Botanical Report for the Middle Santiam Watershed

Alice C. Smith
March 1996

Table of Contents

Introduction

Disturbance is a natural and integral part of the forest ecosystem. Floods, mass soil movement and wildfire were probably the most important natural disturbance agents operating in the watershed over the past millennium. However, in the past 100 years, management activities have confounded natural disturbance regimes and have altered ecosystem functioning. For instance, the pattern of timber harvest has affected the diversity and distribution of plant species as well as the age class distribution of forested plant communities. Timber harvest and associated road building have decreased and fragmented habitat for old-growth related plants and fungi, while simultaneously increasing habitat for invasive non-native plants. Species composition in riparian areas has been altered and simplified by the early seral conditions that follow timber harvest and the planting of a single tree species. Some special habitats (non-forested communities) have been permanently altered by roads, rock quarries, and the introduction of non-native plant species.

The Middle Santiam Wilderness, composed primarily of late successional forest, acts as a reservoir of habitat for old-growth related species. However, corridors of late-successional forest habitat leading to other areas within and out of the watershed are limited. Complete harvest of the private industrial lands in the west half of the watershed, extensive harvest of private and federal lands in the checkerboard, and fragmentation of forests east of the Middle Santiam Wilderness has resulted in dispersal barriers for many species.

Data Gaps

The botanical information in this report is based on existing records, literature, survey information and qualitative analysis. Information is limited on several topics in this report and extensive data gaps exist. The known distribution of rare plants is based on surveys that cover only about 15% of the federal lands in the watershed. Special habitats have recently been mapped on GIS but accompanying data has not been entered into the database. Surveys for noxious weeds have been limited to a few species, and no surveys have been done for species on the survey and manage list (ROD Table C-3 1994). Reconstruction of historical vegetation patterns prior to 150 years ago is based on sketchy information. Given this lack of information, some of the key questions are not definitively answerable.

Habitat Connectivity for Late Successional Species

Connectivity and Corridors

Many of the species inhabiting late-successional forests stands have limited dispersal capabilities. Corridors of late successional forest habitat allow for reproduction between populations, maintaining and enhancing genetic diversity, and serve as a hedge against catasptophic disturbance. Habitat for late successional forest species, including lichens, fungi and bryophytes

among others, has declined in the watershed due to harvest of old-growth stands and associated road-building. Late-successional forest has almost been eliminated from the private lands in the western portion of the watershed and in the checkerboard. Federal lands in the checkerboard have also been heavily harvested and contain little late successional forest. Riparian reserves in these areas are not functioning as corridors for late successional species. Riparian forests were harvested along with adjacent stands and replanted with a single species, simplifying what is normally a species rich community. The remaining old-growth in the watershed is concentrated on federal lands in the Middle Santaim Wilderness and east into the Pyramid Creek subwatershed. Old-growth forests outside and east of the wilderness are fragmented, particularily in the Scar Mountian area. Small fragmented stands, such as leave strips between units, are suseptable to windthrow and other agents of edge creep, which reduces their ability to function as corridors. Harvest units that are still in an early seral stage may be too wide for some species to disperse across. Geneflow is restricted as populations of species with limited dispersal abilities are isolated. Some species may be able to persist as adults in fragmented or isolated stands but are unable to reproduce under these conditions. The lack of corridors makes these species susceptible to catastrophic disturbance, such as wildfire.

Development of a corridor along the Middle Santiam River east of the wilderness boundary is problematic due to alternating sections of private land. Acquiring land suitable for the eventual re-establishment of riparian and late-successional corridor should be a priority. Restoration of riparian reserves on federal land will aid in their eventual corridor role. Restoration activities include planting a mix of species including Pacific yew, bigleaf maple and western red-cedar to facilitate development of habitat for bryophytes and lichens. Other possibilities include precommercial and commercial thinning to enhance the above tree species, creation of snags, and uneven aged management of stands. Transpanting dispersal-limited species, such as foliose lichens, into designated corridors or riparian reserves may also be an option.

Survey and Manage Species: fungi, bryophytes, lichens and vascular plants

The ROD and S&G for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (USDA and USDI 1994) contains a species list, survey strategies, and guidelines for managing a large number of species that have been given little consideration in past forest management: fungi, lichens and bryophytes, as well as some vascular plants and a number of animals. These species are generally associated with late-successional forests. The Regional Ecosystem Office (REO) is collating location information and survey protocals. The location database was released in 1995; survey protocals are due out in 1996. Survey strategies include the following:

Survey strategy 1: manage known sites;
Survey strategy 2: survey prior to activities and manage sites;
Survey strategy 3: conduct extensive surveys and manage sites;
Survey strategy 4: conduct general regional surveys.

Activities implemented in 1995 and later must include provisions for known sites if the species is under survey strategy 1. For species under survey strategy 2, activities implemented in 1999 or later must have completed surveys. Survey strategies 3 and 4 are more general and must be underway in 1996. Surveys have not been initiated for the vast majority of these species. Mitigation measures for these species can be found in Appendix J2 of the FSEIS (Holthausen et al. 1994).

The locations that are documented in the Middle Santiam watershed are from incidental sightings and from research done by Steve Sillett (1995) in the Middle Santiam Wilderness. Appendix J2 of the FSEIS (Holthausen et al. 1994) provides descriptions of the habitat and range of many of these species. Table 1 lists those survey and manage species documented in the watershed.

Table 1: Survey and manage species documented in the Middle Santiam watershed.

Category	Species	Subwatershed	Survey Strategy
Rare leafy lichen	*Tholurna dissimilis*	Upper MidSantiam	1,3
Nitrogen-fixing lichens	*Lobaria oregana*	Knob Rock, Pyramid	4
	Lobaria pulmonaria	Knob Rock	4
	Lobaria scrobiculata	Knob Rock	4
	Nephroma bellum	Knob Rock	4
	Nephroma helveticum	Knob Rock	4
	Nephroma parile	Knob Rock	4
	Panneria saubineti	Knob Rock	4
	Pseudocyphellaria anomala	Knob Rock	4
	Pseudocyphellaria anthraspis	Knob Rock	4
	Pseudocyphellaria crocata	Knob Rock, Pyramid	4
	Stricta fuliginosa	Knob Rock	4
Rare N-fixing lichens	*Nephroma occultum*	Knob Rock	1,3
	Pseudocyphellaria rainierensis	Knob Rock, Pyramid	1,2,3
Rare oceanic influenced lichen	*Hypogymnia oceanica*	Pyramid Creek	1,3
Bryophytes	*Antitrichia curtipendula*	Knob Rock	4
		Knickerbocker	
	Douinia ovata	Knob Rock	4
Vascular plants	*Allotropa virgata*	Upper Mid-Santiam	1,2
	Botrychium montanum	Pyramid Creek	1,2

Discussion of Survey and Manage Species Groups:

Fungi:

Fungi are critical components of the forest ecosystem. Some are saprobes, decomposers of fallen trees and litter, that release nutrients and break down the physical structure of wood so it can be inhabited by bacteria and insects. Other fungi are pathogens that rely on live trees and may eventually kill their hosts. The beneficial aspects of fungal pathogens in forest ecosystems have recently come to light. Laminated rootrot (*Phellinus weirii*), the bane of traditional foresters, increases both structural and species diversity at stand and landscape levels (van der Kamp 1991). As pockets of Douglas-fir die of root rot, other species that are more tolerant of the disease, including western hemlock and hardwoods, replace Douglas-fir. Hardwoods support an abundance of bryophytes and lichens that provide habitat for invertebrates, as well as food and nesting habitat for vertebrates. The fallen Douglas-fir logs are broken down by decomposers and microbes and provide habitat for amphibians, small mammals, and insects, including carpenter ants, which are the main food source for pileated woodpeckers (Maser and Trappe 1984, Beckwith and Bull 1985). Down logs act as sponges, retaining water through the summer, and are a good substrate for plant roots and their associated mychorrizal fungi (Perry undated). Many of the survey and manage fungi are mycorrhizal: they form a relationship with vascular plants in which the fungus transfers nutrients in return for energy supplied by the plant. Mycorrhizal fungi thus reduce nutrient leaching by tying up released nutrients and transferring them to vascular plants. Some of the rare vascular plants in the watershed are absolutely dependent on mycorrhizal fungi for their survival, and most plant species in old-growth forests rely on mycorrhiza to some extent. Mushrooms, conks, and truffles are fruiting bodies of fungi. These fruiting bodies concentrate minerals and many are eaten by small mammals that subsequently disperse the fungal spores in their fecal pellets (Maser et al. 1978, Trappe and Luoma 1992). Edible mushrooms are a major special forest product and some fungi are harvested for medicinal use.

It is estimated that there is habitat for 181 of the 237 species of survey and manage fungi in the watershed, however, no surveys have been done and habitat information is still limited.

Lichens

Lichens are organisms that contain both a fungal component and a photobiont, which may be alga, cyanobacteria, or both. Lichens have a number of different growth forms and occupy many substrates. They may be epiphytes hanging on trees, colorful disks imbedded in rocks, or leaf-like, growing flat on mineral soil. Lichens absorb water and nutrients from the air; they accumulate sulfur, metals and other air pollutants in their tissue, which makes them useful in air quality monitoring, but also makes them susceptable to air pollution. Lichens that contain cyanobacteria are able to fix nitrogen from the atmosphere; when they fall to the ground and decompose the nitrogen becomes available to other organisms. Nitrogen-fixing lichens are most abundant in old-growth forests and are virtually absent from young stands (Neitlich 1993). A study in the H. J. Andrews Experimental Forest found that lichens contribute approximately16 pounds of nitrogen per acre per year to the forest ecosystem (Neitlich 1993). Lichens also provide forage and nesting material for a variety of animals. Flying squirrels, a prey species for

northern spotted owls, depend on lichens for winter forage. Black-tailed deer and elk also utilize lichens for winter forage. Further, 19 bird species of the west Cascades utilize lichens in their nests (Neitlich 1993). Lichens have been harvested for their medicinal qualities, as well as for dye-making and floral arrangements.

Fifteen of the 81 lichens in the survey and manage list are documented in the Middle Santiam watershed. There is habitat for an additional 51 lichens on the list, however, no surveys have been initiated. The nitrogen-fixing lichens are probably prevalent in old-growth forests wherever they occur in the watershed. Based on their habitat requirements, these species are likely to be absent or rare on the private lands in the western portion of the watershed, and rare in the heavily harvested checkerboard. Iron Mountain is the only known site in Oregon of the rare leafy lichen, *Tholurna dissimilis*. This species grows on windswept trees on high ridges and in the upper canopy of old-growth trees (Holthausen et al. 1994). The site is within the Iron Mountain/Echo Mountain Botanical Special Interest Area.

Two rare nitrogen-fixing lichens (*Nephroma occultum* and *Pseudocyphellaria rainierensis*) are found in the watershed; these are located in the Middle Santiam Wilderness and in old-growth forest to the east of the Wilderness. *Nephroma occultum*, known as the cryptic paw, has been found at only 5 or 6 sites in the United States. *Pseudocyphellaria rainierensis*, the old-growth specklebelly, typically inhabits understory trees and the lower canopy of late-successional forests. This species has been found at six sites in Oregon, two of which are in the Middle Santiam watershed. Another rare lichen found in the watershed is *Hypogymnia oceanica*, the lattice bone. This species is thought to have a primarily coastal distribution in SE Alaska and British Columbia. It is speculated that the maritime microclimates in old-growth forests may mimic its usual coastal habitat (Holthausen et al. 1994).

Bryophytes

Bryophytes are nonvascular plants that include the liverworts and mosses. These species absorb water and nutrients into their tissues from rain and fog, and like lichens, accumulate air pollutants. There are 23 species of mosses and liverworts in the survey and manage list. Habitat for 14 of these species occurs in the watershed. Nine of these are either restricted to, or often found in, riparian areas. Two species (*Antitrichia curtipendula* and *Douinia ovata*) are documented in the watershed. *Antitrichia curtipendula* is a moss thought to be particularily important in water retention, nutrient cycling and maintenance of microclimate. It inhabits riparian zones and forest canopies where it often forms a sleeve around the limbs of trees. This species is declining in Sweden from air pollution and it is thought that populations in low elevations in the Pacific Northwest will decline for the same reason (Holthausen et al. 1994). This species is also one of several that make up what is genericly described as "vine maple moss", a special forest product that has been heavily harvested in other watersheds. This species has no doubt declined in the watershed due to extensive harvest of its habitat, particularily on private lands. *Douinia ovata* is a liverwort found in the forest canopy and on rock outcrops subject to fog interception (Holthausen et al. 1994). This species is also susceptible to air pollution and has most likely declined in the watershed due to loss of habitat.

Vascular Plants

Habitat for seven of the 16 vascular plants on the survey and manage list is found in the watershed. Two of these seven are already documented in the Middle Santiam: *Allotropa virgata*, and *Botrychium montanum*. *Botrychium* is discussed in this document under Sensitive Plants and will not be addressed further.

Allotropa virgata (candystick) is an achlorophyllous, mycotrophic plant that inhabits dry soils under a closed canopy in pole, mature or old-growth forests. It is dependent on its mycorrhizal association with fungus, which transfers energy and nutrients from the soil and an adjacent photosynthetic plant to *Allotropa*. This species is commonly called candystick for its dramatic red and white striped stems. Plants may not flower every year, instead, may remain dormant underground. *Allotropa* does not tolerate competition with other plants and appears to be associated with decaying logs. Thinning may be detrimental to this species because it results in increased competition in the understory, reduces coarse woody debris, and may result in mechanical disturbance to the ground (Holthausen et al. 1994). *Allotropa* is documented at two locations in the Middle Santiam watershed; both are in Matrix. There is abundant habitat for this species on dry, south and west aspects above the Middle Santiam River and elsewhere in the watershed.

Special Habitats, Special Areas, and Rare/ Uncommon Forested Plant Associations

Special Habitats

The occurrence of special habitats (non-forested communities) and their distribution across the landscape is important for biodiversity of plant and animal species. Eighty-five percent of the flowering plants in the central western Cascades are found in non-forested areas such as rock outcrops and meadows which comprise only about five percent of the landbase (Hickman 1976). Forestwide standard and guideline FW-211 directs us to protect these habitats and their ecotones. Many sensitive plant species and other plant species of concern are associated with these habitats and are thus protected along with the overall biodiversity in these communities. The Special Habitats Management Guide (WNF 1992) provides descriptions of each special habitat and lists the wildlife that is associated with them. The guide provides a methodology for inventory, mapping and databasing information as well as providing management prescriptions.

Special habitats have been mapped and are being digitized into GIS, however, the accompanying data will not be input in time to use for this analysis. The following is a qualitative assessment of the occurrence and distribution of special habitats in the watershed.

The distribution of special habitats in this watershed is skewed toward higher elevations. Most of the larger special habitats are associated with old Cascade peaks, including Iron Mountain, Cone Peak, Echo Mountain, and the Three Pyramids. Some of these peaks host a wide array of community types and thus provide habitat for a great diversity of plants and animals. Special habitats are rarer at low elevations on the west end of the watershed. Rock outcrops and cliffs are well distributed throughout most of the watershed. Dry rock gardens are associated with some of these rock formations, for instance, on Iron Mountain and Cone Peak. Moist rock gardens are far less common. Sitka alder communities are located on the north slopes of old Cascade peaks but are relatively uncommon in the watershed.

The Middle Santiam watershed contains a significant number of wetlands. Lakes, ponds, sedge meadows and wet meadows are common in the Pyramid subwatershed and scattered throughout the rest of the watershed. Bogs, with their characteristic *Sphagnum* and sundew (*Drosera* spp.) communities, are rare in this watershed as they are in others. There are two bogs documented in the watershed. The floating bog in Parish Lake is an outstanding example of this wetland type. It harbors a diverse plant community, including the rare American scheuchzeria (a Region 6 Sensitive Species), and white beakrush and great sundew, both of which are uncommon (refer to Tables 3 and 4). The second bog is adjacent to the 2266 road approximately one half mile northeast of Parish Lake.

Scattered mesic meadows are found in the Middle Santiam but are not common; these are good sites for collection of native grass seed, which is grown out and used as stock for revegetation projects.

Special habitats have been disturbed in areas of past timber harvest. Forty-seven percent of the special habitats on federal land in the watershed are in or adjacent to roads or harvest units. Most of these occur in the Upper Middle Santiam and Pyramid Creek subwatersheds. Special habitats in subwatersheds that are primarily privately owned (Cougar, Tally Creek, and Knickerbocker) are surrounded by harvest stands. Rock outcrops and rock gardens have been used as quarries if the rock was suitable and road-building was occurring in the area. Cliffs and rock outcrops have been convenient boundaries for harvest units and have served as efficient fuel breaks during slash burning. The effects of timber harvest and broadcast burning on rock communities is substantial, though not well documented. Many species that inhabit these communities are slow growing, particularly the lichens, and little is known about their rates of establishment. Non-native plants that invade harvest units and roads become established and proliferate in special habitats, outcompeting native vegetation. Small wetlands within harvest units have also been impacted by removal of the adjacent tree canopy and subsequent changes in the hydrology and species composition. Aerial photos have documented the effects of timber harvest on ponds, some of which dry up after the canopy is removed. Only recently have buffers been retained around special habitats in an effort to reduce microclimatic changes and direct physical disturbance. Many wetlands in the Pyramid Creek subwatershed were impacted by windthrow in the 1990 windstorm which hit the fragmented landscape of the Scar area particularly hard. Restoration opportunities abound in this portion of the watershed.

Rare and Uncommon Forested Plant Associations

Rare and uncommon forested plant associations contribute to the watershed's diversity of community types. These communities may reflect unusual environmental conditions or be at the northern or southern extent their range (Dimling and McCain 1992). Plant associations that are known from five or fewer sites on a district are considered rare. Plant associations known from 6-11 sites on a district are uncommon. In some instances, the designation rare-uncommon was used if the status was unclear. On-going field observations are needed to verify plant association rarity. Rare-uncommon plant associations are treated as special habitats and should be maintained as recommended in the Special Habitats Management Guide (WNF 1992).

Two rare-uncommon and two uncommon forested plant associations have been identified in the Middle Santiam watershed from ecoplot data (Table 2).

Table 2: Rare/uncommon forested plant associations in the Middle Santiam watershed.

Series	Plant Association	Rarity	Location	Ecoplot
Mountain hemlock	TSME/VAME/XETE	U	T.12S., R.04E., Sec. 4	373
Western hemlock	TSHE/LIBO2	R-U	T.12S., R.05E., Sec 23	6887
	TSHE/ACTR	R-U	T.12S., R.05E., Sec 26	6883
	TSHE/RHMA/LIBO2	U	T.13S., R.05E., Sec 12	46

Special Areas

Iron Mountain/Echo Mountain Botanical Special Interest Area

The Iron Mountain/Echo Mountain SIA harbors an incredible array of plants. Over 300 flowering plants are found on Iron Mountain alone (Ross and Chambers 1988). Only the east and north aspects of Iron Mountain, Cone Peak and Echo Mountain are in the Middle Santiam watershed. A plant list for this area has been initiated. The Iron Mountain and Cone Peak trails receives heavy hiker traffic during the wildflower season. The Friends of the Iron Mountain Area implements an interpretive program on Iron Mountain during the summer months and helps maintain the trail and facilities. An implementation guide for this SIA is in draft form. The meadows on these peaks have likely been maintained by several disturbance processes, including pocket gopher activity, needle ice formation, wildfire, climatic variability, and shallow soils. Tree encroachment is occurring and may necessitate the eventual use of prescribed fire or mechanical tree removal to help maintain these openings.

Middle Santiam Wilderness and Research Natural Area

The Middle Santiam RNA is located on the west side of the Middle Santiam Wilderness. Both areas are composed primarily of late-successional forest (400-500yrs) in the *Tsuga heterophylla* Zone (Franklin and Dyrness 1973). The RNA was established in 1979, prior to the designation as

Wilderness in 1984. The Wilderness, at 8533 acres and ranging from about 1500 to 4965 feet in elevation, is home to many old-growth related species, inluding many on the survey and manage list (refer to Table 5). Windthrow along the west edge of the Wilderness (and the RNA) has occurred due to the large area of private cutover lands directly west of the Wilderness. The forests on this private land were clearcut in the 1980's. Given this recent harvest, the unravelling of this edge is likely to continue for many years to come. Weed species are increasing in the RNA and Wilderness. This problem is further discussed on page 16 of this document.

Daly-Parish Lakes Special Interest Area
The Daly-Parish Lakes SIA is 405 acres in size and contains two lakes and many wetlands. The two bogs located in this watershed are both in the SIA, along with several ponds and wet meadows. The lakes are easily accessed from well-maintained roads and get high visitor use in the summer and fall. Recreational camping sites at both lakes are in need of restoration. Parish Lake contains a prime example of a floating bog and an associated diverse assemblage of plant species, some of which are quite rare. The bog can be accessed at either end by old semi-submerged logs. Fishermen use the bog to access a large area of the lake, leaving behind fishing line and bate containers. Walking on the bog should be discouraged with appropriate interpretive signing, removal of the access logs, or both.

Rare Plants in the Middle Santiam Watershed

Sensitive Plants

The purpose of the Sensitive Plant Program is to protect rare species so that they will not need to be listed as threatened or endangered under the Endangered Species Act. Species on the Region 6 Sensitive Plant List are afforded protection to avoid losses resulting from direct or indirect effects of management activities. Sensitive species often have very specific habitat requirements or may be at the edge of their range. The Oregon Natural Heritage Program (ONHP) maintains several lists of plants based on rarity: List 1 contains species which are endangered or threatened throughout their range. List 2 contains species that are threatened or endangered in Oregon but are more common or stable elsewhere. Species found on the ONHP Lists 1 and 2 are placed on the Region 6 Sensitive Plant List.

Five plant species that are on the Region 6 Sensitive Plant List have been found in the Middle Santiam watershed (Table 3). Most of these sensitive species occur in non-forested habitats, such as wetlands and rock gardens. The exception to this is western goblin (*Botrychium montanum*). Habitat for an additional 20 sensitive plant species occurs in the watershed. Approximately 15% of the Forest Service land in the watershed has been surveyed for sensitive plants, mostly in conjunction with proposed timber sales and other projects. Surveys for rare plants have not been done within the Middle Santiam Wilderness, nor on private lands in the watershed.

Table 3: Sensitive Plants Located in the Middle Santiam Watershed.

Scientific name	Common name	# of pops.	Subwatershed	ONHP status
Aster gormanii	Gorman's aster	1	Upper Mid-Santiam	1
Botrychium montanum	western goblin	1	Pyramid Creek	2
Ophioglossum pusillum	adder's-tongue	1	Pyramid Creek	2
Romanzoffia thompsonii	Thompson's mistmaiden	1	Upper Mid-Santiam	1
Scheuchzeria palustris var. *americana*	American scheuchzeria	1	Pyramid Creek	2

Other Plant Species of Concern

In addition to those species that are sensitive, there are two plant species on the Review List and five plant species on the Willamette National Forest Concern List documented in the watershed (Table 4). The Review List contains species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range. The Willamette National Forest maintains a Concern List for locally rare species that are not included in the above list. As with the sensitive plants, most of these species are associated with riparian areas or special habitats, including but not limited to, wet meadows, rock outcrops, cliffs and talus.

Table 4: Plant Species of Review and Concern Located in the Middle Santiam Watershed.

Scientific name	Common name	# of pops.	Subwatershed	Status
Botrychium virginianum	rattlesnake fern	1	Upper Mid-Santiam	Concern
Brickellia grandiflora	large-flowered brickellia	1	Pyramid Creek	Concern
Castilleja rupicola	cliff paintbrush	2	Pyramid Creek Upper Mid-Santiam	Review
Douglasia laevigata	smooth douglasia	3	Pyramid Creek Upper Mid-Santiam	Review
Drosera anglica	great sundew	1	Pyramid Creek	Concern
Orobanche pinorum	pine broomrape	1	Upper Mid-Santiam	Concern
Rhynchospora alba	white beakrush	1	Pyramid Creek	Concern

Discussion of Sensitive Plants

Gorman's aster (*Aster gormanii*)
Gorman's aster is a candidate for federal listing as threatened or endangered (Catagory 2). This species occurs only in the Cascade Range of Oregon from Iron Mountain on the Willamette National Forest north onto the Mt. Hood National Forest and west on the BLM Salem District. Gorman's aster generally occurs in non-forested openings on shallow and well drained soils and scree, at elevations ranging from 3900 feet to 6000 feet. It is a long-lived herbaceous perennial in the sunflower family. This aster exhibits extensive rhizomitous growth, and individual plants may have over 100 stems. Its flowering period lasts anywhere from late July through mid-September depending on the site. Gorman's aster appears to have extremely poor seedling recruitment, low adult mortality, and low production of viable seeds. A Conservation Strategy for this species was completed in 1994.

The southern-most population of Gorman's aster is found in the Middle Santiam watershed on the northeast slope of Iron Mountain. This population is growing on a steep, ravelly scree slope that makes monitoring difficult without negatively impacting the habitat. It was discovered in 1979 and described as being well over 50 mats (Fitz, sighting report on file). A census of the population conducted in 1990 found 43 mats. Further censusing is needed to determine if indeed the population is declining. Habitat for Gorman's aster is uncommon in the watershed and most of it has been surveyed in the past five years. Additional populations are not likely to be found in the Middle Santiam. Populations have been found outside this watershed on the Middle Pyramid and Crescent Mountain.

Western goblin (*Botrychium montanum*)
Western goblin is a primitive fern found associated with western red-cedar (*Thuja plicata*) or incense cedar (*Calocedrus decurrens*) at 3000-4000 feet in elevation. This species is included in the list of survey and manage species (Table C-3) of the Record of Decision and Standards and Guidelines for Management of Habitat for Late Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. There is one small population located in the Late-Successional Reserve within the watershed; it is one of two populations known to occur on the Willamette National Forest. This population is located in a small western red-cedar grove in a narrow stand beween two clearcuts which makes the stand susceptable to windthrow. Several of the largest cedars in the stand were blown down in the 1990 windstorm and an additional tree came down in 1994. The stand is clearly unravelling, however, what effect this change to the habitat has on the western goblin is not known. This species is dependent on mycorrhizal fungi; gametophytes must be infected with the fungus soon after germinating to survive. The complex life cycle of moonworts makes it difficult to determine population trends in the absence of long-term data, however, intensive monitoring of this population has been done for the past three years and will eventually lead to a better understanding of population trends.

Habitat for western goblin is limited in most of the watershed. Past harvest of old-growth forest in the elevational band occupied by the western goblin has significantly reduced its habitat. Also, western-red cedar near forest roads has often been harvested in small sales for use as cedar shakes. Suitable habitat can still be found in the Knob Rock and Pyramid Creek subwatersheds. Remaining stands containing a significant amount (50%) of western red-cedar or incense cedar should be inventoried and retained throughout the watershed as potential habitat. Planting western red-cedar in degraded riparian areas would initiate the development of habitat for this species.

Adder's-tongue (*Ophioglossum pusillum*)
Adder's-tongue is a fern with a circumboreal distribution that inhabits pond margins and wet meadows. Each individual produces a single frond that can be easily overlooked amoung the sedges and other wetland vegetation. There are five populations documented on the Willamette National Forest, two of which are on the Sweet Home Ranger District. One population occurs in the watershed on the edge of a small pond near Gordan Peak. Population size is estimated at 200-300 individuals, however, yearly monitoring has not been done. Adder's-tongue is dependent on mycorrhizal fungi and although individuals are perennial, they may not emerge every year. An interagency Conservation Strategy is being developed for this species. Habitat for adder's-tongue is prevalent in the watershed, particularly in the Pyramid Creek subwatershed.

Thompson's mistmaiden (*Romanzoffia thompsonii*)
Thompson's mistmaiden is found in seepy areas on open, rocky, south-facing slopes. This small annual plant is a local endemic, found only within a narrow geographic range on the west side of the Cascades, mostly on the Willamette and Umpqua National Forests. Iron Mountain, Cone Peak, and Browder Ridge are at the center of its distribution. There is one population in the Middle Santiam watershed, located several miles west of the South Pyramid. Habitat for this species is very specific and is not common in the watershed, nor was it likely common historically. The invasion of non-native plants into its habitat is currently a concern. St. John's-wort (*Hypericum perforatum*) is a highly competitive noxious weed that is invading a population of Thompson's mistmaiden on Iron Mountain. Any change in the hydrologic flow upslope from populations may adversely affect this species.

American Scheuchzeria (*Scheuchzeria palustris var. americana*)
Scheuchzeria inhabits sphagnum bogs and lake margins above 3000 feet in elevation. It occurs from Alaska south to California and in eastern North America. Scheuchzeria is a perennial plant with rhizomes. It is classified in its own family (Scheuchzeriaceae), which is closely allied with the rush family. Its vegetative appearence is rush-like, but its inflated follicle fruits are quite distinctive. Scheuchzeria blooms in June and July.

On the Willamette National Forest, scheuchzeria has been found at four locations, two of which are on the Sweet Home Ranger District. One of these populations is in the Middle Santiam watershed at Parish Lake. The Parish Lake population consists of three subpopulations, one is on a floating bog at Parish Lake, another is at a bog about 1/4 mile northeast of Parish Lake, and the third is located in a wetland 1/4 mile south of Parish Lake. This third subpopulation is adjacent to a clearcut harvested in the mid-1980's. The clearcut is directly south of the wetland and no doubt greatly increased its exposure to wind and solar radiation. The scheuchzeria population was not discovered until 1990 making it difficult to ascertain the impact of the adjacent timber harvest to the population and its habitat. This wetland is also heavily used by elk in the summer.

Noxious Weeds and Invasive Non-native Plants

Noxious weeds and other invasive non-native plants are a threat to native plant diversity. These species originate from other continents and are able to displace and outcompete native species because they arrive without the host of predators, disease, and other ecosystem components that limit their abundance in their homeland. Noxious weeds also reduce the quality and quantity of forage available for animals because many of these weeds are toxic or otherwise unpalatable.

The Middle Santiam watershed has a moderate abundance and diversity of non-native plants as compared to other watersheds on the district. A long history of logging and roading, along with large amounts of private timber lands, have led to weed establishment. Thirty-one species of non-native plants have been documented in the Middle Santiam watershed (Table 5). Five of these non-native species have been legally designated as noxious, which is defined as "species of plants that cause disease or are injurious to crops, livestock or land, and are thus detrimental to agriculture, commerce or public health" (USDA 1988). The ecological impact of non-native plants to the native flora has not been a criteria for noxious weed designation.

Table 5: Noxious weeds and invasive non-native plants found in the Middle Santiam watershed.

Common name	Scientific name	Biological control?	Occurrence
common centaurium	*Centaurium umbellatum*	no	patchy
ox-eye daisy	*Chrysanthemum leucanthemum*	no	widespread
Canada thistle	*Cirsium arvense*	yes	widespread
bull thistle	*Cirsium vulgare*	yes	widespread
hedgehog dogtail	*Cynosurus echinatus*	no	patchy
Scotch broom	*Cytisus scoparius*	yes	patchy

Common name	Scientific name	Biological control?	Occurrence
Queen Anne's-lace	*Daucus carota*	no	patchy
foxglove	*Digitalis purpurea*	no	patchy
annual fleabane	*Erigeron annuus*	no	patchy
St.John's-wort	*Hypericum perforatum*	yes	widespread
spotted cat's-ear	*Hypochaeris radicata*	no	widespread
bearded iris	*Iris* sp. or hybrid	no	isolated
wall lettuce	*Lactuca muralis*	no	widespread
prickly lettuce	*Lactuca serriola*	no	patchy
nipplewort	*Lapsana communis*	no	patchy
coast tarweed	*Madia sativa*	no	isolated
reed canarygrass	*Phalaris arundinacea*	no	patchy
English plantain	*Plantago lanceolata*	no	widespread
common plantain	*Plantago major* var. *major*	no	patchy
selfheal	*Prunella vulgaris* var. *vulgaris*	no	patchy
Himalaya blackberry	*Rubus discolor*	no	patchy
evergreen blackberry	*Rubus laciniatus*	no	patchy
red sorrel	*Rumex acetosella*	no	patchy
curly dock	*Rumex crispus*	no	patchy
tansy ragwort	*Scenecio jacobaea*	yes	widespread
common tansy	*Tanacetum vulgare*	no	isolated
dandelion	*Taraxacum offinale*	no	patchy
salsify	*Tragopogon* sp.	no	patchy
red clover	*Trifolium pratense*	no	patchy
common mullein	*Verbascum thapsus*	no	isolated
veronica	*Veronica serpyllifolia*	no	patchy

Invasion and Establishment

Many non-native species are colonizers of exposed mineral soil. Soil disturbance, whether natural or anthropogenic, is generally required for these species to get established. Timber harvest and associated road building provide good conditions for weed establishment (USDA 1988). Seeds may be carried in by vehicles, logging equipment, or as contaminates in erosion control and forage seed mixtures. The increased light found along roadsides, combined with continued disturbance from traffic, allow roads to serve as corridors for weed invasion (Parendes 1994). Landslides and road failures open up new habitat and carry existing weed seed downstream to new locations. Once established, many weed species are dispersed by wind-blown seed and invade open, disturbed sites such as timber harvest units. Birds and other animals may also spread non-native plants by eating the seed and dispersing it elsewhere. Road maintenance activities, such as brushing and ditching, sustain the light and disturbance required by these species, and serve to spread the weeds if the soil and plant material is deposited in another area.

Most of the weed populations found in the Middle Santiam watershed are located on roadsides, landings, clearcuts, and along trails. However, several weed species have been observed invading rock garden and dry meadow communities. Small-scale disturbance mechanisms, for example, gopher burrowing, appear to enhance the spread of weeds in these natural openings. These communities are often botanically rich which makes the invasion of highly competitive weeds a noteable concern. Other weed species are apparently well-suited for invading forested stands. Wall lettuce (*Lactuca muralis*) spreads by windblown seeds and is found throughout the district, including in forests of the Middle Santiam Wilderness and Research Natural Area. Presumably, natural disturbance factors, such as windthrow and mountain beaver activity, provide suitable sites for establishment.

Weed species are increasing in the Middle Santiam Wilderness and Research Natural Area. The large number of landflows in this watershed have increased habitat for non-native species. Landslides and fill failures expose mineral soil suitable for establishment by weedy species. As disturbed and weed infested soil is carried downstream, some of the sediment is deposited on the low gradient reaches of the Middle Santiam River. The large gravel bars that result are now host to at least nine species of non-natives that apparently arrived in contaminated soil from areas higher in the watershed. Another source of weeds in the Wilderness and RNA is the large cutover tract of private land to the west which acts as a reservior of early seral weedy species. Those that are spread by windblown seed (thistles, for example) disperse on the prevailing westerly winds into disturbed sites in tthe RNA.

Isolated populations of non-native blackberries (*Rubus discolor* and *R. lasiniatus*) have been found adjacent to roads in the Upper Mid-Santiam subwatershed. These species are extremely invasive; they have been documented at over 100 sites on the district, mostly in the adjacent South Santiam watershed. It is likely that the actual number of sites is much greater because a

systematic survey for non-native blackberries has not been done. It is apparent that they are now invading the Middle Santiam watershed via roads that enter the watershed from the South Santiam. It has been observed that blackberries are most likely to get established in moist microsites, for instance, under or between logs, and in areas that are seasonally wet, such as ditches and riparian areas. Blackberries spread vegetatively, growing roots at the end of their canes during the winter when vegetative growth is minimal and soils are more easily penetrated. There are no biological controls available for blackberries and manual removal is difficult, particularly once the plants are well-established. The ability of blackberry to spread beneath a forest canopy, rather than remaining in open, disturbed sites, makes it a greater threat to native plant diversity than many of other weeds found in the watershed.

Weed Survey and Control

The Forest Service coordinates weed survey and control activities with the Oregon Department of Agriculture (ODA) Noxious Weed Program under a Region 6 memorandum of understanding. A survey for five noxious weed species in the watershed was done by the ODA in 1989. The results were recorded on a district map and kept in computer files. A follow-up survey needs to be done to determine population trends of these five species. Control strategies for noxious weeds are outlined in the Integrated Weed Management Plan Environmental Assessment (WNF 1993). Species classified as new invaders are given the highest priority for control. Control methods have included manual removal and the release of insects as biological control agents. Herbicides have not been used to control weeds on Forest Service lands in the Middle Santiam watershed for approximatety 10 years, however, the Integrated Weed Management Plan Environmental Assessment (WNF 1993) provides for the use of herbicides on new invaders.

Reducing soil disturbance in the watershed is probably the most effective preventative measure that can be done to curb the weed invasion. The lower levels of timber harvest and associated road building called for in the WNF Land and Resource Management Plan as amended by the ROD will likely decrease the spread of those non-native species that require disturbance and high levels of light to get established. Preliminary results of a study in H. J. Andrews Experimental Forest suggest that closing roads may reduce weed populations (Parendes 1994). Possible explanations include reduced disturbance and introduction of weed seeds from traffic and the decrease in light levels as the forest canopy closes (Parendes 1994). Allowing red alder (*Alnus rubra*) to invade closed roads limits the ability of roads to act as corridors for weed invasion. Many weed species decline in abundance in timber harvest units as the trees get bigger and the forest canopy is re-established.

Manual removal, which includes pulling or cutting, is expensive and time-consuming because it often must be done repeatedly in order to be effective. For these reasons, manual removal is generally only used when weed populations are isolated, are invading sensitive areas, or if the area is specifically being managed for forage production. Manual removal of isolated populations of non-native blackberries is recommended in this watershed.

Biological controls do not eradicate weeds but serve to slow their spread and stabilize populations over time. The insects used as biological control may reduce plant vigor or reduce the number of seeds produced by a plant. They are non-native insects that have evolved with the plant in its natural range. The insects are introduced after being tested by USDA-APHIS to see that they do not consume or inhabit non-target plants. There is some ecological risk to releasing these insects; despite testing, insect species can adapt to native plants. A risk assessment is completed to determine if the benefits of the biocontrol agent outweigh the risks of its release. The cinnibar moth (*Tyria jacobaea*) released for controlling tansy ragwort (*Scenecio jacobaea*) has repeatedly been observed consuming the native relative, arrowleaf groundsel (*Scenecio triangularis*). The ODA has recently begun monitoring to determine the extent of this problem (Miller, pers.comm.). Biological control agents are present on several noxious weeds in the Middle Santiam watershed, including tansy ragwort and St. John's-wort.

The use of herbicides is limited to new invaders that are isolated in distribution and cannot be controlled with manual removal or biological control agents. Species having these characteristics have not been found in the Middle Santiam watershed.

Riparian Reserves

The interim widths prescibed for the riparian reserves should be retained as a minimum at this time for several reasons. The survey and manage list (USDA, USDI 1994) contains many species that are associated with riparian areas, particularly lichens and bryophytes. Riparian reserves were considered an intergral conservation measure for these species during the effects analysis of Option 9 (Holthausen et al. 1994). There are many species not listed in the survey and manage list that are also restricted to riparian areas. Riparian areas, with their better growing conditions, are quicker to attain characterisitics of old-growth forests than upland sites and thus are important for connectivity of old-growth related species, particularly in areas of the watershed that contain limited amounts of old-growth forest. Information on the distribution and life histories of riparian dependent species is very limited. No surveys for riparian survey and manage species have been conducted and survey protocals have yet to be developed. Finally, retention of interim riparian reserve widths at this time does not preclude management activities at some point in future when the habitat requirements of riparian species are better understood. Any management within riparian reserves should be done only to enhance structural and species diversity with the intent of increasing habitat suitability for riparian species in areas that have been biologically simplified, i.e., plantations.

The draft Terrestrial Ecology Addendum (1995) contains a list of species that must be considered prior to modifying riparian reserve boundaries. Species were deleted from this list if their ranges did not overlap the Middle Santiam watershed. Modifications were made only to the vascular plant portion of the list. Those marked with an asterisk are survey and manage species.

Bryophytes

*Kurzia makinoana**
Marsupella emarginata var. *aquatica**
*Scouleria marginata**
*Tritomaria exsectiformis**

Lichens

*Cetrelia cetroides**
*Collema nigrescens**
*Dermatocarpon luridium**
*Hydrothyria venosa**
Leptogium burnetiae var. *hirsutum**
*Leptogium cyanescens**
*Leptogium rivale**
*Leptogium saturninum**
*Leptogium teretiusculum**
*Platismatia lacunosa**
*Ramalina thrausta**
*Usnea longissima**

Fungi

*Galerina sphagnicola**
*Helvella compressa**
*Helvella crassitunicata**
*Helvetta elastica**
*Helvetta maculata**
Polyozellus multiplex
*Phlogiotis helvelloides**
*Rickenella setipes**

Vascular Plants

Adiantum pedatum
Aralia californica
Asarum caudatum
*Botrychium minganense**
Cimicifuga elata
*Coptis trifolia**
*Corydalis aguae-gelidae**
Dryopteris austriaca
Gymnocarpium dryopteris
*Habenaria orbiculata**
Habenaria saccata
Lysichiton americanum
Menziesia ferruginea
Mitella breweri
Mitella caulescens
Mitella ovalis
Mitella pentandra
Poa laxiflora
Scoliopus hallii
Streptopus amplexifolius
Streptopus roseus
Taxus brevifolia
Thuja plicata
Tiarella laciniata
Tiarella unifoliata
Vaccinium membranaceum
Viola glabella

Summary of Botanical Restoration Opportunities for the Middle Santiam Watershed

In addition to the following specific projects or recommendations, it is assumed that progress will be made toward filling data gaps that exist for this watershed as well as others on the district. Surveys for sensitive plants will continue at the project level, as will monitoring of known sensitive plant populations and development of Conservation Strategies for these species; inventories for survey and manage species will commence once protocols are developed; special habitats mapped through the use of aerial photos will be field verified; noxious weeds will be controlled in a manner consistant with the Integrated Weed Management EA; the collection and propagation of native species will continue for use in restoration projects.

Habitat Connectivity and Late Successional Forest Species

1. Restore corridors through aquisition of critical private lands and silvicultural practices that may enhance late-successional development and restoration of roads (refer to page 2).

Survey and Manage Species - specific mitigation measures for survey and manage species can be found in Appendix J2 of the FSEIS (1994). The following are some of the more general recommendations that can benefit many of these species simultaneously.

2. Retention trees in managed Matrix stands should be left both scattered and in clumps to aid in the retention and dispersal of epiphytes. These trees should be large, with large lateral branches and emergent crowns. The same retention trees need to be left over successive harvest rotations.

3. Plant a diversity of tree species, including Pacific yew and bigleaf maple, in plantations, particularly along riparian areas. These species support an abundance of bryophytes and lichens not found on typical plantation species.

4. Retain a diverstiy of tree species, including hardwoods, during precommercial and commercial thinning operations.

Special Habitats/Rare Forested PA's/Special Areas

5. Eradicate noxious weeds from the Iron Mtn./Echo Mtn. Botanical SIA.

6. Develop interpretive signing to educate users of Parish Lake to the sensitivity of the floating bog plant community.

7. Restore recreation sites at Parish Lake and Daly Lake using native vegetation.

Sensitive Plants

For *Botrychium minganense* and *B. montanum* (these are survey and manage species also):

8. Identify, inventory and retain stands with significant cover (>50%) of western red-

cedar or incense cedar.

9. Plant pockets of western red-cedar on moist, flat sites adjacent to wetlands and riparian areas to reinitiate habitat for these species; many of these sites have been harvested and replanted with Douglas-fir.

For *Scheuchzeria palustris* (American scheuchzeria)

10. Discourage people from walking on Parish Lake bog (see # 6).

11. Continue monitoring southern subpopulation for effects of adjacent timber harvest and elk use.

Noxious Weeds and Invasive Non-native Plants

12. Monitor the occurrance, distribution, and abundance of invasive non-native plants in the RNA and Wilderness.

13. Allow red alder to invade roadbeds as they are abandoned to shade out weedy species. Higher elevation roads that are not likely to revegetate quickly after closing should be seeded with native herbaceous species.

14. Complete a survey for non-native blackberries in the watershed and repeat the roadside weed survey done in 1989 to document changes in populations of the five species recorded in that survey.

15. Aggressively control non-native blackberries in areas of the watershed where they are not well-established using manual removal methods.

References

Beckwith, R. C. and E. L. Bull. 1985. Scat analysis of the arthropod component of pileated woodpecker diet. Murrelet 66:90-95.

Dimling, J. and C. McCain. 1992. Special Habitats Management Guide. Willamette National Forest. Eugene, Oregon.

Franklin, J. F. and C. T. Dyrness. 1973. Natural Vegetation of Oregon and Washington. Reprinted by Oregon State University Press, Corvallis, Oregon.

Hickman, J. C. 1976. Non-forest vegetation of the central western Cascade Mountains of Oregon. Northwest Science 50:145-155.

Holthausen, R. S., et al. 1994. Appendix J2 Results of the Additional Species Analysis. Final Supplemental Environmental Impact Statement for Late-Successional Species in the Range of the Northern Spotted Owl. USDA and USDI, Forest Service and Bureau of Land Management. Portland, Oregon.

Lellinger, D. B. 1985. A Field Manual of the Ferns and Fern-allies of the United States and Canada. Smithsonian Institution Press, Washington DC.

Maser, C. and J. M. Trappe. 1984. The seen and unseen world of the fallen tree. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, GTR-PNW-104.

Maser, C., J. M. Trappe and R. Nussbaum. 1978. Fungal-small mammal interrelationships with emphasis on Oregon coniferous forests. Ecology 59(4):799-809.

Miller, Glenn. 1995. Personal communication. Oregon Department of Agriculture, Noxious Weed Program, Salem, Oregon.

Neitlich, P. N. 1993. Lichen abundance and biodiversity along a chronosequence from young managed stands to ancient forest. Master's Thesis. University of Vermont.

Oregon Natural Heritage Program. 1993. Rare, threatened and endangered plants and animals in Oregon. Oregon Natural Heritage Program, Portland, Oregon.

Parendes, L. 1994. Preliminary report: patterns of invasion by nonnative plant species in the H.J. Andrews Experimental Forest, Blue River Ranger District, Willamette National Forest, Department of Geosciences, Oregon State University, Corvallis, Oregon.

Perry, D. Undated. The ecology of coarse woody debris in Pacific Northwest forests: overview, and the role of down logs in ecosystem processes. A report prepared for the spotted owl recovery team. Oregon State University, Corvallis.

Ross, Robert A. 1994. Personal communication. Linn Benton Community College, Albany, Oregon.

Ross, R. A., and H. L. Chambers. 1988. Wildflowers of the Western Cascades. Timber Press, Portland, Oregon.

Sillett, S.C. 1995. Branch epiphyte assemblages in the forest interior and on the clearcut edge of a 700-year-old Douglas fir canopy in western Oregon. The Bryologist 98(3):301-312.

Thomas, J.W. et al. 1993. Forest Ecosystem Management: an Ecological, Economic, and Social Assessment. Report of the Forest Ecosystem Management Assessment Team. USDA, USDI, and USDC, Portland, Oregon.

Trappe, J. M. and D. L Luoma. 1992. The ties that bind: fungi in ecosystems. In: The Fungal Community. Eds. G. C. Carroll and D. T. Wicklow. Marcel Dekker, Inc., New York.

USDA, USDI. 1994. Record of Decision and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Related Species Within the Range of the Northern Spotted Owl. Portland, Oregon.

USDA Forest Service. 1988. Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation. Pacific Northwest Region.

USDA Forest Service. 1993. Environmental Assessment for Integrated Weed Management Plan, Willamette National Forest.

van der Kamp. 1991. Pathogens as agents of diversity in forested landscapes. The Forestry Chronicle 67:353-354.

FISHERIES REPORT FOR THE MIDDLE SANTIAM WATERSHED ANALYSIS

by
Todd D. Buchholz, Fisheries Biologist
March 1996

Introduction

Much of the discussion which follows is based on USFS Region 6, OSU, and ODFW stream surveys as well as personal communication with ODFW biologists and long term residents of the Sweet Home area. Stream surveys are not absolute, but rather give a gross overview of physical characteristics which comprise a stream habitat. Some data is collected as to the presence of aquatic dependent species, however, that portion of the survey is not intense enough to determine population abundance or distribution within a stream and can not be used to say that a particular specie in not present in a stream.

Because a typical stream survey does not include Class IV and few Class III streams, information regarding these stream Classes is very thin. What little information is available is usually associated with a site specific project, and even then, little or no systematic aquatic dependant specie data was collected.

Before any site specific project is undertaken in or adjacent to a stream, regardless of its Class, a survey to determine presence or absence of those aquatic dependent species deemed relevant, especially fish, must be undertaken. The Record of Decision (USDA 1994) distinguishes a fish-bearing stream by the *presence of any species of fish for any duration,* as an intermittent stream may be used as spawning and rearing, refuge areas during flood events, or travel routes for fish emigrating from lakes (USDA 1994).

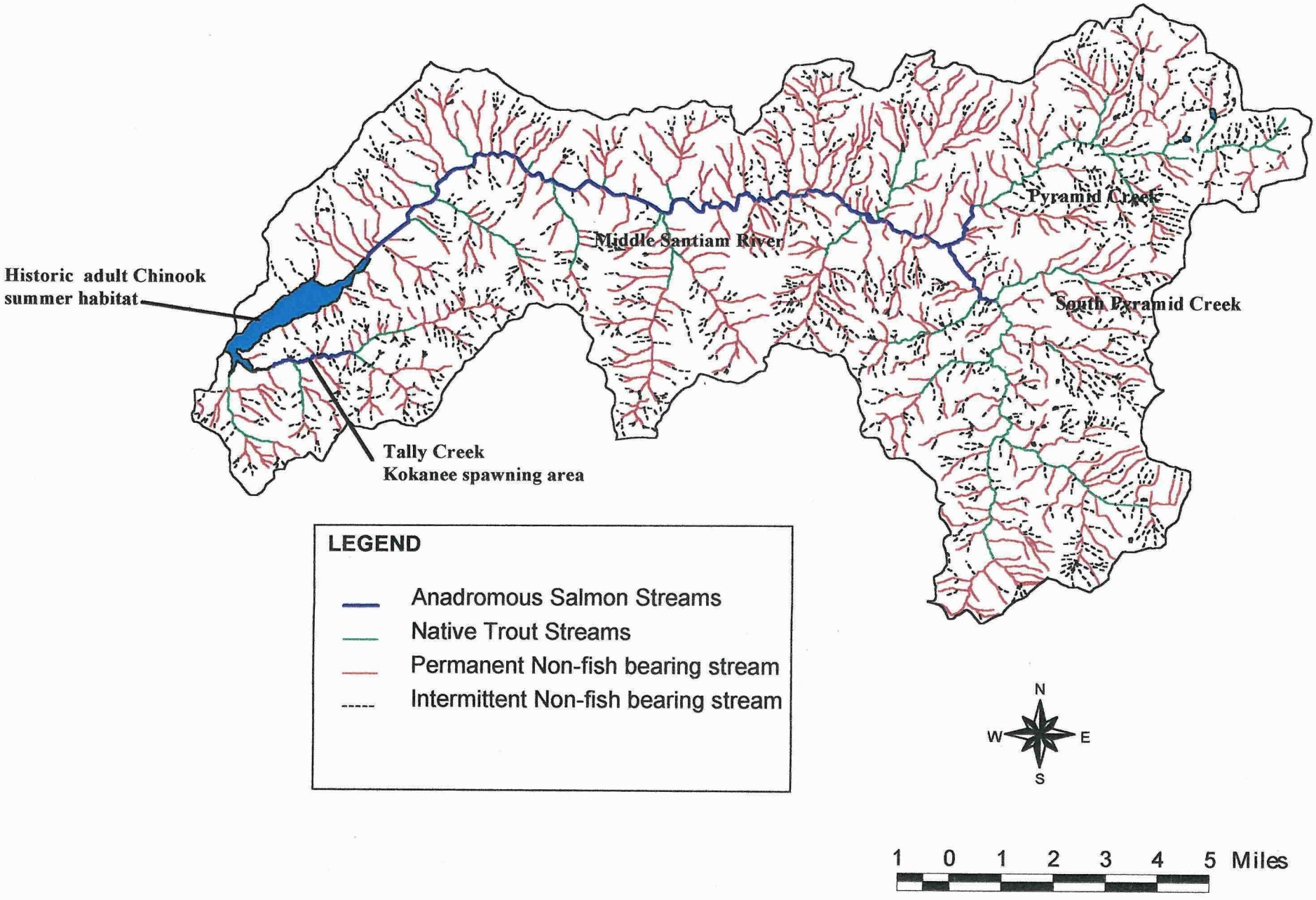
Biological Characterization

Fish Species in the Watershed

Many of the same fish species present in the South Santiam Watershed can be found in the Middle Santiam Watershed with the notable exception of the native anadromous salmonids, Willamette spring chinook and winter steelhead. These two species are no longer present in the watershed due to passage problems associated with Green Peter dam and its reservoir. Table 1 lists the major fish species which were or are now present within the watershed. Figure 1 shows the general distribution of anadromous and native trout in the watershed. The map is not complete as many Class III and IV streams remain to be identified and or classified as fish, or non-fish bearing stream.

Winter steelhead are native to the Santiam subbasins. Before construction of U.S. Army Corps of Engineers dams in the North and South Santiam subbasins, the Santiam system produced the majority of the winter steelhead run that migrated above Willamette Falls. Historic runs above the Foster/Green Peter Dams were estimated at 2600 winter steelhead (USDI 1961). In 1959 the U.S. Fish and Wildlife Service conducted redd counts above the Green Peter reservoir site. USFWS estimated that 2,200 winter steelhead spawned upstream from the dam site. Spawning

Figure 1: Fish Distribution in the Middle Santiam Watershed



habitat for about 700 steelhead were the estimated losses due to the inundation of spawning grounds created by filling Foster and Green Peter reservoirs. Mainstem stream habitats in Lower and Upper Middle Santiam Landform Block could probably support historic numbers of adult spawners, although habitat degredation in tributary streams in the Lower Block may not support historic numbers of juvenile steelhead.

Reestablishment and increase of native winter steelhead runs above Foster and Green Peter are currently a high priority of the State of Oregon. The State especially desires that native, wild stocks of winter steelhead be increased so that reliance on hatchery production of the fish can be decreased.

Table 1. Fish species presence within the Middle Santiam Watershed.

Species	Historic	Present Today
Winter Steelhead	Yes	No
Spring Chinook	Yes	No
Rainbow Trout	Yes	Yes
Cutthroat Trout	Yes	Yes
Kokanee	No	Yes
Large/small mouth Bass	No	Yes
Squawfish	Yes	Yes
Bull Trout	Yes	No
Oregon Chub	No	No
Sculpin Species	Yes	Yes

Willamette spring chinook are also native to the Santiam Subbasin. The ODFW estimates that of the total run of naturally produced spring chinook above Willamette Falls, approximately 40 percent return to the Santiam Subbasin (ODFW 1992). 85 percent of spring chinook production in the South Santiam was above Foster Dam. Estimates of as many as 1,400 spring chinook migrated past the Foster Dam site before the dams were built of which, one half to two thirds of the run entered the Middle Santiam. Prior to construction of Green Peter Dam, Spring chinook adults entered the Middle Santiam in the spring, stayed in deep, cool pools in the summer and spawned in the fall. Those summer holding pools are now under Green Peter Reservoir.

Although probably enough suitable spawning habitat still exists in the Watershed, without the summer holding pools, the present day habitat will probably not support historic numbers of chinook.

Bull Trout

Bull trout were last seen in the Santiam system in the mid-1950's. Populations in the Middle and South Santiam Rivers were probably remnants of a greater, westslope Cascade population that was interconnected by cold glacer feed streams during the last glaciation. Today there are very few suitablably cold streams in the Watershed which could support any or all the the Bull trouts life history stages. Reintroduction of Bull trout into this Watershed is very low on the ODFW list of priorities (personnel communication with Wayne Hunt ODFW district biologist).

Tally Landform Block

Tally Creek is the major fish bearing stream within this Block. Winter steelhead and spring chinook probably utilized portions of this stream at some point in their life histories. Today most of the kokanee spawning for the entire Green Peter Reservoir occurs in this creek, with some spawning occurring in the Middle Santiam River.

Most of the streams in this block have a large legacy of down wood from old harvest areas but have little chance of replacing that wood once it decomposes. The riparian vegetation is fairly devoid of mature conifers and will continue to be so as this Block will be harvested on less than 80 year rotations. Oregon Department of Forestry riparian management guidelines are supposed to insure some retention of large conifers within seventy-five feet of Class I and II streams, but do not require retention along Class III and IV streams. This management scenario will result in a landform block mostly devoid of large wood not only in fish bearing streams, but riparian and upland areas as well.

Restoration Opportunities

As the legacy of down wood disappears large wood will have to be imported into the streams. In the meantime, whatever silviculture practices that encourage tree growth, and retention of large trees and hardwoods in riparian areas along all stream Classes should be encouraged.

Lower Middle Santiam Landform Block

This portion of the Middle Santiam River has been heavily impacted by the construction of Green Peter Dam and by timber harvest. Most, if not all of the summer holding habitat for Spring chinook occurred in the western half of this Block, and is now under the waters of the reservoir. Large numbers of Steelhead were also present. Resident rainbow trout, cutthroat trout, dace, sculpins, squawfish and whitefish reside in the mainstem and tributaries. Some kokanee spawning occurs in the mainstem. The River does have a legacy of down wood from past harvest activities.

New wood does wash down into the mainstem from the Upper Middle Santiam Landform Block. The mainstem does provide suitable spawning and early rearing habitats for anadromous and native fish.

If riparian areas are protected, and if large wood continues to move into the mainstem river from the upstream Block, some level of winter steelhead could be supported, but probably less than pre-harvest times as many of the tributaries are no longer quality rearing habitat due to the eventual lack of large wood in a landscape managed under a 60 to 80 year harvest rotation. Reintroduction of spring chinook would meet with less success as the summer holding habitat is no longer available in historic, pre-Dam amounts.

The same situation happening along riparian areas in Tally Block is present in this Block too, lots of little trees with little opportunity for future large wood recruitment.

The USGS maintained a gauging station on the Middle Santiam near the Forest boundary. Stream temperature data from pre-harvest and present day shows that the mainstem often exceeded the State of Oregon Department of Environmental Quality seven day running average of 64° F, especially late in the summer. However this does not present a problem for salmonid survival because; Winter steelhead spawn in early spring to early summer, with juveniles dispersing to smaller, colder tributaries as the summer progresses; Spring chinook spawn in the fall as the first rains begin to lower stream temperatures; native trout and other fish species have evolved and adapted to conditions within the mainstem and tributaries.

Restoration Opportunities

The same opportunities exist in this Block as in Tally except that the mainstem will probably receive some natural recruitment of large wood from the upstream Block. Again, large conifers and hardwoods should be left in the riparina areas, even in Class III and IV streams.

Upper Middle Santiam Landform Block

This block contains the greatest portion of intact riparian and stream habitats. Spring chinook and winter steelhead were well seeded in the Middle Santiam River and the Pyramid Creek system. Although the falls at Shedd Camp are passable during high flows, Anadromous salmonid distribution ended pretty much ended here. This Block could probably support historic numbers of winter steelhead and spring chinook (if summer holding habitat was restored) as most of the instream and riparian habitats are either intact or recovering from harvest. Native cutthroat and rainbow trout and sculpin species are well distributed throughout the mainstem river and many of its tributaries.

Bull trout were reported in the watershed up to the early 1950's. This was probably a remnant population left over from the last glaciation when cooler water temperatures allowed for a greater distribution of this species throughout the western Cascades. This watershed is low on ODFWs

priority list for Bull trout restoration because of mainstem water temperatures (greater than 55°F) and relatively small number of miles of stream which have consistent temperatures at or below 55° which would be suitable for spawning and rearing.

Stream surveys of South Pyramid, Scar and Single Creeks conducted in 1995 indicate large woody material is present in good numbers, and that the riparian vegetation is adequate to maintain large wood recruitment. Approximately five miles of the Middle Santiam River flows through the Middle Santiam Wilderness with its intact riparian area. Pyramid, Scar, Single and South Pyramid Creeks all have had harvest activities in or near riparian areas. Most of this Block is National Forest and LSR. If the Forest Plan Riparian Reserve system is maintained in the future, it should insure quality stream and riparian habitats regardless of timber harvest rotations.

The checkerboard land ownership pattern in the headwaters of the Middle Santiam make consistent stream and riparian management difficult as the private lands are typically managed for wood fiber on a less than 80 year harvest rotation, with little chance of maintaining large wood in Class III and IV streams.

Restoration Opportunities

Consolidation of land ownership in the headwaters so as to implement consistent land management practices would be the best, long-term strategy for this Block. A fully implemented Riparian Reserve strategy should greatly lessen the need for intense instream restoration projects. This is a good place for a "hands off, and don't do anything stupid" approach to watershed restoration at least as far as the fisheries resource is concerned.

Issues and Key Questions

Columbia Basin Overview

The decrease in abundance and distribution of native stocks of anadromous salmonids, as well as some stocks of resident fish species, is an over-riding issue which dictates fish management activities throughout the Columbia River Basin.

FEMAT describes the primary factors contributing to the decline of anadromous salmonid stocks within the Columbia River Basin as: (1) degradation and loss of freshwater and estuarine habitats; (2) timing and over-exploitation in commercial and recreational fisheries; (3) migratory impediments such as dams; (4) loss of genetic integrity due to the effects of hatchery practices and introductions of non-local stocks.

Loss and degradation of freshwater habitats are the most frequent factors responsible for the decline of anadromous salmonid stocks (Nehlsen et al. 1991), as well as some resident fish species (Williams et al. 1989). On forested lands, the most significant management activities affecting fish habitat are timber harvest and associated activities. Large woody material is recognized as one of

the most important elements in the function of streams in the Pacific NorthWest.

This component of instream and riparian habitats has been reduced due to a variety of past timber management including mandated cleanup project which removed large wood from streams throughout the Basin.

Willamette Basin Overview

The decline in abundance and distribution of wild native winter steelhead and spring chinook populations, the listing of the Oregon Chub, the petition for listing of the Bull Trout for protection under the Endangered Species Act, and maintenance and enhancement of resident native fish populations, are the major fish related issues driving management activities within the Willamette Basin.

Willamette winter steelhead are one of the few anadromous fish stocks native to watersheds above the Willamette falls, and spring chinook are the only race of salmon native to the Santiam basin. Both species are recognized by the Oregon Department of Fish and Wildlife as stocks of concern in part due to loss of quality spawning and rearing habitat as a result of channelization, dams, and lack of large wood in spawning streams (ODFW, 1992).

Middle Santiam Watershed Overview

The construction of Green Peter Dam with its non-functioning fish passage facilities and the size of its reservoir have eliminated anadromous salmonids from the Middle Santiam, as well as creating enhanced conditions for fish species which prey upon salmonids. Much of the summer holding habitat for spring chinook is now under the reservoir. The U.S. Army Corps of Engineers has drafted a fish restoration study for the Middle Santiam.

Key Questions

- WQ1. What are the implications of applying current State Water Quality standards on future management of Federal lands in the watershed (pages 6, 13)?
- WQ2. What standards for temperature and sediment should be established for this stream system (page 14)?
- WQ3. What type of watershed restoration investment is appropriate for this watershed (pages 5,6,7, 13)?

- WQ4. What is the capability of the watershed to support reintroduced populations of anadromous fish (pages 4,5,6)? Is there a specific water quality factor that limits or adversely effects fish production (pages 6,13)? Where and what actions would need to be taken in this watershed prior to reintroduction (pages 5,13)?

- FC4. How will the potential harvest pattern created by the interim Riparian Reserves effect the overall function of the watershed (data gap)? What widths of Riparian Reserves will accomplish the Aquatic Conservation Strategy objectives in this watershed(page14)?

- FC7. What, where and in what priority do we need to do restoration or enhancement of habitat for wildlife (particularly Threatened, Endangered and Sensitive species) (page13)?

Relevant Processes and Trends

Aquatic and riparian habitats are products of the geology, soils, topography, vegetation, climate, and hydrology of a watershed. These characteristics remain fairly constant, as does the productivity of the aquatic habitats. Any change in these conditions can bring about changes in habitats that greatly affect aquatic dependant species populations abundance and distribution.

Key physical components of a fully functioning aquatic ecosystem include complex habitats consisting of flood plains, banks, channel structure (i.e. pools and riffles), water column and sub-surface waters. These are created and maintained by rocks, sediment, favorable conditions of water quantity and quality and most importantly, large wood and riparian vegetation. Up slope and riparian areas influence aquatic systems by supplying sediment, large wood and water.

Large woody material is one of the most important elements in the function of streams, it affects channel morphology and habitat quality for a variety of aquatic dependent species. Large wood helps to dissipate stream energy, retains gravels, effects stream sinuosity, and slows down the nutrient cycling process. Large wood deposited on floodplain and in off-channel areas provides protective cover for juvenile fish during winter high flows (Everest el al. 1985). Many of the fish bearing streams in the analysis area are high energy systems and therefore necessitate individual pieces of wood be at least 50 long and 24 inches in diameter at the small end.

Most streams and salmonid populations in the Pacific NorthWest have undergone extensive change since European settlement began in earnest 150 years ago. Stream habitats do not exhibit the potential productivity that was likely present prior to extensive human manipulation of the landscape (Sedell and Luchessa 1982). Historically wild fish stocks evolved with streams that were at times obstructed by fallen trees and land flows, beaver dams, and vegetation growing in and alongside channels, with areas of backwater, pools or low-velocity regions for refuge during high flows. The Upper landform block minics these conditions. Tributaries which were well connected to larger fish bearing streams acted as high flow refugia and as rearing areas for

juvenile salmon, as well as habitat for resident adult fish.

Today aquatic landscape and associated dependant species, is defined by the lack of fish passage at Green Peter Dam, degraded riparian areas in heavily harvested areas, and continued interactions with earth flows and flood events.

Dams

In the early 1920s the Oregon Game Commission placed a fish collection weir in the Middle Santiam River near present day Foster to trap steelhead and chinook with the intend of collecting eggs to seed other stream systems in Western Oregon (Bob Mealy, personnel communication). Prior to this collection program, the Middle Santiam provided a good enough fishery for Warm Spring Indians to gather at the confluence of Canyon Creek to gather salmon. Area residents believed that the decline in steelhead and chinook numbers began with the Game Commissions collection program. The runs recovered quickly enough by the 1950's so that life time Sweet Home resident and retired Forest Service employee Wayne Miller had no trouble catching the daily limit of two Winter Steelhead when he and his brother fished the Middle Santiam around Shedd Camp.

Construction of Foster (1968) and Green Peter (1968) Dams contributed to the decline in wild winter steelhead and spring chinook in the Middle Santiam. Attempts to pass adult winter steelhead over Foster and Green Peter have had mixed results. Passage of juvenile steelhead downstream has been less successful, particularly in Green Peter due to the large pool size and large population of prey species. Today, no fish passage occurs at Green Peter; however, the U.S. Army Corps of Engineers is currently conducting a feasibility study to determine juvenile passage techniques.

Even if spring chinook were to be reintroduced above Green Peter, they would find most of their summer holding habitat (deep, cool pools) are no longer available as they have been inundated by Green Peters reservoir. Most of the Middle Santiam River not influenced by the reservoir is still suitable steelhead and chinook spawning habitat.

Foster passes approximately 300 adult winter steelhead each year. No spring chinook were passed upon completion of a spring chinook and summer steelhead hatchery below Foster which was intended to mitigate the effects of limited fish passage over Foster. Concerns of wild spring chinook introducing disease into the upstream water supply for hatchery raised chinook was the reason given for denying access above Foster. In the spring of 1994, Oregon Department of Fish and Wildlife, having reevaluated that decision, began reintroducing spring chinook smolts into Middle Santiam headwater streams in the hopes of reestablishing this run.

Timber Harvest

Prior to the early 1980's, timber harvest activities rarely took aquatic, riparian and special habitats

into consideration when developing sale prescriptions. Little if any buffers remained around fish-bearing and nonfish-bearing streams after harvest. Many sale prescriptions called for removal of wood material from streams prior to sale closure although this watershed seems to not have had the systematic stream clean out efforts as did the South Santiam. Absence of protection for riparian areas around nonfish-bearing has reduced the amount of wood which these streams could deliver to fish-bearing streams. Long term recruitment of large wood to many streams is also impaired due to inadequate buffers, partial harvest and salvage logging within the buffer.

Old harvest practices which eliminated riparian timber have left many of today riparian areas in the stand initiation or stem exclusion stage of stand development. Silviculture practices may be needed to accelerate the development of overstocked plantations within Riparian Reserves into stands which meet Aquatic Conservation Strategy Objectives (see Restoration Priorities).

Logging has most heavily impacted Knickerbocker, Cougar, Tally and Upper Middle Santiam subwatersheds The checker board land ownership pattern in Upper Middle Santiam makes long-term, integrated land management difficult.

Floods

Flood events occur more frequently than do fire in the watershed. Floods effect the ecology of the stream and riparian area by rearranging stream bed habitats, scouring away aquatic or riparian plants and increasing the drift of aquatic insects. Most aquatic species avoid high velocities and associated debris by sheltering behind rocks or woody material along the stream's edges and in backwaters. When floods occur at unusual times or of significant magnitude and duration, many fauna may be severely effected, and may require many years to recover (Gordon et al 1993). Large wood and intact riparian area dampen flood effects by dissipating flow energies and creating high flow refugia areas for many aquatic dependant species.

Floods are not necessarily bad. The 1964 and 1996 events added large amounts of wood into the stream systems creating diverse fish habitat.

Sediment Load

Sediment input to the stream system is affected by all of the above processes. Sediment loading in turn affects the quality of the aquatic habitat due to the timing of the input, the size of the sediment and the quantity of that input. Timing is important with regards to a particular species life history. A particular sediment load during the early juvenile stage may have much greater impacts to a species survival than during the adult stage.

Roads

Roads were built to higher design criteria by the time the road system began to grow in this watershed. Unlike the South Santiam road system where many roads were sidecast and could contribute to the sediment regime, the roads in the Middle Santiam contribute little to the overall sediment production.

The amount of sediment created by roads may be but a blip when the geology of the watershed is considered. However, many aquatic dependant species can not tolerate excessive amounts of fine sediments during the reproductive and juvenile portions of their life histories. Fine materials generate turbidity that are detrimental to fish reproduction, coating the eggs and reducing or eliminating necessary oxygen interchange (Bell 1986).

Roads often block migration routes for aquatic dependant species. Culverts either produce water velocities too high for upstream passage or the height from the stream to the culvert mouth is too great for species to jump or crawl. Many of the culverts in the watershed are passage barriers. The Willamette National Forest is currently assessing all culverts within the watershed using a modeling methodology developed after Furniss. Although unavailable for this document, data will be available for site specific project analysis.

Invasive Non-Native Plants

One does not usually think of non-native plants effecting stream and riparian habitats. However, two species in particular, Himalaya and evergreen blackberries, may a pose serious threat to long term wood recruitment. Blackberries are well suited for invading forested stands. They effectively dominate riparian vegetation to the point where they can exclude all other plants including small conifers and hardwoods.

Any stream and riparian restoration efforts which include riparian plantings of conifers and hardwoods will need to consider the effects of these invasive non-native plants on the long term effectiveness of the restoration effort.

Water Quality/Quantity/Water Temperature

Turbidity as suspended material is not generally a problem. Seasonal runoff in specific sites may cause increased suspended material to be transported in and through a stream as discussed in Sediment.

The State of Oregon Department of Environmental Quality has revised water quality standards. The mainstem Middle Santiam River often exceeds the seven day running average of 64° F, especially late in the summer. This does not present a problem for salmonid survival because; Winter steelhead spawn in early spring to early summer, with juveniles dispersing to smaller, colder tributaries as the summer progresses; Spring Chinook spawn in the fall as the first rains

begin to lower stream temperatures; native trout spawn and rear in or near the cool water influence of tributaries.

Influences Outside the Watershed

A discussion of the processes influencing the population dynamics of anadromous salmonids within the watershed can not be complete without discussing the processes acting on these species once they leave the watershed.

Juvenile salmonids are preyed upon by many different species from egg to adult. Prey species such as crayfish, Northern squawfish, osprey, marine mammals, and humans all take a toll on the numbers of fish migrating to and from the ocean. Ocean conditions (temperatures, up welling, El Nino, etc) determine the abundance of food available to ensure survival of adequate numbers of returning adult salmonids.

The human population has grown from five billion people in 1987 to a projected six billion mouths in 1997. As the human population has increased, so to has the demand for resources to feed that population. Nearly every major fishery in the world is already fully exploited or overexploited (Brouha, 1994) salmonids included. As human pressures on aquatic resources increases, the need to insure adequate refugia for aquatic dependent species from such human exploitations increases as well.

Restoration Priorities

Prioritization of restoration needs are based on Aquatic Conservation Strategy Objectives to maintain and restore the ecological health of the watershed.

1. Protect best remaining habitats.

The first priority is to protect those areas which currently contain the best habitat or greatest potential for recovery. The Upper Middle Santiam Landform Block contains the best and most contiguous stream and riparian habitats in the watershed. This Block would provide the most and best anadromous salmon habitat should steelhead and chinook be successfully reintroduced. This Block now provides the most and best habitats for native fish and aquatic dependant species, and should continue to do so if Forest Plan Riparian Reserves are maintained.

The few large standing trees that still occur in riparian areas in Tally and Lower Middle Santiam Blocks should be kept. Large down wood should also be kept in streams and riparian areas within these Blocks.

The Middle Santiam River has higher average temperatures than the State water quality standards permit. There seems to be little need to attempt to rectify this situation as the aquatic species present in the River have evolved with this condition. Therefore the average high temperature

standard in this River should reflect the naturally higher average temperatures present in this system (see Hydrology Report).

2. Restore degraded habitats

Tally and Lower Middle Santiam Blocks will most likely be managed on a less than 80 year harvest rotation. Little or no large wood recruitment will occur in these perpetually young stands. As the legacy of existing large woody material disapears over time, large wood will need to be imported into these Blocks to maintain that component of the aquatic and riparian habitats, especially in Class III and IV streams.

Data Gaps

Many Class III and IV streams need to be surveyed and reclassified if : 1. they support fish; 2. they run water year round.

Many Class IV streams do not show on our maps or GIS. The stream layer in GIS should be updated as these are found during stream surveys or project work. If budgets allow specific surveys to update the stream layer than by all means do so.

Are the Riparian Reserves widths adequate to meet ACS objectives? Their are plenty of examples of riparian area diversity in the AMA. This may provide an opportunity to proof the hypothesis that the Reserves are based on.

What are the life history requirements of , and species distribution and abundance of non-salmonid fishes (sculpins, dace etc).

Are those mollusks and aquatic insects endemic to the Willamette NF from the J2 list present within the watershed, and how/what protocol do we search form them?

What is the real effect of road induced sediments to the aquatic habitat and aquatic dependant species within this watershed.

References

Bell, M.C. 1986. Fisheries handbook of engineering requirements and biological criteria. US Army Corps of Engineers, North Pacific Division. Portland OR.

Brouha, P. 1994. Population Growth: The Real Problem. Fisheries 19(9):4pp.

Dimling, J.; C.McCain. 1992. Willamette National Forest Special habitat management guide. Eugene, OR: USDA. Forest Service.

Everest, F.H., et al. 1985. Salmonids. In Management of wildlife and fish habitats in forests of western Oregon and Washington. E.R. Brown, ed. USDA, Forest Service, Pacific NorthWest Region, Portland, OR.

Gordon, N.D, T. McMahon, B. Finlayson. 1993. Stream Hydrology, an introduction for ecologists. John Wiley and Sons. New York, NY.

Griffith, E.J. 19??. Abstract of Willamette Valley and Cascade Mountain Wagon Road Company, 1864-1911. Report number 5 in a mimeographed series of brief manuscripts, records and studies by the Works Progress Administration county and local historical records survey of Oregon.

Howell, P.J., K.Jones, D.Scarnecchia, L.LaVoy, W.Dendra and D.Ortmann. 1985. Stock assessment of Columbia River anadromous salmonids. Vol.II: steelhead stock summaries, stock transfer guidelines-information needs. USDOE Bonneville Power Administration, Division of Fish and Wildlife.

Mattson, C.R. 1962. Early life history of Willamette River spring chinook salmon. Fish Commission of Oregon, Portland, Oregon. 49 pp.

McIntosh, B.A.; S.E.Clarke; J.R.Sedell. Summary Report for Bureau of Fisheries, Stream Habitat Surveys, Willamette River Basin 1934-1942. Corvallis, OR: USDA. Forest Service and Oregon State University.

Meehan, W.R., and T.C.Bjornn. 1991. Salmonid Distributions and Life Histories. American Fisheries Society Special Publication 19:47-82 pp.

Moring, J.R., ed. 1978. Proceedings of the Wild Trout--Catchable Trout Symposium, February 15-17, 1978. Oregon Department of Fish and Wildlife, Research Division. Portland, OR.

Murphy, M.L., and W.R.Meehan. 1991. Stream ecosystems. In Influences of forest and rangeland management on salmonid fishes and their habitats. W.R.Meehan, ed. American Fisheries Society Special Publication 19. Bethesda, MY. Pp17-46.

Nicholas, J.W. 1978. A review of literature and unpublished information on cutthroat trout (Salmo clarki clarki) of the Willamette watershed. Oregon Department of Fish and Wildlife. Information Report Series, Fisheries No. 78-1.

Oregon Department of Fish and Wildlife. 1992. Santiam and Calapooia Subbasin Fish Management Plan. Salem, OR.

Oregon Department of Fish and Wildlife. March 21, 1995. Personnal communication with John Haxton, District Fish Biologist, Salem OR.

Oregon State Game Commission. 1953. Fishery Division Annual Report. Portland, OR.

Sedell,J.R., and K.J.Luchessa. 1982. Using the historical record as an aid to salmonid habitat enhancement. Pages 210-223 *in* Armantrout (1982).

Skeesick, D.G.; S.V.Jones. 1988. Willamette National Forest Fish Status Report. Eugene, OR: USDA. Forest Service.

Swanson,F.J., and G.W. Lienkaemper. 1978. Physical consequences of large organic debris in Pacific Northwest streams. U.F. Forest Service General Technical Report PNW-69.

USDA Forest Service et. al. 1993. Forest Ecosystem Management (FEMAT): An Ecological, Economic, and Social Assessment ; Report of the Forest Ecosystem Management Assessment Team. Washington D.C.

USDA Forest Service. 1985. Management of wildlife and fish habitats in forests of western Oregon and Washington, Part 1- Chapter Narratives. Pacific Northwest Region.

USDA Forest Service. 1993. Environmental Assessment for the Moose Creek Rehabilitation Project. Eugene OR.

USDA Forest Service. 1994. Record of Decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl. Washington, D.C.

USDA Forest Service. 1994. An Assessment of the Conservation needs for Bull Trout. Region1, 6 and Intermountain Research Station. 45pp.

USDA Forest Service. 1994. Environmental Assessment for the Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California. Washington, D.C.

USDA Forest Service. 1994. Final Supplemental Environmental Impact Statement on

Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. Washington, D.C.

U.S. Department of the Interior, Fish and Wildlife Service. 1961. Green Peter Dam and Reservoir Project, A detailed Report on the Fish and Wildlife Resources. Portland, OR, May, 1961.

HERITAGE RESOURCE REPORT

Middle Santiam Watershed Analysis

March 1996

This document is intended as a source of data in support of a comprehensive landscape analysis of the Middle Santiam watershed. In no manner does this level of documentation repeal any burden of site specific investigation mandated by the NEPA process or Federal law or regulation. This report is not exempt from the Freedom of Information Act. At the project level a full heritage resource field survey and requisite documentation will be required to meet compliance with agency standards.

Introduction

The Middle Santiam watershed reflects the impact of human use throughout time. Archaeological dating of sites within the watershed place human activity back at least 5000 years ago, and likely 8000 years ago. During this span of time the habitation, resource exploitation, travel, and religious practice within the watershed transpired on the land from the viewpoint of extensive/intensive and pre-contact/historic perspectives. Indigenous peoples engaged in cultural activity for millenia, adapting to changes in climate and the corresponding faunal/floral shifts that occurred since the glacial retreats of the late pleistocene. It can be demonstrated that the climate changed from one of cool, moist post-glacial to a warmer, drier altithermal stage (climaxing about 4500 years ago), and is currently returning to a cooler, more moist stage. Cultural adaptation to these gradual and sometimes dramatic environmental shifts was necessary for survival. The archaeological record within the Middle Santiam watershed contains data vital to the understanding of these cultural processes that accompanied the indigenous people during their journey through time. The historic dynamics of the watershed (since pioneer contact) are recorded in written history and the archaeological record serves to fine-tune the broad sweeps of progress that tend to paint the local history.

Heritage Resource Program Discussion:

The Heritage Resource Program encompasses the significant historic and prehistoric properties (sites and objects) within the Sweet Home Ranger District. The location, recording, protection, management, interpretation and research of these cultural resources across the landscape are deemed essential to fulfilling legal obligations and public expectations. The Heritage Program contributes to the understanding of how humans fit in an ecosystem over time.

Virtually all landscapes have been modified by human activities since the Pleistocene. Discussions of the natural environment, therefore, include humans and their effect on and interaction with the rest of the world. Analysis of historical ecological processes and past human impacts reveal the dynamics of past trends and future paths. Comparisons between landscapes past and present indicate how change due to economic and environmental factors (drought, fire, mining, homesteading, transportation) has occurred. Examination of the current

socioeconomic situation and relationship to the historic context aids identification of broad regimes of culture change.

Principle issues for the Heritage Resource Program within the Middle Santiam are watershed fourfold:

- Protect significant properties/mitigate both human and nature caused adverse impacts
- Interpret past for public education and enjoyment
- Develop partnerships in heritage property management
- Implement property acquisition strategy to increase land base of significant heritage resources.

The identified heritage resources within the Middle Santiam Watershed include both prehistoric and historic properties. Activity areas, travel routes, artifacts and features have been recorded throughout the watershed. Discovery has occurred through random reconnaissance and project specific inventory. Significant sites are afforded protection under the Forest Land Management and Resource Plan, reflecting legal mandates from decades of historic preservation legislation and regulation. Protection includes avoidance from project impacts and mitigation of adverse impact from natural causes (flood plain erosion, landslides, etc.) as well.

Location of sensitive archaeological sites is protected information and will not be made available on a site specific basis in this document.

Existing Conditions

The existing conditions of recorded heritage resources within the Middle Santiam Watershed currently range from relatively undisturbed and protected to disturbed and at risk. Prehistoric sites have been either avoided or adverse impacts have been mitigated through data recovery excavation within the last 15 years. Prior to 1979 sites were not located, recorded or protected and management activities damaged properties, primarily through road building and timber harvest activities. The loss of significant data from past unmitigated site disturbance furthers the urgent focus to preserve what data still exists across the landscape. The prehistoric sites are largely unstudied, not interpreted, and are not receiving the benefit of management through appropriate partnership.

Historic sites are generally located along historic trails. The Forest administrative historic trails (see attached map) have been impacted (replaced) by logging road construction and timber harvest units to a lesser degree. These trails and associated early administrative era facilities/sites are currently being protected from further unmitigated adverse impact.

Desired Conditions

Desired conditions for prehistoric sites within the Middle Santiam Watershed would include a management plan for thematic consideration of site significance, evaluation, protection, monitoring and interpretation developed and administered through a partnership with the Forest Service, appropriate Tribes, academic institutions, professional and amateur archaeological associations, and concerned citizens. Sites would be protected from human and nature caused adverse impacts. All processes, both natural and resultant from past management

activities, would be addressed. Erosional impacts and wind damage are primary among the active processes that affect subsurface prehistoric properties.

Desired conditions for historic sites would parallel the thematic management considerations discussed for prehistoric sites. Condition/protection of historic linear features must be addressed when mitigating adverse impacts to historic properties. Any historic structures associated with the Forest Service early administrative era (trail shelters) would be afforded protection through long term management to ensure integrity of character and in-kind replacement as needed.

Restoration Opportunities

Potential exists to mitigate adverse impacts to identified significant heritage properties within the Middle Santiam Watershed. A partial listing includes:

- vegetative modification to wind proof trees with prehistoric sites that are at risk to wind throw (upland improvement),
- stream bank reinforcement/stabilization to prevent erosion of heritage properties (stream channel restoration),
- vegetative planting/drainage placement/overburden removal to mitigate adverse impacts from land failure damage to heritage properties (erosion and sedimentation),
- heritage property acquisition to place significant sites in federal ownership thereby affording requisite protection.

Heritage Resource Current Data / Discussion

The heritage resource program on the Sweet Home Ranger District has been active for 16 years. During that time the identification and documentation of historic properties has proceeded on a project level basis with very little effort allowed on a systematic stratified inventory basis. Nevertheless, a large volume of archaeological properties has been identified. Within the Middle Santiam watershed a total of 96 archaeological sites (9 of which are historic), 37 isolates finds, and 8 historic trails (77 miles) have been identified. Of these, 28 archaeological sites have been evaluated for significance with 19 determined eligible for the National Register of Historic Places. One site has been excavated for data recovery to mitigate impacts from land management activities. No sites have been identified as requiring data recovery excavations to mitigate effects from natural causes (land slides, erosion, wind throw, etc.). Sites have been identified in all subwatersheds with many sites shared between more than one subwatershed. A total of 5700 acres of high probability has been surveyed with 23,700 acres of high probability remaining to be surveyed on National Forest lands within the watershed. Projects that have been surveyed for heritage resources include timber sales, road system development, trail development and maintenance, special use permits, and wildlife/fisheries projects.

The overwhelming majority of heritage resources identifed within the watershed are classified as prehistoric lithic dominated sites. These sites consist primarily of stone tools and tool manufacture waste material. Buried sites such as these are important for the information that they contain. Analysis of sites in this watershed has produced a picture of past indigenous life that was

semi-nomadic, with seasonal round based activites at recurrent transitional, temporary, extensive locations and at fixed, ceremonial, intensive locations.

Excavations have occurred primarily along ridge top locations where transportation system development proposals placed them at risk of adverse impact. Evidence from these analyses indicates that these sites served as upland seasonal base camps and resource exploitation locales. No sites have been excavated along the lower elvation river terraces within the watershed.

The most unusual site to have been examined has been a large biface obsidian cache located within the Upper MidSantiam subwatershed. Data indicate that the bifaces were cached approximately 4500 years ago and that environmental conditions included a drier pine forest where now exist hemlock and red cedar. The obsidian used to make the bifaces was procurred at Obsidian Cliffs on the west slope of the North Sister, approximately 25 miles southwest of the cache site.

Ethnographic indigenous culture was decimated by disease (at least 70% of the population perished) just prior to contact with pioneers and settlers in the Willamette Valley and western Cascade Mountains. Old world diseases preceded settler arrival. This fact is important for the recognition that sources of pre-contact Kalapuya and Molala information are rare in the written record. Few survivor informant accounts exist from early reservation interviews. The Kalapuya bands were based in the valleys just west of this watershed but moved upland into the Middle Santiam drainage during late spring and summer. The Molala dwelt in the Cascade Mountains year round. Indigenous survivors of the early diseases and pioneer/settler contact with both the Kalapuya and Molala were removed to the Grand Ronde, Siletz, and Warm Springs Reservations in the mid 1850s.

Information obtained from contact with Siletz, Grand Ronde and Warm Springs representatives indicates that regular use of ceremony accompanied the indigenous cultural practices within the watershed. The Warm Springs Confederation of tribes represents the Tenino and Northern Paiute bands which travelled across the eastern portion of the watershed along the Buck Mountain trail (probably the Gordan Peak trail) in ethnographic times as late as 1910 (as documented in early Ranger dairies). The lifeway of indigenous culture as preserved in the archaeological record is largely supportive of tribal oral traditions. Therefore a continuum of usual and accustomed traditions becomes a point for discussion between tribal leaders and agency officials, within the government to government relationship that is Regional and National policy.

Access to traditional and ceremonial resources and sites for usual and accustomed practice is a discussion to be undertaken from both short and long term perspectives. Reasonable and consistent application of policy is a critical component for successful relations in this arena.

Following the contact period with non-indigenous culture the watershed endured the on-set of trapping, pioneers, road building, prospecting, railroading, grazing, stock drives, lumbering, settlers and early Forst Service administration. These activities are captured in early journals, dairies, histories, and interviews. Physical remains of these post-contact human uses within the watershed are rare with the exception of historic features from the custodial era of Forest Service administration.

Among the rare pre-Forest Service Euro-American heritage data within the watershed one prominent pioneer name stands out; Judge John Breckenridge Waldo. Judge Waldo explored the High Cascades from 1880-1907. His discoveries,

documented in dairies and letters, helped create awareness of the high country culminating in the Skyline Trail, the creation of the Forest Reserves, wilderness designations, and Crater Lake National Park. Waldo Glacier on Mt. Jefferson and both Waldo Mtn. and Waldo Lake, east of Oakridge honor his name. The base camp for many of Judge Waldo's exploration was at "inscription camp" located within the Pyramid Cr. subwatershed. Judge Waldo would leave his home near Salem and head east through the old Quartzville mining District, pass through the Little Meadows packing supply area, and then set up camp near Daly Lake at inscription camp. From this location he and his party would explore north or south, sometimes for weeks at a time. They would return to inscription camp to fish, rest, and write journals prior to returning to civilization. Waldo and his party built the first trail around Daly Lake on September 23, 1895.

Historic features remaining from the Forest Service administrative era include the early trails, lookout sites, and shelters. The historic trail system was present in all subwatersheds and consisted of 4 main (53 miles) and 5 way/secondary (24 miles) trails. Of the 77 miles of original historic trails 28 miles have been impacted by road construction and another 8 miles have been impacted by harvest units. All three of the historic lookouts have been destroyed . Old lookout sites are found on Chimney Peak, Scar Mountain, and the Middle Pyramid, within the Knob Rock, Pyramid Creek, and Upper MidSantiam subwatersheds respectively. The system of trails and lookouts was a critical component of the early efforts to control wildfire in the Forests. The early trail shelters were simple three sided lean-to constructions. Two of the original four remain standing in this watershed. Shelters remain near Chimney Peak and at Shedd Camp while those at Cool Camp and Swamp Creek no longer exist. Historic trails are recorded as archaeological sites and afforded protection by the Forest Land and Resource Management Plan.

The Middle Santiam watershed serves as a heritage time capsule for the early Forest Service administrative era. This is in part because the watershed was entered for management purposes only recently in comparison with surrounding watersheds (South Santiam, Quartzville, and North Santiam). Therefore, many of the historic trails are intact for long stretches, two trail shelters still exist (no others on the Sweet Home RD), and a third shelter site at Swamp Creek could be easily rebuilt as the setting remains natural/unmanaged. Much of the solitude of the early days can still be realized on the historic trail system within this watershed, unique for the Sweet Home RD.

Early grazing allotments permitted extensive sheep access to the Pyramid Creek and Upper MidSantiam subwatersheds. This use was at its highest level on Crescent Mtn. from 1880 through 1910. Records of early sheep camps are on file within the District files. These camps were seasonal, with no permanent structures, and currently are overgrown and exhibit only scant evidence in the form of incidental debris such as rusted metal (cans) and few weathered boards.

Use Of Fire

Indigenous oral traditions and early trapper journals identify seasonal use of fire by Kalapuya, Molala, Tenino, and Northern Paiute peoples prior to contact with non-indigenous culture. Fire was used to maintain openings ensuring hunting opportunities and increasing diversity of vegetation through creation and maintenance of "edge effect" promoting a diversity of habitats. Indigenous use of fire is known to aid in the gathering of insect and seed food sources, fireproofing areas (protecting certain medicine plants), pest management (insects and rodents), improving yields (camas, tobacco, berry plants), acorn

collection, warfare (denying hiding places, offensive weapon), clearing areas for travel, and increasing visibility through forests and brush lands. The lack of written records of specific indigenous use of fire within this watershed should not be reason enough to discount its use and impact on the landscape. Indigenous populations were decimated prior to contact, past cultural practices disappeared and were therefore not recorded in early local written records. Tribal oral histories tell of the use of fire in this area, and the arrival of grazing permittees at the end of the last century found many open grassy areas that today have been replaced by forest species. Although these openings may have been the result of natural (not human caused) fires, further studies may differentiate between the two. It has been documented that American Indian burning practice differs from natural fires by the seasonality of burning, frequency of burning certain areas, the intensity of the fire, and overall ignition patterns. It is likely that fire was one of many tools that indigenous peoples used to modify the cultural landscape for millenia in this watershed. Post-contact elimination of fire from the historic landscape has allowed the encroachment of forest species, replacing open areas managed for millenia and thereby masking the cultural landscape as perhaps previously maintained.

Traditional and Ceremonial Use

The Middle Santiam watershed served as the seasonal home range for indigenous peoples the descendants of whom are represented by three confederated tribal governments. The Warm Springs and Grand Ronde Confederations are non-treaty tribes and the Siletz Confederation is an executive order tribe. No existing treaty rights pertain within the watershed. However, given the ethnographic records, oral tribal traditions, and archaeological data for the area, there is conclusive evidence that this watershed served the traditional and ceremonial needs of indigenous poeples both at the time of contact and for previous millenia.

This watershed was important strategically to indigenous inhabitants of the Willamette Valley (Kalapuya), Cascades (Molala), and Central Oregon (Tenino and Northern Paiute). The Middle Santiam River corridor presented a secondary east-west travel route between the central/upper Willamette Valley and Central Oregon. A primary north-south travel route through the central Cascade Mountains traversed the eastern portion of the watershed and was known in pioneer times as the Buck Mountain trail (Pyramid Cr. and Upper MidSantiam subwatersheds).

The benches, springs, saddles, and terraces along travel systems provided locations for base camps, from which hunting, gathering, and religious activities occurred. These locations may have served as the early summer camps for the Cascade dwelling Molala and also provided the base for later seasonal use by the Willamette Valley based Kalapuya. The Tenino and Northern Paiute bands from Central Oregon at the time of contact travelled across the eastern portion of the watershed en route to summer base camps in the South Santiam watershed. This model of at least four different indigenous cultures using this watershed at the time of contact is very likely one that had occurred for millenia, with overlapping areas of resource procurement, ceremonial and religious significance, and seasonal habitation: - indicating a complex system of dynamic inter-tribal relationships.

Access to sites and resources for traditional or ceremonial use is important to American Indian people today. The Middle Santiam watershed is a part of the ecosystem where their ancestors lived in the past and where they can continue past traditions today. What many see as a Forest may be viewed as a place of

worship, medicine, and education by American Indians. The success of continued traditional and ceremonial practice is dependent on the government to government relationships that are developed between the tribes and the Federal government. This relationship recognizes the rights of American Indians in terms of treaty obligations (not applicable in this watershed) and continued traditional and ceremonial access to sites and resources. It is in the interest of the tribes and the land managing agencies to build stable, long term working relationships, based on truth and respect, that seek positive, mutually understood, and beneficial solutions to common situations. Sensitivity to traditional beliefs and practices through an understanding and appreciation of culture and religion is key to the identification and acknowledgement of tribal cultural interests in agency activities and land/resource management planning. Land and resources hold a special and unique meaning in the spiritual and everyday lifeways of many American Indians. The values that these people hold for the land are important considerations in the management of National Forest lands.

The Middle Santiam watershed does contain many traditional, historic, and contemporary use areas of importance to the peoples of the Grand Ronde, Siletz, and Warm Springs Confederations. Cultural practices, such as the gathering of plant resources, religious ceremony, and youth education have occurred and will continue to occur. It is vital to the success of healthy government to government relations that a partnership be built and enhanced through the understanding of interests and the development of shared long and short term goals. Identification of specific traditional or ceremonial resources and/or sites may not be appropriate in many cases due to the confidentiality that accompanies many aspects of American Indian culture. Respect for this interest will be a given within the Middle Santiam watershed. All information regarding specific traditional and ceremonial sites will be maintained in the heritage resource files on the Sweet Home Ranger District and will NOT be available to the general public. This practice is consistent with agency standards regarding the availability of archaeological site specific data.

Tribal representatives have expressed concerns for long-term availability and access for ceremonial and traditional practice within this watershed. To successfully manage in response to this interest, the Sweet Home Ranger District must recognize and respond to requests from the aforementioned tribal confederations with histories of cultural presence in the Middle Santiam watershed. Traditional resource procurement practice was in response to religious, housing, food gathering (and preparation/storage), utilitarian/tool, dress/adornament, leisure (games/music), hunting, fishing and other needs. The diversity of resources required for these practices, and the spiritual connectivity of culture to the environment placed traditional and ceremonial customary practice extensively across the cultural landscape. The seasonal round of the past ensured survival through effective resource use, traditional ceremony, and continued resource availability. Today continued availability and access depend on consentual relations both formal and informal.

Formally the District can acknowledge the interests of traditional and ceremonial use and also recognize that these interests are a higher priority than general public requests for those same resources. This does not necessarily mean that both tribal and general public requests cannot be accomodated. It does mean, however, that until such a time when a much more complete inventory of resources that may be in high demand for both tribal and non-tribal use is realized - that informally the land managers will work toward accomodation for all but with a realization that apppropriate traditional or ceremonial requests will be accomodated at a higher priority, within the limits of law and regulation.

Recognition of the lack of an adequate inventory of traditional and ceremonial resources and site locations is in response to the need to provide a stable long term resource base from which traditional and ceremonial requests may be accomodated. All discussions of such an inventory must respect the need for confidentiality to protect certain tribal knowledge and traditions to be determined in consultation with tribal leaders.

Conclusion

The District heritage resource data base validates the presence of American Indian culture within the Middle Santiam watershed for thousands of years. The watershed was in the past and continues to be strategically important for traditional and ceremonial use by peoples whose ancestors inhabited the Willamette Valley, the Cascade Mountains, and the plateau of central Oregon. The watershed hosted a wide variety of human activities that resulted in a landscape that was significantly modified at the time of contact with the non-indigenous world. The archaeological data contained within the watershed contain important information that will continue to be discovered, protected, and interpreted.

Traditional and ceremonial use is recognized as an important interest by the descendants of the indigenous inhabitants/users of this watershed. It is in the best interests of both tribal and agency leaders to continue discussions of common situations with a goal of a government to government relationship built on open communication, accomodation of need, trust, and respect.

From an anglo-American historic perspective, the Middle Santiam watershed still embodies much of the character of the early Forest Service administrative era in that historic trails and shelters may still be enjoyed in relative solitude. The presence of Judge Waldo, a principle figure in the exploration and preservation of the High Cascades, sets this watershed aside from others within the Sweet Home RD.

KEY QUESTIONS: Sustainable Communities

The following two key questions are addressed in terms of application to tribal government interests within the South Santiam watershed.

Question: What parts of the watershed have attributes that lend themselves to American Indian traditional and/or ceremonial use?

Discussion: The Middle Santiam watershed contains elements of traditional and ceremonial cultural practice in terms of intensive site specific concerns and extensive resource availability interests. The entire watershed is part of a broad cultural landscape wherein a semi-nomadic tradition of seasonal round resource procurement activities inter-twined with a complex ceremonial practice of spirituality.

In general, areas containing resource gathering opportunities for traditional or ceremonial practice include riverine and upland areas with a lesser emphasis on forested mid-slopes. Natural openings are also likely to lend themselves to traditional or ceremonial use. Resource diversity is a key to likely areas which might be considered important for tribal interests. A listing of areas of interest would include consideration for the availability the following: camas, yew, huckleberries, beargrass, cedar, salmon, elk, lithic (stone tool) source material, and other resources essential for material and spiritual culture.

In general, sites important to traditional and ceremonial tribal interests are fixed and are situated in places of medicinal, religious, or resource significance. They may be found along riverine and/or travel corridors, caves/outcrops, openings, and places of specific resource or religious importance.

Specifically at least 14 locations have been identified as important to tribal traditional or ceremonial interests within the Middle Santiam watershed (in all subwatersheds). Exact locations and discussions of use are on file in the District heritage resource files and are not for general public review. Areas range in scope from less than one acre to several miles long, from extensive transitory in nature to intensive and fixed, and from utilitarian/material to religious/ceremonial.

In conclusion, broad areas within the watershed have been identified as containing attributes likely to serve tribal traditional and ceremonial use interests. Specific locations and resources have been thus far identified - however this list will continue to grow as a healthy government to government relationship is nurtured. The District will be aware of the sensitivity and importance of traditional and ceremonial use requests and strive to accomodate tribal interests in the spirit of mutual partnership and respect.

Question: What limits the availability of resources needed for traditional or ceremonial uses?

Discussion: Resources important to traditional and ceremonial use are limited by the following factors; scarcity, seasonality of need, geology, incomplete inventory, and lack of awareness/sensitivity in land management. All of these limiting factors, both natural and human caused, can be overcome to a great degree by programmatic consideration and in some cases long term commitment to education and collaboration.

Scarcity of resources can be analyzed in terms of actual quantities available, competition for rare or protected entities, and the limits of what is inventoried. In order to ensure long term resource availability it is necessary to practice limited procurement strategies. Many traditional tribal practices are consistent with this approach. Perhaps a hierarchy of use can be considered whereby if resources are scarce the first priority is for tribal use and general public requests would be considered secondarily. If availability is so limited that not all tribal use can be accomodated (and still ensure long term availability) then ceremonial use might have priority over traditional practice. Any such management scheme would need the full exploration of tribal interests within the government to government relationship critical to success.

Seasonality of need reflects the interaction between natural availability (of plant resources) and traditional and ceremonial cultural timing requirements. For example, certain resources may be required for a ceremony which takes place in winter but the only time to properly acquire that resource may be during another season. Considerations of access, limited or unknown availability beyond this watershed, and religious practice may make a request seem to be untimely from a non-Indian point of view. Nevertheless, when ceremony and tradition call for resource procurement significant delay may render a cultural event meaningless. It would seem prudent for discussions to encourage tribal requests for access or resources that might need administrative action (inter-disciplinary resource consideration, opening a gate/road, limiting general public presence in the area, etc) to occur with sufficient lead time for success.

Geological constraints for availability of resources is in reference to the fact that lithic sources are finite (in a cultural timeframe). Stone tool quarry sites may be very limited in size. Sensitivity to the need for additional source sites could be addressed when developing management plans and implementing activities. Timely identification of lithic material might lead to the continued availability of resources that might otherwise become exhausted within this watershed. An example of this would be cryptocrystalline silicate (CCS) that does occur in limited quantities within the watershed. In order to ensure continued supply within the watersheds additional CCS sources could be identified during ground disturbing activities (road building, landing construction, etc) as replacement options, in case traditional sites become exhausted. This would take coordinated action based on interest based planning stemming from collaborative government to government relations.

Incompleteness of inventories is potentially a contributing factor to discussions about scarcity, geology, and seasonality. Without a reasonably complete data base from which to project action it is very difficult to ensure that long term interest driven objectives can be met. Once the need for a traditional and cermonial use inventory can be established with proper tribal input regarding confidentiality/sacred knowledge, then resource personnel who are on the ground daily can begin to build inventory data. A resource may not be as scarce as suspected once the landscape is inventoried. Replacement areas could be identified for non-Indian use or for when traditional resources become depleted; i.e. beargrass overcut, huckleberries overgrown, yew over harvested, cedar over harvested, salmon and other riverine resources over fished/over dammed.

Any lack of awareness and sensitivity to traditional and ceremonial American Indian cultural needs can be addressed through an education program aimed at agency employees likely to find themselves in contact with tribal representatives or in positions as decision makers.

In conclusion it appears that the lack of a sufficient inventory of traditional and ceremonial resources needs to be addressed within the context of government to government relations. An objective of such collaboration would be to identify, as culturally appropriate, those resources and areas which are limited and to plan for long term availability for traditional and ceremonial use. Short term objectives need to address the identification of essential resources, and the careful planning, implementation, and monitoring of management activities to provide for resource enhancement or replacement as appropriate.

HERITAGE RESOURCE RECOMMENDATONS

MIDDLE SANTIAM WATERSHED ANALYSIS

The following recommendations are drawn from the Heritage Resource Report for the Middle Santiam watershed analysis and are intended to highlight opportunities within the cultural and resource landscape.

Programmatic Recommendation:

It is recommended that the US American Indian Policy, USFS and Region 6 American Indian Policies be fully implemented within the Middle Santiam watershed. The policy calls for tribal and agency leaders to walk the land, gain understanding of interests, become sensitive to traditional beliefs and practices, and build a collaborative, stable, long-term working relationship: - resulting in positive, mutually understood, and beneficial solutions to common situations. Long-term availability of traditional and ceremonial resources, access to those resources and sacred areas, and concerns for cultural confidentiality are among important aspects to encorporate into the administration of programs and activities within this watershed.

Huckleberry management: Cougar Rock SIA and Trapper Mtn

District facilitation of appropriate tribal interests and compatible research objectives resulting in co-management of traditional huckleberry grounds within the watershed is recommended. Concerns for quality, competing species encroachment, plant treatment, cultivation/harvest practice, traditional and ceremonial practice, and youth involvement/education are among items for consideration.

Native Plant Program:

Collection of native seeds, the transplanting of native plants, and the involvement of American Indian youth in these efforts are recommended. Program inventory and monitoring are essential and would also be a valuable component of tribal youth education programs.

Cedar Management:

Tribal and District partnership to ensure availability of cedar for traditional and ceremonial use is recommended. The Pyramid and Tommy Creek areas have been identified by tribal representatives as a preliminary location for consideration.

Education Recommendation:

Interpretation of Judge J. B. Waldo presence within this watershed for public education is recommended. The District has sufficient information to develop an interpretive display in recognition of JB Waldo's early explorations of the High Cascades. Inscription camp near Daly Lake was a base for many of his explorations. A carved stump from this camp has been recovered and should be interpreted for public education and enjoyment.

Land Acquisition Recommendation:

A land exchange program oriented toward acquisition of heritage reources is recommended to place important properties under federal protection. Resource protection, interpretation, and public education value are primary considerations.

Properties recommended for acquisition include:

1) T 12S, R 4E, Sec 27, (SE 1/4 SE 1/4. NE 1/4 SE 1/4. SE 1/4 NE 1/4)-Cougar Rock Area,

2) T 13S, R 6E, Sec 9, (NW 1/4 NW 1/4. SW 1/4 NW 1/4)-Dry Lake Area,

3) T 12S, R 6E, Sec 33, (NE 1/4 SE 1/4. SE 1/4 SE 1/4)-South Pyramid Area,

4) T 13S, R 5E, Sec 15, (NE 1/4 NE 1/4)-Harter Mtn. Area,

5) T13S, R 3E, Sec 12, (SE 1/4 NW 1/4)-Moose Ridge Area.

Heritage Program Recommendations:

Historic name recognition - Judge J. B. Waldo. It is recommended that the trail around Daly Lake be named after Judge John B. Waldo in honor of his early presence within the Middle Santiam watershed. Judge Waldo was a primary figure in the preservation of the High Cascades.

Historic trail shelter reconstruction - Swamp Creek. The Swamp Creek trail shelter has collapsed from benign neglect and windfallen trees. It is recommended that this historic trail shelter be reconstructed on or near the orginal location. This action would provide the third of the original four trail shelters within the watershed and allow for an enhancement of the early Forest Service administrative era character already recognized as unique on the Sweet Home RD.

Thematic site management - watershed scale. The District should explore opportunities to engage in thematic archaeological site management within the Middle Santiam watershed. Site significance, condition, protection, inventory strategies, and mitigation options are among factors in such a consideration. Involvement of tribal interests/representatives in this effort is also recommended. Desired outcomes are to prioritize heritage resource program needs, minimize data redundancy, streamline administrative process, and maximize efficiency.

Site monitoring - watershed scale. Archaeological site condition should be monitored regularly to establish the need for mitigation of adverse impact to site integrity from human and natural causes. This monitoring is recommended as a higher priority for this watershed than the usual District-wide random sample/project driven strategies due to the high level of American Indian cultural heritage interest that has been demonstrated.

Site discovery - high probability zones. The District should recognize the importance of continued inventory of high probablity areas within this watershed. Section 110 of the National Historic Preservation Act, 1966, calls for the complete inventory of lands within federal jurisdiction (independent of NEPA compliance). Partnership between research, the tribes, and federal agencies could provide resources to augment current low levels of program inventory and complete the inventory as directed.

Middle Santiam Watershed Analysis
Watershed, Hydrology, Water Quality, and Stream Channels

The following information was compiled during the watershed analysis process for the Middle Santiam River watershed. This information is being stored within a working file at the Sweet Home Ranger District office, Sweet Home, Oregon. Information in this file was used to establish and address Issues, Characterization, Trends, and Recommendations for the watershed analysis.

The file contains the following information:

- Overview Questions
- Characterization Questions
- Meeting Notes
- Interview information
- Middle Santiam Physical Domain Write-up
- Correspondence with outside agencies
- Middle Santiam Hydrographs

- Geographical information reports:
  - Riparian reserve acreage summary by seral stage
  - Total acres within riparian reserves
  - Total acres unstable soils within riparian reserves
  - Total acres stabilized landflows within riparian reserves
  - Total miles of roads by landform block
  - Total area by landform block
  - Area by 6th field watersheds within Middle Santiam Watershed
  - Miles of streams by stream class by 6th field, stream density calculations
  - Seral stages by 6th field for riparian reserves
  - Miles of streams by stream class for Middle Santiam Watershed
  - Total acres seral stages by ownership blocks
  - Total acres seral stages by landform blocks

- Original manuscripts for Hydrology, Water Quality, and Stream Channels
- Longitudinal Profiles:
  - Cougar Creek; Scar Creek; Middle Santiam River; South Pyramid Creek; Jude Creek; Pyramid Creek; Chimney Creek; and Bear Creek.
- Historic map and characteristics of Middle Santiam River ODFW Report, 1938. Notes
- Long term Patterns of Water Quality in a Managed Watershed in Oregon: 1. Suspended Sediment; Kathleen Sullivan, 1985.
- Middle Santiam Watershed Characterization
- ARP Values and Mid-Point ARP 5th and 6th field watersheds. Forest Report
- U.S.G.S. Reports:
  - Time series Temperature for the Middle Santiam at Foster and Cascadia site.

David Halemeier
North Zone Hydrologist
April 1996

WATERSHED ANALYSIS

MIDDLE SANTIAM WATERSHED

WILLAMETTE BASIN

SOILS AND GEOLOGY REPORT

APRIL 1, 1996

TABLE OF CONTENTS

April 1, 1996

Reply To: 2550 Soil Management
2520 Watershed Protection and Management

Subject: Middle Santiam Watershed Analysis - Soils and Geology

To: District Ranger, Sweet Home Ranger District

I. PROCESS AND ASSUMPTIONS

A. INTRODUCTION

"Watershed Analysis is a procedure used to characterize the human, aquatic, riparian, and terrestrial features, conditions, processes, and interactions within a watershed. It provides a systematic way to understand and organize ecosystem information. In so doing, watershed analysis enhances our ability to estimate direct, indirect, and cumulative effects of our management activities, and guide the general type, location, and sequence of appropriate management activities within a watershed." (Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis, Revised August, 1995, Version 2.2, Portland, Oregon, page 1).

To work through this process, the Middle Santiam Watershed Analysis was conducted from January through April of 1996 on the Middle Santiam Watershed, located above Green Peter Reservoir (see nearby figure). Over half the acreage lies within the Sweet Home Ranger District of the Willamette National Forest. The core team consisted of six individuals, a team leader and five resource representatives: Soils/Geology, Hydrology, Fisheries/Wildlife, Engineering/Recreation, and Vegetation.

The recently revised Federal Guide for Watershed Analysis (Version 2.2) states that the process for conducting ecosystem analysis at the watershed scale has six steps: 1) Characterization of the watershed; 2) Identification of issues and key questions; 3) Description of current conditions; 4) Description of reference conditions; 5) Synthesis and interpretation of information; and 6) Recommendations. All watershed analysis should address the basic ecological conditions, processes, and interactions at work in the watershed, and the Revised Guide states that the following core topics should be addressed in the six step process: Erosion processes, Hydrology, Vegetation, Stream channels, Water quality, Species and habitats, and Human uses.

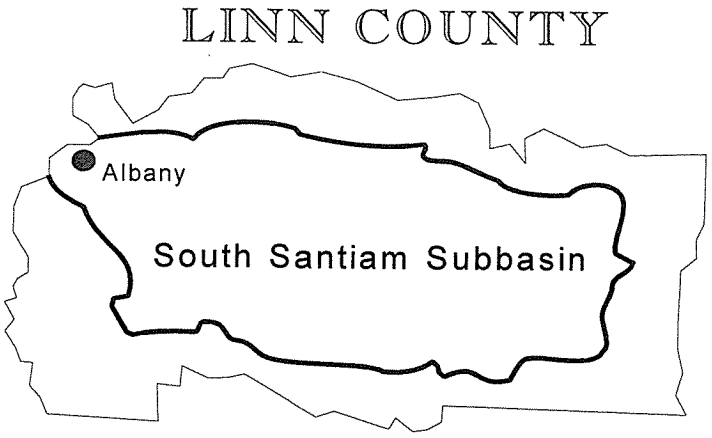
This Soils and Geology Report will focus primarily on the first of the these core topics - EROSION PROCESSES. Some discussion of the effects erosion process have on stream channel morphology and water quality will also ensue. The Revised Guide states that core questions are designed to guide the teams through the six step process, and lists the following for EROSION PROCESSES:

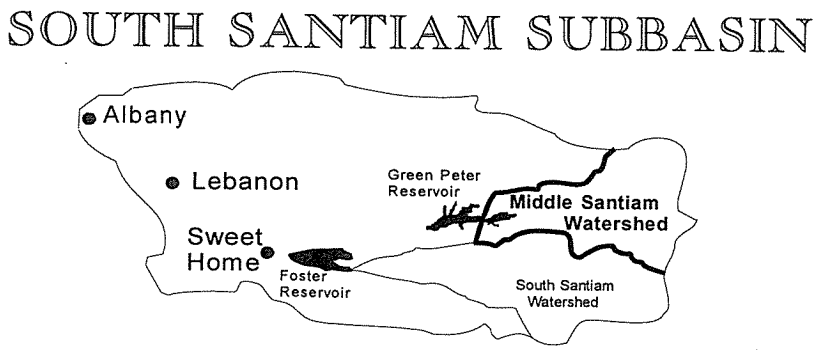
Step 1: What erosion processes are dominant within the watershed? Where have they occurred or are they likely to occur?

Step 3: What are the current conditions and trends of dominant erosion processes prevalent in the watershed?

Step 4: What are the historical erosion processes within the watershed? Where have they occurred?

Vicinity Map





Step 5: What are the natural and human causes of changes between historical and current erosion processes in the watershed? What are the influences and relationships between erosion processes and other ecosystem processes?

It is in answering these core questions that the upland story will unfold, and its links with the riparian system, as well as management activities, will be established and defined.

B. FRAMEWORK and FOUNDATION

In order to begin that task, a framework is needed in which to operate. Three components that formed the foundation for the upland portion of analysis process were (1) the 1990 Willamette National Forest Land and Resource Management Plan (LRMP) which includes Management Area 15 (MA-15) Standards and Guides for Riparian Protection; (2) the landtype definitions found within the 1973 and 1990 editions of the Willamette National Forest Soils Resource Inventory, and the Soil Survey of Linn County Area, Oregon (Langridge, Russell W., Soil Survey of Linn County Area, Oregon. United States Department of Agriculture, Soil Conservation Service, July, 1987, 344p, 97 plates); and (3) the professional judgement of resource personnel that developed from experience and intensive field reconnaissance and review. The forest wide standards and guides for Soil and Water Quality include FW-079 through FW-114 and those for Management Area 15 (MA 15) are MA-15-01 to MA-15-41. MA-15 was especially developed to preserve and enhance the vegetation and lands adjacent to rivers, streams, lakes, and wetlands for the animal and plant species that are dependent on them. These basic LRMP Standards and Guides represent the collective thought and wisdom of over a decade of prior experience by Willamette National Forest watershed personnel. With the use of trial and error, observation and deduction, and scientific investigation, considerable expertise developed on Forest as to what protection measures worked, and what did not. From that experience base, from over 20 years of monitored effects of timber harvest, and in coordination with research at Oregon State University, the Willamette National Forest developed the soil and water protection measures and best management practices for the 1990 Forest Plan.

To be able to begin, some level and type of management intensity, some alteration of the ecosystem, must be anticipated in some time frame in order to provide the backdrop for the analysis, or no analysis is needed. In this case, this management intensity is considered the harvest level established in the Willamette National Forest Land and Resource Management Plan as amended by the Record of Decision and the Standards and Guides for Management of Habitat for Late Successional and Old Growth Forest Related Species within the Range of the Northern Spotted Owl. Forest Plan allocations include Late Successional Reserves, Riparian Reserves, Wilderness Areas, Matrix Lands, and an Adaptive Management Area, as well as land management allocations (see nearby figures).

A fundamental constituent of watershed analysis, and an appropriate place to initiate the inquiry, is upland condition. Upland condition involves a complex set of interacting variables that includes geology, topography, climate, soils and vegetation. The relative importance and performance of these attributes is best assessed and critiqued by qualified personnel engaged in intensive field level investigation and data collection in a systematic and meaningful manner. Field work generally followed a relatively specific sequence that attempted to develop a "story" about the landscape and provided the basis for the technical conclusions. In specific, the principal performers on the upland stage are five in number: (1) geomorphic setting, (2) landtype distribution, (3) soil suitability, (4) slope stability, and (5) site productivity. To reemphasize,

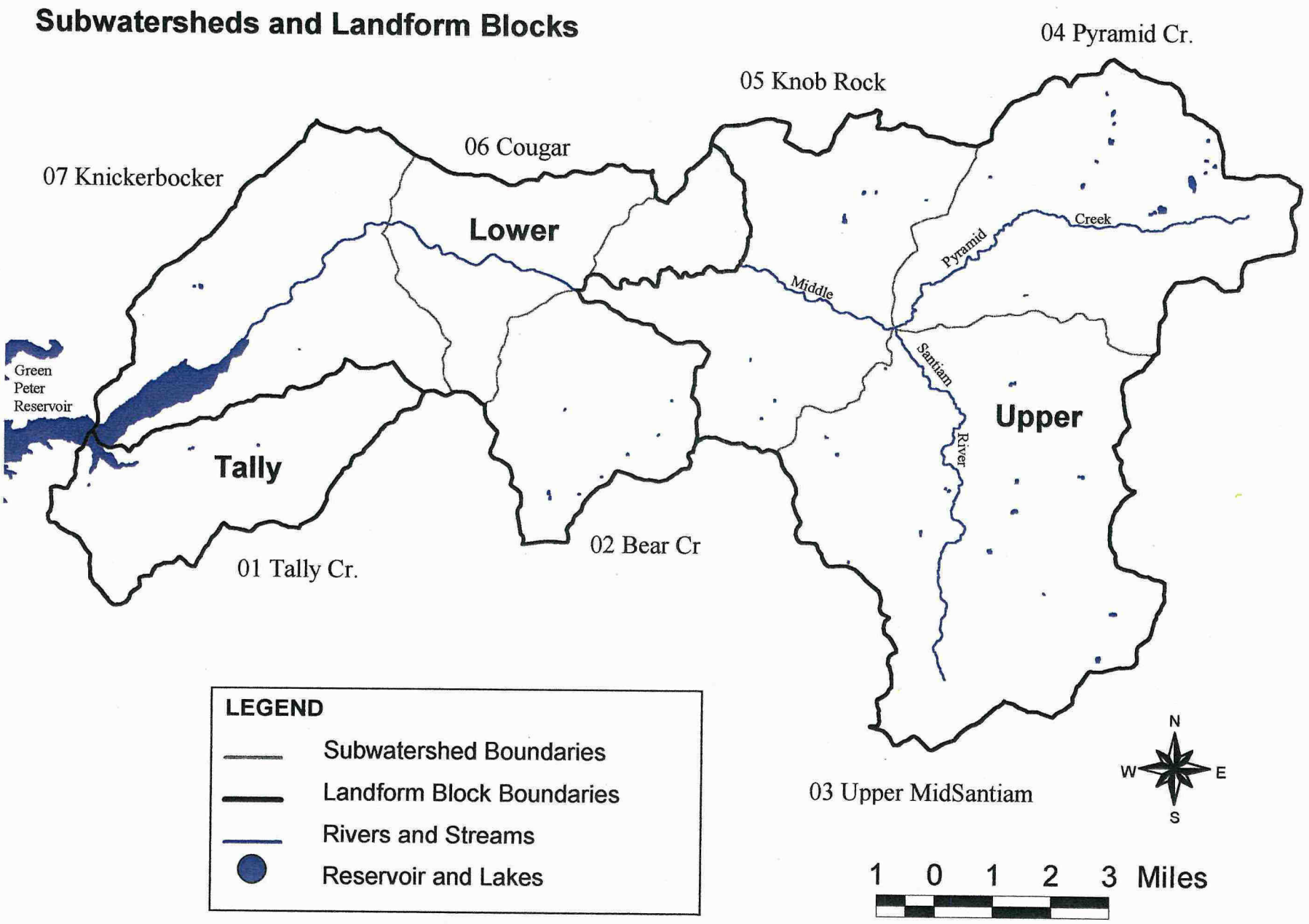
this was a field based study. This report compiles over a decade of project work and summarizes the results. My field investigations of landtypes and their specific attributes and the resulting conclusions about Holocene geomorphic history form the groundwork for the conclusions, recommendations and mitigations that follow in this report.

This process commenced with a field evaluation of the geomorphic setting (1) or the basic geologic framework in which the landscape was formed. Utilizing the 1973 WNF Soil Resource Inventory definitions, landtype distribution (2) was determined by entirely remapping most non wilderness, non LSR, National Forest System lands within the project area. The 1973 SRI was employed instead of the 1990 version because it allowed more versatility and site specificity than the latter model. The 1990 model (which exists in digital format) was applied when information on the broad, general features of the landscape was desired to compare or enhance other data of a more general nature. As part of this landtyping process, soil suitability (3) was evaluated. Unsuited soils were designated in two categories: unreforestable and irreversible impact from active slope (4) instability. When actively unstable or potentially highly unstable areas were encountered, additional field review occurred to determine the failure history and the likely future failure potential that was anticipated (based on a geotechnical review). Lastly, site productivity (5) was evaluated to determine regeneration potential, erosion resistance, management opportunities, and needed mitigations. These five activities just as often occur simultaneously as sequentially in order to manage a multiple working hypothesis about the landscape and finally to settle on a likely geologic context and time frame for basin morphology and erosion potentials.

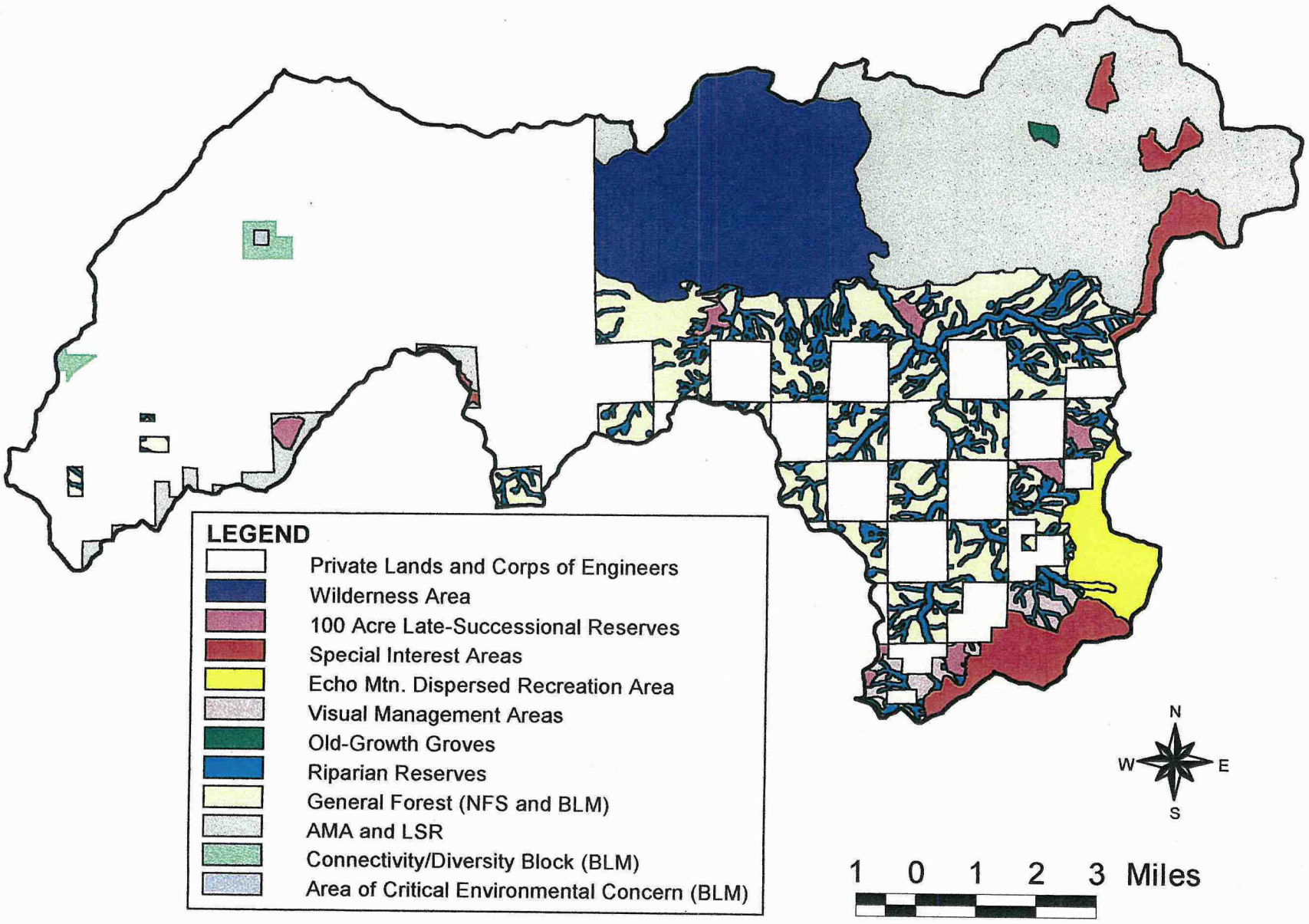
Several decisions are required in order to conduct a meaningful analysis in the appropriate time frame. Data must be analyzed and presented in systematic manner. Critical to the evaluation of the core questions are the spatial and temporal sideboards that will be employed. For the Middle Santiam Watershed, landform blocks were utilized to organize and stratify the terrain. These landform blocks (Upper Middle Santiam, Lower Middle Santiam, and Tally Creek) were geographically defined by subwatersheds or portions there of.

The Middle Santiam is divided into seven discrete geographic areas or subwatersheds, as follows: Bear Creek (6744 acres), Cougar (6397 acres), Knickerbocker (11,526 acres), Tally Creek (7616 acres), Knob Rock (14,183 acres), Pyramid Creek (13,362 acres) and Upper Middle Santiam (20,787 acres) for a grand total of 80,614 acres. Subwatersheds (PIGs) always follow stream divides and represent true watershed drainages. Consequently, most are divided by a major stream channel. For the Middle Santiam watershed analysis, the upland condition will be analyzed by landform block, which are generally aggregates of subwatersheds. This unit is small enough to provide meaningful conclusions about geologic processes, and large enough not to bog down in meaningless or insanely repetitive details (see nearby figure).

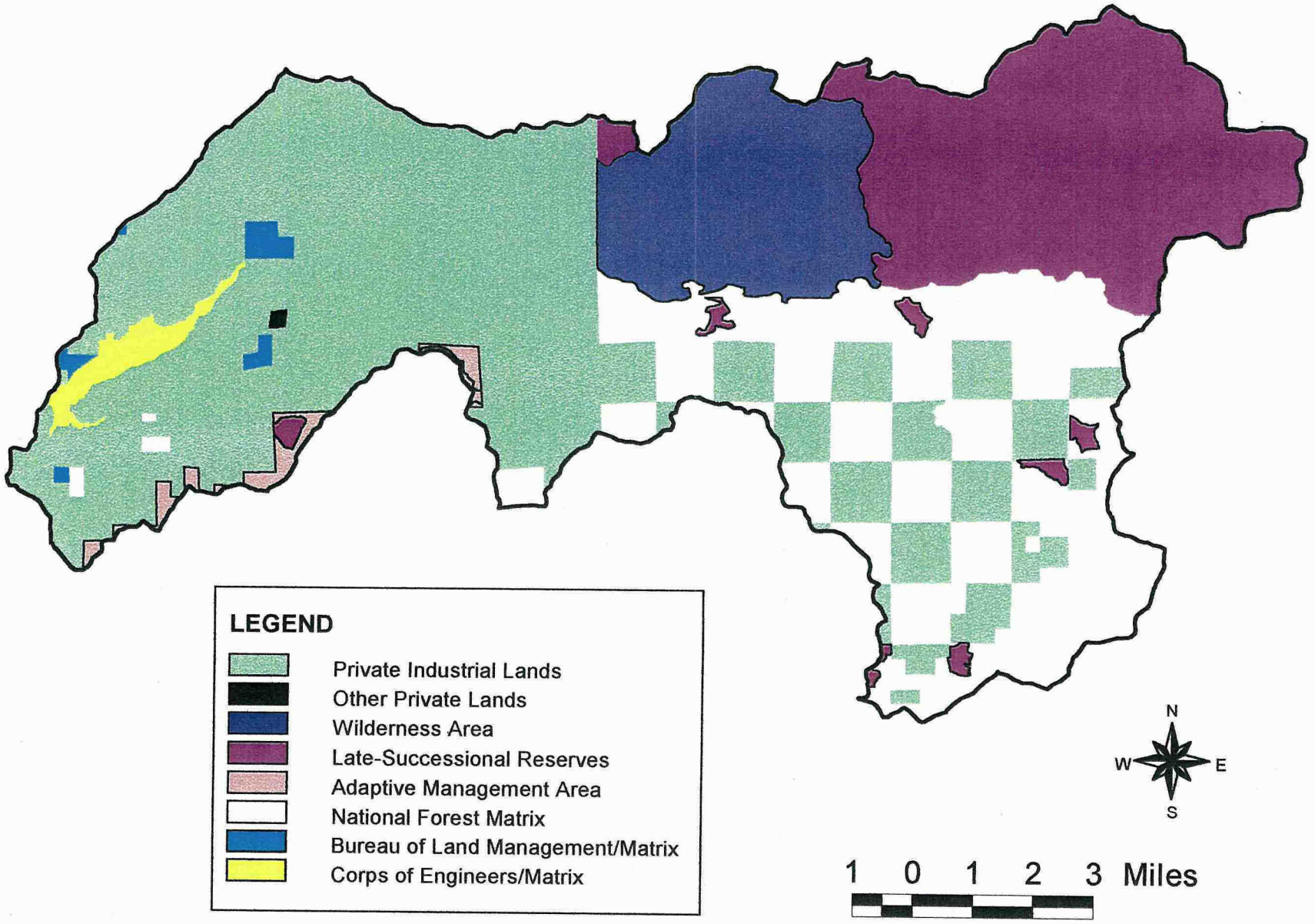
From a geologist's point of view, time is a wonderfully dualistic notion. On the one hand, it provides an exacting chronology with which to catalogue the flow of planetary events. While on the other, millions of years can be condensed to seconds of discussion. Mountain ranges appear and erode away into seas long since vanished with a mere utterance. Obviously, just as one can be lost in space, being lost in time can be very time consuming to the analysis process. Certainly, the basic geology will be addressed, but primarily as a discussion item. For the analysis, the basic question of "SO WHAT" needs to be considered. What happened hundreds of thousands of years ago to a stream or mountain side probably has little bearing on the core questions. For example, much of the area was glaciated during the early Pleistocene, but little would be


Subwatersheds and Landform Blocks
04 Pyramid Cr.
05 Knob Rock
06 Cougar
07 Knickerbocker
Lower
Pyramid
Creek
Middle
Green
Peter
Reservoir
Santiam
River
Upper
Tally
02 Bear Cr
01 Tally Cr.
03 Upper MidSantiam
LEGEND
Subwatershed Boundaries
Landform Block Boundaries
Rivers and Streams
Reservoir and Lakes
N
W
E
S
1 0 1 2 3 Miles

Land and Resource Management Plan Allocations



Ownership and Forest Plan Allocations



achieved in analyzing the effects of another glacial advance. For this process, relatively distant (older) geologic events will be discussed where appropriate to set the stage for impending evaluations. But, the time frames for more focused discussion will generally fall within the range of the oldest vegetation or about 500 to 800 years.

II. GEOLOGY

Watershed analysis is intended to provide a scientifically sound understanding of the processes and interactions within a watershed. The end product should be solidly based on existing systems (if possible); it should be implementable and reproducible by others. The following section examines the physical components of Geology and Soils by discussing the underlying geologic foundation and its relationship to the present situation. The information provided in and inferred from the Soil Resource Inventory provides much of the technical data that the erosion and sedimentation modules require. A discussion of the intricacies and complexities of the 1973 Soil Resource Inventory and its current management interpretations is found in the Appendix.

(NOTE: The following geology discussion is based on information provided by Walker, George W. and Duncan, Robert A., 1989, Geologic Map of Salem 1o by 2o Quadrangle, Western Oregon. Miscellaneous Investigation Series, MAP I-1893, Department of Interior, U.S. Geological Survey, 1989, and personal observations.)

The Middle Santiam River, on the western slope of the Cascade Range, is part of the South Santiam subbasin, which is component of the Willamette River Basin. The Cascade Range, which contributes the preponderance of drainage area for the Willamette River, extends for over 625 miles from northern California well into British Columbia in Canada. The general physiography of the Cascades is dominated by a string of potentially active volcanic peaks. These relatively recent craggy summits overlie a complex geological sequence of older volcanic and sedimentary rocks. The over all form of the north - south trending Cascades reflects the line of subduction of the Pacific oceanic plates as they move under the North American continental plate. This plate commotion has modified the Cascades by basin and range faulting to the east, and episodic mountain building and vulcanism throughout their history and extent. The surface expression of these rock sequences have been altered through time by the numerous rivers that drain the wet western flanks and by intensive periods of mountain glaciation.

The Middle Santiam Watershed analysis area contains about 80,614 acres. Located entirely within the Western Cascades physiographic region, the Middle Santiam watershed is composed of older Tertiary lava flows, tuff and intrusive rocks. More specifically, undivided Miocene and Oligocene tuffaceous sedimentary rocks, basalt flows and tuffs form the foundation of the Middle Santiam watershed. They consist of a heterogeneous assemblage of continental, largely volcanogenic deposits of basalt and basaltic andesite, including flows and breccias, complexly interstratified with epiclastic and volcanoclastic deposits of basaltic to rhyodacitic composition. Also incorporated in the sequence are extensive rhyodacitic to andesitic ash-flow and air-fall tuffs, abundant lapilli tuff and tuff breccia, andesitic to dacitic mudflow (lahar) deposits, massive to bedded fine- to coarse- grained tuffaceous sedimentary rocks, and volcanic conglomerates. Radiometric potassium/argon dates on parts of this formation are mostly 32 to 17 million years old. Most of this strata was previously assigned to the Little Butte Sequence. The clastic or sedimentary portion of the assemblage forms a prominent escarpment along the north boundary of this watershed from Knob Rock east to Trappers Butte (Walker and Duncan, 1989).

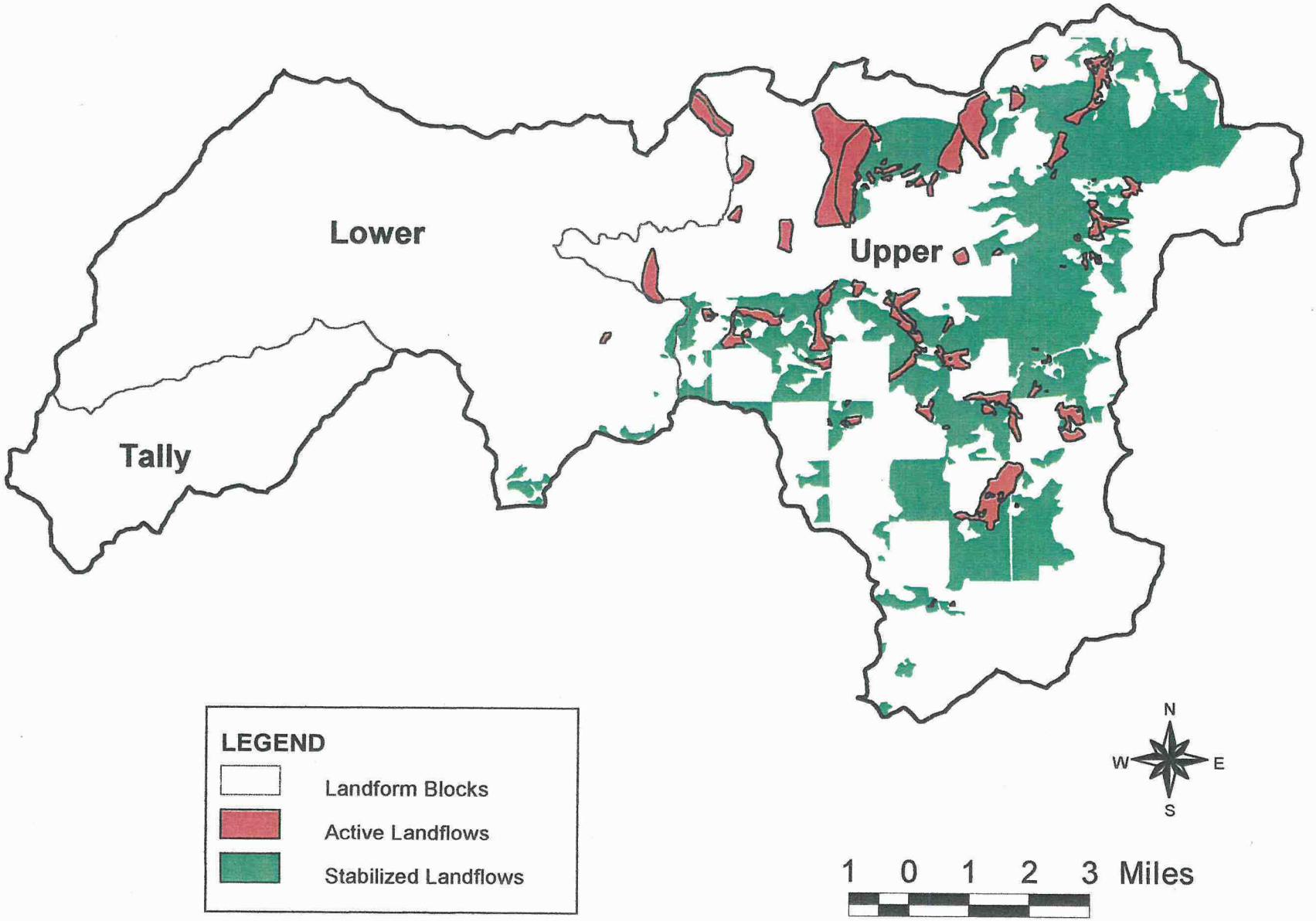
Flows and flow breccias of olivine andesite, basaltic andesite, and some basalt generally form a broad crescent-shaped cap on the higher elevation main ridges that extend east from Swamp Mountain to Scar Mountain, south to the Pyramids, Crescent Mountain, North Peak, South Peak and Iron Mountain, and finally back towards the west to end at Harter Mountain. This flow unit lies unconformable on the older Tertiary deposits below. Erupted mostly from widespread, northwest trending dikes and dike swarms and related plugs and lava cones, their potassium-argon age dates range from about 17 to 10 million years ago or Middle to late Miocene. These rocks have previously been designated as the Sardine Formation by some authors. Overlying these broad upland deposits are even younger ridge capping flow and flow breccias of olivine basalt and basaltic andesite. Some flows of this youngest capping unit are lithologically similar to flow rocks of the High Cascade volcanic sequence and some are more like flows that in the past have been mapped as part of either the Sardine Formation or the Battle Ax lavas (depending on location). Potassium-argon ages of rocks of this unit range from about 1 to 10 million years old or early Pleistocene, late Miocene and Pliocene (Walker and Duncan, 1989).

Associated with plate tectonic movement and subduction zone melting that provided the cauldron from which the Cascade volcanic peaks drew their volcanic broth, was also a sequence of sulphide mineralization. Concentrations of gold, silver, copper and lead minerals lay like widely spaced beads on an unclasped necklace that is strung down the western front of the Cascade Range. Historically, each bead has been the center for mineral exploration and mining activity since the late 1800's. This necklace extends from at least Mt. Hood to well into the Umpqua National Forest. The line of the chain crosses this watershed in the north around Chimney Peak and Galena Mountain and extends southward along the western Forest Boundary and Bear Creek to leave our study area at Bear Creek's headwaters near Moose Mountain. The Middle Santiam watershed appears to lie in the empty area between the beads. To the north is the Quartzville mining district and to the south is the Blue River (Gold Hill) mining district. Little or no base and/or precious metal mineralization has ever been found in the Middle Santiam. However, Galena Mountain, named for the lead sulfide crystals found in it's rocks, is located on the northern boundary of this watershed. In like manner, extensive prospector-type mining occurred around the turn of the century in the head waters of McQuade Creek, just northwest of Chimney Peak. Who knows what lies hidden in the dense canopy and underbrush along the western boundary of the Middle Santiam Wilderness?

The surface expression of these rock formations has been extensively modified by erosion since late Miocene time, especially from Pleistocene through Holocene with both mountain glacial activity and slope instability. Glacially derived soils are common to higher elevation tablelands, especially at the headwaters of Pyramid and South Pyramid Creek, and the Middle Santiam River. Ice cap glaciers probably covered the High Cascade platform to the east of this watershed many times during the Pleistocene. During the earliest and most extensive glacial periods, valley glaciers probably travelled down the Middle Santiam canyon and some of its tributaries as they acted as outlets for excess ice accumulation to the east. The younger and more recent glaciations may have had smaller localized valley glaciers carve cirques on the north and east aspects of the higher peaks. However, evidence is scanty, and much of it (if it existed) has been obscured by subsequent large scale slope instability. The basic cirque form, a bowl-shaped depression with a sheer to very steep rocky headwall, is now found only at the higher elevations around Cone Peak, South Peak and North Peak.

Locally, the materials of the Little Butte Series weather to form deep colluvial and residual soils that give rise to unstable soils with both rotational and translational failures common. It seems likely that the numerous glacial

Active and Stabilized Landflows



features, such as hanging valleys and assorted morainal deposits, resided on the landscape at one time. Since then almost all have been extensively altered or eliminated by stream erosion and large scale slope instability. Stabilized slump/landflow features, such as sag ponds, bench and scarp topography, and disrupted drainages, are common in throughout the upper Middle Santiam. Large scale slump/earthflow instability has been a significant factor in slope development or stream channel morphology for several thousand years, certainly since the end of the Pleistocene some 10,000 years ago. Over 40% of the mapped area occurs on stablized landflows. Of critical interest, in many localized areas of most drainages, actively unstable remnants of these larger landflows can still be found, and most still manipulate and control stream morphology to a high degree.

This complex geologic history has produced a myriad of diverse landforms and soils. A geomorphically moderately to highly complex terrain with a distinctive and diverse topographic expression, landforms range from highly glaciated upland benches and flats with extensive ground moraine (such as the headwaters of Single Creek or Cougar Creek), to steep rocky canyons and crags of Chimney Peak and Chimney Creek, to the large scale stabilized slump / earthflow complexes and associated glacial deposits of upper Pyramid Creek, to the flat stable river terraces and outwash plains of lower Middle Santiam River around the confluence with Bear Creek. A critical component of each landform block will be the sorting out the specific geomorphic history (see figure nearby).

III. LANDFORM BLOCK EVALUATION (see figure nearby)

To best describe the Middle Santiam Watershed in a thorough, but not overly detailed manner, the watershed can be divided into three geographic areas, called landform blocks, (subwatersheds, aggregates of subwatersheds, or aggregates of portions of subwatersheds) that will be evaluated individually. Differentiation of each landform block involves geomorphic factors such as bedrock geology, glacial history, and physical description. Each area is addressed in two parts. The first, a descriptive segment, reviews their natural features and the distribution, type and relative importance of the principal upland environmental processes and time frames in operation. This section attempts to answer questions asked previously in Steps 1, 3, and 4 for Erosion Processes. The second, an appraisal segment, evaluates in a qualitative way the effects of previous land management activities on the landform block (subwatersheds, or parts there of) under discussion and their relation to natural rates of disturbance in the study area. This section attempts to answer the questions posed in Step 5 of Erosion processes.

A. UPPER MIDDLE SANTIAM LANDFORM BLOCK -- "Upper Block"

1. Descriptive Section:

The most distinguishing features of this landform block include the land flow-formed lakes (Daly, Parish, Don, Rigs, Scar) along the northern boundary and the stratified, near-vertical, sedimentary rock scarps that provide a backdrop to these same lakes. This escarpment extends from Trappers Butte on the east to Knob Rock on the west. These noteworthy features, as well as the glacially formed benches near Harter Mountain on the south side of this landform block, both give way down their respective valleys to extensive slump/earth flow complexes.

This landform block is composed of the two complete subwatersheds, 03 Upper Mid Santiam and 04 Pyramid Creek, as well as a major portion of a third

subwatershed, 05 Knob Rock. That part of Knob Rock which is north of the Middle Santiam River and west of Fitt Creek, is included within the next landform block because of its geologic similarities to the west. A cursory look at the nearby map quickly shows that the Upper Middle Santiam landform block comprises the principal headwaters for the Middle Santiam River. The elevation ranges from about 1500 feet at the confluence with Bear Creek at the western boundary to 5022 feet at Scar Mountain on the north, to 5618 at the Three Pyramids and 5720 at Crescent Mountain on the east, and finally to the highest point, North Peak at 5795 feet on the southeast.

Taken together, these drainages form typical, low to high elevation, Western Cascades, dendritic, stream systems. Bedrock is considered Oligocene to early Miocene in age (25 to 40 million years) and is composed primarily of volcanic tuffs, breccias, ash flows and tuffaceous sedimentary rocks, with the occasional basaltic flow and intrusion mixed in. Extensive erosion, from glaciations, earth failures, and stream down cutting has occurred throughout the last several hundred thousand years to form the highly dissected valleys now present. Geomorphically a highly diverse region, landforms range from highly glaciated upland benches and headwalls at the higher elevations to large scale, stabilized slump/earthflow complexes, to small localized areas of actively unstable ground, to steep highly dissected V-shaped draws and headlands. Local relief ranges to over 1800 feet, but the topography is highly diverse with gently sloping benches often giving way to large nearly vertical rock cliffs that then terminate downslope in a complex of smaller scarps, swales, and steep sideslopes. In this tangled terrain, soil types are highly variable, but taken together are all relatively productive as the areas show a wide range of western hemlock to silver fir and mountain hemlock plant communities and grows Site II to Site V Douglas Fir with the highest site land most common in the valley bottoms.

In the near term of centuries to millennia, slope instability from landslides, landflows and debris chutes have most acted upon the sideslopes and streams of this subwatershed. In fact, the most potentially unstable terrain in the entire watershed exists within this landform block. Numerous active slump\earthflows of several acres to several score acres have blocked and controlled base levels on almost every major stream within this landform block. The result of numerous live stream intercepts with active landflows has been and continues to be the creation of an extremely sediment rich system with broad meandering channels, wide gravelly flood plains, abrupt gradient changes at blockages, and streams with naturally high turbidity values. It needs to be restated that these conditions are common in almost every drainage within this landform block, and have been in place for several hundred years, if not longer. More is to follow. These slide zones will continue to supply the Middle Santiam and its tributaries with sediment for decades, and possibly centuries, to come. The nearby map displays the currently known actively unstable or potentially highly unstable soils within this area.

Finally, creep and colluvial deposition from slope ravel and slough certainly play a dominant roll in the more steady state and much slower sediment delivery from the steep sideslopes. Intensive, often large scale, fire activity and the resulting vegetation removal undoubtedly accelerates these rates. Much of this area appears to have been involved in stand replacement fires and underburns from around 1700 to the late 1800's. At a much slower rate, stream erosion and deposition have shaped the lower portions of these drainages where stream terraces have developed at various gradient control points as a result of the considerable sediment input in the last thousand years or so. In the more distance past, a dominant, although intermittent, stream terrace is located approximately from above Shed Camp to almost Fitt Creek, on the south side of the Middle Santiam River. This prominent terrace is likely the result of

outwash from one of the older glaciations and is now over 400 feet above the current valley floor.

?. Appraisal Section:

Major disturbance mechanisms have been common to this landform block. In the near term of centuries to millennia, slope instability from landslides, landflows and debris chutes altered sideslopes and shifted streams. In this same time period (for at least the last 600 to 800 years), stand replacement fires have spread across the higher elevations and south aspects to create a patchwork of new stands from Fitt Creek on the northwest to North Peak on the southeast. Two 100 year return interval flood events are on record (1861 and 1964). The 1996 storm certainly will fall in the range of the top ten floods on the Willamette system in the historical record (back to 1813). Finally, from about 1940 to 1990, timber harvest and the concomitant road construction extended across major portions of this landform block. With that as the standard, the following consequences of man's activities are measured, with operations on Federal land the usual yardstick.

a. DISPLACEMENT: Displacement occurs with three separate timber harvest activities: yarding, slash treatment, and road building and maintenance. Yarding activities on existing plantations have for the most part occurred with the appropriate suspension requirements. Slash treatments have usually maintained adequate duff retention standards. Little or no evidence can be found to indicate that these two timber management activities have resulted in detrimental soil displacement or off site soil movement. Finally, most roads have generally been constructed to access stable benches and flats. Although some locations are on steep sideslopes, and some sidecast roads were noted, fortunately most seriously steep sideslopes have been avoided. Although difficult to equate, displacement of soil from timber management and downslope creep from colluvial processes probably are of the same order of magnitude when considered in approximately the same time frames and viewed over the entire study area. When one considers the natural sediment input to the system from the complex of active landflows and other highly unstable terrain, road construction has had almost no effect on sediment input and distribution to stream channels, except on some very localized sites.

b. COMPACTION: Excessive compaction generally results from unrestricted tractor yarding and piling. The more gently sloping, older plantations, predominately at the higher elevations were certainly tractor yarded with only minimal control on skid road density. Excessive compaction may have occurred in many areas. It is likely that this compaction is beginning to ameliorate as root growth and frost action begin to operate to reduce soil density. For the most part, sideslopes in this subwatershed are either too steep to tractor yard, or designated skid roads were required, or cable systems were utilized instead of tractor, so that the expected compaction is not cumulatively significant.

c. NUTRIENT LOSS: A portion, perhaps a majority of this landform block was involved in widespread wildfires approximately one hundred to two hundred years ago. These fires left a profuse patchwork pattern of burnt, underburnt, and unburnt timber that has now grown up in a melange of stands and stand conditions. These natural fires consumed a considerable amount of the above ground organic matter in many areas. Scant amounts of down woody debris remain on numerous localities (3 to 5 tons per acre). On the other hand, many sites, especially on the north aspects, in the deeper draws, and on the more protected benches, survived the conflagration, and retained either an extensive Doug fir over story with considerable down woody debris (100 to 300 tons per acre) or show no evidence of fire for many centuries. Consequently, a wide range in the

above ground tonnage of organic matter exists, and overall, tonnages are considered some of the heaviest in the entire analysis area. The oldest timber harvest plantations with low utilization standards, resulted in extensive amounts of large woody debris and slash retained on the ground. The harvest units of the 1970's and early 1980's, with YUM or PUM yarding standards and fall burns, display a commensurate removal of above ground nutrient matter similar to that of severe natural fires. The most recent timber harvest with down woody debris and duff retention standards has been more benign and retained about as much organic matter as is displayed in the less intense fire regimes.

d. INSTABILITY: As was discussed earlier, numerous areas of large scale, actively unstable, slump / earth flows, as well as recently stabilized landslides, exist in this subwatershed. This condition has persisted for at least 300 years or more, and may have been the product of regional tectonic activity. In addition, several zones of critical highly dissected sideslopes with shallow, often debris chute prone soils are in evidence. These slide zones display considerable natural, translational, slope instability that appears to be related to the stand replacement fire and/ or flood events. For the most part, harvest units have not been located in the most sensitive areas, except for some glaring exceptions like the "Middle Santiam Slide" which has closed FS RD 2041000 near the Middle Santiam River. In this particular case, several road sidecast failures appear to have lead to a massive in-unit slope failure that has resulted in approximately 13 acre active land flow. However, field inventories indicate that road sidecast failures failures are almost inconsequential when compared to the massive rates of sediment input to the streams from the natural failures. Of critical importance is the observation that most failure systems provide adjacent streams with necessary structure, either in the form of large woody debris or boulders (often both). Stream morphology and function have adjusted to the high rates of sediment input because of the stabilizing influence of adequate structure. The numerous active floodplains that often occur along many Middle Santiam streams bear testament to this phenomenon.

In conclusion, this section of the Middle Santiam is currently a sediment rich system with extensive structure. Field evidence indicates that this sediment-rich condition has been in place for several centuries, and is not likely to change for perhaps many decades or even centuries into the future. From a sediment budget standpoint, the numerous areas of active (or potentially highly active) slope instability from both slumps and debris chutes, are the principal agents affecting change in the channels. The affects from the recent catastrophic fires on ravel and slough, though extensive, are but a distant second in sediment generation race. It is likely that the fires played a greater role in recent stream morphology by either producing or consuming considerable amounts of large woody debris, or by changing evapotranspiration rates, than any direct affects to soil fertility or creep. Finally, in this landform block, man caused effects to this date can be considered only an "also ran" in this particular contest. In future, harvest activities should be located and scheduled so as to provide a continuous high level of large woody debris to the deficient stream channels.

B. LOWER MIDDLE SANTIAM LANDFORM BLOCK -- "Lower Block"

1. Descriptive Section:

This landform block is composed of the two complete subwatersheds, 02 Bear Creek and 07 Knickerbocker Creek, as well as a small portion of a third subwatershed, 05 Knob Rock (see nearby map). From the previous discussion, most of Knob Rock

is located within the Upper Middle Santiam landform block. However, the northwestern portion, north of the Middle Santiam River and west of Fitt Creek, has a much greater geomorphic similarity to this, the Lower Middle Santiam Block. A quick look at the nearby map emphasizes that the Lower landform block is principally a transport reach of the Middle Santiam River. Smaller drainages commonly enter at right angles from both the north and south. Taken together, these drainages form typical, low to high elevation, Western Cascades, parallel stream systems. Bedrock is considered Oligocene to early Miocene in age (25 to 40 million years) and is composed primarily of volcanic tuffs, breccias, ash flows and the occasional basaltic flow and intrusion mixed in. Extensive erosion from stream down cutting has occurred throughout the last several million years to form the highly dissected valleys now present. Since this landform block extends well to the west of the much of the Cascade crest highlands, it is doubtful that much of this portion of the Middle Santiam was ever glaciated. Or, evidence of such an event has been considerably obscured by the passage of time and subsequent erosion.

The elevation ranges from about 1010 feet at the full pool elevation of Green Peter reservoir on the western boundary of this block to 4965 feet at Chimney Peak on the northeast, to 4966 at Galena Mountain on the north, to 4692 feet at Cougar Rock on the south. The most distinguishing feature of this landform block is seen as it is viewed in cross section from Cougar Rock in the south to Galena Mountain on the north. In this light the majestic headlands of the Cougar Rock promontory plunge headlong down Cougar and Bear Creeks to narrow terraces along the Middle Santiam only to rise abruptly along Twin Falls Creek to the crags and bluffs of Galena Mountain. With about 3300 feet of relief on the south and nearly 3500 feet on the north, the cross section forms a classic V-shaped valley for much of this east to west flowing transport reach of the Middle Santiam River.

Geomorphically a relatively uniform region, landforms are principally steep, highly dissected, V-shaped draws and sharp ridged headlands with shallow-soiled sideslopes that abruptly transition downslope into gently sloping floodplains and stream terraces. The steep sidewalls of this valley sprout numerous rock outcrops and bluffs, and once supported an extensive blanket of old growth Douglas fir on the shallow, often rocky soils. By contrast, the gently sloping to flat lying terrace deposits of the valley bottom are comprised almost entirely of glacial outwash materials. Even this precipitous terrain is relatively productive as most slopes now display a cloak of Douglas Fir regeneration on a wide range of western hemlock to silver fir communities on Site II to Site V lands. In most instances, the highest site land is located in or adjacent to the valley bottoms.

The principal sediment delivery systems in operation depend entirely on the slope position that is occupied. On the steep shallow - soiled scarps, slope ravel and slough predominate when vegetation cover has been reduced. The more mundane creep commands the day to day reign in the forested environment. Few areas of active slope instability are present. It seems likely that, given the steep dissected nature of the valley walls, debris chutes would occupy a prominent role in the down slope movement of soil and debris. Since little evidence was found to indicate that this is major source of sediment generation in this century, it would seem that this mechanism is highly episodic in nature. This landform block was likely extensively underburned about one hundred to two hundred years ago. These fires were followed by a 100 year storm event in 1864. The high number of steep bed rock draws would seem to indicate that debris chutes are a likely failure mechanism. However, little photo or circumstantial evidence is available to indicate that "natural" debris chute slope instability has been a significant factor for sediment movement in the

last several decades. Likely, little material remains to fail after thousands of years of fires and floods.

2. Appraisal Section:

Almost all of this rugged landform block is covered by private, industrial forestry, land holders. The entire landform block has been entered and harvested in the last fifty years, with a large bulk of the acreage cut in the 1960's and 1970's. Almost none of the original stands remain. Sidecast roads are common, and tractor logging was used extensively, even on the steeper ground in some areas. Some management induced debris chute failures are evident, and extensive off site erosion was likely in prior years. In more recent years, private land owners have utilized more advanced skyline yarding systems. However, sidecast road construction on steep sideslopes was a common practice to access the skyline landings. In addition, few if any riparian buffers were implemented on any streams but the main stem. For the most part, this entire area of private land holdings is now extensively covered with thick brush or well stocked with advanced regenerated of alder, western hemlock, and fir.

> NOTE: Most of the following information was gleaned from a few drive throughs of the landform block, some past rescues of injured woods workers and hunters, and information taken from the Soil Survey of Linn County Area, Oregon, (Langridge, Russell W., Soil Survey of Linn County Area, Oregon. United States Department of Agriculture, Soil Conservation Service, July, 1987, 344p, 97 plates);

a. DISPLACEMENT: To begin, most of this landform block is located on private, industrial forest land. Limited first hand knowledge is available on specific practices. With that in mind, displacement occurs with three separate timber harvest activities: yarding, slash treatment, and road building and maintenance. Yarding activities on existing plantations have for the most part occurred with the appropriate suspension requirements, although tractor logging on steep sideslopes did occur in some units. Slash treatments have usually maintained adequate duff retention standards. This is especially true in that most of this managed land was never broadcast burnt to reduce slash. Some evidence can be found to indicate that these two timber management activities have resulted in detrimental soil displacement or off site soil movement, but it is usually of a limited degree. However, the development of the road system has been extensive with midslope roads commonly found on steep sideslopes and usually built with side cast construction standards. Although road failures have not been extensive to date, it seems likely they will increase as the stumps and slash that contain much of the sidecast material, finally deteriorates. Although difficult to equate, displacement of soil from timber management (primarily road construction) probably greatly exceeds that from downslope creep by colluvial processes when considered in approximately the same time frames and viewed over the entire study area.

b. COMPACTION: Excessive compaction generally results from unrestricted tractor yarding and piling. For the most part, sideslopes in this landform block are too steep to tractor yard. Few tractor logged units were observed. Consequently, compaction is not considered a cumulative concern. Though it seems likely that those units that were tractor harvested have been significantly compacted.

c. NUTRIENT LOSS: Much of this landform block appears to have been underburnt as part of a much larger stand replacement fire approximately one hundred to two hundred years ago. These fires consumed a considerable amount of the above ground decomposing organic matter in many areas, both on the north and south

aspects. It seems likely that with timber harvest, the above ground tonnage of decomposing organic matter generally increased over preharvest conditions. On the whole, the landform block now resides at the middle to upper end of the spectrum of available decomposing organic matter, primarily as a result of harvest residue and lack of slash treatment. Much of the ravel and slough of the soil resulting from logging related disturbance has probably been stabilized by that debris mat. Therefore many of the timber harvest plantations maintain a storage of above ground nutrient capital that is not reflected in the "natural" fire history of the last couple of centuries.

d. INSTABILITY: In stark contrast to the Upper Middle Santiam landform block, this section, although much steeper and more dissected, is also naturally much more stable. Several areas appear to have the potential for considerable natural, debris chute type, slope instability. And, it seems likely that sustained stretches of substantial slope stability were punctuated by relatively brief periods of intense debris chute activity, usually related to contemporaneous large scale stand replacement conflagrations and/or intensive storm events. Several cycles of fires and storms have, for the most part, left little material to fail. Harvest units have been located on almost all slopes, and few in unit slope failures were noted. However, as was discussed previously, road sidecast failures are likely on the rise. It is difficult to determine if natural rates of slope instability are currently maintained over the long term. Certainly, the amount of large woody debris naturally associated with them has not been.

Management related sediment and debris input to the streams may have equalled the natural extremes that result during periods of either catastrophic storm and/or fire events. It seems likely that the almost unrestrained harvest activity of prior years increased both the woody debris and the sediment loads to levels that are typical only infrequently found in the streams of this landform block. In many streams the slash and woody debris act as filters to restrict sediment movement. With logging activity tapering off from historically high levels, sediment movement off the private land is probably much less than in previous years. Many existing roads, units, and stream channels have begun to stabilize as they are overgrown with vegetation. However, with the passage of time, numerous sidecast road segments will begin to degenerate as the underlying stumps and slash decomposed past the point of any retaining capacity. Floods will stress debris laden structures. Wildfires may flash through unburnt units. It remains to be seen how this landform block will react to the passage of time and disturbance events.

C TALLY LANDFORM BLOCK -- "Talley Block"

1. Descriptive Section:

This landform block is composed of only one subwatershed, which, not surprisingly, is 01 Tally Creek. A quick look at the nearby map shows that Tally Creek, at the southwestern corner of the watershed, is not directly linked to the Middle Santiam system. The creek enters Green Peter Reservoir before it reaches the Middle Santiam River, and now never actually runs into a free flowing Middle Santiam Channel. The elevation ranges from about 1010 feet at the full pool elevation of Green Peter reservoir on the western boundary of this landform block to around 4400 along Moose Ridge on the east. It is comprised almost entirely of private land, with the bulk of the acreage controlled by large industrial land owners.

Most of the following information was gleaned from a few drive throughs of the subwatershed, some past timber sale work on small tracts of Forest Service land, and the USDA Soil Conservation Service Soil Survey of Linn County Area Oregon (July, 1987).

This area represents the lowest and consequently the oldest and most weathered section in the geologic sequence. Bedrock is considered Oligocene to early Miocene in age (25 to 40 million years) and is composed primarily of volcanic tuffs, breccias, and ash flows, with the occasional basaltic flow and intrusion mixed in. Geographically, the area is a mosaic of isolated and interconnected benches and flats that are separated and split by steep, shallow soiled scarps and incised stream channels. Ancient slumping and stream terrace development once formed a relatively gently rolling landscape with deep soils. Subsequent erosion and stream down cutting have both worn away the once dominant highlands as well as carved and incised the rolling hills and valleys to create the present terrain. In total, these drainages form typical, gently to moderately sloping, low elevation, Western Cascades dendritic stream systems. Soils are commonly plastic to nonplastic, silty clay loams to sandy loams. Plant communities are dominated by western hemlock types which grow predominately Site I to Site III Douglas Fir.

The principal sediment delivery system in operation is the gradual downslope movement of the soil mantel by creep or other colluvial mechanisms. This process would appear to be accelerated during large scale fire events. However, little is known of the fire history in this area. Timber harvest of the entire subwatershed in the last century or so has obscured much of that information.

2. Appraisal Section:

Almost all of this productive landform block is covered by private, industrial forestry, land holders. The entire landform block has been entered and harvested in the last fifty years, with a large part of the acreage harvested in the 1950's and 1960's. Almost none of the original stands remain. Sidecast roads are common, and tractor logging was used extensively, even on the steeper ground. Few if any riparian buffers were placed on streams. For the most part, this entire area of private land holdings is now extensively covered with thick brush or well stocked with advanced regeneration of alder, western hemlock, and Douglas Fir.

a. DISPLACEMENT: Displacement occurs with three separate timber harvest activities: yarding, slash treatment, and road building and maintenance. Harvest activities began in this subwatershed many decades ago when there were few standards. Suspension requirements and slash treatment objectives were considered only in the light of the economics of harvest, and roads were constructed to where ever access was needed. It is likely that extensive soil displacement occurred in those early harvest periods. Whatever the situation initially, these sites have stabilized as a vegetative blanket has sprouted over the entire area in the years following harvest. Since that time, reentry has been more controlled by the Oregon Forest Practices Act. Soil disturbance has been significantly reduced, and the road system improved. However, these soils are highly weathered silty clay loams. Even now, disturbed soil can produce limited amounts of sediment transport while still generating extensive amounts of turbidity.

It is difficult, with limited field reconnaissance and knowing the likely history of the area, as well as the current harvest standards on Private land, to make some logical assessment of soil displacement rates in relation to the natural regime. Suffice it to say that the current disturbance rate is

substantially less than during the previous harvest cycle, and is certainly working towards some more natural level.

b. COMPACTION: Excessive compaction generally results from unrestricted tractor yarding and piling. The more gently sloping, older plantations were certainly tractor yarded and tractor piled, with little or no control on skid road density. Excessive compaction must have occurred in many areas. It is likely that this compaction is beginning to ameliorate as root growth and frost action begin to operate to reduce soil density. These events were probably cumulatively significant for this subwatershed. Tractor harvest methods still continue to be favored by private land owners for their cost savings and versatility. Subsoiling is not yet that popular with many private land owners. It should be noted that constraints and controls on tractor harvest and slash treatment have increased considerably in the last couple of decades. So, although compaction was and may still be an issue on these lands, the trend has improved over the situation apparent some decades ago.

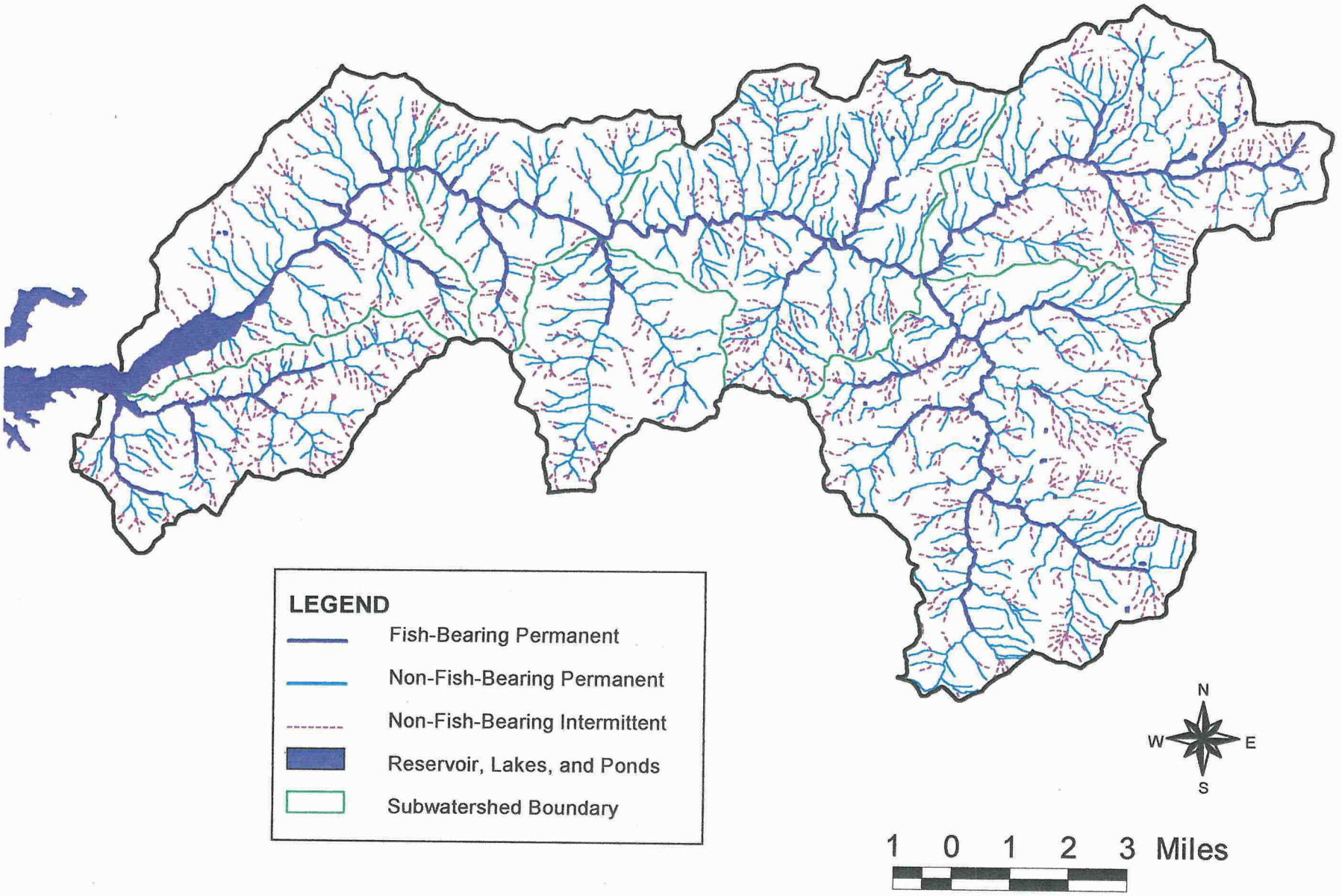
c. NUTRIENT LOSS: Portions of the Tally block were burnt or underburnt in stand replacement fires of one hundred to two hundred years ago. A mosaic of stand ages and conditions resulted from those conflagrations. Since then, the harvest of this entire landform block in the last fifty years or so has left considerable variability in the amount of downed woody debris and decomposing organic matter found there. Some areas were completely cleared with tractor piling; some areas were fall burnt at low fuel moistures; and some areas had no treatment what so ever. These treatments were superimposed on sites with a great deal of variety in the amount of above ground decomposing organic matter originally present. In more recent years, utilization has increased and burning has tended to decrease. What does this mean for long term carbon and nutrient cycling? It is a tough call at this point in time, but on average across the landscape natural levels have likely been maintained. Although, on a case-by-case basis, considerable deviation from the norm is likely.

d. INSTABILITY: Slopes are naturally relatively stable in this land form block. For the most part, managed timber stands now occupy the landscape and provide the vegetative cover for almost the entire area. As a result of this timber management in the last half century or so, almost all the drainage is well roaded. Harvest was conducted both with ground based and skyline logging systems to landings, accessed by local roads. These roads were primarily constructed with sidecast techniques. However, road related slope failures were not overly common, because of the considerable amount of relatively gently sloping land that was harvested. In unit slope instability from harvest does not appear to be extensive, and some stands are now being entered for the second rotation. Qualitative observations now indicate that over perhaps several decades, natural slope instability, road failures, and soil creep probably provide about equal amounts of material to the various stream systems.

IV. RIPARIAN RESERVE DESIGNATION - UPLAND (see nearby figure)

The appropriate size of the riparian reserve for a particular site depends on the physical function and interaction between the upland and the riparian zone. Watershed processes must be considered in light of natural and management induced disturbance regimes. Geomorphically appropriate criteria for establishing boundaries must rest on a firm foundation. The basic building blocks for the Upland Slope Stability Riparian Reserve prescriptions are grounded in the MA-15 Standards and Guides, the objectives established in the Aquatic Conservation Strategy, and the ROD Standards and Guides. Within the MA-15 direction, buffer widths are shown as acceptable ranges. The range of

Stream System



acceptable widths for the various stream classes is as follows: (horizontal width)

Class I: 150 to 400 feet. Class II: 100 to 200 feet.

Class III stable: 50 to 100 ft. Class III possibly unstable: 75 to 125 ft.

Class IV stable: No prescribed buffer necessary.

Class IV moderately stable - 25 to 50 feet.

Class IV potentially unstable: 25 to 100 feet.

Ephemeral channels - no protection.

The basis for comparison to develop the upland prescription is the LRMP MA-15 Standard and Guide at the lower range of adequate protection. Each of the five factors - geomorphic setting, landtype distribution, soil suitability, slope stability, and site productivity - will be considered and evaluated in light of the low range of acceptability for adequate riparian protection. If this low range appears acceptable for the specific topic being considered, then a sidewards arrow (---->) is displayed in the evaluation box. If an increased riparian reserve distance is considered necessary, based on upland conditions, then an upward arrow (/|\) was designated. All factors were not considered equally and the summing of arrows does not indicate a direct correlation with absolute distance. Buffer widths were increased when the field evidence indicated more protection was required to meet the WNF LRMP and the Aquatic Conservation Strategy objectives. As it was defined as such, the Standards and Guides for Management of Habitat for Late Successional and Old Growth Forest Related Species within the Range of the Northern Spotted Owl for interim widths for Riparian Reserves provides a high level of fish habitat and riparian protection. Consequently, the distances outlined for the Interim Riparian Reserve widths (prior to watershed analysis) are considered an upper limit of acceptable protection.

Table I on the next page shows a sample form that will be utilized in this portion of the analysis. For each of the five factors, a detailed explanation is provided along with some of the specific analysis items that were involved in the decision. It must be stated here again for the record that the distances outlined in the previous paragraph for the Upland Slope Stability Riparian Reserve Recommendation have two major conditions attached:

1) This initial riparian reserve prescription still requires an hydrologic and biologic evaluation to complete the Soil/Water/Fish objective. This upland recommendation only starts the process; and

2) The distances outlined are appropriate at the LANDFORM BLOCK SCALE! They are provided for planning purposes only. They serve as a guide, not a constraint. Resource specialists with site specific field review at the time of project planning and implementation will be the ultimate arbiter of riparian width designation. It is estimated that, with project implementation, some widths will be wider, and some narrower, based on specific on-the-ground conditions (Refer to the nearby location map for more information).

PSUB: Sample Form with explanations.

Basis for comparison is Land and Resource Management Plan MA-15-03 Standards and Guidelines at the lower (narrower) range of adequate protection.

Geomorphic setting Slope forming process	Geologic history, primarily late Pleistocene and Holocene geomorphic events. Basic sediment delivery mechanisms and time frames in which they operate. West or High Cascades physiographic province.	
Landtype Distribution Description	Complexity of landtypes, their spatial orientation and distribution across the landscape. Location of critical soils in relation to other landtypes.	
Soil Suitability	Type, amount, and distribution of unsuited lands.	
Slope Stability Sediment Delivery	Amount of potentially unstable, not necessary unsuited lands. Translational or rotational failure mechanisms and movement rates. Failure history.	
Site Productivity	Range of Site Class and regeneration potential. Moisture holding capacity. Resistance to disturbance from natural or management induced events. Basis for suspension and duff retention objectives.	

UPLAND/SLOPE STABILITY RIPARIAN RESERVE OBJECTIVE:

Upper Middle Santiam Landform Block

Basis for comparison is Land and Resource Management Plan MA-15-03 Standards and Guidelines at the lower (narrower) range of adequate protection.

Geomorphic setting Slope forming process	Older Western Cascades with highly dissected, complex topography and steep sideslopes. Stream down cutting, glaciation and slope instability predominate.
Landtype Distribution Description	Varies widely from very steep rocky side slopes to upland glacially formed benches and slump topography.
Soil Suitability	Unsuited areas are numerous, and vary between rocks and cliffs, and unstable landflows and debris chutes.
Slope Stability Sediment Delivery	Many areas are unstable. Several debris chute prone slopes. Extensive failure episodes.
Site Productivity	Site Class II to V with higher site class in valley bottoms. Lower site class tend to predominate at higher elevations on rocky sideslopes.

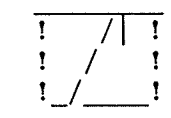
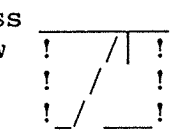
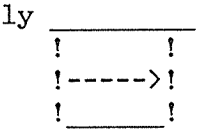
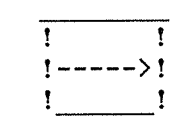
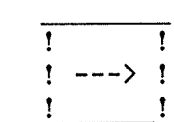
UPLAND/SLOPE STABILITY RIPARIAN RESERVE OBJECTIVE for Upper Middle Santiam:

Riparian reserves highly variable and range from "interim" widths as outlined in the Standard and Guides (C-30 and C-31) for Management of Habitat for Late Successional and Old Growth Forest Related Species Within the Range of the Northern Spotted Owl, to LRMP MA-15-03 Standard and Guide widths at moderate range of adequate protection. Avoid potentially highly unstable, not necessarily unsuited lands with most timber management activities.

Riparian reserve recommendations apply only to National Forest System lands. Private industrial holdings are regulated by the State Forest Practices Act.

Lower Middle Santiam Landform Block - FEDERAL LANDS ONLY

Basis for comparison is Land and Resource Management Plan MA-15-03 Standards and Guidelines at the lower (narrower) range of adequate protection.

Geomorphic setting Slope forming process	Older Western Cascades. Complex highly dissected topography with steep rocky sideslopes, upland glacial benches and lowland stream terraces.	
Landtype Distribution Description	Limited number of landtypes found across the country side. Soils usually shallow and rocky on steep sideslopes.	
Soil Suitability	Unsuited areas are common, and generally related to areas of rocks and cliffs.	
Slope Stability Sediment Delivery	Slopes generally relatively stable, except for road sidecast. Some highly debris chute prone slopes in limited areas.	
Site Productivity	Site Class III to V. May be some Site Class II in valley bottoms. Lower site classes tend to predominate at higher elevations on steeper sideslopes.	

UPLAND/SLOPE STABILITY RIPARIAN RESERVE OBJECTIVE for Sheep (39):

Meet LRMP MA-15-03 Standard and Guide at moderate to high range of adequate protection, unless site specific analysis dictates otherwise. Avoid potentially highly unstable, not necessarily unsuited lands with most timber management activities.

Riparian reserve recommendations apply only to National Forest System lands. Private industrial holdings are regulated by the State Forest Practices Act.

Talley Landform BLock - FEDERAL LANDS ONLY

Basis for comparison is Land and Resource Management Plan MA-15-03 Standards and Guidelines at the lower (narrower) range of adequate protection.

Geomorphic setting Slope forming process	Older Western Cascades with moderately dissected topography. Numerous benches and flats reflecting older valley levels. Slopes gentle to steep with soils varying accordingly.	! ! ! ---> ! ! !
Landtype Distribution Description	Relatively uniform distribution of highly weathered volcanic material on a variety of sideslopes.	! ! !-----> ! !
Soil Suitability	Unsuited areas are relatively rare and usually only small rock outcrops.	! ! !-----> ! !
Slope Stability Sediment Delivery	Soils are relatively stable throughout. Some localized debris chute areas, often related to old roads.	! ! !-----> ! !
Site Productivity	Site Class I to III. Higher Site Class common in valley bottoms at lower elevations.	! ! ! ---> ! ! !

UPLAND/SLOPE STABILITY RIPARIAN RESERVE OBJECTIVE:

Meet LRMP MA-15-03 Standard and Guide at low to moderate range of adequate protection, unless site specific analysis dictates otherwise.

Few National Forest System lands are located within this subwatershed. Private industrial holdings are regulated by the State Forest Practices Act.

V. SUMMARY OF FINDINGS

Relating environmental change to land use activities is one of the key goals of watershed analysis. The process for the uplands involves determining the type, aerial extent, frequency, and intensity of watershed processes, such as slope stability, fire, and flood, in order to compare natural disturbance regimes with disturbance regimes under managed conditions. The objective is to identify parts of the landscape that are sensitive to specific disturbance processes or critical to beneficial uses. Some sites are more sensitive to change than others. This sensitivity often results from the inherent properties and the ecologic history of a particular area. The major short term impacts to soil productivity from harvest activity, as discussed in the Willamette National Forest Final Environmental Impact Statement (FEIS 1990), include displacement, compaction, nutrient loss, and instability. The following sections, consider in a qualitative way, the effects of previous land management activities on the landform blocks under discussion, and their relation to natural rates of disturbance in the study area. It closes with a brief discussion on wetlands and a summary of the the upland riparian reserve recommendations.

A. DISPLACEMENT: Displacement occurs with three separate timber harvest activities: yarding, slash treatment, and road building and maintenance. We will look at the yarding and slash disposal first.

In summary, little or no evidence can be found to indicate that these two timber management activities have resulted in detrimental soil displacement or off site soil movement of any significant degree for most harvested units on Federal land in the analysis area. Willamette National Forest monitoring efforts over a number of years have consistently shown that off-site sediment movement from units where appropriate suspension and duff retention standards have been implemented, has been very low, especially in relation to natural disturbance events such as wildfire. Those conclusions were again reinforced with field observations for this investigation. To be sure, detrimental soil displacement from tractor piling likely resulted in many units on the Willamette Forest in years past, but that activity has not been considered a appropriate management option for about a decade. Whether inappropriate tractor piling occurred on the older units in this basin is now not pertinent; these areas have long since vegetated over and completely stabilized. Overland flow, indicative of compaction, but potentially resulting in erosion, was seldom noted in any of the field reconnaissance on the more gently sloping, older plantations.

On the private, industrial lands, both on and off Forest, enforcement of the Oregon State Forest Practices Act has been much more aggressive in recent years, especially in the areas of erosion and sediment control. When compared to harvest practices of twenty to fifty years ago, today's standards are much stricter. Considerably less off site sediment movement is anticipated in this harvest cycle. How this relates to the natural range of variability is difficult to envision at this point. It would seem that future harvest activities on private lands will more likely mimic natural rates.

Finally, we come to roads, the bane of water quality and stream habitat, so it would seem. Approximately, 275 miles of Forest Service road currently exist on the Willamette National Forest portion of the watershed. They range from a double lane, paved Forest highway (the upper paved portion of FS RD 2266000 - Parish Lake Road) to grown over tracks that are difficult to walk along. Many miles of roads have been constructed on stable benches and flats, but numerous sidecast roads segments are also present. Road construction standards have varied over time and range from over built sidecast extravaganzas to narrow lanes, laid lightly on the land. With all that to consider, within the Upper

Middle Santiam landform block, displacement of soil and rock from road construction is not significant when compared to the mass of material displaced by active and semiactive slope instability (landflows and debris chutes) when considered in approximately the same time frames over the entire landform block.

When looking at the Lower Middle Santiam and Tally landform blocks, because natural slope instability has been relatively minor, road construction and road sidecast failures appear to be the dominant sediment relocation process for the decades from the late 1950s to the 1990s. This level of industriousness on these lands has slowed considerably as this century comes to a close, but many sites still continue to provide sediment to individual stream reaches at rates considerably above more natural mechanisms.

In other words, at least on Federal land, when looking at sediment budgets and sediment input to streams, roads have not caused much of a problem over much of the area. And, where they have, this situation has significantly abated. To begin the examination on roads, we must first note that the following discussion looks at roads as long term features that reside on the landscape. What it does not evaluate is the concern of short term turbidity increases that result directly from management induced activities. As as example, winter haul of timber on a low strength, poor quality aggregate during periods of heavy rain and saturated soils will generate considerable turbidity. If you want to stop the cloudy water, stop the haul or mitigate the adverse effects. Don't blame the road. Additional stability issues and that sediment potential are also addressed in Section D.

On the other hand, this discussion would not be complete without calling attention to the consequences of "older" road construction (and some that are not so old). Some road segments constructed from the 1940's through the early 1980's were built without regard to sediment impacts to streams. Roads were located without consideration for steep sideslope slough situations; excess excavation was sidecast directly into stream channels; and little heed was given to time of construction, long term stability, or maintenance needs. That this was done is regrettable. Some of these situations have stabilized over time, and some still persist and produce higher than desirable levels of off site sediment movement. The point here is that these are localized problems that require correction, but the adverse effects (if any) are usually associated with only the adjacent stream reaches.

What does it all mean? It is intended to unearth a more down-to-earth conceptualization of sediment in the ecosystem. Sediment from timber management activity is not a significant issue in this basin, except as noted previously. Older units have almost completely revegetated. Duff retention and suspension on more recent units are well within guidelines. Older roads have revegatated, and newer roads have generally been constructed to higher standards. Some problem sites are present, and require restoration. However, streams channels and riparian areas do not display those features which might indicate problems with excessive off site sediment generation. This can be most clearly observed where undisturbed channels, such as many unmanaged reaches of the Middle Santiam River, with an extremely high natural sediment lodes and considerable amounts of large woody debris, do not appear to adversely affect aquatic species population dynamics. <u>The removal of large woody debris and essential stream structure through harvest and stream cleanout</u> appears to have more affected stream channel morphology than sediment inputs from management activities.

3. COMPACTION: The analysis indicated that existing compaction, which resulted from unrestricted tractor yarding and tractor piling, is not considered cumulatively significant within the basin on the Federal land. Looking at the

topography under Forest Service control, most of it is too steep for tractor usage. However, some of the more gently sloping, older plantations throughout the basin were likely tractor yarded with only minimal control on skid road density, and may have been tractor piled also. Although overland flow (indicating increased density and poor infiltration) and extensive skid road scars were not noted in many of the existing plantations, it is likely that detrimental compaction exceeded the 20% Regional Standard level in some units. Mitigation of previous compaction concerns through subsoiling is not likely at this late date as most plantations have existing regeneration that is too large and closely spaced to effectively subsoil without excessive root pruning. In addition, more recent management activities have resorted to non ground based options, or restricted tractor activities to existing skid road systems.

On the private land, and primarily off forest, this discussion is more complex. Certainly, most of the private land in the Lower Middle Santiam landform block is too steep for tractor usage; while, considerable acreage in Tally may have originally been tractor harvested. It is likely that detrimental compaction exceeded the 20% Regional Standard level over large areas, in some drainages. That compaction is beginning to ameliorate as root growth and frost action begin to operate to reduce soil density over the levels achieved in the initial harvest. Private land owners are generally not as aggressively concerned about compaction as their federal counterparts. And, it seems likely that future second growth harvest on some private lands will also be ground based. This second round of management may not achieve the levels of compaction that accompanied the initial entries, because of the smaller log size and increased control on skid road density. It should follow that the resulting cumulative effects will be less evident. The net result on factors like productivity and runoff is difficult to assess without more field work.

C. NUTRIENT LOSS: Nutrient loss from harvest and slash treatment is not considered significant for federally managed lands in the watershed. An extensive fire history is available in the living forest record. The earliest chapters are recorded at the lower elevations along much of the Middle Santiam main stem where numerous Douglas fir old growth stands can be located. For example at the confluence with Pyramid Creek and extending east along both streams lies a prime patch of "old growth" at approximately 450 to 550 years of age. These old growth patches likely sprouted from the great fires of the late 13th and 14th centuries and have survived younger conflagrations that skipped across the watershed from the mid 1700's to the mid 1800's. The offshoot of these younger fires is reflected in the numerous 100 to 200 year old Doug fir stands that can be found scattered through out the basin.

From the previous discussion, it is evident that parts of the Middle Santiam Watershed were burnt, reburnt, or underburnt in large scale, stand replacement type fires that began approximately five hundred years ago. In many areas, these fires consumed most of the above ground organic matter, and extensive acreage now exists that displays very little down woody debris (3 to 9 tons per acre) after almost one to two centuries of time. On the other hand, numerous sites, especially on the north aspects and in the deeper draws and sheltered benches avoided the conflagrations, and show little if any effects from the fires that raged around them. Live snags and extensive down woody debris (from 100 to 300 tons) can commonly be observed. Consequently, a wide range in the above ground tonnage of decomposing organic matter exists across the subwatersheds. Timber harvest over time has tended to mimic this wide diversity of tonnages. The oldest timber harvest plantations with low utilization standards, resulted in extensive amounts of large woody debris and slash retained on the ground. The harvest units of the 1970's and early 1980's, with YUM or PUM yarding standards and fall burns, display a commensurate removal of above ground nutrient matter

similar to that of severe natural fires. The most recent timber harvest with down woody debris and duff retention standards has generally been more benign and retained about as much organic matter as is displayed in the less intensive fire regimes. Finally, as implemented, special forest product harvest and forest fertilization programs do not appear to have any appreciable negative effects on nutrient cycling.

It needs to be pointed out that the previous discussion involves many, many thousands of acres of harvested and natural stands. A wide range of conditions exist, both manmade and natural, and general statements are necessary to capture critical highlights. From a long term soil productivity standpoint, high levels of carbon storage currently evident on some sites may be no more beneficial than situations where carbon storage is in shorter supply. However, productivity can be viewed from many vantage points. One that has achieved more prominence recently is habitat for a variety of ground dwelling amphibians and mollusks. It seems likely that particular subwatersheds with higher concentrations of older stands or isolated "old growth" patches in younger fire regenerated stands have provided considerable high quality, productive habitat for these creatures for the last several hundred years or so.

D. INSTABILITY: When the entire basin is taken into account, it appears that natural rates of slope instability are currently maintained. The slope failure record for the Middle Santiam project area is a complex one, and the previous conclusion does require clarification. The Upper Middle Santiam landform block displays features that indicate that considerable instability has occurred there in the last 300 years or so to present, and more is to follow (in most areas). Extensive areas of actively unstable slump / earthflows, massive landslides, and steep, highly dissected sideslopes with shallow, often debris chute prone soils can be found in these subwatersheds. Many events are related to the stand replacement fires and/or extensive flooding. Some slope movement may be correlated to regional tectonic activity. Whatever the case, the cumulative effect of this slope instability is to produce a naturally sediment rich system for the hydrologic regime. Field inventories indicate that road sidecast failures are not significant when compared to the massive rates of sediment input to the streams from the natural system. In unit slope failures replicate conditions similar to natural fire related instability. Consequently, harvest activities are but a distant second in this sediment generation race. It is worth repeating that the removal of large woody debris and essential stream structure through harvest and stream cleanout appears to have more affected stream channel morphology than sediment inputs from management activities.

It would be nice if this was the complete story in the Middle Santiam, but it is not. For the Lower Middle Santiam landform block, numerous localized areas of steep dissected sideslopes with potentially unstable draws can be found. These areas display considerable natural, debris chute type, slope instability that appears to be related to the stand replacement fire and/or flood (or other catastrophic) events over the last 300 to 600 years. Natural failures are generally linked closely with episodic catastrophic events, and over the long term natural failure rates occur at a relatively similar frequency, intensity and magnitude. Unfortunately road sidecast, road related drainage and washout failures have been the principal mechanism for the downslope movement of soil in the last several decades. In the near term, forest management related events have outpaced their natural counterparts by a considerable degree. Consequently, it is difficult to determine if "natural rates" of instability are currently maintained as one has to define the yardstick for measurement. Whatever the case, increased sediment from these failures is not the principal factor affecting stream integrity at this time. Many affected reaches show limited sediment storage, and appear "sediment deficient". What has changed is

the stream's sediment storage capability, provided by the stabilizing influence of large woody debris.

Little site specific information is available for the Tally landform block. It seems likely that slope instability has not been a major factor there with intensive management, but sufficient field work has not been done to confirm that hypothesis.

In conclusion, there seems little doubt that sidecast road construction, poor road maintenance practices, and harvest of highly failure prone soils can increase the incidence of failures. On the other hand, natural failures provide sediment to streams, often far in excess of human caused events, and maintain relatively high population levels of aquatic organisms. The concern then is not so much with the amount of sediment as with how it reacts in the system. Perhaps the major controlling factor is available stream structure, primarily in the form of large woody debris and boulders. The removal of large organic material in critical locations through harvest, road construction, or stream cleanout can increase the severity of failure impacts by (1) overloading natural systems with sediment to the point existing features fail, or (2) allowing sediment to be rapidly flushed through the system and thereby robbing the stream of necessary bank building material. The major difference, then, between apparent "natural" failures and road and unit related events is that downslope of several of the management induced failures timber harvest has removed the large woody debris that was once present along the drainages and swales. This results in large flushes of sediment without the stabilizing structure of large woody debris being carried with it. Remember, for many subwatersheds in this analysis area, failures provide the stream systems with almost all of the components necessary for proper function.

HOWEVER, just because slides can be beneficial to streams, does not mean that we should just let them slip slide away. Our goal is the elimination of management induced slope failure. Sensitive areas must be avoided, or effects mitigated. Aggressive efforts in sidecast pull back, storm proofing and road decommissioning are necessary, especially in areas with high hazard and low amounts of existing structure.

E. WETLANDS

This report recognizes that wetlands represent a continuum between aquatic and terrestrial ecosystems, and that discrete categories of wetlands, from the standpoint of hydrology and other associated properties, may be difficult to determine. Identification of the functional aspects of wetland ecosystems is key. Emphasis on hydrologic, geomorphic and biotic composition are essential to derive the ecological significance of the functions. In this report Landtype 6 is used to identify those areas that display functional wetland characteristics: 1) typical wetland vegetation, such as sedges, rushes, skunk cabbage, tag alder, etc; 2) evidence of water at least seasonally, such as ponding or seepage; 3) soil features that indicate saturated soil conditions at least part of the year; and finally, 4) sufficient size that the area could be located on a resource photo. Mapped wetlands can be found in three categories: 1) relatively flat lying ponds and marshes, 2) wet/dry meadow complexes on slight to moderate sideslopes, and 3 (tag alder and/or devils club patches on steep rocky sideslopes. The ponds and marshes were most common in the stabilized landflows and glacial deposits of the Upper Middle Santiam landform block. The tag alder/devils club brush patches were commonly associated with north aspect, high elevation, rock scarps and talus (that were probably small, late Pleistocene cirques or ice fields). The MA 15 Standards and Guides in the 1990 Willamette

National Forest Land and Resource Management Plan provide adequate protection measures for these important landscape features.

Areas that were NOT mapped as wetlands (Landtype 6) are of two kinds: One is active drainages or riverine areas. These are considered riparian in nature and are discussed quite adequately in the hydrology report. The other are those features that were too small, generally less than 1/10 (0.10) acre to be noted on the resource photos, but contain some element of wetland characteristics, such as wet soil or typical vegetation. (On small sites, these two features often are not readily associated with each other). An important aspect to consider in determining if protection of these very small sites is needed is their function in the context of that particular landscape. For example, a small seepage area used as a watering hole in a dry upland expanse has a far different ecological value than that same seepage area in the vicinity of a several streams and ponds. Conditions such as these are very common in the Upper Middle Santiam landform block where the landflows have disrupted drainages and created numerous seeps and seepage areas. Often times these areas are distinguished only by one or two skunk cabbage plants, or a trickle of water in a mountain beaver hole. At project implementation, these sites need to be evaluated critically and site specifically to determine if a lot, some or no protection at all is the appropriate mitigation for the activity under review.

F. RIPARIAN RESERVE DESIGNATION

The appropriate size of the riparian reserve for a particular site depends on the physical function and interaction between the upland and the riparian zone. Watershed processes must be considered in light of both natural and management induced disturbance regimes. The Upland/Slope Stability Riparian Rerserve objectives for this project area fall within the range of the Willamette National Forest Land and Resource Management Plan MA-15-03 Standards and Guides for the Federal land component of all landform blocks. These standards are established in order to meet the objectives of the Aquatic Conservation Strategy.

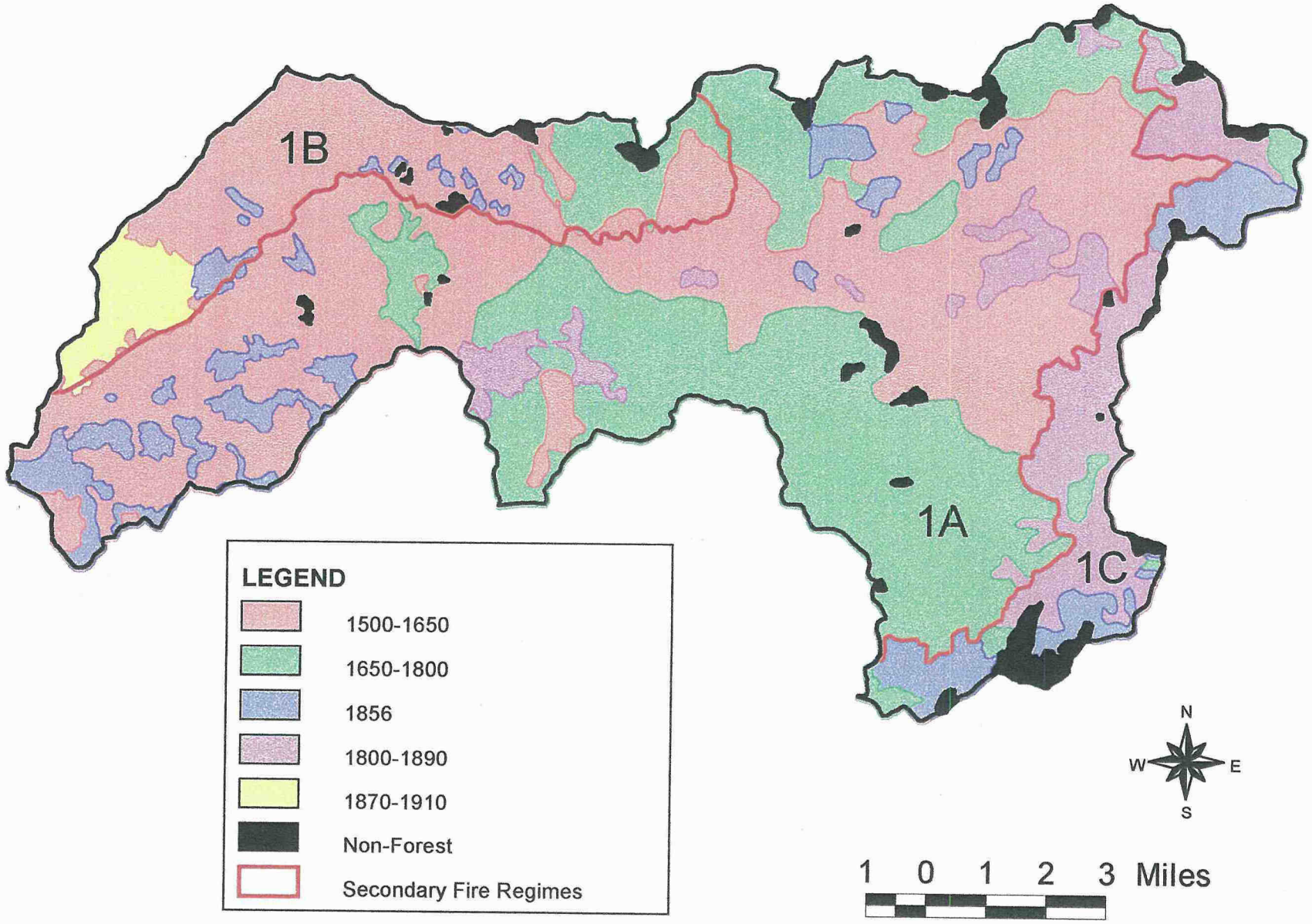
VI. INTERPRETATIONS AND MANAGEMENT RECOMMENDATIONS.

The Watershed Analysis Guide requires that the results of the analysis be utilized to identify the watershed processes and ecosystem concerns that will need to be addressed at the project planning scale ON THE FEDERAL LANDS in different parts of the watershed, as appropriate. From the previous discussion, noteworthy natural disturbance events are numerous and have indelibly impacted the Middle Santiam canyon during the Pleistocene and Holocene. Numerous glaciations were active several hundreds of thousands to tens of thousands of years ago. Since then, stand replacement fires have altered the canopy cover and organic matter distribution over the entire basin numerous times, and certainly three times in the last 800 years or so. Slump / earthflow slope instability has shifted whole mountain sides downslope, and the resulting sediment profoundly influenced channel morphology. Many of these slide zones have stabilized; many have not. Slope instability seems to be related to flood and/or fire events, and major slope movements may be related to regional tectonic activity.

From an upland standpoint, man's activities in this basin, primarily timber harvest, have had little commensurate effect for all the supposed implications of timber management, except for the excessive removal of large woody debris and the poor construction practices on some localized road segments.

A. GENERAL PLANNING

Fire Regime Areas and Fire History



1. SLOPE INSTABILITY: As was stated previously, slump / earthflow activity is now a major factor in basin morphology. Most localized areas of larger scale, active slope instability associated with slump/earthflows have yet to be directly harvested, and can easily be avoided. Indirect effects from drainage and evapotranspiration changes are not readily apparent at this point. Timber harvest has accelerated failure rates in some highly debris chute prone localities, but again much of these landtypes have been eschewed in the last decade. As was explained in previous sections, actively unstable and potentially highly unstable, not necessarily unsuited terrain have been eliminated from most management considerations. What this means is that the desired future condition for highly failure prone lands is a mature, healthy stand of evenly spaced trees that are free to grow. The objective is a stand that has good root strength and high levels of evapotranspiration. Consequently, silvicultural practices, such as precommercial or commercial thinning, in areas previously harvested, would benefit the site if final objective is a well stocked, thrifty stand. Such proposals obviously need to be evaluated on a case by case basis, but such silvicultural management should not be precluded outright. As it is currently being implemented, special forest product harvest has no appreciable effect on slope stability, and should continue on these sites and elsewhere, as applicable.

2. FIRE EFFECTS: Fire is a natural component of the west Cascades ecosystem (see nearby figure). Major fire periods display recurrence intervals of about 150 to 300 years. Shorter intervals are recorded for specific fires within these larger fire sequences. From a soil productivity standpoint, particularly when viewed from an above ground carbon storage perspective, most naturally occurring wildfires were not kind to the soil resource. Considerable duff and down woody debris were consumed, along with extensive amounts of above ground, living organic matter. Timber management and the concomitant slash treatment in the 1970's and early 1980's tended to duplicate severe fires or worse with tractor piling. Since about 1985, with (1) the initiation of duff retention standards, with (2) the retention of down woody debris, with (3) the use of non fire treatments such as grapple piling, and with (4) the elimination of dozer piling, the prospects for long term soil productivity have improved considerably.

On another front, aggressive fire fighting standards and techniques have certainly lessened the severity of fires, but they have also significantly reduced the acreage affected. Little or no field evidence was found to indicate that fire suppression to date has effected the growth sequence and development of stands or existing openings. But, disturbances are necessary and will eventually occur. They can be controlled and manipulated or unrestrained and rampant. From a <u>short term</u> nutrient cycling standpoint, timber harvest with little or no slash treatment on manageable lands or protection of non harvest, reserve areas is preferred in order to allow for additional buildup of organic matter and duff. Unfortunately, from a <u>long term</u> productivity standpoint, this desire has to be balanced with the potential for extensive, unrestrained wildfire. Uncontrolled fire at high fuel loadings and low fuel moisture will increase fire severity and cause soil damage and nutrient loss. This situation does not change significantly whether the area is untreated slash after logging, a late secessional reserve, or wilderness. No specific recommendations are forth coming as to the appropriate level of risk that should be assumed. However, control of fuel loading, either by fire or through some other mechanical or manual method, is much preferred over most wildfire scenarios. It remains to be seen if the reduction in the effective transportation system because of

funding cuts in recent years will have an adverse effect on wild fire management because of a growing loss of access capability.

3. COMPACTION: Soil compaction fortunately, is not duplicated well in nature, except on grander scales, such as glacial and sediment loading. Consequently, man's activities can play a significant, cumulative, and often detrimental roll in this arena. The major source of most compaction (and also much disturbance) is ground based skidding equipment used during periods of higher soil moisture. Fortunately, unrestricted tractor yarding and tractor piling have not been considered options on those landtypes where sideslopes are gentle enough to support tractor usage for almost a decade. The silty nature of the fine grained soils, and evidence that significant soil moisture is available most of the year indicate that any type of unrestricted tractor yarding and piling (even low ground pressure during the summer months) could lead to unacceptable soil compaction and/or disturbance. Restricted tractor yarding from predesignated skid roads or shovel yarding while operating on slash have been the primary methods of operation within the standard operating season (June 1 to October 31). Reducing the effective weight of the tractors, reducing the number of trips over a piece of ground, or confining equipment to rocked roads, are all means to reduce the risk of soil compaction and displacement. Yarding over frozen ground, or over a deep, solid snow pack (24 inches of dense snow **or equivalent**) works well and has reduced soil disturbance and compaction. In addition, as a mitigating measure, at the completion of harvest activities, tractor skid roads (existing or created) that are not part of the designated transportation system are generally subsoiled with a "Forest cultivator" or an equivalent winged ripper in order to return the site to near original productivity.

Considering that many sideslopes located within the Middle Santiam canyon are too steep for ground based equipment, that much of the harvest in the last decade was accomplished with cable systems instead of ground based operations, that many of the older tractor logged units are now beginning to actively loosen the soil through a variety of natural mechanisms, the effects from tractor usage in this basin at this point are not cumulatively critical. Proper implementation of existing Forest standards and guides should ensure that compaction does not again press ahead.

4. PRODUCTIVITY: The most nutrient rich portion of the forest soil horizon is the duff / topsoil layer. Adequate protection is achieved through duff retention standards. Duff Retention is the percent of effective ground cover (generally considered the duff and litter layer, and based on the existing premanagement condition) that needs to remain after cessation of management activities (FW-084 and FW-085) in order to minimize nutrient loss, and to protect against erosion. Consequently, specific duff retention standards will be recommended for most management actions. Another aspect of long term nutrient availability and ectomycorrhizal formation is the amount of larger woody material retained on site. Management activities will be planned to maintain enough large woody debris (dead and down) to provide for a healthy forest ecosystem and ensure adequate nutrient cycling (FW-085). At this time, site specific needs will be considered commensurate with wildlife objectives as outlined in FW-212a and FW-213a (as amended). In all most all harvest scenarios, PUM yarding is not recommended in order to provide for the retention of additional woody debris to further minimize sloughing and raveling on the steeper slopes (FW-084), and to provide for added nutrient recycling (FW-085) and wildlife habitat (FW-212). However, since fire is a natural component of the west Cascades ecology, broadcast burning under controlled conditions is an acceptable slash treatment

alternative for most sites. Nonburning options should also be considered (FW-250 and FW-251). Grapple piling (on the gentler slopes), the minor spot burning of concentrations, or hand pile and burn may be other options to evaluate. These factors will have to be considered on a case-by-case basis in conjunction with silvicultural and slash treatment objectives.

Other management activities, such as special forest products, forest fertilization, personal use removal, pruning, brush release, and precommerical thinning, all affect nutrient availability. At this point in time, as implemented, these activities do not appear to have any appreciable negative effects on nutrient cycling, and are recommended to continue as outlined in appropriate NEPA documents.

B. TRANSPORTATION PLANNING: Surprisingly, as has been discussed previously, from a sediment generation and movement standpoint, roads have not had an overall significant effect on stream generated sediment and sediment budgets, except for some localized reaches. Consequently, additional roading is considered acceptable in this basin. However, the previous discussion does not imply that expanding the road network is an excursion lightly traveled. Just because we can build, does not mean we should. Furthermore, any expansion of the road network in one area should generally be accompanied by an concomitant reduction elsewhere. NOTE that this does NOT imply obliteration! The Record of Decision and Standards and Guides for the Supplemental Environmental Impact Statement on Management of Habitat for Late- Successional and Old Growth Forest Related Species within the Range of the Northern Spotted Owl recommends road decommissioning. Decommissioning occurs when we remove those elements of a road that reroute hillslope drainage and present slope stability hazards. The FEIS requires that the amount of road mileage in key watersheds should be reduced through decommissioning of roads. The Middle Santiam is not a Key Watershed. However, the idea is a sound one. As long as road maintenance dollars are sufficiently lacking that adequate road maintenance is not performed on a regular and continuing basis, then, for each mile of road constructed, at least one mile of road should be hydraulically decommissioned, with priority given to roads that pose the greatest risks to riparian and aquatic ecosystems. Decommissioned road miles can be banked for future construction opportunities. It needs to be pointed out that roads which are well constructed, stable and able to handle storm drainage are "decommissioned", and little or no physical work may be required to maintain this storm proofed condition. In the future, roads need to be maintained and used, or decommissioned, but not just left alone.

Geotechnical evaluations of future roading options and reconstruction needs are necessary to reduce or eliminate potential problems. Such reports, including both the reconnaissance phase and more detailed P-line investigations, have commonly been completed on proposed road and haul routes since the mid 1970's on some Districts. They must continue. FW-310 indicates that Forest development roads shall be located, designed, constructed, and reconstructed based on the following criteria: resource management objectives, environmental needs, safety, traffic requirements, traffic service levels, vehicle characteristics, road users, season of use, and economics. In order to meet the environmental needs, road design, construction and maintenance will be implemented with Best Management Practices to meet State Water Quality standards (FW-094). Specific BMP objectives that are applicable to road construction and reconstruction will follow. They may be used alone or in conjunction with each other to reduce erosion and sediment yield to streams and wetlands.

Locate and design roads to minimize soil and water resource impacts (R-1, -4, R-10, R-11, R-12):

Prevent, limit, and mitigate erosion, sedimentation and resulting water quality degradation with construction and maintenance activities through timely implementation of erosion control practices and traffic control during wet periods (R-3, R-3, R-9, R-20);

Minimize erosion by conducting operations during minimal runoff periods (R-9, R-20);

Minimize erosion by road cuts, fill slopes and the travel way by various soil stabilization measures (seeding, mulching, straw bales, erosion netting, etc. (R-5, R-8);

Minimize the erosive effects of concentrated water and the degradation of water quality by the proper design and construction of road drainage systems and drainage control structures (R-6, R-7, R-13, R-14);

Insure that debris generated during road construction is kept out of streams and to prevent slash and debris from subsequently obstructing channels (R-15) (unless stream channel objectives are being achieved);

Maintain all roads in a manner which provides for soil and water resource protection by minimizing rutting, sidecasting, and blockage of drainage facilities (R-18, R-19).

C. RESTORATION: Large woody debris (LWD) and sidecast road construction are the two acts on the timber management stage where poor performance has produced adverse effects to the natural regime. Large woody debris requirements are necessary in two different capacities: 1) on the upland sideslope for nutrient recycling, soil structure maturation, ravel reduction, and selected wildlife habitat, and 2) in the stream channels for drainage structures and sediment storage. Many upland areas in the Middle Santiam are naturally deficient in LWD because of the active fire history in the last 200 years or so. Current "natural levels" are often below Forest Standard and Guide direction. Does this mean that LWD is not needed. Not necessarily. Only that, its retention should be viewed as an enhancement, not a mitigation. (Refer to the previous discussion on nutrient loss and fire effects).

In some areas, stream integrity has been seriously compromised by the harvest of timber both in the riparian areas and in the uplands. In the stream channels this is evidenced by the lack of structure and sediment storage, and either extensive bedrock channels or long riffle reaches. In the uplands, debris chute areas without large woody debris have moved only sediment into the channels. In many cases, this can result in either the complete stripping of sediment and structure on higher gradient reaches, or the overloading of existing structures on the lower gradient sections. The importance of large woody debris and stream structure can not be over emphasized. The reintroduction of LWD to deficient channel reaches is one of the highest restoration priorities from an upland standpoint. However, this activity must be coordinated with Hydrology and Fisheries Resources to provide an effective and implementable program.

Aggressive road decommissioning and storm proofing are necessary on many local roads to reduce the risk of catastrophic failure during storm events, to reduce overall road maintenance costs, and to protect the facilities. Many older sidecast roads, fortunately, still retain considerable standing green timber below the road cuts. This living retaining wall has allowed much excess excavation to disperse into downslope vegetation in dribbles, instead of debris

chutes. Sidecast pull back of of unstable fills on steep hillsides is essential if planned timber harvest units may remove stabilizing vegetation. Another option on some hillsides may be sufficient green tree retention in critical areas. At this point, the most critical areas to concentrate sidecast pullback efforts are located in the Upper Middle Santiam landform block, primarily on private land.

D. INDIRECT AND CUMULATIVE EFFECTS ASSESSMENT: At this time, no single unit measure of long-term soil productivity is widely used. Information on the survival and growth of planted seedlings may indicate short-term changes in site productivity. However, the relationship of short-term changes to long-term productivity is not fully understood at present. Experience indicates that the potential impacts on soils are best evaluated on a site specific, project by project basis. The major soils concerns - compaction, nutrient loss, displacement and instability - are most effectively reviewed, for both short and long-term effects, at the project level. With proper project implementation unacceptable cumulative effects on the soils resource are not anticipated (BMP W-5). Consequently, the utilization of soil protection measures and best management practices will generally preclude the need for additional cumulative effects analysis. Deviations from the standards and guidelines would be the primary trigger for an additional cumulative effects review.

E. MONITORING: Prescriptions for soil protection, watershed considerations and riparian needs take into account past and predicted future land management activities. The soils mitigation measures, as well as the streamside management zones, are designed to provide a level of riparian habitat protection and erosion control that is consistent with the recently adopted Aquatic Conservation Strategy. On site sedimentation is anticipated to be within the State of Oregon, Department of Environmental Quality, guidelines. With project implementation, site specific prescriptions or mitigation measures are designed to meet or exceed the requirements outlined in the General Water Quality Best Management Practices Handbook (Pacific Northwest Region, November 1988). For any project activity, appropriate constraints or mitigations will be developed to meet the intent of adequate resource protection or enhancement as directed in the 1990 Willamette National Forest Land and Resource Management Plan as amended by the Record of Decision and the Standards and Guides for the Supplemental Environmental Impact Statement on Management of Habitat for Late Successional and Old Growth Forest Related Species Within the Range of the Northern Spotted Owl. As the proposed project is initiated, it will be monitored to evaluate implementation efficiency, prescription adequacy, and to update sale area rehabilitation needs or protection. Specific monitoring questions in Chapter V of the Land and Resource Management Plan that will be addressed include V-M22 through V-M34.

Douglas C Shank

DOUGLAS C. SHANK

Geology, Soils and Watershed
Detroit and Sweet Home Ranger Districts
Willamette National Forest

A. Appendix A - SOIL RESOURCE INVENTORY (SRI)

1. Statement of Activities and Description of Process.

The major portion of this field investigation was directed at distinguishing the various identifiable landtype components within the study area and mapping them on the photo overlays. The information was then transferred to registered overlays in order to represent the data on a standard four inch to one mile map base (1:15840). In general, the field investigation confirmed some of the original 1973 SRI designations, but considerable refinement and subdivision of the various boundaries were developed. Many of the landtypes have several components which were not separated in the original SRI because of the small mapping scale that was utilized (one-inch-equals-one-mile or 1:63360).

2. Description and discussion of landtypes

A. The Middle Santiam analysis area contains about 80,614 acres, of which about 54% (45,195 acres) are National Forest System lands and 44% (35,419 acres) are other ownerships, most of which are the larger private industrial landowners. The landtype remapping process (FW-180) reviewed about 29,578 acres, primarily on non-wilderness, Forest Service land (with an emphasis on Matrix) for their landtype designation. Some private land was included, especially where active landflows traveled from one ownership to the next. Unsuited and unmanageable landtypes occur in two distinct categories - those acres that are not regenerable within five years, and those areas of actively unstable ground where harvest will cause irreversible impacts. Areas of potentially highly unstable, not necessarily unsuited lands were not very extensive in this analysis area, and these arces have been included with the actively unstable portion. These categories total nearly 4600 acres or about 16% of the mapped area. The acreage figures are only approximate as some conditions overlap; some areas, especially in northern portion of the Uppper Middle Santiam landform block were not remapped; and much private land is included in the numbers (Refer to nearby figure). Consequently, percentages of the mapped area will be stated instead of acres. Based on extensive field work, these percentages should apply fairly well to the entire Willamette National Forest land base in the Middle Santiam.

1) Those landtypes (about 10% of the mapped area) which are considered to have regeneration difficulties (BMP T-20) could include 1, 2, 3, 4, 5, 6, 7, 62, 210, 310, 610, and 710 or combinations of these landtypes. Almost all have numerous rock outcrops and cliffs, shallow gravelly soils with rock fragment content generally greater than 70%, and talus. Landtypes 6 and 7 are wet and dry meadows, respectively, and most areas of Landtype 6 are considered "wetlands" (BMP T-17 and W-3). All are currently considered noncommercial forest land or nonreforestable in the five-year time frame. Officially, 210, 310, and 610 are defined as marginally reforestable at least to extensive levels on easterly and northerly aspects, and nonreforestable in the five-year time frame on southerly and westerly aspects. However, almost no successful timber management (within the five year time frame) was noted on these landtypes in the study area in older units where some harvest occurred. This is also true for the high elevation landtypes of 731, 736, 737, and 740 (if present). Consequently, these landtypes are all considered unmanageable (no sufficient assurance of regeneration within the five year time frame) land in this report.

2) Landtypes considered unsuited because harvest will result in irreversible resource damage (about 8% of the mapped area) are primarily those that are actively unstable or potentially highly unstable slump/earth flows (FW-105, BMP T-6). They could include the primary Landtypes 25 and 35, and the complexes of 255 (25 plus 35), 256, and 356. Landtypes 256 and 356 have actively unstable areas very closely associated and generally in direct contact with stream riparian areas or stream courses. These areas all commonly display slump type topography and include such features as tension cracks, bare soil scarps, leaning and fallen trees, sags and depressions, seeps, and disrupted drainages. Failure depths are such that root strength probably has little affect in most areas. However, the instability problem might be aggravated by timber harvest or catastrophic fire, as removing the trees tends to raise ground water levels due to the loss of evapotranspiration. This in turn might reduce the soil strength and can cause increased or renewed instability.

3). Potentially highly unstable, not necessarily unsuited lands, range from the shallow, translational debris chute to the more massive, rotational, slump earth flow. Actively unstable and associated potentially highly unstable lands have already been excluded from consideration as unsuited lands. Potentially, moderately to highly unstable, not necessarily unsuited lands also exist in form of marginally stabilized earthflows and highly prone debris chute areas. These critical slope instability areas have been delineated in the field review by landtypes or complexes of landtypes that include 251, 252, 253, 254, and 353. They are defined geomorphically as areas that a) display evidence of periodic movement or catastrophic failure over the last 300 years or so, usually within the last 130 to 140 years, and especially within the last 30 to 50 years; b) usually include additional potentially unstable deposits or material; and c) exhibit slope or soil characteristics that indicate future catastrophic failure is likely in the foreseeable future (generally considered a major storm event such as the 50 or 100 year return interval).

Generally, these landtypes are such that these areas would not meet the definitions of "unsuited" as outlined previously, but should be considered potentially unstable (FW-107). For this analysis, because of the nature of the instability and the associated complexes, most of these areas have been included within the previous category. Probable changes in evapotranspiration and infiltration rates, as well as ground water regimes and water tables, could occur with some management activities and exacerbate the potential instability problems further, either locally or as a cumulative effects condition. These landtypes and most complexes of these landtypes have been excluded from management considerations at this point. However, a more specific site investigation could conclude that specific locations are manageable at low risk, or could be entered with appropriate mitigations in place.

B. Landtype complexes, such as 3-210, 251-252, or 8-201-204 have elements of both (or all) landtypes that were either not differentiateable at the photo scale, or sufficient field time was not available to distinguish the various components.

C. Landtypes with an alpha subscript are similar to the numeric designation, but changes are needed to better define the specific site condition. For example, Landtypes 202S and 214S are similar in nature and description to

202 and 214, except that both are derived from Tertiary sedimentary strata, instead of volcanic material.

D. Landtype 55 contains a significant element of glacially derived soils. This is not mentioned in the text of the SRI description. It generally found at the midrange of elevations and ususlly contains western hemlock plant communities, or communitites in transition to silver fir.

E. The remaining landtypes are adequately discussed in the Soils Resource Inventory. This document, first developed in 1973 and updated in 1990, was made to provide some basic soil, bedrock and landform information for management interpretations in order to assist forest land managers in applying multiple use principles. Mapping standards and definitions are based on the 1973 version. The Soils Resource Inventory Interpretive Tables developed for the 1973 landtypes (including Engineering, Timber Management, Recreation, and Erosion) are most informative when utilized with the field verified soils maps. Copies of both documents are file at the Sweet Home District with Resource personnel.

Appendix B - BRIEF BIOGRAPHICAL SKETCH OF THE AUTHOR

I received a Bachelor of Science degree in Geology from Youngstown State University in Ohio in 1971, and a Master of Science degree in Geology from Arizona State University in 1973. My areas of specialization include environmental and engineering geology, as well as geomorphology. Since 1976, I have been employed by the U.S. Department of Agriculture, Forest Service. From 1976 to 1979, I worked with the Santiam Engineering Zone as an engineering geologist. I was responsible for the geotechnical aspects of forest road reconnaissance, location, and design, as well as rock resource development. During 1980, I assumed the duties of a timber sale planner on the Sweet Home Ranger District, responsible for environmental assessment formulation. Since 1981, I have been at my present position as District Geologist for the Sweet Home and Detroit Ranger Districts of the Willamette National Forest. At this position, I have the responsibility for 1) reviewing proposed land management activities which may affect soil productivity, watershed quality, and riparian habitat, for 2) assuring compliance with applicable laws, regulations, and guidelines, and for 3) reducing or mitigating adverse effects on those resources. I am a certified engineering geologist by the State of Oregon (E097).

MIDDLE SANTIAM WATERSHED ANALYSIS

VEGETATION AND SILVICULTURE

ANALYSIS FILE

1996

VEGETATION AND SILVICULTURE ANALYSIS FILE
MIDDLE SANTIAM WATERSHED ANLAYSIS

SERAL STAGE DESCRIPTION

Forest vegetation in the watershed is described by structural characteristics of tree stands in their different stages of development over time. These are referred to as seral stages in this report and the watershed analysis.

The four basic seral stage stand structures used are those described in Forest Stand Dynamics by Oliver and Larson (McGraw-Hill 1990). They are:

1. Stand Initiation Stage - During this stage plant and tree regeneration is taking place on the area opened up by a disturbance.

2. Stem Exclusion Stage - This is the stage where saplings and seedlings have grown to develop a dense canopy that prevents further regeneration.

3. Understory Reinitiation Stage - As the trees get larger this is the stage where natural thinning occurs and the main canopy develops openings. Understory trees, shrubs, and herbaceous plants are established during this stage.

4. Old Growth Stage - Eventually, large trees in the overstory die, creating large snags and down wood; younger trees in the lower canopy layers are released, and the stand develops into an uneven age structure with an irregular canopy.

For this analysis the Old growth stage will be referred to as Late Successional/Old Growth (LS/OG) since it includes some stands that may not meet formal definitions of old growth (PNW-447, R-6, ESOG, etc) but do contain large older, 150+ year old trees. A large percentage of identified LS/OG however does meet Ecologically Significant Old Growth (ESOG) criteria.

See Figure 10 in the Watershed Analysis for additional description of these seral stages. Also a map of the seral stage distribution in the watershed can be found in Figure 11 of the Watershed Analysis.

About 38% of the watershed is covered with older seral stages (understory reinitiation -18%- and late-successional/old growth -20%-) dominated by conifer tree species with a high degree of canopy closure. The other 58% is in early seral stages as a result of clearcut patch harvesting that has been scattered through-out the watershed, mostly over the last twenty years. The remainder of the area is non-forest.

A DESCRIPTION OF PROCEDURES USED TO DELINIATE SERAL STAGES IN GIS

As is usually the case we had a tight time frame in which to accomplish the watershed analysis. We used existing GIS information with assumptions, along with some photo interp to identify and map the 4 categories. The stages can be identified off ortho-photo quads along with occassionally referencing to resource scale aerial photos and some groundbased feedback by people familiar with the areas.

We used the VEG4 SERAL_STAGE field to create a GIS map overlay as a base source of info for FS land, to help identify boundaries, and highlight areas of disagreement with other sources of information so those areas could be further scrutinized.

We did not have any GIS information on the 44% of the watershed in private ownership and we delineated that area just from photos. The vast majority of this private land is in the 2 earliest seral stages.

Stand Initiation Stage - On FS land we used VEGIS managed stand ages 0-20 years and size class 1-2 to approximate this stage followed by a quick ortho-photo check for data base accuracy.

Stem Exclusion Stage - We used VEGIS managed stand ages 20-(oldest plantation age) years and size class 2.5 and 3 to approximate this stage. Where there were lots of holes in this stage we used a 70% or greater canopy cover rule of thumb to correspond to ARP criteria.

Understory Reinitiation Stage - This stage was defined by elimination due to not being in the other 3 stages. Any non-forest land was removed before defining this stage.

Old Growth Stage - In the WA I called this Late Successional and Old Growth. It includes the most liberal of the formal definitions of old growth plus additional stands of large old trees (including some that are devoid of enough snags and large down wood to meet the formal definitions). This stage included all areas identified on an old hand-colored field-verified district Ecologically Significant Old Growth (ESOG) map and included areas that didn't quite meet ESOG standards due to small stand size. This district ESOG map was overlayed on the VEG4 SERAL_STAGE - Old field GIS map, and those areas outside the ESOG delineations but still inside the VEG4 delineations were scrutinized on aerial photos, and changes made to match aerial photo interp and district ground knowledge where necessary.

Also hardwood stands, mostly alder (Alnus rubra) were identified separately on the seral stage map. These amounted to a fraction of a percentage of the watershed and were not identified among the 4 seral stages so that they could be tracked separately.

These are approximate delineations for all stages. The seral stage mapping on this watershed analysis was done to an accuracy level slightly less than what was done on the South Santiam Watershed Analysis* due to time and budget constraints, and a higher percentage of private lands on which we lack detailed mapping. Overall however, the mapping gives a good approximate picture of how larger blocks of seral stages are distributed on the landscape in the Middle Santiam Watershed.

*See Appendix "C" in the "Vegetation and Silviculture Report" of the South Santiam Watershed Analysis for an accuracy assessment of the seral stage mapping for that watershed.

SERAL STAGE MAPPING OF HISTORIC VEGETATION FROM 1944 TIMBER TYPE MAP

A serial stage map was created by estimating and transposing information from a 1944 forest survey of Oregon and Washington timber types by USDA Forest Service. The 1944 survey map information is digitized on the Willamette National Forest GIS system.

The seral stage mapping from this 1944 timber type map resulted in rougher, more approximate accuracy of line locations and polygon shapes than for the current seral stage mapping as discussed previously. Several sources of error and roughness were inherent in converting this to a seral stage map. (1) The mapping accuracy was approximate to begin with due to the mapping technology and methods used for this 1944 survey. Our current mapping shows similar size and shape of some of the timber types but some polygons or parts of their boundaries were sometimes shifted as much as +/- 1/2 mile. (2) Archaic and imprecise timber type categories were converted to seral stages categories. In many cases 2 seral stage categories could fit the 1 timber type description and a best guess judgement had to be made as to which seral stage best fit the timber type. Using the the current seral stage as reference increased the accuracy of this in locations that had not been harvested. (3) Private land comprising 44% of the watershed was not included in the 1944 survey. 1944 seral stages for private land were estimated from old aerial photographs since the majority of this land has been clearcut harvested. Many of the older photos had lower resolution of detail than modern photos making it difficult to split out smaller polygons.

The net result is a jig-saw patterned mosaic in which any 1 delineation is very approximate but the rough pattern across the landscape is similar to what an actual 1944 seral stage pattern probably looked like.

A 1900 seral stage vegetation map would look similar to this in pattern except most of the seral stage 3 would be stages 2 or 1, and some small amounts of seral stage 4 would be stage 3.

The interpretive legend for the 1944 timber type map is attached.

STAGE	RANGE
1	1943 - 1914
2	1929 - 1874
3	1894 - 1750
4	1770 →

= CODES USED IN MID SANTIAM W.A.

EGEND NO. 1 TO BE USED WITH MAPS PUBLISHED BEFORE 1947

LEGEND FOR COUNTY FOREST TYPE MAP

WESTERN OREGON AND WESTERN WASHINGTON
PREPARED BY FOREST SURVEY

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
STEPHEN N. WYCKOFF, DIRECTOR 424 U. S. COURT HOUSE, PORTLAND, OREGON
U. S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

PENCIL NUMBER[1]	TYPE NUMBER	DEFINITION
		NONFOREST LAND TYPES
D-353½	(2)	NONFOREST LAND OTHER THAN AGRICULTURAL.
D-353	(3)	AGRICULTURAL: CULTIVATED, AND CLEARED PASTURES ON OPERATED FARMS.
D-353	(3X)	AGRICULTURAL ZONE: A LARGE AREA OF AGRICULTURAL LAND CONTAINING SCATTERED AREAS OF FOREST LAND TOO SMALL TO MAP IN PLACE
		WOODLAND TYPES
D-352½	(4)	OAK-MADRONE: FOREST OF MORE THAN 60% OAKS AND/OR MADRONE.
D-324	(5½)	PONDEROSA PINE WOODLAND: SCATTERED STAND OF PONDEROSA PINE ON UNFAVORABLE SITES.
		TIMBERLAND TYPES
D-354 4	(6)	DOUGLAS-FIR, LARGE OLD GROWTH: FOREST OF OVER 60% DOUGLAS-FIR, OVER 40" DBH.
D-354½ 4	(7)	DOUGLAS-FIR, SMALL OLD GROWTH: FOREST OF OVER 60% DOUGLAS-FIR, 22-40" DBH.
D-389 C-14 OR E-912 3	(8)	DOUGLAS-FIR, LARGE SECOND GROWTH: FOREST OF OVER 60% DOUGLAS-FIR, 22-40" DBH.
D-389 C-14 OR E-912 2 1 N	(9)	DOUGLAS-FIR, SMALL SECOND GROWTH: FOREST OF OVER 60% DOUGLAS-FIR, 6-20" DBH.
D-389 C-14 OR E-912	(10)	DOUGLAS-FIR, SEEDLINGS AND SAPLINGS: FOREST OF OVER 60% DOUGLAS-FIR, LESS THAN 6" DBH.
D-355½	(11)	SITKA SPRUCE, LARGE: FOREST OF OVER 50% SITKA SPRUCE, AND OVER 24" DBH.
D-355½		SITKA SPRUCE, SMALL: FOREST OF OVER 50% SITKA

D-355½	(13)	SITKA SPRUCE, SEEDLINGS AND SAPLINGS: FOREST OF OVER 50% SITKA SPRUCE, LESS THAN 6" DBH.
D-323 ✓ 4	(14)	WESTERN HEMLOCK, LARGE: FOREST OF OVER 50% WESTERN HEMLOCK, AND OVER 20" DBH.
D-323 ✓ 2	(15)	WESTERN HEMLOCK, SMALL: FOREST OF OVER 50% WESTERN HEMLOCK, 6-20" DBH.
D-323	(16)	WESTERN HEMLOCK, SEEDLINGS AND SAPLINGS: FOREST OF OVER 50% WESTERN HEMLOCK, LESS THAN 6" DBH.
D-335	(17)	WESTERN REDCEDAR, LARGE: FOREST OF OVER 40% WESTERN REDCEDAR, AND OVER 24" DBH. 17-IC INDICATES INCENSE CEDAR TYPE.
D-389 OVER D-335	(18)	PORT ORFORD WHITE-CEDAR, LARGE: FOREST OF OVER 20% PORT ORFORD WHITE-CEDAR, AND OVER 30" DBH.
D-335	(19)	CEDAR, SMALL: FOREST OF 40% OR MORE OF EITHER WESTERN REDCEDAR OR PORT ORFORD WHITE-CEDAR, AND LESS THAN 24" OR 30" DBH RESPECTIVELY.
D-324	(20)	PONDEROSA PINE, LARGE: FOREST OF OVER 50% PONDEROSA PINE, AND OVER 22" DBH.
D-354½ OVER D-324	(20)A	SUGAR PINE, LARGE: FOREST OF 20% OR MORE OF SUGAR PINE, AND OVER 22" DBH.
D-324	(21)	PONDEROSA PINE, SMALL: FOREST OF OVER 50% PONDEROSA PINE, 12-22" DBH.
D-324	(22)	PONDEROSA PINE, SEEDLINGS, SAPLINGS, AND POLES: FOREST OVER 50% PONDEROSA PINE, LESS THAN 12" DBH.
D-320½ X 3	(23)	FIR-MOUNTAIN HEMLOCK, LARGE: FOREST OF OVER 50% OF EITHER NOBLE, SILVER, OR SHASTA FIR AND/OR MOUNTAIN HEMLOCK, OVER 16" DBH.
D-320½ 2-3	(24)	FIR-MOUNTAIN HEMLOCK, SMALL: FOREST OF OVER 50% OF EITHER NOBLE, SILVER, OR SHASTA FIR AND/OR MOUNTAIN HEMLOCK, LESS THAN 16" DBH.
D-343	(25)	LODGEPOLE PINE, LARGE: FOREST OF OVER 50% LODGEPOLE PINE, OVER 12" DBH.
D-343	(26)	LODGEPOLE PINE, SMALL: FOREST OF OVER 50% LODGEPOLE PINE, LESS THAN 12" DBH.
D-325	(27)	WHITE FIR-LARCH-DOUGLAS-FIR, LARGE: MIXED FOREST OF WESTERN LARCH, WHITE FIR, DOUGLAS-FIR, PONDEROSA PINE

D-325	(28)	WHITE FIR-LARCH-DOUGLAS-FIR, SMALL: MIXED FC OF WESTERN LARCH, WHITE FIR, DOUGLAS-FIR, PON OSA PINE, OR LODGEPOLE PINE, LESS THAN 20" DE
D-350	(29)	WHITE FIR, LARGE: FOREST OF OVER 50% WHITE F OVER 20" DBH.
D-350	(30)	WHITE FIR, SMALL: FOREST OF OVER 50% WHITE F LESS THAN 20" DBH.
D-352½	(31)	HARDWOODS: ALDER, MAPLE, ASH, AND/OR COTTONW PREDOMINATING. 31.5 INDICATES MERCHANTABLE S
D-323½	(32)	REDWOOD: FOREST OF OVER 80% REDWOOD.
D-335 OR D-378	(33)	SUBALPINE: FOREST AT THE UPPER LIMITS OF TRE USUALLY UNMERCHANTABLE.
D-321	(35)	NONRESTOCKED CUTOVERS: NONRESTOCKED LOGGED A CLEAR CUT PRIOR TO 1920; 35A, CUT SINCE JANUA 35B, CUT SINCE JANUARY 1930.
D-322	(36)	RECENT CUTOVERS: AREAS CLEAR CUT AS FOLLOWS: ON MAPS DATED PRIOR TO 1936—CUT SINCE 1920 ON MAPS DATED FROM 1936-45 —CUT SINCE 1930 ON MAPS DATED SINCE 1945 —CUT SINCE 1940
D-321½	(37)	DEFORESTED BURN: NONRESTOCKED BURN, NOT CUT
D-353	37 (3A)	DEFORESTED BURN: INTENTIONAL FOR AGRICULTURE (FOUND EXTENSIVELY IN DOUGLAS COUNTY, OREGON)
DOTS IN TYPE COLOR	(38)	NONCOMMERCIAL ROCKY AREAS.
	*	OCCUPIED FARMS OF LESS THAN 40 ACRES OCCURRING FOREST ZONE

AGE OF SECOND-GROWTH STANDS UNDER 20" DBH IS SHOWN BY 10-YEAR CLA DENSITY OF STOCKING BY BARS: — (POORLY STOCKED) 10 TO 39 PERCENT =(MEDIUM STOCKED) 40 TO 69 PERCENT STOCKED; ≡ (WELL STOCKED) 70 PERCENT STOCKED.

THE NUMBER 34 DOES NOT INDICATE A TYPE BUT IS A PREFIX NUMBER TO A RESTOCKED AREA CLEAR CUT PRIOR TO 1920 IN CASE OF MAPS DATED PR 1936, PRIOR TO 1930 IN CASE OF MAPS DATED FROM 1936 TO 1945, AND 1940 IN CASE OF MAPS DATED SINCE 1945. IT IS ALSO USED TO INDICA SELECTIVELY CUT AT ANY TIME. IN THE COMBINATION SYMBOL, 34 - 10 ETC., THE SECOND NUMBER INDICATES THE TYPE.

SUGAR PINE

Sugar Pine (Pinus Lambertiana) trees exist in the Middle Santiam and are near the northern extent of their range in this watershed. They are mostly found in warm microclimates on south facing slopes and ridgetops. A high level of mortality of older trees has been occuring over the last decade, most likely due to white pine blister rust. Reforestation in the watershed includes planting rust resistant Sugar Pine in compatible plant associations.

This was not identified as an issue in the Watershed Analysis because it is a larger scale problem in this portion of the Western Cascades and is not unique to this watershed.

Middle Santiam River Watershed Analysis - Wildlife Summary

Detailed information on wildlife and wildlife habitat assessments compiled for the Middle Santiam Watershed Analysis is located at the Sweet Home Ranger District. Contact the district wildlife biologist for information regarding the following categories plus available scientific literature for species mentioned.

Threatened, Endangered, & Sensitive Species - List of T, E, & S species occurring within the watershed, species locations, survey history.

Northern Spotted Owls - Owl and dispersal habitat maps, Santiam pass area of concern, owl locations, habitat information, reproductive success, survey history.

Survey and Manage Species - Species list from the ROD occurring within the watershed.

Wildlife Guilds - Guild habitat maps, species occurrence.

Big Game - Big game management areas, habitat modeling results, road closures, winter range maps.

Wildlife Trees and Down Wood - Habitat definitions, habitat levels, modeling results.

Biological Diversity - Connectivity, pileated and marten habitat, dispersal corridor.

United States Department of Agriculture | Forest Service | Willamette NF Sweet Home Ranger District | 3225 Highway 20 Sweet Home, OR 97386 Tel (541) 367-5168 FAX (541) 367-5506

Reply To: 1920

Date: March 15, 1996

Subject: Wild and Scenic River Eligibility
Middle Santiam River and Tributaries

To: Watershed Analysis Files

The latest watershed analyses efforts are an ideal opportunity to provide information and review of the Wild and Scenic Rivers Eligibility process. Two primary areas of input can assist this process:

Review and validate previously identified river segments, river classifications and outstandingly remarkable values.

Determine potential eligibility of Middle Santiam tributaries not previously reviewed.

PREVIOUS FINDINGS

A.) Two segments of the Middle Santiam River were defined as eligible for future designation.

Segment 1: Starting at Private boundary (Sec 31, T.12S., R.6E.) downstream to the Road 2041 bridge crossing.

Distance: 2 miles
Classification: Scenic

OR Values:
* Anadromous Fish Habitat Potential
* Wildlife Habitat

Segment 2: Starting at Road 2041 Bridge downstream to the Forest Boundary.

Distance: 6 miles
Classification: Wild

OR Values:
* Anadromous Fish Habitat Potential
* Wildlife Habitat
* Recreation
* Scenery
* Vegetation/Ecology
* Geology/Hydrology

B.) None of the tributaries to the Middle Santiam River were previously reviewed for eligibility as Wild and Scenic River segments.

WATERSHED ANALYSIS FINDINGS

A.) Segment 1

No changes are recommended to the segment description or classification.

Once the land exchange plan along the river corridor is complete and riparian reserve vegetation has recovered to at least the Understory Reinitiation stage, there may be value in reviewing segments upstream of segment 1 for eligibility.

Outstandingly Remarkable Values:

Fisheries-
- Historical information confirms that native winter steelhead migrated into this river segment as far as the falls at Shedd Camp, prior to construction of Green Peter Dam. It is also likely, but to a lesser extent, that spring chinook used this segment as well.
- Interaction of earthflows and large wood structure created good habitat conditions for salmonids.
- The riparian corridor has remained relatively undisturbed by harvest, road construction or fires. Almost all of the corridor is in late seral stage.
- **This value is confirmed as Outstandingly Remarkable.**

Wildlife-
- Identified as outstandingly remarkable because of condition of late seral forest communities.
- Possesses high quality habitat for sensitive old growth dependent species.
- River corridor is critical link for north-south migration of old growth dependent species.
- **This value is confirmed as Outstandingly Remarkable.**

Vegetation-/Old Growth
- Not previously identified as Outstandingly Remarkable.
- High quality old growth forest communites, but not unique or unusual to central Cascades.
  A rare lichen species has been found in this river corridor.
- Watershed Analysis found that despite conditions of resources, **this value is not an Outstandingly Remarkable Value.**

Geology-/Hydrology
- Not previously identified as Outstandingly Remarkable.
  Part of distinctive watershed processes defined by many active landflows, high sedimentation, and wide floodplains.
- Most of segment is rock channel and considered a transport reach for upstream instability.
- Watershed Analysis found that despite conditions of resources, **this value is not an Outstandingly Remarkable Value.**

Segment 2

No changes are recommended to the segment description or classification.

Outstandingly Remarkable Values:

Fisheries-
- Historical information confirms that native winter steelhead migrated into this river segment, prior to construction of Green Peter Dam.
- Interaction of earthflows and large wood structure created good habitat conditions for salmonids.
- Wide flood plains acting as depositional zones for fine gravels and sand offer excellent spawning habitat for winter steelhead, and food factories for juveniles.
- The riparian corridor has remained relatively undisturbed by harvest, road construction or fires. A diverse mix of late seral conifer, and hardwood flood plain communities provide structure and shade to the river channel.
- Relatively undisturbed tributaries in a late seral landscape offer ideal refugia for juveniles during critical times.
- **This value is confirmed as Outstandingly Remarkable.**

Wildlife-
- Identified as outstandingly remarkable because of condition and extent of late seral forest communities.
- Possesses high quality habitat for sensitive old growth dependent species, contributing to a connected LSR to support at least 17 pairs of Northern spotted owls.
- Possesses healthy, intact riparian habitat for a variety of species. Offers good nesting habitat for Harlequin Ducks.
- Provides good winter range habitat for elk.
- **This value is confirmed as Outstandingly Remarkable.**

Vegetation-/Old Growth
- Identified as Outstandingly Remarkable because of condition and extent of late seral forest communities.
- Contains proposed Research Natural Area, identified as a unique old growth forest community with high biomass.
- Extensive continuum of riparian plant communities within a broad alluvial flood plain. Communities range from unstable red alder gravel bars to stable big leaf maple/ grand fir older river benches.
- **This value is confirmed as Outstandingly Remarkable.**

Geology-/Hydrology
- Identified as potential Outstandingly Remarkable because of Alluvial flood plain and extent of landflow instability within the watershed.
- Most of flood plains are concentrated in upper half of segment. Lower half of segment is a constrained river channel more typically found in central Cascades.
- These features were NOT found to be unique. Similar conditions can be found in the Breitenbush, Blowout, and Mckenzie Drainages of this SCORP Region.
- **This value is NOT an Outstandingly Remarkable Value.**

Scenic-
- Identified as Outstandingly Remarkable.
- Wilderness setting composed of late seral forest communities offer ideal landscape and foreground forest views.
- Open, wide flood plains along the upper river permit expansive views of forest hillsides and prominent Old Cascade Peaks.
- Human caused modifications create minor intrusions on landscape.
- Proximity of Mid-Santiam slide to road access offers stunning visuals of natural forces.
- **This value is confirmed as Outstandingly Remarkable.**

Recreation-
- Wilderness setting focused around large Cascade river basin is unique to SCORP region.
- Open, wide flood plains increases accessibility of river to visitors.
- Area offers an excellent setting for dispersed recreation, including hiking, fishing, hunting, horse riding.
- Other values, such as wildlife, geology/hydrology, and vegetation tie in well with visitor preferences for forest settings.
- The 1996 storm is likely to change the nature of recreation opportunities connected with this segment, by making the area less accessible.
- **This value is confirmed as Outstandingly Remarkable.**

B.) The following tributaries in the Middle Santiam watershed have been identified for eligibility consideration. They are arranged into three groups based on major drainage patterns.

Wilderness Area

Chimney Creek
Fitt Creek
Egg Creek
Jude Creek
Donaca Creek
Swamp Creek

Upper Middle Santiam

Bachelor Creek
South Pyramid Creek
Holman Creek
Cougar Creek
Lake Creek

Scar Basin

Pyramid Creek
Scar Creek
Single Creek

On March 15, 1996, the district IDT gathered to discuss resource conditions for these tributaries and to establish findings of eligibility. Only two (2) tributaries were found to have resource conditions that may be significant for an eligibility finding.

Scar Creek and Upper Pyramid Creek

Finding: Hydrology/Geology ORV

Resource Conditions:

* Upper Pyramid Creek basin has been formed by very old slump topography, creating unusual hydrologic functions and vegetative communities.
* Landflows have created slump lakes (Daly, Parish, Scar, Don are the largest) and wetlands, rerouting stream channels, and causing flows to travel subsurface.
* The Parish lake bog is one unique outcome of this ancient landform.

Other points of discussion

Ancient tribes represented by the Warms Springs Confederation were known to use the Gordan Peak trail for east/west migration through the watershed. Swamp Creek parallels this ridge trail and may have been a source of medicinal plants. No information is available to confirm or deny this connection.

Establishment of a summer camp at the headwaters of Pyramid Creek by Judge John Breckenridge Waldo in the 1880s provides historical significance to the area around Daly Lake. This use pattern was not deemed significant enough to list Historic/Prehistoric resources as an ORV.

The presence of old growth habitat and a rare lichen species along Pyramid Creek was noted. Though riparian leave strips were retained, the Pyramid Creek corridor was shown to be fragmented by past harvest activity.