Chapter IV Interpretation

Erosion Processes

In Landform Blocks 1,2, and lower reaches of 3, the dominant mass wasting process is rapid debris avalanche/flow failure induced by high intensity storm events in conjunction with timber harvest and road building. These type of events input elevated levels of sediment into stream in "pulses" rather than "chronically", such as large earthflows in Landform Block 4, or marginal road surfacing.

Lamberti et.al. (91) concluded that in this instance {pulse related} "Disturbance size and timing thus favored rapid recoloniztion of the affected reaches. In general, this rapid recoloniztion may reflect some preadaptation to episodic disturbance imparted by adaption to physically similar but more regular and frequent disturbance such as floods.

Anderson, in his 1992 paper on the same {pulse related} event noted in regard to population recovery that " While the perturbation was due to clearcutting, even in pristine streams a similar effect could result from beaver activity, wildfire, or debris torrents" and that " The debris torrent at Quartz Creek denuded 300m of stream bed and the adjacent riparian strip but it was recolonized by a major component of the typical macroinvertebrate community within a few months. This level of disturbance appears to increase biodiversity by opening up habitat patches and adding to the complexity of the physical habitat as well as to the variety of autochtonous and allochthonous foods." The natural interval for these type of failures is about 50 years, however clearcutting and road construction can increase this return interval considerably, thereby making stream recovery difficult.

Mills, in his 1983 study of the Lookout Creek earthflow determined that it was moving at a rate of almost 5 inches per year over a two year period. A wood sample for 77 feet below the surface in an exploration bore hole was Carbon 14 age dated at >40,000 years. This indicates that this type of slope failure typical of this landform block is "chronic" producer of stream sediment rather than the "pulse" type typical of the debris avalanche failures in shallower soils of the other landform blocks.

Wallenstein (95) noted that "The H.J. Andrews Experimental Forest was cut heavily in the decades of the 1950's and 1960's. Consequently, it suffered numerous landslides in severe storms of this period, including 43 slides from a series of strong storm events in December 1964 and January 1965" and that "Forest cutting was minimal in the Upper Blue River through the 1950's but was heavy from about 1960 to 1990. This unit did not suffer as heavily in the strong storms in 1964, but produced more landslides during a 1986 storm event."

He did not conclude from this limited study what exactly were the other limiting parameters that could be used to predict landslide distribution and control but he said "The results indicate that physical controls on landslide occurrence may be more complex than was assumed for the purposes of this study. There may be other physical controls that play an important role, such as geomorphic setting, hydrological features, and geologic structure. It is likely that one or more of these factors is/are not randomly distributed with respect to slope."

Other properties that have a much more direct influence on landslide behavior are soil shear strength and ground water fluctuation along with slope geometry. Uncontrolled wildfire can be a direct controlling agent influencing the first two. Soil Transfer rates were calculated using the first two properties with the historical fire return interval and the probability of failure. The rates were calculated for reference conditions and then compared to those measured during high intensity road construction and logging during the period 1945-1979, Marion (81) and the most current conditions between 1990 and present. This comparison displayed that the natural range of variability for soils transfer rate to streams due to mass wasting is around 52 to 216 cubic meters/square kilometer/year for Landform Block 3, which is used

as the quantitative index reference area. During the periods of high intensity logging and road construction, slope failures related to clearcutting was over ten times the estimated historical reference condition rate for medium intensity wildfire which has similar characteristics as clearcutting, and three times the rate for high intensity wildfire. During the past 5 years, the rate has dropped below the natural background rate due to elimination of road building, reduction in harvest, and fire suppression. This agrees with Wallenstein's projections for watershed recovery and land use effects on landslide hazard.

Clearcuts, road construction and high intensity wildfires on SRI 21 soils and complexes on slopes greater than 70% can significantly increase this rate.

Most road related slope failures are from side-cast construction on slopes greater than 70%.

There is a significantly smaller number of road-related acres or events of mass wasting compared to natural events, however, sediment delivery volumes from road surfaces is unknown.

Rock aggregate fro road surfacing has generally been of high quality in the watershed, which has kept road surface sediment contributions to a minimum, however, in the Tidbits and Cook-Quentin Creek drainages continual ravel from road cutslopes require yearly ditch cleaning.

36% of the slope failures that resulted from the storm damage of the 1986 event were caused by plugged culverts. Another 41% was a result of saturated road fills.

The probability of a large subduction earthquake off the Oregon coast with a magnitude 8.0 or greater is high, but the distance from the probable focus to the watershed will provide attenuation which will reduce damage. Blue River Dam has been inspected and designed to withstand any probable earthquake loads, however, local crustal generated earthquakes can be a hazard and can cause landslide and debris avalanche dams.

Vegetation

The current vegetation pattern and distribution within the watershed is a result of clearcut harvest and wildfire. Historically vegetation patterns were primarily created by wildfire both upslope and in the riparian. Fire has played a role in influencing riparian vegetation in all Landform Blocks except perhaps in Lookout. For Landform Blocks 1,2 and 3 fire played a significant role in returning many of the lower order stream channels to early seral stages. These stands would typically become established with conifer seedlings, with perhaps a fringe of hardwoods along the banks depending on the moistness of the site and the seed source. Under a natural regime the Tidbits drainage is the only drainage that would be dominated by hardwoods within the riparian areas of these lower order streams. This is due to the naturally high frequency of debris slides and debris flows which are triggered during periods of large storm events. The pattern and distribution of riparian vegetation was also influenced by floods.

The higher order stream channels within Landform Blocks 1,2 and 3 would remain too moist to carry a stand replacement fire. Thus, these riparian areas would generally maintain mature stands of conifers with gaps created by large floods, wind, disease, and insects.

Landform Block 4 (Lookout) would also have some part of the lower order streams in early seral condition, though probably less than in the rest of the watershed. This is due to the longer fire return interval and the low frequency of debris flows and debris slides. The exception is the vicinity of Lookout Mountain which is subject to debris slides. Some of the lower order streams may be dominated by hardwoods where associated with earthflows or landslides. Along the higher order streams, fire would be less likely to significantly influence middle or late seral stands. Depositional features dominated by

hardwoods as a result of flood events would more likely occur in this geomorphic block due to the wide, unconstrained valley.

Overall the change in the vegetation pattern is from one of large patches with a high amount of diversity and variability to a fragmented landscape with many managed stands lacking some structural features. Most of the managed stands from the 1950's to the mid 1980's lack snags and a smaller percentage lack down wood. The percentage distribution is within the range of variability as defined by REAP.

The occurrence of non-forested areas was probably greater in the past when fire played a dominant role in shaping the vegetation. Conifer encroachment has been occuring in meadows and sitka alder communities although the extent is not known at this time. There has been harvest adjacent to many of the non-forested areas resulting in open conditions surrounding these areas. Roads have been built through some of the sitka alder communities. Where harvesting and roading has occurred it has resulted in a reduction in size of these plant communities and potentially a change in the microclimate. The alterration of microclimates through increased exposure to wind, sunlight, precipitation and temperature conditions can in turn alter species composition and distribution. There is no current data on change in plant communities and no specific historic data to compare it to.

Aquatic habitat is relatively uncommon in the watershed. There are a few small wetlands and ponds within harvest units. The change in seral stage from late to early successional has resulted in more open conditions surrounding these areas and a potential change in species composition. Data is not available on the condition and plant communities present prior to harvest. It is also unkown if the hydrology of the sites were changed through this change in vegetation. Much of the mature forest surrounding Wolf Lake has been harvested and is currently in an early seral condition. At the turn of the century about half of the lake was surrounded by old forest and half by young forest.

Habitat for 20 rare species, those species that have limited geographic range or highly specific habitat requirements, occur in the watershed. Current surveys are limited and historical data is non-existent for these plants.

Non-native weeds have increased in both number of species and distribution since the settlers in the early 1900's. Harvest operations, road construction, and livestock grazing all have contributed to the spread of weeds in the watershed. Most of the weed populations are located along road systems, landings, in early seral harvest units, along trails and in the campgrounds at Blue River Reservoir. Only one of the species is classified as a "new invader" and is the highest priority for control. This is spotted knapweed and it occurs adjacent to Forest Service road 15.

During the 1970s and 1980s there were many experimental plantings in the drawdown zone of the reservoir. A variety of native non-local species were planted as well as ornamental horticulture varieties of shrubs and trees. Many of the non-local species did not survive. Recently the emphasis has been on using native species. Seed and transplant plugs from two sedge species that grow at Fish Lake have been used as well as native willow. These species appear to be the most successful in terms of survival and also meet the native seed policy.

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

Harvest of old-growth and riparian forests and associated road building has reduced and fragmented the amount of habitat available for many of the survey and manage species. Past silviculture practices typically fragmented late-successional stands, reduced duff and large rotting logs on the forest floor and emphasized homogeneous conifer plantations. Early harvest of vegetation along many of the creeks have resulted in an increase of early seral red alder stands. A lack of hardwood and conifer diversity in riparian zones decreases species diversity, particularly epiphytic bryophyte and lichen species.

The Mann/Blue River/Wolf and the Cook/Quentin geomorphic blocks have the largest percentage of dispersed early seral units (65%) and fragmentation in the watershed. These units result in extensive older forests edges affected by an altered microclimate. Harvest increases stand edge fragmentation, this zone of edge influence can change light, air and soil temperatures, wind humidity, and tree mortality from 200 feet to more that 790 feet into the forested stand (Chen 1995). Many of these species are dependent to interior old-growth habitat.

The extremely slow growth rates and long periods required for certain late-successional and old-growth associated species to colonize younger stands emphasizes the importance of linkage to older stands. Unsuitable habitat in fragmented areas may prevent gene flow and colonization into younger stands. Neitlich's (1993) study in the H. J. Andrews, found in forty year old stands, conifers five meters from old growth trees had a greater lichen species richness and biomass then the interior of the young stands.

The majority of the mature conifer stands in the watershed average 150 years old. Neitlich's (1993) study in the H. J. Andrews found epiphyte lichen biomass to increase significantly in forest stands 140 years old. Nitrogen-fixing lichens are most abundant in old-growth forests and are virtually absent from young stands (Neitlich, 1993). Lobaria oregana accounts for over half of the total epiphyte biomass in old-growth Douglas fir forests (Pike et al., 1977) but it is much less abundant in younger forests (Neitlich, 1993). The biological and economical importance of lichens are of great significance. Nitrogen fixation levels by lichens in old-growth forests have been found to be approximately 145 times those of 40 year old stands and contribute approximately 16 pounds of nitrogen per acre per year to the forest ecosystem (Neitlich, 1993). Lobaria oregana and L. pulmonaria are found in mature and late-successional forest stands throughout the watershed. Eighteen of the twenty-six nitrogen-fixing lichen species in the survey and manage list are documented in the H. J. Andrews. Potential habitat for many of these species is present in older conifer stands in the watershed, however only the H. J. Andrews been extensively studied.

Hydrology

Drainages that had a high percentage of harvest units or mid-slope roads located within potentially high contributing areas to rain-on-snow, are considered to contribute to increased peak flows. Blue River Face and Quentin Drainages had both harvest units and mid-slope roads located within high contributing areas, likely resulting in increased peak flows. Tidbits drainage also had a large area of harvest units located with high contributing areas. Cook and Mann drainages had harvest units located within high contributing areas to a lesser degree than Blue River Face and Quentin, but probably still cause increased streamflows. Roads may increase peak flows independent from harvest units, and may be causing increased flows in Mann, Lookout, and McRae drainages.

ARP is a relative measure of the hydrologic recovery used by the WNF. This is the percent of the watershed considered to have large enough trees to intercept and hold snow within their canopies. A threshold value has been calculated that should be met in order to ensure that peak flows are not augmented and channel damage does not occur. Blue River Face is the only small drainage to have the most probability of experiencing peak flows. The ARP level is 78%. All other Landform Blocks and smaller drainages are above 80% and above the threshold value.

Water Quality

Historically summer stream temperatures would have been relatively cool during periods of high base flows and moderately warm summer air temperatures. Climatic conditions of low base flows coupled with unusually high air temperatures would have caused summer stream temperatures to be higher than

average. Fires that consumed extensive riparian vegetation would have allowed for increased solar radiation input, thereby causing increased summer stream temperatures.

An analysis of the current situation used data for Lookout Creek. The results of the analysis displays that in all probability environmental factors, base flows and air temperature, and not management related activities, are driving summer stream temperatures to exceed the proposed state standards. Data from Blue River is to be analyzed as well but is not complete yet.

Stream Channel and Fish Habitat

Landform Block 1

44% of the riparian (as defined in the ROD) has been harvested and 2% roaded. Class II and IV streams, along with the area surrounding the reservoir have been the most heavily managed. Several of the smaller drainages have higher percentages harvested than the overall Block. These include Mona, Reservoir Face, North Fork Quartz, Scout and Simmonds. Simmonds and North Fork Quartz Creeks have been harvested along the main stream channels and have had roads built along the channels. This has resulted in a decreased ability of the riparian area to provide large wood, stability and shade to the channel. This is particularly true for the lower half of the North Fork Quartz stream length, which was heavily logged. The upper sections of the channel were left relatively intact, providing good amounts of wood to the upper channel. Wood in the channel has often been pulled out. Mining as well as harvest has played a role in this Landform Block. As trees within the riparian continue to grow improvements are being seen. Stream shading and temperatures are recovering. However there does not appear to marked recovery of the riparian areas and water quality in and near mine tailings in Quartz Creek.

Current sediment delivery to streams in this block is due to road related failures, particularly in Tidbits Creek. Full bench construction on steep slopes has resulted in chronic input of sediment. Unlike the debris slides and debris avalanches which historically pulsed various sized sediment and large wood into the streams, chronic input of sediment associated with roads in the Tidbits drainage are fines, gravels, and cobbles that dribble into the stream virtually continuously. This road related sediment may fill some pools in Tidbits Creek, however most sediment is probably flushed downstream into Blue River and Blue River Reservoir. Mass wasting has also resulted from harvesting in the Tidbits drainage, contributing large quantities of sediment to the stream channel. Old abandoned logging roads up the bottoms of Simmonds, Quartz and North Fork Quartz Creeks provided sediment to the channels especially during construction. Harvest of riparian vegetation and yarding down the channel bottoms of Simmonds, Quartz and North Fork Quartz caused extensive erosion of the floodplain and riparian areas. Riparian areas that were once dominated by conifers are now hardwood stands.

The quality of fish habitat has declined as a result of these management activities and fish abundance and diversity has decreased. Simmonds, Mona, Tidbits and Ore Creeks have decreased amounts of wood in the channel and there is a decreased potential for significant input of large wood in the near future. North Fork Quartz and Quartz Creek have the most in stream wood on average due to the intact older forest adjacent to the channel in some sections. As a result of the harvest of conifers adjacent to the creeks stream shading was decreased but it is currently recovering. Since most of the shade is being provided by deciduous trees, and they provide little protection from cold winter weather, winter stream temperatures may be colder than natural stream temperature variation.

Embeddedness is high in Quartz Creek and North Fork Quartz Creek due to roads, logging and naturally caused erosion. Since spawning gravels were relatively clean of fines, the fines are most likely limiting fish production by decreasing rearing habitat. In Tidbits Creek, cobble embeddedness is low. Fines are readily flushed from the creek due to the lack of in stream structure to slow the water.

The mining activities may have affected water quality and, in turn, the health of the aquatic ecosystem in Quartz Creek. A metallic liquid, potentially mercury, was seen in the creek
Fish population interactions have decreased due to the placement of impassable culverts at the mouths of Ore and Quartz Creeks. These culverts have isolated populations of cutthroat trout and excluded rainbow trout upstream migrations. The Barriers resulting from culverts in Ore and Quartz Creeks prevent migration of fish from Blue River and its tributaries. Blue River Dam blocks interaction of Simmonds Creek and McKenzie River populations with those in tributaries upriver. The Dam also intercepts downstream flow of large wood and bedload affecting down river habitat. The reservoir has severely change 6 miles of river habitat.

Landform Block 2

This area has the lowest percentage of managed riparian area of all four blocks, with 26% harvested and 1% roaded. The breakdown between the two drainages are nearly identical for management in riparian areas of all stream classes. However, the Class II riparian areas of Cook Creek have been more heavily harvested than Class II streams in Quentin.

When compared with other streams in the watershed the average large wood per mile in Cook and Quentin Creeks is moderate to low. This may be due to the low amount of slope failures. This area contains relatively fewer site specific slope failures than any of the other Landform Blocks. There have been few harvest and road related failures causing stream channel scour. This is due to the relatively low harvest rates, consideration of road placement, low road density, and the fact that much of the upper portions of these drainages were unmanaged during the 1964 flood. Road related slides triggered by the 1964 flood provided sediment that aggraded the channel bottoms of Cook and Quentin Creeks, with accumulation principally at the mouth of Cook Creek.

There is more large wood in Quentin than in Cook Creek. This may be due to impacts that logging activities have had upon Cook Creek or it may also be due to the addition of large wood resulting from a large, stream-side slide originating in forested terrain in Quesntin Creek.

Stream canopy shading appears to be naturally low in both Quentin and Cook Creeks due to clearing of riparian vegetation during high flows and also due to the southerly aspect of the drainage.

Landform Block 3

This block along with Block 1 has had the most management in the riparian areas. 44% of the riparian area has been harvested while 4% is in a roaded condition. All smaller drainages within this block have been heavily managed.

The area contain 28% of the total natural failures, 18% of the road failures and 36% of the post harvest failures in the watershed. .This block also contains 2 ancient landslides with over 400 acres, and 9 areas of unstable soils containing over 500 acres. Mass wasting of harvest units have generally occurred in the lower sections of Blue River, triggered by the 1964 flood. Most of the sediment generated by these slides was transported down into what is now Blue River Reservoir, with some local deposition within the river at small meander bends. A debris flow scoured Mann Creek to bedrock when a small earthen dam located on private ground failed in the mid 1980s.

There has been a significant decrease in pool habitat in Mann Creek between 1975 and 1991. This is likely due to pool filling from accelerated erosion and sedimentation and debris torrents. Mann Creek also has low amount of large wood due to the amount of management in riparian areas.

Forest Service Road 15 severely impacts the quality of aquatic habitat in lower Blue River by reducing potential large wood input, channel/floodplain interactions, and stream canopy shading. The proximity of the road to the river between the reservoir and Quentin Creek has also facilitated wood salvage efforts in

the past, further decreasing the amount of in-stream wood. There has also been a significant decrease in pools within Blue River between 1937 and today due to the effects of natural and human accelerated erosion. The decrease of the amount of large wood in the river probably doesn't play a major role in the decrease in pools. Similar low pool per mile rates occur in similar river reaches with significantly different amounts of in-stream large wood.

The populations of wild trout within Blue River has likely declined since the introduction of hatchery rainbow trout. Hatchery fish out-compete and displace wild fish. Genetic interaction may be occuring. Fish populations within this landform block are genetically isolated from those in the McKenzie River by the Blue River Dam.

Although the release of Chinook salmon juveniles in the reservoir to supplement down-river fisheries restores the presence of that species with the watershed, the aquatic ecosystem would more directly benefit from the release of adult Chinook. Their spawned-out carcasses provide rich nutrients to the aquatic ecosystem.

Landform Block 4

Relative to the other 3 blocks within the watershed, the riparian areas in this block are in a less managed condition. Total harvest within riparian areas is about 28% which is similar to the amount in Landform Block 2. Harvest within riparian areas has occured mainly in those areas adjacent to Class IV and Class II streams and the harvesting is split nearly equally between Lookout and McRae smaller drainages There is a significant portion of each of these areas that has remained unmanaged. Roads within riparian areas account for 3% in Lookout Creek and 2% in McRae Creek.

Both road and harvest related mass wasting has contributed sediment to Lookout Creek. The amount of sediment delivery into the creek was high during the 1964 flood due to the relatively large number of harvest and road acres in existence prior to the 1964 flood, and the amount of unstable, earth flow terrain on which the roads and harvest were located. The large volume of sediment and debris provided ample material for devastating the riparian vegetation on the wide, unconstrained valley bottom, and creating new floodplains through deposition of sediment. With the upper, more constrained sections of Lookout Creek, erosional material moved downstream tot he lower gradient, wider valley bottom section, with local accumulation within the upper channel reaches.

Logging and road building have decreased the amount of large wood available to the stream. The result is less stream energy dissipation, habitat complexity, nutrient retention, spawning gravel collection, and pool scouring in Lookout Creek. Pools have decreased in quantity in the lower 2.3 miles of Lookout Creek between 1937 and today. This is due to the additions of sediment related to management activities. Because pools are important holding and rearing habitat for adult and sub-adult cold water fish species, their relative quantity can be used as an index to habitat quality.

Above Forest Service Road 360, Mack Creek is unmanaged and in-stream wood levels average 250 pieces per mile. The amount of large wood per mile in this section of the creek was used as a reference point in an attempt to characterize wood levels in other similar sized streams in the watershed as high, moderate or low. The lack of management adjacent to the Mack Creek, the long fire return intervals and the frequency of natural landslides acting as a wood delivery mechanism all contribute to the levels of wood in Mack Creek.

Species and Habitats

Snag and Log Habitat
Logging activities have reduced the levels of snags and logs in the watershed from historic conditions. This is especially true in the Mona Scout, Lower Blue River, Upper Blue River. South Blue Lake and Mann Creek subwatersheds.

Down logs densities vary considerably. It is uncertain exactly how much the current condition has changed from the past but logging did reduce down wood in harvested stands from about 1975-1986.

The following interpretations are based on the analysis using the habscapes model. The conditions described in Chapter III are generalizations based on guilds. There may be differences for some species which have specific habitat conditions not well represented by a guilding process.

Early Seral Habitat
The watershed currently contains 26% early seral habitat which is within the range of historic variability. This habitat has changed from being created by fire to being created by logging. Although structural elements were lacking in areas logged from 1950-1986, they are currently being prescribed for all harvest areas. The length of time areas remain in early seral has declined over the historic timeframe due to aggressive reforestation of logged and burned areas. At this point the trend is for a continuation of early seral with more structure. It will take several years of leaving amounts of structural components on the high end of the range of natural variability to obtain the landscape and associated population levels which existed prior to logging activities.

Late Seral Habitat
Currently late seral habitat occupies 37% of the watershed. This is within the range of historic variability, but on the low end. The viability of species associated with late seral in this watershed is moderate to high for large home range species. There are however concerns for the low mobility, small home range patch species. The concern is not with the total amount of habitat but for their dispersal capabilities in the Mann and Wolf drainages. There is also a concern about connectivity to the north. 61% of the watershed is highly suitable for large home range, mosaic species, which is concentrated in Lookout, Cook, Tidbits and Simmonds Creek areas.

Contrast Species
About 20% of the watershed is providing edge habitat for contrast species with large and medium home ranges. There is about 13% suitable habitat for the small home range species. Habitat for these species appears to be fairly concentrated with a few gaps across the watershed. There are only four species in this guild, two of which have been confirmed in the watershed. The others, flammulated owl and Lewis' woodpecker are generally found on the east side of the Cascades and their generally preferred habitat is not found in the watershed. There is no concern for adequate distribution and abundance of habitat for any of the contract species.

Generalists
There is no concern for habitat generalists. They can use the variety of seral stages that exist or will exist in the future. Structure is important since many use snags for breeding and benefit from down woody material.

Non-forested Habitat
The habitat is uncommon in the Blue River watershed. In some areas, it has been decreasing slightly due to fire suppression and resulting conifer encroachment in meadows. Meadows in the watershed are located mainly in the higher elevation ridgetops. If fire suppression continues, there is a concern that natural meadow communities that evolved with fire will change, which could impact wildlife species

which use this habitat. Meadows are a longer term early seral habitat than logged areas which are reforested, and reduction in their quantity may affect wildlife in the long term.

Dispersal Habitat

Between mature and late:

The main difference in dispersal conditions between the past and now is that the remaining mature and late seral stands have a patchier distribution. Thus while there may be more routes of habitat which appear to be suitable, these routes are narrower, have more edge effects and may be less effective

Between early and young:

More is provided currently than was present in 1900.