

Watershed Vegetation/Ecosystems Inventory and Analysis

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Abstract: The Illinois Basin is part of a diverse ecological region which has complex vegetation patterns. To help simplify this complexity, thirteen broad vegetation-climatic zones were classified and mapped for the watershed. Local landscapes were classified and intensively mapped for the central valley floor. Ownership, use and management statistics are presented for the basin/subwatersheds. Runoff was correlated with cover types for hydrology modeling. About 95 percent of the basin is in native cover with 30 percent in a timber management base. In the last 50 years, 15 percent has had wildfire, 9 percent was clearcut and 14 percent had selective cutting.

Introduction and Setting

The vegetative component of natural landscapes is one of the most visible features in a watershed. Its importance to the public, to ecological processes and to watershed management often makes it a centerpiece for inventories and assessments.

Vegetation inventories are most meaningful when done on an ecological basis and with an ecosystem framework that relates vegetation to its home or environment. This is the approach used here for discussing vegetative resources of the Illinois River Watershed.

The watershed (basin) is part of a large, diverse ecological region in southwest Oregon and northwest California, long recognized by ecologists as different from adjoining areas. Vegetative diversity here is the response to a wide variety of contrasting environmental factors involving climate, geology, soils, topography and biological factors. Superimposed over this environmental grid are the effects of management activities and natural disturbances, particularly fire. This broad array of site factors coupled with major regional and local environmental gradients create a wide variety of ecological niches in the landscape. As a result, the Siskiyou Mountains have an unusual mix of species from adjoining regions and great diversity in habitats.

Environmental Factors Affecting Local Ecosystems

Geology and Soils - Soil properties and related geologic features directly affect Illinois Watershed vegetation. Some rock types such as serpentinized peridotite (ultramafic) have unusual effects on the chemical properties of associated soils, greatly affecting plant adaptation, production and composition of the site. Other characteristics of importance to plant adaptation and growth are soil depth, texture, nutrient supply, drainage and rock

fragrant content. These all function together to either restrict or facilitate vegetative development to the maximum under the prevailing climate.

A geology map of the Siskiyou Mountains developed by Coleman was adapted for use in this watershed (Appendix A, Map 1). Because of its contribution to soil development, geology is uniquely related to soil type. For example, the most productive soils for Douglas-fir are those that formed in material derived from metamorphosed sedimentary and volcanic rock (Josephine County Soil Survey Report, page 111). It further states that the least productive soils for Douglas-fir are those derived from ultramafic rock, such as peridotite and serpentine. Other examples of geological effects on the local ecology occur with soils derived from granodiorite, quartz-diorite or granite (page 147). Vegetation on these coarse textured soils encounters increased droughtiness and lower fertility, while forest managers encounter tree regeneration difficulties and high soil erosion potential.

In addition to geology, soil factors alone can alter the vegetation potential. For example, shallow soils in the interior valley restrict the development of conifers and support white oak-grass savanna on low elevation southerly aspects. And wet, poorly drained soils of swales or bottomland support hardwoods with grass or sedge understories. Soil information for the Oregon portion of the watershed is available in the Josephine County Soil Survey Report and Curry County Soil Survey prepublication manuscript (see literature reference list).

Topography - The Illinois River Watershed extends over 50 miles in length from its headwaters in the Siskiyou Mountains through the Coast Range to its mouth at Agness. Mountainous topography is found throughout its extent except for the central interior valley around Cave Junction. Topography in this watershed has a profound influence on the vegetation, with very predictable changes in cover as the result. For example, increasing elevation elevates the landscape into colder environments with shorter growing seasons, colder temperatures, higher precipitation and higher snowfall. In the Illinois Watershed, this means predictable changes in potential species composition and eventually reduced site productivity. Steep topography creates aspect differences on north facing and south facing slopes. Vegetation on southerly aspects is adapted to warmer and dryer conditions, always differing from that of northerly aspects with cooler temperatures, less direct solar radiation and greater moisture availability. And in some areas the configuration and position of mountain canyons/valleys below high elevation snow zones traps cold air, as in the upper Deer Creek drainage. This creates a zone or pocket of more cold tolerant vegetation which resembles ecosystems at much higher elevations.

Climate - Climate is the primary filter for vegetation regarding plant adaptation to any region. Southwest Oregon has the most contrasting climatic regimes in the Pacific Northwest. The marine climate at Oregon's coast with very mild, humid environments changes eastward to the dry, warm interior, a more continental-like climate. North to south a large transition occurs from the mild, moist climate of northwest Oregon

(Willamette Valley) to the Mediterranean climate of central California. The Illinois Basin is significantly influenced by these regional transects in climate, which in addition to topography produce the local contrasts in weather patterns within the watershed.

Two maps are available which display annual precipitation for southwest Oregon. Both maps were produced by Oregon State University (Taylor, 1993, Extension Service, 1982) and were used to make precipitation estimates for this report (Appendix B, Tables 1, 2).

The river mouth at Agness lies in a narrow coastal valley with average annual precipitation of about 85 inches. Climate here is still very much coastal but with less fog and warmer summers. High ridges in the vicinity are thought to average 120 to 140 inches annually. Thirty miles inland the larger central valley at Cave Junction lies in a rain shadow east of the Coast Range Mountains. This interior valley with less precipitation (about 55 inch average) has hot summers and more spring frost than at Agness. However, when compared with other interior valleys at Grants Pass or Roseburg and Medford, Cave Junction is much higher in precipitation, with less extremes in temperature.

Climatic variation is closely linked to local topography as discussed above. The interior mountains in the Siskiyou or upper watershed average only about half of the precipitation received by the coastal mountains, or 50 to 80 inches. Besides the rain shadow effect from the Coast Range Mountains, elevational temperature zones are striking, becoming progressively colder with shorter growing seasons and longer periods of snow cover as elevation increases. Also, the coastal mountains are colder, at lower elevations, than are the Siskiyou east of Cave Junction. Consequently, the elevation of the primary winter snow zone east of the Redwood Highway begins nearly 1,000 feet higher than it does west of the highway.

In addition, much local variation in vegetation can be attributed only to "microclimate" differences as the result of topographic effects. Examples include the ponding of cold air in narrow valleys, higher humidity/fog in some localities and the modification of available moisture with aspect, i.e., dry, hot southerly slopes and moist, cool northerly slopes. These conditions are repeated throughout much of this watershed.

Summary of Conclusions/Concerns

- Vegetation/climatic zones were used to delineate geographical areas with unique ecological characteristics. Management implications were also identified for the zones.
- Subwatersheds were characterized and analyzed in numerous ways to summarize ecosystem parameters, land use, treatment history and management interpretations.
- Runoff characteristics were found to be inherently different between the subwatersheds because of ecosystem differences (climate, soil/geology, cover).
- Ecosystem impacts related to watershed development, use and management have included changes in wildlife use, runoff hydrology, water quality, plant cover/composition, site productivity, site sustainability and natural burning cycles.

- Watershed hydrology changes were initiated with European settlement in the 1850's. Hydrology has also been significantly impacted by ecosystem management during mid (20th) century. The relative, cumulative hydrologic impacts of land use changes, management treatment and wildfire history were considered for the present decade, one historic period, and a full cover baseline.
- Native prairie, oak savanna, wetlands and riparian ecosystems were probably impacted the most during the first 50-75 years of settlement (mining, grazing and agriculture). Upland forest ecosystems have been impacted the most during the last 75 years since settlement due to timber harvests, roading and fire control. Ecological status varies by location/treatment but is mostly mid-seral, or in some areas totally converted from native vegetation to other uses.
- Roading covers 1.2 percent of the basin (2.6 miles/section). Its greatest environmental impact is in sensitive local areas, and in subwatersheds where density is much higher, i.e., Deer Creek (5.7 miles/section), Althouse Creek (4.4 miles/section).
- The timber management base where sustained timber harvest is an objective and support to the local economy is about 30 percent of the watershed (190,000 acres).
- In the last 50 years, about 9 percent of the basin (55,000 acres) has had clearcutting, largely in Althouse Creek and five other subwatersheds. Between half and two thirds of this acreage has not yet fully recovered hydrologically.
- Nearly 90,000 acres (14 percent of the Illinois River Basin) have had partial cut harvesting over the last half century, with the greatest acreage in Deer Creek and West Fork Illinois River subwatersheds. An estimated 20 to 50 percent has not fully recovered hydrologically.
- Wildfires have burned 15 percent of the Illinois Basin in the past 50 years. Under historic conditions, probably 90 percent of the area would have burned at least once, and some areas would have reburned twice or several times.
- Wildfire acreage since World War II (nearly 100,000 acres) is primarily in the Indigo and Silver Creek watersheds. About 20 to 40 percent was stand replacement burning with the rest underburning. Most acreage has not fully recovered hydrologically, and severely burned areas will be in recovery for at least a couple more decades.
- Fire control has protected large acreages from natural burning. Impacts to local ecosystems include increased forest understory density, prolonged litter accumulation with delayed nutrient releases, species composition changes, greater forest disease/pest outbreaks, woody species creep into historically open sites, and higher risk of catastrophic fires.
- The high percentage of this watershed in public ownership (82 percent) gives the public an opportunity for input into management of the majority of the basin. But mixed ownership patterns (Federal and private) in many subwatersheds also mean cooperative efforts are essential for implementing watershed-level activities, such as management of hydrologic condition, water quality, fisheries, etc.

Scope and Objectives

The vegetation section focuses on identifying and characterizing broad (regional) ecosystems, their location and extent within the Illinois River Watershed (basin). Special emphasis will also be given to identify local ecosystems and soil-vegetation relationships of the central valley floor or heart of the watershed. The recent vegetative treatment history (covering the last half century) is presented and evaluated. Baseline land use and vegetation management data for the last half of the century are discussed and related to landscape conditions and ecological processes. The information is an essential contribution to the goal of making this watershed inventory/assessment “ecosystem based.”

Subject matter to be covered in the vegetation section includes:

1. Environmental setting and major climatic zones (macroclimate)
2. Regional ecosystems (vegetation zones) of the watershed
3. Landscape data/management interpretations for ecological zones
4. Local soil-vegetation patterns and potential plant communities (including riparian) of the large central (interior) valley
5. Ownership, land use, wildfire and timber harvest statistics
6. Vegetation and landscape changes from land use conversion, disturbance and management
7. Subwatershed facts, statistics and comparisons
8. Runoff and watershed hydrology for different decades, treatments and vegetative cover - see hydrology section also

Results and Discussion

Watershed Potential Vegetation-Climatic Zones

Vegetation/climatic zones are proposed for the Illinois Watershed after correlating climatic records with topography and vegetation patterns on the landscape. Climatic relationships are expressed in vegetation through species presence and abundance, the growth form and vigor of some species, the topographic position of plant communities and the way communities are grouped together across the landscape. An NRCS vegetation inventory and analysis of plant distribution patterns is the basis for proposed ecological zones believed to be closely linked to climatic patterns.

A Natural Vegetation and Climatic Zone map related to both present and potential vegetation is presented as Map 2 (Appendix A). Regional zonation is delineated primarily from observations of vegetation on “typical soils” that are without major limitations for plants. A landscape cross-section (Appendix B, Figure 1) gives a topographic transect showing the relationship of vegetation zones to relief.

The zone map for a watershed can serve as a guide to help users simplify and understand extensive, complicated vegetation patterns. Although vegetation zones may cover large

geographical areas, the same basic set of ecological sites is repeated throughout the zone. A zone map is the visual display for the general location/range of individual plant communities on the landscape. And, plant community landscape descriptions are the key to where they are located within the zones.

Native vegetation (plant associations) of the Illinois Watershed has been classified, primarily by USFS (outside Interior Valley) and NRCS (within Interior Valley) - see Appendix E and literature references by Atzet (1979, 1996), Hickman (1997). More study would show that this is not a complete list. Detailed "ecological site" mapping by NRCS was done in the Interior Valley surrounding Cave Junction and Selma (Hickman, 1997). A vegetation map for this valley is included here as Appendix A, Map 3. Considerable "plant association" mapping has been done by USFS for several subwatersheds (see assessment reports cited in the reference list).

Vegetation zone maps are best made after actual detailed mapping of ecological sites or plant associations, which was beyond the scope of NRCS inventory for this report. Consequently, the mapping was accomplished using NRCS field plot samples, reconnaissance, and other studies available within the watershed. Field plots were analyzed and sorted on plant association tables into landscape groups that are summarized in Appendix B, Table 5.

Thirteen vegetative zones were identified and mapped. Three of these are moist, low-elevation upland landscapes. Two are dryer, low-elevation valleys and foothills. Four are cool, middle-elevation mountains which are intermittent snow zones, and four are cold, high-elevation mountains that are heavy snow pack areas with very short growing seasons.

A vegetation zone chart comparing climatic and management characteristics of the zones is presented in Appendix B, Table 1. The summary of key native plant species characterizing vegetation zones is given to illustrate their similarities and differences. Appendix B, Table 2 provides vegetation zone acreages and other zone data by subwatersheds. A subwatershed map of the basin, including watershed acreages, is provided as Appendix A, Map 4.

Coastal Tanoak Zone - This climatic zone occurs only on the west side of the Coast Range (Appendix A, Map 2) and covers 65,000 acres or 10.3 percent of the basin. Here in the lower watershed, marine climatic influences have a strong effect on vegetation. Cloud cover and/or fog occur often enough in the summer to create a moderating effect on summer temperatures and evapotranspiration. Average annual precipitation is high or about 90 to 130 inches. Elevation ranges from near 400 feet in coastal valleys to about 2,800 feet on ridges. Soils with mesic temperature regimes and udic moisture regimes typify this zone.

The Coastal Tanoak Zone is best characterized by Douglas-fir and a very large, productive growth form of tanoak on all aspects, where soils are suitable. North slopes

have few other trees in the potential overstory, but incidental chinkapin, Port-Orford-cedar or red alder are sometimes present. California laurel occurs in local areas with madrone and sometimes sugar pine on south aspects.

Understories are often dense with tanoak reproduction and a few evergreen shrub species, namely salal, rhododendron, and/or evergreen huckleberry. A few deciduous shrubs like dewberry, wildrose and red huckleberry may occur. Sword fern is very common and nearly always present along with beargrass.

This zone has the highest forest productivity in the watershed (see Appendix B, Table 1), except on restrictive soils, i.e., shallow, stony, chemically imbalanced and coarse textured uplands. A major management concern is the competitive nature of tanoak which readily sprouts after cutting or burning, and is a very aggressive understory competitor (sprouter). Compared to the **Interior Tanoak Zone**, there is generally less concern over insect and disease problems here, except as follows. Sugar pine, although a minor species, may have a higher incidence of blister rust, and the potential for Port-Orford-cedar infection with root rot disease seems to be higher in the coastal zone.

Interior Tanoak Zone - This climatic zone occurs in the central watershed (east side of the Coast Range) and in the Siskiyou Mountains (Appendix A, Map 2). It covers about 264,000 acres and is the largest vegetation zone (42 percent of the basin). When compared with the **Coastal Tanoak Zone**, it is warmer in the summer with greater extremes in temperature. Also, it is generally lower in precipitation with a longer period of summer drought, and has greater plant moisture stress. Precipitation is estimated to average from 50 inches adjacent to the Interior Valley to nearly 100 inches annually on its western boundary. Elevation is generally under 2,800 to 3,000 feet west of the Redwood Highway and under 4,000 feet east of the highway. Soils with mesic temperature regimes and xeric moisture regimes are typical of the zone.

The presence of east side indicator plants and lower forest productivity, especially for tanoak, help separate the **Interior Tanoak** from the **Coastal Tanoak Zone** (Appendix B, Table 1). It is characterized by an abundance of tanoak in tree form on north aspects, and by tanoak typically in shrub form on south slopes. Douglas-fir is the primary overstory associate which usually dominates older stands. Rhododendron, salal and Port-Orford-cedar are less important here than in the **Coastal Tanoak Zone**, with sugar pine, ponderosa pine, incense cedar, madrone, black oak and canyon live oak becoming very important. Shrub cover is less evergreen dominant and more mixed with deciduous species, of which poison oak, hazel and oceanspray are very common.

Some features of this zone have important impacts for management (Appendix B, Tables 1 and 2). The hot summers and longer dry season greatly increase the length and severity of the fire season. There is a general increase, over the coastal zone, in plantation problems and disease/insect infestations (mistletoe and root rot for Douglas-fir; bark beetles for sugar pine and ponderosa pine). Also of concern here is the competitive nature of several aggressive hardwoods, but with less potential for red alder.

Lower Illinois River Canyon - This is a minor zone of 10,700 acres (1.7 percent of basin) that appears to be a special, transitional climatic situation. It is confined to lower elevation slopes of the lower Illinois River canyon (Appendix A, Map 2) below about 1,600 feet. It may be the result of warm east-west air movement from the interior through this canyon, which crosses the Coast Range Mountains. Average annual precipitation is assumed to be about 100 inches or more. Soils with mesic temperature regimes and both udic and xeric moisture regimes characterize the zone.

The lower Illinois canyon could not be accessed for this inventory because of its remote location, so data from other studies was used for its description. Much of the available information came from a USFS study by Emmingham in the Illinois River corridor, the only known source of ecological data for the area (see reference list).

Although the zone is primarily found within the coastal portion of the watershed, its position is thought to be transitional between climates of all adjoining zones. It is believed to be similar to the Rogue River canyon above Illahe which is vegetatively transitional and may be a westward funnel for warm air at times from the hot interior. Both canyons cross the center of the Coast Range and are the connections between coastal and interior climates. At the upper end of the zone, this canyon begins to blend in with the **Interior Tanoak Zone** and disappears. At the lower end, the zone merges with a unique coastal valley centered geographically around Agness.

Vegetation is similar to the **Coastal Tanoak Zone** with less of the mesic species such as rhododendron and salal on the more productive soils. Evergreen huckleberry is strong and some of the east side indicators like black oak and canyon live oak may appear more frequently, especially on stony or southerly slopes. Forest management does not include timber production here because of its rugged, remote location and unique environmental values that have been set aside for other uses (see Appendix A, Map 7).

Coastal Valley Black Oak Zone - This minor climatic zone occupies about 10,000 acres (1.6 percent of basin) at the mouth of the Illinois River canyon (Appendix A, Map 2). It is an extension of the larger open valley at Agness that extends up the Rogue River just past Illahe. Elevational range is generally below 1,600 feet, and average annual precipitation is about 85 inches near Agness. Soils have mesic temperature regimes and udic or xeric moisture regimes.

As in the adjacent uplands, Douglas-fir and tanoak are the primary overstory species. Although precipitation here is high, other vegetative characteristics make it appear to be much dryer. Many interior (east side) species become prominent here, creating an island surrounded by coastal vegetation. For example, more drought-tolerant species are abundant, such as black oak, white oak, ponderosa pine, hazel and deerbrush. And some of the more prominent mesic species such as rhododendron, salal and Cascade Oregongrape are scarce or absent.

The explanation for this situation may be the result of warm air movement from the hot interior down the large Rogue River Canyon (and possibly the Illinois River Canyon) toward Agness. This canyon may somehow act as a funnel from the interior for warm air in the summer and possibly for colder air at times in the winter, which reaches this valley and modifies the prevailing climate.

Only a small portion of the zone (confined to private land) is available for timber management since the public lands here are classified for other uses (Appendix B, Table 3). The deeper soils without restrictions are very productive timber sites. Valley terrace forest soils have strong deciduous shrub understories. Numerous areas on benches and south slopes have restrictive soils which support hardwood tree/grass savanna and provide much diversity for wildlife.

Interior Valley Black Oak Zone - This zone includes the entire central valley floor and foothills around Cave Junction (Appendix A, Maps 2 and 3) covering nearly 85,000 acres or 13.5 percent of the Illinois Basin. Much of the private ownership in the Illinois Basin (nearly 35 percent) is in the **Interior Valley Zone**, along with about 25 percent of the total BLM ownership (Appendix A, Map 5). Precipitation for the zone is under 60 inches, averaging about 55 inches near Cave Junction, but probably as low as 45 inches in the Selma area. Although summer temperatures can be very hot, spring frosts can occur in the valley as late as May, especially in the Deer Creek valley above Selma, which seems to be the colder side of the zone. Soils in this valley have mesic temperature regimes and xeric moisture regimes. A very condensed, small-scale composite map of the soil mapping for this zone was prepared on GIS from the Josephine County Soil Survey Report and is filed with NRCS.

This valley and associated foothills have an unusual combination of very hot summers and somewhat high annual precipitation, at least when compared to other southern Oregon valleys. Under this climatic regime (on non-serpentine soils), there are large areas with the potential for productive Douglas-fir dominated stands. These often contain sugar pine, ponderosa pine, incense cedar, madrone, black oak and/or live oak. Deciduous shrubs are prominent, particularly hazel, snowberry and poison oak. Interspersed throughout the area is white oak savanna, Jeffrey pine-grass savanna, poor quality Douglas-fir/Jeffrey pine forest and brush fields of manzanita or ceanothus. Hardwood or hardwood-conifer bottomlands and riparian corridors which support cottonwood, ash, maple, oak, California Laurel, white alder, willow, ponderosa pine, incense cedar and/or sometimes Douglas-fir are common.

A more detailed investigation was made of the ecosystems in the **Interior Valley Zone**, than for other vegetation zones of the Illinois Watershed. This work was described in a publication by Hickman (Appendix E) and included a map of the potential vegetation or ecological sites (Appendix A, Map 3). This study describes in detail the landscape positions of plant communities, their extent in the valley, some historic comparisons with present conditions, and the soil relationships with vegetation.

Forest management in the **Interior Valley Zone** occurs on a wide variety of soils with low-to-moderate productivity (see soil survey publication: Borine, 1983). Problems on plantations range from moderate to high due to the hot, droughty summer climate and aggressive shrub or grass competition. Conifer damage and/or mortality is widespread in some species, particularly from root rot disease and mistletoe in Douglas-fir, and bark beetles in ponderosa pine. Trees are most vulnerable in drought cycles, especially in high density stands, to root disease and beetles.

The potential for wildfire ignition here (Appendix B, Table 1) is probably highest in the watershed because of the long, dry season, highly flammable fuels and wide variety of sources that can cause fires. Also, weeds (especially exotic grasses/forbs) are the most widespread and abundant in the Interior Valley vegetative zone. This is probably due to 1) the climate, 2) the wide variety of environmental niches, 3) the large proportion of plant cover that is disturbed (and vulnerable to weed invasion) or converted from native to other land uses (urban, agriculture, roads), and 4) the high potential for weed transport into the valley via traffic, agricultural supplies-products, and residential development or landscaping. Lastly, the greatest competition for use of natural resources occurs in this zone or ecosystem of the watershed. Nearly all of the people and most industrial, residential, and agricultural developments of the Illinois basin are found here (Appendix A, Map 6). Consequently, the demand for water, wood products, industry-providing jobs, recreational opportunities, fish/wildlife, and new land for development is high.

Cool Mixed Conifer Zone (west) (east) - This productive, high elevation, mixed conifer forest ecosystem is confined to an elevation belt between about 3,600 and 4,800 feet in the Siskiyou Mountains, and 2,800 to 4,000 feet in the Coast Range Mountains west of the Redwood Highway (see Appendix B, Table 1, and Appendix A, Map 2). Watershed coverage is about 101,500 acres or 16.2 percent of the basin (west side) and 33,500 acres or 5.3 percent (east side). About 93 percent of the zone is managed by the USFS with about 3,900 acres in private ownership. The zone represents upper slopes, ridgetops and islands around low mountain peaks. Average annual precipitation is estimated at 50 to 75 inches in the east side zone and 60 to 120 inches west of the highway. Precipitation comes mostly as rain but with significant amounts of snow making this an intermittent snow zone in the winter. This zone has a shorter growing season, because of its elevation, than either tanoak zone below, with longer winters and cooler temperatures year around. Soils with frigid or sometimes mesic temperature regimes, and xeric moisture regimes typify this zone.

Potential overstory dominants are white fir and Douglas-fir on north aspects, occasionally with bigleaf maple, incense cedar and/or sugar pine. In some stands, Brewers spruce may also occur. Warmer south slopes have Douglas-fir potentially dominant, with less white fir and varying amounts of ponderosa pine, incense cedar or sugarpine. Some scattered madrone and black oak may also occur, especially in the lower portions of the elevation belt for this zone. Understories have a wide variety of deciduous and evergreen shrubs, including snowberry, rose and Cascade Oregongrape. Rhododendron, vine maple and salal, which are natives in west side understories, develop into brush field dominants in

openings. However, east of the Redwood Highway, they rarely occur and are found mainly in patches in local areas. Also in this cool climate, greenleaf manzanita and Saddle oak are abundant along roads and in brush stands, along with the shrub forms of chinkapin and tanoak. A rich assortment of understory forbs indicate high moisture availability and/or cooler temperatures. Cool temperatures are also indicated by the diminished growth form of both tanoak and chinkapin (shrub size) and absence of madrone on north aspects. Pacific Yew and Port-Orford-cedar are often found in drainages and occasionally in north slope stands, especially in the west side area.

This zone is very rich in terms of floristic composition and highly productive for tree growth when non-restrictive soils are considered. The area provides summer range for wildlife, and formerly for domestic livestock, especially in open canopies and where meadows or shallow grassy soils are present. Climatic differences with lower elevation zones affect forest management decisions through shorter seasons for management activities, major differences in overstory composition, fewer plantation regeneration problems, changes in understory shrub competition, and difficult brush field problems. The east side-west side break in this zone at the Redwood Highway is important in order to recognize two similar but distinct ecosystems. Earlier it was pointed out that there were differences in both precipitation range and elevation, the east side zone being both higher and dryer. Some of the differences in species composition have been mentioned, notably the abundance of rhododendron and salal in the west side zone. Also, it is believed that forest tree disease and insect problems are greater in the east side than west side ecosystem. The **Cool Mixed Conifer Zone** has a high potential for Fir Engraver beetle damage and dwarf mistletoe disease in white fir, especially in the dryer east side. Other diseases common to both areas are root rot diseases in white fir, Douglas-fir and Port-Orford-Cedar.

Cool Douglas Fir-Chinkapin Zone - This zone is minor in extent covering 8,300 acres (1.3 percent of basin) and was mapped only in the upper watershed or Siskiyou Mountains. It is confined to cold air drainage pockets in restricted valleys or canyons (Appendix A, Map 2). Locations of these pockets are below high, cold ridges of the snow zone, resulting in a shorter growing season and increased opportunity for late spring frosts. Elevation range varies with location but reaches as low as 2,600 feet or lower, and extends up to the **Cool Mixed Conifer Zone** boundary at 4,000 feet. Precipitation is estimated at 50 to 70 inches or more, but the proportion of rain to snow in these localized areas has not been determined. Soil temperature regimes have not been measured but appear to be frigid with xeric moisture regimes.

Vegetation descriptions and forest management concerns here generally resemble that for the **Cool Mixed Conifer Zone (west)**, except for the absence of the typical intermittent snow load at this elevation. In both vegetation zones, chinkapin and rhododendron are prominent.

Cool Western Hemlock Zone - Except for very minor occurrences in the Rough & Ready Watershed, this zone (Appendix A, Map 2) is confined to the upper elevations of

Silver Creek Watershed near the north end of the basin. It covers about 6,000 acres (1 percent of Illinois Basin) at elevations between about 2,800 and 4,000 feet and continues northward outside the watershed. About 95 percent of the zone is under BLM management. Precipitation is estimated to average 90 to 110 inches annually, coming in the form of rain and snow and making it part of the intermittent snow zone. Since western hemlock areas in southwest Oregon are usually associated with increased cloud cover, fog or other factor which reduces summer moisture stress, its occurrence must relate to local microclimatic factors that reduce transpiration. Also, it may be a remnant of some historic and much wider ranging distribution during a different climatic era. Soil temperature regimes are thought to be frigid, with both udic and xeric moisture regimes in the zone.

Douglas-fir, white fir, and/or western hemlock are overstory dominants, depending on stand history and landscape position, with minor amounts of chinkapin and sugar pine. Hemlock is absent in droughty positions, but elsewhere usually present in the canopies or at least understories.

Hemlock dominant stands, unlike older Douglas-fir stands, often support less understory cover. Understories are primarily, but not exclusively, evergreen shrubs such as rhododendron, Cascade Oregongrape, salal, shrub chinkapin, western princespine, and Sadler oak. Grasses are sparse along with forbs like common beargrass, vanillaleaf and pyrola.

Forest productivity is medium, and plantation problems range from moderate to low (Appendix B, Table 1). Overstory removal and old wildfire sites can develop into dense brush fields of evergreen shrubs, especially salal, Sadler oak, Cascade Oregongrape, chinkapin and rhododendron.

Cold White Fir Zone (west) (east) - The **Cold White Fir Zone** covers 4.6 percent of the basin and is found on high elevation slopes or ridgetops (Appendix B, Table 1, and Appendix A, Map 2). West of the Redwood Highway it includes most ridges and peaks above 3,900 to 4,000 feet and covers about 18,000 acres (2.9 percent of basin). Over 90 percent of the zone is under USFS management. On the east side, this zone of 11,000 acres (1.7 percent of basin) is a narrow band and transition at about 4,800 to 5,400 feet elevation occurring between the **Cool Mixed Conifer** and **Shasta Fir zones**. Precipitation comes mostly in the form of snow between October and April, making this a major snow zone for the Illinois watershed. Average annual precipitation is about 70 to 80 inches for this zone in the Siskiyou, but west of the Interior Valley it is estimated to reach 70 to 140 inches. The growing season is very short in contrast with lower elevations of the watershed. Soils characterizing this zone have xeric moisture regimes, and frigid or cryic temperature regimes.

Important tree species in the zone are white fir, which dominates north aspects forming nearly pure stands, and Douglas-fir which is codominant with white fir on south aspects. Other less common species that may occur in some local areas are Pacific yew, Brewer

spruce and white pine. Shasta fir or incense cedar are present in transitional areas. Shrub composition is low, represented by species such as western princespine, Sadler oak, common snowberry, sidebells pyrola, Cascade Oregongrape and big huckleberry. Rhododendron has been found in a few widely scattered locations. The herbaceous layer is sparse and composed of cold tolerant species such as pyrola, solomonseal, scouler bellflower, beadlily and vanillaleaf.

Forest managers should expect low productivity (slow growth) and significant problems for regeneration or plantations (Appendix B, Table 1). Clearcuts here require a very long time period for stand replacement. Increased climatic limitations such as cold temperatures, short growing seasons, and long periods of snow pack restrict management options.

Wildfire risks are significant but less than for low elevations. The zone provides summer range for wildlife (big game) and formerly for domestic livestock (east side). Riparian corridors, meadows, timber harvest units, and openings on southerly aspects or along roads provide most of the available forage.

Cold Shasta Fir Zone (west) (east) - The highest and coldest climatic area covering 2.5 percent of the Illinois River Watershed is the **Cold Shasta Fir Zone** (see Appendix B, Table 1, and Appendix A, Map 2). It is a significant part of the 45,000-acre upper snow pack acreage in the Illinois Basin (Appendix B, Table 2). All of the zone is in public ownership, mostly USFS. West of the Redwood Highway and covering about 4,400 acres (0.7 percent of basin), it is found at 3,900 to 5,300 feet, immediately above the **Cool Mixed Conifer Zone**, and adjacent to (not above as in the Siskiyou) the **Cold White Fir Zone**. Its occurrence in the Coast Range is unusual, especially at this low elevation, and it is located only in the vicinity of Bear Camp and Hobson Horn Ridge. East of the highway it occurs above the **Cold White Fir Zone** at about 5,200 to 6,800 feet elevation, primarily as mountain peaks and ridges covering 11,100 acres (1.8 percent of basin). Precipitation is estimated as 70 to 80 inches in the Siskiyou and 120 to 140 inches in the Coast Range, coming mostly in the form of snow between October and April. The snow free period provides only a short, mostly dry, cool growing season with low evapotranspiration rates. In the Coast Range, it is thought to be marginal for both a frigid temperature regime and udic moisture regime. In the Siskiyou Mountains, it has a cryic temperature regime and udic moisture regime.

Vegetative composition of the zone is much like that of the adjacent white fir areas, with the addition of Shasta red fir as both an understory and overstory species, and the near absence of species such as incense cedar. Here Shasta fir becomes dominate on typical north aspects, with white fir more important on warmer southerly aspects. White pine and Brewer spruce are also present in some stands. At the higher elevations, mountain hemlock can occur as a minor species, and a few isolated locations have mountain hemlock as an overstory dominant.

Forest productivity is low and forest management options are limited, much as in the **Cold White Fir Zone** (see Appendix B, Table 1). Competition from both evergreen and deciduous shrubs is low, but plantation problems and regeneration concerns after harvest are high. Wildfire risks are significant but less than low elevations. This zone, as described for the lower white fir area, is summer range for wildlife.

Today's Landscapes/Ecosystems - Status and Treatment History

Today's landscapes are the result of many factors which maintain, alter or have eliminated the potential for native vegetation. Some of these factors - ownership, land use, management treatment, natural environmental influences.

Use and management are, of course, related to ownership goals, the result of land owner/manager decisions. In this watershed of 628,500 acres, about 81.5 percent or 512,500 acres are in Federal ownership, 0.6 percent is state/county (3,650 acres), and 18 percent or 112,600 acres are in private ownership (Appendix B, Table 3). Private lands occur in all but one subwatershed, but mainly in seven of the thirteen in the basin. The greatest proportions of private land are in Deer Creek and West Fork Illinois watersheds.

Most of the basin (over 95 percent) is still in native forest or conifer-hardwood, savanna cover providing timber, water, recreation, fish, wildlife, habitat, minerals and other watershed values (Appendix A, Maps 6 and 7). Over 365 miles of anadromous fish stream habitat are present (Appendix B, Table 2) dispersed throughout every subwatershed of the basin (Appendix A, Maps 4 and 13). Urban centers are primarily at Cave Junction, Kerby and Selma where agriculture, lumber and tourism are important valley industries.

Land Use Conversions from Native Cover - During the last 150 years nearly 29,000 acres or 4.5 percent of the watershed (Appendix B, Tables 3 and 4) have been converted from native cover to other cover types. Of this about 3,500 acres (0.6 percent) are now in urban, industrial, rural homes and farmsteads. An estimated 16,600 acres (2.6 percent of the watershed) or 14.8 percent of the total private acreage have been cleared for agriculture since settlement. These lands are presently irrigated cropland, irrigated pasture, dry pasture/cropland, cleared or semi-cleared native pasture, idle/abandoned fields and openings supporting weeds/shrubs/other natives, or remnants of the former crop. Of this, 9,100 acres or about 55 percent of the cleared agriculture land have surface water rights for irrigation.

Other land cover changes have occurred as well. About 2,500 miles of roads (all types) are in existence in the watershed (Appendix B, Table 4). This has removed from native cover at least 7,500 acres (1.2 percent of basin) and resulted in a road density for the entire watershed of 2.6 miles per section. Mining activities for nearly 150 years have altered the potential and character of many small local areas in the uplands but particularly in riparian zones (unknown acreage). See Appendix A, Map 6 for current (active) commercial and recreational mining or quarry locations which are only a fraction

of the historic mining claims. Water storage sites have resulted in only minor conversions in land use, i.e., numerous small ponds and two larger projects (Lake Selmac, Esterly Lakes). After considering all the above "land use conversions" or deductions from native cover, this leaves about 600,000 acres or 95.5 percent of the Illinois River Watershed in some type and growth stage of natural vegetation.

A. Subwatershed Comparisons

The thirteen subwatersheds of the Illinois River Basin were compared regarding land use-status in Appendix B, Tables 3 and 4. Most of the land use conversions from native cover have been on private lands. Private land occurs in all but one subwatershed, Collier Creek. The greatest proportion of private land occurs in six watersheds, namely Deer Creek (29 percent), Sucker Creek (10 percent), Althouse Creek (9 percent), East Fork (14 percent), West Fork (23 percent) and Mainstem (11 percent). Irrigated agriculture occurs in only seven, with the least in Rough & Ready Watershed but over 2,000 acres each in Deer Creek and East Fork Illinois River. With the exception of Mainstem, road density is greatest (at least 2.5 miles/section) in those watersheds which have large acreages of private ownership. The highest road density is in Deer Creek watershed (5.7 miles/section). Lowest road density is in Collier and Rough & Ready watersheds with under one mile per section. Urban/residential development acreage is highest in four watersheds. These are West Fork, East Fork, Mainstem and Deer Creek watersheds.

B. Environmental Effects of Conversion

Large-scale landscape conversions from native cover always have environmental impacts as they permanently alter the historic, dynamic (seemingly chaotic) balance among local environmental and biotic factors. No opinion will be offered here as to the degree to which the impacts discussed below are beneficial or adverse to the public, ecosystems or watershed health. A list of some examples follows:

1. Normal wildlife use patterns are altered from historic times and some habitat is eliminated and/or replaced by other types of habitat. Also, wildlife population numbers and species present have changed accordingly.
2. Increased water runoff occurs from agricultural lands, urban areas, industrial sites and road systems, resulting in seasonal changes of peaks and low flow volumes. Road systems are thought to make an impact at the watershed level when density exceeds 4 miles/section (see 1997 USFS reference for Lawson watershed, page 25). Deer Creek watershed far exceeds this with about 5.7 miles/section (Appendix B, Table 4). Rooding in Althouse and East Fork Illinois is also likely to have impacted hydrology.
3. Water rights appropriations for 9,100 acres of irrigation and for other uses have withdrawn significant water from stream systems during low flow seasons when beneficial uses of water are in competition with fish and aquatic resources. Lower summer volumes can result in higher water temperatures during critical periods in the life cycle for some aquatic species. Water withdrawals would amount to 31,800 acre

feet for the season if 3.5 acre feet were diverted per acre, and all 9,100 acres were actually irrigated.

4. Water quality is impacted in addition to water temperature already mentioned above. Chemical pollutants in runoff and into ground water from highways, urban, industrial and agricultural use areas are an ongoing risk. Increased sedimentation occurs from unprotected construction sites, sloping exposed agricultural land, mining areas, and especially road systems.

Land Use for Ownerships Retained in Native Cover

A. Private

About 92,500 acres or 82 percent of all private lands remain in natural or managed native cover (minus that portion in roads). An estimated 80,000 acres (see Appendix B, Table 3) or 71 percent of private land acreage has commercial forest potential in terms of tree production and site quality. This figure will be used here to represent the potential private timber base for the Illinois Watershed since nearly all of these lands have been harvested in this century. The actual private timber management base is unknown and no doubt less than shown, being entirely related to owner or manager objectives. It is assumed that some areas or parcels are not being retained or managed for timber production, but for other values as listed below.

An estimated 12,000 acres or 11 percent of private land acreage is range, non-commercial forest land, hardwood/conifer savanna, meadow or riparian vegetation. These areas have values/uses for owners that may include wildlife, aesthetics, open space, watershed, education, preservation, grazing, rural housing, firewood, and resale. However, they are frequently interspersed throughout an ownership adjacent to commercial forest and may be retained merely to maintain the integrity of the property.

B. Federal (allocations)

Federal lands cover about 512,000 acres or 81.5 percent of the Illinois River Watershed. They include Forest Service, Bureau of Land Management and National Monument managed lands (Appendix B, Table 3). As the result of Congressional mandates, Federal policy and land use planning decisions, all Federal lands are classified under a dominant use category and managed to accomplish related objectives or requirements. The land use allocations shown in Appendix B, Table 3 are displayed for the watershed in Appendix A, Map 7.

About 109,000 acres (21 percent) of the Federal acreage is classified as **Matrix** or multiple-use land where timber production is an important objective. For all other allocation categories where logging is permitted, tree harvesting is only a means of enhancing or meeting other primary objectives. About 222,000 acres (43 percent of Federal) is **Late Successional Reserve (LSR)** where all management must consider or promote old growth forest characteristics. Riparian management is of concern everywhere, but when this is the dominant objective, perennial stream corridors are

classified for **Riparian Protection** (24,500 acres, 4.8 percent of Federal). About 156,000 acres or 30.5 percent of Federal lands in this watershed are allocated to a number of other special categories such as **Wilderness**, **Wild River** and **Research Natural Area** (Appendix B, Table 3). All are highly protected/managed areas for research, preservation and/or public use of a special or unique resource/value.

For ease of comparison, fifteen Federal land use allocation categories are shown in Appendix B, Table 3 as they are distributed across the subwatersheds of the Illinois Basin. **Wilderness** covers about 69,000 acres (13 percent of Federal lands) and is found in five subwatersheds with nearly 42,000 acres in the Mainstem watershed. **Late Successional Reserve** occurs in every subwatershed and is the largest class (220,000 acres, 43 percent of Federal). Although Creek watershed has the smallest LSR acreage with about 3,600 acres, and Indigo has the largest LSR acreage covering over 41,000 acres or 85 percent of this subwatershed. **Matrix**, the multiple-use class, is a significant land use in all but two of the subwatersheds, Rough & Ready and Collier Creek. The 109,000 acres of **Matrix** lands (21 percent of Federal) is found primarily in eleven of the subwatersheds, ranging from about 2,900 acres or 6 percent of the Indigo Watershed, to 17,400 acres or 24 percent of the Deer Creek Watershed.

Treatment and Management History for Native Landscapes - An estimated 600,000 acres (95.5 percent) of the Illinois River Basin (**Tables 3, 4**) remain in natural or managed native cover (after deleting urban, industrial, agriculture, roads, mining areas, and rural farmsteads). Existing vegetation and ecological status (important for making future management decisions and evaluating prior treatments) must be determined by an on-site inventory, which was beyond the scope of this study. Consequently, this assessment is based on observations during reconnaissance of the watershed and by relying on watershed analysis reports (see reference list). Communication with staff specialists from USFS, BLM and ODF has provided additional information from which to assemble the data and analysis for this section.

Historic vegetation was sketchily documented just after settlement began in the 1850's during the original General Land Office survey of townships and sections. In 1914, the Oregon Department of Forestry did a broad plant cover map of Oregon (see Appendix A, Map 17). The first comprehensive survey of vegetation was a cover-type map published in 1936 by USFS Pacific Northwest Forest and Range Experiment Station for southwest Oregon (see Appendix A, Map 18). After World War II, Federal timber harvests and resource inventories greatly accelerated. In recent decades, treatment records, inventory maps and resource data have become readily available in watershed assessment documents and other reports.

The extent of three landscape treatments involving forest cover in this basin will be summarized for the past half century. They are wildfire, clearcut logging and selective/partial-cut harvesting, which have certainly influenced the appearance and present condition of the watershed (Appendix A, Maps 8, 10, 11 and 12).

A. Wildfire History

Most of the older stands remaining in the watershed developed with or following the effects of wildfires. Since World War II, about 97,600 acres or 15.5 percent of the watershed has been subjected to wildfires (Appendix B, Table 4). About 96 percent of this acreage has been burned since 1985. Appendix A, Map 9 shows the ignition source and origin for fires within the National Forest boundary between 1939 and 1997. This map shows that lightning is a major cause, particularly on the eastern side of the Coast Range and Siskiyou. In fact, the Illinois River Watershed, according to communication with USFS, is within the more lightning prone area of southwest Oregon and northern California. Appendix A, Map 10 shows actual wildfire acreage within the National Forest boundary of the watershed over the past 50 years. Due to very effective fire control, only small areas have burned until recently, with the occurrence of Silver Creek fire in the Coast Range and two smaller fires in the upper Illinois basin.

Fire control became much more effective at the end of World War II when the smoke jumper base was established south of Cave Junction and wildfire acreage dropped dramatically. Fires on private lands of the Interior Valley Zone burned minor acreages during the same period, affecting probably less than 3,000 acres. The typical fire season and relative risk of ignition associated with each vegetative-climatic zone is shown in Appendix B, Table 1. It is greatest but not limited to late May through October in the Interior Valley (normal years), decreasing to July through September in the high, cold White Fir and Shasta Fir Zones. The relative risk of ignition during these periods is estimated as high for seven vegetation zones covering 513,000 acres or 82 percent of the watershed, medium for two zones or about 72,000 acres (11 percent) and low for the four cold zones covering over 44,000 acres or 7 percent of the watershed.

Most large forest fires in this area have been variable in burning intensity and range from light to severe across the landscape. Historically, the major fires here have resulted in 20 to 40 percent of the total area being severely burned and classified as “stand replacement” fires (communication with USFS). The light intensity areas are primarily underburned where much or all of the overstory survives.

Subwatershed Comparisons - Seven of the thirteen subwatersheds have had over 4,000 acres (each) burned in wildfires the last 50 years. These ranged from 8 percent of the West Fork Illinois to 43 percent of Indigo Creek and 47 percent of Silver Creek watersheds. Uncontrolled fires have been minor in Deer Creek, Sucker Creek, Rough & Ready and Briggs Creek watersheds. Fires were negligible in Althouse Creek and Lawson Creek watersheds.

Response and Effects - The status of today’s vegetation on sites recovering from wildfire, is related to several local variables, i.e., burning intensity, weather, soil/site characteristics, natural seed sources, tree planting efforts and elapsed time since the wildfire. Most stand replacement fires have been restocked naturally or artificially. It is assumed that full hydrologic recovery on forest land would occur within 20 to 40 years. Less time may be required for some grassland and savanna sites. Rotation age for new

tree stands would be reached within 60 to 100 years, depending on elevation, aspect, climatic zone, management and other site characteristics. With about 93,500 acres burned during the last 10 years (96 percent of the 97,600-acre total), recovery for the severely burned portions will be in progress for several more decades, depending on location.

Other possible effects from “stand replacement” wildfire:

1. Riparian tree/shrub cover loss where directly affected.
2. Increased water temperature where much stream shade is lost.
3. Peak runoff increases in local drainages.
4. Sediment increases downstream below accelerated erosion areas.
5. Initiation of new forest stand or rotation cycle.
6. Wildlife use pattern changes.
7. Decline in public use temporarily.

B. Clearcutting Harvest History

During the last half century, it is estimated that about 55,000 acres (9 percent) of the Illinois River Watershed has been clearcut (all ownerships). Appendix B, Table 4 gives a summary of clearcut acreages by decades for the watershed, and Appendix A, Map 11 shows the location of these harvests on Federal lands. About 43,500 acres of this harvesting (7 percent of the watershed) is on Federal lands, with most of the cutting distributed over the decades between 1955 and 1990. Prior to 1956, cutting was largely focused on private lands when much of the timber base was being cut. With increased environmental concerns, conflicts and restrictions on management, cutting has dramatically declined since the mid-1980's.

Subwatershed Comparisons - Althouse Creek watershed has had the greatest proportion of clearcutting with over 4,600 acres or 16 percent of the watershed cut. However, Deer Creek, Sucker Creek, Briggs Creek, Indigo Creek and East Fork Illinois each have 10 percent or more in final harvest cuts. Two watersheds, Josephine and Rough & Ready, both have had only negligible clearcutting (0.5 percent or less).

Response and Effects - Most clearcut acreages have been restocked within 5 years of harvest and are subject to roughly the same recovery periods discussed above after wildfires. However, runoff characteristics, sediment production, and the manner of vegetative recovery could vary from that after “stand replacement” burns, depending on harvest method, slash treatment and site preparation techniques. Because of the distribution of clearcut harvests throughout the last half century, between a third and half of this acreage has recovered hydrologically. But for nearly all areas, stand development will be occurring from one to several more decades before rotation age is reached.

Other possible environmental effects:

1. Increased peak run-off in local drainages.
2. Increased downstream sedimentation below erosion areas.
3. Wildlife use pattern changes.
4. Weed introduction along skid roads and in landings.

C. Partial Cut Harvest History

Partial cut harvesting over this 50-year period (Appendix A, Map 12) is estimated to have occurred on about 88,000 acres or 14 percent of the watershed (Appendix B, Table 4). For the purposes of this analysis, several types of selective cutting and partial cutting were grouped together. Data from USFS and BLM show that about 19,300 acres (3.1 percent of watershed) had selective cutting on Federal lands (excluding precommercial thinning). About 69,000 acres (11 percent of watershed) were estimated to have had partial cutting on private land since World War I, which is much of the private land with commercial timber potential. Some private harvests, especially in the middle of the century, were very heavy cuts, but fell short of our definition of clearcutting (from a hydrologic viewpoint, not requiring replanting or not totally devoid of canopy).

Since the heavy cutting pressure on most private forests just before and after World War II, many of these lands have been entered again once or twice for cutting. Federal harvests were very light immediately after the war and again in the present decade, but much higher between 1955 and 1990. Partial cutting is currently a more common practice than clearcutting for a variety of reasons, but for many stands it eliminates the expensive practices of site preparation and replanting. Over the last half century, about two thirds as much acreage in the watershed has been clearcut as had selective cutting.

Subwatershed Comparisons - Partial cut harvesting was greatest in the Deer Creek Watershed with 39 percent or over 28,000 acres cut, followed by West Fork Illinois River with 19,500 acres cut or about 37 percent of its watershed. Sucker Creek, Althouse Creek and East Fork Illinois each range from 14 percent to 18 percent in partial cuts. Three subwatersheds probably have less than 1 percent in selective cuttings, which are Josephine, Rough & Ready and Collier Creek watersheds.

Response and Effects - Runoff changes are less dramatic here than following clearcuts. It is assumed that full hydrologic recovery would normally occur within 10 to 30 years, and could be less for very low-volume cuts. This recovery interval is primarily a function of the climatic zone, site characteristics and treatment, especially the method and volume of removal.

Based on the expected recovery rate, 50 to 80 percent of the acreage has probably recovered hydrologically from harvesting, depending on the date of the last entry. Without stand inventories, it is not known how much acreage is available for commercial harvest now, or the rate it will become available in the coming decades from the stands represented by various ages of partial cuts. This is a function of stand composition, size classes and site quality.

Selective cutting generally reduces the environmental impacts of timber harvesting. Although ground systems for timber removal can still allow weed introduction, erosion and hydrology changes from roading, other benefits do occur. It can reduce the need for

replanting and minimize the disruption of wildlife use patterns. Also, more ground cover is retained on the site, reducing possible increases of erosion and runoff on harvest areas.

D. Other Historical Influences

Area of Concern - An estimated 356,000 acres or 56 percent of the Illinois River Basin remain in native cover (urban, roads, agriculture, reservoirs, mines, industrial, farmsteads excluded) and **have not** been commercially harvested or altered by wildfire during the last half century (Appendix B, Tables 3 and 4). However, prescribed burning acreage, if any, has not been deducted from this total. Among the subwatersheds, Rough & Ready has the least proportion of unaffected acreage with over 98 percent untreated. About 80 to 85 percent of Lawson and Collier watersheds are unaltered by harvests or wildfire and remain in native or natural cover. Eight watersheds range between 50 percent and 75 percent unaffected, and two watersheds, Silver Creek and Indigo Creek, have about 40 to 45 percent of their acreage remaining unimpacted by these factors in the last 50 years (Appendix B, Tables 3 and 4).

Some of these areas have had treatment **prior** to the last 50 years of record. Numerous parcels of timber have been logged (primarily on private), and some acreages burned (all ownerships) in the first half of this century. Prior to the establishment of a smoke jumper base and more effective fire control in the 1940's, wildfire acreage was much more extensive across the Siskiyou National Forest (personal communication with USFS ecologist, Tom Atzet).

Influences and Impacts - Unburned and unlogged forest ecosystems (as well as managed stands) in the Illinois River Watershed are subjected to a variety of natural but often catastrophic influences. These include areas of insect or disease outbreaks, ice damage (breakage), windthrow and landslides, all of which may be related to extreme climatic cycles or events (i.e., drought, wind, climatic extremes, etc.). Although not presented in this report, sizable epidemics, impacts and occurrences are generally known and documented on Federal ownerships.

Wildlife populations and areas of historic localized livestock use have impacted non-forest communities, particularly herbaceous vegetation. Historically, grazing by cattle and sheep was much more widespread when forest understories were more open, grasslands had less invasion by woody species and forage was more abundant. It is in these early decades that unmanaged livestock grazing is believed to have had its greatest effect on the condition and stability of grassland and oak/conifer savanna communities. This resulted in the invasion of numerous weeds dominating some of these understories today. Exotic-noxious weeds occur primarily in altered or disturbed ecosystems of the watershed. Full stands of native cover in all climatic zones, especially forest vegetation, are mostly closed communities and highly resistant to invasion from most exotic weeds.

No livestock grazing allotments have had livestock use on the Siskiyou National Forest for several years. The last major allotment on BLM in the watershed was closed at least 15 years ago. Only a minor portion of the Interior Valley has been under BLM permit for

livestock since that time. As a result, livestock have made little use of the forage resource for many years, except on grazed private parcels. Use has been negligible or absent, except in those intermingled stands near farmsteads or pastures.

The greatest impact or change for these native landscapes is the lack of periodic underburning for an extended period of time. Nearly 85 percent of the watershed has not burned from wildfire in the last 50 years, and much of it may not have burned during the entire century. The absence of natural underburning in unmanaged native stands will inevitably lead to higher risk of catastrophic burning when fires eventually do occur. In order to re-establish fire intervals, a limited amount of prescribed burning has been used in portions of the Illinois Basin (not summarized for this report), which has lessened the impact on treated areas. Some watershed reports discuss this topic as in Lawson Creek where it is reported that 12 percent of the watershed has had prescribed burning.

Historic fire return intervals estimated for this watershed ranged from annually to once every several decades, depending on climatic zone and vegetation type (Appendix B, Table 1). Burning is generally long overdue for most acreage in the cool and warm climatic zones, being prolonged far beyond historic intervals. Vegetation in the cold climatic zones were generally burned less frequently and are less critical.

The effects of this unnatural restraint (fire control) on these ecosystems are significant for the developing vegetation and for society as well. Protection from natural burning has resulted in the following impacts within this basin:

1. Tree stand density is generally increasing and many stands are overstocked, **reducing growth rates** (production) and possibly **water yield** (discharge).
2. Fire-sensitive species, such as white fir, are increasing in forest understories with the lack of fire.
3. Increases in shade-tolerant species, including shrubs and tree reproduction, are occurring in the understories of dense canopies, adding ladder fuel to stands.
4. A reduction in the cover of shade-intolerant pine is occurring in the understory and overstory of developing stands.
5. Prolonged accumulation of litter (delaying nutrient releases) and higher fuel loads (increasing catastrophic fire risk) in some ecosystems are occurring.
6. There is increased movement of conifers into savanna or open grasslands and into the margins of true meadows (Douglas-fir and cedar in lower meadows, and true fir in high elevation glades).

Watershed Hydrology - Indexing Runoff to Cover and Landuse

Water yield and timing of the discharge through drainage systems of the watershed are closely related to land use and vegetative cover. The relationship of runoff potential to these variables must be identified in order to model watershed hydrology under a variety of landscape conditions. In this section, the process used for indexing runoff and relating it to landscapes for hydrology modeling will be discussed (see SCS National Engineering

Handbook, Section 4 - Hydrology, 1964). The actual results of this modeling process will be presented and discussed in the hydrology chapter of this report, which follows.

Procedure - First, a generalized list of cover types anticipated was prepared for the entire watershed. These included several agricultural types, urban, roads, water, riverwash and a large number of native vegetation groups. Plant communities from the vegetation inventory were separated into broad climatic zones, then grouped into hydrologically similar types of plant cover. Subgroups of some vegetation types were set up to track cover changes and stand development, over time, after clear cutting, partial cutting and wildfires. This provided a way to recognize the time intervals needed for hydrologic recovery. Also, the entire list (above) was divided into four standard soil hydrologic groups based on NRCS soil survey data. This information was structured as a worksheet table and printed as a template for summarizing data and doing calculations (see Appendix B, Table 6).

Next, runoff curve numbers were assigned to all cover types on the template list that were assumed to be needed in the watershed. This number or value represents the potential for immediate runoff from rainfall on unfrozen soils. After reviewing considerable literature from the West on runoff curve numbers applied to a variety of situations, curve numbers were selected using judgment as to the absolute values that were appropriate and the relative differences one might expect between categories on the table. Without actual runoff research in the watershed on which to base the curve numbers, only checks with stream gauge data in the area will be available to help with calibration of the model.

Third, acreages for all appropriate cover groups were estimated and documented on the runoff worksheet (template) by subwatersheds. Lack of specific inventory data for resources or land uses was frequently encountered. In this case, the development of land use and cover information required making estimates based on observations or best judgment. To assemble the data, acreages from both estimates and inventories were used to complete the runoff curve worksheet. However, the numerous cover categories had to be further generalized at times because of a lack of information and also due to complexity. Even with GIS capabilities for assembling some of the data, compiling acreages into composite groups for the worksheet became too tedious or complex for the time available and level of accuracy possible, to avoid some generalization.

Acreages of urban, industrial, rural farmsteads and roads were estimated by examining the maps available for the project and through GIS. Agricultural areas were estimated from soil survey maps and USGS quadrangle maps by delineating areas thought to be cleared for crops, hay, irrigated pasture and developed dryland pasture. Agriculture is probably overestimated as there are some inclusions of uncleared areas. Also, some openings may be natural openings never cleared or developed as agricultural lands. An irrigated land base map was available from the Oregon Department of Water Resources.

Lastly, the data was tabulated for each subwatershed. A weighted average of runoff curves for all cover/acreage groups on the table was calculated to provide a single

composite runoff curve for each subwatershed. This value was then used in the hydrologic model.

Seasonally, the period most likely to generate large volumes of runoff is late fall or early winter. At this period, deciduous leaves have fallen, soils have become nearly saturated from earlier rains (between Antecedent Moisture Condition II and III), and snow normally is accumulating in the upper elevations. The hydrologic model as used here will estimate runoff during this period (December, January).

Assumptions and Qualifications - The following comments are provided to explain the rationale used for runoff assessment:

1. For the interior of the watershed at middle and low elevations, hydrologic recovery following selective harvests was assumed to be 20 years. Recovery following clearcut logging was assumed to be 30 to 40 years.
2. For the coastal climate of the lower watershed (see Coastal Tanoak Zone), partial-cut hydrologic recovery was assumed to be 10 years and clearcut recovery was assumed to be 20 to 30 years. These recovery intervals were applied to the low elevation Tanoak Zone of four subwatersheds, namely Lawson, Collier, Silver and Indigo.
3. Full hydrologic recovery in the high elevation snow zones was assumed to be slower than vegetation zones below this elevation. Here, 20 to 30 years were assumed for partial cuts and at least 40 to 50 years may be needed for clearcuts.
4. Bottomland and gentle valley terrace forests were assumed to have lower runoff potential than comparable upland forests in the foothills and mountains. Consequently, lower runoff curve numbers were assigned to valley floor forests.
5. Serpentine soils are extensive throughout some parts of the watershed and have significant effects on cover, plant composition and production. High runoff is easily observed on these soils, especially shallow ones, during storms. To show greater runoff from serpentine soils, higher runoff curve numbers were assigned to the related plant communities, which are usually in the "C" and "D" soil hydrologic groups.
6. Many winter storms in December and January produce rain in the lower elevations and snow pack in the upper elevations. Except for a "rain on snow" event, runoff is generated primarily from the lower and middle elevations during these storms, while in the upper snow zone runoff is largely deferred until late spring. Therefore, it seemed appropriate to discount runoff in the primary snow pack associated with the four **cold** vegetation zones of the watershed. In some storms, depending on freezing level, it would also be proper to discount runoff in the "intermittent snow zone" covering all four **cool** vegetation zones, when rain is confined to even lower elevations. To correct for this disparity in runoff from different elevational zones, lower runoff curve numbers were assigned to the upper elevations, but one wonders if any runoff should be counted at all from the snow zones during early winter.
7. For this analysis, clearcuts and high-intensity (stand replacement) fires have been grouped into the same runoff curves. Low-intensity underburns are grouped with selective harvests for runoff. It could be argued that intense fires produce ground

conditions suitable for higher discharge than clearcuts unless the harvest was followed by extensive slash treatment. However, some grouping of conditions was essential to completing the work with the staff time available. Also, we did not have maps available to us for identification of fire intensity (often quite variable within a burn), only burned and non-burned areas. After consulting with fire control staff on the Siskiyou National Forest, it was decided to sort out these differences. In this report, we will assume percentages for high and low intensity of 30 percent and 70 percent, and proportion the total acreage for large burns into each class. Recent large burns in this watershed have ranged from 20 percent to 40 percent high-intensity burns (communication from USFS fire specialists) with much of the high-intensity burning occurring on south slopes.

8. Cutting records on Federal lands (BLM and USFS) were treated as follows: Several variations of clearcutting were grouped into one cutting class for runoff curve number estimation. Several variations of selective cutting were grouped together into one cutting class (partial cut). Although records were available by years, harvests were grouped into 5- or 10-year periods by decades. This was done to reduce the complexity of assembling data and assigning runoff curve numbers to cover classes.
9. Private lands make up about 18 percent of the watershed (112,600 acres) of which about 92,000 acres are estimated to support natural cover, mostly forests. No comparable long-term data base for private cutting was available as on Federal lands. Interviews with three local foresters in southwestern Oregon were used to create a rough estimate of the amount and type of private land cutting over the last half century. This was helpful for completing the harvest history of the remaining lands for hydrologic modeling.
10. Some data such as hydrologic recovery intervals or wildfire intensity patterns would be more specific if cover classes could be separated by aspect (north and south slopes) for runoff curve development. However, it was considered to be too complex and impractical to consider additional refinement of the data for this purpose. It is hoped that the curve numbers assigned for runoff characterization would adequately represent an average for the mix of these important landscape features.
11. For all harvests and burn areas, hydrologic recovery is assumed to be more rapid initially and slowing with time.
12. The effects of roads on runoff are probably understated. Communications with OSU Forestry Department point out the effect of these roads on peak runoff and the hydrologic connection of roads with stream systems. Runoff probably exceeds the magnitude of discharge calculated from the surface area involved, since both overland flow and subsurface drainage are intercepted.

Time Periods and Conditions Evaluated - The first run of the hydrology model was an assessment of "Full Cover" for each subwatershed. This situation was a theoretical condition never seen historically and not probable in the future. It is a "no-disturbance" condition where potential cover is assumed for the entire watershed (at least to an

adequate hydrologic stage) to provide a baseline for comparing with all other conditions or time periods.

Time periods selected for modeling were as follows: The present decade (mid-1990's) is important to identify where we are now. The pre-settlement condition in the 1840's is of great interest as a comparison, but no cover data exists that is adequate for runoff assessment. In fact, the earliest data set suitable for modeling runoff over the entire watershed is from about World War II. About three decades of treatment records are needed to provide age classes of cover so the mid-1960's was chosen for comparison with the present decade.

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