrhynchos*	Summer
common raven	*Corvus corax*	
black-capped chickadee	*Parus atricapillus*	
mountain chickadee	*Parus gambeli*	
chestnut-backed chickadee	*Parus rufescens*	
plain titmouse	*Parus inornatus*	Uncommon
bushtit	*Psaltriparus minimus*	Uncommon, fall and winter
red-breasted nuthatch	*Sitta canadensis*	Uncommon
white-breasted nuthatch	*Sitta carolinensis*	
pygmy nuthatch	*Sitta pygmaea*	State sensitive, uncommon
brown creeper	*Certhia americana*	Uncommon
canyon wren	*Catherpes mexicanus*	Uncommon
Bewick's wren	*Thryomanes bewickii*	Uncommon
house wren	*Troglodytes aedon*	Uncommon
winter wren	*Troglodytes troglodytes*	Uncommon
American dipper	*Cinclus mexicanus*	Uncommon
golden-crowned kinglet	*Regulus satrapa*	Uncommon, summer
ruby-crowned kinglet	*Regulus calendula*	Uncommon, summer
western bluebird	*Scialia mexicana*	State sensitive, summer
mountain bluebird	*Scialia currucoides*	Uncommon, summer
Townsend's solitaire	*Myadestes twonsendii*	Summer
American robin	*Turdus migratorius*	Summer and migration
varied thrush	*Ixoreus naevius*	Uncommon
hermit thrush	*Catharus guttatus*	
gray catbird	*Dumetella carolinensis*	Rare, summer
sage thrasher	*Oreoscoptes montanus*	Uncommon
cedar waxwing	*Bombycilla cedrorum*	Uncommon, spring and summer
loggerhead shrike	*Lanius ludovicianus*	Uncommon
European starling	*Sturnus vulgaris*	Introduced
solitary vireo	*Vireo solitarius*	Uncommon, summer

Common Name	Species	Comments
warbling vireo	*Vireo gilvus*	Summer
orange-crowned warbler	*Vermivora celata*	Uncommon, summer
yellow warbler	*Dendroica petechia*	Summer
yellow-rumped warbler	*Dendroica coronata*	Summer
Townsend's warbler	*Dendroica townsendi*	Uncommon, summer
black-throated gray warbler	*Dendroica nigrescens*	Uncommon, summer
hermit warbler	*Dendroica occidentalis*	Uncommon, summer
MacGillivray's warbler	*Oporornis tolmiei*	Uncommon, summer
common yellowthroat	*Geothlypis trichas*	Uncommon, summer
Wilson's warbler	*Wilsonia pusilla*	Uncommon, summer
Nashville warbler	*Vermivora ruficapilla*	Summer
yellow-breasted chat	*Icteria virens*	Uncommon, summer
westen tanager	*Piranga ludoviciana*	Summer
black-headed grosbeak	*Pheucticus melanocephalus*	Uncommon, summer
lazuli bunting	*Passerina amoena*	Uncommon, summer
green-tailed towhee	*Pipilo chlorurus*	Summer
rufous-sided towhee	*Pipilo erythrophthalmus*	
chipping sparrow	*Spizella passerina*	Summer
vesper sparrow	*Pooecetes gramineus*	Uncommon, summer
savannah sparrow	*Passerculus sandwichensis*	
fox sparrow	*Passerella iliaca*	Uncommon
song sparrow	*Melospiza melodia*	
golden-crowned sparrow	*Zonotrichia atricapilla*	Uncommon, winter
white-crowned sparrow	*Zonotrichia leucophrys*	
lark sparrow	*Chondestes grammacus*	Summer
Oregon junco	*Junco hyemalis*	
red-winged blackbird	*Agelaius phoeniceus*	Summer
western meadowlark	*Sturnella neglecta*	Summer
Brewer's blackbird	*Euphagus cyanocephalus*	Summer
brown-headed cowbird	*Molthrus ater*	Introduced, uncommon, summer
northern oriole	*Icterus galbula*	Uncommon, summer
purple finch	*Carpodacus purpureus*	
house finch	*Carodacus mexicanus*	
Cassin's finch	*Carpodacus cassinii*	Summer
red crossbill	*Loxia curvirostra*	Uncommon
pine siskin	*Carduelis pinus*	
American goldfinch	*Carduelis tristis*	Summer
evening grosbeak	*Coccothraustes vespertina*	
house sparrow	*Passer domesticus*	Introduced

Common Name	Species	Comments
MAMMALS		
opossum	*Didelphis virginiana*	
vagrant shrew	*Sorex vagrans*	Uncommon
coast mole	*Scapanus orarius*	Uncommon
little brown myotis	*Myotis lucifugus*	
Townsend's big-eared bat	*Plecotus townsendii*	State sensitive
silvery-haired bat	*Lasioncycteris noctivagans*	
hoary bat	*Lasiurus cinereus*	
pallid bat	*Antrozous pallidus*	State sensitive
black bear	*Ursus americanus*	Uncommon
American marten	*Martes americana*	State sensitive
fisher	*Martes pennanti*	State sensitive
river otter	*Lutra canadensis*	Uncommon
long-tailed weasel	*Mustela frenata*	Uncommon
ermine	*Mustela erminea*	
mink	*Mustela vison*	
raccon	*Procyon lotor*	
badger	*Taxidea taxus*	
wolverine	*Gulo gulo*	State threatened
spotted skunk	*Spilogale putorius*	Uncommon
striped skunk	*Mephitis mephitis*	
coyote	*Canis latrans*	
red fox	*Vulpes vulpes*	
bobcat	*Felix rufus*	
cougar	*Felix concolor*	Uncommon, increasing
yellow-belly marmot	*Marmota flaviventris*	
California ground squirrel	*Spermophilus beecheyi*	
Townsend's ground squirrel	*Spermophilus townsendii*	Uncommon
least chipmunk	*Eutamias minimus*	
yellow-pine chipmunk	*Eutamias amoenus*	
silver grey squirrel	*Sciurus griseus*	
chickaree (pine squirrel)	*Tamiasciurus douglasii*	
northern flying squirrel	*Glaucomys sabrinus*	Uncommon
golden-mantled ground squirrel	*Callospermophilus lateralis*	
northern pocket gopher	*Thomoys talpoides*	
western pocket gopher		
Great Basin pocket mouse	*Perognathis parvus*	Uncommon
Ord's kangaroo rat	*Dipodomys ordii*	Uncommon
beaver	*Castor canadensis*	

Common Name	Species	Comments
deer mouse	*Peromyscus maniculatus*	
bushy-tailed woodrat	*Neotoma cinerea*	Uncommon
dusky-footed woodrat	*Neotoma fuscipes*	Uncommon
mountain phenacomys	*Phenacomys intermedius*	Status unknown
mountain vole	*Microtus montana*	Status unknown
longtail vole	*Microtus longicaudus*	Status unknown
sagebrush vole	*Lagurus curtatus*	Status unknown
Oregon vole	*Microtus oregoni*	Status unknown
muskrat	*Ondatra zibethicus*	
house mouse	*Mus musculus*	
Norway rat	*Rattus norvegicus*	Introduced, uncommon
jumping mouse	*Zapus princeps*	Uncommon
porcupine	*Erethizon dorsatum*	
snowshoe hare	*Lepus americanus*	
white-tailed jack rabbit	*Lepus townsendii*	State sensitive
black-tailed hare	*Lepus californicus*	
pika	*Ochotona princeps*	
brush rabbit	*Sylvilagus bachmani*	
mountain cottontail	*Sylvilagus nuttallii*	
Rocky Mountain elk	*Cervus canadensis canadensis*	Some hybrids
mule deer	*Odocoileus hemionus hemionus*	Rare, Some hybrids
black-tailed deer	*Odocoileus hemionus columbianus*	Some hybrids
pronghorn antelope	*Antilocapra americana*	Uncommon
	REPTILES	
long-nosed leopard lizard	*Gambelia wislizenii*	
sagebrush lizard	*Sceloporus graciosus*	
western fence lizard	*Sceloporus occidentalis*	
side-blotched lizard	*Uta stansburiana*	
northern alligator lizard	*Elgaria coerulea*	
southern alligator lizard	*Elgaria multicarinata*	
short-horned lizard	*Phrynosoma douglasii*	
western skink	*Eumeces skiltonianus*	
rubber boa	*Charina bottae*	
racer	*Coluber constrictor*	
sharp-tailed snake	*Contia tenuis*	State sensitive
ringneck snake	*Diadophis punctatus*	
night snake	*Hypsiglena torquata*	
striped whipsnake	*Masticophis taeniatus*	

Common Name	Species	Comments
gopher snake	*Pituophis melanoleucus*	
western terrestrial garter snake	*Thamnophis elegans*	
common garter snake	*Thamnophis sirtalis*	
Northwestern garter snake	*Thamnophis ordinoides*	
western rattlesnake	*Crotalus viridis*	
California mountain kingsnake	*Lampropeltis zonata*	State sensitive
	AMPHIBIANS	
Pacific giant salamander	*Dicamptodon tenebrosos*	
Northwestern salamander	*Ambystoma gracile*	
long-toed salamander	*Ambystoma macrodactylum*	
Cope's giant salamander	*Dicamptodon copei*	State sensitive
rough-skinned newt	*Taricha granulosa*	
ensatina	*Ensatina eschscholtzii*	
western toad	*Bufo boreas*	
bullfrog	*Rana catesbeiana*	Introduced
Pacific treefrog	*Pseudacris regilla*	
Great Basin spadefoot toad	*Scaphiopus intermontanus*	
northern leopard frog	*Rana pipiens*	
red-legged frog	*Rana aurora*	State sensitive
spotted frog	*Rana pretiosa*	State sensitive, Federal candidate
Cascade frog	*Rana cascadae*	State sensitive, Federal candidate
tailed frog	*Ascaphus truei*	State sensitive, Federal candidate
Pacific chorus frog	*Pseudarcis regilla*	
	FISH	
Redband rainbow trout	*Oncorhynchus mykiss gairdneri*	Endemic
summer steelhead trout	*Oncorhynchus mykiss gairdneri*	
rainbow trout	*Oncorhynchus mykiss* ssp.	Hatchery introduced
spring chinook salmon	*Oncorhynchus tshawytscha*	
brook trout	*Salvelinus fontinalis*	Introduced
sculpin	*Cottus* sp.	Species unidentified
longnosed dace	*Rhinchthys cataractae*	
mountain whitefish	*Prosopium williamsoni*	
smallmouth bass	*Micropterus dolomieui*	Introduced
largemouth bass	*Micropterus salmoides*	Introduced
brown bullhead	*Icatalurus nebulosus*	Introduced
bluegill	*Lepomis macrochirus*	Introduced
goldfish		Introduced

Common Name	Species	Comments
	INVERTEBRATES	
Cascades apatanian caddisfly	*Apatania tavala*	R6 Sensitive
Mt. Hood primitive caddisfly	*Eobrachycentrus gelidae*	R6 Sensitive
one-spot rhyacophilan caddisfly	*Rhyacophila unipunctata*	R6 Sensitive
Mt. Hood farulan caddisfly	*Farula jewetii*	R6 Sensitive
western pine beetle	*Dendroctonus brevicomis*	Pest
mountain pine beetle	*Dendroctonus ponderosae*	Pest
Douglas-fir beetle	*Dendroctonus psedutsugae*	Pest
fir engraver beetle	*Scolytus ventralis*	Pest
western spruce budworm	*Choristoneura occidentalis*	Pest

C-3 Plants: Occurrance and Potential for Occurrance

I. POINTS OF INTEREST - SUMMARY

1. Appendix J2-172, Rare Gilled Mushrooms, *Cortinarius weibeae*, Section VII. C. Mitigation Measures: "Establish Mycologogical Interest Area to provide protection for the type locality (the only known location) of *C. weibeae*." Currently this species has documented occurrence only in the White River Watershed, MHNF.
2. Appendix J2-159, Section IV. E.: "According to chanterelle experts, our common chanterelle is not *Cantharellus cibarius*, but could be more related to or the same as *C. formosus*." *C. formosus* is in survey strategy 1 and 3; *C. cibarius* is in survey strategy 3 and 4.
3. Appendix J2-163, 164, Uncommon and Rare Coral Fungi, Section IV. E.: "The taxonomy of this group is currently being reviewed by Currie Marr." (Changes in grouping and ranking may or may not be necessary as a result.)
4. Appendix J2-166, 167, *Phaeocollybia*, Section IV. E.: "The genus is currently under investigation by Lorelei Norvell, [UW]. Therefore, improved knowledge . . . is forthcoming."
5. Appendix J2-168, Uncommon Gilled Mushrooms, Section IV.E.: "The distribution, frequency, and ecology of these species requires extensive study."
6. ROD C-58, Additional Lichens: Habitat information could not be found in Appendix J2 or available references for the following species--*Cladonia norvegica, Heterodermia sitchensis, Hygomnia vittiata.*
7. The most prevalent message in Appendix J2 regarding lichens and bryophytes: "Knowledge of distribution and ecology within the region is inadequate."

II. DISCREPANCIES

1. Appendix J2 and ROD C-3: Under Undescribed Taxa, Rare Truffles & False Truffles, sp. nov. #Trappe 7516 and 9608 are listed as *Gastrosuillus*. According to the PNW Research Station database of fingi, these species numbers are recorded as the genus *Gastroboletus*.
2. ROD C-3 Fungi, Rare Cup Fungi, page C-54: *Aleuria rhenana* and *Bryoglossum gracile* are not ranked under a survey strategy; however, Appendix J2, pages 198 and 199, Section C indicates a ranking of 1 and 3 is appropriate. This adjustment is made herein.

III. CODES USED IN THE ATTACHED TABLE

The attached table format is similar to the ROD Table C-3 on pages 49-61, with fungi groups listed first, lichen groups second, bryophytes third, and vascular plants last. Additional columns were added to incorporate habitat information and knwon range and/or geographic extent. Appendix J2, pages 83-247, provided a large percent of the information available regarding species range and geogrpahic extent. A format key is also attached. The key identifies codes used to expedite and condense this document. Among the codes is "D" for documented occurrence on the Mt. Hood National Forest. An asterisk (*) preceding a D indicates that there is a specimen of the species in our Forest Herbarium at the Supervisor's Office in Gresham.

Survey Strategy

1 = manage known sites
2 = survey prior to activities, manage sites
3 = conduct extensive surveys and manage sites
4 = conduct general regional surveys

Occurrence

D - Documented sites
P - Potential habitat present
N - Not likely to occur
? - Unknown, inadequate information

Trees and Shrubs

ABAM - *Abies amabalis* (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* species (manzanita)
CACH - *Castanopsis chrisophylla* (chinquapin)
CHNO - *Chamaecyparis nootkatensis* (Alaska yellow-cedar)
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)

IV. C-3 FUNGI

SPECIES	SURVEY STRATEGY	PRESENCE	HABITAT	KNOWN RANGE OR GEOGR. EXTENT
MYCHORRHIZAL FUNGI:				
	BOLETES			
Gastroboletus subalpinus	1, 3	D	above 4500', ectomychorrizal with pines	Endemic OR Casc. and N. Sierras
Gastroboletus turbinatus	3	D	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 ELEV.				
Boletus piperatus	3	D	low-mid elev. forests, requires coarse woody debris in PSME	Unknown
Tylopilus pseudoscaber	1, 3	?	low elev., moist habitat, often with PISI	PNW coast endemic
RARE BOLETES				
Boletus haematinus	1, 3	P	high elevation ABAM	CA north to WA
Boletus pulcherrimus	1, 3	P	low-mid elev. conifer	CA to Canada, north to Olympics
Gastroboletus imbellus	1, 3	P	upper mid elev. (5000') w/ ABAM, ABGR, PSME, TSHE, TSME, possibly ectomychorrizal with pine	locally endemic to Willamette NF (WNF) Ollalie Trail and Lamb Butte Scenic
Gastroboletus rubur	1, 3	P	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	P	mid-high elev. in mature forests w/abundant large woody debris (relies on mammals for dispersal)	Cascade Mts. of CA north to Mt. Adams and northern ID
Rhizopogon abietis, *R. atroviolaceus,* *R. truncatus*	3	P	high elev. mixed conifer (true firs, pines, PSME, TSME) in moderate to dry sites	E Canada, E USA, N. Rockies, Strawberry Mtns, OR, Casc. and Klam. mtns.
Thaxterogaster pinque	3	D	only mid-high elev. true firs w/ thick humus, LWD	Casc. mtns. south of Canadian border to N. Sierras, Sisk. mtns OR, Klam. mtns CA
UNCOMMON FALSE TRUFFLES				
Macowanites chlorinosmus	1, 3	?	low elev. PISI, PSME, TSHE with LWD	endemic OR coast and Coast Ranges
RARE FALSE TRUFFLES				
Alpova alexsmithii	1, 3	P	mid to upper elev. w/true firs, TSHE and possibly pines	endemic to Casc. mtns & Brit. Col. Coast Range
Alpova olivceotinctus	1, 3	?	a single site known in the range of n. spotted owl w/Shasta fir	Unknown
Arcangeliella crassa, *A. lactarioides*	1, 3	?	mid-high elev. montane forests with Abies spp. and/or PSME	western OR, N. CA mtns, Shasta/Lassen

Destuntzia fusca, D. rubra	1, 3	P	low to lower-mid elev. in varioously mixed true firs, TSHE, PSME, oaks, pines, redwood	Mendocino Cnty, CA & WNF, Linn City
Gautieria magnicellaris	1, 3	P	high elev. w/ TSME and true firs	WNF, Klamath NF (KNF), Mt. Wash. Wild., NE USA, Germany, Czechoslovakia
Gautieria otthii	1, 3	P	mid to upper-mid elev. ectomychorrizal w/Pineceae	N CA, Sisk. mtns, OR central Casc., Europe, AK
Leucogaster citrinus	1, 3	P	low to high elev. w/PSME, TSHE, CACH, ARsp, tanoak, or in stands w/LWD	Mendocino Cnty, CA north to Linn & Benton Counties
Leucogaster microsporus	1, 3	P	mid elev. w/PSME or in stands w/abundant LWD	Slopes of W. Casc mtns, N. Casc & Coast Range, OR to S. Casc. of WA
Macowanites lymanensis	1, 3	?	mid elev. old growth TSME/ABPR forest	Lyman Lake, Wenatchee NF
Macowanites mollis	1, 3	P	mid elev. mature to old growth PSME, pines	Mt. Rainier NP, Larch Mt, MHNF
Martellia idahoensis	1, 3	P	mid-upper mid. elev. w/true firs & Pineceae	Coast Range SNF, Cascade Range WNF, N ID
Martellia monticola	1, 3	P	mid-high elev. old growth TSME/Abies spp.	central to north OR Cascades
Octavianiana macrospora	1, 3	P	mt. foothills in PSME/TSME old growth forest	former Twin Bridges CG
Octavianiana papyracea	1, 3	?	coastal moixed PSME/TSME/PISI forest in a fog belt	Humbolt CO, CA
Rhizopogon brunneiniger	1, 3	D	low-high elev. dry old growth PSME/TSME/fir/pine forest	N. OR Casc. & Coast ranges, N. CA
Rhizopogon evadens var. *subalpinus*	1, 3	P	upper mid elev. TSME/fir/pine forest near timberline	N CA to WA and ID
Rhizopogon exiguus	1, 3	P	moist-dry mature to old growth PSME/TSME low-mid elev. forest	Casc. mtns of WA , and OR Coast ranges
Rhizopogon flavofibrillosus	1, 3	P	mid-upper mid elev mature to old growth mixed conifer forest	N CA, Siskiyou mtns, central Cascades of OR
Rhizopogon inquinatus	1, 3	P	mid-upper mid elev. mature to old growth PSME forest	S. Santiam River, WNF, & ID
Sedecula pulvinata	1, 3	?	mid-high elev. old growth TSME/Abies spp.	Mt., Shasta to Yuba Pass, CA; CO
UNDESCRIBED TAXA, RARE TRUFFLES, & FALSE TRUFFLES				
Alpova sp. nov. Trappe #9730, #1966; *Arcangeliella* sp. nov. Trappe #12382	1, 3	?	mid-high elev. mature to old growth PSME/PILA/ARsp/ PIAT/ABMASH forest	Siskiyou mtns of SW OR
Arcangeliella sp. nov. Trappe #12359	1, 3	?	mature to old growth PISI/TSME/PSME coastal fog belt forest	Lane, Lincoln, & Tillamook counties, OR
Chamonixia pacifica sp. nov. Trappe #1038	1, 3	?	upper mid elev. old growth PSME/TSME/PISI/ABAM forest	N. coastal OR and N Cascades of WA

Elaphomyces sp. nov. Trappe #12768	1, 3	?	mature to old growth PISI/TSME/PSME coastal fog belt forest	Lane, Lincoln, and Tillamook counties, OR
Gastroboletus sp. nov. Trappe #2897	1, 3	?	mid-high elev. mature to old growth PSME/ PISI/ARsp/ PIAT/Shasta fir	Siskiyou mtns of SW OR
Gastroboletus sp. nov. Trappe #7515	1, 3	P	high elev. old growth TSME forest	Crater Lake NP
Gastrosuillus sp. nov. Trappe #7516	1, 3	P	high elev. mature to old growth true fir and coniferous forest	KNF, OR
Gastrosiullus sp. nov. Trappe #9608	1, 3	?	upper mid elev. mature mixed conifer forest with PILA	Lassen NF, CA
Gymnomyces sp. nov. Trappe #4703	1, 3	?	upper mid elev. mature ABPR forest	Suislaw NF (SNF) and Coast Range of OR
Gymnomyces sp. nov. Trappe #5052	1, 3	P	high elev. mature to old growth TSME/ABAM forest	Phlox Point, MHNF
Gymnomyces sp. nov. Trappe #1690, 1706, 1710	1, 3	P	upper mid elev. mature to old growth ABGR/ABPR/ABAM/ TSME forest	W OR Cascades, WNF
Gymnomyces sp. nov. Trappe #7545	1, 3	P	upper mid elev mature to old growth true fir and coniferous forest	KNF, OR
Hydnotrya sp. nov. Trappe #787, 792	1, 3	P	upper mid elev, old growth ABAM/TSME forest	Mt. Jefferson, WNF
Hydrotrya subnix sp. nov. Trappe #1861	1, 3	P	old growth ABAM forest	Gifford Pinchot NF (GPNF)
Martellia sp. nov. Trappe #311, 649	1, 3	P	high elev. mature to old growth TSME/ABAM forest	Phlox Point, MHNF
Martellia sp. nov. Trappe #1700	1, 3	P	upper mid elev. mature to old growth ABGR/ABAM/PSME/ TSME forest	WNF
Martellia sp. nov. Trappe #5903	1, 3	P	upper mid elev. old growth ABAM/TSME forest	Mt. Jefferson, WNF
Octavianina sp. nov. Trappe #7502	1, 3	P	upper mid elev mature to old growth ABGR/ABAM/PSME/ TSME forest	WNF
Rhizopogon sp. nov. Trappe #9432	1, 3	?	mid-high elev. mature to old growth PSME/PILA/ARsp/ PIAT/Shasta pine forest	Siskiyou mtns of SW OR
Rhizopogon sp. nov. Trappe #1692, 1698	1, 3	P	upper mid elev mature to old growth ABGR/ABAM/PSME/ TSME forest	WNF
Thaxterogaster sp. nov. Trappe #4867, 6242, 7427, 7962, 8520	1, 3	?	mature to old growth PISI/TSME/PSME coastal fog belt forest	Lane, Lincoln, and Tillamook counties, OR
Tuber sp. nov. Trappe #2302, 12493	1, 3	?	same as above	same as abover
RARE TRUFFLES				
Balsamia nigra	1, 3	P	low elev. mature xeric pine-oak forest	Sierra Nevada mtns CA to Yamhill CO, OR
Choiromyces alveolatus	1, 3	P	mid-high elev old growth TSME/Abies spp forest	Mt. Hood, OR to Yuba Pass, CA

Choiromyces venosus	1,3	P	low elev w/coniferous, decidious or mature PSME forest	Springfield, OR and Europe
Elaphomyces anthracinus	1, 3	P	mature PIPO forest	W Europe, E North Am., E OR Cascades
Elaphomyces subviscidus	1, 3	P	mid elev mature to old growth pine forest	central to S OR Cascades
RARE CHANTERELLES				
Cantharellus formosus	1, 3	P	coniferous and mixed forest	N CA, OR, and WA
Polyozellus multiplex	1, 3	P	intermittent streams of montane fir forest	N. Sierras, CA and OR & WA Cascades
Cantharellus cibarius, *C. subalbidus,* *C. tubaeformis*	3, 4	P	coniferous and mixed forest late-successional forest	N CA, OR, and WA
CHANTERELLES - GOMPHUS				
Gomphus bonarii, *G. clavatus,* *G. floccosus,* *G. kauffmanii*	3	P	late-successional western conifer forests	throughout region, esp. N CA
UNCOMMON & RARE CORAL FUNGI	(Appendix J2, p. 163-164)			
(*Ramaria* spp.)	1, 3 and 3	P	with TSHE, true firs, spruce, pines, PSME, and yew	N CA, OR, & WA. Overall distribution of individual species unknown
PHAEOCOLLYBIA	(Appendix J2, p. 166)			
(*Phaeocollybia* spp.)	1, 3	P	low elev to montane w/conifers, moist habitat, prefers low elev.	Distribution and frequency currently under study
UNCOMMON GILLED MUSHROOMS	(Appendix J2, p. 168)			
(*Catathelasma* spp., *Cortinarius* spp., *Dermocybe* spp., *Hebeloma* spp., *Hygrophorus* spp., *Russula* spp.)	1, 3 and 3	P	ectomychorrizal in low elv. to montane with conifers	Distribution and range of individual species unknown, some may be PNW endemics
RARE GILLED MUSHROOMS				
Chroogomphus loculatus	1, 3	P	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	P	Range and elev. of host species unknown. All require diverswe coniferous forests w/heavy humus layer and LWD	Oerall ecology and distribution not well known
Cortinarius verrucisporus	1, 3	P	high elev. montane w/true firs & conifers; hypogenous (fruits underground)	CA and OR
Cortinarius wiebeae	1, 3	D	same as above	local endemic, MHNF only known site
UNCOMMON ECTO-POLYPORES				
Albatrellus ellsii *A. flettii*	3	?	coastal old-growth and mixed hardwood forest	WA, OR, N CA, Rocky Mtns, NE US and Europe

RARE ECTO-POLYPORES				
Albatrellus avellaneus *A. caeruleoporus*	1, 3	?	coastal old-growth and mixed hardwood forest	WA, OR, N CA, Rocky Mtns, NE US and Europe
TOOTHED FUNGI				
Hydnum repandum *H. umbilicatum* *Phellodon atratum* *Sarcodon fuscoindicum* *S. imbricatus*	3	P	late successional and second growth conifer and hardwood forest	widespread in N America and Europe
RARE ZYGOMYCETES				
Endogone acrogena	1, 3	P	low elevation mesic old-growth PSME/TSME forest	W Cascades from Mt. Rainier to Whitechuck R.
Endogone oregonensis	1, 3	?	low elevation old-growth PSME/PISI/TSME coastal forest	Suislaw NF
Glomus radiatum	1, 3	P	mature to old-growth coastal redwood/Alaska cedar mesic wet forest	OR and WA Cascades, N CA, NE US
SAPROBES (DECOMPOSERS):				
UNCOMMON GILLED MUSHROOMS				
Species are collectively grouped. See Appendix J2, p. 179	1, 3 3	?	low-mid elev conifer ecosystems; on PISI, recently fallen logs or decomposed logs	N CA, OR, WA
RARE GILLED MUSHROOMS				
Clitocybe subitopoda *C. senilis*	1, 3	P	low-mid elev moist late successional forest, large logs in later stages of decay	WA, OR, CA
Neolentinus adherens	1, 3	P	low-mid elev moist late successional forest, large logs in later stages of decay	Olympic NP
Rhodocybe nitida	1, 3	P	low-mid elev moist late successional forest, large logs in later stages of decay	WA, OR, CA
Rhodocybe speciosa	1, 3	P	low-mid elev moist late successional forest, large logs in later stages of decay	Mt. Rainier NP to Barlow Pass
Tricholomopsis fulvenscens	1, 3	P	low-mid elev moist late successional forest, large logs in later stages of decay	Mt. Hood area, Mt. Rainier NP, Mt. Baker-Snoqualime NF (MBS)
NOBLE POLYPORE	***(rare and endangered)***			
Oxyporus nobilissimus	1, 2, 3	P	late successional forest on *Abies* spp., esp. *A. procera*	OR and WA Cascades
BONDARZEWIA POLYPORE				
Bondarzewia montana	1, 2, 3	P	late successional high elev forest in association with *Abies*	Pacific Northwest, W NV, ID
RARE RESUPINATES & POLYPORES				
Aleurodiscus farlowii	1, 3	P	on wood, humus, litter, stumps, and dead roots	WA, OR, N CA
Dichostereum grandulosum	1, 3	P	on wood, humus, litter, stumps, and dead roots	WA, OR, N CA

Cudonia monticola	3	P	duff layer of mature conifer forest	WA, OR, N CA
Gyromitra californica *G. esculenta* *G. infula* *G. melaleucoides* *G. montana (G. gigas)*	3, 4	P	decaying matter in soil and rotten wood in older forest (*G. ensculenta* prefers second growth)	northwestern N. America and Europe
Otidea leporina *O. onotica* *O. smithii*	3	P	conifer duff in moist-wet late successional mid-low elev conifer forest	Unknown
Plectania melastoma	3	P	late successional to old-growth conifer forest duff	NE and NW North America and Europe
Podostoma alutaceum	3	P	mature conifer & mixed conifer/hardwood forest duff	Pacific Northwest
Sarcosoma mexicana	3	P	late successional & old-growth high elevation forest	Coastal OR and WA
Sarcosphaera eximia	3	P	conifers aned Fagaceae sp. on chalky soils	Pacific Northwest, CA, Rockies, NE US, Europe
Spathularia flavida	3	P	duff layers of mature conifer forest	OR, WA, and N CA
RARE CUP FUNGI				
+Aleuria rhenana	1, 3	P	late successional forest litter	San Francisco to Mt. Rainier
+Bryoglossum gracile		P	mossy, wet alpine/subalpine montane conifer forest	arctic and alpine N America and Europe
Gelatinodiscus flavidus	1, 3	P	needles, cones, and twigs of high elevation CHNO	BC, Olympic Pennisula, OR and WA Cascades, central OR
Helvella compressa *H. crassitunicata* *H. elastica* *H. maculata*	1, 3	P	low-mid. elev riparian and wet late successional forest	temperate forested areas of N America
Neournula pouchetii	1, 3	P	late successional *Thuja* and *Tsuga* forest	N OR, WA
Pithya vulgaris	1, 3	P	high elevation *Abies* forest	BC, WA, ID, OR
Plectania latahensis	1, 3	P	upper montane, subalpine conifer forest	BC, WA, ID, OR
Plectania milleri	1, 3	P	montane, subalpine conifer forest	BC, WA, ID, OR
Pseudaleuria quinaultiana	1, 3	P	low elev wet late successional conifer forest on wood or soil	Olympic Pennisula, coastal OR & WA
CLUB CORAL FUNGI				
Clavariadelphus ligula *C. pistilaris* *C. truncatus* *C. borealis* *C. lovejoyae* *C. sachalinensis* *C. subfastigiatus*	3, 4	P	cool/cold moist late successional hardwood or conifer forest, increases in frequency with increasing latitude & elevation, needs well developed liter layer	Pacific Northwest, BC, AK, Midwest, and eastern N America
JELLY MUSHROOM				

Phlogoistis helvelloides	3, 4	P	riparian zones, upper headwater seeps, intermittent streams w/LWD	Pacific Northwest, Midwest, Rockies
BRANCHED CORAL FUNGI				
Clavulina cinerea *C. cristata* *C. ornatipes*	3, 4	P	late successional forest with well devloped litter layer	Pacific Northwest and elsewhere
MUSHROOM LICHEN				
Phytoconis ericetorum	3, 4	P	LWD in well lit forest with alternating high/low moisture, increases northward	CA to arctic, coast to subalpine elevation
PARASITIC FUNGI	(Appendix J2 p. 212)			
Species are collectively grouped. See Appendix J2, p. 212	3	P	late successional moist forest on a host fungus	Pacific Northwest, distribution and ecology are unknown
CAULIFLOWER MUSHROOM				
Sparassis crispa	3	P	low-mid elev old growth conifer forest on large roots, esp. PSME	Pacific Northwest and N CA
MOSS DWELLING MUSHROOM	(Appendix J2 p. 216)			
Species are collectively grouped. See Appendix J2, p. 216	3	P	late successional moist forest, closely associated with and dependent on mosses	Pacific Northwest, Olympic Pennisula
CORAL FUNGI				
Clavicorona avellanea	3	P	low-mid elev moist late successional forest on large roots	Pacific Northwest

V. C-3 LICHENS

SPECIES	SURVEY STRATEGY	PRESENCE	HABITAT	KNOWN RANGE OR GEOGR. EXTENT
RARE FORAGE LICHENS				
Bryoria tortuosa	1, 3	P	low-mid elev, coastally on conifers, inland in pine-oak wet regimes	Central CA to BC, Cascades
RARE LEAFY LICHENS				
Hypogymnia duplicata	1, 2, 3	?	low elev wet, foggy windy coast and maritime sites on conifers	OR to AK
Tholuma dissimilis	1, 3	P	subalpine fog zone on stunted TSME, canopy of old growth PSME	Montane areas of OR and WA
RARE NITROGEN-FIXING LICHENS				
Dendriscocaulon intricatulum	1, 3	P	low-mid elev. wet boreal, riparian, late successional forest	southern WA to SE AK
Lobaria hallii	1, 3	P	low-mid elev wet, foggy forest on large diameter hardwoods and on shrubs	central coastal CA to N AK
Lobaria linita	1, 3	P	old growth PSME and moist fir forest	N OR to SE AK, ID
Nephroma occultum	1, 3	P	pristine old growth approx. 400 years old	WNF to BC
Pannaria rubiginosa	1, 3	P	bases of trees in mature forest	Salem, OR & Mt. Rainier
Pseudocyphellaria rainierensis	1, 3	P	old growth forest on trunks of PSME	Cascades of OR and WA
NITROGEN-FIXING LICHENS				
Lobaria oregana	4	P	open 200 yr-old old growth & coastal foests on conifers	PNW Cascades
Lobaria pulmonaria	4	P	moist, hardwood, old growth forest & swamps	PNW Cascades
Nephroma bellum	4	P	open old growth and along roadsides	PNW Cascades
Nephroma helveticum	4	P	N. coastal, montane forests & foothills woodlands and valleys	PNW Cascades
Nephroma larvigatum	4	P	low elev. coastal and old growth forest	PNW Cascades
Nephroma parile	4	P	moist coniferous & deciduous old growth forests	PNW Cascades
Nephroma resupinatum	4	P	low-mid elev coastal and montane coniferous shady forests	PNW Cascades
Pannaria leucostictoides	4	P	low elev open coastal and old growth forest	PNW Cascades
Pannaria mediterranea	4	P	old growth forest 140-200 yr old	PNW Cascades
Pannaria saubinetii	4	P	old growth forest 140-200 yr old	PNW Cascades

Peltigera collina	4	P	low-mid elev coastal, montane, and old growth forests	PNW Cascades
Peltigera neckeri	4	P	old growth forest 140-200 yr old	PNW Cascades
Peltigera pacifica	4	P	old growth forest 140-200 yr old	PNW Cascades
Pseudocyphellaria anomala	4	P	low-mid elev coastal, montane, and old growth forests	PNW Cascades
Pseudocyphellaria anthrapsis	4	P	low-mid elev open coniferous old growth forest	PNW Cascades
Pseudocyphellaria crocata	4	P	old growth forest 140-200 yr old	PNW Cascades
Stricta beasuvoisii	4	P	old growth forest 140-200 yr old	PNW Cascades
Stricta fuliginosa	4	P	low elev coastal adn moist coniferous old growth forests	PNW Cascades
Stricta limbata	4	P	low-mid elev coastal and old growth forests	PNW Cascades
PIN LICHENS	(See Appendix J2 p 234-235)			

Species grouped collectively; all have potential to occur in MHNF watersheds. Three species listed below have special information.

Calicium adaequatum *C. viride* *Stenocybe clavata*	4	P	sheltered microsites w/high atmospheric humidity provided by old growth forest conditions; substrate and texture specific	PNW and N Europe; endemic to PNW
RARE ROCK LICHENS				
Pilophorus nigricaulis	1, 3	P	talus rock patches within old growth forest with low fire frequency	coastal OR, WA, BC
Stricta arctica	1, 3	?	rock outcrops in foggy wet coastal forest	coast range of OR
RIPARIAN LICHENS				
Centrelia cetrarioides	4	P	mid-low elev foggy riparian forest on older hardwood trees	coastal OR to AK
Collema nigrascens	4	P	low-mid elev foggy riparian forest mostly on QUGA	PNW to AK (to Equador)
Leptogium burnetiae var *hirsutum*	4	P	low-mid elev foggy riparian forest on older hardwood trees	PNW and N Europe
Leptogium cyanescens	4	P	low-mid elev foggy riparian forest on older hardwood trees	Equador to AK, including OR
Leptogium saturnium	4	P	low-mid elev boreal riparian forst on older hardwood trees	PNW, mostly Canada
Leptogium teretiusculum	4	P	low-mid elev foggy riparian forest on older hardwood trees	PNW and MT
Platismatia lacunosa	4	P	low-mid elev moist forest on decidous and hardwood trees	central OR to south central AK
Ramalina thrausta	4	P	low-mid elev boreal forest on hardwood and conifer trees	OR, WA, ID, MT. CA, BC
Usnea longissima	4	P	low-mid elev wet coniferous/ hardwood forests and swamps	northwest CA to AK
AQUATIC LICHENS				

Dermtocarpon luridum	1, 3	P	low-mid elevation streams	OR, CO, VA, BC
Hydrothyria venosa	1, 3	P	mid-high elev clear, cold streams in pristine old growth	central CA to central BC
Leptogium rivale	1, 3	P	low-mid elevation strerams	OR and MT
RARE OCEANIC INFLUENCED LICHENS				
Bryoria pseudocapillaris	1, 3	n	PISI forests, open sand dunes on coast	OR coast
Bryoria spiralifera	1, 3	n	pantropical areas, on pennisulas and headlands	northern CA
Bryoria subcana	1, 3	n	coastal bays and streams	CA, OR, AK
Buellia oidalea	1, 3	n	low elev dry coastal oak forest	Mexico to BC
Erioderma sorediatum	1, 3	n	stabilized sand dunes in old PISI and PICO forest	OR coast
Hypogymnia oceanica	1, 3	n	coast and maritime climates in old growth forest	Inland and coastal OR
Leioderma sorediatum	1, 3	n	stabilized sand dunes in old PISI and PICO forest	OR coast
Leptogium brebissonii	1, 3	n	stabilized sand dunes in old PISI and PICO forest	OR coast
Niebla caphalota	1, 3	n	promontories of land along windswept coasts	coastal S CA to maritime N WA
Pseudocyphellaria mougeotiana	1, 3	n	coastal old growth PISI forest	OR coast
Teloschistes flavicans	1, 3	P	dry uplands & prairies, on coastal shrubs	Equador to OR coasts
Usnea hesperina	1,3	n	broken dune PICO forest	OR coast
OCEANIC INFLUENCED LICHENS				
Centraria californica	1, 3	n	scrubby dune areas on old growth PICO	S CA to SE AK coasts
Heterodermia leucomelos	1, 3	n	large PISI in forested headlands	S CA to NW WA coasts
Loxospora sp nov "corallifera"	1, 3	n	old growth conifers on immediate coast	PNW coasts
Pyrrhospora quernea	1, 3	n	old growth conifers on immediate coast	S CA to N WA coasts
ADDITIONAL LICHENS	(Added after Appendix J2)			
Cladonia norvegica	3	?	unknown	unknown
Heterodermia sitchensis	3	?	unknown	unknown
Hygomnia vittiata	3	?	unknown	unk nown
Hypotrachyna revoluta	3	P	high elevation open forest	N CA, W OR, W WA
Ramalina pollinaria	3	n	low elevation north coastal forest with sandstone *outcroppings*	W OR and W WA
Nephroma isidiosum	3	?	unknown	unknown

VI. C-3 BRYOPHYTES

SPECIES	SURVEY STRATEGY	PRESENCE	HABITAT	KNOWN RANGE OR GEOGR. EXTENT
Antitrichia curtipendula	4	P	low-mid elev old growth forest canopies	N CA to N OR west of Cascades
Bartramiopsis lescurii **X**[1]	1, 3	P	old growth forest	PNW, esp. WA
Brotherella roellii **X**	1, 3	P	low-mid elev old growth forest on rotting llogs	WA Cascades
Diplophyllum albicans **X**	1, 3	n	coastal old growth TSME/PISI forest	unknown
Diplophyllum plicatum	1, 2	n	coastal PISI forest	W OR and W WA
Douinia ovata	4	P	low-mid elev. foggy old growth forest with ridges and rock outcrops	PNW Cascades and coast
Encalypta brevicolla var *crumiana* **X**	1, 3	P	foggy rock outcrops shaded by old growth forest	mountains of OR and WA
Herbertus aduncus **X**	1, 3	P	high elevation old growth forest	OR and WA Cascades and coast
Herbertus sakurali **X**	1, 3	?	foggy rocky faces in old growth forests	N OR coast range
Iwatsukella leucotricha **X**	1, 3	?	bark in old growth forest	N OR coast range
Kurzia makinoana	1, 2	P	low elevation old growth forest	OR and WA
Marsupella emarginata var *aquatica*	1, 2	P	mid-high elevation stream splash zones	OR Cascades
Orthodontlum gracile **X**	1, 3	n	old growth redwood forest	N CA and SW OR
Plagiochila satol **X**	1, 3	P	old growth forest on cliffs, rocks, and bark	PNW
Plagiochila semidecurrens var *crumniana* **X**	1, 3	P	low elevation shrub thickets, odl growth swamps, stream edges	WA
Ptilidium californicum	1, 2	P	conifers in old growth forest	N CA to WA
Racomitrium aquaticum **X**	1, 3	P	shaded moist rocks & streambanks of old growth forest	unknown
Radula brunnea **X**	1, 3	n	foggy rock walls in old growth forest	north coast range of OR
Scouleria marginata	4	P	splash zones of streams	PNW endemic
Tetraphis geniculata **X**	1, 3	P	low-mid elev old growth forest on shaded moist wood	N CA to W WA
Tritomaria exsectiformis	1, 2	P	old growth forest on moist shaded rocks	OR and WA
Tritomaria quinquedentata	1, 3	P	old growth forest on moist shaded rocks	OR and WA

[1] Added after Appendix J2

VII. C-3 VASCULAR PLANTS

SPECIES	SURVEY STRATEGY	PRESENCE	HABITAT	KNOWN RANGE OR GEOGR. EXTENT
Allotropa virgata	1, 2	D	1500-500' elev under closed canopy ABAM, ABGR, PICO, PSME; requires association w/fungus andvasc. plants (saprophytic)	east slopes Cascades to coast, BC to CA; disjunct in ID and MT
Arceuthodium tsugense	1, 2	P	parasitic primarily on TSHE older than 600 years and on shore pine	rare from AK south to CA and S OR
Aster vialis	1, 2	n	low elev w/mid successional conifers; thriving on edge habitats or in canopy openings	endemic to Lane, Linn, and Douglas counties, OR
Bensoniella oregana	1, 2	n	3000-5000' elev w/mixed evergreen and white fir, meadows, streams	coast range OR, CA; Douglas, Josephine, Curry, Roseberg counties OR
Botrychium minganese	1, 2	D	variable elev with THPL and /or ACCI, ACMA habitats	endemic to N America
Botrychium montanum	1, 2	D	3200-4100' (MHNF) in deep shade old growth THPL, seeps	endemic to western N America
Clintonia andrewsiana	1, 2	n	coastal redwood forest	CA coast
Coptis asplenifolia	1, 2	?	360-3600' w/ABAM, TSHE, THPL in cool, wet, shady habitats	OR coast range, WA Cascades, Olympic Pennisula
Coptis trifolia	1, 2	D	perimeters of small wetlands and swamps w/PSME	Disjunct in OR (MHNF); eastern OR
Corydalis aquae-gelidae	1, 2	?	1220-4260' on gravel bars in cold perrenial streams w/high canopy	GPF, MHNF, Salem BLM
Cypripedium fasciculatum	1, 2	?	1300-5300' in 60-100% shade by numerous plant communiities	western US
Cypripedium montanum	1, 2	P	broad rang eof habitats, presence of specific symbiotic fungi	all Cascade provinces (Wasco, Hood River counties)
Galium kamtschaticum	1, 2	P	seeps w/conifers and west Cascades riparian associated species	circumboreal Olympic and W WA Cascades provinces
Habenaria orbiculata	1, 2	?	mesic-dry mossy forest w/deep litter in TSHE and lower ABAM zones	uncommon, widespread, W WA Cascades provinces
Pedicularis howellii	1, 2	n	4200-6300' in mixed conifer/ shrub, edge of openings or damp shade	Endemic to the Siskiyou Mtns.
Scoliopus biglovei	1, 2	n	low elevation redwood forest	Endemic to CA, Siskiyou NF, Six Rivers NF

VIII. REFERENCES

Arno, S.F. and R.P. Hammerly. 1977. Northwest trees: identifying and understanding the region's native trees. The Mountaineers, Seattle, WA.

Arora, D. 1979. Mushrooms demystified. Second edition. Ten Speed Press, Berkeley, CA.

Bovey, R.B., J.E. Marsh, and D.H. Vitt. 1988. Mosses, lichens, and ferns of northwest North America. University of Washington Press, Seattle, WA.

Boyll, M. 1994. Ecologist, Mt. Hood National Forest (List of lichen specimens in the Mt. Hood National Forest herbarium). Personal communication.

Castellano, M. 1994. Mycologist, Pacific Northwest Research Station. (Database list of J2 and C-3 fungi species in Oregon and Washington) Personal communication.

Christy, J.A. 1994. Oregon Natural Heritage Program (C-3 bryophytes habitat and potential for occurrence on the Mt. Hood National Forest). Personal communication.

Cole, M. and M.E. Hale, Jr. 1988. Lichens of California. University of California Press, Berkeley, CA.

Forest Service and Bureau of Land Management. 1994a. Final supplemental environmental impact statement on management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. Appendix J2. USDA Forest Service, Pacific Northwest Region, Portland, OR.

Forest Service and Bureau of Land Management. 1994b. Standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl (ROD). USDA Forest Service, Pacific Northwest Region, Portland, OR.

Forest Service. 1994c. Sensitive plants of Mt. Hood National Forest. USDA Forest Service, Mt. Hood National Forest, Gresham, OR.

Geiser, L. 1994. Lichen specialist, Siuslaw National Forest, Corvallis, OR. (C-3 coastal lichen species, habitat types and potential for occurrence on the Mt. Hood National Forest). Personal communication.

Hale, M.E. 1979. How to know the lichens. Second edition. William C. Brown Co., Dubuque, IA.

Hickman, J.C. 1993. The Jepson manual, higher plants of California. University of California Press, Berkeley, CA.

Hitchcock, C.L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle, WA. 730 p.

Lawton, E. 1971. Moss flora of the Pacific Northwest. Hattori Botanical Laboratory, Nichinan, Japan.

Sullivan, M. 1994. District botanist, Zigzag/Columbia Gorge Ranger Districts, Mt. Hood National Forest (Species inventory list of fungi on Old Maid Flats, 109 species). Personal communication.

Vrilakas, S. 1994. Database contact, Oregon Natural Heritage Program. (C-3 species on the Oregon Natural Heritage Database list of rare, threatened, and endangered [species] of Oregon). Personal communication.

Wagner, D.H. 1994. Oregon Natural Heritage Program. (Synopsis of liverworts on the Oregon Natural Heritage Program list). Personal communication.

Known and Suspected Tree Species in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
ABAM	Abies amabilis	Pacific silver fir	N
ABGR	Abies grandis	grand fir	N
ABLA2	Abies lasiocarpa	subalpine fir	N
ABPR	Abies procera	noble fir	N
ACGLD	Acer glabrum douglasii	Douglas maple	N
ACMA	Acer macrophyllum	bigleaf maple	N
ALRH	Alnus rhombifolia	white alder	N-S
ALRU	Alnus rubra	red alder	N
ALSI	Alnus sinuata	Sitka alder	N-S
CHNO	Chamaecyparis nootkatensis	Alaska yellow-cedar	N-Rare
CONU	Cornus nuttallii	Pacific dogwood	N
JUCOM	Juniperus communis montana	common juniper	N
JUOC	Juniperus occidentalis	western juniper	N
LAOC	Larix occidentalis	western larch	N
LIBO	Libocedrus decurrens	incense-cedar	N
PIAL	Pinus albicaulis	whitebark pine	N
PICOL	Pinus contorta latifolia	lodgepole pine	N
PIEN	Picea engelmannii	Engelmann spruce	N
PIMO	Pinus monticola	western white pine	N
PIPO	Pinus ponderosa	ponderosa pine	N
POTR	Populus tremuloides	quaking aspen	N
POTR2	Populus trichocarpa	black cottonwood	N
PREM	Prunus emarginata	bittercherry	N
PRVI	Prunus virginiana	chokecherry	N
PSMEM	Pseudotsuga menziesii menziesii	Douglas-fir	N
QUGA	Quercus garryana	Oregon white oak	N
RHPU	Rhamnus purshiana	cascara buckthorn	N-S
SAGEM	Salix geyeriana meliana	Geyer willow	N-S
SALAL	Salix lasiandra lasiandra	Pacific willow	N-S
SAPHP	Salix phylicfolia pennata	tea-leaved willow	N-S
SASC	Salix scouleriana	Scouler's willow	N
SASI2	Salix sitchensis	Sitka willow	N
TABR	Taxus brevifolia	Pacific yew	N
THPL	Thuja plicata	western redcedar	N
TSHE	Tsuga heterophylla	western hemlock	N
TSME	Tsuga mertensiana	mountain hemlock	N

N = Native, N-S = Native, Suspected to occur

Known and Suspected Shrub Species in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
ACCI	Acer circinatum	vine maple	N
ACGLD	Acer glabrum douglasii	Douglas maple	N
ALINO	Alnus incana occidentalis	mountain alder	N
AMAL	Amelanchier alnifolia	serviceberry	N
ARNE	Arctostaphylos nevadensis	pinemat manzanita	N
ARPA	Arctostaphylos patula	greenleaf manzanita	N
ARUV	Arctostaphylos uva-ursi	kinnickinnick	N-S
ARAR	Artemisia arbuscula	low sagebrush	N
ARCA	Artemisia cana	silver sagebrush	N-S
ARRI	Artemisia rigida	stiff sagebrush	N
ARTR	Artemisia tridentata	big sagebrush	N
BEAQ	Berberis aquifolium	tall Oregongrape	N
BENE	Berberis nervosa	Cascades Oregongrape	N
BERE	Berberis repens	dwarf Oregongrape	N
BEGLH	Betula glandulosa hallii	Hall's birch	N-S
CAME	Cassiope mertensiana	Merten's mountain heather	N-S
CACH	Castanopsis chrysophylla	golden chinkapin	N
CEIN	Ceanothus integerrimus	deerbrush ceanothus	N
CEPR	*Ceanothus prostratus*	*mahala mat*	N
CESA	Ceanothus sanguineus	redstem ceanothus	N
CEVEV	Ceanothus velutinus velutinus	snowbrush ceanothus	N
CHNAA	Chrysothamnus nauseosus albicaulis	gray rabbitbrush	N
CHVI	Chrysothamnus viscidiflorus	green rabbitbrush	N-S
CLLI	Clematis ligusticifolia	western clematis	N
COSTO	Cornus stolonifera occidentalis	red-osier dogwood	N
COCOC	Corylus cornuta californica	California hazel	N
CRDOD	Crataegus douglasii douglasii	black hawthorn	N
CYSC	Cytisus scoparius	Scotch broom	I-W
GAHU	Gaultheria humifusa	alpine wintergreen	N-S
GASH	Gaultheria shallon	salal	N-S
HODI	Holodiscus discolor	oceanspray	N
KAMI	Kalmia microphylla	alpine laurel	N-S
KAOC	Kalmia occidentalis	western swamp laurel	N-S
LOCA2	Lonicera caerulea	sweet-berry honeysuckle	N-S
LOCI	Lonicera ciliosa	orange honeysuckle	N
LOCO	Lonicera conjugialis	purple-flower honeysuckle	N-S
LOIN	Lonicera involucrata	black twin-berry	N
MEFEG	Menziesia ferruginea glabella	fool's huckleberry	N
MYGA	Myrica gale	wax myrtle	N-S
OPHO	Oplopanax horridum	devil's club	N-S
PAMY	Pachistima myrsinites	Oregon boxwood	N
PHLE2	Philadelphus lewisii	syringa	N
PHEM	Phyllodoce empetriformis	red mountain-heather	N
PHGL	Phyllodoce glanduliflora	yellow mountain-heather	N-S
PHCA3	Physocarpus capitatus	Pacific ninebark	N
POFR	Potentilla fruticosa	shrubby cinquefoil	N-S
PUTR	Purshia tridentata	antelope bitterbrush	N
RHAL	Rhododendron albiflorum	Cascades azalea	N
RHMA	Rhododendron macrophyllum	rhododendron	N
RHDI	Rhus diversiloba	poison oak	N
RIBR	Ribes bracteosum	blue currant	N-S
RICEC	Ribes cereum cereum	wax currant	N

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Known and Suspected Shrub Species in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
RIHO	Ribes howellii	mapleleaf currant	N-S
RIHUP	Ribes hudsonianum petiolare	black currant	N-S
RILA	Ribes lacustre	prickly currant	N
RILO	Ribes lobbii	Lobb's gooseberry	N-S
RISA	Ribes sanguineum	red currant	N
RITR	Ribes triste	wild currant	N-S
RIVI	Ribes viscosissimum	sticky currant	N
RIWA	Ribes watsonianum	spiny gooseberry	N-S
ROCA2	Rosa canina	dog rose	I-S
ROGY	Rosa gymnocarpa	baldhip rose	N
RONUH	Rosa nutkana hispida	Nootka rose	N
ROPI	Rosa pisocarpa	clustered wild rose	N-S
ROWOU	Rosa woodsii ultramontana	pearhip rose	N
RUDI	Rubus discolor	Himalayan blackberry	I
RULE	Rubus leucodermis	blackcap	N
RUNI	Rubus nivalis	snow bramble	N
RUPA	Rubus parviflorus	thimbleberry	N
RUURM	Rubus ursinus macropetalus	Pacific blackberry	N
SACE	Sambucus cerulea	blue elderberry	N
SARAM	Sambucus racemosa melanocarpa	black elderberry	N-S
SOAU	Sorbus aucuparia	European mountain-ash	I-S
SOSCS	Sorbus scopulina scopulina	Cascade mountain-ash	N-S
SOSIG	Sorbus sitchensis grayi	Sitka mountain-ash	N
SPBEL	Spiraea betulifolia lucida	shiny-leaf spirea	N
SPDED	Spiraea densiflora densiflora	subalpine spirea	N-S
SPDOM	Spiraea douglasii menziesii	Menzie's spirea	N-S
SPPY	Spiraea pyramidata	pyramid spirea	N-S
SYALL	Symphoricarpos albus laevigatus	common snowberry	N
SYMOH	Symphoricarpos mollis hesperius	creeping snowberry	N
SYORU	Symphoricarpos oreophilus utahensis	mountain snowberry	N-S
VAAL	Vaccinium alaskaense	Alaska huckleberry	N-S
VACA	Vaccinium caespitosum	dwarf huckleberry	N-S
VADE	Vaccinium deliciosum	Cascades huckleberry	N-S
VAME	Vaccinium membranaceum	big huckleberry	N
VAOC2	Vaccinium occidentale	western huckleberry	N-S
VAOV	Vaccinium ovalifolium	oval-leaf huckleberry	N-S
VAOXI	Vaccinium oxycoccos intermedium	wild cranberry	N-Rare
VASC	Vaccinium scoparium	grouse whortleberry	N
VAUL	Vaccinium uliginosum	bog blueberry	N-S
VIED	Viburnum edule	high-brush cranberry	N-S

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Known and Suspected Grasses and Grass-like Plants in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
AGTR?	Agropryon tricophorum	pubescent wheatgrass	??
AGCAM	Agropyron caninum majus	bearded wheatgrass	N
AGCR	Agropyron cristatum	crested wheatgrass	I
AGDA	Agropyron dasystachyum	downy wheatgrass	N-S
AGIN2	Agropyron intermedium	intermediate wheatgrass	I
AGRE	Agropyron repens	quack grass	I-S
AGSM	Agropyron smithii	bluestem wheatgrass	N
AGSP	Agropyron spicatum	bluebunch wheatgrass	N
AGALA	Agrostis alba alba	red top bentgrass	I
AGALP	Agrostis alba palustris	creeping bentgrass	I-S
AGDI	Agrostis diegoensis	thin bentgrass	N-S
AGEX	Agrostis exarata	spike bentgrass	N-S
AGHO	Agrostis howellii	Howell's bentgrass	N-S
AGHU	Agrostis humilis	alpine bentgrass	N-S
AGID	Agrostis idahoensis	Idaho bentgrass	N-S
AGIN3	Agrostis interrupta	interrupted apera	I-S
AGOR	Agrostis oregonensis	Oregon bentgrass	N-S
AGSC	Agrostis scabra	winter bentgrass	N-S
AGTE	Agrostis tenuis	colonial bentgrass	I-S
AGTH	Agrostis thurberiana	Thurber bentgrass	N-S
AGVA	Agrostis variabilis	varient bentgrass	N-S
ALAE	Alopecurus aequalis	shortawn foxtail	N-S
ALGE	Alopecurus geniculatus	water foxtail	N-S
ALMY	Alopecurus myosuroides	black twitch	I-S
ALPR	Alopecurus pratensis	meadow foxtail	I-S
AREL	Arrhenatherum elatius	tall oatgrass	I
AVFA	Avena fatua	wild oat	I-S
BRCAC	Bromus carinatus carinatus	California brome	N
BRCO	Bromus commutatus	hairy brome	I
BRINI	Bromus inermis inermis	smooth brome	I
BRMO	Bromus mollis	soft brome	I
BROR	Bromus orcuttianus	Orcutt brome	N-S
BRRI	Bromus rigidus	ripgut	I-S
BRSE	Bromus secalinus	rye brome	I-S
BRST	Bromus sterilis	barren brome	I-S
BRSU	Bromus suksdorfii	Suksdorf's brome	N-S
BRTE	Bromus tectorum	cheatgrass	I
BRVUV	Bromus vulgaris vulgaris	Columbia brome	N
CABR7	Calamagrostis breweri	shorthair reedgrass	N
CACA	Calamagrostis canadensis	bluejoint reedgrass	N-S
CAPU	Calamagrostis purpurascens	purple reedgrass	N-S
CARU	Calamagrostis rubescens	pinegrass	N
CAAM	Carex amplifolia	big-leaf sedge	N
CAAP3	Carex aperta	Columbia sedge	N-S
CAAQ	Carex aquatilis	water sedge	N
CAAT	Carex athrostachya	slenderbeaked sedge	N-S
CAAU	Carex aurea	golden sedge	N-S
CABRB	Carex breweri breweri	Brewer's sedge	N-S
CABR6	Carex brunnescens	brown sedge	N-S
CABU3	Carex buxbaumii	Buxbaum's sedge	N-S
CACA4	Carex canescens	gray sedge	N-S
CACU2	Carex cusickii	Cusick's sedge	N-S

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Known and Suspected Grasses and Grass-like Plants in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
CADE	Carex deweyana	Dewey's sedge	N
CADI	Carex disperma	soft leaved sedge	N-S
CAEU	Carex eurycarpa	wide-fruit sedge	N-S
CAFR	Carex fracta	fragile-sheathed sedge	N-S
CAGE	Carex geyeri	elk sedge	N
CAHA2	Carex halliana	Hall's sedge	N
CAHO	Carex hoodii	Hood's sedge	N-S
CAHY	Carex hystricina	porcupine sedge	N-S
CAIL	Carex illota	sharp sedge	N-S
CAIN5	*Carex interior*	inland sedge	N-S
CAJO	Carex jonesii	Jone's sedge	N-S
CALA	Carex laeviculmis	smooth stoloned sedge	N-S
CALEL2	Carex lenticularis lenticularis	no common name	N-S
CALE6	Carex leporina	Sierra-hare sedge	N-S
CALE8	Carex leptalea	bristle-stalked sedge	N-S
CALI3	Carex limnophila	pond sedge	N-S
CALI	Carex limosa	mud sedge	N-S
CALU	Carex luzulina	woodrush sedge	N-S
CAME2	Carex mertensii	Merten's sedge	N
CAMI	Carex microptera	small-winged sedge	N-S
CAMU2	Carex muricata	muricate sedge	N-S
CANE?	Carex nebraskensis	Nebraska sedge	N
CANE2	Carex neurophora	alpine nerved sedge	N-S
CANI2	Carex nigricans	black alpine sedge	N
CAPA	Carex pachystachya	thick-headed sedge	N-S
CAPEV	Carex pensylvanica vespertina	long stoloned sedge	N
CAPH	Carex phaeocephala	dunhead sedge	N-S
CAPR	Carex praticola	meadow sedge	N-S
CARO	Carex rossii	Ross sedge	N
CARO2	Carex rostrata	beaked sedge	N
CASC5	Carex scopulorum	Holm's Rocky Mountain sedge	N-S
CASI2	Carex simulata	short-beaked sedge	N-S
CASI3	Carex sitchensis	Sitka sedge	N-S
CASP	Carex spectabilis	showy sedge	N
CAST	Carex stipata	sawbeak sedge	N-S
CAVEV	Carex vesicaria vesicaria	inflated sedge	N-S
CAVU	Carex vulpinoidea	fox sedge	N-S
CILA2	Cinna latifolia	wood reed	N-S
CYEC	Cynosurus echinatus	hedgehog dogtail	I-S
DAGL	Dactylis glomerata	orchardgrass	I
DACAC	Danthonia californica californica	California oatgrass	N
DAIN	Danthonia intermedia	timber oatgrass	N-S
DASPP	Danthonia spicata pinetorum	poverty danthonia	N-S
DAUN	Danthonia unispicata	onespike oatgrass	N
DEAT	Deschampsia atropurpurea	mountain hairgrass	N
DECEC	Deschampsia cespitosa cespitosa	tufted hairgrass	N
DEDA	Deschampsia danthonioides	annual hairgrass	N
DEEL	Deschampsia elongata	slender hairgrass	N
DUAR	Dulichium arundinaceum	dulichium	N-S
ECCR	Echinochloa crusgalli	watergrass	N-S
ELAC	Eleocharis acicularis	needle spike-rush	N-S
ELOV	Eleocharis ovata	ovoid spike-rush	N-S

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Known and Suspected Grasses and Grass-like Plants in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
ELPA	Eleocharis palustris	common spike-rush	N
ELPA2	Eleocharis pauciflora	few-flowered spike-rush	N-S
ELCA2	Elymus caput-medusae	medusahead wildrye	I
ELGLG	Elymus glaucus glaucus	blue wild rye	N
ELGLJ	Elymus glaucus jepsonii	blue wild rye	N
ERGR2	Eriophorum gracile	slender cottongrass	N
ERPO2	Eriophorum polystachion	many-spiked cottongrass	N
FEAR3	Festuca arundinacea	reed fescue	I
FEID	Festuca idahoensis	Idaho fescue	N
FEME	Festuca megalura	foxtail fescue	N-S
FEMI	Festuca microstachys	small fescue	N
FEMY	Festuca myuros	rat-tail fescue	N-S
FEOC	Festuca occidentalis	western fescue	N
FEOV	Festuca ovina	sheep fescue	N-S
FEOVB	Festuca ovina brevifolia	alpine fescue	N-S
FERUR	Festuca rubra rubra	red fescue	N-S
FESC	Festuca scabrella	rough fescue	N-S
FESU	Festuca subulata	bearded fescue	N-S
FEVI	Festuca viridula	green fescue	N
GLBO	Glyceria borealis	northern mannagrass	N-S
GLEL	Glyceria elata	tall mannagrass	N
GLSTS	Glyceria striata stricta	fowl mannagrass	N-S
HIOD	Hierochloe odorata	Seneca grass	N-S
HOLA	Holcus lanatus	common velvet-grass	I
HOBR	Hordeum brachyantherum	meadow barley	N-S
JUAC	Juncus acuminatus	tapered rush	N-S
JUBAB	Juncus balticus balticus	Baltic rush	N
JUBU	Juncus bufonius	toad rush	N
JUCOO	Juncus covillei obtusatus	Colville's rush	N-S
JUDRS	Juncus drummondii subtriflorus	Drummond's rush	N-S
JUEF	Juncus effusus	common rush	N
JUEFC	Juncus effusus compactus	soft rush	I-S
JUENE	Juncus ensifolius ensifolius	dagger-leaf rush	N
JUFI	Juncus filiformis	thread rush	N-S
JUME	Juncus mertensianus	Merten's rush	N-S
JUNEN	Juncus nevadensis nevadensis	Sierra rush	N-S
JUOR	Juncus orthophyllus	straight-leaved rush	N-S
JUPA	Juncus parryi	Parry's rush	N-S
JURE	Juncus regelii	Regel's rush	N-S
JUSU	Juncus supiniformis	spreading rush	N-S
JUTE	Juncus tenuis	slender rush	N-S
KOCR	Koeleria cristata	prairie junegrass	N
LEOR	Leersia oryzoides	soland	N-S
LOMU	Lolium multiflorum	Italian ryegrass	I-S
LOPE2	Lolium perenne	English ryegrass	I-S
LUCA2	Luzula campestris	field rush	N
LUHI	Luzula hitchcockii	Hitchcock's woodrush	N
LUPA	Luzula parviflora	smallflowered woodrush	N-S
MEBU	Melica bulbosa bulbosa	oniongrass	N
MESM	Melica smithii	Smith's melic	N-S
MESU	Melica subulata	Alaska oniongrass	N
MUFI	Muhlenbergia filiformis	pullup muhly	N

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Known and Suspected Grasses and Grass-like Plants in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
PAOC2	Panicum occidentale	western panicgrass	N-S
PASC	Panicum scribnerianum	Scribner witchgrass	N-S
PHAL	Phleum alpinum	alpine timothy	N
PHPR	Phleum pratense	timothy	I
PLRE	Pleuropogon refractus	nodding semaphoregrass	N-S
POAN	Poa annua	annual bluegrass	I-S
POBU	Poa bulbosa	bulbous bluegrass	I
POCO	Poa compressa	Canadian bluegrass	N
POCUP	Poa cusickii	Cusick's bluegrass	N-S
POGR2	Poa gracillima gracillima	Pacific bluegrass	N-S
POGR5	Poa grayana	Gray's bluegrass	N-S
POJU	Poa juncifolia	big bluegrass/alkali bluegrass	N
POLEL	Poa leptocoma leptocoma	bog bluegrass	N-S
PONEW	Poa nervosa wheeleri	Wheeler's bluegrass	N
POPA	Poa palustris	fowl bluegrass	I-S
POPR	Poa pratensis	Kentucky bluegrass	I
POSA3	Poa sandbergii	Sandberg's bluegrass	N
POMO	Polypogon monspeliensis	annual beard-grass	I-S
PUPAM	Puccinellia pauciflora microtheca	weak alkaligrass	N-S
RHAL3	Rhynchospora alba	white beakrush	N-S
SCCE2	Scirpus cespitosus	tufted clubrush	N-S
SCMI	Scirpus microcarpus	small-flowered bulrush	N-S
SCBO	Scribneria bolanderi	Scribner's grass	N-Rare
SIHA	Sitanion hanseni	Hansen squirreltail	I?
SIHYH2	Sitanion hystrix hystrix	bottlebrush squirreltail	N
STLEL	Stipa lemmonii lemmonii	Lemmon's needlegrass	N
STOCM	Stipa occidentalis minor	small needlegrass	N-S
STOCO	Stipa occidentalis occidentalis	western needlegrass	N
STTH	Stipa thurberiana	Thurber needlegrass	N?
TRCA	Trisetum canescens	tall trisetum	N
TRCE	Trisetum cernuum	nodding trisetum	N-S
TRSP	Trisetum spicatum	downy trisetum	N-S

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Known and Suspected Herb Species in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
ACMI	Achillea millefolium	yarrow	N
ACTR	Achlys triphylla	vanillaleaf	N
ACCOH	Aconitum columbianum howellii	monkshood	N-S
ACRU	Actaea rubra	baneberry	N
ADBI	Adenocaulon bicolor	pathfinder	N
AGURU	Agastache urticifolia urticifolia	nettle-leaf horse-mint	N-S
AGAUA	Agoseris aurantiaca aurantiaca	orange agroseris	N
AGEL2	Agoseris elata	tall agroseris	N-S
AGGLM	Agoseris glauca monticola	pale agroseris	N-S
AGGR	Agoseris grandiflora	large-flowered agroseris	N-S
AGHE	Agoseris heterophylla	annual agroseris	N-S
AGRE2	Agoseris retrorsa	spear-leaf agroseris	N-S
ALOC	Alchemilla occidentalis	western lady's-mantle	N-S
ALPLA	Alisma plantago-aquatica americanum	American waterplantian	N-S
ALAC	Allium acuminatum	tapertip onion	N
ALCA	Allium campanulatum	Sierra onion	N-S
ALCE	Allium cernuum	nodding onion	N-S
ALDON	Allium douglasii nevii	Douglas' onion	N-Rare
ALVA	Allium validum	Pacific onion	N-S
ALVI	Allotropa virgata	candystick	N-Rare
AMPO	Amaranthus powellii	Powell's amaranth	N-S
AMLY	Amsinckia lycopsoides	tarweed	N-S
AMME	Amsinckia menziesii	Menzie's tarweed	N-S
AMRE2	Amsinckia retrorsa	rigid tarweed	N
AMTE	Amsinckia tessellata	tessellata tarweed	N-S
ANMA	Anaphalis margaritacea	pearly-everlasting	N
ANDE	Anemone deltoidea	threeleaf anemone	N-S
ANDRD	Anemone drummondii drummondii	Drummond's anemone	N-S
ANLY2	Anemone lyallii	Lyall's anemone	N-S
ANOC	Anemone occidentalis	western pasqueflower	N-S
ANORO	Anemone oregana oregana	Oregon anemone	N
ANCA	Angelica canbyi	Canby's angelica	N-S
ANAL	Antennaria alpina	alpine pussytoes	N-S
ANDI	Antennaria dimorpha	low pussytoes	N
ANLU	Antennaria luzuloides	woodrush pussytoes	N
ANMI2	Antennaria microphylla	rosy pussytoes	N
ANNE2	Antennaria neglecta	field pussytoes	N-S
ANPU	Antennaria pulcherrima	showy pussytoes	N-S
ANRA	Antennaria racemosa	raceme pussytoes	N-S
ANUM	Antennaria umbrinella	umber pussytoes	N-S
ANCO	Anthemis cotula	mayweed chamomile	I-S
APBO	Apargidium boreale	apargidium	N-S
APANP	Apocynum androsaemifolium pumilum	bitterroot/dogbane	N
AQFO	Aquilegia formosa	red columbine	N
ARTH	Arabidopsis thaliana	common wall cress	I-S
ARDR2	Arabis drummondii	Drummond's rockcress	N-S
ARFU2	Arabis furcata	Cascade rockcress	N-Rare
ARGL	Arabis glabra	tower mustard	N-S
ARHIG	Arabis hirsuta glabrata	hairy rockcress	N-S
ARHO	Arabis holboellii	Holboell's rockcress	N-S
ARMIM	Arabis microphylla microphylla	littleleaf rockcress	N-S
ARPLH	Arabis platysperma howellii	flatseed rockcress	N-S

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Known and Suspected Herb Species in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
ARSPA	Arabis sparsiflora atrorubens	sicklepod rockcress	N-Rare
ARAM2	Arceuthobium americanum	American dwarf mistletoe	N
ARCA	Arceuthobium campylopodium	western dwarf mistletoe	N
ARDO3	Arceuthobium douglasii	Douglas dwarf mistletoe	N
ARMI3	Arctium minus	common burdock	I-S
ARCAA	Arenaria capillaris americana	mountain sandwort	N-S
ARMA3	Arenaria macrophylla	bigleaf sandwort	N
AROB	Arenaria obtusiloba	arctic sandwort	N-S
ARRU	*Arenaria rubella*	reddish sandwort	N-S
ARSE	Arenaria serpyllifolia	thyme-leaf sandwort	I-S
ARAMA	Arnica amplexicaulis amplexicaulis	clasping arnica	N-S
ARCHF	Arnica chamissonis foliosa	meadow arnica	N-S
ARCOC	Arnica cordifolia cordifolia	heartleaf arnica	N
ARDIE	Arnica discoidea eradiata	rayless arnica	N
ARFU	Arnica fulgens	orange arnica	N-S
ARLA	Arnica latifolia	mountain arnica	N
ARMO	Arnica mollis	hairy arnica	N
ARPA3	Arnica parryi	nodding arnica	N-S
ARBI	Artemisia biennis	*bien wormword*	N-S
ARLU	Artemisia ludoviciana	western mugwort	N-S
ARTIU	Artemisia tilesii unalaschcensis	mountain wormwood	N-S
ARSY	Aruncus sylvester	goatsbeard	N
ASCA3	Asarum caudatum	wild ginger	N
ASALA	Aster alpigenus alpigenus	alpine aster	N
ASFO	Aster foliaceus	leafy aster	N-S
ASGO	Aster gormanii	Gorman's aster	N-S
ASLEL	Aster ledophyllus ledophyllus	Cascade's aster	N-S
ASMO	Aster modestus	few-flowered aster	N-S
ASOCO	Aster occidentalis occidentalis	western mountain aster	N-S
ASRA	Aster radulinus	rough-leaved aster	N-S
ASSU2	Aster subspicatus	Douglas' aster	N-S
ASHOH	Astragalus howellii howellii	Howell's milkvetch	N-Rare
ASTY	Astragalus tyghensis	Tygh Valley milkvetch	N-Rare
ATPU	Athysanus pusillus	sandweed	N-S
BACAI	Balsamorhiza careyana intermedia	Cary's balsamroot	N-S
BASA	Balsamorhiza sagittata	arrowleaf balsamroot	N
BASE	Balsamorhiza serrata	serrate balsamroot	N-S
BAOR	*Barbarea orthoceras*	American wintercress	N-S
BAVE	Barbarea verna	early wintercress	I-S
BICE	Bidens cernua	nodding beggers-tick	N-S
BIFR	Bidens frondosa	leafy beggers-tick	N-S
BODED	Boisduvalia densiflora densiflora	dense spike-primrose	N-S
BOMAM	Boykinia major major	mountain boykinia	N-S
BRCA2	Brassica campestris	field mustard	I-S
BRGR2	Brickellia grandiflora	large-flowered brickellia	N-S
BRCO3	Brodiaea congesta	northern saitas	N-S
BRHO	Brodiaea howellii	Howell's brodiaea	N-S
CAMA	Calochortus macrocarpus	*sagebrush mariposa*	N-S
CASU6	Calochortus subalpinus	mountain mariposa	N-S
CABIR	Caltha biflora rotundifolia	white marshmarigold	N-S
CABU2	Calypso bulbosa	calypso orchid	N
CAQUQ	Camassia quamash quamash	camas	N

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Known and Suspected Herb Species in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
CARO3	Campanula rotundifolia	Scotch bellflower	N-S
CASC	Campanula scabrella	rough harebell	N-S
CASC2	Campanula scouleri	Scouler's harebell	N-S
CABU	Capsella bursa-pastoris	shepard's-purse	I
CABRB	Cardamine breweri breweri	Brewer's bittercress	N-S
CACOL	Cardamine cordifolia lyallii	large mountain bittercress	N-S
CAOLO	Cardamine oligosperma oligosperma	little western bittercress	N-S
CAPE4	Cardamine pensylvanica	Pennsylvannia bittercress	N-S
CADR2	Cardaria draba	hoary pepperwort	N-S
CAMIM	Castilleja miniata miniata	common paintbrush	N
CAPAO	Castilleja parviflora oreopola	magenta paintbrush	N-S
CARU4	Castilleja rupicola	cliff paintbrush	N-S
CASU3	Castilleja suksdorfii	Suksdorf's paintbrush	N-S
CAMI4	Caucalis microcarpa	California hedge-parsley	I-S
CECY	Centaurea cyanus	bachelor's button	I
CEDI	Centaurea diffusa	diffuse knapweed	I-W
CEMA	Centaurea maculosa	spotted knapweed	I-W
CENI3	Centaurea nigra jacea	brown knapweed	I-W
CEUM	Centaurium umbellatum	common centaury	I-S
CEMI	Centunculus minimus	chaffweed	N-S
CEAR	Cerastium arvense	field chickweed	N-S
CENU	Cerastium nutans	nodding chickweed	N-S
CEVU	Cerastium vulgatum	common chickweed	N
CHDOA	Chaenactis douglasii achilleaefolia	hoary chaenactis	N-S
CHAL	Chenopodium album	lambsquarter	N
CHME	Chimaphila menziesii	little pipsissewa	N-S
CHUMO	Chimaphila umbellata occidentalis	prince's-pine	N
CHLE2	Chrysanthemum leucanthemum	oxeye daisy	I
CIIN	Cichorium intybus	wild succory	I-S
CIDO	Cicuta douglasii	western water-hemlock	N-S
CIAL	Circaea alpina	nightshade	N-S
CIARH	Cirsium arvense horridum	Canada thistle	I-W
CIVU	Cirsium vulgare	bull thistle	I-W
CLPU	Clarkia pulchella	elkhorns clarkia	N
CLRH	Clarkia rhomboidea	common clarkia	N
CLLAL	Claytonia lanceolata lanceolata	western springbeauty	N
CLMEB	Claytonia megarhiza bellidifolia	alpine springbeauty	N-S
CLUN	Clintonia uniflora	queencup beadlily	N
COPA	Collinsia parviflora	small-flowered blue-eyed mary	N
COGR2	Collomia grandiflora	large-flowered collomia	N
COLI2	Collomia linearis	narrow-leaf collomia	N-S
COUMP	Comandra umbellata pallida	pale bastard toadflax	N
COMA2	Conium maculatum	poison hemlock	N-W
COAR2	Convolvulus arvensis	field morningglory	I-S
COCAG	Conyza canadensis glabrata	horseweed	N-S
COLA	Coptis laciniata	cutleaf goldenthread	N-S
COMA3	Corallorhiza maculata	Pacific coralroot	N-S
COST3	Corallorhiza striata	hooded coralroot	N
COCA4	Cordylanthus capitatus	Yakima birdbeak	N-S
COCA	Cornus canadensis	dogwood bunchberry	N
COSC	Corydalis scouleri	Scouler's corydalis	N-S
CRBA2	Crepis barbigera	bearded hawksbeard	N-S

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SPECIES	SPECIES NAME	COMMON NAME	STATUS
CRMU	Crocidium multicaule	spring-gold	N
CRAF	Cryptantha affinis	slender cryptantha	N-S
CRAM	Cryptantha ambigua	obscure cryptantha	N-S
CRFL	Cryptantha flaccida	weak-stemmed cryptantha	N-S
CRIN2	Cryptantha intermedia	common cryptantha	N
CYOF	Cynoglossum officinale	houndstongue	I-W
CYMO	Cypripedium montanum	mountain lady's-slipper	N-Rare
DACA4	Daucus carota	Queen Anne's lace	I
DEGL2	Delphinium glareosum	rockslide larkspur	N-S
DENUN	Delphinium nuttallianum nuttallianu	upland larkspur	N
DERI	Descurainia richardsonii	mountain tansy	N-S
DIAR	Dianthus armeria	grass pink	I-S
DIUN	Dicentra uniflora	steer's head	N-S
DISY	Dipsacus sylvestris	teasel	I-S
DIHOO	Disporum hookeri oreganum	Hooker's fairybells	N
DOCO	Dodecatheon conjugens	desert shooting star	N-S
DODE	Dodecatheon dentatum	white shooting star	N-S
DOJE	Dodecatheon jeffreyi	Jeffrey's shooting star	N-S
DOPO	Dodecatheon poeticum	narcissus shooting star	N
DOPU2	Dodecatheon pulchellum	few-flowered shooting star	N-S
DOEL	Downingia elegans	showy downingia	N
DRAU	Draba aureola	alpine draba	N-S
DRVE	Draba verna	spring Whitlow-grass	N
DRAN	Drosera anglica	great sundew	N-S
DRRO	Drosera rotundifolia	sundew	N-S
EBAU	Eburophyton austiniae	snow-orchid	N-S
EPAL	Epilobium alpinum	alpine willow-herb	N-S
EPAN	Epilobium angustifolium	fireweed	N
EPGL	Epilobium glaberrimum	smooth willow-herb	N
EPGL2	Epilobium glandulosum	common willow-herb	N-S
EPLU	Epilobium luteum	yellow willow-herb	N-S
EPMI	Epilobium minutum	small-flowered willow-herb	N-S
EPPAP	Epilobium paniculatum paniculatum	autumn willow-herb	N
EPWA	Epilobium watsonii	Watson's willow-herb	N-S
ERSE	Eremocarpus setigerus	doveweed	N
ERAC	Erigeron acris	bitter fleabane	N-S
ERAN	Erigeron annuus	annual fleabane	N-S
ERCOC2	Erigeron compositus compositus	cut-leaved daisy	N-S
ERDI	Erigeron divergens	diffuse fleabane	N-S
ERFI	Erigeron filifolius	thread-leaf fleabane	N
ERLI	Erigeron linearis	line-leaf fleabane	N
ERPEC	Erigeron peregrinus callianthemus	subalpine daisy	N
ERSP	Erigeron speciosus	showy fleabane	N-S
ERSTS	Erigeron strigosus strigosus	daisy fleabane	N
ERCOC	Eriogonum compositum compositum	northern buckwheat	N
ERDO	Eriogonum douglasii	Douglas' buckwheat	N
EREL2	Eriogonum elatum	tall buckwheat	N
EROV	Eriogonum ovalifolium	cushion buckwheat	N-S
ERPYC	Eriogonum pyrolifolium coryphaeum	alpine buckwheat	N-S
ERSP	Eriogonum sphaerocephalum	rock buckwheat	N
ERST2	Eriogonum strictum	strict buckwheat	N
ERUM	Eriogonum umbellatum	sulfur buckwheat	N

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SPECIES	SPECIES NAME	COMMON NAME	STATUS
ERLA	Eriophyllum lanatum	eriophyllum	N-S
ERCI	Erodium cicutarium	crane's-bill	I
ERAR2	Erysimum arenicola	sand-dwelling wallflower	N-S
ERAS	Erysimum asperum	prairie rocket	N-S
ERGRG	Erythronium grandiflorum grandiflorum	yellow fawn-lily	N
ERMO	Erythronium montanum	avalanche lily	N-S
EUOC	Eupatorium occidentale	western boneset	N-S
FLPR	Floerkea proserpinacoides	false-mermaid	N-S
FRVEB	Fragaria vesca bracteata	woods strawberry	N
FRVIP	Fragaria virginiana platypetela	broadpetal strawberry	N
FRALC2	Frasera albicaulis columbiana	Columbia frasera	N
FRPU	Fritillaria pudica	yellow bell	N
GAAR	Gaillardia aristata	gaillardia	N-S
GAAPE	Galium aparine echinospermum	cleavers	N-S
GABI	Galium bifolium	thinleaf bedstraw	N
GABO	Galium boreale	northern bedstraw	N-S
GAOR	Galium oreganum	Oregon bedstraw	N
GATRP	Galium trifidum pacificum	small bedstraw	N-S
GATR	Galium triflorum	sweetscented bedstraw	N
GADI	Gayophytum diffusum	spreading groundsmoke	N-S
GAHU2	Gayophytum humile	dwarf groundsmoke	N-S
GARA2	Gayophytum racemosum	reacemed groundsmoke	N-S
GECA	Gentiana calycosa	explorer's gentian	N
GECA3	Geranium carolinianum	Carolina geranium	I-S
GEMA	Geum macrophyllum	Oregon avens	N
GETRC	Geum triflorum ciliatum	prairie smoke	N-S
GIAG	Gilia aggregata	skyrocket	N
GICAC	Gilia capitata capitata	bluefield gilia	N-S
GLHE	Glecoma hederacea	Gill-over-the-ground	I-S
GNCH	Gnaphalium chilense	cotton-batting plant	N-S
GNMI	Gnaphalium microcephalum	slender cudweed	N-S
GNPA	Gnaphalium palustre	lowland cudweed	N-S
GNVI	Gnaphalium viscosum	sticky cudweed	N-S
GOOB	Goodyera oblongifolia	rattlesnake plantain	N
GREB	Gratiola ebracteata	bractless hedge-hyssop	N-S
GRNE	Gratiola neglecta	American hedge-hyssop	N-S
GRNAI	Grindelia nana integrfolia	low gumweed	N-S
HADID	Habenaria dilatata dilatata	white bog-orchid	N
HAEL	Habenaria elegans	elegant rein-orchid	N
HASA	Habenaria saccata	slender bog-orchid	N-S
HAUN	Habenaria unalascensis	Alaska rein-orchid	N-S
HADID2	Hackelia diffusa diffusa	diffuse stickseed	N
HAMI	Hackelia micrantha	blue stickseed	N-S
HABL	Haplopappus bloomeri	rabbitbrush goldenweed	N
HACA	Haplopappus carthamoides	Columbia goldenweed	N-S
HAGR	Haplopappus greenei	Green's goldenweed	N-S
HAHA	Haplopappus hallii	Hall's goldenweed	N-S
HEUND	Helianthella uniflora douglasii	Rocky Mountain helianthella	N-S
HELA	Heracleum lanatum	cow-parsnip	N
HEPU	Hesperochiron pumilus	dwarf hesperochiron	N
HERA2	Heterocodon rariflorum	heterocodon	N-S
HECH	Heuchera chlorantha	meadow alumroot	N

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SPECIES	SPECIES NAME	COMMON NAME	STATUS
HECYA	Heuchera cylindrica alpina	roundleaf alumroot	N
HEGL2	Heuchera glabra	smooth alumroot	N-S
HEMID	Heuchera micrantha diversifolia	smallflower alumroot	N-S
HIAL2	Hieracium albertinum	yellow hairy hawkweed	N
HIAL	Hieracium albiflorum	white hairy hawkweed	N
HICY	Hieracium cynoglossoides	houndstongue hawkweed	N
HIGR	Hieracium gracile	alpine hawkweed	N
HISC	Hieracium scouleri	woolly-weed	N-S
HOFUF	Horkelia fusca fusca	tawny horkelia	N
HYCAC	Hydrophyllum capitatum capitatum	ballhead waterleaf	N
HYFEA	Hydrophyllum fendleri albifrons	Fendler's waterleaf	N-S
HYAN	Hypericum anagalloides	bog St. John's-wort	N
HYFOS	Hypericum formosum scouleri	western St. John's-wort	N-S
HYPE	Hypericum perforatum	St. John's-wort	I-W
HYMO	Hypopitys monotropa	pinesap	N
IDSC	Idahoa scapigera	scalepod	N
ILRIR	Iliamna rivularis rivularis	streambank globe mallow	N-S
LABI2	Lactuca biennis	tall blue lettuce	N-S
LAPU	Lactuca pulchella	blue lettuce	N-S
LASE	Lactuca serriola	prickly lettuce	I-S
LARA	Lagophylla ramosissima	hareleaf	N-S
LAPU2	Lamium purpureum	red henbit	I-S
LALA	Lathyrus lanszwertii	thick-leaved peavine	N-S
LAPAP	Lathyrus pauciflorus pauciflorus	few-flowered peavine	N-S
LASY	Lathyrus sylvestris	flat peavine	I-S
LEMI	Lemna minor	water lentil	N-S
LETR	Lewisia triphylla	threeleaf lewisia	N-S
LIGR	Ligusticum grayi	Gray's licorice-root	N
LICO4	Lilium columbianum	Oregon lily	N
LIWA	Lilium washingtonianum	Washington lily	N
LIBA	Linanthus bakeri	Baker's linanthus	N
LIHA	Linanthus harknessii	Harkness' linanthus	N-S
LISE	Linanthus septentrionalis	northern linanthus	N-S
LIDA	Linaria dalmatica	dalamation toadflax	I-W
LIVU2	Linaria vulgaris	butter-and-eggs	I-W
LIBOL	Linnaea borealis longiflora	twinflower	N
LICA3	Listera caurina	western twayblade	N
LICO2	Listera convallarioides	broad-lipped listera	N
LICO3	Listera cordata	heart-leaf listera	N
LIBU	Lithophragma bulbifera	rocket-star	N
LIGL	Lithophragma glabra	smooth prairiestar	N
LIPA	Lithophragma parviflora	smallflower prairiestar	N
LIRU	Lithospermum ruderale	stoneseed gromwell	N
LOCA4	Lomatium canbyi	Canby's desert-parsley	N
LODID	Lomatium dissectum dissectum	fern-leaved desert-parsley	N
LOGO	Lomatium gormanii	Gorman's desert-parsley	N-S
LOMA	Lomatium macrocarpum	large-fruit lomatium	N-S
LOMAF	Lomatium martindalei martindalei	Martindale's lomatium	N
LONU	Lomatium nudicaule	barestem lomatium	N
LOTR	Lomatium triternatum	nine-leaf lomatium	N
LOWA	Lomatium watsonii	Watson's desert-parsley	N-S-Rare
LOCRC	Lotus crassifolius crassifolius	big deervetch	N

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SPECIES	SPECIES NAME	COMMON NAME	STATUS
LONED	Lotus nevadensis douglasii	Nevada deervetch	N
LOPI2	Lotus pinnatus	meadow deervetch	N-S
LOPU	Lotus purshiana	Spanish-clover	N
LUPAA	Ludwigia palustris americana	water-purslane	N-S
LUPE	Luetkea pectinata	partridgefoot	N
LUNAG	Luina nardosmia glabrata	silvercrown luina	N
LUST	Luina stricta	toungue-leaf luina	N-S
LUAR3	Lupinus argenteus	silvery lupine	N-S
LUCA	Lupinus caudatus	tailcup lupine	N
LULAS	Lupinus latifolius subalpinus	oroadleaf lupine	N
LULAL3	Lupinus laxiflorus laxiflorus	spurred lupine	N-S
LULEL2	Lupinus lepidus lobbii	prairie lupine	N
LULEL	Lupinus leucophyllus leucophyllus	velvet lupine	N
LUPOP2	Lupinus polyphyllus polyphyllus	bigleaf lupine	N
LUSE	Lupinus sericeus	silky lupine	N-S
LYCO	Lychnis coronaria	rose campion	I-S
LYAM3	Lycopus americanus	cut-leaved water horehound	N-S
LYUN	Lycopus uniflorus	northern bugleweed	N-S
LYAM	Lysichitum americanum	skunk cabbage	N
MACI	Madia citriodora	lemon-scented tarweed	N
MAEX	Madia exigua	little tarweed	N
MAGL	Madia glomerata	cluster tarweed	N
MAGR	Madia gracilis	slender tarweed	N
MAMI	Madia minima	small-head tarweed	N
MAMA2	Matricaria matricarioides	pineapple weed	N-S
MEAL	Melilotus alba	white sweet-clover	I-S
MEARG	Mentha arvensis glabrata	field mint	N-S
MECIC	Mertensia ciliata ciliata	broad-leaf bluebell	N-S
MIAL2	Microseris alpestris	alpine lake agoseris	N-S
MILA	Microseris laciniata	cut-leaved microseris	N
MINU	Microseris nutans	nodding microseris	N-S
MITR	Microseris troximoides	false-agroseris	N
MIGR	Microsteris gracilis	pink microsteris	N-S
MIBR2	Mimulus breweri	Brewer's monkeyflower	N-S
MIFL	Mimulus floribundus	purple-stem monkeyflower	N-S
MIGUG	Mimulus guttatus guttatus	yellow monkeyflower	N
MILE	Mimulus lewisii	Lewis' monkeyflower	N
MIMOM	Mimulus moschatus moschatus	musk-flower	N-S
MIPR	Mimulus primuloides	primrose monkeyflower	N-S
MITI	Mimulus tilingii	large mountain monkeyflower	N-S
MIBR	Mitella breweri	Brewer's mitrewort	N
MICA3	Mitella caulescens	leafy mitrewort	N-S
MIDI	Mitella diversifolia	angle-leaved mitrewort	N-S
MIPE	Mitella pentandra	alpine mitrewort	N-S
MITR2	Mitella trifida	three-tooth mitrewort	N-S
MOODO	Monardella odoratissima odoratissim	monardella	N-S
MOUN2	Monotropa uniflora	Indian-pipe	N
MOCH	Montia chamissoi	water montia	N-S
MOCO	Montia cordifolia	broadleaved montia	N-S
MODI	Montia dichotoma	dwarf montia	N-S
MOFO	Montia fontana	water chickweed	N-S
MOLI	Montia linearis	narrow leaved montia	N

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SPECIES	SPECIES NAME	COMMON NAME	STATUS
MOPAP	Montia parvifolia parvifolia	littleleaf montia	N
MOPE	Montia perfoliata	miner's lettuce	N
MOSI	Montia sibirica	candyflower	N-S
MOSP	Montia spathulata	common montia	N-S
MYDI	Myosotis discolor	yellow and blue forget-me-not	I-S
MYLA	Myosotis laxa	small flowered forget-me-not	N-S
MYMI	Myosotis micrantha	blue scorpion-grass	I-S
MYSY	Myosotis sylvatica	wood foregt-me-not	N-S
MYMI2	Myosurus minimus	least mouse-tail	N-S
NADI	Navarretia divaricata	mountain navarretia	N-S
NAINP	Navarretia intertexta propinqua	needle-leaf navarretia	N
OEHO	Oenothera hookeri	Hooker's evening primrose	N
ONVI	Onobrychis viciaefolia	saintfoin	I
ORFA2	Orobanche fasciculata	clustered broomrape	N
ORPI	Orobanche pinorum	pine broomrape	N-S
ORUN	Orobanche uniflora	naked broomrape	N
ORHI	Orthocarpus hispidus	hairy owl-clover	N-S
OSCH	Osmorhiza chilensis	sweet-cicely	N
OSOC	Osmorhiza occidentalis	western sweet-cicely	N-S
OSPU	Osmorhiza purpurea	purple sweet-cicely	N-S
OXDI	Oxyria digyna	mountain sorrel	N-S
PABR	Paeonia brownii	Brown's peony	N
PAFIH	Parnassia fimbriata hoodiana	fringed grass-of-parnassus	N-S
PEAT3	Pedicularis atollens	little elephant's head	N-S
PEBRF	Pedicularis bracteosa flavida	bracted lousewort	N-S
PECO2	Pedicularis contorta	white coiled-beak lousewort	N-S
PEGR	Pedicularis groenlandica	elephant's head	N
PERA	Pedicularis racemosa alba	leafy lousewort	N
PEDAM	Penstemon davidsonii menziesii	Davidson's penstemon	N-S
PEEU	Penstemon euglaucus	glaucous penstemon	N
PEFRF	Penstemon fruticosus fruticosus	shrubby penstemon	N-S
PEGL	Penstemon glandulosum	glandular penstemon	N-S
PEPR2	Penstemon procerus	small-flowered penstemon	N-S
PERID	Penstemon richardsonii dentatus	Richard's penstemon	N
PERU	Penstemon rupicola	rock penstemon	N
PERYV	Penstemon rydbergii varians	Rydberg's penstemon	N-S
PESU2	Penstemon subserratus	fine-toothed penstemon	N-S
PEBO	Perideridia bolanderi	Bolander's yampah	N-S
PEGA2	Perideridia gairdneri	Gairdner's yampah	N
PEOR	Perideridia oregana	Oregon yampah	N-S
PHHA	Phacelia hastata	whiteleaf phacelia	N
PHHE	Phacelia heterophylla	varileaf phacelia	N-S
PHLI	Phacelia linearis	threadleaf phacelia	N-S
PHPR2	Phacelia procera	tall phacelia	N-S
PHDIL	Phlox diffusa longistylis	spreading phlox	N-S
PHHE2	Phlox hendersonii	Henderson's phlox	N-S
PHHO	Phlox hoodii	Hood's phlox	N-S
PHSP	Phlox speciosa	showy phlox	N
PHCH	Phoenicaulis cheiranthoides	daggerpod	N
PLSC2	Plagiobothrys scouleri	Scouler's popcorn-flower	N-S
PLTE	Plagiobothrys tenellus	slender popcorn-flower	N
PLLA	Plantago lanceolata	English plantian	I-S

N = Native, I = Introduced, S = Suspected to Occur, W = Noxious Weed

Known and Suspected Herb Species in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
PLMA	Plantago major	common plantian	N-S
PLMA3	Plectritis macrocera	longhorn plectritis	N
POOC	Polemonium occidentale	western polemoniun	N
POPU	Polemonium pulcherrimum	skunk-leaved polemonium	N
POAC	Polygonum achoreum	smartweed	N-S
POAV	Polygonum aviculare	doorweed	N-S
POBI	Polygonum bistortoides	snakeweed	N
POCO4	Polygonum coccineum	water smartweed	N-S
POCO5	Polygonum confertiflorum	closeflowered knotweed	N-S
POCO2	Polygonum convolvulus	dullseed	I-S
PODOL	Polygonum douglasii latifolium	mountain knotweed	N-S
POHY	Polygonum hydropiper	marshpepper smartweed	I-S
POHY2	Polygonum hydropiperoides	waterpepper	N-S
POKE	Polygonum kelloggii	Kellogg's knotweed	N-S
POLA	Polygonum lapathifolium	willow weed	I-S
POMA	Polygonum majus	Palouse knotweed	N
POMI2	Polygonum minimum	laefy dwarf knotweed	N-S
PONEN2	Polygonum newberryi newberryi	Newberry's fleeceflower	N
PONU2	Polygonum nuttallii	Nuttall's knotweed	N-S
POPE	Polygonum persicaria	heartweed	N-S
POPH	Polygonum phytolaccaefolium	alpine knotweed	N-S
POEP2	Potamogeton epihydrus	ribbon-leaf pondweed	N-S
POGR3	Potamogeton gramineus	grass-leaved pondweed	N-S
PONA2	Potamogeton natans	broadleaved pondweed	N-S
PODR	Potentilla drummondii	Drummond's cinquefoil	N-S
POFL2	Potentilla flabellifolia	fan-leaf cinquefoil	N
POGL	Potentilla glandulosa	sticky cinquefoil	N
POGR	Potentilla gracilis	slender cinquefoil	N
POPA3	Potentilla palustris	marsh cinquefoil	N-S
PORI	Potentilla rivalis	brook cinquefoil	N-S
POVIP	Potentilla villosa parviflora	villous cinquefoil	N-S
PRVUV	Prunella vulgaris vulgaris	self-heal	I
PTAN	Pterospora andromedea	pinedrops	N
PYASA	Pyrola asarifolia asarifolia	alpine pyrola	N-S
PYCH	Pyrola chlorantha	green wintergreen	N-S
PYMI	Pyrola minor	lesser wintergreen	N-S
PYPI	Pyrola picta	white vein pyrola	N-S
PYSES	Pyrola secunda secunda	sidebells pyrola	N
PYUN	Pyrola uniflora	wax-flower pyrola	N-S
RAAL	Ranunculus alismaefolius	water-plantain buttercup	N-S
RAAQC	Ranunculus aquatilis capillaceus	white water-buttercup	N-S
RAAR2	Ranunculus arvensis	field buttercup	N-S
RACY	Ranunculus cymbalaria	shore buttercup	N-S
RAES	Ranunculus eschscholtzii	subal pine buttercup	N-S
RAFL2	Ranunculus flammula	creeping buttercup	N-S
RAGL	Ranunculus glaberrimus	sagebrush buttercup	N
RAOCO	Ranunculus occidentalis occidentali	western buttercup	N
RAORP	Ranunculus orthorhynchus platyphyll	straightbeak buttercup	N
RAPO	Ranunculus populago	mountain buttercup	N-S
RARE	Ranunculus repens	creeping buttercup	N
RASC	Ranunculus sceleratus	blister buttercup	N-S
RAUNP	Ranunculus uncinatus parviflorus	little buttercup	N

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Known and Suspected Herb Species in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
ROSI	Romanzoffia sitchensis	Sitka mistmaiden	N-S
RULA	Rubus lasiococcus	dwarf bramble	N
RUNI	Rubus nivalis	snow bramble	N-S
RUPA	Rubus parviflorus	thimbleberry	N
RUPE	Rubus pedatus	strawberry bramble	N-S
RUUR	Rubus ursinus	Pacific blackberry	N
RUOCO	Rudbeckia occidentalis occidentalis	blackhead	N-S
RUAC	Rumex acetosella	sheep sorrel	I
RUCR	Rumex crispus	sour dock/curly dock	I
RUMA2	Rumex maritimus	golden dock	I-S
RUOCP	Rumex occidentalis procerus	western dock	N-S
RUSA	Rumex salicifolius	willow dock	N-S
SASA	Sagina saginoides	alpine pearlwort	N-S
SAMI	Sanguisorba minor	small burnet	I
SAOC	Sanguisorba occidentalis	annual burnet	N-S
SASI	Sanguisorba sitchensis	Sitka burnet	N-S
SAGR	Sanicula graveolens	Sierra sanicle	N
SADO	Satureja douglasii	yerba buena	N
SAAR	Saxifraga arguta	brook saxifrage	N-S
SAFEM	Saxifraga ferruginea macounii	rusty saxifrage	N-S
SAIN	Saxifraga integrifolia	swamp saxifrage	N
SAME3	Saxifraga mertensiana	wood saxifrage	N-S
SAORO	Saxifraga oregana oregana	Oregon saxifrage	N
SAPUC	Saxifraga punctata cascadensis	dotted saxifrage	N-S
SATOT	Saxifraga tolmiei tolmiei	alpine saxifrage	N-S
SCPAA	Scheuchzeria palustris americana	scheuchzeria	N-S
SCLA	Scrophularia lanceolata	lance-leaf figwort	N-S
SCGA	Scutellaria galericulata	marsh skullcap	N-S
SEDI	Sedum divergens	spreading stonecrop	N-S
SEOR2	Sedum oreganum	Oregon stonecrop	N
SEOR3	Sedum oregonense	creamy stonecrop	N
SECA	Senecio canus	woolly groundsel	N
SECY	Senecio cymbalarioides	alpine meadow butterweed	N-S
SEFOH	Senecio foetidus hydrophiloides	sweetmarsh butterweed	N-S
SEIN	Senecio integerrimus	western groundsel	N
SEJA	Senecio jacobaea	tansy ragwort	I-W
SEPS	Senecio pseudaureus	streambank butterweed	N-S
SESY	Senecio sylvaticus	wood groundsel	I-S
SETRT	Senecio triangularis triangularis	arrowleaf groundsel	N
SEVU	Senecio vulgaris	common groundsel	I-S
SIPR	Sibbaldia procumbens	creeping sibbaldia	N-S
SIOR	Sidalcea oregana	Oregon checker-mallow	N-S
SIAN2	Silene antirrhina	sleepycat	N-S
SICU2	Silene cucubalus	bladder campion	I
SIDOD	Silene douglasii douglasii	Douglas' silene	N-S
SIOR2	Silene oregana	Oregon silene	N
SISU2	Silene suksdorfii	Suksdorf's silene	N-S
SIAL	Sisymbrium altissimum	tumblemustard	I-S
SIDO	Sisyrinchium douglasii	grass-widows	N
SISU	Sium suave	hamlock water-parsnip	N-S
SMRA	Smilacina racemosa	false solomon's seal	N
SMST	Smilacina stellata	starry false solomon-plume	N

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Known and Suspected Herb Species in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
SODU2	Solanum dulcamara	blue bindweed	I-S
SOCAS	Solidago canadensis salebrosa	Canadian goldenrod	N-S
SOOC2	Solidago occidentalis	western goldenrod	N-S
SOSP	Solidago spathulata	dune goldenrod	N-S
SOAS	Sonchus asper	prickly sow-thistle	I-S
SPAN	Sparganium angustifolium	narrowleaf bur-reed	N-S
SPEMM	Sparganium emersum multipedunculatu	simplestem bur-weed	N-S
SPEU	Sparganium eurycarpum	broadfruited bur-weed	N-S
SPMI2	Sparganium minimum	small bur-weed	N-S
SPAR2	Spergula arvensis	stickwort	I-S
SPRU	Spergularia rubra	red sandspurry	I-S
SPRO	Spiranthes romanzoffiana	ladies-tresses	N
SPPO	Spirodela polyrhiza	great duckweed	N-S
SPUMC	Spraguea umbellata caudicifera	pussypaws	N
STCO4	Stachys cooleyae	great betony	N
STRI	Stachys rigida	rigid betony	N-S
STCA	Stellaria calycantha	northern starwort	N-S
STCR	Stellaria crispa	crisped starwort	N-S
STJA	Stellaria jamesiana	sticky starwort	N-S
STLO2	Stellaria longifolia	long-leaved starwort	N-S
STME	Stellaria media	chickweed	I-W-S
STNI	Stellaria nitens	shining chickweed	N-S
STOB	Stellaria obtusa	bluntsepaled starwort	N-S
STSI	Stellaria simcoei	Simcoe Mt. starwort	N-S
STUM	Stellaria umbellata	umbellate starwort	N-S
STAMC	Streptopus amplexifolius chalazatus	clasping-leaved twisted-stalk	N-S
STROC	Streptopus roseus curvipes	sessile-leaved twisted-stalk	N-S
STSTB	Streptopus streptopoides brevipes	rosy twisted-stalk	N
SURA	Suksdorfia ranunculifolia	buttercupleaved sukdorfia	N-S
SUVI	Suksdorfia violacea	violet suksdorfia	N-S
TAVU	Tanacetum vulgare	common tansy	I-S
TAOF	Taraxacum officinale	dandelion	I
TECAO	Teucrium canadense occidentale	wood sage	N-S
THOC	Thalictrum occidentale	western meadowrue	N
THLAS2	Thelypodium laciniatum streptanthoi	thick-leaved thelypody	N-S
THMOO	Thermopsis montana ovata	common mountain thermopsis	N-S
THFEG	Thlaspi fendleri glaucum	Fendler's pennycress	N-S
THCU	Thysanocarpus curvipes	sand fringepod	N
TITRU	Tiarella trifoliata unifoliata	coolwort foamflower	N
TOGLB	Tofieldia glutinosa brevistyla	tofieldia	N-S
TRDU	Tragopogon dubius	yellow salsify	I
TRCAO	Trautvetteria caroliniensis occiden	false bugbane	N
TRLA2	Trientalis latifolia	western starflower	N
TRCY	Trifolium cyathiferum	cup clover	N-S
TRDU2	Trifolium dubium	suckling clover	I-S
TRERE	Trifolium eriocephalum eriocephalum	woolly-head clover	N
TRHY	Trifolium hybridum	alsike clover	I
TRIN	Trifolium incarnatum	crimson clover	I
TRLO	Trifolium longipes	long-stalked clover	N-S
TRMA	Trifolium macrocephalum	big-head clover	N
TRMI	Trifolium microcephalum	small-head clover	N-S
TRPR	Trifolium pratense	red clover	I

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Known and Suspected Herb Species in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
TRPR2	Trifolium procumbens	hop clover	I
TRRE	Trifolium repens	white cloverq	I
TROV	Trillium ovatum	white trillium	N
TYLA	Typha latifolia	cattail	N
UTDI	Urtica dioica	stinging nettle	N
UTIN	Utricularia intermedia	mountain bladderwort	N-S
UTMI	Utricularia minor	lesser bladderwort	N-S
UTVU	Utricularia vulgaris	common bladderwort	N-S
VASI	Valeriana sitchensis	Sitka valerian	N
VALO	Valerianella locusta	lamb's lettuce	I-S
VECA	Veratrum californicum	false hellebore	N
VEVI	Veratrum viride	green false hellebore	N
VETH	Verbascum thapsus	woolly mullein	I
VEAM	Veronica americana	American brooklime	N-S
VEAN	Veronica anagallis-aquatica	water pimpernel	I-S
VEAR	Veronica arvensis	common speedwell	I
VECU	Veronica cusickii	Cusick's speedwell	N-S
VEPEX	Veronica peregrina xalapensis	purslane speedwell	N-S
VESC	Veronica scutellata	marsh speedwell	N-S
VESEH	Veronica serpyllifolia humifusa	thyme-leaved speedwell	N-S
VEWO	Veronica wormskjoldii	American alpine speedwell	N-S
VIAMT	Vicia americana truncata	American vetch	N
VICR	Vicia cracca	bird vetch	N-S
VISA	Vicia sativa	common vetch	I-S
VIMI	Vinca major	periwinkle	I
VIAD	Viola adunca	early blue violet	N
VIGL	Viola glabella	pioneer violet	N
VIMA	Viola macloskeyi	small white violet	N-S
VINU	Viola nuttallii	Nuttall's violet	N
VIOR2	Viola orbiculata	round-leaved violet	N-S
VIPA	Viola palustris	marsh violet	N
VIPUV	Viola purpurea venosa	goosefoot violet	N-S
VISE	Viola sempervirens	redwoods violet	N-S
VISH	Viola sheltonii	Shelton's violet	N-S
VITR2	Viola trinervata	sagebrush violet	N-S
WYAM	Wyethia amplexicaulis	mule's-ears	N
XASTC	Xanthium strumarium canadense	common cocklebur	N-S
XETE	Xerophyllum tenax	beargrass	N
ZIVE	Zigadenus venenosus	meadow death-camas	N

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Known and Suspected Ferns and Fern-Allies in White River Subbasin

SPECIES	SPECIES NAME	COMMON NAME	STATUS
ADPE	Adiantum pedatum	maidenhair fern	N-S
ASDE	Aspidotis densa	pod fern	N-S
ASTR	Asplenium trichomanes	maindenhair spleenwort	N-S
ATFI	Athyrium filix-femina	lady fern	N
BOLA	Botrychium lanceolatum	lance-leaved grapefern	N
BOMI	Botrychium minganense		N-Rare
BOMO	Botrychium montanum		N-Rare
BOMU	Botrychium multifidum	leathery grapefern	N
BOPI	Botrychium pinnatum		N-S
BOSI2	Botrychium simplex	little grapefern	N-S
BOVI	Botrychium virginianum	Virginia grapefern	N
CHGR	Cheilanthes gracillima	lace lip-fern	N
CRCRA	Cryptogramma crispa acrostichoides	rock-brake	N-S
CYFR	Cystopteris fragilis	brittle bladder fern	N-S
DRAU2	Dryopteris austriaca	mountain wood fern	N-S
EQAR	Equisetum arvense	common horsetail	N
EQHYA	Equisetum hyemale affine	Dutch rush	N-S
GYDR	Gymnocarpium dryopteris	oak fern	N-S
ISEC	Isoetes echinospora	bristle-like quillwort	N-S
ISHO	Isoetes howellii	Howell's quillwort	N-S
ISLA	Isoetes lacustris	lake quillwort	N-S
LYAN	Lycopodium annotinum	stiff club moss	N-S
LYCL	Lycopodium clavatum	stag's horn moss	N-S
LYSE	Lycopodium selago	fir clubmoss	N
LYSI	Lycopodium sitchensis	Alaska clubmoss	N-S
OPVU	Ophioglossum vulgatum	Adder's-tongue	N-S
PITR	Pityrogramma triangularis triangula	gold-fern	N-S
POAM4	Polypodium amorphum		N-S
POHE	Polypodium hesperium	licorice polypody	N-S
POAN3	Polystichum andersonii	Anderson's sword fern	N-S
POKR	Polystichum kruckebergii	Kruckeberg's sword fern	N-S
POLO2	Polystichum lonchitis	mountain holly fern	N-S
POMU	Polystichum munitum	sword fern	N
PTAQP	Pteridium aquilinum pubescens	bracken fern	N
SEDES	Selaginella densa scopulorum	compact selaginnella	N-S
SEWA2	Selaginella wallacei	Wallace's selaginnella	N-S
THNE	Thelypteris nevadensis	Sierra wood fern	N-S
WOOR	Woodsia oregana	western woodsia	N-S
WOSC	Woodsia scopulina	Rocky Mountain woodsia	N-S

N = Native, S = Suspected to Occur

C

Aquatic and Riparian Ecology Report
White River Subbasin Analysis

July 1995

APPENDIX C

Lucy Wold
with
Artis Holmquist, Chris Brun, Danalyn Loitz,
Katie Serres, Bill Wall, Duane Bishop

Issue 1J: Are the current standards for water quality and aquatic habitat elements appropriate for all streams in the White River Subbasin?

NO. An intent of the Columbia River Policy Implementation Guide (PIG 1991) interagency and Tribal agreement was establishment of anadromous fish habitat and water quality parameters within the range of the northern spotted owl. Only 2 miles of White River mainstem - between White River Falls and the Deschutes River - is anadromous habitat. A discussion of the Mt. Hood National Forest Land and Resource Management Plan (LRMP) aquatic and riparian habitat quality parameters (*e.g.* numeric pool and large wood standards), in context of the PIG standards, is more appropriate for the resident fishes streams upstream of the Forest boundary.

Aquatic Conservation Strategy objectives in the Record of Decision for the President's Forest Plan (ROD 1994) apply to all land managed by the Mt. Hood National Forest in the White River Subbasin. State Water Quality standards are applicable to the whole subbasin. Some of tentative standards agreed to by The Confederated Tribes of Warm Springs Reservation of Oregon (The Tribes), Columbia River Intertribal Fish Commission (CRITFC), and Mt. Hood National Forest (MHNF) as part of the LRMP appeal resolution are addressed. Application of locally refined and recommended numeric standards developed in this analysis, and other management, restoration, and monitoring recommendations from this analysis, should meet the intent of the interagency PIG agreement, State Water Quality Standards, a portion of the Tribal agreements, and the Aquatic Conservation Strategy objectives for Mt. Hood National Forest land in the White River Subbasin.

Current condition and range of natural condition analyses. Information in the Mt. Hood National Forest stream surveys database (1989-94) was used to describe the current conditions and predict the range of natural conditions of perennial, fish-bearing streams within the MHNF in White River Subbasin (Figure 1; Tables 1-2). The streams are stratified by gradient criteria. Unsurveyed streams were stratified by calculation of the weighted average gradient between tributary junctions. Surveyed streams 1989-92 were stratified by the average gradient of the surveyed segment as measured in the field. Surveyed streams 1993-94 were stratified by geomorhpic characteristics, including gradient, as measured in the field (Rosgen 1994).

In perennial streams, the lowest gradient reaches (<2.0% gradient) are potential "hotspots" for fisheries productivity. Tygh Valley area would have been the most productive area in the subbasin prior to extensive agricultural development and simplification of the wetlands from removal of beaver and riparian vegetation. Low gradient reaches are depositional areas for wood and sediment (Montgomery and Buffington 1993), and are the channel morphologies most responsive to management impacts (Rosgen 1994).

The moderate gradient perennial reaches (2.0-3.9% gradient) are transition zones for wood and sediment transport; are moderately productive for fish; and highly productive for amphibians and macroinvertebrates. In headwater areas, moderate gradient reaches are most commonly boulder formed step-pool channels, and are resistant to management impacts (Rosgen 1994; Montgomery and Buffington 1993; Stream Team July 1995 draft report).

High gradient perennial reaches (4.0-9.9%) are transport zones for wood and sediment; are low productivity for fisheries; highly productive for amphibians and macroinvertebrates. The typical bedrock-boulder cascade-pool channel morphologies are resistant to management impacts (Rosgen 1994; Montgomery and Buffington 1993; Stream Team in prep.). Steep, headwater reaches (≥10% gradient) are not likely to be naturally fish-bearing. Fish may occupy steep, headwater reaches if they were stocked in lower gradient reaches or a lake upstream, and washed down during high flows.

SWS	Stream Name	Year	Reach	From RM	To RM	reach length	stream order	SWD /mile	LWD /mile	pools /mile*	residual pool depth	gradient	dominant substrate	valley form	canopy cover
16H	Camas Creek	89	1	0	1.7	1.6	3	17	8	19	1.2	2	GR	3	3
16E	Cedar/Forest Crk	89	1	0	3.8	3.1	2	111	29	32	1.2	4	GR	NI	4
16F	Frog Creek	89	1	0	2.3	2.8	4	89	47	29	1.2	2	GR	5	4
16F	Frog Creek	89	2	2.3	4.5	1.9	4	113	58	8	1.2	1	GR	10	4
16F	Frog Creek	89	3	4.5	5.9	1.1	4	71	28	1	2.8	1	GR	7	4
16F	Frog Creek	89	4	5.9	8.1	2.5	2	32	19	1	0.9	1	SA	7	4
16H	Clear Creek	90	1	0	1.8	1.2	5	40	19	7	2.6	3	CO	5	3
16H	Clear Creek	90	2	1.8	3.1	1.1	5	123	37	1	1.0	4	CO	2	2
16H	Clear Creek	90	3	3.1	3.3	0.2	5	0	0	0	0.0	2	SA	NI	2
16H	Clear Creek	90	4	3.3	3.4	0.1	4	266	58	0	0.0	4	SA	NI	2
16H	Clear Creek	90	5	3.4	3.5	0.1	4	0	0	0	0.0	1	SA	NI	2
16H	Clear Creek	90	6	3.5	5.9	2.1	4	132	24	3	2.2	2	CO	NI	2
16H	Clear Creek	90	7	5.9	6.1	0.2	4	0	0	0	0.0	2	NI	NI	2
16H	Clear Creek	90	8	6.1	6.2	0.2	4	59	13	7	1.5	2	NI	NI	2
16H	Clear Creek	90	9	6.2	6.3	0.1	4	0	0	0	0.0	2	NI	NI	2
16H	Clear Creek	90	10	6.3	6.6	0.2	4	246	47	0	0.0	2	CO	NI	2
16H	Clear Creek	90	11	6.6	6.7	0.1	4	0	0	0	0.0	2	SA	NI	2
16H	Clear Creek	90	12	6.7	10.9	3.9	3	82	10	2	1.7	2	NI	NI	3
29C	Little Badger	90	1	0	6.5	5.8	3	59	46	25	1.6	6	CO	5	3
16E	Boulder Creek	91	1	0	1	0.8	3	66	38	12	3.2	11	SB	3	1
16E	Boulder Creek	91	2	1	2.3	1.4	3	82	64	7	3.1	5	CO	3	1
16E	Boulder Creek	91	3	2.3	3.5	1.0	3	97	61	6	2.6	4	CO	4	1
16E	Boulder Creek	91	4	3.5	5.8	2.1	3	85	81	6	2.4	4	CO	4	1
16E	Boulder Creek	91	5	5.8	7.1	0.9	3	65	45	3	3.0	4	CO	4	1
16E	Boulder Creek	91	6	7.1	11	3.9	3	138	124	4	2.5	2	CO	4	1
29B	Badger Creek	92	1	4.5	7.6	3.2	4	31	19	12	2.0	1	CO	5	2
29B	Badger Creek	92	2	7.6	14.3	7.2	4	37	26	14	1.7	3	SB	3	3
29B	Badger Creek	92	3	14	20.9	6.9	4	94	51	20	1.8	5	SB	3	4
16C	Barlow Creek	92	1	0	1.5	1.6	4	72	32	19	2.3	2	GR	4	3
16C	Barlow Creek	92	2	1.5	4.8	3.8	4	24	25	17	1.7	2	GR	6	3
16C	Barlow Creek	92	3	4.8	5	0.6	4	29	21	29	1.3	3	GR	6	3
16C	Barlow Creek	92	4	5	5.5	0.3	3	44	25	3	2.0	2	CO	8	2
16C	Barlow Creek	92	5	5.5	5.7	0.1	3	0	0	24	1.3	1	GR	8	1
16C	Barlow Creek	92	6	5.7	6.6	0.6	3	34	20	13	1.1	15	GR	3	3
30G	Threemile Creek	92	1	12	19.4	6.8	2	123	56	13	1.3	6	CO	3	3
16A	White River	92	1	25.1	30.8	6.9	5	26	16	9	2.1	1	CO	2	3
16A	White River	92	2	30.8	32.3	1.5	5	48	21	9	2.4	1	CO	4	3
16A	White River	92	3	32.3	36.4	6.8	5	13	2	3	2.0	2	CO	6	2
16A	White River	92	4	36.4	40.2	3.3	4	37	5	4	2.3	5	GR	6	3
16A	White River	92	5	40.2	42.1	1.4	4	51	4	4	1.6	3	CO	6	1
16A	White River	92	6	42.1	45.1	4.3	4	0.2	0	2	1.7	10	SA	3	1
30B	Rock Creek	92	1	8.7	9.2	0.0	NI	52	20	82					
30B	Rock Creek	92	2	9.2	10	0.0	NI	70	41	59	Pre-project Survey				
30B	Rock Creek	92	3	10	11.4	0.0	NI	101	21	121	Will be surveyed in 1995				
30B	Rock Creek	92	4	11	13.3	0.0	NI	59	8	68					

Table 1. Summary of selected stream survey data 1989-92 White River Subbasin.

SWS	Stream Name	Year	Reach	From RM	To RM	reach length	stream order	SWD /mile	LWD /mile	pools /mile*	residual pool depth	gradient	dominant substrate	Rosgen Class	%eroding banks
16A	Bonney Creek	93	1	0	0.1	0.1	3	141	178	30	1.7	3	CO	B3	2.3
16A	Bonney Creek	93	2	0.1	0.3	0.2	3	145	88	107	1.5	2	SA	B5	0.2
16A	Bonney Creek	93	3	0.3	0.6	0.3	3	68	31	65	1.8	4	SA	DA6	0.0
16A	Bonney Creek	93	4	0.6	1.1	0.5	2	108	46	56	1.4	7	CO	B3a	0.0
16A	Bonney Creek	93	5	1.1	1.8	0.8	2	80	45	83	1.3	15	CO	A3a+	0.0
16A	Bonney Creek	93	6	1.8	1.9	0.0	1	0	26	26	0.7	17	BR	B1a	0.0
16A	Bonney Creek	93	7	1.9	2	0.1	1	14	42	141	1.1	10	CO	A3a+	0.0
16A	Bonney Creek	93	8	2	2.9	0.9	1	25	18	84	1.3	20	BR	A1a+	0.0
16A	Bonney Creek	93	9	2.9	3.1	0.2	1	0	0	59	1.1	9	CO	A3	0.0
16A	Bonney Creek	93	10	3.1	3.9	0.8	1	0	0	63	1.1	4	SA	E6	0.0
30C	Gate Creek	93	1	0	3.1	2.8	4	22	6	60	1.3	2	CO	B3	1.8
30C	Gate Creek	93	2	3.1	4.1	1.2	3	138	104	85	0.9	2	CO	B3	4.5
30C	Gate Creek	93	3	4.1	4.6	0.4	3	150	92	107	0.7	3	GR	B5	5.1
30C	Gate Creek	93	4	4.6	10.4	5.9	2	285	85	91	0.9	4	CO	B3a	1.5
30C	Gate Creek	93	5	10	11	1.0	1	56	42	26	0.4	13	CO	A3a+	0.0
29F	Jordan Creek	93	1	4.1	5.3	1.1	4	3	15	38	1.3	3	CO	B3	0.0
29F	Jordan Creek	93	2	5.3	14.5	11.0	3	18	40	44	1.3	6	CO	A3	0.2
29F	Jordan Creek	93	3	15	15.5	1.0	1	0	15	8	1.2	14	CO	A3a+	0.0
16A	NF Iron Creek	93	1	*0*	*0.6*	*0.6*	4	21	2	54	1.2	4	CO	C3b	1.5
16A	NF Iron Creek	93	2	0.6	2.1	1.4	3	77	5	65	1.3	5	CO	B3a	0.8
16A	NF Iron Creek	93	3	2.1	2.7	0.6	3	103	61	88	1.1	9	GR	C4b	1.0
16A	NF Iron Creek	93	4	2.7	3.2	0.5	2	112	21	43	0.9	21	GR	A4a+	0.0
30C	Pup Creek	93	1	0	1	1.1	1	23	25	55	0.6	5	GR	B4a	2.4
30E	SF Gate Creek	93	1	0	0.6	0.7	3	82	26	72	0.8	3	GR	B4	0.1
30E	SF Gate Creek	93	2	0.6	2.3	1.1	3	121	99	48	0.9	4	CO	B3a	0.7
30E	SF Gate Tributary	93	1	0	1.6	1.4	2	66	88	63	1.1	3	GR	B4	0.6
30F	Souva Creek	93	1	0	0.6	0.4	2	71	65	73	1.2	3	SA	B5	6.0
30F	Souva Creek	93	2	0.6	2.2	1.6	2	76	77	91	0.8	3	GR	B4	0.4
30F	Souva Creek	93	3	2.2	3.6	1.8	2	111	141	80	0.8	5	CO	B3	4.0
30F	Souva Creek	93	4	3.6	4.6	0.4	2	60	54	92	0.9	3	SA	B5	5.0
30F	Souva Creek	93	5	4.6	5.6	2.4	2	82	75	40	0.8	3	GR	B4	9.3
16C	Green Lake Creek	94	1	0	0.1	0.1	3	43	7	173	1.1	4	GR	B4a	0.0
16C	Green Lake Creek	94	2	0.1	1.5	1.6	3	17	15	129	*0.8*	18	GR	A4a+	*0.0*

Table 2. Summary of selected stream summary data 1993-94 White River Subbasin.

The 1989-92 stream survey data is based on USFS Region 6 protocols (USFS version 7.0 1993). The 1993-94 surveys are a combination of Regional and MHNF protocols (Wold and Dore draft). There is no survey or monitoring data available for intermittent and ephemeral streams. Detailed stream survey reports are on file in the Gresham Supervisor's Office and the District offices.

Criteria for 1989-92 stream surveys:

- Pools/mile 1989-92 were longer than they were wide
- Residual pool depth is the lowflow maximum pool depth
- Primary pools are ≥3 feet deep
- Canopy cover codes are: 1 = 0-25%, 2 = 25-50%, 3 = 50-75%, 4 = 75-100%
- LWD = large woody debris = ≥20" diameter and ≥35 feet long
- Large wood includes instream and trees that were "live & leaning" over the active channel
- SWD = small woody debris = ≥12" diameter and ≥35 feet long
- width to depth ratios were based on pool habitat
- reaches were based on a variety of factors that are not necessarily geomorphic
- Stream orders were calculated from the MHNF streams map

Criteria for 1993-94 stream surveys:

- Pools/mile 1993-94 = all pools
- Residual pool depth is the lowflow maximum pool depth
- Primary pools are ≥3 feet deep
- LWD = large woody debris = ≥20" diameter and ≥35 feet long
- SWD = small woody debris = ≥12" diameter and ≥35 feet long
- Large wood includes instream and trees that were "live & leaning" over the active channel
- 1993-94 Rosgen reaches are based on map and field-measured geomorphic features (*i.e.* entrenchment and width to depth ratios, sinuosity, gradient, and dominant substrate)
- width to depth ratios are based on straight section of riffles
- Stream orders were calculated from the MHNF streams map

Figure 1. Geomorphic & Surveyed Reach Breaks

insert between page 4+6 Appendix C

LRMP numeric aquatic and riparian standards:

- ▯ Maintain or enhance natural levels of habitat complexity (FW-087)
- ▯ Maintain or enhance natural levels of pool habitat (FW-088)
- ▯ Maintain or increase the residual lowflow volume of pools (FW-089)
- ▯ Maintain ≥1 primary pool (>3 ft. deep) every 5-7 bankfull channel widths in gravel dominated or low gradient (<3%) reaches (FW-090)
- ▯ Maintain ≥1 primary pool (≥3 ft. deep) every 3 bankfull channel widths in boulder/rubble dominated or moderately steep gradient (>3%) reaches (FW-091)
- ▯ Maintain at least 90% of naturally occurring and potential large wood and effective instream cover (FW-092, 096)
- ▯ Maintain multi-piece accumulations of large wood and fallen trees with an emphasis on attached rootwads (FW-092, 093)
- ▯ Maintain an average of ≥106 pieces of woody debris ≥35 feet long per mile of fish-bearing streams east of the Cascades crest. Eighty percent of the wood (≥85 pieces) should have a minimum diameter ≥12 inches. Twenty percent of the wood (≥21 pieces) should have mean diameters ≥20 inches (FW-094, 095)
- ▯ Maintain <20% surface fines <1 millimeter diameter and <25% embeddedness on area weighted average, in fastwater riffle and spawning habitat (FW-097, 099)
- ▯ Maintain the natural condition of streambank and shoreline stability, and restore streambanks degraded by management activities (FW-102, 103)
- ▯ Maintain or enhance the natural condition and quantity of subsurface hyporeic zones, side channels, ponds, wetlands, and other special aquatic habitats (FW-104)
- ▯ Increase stream shading where State Water Quality Standards are exceeded (FW-128)
- ▯ Maintain populations consistent with site potential productivity (LRMP B7 DFS)
- ▯ Fish habitat capability will be maintained at existing levels or higher (FW-137)
- ▯ Screen water diversions on fish-bearing streams (FW-143).

Aquatic Conservation Strategy Objectives not addressed above:

- ▯ Tier II Key Watersheds were selected as sources of high quality water, and may/may not contain at-risk fish stocks
- ▯ No new roads will be built in Key Watersheds
- ▯ Reduce existing road system and non-system road mileage outside roadless areas. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds
- ▯ Key Watersheds are highest priority for restoration
- ▯ Watershed analysis is required prior to management activities, except minor activities such as those Categorically Excluded under NEPA (not including timber harvest)
- ▯ Timber harvest cannot occur in Key Watersheds prior to completing a watershed analysis
- ▯ Maintain or restore functional floodprone areas accessible to bankfull floods

Draft PIG numeric standards for large wood, channel morphology, temperature, and pools:

- Inherent channel forming and maintenance processes continue to operate without substantial long-term or watershed-wide modifications
- ≥20 pieces per mile of instream and "live and leaning" large wood ≥20" in diameter and ≥35' long large wood for streams "eastside" areas ("eastside" to be defined by a Regional working group)
- Average width to depth ratio (measured as average bankfull width / average depth) ≤10 in all systems
- Compliance with State Water Quality standards (<58^{0} F), or summer temperatures <68^{0} F
- Pool frequencies based on lowflow wetted width of the channel, or range of natural condition

Lowflow wetted width	Pools/Mile
0.1-5 ft.	184
5.1-10 ft.	96
10.1-15 ft.	70
15.1-20 ft.	56
20.1-25 ft.	47
25.1-50 ft.	26
50.1-75 ft.	23
75.1-100 ft.	18

Tentative Tribal LRMP appeal settlement agreements:

- Cobble embeddedness will not exceed 20%, or range of natural conditions as measured by Wolman pebble counts in wilderness or unroaded areas with similar geomorphologies
- Develop an atlas of all known sources of chronic sediment as part of watershed analysis.
- Model estimates and ranges of sediment yield by soil type and activity during watershed analysis.

Findings:

- The maximum residual pool depths in Badger Creek are not significantly different above and below the Highland Ditch diversion (means = 1.8 ft., $t_{(0.20)} = 1.65$).
- The range of natural conditions for large wood, primary pools, and maximum residual pool depth in wilderness reaches of Badger, Little Badger, Fifteenmile, and Fret creeks are highly variable (Tables 4-6).
- The majority of wilderness pools - in all stream orders and reach types - have no large wood (mode = 0) (Table 6).
- Maximum residual pool depth, large wood, substrate, primary pools, and stream order are not significantly correlated (confidence interval 80%) (Table 7).
- Residual pool volume may have correlated significantly with large wood (Bilby and Ward 1989), but volume was not calculated.
- Review of the comments sections in stream survey reports indicates riparian vegetation and streamside vegetation management are correlated with large wood.
- In general, residual pools were deeper in higher order streams than first and second order streams, but ranges were overlapping, and the correlation co-efficient was not significant (Table 6-7). The trend may have been stronger with larger sample sizes.
- All the third order reaches in Boulder Creek had residual pools as deep, or deeper than the deepest fourth and fifth order residual pools (Figure 4; Table 6).
- MHNF stream survey data in the Crest and Transition zones of the White River Subbasin indicates large wood loadings are below the range of natural conditions for 106 miles of streams; and above the range of natural conditions for 2 miles of stream (Tables 1-2, 5).
- The current range of natural conditions for large wood calculated as pieces per mile in the Badger Wilderness, particularly in the Eastside Zone, may be on the high side of historical levels in some localities because of sixty years of fire suppression, and vegetative-type conversions from hardwood to conifer-dominated riparian areas.
- The LRMP and PIG standards for large wood ≥20" diameter (≥20/21 pieces/mile) is below the estimated range of natural conditions for White River Subbasin (38-103 pieces/mile; mean 57) (Table 5).
- The LRMP standard ≥103 pieces/mile for total large wood ≥12" - is at the low end of the range, and below the mean, of natural conditions (58-284 pieces/mile; mean =180) (Tables 3, 5-6).
- The Wenatchee National Forest in eastern Washington, and the Malheur and Wallowa-Whitman National Forests in eastern Oregon found similar large wood loads within the range of natural conditions of unmanaged streams (*i.e.* ≥100 pieces of large wood ≥12 " diameter per mile; ≥20% >20" diameter).
- The LRMP standard for primary pools is far above the range of natural conditions (Table 3).
- Range of natural conditions for a B4 reach in Fifteenmile Creek (*i.e.* 106 pools/mile) was above the LRMP (66 pools/mile) and PIG (70 pools/mile) standards for streams 5-10 ft. wide at lowflow wetted width.
- Range of natural conditions for a A6a+ reach in Fifteenmile Creek (i.e. 65 pools/mile) was below the LRMP (196 pools/mile) and PIG (96 pools/mile) for streams 5-10 ft. wide at lowflow wetted width.
- Reaches that meet LRMP standards for fine surface sediment (<20% <1 mm) may exceed biologically significant levels (<20% <6 mm) (Table 8).
- With the exception of upper White River floodplain, ≥95% stability was within the range of natural condition for streambanks (Table 3).
- PIG recommendations for width to depth ratios ≤10 do not represent the range of natural conditions for many stable channel forms (Rosgen 1994). Only the "A" and "E" channels meet this criteria within the range of natural conditions of the stable channel forms.

Analysis Methods: Comparisons between the current condition and LRMP and PIG numeric desired conditions for pools and wood (Tables 3 part I and II) indicated a need to analyze the range of natural conditions within White River Subbasin. Badger Creek Wilderness segments of Badger and Little Badger creeks (Badger-Tygh Watershed), and Fifteenmile and Fret creeks (Miles Creek Watershed) were analyzed for range of natural conditions for selected wood and pool parameters that were data and standard driven (Table 3), and possible correlations between number of pools, large wood, stream order, and substrate (Table 7). Variables and data limitations are listed below.

- Current conditions in 28 miles of perennial fish-bearing streams in the Badger Creek Wilderness were used as the basis for the range of natural conditions of aquatic variables.
- Trees that were "live and leaning" over streams are included in the large wood calculations to meet Regional protocols.
- Short "reaches" with lengths <0.2 miles often represent special features such as waterfalls and dams, and are not geomorphic units and were not included in analysis of large wood .
- The pieces of large wood and depth of residual pools per mile above and below the Highland Ditch diversion were not significantly different, so all wilderness stream segments were used for analyses.
- Detailed riparian vegetation data was not available for possible large wood correlations.
- Residual pool volumes cannot be calculated from the available data, so could not be analyzed for possible correlations with pieces of wood and stream order.
- Substrate data is averaged by reach during surveys, and is not available for individual habitat units.
- Only 2 reaches of Fifteenmile Creek 1994 data was used to analyze the range of natural conditions for the total 1994; Montgomery and Buffington 1993; others).

Stream Name	Reach	Gradient	Primary Pools	LRMP DFC Prim Pools	Pools /Mile	PIG DFC Pools	LWD ≥20"	PIG/LRMP LWD ≥20"	LWD ≥12"	LRMP DFC LWD ≥12"
Badger Creek 92	1	1	4	49	12	70	19	≥20/21	50	≥106
Badger Creek 92	2	3	3	61	14	70	26	≥20/21	63	≥106
Badger Creek 92	3	5	6	30	20	56	51	≥20/21	145	≥106
Barlow Creek 92	1	2	10	59	19	56	32	≥20/21	105	≥106
Barlow Creek 92	2	2	2	61	17	56	25	≥20/21	49	≥106
Barlow Creek 92	3	3	0	50	29	26	21	≥20/21	50	≥106
Barlow Creek 92	4	2	0	NI	3	184	25	≥20/21	70	≥106
Barlow Creek 92	5	1	8	NI	2'	47	0	≥20/21	0	≥106
Barlow Creek 92	6	15	0	50	13	70	20	≥20/21	54	≥106
Bonney Creek 93	1	3	0	98	30	26	178	≥20/21	319	≥106
Bonney Creek 93	2	2	0	104	107	18	88	≥20/21	233	≥106
Bonney Creek 93	3	4	9	126	65	23	31	≥20/21	99	≥106
Bonney Creek 93	4	7	0	50	56	23	46	≥20/21	154	≥106
Bonney Creek 93	5	15	4	44	83	18	45	≥20/21	125	≥106
Bonney Creek 93	6	17	0	44	26	26	26	≥20/21	26	≥106
Bonney Creek 93	7	10	0	NI	141	18	42	≥20/21	56	≥106
Bonney Creek 93	8	20	3	40	84	18	18	≥20/21	43	≥106
Bonney Creek 93	9	9	5	84	59	23	0	≥20/21	0	≥106
Bonney Creek 93	10	4	0	108	63	23	0	≥20/21	0	≥106
Boulder Creek 91	1	11	8	24	12	70	0	≥20/21	0	≥106
Boulder Creek 91	2	5	6	24	7	96	0	≥20/21	0	≥106
Boulder Creek 91	3	4	3	24	6	96	0	≥20/21	0	≥106
Boulder Creek 91	4	4	4	14	6	96	0	≥20/21	0	≥106
Boulder Creek 91	5	4	3	20	3	184	0	≥20/21	0	≥106
Boulder Creek 91	6	2	2	50	4	184	1	≥20/21	1	≥106
Camas Creek 89	1	2	1	77	18	56	8	≥20/21	25	≥106
Cedar/Forest Creek 89	1	4	0	42	32	18	50	≥20/21	240	≥106
Clear Creek 90	1	3	7	62	7	96	19	≥20/21	59	≥106
Clear Creek 90	2	4	0	NI	1	184	37	≥20/21	160	≥106
Clear Creek 90	3	2	0	NI		NI	0	≥20/21	0	≥106
Clear Creek 90	4	4	0	NI	0	NI	58	≥20/21	324	≥106
Clear Creek 90	5	2	0	NI		NI	0	≥20/21	0	≥106
Clear Creek 90	6	2	1	68	3	184	24	≥20/21	157	≥106
Clear Creek 90	7	2	0	NI		NI	0	≥20/21	0	≥106
Clear Creek 90	8	2	0	NI	7	96	13	≥20/21	73	≥106
Clear Creek 90	9	2	0	NI		NI	0	≥20/21	0	≥106
Clear Creek 90	10	2	0	NI	0	NI	47	≥20/21	293	≥106
Clear Creek 90	11	2	0	NI		NI	0	≥20/21	0	≥106
Clear Creek 90	12	2	1	61	2	184	10	≥20/21	92	≥106
Frog Creek 89	1	2	0	56	29	26	47	≥20/21	137	≥106
Frog Creek 89	2	1	0	41	8	96	58	≥20/21	170	≥106
Frog Creek 89	3	1	0	NI	1	184	28	≥20/21	99	≥106
Frog Creek 89	4	1	0	84	1	184	19	≥20/21	52	≥106
Gate Creek 93	1	2	4	107	60	23	6	≥20/21	28	≥106
Gate Creek 93	2	2	0	111	85	18	104	≥20/21	242	≥106
Gate Creek 93	3	3	0	160	107	18	92	≥20/21	242	≥106
Gate Creek 93	4	4	0	52	91	18	85	≥20/21	371	≥106
Gate Creek 93	5	13	0	79	26	26	42	≥20/21	98	≥106
Green Lake Creek 94	1	4	0	116	173	18	7	≥20/21	51	≥106
Green Lake Creek 94	2	18	0	94	129	18	15	≥20/21	32	≥106
NF Iron Creek 93	1	4	6	44	54	23	2	≥20/21	22	≥106
NF Iron Creek 93	2	5	4	57	65	23	5	≥20/21	82	≥106
NF Iron Creek 93	3	9	0	65	88	18	61	≥20/21	164	≥106
NF Iron Creek 93	4	21	0	84	43	26	21	≥20/21	133	≥106
Jordan Creek 93	1	3	3	65	38	26	15	≥20/21	18	≥106
Jordan Creek 93	2	6	2	37	44	26	40	≥20/21	57	≥106
Jordan Creek 93	3	14	0	126	8	96	15	≥20/21	15	≥106
Little Badger 90	1	6	2	32	25	47	46	≥20/21	105	≥106
Pup Creek 93	1	5	0	103	55	23	25	≥20/21	48	≥106
SF Gate 93	1	3	1	124	72	23	26	≥20/21	109	≥106
SF Gate 93	2	4	0	62	48	26	99	≥20/21	219	≥106
SF Gate Tributary 93	1	3	1	185	63	23	88	≥20/21	154	≥106
Souva Creek 93	1	3	0	107	73	23	65	≥20/21	136	≥106
Souva Creek 93	2	3	0	142	91	18	77	≥20/21	153	≥106
Souva Creek 93	3	5	0	67	80	18	141	≥20/21	253	≥106
Souva Creek 93	4	3	0	130	92	18	54	≥20/21	114	≥106
Souva Creek 93	5	3	0	133	40	26	75	≥20/21	157	≥106
Threemile Creek 90	1	6	0	23	13	70	56	≥20/21	180	≥106

Table 3. Comparisons of current condition with LRMP and PIG numeric desired conditions.

Discussion of Results:

Pools. Research indicates stream width, gradient, substrate, and geomorphology influence the number and size of pools per mile, and the range of natural conditions within a given geomorphic reach type is highly variable (Overton et al. draft; Rosgen 1994; Montgomery and Buffington 1993; others). PIG and LRMP standards do not fit the wide range of natural conditions demonstrated in a complex, large subbasin like White River. For example, primary pools $\geq$3 feet maximum depth (LRMP standard), are important features of higher order, anadromous salmonid streams - particularly for summer run salmon and steelhead that need large pools to hold in over the summer - but occur less frequently in lower order, headwater streams (Tables 3 and 5; MHNF stream survey data). Plunge pools associated with bedrock substrates and high gradients form the deepest pools in headwater streams, and may or may not be fish habitat.

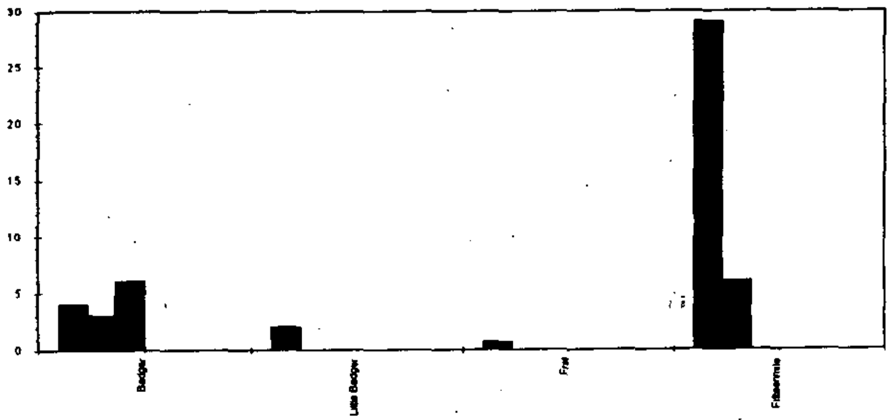

Figure 2. Number of primary pools $\geq$3 feet deep by reach in Badger Creek Wilderness streams (n = 9).

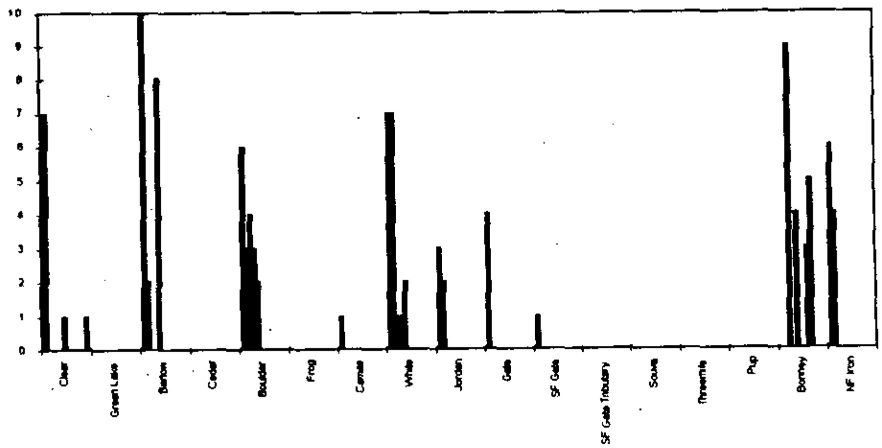

Figure 3. Number of primary pools $\geq$3 feet deep in non-wilderness streams.

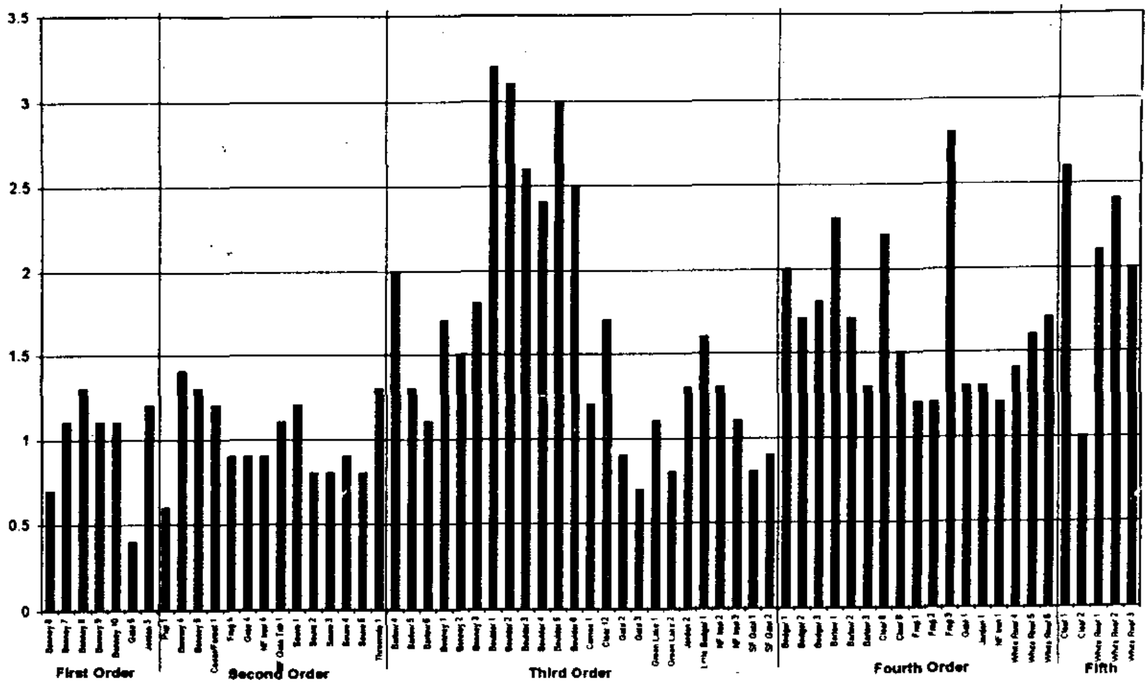

Figure 4. Maximum residual pool depth in feet by reach and order.

The survival of small, resident trout is not dependent on large pools when smaller, good quality pools and perennial flow are available. Deep, high volume pools can become critical lowflow refugia when baseflows are excessively low, water temperatures are excessively high, and residual pools are filled with excessive sediment due to natural or unnatural conditions. However, isolated large pools without perennial flow cannot mitigate loss of feeding habitat, increased predation, and water quality effects in de-watered stream segments. White River Subbasin has serious lowflow and de-watering problems below water diversions in a number of stream segments that do not have high numbers of primary pools (Figures 6 & 13; Table 3).

In the upper White River Subbasin the risk of landslide, or other large-scale processes, that have the potential to produce enough sediment to obscure pools is low. Channelization and channel downcutting (*i.e.* gulling) that produces straight channels with few pools are not significant factors in the upper subbasin. Therefore, the quality and volume of pools - not the number or maximum depth of pools - are potentially influenced by MHNF management activities. The quality of pools can be evaluated using cover components such as substrate, large wood, overhanging banks, white water, emergent vegetation, and residual pool volume, depending on the species and age class of interest. Coarse substrates and large wood - particularly large wood jams and rootwads - enhance pool cover and volume, increasing the amount of habitat available for trout and other fishes. Pools with large wood and coarse substrates also increase survivorship of young-of-the-year fishes, and provide slowwater "velocity refugia" to protect juvenile and adult fishes from being flushed downstream during seasonal peakflows (Pearsons *et al.* 1992; Bustard and Narver 1975a, 1975b).

Complex substrates and residual pool volumes are good indicators of whether or not pool filling is occurring as a result of sedimentation. The volume of sediment accumulated in pools, and the possible effects of sedimentation on residual pool volume cannot be determined without data for analysis of pool volume potential such as Lisle and Hilton (1992). Streamshade and baseflow are other critical components for maintenance of coldwater habitat.

Habitat specific stream survey data is available for restoration project-level planning, or more detailed habitat quality and causal effect analyses than were done for this report (see Badger-Tygh Watershed, Rock-Threemile Watershed, White River Watershed, and Miles Creek Watershed stream survey reports 1989-94).

Wood. Bilby and Ward (1989) found the majority of large wood in small Washington streams (<23 feet wide) was oriented perpendicular to the channel and formed dam/plunge pools (42%). Large wood was often oriented downstream in large streams (>23 feet wide), and the majority of pools formed with wood were scour pools (62%). Bilby and Ward demonstrated higher order, large volume streams retain less wood of larger size than lower order, low volume streams because of hydraulic power.

Weighted averages for the entire length of the 4 wilderness streams - Fifteenmile, Fret, Badger, and Little Badger - were used to derive the range of natural conditions for wood loadings (Figures 2-4; Tables 4 and 5). Reaches >0.2 miles long are analyzed as separate samples for the interquartile for large wood in the wilderness streams (Table 5). The Wenatchee National Forest in eastern Washington, and the Malheur and Wallowa-Whitman National Forests in eastern Oregon found similar large wood loads within the range of natural conditions of unmanaged streams (*i.e.* ≥100 pieces of large wood ≥12 " diameter per mile; ≥20% >20" diameter).

Figure 5. Average pieces of large wood in Badger Creek Wilderness streams.

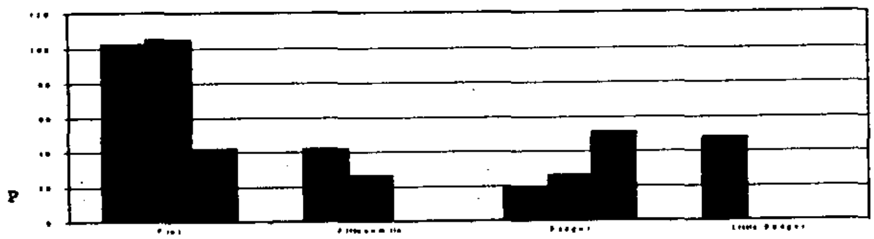

Figure 6. Pieces of large wood >20" diameter by reach in wilderness streams.

Stream	Reach	Survey Length	Pieces of LWD >20"	Pieces of LWD >20"/Mile	All Pieces of Wood >12"	All Pieces of Wood >12"/Mile
Fret	1	2440 ft.	47	102	149	322
	2	7833 ft.	155	105	391	264
	3	505 ft.	4	42	21	220
	totals	**2.0 miles**		**103/mile**		**281/mile**
Fifteenmile	7	8976 ft.	71	42	518	152
	8	2640 ft.	13	26	106	42
	totals	**2.2 miles**		**38/mile**		**284/mile**
Badger	1	16991 ft.	61	19	101	75
	2	37874 ft.	225	26	261	97
	3	36342 ft.	344	51	631	92
	totals	**17.3 miles**		**40/mile**		**58/mile**
Little Badger	**1**	**6.5 miles**		**48/mile**	**95/mile**	**95/mile**

Table 4. Large wood in Badger Creek Wilderness streams surveyed 1990-94.

Stream Variable	RNC	Mean	Mode	Interquartile Range	Survey Sample
All wood >12" diameter	0 - 10 pieces /pool	1.1	0		455 pools
	95 - 284 pieces /mile	180	NA		28 miles /4 streams
	42 - 322 pieces/mile	142	NA	92-152 pieces/mile	8 reaches >0.2 miles long
Large wood >20" diameter	0 - 8 pieces /pool	0.4	0		455 pools
	38 - 103 pieces /mile	57	NA		28 miles /4 streams
	19 - 105 pieces/mile	53	NA	26-51 pieces/mile	8 reaches >0.2 miles long
Pools / 5-10 ft. wide stream	106 pools /mile	NA	NA		1.7 miles /1 B4 reach
Pools / 5-10 ft. wide stream	65 pools /mile	NA	NA		0.5 miles /1 A6a+ reach
Number of primary pools	0.7 - 29 mile	6.6	4		28 miles /4 streams
Max residual pool depth	0.4 - 2.1 /feet	1.0	0.9		136 pools

Table 5. Range of natural conditions for wood and pools in Badger Wilderness.

A frequency analysis of large wood in non-wilderness reaches indicates the large wood loads for most surveyed segments have a similar interquartile range compared to the wilderness results (IQR = 20-61; Figures 4-5). Survey reaches <0.2 miles long are generally special features such as chutes, falls, dams and were not included in this analysis. White River mainstem was excluded from the analysis because it is higher order than other streams in the subbasin and has periodic, "stream cleaning" debris torrents.

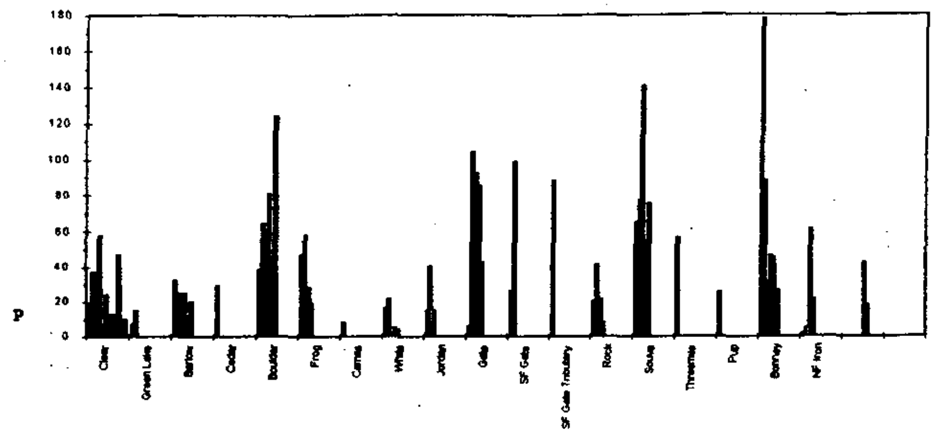

Figure 7. Number of pieces of large wood >20" diameter by reach in non-wilderness streams.

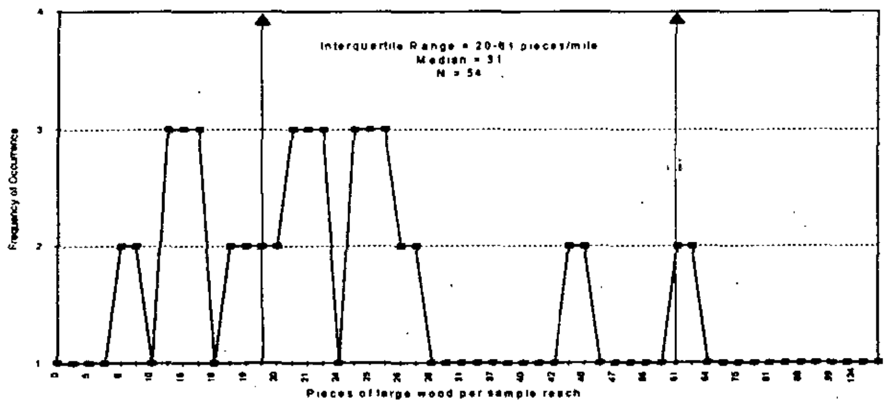

Figure 8. Pieces of large wood ≥20" diameter in non-wilderness reaches >0.2 miles long.

There was no demonstrable correlation between stream order and pieces of large wood, or maximum residual pool depth and pieces of large wood in analysis of the White River Subbasin stream data (Tables 6-7).

Aquatic Habitat Variable	RNC	Mean	Mode	S.E.	Sample Size
wood ≥12" diameter in first order wilderness pools	0-4	0.7	0	0.18	37 pools
wood ≥12" diameter in second order wilderness pools	0-6	1.3	0	0.10	184 pools
wood >12" diameter in third order wilderness pools	0-39	3.7	0	0.61	159 pools
wood ≥12" diameter in fourth order wilderness pools	0-10	1.1	0	0.12	191 pools
max residual pool depth in all first order streams	0.4-1.3	0.9	1.1	0.11	8 reaches
max residual pool depth in all second order streams	0.8-1.4	1.0	0.9	0.06	13 reaches
max residual pool depth in all third order streams	0.7-3.2	1.7	1.3	0.16	24 reaches
max residual pool depth in all fourth order streams	1.2-2.8	1.7	1.7	0.11	17 reaches
max residual pool depth in all fifth order streams	1.0-2.6	2.0	NA	0.28	5 reaches

Table 6. Summary statistics for wood, stream order, and maximum residual pool depth in wilderness and non-wilderness streams.

Variable 1	Variable 2	R^2	Sample Size
wood >12" diameter	wilderness stream orders	0.00	455 pools
maximum residual pool depth	wilderness stream orders	0.30	455 pools
maximum residual pool depth	wilderness wood >12" diameter/pool	0.01	455 pools
primary pools >3 ft. deep	all streams average substrate/reach	0.23	65 reaches
average residual pool depth	all stream orders	0.23	65 reaches
average residual pool depth	all streams average substrate/reach	0.05	65 reaches
average residual pool depth	all streams average wood >12" diameter/reach	0.05	65 reaches

Table 7. Correlation statistics for wood, stream order, and pools in wilderness and non-wilderness streams.

Causal factors for the differences between wood loads in the wilderness streams were not analyzed due to time constraints, but probable factors for localized differences include fire and suppression history, insect and disease infestations, elevation, vegetation-type, site potential, climatic and precipitation zones; and possibly interpretation of "live and leaning" trees by different survey crews. Multi-variate analyses done by the Wenatchee National Forest in eastern Washington has shown landform type to be the most significant factor relating to large wood loads (*i.e.* landform accounted for 37% of the variation between streams), followed by potential tree forms.

Historically, wilderness fires were frequent, low intensity with mosaic patterns that did not consume much down wood in the channel or kill mature trees in the riparian zone, but created open cathedral stand conditions. Due to sixty years of fire suppression some stands that were dominated by large volume, mature trees have been replaced with more numerous stems per acre of smaller diameter trees. It is possible that the some of the 28 miles of Badger Wilderness streams are currently on the high range of large wood loading, calculated as pieces per mile. Wood volumes may be similar. Smaller diameter trees have shorter retention times than large diameter trees as down wood in the riparian zone or channel. Current fire conditions, because of suppression, are likely to kill riparian trees and contribute short term pulses of down large wood to riparian zones and channels.

A severe drought equivalent to the Dust Bowl of the 1930's effected the western region of the United States during the late 1980's-early 90's. Insect and disease epidemics associated with drought stress have killed, or will kill, a large number of conifers in the wilderness. As a result, there will be a substantial recruitment of snags and down large wood in the wilderness in the near future. Recommended Riparian Reserve buffers will determine prescriptions for vegetation management in non-wilderness riparian areas.

Historically, the riparian community in the Eastside Zone consisted of hardwood stands. The Transition Zone was conifer dominated with scattered hardwoods and hardwood shrub. Because of fire exclusion, stream flow regulation, livestock grazing, and timber management, the riparian areas in the Transition and Eastside zones are currently dominated by conifers. Cottonwood stands require 100 year flood events for groundwater recharge and substrate scour to facilitate recruitment of new trees. Irrigation ditches and flow regulation in all the perennial Eastside Zone streams may have reduced the frequency and probability of occurrence of 100 year flood events.

The rate of down wood recruitment was more rapid in hardwood stands - approximately 80 year rotation versus 200 years - but mature cottonwoods are smaller than mature conifers, and length of time cottonwoods last in a stream is shorter than conifers. Conversion to conifer dominated stands probably resulted in a lag time in the large wood recruitment cycle - from shorter to longer rotations of longer lasting large woody debris. Restoration projects that will restore cottonwoods to the riparian zones that were historically dominated by hardwoods, are opportunities to increase conifer snags and down large wood in riparian and aquatic habitats.

Large wood that moves and redistributes during floodstage events may form debris jams. The debris jams stabilize and collect smaller size wood, sediment, and vegetative debris, increase pool volume, and provide complex habitat for fishes. A number of culverts on Little Badger, Jordan, Pen, Tygh, Gate, SF Gate, and Threemile creeks are probably migration barriers for large wood moving downstream from the steeper, more heavily forested reaches in the Transition Zone to less productive reaches in the Eastside Zone (Table 18).

The highly mobile riparian area in upper White River is a mix of small hardwoods and conifers, and does not support older, larger trees. The upper floodplain is very dynamic. The active channel shifts between Mineral and Iron creeks, and has periodic debris torrents that flush the White River Gorge reaches of large wood.

Sediment. For this analysis, rivermiles are calculated from the mouth of the creek upstream, or from the rivermile at the Forest Service boundary (Table 5). Percentages of surface fines are based on Wolman (1954) "pebble" counts. Pieces of substrate (*i.e.* "pebbles") were collected across transects that run perpendicular to the flow in fastwater riffle and pooltail crest spawning habitats (n = ≥100 substrate samples taken at ≥10 transects/location). The spawning substrate for resident trout was defined as fine gravel-small cobble (6-128 mm). Surface fines were defined as silt-very fine gravel (*i.e.* <6 mm; Bjornn and Reiser 1991), and as silt-coarse sand (*i.e.* <1 mm; LRMP). The dominant particle size (*i.e.* "D50") is identified as the median size of substrate expressed in millimeters, or the size that is ≤50% of the total sampled substrate. Wolman pebble counts are conservative estimates of surface fines, since the method statistically under-represents small particles that are difficult for samplers to pick up.

Stream Name	Location	River mile	% Surface Fines <6 mm	% Surface Fines <1 mm	D50 Particle Size	Stream Gradient	Cattle Damage
Green Lake	below Road 220	0.3	13	3	26	8.6	
Green Lake	mouth	0.0	85	75	~ 0.1	0.6	
Buck	mouth	0.0	18	12	47	3.9	
Bonney	below Road 48	0.3	45	36	9	2.9	
Red	below Road 48	0.3	42	28	5	7.0	
NF Iron	mouth	0.3	36	22	9	3.6	
Clear	below Clear Creek CG	3.0	19	11	26	0.7	
Clear	mouth	0.3	19	12	99	5.7	
Frog	mouth	0.25	66	45	~ 0.1	1.2	
Camas	below Road 241	0.8	36	25	11	3.2	yes
Barlow	mouth	0.0	54	35	5	1.6	
Barlow	upstream of Grindstone CG	3.5	15	5	50	3.1	
Deep	below Road 140	0.5	31	13	13	5.0	
Lost	above Road 48	0.5	55	47	0.5	2.4	yes
Threemile	below Road 4811	11.5	14	11	33	1.5	
Rock	staff gage site	6.25	33	21	8	1.8	
Rock	below Road 48	4.75	21	14	27	1.5	yes
NF Rock	mouth	0.0	23	12	12	2.5	
Little Badger	below Little Badger CG	1.5	25	7	26	2.0	
Pup	below Road 4811	0.3	34	27	15	8.3	
Gate	below Road 48	7.0	71	61	~ 0.1	1.5	yes
Gate	below Road 4811	13.25	22	13	13	6.0	
SF Gate	below Road 4830	0.25	53	31	1	2.0	yes
Jordan	above Road 2730	6.75	19	7	31	1.8	
Tygh	above Road 2730	12.25	6	4	83	3.2	
Badger	below Bonney Crossing CG	9.75	15	5	55	1.6	
Souva	below Road 4820-120 spur	0.75	25	18	13	2.3	yes
Boulder	below Road 3530	2.0	18	9	60	1.5	
Boulder	mouth	1.5	24	18	56	2.7	
Boulder	end of Road 4880	8.75	54	43	3	1.9	
Swamp	above Road 4880	0.75	60	45	2	5.1	
Cedar (Forest)	mouth	0.0	33	19	16	4.4	
Mineral	below confluence with SF and NF Mineral	0.5	11	6	73	1.9	
SF Mineral	below Road 224	1.0	16	13	51	3.5	
NF Mineral	mouth	0.0	20	15	27	2.5	

Table 8. White River Subbasin instream fine sediment data collected by Wolman pebble counts in 1994.

Bjornn and Reiser (1991) demonstrated the survival of salmon and trout embryos decreases rapidly when fine sediment <6 millimeters diameter exceeds 20 percent, because eggs and fry are dependent on course substrates with high oxygen levels during development. Thirteen of the 35 sample sites on Green Lake, Buck, Clear, Barlow, Threemile, Jordan, Tygh, Badger, Boulder, Mineral, SF Mineral, and NF Mineral creeks had <20% surface fines <6 mm in spawning habitat (Table 8). Another six sites on Rock, NF Rock, Little Badger, Gate, Souva, and Boulder creeks exceeded the 6 mm standard by 20%, or less. Sites on Green Lake, Bonney, Red, NF Iron, Frog, Camas, Barlow, Deep, Lost, Rock, Pup, Gate, SF Gate, Boulder, Swamp, and Cedar/Forest creeks exceeded the standard by more than 20%. A number of sites on Deep, Rock, NF Rock, Little Badger, Gate, Souva, Boulder, and Cedar/Forest creeks met the LRMP sediment standard of <20% surface fines <1 mm, but exceeded the biologically significant standard of <6 mm demonstrated by Bjornn and Reiser 1991, and proposed by the Tribes as part of the LRMP appeals settlement.

Stable sediment distributions, such as the example of Tygh Creek within the Badger Creek Wilderness (Figure 8), appear as curves that may/may not be skewed toward finer or coarser substrates as a function of stream gradient and other geomorphic factors (Rosgen 1994). Bimodal distributions of surface particles have large peaks in both the fine and coarser sediment ranges, as in the Camas Creek example (Figure 9), and are indicative of excessive fine sediment accumulations (other sample site histograms in project file). Based on the pebble counts, <20% surface fines <6 mm appear to be within the range of natural conditions for the fish-bearing tributaries to White River (more details on sediment surveys in project file).

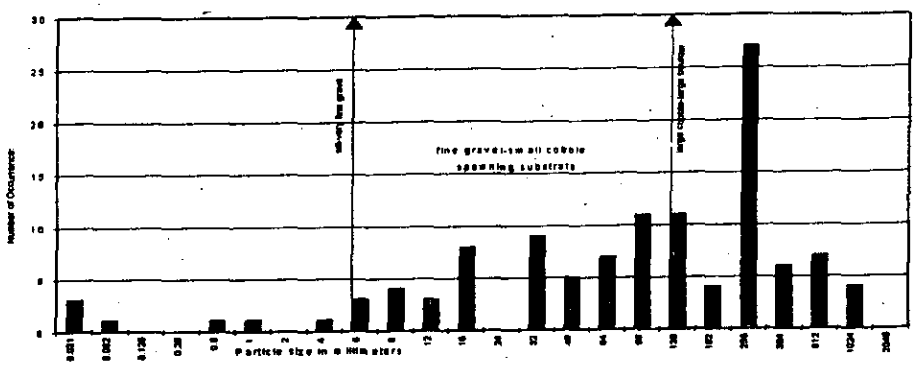

Figure 9. Surface particle size distribution in Tygh Creek within the Badger Wilderness.

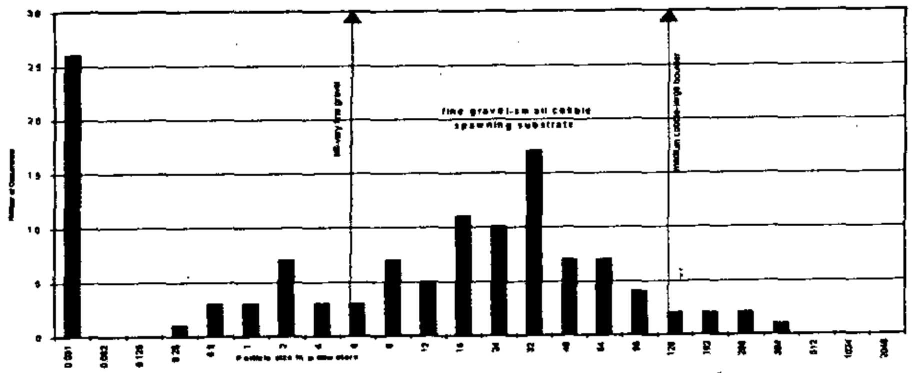

Figure 10. Surface particle size distribution in Camas Creek below Road 2140.

The mainstem of White River is unique within the subbasin. Named by euro-american settlers for it's large supply of glacial silt - White River has natural aggradation-degradation cycles associated with silt deposited from the glacier, and periodic debris torrents that are triggered by large rain-on-snow events. The debris torrents flush large volumes of glacial sediment stored in the White River floodplain above Highway 35 bridge (*e.g.* a large debris torrent took out the Highway 35 bridge in 1974). The White River Gorge, downstream of Highway 35, has the capacity to move large amounts of sediment that are deposited downstream in Tygh Valley, or carried out to the Deschutes River. Naturally and unnaturally produced, excessive sediment loads are expressed as large point bars; mid-channel bars; increases in the channel width to depth ratio; and some tortuous meander patterns in the low gradient, depositional areas of Tygh Creek and White River (Figure 11).

Redband trout reproduction is timed to the natural occurrence and magnitude of scouring peakflows, and fine sediment deposition in White River Subbasin. The largest and flashiest annual peakflows are initiated by mid-December to mid-January rain-on-snow storms in the Crest and upper Transition zones, prior to spring spawning. During the summer months, after the young-of-the-year fish are out of the substrate, the turbidity and silt load of mainstem White River increase as the White River Glacier melts up on Mt. Hood. Therefore, when resident trout spawn in the spring - following the high winter flows that scour fine sediment from the substrate, and prior to the summer flows that deposit glacial silt - suitable substrate is available in White River (BPA 1985). A more appropriate LRMP standard for trout and salmon spawning habitat in White River Subbasin would be "<20% surface fines <6 millimeters diameter, or range of natural conditions in spawning habitat during the reproductive season".

Given the time frame of this analysis, causal relationships between management activities and current sedimentation levels; sediment sources; and sediment yields by soil type were not determined   Causal relationships analyses would examine correlations between instream sediment loads and sediment producing human activities such as roading, tractor harvest, recreational campground and dispersed campsite use, off-highway vehicle use, human or livestock-caused eroded streambanks, agriculture; natural features such as highly erosive and low resiliency soils, subwatershed units, stream reaches; and the effects of flow regulation on the maintenance of channel configurations, pools, and substrate compositions. Potentially large volume, management-induced sources of sediment in White River Subbasin are roads and their associated ditches; under-sized culverts; recently harvested tractor units; riparian zone sand and gravel pits; the extensive open, ditch system; streambanks eroded by cattle or recreational activities concentrated along rivers or lakes; and agricultural fields. For example, McCubbins Gulch is a historically intermittent stream that has augmented, perennial flow from the Clear Creek ditch. Increased flow in the McCubbins subwatershed causes erosion in the ditch, McCubbins Creek and gullies into White River. The sediment is deposited in downstream pools and cultivated fields. Highland Ditch in the Badger Wilderness blowouts periodically and contributes large amounts of sediment downstream.

Disturbance forces with the potential to trigger large scale erosion are debris torrents in White River mainstem; rain-on-snow storms in the Crest and upper Transition zones; floodflows in the lower Transition and Eastside zones; and peakflows that exceed the range of natural conditions as a result of created openings and increased drainage densities.

Figure 11.
Tygh Valley 1980

Bank Stability. Overton *et al.* (draft) established a standard for streambank stability based on the range of natural conditions for unmanaged streams. This standard is applicable to all streams in the subbasin, except the upper mainstem of White River where large amounts of sediment from the glacier, and debris torrents keep the channel in a continual state of aggrading and degrading, and the banks eroding. Other stream reaches in the subbasin that have >5% eroded banks are outside the range of natural conditions as a result of hoofshear and chiseling damage from range cattle, recreational livestock, or other human activities (Tables 3).

Channel Maintenance Flows. Recent research by the USFS Stream Team (July 1995 draft report) indicates maintenance of low gradient, gravelbed reaches (*i.e.* <3% gradient) requires flood flows between 0.6-2.5 times of bankfull stage (*i.e.* includes 25 year flood events) to move sediment, maintain channel form and function, recharge the watertable, and maintain the riparian vegetation that is critical to channel stability. Andrews' (1995) research produced similar requirements for channel maintenance flows (*i.e.* 0.8-1.8 times bankfull). The substrate scour and watertable recharge associated with hundred year floods is required to maintain regeneration of the cottonwood stands that stabilize streambanks in the Eastside Zone. Irrigation withdrawals may have decreased the frequency and magnitude of flood stage events, particularly in the Eastside Zone, and may be a factor, along with grazing and fire suppression, in the decline of cottonwood in the riparian zone. Monitoring bedload movement, flow, stage, and channel cross-sectional profiles on reaches that meet these criteria - above and below water diversion points - is recommended.

Sinuosity, Width to Depth and Entrenchment Ratios. PIG recommendations for width to depth ratios ≤10 are below the range of natural conditions for B and C stable channel forms (Rosgen 1994). Only the Rosgen "A" and "E" channels meet the PIG criteria for low width to depth ratios within the range of natural conditions of the stable channel forms. The Rosgen "G" channels - an undesirable, unstable gully form - also have low width to depth ratios that meet the PIG criteria. The range of natural conditions for stream width to depth, sinuosity and entrenchment ratios are listed in Table 9.

Rosgen Stable Channel Type	RNC for Sinuosity	RNC for Entrenchment Ratio	RNC for Width to Depth Ratio
A	<1.2 = low	<1.4 = high	<12 = low
B	>1.2 = moderate	1.4-2.2 = moderate	>12 = moderate
C	>1.4 = high	>2.2 = slight	>12 = moderate/high
E	>1.5 = high	>2.2 = slight	<12 = low

Table 9. Range of natural conditions for Rosgen channel types.

Width to depth and entrenchment ratios are not a management concern for the extremely stable cascade-pool and step-pool channel forms with boulder and bedrock substrates. Channel condition monitoring and restoration efforts should be focused on reaches with gradients <3% and predominantly cobble or finer substrates that are sensitive to management activities, and do not meet the range of natural conditions for width to depth ratios in straight riffle sections (Rosgen 1994). In the lower subbasin moderate-low gradient reaches, such as segments of Badger Creek, have been farmed and channelized with heavy equipment after floods to "protect" agricultural investments (long time residents, pers. comm.). The result are modified channel morphologies including decreased sinuosity, entrenchment, and width to depth ratios. There is no indication of sinuosity, width to depth or entrenchment morphology problems on streams surveyed 1993-1994. Survey data that pre-dates 1993 was collected in pools and is not appropriate for width to depth analyses.

Recommendations for changes in riparian and aquatic standards based on these analyses:

- Change terminology "maintain or enhance" in the LRMP aquatic habitat standards to "maintain or promote within the range of natural conditions".
- Base numeric standards for channel on the entrenchment ratios, width to depth ratios, meander lengths, and gradient parameters of stable channel forms (Rosgen 1994), or the range of natural conditions.
- Focus channel morphology and restoration efforts on sensitive reaches <4% gradient with cobble and finer substrates.
- Base number of pools per mile on the range of natural conditions from local and/or Intermountain Research data (Overton *et al.* draft).
- Change FW-102 to "streambank stability shall be maintained at ≥95%, or the range of natural conditions".
- Change standards FW-094,095 for large wood to "maintain or promote an average of 57 pieces of large wood ≥20 inches diameter and ≥35 feet long per mile; or an average of 180 pieces of combined small and large wood ≥12" diameter and ≥35 feet long per mile with ≥30 percent with a diameter ≥20 inches; or range of natural conditions".
- Change the LRMP surface sediment standard FW-097 to "<20% surface fines <6 millimeters diameter, or seasonal range of natural conditions in riffles and spawning habitat".
- Change the LRMP standard FW-092, 093 for large wood to "maintain 100% of potential and naturally occurring in-channel large woody debris in conjunction with riparian stand management to promote ecosystem health and resiliency".
- Change LRMP standard FW-128 for stream shading to "maintain or promote ≥70% canopy closure in mountain hemlock/silver fir and Douglas fir/grand fir dominated stands, and ≥50% canopy closure in pine-oak dominated stands, or range of natural conditions".
- "Maintain favorable conditions of flow" (Organic Act 1897).

Issue 2D: Can we restore compacted areas without further degrading the riparian and aquatic ecosystems?

YES. It is an appropriate restoration practice to treat compacted sites when short-term sediment inputs are outweighed by long-term benefits of chronic or catastrophic sediment prevention; increased site productivity, large woody debris recruitment potential, and streamside canopy closure; decreased peakflow runoff and increased soil infiltration. Consider current state of recovery; potential benefits; implementation and post-project erosion control measures when selecting compacted sites for treatment.

Issue 3A: *Are there stream reaches or riparian areas where large woody debris levels or recruitment potential are low and outside the range of natural conditions?*

YES. Current condition for down large woody debris was based on MHNF stream surveys, and range of natural condition analyses (Tables 1-7). Future large wood recruitment potential in Riparian Reserves on the Forest was projected with a matrix approach (Washington DNR 1993) based on the current condition of stands with the interim Riparian Reserve from the ROD (Table 10; Figure 12). Dominant tree types represent ≥70% of total trees in the stand. All other cases are mixed dominance. Seedlings, sapling, and small poles are early seral conifers or hardwoods. Small trees are 8-21 inches diameter at breast height (DBH). Large trees are >21 inches DBH. Sparse canopy closure is <70% in hemlock and fir community types, and <50% in the pine/oak community. Alpine, grass/forb, rock, shrub/scrub and other acres that have no natural large wood recruitment potential are listed as "none".

Recruitment potential was correlated with timber harvest activity from data that was updated by district personnel in April 1995 (Figure 13). The polygon data is based on timber stands, and is not specific to portions of stands within the Riparian Reserves. Natural debris torrents in Upper White River mainstem and the 1973 Rocky Burn were considered in interpretation of the results. Other management-related causes for low wood recruitment potential, such as recreational site development, were not analyzed.

Dominant Tree Type	Structural Stage and Density					
	Seedling/Sapling/Pole		Small Tree		Large Tree	
	Sparse	Dense	Sparse	Dense	Sparse	Dense
Conifer	low	medium	medium	high	medium	high
Mixed	low	low	low	high	medium	high
Deciduous	low	low	low	medium	low	medium

Table 10. Riparian large wood recruitment potential model.

Findings:

- Approximately 48% of the managed stream miles surveyed have relatively low large wood loadings at or below the range of natural conditions compared to wilderness streams.
- A total of 31.5 MHNF miles of Bonney, NF Iron, Clear, Frog, Gate, SF Gate, Badger, and Jordan creeks had relatively low large wood loadings (*i.e.* <35 pieces of large wood/mile) when they were surveyed compared to other reaches in the subbasin (Tables 3, 5).
- All of Barlow, Green Lake, Boulder, Cedar, Pup, and Camas creeks (24.6 miles) had wood loadings below the range of natural conditions (Tables 3, 5).
- Large wood loading on a tenth of a mile reach at the mouth of Bonney Creek, and a 1.8 mile reach of Souva Creek are above the range of natural conditions, based on Badger Creek Wilderness streams.
- Overall, 48% of the 25,916 unharvested Riparian Reserve acres in the subbasin had high wood recruitment potential compared to 6% of the 4,566 harvested acres (Table 11).

- Eighty-one percent (3,714 acres) of the harvested acres in the Riparian Reserves have low large wood recruitment potential because they are in an early seral stage, and/or have sparse canopy closure (Table 11).
- Only 19% (5,113 acres) of the unharvested riparian acres have low large wood recruitment potential.
- Upper White River subwatershed has the most riparian acres (1,273 acres) with naturally low large wood potential because of it's highly dynamic floodplain (Table 11).
- Upper Rock Creek, Threemile, and Gate creek subwatersheds within the 1973 Rocky Burn area have moderate-high percentages (20-74%) of riparian acres in early seral conifer/brush with low recruitment potential (Table 11). Timber salvage activity after the burn removed short-term large wood recruitment potential.
- Upper Rock Creek has been particularly impacted by recent fire and fire salvage logging history - 74% of the riparian area has low wood potential (Table 11).
- The Eastside Zone vegetation types in McCubbins Gulch, Byzandine Gulch, Lower Rock Creek, and Hazel Hollow have more hardwood and brush acres with naturally low large wood potential than subwatersheds in the Transition or Crest zone subwatersheds (Table 11).
- Barlow, Cedar (Forest), Frog, Clear, Byzandine Gulch, Little Badger, Pine, and Souva subwatersheds have high percentages (≥60%) of unharvested riparian acres with high large wood recruitment potential (Table 11).
- White River Gorge Wild and Scenic Area, and segments of Tygh, Jordan, and Badger creeks in the State Game Management Area have large wood recruitment potentials that have been effected by a recent history of fire suppression, and will have high conifer recruitment following the current drought-induced, insect and disease outbreaks.
- On private land, large wood loads and recruitment potential are limited in the foreseeable future because of timber harvest, agriculture and rangeland uses in the riparian zone.
- Some of the reaches that had low wood loadings have had restoration project work - including large wood loading, and instream wood and rock structures - since they were surveyed (Table 12).
- Others have pending or proposed project work that will restore large wood loadings and recruitment potential Table 12).

Watershed	Unmanaged Acres Low	Unmanaged Acres Medium	Unmanaged Acres High	Unmanaged Acres None	Managed Acres Low	Managed Acres Medium	Managed Acres High	Managed Acres None	Total Acres Low	Total Acres Medium	Total Acres High	Total Acres None
16A WHITE R GORGE	188	487	460	82	460	49	15	0	647	536	474	82
16B UPPER WHITE R	1,273	773	2,142	652	161	30	10	0	1,433	803	2,152	652
16C BARLOW CR	222	615	1,451	57	12	0	0	0	235	615	1,451	57
16D CEDAR CR	12	67	309	0	143	10	12	0	156	77	321	0
16E BOULDER CR	119	660	919	37	133	25	12	0	252	684	932	37
16F FROG CR	84	287	1,109	22	581	12	49	0	665	299	1,159	22
16G CLEAR LAKE	203	166	531	410	390	40	10	0	593	205	541	410
16H CLEAR CR	119	477	1,347	54	793	30	94	0	912	507	1,441	54
16I MCCUBBINS GULCH	77	74	156	0	79	20	2	0	156	94	158	0
16J BYZANDINE GULCH	62	2	124	2	0	0	0	0	62	2	124	2
16K KELLY SPG GULCH	0	0	0	2	0	0	0	0	0	0	0	2
29A TYGH CR	198	279	571	5	0	0	0	0	198	279	571	5
29B BADGER CR	519	971	1,468	72	32	0	0	0	551	971	1,468	72
29C LITTLE BADGER CR	104	366	828	0	116	153	17	2	220	519	845	2
29D PINE CR	27	54	166	0	0	0	0	0	27	54	166	0
29E GUMJUWAC CR	22	175	69	0	0	0	0	0	22	175	69	0
29F JORDAN CR	516	573	667	44	128	44	22	0	645	618	689	44
30A LOWER ROCK CR	44	121	0	2	2	0	0	0	47	121	0	2
30B UPPER ROCK CR	717	146	25	82	22	10	0	0	739	156	25	82
30C GATE CR	213	534	306	5	277	2	10	0	489	536	316	5
30D HAZEL HOLLOW	52	198	37	0	27	101	5	0	79	299	42	0
30E S FORK CR	7	247	79	0	178	30	0	0	185	277	79	0
30F SOUVA CR	15	91	168	0	67	25	2	0	82	116	171	0
30G THREEMILE CR	321	175	373	12	72	2	7	0	393	178	381	12
Total	5,113	7,539	13,304	1,542	3,674	583	269	2	8,787	8,122	13,573	1,544

Watershed	Percent of Unmanaged Acres Low	Percent of Unmanaged Acres Medium	Percent of Unmanaged Acres High	Percent of Unmanaged Acres None	Percent of Managed Acres Low	Percent of Managed Acres Medium	Percent of Managed Acres High	Percent of Managed Acres None	Percent of Total Acres Low	Percent of Total Acres Medium	Percent of Total Acres High	Percent of Total Acres None
16A WHITE R GORGE	15%	40%	38%	7%	88%	9%	3%	0%	37%	31%	27%	5%
16B UPPER WHITE R	26%	16%	44%	13%	80%	15%	5%	0%	28%	16%	43%	13%
16C BARLOW CR	9%	26%	62%	2%	0%	0%	0%	0%	10%	26%	62%	2%
16D CEDAR CR	3%	17%	80%	0%	87%	6%	7%	0%	28%	14%	58%	0%
16E BOULDER CR	7%	38%	53%	2%	78%	14%	7%	0%	13%	36%	49%	2%
16F FROG CR	6%	19%	74%	1%	90%	2%	8%	0%	31%	14%	54%	1%
16G CLEAR LAKE	15%	13%	41%	31%	89%	9%	2%	0%	34%	12%	31%	23%
16H CLEAR CR	6%	24%	67%	3%	87%	3%	10%	0%	31%	17%	49%	2%
16I MCCUBBINS GULCH	25%	24%	51%	0%	78%	20%	2%	0%	38%	23%	39%	0%
16J BYZANDINE GULCH	32%	1%	65%	1%	0%	0%	0%	0%	32%	1%	65%	1%
16K KELLY SPG GULCH	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	100%
29A TYGH CR	19%	27%	54%	0%	0%	0%	0%	0%	19%	27%	54%	0%
29B BADGER CR	17%	32%	48%	2%	100%	0%	0%	0%	18%	32%	48%	2%
29C LITTLE BADGER CR	8%	28%	64%	0%	40%	53%	6%	1%	14%	33%	53%	0%
29D PINE CR	11%	22%	67%	0%	0%	0%	0%	0%	11%	22%	67%	0%
29E GUMJUWAC CR	8%	66%	26%	0%	0%	0%	0%	0%	8%	66%	26%	0%
29F JORDAN CR	29%	32%	37%	2%	66%	23%	11%	0%	32%	31%	35%	2%
30A LOWER ROCK CR	26%	72%	0%	1%	100%	0%	0%	0%	28%	71%	0%	1%
30B UPPER ROCK CR	74%	15%	3%	8%	69%	31%	0%	0%	74%	16%	2%	8%
30C GATE CR	20%	50%	29%	0%	96%	1%	3%	0%	36%	40%	23%	0%
30D HAZEL HOLLOW	18%	69%	13%	0%	20%	76%	4%	0%	19%	71%	10%	0%
30E S FORK CR	2%	74%	24%	0%	86%	14%	0%	0%	34%	51%	15%	0%
30F SOUVA CR	5%	33%	61%	0%	71%	26%	3%	0%	22%	32%	46%	0%
30G THREEMILE CR	36%	20%	42%	1%	88%	3%	9%	0%	41%	18%	39%	1%
Total	19%	27%	48%	6%	81%	13%	6%	0%	27%	25%	42%	5%

Table 11. Results of large wood recruitment potential in harvested and unharvested Riparian Reserve areas.

Project Name	Location	Project Type	Project Year / Planning Status
Gate Creek	between roads 4811 & 4813	instream structures	1993
Gate Creek	rivermile 10.9-13.0	large wood loading	1991
Gate Creek	rivermile 5.25-6.0	large wood loading	1994
Pup Creek	rivermile 0.3-0.5	large wood loading	1992
Deep Creek	rivermile 0.5-2.0	instream structures	1991
Jordan Creek	rivermile 13.0-14.2	instream structures	1988
Cedar (Forest) Creek	rivermile 4.5-5.5	large wood loading	1994
Threemile Creek	rivermile 12.25-13.7	instream structures	1985
Threemile Creek	rivermile 12.25-13.7	cattle exclosure fence	1985
Rock Creek	rivermile 9.2-10.0	instream structures	1986
Rock Creek	rivermile 9.2-10.0	cattle exclosure fence	1986
Rock Creek	rivermile 9.2-10.0	instream structures	1993
Rock Creek	rivermile 9.2-10.0	cattle exclosure fence	1993
Rock Creek	rivermile 9.2-10.0	streambank stabilization	1993
Rock Creek	rivermile 9.2-10.0	large wood loading	1993
Rock Creek	rivermile 8.8-9.0	cattle exclosure fence	1994
Rock Creek	rivermile 13.5-14.0	cattle exclosure fence	1995
Rock Creek	rivermile 13.5-14.0	streambank stabilization	1994
Frog Creek	rivermile 3.5-3.8	instream structures	1992
Camas Creek	rivermile 0.75-1.0	instream structures	1990
Clear Creek	Clear Creek Campground	instream structures	1993
Rock, Rock, Threemile	Rocky Burn area	riparian planting and large wood loading	no planning to date
Threemile Creek	T03, R11E, Sec. 31-32 T04S, R11E, Sec. 3-4	large wood loading	planning started
Camas Creek		instream structure maintenance	planning started
Frog Creek		instream structure maintenance	planning started
Gate Creek	T04S, R11E, Sec. 17	riparian underburning	planning started
Rock Creek	T04S, R11E, Sec. 8-9	large wood loading, erosion control, channel restoration	planning started
numerous	White River Subbasin	seed and fertilize old riparian restoration projects	NEPA not required

Table 12. Implemented and proposed riparian and instream restoration projects.

Figure 12. White River Subbasin Large Wood Recruitment Potential Within Riparian Reserves

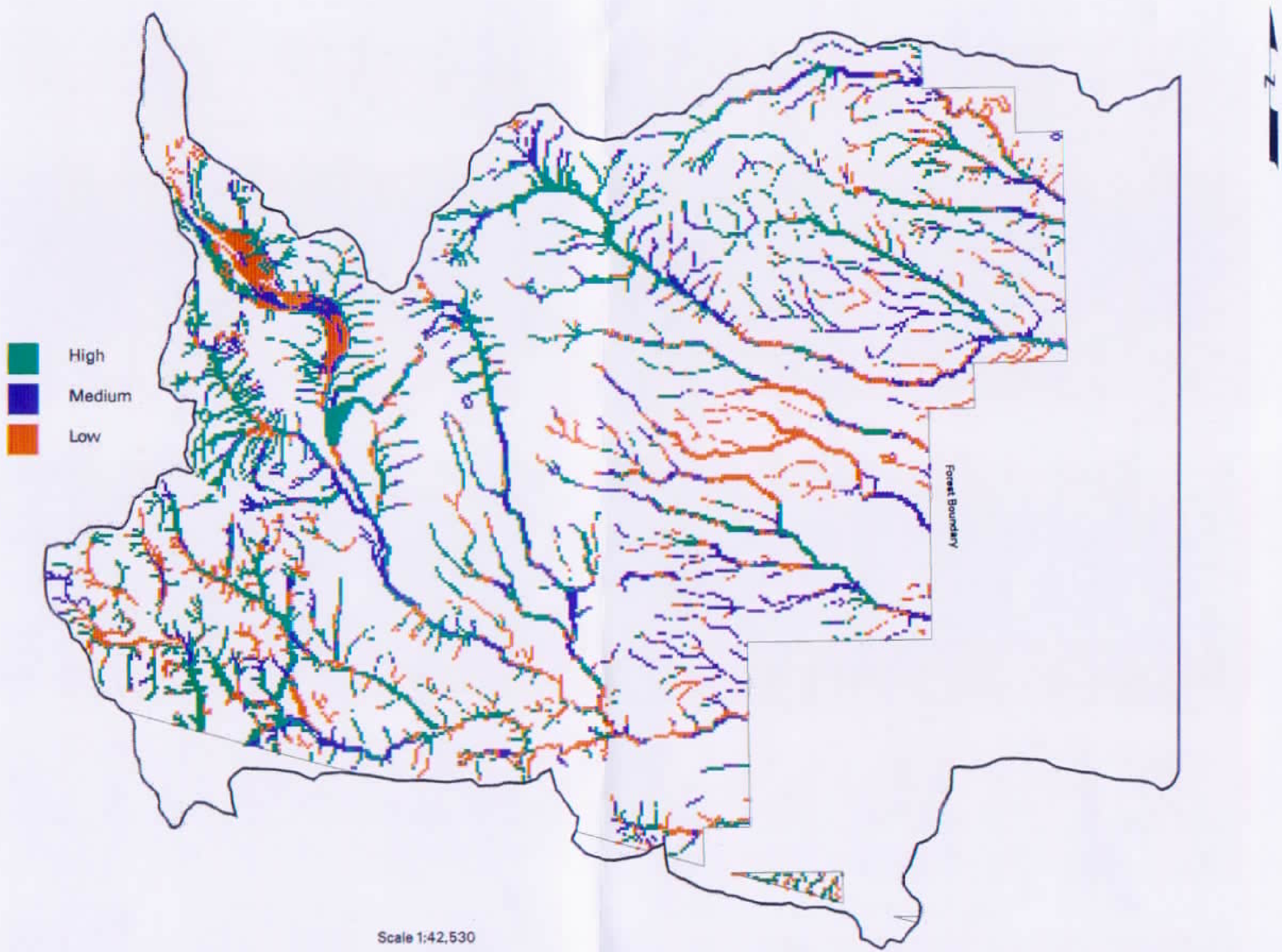

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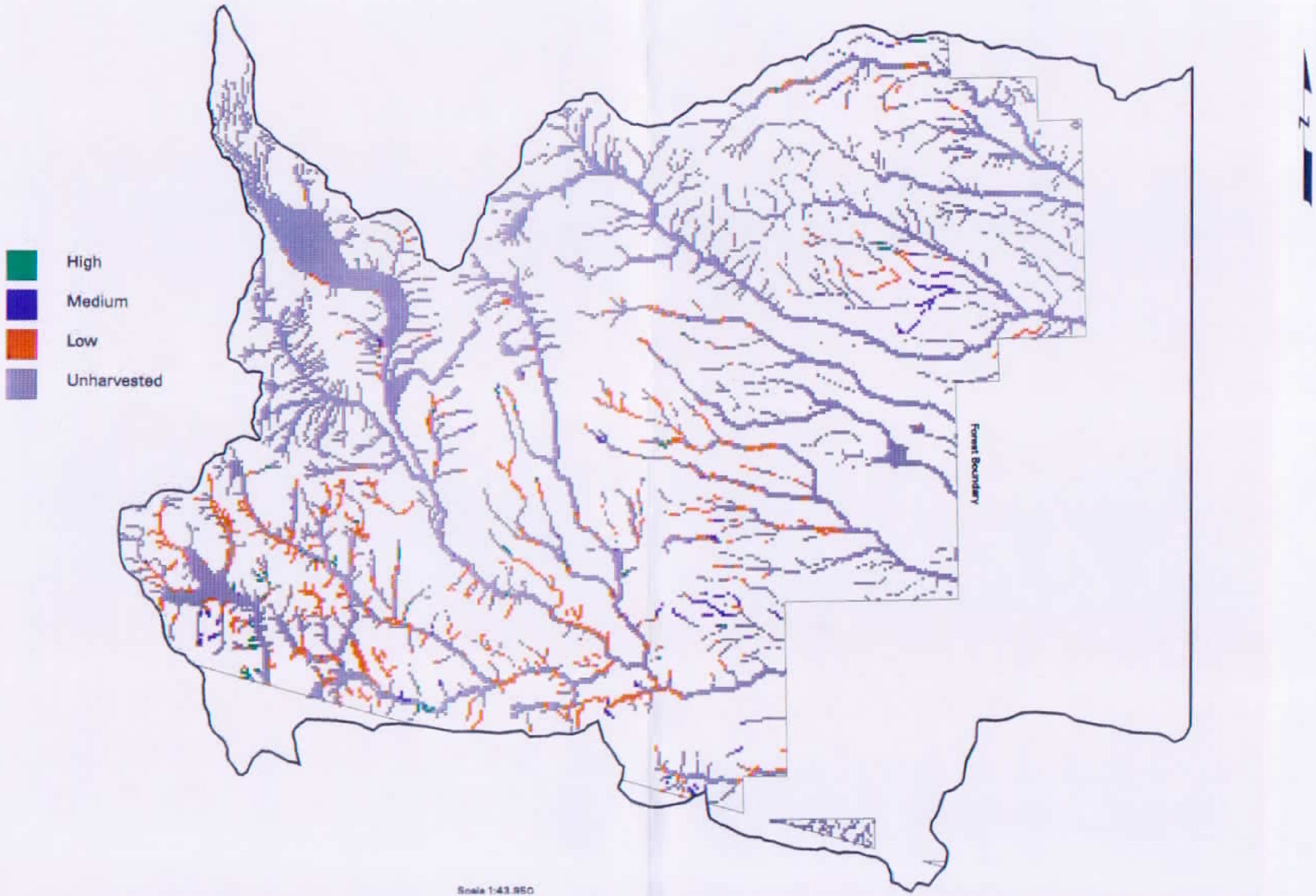
Figure 13. White River Subbasin Large Wood Recruitment Potential in Harvested Units Within Riparian Reserves



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Issue 3B: Are there stream reaches where the water temperatures or predicted peakflows are outside the range of natural conditions?

YES. Water in the mainstem White River is not legally over-allocated, but it is ecologically over-allocated. There has been very little monitoring to address the impacts of irrigation withdrawals on the quantity and quality of water delivered to the White and Deschutes rivers after irrigation withdrawals. U.S. Geological Survey gage stations have been collecting peak and baseflow information at various stations in White River since 1912 (periods of record vary). MHNF district personnel installed temperature monitoring devices on the perennial streams at, or near, the Forest Service boundary in 1993-94.

Monitored streams with water temperatures exceeding State Water Quality baseline standards 1993-94 are: White River at the Forest boundary and at White River Falls; Threemile and Badger creeks at the Forest boundary; Jordan and Tygh creeks above FS Road 27 near the Forest boundary (Table 13; Hydrology Report). Water temperatures below the Rocky Burn area exceeded State Water Quality baseline standards 114-146 days/year 1993-94 (Table 13). Other streams with monitoring sites that have water temperatures exceeding State Water Quality baseline standards of 14.4^{0}C (58^0 F) are White River at the Forest boundary and at White River falls; Threemile and Badger creeks at the Forest boundary; Jordan and Tygh creeks above FS Road 27 near the Forest boundary. The Rock Creek Forest boundary monitoring site is downstream of the Rocky Burn and Rock Creek Reservoir.

Irrigation ditches withdraw water from most of the perennial streams in the upper White River Subbasin, and all the perennial streams in the lower subbasin (Figure 14; Hydrology Report). Clear, Jordan, and Badger creeks have reduced summer lowflows as a result of irrigation withdrawals. Threemile, Rock, Gate, Lost, and Frog creeks, that were historically perennial, are de-watered for miles on and off Forest, during the irrigation season. Elevated water temperatures during summer lowflows and drought years are exacerbated by irrigation withdrawals and openings in the riparian canopy cover. The result is a significant loss of rearing habitat for young-of-year fishes, and increased water temperatures. These combined effects are most critical for at-risk species within the area of the Rocky Burn in upper Rock Creek and Gate Creek that have 2 of the 3 remaining populations of genetically intact, endemic redband trout that have been isolated tens of thousands of years above the White River Falls (Currens 1990) (Figure 15).

Stream Name / Water Year	State Temperature Standards		7 Day Average High		Total Days >State Standard	Annual Maximum	Maximum Daily Range
	^{0}C	^{0}F	^{0}C	^{0}F	days	^{0}C	^{0}C
White River - Forest boundary 92	14.4	58	21.8	71.2	83	23.8	12.9
White River - below falls 92	14.4	58	23.8	74.8	145	24.8	7.5
Threemile Creek - above burn 93-94	14.4	58	11.6-13.0	52.9-55.4	0	12.2-13.9	3.0-5.8
Threemile Creek - Forest boundary 93-94	14.4	58	18.0-19.8	64.4-67.6	45-73	18.7-21.3	8.5-9.1
Gate Creek - Forest boundary 93-94	14.4	58	20.6-24.1	69.1-75.4	NA-105	21.4-26.0	7.6-8.4
Rock Creek - above burn 93-94	14.4	58	13.3-16.7	55.9-62.1	1-NA	14.8-18.5	5.6-6.5
Rock Creek - Forest boundary 93-94	14.4	58	23.0-26.3	73.4-79.3	114-146	26.2-28.4	10.7-11.7
Badger Creek 94	14.4	58	19.2	66.6	61	20.8	6.1
Jordan Creek 94	14.4	58	17.7	63.9	37	18.8	4.8
Tygh Creek 94	14.4	58	15.5	59.9	12	16.4	2.5
Cedar (Forest) Creek 94	14.4	58	9.5	49.1	0	9.9	2.7

Table 13. Stream temperature statistics for White River Subbasin.

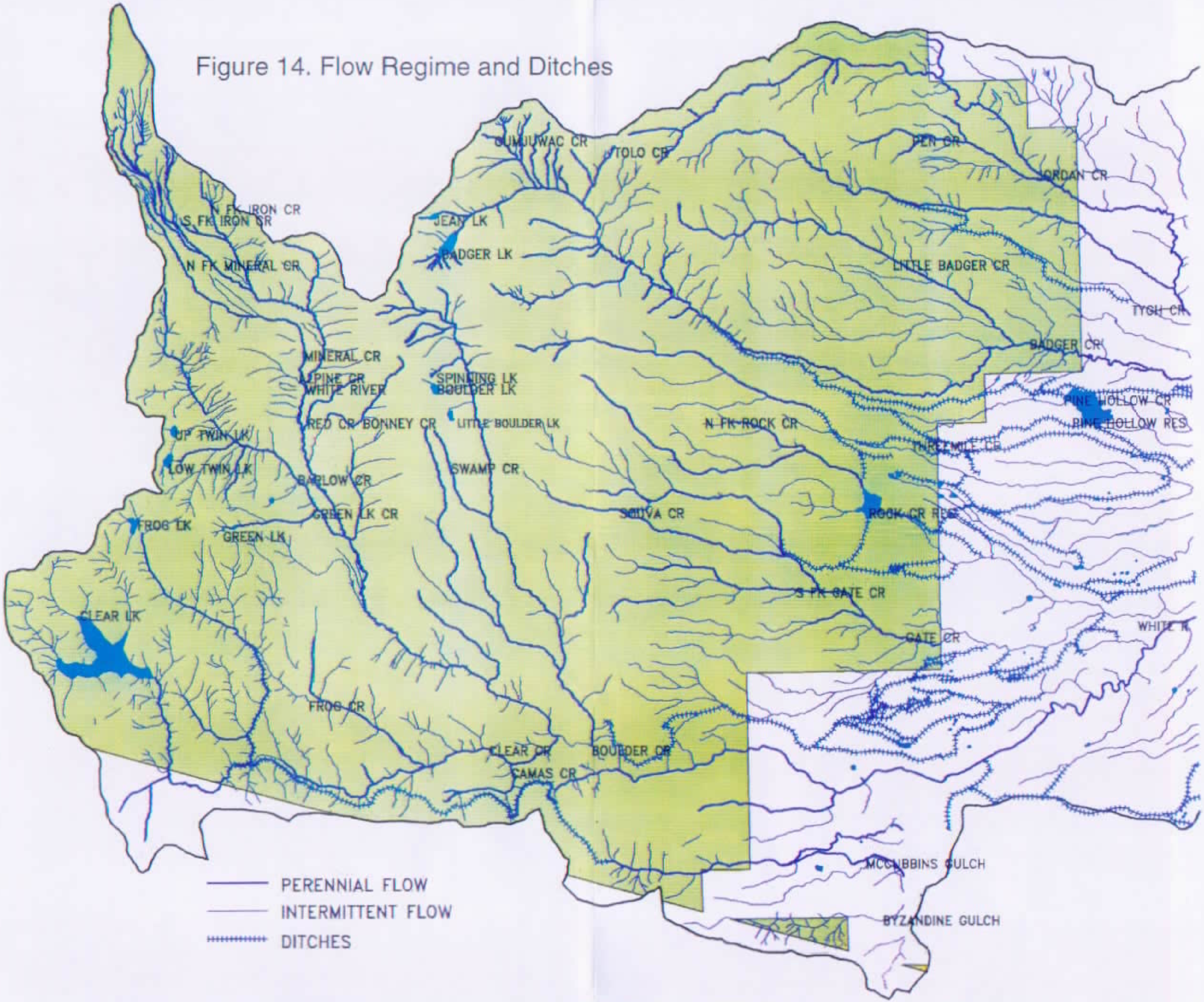

Figure 14. Flow Regime and Ditches

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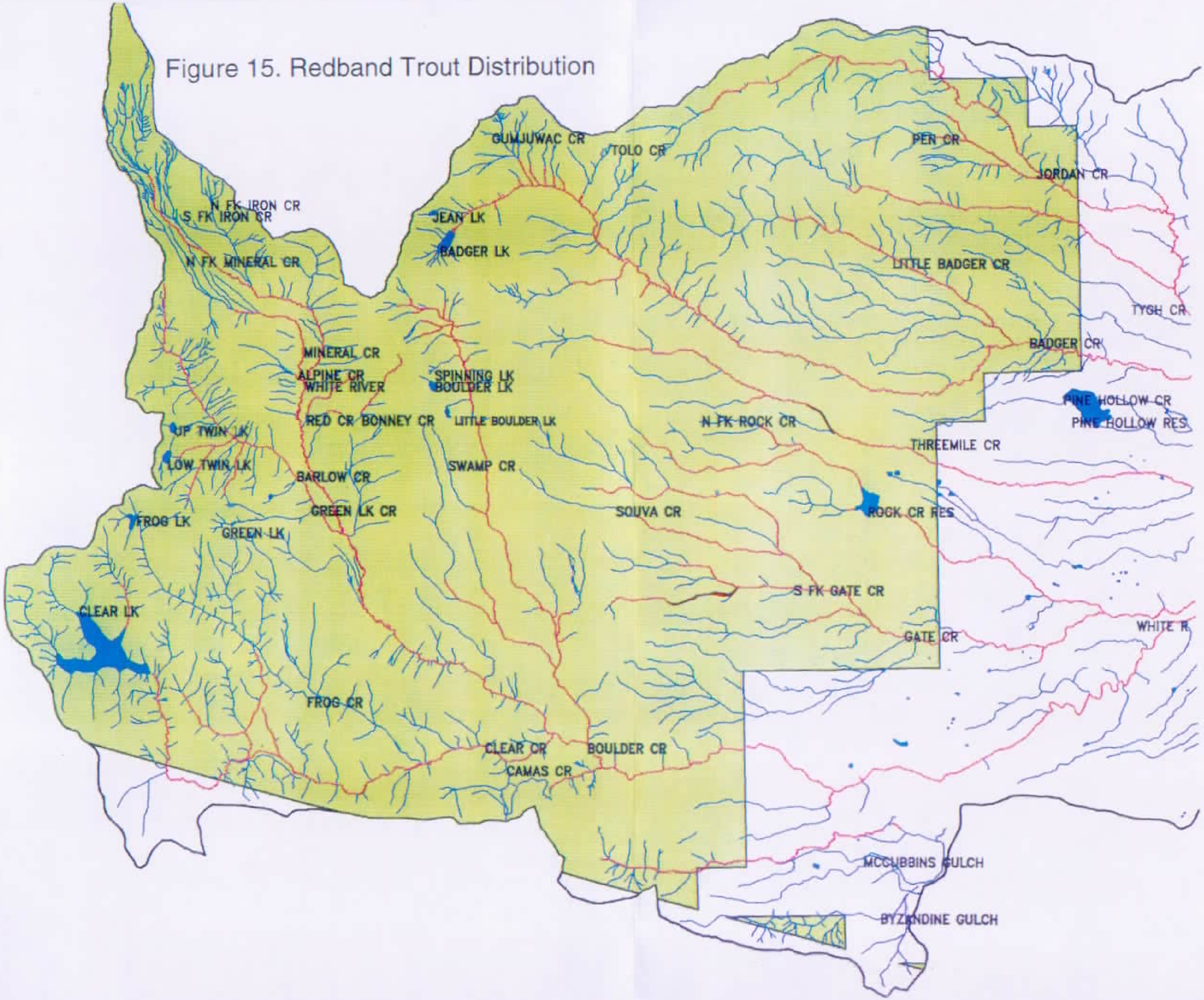
Figure 15. Redband Trout Distribution



Issue 5A: Do Forest Plan standards and guidelines provide adequate restrictions to allow attainment of the Aquatic Conservation Strategy objectives on the National Forest lands?

NO. The Forest Plan standards and guidelines should be revised to incorporate finding in the White River Subbasin, and other Forest watershed analyses. Grazing, recreation, transportation, and other sections of the Plan need to be cross referenced in a hierarchy that will display resolution with the Aquatic Conservation Strategies outlined in the ROD.

Issue 5B: Does the amount of riparian area detrimentally effected by grazing prevent attainment of the Aquatic Conservation Strategy objectives or State Water Quality standards?

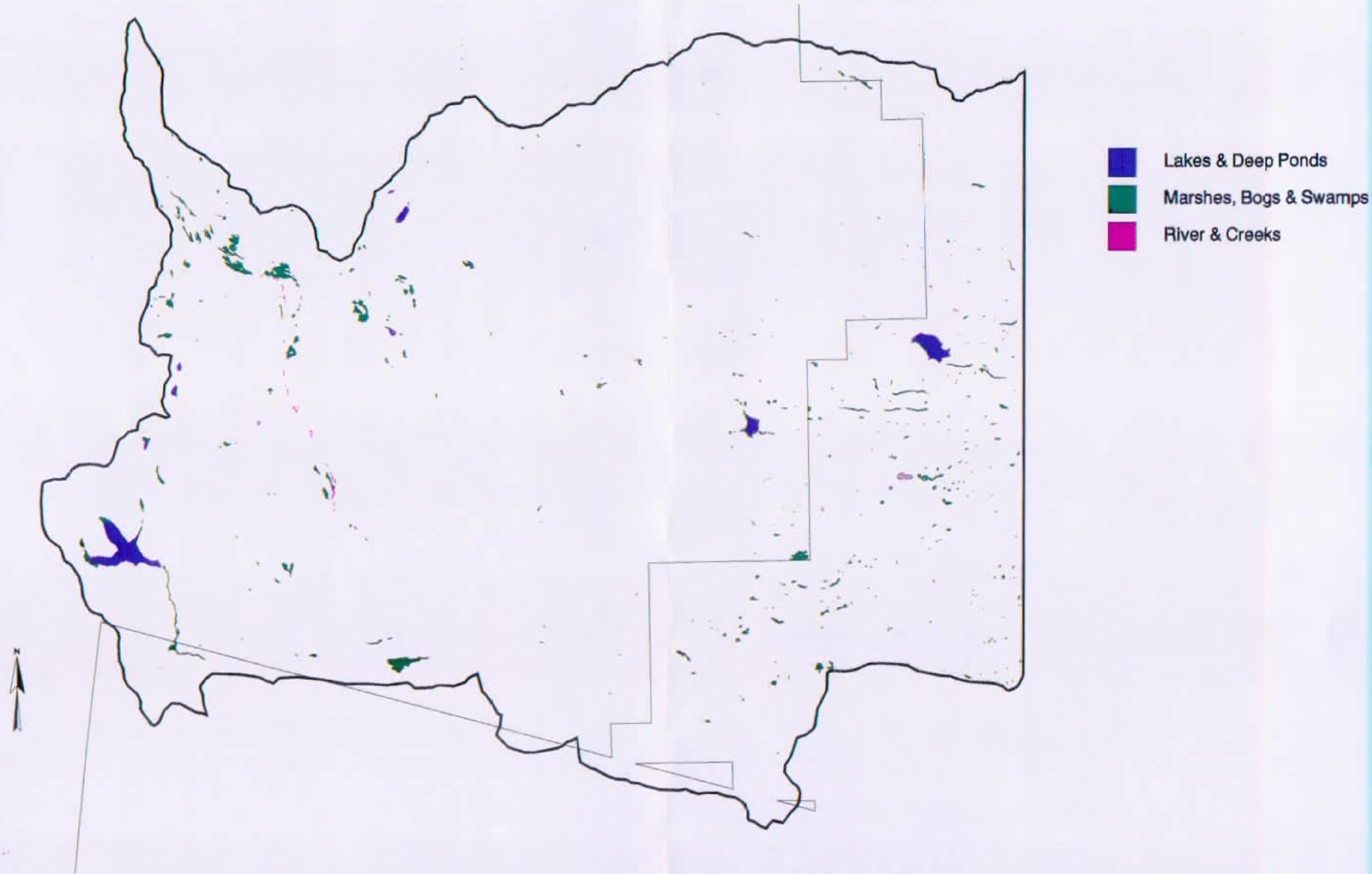
YES, in localized areas on Forest. It is extremely difficult, if not impossible to graze riparian areas and wet meadows, and meet Aquatic Conservation Strategy objectives. Wetland areas in the upper White River Subbasin that are susceptible to damage from livestock grazing were mapped and acres summarized from National Wetlands Inventory, Division of State Lands Wetlands Program (1990) (Figure 16; Table 14). Oregon is one of several states that has adopted the National Wetlands Inventory as a basis for a State Wetlands Inventory and Management Program as per Senate Bill 3 (1989). "The National Wetlands Inventory does not delineate the legal boundaries of wetland for regulatory purposes" (ODSL 1990). Persons planning land modifications within or adjacent to wetland areas should seek advice from the appropriate agencies. In Oregon the state wetlands are regulated by the Division of State Lands and the U.S. Army Corps of Engineers.

Lacustrine areas are lakes, reservoirs, and deep ponds that typically have deep, open water, and wave action. Palustrine areas are freshwater marshes, bogs, swamps, and farm ponds. Palustrine wetlands are dominated by trees, shrubs, persistent emergent vegetation, and some non-vegetated wetlands that do not meet the lacustrine criteria. Water regimes are temporarily flooded, saturated, seasonally flooded, semi-permanently flooded, and permanently flooded. Special modifiers are beaver formed, diked/impounded, and excavated wetlands.

Lakes, ponds, forested, scrub/shrub, and emergent wetlands form 62% of the wetland acreage. Wetlands of all types were rare - approximately 2,243 acres or 1% of approximately 158,000 acres - in the upper White River Subbasin. Some areas that were not included in the NWI were cedar swamps (*e.g.* Post Camp area), the wetland at Pup Creek, and beaver activity noted in stream surveys does not show up in the wetland inventory.

Stream reaches that are most susceptible to grazing damage from livestock are the low gradient, depositional and meadow reaches. Bank erosion on heavily grazed sections of Clear, Rock, Souva, Camas, Lost, Gate, and SF Gate creeks is outside the range of natural conditions ($\leq$5%) as a result of cattle grazing and contributes fine sediment to aquatic habitats downstream (Tables 1-2, & 7). Upper Twin Lake has loss of riparian vegetation due to recreational stock, and Green Lake has loss of riparian vegetation due to cattle grazing (Wall unpub.). These areas do not meet Aquatic Conservation Strategy objectives to: 3) "Maintain and restore the physical integrity of the aquatic ecosystem, including shorelines, banks, and bottom configurations"; 4) " Maintain and restore water quality to support healthy riparian, aquatic, and wetland ecosystems; 5) "Maintain and restore the sediment regime under which aquatic ecosystems evolved"; 8) "Maintain and restore the species composition and structural diversity of plant communities in the riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration..."; 9) "Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species".

Figure 16. National Wetlands Inventory



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Key to Wetland Codes in Order of Appearance	Wetland Code	Acres	Frequency of Occurrence	% of Total Wetland Acres
L = lacustrine	L1UBH	107	7	5
P = palustrine	L1UBHh	637	3	28
R = riverine	L2USAh	1	1	<1
	L2USCh	86	4	4
1 = limnetic	PABFh	20	33	1
2 = littoral	PABFx	<1	2	<1
3 = upper perennial	PABHh	10	5	<1
	PEMA	33	24	2
UB = unconsolidated bottom	PEMAh	6	1	<1
US = unconsolidated shore	PEMB	110	28	5
AB = aquatic bed	PEMC	198	90	9
EM = emergent wetland	PEMCh	109	58	5
FO = forested wetland	PEMCx	1	2	<1
SS = scrub/shrub wetland	PEMF	3	2	<1
A = temporarily flooded	PFOA	115	14	5
B = saturated	PFOB	30	6	1
C = seasonally flooded	PFOC	289	40	13
F = semi-permanently flooded	PSSA	7	4	<1
H = permanently flooded	PSSB	33	19	2
	PSSC	271	87	12
b = beaver	PSSCh	15	9	1
h = diked/impounded	PUBFb	<1	1	<1
x = excavated	PUBFh	40	69	2
	PUBFx	2	3	<1
	PUBH	9	5	<1
	PUBHh	32	20	1
	PUBHx	3	2	<1
	PUSAh	4	10	<1
	PUSAx	1	1	<1
	PUSC	3	1	<1
	PUSCh	36	65	2
	PUSCx	2	7	<1
	R3USA	29	36	1

Table 14. Wetlands within the upper White River Subbasin.

Issue 5C: Is continued grazing appropriate in LSRs, Riparian Reserves, and meadows?

Not at current levels or with current systems. Current grazing levels and systems are not protecting streambanks and lakeshores from excessive erosion and vegetative damage in sensitive areas, and areas heavily used by cattle and recreational livestock (Table 8). Long Prairie did not meet LRMP standards and guidelines during 1994. Badger Allotment met LRMP standards and guidelines during 1994. None of the allotments has been monitored for streambank condition, water quality, native plant community composition, and factors that effect the health and function of the riparian and aquatic ecosystems. Rock, Gate, SF Gate, and Souva creeks, and Camas Prairie are the most critical areas for change in range and recreational stock management, and riparian and aquatic monitoring to protect at-risk spotted frogs and redband trout. Barlow Stewardship Area has implemented and proposed range improvement projects to restore and protect riparian and aquatic resources (Table 15).

Project Name	Location	Project Type	Project Year / Planning Status
Threemile Creek	rivermile 12.25-13.7	cattle exclosure fence	1985
Rock Creek	rivermile 9.2-10.0	instream structures	1986
Rock Creek	rivermile 9.2-10.0	cattle exclosure fence	1986
Rock Creek	rivermile 9.2-10.0	cattle exclosure fence	1993
Rock Creek	rivermile 8.8-9.0	cattle exclosure fence	1994
Rock Creek	rivermile 13.5-14.0	cattle exclosure fence	1995
Threemile Creek	T04S, R11E, Sec. 3-4	rebuild cattle exclosure fence on 0.5 miles of stream	NEPA not required
Threemile Creek	T03S, R10E, Sec. 25	build water trough, build cattle exclosure fence around spring	NEPA started
Gate Creek	T03, R11E, Sec. 16	use large wood as cattle barriers to protect riparian zone and creek	planning started
Souva Creek	T04S, R10E, Sec. 13	build cattle exclosure fence to protect riparian and creek	planning started
Cedar/Forest Creek	Forest Creek campground T04S, R10E, Sec. 34	build cattle exclosure fence and cattle guard to control livestock	planning started

Table 15. Implemented and proposed range allotment projects in the Barlow Stewardship Area.

Issue 5E: Are range allotment management plan revisions on schedule to meet Salmon Summit agreements for the protection of salmonid fishes?

YES. Only Long Prairie and Badger grazing allotments have cattle activity on segments of anadromous fisheries streams - both outside the White River Subbasin. Long Prairie is on schedule for Allotment Management Plan revision in Fiscal Year 1996, and Badger Allotment is on schedule for AMP revision in FY 1998.

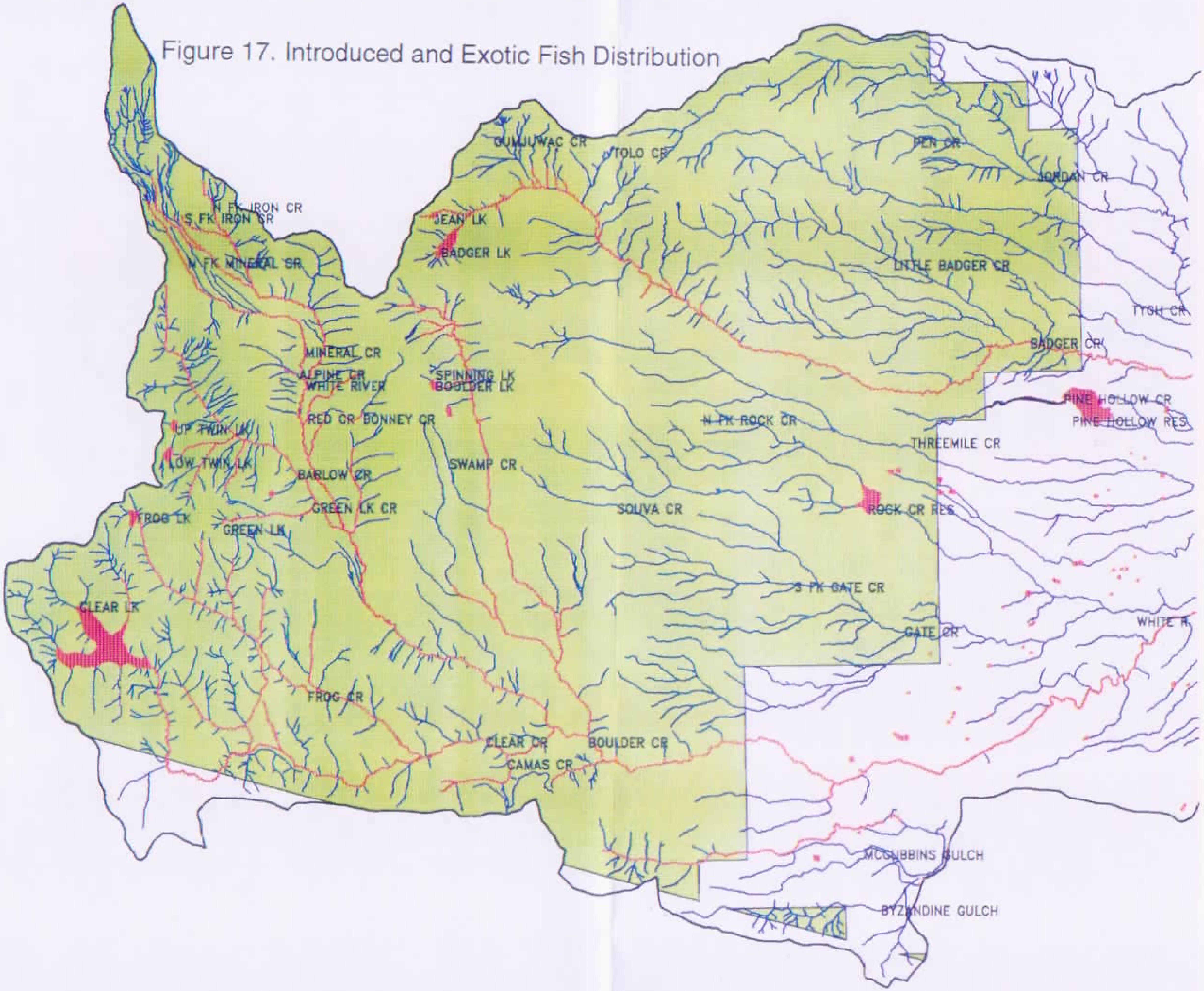
Issue 6D: Are introduced animal species crowding out or preying on native species or diluting the purity of the gene pool?

YES. All lakes on Forest Service land in the upper White River Subbasin have introduced rainbow trout or exotic brook trout stocking programs. Various combinations of exotic brown bullheads, largemouth and smallmouth bass, and bluegill that are predaceous and competitive with other fishes and amphibians have been introduced to Pine Hollow Reservoir, Rock Creek Reservoir, Threemile Creek, and constructed farm ponds (Figure 17; Table 16). A relatively small population of largemouth bass has populated Threemile Creek from Pine Hollow Reservoir (BPA *et al.* 1985). Bullfrogs that are predaceous on native amphibians have been sighted within constructed stock ponds occupied by Pacific chorus frogs.

There are no known extant populations of native fishes in the White River lakes, but before reservoir construction and fish stocking, Clear and Badger lakes probably had populations of redband trout. The rest of the lakes were probably fishless. In many naturally fishless lakes in the Northern Cascades, salamanders are the top carnivores (Liss *et al.* 1995). Introduced and exotic fishes in the lakes, and escapement and natural reproduction in the stream network effects the biodiversity and biomass of fish, macroinvertebrates, zooplankton, and most amphibian populations (Liss *et al.* 1995). Exceptions are northwestern salamanders and rough-skinned newts that are toxic in larval and adult forms, and can co-exist with introduced fish predators (Leonard *et al.* 1993).

In addition, introduced rainbow trout hybridize with redband trout, diluting the gene pool of a unique FS Sensitive subspecies of redband trout that evolved in isolation above White River Falls over geologic time, and is endemic to the White River Subbasin (Currens 1990).

Figure 17. Introduced and Exotic Fish Distribution



Subwatershed	Species	Status	Locality
Jordan*	redband trout	endemic	creeks
	sculpin spp.	native	creeks
	bluegill	exotic	farm ponds
	smallmouth bass	exotic	farm ponds
Rock-Threemile*	redband trout	endemic	creeks and ditches
	sculpin spp.	native	creeks and ditches
	rainbow trout	introduced, currently stocked	Rock Creek, Rock Creek Reservoir, ditches
	bluegill	exotic	farm ponds and Pine Hollow Reservoir
	smallmouth bass	exotic	farm ponds and Pine Hollow Reservoir
	largemouth bass	exotic	Pine Hollow Reservoir, Threemile Creek
	brown bullhead	exotic	Pine Hollow Reservoir
Gate*	redband trout	endemic	creeks and ditch
	sculpin spp.	native	creeks and ditch
	bluegill	exotic	farm ponds
	smallmouth bass	exotic	farm ponds
Badger-Tygh	redband trout	endemic	creeks and ditches
	sculpin spp.	native	creeks and ditches
	rainbow trout	introduced, currently stocked	creeks, ditches, Badger and Jean lakes
	brook trout	exotic, naturally reproducing	creeks, ditches, Badger and Jean lakes
	bluegill	exotic	farm ponds
	smallmouth bass	exotic	farm ponds
McCubbins	redband trout	endemic	creeks and ditches
	sculpin spp.	native	creeks and ditches
	rainbow trout	introduced	creeks and ditches
	brook trout	exotic	creeks and ditches
	bluegill	exotic	farm ponds
	smallmouth bass	exotic	farm ponds
Clear	redband trout	endemic	creeks and ditches
	sculpin spp.	native	creeks and ditches
	rainbow trout	introduced, currently stocked	creeks, ditches, Clear and Frog lakes
	brook trout	exotic, naturally reproducing	creeks, ditches, and Clear Lake
	bluegill	exotic	farm ponds
	smallmouth bass	exotic	farm ponds
Barlow	redband trout	endemic	creeks
	sculpin spp.	native	creeks
	rainbow trout	introduced, currently stocked	creeks and Green Lake
	brook trout	exotic, currently stocked	creeks, Catalpa, Lower and Upper Twin lakes
Boulder	redband trout	endemic	creeks and ditches
	rainbow trout	introduced, currently stocked	creeks, ditch, Boulder Lake
	brook trout	exotic. naturally reproducing in Boulder; stocked in Little Boulder	creeks, ditch, Boulder and Little Boulder lakes
Upper White River	redband trout	endemic	river and creeks
	sculpin spp.	native	river and creeks
	rainbow trout	introduced	river
	brook trout	exotic	river
White River Gorge	redband trout	endemic	river and creeks
	sculpin spp.	native	river and creeks
	rainbow trout	introduced	river
	brook trout	exotic	river
Lower White River	summer steelhead	native	lower 2 miles to Deschutes
	spring chinook	native	lower 2 miles to Deschutes
	redband trout	endemic	river and creeks
	sculpin spp.	native	river and creeks
	mountain whitefish	native	river
	rainbow trout	introduced	river and creeks
	bluegill	exotic	farm ponds
	smallmouth bass	exotic	farm ponds

*genetic integrity of endemic redband trout

Table 16. Native, introduced, and exotic fish species in the White River Subbasin.

Issue 6E: Will stocking of introduced and exotic fishes continue? Are these fishes likely to escape and interbreed with the native fishes?

YES. ODFW has changed it's wild fish management policy, and no longer stocks streams within the White River Subbasin. The high lakes are still stocked annually or biannually, and there are no immediate changes in ODFW stocking program predicted. ODFW has requested input from USFS Region 6 and Mt. Hood National Forest on assessment of stocking programs to protect the integrity of individual lake ecosystems and native trout within the Cascades Range.

The State of Oregon and MHNF have standards that requires installation of fish screens on water diversions for all fishbearing streams. None of the lakes or diversions are currently screened, and there is escapement and natural reproduction of introduced rainbow and exotic brook trout in the most of the subbasin (Table 16). Domesticated rainbow/redband stocks can interbreed with endemic redband trout (see Issue 11C). Clear, Badger, and Jean lakes; Pine Hollow Reservoir; and Clear Lake, Highland, Frog, Threemile, Lost/Boulder, and Gate ditches are top priorities for screening (Table 17). Ditches that carry more perennial flow than is left in the streams may provide critical summer, lowflow habitat should be screened at the Forest boundary rather than the inlet.

USFS fisheries costshare funds were available for fish screens in 1995. However, ODFW has not been actively pursuing fish screening because of maintenance and social concerns involving the irrigation districts, and the proposed screens were not approved for FY 1995. Instead of fish screens, USFS Fisheries Biologists will install an upstream migration barrier in Gate Creek Ditch during 1995 to prevent rainbow trout from migrating upstream into Gate Creek. Installation of upstream migration barriers does not preclude the need for fish screens to prevent redband trout from washing down into the irrigation ditches and Rock Creek Reservoir.

Project Name	Location	Notes	Planning Status
Clear Lake	MHNF	install fish screen at outlet	
Badger Lake	MHNF	install fish screen at outlet	
Jean Lake	MHNF	install fish screen at outlet	
Pine Hollow Reservoir	private land	install fish screen at inlet and outlet	
Clear Creek Ditch	T04S, R09E, Sec. 32	install fish screen at Forest boundary	NEPA not done
Frog Creek Ditch	T04S, R09E, Sec. 34	install fish screen at inlet	NEPA not done
Threemile Creek	T04S, R11E, Sec. 11 headgate on private land	install fish screen at inlet	NEPA not required
Highland Ditch on Badger Creek	T04S, R11E, Sec. 29	install fish screen at Forest boundary; piping to prevent erosion and conserve water	NEPA not done
Lost/Boulder Ditch	T04S, R10E, Sec. 27	install fish screen at inlet	NEPA done
Gate Creek Ditch	T04S, R11E, Sec. 21	install fish screen at Forest boundary	NEPA done

Table 17. Proposed fish screen and ditch improvement projects on Mt. Hood National Forest.

Issue 6F: Are the introduced and exotic species effecting the viability of any threatened, endangered, sensitive, or at-risk species?

YES. Interbreeding with introduced and naturally reproducing hatchery "rainbow" trout from native Deschutes River redband (*O. mykiss gairdneri*) and other rainbow/redband stocks of coastal (*O. mykiss iridius*) or unknown origins is diluting the gene pool of endemic, FS Sensitive redband trout, *Oncorhynchus mykiss gairdneri* in most of the subbasin. Areas of upper Rock Creek, Gate, Jordan, and Threemile creeks have retained genetic integrity of the endemic redband trout (Kostow *et al.*, draft; BPA 1985; Currens 1990; Behnke, 1992). Resident fish and Oak Springs Hatchery fish were free of viral diseases as of 1985 (BPA 1985), however, introduction of viral contaminants is a risk commonly associated with hatchery-produced trout.

All the introduced and exotic game fishes are predating on and competing with native redband trout, sculpins, aquatic amphibians, and zooplankton in the upper subbasin; and on whitefish, long-nosed dace, as well, in the lower subbasin. At-risk amphibian species in White River Subbasin are: spotted frog (FWS C2, State Status Concern), Cascades torrent salamander (FEMAT Species of Concern, State Status Vulnerable), Cascades frog (USFWS C2, State Status Vulnerable), Cope's giant salamander (FS Sensitive, FEMAT Species of Concern, State Status Undetermined), Tailed frog (USFWS C2, FEMAT Species of Concern, State Status Vulnerable) (Table 18). Fences have been constructed around some wetlands and streams within the active range allotments to allow these habitats to recover their ecological functions.

Without long term monitoring data we cannot unambiguously state that amphibians are suffering from unusual declines within the White River Subbasin. However, there is good reason to suspect the viability of amphibians and their habitats are potentially at risk, based on existing sediment, water temperature, and streamflow data.

Current and historic livestock grazing may have had cumulative effects on the water quality and hydrology of Camas Prairie which could effect the viability of the Mt. Hood National Forest's only population of spotted frogs (FWS C2, State Species of Concern). The effect of livestock fecal material on water quality has not been analyzed. Hoofshear damage to some streambanks within the grazing allotments contribute sediment and decrease the width to depth ratio of the channel, increasing water temperatures.

Rough-skinned newts may gain a competitive advantage over other amphibians when introduced fish predators are a factor (Corkran and others pers. comm.).

WS #	Stream Name/Year	Observer	Location	Common Name	No.	Phase	Notes
16	Alpine Creek	Wondercheck	creek	Cope's giant salamander,			
				cascades frog, tailed frog			
16	Barlow Creek 93	Fisheries Crew	creek	unidentified large salamanders	> 1		
16	Bonney Creek 93	Fisheries Crew	RM 2.75	cascades frog	> 5	adult	time constrained search
			RM 2.75	cascades frog	> 50	juvenile	time constrained search
			RM 0.6 to 2.25	Pacific giant salamander	> 1	neotenic	time constrained search
		Wondercheck	creek	Cope's giant salamander			
16	Bonney Meadows	Corkran	meadow	cascades frog, Pacific chorus			
				frog, Cope's giant salamander,			
				long-toed salamander			
16	Boulder Creek	Corkran	creek	Cope's salamander, tailed frog			
16	Boulder Lake	Corkran	lake	cascades frog, NW salamander,			
				rough skinned newt			
16	Boulder Creek ponds	Corkran	ponds	cascades frog, NW salamander			
16	Buck Creek	Corkran	creek	Cope's salamander, tailed frog			culvert migration barrier
16	Buck Creek tributaries	Wondercheck	creek	Cope's giant salamander			culvert migration barriers
16	Camas Creek 90	Fredericks	Rd. 2120-240	cascades frog		adults	
						juveniles	
16	Camas Prairie	Corkran	meadow pools	spotted frog,			**only population on MTH**
				cascades frog, Pacific chorus			
				frog, rough-skinned newt			
16	Catalpa Lake	Wall	lake	rough-skinned newt, western toad			
16	Clear Creek 90	Fisheries Crew	RM 5.3	Cope's giant salamander	1	neotenic	
			RM 5.3	tailed frog	1	tadpole	
			RM 5.3	cascade frog	1	adult	
16	Clear Creek ditch 90	Fredericks	ditch	none			
16	Clear Lake	Corkran	lake	western toad, rough-skinned			
				newt, cascades frog,			
				Pacific chorus frog			
		Fredericks 90	NW lake branch	cascades frog			
			NE lake branch	cascades frog, Pac. chorus frog			
16	Devil's Half Acre	Mellen 87	meadow	cascades frog		juvenile	
16	Frog Creek	Wondercheck	creek	cascades frog			
16	Frog Creek Tributary	Corkran	creek	western toad, cascades frog			
16	Frog Lake	Corkran	lake	western toad, rough-skinned newt			
				Pacific chorus frog, long-toed			
				salamander, NW salamander,			
		Wondercheck	lake	cascades frog			
16	Green Lake	Corkran	lake, meadow	western toad, rough-skinned newt			
				Pacific chorus frog, long-toed			
				salamander, NW salamander,			
				cascades frog			
16	Iron Creek 93	Fisheries Crew	NI	Pacific giant salamander			
16	Iron Creek tributary 94	Corkran	creek	Cope's salamander, tailed frog,			
16	Lower Twin Lake	Wall	lake	rough-skinned newt			
16	McCubbins Campground	Fredericks 90	campground	no suitable habitat			
16	Palmateer Meadows	Mellen 87	meadow	none			
16	SF Iron Creek	Wondercheck	creek	Cope's giant salamander,			
				cascades frog			
16	SF Iron Tributary	Wondercheck	creek	Cope's giant salamander			culvert migration barrier
16	White River 93	Wondercheck	creek	cascades frog	> 1	adult	
16	Spinning Lake area	Corkran	lake and ponds	cascades frog, NW salamander			
29	Badger Creek 92	Fisheries Crew	RM 14.5-21.0	unid. frog, large unid. salamander	> 1	tadpoles	
29	Jordan Creek 93	Fisheries Crew	RM 4.8 & 9.6	Pacific tree frog	> 1	adult	
		Fisheries Crew	RM 4.8	cascades frog	1	adult	
		Fisheries Crew	RM 14.6	tailed frog	1		
30	Gate Creek 93	Fisheries Crew	creek	tailed frog	> 1	tadpole	
		Fisheries Crew	creek	Cope's giant salamander	> 1	neotenic	
		Fisheries Crew	creek	Pacific giant salamander	1	neotenic	

Table 18. Amphibian sitings summaries for White River Subbasin.

Issue 7B: Are landscapes and ecosystems becoming less stable and resilient?

YES. The combined effects of intensified floods due to 2 year return interval peakflow increases and culverts; annual runoffs diminished by water diversions; low summer baseflows intensified by irrigation withdrawals and decreases in baseline baseflows; increased fire intensities and frequencies; epidemic proportions of forest disease and infestation; manmade migration barriers such as culverts, reservoirs and ditch diversions; permanent or long-term alterations in the amount and pattern of landscape openings and vegetative type conversion due to timber harvest, agriculture, range, and human habitation are well outside the range of natural conditions for landscape patterns and processes. Quality habitat and current distributions of native species has been altered by altered processes and landscape patterns. For example, the spotted frog population does not have any resiliency in terms of locality, should the habitat quality of Camas Prairie be degraded.

Low gradient reaches with well developed floodplains are the most highly productive (Figure 1); most susceptible to morphological changes associated with management activities; and are the most critical in terms of flood response. Rock Creek is artificially entrenched within it's floodplain upstream of Rock Creek Reservoir as a result of cattle damage. Jordan, Tygh, and Threemile creeks are artificially entrenched and disconnected from their floodplains in the agricultural lands as a result of well-intentioned, but mis-informed flood control efforts. In fact, streams that are disconnected from their floodplains are far less resilient to floodflow effects, since vegetated floodplains function to slow water velocity, and store water and sediment.

The ditch system is not constructed with the natural gradients, sinuosity and channel roughness elements (coarse substrates and large wood) to withstand floodflows without excessive erosion and gullying (e.g. Highland and Clear Creek ditches). Water withdrawals for irrigation increase the intensity and duration of low summer baseflows, and increase water temperatures. Eastern Cascades coldwater species may be able to tolerate some increases in water temperatures, but growth and reproductive success are dependent on the intensity, duration, and daily range of temperature fluctuations.

Resident fishes are diverted into the ditches by way of unscreened diversions. Only Tygh Creek has a recently installed fish screen (spring 1995) at the MHNF boundary. Some of the ditches (e.g. Clear Creek Ditch) provide fisheries opportunities, but all the ditches are managed as water conveyances so instream large wood is frequently removed; sediment levels are often high; State water temperature standards and Riparian Reserves are not applicable. Therefore, the ditch habitat does not replace natural riparian and aquatic ecosystem losses.

Excessive sedimentation above background or annual high flows consistently below bankfull, can overwhelm the capacity of a channel to move the sediment downstream, resulting in pool filling, cobble/gravel embeddedness, bar building, gullying, decreased channel length, increases in the channel width, decreases in channel depth, increases in bank erosion, increases in bedscour, and increases in the rate of channel migration. On Forest examples of excessive fine sediment in fastwater riffle habitats are listed in Table 8. Examples of mid-channel bars, large point bars, channel widening, and tortuous meander bends that are indicative of excessive sediment loads (Rosgen 1994) are visible in a 1980 aerial photograph of Tygh Creek and White River in the Tygh Valley area (Figure 11). As a result, the Tygh Valley area is less resilient to future flood events.

Issue 7C: Do the different terrestrial and aquatic landscape processes and patterns (pre-1855 and current direction) effect species viability?

YES. Pre-1855 flood, drought, fire effects and natural migration barriers were the dominant terrestrial and aquatic landscape processes driving the patterns and species distribution in the Crest, Transition and Eastside zones. Infrequent, natural fires had the capacity to burn whole subwatersheds when driven by westerlies. Localized subwatershed effects resulting from fire were mitigated by dilution in higher order streams in the network. Large-scale debris torrents and rain-on-snow floods shaped streams channels, flushed fishes downstream, and re-distributed large wood and sediment. Disease, insects, and fire killed large wood that became wildlife or fish habitat in the terrestrial, riparian, and aquatic ecosystems. Fish migrated to coldwater, perennial streams during drought cycles, or succumbed to terrestrial predators and diminishing habitat in intermittent streams.

Resident redband trout evolved in a highly dynamic system of drought, flood, and fire cycles; are very adaptive to changes on a wide variety of scales; and are still viable in Rock, Jordan, and Gate subwatersheds. However, the combined effects of intensified floods due to baseline peakflow increases and culverts; annual runoffs diminished by water diversions; low summer baseflows intensified by irrigation withdrawals and decreases in baseline baseflows; increased fire intensities and frequencies; epidemic proportions of forest disease and infestation; manmade migration barriers such as culverts, reservoirs and ditch diversions; permanent or long-term alterations in the amount and pattern of landscape openings and vegetative-type conversion due to timber harvest, agriculture, range, and human habitation are well outside the range of natural conditions for landscape patterns and processes. Reservoir construction and hydrology changes has had the greatest impact on the MHNF population of spotted frogs.

Beaver-created wetlands were common in the Tygh Valley and Smock Prairie areas prior to euro-american settlement. Complex, slowwater habitats created by beaver activity are highly productive areas for rearing young-of-the-year trout; are nutrient and sediment sinks; moderate baseflows; and provide velocity breaks for fishes during peakflows. From the mid-1800's to the turn of the century, beaver were harvested commercially; and dams were removed as soon as they were established during the last century to protect agricultural investments. "It was common to find lakes in the morning where the beaver had been working overnight", long-time area residents (pers. comm.). Beaver declines were noted as early as the 1930's when a moratorium on trapping all but "nuisance" beaver was instated. Current beaver activity on MHNF streams are noted in individual stream survey reports. For example, Clear Creek has a number of beaver-created wetlands downstream of Clear Lake.

Issue 8A: Do we have adequate information to assess the viability of all relevant species listed in the FSEIS and C-3 table if we decide to recommend changes in the Riparian Reserve widths, or if the FSEIS suggested that further viability analysis was appropriate during watershed analysis?

NO. Molluscs have not been surveyed in the subbasin. There is potential habitat around springs, seeps, talus slopes, and riparian habitats for a number of slugs, and land and freshwater snail species from the ROD C-3 table (Huff unpub.). There is a population of small, "fingemail" clams in upper Threemile Creek that are probably *Pisidium* spp., but not likely the C-3 table species *Pisidium ultramontanum* or "montane peaclam" (Furnish pers. comm.; Frest and Johannes 1993).

Demographic and distribution information for aquatic amphibians in the White River basin has been collected opportunistically, primarily during summer and fall months. None of the terrestrial amphibian species addressed in the C-3 tables has been sighted, and there is no potential habitat for these species in the White River Subbasin. Systematic population surveys during the spring months are required for viability assessment. Riparian Reserve widths that meet or exceed the minimum recommendations in the ROD are probably conservative approximations of riparian habitat requirements for aquatic amphibians. A more important consideration is the evaluation of activities such as roading, recreation, sand and gravel mining, and livestock grazing within the Riparian Reserves and their compatibility with Aquatic Conservation Strategy objectives for riparian dependent vertebrate species.

Upper White River Subbasin is breeding habitat for FS Sensitive harlequin ducks. Harlequin ducks nest in debris along streambanks adjacent to fastwater, and feed on molluscs, insects, and fishes (ODFW 1992). Harlequin ducks have been observed nesting and rearing in the first reach of SF Iron Creek, and the second to third reaches of mainstem White River. The White River Wild and Scenic designation and recommended Riparian Reserve designation for SF Iron Creek is expected to provide protection for harlequin duck habitat and aquatic prey species.

Issue 8B: Are there additional species within the range of the northern spotted owl that are not dealt with in existing direction?

YES. The Mt. Hood area has the greatest number of FWS special status aquatic invertebrate taxa of any comparable region in the Pacific Northwest. The high number of at-risk invertebrates may be a function of the intensity of survey effort invested in the Mt. Hood area (Wisseman 1990). There are four species of FWS C2 aquatic macroinvertebrates in North Fork Iron Creek above Highway 35, in the Upper White River subwatershed - the Mt. Hood primitive brachycentrid caddisfly, the Cascades apatanian caddisfly, the Mt. Hood farulan caddisfly, and the one-spot rhyacophilan caddisfly (Wisseman 1990). Mt. Hood farulan caddisfly has also been found in South Fork Iron Creek near Government Camp (Wisseman 1990). Wisseman categories South Fork and North Fork Iron creeks as "cold, spring-fed streams with no glacial meltwater, dense forest canopies, frequent large woody debris jams, cobble-mineral and mossy substrates". Timber harvest and other activities that would increase sedimentation and water temperatures are the greatest risk to the viability of these caddisflies.

No water quality or macroinvertebrate monitoring data has been collected, so the effects of organic enrichment from fertilizers and livestock excrement, and pesticides from the agricultural and rangelands in the lower subbasin cannot be evaluated. However, there are probably significant water quality and ecological effects associated with agricultural and rangeland by-products in some of the tributaries to White River in the lower subbasin, as there are in adjoining Miles Creek watershed (Mangum 1990). For example, cattle have free access to Rock and Gate creeks, and their tributaries in the Smock Prairie area, and agricultural development is extensive in the Tygh Valley area.

Native sculpins of unknown species are the second most numerous fishes in the White River Subbasin, second only to rainbow/redband trout (BPA 1985), and are food items for redband trout (FS Sensitive, FWS C2) and Cope's giant salamander (FS Sensitive). Both the torrent and shorthead sculpins have potential habitat in the subbasin. Shorthead sculpin are typically found in coldwater, fastwater habitats with cobble/gravel substrates at elevations >2,500 feet on the eastside of the Cascades (Wydoski and Whitney 1979). The torrent sculpin inhabitats streams and lakes. In streams >8 feet wide, the torrent sculpins use similar habitat as the shorthead sculpin (Wydoski and Whitney 1979). In lakes, the torrent sculpin inhabits rocky beach areas. Both sculpins spawn in coarse substrates and feed on benthic invertebrates, so they are sensitive to fine sediment levels and may be good indicators of aquatic habitat conditions. A long period of reproductive isolation above White River Falls may have resulted in some endemism within the sculpins that could be determined with DNA analysis.

Crayfish are abundant in Badger Lake and upper Badger Creek, and there has been some recreational crayfish harvesting in the lake (USFS district personnel). Mt. Hood National Forest biologists found crayfish in Frog Lake, and crayfish are likely to occur in Clear Lake even though it is a drawdown reservoir (USFS and ODFW personnel). Crayfish distribution in the subbasin is not well documented, and population dynamics are not monitored. There is no documentation of ODFW introducing crayfish as a food source to lakes stocked with trout. Other methods of introduction, such as ditches and anglers are undocumented. Crayfish carry thomey-headed worms - a non-specific parasite commonly effecting birds, fish, amphibians, and other carnivores in the foodchain.

Cascade torrent salamanders, *Rhyacotriton cascadae*, a FEMAT Species of Concern and State Status Vulnerable species are not addressed in the C-3 table. Cascades torrent salamanders have not been sighted within the White River Subbasin, but potential habitat occurs within the upper White River Subbasin, and the geographic locality infers probable occurrence.

Issue 8C: Should species management focus on protecting individual species, or should it focus on providing habitat within the range of natural conditions?

YES and NO. Where isolated or unique populations are at risk, such as the spotted frogs on Camas Prairie; the endemic redband trout in upper Rock Creek, Jordan and Gate subwatersheds; or the caddisflies in North and South Fork Iron creeks, it is necessary to place special emphasis on conservation of these species.

Generally, providing habitat within the range of natural conditions will provide for the needs of resident, aquatic species. However, in the presence of exotic brook trout, the native redband trout and sculpins have an additional predator and strong competition for available habitat and food resources in the upper White River Subbasin (Hawkins 1992). Brook trout young-of-the-year are spawned in the fall and have a predaceous and competitive advantage over redband/rainbow trout that are spawned in early spring. In the lower subbasin, the endemic redband trout have an advantage because they can thrive in water temperatures that are too warm for brook trout (Behnke 1992; Wydoski and Whitney 1979).

Issue 8C: Are there species beyond the range of the northern spotted owl that are unique, rare, or at-risk?

YES. Adult summer (*O. mykiss gairdneri*) and spring chinook (*O. tshawytscha*) (FWS C2) use the lower 2 miles of White River below the White River Falls during their Deschutes River migrations. Whether they rest, feed, or spawn in the White River is unknown. The 180 foot long White River Falls are a natural barrier to upstream anadromous fish migration. The ODFW and Tribal proposal to create anadromous fish passage above the White River Falls is no longer viable, in part because of concerns about introduction of a redband trout/steelhead subspecies that would hybridize with the endemic White River redband trout. However, the Tribes are particularly concerned about the White River Subbasin as a source of abundant, cold water to trigger anadromous fish runs in the Deschutes River.

The longnosed dace (*Rhinichthys cataractae*) and the mountain whitefish (*Prosopium williamsoni*) in mainstem White River may have some endemism because of their genetic isolation above White River Falls.

Issue 8E: Are connectivity and dispersal habitat sufficient to allow gene flow at the metapopulation scale?

NO. The metapopulation for the White River subspecies of redband trout is the White River Subbasin (Kostow *et al.* draft). Impassable irrigation diversion dams prevent lowflow, upstream migrations of FS Sensitive redband trout and Cope's giant salamander in lower Tygh, Badger, and White River downstream of the Forest boundary (BPA *et al.* 1985). On Forest, irrigation dams may be migration barriers at the ditches on Badger (Highland Ditch), Threemile, upper Gate, Boulder, Cedar (Forest), Frog, and Clear creeks. Fish can populate downstream areas by washing over the diversion dams at high flow, but cannot migrate upstream of the ditch diversions. Clear Lake and Rock Creek reservoirs have outlet dams that are barriers to upstream migration. Road culverts were evaluated by district Fisheries Biologists, and the ones that were judged too steep, too long, too small, too high above the water's surface, or lacking a large jumping pool at the outlet are "barriers" to fish and Cope's giant salamander upstream migration at number of localities in the White River Subbasin (Table 19). A number of the undersized road culverts in the Eastside Zone are suspected of inhibiting the migration of large wood through the subbasin to non-forested reaches downstream (Table 19).

Camas Prairie, an 86 acre wet meadow in the Clear Creek subwatershed, is the only location on the Mt. Hood National Forest that currently supports spotted frogs. The isolated spotted frog population in Camas Prairie was historically part of a metapopulation of spotted frogs connected by the Big Meadow system, Clear Lake, Timothy Lake, Little Crater Meadow, and Clackamas Lake, as late as the 1930's (Hayes et. al. 1994). The Big Meadow ecosystem was fragmented when Timothy and Clear lakes were flooded by construction of reservoirs. In addition roads, livestock corrals, and hiking trails within Camas Prairie may be inhibiting localized habitat connectivity, hydrology, and gene flow. Spotted frogs are warmwater marsh specialists most often found in herbaceous, perennial wetland communities. Unlike other ranid frogs, the females and tadpoles may need periods of ≥ 3 months in warm, standing water $>25^0$ C to complete the reproductive cycle and mature into frogs, and isolated populations of spotted frogs with habitat less than 11 acres do not appear to be self-sustaining (Hayes *et al.* 1994). Spotted frogs and their tadpoles are an important food source for aquatic garter snakes and migrating sandhill cranes (State Sensitive) that stop over in Camas Prairie (Ted Koch, FWS Boise, pers. comm.).

Distribution of other at-risk amphibian species in the White River Subbasin does not suggest lack of gene flow at this time. Dynamics of a population and its response to environmental change depend on survival, fecundity, longevity and age at maturity. To predict with some degree of confidence the probability that a given population and gene flow will persist, demographic surveys, population monitoring, and genetic testing are recommended to project future population growth, gene flow viability, and population resiliency.

SWS Number	Stream Name/ Stream Survey Date	Road Number	Priority	Comments	Reach No.	River Mile	Culvert Type	Pool Depth	Jump Height	Stream Width	Inlet Gradient	Culvert Gradient	
16A	White River	4885	2	waterchance at Keeps Mill Campground									
16A	Bonney Creek 93	48	1	migration barrier	4	0.9	round	2	0	10	8	10	8
16A	Bonney Creek 93	4890-220	NA	not a migration barrier	5	1.4	elliptical	2	4	10	4	10	4
16A	Bonney Creek	4891	1	migration barrier, re-design, waterchance?, trashrack	9	2.6	elliptical		0	8	8	2	5
16A	Iron Creek 93	48	NA	not a migration barrier	3	2.2	arch	2	1	10	9	8	9
16A	Iron Creek 93	35	NA	few fish	4	2.7	round		2	3	20	20	4
16B	White River	35	1	undersized bridge									
16B	White River	43	1	migration barrier									
16B	Iron Creek tributary	4880	2	Cope's migration barrier									
16A	Iron Creek tributary	4880	2	Cope's migration barrier									
16B	NF Iron Creek	48	2	Cope's migration barrier									
16B	Red Creek	48	1	migration barrier									
16B	Red Creek	4880-220	1	migration barrier									
16C	Barlow Creek 92	3530	NA	few fish	5	5.7	round	2	0	4	1	1	3
16C	Barlow Creek	3530	2	waterchance at Devil's Half Acre Campground									
16C	Barlow Creek	3530	2	waterchance									
16C	Barlow Creek	3530-221	2	waterchance at Barlow Creek Campground									
16C	Barlow Creek	3530-260	2	waterchance									
16C	Green Lake Creek 94	43-220	done	migration barrier, FY95 K-V project	2	0.2	round	2	2	6	7	15	4
16E	Boulder Creek 91	48	NA	not a migration barrier	3	3.2	arch					2	19
16E	Cedar (Forest) Creek	48-280	?	migration barrier ?			round						
16E	Swamp Creek	4881-121	2	waterchance available only at high stage									
16E	Lost Creek	4880	2	waterchance									
16E	Lost Boulder Ditch	4880-120-123	2	waterchance									
16F	Frog Creek 89	2130	2	migration barrier ?, waterchance	1	0.9	elliptical	4	0	16	1	4	8
16F	Frog Creek 89	43	done	baffled, not a migration barrier	2	3.7	arch	2	1	11	1	2	8
16F	Frog Creek 89	2610-240-241	done	re-contoured stream at outlet	4	7	round		1	12	2	2	6
16F	Frog Lake	2610-230	2	waterchance									
16F	Frog Creek tributary	4320-014	2	waterchance									
16H	Camas Creek 89	2120-240	done	baffled, not a migration barrier	1	0.8	elliptical	3	1.3	8	2	4	[illegible]
16H	Clear Creek 90	2130	2	headgate possible barrier	6	4.6	arch		0	30	2	2	11
16H	Clear Creek 90	42	1	migration barrier ?, waterchance, sediment buildup ?	12	12	arch		0	35	2	3	12
29C	Little Badger 90	2711-130	1	migration and LWD barrier, waterchance	1	1.4	round	1	0	2	8	2	4
29C	Little Badger 90	2710	1	migration and LWD barrier, waterchance	1	2	round	3	0	11	8	2	5
29F	Jordan Creek 93	2730	NA	private swimming hole	2	8.5	round	7	0	6	3	3	12
29F	Jordan Creek	27	2	waterchance, large wood barrier									
29F	Pen Creek	27	3	large wood barrier									
29F	Pen Creek	27-120	3	large wood barrier									
29F	Tygh Creek	27	2	large wood barrier, waterchance?									
29F	Tygh Creek	27-120	3	large wood barrier									
30B	NF Rock Creek	4810-140	?	migration barrier ?			round						
30C	Gate Creek	48	1	migration and LWD barrier, waterchance, sediment buildup									
30C	Gate Creek 93	3530	NA	ODFW ford not open	1	1.9	round	9	0	3	7	1	8
30C	Gate Creek 93	4813	1	migration barrier, waterchance, undersized pipe, sedimen	4	5.3	round	3	0	12	2	6	4
30C	Gate Creek 93	4820	1	migration and LWD barrier	4	7.7	round		0	10	5	7	4
30C	Gate Creek 93	4811	1	migration barrier, waterchance, sediment buildup	4	10	round	13	0	8	6	7	3
30C	Gate Creek Ditch	4820	?	undersized pipe?									
30C	Pup Creek 93	4811	?	migration barrier ?	1	0.2	round		0	5	2	2	2
30C	Pup Creek 93	4814	?	migration barrier ?	1	0.8	round	1	0	3	3	2	2
30E	SF Gate Creek 93	4830	2	LWD barrier, waterchance	1	0.2	round		0	2	3	3	3
30E	SF Gate Tributary 93	4840	2	waterchance	1	0.4	round	1	0	3	4	2	2
30F	Souva Creek 93	4811	?	migration barrier ?, LWD barrier	3	2.8	round	1	0	3	4	2	2
30F	Souva Creek 93	4814	NA	no fish	5	3.7	round	11	0		6	3	2
30F	Souva Creek 93	4813	NA	no fish	5	5	round		0	1	6	4	2
30G	Threemile 90	SLING RD	1	dewatered by ditch diversion, damaged pipe	1	14	round	2	0	8	3	2	4
30G	Threemile	4810	1	migration and LWD barrier, waterchance									
30G	Threemile	Old Road	1	undersized pipe, migration barrier									
30G	Threemile	4811-170	1	clogged, diverting water, barrier			round						

Table 19. Aquatic migration barriers, large wood migration barriers, and pumpchances.

Issue 8F: Does the White River Subbasin provide important habitat for species when considered at the metapopulation scale?

YES. Spotted frogs have declined across their range. Historically, the majority of spotted frogs occurred in large, wet meadow ecosystems like the Willamette Valley (Hayes *et al.* 1994). Currently, remnant populations of spotted frogs in Washington and Oregon are restricted to public lands at elevations between 4000-5000 feet which is the upper end of their range (Hayes *et al.* 1994). There are only 3 known populations in Washington, 3 populations west of the Cascades crest in Oregon (2 on the Willamette NF, 1 Big Meadows), 3 potential localities in the Klamath Basin, and 20 potential localities east of the Cascades crest, including Camas Prairie. The rest of the potential sites, primarily on Deschutes National Forest, will be surveyed during 1995 (Hayes pers. comm.). British Columbia populations are extinct.

The spotted frogs will be split into 3 different species in the near future (Corkran, Hayes pers. comm.). Genetic testing, scheduled for 1995, will determine if the Camas Prairie population is the Western spotted frog. If so, it will warrant listing under the Endangered species act (Corkran pers. comm.).

Other at-risk amphibians were sighted in all White River subwatersheds (Table 18). Most amphibians are at risk from stochastic processes, rather than limited gene pools resulting from a small population size (Corkran pers. comm.). Actions that minimize risks associated with population dynamics also minimize genetic risks.

Issue 8H: Can the public lands provide for ecosystem conservation and species viability for all ecosystem components in the White River Subbasin?

YES. The critical components for riparian and aquatic ecosystems are still available on the public lands, although habitat quality and quantity have been reduced by reservoir construction, irrigation withdrawals, migration barriers created by road culverts and diversion dams, increased water temperatures, livestock grazing, fish stocking in historically fishless lakes, reduction of riparian and instream large woody debris, and ground disturbing activities that yield sediment.

Issue 9A: Are trends for the various types of recreation uses increasing or decreasing?

There is not enough recreation data, and the current method of data collection, make any conclusions regarding recreation trends in specific destinations tied to coldwater fishing activities difficult (Table 20). However, the population of the greater Portland metropolitan area is increasing, and we expect demands for all types of recreation to follow population trends, as the Frog Lake and Barlow Creek data indicates. Within the areas surveyed, the limited data does indicate areas of heavy coldwater fishing activity. Collection of site specific recreation data would facilitate monitoring and management of recreation trends.

Locality	Year	Visitors	RVDs	Year	Visitors	RVDs	Year	Visitors	RVDs
Barlow Creek	1990	47	-	1993	450	161	1994	450	161
Frog Lake	1990	1645	-	1993	5500	1971	1994	5500	1971
Rock Creek Reservoir				1993	1160	416	-	-	-
Boulder Lake				1993	750	269	-	-	-
Barlow Crossing				1993	680	244	1994	680	244
Clear Lake				-	-	-	1994	6500	2329
Clear Creek				1993	900	323	1994	900	323
Keep's Mill				1993	860	308	1994	850	305
White River Station				1993	1350	484	1994	1350	484
Devil's Half Acre				1993	990	355	1994	990	355
Grindstone				1993	50	18	1994	50	18

Table 20. *Coldwater fishing* data for destinations in the White River Subbasin 1990-1994. "RVDs" are *the amount* of time actually spent engaged in the activity of interest.

In recent years there have been some demographic and use changes associated with recreation in the privately-owned portion of White River Subbasin. The Pine Hollow and Rock Creek areas have recently increased by approximately 650 residents, mostly retired "snowbirds", that have moved to the area permanently or seasonally (approximately 50-50 split). A new lodge and cabins for recreational hunters and other uses is being built in the Wamic area. Some subdividing of larger land holdings is occurring. A private individual recently purchased 1,300 acres that was agricultural land and a sand and gravel operation on the south side of White River, just downstream of the Falls. The pit will be restored and the vegetation will be converted to buckwheat, corn and shrubs as cover and feed for game birds in 1995. The acreage and frontage rights to White River will be used as a private hunting and fishing guide operation.

Issue 9B: Have high levels of recreation use created detrimental impacts to soil, water, vegetation, wildlife, and fish?

YES. Demand for fish stocking by recreational anglers has impacted native amphibians, fishes and zooplankton by predation, competition, or genetic hybridization in most of the subbasin (Figure 16; Table 16). High recreation use has compacted soil, increased shoreline erosion, and trampled vegetation around heavily used sites on Frog, Lower Twin and Upper Twin lakes as a result of human foot traffic, campground and dispersed site use, vehicle traffic, and recreational stock (see Appendix C. Lakes Reports). The riparian areas around Boulder and Jean lakes have small reductions in vegetative cover, and may be areas of concern as recreational demands increase. Restoration and monitoring are recommended.

At the time of survey, Catalpa Lake's riparian area was lush and in excellent condition when compared to other unimpacted cascade lakes within the Mt. Hood National Forest. Other riparian areas that show no obvious effects from present management activities are Little Boulder Lake and Upper Twin Lake (see Appendix C. Lakes Reports).

High levels of off-highway vehicle activity and dispersed camping in the McCubbins Gulch and Gate Creek areas are resulting in detrimental impacts to other resources. Restoration is proposed for the Gate Creek and Road 4800-140 area - an 80 acre parcel of Rocky Mountain Elk Foundation land acquired by MHNF in 1995. These and other restoration recommendations for roads, trails, and campgrounds are listed in Tables 21-22.

Project Name	Location	Notes	Planning Status
Frog Lake		restore riparian area and shoreline	planning not started
Lower Twin Lake		restore riparian area and shoreline	planning not started
Upper Twin Lake		restore riparian area and shoreline	planning not started
Camas Prairie		redesign trail and road system to protect spotted frogs	planning not started
Clear Creek Campground		move campsites and restore riparian area	?
Badger Lake Campground	T03S, R10E, Sec. 16	restore riparian area and streambanks	NEPA not required
Bonney Crossing Campground	T04S, R11E, Sec. 2	restore riparian area and streambanks	NEPA not required
Badger Creek	T03S, R10E, Sec. 16	restore 1 mile of trail in wet meadow	NEPA not required
Little Badger Creek	Trail 469: T03S, R11E, Sec. 15, 23	build 2 stock bridges and 1 mile of trail reconstruction	NEPA started

Table 21. Proposed campground and trail restoration projects.

Issue 9D: What level of recreational use is appropriate in LSRs and Riparian Reserves?

Recreational human, livestock, and vehicle use and access that does not significantly effect water quality by sedimentation or fecal contamination; does not alter the physical integrity of riparian, floodplain and channel function; does not alter native biodiversity by stocking introduced and exotic game species; maintains native plant biodiversity and does not introduce or spread noxious weeds; and maintains the experiential quality sought by the recreationist.

Issue 9e: Do any of the current dispersed recreation activities conflict with the Aquatic Conservation Strategy and LSR objectives?

YES. Current dispersed recreation activities at Frog, Green, and Lower Twin lakes conflict with the Aquatic Conservation Strategy objectives to 1. "maintain and restore the physical integrity of the aquatic ecosystem, including shorelines and banks", 2. "maintain and restore the sediment regime under which the aquatic ecosystem evolved", and 3. "maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands...".

Issue 10C: Are the designated use types appropriate for the trails in the LSRs and Riparian Reserves?

NO. Off Highway Vehicle (OHV) use within the riparian zones, and at unconstructed stream crossings is not consistent with Aquatic Conservation Strategy objectives for the Riparian Reserves. McCubbins Gulch area has extensive, OHV use off designated trails. There is extensive OHV damage to the riparian and drainage network around Gate Creek on the 80 acre parcel of formerly private Rocky Mountain Elk Foundation land acquired by MHNF in 1995. Other unconstructed stream crossings are identified in Table 22.

Issue 10D: Are road and trail locations and densities appropriate to meet the Aquatic Conservation Strategy objectives?

NO. White River Subbasin is a Tier 2 Key Watershed for protection of high quality water and at-risk fish stocks. Aquatic Conservation Strategy objectives for Key Watersheds are 1) no new road construction in roadless areas, 2) reduction of existing road system and nonsystem road mileage outside roadless area, 3) no net increase in amount of roads. Some road obliterations for the protection of aquatic and riparian habitats have been implemented, and other road obliteration and closure recommendations are listed in Table 22.

Project Name	Location	Project Type	Year/Status
Boulder Creek	Road 4800-039	road obliteration	done
Gate Creek	Road 4812-160	road obliteration	done
Pup Creek	Road 4813-011	road obliteration	done
Threemile Creek	Road 4811-014	road obliteration	done
Badger Creek tributary	Road 2710-020	road obliteration	done
Badger Creek tributary	Road 2710-120	road obliteration	done
Badger Creek	Road 2710-130	road obliteration	done
Swamp Creek	Road 4880-spur	road obliteration	done
Gate Creek	roads upstream from Road 48	obliteration, closure native surface	NEPA done
Keep's Mill Road	Road 4885 into Keep's Mill	road obliteration	none
Road 4820	cutslope	cutslope revegetation	not required
Road 4810-170	road crossing and stream	remove culvert on a ripped road	started
Tygh Creek crossing	Road 2700-120	construct creek crossing, surface road	none
Badger Lake	Road 4860-140	native surface, gullying, rockfall, drainage problems	none
Road 2710-160		native surface reconstruction	none
Highland Ditch	Road 2710	reconstruction of native surface road, water runs down roadbed	none
Gate Creek	Road 4800-140 and 80 acre exchange parcel	road closure/ obliteration; riparian, campsite, and OHV restoration	none
Riparian skid roads	throughout subbasin	obliterate skid roads in riparian zones	none
Road 2711-120		reconstruction of gravel surface road	none
Road 2711-120		reconstruction of gravel surface road	none
Barlow Road 3520	milepost 0 to end	native surface, unmaintained waterbars	none
Barlow-Bear Springs	OHV trail		none
Badger Lake	Road 4860	native surface	none
Road 27	MP 0 to end	cut and fillslope failure, steep grades	none
local roads off Road 27		drainage problems	none
Road 4300-220		drainage problems	none
Road 2120		steep, eroding, native surface	none
Road 48	MP 0 to end	cutslope failures	none
Gate Creek crossing	Road 48 in Section 25?	slumps?	none
Blue Box Pass Road	Road 2660	drainage and blowdown problems	
Frog Lake Butte access	roads 4300-250, 2610-220, 2610-260	high rainfall area, drainage design problems	
Clear Lake access	roads 2630-014, 016, 017, 018, 019	drainage problems?	
Clear Lake access	Roads 2630-013, 015	submerged during high water	
Rock Creek Reservoir	all roads upstream of reservoir	sediment source	
Boulder Ditch	Road 48	ditch seepage above road, blowout potential	
Lost Creek Ditch	?	blowout potential	
Frog Creek Ditch	?	blowout potential	
Clear Creek Ditch	?	blowout potential	

Table 22. Implemented and proposed road obliteration, restoration, and maintenance.

Issue 10I: Are pumpchance design, maintenance, and locations appropriate to meet the Aquatic Conservation Strategy objectives?

NO. Pumpchances in the White River Subbasin were located for fire protection and easy accessibility from roads, and were not designed to meet Aquatic Conservation Strategy objectives. A network of pumpchances are necessary to protect resources in the subbasin from catastrophic fire, however, all the pumpchances need to be evaluated for improvement opportunities to reduce riparian and aquatic impacts. Some pumpchances may need to be reconstructed, designated for seasonal use only, or obliterated because of lowflow and water quality conflicts with instream beneficial uses (Tables 8 & 22). Pumpchances restoration proposals are not available for the White River Stewardship Area.

Project Name	Location	Planning Status	Notes
Threemile Creek	T04S, R11E, Sec. 3	planning started	pumpchance reconstruction, riparian revegetation, and limit access
Gate Creek	T04S, R10E, Sec. 11, 12	planning started	pumpchance reconstruction, riparian revegetation, and limit access
Little Badger Creek	T03S, R11E, Sec. 23	planning started	pumpchance reconstruction, riparian revegetation, and limit access
Boulder Creek	T04S, R10E, Sec. 26, 34 (4 sites)	planning started	pumpchance reconstruction, riparian revegetation, and limit access
Tygh Creek	T03S, R12E, Sec. 18	planning started	pumpchance reconstruction, riparian revegetation, and limit access

Table 23. Proposed pumpchance restoration and reconstruction projects in the Badger Stewardship area.

Issue 11B: Is water currently over-allocated to provide for instream beneficial uses in any streams?

YES. Current water allocations for irrigation allow de-watering miles of Threemile, Rock, Gate, Lost, and Frog creeks (Figure 13; Hydrology Report). All other perennial creeks have decreased low summer and bankfull discharge flows because of irrigation withdrawals. Instream temperatures that do not meet State Standards (Table 13) for coldwater fisheries are indicative of ecological over-allocation. State Water Rights legislation requires streamflows be maintained during the irrigation season, but no minimum flow standards were set or are enforced for White River Subbasin.

Oregon State Parks has petitioned the State of Oregon to secure the water right at White River Falls that was relinquished by the Wasco County Public Utility District. Oregon State Parks would use the water right to maintain the flows over White River Falls for public enjoyment.

Issue 11C: Can we meet the State management objectives for deer, elk, and game fish, and still meet ecosystem objectives in the ROD?

NO. ODFW eliminated the stream stocking program in 1994 to comply with the ODFW Wild Trout Management Plan. At the present time, we meet ODFW management objectives for catchable trout fisheries in these lakes. However, US Fish and Wildlife Service considers species introductions as a primary cause of native species declines - second only to habitat loss and alteration. Although it is not expressly stated, it is implied that introduced and exotic game fish management objectives conflict with native species and aquatic ecosystem objectives in the Aquatic Conservation Strategy (ROD 1994).

ODFW has altered their hatchery fish stocking program in White River Subbasin since 1992 because of concerns about redband trout genetics. Most of the high lakes are stocked with exotic brook trout, with the exceptions of Boulder and Jean lakes that have "rainbow" stocking programs. Deschutes River redband trout stocks are no longer planted in White River Subbasin, although they have escaped and are naturally reproducing in most of the stream network (Figure 16; Table 16). The rainbow/redband trout (O. *mykiss* spp.) stocks currently produced by the Oak Springs Hatchery for White River are Roaring River and Cape Cod stocks. These domesticated stocks are fall spawners, and susceptible to a local, internal parasite *Ceratomyxa shasta*. In theory, these stocks will not interbreed with the spring spawning, endemic redband trout, and will contract *C. shasta* and die if they escape downstream to the Deschutes River (Newton pers. comm.). Fishes that spawn in the fall, such as brook trout and the domesticated strains of rainbow/redband are likely to have high young-of-the-year mortalities in stream habitats because of high winter floodflows. However, the domesticated strains could revert back to spring spawning in the wild, and interbreed with endemic redbands.

Rock Creek and Pine Hollow are artificial reservoirs close to local communities that provide stocked, recreational fisheries on and off the National Forest. Rock Creek had a population of redband trout in the stream segments flooded for Rock Creek Reservoir, that has been permanently extirpated; and there are no at-risk amphibians with critical habitat in either reservoir. Therefore, there are opportunities to provide introduced and exotic fisheries in Rock Creek and Pine Hollow reservoirs with minimal impact to at-risk aquatic species, if all outlets are screened to prevent migration of introduced and exotic fishes into the stream network. We recommend the high lakes be managed for native fisheries only to protect the native fauna, and provide a different recreational experience.

Issue 11F: Is current direction adequate to provide for protection of tribal rights and trust resources?

YES. However, the Tribes are very concerned with the quality and quantity of water coming from "The Water Giver" (Mount Hood) for anadromous fisheries in the Deschutes River to support the at-risk summer steelhead and spring chinook salmon. The Tribes are also concerned about the riparian and aquatic impacts of livestock grazing on range allotments in terms of sediment production and water quality, and the effects on fisheries resources.

CONCLUSIONS:

- The native vertebrate and invertebrate communities of the natural lakes and ponds, rivers and creeks in most of White River Subbasin have been altered by reservoir construction and ODFW fish stocking programs. The exceptions are upper Rock Creek above Rock Creek Reservoir, and Jordan and Gate subwatersheds where the impacts of fish introductions has been minimal.
- Protection of the genetic integrity of FS Sensitive, endemic redband trout in Gate, Jordan, and upper Rock-Threemile subwatersheds is the highest priority for fisheries management in White River Subbasin.
- The effects of the 1973 Rocky Burn (*i.e.* reduction of instream large wood, reduction of large wood recruitment potential, reduction of stream canopy cover, increased water temperatures, increased sedimentation), livestock grazing, water withdrawals for irrigation, and introductions of hatchery rainbow/redband trout are the greatest apparent threats to the endemic redband trout in Gate, Jordan, and upper Rock-Threemile subwatersheds.
- Irrigation diversion dams and a number of road culverts are probable upstream migration barriers for FS Sensitive Cope's giant salamander and fishes.
- Some culverts are barriers to the downstream movement of large woody debris.
- Pumpchances need to be evaluated for conflicts with the Aquatic Conservation Strategy.
- Camas Prairie in the White River watershed has a regionally important population of spotted frogs.
- Other at-risk aquatic amphibians appear well distributed within the White River Subbasin.
- Introduced and exotic fishes and bullfrogs, livestock grazing, reservoir development and water diversions are the greatest apparent risks to aquatic amphibians in the White River Subbasin.
- Demands for irrigation water and aquatic recreational opportunities in the White River Subbasin will increase over time, and will require careful planning and monitoring to avoid conflicts with the Aquatic Conservation Strategy objectives.
- Riparian areas and instream aquatic habitat parameters on National Forest land will improve in the foreseeable future and move toward the range of natural conditions and dynamic equilibrium if the restoration and management recommendations in this report are implemented to meet Aquatic Conservation Strategy Objectives.
- There have been some changes in the demographics and uses in the lower White River Subbasin. However, there are no foreseeable significant changes in water allocations, rangeland, and agricultural practices that are impacting aquatic and riparian resources in the lower White River Subbasin.

MANAGEMENT RECOMMENDATIONS:

- Manage Gate and Jordan subwatersheds, and upper Rock Creek for protection of FS Sensitive, endemic redband trout that are unique to the White River Subbasin.
- Install fish screens on all ditches, reservoirs and lakes with populations of introduced and exotic fish species (FW-143).
- Screen all inlets and outlets to Rock Creek and Pine Hollow reservoirs to prevent migration of introduced and exotic fishes into the stream network, and provide introduced and exotic fisheries opportunities that will have minimal impacts on native at-risk fish and amphibians in the rest of the subbasin.
- Manage the high lakes for native fisheries only to protect the native fauna, and provide a different recreational experience for anglers.
- Correct established human-made passage barriers (FW-115-117).
- Change LRMP aquatic and riparian standards as recommended in Issue 1J. to better reflect the range of natural variability and biological significance.

- Restore minimum baseflows in de-watered segments of Threemile, Frog, Lost, and Rock creeks to protect National Forest resources through enforcement of LRMP standard FW-074, and the Organic Act.
- Participate with ODFW in development of fisheries plans for the lakes and reservoirs that will provide native fisheries opportunities, and restore and protect native aquatic vertebrate and invertebrate biodiversity.
- Recommend the SF and NF Iron Creek subwatersheds above Highway 35 be set aside as Riparian Reserves for protection of the water quality critical to the viability of 4 species of caddisflies with FWS C2 status, and FS Sensitive harlequin ducks in SF Iron Creek.
- Add 300 ft. to the recommended Riparian Reserve widths on Green Lake and the north shore of Frog Lake which have extended riparian areas including wetlands, seeps, and springs that extend an estimated 300 ft. or greater from highwater line.
- Change management activities and implement restoration projects to restore the riparian areas with notably compacted areas or loss of vegetative cover resulting from recreational or commercial livestock use around Frog, Green, and Lower Twin lakes.
- Establish baseline and trend monitoring of water quality and riparian condition as recreational demands associated with lakes increases.
- Develop a plan to meet Aquatic Conservation Strategy objectives of "maintain and restore" for lake ecosystems.
- Manage Camas Prairie for conservation of the spotted frog population.
- Restore riparian vegetation in areas effected by timber management, livestock grazing, and recreation.
- Modify road culverts and diversion dams that are upstream migration barriers.
- Conduct comprehensive amphibian surveys of lakes, streams, wetlands, and stockponds, that key in on prime breeding sites during the spring.
- Assess the effects of vehicle traffic on amphibians during annual migrations.
- Minimize human disturbance of meadow and wetland areas.
- Monitor amphibian population trends to locate high priority sites for amphibian management and habitat restoration.

BIBLIOGRAPHY

Behnke, R. J. 1992. Native trout of Western North America. Amer. Fish. Soc. Monograph 6. 275 p.

Bilby, R. E. and J. W. Ward. 1989. Changes in characteristics and function of woody debris with increasing size of streams in western Washington. Trans. AFS 118:368-378.

Blaustein, A., D. B. Wake and W. P. Sousa. 1994. Amphibian declines: judging stability, persistence and susceptibility to local and global extinction. Conservation Biology 8:60-71

Bonneville Power Administration, Oregon Department of Fish and Wildlife, and USFS Mt. Hood National Forest. 1985. White River Falls Fish passage project, final technical report. 101 p.

Bury, R. B. 1988. Habitat relationships and ecological importance of amphibians and reptiles. Contribution #74 of the old growth wildlife habitat program. USFS, Olympia.

Bjornn, T. C. and D. W. Reiser. 1991. W. R. Meehan *ed.* Habitat requirements of salmonids in streams *in* Influences of forest and rangeland mangement on salmonid fishes and their habitats.

Corkran, C., C. Thoms, and M. P. Hayes. 1994. Field manual of Oregon Amphibians Parts I & II. ODFW

Corn, P. S. and R. B. Bury. 1990. Sampling methods for terrestrial amphibians and reptiles. Gen. Tech. Rep. PNW-GTR-256. USFS PNW Research Station. 34 p.

Currens, K. 1990. Summary of the genetic analysis of White River rainbow trout. Oregon Cooperative Fish Unit OSU Corvallis for ODFW.

Dore, J. and L. Wold. unpub. Mt. Hood National Forest stream survey handbook.

Hawkins, C. P. 1992. Cumulative watershed effects: An extensive analysis of responses by stream biota to watershed management. Utah State Univ. Cooperative Agreement Rep. No. PSW 88-0011CA

Hayes, M. P. 1994. The spotted frog (*Rana pretiosa*) in Western Oregon. ODFW Tech. Rep. 94-1-01.

Heyer *et al.* ed., 1994. Measuring and monitoring biological diversity: Standard methods for amphibians. Smithsonian, Washington.

Johnson, D. M., R. R. Peterson, D. R. Lycan, J. W. Sweet, M. E. Neuhaus. 1985. Atlas of Oregon Lakes. OSU Press, Corvallis, OR.

Kostow, K. *et al.* draft. Oregon Department of Fish and Wildlife 1994 Annual Report: Rainbow/redband/steelhead trout (*Oncorhynchus mykiss*).

Land, R. 1987. Extinction thresholds in demographic models of territorial populations. American Naturalist 130:624-635.

Leonard *et al.* 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle.

Lisle, T. E. and S. Hilton. 1992. Volume of fine sediment in pools:An index of sediment supply in gravel-bed streams. Water Res. Bull. Vol. 28: No. 2

Liss, W. J., G. L. Larson, E. Deimling, L. Ganio, R. Gresswell, R. Hoffman, M. Kiss, G. Lomnicky, C. D. McIntire, R. Truitt, and T. Tyler. 1995. Ecological effects of stocked trout in naturally fishless high mountain lakes, North Cascades National Park Service Complex, USA. USDI Tech. Rep. NPS/PNROSU/NRTR-95-03

Montgomery, D. R. and J. M. Buffington. 1993. Classification, predication of channel response, and assessment of channel condition. WA DNR Timber, Fish and Wildlife.

Oregon Department of Fish and Wildlife. 1992. Sensitive Vertebrates of Oregon.

Overton, K. draft. Stream database that represents natural conditions.

Raphael, M. G. 1988. Long-term trends in abundance of amphibians, reptiles, and mammals in Douglas-fir forests of Northwestern California. In: R C. Szaro, K. E. Severson, and D. R. Patton, tech. coords., Symposium for management of amphibians, reptiles and small mammals in North America. Flagstaff, AR. July 19-21, 1988.

Rosgen, D. 1994. A classification of natural rivers. Catena Vol. 22: No. 3 pp. 169-199.

USFS 1994. Record of Decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl. U.S. Government Printing Office, Washington.

USFS. 1994. Miles Creek watershed analysis. Mt. Hood National Forest, Gresham.

USFS. 1993. White River wild and scenic river management plan. Mt. Hood National Forest, Gresham.

Wall, W. R. unpub. White River Subbasin lake reports within the Mt. Hood National Forest. Mt. Hood NF.

Washington Department of Natural Resources. 1993. Timber, fish and wildlife watershed analysis guide. ver. 2.0

Wisseman, R. W. 1990 draft. Review of the candidate endangered or threatened aquatic invertebrate species listed for Mt. Hood National Forest Oregon. pp. 17.

Wydoski, R. S. and R. R. Whitney. 1979. Inland fishes of Washington. Univ. WA Press.

PERSONAL COMMUNICATIONS

Char Corkran, Herpetologist, Mt. Hood Study Group

Marc P. Hayes, Herpetologist, Portland State University

Ted Koch, Wildlife Biologist, USFS Wildlife Service, Boise, Idaho

Jim Newton, Fisheries Biologist, Oregon Department of Fish and Wildlife

Appendix A. Restoration and monitoring recommendations. Established aquatic monitoring sites are listed in Table 1. Riparian and aquatic restoration project and monitoring recommendations that are specific to functional management areas are addressed as part of the answer to appropriate issue questions. Badger Stewardship Area had done some restoration project planning prior to subbasin analysis, and for that reason, have more specific project recommendations that White River Stewardship Area. Other more generic subbasin-level monitoring and restoration recommendations are presented in Table 2.

Location	Pebble Count	Thermograph	Staff Gauge	Photo Point	Cross Section
Badger Creek	X	X	X		
Threemile Creek	X	X	X		
Clear Creek	X	X			
Barlow Creek	X				
SF Iron Creek	X				
NF Iron Creek	X				
Iron Creek	X				
NF Mineral Creek	X				
SF Mineral Creek	X				
Mineral Creek	X				
Rock Creek	X	X	X	X	X
Gate Creek	X	X		X	
SF Gate Creek	X				
Souva Creek	X				
Boulder Creek	X				
Cedar (Forest) Creek	X	X			
Deep Creek	X				
Frog Creek	X	X			
Camas Creek	X				
Swamp Creek	X				
Jordan Creek	X	X			
Tygh Creek	X	X			
Little Badger Creek	X				
Green Lake Creek	X				
Red Creek	X				
Bonney Creek	X				
Buck Creek	X				

Table 1. Established aquatic monitoring sites in White River Subbasin.

Altered Process	Watershed Monitoring	Monitoring Objective	Restoration Opportunities	Restoration Objective	Potential Benefits
Increased Peakflows	Crest stage gauges channel cross sections and particle size distribution sampling in areas sensitive to degrading or aggrading	Determine magnitude and possible effect of altered peakflow timing, frequency, and landscape level pattern	Road obliteration Silviculture to move stands to hydrologic maturity	Decrease created openings Re-create historical landscape patterns by decreasing fragmentation of terrestrial vegetation Decrease stream drainage network Stabilize peak flows Decrease erosion and increase channel stability	Less flooding Increased fish survival Opportunity for wood products
Decreased Baseflows	Baseflow measurements	Determine factors I nfluencing baseflows regime Monitor compliance with proposed baseflow requirements for the aquatic ecosystem Monitor effectiveness of water conservation projects	Road obliteration Irrigation ditch and delivery system improvements Other water conservation projects Silviculture to reduce stems per acre of small, understory trees Improve pumpchances Maintain instream flow for protection of MNHF Resources through enforcement of the Organic Act	Decrease drainage density Increase baseflows and maintain perennial flows Lower stream temperature Reduce vegetative interception and transpiration Reduce ladder fuels Interrupt budworm feeding Increase baseflows by limiting pump chances to areas with adequate baseflows and reduce sediment by armoring	More water available for beneficial uses Increased fish survival Sediment reduction Crown fire hazard reduction Reduced drought stress for terrestrial and aquatic communities
Increased Water Temperatures	Continuous stream temperature recorders	Assess compliance with State Standards Identify magnitude of increases from point sources	Silviculture to accelerate canopy closure in the Riparian Zone	Decrease stream temperatures by shading the stream Increase in-channel large woody debris and snag levels Reduce hazard of catastrophic fire	Increased fish survival and productivity
Accelerated Erosion	Channel cross section and particle size Distribution sampling on depositional reaches with high levels of fine sediment Survey to identify point sources of sediment including intermittent and ephemeral tributaries Best Management Practices implementation and effectiveness monitoring	Determine magnitude, biological effects, channel response and compliance with numeric sediment standards Identify restoration opportunities	Stabilize and vegetate point sources of sediment including developed and dispersed campsites, recreational trails, road cutslopes, fillslopes, ditches, and culvert outlets Obliterate roads Deep soil tillage Design trails and stream crossings suitable for recreational use type Erosion control Strip planting and retention of residual organic matter on agricultural lands	Reduce sediment production and delivery Provide better fish habitat Meet State Water Quality standards Stabilize channels Meet ROD Key Watershed objectives Increase baseflows and maintain perennial flows Reduce soil compaction and increase infiltration	Clean, cold water Increased fish survival and productivity Aesthetically pleasing recreation sites Increased site productivity More recreational opportunities, aesthetically pleasing viewsheds Stable channels tha will not erode fields Long term site productivity

Table 2. Aquatic monitoring and restoration recommendations for White River Subbasin.

Table 2. continued....

Altered Process	Watershed Monitoring	Monitoring Objective	Restoration Opportunities	Restoration Objective	Potential Benefits
Altered channel morphology	Mt. Hood National Forest Stream Survey Protocols	Quantification of channel condition and stability throughout the watershed	Restoration of channel geometry Streambank stabilization and removal of fords at campgrounds Riparian exclosure fences Water gaps and/or out- of- channel water developments for livestock	Create stable channel form Minimize sedimentation due to channel adjustments and bank damage Re-establish riparian vegetation to improve stream shade and aquatic habitat Lower stream temperature Wetlands protection Reduce sedimentation though reduction of streambank trampling	Clean water Increased fish survival and productivity Improved scenic quality
Low levels of In-channel Large Woody Debris	Complete and maintain MHNF survey/re-survey schedule for fish-bearing perennial and intermittent streams	Quantification of aquatic habitat condition, including large wood loading and potential throughout the watershed	Riparian silviculture Removal or modification of culverts that are large wood migration barriers	Grow large diameter trees Create standing and down woody debris Provide material for instream structure projects Allow movement of large wood in the streams	Increased fish survival and aquatic productivity Channel stability
Amphibian Viability	Conduct time constrained amphibian surveys on perennial and intermittent streams	Assess species distribution, age class structure, relative abundance, and community composition			
Aquatic Migration	Conduct seasonal surveys of barrier modification and fish screening projects	Determine effectiveness of project work to facilitate and/or prevent migration	Removal or modification of human-created barriers, and screening irrigation ditches and pump intakes	Historic distribution of native fishes and amphibians Increase survival of at-risk redband trout and Cope's giant salamander	Increased native fish and amphibian survival and productivity

APPENDIX D: SOILS REPORT

Background Information:

This report is a compilation of several soil reports based upon field examination as well as soil information from the 1979 Soil Resource Inventory (SRI) for the Mt. Hood National Forest. Our discussion of soils begins with the premise that there are five soil forming factors at work in the environment. They are *climate, topography, vegetation (biology)*, and a *parent material* over a length of *time*. To expand a bit, we need to think about wetness, dryness, how hot or cold it is, how gentle or steep the terrain is, what is growing there, what the soils have formed from (geology), and over what period of time these individual factors have been interacting. Given this starting point, we start with a broad overview of the White River watershed before focusing on key questions and concerns regarding the soils.

On average, the topography of the watershed is rather gentle, with most of the steep portions in the west and flatter terrain in the east. The vegetative patterns and types are located in another section of the analysis, and ties together closely with climate. In general, there are four parent materials in which soils are forming. The first is a mixture of loess and volcanic ash over soft, ashy rock (called pyroclastic rock) located on the east quarter of the watershed. The second is a mix of volcanic ash and soils that have formed in place over a harder lava flow rock called andesite or basalt located in the mid elevations of the watershed. Third, is a mix of volcanic ash and rocks that were ground up from the movement of glaciers that were in place prehistorically (referred to as glacial till or outwash), located at the high elevations. And fourth are very silty and sandy soils forming within the White River mainstem subwatershed that have come down from the flanks of Mt. Hood. Most of the ash and loess deposits, glacial activity, and underlying rock deposits are just a few million years old, with most of the major soil forming events being within the last 20,000 years.

Key Questions:

Should the standard methods for stand management change where compaction is an identified problem?

Because compaction has been identified as a problem, we have started to make gradual changes in the way we operate. For example, we're using some different types of logging equipment, long term slash disposal contracts (with one contractor to assure quality on the Barlow District), less dozer piling of logging residue, and more intensive mitigation measures such as mapping new and existing skid roads so they can be tracked over time and used again.

Do we have soils at very high risk of compaction from past and potential use of mechanized equipment?

Yes, most soils in the mid and low elevations of the watershed can be compacted rather easily due to a moderate texture, somewhat low in organic matter, weak structure, and easily accesible terrain. Higher elevation soils formed from glacial material tend to have a higher rock content, which actually reduces the compaction risk.

Can we restore compacted areas without further degrading the riparian and aquatic ecosystems?

Yes, in most cases. We have experience with successful projects that do just that, such as road decommissioning in the Little Badger subwatershed in 1993. Although there may be a risk of some sedimentation following such a project, the long term positive effects outweigh the negative.

Have high levels of recreation use created detrimental impacts to soil, water, vegetation, wildlife, and fish?

In general, **yes**. Although the term 'high levels' may be somewhat misleading compared to campgrounds at Timothy Lake for example. All of our developed campgrounds are located within riparian reserves, and most have at least a few sites directly on the stream banks. The result has been the chronic loss of riparian forbs and shrubs, as well as low numbers of tree and shrub seedlings, which over the long term will result in lack of replacement vegetation for those individuals that die. Not only is this detrimental to the riparian zone, but the overall camping experience will be reduced due to the lack of shade. Except for some localized damage from OHV use and dispersed camping that we know of, we don't really have a good assessment of the overall impacts.

Is compaction a significant problem in LSR's, riparian reserves, or matrix lands?

To answer this question we have used our Geographic Information System (GIS) to identify the method that land has been logged within the watershed. Each harvest unit was placed in a category of cable logged, tractor logged with no fuel treatment or underburned, tractor logged with no record of what fuel treatment was done, and tractor logged with machine piling of logging residue (slash). GIS can now produce a map of the watershed that shows each category in a different color and we can overlay this map with a map that shows how resilient the soils are to compaction, calculate the acres in each category and produce the results in Tables 1 and 2.

The matrix shows a total of 5632 acres of compaction within the White River watershed. Broken down by subwatershed from the most impacted to the least - Rock-Threemile, Clear, Gate, White River, Boulder, Jordan, Badger-Tygh, McCubbins, and Barlow. The same ranking could be done in terms of road density, since most roads were constructed in association with harvest units. Therefore, it follows that a ranking of watersheds for restoration projects that reduce the effects of compaction and road density would be similar also.

The effects of compaction include reduced productivity, increased overland flow and potential sedimentation if the erosion is in proximity to a stream, increased peak streamflow and bank erosion, lower summer flow, and higher root rot potential. We can state with confidence that we are not within the range of natural condition for compaction, since it was likely minimal and very localized prior to the 1865 benchmark for this analysis. In summary to answer the question, compaction is a significant problem in localized areas where it is probably interacting with other detrimental impacts such as loss of large woody debris, hot slash fires, or altered soil biological activity to cause reforestation and revegetation failures.

How We Calculated Compaction.

The percentage coefficients for tractor only, tractor with unknown fuel treatment, and tractor and machine pile come from actual on the gound monitoring of harvest units from the past 15 years or so. The percentage coefficients are 26% (with a range of 12%-46%) for tractor and machine pile, and 18% (with a range of 6%-39%) for tractor logged only. Skyline or cable logged units were not caculated based on the small compaction percents they represent. Given the acreage produced from GIS, multiplied by the percent of each unit compacted gives us an approximate estimation of how much compaction exists in the watershed. The estimated acreage does not include system roads, camping areas, remnant compaction from old grazing, and the possibility that some of the tractor units with unknown fuel treatment may have been machine piled. We could then assume that the estimate is likely to be lower than the actual.

The model assumes that compaction hazard is the same everywhere, soils are not recovered from past compaction, no rehabilitative measures have been performed (such as subsoiling to reduce compaction), the harvest unit acreage is accurate, compaction monitoring is accurate and uniform across each type of harvest unit, and multiple entry areas have not been specifically identified. We also have several old harvest units that were identified on aerial photos, but we could not find any records on how they were harvested and what the fuels treatments were (if any).

Table 1. Potential acres detrimentally compacted using low coefficient for Tractor/No Data category.

Allocation	Logging/Fuels Treatment	Potentially Compacted Acres: Low Resiliency	Potentially Compacted Acres: Medium Resiliency	Compaction Coefficient	Acres Compacted
LSR	Tractor/Machine Pile	123	1,011	0.26	294.84
	Tractor	58	515	0.18	103.14
	Tractor/No Data	80	271	0.18	63.18
Other	Tractor/Machine Pile	3,679	8,965	0.26	3,287.44
	Tractor	829	4,453	0.18	950.76
	Tractor/No Data	22	5,164	0.18	933.48
				Total	5,632.84

Table 2. Potential acres detrimentally compacted using high coefficient for Tractor/No Data category.

Allocation	Logging/Fuels Treatment	Potentially Compacted Acres: Low Resiliency	Potentially Compacted Acres: Medium Resiliency	Compaction Coefficient	Acres Compacted
LSR	Tractor/Machine Pile	123	1,011	0.26	294.84
	Tractor	58	515	0.18	103.14
	Tractor/No Data	80	271	0.26	91.26
Other	Tractor/Machine Pile	3,679	8,965	0.26	3,287.44
	Tractor	829	4,453	0.18	950.76
	Tractor/No Data	22	5,164	0.26	1,348.36
				Total	6,075.8

18 May, 1995 Final

E

To: Louisa Evers
From: Caitlin Cray and Lance Holmberg

APPENDIX E

Botanical Input for White River Watershed Analysis

This report includes information on habitat, population status, and management guidelines for rare plants, noxious weeds, certain survey and manage species (mosses, liverworts, lichens, fungi, vascular plants), riparian species, and species with social and/or economic value which occur in White River Watershed. The report follows the outline of questions set forth in the terrestrial module for watershed analysis.

I How do conditions in the watershed affect viability of species that occur within it?

A Species for which broad-scale strategy was determined adequate, but which need further analysis to asses potential changes to Riparian Reserves (Appendix 2), LSR's, or matrix.

1 What is the historic and current distribution of the sp. and its habitat in the watershed? (from Appendix 2)

None of the fungi, lichen, or bryophyte species listed in Appendix 2 are known to occur in White River watershed. Surveys for these species should be conducted for project level analysis prior to altering riparian buffer widths.

VASCULAR PLANTS

Adiantum pedatum: Believed to be present but not documented in survey and collection records. If present then restricted to very moist and buffered seeps and riparian areas. The sp. has not been inventoried so no current or historic distribution information available for this watershed. Interaction with other populations would be by spore distribution into and out of the area. Prevailing winds are westerly. This watershed would likely have little effect on the overall maintanence of the species. Riparian reserves, wilderness, congressionaly withdrawn lands for the White River Wild and Scenic area and key site riparian areas will provide for full protection and maximum distribution in the watershed.

Asarum caudatum: Current and historic distribution is along the more moist and humid streams and seeps especially along Barlow Creek and the White River below highway 35 and the Barlow Road crossing. Populations are small and scatterd as this area is just barely suitable in only a few locations and likely is little changed from historic levels. Past conditions of the species and its habitat are probably similar to current conditions except for some logging activity around wet areas between White River and Barlow Butte below highway 35. The area appears to be recovering.

The sp. is wide spread in low to mid elevations on the westside of the Cascades and Coast Range. Wild ginger is common and probably stable over its range. The populations in this watershed are probably isolated from surrounding watersheds.

The populations in the White River watershed are protected by both Riparian Reserves and Congressionaly withdrawn lands. There do not appear to be any immediate threats. Shaded moist sites with a deep duff will maintain the species and restoration of canopy in harvest areas will allow the plant to recover where it was reduced by timber harvest. Timber harvest and road construction that reduce shade and humidity would reduce habitat and the population.

Habenaria saccata & Lysichiton americanum: Slender bog-orchid and skunk cabbage are common in seeps, bogs and other areas with saturated soils. The populations are likely stable throughout the range and while spotty in distribution are likely not entirely isolated geneticaly. Birds and perhaps larger mammals probably transport occasional seed from one wet site to another. The riparian reserves will protect the habitat, however even in distrubed areas these species will persist if the site stays wet.

Mitella breweri, M. caulescens, M. pentandra, Tiarella unifoliata, Viola glabella, Streptoptus amplexifolius, S. roseus: All of these species are relatively common in moist woods and wetter areas near streams. All have been documented in the White River area but are more typical of west side plant communities where they are widespread. They are present in some timber harvest areas but are not threatened and are likely stable through out their entire range. Where reduced or eliminated by harvest they will likely recover on their own as the the canopy closes and understory conditions return to preharvest conditions. They are probably present in wilderness, riparian reserves, late succesional reserves and congressionally withdrawn wild and scenic river lands which will contribute to a well-distributed and protected population within the watershed.

Menziesia ferruginea: Fool's huckleberry is relatively common at higher elevations in moist woods and stream banks. It is not rare or endangered. It is likely stable throughout its range and is not isolated in this watershed. The historic population and distribution is probably similar to the present and will likely return to most disturbed areas as the forest regains its preharvest character. LSR's, riprian reserves,the White River Wild and Scenic area and wilderness areas all will contribute to a well distributed population throughout the watershed.

Taxus brevifolius: Western yew is common along many streams within White River watershed (ie Forest Creek, Gate Creek, Cedar Creek). Many wild ungulates feed on western yew (outplanted seedlings should be protected from browsers). Fibrous root system can stabilize stream banks. A variety of age classes is present in most populations, and populations are well connected by stream corridors so the populations appear stable. Since taxol, the anti-cancer drug derived from bark and leaves of yew, can now be synthesized from scratch in a laboratory, this species is no longer harvested commercially.

Vaccinium membranaceum: Big or thinleaf huckleberry is common at elevations generally above 3,000 ft. in this watershed. This is typically an upland species that is probably well connected to adjoining populations through continuity of habitat, pollination by insects and normal seed distribution. It recovers well and often increases as a result of disturbance. Heavy shade will inhibit the bushes but they usually remain present in old-growth situations at reduced levels. The species is widely distributed throughout the northwest and east to Montana. The elimination of large scale wildfire and the resulting forest encroachment upon large fire-maintained huckleberry fields has reduced the number of acres of high density populations but has not reduced the range of the species. All land allocations will contribute to maintaning a well distributed population. Extremly hot burns and frost pockets resulting from clear cuts will likely diminish its density in some small areas but this species would be hard to eradicate. Restoration is rarely a concern. The seeds are readily distributed by wide ranging animals such as bears and coyotes. Except in frost pockets if the plant was present it probably still is and will usually increase as a result of disturbance.

B Species for which finer scale attention was deemed necessary in the EIS

1 What locally rare and endemic species from Table C-3 of Attachment A to the ROD are located in the watershed; where are they ; and what are appropriate steps for managment of their sites?

Survey and Manage Species from Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (USDA, USDI, 1994).

The following list includes species that have been documented or seen in White River Watershed. Survey and manage (S&M) species which are included on our Regional Forester's Sensitive Species list, or on Oregon Natural Heritage Program's (ONHP) Species of Concern list are discussed in subsequent sections of this report.

Latin name	Survey Strategy*
FUNGI	
Albatrellus ellisii	3
Boletus piperatus	3
Cortinarius wiebeae	1,3
Gastroboletus subalpinus	1,3
Gastroboletus turbinatus	3
Rhizopogon brunneiniger	1,3
Thaxterogaster pinque	3

BRYOPHYTES

Antitrichia curtipendula 4

VASCULAR PLANTS

Allotropa virgata 1,2

* Survey Strategy: 1= Manage known sites: Maintain regionally consistent GIS database of known sites, adopt site specific measures to preserve the population. For rare and endemic fungi 160 acre management areas may be temporarily withdrawn from ground disturbing activity until site specific management plansi are developed.

2= Survey prior to ground-disturbing activities: Survey protocols and management standards are currently being developed by the Regional Ecosystem Office (REO) and will be implemented as soon as possible.

3= Conduct extensive surveys: Locate high-priority sites for species management by conducting sytematic surveys over wide areas (modeled after sampling strategy used by ecologists to determine plant associations). No need to do site specific survey prior to ground disturbing activity. REO is developing survey protocol and plan; surveys will begin in 1996.

4= General regional surveys: Objective is to acquire better understanding of these species (habitat, range, distribution, abundance, etc) and determine necessary levels of protection. REO is developing survey plan which will be implemented in 1996 and completed within 10 years.

Albatrellus ellisii (strategy 3): Uncommon ecto-polypore. Mycorrhizal, edible, rarely collected commercially. Populations very scattered but may appear common due to heavy fruiting of single populations. Associated with old growth forests. Chiefly coastal but occurs in PNW, no Cal, Rocky Mtns, northeast US. We have inadequate knowledge of its life history and ecology. Primary concern is for populations in coastal forests (where much of it's historic habitat has been altered).

Survey for this species during general regional inventory of fungi to determine range, abundance, habitat requirements, etc. If in found within a project area, situate green tree retention areas around populations, and leave existing coarse woody debris in place within these retention areas.

Boletus piperatus (strategy 3): Low to mid elevation bolete. mycorrhizal, requires large, well- decayed (classes 3,4,5) coarse woody debris. Populations may be isolated from one another (few opportunites for outcrossing). Much historically suitable habitat for this species has been altered. Occurs throughout the range of the northern spoted owl, primarily in coastal forests.

Identify areas where low elevation old-growth forest are limited and manage to allow adjacent stands to develop into late successional forests. For populations in matrix land allocation, minimize disturbance to the site, situate green tree retention areas over the population and leave existing coarse woody debris (especially class 3,4,or 5 logs) in place around the population.

Cortinarius wiebeae (Strategies 1 and 3): rare gilled mushroom. ectomycorrhizal, occurs in montane late-successional forests with true firs and other conifers. Fruiting body produced at or below ground level. Fruits during late spring and early summer. May be dispersed by animals.

C. weibeii known only from Camas Corral, Bear Springs RD, Mt Hood National Forest (Appendix J2, p 172; type locality). We have inadequate knowledge of its ecology, life history, range or abundance.

Maintain late successional forest around known site. Establish Mycological Special Interest Area to protect type locality (the only known population). Survey suitable habitat in the vicinity to locate additional populations. Investigate relationship between mycophagous animals and this species.

Gastroboletus subalpinus (strategies 1 and 3): Endemic to Oregon Cascades and northern Sierras, probably ectomycorrhizal with lodgepole pine and whitebark pine, possibly with other conifers in the pine family. Found above 4,500 ft elevation. Type locality, and northernmost record, is at Cloud Cap, Mt Hood NF. Eight (8) sites known, and, while the species may be locally abundant at these sites, populations are widely scattered and often in areas with heavy recreational use.

Survey to delineate boundaries of known populations and examine suitable habitat to locate new sites. Monitor populations for recreation impacts, and develop management guidelines for the species.

Gastroboletus turbinatus and **Thaxterogaster pinque** (strategy 3): Ectomycorrhizal fungi found in mature to oldgrowth forests and associated with a variety of conifers. Found in areas with thick humus and abundant coarse woody debris. Both species found in the Cascades and northern Sierras as well as other mountainous regions in the United States.

Most known sites already protected by existing land allocations (wilderness area, special interest areas, etc).

Rhizopogon brunneiniger (Strategy 1 and 3): Rare false truffle which grows in a variety of forests and elevations. Known sites range from northern Oregon Cascades south through coast, Siskyou, and Klamath Mountains. Only 5 populations known; type locality is at Devil's Half Acre Campground, Mt Hood National Forest. Most known sites are in matrix land allocation.

Inventory type locality at Barlow Campground to delineate boundary of population and determine habitat. Establish Mycological Special Interest Area around type locality to protect population and adopt managment guidelines to ensure that known populations persist. Survey suitable habitat to find additional locations

Antitrichia curtipendula (strategy 4): This is a strategy 4 sp. for CA only.

Allotropa virgata :(strategy 1 and 2): ALVA is a non-green flowering plan in the heath/rhododendron family that necessary nutrients from mycorrhizal fungi commonly associated with conifers. It appears to be parasitic on the fungus but the relationship may be more complex, such that all three partners benefit. Based on reports from ecoplots, ALVA is found in stands asyoung as 30 years but mostly over 100 years.

ALVA occurences on the Mt. Hood N.F. from ecology plots were from western hemlock & Pacific silver fir zones. A brief investigation turned up one report, from memeory, at the end of the 4812-141 road.

Important habitat elements are believed to be:

1) Well drained acidic soil.
2) logs in decay class 4&5
3) tree hosts necessary the mycorrhizal fungal associates, such as Douglas-fir, grand fir, Pacific silver fir, western hemlock, lodgepoe pine.
4) interior forest conditions including microclimate, shade, etc.
5) duff layers
6) fire history is evident at several sites

Managment activities that could affect habitat elements and functions would be clear cutting, intensive thinning or other action that would remove the mycorrhizal host trees or reduce interior forest conditions. Fire surppression may contribute to long term loss of populations as underburns reduced competition or, in more intense fires, resulted in more large logs that decay to class 4&5. ALVA flower stalks (plants may be present and not flower) do not appear in openings and edges.

The extent of interaction with populations in other watersheds is unkown. The seeds are very small and are wind distributed however their extreme small size means they are vulnerable to dessication.

Appendix J2/FEIS 1994 states that "Fire suppresion, fragmentation of habitat and reduction in coarse woody debris are primary factors contributing to the decline of the species." This may hold true for large areas in this watershed.

C Species which were outside the scope of the EIS and which are deemed to be at risk.

1 What spp. comprise this category and what is the basis for concluding that viability of the species is at risk?
2 What are the activities or trends in the population that place the species at risk?
3 What is the role of the watershed in the maintenance ot the population?

The following species of concern are known or suspected to occur in the White River Watershed. Sensitive plant species who's range does not extend into White River Watershed, or for which nc suitable habitat exists within the watershed have been excluded. Relatively common species whose range and abundance has been reduced from historic levels (eg. idaho fescue (Festuca idahoensis), bluebunch wheatgrass (Agropyron spicatum)) are discussed at the end of this section.

Table of vascular plant species known or suspected to occur in the White River watershed that have been identified as species of concern.

	MTH 94	FWS 93	ODA 93	ONHDB
Agoseris elata (susp)	sens.			
Allium campanulatum	inv.			4
Allium douglasii var. nevii	inv.			4
Allium macrum	inv.			4
Arabis furcata	inv.			4
Arabis sparsiflora v. atro.	sens.			2
Astragalus howellii	sens.		C	1
Astragalus tyghensis		C2	C	1
Botrychium minganense	sens.			2
Botrychium montanum	sens.			2
Calamagrostis brewerii	sens.			2
Chaenactis nevii (susp)				4
Claytonia umbellata	inv.			4
Collomia larsenii (susp)				4
Coptis trifolia	sens.			2
Cypripedium montanum	inv.			4
Delphinium nuttallii	inv.			3
Hackellia diffusa v. cottoni	inv.			4
Huperzia occidentalis	sens.			2
Lewisia columbiana v. var. columbiana (susp)	sens.			2
Linanthus bakeri	inv.			3
Lomatium watsonii (susp)	sens.			2
Lycopodium annotinum	inv.			4
Scribneria bolanderi	sens.			2
Vaccinium oxycocus	inv.			4
Utricularia minor (susp)	sens.			

MTH 94 Is an update of Region 6 list and the Oregon Natural Heritage Data Base list. Sens. is sensitive on the R6 list, inv. is of local concern.
FWS C2: Federal candidate list from Feb. 21, 1990 Federal Register, vol. 55, no.35
ODA C: Oregon Department of Agriculture candidate species list dated March, 1991.
ONHDB: Oregon Heritage Data Base, August, 1993.

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. May be common elsewhere.
3 Species for which more information is neede before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.
4 Taxa which are of concern, but are not currently threatened or endangered. This includes taxa which are declining in numbers or habitat but are sill too common to be proposed as threatened or endangered.

Agoseris elata: **Not documented in White River Watershed but suitable habitat present.** Perennial plant in the Asteraceae (sunflower family) which produces a single, dandelion-like inflorescence atop a naked stem, with a large rosette of basal leaves. It occurs in vernally moist to wet montane meadows from Washington to California. It is considered sensitive in both Washington and Oregon (Oregon Natural Heritage Program, 1993, Washington Natural Heritage Program, 1994).

Maintain current watertable levels (ie do not excavate new watersources or clearcut timber within 1/4 mile of meadow), control or eradicate noxious weed populations in the vicinity of wet meadows. Survey suitable habitat to determine population size and distribution.

Allium campanulatum: At edge of distribution locally rare, found on Barlow Butte, habitat is not likely to be affected by any activity, isolated, more common elsewhere, found on dry soils at med. to high elevations in mts. Distribution in watershed is likely unchanged and stable. No managment actions needed at this time.

Allium douglasii var. nevii: Found at Hunter Prairie off forest on BLM and Oregon state land, likely on private land, not likely to be adversly effected on government land by activities but may be reduced by grazing and agriculture on private land. This is its' southern limit, found north along the east Cascades and more common elsewhere, population interactions unknown. It is found in shallow rocky soils that are wet in spring but very dry through summer and fall. Likely genetically isolated. Not known to be at risk, no managment actions needed at this time.

Allium macrum: Found on and adjacent to the small eastern triangle on Forest Service land, private land and likely on the Warm Springs reservation. Widely scattered but local over s.c. WA and n.c. OR. This population is likely genetically isolated. Distribution is probably unchanged but change in abundance not known. The local habitat appears to be little altered. No managment activity occuring in area except power lines. Habitat is very dry & rocky with little soil. This population not at risk and no managment action is needed.

Arabis furcata: Locally uncommon on high ridges but wide spread and more common elsewhere. Local population is all on Forest Service land. Distribution and abundance likely little changed from historic levels and currently little affected by human activities. Likely genetically isolated. Not known to be at risk, no managment activity needed.

Arabis sparsiflora v. atrorubens: Tall (3-12 decimeters) perennial plant in the Brassicaceae (mustard family) which produces several small, deep purple flowers in late April to early May. It grows in open, rocky areas within Ponderosa pine (Pinus ponderosa) and white oak (Quercus garryana) woodlands along the eastern edge of Mt Hood National Forest. Locally rare but more common northward,

One known population within White River Watershed; 4 populations in adjacent watershed (Miles Creek). Population in the watershed (south of Little Badger

Campground) should be resurveyed in May to see if population is stable. 15 plants recorded in this population in August, 1989.

Possible threats to the population include habitat loss (due to logging or road construction), loss of individual plants (due to grazing or ersosion of loose soil at the site), and increased competition for water and nutrients from introduced plant species (ie diffuse knapweed (Centaurea diffusa), cheatgrass (Bromus tectorum) or native species that have increased due to fire exclusion (ie grand fir (Abies grandis) and ponderosa pine seedlings).

Populations should be excluded from timber sale areas and road construction routes. Noxious weed infestations adjacent to known populations should be controlled. Suitable habitat throughout the watershed should be surveyed to determine range and size of sicklepod rockcress populations. District should consider conducting a controlled burn across a portion of one of the populations to examine effects of fire on this species. Number of individuals, cover and composition of associated species must be monitored before and several years after an underburn. Burned and unburned portions of the poulation must be monitored according to the same protocol.

Astragalus howellii: Perennial legume known from Sherman and Wasco counties, Oregon. Several populations occur in the watershed, primarily in open, grassy pine/oak woodlands above Little Badger Creek. Four populations occur on Forest Service land; more than 2000 individual plants exist in the area.

Much of the meta-population lies within Badger Grazing Allotment but no studies have been conducted to determine effects of livestock grazing on this species. Populations have not been monitored systematically to determine if the milkvetch population is increasing, decreasing, or remaining stable but large number of individuals on Forest Servuce and BLM lands which have been grazed for many years suggests that the population is stable. Plant grows in and along native surface and gravel roads so it can tolerate some disturbance and compaction. Plant appears to be palatable - tops of plants (including seed pods and flowers) often browsed by animals (rabbits, deer, cows, judging from feces in the area).

Species should be included in monitoring strategy designed to investigate the effects of grazing and ground fire on understory vegetation in local pine/oak plant communities.

Astragalus tyghensis:(from the "Status Report for Astragalus tyghensis" March 1992; by Thomas Kaye and Keli Kuykendall, Oregon Department of Agriculture, Natural Resources Division, Plant Conservation Program and phone conversation with Ron Halverson, botanist for the BLM Prineville District). This is a rare plant that is very localized. The plant population has been reduced from historic levels however the range is likely about the same. The report stated that "Plowing and agriculture represent the most immediate threats to Astragalus tyghensis populations followed by grazing, quarrying, and road building." In a recent phone conversation Ron Halverson mentioned invasion and competition by non-native annuals, such as cheat grass and annual rye, off-highway vehicles and grazing by cattle and deer. Personal observation is that the wide road right-of-way on highways 216 and 197 may actualy be providing a refuge area for the species. Astragalus tyghensis is a narrow endemic of table lands and canyon walls near the confluence of the White River and the Deschutes River. A new population was found on the east side of the Deschutes river near Maupin in the Criterion area on private land that will likely be acquired by the BLM. The sp. is found in 3 basic habitat types. The majority of the population is found in mounded prairie (biscut scabland or mima type topography) growing on the tops and slopes of the mounds. Other habitats are bunchgrass slopes below rimrock and loosely wooded canyon wall to rim rock. Oregon State is conducting surveys for BLM that vary from one to two year intervals tracking the known populations, especially on Federal and state land. Most sites are doing well and need no protection. Sites that have been reduced by grazing are slated for fencing. A site on state land near White River Falls was fenced about 3 years ago and has rebounded from near certain extirpation. R. Halverson's report is that the species is not in danger at this time. Current managment actions appear to be adequate.

Botrychium minaganense & B. montanum These species are similar and can be lumped together for this analysis. Both spp. have been documented on Red Creek, Buck Creek and Little Badger Creek. B. montanum was also found along the Barlow Rd. near the White River. B. lunaria has been reported in the Badger wilderness but all previous reports of this species have proven to be either B. montanum or B. minganense. Population levels range from 7 to 817 individuals at a site. No information is available on historic population levels. The plants are small and hard to detect, readily eaten by mice, and typically are found only in July-Sept. They are long lived but may not come up in some years. The plants may be present in some sites where prior surveys did not find any Botrychiums. All sites in this watershed are in seeps with deep shade under western red cedar along minor drainages. There are a large number of sites in the watershed that appear to be suitable but very few populations of these Botrychiums have been found. Some habitat has been lost through timber harvest, and road and trail construction. There are no records to document population trend in the watershed. Restoration of the cedar dominated habitat might allow a remnant population to recover or provide habitat for successful recolonisation if spores were to germinate on the site. These species may have unknown cultural requirements. Botrychium montanum is frequent in British Columbia, Washington, Montana, Washington and Oregon according to A Field Manual of the Ferns & Fern-Allies of the United States and Canada, David Lellinger but rare according to David Wagner in a Guide to the Species of Botrychium in Oregon. The Oregon distribution is Cascades south to Linn County also Grant and Wallowa counties. B. minganense is rare, found across nothern North America according to D. Lellinger while Wagner says it is widespread but in small populations. The Oregon populations are the northern Oregon Cascades, Wallowa, Blue and Ochoco mountains. Population trends are not known and most populations are isolated from each other.

Chaenactis nevii, and Collomia larsenii: Known populations are currently secure (in Badger Wilderness Area on high elevation, rocky, inaccessible ridges). No management action or mitigation needed.

Claytonia umbellata: This species is at its very northernmost distribution ranging south and east to the Steens and northeastern California. Distribution and abundance likely stable and little changed from historic levels as the plant inhabits dry rocky talus areas little affected by human activity. The plant just barely crosses into the watershed in the small east triangle and is likely found on the adjoining reservation land. There is no managment plan and none seems necessary at present.

Coptis trifolia was recently discovered in White River watershed. There are no historic records. The population is along Clear Creek on the Warm Springs Indian Reservation near the forest boundary. Two other populations are nearby, one in Little Crater Meadow in the Clackamas River watershed and the other in Jackpot Meadow in the Salmon River watershed. These are the only known sites in Oregon. The species is common from Vancouver Island north. All our populations are small and essentially isolated. Cattle grazing could pose a threat to this species from trampling, however grazing is now much reduced from historic levels. Only a small portion of apparently suitable habitat is occupied. We do not know if the populations have been reduced by managment activity. The plant is likely stable over its entire range. The Little Crater population is in Key site riparian and the Jackpot Meadow population is in riparian reserve. Our populations are found along the edge of wet meadows in partial shade of brush and trees. While there are no known Coptis trifolia populations on Forest Service land in the White River watershed, maintaining the riparian reserves should protect any undiscovered populations. Grazing does not seem to be affecting the plant at present however the plants are likely vulnerable to trampling.

Cypripedium montanum: A C-3 species for the westside Cascades but not eastside where it is more common. Found from Alaska south to San Francisco Bay area and east to s.w. Alberta, Wyoming and Montana. Distribution and abundance were likely reduced as a result of logging and collection. Managment activities are controlable but illegal collection is more difficult to prevent. Habitat is dry to fairly moist, open to shrub or forest covered valleys or mt. sides. Reduction in fire frequency may have reduced the amount of suitable habitat and increased fire intensity that would kill the rhizomes. Several sites have been found on the south side of the White River near the eastern edge of the National Forest and it is likely present on adjacent land to the east. The populations may not be interacting with others. Large scale conservation strategy not known for eastside. The species does not appear to be at risk in this watershed. Surveys to locate unkown populations, protection from ground distubance and maintanence of moderately open canopy & reduction of fuel load will reduce risk and may help expand distribution.

Delphinium nuttallii: A more nothern sp. that is uncommon in this area, ranging from Pierce & e. Grays Harbor Co. WA south to Col. Gorge and Clack. Co. Historic disribution and abundance not known. It was found on Barlow Butte associated with basalt talus and is unikely to be affected by human activity. General habitat is gravel outwash prairies and basalt cliffs. Unlikely to interact with adjacent populations. No conservation strategy in place and not likely needed at present.

Hackellia diffusa v. cottoni: Found along White River on Bear Springs side near east boundary. Secure from human disturbance. Need more info.

Huperzia occidentalis: Was Lycopodium selago. Circumboreal distribution that reaches south to the Mt. Hood area, always in moist situations. Very uncommon on the eastside of the Cascades in Oregon apparently only in the White River and Clear Creek drainages. Much more common on the west side. Historic population and distribution not known but probably not greatly reduced and will likely increase if wet habitat protected. Our populations are small stray islands, of little overall significance but unique here. They are unlikely to interact with populations in adjacent watersheds but the light wind born spores from western populations will be carried here by prevailing winds. There is no large scale conservation strategy and likely non needed if riparian reserves are in effect.

Lewisia columbiana var. columbiana: **Not documented in White River Watershed but suitable habitat present.** Succulent perennial which grows on exposed gravel banks and rocky slopes. Found in Oregon, Washington, Idaho and other states, the species occurs along the west side and crest of the Cascade mountains. A tentative siting has been recorded above Badger Lake.

Habitat for this species is rough and not readily accessible; management activities not likely to impact populations. Survey suitable habitat above Badger Lake and Gumjuwac Saddle area in June or July to confirm siting and locate additional populations, if any.

Linanthus bakeri: Uncommon here but common south to Sierra Nevada and north coast ranges of CA. Historic data not available but species is likely not greatly reduced. Found at Hunter Prairie and likely throughout Juniper Flat in biscut scab land which is mostly private with some BLM and OR state holdings. Habitat is lower elevation in dry open places. No large scale conservation strategy in place and no managment actions needed at this time.

Lomatium watsonii: **Not documented in White River Watershed but suitable habitat present.** Low, yellow-flowered lomatium found on open hillsides from south central Washington to north central Oregon. It occurs in Columbia River Gorge and suitable habitat (rocky, open hillsides, often with sage brush) exists in White River watershed. Given it's habitat requirements, this species is not likely to be impacted by managment activities. Suitable habitat for this species should be surveyed in April or May.

Lycopodium annotinum: Comments for Huperzia occidentalis apply here except that L. annotinum is more common on both sides of the Cascades. Surveys found enough populations that this species will likely be dropped from future concern lists.

Scribneria bolanderi: Uncommon, WA, OR & CA. Historic distribution and abundance not known. The plant is a small (10 -20 cm), slender annual in the Poaceae (grass family) which grows in vernally moist swales, scabland, and other poorly drained sites. Known populations exist in Wasco, Lake, and Joshephine counties, OR (Oregon Natural Heritage Program, 1993) and it is reported from "dry, disturbed areas" in southern California (Hickman, 1993).

Found on the lower east part of Barlow district associated with vernal pools in shallow rocky soils, also in the Hunter Prairie area and likely throughout Juniper Flat and Smock Prairie. Present on an abandoned and ripped skid road. May be reduced by early grazing. May interact weakly with populations on other watersheds through seed adhering to birds' feet and being transported to other vernal pools. No large scale conservation strategy in place and no managment action needed at this time.

Vaccinium oxycocus: Found across Canada s. to OR and ID, Eurasia, usually in sphagnum bogs. Uncommon here because habitat is not common but abundant iin suitable sites. It is growing at Camas Prairie in this watershed and likely does not interact with other populations except through possible movement of seed by birds. Protected by key site riparian, not at risk, no large scale conservation strategy in place and none needed at this time.

Native bunchgrasses (including bluebunch wheatgrass (Agropyron spicatum), and Idaho fescue (Festuca idahoensis) and native perennial forbs associated with biscuit scabland and grasslands: The above mentioned species are widespread and common in eastern Washington and Oregon, and the Great Basin. These species are major components of many arid grassland and shrub-steppe plant communites and are often used to define particluar plant associations. However, a large percent of areas in the west that were historically dominated by native bunchgrasses have been converted to agricultural use, invaded (and on many acres, dominated) by nonnative plants, and/or altered by livestock grazing.

Biscuit scablands and grasslands within White River watershed have experienced all of these activities and the distribution and abundance of native plants in these habitats has been reduced from historic levels. While the watershed harbors several meadows dominated by native grasses and forbs (ie, meadows south of Highland Ditch; open, oak woodlands north of Little Badger Creek), no open, grassy areas are free of introduced weeds (ie bulbous bluegrass (Poa bulbosa), cheatgrass (Bromus tectorum), orchard grass (Dactylis glomerata), knapweed species (Centaurea spp.)). These habitats are typically flat or gently sloped, with few trees, so they lend themselves to farming, offroad vehicle use, and grazing.

Permanent monitoring plots should be established in a variety of grassland plant communities, to see if individual species are increasing, decreasing, or remaining stable in distribution and abundance. Plots should be situated in grazed and ungrazed areas to investigate effect(s) of grazing on these plant communities. Vegetation monitoring plots should also be established within and adjacent to prescribed underburns.

Several patches of our most weed-free grasslands dominated by native species could be protected from grazing, soil disturbance, and further weed encroachment. These patches would preserve examples of these plant communities, serve as "control" communities to compare with other management areas, and provide base from which to collect seeds needed to restore degraded areas.

All of the species listed in this section are associated with unique habitat types including wetlands, cedar swamps, riparian zones, rock outcrops, vernally moist sacblands, and both wet and dry meadows. Sensitive plant surveys should be conducted in these habitats prior to implementing any projects that could effect the local hydrology or plant community (i.e. digging, road construction, grazing, burning). In general, these areas should be managed in order to maintain natural native plant community, avoid soil erosion or alteration in the watertable, and control or prevent noxious weed infestation. Prescribed fire used in these habitats should emulate conditions under which resident native plants evolved. Late summer or fall burning is best from the perspective of a northwest native plant. While weather and fuel conditions may be easier to work with in the spring, most plants are just begining to put out new growth and reproductive structures at that time. If leaf and flower buds are incinerated, the plant may not be able to resprout or set seed later in the season.

II. What are conditions of terrestrial ecosystems; how do these conditions influence ecological diversity and maintenance of ecological processes (ie nutrient cycling, succession, etc).

1. **Riparian Reserve Habitat**
Many ditches shunting water from creeks; ex. Highland Ditch, Clear Creek Ditch, Boulder Ditch, etc)

Old skid trails bisect many intermittent streams (ex. w/in 4830 sale area, within Haze timber sale). Water comes to the surface in these areas and pools up.

Can be difficult to define intermittant streams which flow over flat or gently sloped terrain in dry pine/oak or grand fir stands. Channels in these areas may be poorly defined (little downcutting or scour; wetland indicator plants often absent).

Riparian Veg: band may be narrow (see mid section of Gate Creek), absent (see Rock Creek w/in Rocky Burn or intermittant tribs to Hazel Creek), or wide (see Gate Creek at intersection with Barlow Road). Vegetation along many miles of small permanent and intermittant streams dominated by conifers. Lack of regen in dense grandfir dominated riparian areas. Lots of oak and upland bunchgrass within 100 ft of streams at southeast portion of Barlow RD. Awaiting riparian plant association guide (in preparation by Area Ecologist, Nancy Diaz) - ?available in 1995?

3. **Do we want to modify and standards and guides for Matrix lands? If so, why, and what are these lands like?**

Are there populations of introduced plant and/or animal species in the watershed? Do they have an influence on ecosystem functions?

Noxious Weeds

Noxious weeds compete with native vegetation and can displace desirable plants, thereby diminishing the quality and quantity of wildlife forage, altering the structure and composition of plant communities (as when a taprooted thistle replaces a fibrous rooted bunchgrass, or when scoth broom fills in a meadow formerly occupied by grasses and forbs), and reducing biological diversity (as when houndstongue or knapweed invades and dominates an open area formerly covered with native grasses, forbs, or shrubs). Symbiotic relationships between local plants, fungi, bacteria, insects, birds, mammals may be disrupted as exotic species move into an area and displace native species. Several weed species (ex cheatgrass (Bromus tectorum), knapweed (Centaurea spp.)) can outcompete native vegetation for water and soil nutrients in our dry, eastside ecosystems.

Management activities should, therefore, minimize introduction and spread of noxious weeds and eradicate infestations, where feasible.

The Noxious Weed Management Plan for Mt. Hood National Forest (Helliwell, et. al., 1990) identifies "A" rated, "B" rated, and Detection weeds for each Ranger

District. According to this plan, "A" rated weeds should be controlled or eradicated at Ranger District level. "B" rated weeds are generally more widely distributed; infestations should be controlled or contained at Ranger District level in cooperation with Oregon Department of Agriculture. Detection weeds generally include species with small, isolated populations. These species should be eradicated as sites are discovered. Top priority under the noxious weed management plan is to prevent establishment of Detection weeds.

Tansy ragwort (Senecio jacobea) and spotted knapweed (Centaurea maculosa), both "A" rated weeds, occur on Forest Lands in White River watershed. These species should be controlled or eradicated in the watershed.

Four "B" rated weeds, including Canada thistle (Cirsium arvense), diffuse knapweed (Centaurea diffusa), scotch broom (Cytisus scoparius), and st. johnswort (Hypericum perforatum) occur in White River Watershed. Houndstongue (Cynoglossum officinale), an aggressive invader which is toxic to livestock also occurs in White River Watershed (all known sites are south of the White River on Bear Springs Ranger District). Infestations of these species should be controlled or contained in the watershed in cooperation with Oregon Department of Agriculture.

Several "detection" weeds are known or suspected to occur in White River Watershed: dalmation toadflax (Linaria dalmatica), leafy spurge (Euphorbia escula), musk thistle (Carduus nutans), rush skeletonweed (Chondrilla juncea), yellowstar thistle (Centaurea solstitialis), white top (Cardaria spp.), scotch thistle (Onopordum acanthium), yellow toadflax (Linaria vulgaris), Russian knapweed (Acroptilon repens), brown/meadow knapweed (Centaurea jacea/C. pratensis), poison hemlock (Conium maculatum), perennial pepperweed (Lepidium latifolium). Populations of these species should be eradicated as they are discovered.

The following weed control actions are recommended:

1. Teach all field going employees to recognize and report noxious weeds. Encourage employees to uproot any small, isolated weed population as soon as it is discovered and report site to District Noxious Weed Coordinator (Linda Cartwright, Barlow; Lance Holmberg, Bear Springs)
2. Eradicate all detection weeds found in the Watershed. Manually remove potential invaders including scotch broom (Cytisus scoparius), and houndstongue (Cynoglossum officinale) from the Watershed.
3. Promptly reseed bare ground at landings, skid roads, etc with certified weed-free seed or native shrubs.
4. Monitor noxious weed sites in the watershed and update GIS records of noxious weed populations
5. Develop and mainatin a standardized database for tracking noxious weed populations. Database should include observation date, population size, treatments used, and should link to a GIS datalayer with a unique polygon assigned to each population of each species. Coordinate database development with neighboring land managers and Oregon Department of Agriculture.
6. Road construction and logging equipment from areas with infestations of scotch broom, houndstongue, tansy ragweed, or any detection weeds should be cleaned before entering project areas within the watershed.

7. Use integrated pest management methods (biological controls, manual removal, and herbicide application, if appropriate) to contain established infestations of knapweed, st. johnswort, and Canada thistle.
8. All seed purchased for revegetation must meet all states noxious weed free seed certification tests.

How does White River watershed contribute to social, cultural, and economic demands, including demands for species needed for ecological restoration? Discuss fungi, plants, lichens, bryophytes which satisfy these demands. (which spp? What's their condition in the watershed? What's their range, where do you find them, value/level of demand, what's the supply like, how do we manage them?, etc.

COMMERCIALLY HARVESTED EDIBLE FUNGI

White River watershed harbors scattered patches of matsutake (Tricholoma magnivilare), boletes (Boletus edulis), and morels (Morchella spp.). All three of these species are harvested commercially in the watershed but morels are the most plentiful. Morels are collected in spring around Rocky Burn and any recently burned areas. Boletes are picked in the spring time at low elevations in oak dominated woodlands, but the majority fruit in late summer and early fall at high elevations, usually near mtn hemlock. Matsutake fruit in fall, after some rain and cooler temperatures arrive. Matsutake and bolete patches generally fruit every year in approximately the same locations. Morels are usually most plentiful the first three years after a fire. Some areas (ie Rocky Burn) produce morels every year, even if not burned.

Price per pound varies depending on supply and grade of the mushroom but wholesale prices (ie, what a buyer at a roadside station will pay a picker coming straight from the woods) range from ca. $5-$12/lb for boletes and morels, and ca. $5-$50+/lb for matsutake.

We have no quantitative data on abundance or distribution of any of these species within the watershed, nor do we have any management plan for these species.

Management ideas: Quantify morel production after we underburn an area. If we can predict how productive a given area will be, we could assess the value of the crop and issue a combination of commercial and private collection permits at fair cost.

For all these fungi, we should maintain existing populations and investigate methods of increasing mushroom production and distribution. We should also figure out how much is actually being collected (with or without permits!) and what the crop is worth.

OTHER EDIBLE FUNGI

Several delicious, edible fungi grow in White River watershed and are collected for personal use. Chicken of the woods (Laetiporus sulphureus) is common and widespread, appearing in late summer and early fall as layered shelves of soft,bright yellow or orange fungi on dead trees and logs. Although young, tender specimens are delicous if cooked, this mushroom causes gastrointestinal distress in some people. Shaggy manes (Coprinus commatus) are abundant on roadsides (especially paved roads) after the first fall rains. Popular edibles, they must be consumed the day you pick them or they "melt" into a pool of black liquid and spores. Oyster mushroom (Pleurotus ostreatus) grows on dead cottonwood trees and logs. Populations fruit from the same log for many years, some in the spring,others in the fall.

No management action needed.

COMMERCIALLY HARVESTED MEDICINAL HERBS

Valerian (Valeriana sitchensis) grows in moist to mesic habitats at upper elevations (ie above 4,000 ft) in White River watershed. Common in wet meadows and subalpine forest-park plant communities, it also grows in drier areas including shelterwoods and open forest stands. Roots are collected commercially for medicinal use. In the last two years, Barlow RD has recieved permit requests for 500-1000 lbs of roots each year. Collectors say that the plant resprouts from root fragments left in the soil, however, the district has not tested this hypothesis.

We have no management plan for this species. We should select well defined areas in which to allow and administer permits to be sure no sensitive plants or fragile habitats (ie wetlands, riparian zones) are damaged by root digging. Should establish monitoring plots in harvest areas to determine effects of digging roots on the population.

Arnica (Arnica latifolia, A. cordifolia), goldenrod (Solidago canadensis, S.spathulata), yarrow (Achillea millefolia), and st john's wort (Hypericum perforatum): Only the flowers of these spp. are collected. Yarrow and goldenrod are common throughout the watershed on roadsides and in clearcuts and shelterwoods. These two species are quite common; no management plan needed at this time.

St John's wort is a noxious weed which grows along roadsides at moderate elevations in the watershed; no problem collecting flowers of this species.

Various species of arnica grow in White River watershed. A. latifolia occurs in scatterd patches, often in wetlands. A. cordifolia and A. discoidea grow in openings in dry grandfir/douglas fir forested areas. Individual patches can be dense but we have not conducted surveys to determine distribution and abundance of these arnica species.

An idea for commercially harvested medicinal plants: we could try propogating these species from seeds or cuttings, and use these species to revegetate decommissioned roads. Once populations are established on these old, riped roads, we could issue permits for collecting on these roads, which have already been surveyed for sensitive species, cultyral resources, etc.

Chimaphila (Chimaphila umbellata): Understory species common in grand fir dominated plant associations throughout White River watershed. Rarely collected on Barlow Ranger District (? Bear Springs). Used as flavoring in Pepsi Cola.

CULTURALLY IMPORTANT EDIBLE PLANTS

yampah (Perideridia gairdnarii), camas (Camassia quamash), biscuitroot (Lomatium species): These species grow in dry scabland and/or pine/oak plant communities. All have fleshy edible roots, collected for centuries by Native Americans. Lomatium, the most abundant of these root plants, is common at low elevations in White River watershed. No management plan has been developed for these species and we do not have quantitative information on their distribution and abundance.

Do historic gathering grounds exist in the watrshed? If so, can we restore them to support traditional levels of gathering? How does grazing effect these species? How do these species respond to spring versus fall underburns?

Huckleberries (Vaccinium membranaceum) Big or thinleaf huckleberry is common at elevations generally above 3,000 ft. in this watershed. This is typically an upland species that is probably well connected to adjoining populations through continuity of habitat, pollination by insects and normal seed distribution. It recovers well and often increases as a result of disturbance. Heavy shade will inhibit the bushes but they usually remain present in old-growth situations at reduced levels. The species is widely distributed throughout the northwest and east to Montana. The elimination of large scale wildfire and the resulting forest encroachment upon large fire-maintained huckleberry fields has reduced the number of acres of high density populations but has not reduced the range of the species. All land allocations will contribute to maintaning a well distributed population. Extremly hot burns and frost pockets resulting from clear cuts will likely diminish its density in some small areas but this species would be hard to eradicate. Restoration is rarely a concern. The seeds are readily distributed by wide ranging animals such as bears and coyotes. Except in frost pockets if the plant was present it probably still is and will usually increase as a result of disturbance.

blackberries/raspberries
strawberries
red willow
whitebark pine
wild onions

SPECIES COLLECTED COMMERCIALLY FOR FLORAL INDUSTRY OR HOLIDAY DECORATION
beargrass
conifer boughs
christmas trees
lichens
mosses

POPULAR TRANSPLANTS
vinemaple
orgeon grape
boxwood
lilies
mock orange
wild lilac
pines dug for bonsai from the the higher rocky sites

SPECIES USED IN WOOD PRODUCTS INDUSTRY

douglas fir
western redcedar
silver fir
noble fir
grand fir
larch
lodgepole pine
western white pine
ponderosa pine
western hemlock
mountain hemlock
engleman spruce

ECOLOGICALLY IMPORTANT SPECIES (for restoration projects, ecosystem process, etc)

Oregon white oak
nitrogen fixers (lupine, deervetch, ceanothus species, lichen species)
native bunchgrasses (big blue wildrye, columbia brome, idaho fescue, western fescue, prairie junegrass)
riparian shrubs (willow, cottonwood, red osier dogwood, etc)
mycorrhizal fungi

REFERENCES

Helliwell, R., L. Cartwright, T. Butler, B. Otani, L. Kemp. 1990. Mt. Hood National Forest Noxious Weed Management Plan. U.S. Dept. of Agriculture, Forest Service.

Hickman, J.C. 1993. The Jepson Manual. University of California Press. Berkeley, California.

Hitchcock, C. Leo, A. Cronquist, M. Owenby and J. W. Thompsen. 1969. Vascular Plants of the Pacific Northwest. University of Washington Press, Seattle WA and London.

Kaye, T., K. Kuykendall. 1992. Status Report for Astragalus tyghensis. Oregon Department of Agriculture, Natural Resources Division, Plant Conservation Biology Program. Salem, OR

Oregon Natural Heritage Program, 1993. Rare, Threatened and Endangered Plants and Animals of Oregon. Oregon Natural Heritage Program, Portland, Oregon.

USDA, USDI, 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. U.S. Department of Agriculture, U.S. Dept. of Interior, Portland, Oregon. pp C4-6, C49-61.

USDA, USDI, 1994. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. Appendix J2.

Washington Natural Heritage Program, 1994. Endangered, Threatened and Sensitive Vascular Plants of Washington. Department of Natural Resources. Olympia, Washington.

Things to do in White River Watershed (restoration projects)

- Survey watershed for strategy 2 survey and manage species. REO will have survey protocols and management recommendations figured out sometime in 1996 (or sooner). We are required to implement these surveys and management standards (ROD, p C-5).

- Establish mycological special interest area around Cortinarius weibeii (type locality).

Noxious Weeds:

1. Teach all field going employees to recognize and report noxious weeds. Encourage employees to uproot any small, isolated weed population as soon as it is discovered and report site to District Noxious Weed Coordinator (Linda Cartwright, Barlow; Lance Holmberg, Bear Springs)
2. Eradicate all detection weeds found in the Watershed. Manually remove potential invaders including scotch broom (Cytisus scoparius), and houndstongue (Cynoglossum officinale) from the Watershed.
3. Promptly reseed bare ground at landings, skid roads, etc with certified weed-free seed or native shrubs.
4. Monitor noxious weed sites in the watershed and update GIS records of noxious weed populations
5. Develop and mainatin a standardized database for tracking noxious weed populations. Database should include observation date, population size, treatments used, and should link to a GIS datalayer with a unique polygon assigned to each population of each species. Coordinate database development with neighboring land managers and Oregon Department of Agriculture.
6. Road construction and logging equipment from areas with infestations of scotch broom, houndstongue, tansy ragweed, or any detection weeds should be cleaned before entering project areas within the watershed.
7. Use integrated pest management methods (biological controls, manual removal, and herbicide application, if appropriate) to contain established infestations of knapweed, st. johnswort, and Canada thistle.
8. All seed purchased for revegetation must meet all states noxious weed free seed certification tests.

SPECIAL AND UNIQUE HABITATS

Update GIS data as these habitats are field checked. Update SCCA database (or whatever veg layer data system we choose to stick with).

Sensitive plant surveys should be conducted in these habitats prior to implementing any projects that could effect the local hydrology or plant community (i.e. digging, road construction, grazing, burning). In general, these areas should be managed in order to maintain natural native plant community, avoid soil erosion or alteration in the watertable, and control or prevent noxious weed infestation. Prescribed fire used in these habitats should emulate conditions under which resident native plants evolved. Late summer or fall burning is best from the perspective of a northwest native plant. While weather and fuel conditions may be easier to work with in the spring, most plants are just begining to put out new growth and reproductive structures at that time. If leaf and flower buds are incinerated, the plant may not be able to resprout or set seed later in the season.

SPECIES OF CONCERN

SOCIALLY, CULTURALLY, ECONOMICALLY, AND/OR ECOLOGICALLY IMPORTANT SPECIES

Valerian (V. sitchensis) We should select well defined areas in which to allow and administer permits to be sure no sensitive plants or fragile habitats (ie wetlands, riparian zones) are damaged by root digging. Should establish monitoring plots in harvest areas to determine effects of digging roots on the population.

An idea for commercially harvested medicinal plants: we could try propogating these species from seeds or cuttings, and use these species to revegetate decommissioned roads. Once populations are established on these old, riped roads, we could issue permits for collecting on these roads, which have already been surveyed for sensitive species, cultyral resources, etc.

United States Department of Agriculture | Forest Service | Mt. Hood National Forest | Hood River Ranger District
6780 Highway 35
Mt. Hood/Parkdale, OR 97041
(503) 352-6002

Date: May 19, 1995

Subject: Cultural and Historic Medicinal and Edible Plants in the White River Watershed - Ethnobotanical Resources

To: White River Watershed Analysis, Louisa Evers

From: Susan Nugent

This document focuses on cultural and historic use plant species in the White River Watershed, and is submitted in response to the following Watershed Analysis questions:

> How does the White River Watershed contribute to social, cultural, and economic demands; including demands for species needed for ecological restoration? **(Which species, their value,** available supply, range, and **possible management of)**
>
> Do historic gathering grounds exit in the watershed? If so, can we restore them to support traditional levels of gathering?
>
> How does grazing affect these [cultural plants] species?
>
> How do these [cultural plants] species respond to spring versus fall underburns?

WHICH SPECIES? VALUE?

This study documents approximately 200 cultural and historic use plants (there are potentially many more) that occur in various habitats and distribution within the White River watershed. Attention is especially given to plants that are noted in references as having current and past use by local Native Americans of the mid-Columbia area.

WHICH SPECIES? VALUE? cont.

The attached list identifies plants by common, latin, and Sahaptin names (Warm Springs, Yakima, and Umatilla Native Americans). Uses are divided into three components:

(*) Native American Cultural Foods (Warm Springs, Yakima, Umatilla)
These species include important root and berry plants, vegetable and flour/grain production plants. (70 plant species)

(+) Native American Medicinal, Ceremonial, or Traditional Use
These species include various non-food uses such as basket weaving and dipnet cordage, long-house and ceremonial purification, cooking utensil materials, dyes, hair and skin tonics, internal and external medicines, traditional potions, "smokes", and gum. (80 plant species)

( ) **"General Historic Use (Edible and Medicinal).**
Species in this category cover use from pioneers to present, and include private and commercially collected plants. (40 plant species)

MANAGEMENT?

Treaty Rights:

The 6,500,000 acre range of the Mid-Columbia Native Americans, prior to the forming of reservations, included the lands north (and east) of Mt. Jefferson to the Columbia River. The division ran north along the crest of the Cascades to Mt. Hood and down across the Hood River Valley to the Columbia River. These traditional use lands (including the White River Watershed), exclusive of current reservation boundaries, were ceded to the U.S. Government in the 1855 Treaty With The Tribes Of Middle Oregon. Special rights to fishing, hunting, gathering roots and berries, and pasturing stock "...in unclaimed lands, in common with citizens", are provisions of the treaty. The Confederated Tribes of Warm Springs should be included in the planning process for all USFS projects.

A Plan For Preservation of Cultural Foods/Gathering Grounds:

A Warm Springs report titled "The Preservation and Management of Cultural Plants on the Warm Springs Indian Reservation; A Proposal", by botanist Richard Helliwell, outlines a strategy for management of cultural plants. In addition to management recommendations the report identifies five root plants that are currently important cultural foods, Camas (Cammassia quamish), Bitteroot (Lewisia rediviva), Biscuit root (Lomatium cous), Canby's desert parsley (Lomatium canbyi), Indian carrot (Perideridia gairdneri).

Helliwell's report begins..."Families have long had favorite areas for collecting roots; areas they return to year after year. However the Reservation is to large and varied for any single family or person to be familiar with the entire range of cultural plant populations, therefore, as the plants of a favorite area are depleted the people may not know where to turn. This is the manner in which traditions die."

MANAGEMENT? cont.

Gathering Grounds:

Historic gathering grounds may or may not be in need of restoration to "...support traditional levels of gathering". The tribal council should be contacted to inquire whether or not they would like to coordinate management plans for their cultural plants and gathering grounds in the WRWS. The current trend of huckleberry enhancement projects is an example of one type of production increase "management". Isolating cultural gathering grounds from land management practices should also be considered. At a minimum, Aquatic Conservation Strategy Objectives (1994 ROD, B-11) should be addressed in all riparian reserves (a large percentage of root foods are found in moist/wet meadows and rparian areas).

Grazing:

The Warm Springs Tribes are likely best able to identify acceptable or or unacceptable impacts of grazing on their historic gathering grounds and cultural plants. Consultation with the Tribal Council should include review of current range management practices (USFS and WS) to address management issues and concerns. Topics for discussion should include: Adjustment of grazing practices, and/or exclosure of riparian reserves to protect cultural plants in meadows etc. (see ROD C-33, GM-1 through GM-3). Range improvement seeding with non-native plant species, and noxious weed control.

Noxious Weeds and Non-Native Plants:

There are several naturalized non-native plants that have been used by the Mid-Columbia Native Americans, and are currently sought for medicinal purposes by private and commercial collectors. The attached list does not identify which species are native or non-native (see "Plant Species Predicted in the White River Watershed", a database query in the WRWS analysis file). Control of noxious weeds may be an issue in the WRWS; areas of critical concern should be identified, mapped, and treatment should be addressed by an inter-disciplinary team. Meticulous research should be conducted prior to release of any biological control agents within the WRWS. Desirable non-native plants (cultural and medicinal) should be identified in an approved plan for the management of such species within the WRWS.

MANAGEMENT? cont.

Fire - Spring vs. Autumn:

Fire naturally occurs in the heat of mid-summer to late fall, with occasional lightening strikes in spring. Most of the cultural root and berry crops are located in meadows, which naturally are encroached upon by surrounding forests. Some meadows may have a history of fire (natural or human-caused). Many fire dependant species have adapted reproductive processes in response to timing and intensity of fires. Most plant species do not respond well to fire during the growth and nutrient cycling phase which occurs during spring through summer. Other species may not regenerate well overall after fire regardless of the timing or intensity. While spring burns might be more feasible and easier to control than fall burns the timing is critical to survival and reproductive rates of all species involved. Further study should be done (in consultation with the Warm Springs Tribal Council) on a project specific level to identify fire responses of target cultural plants in proposed burns. Study should also consider fire "mimicking" management by cutting or thinning encroaching vegetation.

CONCLUSION

Specific uses associated with each plant species will be described in a later document for inclusion to the White River Watershed Analysis file. Historic gathering grounds do exist within the White River Watershed but, for courtesy reasons are not identified in this document. Consultation with the Tribal Council of Warm Springs should occur before disclosing in a public document the locations of historic tribal gathering grounds. The Confederated Tribes of Warm Springs should be included in the planning process for all USFS projects.

J. Susan Nugent
HRRD Botanist

cc: Marty Stein, Mt. Hood NF Botanist
cc: Richard Helliwell, Umpqua NF Botanist
cc: Lance Holmberg/Caitlin Cray, Botanists Barlow RD
cc: Molly Sullivan, Botanist Zig-Zag RD

White River WSA - Ethnobotany

NOTE: Sahaptin names here are not complete without symbols that must be drawn in by hand. Refer to original hard copy.

* = Native American Cultural Foods (Warm Springs, Yakima, Umatilla)
+ = Native American Medicinal, Ceremonial, or Traditional Use
= General Historical Use (Edible and/or Medicinal)

TREES		**WARM SPRINGS SAHAPTIN**
+Fir, silver	Abies amabilis	patuswai
+Fir, grand	Abies grandis	"
+Fir, subalpine	Abies lasiocarpa	"
+Fir, noble	Abies procera	"
+Alder	Alnus rubra, A. sinuata	psuuni
+Chinquapin/chestnut	Castanopsis crysophylla	
+*Hawthorn	Crataegus douglasii	snm-aasu
+Western larch	Larix occidentalis	xatawas/ kimila
+Engelmann spruce	Picea engelmannii	
*Pine, whitebark	Pinus albicaulis	ninik-aas
+Pine, lodgepole	Pinus contorta v. latifolia	kalam-kalam
*+Pine, ponderosa	Pinus ponderosa	tap'aas
+Douglas fir	Pseudotsuga menziesii	pat'atwi
Pacific yew	Taxus brevifolia	wawanins
+Cedar	Thuja plicata, Chamaecyparis nootkatensis	nank
+Hemlock	Tsuga heterophylla, T. mertensiana	waqutqut
+Quaking aspen	Populus tremuloides	nini
+Black cottonwood	Populus tricocarpa	xpxp
*Garry oak/White oak	Quercus garryana	c'unips

SHRUBS		
+Maple	Acer circinatum, A. glabrum v. douglasii	twanuwaas "
+Big leaf maple	Acer macrophyllum	sqims
*Serviceberry	Amalanchier alnifolia	ccaa
+Kinnikinnick	Arctostaphylos uva-ursi	ilik
+Sagebrush	Artemesia arbuscula, A. rigida, A. tridentata	tawsa-tawsa tausa
+Oregon-grape	Berberis aquifolium, B. nervosa, B. repens	lkawkaw lk'auk'au
+Snowbrush ceanothus	Ceanothus velutinus	
+Rabbitbrush	Chrysothamnus nauseosus, C. viscidiflorus	psxu
+Western pipsissewa	Chimaphila umbellata	
+Pacific dogwood	Cornus nutallii	
+"Red willow"/dogwood	Cornus stolonifera	luc'ani
*+Wild hazelnut	Corylus cornuta	
*+Hawthorne	Crataegus douglassii	snmaasu
*+Salal	Gaultheria shallon	niq'ul
+Ocean spray	Holodiscus discolor	
+Juniper	Juniperous occidentalis	puus
+*Honeysuckle	Lonicera involucrata	wapaanla-nmi tkatat

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SHRUBS cont.

+Fools huckleberry	Menziesia ferruginea	
Devil's Club	Oplopanax horridum	
+Mock-orange	Philadelphus lewesii	saxi
+Bitter cherry	Prunus emarginata	
*Chokecherry	Prunus virginiana	tms / tmsas
+Cascara	Rhamnus purshiana	att'itas
+Cascades azalea	Rhododendron albiflorum	
+Sumac	Rhus glabra	
*Currant, gooseberry	Ribes aureum,	xn
	R. cereum, R. lacustre, R. sanguineum	pinus-aas
+*Rose	Rosa nutkana, R. gymnocarpa	sk'apaswai
*Thimbleberry	Rubus parviflorus	atunatuna
*+Salmonberry	Rubus spectabilis	
*Blackberry	Rubus ursinus, Rubus spp.	wisik
+Willow	Salix exigua, Salix spp	txs
*Elderberry	Sambucus cerulea	mt'paas
+Snowberry	Symphoricarpos mollis, S. albus	
+Spiraea	Spiraea betulifolia, Spiraea spp	
*Black huckleberry	Vaccinium alaskaense	wiwnu
*Dwarf huckleberry	V. caespitosum	wiwluwiwlu
*Mountain huckleberry	V. deliciosum	ililmuk-aas
?Bog blueberry	V. occidentale	
*Blue huckleberry	V. ovalifolium, V. membranaceum	wiwnu
*Cranberry	V. oxycoccos	yuxpas
*Red huckleberry	V. parvifolium	luca-luca wiwnu
*Grouseberry	V. scoparium	wiwlu-wiwlu
+Highbush cranberry	Viburnum edule	

FORBS

+Yarrow	Achillea millefolium	wapnwapn
+Vanilla leaf	Achlys triphylla	
+Maidenhair fern	Adiatum pedatum	
+Horsemint	Agastache urticifolia v. urticifolia	
*Wild onion	Allium acuminatum, Allium spp	samamui
Anemone	Anemone deltoidea, A. oregana	
Pussytoes	Antennaria luzuloides	
+Arnica	Arnica cordifolia, A. latifolia, A. mollis	
+Indian Hemp/dogbane	Apocynum sibiricum, A. androsaemifolium	txws
Wild ginger	Asarum caudatum	
*Balsamroot sunflower	Balsamorhiza careyana, B. sagitatta	pusxas
*"Buttons"	Brodiaea hyacinthina, B. howellii	st'xws
*Cat's ears	Calochortus macrocarpus, C. subalpinus	nunas
*Camas	Camassia quamash, C. leichtlinii	waq'amu
+Cohosh	Cimicifuga laciniata	
Thistle	all Circium spp	

NOTE: Sahaptin names here are not complete without symbols that must be drawn in by hand. Refer to original hard copy.

* = Native American Cultural Foods (Warm Springs, Yakima, Umatilla)
+ = Native American Medicinal, Ceremonial, or Traditional Use
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FORBS cont.

*Indian potato	Claytonia lanceolata	anias
+Clematis	Clematis ligusticifolia	tamq'ikskula
Queencup/Beadlily	Clintonia uniflora	
Goldenthread	Coptis laciniata	
+Bunchberry dogwood	Cornus canadensis	
Bleeding heart	Dicentra formosa	
Foxglove	Digitalis purpurea	
*+Woodfern	Dryopteris austriaca	
Fireweed	Epilobium angustifolium	
+Horsetail	Equisetum spp	
Stork's bill	Erodium cicutarium	
*Avalanche/Fawn lily	Erythronium grandiflorum, E. montanum, E. oregonum	
*Wild strawberry	Fragaria vesca v. bracteata	suspan
	F. virginiana v. platypetela	"
*Yellowbell/Choc. lily	Fritillaria pudica, F. lanceolata	skni
Bedstraw	Galium triflorum, Gallium spp	
Old man's whiskers	Geum triflorum	
+Gum plant	Grindelia spp	
*Cow's parsnip	Heracleum lanatum	
Hawkweed	Hieracium albiflorum, H. albertinum	
St. John's Wort	Hypericum perforatum	
+Oregon Iris	Iris tenax	
*Bitterroot	Lewisia rediviva	piaxi
*Lovage	Ligusticum canbyi, L. grayi	ayun
*Tiger lily	Lilium columbianum	paanat
+*Skunk cabbage	Lysichitum americanum	watiptip
*Indian celery & roots	Lomatium canbyi	luks
	L. cous	xaus
	L. dissectum	caluks
	L. gormanii	sasamit'a
	L. grayi (L. suskdorfii)	latitlatit
	L. macrocarpum	pula
	L. nudicaule	xamsi
	L. piperi	mamn
	L. triternatum (formerly used as food)	
+Tallcup lupine	Lupinus caudatus	
+Wild mint	Mentha arvensis	suxwasuxwa
*False dandelion	Microseris troximoides	micuna
+Mountain monardella	Monardella odoratissima	waas
*+Miner's lettuce	Montia perfoliata, M. parvifolia, M. siberica	
*Yellow pond lily	Nuphar polysepalum	
Oregon oxalis	Oxalis oregana	
+Penstemon	Penstemon humilis, P. euglaucas	
*Indian carrot/yampah	Perideridia gairdneri	sawitk

White River WSA - Ethnobotany

NOTE: Sahaptin names here are not complete without symbols that must be drawn in by hand. Refer to original hard copy.

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FORBS cont.

Plantain	Plantago major	
*Knotweed	Polygonum bistortoides	
Self Heal	Prunella vulgaris v. vulgaris	
+Bracken fern	Pteridium aquilinum	c'alaca
(*Wapato	Sagittaria cuneata*, S. lattifolia (*referenced at Beaver Crk Prairie)	"wapato"
Yerba buena	Satureja douglassii	
*Stonecrop	Sedum stenopetalum	
False Solomon's seal	Smilacina racemosa, S. stellata	
Goldenrod	Solidago canadensis v. salebrosa	
Twisted stalk	Streptopus amplexifolius	
Dandelion	Taraxacum officinale, Taraxacum spp	
Foamflower	Tiarella trifoliata v. unifoliata	
+Salsify	Tragopogon dubius	
+Trillium	Trillium ovatum	sapanica
*Cattail	Typha latifolia	sc'iu
Nettle	Urtica dioica v. lyallii	ala'ala
+Valerian	Valeriana sitchensis	
+False helibore	Veratrum californicum, V. viride	mimun
Mullein	Verbascum thapsus	
Wild violet	Viola glabella, v. orbiculata	
*Mule's ears (piipipi)	Wyethia amplexicaulis	piipii
+Beargrass	Xerophyllum tenax	yai

GRASS/SEDGE/RUSH

*Bluebunch wheatgrass	Agropyron spicatum	wasku
*Bromes	Bromus carinatus, B. vulgaris	"
*Great basin wildrye	Elymus cinereus (reported on WS)	swict
*Idaho fescue	Festuca idahoensis	"
*Sandberg's bluegrass	Poa sandbergii	"
+Sedge	Carex spp	
*Parry's Rush	Juncus parryi	

LICHENS

*Black tree lichen	Bryoria fremontii	k'unc
+Wolf lichen	Letharia vulpina	
+Lung lichen	Lobaria pulmonaria	

FUNGI, BRYOPHYTES And Special Forest Products:

See "Botanical Input For White River Watershed Analysis", 5/18/95
C. Cray, L. Holmberg.

REFERENCES

Castleman, Michael. 1991.
The Healing Herbs. Rodale Press, Emmaus PA.

French, David, and French, Katherine. 1989
"Warm Springs Sahaptin Medicinal Plants", A Summary (Preliminary Version)
Reed College, Portland OR.

Helliwell, Richard. 1988
"Forest Plants of The Warm Springs Indian Reservation"

Helliwell, Richard. 1989
"Important Traditional Plants of the Warm Springs Indian Reservation"
Warm Springs Culture and Heritage Program

Helliwell, Richard. 1988
"Preliminary Plant Term List: Warm Springs Sahaptin, Wasco, and Paiute"

Helliwell, Richard. 1987
"The Preservation and Management of Cultural Plants on the Warm Springs Indian Reservation; A Proposal"

Hitchcock, C.L., and Cronquist A. 1973
Flora of the Pacific Northwest. University of Washington Press, Seattle WA.

Hunn, Eugene S., and French, David H. 1981
"Lomatium: A Key Resource for Columbia Plateau Native Subsistence"
Northwest Science Magazine, Volume 55 #2, May 1981, pp 87-94

Hunn, Eugene S. 1990
Nch'i-Wana, "The Big River": Mid Columbia Indians and Their Land.
University of Washington Press, Seattle.

Hutchens, Alma R. 1991
Indian Herbology of North America. Shambhala, Boston & London

Kirk, Donald R. 1970.
Wild Edible Plants of Western North America. Naturegraph Publishers, Happy Camp, CA.

Lewis, W.H., and Elvin-Lewis, M.P.H. 1977
Medical Botany: Plants Affecting Man's Health. A Wiley-Interscience Publication, New York.

Mahar, Michael J. 1953
"Ethnobotany of the Oregon Paiutes of The Warm Springs Reservation"
A Thesis to the Division of History and Social Science, Reed College

Martin, Gary J. 1995
Ethnobotany. A People and Plants Conservation Manual. Chapman and Hall, London

REFERENCES

Moore, Michael. 1993
Medicinal Plants of the Pacific West. Red Crane Books, Sante Fe NM

Murdock, George P. 1980
"The Tenino Indians". Ethnology 19:129-149

Turner, Nancy J., et al.
Thompson Ethnobotany: Knowledge and Usage of Plants by the Thompson Indians of British Columbia. Memoir No. 3, Royal British Columbia Museum. pp 70-76

Zukar, Hummel, Hogfoss. 1983
Oregon Indians: Culture, History, & Current Affairs. Western Imprints, The Press of the Oregon Historical Society.

USDA Forest Service, 1989. "Rural Development Opportunities in Special Forest Products", Cooperative Forestry, Washington DC

USDA, Hopkins, William E., and Rawlings, Robert C. 1985
Major Indicator Shrubs and Herbs on National Forests of Eastern Oregon. USDA Forest Service, Pacific Northwest Region, R-6-TM-190-1985

USDA, Lesher, Robin D., and McClure, Richard H. Jr. 1986
Major Indicator Shrubs and Herbs on National Forests of Western Oregon and Southwestern Washington. USDA Forest Service, Pacific Northwest Region, R6-TM-229-1986

OTHER:

"Botanical Input For White River Watershed Analysis", 5/95
C. Cray, L. Holmberg

"Camas Prairie Plant List", 1989-1994
L. Kemp, R. Helliwell, L. Holmberg

"Foreman Triangle", Plant Species List
Author Unknown

"Plant Species List, Hunter Prairie & Vicinity"
Author Unknown

"Plant Species Predicted in the White River Watershed", 3/95
(a database query by C. Cray)

"Working List of Plant Species Found on Butte POA"
(L. Kemp, R. Helliwell, L. Holmberg)

Acknowledgements

Special thanks to Richard Helliwell (Umqua NF Botanist), and Kathy Martins (Cultural Resources, Bear Springs RD) for providing information specific to the Confederated Tribes of Warm Springs.

APPENDIX F: LIVESTOCK GRAZING

Introduction

This section discusses background information on livestock grazing within White River subbasin. The focus is on commercial livestock use; recreational livestock use will be mentioned only briefly. Topics include historical use levels, the general condition and trend for each allotment, and monitoring.

Historical Use: National Forest Lands

The earliest records date to 1905, when the Forest Service was created. Before 1905, no agency was in place to mange or monitor livestock grazing with any consistency. The earliest known grazing occurred during the Euro-American settlement period by travelers on the Barlow Road. Many settlers brought large herds of cattle with them to serve as a food source on the trail, as draft animals, and as the beginnings of their new farms. Extensive grazing occurred along the Barlow Road, particularly at rest points and campsites. Typical sites include Gate Creek area at the tollgate, around Immigrant Springs, and in the White River floodplain. Grazing was generally poor at this last site.

As Euro-Americans began settling White River basin itself, they also developed large herds of both cattle and sheep. Sheep would graze the high elevations while cattle would graze the low and mid-elevations. Sometime between the establishment of the Cascade Range Forest Reserve and 1901, grazing was prohibited in north of the Barlow Road and west of the east boundary of Grid 410. This rule only effectively restricted sheep grazing. Farmers east of the Reserve boundary would simply tum their cattle loose in spring and collect them in the fall. The surveyors of the Forest Reserve noted as many as 700 head within the restricted area.

After the Forest Service was established in 1905, the rangers began establishing individual allotments for cattle and sheep. Most of these early allotments were small due to the small size of many grazing operations. Before about 1955, sheep grazing far outweighed cattle grazing. Sheep grazing peaked during World War I to provide meat and wool for the war effort and cattle grazing peaked shortly thereafter.

Year	Sheep	Cattle
1906	21,185	2,633
1907	22,425	2,068
1918	22,565	3,936
1922	21,200	4,390
1941	12,575	1,912
1942	11,611	1,633
1943	6,871	1,801
1955	100	1,326

Current Use: National Forest Lands

All or part of four cattle allotments lie within White River subbasin on National Forest lands. Wapinitia Allotment also lies in the Salmon River and Oak Grove Fork watersheds. Maps of the current allotment boundaries and allotment improvements are stored digitally at Barlow Ranger District. Range improvements consist of fencing, corrals, watering locations, exclosures around sensitive areas, and cattle guards on main roads. Current permits are for:

Allotment	Permittees	Permitted Total[1]	Range Type
Badger	Pat Nogle, Bruce Davenport	80	Mostly permanent
Grasshopper	Jack Stevens	400	Mostly transitory
White River	Chuck Petroff, Steve Reffett	250	Mostly transitory
Wapinitia	Mike Filbin	100	Transitory

[1] All permits are for cow-calf pairs

Grazing on Other Ownerships

Grazing allotments lie on both ODFW and BLM lands as well as on private lands. Oregon Department of Fish and Wildlife uses two grazing systems. In the first system priority permits were given to the landowners who sold land to ODFW in return for grazing rights. Seven permits were awarded under this system and the same fee charged to the permitees regardless of location. In the second system, general grazing permits are available for the public to bid on once every five years. High bidder recieves the permit. Three permits are awarded under this system.

Grazing on ODFW lands is designed to benefit wildlife as the top priority. To meet this goal, ODFW keeps livestock numbers well below the carrying capacity of the range if it were managed for livestock production. Other management strategies include resting pastures every other year; heavy grazing on antelope bitterbrush every 3-8 years; limiting utilization to 2-3 inch stubble on Idaho fescue, 10% maximum of current leader growth on antelope bitterbrush, and an unbroken sod with fall regrowth on irrigated pastures; and salting. See the management plan for the White River Wildlife Area for more detail on grazing management. Current grazing permits on ODFW lands include:

Permittee	Permitted Total[1]
John Mayfield	??
Rick Harvey	40
Leo Jilk	60
D.A. Harvey	35
Gary Thompson	55
Jim Kennedy	71
Delbert Endersby	??
Lyle Driver	50
D. and J. Ashley	80
Randy Marshall	160

[1] Cow-calf pairs

The BLM also manages about 10 allotments along the White River canyon rim. Most farmers also raise cattle as well as crops. Several farmers plan to convert their CRP lands into grazing lands. As wheat prices rise, some of this pasturage may be converted to crops.

Badger Allotment

Before 1988, a single permittee ran cattle in the allotment. The previous permittee lived next to the Forest boundary and also held a private lease on nearby Mountain Fir lands. He managed the combination of his land, the Mountain Fir lease, and the Forest Service permit as one grazing unit. The entire unit was more intensive during that period. This permittee died and the surviving family was not interested in continuing the operation. The current permittees recieved their use permits in 1988 and also picked up the Mountain Fir lease. Each permittee runs an equal number of pairs. When Mountain Fir sold their land, the use levels dropped to that permitted only on the National Forest lands--80 pairs total. In 1994, these permittees constructed a drift fence to keep the cattle out of Tygh Creek and received permission to graze the included state managed land (formerly Mountain Fir lands). Badger Allotment was rested from grazing in 1992 and 1993.

Badger Allotment suffers somewhat from poor cattle distribution. The animals tend to use the same areas over and over while generally ignoring areas with abundant feed. They tend to drift into the riparian areas for water and shade. lastly, they tend to key in on recent forage seedings by ODFW, and roadbed and cutbank stabilization seeding by the Forest Service. We do understand why the cattle tend to ignore areas that seem suitable for grazing. The three main theories are lack of sufficient water, low palatability of the available feed (too much dead crown), and failure to push the cattle enough. Noxious weeds do not appear to pose any significant problems. Overall, the range condition seems to be improving, with the 2 year rest showing significant results.

Grasshopper Allotment

Shortly before the Rocky Burn, the permitted use level was 400 pairs. In 1977, the permitted use level was raised to 600 pairs to take advantage of the abundant feed within the fire area. By 1979, permitted use dropped back to 400 pairs, but increased in 1980 to 800 pairs. In 1989, the permit was dropped to its current level to reflect loss of feed in the Rocky Burn. The allotment was rested from grazing in 1983, 1986, 1987, and 1989.

Grasshopper Allotment also suffers from poor cattle distribution. Many fences are in poor repair and do not serve their intended purpose. The current permittee purchased an entirely new herd when he recieved his first permit. The permittee, his herders, and the herd did not know the area, so did not know where to find feed and water when moved. As a result, the cattle tend to drift back down to the low country into areas they learned about first, the low country is over-utilized, and the high county is under-utilized. This situation is improving as the permittee, herders, and herd learn the area.

The allotment is well watered although many ponds no longer hold water. Some ponds never did hold water. Certain riparian areas tend to get overused. The low country also suffers from high levels of cheatgrass, knapweed, and thistles. The knapweed and thistles are listed as noxious weeds. Cheatgrass is palatible, but has usually seeded out before the cattle are allowed to graze. The permittee is not allowed to graze the uppermost portion of the allotment, the area around Camp Windy and Bonney Meadow.

White River

One permit is for 55 pairs and the other for 195 pairs. Before 1990, the permittees also used the adjacent Mountain Fir lands for grazing. A private individual purchased those lands, fenced the boundary, and is using it to graze his own cattle.

Cattle distribution is generally good within this allotment. A drift fence along the Keeps Mill Road separates the allotment into an eastside and a westside section. The eastside section is considered early season range and the westside as late season range. The McCubbins Gulch OHV area is also fenced to keep cattle out. Between the loss of the Mountain Fir lands for grazing by these permittees, McCubbins Gulch OHV Area, lack of clearcutting, and general forest succession the amount of feed is declining. This allotment has very little permanent range. Further, houndstongue, a noxious weed, is well established on the eastside section and spreading into the westside section. Some short-term forage increase is expected as grass replaces thistle in older clearcuts, but this increase covers only a small percentage of the allotment.

The main concerns in White River allotment are riparian area damage in Camas Prairie and Clear Creek. In 1994, cattle from this allotment kept drifting onto US Highway 26. Since Wasco County is open range, the state does not require that Highway 26 be fenced.

Wapinitia Allotment

The general information on this allotment covers the entire area. Specific comments only refer to that portion of the allotment in White River subbasin. The permitted use levels were 130 pairs from 1984-1992. The current permittee was only able to run 100 pairs initially. In 1993, the use level was dropped to 100 pairs due to decreasing forage availability. Wapinitia allotment is all transitory range. Since the Forest Service is not clearcutting, no new range is being created. Livestock use in the Key Site Riparian Areas is restricted by the Forest Plan to 30% utilization and 35% in all other riparian areas.

Cattle distribution could be better. Within White River subbasin use tends to concentrate around Clear Lake, creating conflicts with dispersed recreation users, although much larger problems are present in Little Crater Meadows outside White River subbasin. In general, the allotment is well watered and the cattle know where to find feed and water when moved. Tansy ragwort is present but the current biocontrol keeps the population levels under control.

Monitoring Plots

Two types of plots have been established in the various allotments. The short-term plots are to monitor utilization levels, using caged vegetation as a control. These plots are measured twice each year for vegetation height and green weight. Long-term plots are intended to reveal condition and trends in vegetation and soil condition. These consist of 100 foot transects that examine plant species composition, cover, and percent of bare soil. Data is read on 5 sample points using a 3X3 foot square. Long-term plots are read every 3 years.

Recreational Livestock

Recreational livestock use is generally low due to lack of facilities and good trails. Bonney Meadows shows the most damage, primarily tied to high levels of saddle and pack horses during hunting seasons. Streams within or near the campground are often dammed, apparently to provide watering spots. Bonney Meadows Campground does not have any livestock handling facilities, such as loading ramps, hitch rails, corrals, or watering troughs. Bonney Crossing Campground provides corrals, hitch rails, and loading ramps, but does not have watering troughs. The White River Wild and Scenic River Plan calls for construction of limited facilities at White River Station Campground. Elsewhere, the primary concern with recreational livestock is weeds from feces and hay. Riders are not required to use certified weed free hay or hay pellets.

Range Improvements

Ponds.

"Sandpiper Pond"
Blue Heron Pond
Snipe Pond
Killdeer Pond
Curlew Pond
Plover Pond
Kingfisher Pond
Black Bear Spring
Bluejay Pond
Teal Pond
Mallard Pond
Chickadee Pond
Thrush Spring
Deer Spring
Pidgeon Spring
Robin Spring
Skidder Spring
Cougar Spring
Turkey Spring
Coyote Spring
Swallow Spring
Souva Spring--Grasshopper
Rock Creek Spring--Grasshopper
Bell Spring--Grasshopper
Chirpy Spring--Grasshopper
Mukluks--White River
Black Bear Pond
Diamond Spring
unnamed spring
Fungi Pond
Hickory Pond
Mama Bear Pond
Magpie Pond
Badger Point Pond
Fire Pond
Gobbler Pond
Big Boulder Pond
C-K Pond
Stony Pond
Postage Pond
Page Pond
Catspaw Pond
Big E Pond
Blue Grouse Pond
Elk Pond
Blackbird Pond
Raven Spring
Bambi Spring
unnamed spring
Chase Ditch Pond
Hummingbird Pond--Badger
Eagle Pond
Redtail Pond
Cougar Pond
Elk Spring
Stockton Spring--Grasshopper
Bennett Spring--Grasshopper
Douglas Spring--Badger
Guzzler #1--Badger
Guzzler #2--Badger
Mucky Pond

Seedings.

1. 4-11 Project--Grasshopper
2. Smock Project--Grasshopper
3. Rock Creek Road Area--Grasshopper
4. Road 48 Underburn--Grasshopper
5. White River

Corrals.

1. Camas Prairie--White River
2. 4 corners (temporary)
3. Happy Ridge--Badger
4. Tyghee Ranch--Badger

Range Utilization Cages.

Allotment	Identifier	Utilization Standard	Average Actual Use[1]
Wapinitia	Clear Lake 1	35%	35%
Wapinitia	Clear Lake 2	35%	17%
Wapinitia	Clear Lake 3[2]	35%	25%
White River	Camas Prairie 1	30%	8%
White River	Camas Prairie 2	30%	55%
White River	Camas Prairie 2B	30%	63%
White River	White River/East Unit	50%	50%
White River	Evick Spring Road 2110	50%	55%
Grasshopper	Spring Exclosure (Skidder Pasture)[3]	35%	85%
Grasshopper	North Fork Rock Creek (Cougar Pasture)	50%	42%
Grasshopper	North Rock Creek Pasture (N of Rd 48)	50%	35%
Grasshopper	South Rock Creek Pasture (S of Rd 48)	50%	60%
Grasshopper	Barlow Pasture	50%	56%
Grasshopper	Smock Prairie	50%	71%
Badger	Hummingbird Pond[4]	50%	No Data

1 Data sets range from 1 to 4 years

2 Cage was missing 1993

3 Site now inside an exclosure, protected from livestock use; data last read in 1993

4 Need to relocate site, right next to pond

APPENDIX G: FEMAT AND WATERSHED ANALYSIS

Introduction

In order to better accomplish the task of Watershed Analysis, we found it helpful to review the FEMAT report and the ROD for the Northwest Forest Plan to better understand the *intent* of the people who prepared these documents and management direction. This review is necessary since we feel that the actual conditions found on the eastside of the Mt. Hood National Forest do not fit the conditions described in the two guiding documents very well. Therefore, we reviewed what we believe is the relevant content of both documents and discussed what we think are the real concerns.

This report is divided into several sections and subsections. It contains summaries of the terrestrial and aquatic sections of the FEMAT report with supplemental information from the ROD, what we think the summaries mean, and what our analysis revealed. The analysis covers what we think the FEMAT scientists wanted us to examine most closely in evaluating the condition of our subbasin and watersheds.

Terrestrial Section

The eastside of the Mt. Hood National Forest falls into the Eastern Oregon Cascades physiographic province. The FEMAT report recognizes that conditions in the Eastern Oregon Cascades Province differ from the western provinces and that fire formerly played a significant role in shaping the forests. Fire exclusion has resulted in significant fuel accumulations in some areas and shifts in tree species compositions. The eastside forests are now more susceptible to catastrophic fires and to epidemic attacks of insects and disease. Any plan to protect late-successional/old growth forests must include considerable attention to fire management and to the stability of forest stands.

The FEMAT scientists used the following definitions to determine the amount of late successional forest:

- *Small conifer* - stands dominated by trees 6-21 inches DBH. Includes some stands with scattered large overstory trees that provide some old forest characteristics.
- *Medium/large single-storied conifer* - stands dominated by trees 21+ inches DBH with only one canopy layer; considered LATE-SUCCESSIONAL
- *Medium/large multi-storied conifer* - stands dominated by trees 21+ inches DBH with more than one canopy layer; considered OLD GROWTH

The late-successional/old growth conditions that are the focus of the report are:

- *Maturation stage* - slowed rate of height growth and crown expansion, heavy limb formation, gaps between crowns become larger and more stable or expand from insect and disease mortality. Large dead and fallen trees begin to accumulate. The understory may be characterized by seedlings and saplings of shade tolerant species.
- *Transition stage* - original cohort of overstory trees approaches maximum height and diameter and growth is slow. Tree crowns become more open and irregular in shape and contain heavy limbs. Broken, dead, and decaying portions of tree crowns are common. Old trees become relatively resistant to low and moderate intensity fire, and, depending on species, crown bases are high above the understory and bark is relatively thick. Understory trees form multiple canopy layers; coarse woody debris accumulates to relatively high levels; low and moderate intensity disturbances from insects, disease, and fire create patchy openings and accumulations of dead standing trees. Disturbances frequently promote establishment or advancement of understory trees that eventually fill the holes in the canopy.
- *Shifting gap stage* - last of the original cohort of overstory trees dies and all trees in the canopy have established following smaller gap-type disturbances.

The report recognizes the role of large stand-replacing fires in resetting the successional processes and developing new areas of late-successional forests. However, due to the relatively low remaining proportion of late-successional ecosystems at this time, we should protect what remains from fire or other resetting disturbances.

The important functions of late-successional forests include:

- buffering the microclimate during seasonal extremes
- producing food for consumer organisms occupying late-successional forests
- storing carbon
- nutrient and hydrological cycling
- providing sources of arthropod predators and organisms beneficial to other ecosystems or successional stages
- retaining nutrients
- maintaining low soil erosion potential
- intercepting more moisture from low clouds and fog

The important assumptions and thought processes regarding late-successional forests used in assessing the effects of the Northwest Forest Plan are:

- Any stands where the dominant overstory trees are at least 80 years old are late-successional.
- The average regional natural fire rotation was 250 years for fires which removed 70% or more of the basal area, resulting in a maximum of 60-70% of the forest area as dominated by late-successional or old growth forest.
- Using expert opinion, the average low over any 100 year period was 40% coverage by late-successional forest, with lower values expected for individual provinces.
- The main factors that influence species populations which the FEMAT report focused on are:
  1. habitat conditions on federal lands (within the range of the northern spotted owl)
  2. life history characteristics of the species assessed
  3. "bottleneck" periods of low habitat and populations
- The main attributes characterizing the quantity and quality of the ecosystem are:
  1. Abundance and ecological diversity - acreage and variety of plant communities
  2. Processes and functions - ecological actions that lead to the development and maintenance of the ecosystem and the values of the ecosystem for species and populations
  3. Connectivity - extent to which the landscape pattern provides for biological flows that sustain animal and plant populations
- The relevant processes are:
  1. Tree establishment, maturation, and death
  2. Gap formation and filling
  3. Small and large scale disturbances
  4. Decomposition
  5. Nitrogen fixation
  6. Canopy interception of energy and matter
  7. Energy and matter transfers between the forest and the atmosphere

- The relevant functions are:
  1. Maintenance of populations of species that use late-successional ecosystems
  2. Contribute to the diversity and productivity of other ecosystems

The FEMAT scientists concluded that no management option considered could provide for a return to conditions that closely match those of previous centuries. Humans are simply too widespread over the landscape and have made too many changes. They also recognized that some late-successional/old growth forest types, such as fire dependent ponderosa pine, have been reduced to a small fraction of historic levels and that some community and ecosystem types of low elevations and valley margins have been totally lost.

The FEMAT scientists recommended establishment of Late-Successional Reserves for the following purpose:

- Maintain natural ecosystem processes such as gap dynamics, natural regeneration, pathogenic fungal activity, insect herbivory, and low-intensity fire.

Interpretations of FEMAT-Terrestrial Section

In reading the FEMAT report in detail, it became clear to us that the overriding concern in the terrestrial ecosystem was for **species dependent on stands dominated by large, old trees.** These forest types are considered to be in short supply over the range of the northern spotted owl since they also contain or contained the trees of highest economic value. Therefore, to meet the **intent** of FEMAT and the Northwest Forest Plan, our efforts should focus on *maintaining, enhancing, or restoring stands dominated by large, old trees at the levels of coverage and landscape patterns that provide for the conservation of species dependent on those forests.*

The detailed descriptions of stand types, disturbance patterns and frequencies, and structural stages appear to fit the conditions found in the Crest Zone of White River subbasin very well. The only exception is that current structural stages and our understanding of climate cycles, epidemic insect cycles, and fire frequencies strongly suggest that the closed canopy forests never or very rarely reach the shifting-gap stage before a stand resetting event occurs. The only locations within the subbasin where forests might reach the shifting-gap stage are close to Mt. Hood or Lookout Mountain where mountain hemlock is climax.

The medium/large single-storied conifer stand description appears to fit our description of a Cathedral stand. Cathedral stands are mid- to late-successional in the Crest Zone and disturbance dependent old growth in the Transition Zone. The medium/large multistoried conifer stand description appears to match our description of a Late Seral Tolerant Multistoried stand. The Late Seral Tolerant Multistoried stand is old growth in the Crest Zone and the western edge of the Transition Zone. The FEMAT report does not contain an old growth description that would match Late Seral Parklike, the old growth structure type in the Eastside Zone and eastern edge of the Transition Zone. Late Seral Parklike stands are disturbance dependent.

We believe that to meet the intent of the Northwest Forest Plan, we need to:

1. Define what "late-successional" means in each climate zone.
2. Describe the relevant structural stages.
3. Evaluate how well the current late-successional and old growth stands are providing the functions identified above.
4. Evaluate the quantity and quality of the late-successional and old growth habitat, particularly in LSRs and make recommendations on restoration and protection needs.

Late-Successional Definitions.

Historic late-successional/old growth forests for each climate zone in White River subbasin.

Zone	Structural Stages	Description
Crest	Late Seral Tolerant Multistoried	Stands with two or more canopy layers where true fir or hemlock is climax. Lowest canopy layer is composed of tolerant species. Upper canopy layer(s) composed of a mix of tolerant, semi-tolerant, and intolerant conifer species. Stand is growing at acceptable/desirable rates and density is at acceptable/desireable levels.
	Cathedral	Semi-open to closed stands dominated by widely spaced, large diameter trees usually greater than 20" DBH. Understory is brush, brush and grass, grass, and scattered conifer regeneration. Obvious understory tree canopy covers less than 25% of the area. Canopy closure 60-90%.
	Mature Stem Exclusion	Single layer, stands either single-aged to multi-aged that require disturbance to move into the next stage. Stands are closed canopy dense stands with early seral species occupying the dominant and co-dominant stand positions and late seral species (tolerants) in the co-dominant and intermediate positions.
Transition	Late Seral Tolerant Multistoried	Same as above.
	Cathedral	Same as above except canopy closure 40-80%; disturbance dependent Old Growth.
	Late Seral Parklike	Open canopy stands maintained by frequent, low intensity disturbance (usually fire). Understory tree canopy covers less than 20% of the area. Overstory consists of Oregon white oak and ponderosa pine greater than 20 inches DBH and with yellow/orange bark. Canopy closure ranges from 25-50%.
Eastside	Late Seral Parklike	Same as above.

Of these late-successional forest types the Cathedral forest and the Late Seral Parklike forest are dependent on large scale, low intensity disturbance to maintain their presence. Without this disturbance, stand density increases and they lose their Old Growth character. In the Eastside and Transition Zones, Late Seral Parklike stands tend to stagnate, fuels accumulate, and insect activity increases. These stands will not regain their Old Growth character nor move into another recognizable stage. The stage becomes set for a large stand-replacing event which is atypical.

In the Transition Zone, Cathedral stands also tend to stagnate but they may move in the direction of Late Seral Tolerant Multistoried. Along the west edge of the zone, such a move is expected. However, in most of the Transition Zone, such a move allows fuels to accumulate and insect and disease activity to increase, setting the stage for a large-scale stand replacing event which is atypical. Many formerly Cathedral stands are now in this stage and we are unsure if they will move into another recognizable stage in the absence of disturbance.

In the Crest Zone, Cathedral Forests can follow two general successional pathways. In the first, Cathedral Forests typically pass into the Mature Stem Exclusion stage and then into Late Seral Tolerant Multistory. In the second, Cathedral Forests appear between the Mature Stem Exclusion stage and the Late Seral Tolerant Multistory Forests. The first pathway tends to occur more often along the east edge of the Crest Zone while the second pathway tends to occur in most of the zone. Each of these three stages may last a long time or succession may proceed relatively quickly, depending on the site. As stands approach the Shifting-Gap stage described in the FEMAT report a stand replacing event usually occurs and resets the successional clock.

Of the three zones, only the Crest Zone contains any late-successional forest as described above. Fully developed Late Seral Tolerant Multistory stands cover about 25% of the Crest Zone (mapped as Old Growth). Another 35-50% of the area is in the Mature Stem Exclusion stage or just entering the Late Seral Tolerant Multistory stage (mapped as Mature Stem Exclusion and Understory Reinitiation).

In the Transition Zone, we have mapped a few areas of Old Growth, but it is an atypical Old Growth for the zone. The typical Old Growth would be the Cathedral forest. The Old Growth as mapped more closely resembles Late Seral Tolerant Multistoried and is considered an unstable forest type where it appears. We consider such forest as unstable because it is highly susceptible to epidemic levels of insects and disease and stand-replacing fire.

The Eastside Zone has no Old Growth forest left. Many large trees were cut, but a more significant factor has been fire exclusion. Such stands could be considered late-successional only on the basis of stand age. By excluding fire, we have allowed stand densities to increase far beyond what the area can support during dry periods, allowed conifers to successfully invade woodlands and dry meadows, and allowed more fire susceptible conifer species to invade the western half of the zone. We are not sure what to call the resulting forest but we know it does not function as Old Growth within this zone.

Further, we believe that the entire concept of late-successional forest does not apply well to the Eastside Zone. All-aged forests dominated the zone. We could find no evidence that stand-replacing events occurred on the uplands. Instead, all disturbances appear to be limited only to single trees or small groups or of such low intensity that stands were not replaced. All disturbances were very frequent such that conditions did not develop that would result in stand replacement.

Functions of Late-Successional Forests.

The FEMAT report lists several functions of late-successional forests. We compared that list with what we believe are the functions of late-successional forest in White River subbasin by climatic zone. Within the Crest Zone, all functions listed except one seem to apply. The late-successional forests do not appear to function as an intercept for more moisture from low clouds and fog. Low clouds and fog typically occur in late fall, winter, and early spring for short periods of time. However, significant condensation on the trees does not occur except very rarely and primarily near upper timberline on Mt. Hood and Lookout Mountain. Fog drip from the trees does not seem to happen. Hoar frost does form on trees in winter but tends to sublime off rather than melt off.

Within the Transition Zone late-successional forests do not serve as a significant intercept for more moisture from low clouds and fog and fire. Decay in the Transition Zone is limited by lack of moisture and high summer temperatures even in late-successional forests. Fire plays an increasingly important role in nutrient cycling between the west edge and the east edge of the zone. Without fire the Transition Zone retains nutrients "too long", limiting nutrient availability. The effects on the nutrient cycle are uncertain but appear to reduce fertility over the long-term as more and more nutrients become locked up in thickening duff layers. Exclude fire too long within this zone and when it does burn, excessive amounts of nutrients are volatized or otherwise lost from the system. The Transition Zone extends into the upper limits of big game winter range; the typical late-successional forest functions as thermal cover with some forage during open winters.

Within the Eastside Zone many of the functions listed do not appear to occur or operate in very different manners than the FEMAT scientists appear to have envisioned. For example, extensive fog and low clouds occur during the winter months but little fog drip results. Instead the fog serves as a barrier to thermal radiation on otherwise sunny days and greatly suppresses diurnal temperature changes. Cold conditions can prevail for many days to weeks under this persistent fog. Such fogs only form north of White River and appear to be influenced by the Columbia River Gorge. These fogs also appear to be a factor in limiting the presence of western juniper and sagebrush north of White River although we do not understand the mechanisms involved.

Fire plays a much more important role in nutrient cycling in the Old Growth forests of the Eastside Zone. Native bunchgrass understories were an important source of short-term nutrients and may have been more important in reducing soil erosion than the trees. Old Growth forests are very important providers of big game thermal cover and forage during the winter.

Quality and Quantity of Late-Successional Forests

Within the Crest Zone the quantity of late-successional forest appears to be adequate but the quality is below the range of natural variability. Previously the disturbance patterns created large continuous blocks of late-successional forest as well as large blocks of early successional forest. The current pattern is of smaller blocks of late-successional forest and highly fragmented small blocks of early seral stands.

Within the Transition Zone both the quality and quantity of late-successional forests are low. We have less late-successional forest than what was typical before 1855. Further, the quality of what late-successional forest remains is low. Stands are denser than typical of pre-1855 conditions and more dominated by late successional, fire sensitive species. Many stands have much higher levels of insects, disease, and mistletoe than was typical. Lastly, the Transition Zone used to contain a mix of medium and large sized continuous blocks of late-successional and early successional forest. The current forest is highly fragmented except in the Rocky Burn.

Within the Eastside Zone the Old Growth forest has been completely lost, primarily due to fire exclusion. The forest that remains is of low quality, highly susceptible to epidemic insect attack and stand-replacing fire. The Eastside Zone has lost habitat or contains severely degraded habitat for species dependent on large old ponderosa pine.

Aquatic Section

The key physical components of the aquatic ecosystem include:

- floodplains
- banks
- pools and riffles
- the water column
- subsurface water

These physical components are created by:

- rocks
- sediment
- large wood
- favorable water quantity and quality

The source areas for all these materials are the headwaters, adjacent uplands, and riparian areas. Delivery mechanisms include landslides and floods. *Streams are disturbance dependent ecosystems.* The FEMAT scientists specifically stated that they do **not** expect all of the desired features to occur in a specific stream reach, but they **should** occur throughout a productive watershed.

Large wood serves to:

- influence channel morphology by affecting longitudinal profile, pool formation, channel pattern and position, and channel geometry
- trap sediment and organic matter
- affect the formation and distribution of aquatic habitat units
- provide cover and complexity
- act as a substrate for biological activity

Large wood enters streams from the adjacent riparian zone, from tributaries that may not be inhabited by fish, and from hillslopes.

The FEMAT report defined favorable water quality as well oxygenated water generally less than 68° F at all times of the year and free of excessive amounts of suspended sediments and other pollutants that could limit primary production and benthic invertebrate production. [The temperature listed in the FEMAT report may be a typographical error.] It defined favorable water quantity as the timing, magnitude, duration, and spatial distribution of peak and low flows sufficient to create and sustain riparian and aquatic system habitat and to retain patterns of sediment, nutrient, and wood routing. They also noted that the timing, variability, and duration of floodplain inundation and water table elevation in meadows, floodplains, and wetlands affect the maintenance of main channel connectivity.

In terms of favorable water quality and quantity, harvest and roading have the largest effects. Harvest affects rain and snow interception, fog drip, transpiration, and snow accumulation and melt but is a temporary effect. As new vegetation replaces what was cut, these effects become less pronounced over time. Roads, on the other hand, increase surface runoff while the associated ditches extend drainage networks, collect surface and subsurface water, and transport this water quickly to streams. The effects from roads are as permanent as the roadbed itself.

The diversity of fish communities is strongly influenced by habitat complexity. Factors which define habitat complexity include:

- variety and range of water depths and velocities
- number of pieces and size of wood
- types and frequencies of habitat units
- variety of bed substrates

Large deep pools (>6 ft deep and 50 sq yds surface area) are a primary characteristic of high quality aquatic ecosystems. The number of such pools have decreased across the area covered by the Northwest Forest Plan primarily due to filling in by sediment, loss of pool forming structures such as boulders and large wood, and channelization. Other activities which simplify aquatic habitat include reduction of wood in channels, constricting channels with bridge approaches or streamside roads, and increased mass failures.

The riparian ecosystem is intimately connected to the aquatic ecosystem. The riparian ecosystem functions include:

- providing large wood to streams
- moderating temperature and light levels

- stabilizing banks via root systems thereby allowing development and maintenance of undercut banks and protecting banks from large storm flows
- contributing leaves, twigs, and fine litter to the aquatic system food base

At the landscape scale the Aquatic Conservation Strategy is designed to:

1. Limit or exclude land use activities in parts of the watershed prone to instability.
2. Minimize increases in peak flows due to land use activities.
3. Protect headwater riparian zones so that debris flows contain the large wood and boulders necessary for creating habitat downstream.
4. Limit bank erosion from land use activities.
5. Ensure an adequate and continuous supply of large wood, shade, and microclimate protection.
6. Target the watersheds currently containing the best habitat or with the greatest potential for recovery for increased protection and as priorities for restoration programs.

At present, the scientific understanding of fish habitat relationships is inadequate to allow definition of specific habitat requirements throughout the life cycle at the watershed level. We know the general habitat needs but we cannot specify how these habitat conditions should be distributed through time and space to provide those needs.

The FEMAT scientists clearly state: "Structural components of stream habitat must not be used as management goals in and of themselves. No target management or threshold level for these habitat variables can be uniformly applied to all streams. While this approach is appealing in its simplicity, it does not allow for natural variation among streams." In other words, simply attaining specific values does not insure that aquatic ecosystem processes are protected.

As part of the ACS objectives, we now have Riparian Reserves. Riparian Reserves should serve several purposes:

- Riparian dependent resources receive primary emphasis.
- Maintain the hydrologic, geomorphic, and ecologic processes that directly affect streams, stream processes, and fish habitats.
- Include the primary source areas for wood and sediment such as landslides and landslide-prone slopes in headwater areas and along streams.
- Connect all parts of the aquatic ecosystem including maintaining and restoring riparian structures and functions of intermittent streams.
- Enhance habitat conservation of species dependent on the ecotone between riparian areas and uplands, including providing improved travel corridors for many terrestrial plants and animals.

Interpretations of FEMAT-Aquatic Section

In reading the FEMAT report, it became clear that the overriding concern was on the **processes** that affect aquatic and riparian ecosystem functioning and habitat quality and not on the individual elements that make up that habitat. It is perfectly acceptable to have sediment enter the streams, but not more sediment than the system has evolved to handle. It is desirable to have occasional landslides, blowouts, and gutting of streams as long as it does not happen at more frequent intervals than the streams evolved under. The concern seems to be similar to one of the terrestrial concerns: disturbance is not bad, in fact it is needed to keep systems healthy. However, systems become unhealthy when human activities drastically alter the timing, frequency, duration, and severity of those disturbances. Therefore, to meet the **intent** of FEMAT and the Northwest Forest Plan, our efforts should focus on *maintaining, enhancing, or restoring the processes that drive aquatic and riparian ecosystem functioning.*

The FEMAT scientists did not address one factor that may have an even larger influence on aquatic and riparian ecosystem functioning than roads. We can build, redesign, close, rip, or obliterate roads and stream crossings more-or-less as we deem fit. However, the streams in the White River subbasin are subject to irrigation withdrawals. These withdrawals are even more permanent than roads since they are tied to water rights controlled by the state. The impacts of irrigation withdrawals are somewhat less where the ditches do not flow year-round. In those streams, high flows tend to be more preserved since the period of highest flow occurs before the irrigation season begins. However, the diversion point effectively blocks the further downstream movement of large wood, sediment, and boulders.

The FEMAT scientists did not consider the role of hardwood trees in riparian functioning. Through much of the range of the northern spotted owl, hardwood tends to have a brush form rather than a tree form. Where it does form trees, the trees are not considered to be of sufficient size. This lack of consideration may be because in much of the area covered by the Northwest Forest Plan, riparian areas normally dominated by large hardwood trees are rare. What little information we have been able to find on historic vegetation coupled with what we find along our streams today suggests that certain streams in the Crest Zone and most streams in the Eastside Zone were dominated by large diameter cottonwood and willow trees.

In order the meet the intent of FEMAT we believe we need to:

1. Describe the relevant disturbance processes for the streams in White River subbasin.
2. Examine how past and present land uses have affected those processes and relevant stream features.
3. Develop Riparian Reserve width recommendations that account for the local processes and meet the ASC objectives.
4. Develop a list of recommended restoration projects.

Results of Tasks--Aquatic/Riparian Ecosystems

Relevant Disturbance Processes

Before we could confidently tackle the disturbance processes we had to review many of the descriptions and assumptions made by the FEMAT scientists to verify whether they applied to White River subbasin. Further, we felt we needed to consider the riparian ecosystems in conjunction with the aquatic ecosystems.

Physical components. All the physical components listed are important to White River subbasin. Pool size does differ a great deal from the description in FEMAT. Channel morphology, stream gradients, and topography prevent such large pools from forming in most of the White River subbasin. Pocket pools are much more important and prevalent than channel-wide pools. Large channel-wide pools typically form only as the result of landslides that block a stream (extremely rare in White River subbasin) and beaver ponding. A high quality pocket pool is one that is at least twice as deep as the adjacent riffle and encompasses 50% or more of the water volume at that location. Subsurface water is very important in White River subbasin.. The subbasin may have more subsurface flow than surface flow, particularly in late summer and fall.

Delivery mechanisms. Landslides are not a significant delivery mechanism for rocks, sediment, and large wood in White River subbasin. Small avalanches may be significant in some smaller streams in the Crest Zone. More important delivery mechanisms include those which kill or topple trees in the riparian area or adjacent uplands such as fire, insects, disease, and, to a limited extent, wind.

Large wood functions. In addition to the functions listed, large wood provides a stream crossing method for non-arboreal animals. This function may be a critical connectivity link across streams for small animals.

Water quality and quantity. Redband trout can tolerate much warmer water than other salmonids. This species has been noted feeding in streams as warm as 75°F. High quality water occurs at a lower temperature than 75°F but may also occur at a higher temperature than 58°F (Oregon State water quality standard).

Favorable water quantity should also retain the patterns of bank and streambed scour. The water table is generally within the range of natural variability within the National Forest boundary except within the Rocky Burn on Rock Creek above Rock Creek Reservoir and Threemile Creek above the 2710 road. Within the Burn, these two creeks are downcutting. Conversely, Threemile Creek appears to be aggrading near the Forest boundary. We are not sure why since this stream is dewatered in summer about 1 1/2 miles west of the Forest boundary.

Gate Creek subwatershed contains vernally wet meadows just west of the Forest boundary. These meadow complexes do not appear to be hydrologically connected even through subsurface flow to the rest of the subwatershed. Water collects during early spring in scablands between areas of deeper soil and usually evaporates before June.

In terms of favorable water quality and quantity, harvest does not affect fog drip since fog drip is not a significant factor in White River subbasin. Harvest can affect the presence and frequency of frost heaving if harvest creates a frost pocket. Frost heaving is a source of sediment and improves percolation. Frost heaving is most significant in the Crest Zone, due to prolonged cold and overall colder winter temperatures and in the Eastside Zone due to the greater amount of bare soil and the lack of snow cover in winter. In addition, persistent winter fog develops in the Eastside Zone north of White River. The fog blocks radiant heat from otherwise sunny days and persist for several days to several weeks. Temperatures can remain below freezing under the fog and rise above freezing elsewhere. Large areas of frost heaving can occur under these persistent fogs.

Even more significant than harvest and roads are the irrigation withdrawals in White River subbasin. The withdrawals significantly reduce both water quantity and quality. The reduction in quantity leaves the stream less able to absorb or otherwise deal with sediment and heat inputs that otherwise might not have a significant impact. The withdrawals are even more permanent than the roads since the Forest Service does not control water rights but they do control the road network.

Habitat complexity. Additional factors in habitat complexity include:

- Seasonal flow - some intermittents are fish bearing only part of the year and/or not every year
- Annual temperature fluctuations
- Species of wood
- Stream order

Habitat simplification. Other factors that simplify aquatic and riparian habitat are:

- Irrigation withdrawals - decrease the number and size of pocket pools, reduce bank and bed scour, increase sediment deposition rates, reduce wood movement, redistribute total number of riparian acres in the watershed, decrease peak and low flows
- Road maintenance - removes rocks and wood that otherwise might have fallen into the stream or riparian area, increases sediment from sidecasting soil and fine rock. Winter sanding along Highways 35 and 26 results in very high sediment loads in Barlow, Clear, Iron, and Mineral creeks
- Culverts - prevent wood passage

- Fire exclusion - reduces riparian vegetation and habitat diversity
- Loss of beaver - reduces riparian hardwood tree communities, especially important for black cottonwood and possibly for aspen
- Ditch blowouts - high sediment source
- *Intense recreation use - high sediment* source, compaction, loss of riparian vegetation

Riparian ecosystem functioning. Other functions of the riparian ecosystem include:

- storing water thereby moderating flow and extending the flow period, particularly on intermittents
- providing habitat for riparian-dependent species and aquatic species that include a terrestrial stage in their life cycle
- moderating humidity
- intercepting sediment

Riparian hardwoods. The FEMAT report did not discuss riparian hardwood communities in any detail. In White River subbasin, riparian hardwood trees are an important source of habitat diversity. The impression in the FEMAT report is that hardwoods are less desirable than conifers. It is true that a *hardwood log will not last as long in a stream* as a conifer log of the same size. For example, a hardwood log less than 18 inches in diameter tends to flush out where a conifer log of the same size tends to remain in place.

However, hardwood trees can serve many important functions. Hardwoods differ chemically from conifers, which could have a significant effect on macroinvertebrate species compositions and population levels. Since all our hardwoods are deciduous, streamside trees contribute a large input of leaves every year. Hardwood trees shed large branches more frequently than conifers. Hardwood tree communities provide a habitat for certain species that would not be present or as prevalent without these communities. For example, downy woodpeckers are dependent on riparian hardwood trees. Oregon black truffles tend to grow on cottonwood. Hardwoods are a primary production area for butterflies.

Beavers are dependent on riparian hardwood trees. Beaver ponding has a significant impact on aquatic habitat. Beavers are the only known source of large, channel-wide ponds in the White River subbasin. Beaver ponds trap more organic material, such as hardwood leaves, than other channel structures. The *combination* of beaver ponding, flooding, and fire promotes the development and retention of hardwood tree communities in the Crest Zone, increasing ecotone habitat and overall species richness.

Purposes of Riparian Reserves. We added some refinements to the purposes for Riparian Reserves:

- Riparian dependent resources receive primary emphasis (no change).
- Maintain the hydrologic, geomorphic, and ecologic processes that directly affect streams, stream processes, fish habitats, *riparian vegetation, and riparian habitats.*
- Include the primary source areas for wood and sediment. *The primary source areas for large wood is along streams and further upstream. Recognize that in a normal water year peak flows can move wood 100 yards or more.*
- Connect all parts of the aquatic ecosystem including maintaining and restoring riparian structures and functions of intermittent streams. *Even intermittent streams and ephemeral streams that do not support riparian vegetation are important sources of small wood, leaves, twigs, nutrients, sediment, and subsurface water.*
- Enhance habitat conservation of species dependent on *both the riparian areas and* the ecotone between riparian areas and uplands, including providing improved dispersal and travel corridors for many terrestrial plants and animals.

Pre-1855 Disturbance Processes

Zone	Disturbance Process	Remarks
Crest	Stand-replacing fire	Infrequent but large scale. Create snags and large openings. Large pulse of nutrients. High intensity rain shortly after fire can result in large pulse of ash which rapidly and drastically reduces pH and kills fish and macroinvertebrates. Increased sediment from areas of high severity burning on steep slopes. Within 5-10 years, large episode of large wood input followed by long period of little or no wood input. Riparian area not a barrier to fire spread. Large areas along streams burned, some intermittent streams may be burned along entire length.
	Mudflows	Mainstem White River only, although affects lower Iron and Mineral creeks. Originates on Mt. Hood. Buries forests and kills trees but trees may not fall for many decades. Can create frost pockets. Moves boulders and trees. Changes river course and locations of stream confluences. Large pulse of sediment during original event and as new river course and confluences stabilize. Redistributes stream and riparian large wood, creates logjams. Changes pool and riffle size and location. Change channel morphology. Most events run out on White River sand flats but can reach the Deschutes River.
	Rain-on-snow, floods	Many of same effects as mudflow but can occur on all streams. Rain-on-snow rarely a significant event but produces a winter flood. Effects greater downstream.
	Frost	Favors frost hardy species such as lodgepole pine and riparian hardwoods. Can create meadows. Retards succession. Linked to mudflows, floods, fire.
	Insect epidemics	Defoliators. Creates conditions suitable for stand-replacing fire and increases severity of rain-on-snow events. Creates snags and downed wood.
	American Indian burning	Camp Windy and upper White River only. Repeated burning on short intervals (5-7 years). Reduces soil nutrients and organic matter. Disfavors trees and favors shrubs and meadows (huckleberries). Creates frost pockets. Increases soil bulk density as lose organic matter, reduces water infiltration.
	Beaver ponding	White River, Barlow, lower Iron, Mineral, and Boulder creeks only. Creates large pools. Favors riparian hardwoods, especially cottonwood, willow, and aspen. Creates conditions suitable for hardwood trees. Retards succession. Increases riparian area.
Transition	Stand-replacing fire	See above. More frequent and smaller scale than in Crest Zone.
	Underburning	Relatively frequent and covered moderate to large sized areas. Favors fire resistant species, disfavors fire sensitive species. Small to moderate pulse of nutrients. Create scattered snags. Riparian area often a barrier to fire spread.

	Rain-on-snow, floods	Same as above. Rain-on-snow events more frequent than in Crest Zone. Impacts higher, more wood moved, more logjams created, greater changes in pools, riffles, channel morphology.
	Insect epidemics	Defoliators and bark beetles. Epidemics tend to cover a smaller area during any given event. Tend to be restricted to areas which have escaped burning long enough to support significant numbers of host species.
	Disease	Primarily root disease. Mostly restricted to pockets which have escaped burning for longer than usual interval and have higher than normal component of host species.
	Beaver ponding	Same as above. Relatively infrequent due to lack of riparian hardwood trees. Primarily restricted to east edge of zone.
Eastside	Underburning	Frequent and covered large areas. Very low intensity. Favors fire resistant forests. Small pulse of nutrients. Create scattered snags. Riparian area usually a significant barrier to fire spread. Dominated by American Indian burning.
	Rain-on-snow, floods	Same as above (see Crest Zone). Rain-on-snow events relatively rare due to lack of snow. Highest level of flooding impacts due to cumulative effects and larger streams.
	Insect epidemics	Bark beetles. Usually small scale (individual trees or small clumps) tied to tree age and patch density. Creates snags.
	Beaver ponding	Same as above (see Crest Zone). Significant in all streams.
	Flood deposition	Similar effects as mudflow but deposits not as deep.

Post-1855 Disturbance Processes

Since 1855, we have added the following disturbance processes:

- Reservoir and pond construction (primarily Crest and Eastside zones)
- Irrigation diversions and withdrawals (primarily Transition Zone)
- Roading (all zones)
- Channelization (primarily Eastside Zone)
- Timber harvest (all zones)
- Grazing (all zones)
- Permanent human settlement (primarily Eastside Zone)
- Recreation (all zones)
- Application of various herbicides and pesticides (primarily Eastside Zone)
- Mushroom raking

In other cases, human occupation has resulted in certain changes that are not necessarily disturbance events but could have significant impacts on aquatic and riparian functioning. These changes include:

- Extirpation of wolf, lynx, and grizzly bear
- Introduction of nonnative plants, animals, and fish

- Reduction in beaver populations on within the Forest boundary
- Increased populations of deer, elk, pocket gophers
- Fire exclusion
- Shift in burning from predominately during the dormant season for plants to predominantly during the active growing season
- Pile burning verses landscape or site burning
- Reduction in the average size of trees
- Shift toward dominance by late-successional tree species (climatic climax species)
- Increased soil compaction

Of the pre-1855 disturbance processes, we have had no effect on the frequency of mudflows and rain-on-snow events. We have reduced the fire frequencies, particularly in the Transition and Eastside zones, thereby increasing the frequency and scale of insect and disease outbreaks. We have eliminated American Indian burning and not replaced it with another disturbance type. We have virtually eliminated beaver ponding within the Forest boundary by reducing the disturbances that created favorable habitat.

The results of all these changes include increased sediment delivery to the streams, reduced availability of very large wood, reduced water quantity below irrigation diversions and possibly increased water quantity above diversion points, and reduced water quality due to increased sediment and water temperature. We do not clearly understand the effects of losing riparian hardwood tree communities. The effects on the key physical components include:

- Floodplains - generally smaller, less able to function as sponges and areas to slow water velocity.
- Banks - less stable where vegetation is more sensitive to disturbance (shift in community to a more fire sensitive one with concurrent shift from predominance of underburning to predominance of stand-replacing fire) and where vegetation is reduced (Rocky Burn, high recreation use areas, OHV trails, livestock trails into streams and other watering locations).
- Pools and Riffles - fewer pools where large wood movement is blocked (irrigation diversions, culverts, streamside roads), stream power reduced (below irrigation diversions that remain open year-round), sediment levels higher than typical of pre-1855 conditions, beaver populations reduced or eliminated (streams within the Forest boundary), and where introduced winter annual grasses dominate (more bare ground, roots shallower and less able to hold soil, reduced vegetation cover in summer and fall).
- The Water Column - reduced below irrigation diversions, eliminated where diversions dewater streams (Lost Creek near confluence with Boulder Creek; Threemile Creek, Rock Creek ,Gate Creek near or at the Forest boundary; short stretch of Frog Creek); may be reduced where land management has increased stand densities and resulting evapo-transpirational demands (potentially Eastside Zone).
- Subsurface Water - forced to surface in compacted intermittents and ephemerals and along roads; may be reduced where increased stand densities have increased evapo-transpirational demands.

Riparian Reserve Width Recommendations

The goal of Riparian Reserves is to maintain the natural disturbance regime appropriate to the zone in which a stream flows through. Almost all streams cross two zones and several cross all three. Riparian Reserves are **not** intended to be areas of no management. The intent is that land uses and management activities will either incorporate riparian processes and functions or to maintain, develop, or enhance riparian resources. Land uses or events that mimic or include natural disturbance regimes and landscape patterns are acceptable and, in some cases, desirable.

General guidelines for increasing Reserve widths beyond the interim widths are:

1. Area has a high density of mapped and unmapped springs, and/or many wet area indicator species (see proposed Riparian Reserve for upper Boulder Creek).
2. Consolidate complexes of meadows, rocky slopes and talus patches, and intermittent streams.
3. Connect wet meadows to nearby intermittent streams where not directly connected to a perennial stream.
4. Consolidate headwall areas where many intermittent streams originate.
5. Protect wet meadows, Key Site Riparian Areas identified in the Mt. Hood Forest Plan, and other wetlands greater than 1 acre, insuring that Riparian Reserve width provides adequate protection to meet the management objectives of these sites.
6. Protect microclimate for *Botrychium* spp. in cedar swamps regardless of swamp size (Reserve boundary approximately 200 feet wide).

Specific guidelines include:

1. Within well defined canyons, the Riparian Reserve should run rim-to-rim. Purpose is to incorporate primary large wood and sediment sources.
2. Incorporate all of White River floodplain above Deep Creek into one continuous reserve. Purpose is to recognize channel shifting and high levels of subsurface flow (see White River Wild and Scenic River EA and Management Plan for more details on hydrology of upper White River floodplain).
3. On reservoirs with large drawdown zones, use interim widths for constructed ponds and reservoirs as measured on horizontal distance. Purpose is to reduce recreation uses that prevent development of riparian vegetation within the drawdown zone and to reduce sediment input from recreation use of drawdown zone.
4. In Badger Wilderness, use the interim widths as described (slope distance) for the various stream types and lakes. Purpose is to better guide recreation management and development of wilderness fire plan.
5. If Riparian Reserve crosses a large paved road paralleling a stream evaluate whether the riparian processes and functions can be met by shifting the Reserve to one side of the road. If they cannot, the Riparian Reserve should cross the road. Examine include what impacts the drainage ditch network, culvert locations, and drainage flows have on the stream to which the Reserve is assigned. If the water from the ditch opposite the stream eventually flows into that stream, then the Reserve should incorporate that ditch network. Examine whether the road has created an unstable area above the road. If so, expand the Reserve to incorporate the unstable area. Purpose is to address atypical sediment source.
6. Where ditches use natural channels but are not fish-bearing, establish a Riparian Reserve using the guidelines appropriate for the type the stream would be if it was not used as a water transmission corridor (usually intermittent). Purpose is to protect water quality consistent with state standards.
7. Establish a perennial fish-bearing Riparian Reserve on any ditches that use natural channels and are fish-bearing. The purpose of such reserves is to maintain suitable water temperatures for fish using the natural channels. The Reserve along the constructed portion of the ditch is not intended to prohibit maintenance to protect its function as a water transmission corridor. This Reserve is intended to be consistent with the management strategy of the Mt. Hood Forest Plan (see FW-085, FW-086, FW-706, FW-707, FW-708, B7-049, and B7-050)

8. On south aspects of perennial streams in very dry areas, the Riparian Reserve may be narrowed where there is little or no riparian vegetation beyond the immediate stream channel AND the slope immediately above the stream contains few large trees (naturally low downed wood potential). The Riparian Reserve must include all riparian vegetation or the 100 year floodplain, whichever is greater. The purpose is to recognize where certain aspects do not contribute very much to riparian functioning beyond topographic shading.
9. On north aspects of perennial streams in the Eastside Zone, the Riparian Reserve width should include all the potential area that will support stable Cathedral forests. The purpose is to provide connectivity and dispersal for wildlife species dependent on more closed canopy forests and big game severe weather, or thermal, cover.
10. On intermittents the Riparian Reserve should not extend beyond the sideslope gradient break that defines the actual riparian area. Consider soil type, slope, and aspect in defining these reserve widths for downed wood and sediment potential. The purpose is to only include that area which contributes to riparian functioning of a given intermittent.
11. In flatter areas with substantial subsurface flow, consider establishing Riparian Reserves on ephemerals. The purpose is to recognize the importance of subsurface flow in areas with little surface flow. Examples of such areas include Gate subwatershed, the Douglas Cabin area in Badger-Tygh subwatershed, and Owl Hollow in Jordan subwatershed.
12. Riparian Reserve widths may need to be adjusted where harvest has greatly narrowed or severed links within what would normally be considered the riparian area. The purpose would be to provide connectivity for dispersal of late-successional species. The Reserve would return to its "normal" location once the harvested areas have recovered sufficiently to provide for dispersal of those species.

Riparian Reserves will not be 100% late-successional forest. First, such a condition would place these areas outside the Range of Natural Condition. Second, corridor connectivity should not be totally dependent on Riparian Reserves. For many species the main corridor needs for dispersal are north-south yet many of the streams in White River subbasin run west-east.

We expect vegetation management to occur within Riparian Reserves to meet Reserve objectives. On areas otherwise suited for ground-based harvesting systems the following guidelines should apply:

1. In previously harvested areas avoid constructing or designating any new skid trails within a Riparian Reserve.
2. Where equipment must enter a Riparian Reserve to remove felled trees, use existing skid trails and roads.
3. Directionally fell trees away from the stream within a Riparian Reserve.
4. Do not use bulldozers to pile slash within a Riparian Reserve. Instead use a grapple piler or other equipment that can operate from the designated skid system.
5. Avoid crushing slash within a Riparian Reserve in the Eastside Zone.

On areas suited for aerial harvesting systems the following guidelines should apply:

1. Keep cable corridors as narrow as possible.
2. Evaluate the feasibility of harvesting systems that do not create straight corridors. Examples of such systems to consider are zig-zag yarding systems and helicopter yarding.

Preliminary Peakflow Report
White River Watershed Analysis

APPENDIX H -

I. Introduction

Analysis of peak streamflows is important for several reasons. Ecologically, the most significant acute impacts from flowing water happen during infrequent, high volume flows. Streambanks and beds are scoured, massive amounts of sediment are moved, and riparian vegetation may be altered. More significant from year to year is the impact of the bankfull flow. Bankfull flow is often described as the high flow during two out of three years, or as a stream discharge having a recurrence interval of 1.5 years (Dunne and Leopold, 1978). The shape of the channel more closely reflects the bankfull width and height than it does the less frequent floods. If the bankfull flow is raised above the range of natural conditions, excess scouring can occur. If lower, the stream may not have the power to move its natural sediment load and cause sediment deposition within the watershed. Both condition may lead to excessive headcutting. From a human perspective, increased peakflows may place life and property at risk from flooding.

II. Methods

Peakflow was analyzed for the White River subbasin both by a qualitative examination of current and historical processes in the drainage, and quantitatively through the use of two hydrologic models and an examination of flow records from the USGS gaging station at White River falls. The models used are the Aggregate Recovery Percentage (ARP) model, to compare the current state of hydrologic recovery of the basin with the of the base, pre-management condition, and the Water Available for Runoff (WAR) model, to compare the changes in peakflows between the existing condition and a hydrologically recovered, more fully forested condition.

III. Processes Affecting Peakflows in the White River Subbasin

Judging from the vegetation patterns indicated on a 1901 map of the White River drainage, it is likely that periodic burning by Native Americans was practiced there. Increased burning would likely have increased peakflows occurring in the fall in the drainage by reducing evapotranspiration, unless the prescribed burning at lower intensities reduced the incidence of larger scale, more catastrophic burning.

Europeans first settled the basin in about 1855 and irrigation began soon thereafter. Though irrigation withdrawals have a significant impact on baseflow, the impact on peakflow is negligible unless the water withdrawals continue year-round. There are currently several year-round irrigation ditches, though the number of these ditches is not high enough to cause much of a decrease in to peakflows.

Historically, there were much higher levels of large wood in the streams in this basin. Wood has been removed in salvage logging and stream "cleaning" operations. One physical effect of large wood in stream channels is to slow down moving water, which tends to desynchronize the timing of peak inflow and outflow of water, reducing the peakflows. The removal of beaver from most of the basin has further reduced peak flows, though this effect is likely to be noticed only at the smaller peakflows. Large natural openings in forested areas in this basin, historically, were created by fire. Today they are caused by clearcuts and agriculture. A significant hydrologic difference between these two types of openings is that natural openings from fires typically had many snags whereas clearcuts and agriculture are largely devoid of snags. An opening with a high snag density retards the development of a large snowpack which in turn leads to a smaller contribution to the peakflow. Channelization with mechanized equipment in the lower part of the basin has also likely increased peakflows by reducing channel lengths. This results in steeper stream gradients, which speeds the throughput of flowing water and frequently reduces streambank roughness which increases stream velocity.

Based on the processes examined here, it is safe to say that current management in this basin has caused an increase in peak flows relative to likely flows without such management. The changes in resulting peakflows are likely influenced most heavily by climatic changes, especially in this basin, where the range of annual precipitation currently varies from about 12 to 120 inches per year.

IV. Streamflow Records

There is one USGS gaging station currently operating in the White River basin, located below White River Falls at River Mile 2.0. The period of record is 1919-1987, or 68 years. All streamflow figures reported here were taken from this single gaging station (USGS, 1990). The maximum recorded streamflow for the period of record is 13,300 cfs on 1/6/23. For an estimate of bankfull discharge, the published 2-year, 7-day flood has been used. Table 1 compares the bankfull flows of the White River with those of nearby basins. Flow data for the Hood River has been included here to show the influence of precipitation on peak flow. Annual precipitation in the White River subbasin varies mostly from 12 to 70 inches a year with higher annual amounts near the peak of Mt. Hood, while the annual precipitation in the Hood River basin varies from 30 to 150 inches per year. Most precipitation in the subbasin falls as snow. On an annual basis, bankfull/peak flows occur during April or May, as a result of snowmelt. The less frequent large peak flow events are caused by rain-on-snow events. The regional flood of December, 1964, is often used as a benchmark to determine the effects of a 100-year flood event on the landscape.

Because human occupation of floodplains is much lower in the White River subbasin than in nearby, more populated subbasins such as Fifteenmile Creek, not as much information, either formal or anecdotal exists on the effects of the 1964 flood on the White River subbasin. Anecdotal evidence indicates that the flood was significant enough for residents of the town of Tygh Valley to clear wood from and straighten portions of Tygh Creek and the White River in an attempt to ameliorate the impacts of future floods, a practice instituted at the same time in nearby streams. Unfortunately, such practices have the opposite effect from that intended and do additional long-term ecological damage.

TABLE 1: *Peak Flow and Water Yield at White River and Nearby Basins*

			7-day, 2yr		Instantaneous	
Location	Area, sqmi	Elev.ft	Peak Flow cfs	Yield cfs/sqmi	2yrPeak Flow cfs	Yield cfs/sqmi
White River below Tygh Valley	417.0	870	1720	4.12	3040	7.29
Warm Springs River near Kahneeta	528.0	1400	1560	2.97	2940	5.56
Shitike Creek near Warm Springs	75.8	1800	334	4.41	619	8.17
Deschutes River near Madras	7820.0	1390	6900	0.88	?	?
Hood River at Tucker Bridge	279	383	4510	16.16	11100	39.78

V. Hydrologic Models

Two hydrologic models have been used in this analysis and elsewhere on the Mt. Hood National Forest to predict the likely volume of peakflows in a drainage in its existing state, and to compare it with a state of altered vegetation. The comparison is usually between the existing condition and a past or future desired or base condition. These two models are the ARP model and the WAR model (designed by the Washington State Department of Natural Resources). The ARP model is a risk prediction model, intended to predict the susceptibility of a watershed to sustain damage from winter rain-on-snow events. The theoretical basis for the model is described fully in a paper by Jere Christner (1981). This model predicts this risk solely on the basis of the state of hydrologic recovery of the vegetation and does not account for variations in climatic, geographic, or other enviromental factors. The Mt. Hood NF Land and Resource Management Plan (LRMP) (1990) uses a minimum desired threshold for ARP of 65% for a watershed. Thus the watershed impact area should not exceed 35%.

The ARP model was used here to indicate only a general state of recovery and has a wide range for the standard error. The reason for this is twofold. First, ARP was designed to be used on watersheds smaller than the White River subbasin. Second, the base condition with which the existing condition was compared, is based on estimates from a crude map made in 1901. The base condition chosen was a "pre-management" condition to determine how the results of ninety years of management have changed the state of hydrologic recovery of the White River subbasin. Because the ARP model is intended for forested land, the analysis area was limited to elevations in the subbasin above 2400 feet, the lower boundary of the rain-on-snow zone. Surprisingly, there is no significant difference between the estimated ARP value for

1901: 73.7% and that for 1991: 70.5%. In both scenarios, the percentage of land in hydrologically recovered spruce-fir forest is about the same. Significant differences in vegetation categories are a reduction in partially recovered pine-oak to partially recovered spruce-fir forest types from 1901 to 1991, and a reduction in the percentage of naturally nonvegetated land.

The WAR model was used to estimate the difference in peak flows between the existing (1991) condition and a "fully-forested" condition. For the purposes of this model, fully-forested means that all land above 2400 feet, the lower elevation boundary for the rain-on-snow zone, and receiving at least 25 inches of rain per year, were modeled as fully forested, except those that are considered naturally unvegetated, such as talus slopes, open water, and perennial snow fields. The White River subbasin was stratified into nine areas: three elevational zones in each of three watersheds. The elevational zones are the rain-dominated zone, comprising all land below 2400 feet above mean sea level; the rain-on-snow zone, comprising all land between 2400 and 4800 feet; and the snow-dominated zone, comprising all land above 4800 feet. The three watersheds were the three fifth-field watersheds in the HUC system: White River mainstem (1707030616), Rock-Threemile-Gate (1707030629), and Badger-Jordon-Tygh (1707030630). The vegetation database used for this analysis is the satellite-based ISAT database. Because this database did not include vegetation for the Postage Stamp and Shearer's Bridge quadrangles, vegetation for those areas were stratified by aerial photo interpretation.

Inputs to the WAR model are vegetation type, windspeed, precipitation, temperature, and snowpack snow-water equivalent. These variables were used to produce the thickness of a layer of "water available for runoff." Details of this procedure are described in detail in the Washington Forest Practices Watershed Analysis Handbook (Washington Forest Practices Board, 1993). Windspeed data was taken from the Wamic RAWS station. Precipitation and temperature data was estimated from NOAA data at the Dufur station and from an isohyetal map in a Mt. Hood NF Plant Association Guide (Topik et al, 1988). Snowpack information and additional air temperature data were taken from the Clear Lake SNOTEL site. The results from the WAR model are presented in Tables 2A-2D.

Streamflows were then estimated using a set of regional regression equations published by the USGS (Harris and Hubbard, 1983). For the White River subbasin, the equations for the "North Central Region" were used. Inputs to these equations are drainage area, mean annual precipitation, and mean minimum January temperature. Of these three variables, temperature is most subject to mis-estimation so temperature was varied to calibrate the model. Fortunately, a 68-year period of record for streamflow was summarized for the White River USGS gaging station in 1987 (Moffat et al, 1990) and this data was used to calibrate the prediction equations. Specifically, the values for instantaneous peak flow at specified return intervals were used for the calibration procedure. Because the flow records captured rain-on-snow events, described as "unusual storms" in the WAR methodology, the regression used WAR values for unusual storms. With the model calibrated, flows for each of the three subbasins could be estimated with greater confidence.

A linear regression was used to convert WAR thicknesses to streamflows, using streamflow as the dependent variable with WAR as the independant variable. The r-squared values for this six data point regression (2,5,10,25,50, and 100-year storms) was between 0.95 and 0.98 for all four regressions (one for each of the three watersheds and one for the entire subbasin).

Results. The difference in WAR for "average" storms in the existing condition relative to the fully forested condition varied from 0-6.1%, with most values being less than 4%. The biggest differences are predicted to occur for 2-year storms, and for all storms the largest changes are predicted to occur in the RockThreemileGate watershed. This indicates that of the three watersheds modeled, this watershed is in the least hydrologically recovered condition. This pattern is generally true for the unusual, rain-on-snow events, also, but the predicted percentage difference is larger between the current and the hydrologically recovered condition, ranging from 6.1% to 12.9%.

These general patterns also hold true for predicted changes in streamflow, though the predicted percentage difference is greater. For most average storms, this percent difference is generally less than 10%, except for 2-year storms on the White River Mainstem (15.7%) and RockThreeMileGate (23.4%). Differences for unusual, rain-on-snow storms are predicted to be significantly larger, ranging 17.4% to a high of 54.3% for the 2-year event on RockThreeMileGate. An important trend here is that the difference between the flows for the existing condition relative to the hydrologically recovered condition is predicted to decrease as the storms get larger and less frequent, both for average and for unusual storms. The WAR handbook estimates that predicted percentage differences in flow less than 10% could be error in the model so they should not be considered significant. Assuming that this is correct, we can safely infer from the results presented in this analysis, that there is not likely to be a significant difference between flows for average storms between the existing and hydrologically recovered conditions. For unusual rain-on-snow storms, however, we are likely to see significant differences in flows, the percent change being the greatest for the smaller storms, and the greatest changes occurring in the RockThreeMileGate watershed.

VI. Conclusion

Viewed qualitatively, the past and current management practices of stream cleaning, beaver eradication, clearcut logging, and broadcast burning all tend to increase peakflows in a basin. Changes to peakflows resulting from climate change in the past century have the potential to mask management-induced changes. The decrease in the perennial snowpack and annual precipitation on Mt. Hood observed over the current drought cycle are likely to result in smaller peakflows from both average and unusual winter storm events, as well as lower snowmelt-caused bankfull flows. The climate "unknowns" make it difficult to determine the difference in existing peakflows relative to those of the "pre-management" condition. Through the use of the ARP model, it is estimated that the state of hydrologic recovery of the basin vegetation is about the same today as it was 100 years ago.

Through the use of the WAR model, it appears that peakflows from average winter storms in the existing condition are not significantly different than those of a hydrologically recovered condition, while the likely difference in peak flows resulting from unusual rain-on-snow storms between the two conditions is likely to be significant. Furthermore, for the White River drainage, the results of this model indicate that this difference is likely to decrease as the storms become larger and less frequent. An important implication of this trend is that the impact of human management on altered peakflows is likely to be felt at the smaller more frequent storms, including the bankfull flows which are considered the channel-forming flows. Finally, of the three watersheds modeled within the White River drainage, the RockThreemileGate watershed is predicted to have the largest difference in peakflows between the current and hydrologically recovered conditions.

VII. References

Christner, Jere. 1981. Changes in Peak Streamflows from Managed Areas of the Willamette National Forest. USFS, Willamette National Forest. Eugene, OR.

Dunne, Thomas, and Luna Leopold. 1978. Water in Environmental Planning. W.H. Freeman&Co. New York.

Harris, D.D., and Lawrence E. Hubbard. 1983. Magnitude and Frequency of Floods in Eastern Oregon. US Geological Survey, Water Resources Investigations Report 82-4078. Portland, OR.

Moffatt, Wellman, and Gordon. 1990. Statistical Summaries of Streamflow Data in Oregon, Vols I&II. U.S. Geological Survey, Portland, OR.

Topik, Christopher, Nancy Halverson, and Tom High. 1988. Plant Association and Management Guide for the Ponderosa Pine, Douglas-fir, and Grand Fir Zones. USDA Forest Service, Mt. Hood National Forest. Gresham, OR.

United States Forest Service. 1990. Mt. Hood National Forest Land and Resource Management Plan Field Guide. USDA Forest Service, Mt. Hood National Forest. Gresham, OR.

Washington Forest Practices Board. 1993. Board Manual: Standard Methodology for Conducting Watershed Analysis, Version 2.0. Washington State Department of Natural Resources, Olympia, WA.

TABLE 2A: White River Mainstem, Watershed 1707030616

Acres: 126040.9 **Sqmi:** 196.9

		Water Avail for Runoff, in			Flow from WAR cfs			
Recurrence Interval	Storm Intensity	Existing Condition	Hydrologically Recovered	Percent Chg From Exstg	Existing Condition	Hydrologically Recovered	Percent Chg From Exstg	USGS eq Predicted
2 year	Average	1.9	1.8	5.5%	541	468	15.7%	
2 year	Unusual	2.5	2.3	11.0%	1202	907	32.6%	1301.3
5 year	Average	2.6	2.5	3.9%	1356	1224	10.8%	
5 year	Unusual	3.4	3.1	8.0%	2626	2132	23.2%	2347.5
10 year	Average	2.9	2.8	3.6%	1707	1553	9.9%	
10 year	Unusual	3.6	3.4	7.4%	3248	2681	21.2%	3017.0
25 year	Average	3.2	3.1	3.2%	2278	2093	8.8%	
25 year	Unusual	4.0	3.8	6.6%	4241	3566	18.9%	4088.7
50 year	Average	3.3	3.2	3.1%	2524	2326	8.5%	
50 year	Unusual	4.2	3.9	6.4%	4717	3994	18.1%	4779.8
100 year	Average	3.4	3.3	2.9%	2785	2575	8.2%	
100 year	Unusual	4.3	4.1	6.1%	5159	4392	17.4%	5872.4

TABLE 2B: RockThreeMileGate, Watershed 1707030629

Acres: 60108 **Sqmi:** 94

		Water Avail for Runoff, in			Flow from WAR cfs			
Recurrence Interval	Storm Intensity	Existing Condition	Hydrologically Recovered	Percent Chg From Exstg	Existing Condition	Hydrologically Recovered	Percent Chg From Exstg	USGS eq Predicted
2 year	Average	1.9	1.8	6.1%	283	229	23.4%	
2 year	Unusual	2.4	2.1	12.9%	636	412	54.3%	717.0
5 year	Average	2.6	2.5	4.3%	908	782	16.2%	
5 year	Unusual	3.2	2.9	9.3%	1802	1311	37.5%	1492.3
10 year	Average	2.9	2.8	4.0%	1211	1055	14.8%	
10 year	Unusual	3.5	3.2	8.6%	2383	1777	34.1%	2070.1
25 year	Average	3.1	3.0	3.7%	1568	1379	13.7%	
25 year	Unusual	3.7	3.5	7.9%	3074	2341	31.3%	3019.8
50 year	Average	3.2	3.1	3.5%	1787	1579	13.2%	
50 year	Unusual	3.9	3.6	7.6%	3539	2725	29.9%	3724.2
100 year	Average	3.3	3.2	3.4%	2027	1799	12.7%	
100 year	Unusual	4.0	3.7	7.3%	3983	3094	28.7%	4750.4

TABLE 2C: BadgerJordanTygh, Watershed 1707030630

Acres: 81903 **Sqmi:** 128

		Water Avail for Runoff, in			Flow from WAR cfs			
Recurrence Interval	**Storm Intensity**	**Existing Condition**	**Hydrologically Recovered**	**Percent Chg From Exstg**	**Existing Condition**	**Hydrologically Recovered**	**Percent Chg From Exstg**	**USGS eq Predicted**
2 year	Average	1.8	1.8	-1.9%	361	382	-5.6%	
2 year	Unusual	2.6	2.3	11.3%	1115	815	36.8%	1218.8
5 year	Average	2.6	2.5	0.2%	1066	1059	0.6%	
5 year	Unusual	3.5	3.2	10.2%	2645	1994	32.7%	2318.4
10 year	Average	2.8	2.8	0.4%	1377	1363	1.0%	
10 year	Unusual	3.8	3.4	9.7%	3315	2532	30.9%	3074.6
25 year	Average	3.1	3.1	0.8%	1916	1874	2.3%	
25 year	Unusual	4.2	3.8	9.3%	4434	3422	29.6%	4278.1
50 year	Average	3.3	3.2	1.2%	2167	2095	3.5%	
50 year	Unusual	4.3	4.0	9.5%	5017	3852	30.2%	5113.4
100 year	Average	3.4	3.3	1.5%	2439	2332	4.6%	
100 year	Unusual	4.5	4.1	9.7%	5567	4255	30.8%	6370.0

TABLE 3D: Entire White River Subbasin, 17070306 (16,29,30)

Acres: 268052 **Sqmi:** 419

		Water Avail for Runoff, in			Flow from WAR cfs			
Return Interval	**Storm Intensity**	**Existing Condition**	**Hydrologically Recovered**	**Percent Chg From Exstg**	**Existing Condition**	**Hydrologically Recovered**	**Percent Chg From Exstg**	**USGS eq Predicted**
2 year	Average	1.8	1.8	3.4%	1176	1074	9.5%	
2 year	Unusual	2.5	2.2	11.5%	2770	2036	36.1%	3081.6
5 year	Average	2.6	2.5	2.8%	3057	2830	8.0%	
5 year	Unusual	3.4	3.1	9.0%	6051	4855	24.7%	5622.3
10 year	Average	2.8	2.8	2.7%	3864	3594	7.5%	
10 year	Unusual	3.6	3.4	8.3%	7521	6121	22.9%	7302.3
25 year	Average	3.1	3.1	2.5%	5107	4765	7.2%	
25 year	Unusual	4.0	3.7	7.7%	9956	8040	23.8%	9952.8
50 year	Average	3.3	3.2	2.6%	5685	5300	7.3%	
50 year	Unusual	4.2	3.9	7.6%	11126	9019	23.4%	11639.1
100 year	Average	3.4	3.3	2.6%	6304	5871	7.4%	
100 year	Unusual	4.3	4.0	7.5%	12220	9931	23.0%	14350.4

Baseflow Report
White River Watershed Analysis

I. Introduction

Baseflow, or the slow release of stored subsurface water to surface water, is critical to watershed health. Baseflow provides during times of little or no precipitation: habitat to fish and other aquatic organisms, sustains habitat for riparian flora and fauna, and maintains cover, forage, and transportation corridors for other terrestrial wildlife. Baseflow provides for beneficial downstream human uses during the summer lowflow period. In the White River subbasin, this includes water for irrigation, livestock, municipal and domestic water supply, sport fishing, and power generation, as well as contributing to the baseflow of the watershed into which it flows, the Deschutes River.

II. Procedure

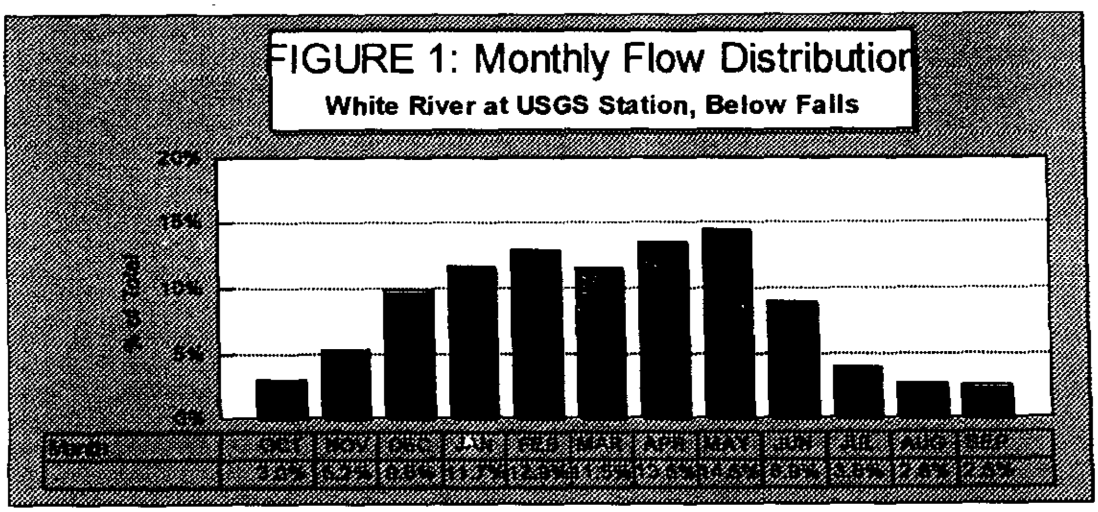
Baseflow has been analyzed with information from four primary sources of data:

·Forty years of flow data from the USGS station in the basin at White River Falls, on the White River
·The online water rights/allocation database maintained by the Oregon Water Resources Dept (ORWRD)
·Database of individual water rights in the White River basin, also from ORWRD
·Stream and ditch information from the Mt. Hood NF GIS database.

Water yield for the basin was calculated from flow data and compared with nearby East-draining basins to identify general lowflow characteristics. Next, the current water allocation status of the basin as determined by ORWRD was examined to determined if or how close the basin is to maximum allowable water allocation. Next, the individual water rights were examined to determined the types of uses in the basin. Next, the stream and ditch density on National Forest land was analyzed to attempt to determine

III. Streamflow Records

There is one USGS gaging station with a significant period of record in the White River basin, located below White River Falls at River Mile 2.0. The period of record is 1919-1987, or 68 years. All streamflow figures reported here were taken from this single gaging station (USGS, 1990). Because the published record precedes the recent drought cycle, it is possible that the low flow figures may be higher than their true values. The mean flow is the highest in May, at 743 cfs, and is lowest in September, at 127 cfs. Because of natural variation, April and May may be considered the peak flow months, and August, September, and October, the low flow months. The low flow reached for a seven-day period, on average, every two years, is 110 cfs. The lowest mean monthly flow on record is 80 cfs during August, 1941. Peak flow in this subasin is sustained by snowmelt. Summer baseflow is augmented by snow-and-glacier melt from Mt. Hood. Figure 1 shows the monthly distribution of streamflow as a percent of annual flow.



Though not a mathematically rigorous method of comparison because a large number of geographic and climatic variables affect streamflow, it is interesting to note that the summer low flow water yield of the White River basin is lower than the closest gaged basins draining the Eastern slopes of the Cascade Mountains. Table 1 displays the water yield for these basins and for a portion of the Deschutes basin. Note that the 7day, 2yr water yield for the White river is only 59% of that for the Deschutes, even though the Deschutes is highly irrigated and is considered over-allocated to irrigation in many locations and during many months by ORWRD. This is an initial indication that low baseflow may be an issue in this basin.

TABLE 1: Low Flow Water Yield in the White River and nearby Basins

Location	Area, sqmi	Elev, ft	7-Day, 2yr Low Flow cfs	Yield cfs/sqmi	7Day 10yr Low Flow cfs	Yield cfs/sqmi	Extreme cfs	Yield cfs/sqmi	Yrs Rec
White River Below Tygh Valley	417.0	870	110	0.26	86	0.206	7.5	0.02	75
Warm Springs R. @Kahneeta	526.0	1400	244	0.46	198	0.376	160	0.30	5
Shitike Creek nr Warm Springs	75.8	1600	40	0.53	24	0.316	17	0.22	13
Deschutes nr Madras	7620.0	1390	3420	0.44	3120	0.400			64

Low baseflow is a concern not only because effective habitat for aquatic organisms is reduced, but because of the probable degradation of water quality that often accompanies low flow. Stream temperatures are usually raised during low flow, in part because the width/depth ratio of a stream increases, exposing a higher ratio of surface area to volume to direct solar, and to atmospheric heating. Lower dissolved oxygen content and increased algal and pathogen populations are often the result of low baseflow.

Water withdrawals for beneficial human uses has been identified as an issue in the White River subbasin. ORWRD maintains a database of water allocation on many streams throughout the state to determine if a stream is overallocated. Criterion for overallocation is that water currently allocated (according to a formula derived from outstanding water rights) be in excess of the mean monthly flow that is exceeded 80% of the time from the natural streamflow. Table 2 shows the calculated natural streamflow (80% value), the consumptive uses, the instream water rights, and the remaining water available for allocation. Irrigation uses are considered instream water rights, all other uses (domestic, commercial, incdustrial, municipal) are considered consumptive. All values are in cfs.

TABLE 2: Water Allocation on the White River (mainstem), cfs

Month	80% Natural Streamflow	Consumptive Uses	Instream Water Rights	Water Avail For Allocation
JAN	250	8	60	182
FEB	366	13	100	253
MAR	376	12	145	219
APR	452	47	145	260
MAY	477	78	145	254
JUN	290	88	100	102
JUL	192	113	60	19
AUG	159	89.9	60	9.1
SEP	148	65	60	23
OCT	149	32	60	57
NOV	151	5	60	86
DEC	211	7	60	144

The months of August and September are the most highly allocated with only 9.1 and 19 cfs available for further allocation. But because the Deschutes River at the point of the confluence of the White and the Deschutes Rivers is considered overallocated during the months of Jan, Jul, Aug, Sep, Oct, and Nov, the White River subbasin is considered overallocated during those months - due to the cumulative impact of water withdrawal in a more regional context, and is unlikely to be granted any further water rights.

ORWRD has long-range plans to predict water allocation status on watersheds within the White River subbasin, but have not yet initiated this research. Field observations by personnel from the USFS and other public agencies indicate that overallocation of water is an issue on some of the streams within the White River subbasin, both on and off NF land. Specifically, Rock, Threemile, Gate, and Lost Creeks are completely dewatered below diversion points and Boulder, Cedar, Souva, Badger, Frog, and Clear Creeks are dewatered by withdrawals by a large enough percentage to be of concern.

IV. Water Rights

One method of dividing water rights is into "primary" and "non-primary." Non-primary water rights are limited to available water. ORWRD uses primary water rights as the basis for decision-making for new allocations. The first water rights in the White River subbasin still recognezed today were granted in 1865. According to the ORWRD water rights database used for this analysis, there are 135 primary water rights outstanding in the White River basin, including groundwater withdrawals. Of these, 122 are for irrigation, including stock watering; 4 are for domestic use; 2 for municipal use, 6 are for other industrial uses, and one for power generation at White River Falls. A water right is specified as a numerical limit in cfs, gallons per minute (gpm), or acre-feet (af), and an additional limit is often imposed on irrigated acres via a calculation based on number of irrigated acres allowed. ORWRD uses these calculations in determining the allocation status of the basin.

V. Stream/Ditch Density

Irrigation Ditches reduce the effective baseflow in a watershed in several important ways. First, by withdrawing water from the natural stream system, the quantity of water is reduced downstream. Second, irrigation ditches, especially in the White River subbasin, are rarely lined with impervious material, so that a substantial percentage of the withdrawn water is lost through seepage of this water into the surrounding groundwater. Natural stream channels are lined with varying thicknesses and sizes of geologic material, deposited over many years, that provide natural barriers to water loss by seepage. This level of substrate is usually lacking in human-created stream channels.

The increase in effective stream density due to the presence of ditches is a useful metric by which to measure the effects ditches on the stream network. Ditches also tend to reduce peak flows because an increase in stream density causes a given flow to be spread out over more miles of stream. The larger the flow, the less this effect is noticed.

There are approximately 49 miles of ditch on National Forest land in the White River subbasin. A rough estimate of the number of ditch miles off-forest in this subbasin is three times that amount, or 150 miles. On National Forest land in this subbasin there are 74.9 miles of perennial streams and 405.17 miles of intermittent streams. The increase in perennial stream density due to irrigation ditches is thus 53% (10% increase in the overall stream network). This is a significant alteration to baseflow in the basin! Given the legal framework for water rights in Oregon, options are few for ameliorating the resulting increase in stream temperature, disruption in aquatic fauna corridors, and reduction in volume for downstream beneficial uses resulting from the partial and total dewatering of stream reaches found both on and off National Forest land. One possibile method of ameliorating this situation is to line the irrigation ditches with impervious material, in exchange for a conversion of the water saved into instream water rights.

Dewatering of tributaries in the basin is masked by a unique feature of the hydrology of the White River. Summer flows on the White River mainstem are supplemented by meltwater from the White River glacier on Mt. Hood. This glacier is smaller now relative to its size at the beginning of the twentieth century and has noticeably shrunk during the current drought cycle. If this trend is not reversed, we can expect baseflows in the basin to decrease noticeably, and soon.

VI. Conclusion

Though water allocation in the White River subbasin is not currently beyond the legal threshold as calculated by ORWRD, examination of the effects of water allocation at both larger and smaller scales than the White River subbasin indicates that water is overallocated in some streams and stream reaches. The Deschutes River, the river to which the White River drains, at the point of confluence with the White River is considered legally overallocated during six months of the year. Of the streams within the White River subbasin on National Forest land, four are known to be completely dewatered below diversion points and six more are dewatered by a large enough percentage to be of concern. The White River glacier, which supplements summer lowflow, has been shrinking for at least a century. This trend, combined with the continuing drought, almost assures that summer lowflows will continue to decrease, exacerbating the existing conflicts between beneficial human uses and those by resident fauna and flora.

VII. References

Moffatt, Robert, Roy E. Wellman, and Janice M. Gordon. 1990. Statistical Summaries of Streamflow in Oregon, Volumes I and II. United States Geological Survey, Portland, OR.

Oregon Water Resources Department, 1995. Public Access On-line Water Allocation Database. Salem, OR.

Oregon Water Resource Department. 1995. Electronic Water Rights Database. Salem, OR.