United States
Department of
Agriculture

Forest Service

**Pacific
Northwest
Region**

1997

# CAVE-BEAR CREEKS WATERSHED ANALYSIS

## MT. ADAMS RANGER DISTRICT

## GIFFORD PINCHOT NATIONAL FOREST

Log Pond at Hollenbeck Mill, circa 1950

# THE ANALYSIS TEAM

Mary Bean - *Outdoor Recreation Planner*

Ross Bluestone - *Outdoor Recreation Planner*

Bruce Burke - *Engineer*

Jim Chamberlin - *Geologist*

Sally Claggett - *Botanist*

Bengt Coffin - *Hydrologist*

Ken Cosentino - *Geographic Information Systems*

Robert Crump - *Fire and Fuels Specialist*

John Forsberg - *Silviculturist*

Cheryl Mack - *Archeologist*

Rolando Mendez-Treneman - *Wildlife Biologist*

Jon Nakae - *Project Coordinator*

Betsy Scott - *Fisheries Biologist*

John Scott - *Botany*

**Cover Photo:** Hollenbeck Mill was located at the junction of State Highway 141 and Forest Road 88. Bear Creek fed the log pond. Photo by Smith Scenic View of Tacoma, Washington.

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# CAVE-BEAR CREEKS WATERSHED ANALYSIS

## SUMMARY

This report documents the watershed analysis conducted for the Cave-Bear Creeks Watershed. This watershed is located in southwestern Washington, just east of the Cascade crest. The watershed totals 33,437 acres, of which 22,298 acres are located on federal land within the Gifford Pinchot National Forest. Cave and Bear Creeks are tributaries of the White Salmon River, which flows into the Bonneville Pool of the Columbia River.

### EROSION PROCESSES

- The bulk of the landscape was formed by relatively recent lava flows 20-30 thousand years ago from Lemei and other Indian Heaven volcanoes. These fluid eruptions reached as far as Husum. They are reflected in the gentle topography of the middle watershed.

- Older volcanic activity formed the Peterson Ridge and Guler Mountain areas about 15-20 million years ago. Due to greater weathering, these areas have deeper soils, steeper slopes and greater mass flow potential.

- Mass failure rates are low. Active failures are extremely limited. Soils with the potential for mass failure occur in the Peterson Ridge and Guler Mountain areas; these areas comprise a minor portion of the landscape. Road construction through these areas has increased the potential for mass failures.

- Surface soil erosion is also generally low given the gentle topography of the watershed. In considering the principal current disturbance agents, roads stand apart from logging and grazing as the dominant agent to increase natural erosion rates and subsequent stream sedimentation.

- The volcanic geology tends to validate the theory that subsurface water flow from this watershed may feed the abundant springs in the middle reach of the White Salmon River. These springs are an outstanding and remarkable feature of the middle reach of the White Salmon River, supporting its potential designation as a Wild and Scenic River.

### HYDROLOGY

- Much of the total precipitation falling in the watershed exits as subsurface flow. Most streams are completely dry throughout much of the year (including lower Cave and Bear Creeks), and for much of the year there is no surface water discharge from this watershed to the White Salmon River.

- Approximately 3/4 of the watershed (73%) is in elevations with a high probability of experiencing rain-on-snow.

- Over 1/3 of the watershed (39%) is in seedling/sapling or pole-sized vegetation (i.e. not fully hydrologically recovered).

- Aggregate Recovery Percentage (ARP) ranges from 62% to 76% in the four subwatersheds, and average 66% across the watershed.

- In the Bear Creek subwatershed, ARPs calculated for off-Forest lands are nearly 20 points lower than those calculated for the National Forest portion (56% vs. 73%).

- Road densities are higher than in any other watershed on the Mt. Adams and Wind River Ranger Districts, ranging from 2.8 to 4.8 mi/mi$^2$ across the four subwatersheds, and averaging 3.8 mi/mi$^2$ .

- Modeling of the two-year peak flow predicts increases of 10% in the Bear Creek subwatershed during "average" rain-on-snow conditions as a result of changes in seral class of forest vegetation.

- Vegetation recovery is occurring fastest in the Coyote and Cave Creek subwatersheds.

## VEGETATION

- Historic vegetation reflects stand replacing fire disturbance as well as frequent underburning. Ignition sources were lightning and Native Americans.

- Historic vegetation (circa 1800) was likely comprised of 60% late-successional , 30% mid-successional, and 9% early-successional forest with 1% non-forest. These stands had large amounts of interior habitat and little edge habitat. Stands within the grand fir zone were dominated by ponderosa pine, and maintained by frequent fires.

- Current vegetation reflects the timber harvest and fire suppression. The distribution of successional forest classes are within the Range of Natural Conditions.

- While mid-successional forest still comprises 30% of the watershed, today there are less late-successional forest (29%) and more early-successional forest. Because of dispersed setting clearcuts, stands in all seral stages are of smaller size, more fragmented, and with greater edge. The predominance of ponderosa pine has been reduced via partial cutting and in-growth of Douglas-fir and grand fir

- Forests in the lower watershed, around Trout Lake, have been converted to non-forest, agricultural or urban land.

- Other non-forest such as dry meadows (Peterson Prairie and Lost Meadows) and wet meadows (Cave Creek and Lost Meadows) diversity the landscape. Pale-blue eyed grass, a state sensitive species, occurs in both Cave Creek and Peterson Prairie. Golden chinquapin, also state sensitive, occurs on dry slopes of Peterson Ridge.

- Prescribed fire may be a useful tool to maintain dry meadows and reduce catastrophic fire risk in the lightning prone Peterson Ridge/Flattop area of the Peterson LSR/MLSA.

- Prescribed fire may be useful tool to develop open pine stands, similar to those which once dominated the watershed.

- While the long-term timber output for Forest Service lands could approach 14 mmbf/decade, current stand conditions and concerns for water and wildlife resources suggest that only 7.4 mmbf can be produced this first decade of the Northwest Forest Plan.

## STREAM CHANNELS

- Channel processes throughout much of the watershed are strongly influenced by the underlying lava.

- Lower reaches of channels on the lava flows appear to respond to high flows by spilling water and inundating adjacent areas as opposed to sustaining damage to channels.

- Currently, early-successional forest comprises 15% of the watershed's Riparian Reserves. This is within the Range of Natural Conditions (5-30%).

- Currently, late-successional forest comprises 34% of the watershed's Riparian Reserves. This too is within the Range of Natural Conditions (23-92%).

## WATER QUALITY

- Beneficial uses in the watershed include domestic water sources, resident fish, and a downstream Wild and Scenic River (lower reach of the White Salmon River).

- Very few streams in the watershed have perennial flow. During most of the year, there is no surface water discharge from this watershed to the White Salmon River.

- Insufficient water quality data exist to allow characterization of the watershed.

- Water temperatures have met state standards in Cave Creek (above the beaver ponds), but may be increased in reaches affected by the beaver dams.

- Coliform levels have not been measured on the Forest, and have not been identified as a problem off-Forest.

- Turbidity levels have not been measured.

## FISHERIES

- No anadromous or TES fish species are present in the watershed.

- There are no fishbearing lakes in the watershed.

- Cave Creek and its tributary Beaver Creek are the only fishbearing streams in the watershed, and contain eastern brook and rainbow trout.

- No fish stocking has occurred in the watershed since 1985.

- Large woody debris is lacking in Cave and Beaver Creeks.

- Width-to-depth ratios are "good" and pools are "good" in Beaver and Cave Creek (including the beaver ponds) according to Columbia River Policy Implementation Guide (PIG) standards.

- Beaver play an important role in maintaining pool habitat in Cave and Beaver Creeks.

- Low flows appear to be the limiting factor for fish production in the watershed.

## TERRESTRIAL WILDLIFE

- The watershed hosts a rich wildlife community indicating diverse landscape with a moderate to high degree of productivity. There have been more than 500 documented wildlife species representing at least 50 species.

- The communities and special niches of this watershed include old-growth forest, basalt caves, wetlands, upland meadows, and snag habitat.

- Habitat capability for management indicators species (pileated woodpecker, hairy woodpecker, spotted owl, and pine marten) are currently within the historic maximum and minimum levels. They are all expected to improve in the future given current management direction on Forest Service lands.

- Current interior late-successional forest is less than 20% of the watershed.

- Riparian Reserve connectivity is lacking between the northern and southern halves of the watershed; otherwise; the watershed is sufficiently interconnected along Riparian Reserves and via the Peterson LSR/MLSA.

- Open road density for the watershed is 2.0 mi/mi$^2$, ranging from 0.8 to 3.4 mi/mi$^2$ within subwatersheds. Both the Coyote Creek and Cave Creek subwatersheds exceed the 2.0 mi/mi$^2$ threshold.

- There are 14 spotted owl pairs who reside within 1.8 miles of the watershed. The primary activity areas of five of the 14 pairs is within the watershed boundary; three of these five pairs are within the Peterson LSR/MLSA. Seven of these pairs are in an incidental take condition because of limited habitat.

- The Peterson LSR/MLSA dominates the central portion of the watershed and totals nearly a third of the total area. Presently, 58% of this reserve is considered spotted owl habitat and another 25% is expected to become habitat in 25-50 years.

- All of the mapped caves on Forest Service land in this watershed are in the Peterson LSR/MLSA.

## HUMAN USES

- Native Americans have long been present in the watershed. Lands were ceded by the Yakama Indian Nation, and are subject to the Treaty of 1855.

- European settlement began in the 1870s. Extensive water diversion and logging began at the turn of the century. Dairy and other livestock grazing occurred as well.

- Today, cattle grazing occurs throughout the watershed. The Ice Caves Cattle and Horse Allotment overlaps all federal land in the watershed.

- Timber harvest is actively occurring on all ownership's. Land exchanges are in progress to change ownership of approximately 3000 acres of federal land in the Cave Creek subwatershed to state and private ownership. Current federal allocation of these lands is general forest - matrix, and they would continue to have timber extracted once exchanged.

- A variety of special forest products are available within the watershed. Their continued collection from federal lands is expected, as current practices are consistent with management direction.

A variety of recreation occurs, often related to special forest product collection, hunting, caving, and winter sports. Though developed campgrounds are few, there are numerous opportunities for dispersed camping. With the exception of some dispersed campsites, these recreational uses are largely compatible with federal resource management for water and wildlife.

# CAVE-BEAR CREEKS WATERSHED ANALYSIS

## SYNTHESIS TABLE

| SUBWATERSHED | Threshold | COYOTE | DRY | BEAR | CAVE | TOTAL |
|---|---|---|---|---|---|---|
| Total Area | | 7,679 ac | 5,745 ac | 9,931 ac | 10,0822 ac | 33,437 ac |
| Federal (FS) Area | | 7,679 ac | 5,745 ac | 3,357 ac | 5,517 ac | 22,298 ac |

| EROSION (FS only) | | | | | | |
|---|---|---|---|---|---|---|
| Active Failures | | 0 ac | 98 ac (2%) | 0 ac | 2 ac (<1%) | 100 ac (<1%) |
| Potentially Unstable | | 160 ac (2%) | 682 ac (12%) | 605 ac (18%) | 1257 ac (23%) | 2704ac (12%) |
| Severe Erosion Potential | | 0 ac | 0 ac | 0 ac | 0 ac | 0 ac |

| HYDROLOGY | | | | | | |
|---|---|---|---|---|---|---|
| Aggregate Recovery % (ARP) | <75% | 68% | 76% | 62% | 63% | 66% |
| Rain-on-Snow % | | 75% | 30% | 82% | 86% | 73% |
| Road Density | >3.0 mi/mi$^2$ | 4.8 mi/mi$^2$ | 2.8 mi/mi$^2$ | 3.2 mi/mi$^2$ | 4.3 mi/mi$^2$ | 3.8 mi/mi$^2$ |
| Mid-Slope Roads | | 20% | 34% | 23% | 42% | 30% |
| Drainage Density Increase | | 171% | 53% | 76% | 81% | 87% |
| Compacted Soils Hydrology | | 4% | 4% | 3% | 4% | 4% |
| 2-Year Peak Flow | >10% | 6% | 4% | 10% | 7% | |
| Peak Flow Risk | High | High | Mod | High | High | High |

| VEGETATION | | | | | | |
|---|---|---|---|---|---|---|
| Non-Forest | | 1% | 4% | 4% | 6% | 4% |
| Early-Sucessional Forest | <6%, >52% | 24% | 16% | 18% | 27% | 22% |
| Mid-Successional Forest | <6%, >80% | 28% | 45% | 58% | 47% | 45% |
| Late-Successional Forest | <15%,>90% | 47% | 34% | 20% | 20% | 29% |
| FS 10 Yr Timber Contribution | | 3.4 mmbf | 3.5 mmbf | 0.5 mmbf | 0 mmbf | 7.4 mmbf |
| LSR/MLSA Thinning Potential | | - | 334 ac | 191 ac | | 525 ac |

| STREAM CHANNELS | | | | | | |
|---|---|---|---|---|---|---|
| Rosgen Type AA | | 4.4 mi | 13.9 mi | 16.7 mi | 27.3 mi | 62.3 mi |
| Rosgen Type A | | 3.6 mi | 6.9 mi | 11.9 mi | 5.9 mi | 28.3 mi |
| Rosgen Type B | | 10.0 mi | 5.0 mi | 6.3 mi | 2.3 mi | 23.6 mi |
| Rogen Type C, G, or E | | 1.6 mi | 1.1 mi | 5.1 mi | 12..3 mi | 20.1 mi |
| Riparian Early-Successional | <5%, >30% | 12% | 9% | 15% | 20% | 15% |
| Riparian Late-Successional | <23%,>92% | 52% | 36% | 36% | 26% | 34% |

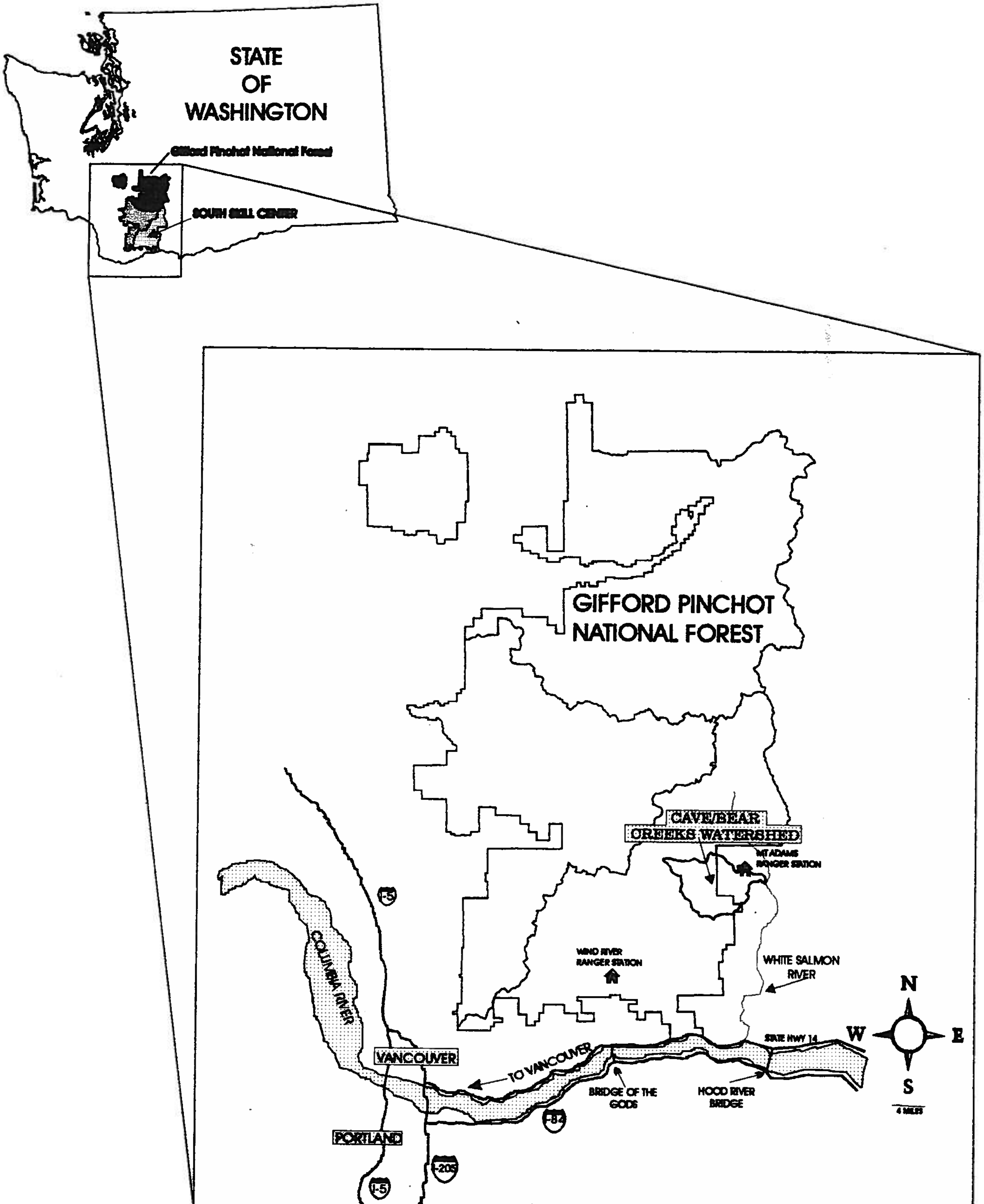
| WATER QUALITY | | | | | | |
|---|---|---|---|---|---|---|
| Temperature (Grab Sample) | >16°C | | | | 17°C | |
| Coliform (Peterson CG) | Any | None | | | | |
| Sediment (Rd & Stream Xing) | | 2.9/mi$^2$ | 3.9/mi$^2$ | 4.1/mi$^2$ | 6.0/mi$^2$ | 4.4/mi$^2$ |

| FISHERIES | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fish Bearing Streams | | None | None | None | Cave | Beaver | |
| Pools per mile | <40/mi | | | | 14/mi | 106/mi | |
| Width:Depth | >10:1 | | | | 7.1:1 | 6.2:1 | |
| LWD/Mile | <40/mile | | | | 23/mi | 4/mi | |
| Max Water Temperature | >20°C | | | | 17°C | 14°C | |
| Channel Stabilty Rating | Poor | | | | Fair | Fair | |

| WILDLIFE | | | | | | |
|---|---|---|---|---|---|---|
| Interior Habitat | | | | | | 50% |
| Interior Late-Successional | | | | | | 20% |
| Fragmentation (ranking) | | 2 | 3 | 4 (least) | 1 (most) | |
| Spotted Owls w/in 1.8 mi | | | | | | 14 pair |
| Owls in Take Condition | > 0 pair | 2 pairs | 3 pairs | 0 pairs | 2 pairs | 7 pairs |
| Owls in LSR/MLSA | | | | | | 3 pair |
| Open Road Density | > 2.0 mi/mi$^2$ | 3.4 mi/mi$^2$ | 1.9 mi/mi$^2$ | 0.8 mi/mi$^2$ | 2.4 mi/mi$^2$ | 2.0 mi/mi$^2$ |

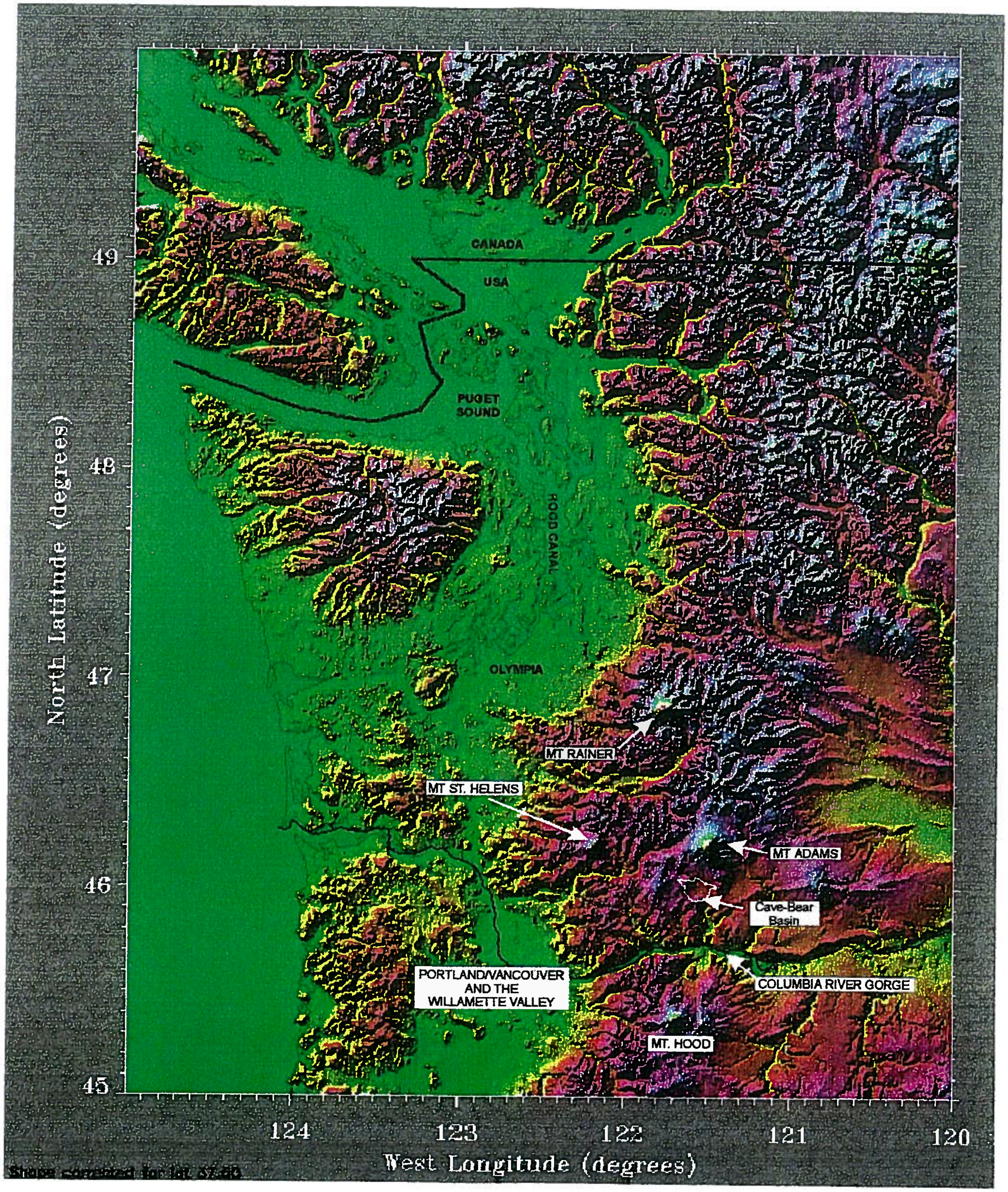
| HUMAN USES | | | | | | |
|---|---|---|---|---|---|---|
| Dispersed Campsites | | 29 | 15 | 3 | 11 | 58 |

# VICINITY MAP



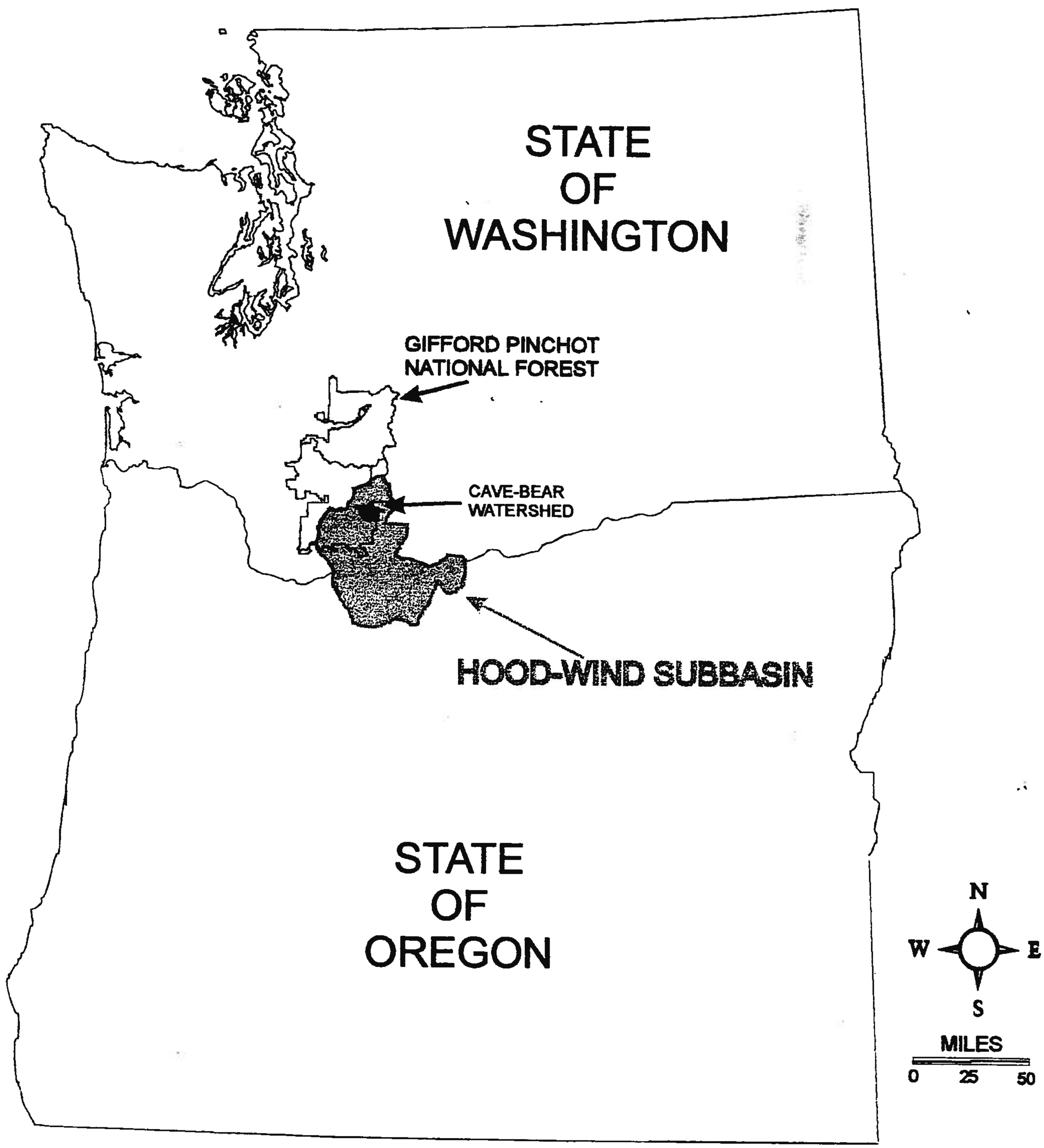

MAP A

# TOPOGRAPHIC RELIEF

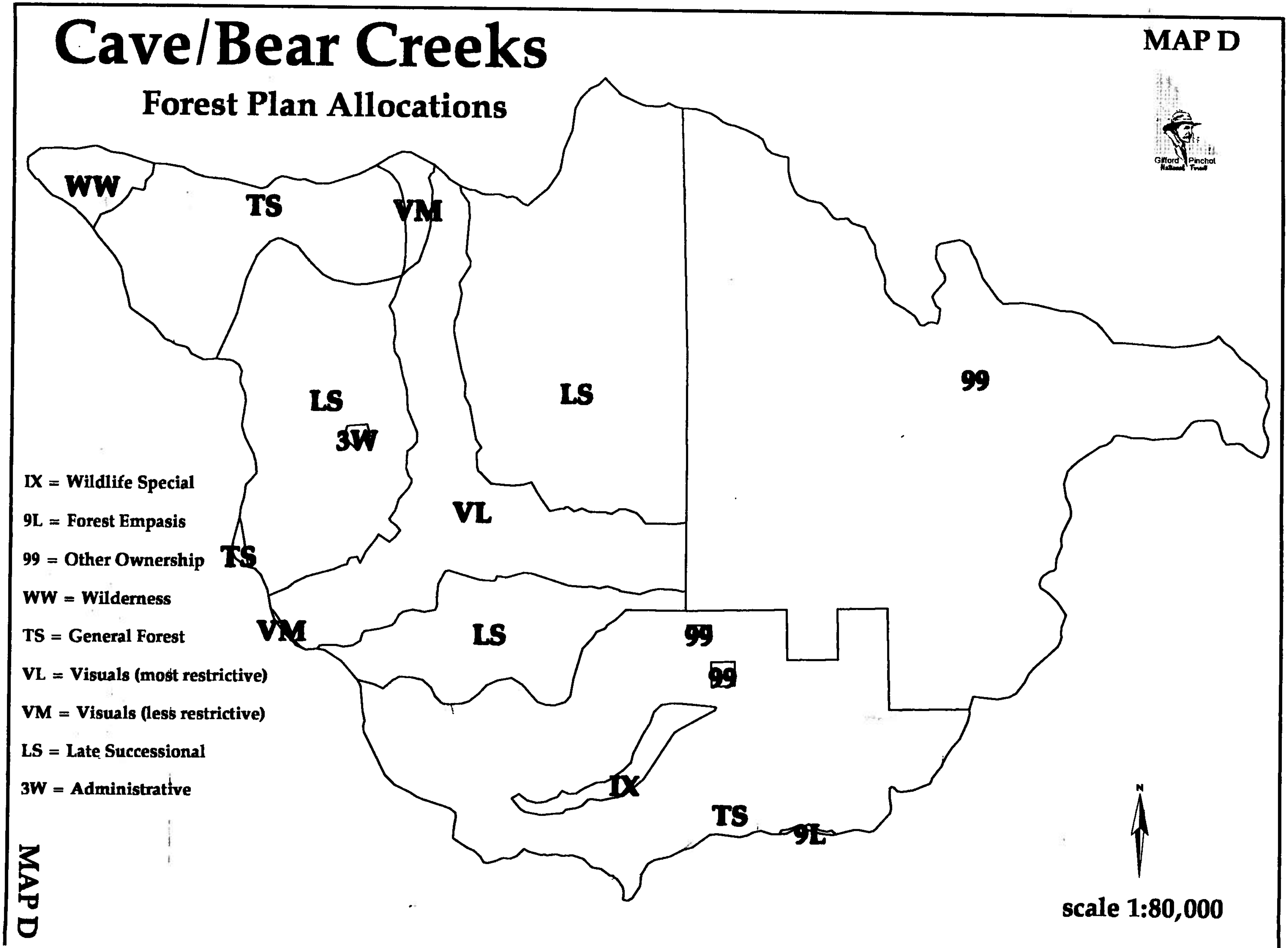



MAP B

# HOOD-WIND SUBBASIN




MAP C

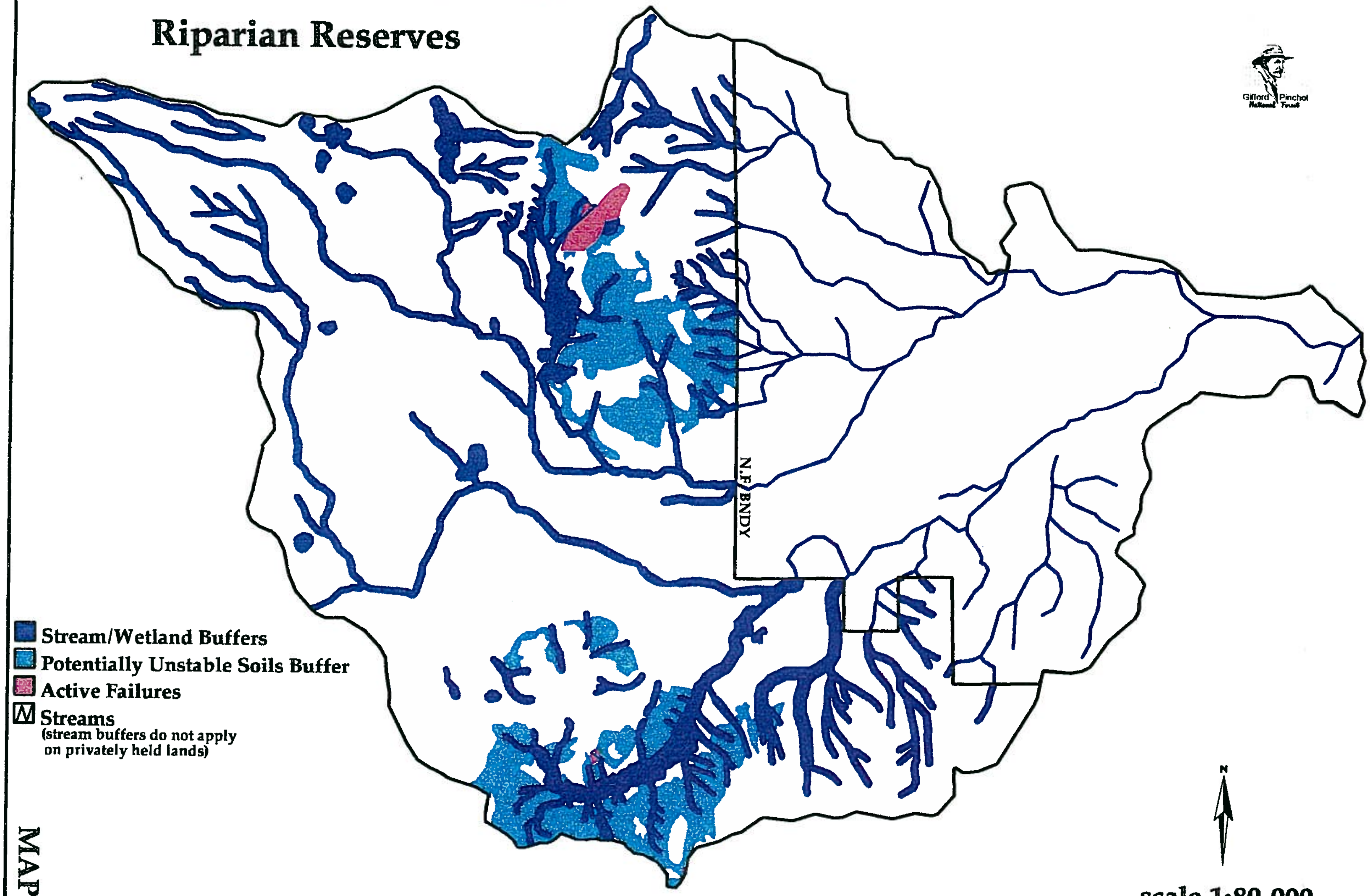


Cave/Bear Creeks
Forest Plan Allocations
MAP D
Gifford Pinchot National Forest
WW
TS
VM
LS
3W
LS
VL
99
TS
VM
LS
99
99
IX
TS
9L
IX = Wildlife Special
9L = Forest Empasis
99 = Other Ownership
WW = Wilderness
TS = General Forest
VL = Visuals (most restrictive)
VM = Visuals (less restrictive)
LS = Late Successional
3W = Administrative
N
scale 1:80,000
MAP D

# Cave-Bear Creeks

## Riparian Reserves

MAP E

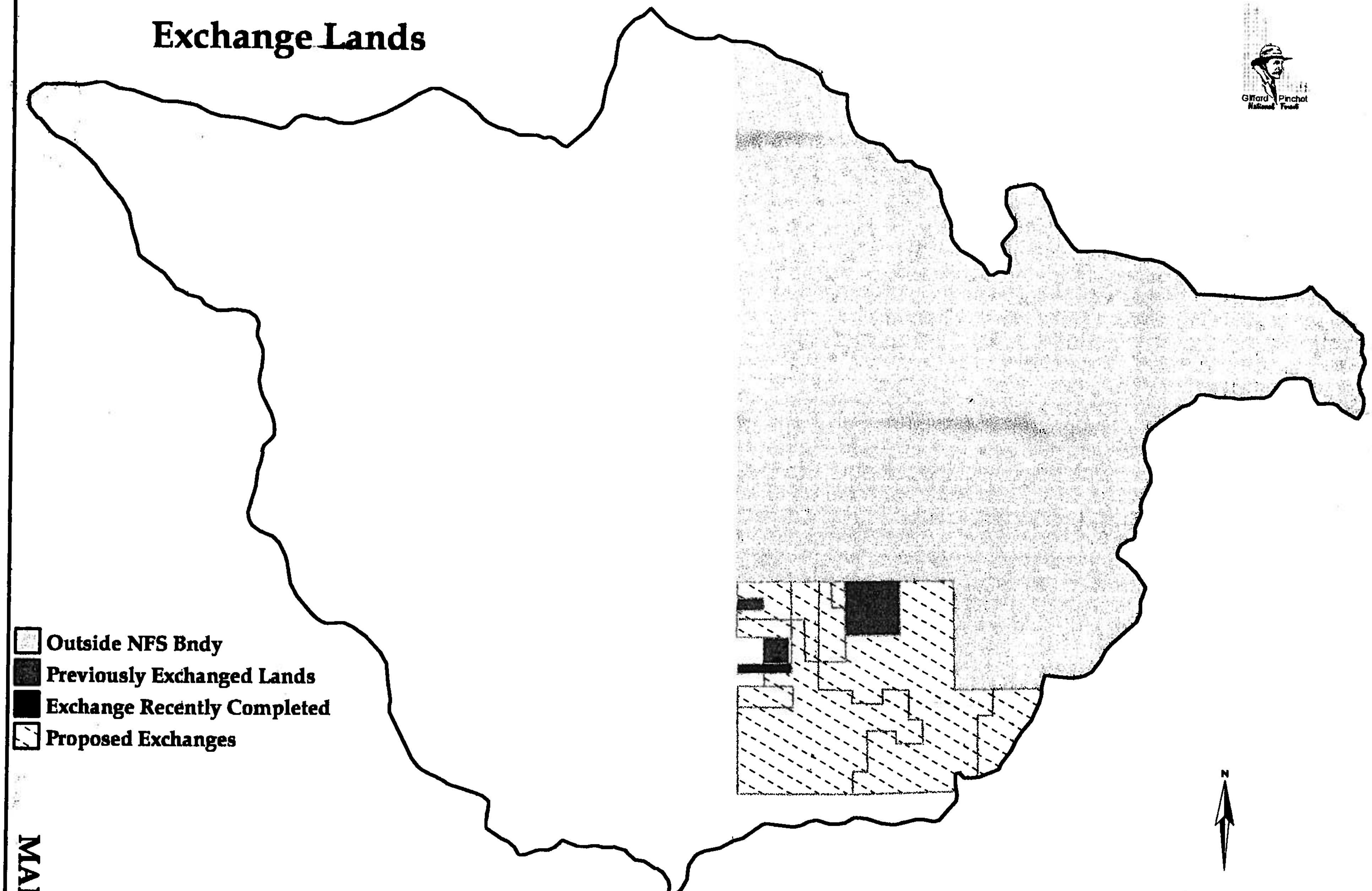



MAP E

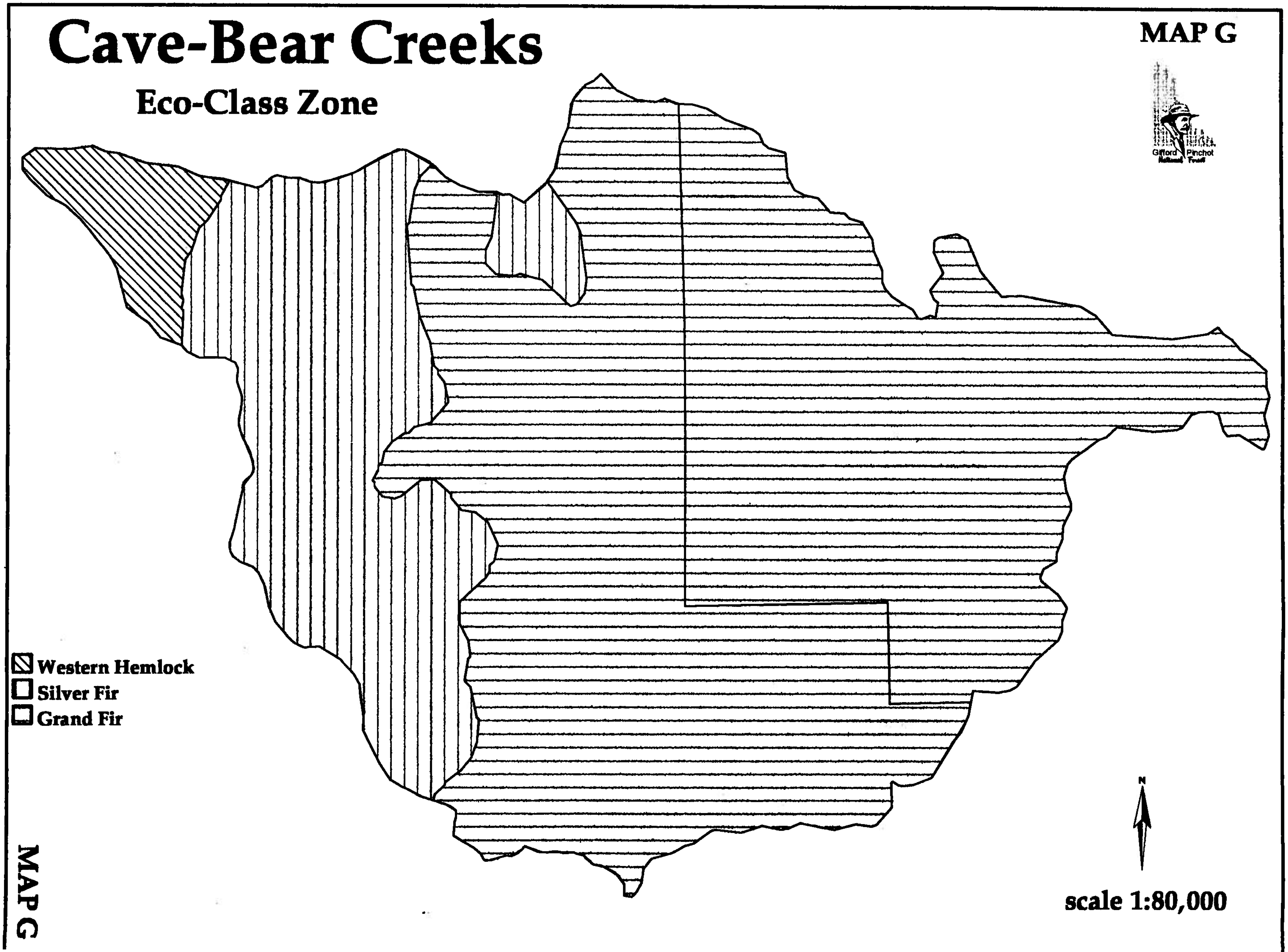
# Cave-Bear Creeks

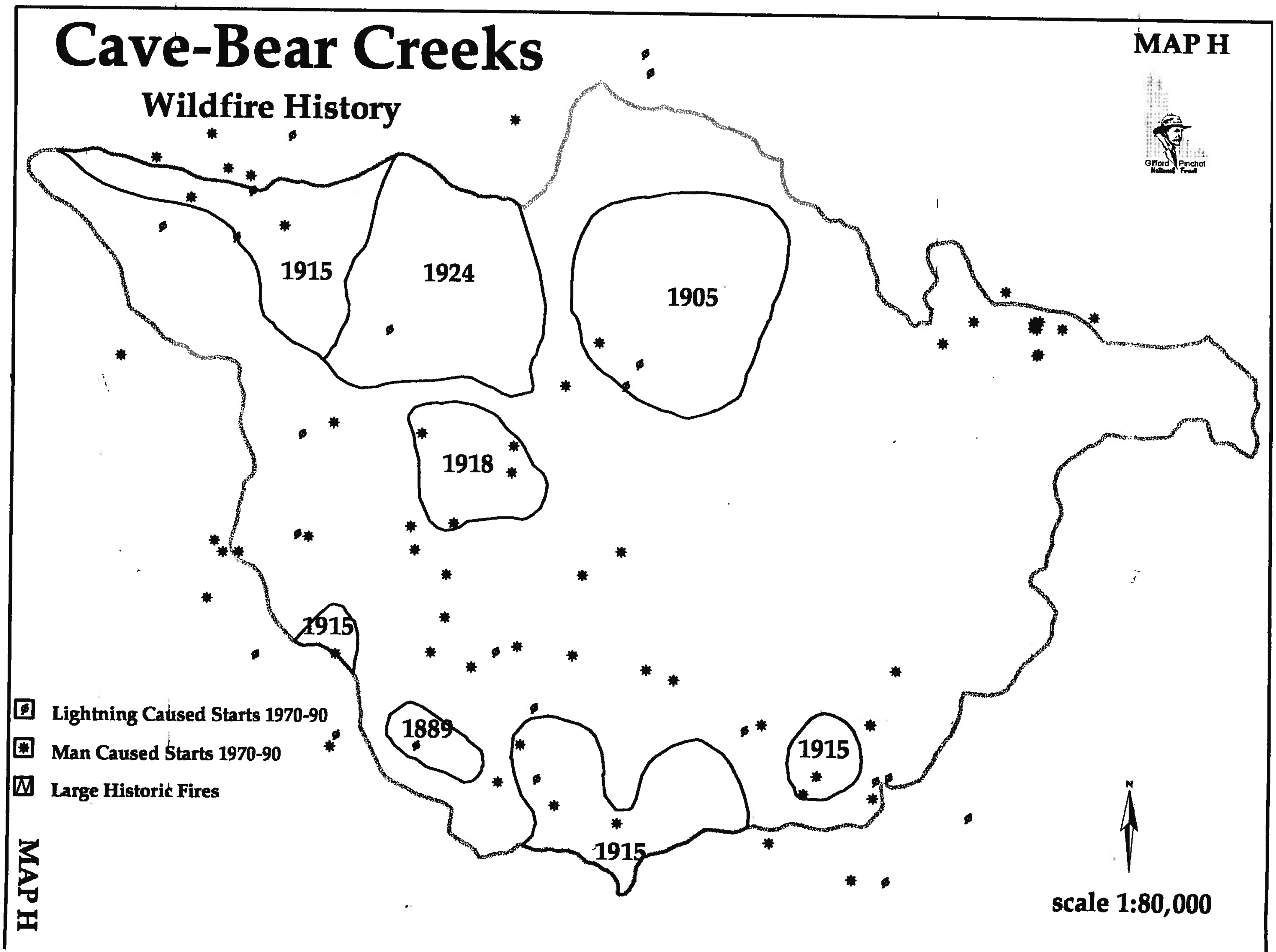
## Exchange Lands

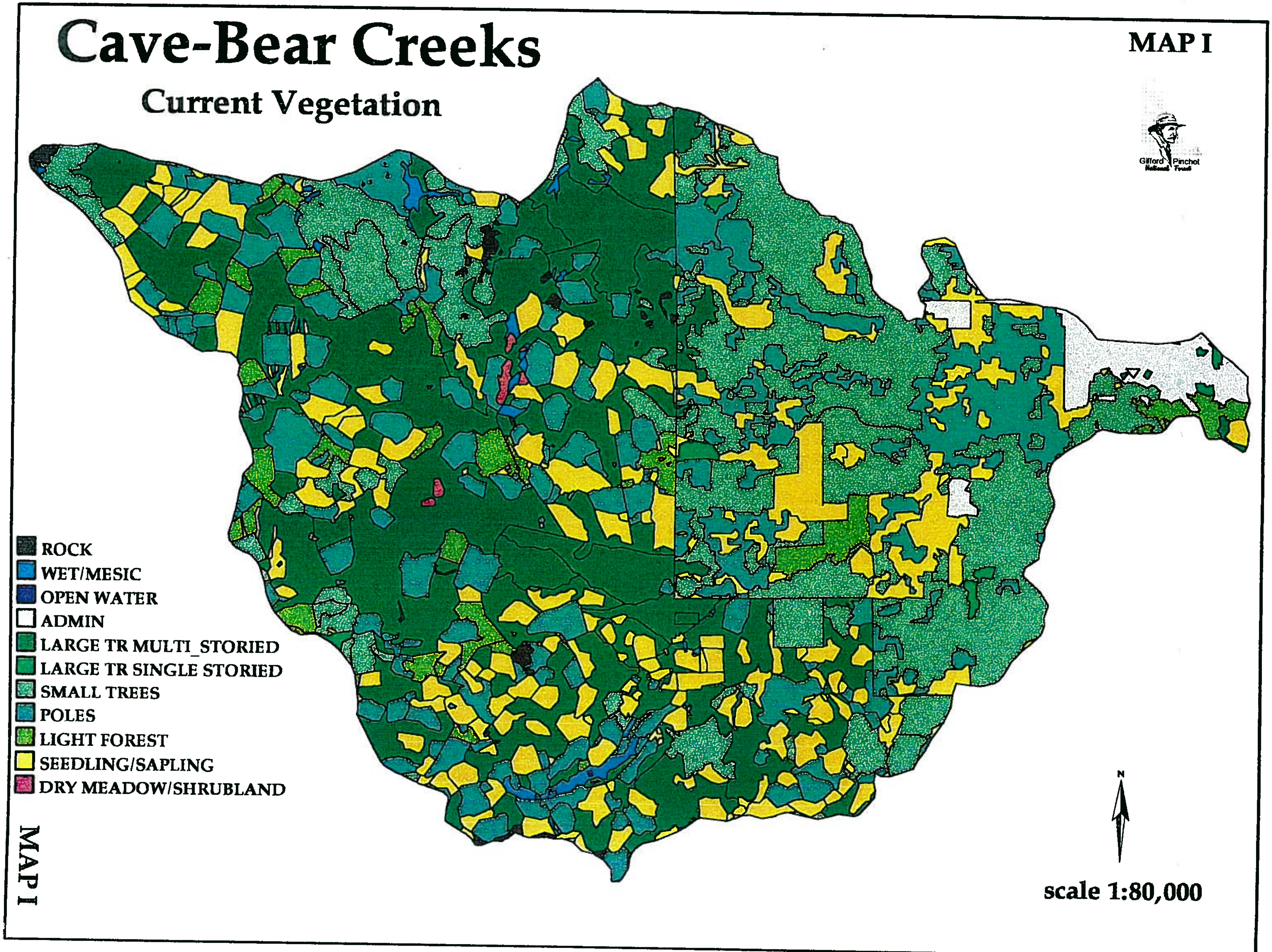
**MAP F**



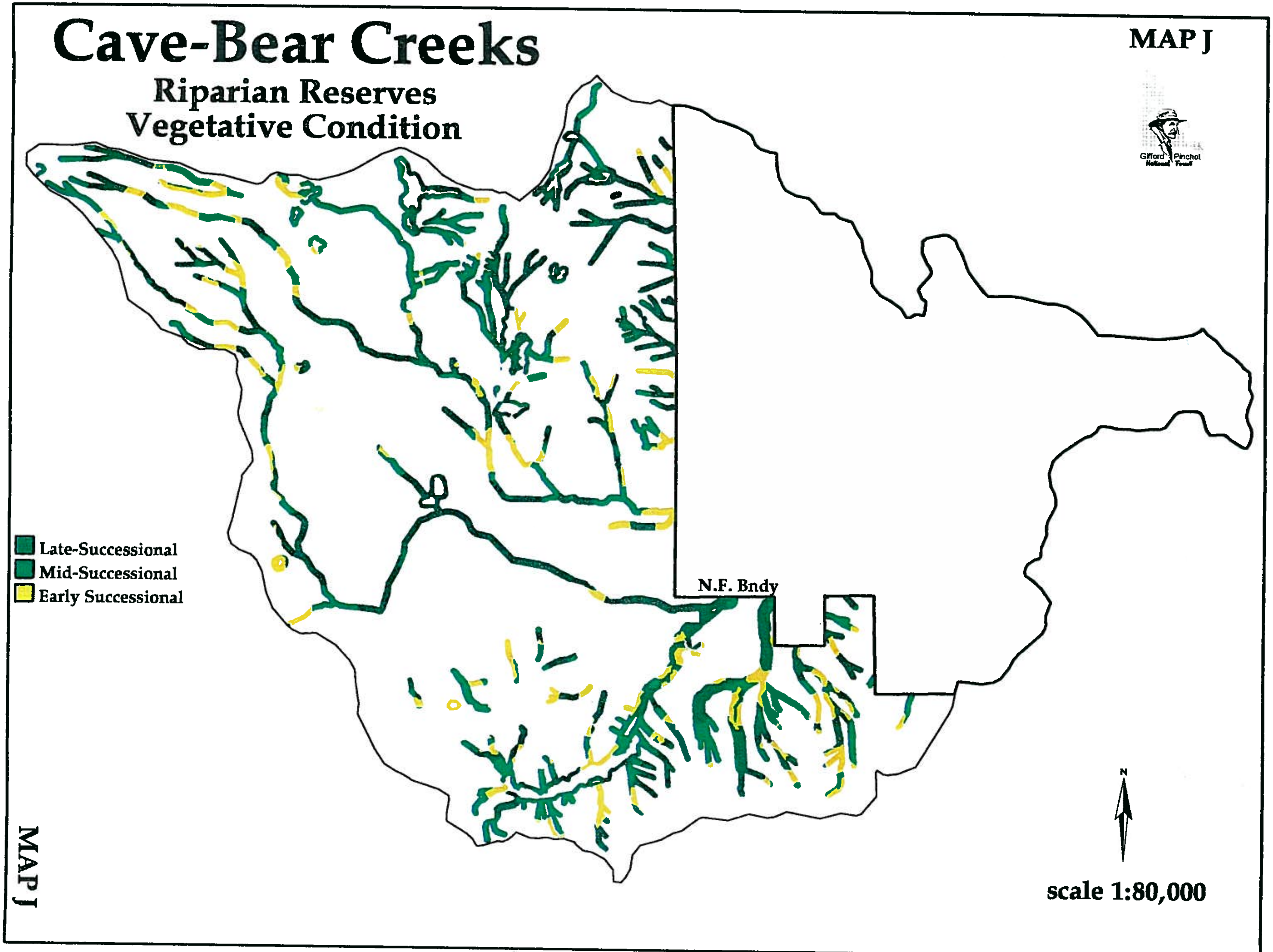

MAP F


Cave-Bear Creeks
Eco-Class Zone
MAP G
Gifford Pinchot National Forest
Western Hemlock
Silver Fir
Grand Fir
N
scale 1:80,000
MAP G


Cave-Bear Creeks
Wildfire History
MAP H
Gifford Pinchot National Forest
1915
1924
1905
1918
1915
1889
1915
1915
Lightning Caused Starts 1970-90
Man Caused Starts 1970-90
Large Historic Fires
N
scale 1:80,000
MAP H



Cave-Bear Creeks
Current Vegetation
MAP I
Gifford Pinchot National Forest
ROCK
WET/MESIC
OPEN WATER
ADMIN
LARGE TR MULTI_STORIED
LARGE TR SINGLE STORIED
SMALL TREES
POLES
LIGHT FOREST
SEEDLING/SAPLING
DRY MEADOW/SHRUBLAND
N
scale 1:80,000
MAP I

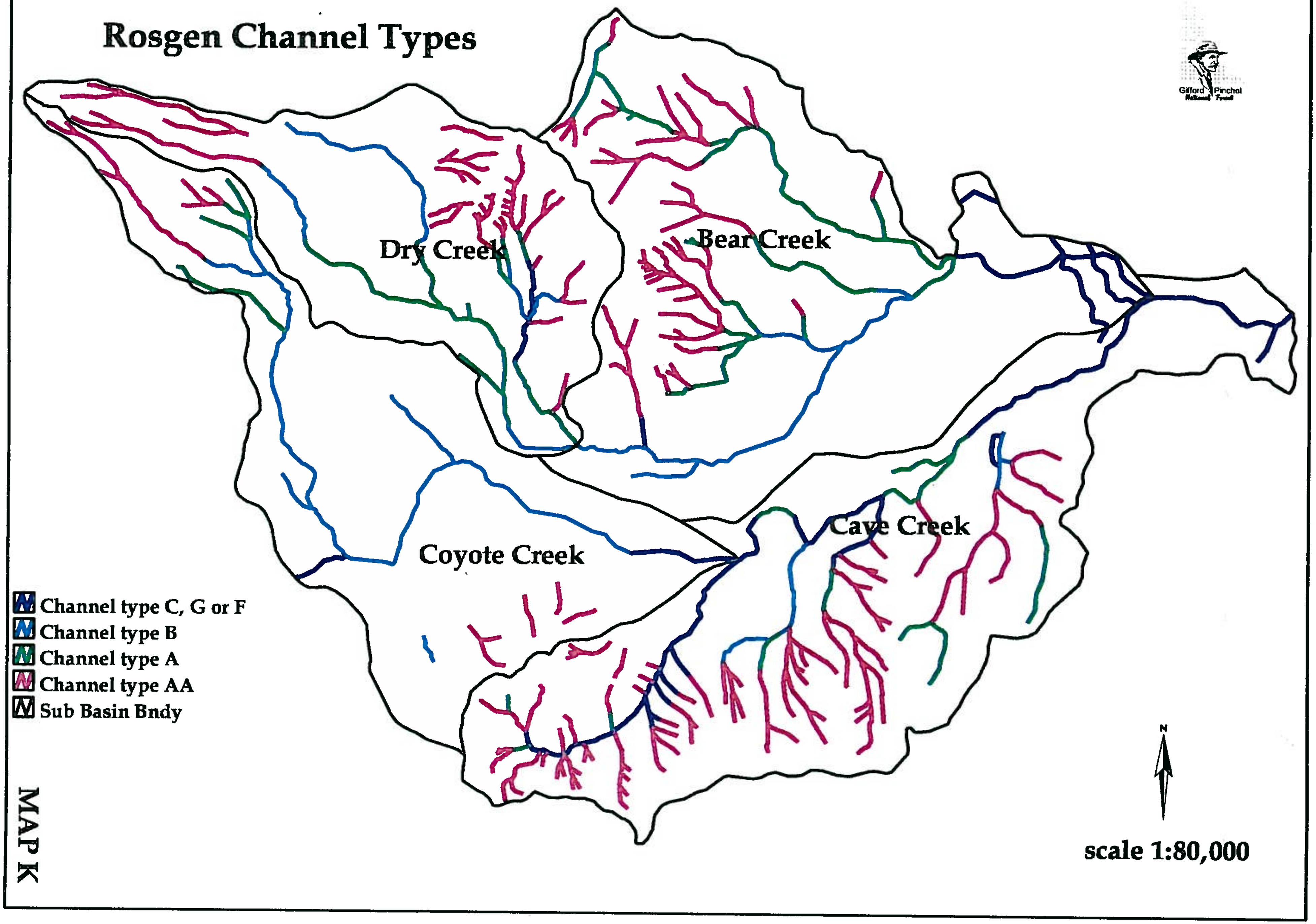


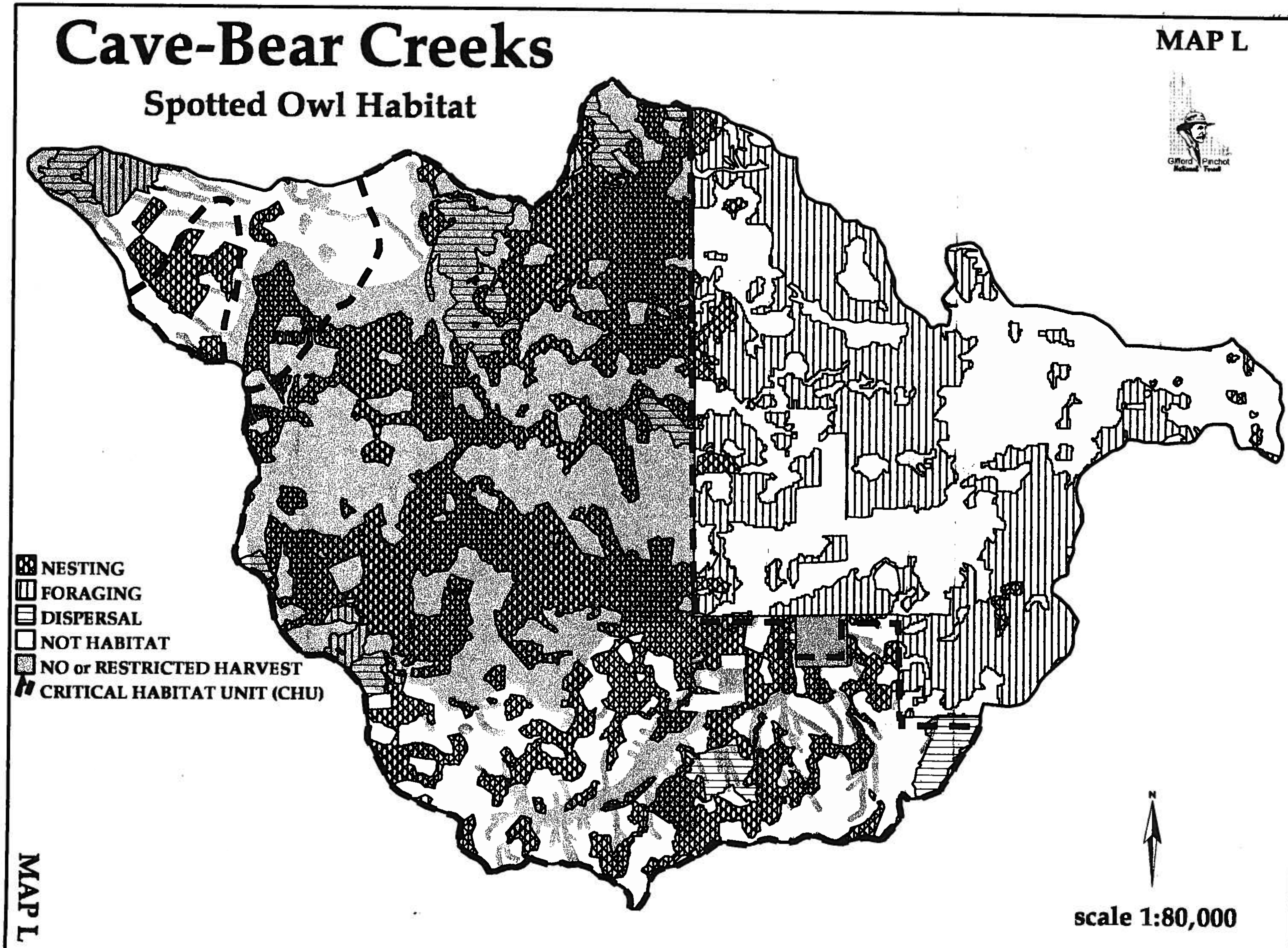
Cave-Bear Creeks
Riparian Reserves
Vegetative Condition
MAP J
Gifford Pinchot National Forest
Late-Successional
Mid-Successional
Early Successional
N.F. Bndy
N
scale 1:80,000
MAP J

# Cave-Bear Creeks

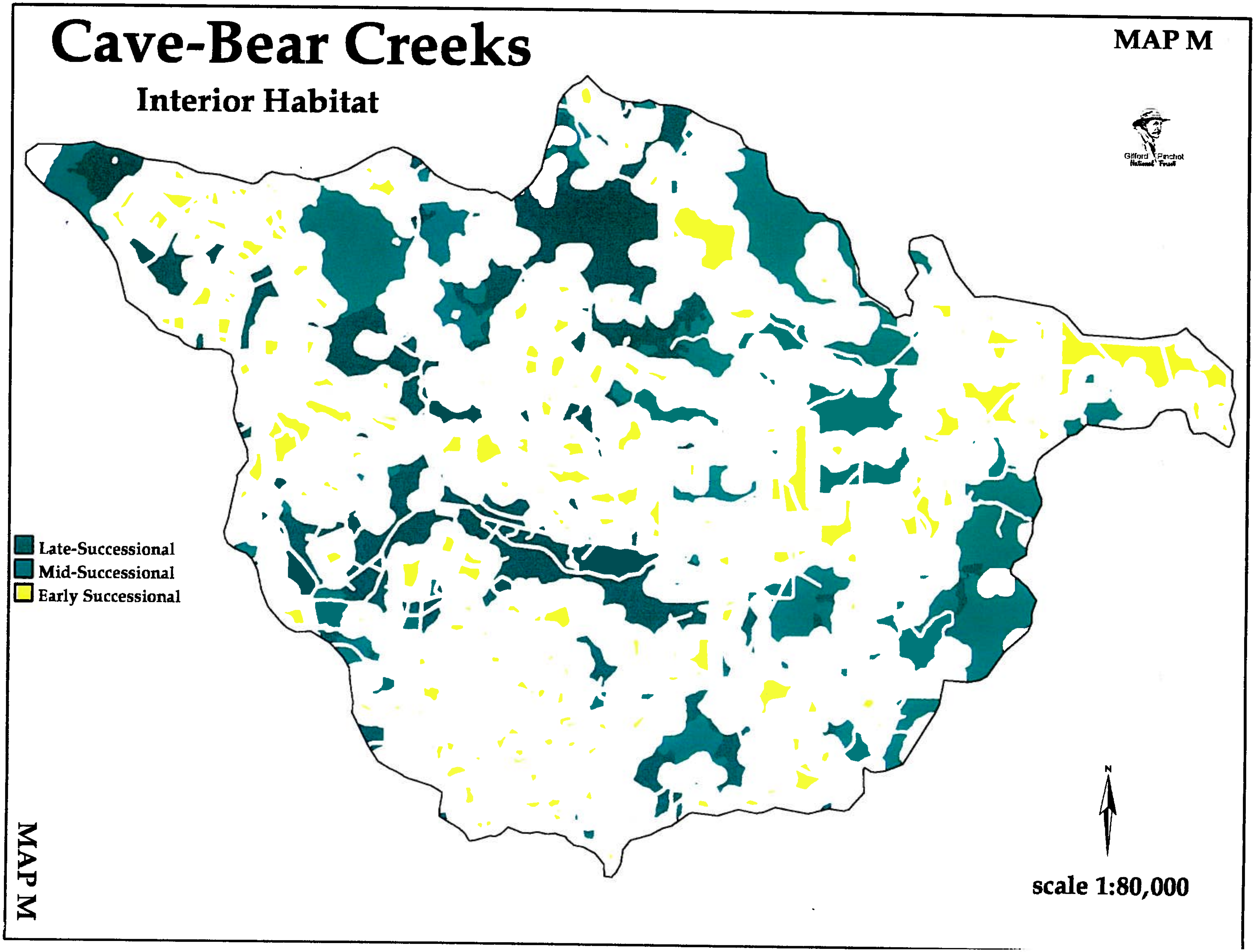
## Rosgen Channel Types

MAP K



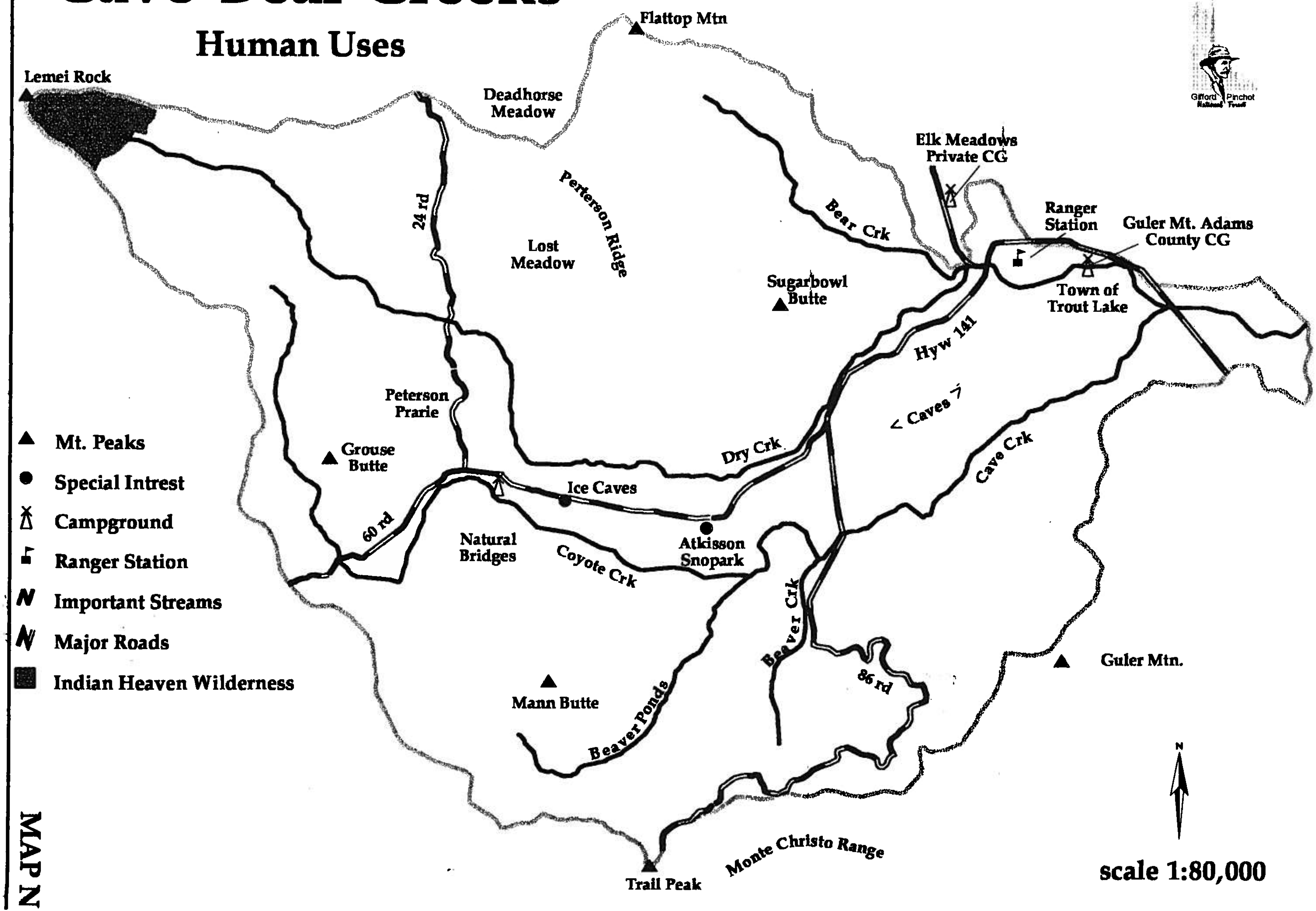


Cave-Bear Creeks
Spotted Owl Habitat
MAP L
Gifford Pinchot National Forest
NESTING
FORAGING
DISPERSAL
NOT HABITAT
NO or RESTRICTED HARVEST
CRITICAL HABITAT UNIT (CHU)
N
scale 1:80,000
MAP L

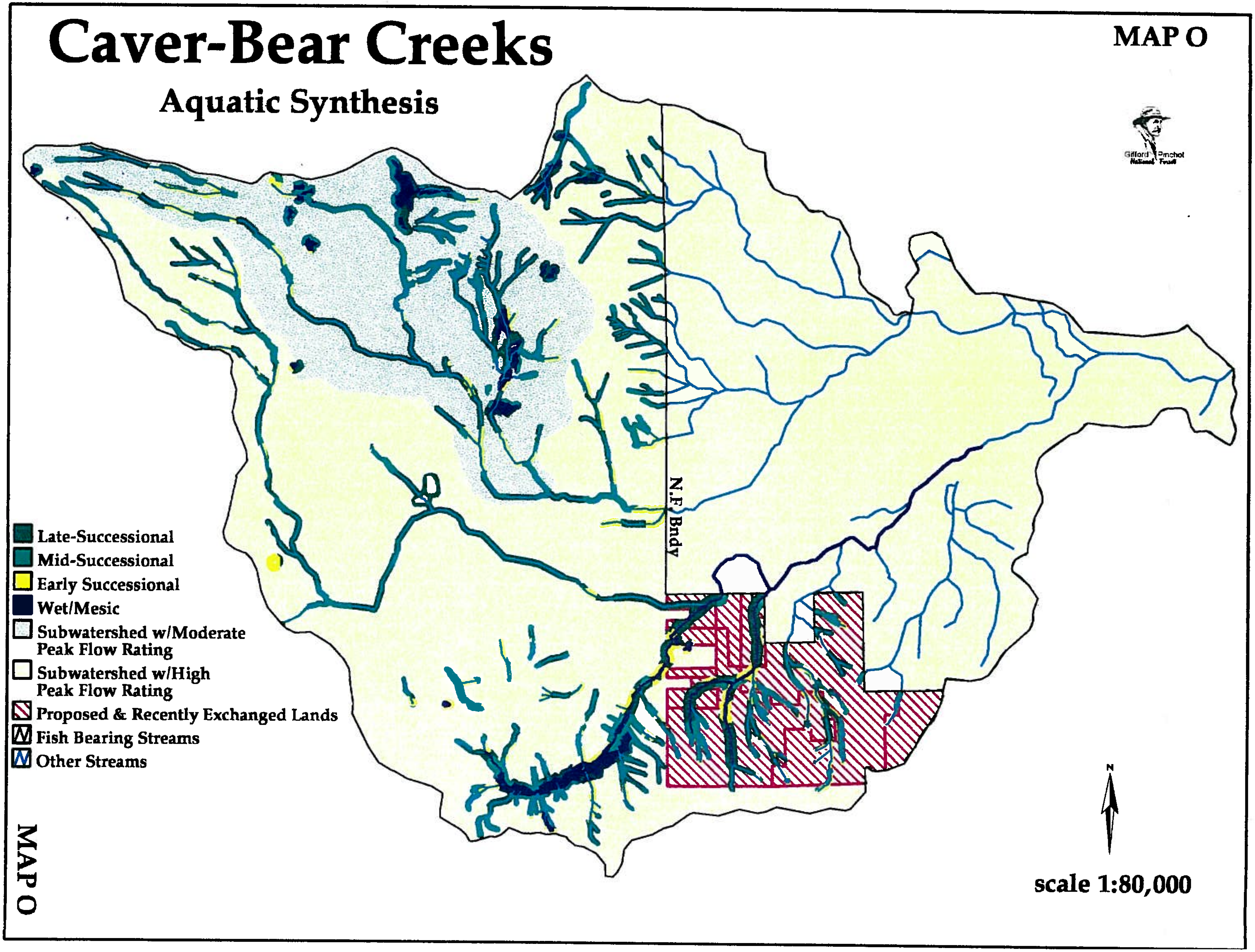

Cave-Bear Creeks
Interior Habitat
MAP M
Gifford Pinchot National Forest
Late-Successional
Mid-Successional
Early Successional
N
scale 1:80,000
MAP M

# Cave-Bear Creeks

## Human Uses




MAP N

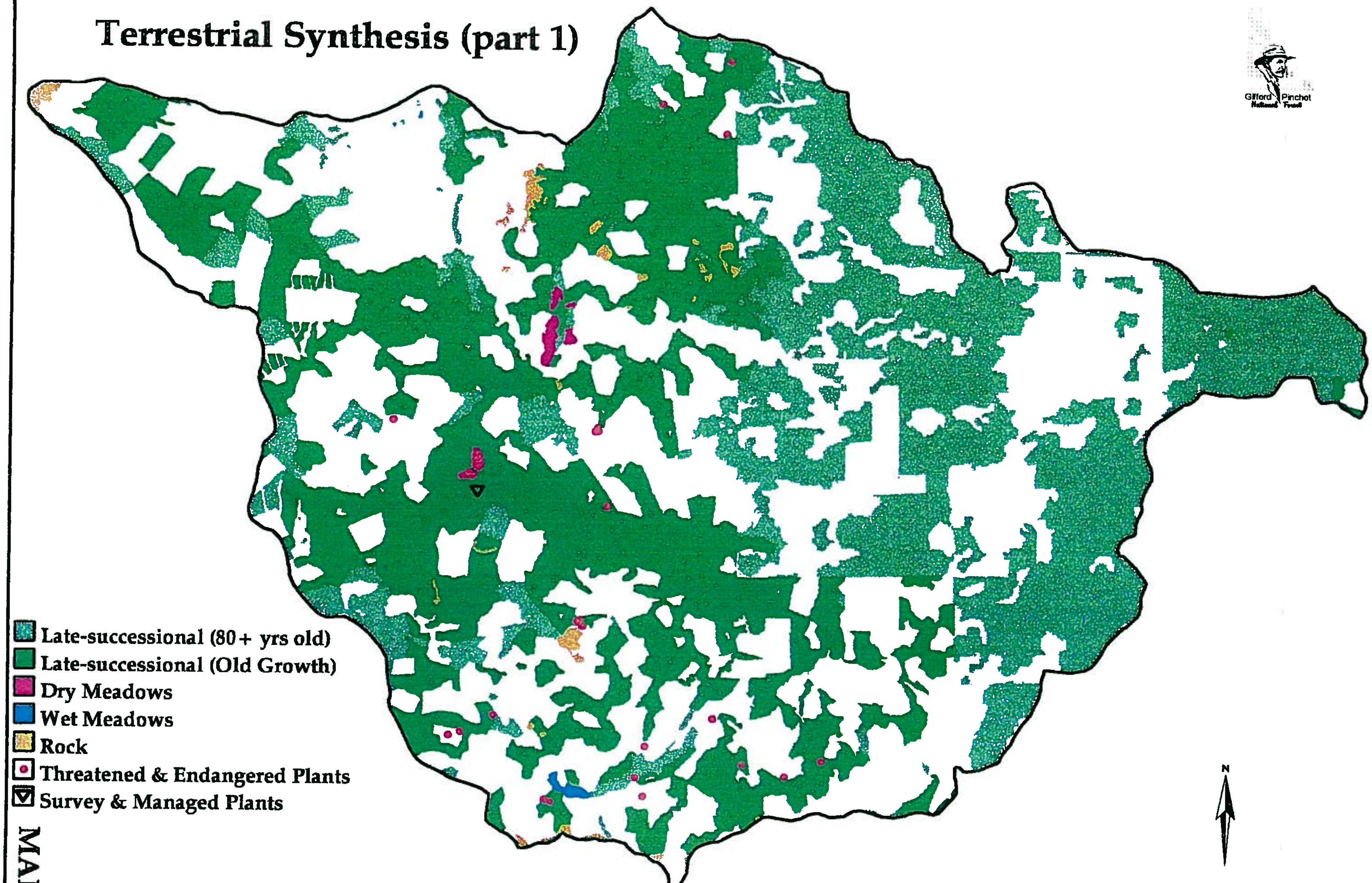


Caver-Bear Creeks
Aquatic Synthesis
MAP O
Gifford Pinchot National Forest
N.F. Bndy
Late-Successional
Mid-Successional
Early Successional
Wet/Mesic
Subwatershed w/Moderate Peak Flow Rating
Subwatershed w/High Peak Flow Rating
Proposed & Recently Exchanged Lands
Fish Bearing Streams
Other Streams
N
scale 1:80,000
MAP O

# Cave-Bear Creeks

## Terrestrial Synthesis (part 1)

MAP P

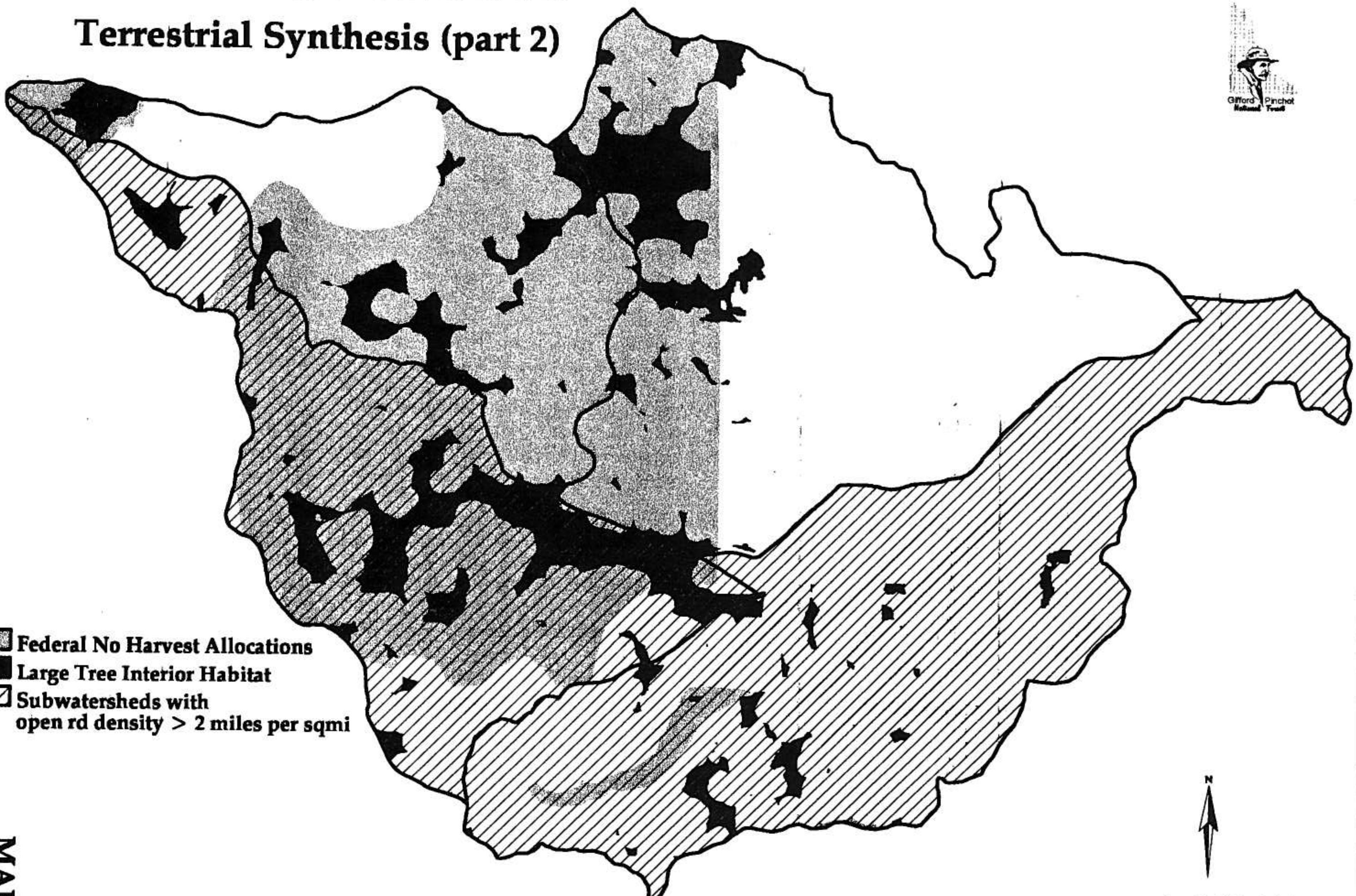



MAP P

# Cave-Bear Creeks

## Terrestrial Synthesis (part 2)

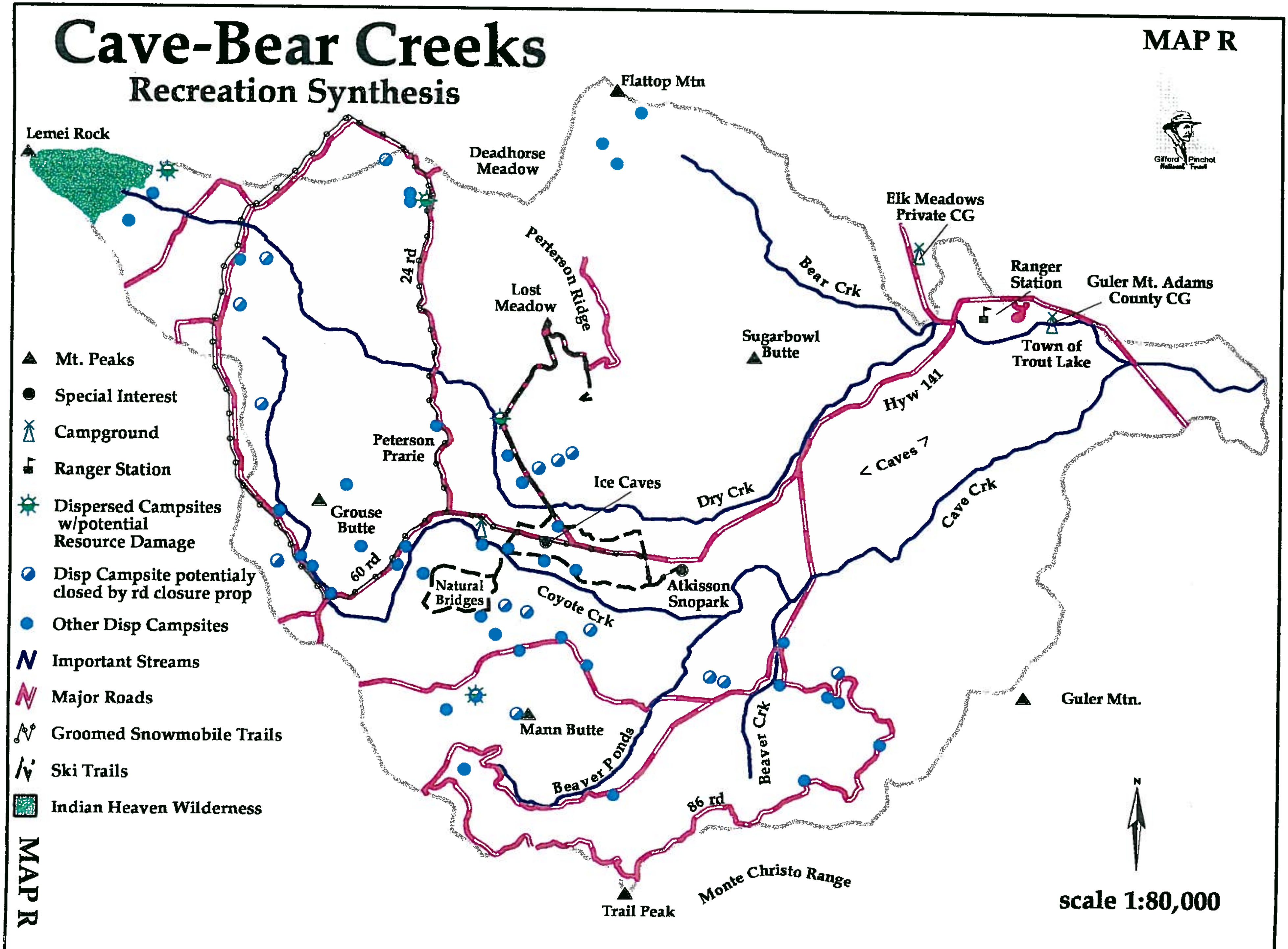
MAP Q




- Federal No Harvest Allocations
- Large Tree Interior Habitat
- Subwatersheds with open rd density > 2 miles per sqmi

scale 1:80,000

MAP Q

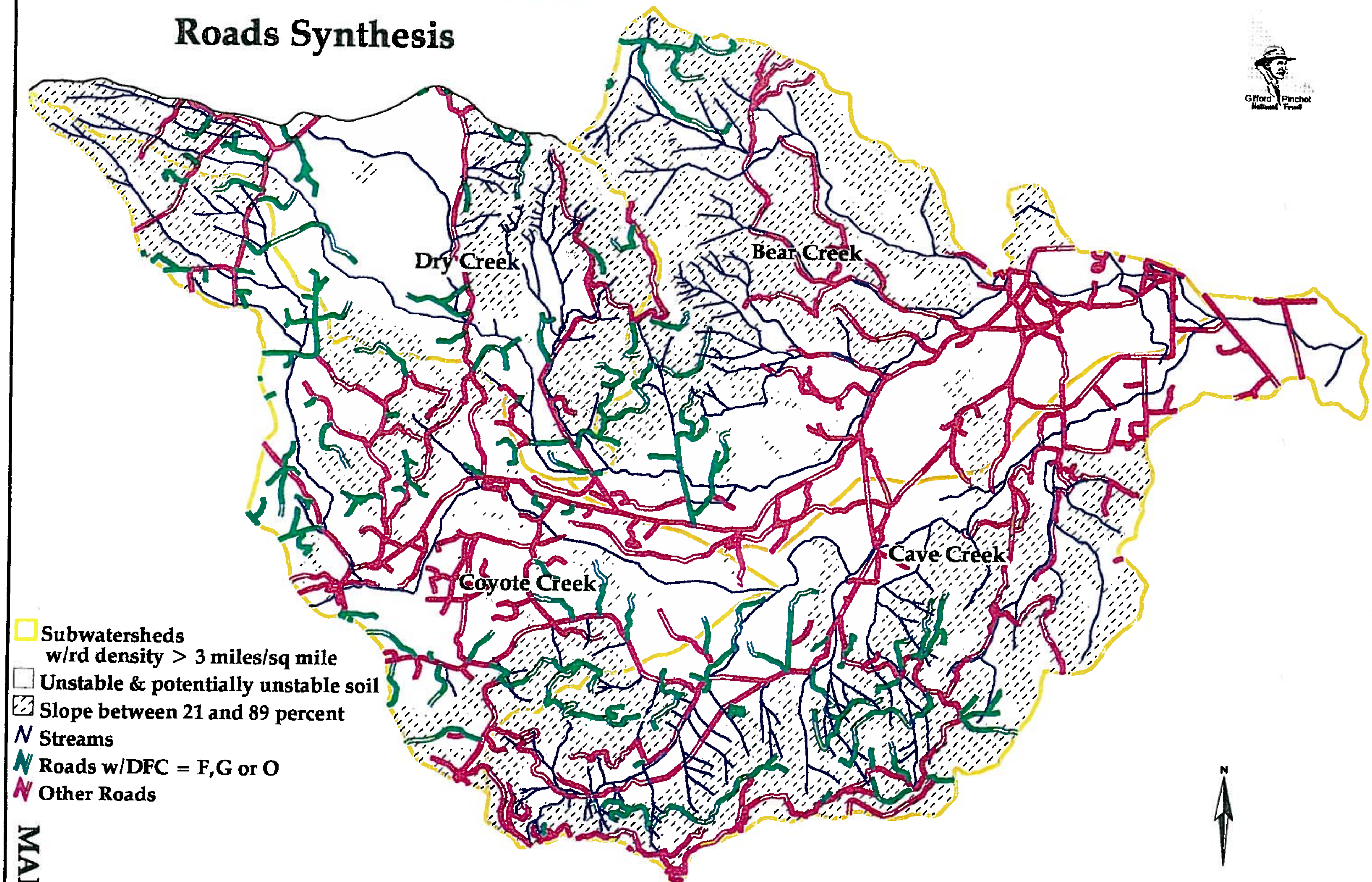


Cave-Bear Creeks
Recreation Synthesis
MAP R
Gifford Pinchot National Forest
Lemei Rock
Flattop Mtn
Deadhorse Meadow
Perterson Ridge
Lost Meadow
24 rd
Bear Crk
Elk Meadows Private CG
Ranger Station
Guler Mt. Adams County CG
Town of Trout Lake
Sugarbowl Butte
Hyw 141
Caves
Peterson Prarie
Ice Caves
Dry Crk
Cave Crk
Grouse Butte
60 rd
Natural Bridges
Coyote Crk
Atkisson Snopark
Mann Butte
Beaver Ponds
Beaver Crk
86 rd
Guler Mtn.
Trail Peak
Monte Christo Range
N
scale 1:80,000
Mt. Peaks
Special Interest
Campground
Ranger Station
Dispersed Campsites w/potential Resource Damage
Disp Campsite potentialy closed by rd closure prop
Other Disp Campsites
Important Streams
Major Roads
Groomed Snowmobile Trails
Ski Trails
Indian Heaven Wilderness
MAP R

# Cave-Bear Creeks

## Roads Synthesis

MAP S




MAP S

# CHAPTER I - INTRODUCTION

This report documents the watershed analysis conducted for Cave-Bear Creeks Watershed. This analysis responds to the President's Northwest Forest Plan, which specifies watershed analysis as an integral component of its Aquatic Conservation Strategy. This analysis follows the process described in the Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis Version 2.2 (USDA-FS et al. 1995). This assessment includes both federal and non-federal lands within the Cave-Bear Creeks Watershed.

## LOCATION AND SETTING

The Cave-Bear Creeks Watershed is located in southwestern Washington just east of the Cascade crest. Its headwaters originate from the Monte Cristo Range to the south, Indian Heaven Wilderness to the west, and Flattop Mountain to the north. Cave Creek and Bear Creek are two separate streams with little topographical separation in their lower reaches. The general drainage pattern is easterly to the town of Trout Lake, WA, where Cave and Bear Creeks join just prior to draining into the White Salmon River. The White Salmon River flows into the Bonneville Pool of the Columbia River.

## CLIMATE

Being just east of the Cascade crest, the watershed lies in the transition zone between the temperate marine climate and a continental climate. Winters are cool and wet. Summers are dry. Mean annual precipitation averages 70 inches per year, most of which occurs between November and April and is composed of rain and snow.

## TOPOGRAPHY

While the headwater regions are moderately steep, most of the watershed slopes gently to the east. Elevations vary from 5,600 to 1,950 feet at the White Salmon River confluence.

## ECOLOGICAL SCALES

Cave-Bear Creeks Watershed covers 33,437 acres. It comprises approximately one-third of the upper White Salmon River federal fifth-field watershed. The next larger ecological unit would be the Hood-Wind Subbasin, as defined by the First Approximation of Ecosystem Health (USDA-FS 1993). The Hood-Wind Subbasin is a collection of watersheds that drain into the Columbia River between The Dalles and Bonneville Dams (see Map xx). It includes the Hood, Wind, Little White Salmon, and White Salmon Rivers. The Hood-Wind Subbasin is important in that it is the scale at which the historical range of natural conditions for several resources (e.g. acres of old-growth forest or maximum water temperatures) is analyzed. Going further up in scale, the Hood-Wind Subbasin lies within the Lower Columbia River Basin.

## FEDERAL LAND ALLOCATIONS

The upper two-thirds of the watershed is situated within the legislated boundary of the Gifford Pinchot National Forest. The lower one-third of the watershed is a mix of private and Washington Sate lands. Management direction for Forest Service lands is provided by the Gifford Pinchot National Forest Land and Resource Management Plan (LRMP) as amended by the Record of Decision (ROD) for the President's Northwest Forest Plan. Per the LRMP, the Cave-Bear Creek Watershed is categorized as a Non-Key watershed. The dominant land allocations are Managed Late-Successional Area, Late-Successional Reserve, and Matrix - General Forest.

# CHAPTER II - CHARACTERIZATION

This chapter identifies the dominant physical, biological, and human processes or features of the watershed that affect ecosystem function and conditions. Location of the watershed, ownership pattern, and major land allocations are presented on Maps xx and xx.

## EROSION PROCESSES

- The Cave-Bear Creeks Watershed has a flat topography relative to surrounding watersheds. This is due to its volcanic history of lava flows from Indian Heaven.
- Glacial deposits from Mt. Adams and Indian Heaven have contributed to the gentle topography. They have also influence the creation of meadows such as Peterson Meadows.
- Mass wasting is not a dominant process, in part because of the gentle topography.
- Surface erosion appears to be the dominant process, but it is not high relative to other watersheds.

## HYDROLOGY

- Annual maximum peak flows currently occur in response to rain-on-snow events (similar to surrounding watersheds).
- Streamflows change rapidly from little to no flow to high flow following individual storms and following wet periods during the winter months.
- Most streams are completely dry throughout much of the year, and for most of the year there is no surface water discharge from this watershed to the White Salmon River.
- This watershed may be a source area for water emanating from springs along the White Salmon River.
- The lower watershed includes a number of irrigation ditches, most of which originate from Trout Lake Creek and bring water into the Cave-Bear Creeks watershed.

## VEGETATION

- Vegetative condition is similar to surrounding watersheds. More recent fire history is evident on ridgetops. The fire history includes re-burns of the same areas (Yacolt, Twin Buttes, and Smokey Creek Burns). Old-growth forest comprises the middle part of watershed on federal land.
- Watershed lies within a known lighting track from the southern boundary of Monte Cristo, north towards Flattop Mountain.
- Historical conditions (1800's) suggest more ponderosa pine and more open conditions along Road 24 and is perhaps due to a frequent fire interval. This area was used a trail to cross the Cascades.

## STREAM CHANNELS

- Historical surveys of the valley show many of the channels disappearing or "sinking" as they cross the valley.

- Channels in the lower watershed have been altered by ditching, diversions, and relocating.

## WATER QUALITY

- Water quality is important in the watershed for fisheries, domestic use, and because water from the Cave-Bear Creeks watershed contributes to the flow of the White Salmon River. The lower reach of the White Salmon River (below Northwestern Lake) has been designated a Wild and Scenic River while the middle and upper reaches are proposed Wild and Scenic.

- Primary water quality parameters of concern in the watershed include fecal coliform, sediment or turbidity, and water temperature. Little water quality data has been collected in the watershed to assess the conditions of these parameters.

- Effects of surface water on the quality of ground water or water discharge to the White Salmon River have not been established.

## SPECIES AND HABITATS

- The communities and special niches of this watershed include late-successional conifer forest, basalt cave (lava tubes), wetlands (including beaver ponds), upland meadows, and snag habitat.

- Distinct wildlife communities are present, though there is some overlap in habitat used by wildlife. As an example, Townsend's big-eared bats hibernate and roost within caves, but they forage wetlands and late-successional forest.

- A portion of the elk population is resident year-round. The remaining portion migrates to the Lewis River Watershed in the vicinity of Lone Butte, where they stay from spring to early winter. The migratory behavior of elk in this watershed has been documented using radio telemetry.

- The Peterson Late-Successional Reserve / Managed Late-Successional Area occupies a large percentage (38%) of the watershed. This area is intended as a source area for late-successional and old-growth forest dependent species in the larger landscape.

- During the summer, beaver ponds provide some of the only surface water in what is otherwise a dry landscape.

- There are no federal listed threatened or endangered fish species present. Rainbow and brook trout inhabit Cave and Beaver Creeks, and the beaver ponds in these streams are important fish rearing sites.

## HUMAN USES

- The full range of forest recreation occurs in this watershed. Unique recreation activities include spelunking and winter recreation (snowmobiles and cross country skiing).

- Agricultural activities occur in and around Trout Lake in the lower watershed.
- Grazing occurs both on Forest Service land (Cave Creek Allotment) and off-Forest.
- The entire watershed is land ceded by the Yakama Indian Nation and federal land is subject the Yakama Indian Treaty of 1855.
- The Yakama and other tribes have used the watershed both historically and currently. Huckleberry and other native plant gathering occur. Lava tubes in the watershed are a source of mythology.
- Stream channel manipulation and irrigation ditch construction began with the early settlers of Trout Lake.
- McClellan's Trail is a historical trans-Cascade route that was used even earlier by trappers of the Hudson Bay era and native Americans.
- The lower subwatershed (town of Trout Lake) was logged in the 1800's with logs splash dammed down the White Salmon River.
- Timber harvesting today occurs on federal, state, and private lands.

# CHAPTER III - ISSUES AND KEY QUESTIONS

## EROSION PROCESSES

### ISSUE: Erosion Processes

While landslides and debris flow can add substantial sources of sediment and large woody debris to stream systems, the gentle slopes and stable soils in this watershed suggest that mass wasting and surface erosion are not dominant processes.

KEY QUESTIONS:

1. What is the dominant or most important erosion process and what is its sensitivity to management actions?
2. Where are the potential or active mass wasting sites in the watershed?
3. In what part of the watershed is surface soil erosion likely to occur and get into steams?
4. What is the natural rate of sediment production?
5. Where are the potential mass wasting sites that are likely to be accentuated by management actions?
6. Which surface soils are subject to increased erosion from management actions (e.g. roads, timber harvest, grazing, recreation, and fire) and to what extent has soil compaction and displacement increased erosion and sedimentation?
7. What is the road erosion potential?
8. What stream crossings (roads) are at risk for culvert failure?
9. Are cave formations sensitive to physical changes?
10. To what extent does sedimentation occur in caves and affect water drainage and filtering?
11. What are the geologic influences on subsurface water flow?

## HYDROLOGY

### ISSUE: Peak Flows, Low Flows, and Flooding

This issue includes the concern for increased peak flows on federal land, and the concerns regarding flooding in the town of Trout Lake.

KEY QUESTIONS:

1. What factors are involved in peak flows and flooding?
2. Where and to what degree do these factors occur?
3. How have these factors changed over time?
4. How has flooding changed over time in Trout Lake?
5. What is the current risk of increased peak flows?
6. What can be done to affect peak flows or flooding?

## VEGETATION

### ISSUE: Fire

Either through human or natural ignitions, fire has been one of the major sources of disturbance in the watershed. The occurrence intervals for natural large fires range between 125 and 500 years. Due to lightning, total fire occurrence is relatively high, but large fires resulting from these ignitions have been infrequent.

Increased human settlement and fire suppression efforts over the past half century may have changed the historical pattern of fire on the landscape.

KEY QUESTIONS:

1. What is the natural role of fire within the watershed and how has that changed given recent fire suppression?
2. What is the current risk of a large fire occurring within the watershed and where is the highest risk?
3. Where can we benefit from managed fires, either prescribed or natural ignitions?
4. What social and political concerns, including the protection of property and life, will affect fire protection, fire use and fuel treatment programs? Are there feasible measures to deal with these concerns while achieving overall resource concerns in the watershed?

## ISSUE: Timber Harvest Level from National Forest lands

Scheduled timber harvest is permitted from matrix lands on the National Forest. However, timber harvest can only be considered in the realm of meeting all other ecosystem needs.

KEY QUESTIONS:

1. What are the current vegetative seral stages within the Matrix?
2. What is the long-term probable sale quantity (PSQ) and what is the short term yield given current conditions?
3. What are the current resource limitations to meeting PSQ?

## ISSUE: Peterson Late-Successional Reserve and Managed Late-Successional Area

An analysis of the Peterson LSR/MLSA is contained within the Gifford Pinchot National Forest Late-Successional Reserve Assessment (currently in progress).

KEY QUESTION:

1. To what extent do treatments proposed within the LSRA mesh with aquatic and terrestrial conditions and issues for the watershed?

## ISSUE: Soil Productivity

Forest Service policy (FSM 2520, R6 supplement #50 ROD p C-44) requires protection of soils to maintain productivity, hydrologic function, and biotic functions. The gentle topography of the lends itself to ground based logging, and other vehicle traffic off-roads, and runs the risk of adversely compacting and displacing soils on greater the 20% of the activity areas.

KEY QUESTIONS:

1. What is the extent of soil productivity loss due to forest management activities in this watershed?
2. What soils are subject to adverse compaction and hence require extra precaution?
3. What rehabilitative measures could be undertaken to correct existing soil damage?

## ISSUE: Plants of Concern

There are many special habitats in the watershed and numerous plant species of concern.

KEY QUESTIONS:

1. What special habitats occur in the watershed?
2. What survey and manage species occur within the watershed?
3. What Washington State or Forest Service listed sensitive species occur?
4. What federal listed threatened or endangered plant species occur?
5. How are habitats and plant populations of concern expected to change over time?

### ISSUE: Noxious Weeds, Non-Native Plant Species

Noxious weeds and non-native plant species occur in the watershed and have the potential to spread.

KEY QUESTIONS:

1. What introduced species are present and where?
2. What has been and what is the potential effect of non-native populations on native flora and fauna and water quality?
3. What has been and what is the potential effect of non-native populations on range cattle?

## STREAM CHANNELS

### ISSUE: Stream Channels

Stream channels and their morphology are important to understanding watershed issues relating to peak flows, water quality and fish habitat.

KEY QUESTIONS

1. What types of channels are present in the watershed and where do they occur?
2. What factors influence channel conditions?
3. How have these factors changed over time?

## WATER QUALITY

### ISSUE: Water Quality

This issue relates to water quality in streams on the National Forest, water quality in subsurface water in the valley, and potential water quality effects to the White Salmon River from the Cave-Bear watershed.

KEY QUESTIONS:

1. What is the quality of surface waters in the watershed?
2. What is the quality of subsurface waters?
3. What is the quality of seeps and springs on the White Salmon River?
4. How is the quality of surface, subsurface, and seep or spring waters linked?
5. What factors may affect the quality of these waters, and where are they located?
6. How have these factors changed over time?
7. What streams do not meet state water quality standards?
8. Are state water quality standards attainable?
9. How does water from this watershed affect quantity and quality of water in the White Salmon?

# SPECIES AND HABITATS

## ISSUE: Fish Habitat

Human disturbances such as riparian area harvest, road construction, and stream diversions have altered fish habitat within the Cave-Bear Creeks Watershed. These disturbances influence water quality and quantity as well as fish population viability.

KEY QUESTIONS:

1. What are the historical and current fish habitat conditions in the watershed?
2. How and where have past management activities degraded fish habitat conditions?
3. How can future management activities improve the existing habitat conditions?

## ISSUE: Fish Populations

Resident trout species are currently present in the watershed. The distribution and type of species may have been altered by past management activities.

KEY QUESTIONS:

1. What is the current and historical fish distribution in the watershed?
2. How have management activities (e.g. diversions, fish stocking, and migration barriers) affected fish species populations and distributions?

## ISSUE: Wildlife

The watershed has an array of habitat that house an equally diverse array of wildlife.

KEY QUESTIONS:

1. What is the capability of the watershed to maintain the current wildlife community? Wildlife has been grouped as follows:
   - Late-successional and old-growth forest related species (consider fragmentation and connectivity).
   - Cave dependent wildlife.
   - Wetland dependent wildlife.
   - Upland meadows dependent wildlife.
   - Snags dependent wildlife.
   - Wildlife influenced by open road density.
   - Other federal listed threatened and endangered species, and survey and manage species.

# HUMAN USES

## ISSUE: Cultural Resources

Native Americans have used the Cave-Bear Creeks Watershed from thousands of years ago to the present. The entire watershed is land ceded by the Yakama Indian Nation and federal land is subject to the Yakama Indian Treaty of 1855.

KEY QUESTIONS:

1. What areas are of special interest to Native American bands and tribes?
2. What resources are important for traditional uses and how should they be managed?

## ISSUE: Dispersed Recreation

Dispersed recreation is highly valued public use of National Forests. However, there are landscape features such as riparian zones and caves, which are easily impacted by human use.

KEY QUESTIONS:

1. What amount of dispersed recreation is appropriate within the watershed?
2. What areas are resilient to dispersed recreational camping?
3. Are there wildlife and plant species being impacted by this activity?
4. Which caves are vulnerable to use? Which caves can we allow recreation to occur?

## ISSUE: Special Forest Products

There is a wide range of special forest products harvested from the watershed on an annual basis for personal and commercial uses. Examples include beargrass, berries, mushrooms, boughs, vegetative transplants (vine maple). Common rock extraction also occurs from Mann Butte Rock Pit.

KEY QUESTIONS:

1. What materials are being removed? From where?
2. Are there any specific opportunities or concerns in this watershed?
3. Are there any mining claims in the watershed?

# CHAPTER IV - REFERENCE CONDITIONS / CURRENT CONDITIONS / SYNTHESIS

# EROSION PROCESSES

## REFERENCE CONDITIONS

The Cave-Bear Creeks Watershed is characterized by volcanic formation and glacial action along with the erosion processes of wind and water. A large portion of the watershed is gently sloping following a lava flow out of Indian Heaven. These flows form the western portion of the watershed and move through the center towards the town of Trout Lake. These flows were deposited somewhere between 20 to 130 thousand years ago. There were numerous flows that were fairly fluid and have been mapped past Husum. Being so fluid, they created numerous lava tubes of which Ice Cave is one of the better known. These lava tubes are unique in that they form one of the largest concentration of tubes in the country. They are also important for the habitat that they support.

The Peterson Ridge area in the northern part of the watershed is of a much older volcanic activity. This area was formed 20 to 15 million years ago. There are many different flows characterized by pyroclastics interbedded with thinner basalts and andesites. Likewise, the southern portion of the watershed (Trail Peak area) was formed about the same time. These two area are where there is a higher likelihood of having slope stability concerns. This is because there are steeper slopes, more soil, and the weathering characteristic of pyroclastic flows is to silts and clays.

The only other dominant feature in the watershed is Mann Butte, which is an intrusive rhyolite. This intrusion was formed somewhere from 2 to 26 million years ago. The material from Mann Butte has been used extensively on roads in the area and is easily distinguished by the light color of the material.

### MASS WASTING

The natural potential for mass wasting in this watershed is moderate to low, due to the terrain being moderate to gently sloped with shallow soil depths and lava flows that weather to sands and silts, rather than clays and silts. Mass wasting and potentially unstable ground is confined to the older, steeper ground in the watershed (i.e. Peterson Ridge, Trail Peak, Mann Butte). These areas are mostly in the southern and north central portions of the watershed, as can be seen on the Riparian Reserve Map. Mass wasting potential also exists along stream channels that have over- steep banks in soil material. These banks are susceptible to failure, especially during large storm events. Overall, mass wasting does not appear to have been a dominant process in historical times.

### SURFACE EROSION

As with mass wasting, the gentle slopes and soil types temper the natural rate of surface soil erosion. Higher rates of surface erosion would have occurred on the steeper slopes, especially following high intensity fires that left bare mineral soils. These exposed soils would be subject to the erosion vectors of wind, ice, and water. Volcanic activity that deposited layers of tephra were also very susceptible to erosional movement, until new vegetation became established to hold these deposits in place. Given low potential for either mass wasting of surface erosion, combined with relatively few streams, the natural rate of sediment production is assumed to be low.

# CURRENT CONDITIONS

## MASS WASTING

The only known active, large, deep seated landslide in the watershed is located in the Peterson Ridge area. There are other smaller failures in this vicinity and on the opposite side of the watershed near Trail Peak and Mann Butte. Potential unstable soils are also found in these areas. Together these soils comprise 12% of the federal portion of the watershed (see Table 1). The non-federal portion has even a lower percentage given it has a more gentle topography. Of special note is the amount of potentially unstable soils that surround the upper reach of Cave Creek (see Riparian Reserve Map). This reach contains the beaver ponds which hold perhaps the bulk of the fish population in the watershed.

Road construction is the management activity with the greatest potential to effect mass wasting rates. Small slope failures can be found throughout the watershed associated with road cut banks and fills. Most of these disturbances are associated with older roads. It is assumed that improved construction practices in recent years has reduced the potential for these kinds of failures on newer roads. The recent flood events of 1996 and 1997 caused the fewest road failures or landslides in this watershed than in other watersheds on the Forest. Thus, it appears that mass wasting is not a dominant process under current conditions, with the exception of the Peterson Ridge area and the headwaters of Cave Creek.

Table 1. Active Failures and Potentially Unstable Soils.

| Subwatershed | Active Failures | Potentially Unstable Soils |
|---|---|---|
| Coyote | 0 acres | 160 acres (2%) |
| Dry | 98 acres (2%) | 682 acres (12%) |
| Bear* | 0 acres | 605 acres (18%) |
| Cave* | 2 acres (<1%) | 1257 acres (23%) |
| Watershed Total* | 100 acres (<1%) | 2704 acres (12%) |

* Federal land only

## SURFACE EROSION

As stated under reference conditions, this watershed has low potential for surface erosion save for the steeper slopes and following intense fires. In current times, large intense wildlife fires have been kept in check through aggressive fire suppression. However, road construction, timber harvest, and grazing are current activities that bare soils and influence surface erosion.

## TIMBER MANAGEMENT

Timber management affects surface erosion rates through the reduction in vegetative cover and the compaction of soils. Per the Gifford Pinchot National Forest Soil Resource Inventory (1992) half of the soils (11,217 acres) in the federal portion of the watershed have slight surface soil erosion potential and the other half has moderate potential. There are no soils rated with a severe or very severe erosion potential. Surface soil erosion potential largely corresponds with slope. Table 6 (see Hydrology section) shows that 4% of the federal lands has been compacted from timber harvest activity such that hydrology may be affected. These are predominantly soils with slight surface erosion potential. Consequently, this suggests that general surface erosion and sedimentation from managed and unmanaged forest lands is low. The concern is primarily related to road contributed surface erosion.

## GRAZING

The Ice Caves Cattle Allotment overlaps all of the federal portion of the watershed. Approximately 200 head of cattle graze between the months of June and September. Given the low numbers of cattle and the large area of the allotment (31,543 acres), the potential for affecting surface erosion is only realized in areas where cattle congregate, which would be near water sources and areas of primary forage production (meadows). In these areas cattle may cause soil compaction such that surface erosion is increased. Bank erosion may also be increase along streams. Other ungulate use also contribute to these erosion processes. Known sites with erosion problems are very limited in both location and extent.

## ROADS

Roads contribute to surface erosion in several ways. Erosion may be greatest following initial constructions when soils are disturbed, unconsolidated or compacted, and unvegetated. Once constructed, roads intercept and re-route surface and subsurface flows. The material used to surface roads (or lack of material) also influence erosion.

The Cave-Bear Creeks Watershed has a very high road density, 3.8 miles per square mile. Dry Creek subwatershed has the highest density at 4.8 miles per square mile (see Table 4 in Hydrology section). In addition many of these roads are native surface (no rock) or are surfaced with Mann Butte rock. Mann Butte rock was used widely in this watershed to surface roads due to its easy extraction and processing. However, the attributes that make processing easy (soft and light), also make it weather faster and more easily moved by water. Consequently, surface erosion potential from roads stands out as the dominant erosion process in the watershed.

The impact of surface erosion on stream sedimentation is not known as many of the roads in the watershed are on gentle slopes where eroded soils would not move far over a period of time. Also, stream density is low (2.5 stream miles per square mile). The Washington Department of Natural Resources Sediment Model could be used to provide an estimate. This model was not run for this initial watershed analysis due to the lack of field data and the resulting large number of assumptions that would have been needed. Completion of Phase II Road Condition surveys would provide sufficient field information to garner reliable results from this model. Still, based on our experience with this model on other watersheds, we estimate that the vast majority of this watershed which is on gentle slopes produces 30-50 tons of sediment per square mile per year. On steeper slopes sediment production jumps to 40-70 tons of sediment per square mile per year. These rough estimates consider the high road density, high proportion of native surface roads, few streams, and moderate vegetative cover on road fill/cut slopes. These estimates await model or field validation.

# SYNTHESIS

## MASS WASTING

Active and potential mass wasting sites are limited to the Peterson Ridge area and Trail Peak / Mann Butte areas. Active sites are very limited in both location and extent. Potentially unstable soils in the Trail Peak / Mann Butte area surround the upper Cave Creek, and its fish bearing beaver ponds. Both active and potential mass wasting sites are captured within Riparian Reserves. This reduces the likelihood that natural mass wasting rates would be increase by future management actions, though it does not preclude new road construction. Existing roads through these sites remain of concern. Also, any road construction on steep slopes has the potential for slope failure given inattention to design or construction techniques.

## SURFACE EROSION

Surface erosion from roads stand out as the dominant erosion process. This is because of high road densities in the watershed (3.8 mi/mi$^2$) of which most are either native surface or surfaced with Mann Butte rock. Phase II Road Condition Surveys are needed in this watershed. These surveys would provide information on road surfacing, rutting, cut /fill slope condition, and culvert condition. Surveys should focus on the stream crossings, as this is where the sedimentation potential is realized. In addition, the flashy nature of water runoff in the watershed suggest some risk for fill failure where culverts are used in stream crossings. With this information, the Washington Department of Natural Resources sediment model may be run. More importantly, these survey would provide information to prioritize restoration efforts. In the meantime, known areas of culvert failure and road erosion would comprise the initial list of restoration projects.

## CAVES AND SUBSURFACE WATER FLOW

The final three key questions for this core topic focus on cave stability, cave sedimentation, and subsurface water flow.

In general, cave formations are physically stable geologic features. The fragile physical features that are found within caves (i.e. stalagmites) are sensitive to breakage primarily from human visitation. Nearly all the caves on federal land are located with the Peterson LSR/MLSA.

Overall rates of sedimentation within caves is unknown. For these shallow lava tubes, sedimentation typically would occur from surface water run-off in the cave opening. This probably has a minimal affect on water drainage and filtering through lava tubes.

The volcanic basalt that underlie the watershed generally follow the surface slope in an easterly direction towards the White Salmon River. Thus, subsurface water is flowing in a similar direction. Soils in the watershed drain well to charge subsurface flow. While there may be some free water piping through lava tubes, most subsurface flow would occur in the layers of higher permeability between lava flows.

# HYDROLOGY

## REFERENCE CONDITIONS

### FLOODS

Flooding has been a concern in the Trout Lake Valley since the time the earliest European immigrants began settling the valley. Reports from early settlers' diaries and newspaper accounts tell of Trout Lake Creek annually overflowing its banks, and of recurrent outbreaks of diphtheria in the valley associated with flooding. Early newspaper stories and local residents refer to the floods of 1889 and 1933 as the largest floods to occur in the valley (manuscripts on file at the Mt. Adams Ranger District). Because of gaps in streamflow records, it is unknown how the 1933 and 1889 floods would have compared to the 1996 flood in terms of peak streamflow. It is clear however, that much development has occurred in the valley over the past 60-100 years, so the effects of the '96 flood may have impacted more people and infrastructure in the valley than the earlier floods.

Although Trout Lake Creek is generally the stream referred to in these early reports, some long term residents of the valley remember Bear Creek flooding as well. There is still much debate amongst locals as to the actual location of Bear Creek at that time, and the degree to which Bear Creek was responsible for the flooding that occurred in the town of Trout Lake. One account of the 1933 flood describes a bridge over Bear Creek that was lost during the flood. The bridge was at that time located on what is now Highway 141 just west of the Mt. Adams Ranger Station. According to this report, at the time of the 1933 flood, Bear Creek may have flowed directly into Trout Lake as opposed to flowing through town as it does today. Because of the degree of water management that has occurred in the valley since as early as the late 1800's, it may be nearly impossible to determine the original locations of all of the streams in the valley. Nevertheless, because much of the town of Trout Lake is located in the floodplain of Trout Lake Creek, Bear Creek, and/or Cave Creek, it is not surprising that flooding occurs here and that it impacts residents and businesses of the town.

### LOW FLOWS

While too much water was a problem during winter and spring flooding, the valley has had problems with too little water during other times of the year. Ditch systems were being constructed as early as the late 1800's to move water from one part of the valley to another for irrigation, livestock, or domestic use. In 1908, the Lost Creek ditch was created to bring water from the Little White Salmon watershed into the Cave-Bear watershed. The lack of water in the Cave-Bear watershed during summer months is likely attributable at least in part to the highly porous basalts underlying much of the watershed. Water delivered to the valley floor by springs and streams originating in the upper watershed quickly percolates through the shallow soils and lava, or infiltrates through stream bottoms. Although there are no known studies to confirm this, it seems likely that this percolating water from the Cave-Bear watershed is in large part re-emerging as seeps and springs along the banks of the White Salmon River below Trout Lake.

### DISTURBANCE

Vegetation and fire frequency analysis has found that wildfire historically played a dominant role in determining age class distribution of forest vegetation across the landscape. In an 1899 survey of southwest Washington, Plummer (1900) found that approximately 26% of the White Salmon River watershed was in "burned areas", and approximately 73% was "timbered". Plummer's surveys of nearby watersheds found "burned areas" comprising 16% of the Wind River, and 7% of the Little White Salmon River watershed at that time. Although these conditions represent only a snapshot in time, they provide some context for the magnitude and range of areas burned in the past by wildfire, and the relative proportion of these large watersheds in early seral condition at the time of the survey.

Following large scale fires, peak flows resulting from heavy fall rains and rain-on-snow would likely have increased for a period of time before vegetation was re-established in the watershed. Peak flows from spring snowmelt conditions may have also been increased following large scale loss of forest cover due to the increased exposure of the snowpack to solar radiation. At the same time, summer low flows may or may not have increased as a result of the loss of forest vegetation. Water "losses" to evapotranspiration would be reduced as forest cover was removed, which would tend to allow increased soil water and potentially increased streamflows during the summer months.

In the Cave-Bear watershed however, actual increases in streamflow on the valley floor would likely have been minimal because of the limited water holding capacity of the shallow soils and extreme porosity of the underlying geology and stream channels in the lower watershed. Evidence of the excessive infiltration capacity of these channels is found in the degree to which streamflow decreases in a downstream direction in the lower watershed. For example, even during high flow events, the mouth of Cave and Bear Creeks has been observed to remain completely dry, even when both streams appear to have near bankfull flow further upstream. In summer months, the lower reaches of both of these streams are dry.

# CURRENT CONDITIONS

## FLOODS

Because streams in this watershed have never been gauged, peak streamflow levels in Cave and Bear Creeks during floods are largely unknown. However, streamflow has been measured in Trout Lake Creek, another tributary to the White Salmon River lying just north of this watershed, and at various locations on the White Salmon River. The February 1996 flood was probably the largest event recorded in over 70 years at the gauging station on the White Salmon River near Underwood (Figure 1). However, actual height of the '96 flood at its peak is unknown because the gauging station was destroyed when flashboards failed on the dam at Northwestern Lake. Prior to failure of the flashboards, the flow was approximately as high as the peak of record at that station (15,300 cfs), which occurred in January, 1974. When the flashboards failed during the '96 flood, flow records indicate that discharge tripled just before the gauge quit working. Trout Lake Creek, Bear Creek and Cave Creek all flowed over their banks during this major event, and the town of Trout Lake was inundated.

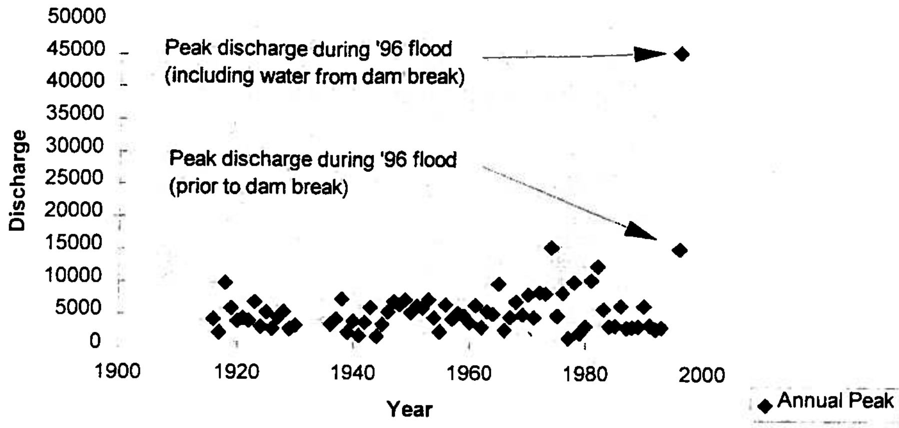



Figure 1. Annual Maximum Peak Flows on the White Salmon River near Underwood

The '96 flood was typical of the kinds of conditions that cause the largest flooding for systems like the Cave-Bear watershed. A heavy snowfall was followed by freezing and a subsequent warm, wet frontal system that remained in the area over a period of days. The resulting snowmelt combined with runoff from heavy rains caused major flooding throughout the region. Although the largest floods on Cave-Bear probably occur in response to these types of rain-on-snow events, this system also experiences high flows during the spring months when air temperatures rise and cause rapid and widespread snowmelt in the watershed.

Figure 2 shows the monthly high flows in Trout Lake Creek during the year of 1968. Streamflow levels at this gauging station do not include flow from the Cave-Bear watershed, but the general timing and relative magnitude of flows would be similar, with expected variation due to influence of the lava in Cave-Bear, along with differences in topography, elevation, watershed position and orientation.

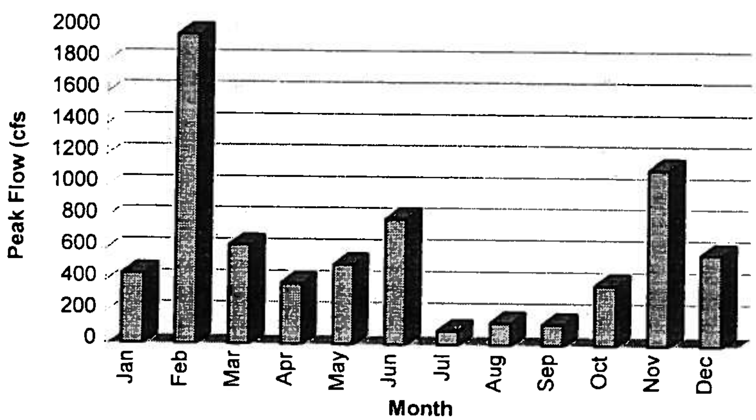



Figure 2. Monthly High Flows on Trout Lake Creek, 1968.

In general, this figure indicates that during 1968, there are three distinct peaks: two peaks in the fall and winter driven by rain and rain-on-snow, and one smaller peak during the spring snowmelt period. Although the month of the peaks would shift from year to year, the general pattern of high flows is representative of what happens in Trout Lake Creek, and generally what is expected to occur in the Cave-Bear watershed.

## VEGETATION

Vegetation in the watershed plays a strong role in determining the timing and magnitude of water available for runoff during periods of rainfall and snowmelt. Currently, approximately 95% of the watershed is in a forested condition, and approximately half of that is in either seedling/sapling or pole-sized stands. Figure 3 shows the distribution of tree size classes in the watershed.

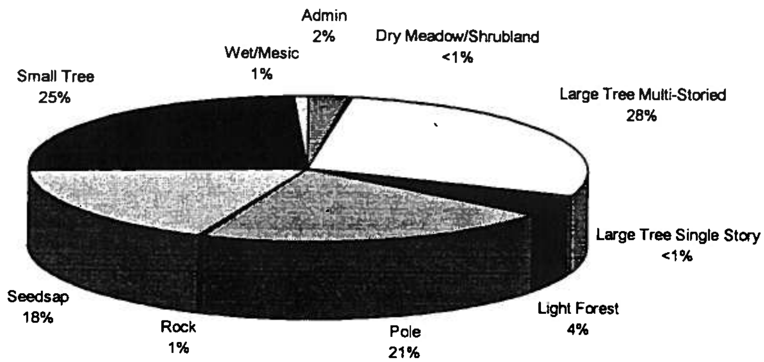



Figure 3. Dsitribution of Tree Size Classes in the Watershed.

The proportion of the watershed in younger age class forest types (i.e. seedling/sapling and poles) is important because of the influence vegetation has on snow accumulation and melt rates, particularly as it relates to rain-on-snow processes. These younger stands are considered hydrologically immature, because they have less capacity for snow interception and retention in the canopy, and are less effective at impeding wind movement across the snowpack.

The Aggregate Recovery Percentage (ARP) is a tool used to index the proportion of a watershed in a hydrologically "mature" condition (White and Crist 1988). Hydrologically mature stands in general include any fully stocked stand with average tree sizes larger than the pole size class. These larger trees have greater capacity to intercept and retain snow in the forest canopy, and are more effective at limiting snowmelt during rain-on-snow by impeding wind movement across the snowpack. An ARP of near 100 indicates that nearly all of the forest vegetation in the watershed is in hydrologically mature condition, whereas an ARP of 0 would indicate that all forest vegetation in the watershed is hydrologically immature. As the ARP for a watershed decreases, the risk of increased peak flows is increased. Table 2 presents the ARP values for each subwatershed in the Cave-Bear watershed.

Table 2. Subwatershed Aggregate Recovery Percent (ARP) and Percent Rain-on-Snow (ROS)

| Subwatershed | Acres | ARP | % ROS |
|---|---|---|---|
| Coyote | 7,679 | 68% | 75% |
| Dry | 5,745 | 76% | 30% |
| Bear | 9,931 | 62% | 82% |
| Cave | 10,082 | 63% | 86% |
| Watershed Total | 33,437 | 66% | 73% |

Because ARP values are used in part to assess the effects of vegetation cover on peak flows resulting from rain-on-snow driven floods, the elevations of the subwatershed are also important in assessing the risk of increased peak flows. Table 2 shows the percent of each subwatershed in the high probability rain-on-snow elevations, which are generally considered to be 1,500-3,500 feet elevation in this watershed. From the data presented above, it is apparent that both the Cave Creek and Bear Creek subwatersheds are at higher risk of increased peak flows due to their harvest history and elevation.

Cumulative effects tools like the ARP are applied at the subwatershed scale regardless of land ownership differences within the subwatershed. However, it is noteworthy that harvest histories differ between National Forest and non-National Forest lands within the watershed. To quantify these differences, the ARP was calculated for the Cave Creek and Bear Creek subwatersheds for National Forest lands, and for non-National Forest lands. Results are presented in Table 3.

Table 3. Comparison of ARP's for National Forest and Non-National Forest Portions of the Watershed.

| Subwatershed | ARP--NF Only | ARP--non-NF | Total ARP |
|---|---|---|---|
| Bear | 73 | 56 | 62 |
| Cave | 61 | 66 | 63 |

As indicated in the Table 3, the Bear Creek subwatershed has been more heavily cut below the National Forest boundary than on the National Forest, and the Cave Creek subwatershed has been more heavily cut on the National Forest portion than on the non-Forest. In terms of the effect of these differences on peak streamflows, there is none. This exercise was only done to illustrate the differences in current conditions between the National Forest and non-National Forest portions of the watershed, and to show why there is a higher level of concern for increased peak flows in the Bear Creek subwatershed than conditions on the National Forest portion of the watershed would indicate when looked at in isolation.

## ROADS

Roads are another important feature on the landscape that can affect the hydrologic functioning of a watershed. By impeding water infiltration, intercepting subsurface water and converting it to surface flow in roadside ditches, roads can accelerate the rate at which water moves from hillslopes into streams. As the number of roads or road density is increased in a watershed, the potential for this localized effect on hillslope hydrology to affect watershed hydrology by changing the rate or timing of streamflows is increased. Table 4 displays the current road mileage and road densities for each subwatershed.

Table 4. Road Miles and Density.

| Subwatershed | Road Miles | Road Density ($mi/mi^2$) |
|---|---|---|
| Coyote | 57.1 | 4.8 |
| Dry | 25.0 | 2.8 |
| Bear | 50.1 | 3.2 |
| Cave | 67.3 | 4.3 |
| Watershed Total | 199.5 | 3.8 |

The degree to which any particular road intercepts subsurface flows and re-routes this water to streams via roadside ditches is dependent upon a number of variables including the soil type and depth, subsurface hydrology, geology, slope, and position of the road on the hillslope. Roads located along ridgetops are probably less important to changes in hydrologic flow paths because these roads have no cutslope and no drainage area above them. Roads in mid-slope positions have relatively larger drainage areas above them, and may have long distances below them through which water would normally have flowed via subsurface pathways. When they are intercepting subsurface water, these roads may have the greatest effect on changing the timing of water delivery from hillslopes into stream channels. Roads in lower hillslope positions are probably the most likely to be intercepting subsurface flows, because these landscape positions are where subsurface water builds up during precipitation or snowmelt periods. Table 5 displays the percent of total road miles in each subwatershed that are located in mid-slope positions. These numbers were arrived at by using a computer query (developed in GRID), and modified based on local knowledge of topography in this watershed. Because this methodology is new and hasn't been field checked, accuracy of this data is considered moderate at best.

Table 5. Road Landscape Position and Affect on Drainage Density.

| Subwatershed | Roads in Mid-Slope Positions (as a % of total road miles) | Natural Drainage Density (mi/mi$^2$) | Current Drainage Density (% increase over natural)* |
|---|---|---|---|
| Coyote | 20% | 1.59 | 171% |
| Dry | 34% | 2.99 | 53% |
| Bear | 23% | 2.42 | 76% |
| Cave | 42% | 3.00 | 81% |
| Watershed Total | 30% | 2.50 | 87% |

* See following paragraph for qualification of these numbers.

During runoff periods, as additional miles of road begin to capture and route water through roadside ditches, the effective surface drainage network in a watershed can be substantially increased. Table 5 displays the natural drainage network density for each subwatershed, and the percent that the natural drainage density may be increased during runoff periods as a result of the current level of road miles in the watershed. The values presented in this table were determined by assuming that approximately 57% of the roads in the watershed function as extensions of stream channels by routing water directly from hillslopes to streams (following Wemple 1994). However, because of the very gentle topography in this watershed, it is probable that substantially less than 57% of the road system is actually intercepting and rerouting water in this way. Since the degree of difference is unknown, these values are presented here as the upper end of what would be expected. The drainage density increases reported here are quite high compared to other watersheds on the Forest. This is due to a combination of high road densities and particularly low natural drainage densities in the watershed.

## OTHER WATERSHED DISTURBANCES

Land converted from forest land to other vegetation types or other uses may also be an important factor in assessing the degree to which watershed hydrology has been changed in this watershed. Land uses including residential and commercial development compact soils and cover the ground surface with impervious material, causing water to run overland instead of seeping into the ground and flowing more slowly through subsurface pathways. Approximately 2% of the watershed is in the "administrative" land use class, indicating developed areas such as residential, commercial, or administrative uses. Most of this type of land is in the lower watershed, in and around the town of Trout Lake.

Agricultural uses and forest practices such as timber harvest can also affect hydrologic processes. Landings, temporary roads and skid trails can compact soils and accelerate water runoff processes. On National Forest lands in the watershed, it is reasonable to assume that any past harvest areas on slopes of less than 35% were logged using ground-based logging systems. When these systems are used, particularly on soils with a high potential for compaction, skid trails can be compacted to the degree that they allow surface concentrations of water to develop and run down the skid roads. The same effect can occur from landings and temporary roads. The effect of this can be to accelerate the rate of water movement from hillslopes into stream channels, which can potentially contribute to higher peak flows. Table 6 summarizes the acres of ground based logging that has occurred on the National Forest portion of the watershed.

Table 6. Acres of Compacted Soils Affecting Hydrology in National Forest Timber Harvest Areas.

| Subwatershed | Acres of Ground Based Logging on National Forest | Compacted Acres Affecting Hydrology* | % of Subwatershed Compacted** |
|---|---|---|---|
| Coyote | 3339 | 334 | 4 |
| Dry | 2185 | 219 | 4 |
| Bear | 1114 | 111 | 3 |
| Cave | 2290 | 229 | 4 |
| Watershed Total | 8928 | 893 | 4 |

*Assumes 10% of each ground based logging is compacted (landings, temp road, main skid roads) .
** Federal land only.

The Gifford Pinchot Forest Plan limits soil disturbance, displacement and compaction to 20% of the area harvested. While it is reasonable (based on past monitoring) to assume that soils on 20% of each of these units is in fact disturbed to some degree by the logging, it is likely that not all 20% of each unit is compacted to the degree that water infiltration is prohibited or overland flow is caused. Thus, the assumption used in the previous table is that half of the disturbed soil (10% of the total unit area) is compacted to the level that hydrology is affected. Of this portion, not all of it would be hydrologically linked (through surface flow) to stream channels during runoff, which would tend to reduce the actual effects on peak flows. Moreover, in the more recently harvested areas, post harvest subsoiling or ripping of landings, temporary roads, and in some cases skid trails has been done to restore water infiltration and reduce or disperse overland flow.

## RISK OF INCREASED PEAK FLOWS

Based on the vegetation age classes present, the elevations of the subwatershed, and the degree of roading that has occurred, a relative risk rating was used to identify those subwatersheds with the highest potential for increased peak streamflows. The risk rating indicates relative differences between subwatersheds, rating each subwatershed as "high", "medium" and "low" risk for increased peak flows. Figure 4 presents the results of this risk rating.

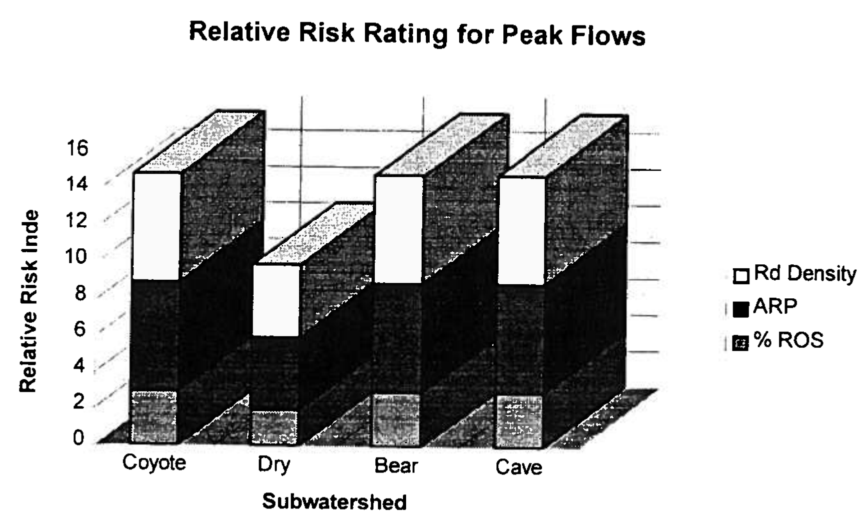



Figure 4. Relative Risk of Increased Peak Flows by Subwatershed.

Based on this rating, the Coyote, Bear, and Cave Creek subwatersheds have a relatively high risk of increased peak streamflows. Dry Creek has the lowest relative risk for the watershed, but is still rated as moderate risk in comparison with other subwatersheds on the South Skill Center.

## PREDICTED CHANGES IN PEAK STREAMFLOWS

To further investigate potential changes in peak streamflows resulting from past forest practices, streamflows were modeled under current vegetative conditions and compared against streamflows modeled under fully forested (i.e. pre-harvest) conditions. The model used for this is a tool developed for watershed analysis by the Washington State Department of Natural Resources. The Hydrologic Change Model calculates differences in snow accumulation and melt based on changes in vegetative conditions in the watershed. Based on the amount of snow accumulation and calculated rates of snowmelt, the model predicts a volume of water available for runoff for a range of flood recurrence intervals. Differences in water available for runoff are then converted to streamflow to show differences in predicted flow under different vegetative conditions. This model does not in any way address routing of the water from hillslopes into stream channels, so the effect of roads on peak flows is not taken into account.

The model was run for each subwatershed in the watershed. Peak flows were calculated for the flood with a two-year recurrence interval under current conditions and under fully forested conditions. The two-year event is used because the higher frequency events show the greatest relative change in magnitude as a result of changes in forest cover, and because these events are considered to be the most important events from a stream channel and fish habitat perspective. Streamflows modeled under current conditions are compared against those modeled under fully forested conditions to show the magnitude of difference in streamflows under the two vegetative conditions. Figure 5 presents the results of this modeling effort.

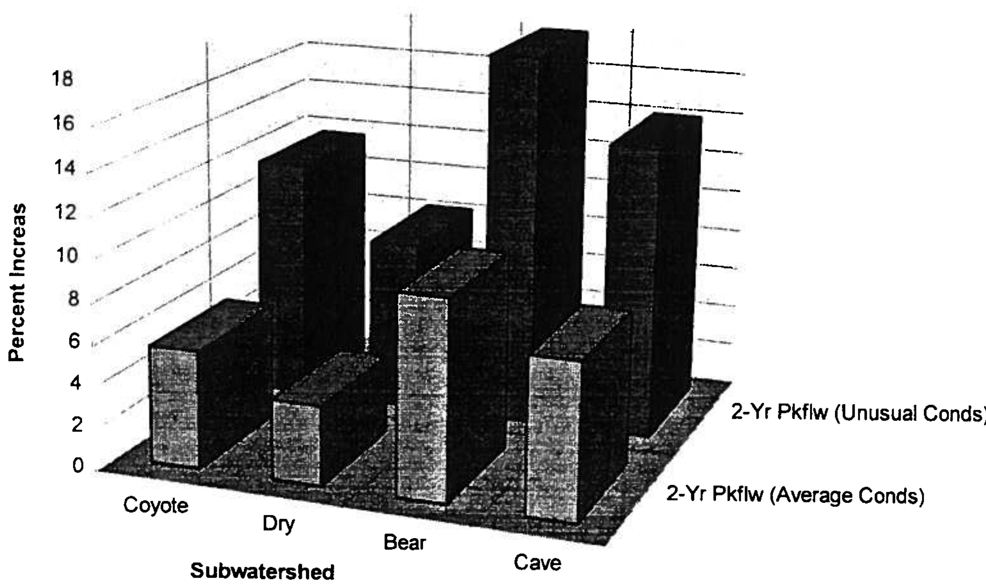



Figure 5. Predicted Peak Flow Increases Under Current Vegetative Conditions for Two Storm Intensities.

In this watershed, the two year flood is predicted to have increased by from 4 to 10 percent under "average" storm conditions, and from 8 to 18% under "unusual" storm conditions. The Bear Creek subwatershed shows the largest relative increase, at 10% under "average" rain-on-snow storm conditions. Results from this modeling support the relative risk ratings, in that Dry Creek has the lowest risk of increased peak flows, and Bear and Cave Creeks have a relatively higher risk.

## LOW FLOW

As noted previously, there has been no measurement of streamflows in the Cave-Bear watershed, so actual low flow levels are unknown. However, during summer months, it is clear that lower Cave and Bear Creeks have no flow at all. Although this could be in part due to upstream diversions, historical maps created prior to development of the Trout Lake Valley show these streams going dry at that time as well. If the Cave-Bear watershed produced water at the same rate (per acre) as the Trout Lake Creek watershed, low flow volumes generated in Cave-Bear would be on the order of 75% of the Trout Lake Creek low flows, or in the range of approximately 20 cfs during minimum flow conditions.

Even if as little as half as much water is delivered to Cave-Bear as to Trout Lake Creek, there would be on the order of 10 cfs generated from the Cave-Bear watershed during summer months if snowmelt and runoff processes occurred at rates similar to those in Trout Lake Creek. Currently however, there is no surface discharge from the watershed for at least several months of the year. This water is either being diverted from the stream and not showing up as return flow, or is being routed out of the watershed through subsurface pathways. Numerous springs found along the White Salmon River below the Trout Lake Valley suggest possible subsurface routing of water from the Cave-Bear watershed to the White Salmon River.

## SYNTHESIS

The primary trend in factors affecting peak and low flows in this watershed has been the shift from a fire dominated system to one where timber harvest, road construction, farming and residential development have become the dominant disturbance processes. On the National Forest portion of the watershed, timber harvest and road construction are the most important factors likely to occur that will affect peak and low flows. Hydrologic recovery in this part of the watershed will occur as forest vegetation matures and develops, and as roads and compacted areas are decommissioned or rehabilitated. Realistically, the recovery or lack of recovery in this portion of the watershed will depend on the relative proportion of the watershed that is harvested, the natural rate of recovery of forest vegetation in the watershed, the miles of road constructed, and miles of road decommissioned,. Figure 6 presents the projected trends in hydrologic recovery of vegetation in the watershed as indexed by the Aggregate Recovery Percentage (assuming no additional harvest).

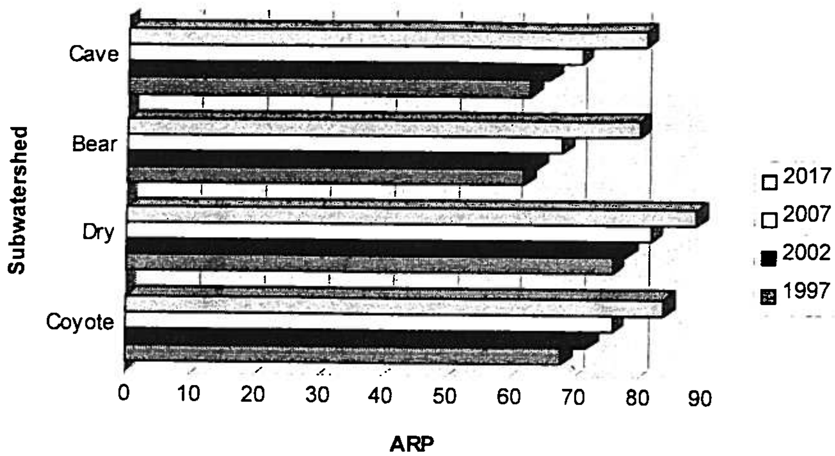



Figure 6. Aggregate Recovery Percentages for the Years 1997-2017.

Based on current vegetative conditions, hydrologic recovery of forest vegetation is occurring most rapidly in the Coyote and Cave Creek subwatersheds. In the second decade (2007-2017), recovery rates are highest in the Bear Creek subwatershed. The different rates of recovery indicate differences in the age class of early-successional forest. The differences in recovery rates in this watershed indicate that the early-successional stands in the Bear Creek watershed are probably slightly younger than the average age of early seral stands in the Coyote and Cave Creek subwatersheds, so don't reach their maximum rate of recovery for another decade.

For purposes of illustrating the current recovery rates, Figure 6 assumes no additional harvest in the watershed. However, timber harvest is expected to continue here, both in the "Matrix" on National Forest lands, and on the state and private lands below the Forest boundary. The rate and timing of this harvest is unknown. In addition, forest lands in the Trout Lake Valley will likely continue to be converted to residential and other uses as developmental pressures in the valley continue. These types of changes, because they are permanent, will have more persistent effects on streamflows in the watershed.

Although some road construction may still occur in the matrix portion of the National Forest, the amount of construction will be much lower than previous rates, and will likely be offset by road decommissioning done in association with timber sales or watershed restoration programs. Road construction below the National Forest boundary is likely to continue for access to new housing developments and to harvest units on state and private forest lands.

## DATA GAPS

- Streamflow data for any stream in the watershed
- Discharge data for the seeps and springs along the White Salmon River
- Historical location of Bear Creek, Cave Creek

# VEGETATION

## REFERENCE CONDITIONS

## ECOLOGICAL ZONES

### FOREST ZONES

The watershed is dominated by forested ecotypes. The dominant forest zones (also referred to as plant series) present are grand fir (67%), Pacific silver fir (26%); and mountain hemlock (1%) (refer to Gifford Pinchot National Forest plant association handbooks). Small inclusions exist of western hemlock, western redcedar, subalpine fir, and lodgepole pine zones as well. This ecological variety is a reflection of the breadth of environmental conditions, particularly temperature and moisture gradients. The climate on the east slopes of the Cascade Range combines features of both maritime and continental regimes. Dominant characteristics are the rain shadow effects of the Cascade crest, elevation-related temperature differences, and very low summer precipitation. Elevations within the watershed range from about 1,950 feet in the Trout Lake Valley to 5,925 feet at Lemei Rock in the Indian Heaven Wilderness.

The grand fir zone occurs on the warmest and driest sites in the analysis area and is the driest plant series on the Gifford Pinchot National Forest. These sites are found on south-facing slopes and on lower elevations within the National Forest boundary. Nearly all of the state and private lands within the watershed are within the grand fir zone. The upper elevation limit of the grand fir zone occurs where greater moisture and cooler temperatures favor the reproduction of Pacific silver fir (Pacific silver zone). The Pacific silver fir zone is found on the north slopes in the Peterson Prairie area, and mid to upper elevations of the Cave Creek drainage to about 4,000 feet. The mountain hemlock zone occurs at the highest elevations, typically above about 4,000 feet, and within the Indian Heaven Wilderness. These zone is characterized by deep snowpacks and short growing seasons. There also are inclusions of the subalpine fir and lodgepole pine zones in areas where cold air accumulates, such as around high elevation openings with gentle topography. The western hemlock and western redcedar zones occur in limited locations, mostly along the Cave Creek drainage and tributaries where its is moist and relatively warm.

### NON-FOREST ZONES

The are a number of non-forest ecological zones present. These include tallus slopes and rock outcrops, dry and wet meadows, and the numerous underlying caves. These non-forest zones historically comprised less than one percent of the watershed. Because of their relative scarcity, these features are often considered unique or special habitats. These areas are the source for much of species richness and overall biodiversity that is found within the watershed. These features typically are slow to change either through succession or disturbance (fire), though in some cases (dry meadows) it is fire which helps maintain the condition. Consequently, the features found today were likely present in historical times.

## DISTURBANCE - FIRE

### FIRE GROUPS

A report was prepared addressing the role of fire on the Mt. Hood and Gifford Pinchot National Forests titled *Fire Ecology of the Mid-Columbia* by Louisa Evers and others in 1994. Several fire groups are identified based on ecological plant series which have similar fire histories. The four fire groups present in this watershed are Miscellaneous Special Habitats (Group 0); Dry Grand Fir (Group 3); Cool, Dry Lower Subalpine (Group 5); and Warm, and Moist Western Hemlock and Pacific Silver Fir (Group 8).

**Miscellaneous Special Habitats (Group 0)**
Rock outcrops, talus, meadows, alder glades, riparian communities, and recent volcanic deposits comprise Group 0. These areas have little fuel present, or very discontinuous fuels. Such areas generally don't carry fire except under extreme conditions.

**Dry Grand Fir (Group 3)**
This fire group includes the gentle slopes in the western half of the watershed and the south slopes on Flattop Mountain. Fires are estimated to have burned about every 25-100 years. Prior to fire exclusion, Group 3 probably experienced a fairly even mix of crown fire (stand replacement) and underburning. Most fires probably included both crown fire and underburning. Fire starts would have burned for weeks to a couple of months. Medium sized fires (10-1,000 acres) may have been more common. Under current stand conditions (following about 85 years of fire suppression), fires would tend toward crown fires. Fires either tend to stay small (less than 10 acres) because of aggressive initial suppression, or get large (greater than 1,000 acres) during periods of extreme fire weather conditions.

**Cool, Dry Lower Subalpine (Group 5)**
This fire group is located at the higher elevations of the watershed on the eastern slopes of Indian Heaven Wilderness. Prior to suppression, this group probably had a stand replacement fire interval of about 200-270 years. However, during the life of the stand, occasional low to moderate intensity ground fires occurred. These lower intensity fires would create canopy gaps, resulting in stands containing a mosaic of age classes and a variety of conifer species. Native Americans may have ignited some fires at high elevations in order to perpetuate huckleberry gathering areas. In the absence of fire, huckleberry-producing early seral communities are replaced by overtopping forest vegetation resulting in much lower berry production.

**Warm, Moist Western Hemlock and Pacific Silver Fir (Group 8)**
This fire group occurs throughout the vast majority of the analysis area in the mid to upper elevation slopes not included under the Grand Fir or Subalpine Fir fire groups. Stand replacement fires in the Pacific Silver Fir Zone are estimated to occur at intervals of 90-730 years. Low severity understory burns appear to take place every 40-50 years during the first 150 years of stand development. After that point, a fire may burn every 125-500 years. The understory fires serve to prepare mineral soil seedbeds, producing a mosaic of stand structures and age classes across the landscape. Most fires are believed to have been very small (less than 10 acres), or very large (greater than 1,000 acres) depending on burning conditions.

In summary, the fire return interval outside of the Indian Heaven area, may be from 30 - 100 years. This was found to be true in a similar area just to the south of the forest on the Mt. Hood National Forest. Stand replacement fires though may have occurred every 100-200 years. In the higher elevations of Indian Heaven, these intervals would be longer. Unusual stand conditions or fire weather result in the stand replacement type of fire. A very rough assumption could be made stating that fires in the 1-10 acres size occur 90% of the time in the 30-100 year interval range and fires that are greater than 100 acres occur 10% of the time and fall into the 100-200 year interval.

## LIGHTNING TRACK

The watershed lies in the path of a weather pattern that produces lightning. This weather pattern sets up when there is a high pressure to the east of the watershed and a low pressure system moving into the region from the south. Typically this weather pattern produces cumulous clouds that move from a south to north direction. As they move over Big Huckleberry, Trail Peak , Guler, Flattop Mountain, or the Cascade Crest, they tend to develop into the type of storms that produce lightning. These storms usually occur in June but can occur as late as August/early September.

**HISTORICAL FIRES (PRE-1900)**

Prior to settlement, large-scale natural fires periodically burned throughout the watershed. Summer lightning storms moving up from the south over Trail Peak, Guler, and Flattop started fires. In addition, Native Americans ignited burns by either leaving their drying logs smoldering after leaving the berry fields or by directly setting fire to berry patches at the end of the berry season in order to maintain or re-vitalize huckleberry production (Plummer 1900, French 1957). The McClellan party in 1853 noted that once passing Goose Lake, the vegetation drastically changed to widely space ponderosa pine that resembled a park. McClellan was following a trail used by Native Americans and that was previously noted in 1830 by Hudson Bay Company trappers. Thus, it is likely fire were intentionally used to reduce brush to facilitate travel along this route. Plummer in 1899 noted that this area was 75% comprised of ponderosa pine at 3-5 bm per acre. Combined, these vegetative descriptions suggest a large area of lightly stocked pine forest, perhaps maintained by underburns. Plummer also mapped burns (1880-1899), which were likely stand replacing events (refer to Fire History Map). General Land Office survey notes (Clark 1882) also describe where brush fields and burns were encountered during township line surveys in east half of the watershed. Thus, stand replacing burns had also occurred in this area; however, we have insufficient information to map these fires.

## FOREST SERAL DISTRIBUTION

**SUCCESSIONAL STAGES**

Pre-European settlement is the point of reference for vegetation conditions in the Cave-Bear Watershed. The watershed has a long history of human use which has greatly influenced the vegetation and associated habitats now present. The most important human activity prior to settlement was Native American burning. Since settlement, human influences include fire suppression and timber harvest. Table 7 displays the percent of area by vegetation condition and how conditions have likely changed from about 1800 to the present day.

Table 7. Historical Forest Successional Conditions

| Period | Non-Forest | Early Successional | Mid Successional | Late Successional |
|---|---|---|---|---|
| Range of Natural | 1% | 6%-52% | 6%-80% | 15%-90% |
| Circa 1800 | 1% | 9% | 30% | 60% |
| Circa 1900 | 3% | 17% | 45% | 35% |
| Current Conditions | 4% | 22% | 45% | 29% |

Definitions: Non-forest - rock, meadows, agricultural and domestic conversions.
Early Succession - Seedling and saplings.
Mid Succession - Poles and small trees.
Late succession - large trees.

The range of natural condition is adapted from *A First Approximation of Ecosystem Health* (USDA-FS 1993), which is also known as the Regional Ecosystem Assessment Project or REAP. The REAP characterized various ecosystem components in pre-settlement times. The scale of analysis was the subbasin level. The Cave-Bear Creeks watershed lies within the Hood-Wind Subbasin, which also includes Hood River, Wind River, White Salmon River, and Little White Salmon River Watersheds (see Hood-Wind Subbasin Map). The natural range values presented in Table 7 represent the weighted average for the grand fir and Pacific silver fir zones.

The 1800 figures are based on the few historical descriptions that are available such as the McClellan party journals and GLO survey notes. The forest in the early 1800's contained about 60% of the area in stands of large trees that contained single and multi-storied canopies. Included in this component were open park-like ponderosa pine stands that existed in the central portion of the basin along the route traveled by the McClellan survey party. Until European settlement, wildfires either started by lightning or by Native Americans, were the major cause of disturbance and source for young forests. It is speculated that the historical pattern of Native American burning and land use was drastically altered after 1800 because disease and pestilence decimated the native populations of the Columbia River Basin. After 1880, settlers began to move into the Trout Lake area and lands were harvested and converted from forest land to agriculture uses.

The 1900 figures were derived from survey notes of Fred G. Plummer who surveyed the timber values of the Columbia National Forest and mapped the burns that were obvious at that time. The first commercial logging in the watershed was in 1900. The early commercial logging was done mainly along the lands adjacent to the White Salmon River where logs could be easily skidded to splash dams on the river. Wildfires and the suppression of wildfires played an important role in shaping the vegetation that exists today. Records show that there were over 5,700 acres of wildfires between 1880 and 1920. Many of these fires were stand replacement fires that contributed to the seedling/sapling component at the turn of the century and which are just becoming late-successional forest today.

The current figures in Table 7 represent the data that resides within the Forest's IVEG data base. The current vegetation is greatly influenced by events that have taken place since the turn of the century. It wasn't until after 1920 that wildfires were aggressively suppressed to keep them from growing to a large size. This, along with the selective and salvage harvest of large mature trees, has contributed to the establishment and growth of grand fir into prominence within the watershed. Since 1950, the watershed has seen over 13,400 acres of regeneration clearcut and shelterwood timber harvest on federal, state, and private lands. These harvests generally cut the older mature stands and converted them to young stands.

## COMPOSITION AND STRUCTURE

The early-successional stage lasted longer historically than today. With current forest management, stands are re-established more quickly through reforestation efforts, thus shortening the early seral stage. Historical fire events periodically created large openings which in turn may have been great distances from seed sources. Combined with the dense woody shrubs that develop following disturbances (which retards conifer regeneration establishment), stands likely remained in an early seral condition comprised of seedlings and saplings much longer than under current forest practices. In addition, early seral communities created by fire normally had a snag (and subsequent down log) component whereas most of the harvested lands do not contain appreciable amounts of snags.

The late-successional forest stage would have had a large component of old-growth forest, due to the large percentage of acreage represented and long intervals between stand replacing fires. This would be true even within the Grand Fir Zone and fire group 3 where the short fire intervals reflects a greater proportion of underburns. This disturbance pattern would also influence the density and species composition. Late-successional stands in the grand fir ecoclass would have widely spaced large trees, with a greater proportion of the trees comprised of early seral species such as ponderosa pine and Douglas-fir. Vegetative descriptions by the McClellan party in 1853 and Fred Plummer in 1900 match these expectations. McClellan's party describe a park-like setting with trees 30 yards apart after passing Goose Lake heading east. Plummer describes the timber as being 75% ponderosa pine on lands that are mapped grand fir ecoclass. Current stand ages and species composition support these descriptions for lands adjacent the historical trail (south of Road 60 and 24), though the conditions are more variable outside this band.

Patch sizes in presettlement vegetation communities were quite variable, but large patches tended to dominate the landscape. The large patches were either or both late and early seral patches in any given point in time as dictated primarily by fire occurrence.

## SOIL PRODUCTIVITY

Soil productivity is a result of soil structure and nutrient availability. The processes of compaction, erosion, mass wasting, and volatilization of organic matter have the potential to affect significant change in a short time period to soil structure and nutrient availability and hence soil productivity. The processes of soil weathering, nutrient deposition, leaching, and biologic interactions also affect these soil attributes, but these processes occur much more slowly and are less affected by management actions.

Forest soils in this watershed rate as site class IV-V for Douglas-fir productivity (90-160 cubic feet per acre per year of timber). Historically, fire was the main factor in affecting rapid changes in soil productivity. Fire can volitilize both above and below ground soil organic matter (nutrients). Exposed mineral soils would then be subject to erosion and mass wasting under the altered hydrologic regime.

# CURRENT CONDITIONS

## DISTURBANCE

### FIRE

**Fire Suppression Efforts**
All fires have been actively suppressed since the early 1930's. A combination of suppression tactics have been employed. These range from bulldozer constructed fireline to hand constructed fireline. The current Forest Plan direction provides for the use of appropriate suppression response to any wildfire in the watershed. Appropriate suppression responses could be either control, confine or contain. Each management allocation in the Forest Plan has a suggested suppression response based on values at risk.

**Fire History (post 1900)**
There appears to have been a number of large fires in the watershed between 1910 and 1924. In that time period there were 7 fires over 200 acres. The specific cause is unknown, however due to the amount of human activity in this area during this time period it is assumed that these fires were most likely caused by some type of human activity.

Records of fire starts during the period from 1930 through 1970 are scarce. Records kept from 1970 through 1990 indicate at least 59 known fire starts on Forest Service land. Fire starts on land other than Forest Service were not obtained for this report. The following table shows the breakdown by statistical cause.

Table 8. Fire Starts and Causes from 1970-1990.

| Statistical Cause | Number of Fires | Percent |
|---|---|---|
| Smoking | 21 | 35 |
| Lightning | 16 | 27 |
| Campfires | 11 | 19 |
| Equipment Use | 2 | <1 |
| Debris Burning | 2 | <1 |
| Children | 3 | <1 |
| Miscellaneous | 3 | <1 |
| Arson | 1 | <1 |
| **Total** | **59** | |

The previous table indicates that a large percentage of the fire starts (73%) are from human activities. Out of the 73%, 54% were the result of smoking and campfires. These high numbers can in part be attributed to the high recreational use that this watershed receives. The second highest cause of fire starts during this 20 year period, 27%, were the result of lightning.

## TIMBER HARVEST

The first harvesting was done by settlers to clear land and provide timber for building materials. The first commercial timber operation occurred in 1900 in the Trout Lake area. Until 1950 most timber harvesting on National Forest land consisted of partial cutting and salvage logging. Over the years, much of the high valued ponderosa pine was selectively harvested. Clearcutting followed by planting was a common practice from the 1950's into the 1990's. Shelterwood harvest began in the late 1960's on high elevation plateaus between Peterson Prairie and Indian Heaven to ameliorate site conditions in order to reduce frost damage to conifer regeneration. Regeneration harvest on National Forest lands between 1950 and 1996 varied from zero to over 700 acres annually. Information on harvest on private and state lands is incomplete but shows high levels of harvest in the late 1970's and early 1980's.

## INSECTS AND DISEASE

The primary insects and diseases affecting forests in the watershed include western white pine blister rust, laminated root disease, Armillaria root disease, and bark beetles, and western spruce budworm.

### White Pine Blister Rust

Blister rust is an introduced disease affecting western white pine trees. Ribes species (currents and gooseberries) are alternate hosts. This disease has caused large-scale mortality of white pine over many years. White pine occurs as a minor species throughout the analysis area. Preventative measures that can be implemented to minimize blister rust impacts include planting genetically resistant western white pine for reforestation and branch pruning during early stand development.

### Laminated Root Rot

This disease is found throughout the forested ecosystem and causes mortality to Douglas-fir and true firs. Western hemlock and western larch are moderately resistant; western white pine, ponderosa pine and western redcedar are highly resistant; and hardwood species are immune to the disease. Laminated root rot causes mortality in small areas, from a few trees to up to 2-3 acres in size in this vicinity. Trees weakened by the disease are often attacked by bark beetles. The disease continues to spread by root contact gradually until it encounters areas with immune species or no susceptible root systems.

### Armillaria Root Rot

Armillaria is found within the watershed. Conifers affected by this disease depend on the particular strain or sub-species. One strain affects mostly Douglas-fir and true firs, while a different strain affects ponderosa pine and true firs. The disease normally becomes established on trees of low vigor, then spreads by root contacts. Species that are not affected to a large degree by this disease include western white pine, western larch, and lodgepole pine. The primary strategy to be employed to reduce the effects of Armillaria include maintaining tree vigor and stand diversity.

### Bark Beetles

Various species of bark beetles affect different tree species in stands weakened by overstocking or root disease, particularly during a prolonged drought period. Bark beetles that are present in the watershed include the Douglas-fir beetle, fir engraver, western pine beetle, and mountain pine beetle. The resultant mortality frequently cause small gaps with high levels of snags and downed logs. Where undesired, bark beetle impact can be minimized by controlling tree density so as to maintain tree health and vigor.

**Western Spruce Budworm**
Western spruce budworm defoliates a variety of conifer species but mainly grand fir, Douglas-fir, western larch, and Engleman spruce. Currently, there are very low numbers of budworm present. The greatest risk to budworm occurs in Grand Fir zone where fire suppression and increasing stand density has resulted in the predominance of host species with low vigor. Western spruce budworm outbreaks occur cyclically, and an outbreak is currently affecting grand fir stands just three miles northeast of this watershed. The impact in this watershed may be very limited as the climate is slightly more moist.

## FOREST SERAL DISTRIBUTION

### SUCCESSIONAL STAGES

All forest successional stages occur in the Cave-Bear Creeks watershed. Per a query of the Forest's IVEG database, the acres of forest in each successional stages by subwatershed are shown in the following table.

Table 9. Current Forest Successional Conditions by Subwatershed.

| Subwatershed | Early Successional (Seedling/Sapling) | Mid Successional (Pole) | Mid Successional (Small Tree) | Late Successional (Large Tree) |
|---|---|---|---|---|
| Coyote Creek | 1,873 Acres | 1,608 Acres | 518 Acres | 3,612 Acres |
| Dry Creek | 931 | 1,292 | 1,316 | 1,957 |
| Bear Creek | 1,835 | 2,243 | 3,554 | 2,031 |
| Cave Creek | 2,687 | 1,801 | 2,934 | 1,969 |
| Watershed Total | 7,326 (22%) | 6,944 (21%) | 8,322 (25%) | 9,569 (29%) |

Note: Seedling/Saplings are 0-4.9 " dbh; poles are 5-8.9" dbh; small trees are 9-20.9" dbh, large trees are 21+" dbh.

The vast majority of the early seral stands originated following timber harvest over the last 20 years. These young stands are dispersed throughout the analysis area except for within the Indian Heaven Wilderness and Smoky Creek burn. Pole-sized stands include primarily plantations that have grown to 5 inches or greater dbh. Mid-successional small tree stands (9-21 inches dbh) originated following wildfires earlier this century (1902-1924). Most of this area is in the vicinity of the Smoky Creek burn. Late-successional forests are located mostly in the Pacific silver fir and grand fir zones and have originated from older wildfires.

### COMPOSITION AND STRUCTURE

Structure and composition of forested stands within the analysis area are closely correlated with the seral stage and ecological zones in which they occur. Old-growth stands which occur in all ecological zones tend to be the most diverse in both structure and species composition. Late-successional stands tend to be more even-aged.

Within the grand fir zone late-successional forests, species composition is almost exclusively Douglas-fir and grand fir. These stands may have remnant old-growth ponderosa pine, western larch, or Douglas-fir that avoided being selectively logged in the 1950's or earlier. Understories are comprised of young conifer regeneration in skid trails or other areas of disturbance. The origin of the main cohort of Douglas-fir and grand fir can be traced back to either the 1850's for areas south of Road 24 along McClellan's trail, to the mapped burns in the 1880-1920's, or to the earliest logging in the Trout Lake Valley.

Fire occurrence in the Pacific silver fir and mountain hemlock zones, which is more infrequent than the grand fir zone, also leads to a greater mosaic pattern and structural diversity within stands. Late-successional forests contain a variety of species and well-developed vertical canopy structure. The overstory tends to have more old-growth trees commonly 200-300 years old. Gaps have formed in the canopy, with small areas of conifer regeneration and other early-successional vegetation present. Species present in high abundance include western hemlock, Pacific silver fir, mountain hemlock, Douglas-fir and noble fir. Minor species include western white pine, western redcedar, lodgepole pine, Engelmann spruce, subalpine fir, black cottonwood, quaking aspen, and white alder. While stands are more even-aged, this same diversity of species is also present in the mid-successional, small tree stands that now occupy the Smokey Creek Burn.

With the aggressive suppression of fires, early-successional forest today owe their existence largely to clearcut timber harvests. Species diversity within these stands largely reflect their ecological zone. High numbers of snags and downed logs which would have been present historically in early-successional stands are missing. These stands today advance more quickly into the mid-successional stage of closed canopy, pole sized trees.

Patch sizes associated with timber harvest tend to be smaller and more dispersed than those in pre-settlement conditions. Presently, a large range of patch sizes still exists, but a high frequency of small patches (less than 40 acres) tend to dominate the landscape. Consequently, the patch size of late-successional and old-growth forest has become smaller and fragmented. On federal land, large patches presently remain in the Peterson Ridge / Flattop Mountain / Smokey Creek Burn area, Indian Heaven Wilderness, and along Road 24 that although partial cut, remains as contiguous late-successional forest.

The watershed does have a number of old-growth stands that were shelterwood cut, primarily within the Pacific silver fir zone, but also in the grand fir zone. These stands have approximately 30% canopy closure in large old-growth trees over an understory of conifer seedling/saplings, big huckleberry, and vine maple (see Light Forest on Current Vegetation Map).

## UNIQUE HABITATS.

The analysis area contains a wide variety of unique communities, most of which are habitats for several threatened, endangered, sensitive, and otherwise unusual plant and animal species. The species associated with many of these unique habitats may be found in the *Wildlife Habitat Relationships, Mt. Hood and Gifford Pinchot National Forests* (Mellen et al. 1995).

### FOREST HABITATS

#### Old-Growth Forest

The watershed contains 9,427 acres (28% of the area) of old growth forest. Old growth forest is comprised of the large tree - multiple story subset of late-successional stands (see Current Vegetation Map). Such stands are unique due to their relative scarcity in the Southwest Washington Province. Old-growth forests are also important habitat for a wide variety of fauna and flora, many of which are threatened, endangered, or sensitive. Some of the many plant and animal species dependent on late-successional and old-growth forests include survey and manage species, fringed pinesap, neotropical birds, bald eagles, northern spotted owls, roosting habitat for bats, and many others. Table 10 displays the breakdown of old-growth forest in the watershed by ownership and management allocation.

Table 10. Distribution of Old-Growth Forest in the Watershed.

| Land Ownership / Allocation | Old-Growth Forest Acres | Percent of Ownership / Allocation |
|---|---|---|
| Federal land | 8,394 | 41.7% of federal land |
| Matrix | 2,257 | 11.2% of federal land |
| All no-harvest allocations | 6,137 | 30.5% of federal land |
| State and Private Land | 1,033 | 7.7% of state and private land |
| Watershed Total | 9,427 | 28% of watershed |

Note: This analysis considered all 1894 acres of planned and completed land exchanges as state and private land (Federal Land Area - 20,114 acres; State and Private Area - 13,318 acres).

### Riparian Areas

The watershed contains 131 miles of stream and their associated riparian areas. In addition there are 267 acres of wetlands and ponds with their riparian areas. Riparian areas contain elements of both aquatic and terrestrial ecosystems which mutually influence each other. Riparian areas typically receive high use by wildlife such as breeding habitat and wildlife movement corridors. Within the conifer covered Riparian Reserves it is comprised of the following classes: 15% early-successional forest, 51% mid-successional, and 34% late-successional.

## NON-FOREST HABITATS

### Dry Meadows

The watershed contains about 63 acres of dry meadows that are located in the Peterson Prairie and Lost Meadow areas. Historically this vegetation type occurred on more acres than at present. The absence of periodic under burning has permitted conifers to encroach on the meadows. Quaking aspen occurs sporadically throughout the meadow habitat. Existing aspen groves are remnants of pre-settlement times when fires were more frequent and grazing by cattle, elk, and deer were not an impact to the aspen. The species grows in clones and tends to be intolerant of competition from other species. The species thrives in an environment where competition is kept low through periodic underburning. An inventory of aspen does not exist.. Under current conditions, the existing aspen will die out as the conifer stands mature to late-successional and fire continues to be excluded.

### Wet Meadows

Wet meadows are rare in this watershed, the District, and Forest. The three main areas in this watershed are Lost Meadow area, the Cave Creek wetlands, and unnamed wetlands southwest of Deadhorse Meadow. Wet meadows total 266 acres. The Cave Creek wetlands have a known population of pale blue-eyed grass, a sensitive plant species. The Cave Creek vicinity also contains areas of beaver ponds and western redcedar groves with unusually large old-growth trees. Cave Creek wetlands and beaver ponds are allocated as a wildlife special area (IX) under the Forest Plan. The meadow near Deadhorse meadows lies within Smoky Creek Burn.

### Talus and Rock Outcrops

Rocky talus slopes in a forested setting is a specialized habitat for several plant and animal species such as snakes and amphibians. The larch mountain salamander (a State sensitive species) is known to inhabit talus slopes adjacent to mature forest. There are also often diverse assemblages of moss and lichens, including Barrett's penstemon. Rock outcrops occur along ridge tops like in the area of Peterson Ridge. The current inventory of rocky areas is 177 acres. These habitats contain vegetative species not found in the forested settings. Examples are: oak, golden chinquapin, juniper, balsam arrowroot, and scarlet gillia.

### Caves

An abundance of caves (predominantly lava tubes) are present within the analysis area. These provide unique habitat for cave-adapted organisms including bats and rare invertebrates. For many of cave dwelling species, the vegetation surrounding cave openings is an integral habitat component. There are an estimated xx cave openings in the watershed.

**Monte Cristo Botanical Special Area**

The northeastern crest of the Monte Cristo Range in the vicinity of Monte Cristo peak is combination of forest, dry meadows, and rock outcrops. This unique assemblage of ecotypes has been designated a botanical special interest area (9L) under the Forest Plan. It is also under consideration for designation as a Research Natural Area. Situated along the crest, the bulk of the botanical special interest area and proposed Research Natural Area lies in the Little White Salmon River Watershed. A smaller portion lies within the White Salmon River Watershed and only 5 acres lies within the Cave-Bear Creeks Watershed.

## SOIL PRODUCTIVITY

Today, natural fire has been modified through active fire suppression. Timber harvest and subsequent slash treatment are the main factors affecting rapid change to soil productivity. Both logging and slash treatments remove organic material from above ground and from the soil's duff layer. Timber harvest, in particular tractor log skidding, has the potential to displace and compact soils. Denuded, displaced, and compacted soils are further subject to surface erosion. As much as 40% of the federal land in the watershed has been logged via ground based machinery. Assuming soil disturbance directives have been met, measurable compaction has occurred on log skid roads and landings, and total 6% of the watershed (see Table 11). Road construction would also cause direct losses in soil productivity and indirectly increase the potential for adjacent mass failure through the alteration of subsurface hydrology.

Table 11. Acres of Compacted Soils Affecting Growth in National Forest Timber Harvest Areas.

| Subwatershed | Acres of Ground Based Logging on National Forest | Compacted Acres Affecting Growth* | % of Subwatershed Compacted** |
|---|---|---|---|
| Coyote | 3339 | 549 | 7 |
| Dry | 2185 | 326 | 6 |
| Bear | 1114 | 183 | 5 |
| Cave | 2290 | 313 | 6 |
| Watershed Total | 8928 | 1371 | 6 |

*Assumes 20% of the area compacted on soils with high compaction potential and 10% area compacted on all other soils. Soils with high compaction potential in this watershed are Soil Management Units 3, 23, 24, 45, 46, 88, 94, 95, 1594, 2493 (refer to Gifford Pinchot Soil Resource Inventory 1992).
** Federal land only.

Cattle grazing also has the potential to alter soil productivity through vegetative changes and compaction, but the overall impact is minor in comparison to logging. Noxious weeds have been surveyed on many roads in the watershed. Noxious weed introduction and spread is influenced by timber harvest, road construction, grazing. Noxious weeds in and of themselves can cause compaction (Brotherson and Field 1987; Lacey et al. 1989).

## PLANTS OF CONCERN

### NOXIOUS WEEDS

There has been limited noxious weed data collected within this watershed. Systematic noxious weed surveys of road corridors were conducted in Skamania County in 1995 and by the Gifford Pinchot National Forest in 1995 and 1996 (on file at the Mt. Adams Ranger District). Many of the same noxious weed species that occur in the surveyed areas also occurring the surroundings areas and outside of the watershed.

There are currently 100 species of plants that have been listed as noxious weeds on the Gifford Pinchot National Forest (see Appendix B). This is the same list used by the state of Washington. These weeds are classified depending on size of the infestation and the ability to control them. The classification of noxious weeds are: Class A, Class B, Class B designate, or Class C noxious weeds (Chapter 16-750 WAC).

- **Class A** noxious weeds are those noxious weeds not native to the state that are of limited distribution or are unrecorded in the state and that poses a serious threat to the state. They are targeted for eradication.
- **Class B** noxious weeds are those noxious weeds not native to the state that are of limited distribution or are unrecorded in a region of the state and the pose a serious threat to the region. The goal is to contain to current regions and prevent further spread.
- **Class B designate** are those Class B noxious weeds whose populations in a region or area such that all seed production can be prevented within a calendar year.
- **Class C** noxious weeds are other noxious weeds that pose a threat. Control is determined at the county or weed district level.

The noxious weeds which currently occur in the watershed are indicated in Appendix B. More weed species are suspected to exist.

## THREATENED, ENDANGERED AND SENSITIVE SPECIES

Four TES plant species are known to occur in Cave-Bear watershed:

- Pale blue-eyed grass (*Sisyrinchium sarmentosum*) - FWS species of concern, FS Region 6 and state sensitive
- Golden chinquapin (*Chrysolepis chrysophylla*) - FS Region 6 and state sensitive
- Fringed pinesap (*Pleuricospora fimbriolata*) - FS Region 6 sensitive
- Pine broomrape (*Orobanche pinorum*) - FS Region 6 sensitive

Pale blue-eyed grass occurs in both the dry and wet meadow habitats that have been mapped in the watershed. This includes Peterson Prairie and the Cave Creek wetlands. It also occurs in South Prairie in the adjacent Little White Salmon River Watershed. These populations of blue-eyed grass are large and some of the only populations world. Other populations occur in Klickitat County, Washington, and Clackamas County, Oregon. Golden chinquapin populations are also very few in Washington State; although, it is common and even abundant in Oregon. In this watershed, golden chinquapin occurs in forested habitat of very thin soils and low site quality such as ridge tops and near rock outcrops on southern exposures (Peterson Ridge area).

Fringed pinesap is a mycotroph, a non-photosynthesizing plant that feeds off of or is symbiotic with soil fungi. Pine broomrape, also a non-photsynthesizing plant, is parasitic to the shrub oceanspray (*Holodiscus discolor*).

## SURVEY AND MANAGE SPECIES

Survey and Manage species are a large group of life forms that receive special listing in the Northwest Forest Plan due to a lack of knowledge on their abundance, live histories, and overall uncertainty of their viability. Only three Survey and Mange botanical species are known to occur in this watershed:

- *Lobaria pulmonaria* (nitrogen fixing lichen) - Strategy 4, located in SE 1/4, Sec 7, T5N, R10E.
- *Lobaria scrobiculata* (nitrogen fixing lichen) - Strategy 4, located in SE 1/4, Sec 7, T5N, R10E.
- *Rhizopogon evadens* var. *subalpinus* (rare false truffle) - Strategy 1 and 3, located in NE 1/4, Sec 34, T6N, R9E.

There are undoubtedly more Survey and Manage species occurring in the watershed; however, no surveys have been done for these species. Habitat for the noble polypore (*Oxyporus noblissimus*) occurs on the old noble fir trees and snags along the crest of the Monte Cristo Range. Consult Appendix C for a list of potential and nearby Survey and Manage species.

# SYNTHESIS

## FIRE

### CHANGING ROLE OF FIRE

It can be argued that the rate of fire ignitions today is unchanged from the past. Lightning still occurs, and human ignited fires of today replace the fires set by Native Americans in the past. Yet with the advent of aggressive fire suppression, these fires have been kept to very small sizes (less than an acre) since 1924. This alteration of fire ecosystem is most evident in the grand fir zone, especially along the historical McClellan trail which is assumed to have had frequent underburns. With the selective removal of the large ponderosa pine and suppression of fires, these areas are now dominated by grand fir and Douglas-fir 80-150 years old. Outside of this band, stand densities have also increased with the ingrowth of grand fir. Because of higher total fuel loading, higher dead fuels and greater horizontal and vertical fuel continuity, escaped fires in these stands today would have a greater tendency to be large stand replacement fires rather than underburns. In the other fire groups, which have longer fire intervals (200+ years), fire suppression for the past 70 years has not been long enough to greatly impact fire cycles and subsequent fire intensities.

### LARGE FIRE RISK

A large fire could occur anywhere within the watershed if the weather and fuel conditions are just right. Stand conditions between the timber harvested units are at a higher risk than those areas that have been harvested and the slash treated. There are some areas that the stand has been harvested; however, the logging debris was either minimally treated or was not treated at all. These areas also pose a higher risk of fire. Stands along the major ridge lines that have been developing a high live and dead fuel loading along with the horizontal and vertical fuel continuity are at risk (Peterson Ridge, Mann Butte and Trail Peak). The Peterson LSR/MLSA includes the Peterson Ridge, which has a high occurrence of lightning.

The probability of a human caused fire is very high in this watershed. This is based on the high recreational use of the area. Smoking accounted for 36% of the fire starts during the last 20 years. No one area can be pinpointed as being at a higher risk than another simply due to the amount of use the area receives.

The probability of lightning caused fire is also very high in the watershed. Lightning accounted for 27% of the recorded fires during the last 20 years on Forest Service land. The highest number of lightning caused fire starts were recorded in the area of Trail Peak and Guler Mountain. Most all of the high ridges or prominent points had recorded a fire start. The risks associated with these high points were discussed above.

### MANAGED FIRES

Development of a wilderness fire plan for the Indian Heaven Wilderness could include provisions for allowing a wildland fire to be managed under certain prescriptions. This area could also benefit from management ignited fires. By applying fire to specific areas prior to a lightning ignited fire, you control the intensity and severity levels. You can manage the effects and tailor them to what best mimics fires natural role. That may mean in some areas a stand replacing fire may be necessary.

Other areas that would benefit from managed fires are in the areas that used to be open stands. These areas are abundant throughout the watershed. Not all areas could be expected to accommodate fire without some other treatment occurring first. Since the entire watershed has been at one time dependent on fire, you could potentially look to introduce fire back into all areas. The objective would be to get stands into a condition that would support low intensity underburns. Finally, dry meadows (Peterson and Lost) could also benefit from managed fires to reduce tree encroachment, and if it benefits sensitive plants (pale blue-eyed grass).

### SOCIAL AND POLITICAL CONCERNS

Obviously, the protection of human life and property would be the two primary social and political concerns that would affect fire protection, fire use and fuel treatment programs. Otherwise, recreational use is a big aspect of the watershed, as is the maintenance of late-successional and old growth forest (Peterson LSR/MLSA), and the timber value on remaining Matrix lands.

Nationally there is recognition that the exclusion of fire over the past few decades has resulted in a decline in forest health. In addition the fuel profiles have been changing to the point that if the weather conditions are just right and a fire does exceed initial attack, a fire of significant size is more apt to occur. In response to these concerns, an emphasis is being placed on changing the fuel profiles back to a more historical profile rather than waiting for or betting against a wildfire occurring.

A through analysis of fuel loading and stand conditions needs to be undertaken to determine where the areas with the highest potential for utilizing fire are. Fuel and stand conditions adjacent to administrative sites, private property, lightning risk zones, and the Peterson LSR/MLSA allocations would be a initial high priority areas.

The use of fire within the Peterson LSR/MLSA would be subordinate to its objective of providing old-growth forest for the species that need it. Due to the current lack of old-growth with the Southwest Washington Province, protection of existing old-growth is paramount; and hence the remaining emphasis on fire suppression. Use of fire as management tool to help develop fire tolerant stands is acceptable where it doesn't cause loss of suitable habitat or risk conflagration. The Peterson LSR/MLSA covers about a third of the watershed and about half of the federal land within the watershed. It also includes the lightning prone Peterson Ridge and Flattop Mountain areas.

## TIMBER HARVEST LEVEL FROM NATIONAL FOREST LANDS

### REGENERATION HARVEST FROM MATRIX LANDS

Timber harvest levels have been calculated for the purpose of estimating the timber contributions from this watershed to the South Skill Center (Mt. Adams and Wind River Ranger Districts) and Gifford Pinchot National Forest (see Table 12). The PSQ (Probable Sale Quantity) column shows the acres and volume estimated for the watershed per the Forests August 1997 update of PSQ. For this watershed analysis, we used two different methods to estimate timber contributions for this decade for Matrix lands. The "optimal" method is an area control model that assumes management of suitable lands under a minimum 110 year rotation and no constraints from present vegetative conditions. This method yields the acres that could be harvested under ideal conditions while following all LRMP standards and guidelines. The other method, called the "forecast" method, assumes we are 40 years in the rotation and meters the remaining existing inventory of mature forest through the remaining rotation length which depends on the management allocation. The "forecast" method also attempts to model possible hydrologic constraints in that regeneration harvest is capped if the ARP (aggregate recovery percentage) is below 70% (refer to the Hydrology section). Note in the table below that this methodology results in no regeneration harvest for either Coyote or Cave Creek subwatersheds.

Table 12. Decadal Regeneration Harvest Estimates from Matrix Lands.

| Subwatershed / | PSQ | | Optimal | | Forecast | |
|---|---|---|---|---|---|---|
| **Allocation** | **Acres** | **MBF** | **Acres** | **MBF** | **Acres** | **MBF** |
| Coyote Creek | | | | | | |
| General Forest | - | - | 170 | 4,760 | 0 | 0 |
| Visual Emphasis | - | - | 1 | 28 | 0 | 0 |
| Dry Creek | | | | | | |
| General Forest | - | - | 94 | 2,632 | 72 | 2,016 |
| Visual Emphasis | - | - | 8 | 224 | 6 | 168 |
| Cave Creek | | | | | | |
| General Forest | - | - | 113 | 3,164 | 0 | 0 |
| **Watershed Total** | **366** | **10,200** | **386** | **10,808** | **72** | **2,184** |

## COMMERCIAL THINNING

The PSQ model for determining thinning acres was based on a query of the IVEG data base for stands that were 40-120 years old, had 70% or greater canopy closure, and had trees in the 10-21" dbh size class. Our "optimal" method assumed all Matrix stands would be thinned at least one time per rotation. Our "forecast" method was similar to the Forest PSQ method; however, we required that stands have a minimum total volume of 25 mbf per acre. With this last constraint , the "forecast" method could not produce any stands that were ready for thinning. There are, however, 525 acres of stands within the Peterson LSR/MLSA allocation which meet this criteria (see Table 13). Commercial thinning is permitted within LSR/MLSA to meet late-successional forest objectives. Consequently, these 525 acres would form a base from which thinning is a possibility, pending further investigation of stand conditions and potential benefit from thinning. Any potential timber yield from LSR/MLSA or Riparian Reserves would not have been included in PSQ.

Table 13. Decadal Thinning Levels from Matrix Lands.

| Subwatershed | PSQ Thin Acres | Optimal Thin Acres | Forecast Thin Acres |
|---|---|---|---|
| Coyote Creek | - | 171 | 0 |
| Dry Creek | - | 102 | 0 |
| Cave Creek | - | 113 | 0 |
| **Watershed Total** | 71 | **386** | **0** |

Table 14. Commercial Thinning Candidate Stands within the Peterson LSR/MLSA.

| Subwatershed | Potential Thin Acres |
|---|---|
| Dry Creek | 334 |
| Bear Creek | 191 |
| **LSR/MLSA Total** | **525** |

## TIMBER SUMMARY

The forecast modeling exercise demonstrate that current vegetative conditions and resource concerns greatly limit the amount timber that could be harvested this decade to meet PSQ estimates, though in the long term under optimal conditions, the PSQ estimate could possibly be exceeded. Current limitation are primarily due to concerns for peak flows (of which ARP is but one measure) and lack of thinning candidate stands. The forecast model suggests the sole timber contribution is regeneration harvest from Dry Creek Subwatershed. Other non-modeled contributions may come from regeneration harvests which retain large amounts of the overstory (>40% canopy closure) in an attempt to mitigate stand level contributions to peak flows. In addition, there may be thinning opportunities revealed during the more intensive review that occurs during project planning. Other timber yield, not associated to PSQ yet contributing to annual timber objectives, may occur from salvage, thinning within Peterson LSR/MLSA and Riparian Reserves, and mechanical fuel reductions prior to prescribed burning. Timber yield from these latter actions is largely incidental to achieving some other non-timber objective.

## TIMBER STAND IMPROVEMENT

Timber stand improvement activities are silvicultural treatments in young forest stands to increase tree vigor and growth and to minimize insect, disease, and animal problems. The most common improvement activities that have taken place within the Cave-Bear watershed are pre-commercial thinning, pruning to reduce white pine blister rust, and pruning to improve wood quality. Pre-commercial thinning is an important stocking level control treatment that is used to control stand density and species composition to assure that stands do not become stagnated at a young age. White pine blister rust bough pruning is a treatment that reduces the spread of blister rust on western white pine allowing the trees to survive and grow to merchantable sizes. Pruning for wood quality is done on young Douglas-fir and ponderosa pine trees to order to clear, knot-free wood that has greater economic value. Timber stand improvement work is considered an investment in the future growth and development of a stand. The activity most widely employed with the watershed has been pre-commercial thinning. The District maintains an inventory of stands in the sapling stage that are ready for treatment. Table 15 lists the acres of seedling/sapling stands on National Forest lands that are candidates for one or more tree improvement activities within the next decade.

Table 15. Potential Timber Stand Improvement Areas.

| **Subwatershed / ROD Allocation** | **Acres of Seedlings/Saplings** |
|---|---|
| Coyote Creek | |
| LSR/MLSA | 744 |
| Matrix | 527 |
| Dry Creek | |
| LSR/MLSA | 412 |
| Matrix | 216 |
| Bear Creek | |
| LSR/MLSA | 640 |
| Cave Creek | |
| Matrix | 995 |
| **Total** | **3,534** |

## SOIL PRODUCTIVITY

Conservation of soil productivity is required by essentially every law or regulation that governs Forest Service activities. We are directed to manage our lands without significantly impairing the productivity of the soil. Soil damage can also lead to degraded aquatic conditions via erosion and sedimentation.

In Forest Service Region 6 there have been standards and guidelines for soil management for over 20 years (FSM 2520, R6 supplement #50). These are intended to describe significance in terms of degree and extent of the various forms of soil damage which result in impairment of productivity. The Gifford Pinchot Forest Plan directs that no more than a total of 20% of an activity area may be compacted, puddled, displaced, or subjected to a severe burn as a result of the activity (Forest Plan p. IV-61). In addition, the President's Northwest Forest Plan further directs modification of site treatment practices and harvest methods to minimize soil disturbance, so that fungi, arthropods, and other soil organisms are not adversely affected (ROD S&G p. C-44).

For federal lands, timber harvest will continue, but likely with better implementation of mitigation for soil productivity. Approximately, 6% of the federal portion of the watershed is comprised of soils with a high compaction potential and also a candidate for future ground based timber harvest. Reducing initial impacts by pre-designating skid trails, as well as subsoiling skid trails and landings after harvest, will help to mitigation soil compaction on these lands. Soil impacts from slash burning should decrease as the trend away from broadcast burning will continue. This may be offset slightly by increased utilization of logging residue and increased underburning elsewhere in the watershed. Even though this a non-key watershed under the President's Northwest Forest Plan, road density should decrease in the future through the decommissioning of existing roads, particularly within the Peterson LSR/MLSA.

Monitoring of soil disturbance in timber harvest units in 1995 and 1996 has shown that we have been successful in limiting total soil disturbance to less than 20% of the activity area (Gifford Pinchot National Forest Annual Monitoring and Evaluation Reports 1995 & 1996). This threshold was not always met in years prior to 1995.

The damage already done due to past logging and road construction will remain; although, some will be corrected through restoration and some will be corrected naturally through root action, pocket gophers, and frost heave. Restoration activities to restore soil productivity should focus on ripping/subsoiling landings, un-obliterated temporary roads, as opposed to skid roads and other areas within stocked plantations. This would focus action on the soils most adversely compacted from both a soil productivity and hydrologic point of view. These activities could be combined with other system road decommissioning projects.

Other uses of the watershed such as grazing and dispersed/developed recreation sites will have a minor effect on soil productivity; although, it may be a large effect on a localized area. Prescribed burns will remove the vegetation and also volatilize some of the soil organic matter.

## PLANTS OF CONCERN

### NOXIOUS WEEDS

The long term goal in this watershed for noxious weeds are to continue inventories, then control and eradicate all weed populations

Roads and domestic grazing are two of the primary means of weed dispersal, usually only part of a plant or propagule. Other avenues for propagule movement include trails (especially those used by pack animals), stream channels, and air. Of particular interest are corridors that link otherwise isolated patches. These corridors have the potential to bring propagules of species into an area that they otherwise could not reach. Further analysis to noxious weeds should review where these corridors occur relative to known weed population in order to focus eradication efforts.

### THREATENED, ENDANGERED, AND SENSITIVE SPECIES

Of the four TES plant species known to occur, Pale blue-eyed grass and golden chinquapin are of particular importance within Cave-Bear watershed, as well as regionally. Fringed pinesap and pine broomrape are expected to be removed from listing as they have been found to be more abundant and widely distributed.

**Pale Blue-Eyed Grass**
Pale blue-eyed grass is known to occur only in the Cascade Mountains of southern Washington and northern Oregon, where it is found in habitats of moist to dry meadows and wetlands. Of 14 subpopulations in Washington, 11 occur on Mt. Adams Ranger District. Subpopulations in Cave-Bear watershed are located near the geographic center of the species' range in the state, and as such are potentially an important link between subpopulations within and outside of the watershed.

GIS data indicates there is about 329 acres of suitable habitat (dry meadow/shrubland and wet mesic habitat) in the watershed for pale blue-eyed grass. This is slightly less than 1% of the total area for the watershed. Aerial photographs from 1959 to 1995 indicate current habitat conditions may be in decline as a result of encroachment of conifers and other woody vegetation. Some of the factors that have influence suitable habitat conditions include: beaver dams, fire; both natural and human initiated , logging, cattle grazing, and clearing of encroaching vegetation.

In some instances, active measures to maintain habitat, such as prescribed burning or pulling of encroaching conifers, may be preferable to allowing natural succession to occur in riparian areas and other reserves (Peterson LSR/MLSA). Interactions with cattle grazing are also interest, as the known populations in this watershed are in areas where cattle have grazed for years. A multi-year monitoring study of pale blue-eyed grass is currently underway at Cave Creek to determine to asses the impacts of a cattle exclosure (Raven 1996).

**Golden Chinquapin**
Golden chinquapin reaches the northern extent of its range in Washington state. Although this species is more common to abundant in California and Oregon, only 27 relatively small subpopulations are known in Washington. Twenty-six of these subpopulations occur on or near the Gifford Pinchot National Forest primarily in the Little White Salmon River and Cave-Bear watersheds. Subpopulations in Cave-Bear represent the northern extent of the species range (excluding a disjunct population in Mason County on the Olympic Peninsula). Golden chinquapin also plays an important role as a specific host for breeding Herr's golden hairstreak butterfly (Habrodais grunus herri), a state listed threatened species.

### SURVEY AND MANAGE SPECIES

Of the species known to occur, *Lobaria pulmonaria* and *Lobaria scrobiculata* both occur on federal land allocated general forest. This particular area; however, is under consideration for exchange to Washington State or private ownership. *Rizopogon evadens* var. *subalpinus* occurs within the Peterson LSR/MLSA. *Oxyporus noblissimus*, which is suspected to occur near Monte Cristo, would likely occur within the botanical special interest area and proposed Research Natural Area. Depending on the strategy listed in the Northwest Forest Plan, surveys for specific species would occur prior to projects affecting habitat, or through extensive regional surveys.

## DATA GAPS

- Incomplete inventory of small wetlands, which influences hydrologic analyses, habitat assumptions, and the amount of suitable acres available for timber harvest.
- Regular updates of forest successional development, primarily in plantations which have advanced from early to mid-successional. This may affect Aggregate Recovery Percentages, spotted owl habitat analysis, and other analyses that rely on information on stand trees classes and successional development.
- Cursory inventory information on species presence and distribution for unique, TES, and Survey & Manage plants and animals.

# STREAM CHANNELS

## REFERENCE CONDITIONS

Stream channels are integrating features of the watershed that reflect a combination of the riparian and upslope watershed conditions, and the geomorphic channel type. Conditions within stream channels are important because these areas comprise the habitat for fish and other aquatic species that rely on fluvial systems. Channel conditions, combined with riparian condition can strongly affect water quality and the microclimate for riparian dependent species. Upslope conditions can indirectly affect channel condition by influencing the rate, timing and quantity of water delivered to the stream. Because of the interactions of the stream with the riparian area and linkages with upslope processes, any activities or disturbances occurring in the watershed have the potential to affect conditions in the stream channels and associated riparian areas.

The single most dominant historical factor that continues to affect stream channels in the watershed is the influence of the lava flows, which cover most of the valley bottom and much of the middle portion of the watershed. Channel form, processes and location, as well as the persistence of water in those channels are all strongly controlled by the underlying geology. The lava flows occurred over 20,000 years ago, originating from vents near Lemei Rock, and flowing down to the White Salmon River. As the lava moved down toward the White Salmon River, it filled in low lying areas, effectively reducing local variations in topography along a swath down the center of the watershed.

In addition to changing the topography, these events modified the hydrology of the area, by filling in existing stream channels, and forming a new highly porous surface on which new streams began to develop. The lava surface now forms a slope that drops sharply from Lemei, and then dips to the White Salmon River, with gradient decreasing in an eastward direction. Below the surface of the lava flow, numerous lava tubes formed, creating additional subsurface routes for water moving downslope. Uplands along the Monte Cristo Range on the southern boundary of the watershed, and along Peterson Ridge and the northern boundary of the watershed were largely unchanged by the lava flows except along contact zones at the outer boundaries of the flows.

In geologic terms, the portion of the landscape affected by the lava flows is relatively young, and as such the soils and stream channels are still in early developmental stages. Streams in this portion of the watershed differ from those in the unaffected portions of the watershed in both their form and response to disturbance. Channels on the lava flows are largely controlled by boulders and bedrock, having formed in shallow depressions or fractures in the lava flows, or in collapsed lava tubes. In some reaches, these streams appear to be substantially undersized for their drainage area. During high flows, areas surrounding these reaches become inundated, functioning as floodplains. In many cases, boundaries of flood prone areas are difficult or impossible to define due to the lack of topographic relief associated with these streams. The combination of shallow soils, highly pervious ground surface, and lack of topographic relief around many streams in the lava flow influenced portion of the watershed contributes to a general lack of distinguishable riparian character, particularly riparian vegetation along these streams.

In the more recent past, riparian and channel conditions varied in response to large scale disturbance of upland vegetation or to local disturbances in the riparian area. Since the time of the lava flows, fire and flooding have probably been the dominant factors affecting channel condition and channel change. Large-scale fire indirectly affected channel conditions by reducing forest cover and thus influencing peak streamflows (see Hydrology section in this report), but also had a direct effect on conditions in the riparian area when it burned riparian vegetation. Flooding plays an important role in channel condition, but may have greater effect when flood frequency or magnitude is increased (ie. following large scale vegetative removal) and when mature riparian vegetation has been eliminated or reduced. It appears that those channels formed on the lava beds may be less affected by high flows because of the composition of their bed and banks, and because they dissipate energy by actively using a large flood-prone area.

*A First Approximation of Ecosystem Health* (USDA-FS 1993), which is also known as the Regional Ecosystem Assessment Project or REAP, identified a range of natural conditions for riparian vegetation within the Hood/Wind Subbasin. Per this report, early-successional vegetation historically comprised 5-30% of the riparian area. Late-successional vegetation comprised 23-92% of the riparian area within the Hood/Wind Subbasin.

# CURRENT CONDITIONS

From the late 1800's to the present, timber harvest, roading, development of land for homes and farms, and ditching or re-routing of streams have been the dominant disturbance processes affecting riparian conditions and stream channels in the Cave-Bear Creek watershed. Past harvest practices allowed for timber harvest along streams, and road construction which often followed stream systems required felling of additional trees in the riparian area. In addition, fisheries biologists and hydrologists used to consider woody debris in the stream channel as impediments to fish passage and conveyance of flood water, and required logging operations on National Forest lands to remove woody debris from streams. The combination of these practices resulted in the conversion of many riparian areas to early seral conditions, and the loss of large standing and down conifers in the riparian area and stream channel.

## RIPARIAN VEGETATION

Currently, approximately 15% of the Riparian Reserves along stream and wetlands in the Cave-Bear Creek watershed are in seedling or sapling age classes (see Table 16). Riparian Reserve additions due to unstable or potentially unstable soils are not included in these figures. Because fire suppression has severely limited the number of fires in the area over the past several decades, the current acreage of riparian area in seedlings and saplings directly reflects timber harvest that has occurred in the riparian areas. In those streams not formed on the lava flows (i.e. upper Cave, Beaver and Bear Creeks among others) a high percent of the riparian area in early seral condition suggests that channel stability may be reduced by a lack of well established root systems of large conifers. In addition, these reaches may be more susceptible to stream heating if the early seral vegetation is not yet providing full shade to the stream, and would have reduced source material for future large woody debris.

Table 16. Forest Succession Class within Riparian Reserves (excluding unstable soils additions)

| Subwatershed | Early-Successional* | Late-Successional** |
|---|---|---|
| Coyote | 12% | 52% |
| Dry | 9% | 36% |
| Bear | 15% | 36% |
| Cave | 20% | 26% |
| Watershed Total | 15% | 34% |

* Range of Natural (from REAP) 5-30%

** Range of Natural (from REAP) 23-92%

Percent of the Riparian Reserve in late-successional stage provides an indication of the amount of the riparian area where there are large well established root systems and a high degree of large woody debris recruitment potential. Currently, 34% of the Riparian Reserves in the watershed are comprised of late-successional forest. At a very coarse level, subwatersheds with a high percent of riparian late-successional forest would suggest a lower potential for concerns related to future recruitment of large woody debris, and may suggest areas of greater stream channel stability, particularly in those non lava flow-influenced stream reaches. Although each of the four subwatersheds in the Cave-Bear watershed have riparian vegetation which is within the range of natural conditions described by REAP, Cave Creek is at the very low end of the range for late-successional. This condition can probably be attributed to a combination of past timber harvest and a series of wildfires that burned areas in this watershed during the early 1900's.

## CHANNEL TYPES

Channel gradients are a primary element used in channel typing, and a key factor in assessing channel response to disturbance such as high flows, bank disturbance, and riparian vegetation removal. A combination of stream survey results and mapping from air photos and topographic maps was used to classify streams in the Cave-Bear watershed into gradient classes and Rosgen (1996) defined channels types. Table 17 summarizes the results for each subwatershed. Due to limited time frames for this analysis and the timing of the assessment, very few reaches have been field verified for channel type.

Table 17. Rosgen Channel Types by Subwatershed (in miles of stream length).

| Subwatershed | AA | A | B | C, G, or E |
|---|---|---|---|---|
| Coyote | 4.4 | 3.6 | 10.0 | 1.6 |
| Dry | 13.9 | 6.9 | 5.0 | 1.1 |
| Bear | 16.7 | 11.9 | 6.3 | 5.1 |
| Cave | 27.3 | 5.9 | 2.3 | 12.3 |
| Watershed Total | 62.3 | 28.3 | 23.6 | 20.1 |

The A and AA channel types are the highest gradient stream reaches in the watershed. High gradient channels can be primary sediment source areas as well as providing rapid transport of sediment to downstream reaches. Major disturbance processes in these channels typically include avalanches, debris torrents, and other forms of mass wasting. Most of the AA channels in the watershed occur in the areas not affected by the lava flows, including the Peterson Ridge area, and the north facing slopes of the Monte Cristo Range. The only AA channels found in areas directly affected by the lava flows are the steep slopes up near Lemei, where the lava flows began.

Streams classified as Rosgen B channels have moderate gradients and are generally considered "transport" reaches. These reaches have enough slope to transport most of the sediment that is supplied from upslope or from upstream reaches, and are typically relatively stable reaches. In this watershed, a large majority of the B channels are in the Coyote and Dry Creek systems, the streams that are most dominated throughout their lengths by the lava flows. Because of the slope, the channel form, and the material making up the channel bed and banks, the Coyote and Dry Creek systems appear to be sediment limited, high energy streams in their upper and middle reaches.

Lower gradient stream reaches in this watershed include a combination of C, E, and G channels. Most of the C channels that occur in the watershed are located in the Cave Creek subwatershed. These channels are primarily associated with deposition areas, areas not impacted by the lava flows, or where streams follows the general contact zone between uplands and the lower gradient areas dominated by the lava. These are alluvial streams, and as such are relatively sensitive to physical bank disturbance, and to increases in peak streamflows, particularly when streambank vegetation has been removed.

The E channels in this watershed generally include those streams flowing through meadow systems, which occur in the Lost Meadow portion of the Dry Creek subwatershed, and in the Cave and Beaver Creek systems in the Cave Creek subwatershed. When in undisturbed condition, these reaches are generally not as sensitive to peak flow increases, because they have large floodplains that become inundated during high flows. However, they can be destabilized by physical disturbance to the banks and by loss of vegetation along the channels. Once this occurs, high flows become more effective at eroding channel banks and downcutting. An example of where this may have occurred in this watershed is in Lost Meadow in the Dry Creek subwatershed, where deep gullies have formed, and progressively headcut over the past 40 years. It is possible that this downcutting and headcutting is a response to a combination of historically heavy grazing in that location, and timber harvest which has occurred subsequently in the immediate area surrounding the meadow.

## SYNTHESIS

Stream channels throughout much of this watershed are somewhat unique in that they are largely bounded on the bed and banks by lava flow material and by boulders left behind from the lava flow. These channels in many places appear undersized, but have broad gently sloping areas on either side where water can spread out during high flows. Little topographic relief separates streams (and subwatersheds) in this lava flow-dominated portion of the drainage. In fact, because topographic relief is so muted in this part of the watershed, combined with the lack of riparian vegetation along many streams flowing on the lava, it is sometimes difficult to discriminate between streams and ditches. Channels in this portion of the watershed appear to be less sensitive to damage from physical disturbance and high flow events, due to their rocky bed and banks, and the large flood-prone areas adjoining them where high flow waters can spread out and dissipate energy.

## DATA GAPS

- Field verified Rosgen channel typing.
- Channel change over time.

### DATE SOURCES AND CONFIDENCE LEVELS

| Assessment Tool | Data Source | Confidence |
|---|---|---|
| Riparian Area Vegetation | GPNF streams Layer | Low/Mod |
| | GPNF Riparian Reserve layer | Low/Mod |
| | GPNF IVEG layer | Mod/High |
| Rosgen Channel Type | Region 6 Level II Stream Survey | Mod |
| | Aerial photographs | Mod/High |
| | Topographic maps | Mod |

# WATER QUALITY

## REFERENCE CONDITIONS

### WATER TEMPERATURE

Historically, water temperatures in streams in the watershed varied along with the amount and quality of riparian canopy cover. The primary factors affecting riparian canopy cover were fire, insect and disease outbreaks, and debris torrents or large scale flooding that removed riparian vegetation. As the percent of the riparian area in early seral condition increased, the potential for increased maximum water temperatures increased. The Regional Ecological Assessment Project (USDA-FS 1993) concluded that early-successional forests ranged from 5-30% riparian areas under natural conditions (pre-settlement). The REAP also defined the range of natural conditions for water temperatures in the Hood-Wind Subbasin to be 7-20 °C.

### TURBIDITY

Historical turbidities were linked closely to large scale disturbances including fire, mass wasting and flooding. Surface soil inputs were negligible under fully forested conditions, but would have increased for a short period following fire, particularly in the case of high intensity burns that damaged soil conditions. The watershed is considered relatively stable in terms of mass wasting, but following large scale or intense fires, the potential for mass wasting would have increased for a period of time, particularly from the Peterson Ridge area and from the slopes of the Monte Cristo Range. The most common cause for changes in turbidity under historical conditions was likely the occurrence of high streamflow events that caused streambank cutting, particularly in the C channels in the watershed, such as those in the Cave Creek subwatershed.

## CURRENT CONDITIONS

### WATERS WITHIN THE CAVE-BEAR CREEKS WATERSHED

Streams within the National Forest are classed by the Northwest Forest Plan as either "perennial fish-bearing", "perennial non fish-bearing", or "intermittent". Perennial streams are those that flow water year-round. Intermittent streams are those that only have flow during some part of the year. Some intermittent streams flow only during rainfall or high flow conditions, and others may flow for most of the year, but run dry for a short period of time in the late summer. Table 18 lists the miles of stream in the watershed, and the acres of lakes, ponds and wetlands. For purposes of this analysis, federal stream classes were applied to all streams in the watershed to the extent that classes could be determined from local knowledge of the non-federal portion of the watershed.

Table 18. Aquatic Resources in the Watershed.

| Aquatic Resources | Miles/Acres |
|---|---|
| Perennial Fish-Bearing Streams | 2 miles |
| Perennial Non Fish-Bearing Streams | 22 miles |
| Intermittent Streams | 107 miles |
| Lakes/Ponds | 4 acres |
| Wet Meadows | 263 acres |

## BENEFICIAL USES AND KEY WATER QUALITY PARAMETERS

All streams and lakes within the Cave-Bear Watershed are rated by the Washington State Department of Ecology (WSDOE) as either Class AA (extraordinary), Class A (excellent), or Lake Class. Stream segments on National Forest lands are rated as Class AA, as are all streams that feed lakes within the watershed. Specific water quality criteria have been established by WSDOE for each of these classes in conformance with the present and potential uses of the water. The purpose for these criteria and the state water quality standards is to ensure that water quality is maintained at levels that continue to support beneficial uses of those waters. The Cave-Bear Watershed has a number of important beneficial uses that drive the need for water quality protection. Table 19 identifies the beneficial uses that occur in the watershed, the subwatersheds they are located in, and the primary water quality parameters of concern. The table is not inclusive of all water quality parameters that may affect the identified beneficial use, but identifies the key or dominant parameters of concern.

Table 19. Beneficial Uses and Primary Water Quality Parameters of Concern in the Watershed.

| Beneficial Use | Subwatershed | Primary Parameters of Concern |
|---|---|---|
| Domestic Water Supply | Bear, Cave | Fecal Coliform, Turbidity |
| Resident Fish (and Other Aquatic Organisms) | Cave (all) | Temperature, Turbidity |
| Recreation | Coyote, Cave | Fecal Coliform, Turbidity |
| Agriculture | (all) | |
| Wildlife | (all) | |
| Downstream Wild and Scenic River | (all) | Fecal Coliform, Turbidity, Temperature |

### BENEFICIAL USES

**Domestic Water Supply**

Although much of the town of Trout Lake lies within the Cave-Bear watershed, most of the residents get their drinking water from the Glacier Springs Water District, which uses a water source in the Upper White Salmon River watershed. A number of private landowners in the valley have their own water sources, particularly those who live in the lower Cave and Bear Creek subwatersheds. These sources are for domestic use, irrigation and stock watering, and come from either groundwater, springs, or from surface channels. On the National Forest, there is a spring in the Coyote Creek subwatershed that is used as the water source for the Peterson Prairie campground. Activities that could pose a threat to the water quality of these sources include waste material from livestock, wildlife, septic systems, and recreational users of the watershed. Timber harvest, road and landing construction, and other land use activities could also potentially affect turbidities in some of those systems.

**Resident Fisheries**

The Cave-Bear watershed has a limited resident fishery, largely because of the lack of year-round water throughout major portions of the watershed. Nevertheless, in those reaches that do support resident fish, water quality is important for maintaining good fish habitat. Presence of rainbow and eastern brook trout has been confirmed in Cave and Beaver Creeks, both of which are in the Cave Creek subwatershed. The primary water quality threats to these fish would be temperature increases (and resultant decreases in dissolved oxygen), and increases in sediment. Loss of streamside shade from timber harvest, grazing, or road construction, and sediment introduction from these same sources are the most likely pathways for affecting the fish through changes in water quality. Continued sediment input from areas of excessive streambank cutting, from existing road systems, and from recreation areas and other developed sites is also a concern.

**Wild and Scenic River**

The lower, middle, and upper reaches of the White Salmon River are all either designated or proposed for Wild and Scenic River designation. Because of this designation and the amount of recreation taking place in the White Salmon River, water quality of the river and of tributaries to the river is important. The Cave-Bear watershed is approximately 33,437 acres in size, representing approximately 8% of the White Salmon River watershed, or nearly one quarter of the area contributing flow to the upper portion of the White Salmon River. Although there is not often a direct surface flow connection between Cave or Bear Creek and the White Salmon River, it is assumed that the Cave-Bear system contributes water to the White Salmon River, roughly in proportion to the percent of the watershed it occupies. A number of seeps and springs along the White Salmon River in the reaches below the confluence with Trout Lake Creek are the most likely places where water from Cave-Bear enters the White Salmon River. Although water discharged from Cave-Bear could be a major contributor to total flow in the Upper White Salmon River, it is unknown to what degree the quality of Cave-Bear water is altered by filtering, temperature modification, or other means before it reaches the White Salmon River.

## WATER QUALITY PARAMETERS

Very little water quality data has been collected in this watershed. Essentially, water temperature data has been collected in just one subwatershed, fecal coliform testing has been done for private well systems and at the Peterson Prairie campground, and sediment or turbidity data has not be collected anywhere in the watershed.

**Water Temperature**

Because of the limited distribution of fish and of year-round surface water in the watershed, maximum water temperatures have not been an issue throughout most of the analysis watershed. Nevertheless, the Forest Service and Underwood Conservation District operated a water temperature station in upper Cave Creek over a period of three summers (1994-96) as part of the White Salmon River Assessment and Enhancement Project. The station was located in Cave Creek just above the large beaver ponds that are included in the Wildlife Special Area. Maximum water temperature reached during that three year period was 12.6° C, well under the 16° C maximum allowed under state water quality standards (Table 20).

Table 20. Maximum Water Temperatures in Cave Creek (above the beaver ponds) 1994-1996.

| Year | Month Maximum Temp. Occurred | Maximum Temperature |
|---|---|---|
| 1994 | August | 12.6° C |
| 1995 | July | 12.0° C |
| 1996 | July, August | 12.6° C |

During a 1989 stream survey, a grab sample found water temperature in Cave Creek below the beaver ponds to be 17° C, one degree above the state standard. Because this sample and those presented in Table 20 were not collected during the same year, they cannot be used to assess the effects of the beaver ponds, but it is likely that some heating occurs in this slack water reach of the stream. The degree to which water temperatures are increased in these ponds, and the downstream propagation of this increase is unknown. Although the effects of any temperature increase in the beaver pond on dissolved oxygen (and fish) are unknown, it is likely that primary productivity levels are high in these ponds due to the temperature and supply of nutrients. This may actually be a benefit to fish, as long as temperatures do not reach lethal levels, and are not sustained at high levels throughout the system.

Aside from the beaver ponds, seral condition of riparian vegetation can be used to indicate areas that may have temperature concerns due to a lack of shade. Currently, approximately 20% of the Riparian Reserves (excluding Reserves identified due to unstable or potentially unstable soils) in the Cave Creek subwatershed are in either seedling or sapling vegetation. It is unknown how much of this is in the portion of the drainage which has water throughout the summer, or how temperatures are affected by this condition. Table 21 shows the percent of the Riparian Reserves (excluding Reserves identified due to unstable or potentially unstable soils) in the watershed that are currently in seedling/sapling vegetation.

Table 21. Percent of the Riparian Reserve Currently in Early-Successional Forest (seedling/sapling size trees).

| Subwatershed | % Riparian Reserve Early-Successional |
|---|---|
| Coyote | 12% |
| Dry | 9% |
| Bear | 15% |
| Cave | 20% |
| Watershed Total | 15% |

**Coliform**

Only one location in the watershed is regularly monitored for fecal coliform. This site is the spring that feeds the Peterson Prairie Campground, on the National Forest. Over several years of testing at monthly intervals, results have shown no problem with fecal coliform there. Additional one-time testing for coliform has been done on private lands in the watershed, as part of the permitting process for domestic use wells. The county health department has record of nine such tests taken over the past three years in the lower Cave-Bear watershed. In each of these cases, coliform levels were deemed satisfactory by the Health Department. Well depths in this area generally range from 100 to 300 feet. The greatest potential source of coliform contamination on the National Forest is from livestock (Ice Caves Allotment), wildlife, and recreationists. On the private land below the National Forest boundary, livestock, wildlife and septic systems are the most likely sources.

**Sediment/Turbidity**

There has been no data collected in the watershed to assess sediment levels or turbidity. Potential sources of turbidity include sediment introduction from harvest units, roads, and other developed areas, but also include sediment production occurring through streambank cutting and bank or slope failures. Upslope mass wasting potential is relatively low in this watershed compared with other watersheds on the Forest (see Mass Wasting section of this report), so this is likely a relatively small part of the source for turbidity over the long term.

More chronic, though lower intensity inputs of sediment in the watershed may be a result of sediment contributions from roads, harvest units, other areas where surface vegetation and soils have been disturbed, and from streambank cutting. Locations where roads cross streams are one of the primary avenues for sediment from the road prism to be delivered to a stream network. Table 22 shows the density of road crossings (number of road crossings per square mile of watershed area) by subwatershed.

Table 22. Road / Stream Crossings and Crossing Density by Subwatershed.

| Subwatershed | Perennial Stream Crossings | Intermittent Stream Crossings | Total Stream Crossings | Stream Crossing Density per Mile$^2$ |
|---|---|---|---|---|
| Coyote | 0 | 35 | 35 | 2.9 |
| Dry | 4 | 31 | 35 | 3.9 |
| Bear | 11 | 52 | 63 | 4.1 |
| Cave | 25 | 70 | 95 | 6.0 |
| Watershed Total | 40 | 188 | 228 | 4.4 |

It is not surprising that the stream crossing densities in this watershed are considerably lower than in some other watersheds on the Forest. The low densities do not reflect a lack of roads, but the very few streams that exist in the watershed. This watershed actually has some of the highest road densities of any watershed on the Mt. Adams and Wind River Ranger Districts, and possibly on the Forest.

Sediment from stream channels can be another important component in the total sediment load carried by a stream, and the potential for this is largely a function of the stream channel type and its condition. Both Cave and Beaver Creeks have reaches classified as Rosgen C and E channels (see Stream Channels section of this report). These channel types have an increased potential for delivering sediment, particularly when they have been de-stabilized by riparian timber harvest, large woody debris removal, or heavy grazing. Table 21 presented earlier in this section indicates areas where riparian vegetation is in an early-successional condition. Watersheds with Rosgen C type channels and a high degree of early successional riparian vegetation are particularly subject to sediment introduction from streambanks. Similarly, areas with E channels that are heavily grazed will have higher potential for sediment introduction from streambank erosion and scour.

# SYNTHESIS

## TRENDS AND IMPLICATIONS TO BENEFICIAL USES

Because the Northwest Forest Plan identified the Cave-Bear Watershed as a non-Key watershed, and much of the Federal portion of the watershed as Matrix, timber harvest and some degree of road construction will continue to occur on the National Forest portion of the watershed. However with application of Riparian Reserves on all aquatic features, harvest will not occur in riparian areas unless it is shown to benefit aquatic systems. On National Forest lands, this should eliminate future reductions in streamside shade that would negatively affect water temperatures. Similarly, sediment introduction from timber harvest on National Forest lands will be reduced by not harvesting along streamsides or in areas that may cause sediment to be delivered to the stream.

Road construction is similarly being reduced on the National Forest, because budgets no longer allow for adequate maintenance of the road network. Efforts are underway to reduce the total miles of road on the Forest to reduce maintenance costs and to reduce the chronic and episodic input of sediment from road systems. Although there will continue to be some sediment introduction from new (primarily temporary) roads, and from roads that are being decommissioned, the net input of sediment to streams on the Forest is expected to drop due to the use of Riparian Reserves on all Forest streams. Because Cave-Bear is a non-Key Watershed, money to eliminate existing unused and infrequently maintained roads is difficult to get. Without an increase in road maintenance funds, there will likely continue to be sediment production from these roads until they are actively decommissioned.

Fecal coliform levels on the National Forest portion of the watershed are likely to increase over time as recreational pressures increase across the Forest. Input from livestock and wildlife will presumably continue at rates similar to those of today.

On state and private lands below the Forest boundary, harvest and roading are less restricted, so may continue to affect riparian shade and sediment inputs. Continued development of the valley bottom will require additional septic systems, which could increase the potential for contamination of nearby water sources. Also, with increased development will be increased needs for water. Increased water withdrawals from surface or subsurface sources may affect water quality by changing the concentration of current and future contaminant levels in these waters. Alternatively, improvements in land management resulting from individual actions or via projects stemming from the cooperative watershed enhancement program coordinated by the Underwood Conservation District may lead to improvements in water quality, particularly in the lower watershed.

## DATA GAPS

There are major data gaps for all parameters of water quality. This includes water temperature, turbidity, fecal coliform, and nutrients. In addition, the routing of water through the watershed, and any effects this may have on water quality, are largely unknown.

# SPECIES AND HABITATS - FISHERIES

## REFERENCE CONDITIONS

### INTRODUCTION

This analysis area is part of the White Salmon River watershed which is a tributary to the Columbia River. The four subwatersheds in this watershed analysis area include Coyote Creek, Dry Creek, Bear Creek, and Cave Creek. There is a total of 10.7 miles of fishbearing streams, 10.6 miles of perennial non fishbearing streams, and 109.5 miles of intermittent streams in this analysis area. The only fishbearing streams are Cave Creek and it's tributary Beaver Creek, and only small portions of other streams in the analysis area are perennial. The majority of streams in the Lost Meadow Creek, Dry Creek and Bear Creek subwatersheds and all of the Coyote Creek subwatershed are intermittent. No anadromous fish inhabit streams in the analysis area. There are several stream diversions on Cave and Bear Creeks. Cave Creek enters the White Salmon River just below the Trout Lake Creek confluence, and Bear Creek presently flows through the field adjacent to the Trout Lake store and joins Cave Creek just before the 141 road bridge. No fishbearing lakes exist in the analysis area.

### ANADROMOUS FISH POPULATIONS

Condit Hydrologic Project is located on the White Salmon River 3.3 miles upstream from the confluence with the Columbia River. An impassable concrete dam is present at this site and was completed in 1911. In 1913 a fish ladder was included in the Condit project and was washed out that same year. This dam has blocked upstream migration of salmonids since 1913. Prior to construction of Condit dam, anadromous fish could migrate at least to Husum Falls on the White Salmon river (river mile 7.6) and steelhead (*Oncorhynchus mykiss*) migrated to river mile 16.2 where three sets of falls exist. The upper drainage above this fall, including this analysis area, contained no anadromous fish according to studies of the area. However, affidavits from local residents said steelhead where found as far up as Trout Lake Creek (river mile 25.8) before the dam was built. It therefore remains uncertain if steelhead ever inhabited the White Salmon River above river mile 16.2 or streams in this watershed analysis area. Pacificorp Electric Operations is presently applying to the Federal Energy Regulation Commission (FERC) for a new license to continue operation of the Condit Hydroelectric project. The final Environmental Impact Statement on this project has been completed and a preferred alternative has been chosen. This alternative includes a fish ladder for upstream fish passage and a fixed screen system to pass migrants downstream. Pacificorp is also considering dam removal if it is more cost effective. Due to the intermittent/subterranean nature of the streams in the Cave-Bear Creeks watershed analysis area it is highly unlikely these streams ever supported anadromy in the past or will in the future.

### RESIDENT FISH POPULATIONS

The earliest records of fish residing in the Cave-Bear Creeks watershed analysis area comes from J. C. Cooper in 1853. Cooper was a naturalist for the railroad survey through the Cascades lead by Captain McClellan. In his report Mr. Cooper stated that the Indians reported harvesting fish from Cave Creek (species unknown). It can be assumed that Cave, Beaver, and Bear Creek (if Bear was ever fishbearing) were most likely inhabited by the same fish species as found in the White Salmon River. No records exist which show presently listed TE&S species were ever in this drainage.

## FISH HABITAT

Some historical information on stream characteristics was documented by Newton Clark in 1882. Clark was a land surveyor for the General Land Office (GLO) and his survey notes contained some information on stream characteristics in this analysis area. During the survey which took place between June and October of 1882, Cave Creek was crossed six times in the section of stream between the current Wood road in Trout Lake and the 8620-024 road (approximately ¾ of the stream length). In the points crossed, Cave Creek's width varied from 5 feet to 20 feet and was described as having low banks, clear water, and a "gravely" or "rocky" bottom (Table 23). The current was described as rapid in all areas except one point which is located approximately one mile downstream of the 8620 road. Dry Creek, which the notes referred to as Lost Creek, was crossed in three points within a one mile stretch of stream length in sections 30 and 31 of T 6 N, R 10 E. Here the stream varied in width from 5 to 13 feet and was described as having low banks, a "rocky" bottom, and clear rapid water. Bear Creek was crossed at two points in T 6 N, R 10 E in sections 17 and 21. Stream width in this area varied between five and ten feet and was described as having low banks, a gravel bottom, and a rapid current. Beaver Creek was crossed at two points where the width was 6.6 feet at both spots, and also was described as having low streambanks, a gravel bottom, and a rapid current. The description of a rapid current in the summer season in all four of these streams is very different than today. The summer flows in Bear and Dry Creeks at these locations currently are dry, and flow is slow in Cave and Beaver Creeks. No mention of a sand/silt substrate is made in Cave Creek during the historical survey, yet they are the dominant substrates in Cave Creek today (Table 23). Very little gravel was observed in a survey of Cave Creek in June, 1997. Management actions most likely contributed to these changes over time, but specifically how and when is undetermined.

Table 23. Comparison of Historical Fish Habitat (September, 1882) to Current (Cave- July 1993, Beaver- August, 1996).

| Creek | # of Times Stream Crossed | Stream Width | Dominant Substrate | Water Clarity | Stream Flow |
|---|---|---|---|---|---|
| **Cave Creek** | | | | | |
| Historical | 7 | 5-20 | Gravel | Clear | Rapid |
| Current | | 7 (ave.) | Sand | Clear | Slow |
| **Beaver Creek** | | | | | |
| Historical | 2 | 6.6 | Gravel | no data | Rapid |
| Current | | 6.4 (ave.) | Gravel | Clear | Slow |
| **Bear Creek** | | | | | |
| Historical | 4 | 5-8 | Gravel | no data | no data |
| Current | | no data | no data | Dry | Dry |
| **Dry Creek** | | | | | |
| Historical | 3 | 5-13 | "Rocky" | Clear | Rapid |
| Current | | no data | Lava rock | Dry | Dry |

Specific data on historical stream channel conditions in the basin such as the number of pools/mile or amount of large woody debris (LWD) does not exist. Due to this data gap comparisons are made to the range of natural conditions as determined for the Hood-Wind Subbasin in the Regional Ecosystem Assessment Report (USDA-FS 1993). The natural range for pools in the Hood-Wind subbasin are 40-60 pools per mile, and stream temperatures range from 7-20° C (Table 24). Comparisons were also made to the Columbia River Anadromous Fish Policy Implementation Guide (PIG) Desired Future Conditions (DFC's) (USDA-FS 1991), which are thought to be close.to the "natural" unmanaged conditions. These DFC's are a core of minimum numeric values which describe fully functioning aquatic systems. Due to the variability of stream systems, a range of DFC values should be determined for each particular watershed area. This has not been done in any streams in this analysis area, so the general PIG DFC criteria for good fish habitat was used in this analysis. The criteria are: 80 pieces of large woody debris (LWD) per mile, width to depth ratios less than 10, and stream temperatures less than 16° C (Table 24). The number of pools per mile is based on stream width and therefore varies by stream.

Table 24. Columbia River Basin Policy Implementation Guide (PIG) Element Ratings and Hood-Wind Subbasin Range of Natural Conditions (RNC).

| PIG Elements | "Good" | "Fair" | "Poor" | Hood-Wind RNC |
|---|---|---|---|---|
| # Large Pools per Mile* | 100% | 50-99% | <50% | 40-60 |
| # LWD per Mile | >=80 | 40-79 | <40 | - |
| Width to Depth Ratio | <10:1 | - | >10:1 | - |
| Temperature C | <16 | 16-20 | >20 | 7 to 20 |

* Based on stream width.

No fishbearing lakes exist in the Cave-Bear Creeks watershed analysis area. The analysis area was first homesteaded in 1879 and irrigation began at this time. Early notes show Cave Creek was used for irrigation at least as early as 1900.

# CURRENT CONDITIONS

## FISH POPULATIONS

Cave Creek and it's tributary Beaver Creek contain eastern brook (*Salvelinus fontinalis*)and rainbow trout (*Oncorhynchus mykiss*). Washington State 1936 Fish and Game records show stocked cutthroat (*Salmo clarki*) and rainbow trout inhabiting Cave Creek at that time (Table25). Stocking records also show Cave Creek was stocked with rainbow and cutthroat in 1940, 1947, and 1953. No cutthroat have been found in Cave Creek during recent population surveys. Eastern brook trout were intermittently stocked in the 1970's and 1980's in the large beaver pond in Cave Creek. In a 1993 electro-fishing survey only rainbow trout were found, although eastern brook trout are known to inhabit the beaver pond in Cave Creek. This large beaver pond/marsh (approximately 0.9 mi. in length at time of survey) was not sampled, as it was inaccessible. No stocking since that time has occurred in any streams in this watershed. No genetic studies have been done to determine if the rainbow trout currently inhabiting the stream are a genetically distinct population or a hatchery cross. It is also unknown if any cutthroat still exist in the drainage. The fish populations in Cave Creek are reproducing and appear to be maintaining adequate population levels. During the summer Cave Creek is dry from Beaver Creek to just below the Road 8620.

The Lost Creek ditch stream diversion, first built in 1908, is found in this watershed. This diversion diverts water from Lost Creek, a stream in the Little White Salmon River Watershed, and routes it into Coyote Creek. The water right permit for this diversion was granted in 1933 by the state of Washington for a maximum of five cubic feet per second (cfs). The ditch was originally built to provide irrigation water to the Trout Lake Valley, but today it provides drinking water for cattle in the Ice Caves Cattle and Horse Allotment. Cattle grazing has occurred in this allotment since 1911. The diversion enables Coyote Creek to have flowing water down past the Peterson Campground during the summer months when it is usually dry. The diversion intake gate is kept at a 5 cfs level, is open from June through September, and an intake screen is present to prevent fish migration. The amount of water diverted travels through lava rock and flows subterranean before reaching Cave Creek. Sheep were grazed in this watershed as early as 1885, but currently no sheep allotments are found in this watershed area.

In 1938 several fish rearing ponds were constructed along Coyote Creek in the area where Peterson Campground is found today. These ponds were filled in the summer with water from the Lost Creek ditch and were only used for a couple of years and then abandoned due to lack of water.

Table 25. Fishbearing Streams in the Watershed.

| Stream | Class | Fish Species Present | Presently Stocked | Date First Stocked * | First Species Stocked | Natural Population |
|---|---|---|---|---|---|---|
| **Cave Creek** | II | Rainbow Trout | No | 1936 | Rainbow | no data |
| | | Eastern Brook | No | 1936 | Cutthroat | |
| | | | | 1970's? | Brook | |
| **Beaver Creek** | II | Rainbow Trout | No | no data | no data | no data |
| ** | | Eastern Brook | No | no data | no data | |

* Earliest documentation found.

** Stocked fish were free to move into Beaver Creek.

## FISH HABITAT

Some fish habitat data was noted in the 1936 Washington Department of Fish and Game records. These records state that there were 3 miles of "fishable" stream length in Cave Creek, it was 5 feet wide and 1 foot deep, had a bedrock/mud bottom, had poor spawning habitat, and six 10 inch cutthroat and rainbow trout were caught on that particular day. These habitat conditions are very similar to current conditions.

The Forest Service portion of Cave Creek beginning at the Beaver Creek confluence was surveyed for fish habitat conditions in 1993. Results of this survey and the 1996 Beaver Creek survey as compared to the REAP RNC's and PIG DFC's are displayed in Table 26. The ratings for large woody debris (LWD) are poor in both fishbearing streams as compared to the PIG criteria. The poor rating in Cave Creek for the number of pools/mile is not accurate for the stream overall since the large beaver pond (0.9 miles long, 700 feet wide) is not included in this tabulation. A pond of this size can not be surveyed as length, width, depth, number of pieces of LWD, etc., can not be measured due to inaccessibility.

Table 26. Stream Survey Data Comparison to the Hood-Wind Subbasin RNC or PIG Rating.

| Survey Criteria | Cave Creek | Beaver Creek |
|---|---|---|
| Stream Length Surveyed | 3.0 miles* | 1.3 miles |
| Average Number of Large Pools | 14.4 pools/mi | 106 pool/mi |
| PIG Rating | 10% - "Poor" ** | 87% - "Fair" |
| Hood-Wind RNC | Below RNC | Exceeds RNC |
| Width to Depth Ratio | 7.1:1 | 6.2:1 |
| PIG Rating | Good | Good |
| Hood-Wind RNC | - | - |
| Average Large Woody Debris | 22.6 pieces/mi | 3.8 pieces/mi |
| PIG Rating | Poor | Poor |
| Hood-Wind RNC | - | - |
| Maximum Water Temperature | 17°C in 1989 | 14°C in 1996 |
| PIG Rating | Fair | Good |
| Hood-Wind RNC | Within RNC | Within RNC |
| Channel Stability Rating | Fair | Fair |
| PIG Rating | - | - |
| Hood-Wind RNC | - | - |

* Total length of survey of Cave Creek was 4.6 miles, but the dry portion and large beaver pond (approximately 2.5 miles) were not included in the calculations for the PIG rating. Total stream length is approximately 10.4 miles, yet only the portion on Forest Service land was surveyed.

** Rating considers stream width. It would rate "good" overall in Cave Creek if the very large beaver pond were included in calculations.

## CAVE CREEK

Cave Creek is a low gradient stream which runs parallel to Roads 8620031 and 8631 for approximately four miles. These roads are most likely a major sediment source to the stream. Approximately two-thirds of the stream length is dry during the summer months. During an average water year Cave Creek is dry between Beaver Creek and the Road 8620 crossing. It is assumed the fish migrate to the beaver pond and the stream above as the stream dries up. These low flows greatly limit the amount of available fish habitat during the summer. Beaver Creek contributed 100% of the flow below the Cave Creek confluence during the time of a 1993 stream survey. During the winter/spring Coyote Creek is a major contributor of streamflow, but this stream is dry during the summer. A substantial beaver population exists in the upper portions of the stream above Road 8620.

Rosgen channel types in most of Cave Creek are C and E types. The C channels are lower gradient reaches which are more sensitive in terms of response to changes in stream flow and inputs of sediment and wood. These reaches typically have higher width-to-depth ratios, which leaves them more prone to solar heating. One water temperature grab sample taken during a stream survey in the area just below the beaver pond was 17°C, which does not meet state water quality standards. The Rosgen E channels flow through meadow systems. These channels are heavily dependent on streambank vegetation for stability and are more sensitive to loss of bank vegetation by animal grazing.

A large beaver pond/marsh is present in the southeast corner of Section 11, T6N, R10E. This pond is an important trout rearing area. Overbank flows are common in most of the stream, especially the stream section above Road 8620. The stream annually overflows this road crossing during the spring as it is located in a wet marsh. Cattle in the Ice Caves Allotment use Cave Creek as a major water source. The stream survey noted degradation from cattle presence in the form of bank crushing, riparian vegetation removal, sedimentation, and animal feces in and along Cave Creek. Silt accumulations up to one foot in depth were found in lower Cave Creek in 1989. Spawning habitat is lacking in Cave Creek due to a lack of gravel and high silt loads. Nevertheless, fish reproduction appears to be successful due to the presence of rainbow trout even though fish stocking has not occurred in the area in over 12 years. These trout were found above the beaver pond area as all Forest Service land below the pond is dry in the summer. In the private land portion of the stream several irrigation diversions are found and much of the stream has been channelized. During even the highest streamflow in the spring of 1997, above surface water did not enter the White Salmon River from Cave Creek.

**Migration Barriers**
No migration barriers were noted in the stream survey of Cave Creek on the Forest Service land. The private land portion of the stream contains several fish barriers from stream diversions and man-made dams.

### BEAVER CREEK

Beaver Creek enters Cave Creek approximately 250 feet from the Road 86 crossing. Beaver Creek appears to not lie in it's original channel as it runs a straight course resembling an irrigation ditch from it's confluence with Cave to a distance of approximately 600 feet. Large berms exist on both sides of the stream on this section where it parallels the road and was most likely channelized when the road was built. A few cabins exist along this stream and a concrete dam with removable boards is present adjacent to one cabin along with PVC pipe. Trout up to eight inches long were observed during the stream survey in the summer, and several beaver dams and ponds are present above the Road 8620 and Road 8620011 crossings. These ponds proved important pool habitat. Abundant rainbow trout fry were observed in the reach of Beaver Creek adjacent to the lower cabin site on June 4, 1997. This area contained excellent trout spawning and side channel rearing habitat and is classified as an E Rosgen channel type. A Rosgen F channel is present above this which is heavily downcut resembling a trench (see Hydrology section for more information of Rosgen types). Large woody debris is presently lacking in this stream, but the riparian areas are forested with small saw and mature trees which will provide large woody debris recruitment in the near future.

**Migration Barriers**
One small concrete dam exists adjacent to a cabin is most likely a barrier to fish migration when the dam boards are in place during low flow. The two culverts on the stream are not considered barriers.

## SYNTHESIS

In the area of Cave Creek below the beaver pond (Road 8620) there are extremely low numbers of instream large woody debris, abundant sediment, very little spawning gravel, and extremely low flow. These conditions are most likely caused by a combination of management activities including extensive timber harvest (ARP level of 65%, 18% of the riparian area is comprised of early-successional forest), cattle grazing, and road construction (4.3 miles/sq. mile). These management activities occur in a landscape where 86% of the subwatershed is in the rain-on-snow zone, channels are low gradient and unconfined resulting in overbank flows, and highly porous stream bottom materials resulting in subterranean flow. This area of the stream is considered a Rosgen C channel type which is very responsive to these conditions (see Hydrology section). Low flows greatly reduce the amount of available fish habitat during the summer months and fish are forced to move upstream into the beaver pond/marsh and stream above the pond or into Beaver Creek. This area of Cave Creek provides good fisheries habitat and has not been managed as intensely as Cave Creek below the beaver pond. The beaver pond in Cave Creek provides the majority of adult holding and feeding fish habitat.

Beaver Creek contains excellent fish spawning and rearing habitat and fish from Cave Creek are most likely reproducing and rearing in this stream. Spawning and fry rearing is also most likely occurring in Cave Creek above the beaver pond. Beaver Creek appears to be critical to maintaining fish populations in Cave Creek below the beaver pond. When this area is traded to private industry the Cave Creek and Beaver Creek's fish populations may greatly diminish if the spawning and rearing habitat in Beaver Creek is not maintained. The private cabins along Beaver Creek do not appear to be influencing the stream habitat in that area.

Fish may be indirectly killed in the private land portions of Cave Creek where unscreened stream diversions allow for fish migration into diversion channels, or diversions lower the flow so much in the mainstem that fish can not thrive.

## FUTURE CONDITIONS

- Cave Creek below the beaver pond and all of Beaver Creek are currently being traded to private industry. Stream habitat conditions may be degraded in the future in these streams if riparian areas are not left intact. Establishment of riparian reserves on Forest Service land will improve stream habitat conditions in the future. As previously impacted riparian areas recover they will provide the streams with large woody debris, provide shade and cover, lower water temperatures, increase pool habitat, decrease width to depth ratios, and decrease sediment input.
- Sediment loads may increase if roads are not maintained due to a lack of funds.
- Grazing of approximately 200 head of cattle will most likely continue in the Ice Caves Cattle and Horse Allotment which may degrade water quality and streambank stability.
- Stream diversions on private land will continue to draw water from streams decreasing low flows and raising water temperatures below the diversions.
- Fish Stocking is not likely to continue in Cave Creek as populations are reproducing successfully.

## DATA GAPS

- Local desired future stream habitat conditions more specific to the analysis area streams than the general PIG criteria.
- Historical fish species distribution.
- Effects of low flows on fish populations (due to diversions or natural conditions).
- Genetic sampling to determine if any wild rainbow trout exist in the watershed.
- Through population sampling to determine if cutthroat trout are still present in the watershed.
- Effects of low flows on fish populations (due to diversions or natural conditions).
- Channel stability surveys on non fish bearing streams.
- Water temperatures in all streams.

# SPECIES AND HABITAT - WILDLIFE

## REFERENCE CONDITIONS

Historical wildlife species and abundance is inferred from historical vegetation patterns (refer to Vegetation Section). Prior to European settlement in the 1870s, 99% of the watershed was a forested landscape in varying stages of successional development, with fire being the dominant force to reset succession. The Regional Ecological Assessment Report (USDA-FS 1993) determined a Range of Natural Conditions (RNC) for forest successional stages within the larger Hood-Wind Subbasin. Based on this RNC and weighted by the dominant ecological zones in this watershed (grand fir -67%, Pacific silver fir -26%), a historical maximum and minimum habitat capability level were calculated for four management indicator species (See Figure 7). Habitat levels are represented by wildlife indicator species often associated with a particular habitat. Pileated woodpecker would capture the large snag habitat, hairy woodpeckers smaller snags and hardwoods, spotted owl the late sere forest, and pine marten a combination of snags, logs, and late sere forest

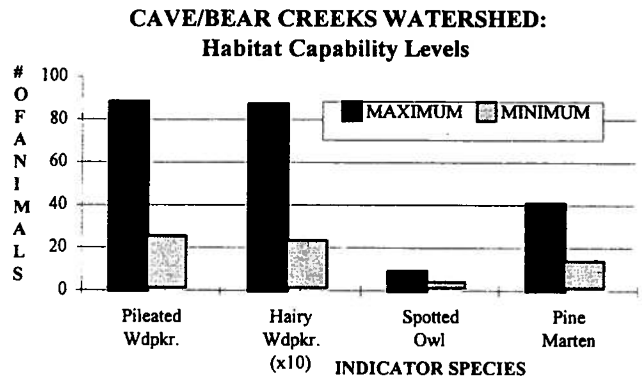



Figure 7. Historical Habitat Capability Levels for Management Indicator Species.

As can be see in the Figure 7, populations could have varied dramatically for all of management indicator species. This reflects the predilection for large portions of the watershed to be in somewhat stable old-growth condition, and the infrequent but drastic stand replacing fire, converting significant portions of the watershed to early-successional conditions. An interpretation of this chart is that as long as habitat levels stayed within these upper and lower bounds, then a wildlife community would rebound and recolonize previously vacated areas.

Fire also influenced the historical vegetative composition, structure, and patch size. Historical patch sizes were likely larger with less edge habitat than today, which would have benefited the northern spotted owl to the detriment of the barred owl. The early-successional conditions would have lasted longer to the benefit of the great horned owl, and would have had more snags than today to the benefit of the woodpecker guild. There was likely greater dominance of ponderosa pine in the grand fir zone to the benefit of the white headed and black backed woodpeckers. Lastly, overall human presence would have been less to the benefit of the grizzly bear and gray wolf.

# CURRENT CONDITIONS

## LANDSCAPE DIVERSITY

This watershed hosts a rich wildlife community indicating a diverse landscape with a moderate to high degree of productivity. More than 500 documented wildlife sightings (USDA-FS 1997, USDI-FWS 1997) representing at least 50 species, were located for the watershed and the area within 1 mile of its boundary. The dominant wildlife groups documented included raptors, omnivores, carnivores, and cavity users.

* Owls (spotted, barred, and great horned) and goshawk dominated the raptor group. This group hunts during all hours of the day, may reside year-round and/or migrate, and is associated with larger (> 21") diameter conifer trees. These raptors use all successional stages of the conifer forest, edge and interior habitat, upland and riparian habitat.

* Black bear is the dominant omnivore present. It resides in the watershed year-round hibernating and giving birth during the winter, foraging on spring growth upon emergence from hibernation, shifting to young elk and deer during summer, then berries and shrubs in the fall. Most of the 33 bear sightings, including a suspected bear den, are within 2 miles of the Cave Creek wildlife special a mile-long by half-mile wide riparian area. Black bears could use snags as well as caves for hibernation purposes.

* Of the 31 carnivore sightings located, the dominant groups included 11 cat family contacts, 13 weasel family, and 4 dog family. The cats included bobcat, mountain lion, and lynx. Mountain lion and bobcat sightings were similar in abundance. A surprise 1989 sighting of a lynx in the headwaters region of Cave Creek was located. In the weasel family, pine marten was prevalent though also present were weasel and mink. Coyote and gray wolf were noted. The gray wolf contact was in the form of a howl in August 1991 about 1-mile west of the watershed boundary.

* Cavity using bird species were well represented. Pileated woodpecker dominated this group. Also present were sightings of bluebird (mountain and western), common flicker, white headed woodpecker, hairy woodpecker, and wood duck. The bluebirds are migratory leaving the area in mid to late fall and returning to nest in early summer. At the eastern end of the watershed, white headed woodpecker activity was detected. The white headed woodpecker is uncommon is usually associated with more dry environments such as in ponderosa pine communities. All sizes of cavities, and age classes of riparian and conifer forest are represented.

## WILDLIFE COMMUNITIES

The communities and special niches of this watershed include late successional conifer forest, basalt caves, wetlands, upland meadows, and snag habitat.

### CONIFER FOREST

Likely the most well known wildlife member of the late successional conifer forest community is the northern spotted owl. Habitat for this representative species occupies about 45 percent of the watershed. An additional 39 percent is expected to function as spotted owl habitat during the next 75-100 years. Low habitat levels, in both quantity and quality, is considered a likely limiting factor for spotted owls in this watershed. Given the current habitat levels, more spotted owls are present than would be expected. It is likely that a high degree of resource competition is occurring amongst spotted owls and with other competing raptors such as barred owl and great horned owl

**Surveys**

- *Spotted Owl.* Twenty-four percent (24%) of the watershed has been surveyed for northern spotted owl. As depicted Table 27, home ranges of 14 spotted owl pairs likely overlap into this watershed. The primary activity area of five of the 14 centers is within the watershed boundary: 315, 316, 318, 319, 329. Activity center #3020 is quite close to the watershed boundary; it is 0.17 miles from the boundary. The Bear Creek center is on Washington Department of Natural Resources land.

- *Carnivores.* Two baited camera stations were used as carnivore sampling sites during the winter of 1997. The stations were baited to attract carnivores to the site where they trip a laser beam and are photographed. No large predators were detected during the 1997 effort. Though not photographed at the stations, coyote, cougar, bobcat, weasels, and bear are known to be present in the watershed.

**Spotted Owl Centers**

Precariously low habitat levels are present in seven of the activity centers: 314, 318, 319, 320, 329, 3020, 3118. These seven centers are considered to be in a TAKE condition. Most of the habitat shortages are in the area nearest the center, at the 0.7 mile radius. A habitat shortage is considered to exist when less than 2,663 or less than 500 acres are present at the 1.82 or 0.7 mile radius, respectively.

Table 27. Current Spotted Owl Centers and Habitat Conditions.

| Owl Center* | Suitable Habitat Acres** | |
|---|---|---|
| | 0.7 Mile Radius | 1.82 Mile Radius |
| 314 | 217 | 2,181 |
| 315 | 822 | 3,470 |
| 316 | 697 | 3,170 |
| 318 | 469 | 2,678 |
| 319 | 294 | 2,656 |
| 320 | 120 | 2,685 |
| 321 | 816 | 3,435 |
| 329 | 395 | 3,365 |
| 3017 | 534 | 4,063 |
| 3020 | 260 | 2,663 |
| 3118 | 1 | 2,214 |
| 3219 | 756 | 3,160 |
| Bear Cr (DNR) | 654 | 3,506 |

* Shading means owl center is in an incidental take condition at either the 0.7 or 1.82 mile radii.

* *Suitable habitat includes nesting, roosting, and foraging habitat

**Fragmentation.**

Fragmentation has substantially changed the amount of available interior forest habitat. This watershed is located within the Eastern Cascades Province. Forests in this region are highly fragmented due to logging and a variety of natural factors (poor soils, high fire frequencies, high elevations). Within the Cave-Bear Creeks watershed, about 56% of the conifer forest stands in this watershed are less than 50 acres in size. Late successional forest stands constitute about 29% of the landscape and have an average size of 214 acres. The larger stands of late successional forest are considered a limited resource for wildlife habitat. Interior habitat is what is lost during fragmentation. Edge habitat is what is gained. About 50% of the watershed provides interior habitat. Of the interior habitat, 39% is in late-successional forest, 16% mid-successional forest, and 45% early-successional forest.

**Habitat Capability**

The landscape's capability to support various wildlife communities reflects past changes in habitat distribution over time and space. Historical fires defined the maximum and minimum levels of early and late-successional forest. Intensive and extensive stand replacement fires resulted in minimal levels of late successional forest and maximum levels of early sere. Timber harvesting has replaced fire as the primary disturbance regime and, in this report, is considered to have a similar effect on forest successional distribution. The ability of the watershed to support the wildlife community is tied closely to the distribution of forest successional stages. The following figure shows management indicator species abundance under the historical maximum and minimum habitat condition (REAP RNC), current conditions, and possible condition 100 year in the future given current management guidelines. An assumption for the future capability is that all of the conifer forest on private lands would be regenerated at least one time and that Matrix grounds would be managed on a 120 year rotation. The model indicates that current and future populations are within the range of natural conditions. The existing capability for three pairs of spotted owl reflects the effects of timber harvesting on habitat acreage as well as its distribution, including fragmentation, across the landscape.

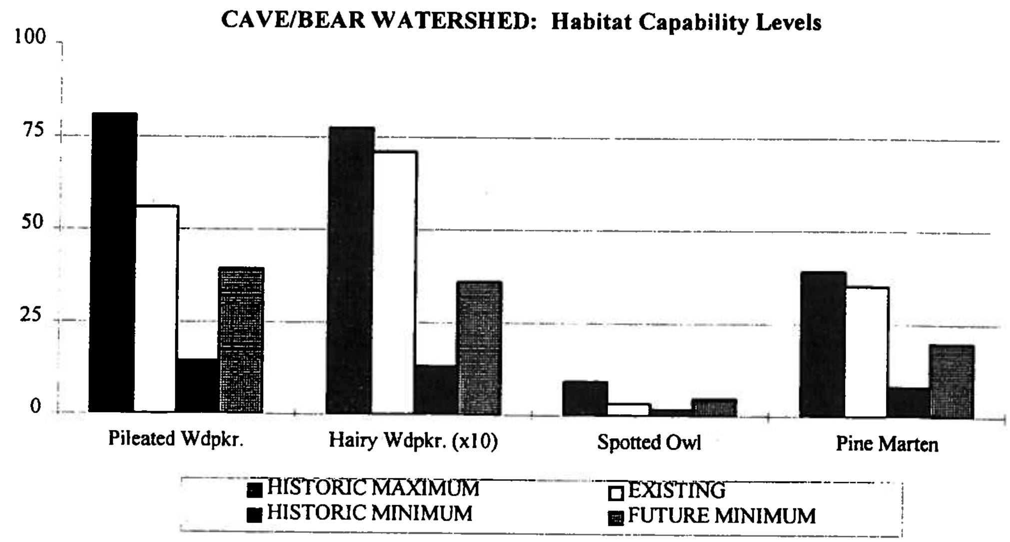



Figure 8. Habitat Capability Levels for Management Indicator Species.

The future condition of National Forest lands in the watershed is likely one dominated by late-successional conifer forest. This condition reflects land allocations under the Northwest Forest Plan. Under this plan, about 22% of the landscape would be subject to intensive timber harvest. The remaining 78% of the area would continue its vegetative development towards late-successional conditions until some non-timber disturbance reset succession. The resultant capability would favor the late-successional wildlife community and they would tend towards their historical maximum level.

**Peterson LSR/MLSA**

The Peterson LSR/MLSA occupies 38% (12,757 acres) of the watershed. Presently, 58% of the reserve is considered spotted owl nesting/roosting habitat and an additional 33% is expected to develop into habitat over the next century. The developing habitat comes from existing younger forest and should function as habitat in two general time frames: 19% (2,433 ac.) in the next 25-50 years; 14% (1,799 ac.) in the next 75-100 years. Three activity centers are present within this area: 315, 316, and 329. Activity center 329 is at a TAKE level. A total of 11 spotted owl pairs depend on habitat within this area for their livelihood: The LSR is expected to serve in the long term as an area that activity supports a late-successional forest wildlife community.

**Connectivity**

Future late-successional habitat connectivity is primarily through Riparian Reserves, reserve green trees aggregates within matrix lands, and other no-harvest allocations. These reserves constitute about 34% of the watershed. One of its expected functions is to facilitate dispersal of individual wildlife members across the watershed. Forest structure within these Riparian Reserve is evenly distributed between early, middle, and late-succession. Early-successional forest is are not expected to readily conduct late-successional wildlife across the landscape. The distribution of the Riparian Reserves results in a moderate degree of inter-connectivity across the landscape. An east-west band (0.5-1.5 miles wide) lacking in Riparian Reserves separates the northern and southern halves of the watershed. This band extends across two-thirds of the watershed and likely interferes with dispersal of riparian habitat associated species, such as amphibians. In this area; however, the uplands are well connected with late-successional forest. With the exception of this east-west band just mentioned, the watershed is sufficiently interconnected along Riparian Reserves to maintain gene flow.

## BASALT CAVES

The National Cave Resource Institute has documented 77 caves on the Mt. Adams Ranger District of which 70 are on federal lands in this watershed. There are at least 16 more caves in this watershed on state and private lands. The caves are basalt lava tubes, generally shallow in depth and in areas with a low slope gradient. Most of the caves have been discovered in the large flat between Peterson Prairie and the town of Trout Lake. Some of the caves have open connections and form cave systems.

Caves are especially known for their function as bat habitat. Bats use the caves for hibernating in the winter, for giving birth in the spring, for roosting in the summer, and for breeding in the fall. Indeed, the caves are an essential component of bat habitat. Known bats using these caves include Townsend's big-eared bat, and myotis spp. The big-eared bats are believed to use the caves year-round, and the myotis bats are suspected of using them primarily during the summer.

## WETLANDS

This habitat is unique in this watershed in that it is most often present as a function of beaver dams. Less than one percent of the watershed fall into this category. The porosity of the soils results in a rapid rate of water percolation leaving limited amounts of surface water. Beaver ponds can hold surface water for longer periods because of dams which prevent overland flow, and settling of fine sediments because of reduced current. The sediments reduce the soil's porosity thereby controlling water percolation. The ponds are present year-round and are deep enough so as not to freeze completely. Associated with the ponds would be such wildlife as beaver, belted kingfisher, trout, coyote, amphibians, elk, and osprey. An example of this limited habitat is the Cave Creek Wildlife Special. Older and smaller ponds are used in the spring by reproducing Cascade and chorus frogs. These smaller ponds tend to dry up during the summer leaving primarily water pockets (less than 10' wide), saturated soils with sedge vegetation, and upland grass meadows. Sampling during the spring of 1997 revealed 15 egg masses and 5 male Cascade frogs. Also detected with the Cascade frogs were 10-15 chorus frogs.

Elk are one of the species that use this habitat and a notable observation is that portions of the population migrate out of the watershed each winter. The migrating elk winter in the Cave-Bear watershed usually arriving in December and departing during March. The summering watershed for these animals is the Lewis River. Radio telemetry was used to determine home ranges.

## UPLAND MEADOWS

This habitat is particularly limited in area and distribution. This habitat like wetlands, occupies less than one percent of the area. Its structural condition is maintained through disturbance such as fire, windstorm, insect, disease, flooding, and timber harvesting. In the absence of disturbance these meadows would be overgrown by conifer forest. An example of such a meadow is Peterson Prairie.

## SNAG HABITAT

Using data from Stand Examinations and Forest Inventory Plots, the snag resource was estimated. Approximately 57 percent of the watershed has at least 3.4 snags (at least 16.9" DBH) per acre. This estimate was made using an electronic, roving 10-acre window that moved across the landscape averaging snag densities based on stand structure. Forty-four percent of the landscape is in the <2.6 snags per acre category. A density of 2.6 snags per acre is considered to provide for at least 40% of the habitat capability for cavity users.

## OTHER THREATENED, ENDANGERED, SENSITIVE, OR SURVEY AND MANAGE SPECIES

### Critical Habitat

Northern spotted owl Critical Habitat Unit (CHU) WA-41 encompasses 58% of the watershed and affects about 90% of the National Forest System lands. Though more than half of the watershed is CHU, the watershed in itself constitutes 12% of the entire CHU which is 168,857 acres in size. Fifty percent (85,006 ac.) of the entire CHU is suitable spotted owl habitat, and an additional 71,880 acres are expected to become suitable during the next 50-100 years. The Peterson LSR occupies 38% (12,757 acres) of the watershed and is nearly overlapped by the this CHU WA-41 (see Spotted Owl Habitat Map).

Table 28 displays a breakdown of spotted owl habitat within CHU-WA-41 in this watershed only. The bulk of currently suitable habitat is protected within non-harvest allocations, most within the Peterson LSR/MLSA.

Table 28. Spotted Owl Habitat Acreage within CHU WA-41 within Watershed.

| Allocation | Suitable | Dispersal | Other Non-Suitable | Total Acres |
|---|---|---|---|---|
| Matrix | 2,103 | 280 | 3,519 | 5,902 (30%) |
| Non-Matrix (Riparian, LSR, MLSA etc.) | 6,610 | 830 | 6,340 | 13,780 (70%) |
| Total Acres | 8,713 (44%) | 1,110 (6%) | 9,859 (50%) | 19,682 |

Because of their vastly different sizes in this watershed, the CHU includes much more suitable spotted owl habitat than does the LSR/MLSA. However, for this watershed it does appear that the federal land allocations per the Northwest Forest Plan would provide an increase in suitable spotted owl habitat over time, and in essence, adequately replace the function of CHUs. As stated previously under the discussion of spotted owl habitat in the Peterson LSR/MLSA, additional development of suitable habitat in the next 50 years is estimated at 2,433 acres. Per Table12 (see Vegetation section), under optimal conditions for timber management, we could expect to regenerate 1,930 acres, with a corresponding loss of suitable habitat, within the next 50 years. In reality, the forecast regeneration harvest rate is much less and is further countered by increases in suitable habitat within Riparian Reserves. Overall, there would be a net increase in suitable spotted owl habitat over time on federal lands in this watershed. Because CHUs and LSRs overlap watershed boundaries and exceed the watershed scale, a more thorough comparison of these management strategies requires a larger scale analysis, at least as large as the entire Gifford Pinchot National Forest.

### Great Gray Owl

A small amount (190 ac.) of potential habitat for great gray owl is present at the north-central edge of the watershed and in the Peterson Prairie area. No sightings of great gray owl are documented and no focused surveys for this species have been conducted in this watershed. The Peterson Prairie and Lost Meadow areas are considered the most likely to generate owl activity in this watershed.

**Grizzly Bear**
The watershed is not considered suitable grizzly bear habitat. The presence and distribution of roads is the primary factor against habitat suitability. No systematic surveys for grizzly bear have been conducted in this watershed and no documented sightings were located.

**Lynx**
A very small portion (5 ac.) of the west-north-western edge of the watershed is considered lynx habitat. A single 1989 sighting of a potential lynx was documented in the central portion of the watershed.

**Gray Wolf**
About one third of the watershed is considered potential gray wolf habitat. This area is in the western half of the watershed. No systematic surveys for wolf have been conducted in this watershed and no documented sightings were located.

## WILDLIFE HARASSMENT POTENTIAL

Harassment potential, that is the involuntary displacement by people of wildlife from a site, is directly related to the likelihood of contact between people and wildlife. Most human activity is along roads especially roads with motorized traffic. Therefore, as open road levels increase so does the likelihood of wildlife harassment. As the following figure shows, open road density for the watershed ranges from 0.8 to 3.4 mi./mi$^2$. Overall open road density in the watershed is 2.0 mi./mi$^2$. An open road density of 2.0 mi/mi$^2$ has been used as the general open road density objective on the Gifford Pinchot National Forest to moderate wildlife harassment potential..

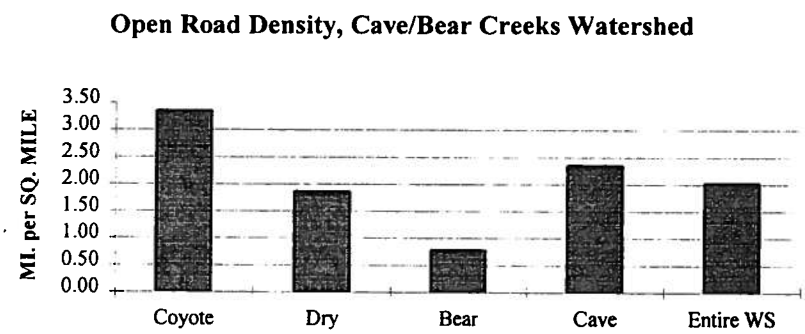



Figure 9. Open Road Density in the Watershed.

# SYNTHESIS

Timber harvest, vegetative succession, and wild fire are likely the most influential forces in this watershed. Timber harvest is likely the most active, by intensity and frequency, force to influence the future condition of this landscape. Vegetative succession will be the most prevalent and continuous force to manifest itself especially in the Peterson LSR/MLSA. Wild fire is considered the force most likely to cause an intense and significant change in the LSR/MLSA. Timber harvest and replanting prescriptions can facilitate attainment and maintenance of the desired future condition by aggregating project sites to create 200-300 acre contiguous, similar successional stage stands. Replanting can provide species and stocking diversity. The prevention of catastrophic loss of habitat within the Peterson LSR/MLSA is essential.

Fire management can be used to maintain and or reintroduce vegetative gaps across the landscape. Fire applications include the following:

- Control the rate of conifer encroachment into meadows and oak woodlands.
- Create, maintain and or consume the snag resource.
- Create and maintain diversity into tree stocking density.
- Prevent catastrophic fires in LSR/MLSA by controlling fuel and ladder buildup.
- Protect known spotted owl activity centers from stand replacement fire.

# HUMAN USES

## REFERENCE CONDITIONS

The area within the Cave and Bear Creek watershed has seen a long history of human use. Areas within the watershed were intensively used and even managed by Indian people. The general routes of travel used prehistorically are generally in the same location as the earliest historical routes. In the more distant past, the hunting of large mammals and the quarrying of stone for tools were important activities in the Forest, and in the more recent past huckleberries, beargrass, cedar bark, and other plant foods and medicines were sought on Mt. Adams' slopes.

### PREHISTORIC USE

During recent years a number of sites on the Gifford Pinchot National Forest have been the subject of archaeological investigations. Several of these sites, including the Vine, Squirrel, Lost, Fallen Arches Cave and Ice Cave sites, are located within the Cave and Bear Creek drainage. Information from these excavated sites helps to provide a context for understanding the pattern of prehistoric use within the watershed.

These sites suggest a broadly similar pattern of human use within this portion of the Gifford Pinchot National Forest, which in itself is similar to that seen throughout the central Cascades at this time period. This pattern is one of repeated seasonal occupation by small groups, beginning approximately 7000 years ago and continuing into the historic period. A disruption in occupation may have occurred in parts of the southern Washington Cascades, due to the effects of the ca. 3500 B.P. eruption of Mount St. Helens, which deposited a thick layer of tephra (Ye and Yn) over parts of the area. It has been suggested that this Smith Creek eruptive period (set Y) of Mount St. Helens was devastating enough to have led to abandonment of the area and a hiatus in human occupation throughout the southern Washington Cascades, between approximately 3500 and 2000 B.P. (Lewarch and Benson 1991, McClure 1992). Occupations dating to 2000 B.P. and later in the southern Washington Cascades are generally limited use locations, exhibiting a low diversity of tool types. It is only the earliest components from the Vine and Squirrel sites, dating to before 5000 B.P., that contain a wide variety of heavy task tools, while the remainder of the assemblages are characterized by debitage, cores, and a limited variety of chipped stone tools.

### HISTORIC NATIVE AMERICAN SUBSISTENCE AND LAND USE PATTERNS

The people who occupied this area during historic and late prehistoric times included the Sahaptin-speaking Klickitat, Yakama, Taitnapam, Kamiltpah, Wyam and Tenino Indians, as well as the Chinookan-speaking Wishram, Wasco and White Salmon Indians.

Their settlement pattern involved winter residence in semi-permanent villages located in sheltered locations along either a major river or tributary, and seasonal camping at root digging grounds, fishing stations, and hunting and berrying locales (Ray 1939). The seasonal salmon runs along the Columbia and its major tributaries formed the emphasis of their subsistence economy, but people took advantage of a wide variety of plant and animal resources throughout the year. After about A.D. 1730, this collecting strategy was succeeded in some parts of the Plateau by an increasing dependence on hunting with equestrian mobility (Schalk and Cleveland 1983).

It was usually during the late summer and fall that people moved into the mountains, following the ripening berries. Camps, consisting of extended families, were dispersed across the uplands. One type of shelter used was the conical mat house, later replaced by the more typical Plains tipi-like structure. At the culmination of the berry season people would congregate at social gathering sites to meet with other bands before the upcoming isolation of winter.

Periodic hunting and fishing took place throughout the summer. Deer, elk and bear are the species most frequently mentioned, but a wide variety of animals and birds were hunted, both for meat and fur. These include grouse, duck, quail, rabbit, squirrel, beaver, otter, raccoon and mountain goat. Wolf, fox and cougar were taken for their fur. Trout Lake Creek was an important fishery historically, and both trout and steelhead were reportedly present (Johnson Meninick, personal communication). Freshwater clams were also collected in Trout Lake Creek.

Aside from fruits, nuts and game animals, a variety of other plants were collected while in the mountains. These include tules, which were woven into mats; the bark of the western redcedar, which was used to make folded bark baskets; cedar root and beargrass, which were used in the manufacture of coiled baskets; kinnikinnick leaves for smoking; and a variety of plants collected for medicinal purposes. One of the meadows at Deadhorse Meadows is a cranberry bog, and cranberries were gathered there historically. Hazelnuts were collected in the Trout Lake valley. Root foods were also collected in the Trout Lake valley, particularly camas and wild carrot. Several elderly Yakama women have recalled in interviews that the marshy areas around the edge of Trout Lake were noted as a place to collect tules for mats, used to spread huckleberries on while drying. The wood of the oceanspray was also collected to make mat needles (Billy 1992, 1995).

## BERRY PICKING

Along with trout and animals such as deer, elk, bear and grouse, a wide variety of fruits and nuts were also available within the watershed. These included huckleberries, strawberries, raspberries, blackberries, gooseberries, currants, salmonberries, chokecherries, service berries, elderberries, salal berries, cranberries, kinnikinnick, black lichen, hazelnuts and white bark pine nuts. Huckleberries are notable in that they were available in quantities suitable for collection as a stored food, and they could be dried to a raisin-like state. Huckleberries were considered the most important. The Yakama and Klickitat gathered them in quantity on the slopes of Mt. Adams

Plummer (1900), in an early report for the United States Geological Survey, discussed the various causes of forest fires in what is now the Gifford Pinchot National Forest. In spite of its small size, the Cave and Bear Creek watershed had several areas classified as burns in the period between 1880 and 1900, including one near Deadhorse Meadow, one southwest of Mann Butte, one northeast of Guler Mountain, one northwest of Sugarbowl Butte, and one south of Coyote Creek. Plummer wrote that "Indians also start fires for the purpose of promoting the growth of huckleberries, blackberries and raspberries, and also to drive game." (1900:135). According to French (1957) the Indians in this area considered trees to be like weeds overrunning their huckleberry fields. The solution to this problem was to start fires under controlled conditions. French reports that a "common technique for increasing the probability that a fire would indeed occur was to leave the log burning that had served as the reflector during the course of the heat drying of huckleberries" (1957:3). This has been corroborated in recent interviews with elderly Yakama informants, who describe how certain men were chosen specifically for the task of staying behind at the end of the season to burn the fields. These men were chosen for their knowledge, because not only did they have to burn the fields, they also needed to possess the power to call on rain and thunder to put the fire out. The informants stressed that this was not done every year, but only when needed. Accepting that local Indians most likely used fire as a tool for enhancing huckleberry production, it is also likely that the locations of huckleberry fields would simply shift as naturally-occurring fires opened up new areas, and older burns reforested.

## SPECIAL SITES

Verne Ray, in his 1936 inventory of Klickitat villages and camps, lists a number of summer camps within the watershed boundary (1936:148-149). His information was derived from interviews with Lucy Quaempts and pertains to the period around 1850. Mrs. Quaempts described the following camps within the watershed boundary:

> *ca'xcaxunmi* (most likely "kingfisher", but possibly osprey or heron) - the largest summer village of the Klickitat, located at Trout Lake. This camp was used for trout fishing and berry picking.
>
> *lu'axam* ("burnt ground") - a summer camp at Deadhorse Meadow.
>
> *lma'ma* ("old woman") - a summer camp at Lemei Rock
>
> *tak ta'k* ("little meadows") - an important temporary camp at Peterson Prairie, near the head of "lava" creek. The summer population varied from 100 to 150.

It is likely that the three summer camps referred to above correspond generally to existing campgrounds. The site of *lu'axam* most likely corresponds to Smoky Creek Campground, *lma'ma* to the current site of Little Goose Campground, and *tak ta'k* to Peterson Prairie. A 1938 USDA Forest Service recreation report states that most of the campgrounds in the area developed as a direct outgrowth of the huckleberry fields (Langdon 1938). The report also states that none of these campgrounds were artificially started - development followed established use of an area (Langdon 1938). Several Indian informants have referred to the Smoky Creek Campground as having been the traditional camp of the Slockish family, who were Klickitat Indians from the White Salmon area.

## OTHER SITES

A. J. Splawn also provided Indian names for features within the watershed boundary, including *Tach-tach-quie-quie* as the name for the Ice Caves, *La-cas-scon-nee* as the name for other lava tubes in the area, and *Shock-shock-la-nee* as the name for the town of Trout Lake (Splawn 1944:482-83). The latter term is the same as that recorded by Verne Ray, meaning "place of the kingfisher".

Members of the McClellan expedition in 1853 recorded Indian names for most of their camps and for many natural features encountered along the trail. They (Minter, Duncan, Gibbs) referred to Cave Creek as the *Hool-hool-se* River, also spelled *Huhl-huhl-olse* (Cooper) and *Wolch-wolch-he-lis* (McClellan). They also give this name to their camp in the lower Trout Lake valley.

Members of the Yakama Indian Nation have also provided Sahaptin names for places on the forest. The name for Peterson Prairie is *Wish-wow-to-kow-wis*, a phrase which means "overnight camping place". The name given for Lemei Rock is *Lah-ma-mah-po-sh-wah*, meaning "old lady rock".

## PEELED CEDAR

Within the watershed boundary a total of 236 peeled cedar trees have been documented, in 22 clusters or sites. The peeled trees appear to cluster in two areas, including the area surrounding Mann Butte and the original route of the Service Trail from Trout Lake. Peeling dates have been determined through tree ring counts in four of these sites, and the 10 peeling dates ranged from A.D. 1776 to A.D. 1899, with a mean date of A.D. 1843. The peeling dates are all from sites in the vicinity of Mann Butte, and indicate use of that area from the late 1700's through the late 1800's.

The association of peeled cedar sites with former huckleberry fields and camps has been documented in other parts of the Forest, most notably in the Red Mountain area in the southern part of the Indian Heaven Wilderness, and on Little Huckleberry Mountain. It is likely that large clusters of peeled cedar trees without obvious associations are located near former huckleberry fields that have since reforested. It seems likely that the area in the vicinity of Mann Butte was used as a huckleberry field during the 1800's, given that 215 of the 236 recorded peeled trees in the watershed are located here.

## TRAILS

A number of historical travel routes exist within the watershed boundary. The Indian trail followed by Captain George McClellan in 1853 served as a major cross-Cascades route, connecting the Vancouver area to the Yakima Valley. The first historical reference to this trail occurs in the 1830 journal of John Work, an employee of the Hudson's Bay Company .

The 1882 General Land Office survey notes for Township 6 North, Range 10 East, along with the accompanying Plat map, documents the exact location of this trail from the National Forest boundary east into the Trout Lake valley (Clark 1882). The surveyors noted an "Indian Trail, 20 lks. wide", which crossed the Forest boundary at the location of Forest Road 2400017, just south of Forest Road 24. The trail noted by the surveyors was over 13 feet wide. It passed the Lava Bridges (known today as Natural Bridges) and a series of caves, generally paralleling Cave Creek into the lower Trout Lake valley. A branch of this trail split off in Section 28, heading directly north past the Butter and Cheese Caves to the lake itself. The main branch of the trail continued east, passing along the southern base of Little Mountain and continuing east to the Glenwood Valley. At the southwestern corner of Little Mountain it intersected a trail going south to the Columbia River.

The eastern portion of Township 5 North, Range 10 East was also surveyed in 1882, and Clark noted an "old trail" between sections 9 and 10, along the northeast slopes of Guler Mountain. This precedes both the establishment of the Forest Reserves as well as the earliest known grazing in the area. Since there was only one settler in the Trout Lake Valley at that time, it is likely this was also an Indian trail.

Another early trail which was used originally established by Indians is the Service Trail, which connected Trout Lake to the Mosquito Lakes area. This road paralleled Spring Creek into the Trout Lake valley, north of Sugarbowl Butte. This route provided wagon access from Trout Lake to Deadhorse Meadows as early as 1910. As stated above, a 1910 Special Fire Report states that ". . . a large part of the Indians enter the Forest by means of the road which ends at the Dead Horse Ranger Station" (Stabler 1910:10).

## SUMMARY

The ethnographic pattern indicated for the southern part of the Gifford Pinchot National Forest is one of warm season use. The collection and processing of various plant foods were the primary focus of activities, along with opportunistic use of game animals and fish. Within the watershed boundary, huckleberries were intensively utilized, both as an over-winter staple and as an item of trade. It is likely that Indians utilized fire as a tool to "manage" huckleberry fields, in order to enhance their productivity. The distribution and density of peeled cedar sites are one indicator of the location and intensity of use of former huckleberry fields, as well as indicating general routes of travel. Based on a variety of historical sources, it is likely that the intensity of human use of certain parts of the watershed was much greater in the past than it is today. This is particularly true for areas around what is now called Mann Butte.

## HISTORICAL LAND USE DURING THE PERIOD OF FOREST SERVICE ADMINISTRATION

### GRAZING

The earliest grazing of domestic livestock in the Mt. Adams area was the grazing of horses brought in by the Indians, which could potentially date to the mid-1700's. Horses aside, grazing activities within the watershed date back to the turn of the century. Sheep were the first livestock brought in to the area, with cattle following a decade or so later.

The 1911 Grazing Report for the Columbia National Forest (Stabler 1911) refers to grazing within the watershed boundary.

> Only one band is to be put in the Race Track country next season and this will make some range available at the Ice Caves for cattle belonging to Trout Lake ranchers. There is, however, plenty of feed at the Caves and Peterson Prairie in the spring for two bands, and the band which goes to Dead Horse from the Hole-in-the-ground by way of Trout Creek crossing could enter the forest by Guler and the Caves and go thence to Dead Horse by the trail if properly handled (1911:11)

For the period between 1911 and 1952, District files contain information on several early sheep allotments, including Little Huckleberry , Cultus Creek (later called Twin Buttes), and the Deadhorse Meadows Division of the Niggerhead allotment. Most of these were located within areas that had burned in one of the large fires around the turn-of -the-century, although later burns such as Smoky Creek were added to allotments at later dates. There were approximately 1200 sheep under permit on each of these ranges. With the exception of Twin Buttes, the sheep allotments were discontinued in the 1940's due to declining condition of the range.

Sheep camps within the watershed boundary include Smoky Burn Camp, Deadhorse Camp (Twin Buttes allotment), Dead Horse Camp (Deadhorse Division of the Niggerhead allotment), Coyote Camp and North Butte Camp (Little Huckleberry allotment).

Major stock driveways within the watershed included the Peterson Driveway and the Service Trail/Middle Trail Driveway. Other stock developments include a water system for sheep at Smoky Creek, constructed in 1940. It contained eight wooden troughs, sixteen feet long, as well as a fenced pasture.

According to Ernie Childs, the first cattle allotment on the Forest was the Trout Lake Cattle Allotment in 1912. Max Ladiges was one of the first permittees. This allotment extended from the Forest boundary south to the divide, then from Trail Peak to Beaver Creek, then to Peterson Prairie and north toward Lemei Rock and Smoky Creek. It abutted against the Cultus Creek and Little Huckleberry sheep allotments. Mr. Childs ran cattle on this allotment in the 1920's, and in the 1930's Carl Peterson and Ulrich Zuberbuhler joined him. This group was referred to as the Trout Lake Cattlemen's Association. Spencer Frey joined the group in the 1940's. Mr. Childs ran cattle alone on this allotment from the late 1940's until the mid 1950's, after which time Spencer Frey assumed it.

### HOMESTEADING

The Peter Stoller family were the first non-Indian settlers in the Trout Lake Valley. They homesteaded 160 acres on the north side of Trout Lake Creek below the lake in 1879. Charles Pearson was the second settler in the valley, homesteading the land southeast of Stoller's claim in 1882. William Stadelman homesteaded land to the southeast of the Pearson claim in 1883. Both of these men married daughters of Peter Stoller. The area that later came to be known as the Hollenbeck Mill site was originally homesteaded by the Aerni family in 1885. Noah Etter homesteaded to the south of the Pearson claim in 1885. Peter and Elizabeth (Aerni) Schmid homesteaded the "Lake Place" in 1887, located immediately south of the lake.

These early settlers used the abundant native grasses as summer pasture and harvested it for hay to feed their stock in winter. The area at the southwestern end of the valley, reportedly extending as far west as the Ice Caves and Peterson Prairie, contained excellent grass, and many of the early pioneers grazed their cattle here in the summer. The portion of Township 6 North, Range 10 East along Cave Creek was described in the 1882 GLO notes as being free of undergrowth and covered with an excellent growth of grass.

William Stadelman, who had settled in the valley north of Little Mountain in 1883, experimented with irrigation in 1887 from "the small creek which ran through his place". This creek was Cave Creek. He found he could raise much better crops with the use of water. In 1889 the Trout Lake Irrigation Company was formed by William and Frank Coate and Rufus Byrkett. The first large ditch in the valley originated in the White Salmon River, and was followed by a number of others. Between 1890 and 1900, five ditches were built from the White Salmon River, and two from Trout Lake Creek. Large crops of red clover were grown with the aid of irrigation. Settlement in the valley increased, and more land was cleared and more cattle brought in. Rye, red clover and Lincoln grass were the main crops raised for hay, but wheat and oats were also grown.

Although irrigation in the Trout Lake Valley began in the 1880's, a number of ditches were added later. According to Ben Marshall, Joseph Aerni was responsible for diverting Bear Creek east through what's now the County Park from its original channel which drained into the lake.

The Lost Creek Ditch was constructed in 1908, by the Lost Creek Water Association. Although the diversion was located on Lost Creek , seven miles southwest of the Trout Lake valley, the ditch ultimately extended to the upper Trout Lake valley. Water was carried by ditch from Lost Creek to the channel of Coyote Creek, and from Coyote Creek it was extended by ditch to Trout Lake. It is shown as completed on the 1913 Plat map for T. 6 N., R. 10 E, where it passes through five homesteads outside of the Forest boundary. There is some indication that initially the water in Coyote Creek was diverted into Cave Creek, and then diverted from Cave Creek to farms in the valley. However by 1913 water was being diverted from Coyote Creek by ditch into the upper part of the valley.

## EARLY LOGGING

The earliest logging within the watershed, outside of clearing land for homesteads, occurred on the "flats" in the lower Trout Lake Valley. Near the turn of the century, large pine was being cut and skidded by horse and oxen teams to the White Salmon River, where they were then floated or driven down the river. There were two splash dam on the river within the Trout Lake valley.

Broughten Lumber Company's operation extended slightly into the far southwestern portion of the watershed in the 1940's. In the late 1940's Long Bell Lumber Company out of Longview, Washington, built Forest Roads 86 and 8620 as far as the Mann Butte Rock Pit. They constructed Forest Road 86 south of the 8620 junction, in order to access the R. B. Norris clear cut fir sale, which was a war time sale awarded in June of 1945. This sale was located in Section 17 of T. 5 N., R. 10 E.

## TRAPPING

The trapping of animals for their furs has been an ongoing activity on the Forest since at least the turn-of-the-century, and may possibly extend back to the Hudson's Bay era. Weasel, raccoon, marten, fisher, coyote and fox were species known to have been trapped. Among the early settlers, Peter Stoller, Peter Schmid, and Ulrich Zuberbuhler were all known to have trapped in the winter.

## MINING

There are a number of recorded mining claims in the vicinity of Cave Creek and Mann Butte, most of which date to the 1950's and 1960's. A mining camp containing artifacts pre-dating 1932 was located on the southwest side of Mann Butte, however, indicating that mining has occurred there over a longer time period.

# CURRENT CONDITIONS

## NATIVE AMERICAN USE

Yakama Indians continue to collect traditional resources from the watershed, including foods such as huckleberries, trout, deer, elk and bear, along with cedar bark, beargrass, cedar roots, and medicinal plants. Forest Road 24 provides access to Sawtooth Huckleberry Fields and nearby Indian camps. Both partial cut stands and past clearcuts along this route provide huckleberries. Huckleberries are also found within the clearcut forests on the slopes of Guler Mountain, though regenerating conifers are quickly shading big huckleberry bushes in may many of these stands.

## GRAZING

Grazing occurs on private lands (dairy and cattle) and on Forest Service lands. The bulk of the 31,543 acre Ice Caves Cattle Allotment occurs within federal lands of the Cave-Bear Creek Watershed. The allotment has approximately 200 head which graze from June to September. The allotment is served by temporary corrals near Cave Creek meadow area and the fenced enclosure of Peterson Prairie. The Lost Creek ditch extends available water into the watershed for this allotment. Primary forage production used by allotment cattle is provided by Lost Meadows, Peterson Prairie, Cave Creek meadow area, and South Prairie (Little White Salmon Watershed). Roadsides and the early successional forests that follow timber harvest provide transitional forage.

## DEVELOPMENT

The watershed includes a large portion of the town of Trout Lake. Agriculture and cottage industries are the primary activities along with rural housing development.

## TIMBER HARVEST

Management of forest lands for timber resources occurs on private, state, and Forest Service lands in the watershed.

## MINING

There are several mineral claims in the vicinity of Mann Butte; however, none are known to be active and no operating plans have been submitted to the Forest Service. Mann Butte Rock Pit provides common rock that has been used widely in the watershed for roads both on and off the federal lands.

## SPECIAL FOREST PRODUCTS

Special or miscellaneous forest products consist of plants, parts of plants, fruits of plants, and in some cases rocks and minerals from forest lands. The products are used for a variety of purposes that include food, fuel, building material, landscape materials, and medicinal uses. Humans from early Native Americans times to the present day have gathered, picked, or collected these products from the forest. Some special forest products are taken for personal use where others are taken for commercial use to be resold or use as raw materials for other products. Through a permit system and monitoring the Forest Service regulates use. The following is a discussion of the more common special forest products collected within the Cave-Bear watershed.

- **Berries.** Several species of berries including huckleberries, blackberries, wild strawberries, and elderberries to name a few are harvested by the public-at-large during late summer. Picking for personal use is not regulated other than honoring Native American treaty right areas. Commercial picking requires a permit.

- **Mushrooms.** Mushrooms and other forms of fungus and lichens are harvested in the spring or the fall depending on the type. Personal use picking requires a free use permit and commercial picking requires a charge permit. Competition can be high for certain species of mushrooms in certain areas. Collection may occur anywhere except within wilderness and research natural areas.

- **Beargrass.** The tops of beargrass are collected for floral arrangements. Most all of the collection is for commercial use and require a charge permit. Collection may occur anywhere except within wilderness and research natural areas.

- **Transplants.** Several species of trees and shrubs are dug and removed for both personal use and commercial use. Small conifer trees are sold from overstocked plantations and along roads where thinning is desirable Shrub species, most notably vine maple in this watershed, is dug by commercial permit for use in the landscape industry. An individual can obtain a free use permit to dig five transplants for home use. A commercial digger requires a charge permit. All permitted use is restricted to designated areas to order to avoid resource damage and unintentional digging in protected habitats.

- **Poles.** A variety of pole products are sold to the public for use as house logs and fence poles. The preferred species for pole material is lodgepole pine. Permits are sold for personal use and cutting is restricted to designated areas where tree thinning is desirable.

- **Posts and Shakes.** Down western red cedar is salvaged for fence posts and sometimes shakes. The demand for this product is going down since quality cedar is difficult to find and people are using other materials for posts and roofing. Cedar salvage is only available by permit and now restricted to landings around harvest operations.

- **Firewood.** Firewood cutting was at one time very widespread in the watershed but is now regulated to designated areas along roads and logging landings. Firewood cutting may cause temporary roads to be kept open for a period of time after logging to facilitate removal.

- **Common** Rock. Permits are sold to individuals to remove rock from quarries for personal use. Mann Butte is the area in the watershed that receives the most use.

## RECREATION

This watershed provides the setting and resources that people rely on in order to pursue the various activities they value. In some cases, facilities, such as campgrounds, are the focal point of these activities. In other cases, such as special forest products gathering, the natural resource and/or the activity takes the forefront, and few, if any, facilities are used. Visitors may engage in several activities during one outing, such as hiking and fishing during the day, while camping at night, or they may simply engage in one activity on a day-trip. Based on the increase in use in recent years and the projected growth associated with a rapidly expanding nearby urban area, we assume that the demand for and amount of use will continue to grow for the foreseeable future.

The following activities and attendant facilities have been identified as important aspects of the human uses of the area.

## CAMPING

### Developed Campgrounds

There are three developed campgrounds: Peterson Prairie (Forest Service), Elk Meadows (privately owned) and Mt. Adams Guler (Klickitat County facility). All three campgrounds have a variety of users, ranging from tent campers to those who arrive in motorhomes valued at several thousand dollars. The camping season generally runs from Memorial Day to the end of hunting season in mid-November, depending on weather conditions and accessibility. Use varies throughout the summer season with the majority occurring during the holiday weekends such as Memorial Day, the Fourth of July and Labor Day, and in late summer / early fall when huckleberry-picking is a major activity.

### Dispersed Camping

Historically, the Forests have provided a range of recreation settings and developments to suit the range of tastes of its customers. This is the basis of the Recreation Opportunity Spectrum (ROS), which provides guidelines regarding social, physical and managerial settings, so that users may meet their varying expectations. In essence, at one end of the spectrum("Primitive"), a visitor could expect a pristine setting, no motorized use, little or no facility development, few other visitors and little or no evidence of management intervention. At the other end of the spectrum ("Urban"), a visitor may expect a full line of facilities, including flush toilets, paved parking lots, fitness equipment and expresso stands, opportunities to meet and mingle with others, and strict rules regarding use of the area.

Recreation settings within this watershed range generally fall within the "Roaded Natural" opportunity class, which are relatively natural appearing settings that are accessible by road and have facilities designed to accommodate and enhance visitor use while protecting the resources which draw visitors there in the first place.

Some Forest visitors prefer more primitive settings than our developed recreation facilities provide, and create their own dispersed campsites. By definition, dispersed campsites are created by users. Various degrees and types of alteration make these areas identifiable as campsites. Recent surveys of the watershed have been able to identify 58 dispersed campsites.

## DAY USE

### Facilities

The two developed day-use facilities within the Watershed are recognized for their geological, cultural and recreational values. They are:

- Ice Caves
- Natural Bridges

In addition, McClellan's Trail is considered a significant historical feature of the area and is highlighted by a series of interpretive signs.

### Activities

Day use activities are primarily driving for pleasure with short hiking excursions. Though there are no maintained trails in the watershed, there are numerous use-made trails extending from Ice Caves, Natural Bridges, the campgrounds and parallel streams. Many day use activities center around the collection of huckleberries or other miscellaneous forest products for personal use.

Fishing and Hunting are popular, yet unquantified, activities within the watershed. These activities, like many other recreational activities, appear to be on the rise. Issues and concerns related to these activities are those identified under "Dispersed Camping," and may involve either day or overnight use.

Driving for Pleasure is an often noted reason for visiting the Forest. Forest Road 24 extends from the terminus of State Route 141 providing access to Peterson Prairie and Sawtooth Berry Fields. Per the LRMP, lands within a quarter mile on either side of Forest Road 24 are managed for Visual Emphasis. This area also lies within the Peterson LSR/MLSA.

## CAVES

There are numerous lava sinks and caves within the Watershed. There are approximately 70 caves on federal lands and another 16 caves on state and private lands. Many of the caves have significant geologic, cultural, and or biologic values. The Forest Service has developed the Ice Caves and Natural Bridges into day-use areas, promoting their recreation use. Other cave locations remain confidential, though many sites are named on USGS maps and are visited by members of speleological organizations or the public at large.

## TRAILS

There are no maintained recreational trails within the watershed, except for the snowmobile and ski trails which are posted along roads. Segments of historical trails can be found, but most have become roads.

## WINTER RECREATION

Winter recreation activities occur throughout the watershed, generally from mid-December to April. Program administration and facilities maintenance is accomplished through a cooperative agreement with the Washington State Parks and Recreation Commission.

### Facilities

Atkisson Sno-Park is located on Forest Road 24 at the terminus of State Route 141. Shelter, restrooms and paved parking lot provides access to 80-miles of groomed snowmobile trail system and approximately 21 miles of designated, ungroomed ski trails.

Peterson Prairie Guard Station is located at junction of Forest Roads 24 and 60. It has become a very successful winter recreation rental under Granger-Thye authority since 1993. Provides access to same trail system as Atkisson.

### Activities

Snowmobiling and skiing are the primary winter recreation activities; although, some snowshoeing and sledding also occur. An undetermined amount of winter activities occur outside of developed trails. The Sawtooth Berry Fields and Steamboat Mountain areas are popular destinations for snowmobilers. Impacts of these activities may include wildlife disturbance and trespass into Indian Heaven Wilderness, although neither of these are currently viewed as management problems.

A Special Use Authorization is utilized by one outfitter/guide who provides transportation over approved Forest roads via a “Snow-Cat”.

## SPECIAL USES

Special Use Authorizations within the Watershed include:
- Outfitting/Guiding (Snow-Cat)
- Peterson Prairie Guard Station rental

Other occasional special uses occurring within the watershed include small rock collection, apiary placement, recreation special events, and commercial photography. The rock pit and storage area at Forest Roads 88 and 8821 are used for Forest road-building and maintenance.

# SYNTHESIS

## NATIVE AMERICANS

The United States has a trust responsibility to the tribal governments, brought about by treaties and law. The welfare, the land and the resources of the tribe are entrusted to the United States Government. On lands ceded to the United States that later became National Forests, the rights and privileges of Indian tribes vary. The Forest Service's goal in relation to trust responsibilities and treaty rights has been to understand when an assigned trust duty or treaty right exists, and to determine responsibilities, in light of the interests of potentially affected Indian tribes.

The obligation that the government has toward tribal governments is particularly important where it involves lands that are subject to treaty rights. All of the Cave and Bear Creek watershed is within the ceded lands of the Yakama Indian Nation, per the Treaty of 1855.

Indian people in this area consider huckleberries to be one of the five sacred foods, honored annually by a "first foods" feast held when the berries ripen in the mountains. Along with salmon, roots and venison, huckleberries were and are an important part of the traditional diet. The Gifford Pinchot National Forest completed a comprehensive study of traditional American Indian uses of the forest in 1995 (Hajda et al. 1995). Information in this overview was compiled from a review of existing literature and interviews with over thirty Indian consultants, representing most of the tribal groups who used the forest in the past. During the course of these interviews, Indian people expressed concern that resources on the forest, and their access to them, are being lost (Hajda et al. 1995:64). They are concerned that non-Indians collect large quantities of traditionally used foods and materials for commercial use. There was a general concern that road building and logging have led to loss of habitat for animals, birds and fish. People had a strong concern for water quality.

> Traditional use of mountainous areas like the GPNF was and is shaped by the belief that these areas were sacred, places of spiritual power and the home of special beings. There are many spirits and beings who live or are found only in upland areas of the Forest and are the source of numerous tales and legends. Mountains are the source of water and provide clean air. Plants and animals, and especially medicinal plants, in upland settings have spiritual or healing qualities lacking or poor in the lowland plants and animals. For these reasons, mountains are unique places for spiritual renewal; traditionally individuals traveled to the mountains to obtain guardian spirits. (Hajda et al. 1995:ii)

It is likely that Yakama Indians will continue to collect traditional resources from the watershed, including foods such as huckleberries, trout, deer, elk and bear, along with cedar bark, beargrass, cedar roots, and medicinal plants. Many of these resources assume symbolic as well as practical importance in times of change.

Indian people consider that the Forest Service has a trust responsibility to ensure a continuing supply of traditionally used resources over time. The commercial harvest of huckleberries, beargrass, and medicinal time. Timber harvest and road building could potentially impact the availability of cedar for traditional use.

## SPECIAL FOREST PRODUCTS

Special forest products gathering, especially commercially, appears to be on the increase. This increase has been particularly noted in the last five years, with the most highly demanded products being mushrooms, beargrass and huckleberries. Gathering special forest products is a long-standing traditional use in the watershed. Although this activity has occurred over decades and even centuries in some cases, commercial collecting has increased dramatically in the last five years. Demand for wild mushrooms, berries and beargrass in the Portland/Vancouver and Seattle/Tacoma metropolitan areas is great, and such activities yield high pay-offs.

Many Forest visitors have traditionally collected these products for personal use and enjoyment, often engaging in other recreation activities such as hiking and camping while on the Forest. However, with the marked increase in commercial collecting, several concerns have escalated, including: destruction/depletion of the resources (e.g. improper mushroom harvesting techniques damaging reproductive potential of an area), conflicts with recreationists and between collectors, conflicts with Native American traditional uses, displacement of recreational visitors from camping areas, increased litter and human waste at developed and dispersed recreation sites, increased litter being deposited on private lands adjacent the Forest, and illegal collection, such as in designated Wilderness, with inadequate enforcement of permit conditions by those issuing the permits.

Resource concerns arise more frequently with the commercial collection of products which do not have designated collection areas, such as mushrooms, huckleberries, and beargrass. Wilderness, research natural areas, and traditional Native American treaty areas (i.e. Sawtooth Huckleberry Field handshake agreement area) are the only areas off-limits to collection. In general, the harvest of fruits (mushrooms and berries), and tops of beargrass do not affect the individual plants survival, and there are enough unharvest fruits to provide for future populations. The LSR Assessment for the Gifford Pinchot National Forest (draft) assessed the concern for wildlife (i.e. flying squirrels) that are dependent on certain mushrooms (boletes and matsutake) for their diet. Citing a study on the Crescent Ranger District, even during years of intense harvest, much of mushroom fruiting bodies remain on site for spore production and wildlife foraging. Overall forest management within this watershed is likely to create a range of successsional conditions required by the various plants and fungi. The one exception may be huckleberries, as the current huckleberry fields owe their existence to large stand replacing fires which today are undesired and suppressed. The issuance of mushrooms, huckleberries, and beargrass permits as well as product removal should be monitored on Forest-wide basis, and communication with the Yakama Indian Nation be maintained over availability and management of traditional plants.

Other miscellaneous forest products (vegetative transplants, posts, poles, shakes, firewood, common rock) occur only from designated areas. The products are collected infrequently in comparison to the previous group of products. The restriction to designated areas allow us to direct these activities to sites where the impact is neutral or beneficial to the desired management objective of those areas.

## DISPERSED CAMPING

The density of small spur roads and flat topography of the watershed facilitates numerous opportunities for dispersed camping. We have been able to identify 58 sites of repeated use. The demand for dispersed recreation is expected to increase following the general trend in increased population and increase. This watershed has the additional attractions of special forest products (mushrooms, huckleberries) and caves. This watershed also provides late-successional and old-growth forest, with much of it protected and to be enhanced within the Peterson LSR/MLSA management allocation.

Concerns with dispersed camping relate to garbage and adverse riparian impacts to aquatic resource and wildlife (especially amphibians). The most desirable campsites are generally associated with water with campsites placed as close as possible. Vegetation trampling and denuding with subsequent erosion and sedimentation are possible impacts. Analysis of the inventoried dispersed camps shows that only 17% are located within riparian areas and only 10% are located in riparian areas with soils subject to moderate or greater susceptibility to soil or site damage. Most dispersed camp sites (83%) are located in upland areas, sites that are suited to recreation development with low or moderate susceptibility to soil and site damage. The predominately gently slopes of the watershed combined with the relative paucity of streams and riparian areas, make the area resilient to dispersed camping. Given the recent trend to decommission roads to reduce stream sedimentation and wildlife harassment, acceptable dispersed camping can be optimized by maintaining the accessibility of the first 100 feet of roads to be decommissioned, and rehabilitating those few sites in riparian areas and on sensitive soils.

## CAVES

Until recently, there was very little guidance/policy available for implementing the National Caves Resources Protection Act. Cave management has consisted primarily of not providing information to recreationists regarding caves except for Ice Caves and Natural Bridges. Despite this stance, many caves in the watershed are visited frequently by individuals and members of various caving organizations. With the help of the Northwest Cave Resource Institute, inventories of caves and their values are occurring. As a result of this information, we have recently closed the Chubby Bunny Cave and Christmas Tree Cave to public use by gating their entrances in order to preserve the pristine condition of geologic features. Like any other prohibition of an existing use, some cavers are not in favor of these actions. As with most other recreation activities, it is assumed that demand will continue to increase as populations of nearby urban areas do. Consequently, similar actions to reduce cave visitation may be necessary to meet environmental laws such as the National Cave Resources Act, Endangered Species Act, and Antiquities Act.

# CHAPTER V - RECOMMENDATIONS

# RESTORATION TREATMENTS

## EROSION PROCESSES and HYDROLOGY

### Subsoiling

*Objectives:* Reduce soil compaction to improve water infiltration, reduce erosion, and accelerate vegetative growth on land compacted by logging equipment.

*Location:* Landings and unobliterated temporary roads in past harvest units located along system roads to be obliterated, decommissioned, or stormproofed.

*Description*: On landings and unobliterated temporary roads which were not previously ripped, use a winged ripper, excavator, or tractor with rakers, to loosen compacted soils. Skid trails within units, may also have adverse compaction, however, they are likely to be partially revegetated with shrubs and trees and thus should be left as is. Waterbar where slope exceeds 5% and seed with grass or forbs, native species preferred. Conduct in conjunction with system road obliteration, decommissioning, or stormproofing projects.

## VEGETATION

### Commercial Thinning and Structural Enhancement in Riparian Reserves and Peterson LSR/MLSA

*Objective*: The objective of thinning and structural enhancement in these reserves is to accelerate the development of stands toward late-successional characteristics, such as large individual trees, snags, downed logs, and canopy layering. Objectives expand in Riparian Reserves to include stream shade, bank stability, and coarse woody debris recruitment. Candidate stands are typically 40-80 years of age (younger stands preferred), within a landscape lacking late-successional diversity, and where the individual stand's development trajectory suggests stagnation or slow structural development. While excess trees could be removed as a commercial product, timber is not the principle objective, though it could provide revenue to implement the project or leverage treatments over a larger area. All actions would need to be consistent with the Forest's Late-Successional Reserve Assessment (LSRA) which is currently being reviewed.

80 in LSR/MLSA

*Location*: Overly dense stands comprised of small trees that are under ~~100~~ years of age within Riparian Reserves or the Peterson LSR/MLSA.

*Description*: Commercial thinning reduces inter-tree competition through individual tree removal or the creation of small gaps (1/10 acre). A portion of the excess tree would be left standing and converted to snags. Other excess trees would be left on site to accentuate downed log levels (refer to LSR Assessment for guidelines on snags and downed logs). Created gaps could be planted with shade tolerant species (western redcedar, western hemlock, a pacific silver fir). Within the grand fir ecological series, crown thinning around remnant ponderosa pine and western larch may help to maintain these trees. Gaps here could be planted to pine or larch. Trees excess to habitat needs would be removed as a commercial product. Structural enhancement projects are similar, but there is no commercial extraction of excess trees. Within the LSR/MLSA there are 3,766 acres of stands in the pole and small tree size classes. A query of the data base shows that there are 334 acres in the Dry Creek subwatershed and 191 acres in the Bear Creek subwatershed that currently meet age and size requirements for treatment. Within the Riparian Reserve there are 1,773 acres of stands in the pole and small tree size category. Further exams are needed to determine which of these stands are suitable and feasible for treatment.

## Young Forest Stand Improvement Projects in Riparian Reserves and Peterson LSR/MLSA

*Objective*: Young stand thinning seeks to reduce tree stocking of very dense sapling stands so as to maintain or accelerate stand growth and avoid stagnation. Lower branch pruning of western white pine may also occur to reduce infection and mortality from white pine blister rust. Other aspects of species diversity can be also be manipulated at this time.

*Location*: All subwatersheds that contain overstocked sapling stands. Areas are examined periodically and a needs list is maintained. Candidate stands are typically clearcuts that have been reforested. Sapling stands contain trees with an average diameter less than 5 inches dbh.

*Description*: In young stand thinning, trees are felled to achieve a desired spacing and stocking level. Leave trees are typically the largest individuals and include the least common conifer species. Leave trees spacing may be altered to achieve big game hiding cover or accentuate natural openings and perpetuate gaps. Excess trees are not of a commercial size and are usually left of site, though occasionally noble fir trees are removed as transplants and white pine boughs are removed for ornamental greenery. Lower branch pruning of western white pine removes all of the lower branches within four feet of the ground. Stand treatment prescriptions would be based on site specific analysis and resource needs.

## Prescribed Underburning

*Objective:* Re-introduce fire as means of maintaining open, mature stands comprised of early seral conifer species (ponderosa pine, western larch, Douglas-fir). This would replicate historical conditions on a small percentage of the watershed that is within the grand fir ecological series. It would diversify the late-successional and old-growth community by adding an east side old-growth condition where it once was well represented, but has since become denser and with much greater numbers of shade tolerant conifers. This would marginally reduce fire hazards and improve forest health. This treatment could also occur on the more fire-prone ridges to achieve greater reduction in fire hazard.

*Location:* Near Road 24 and the historical McClellan Trail within the Peterson LSR/MLSA and grand fir ecological series. Candidate stands would may been previously commercially thinned, while also having some remnant ponderosa pine and western larch. Candidates stands may also occur on ridgetops in the Peterson Ridge and Flattop Mountain area.

*Description:* Stands would receive a light underburn in the spring or late fall. Previously thinned stand are good candidates in that stocking and ladder fuels are reduced, and existing skid roads may serve as control lines. Still some preparation prior to burning is likely to be needed to tie firelines together and arrange existing fuels. In some stands, the commercial removal of some trees may facilitate stand preparation. Additional underburning would be needed in the future to maintain the desired condition. Opportunities are limited to implement this treatment and not affect current habitat suitability for late-successional species are limited. Still, it appears valuable to attempt this treatment given our imperfect knowledge of the ecological consequences of the current landscape. Project design would need to be consistent with the LSR Assessment or be individually approved by the Regional Ecosystem Office.

### Meadow Maintenance

*Objective*: Reduce or eliminate the loss of dry meadow habitat to conifer succession and stabilize existing populations of pale blue-eyed grass and quaking aspen. Over the years, conifers have invaded into the meadows and resulted in a reduction in meadow size. The invading conifers also compete with some of the native meadow plant species.

*Location*: Dry meadow habitat is found at Peterson Prairie, Lost Meadows, and Cave Creek. Wet meadow habitat is found at Lost Meadows, Cave Creek, and southwest of Deadhorse Meadows. Small meadows are also found dispersed across the watershed.

*Description*: Initiate projects that reduce the invasion of conifers into the dry meadows and help restore early-successional native vegetation.

- Cut invading seedling, saplings, and poles. Material cut could be piled for burning or sold as a special forest product like in the case of lodge pole pine poles.
- Underburn portions of the meadows on a regular basis to maintain pale blue-eyed grass habitat.
- Release aspens to stimulate regeneration. This would involve making clearings up to one-half-acre in size around individual aspen trees or groups of trees. Competing conifers would be cut. A few aspen would be cut to stimulate root sprouting. To assure success of regeneration, fence enclosures would be installed to protect sprouting aspen from browsing and grazing damage from deer, elk, or cattle.

## STREAM CHANNELS

No Projects

## WATER QUALITY

No Projects

## SPECIES AND HABITAT

### Water Diversion Documentation and Fish Screening

*Objective:* Maintain/Improve Fish Habitat

*Location:* Cave and Beaver Creeks at Forest Service boundary.

*Description:* Several diversions are present on these streams. Determination needs to be done to see if any are on FS land, and if so are they legal documented diversions. All legal diversions on FS land should be screened to prevent fish migration.

### Beaver Pond Maintenance

*Objective:* Maintain existing beaver ponds for fish habitat and year round open water.

*Location:* Cave Creek Wildlife Special allocation and Lost Meadows.

*Description:* Armor failing portions of the 8631020 road fill which forms part of the beaver dam. At the Lost Meadows site, maintain the water supply into the existing beaver pond.

### Wildlife Observation Platform

*Objective:* The platform would provide landscape and site interpretation, while being handicap user friendly.

*Location:* Beaver pond at the Cave Creek Wildlife Special allocation

*Description:* Provide a short (<0.5 mile) trail to an elevated observation and day picnic platform.

### Upland Forest Gaps

*Objective:* This measure contributes to landscape diversity and provides a unique, limited habitat.

*Location:* Watershed wide.

*Description:* Develop and maintain up to 0.5 acre upland forest gaps in which conifer density is low enough so as to allow the site to function as an upland meadow (grasses, forbs and shrubs).

### Nesting and Roosting Structures.

*Objectives:* Speed recovery of wildlife species whose population levels have declined due to loss of cavity and or coarse woody debris habitat.

*Location:* Watershed wide in the vicinity of wetlands, meadows, and recreation sites.

*Description:* Snags have been selectively removed from the landscape and species like osprey *(Pandion haliaetus*), bats, and large cavity users could benefit. Nest structure to include tree-top platforms, tree-trunk excavations, boxes, and or artificial "trees" for holding nest structures.

## HUMAN USES

### Dispersed Camp Site Revegetation

*Objective*: Decrease sedimentation to stream courses and contamination from human waste. Maintain options for dispersed camping in more upland sites if possible.

*Location:* Dispersed campsites #95, 116, 283, and 290 (refers to GIS #s) which are located within Riparian Reserves and on soils subject to site disturbance.

*Description:* Move camping areas 100 feet or more away from streams if possible. Discourage motorize access to old sites via barriers and signs. Revegetate denuded areas.

## Road Management

Roads serve a variety of human uses and also create a variety of resource impacts. The following general recommendations have been made and are followed by specific recommendations for problem areas. Also refer to Appendix D for a list of all roads in the watershed and their conditions per the Mt. Adams Ranger District Access and Travel Management Plan.

### GENERAL RECOMMENDATIONS

### Level 2 Road Condition Surveys

*Objectives:* Level 2 road condition surveys provide highly reliable data on the current condition of roads. Such information permits identification of problems sites and conditions leading to future problems.

Location: All federal roads in the watershed.

Description: Level 2 road condition surveys require field review of every road mile. The condition of the road surface, culverts, cut and fill slopes, and entrance management are recorded.

### Road Obliteration or Decommissioning

*Objectives:* 1) Restore hillslope hydrologic functions by reducing interception of subsurface flow, increasing surface infiltration; and reducing volume of water routed through roadside ditches. 2) Reduce sediment production from road surfaces, cuts and fills, road crossings, and culvert or fill failures. 3) Reduce wildlife harassment on open roads.

*Location:* Highest priority areas are the Bear, Coyote and Cave Creek subwatersheds which have high road densities. Priority within subwatersheds would be roads that have resource damage (fill failure, culvert failure, gullying) in proximity to streamcourses, mid-slope roads, and other roads that are not needed in future.

*Description:* Road obliteration requires removal of culverts and rock, shaping of the cut and fill slope back to natural contours, and re-vegetating bare soils. This prescription is applied to where roads are not desired in the short or long term future. Road decommissioning requires removal of culverts, surface ripping, waterbarring, barrier construction at the entrance. Road decommissioning is applied to roads that are not needed in the short term, but may be needed in the long term. Subsoiling/ripping of compacted soils in adjacent harvest units may occur in conjunction with these projects (see Subsoiling).

### Road Closures

*Objective:* Decrease open road density to reduce potential harassment to wildlife. Strive towards an open road density of 2.0 miles per square mile.

*Location:* Peterson LSR/MLSA within Coyote Creek subwatershed (current open road density of 3.4 $mi/mi^2$) and Cave Creek subwatershed (current open road density of 2.4 $mi/mi^2$). Priority would be for roads in vicinity of wetlands, near known spotted owl nest sites, or within the Peterson LSR/MLSA.

*Description:* Road closure requires construction of barrier near the road entrance (rock, earth, gate) to discourage motorized access. Legal closure (via CFR code) which makes vehicular trespass illegal, may or may not be applied. Stormproofing of the road behind the closure would occur as needed..

## SPECIFIC RECOMMENDATIONS

### Road 2400020

*Objective:* Reduce sedimentation, wildlife harassment, and road maintenance costs.

*Location:* Road 2400020 beyond junction with Road 2400025.

*Description:* Decommission Road 2400020 from its junction with Road 2400025. Road crosses Dry Creek. Dry Creek and another tributaries have eroded and gullied road surface.

### Road 2400027

*Objective:* Reduce sedimentation, wildlife harassment, and road maintenance costs

*Location:* Road 2400027 from junction with Road 2400020.

*Description:* Decommission. This road is a spur off Road 2400020.

### Road 2400031

*Objective:* Improve passenger car travel to Ice Caves Recreation Site

*Location:* Road 2400031 from entrance to Ice Caves.

*Description:* Resurface and grade.

### Road 2400050

*Objective:* Improve passenger car travel to Natural Bridges Recreation Site.

*Location:* Road 2400050 from entrance to Natural Bridges.

*Description:* Remove brush and prune tree limbs along road sides. Road passes through older conifer plantation.

### Road 2400707

*Objective:* Reduce sedimentation, wildlife harassment, and road maintenance costs

*Location:* Road 2400707 from junction with Road 2400020.

*Description:* Decommission. This road is a spur off Road 2400020.

### Road 2420000

*Objective:* Reduce sedimentation. Reduce road maintenance costs

*Location:* Road 2420 at Lost Meadow

*Description:* Specific action as yet undetermined. Steams draining Lost Meadow have diverted into the road ditch and meander across the road bed. Situation is complicated by beaver dam construction. Road access is desired for both the long and short term for cattle allotment management, fire suppression access to Peterson Ridge and Flattop area, and plantation management.

**Road 6035000**

*Objective:* Reduce sedimentation and reduce maintenance costs.

*Location:* Road 6035000 between Road 6035051 and Road 6020000

*Description:* Assess culverts at stream crossing for`adequacy to handle 100 year flood. Replace if necessary or install hardened drain dips.

**Road 8600000**

*Objective:* Reduce rockfall hazard to improve safety.

*Location:* Road 86, one mile north of junction with Road 1840 (top of Guler).

*Description:* Maintenance, screening, or slope stability measure of some kind.

**Road 8620000**

*Objective:* Improve fish passage and reduce sedimentation. Reduce road maintenance costs.

*Location:* Road 8620000 crossing of Cave Creek

*Description:* Specific action as yet undetermined. Cave Creek chronically spills across road in this low lying area.

**Road 8620000**

*Objective:* Reduce sedimentation, improve fish passage, reduce maintenance costs.

*Location:* Road 8620 east of junction with Road 8620020.

*Description:* Specific action as yet undetermined. Assess culverts for adequate size. This perennial tributary to Beaver Creek chronically crosses road surface. Road constructed in low lying area.

# ONGOING HUMAN USES

## Native American Traditional Uses

The entire watershed is on ceded lands and the federal portion is subject to the Yakama Indian Treaty of 1855. It is likely that Yakama Indians will continue to collect traditional resource from the watershed, including clean water and such foods as huckleberries, trout, deer, elk, and bear, along with cedar bark, beargrass, cedar roots, and medicinal plants. Many of these resource assume symbolic as well as practical importance.

**Recommendations:**

- Recognize federal trust responsibility to ensure a continuing supply of traditionally used resources over time.

- Continue frequent and open dialogue with the Yakama Indian Nation regarding proposed projects on ceded land and other management actions effecting tradition uses.

## Recreation

The watershed provides a range of recreational opportunities and demand for these opportunities is increasing.

**Recommendations:**

- Continue to maintain existing developments and day use sites (Peterson Prairie Campground, Peterson Prairie Guard Station, Atkisson Shelter, Ice Caves, and Natural Bridges). Maintenance includes safety improvements such as hazard tree removal at sites, and brushing and grading of access roads suitable for passenger car travel.

- Dispersed camping should be permitted and facilitated where impacts are acceptable. The watershed is largely resilient to dispersed camping (acceptable soils, few riparian areas) and is likely to attract dispersed camping for both hunting and collection of miscellaneous forest products. While some dispersed campsites warrant rehabilitation (see restoration recommendations), most sites cause no problems. Dispersed camping is a need to consider when determining which roads to close to benefit water and wildlife resources.

- Continue and expand evaluation of caves with caving organizations. These organization typically volunteer to map and catalogue cave resources. These relationships provide a dual forum to educate the Forest Service on cave issues and caver needs, as well as inform and educate cavers of our cave management actions.

- Capacity for winter recreation is expected to remain as is through the continue maintenance and snow plowing to Atkisson Sno*Park and grooming of snowmobile trails, via Forest Service and state funds. Existing and future opportunities for cross country ski trails would be unaffected by possible road decommissions/closures.

## Special Forest Products

Special Forest Product collection occurs watershed-wide. Collection is for both personal use and for commercial re-sale. Within the last five year, collections of mushrooms, beargrass, and huckleberries appears to be increasing.

**Recommendations:**

- This watershed analysis has not revealed any reason to not offer both personal and commercial permits for the collection of mushrooms, huckleberries, or beargrass from federal lands in the watershed. This includes both matrix land and the Peterson LSR/MLSA. Permits and product removal should continue to be monitored on a Forest-wide basis, and communication with the Yakama Indian Nation be maintained over the availability and management of traditional plants.

- Other miscellaneous forest products (vegetative transplants, posts, poles, shakes, firewood, common rock) currently occur only from designated areas. This is expected to remain the same. The restriction to designated areas has allowed us to direct these activities to sites where the impact is neutral or beneficial the desired management objective of the area.

## Regeneration Timber Harvest and Commercial Thinning in Matrix

Regeneration harvest methods is a broad class of cutting methods that harvest a mature overstory to the extent that a new cohort of trees can be regenerated, either through natural seeding or planting. Regeneration harvest can be used to achieve both even-aged or multi-aged management objectives. The residual, post harvest canopy coverage of the mature trees can vary from 15-50%. The actual cutting method and long term management regime is determined for each stand based on the land allocation, site conditions, and other resource considerations. In general, regeneration harvest methods maximize timber yield and is appropriate on lands allocated Matrix-General Forest. Other resource concerns that drive the use of regeneration harvest methods include forest health, scenery, habitat needs for early-successional conditions, fire/fuel management.

Commercial thinning is done in young stands (typically 40-100 years old) where growth is being or expected to be inhibited by the density of the stand. Commercial thinning captures potential suppression mortality, while increasing the growth and future timber yield of leave trees.

### DRY CREEK SUBWATERSHED

**Concerns:**

- Peak flow risk is moderate. Neither road density nor ARP for the subwatershed exceed thresholds.

- The combined peak flow risk of Dry Creek and Bear Creek is high, as is the combined peak flow risk of the entire watershed.

- Largest amount of interior late-successional habitat, relative to other three subwatersheds.

- Three spotted owl pairs with habitat below incidental take level.

**Recommendations:**

- Dry Creek Subwatershed shows the greatest potential to yield a timber sale this decade. The "forecast" timber yield for the decade is 94 acres of regeneration harvest yielding 2.6 mmbf.

- While peak flow risks within the subwatershed are moderate, there is high risk for all of the Bear Creek and Cave Creek drainages. This suggests that regeneration harvests which reduce canopy closure below threshold levels within the rain-on-snow zone (1500-3500 ft elev.) be used with caution. Currently the Forest uses 40% canopy closure as the threshold for designating harvest units as hydrologically unrecovered for ARP modeling.

- While the query of the data base disclosed no thinning opportunities, there may be some limited opportunities within the Smoky Creek Burn.

- Thinning to provide timber yield is encouraged where it is beneficial to timber yield given it has less impact on water yield (peak flows) and can maintain habitat functions and connectivity for some late-successional wildlife.

- Road density is moderate and opportunities should be reviewed to obliterate, decommission, or close unneeded roads via timber sale KV funds. Mid-slope roads and roads crossing drainages should be examined, along with any known sites causing sedimentation. Subsoiling of adjacent unripped log landings and unobliterated temporary roads should also be considered. Specific placement of road closure devices (e.g. berms) should maintain dispersed camping opportunities.

## COYOTE CREEK SUBWATERSHED

**Concerns:**

- Peak flow risk is currently high (ARP at 68% and very high road density). ARP predicted to rise to above 70& in year 2002.

- Very high open and total road density.

- Two spotted owl pairs with habitat below incidental take level.

**Recommendations:**

- The predicted ARP recovery to above 70% in year 2002, suggests that it may be reasonable to schedule a timber sale in this subwatershed at that time. This would be late in the first decade of the Presidents Northwest Forest Plan. The optimal regeneration acres would be 170 acres for the decade yielding 4.7 mmbf.

- All opportunities for thinning should be pursued. There are likely to be very few candidate stands.

- As with Dry Creek, there would remain a high risk of peak flows when considering the Cave Creek drainage and Cave-Bear Creeks Watershed. Again regeneration harvests which reduce canopy closure below thresholds levels within rain-on-snow zone should be used with caution.

- Given very high road density and impact on drainage density, all opportunities for road obliteration, decommission, and or closure should be exploited using timber sale KV funds. Mid-slope roads and roads crossing drainages should be examined, along with any known sites causing sedimentation. Subsoiling of adjacent unripped log landings and unobliterated temporary roads should be considered. Specific placement of road closure devices (e.g. berms) should maintain dispersed camping opportunities.

### CAVE CREEK SUBWATERSHED

**Concerns:**

- Peak flow risk is currently high (ARP at 63% and very high road density).
- Large amounts of private and state land in subwatershed, with potentially more given land exchange proposals. Harvest rates unknown.
- High open road density.
- The only fish bearing reaches in the watershed occur in Cave and Beaver Creeks. Poor amounts of large woody debris in both streams and high water temperature in Cave Creek. Fish populations appear stable.
- Two spotted owl pairs with habitat below incidental take level.

**Recommendations:**

- Defer regeneration harvest this decade (until year 2004). High risk for peak flows may be accentuated following land exchange to private and Washington State DNR. Regeneration candidate stands above 3500 feet (above rain-on-snow zone) and outside of potentially unstable soils are limited. Salvage should occur as warranted.

### BEAR CREEK SUBWATERSHED

There are no Forest Service matrix lands within the Bear Creek Subwatershed (all within Peterson LSR/MLSA; refer to restoration treatments).

## Timber Stand Improvement Projects in Matrix

Timber Stand Improvement (TSI) projects include precommercial thinning, lower branch pruning of western white pine to decrease mortality from white pine blister rust, and branch pruning of Douglas-fir and ponderosa pine to improve future wood quality. These actions occur in reforested stands comprised of sapling sized (0-5 inches dbh) trees.

**Recommendations:**

- Continue TSI projects in all stands warranting treatments in all subwatersheds. Precommercial thinning speeds hydrologic recovery and development of late-successional attributes.
- Foster species diversity in thinning by making the least prevalent conifer species priority for leave trees (usually western redcedar, western larch, western white pine).
- At this point of stand development, select for height and health in pre-commercial thinning.
- Consider hiding cover needs when thinning adjacent to major roads or other deer/elk habitat needs (i.e. wetlands).
- Perpetuate small gaps (0.1 - 0.5 acres) within the stand by accentuating openings or poorly stocked areas. These gaps provide within stand spatial and vertical diversity (see Upland Forest Gaps under Restoration Recommendations).

## Ice Caves Cattle and Horse Allotment

The Ice Caves Cattle and Horse Allotment overlaps nearly the entire watershed. An estimated 200 head of cattle drift from state and private land on to federal land in June and graze through September. The allotment is managed on a ten year term permit. It was last issued in 1993. Mid-term modifications are made through adjustments in the annual operating plan.

**Recommendations:**

- Complete monitoring of Cave Creek Wildlife Special Area fenced exclosure to assess grazing impacts to the following: vegetative cover, growth, species abundance, species diversity; noxious weeds populations; pale blue-eyed grass populations; and stream bank stability. This fall marks the end of the three year monitoring plan which was required per the Decision Notice of July 12, 1993, which extended the ten year term permit for this allotment. Purpose of the this monitoring project was to determine the appropriateness of cattle grazing within the Cave Creek Wildlife Special Area. If grazing impacts exceed thresholds, maintain the Wildlife Special Area allocation and exclude grazing from the entire area. If grazing impacts are within thresholds, remove the fenced exclosure and permit grazing within the entire Wildlife Special Area allocation. Refer to Ice Caves Cattle and Horse Allotment Decision Notice and Environmental Assessment.

- Continue annual clean out of vegetation within Lost Creek Ditch from Road 66 and Peterson Prairie Campground to facilitate water flow down the ditch.

- Continue to monitor diversion of the permitted 5 cfs of water from Lost Creek into the ditch from June 1 to September 30, under the stated temperature limitations (16°C maximum for Lost Creek).

# MONITORING

## EROSION PROCESSES

### Washington Department of Natural Resources Sediment Model

*Objective:* Determine modeled rates of generated sediment. Use as guide for prioritizing restoration efforts and overall road management. Establish current baseline conditions with which to validate in the field and to compare future management action and impacts.

*Parameters to Monitor:* Road density, road surfacing, cut and fill slope vegetation, stream crossing, stream density, soil types, road condition surveys.

*Location/Timing:* Model can be run in the office using data in this watershed analysis and the results of Level 2 Road Condition Surveys.

## HYDROLOGY

### Hydrologic Change Model Validation

*Objective:* Validate input parameters (climatic variables) for the model.

*Parameters to Monitor:* Air temperature and wind speeds during rain-on-snow.

*Location/Timing:* Climatic data is available from local weather stations. Validation should be done prior to use of the model again on this watershed.

### Hydrologic Change Model and Peakflow Relative Risk Rating--Comparison

*Objective*: Validate that both tools used for assessing risk lead to common results, or if they differ, identify the specific reasons why they differ.

*Parameters to Monitor:* Results of the Hydrologic Change Model and Risk Rating.

*Location/Timing:* Can be done at the District prior to the next watershed analysis iteration.

## VEGETATION

### IVEG Data Base Update

*Objective:* Keep IVEG data base current so as to improve accuracy of analysis. Key areas to update are inventory of small wetlands (less than one acre) and development of plantations beyond pre-commercial thinning age entering mid-successional development.

*Parameters to Monitor:* Stand development changes in plantation and small wetlands.

*Location/Timing:* Field review and examination of the features can occur during timber sale field reconnaissance. Data base updates should occur concurrent with project level environmental analysis.

### Threatened, Endangered, Sensitive (TES), Survey and Manage (S&M) Species Inventory

*Objective:* Determine presence of TES and S&M plant species and update digital data base of species locations.

*Parameters to Monitor:* TES and S&M plant species.

*Location/Timing:* Determine presence of TES and S&M plants and animals prior to project implementation. Field review and examination to occur in support of project environmental analysis. Implement surveys to protocol for Level II survey and manage species. Update inventories accordingly.

## STREAM CHANNELS

### Rosgen Channel Types

*Objective:* Field verify channel typing done from the office.

*Parameters to Monitor:* Gradient, morphology, substrate, and Rosgen channel type.

*Location/Timing:* Cave Creak, Bear Creek, Dry Creek, Coyote Creek, and major tributaries. Can be done in the summer months as part of stream surveys.

### Channel Change Over Time

*Objective:* Document changes in channel form and condition over time.

*Parameters to Monitor:* Channel cross-section, form, and substrate.

*Location/Timing:* Selected reference and response reaches in the watershed. Every one to five years and following major streamflow events.

## WATER QUALITY

### Water Temperature

*Objective:* Identify what streams meet and do not meet state water quality standards. Identify areas where beneficial uses may not be fully supported based on water temperatures.

*Parameters to Monitor:* Hourly water temperature.

*Location/Timing:* Cave Creek above, below, and within large beaver pond complex.

## Turbidity

*Objective:* Identify current turbidity levels in each subwatershed.

*Parameters to Monitor:* Turbidity and flow.

*Location/Timing:* Cave Creek, Bear Creek, and major tributaries during a range of flows.

## Fecal Coliform.

*Objective:* Determine compliance with state water quality standards and locate areas that may need particular management emphasis.

*Parameters to Monitor*: Fecal coliform.

*Location/Timing:* Monitoring should be done near all high use areas for one year on a quarterly basis to assess conditions throughout different times of the year. Frequency of sampling may then concentrate on high use periods only.

## Springs along the White Salmon River

*Objective:* Determine the quality of water entering the White Salmon River as springs, and potentially help determine sources and pathways of this water.

*Parameters to Monitor:* Temperature, turbidity, and nutrients.

*Location/Timing:* Monitoring of springs may be dependent on levels of flows in the White Salmon River, and when springs are accessible above river level. Best case would be to sample quarterly to assess seasonal changes.

# SPECIES AND HABITAT

## Cave Creek Large Woody Debris (LWD) Project

*Objective:* Determine if the 1993 instream addition of large woody debris was successful in improving fish habitat.

*Parameters to Monitor:* Fish presence, pools, channel substrate.

*Location/Timing:* **Where is this at? Time of year?**

## Cattle Grazing within the Cave Creek Wildlife Special Area

*Objective:* To ensure that livestock grazing in this area is conducted in a manner consistent with the Aquatic Conservation Strategy. In addition assess impacts to pale blue-eyed grass , a sensitive species. Increase the applicability of findings of the ongoing monitoring effort which describes botanical structure and species composition before and after livestock grazing. Systematic sampling of Biological components such as mollusks and amphibians should be measured.

*Parameters to Monitor:* Forage quantity, quality, and species distribution. Pale blue-eyed grass population. Changes in stream bank structure and consolidation. Abundance, distribution, and productivity of mollusks and amphibians; assess habitat characteristics of areas where individuals are located.

*Location/Timing:* Fenced and unfenced portions of Cave Creek Wildlife Special Area and their established vegetation and photo plots which are monitored spring and fall. Use USDA R6 protocol for mollusks and amphibian surveys. Refer to preliminary *Raven's 1996 Monitoring of Cave Creek* Sisyrinchium sarmentosum *(Suksdorf ex Green) Population*, unpublished report for Gifford Pinchot National Forest.

## Mollusks and Amphibian Survey

*Objective:* Support site disturbing projects such as Ice Caves Cattle allotment, road work (e.g. Lost Meadow) by establishing baseline biologic conditions.

*Parameters to Monitor:* Survey for mollusks and amphibians determining presence, distribution, and productivity.

*Location/Timing:* Of particular emphasis would be the Cave Creek Wildlife Special area, Lost Meadow, and the meadow southwest of Deadhorse Meadow. Sample according USDA Forest Service R-6 protocol, spring and summer periods.

## Monitor Timber Sale Mitigation Measures Effectiveness for Bats and Cavity Dependent Birds

*Objective:* Monitor the effectiveness of timber sale mitigation measures for bats and cavity users.

*Parameters to Monitor:* Wildlife use of green tree retention areas and snags.

*Location/Timing:* Watershed and District wide, pre and post timber sale use of 15% retention areas, wildlife trees (pre and post conversion), riparian reserves, and cave buffers.

## Cave Management Plan

*Objective:* Develop Cave Management Plan.

*Parameters to Monitor:* Determine presence, distribution, condition and use (wildlife and human) of caves in sufficient detail for the development of a Cave Management Plan. Incorporate services and advice of Speleological Society existing and ongoing efforts.

*Location/Timing:* Watershed and District-wide.

## Spotted Owl Productivity

*Objective:* Test the Northwest Forest Plan assumption that the Peterson LSR/MLSA is effectively contributing to the spotted owl population of the landscape.

*Parameters to Monitor:* Measure spotted owl productivity (site occupancy and number of young produced) and population mixing. The need is to ensure that protected spotted owl areas are contributing at least as many dispersing young into the landscape as Matrix sites.

*Location/Timing:* Activity centers in both the Peterson LSR/MLSA and adjoining Matrix lands.

### Townsend's Big-Eared Bat

*Objective:* Monitor cave site productivity of Townsend's big-eared bat.

*Parameters to Monitor:* Number of individuals present and number of young produced.

*Location/Timing:* Known use caves (Christmas Tree Cave, ...). Monitor for hibernation (winter), birthing (late spring), roosting (summer and fall).

### Great Gray Owl

*Objective:* Determine presence and distribution of great gray owl.

*Parameters to Monitor:* Number of individuals detected.

*Location/Timing:* Most likely habitats, such as Peterson Prairie and Deadhorse Meadow.

## HUMAN USES

### Special Forest Products Permits

*Objective:* Determine trends in the types of products collected and amounts. Initial starting point in determining resource impact. Useful for dialogue with Yakama Indian Nation concerning traditional resources.

*Parameters to Monitor:* Number and types of permits. Monitor on Skill Center and Forest basis.

*Location/Timing:* Tally number of permits at end of year.

## REFERENCES CITED


Billy, Louise. 1992. Transcription of videotaped interview. On file at Mt. Adams Ranger District. Trout Lake, WA.

Billy, Louise. 1995. Transcription of videotaped interview. On file at Mt. Adams Ranger District. Trout Lake, WA.

Brotherson, J.D. and D. Field. 1987. "Tamerix: Impacts of a Successful Weed." In: *Rangelands* 9(3). June, 1987.

Burtchard, G. 1990. *The Posy Archaeological Project: Upland Use of the Central Cascades, Mt. Hood National Forest.* Report Submitted to Mt. Hood National Forest, Gresham, Oregon. Laboratory of Archaeology and Anthropology, Portland State University. Portland, Oregon.

Clark, Newton. 1882. Field Notes of the Survey of the Exterior and Subdivision Lines of Township 6 North, Range 10 East, Willamette Meridian, Washington Teritory, by Newton Clark. Survey commenced September 18, 1882. Survey completed October 11, 1882.

Cooper, J. G. 1853. Notebook, Northern Pacific Railroad Survey. Smithsonian Institution, Natural Museum. Washington D.C.

Evers, L. et al. 1994. *Fire Ecology of the Mid-Columbia.* Barlow Ranger District, Mt Hood National Forest, USDA Forest Service. Portland, Oregon.

French, D. 1957. "Aboriginal Control of Huckleberry Yield in the Northwest." Paper Presented at the *Annual Meeting of the American Anthropological Association.* Chicago, Illinois.

Gibbs, G. 1855. "Report of Mr. Geroge Gibbs to Captain McClellan, on the Indian Tribes of the Territory of Washington." *Reports of Explorations and Surveys to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean.* 1:402-434. Executive Document No. 778, 2nd Session, 33rd Congress, 1853-54.

Hajda, Yvonne, et al. 1995..*Ethnographic Sites of the Gifford Pinchot National Forest, Washington.* Volume I. Archaeological Investigations Northwest, Inc., Report No. 59. Portland, Oregon.

Kaye, T., N. Fredericks, and J. Gammon. 1991. *Population Monitoring for Fringed Pinesap on the Gifford Pinchot National Forest.* USDA-Forest Service, Oregon Department of Natural Resources, and Washington Department of Narual Resources.

Kruckeberg, A.R. 1980. "Golden Chiquapin (*Chrysolepis chrysophylla*) in Washington State: A Species at the Northern Limit of its Range." In: *Northwest Science.* 54 (1):9-16.

Lacey, J., C. Marlow, and J.R. Lane. 1989. "Influence of Spotted Knapweed (*Centaurea maculosa*) on Surface Runoff and Sediment Yield." In: *Weed Technology.* Volume 3:627-631.

Langdon, James. 1938. *Twin Buttes Recreation Unit.* Recreation Atlas on file at the Mt. Adams Ranger District, Trout Lake, WA.

Lewarch, Dennis and James Benson. 1991.."Long-Term Land Use Patterns in the Southern Washington Cascade Range." *Archaeology in Washington* 3:27-40.

McClellan, G.B. 1853. Journal, May 20 - December 15. Library of Congress.

McClure, Richard H. 1992. In *Archaeological Assessment of the Beech Creek Site (45LE415), Gifford Pinchot National Forest*. Gifford Pinchot National Forest Headquarters, Vancouver,Washington.

Mellen, K. et al. 1995. *Wildlife Habitat Relationships Mt. Hood and Gifford Pinchot National Forests*. Mt. Hood National Forest, USDA-Forest Service. Gresham, Oregon.

Meninick, Johnson. 1996. Personal Communication.

Plummer, F. 1900. Mount Rainier Forest Reserve, Washington. *Twenty-First Annual Report of the United State Geological Survey,* Part V. Document No. 5, 56th Congress, 2nd Session.

Raven, A. 1996. *1996 Monitoring of the Cave Creek* Sisyrinchium sarmentosum *Suksdorf ex Greene Population*. On file at Mt. Adams Ranger District. Trout Lake, WA.

Ray, Verne. 1936. *Native Villages and Groupings of the Columbia Basin.*

Ray Verne. 1939. *Cultural Relations in the Plateau of Northwestern America*. Publications of the F.W. Hodge Anniversary Publication Fund 3. The Southwest Museum, Los Angeles. CA.

Rosgen, Dave. 1996. *Applied Channel Morphology*. Printed Media Companies. Minneapolis, MN.

Schalk, Randall and Gregory Cleveland. 1983. "Sequence of Adaptations in the Columbia-Fraser Plateau." In *Cultural Resource Investigations for the Lyons Ferry Fish Hatchery Project, Near Lyons Ferry, Washington.* Washington State University, Laboratory of Archaeology and History, Project Report 8.

Splawn, A.J. 1944. *Ka-mi-akin, Last Hero of the Yakimas.* Portland, Oregon Historical Society.

Stabler, H.O. 1910. *Special Fire Report of 1910, Columbia National Forest*. November 5, 1910. Manuscript on File at Mt. Adams Ranger District. Trout Lake, Washington.

Stabler, H.O. 1911. *Grazing Report, Columbia National Forest*. Manuscript on File at Mt. Adams Ranger District, Trout Lake, Washington.

USDA-Forest Service. 1990. *Land and Resource Management Plan Gifford Pinchot National Forest*. Pacific Northwest Region.

USDA-Forest Service. 1991. *Columbia River Basin Anadromous Fish Policy Implementation G uide*. Regions 1, 4, and 6.

USDA-Forest Service. 1992. *Soil Resource Inventory, June 1992*. Gifford Pinchot National Forest. Pacific Northwest Region.

USDA-Forest Service. 1993. *A First Approximation of Ecosystem Health*. Regional Ecological Assessment Project, Pacific Northwest Region. Portland, Oregon.

USDA-Forest Service. 1993. *Mt. Adams Ranger District Access and Travel Management Plan*. Mt. Adams Ranger District, Gifford Pinchot National Forest. Trout Lake, WA.

USDA-Forest Service and USDI-Bureau of Land Management. 1994. *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* and *Standard and Guidelines for Management of Habitat for Late-Successional* *and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl.* Pacific Northwest Region.

USDA-Forest Service, et al. 1993. *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment* (Report of the Forest Ecosystem Management Assessment Team). Portland, Oregon.

USDA-Forest Service, et al. 1995. *Ecosystem Analysis at the Watershed Scale Version 2.2* (The Federal Guide for Watershed Analysis). Portland, Oregon.

USDA-Forest Service. 1997. WLDOBS query for wildlife sightings within T5N, R9&10E, T6N, R8-10E., On file at Mt. Adams Ranger District, Trout Lake, WA.

USDI-Fish and Wildlife Service. 1997. Query of the Washington Natural Heritage Program data base for wildlife and plant sightings within one mile of the Cave-Bear Creeks Watershed. On file at Mt. Adams Ranger District, Trout Lake, WA.

Wemple, Beverley. 1994. *Hydrologic Integration of Forest Roads with Stream Networks in Two Basin, Western Cascades. Oregon.* M.S. Thesis, Oregon State University. Covallis, OR.

White, J. and C. Crist. 1988. *Determining Hydrologic Recovery and Wildlife Condition of Timber Stands.* USDA Forest Service. Gifford Pinchot National Foret. Vancouver, WA.

Work, John. 1830. "Journal of John Work." Reprinted in *Oregon Historical Quarterly.* 10:296-313.

# APPENDIX A

Cave Bear WA Vegetation Tables

| | | VEGETATION SERAL STAGES FOR NON MATRIX LANDS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | | | | | | | | | | | | |
| MAC | S/Sap | L. For | Poles | Sm. Trees | LTSS | LTMS | Admin | Rock | Water | Wet Mdw | Dry Mdw | |
| Coyote | | | | | | | | | | | | |
| MLSR | 744 | 469 | 1112 | 371 | 18 | 2662 | 3 | 32 | 1 | 1 | 18 | |
| LSR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| WW | 0 | 0 | 0 | 85 | 0 | 10 | 0 | 8 | 0 | 3 | 0 | |
| IX | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 9L | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Pvt | 6 | 0 | 0 | 7 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | |
| Totals | 750 | 469 | 1112 | 463 | 18 | 2679 | 3 | 40 | 1 | 4 | 18 | |
| | | | | | | | | | | | | |
| Dry Creek | | | | | | | | | | | | |
| MLSR | 369 | 241 | 766 | 238 | 0 | 1174 | 0 | 14 | 0 | 33 | 44 | |
| LSR | 43 | 0 | 83 | 454 | 0 | 482 | 0 | 48 | 0 | 28 | 1 | |
| WW | 0 | 0 | 0 | 81 | 0 | 170 | 0 | 22 | 0 | 0 | 0 | |
| IX | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 9L | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Pvt | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Totals | 412 | 241 | 849 | 773 | 0 | 1826 | 0 | 84 | 0 | 61 | 45 | |
| | | | | | | | | | | | | |
| Bear Creek | | | | | | | | | | | | |
| MLSR | 476 | 92 | 352 | 79 | 0 | 483 | 0 | 0 | 0 | 0 | 0 | |
| LSR | 164 | 0 | 120 | 191 | 0 | 1300 | 0 | 17 | 0 | 23 | 0 | |
| WW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| IX | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 9L | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Pvt | 1088 | 15 | 1771 | 3284 | 59 | 189 | 227 | 0 | 0 | 0 | 0 | |
| Totals | 1728 | 107 | 2243 | 3554 | 59 | 1972 | 227 | 17 | 0 | 23 | 0 | |
| | | | | | | | | | | | | |
| Cave Creek | | | | | | | | | | | | |
| MLSR | 3 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | |
| LSR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| WW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| IX | 17 | 1 | 82 | 0 | 0 | 82 | 0 | 0 | 2 | 98 | 0 | |
| 9L | 6 | 0 | 0 | 5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | |
| Pvt | 788 | 348 | 684 | 2315 | 67 | 38 | 531 | 0 | 0 | 0 | 0 | |
| Totals | 814 | 349 | 766 | 2320 | 67 | 128 | 531 | 0 | 2 | 98 | 0 | |
| | | | | | | | | | | | | |
| Totals | | | | | | | | | | | | |
| MLSR | 1592 | 802 | 2230 | 688 | 18 | 4326 | 3 | 46 | 1 | 34 | 62 | |
| LSR | 207 | 0 | 203 | 645 | 0 | 1782 | 0 | 65 | 0 | 51 | 1 | |
| WW | 0 | 0 | 0 | 166 | 0 | 180 | 0 | 30 | 0 | 3 | 0 | |
| IX | 17 | 1 | 82 | 0 | 0 | 82 | 0 | 0 | 2 | 98 | 0 | |
| 9L | 6 | 0 | 0 | 5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | |
| Pvt | 1882 | 363 | 2455 | 5606 | 126 | 234 | 758 | 0 | 0 | 0 | 0 | |
| | | | | | | | | | | | | |
| TOTAL | 3704 | 1166 | 4970 | 7110 | 144 | 6605 | 761 | 141 | 3 | 186 | 63 | 24853 |
| % area | 14.9 | 4.7 | 20.0 | 28.6 | 0.6 | 26.6 | 3.1 | 0.6 | 0.0 | 0.7 | 0.3 | |

Cave Bear WA Vegetation Tables

VEGETATION SERAL STAGES FOR MATRIX LANDS

| Unit MAC | S/Sap | L. For | Poles | Sm. Trees | LTSS | LTMS | Admin | Rock | Water | Wet Mdw | Dry Mdw | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coyote | | | | | | | | | | | | |
| TS | 527 | 123 | 493 | 55 | 0 | 913 | 0 | 0 | 0 | 2 | 0 | |
| VM | 0 | 4 | 3 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | |
| totals | 527 | 127 | 496 | 0 | 0 | 915 | 0 | 0 | 0 | 2 | 0 | |
| Dry Creek | | | | | | | | | | | | |
| TS | 216 | 62 | 376 | 505 | 0 | 77 | 0 | 0 | 1 | 18 | 0 | |
| VM | 0 | 0 | 67 | 38 | 0 | 54 | 0 | 0 | 0 | 39 | 0 | |
| totals | 216 | 62 | 443 | 543 | 0 | 131 | 0 | 0 | 1 | 57 | 0 | |
| Cave Creek | | | | | | | | | | | | |
| TS | 1503 | 21 | 1035 | 614 | 0 | 1774 | 0 | 36 | 0 | 21 | 0 | |
| VM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| totals | 1503 | 21 | 1035 | 614 | 0 | 1774 | 0 | 36 | 0 | 21 | 0 | |
| Totals | | | | | | | | | | | | |
| TS | 2246 | 206 | 1904 | 1174 | 0 | 2764 | 0 | 36 | 1 | 41 | 0 | |
| VM | 0 | 4 | 70 | 38 | 0 | 56 | 0 | 0 | 0 | 39 | 0 | |
| G Totals | 2246 | 210 | 1974 | 1212 | 0 | 2820 | 0 | 36 | 1 | 80 | 0 | 8579 |
| % area | 26.2 | 2.4 | 23.0 | 14.1 | 0.0 | 32.9 | 0.0 | 0.4 | 0.0 | 0.9 | 0.0 | |

VEGETATION SERAL STAGES FOR PRIVATE LANDS

| Unit MAC | S/Sap | L. For | Poles | Sm. Trees | LTSS | LTMS | Admin | Rock | Water | Wet Mdw | Dry Mdw | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coyote | | | | | | | | | | | | |
| Pvt | 6 | 0 | 0 | 7 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | |
| Bear Creek | | | | | | | | | | | | |
| Pvt | 1088 | 15 | 1771 | 3284 | 59 | 189 | 227 | 0 | 0 | 0 | 0 | |
| Cave Creek | | | | | | | | | | | | |
| Pvt | 788 | 348 | 684 | 2315 | 67 | 38 | 531 | 0 | 0 | 0 | 0 | |
| Totals | 1882 | 363 | 2455 | 5606 | 126 | 234 | 758 | 0 | 0 | 0 | 0 | 11424 |
| % area | 16.5 | 3.2 | 21.5 | 49.1 | 1.1 | 2.0 | 6.6 | 0.0 | 0.0 | 0.0 | 0.0 | |

VEGETATION SERAL STAGES FOR ALL LANDS IN CAVE/BEAR

| Sub WS | S/Sap | L. For | Poles | Sm. Trees | LTSS | LTMS | Admin | Rock | Water | Wet Mdw | Dry Mdw | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAT | 2246 | 210 | 1974 | 1212 | 0 | 2820 | 0 | 36 | 1 | 80 | 0 | 8579 |
| NO-MAT | 3704 | 1166 | 4970 | 7110 | 144 | 6605 | 761 | 141 | 3 | 186 | 63 | 24853 |
| TOTALS | 5950 | 1376 | 6944 | 8322 | 144 | 9425 | 761 | 177 | 4 | 266 | 63 | 33432 |
| % area | 17.8 | 4.1 | 20.8 | 24.9 | 0.4 | 28.2 | 2.3 | 0.5 | 0.0 | 0.8 | 0.2 | |

Cave Bear WA Vegetation Tables

| | | VEGETATION SERAL STAGES FOR ALL LANDS IN CAVE/BEAR outside Matrix | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub WS | S/Sap | L. For | Poles | Sm. Trees | LTSS | LTMS | Admin | Rock | Water | Wet Mdw | Dry Mdw | |
| Coyote | 750 | 469 | 1112 | 463 | 18 | 2679 | 3 | 40 | 1 | 4 | 18 | |
| Dry Creek | 412 | 241 | 849 | 773 | 0 | 1826 | 0 | 84 | 0 | 61 | 45 | |
| Bear Cr | 1728 | 107 | 2243 | 3554 | 59 | 1972 | 227 | 17 | 0 | 23 | 0 | |
| Cave Cr | 814 | 349 | 766 | 2320 | 67 | 128 | 531 | 0 | 2 | 98 | 0 | |
| Totals | 3704 | 1166 | 4970 | 7110 | 144 | 6605 | 761 | 141 | 3 | 186 | 63 | |

| | | VEGETATION SERAL STAGES FOR MATRIX LANDS w/o Land Exchange | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | | | | | | | | | | | | |
| MAC | S/Sap | L. For | Poles | Sm. Trees | LTSS | LTMS | Admin | Rock | Water | Wet Mdw | Dry Mdw | |
| Coyote | | | | | | | | | | | | |
| TS | 527 | 123 | 493 | 55 | 0 | 898 | 0 | 0 | 0 | 2 | 0 | |
| VM | 0 | 4 | 3 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | |
| totals | 527 | 127 | 496 | 0 | `0 | 900 | 0 | 0 | 0 | 2 | 0 | |
| Dry Creek | | | | | | | | | | | | |
| TS | 216 | 62 | 376 | 505 | 0 | 77 | 0 | 0 | 1 | 18 | 0 | |
| VM | 0 | 0 | 67 | 38 | 0 | 54 | 0 | 0 | 0 | 39 | 0 | |
| totals | 216 | 62 | 443 | 543 | 0 | 131 | 0 | 0 | 1 | 57 | 0 | |
| Cave Creek | | | | | | | | | | | | |
| TS | 995 | 21 | 679 | 147 | 0 | 1226 | 0 | 36 | 0 | 21 | 0 | |
| VM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| totals | 995 | 21 | 679 | 147 | 0 | 1226 | 0 | 36 | 0 | 21 | 0 | |
| Totals | | | | | | | | | | | | |
| TS | 1738 | 206 | 1548 | 707 | 0 | 2201 | 0 | 36 | 1 | 41 | 0 | |
| VM | 0 | 4 | 70 | 38 | 0 | 56 | 0 | 0 | 0 | 39 | 0 | |
| G Totals | 1738 | 210 | 1618 | 745 | 0 | 2257 | 0 | 36 | 36 | 80 | 0 | 6720 |

| | | VEGETATION SERAL STAGES FOR MATRIX LANDS w/o Land Exchange Within True Riparian | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | | | | | | | | | | | | |
| MAC | S/Sap | L. For | Poles | Sm. Trees | LTSS | LTMS | Admin | Rock | Water | Wet Mdw | Dry Mdw | |
| Coyote | | | | | | | | | | | | |
| TS | 33 | 20 | 51 | 12 | 0 | 108 | 0 | 0 | 0 | 2 | 0 | |
| VM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| totals | 33 | 20 | 51 | 0 | 0 | 108 | 0 | 0 | 0 | 2 | 0 | |
| Dry Creek | | | | | | | | | | | | |
| TS | 56 | 17 | 49 | 62 | 0 | 16 | 0 | 0 | 1 | 18 | 0 | |
| VM | 0 | 0 | 17 | 13 | 0 | 22 | 0 | 0 | 0 | 39 | 0 | |
| totals | 56 | 17 | 66 | 75 | 0 | 38 | 0 | 0 | 1 | 57 | 0 | |
| Cave Creek | | | | | | | | | | | | |
| TS | 266 | 3 | 222 | 104 | 0 | 431 | 0 | 36 | 0 | 21 | 0 | |
| VM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| totals | 266 | 3 | 222 | 104 | 0 | 431 | 0 | 36 | 0 | 21 | 0 | |
| Totals | | | | | | | | | | | | |
| TS | 355 | 40 | 322 | 178 | 0 | 555 | 0 | 36 | 1 | 41 | 0 | |
| VM | 0 | 0 | 17 | 13 | 0 | 22 | 0 | 0 | 0 | 39 | 0 | |
| G Totals | 355 | 40 | 339 | 191 | 0 | 577 | 0 | 36 | 36 | 80 | 0 | 1654 |

| | | | | | Net Land Exchange | |
|---|---|---|---|---|---|---|
| | S/Sap | L.For | Poles | Sm.Trees | LTSS | LTMS |
| Coyote | | | | | | 15 |
| Cave | 508 | | 356 | 467 | | 548 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | VEGETATION SERAL STAGES FOR LSR and MLSR | | | | | | | | | | |
| sub-basin | S/Sap | L. For | Poles | Sm. Trees | LTSS | LTMS | Admin | Rock | Water | Wet Mdw | Dry Mdw | |
| Coyote | | | | | | | | | | | | |
| MLSR | 744 | 469 | 1112 | 371 | 18 | 2662 | 3 | 32 | 1 | 1 | 18 | |
| LSR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Totals | 744 | 469 | 1112 | 371 | 18 | 2662 | 3 | 32 | 1 | 1 | 18 | |
| | | | | | | | | | | | | |
| Dry Creek | | | | | | | | | | | | |
| MLSR | 369 | 241 | 766 | 238 | 0 | 1174 | 0 | 14 | 0 | 33 | 44 | |
| LSR | 43 | 0 | 83 | 454 | 0 | 482 | 0 | 48 | 0 | 28 | 1 | |
| Totals | 412 | 241 | 849 | 692 | 0 | 1656 | 0 | 62 | 0 | 61 | 45 | |
| | | | | | | | | | | | | |
| Bear Creek | | | | | | | | | | | | |
| MLSR | 476 | 92 | 352 | 79 | 0 | 483 | 0 | 0 | 0 | 0 | 0 | |
| LSR | 164 | 0 | 120 | 191 | 0 | 1300 | 0 | 17 | 0 | 23 | 0 | |
| Totals | 640 | 92 | 472 | 270 | 0 | 1783 | 0 | 17 | 0 | 23 | 0 | |
| | | | | | | | | | | | | |
| Cave Creek | | | | | | | | | | | | |
| MLSR | 3 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | |
| LSR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Totals | 3 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | |
| | | | | | | | | | | | | |
| Totals | | | | | | | | | | | | |
| MLSR | 1592 | 802 | 2230 | 688 | 18 | 4326 | 3 | 46 | 1 | 34 | 62 | |
| LSR | 207 | 0 | 203 | 645 | 0 | 1782 | 0 | 65 | 0 | 51 | 1 | |
| | | | | | | | | | | | | |
| TOTAL | 1799 | 802 | 2433 | 1333 | 18 | 6108 | 3 | 111 | 1 | 85 | 63 | 12756 |
| % area | 14.1 | 6.3 | 19.1 | 10.4 | 0.1 | 47.9 | 0.0 | 0.9 | 0.0 | 0.7 | 0.5 | |

APPENDIX B

| Gifford Pinchot NF Noxious Weed List | | | | |
|---|---|---|---|---|
| Codes | Class | Scientific Name | Common Name | Occurs in Cave/Bear |
| ABTH | A | *Abutilon theophrasti* | Velvetleaf | |
| CAPY3 | A | *Carduus pycnocephalus* | Thistle, Italian | |
| CATE4 | A | *Carduus tenuiflorus* | Thistle, Senderflower | |
| CECA | A | *Centaurea calcitrapa* | Starthistle, Purple | |
| CEMA2 | A | *Centaurea macrocephala* | Knapweed, Bighead | |
| CENI3 | A | *Centaurea jacea x nigra* | Knapweed, Meadow | yes |
| CENI4 | A | *Centaurea nigrescens* | Knapweed, Vochin | |
| CRVU | A | *Crupina vulgaris* | Crupina, Common | |
| HECI | A | *Helianthus ciliaris* | Blueweed, Texas | |
| HEMA | A | *Heracleum mantegazzianum* | Hogweed, Gaint | |
| HIPI | A | *Hieracium pilosella* | Hawkweed, Mouseear | |
| HITR | A | *Hibiscus trionum* | Mallow, Venice | |
| ISTI | A | *Isatis tinctoria* | Woad, Dryer's | |
| MINY | A | *Mirabilis nyctaginea* | Four O' Clock, Wild | |
| PEHA | A | *Peganum harmala* | Peganum | |
| PRLO | A | *Proboscidea louisianica* | Unicorn-Plant | |
| SAAE2 | A | *Salvia aethiopsis* | Sage, Mediterranean | |
| SACA | S | *Salvia sclarea* | meadow clary | |
| SIMA3 | A | *Silybum marianum* | Thistle, Milk | |
| SOEL | A | *Solanum elaeagnifolium* | Nightshade, Silverleaf | |
| SOHA | A | *Sorghum halepense* | Johnsongrass | |
| SORO | A | *Solanum rostratum* | Buffalobur | |
| SPPA2 | A | *Spartina patens* | Cordgrass, Salt Meadow | |
| ZYFA | A | *Zygophyllum fabago* | Bean-Caper, Syrian | |
| ACRE | B | *Acroptilon repens* | Knapweed, Russian | |
| ALMY | B | *Alopecurus myosuroides* | Blackgrass | |
| ALPS | B | *Alhagi pseudalhagi* | Camelthorn | |
| AMFR | B | *Amorpha fruticosa* | Indigobush | |
| ANAR7 | B | *Anchusa arvensis* | Bugloss, Annual | |
| ANOF | B | *Anchusa officinalis* | Bugloss, Common | |
| BRAL | B | *Bryonia alba* | Bryony, White | |
| CAAC | B | *Carduus acanthoides* | Thistle, Plumeless | |
| CANU5 | B | *Carduus nutans* | Thistle, Musk | |
| CEDI | B | *Centaurea diffusa* | Knapweed, Diffuse | yes |
| CEJA | B | *Centaurea jacea* | Knapweed, Brown | |
| CELO | B | *Cenchrus longispinus* | Sandbur, Longspine | |
| CEMA | B | *Centaurea maculosa* | Knapweed, Spotted | |
| CENI | B | *Centaurea nigra* | Knapweed, Black | |
| CESO | B | *Centaurea solstitialis* | Starthistle, Yellow | |
| CHJU | B | *Chondrilla juncea* | Skeletonweed, Rush | |
| CYES | B | *Cyperus esculentus* | Nutsedge, Yellow | |
| CYSC | B | *Cytisus scoparius* | Broom, Scotch | |
| ECVU | B | *Echium vulgare* | Blueweed | |
| EGDE | B | *Egeria densa* | Elodea, Brazilian | |

| Codes | Class | Scientific Name | Common Name | Occurs in Cave/Bear |
|---|---|---|---|---|
| EUES | B | *Euphorbia esula* | Spurge, Leafy | |
| HIAU | B | *Hieracium aurantiacum* | Hawkweed, Orange | |
| HIPR | B | *Hieracium pratense* | Hawkweed, Yellow | |
| HYRA | B | *Hypochaeris radicata* | Cat's Ear, Spotted | |
| LAHY | B | *Lamiun hybridum* | Deadnettle, Hybrid | |
| LELA | B | *Lepidium latifolium* | Pepperweed, Perennial | |
| LEVU | B | *Leucanthemum vulgare* | Daisy, Oxeye | yes |
| LIGED | B | *Linaria genistifolla dalmatatian* | Toadflax, Dalmatian | |
| LYHO | B | *Lepyrodiclis holsteoides* | Lepyodiclis | |
| LYSA | B | *Lythrum salicaria* | Loosestrife, Purple | |
| LYVI | B | *Lythrum virgatum* | Loosestrife, Wand | |
| LYVU | B | *Lysimachia vugaris* | Loosestrife, Garden | |
| MYBR | B | *Myriophyllum brassiliense* | Parrot Feather | |
| MYSP | B | *Myriophyllum spicatum* | Watermilfoil, Eurasian | |
| ONAC | B | *Onopordum acanthium* | Thistle, Scotch | |
| PIHI | B | *Picris hieracioides* | Oxtongue, Hawkweed | |
| ROAU | B | *Rorippa austriaca* | Fieldcress, Austrian | |
| SEJA | B | *Senecio jacobaea* | Ragwort, Tansy | yes |
| SOAR | B | *Sonchus arvensis arvensis* | Sowthistle, Perennial | |
| SPAL | B | *Spartina alterniflora* | Cordgrass, Smooth | |
| SPAN2 | B | *Spartina anglica* | Cordgrass, Common | |
| SPSA | B | *Sphaerophysa salsula* | Swainsonpea | |
| TOAR | B | *Torilis arvensis* | Hedge Parsley | |
| ULEU | B | *Ulex europaeus* | Gorse | |
| AECY | C | *Aegilops cylindrica* | Goatgrass, Jointed | |
| ANSY | C | *Anthriscus sylvestris* | Chervil, Wild | |
| ARAB | C | *Artemisia absinthium* | Wormwood, Absinth | |
| CADR2 | C | *Cardaria draba* | Cress, Hoary | |
| CAPU3 | C | *Cardaria pubescens* | Whitetop, Hairy | |
| CHMI2 | C | *Chaenorrhinum minus* | Snapdragon, Dwarf | |
| CIAR | C | *Cirsium arvense* | Thistle, Canada | |
| CIVU | C | *Cirsium vulgare* | Thistle, Bull | |
| COAR2 | C | *Convolvulus arvensis* | Bindweed Field | |
| COMA2 | C | *Conium Maculatum* | Poison Hemlock | |
| CUAP | C | *Cuscuta approximata* | Dodder, Smoothseed Alfalfa | |
| CYOF | C | *Cynoglossum officinale* | Hound's Tongue | |
| DACA4 | C | *Daucus carota* | Carrot, Wild | |
| ERVES | C | *Eruca vesicaria spp. sativa* | Garden, Rocket | |
| GYPA | C | *Gypsophila paniculata* | Baby's Breath | |
| HEPU2 | C | *Hemizonia pungens* | Spikeweed | |
| HYNI | C | *Hyoscyamus niger* | Henbane, Black | |
| HYPE | C | *Hypericum perforatum* | St. John's Wort, Common | yes |
| KOSC | C | *Kochia scoparia* | Kochia | |
| LIVU2 | C | *Linaria vulgaris* | Toadflax,Yellow | |
| LYAL | C | *Lychnis alba* | Cockle, White | |
| MAMAA | C | *Matricaria maritima var. agrestis* | Mayweed, Scentless | |
| PHAR | C | *Phalaris arundinacea* | Canarygrass, Reed | |

| Codes | Class | Scientific Name | Common Name | Occurs in Cave/Bear |
|---|---|---|---|---|
| POCU2 | C | *Polygomum cuspidatum* | Knotweed, Japanese | |
| PORE2 | C | *Potentilla recta* | Cinquefoil, Sulphur | |
| SECE | C | *Secale cereale* | Rye, Cereal | |
| SODU2 | C | *Solanum dulcamara* | Nightshade, Bitter | |
| TAMAR | C | *Tamarix species* | Saltcedar | |
| TAVU | C | *Tanacetum vulgare* | Tansy, Common | |
| TRTE | C | *Tribulus terrestris* | Puncturevine | |
| VETH | C | *Verbascum thapsus* | Mullein, Common | |
| XASP | C | *Xanthium spinosum* | Cocklebur, Spiny | |

## Appendix C. Survey and Manage Plants and Fungi Likely to Occur in the Cave-Bear Creeks Watershed.

| SPECIES | STRATEGY | Documented on GPNF? |
|---|---|---|
| **VASCULAR PLANTS** | | |
| Allotropa virgata | 1, 2 | Y |
| Cypripedium fasciculatum | 1, 2 | Y |
| **MUSHROOMS** | | |
| Boletus pulcherrimus | 1, 3 | Y |
| Gastroboletus rubra | 1, 3 | |
| Nivatogastrium nubigenium | 1, 3 | |
| Thaxterogaster pinque | 3 | Y |
| Alpova alexsmithii | 1, 3 | |
| Leucogaster microsporus | 1, 3 | |
| Macowanites mollis | 1, 3 | |
| Rhizopogon evadens var. subalpinus | 1, 3 | Y |
| Rhizopogon exiguus | 1, 3 | Y |
| Hydnotrya subnix | 1, 3 | Y |
| Cantharellus formosus | 1, 3 | Y |
| Polyzellus multiplex | 1, 3 | Y |
| Cantharellus cibarius | 3, 4 | Y |
| Cantharellus subalbidus | 3, 4 | Y |
| Cantharellus tubaeformis | 3, 4 | Y |
| Gomphus bonarii | 3 | |
| Gomphus clavatus | 3 | Y |
| Gomphus floccosus | 3 | Y |
| Gomphus kauffmanii | 3 | Y |
| Cortinarius canabarba | 1, 3 | |
| Cortinarius rainierensis | 1, 3 | |
| Cortinarius variipes | 1, 3 | |
| Tricholoma venenatum | 1, 3 | |
| Hydnum repandum | 3 | Y |
| Hydnum umbilicatum | 3 | |
| Phellodon atratum | 3 | |
| Sarcodon fuscoindicum | 3 | Y |
| Sarcodon imbricatus | 3 | |
| Clitocybe subditopoda | 1, 3 | |
| Clitocybe senilis | 1, 3 | |
| Rhodocybe nitida | 1, 3 | |

| SPECIES | STRATEGY | Documented on GPNF? |
|---|---|---|
| Rhodocybe speciosa | 1, 3 | |
| Tricholomoppsis fulvescens | 1, 3 | |
| Oxyporus nobilissimus | 1, 2, 3 | |
| Bondarzewia montana | 1, 2, 3 | |
| Aleurodiscus farlowii | 1, 3 | |
| Dichostereyn granulosum | 1, 3 | |
| Cuonia monticola | 3 | |
| Gyromitra californica | 3, 4 | |
| Gyromitra esculenta | 3, 4 | |
| Gyromitra infula | 3, 4 | |
| Gyromitra melaleucoides | 3, 4 | |
| Gyromitra montana | 3, 4 | |
| Otidea leporina | 3 | |
| Otidea onotica | 3 | |
| Otidea smithii | 3 | |
| Plectania melastoma | 3 | |
| Podostroma alutaceum | 3 | |
| Sarcosoma mexicana | 3 | Y |
| Sarcosphaera eximia | 3 | |
| Spathularia flavida | 3 | |
| Aleuria rhenana | 1, 3 | Y |
| Helvella compressa | 1, 3 | Y |
| Helvella crassitunicata | 1, 3 | |
| Helvella elastica | 1, 3 | |
| Helvella maculata | 1, 3 | |
| Neournula pouchetii | 1, 3 | |
| Plectania milleri | 1, 3 | |
| Clavariadelphus ligula | 3, 4 | |
| Clavariadelphus pistilaris | 3, 4 | |
| Clavariadelphus truncatus | 3, 4 | |
| Clavariadelphus borealis | 3, 4 | |
| Clavariadelphus lovejoyae | 3, 4 | |
| Clavariadelphus sachalinensis | 3, 4 | |
| Clavariadelphus subfastigiatus | 3, 4 | |
| Phlogoitis helvelloides | 3, 4 | |
| Clavulin cinerea | 3, 4 | Y |
| Clavulina cristata | 3, 4 | Y |
| Clavulina ornatipes | 3, 4 | |
| Phytoconis ericetorum | 3, 4 | |
| Sparassis crispa | 3 | Y |

| SPECIES | STRATEGY | Documented on GPNF? |
|---|---|---|
| Clavicorona avellanea | 3 | |
| Cordyeps captata | 3 | Y |
| Ramaria abietina | 3 | Y |
| Ramaria araiospora | 1, 3 | Y |
| **LICHENS** | | |
| Collema nigrescens | | |
| Leptogium saturninum | | |
| Platismatia lacunosa | | |
| Ramilina thrausta | | |
| Usnea longissima | | |
| Dermatocarpon luridum | | |
| Hydrotheria venosa | 1, 3 | Y |
| Leptogium rivale | 1, 3 | Y |
| Cladonia norvegica | 3 | Y |
| Heteroderma sitchensis | 3 | |
| Hypotrachyna revoluta | 3 | Y |
| Nephroma isidiosum | 3 | |
| Tholurna dissimilis | 1, 3 | |
| Dendriscocaulon intricatulum | 1, 3 | Y |
| Lobaria hallii | 1, 3 | Y |
| Lobaria linita | 1, 3 | |
| Nephroma occultum | 1, 3 | Y |
| Pannaria rubiginosa | 1, 3 | |
| Psuedocyphellaria rainierensis | 1, 3 | Y |
| Lobaria oregana | 4 | Y |
| Lobaria pulmonaria | 4 | Y |
| Lobaria scrobiculata | 4 | Y |
| Nephroma bellum | 1, 3 | Y |
| Nephroma helveticum | | |
| Nephroma parile | | |
| Nephroma resupinatum | 4 | Y |
| Pannaria leucostictoides | | |
| Pannaria mediterranea | | |
| Pannaria saubinetii | 4 | Y |
| Peltigera collina | | |
| Peltigera neckeri | | |
| Peltigera pacifica | | |
| Pseudocyphellaria anomala | 4 | Y |
| Pseudocyphellaria anthrapsis | 4 | Y |

| SPECIES | STRATEGY | Documented on GPNF? |
|---|---|---|
| Pseudocyphellaria crocata | 4 | Y |
| Sticta beauvoisii | | |
| Sticta fuliginosa | 4 | Y |
| Sticta limbata | 4 | Y |
| Calicium abictinum | 4 | Y |
| Calicium adaequatum | 4 | Y |
| Calicium adspersum | 4 | |
| Calicium gancellum | 4 | Y |
| Calicium glaucellum | 4 | |
| Calicium viride | 4 | |
| Chaenotheca brunneola | 4 | |
| Chaenotheca chrysochephala | 4 | |
| Chaenotheca ferruginea | 4 | |
| Chaenotheca furfuracea | 4 | Y |
| Chaenotheca subroscida | 4 | Y? |
| Chaenotheca pusilla | 4 | |
| Cyphelium inquinans | 4 | Y |
| Microcalicium arenarium | 4 | |
| Mycrocalicium subtile | 4 | |
| Stenocybe clavata | 4 | |
| Stenocybe major | 4 | |
| Pilophorus nigricaulis | 1, 3 | |
| Cetrelia cetrarioides | 4 | Y |
| Collema nigrescens | 4 | Y |
| Leptogium burnetiae var. hirsutum | 4 | |
| Leptogium cyanescens | 4 | |
| Leptogium saturninum | 4 | Y |
| Leptogium teretiusculum | 4 | Y |
| Platismatia lacunosa | 4 | |
| Ramalina thrausta | 4 | |
| Bryoria pseudocapillaris | 1, 3 | Y |
| **BRYOPHYTES** | | |
| Antitrichia curtipendula | 4 | Y |
| Diplophyllum albicans | 1, 3 | Y |
| Douinia ovata | 1, 3 | Y |
| Ptilidium californicum | 1, 2 | Y |
| Tetraphis geniculata | 1, 3 | Y |
| Ulota megalaspora | 4 | Y |

APPENDIX D Cave Bear WA Roads (A&TM)

| Road Segment | Subwatershed | Miles | DFC | Land Allocation | |
|---|---|---|---|---|---|
| 2420728_01 | Coyote | 0.2 | O | | MLSA |
| 2420730_01 | Dry | 0.0 | O | Riparian | MLSA |
| 2420730_01 | Dry | 0.0 | O | | MLSA |
| 6000061_01 | Coyote | 0.6 | O | | MLSA |
| 6000718_01 | Coyote | 0.2 | O | | MLSA |
| 6000719_01 | Coyote | 0.1 | O | | MLSA |
| 6000721_01 | Coyote | 0.3 | O | | MLSA |
| 6000723_01 | Coyote | 0.1 | O | | MLSA |
| 6000735_01 | Coyote | 0.1 | O | | MLSA |
| 6035773_01 | Dry | 0.1 | O | Riparian | |
| 6035773_01 | Dry | 0.2 | O | | |
| 6610730_01 | Cave | 0.1 | O | Riparian | |
| 6610730_01 | Cave | 0.1 | O | | |
| 8600704_01 | Cave | 0.1 | O | | |
| 8600731_01 | Cave | 0.1 | O | Riparian | |
| 8600731_01 | Cave | 0.4 | O | | |
| 8620727_01 | Cave | 0.1 | O | Riparian | AWA |
| 8620727_01 | Cave | 0.0 | O | Riparian | |
| 1700017_01 | Coyote | 0.5 | H | | MLSA |
| 1700017_01 | Bear | 0.2 | H | | MLSA |
| 2400025_01 | Bear | 0.2 | H | Riparian | MLSA |
| 2400025_01 | Bear | 0.4 | H | | MLSA |
| 2400043_01 | Coyote | 0.1 | H | Riparian | MLSA |
| 2400043_01 | Coyote | 0.2 | H | | MLSA |
| 2400050_02 | Coyote | 0.8 | H | | MLSA |
| 2400060_01 | Coyote | 1.0 | H | | MLSA |
| 2400702_01 | Bear | 0.1 | H | Riparian | MLSA |
| 2400702_01 | Bear | 0.2 | H | | MLSA |
| 2400704_01 | Bear | 0.2 | H | | MLSA |
| 2400711_01 | Coyote | 0.2 | H | | MLSA |
| 2400711_01 | Bear | 0.1 | H | | MLSA |
| 2400713_01 | Coyote | 0.1 | H | | MLSA |
| 2400716_01 | Coyote | 0.0 | H | Riparian | MLSA |
| 2400716_01 | Coyote | 0.2 | H | | MLSA |
| 2400721_01 | Coyote | 0.3 | H | | MLSA |
| 2400728_01 | Coyote | 0.4 | H | | MLSA |
| 2400729_01 | Coyote | 0.4 | H | | MLSA |
| 2400730_01 | Coyote | 0.1 | H | | MLSA |
| 2400733_01 | Coyote | 0.8 | H | | MLSA |
| 2400734_01 | Coyote | 0.2 | H | | MLSA |
| 2400736_01 | Coyote | 0.8 | H | | MLSA |
| 2400737_01 | Coyote | 0.2 | H | | MLSA |
| 2420031_02 | Coyote | 0.0 | H | Riparian | MLSA |
| 2420031_02 | Dry | 0.3 | H | Riparian | MLSA |
| 2420031_02 | Dry | 0.5 | H | | MLSA |

| Road Segment | Subwatershed | Miles | DFC | Land Allocation | |
|---|---|---|---|---|---|
| 2420705_01 | Bear | 0.2 | H | | MLSA |
| 2420709_01 | Coyote | 0.5 | H | | MLSA |
| 2420709_01 | Bear | 0.2 | H | | MLSA |
| 2420727_01 | Coyote | 0.1 | H | | MLSA |
| 2420727_01 | Dry | 0.0 | H | | MLSA |
| 6000023_01 | Coyote | 0.6 | H | | MLSA |
| 6000040_01 | Coyote | 0.1 | H | Riparian | MLSA |
| 6000040_01 | Coyote | 1.9 | H | | MLSA |
| 6000051_01 | Coyote | 0.9 | H | | MLSA |
| 6000104_01 | Coyote | 0.5 | H | | MLSA |
| 6000104_01 | Coyote | 0.0 | H | | |
| 6000708_01 | Coyote | 0.2 | H | | MLSA |
| 6000709_01 | Coyote | 0.2 | H | | MLSA |
| 6000711_01 | Coyote | 0.1 | H | | MLSA |
| 6000736_01 | Coyote | 0.5 | H | | MLSA |
| 6000739_01 | Coyote | 0.7 | H | | MLSA |
| 6000739_01 | Coyote | 0.1 | H | | |
| 6035051_01 | Coyote | 0.1 | H | | |
| 6035051_01 | Dry | 0.1 | H | Riparian | |
| 6035051_01 | Dry | 0.9 | H | | |
| 6610260_01 | Cave | 0.1 | H | | |
| 6610281_01 | Cave | 0.5 | H | | |
| 6610719_01 | Coyote | 0.3 | H | | |
| 6610723_01 | Cave | 0.5 | H | | |
| 6610726_01 | Coyote | 0.1 | H | | |
| 6610728_01 | Cave | 0.4 | H | | |
| 6610729_01 | Cave | 0.1 | H | Riparian | |
| 6610729_01 | Cave | 0.2 | H | | |
| 6610740_01 | Cave | 0.2 | H | | |
| 6610741_01 | Cave | 0.2 | H | | |
| 8600080_01 | Cave | 1.1 | H | | |
| 8600085_01 | Cave | 0.1 | H | | |
| 8600733_01 | Cave | 0.3 | H | | |
| 8620027_01 | Coyote | 0.3 | H | | |
| 8620027_01 | Cave | 0.3 | H | | |
| 8620031_01 | Cave | 0.3 | H | Riparian | AWA |
| 8620031_01 | Cave | 0.8 | H | Riparian | |
| 8620031_01 | Cave | 0.9 | H | | |
| 8620716_01 | Cave | 0.3 | H | | |
| 8620747_01 | Coyote | 0.1 | H | | |
| 8631020_01 | Cave | 0.4 | H | Riparian | AWA |
| 8631020_01 | Cave | 0.0 | H | | AWA |
| 8631725_01 | Coyote | 0.1 | H | | |
| 8631725_01 | Cave | 0.2 | H | | |
| 8631727_01 | Coyote | 0.2 | H | | |

Cave Bear WA Roads (A&TM)

| Road Segment | Subwatershed | Miles | DFC | Land Allocation | |
|---|---|---|---|---|---|
| 2400020_02 | Bear | 0.0 | G | Riparian | MLSA |
| 2400020_02 | Bear | 0.4 | G | | MLSA |
| 2400027_01 | Bear | 0.0 | G | Riparian | MLSA |
| 2400027_01 | Bear | 0.3 | G | | MLSA |
| 2400081_01 | Dry | 0.1 | G | Riparian | MLSA |
| 2400081_01 | Dry | 0.6 | G | | MLSA |
| 2400701_01 | Bear | 0.2 | G | | MLSA |
| 2400707_01 | Bear | 0.1 | G | Riparian | MLSA |
| 2400707_01 | Bear | 0.5 | G | | MLSA |
| 2400715_01 | Coyote | 0.2 | G | | MLSA |
| 2400723_01 | Coyote | 0.5 | G | | MLSA |
| 2400739_01 | Coyote | 0.2 | G | | MLSA |
| 2400743_01 | Dry | 0.3 | G | | MLSA |
| 2400745_01 | Dry | 0.1 | G | Riparian | MLSA |
| 2400745_01 | Dry | 0.2 | G | | MLSA |
| 2400746_01 | Dry | 0.2 | G | | LSR |
| 2400746_01 | Dry | 0.1 | G | | MLSA |
| 2400748_01 | Dry | 0.0 | G | | |
| 2420024_01 | Dry | 0.0 | G | | MLSA |
| 2420024_01 | Bear | 0.2 | G | | MLSA |
| 2420060_01 | Bear | 0.0 | G | | LSR |
| 2420060_01 | Bear | 0.4 | G | | MLSA |
| 2420736_01 | Dry | 0.1 | G | Riparian | MLSA |
| 2420736_01 | Dry | 0.0 | G | | MLSA |
| 2420742_01 | Dry | 0.1 | G | | LSR |
| 2420742_01 | Dry | 0.2 | G | | MLSA |
| 2420752_01 | Dry | 0.0 | G | | MLSA |
| 2420752_01 | Bear | 0.4 | G | | MLSA |
| 2420765_01 | Dry | 0.1 | G | | LSR |
| 2420765_01 | Dry | 0.4 | G | | MLSA |
| 2420765_01 | Bear | 0.0 | G | | LSR |
| 6000080_01 | Coyote | 0.7 | G | | MLSA |
| 6000715_01 | Coyote | 0.3 | G | | MLSA |
| 6000727_01 | Coyote | 0.4 | G | | MLSA |
| 6000729_01 | Coyote | 0.1 | G | | MLSA |
| 6000731_01 | Coyote | 0.2 | G | | MLSA |
| 6020011_02 | Coyote | 0.1 | G | | |
| 6020090_01 | Coyote | 0.1 | G | Riparian | MLSA |
| 6020090_01 | Coyote | 0.1 | G | | MLSA |
| 6020090_01 | Coyote | 0.2 | G | | |
| 6020090_01 | Dry | 0.1 | G | Riparian | MLSA |
| 6020090_01 | Dry | 0.9 | G | | MLSA |
| 6020719_01 | Coyote | 0.0 | G | Riparian | MLSA |
| 6020719_01 | Coyote | 0.1 | G | | MLSA |
| 6020721_01 | Coyote | 0.4 | G | | MLSA |

| Road Segment | Subwatershed | Miles | DFC | Land Allocation | |
|---|---|---|---|---|---|
| 6020722_01 | Coyote | 0.1 | G | | MLSA |
| 6020724_01 | Coyote | 0.3 | G | | MLSA |
| 6020741_01 | Coyote | 0.1 | G | Riparian | MLSA |
| 6020741_01 | Coyote | 0.2 | G | | MLSA |
| 6020742_01 | Coyote | 0.1 | G | | MLSA |
| 6020746_01 | Dry | 0.2 | G | | MLSA |
| 6020754_01 | Coyote | 0.1 | G | | MLSA |
| 6020754_01 | Coyote | 0.0 | G | | |
| 6020756_01 | Coyote | 0.1 | G | Riparian | MLSA |
| 6020756_01 | Coyote | 0.1 | G | | MLSA |
| 6020760_01 | Coyote | 0.0 | G | | MLSA |
| 6020760_01 | Coyote | 0.1 | G | | |
| 6020770_01 | Coyote | 0.1 | G | | |
| 6020770_01 | Dry | 0.0 | G | Riparian | MLSA |
| 6020770_01 | Dry | 0.3 | G | | MLSA |
| 6020770_01 | Dry | 0.1 | G | | |
| 6020773_01 | Coyote | 0.4 | G | | |
| 6020773_01 | Dry | 0.1 | G | | |
| 6020775_01 | Dry | 0.5 | G | | |
| 6020776_01 | Dry | 0.1 | G | Riparian | |
| 6020776_01 | Dry | 0.1 | G | | |
| 6020781_01 | Dry | 0.2 | G | | |
| 6020782_01 | Dry | 0.3 | G | | |
| 6020784_01 | Dry | 0.2 | G | | |
| 6020785_01 | Dry | 0.1 | G | | MLSA |
| 6020785_01 | Dry | 0.2 | G | | |
| 6030089_01 | Coyote | 0.1 | G | | |
| 6030794_01 | Coyote | 0.1 | G | | |
| 6035767_01 | Coyote | 0.3 | G | | |
| 6035769_01 | Dry | 0.2 | G | | |
| 8600705_01 | Cave | 0.3 | G | | |
| 8600708_01 | Cave | 0.1 | G | Riparian | |
| 8600708_01 | Cave | 0.2 | G | | |
| 8600709_01 | Cave | 0.1 | G | Riparian | |
| 8600709_01 | Cave | 0.4 | G | | |
| 8600710_01 | Cave | 0.2 | G | | |
| 8600711_01 | Cave | 0.1 | G | Riparian | |
| 8600711_01 | Cave | 0.5 | G | | |
| 8600732_01 | Cave | 0.2 | G | | |
| 8600734_01 | Cave | 0.1 | G | | |
| 8620037_01 | Cave | 0.7 | G | | |
| 8620704_01 | Cave | 0.1 | G | | |
| 8620723_01 | Cave | 0.1 | G | Riparian | AWA |
| 8620723_01 | Cave | 0.0 | G | Riparian | |
| 8620723_01 | Cave | 0.0 | G | | AWA |

| Road Segment | Subwatershed | Miles | DFC | Land Allocation | |
|---|---|---|---|---|---|
| 8620724_01 | Cave | 0.1 | G | Riparian | |
| 8620724_01 | Cave | 0.1 | G | | |
| 8620728_01 | Cave | 0.1 | G | | |
| 8620746_01 | Coyote | 0.4 | G | | MLSA |
| 8631011_01 | Cave | 0.0 | G | Riparian | AWA |
| 8631011_01 | Cave | 0.4 | G | Riparian | |
| 8631011_01 | Cave | 2.2 | G | | |
| 8631015_01 | Cave | 0.1 | G | Riparian | |
| 8631015_01 | Cave | 0.1 | G | | |
| 8631705_01 | Cave | 0.0 | G | Riparian | |
| 8631705_01 | Cave | 0.0 | G | | AWA |
| 8631705_01 | Cave | 0.2 | G | | |
| 8631706_01 | Cave | 0.0 | G | Riparian | |
| 8631706_01 | Cave | 0.3 | G | | |
| 8631707_01 | Cave | 0.1 | G | | |
| 8821131_01 | Dry | 0.3 | G | Riparian | LSR |
| 8821131_01 | Dry | 0.7 | G | | LSR |
| 2400020_01 | Bear | 0.5 | F | Riparian | MLSA |
| 2400020_01 | Bear | 0.4 | F | | MLSA |
| 2400045_01 | Coyote | 0.4 | F | | MLSA |
| 2400700_01 | Bear | 0.1 | F | Riparian | MLSA |
| 2400700_01 | Bear | 0.8 | F | | MLSA |
| 2400741_01 | Dry | 0.1 | F | Riparian | MLSA |
| 2400741_01 | Dry | 0.1 | F | | MLSA |
| 2400742_01 | Coyote | 0.0 | F | | MLSA |
| 2400742_01 | Dry | 0.5 | F | | MLSA |
| 2400749_01 | Dry | 0.1 | F | | |
| 2420020_01 | Dry | 0.1 | F | Riparian | MLSA |
| 2420020_01 | Dry | 0.2 | F | | MLSA |
| 2420020_01 | Bear | 0.3 | F | Riparian | MLSA |
| 2420020_01 | Bear | 1.8 | F | | MLSA |
| 2420031_01 | Dry | 0.0 | F | Riparian | MLSA |
| 2420031_01 | Dry | 0.3 | F | | MLSA |
| 2420041_01 | Dry | 0.1 | F | Riparian | MLSA |
| 2420041_01 | Dry | 0.3 | F | | MLSA |
| 2420710_01 | Dry | 0.1 | F | Riparian | MLSA |
| 2420710_01 | Dry | 0.0 | F | | MLSA |
| 2420710_01 | Bear | 0.0 | F | | MLSA |
| 2420713_01 | Dry | 0.2 | F | Riparian | MLSA |
| 2420713_01 | Dry | 0.3 | F | | MLSA |
| 2420719_01 | Dry | 0.7 | F | | MLSA |
| 2420719_01 | Bear | 0.1 | F | | MLSA |
| 2420721_01 | Dry | 0.1 | F | | MLSA |
| 2420725_01 | Coyote | 0.2 | F | | MLSA |
| 2420725_01 | Dry | 0.1 | F | | MLSA |

| Road Segment | Subwatershed | Miles | DFC | Land Allocation | |
|---|---|---|---|---|---|
| 6000012_01 | Coyote | 0.1 | F | Riparian | MLSA |
| 6000012_01 | Coyote | 0.1 | F | | MLSA |
| 6000071_01 | Coyote | 0.4 | F | | MLSA |
| 6000071_01 | Dry | 0.2 | F | | MLSA |
| 6000738_01 | Coyote | 0.1 | F | | MLSA |
| 6020011_01 | Coyote | 0.1 | F | Riparian | MLSA |
| 6020011_01 | Coyote | 0.3 | F | | MLSA |
| 6020011_01 | Coyote | 0.1 | F | | |
| 6020031_01 | Coyote | 0.0 | F | | |
| 6020040_01 | Coyote | 0.1 | F | Riparian | MLSA |
| 6020040_01 | Coyote | 0.4 | F | | MLSA |
| 6020040_02 | Coyote | 0.6 | F | | MLSA |
| 6020040_02 | Dry | 0.3 | F | | MLSA |
| 6020705_01 | Coyote | 0.2 | F | Riparian | MLSA |
| 6020705_01 | Coyote | 0.1 | F | | MLSA |
| 6020706_01 | Coyote | 0.3 | F | | MLSA |
| 6020712_01 | Coyote | 0.1 | F | | MLSA |
| 6020712_01 | Coyote | 0.1 | F | | |
| 6020717_01 | Coyote | 0.1 | F | Riparian | MLSA |
| 6020717_01 | Coyote | 0.1 | F | | MLSA |
| 6020723_01 | Coyote | 0.2 | F | | MLSA |
| 6020728_01 | Coyote | 0.1 | F | | MLSA |
| 6020732_01 | Coyote | 0.0 | F | | MLSA |
| 6020738_01 | Coyote | 0.0 | F | Riparian | MLSA |
| 6020738_01 | Coyote | 0.1 | F | | MLSA |
| 6020744_01 | Coyote | 0.1 | F | | MLSA |
| 6020744_01 | Dry | 0.3 | F | | MLSA |
| 6020745_01 | Coyote | 0.1 | F | | MLSA |
| 6030091_01 | Coyote | 0.5 | F | | |
| 6600130_01 | Coyote | 0.5 | F | | |
| 6600150_01 | Coyote | 0.3 | F | | MLSA |
| 6600788_01 | Coyote | 0.1 | F | | MLSA |
| 6600789_01 | Coyote | 0.1 | F | | MLSA |
| 8600031_01 | Cave | 0.1 | F | Riparian | |
| 8600031_01 | Cave | 0.6 | F | | |
| 8600036_01 | Cave | 0.6 | F | Riparian | |
| 8600036_01 | Cave | 1.0 | F | | |
| 8600051_01 | Cave | 0.6 | F | | |
| 8600071_01 | Cave | 0.3 | F | | |
| 8600717_01 | Cave | 0.2 | F | | |
| 8600719_01 | Cave | 0.1 | F | Riparian | |
| 8600719_01 | Cave | 0.3 | F | | |
| 8600721_01 | Cave | 0.0 | F | Riparian | |
| 8600721_01 | Cave | 0.2 | F | | |
| 8600730_01 | Cave | 0.5 | F | | |

Cave Bear WA Roads (A&TM)

| Road Segment | Subwatershed | Miles | DFC | Land Allocation | |
|---|---|---|---|---|---|
| 8620011_01 | Cave | 0.6 | F | Riparian | |
| 8620011_01 | Cave | 0.9 | F | | |
| 8620015_01 | Cave | 0.2 | F | Riparian | |
| 8620015_01 | Cave | 0.3 | F | | |
| 8620020_01 | Cave | 0.0 | F | Riparian | |
| 8620020_01 | Cave | 0.9 | F | | |
| 8620024_01 | Cave | 0.5 | F | Riparian | |
| 8620024_01 | Cave | 0.5 | F | | |
| 8620028_01 | Coyote | 0.1 | F | | |
| 8620028_01 | Cave | 0.2 | F | | |
| 8620042_01 | Coyote | 0.0 | F | Riparian | |
| 8620042_01 | Coyote | 0.2 | F | | MLSA |
| 8620042_01 | Coyote | 0.3 | F | | |
| 8620046_01 | Coyote | 0.6 | F | | MLSA |
| 8620061_01 | Coyote | 0.1 | F | Riparian | MLSA |
| 8620061_01 | Coyote | 0.2 | F | Riparian | |
| 8620061_01 | Coyote | 0.3 | F | | MLSA |
| 8620061_01 | Coyote | 1.2 | F | | |
| 8620061_01 | Cave | 1.2 | F | | |
| 8620090_01 | Coyote | 0.5 | F | | MLSA |
| 8620090_01 | Coyote | 0.0 | F | | |
| 8620715_01 | Cave | 0.0 | F | Riparian | |
| 8620715_01 | Cave | 0.4 | F | | |
| 8620743_01 | Coyote | 0.2 | F | | MLSA |
| 8620743_01 | Cave | 0.1 | F | | MLSA |
| 8620743_01 | Cave | 0.1 | F | | |
| 8620745_01 | Cave | 0.4 | F | | |
| 8620751_01 | Coyote | 0.5 | F | | |
| 8620758_01 | Coyote | 0.1 | F | | |
| 8631050_01 | Coyote | 0.8 | F | | |
| 8821091_01 | Bear | 0.1 | F | Riparian | LSR |
| 8821091_01 | Bear | 1.3 | F | | LSR |
| 8821110_01 | Bear | 0.2 | F | Riparian | LSR |
| 8821110_01 | Bear | 1.2 | F | | LSR |
| 8821112_01 | Bear | 0.5 | F | | LSR |
| 8821115_01 | Bear | 0.1 | F | | LSR |
| 2420000_02 | Dry | 0.4 | E | | LSR |
| 2420000_02 | Dry | 0.3 | E | | MLSA |
| 2420000_02 | Bear | 0.3 | E | | LSR |
| 2420000_02 | Bear | 0.3 | E | | MLSA |
| 2420051_01 | Dry | 0.1 | E | Riparian | LSR |
| 2420051_01 | Dry | 0.9 | E | | LSR |
| 2420051_01 | Dry | 0.3 | E | | MLSA |
| 1840000_02 | Cave | 0.0 | B | | |
| 2400041_02 | Coyote | 0.0 | B | Riparian | MLSA |

| Road Segment | Subwatershed | Miles | DFC | Land Allocation | |
|---|---|---|---|---|---|
| 2400041_02 | Coyote | 0.8 | B | | MLSA |
| 2420000_01 | Coyote | 0.0 | B | | MLSA |
| 2420000_01 | Dry | 1.1 | B | Riparian | MLSA |
| 2420000_01 | Dry | 2.0 | B | | MLSA |
| 2420000_01 | Bear | 0.0 | B | Riparian | MLSA |
| 2420000_01 | Bear | 0.7 | B | | MLSA |
| 6000030_01 | Coyote | 2.1 | B | | MLSA |
| 6020000_01 | Coyote | 0.5 | B | Riparian | MLSA |
| 6020000_01 | Coyote | 0.2 | B | Riparian | |
| 6020000_01 | Coyote | 1.0 | B | | MLSA |
| 6020000_01 | Coyote | 0.8 | B | | |
| 6020000_01 | Dry | 0.2 | B | Riparian | |
| 6020000_01 | Dry | 0.8 | B | | |
| 6030000_03 | Coyote | 0.1 | B | Riparian | |
| 6030000_03 | Coyote | 0.5 | B | | |
| 6035000_03 | Coyote | 0.0 | B | Riparian | |
| 6035000_03 | Coyote | 0.8 | B | | |
| 6035000_03 | Dry | 0.2 | B | Riparian | |
| 6035000_03 | Dry | 0.9 | B | | |
| 6610000_01 | Coyote | 0.4 | B | | |
| 6610000_01 | Cave | 0.2 | B | Riparian | |
| 6610000_01 | Cave | 2.6 | B | | |
| 8600000_01 | Bear | 0.4 | B | | |
| 8600000_01 | Cave | 0.0 | B | Riparian | |
| 8600000_01 | Cave | 1.4 | B | | |
| 8600000_02 | Cave | 0.7 | B | Riparian | |
| 8600000_02 | Cave | 4.6 | B | | |
| 8600000_03 | Cave | 0.8 | B | | |
| 8600041_01 | Cave | 0.2 | B | | |
| 8620000_01 | Cave | 0.0 | B | Riparian | AWA |
| 8620000_01 | Cave | 0.7 | B | Riparian | |
| 8620000_01 | Cave | 0.2 | B | | AWA |
| 8620000_01 | Cave | 0.4 | B | | |
| 8620000_02 | Coyote | 0.1 | B | Riparian | MLSA |
| 8620000_02 | Coyote | 0.1 | B | Riparian | |
| 8620000_02 | Coyote | 1.6 | B | | MLSA |
| 8620000_02 | Coyote | 1.0 | B | | |
| 8620000_02 | Cave | 0.1 | B | Riparian | AWA |
| 8620000_02 | Cave | 0.3 | B | Riparian | |
| 8620000_02 | Cave | 0.1 | B | | AWA |
| 8620000_02 | Cave | 0.6 | B | | |
| 8620051_01 | Coyote | 0.1 | B | Riparian | MLSA |
| 8620051_01 | Coyote | 0.5 | B | | MLSA |
| 8620070_01 | Coyote | 0.0 | B | Riparian | |
| 8620070_01 | Coyote | 0.5 | B | | |

| Road Segment | Subwatershed | Miles | DFC | Land Allocation | |
|---|---|---|---|---|---|
| 8631000_01 | Coyote | 0.6 | B | | |
| 8631000_01 | Cave | 0.5 | B | Riparian | AWA |
| 8631000_01 | Cave | 1.3 | B | Riparian | |
| 8631000_01 | Cave | 0.2 | B | | AWA |
| 8631000_01 | Cave | 0.7 | B | | |
| 8631000_02 | Cave | 0.3 | B | Riparian | AWA |
| 8631000_02 | Cave | 0.1 | B | Riparian | |
| 8631000_02 | Cave | 0.4 | B | | AWA |
| 8631000_02 | Cave | 0.2 | B | | |
| 8821000_02 | Dry | 0.1 | B | | LSR |
| 8821000_02 | Dry | 0.0 | B | | |
| 1700011_01 | Bear | 0.3 | A | | MLSA |
| 1700011_01 | Bear | 0.1 | A | | |
| 1721000_01 | Bear | 0.5 | A | | |
| 2400000_01 | Coyote | 1.4 | A | | MLSA |
| 2400000_01 | Bear | 1.0 | A | | MLSA |
| 2400000_01 | Bear | 0.0 | A | | |
| 2400000_02 | Coyote | 0.3 | A | Riparian | MLSA |
| 2400000_02 | Coyote | 1.0 | A | | MLSA |
| 2400000_02 | Dry | 0.1 | A | Riparian | LSR |
| 2400000_02 | Dry | 0.3 | A | Riparian | MLSA |
| 2400000_02 | Dry | 0.0 | A | Riparian | |
| 2400000_02 | Dry | 0.2 | A | | LSR |
| 2400000_02 | Dry | 1.7 | A | | MLSA |
| 2400000_02 | Dry | 0.5 | A | | |
| 2400031_01 | Coyote | 0.5 | A | | MLSA |
| 2400031_01 | Bear | 0.0 | A | | MLSA |
| 2400041_01 | Coyote | 0.1 | A | Riparian | MLSA |
| 2400041_01 | Coyote | 0.4 | A | | MLSA |
| 2400050_01 | Coyote | 0.6 | A | | MLSA |
| 2400069_01 | Coyote | 0.3 | A | Riparian | MLSA |
| 2400069_01 | Coyote | 0.2 | A | | MLSA |
| 2400071_01 | Coyote | 0.0 | A | Riparian | MLSA |
| 2400071_01 | Coyote | 0.1 | A | | MLSA |
| 6000000_05 | Coyote | 0.0 | A | Riparian | MLSA |
| 6000000_05 | Coyote | 0.5 | A | | MLSA |
| 6000000_05 | Coyote | 0.0 | A | | |
| 6000000_06 | Coyote | 0.2 | A | Riparian | MLSA |
| 6000000_06 | Coyote | 1.5 | A | | MLSA |
| 6600000_03 | Coyote | 0.1 | A | Riparian | MLSA |
| 6600000_03 | Coyote | 0.2 | A | | MLSA |

## LISTING OF ALL DISTRICT ROADS WITH DESIRED FUTURE CONDITION

The table on the following pages lists every road on the Mt. Adams District road network and includes proposed desired future condition catagories. The definitions of the individual catagories are listed below.

| DFC Code | Description |
|---|---|
| A. | These roads are open to public use and are maintained for travel by a prudent driver in a standard passenger car. Safety and directional signing are consistent with the National Highway Safety Act. These roads may be closed seasonally (for a portion of the year). |
| B. | These roads are open to public use and are maintained for travel of high clearance vehicles. Passenger cars are allowed to use these roads, but vehicle damage or safety problems may result from lack of clearance. These roads may also be closed seasonally. |
| E. | These roads are closed year round to the public with a gate, guardrail, or other removable barricade. These roads are open to justifiable administrative use and are maintained for travel of high clearance vehicles. |
| F. | These roads and their continued use are not causing resource damage. Brush will not be cut, and logs or rocks will not be removed unless resource damage is occurring. This lack of maintenance may eventually result in roads that are impassable to motor vehicles. These roads may have waterbars or other weatherization features. There would be no legal restriction on public use as long as no environmental damage occurs. This type of management is commonly referred to as "allow to close naturally" or maintenance level "2/1". |
| G. | These roads and their continued use have resource concerns and will be closed to the public year-round. Active measures will be taken to mitigate the damage caused by the road prism itself. Access will be denied by closure devices, natural barricades, or removal of culverts. In some instances roads may be scarified and seeded or planted, but will remain on the system for potential use in the future. |
| H. | These roads will be closed year round and will be converted to trails when funds become available. Roads needed for management activities within the next 20 years that do not have resource concerns will not be converted to trails. |
| O. | These roads have resource concerns, are in conflict with management guidelines, are not needed for management activities within the next 20 years, or are no longer discernable as a road. They will be decommissioned and removed from the road system. |