CALAPOOYA WATERSHED ANALYSIS

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1.0 WATERSHED CHARACTERIZATION

This section provides a regional setting for the Calapooya Watershed Analysis Unit (WAU) and describes dominant human, physical, and biological features and functions that characterize it. This discussion provides a basis for the watershed analysis, providing a context for addressing ecosystem condition and function in the WAU.

1.1 REGIONAL SETTING

Geographic Location and Population

The Calapooya Watershed Analysis Unit (WAU) is located in western Oregon midway between Eugene/Springfield and Albany/Corvallis within the Calapooya fifth-code watershed in the eastern part of the Upper Willamette River Sub-basin (Figure 1-1). The WAU covers approximately 53 square miles (33,790 acres) within the Calapooya watershed, which covers about 372 square miles. The Calapooya WAU is accessed by State Highway 228 between the Halsey I-5 interchange to the west and Sweet Home to the east. The towns of Brownsville, Crawfordsville, and Holley (population approximately 5,689) are within or adjacent to the WAU and the entire WAU is within Linn County (population approximately 91,227). The Calapooya WAU itself is situated south of the Calapooya River and extends upslope to the divide with the Mohawk River to the south (see Figure 1-2). This river is known locally as the Calapooia River though referenced by the BLM as the Calapooya River and should not be mistaken for a drainage of the same name to the south.

Ownership and Land Use

Forest and agricultural production represent the predominant land uses in the region. The Bureau of Land Management and Forest Service are the major federal land administrators in the region. The Calapooya WAU is within the McKenzie Resource Area of BLM's Eugene District. The Willamette National Forest is located east and upstream of the WAU. Several large private industrial forest land owners are also represented. Agriculture operations are primarily restricted to the valley bottoms and include grass seed, dairy, and livestock production. Other significant products of the region include manufacturing and rare metals production but occupy a relatively low portion of the land use in the region.

Physiography, Climate, and Drainage

The Calapooya WAU lies predominantly within the Western Cascade physiographic province as described by the Standards and Guidelines and Franklin and Dyrness (1973), though some of the lands in the western portion of the WAU contain landscapes representative of the Willamette Valley province. The Coburg Hills, a prominent physiographic feature of the region, forms a transition between the two provinces. Western Oregon has a maritime climate characterized by wet, mild winters, cool, dry summers and a long frost-free period. Annual precipitation in the region is approximately 42.5" with average January temperatures about 39° and July temperatures averaging around 65°. By comparison, mean annual precipitation within the WAU is about 55". Drainages in these provinces flow to the Willamette River which in turn joins the Columbia River at Portland.

Vegetation and Habitat

Major vegetational areas of the region include the *Tsuga heterophylla* (western hemlock) Zone and Willamette Valley Zone described by Franklin and Dyrness (1973). Douglas-fir is typically dominant in the western hemlock Zone as a sub-climax species at various seral stages reflective of the disturbance in the post-settlement period. Grasslands, Oregon white oak woodlands, and coniferous stands of Douglas-fir represent the successional pattern in the Willamette Valley Zone though much of this zone is in agricultural production. These vegetational areas are entirely within the range of the Northern Spotted Owl. Big game including Roosevelt elk and black-tailed deer are also found throughout the region. Finally, extensive riparian areas and aquatic habitat conditions support anadromous and resident salmonid fisheries within the WAU and the Calapooya watershed.

1.2 HUMAN USE CHARACTERISTICS

Ownership

Land ownership within the Calapooya WAU is presented in Figure 1-3. Small private landowners represent the single largest ownership category in the WAU (approximately 13,116 acres). Close to 700 small private landowner parcels exist within the Calapooya WAU and roughly 88% of the area represented by this group are in parcels 20 acres or greater. The larger parcels form a significant contiguous block throughout the WAU comparable in size to the other major landowner categories, BLM and private industrial land. In numbers, however, over 60% of the small private landowner parcels are in lots less than 20 acres (Linn County 1998). The smaller parcels tend to be grouped along the major access roads and adjacent to the larger small private landowner parcels. Overall, small private landowner parcels form a solid block of ownership in the lower elevations of the WAU.

Several private industrial forest landowners are represented in the WAU including Willamette Industries, Inc., Timber Service Company, Weyerhaeuser Company, and Rosboro Lumber Company. As a group, this represents the second largest ownership category within the WAU (approximately 12,723 acres). Private industrial parcels are generally distributed within the middle and upper elevations of the , intermixed or adjacent to BLM-administered land and adjacent to the larger small private landowners.

BLM-administered land is the least predominant ownership category within the WAU (roughly 7,676 acres). All BLM land in this WAU is within the BLM's McKenzie Resource Area and managed by the Eugene District office. Most of these lands came under federal ownership through revestment of Oregon & California Railroad Company land grants (O&C lands) and through acquisition of lands from the Blagen Mills Lumber Company. O&C lands are distributed in a "checkerboard" pattern with the private industrial landowners in the eastern part of the WAU. The Blagen Mills parcels, combined with O&C lands, create a large contiguous area within the western half of the WAU. These large blocks of BLM land are predominantly at the middle and upper elevations, through several scattered small BLM parcels exist on the lower slopes.

Land Use

Prior to the performance of this watershed analysis, three land use allocations have been designated for BLM lands in the Calapooya WAU pursuant to the Eugene District's Record of Decision and Resource Management Plan (USDI, BLM 1995), (see Figure 1-3):

Matrix – General Forest Management Area – This is the predominant BLM land use allocation representing approximately 5,482 acres distributed in large blocks throughout the WAU. These lands are dedicated to producing a sustainable supply of timber and other forest commodities, to provide jobs, contribute to community stability, and to provide early-successional habitat. This land use allocation comprises roughly 71% of BLM-administered land within the WAU.

Matrix – Connectivity Blocks – These allocations are spaced throughout the Matrix to provide late successional habitat and connectivity while supporting limited timber production. Three blocks exist within the WAU representing roughly 1,581 acres or 21% of BLM-administered land within the WAU.

District Designated Reserves – DDRs are administratively withdrawn areas set aside to manage special resource values in the WAU. Approximately 613 acres, or 8% of BLM land, are withdrawn in the Calapooya WAU, including: Bald Eagle Habitat Areas (BEHAs), Relict Forest Islands (RFIs), Research Natural Areas (RNAs), and other Areas of Critical Environmental Concern (ACECs).

One additional land use allocation, Riparian Reserves, will be established within this WAU as part of this watershed analysis. Riparian Reserves are areas along streams, wetlands, ponds, and lakes where the conservation of aquatic and riparian-dependent terrestrial resources receive primary emphasis. Using Eugene District guidelines, Riparian Reserves will be established along fish-bearing streams at a total width of 800 feet and along nonfish-bearing water at a total width of 400 feet. These designations will be presented in Section 3.1 along with their location and associated revisions to acreage allocations that will be used as the basis for analysis.

On private lands, major land uses include the following:

Timber Production – Active forest land manage ment occurs on all private industrial parcels and less than half of the larger small private landowner parcels. Harvest activity within the last 20 years is evident on nearly all parcels and the existing road system provides access to most land for future commodity extraction. When combined with BLM Matrix, timber production is the single greatest land use in the WAU.

Agriculture – Agriculture is the second most predominant land use, occurring primarily on the lower elevation, relatively flat stream valleys within larger small private landowner parcels in the WAU. Large fields tend to be used for both grass seed production and livestock grazing. In many cases, these uses are seasonally rotated when sheep are produced. Livestock grazing of sheep, cattle, and horses also occurs on smaller holdings and several small livestock feeding operations exist.

Rural Residential – This land use includes residences and associated small-scale agriculture on parcels that will support it. This land use is represented on nearly all smaller private landowner parcels and on relatively small portions of some of the larger small private parcels. Compared to the other land uses described above, this is a relatively small land use in the WAU.

Overall, timber production has historically been the predominant land use on both BLM managed lands, private industrial ownerships, and larger small private parcels. Based on review of stand age data and field reconnaissance, timber harvests began in the WAU at the early part of this century. Over time, harvest activities have more or less progressed on a constant basis over time. Harvest activity has not occurred in the past five years on BLM managed lands, however, a significant amount of harvesting has occurred recently on private lands, some making a second entry into these stands. Even-aged management through clear cutting has been and continues to be the main silvicultural system employed, though selective harvests (e.g., selection, shelterwood, and commercial thinning) are evident, primarily on small private land ownerships.

Finally, in addition to BLM land use allocations and the general private land uses described above, several special land uses exist in the WAU:

Rights-of-Way – Two transmission rights-of-way traverse the middle section of the WAU from north to south. These prominent land uses cross all landowner categories and are generally characterized by intensive vegetation management to keep these lines clear of brush and trees. Approximately 275 acres of state and county road rights-of-way also exist which are managed for transportation and, in some cases, weed suppression.

Parks – One developed county park, the McErcher Park, exists within the WAU. Located west of Crawfordsville along the Calapooya River, this park provides a scenic wayside, picnicking, and fishing access along Highway 228. It is situated on county land adjacent to rural residential land uses and adjacent to a BLM DDR.

Dispersed Recreation – Hunting and recreational driving represent the significant recreational activities on BLM managed lands and private industrial lands. Some special forest product gathering also occurs (e.g., firewood, boughs, mushrooms, and moss). Gated access to some of these lands seasonally limits these activities. Dispersed camping is associated with these activities on a limited basis, primarily on BLM land. Some fishing occurs seasonally along fish-bearing streams within the WAU, though access is limited by the high proportion of private landowners situated along these fisheries.

1.3 PHYSICAL CHARACTERISTICS

Geomorphology and Soils

Elevations within the WAU range from a low of 380 feet to 2,864 feet at Horse Rock, located on the WAU's southern divide. Less than 10 percent of the WAU exceeds an elevation of 2,000 feet. Elevations along the divide typically range from 2,000 to 2,400 feet, although numerous saddles occur where elevations are as low as 1,183 feet.

The Calapooya WAU faces to the north, with the river forming the northern boundary of the WAU. The river within the WAU flows through a floodplain of stratified Quaternary (1.6 million years to present) alluvial terraces (see Figure 1-4). Quaternary lacustrine and fluvial sediments associated with the Willamette Valley are found near the river at the west margin of the WAU and within the lower elevations of Courtney Creek. More recent alluvial deposits border Brush Creek and portions of Courtney Creek, the two major tributaries to the river within the WAU.

Slopes bordering the low elevation alluvial areas typically have only gentle to moderate gradient, and gradient of the Calapooya River and the main stems of Brush and Courtney Creeks remain generally below 1% for nearly their entire length. The river is well-confined throughout most of the WAU by relatively high old terraces, although in some relatively isolated areas more recent and lower elevation floodplain terraces border the river. Confinement and entrenchment of Courtney and Brush Creeks are variable, and are described and mapped in detail in Chapter 3 of the analysis. In general, slopes become steeper at the higher elevations towards the WAU divide to the south, and to the east. Tributaries draining these areas rapidly become quite steep and well-confined. Steep inner gorge slopes are infrequent within the WAU and are almost entirely limited to headwater tributary locations, and isolated locations along the river.

The upland slopes of the WAU are formed from Tertiary (1.6 to 66 million years before present) Western Cascade volcanoclastic rocks (Walter and MacLeod 1991). Heterogenous and undifferentiated tuffaceous, basaltic and andesitic flow volcanics are the prevalent geologic formation mapped in the WAU. Slopes are typically gentle to moderately steep in these areas, although steeper slopes occur below benches and along some tributary stream courses. Ancient slumps and earthflows, both mapped and inferred, are common in these materials. A large ancient landslide is mapped in the headwaters of Courtney Creek, and similar slides are inferred in other areas of the WAU. More resistant basalt and andesite flows interbedded with weaker flow breccias are found generally at the higher elevations near the divide and between Courtney and Brush Creeks. Glaciation has not occurred within the WAU.

The volcanoclastic parent materials that form the upland soils of the WAU form moderately deep to deep, well drained soils. Surface textures are predominantly silt loam to silty clay loam, with clay dominant in the subsurface horizons. Clay content for most of the soils mapped in the WAU typically range from 35 to 60% below a depth of approximately 6 to 12 inches. Along some ridge and adjacent slope locations, soil depth is shallow, and stone content is high.

Precipitation and Hydrology

Mean annual precipitation within the WAU averages approximately 55 inches, ranging from 46 inches where the river exits the WAU at elevation 380 increasing with elevation and to the east to a maximum of approximately 64 inches along the WAU divide (Miller et al. 1973). Most precipitation within the WAU falls as rainfall due to the WAU's relatively low elevation. Typical of the maritime climate of western Oregon and Washington, more than 70% of annual precipitation in the Calapooya WAU falls in the five months of November through March.

Streamflow was recorded within the WAU on the Calapooya River by the U.S. Geological Survey at Holley from 1933 through 1990 (Wellman, et al. 1993). Drainage area of the Calapooya at Holley is 105 square miles. Mean annual streamflow is 437 cubic feet per second (cfs). Streamflow patterns reflect the annual distribution of precipitation, with flows increasing rapidly from their seasonal lows in the early fall in response to late fall and winter precipitation. The highest mean monthly flow occurs in December, and the lowest flows occur in August and September, when flows of less than 50 cfs are common. Seventy three percent of annual streamflow volume occurs in the five months of November through March. For this watershed analysis, seven sub-watersheds have been designated (see Figure 1-5).

Peak flows occur during the winter months of November through February, with approximately 60 percent of all annual peaks occurring in December and January. The largest peak flow of record at Holley (12,600 cfs), occurred on December 22, 1964. A flood of similar magnitude is inferred to have occurred in 1996, based on large floods observed at gaging stations on surrounding rivers. Additional floods exceeding the 10 year event occurred in 1945, 1954, 1956, 1958, 1961, and 1972. The main tributaries to the Calapooya River within the WAU are Brush Creek and Courtney Creek. No streamflow records for these tributaries were found.

Much of the Calapooya River watershed upstream of Holley is subject to periodic snowfall and subsequent snow melt during warm mid-winter rain-on-snow (ROS) events, which are associated with nearly all major peak flows of the river. However, the tributary watersheds of the Calapooya WAU have relatively low elevations, with little area in the primary ROS zone, most subject to snow accumulation and melt (2,100 to 2,900 feet). Streams within the WAU are less affected by increased snow accumulation and accelerated melt associated with removal of forest canopy than are watersheds with greater area in the primary ROS zone.

Soil Erosion and Mass Wasting Processes

Soil erodibility "K" factor for the soils found in the WAU fall almost entirely within the low (K < 0.25) and moderate (K = 0.25 to 0.40) erodibility classes (Soil Survey of Linn County Area Oregon, USDA 1987). However, erodibility of most upland soils in the WAU is described as moderate to high, and soils are subject to severe compaction and puddling. These soils are subject to erosion where exposed and compacted or puddled with associated destruction of internal macropores; delivery of sediment to streams can result, particularly on steep slopes. Road surfaces have poor bearing strength when wet, and unsurfaced roads are subject to rutting, concentration of surface flows, and delivery of sediment to streams. Heavily used ground-based skid trails are subject to severe compaction, generation of surface flows, erosion, and attendant sediment delivery if poorly drained and located. However, harvest-caused erosion is rare within the WAU, and is not a significant source of delivered sediment.

Ancient deep-seated slumps and earthflows associated with the clay rich soils formed from weak volcanoclastic parent materials are inferred to have occurred throughout the WAU on gentle to moderate slopes. Most of these formations are not currently active and/or recognizable. Although these forms of failure are not particularly sensitive to management activities and typically do not deliver large volumes of sediment to stream systems, road construction on moderate to steep locales within slump/earthflow formations can cause local reactivation and acceleration of erosion processes. However, few instances of reactivation have occurred in recent years.

Shallow rapid forms of mass wasting (debris avalanches and debris flows) are much more sensitive to forest management activities and can have substantial effect on stream systems. However, relatively few debris avalanches and debris flows were observed within the WAU.[1] This finding is consistent with the literature and previous watershed analysis results from throughout the coastal and interior Northwest: the preponderance of debris avalanches and debris flows occur on slopes steeper than 70%, and few areas within the Calapooya WAU are this steep.[2] Based on these observations, mass wasting is of less significance than is surface erosion from roads as a source of sediment delivery to streams within the WAU.

Stream Channels Processes

The Calapooya River is a low gradient (< 1 %), sinuous reach throughout the WAU, and flows through a wide alluvial valley. In many areas the river is confined by old alluvial terraces that the river downcut through thousands of years ago, while in isolated areas it is unconfined where it borders lower floodplain alluvial terraces. Partial shade is provided to the river by a narrow band of mixed conifer and hardwood, but most of the channel is exposed to direct solar radiation. Large woody debris (LWD) quantity is low due to historic riparian harvest along the river and its tributaries within and upstream of the WAU, and due to historic splash damming and river log drives and associated channel cleaning. LWD recruitment

[1] Significant floods occurred in 1945, 1954, 1958, 1964, 1972 and 1996. Timing of photography relative to flood history is poor. The 1964 photos are post-1964 flood, but do allow detection of larger failures associated with 1950's era floods. The 1969 photos allow detection of 1964 failures, although small failures, perhaps including some debris flows, may not be recognizable, and stereo coverage was incomplete due to a few missing and mutilated photos.

[2] Stark et al. (1998) report landslide density in excess of 7 slides/mi^2 for the Calapooya river watershed upstream of our WAU, and including approximately 3 mi^2 of the eastern margin of our WAU. However, within their "Lower Calapooya" sub-watershed, landslide density dropped to substantially less than 1/mi^2.

potential is generally low. Only one short (less than 1,000 feet) reach of the river within the WAU is bordered by BLM ownership.

Stream gradients within the alluvial areas bordering most of the mainstem length of Brush and Courtney Creeks are low (usually much less than 1%), and channels are unconfined to weakly confined. Brush Creek is sinuous, but Courtney Creek has been channelized for much of its length as it passes through the agricultural lands at the lower elevations in the western part of the WAU[3]. Confinement and entrenchment of the mainstems of Courtney and Brush Creeks is variable, but nearly all mainstem reaches are classified as response reaches, and Rosgen C. Channel classification is described and mapped in more detail in Chapter 3. There is no BLM ownership within these lowland alluvial areas, most of which have been cleared for agricultural uses. The Calapooya River and its fish-bearing tributaries within the WAU, are poorly shaded at their lower elevations associated with agricultural and rural land uses. Near-term LWD recruitment potential of Brush and Courtney Creeks is low to moderate due to historic riparian harvesting adjacent to their main stems and tributaries, mainstem adjacent roads, and continued deforestation along the agricultural reaches in the lowlands. Unstable and actively eroding streambanks are common for both Brush and Courtney Creeks where streambanks are poorly vegetated and/or grazed within the alluvial soils of these valley-bottom areas.

Calapooya River water quality has been monitored at River Mile 3 near Albany beginning in 1972. Water quality is considered seasonally poor for fecal coliform, biochemical oxygen demand, nitrate and ammonia nitrogen, total phosphorous, and total solids. High summer water temperatures contributing to eutrophication are also reported (Cude 1998). With possible exception of a minor contribution to water temperature, these water quality conditions are unrelated to forest management practices within the WAU, and are reported to be mostly associated with agricultural and waste discharges occurring in the lower 35 miles of the river downstream of the WAU (Cude 1998). The Calapooya River from Albany to Brush Creek is on the Oregon DEQ 303(d) list for water temperature and fecal coliform. Contributing factors to warm water temperature are low elevation and associated warm air temperature, and removal of mainstem shade.

[3]Courtney Creek does not flow into the Calapooya River Within the WAU: it enters the river approximately 10 miles downstream of the WAU's western boundary.

1.4 BIOLOGICAL CHARACTERISTICS

Vegetation Patterns

Figure 1-6 presents vegetation classification in the Calapooya WAU based on seral stage development. BLM land was classified using the BLM's Forest Operations Inventory and private land was classified using interpretation of ortho-rectified color aerial photography flown in 1995. Field reconnaissance has been performed to develop and verify classification rules and classifications have been spot-checked to verify individual classifications and to update classifications due to post-1995 disturbance (e.g., timber harvests). This classification makes it possible to observe several significant vegetation patterns for the Calapooya WAU that have relevance to this watershed characterization:

Non-Forested – Non-forest lands primarily include the agricultural and rural residential land uses described previously. These lands tend to be on lower elevations on relatively flat topography. They are permanently converted from forest cover and provide minimal hydrologic maturity. Minor components of this vegetation classification include meadows and grasslands occurring on the ridge top and scattered rock outcrops and transmission rights-of-way. Overall, 8,690 acres of non-forested land occurs in the WAU.

Hardwoods – This vegetation type is represented by Oregon white oak woodlands that once dominated the lower elevation alluvial flats and foothills. This vegetation type is found exclusively on the non-industrial small private lands and most of the 388 acres that were found in the WAU exist in isolated stands in the Courtney Creek drainage.

Early Seral Immature – Young Douglas-fir stands (0-6 years), developing after timber harvest activity, define this vegetation classification. Approximately 4,424 acres occur, primarily in large blocks, throughout the privately-held forested portions of the WAU. These stands offer minimal hydrologic maturity and contain elements of early-successional development.

Early Seral Intermediate – This vegetation classification represents the next stage in hydrologic maturity, but still is typical of early seral stands. Stand ages range between 7 to 20 years, and tree size and canopy cover has developed such that it offers more protection. This vegetation pattern is less predominant than it's immature counterpart (2,717 acres) but occurs on BLM land, as well as private land.

Mid/Late Seral – Mid/Late seral stands are found in extensive blocks on BLM land in middle and upper elevations of the WAU and in fragmented stands intermixed with early seral stands in the middle and lower elevations. Roughly 16,275 acres occur on both BLM and private lands. Compared to early seral stands, mid/late seral stands are older (21-80 years), have high crown closure and larger tree sizes offering hydrologically mature conditions.

Mature/Old Growth – Approximately 1,296 acres of mature and old growth forest occur in the WAU, primarily on ACECs, DDRs, and Connectivity Blocks within BLM lands. A lesser amount exists on private land, though it should be noted that a significant amount of late seral stand conditions exist on private lands approaching a mature condition. These stands provide late-successional stands described in the Northwest Forest Plan and Eugene District Resource Management Plan.

With the exception of large blocks of mid/late seral stands on BLM land and non-forested private lands, the vegetation pattern in the Calapooya WAU is fairly diverse. Historically, periodic fire appears to be the major disturbance factor affecting vegetation patterns. Since settlement of the region, however, human activity has been the major disturbance factor and is responsible for the vegetation pattern we see today.

Wildlife Habitat Features

Wildlife habitat characteristics and values in the Calapooya River WAU have been influenced by logging, road construction, urban and residential development, construction of utility rights-of-way, and conversion of forested lands to pastures and croplands. Periodic high winds have also altered the canopy structure and composition of forest communities, especially on high-elevation ridges, with remnant old-growth and mature forest communities. Effects of high winds are evident, resulting in relatively high densities of large Douglas-fir trees with broken-off tops (i.e., "snags"). The lack of fire-scarred trees in the WAU indicates that wild fire has not had a significant effect on forest composition and structure, at least locally.

The human activities and natural forces that have altered seral ecology of conifer forests (e.g., removed substantial amounts of old-growth and mature forest stands) eliminated large acreages of white oak woodland, fragmented habitat, and decreased effectiveness of hiding and thermal cover for Roosevelt elk, black-tailed deer, and other species especially sensitive to human activities.

Forest habitats on slopes and in the headwaters of the WAU are dominated by Douglas-fir with varying amounts of western hemlock, western red cedar, big-leaf maple, and various species of shrubs and forbs. In portions of the WAU, where extensive clear-cut logging has taken place, and conifer reproduction has been unsuccessful, big-leaf maple is a dominant tree, rapidly becoming established in the absence of conifer competition.

The relatively flat valley floor has mostly been converted to non-native grassland with scattered patches of large-diameter white oak remaining along streams (e.g., Courtney Creek) and in pastures. Sheep grazing, especially in the northwestern portion of the WAU, is a major use of grasslands, pastures, and remnant white oak stands.

Riparian vegetation occupies narrow zones (usually less than 50 feet in width) on the flood plains of perennial streams that are tributary to the Calapooya River. Red alder and big-leaf maple typically form the dominant overstory canopy, with a dense shrub layer being composed of red-osier dogwood, snowberry, thimble berry, and numerous other deciduous shrubs and forbs. Conifers are interspersed among deciduous species in the riparian zone and predominate on slopes adjacent to the floodplain. Wetlands occur along margins of streams and at sites where shallow groundwater discharges as springs and seeps.

Riparian vegetation along the Calapooya River has been extensively altered by human developments; consequently, the zone of riparian vegetation is narrow, occupying stream banks and areas subject to periodic flooding.

Common wildlife species in the WAU include Roosevelt elk, black-tailed deer, mountain lion, black bear, raccoon, beaver, and small mammals such as mice and voles. Birds include bald eagle, spotted owl, goshawk, saw-whet owl, red-tailed hawk, waterfowl, members of the jay family, and numerous migratory birds

Fisheries

Streams within the WAU which harbor fish are the Calapooya River, Courtney Creek, Brush Creek, Pugh Creek and their major tributaries. These streams provide spawning and rearing habitat for salmonid species at lower elevations of the WAU where stream gradients are relatively low and suitable spawning gravels are present. As gradients in the WAU increase, and spawning gravels are scarce or lacking, barriers to fish passage (e.g., perched culverts, waterfalls, and woody debris) often exist, and seasonally low stream flows limit habitat suitability. The WAU has about 52 miles of fish-bearing streams (see Figure 1-7), most of which are on private lands.

Suitable spawning gravel is present in the Calapooya River intermittently between Brownsville and Holley. The best spawning areas for salmonids occur from Holley upstream to the headwaters and in Brush Creek upstream from the confluence with the Calapooya River for about two miles.

Historically, the Calapooya River has not been a major producer of anadromous fish due to the construction of dams and irrigation diversions in the early part of this century. These structures blocked or inhibited upstream fish passage and spawning. However, removal or modification of some of these barriers over the last 30 years, to enhance anadromous fish passage, has improved access to spawning areas for Chinook salmon, and steelhead (winter). Both Chinook salmon and steelhead are confined to the mainstem of the Calapooya River.

Resident fish in the WAU include coastal cutthroat trout, rainbow trout, whitefish, large-scale suckers, Pacific lamprey, western brook lamprey, speckled dace, long-nosed dace, northern squawfish, redside shiner, and various species of sculpins. Cutthroat trout are the most widely distributed salmonid in the WAU. These fish are present in the mainstem of the Calapooya River, Courtney Creek, Brush Creek, and their major tributaries.

Special-Status Species

Special-status species include plants and animals that are listed under the Endangered Species Act of 1973 as threatened, endangered, or candidates for listing; species classified by BLM as "sensitive"; and species identified by the Oregon Natural Heritage Program as warranting special management consideration because of rarity or threats to population viability. Two species listed as threatened are present in the WAU (bald eagle and spotted owl). Bald eagles are winter residents that roost and forage in the western portion of the WAU in the vicinity of Coburg Hills and the Courtney Creek drainage (Figure 1-7) where carrion from domestic sheep operations is an attractive food source and forested perching and roosting sites are nearby. Extensive timber harvesting on both private and federally managed lands in the Coburg Hills has been identified as having the potential to adversely affect wintering bald eagles through the reduction in suitable roosting and perching habitat.

Spotted owls nest in the WAU where mature and old-growth Douglas-fir stands provide habitat (i.e., large-diameter snags). There are five known spotted owl nesting sites and associated activity centers (i.e., a 100-acre zone surrounding nest sites) in the WAU. There are also Connectivity Blocks identified within the WAU that are retained as late-successional/old-growth refuges that provide habitat for breeding, feeding, dispersal, and movement of spotted owls and other species dependent on mature or old-growth forests. Suitable habitat (i.e., late-successional and old-growth Douglas-fir forests) for red tree voles, an important prey of spotted owls, is present in the WAU. This species has been identified by the BLM as a "survey and manage" species (BLM-Instruction Memorandum No. OR-97-009), requiring special consideration when planning resource activities that could affect this species. Other special-status wildlife species are discussed in Chapter 3.

Special-status plants that have been documented for the WAU include: *Isoetes nutallii, Cimifuga elata, Githopsis specularoides, Juncus kellogia, Lecidea dolodes, Blepharopappus scaber, Aster vialis,* and *Orobanche pinorum*. These plants are often associated with special habitats such as wetlands, grassy balds, and late-successional forest. Other species of special-status, such as bryophytes, lichens, and fungi, may also be present in the WAU, but their presence or absence has not be extensively researched.

Habitats with exceptional ecological values because of rare natural plant communities, late successional habitats, high levels of diversity, and important scientific values have been designated as Research Natural Areas (RNA's) and Areas of Critical Environmental Concern (ACEC) (Figure 1-7). The Horse Rock RNA/ACEC, in the Calapooya WAU, is being managed to preserve blue wildrye and red fescue bald communities, the Lemmon's needle grass-moss community, and a forest community classified as a Douglas-fir/western hemlock association with an understory dominated by small Oregon grape, salal, and snowberry.

Noxious Weeds

Noxious weeds are invasive plants specified by law as especially undesirable, troublesome, and difficult to control. Noxious weeds typically invade and proliferate on sites that have had the plant cover and soil removed or disturbed. Logged areas, roadsides, utility corridors, abandoned crop fields and heavily grazed sites are especially susceptible to noxious weed infestations. Noxious weeds in the WAU include: Scotch broom, meadow knapweed, spotted knapweed, Saint John's wort, tansy ragwort, Canada thistle, and bull thistle. As dense overstory canopies of trees and shrubs become established on sites with weed infestations, shading and competition with woody plants often reduces the density of noxious weeds.

2.0 ISSUES AND KEY QUESTIONS

This section reports issues and key questions identified by BLM to be used for focusing watershed analysis on those elements of ecosystem condition and function that are most relevant to management within the Calapooya WAU.

Physical Conditions and Processes

ISSUE: HYDROLOGIC CHANGE

- What are the dominant hydrologic (flow) characteristics in the watershed (i.e. peak flows, minimum flows, total discharge)?
- What are the current watershed conditions influencing hydrologic response?
- What is the influence of land use on runoff during storm events which generate peak flows?
- What are the effects of changes in runoff on flood peaks?
- How has the amount, timing, and delivery of water, sediment, and wood changed in the watershed?

ISSUE: EROSION PROCESSES

- What erosion processes are dominant within the watershed (hillslope erosion, road-related surface erosion, mass movement).
- Where do natural erosion processes tend to occur?
- What are the current conditions and trends of the dominant erosion processes within the watershed, and how do they differ from historical erosion processes?
- Have management and human-related activities affected erosion processes?
- What is the mass wasting potential in the watershed?
- What areas are sensitive to forest practices?

ISSUE: WATER QUALITY

- What are the current water quality conditions? How does water quality in the watershed compare to State water quality standards?
- How and where are the beneficial uses affected?
- Where in the watershed and on BLM lands do erosion processes (mass wasting, hill slope erosion, road-related erosion) have the greatest potential to deliver sediment to stream channels or other water resources?

ISSUE: SOIL QUALITY

- Has soil quality (long-term productivity) been significantly altered by past activities?
- Where?

Biological Conditions and Processes

ISSUE: KEY WILDLIFE HABITAT

- What role does the watershed play in providing conservation or recovery of wildlife, especially as it relates to the BLM Eugene District's Resource Management Plan (RMP) and the Northwest Forest Plan (NFP) Strategy?
- Listed are most of the species and/or habitats of concern in the Calapooya watershed area; bald eagle northern spotted owl, peregrine falcon, big game, red tree vole, Oregon megomphix/papillose tail-dropper/blue-gray tail-dropper, Oregon slender salamander, indigenous bat communities, forest fragmentation, mature and old growth timber habitat, riparian habitat, refugia/inoculum habitat, and standing dead tree and coarse woody debris conditions.
- What is the current condition of the aquatic ecosystem and riparian reserves (vegetation, age classes, downed wood, and snags)?

These, and other basic issues and key questions outlined in the Federal Guide, will form the basis of the description of current and reference physical and biological conditions in the next section.

3.0 CURRENT AND REFERENCE CONDITIONS

This section presents current and reference physical and biological conditions emphasizing issues and key questions identified by the BLM in Section 2.0 for the Calapooya Watershed Analysis Unit (WAU). Topics addressed in this section include:

- Riparian Reserves
- Erosion Processes
- Hydrologic Change
- Water Quality
- Stream Channels
- Terrestrial Resources
- Riparian Resources
- Aquatic Resources

For each topic, reference conditions and current conditions are presented in chronological fashion, providing a comparable basis for evaluating and assessing each concern.

3.1 RIPARIAN RESERVES

Figure 3-1 presents BLM's land use allocations including the designation of Riparian Reserves. This land use allocation has been established as part of this watershed analysis along streams, wetlands, ponds, and lakes where the conservation of riparian-dependent terrestrial resources receive primary emphasis. Using Eugene District guidelines, Riparian Reserves were established along fish-bearing streams at a total width of 800 feet and along nonfish-bearing streams at a total width of 400 feet. Designation of fish-bearing streams will be discussed in detail in Section 3.8 and are presented in Figure 3-1 as well. Pursuant to the Northwest Forest Plan and the Eugene District Resource Management Plan, the Riparian Reserve designation supersedes any other land use allocation previously described in the Watershed Characterization.

Table 3-1 presents acreages for each land use allocation distributed by those sub-watersheds introduced in Section 1.3. The Riparian Reserve land use allocation accounts for roughly 35% of BLM-administered lands and is distributed more or less proportionally among each sub-watershed. When combined with Connectivity Blocks and District Designated Reserves, over half the ownership is in a land use allocation where management for late successional species and/or riparian and aquatic habitat gains greater consideration. Two sub-watersheds, Northwestern Tributaries and Western Tributaries are comprised solely of these designations. Of the remaining sub-watersheds, the General Forest Management Area designation is found on roughly 46% of the WAU, again proportionally distributed among sub-watersheds. Overall, these land use allocations will be used as the basis for summaries presented throughout the remainder of this section.

TABLE 3-1

Acreages of BLM Land Use Allocations by Sub-watershed

Sub-watershed	Total Acres	Matrix – GFMA		Matrix – Connectivity Blocks		District Designated Reserves		Riparian Reserves	
		Acres	%	Acres	%	Acres	%	Acres	%
Courtney Creek	2817	1355	48	242	8	213	8	1007	36
East Fork Brush Creek	1672	760	45	282	17	0	0	630	38
Eastern Tributaries	1131	756	67	0	0	0	0	375	33
Lower Brush Creek	47	26	55	0	0	0	0	21	45
Northwestern Tributaries	91	0	0	0	0	70	77	21	23
West Fork Brush Creek	1221	637	52	179	15	0	0	405	33
Western Tributaries	698	3	<1	299	43	163	23	233	33

Total	7676	3537	46	1001	13	445	6	2693	35

3.2 EROSION PROCESSES

Three types of erosion processes are examined in this assessment: mass wasting, hillslope erosion, and road erosion. Key questions to be answered by this analysis are:

- What erosion processes are dominant in the watershed?
- Where do natural erosion processes tend to occur?
- What are the current conditions and trends of the dominant erosion processes in the watershed, and how do they differ from historical erosion processes?
- Have management and human-related activities affected erosion processes?
- What is the mass wasting potential in the watershed?
- What areas are sensitive to forest practices?

Watershed Overview

The Calapooya WAU is located in west central Oregon, northeast of Eugene, in Linn County. Elevation in the WAU varies from a low of 380 feet along the Calapooya River to a high of 2,864 feet at Horse Rock. Annual precipitation ranges from approximately 46 inches at the lower elevations to approximately 64 inches along the southern WAU divide. Most of the precipitation in the WAU falls as rain, with very little snow accumulation occurring below 2,000 feet. Most surface erosion occurs in the WAU during winter and spring months when approximately 70% of annual precipitation occurs.

The Calapooya River within the WAU flows through a floodplain of stratified Quaternary (1.6 million years to present) alluvial terraces. Quaternary lacustrine and fluvial sediments associated with the Willamette Valley are found near the river at the western margin of the WAU and in the lower elevations of Courtney Creek. More recent alluvial deposits border Brush Creek and portions of Courtney Creek, the two major tributaries to the river within the WAU. The most erodible soils in the WAU occur on gentle slopes in these alluvial formations. These areas were converted from forests to other land uses several decades ago.

The upland slopes of the WAU are formed from Tertiary (1.6 to 66 million years before present) Western Cascade volcanoclastic rocks. Heterogeneous and undifferentiated tuffaceous, basaltic, and andesitic flow volcanics are the prevalent geologic formation mapped in the WAU. Slopes are typically gentle to moderately steep in these areas, although steep slopes exceeding 50% are intermixed with more gentle slopes particularly in the headwaters of Courtney Creek and the West Fork of Brush Creek. Many of these steep areas are associated with basalt and andesite flows interbedded with weaker flow breccias found generally at the higher elevations near the WAU divide and between Courtney and Brush Creeks. Glaciation has not occurred in the WAU.

The volcanoclastic parent materials that form the upland soils of the WAU form moderately deep to deep, well drained soils. Surface textures are predominantly silt loam to silty clay loam, with clay dominant in the subsurface horizons. Clay content for most of the soils mapped in the WAU typically range from 35 to 60% below a depth of approximately 6 to 12 inches. Along some ridge and adjacent slope locations, soil depth is shallow, and stone content is high.

Reference Conditions

The reference condition for this WAU is fully forested, subject to periodic wildfires of low severity and low extent. Mass wasting during forested periods was likely limited, and associated almost entirely with major storms and floods. Channel-scouring debris flows undoubtedly occurred in steep first and second order channels, depositing coarse sediment and large woody debris (LWD) into transport/response transitional areas. However, these events do not appear to have been common, as is the case for steeper landscapes and greater amounts of precipitation.

Surface erosion rarely occurred in the WAU prior to disturbance of soils by road construction, logging, and forest conversion to non-forest land uses. Nearly all natural erosion occurred as mass wasting, soil creep, and related streambank and channel erosion.

Logging practices in the WAU, which remain evident on 1964 and 1969 air photos, unquestionably added large amounts of sediment. Steep slopes were commonly tractor logged downhill, within headwater tributaries, and/or to log landings located adjacent to streams. Trails excavated into hillsides were common. Few streams were protected by any form of streamside buffer. Old first-entry skid trails that had been excavated into hillsides and led down to streams were observed within recently uphill-logged cable units. The contrast in quantity of delivered sediment from the old versus current practices is dramatic, decreasing from perhaps as much as several tons per acre to near zero currently.

Current Mass Wasting Conditions

The landslide hazard assessment for the Calapooya WAU was conducted according to the WFPB Manual (WFPB 1995). The primary objectives of this analysis are to identify the geomorphic circumstances where landslides are most likely to occur, to identify and map these locations, and to identify any management practices that contribute to the occurrence of landslides in the WAU.

Ancient, deep-seated slumps and earthflows associated with the clay rich soils formed from weak volcanoclastic parent materials are inferred to have occurred throughout the WAU on gentle to steep slopes. Most of these formations are not currently active or recognizable. Although these forms of failure are not particularly sensitive to management activities and typically do not deliver large volumes of sediment to stream systems, road construction on moderate to steep locales within slump/earthflow formations can cause local reactivation and acceleration of erosion processes. However, few instances of reactivation have occurred within the Calapooya WAU in recent years.

Shallow-rapid forms of mass wasting are much more sensitive to forest management activities and can have substantial effects on stream systems. However, relatively few shallow-rapid failures were observed in the WAU. This finding is consistent with the literature and previous watershed analysis results from throughout the coastal and interior northwest; the preponderance of debris avalanches and debris flows occur on slopes steeper than 70 percent, and few areas within the Calapooya WAU are this steep.

Background

Mass wasting is a major erosion process in many forested watersheds of the northwest. Slope gradient and ground water are the two factors that have the greatest effect on slope stability, although additional factors such as composition, depth, and degree of weathering of parent materials, and micro-topographic features are also important. Three types of mass wasting contribute to stream habitat change: deep-seated slumps and earthflows, shallow rapid failures, and debris flows down stream channels, sometimes referred to as debris torrents.

Slumps and earthflows are typically triggered by the build-up of pore water pressure in mechanically weak, and often clay-rich, parent materials. Earthflows are commonly reported as significant processes in western Oregon, California, and Washington. Shallow rapid failures are more common than slumps and earthflows and are primarily associated with two specific landforms: bedrock hollows (also referred to as swales or zero-order basins), and stream-adjacent inner gorges. Furthermore, few shallow rapid failures occur on slopes of less than 60% gradient, with the majority occurring on slopes exceeding 70% gradient (Benda, et al. 1997). Shallow rapid failures and debris torrents are the forms most likely to be influenced by forest management activities (Ice 1985). Debris torrents are by far the form of mass wasting that is most destructive to stream habitat.

Roads are the predominant cause of increased rates of mass wasting associated with forest management, with acceleration factors due to roads commonly found to be in the range of ten to one hundred times greater for roads than for harvesting (Swanston and Swanson 1976). Road fill failures, including fill failures associated with culvert blockages and diversions, are the predominant form of road-associated mass wasting.

Rates of shallow rapid failures on steep sites can be accelerated during the first 6 to 15 years following clearcut harvest due to loss of apparent soil cohesion attributed to root decay (Benda, et al. 1997; Gray and Megahan 1981). Rates of failure acceleration in clearcuts versus forest have been reported to range from 1.0 to 8.7 times.

Methods

Aerial photo analysis and field investigations were used to analyze the hazard for mass wasting for the Calapooya WAU. Four sets of aerial photographs were examined to identify landslide locations and the history of mass wasting in the WAU (1964 B/W 1969 B/W 1984 color, 1995 color). Locations of landslides observed on the aerial photos were plotted on a WAU base map (Figure 3-2), and landslide features were recorded in a database (Appendix A, Table A-1).

Field investigations were also conducted. A number of the landslides identified from the aerial photos during this analysis were visited during these field investigations. Additional landslides located during the course of the field investigations were also recorded on the map and their characteristics recorded in the database. Physical characteristics of the landslides and local geomorphic circumstances were confirmed and/or recorded, as was any evidence of past management activities and their contribution to failure occurrence. All landslides were classified according to the conventions in the Washington Forest Practices Board Manual (WFPB 1995).

Landslide Inventory

A total of 16 landslides were observed within the 53 mi^2 Calapooya WAU, a density of only 0.3 landslides per mi^2. Four of these 16 were rated "questionable," meaning that we judged that the feature observed on the aerial photo might be a failure, but likely was not. The characteristics of each landslide observed are recorded in Table A-1. All of the landslides were considered to have originated, or at least to have been reactivated, relatively recently. Most landslide surfaces observed on pre-1995 aerial photos have revegetated and are no longer visible on the 1995 aerial photos. Continuing surface erosion from these surfaces is unlikely. Surface erosion from more recent failures was not specifically assessed.

As shown in Table A-2 (Appendix A), the vast majority of landslides were shallow rapid (SR) failures. Nearly half of these failures were associated with roads that contributed to failure through undercutting and removal of lateral support or through failure of fill materials. Debris torrents were infrequent. Only two debris torrents were related to management activities, both cases being harvest-related. These two debris torrents were responsible for 86% of the total sediment delivered from mass wasting in the WAU (see Table A-3). Only one deep-seated failure was observed - a sunken grade along the paved road near the divide at the upper end of the mainstem of Brush Creek.

Landslide Hazard Classes and Mass Wasting Management Units

Standard WFPB Manual procedures call for classification of the WAU into Mass Wasting Management Units (MWMU). Each MWMU is classified as having high, medium, or low potential for mass wasting to deliver sediment to streams, and also rated for combined potential hazard of mass wasting and sediment delivery to streams.

Sixteen landslides were observed to have occurred in the WAU (0.3 landslides per mi^2) since or shortly prior to 1964. This is a low rate of activity for watersheds west of the Cascades. All but two management-related failures occurred on slopes exceeding 50% gradient, in headwall and/or groundwater convergent locations, within inner gorges, or on planar slopes of 70% gradient or greater. One Moderate and one High hazard MWMU were identified for these sites within the WAU; all other areas of the WAU are Low hazard (see Figure 3-3). Each MWMU delineated for the WAU is described below. Additional information for those MWMU having Moderate or High hazard ratings is found in Forms A-2 (Appendix A). Table A-4 (Appendix A) shows the area of each MWMU in each sub-watershed.

MWMU #1 occurs on level to nearly level alluvial and lacustrine deposits adjoining the Calapooya River and the lower reaches of Brush and Courtney Creeks as these systems enter the Willamette valley. It should be noted that streambanks of the Calapooya River are high and steep in some areas, are potentially subject to inner gorge and streambank failures, and that these areas are unmapped inclusions within MWMU #1. No failures were observed in this unit, and mass wasting hazard is Low.

MWMU #2 occurs on gentle to moderately steep (10 to 49%) slopes formed from stratified volcanic flow breccias, tuff, basalt and andesite flows. MWMU #2 areas are found upslope of MWMU #1 throughout the WAU, with areas of MWMU #3 and MWMU #4 interspersed within it. This area is extensive, yet only two failures were associated with management, both of which were small road failures that did not deliver sediment to streams. Mass wasting hazard is rated Low for both roads and harvest.

MWMU #3 occurs on steep (50 to 70%) slopes formed from stratified volcanic flow breccias, tuff, basalt and andesite flows similar to those found in MWMU #2. Ten management-related failures were observed, four of which delivered sediment to streams. All failures observed occurred in concave headwalls and hollows where groundwater concentrates. Mass wasting potential hazard and delivery potential are rated Moderate for these sites within the mapping unit.

MWMU #4 occurs on very steep (>70%) slopes formed from stratified volcanic flow breccias, tuff, basalt and andesite flows similar to those found in MWMU #2 and MWMU #3. Stream-adjacent inner gorges with slopes greater than 40% are also included within this MWMU, but are not mapped. One inner gorge failure was observed. Presence or absence of High hazard inner gorge sites should be confirmed during project-level analysis. Four management-related failures were observed, two of which delivered sediment to streams. Failures occurred in both concave headwalls and planar slope locations. Less than 1% of the WAU exceeds 70% slope, and MWMU #4 has the highest rate of failure per unit area in the WAU. Mass wasting potential hazard and delivery potential are rated High for this mapping unit.

Delivered quantity of sediment from mass wasting was estimated for each failure and the total for each sub-watershed was tabulated, as shown in Table A-3 (Appendix A). Delivered volume for the WAU totaled 31,440 tons for the 35-year observation period, or 16.9 tons/mi^2/year. This compares to an estimated natural rate of 25.6 tons/year, and 6.5 tons/year contributed from roads (see Road Erosion section). Delivered mass wasting volume was substantial in the Courtney Creek and West Fork Brush Creek sub-watersheds, primarily due to the one debris torrent that occurred in each of these two sub-watersheds. Delivered mass wasting volume in all other sub-watersheds was minor.

Confidence In Work Products

Confidence in the work products for this analysis is moderate. Four sets of aerial photographs were reviewed, coverage was complete, and quality of the photography quite good. Additional sets of photography, including pre-1964 photography, may have allowed detection of additional failures and furthered our understanding of historical affects and trends. Volumes of the failures identified were estimated from the photos and are only approximate. Although mass failures could not always be detected in some areas due to presence of dense timber stands, additional failures were located and geomorphic relationships confirmed or established during the field investigations, including field inspection of 80-90% of the road mileage in the WAU. Most importantly, confidence is high that this WAU has a low level of mass wasting activity and that moderate to high hazards are limited to a relatively small area within the WAU.

Current Hillslope Erosion Conditions

The hillslope erosion analysis for the Calapooya WAU was conducted in accordance with the Surface Erosion module in the WFPB Manual and is based on field investigation and review of aerial photography.

Soil disturbance associated with forest harvesting can result in erosion and subsequent delivery of eroded materials (sediment) to streams. However, erosion and sediment delivery caused by harvesting only occurs under rather specific circumstances where 1) soils are disturbed, 2) disturbed soils are subject to overland flow and particle detachment (erosion), 3) eroded soil particles (sediment) are transported to streams without deposition onto the forest floor.

Soil Erodibility

The Natural Resources Conservation Service (NRCS) mapped the soils of the WAU on ortho-photography as part of the Linn County Soil Survey (USDA 1987). The NRCS identified at least 21 different soil series and numerous series phases within the WAU. The most prevalent soil types in the lower elevations of the WAU are the Clackamas, Coburg, and Courtney series, which are described as deep (approximately 60 inches in depth); the most prevalent soils in the higher elevations are the Bellpine, Nekia, and Peavine series, which are described as moderately deep (20-40 inches in depth).

Soil erodibility "K" factor for the soils found in the WAU fall almost entirely within the low (K < 0.25) and moderate (K = 0.25 to 0.40) erodibility classes (see Figure 3-4). The relatively low K factors indicate that these soils are generally not easily detached, or are moderately detachable. However, erodibility of many upland soils in the WAU is described by the county survey as moderate to high (see Figure 3-5), these interpretations being largely a function of slope steepness (see Figure 3-6). These soils are also subject to severe compaction and puddling. While we report the NRCS interpretations of soil erodibility, as suggested by the Washington watershed analysis procedures, we did not observe hillslope erosion within forest harvest areas, irrespective of the NRCS K factor and slope-based hazard ratings. Table B-1 (Appendix B) shows the area in each sub-watershed by slope class, K factor, and erosion potential rating.

Hillslope Erosion and Delivery

Much of the forested area of the WAU has been harvested in the last 50-70 years. Several areas have been harvested within the past three to five years, all of which are on private ownership.

Hillslope erosion and delivery were evaluated through a combination of aerial photo surveys and field site inspections. Examination of the most recent aerial photos (1995 color) revealed no evidence of gullying associated with recent logging. Five units harvested within the previous five years, some as recently as the spring or summer of 1998 (estimated), were field inspected (see Figure 3-6).[1] Most of these units were inspected during heavy continuous rainfall in November 1998. Sites geographically distributed throughout the WAU were sought so that a range of harvest, slope, and soil conditions were selected. This was achieved, although harvested sites were limited to private lands, which limited distribution to some degree. Sites were selected during mass wasting and road erosion field evaluations, because no recent aerial photos were available to allow pre-selection of sites. Selected areas were inspected for evidence of gully and rill erosion and subsequent transport and delivery of sediment to streams, the goal being to determine delivered hazard.

Three selected sites had been harvested with mechanical harvesters and two had been cable logged. Most of the sites that we inspected fell within areas mapped as high or moderate hazard according to the NRCS soil erodibility ratings. However, we observed very little mineral soil exposure (approximately less than 10 percent in all cases) in these logged sites, and no sediment delivery to streams. Sediment delivery did not occur for several reasons; soil disturbance was patchy and discontinuous, which limited initiation of overland flow and particle detachment. Patchy and discontinuous disturbance also allowed on-site infiltration of water, and sediment (had we observed any) would be expected to be trapped in undisturbed areas or disturbed areas having a high density of sediment trapping obstructions. Furthermore, although units observed were large clearcuts (approximately 30 to 80 acres), they were separated from potential receiving streams by unharvested areas and/or vegetated riparian zones approximately 20 to 75 feet in width. Sediment from diffuse sources seldom moves further than 50 feet across the forest floor where sediment trapping capability has not been depleted (Ketcheson and Megahan 1996).

Table B-2 (Appendix B) provides a summary of hillslope erosion field information. Most of the units inspected had minimal soil exposure. Regardless of logging method and silvicultural treatment, sediment delivery to streams was not observed from any of the harvest units inspected.

Hillslope Erosion Conclusions

Logging practices within the past five years have not contributed substantial amounts of delivered sediment to streams in the Calapooya WAU.

[1] Standard WFPB Manual procedures require evaluation of units harvested within the previous five years. Units harvested early in this period allow observation of effects following seasonal precipitation and runoff effects, but some disturbed areas may be obscured in areas revegetated. Units inspected late in the period allow observation of recent disturbance patterns absent vegetative regrowth.

Delivery of eroded material due to harvest activities was not observed. The erosion potential ratings from existing soil surveys are heavily based on slope steepness, but we did not observe hillslope erosion associated with logging, even on steep slopes.

Current Road Erosion Conditions

The road erosion and delivery analysis for the Calapooya WAU was conducted in accordance with the Surface Erosion module in the WFPB Manual and is based on extensive field investigation and review of aerial photography. The WAU (33,790 acres) was divided into seven sub-watersheds (Figure 1-5) for the Hydrology module; these same sub-watersheds were used to facilitate identification of significant sediment inputs from roads and are referred to throughout this chapter.

The majority of roads in the WAU are either paved or rock surfaced. State Highway 228 parallels the Calapooya River downstream from Holley. Sections of paved road run directly adjacent to stream segments along Courtney Creek, Brush Creek, and West Fork Brush Creek; sections of gravel road are also adjacent to East Fork Brush Creek. Several smaller paved roads are used by residents with homes and/or farms in the WAU. Most roads in the forested portions of the WAU are rock surfaced, and many are gated, and therefore receive little traffic outside of periods of active harvest, which are limited to specific times and locations. Unsurfaced roads have poor bearing strength when wet, and are subject to rutting, concentration of surface flows, and significant delivery of sediment to streams.

Background

It is a well established principle that while all roads generate erosion, only a portion of the road system actually delivers sediment to streams (Ketcheson and Megahan 1996; Megahan and Ketcheson 1996). Sediment is delivered to streams from forest roads in two ways: 1) "directly" via road ditches that drain directly into streams, and 2) "indirectly" via drainage structures where sediments are discharged onto forest slopes and where some portion of the sediment eventually reaches streams. In the case of direct delivery via road ditches, 100% of the eroded volume from the road cutslope, ditch, and portion of the road tread runoff contributing to the ditch is delivered to the stream system. In the case of indirect delivery, some or all of the sediment discharged from the road does not reach streams due to the filtering and sediment trapping effects of intervening buffer strips (Elliot, et. al 1997; Haupt 1959; Ketcheson and Megahan 1996; Megahan and Ketcheson 1996; Packer 1967).

Sediment Delivery Modeling

We applied the standard Watershed Analysis Version 3.0 methodology for modeling erosion and sediment delivery rates from roads. However, some of the standard assumptions are not appropriate for much of the road system in the Calapooya WAU. We therefore adjusted application of coefficients and the methodology as necessary for this Level II analysis.

The standard methodology examines the primary variables that affect the road and sediment delivery processes: traffic rates, surfacing materials, drainage design, and erodibility of soils based on the soil's geologic parent material. Coefficients for each of these primary factors vary relative to a standard "Reference Road." The Reference Road is insloped with a ditch, has native surface road tread and ditch, cutslope gradient of 1:1, fillslope gradient of 1.5:1, sustained grade of 5-7%, and average cross drain spacing of 500 feet. The proportions of the total long-term average road erosion rates attributed to the components of the standard road prism are: road tread - 40%; cutslope/ditch - 40%; and fillslope - 20%.

Standard coefficients for the Road Tread Surfacing Factor:

Native:	1.0
Gravel, 2-6" deep	0.5
Gravel, >6" deep	0.2
Dust oil:	0.15
Paved:	0.03

Standard coefficients for the Traffic Use Facto:

Mainline (heavy truck traffic)	20
Active Secondary (moderate truck traffic)	2
Inactive Secondary (light traffic)	1

Abandoned (no traffic) .02

Standard Sediment Delivery coefficients:

Direct Delivery (ditches running into streams)	1.0
Roads within 200 feet of streams	0.1
Roads further than 200 feet from streams	0

Rather than sampling selected road segments and extrapolating the results to the entire road system in the WAU (as suggested in the WFPB Manual), we evaluated road erosion at two types of potential delivery sites throughout the WAU: 1) we visited in the field every location where a road might be within 200 feet of a stream, and 2) we visited a sampling of locations where roads crossed streams. We believe this survey to be an improvement over standard procedures, because: 1) it allows complete verification of delivery from stream-adjacent road segments, and 2) it provides more accurate quantification of delivery from road crossings, which is where the majority of road sediment delivery occurs.

During our field inspections, we found that many road segments in the WAU do not fit the description of the Standard Road; this is particularly true for roads on the gentle slopes and valley bottoms of the lower elevations in the WAU. For many of the road segments in these areas, there are little or no cuts and fills, and in many cases roads were either crowned or outsloped without a ditch. Rather than apply the standard assumption coefficients of 0.40 for road tread, 0.40 for cuts and ditches, and 0.20 for fillslopes to road segments where they clearly were inappropriate, we estimated the appropriate weighting coefficient for each road prism component as proportional to the width of that component, i.e., we estimated the average widths of road tread, cutslope, and fillslope for each road segment and calculated coefficients for each component as the percentage of area occupied by that component.[2]

We also adjusted application of the delivery coefficient for stream-adjacent segments. Rather than assume 10% delivery from any road segment within 200 feet of a road, during our field inspections, we traced sediment plumes below cross drains to verify delivery to a stream channel. Several plumes were traced until we were confident that we were able to identify the general circumstances where sediment reached streams. If sediment from a cross drain was trapped prior to entering a stream, e.g., due to filtering vegetation and/or flat level ground in the intervening buffer strip, then we judged that there was no sediment delivery and assigned a delivery coefficient of zero to that segment. In most cases, we found that the sediments were deposited within 50 feet of the road tread, and rarely beyond 100 feet, even on steep slopes. This finding is consistent with research done in western Oregon by Brake, et al (1997), who found that sediment never traveled farther than 23 meters below culverts. All other stream-adjacent segments were assigned a delivery coefficient of 10%, because we judged that this was representative of the average conditions for those stream-adjacent segments that did exhibit evidence of sediment delivery to stream channels; these segments are tabulated in Table C-1 (Appendix C). This approach is consistent with research done in northern Idaho by Megahan and Ketcheson (1996), who found that on average, 90% of the total sediment volume was trapped in the buffer strip within 32 meters below culverts.

The WFPB Manual provides standard coefficients for cutslope and fillslope vegetative cover and rock. We estimated percent cutslope and fillslope cover for each road segment and then applied the standard coefficients in the standard way in the modeling.

Table B-5 of the WFPB Manual provides Basic Erosion Rates (in tons/acre) for various geologic parent materials for application in the road modeling. The rates in the WFPB Manual Table vary from a low of 10 to a high of 110 tons/acre. All upland soils in the Calapooya WAU are derived from volcanoclastic rocks that are highly weathered; these soils also have very high clay content, which makes them more resistant to detachment. Therefore, we used the Moderate Basic Erosion Rates from Table B-5 of the WFPB Manual: 30 tons/acre for roads greater than two years old, and 60 tons/acre for roads less than two

[2] WWA has conducted several Level II road erosion analyses employing this modification of the standard procedure, including analyses which have been peer reviewed by authors of the standard WFPB Manual procedure and approved per Washington's rigorous review process.

years old.

Road types are mapped in Figure 3-7. We applied the standard modeling procedures to each road segment that we evaluated. The detailed spreadsheet calculations are shown in Table C-1 (Appendix C). For stream-adjacent segments, Cut Delivery (in tons/year) is the product of Cut Width, Road Length, Basic Rate, Veg. Factor, and Delivery %. Fill Delivery is calculated in an analogous manner. Tread Delivery is also calculated in a similar fashion, with Tread Surface and Traffic Factors substituted for the Veg. Factor. Total Delivery for the segment is then the sum of Cut, Fill, and Tread Delivery. The contributions from each stream-adjacent segment were then summed for each sub-watershed, as shown in Table C-2 (Appendix C).

In the case of stream crossings, the delivery rate is 100% for that portion of the eroded volume that reaches the ditch, i.e., cutslope erosion and that part of the tread that drains to the ditch; the delivery rate is 10% for that portion of the eroded volume that delivers indirectly via the fill, i.e., fillslope erosion and that part of the tread that drains toward the fillslope. Therefore, for stream crossings, Cut Delivery (in tons/year) is 100% of the product of Cut Width, Road Length, Basic Rate, and Veg. Factor; Fill Delivery is 10% of the product of Fill Width, Road Length, Basic Rate, and Veg. Factor. The Tread/Traffic Rate (in tons/acre/year) is the product of the Basic Rate, Tread Surface and Traffic Factors. The Tread to Ditch delivery (in tons/year) is the volume of sediment that flows directly to the ditch (100% for insloped road, 50% for crowned, 0% for outsloped), that is, the product of Tread Width, Road Length, Tread/Traffic Rate, and Tread Delivery to Ditch %. The Tread Over Fill delivery (in tons/year) is the volume of sediment that flows toward the fill and delivers at a rate of 10%, that is, 10% of the product of Tread Width, Road Length, Tread/Traffic Rate, and one minus Tread Delivery to Ditch %. Total Delivery for each crossing is then the sum of Cut, Fill, Tread to Ditch, and Tread Over Fill Delivery.

The results for crossings were then subtotaled for each road type, and an average delivery per crossing (in tons/year) was calculated for each road type. The number of stream crossings were then counted and tabulated by road type and by sub-watershed. Multiplying the average delivery per crossing for each road type by the number of crossings of that road type and then summing across all road types yielded the total delivery from stream crossings within each sub-watershed (Table C-2, Appendix C). The sediment contributions from stream-adjacent road segments within each sub-watershed were then added to the sediment contributions calculated for crossings to arrive at a total road sediment delivery estimate for each sub-watershed.

Natural background rates of erosion were calculated using standard WFPB Manual procedures (see Table C-3, Appendix C). Soil creep rates were determined on the basis of slope. A soil depth of 1.5 meters was used in all sub-watersheds. For each sub-watershed, the total length of stream in the sub-watershed was first multiplied by 2 (two sides of the stream), then multiplied by the estimated soil depth and creep rate to yield an annual sediment volume. This annual sediment volume was then converted to an annual sediment yield and adjusted for the coarse fragment fraction to arrive at the annual fine sediment yield per unit area for each sub-watershed.

Table C-4 (Appendix C) summarizes the results of the road sediment modeling. Road sediment is compared to the natural background sediment rate by sub-watershed, per the WFPB Manual. Table C-4 (Appendix C) also shows several other road parameters of interest, including road density, number of stream crossings, and sediment per road mile.

Road Erosion and Sediment Delivery Results and Conclusions

The modeling and spreadsheet calculations reveal that road erosion and sediment delivery in the Calapooya WAU is relatively low in comparison to the natural background erosion rate (i.e., <50% of natural). The relative magnitude of road erosion and sediment delivery within each sub-watershed is shown in the last column of Table C-4 (Appendix C), % Increase factor. The road erosion increase factor for each sub-watershed is computed by dividing delivered road sediment by the natural background rate of erosion. Where the increase factor is less than 0.5, it receives a Low Hazard Rating, between 0.5 and 1.0 the hazard is Moderate, and when greater than 1.0 (road sediment exceeds natural sediment), the rating is

High. For increases of 50 to 100%, the effect of sediment within stream channels may be small, but chronically detectable (WFPB 1995). Increases exceeding 100% are likely to produce adverse affects on instream habitat characteristics and beneficial uses (exceed Washington state water quality standards) (WFPB 1995).

The road sediment increase factor does not exceed 0.5 for any of the sub-watersheds; the increase factor ranges from 0.20 (in West Fork Brush Creek) to 0.37 (in the Western Tributaries). All sub-watersheds, as well as the entire WAU, therefore receive a hazard rating of Low. This result is due in part to the relatively large proportion of road miles in the WAU that are either paved or graveled; 76% of all stream crossings occur on paved or graveled roads.

It is interesting to compare our road surface erosion findings to those reported by Weyerhaeuser Company for the Calapooya River basin and its subbasins upstream of our WAU, including their "Lower Calapooya" subbasin that partially overlaps our WAU. Weyerhaeuser (Stark, et al, 1998) report natural background rates of subbasin erosion of 13.5 to 29.8 tons/mi^2/yr for the Lower Calapooya subbasin, which compares quite closely to our finding of 25.6 tons/mi^2/yr for the Calapooya WAU. Weyerhaeuser reports increases in sediment delivery from roads of up to 80% above natural, with the least increase, 22%, reported for the Lower Calapooya. We found a 25% increase in sediment delivery from roads in the Calapooya WAU.

Two particular sections of road deserve special attention. In the northeast quarter of Section 28, T14S, R2W, there is a section of gravel road that is significantly rutted and gullied, although it appears this section of road receives little traffic, and does not deliver sediment. Another road segment running north to south near the eastern boundary of Section 23, T14S, R2W is native surface and is severely rutted with water running down the road tread. This road segment does deliver sediment to a tributary of Courtney Creek; it should also at least be water barred, possibly culverts installed and/or closed to traffic.

Confidence in Work Products

Road erosion and sediment delivery rates used in this analysis are based on the standard WFPB modeling procedures (WFPB 1995). While simplifications, averages, and generalized coefficients are relied upon heavily within the methodology, we believe that the approach is basically sound. Several Level II adjustments to the standard procedure were also applied to more realistically represent local road sediment delivery circumstances; consequently, confidence in the predicted quantity of total delivered road sediment is moderate. Furthermore, we field-inspected 100% of all stream-adjacent road segments and 12% of all stream crossings. Therefore, confidence is high that we correctly identified circumstances where roads have high sediment delivery potential, and that we correctly identified the important road erosion and sediment delivery sources.

The increase factors rely on estimates of natural background rates of erosion and also on the Basic Erosion Rates for roads. While we carefully developed the estimates for each of these rates based on the standard WFPB Manual methodology, the absolute accuracy of either method is unknown. Our confidence in the estimates for the increase factors is no greater than moderate; however, confidence is moderately high that we correctly identified the relative degree of road erosion and delivery in relation to natural rates of erosion within each sub-watershed.

Soil Productivity and Resiliency

Productivity of the soils in the WAU is high. Douglas-fir site index values are provided for each soil series mapped within the WAU (USDA 1987), as displayed in Figure 3-8. Site index values range from 115 to 180, and fall within site classes 1 and 2. Acreage by site index and class is summarized for the WAU in Table 3-2.

As mentioned in the Surface Erosion discussion, nearly all of the WAU was clearcut harvested 40 or more years ago, and many areas have now been logged a second time. Both logging and silvicultural practices have changed substantially between these entries.

Slopes throughout most of the WAU are relatively gentle (Figure 3-6). During the first entry, gentle and moderate slopes as steep as 50% were tractor logged. Soil disturbance, removal of soil surface horizons, compaction, and subsequent erosion

TABLE 3-2

Soil Timber Productivity

Douglas-fir Site Index	Site Class	Area (acres)
0 *	II	9,488
115	II	534
120	II	1,126
130	II	2,473
subtotal		13,621
140	I	103
145	I	2,174
150	I	5,112
155	I	4,554
160	I	4,041
165	I	1,281
180	I	2,904
subtotal		20,169
Total		33,790

* Non-forest lands

have caused substantial loss of soil productivity, particularly where skid trails were excavated. Effects in these areas can be expected to persist for decades. Although these areas are recovering, impacts on the most heavily disturbed surfaces can be expected to persist for several more decades. Even on gently sloped areas where trails were not excavated, first-entry old-growth tractor logging typically resulted in deep soil disturbance and persistent loss of productivity. The proportion of the WAU affected by these first-entry tractor logging effects might be on the order of ten percent of the WAU, but the actual measure is unknown.

First-entry cable logging, typically by high-lead, occurred on the WAU's steeper slopes, found primarily in the headwater areas. Although some soil disturbance and soil compaction is known to be associated with high-lead logging, the proportion of area affected and the degree of the effects are far less than that caused by tractor logging, and as a result, soil effects are less persistent, such that early cable logging effects would be difficult to detect.

Recent logging and silvicultural techniques are far different from first logging-entry methods. Cable logging is now being used on much gentler slopes, and mechanical harvesting is being used in most of the areas originally tractor logged. Trees logged are much smaller and equipment is typically operated on top of logging slash, thereby minimizing soil effects. Furthermore, site preparation methods that disturb or severely burn the soil were not observed for recent activities. Soil compaction, disturbance, and erosion are limited in these recent activities, and persistent effects are not expected.

Summary of Erosion Process and Soil Quality Effects

Road-related sources of surface erosion sediment are relatively low (< 50%) compared to natural watershed rates of erosion for all sub-watersheds in the WAU. Mass wasting erosion associated with management is also relatively low for the WAU, with the exception of locations where debris torrents have occurred, i.e., Courtney Creek and West Fork Brush Creek sub-watersheds. Failures have occurred in association with both roads and harvest in steep areas. Mass wasting hazards are confined to specific areas on steep slopes. Steep slopes occupy only 3.2% of the WAU. Hillslope erosion is not a substantial source of delivered sediment from forest lands to streams in the WAU, and no soils in the WAU were noted as being particularly sensitive to current harvest practices relative to surface erosion processes. Areas cleared for agricultural and rural uses may contribute substantial quantities of sediment to streams in the lower elevations of the WAU where these uses are prevalent, but no attempt was made in this analysis to quantify any such contributions.

Long-term productivity of forest soils has been decreased primarily where soils have been deeply disturbed by excavated skid trails and/or heavily used trails, both associated with historic logging practices. Soil compaction and direct loss of surface soil horizons were the primary effects. Harvest methods and restrictions applied in current logging operations will have less impact, and soil recovery rates will be more rapid.

3.3 HYDROLOGIC CHANGE

Issues and questions to be examined in this assessment include:

- What are the dominant hydrologic (flow) characteristics in the watershed (i.e., peak flows, minimum flows, total discharge)?
- What are the current watershed conditions influencing hydrologic response?
- What is the influence of land use on runoff during storm events that generate peak flows?
- What are the effects of changes in runoff on flood peaks?
- How have the amount, timing, and delivery of water, sediment, and wood changed?

Reference Conditions

The reference condition for this WAU is fully forested, subject to periodic wildfires of low severity and low extent. Wildfires may have resulted in overland flow in some areas of the WAU, resulting in elevated peak flows. Wildfire-induced rain-on-snow flood effects were minimal due to the low elevation of the WAU (see Current Conditions fully-harvested results). This Current Conditions section is a comparison to the fully forested reference.

Current Conditions

This report presents the findings of a Hydrologic Conditions Assessment for the Calapooya (WAU) conducted according to the Washington Forest Practices Board Standard Methodology for Conducting Watershed Analysis, Version 3.0 (WFPB 1995). The purpose of the Hydrologic Conditions Assessment is to evaluate the affects of forest cover removal on peak flows in the WAU.

This analysis addresses the key questions through discussions of the following topics: summary of current watershed conditions, review of large peak flows and low flows, modeling of peak flow increases caused by mid-winter rain-on-snow (ROS) events, hazard calls, conclusions, and confidence in work products.

Overview

The fundamental underlying assumption of the Washington hydrologic analysis procedure (WFPB 1995) is that the greatest likelihood of cumulative changes in forest hydrologic processes is due to increases in peak flows attributable to the influence of timber harvest on snow accumulation and melt rates during rain-on-snow (ROS) events.

The WAR analysis provides a means of estimating the magnitude of changes in water available for runoff (WAR) that are likely to be produced by rain-on-snow conditions for various levels of hydrologic maturity and for various flood recurrence intervals. For this analysis, we applied the basic WFPB Manual procedure using local climatic data to estimate values for the processes which generate WAR, including storm rainfall, snow accumulation, and snow melt. WAR estimates were then used to estimate peak flows.

We modeled a range of conditions under which ROS-generated WAR might occur. Each scenario represents a particular combination of three conditions: precipitation amount, storm type, and the hydrologic maturity of vegetation in the drainage. Precipitation amounts used in this and assessment are the 24-hour totals for the 2, 5, 10, 100-year return intervals. Two storm intensities were considered: an “average” storm, representing a typical ROS event; and an “unusual” storm, representing a less frequent, more intense event. Three vegetation cover conditions were considered: “fully-forested,” representing the reference conditions; the “current” condition, representing the present day distribution and composition of land use and cover types; and “clearcut,” representing removal of all forest canopy cover.

Estimation of the WAR requires addition of the estimated 24-hour snowmelt to the 24-hour precipitation amount for a given return interval. The snowmelt was determined by simulating a 24-hour storm event occurring over a modeled snowpack, taking into consideration the effects of forest cover on snow accumulation and wind speed. Snow accumulates to greater depth in open forests than it does under dense canopy cover, and snow melts faster in open forests during ROS conditions due to greater wind speeds over the snowpack.

Flood frequency analysis is a method of estimating flood magnitudes at selected recurrence intervals. Regional flood frequency relationships have been developed by the USGS for western Oregon, which relate streamflow for various recurrence intervals to drainage basin characteristics. These flood discharge estimates are baseline flood magnitudes, to which we must add the additional flood volume predicted to occur as a result of the melted snow component of WAR during ROS conditions. To do this, we followed standard WFPB Manual procedures to develop regression equations that correlate peak flows, as predicted by the USGS regional equations, to 24-hour storm precipitation. Finally, peak flows for each forest cover and meteorologic scenario were estimated by substituting the 24-hour WAR values (in place of precipitation) into these regression equations.

Sub-watershed Assessment Units

The Calapooya WAU was divided into 7 sub-watersheds (Figure 1-5). The Eastern Tributaries and the Northwestern Tributaries sub-watersheds include lands adjacent to the Calapooya River and a number of small streams that drain directly to the river. Similarly, the Western Tributaries contain several small streams that drain to Courtney Creek outside of the WAU. For this reason, the modeling results are somewhat difficult to interpret, but they provide an idea of general peak flow conditions in this area.

Current Watershed Conditions

Current vegetation conditions in the WAU are shown in Figure 1-6. Descriptions of each map unit can be found in Section 1.4. Table D-1 (Appendix D) summarizes vegetation condition by rain-on-snow potential zone by sub-watershed, and a summary of this information for the entire WAU is presented in Figure D-1 (Appendix D).

Streamflow and Climatic Records

The Calapooya River had been continuously gauged at Holley beginning in 1935, but this station was discontinued by the USGS in 1987. The Calapooya River was also gauged at Albany from 1940 to 1981. Two other nearby gauging stations are located to the northeast of the Calapooya WAU on the South Santiam River at Cascadia and at Waterloo. The highest flow of record at three of these stations occurred in December 1964; the highest flow on record at Albany occurred in December 1955. Other large peak flows at these stations occurred in December 1945, February 1961, and January 1972. The region also experienced a large, widespread storm in November 1996, but since no streamflow records exist in or near the WAU for this time period, no peak flow comparisons can be made. Mean daily discharge at all four gauges tends to be highest in the months of December and January.

The lowest flows recorded for the Calapooya stream gauges occurred in the month of September; the extreme low flows for the South Santiam gauges were recorded in the months of October and December. Mean daily discharge at all four gauges tends to be lowest in the months of August and September.

Streamflow data is not reported for tributaries within the WAU. Mean annual and peak flows are likely to be proportionately similar to those reported for the Calapooya River. Low flows may be proportionately much lower due to numerous diversions and withdrawals, particularly from Calapooya Creek and Brush Creek, the two largest tributaries in the WAU.

Rain-on-Snow Modeling

The standard methodology (WFPB 1995) was used to model the effects of forest cover removal on peak flows during mid-winter rain-on-snow events. It should be noted, however, that it is probably quite rare that significant mid-winter rain-on-snow events occur, because the majority of the WAU is below the elevation of the primary rain-on-snow zone. The reference condition for this analysis is the "fully forested" condition. For more information on the model, its assumptions, and its input parameters, the reader is referred to the WFPB Manual (WFPB 1995).

Model inputs

Vegetation conditions were modeled using vegetative seral stage information shown in Figure 1-6. These vegetation condition categories were grouped into three Hydrologic Condition categories (mature, intermediate, immature) based on their ability to intercept snow and reduce wind at the snow surface. For each Hydrologic Condition category, a forest canopy cover factor (F_c) was assigned according to the standard methodology (see Table 3-3).

For "usual" winter conditions, a wind speed of 4 m/s was used, which is the wind speed that is exceeded 50% of the time, as recorded at representative weather stations in the area during mid-winter storms. Values used by Stark, et al., (1998) as used in a watershed analysis for Weyerhaeuser Company for the Calapooya River immediately upstream of the Calapooya WAU, were confirmed and used in the WAU. For the "unusual" modeled condition, the 16% exceedance value of 7 m/s was used, also consistent with the Weyerhaeuser analysis.

The western Washington generalized regional temperature lapse rate equation (as provided in the Standard Methodology) was modified by adding 2.7°C to the relationship indicated in the WFPB Manual; this was based on information obtained from Weyerhaeuser Corporation (Stark, et al. 1998), and reflects the generally warmer climate in southwestern Oregon versus western Washington. This relationship was then used to calculate a storm temperature for each precipitation zone. For the "unusual" modeled condition, one standard error (assumed to be 2°C) was added to the modeled temperature for each precipitation zone.

Average storm:T (°C) = 12.7 – 0.006 E

Unusual storm:T (°C) = 14.7 – 0.006 E

(E = elevation in meters)

Rain-on-snow potential zones were determined by elevation based on the general procedures of Brunengo, et al., (1993) consistent with information obtained from Weyerhaeuser Corporation (Stark, et al. 1998); these zones are shown in Figure 3-9.

The NOAA Atlas (Miller, et al. 1973) was used to determine the 24-hour precipitation intensity for various recurrence intervals for the WAU (see Table D-2, Appendix D).

Average snowpack on January 1 was calculated for snow survey sites located at Daly Lake, Hoggs Pass, Jump-Off-Joe, Marion Forks, McKenzie, and Santiam Junction. This data was then used in a

TABLE 3-3

Hydrologic Condition Class and Forest Canopy Density for each Vegetation Cover Type.

Vegetation Cover Type	Hydrologic Condition	Modeled Canopy Density, F_c
Mature/old growth	Mature	0.85
Mid/late seral stage	Mature	0.85
Early seral, 7-20 years	Intermediate	0.40
Early seral, 0-6 years	Immature	0.05
Hardwood	Immature	0.05
Non-forest	Immature	0.05

linear regression to obtain SWE as a function of elevation (see Figure D-2, Appendix D). For "unusual" conditions, one standard error of the estimate was added to the calculated SWE.

To translate Water Available for Runoff (WAR) in the model to a resultant discharge, the Standard Methodology was used. This approach requires calculation of flood magnitudes of various return intervals for each sub-watershed (see Table D-3, derived from Harris, et al. 1979). A linear regression is then run for flood magnitude versus 24-hour precipitation of the corresponding recurrence interval (see Table D-4, Appendix D). This same input versus output relationship is then used to translate the "enhanced" WAR (from rain-on-snow) into streamflow. The USGS predictions of discharges for each sub-watershed are summarized in Appendix D.

Results

The results for the ROS model simulation are presented in Table D-5 (Appendix D). The first portion of each table deals with predictions of Water Available for Runoff (WAR) for each recurrence interval for each sub-watershed. The data are summarized for a fully forested condition, the current condition, and for a completely clearcut condition. In the lower part of each table, predicted discharges for each recurrence interval are calculated for each sub-watershed. As with WAR, the discharge calculations are presented for the fully forested, current, and fully clearcut condition. Percentage increase calculations above a fully forested condition are shown for the current condition and the fully clearcut condition.

In this simulation, three sub-watersheds (Lower Brush Creek, Northwest Tributaries, and Western Tributaries) did not generate WAR values in excess of the 24-hour precipitation. This resulted because these sub-watersheds do not include any area in the ROS elevation zone; therefore, within the simulation, there is no snow to be melted from the Lowland and Rain Dominated zones, irrespective of forest vegetative condition.

Four sub-watersheds generated WAR in excess of the 24-hour precipitation; these were higher elevation sub-watersheds with at least some area in the rain-on-snow zone: Courtney Creek, East Fork Brush Creek, Eastern Tributaries, and West Fork Brush Creek.

The predicted increase in peak flow for the current condition (both average and unusual storms) was essentially zero (< 0.2%) for any sub-watersheds that had a response (Table 3-4). The most responsive sub-watershed was Courtney Creek; this is to be expected, since it has the highest percentage of its area within the higher elevation rain-on-snow precipitation zone. With regard to the fully clearcut condition, predicted increases in discharge ranged from 0% to 3.5% for the average storm, and 0% to 7.3% for the unusual storm.

TABLE 3-4

Hydrologic Modeling Results for Average Storm and Current Vegetative Conditions

Sub-watershed	**% Increase in Peak Flow**			
	Recurrence interval			
	2-year	5-year	10-year	100-year
Courtney Creek	0.1%	0.1%	0.0%	0.0%
East Fork Brush Creek	0.0%	0.0%	0.0%	0.0%
Eastern Tributaries	0.0%	0.0%	0.0%	0.0%
Lower Brush Creek	0.0%	0.0%	0.0%	0.0%
Northwest Tributaries	0.0%	0.0%	0.0%	0.0%
West Fork Brush Creek	0.1%	0.0%	0.0%	0.0%

Western Tributaries	0.0%	0.0%	0.0%	0.0%
Calapooya WAU	0.0%	0.0%	0.0%	0.0%

Hazard Calls

The Washington watershed analysis methodology assumes that there are no adverse effects for peak flow increases of up to 10%. This is assumed because of the inherent error in the modeling, and because changes in peak flows less than 10% are typically below the detection limits using standard stream gauging techniques. All sub-watersheds in the Calapooya WAU, as well as the entire WAU as a whole, have predicted increases in peak flows of less than 10% for all modeled scenarios. Therefore, all sub-watersheds have been assigned a low sensitivity to peak flow increases.

Conclusions and Discussion

Mid-winter rain-on-snow conditions are not a dominant peak flow triggering mechanism in the Calapooya WAU. The most likely runoff triggering mechanism in the Calapooya WAU is rainfall occurring during large frontal storms coming off the coast.

With regard to mid-winter rain-on-snow events, the Courtney Creek sub-watershed was most sensitive because it has the greatest percentage of area in the ROS zone. Predicted increases in streamflow for the 2-year event (fully clearcut vs. fully forested condition) were 3.5% for the average storm and 7.3% for the unusual storm.

Under all modeling scenarios, current vegetation conditions produced essentially no predicted increases in peak flows. The lack of response of all sub-watersheds to timber harvest is explained by the proportionally small amount of each sub-watershed that is in a hydrologically immature condition.

Amount, timing, and delivery of water, sediment, and wood from the forested parts of this WAU have not changed appreciably from the reference condition due to forest management effects on peak flows. Compaction of road surfaces generates overland flow of water on these surfaces, which in turn transports sediments to streams within the WAU. However, delivered volume of sediment within the forested areas of the WAU is relatively low in all sub-watersheds. Although surface runoff from roads changes the normal flowpaths of forest slope runoff to some degree, effects on peak flows within this WAU large enough to affect stream processes are unlikely due to limited length of road that discharges water to the stream network (see Section 3.2 Current Road Erosion Conditions). Substantial hydrologic changes have occurred in the lower elevations of the WAU, closest to the river, where tributaries are largest (and most sensitive). The reference condition for these areas is forest. Deforestation and water withdrawals has had major effects on routing of water, sediment and wood within nearly all streams entering the river or otherwise flowing from the WAU (i.e., Courtney Creek).

Low flow volume and total water yield in streams draining the forested portions of the WAU are likely to exceed quantities that would be produced in the theoretical fully forested condition. All studies of forested watersheds have demonstrated small increases in low flows and water yield, with only two exceptions that are relevant to the WAU. Decreased low flows have been observed for several years following clearcutting of riparian areas followed by dense regrowth of riparian hardwoods, and decreased low flows have been recorded following old-growth harvest in watersheds subject to heavy fog and low cloud cover, conditions not common to the Calapooya WAU. Seasonal low flow and water yield to the Calapooya River are diminished by irrigation of agricultural lands and other uses in the non-forested portions of the WAU.

One additional issue deserves special attention. During the course of field work for the road erosion assessments, during a moderately intense storm of several days duration, a few locations were observed where culverts were apparently too small; water was ponded above the top of the pipe inlet and was becoming backed up upstream of the pipe. These locations were in the East Fork of Brush Creek and are noted in Figure 3-7.

Confidence in Work Products

Caution should be used with regard to the results of the peak flow analysis. The sensitivity of the modeling results to input parameters and the assumptions inherent in the modeling do not lend themselves to a high degree of confidence in the absolute magnitude of the predictions. However, this model does represent a fairly simple tool for obtaining information on the relative potential for forest cover removal to increase peak flows.

Summary of Hydrologic Changes

Amount, timing, and delivery of water, sediment, and wood from the forested parts of this WAU have not changed appreciably from the reference condition due to forest management effects on peak flows and runoff regimes. Due to its low elevation and small area within primary zones of mid-winter snow accumulation, the WAU is insensitive to harvesting effects on peak flows. Surface runoff from roads in the WAU large enough to affect stream processes is unlikely. Low flows are decreased in the lower elevations of the WAU due to diversions for irrigation and domestic uses. Current effects on low flows (i.e., increases) in forested parts of the WAU are likely to be immeasurably small. Future conditions and management effects for both peak and low flows are expected to be minor.

3.4 WATER QUALITY

Issues and questions to be examined in this assessment include:

- What are the current water quality conditions? How does water quality in the watershed compare to State water quality standards?
- How and where are the beneficial uses affected?
- Where in the watershed and on BLM lands do erosion processes (mass wasting, hill slope erosion, road-related erosion) have the greatest potential to deliver sediment to stream channels or other water resources?

Reference Conditions

It is assumed that nearly all Oregon Department of Environmental Quality (DEQ) water quality criteria were met throughout the WAU during most pre-disturbance conditions. However, water temperature likely exceeded the standards within the river and within tributaries at lower elevations even under full canopy closure, the prevalent reference condition. Suspended sediment and turbidity would have been periodically high during storm and flood events large enough to initiate channel scouring and/or mass wasting. Major fires periodically caused surface erosion, mass wasting, and channel erosion sequences, and substantial effects on many water quality parameters, including temperature, suspended sediment, turbidity, pH, dissolved solids, dissolved oxygen, nitrogen and phosphorus.

Current Conditions

The Calapooya River from Albany upriver to Brush Creek is on the Oregon Department of Environmental Quality (DEQ) 303(d) list for water temperature and fecal coliform. Contributing factors to warm water temperature are low elevation and associated warm air temperature, and removal of mainstem shade. With exception of increased water temperature, these water quality conditions are unrelated to forest management practices within the WAU, and are reported to be mostly associated with agricultural and waste discharges occurring in the lower 35 miles of the river, downstream of the WAU (Cude 1998). Primary sources of fecal coliform include municipal point source discharges and agricultural non-point sources.

Water quality data reported for the WAU is limited (see Table E-1, Appendix E). The Oregon DEQ reports water quality data for limited dates of observation for three years, 1972, 1974, and 1975, for the Calapooya River at Holley, at Crawfordsville, and at Brownsville (just downstream from the WAU). No data is reported for any of the tributaries within the WAU. Stark, et al., (1998) report limited turbidity and stream temperature data for locations within or adjacent to the WAU. In addition to data collected within the WAU, Calapooya River water quality has been monitored at River Mile 3 near Albany beginning in 1972. The Albany data combined with the limited observations from within the WAU is adequate only for general characterization of water quality conditions.

The Calapooya at Albany monitoring site is located approximately 40 river miles downstream of the WAU. Drainage area at the site is approximately three times that of the Calapooya upstream of and including the WAU, and most lands between the WAU and Albany are agricultural. Water quality is considered seasonally poor for fecal coliform, biochemical oxygen demand, nitrate and ammonia nitrogen, total phosphates, and total solids. High summer water temperatures contributing to eutrophication are also reported (Cude 1998). In a watershed assessment of the Calapooya River basin upstream of the WAU, Weyerhaeuser Company examined the DEQ Albany dissolved oxygen, pH, fecal coliform, and water temperature data (Stark, et al. 1998). They report that water temperature and dissolved oxygen commonly exceed the Oregon water quality criteria seasonally from late June through October, and that pH remains within standard (see Table E-2, Appendix E).

Water quality data are reported by the DEQ for a total of six dates at Holley and at Crawfordsville, and a total of eight dates at Brownsville, for the four year period 1972 through 1975 (Table E-1, Appendix E). These data are insufficient for statistical analysis, including computation of meaningful averages. However, the data do confirm that water temperature and dissolved oxygen concentration excursions do occur during summer months. Suspended sediment data were not reported by the DEQ for these stations.

Stark, et al., (1998) report turbidity data for the Calapooya River within and upstream of the WAU. Turbidity was sampled during a single late-spring 1998 storm and was found to increase in the downstream direction. Turbidity increased from 3.4 NTU just upstream of the WAU to 7 NTU at Holley, 9 NTU at Crawfordsville, and 12.6 NTU at Brownsville, just downstream of the WAU.

Stark, et al., (1998) also report water temperature data for the mainstem Calapooya River, which was also found to increase in the downstream direction, with temperatures increasing from 18.3^{0}C at the “Upper Calapooya” site to 25.9^{0}C at the “Lower Calapooya” site located at the upper end of the WAU (exact locations not reported).

Although water quality data are not reported for tributaries of the river within the WAU, some general characterizations and conclusions are warranted. Stream shade is nearly absent along extended reaches of Courtney Creek, and high water temperatures are a certainty. Although exposure of Brush Creek is not so severe, it also is sufficient to cause warm water temperatures. Although forest road systems do not discharge a large quantity of sediment to streams within the WAU, occasional high suspended sediment concentrations and turbidity may occur. As streams pass through disturbed and deforested soils at lower elevations, sediment concentration and turbidity are expected to increase. Because Courtney Creek discharges into the river several miles downstream of the WAU, and because the size of the WAU and of the tributary watersheds within the WAU are small in comparison to the watershed of the Calapooya River at tributary confluences, tributary effects upon the river would be difficult to detect even with intensive monitoring methods.

Water quality effects related to forest management are limited to stream temperature and sediment. Removal of shade due to past harvest of riparian stands contributes to increased temperature of all fish-bearing streams within the WAU. Temperatures within the river are elevated due to natural exposure of river water surfaces, and due to removal of riparian vegetation both within and upstream of the WAU. Fish rearing and spawning capability may be impaired by high temperatures. Forest land headwater stream temperatures are expected to decrease in future years as riparian shade is reestablished and left undisturbed. Temperatures within the river and mainstems of tributaries within the WAU will depend on reestablishment of riparian shade on rural and agricultural lands, which is uncertain. Elevated sediment delivery associated with forest management in the WAU is currently low. Recently adopted more restrictive riparian management practices and decreased rates of road construction and associated surface and mass wasting sediment should further reduce future effects from both private and Federal lands throughout the WAU. Violations of Oregon water quality standards related to sediment from forest lands have not been reported within the WAU, and none are expected.

Water Rights

A total of 136 water diversions are currently granted within the WAU (see Table E-3, Appendix). The greatest number of diversions occur from the Calapooya River, with additional diversions from Brush Creek, Courtney Creek, and other unnamed tributaries. A number of wells also exist in the WAU. The majority of the diversions are for irrigation purposes, with some diversions for livestock watering and domestic water supply.

3.5 STREAM CHANNELS

Reference Conditions

Lowland channels prior to human-caused effects and development were set in a fully forested environment. All channels were well shaded by dense canopies of mixed hardwood and conifer forest. Large woody debris (LWD) in these channels is inferred to have been abundant. Channels likely were less entrenched than they are today and likely flowed through extensive wetland complexes, which have long since been drained and eliminated to facilitate agricultural uses. Lowland channels are very low gradient and were not subject to debris flow scouring events. Streambanks were predominantly stable, but episodes of streambank scour likely occurred in association with major floods and wildfires.

The Calapooya River was also bordered by dense stands of mixed conifers and hardwoods, the latter predominantly oaks. LWD may have been moderately plentiful along stream margins, but likely was uncommon at mid-channel locations due to the large size of the river and its high degree of natural channel entrenchment. Streambanks were stable, although episodes of bank failure occurred during floods. Substrates were dominated by boulder, cobble, and gravel, much as they are today.

Current Conditions

All streams were classified according to two systems: 1) Washington state Source, Transport, and Response reaches (Figure 3-10), and 2) Rosgen system (Figure 3-11). Stream length for each class in the Washington system is summarized by sub-watershed in Table F-1 (Appendix F); Table F-2 contains similar information for the Rosgen classification system. Channels within the WAU, particularly the main tributary reaches at the lower elevations near the Calapooya River, have changed significantly from reference conditions.[3]

The channel in those sections of the Calapooya River that are highly entrenched is much the same today as in the reference condition. More alluviated and less constrained reaches, most common in the western reaches of the river within the WAU, may have become less stable, and with fine particles more common. Log drives and channel clearing early this century removed habitat complexity. Large and medium sized conifers and hardwoods border most reaches, but width of this vegetative band is typically too narrow to provide high LWD recruitment or shade approximating naturally occurring density.

All tributary channels in the WAU, with one exception - Pugh Creek at the extreme eastern margin of the WAU - flow through lands cleared for agriculture, grazing, or rural homesite uses. Lowland tributary streams, particularly Courtney Creek, have been purposefully simplified and channelized to accommodate agricultural uses and to prevent flooding. These channels are classified as response reaches in the Washington methodology, but do not function as such due to channelization; they are not classified per the Rosgen system. Even where not channelized, riparian forest has been cleared from nearly all reaches of the main tributaries for much of their length until they reach steeper slopes maintained as forests. Riparian vegetation is typically young and occurs only in narrow bands in these areas. Grazing and devegetation of channel banks cause severe streambank erosion in many areas.

Stream channels within forested areas are stable. Few stream miles have been affected by scouring debris flows, and none have been affected within the past 30 years. Landslide effects of any form are infrequent. Fines content of channel substrates may be elevated above natural levels, but likely is decreasing, given much improved current practices. However, substrate data have not been recorded for streams in the WAU. Riparian vegetation is much changed from the reference condition. Nearly all channels are now bordered by relatively small stands of mixed conifer and alder/maple hardwoods. As a result, shade, LWD, and LWD recruitment potential are

[3] Interpretation of management and input process effects (water, sediment, wood, thermal) is largely a process of watershed Synthesis, and is the end-point product of most watershed analyses. This Calapooya Watershed Assessment is limited to Federal Guide steps 1 through 4, and does not include steps 5 and 6, Synthesis and Management Recommendations. Because the Synthesis step is not included, discussion within this Channels section is limited to that which is provided.

typically low to moderate.

3.6 TERRESTRIAL RESOURCES

Key issues and questions addressed in this section include:

- What is the array and landscape portion of plant communities and seral stages in the watershed? What processes cause those patterns?
- What are the current conditions, historic array, and trends of the prevalent plant communities and seral stages in the watershed?
- What role does the watershed play in providing conservation or recovery of wildlife, especially as it relates to the BLM Eugene District's Resource Management Plan (RMP) and the Northwest Forest Plan (NFP) Strategy?
- Listed are most of the species and/or habitats of concern in the Calapooya watershed area: bald eagle, northern spotted owl, peregrine falcon, big game, red tree vole, Oregon megomphix/ papillose tail-dropper/ blue-gray tail-dropper, Oregon slender salamander, indigenous bat communities, forest fragmentation, mature and old-growth timber habitat, riparian habitat, refugia/inoculum habitat, and standing dead tree and coarse woody debris conditions.

The role of the watershed in providing conservation or recovery of wildlife will be addressed during Synthesis and Interpretation. Answers to other key questions are presented in terms of reference and current conditions in the following assessments: vegetation, special status plants, noxious weeds, wildlife habitat, and listed wildlife species.

<u>Reference Vegetation Conditions</u>

Prior to the settlement of the region by non-native Americans (prior to 1850), fire was the major disturbance factor affecting vegetation patterns. Wildfires at that time had been variable with the mean fire interval approximately 50 to 60 years with fires being of low severity and small extent. One notable exception, is that during pre-settlement, native Americans used fire on a much more frequent basis to maintain grasslands and oak woodlands in the major river valleys. During the settlement period (1850-1910), fires occurred in the region more frequently, but were even smaller and lower in severity than during the pre-settlement period (Weisberg 1998).

Figure 3-12 presents general vegetation existing in the Calapooya WAU around 1914. Table 3-5 summarizes these vegetation classifications by the current ownership pattern. Acreages reported include rights-of-way within these major ownership categories. This vegetation pattern reflects the fire regime discussed above as well as the emergence of timber harvesting as a disturbance factor in the WAU. According to this data set, the WAU was predominantly forested with merchantable timber covering approximately 25,550 acres (roughly 76% of the WAU). Based on current stand ages of relic forest islands characterized within the BLM's Forest Operations Inventory, it is reasonable to assume that stand ages of merchantable timber in 1914 were in the 80 to 200 year old range (i.e., mature). These stands were likely representative of the western hemlock plant community described by Franklin and Dyrness (1973).

TABLE 3-5

Acreages of 1914 Vegetation Classifications by Ownership Category

Vegetation Class	Total Acres	BLM		Private Industrial		Large Private		Small Private	
		Acres	%	Acres	%	Acres	%	Acres	%
Non-Timber Areas	8240	451	5	1682	20	5181	63	926	12
Merchantable Timber	25550	7225	28	11208	44	6503	25	614	3

Total	33790	7676	23	12890	38	11684	35	1540	4

Non-timbered land (totaling about 8,240 acres) occurred primarily at lower elevations resulting from the conversion to agricultural land uses, though some upper elevation non-timber land is recorded, most likely as the result of logging in the upper sub-watersheds. It is noted that terrain in the lower elevations may have also included wetlands prior to this conversion. This vegetation pattern occurred at higher proportions on what is now Large Private and Small Private ownerships. On BLM-administered lands, only 6% of non-timbered lands existed. Overall, this historic vegetation pattern provides evidence of the early stages of the conversion of the Calapooya WAU to agricultural and timber production in the lower elevations of the WAU land uses starting at the turn of the century.

After the turn of the century, timber harvesting and land conversion activities increased and represented the major vegetation disturbance factors in the WAU. Figure 3-13 presents general vegetation existing in the Calapooya WAU around 1936. Table 3-6 summarizes these vegetation classifications by the current ownership pattern. Non-forest acreage increased by about 4,250 acres to roughly 12,448 acres, representing an increase of about 50% over 1914 levels. The emergence of a significant second growth component is also evident, with about 5,381 acres logged since settlement, approximately 1,064 acres of which had been characterized as "recent" logging activity.

Mature and old-growth stands cover most of the WAU, though this component decreased by about 9,579 acres to a total of approximately 15,971 acres in 1936. On BLM-administered lands, these vegetation categories accounted for about 86% of their current ownership. Any second growth forest on current BLM lands existed on private lands prior to their acquisition or reversion to the BLM. Overall, the timber base still comprised the major vegetation category in the WAU in 1936, however, the vegetation pattern demonstrates a sustained reduction and fragmentation of forested land during the early part of this century.

Current Vegetation Conditions

The vegetation pattern first presented in Section 1.4 and Figure 1-6 represents the current conditions in the Calapooya WAU. Table 3-7 summarizes these vegetation classifications by the current ownership pattern. Since 1936, timber harvesting and land conversion activities have been the dominant vegetation disturbance factors. Timber harvesting has focused primarily on mature and old-growth stands, further reducing this component to approximately 1,295 acres. Even-aged silvicultural methods predominated, fragmenting seral stage conditions in the WAU. A significant second growth component resulted, representing the majority of the WAU (about 23,416 acres). The remainder of the WAU is in a non-forest or hardwood situation covering approximately 9,078 acres, or roughly 3,500 acres more than was reported for 1936. This decrease in non-forested acreage is due to reforestation of what are likely lower quality agricultural lands. It should also be noted that some of this agricultural non-forest land has been converted to rural residential non-forest land. Overall, this current condition reflects a land use that is primarily comprised of timber production, agricultural, and rural residential uses.

TABLE 3-6

Acreages of 1936 Vegetation Classifications by Ownership Category

Vegetation Class	Total Acres	BLM		Private Industrial		Large Private		Small Private	
		Acres	%	Acres	%	Acres	%	Acres	%
Non-Forest	12438	196	2	1756	14	9208	74	1278	10
Recent Harvests	1064	262	25	428	40	369	35	5	<1
Small Second Growth	4317	629	15	2561	59	928	21	199	5
Large Second Growth	10552	3712	35	5633	53	1174	11	33	1

Old-growth	5419	2877	53	2512	46	5	<1	25	1
Total	33790	7676	23	12890	38	11684	35	1540	4

TABLE 3-7

Acreages of Current Vegetation Seral Stage Classifications by Ownership Category

Vegetation Class	Total Acres	BLM		Private Industrial		Large Private		Small Private	
		Acres	%	Acres	%	Acres	%	Acres	%
Non-Forest	8690	139	2	301	3	7172	83	1079	12
Hardwoods	388	0	0	2	<1	385	100	1	<1
Early Immature	4424	55	1	3796	86	549	12	24	1
Early Intermediate	2717	904	33	1018	37	752	28	43	2
Mid / Late	16275	5543	34	7526	46	2813	17	393	2
Mature / Old-growth	1295	1035	80	247	19	13	1	0	0
Total	33790	7676	23	12890	38	11684	35	1540	4

Forested land conditions occur in greater proportions on BLM-administered land and private industrial timberland. Conversely, over 90% of non-forest and hardwood conditions are found on non-industrial private land. On BLM-administered lands, about 72% is in a mid to late seral stage and 13% is mature or old-growth. On Private Industrial lands, about 58% is mid to late seral. Based on historical data, it is estimated that approximately one-third to one-half of this mid/late category is approaching maturity in the next ten years. The remaining seral stages, early immature and intermediate, occur in greater proportions on Private Industrial lands reflecting the recent cutting history. Only about 12% of BLM-administered lands express early seral characteristics. Overall, this vegetation pattern reflects the ecology, disturbance history, and management objectives for these ownerships.

Figure 3-14 and Table 3-8 provide details regarding forest stand structure on BLM-administered lands as characterized by the Forest Operations Inventory. Most importantly, it provides greater detail for interpretation and management of stand conditions on a land use allocation basis. The predominant vegetation classes, (pole timber and small sawtimber, 5 to 11" DBH and 11 to 21" DBH, respectively), are more or less proportionally allocated among land use allocations. Further, these vegetation classes are evenly divided between mid seral conditions (pole timber) and late seral conditions (small sawtimber). Riparian Reserves also have a proportional size class distribution, most likely because this land use allocation is more or less systematically distributed throughout BLM-administered lands. Most significant, however, is that about 75% of mature and old-growth conditions (large sawtimber, 21"

TABLE 3-8

Acreages of BLM Stand Size Classes by BLM Land Use Allocation

Stand Size	Total Acres	Matrix – GFMA		Matrix – Connectivity Blocks		District Designated Reserves		Riparian Reserves	
		Acres	%	Acres	%	Acres	%	Acres	%
Non-Forest	164	76	46	27	17	2	1	59	36
Seedling / Sapling	519	358	69	13	2	0	0	148	29
Pole Timber	2981	1582	53	351	12	67	2	981	33

Small Sawtimber	2945	1254	43	404	14	101	3	1186	40
Large Sawtimber	1067	267	25	206	19	275	26	319	30
Total	7676	3537	46	1001	13	445	6	2693	35

DBH and above) occur in Connectivity Blocks, District Designated Reserves, and Riparian Reserves. Conversely, about two-thirds of early seral stage conditions (seedling/sapling, 0" to 5" DBH) occur on General Forest Management Area. Overall, this distribution of vegetation within the BLM lands reflects the management history and management objectives of these land use allocations.

Figure 3-15 and Table 3-9 provide some details regarding forest age structure on BLM-administered lands as characterized by the Forest Operations Inventory. This provides greater detail for interpretations of wildlife habitat based on stand age, especially for distinguishing between mid (about 21 to 50 years) and late (51 to 80 years) seral stages. Other categories reflect seral stages reported above. Similar to these stand size classes, age classes are more or less proportionally allocated among land use allocations. The most significant result is that this age distribution exhibits a greater proportion of relatively younger stands (21 to 50 years) than was reflected by the pole timber size class reported above. This is reflective of relatively higher site quality in the Calapooya WAU which accelerates stand development. Consequently, the stand size distributions reported above may more representatively report potential habitat conditions (e.g., potentially mature) than age distributions. This finding is consistent with observations made during field reconnaissance and aerial photo interpretation. Overall, this age distribution within BLM lands reflects the management history and stand development capacity of this property.

Finally, it should be noted that little, if any limitations to timber productivity or disturbance due to windthrow, disease, or insect infestation has occurred in the WAU to the extent that they affect vegetation patterns. Based on discussions in earlier sections and review of the Timber Productivity Capability Classifications for the WAU, no significant conditions exist that indicate fragile problems and/or reforestation problems. Based on field reconnaissance, no catastrophic windstorms have been observed to have influenced the WAU. Furthermore, where as insects such as beetles and diseases such as root rots are known to exist in the WAU, there is no evidence from field reconnaissance or stand records to suggest these disturbance factors have directly or indirectly influenced vegetation patterns. Overall, timber productivity and operability are relatively favorable for the WAU as a whole.

TABLE 3-9

Acreages of BLM Stand Age Classes by BLM Land Use Allocation

Stand Age	**Total Acres**	**Matrix – GFMA**		**Matrix – Connectivity Blocks**		**District Designated Reserves**		**Riparian Reserves**	
		Acres	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Non-Forest	140	62	45	27	19	2	1	49	35
0 to 6 years	23	13	57	0	0	0	0	10	43
7 to 20 years	923	566	61	45	5	0	0	312	34
21 to 50 years	5319	2540	48	654	12	169	3	1956	37
51 to 80 years	223	106	48	69	30	0	0	48	22
80+ years	1048	250	24	206	20	274	26	318	30
Total	7676	3537	46	1001	13	445	6	2693	35

Reference Wildlife Habitat Conditions

Table 3-10 lists terrestrial wildlife species addressed in this watershed analysis. Reference conditions for habitat in the WAU are depicted on Figure 3-13, which shows acres of seral vegetation In 1936. Although timber harvesting and other human activities in the WAU began much earlier, 1936 was chosen to represent "reference" conditions because aerial photographs taken in 1936 allowed vegetation to be interpreted and mapped. Table 3-6, presented earlier, provides acreage summaries using classes that roughly correlate to current seral classifications.

TABLE 3-10

Terrestrial Wildlife Species Addressed in Calapooya WAU

Common Name	Scientific Name	Status	Presence
Bald Eagle	*Haliaeetus leucoceophalus*	FT	K
Peregrine Falcon	*Falco peregrinus*	FE	U
Northern Spotted Owl	*Strix occidentalis caurina*	FT	K
Great Gray Owl	*Strix nebulosa*	SM	U
Roosevelt Elk	*Cervus elaphus roosevelt*	Game	K
Black-tailed deer	*Odocoileus hemionus*	Game	K
Mountain Lion	*Felis concolor*	Game	K
Black Bear	*Euarctos americanus altifrontis*	Game	K
Red Tree Vole	*Phenacomys longicaudus*	SM	K
Silver-haired bat	*Lasionycteris noctivagans*	BT	S
Long-legged myotis	*Myotis volans*	BT	S
Western long-eared myotis	*Myotis evotis*	BS	S
Yuma myotis	*Myotis yumanensis*	BT	S
Fringed myotis	*Myotis thysanodes*	BT	U
Sharptail snake	*Contia tenuis*	BA	U
Clouded salamander	*Aneides ferreus*	BA	S
Oregon slender salamander	*Icaricia icarioides fenderi*	BS	K
Northern red-legged frog	*Rana aurora*	BT	U
Oregon megomphix	*Megomphix hemphillii*	SM, BS	K
Papillose tail-dropper	*Prophysaon dubium*	SM, BS	K
Blue-gray Tail-dropper	*Physaon ceruleum*	SM, BS	U
Fender's blue butterfly	*Icaricia icarioides fenderi*	BS (p)	U
Siskyou chloealtis grasshopper	*Chloealtis aspasma*	BS (p)	U
Potentilla root-borer beetle	*Chrysobothris potentillae*	BT	U
Beer's false water penny beetle	*Acneus beeri*	BS (p)	U

Key

Status:
FT = Federal Threatened
FE = Federal Endangered
BS = Bureau Sensitive
BT= Bureau Tracking Species
BA= Bureau Assessment Species
SM = Survey & Manage
Game = Game Species
(p)= provisional status

Presence:
K = Known
S = Suspected
U = Uncertain

In 1936, 21,117 acres in the WAU were forested. The mid/late seral stage comprised the largest forest type in 1936. Mature/old-growth stands comprised roughly 5,420 acres. A large amount of non-forest land (12,431 acres) existed along with a substantial (5,144 acres) early seral stage component.

Although fire has the potential to affect wildlife habitat, its effects were not substantial in 1936. Only about 235 acres of land in the WAU appear to have been deforested by fire.

Snags

Snag densities are greatly influenced by the timber harvest history of the WAU. Under reference conditions, there would have been more snags because more of the forest would have been old-growth. As the level of timber harvest increased, snag numbers in the WAU decreased at a rate proportional to the removal of mature and old-growth forest. Past timber harvest practices often resulted in removal of snags to reduce danger of snags falling on workers. Ecological values of snags and other commercially non-useable forest products were not widely known or reflected in logging practices in the early part of this century.

Large Woody Debris

Large woody debris (i.e. logs, stumps, and large branches) can account for as much as half the organic matter in old-growth Douglas-fir forests (Sollins et al 1987). In advanced stages of decay logs provide germination sites and nutrients for forest vegetation. Logs and other debris also provide habitat for wildlife and modify stream hydrology and fishery habitat.

Like snag density, amounts of large woody debris is associated with timber harvest history of lands in the WAU, fire history, exposure to wind, and pathology associated with insects and fungus (Spies et al 1988). Amounts of woody debris drop significantly in the first years following fire, and gradually increase to maximum levels until the stand is about 500 years old. After 500 years, recruitment of woody debris in Douglas-fir stands levels off and decline due to reduced density of trees and greater proportion of trees that decay more rapidly. Fallen Douglas-fir logs remain on the ground for nearly 200 years, whereas other species such as hemlock, red cedar, and fir decay more rapidly (Spies et al 1988).

Typically, past timber harvest resulted in removal of trees and burning of debris not suitable for wood products. Woody debris levels on logged land are below minimums encountered under natural conditions. Clear cutting removes about 90% of the live stem volume and the remaining 10% is composed of small debris that decomposes rapidly. Because there were more un-logged forests under reference conditions, larger volumes of large woody debris were present on the forest floor than under existing conditions. Clear-cut logging and slash burning has reduced large woody debris on the ground and standing dead material that would become large woody debris.

Trends in recruitment of large woody debris in Douglas-fir stands tend to parallel stand age. Douglas-fir produces approximately 80% of the large woody debris in stands up to 600 years old but comprises only 63% in stands older than 600 years (Spies et al 1988). Because stand age (hence production of woody debris) is directly related to timber management, trends will depend on future management direction. If management allows a larger proportion of the WAU to develop into old-growth stands, more large woody debris would eventually develop.

Habitat Connectivity

Relative amounts and interspersion of plant communities in the WAU has been influenced by road construction, timber harvest, urban/suburban development, and conversion of wetlands and deciduous woodlands to agricultural land. Timber harvest has altered the canopy structure, species composition, and seral ecology of forested land, and the use by wildlife species with affinities for specific types of habitats (e.g., old-growth and wetlands). Conversion of oak forest and conifer stands to agricultural and urban/suburban land uses have removed vegetation on lowlands and riparian areas of major streams (Calapooya River and Courtney Creek).

Habitat connectivity between the Willamette valley and Calapooya watershed has been fragmented by conversion of oak woodlands, wet meadows, and grassland to agricultural and urban/suburban land uses. Wildlife species that frequented the Willamette valley and lowlands of the Calapooya watershed (e.g, white-tailed deer and Roosevelt elk) have been eliminated from lowlands within the WAU. Habitat for elk now is composed of conifer forests and non-forest areas at higher elevations in the WAU. There are few habitat linkages that allow elk to use low-elevation meadows, grassland, and remnant patches of Oregon white oak woodland.

Habitat for relatively immobile species (e.g., amphibians, mollusks, and reptiles) has been reduced throughout the WAU. Large clear-cut areas, high road densities, and widely separated patches of habitat have tended to isolate relatively immobile species. Reduced size of habitat patches has also reduced the potential for special habitats (e.g., old-growth or oak woodland) to support high levels of biodiversity. In general, the larger the size of a block of habitat, the more species the block can support over the long term. Conversely, small, isolated patches of habitat have low potential to support biologically diverse communities.

Road Density

Road density in the WAU was lower in 1936 than today. Most roads in the forested portions of the WAU have been constructed to provide access to timber. As timber harvest acreage has increased, road densities on both BLM and private lands have also increased.

In recent years, more management emphasis has been placed on reducing active road density. It is likely that more roads will be closed and revegetated on BLM lands, whereas on private lands timber will need to be accessible for regular cutting cycles. Because road systems, currently in place, provide adequate access to most of the timber resources in the WAU, it is likely that road densities will remain at current levels on private lands and decrease on BLM lands.

Current Wildlife Habitat Conditions

Mature and old-growth forest, are seasonally critical to Roosevelt elk, black-tailed deer, spotted owls, pileated woodpecker, Vaux's swift, goshawk, great gray owls and other species because of structure, thermal characteristics, nesting/denning sites, production of forage, and security. Approximately 5% of the WAU supports mature or old-growth forests. Of these forest types, 260 acres are on private and 1,035 acres are on BLM land (Table 3-7). Within the mature/old-growth forest, 644 acres are composed of trees over 21 inches in diameter with dense canopies (over 70 percent canopy closure) (Figure 3-14).

Mature and old-growth forests have the highest densities of large snags, important habitat for birds, bats, and small mammals. Woodpeckers are an especially important group that depends on snags and large trees. Cavities at the base of snags also provide dens for black bears, porcupines, and bobcats.

A dominant influence on wildlife and wildlife habitat in the WAU has been timber extraction. Clear-cut logging has largely determined age of forest stands and ecological characteristics (e.g., canopy closure, production of understory shrubs and herbaceous species, interspersion of habitats, size of habitat patches, tree size, density of snags, density of downed woody material, and road density). In general, most wildlife species find primary breeding habitat in grass-forb or shrub stages of ecological succession (15-20 years old) or in large sawtimber or old-growth (Raphael 1990). Closed-canopy sapling and pole stands support the fewest species and the lowest density of species.

The most significant change, from a wildlife perspective, in forest composition between 1936 and the present has been a decrease in mature/old-growth forest (Table 3-7). Currently, there are 1,295 acres of mature/old-growth forest (5% of all forested lands) in the WAU (1035 acres of BLM land and 260 acres of private). In 1936, there were 5,419 acres of mature/old-growth forest in the WAU (2,877 acres on BLM land and 2,542 acres on private land) (Table 3-6).

The largest forest component on both BLM and private lands in 1936 was the mid/late seral stage, 3,712 acres on BLM lands, and 6840 acres on private lands. This seral stage has increased on BLM and private lands to current levels of 5543 and 10,732 acres, respectively. About 65% of all forest lands in the WAU are mid/late seral stages, habitats that tend to be sub-optimal for most wildlife species.

Because land management practices on private land in the WAU are directed toward timber production, mature and old-growth forest habitats, are limited on private lands (i.e., 260 acres of mature/old-growth forest) (Table 3-7).

Snags

The RMP specifies that sufficient numbers of snags be retained for nesting of at least 40% of population for cavity-nesting species. Data for populations of woodpeckers and other cavity nesters in the WAU have not been collected; therefore, it is not known how many snags would be necessary to provide minimum habitat for 40% of cavity nesters. However, surveys by Maxim Technologies (See Appendix G) indicate that snag densities in the WAU are substantially below levels that are optimum for cavity-using birds and mammals. Two strata were chosen for this survey, based on field reconnaissance. Given their clear deficiency of snags, early and mid/late seral stage stands were aggregated into one stratum. Mature/old-growth stands represented the other stratum. Snag survey locations are presented in Figure 3-16.

The U.S. Forest Service and BLM (1998) cite studies that indicate 4.34 snags per acre greater than 15 inches DBH provide 100 percent of nesting needs for primary cavity excavators (i.e, woodpeckers). These snag densities are based on only the need for nesting habitat and do not include foraging habitat. In addition, these calculations do not take into account the numbers of snags required by bats, Vaux's swift, and other cavity-dependent species.

The U.S. Forest Service and BLM (1998) refer to studies that indicate that snag densities vary from 6.5 per acre (>16 inched dbh) at pileated woodpecker nesting sites to 16 per acre (>20 inches dbh) in stands used by Vaux's swift. These agencies cite other studies that suggest that snag densities of 6-15 large (>25 inches) and 6-20 small (9-24 inches dbh) per acre are required to maintain an abundant and diverse cavity-using bird community. Recent snag surveys performed for this WAU analysis found that snag density was highest in mature/old-growth stands, with a total for all sizes and decay classes of 10.3 snags per acre (Table 3-11). Of this total, 2.6 snags were 15 inches in diameter or larger. Snag density in all other seral stages was 1.4 snags per acre, with snags larger than 15 inches in diameter having a density of 0.3 snags per acre. Most snags (60%) are in the oldest, softest decay classes, optimum foraging habitat for some species of woodpecker. About 40% of all snags have less decay and, consequently, are harder. Raw data for these snag surveys are found in Appendix G. Given the low densities observed in these stands, variances associated with these samples were high indicating a large sample size requirement to achieve reasonable confidence. Nonetheless, these findings provide a meaningful representation.

Based on forest inventory data, areas with the highest potential to produce large snags in the future are shown as mature/old-growth forest on Figure 1-6. Approximately 1,035 acres of forest on BLM land has high potential to produce snags over 15 inches in diameter. Within Riparian Reserves, Connectivity Blocks, and District Defined Reserves, total area with mature/old-growth forest is 800 acres (see Table 3-8).

TABLE 3-11

Snag Densities (Snags/Acre) and Decay Classes for Mature/Old-growth Stands

Snag Size	Decay Class 1	Decay Class 2	Decay Class 3	Total(sd)
<11 in.	0.1	2.7	3.8	6.6
11 - 15 in.	0.01	0.4	0.7	1.1
15 + in.	0.2	0.7	1.7	2.6 (12.0)
Total	0.3	3.8	6.2	10.3 (119.3)

Key
Decay Class 1 – Trees that have recently died
Decay Class 2 – Snags that have been dead for several years and have lost some bark and branches
Decay Class 3 – Snags that have been dead a long time and lack branches and bark

Large Woody Debris

The RMP for the Eugene District also specifies that management of general forest areas retain 240 feet of logs per acre that are greater or equal to 20 inches in diameter. Large, downed woody material provides habitat for small mammals, invertebrates, mollusks, amphibians, birds, and other wildlife. Although surveys have not been completed on lands throughout the WAU, it appears from reconnaissance studies that large woody debris on the forest floor is deficient in all seral stages except for mature and old-growth. On BLM land, 644 acres have trees 21 inches in diameter or larger, with canopies of 70-100 percent (Figure 3-14). Stands of large trees with dense canopies have the greatest potential to produce snags and large, downed logs in the near future.

Habitat Connectivity

Interspersion and connectivity of habitats are factors that affect the degree of genetic exchange among populations and utilization of suitable habitat. Ideally, spatially isolated patches of optimum habitat need to be linked with suitable habitats to allow adequate dispersal of species across the landscape.

To enhance connectivity of habitat, some BLM lands have received special management status. Land management designations that help compensate for extensive removal of mature and old-growth forest by providing dispersal connectivity linkages include: Connectivity Blocks, Bald Eagle Habitat Areas, Areas of Critical Environmental Concern, and Research Natural Areas. Figure 1-7 shows lands designated and managed to provide important late-successional habitat and landscape connectivity within the WAU. Approximately 3,138 acres have a primary management objective to enhance habitat connectivity for species associated with late-successional stages, 1,001 acres are to be managed on an extended 150 year rotation while maintaining 25% of the 'best' habitat in large blocks for interior forest habitat, and 3,537 acres are managed as General Forest Management areas.

Riparian Reserves enhance habitat connectivity, especially for relatively mobile species (e.g., spotted owls and other birds, elk, and deer) whose habitat has been fragmented by logging and agriculture. Figure 3-1 shows lands designated as riparian reserves. Approximately 2,693 acres of BLM land are allocated to this land status. Table 3-8 shows acreage of habitat components on BLM land in designated riparian reserves.

Road Density

A significant feature of timber harvesting in the WAU has been construction of roads. Roads directly destroy habitat and render adjacent habitat less suitable for species and individuals that are displaced by vehicular traffic and other human activities. Roads reduce habitat effectiveness by increasing ecotones (i.e., edge areas between habitats) and can inhibit movement of some species between patches of habitat. As presented earlier, there are about 48 miles of roads on BLM land and 166 miles of roads on private land. Road density within the WAU is about 4 miles of road per square mile (see Appendix C, Table C-4). The road density goal for BLM land in the WAU is 1.5 miles of road per section.

Bald Eagle (*Haliaeetus leucocephalus*)

Characterization

Relative abundance and distribution of species

Historically, bald eagles were found in every state and Canadian province, and portions of northern Mexico, but their range and population numbers were reduced dramatically beginning in the early 1900's and accelerating in the 1950's and 1960's, primarily due to habitat loss and the effects of DDT (Clark et al. 1989). Numbers have since recovered somewhat, and the bald eagles are now relatively common throughout much of their former range (DeGraaf et al. 1991). There has been a slow recovery of bald eagles in the Pacific Northwest, and wintering populations appear to be stable or increasing (DellaSala 1989). Occupied nest sites in Oregon have increased from less than 25 in 1971 to more than 350 in 1998 (Isaacs and Anthony 1998).

Bald eagles are winter residents that roost and forage in the western portion of the Calapooya WAU (Figure 1-7). Wintering bald eagles are attracted to carrion from domestic sheep operations (DellaSala et al. 1989). This food source is critical to wintering eagles because other prey species (e.g., waterfowl and fish) are not plentiful in the Calapooya WAU during winter. DellaSala et al. (1989) found that domestic sheep carcasses and afterbirth composed 93.3% of winter bald eagle diets based upon composition of eagle castings collected at roost sites. Small mammals and rodents composed the remainder of their diet.

The Habitat Management Plan for Bald Eagle Winter Sites in the Coburg Hills and the Willamette Valley, Western Oregon (DellaSala1989) listed three confirmed roosting areas and one confirmed and one suspected staging area in the Courtney Creek vicinity, and labeled this the Courtney Creek Complex. The core roost area, known as Area D, was located in the northeast quarter of Section 21, T 14S, R2W. It is located on a northeast aspect hillside with 20- 30% slopes between 680 and 1000 feet in elevation. Numerous large (>40 inch DBH) Douglas-fir more than 200 years old occur in the area, along with several tall snags with lateral branches. Understory plants are dominated by vine maple, red alder, western red cedar, big-leaf maple, Oregon grape, and salal. During the winter of 1988-1989 up to 23 eagles used this site (DellaSala 1989). During wintering bald eagle surveys conducted in early 1998, this site was not surveyed (Schreiber 1998). No explanation is given why this site was not surveyed in 1998 though nine years previous it had been designated as the core roost within the Courtney Creek Complex.

The confirmed roosting and staging site designated Area A in the Habitat Plan (DellaSala 1989) was located on a knoll in the southeast quarter of Section 15, T14S, R2W, at approximately 900 feet elevation. The forest is primarily 45-year-old second-growth Douglas-fir 10 to 15 inches DBH. Roost trees are taller than average Douglas-firs, protrude above the canopy, and have lateral crown and branches suitable for roosting. The most suitable roost trees are located on southeast and northeast aspects with 40 to 50% slopes.

The third confirmed roost area in the Courtney Complex is Area D (DellaSala 1989). It is located in the southeast quarter of Section 21, T14S, R2W.

Much of the forest in the area is second-growth 10-15 inch DBH Douglas-fir interspersed with a hardwood understory. Several large (>20 inch DBH) big-leaf maples and Douglas-fir (26 inch DBH) are distributed along a ridge in the area. In addition there were two large trees, a 37 inch DBH western red cedar and a 105 inch DBH Douglas-fir, that dominated the ridgeline.

Area B is located on private land in the northeast quarter of Section 20, T14S, R2W. The site is characterized by early succession hardwoods with a conifer understory on a northeast aspect with 40 to 50% slopes. A few larger Douglas-firs, including one 35 inch DBH, protrude from the canopy and were sometimes used by staging and roosting eagles in 1988 and 1989(DellaSala 1989).

A suspected staging area, designated Area C, was identified between Sections 19 and 20, T14S, R2W. The vegetation at the site was not discussed by DellaSala (1989).

In 1997, surveys in the Courtney Creek drainage indicated that 30 to 46 bald eagles roosted in the area during peak periods (January and February). The highest numbers of roosting bald eagles used the Courtney Creek drainage. Of the 287 bald eagles observed in the Eugene District during a three-month period in 1997, 182 (63%) eagles were counted at Courtney Creek. There appears to be a slight upward trend in numbers of bald eagles in recent years (Bill Dean pers. comm. with Rebecca Goggans 1995).

In 1998, no wintering bald eagles were observed roosting in Section 15 (Site A) and only two were observed roosting at Area R in Section 22 (Schreiber 1998). According to Schreiber (1998) the roost site in Section 15 has a history of intermittent, low to moderate use by eagles.

Habitat description and distribution

Bald eagles are closely associated with bodies of water in forests, mountains and prairies containing abundant fish resources, though they also feed on waterfowl and other birds, small-to medium-sized mammals, and carrion (DeGraaf et al. 1991).

Roost and nest sites are important habitat components. They use large trees, preferably snags, but also live trees, or rock outcrops and boulders adjacent to water for perching. These sites are usually isolated from human activities, and have good visibility and access (DeGraaf et al. 1991, Reel et al. 1989). Nests are usually built in the top one-third of large living or dead-top conifers or cottonwoods, generally near water, that provide shade and nest support (Reel et al. 1989). If suitable trees are not available they may nest on rocky ledges, cliffs, or pinnacles (Reel et al. 1989). Bald eagles return to the same nest year after year, usually adding new material annually.

In Oregon, the majority of nests are located within one mile of lakes, reservoirs, large rivers, and coast estuaries. Nest trees are larger, dominant or co-dominant trees in the stand and are usually components of old-growth or late seral forests (Harper 1998).

Current and Reference Conditions

Current habitat condition and trend

Communal roost sites in the Courtney Creek drainage and surrounding Coburg Hills generally are in the tallest, oldest Douglas-firs in remnant old-growth and mature forest patches. Eagles also use conifer stands and individual trees and snags as staging areas while traveling to roost sites (DellaSala 1989). The portion of "Bald Eagle Habitat Area" delineated in Section 15 (Figure 1-7) is an important communal roost site in a mature/old-growth Douglas-fir stand. Other roost sites are depicted in Section 21, also in mature/old-growth Douglas-fir stands. Staging areas (i.e., sites where eagles perch between foraging and roosting areas) are depicted in Section 20. The majority of roosting sites in sections 15 and 20 are on BLM lands; however, extensive timber harvesting on adjacent private land has substantially reduced the density of suitable perching and roosting sites in the general area. According to Dean et al (1997), the Calapooya WAU contains 461 acres of Bald Eagle Habitat Areas (BEHAs), of which only 39 acres are suitable habitat. Seventy-six percent of the BEHAs are dominated by trees younger than 81 years. Protection and management of the BEHA's for old-growth forest characteristics will result in a greater percentage of larger-diameter trees and snags, increasing the potential for roosting sites in these areas. Habitat trend on adjacent private lands will probably be toward continued management for timber production, and subsequent early-to-mid succession forests, on forest lands.

Seral vegetation in BEHAs is mostly mid/late (346 acres), mature/old-growth (113 acres), with small areas of early immature and non-forest land (about 3 acres). Although a relatively large proportion of BEHAs is composed of mature/old-growth forest, all of this is not suitable habitat based on studies by Dean et al. (1997).

The only mature-to-old-growth stands located relatively near the valley bottom on federal lands that were not identified as a BEHA are located in the north half of Section 13. No eagles have been recorded staging or roosting in this area to date, but if this stand is managed for large-branched trees and snags, it could conceivably be used in the future. Other mature-to-old-growth stands that have been identified on federal lands in the WAU are probably too far from foraging areas to be used by wintering eagles.

Historic relative abundance and distribution of species

Bald eagles were reported to be common in the Willamette Valley in the mid-nineteenth century (Gabrielson and Jewett 1940), but conditions had changed by 1936 because of intensive logging on public and private lands. There is no information on historic abundance and distribution of bald eagles in the Calapooya WAU. It is not known if wintering bald eagles inhabited the WAU in 1936 or if they were attracted to carrion related to sheep ranching.

Historic relative condition and distribution of habitat

The Willamette Valley consisted of a mosaic of grasslands, oak savannas maintained by fire, and conifer forests interspersed with wetlands, lakes, and ponds during the time of early white settlement (Towle1979, Boyd 1985). High populations of elk, white-tailed deer, and waterfowl provided abundant prey and carrion for bald eagles (DellaSala et al. 1989). By 1936 the Willamette Valley and the Calapooya WAU had been dramatically altered by intensive logging and agriculture. There is no direct documentation, but if wintering bald eagles were present in the Calapooya WAU in 1936, they probably were dependent on old-growth trees and large snags for perching and roosting. This habitat was more extensive in 1936 than it is today; however, it is not known if an adequate winter food base was present in 1936 to attract and retain bald eagles in the WAU. It is possible that there were ponds and wetlands throughout the Calapooya lowlands, which would have supported prey species including waterfowl. Without an adequate food base nearby, it is doubtful that wintering bald eagles would perch and roost in the WAU.

Peregrine Falcon (*Falco peregrinus*)

Characterization

Relative abundance and distribution of species

Though probably never abundant, peregrine falcons once ranged throughout North America in appropriate habitats. Numbers were drastically reduced during the 1950's and 1960's due primarily to the effects of DDT, and they were considered extirpated throughout much of their former range. Due to the curtailment of the use of DDT and an active re-introduction program, their populations are recovering.

There are no records of peregrines currently inhabiting the Calapooya WAU. Suitable habitat may be seasonally used by migrants.

Habitat description and distribution

The peregrine falcon inhabits open habitats from prairie to alpine tundra, including open forested habitats, specializing on avian prey including waterfowl, shorebirds, and a wide variety of passerines (Dobkin 1992). It prefers areas where there are rocky cliffs and ledges overlooking rivers, lakes, and other water areas where there is an abundance of prey (DeGraaf 1991). Breeding pairs prefer to nest on high cliff ledges, where they lay eggs in an open scrape in the soil (Reel et al. 1989). Pairs usually return year after year to the same site (DeGraaf et al. 1991).

There are no known peregrine falcon nest sites within the WAU; however, a survey of potential peregrine falcon nesting sites (BLM file information) indicates that marginally suitable nesting sites may be present in the Horse Rock Research Natural Area (Figure 1-7), in the northwest portion of Section 1. There are cliffs about 64 feet high and 450 wide in a series of rocky meadows, surrounded by forest. The cliffs are probably marginal nesting habitat because they can be accessed by mammalian predators and are generally lower than preferred peregrine nest sites.

Foraging habitat occurs within the WAU where small birds, favored prey of peregrines, can be most easily captured. Peregrines prefer to hunt in open areas where they can isolate potential prey from escape cover (Skaggs and Skaggs 1979). Agricultural fields and greater amounts of open water on private land in the northern portion of the WAU may provide better foraging opportunities for peregrines because of greater access to prey species (passerine birds, shorebirds, and waterfowl). Early seral forest stands throughout the WAU could also be used by foraging peregrines.

Current and Reference Conditions

Current habitat condition and trend

There is very little potential nesting habitat (high cliffs) in the drainage, and that is unlikely to change. Open foraging habitat for migrating or dispersing individuals is distributed throughout the drainage and will change over time as stands mature and others are harvested. The adoption of alternate silvicultural methods that leave more standing trees in a harvest unit could impact the availability of open foraging habitat in forested areas. The lowland area along the Calapooya will likely remain open agricultural areas, though the abundance and availability of water, and associated prey species, may change with changing agricultural practices.

Historic relative abundance and distribution of species

There are no long-term data for occurrence, abundance, and distribution of peregrine falcons within the WAU. It is unlikely, however, given the scarcity of nesting sites (steep cliffs over 100 feet high) and open hunting areas, that peregrines nested or frequently hunted in the WAU in 1936. They may have been transient visitors to the WAU during migration or as dispersing juveniles.

Historic relative condition and distribution of habitat

Habitat conditions for peregrine falcons were probably similar in 1936 to those existing today. There may have been more wetlands and ponds in the bottom of WAU drainages, which would have provided more potential high-quality foraging habitat, but there is no information to support this assumption.

Northern Spotted Owl (*Strix occidentalis caurina*)

Characterization

Relative abundance and distribution of species

The northern spotted owl is resident from southwestern British Columbia south through western Washington and Oregon, into northwestern California (Wilcox 1990, DeGraaf et al. 1991). It is rare or uncommon throughout its range.

There are five known spotted owl activity centers within the Calapooya WAU. An activity center is defined in the Northwest Forest Plan as a 100-acre area of concentrated activity of a pair of spotted owls or a territorial single owl. Three of these activity centers are located on private timberland and two are located on BLM land.

Habitat description

Typical spotted owl habitat in the Pacific Northwest consists of low-elevation forests dominated by Douglas-fir (some stands being 200 years or older) with abundant snags and downed logs. Old-growth coniferous forest, or areas with old-growth characteristics including multi-layered, closed canopies with large diameter trees and an abundance of dead and down woody material, is preferred nesting, roosting and foraging habitat. Northern spotted owls commonly nest in cavities 50 or more feet above the ground in large decadent old-growth trees. Other nest sites include large mistletoe clumps, abandoned raptor nests, and platforms formed by whorls of large branches. They construct nests on broken snags, mistletoe platforms, or on limbs sufficiently large to hold a nest. Mature and old-growth forest also may support higher densities of favored spotted owl prey species (e.g., flying squirrels, red tree voles, and dusky wood rats) (Wilcove 1990, Moench 1998).

Current and Reference Conditions

Current habitat condition and trend

Generally, optimum nesting habitat is composed of trees larger than 21 inches in diameter with a canopy closure greater than 70 %. There are 644 acres of BLM land in the WAU with tree diameters larger than 21 inches and canopies greater than 70 percent; 288 acres of 21-inch or larger trees, with canopies ranging from 40 - 69 percent; and 136 acres of 21-inch or larger trees, with canopies ranging from 10 - 39 percent. Suitable spotted owl nesting habitat on BLM land (forest stands with trees larger than 21 inches in diameter with 40 to 100 percent canopy closure) comprises about 932 acres (Figure 3-14).

To determine the relative amounts of suitable nesting, roosting and dispersal habitat, vegetation within a 1.2-mile radius of the activity center was analyzed (see Table 3-12 and Table 3-13). Forest communities that provide optimum nesting habitat have large trees with cavities, broken tops, mistletoe, or branches capable of holding accumulated organic matter for use as a nest. Roosting and foraging habitat typically tends to be less diverse structurally (i.e., single-story canopy), with smaller trees (i.e., 11 to 20 inches diameter), and with canopy cover ranging from 40 - 60 percent. Dispersal habitat includes conifer forests with trees less than 11 inches in diameter.

Of the forest seral-stage strata depicted on Figure 1-6, mature/old-growth is thought to be suitable nesting, roosting, and foraging habitat. Seral stages, dominated by conifers (early immature, early intermediate, and mid/late) are considered dispersal habitat.

Suitable nesting, roosting, and foraging habitat (i.e., mature/old-growth forest), within 1.2-mile radii of activity centers, comprises from 2 - 18 percent of total habitat. This amount of habitat is substantially less than the 40%, thought to be optimum for areas surrounding activity centers. Most habitats (82% or more) within 1.2 miles of activity centers are composed of vegetation younger than 80 years.

Additional analysis of forest characteristics on BLM land indicates that optimum spotted owl nesting habitat (large sawtimber, with 70 - 100% canopy) ranges from 0-245 acres on BLM land within 1.2-mile radii from activity centers. Comparison of mature/old-growth data with large sawtimber data indicates that most mature/old-growth vegetation is composed of substantial amounts of large sawtimber at canopy closures of 40 - 100 percent. Most large sawtimber is on BLM lands.

TABLE 3-12

Acreage of Current Vegetation Seral Stages within 1.2 Miles of Spotted Owl Activity Centers

Seral Stage	Brush Creek	Pearl Ridge	Brush Creek Alt.	Georges Knob	West Brush Creek
Non-forest	78	475	96	96	43
Early Immature	740	532	718	267	261
Hardwood	0	29	0	0	0
Early Intermediate	213	324	184	79	351
Mid/Late	1250	972	1284	1072	2090
Mature/Old-growth	388	91	382	340	50
Total	2669	2423	2664	1854	2795

Note: Reported total acreages do not equal that of a circle with radius of 1.2 miles(2,895 acres) because the circle falls outside of the WAU boundary and thereby outside of available data for current seral stage.

TABLE 3-13

Acreages of BLM Stand Structure within 1.2-mile of Spotted Owl Activity Centers

Stand Structure	Brush Creek	Pearl Ridge	Brush Creek Alt.	Georges Knob	West Brush Creek
Pole Timber (10-39%)	0	0	0	0	2
Pole Timber (70-100%)	380	0	377	338	673
Large Sawtimber (70-	245	83	236	153	0
Seed./ Sapling (70-100 %)	103	0	92	25	106
Large Sawtimber (10-39%)	0	0	0	0	4
Large Sawtimber (40-69%)	96	4	97	98	34
Pole Timber (40-69%)	22	0	22	0	71
Small Sawtimber (70-	18	4	21	201	87

Small Sawtimber (10-39%)	0	21	0	0	0
Small Sawtimber (40-69%)	12	6	11	12	4
Non-forest	16	1	21	35	14

Historic relative abundance and distribution of species

Although spotted owl surveys were not conducted in 1936, owls may have been more abundant in 1936 than they are at present. A general indication of potential spotted owl abundance can be derived by assuming that spotted owls use habitat in a 1.2-mile radius around a nest. If mature/old-growth were optimally dispersed throughout the WAU, 5,420 acres could theoretically have supported 4.6 pairs of spotted owls in 1936.

Historic relative condition and distribution of habitat

Suitable nesting, foraging and roosting habitats (i.e., mature/old-growth seral stages) for the northern spotted owl were more abundant in 1936 than today. In 1936, approximately 26 percent of the WAU was comprised of mature/old-growth forest.

Great Gray Owl (*Strix nebulosa*)

Characterization

Relative abundance and distribution of species

Great gray owls breed from central Alaska and northern Yukon south locally to California, and east through northern Wyoming to Minnesota and south-central Ontario (DeGraaf et al. 1991). They are locally common to rare. There is no current information on the abundance or distribution of great gray owls in the Calapooya WAU; however, suitable habitat for foraging (early seral forest or meadows) adjacent to nesting habitat (old-growth forest) appears to be present at higher elevations (i.e., above 1,700 feet).

Habitat description and distribution

Great gray owls in the western U.S. occur in mid- to high elevation montane conifer forests. They usually nest in mature or older forest stands where they utilize old nests of other raptors, including goshawks, red-tailed hawks, other large hawks, or ravens (Hayward and Verner 1994), mistletoe clumps, and other platforms created by whorls of branches. In winter they inhabit forests, sparse woodland edges, bordering open fields, or weedy fields with posts and scattered low trees or bushes (DeGraaf et al. 1991).

Preferred foraging habitat for great gray owls consists of recent clear-cut forests (less than 15 years old) or meadows with old-growth forest nearby for nesting (Duncan and Hayward 1994). Access to suitable hunting meadows (or young clear cuts) restricts population densities and range expansion. Pocket gophers, other small mammals, and birds are the primary prey of great gray owls. In Oregon, the majority of nests in one study were in over-mature or remnant stands of Douglas-fir and grand fir forest types on north facing slopes.

Current and Reference Conditions

Current habitat condition and trend

Suitable habitat for foraging (early seral forest or meadows) adjacent to nesting habitat (old-growth forest) appears to be present at higher elevations (i.e., above 1,700 feet). Specific areas with early seral forests adjacent to mature or old-growth forest that may provide appear to be located in several locations in the WAU. These include portions of Section 36, T14S, R2W and Sections 30 and 31, T14S, R1W (west of the West Fork of Brush Creek), portions of Sections 4,5,8, and 9, T15S, R1W at the head of Brush Creek, and portions of Sections 33, 34, and 35, T14S, R1W and Sections 2 and 3, T15S, R1W in the East Fork of Brush Creek drainage. The suitability of these areas to great gray owls over time will depend upon the maintenance of mature-to-old-growth forest adjacent to early seral forest.

Historic relative abundance and distribution of species

There is no information pertaining to great gray owl presence or abundance in the WAU in 1936. As there was more old-growth forest in the WAU in 1936, and there was also extensive timber harvest in parts of the drainage, it is possible that great gray owl numbers were greater at that time than today.

Historic relative condition and distribution of habitat

Suitable habitat for great gray owls appears to have been present in 1936 for foraging (i.e., recent clearcuts) and nesting (mature/old-growth forest).

<u>Roosevelt Elk (*Cervus elaphus roosevelti*)</u>

Characterization

Relative abundance and distribution of species

Although there are no specific population estimates for Roosevelt elk in the Calapooya WAU, this game animal appears to be common and widely distributed, being most abundant in upper elevations of the WAU.

Habitat description and distribution

Habitat quality for elk is determined by relative amounts and spacing of foraging areas, thermal/ hiding cover, and density of roads. Important habitat components include meadows and young clear cuts (less than 20 years old) for foraging, and closed canopy mid/late and mature/old-growth for cover.

Current and Reference Conditions

Current habitat condition and trend

Approximately, 7,141 acres of foraging habitat (i.e., early immature and early intermediate seral stages) and 1,295 acres of optimum thermal and hiding cover are available within the WAU. Of foraging habitat and thermal/hiding cover available to elk, 961 acres and 1,035 acres, respectively, are on BLM lands. Most foraging habitat (85 percent) is on private land and most thermal/hiding cover (80 percent) is on BLM land.

Road density for forested land is the same for both BLM and private land in the WAU, (4 miles of road per square mile of habitat). Road densities higher than 1 mile per square mile are thought to be excessive by the Oregon Department of Fish and Wildlife. Roads displace elk from suitable habitat (especially foraging areas adjacent to roads), increase vulnerability to hunting mortality, and increase illegal kills from poaching.

An accepted method to reduce the adverse effects from high road densities is to close roads to vehicular access. Currently, about 7 miles of BLM roads and 11 miles of private roads have locked gates or barriers that permanently restrict access.

In addition to permanently closed roads, other roads on BLM lands are closed after the elk hunting season. Closures after hunting season reduce displacement of wintering elk from forage sources near roads and reduce potential mortality from poaching.

Historic abundance and distribution of species and condition of habitat

Elk habitat conditions in the WAU during 1936 appear to be similar to current conditions. Foraging areas (i.e., early immature and early intermediate seral stages) comprised 5,144 acres in 1936 and 7,241 acres today. Optimum hiding and thermal cover (mature and old-growth stands) in 1936 comprised 5,420 acres as compared to 1,295 acres today. Road densities in 1936 are not known, but they were lower in 1936 than at present.

Although habitat conditions in the Calapooya WAU may not have changed drastically since 1936, other factors such as hunting mortality probably affected elk in the WAU and region as a whole. Generally, elk populations are higher throughout the range of Roosevelt Elk today than they were in 1936 because of more restrictive hunting regulations and conservation efforts.

<u>Black-tailed Deer (*Odocoileus hemionus columbianus*)</u>

Characterization

Relative abundance and distribution of species

The abundant black-tailed deer, a small western relative of the mule deer, is found in the Pacific Northwest from Alaska south to southern California, including the coastal ranges, the western Cascades, and the Sierras.

Habitat description and distribution

Black-tailed deer prefer forested areas where dense hiding cover is associated with open foraging areas. Like elk, they forage in clearcuts less than 20 years old and seek cover in late seral, mature/old-growth forests. In winter, deer avoid areas where snow accumulates, generally above 2,130 feet.

Current and Reference Conditions

Current habitat condition and trend

Black-tailed deer are abundant throughout the WAU. The proportions and interspersion of forest types (Figure 1-6) in the Calapooya WAU appear to be close to optimal based on the abundance of deer.

Historic relative abundance and distribution of species and condition and distribution of habitat

Habitat conditions in the WAU for black-tailed deer differed most between 1936 and the present in amount of thermal/hiding cover. Thermal/hiding cover in 1936 comprised 5,420 acres (versus 1295 currently) and foraging habitat comprised 5,144 acres (versus 7,141 acres currently). Although mature/old-growth forest are recognized as important habitat components for black-tailed deer, it is not known if this habitat component is an important limiting factor for deer populations. Areas producing large amounts of browse and herbaceous forage may be more important determinants of black-tailed deer density and distribution within the WAU.

Black Bear (*Euarctos americanus altifrontis*)

Characterization

Relative abundance and distribution of species

Black bears are distributed throughout the United States and Canada in mountainous, forested habitats, and in extensive hardwood forests of the interior. They are common in many localities. Though there are no population estimates, black bears are relatively common throughout the forested areas of the Calapooya WAU.

Habitat description and distribution

Black bears occupy forested habitats throughout their range. Important non-forested habitats used by black bears include wet meadows, riparian areas, avalanche chutes, roadsides, burns, sidehill parks, and subalpine ridgetops (MDFWP 1994).

Black bears are opportunistic omnivores. The highest quality black bear foods are products of lush vegetative habitats, including riparian areas. The majority of their diet consists of plant material. Grasses, sedges, and forbs are the primary food items consumed in spring and early summer, while nuts and berries predominated in late summer and fall. Plants used for food by black bears include dandelion, goatsbeard, horsetail, cow parsnip, angelica, sweetvetch, chokecherry, gooseberry, huckleberry, grouse whortleberry, hawthorn, mountain ash, and serviceberry (MDFWP 1994). Insects and carrion are the principal non-plant foods consumed. Home range size and movements of black bears reflect the patchy nature of important food sources. Bears move in response to availability of food, and therefore home ranges may overlap, and vary in size from season to season and year to year (MDFWP 1994).

Current and Reference Conditions

Current habitat condition and trend

The entire forested area of the Calapooya WAU could be considered black bear habitat. The greatest threat to black bears is probably conflict with humans rather than loss of habitat.

Historic abundance and distribution of species and condition and distribution of habitat

There is no data on black bear populations or distribution in 1936 in the Calapooya drainage. Though there were probably heavy livestock grazing impacts in the valleys, and logging and road-building impacts in the forests, black bear could have utilized the entire WAU. Bears were once considered "varmints" throughout the west, and had no legal protection. It is possible that bear numbers were lower in the WAU in the 1930's than today.

Mountain Lion (*Felis concolor*)

Characterization

Relative abundance and distribution of species

Mountain lions are found in suitable habitats throughout western North America. Historically they were probably found in all habitats except open plains, deserts, and grasslands where their stalking ability was limited (MDFWP 1996). Their distribution and abundance is directly related to that of their primary prey species, deer and elk, and is limited to those habitats that allow them to stalk and ambush their prey, particularly rugged terrain or dense cover (MDFWP 1996). Seasonal shifts in elevation follow those of their ungulate prey.

Mountain lion numbers throughout the western United States, including the Calapooya WAU, have been increasing in recent years, probably because lion's favored prey, deer, have also been increasing. Mountain lion populations are thought to reach their highest densities in lower elevation forested areas, on the western slope of the Cascade Range (Lost Creek Watershed Analysis 1997). There are no estimates for mountain lion density in the Calapooya WAU, but the density is probably equal to or greater than average Oregon density of 7.5-7.8 lions per 100 square miles of habitat. Suitable habitat (i.e., forested areas with an adequate prey base) encompasses approximately 39 square miles; therefore, the WAU would likely have the potential to support 2-3 lion territories.

Habitat description and distribution

High quality ungulate habitat is a key feature of mountain lion habitat. In addition to high quality ungulate habitat, quality habitat for small mammals including voles, mice, ground squirrels, and lagomorphs may be important to mountain lions. These small mammals are important foods of sub-adult mountain lions. Some researchers suggest that small mammals must be present as an alternative food source in times of ungulate scarcity for lion survival (MDFWP 1996).

Lions are least likely to frequent early intermediate stands of low diversity which are sub-optimal for prey species, and in open habitats lacking stalking and hiding cover (clearcuts and non-forest land). Prime mountain lion habitat in the Calapooya WAU is found along forest edges at ridge tops, especially in the bottoms of drainages where there is adequate hiding and stalking cover, and quality ungulate and small mammal habitat.

Current and Reference Conditions

Current habitat condition and trend

The interspersion of forested habitats in various seral stages throughout much of the WAU provides excellent habitat for mountain lion prey.

Historic abundance and distribution of species and condition of habitat

There is no data for abundance and distribution of mountain lions in the WAU in 1936. Because mountain lion numbers are closely tied to prey numbers (especially deer), it is likely that lion numbers were lower in 1936 than they are today.

Although habitat conditions in the Calapooya WAU may not have changed substantially since 1936, other factors such as hunting mortality probably affected lion populations as well as elk and deer in the WAU and region as a whole. Generally, lion populations are higher throughout the western U.S. today than they were in 1936 because of more restrictive hunting regulations and conservation efforts.

Red Tree Vole (*Pomo longicaudus*)

Characterization

Relative abundance and distribution of species

The red tree vole is found from southern Washington south to northern California. There is no information on abundance or distribution of the red tree vole in the Calapooya WAU; however, preferred habitat (i.e, mature/old-growth) is present on 1,295 acres (1,035 acres on BLM land and 260 acres on private land).

Habitat description and distribution

Red tree voles live almost exclusively in canopies of Douglas-fir trees, about 100 years old and older. The species is significantly more abundant in mature to late-successional forests but can inhabit stands as young as 40 years old. This vole feeds primarily on Douglas-fir needles and builds nests with needles, lichens, and other organic litter. Mid/late seral and mature/old-growth Douglas-fir stands potentially supporting red vole populations are distributed throughout the WAU at mid-to-high elevations on federal and private land. Specific areas of potential red vole habitat include much of the upper Courtney Creek drainage, especially south of the Creek, excepting Section 26; higher elevation ridges west of the West Fork of Brush Creek and between the West and main forks of Brush Creek, the northeast quarter of Section 33 near the junctions of the main fork and the East Fork of Brush Creek, much of Section 3 south of the East Fork of Brush Creek, and the heads of the Pugh Creek and Carrie Fork Creek drainages.

Current and Reference Conditions

Current habitat condition and trend

Although red tree voles are more abundant in mature/old-growth forest, they also occupy younger Douglas-fir stands. Mid/late seral stands may support adequate populations of voles in the WAU to facilitate connectivity among mature/old-growth stands. Because most of the WAU (71% of the forest) is comprised of mid/late and mature/old-growth habitat, movement, dispersal, and genetic exchange of this small mammal are probably not restricted in the WAU. Existing connectivity blocks and establishment of riparian reserves help ensure that loss of suitable habitat from logging or fire would not isolate population segments of red tree voles within the WAU

Historic relative abundance and distribution of species and condition and distribution of habitat

There are no data for abundance and distribution of red tree voles in the WAU in 1936. However, preferred habitat for red tree voles (mature/old-growth forest) was more abundant in 1936 (26% of WAU) than it is today (5% of WAU).

Silver-haired Bat (*Lasionycteris noctivagans*)

Characterization

Relative abundance and distribution of species

Silver-haired bats are widely distributed in North America. They are quite common in some forested locales in northern latitudes during the summer months (Kunz 1982). They are probable summer residents of the Calapooya WAU, occurring in moderate densities, roosting primarily in old-growth stands of Douglas-fir, and foraging throughout the WAU. They are probably most common where old-growth stands of Douglas-fir are situated near water. These areas include upper Brush Creek, much of the East Fork of Brush Creek, the head of the small drainage west of the West Fork of Brush Creek, and some sections of Courtney Creek.

Habitat description and distribution

These bats utilize forests and open areas with trees for foraging, and are often associated with ponds and streams (Barbour and Davis 1969, Hendricks et al. 1995). In the Pacific Northwest this species utilized more than 24 cover types and more than 12 structural stages (Marcot 1996).

Information on summer day and night roosts for this bat is sketchy, though individuals have been found under loose bark, in woodpecker cavities, in tree trunks, and in bird nests (Barbour and Davis 1969, Nagorsen and Brigham 1993). It is a tree-roosting bat, and is rarely associated with caves or abandoned mines in summer. Silver-haired bats were detected at substantially higher rates in old-growth stands than in young or mature stands of Douglas-fir in an Oregon study (Thomas and West 1991). These bats may be more abundant in old-growth stands because old-growth habitat provides increased variety and abundance of day roosts (Thomas and West 1991). Perkins and Cross (1988) also found most silver-haired bats preferred to roost in old-growth Douglas-fir, where older trees provided roosting crevices and cavities created by wind and lightning damage, shed limb boles, excavations by birds, and cracks in the wood. Silver-haired bats selected open stands of large diameter or tall aspen or Douglas-fir, and appeared to have no decay-stage preference (Vonhof 1996). Others have also reported on the importance of both diameter and height of roost trees for this species (Betts 1996, Parsons et al. 1986).

Evidence suggests that this bat is migratory throughout most of its northern range (Barbour and Davis 1969, Kunz 1982). During migration it may be found in a variety of temporary roosting sites, including buildings, woodpiles, and under tree bark (Barbour and Davis 1969, Nagorsen and Brigham 1993). There is evidence that a few individuals hibernate in northern locales. Turner (1974) reported one hibernating individual in a cave in the Black Hills of South Dakota. Several individuals have been found in British Columbia during winter (Nagorsen and Brigham 1993), where trees appear to be the most important hibernation sites. They have been found hibernating in Douglas-fir snags and under the bark of western red cedar. They also may utilize rock crevices, buildings, and rarely, caves or abandoned mines (Nagorsen and Brigham 1993, Hendricks et al. 1995).

Current and Reference Conditions

Current habitat condition and trend

Though silver-haired bats may be found in numerous forested habitats, they are most common in old-growth Douglas-fir stands. There are approximately 1300 acres of mature or old-growth forest in the WAU. About 80% of these stands are federally managed. Historically, acreage of old-growth stands have been diminishing.

Historic abundance and distribution of species and habitat condition

There is no data on distribution or abundance of this species in 1936. High quality habitat has been reduced from 5,420 acres in 1936 to 1295 acres today. Timber harvesting and associated activities prior to 1936 probably reduced habitat quality from pre-settlement times. If there were more wetlands and ponds in the WAU in 1936 than today this would have increased the quality of habitat for silver-haired bats.

Western Long-eared Myotis (*Myotis evotis*)

Characterization

Relative abundance and distribution of species

The western long-eared myotis is distributed over much of western North America from southern Canada south to southern California, Nevada, and New Mexico. It is relatively common in parts of its range.

Habitat description and distribution

The western long-eared myotis is found in a wide range of mostly montane forested habitats, but may occur in grasslands, semi-arid shrublands, sage, and agricultural areas (Manning and Jones 1989, Nagorsen and Brigham 1993). This species has been documented from sea level to nearly 9000 feet elevation, and is one of the few bats found consistently at high elevations in western Canada (Nagorsen and Brigham 1993). Day roosts may be sheds, abandoned buildings, and under the bark of trees, in tree cavities, and occasionally in caves, mines, and fissures in cliffs (Barbour and Davis 1969, Manning and Jones 1989). Caves and mines are used as temporary night roosts (Nagorsen and Brigham 1993).

Current and Reference Conditions

Current habitat condition and trend

Long-eared myotis is probably a seasonal resident throughout much of the WAU where there are roosts, including tree cavities and under bark of older trees.

Historic abundance and distribution of species and condition and distribution of habitat

There is no historic information on the occurrence or distribution of this species in the Calapooya WAU. There was more old-growth forest in the drainage in 1936, and therefore the potential for more roosting sites.

Long-legged Myotis (*Myotis volans*)

Characterization

Relative abundance and distribution of species

Long-legged myotis is widespread and relatively common throughout much of the west except in lowland deserts. It's occurrence and distribution in the Calapooya WAU is unknown, but it is a probable resident throughout much of the drainage.

Habitat description and distribution

Long-legged myotis is most common in coniferous and coniferous/mixed hardwood communities (Barbour and Davis 1969; Nagorsen and Brigham 1993). Summer day roosts are under tree bark, in rock crevices, and in buildings (Barbour and Davis 1969; Nagorsen and Brigham 1993). Though it does not use caves and mine adits for day roosts, it commonly uses them for night roosts (Barbour and Davis 1969; Nagorsen and Brigham 1993). Maternity colonies are frequently in attics and barns (Barbour and Davis 1969; Nagorsen and Brigham 1993).

In the Central Oregon Cascades, Long-legged Myotis preferred large Douglas-fir snags and hollow western red cedar as day roosts (Ormsbee 1996) and bridges over swift-moving water as night roosts (Perlmeter 1996). Maternity colonies are found in attics and under tree bark (Nagorsen and Brigham 1993). Chung-MacCoubrey (1996) reported that this species prefers ponderosa pine snags and live trees with cracks or loose bark for maternity roosts in pinyon-juniper woodland in New Mexico. Caves and mines are used as hibernacula (Hendricks et al. 1995).

Current and Reference Conditions

Current habitat condition and trend

There is no data on the occurrence and distribution of this species in the Calapooya WAU. Based upon habitat it could be found throughout the drainage. Douglas-fir snags and older trees with creviced or exfoliating bark, primarily located in mature and old-growth forest, provide important day roosts and sites for maternity colonies.

Historic abundance and distribution of species and condition and distribution of habitat

There is no information on the historic occurrence and distribution of this bat in the WAU. However, it was probably as common or more so in 1936 than today, as there was a greater amount of old-growth forest that wold have provided more roost and maternity sites for this species.

Yuma Myotis (*Myotis Yumanensis*)

Characterization

Relative abundance and distribution of species

Yuma myotis range from southern British Columbia through much of the western United States southward to central Mexico, primarily west of the 100th meridian (Barbour and Davis 1969, Hendricks et al. 1995). The species is relatively common in the western U.S. and may occur in the Calapooya WAU.

Habitat description and distribution

Yuma myotis is commonly found in human structures, closely associated with water, and they will use caves as night roost areas. The species is colonial and hangs in a closely clumped group, often under bridges, in mines and caves. It forages over ponds, lakes, rivers, and streams (Barbour and Davis 1969, Nagorsen and Brigham 1993). It appears to prefer relatively open terrain with sparse tree cover (Hendricks et al. 1995). Vegetation cover types utilized by this species include ponderosa pine, Douglas-fir, mountain hemlock, limber pine, western red cedar, juniper, and juniper-big sagebrush (Marcot 1996). Structural stages utilized include young and old single and multi-strata forest, and woodland (Marcot 1996).

Maternity roosts are often in buildings or other man-made structures close to water (Barbour and Davis 1969, Nagorsen and Brigham 1993). Day and night roosts include man-made structures, caves, mines, tree cavities, under loose bark, and in rock crevices (Nagorsen and Brigham 1993, Hendricks et al. 1995).

Current and Reference Conditions

Current habitat condition and trend

There is no data on the occurrence or distribution of Yuma myotis in the WAU. Favorable habitat is found along the mid and lower reaches of most streams. Older stands featuring trees with exfoliating bark and cavities may provide roost sites.

Historic abundance and distribution of species and condition and distribution of habitat

There is no historic data on the occurrence and distribution of this species in the WAU. It is possible there was more standing water in 1936. Greater amounts of mature and old-growth forest wold have provided more potential roost sites.

Fringed Myotis (*Myotis thysanodes*)

Characterization

Relative abundance and distribution of species

Fringed myotis range from southern British Columbia south to southern Mexico and east to the northern Great Plains (Barbour and Davis 1969, O'Farrell and Studier 1980). They are uncommon through most of their range. This species is unlikely in the Calapooya WAU due to habitat limitations.

Habitat description and distribution

Fringed myotis are usually associated with desert, arid grassland, and arid woodland habitats at middle elevations (1,200 to 2,100 meters elevation) in the western United States. Williams (1968) reported this species using sage-grassland habitat in Washington. British Columbia populations are found in arid grassland and ponderosa pine-Douglas-fir forests between 300 and 800 meters in elevation (Nagorsen and Brigham 1993). Though uncommon in Montana and Idaho, a number of specimens have been recorded (Perkins and Peterson 1997). Hendricks et al. (1995) suggest that the species seems to prefer montane and upland forests, as well as desert scrub and non-wooded areas.

Fringed myotis utilize caves, mines, rock crevices, and buildings for both day and night roosts (Barbour and Davis 1969). In a study in Arizona, Morrell et al. (1994) recorded this species using roost sites in snags. Eighty percent of the snags used were ponderosa pine, and 66 percent of all snags used had loose bark and some intact branches. Chung-MacCoubrey (1996) found maternity roosts of this species in large, ponderosa pine snags and live ponderosa with long, vertical cracks or loose bark. Maternity colonies of up to several hundred bats are formed in summer (Hendricks et al. 1995). Fringed myotis use caves and mines for hibernacula. They may migrate short distances between summer range and winter hibernacula (Nagorsen and Brigham 1993).

Current and Reference Conditions

Current habitat condition and trend

There is no evidence that this species is found in the Calapooya drainage. Though fringed myotis have been recorded in upland montane forest, most records are from more xeric habitats. Additionally, the species utilizes caves, mines, rock crevices, and buildings for both day and night roosts, and all of these features are scarce in the WAU.

Historic abundance and distribution of species and condition and distribution of habitat

There is no data regarding occurrence, distribution, or abundance of this species in the Calapooya WAU. This species probably has not inhabited the WAU historically due to habitat limitations.

Sharptail Snake (*Contia tenuis*)

Characterization

Relative abundance and distribution of species

The sharptail snake ranges from the Gulf Islands near Vancouver Island south to south-central California and the Sierra Nevada. Within this range its distribution is spotty. In most areas it appears to be absent, though there are dense populations in a few isolated areas of good habitat.

It has been recorded from sea level in the northern extremity of its range to 6600 feet elevation in the Sierras.

Habitat description and distribution

Sharptail snakes inhabit relatively undisturbed oak and other sclerophyllous hardwood (madrone, chinkapin) woodland on well-drained alluvial terraces and hill slopes. It usually is found in rotting logs, moist talus, under rocks, and boards.

Current and Reference Conditions

Current habitat condition and trend

Remnant stands of native oak woodland are found in the lower Courtney Creek area, but the native grass understory has largely been displaced by agriculture. This trend appears to be continuing.

Historic abundance and distribution of species and condition and distribution of habitat

There is no data on the occurrence of this species or the extent and condition of its habitat in the WAU in 1936. It is possible there was more native oak woodland at that time, primarily in the lower Courtney Creek area, but if present it was likely heavily grazed by sheep.

Oregon Slender Salamander (*Icaricia icarioides fenderi)*

Characterization

Relative abundance and distribution of species

The uncommon Oregon slender salamander ranges along west of the Cascades from the Columbia River south to central Oregon between sea level and 4700 feet. Within its range it has a limited and patchy distribution. It has been recorded in the Calapooya drainage, and suitable habitat is present in mature and old-growth stands.

Habitat description and distribution

The Oregon slender salamander is a terrestrial species (lays eggs on land and avoids streams), favoring habitat conditions present in mature and old-growth forest (e.g., large rotten logs, closed overstory canopy, snags, and partly downed Douglas-fir and hemlock with shedding bark). They have been documented in mid-succession forest, and even in early seral forest where rotten logs were present (Applegarth 1994). Limiting factors to distribution may include a need for minimally disturbed ground with intact root channels or rock fissures in which to seasonally migrate downward.

Current and Reference Conditions

Current habitat condition and trend

Suitable habitat for this species is fragmented by past logging and road construction. Connectivity blocks are too far apart to enhance dispersal of this relatively immobile species.

Establishment of riparian reserves would probably do little, over the short term, to provide additional habitat for this species or enhance habitat connectivity. However, with designation of riparian reserves, 964 acres of mature/old-growth forest on BLM lands would be protected. About 244 acres of mature/old-growth forest would remain in the General Forest Management Areas.

Historic abundance and distribution of species and condition and distribution of habitat

There is no data on historic occurrence, abundance, and distribution of the Oregon slender salamander within the WAU. Because this species is often associated with large, downed logs, it is likely that suitable habitat (i.e., mature/old-growth forest) would have been more abundant in 1936.

Clouded Salamander (*Aneides ferreus*)

Characterization

Relative abundance and distribution of species

The clouded salamander ranges from the Columbia River south to northern California in the Coast Range and the western slopes of the

Cascades, with a disjunct population existing on Vancouver Island, B.C. It is found from sea level to 5400 feet elevation. In many localities it is absent. In most localities it is scarce, and in some it is abundant (Applegarth 1994).

Habitat description and distribution

Clouded salamanders are generally associated with mature and old-growth Douglas-fir forests, though contemporary seral stage may be unimportant as long as a few key habitat components, generally associated with older forest, are available. They occur mainly under loose bark in decayed, standing and fallen Douglas-fir snags, and stumps. They have been found as high as 20 feet in trees. Adjacent trees may be important to provide shading. Clouded salamanders may also be found in cracks in cliff rocks, under moss and leaf litter.

Current and Reference Conditions

Current habitat condition and trend

There are approximately 1300 acres of mature or old-growth forest in the WAU. About 80% of these stands are federally managed. Historically, acreage of old-growth stands have been diminishing. Suitable habitat for this species is fragmented by past logging and road construction. Connectivity blocks are too far apart to enhance dispersal of this relatively immobile species.

Establishment of Riparian Reserves probably do little, over the short term, to provide additional habitat for this species or enhance habitat connectivity. However, 964 acres of mature/old-growth forest on BLM lands are protected.

Historic abundance and distribution of species and condition and distribution of habitat

There is no data on occurrence, abundance, and distribution of clouded salamander within the WAU. Because this species is often associated with large snags, and rotting logs, it is likely that suitable habitat (i.e., mature/old-growth forest) would have been more abundant in 1936.

Northern Red-Legged Frog (*Rana aurora*)

Characterization

Relative abundance and distribution of species

The range of the Northern red-legged frog is from Vancouver Island, British Columbia south to Baja California. It was probably common and widely distributed in the Willamette Valley and other valleys in the Pacific Northwest in the past, but they have become scarce throughout their historic range. They are now absent in many localities in western Oregon (Applegarth 1994). It is unlikely in the Calapooya WAU because of lack of habitat. Applegarth (1994) reported that one of the areas in the Eugene District that had the most red-legged frogs was "the east side of the Coburg Hills". The Calapooya WAU is on the east side of the Coburg Hills.

Habitat description and distribution

Red-legged frogs prefer slack water of ponds and low-gradient streams with emergent vegetation for reproduction. These frogs occur in lower elevations and can be found during the summer months up to 1000 feet from standing water in humid, old-growth forests and moist meadows. They are intolerant of completely unshaded habitats.

Current and Reference Conditions

Current habitat condition and trend

The only low-gradient streams and ponds in the Calapooya WAU are at low elevation on private property. These areas are probably too exposed to sunlight and heat to support red-legged frogs.

Historic abundance and distribution of species and condition and distribution of habitat

There is no data on the distribution of red-legged frog habitat in 1936. However, there were probably no low gradient streams or standing ponds under canopy cover and adjacent to old-growth forest in the Calapooya WAU.

<u>Oregon Megomphix (*Megomphix hemphilli*)</u>

Characterization

Relative abundance and distribution of species

The Oregon megomphix inhabits mature and old-growth forests in the Pacific Northwest at low to moderate elevations (generally under 3000 feet). It ranges from the Olympic Peninsula in Washington south to the Umpqua River in Oregon. It appears to have a very patchy distribution throughout its range (Applegarth 1995). Oregon megomphix have been documented at several sites immediately adjacent to Calapooya WAU on the divide between the Calapooya and Mohawk watersheds (T15S, R1W,Section 7) and at one site within the WAU (T14S, R2W, Section 13).

Habitat description and distribution

This snail requires cool, damp habitats, near headwater streams, usually in mature or late-successional forest stands. Moist areas on or at the foot of rocky, north-facing slopes, and benches in riparian areas located above seasonal flooding, appear to be favored locations. Large rotten logs are an important habitat component for this species and big-leaf maples are typically present. It avoids areas of high soil acidity, such as found under pure conifer canopies. Low permeability bedrock near ridgetops covered with a thin mantle of rock rubble may provide uniform damp refuges during dry periods.

High-quality habitat (i.e., mature/old-growth forests) is present in the Calapooya WAU primarily on BLM land as isolated mature old-growth stands (Figure 1-6), separated by clear cuts and seral stages generally less than 80 years old.

Current and Reference Conditions

Current habitat condition and trend

The Oregon megomphix may be present in more mature/old-growth forest stands than have been documented; however, populations probably are isolated spatially and genetically in the WAU. Large areas of seral vegetation in the WAU, less than 80 years old, with high road densities, probably prevent dispersal of this species. All mollusks have limited mobility, consequently, their ability to colonize potential habitats is poor. For colonization of habitats and genetic exchange among populations, continuous corridors of suitable habitat must be established and maintained.

Historic abundance and distribution of species and condition and distribution of habitat

Historic information on presence, abundance, and distribution of this mollusk in the WAU is not available; however, high-quality habitat (mature/old-growth forest) has been reduced from 5,420 acres in 1936 to 1295 acres today. Timber harvesting prior to 1936 and associated slash burning probably also reduced habitat quality from pre-settlement conditions.

<u>Papillose Tail-dropper (*Prophysaon dubium*)</u>

Characterization

Relative abundance and distribution of species

The papillose tail-dropper slug is a rare species that appears to be widely distributed at mid to low elevations in the Pacific Northwest. It has been recorded at a few location in Washington state (in Lewis, Pierce and Thurston Counties), and as far south as Trinity County in northern California.

This rare slug has not been documented within the Calapooya WAU but has been found just south of the WAU boundary on the divide between the Calapooya and Mohawk River. Given the close proximity of this occurrence, there is relatively high probability that this species could be present in mature or old-growth forest stands in the Calapooya WAU.

Habitat description and distribution

This slug is associated with mid to low elevation (below 2000 feet) old-growth forests. It appears to be more tolerant of drier conditions than the blue-gray tail-dropper, and appears to inhabit undisturbed Douglas-fir forest, or oak forest in valleys. It has been found among mosses under logs in old-growth Douglas-fir/hemlock forest, among rocks in an open evergreen forest, and in "mushroom growth" along at the edge of a mountain meadow (Applegarth 1995). It browses on mushrooms and decaying plants. It may be dependent upon moist, rotting logs for refuge during dry periods. Like the blue-gray tail-dropper, suitable habitat for the papillose tail-dropper is limited and significantly fragmented by logging and roads.

Current and Reference Conditions

Current habitat condition and trend

Mid to low elevation old-growth stands of Douglas-fir (under 2000 feet elevation) are located primarily in the western part of the WAU in the Courtney Creek area, though this species might be found in other old-growth stands in drainage. All remnant old-growth stands are relatively isolated by disturbed forest, therefore slug populations would probably be small and genetically isolated.

Historic abundance and distribution of species and condition and distribution of habitat

Historic information on presence, abundance, and distribution of the papillose tail-dropper in the WAU is not available; however, high-quality habitat (mature/old-growth forest) has been reduced from 5,420 acres in 1936 to 1295 acres today. Timber harvesting prior to 1936 and associated slash burning probably also reduced habitat quality from pre-settlement conditions.

Blue-gray Tail-dropper (*Prophysaon coeruleum*)

Characterization

Relative abundance and distribution of species

The blue-gray tail-dropper is found in mountainous forested habitats in western Oregon and Washington where it appears to be relatively uncommon to rare.

This slug has not been documented in the Calapooya WAU, but may occur in suitable habitats (e.g., north-facing slopes, swales, and riparian zones of stable streams). If this species is intolerant of logging and subsequent slash burning, it may be absent from parts of the WAU that have been logged within the last 100 years. The most likely sites where this species could occur are mature or old-growth stands shown on Figure 1-6. This habitat comprises about 1,295 acres of forested land within the WAU.

Habitat description

This slug species favors cool, moist conditions in minimally disturbed forest. They are found in moderately open to moist, closed canopy conifer and mixed conifer forests at intermediate to higher elevations (1000-4500 ft.). In drier areas it is associated with relatively moist and shaded microsites. Blue-gray tail-droppers eat mushrooms and decaying plants and are often found in association with skunk-cabbage, big-leaf maple, partially decayed logs, leaf and needle litter (especially hardwood leaf litter), mosses, and sword ferns. The Lost Creek Watershed Analysis (1997) states that environmental alterations from logging and fire seem to eliminate tail-dropper slugs locally or increase their rarity.

Current and Reference Conditions

Current habitat condition and trend

Patches of mature and old-growth forest are fragmented within the WAU. It is likely that if populations of this slug were present, there would be little opportunity for genetic exchange among populations, given their relative immobility. Extensive logging over the previous 100 years and high densities of roads has greatly inhibited potential dispersal of slugs. Connectivity blocks in the WAU do little to enhance potential dispersal of this species given isolated occurrence of these blocks.

It is unlikely that designations of riparian reserves would significantly enhance habitat connectivity. All slugs are relatively immobile and even with specially managed lands, substantial habitat fragmentation would continue to isolate populations.

Historic distribution of species and relative condition of habitat

Historic information on presence, abundance, and distribution of this mollusk in the WAU is not available; however, high-quality habitat (mature/old-growth forest) has been reduced from 5,420 acres in 1936 to 1295 acres today. Timber harvesting prior to 1936 and associated slash burning probably also reduced habitat quality from pre-settlement conditions.

Fender's Blue Butterfly (*Icaricia icarioides fenderi*)

Characterization

Relative abundance and distribution of species

Fender's blue butterfly was originally widely distributed in the Willamette Valley and on adjacent low hills in native prairie habitat. It is now known from only four areas of remnant native prairie, including one population in the southern Coburg Hills northeast of Eugene (Applegarth 1995). None are known from the Calapooya WAU.

Habitat description and distribution

Fender's blue butterfly is closely associated with remnant native prairie habitat in and adjacent the Willamette Valley. It utilizes Kincaid's lupine (*Lupinus kincaidii*) as a hostplant, and spurred lupine (*Lupinus laxiflorus*) as an alternate host. Both lupine species are rare.

Current and Reference Conditions

Current habitat condition and trend

There is no known remnant of undisturbed native prairie at lower elevations in the Calapooya WAU. However, there is native grassland in the Horse Rock Ridge RNA, primarily in the Mohawk River drainage, that could support Fender's blue butterfly.

Historic abundance and distribution of species and condition and distribution of habitat

There is no data on the occurrence of this species or the extent and condition of its habitat in the WAU in 1936. It is possible there was more native prairie at that time, primarily in the lower Courtney Creek area, but if present it was likely heavily grazed by sheep. Native prairie also existed at the present Horse Rock Ridge RNA, though the condition of the grasslands, primarily located south of the ridge outside of the Calapooya drainage, is unknown. If this grassland was heavily grazed by livestock at the time it was probably not in very good condition and would not have been optimum habitat for Fender's blue butterfly.

Siskiyou Chloealtis Grasshopper (*Chloealtis aspasma*)

Characterization

Relative abundance and distribution of species

The Siskiyou chloealtis grasshopper is known from two locations, in Jackson and Benton counties. It is not known from the Calapooya WAU, but it may be present in appropriate habitat. The most likely habitat is located on the Horse Rock RNA located on the ridge at the head of the West Fork of Brush Creek and the adjoining drainage to the south in Section 1, T15S R2W. Here south-facing grassland communities abut north-facing old-growth forest.

Habitat description and distribution

The species has been found along the ecotone between forest and mountain meadow, in open hemlock forest, and in grassy areas near the summit of a ridge, along the lower edge of an extensive brushfield (Applegarth 1995). It may lay eggs in soft rotten wood.

Current and Reference Conditions

Current habitat condition and trend

The only potential habitat for this rare grasshopper is now protected by the Horse Rock Ridge RNA. Under protective management this habitat will likely be maintained or improved.

Historic abundance and distribution of species and condition and distribution of habitat

There is no data on the historic occurrence or distribution of this species in the WAU. It is unlikely that there was more habitat in 1936 than today. The condition of grassland at the present Horse Rock Ridge RNA in 1936 is unknown. If it was being grazed by domestic livestock (sheep) it was probably in poor condition.

<u>Potentilla Root-borer Beetle (*Chrysobothris potentillae*)</u>

Characterization

Relative abundance and distribution of species

The rare potentilla root-borer beetle is known from a limited number of specimens collected northwest of Corvallis in 1940, but it may occur in appropriate habitat in Lane County (Applegarth 1995).

Habitat description and distribution

The Potentilla root-borer beetle is associated with several species of *Potentilla* (cinquefoil) and also possibly *Horkelia* growing in relatively dry oak-grass woodlands.

Current and Reference Conditions

Current habitat condition and trend

Very little oak-grassland habitat remains in the WAU. The most extensive remnants are located between conifer forest and grassland/pasture along Courtney Creek. Oak-grasslands are gradually being replaced by agricultural lands throughout the Willamette Valley. Because of its association with oak-grass woodlands, this species is unlikely to be affected by timber harvesting activities.

Historic relative abundance and distribution of species and condition and distribution of habitat

The Potentilla root-borer beetle is not known from the WAU. However, remnant patches of oak-grassland habitat are found at low elevations between upland conifer forests and agricultural lands on valley floors. Oak-grassland habitat was probably more extensive in 1936 than today.

<u>Beer's False Water Penny Beetle (*Acneus beeri*)</u>

Characterization

Relative abundance and distribution of species

This species is known only from its type locality "5 to 15 miles east of Cascadia" (somewhere along the South Santiam River in Linn County). Beetles of the genus are found in Oregon and California, and appear to be rare, with localized distributions (Applegarth 1995).

Habitat description

Beetles in this genus are found at the margins of swift, clear, well-aerated forest streams with gravel or rocky bottoms.

Current and Reference Conditions

Current habitat condition and trend

Water quality is probably relatively good in most of the forested streams in the WAU as a great deal of attention has been given to the issue in the past decade or more. However, siltation from road-building and timber harvest, especially during storm events reduces habitat quality. The trend in water quality improvement should continue, and therefore habitat for false water penny beetles should improve. Areas in the WAU where the beetle is most likely to occur include the middle and upper reaches of Courtney Creek, Bickmore, Pugh, and Carrie Fork Creeks, and the middle and upper reaches of Brush Creek and its forks.

Historic abundance and distribution of species and condition and distribution of habitat

There is no data on the historic presence of this species in the WAU. Though there was more old-growth forest in the WAU in 1936 that today, lowland forests had been extensively logged. Water quality was not a sensitive issue at the time, therefore erosion and siltation in streams were probably much more severe than today. Clear, swift water may have been a rarity at lower elevations in 1936.

Reference Special Status Plants Conditions

Data is not available for presence and distribution of sensitive plant populations in the WAU in 1936.

Current Special Status Plants Conditions

Comprehensive botanical surveys have not been conducted on all land (i.e., BLM and private) in the WAU; however, nine species of special status plants (Table 3-14) have been found on BLM land (Figure 3-17). All BLM-administered land will be managed for conservation and protection of federal candidate species, state-listed species, and BLM sensitive species (USDI BLM 1995). Special-status state and federal plants will be managed to prevent increased threats, leading to reclassification based on more restrictive distribution or threats to population viability.

Two sensitive species (i.e., *Blepharipappus scaber* and *Githopsis specularioides*) have been found within the Horse Rock Ridge RNA (Section 1) and two species also occur within the Coburg Hills Relict Forest Islands RNA (i.e.,*Aster vialis* and *Cimifuga elata).* Sensitive species also occur in wetlands of Section 6 in the headwaters of West Fork Brush Creek (i.e., *Juncus kelloggii* and *Isoetes nuttallii*); Section 36 in the Carrie Fork Creek drainage (i.e., *Cimifuga elata*); and Section 9, on the Calapooya-Mohawk watershed divide. Table 3-15 shows acreage of various land designations occupied by sensitive species.

Most known sensitive plant locations are on land managed as General-Forest Management Areas (47.2 acres). Establishment of Riparian Reserves would protect at least 27.8 acres of sensitive plant habitat.

No surveys for Survey and Manage non-vascular plants (e.g., mosses, lichens, and fungi) have been conducted for the WAU. It is not known whether Survey and Manage non-vascular plants occur in the WAU, although it is likely that some of these small, easily overlooked plants are present. Mature and old-growth forest and wetlands are the most likely habitats to harbor these special-status plants.

TABLE 3-14

Special- Status Plants Documented in the Calapooya WAU on BLM Lands

Scientific Name	Habitat	Status
Aster Vialis	Open forest	Federal candidate
Botrychium virginianum	Moist forest, usually riparian	BLM sensitive
Blepharipappas scaber	Open forest and grassland	BLM sensitive
Cimifuga elata	Moist forest	Federal candidate
Githopsis speculanioides	Dry open places	BLM sensitive
Isoetes nuttallii	Wetlands	BLM sensitive
Juncus kellogii	Aster vialis	State sensitive
Orobanche pinorum	Coniferous forest	BLM sensitive
Lecidea dolodes	Forest lichen	State sensitive

TABLE 3-15

Acreage of Sensitive Plant Habitat by BLM Land Use Allocation

Species	Connectivity Block	District Defined Reserve	General Forest Management	Riparian Reserve	Non-BLM Lands
Aster vialis	0.03	10.61	0	0	0
Cimifuga elata	4.4	6.0	32.3	16.1	0.07
Githopsis specularioides	2.7	0	0	0.21	0.73
Isoetes nuttallii	0.34	0	0	0.17	0.08
Lecidea dolodes	0.99	0	0	0	0
Blepharipappus scaber	2.7	0	0	0.21	0.73
Orobanche pinorum	0	0	14.9	11.1	0.07

Reference Noxious Weed Conditions

There are no data for the presence of noxious weeds in the WAU in 1936; however, based on regional patterns, it is unlikely that noxious weeds were present in large numbers during 1936. In most areas of the Northwest, noxious weed populations have proliferated since 1936.

Current Noxious Weed Conditions

Noxious weeds in the WAU are most abundant on land disturbed by road construction, logging, and agriculture. Roadsides are often colonized by noxious weeds and other invasive species. Roads are conduits by which weed seeds are spread to other sites that have had vegetation removed and soil disturbed. Road density is an indicator of existing and potential colonization by noxious weeds. Another indicator of potential areas that could support noxious weed proliferation is the amount of early immature seral vegetation. Recently, logged areas have a high potential to support noxious weeds until an overstory of shrubs and saplings forms a closed canopy. Although dense overstory canopies of shrubs and trees can greatly reduce densities of noxious weeds, early establishment of weeds on recently logged areas may inhibit natural regeneration of conifers, native shrubs, and forage species important to wildlife.

Total distance of roads on BLM and private land is 48 miles and 166 miles, respectively. Under current conditions, early immature vegetation is most prevalent on private land (4,369 acres on private versus 111 acres on BLM land). Closure of roads and re-establishment of dense overstory canopies on reclaimed roadbeds would likely reduce existing noxious weed populations and prevent additional spread throughout the WAU.

3.7 Riparian Resources

Key questions to be addressed in this section include:

- What is the current condition of Riparian Reserves?
- What information is available regarding the early character of the riparian zone relative to its ability to supply functional large woody debris (LWD)?
- What is the current condition of the riparian zone relative to its ability to supply functional LWD in the near term?
- What are the dominant processes by which LWD is delivered to streams, lakes and wetlands in the WAU?
- What is the current condition of the riparian zone relative to its ability to supply LWD in the long term?
- What was the early condition of the riparian zone relative to its ability to provide shade?
- What is the current condition of the riparian zone relative to its ability to provide shade necessary to maintain desirable summer stream temperatures?

These questions will be addressed in terms of reference and current conditions for the following analyses: large woody debris recruitment and stream shading.

Reference Riparian Stand and LWD Conditions

Low-elevation riparian zones, prior to human development, were fully forested. Channels were well shaded by dense canopies of mixed hardwood and conifer forest. LWD in channels probable was abundant. Channels likely were less entrenched than they are today and likely flowed through extensive wetland complexes, which have been drained to facilitate agricultural uses. Lowland channels are low gradient and were not subject to debris flow scouring. Streambanks were predominantly stable, but episodes of streambank scour likely occurred in association with major floods and wildfires.

The Calapooya River was bordered by dense stands of mixed conifers and Oregon white oak. LWD may have been moderately plentiful along stream margins, but likely was uncommon at mid-channel due to the large size of the river. Streambanks were stable, although bank failure occurred during floods. Substrates were dominated by bedrock boulders, cobbles, and gravel, much as they are today.

Current Riparian Stand and LWD Conditions

Channels within the WAU, particularly the main tributary reaches at lower elevations have changed significantly from reference conditions. The channel within sections of the Calapooya River that are highly entrenched is much the same today as in the reference condition. Less constrained reaches, most common in the western portion of the WAU, may be less stable, with more fine sediments. Log drives and channel clearing early this century removed habitat complexity. Large and medium-sized conifers and hardwoods border most reaches, but width of this vegetative band is typically too narrow to provide high LWD recruitment or adequate shade.

Tributary channels within the WAU, with the exception of Pugh Creek, flow through lands cleared for agriculture, grazing, or rural homesites. Lowland tributary streams, particularly Courtney Creek, have been simplified and channelized to accommodate agricultural uses and to prevent flooding. These channels are classified as response reaches in the Washington methodology, but do not function as such due to channelization. Riparian forest has been cleared from nearly all reaches of the main tributaries for much of their length until they reach steeper slopes. Riparian vegetation is typically young and occurs in narrow bands along low-elevation stream reaches. Grazing and devegetation of channel banks cause severe streambank erosion in many areas.

Generally, stream channels within forested areas are stable. Few stream miles have been affected by scouring debris flows, and none have been affected within the past 30 years. Landslide effects are rare. Fine sediment content of channel substrates may be elevated above natural levels. However, substrate data have not been recorded for streams within this WAU. Riparian vegetation is much changed from the reference condition. Nearly all channels are now bordered by relatively small stands of mixed conifer and alder/maple hardwoods. As a result, shade, LWD, and LWD recruitment potential are typically low to moderate.

LWD Recruitment Assessment Methods

The riparian zone is the primary source area for large woody debris. Large woody debris, including tree boles, root wads and large branches is an important structural component of stream systems (Harmon et. al. 1996, Bisson et. al. 1987). Assessment methods were performed according to the Washington State Forest Practice Board Manual: Standard Methodology for Conducting Watershed Analysis (WFPB 1995). Near-term LWD recruitment potential was derived for current stand characteristics within 100 feet of each bank of the fish-bearing streams, consistent with standard manual procedures.

Approximately 55 miles of streams within the Calapooya WAU are fish-bearing and were assessed for LWD recruitment potential. Most fish-bearing streams are located on private lands (about 50.8 miles) versus BLM-administered lands (4.3 miles). A detailed discussion of aquatic habitat and fisheries associated with these streams is presented in Section 3.8.

All fish-bearing streams were viewed by a trained air photo interpreter using May and June 1995 color stereo pair aerial photographs (1:12,000 scale) to determine near-term LWD recruitment potential. The following riparian stand characteristics were interpreted from aerial photographs: species composition, tree size and stand density. Table 3-16 summarizes the coding system used to determine High, Moderate and Low recruitment potential for LWD. Approximately 30 riparian zone locations were field checked in December, 1998.

Deviation from Standard Methods

Segments were evaluated in increments of 1000 to 1500 feet, which deviates from the 2000-foot segment described in the manual. Given the large amount of managed forest, agricultural use and private land, smaller segments represent more accurately the variation of riparian vegetation.

TABLE 3-16

Coding System for Large Woody Debris

High Recruitment Potential	Moderate Recruitment Potential	Low Recruitment Potential
CMD	CMS	CSS
CLD	CLS	CSD
MLD	HMD	HSS
MMD	HLD	HSD
	MLS	HLS
	MMS	HMS
		MSS
		MSD

First Letter Indicates Species, Second is Age/Size and Third is Density
Species Key: C = Conifer; H = Hardwood; M = Mixed
Size Key: S = Small (DBH < 12"); M = Medium (DBH 12-20"); L = Large (> 20" DBH)
Density Key: D = Dense (< one third bare ground); S = Sparse (> one third bare ground)

Riparian Patterns and Processes

Flows of sediment, water, wood and energy into and out of the riparian zone is controlled by climatic, geologic, topographic, vegetative and management related activities (WFPB 1995). Tree species composition, growth and stand density within the riparian zone are influenced by many factors including moisture, light, soils, geomorphology and disturbance patterns (Stark et al. 1998). In areas where disturbance has occurred within the riparian zone, (either natural or man-made) deciduous tree species are dominated by red alder, big-leaf maple and willow. Conifers in the riparian zones are dominated by Douglas-fir.

Reference LWD Recruitment Conditions

Historic information from the 1910s (see Figure 3-12) indicated that most of the WAU including tributaries were forested. A significant amount of timberless area did exist, however, in the lower WAU along Calapooya River, Courtney Creek, and Brush Creek. Information from 1936 (see Figure 3-13) identified the continued conversion of timber to agricultural land in the lower reaches of the WAU. The amount of forested land converted to non-forest use appears similar to present conditions.

Information from a watershed analysis conducted by Stark et al. (1998) that included portions of this WAU indicated that by the mid 1940s much of the forest land along the Calapooya River and its larger tributaries (Brush Creek, Courtney Creek and Pugh Creek) had been converted from old-growth stands to managed forest and agricultural lands. The remainder of the WAU was covered with large conifers and deciduous trees.

Disturbance Patterns

Timber harvest, agricultural practices, and natural disturbances, such as fire, floods or mass wasting alter riparian vegetation. Removal of riparian vegetation influences both large woody debris recruitment and shading (Stark et al. 1998). Floods that carry debris torrents have impacted the riparian zones to a greater extent than fire or large-scale mass wasting. Only limited signs of recent debris torrents in this WAU were evident during the field reconnaissance as described in Section 3.3.

In many locations throughout the WAU, timber harvest practices included the cutting trees in riparian zones. This is evident on aerial photographs. On private lands, Oregon Department of Forestry requirements for maintaining LWD recruitment potential have increased substantially in recent years. Recent proposed land-management practices include the establishment of riparian reserves, with no-cut buffers on either side of a stream. On Federal lands, requirements for maintaining LWD recruitment potential are substantial. Establishment of riparian reserves will eventually allow continued and future development of LWD within the riparian zones.

Large Wood Recruitment Mechanisms

The delivery of large wood into streams is affected by many factors including tree species and age classes, soil stability, channel configuration and harvest history (Bisson et al. 1987). Recruitment of LWD can occur from chronic, episodic human-caused mechanisms (Steinblums 1977). Chronic inputs include trees or groups of trees that enter the stream channel naturally, from mortality or bank undercutting. Episodic inputs include blowdown or breakage, mass wasting from upslope areas or debris torrents. Human-caused inputs include large-diameter slash from timber harvests and accelerated mass wasting. In the Calapooya WAU, LWD is introduced to the stream systems primarily from the immediate riparian zone through bank cutting, mortality, and blowdown mechanisms.

Current LWD Recruitment Conditions

Recruitment from second-growth stands generally occurs 60 years after harvest or disturbance, with increasing rates thereafter (Grette 1985, Heimann 1988). The greatest potential for recruitment of woody debris is from coniferous stands due to their longevity and stability after death. However, deciduous hardwood species can provide woody debris and influence other riparian functions such as bank stability, shade and undercut bank potential.

Near-Term LWD Recruitment Potential

Table 3-17 lists the miles of low, moderate and high recruitment potential for LWD on BLM and private lands. A listing of the associated riparian stand conditions on a sub-watershed basis can be found in Appendix H. As Table 3-17 indicates, about 41% of the streams have high or moderate LWD recruitment potential while the majority of the streams, 59%, have low recruitment potential. These conditions occur in more or less comparable proportions on BLM versus private lands. Locations of high, moderate, and low LWD recruitment potential are shown in Figure 3-18.

Near-Term LWD Recruitment Potential (Low)

Areas in the Calapooya WAU classified as having "Low" near-term LWD recruitment potential were identified as follows:

- Hardwood Small Sparse
- Hardwood Small Dense
- Mixed Small Sparse
- Mixed Small Dense
- Hardwood Medium Sparse

Small diameter sparse hardwood stands make up almost one-third of the total riparian areas in the WAU. The majority of these stands are young oak trees along Courtney and Brush Creeks, agricultural areas. Dense stands of small hardwoods are found further up the tributaries and in areas where historic clear cutting has taken place. These stands comprise approximately 10% of the riparian areas within the WAU.

Mixed Small Sparse stands and Mixed Small Dense stands make less than 10% of the riparian areas in the WAU. These sparse and dense stands of mixed timber are found throughout the WAU, but occur primarily in the transition areas between agricultural and forest management practices. Douglas-fir, alder and big-leaf maple make up the majority of these stands.

The Hardwood Medium Sparse stands make up about 10% of the riparian areas of the WAU. These stands occur where the tributaries to the Calapooya River pass through agricultural land and along the Calapooya River. These stands consist of mainly Oregon white oak and big-leaf maple.

TABLE 3-17

Miles of Near-Term LWD Recruitment Potential on BLM and Private Lands

Land Ownership	Hazard Rating	Mileage
BLM	Low	2.8
BLM	Moderate	0.2
BLM	High	1.4
Private	Low	29.8
Private	Moderate	14.1
Private	High	6.8
Total		55.1

Near-Term LWD Recruitment Potential (Moderate)

Areas in the Calapooya WAU classified as having "Moderate" near term LWD recruitment potential were identified as follows:

- Hardwood Medium Dense
- Mixed Medium Sparse

Hardwood Medium Dense stands occur about 10% of the riparian areas of the WAU. Oak and big-leaf maple are dominant species along Courtney and Brush Creek in the agricultural areas of the WAU.

Mixed Medium Sparse stands occur in about 15% of the WAU. Only one segment of this stand type was identified and it was in the upper portion of the West Fork of Brush Creek. Dominant species are big-leaf maple and Douglas-fir.

Near-Term LWD Recruitment Potential (High)

Areas in the Calapooya WAU classified "High" for near-term LWD recruitment potential were identified as follows:

- Mixed Medium Dense
- Mixed Large Dense

Mixed Medium Dense stands were found in about 15% of the riparian zones of the WAU. These dense stands of mixed timber are present throughout the WAU, primarily in the transition areas between agricultural and forest lands. Douglas-fir and big-leaf maple make up the majority of these stands.

Mixed Large Dense stands are negligible within the riparian zones within the WAU. These stands consist of primarily mature Douglas-fir and big-leaf maple. The majority of the Mixed Medium and Large Dense stands of timber occur in the upper reaches of the tributaries on public or BLM land.

Long-term LWD Recruitment Potential

Future LWD recruitment is influenced by the current riparian condition. In general, those areas that are currently dominated by young or mature hardwood communities may require long periods of time to establish a conifer component that can contribute stable LWD (Stark et al.Weyerhaeuser, 1998). Four classes of long-term recruitment potential are identified in this assessment based on current riparian stand conditions:

- Low - Hardwood Dominated Stands
- Indeterminate - Sparse Mixed Stands
- Moderate - Dense Mixed Stands
- High - Conifer Dominated Stands

Table 3-18 summarizes the occurrence of these long-term LWD recruitment potential conditions

TABLE 3-18

Long-Term LWD Recruitment Potential on BLM and Private Lands

Land Ownership	Potential LWD Rating	Mileage
BLM	Low	2.2
BLM	Indeterminate	0.7
BLM	Moderate	1.4
Private	Low	23.8
Private	Indeterminate	19.3
Private	Moderate	7.7
Total		55.1

within the WAU. Long term recruitment potential is generally low in the WAU with about 47% of the riparian areas having a substantial hardwood component. Only about 17% are rated moderate, and the remainder are rated indeterminate. Overall, this is reflective of the fact that large portions of the fish-bearing streams pass through agricultural areas or the transition zone between agricultural land and forest lands where the potential for conifer dominated stands in relatively low.

Summary of LWD Conditions

From accounts of reference vegetative conditions, the riparian zone likely supplied large quantities and large piece sizes of LWD. Over time, riparian zone vegetation in the Calapooya WAU has been substantially reduced in size and density in many areas of the WAU. Effects are expected to persist in these areas converted from forest to agricultural and rural residential uses. Most areas within forested portions of the WAU are rapidly recovering their ability to supply functional LWD as riparian stands mature under the protection of Federal and State management requirements. Overall, LWD in the WAU is predominantly supplied to streams from adjacent riparian stands through stream bank cutting, blowdown, and mortality mechanisms. Downstream transport and mass wasting mechanisms appear to be minor in the tributaries, but may be of more importance within the Calapooya River from sources upstream of the WAU.

Stream Shade Assessment Methods

Stream temperatures are affected by stream and basin characteristics including shading, depth of flow, length of exposed reach, interchange of flows with near-channel water, and groundwater inflow. Tributaries of cooler water also play a role in moderating summertime maximum temperatures on larger streams (McSwain 1987, Holaday 1993). Air temperatures generally increase with decreasing elevation, likewise stream temperatures also increase with decreasing elevation causing streams lower in the basin to be warmer than higher streams.

Shade provided by riparian vegetation performs an important function for forest streams by maintaining optimal water temperatures for salmonids. Riparian shade can therefore be used to assess water quality in absence of actual stream temperature data (Stark et al. 1998). Assessment methods were performed in accordance with the WFPB Standard Methodology for Conducting Watershed Analysis (WFPB 1995). The assessment was completed using stereo pair 1:12,000 color aerial photographs. All fish-bearing streams were assessed. Field verification was completed at approximately 30 riparian zone locations within the WAU in December of 1998. Current canopy density is associated with elevation as presented in Table 3-19 to determine if current shade conditions meet the minimum percent shade requirement. This table identifies requirements by

TABLE 3-19

Minimal Stream Shade Requirements by Elevation Class

Minimum Shade Requirement (%)	Elevation (feet)
<10	>2320
10	1960-2320
20	1640-1960
30	1320-1640
40	1000-1320
50	680-1000
60	440-680
70	120-440
80	<120

90	N/A

elevation zone as per the Washington procedure. If current canopy density meets or exceeds the requirement for the elevation zone, the Oregon 7-day average temperature criteria of 64 degrees Fahrenheit is predicted not to be exceeded, and a low temperature hazard is assigned for the stream section. If the minimum canopy requirement is not met, a high hazard is assigned. Moderate hazards are not assigned using these procedures.

Deviation from Standard Methods

Segments were evaluated in increments of 1000 to 1500 feet, which deviates from the 2000 foot segment described in the manual. Given the large amount of managed forest, agricultural use and private land, these smaller segments represent more accurately variation within the riparian zone. Using this procedure, current canopy density is estimated for logical stream reaches.

Reference Stream Shade Conditions

Stream shade patterns roughly correlate with LWD recruitment potential patterns, since both methods are dependent on riparian stand conditions. Consequently, much of the same discussion regarding reference riaparian stand and LWD conditions applies. From accounts of reference vegetative conditions, the riparian zone likely supplied large quantities of shade. Historically, shade was high (> 70%) along tributaries of the Calapooya River. Also, in undisturbed areas along the Calapooya River, shading levels were between 40 and 70%, and in some locations, greater than 70% (Stark et. al. 1998). Over time, however, riparian zone vegetation in the Calapooya WAU has been substantially reduced in size and density in many areas of the WAU thereby reducing stream shade and its moderating affect on stream temperature.

Current Stream Shade Conditions

Table 3-20 and Figure 3-19 presents current shade hazard ratings differentiated by BLM-administered lands and private lands. A listing of the associated shade hazards on a sub-watershed basis can be found in Appendix H. Most of the Calapooya WAU has high shade hazard (approximately 76%) due to the length of streams that pass through agricultural areas and the transition zones between agricultural land and forest lands.

Shade recovery will likely not occur in the agricultural reaches of the tributaries and along the main stem of the Calapooya River unless land-use practices change. Agriculture has limited the potential for the establishment of timber that could eventually provide shade. As the riparian reserves become established in the upper reaches of the tributaries, the potential for shade would increase.

Summary of Stream Shade Conditions

Reference conditions were likely heavy shade for all streams within the WAU. Over time, however, stream shade has been reduced substantially, particularly in the agricultural and rural residential areas of the WAU. Consequently, stream temperatures are elevated above reference conditions and predicted to exceed the Oregon water quality standard in many of these areas.

TABLE 3-20

Miles of Stream Shade Hazard Ratings on BLM and Private Lands

Land Ownership	Hazard Rating	Mileage
BLM	Low	3.3
BLM	High	1.0
Private	Low	9.8
Private	High	41.0

Total		55.1

3.8 AQUATIC RESOURCES

Key questions to be addressed in this section are:

- What is the current condition of aquatic resources?
- Determination of potential fish habitat for spring chinook salmon (*Oncorhynchus tshawytscha*) winter steelhead (*Oncorhynchus mykiss*), resident rainbow trout and cutthroat trout (*Oncorhynchus clarki)*.
- Assessment of fish habitat quality and quantity (pools/riffles, LWD, juvenile rearing, spawning, etc) as well as possible from aerial photographs and the 1991 Oregon Department of Fish and Wildlife aquatic inventory report, provided by BLM.

These questions will be addressed in terms of reference and current conditions in the following discussion.

Reference Fisheries Conditions

Chinook Salmon

Willamette spring chinook salmon area mixed stock of hatchery and native fish. Currently, 5 to 15% of the stock is thought to be of native origin (ODFW 1992). The spring chinook salmon run in the Calapooya River is very small and the chinook salmon of the Upper Willamette basin are currently proposed for listing under the Endangered Species Act. No angler harvest data has been recorded since 1977 and the basin has been closed to chinook angling since 1988 (ODFW 1992). Historically, spring chinook salmon used theCalapooya River mainstem between the town of Holley (river mile 45) and the Treadwell Creek confluence for spawning and rearing (ODFW 1992). Fall chinook salmon were planted in the Upper Willamette Basin in the 1960s and 1970s following passage and water quality improvements of the Willamette River. Although fall chinook salmon did spawn in the Calapooya River in the past, redds have not been reported since 1974 and the population is thought to be minimal or non-existent (ODFW 1992).

Rainbow/Steelhead Trout

Willamette River winter steelhead are one of the few salmonid species native to sub-basins above Willamette Falls. After spending two years in the ocean, winter steelhead migrate into the Calapooya River from February through May. They use the mainstem as a migration corridor to spawning and rearing areas of Brush, Courtney, Pugh, and Carrie Creeks as well as the upper mainstem and its tributaries (ODFW 1992).

Non-native summer steelhead of Skamania stock origin were first introduced into the Willamette River basin in the 1960s following passage improvements at Willamette Falls and improved water quality of the Willamette River (ODFW 1992). Although this stock has been planted in portions of the Santiam sub-basin, they have never been introduced in the Calapooya WAU. The establishment of a wild summer steelhead stock in the Calapooya River from straying of introduced fish is believed to be unlikely (ODFW 1992).

Cutthroat Trout

Cutthroat trout are native to the Willamette River basin including the Calapooya watershed. They are widely distributed throughout the basin and can be found in most streams capable of supporting fish. (Weyerhaueser 1998). Populations of mountain whitefish (*Prosopium williamsoni*) and Oregon chub historically inhabited the WAU, but have not been found in recent fish sampling surveys. Bull trout (*Salvelinus confluentus*) also were native to the Willamette basin, but no record of their presence or use of the Calapooya (current or historical) WAU exists. Other native species found in the WAU include western brook lamprey (*Lampetra richardsoni*), and various sculpin species (*Cottus spp.*).

Current Fisheries Conditions

The Calapooya WAU encompasses approximately 154 miles of channel meeting the definition of a stream in the NFP. Of this, approximately 55 miles (34%) are thought to be fish-bearing. The Calapooya WAU supports both resident and anadromous fish species. Anadromous fish reported in this WAU include spring chinook salmon and winter steelhead. Resident salmonid fish species found in the WAU include cutthroat trout and rainbow trout. Whitefish is also known to occupy the Calapooya River.

Table 3-21 and Figure 3-20 present a summary of known fish presence within the WAU. Distributions were determined through review of fish sampling data, aquatic inventories, and stream surveys from the Calapooya River and tributaries within the WAU (see Appendix I). Also considered were discussions presented in Stark et al. (1998), ODFW (1992), and Armantrout (1995). Field reconnaissance was also performed on these streams to identify habitat limitations and culvert barriers, also shown on Figure 3-20.

Limited fishery data exists for the Calapooya WAU. ODFW has performed electrofishing surveys in tributaries to the Calapooya River (Courtney Creek, Bickmore Creek, East Fork Brush Creek, and West Fork Brush Creek). These surveys were done in 1978, 1979, 1995, and 1996 and report presence or absence of fish species within sampling reaches. Sampled reaches were field checked and fish distributions modified based on observed migration barriers and habitat quality. No additional fish sampling data for streams within the WAU were known to be available at the time of this report.

Cutthroat trout are thought to be widespread in the Calapooya WAU with distribution ranging from the mainstem of the Calapooya to small, unnamed tributaries. Cutthroat trout were found in unnamed tributaries to Courtney Creek, Courtney Creek, unnamed tributaries to the East Fork Brush Creek, and West Fork Brush Creek in electrofishing surveys (see Appendix I). They are also noted to occur in Carrie Creek and Pugh Creek (Stark et al. 1998). Cutthroat are thought to inhabit all fish-bearing streams within the WAU with habitat typically comprised of second order or larger streams, with moderate to steep gradients and drainage areas >142 acres (Armantrout, 1995).

Resident rainbows are likely present in the mid and upper reaches of the of the tributaries within the Calapooya WAU, especially in areas where populations have been isolated from migration by barriers such as road crossings and culverts. ODFW identified one rainbow trout in an unnamed tributary to the East Fork Brush Creek in their 1978 electrofishing survey. Overall, aquatic habitat inventories of upper stream reaches were extremely limited; however, it is clear from the previous section that the lack of riparian stand development and associated in-stream habitat components (e.g., large woody debris and shade cover) constitute significant limitations to aquatic habitat for resident fisheries.

TABLE 3-21

Known Fish Presence on BLM and Private Lands

Land Ownership	Salmonid Species	Mileage
BLM	RB/CT	0.7
BLM	SH/RB/CT	3.4
BLM	CH/SH/RB/SH/WH	0.2
Private	RB/CT	5.1
Private	SH/RB/CT	28.4

Private	CH/SH/RB/CT/WH	13.7
Total		51.5

Salmonid Species Key: RB = Rainbow Trout; CT = Cutthroat Trout; SH = Steelhead; CH = Chinook; and WH = Whitefish

Steelhead are most likely found in the Calapooya River of the WAU. Steelhead are known to use the mainstem of the Calapooya River as a migration corridor to spawning and rearing areas of the upper mainstem Calapooya and its tributaries. They are also known to have used the mainstem as a migration corridor to spawning and rearing areas of Brush, Courtney, Pugh, and Carrie Creeks and are therefore distinguished on Figure 3-20 (ODFW 1992). No aquatic habitat inventory data existed to characterize these reaches; however, it is apparent that seasonal problems associated with low flow and high water temperature may affect juvenile rearing and survival of steelhead/rainbows in the lower reaches of the tributaries of the Calapooya River. Culvert barriers and the lack of habitat complexity observed during reconnaissance may also be limiting factors for steelhead in the WAU.

Information obtained from Stark et al. (1998) indicates that ODFW's long range management policy is to restore the spring chinook run in the Calapooya River. Stocking of fry and adults has occurred in this system since 1981. Chinook have been known to spawn from Holley (northeast corner of the WAU) upstream, confirming their presence in the Calapooya River as it passes through the WAU. Limited information existed to characterize fish habitat quality within the WAU and field reconnaissance was utilized to identify habitat limitations. Based on field reconnaissance, none of the major tributaries to the Calapooya River (Courtney Creek, Brush Creek) appear to have suitable habitat for chinook salmon. Chinook prefer diverse, deep pool habitat with abundant woody debris or undercut banks for cover. The lack of this instream complexity can most likely be attributed to a shortage of LWD, agricultural influences and heavy grazing adjacent to the tributaries.

Potential salmonid species distribution was also evaluated adapting criteria developed by Armantrout (1995) (see Figure 3-21 and Table 3-22). Streams meeting the definition of a stream in the NFP were classified as follows:

- < 3% gradient - Chinook salmon
- < 6% gradient - Steelhead trout
- < 20% gradient - Cutthroat trout

This analysis produces a potential fish-bearing stream network more than double the amount presented above. Most of this increase is due to a) the model's incorporation of steeper gradient streams representing potential cutthrout trout habitat and b) inclusion of unsampled tributaries that the model indicates contains potential fisheries habitat. Conversely, it also indicates a much greater potential Chinook salmon habitat than was discussed earlier. This is likely due to the model's inclusion of stream reaches that are otherwise habitat-limited.

TABLE 3-22

Potential Salmonid Species Distribution on BLM and Private Lands

Land Ownership	Salmonid Species	Mileage
BLM	CT	13.1
BLM	SH/CT	0.6

BLM	CH/SH/CT	0.6
Private	CT	35.6
Private	SH/CT	7.8
Private	CH/SH/CT	60.9
Total		118.6

Salmonid Species Key: CT = Cutthroat Trout; SH = Steelhead; and CH = Chinook

From: Trish Wilson
To: Files
Subject: Calapooya Watershed Analysis Recommendation
Date: February 12th, 2002

The McKenzie Resource Area contracted to have the Calapooya watershed characterization, issues and key questions and current and reference conditions portion of the watershed analysis completed. The work was completed in June 1999. McKenzie Resource Area specialists reviewed work done and developed recommendations. In addition to the recommendations, the current conditions were updated to include a discussion on risk of sediment delivery to fish bearing streams. The recommendations section interdisciplinary team work was completed in 1999. Several events occurred that delayed the finalization of the recommendations documentation until now.

The draft recommendations were available for the specialists to review when doing work in the Calapooya Watershed. Efforts to implement riparian reserves treatments under the Calapooya Timber Sale were hampered by the need to provide habitat protection for Survey and Manage species (Red Tree Voles)

Attached are the update to the current and reference condition section and the recommendations.

Additional Current Condition Information

Risk of Sediment Delivery to Fish Bearing Streams

Information on mass wasting potential was further refined to specify risk areas to downstream resources (see Figure 4-2). GIS overlay maps (potential for mass wasting, streams and potential fish occurrence, the rain-on-snow zone, BLM ownership in the watershed) were used to define risk areas where sediment could possibly reach fish bearing streams and warrant review in the field at the project planning stage.

All mass wasting polygons adjacent to streams in the rain-on-snow zone, and a polygon adjacent to the main stream T&E fishbearing segment of the Calapooya River in T.14S. R.2W. Section 13, were placed in the Risk #1 category. Lower risk areas (Risk #2, Risk #3) correlated with the location of the mass wasting polygons and how they were topographically related to the adjacent stream. If the polygon was situated in a headwall area at an angle where a debris torrent could easily scour the stream for some distance, it was placed in the Risk #2 category. If the mass wasting polygon was located adjacent to a stream, but where slide debris would likely not be transported down the stream channel (ie. the slide would fall into the stream and stay there), it was put into Risk #3 category.

The following are the definitions for the three risk levels:

- Risk Level 1 - Moderate/high mass wasting potential within transient snow zone
- Risk Level 2 -Moderate/high mass wasting potential outside of transient snow zone, headwall areas, high potential mass wasting areas, adjacent to fishbearing streams
- Risk Level 3 - Moderate mass wasting potential outside transient snow zone, adjacent to streams

The risk areas have not been field checked at this time. Early in the project planning stage, areas delineated on Figure 4-1 with potential risk to streams should be reviewed by the Soil/Water staff.

4.0 Calapooya Watershed Analysis Recommendations

4.1 Introduction

A list of recommendations was created by an Interdisciplinary Team (ID Team) using information from chapter 3, field observations, management direction and professional judgement. Figure 4-1 delineates the area covered under this section. The recommendations are suggestions or guidelines as to the possible type of actions based on information that is available. Through further investigation on the ground or by new information, suggested projects may not occur or new ones may be added.

These recommendations are not decisions. Further site-specific field work and analysis are needed before the Area Manager decides to initiate a project. Besides more field work and analysis, an environmental assessment will be prepared where appropriate to adhere to the National Environmental Policy Act of 1969.

4.2 Riparian Reserve Management Recommendations (Plant Species Composition, Structural Diversity and Habitat for Riparian-dependent Species)

The goal of treatments in these areas is to restore structural diversity of riparian plant communities and restore habitats to support populations of plant and wildlife species dependant on riparian habitats. Site specific projects should be based on ecological or biological rationale for management in riparian reserves. Discussed in this section are opportunities for increasing the potential for LWD and snags in the watershed.

The Calapooya watershed analysis unit is deficient in large woody debris (LWD) and snags. See pages 3-27, 28 and 53 for information on the current condition. This watershed has a low potential to provide LWD as described on page 3-51. See figure 3-18, a map, to learn which streams are high, moderate or low recruitment potential. High, moderate and low potential refers to the large wood recruitment potential are defined in the Chapter 3 as:

High potential
- conifer dominated stands or mixed stands with an average dbh greater than 12 inches and dense stands

Moderate potential
- conifer dominated stands or mixed stands with an average dbh greater than 12 inches and sparse stands
- hardwood dominated stands with an average dbh greater than 12 inches and dense stands

Low potential
- conifer dominated stands or mixed stands with an average dbh less than12 inches and sparse or dense stands
- hardwood dominated stands with an average dbh greater than 12 inchesand sparse stands
- hardwood dominated stands with an average dbh less than 12 inchesand sparse or dense stands

4.2.1 Opportunities Watershed-Wide

Thinning

Look for opportunities to thin riparian areas lacking structural diversity indicative of properly functioning riparian areas. Growth potential for existing trees in riparian areas densely stocked with young trees is severely limited by competition/shading. Thinning BLM riparian reserves could accelerate development of forest structure, thus increasing LWD potential. The long term benefits for aquatic and terrestrial wildlife species could be fostered without unacceptable short term effects.

Areas with low LWD potential typically have little down wood in the streams and on the forest floor. Areas with moderate to high LWD potential would have some down wood in the streams and on the forest floor. Efforts to increase LWD potential will focus first on the riparian reserves with low LWD potential because they have the least amount of LWD. At the watershed level, a small percentage of the fish bearing streams are on BLM land; therefore, benefits to fish from increased stream structure would be small. However, species other than fish would benefit from the creation of down wood. The table below describes the priority and locations for thinnings.

Table 4 -1
Priority for increasing the LWD potential

Priority	Current Condition	Location
High	low LWD potential and threatened and endangered species presence	14-1W-33; 15-1W-9
Moderate	low LWD potential and fish presence	14-2W-34,35; 14-1W-31,25
Low	low LWD potential and no fish	unknown; only fishbearing streams were assessed for LWD potential
Low	moderate LWD potential	unknown; only fishbearing streams were assessed for LWD potential

Snag and Down Log Creation

Examine opportunities to create snags and down logs. See section 4.3.1 for more information

4.2.2 Opportunities in Courtney Creek Area

The subbasin is different from the rest of the watershed. This area contains riparian stands that are hardwood dominated or mixed stands of Douglas fir and hardwoods. Therefore, there are some additional management recommendations for this area as discussed in the table below.

Condition	Opportunity	Rational
hardwood dominated stands in riparian reserves older than 49 years	no hardwood conversion is recommended	Conversion efforts in these stands could produce unacceptable levels of sediment to adjacent streams. The negative impacts that would occur from hardwood conversion outweigh the positive impacts. Some areas that are now supporting dense stands of hardwoods may have historically been dominated by conifers. This condition is most likely the result of past management. These stands will proceed at their natural succession rate.
Hardwood dominated stands younger than 49 years	Thinning in hardwood stands would be an opportunity. The thinning should favor creating single stem big leaf maple	Larger hardwoods would benefit both fish and wildlife. Large hardwoods are relatively short-lived, but do provide a source of large diameter dead wood. A high, dense, leaf canopy will provide summer shade and winter sun, large amounts of seed production, and a variety of cavities due to the trees' propensity to sustain damage from storms.
Douglas-fir and hardwood mixed stands	Thinning the stands to favor Douglas-fir, w. hemlock, and w. red cedar.	The objective is to favor the conifers, create larger trees for LWD recruitment potential, future snags, and stand diversity.

4.3 Distribution, diversity, complexity and landscape features

This section will discuss objectives and actions for maintaining and restoring the distribution, diversity, and complexity of the watershed and landscape-scale features (ASCO 1,2). This section will look at upland actions within the context of managing for land use allocation objectives as well as for aquatic resources.

4.3.1 Snags and Down logs

Examine opportunities to create snags and down logs throughout the watershed where levels are below RMP retention standards (3.4 snags/acre and 240 lineal ft of down logs/acre) and where trees are of sufficient size to create snags and down logs that meet RMP specifications. The highest priority areas to consider are within the Bald Eagle Habitat Areas (BEHAs). The McKenzie Resource Area Bald Eagle Habitat Management Plan includes management recommendations for creating snags and down logs within the BEHAs (Appendix K). Other high priority areas to consider for creation of snags and down logs are those areas adjacent to known spotted owl activity areas (potentially improving the habitat) and areas adjacent to BEHAs and stands with sufficient snags and down logs (creating contiguous areas of higher quality habitat for species utilizing snags and down logs).

4.3.2 Oak Woodlands

Through limited field review, it has been noted that 1) no active management has occurred, 2) no vine maple or scotch brown was found in oak woodlands, and 3) Douglas fir is not invading the woodlands. There is a lack of information about the oak woodlands within the watershed. The following recommendations should be considered when an oak woodland has been identified.

- Map the location in GIS
- Prepare a description of the condition of the oak woodlands
- Survey to determine if there are any invasive species present
- Apply recommendations contained in the Oak Woodland Delineation and Assessment

Some of the oak woodlands may exist on wetlands. Different management action or mitigation measures may need to be proposed if the oak woodlands contain wetlands.

4.3.3 Bald Eagle Habitat Area (BEHA)

The portions of the Coburg Hills BEHA that are in the Calapooya watershed are currently used by bald eagles as winter roosting and staging areas. The McKenzie Resource Area Bald Eagle Habitat Management Plan includes site specific management recommendations for maintaining and enhancing this BEHA. Appendix L displays these recommendations for the Calapooya portion of the Coburg Hills BEHA. The following table summarizes some of the objectives and opportunities for the Calapooya portion of the BEHA that are detailed in the management plan.

Objectives	Opportunities/Management Recommendations
• Emphasize large tree development and the recruitment of under story trees to promote stand diversity	• Density management thin on 260 acres. • Understory thinning on 34 acres • Individual tree management by creating snags and/or down logs around the targeted tree on 427 acres
• Manage BEHAs for wildlife species that use tree cavities or down logs; • Enhance stand structure	• Individual tree management by creating snags and/or down logs around the targeted tree on 427 acres. • Create snags and down logs on 369 acres. • Create a minimum of 10 snags per acre and minimum of 500 linear feet of down logs per acre.

4.3.4 Area of Critical Environmental Concern and Research Natural Areas

- Complete a management plan for the Horse Rock Ridge ACEC

4.3.5 Relic Forest Islands

- An ID team needs to examine whether a management plan is needed for these areas. The team should include a wildlife biologist and botanist.

4.3.6 Matrix

- Consider focusing precommerical thinning or thinning in areas access by roads that have been identified for closure.

- No priorities, schedule or constraints for timber harvest were developed. Given that most of the harvesting would be thinnings, no constraints, priorities or scheduling was needed to space out negative effects. The amount of potential thinning and the impacts from thinnings would not generate unacceptable impacts at the watershed level.

4.4 Transportation Management Recommendations

A transportation management assessment was not completed. It is recommended that a transportation management assessment is completed. Until then, transportation management can occur on a case-by-case basis.

TEAM MEMBERS

The recommendations section was developed by BLM personnel

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Paula Larson	Wildlife Biologist
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