UPPER SOUTH FORK OF THE JOHN DAY RIVER

WATERSHED ASSESSMENT

FINAL REPORT

Prepared for

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WATERSHED ISSUES

Aquatic Communities

- *Status of redband trout populations*
- *Impairment of benthic aquatic communities*

Fish Habitat

- *Lack of habitat complexity*
- *Lack of large woody debris*
- *Substrate embeddedness*
- *Fish barriers at road crossings*

Channel Modification

- *Channelization and diking of streams*
- *Stream diversions into unscreened irrigation ditches*

Hydrology and Water Use

- *Low seasonal stream flows*
- *Insufficient instream water rights*

Water Quality

- *High summer water temperatures*
- *Low summer dissolved oxygen*
- *High seasonal turbidity*

Land Use

- *Elevated sediment loading into streams from grazing, road building, and forestry activities*
- *Loss of riparian vegetation*
- *Erosion and destabilization of streambanks and channel incision*
- *High forest road density*

ACRONYMS AND ABBREVIATIONS

BLM	Bureau of Land Management
BMP	Best Management Practices
Cfs	Cubic feet per second
CHT	Channel Habitat Type
CWA	Clean Water Act
DEQ	Department of Environmental Quality
CTWSR	Confederated Tribes of the Warm Springs Reservation
DO	Dissolved Oxygen
DSL	Division of State Lands
EPA	Environmental Protection Agency
ESA	Endangered Species Act
GIS	Geographic Information Systems
GPS	Geographic Positioning System
GWEB	Governor’s Watershed Enhancement Board (now OWEB)
LWD	Large Woody Debris
N/A	Not Applicable
NMFS	National Marine Fisheries Service
NRCS	Natural Resource Conservation Service
NWI	National Wetlands Inventory
OAR	Oregon Administrative Rules
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODSL	Oregon Division of State Lands
ODOT	Oregon Department of Transportation
OWEB	Oregon Watershed Enhancement Board (Formerly GWEB)
OWRD	Oregon Water Resources Department
SB1010	Senate Bill 1010
SFJDR	South Fork of the John Day River
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USFS	United States Forest Service
USFJDR	Upper South Fork of the John Day River
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
303(d) list	State list of water quality impaired streams submitted biannually to the EPA

CHAPTER I: INTRODUCTION

PURPOSE AND SCOPE

The purpose of this watershed assessment is to inventory and characterize watershed conditions of the upper South Fork of the John Day River (USFJDR) watershed and to provide recommendations to address the issues of water quality, fisheries and fish habitat, and watershed hydrology. The assessment is intended to identify alterations to fish habitat, water quality, and hydrology, and to understand how human activities have affected watershed conditions and functions. With these objectives in mind, this assessment was performed by gathering, synthesizing, analyzing, and interpreting existing data, and supplementing existing data sets with new data collected during the assessment. This assessment was performed following the guidelines of the Oregon Watershed Enhancement Board (OWEB) watershed assessment manual (WPN 1999).

Importantly, a watershed assessment of this scale and using these methods does not prescribe site-specific solutions for improving or restoring desirable watershed conditions or functions, but instead is intended to provide resource managers with the information needed to develop more specific action plans and monitoring strategies to improve watershed conditions.

METHODS

ASSESSMENT GUIDELINES

This assessment was performed using the Oregon Watershed Assessment Manual (WPN 1999). The manual provides background information, a framework and methods, and resources for conducting watershed assessments in Oregon. When sufficient data existed, analyses of watershed conditions and functioning were performed using the methods described in the manual.

MAPPING

Maps for this assessment were produced using ArcView 3.2a and ArcView 8.1 (ESRI, Redlands, CA). This software is used to view, create, and analyze Geographical Information Systems (GIS) data. GIS data and maps used in this assessment are available from ABR, Inc. and the Grant Soil and Water Conservation District.

WATERSHED OVERVIEW

LOCATION AND SETTING

Located in central Oregon, the South Fork of the John Day River (SFJDR) flows northward from its headwaters in the Ochoco and Aldrich Mountains and enters the mainstem of the John Day River at Dayville, OR. In its entirety, the South Fork subbasin drains approximately 607 square miles. The length of the mainstem of the South Fork, from its headwaters to mouth is approximately 55 miles. Upstream fish migration is prevented at river mile 28 by the Izee Falls, the watershed above which is referred to as the upper South Fork of the John Day River (USFJDR) watershed. The USFJDR watershed encompasses the uppermost two fifth-field watersheds (Hydrologic Unit Codes 1707020110 & 1707020111) in the South Fork of the John Day River (Figure 1.1). The USFJDR watershed drains approximately 285 square miles (182,188 acres). The watershed occurs primarily in the southwest corner of Grant County, Oregon, with a small fraction of its headwaters reaching south into Harney County. The headwaters largely occur along the Grant-Harney County line in the area of Snow, Whiskey, Alsup, and Cougar mountains. Elevations range from 3,543 feet at Izee Falls to 7,163 feet atop Snow Mountain in the headwaters.

For purposes of this assessment, eleven subwatersheds were identified within the USFJDR watershed (Figure 1.2): Donivan-Bear creeks (26.5 sq mi), Flat-Utley creeks (38.2 sq mi), Corral Creek (19.2 sq mi), Sheep-Pole creeks (16.1 sq mi), Pine Creek (34.2 sq mi), Sunflower Creek (34.9 sq mi), Indian Creek (12.5 sq mi), Morgan-Dry creeks (13.9 sq mi), Poison-Rosebud creeks (23.4 sq mi), Lewis Creek (45.5 sq mi), Venator Creek (20.4 sq mi). To avoid duplication of effort, the Deer Creek subwatershed was not included in this assessment because it occurs below Izee Falls and because Malheur NF has recently completed a Federal watershed analysis of the drainage.

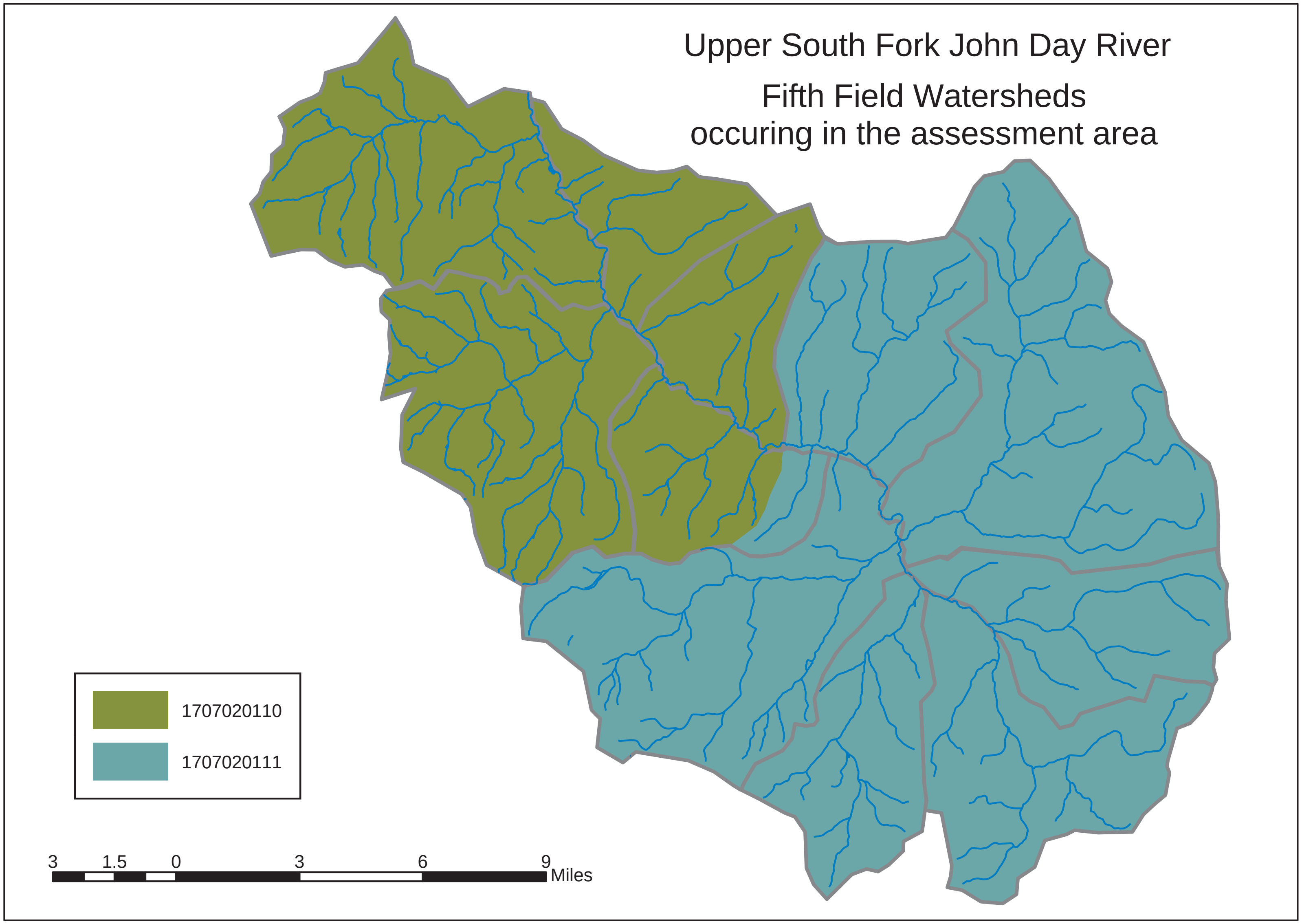

Figure 1.1 Fifth field watersheds occurring within the upper South fork of the John Day River watershed assessment study area. Deer Creek (not shown) is included in the northern watershed, but was omitted from the assessment because it occurs below the Izee Falls and was recently assessed by the Malheur National Forest.

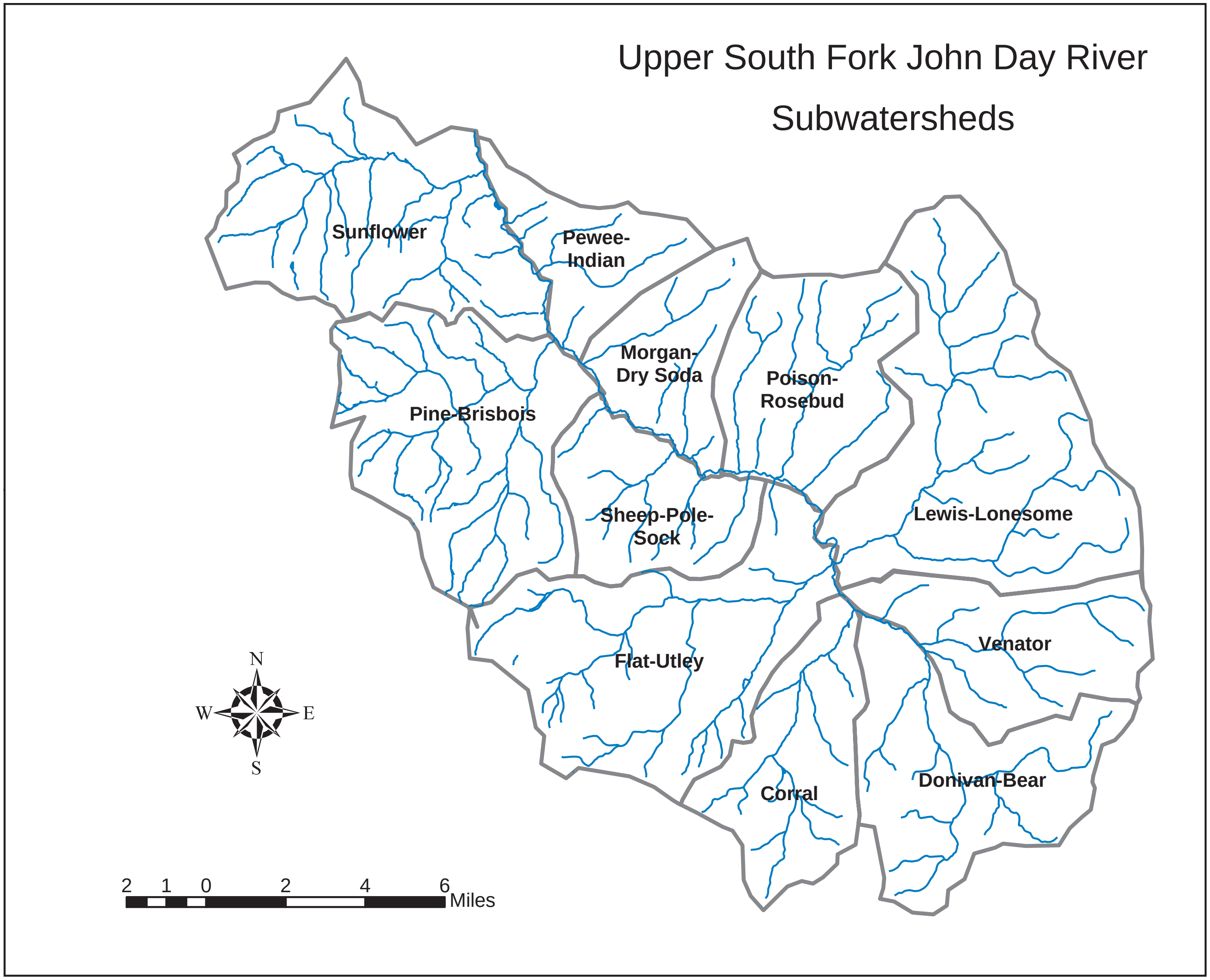

Figure 1.2 Subwatersheds occurring within the upper South fork of the John Day River watershed assessment study area.

ECOREGIONS AND VEGETATION

The South Fork of the John Day River occurs almost entirely within the Blue Mountains Physiographic Province. This larger geographic area is subdivided into ecoregions based on uniform climate, geology, physiography, vegetation, soils, land use, wildlife, and hydrology. Each ecoregion has characteristic disturbance regimes that shape the form and function of watersheds in the region; therefore, the identification of ecoregions within a watershed context can assist in determining how the watershed responds to physical alterations. The USFJDR watershed includes portions of four ecoregions: John Day/Clarno Uplands, John Day/Clarno Highlands, Continental Zone Highlands, and Continental Zone Foothills (Figure 1.3).

The John Day/Clarno Uplands ecoregion consists of the dry foothills that surround the western perimeter of the Blue Mountains and separate the north-central Blue Mountains from the southern Blue and Ochoco mountains. This ecoregion is characterized by highly dissected hills, palisades, and ash beds. Streams in this ecoregion have a low to moderate gradient. Native upland vegetation includes juniper, bluebunch wheatgrass, and Idaho fescue. Potential streamside vegetation in this ecoregion includes cottonwood, alder, willows, mountain alder, hardhack, and infrequent juniper (WPN 1999). Within the USFJDR watershed, this ecoregion occurs throughout the lowland river valley and adjacent hillslopes, and extends in a southwesterly direction up through the Pine Creek subwatershed.

The John Day/Clarno Highlands ecoregion occurs along high elevation slopes that surround the western perimeter of the Blue Mountains and divides the north-central Blue Mountains from the southern Blue and Ochoco mountains. Native upland vegetation in this region is includes grasses, ponderosa pine, and true firs (WPN 1999). Within the USFJDR watershed, only the Sunflower Creek subwatershed occurs within this ecoregion.

The Continental Zone Highlands are typified by undulating hills in the south-central and southwestern Blue Mountains. Streams in this ecoregion are of low to moderate gradient. Native upland vegetation in this ecoregion includes ponderosa pine, lodgepole pine, white fir, and Douglas fir. Potential streamside vegetation in this ecoregion includes white fir, black cottonwood, aspen, alder, willows, mountain alder, and snowberry (WPN 1999). Most of the higher elevation forests occurring in the watershed occur within this ecoregion.

The Continental Zone Foothills, occurring only in the Bear Creek subwatershed within the USFJDR watershed, are characterized by lower-elevation undulating hills along the southern fringe of the Blue Mountains. Dominant native upland vegetation in this ecoregion included grasses, sagebrush, bitter brush, and some juniper. Potential streamside vegetation includes various grasses (including Cusick's bluegrass), shrubs (willows and sagebrush) and aspen (WPN 1999).

Three major vegetational zones occur within the USFJDR watershed and correspond closely with the aforementioned ecoregions. The south and west portions of the watershed occur within the Shrub-Steppe (with *Artemisia tridentata*) Zone; some higher-elevation areas within the southeast portion of the watershed occur within the *Pseudotsuga menziesii* Zone, and much of the northeast portion of the upper watershed occurs within the *Pinus ponderosa* Zone (Franklin and Dyrness 1988). Figure 1.4 illustrates the vegetational zones occurring in the watershed, as determined by the Oregon Natural Heritage Program.

With European settlement of the region, vegetative communities have undergone various and sometimes drastic changes, including changes in species composition, vegetative diversity, and ecosystem structure (BLM 2000). Fire suppression, timber management, and grazing management have worked in concert to alter vegetative communities across the watershed. Historically, the natural fire interval is thought to have occurred every 15–25 years across the John Day Basin. Ponderosa pine forests east of the Cascade Range are documented to have burned as frequently as every five years (Agee 1990). Fire suppression has allowed fire sensitive species, such as western juniper to expand across the landscape. Juniper expansion, in particular, is problematic from a watershed management and water conservation perspective. Juniper crowns often suppress the growth of grasses and other ground

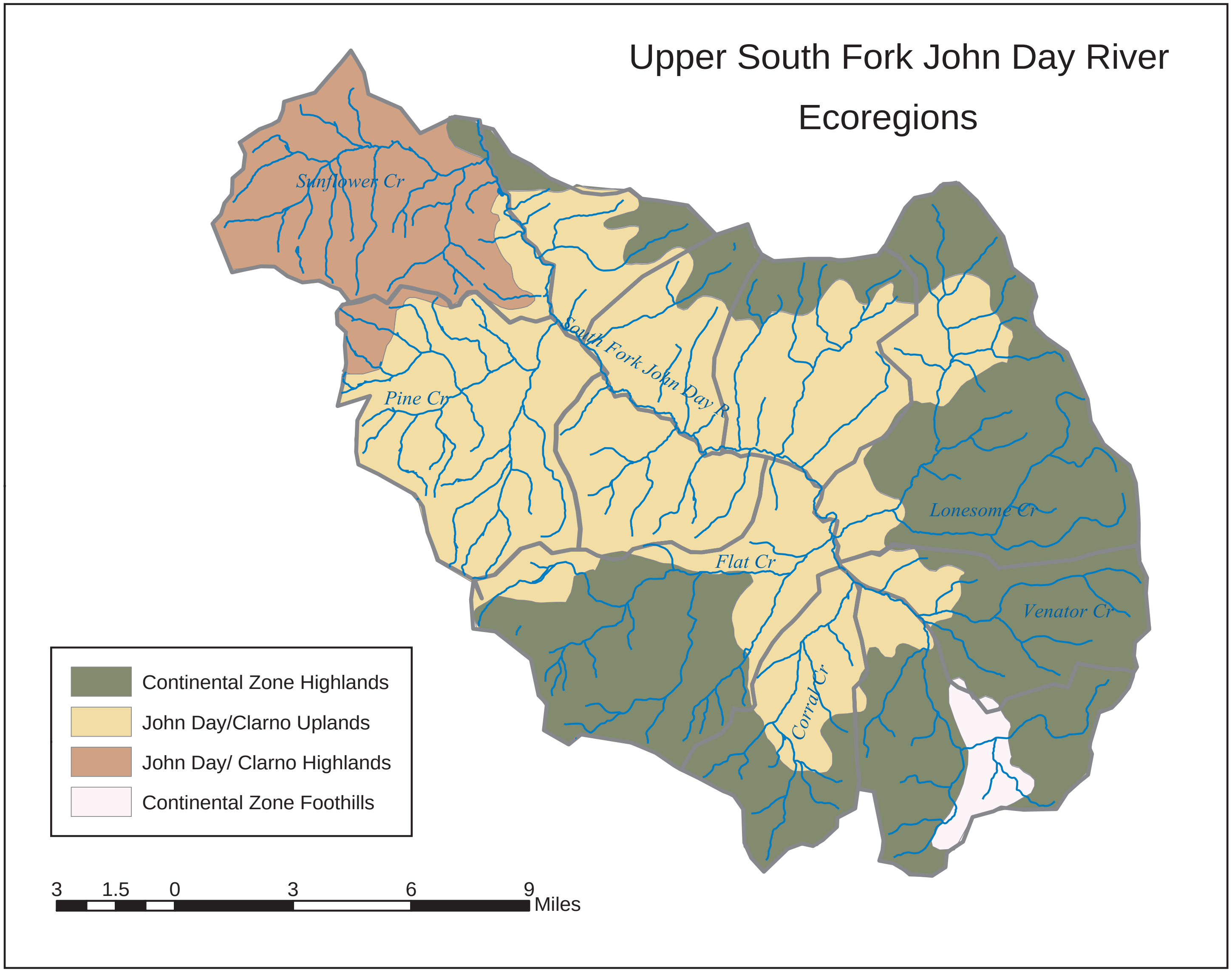

Figure 1.3 Ecoregions occurring within the upper South fork of the John Day River watershed assessment study area.

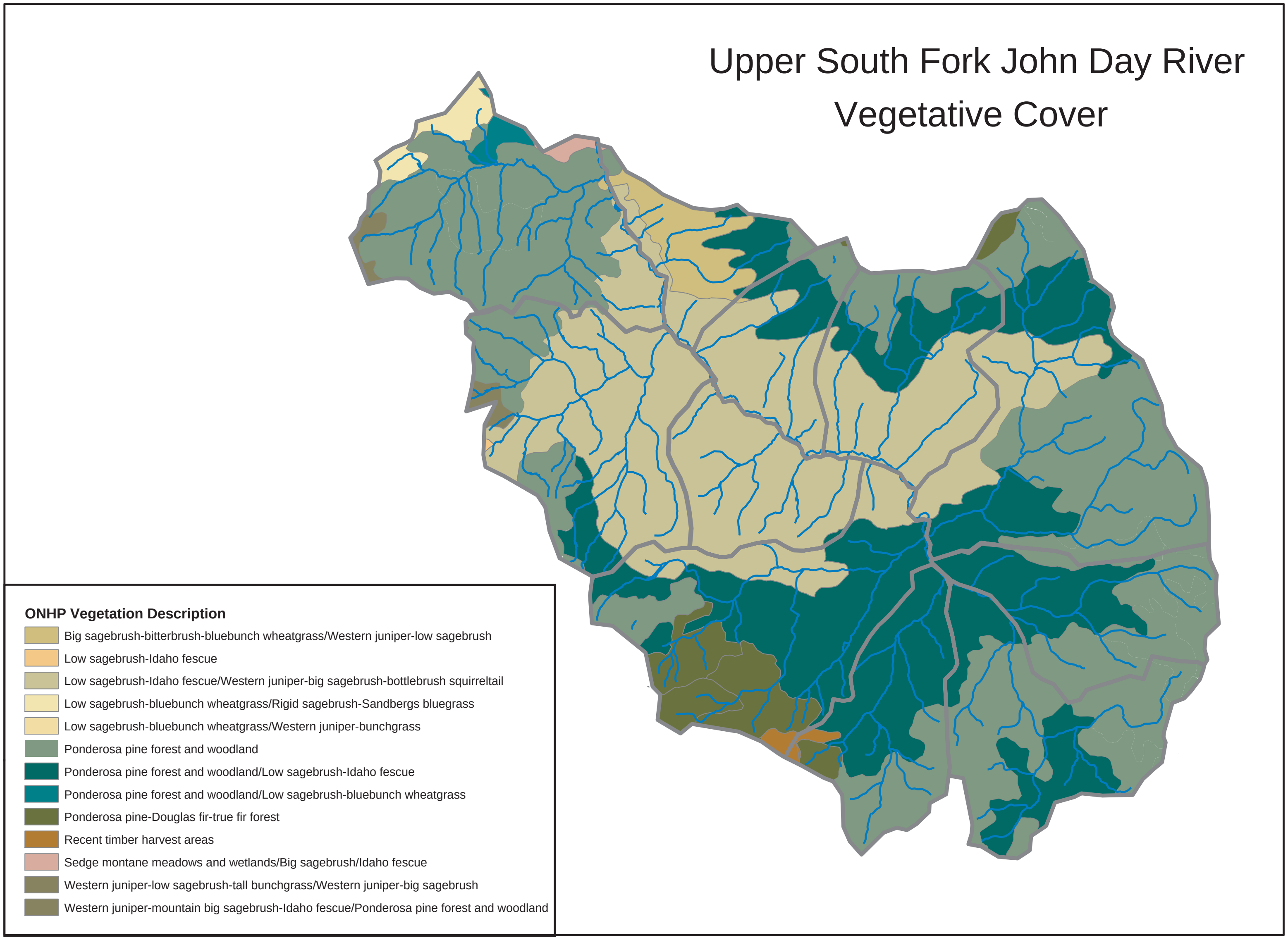

Figure 1.4 Vegetation zones occurring within the upper South fork of the John Day River watershed assessment study area (source: Oregon Natural Heritage Program).

cover beneath them, thereby reducing the fuel required to carry fire to the tree. Junipers also take up, sequester, and transpire large quantities of groundwater, thereby reducing groundwater stores (Shaun Robertson, CTWSR, 2002, personal communication). Junipers are now the dominant vegetative feature on many of the watershed's once grass and shrub-dominated hillslopes occurring between the valley floor and the upland forests. These areas, now with ground cover and understory vegetation largely lacking from grazing pressure and juniper expansion, are susceptible to increased soil erosion.

Fire suppression also has resulted in the decline of fire- and disturbance-dependent species, including quaking aspen (*Populus tremuloides*). Quaking aspen galleries typically occur in riparian areas, where fire and other regular disturbance cycles historically produced conditions favorable to this shade-intolerant species. Fire suppression, overstory encroachment, and heavy ungulate browsing of young shoots have reduced this species abundance in the watershed (DEA 2000). Only small, remnant groves still occur scattered throughout the watershed.

LAND USE AND OWNERSHIP

Forestry and ranching are the primary land uses in the USFJDR watershed. The USFS administers a total of ~156,700 acres within the watershed, divided between the Malheur and Ochoco National Forests. Private lands occur primarily on the valley floor adjacent to the mainstem USFJDR and total ~25,000 acres. The BLM administers ~750 acres occurring primarily along the mainstem river below Pine Creek, as well as portions of the Pewee-Indian and Sunflower watersheds (Figure 1.5).

Grant County has zoned land adjacent to the river as "Multiple Use Range" from County Road 63 upstream to river mile (RM) 37, and as "Primary Forest" from RM 37 upriver to the Malheur NF boundary. The Primary Forest zone is intended to protect forestlands for timber production and to protect watersheds, wildlife habitat, and scenic and recreational values along the river corridor. Land zoned as Primary Forest allows only new farms or forest parcels of greater than 80 acres in lot size, and the total number of home sites cannot exceed one dwelling per 160 acres (BLM 2000).

The USFJDR watershed is sparsely populated, with six active ranches supporting only a few dozen residents. Only one "cross-roads community", Izee, occurs in the watershed; one family of two currently resides in Izee.

The USFJDR watershed occurs almost entirely within the ceded lands of the Confederated Tribes of the Warm Springs Reservation of Oregon. By treaty, the tribes forfeited their rights to their traditional homelands, but maintained certain rights to use the land for ceremony, hunting, stock pasturing, fishing, and subsistence gathering. Tribes continue to have a vested economic and cultural interest in natural resources in the watershed and share responsibility with the Oregon Department of Fish and Wildlife for the fisheries management program for the John Day basin.

GEOLOGY

The rich and complicated geologic history of the region has produced a complex and diverse geology in the USFJDR watershed and throughout the John Day River basin. Geologic formations underlying the watershed are dominated by a combination of sedimentary and igneous rocks (DEA 2000). Geologic formations range from 10 to 250 million years old. The earliest rock formations occurring in the area are lava flows and volcanic ash, sandstone, and shale deposits from at least 250 million years ago (BLM 2000). Between 54 and 37 million years ago, lava, mudflows, and tuffs of the Clarno Formation were produced by a series of widespread volcanic eruptions. Eruptions that followed in the vicinity of the present-day Cascade Range deposited thick layers of volcanic ash in the region, which are termed the John Day Formation. Widespread volcanic activity later occurred between 19 and 12 million years ago and produced flood basalts known as the Columbia River Basalt Group. Younger formations, such as the sand and gravels deposits of the Rattlesnake Formation, also occur in the watershed. Following cessation of volcanic eruptions about 10 million years ago, erosion and faulting have continued to alter the landscape (BLM 2000) producing the present-day physical setting (Figure 1.6)

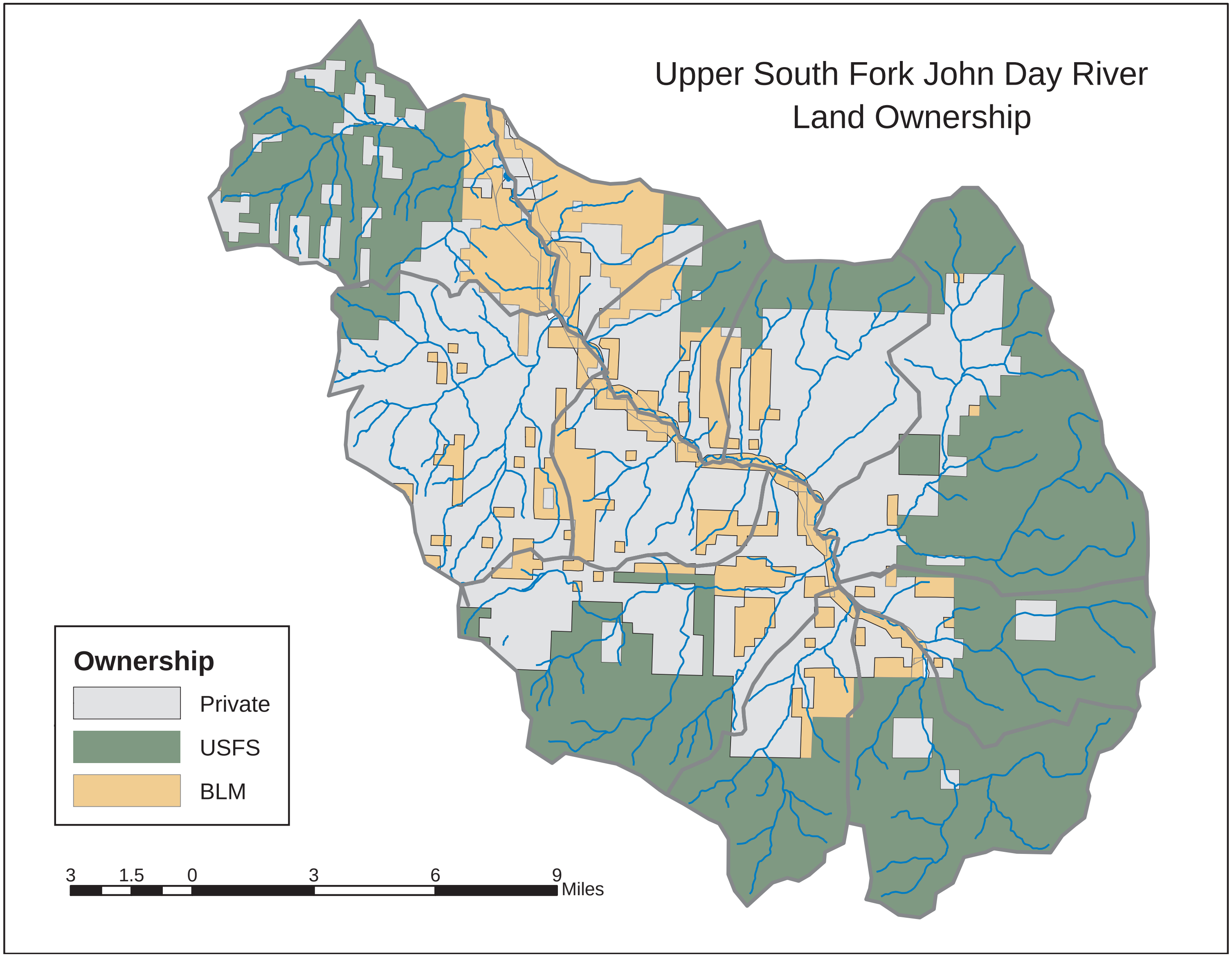

Figure 1.5 Land ownership within the upper South fork of the John Day River watershed assessment study area.

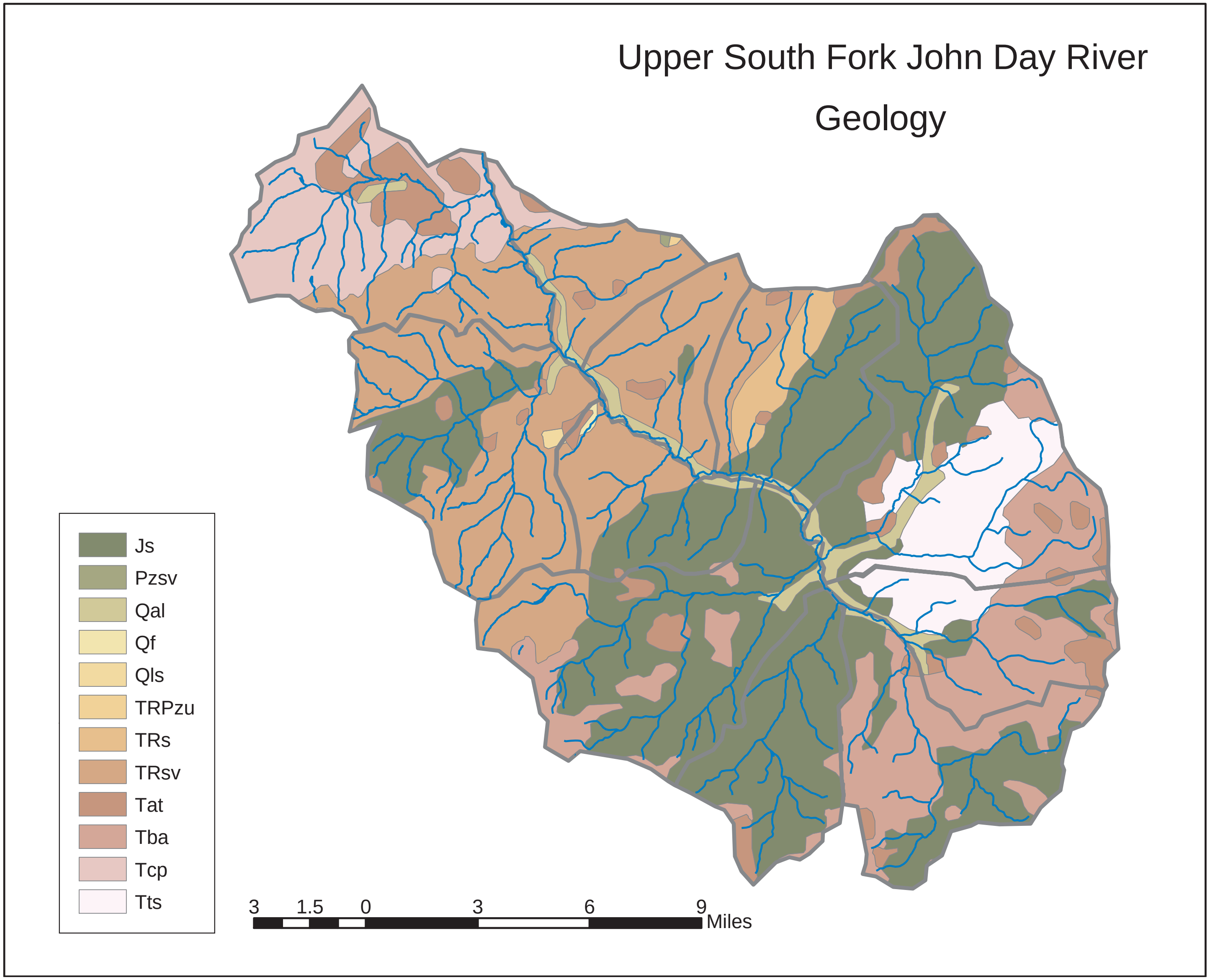

Figure 1.6 Geology of the upper South fork of the John Day River watershed, Oregon.

SOILS

A statewide soil map of Oregon created by the U.S. Department of Agriculture in 1986 indicates that only one soil type occurs on two different land types in the upper South Fork of the John Day River watershed. Soils of the upper reaches of the watershed are xeric frigid soils on forested mountains, while the soils of the lower reaches are xeric frigid soils on grass-shrub uplands (Oregon Water Resources Department 1986). Soils of these types generally have a limited amount of water present, and typically have a temperature regime between 32 and 46 ^{o}F with less than 40 ^{o}F difference between mean summer and mean winter soil temperatures (Soil Science Society of America 2003).

The USDA also classified the soils of the watershed by land capability class in 1961 (USDA 1961). These soils are of three types: Class IIIe adjacent to the South Fork and Lewis Creek, Class VIe in the lower reaches and elevations, and Class VIIe in the upper reaches and elevations. In this classification system, lower numerals indicate soils with fewer limitations and require simpler conservation practices for agricultural use, while higher numerals indicate soils more suited to range and woodland use. As indicated by the "e" designation, soils throughout the watershed tend to have erosion problems.

The Malheur National Forest has performed a detailed soil survey of lands under their management in the watershed. Additionally, the Grant Soil and Water Conservation District is currently mapping soil types throughout Grant County. However, at present, no detailed soil-survey information is available for the entire watershed.

CLIMATE

Oregon is divided into nine climate zones based on similar climatic conditions, including temperature and precipitation. The upper South Fork of the John Day River watershed occurs in Zone 7, the South Central Oregon climatic zone, representing the state's largest climatic division (Oregon Climate Service 2003). This area is semi-arid, with mean annual precipitation in the watershed ranging from less than 20 inches to 40 inches per year. The climate of the USFJDR can be characterized as having short, dry summers and long, cold winters. Periods of prolonged drought and temperatures exceeding 90 ^{o}F are common during summer months, with July and August generally being the hottest and driest months of the year (DEA 2000). Generally, the John Day River Basin tends to be warmer in the winter months than most of central and eastern Oregon and is hot during the summer months. In nearby Dayville, for example, the coldest average monthly temperature is 34 ^{o}F in January, while the warmest, 69 ^{o}F occurs in July (Oregon Water Resources Department 1986).

Precipitation tends to fall as light snow in the winter, as spring and fall rains, or as occasional summer thunderstorms. A snow pack accumulates at higher elevations and snow often covers the ground at lower elevations during the winter months. Average annual precipitation ranges from less than 20 inches at lower elevations to more than 30 inches towards the summit of the Flagtail Mountains (Carlson 1974). Snow accounts for 70% of the average annual precipitation; 60–70% of the total annual precipitation falls from October to March (DEA 2000).

HYDROLOGIC REGIME

The USFJDR watershed discharges an annual average of 100,000 acre feet of water into the mainstem John Day River at Dayville (BLM 2000). The watershed occurs within the Blue Mountain Ecological Reporting Unit (ERU), as described in the Interior Columbia Basin Ecosystem Assessment, Volume I (USDA-USDI 1997). The hydrologic regime of the Blue Mountain ERU is characterized as snow-pack dominated, with approximately 75% of the annual runoff occurring from rain-on-snow events, and 25% resulting from snowmelt. River discharge is highest during winter months and generally peaks in late April during peak snowmelt (BLM 2000), but can occur from March through May. River and stream flows are generally lowest in September; during the low flow months of July through October, conflicting demands for irrigation and instream needs are greatest (BLM 2000).

SPECIAL DESIGNATIONS

The South Fork of the John Day River from its confluence with the mainstem (RM 0) to the Malheur NF boundary (RM 52) was designated by

Congress in 1988 as a Federal Wild and Scenic River (WSR). Under this designation, the USFJDR has received a recreational subclassification as a river that is readily accessible by road or railroad that may have some development along its shoreline and that has undergone some impoundment or diversion in the past (BLM 2000). Under this designation, the river is to be administered in such a way as to protect and enhance the "outstandingly remarkable and significant" values that led to its WSR designation by Congress. Congress noted in the Federal Register of the South Fork of the John Day River:

"This 47 mile river segment has unique and outstanding scenic value with large basalt outcrops and a wide diversity of vegetation which includes grasses, willows, juniper, and ponderosa pine with some Douglas fir on the moist north and east slopes. In the upper reaches, the river flows through relatively level agricultural land before entering the more rugged canyon. The area has high value for sightseeing, camping, fishing, and other forms of dispersed recreation. There are 6 small ranches and a well-maintained public road that parallels the river throughout the 48 mile length. Except the road and ranches, the study area is natural in character. There are numerous small rapids, and the larger Izee Falls area where the river drops 55 vertical feet in a short distance. Aldrich Mountain Study Area provides a backdrop for a portion of the canyon. The Murderer's Creek State Wildlife Management Area is also adjacent to a portion of the river (BLM 2000)."

The USFJDR is also designated as a Scenic Waterway from the Murderer's Creek Wildlife Management Area upriver to County Road 63 (confluence of Pine Creek and the USFJDR). State Scenic Waterways are administered by the Oregon Parks and Recreation Commission, which develops rules for each Scenic Waterway during the management planning process. These rules vary among rivers, depending on the special attributes identified for each, but are always designed to manage development and uses within these river corridors to protect the natural beauty of the river (BLM 2000).

USFJDR WATERSHED COUNCIL

Local landowners first came together to influence land use policy and practices on public lands in the watershed in the early 1980s, when the Forest Service was planning intensive overstory removal logging in much of the upper watershed. Local citizens were concerned that logging might extend into the previously unlogged Utley roadless area. The Forest Service held meetings with local landowners to involve the community in the forest management scoping process. Through these initial efforts, local landowners developed a Cooperative Resource Management Program (CRMP) group to provide local input on all Forest Service scoping activities for timber harvest in the USFJDR watershed.

The CRMP group also began scrutinizing their own land use practices and ranching operations and actively sought funding to improve land management on private lands in the upper watershed. Through these efforts, restoration work was initiated on several private ranches in cooperation with the SWCD in the early 1990s (see Chapter 9). Through the 1990s, land ownership changed on several ranches and participation in the CRMP waned. The upper South Fork of the John Day River watershed council was established in 1998 in an effort to continue to bring local landowners together to work towards improving watershed conditions while maintaining viable and productive ranching operations in the USFJDR watershed.

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CHAPTER 2: HISTORICAL CONDITIONS

Prior to Euro-American settlement of the area, forestland in the upper South Fork of the John Day River watershed was largely dominated by ponderosa pine forests, much of which was likely single stratum old forest maintained by low-intensity fires occurring at 10–35 year intervals (DEA 2000). Douglas fir likely was a small component of these forests, and grand fir stands likely only occurred in wetter areas, including seeps and steep draws that would provide some fire protection for the species. Western juniper, a species highly susceptible to fire and now abundant across the watershed on hillslopes occurring between upland forests and valley floors, was far less abundant prior to settlement of the watershed. Areas now dominated by this species are believed to have supported bunch grass and shrub-dominated vegetative communities (DEA 2000). Non-native vegetation, introduced by Europeans, also has altered the composition of these areas. Cheat grass, for example, is an aggressive colonizer and has replaced other native grasses. Root plants such as camas, onion, yampa, and bitterroot are generally less common in the area than they were historically. Moist to dry meadows likely were more frequent on valley floors, and lush riparian areas composed of aspens, willows, and other small hardwood species were well developed along streams. Wetlands, now infrequent in the watershed, were likely common and maintained by beaver activity.

NATIVE AMERICANS

Native Americans are known to have been present in the South Fork of the John Day River watershed for well over 8,000 years (DEA 2000). Their activities, particularly the use of "cultural" fire, significantly influenced the area's historical landscape and vegetation. The John Day River valley served as a natural boundary between various Native American groups including the Northern Paiute to the south and the Cayuse, Tenino, and Umatilla tribes in the north (Southworth, undated). While the territory boundaries of Native American tribes often shifted, the upper South Fork of the John Day was generally within the Hu'Nipwi'Tika territory. Part of the Northern Paiute tribe, these people were referred to as hunibui (root) eaters, after a primary source of sustenance. Meadows in the area supported the roots of plants such as camas, krouse, arrowroot, wild onion, bitterroot, balsamroot, fawn lily, fleeceflower, and cattails. These meadows, along with the surrounding forests in the area were maintained by the Paiutes through the use of fire. Slow burning, low-intensity fires burned understory vegetation and debris, thereby maintaining open forest and meadow vegetative communities (Grant County 2003). Native Americans used this area only seasonally for forage and hunting, usually spending the winter in Canyon City and Prairie City (Mosgrove 1980).

Claims to these lands by Euro-American settlers strained relations between Native Americans and Euro-Americans. Additionally, settlers brought with them diseases, including smallpox and cholera that severely affected local and regional Native American populations (Boyd 1985). These events led to the signing of treaties by the Walla Walla, Umatilla, Cayuse, and Tribes of Middle Oregon in 1855. The Paiutes signed a treaty for land within the Malheur National Forest in 1868, but the treaty was never ratified (DEA 2000).

THE FIRST EURO-AMERICANS

Fur trappers and traders were the first Euro-Americans to come to the area. Between 1824 and 1827, Peter Skene Ogden of the Hudson's Bay Company led trapping and exploratory trips along stretches of the John Day River, including the South Fork (Mosgrove 1980). Between 1830 and 1870 traders and trappers continued to visit the area, but the majority of Euro-Americans entering Oregon were passing by to the north along the Oregon Trail. It was not until 1862, when gold was discovered near Canyon City, that any significant numbers of settlers came to Grant County. Placer mining was commonly used in the region, yet none is known to have occurred in the South Fork of the John Day River. Fledgling ranching and timber industries began soon after to provide for the inhabitants of the gold boomtowns (Grant County Chamber of Commerce 2003).

GRAZING

Vast areas of free rangeland and "luxuriant bunch grass" referred to in historical accounts attracted homesteaders hoping to raise livestock in Grant County (Southworth, undated). In the 1870s some of the first homesteaders in the watershed, Jim Harrison, John Hyde, and John Brisbois, settled near Izee and brought cattle to the area. These first settlers lived in the area seasonally, returning to the Willamette Valley during the winter months (Oliver Museum 1983). In addition to raising cattle, horses were commonly bred in the area. In 1886, the Grant County news reported, "Over near the South Fork the snow seldom falls to any great depth and a number of horsemen, realizing the advantage this section has over other localities, have secured land and are devoting considerable attention to the raising of horses" (Southworth, undated).

During this time, rangeland management was not practiced and no limits to cattle numbers or season of use restrictions existed. Riparian and fragile range areas were treated in much the same manner as upland areas that were more resistant to grazing pressure. Rangeland was unfenced, allowing cattle to roam between the higher forested areas during the summer and near the river during the winter (Oliver Museum 1983). Overgrazing was problematic and by the late 1870s and early 1880s some range areas in Grant County already had significantly reduced production capacities (Southworth, undated).

Due to this "change in range conditions" from overgrazing, sheep were introduced to the area. In 1882, the Keerins brothers came to Izee and introduced sheep to the watershed (Oliver Museum 1983). With high-quality rangeland becoming increasingly scarce, "range wars" soon broke out between the sheepherders and cattlemen. The sheepherders, only seasonal residents of the area, were hated by the cattlemen who felt the land was theirs, although they rarely owned it (Southworth, undated). In Izee Country, the cattlemen went as far as organizing a group called the "Izee Sheep Shooters," to defend the range (Mosgrove 1980).

UNITED STATES FOREST SERVICE

In 1903, the United States Forest Service was created and rangeland management was introduced to the area. "Specific allotments, controlled numbers of animals, and regulation of time of use on the range" by the Forest Service helped bring the range disputes to an end (Southworth, undated). In 1906, the Blue Mountain Forest Reserve, under management of the Forest Service, was created as a reserve of timberland and other forest resources. These lands, collectively known now as the Malheur National Forest, included area in the watershed. In addition, the Forest Service also started large-scale fire suppression in the area, preventing the small, low-intensity fires that periodically burned the underbrush and gathered debris. As a result larger, high-intensity fires became more frequent in the area (Grant County Chamber of Commerce 2003).

Until the 1920s the Forest Service focused on fire suppression, watershed protection, and grazing management (DEA 2000). Timber was used primarily to provide local settlers with materials for ranching and mining activities and infrastructures. By the late 1930s logging trucks and chainsaws allowed more efficient and profitable tree harvest, at which time the largest and healthiest trees were first targeted, leaving the smaller trees for later cutting upon return visits.

LOGGING

In 1939, timber stands within the Malheur National Forest and the watershed were sold by the Forest Service to the Edward Hines Lumber Company. The sale of the Camp Creek and Murderer's Creek units included "optional areas" that were located in the watershed (Mosgrove 1980). Timber cut within the watershed as part of this sale was likely transported elsewhere for processing.

The first mill in the watershed, built by the Ralph L. Smith Lumber Company, began operation on July 4, 1946. Between the operating years of 1946 and 1949, the mill expanded from sawing 40,000 to 85,000 feet per day (Oliver Museum 1983). While little is known about the operation of the mill during this time, financial records indicate that it was profitable. In 1950, Smith decided to pursue other business interests and sold the mill to Sig Ellingson of the Ellingson Lumber Company. Ellingson operated the mill between 1950 and 1967.

High-quality pine logs mainly from the Malheur and Ochoco National Forests were cut at the mill. These logs were held in a large holding pond, which was supplied with water from the South Fork. The seven-foot band mill was powered by different means including a diesel electric generator, a wood fired boiler/turbine generator, and later with electricity from the Central Electric Cooperative in 1956. It was common to process 90,000 to 100,000 feet during an eight-hour shift. Scraps from the mill were transferred across the river by a conveyor where they were burnt in a wigwam burner. A large camp was associated with the mill and included 30 houses, 20 trailer sites, 5 bunkhouses, a cookhouse, a company store, gas pumps, a post office, and a community hall (Morisette, undated).

AGRICULTURE

Agriculture in the watershed has always consisted primarily of pasture and hay production for the livestock. In 1961, cultivation generally occurred along the upper South Fork and its major tributaries (USDA 1961). In 1978, a combination of irrigated and non-irrigated agriculture occurred in the same general area. Irrigated agriculture produced pasture and alfalfa/meadow hay, while non-irrigated agriculture included pasture, grain hay, grass hay, and grain production (Water Resources Department 1986).

FISHERIES

Little information describing historic fisheries conditions exists. The South Fork contributes to the production of steelhead populations; however, these runs are restricted to the habitat below Izee Falls at River Mile 27.5, outside of the upper watershed. A fish ladder, which would allow access to habitat above the falls, has been considered in the past, but has since been discarded. Much of the habitat occurring above the falls is degraded and would require restoration work (Water Resources Department 1986). Within the watershed, wild redband trout populations persist; Sunflower, Indian, Flat, Lewis, Corral, and Venator creeks have been noted as important to the maintenance of these trout populations in the upper watershed (Water Resources Department, 1986).

CONCLUSIONS

The vegetation and landscape of the USFJDR watershed has been heavily influenced by human activity for more than 8,000 years with the settlement of the area by Native Americans. More recently, watershed characteristics once again experienced substantial change with the immigration Euro-American settlers. Historical activities, in particular, grazing and forest management, have resulted in a significant transformation of the watershed. In the following chapters of this assessment, we examine how and where such activities have altered watershed conditions.

HISTORICAL CONDITIONS TIMELINE

1824–1827Peter Skene Ogden of the Hudson's Bay Company travels throughout the

area for trapping and exploring purposes

1855–1872Reservations established for Native American tribes in the area

1856–1858Eastern Oregon banned to settlers due to ongoing harassment by Native American tribes

Gold discovered in Canyon Creek bringing settlers to the area

1870s Jim Harrison, John Hyde, and John Brisbois homestead near Izee, bringing cattle to the area

1878 Bannock War occurs, Native Americans involved in battle with soldiers at Silver Creek flee through the area

1882 Keerins brothers (Matt, Owen, Joseph, and Dave) come to Izee, bringing sheep to the area

1888 Carlos Bonham family moves to Izee

1889 Izee post office opens with Carlos Bonham as postmaster (November 6)

1889–1890Severe winter

1889–1890First school opens in Izee

1890s–1900sRange disputes between cattlemen and sheepherders

1895 Lee Miller opens a store at the mouth of Antelope Creek

1898 The "Boy's War" occurs, George W. Cutting and a brave are killed

1902 Grant County restricts use of rangeland to its residents

1903 Creation of the Forest Service brings rangeland management to the area ending range disputes

1913 Grange opens in Izee

1929 The Great Depression, many families in the area leave

1939 Timber sale transfers "optional area" in the watershed from the Forest Service to the Hines Lumber Company

1946 Lumber mill built by the Ralph Smith Lumber Company, later purchased and operated by the Ellingson Lumber Company

1964 Flood in the South Fork basin

1967 Ellingson Mill closes

1986 State of Oregon Water Resources Board reports documentation of watershed damage in the Upper South Fork by the BLM, ODFW, and USFS due to poor rangeland management

Sources: Grant County: In the Beginning, History of Grant County, Oregon, The Malheur National Forest: An Ethnographic History, and John Day River Basin Report.

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CHAPTER 3: CHANNEL HABITAT TYPES

INTRODUCTION

Rivers and streams are dynamic systems that are shaped by interacting physical, hydrologic, and biological factors. A river or stream is considered stable when it consistently transports its sediment load associated with local scour and deposition (Rosgen 1996). In other words, when a river is stable, an equilibrium occurs between rates of erosion and deposition (Leopold 1994). When scouring processes produce degradation, or when excessive sediment deposition results in aggradation, the river channel is said to be unstable. Land use can cause channel instability by increasing sediment loads and altering local hydrology; which in turn can alter channel form through degradative or aggradative processes, such as streambed scour or sediment deposition. In the upper South Fork of the John Day River watershed, land use impacts have increased stream sediment loading and altered discharge patterns, resulting in channel instability throughout the watershed.

Channels vary in their sensitivity to these land-use impacts, depending in part on their geomorphic characteristics, including channel gradient, channel size, and channel confinement or constraint. Classification of river segments according to these geomorphic characteristics can help determine their relative sensitivity to disturbance and their responsiveness to restoration efforts, and can therefore help focus restoration efforts on stream reaches or segments that will most likely respond to those efforts.

Several stream classification systems that group streams according to geomorphic characteristics currently exist (e.g. Rosgen 1994, Montgomery and Buffington 1996). The Oregon Watershed Assessment Manual presents a system developed from these existing systems that is designed specifically for grouping Oregon rivers and streams according to their sensitivity to disturbance and their responsiveness to restoration efforts. This stream classification system—Channel Habitat Typing (CHT)—allows streams throughout the state to be classified based on similar geomorphologic characteristics, including stream size, channel gradient, and channel side-slope constraint. Appendix 3.1 lists the characteristics of each type of CHT identified in the watershed.

METHODS

USGS topographic maps (1:24,000 scale) were used as a base map for channel habitat typing. Mylar overlays were placed on the map, and all channels that had previously been noted by ODF fish surveys were typed. Thus, this typing included both perennial and seasonal streams in the watershed. Channel typing was performed following OWEB protocols (WPN 1999). Stream segments were classified by channel gradient and confinement. Channel gradient classes included <1%, 1–2%, 2–4%, 4–8%, 8–16%, and >16%. Channels were classified as Confined, Moderately Confined, and Unconfined, by examination of topographic maps and aerial photographs. Channel habitat type units generally were a minimum of 1000 feet in length; however, exceptions were made when channels exhibited unusual characteristics. Table 3.1 summarizes CHT coding, nomenclature, and attributes of the various CHTs in the OWEB protocol. Field validation of channel habitat typing throughout the watershed occurred in August 2002. CHTs were digitized and lengths measured using ArcView 3.2a

RESULTS

The upper reaches of drainage networks within the watershed consist primarily of constrained channels of moderate-to-steep gradient classes, including Very Steep Headwater channels (VH), Steep Narrow Valley channels (SV), and Moderately Steep Narrow Valley channels (MV) (Figures 3.1 and 3.2). Proceeding downstream through the mid reaches of tributary networks in the watershed, channels become less constrained and gradients are low to moderate (LM, MM). The lower reaches of many tributary drainages, as well as most of the upper South Fork John Day River, consist of unconstrained, low gradient systems on floodplains (FP2, FP3).

A total of 258.4 miles of streams were assigned CHTs throughout the watershed. Among all stream reaches within the watershed, 36.2% (93.4 miles) are CHTs considered to be highly sensitive to disturbance (Table 3.2). More than half of the total watershed channel length classified

Table 3.1. Summary of Channel Habitat Types (CHT) (source: WPN 1999).

Code	CHT Name	Gradient	Channel Confinement	Size
ES	Small Estuary	<1%	Unconfined to moderately confined	Small to medium
EL	Large Estuary	<1%	Unconfined to moderately confined	Large
FP1	Low Gradient Large Floodplain	<1%	Unconfined	Large
FP2	Low Gradient Medium Floodplain	<2%	Unconfined	Medium to large
FP3	Low Gradient Small Floodplain	<2%	Unconfined	Small to medium
AF	Alluvial Fan	1-5%	Variable	Small to medium
LM	Low Gradient Moderately Confined	<2%	Moderately confined	Variable
LC	Low Gradient Confined	<2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2-4%	Moderately confined	Variable
MC	Moderate Gradient Confined	2-4%	Confined	Variable
MH	Moderate Gradient Headwater	1-6%	Confined	Small
MV	Moderately Steep Narrow Valley	3-10%	Confined	Small to medium
BC	Bedrock Canyon	1->20%	Confined	Variable
SV	Steep Narrow Valley	8-16%	Confined	Small
VH	Very Steep Headwater	>16%	Confined	Small

as highly sensitive to disturbance was classified as FP3, indicating that floodplain channels occurring in the lowland areas of the watershed represent a large proportion of the most sensitive channels occurring in the watershed.

Moderately sensitive channels represented 35.3% (91.3 miles) of the total watershed channel length. These channels typically occurred midway through tributary drainage networks, where gradients begin to flatten from steeper headwater areas and channels become less (moderately) constrained. Finally, channels with low sensitivity to disturbance represented 28.5% (73.7 miles) of the total stream length in the watershed. These channels occurred exclusively in steep, confined headwater areas.

DISCUSSION

Channel responsiveness to changes in discharge or sediment loads resulting from disturbance or restoration efforts is largely a function of channel confinement and gradient. Of the CHTs occurring in the watershed, the most responsive CHTs to restoration and enhancement are LM, MM, and MH, and to a lesser extent FP2 and FP3, representing more than 36% of the total stream length in the watershed and presenting significant opportunities for habitat improvement. An additional 35% of watershed stream miles are classified as moderately responsive to restoration efforts and should also continue to be focal points for stream restoration efforts, as well.

Despite the assignment of low sensitivity to nearly a third of all stream miles occurring in the watershed, it should be emphasized that all CHTs

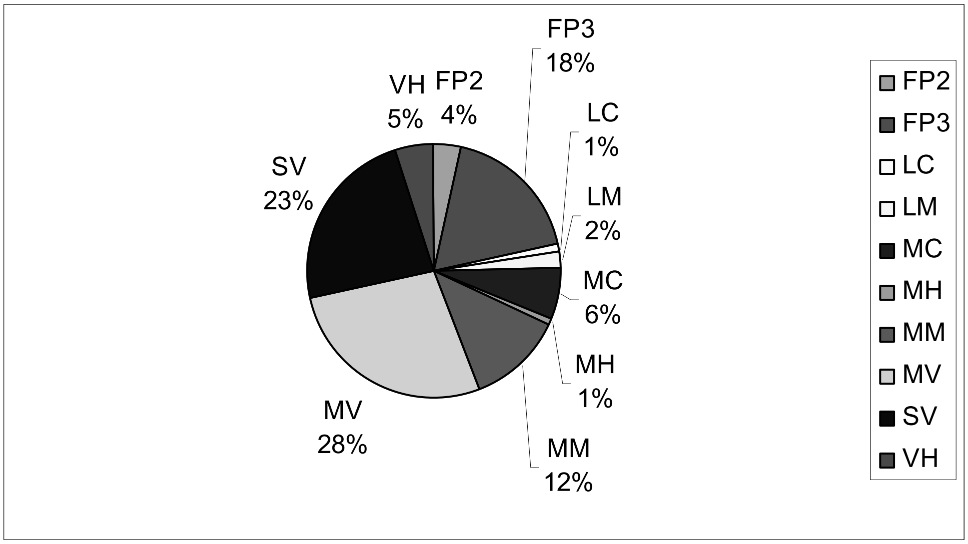

Figure 3.1 Relative frequencies of stream Channel Habitat Types (CHTs) occurring in the upper South Fork of the John Day River watershed, Oregon.

will benefit from the restoration of riparian vegetation. Vegetation near streams helps to absorb stream energy, stabilize streambanks, and reduce sediment loading and stream temperatures. The woody debris input from vegetated banks creates and maintains habitat for young salmonids and other aquatic life. Additionally, leaf litter and insects falling into the stream provide important food sources for stream life.

Although comprehensive soils information does not exist for much of the watershed, the information that does exist suggests that much of the watershed is composed of loosely consolidated soils that tend to have high erosive properties. As a result, channel and overland erosion problems occur throughout the watershed, and are not necessarily limited to affecting particular channel types or locations. During field surveys, even steep and confined headwater reaches showed signs of recent or historic channel entrenchment. When using these channel sensitivity assignments to stream segments in the watershed, field surveys should be performed to determine the condition of headwater reaches, rather than simply assuming that these areas are less degraded and in less need of enhancement.

Depending upon riparian cover, agriculture and range practices, and stream discharge, bottomland channels that are designated LM (Low gradient – Moderately confined) or FP2 or FP3 (Flood Plain-Medium or -Small) can downcut during high flows and become incised. Such events can create severely confined channels that prevent future high-water events from dissipating energy on the floodplain; rather, the energy will further downcut the channel, producing more channel instability and a lower water table.

Channel downcutting already has occurred throughout the basin and likely has resulted from a combination of infrequent, severe storm events and intensive management of timber and grazing lands. Possible causes of channel entrenchment of streams segments have been suggested to include climatic change, heavy grazing, base-level lowering from natural processes, agricultural practices, and road construction (DEA 2000). Loss of beaver dams from historic heavy beaver trapping has also likely contributed to channel-bed erosion and degradation. Currently, riparian vegetation conditions are not adequate to support beaver in much of the watershed without negative effects on riparian regrowth. Check dams have been installed in the mainstem of the USFJDR and several tributaries in an effort to retain sediments and abate channel entrenchment, effectively providing the same functions provided by beaver dams.

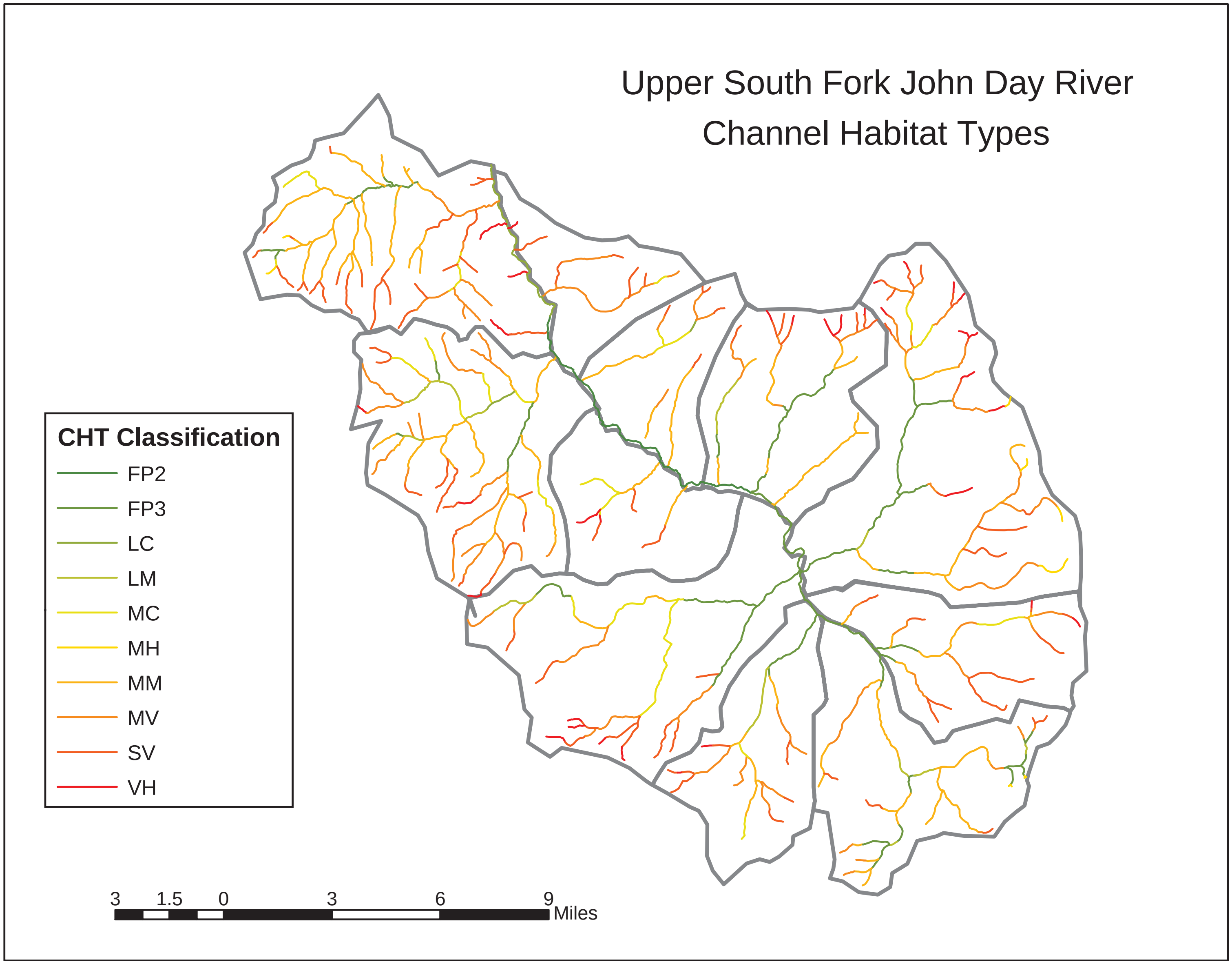

Figure 3.2 Channel Habitat Types in the upper South Fork of the John Day River watershed, Oregon.

Table 3.2. Channel Habitat Types (CHT) occurring in the upper South Fork John Day River watershed, Oregon. Channel habitat types are grouped by their sensitivity to disturbance.

CHT	Sensitivity	Stream Miles	Percent of Total
FP2	High	9.44	3.65
FP3	High	46.90	18.15
LM	High	5.48	2.12
MM	High	31.60	12.23
	High Total	**93.42**	**36.15**
LC	Moderate	2.18	0.84
MC	Moderate	16.22	6.28
MH	Moderate	2.47	0.96
MV	Moderate	70.44	27.26
	Moderate Total	**91.31**	**35.33**
SV	Low	60.48	23.40
VH	Low	13.21	5.11
	Low Total	**73.69**	**28.51**
	OVERALL TOTAL	258.42	100.0

DATA GAPS AND RECOMMENDATIONS

Some Channel Habitat Types were field-checked for accuracy; however, private land access and time constraints prevented a comprehensive check of all of the designations. Because the CHTs were classified according to topographic conditions, some of the stream reaches could have been misclassified as moderately confined or unconfined, rather than confined. More ground-truthing of these areas is required. Future work should expand on the current designations to ensure accuracy, as well as to monitor channels for further entrenchment.

Although channel habitat typing provides one source of information used in identifying restoration opportunities, we suggest that more intensive field-based surveys be performed to examine stream channel conditions to both produce baseline information and to better quantify channel conditions in various areas of the watershed for restoration prioritization.

Although steep, narrow valley channels occurring in headwater reaches of the watershed are characterized as having low responsiveness to restoration efforts, attention to management activities in these areas likely will reduce sediment loading, bank erosion, and habitat degradation in these areas. Emphasis on active restoration efforts, including placement of instream structures, streambank stabilization techniques, and grade controls should continue to be placed on streams of moderate-to-low confinement lower in the drainage network.

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CHAPTER 4: HYDROLOGY AND WATER USE

INTRODUCTION

Understanding how land and water uses can alter natural hydrologic processes necessitates having a basic understanding of how water moves through a watershed. The hydrologic cycle describes movement of water through the watershed through condensation, precipitation, infiltration, runoff, and evapotranspiration. In the atmosphere, water vapor condenses to form clouds, which in turn produce precipitation in the form of rain, sleet, snow, or hail when conditions are suitable. This water, upon reaching the land surface, can either infiltrate the soil or flow into surface waters as runoff. The amount of water that infiltrates the soil is related to land surface slope, vegetation type and cover, soil types, and the degree to which the soil is already saturated. Surface runoff primarily occurs where the ground is saturated or is covered by impervious surfaces. Water is returned to the atmosphere through evapotranspiration, a combination of the evaporation and transpiration processes; surface water evaporates while vegetation transpires drawing water in through roots and releasing it from leaves.

Human activities, including forestry practices, agriculture, grazing, irrigation, urban development, and road building can significantly alter these hydrologic processes. Effects of these activities on watershed hydrology can include changes in the timing and quantity of stream flows, resulting in increased peak flows, reduced low flows, and altered timing and quantities of water yields. Changes in water quantity can consequently alter water quality and aquatic communities. The degree of hydrologic alteration is largely affected by the location, extent, and type of land use activity.

The purpose of this component of the assessment is to evaluate the potential impacts of land- and water-use practices on the hydrology of the upper South Fork of the John Day River watershed. The Watershed Assessment Manual includes screening-level assessments of each of the major land-use types occurring in the USFJDR watershed to determine which land-use types are altering hydrologic processes. An in-depth analysis beyond the scope of this project would be necessary to determine which specific activities were responsible for any hydrologic changes that have occurred.

HYDROLOGIC CHARACTERIZATION

PRECIPITATION

Annual precipitation in the watershed ranges from less than 20 inches to 40 inches per year (Table 4.1). Peak precipitation occurs as snowfall between November and January, while a secondary peak occurs as rain in May and June from localized thunderstorms (Oregon Water Resources Department 1986). In Dayville, at the mouth of the SFJDR, annual precipitation averages only 11.7 inches per year, with the highest monthly precipitation typically occurring in March, April, or May (Table 4.2). Precipitation tends to fall as light snow in the winter, as spring and fall rains, or as occasional summer thunderstorms. A snow pack accumulates at higher elevations and snow often covers the ground at lower elevations during the winter months. Average annual precipitation ranges from less than 20 inches at lower elevations to more than 30 inches towards the summit of the Flagtail Mountains (Carlson 1974). Snow accounts for 70% of the average annual precipitation; 60—70% of the total annual precipitation falls from October to March (DEA 2000).

STREAM FLOW AND PEAK FLOW GENERATING PROCESSES

On the South Fork of the John Day River, discharge tends to be greatest during the winter months, coinciding with maximum snowmelt runoff, and tends to peak in late April. Generally, there is a low flow period between July and October, with lowest discharges typically occurring in September (Oregon Water Resources Department 1986). Only one gauging station is currently in operation in the upper watershed, located on the upper South Fork above Izee Falls and is operated and maintained by the Oregon Water Resources Department. The average daily flow reported by this gauge over the past four years shows the large interseasonal variability in river flow (Figure 4.1). Peak and low flows graphed

Table 4.1. General watershed characteristics of the upper South Fork of the John Day River watershed, Oregon.

	Subwatershed	Subwatershed area (mi^2)	Mean Elevation (feet)	Minimum Elevation (feet)	Maximum Elevation (feet)	Mean Annual Precipitation (inches)
1	Donivan-Bear	26.49	5100	4377	6002	<20
2	Corral	19.20	4985	4250	5720	20-40
3	Flat-Utley	38.15	5479	4196	6762	20-40
4	Sheep-Pole-Sock	16.07	4828	3984	5673	<20
5	Pine-Brisbois	34.19	4722	3901	5543	<20
6	Sunflower	34.85	4601	3629	5573	<20
7	Pewee-Indian	12.48	4820	3629	6012	<20
8	Morgan-Dry Soda	13.94	4872	3896	5848	<20
9	Poison-Rosebud	23.41	5079	4074	6083	<20
10	Lewis-Lonesome	45.50	5150	4259	6041	<20
11	Venator	20.39	5321	4324	6318	<20
Total Watershed		284.67				

over the last four years further illustrates the extreme seasonal and annual variation in flow that can occur in the watershed (Figure 4.2). In the past, the U.S. Geological Survey collected stream-flow data on the South Fork John Day near Izee in 1926 (Station 14039300) and on Venator Creek between 1967 and 1979 (Station 14039200). Peak flows for Venator Creek again illustrate the high annual variability in peak flows (Figure 4.3).

Annual peak flows, defined as the maximum instantaneous rate of flow occurring during the year (WPN 1999), typically occur in the spring between March and May. Most of the watershed occurs within the 3000 to 5000-foot transient snow zone, where spring rain-on-snow events are the dominant peak-flow generating process. As such, this hydrologic analysis assesses the potential effect of forest conditions on watershed hydrology using rain-on-snow events as the primary hydrologic process.

HYDROLOGIC ASSESSMENT

LAND USE

In the upper South Fork of the John Day River watershed, land use is predominantly range land/agriculture (57%) and, to a lesser extent, forestry (43%; Table 4.3). Most of the forested land occurs in the upper reaches of the watershed, while agricultural and range lands generally occur adjacent to the mainstem and the lower reaches of tributaries. Although some forestland is privately owned, the majority of the forested area in the watershed occurs in the Malheur and Ochoco National Forests. Only a small portion of the watershed is used for agriculture, including irrigated pasture and hay production, and non-irrigated hay, pasture, and grain production. The remainder of the watershed is devoted to rangeland, primarily for cattle. There are no zoned urban areas within the watershed, as only the “cross-roads community” of Izee occurs in the upper watershed (Oregon Water Resources Department 1986).

Table 4.2. Monthly mean and extreme climatic data for Dayville, Oregon, 1961–1990 (Oregon Climate Service, 2003).

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean Temperature (°F)													
Maximum	44	50	58	66	72	82	91	90	81	68	52	43	70
Minimum	28	28	34	37	43	49	53	52	45	39	31	24	41
Mean	37	39	46	52	58	65	72	71	63	54	41	34	56
Extreme Temperature (°F)													
Maximum	67	72	80	95	102	103	110	110	106	95	78	65	110
Minimum	-3	-11	18	21	25	33	39	39	25	14	3	-18	-18
Precipitation (inches)													
Monthly mean	0.8	0.9	1.3	1.2	1.8	1.1	0.5	0.9	0.5	0.7	1.1	0.8	11.7
Extreme 24 hour	0.6	0.6	0.7	0.9	1.5	0.6	1.2	1.8	0.6	1.2	0.7	0.5	1.83
Snowfall (inches)													
Monthly mean	2.7	2.1	0.4	0	0	0	0	0	0	0	1.7	4.1	8.27
Average number of days													
Temperature (°F)													
Maximum 90 or more	0	0	0	0.2	2.9	7.8	18	17	6.6	0.7	0	0	49.3
Maximum 32 or less	3.4	1.2	0	0	0	0	0	0	0	0	0.4	4.3	7.6
Minimum 32 or less	22	16	13	7.4	2.3	0	0	0	0.8	5.5	17	22	87.7
Minimum 0 or less	0.3	1	0	0	0	0	0	0	0	0	0	1.4	2.4
Precipitation													
0.01 inches or more	8	7.7	12	10	10	8.6	3.5	4.3	4.8	6.5	9.3	7.1	86.8
0.10 inches or more	2.7	2.8	4.2	3.6	4.7	3.1	1.4	2.4	1.8	2.4	3.6	3.2	33.9
0.50 inches or more	0.1	0.3	0.3	0.4	0.9	0.4	0.2	0.5	0.1	0.1	0.4	0	3.5
1.00 inches or more	0	0	0	0	0.2	0	0.1	0.2	0	0.1	0	0	0.5

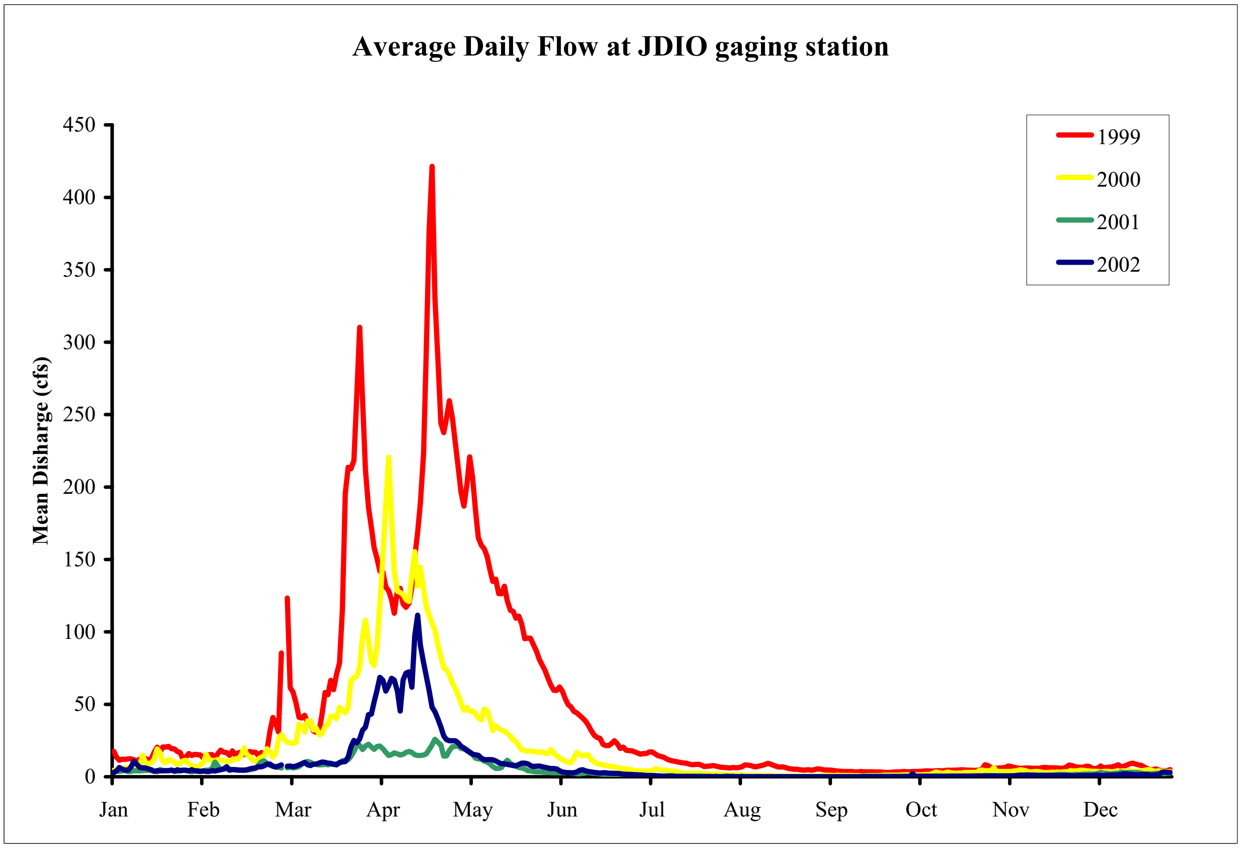

Figure 4.1 Average daily flow above Izee Falls on the South Fork of the John Day River, Oregon, at the JDIO gauging station (USBR 2003).

POTENTIAL FORESTRY IMPACTS

Forest practices, such as the removal and disturbance of timber and other vegetation and associated road building, influence both evapotranspiration and infiltration rates. This alteration can lead to changes in peak and low flows, as well as water yield within a watershed (WPN 1999).

Forestry impacts were evaluated by first determining what peak-flow-generating processes occur in each subwatershed (WPN 1999). If more than 75% of any subwatershed occurred in the rain-on-snow category, the analysis continued to examine the potential effects of current forest conditions on watershed hydrology. Rain-on-snow events are the primary peak-flow generating process at intermediate elevations from 3000 to 5000 feet. The area within this elevation range was calculated for each subwatershed to determine what proportion of each subwatershed occurred in this peak-flow category; all subwatersheds occur primarily in this elevation range, so all were included in the analysis of potential forestry impacts on peak flows.

For this analysis, we assumed that all lowland and valley floor areas currently managed as open rangeland historically had forest crown closures of less than 30%, as these areas were likely grasslands and ponderosa pine savannas prior to Euro-American settlement. We assumed that the forested areas within the watershed generally had crown closures of greater than 30%, but we recognize that some of these forested areas were likely park-like stands of ponderosa pine with canopy closures of less than 30%. According to criteria adapted from the Washington State Department of Natural Resources for use in Oregon (WPN 1999), forested portions of the USFJDR watershed currently with less than 30% crown closure must comprise at least 75% of all forested areas within the rain-on-snow zone to be classified as posing a potential risk of peak-flow

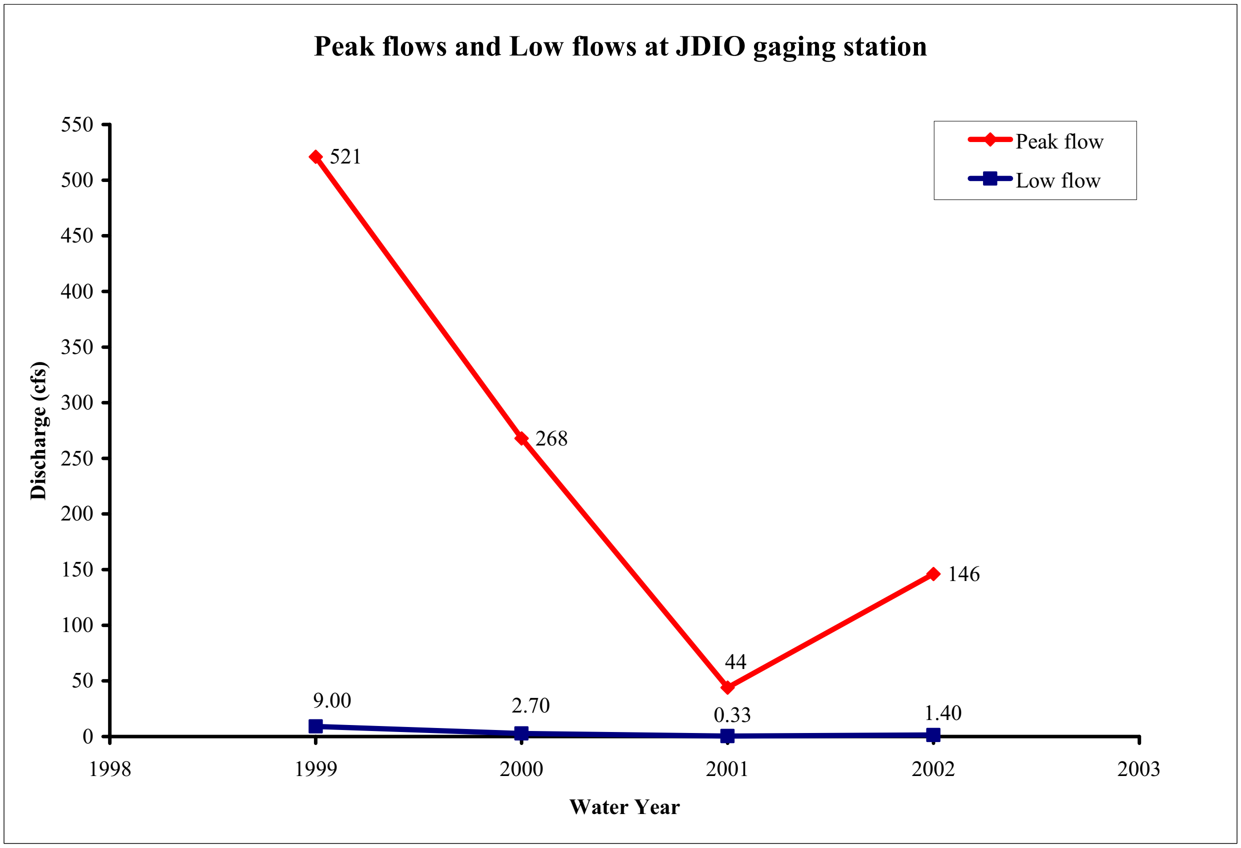

Figure 4.2 Annual peak and low flows above Izee Falls on the South Fork of the John Day River, Oregon, at the JDIO gauging station (USBR 2003).

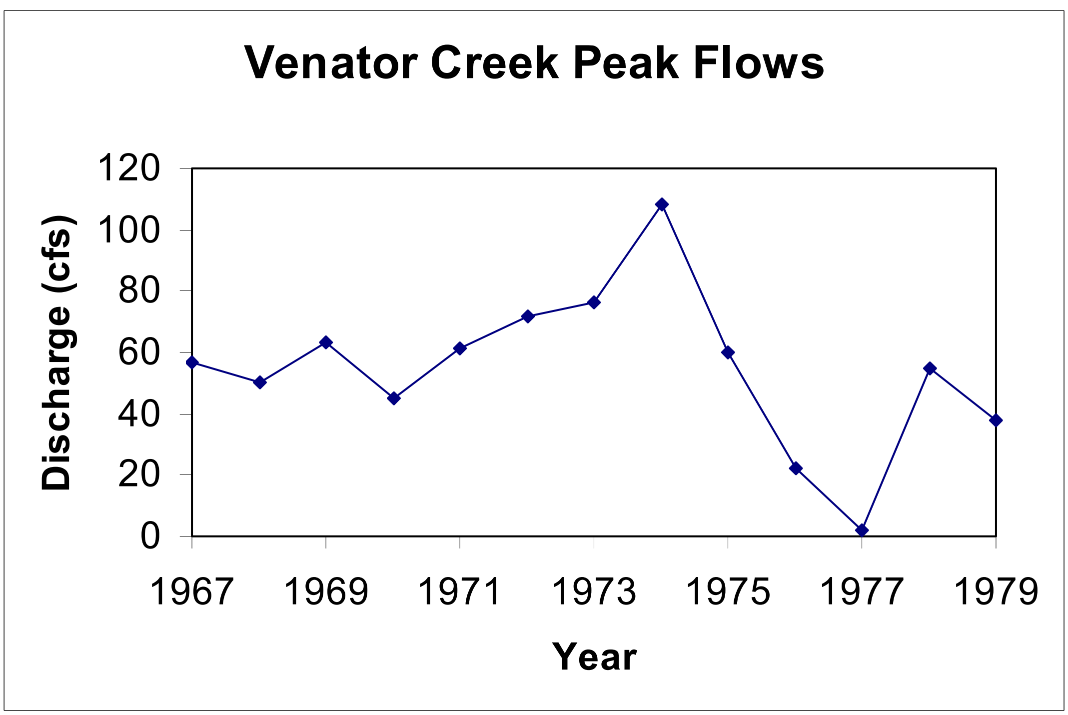

Figure 4.3 Annual peak flows for the period 1967–1979 on Venator Creek, Grant County, Oregon.

Table 4.3. Land-use practices in the upper South Fork of the John Day River watershed, Oregon.

	Subwatershed	Area (Acres)	Forestry Acres	Forestry %	Agriculture and/or Range Acres	Agriculture and/or Range %	Urban Acres	Urban %	Other Acres	Other %
1	Donivan-Bear	16,953	12,250	72	4702	28	0	0	0	0
2	Corral	12,288	6309	51	5979	49	0	0	0	0
3	Flat-Utley	24,416	11,970	49	12,446	51	0	0	0	0
4	Sheep-Pole-Sock	10,285	0	0	10,285	100	0	0	0	0
5	Pine-Brisbois	21,882	3338	15	18,544	85	0	0	0	0
6	Sunflower	22,304	12,315	55	9989	45	0	0	0	0
7	Pewee-Indian	7987	2837	36	5150	65	0	0	0	0
8	Morgan-Dry Soda	8921	1745	20	7176	80	0	0	0	0
9	Poison-Rosebud	14,982	3324	22	11,658	78	0	0	0	0
10	Lewis-Lonesome	29,120	18,837	65	10,283	35	0	0	0	0
11	Venator	13,050	5643	43	7407	57	0	0	0	0
	Total Watershed	182,189	78,567	43	103,621	57	0	0	0	0

enhancement. Across all subwatersheds, only 8% of the total forested area occurring in the rain-on-snow zone had canopy cover values of less than 30%. All but two subwatersheds had forested area with only greater than 30% canopy cover occurring within the rain-on-snow zone, indicating that current forest stand conditions have a low potential risk for increasing peak flows in the watershed.

POTENTIAL AGRICULTURE/RANGELAND IMPACTS

Rangelands are the dominant land use occurring in the upper watershed, representing 57% of the watershed area. As such, the effects of grazing management, both current and historic, on watershed hydrology likely are significant. Valley floor floodplains are the most fertile of the rangelands occurring in the watershed because they have historically trapped nutrient-rich sediments and accumulated plant material. Owing to their productivity, these areas have been altered in a number of ways by grazing management practices. Much of the native riparian and floodplain vegetation has been removed and stream and river channels have been channelized or diked. Increased peak flows have led to channel downcutting throughout the watershed and on the mainstem SFJDR in particular. Downcutting, channelization, and diking have effectively disconnected river segments in the watershed from their floodplains, resulting in loss of flood attenuation capacity, thereby exacerbating peak flows, flow velocities, and channel downcutting.

Additionally, grazing by livestock and other animals can impact rangelands by removing protective vegetation and compacting the soil surface, both of which influence infiltration rates. Infiltration capacity can be reduced to 50–70% of the ungrazed condition in areas of moderate to heavy grazing (Gifford et al. in WPN 1999). In these areas, increased surface runoff is common and may result in production of ephemeral streams that only have flow after major rainfall or snowmelt events (WPN 1999).

The Oregon Watershed Assessment Manual provides a screening-level assessment of agricultural and rangeland uses on hydrology by examining cover types, treatment practices, and soil group combinations to determine where the highest risks for increases in peak flows occur within the watershed. Some combinations of these factors are more likely to reduce infiltration rates, increase runoff, and increase peak-flows. As of the date of this assessment, comprehensive soil survey information for Grant County was not available and precluded an assessment of these land-use practices on watershed hydrology. Although the screening-level assessment could not be performed, we assume that infiltration rates have decreased in much of the watershed being used for grazing. Because such a large proportion of the watershed is used for grazing, we strongly recommend that this or a similar analysis of the potential impact of agricultural and rangeland practices on watershed hydrology be performed upon completion of the County soil survey, as this land use is likely having the largest effect on watershed hydrology.

POTENTIAL FOREST AND RURAL ROAD IMPACTS

Road surfaces, whether paved or compacted fill, are generally impervious to water infiltration. Reduced infiltration of precipitation on the road surface increases surface runoff. Roadways constructed along waterways can restrict lateral channel movement and produce incised channels that are disconnected from their floodplain. As there are no residential or urban areas in the USFJDR watershed, roadways are either forest or rural roads. Other than the county roads that parallel much of the mainstem, Pine Creek, and Antelope Creek, all roads in the watershed are unpaved.

A total of 447.7 miles of roads occur in the watershed, averaging 1.6 miles of road per square mile. Using an average road width of 0.00565 miles, roads total 2.53 square miles, or 0.8%, of the total area in the USFJDR watershed. Among subwatersheds, road densities vary from a low of 0.4% roaded area in the Pole-Sock-Sheep creeks subwatershed to a high of 1.4% roaded area in the Donivan-Bear subwatershed (Table 4.4). At these densities, the watershed-wide risk for peak flow enhancement from road runoff is low (WPN 1999), as is the risk of peak flow enhancement from roads in each of the subwatersheds. However, sediment-laden runoff is common from these roads, and waterways that are near these road systems are more likely to be detrimentally affected by runoff. In the basin, 376 miles of roadways are within 200 feet of the South Fork and its tributaries.

WATER USE CHARACTERIZATION

WATER RIGHTS

The Oregon Water Code, enacted on February 24, 1909, governs the use of the State's waters. This water code established four general principles to govern water use:

- Water belongs to the public.
- Any right to use it is assigned by the State through a permitting system.
- Water use under that permit system follows the "prior appropriation doctrine," i.e., older water uses get priority over newer water uses.
- Permits may be issued only for beneficial use without waste.

–Bastasch (1998)

The Oregon Water Resources Department is responsible for executing the State's laws on water supply and use established in this code. To obtain a water right, an application must be submitted to this agency. The OWRD evaluates the request and, if appropriate, grants a provisional permit for water use to the applicant. When the State confirms water use is in accordance with the permit, a fully certified water right certificate will be granted to the applicant. Water use is appropriated at a certain rate of withdrawal, usually measured in cubic feet per second (cfs). Additionally, restrictions on the total amount of water withdrawn, and the months for which the water right is valid, are established.

In the upper South Fork of the John Day River watershed there are 93 surface water rights (not including ponds or reservoirs), primarily occurring above Pine Creek. Two surface water rights occur in the Sunflower Creek subwatershed, five within the Pine Creek subwatershed, and six in the South Fork John Day above Murderer's Creek water allocation basin (Table 4.5). These water rights are predominantly used for irrigation (69), but also are used for stock water (19), supplemental irrigation (3), primary/supplemental irrigation (1), and stock water/domestic uses (1).

Instream water rights are filed by ODFW, DEQ or Oregon State Parks Department and held in trust for the people of Oregon by the OWRD for instream "public uses" such as recreation,

Table 4.4. Road miles occurring in each subwatershed within the upper South Fork of the John Day River watershed, Oregon.

Subwatershed	Road Length (miles)	Road Area (mi^2)	Watershed Area (mi^2)	% Roaded Area	Miles of road/mi^2
Donivan-Bear	66.0	0.37	26.49	1.4	2.5
Corral	25.4	0.14	19.2	0.7	1.3
Flat-Utley	49.1	0.28	38.15	0.7	1.3
Sheep-Pole-Sock	12.2	0.07	16.07	0.4	0.8
Pine-Brisbois	53.6	0.30	34.19	0.9	1.6
Sunflower	56.8	0.32	34.85	0.9	1.6
Pewee-Indian	8.9	0.05	12.48	0.4	0.7
Morgan-Dry Soda	12.6	0.07	13.94	0.5	0.9
Poison-Rosebud	34.9	0.20	23.41	0.8	1.5
Lewis-Lonesome	93.8	0.53	45.5	1.2	2.1
Venator	34.4	0.19	20.39	1.0	1.7
TOTAL	447.7	2.53	284.67	0.9	1.6

navigation, pollution abatement or conservation. Unlike irrigation or other "consumptive-use" water rights, these water rights seek to ensure that a certain amount of flow is maintained in the stream; however, like "consumptive-use" water rights, they are subject to regulation by priority date under the prior appropriation doctrine. Currently, no instream water rights have been filed with OWRD for the Upper South Fork John Day River Basin.

In the South Fork John Day above Murderer's Creek water availability basin (WAB), the Water Resources Commission adopted flows levels in order to support recreation, fish and wildlife. A flow need of 90 to 225 cfs over the course of the year was adopted for maintenance of the South Fork John Day River State Scenic Waterway. A significant portion of the Upper South Fork John Day River has also been identified as a Federal Wild and Scenic Waterway; no flow levels have been assigned to this designation.

Groundwater use in the watershed is minimal; groundwater is primarily used for domestic purposes. No groundwater monitoring wells occur in the upper SFJDR watershed. The geology of the area is mainly basalt and pre-Tertiary rock, which tend to yield water slowly and in small quantities, making large-scale use difficult (Oregon Water Resources Department 1986).

CONSUMPTIVE WATER USE

Consumptive water uses, or uses which draw water out of the stream, are summarized and reported by the OWRD through the Water Availability Reporting System (WARS). Water diversions occur throughout the watershed (Figure 4.4). Irrigation, agriculture, and storage uses were reported by this system for the USFJDR watershed (Table 4.6). Consumptive use by percent of streamflow (at the 50% exceedence level; i.e., the flow at which half of the monthly flows exceed this value, or the median flow) is highest in the summer months of July, August, and September, when streamflow in the watershed tends to be lowest (Table 4.7). When this use is greater than 10%, the greatest opportunity for flow restoration through conservation measure exists. Using this criterion, flow restoration opportunities are greatest in summer, particularly July through September, when consumptive uses range from 19.2 to 39.0% at the 50% exceedence level in the upper watershed.

RESERVOIRS

Several small reservoirs occur in the USFJDR watershed. The Officer Reservoir, at 14 acres in surface area at capacity, is the largest impoundment in the watershed and occurs in the mid reaches of Utley Creek. Additionally, numerous small seasonal impoundments occur throughout the watershed.

Construction of a large impoundment in the upper watershed has been considered in the past with the rationale that significant quantities of unappropriated winter and spring stream flow

Table 4.5. Water rights for the upper South Fork of the John Day River watershed, Oregon, by water availability basin (WAB) (ponds and reservoirs excluded).

Permit or Certificate	Priority Date	Type of Use	Flow		Time of Diversion
			4/1 to 5/31	6/1 to 9/30	
South Fork John Day above Murderer's Creek WAB					
25401	12/31/1888	Irrigation	0.81	0.4	4/1 to 9/30
25406	12/31/1898	Irrigation	0.18	0.07	4/1 to 9/30
34467	4/6/1962	Irrigation	0.43	0.43	4/1 to 9/30
77092	10/4/1982	Stock water	0.035	0.035	Year Round
77280	9/30/1983	Stock water	0.007	0.007	Year Round
P-51443	1/16/1985	Stock water and Domestic	0.01	0.01	Year Round
Sunflower Creek WAB					
25405	12/31/1895	Irrigation	2.42	1.21	4/1 to 9/30
77053	9/11/1981	Stock water	0.0045	0.0045	Year Round
Pine Creek WAB					
25402	12/31/1890	Irrigation	2	1	4/1 to 9/30
25628	12/31/1890	Irrigation	2.9	1.45	4/1 to 9/30
25403	12/31/1895	Irrigation	1.29	0.64	4/1 to 9/30
25404	12/31/1895	Irrigation	0.2	0.1	4/1 to 9/30
25407	12/31/1900	Irrigation	0.15	0.08	4/1 to 9/30
South Fork John Day above Pine Creek WAB					
52031	12/31/1880	Irrigation	1.16	0.58	4/1 to 9/30
25408	12/31/1882	Irrigation	0.04	0.02	4/1 to 9/30
25409	12/31/1882	Irrigation	0.92	0.46	4/1 to 9/30
25240	12/31/1885	Irrigation	3	1.5	4/1 to 9/30
25928	12/31/1885	Irrigation	0.62	0.31	4/1 to 9/30
25929	12/31/1886	Irrigation	0.76	0.38	4/1 to 9/30
25985	12/31/1886	Irrigation	0.85	0.42	4/1 to 9/30

Table 4.5. (Continued).

Permit or Certificate	Priority Date	Type of Use	Flow 4/1 to 5/31	Flow 6/1 to 9/30	Time of Diversion
25305	12/31/1887	Irrigation	3.12	1.56	4/1 to 9/30
25986	12/31/1887	Irrigation	0.8	0.4	4/1 to 9/30
25410	12/31/1890	Irrigation	1.05	0.52	4/1 to 9/30
35919	12/31/1890	Irrigation	0.06	0.03	4/1 to 9/30
52030	12/31/1890	Irrigation	1.47	0.74	4/1 to 9/30
24838	12/31/1891	Irrigation	0.06	0.03	4/1 to 9/30
25685	12/31/1891	Irrigation	2.28	1.14	4/1 to 9/30
25686	12/31/1892	Irrigation	0.95	0.48	4/1 to 9/30
25929	12/31/1893	Irrigation	1.16	0.58	4/1 to 9/30
25931	12/31/1893	Irrigation	1.42	0.71	4/1 to 9/30
25306	12/31/1894	Irrigation	1.14	0.57	4/1 to 9/30
24914	12/31/1896	Irrigation	0.22	0.11	4/1 to 9/30
25931	12/31/1896	Irrigation	0.35	0.18	4/1 to 9/30
24853	12/31/1898	Irrigation	0.98	0.49	4/1 to 9/30
25307	12/31/1898	Irrigation	2.36	1.18	4/1 to 9/30
44293	12/31/1898	Irrigation	0.55	0.28	4/1 to 9/30
25385	12/31/1900	Irrigation	0.26	0.13	4/1 to 9/30
25687	12/31/1900	Irrigation	0.76	0.38	4/1 to 9/30
44127	12/31/1900	Irrigation	1.73	0.86	4/1 to 9/30
25638	12/31/1901	Irrigation	0.34	0.17	4/1 to 9/30
25639	12/31/1901	Irrigation	0.56	0.28	4/1 to 9/30
25932	12/31/1903	Irrigation	2.04	1.02	4/1 to 9/30
35919	12/31/1903	Irrigation	0.12	0.06	4/1 to 9/30
31730	11/10/1905	Irrigation	0.48	0.24	4/1 to 9/30

Table 4.5. (Continued).

Permit or Certificate	Priority Date	Type of Use	Flow 4/1 to 5/31	Flow 6/1 to 9/30	Time of Diversion
56312	11/10/1905	Irrigation	1.05	0.52	4/1 to 9/30
24980	12/31/1905	Irrigation	0.76	0.38	4/1 to 9/30
25367	12/31/1905	Irrigation	3.91	1.96	4/1 to 9/30
24915	12/31/1908	Irrigation	0.3	0.15	4/1 to 9/30
25386	12/31/1908	Irrigation	0.66	0.33	4/1 to 9/30
1660	5/18/1913	Irrigation	0.75	0.38	4/1 to 9/30
3366	7/3/1916	Irrigation	0.31	0.31	4/1 to 9/30
24102	3/14/1947	Irrigation	0.83	0.83	4/1 to 9/30
27788	11/9/1954	Irrigation	0.5	0.5	4/1 to 9/30
27788	12/9/1954	Irrigation	0.5	0.5	4/1 to 9/30
34601	12/4/1961	Irrigation	0.5	0.5	4/1 to 9/30
34602	12/4/1961	Irrigation	0.11	0.11	4/1 to 9/30
34603	12/4/1961	Irrigation	0.04	0.04	4/1 to 9/30
34604	12/4/1961	Irrigation	0.23	0.23	4/1 to 9/30
57114	3/5/1962	Stock water	0.01	0.01	4/1 to 9/30
34647	4/4/1962	Irrigation	0.69	0.69	4/1 to 9/30
31052	5/15/1962	Irrigation	0.73	0.73	4/1 to 9/30
44126	11/2/1962	Irrigation	2.09	2.09	4/1 to 9/30
56576	1/15/1964	Irrigation	0.3	0.3	4/1 to 9/30
64342	1/15/1964	Irrigation	0.08	0.08	4/1 to 9/30
P-29370	11/15/1964	Irrigation	0.74	0.74	4/1 to 9/30
P-48044	11/15/1964	Supplemental Irrigation	0.74	0.74	4/1 to 9/30
35130	12/15/1964	Primary/ Supplemental Irrigation	0.02	0.02	4/1 to 9/30
42498	5/23/1966	Supplemental Irrigation	7.67	7.67	4/1 to 9/30
44070	4/30/1969	Supplemental Irrigation	0.62	0.62	4/1 to 9/30

Table 4.5. (Continued).

Permit or Certificate	Priority Date	Type of Use	Flow 4/1 to 5/31	Flow 6/1 to 9/30	Time of Diversion
64359	8/10/1981	Irrigation	0.2	0.2	4/1 to 9/30
64361	8/10/1981	Irrigation	0.88	0.88	4/1 to 9/30
65288	8/10/1981	Irrigation	0.97	0.97	4/1 to 9/30
77063	10/4/1982	Stock water	0.005	0.005	Year Round
77069	10/4/1982	Stock water	0.005	0.005	Year Round
77078	10/4/1982	Stock water	0.005	0.005	Year Round
77119	8/26/1983	Stock water	0.02	0.02	Year Round
77136	8/26/1983	Stock water	0.005	0.005	Year Round
77137	8/26/1983	Stock water	0.005	0.005	Year Round
77138	8/26/1983	Stock water	0.005	0.005	Year Round
77139	8/26/1983	Stock water	0.005	0.005	Year Round
77142	8/26/1983	Stock water	0.005	0.005	Year Round
77145	8/26/1983	Stock water	0.005	0.005	Year Round
77146	8/26/1983	Stock water	0.005	0.005	Year Round
77169	8/26/1983	Stock water	0.005	0.005	Year Round
P-48056	9/13/1983	Irrigation	0.58	0.58	4/1 to 9/30
P-48185	9/16/1983	Irrigation	0.625	0.625	4/1 to 9/30
57093	9/21/1983	Irrigation	0.24	0.24	4/1 to 9/30
77275	9/26/1983	Stock water	0.005	0.005	Year Round
P-29370	9/30/1983	Stock water	0.004	0.004	Year Round
P-51420	10/3/1983	Irrigation	0.33	0.33	4/1 to 9/30
	6/26/1987	Irrigation	2.75	2.75	4/1 to 9/30

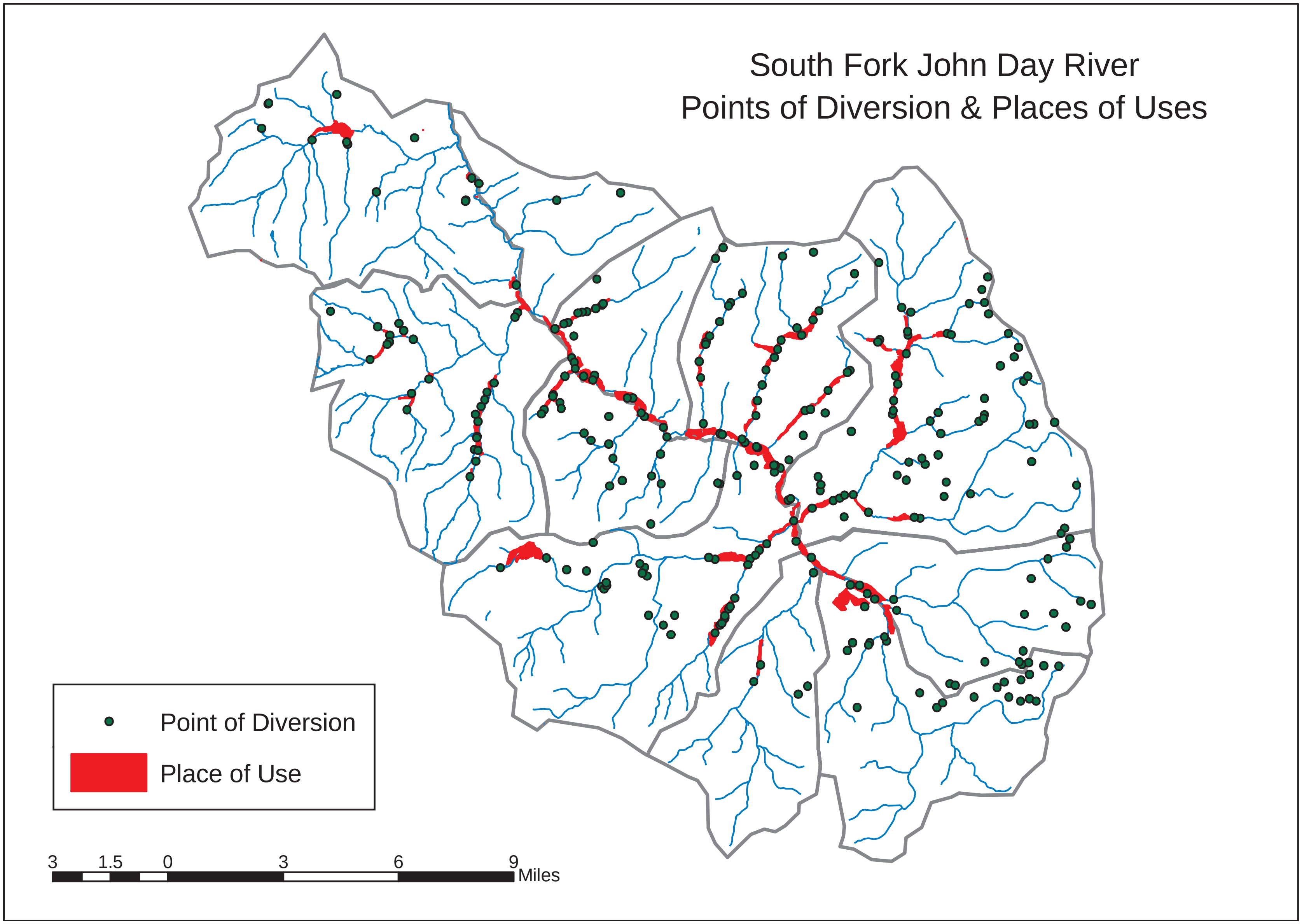

Figure 4.4 Points of water use and diversion occurring in the upper South Fork of the John Day River watershed, Oregon (source: WRD 2003)

Table 4.6. Annual consumptive water use and storage (50% exceedence level) by water availability basin in the upper South Fork of the John Day River watershed, Oregon (OWRD, 2003a).

Water Availability Basin	Irrigation (cfs)	Agriculture (cfs)	Storage (cfs)	Total (cfs)
South Fork John Day above Murderer's Creek	36.18	1.92	0.91	39.01
Sunflower Creek	1.51	0	0	1.51
Pine Creek	2.88	0	0	2.88
South Fork John Day above Pine Creek	30.58	1.20	0.29	32.07

Table 4.7. Monthly water consumption as a percent of the 50% exceedence level for water availability basins (WABs) in the upper South Fork of the John Day River watershed, Oregon (OWRD, 2003a).

	Monthly Water Consumption (%)				
Water Availability Basin	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
South Fork John Day above Murderer's Creek	9.4	46.8	44.0	30.2	8.7
Sunflower Creek	6.3	31.7	28.6	19.2	4.9
Pine Creek	12.9	62.2	53.3	35.2	9.0
South Fork John Day above Pine Creek	14.0	68.3	60.9	39.0	10.7

could be stored for release during the summer and fall. Studies by the Bureau of Reclamation and the Army Corps of Engineers identified 12 potential reservoir sites in the watershed on the south fork itself, as well as Sunflower, Lewis, Lonesome, Venator, and Bear Creeks (Table 4.8). However, the projects were not found to be economically feasible by either of the two agencies. For example, an engineering plan produced by the Bureau of Reclamation proposed erecting a 140-foot high dam that would create a 140-acre reservoir at the Izee Falls site. This project would provide water for irrigation and power purposes, while maintaining a 50 cfs base flow for recommended late-season fish flows. The estimated cost of this project in 1980 was $22,000,000 (Oregon Water Resources Department 1986).

WATER USE ASSESSMENT

WATER AVAILABILITY

The upper South Fork of the John Day River watershed has been divided into four water availability basins (WABs). WABs are designated by the Oregon Water Resources Department for water availability modeling purposes. Within the USFJDR watershed, these basins include the South Fork John Day above Murderer’s Creek WAB (012197130), the Sunflower Creek WAB (012197133), the Pine Creek WAB (012197134), and the South Fork John Day above Pine Creek WAB (012197135, Figure 4.5). All of these WABs occur entirely within the upper South Fork watershed boundaries, with the exception of the South Fork John Day above Murderer’s Creek WAB, which primarily occurs below Izee Falls.

Water availability is calculated for each WAB by the Oregon Water Resources Department by subtracting the estimated consumptive use of existing water rights (mainly irrigation water rights in this watershed) and, in the case of the South Fork John Day above Murderer's Creek WAB, state scenic waterway flows from the natural streamflow. These calculations are made for both 50% and 80% exceedence flow levels. The 50% exceedence flow is the flow at which half of the annual flows exceed this value, or the median flow. This flow value is used as an upper limit in developing in-stream water rights for protection of aquatic species and other in-stream beneficial uses (WPN 1999). The 80% exceedence level represents the stream flow that is in the channel 80% of the time over a 30-year period, in order to

Table 4.8. Potential reservoir sites in the upper South Fork of the John Day River watershed, Oregon, identified by the United States Bureau of Reclamation and the Army Corps of Engineers (Oregon Water Resources Department, 1986).

Site	**Stream**	**River Mile**	**Potential Storage (acre-feet)**	**Drainage Area (mi²)**
Falls	S. Fork John Day	29.3	5800	245
Pine Creek	S. Fork John Day	29.7	50,500	260
Mill	S. Fork John Day	30.1	5800	244
Little Pine	S. Fork John Day	33.6	5800	235
Morgan	S. Fork John Day	35.5	5800	201
Sheep Creek	S. Fork.. John Day	42.0	NA	188
Blackhorse	S. Fork John Day	49.0	6000	143
John Day S. Fork	S. Fork John Day	52.2	2500	35
Sunflower Creek	Sunflower Creek	2.8	2000	18
Lewis Creek	Lewis Creek	0.1	5800	44
Lonesome Creek	Lonesome Creek	0.9	1300	13
Venator Creek	Venator Creek	1.4	1200	13
Bear Creek	Bear Creek	4.4	250	3

include both wet and dry periods in the calculation. OWRD uses the 80% exceedence flow to determine whether new water rights can be issued in a WAB (WPN 1999); water rights are issued only when water is available at the 80% exceedence level.

Natural stream flow and water availability at the 50% and 80% exceedence levels for each WAB are presented in Figures 4.6, 4.7, 4.8, and 4.9. Available water is calculated by summing the estimated consumptive use water rights with applicable state scenic waterway flows and then subtracting this value from the natural streamflow level (at 50% and 80% exceedence levels). In the South Fork John Day above Murderer's Creek WAB, water availability is negative at both exceedence levels for the majority of the year; however, this is due to the non-water righted State Scenic Waterway flow levels. Comparing only the consumptive use with the natural flows at both exceedance levels, the model indicates water is typically available to satisfy existing consumptive use demands year-round. (Figure 4.6). In the Pine Creek and SFJDR above Pine Creek WABs, the water availability analysis at the 80% exceedance level indicates that lack of streamflows can become problematic during July and August (Figures 4.7, 4.8, and 4.9). Altough these figures indicate that zero flows may occur in these two WABs in July and August during a typical water year, actual consumption of water by ranches is lower than the water rights allow (which is what these estimates of use are based on), so streams would not be dewatered at 80% exceedence flows, as these two figures indicate they might be (Phil St. Clair, pers. comm.).

FLOW-RESTORATION PRIORITY AREAS

The Oregon Plan for Salmon and Watersheds establishes streamflow restoration priorities for the recovery of salmonids by WAB (Oregon Water Resources Department 2003b). WABs are ranked by flow restoration needs and opportunities, and are assigned a priority. Streams can be a current resources priority, a priority, not a priority, or remain unprioritized. Need rankings range from 0 to 4, either being unranked, low, moderate, high, or highest, while opportunity rankings are also based

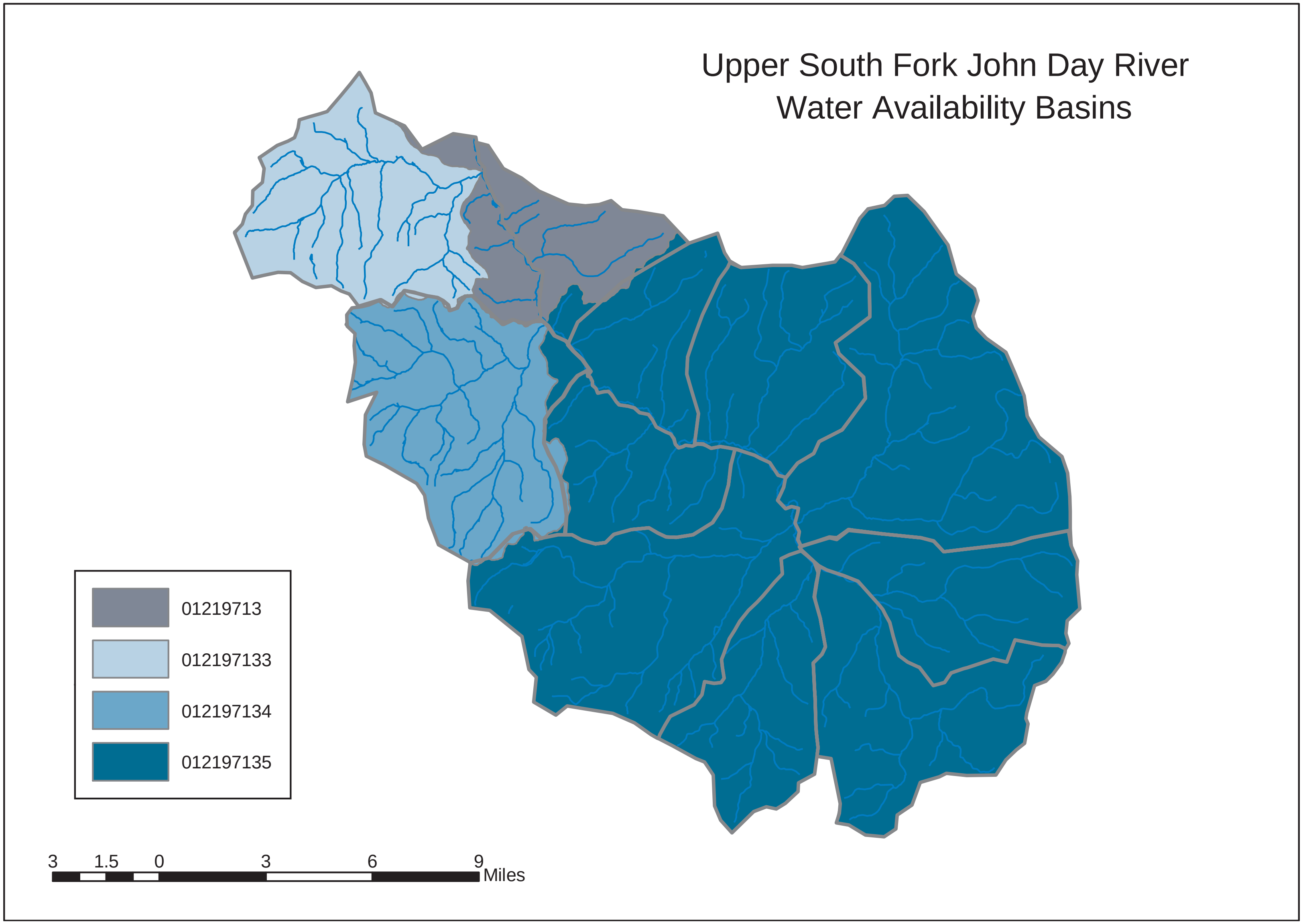

Figure 4.5 Water Availability Basins (WAB) with waters in the upper South Fork of the John Day River watershed, Oregon.

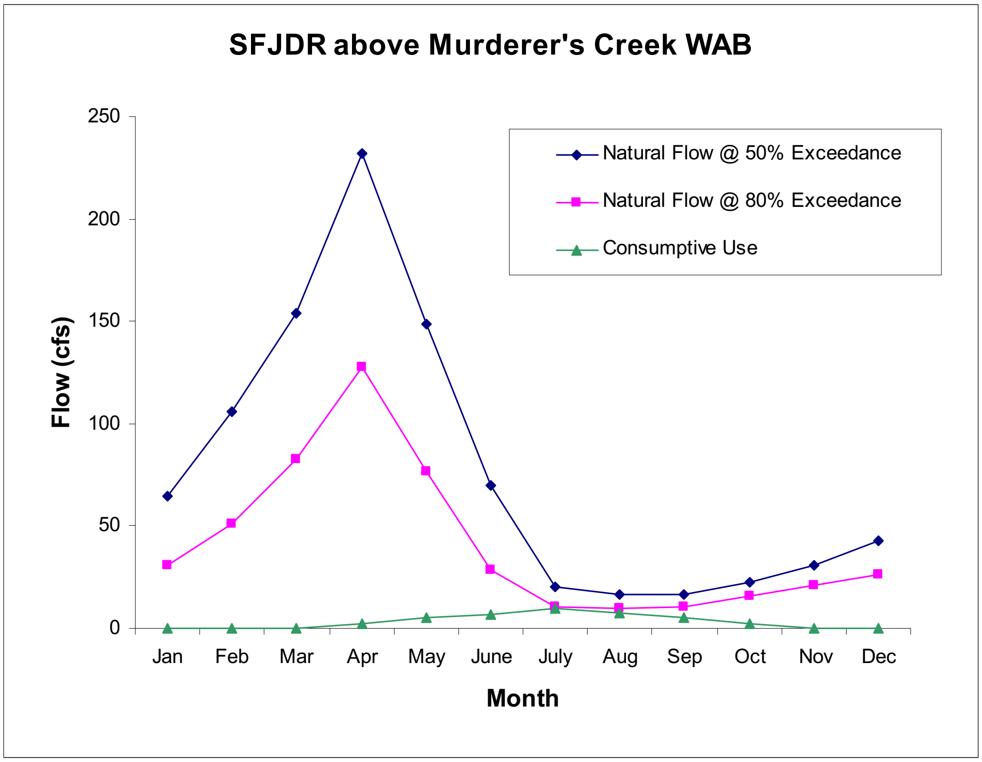

Figure 4.6 Water availability and natural streamflow in the South Fork of the John Day River, Oregon, above Murder's Creek WAB (OWRD 2003a).

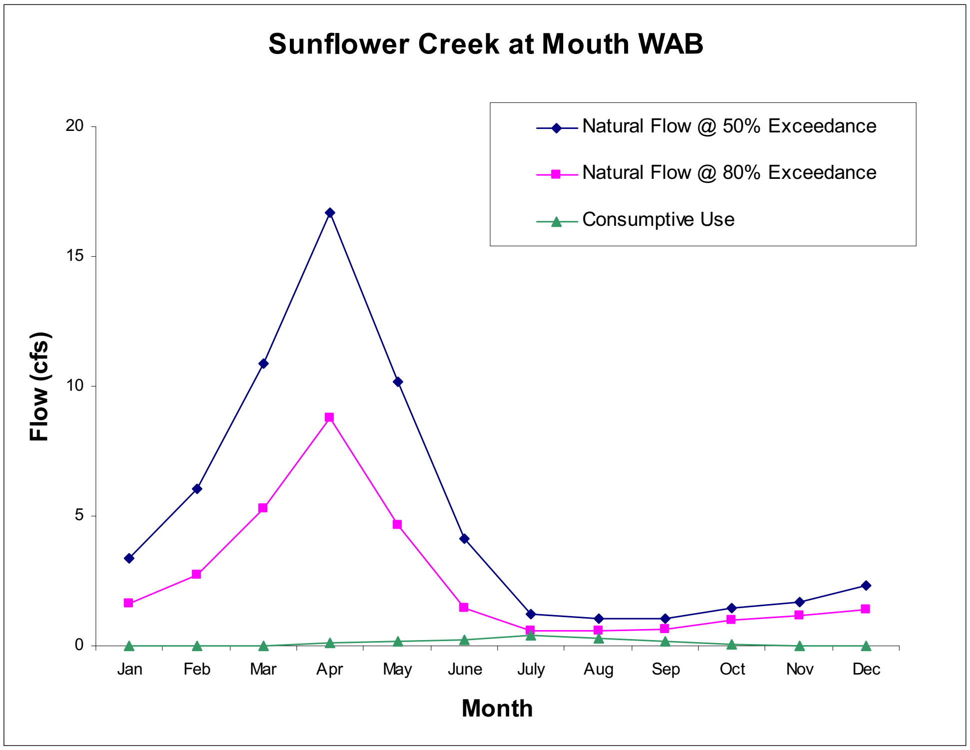

Figure 4.7 Water availability and natural streamflow in the Sunflower Creek WAB, Oregon (OWRD 2003a).

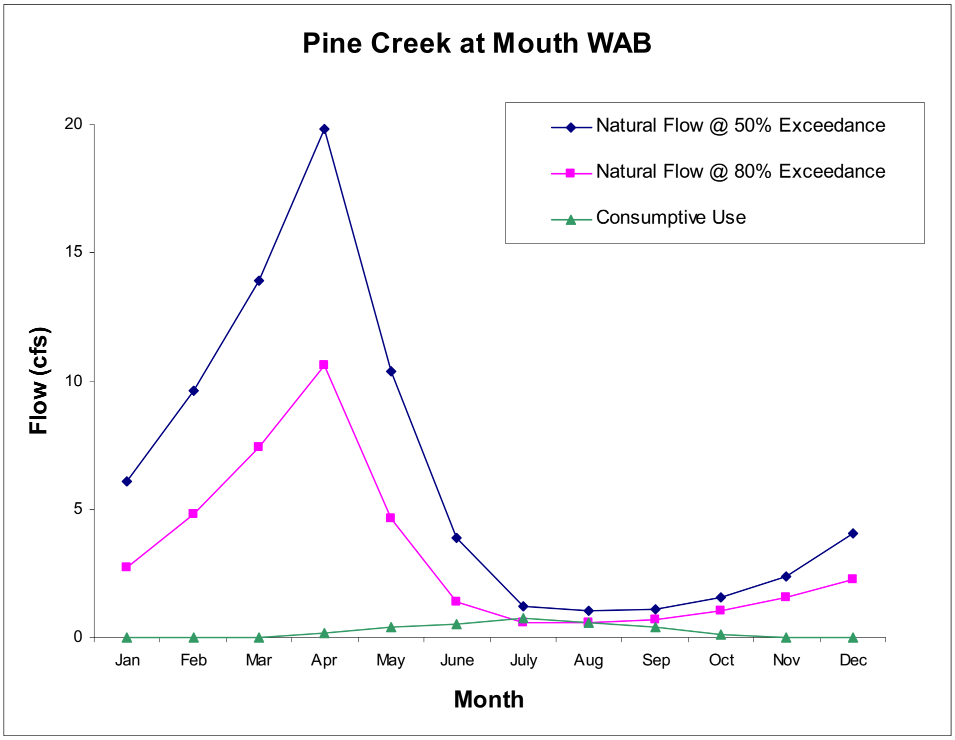

Figure 4.8 Water availability and natural streamflow in the Pine Creek WAB, Oregon (OWRD 2003a).

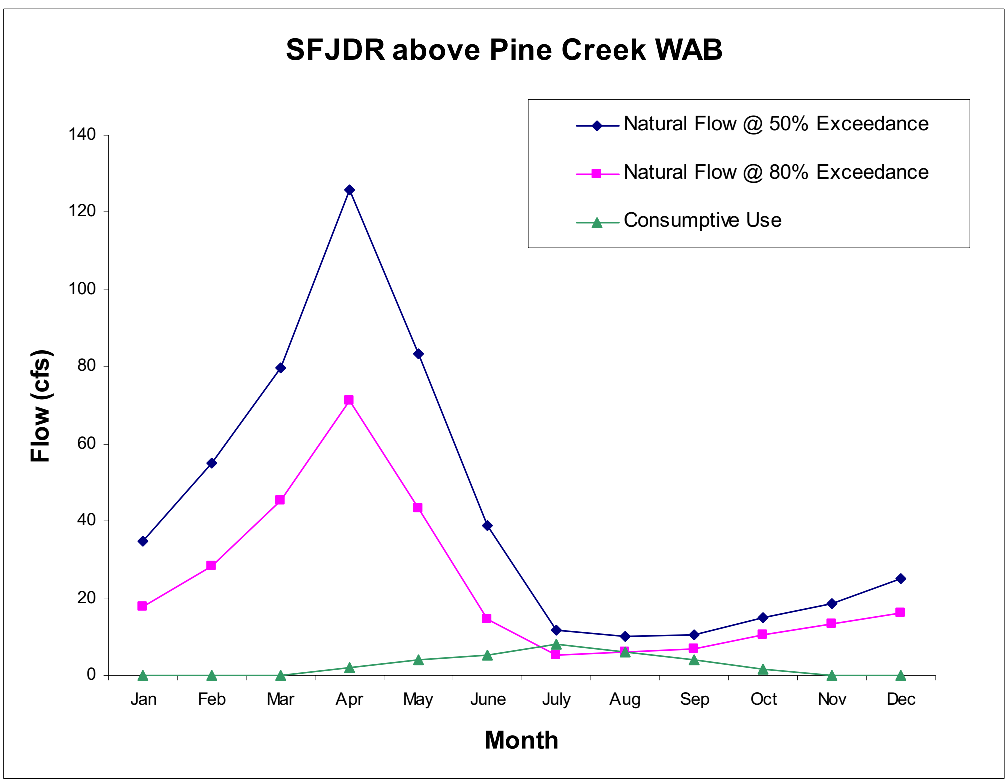

Figure 4.9 Water availability and natural streamflow in the South Fork of the John Day River, Oregon, above Pine Creek WAB (OWRD 2003a).

on a 0 to 4 rating for being unranked, poor, fair, good, or very good. Table 4.9 summarizes the rankings and priorities for streamflow restoration for the WABs in the upper South Fork watershed. Based on evaluation by local ODFW and OWRD staff, the South Fork John Day above Pine Creek WAB has been designated as the only priority basin within the upper South Fork of the John Day River watershed with a high need and good opportunity for streamflow restoration.

CONCLUSIONS

The USFJDR watershed is characterized by very low summer streamflows, and late winter/early spring peak flows. This screening-level assessment indicates that neither current forest conditions (based on canopy closure), nor roads (based on road densities), are significantly altering watershed hydrology and streamflows. Despite the inability to formally assess the potential impact that grazing in the watershed has had on hydrology, the amount of the watershed used for grazing and the obvious effects of grazing management on vegetation and soil conditions suggest that this land use has likely affected streamflows. Grazing practices have likely altered the timing and size of peak and low streamflows by reducing infiltration rates and increasing surface runoff into streams. Channel incision in the watershed also can be partially attributed to these changes in stream discharge.

Based on the water availability model run at an 80% exceedance level, water rights issued and used under the prior appropriation doctrine can result in more water consumed than what is naturally available during July and August in two WABs. A large portion of the Upper South Fork John Day watershed has been designated as a streamflow restoration priority by local ODFW and OWRD staff due to this issue as well as other considerations.

DATA GAPS

A lack of comprehensive soil survey information for the watershed prevented a screening-level analysis of agriculture and rangeland practices on watershed hydrology. The Grant Soil and Water Conservation District is currently mapping soil types throughout Grant County. Once complete, this information will greatly assist in evaluating land use effects on watershed hydrology.

RECOMMENDATIONS

Best management practices on forest and rangelands should include management techniques known to restore and maintain desirable hydrologic functions, including abatement of peak flows, increasing low flow volumes, and increasing groundwater recharge. Management of upland and riparian zones that promotes regeneration and maintenance of natural vegetative communities will enhance groundwater recharge and stabilize discharge. An agricultural water-quality management plan has already been developed for the USFJDR watershed that addresses, among other water quality issues, restoring hydrologic functioning in the watershed through a comprehensive program that includes a combination of education, recommended land treatments, management activities, and monitoring. Implementation of such a plan by area stakeholders and landowners holds good promise for improving hydrologic functioning within the USFJDR watershed.

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Table 4.9. Flow restoration priorities for summer (July through September) by water availability basin in the upper South Fork of the John Day River watershed, Oregon.

Water Availability Basin	Priority	Opportunity	Need
South Fork John Day above Murderer's Creek	No	Good	Moderate
Sunflower Creek	No	Poor	High
Pine Creek	No	Poor	Moderate
South Fork John Day above Pine Creek	Yes	Good	High

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CHAPTER 5: RIPARIAN AREAS

INTRODUCTION

Riparian zones are the terrestrial areas immediately adjacent to rivers, streams, and wetlands. These areas exhibit soil and vegetative characteristics different from those of areas farther upland, as they generally have higher moisture levels that support more diverse and productive plant communities. Riparian areas provide a number of important functions in the maintenance of aquatic ecosystems. Riparian vegetation stabilizes streambanks and dissipates stream water velocities during higher flows, thereby preventing bank erosion. Riparian vegetation also provides stream shading, reducing the amount of solar radiation reaching the stream and, therefore, preventing accelerated warming of stream water. Fish populations benefit from both instream and overhead cover provided by live and dead riparian vegetation. Inputs of leaves, twigs, needles, and other vegetation from the riparian zone often provide the primary food source for stream insects that, in turn, serve as the food base for trout, amphibians, and other aquatic predators. Additionally, riparian vegetation provides a buffer between the stream ecosystem and upland land uses (Hunter 1991, Franklin 1992) and is believed to be important in controlling the amount of sediment and nutrients entering the stream channel from upstream sources.

Riparian areas are the primary sources of large woody debris (LWD), which also serves a number of important roles in streams and rivers. Large woody debris such as dead trees, root wads, and larger limbs, help shape stream channels by directing water movements and capturing sediments, gravels, and debris to increase channel habitat complexity through the formation of pools. More complex habitats and higher pool frequencies created by large woody debris benefit fish populations by increasing habitat quality. LWD slows high water velocities, allowing sediments and organic matter to drop out of the water column, thereby helping to retain these materials in the local stream system for longer periods of time, effectively increasing stream productivity.

Adequate LWD loads in streams are maintained only if suitable numbers of larger trees occur close enough to the stream to enter the water when they fall due to age, disease, or storms. The area from which the stream draws new LWD is called the riparian recruitment zone. A well-stocked riparian recruitment zone will ensure a steady supply of large woody material and a productive and well-functioning riparian area.

METHODS

Digital ortho photogpraphs, taken from May to July 1994, were used to assess riparian conditions in the upper South Fork of the John Day River watershed. Stream layers from the State of Oregon SSCGIS were overlain on the photos in ArcView, to assist in delineating stream channels and buffering left and right banks. The mapping unit used in this assessment of riparian areas is the Riparian Condition Unit (RCU), defined as a segment of the riparian zone of uniform vegetation type, size, and density. RCU lengths vary with the length of contiguous habitat conditions but are generally not less than approximately 1000 feet long. RCUs were further subdivided by stream size, channel habitat type (CHT), subwatershed, and ecoregion. Each RCU was assigned an individual number and then classified or evaluated according to each of the following fields:

Stream Name **–** Streams were named according to the streams layer from SSCGIS. When unnamed tributaries were classified, they were named using numbers assigned in sequential order (e.g., Venator UnnTrib 1, Venator UnnTrib 2).

Subwatershed **–** Streams were placed in subwatersheds based upon drainage patterns, thus portions of the mainstem of the South Fork John Day River have different subwatersheds on each bank.

Ecoregion **–** Ecoregion boundaries were determined from the ecoregion dataset from SSCGIS. Ecoregion descriptions of the basin were obtained from the OWEB Watershed Assessment Manual (WPN 1999: Appendix A), and are listed in Table 5.1.

CHT **–** The layer of digitized Channel Habitat Types was overlain on the riparian layer and the CHT of the riparian condition

Table 5.1. Ecoregion conditions of the upper South Fork John Day River watershed, Oregon (source: WPN 1999: Appendix A).

Potential streamside vegetation: John Day / Clarno Uplands (11a)

CHT Group	RA1 Zone	RA1 Description	RA2 Width	RA2 Description	Other Considerations
Constrained	0-25'	**Type:** Hardwoods and shrubs (willows, mountain alder and Douglas spirea). Infrequent Juniper. **Size:** Small **Density:** Sparse	N/A	**Type:** N/A **Size:** N/A **Density:** N/A	Fire suppression and grazing over the last decades has caused an increase in juniper abundance and a decline in grass dominance. See Kovalchik (1987) and Crowe (1997) for more details about specific plant communities and where they occur.
Semi-constrained	0-50'	**Type:** Hardwoods (cottonwood and alder) and shrubs (willows, mountain alder, Douglas spirea and common snowberry). Infrequent ponderosa pine. **Size:** Small **Density:** Sparse	N/A	**Type**: N/A **Size:** N/A **Density:** N/A	Fire suppression and grazing over the last decades has caused an increase in juniper abundance and a decline in grass dominance.
Unconstrained	0-75'	**Type:** Hardwoods (cottonwood, alder and aspen) and shrubs (willows, mountain alder, Douglas spirea, and common snowberry). Infrequent ponderosa pine. **Size:** Small **Density:** Sparse	N/A	**Type:** N/A **Size:** N/A **Density:** N/A	Fire suppression and grazing over the last decades has caused an increase in juniper abundance and a decline in grass dominance. Under certain circumstances, there are a few potential plant communities having no woody vegetation in RA1, and are characterized by herbaceous plants such as beaked sedge or aquatic sedge at higher elevations.

Table 5.1 (Continued).
Potential streamside vegetation: John Day / Clarno Highlands (11b)

CHT Group	RA1 Zone	RA1 Description	RA2 Width	RA2 Description	Other Considerations
Constrained	0-25'	**Type:** Hardwoods and shrubs (willows, Sitka alder, mountain alder). **Size:** Small **Density:** Dense	25-100'	**Type:** Conifers (infrequent true fir and ponderosa pine). **Size:** Medium **Density:** Sparse	Fire suppression in recent decades has caused an increase in true fir dominance.
Semi-constrained	0-50'	**Type:** Hardwoods (alder and cottonwood) and shrubs (willows, Sitka alder, mountain alder and common snowberry). **Size:** Small **Density:** Dense	50-100'	**Type:** Conifers (infrequent true fir and ponderosa pine). **Size:** Medium **Density:** Sparse	Fire suppression in recent decades has caused an increase in true fir dominance.
Unconstrained	0-75'	**Type:** Hardwoods (alder, willow, cottonwood and aspen) and shrubs (willows, Sitka alder, mountain alder, common snowberry, and shrubby cinquefoil). **Size:** Small **Density:** Dense	75-100'	**Type:** Conifers (infrequent true fir and ponderosa pine). **Size:** Medium **Density:** Sparse	Fire suppression in recent decades has caused an increase in true fir dominance Under certain circumstances, there are a few potential plant communities that have no woody vegetation in RA1, and are characterized by herbaceous plants such beaked sedge or aquatic sedge at higher elevations.

Table 5.1. (Continued).
Potential streamside vegetation: Continental Zone Highlands (11h)

CHT Group	RA1 Zone	RA1 Description	RA2 Width	RA2 Description	Other Considerations
Constrained	0-25’	**Type:** Mixed (white fir, hardwoods) and shrubs (willows, mountain alder).	25-100’	**Type:** Conifers (white fir, Douglas fir, lodgepole pine, and ponderosa pine).	Under certain circumstances, there are a few potential plant communities that have no woody vegetation in RA1, and are characterized by herbaceous plants such as aquatic sedge at higher elevations.
		Size: Small		**Size:** Large	
		Density: Dense		**Density:** Sparse	
Semi-constrained	0-50’	**Type**: Mixed (white fir, willows, black cottonwood, alder) and shrubs (common snowberry, mountain alder).	50-100’	**Type**: Conifers (white fir, Douglas fir, lodgepole pine, and ponderosa pine).	Under certain circumstances, there are a few potential plant communities that have no woody vegetation in RA1, and are characterized by herbaceous plants such as aquatic sedge at higher elevations.
		Size: Small		**Size:** Large	
		Density: Dense		**Density:** Sparse	
Unconstrained	0-75’	**Type:** Hardwoods (black cottonwood, aspen) and shrubs (pacific, Booth, Geyer and Lemmon willow, common snowberry, Mountain alder).	75-100’	**Type**: Conifers (white fir, Douglas fir, lodgepole pine, and ponderosa pine).	Under certain circumstances, there are a few potential plant communities that have no woody vegetation in RA1, and are characterized by herbaceous plants such as beaked sedge, bluejoint reedgrass, or aquatic sedge at higher elevations.
		Size: Small		**Size**: Large	
		Density: Dense		**Density**: Sparse	

Table 5.1. (Continued).
Potential streamside vegetation: Continental Zone Foothills (11i)

CHT Group	RA1 Zone	RA1 Description	RA2 Width	RA2 Description	Other Considerations
Constrained	0-25’	**Type:** Shrubs (willows). **Size:** N/A **Density:** N/A	N/A	**Type:** N/A **Size:** N/A **Density:** N/A	
Semi-constrained	0-50’	**Type:** Shrubs (willows, sagebrush) and Cusick's bluegrass. **Size:** N/A **Density:** N/A	N/A	**Type**: N/A **Size:** N/A **Density:** N/A	
Unconstrained	0-75’	**Type:** Hardwoods (aspen), shrubs (Booth, Geyer and Lemmon willows, shrubby cinquefoil, silver sage, big sage) Cusick's bluegrass, and wooly sedge. **Size:** Small **Density:** Dense	N/A	**Type:** N/A **Size:** N/A **Density:** N/A	Under certain circumstances, there are a few potential plant communities having no woody vegetation in RA1, and are characterized by herbaceous plants such as beaked sedge, tufted hairgrass, or aquatic sedge

Table adapted from WPN 1999 – ecoregion appendix.

unit assigned. When several CHTs occurred in an RCU, the RCU was divided into two or more RCUs.

Stream Size – Derived from ODF stream survey hard-copy maps.

Riparian Area (RA1) Width – The width of vegetation occurring immediately adjacent to the stream (the riparian zone) that most influences water temperature, habitat value, streambank stability, and hydrodynamics of the stream. This width varied from 25 to 75feet, with channel confinement class and ecoregion (Table 5.1).

Riparian Area 1 (RA1) Code – Riparian areas within each RCU were classified according to vegetation type, size, and density using 3-letter codes (Table 5.2)

RA2 Width – RA2 refers to the area beyond the immediate riparian zone that still occurs within the wood recruitment zone. The RA2 width also varies with ecoregion and channel confinement (Table 5.2).

RA2 Code – This portion of the recruitment zone was classified according to vegetation type, size, and density using the letter coding system used to classify RA1 vegetation (Table 5.2)

Permanent Discontinuities – When a road, bridge, or other man-made structure impinges upon the stream channel, it can prevent full hydraulic expression of the stream by restricting normal stream movements and limiting riparian recruitment. Unlike most other restoration opportunities, areas with permanent discontinuities will have no opportunity to contribute to stream health until the discontinuity is removed.

Shade – Shade was visually estimated as high (_70%), medium (40–70%), or low (_40%) on each streambank. Banks were sometimes difficult to distinguish on smaller streams, necessitating that each bank receive the same shade code.

Riparian Recruitment – The **riparian recruitment potential** was first classified as adequate or inadequate by comparing RCU conditions to potential riparian zone vegetative characteristics for that ecoregion and CHT. All RCUs classified as inadequate were then further classified according to their **riparian recruitment situation**, which characterizes the immediate land use conditions that are precluding proper adequate riparian zone recruitment. In non-forested ecoregions, the riparian zones would not have naturally supported enough large trees to establish a significant large woody debris source pool. Therefore, reaches occurring in these areas were classified as having adequate riparian recruitment potential if the riparian zone condition was similar to that naturally occurring in the ecoregion. Otherwise, they were classified as being limited by the dominant land use adjacent to them. The following riparian zone recruitment situations were used to classify RCUs.

- *Adequate* (ADQ): For a given ecoregion, the reach of stream is considered normal, and riparian recruitment is considered adequate to keep coarse woody debris (CWD) in sufficient supply in the stream.
- *Agriculture* (AG): Predominately grazing or haying activities within the riparian zone. Active or incidental loss of riparian and hydrologic structure and function has resulted.
- *Infrastructure* (INF): Roads and, to a lesser extent, bridges built close to the riparian zone have impaired riparian and/or hydrologic function.
- *Small Stand Size* (SS): Forestry or fire has resulted in smaller diameter trees than is normal for the ecoregion, thereby limiting recruitment potential.
- *Wetland* (WET): Hydric soils are preventing riparian establishment.

Additional information included noting the presence of western juniper (*Juniperus*

Table 5.2. Codes assigned to Riparian Condition Units (RCUs) to characterize riparian vegetation types in the upper South Fork of the John Day River watershed, Oregon (WPN 1999).

Code	Vegetation Type
C	Mostly conifer trees (>70% of area)
H	Mostly hardwood trees (>70% of area)
M	Mixed conifer/hardwoods
B	Brush species
G	Grass/Meadow
N	No riparian vegetation
Code	**Tree Size Classes**
R	Regeneration (<4 inch average DBH)
S	Small (4- to 12-inch average DBH)
M	Medium (>12- to 24-inch average DBH)
L	Large (>24-inch average DBH)
N	Nonforest (applies to vegetation Types B, G, and N)
Code	**Stand Density**
D	Dense (<1/3 ground exposed)
S	Sparse (>1/3 ground exposed)
N	Non-forest (applies to vegetation Types B, G, and N)

occidentalis) in the upland, or adding a secondary riparian recruitment code.

Data were field-checked in October 2002. Of the 834 total RCUs assessed, 120 representative samples were chosen for ground-truthing. In addition, high resolution, ungeoreferenced photos flown by the Bureau of Reclamation in August 2002 were used to spot-check the accuracy of the older photos, particularly in relation to forest conditions and management. This approach also allowed the assessment of upland areas that were not field-checked.

Finally, data describing riparian vegetation conditions, riparian recruitment situation, and stream shading were summarized by subwatershed to help identify areas most in need of riparian zone improvement and restoration.

RESULTS

A total of 834 Riparian Condition Units were assessed, totaling 635 miles. Because every mile of stream includes two miles of RCUs, RCUs along 318 miles of stream were assessed (Table 5.3). The number of RCUs occurring in each watershed varied with the number of stream miles in the watershed and the heterogeneity of streamside habitat. Subwatersheds with long, uniform stretches of riparian zone conditions had fewer RCUs than did more diverse and fragmented subwatersheds.

RIPARIAN VEGETATION CONDITIONS

Riparian conditions varied widely throughout the watershed. Riparian zones occurring in lower elevation, nonforested ecoregions in the watershed (represented by the John Day/Clarno Uplands [11a] and the Continental Zone Foothills [11i])) were

Table 5.3. Number and length (feet) of Riparian Condition Units (RCU) classified by subwatershed in the upper South Fork of the John Day River watershed, Oregon.

Subwatershed	Riparian Condition Units Number	Riparian Condition Units Length (ft)	Total Stream Miles
Sunflower	185	589,537	55.83
Corral	45	197,697	18.72
Donivan-Bear	77	275,710	26.11
Lewis-Lonesome	119	477,892	45.25
Flat-Utley	71	378,697	35.86
Morgan-Dry Soda	33	163,231	15.46
Pine-Brisbois	133	552,449	52.32
Poison-Rosebud	70	282,113	26.72
Sheep-Pole-Sock	19	96,003	9.09
Venator	51	200,426	18.98
Pewee-Indian	31	141,743	13.42
Total	**834**	**3,355,498**	**317.76**

composed predominantly of grasses and brush (Table 5.4; Figure 5.1). These riparian areas largely occur on the lower elevation valley floors, where riparian vegetation has historically been cleared to use these areas for hay production and pasturing. Historically, the John Day/Clarno uplands ecoregion (11a), which represents most of the area in the non-forested ecoregion grouping supported hardwood riparian zones composed of willows, alders, aspen, cottonwood, and shrubby species, including willow, mountain alder, and Douglas spirea (WPN 1999; Ecoregion Appendix). In contrast, almost half (47%) of the riparian zone length in these areas is currently composed of grasses, indicating the degree to which riparian zone disturbance has occurred in the lower portions of the watershed.

Within the forested-ecoregion portions of the watershed (represented by the John Day/Clarno Highlands [11b] and the Continental Zone Highlands [11h]), riparian conditions also varied widely, but were represented by a larger proportion of intact riparian zones composed of trees and shrubs (Table 5.5). Historically, riparian zones occurring in both of these ecoregions supported small, dense stands of willow, alder, Douglas spirea, aspen,dogwood, and cottonwood; or mixed, dense stands composed of firs and these hardwood species (WPN 1999). Currently, 76% of the riparian areas occurring in these ecoregions within the watershed support stands of trees of varying composition and sizes. Approximately 24% of these riparian areas support only shrubs or grasses (Figure 5.2).

Among subwatersheds, Pine-Brisbois, Lewis-Lonesome, Poison-Rosebud-Antelope, and Sunflower creeks contained the most miles of treeless or shrubless riparian zones (Figure 5.3), indicating that these subwatersheds should be considered priority areas for riparian zone restoration and protection.

RIPARIAN RECRUITMENT POTENTIAL AND SITUATIONS

Across the watershed, riparian recruitment potential was adequate in only 30% of the total riparian area assessed (Table 5.6; Figures 5.4 & 5.5), indicating that most of the watershed riparian zones do not support sufficient quantities of trees to provide adequate supplies of woody materials to stream channels. Among subwatersheds, Lewis-Sunflower, Pine-Brisbois,

Table 5.4. Number of miles of riparian zone vegetation condition classes by subwatershed in the 11a and 11i (i.e., non-forested) ecoregions of the upper South Fork of the John Day River watershed, Oregon. The heading in bold, small/sparse hardwood forest, is the predominant natural riparian zone condition in the 11a ecoregion, which includes most of the river miles reported in this table.

	Non-forested		**Conifer Forest**			**Hardwood Forest**		**Mixed-species Forest**		
Subwatershed	Grasses	Brush	Small/Sparse	Medium/Sparse	Large/Sparse	**Small/Sparse**	Medium/Sparse	Small/Sparse	Medium/Sparse	Total
Corral	3.2	9.9	1.0	1.6	0.0	**0.0**	0.0	0.0	5.3	21.0
Donivan-Bear	2.2	7.5	0.0	0.0	0.0	**0.0**	0.0	3.3	0.0	13.0
Flat-Utley	13.2	9.3	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	22.5
Lewis-Lonesome	17.4	4.5	0.0	0.0	0.0	**1.7**	0.5	0.0	0.0	24.1
Morgan-Dry Soda	22.4	1.5	0.6	0.0	0.0	**0.0**	0.0	0.0	0.0	24.4
Pewee-Indian	0.0	0.0	0.7	0.0	5.9	**4.8**	0.0	0.8	6.4	18.5
Pine-Brisbois	31.4	27.6	0.8	1.0	0.0	**11.8**	0.0	15.1	7.2	94.8
Poison-Rosebud	26.7	4.1	0.0	0.0	0.0	**1.5**	0.0	0.0	0.9	33.2
Sheep-Pole-Sock	10.0	1.8	0.0	0.0	0.0	**0.0**	0.0	5.6	0.9	18.2
Sunflower	2.1	2.4	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	4.5
Venator	4.1	2.6	0.0	2.2	0.0	**0.0**	0.0	0.9	0.0	9.8
TOTAL	132.6	71.0	3.0	4.7	5.9	**19.9**	0.5	25.7	20.6	284.0

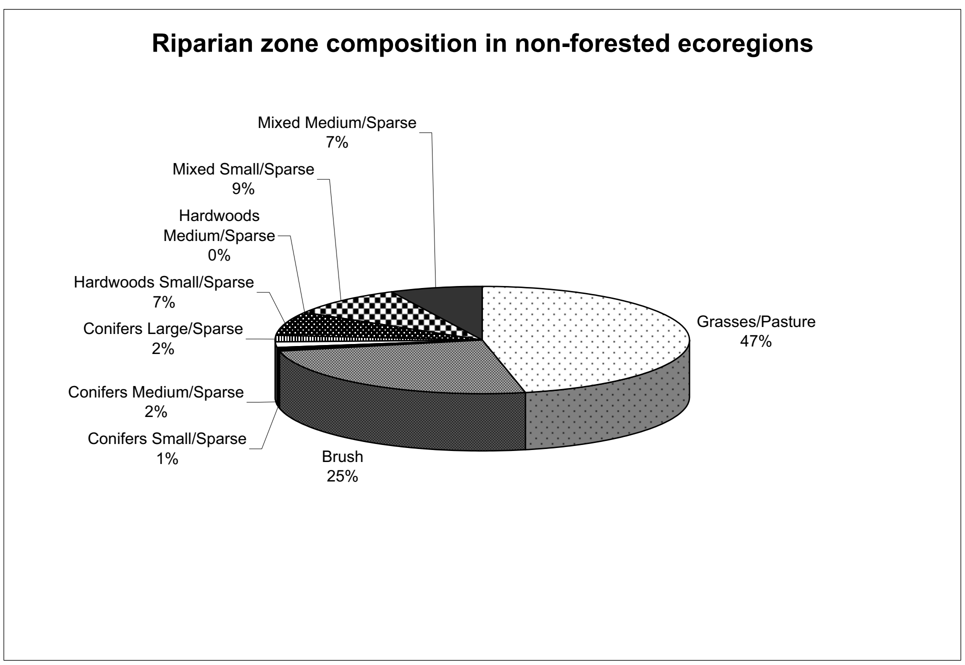

Figure 5.1 Riparian zone composition in non-forested ecoregions of the upper South Fork of the John Day River watershed, Oregon.

Table 5.5. Number of miles of riparian zone vegetation condition classes by subwatershed in the 11b and 11h (i.e. forested) ecoregions in the upper South Fork of the John Day River watershed, Oregon. Headings in bold are the predominant natural riparian zone conditions for these ecoregions.

	Non Forest		**Conifer Forest**			**Hardwood Forest**		**Mixed-species Forest**			
Subwatershed	Grasses	Brush	Small/Sparse	Medium/Sparse	Large/Sparse	Small/Sparse	**Small/Dense**	Medium/Sparse	**Small/Dense**	Small/Sparse	**Total**
Corral	0.0	0.0	0.0	5.6	0.0	0.0	**0.0**	8.8	**0.0**	2.1	16.5
Donivan-Bear	7.2	5.1	0.0	7.1	0.0	4.4	**0.0**	7.3	**0.8**	7.2	39.2
Flat-Utley	3.4	11.7	0.0	8.3	2.5	0.0	**0.0**	18.4	**2.9**	2.0	49.2
Lewis-Lonesome	9.0	0.0	0.0	14.5	11.5	0.0	**0.0**	13.3	**3.0**	15.1	66.4
Morgan-Dry Soda	0.0	0.0	2.4	0.0	0.0	0.8	**0.0**	0.0	**2.2**	1.1	6.5
Pewee-Indian	0.0	0.0	2.5	0.7	0.0	0.0	**0.0**	0.0	**2.6**	1.7	7.6
Pine-Brisbois	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	**8.7**	1.2	9.8
Poison-Rosebud	0.0	1.6	0.0	8.4	0.0	0.0	**0.0**	3.7	**2.4**	4.1	20.2
Sheep-Pole-Sock	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	**0.0**	0.0	0.0
Sunflower	24.4	17.4	15.4	1.7	0.0	1.5	**9.9**	0.0	**15.8**	21.1	97.3
Venator	0.0	1.2	6.1	11.1	0.0	0.0	**0.0**	3.3	**1.5**	5.1	28.2
TOTAL	44.1	36.9	26.4	57.4	14.0	6.8	**9.9**	54.8	**39.9**	60.6	340.9

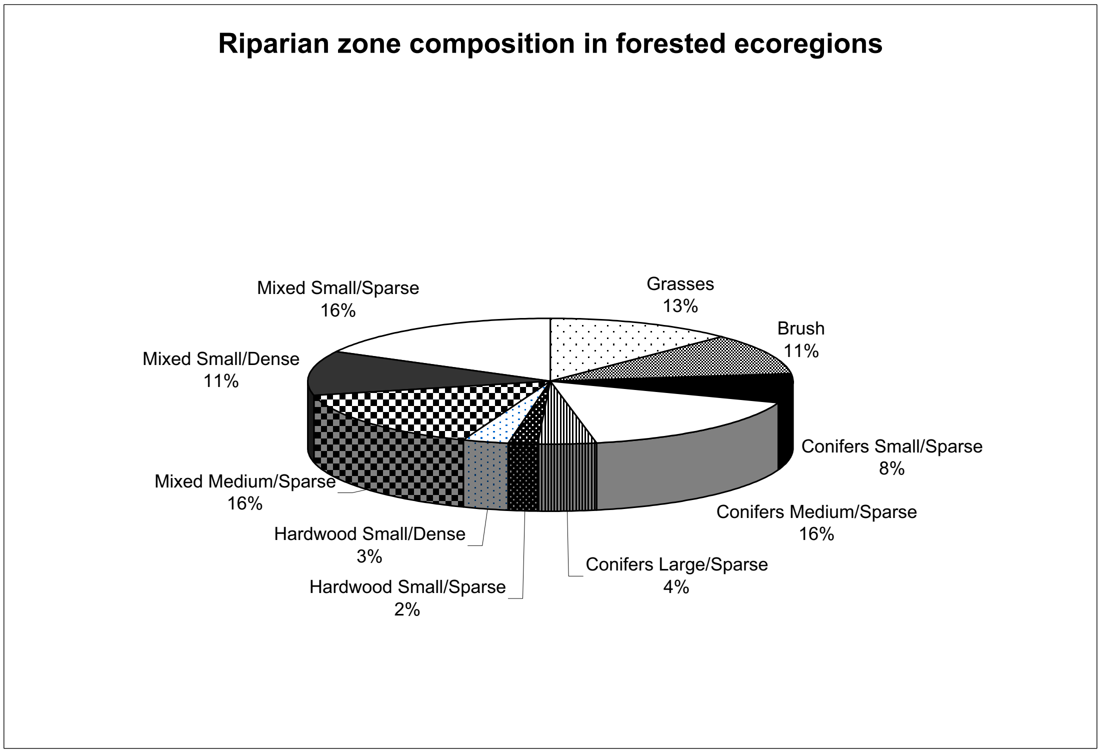

Figure 5.2 Riparian zone composition in forested ecoregions of the upper South Fork of the John Day River watershed, Oregon.

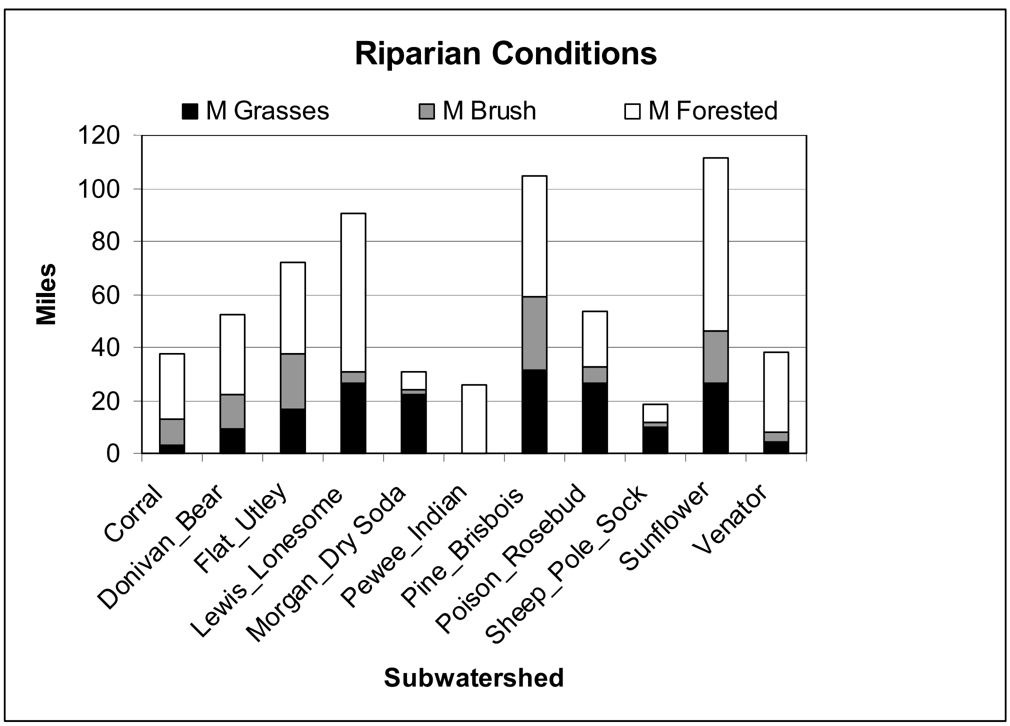

Figure 5.3 Riparian conditions, as determined by dominant vegetation types, occurring in the upper South Fork of the John Day River watershed, Oregon.

Table 5.6. Riparian recruitment potential and situation by subwatershed in the upper South Fork of the John Day River watershed, Oregon.

			Inadequate							
	Adequate		Agriculture		Infrastructure		Small stands		Wetland	
Subwatershed	**ft**	**%**	**ft**	**%**	**ft**	**%**	**ft**	**%**	**ft**	**%**
Corral	48,962	24.7	63,157	31.2	0	0	85,578	43.3	0	0.0
Donivan-Bear	61,598	22.3	49,015	17.8	12,882	4.7	152,215	55.2	0	0.0
Flat-Utley	120,121	31.7	108,165	28.6	5251	1.4	145,160	38.3	0	0.0
Lewis-Lonesome	152,959	32.0	131,711	27.6	26,801	5.6	166,421	34.5	0	0.0
Morgan-Dry Soda	60,662	37.2	56,529	34.6	18,864	11.6	23,614	14.5	3562	2.2
Pewee-Indian	58,615	41.4	0	0.00	55,877	39.4	27,251	19.2	0	0.0
Pine-Brisbois	284,011	51.4	199,757	36.2	22,464	4.1	31,000	5.6	15,217	2.8
Poison-Rosebud	8687	3.1	149,956	53.2	21,716	7.7	101,754	36.1	0	0.0
Sheep-Pole-Sock	36,582	38.1	59,421	62.0	0	0	0	0.00	0	0.0
Sunflower	295,533	50.1	146,784	25.0	33,256	5.6	113,964	19.3	0	0.0
Venator	11,502	5.7	41,317	20.6	0	0	147,607	73.6	0	0.0
TOTAL	**1,139,232**	**34.0**	**1,005,812**	**30.0**	**197,111**	**5.9**	**994,564**	**29.6**	**18,779**	**0.6**

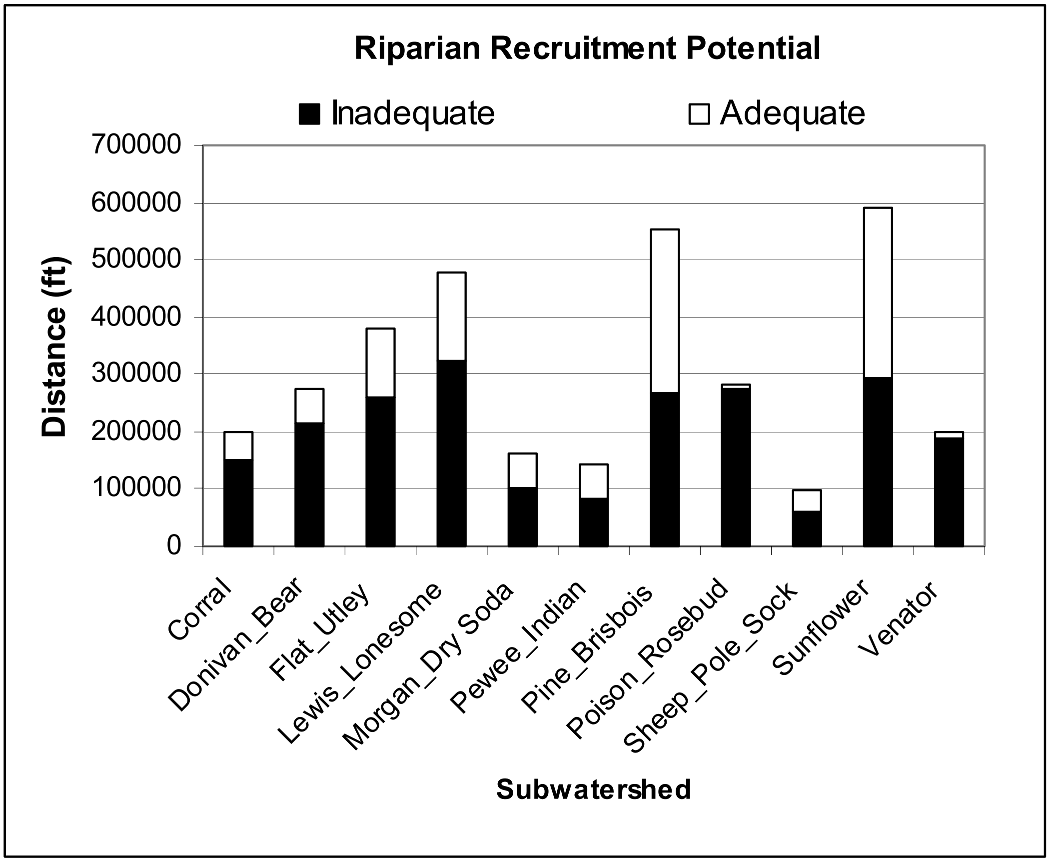

Figure 5.4 Riparian recruitment potential in subwatersheds of the upper South Fork of the John Day River watershed, Oregon.

Poison-Rosebud-Antelope, and Sunflower creek watersheds contained the highest linear distances of riparian zones with inadequate riparian zone recruitment potential. Land uses or conditions (referred to as "situations") identified as most often responsible for producing inadequate riparian recruitment potential were agriculture (30.0%) and small stand sizes (29.6%).

Agricultural practices, including valley floor hayfields and rangelands along streams have prevented trees and shrubs from becoming reestablished. It is recognized that bottomlands along streams can be the most valuable agricultural land in the basin; however, encouraging a larger buffer between land uses and streams will benefit water quality and stream health, which also have values for landowners in the basin (Elmore 1992).

Forestry, another high-value land use in the watershed, is negatively affecting riparian recruitment potential by limiting tree sizes. Stands of smaller trees result either from recent forestry activities (harvest, replanting) or succession of fallow or replanted agricultural land. If allowed to attain larger tree sizes, these situations will eventually produce adequate amounts of LWD; however, if current management regimes continue, large proportions of small tree sizes will persist and continue to deplete streams of important woody structural components.

Roads and bridges comprised the majority of the infrastructure (INF) riparian recruitment situation; 5.9% of the basin's streams were affected in this manner. If the watershed were urbanized, this code would also include buildings, parking lots, and other permanent, man-made features. The rural nature of the watershed confines this condition to roads and bridges, however.

STREAM SHADING

Stream shading also varied extensively across the watershed (Table 5.7). Generally, headwater stream reaches at higher elevations were more

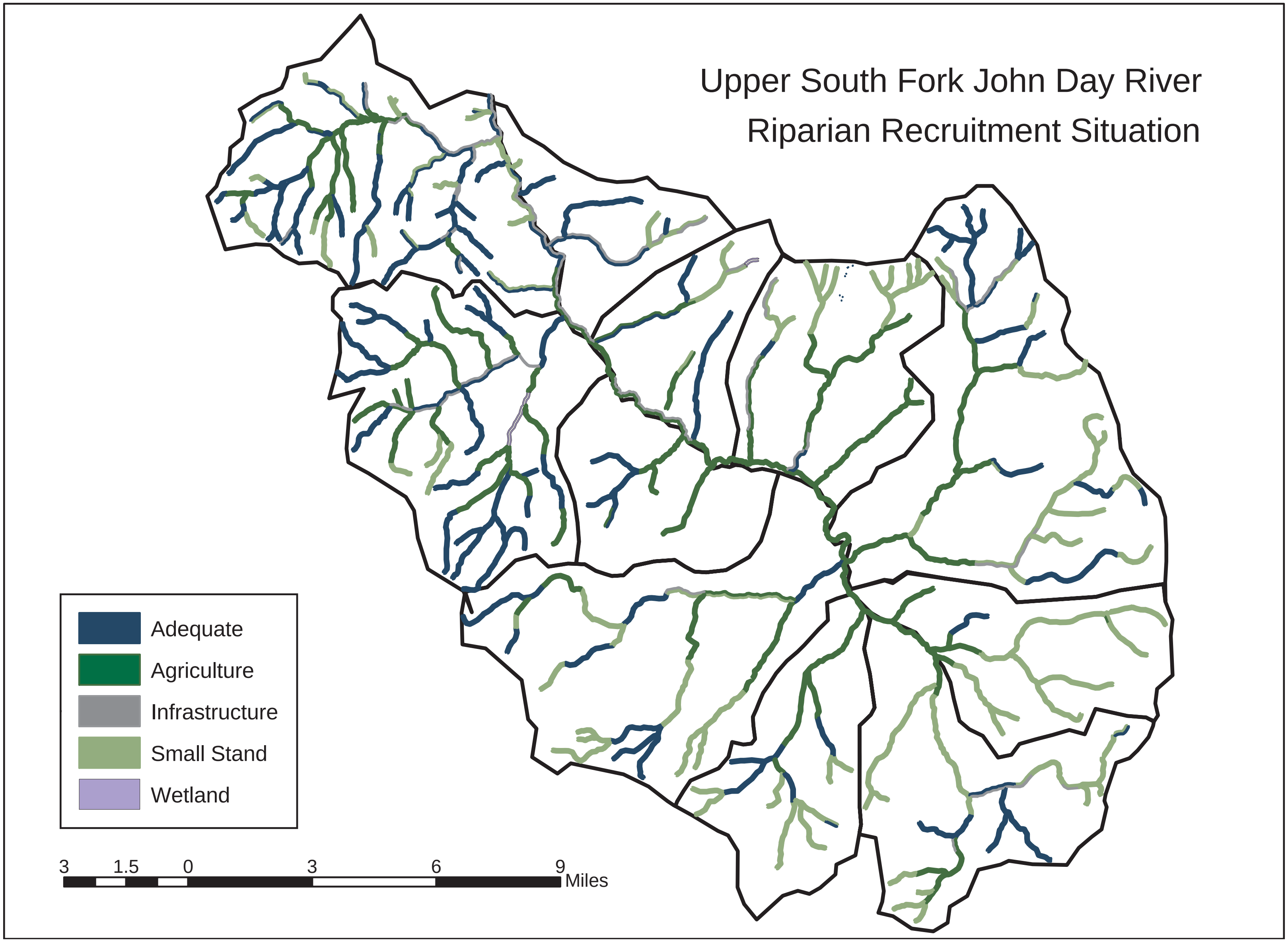

Figure 5.5 Riparian recruitment situations occurring in the upper South Fork of the John Day River watershed, Oregon.

Table 5.7. Linear distance and percent of each subwatershed in each shade category by subwatershed in the upper South Fork of the John Day River watershed, Oregon.

	Light Shade (?40%)		**Medium shade (40–70%)**		**Heavy Shade (>70%)**		
Subwatershed	**ft**	**%**	**ft**	**%**	**ft**	**%**	**Total (ft)**
Corral	194,825	98.5	2872	1.5	0	0	197,697
Donivan-Bear	211,764	76.8	63,946	23.2	0	0	275,710
Flat-Utley	260,818	68.9	117,879	31.1	0	0	378,697
Lewis-Lonesome	388,449	81.3	89,443	18.7	0	0	477,892
Morgan-Dry Soda	145,934	89.4	17,297	10.6	0	0	163,231
Pewee-Indian	92,554	65.3	49,189	34.7	0	0	141,743
Pine-Brisbois	506,413	91.7	46,036	8.3	0	0	552,449
Poison-Rosebud	236,008	83.7	46,105	16.3	0	0	282,113
Sheep-Pole-Sock	91,495	95.3	4508	4.7	0	0	96,003
Sunflower	476,834	80.9	112,703	19.1	0	0	589,537
Venator	110,866	55.3	89,560	44.7	0	0	200,426
TOTAL	**2,715,960**	**80.9**	**639,538**	**19.1**			**3,355,498**

heavily shaded because of the forested nature of these areas (Figure 5.6). More than 89% of the riparian zone distance surveyed had stream shading of less than 40%. Nowhere in the basin did estimated riparian shade levels exceed 70%. Subwatersheds most lacking in stream shading included Corral Creek, Morgan-Dry Soda creeks, Pine-Brisbois creeks, Sheep-Pole-Sock creeks, and Poison-Rosebud-Antelope creeks. Improvements in riparian conditions would increase stream shading and help abate elevation of summertime water temperatures. Because water temperature is such an important determinant of biological stream conditions and a number of stream segments in the watershed violate state standards (see Chapter 8), reestablishing desirable riparian conditions and shading should be a priority in the watershed.

CONCLUSIONS AND RECOMMENDATIONS

Fire suppression, logging, agriculture, and settlement patterns have altered riparian zone conditions throughout the USFJDR watershed. These changes have resulted in reductions in stream shading and riparian recruitment of large woody debris. Riparian zones occurring in upper reaches of stream networks that occur in primarily forested areas are currently being limited by small tree sizes or a lack of trees altogether. Riparian zones occurring on lower reaches and on the mainstem USFJDR are frequently devoid of trees and shrubby species and are dominated by grasses in the areas most intensively used for livestock grazing.

Protection and restoration of riparian zones within the watershed would provide significant benefits to physical, chemical, and biological conditions. To this end, we recommend that landowners be encouraged to remove riparian areas from grazing and establish off-channel watering sources. Riparian fencing can effectively exclude livestock from riparian areas and allow vegetation to regenerate. Planting of woody riparian vegetation will expedite and enhance recovery of the riparian zone. In areas where severe channel incision has occurred and lowered the groundwater table, reestablishment of riparian species can be

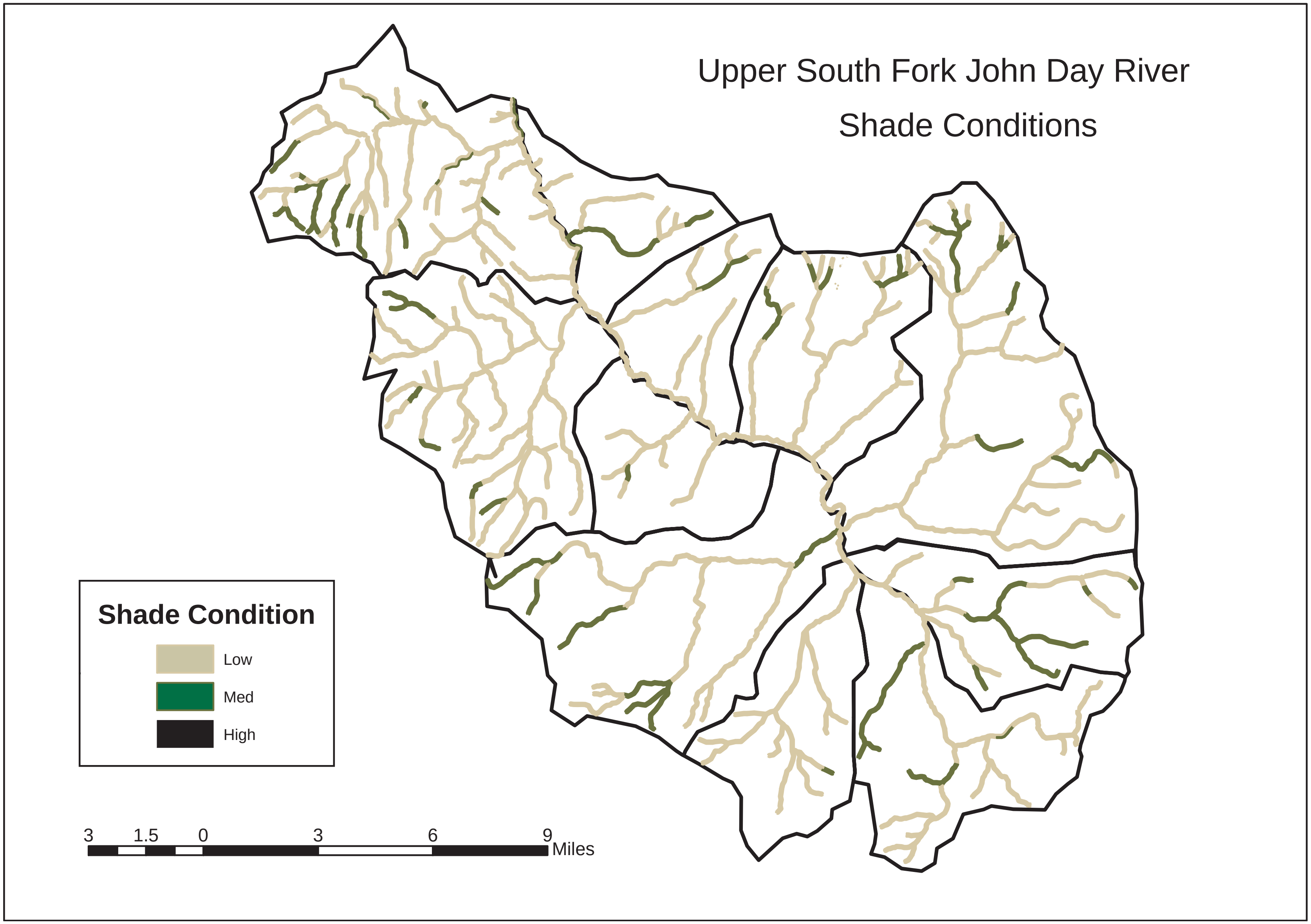

Figure 5.6 Stream shade classes occurring in the upper South Fork of the John Day River watershed, Oregon.

difficult. Under such circumstances, installment of check structures can help re-aggrade the stream channel and raise the water table.

In forested areas of the watershed, riparian zone conditions would benefit most from reducing the impacts of livestock grazing in riparian areas to allow shrub and hardwood regeneration. Such areas could be riparian fenced to further promote recovery of these areas. We suggest that, where practical, these efforts be designed and monitored to allow comparison of these areas with areas that have not undergone restoration or management changes. In areas where small tree sizes are limiting riparian recruitment potential and stream shading, less frequent removal of riparian zone trees would provide better riparian functions than at present.

This watershed-wide, screening-level assessment provides a starting point for characterizing riparian zone conditions in the watershed. A more thorough assessment could include examination of historic photographs and survey notes to better characterize historic riparian zone conditions and to prescribe more specific targets for desirable riparian zone conditions. We also recommend collection of more field data to quantify current riparian zone conditions, particularly in areas of the watershed where conditions could be best improved by riparian restoration and replanting.

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CHAPTER 6: SEDIMENT SOURCES

INTRODUCTION

Erosion and the delivery of sediment into streams are natural processes, and the presence of sediment in rivers and streams is a natural characteristic of these systems. In a system in equilibrium, sediment inputs are balanced by downstream sediment losses, so sediment levels neither increase nor decrease, but remain constant within the system and result in a channel that neither aggrades nor degrades. Alterations to land cover and hydrology by human activities can result in increased sediment loading into streams from either hillslope or channel sources. The primary sources of stream sediment include erosion of uplands (hillslope sources), lateral movement of channels into streambanks (bank erosion), and downcutting of streambeds (Waters 1995).

Sediment is widely recognized as the single greatest pollutant of streams in the United States in terms of quantity involved (Waters 1995). Additionally, the U.S. Environmental Protection Agency has identified sediment as the most important cause of river and stream pollution in the United States in terms of miles of rivers and streams polluted (EPA 1990). Still, separating excessive sediment loading resulting from human activities from natural background levels and rates can be challenging, particularly with a lack of baseline information.

Excessive sediment in streams has been well documented to negatively affect aquatic life and habitats. Fine sediment deposited on spawning gravels can reduce the survival of eggs and other early life stages of fish. Filling in of gravels also reduces habitat available to benthic life and may lead to decreases in macroinvertebrate densities. Suspended sediment also can affect fish and macroinvertebrates by accumulating on gill and other respiratory surfaces, and by disrupting or altering social and feeding behaviors.

TRANSPORT PROCESSES

As previously mentioned, sediment sources can occur from hillslope or channel sources. Hillslope processes include surface erosion, such as that occurring on agricultural lands and roads, as well as mass wasting, such as landslide events. Surface erosion occurs when rainfall intensity exceeds the absorption capacity of the soil, resulting in surface runoff that carries with it suspended sediment. Removal of vegetation and compaction of soil by forestry and agricultural activities reduce the water absorption capacity of soils and generally increase both surface runoff and soil erosion. Roads are also problem sources of sediment production because they increase surface runoff and concentrate runoff through ditches and culverts, and unpaved roads are significant sediment sources, themselves.

Channel sediment sources include debris flows, bank erosion, and channel downcutting. Debris flows occur when landslides enter streams during storm events. As these materials are carried downstream, they may grow in size by incorporating existing stream channel materials, including logs, boulders, and other debris (Roether 2000). Bank erosion, or bank sloughing, occurs by lateral migration of a stream channel into its streambanks. Bank erosion primarily occurs during peak flow events and can be caused by the force of the water (shear stress) exceeding the ability of the bank materials to remain intact. However, in semiarid areas, such as the upper South Fork of the John Day River watershed, bank erosion is thought to often occur as a result of bank slumping due to wetting (Leopold 1992). Under high flows, water moving from the channel into the banks helps hold bank materials together. When high waters recede, however, and water held behind the banks reverses direction and begins seeping back towards the river, a pressure directed from the banks towards the river reduces the bank's ability to stand as a free vertical face and results in bank slumping. Such conditions are likely common in the lower, unconstrained reaches of the USFJDR watershed.

In this chapter, potential sediment sources to streams of the USFJDR watershed are assessed. This assessment focuses on detailed analysis of two sediment sources, roads and channel sources. Other potential sources are identified and discussed, but a lack of appropriate data for the watershed precluded further quantitative assessments.

METHODS

RURAL/FOREST ROAD RUNOFF

The potential for rural and forestland roads to contribute to sedimentation problems in the watershed was assessed using stream and road GIS data layers acquired from SSCGIS and the USFS. In this basic assessment, total road lengths and total stream lengths were first calculated for each subwatershed. The lengths of roads occurring within 200 feet of streams were identified and then summed for each subwatershed. In this assessment, we assumed that a higher proportion of roads within 200 feet of streams (relative to total stream miles occurring in the subwatershed) indicated that roads were likely contributing higher sediment loads to streams. Therefore, the percent of streams within each watershed occurring within 200 feet of roads was calculated and used as the final index of risk of elevated sediment loading from roads in each subwatershed.

CHANNEL SOURCES

Existing data from habitat surveys of stream reaches in the watershed were examined to determine bank stability and estimate the potential contribution of sediment to stream channels from these sources. Data included bank stability ratings of Utley and Corral creeks from 1990–1992 (Caton 1993) and bank stability ratings from eight mainstem USFJDR reaches and lower Lonesome Creek from 2001 (Cole 2002). These data were compared to the ODFW streambank erosion benchmark of 20% to assess these conditions. Bank conditions also were noted during field assessment surveys, but were not assigned quantitative ratings or estimates, and, therefore, are not included in any semi-quantitative analyses, but are noted in the results.

RESULTS

RURAL/FOREST ROAD RUNOFF

Watershed wide, almost 40% of all stream miles in the watershed occur within 200 feet of roads (Table 6.1). Other than lengths of Pine Creek, Antelope Creek, and certain reaches of the mainstem USFJDR, all of these roads occurring adjacent to rivers and streams of the watershed are unpaved and likely produce sediment-laden runoff during significant precipitation events. The Sunflower Creek subwatershed contains the greatest proportion of stream miles occurring within 200 feet of roads, at almost 57%. Indian Creek and Venator Creek subwatersheds also exceed 50%, while close to half of the total stream lengths within the Morgan-Dry Soda, Pine-Brisbois, and Donivan-Bear creek subwatersheds occur within 200 feet of roads. Subwatersheds with the lowest risk for elevated sediment delivery from road runoff include Flat-Utley, Sheep-Sock-Pole, and Corral creek systems.

CHANNEL SOURCES

Both ABR and DEQ data indicate that most of the stream segments assessed in the two studies had streambanks classified as only moderately stable (40-80%) or worse (Tables 6.2 and 6.3). Streambanks were greater than 90% stable in only two of nine ABR study reaches. Seven of these reaches were less than 80% stable and, therefore, did not meet the ODFW habitat benchmark. These data are particularly insightful because they largely represent streambank conditions in areas undergoing riparian and streambank restoration and, therefore, significantly underestimate the severity or extent of streambank erosion occurring in the mainstem SFJDR on pasture and rangelands. ABR field surveys throughout the watershed noted more severe bank erosion and channel incision on the mainstem and on tributaries in areas heavily used for livestock pasturing and not currently undergoing restoration.

DEQ data, although relatively dated (collected 1990–1992), also indicate streambank erosion problems on Utley and Corral creeks (Table 6.3). Restoration activities in these areas since these data were collected perhaps have improved riparian and channel conditions, but the data still underscore the widespread occurrence of streambank erosion in the watershed at accelerated rates in relation to pre-Euro-American settlement.

RIPARIAN GRAZING BY LIVESTOCK

Riparian grazing occurs throughout the watershed on both publicly and privately managed lands. Both the BLM and USFS have numerous grazing allotments on lands under their jurisdiction and have generally allowed cattle full access to riparian zones and stream channels. Livestock

Table 6.1. Lengths of road within 200 feet of streams, and lengths of stream affected by those roads in the upper South Fork of the John Day River watershed, Oregon.

Subwatershed	Total Road Miles	Roads within 200 feet		Streams Affected	
		Miles	**Percent**	**Total Miles**	**Percent**
Corral	25.4	5.9	23.2	23.6	**25.0**
Donivan-Bear	66.0	13.1	19.9	28.1	**46.7**
Flat-Utley	49.1	9.2	18.7	46.7	**19.7**
Lewis-Lonesome	93.8	17.1	18.2	47.7	**35.8**
Morgan-Dry Soda	12.6	7.5	59.5	17.2	**43.6**
Pewee-Indian	8.9	6.9	77.5	12.3	**56.1**
Pine-Brisbois	53.6	26.3	49.1	55.2	**47.6**
Poison-Rosebud	34.9	11.5	32.9	28.6	**40.2**
Sheep-Pole-Sock	12.2	1.9	15.6	17.3	**11.0**
Sunflower	56.8	28.7	50.5	54.2	**56.7**
Venator	34.4	9.5	27.6	18.7	**50.8**
Total	447.7	137.7	30.8	349.6	**39.4**

have at least seasonal access to most streams and riparian zones in the watershed and most of these areas are not exclusion fenced. All of these areas, to various degrees, show signs of both riparian and streambank damage from grazing and trampling. Because a number of factors, including animal densities, duration and season of use, vegetative cover, soil type, and streamflow influence the effects of grazing on streambanks, a detailed quantitative analysis of these impacts is beyond the scope of this assessment. We wish to emphasize, however, that based on the number of stream miles throughout the watershed that livestock have access to and have damaged to various degrees, livestock use of riparian areas and stream channels has significantly contributed to delivery of sediment to streams from both riparian and streambank sources.

DISCUSSION AND RECOMMENDATIONS

Elevated sediment loading into streams of the USFJDR watershed occurs from a number of sources, including road runoff, pasture lands, and from within the stream channels themselves. Land use in the watershed is dominated by cattle grazing, hay production, and forestry, all of which can result in increased sediment loads into stream systems. While Best Management Practices (BMPs) can minimize sediment production and delivery to streams (Waters 1995, Turner 1997), implementation of these practices is not widespread in the watershed. Livestock are not excluded from most riparian areas or stream channels, leading to degradation of channels and aquatic habitats. Bottomland pastures, in particular, appear to be overgrazed, and are sometimes denuded of vegetation by fall, providing no cover on the land to reduce erosion during winter and spring storm and high-flow events.

Most of the watershed is used as rangeland, and the most intensive use of riparian areas by livestock appears to occur at the lower elevations adjacent to stream channels that are generally most sensitive to disturbance (see Chapter 3). Grazing at appropriate stock densities and appropriate times can minimize damaging effects to soils, hydrology, and vegetation (Johnson 1992). Vegetative cover, even in the form of grasses and stubble, slows

Table 6.2. Streambank stability ratings of nine stream and river reaches occurring in the upper South Fork of the John Day River watershed, Oregon (source: ABR 2002).

Reach location	ABR Reach Number	Bank Stability Rating (0–20 scale)
St. Clair ranch, RM	1	13 – moderately stable (60–70%)
St. Clair ranch, RM	2	11 – moderately stable (50–60%)
St. Clair ranch, RM	3	14 – moderately stable (70–80%)
Keerins ranch, RM	4	14 – moderately stable (70–80%)
Keerins ranch, RM	5	11 – moderately stable (70–80%)
Keerins ranch, RM	6	13 – moderately stable (60–70%)
BLM parcel, RM	7	13 – moderately stable (70–80%)
Lonesome Creek, lower	10	16 – more than 90% stable
USFS parcel, RM	11	15 – more than 90% stable

Table 6.3. Average streambank stability ratings of Utley and Corral creek reaches monitored by DEQ from 1990 to 1992 (source: DEQ 1993).

Stream Name	Stream Mile	Average Rating	Stability
Corral Creek	0.2	2.3	Unstable
	1.2	7.0	Little erosion
	2.0	6.0	Little erosion
Utley Creek	0.9	4.2	Moderate erosion
	2.2	1.5	Unstable
	3.5	3.3	Moderate erosion

sediment production and helps sequester sediment before it enters stream systems. Overgrazing can lead to riparian area damage, elevated water temperatures, and increased erosion in both stream channels and in the uplands (Elmore 1992, Waters 1995). Greater protection of riparian zones by way of exclusion fencing, particularly in areas of intensive cattle use likely would reduce sediment loading from both riparian and channel sources. In such areas, development of off-channl water sources would eliminate the need for cattle to enter stream channels. In addition to cattle grazing, elk herds are growing in number in the watershed and have been implicated for contributing to streambank and riparian zone degradation (Phil St. Clair, pers. comm..).

Forestry practices can also severely impact streams via the delivery of sediments. Clearcutting, skid trails, and access roads are all sources of sediment during high rainfall events. While intensive timber cutting no longer occurs in the watershed to the degree that it had in the early 20th century, local forestry activity in the watershed, when it occurs, should be performed with protection of riparian zones and stream channels in mind. In the USFJDR watershed, dense, overstocked forests that have resulted from fire suppression over the last century are extremely vulnerable to stand-replacement fires, rather than the cooler ground fires of the past. These massive fires denude the landscape of vegetation and, for a few years after their occurrence, large quantities of sediment can enter stream systems with rain and snowmelt events (Waters 1995, WPN 1999). Although no large-scale fires have recently occurred in the watershed, several have occurred nearby during the last few summers, including the wildfire that denuded the Black Canyon Wilderness Area in the Murderer's Creek subwatershed in the lower SFJDR. Drought conditions during the past several summers have increased the risks of high-intensity fires in the watershed; if such fires occurred, sediment delivery to streams in the affected area would certainly increase.

Rural and forest road runoff is also likely contributing elevated sediment loads to watershed streams, and the relative contribution likely varies considerably among subwatersheds, as indicated by the relative proportion of stream lengths within 200 feet of roads. Although road densities in the watershed are not high enough to be affecting local hydrologic conditions (see Chapter 4), and because such a large proportion occurs near streams, roads that cannot be decommissioned should be carefully maintained for proper road drainage and water routing. However, the increased use of sediment traps, water bars, and restricting use during wetter months can help reduce sediment and erosion that results from road systems. Additionally, maintenance of roadside ditches should also be timed to allow vegetation to be present during high-flow events in spring. Ditch vegetation slows water velocities and retains sediment, resulting in less delivery of sediment to streams.

DATA GAPS

The timing of this watershed assessment precluded assessing the turbidity of watershed streams during spring high-water events. Because most of the basin's peak-flow generating processes are snowmelt or rain-on-snow, a field assessment would have to take place during a high-water event from March to May. Any future work aimed at further evaluating sediment sources and problem areas in the watershed should include some springtime field visits and data collection, particularly to better assess the effects rangeland management on sedimentation of streams during peak-flow events. Such visits would include visual inspections of ditches and streams for high sediment loading to determine where in the watershed stream sedimentation is most problematic.

Landslides are another significant source of sediment in stream systems, particularly when forest management practices proceed at an unsustainable level (WPN 1999). The decrease in forest overstory, in addition to the proliferation of logging roads and skid trails, can send large amounts of sediment into the waterways. A thorough search of the watershed, whether on the ground, in USFS & BLM records, or in conversations with local residents, would reveal information that would be invaluable to further assessing sedimentation in the basin.

Streambank erosion is occurring throughout the watershed at what appears to be accelerated rates, although few data are available to comprehensively assess the extent of this problem. A more complete inventory of stream habitats in the watershed would provide valuable information that would both better characterize current conditions and provide a baseline for comparison with future data to assess the effects of restoration activities.

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CHAPTER 7: CHANNEL MODIFICATIONS

INTRODUCTION

Channel modification occurs when human alteration results in a change in the physical or hydrologic properties of the stream channel. This component of the assessment identifies existing channel modifications that are affecting channel morphology and hydrologic properties in the upper South Fork of the John Day River watershed and assesses the likely effects of these modifications. In the USFJDR watershed, channel modifications include channelized stream segments, roads that restrict lateral channel migration, irrigation ditches, diversion dams, earthen impoundments, and dikes. Because stream restoration projects are addressed in the Fish and Fish Habitat Assessment chapter and road crossings are addressed in the Sediment Sources chapter, neither is considered in this assessment, although each clearly modifies stream channels.

Because the USFJDR occurs in a very rural area, most channel modification probably is related to agricultural activity and infrastructure. Straightening of river and stream channels, called channelization, was a common practice in the past to increase water velocity and move water through a stream reach more efficiently, thereby more quickly draining a given area and reducing local flooding. To understand how channelization affects rivers and streams, it is useful to view rivers as transporting machines (Leopold 1994). As such, rivers are dynamic systems that attempt to maintain a balance between sediment transport and the energy available from streamflow to perform work. River meanders develop to maintain a channel slope that allows energy to be expended a rate that results in channel stability; that is, the channel neither degrades nor aggrades (Rosgen 1996). Floodplain rivers and streams develop meanders along which energy is expended over longer distances than would be expended in a straight stream channel with the same vertical drop (i.e., steeper gradient). Straightened channels result in steeper channel gradients and produce accelerated water velocities that increase streambank and bed erosion and sedimentation. Channel incision and channel widening both can result from these processes and effectively disconnect the river or stream from its floodplain. Diking often accompanies channelization to further confine stream flows and prevent flooding of lands in agricultural production. Diking further disconnects the stream channel from its floodplain, thereby exacerbating the effects of channelization described above.

Dams and irrigation ditches also alter the natural flow of streams. Some irrigation ditches divert water onto fields in late summer, when stream flows are at their lowest, consequently reducing water available for instream uses. Roads constructed near stream channels may impede or prevent lateral channel migration and produce some of the same effects caused by channelization. In general, all of these activities have the potential to adversely affect stream health by increasing water velocity, decreasing floodplain function, decreasing water quality and quantity, and reducing fish habitat value (Leopold 1996).

METHODS

Channel conditions were evaluated using field assessments, aerial photos (see Chapter 5 – Riparian Conditions), personal interviews, and Federal Emergency Management Agency (FEMA) Floodplain maps. Modifications were mapped using ArcView 3.2a and coded using the following fields:

Site Number – An individual code for the channel modification.

Activity **–** A brief description of the channel modification in question. Categories included Dike, Diversion Dam, Pond/Agricultural Impoundment, Riprap, Roaded, and Channelized.

Data Source **–** The source of the information acquired. Digital Ortho Quads, Bureau of Reclamation aerial photos, ground-truthing, and conversations with watershed resident, Phil St. Clair, were all sources of information. FEMA flood maps were also perused; however, no modifications were identified using this source, due to the coarse resolution of the maps.

CHT – Channel Habitat Type (see Chapter 3) of the stream impacted by the channel modification.

Length – Length, in feet, of the channel modification in question.

Degree of Impact – Subjectively coded as High, Medium, or Low impact, depending upon the nature of the channel modification.

Type of Impacts – Impacts of the channel modification in question upon riparian structure and function were coded as follows.

1. Migration barrier. Fish passage, both anadromous and for fish colonization / seasonal movement are compromised by the activity
2. Loss of spawning / rearing / escape habitat. Simplification of the channel reduces the amount of habitat available for the various life stages of fish species
3. Water quality. Agricultural impoundments can cause increased temperatures and higher nutrient loads in streams
4. Decreased floodplain function. Channelization disconnects the stream from its floodplain, increasing high water flows and depleting groundwater supplies.
5. Flow alteration. Impoundments and channelization change the hydrologic character of the stream, with ponds decreasing peak flows and channelization increasing flows.
6. Erosion potential. Roaded areas adjacent to streams can lead to increased surface runoff.

RESULTS

Twenty-five channel modifications were identified in the watershed (Table 7.1, Figure 7.1). Channel modifications were most frequently associated with grazing or irrigation activities. Diking along the mainstem of the SFJDR to prevent flooding of valley floor pastures was the most common channel modification occurring in the watershed. Diversion dams and irrigation ditches to supply water to hay fields and pastures also were among the most common modifications.

Roads that are constraining the stream channel were identified on five stream segments through the watershed. Four small impoundments occurred in the watershed. During summer field assessments, two of these impoundments, lower Sheep Creek and lower Antelope Creek, contained no water. It is unknown if these impoundments are used for seasonal water storage. The largest impoundment occurs on Utley Creek and occupies ~14 acres at maximum capacity.

Limited ground truthing and incomplete access to private lands precluded a comprehensive assessment of channel modifications in the watershed, but our current assessment likely provides a representative sample of the relative frequencies of different modification types occurring on the watershed and a good sense of what the most common problems associated with channel modification are in the watershed. Identifying smaller channel modifications on aerial photos also may have led to an underestimate of the relative frequency of tributary modifications.

More than half of the channel modifications identified have occurred on the mainstem SFJDR; the others have occurred on tributaries throughout the watershed. Of the modifications identified, 34,993 feet (6.7 mi) occurred on the mainstem of the USFJDR. This value is 70% of all of the modifications in the watershed. Because most of the mainstem river is floodplain (see Chapter 3), the watershed's floodplain channels are being disproportionately affected by channel modifications.

DISCUSSION AND RECOMMENDATIONS

Channel modifications that have occurred in the watershed have resulted primarily from ranching activities and placement of road infrastructure. The most common of these modifications, diking, has likely contributed to alteration of channel dimensions and entrenchment of a number of mainstem segments. The continued presence and function of these dikes will prevent reestablishment of more stable channel conditions in the SFJDR by confining high-water events to the

Table 7.1. Summary of channel modifications in the upper South Fork of the John Day River watershed, Oregon. Site number corresponds to numbers on Figure 7.1.

Site No	Stream	Activity	Data Source	CHT	Length (ft)	Degree of Impact	Types of Impact		
1	USFJDR	dike	DOQ	LC	2123	H	2	4	
2	USFJDR	dike	DOQ, ground	LC	2190	H	2	4	
3	UFSJDR	pond	DOQ	FP2	1105	M	2	3	
4	USFJDR	dike/diversion dam	DOQ, BOR	FP2	1130	H	2	4	
5	USFJDR	pond	DOQ, BOR	FP2	1279	M	2	3	4
6	USFJDR	dike	DOQ, BOR	FP3	2507	H	2	4	
7	USFJDR	dike	DOQ, BOR	FP3	9374	H	2	4	
8	USFJDR	diversion dam	DOQ, BOR	FP3	50	H	4	4	
9	USFJDR	dike	DOQ, BOR	FP3	1994	H	2	4	
10	USFJDR	channelized	DOQ, BOR	FP3	4382	H	2	4	
11	Brisbois Creek	impoundment	DOQ	FP3	1126	H	1	2	3
12	USFJDR	channelized	DOQ	FP2	1118	M	4	6	
13	Utley Creek	impoundment	DOQ, BOR	FP3	1356	H	1	2	3
14	Sunflower Creek	road is constraining channel	DOQ	MV	7073	L	2	4	6
15	Wildcat Creek	road is constraining channel	DOQ	SV	3739	L	2	4	6
16	Rosebud Creek	road is constraining channel	DOQ	FP3	532	L	2	4	6
17	Corral Creek	road is constraining channel	DOQ	FP3	2064	L	2	4	6
18	USFJDR	road is constraining channel	DOQ	FP2	1836	M	2	4	6
19	USFJDR	diversion dam, ditch	BOR, Phil St. Clair	FP3	572	M	2	4	
20	Venator Creek	diversion dam, ditch	BOR, Phil St. Clair	FP3	3702	H	2	4	
21	USFJDR	diversion dam, ditch	BOR, Phil St. Clair	FP3	731	M	2	4	
22	Morgan Creek	Irrigation ditch	DOQ, ground	LC	1727	M	2	4	
23	USFJDR	Irrigation ditch/diversion dam	DOQ, ground	FP2	1282	M	2	4	
24	Antelope Creek	impoundment	DOQ, ground	MM	892	H	1	2	3
25	Sheep Creek	Impoundment	DOQ, ground	MM	365	H	1	2	3
	TOTAL				54,249 (10.3 miles)				

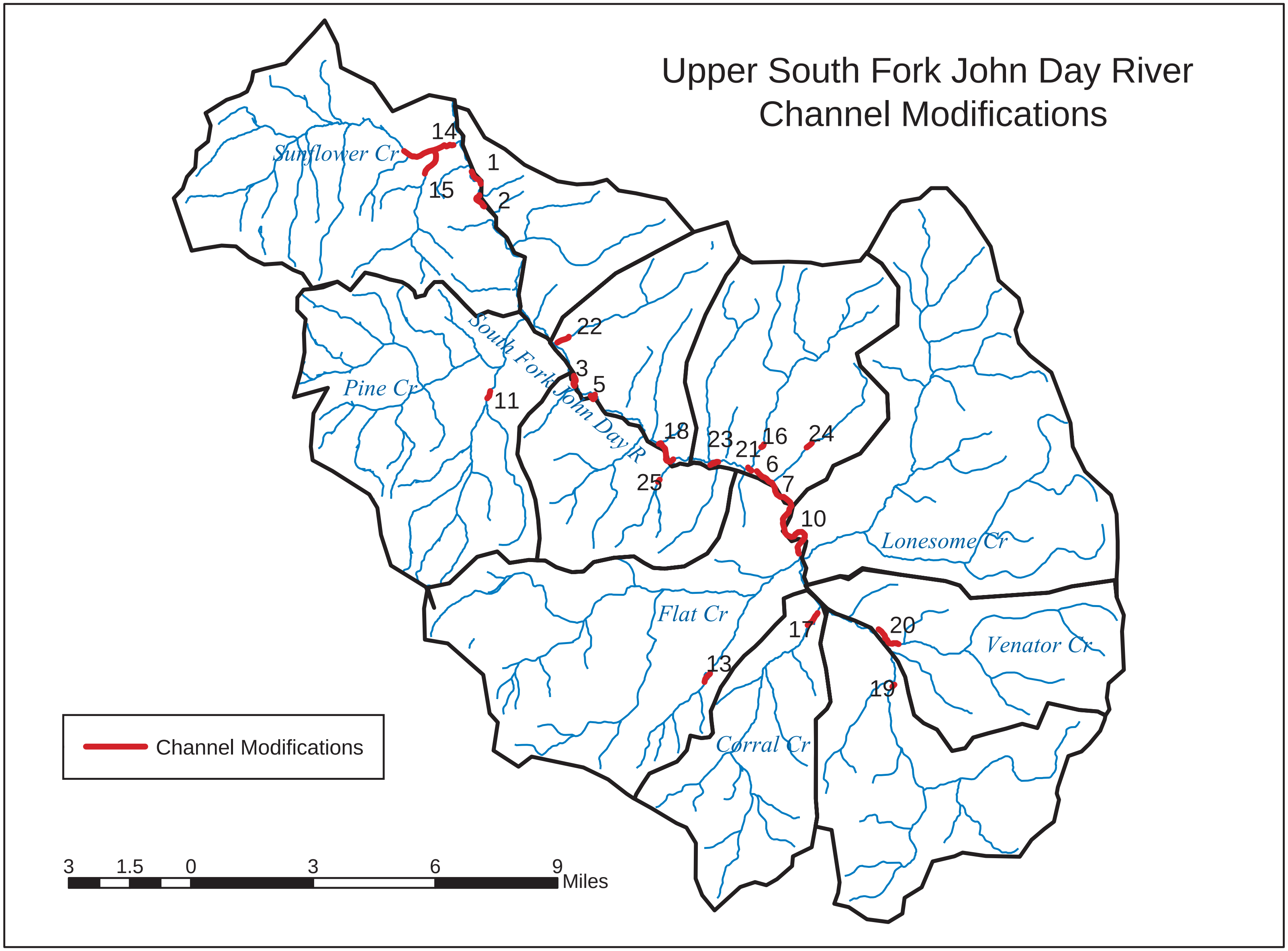

Figure 7.1 Locations of identified channel modifications occurring in the upper South fork of the John Day River watershed, Oregon.

river channel and preventing damaging flood flows from dispersing across the floodplain. Channelization also occurs in a number of reaches in the mainstem. These areas have also contributed to channel downcutting and altered river discharge patterns. Over time, and if left to its own, the river will eventually develop point bars and begin to meander once again, but this process will take decades, perhaps longer. Alternatively, channelized sections could be restored to closely approximate the shape and functioning of historic meandering channels that occurred in the floodplain.

Irrigation ditches and dams are necessary to support the small ranches that occur in the watershed. However, their effects on hydrology and fish populations cannot be overlooked and can be minimized. Fish screens on diversion intakes, as have already been installed on three irrigation ditches in the upper watershed, prevent fish from entering and stranding in irrigation ditches. Small dams used for irrigation diversion can be built to provide better fish passage with the inclusion of fish ladders.

Historically, beavers had a large presence in the watershed (see Chapter 2). Their removal, by trapping for furs, or through elimination to 'free up' the river and streams of the watershed have dramatically changed the character of the watershed, and can, therefore, be considered a channel modification, although one more difficult to quantify than those discussed above. During the droughts of the 1930s, the nearby Silvies River had 'trickled from one beaver dam to the next' (Donovan 1995). The presence of beavers in the pre-European era would have moderated high-water flows, created fish-rearing habitat, and increased the water table elevation. Beavers are far less numerous in the watershed, and yet are perceived as a nuisance species because they cut down and feed on riparian vegetation, including that occurring in restoration areas (Phil St. Clair, 2002, personal communication). Ideally, beavers should be prevented from feeding in sensitive restoration areas until an adequate food base of vegetation becomes reestablished.

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CHAPTER 8: WATER QUALITY

INTRODUCTION

The federal Clean Water Act (CWA) was signed into law in 1972 with the mandate "to protect and maintain the chemical, physical, and biological integrity of the nation's waters." The Oregon Department of Environmental Quality (DEQ), under the authority of the U.S. Environmental Protection Agency, has the responsibility to set standards to protect water quality and to enforce these standards. The CWA requires each state to designate beneficial uses, determine what parameters to measure to ascertain whether beneficial uses are being met, and to develop criteria for those parameters. Beneficial uses have been established by the Oregon Water Resources Department (WRD) for each major river basin in the state and listed in the Oregon Administrative Rules, Chapter 340 Division 41. The WRD has identified 14 beneficial uses in the John Day River basin (Table 8.1); the Oregon Department of Environmental Quality is responsible for ensuring that these beneficial uses are being met. Federal law requires protection of the most sensitive of these beneficial uses. The most sensitive beneficial uses occurring in the upper South Fork of the John Day River watershed are (AWQAC 2002):

- Resident fish and aquatic life
- Salmonid fish spawning and rearing
- Water contact recreation
- Domestic water sources

In Oregon, the Department of Environmental Quality (DEQ) is responsible for developing water quality standards that will protect designated beneficial uses of waters of the state. Section 303(d) of the Clean Water Act requires each state to develop a list of water quality limited streams that violate these water quality standards. This list of water quality limited streams is reviewed, updated, and submitted to the U.S. Environmental Protection Agency every two years. To warrant a listing, water quality criteria must be evaluated using sufficient data that both verify the violation and meet minimum quality assurance requirements. Because sufficient data on water bodies often may not exist that would allow a listing determination to be made, the 303(d) list may under represent the number of impaired water bodies in a given region or watershed. Watersheds lacking sufficient water quality monitoring programs are particularly likely to have streams that are not meeting standards, yet do not occur on the state's impaired water bodies list.

WATER QUALITY MANAGEMENT PLANNING

Federal law requires that 303(d)-listed waterways be managed to meet state water quality standards. DEQ uses total maximum daily loads (TMDLs), which describe how much of a particular pollutant a water body can receive without violating water quality criteria (DEQ 2001), to reduce pollution of listed waters. TMDLs are calculated for each pollutant entering a body of water, and then these maximum allowable pollutant loads are allocated among pollution sources, such as industry or run off from farms and forests. Along with 56 other watersheds, the upper South Fork of the John Day River watershed has received priority one status for completion of TMDLs because of pollution severity and designated beneficial uses in the subbasin. TMDLs for 303(d)-listed waters occurring in the USFJDR watershed are scheduled for completion by DEQ in 2004 (DEQ 2003b). These TMDLs will allocate pollutant loads to different sources, such as agriculture, urban areas, and federal lands. Each jurisdiction will then develop water quality management plans to achieve these load allocations.

In advance of TMDL completion, the Upper Mainstem and South Fork of the John Day River Water Quality Advisory Committee, the Oregon Department of Agriculture, and the Grant Soil and Water Conservation District have developed an Agricultural Water Quality Management Plan. The purpose of the plan is to "identify strategies to reduce water pollution from agricultural lands through a combination of educational programs, suggested land treatments, management activities, and monitoring" (AWQAC 2002). This plan will be the TMDL implementation plan for agriculture's load allocation and may be revised to

Table 8.1. Designated beneficial uses of water bodies in the John Day River Basin, Oregon.

Beneficial Use
Public Domestic Water Supply
Private Domestic Water Supply
Industrial Water Supply
Irrigation
Livestock Watering
Anadromous Fish Passage
Salmonid Fish Rearing
Salmonid Fish Spawning
Resident Fish and Aquatic Life
Wildlife and Hunting
Fishing
Boating
Water Contact Recreation
Aesthetic Quality

address the load allocations as they are developed (AWQAC 2002).

WATER QUALITY PARAMETERS

The Agricultural Water Quality Management Plan (AWQAC 2002) identifies temperature, dissolved oxygen, bacteria, biological criteria, and flow modification (see hydrology and water use section) as water quality parameters of concern. Other parameters, including pH, nutrient concentrations, and turbidity are routinely included in water quality assessment and monitoring, and are included in this assessment.

TEMPERATURE

Water temperature can significantly influence the distribution of aquatic organisms, as all aquatic organisms are adapted to live within a certain range of temperatures. When water temperatures shift outside of the optimal range of aquatic organisms, growth and reproduction rates can be adversely affected. Severe deviations outside of their tolerance range can result in mortality. Salmonids, in particular, require cool water for optimal physiological functioning during various stages of their life cycle, including spawning and rearing. Physical stress and increased susceptibility to fungal infection can occur when temperatures rise above preferred temperatures. Additionally, cold water can hold higher concentrations of dissolved oxygen, and can slow the growth of problem-causing bacteria and algae.

In the USFJDR watershed, land uses including livestock grazing, timber removal, road construction, agricultural practices, and stream-channel disturbances have created conditions that impair water quality by elevating water temperatures. Undesirable effects of these activities, including bank erosion, sedimentation, and removal of riparian vegetation, contribute to increasing water temperatures. Sedimentation and erosion produce wider, shallower stream channels that absorb more solar radiation per unit volume of water than do narrower, deeper channels. A lack of riparian vegetation exacerbates the rate of warming by further increasing the amount of sunlight directly absorbed by the stream (DEQ 2000).

Streams are considered impaired if the rolling seven-day average of the daily maximum temperature exceeds the 64 ^{o}F (17.8 ^{o}C) standard. If stream temperature data are not collected in such a manner that allows calculation of the rolling seven-day average, greater than 25% (and a minimum of at least two exceedences) of the samples must exceed the appropriate standard based on a multi-year monitoring program that collects representative samples during periods of concern. In the USFJDR, mid- to late-afternoon summer water temperatures are typically of concern (DEQ 1998).

DISSOLVED OXYGEN

Salmonids and other cold-water-adapted aquatic life typically require high concentrations of dissolved oxygen (DO). DO concentrations in streams fluctuate predictably both seasonally and over a 24-hour period. Photosynthesis from aquatic plants, respiration from aquatic organisms, and temperature fluctuations all influence DO concentration changes. During the day, algal photosynthesis can produce high DO concentrations by late afternoon. Then at night, when no photosynthesis occurs, yet respiration by aquatic organisms continues and consumes dissolved oxygen, DO concentrations can significantly decrease by dawn. Decomposition of organic wastes by aquatic microorganisms also consumes oxygen; the amount of oxygen consumed in this process is called the biochemical oxygen demand (BOD).

Dissolved oxygen standards vary with the type of aquatic communities that are supported (cold-, cool-, or warm-water) by a particular water body and whether the water body supports salmon spawning and rearing. Oregon waters identified as supporting cold-water aquatic life are to contain dissolved oxygen concentrations of at least 8 mg/L. During salmonid spawning (October–July), a more restrictive criterion of 11 mg/L (or 95% saturation) is specified. For the purpose of this screening level assessment, the criterion has been set at 8 mg/L, as recommended by the Oregon Watershed Assessment Manual (WPN 1999).

BACTERIA

Bacteria found in the coliform group are used as indicators to determine the sanitary quality of water for drinking water and swimming. These bacteria are relatively harmless microorganisms that can be found in the intestines of humans and warm- and cold-blooded animals. The presence of coliform bacteria suggests the possibility of the presence of more harmful fecal coliform bacteria such as *Escherichia coli*. In the past, fecal coliform data were most commonly collected and standards were based on such measurements. As of 1996, however, the standards were changed to measurements based on the number of *E. coli* organisms per 100 ml as these bacteria are more harmful.

BIOLOGICAL CRITERIA

The biological criteria parameter was established to ensure that the state's waters are of "sufficient quality to support the aquatic species without detrimental changes in the residential biological communities." Streams are listed under this criterion if the aquatic community scores are 60% or less of the reference community condition, as determined by multimetric scores or multivariate model scores (DEQ 1998).

PH

The pH value measures the concentration of hydrogen ions in water. Water of pH 7 is neutral, while pH values below 7 indicate acidic conditions, and pH values above 7 indicate alkaline conditions. The chemical form and availability of nutrients and chemicals are influenced by pH, while metal ions become more toxic at lower pH values (WPN 1999). A range of 6.5 to 9.0 is the pH standard for the John Day Basin. If 25% of pH values measured between June and September are greater than pH 8.7, however, the DEQ should determine whether higher values are anthropogenic or natural in origin (DEQ, 1998).

NUTRIENTS

The two primary chemical forms that limit plant growth in water are nitrogen and phosphorus. Excess plant and algae growth can occur when these chemicals are loaded into a water body causing areas of low or no dissolved oxygen. In addition, certain algae can produce chemicals that can be toxic to livestock and wildlife. To prevent the growth of problem-causing plants and algae, water quality criteria for total phosphorus and total nitrate have been established. Total phosphorus measures phosphates in the water column and phosphorus in suspended elements, while total nitrate (usually nitrite plus nitrate) measures most of the nitrogen in the water column. Evaluation criteria of 0.30 mg/L for total nitrate and 0.05 mg/L for total phosphorus have been established in areas where TMDLs have not been established, such as in the upper South Fork basin, (WPN 1999).

TURBIDITY

Turbidity, a measure of water clarity, acts as a gauge of the amount of suspended sediment in the water column. Turbidity varies naturally with soil type. Larger, heavier particles, such as sand, will more readily sink to the stream bottom, while smaller, lighter particles such as silts and clays will remain suspended for longer durations. While clear water is aesthetically pleasing, it is also important for aquatic organisms such as salmonids that sight-feed. Additionally, sensitive gill tissues of fish can be damaged by sediment particles in the water column. To evaluate turbidity by the Oregon Water Quality Standards criterion, paired water samples need to be collected. Turbidity data often are not collected in this manner, so an evaluation criterion of 50 NTU (nephelometric turbidity unit) is recommended for the purposes of this screening-level assessment (WPN 1999).

CONTAMINANTS

Contaminants generally fall into two subgroups, metals and organics, both of which can cause toxicity in aquatic organisms. Criteria for metals contaminants are expressed as acute and chronic values. The presence of metals can cause sublethal effects such as physiological stress and reduced growth and reproduction rates (chronic levels) or death (sublethal levels). These regulatory criteria are generally expressed as formulas, as they are based on the hardness of the water. For organic contaminants, any detection recoded above minimum detection levels is an indicator of impaired water quality (WPN 1999). To our knowledge, no contaminants data are available for the USFJDR watershed.

303(D)-LISTED WATERS

In 2002, the USFJDR mainstem and five tributaries were listed by the DEQ as water quality impaired (DEQ 2003a). Of these streams, four were listed for exceeding water temperature standards, two for impaired aquatic communities, and one for violation of dissolved oxygen standards (Table 8.2, Figure 8.1). In all cases, the Resident Fish and Aquatic Life beneficial use is not being fully supported by current water quality conditions, while the Salmonid Fish Spawning and Rearing beneficial use is also affected in streams that violate temperature and dissolved oxygen criteria.

TEMPERATURE VIOLATIONS

Four of the six currently listed water bodies, mainstem SFJDR, Flat Creek, Grasshopper Creek, and Sunflower Creek, are listed for violating state water temperature standards. The mainstem SFJDR is listed from the mouth into its headwaters, as determined by analysis of BLM, USFS, and DEQ data collected between 1985 and 1994. Sunflower Creek, from its mouth to headwaters, was listed following examination of BLM and USFS data collected in 1994. Flat and Grasshopper creeks were both added to the 303(d) list in 2002. Data in support of the listing were collected by DEQ in 2000, in association with their Regional Environmental Monitoring and Assessment Program (REMAP).

BIOLOGICAL CRITERIA VIOLATIONS

Between September 1990 and May 1992, macroinvertebrate communities were sampled in Corral and Utley Creeks by the DEQ. Corral Creek (at RM 2.0) had a bioassessment score of 16% of the reference community, while Utley creek (at RM 2.2 and 3.5) had bioassessment scores of 45% and 40% of the reference site. These data warranted listing of both creeks by DEQ in 1998.

DISSOLVED OXYGEN VIOLATIONS

Utley Creek was listed for violating the 11 mg/L concentration criterion established for salmonid spawning. At Utley Creek RM 0.9, 50% of samples failed to meet this criterion, while at RM 2.2, 80% failed to meet the criterion, as determined from DEQ data.

2002 DE-LISTED WATER BODIES

Venator and Lonesome Creeks occurred on DEQ's 1998 303(d) list for exceeding water temperature standards. Both creeks have been removed from the 2002 303(d) list because the data used to list these streams were collected during a drought year (1994). In the past, drought years were determined by a declaration of a drought emergency by the Governor's office. While a

Table 8.2. Streams on the 303(d) list occurring in the upper South Fork of the John Day River watershed, Oregon.

Water Body Name	Water Quality Parameter: Temperature	Biological Criteria	Dissolved Oxygen	Data Source(s)
S Fork John Day River	✓			BLM, DEQ,USFS
Corral Creek		✓		USFS
Flat Creek	✓			DEQ, USFS
Grasshopper Creek	✓			DEQ, USFS
Utley Creek		✓	✓	DEQ
Sunflower Creek	✓			BLM, USFS

drought emergency was declared only in certain counties during 1994, it was assumed this applied to the entire state. Due to this apparent flaw in determining drought conditions in various parts of the state, the 2002 303(d) list uses the "Drought Monitor," based on a number of indices, to determine whether a drought year actually occurred. If the data supporting a previous listing were collected only during a drought year, the stream is identified as a "potential concern," and remains as such until it can be shown that the water does not meet water quality standards during non-drought years.

ANALYSIS OF EXISTING DATA

Water quality data in addition to those listed above as supporting data for 303(d) listings in the watershed have been collected by a number of organizations and agencies for various purposes (Table 8.3). No single program has been established to monitor water quality throughout the watershed, and data collection efforts vary extensively among subwatersheds. Below, data collection efforts to date are summarized by parameter, and where sufficient data exist, the data are examined in relation to state water quality criteria.

TEMPERATURE

The few continuous temperature data gathered in recent years in the watershed indicate that water temperature standards are regularly exceeded between June and September. On the upper South Fork above Izee Falls, daily minimum, maximum, and mean water temperatures are measured by an U.S. Bureau of Reclamation's gauging station. Using DEQ criteria, seven-day rolling averages of maximum water temperatures over the past four years were calculated and graphed (Figure 8.2). The number and percent of exceedences over the 64 °F evaluation criterion also were calculated (Table 8.4). Both clearly show the tendency for waters to be impaired due to high temperatures during the low-flow summer months. Temperature data available for Sunflower Creek, one of the northernmost tributaries in the watershed, also show similar trends (Figure 8.3).

DISSOLVED OXYGEN

Corral and Utley Creeks have had measurements that fall below this criterion in the past. Between April 1991 and September 1993, the DEQ sampled Corral Creek at RM 0.2 (9 samples), RM 1.4 (8 samples), and RM 2.0 (5 samples). These sites had exceedences of 0, 0, and 40.0% respectively. Between October 1990 and September 1993, Utley Creek was sampled at RM 0.9 (8 samples), RM 2.2 (6 samples), and RM 3.5 (5 samples). These sites all had exceedences of 0, 16.7, and 20.0% respectively.

BIOLOGICAL CRITERIA

In addition to the sampling that was performed by DEQ on Utley and Corral creeks from 1990 to 1992, macroinvertebrate sampling also has been conducted by the BLM on the SFJDR between 1988 and 1991, by ABR, Inc. on the SFJDR and Lonesome Creek between 2000 and

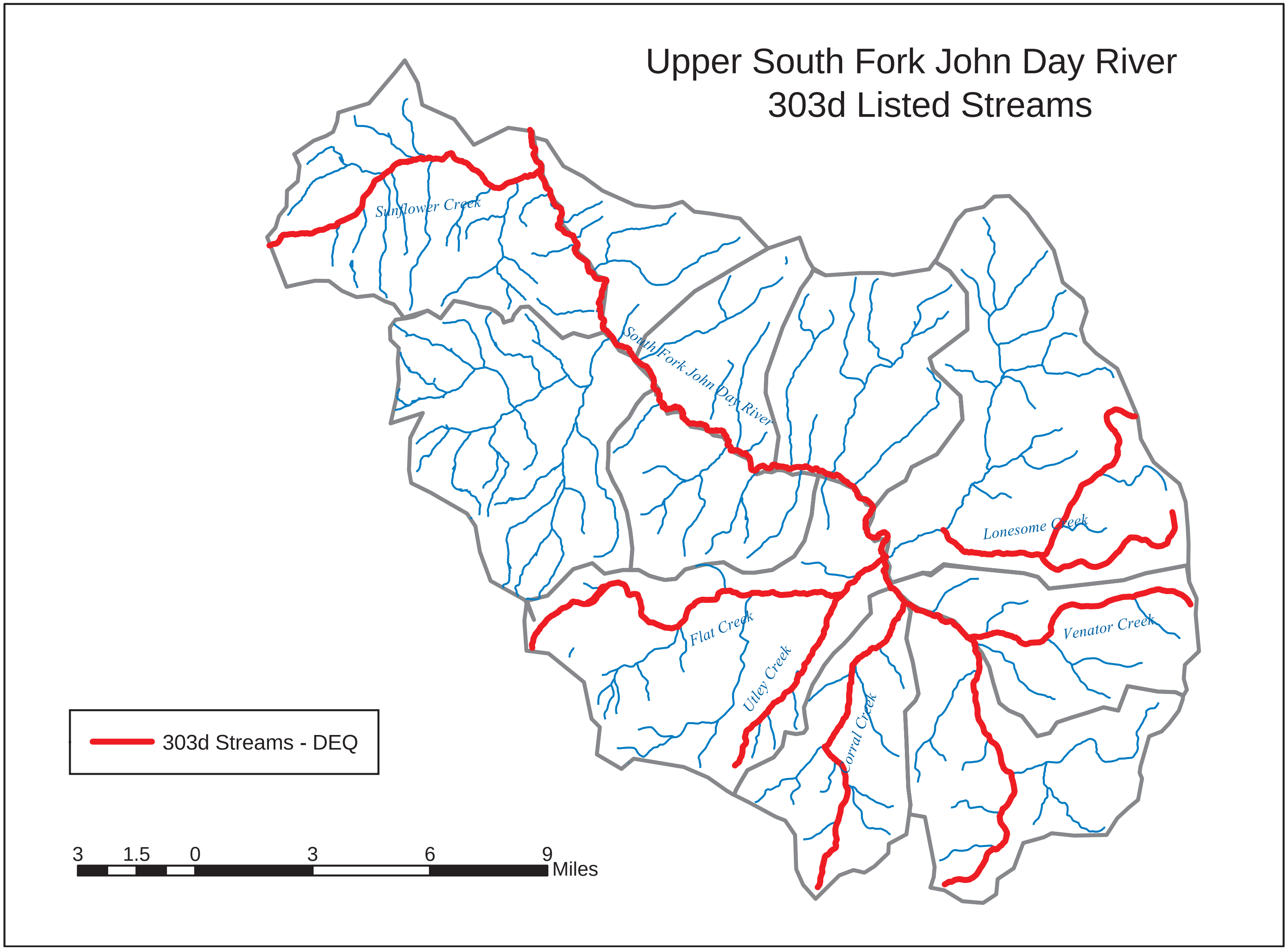

Figure 8.1 Water quality limited streams in the upper South Fork of the John Day River basin, Oregon, listed on the 2002 303(d) list.

Table 8.3. Known water quality assessment and monitoring efforts, including parameters for which data were collected, in the upper South Fork of the John Day River watershed, Oregon.

				Water Quality Parameter							
Stream	**Site**	**Dates**	**Source**	**TEMP**	**DO**	**pH**	**TP**	**TN**	**TUR**	**BAC**	**CON**
USFJD	RM 35.5	1995, May–Sep	BLM	✓		✓	✓	✓		✓	
USFJD	RM 35.5	1996, Mar–May, Dec	BLM			✓					
USFJD	RM 35.5	1997, Apr–Jun	BLM			✓					
USFJD	Above Izee Falls	1995 to Current*	USBR	✓							
USFJD	10 monitoring sites	2000, Aug	ABR	✓	✓	✓	✓				
USFJD	10 monitoring sites	2001, Jul–Aug	ABR	✓	✓	✓	✓				
USFJD	10 monitoring sites	2002	ABR	✓	✓						
Corral	RM 0.2, 1.4, 2.0	1991, Apr, Jun, Oct	DEQ	✓	✓	✓	✓	✓	✓		
Corral	RM 0.2, 1.4, 2.1	1992, May, Oct	DEQ	✓	✓	✓	✓	✓	✓		
Corral	RM 0.2, 1.4, 2.2	1993, Jun, Sep	DEQ	✓	✓	✓	✓	✓	✓		
Grasshopper		2000, Aug	DEQ	✓	✓		✓	✓	✓		
Grasshopper	RM 0.0	1993	USFS								
Flat		2000, Sep	DEQ	✓	✓		✓	✓	✓		
Flat		1994	USFS								
Lonesome	ABR site	2000-2001, Aug	ABR	✓	✓	✓	✓				
Lonesome	FS RD 3180	1994	USFS	✓							

Table 8.3. (Continued).

				Water Quality Parameter							
Stream	**Site**	**Dates**	**Source**	**TEM**	**DO**	**pH**	**TP**	**TN**	**TUR**	**BAC**	**CON**
Murray	Above RD 58	2001–2002, Jun-Oct	USFS	✓							
Pine		2001, Jul	DEQ			✓	✓	✓	✓		
Porcupine		2002, Jun-Oct	USFS	✓							
Sunflower	RM 0.1	1995, May-Sep	BLM	✓		✓	✓	✓	✓	✓	
Sunflower	FS boundary	1996–1997, May–Sep*	BLM								
Sunflower	FS boundary	1999–2002, Jun–Oct*	USFS	✓							
Utley	RM 0.9, 2.2, 3.5	1990, Oct	DEQ	✓	✓	✓	✓	✓	✓		
Utley	RM 0.9, 2.2, 3.6	1991, Jun, Oct	DEQ	✓	✓	✓	✓	✓	✓		
Utley	RM 0.9, 2.2, 3.7	1992, May, Oct	DEQ	✓	✓	✓	✓	✓	✓		
Utley	RM 0.9, 2.2, 3.8	1993, Jun, Sep	DEQ	✓	✓	✓	✓	✓	✓		
Venator	FS RD 3150	1994	USFS	✓							
Wildcat	Below Rd 828	1997, May–Jul	USFS	✓							
Wildcat	Below Rd 829	1998 and 2001, Jun–Oct	USFS	✓							

* Daily sampling during this time period

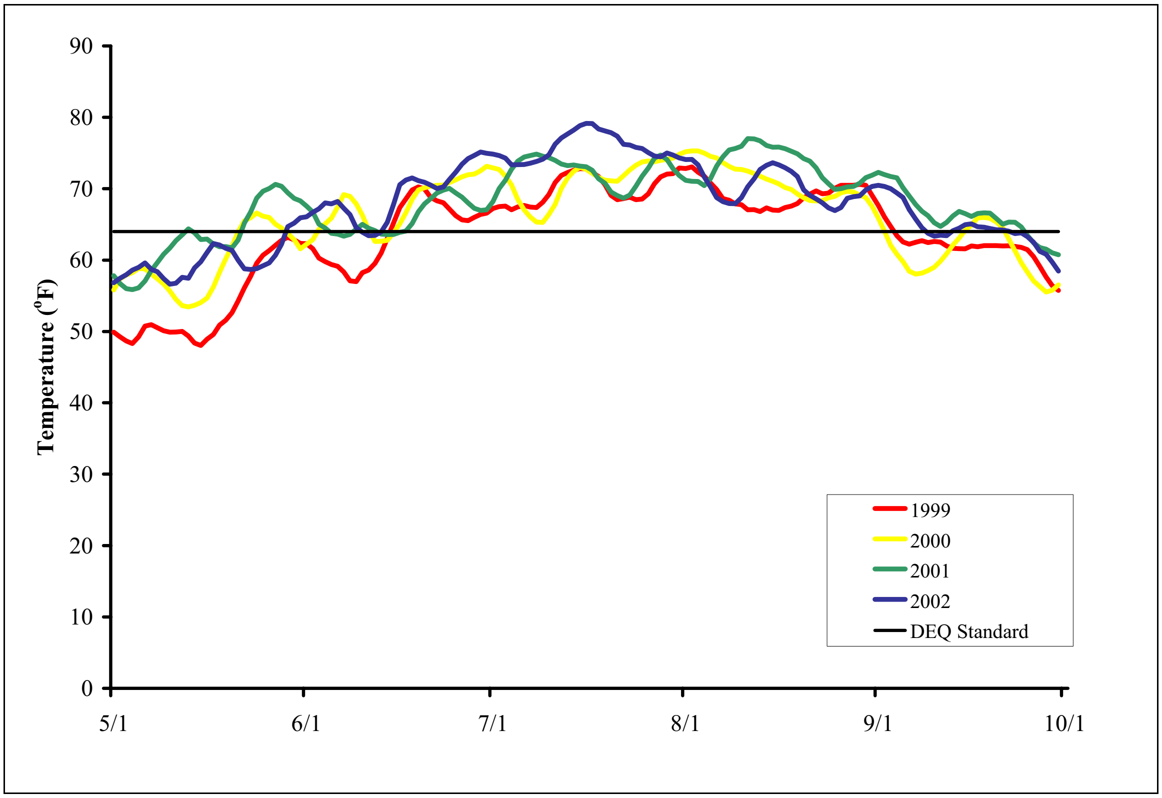

Figure 8.2 Rolling seven-day average of maximum water temperatures from the upper South Fork of the John Day River, Oregon, above Izee Falls, based on the 64 °F evaluation criterion.

2002, and by DEQ in Pine Creek in 2001 and in Grasshopper and Flat Creeks in 2000.

BLM monitored macroinvertebrate community conditions at four stations in the SFJDR between 1988 and 1991, and assessed macroinvertebrate communities in Indian and Flat creeks in 1988. Community conditions were summarized using a Biotic Community Index (BCI), which numerically scores the ecological integrity, then assigns a rating of excellent, good, fair, or poor, based on the index. Both Indian and Flat Creek Macroinvertebrate communities were rated as being in "good" condition (Table 8.5). Only stations 1 and 3 occur in the USFJDR watershed (Figure 8.4). Station 1, occurring at RM 28.1, supported macroinvertebrate communities in fair-to-good condition over the four-year monitoring period. Station 3, occurring at RM 33.7, supported macroinvertebrate communities in poor-to-fair condition during the monitoring period (Mangum 1991). Sedimentation often was cited as one of the limiting factors to macroinvertebrate communities in these monitored reaches, and "management" to improve instream and riparian habitat and instream water quality was recommended for each reach (Mangum 1991). Although the data are now more than ten years old, they likely still have some relevance in characterizing impairment to aquatic communities in the watershed.

More recent data, including those collected by ABR, Inc. for the Grant SWCD, also point towards relatively significant impairment to biological communities in the mainstem of the USFJDR, particularly in privately-owned lowland areas that have historically been intensively managed for grazing and hay production. ABR data collected in 2000 and 2001 indicate that macroinvertebrate communities consistently scored lower in reaches on private land (Figure 8.5, reaches 1 through 6) than on public lands occurring above and below these reaches. Macroinvertebrate community conditions were correlated with both measures of riparian zone and stream substrate conditions, indicating that these differences in community

Table 8.4. Mean, minimum, and maximum monthly water temperatures with number and percent of measurements exceeding the 64 oF standard from the upper South Fork John Day River, Oregon, above Izee Falls (USBOR 2003).

			Water Temperature (°F)				
Year	**Month**	**Number Days**	**Minimum**	**Maximum**	**Mean**	**Number >64°F**	**% Exceedence**
1999	May	31	45.17	64.98	54.80	0	0
	June	30	53.42	71.27	64.45	16	53.3
	July	31	62.31	74.89	70.34	31	100
	August	31	60.81	73.79	68.62	31	100
	September	30	51.62	64.98	60.59	3	10.0
2000	May	31	49.65	69.93	60.06	7	22.6
	June	30	56.49	75.12	68.99	24	80.0
	July	31	59.64	77.32	71.38	31	100
	August	31	63.88	75.67	70.24	31	100
	September	30	53.03	67.89	60.18	9	30.0
2001	May	31	53.27	73.08	64.23	11	35.5
	June	30	57.20	73.63	66.12	22	73.3
	July	31	65.45	76.38	72.39	31	100
	August	31	66.87	78.50	73.54	31	100
	September	30	58.85	71.43	65.02	24	80.0
2002	May	31	52.32	72.45	60.89	3	9.7
	June	30	54.21	77.00	69.76	26	86.7
	July	31	70.09	80.71	75.79	31	100
	August	31	61.52	74.34	69.97	31	100
	September	30	54.52	70.09	63.20	18	60.0

conditions among sites were related to degraded physical conditions (Cole 2002).

BACTERIA

In August 1995, BLM sampled various stretches of the South Fork John Day and its tributaries for fecal coliform. Two sites in the upper watershed were included in this study, at Sunflower Creek and at RM 35.5 on the South Fork. Fecal coliform measurements were 5 and 91 MPN/100 ml, respectively (BLM data). The state standard for fecal coliform is 409 MPN/100 ml. The most probable number of organisms (MPN) is an estimate of the mean density of fecal coliform in the samples.

OTHER PARAMETERS

All pH data available for the upper South Fork of the John Day River watershed and its tributaries are within the acceptable screeening range of 6.5 to 8.5 (ABR, Inc.; BLM; and DEQ data).

All total nitrate data from the watershed fall below the evaluation criterion, while total phosphorus data from the upper South Fork, Corral, Sunflower, and Utley creeks have exceeded the phosphorus criterion. BLM sampled the upper South Fork at RM 35.5 (13 samples) and Sunflower Creek at RM 0.1 (14 samples) during May through September 1995; these streams had exceedences of 30.8 and 7.1%, respectively. Between April 1991 and September 1993, the DEQ sampled Corral Creek at RM 0.2 (10 samples), RM 1.4 (8 samples), and RM 2.0 (6 samples). These sites had exceedences of 70.0, 87.5, and 50.0%, respectively. Between October 1990 and September 1993, Utley Creek samples from RM 0.9 (8 samples), RM 2.2 (4 samples) and RM 3.5 (4 samples) all had 25% exceedences.

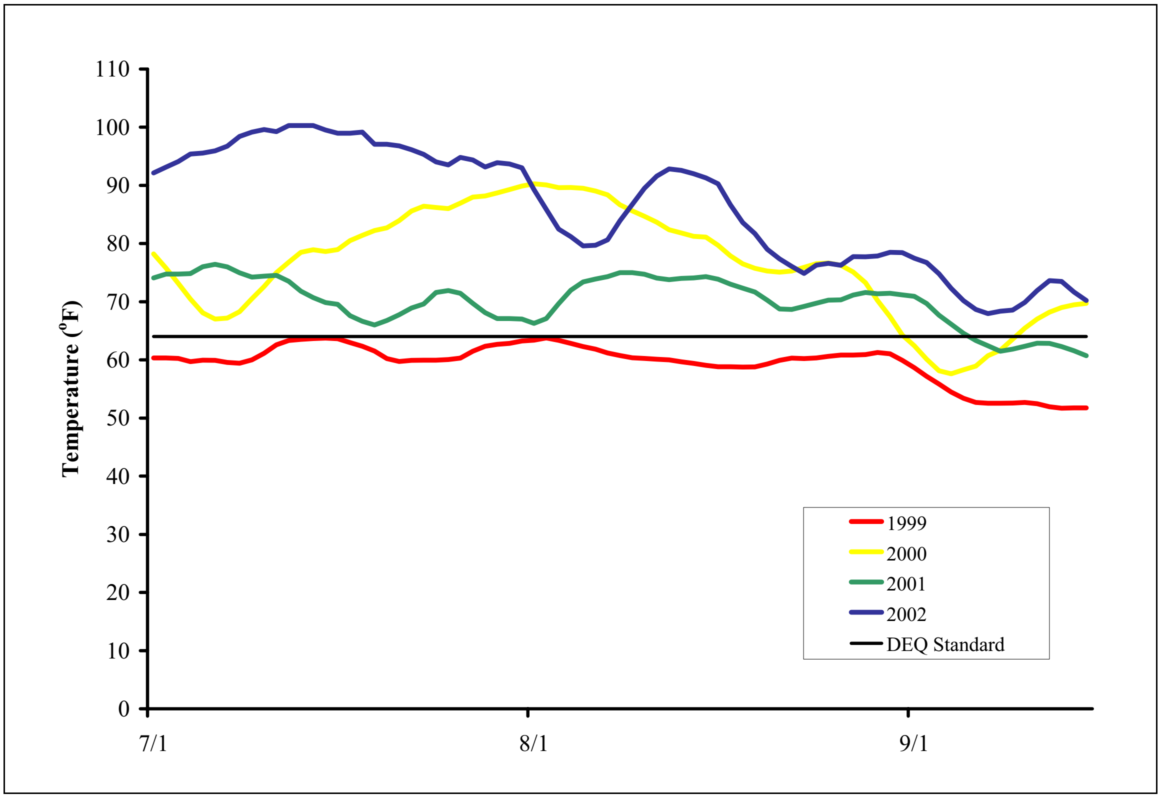

Figure 8.3 Rolling seven-day average of maximum water temperatures from upper Sunflower Creek, Oregon, based on the 64 °F evaluation criterion. Temperatures exceeding 90 degrees in July, 2002 are likely the result of recording air temperatures, rather than water temperatures due to low stream flows.

All turbidity data available for the upper South Fork and its tributaries are well below the 50 NTU evaluation criterion (ABR, Inc.; BLM; and DEQ data). Of 47 samples, a minimum value of 0.21 NTU, a maximum value of 10 NTU, and a mean of 1.50 NTU were calculated from the upper South Fork (16 samples), Sunflower Creek (14), Corral Creek (11), and Utley Creek (11). Because these samples were all collected during low-flow conditions, they are of little use in determining whether land uses in the USFJDR watershed are generating elevated levels of suspended sediment that are impairing aquatic life. Other data, such as measures of stream substrate and embeddedness, suggest that heavy sediment loads are seasonally transported through the watershed; much of this likely occurs as suspended loads.

CURRENT WATER QUALITY MONITORING EFFORTS

EPA ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM

Under the EPA-led Environmental Monitoring and Assessment Program, DEQ is collecting data to determine the current condition of surface waters in the John Day and Deschutes River basins. Between 2000 and 2003, DEQ is assessing the condition of randomly selected river and stream reaches throughout the John Day River basin. In 2000, these efforts included sampling in Grasshopper and Flat creeks, while in 2001 these efforts included sampling in Pine Creek.

DEQ AMBIENT WATER QUALITY MONITORING

The Oregon DEQ has established an Ambient Water Quality Monitoring program to monitor water quality and assess long-term trends statewide. This network covers all major basins and includes 142 monitoring sites on streams and

Table 8.5. Macroinvertebrate community conditions reported by the Bureau of Land Management in the South Fork of the John Day River watershed, Oregon, between 1988 and 1991. Only mainstem stations numbers 1 and 3 occur in the upper watershed (source: Mangum 1991)

		Year			
Station	**River Mile**	**1988**	**1989**	**1990**	**1991**
Indian Creek		Good			
Flat Creek		Good			
SFJDR 1	28.1	Good	Good	Fair	Good
SFJDR 2	9.2	Poor	Fair	Fair	Fair
SFJDR 3	33.7	Fair	Poor	Poor	Fair
SFJDR 4	17.2	Fair	Fair	Poor	Poor

rivers throughout the state. Generally, sites are located on larger river sections in the lower portions of the watershed to better assess cumulative basin effects. The state is divided into 18 monitoring areas, including the John Day basin. As of 1998, five ambient monitoring stations were located in the basin. While none are located in the upper South Fork watershed, two are located near the confluence of the South Fork with the mainstem of the John Day River. Near Dayville, these stations are located above and below the confluence to monitor the cumulative effects of the waters from the South Fork basin.

SWCD AND ABR RESTORATION EFFECTIVENESS MONITORING

Since 2000, Grant SWCD has contracted ABR, Inc. to perform biological, physical, and water quality monitoring in nine river and stream reaches occurring above Izee Falls. Eight of these reaches occur on the mainstem SFJDR from above the Malheur NF boundary to immediately above Izee Falls. Six of these locations occur on private lands currently undergoing restoration; three occur on federal lands. Monitoring occurs only once a year and instantaneous measurements are made only once a year at each site.

CONCLUSIONS AND RECOMMENDATIONS

No water quality data exist for a number of subwatersheds occurring in the upper South Fork of the John Day River watershed, and few data exist for most other subwatersheds. Continuous temperature monitoring by several agencies in the 1980s and 1990s has provided useful water temperature data, but data for other parameters are far less comprehensive.

- Existing data and 303(d) listings suggest that water temperature and dissolved oxygen present the most widespread water quality problems in the basin. Other parameters of concern include nutrient concentrations and bacteria, but a lack of data preclude determining the extent of problems associated with these other parameters in the watershed.
- To better understand and improve the water quality of the USFJDR watershed, monitoring efforts by local agencies and watershed groups should be continued and expanded. We suggest developing a comprehensive and cooperative water quality monitoring plan for the basin that would include selection of regular monitoring sites and continuous or frequent monitoring of selected parameters, including water temperatures and dissolved oxygen. Monitoring sites should be established that would both allow determination of overall trends in water quality, as well as the long-term effects of restoration efforts.

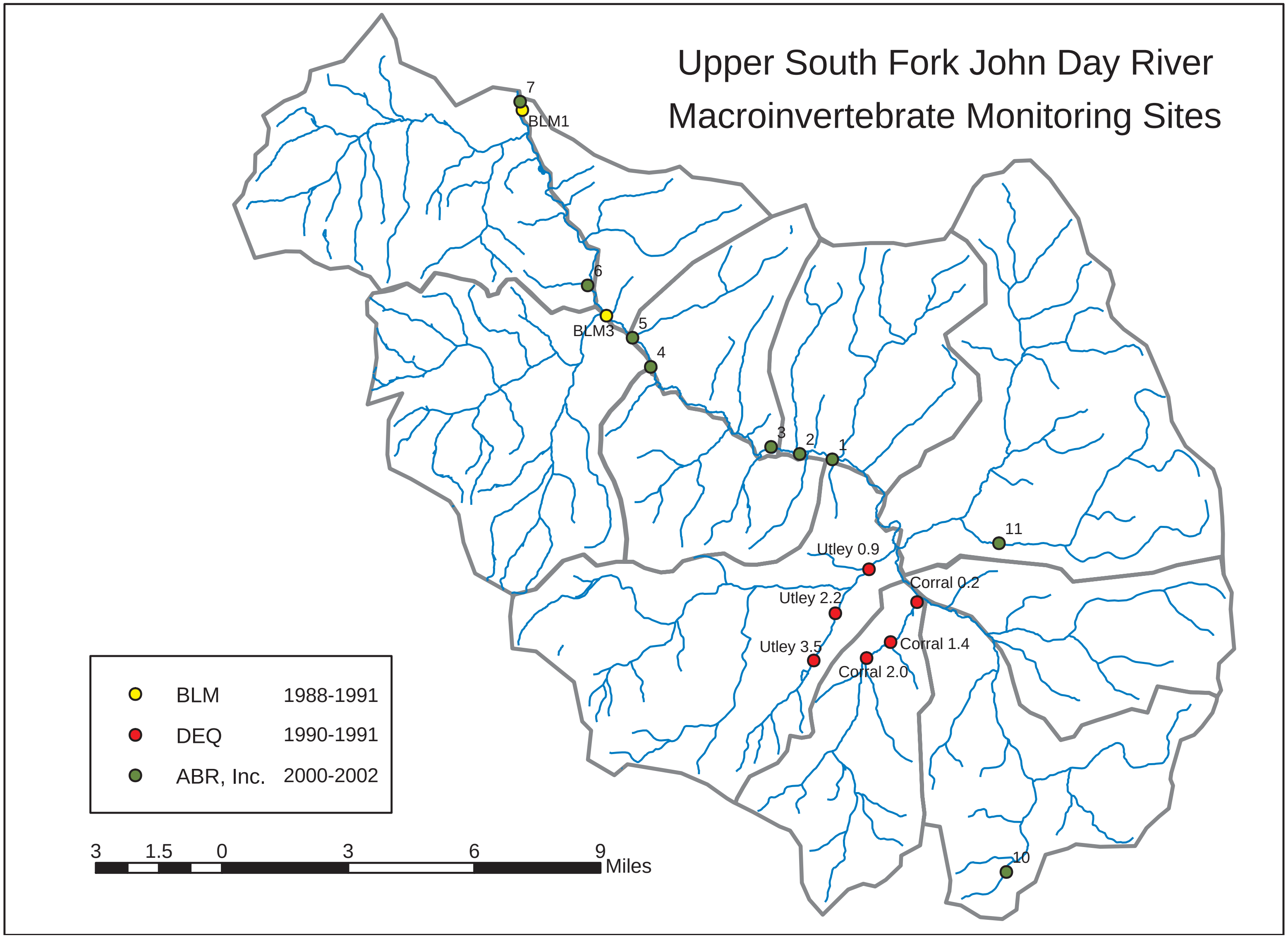

Figure 8.4 Sampling locations for ABR, BLM, and DEQ macroinvertebrate monitoring projects occurring in the upper South Fork of the John Day River watershed.

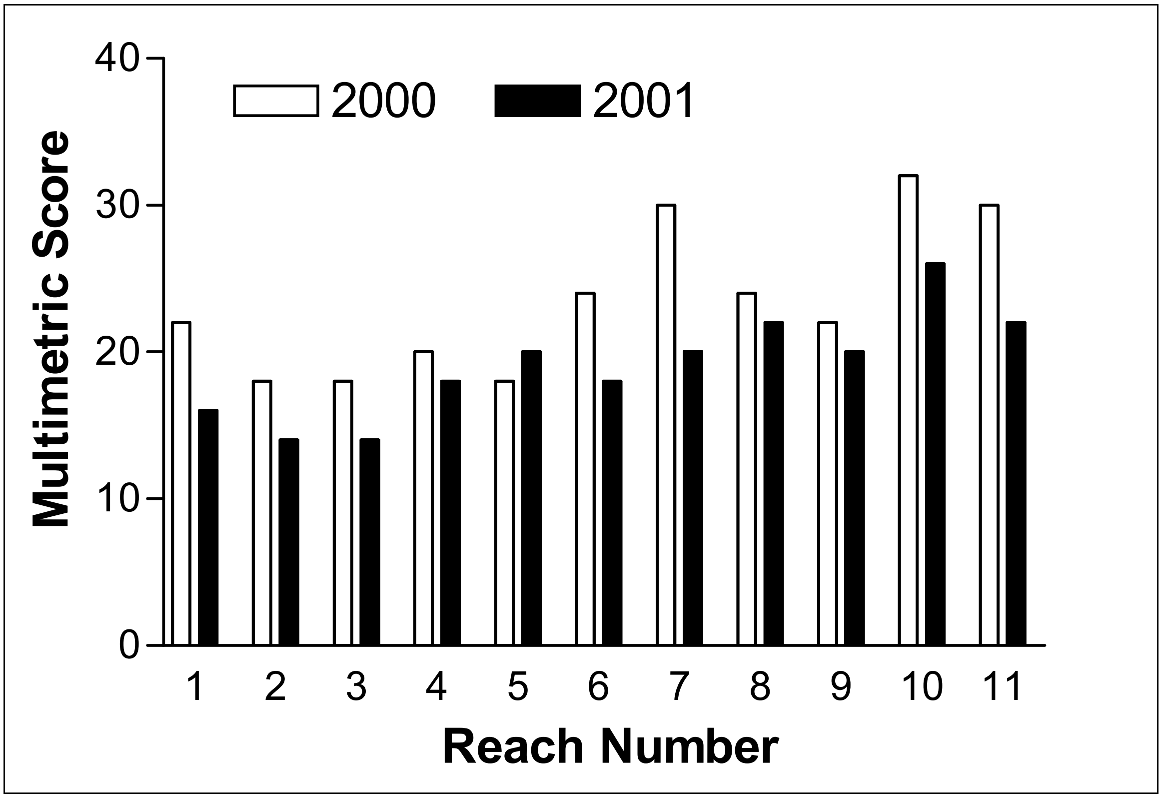

Figure 8.5 Multimetric scores of macroinvertebrate communities sampled in 2000 and 2001 from 11 study reaches in the upper South Fork of the John Day River watershed, Oregon (Cole 2002).

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CHAPTER 9: FISH AND FISH HABITAT

INTRODUCTION

Because salmonids are regarded as among the most sensitive aquatic species, information related to their abundance and distribution can help identify what portions of the watershed are most degraded with respect to habitat and water quality and provide valuable insight into the relative condition of different areas within a watershed. Additionally, assessment of fish habitat can help identify what factors are most limiting to fish populations in the watershed and can assist in identifying restoration priority areas and project types. Fish habitat quality in the upper South Fork of the John Day River watershed and its tributaries has been degraded by a combination of grazing and timber management practices, roads and road crossings, and irrigation diversions. Fish production in the upper watershed is limited by the combined effects of water quality and quantity, including flow reduction or loss, elevated water temperatures, and sedimentation. Arguably, the most significant factor affecting fish populations in the upper watershed is water quantity, as it in turn affects water quality, habitat quality and quantity, and fish passage, all of which are also limiting factors to fish production in the upper South Fork watershed.

In this chapter, existing fish and fish habitat data from the USFJDR watershed are examined to assess the current condition of these resources Little information regarding fish community composition or species abundance exists for the SFDJR above Izee Falls. As a first step towards better understanding the current distribution and abundance of fish in the upper watershed, we have assembled any known fish survey data or information (Table 9.1).

SALMONIDS - REDBAND TROUT

The upper South Fork of the John Day River watershed supports only resident fish above Izee Falls at river mile 27.5 (BLM 2000a). The Columbia basin redband trout (*Onchorhynchus mykiss gairdneri*) is the only salmonid species and the only species of concern known to occur above the falls. ODFW describes the life history of the inland redband trout above Izee Falls as a resident type, indicating that no use by anadromous steelhead occurs above the falls (ODFW 1995). All species groups of inland redband trout are currently classified as "vulnerable" by the ODFW (ODFW 1997). Vulnerable species are defined by ODFW as those species "…for which listing as threatened or endangered is not believed to be imminent and can be avoided through continued and expanded use of adequate protective measures and monitoring" (ODFW 1997). The subspecies was petitioned for listing throughout its range in 1995, but the USFWS determined that listing was unwarranted in the same year; the inland redband trout currently remains unlisted by the federal government. In 2000, the USFWS, in its decision not to list the Great Basin redband trout, indicated that it was continuing to gather information on the "distribution and abundance of native rainbow/redband trout found east of the crest of the Cascade Mountains in the Columbia/Snake, Klamath, and Sacramento River systems" (USFWS 2000), in an effort to better understand the status of the subspecies across its range.

The redband trout/steelhead population in the South Fork of the John Day River is considered a unique group, as determined by genetic analysis and ecosystem comparisons within the John Day Basin (ODFW 1995). ODFW provides further information on the uniqueness of the South Fork John Day redband trout in their 1995 Biennial Report on the Status of Wild Fish in Oregon:

> "There is a barrier falls, Izee Falls, in the upper South Fork. However, the uniqueness of the South Fork group appears to extend below this barrier, therefore the boundary is drawn at the mouth of the South Fork. The uniqueness of the South Fork *O. mykiss* may result from two factors. First, the South Fork environment comprises a desert ecotype that is unique when compared to the rest of the John Day Basin. This feature may produce unique selection pressures on the South Fork populations compared to the rest of the John Day. Second, Bisson and Bond (1971) detected unique related species assemblages in the South Fork John Day and in the mid-Silvies River in the Malheur Lakes Basin that suggest a

Table 9.1. List of known data and information pertaining to fish populations and communities in the upper South Fork of the John Day River, Oregon.

Fish Community Composition/Relative Abundance/Population Estimates:

Bisson, P. A., and C. E. Bond. 1971. Origin and distribution of the fishes of Harney Basin, Oregon. Copeia 2: 268–281.

2000 REMAP fish survey data from Grasshopper Creek at mile 4.2 from the Oregon Department of Environmental Quality, Portland, Oregon

1994 Hankin & Reeves survey of Tamarack Creek, USFS Blue Mountain Ranger District, Malheur National Forest, John Day, Oregon.

1990 ODFW fish population surveys on Utley Creek

Warm Springs Tribe snorkel survey data collected and provided by Shaun Robertson.

Fish Distribution:

End-of-Fish-Use Survey Maps from the Department of Forestry, John Day, Oregon

GIS layer of fish bearing streams in the Malheur National Forest from the USFS, Malheur National Forest, John Day, Oregon.

recent (within the last 10,000 years) stream exchange to have transferred fish in both directions. The uniqueness of the redband trout in this group may be partly explained by an historical event that naturally introduced novel genetic variation into the South Fork John Day from the O. mykiss population in the Silvies River."

POPULATION STATUS AND MANAGEMENT

Because anadromous species, including steelhead and chinook salmon, occur below Izee Falls, fish surveys and other management activities have occurred primarily in the lower watershed below the Falls. Consequently, little is known about the current status of redband trout in the upper watershed other than their approximate distribution, based on U.S. Forest Service and OR Department of Forestry (ODF) information. Very little information exists regarding population status or trends of John Day Basin redband trout (ODFW 1995). In the upper South Fork of the John Day River watershed, very few surveys have been performed to assess the distribution or abundance of the species in the watershed. Surveys performed by various agencies for differing purposes have been limited to a few stream reaches scattered across the watershed. Length frequency data from ODFW surveys of Utley Creek in 1990 indicated that the stream supported a stable population of redband trout, but their abundance was low relative to that of speckled dace (ODFW 1990). No known stocking of redband trout or other fish species by public agencies has occurred above Izee Falls (ODFW, personnel communication). Some private stocking of rainbow trout is known to have occurred in the past on a private reservoir on Donivan Creek and on the Officer Reservoir on Utley Creek (Phil St. Clair, pers. comm.).

DISTRIBUTION BY SUBWATERSHED

Information on redband trout presence and distribution within each subwatershed was obtained primarily from ODF stream survey maps and from redband trout distribution GIS layers obtained from the Malheur NF. ABR field visits and observations from local landowners were used to support these other data sources. In many cases, ODF end-of-fish-use points did not correspond well with distribution data obtained from the NF (Figure 9.1). Under different circumstances, each source of data sometimes seemed to be suspect.

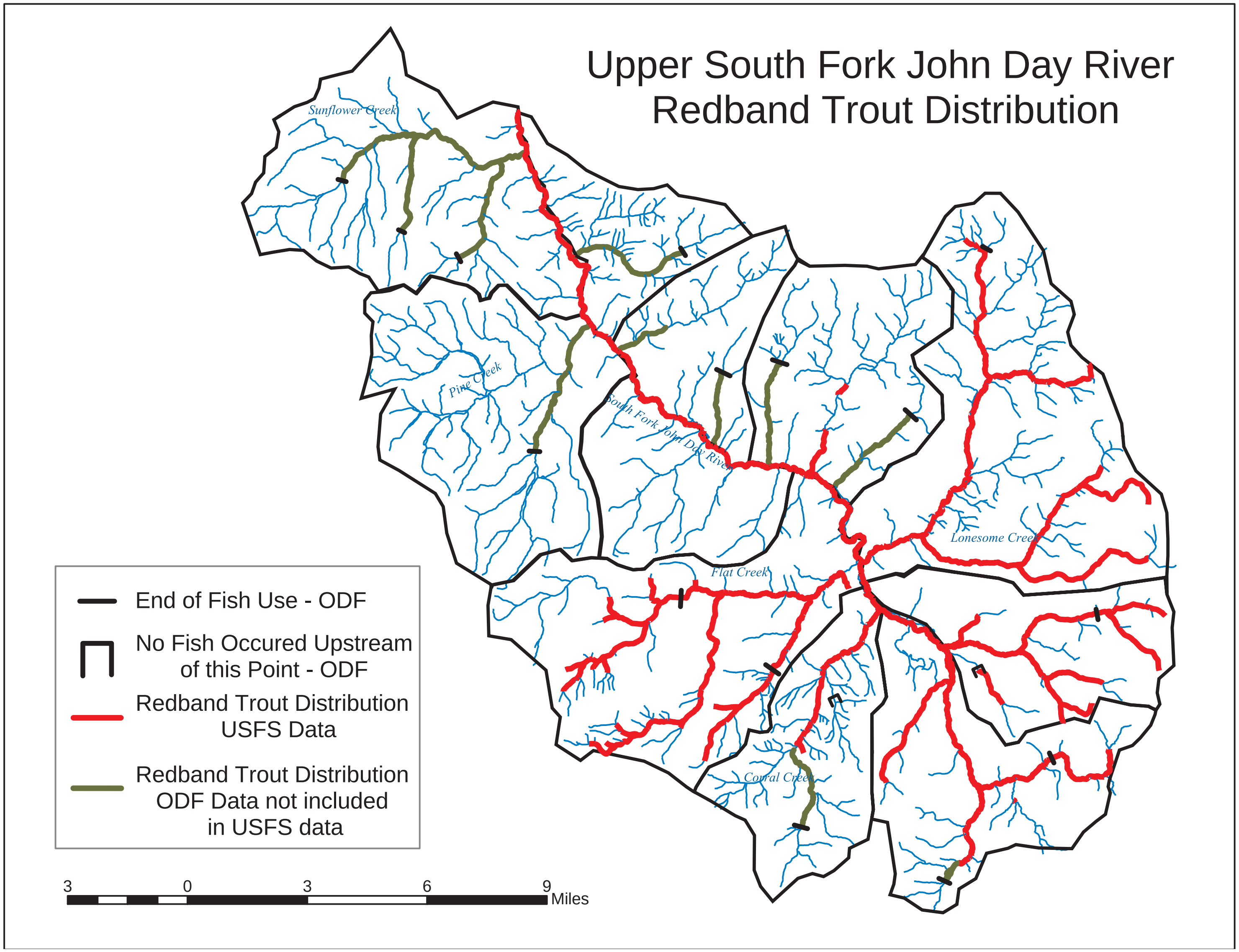

Figure 9.1 Redband trout distribution in the upper South Fork of the John Day River, Oregon, as indicated by Malheur National Forest GIS data and Oregon Department of Forestry fish survey data.

For example, NF GIS data sometimes indicate that redband trout distribution occurs into the extreme upper portions of many of the subwatersheds; even into temporary first- or zero-order streams that would clearly not support fish. In other cases, ODF end-of-fish-use marks sometimes occurred miles below areas currently known to be occupied by fish. Because fish distribution may shift up- or downstream over time in relation to a number of factors, we are not suggesting that these data were erroneous when collected; they simply may be outdated. We strongly advise that the results be used only as approximations of fish distribution until more current and comprehensive data are collected.

Sunflower Creek: Redband trout were found by ODF fish-use surveys to be present throughout much of Wildcat Creek, Cougar Creek, and Sunflower Creek to approximately 1 mile upstream of its confluence with Columbus Creek. Murray Creek, Columbus Creek, and the tributary entering Sunflower Creek almost immediately across the Columbus were all classified as non-fish bearing streams following ODF fish use surveys.

Indian Creek: End of use by redband trout is shown to occur on ODF maps at the confluence of Indian Creek with Frenchy Spring.

Pine Creek: ODF fish survey maps indicate that redband trout occur approximately 2 miles up into Brisbois Creek. Fish were observed by ABR, Inc. biologists above the second road crossing on Pine Creek above the Keerins Ranch, and in Brisbois Creek in August 2000. Extent of use by redband trout through upper Pine Creek and its tributaries is currently unknown.

Flat Creek: Malheur NF GIS data layers indicate that Flat Creek is fish bearing to above its confluence with Spoon Creek. Major Flat Creek tributaries, including Spoon Creek, Alder Creek, and Utley Creek, are classified as fish bearing throughout most of their lengths. However, ODF fish survey maps indicate that fish use ends on Flat Creek approximately 1 mile above its confluence with Alder Creek, several miles lower than the Malheur NF distribution map indicates.

Lewis Creek: Malheur NF GIS layers and ODF fish survey maps indicate that redband trout occur throughout Lewis Creek into its headwaters, including Tamarack Creek and Officer Creek, as well as throughout Lonesome and Grasshopper creeks up into their headwaters.

Corral Creek: According to Malheur NF GIS layers, Corral Creek is fish bearing up to just below the confluence with Rail Creek. ODF fish survey maps, however, indicate that use by redband trout occurred well up into the Corral Creek headwaters, approximately 2 miles above the confluence with Rail Creek.

Utley Creek: ODFW surveys in association with restoration work occurring on Utley Creek sampled redband trout from two 100-m stream reaches within the restoration project area in the lower creek on private land. ODF fish survey maps indicate that fish uses ends at the dam below the Officer Reservoir; Malheur NF maps indicate that redband trout distribution occurs well into the headwaters.

Venator Creek: USFS GIS data indicate that redband trout occur well into the Venator Creek headwaters and in Alsup Creek. To the contrary, ODF fish use surveys indicate that redband trout were not present in a surveyed portion of Alsup Creek that occurs within the reach highlighted by the USFS as supporting redband trout.

Bear Creek/Mainstem SF Headwaters: USFS GIS data indicate that Bear Creek supports redband trout throughout its length up to Hole-In-The-Ground Spring however, ODF survey maps indicate that end of fish use occurs on Bear Creek only up to approximately ½ mile above Cougar Creek. During ABR, Inc. field reconnaissance trips, redband trout were visually observed in Bear Creek at the NF road crossing immediately below Hole-In-The-Ground Spring, indicating that fish are supported at least this far up in the system. The impassable culvert at this road crossing is likely currently preventing fish use above this point.

According to ODF survey maps, fish use ends in the mainstem of the South Fork approximately 1 mile upstream of the FR 47 road crossing in T19S, R29E, section 18. However, USFS GIS data indicate that the mainstem is fish bearing only up to the road crossing. During ABR field surveys in August, this road crossing was found to be impassable to fish. An adult redband trout was observed in the outlet pool below the culvert; the stream bed above the road crossing was completely dry for the few hundred yards that it was walked by the ABR assessment team.

Donivan Creek: USFS GIS data indicate that redband trout occur throughout most of the length of Donivan Creek. The first road crossing along lower Donivan Creek may not currently allow upstream passage of small resident fish (see fish barrier section below).

Rosebud/Poison/Antelope creeks: Redband trout have been observed in both Rosebud and Poison creeks on the St. Clair property (Phil St. Clair, 2002, personal communication). Redband trout have been observed by Phil St. Clair close to the NF boundary on Rosebud Creek and as far upstream as about ½ mile above the county road crossing on Poison Creek. Redband trout have been observed in lower Antelope Creek within the past decade (Phil St. Clair, 2002, personal communication).

Morgan/Dry Soda creeks: Redband trout have been observed in lower Morgan Creek. The extent of their upstream distribution is unknown (Phil St. Clair, 2002, personal communication).

Sheep and Buck Creeks: Historic use of Sheep Creek, an intermittent tributary to the SFJDR is unknown. A culverted road crossing would likely prevent any fish from entering the stream. Trout were once observed in lower Buck Creek, another seasonal stream, but extended periods with no water in the channel preclude the use of this stream by fish (Phil St. Clair, 2002, personal communication).

FISH COMMUNITIES

Little information regarding fish communities exists for the upper South Fork of the John Day River or its tributaries. Non-game species known to occur above Izee Falls include mountain sucker, bridge lip sucker, redside shiner, and speckled dace (BOR 1994). ODFW surveys of Utley Creek in 1990 reported sampling coarse-scale (largescale) suckers (Table 9.2). The few surveys conducted indicate that where water quality and physical conditions permit, less sensitive cyprinid species have become the dominant component of the fish communities. Although these species have occupied the watershed for millennia, their abundance is undoubtedly increasing, as redband trout populations have almost certainly decreased and their distribution contracted in response to degraded water quality and physical habitat. Generally, upper reaches of perennial streams in the watershed that are still well shaded and provide suitable habitat for cold-water species tend to support only redband trout. For example, 1994 USFS surveys of Tamarack Creek, a perennial tributary to Lewis Creek, sampled only redband trout. Likewise, 2000 DEQ surveys of Grasshopper Creek found only redband trout in this forested tributary to Lonesome Creek (DEQ 2002). In contrast, 1990 ODFW surveys of heavily degraded lower Utley Creek found heavy dominance of the fish community by speckled dace. The resulting ODFW report states "…species composition at both sites indicates a high number of dace relative to rainbow, a relationship that indicates water quality problems in this stream" (ODFW 1990).

In recent years, Shaun Robertson, Fisheries Biologist with the Warm Springs Tribes, has performed snorkel surveys to estimate the relative abundance of fish species occurring in the mainstem of the South Fork of the John Day River on the St. Clair ranch in Izee. Survey data indicate that speckled dace and redsided shiners are the most abundant species occurring in the mainstem South Fork of the John Day River in this vicinity (Figure 9.2). Redband trout and sucker species are also common, but their abundance is significantly lower than that of dace and shiners. The numeric dominance of these communities by dace and shiners indicates that current conditions favor species more tolerant of warm water temperatures and other types of water quality impairment. Improved instream conditions resulting from restoration projects and improved land management will favor redband trout and should increase both the distribution and relative abundance of this species.

FISH HABITAT

Although physical habitat data from the USFJDR watershed are scarce, and no long-term monitoring of either resident redband trout populations or their habitat has occurred, habitat

Table 9.2. Fish species known to occur in the upper South Fork of the John Day River watershed, Oregon.

Common Name	Scientific Name	Reference
Redband trout	*Onchorhynchus mykiss giardneri*	Numerous
Mountain sucker	*Catostomus platyrhynchus*	Bisson and Bond 1971
Bridge lip sucker	*Catostomus columbianus*	Bisson and Bond 1971
Redside shiner	*Richardsonius balteatus*	Bisson and Bond 1971
Speckled dace	*Rhinichthys osculus*	Bisson and Bond 1971
Largescale sucker	*Catostomus macrocheilus*	ODFW 1990

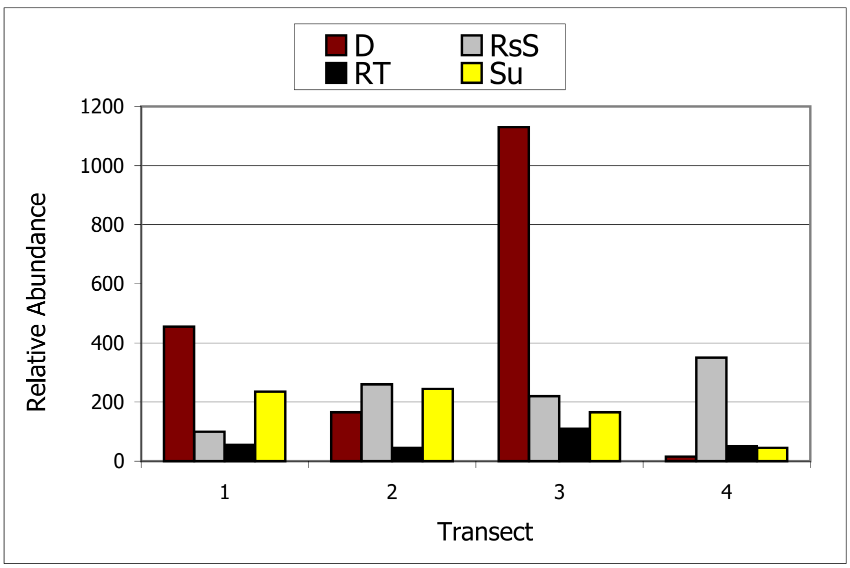

Figure 9.2 Relative abundance of dace species (d), redsided shiner (RsS), redband trout (RT), and suckers (Su) in the upper South Fork of the John Day River, Oregon, near Izee, as determined by snorkel surveys (source: Shaun Robertson, Warm Springs Tribes).

degradation in the upper watershed has clearly occurred. Throughout much of the watershed habitat loss or degradation has resulted from the following causes:

- Loss of riparian vegetation
- Changes in water flow (volume, as well as by timing and levels of peak flows)
- Barriers to fish migration
- Stream channelization and incision
- Unscreened irrigation diversions
- Push up dam construction
- Increased sedimentation

Information characterizing instream physical habitat in the watershed, provided by USFS, ABR, Inc., and DEQ (Table 9.3), is summarized by stream below. OWEB Watershed Assessment protocols include comparing available data to ODFW benchmarks to assess physical conditions. Because various protocols were used in collecting these data, assessing conditions in the watershed in relation to ODFW benchmarks often was not feasible. As an alternative approach, we describe, summarize, and quantify what is known of physical conditions of stream reaches that have

Table 9.3. List of known data and information pertaining to fish habitat in the upper South Fork of the John Day River, Oregon.

Source	Location(s)	Date(s)	Protocol	Data
USFS	Tamarack Creek	8/8/1994	FS R6 Stream Surveys	Stream channel, riparian
ABR, Inc.	Mainstem SFJDR, Lonesome Ck.	8/2000, 8/2001	Modified EPA REMAP	Stream channel, riparian
USFS	Sunflower Creek, Porcupine Creek	2001	Bottom Line Survey	Stream channel, riparian
USFS	Murray Creek, Cougar Creek, Columbus Creek, Wildcat Creek	1996	Bottom Line Survey	Stream channel, riparian
DEQ	Utley and Corral creeks	1990-1992	DEQ NPS Monitoring	Stream channel, riparian

been sampled and then discuss how observed conditions conform to or deviate from known requirements of salmonids.

MAINSTEM OF THE UPPER SOUTH FORK OF THE JOHN DAY RIVER

Most physical habitat data collected in the USFJDR watershed have been collected by ABR, Inc. in association with monitoring stream restoration activities occurring in the upper watershed. Data characterizing instream and riparian conditions were collected from eight reaches occurring in the mainstem USFJDR above Izee Falls in 2000 and 2001 (Chapter 8, Figure 8.4). One station (ABR 7) is located immediately above the falls, three are located on the Keerins ranch (ABR 4–6, two above and one below Pine Creek), three are on the St. Clair ranch (ABR 1–3, occurring from above Rosebud Creek to below Poison Creek), and one site occurs above the confluence with Donivan Creek on USFS land (ABR 10).

Immediately above Izee Falls, the mainstem is relatively confined flowing through a steep-sided canyon. This lower length of the mainstem, from the falls upstream to the lower end of the Keerins ranch, flows primarily through BLM land. Light to moderate grazing occurs through much of this river reach, preventing full recovery of herbaceous and woody riparian vegetation. Sparse riparian vegetation and trampling of streambanks by cattle have eroded streambanks and contributed to sediment loading and deposition in the channel. Data from ABR monitoring reach 7 at river mile 28 indicate that substrate embeddedness is high, averaging about 70% across all habitat types. Channel incision is also occurring in these lower reaches; ABR data indicate that channel incision averages close to 1 m in monitoring reach 7.

Above the canyon, the river floodplain widens considerably for approximately 15 miles upriver to the Malheur National Forest boundary. A number of private ranches occur in these broad valley floodplains, the first above the canyon owned by the Keerins family. Through this length of river, the valley floor has historically been, and continues to be, heavily grazed; riparian vegetation has been completely removed from most of these riparian areas. Three ABR monitoring reaches occur on the Keerins ranch in association with monitoring restoration activities. Reach 6 occurs at the lower end of the ranch at river mile 35. Riparian zone conditions transition from dominance by large mature trees, such as ponderosa pine, to shrubby floodplain-adapted species, such as dogwood and willow species. Willow and dogwood riparian vegetation is thicker along this reach of the mainstem than perhaps any other reach until the forest service boundary at river mile 52. Canopy cover averaged 46% in reach 6, more than ten times higher than canopy cover in monitoring reaches 1–5 farther upstream on the mainstem. Instream physical conditions are degraded, as substrate embeddedness averaged 73% between 2000 and 2001, and incised channel height averaged 1.45 m. Monitoring reaches 4 and 5, both occurring upstream on the Keerins property (river miles 38 and 37, respectively), are characterized as having poor riparian zone development, high substrate embeddedness, and channel incision averaging 1 m.

Likewise, ABR monitoring reaches 1–3 (river miles ~43–45) in the St. Clair ranch are currently characterized by poor stream shading because of little or no canopy cover, by deep channel incision, and by heavily embedded substrate. The St. Clair ranch has recently corridor fenced the river along its entire length through the property. Regeneration of willow, dogwood, and other riparian species is occurring, though regeneration has not yet produced any measurable changes in stream shading. Thousands of linear feet of the river have been armored with juniper riprap on the St. Clair ranch; streambank stability, heavily impaired throughout most of the upper mainstem has improved markedly in the St. Clair reaches through corridor fencing and streambank stabilization.

Physical stream conditions on the St. Clair and Keerins ranches typify those occurring through most of the length of the upper river, and likely represent the best conditions among those occurring on private lands, as these reaches are currently undergoing restoration. Historic clearing of riparian vegetation and continuing extensive use by cattle of the river and its floodplain have denuded valley floor riparian zones of vegetation, deeply incised channels, reduced habitat complexity, and increased fine sediment loading and deposition. The river channel has been channelized in several reaches (see Chapter VIII), and push-up dams for water diversion occur throughout the mainstem. Large wood is conspicuously absent throughout the entire upper mainstem. Without such inputs to create and maintain habitat heterogeneity, habitat in the upper mainstem is dominated by long, homogeneous shallow glides and pools with substrates comprised primarily of fine gravel, sand, and silt. On private lands along most of the length of the mainstem between the canyon and Malheur NF boundary, the river is characterized as having excessive bank erosion, heavily embedded substrate, low woody debris loading, deep channel incision (1–2 m) and poor habitat heterogeneity.

ABR data collected from reach 10, on the mainstem SFJDR above its confluence with Donivan Creek, suggest that the river is of a different character above the Forest Service Boundary. Although light to moderate grazing pressure occurs in these upper reaches, better developed riparian zones with mature trees and understory vegetation, lower substrate embeddedness, and more heterogeneous habitat provide more suitable habitat for redband trout in this upper section of the river.

LONESOME CREEK

ABR monitoring site 11 occurs on Lonesome Creek approximately 1 mile below the confluence with Grasshopper Creek. Both Lonesome and Grasshopper Creeks occur primarily on USFS land and, therefore, occur in more forested areas than tributaries that occur on private lands. ABR monitoring reach 11 on Lonesome Creek occurs immediately below a transitional zone from forest to open pasture in a floodplain averaging ~100 m in width. Light to moderate grazing occurs along Lonesome Creek in this monitoring reach. Consequently, stream shading and streambank stability are poor. Lonesome Creek averages 73% substrate embeddedness in this reach, and contains a heterogeneous mix of riffles, glides, and pools. Channel incision, averaging 0.3 m, is low in this reach in relation to incision observed in other reaches of similar size in the watershed.

TAMARACK CREEK, LEWIS CREEK SUBWATERSHED

USFS stream surveys of Tamarack Creek, a tributary to Lewis Creek, in 1994 indicated that this stream supported redband trout in the survey reach. The surveyed reach occurred on a 3% channel slope, and was dominated by pool habitat (75%) and sandy substrate, indicating that sedimentation was generally high. Large woody debris occurred at a frequency of 35 pieces per mile, far lower than the ODFW benchmark of >20 pieces/100 m. ABR field visits to upper Tamarack Creek also noted that the stream is dominated by sand and fine gravel substrates and unstable banks are common along the much of the channel. In places, the stream is shaded and banks are supported by thickets of alder and dogwood. Where cattle grazing pressure is higher, riparian regrowth is suppressed and streambanks are less stable. On private land below the FS boundary, intensive cattle grazing has eliminated most riparian zone vegetation along Tamarack Creek.

SUNFLOWER CREEK

Ochoco NF crews conducted Bottom Line Surveys in eight reaches comprising the entire length of Sunflower Creek during summer 2001. Survey results indicated that Sunflower Creek did not "meet any of the standards that the Forest Service or the State of Oregon have set forth" to obtain healthy stream status. Sunflower Creek averaged only 23% shade throughout its length (Ochoco NF 2001a), far below the 80% standard established by the Ochoco NF (Grover et al. 1992). More importantly, the survey report noted that the stream meanders through two meadows which decrease stream-wide estimates of shading. Large woody debris abundance in Sunflower Creek of 0.27 pieces/100 feet did not meet the Ochoco NF Forest Plan standard of 0.38 pieces/100 feet (20 pieces/mile). Cutbank frequency was 41.4%, exceeding Forest standards of 20%. Pool frequency in Sunflower Creek, at 0.6 pools/100 feet did not meet the Forest standard of 2 pools/100 feet (Ochoco NF 2001). Survey crews noted observing both redband trout and speckled dace in Sunflower Creek.

SUNFLOWER CREEK TRIBUTARIES: PORCUPINE, WILDCAT, COLUMBUS, COUGAR, AND MURRAY CREEKS

Bottom line surveys were conducted in a number of Sunflower Creek tributaries in 1996 and 2001. Results of these surveys (summarized in Table 9.4) indicate that stream shading standards and pool frequency standards were never met in any surveyed reaches. Conversely, cutbanks (eroding banks) were infrequent and large woody debris frequencies were high enough to meet USFS standards. It is noteworthy that standards for large woody debris during ODFW aquatic inventories are significantly higher than those of the Ochoco NF. Applying the ODFW standard of >20 pieces (15 cm × 3 m minimum size) per 100 meters of stream length, all streams surveyed in the Sunflower Creek drainage failed the ODFW large wood standard.

ABR FIELD OBSERVATIONS DURING WATERSHED ASSESSMENT ACTIVITIES

The few data available that quantify habitat conditions in the watershed suggest that fish habitat throughout the watershed is limited by a number of factors, including water quantity, sedimentation, water temperature, and lack of habitat complexity. ABR field visits to subwatersheds consistently noted large amounts of fine sediments in streams, frequent channel incision and unstable streambanks, lack of large wood loading, and poor riparian zone conditions. Smaller tributaries also often lacked surface water flow, but several years of drought conditions have likely magnified summer low flows in these streams beyond what occurs during a more typical water year.

Sediment

Although sediment yield into streams of the USFJDR has likely always been high (DEA 2000), land management practices have certainly significantly increased sediment loading into streams. Sediment sources in the watershed include channel erosion and surface erosion. From field observations, channel erosion appears to be a significant source of stream sediment throughout much of the upper watershed. Channel erosion occurs as a result of lateral movement of channels into streambanks (bank cutting) and downcutting of streambeds (entrenchment). Since European settlement of the area, both of these processes have occurred at accelerated rates. Increased channel erosion rates in the watershed can be attributed to heavy livestock grazing, road construction, removal of riparian vegetation, timber harvest and other alterations to upland plant communities, and to loss of beaver dams (DEA 2000). During field visits to streams throughout the watershed, a large number of surveyed reaches showed evidence of recent bank erosion and recent or historic downcutting. Stream reaches in which severe bank cutting and entrenchment were observed included

Table 9.4. Results of Bottom Line Surveys of stream and riparian conditions performed in the Sunflower Creek subwatershed in 1996 and 2001 in the Ochoco National Forest, Oregon. An asterisk indicates that the measured parameter failed to meet the Forest standard, as set forth in the Forest Management Plan.

Stream Name	Reach Number	Date Surveyed	Mean Shade (%)	LWD/100 ft	Percent Cutbanks	Pools/100 ft
Sunflower Creek	All	2001	**23***	**0.27***	**41.4***	**0.6***
Porcupine Creek	All	2001	**69***	0.81	14.5	**1.7***
Cougar Creek	1	1996	**23.0***	**0.2***	9.3	**0.2***
	2	1996	**58.6***	0.9	1.7	**0.6***
	3	1996	**79.6***	3.7	0.0	**0.0***
Columbus Creek	1	1996	**27.7***	0.7	6.9	**1.7***
	2	1996	**46.8***	0.7	14.1	**0.1***
Wildcat Creek	1	1996	**49.4***	3.1	2.8	**1.3***
	2	1996	**78.9***	5.3	0.5	**0.4***
	3	1996	**71.3***	3.6	0.0	**0.1***
Murray Creek	1	1996	**19.1***	**0.2***	6.8	**0.7***
Ochoco NF STANDARD			**>80**	**>.38**	**<20**	**>2.0**

the mainstem river, upper Corral Creek, Bear Creek, Tamarack Creek, Buck Creek, Pine Creek, Indian Creek, Cougar Creek, and Venator Creek. This list is certainly not complete, but illustrates the widespread occurrence of erosion-related problems in the watershed.

Dry Channels

ABR field surveys indicated that entire stream reaches are seasonally dry, at least during drier years in the watershed. In 2002, when field observations for the assessment were made, mainstem flows were lower than they had been in years. It follows, therefore, that the following observations likely represent conditions that are more extreme than those on average for that time of year. The following stream reaches were noted as dry, or as having only standing water in isolated pools:

- Sunflower Creek above Keerins Corral
- Cougar Creek above confluence with Sunflower Creek
- Bear Creek immediately above confluence with SFJDR
- Antelope Creek – 1 mile above confluence with SFJDR
- South Fork John Day River above Sunflower Flat
- Brisbois Gulch – upper reaches

Large Woody Debris

Both direct field observation and data from various sources indicate that instream large woody debris quantities are well below ODFW benchmarks across much of the watershed. Refer to Chapter 5 for a more comprehensive discussion of large woody debris.

RESTORATION ACTIVITIES

Restoration activities have occurred on both public and private lands in the watershed. In 1994, the Bureau of Reclamation (BOR) developed a stream restoration program for the Upper South Fork of the John Day River for the John Day Basin Council that focused on improving water quality, water quantity, upland conditions, riparian conditions, and instream fish habitat through a number of proposed restoration activities (BOR 1994). The program mission statement was as follows:

> "The mission of this restoration program is to enhance the health of the South Fork subbasin by increasing water quality and quantity and modulating flows throughout the drainage. This would be accomplished by improving the water retention capability of the upper subbasin above Izee

> Falls through improved land management and specific restoration projects.
>
> Many groups including appropriators, other landowners, concerned citizens, public interest groups, Indian tribes, and local, State, regional, and Federal agencies have identified goals and objectives for resource management and development in the South Fork Subbasin. Improved water quality (lower summer water temperature and reduced sediment loading during high flows) and increased quantity (particularly during the late irrigation season) are generally complementary and achievable goals. Meeting water demands should be attainable through enhancement of the watershed and riparian areas, conservation of water, and improved efficiency and use of water. Resource management activities which improve the watershed will enhance the South Fork subbasin cold water fishery" (BOR 1994).

The report states that redband trout populations above Izee Falls would benefit significantly with the implementation of the proposed watershed and riparian measures. The report adds that "Biologists estimate that steelhead production could conceivably be doubled from Izee Falls to the mouth if the upper South Fork uplands and riparian areas are returned to a high state of health" (BOR 1994). The report also listed restoration projects that had occurred in the watershed to date (Table 9.5). According to the BOR report, restoration work has occurred on Sunflower, Utley, Lonesome, Flat, Corral, Cougar, and Bear Creeks, as well as on the mainstem SFJD River. The report indicates that most restoration projects occurring in the watershed have focused on placement of instream structures to provide grade stabilization and to reduce stream energy and consequent erosion of streambanks and streambeds.

In addition to those projects listed in Table 9.5, ABR field surveys noted riparian plantings on upper Corral Creek and Murray Creek (in the Sunflower Creek subwatershed). In addition, instream structures to enhance physical habitat for salmonids have been placed in the mainstem SFJDR above the confluence with Donivan Creek.

Stream restoration activities have also occurred on private land in the watershed. These restoration projects have primarily occurred in three locations with the cooperation and involvement of local landowners: Utley and Corral Creeks, on the St. Clair Ranch on the SFJDR and selected tributaries, and on the Keerins Ranch on the SFJDR.

Utley and Corral creeks

GWEB-funded restoration projects on Utley and Corral creeks were undertaken in the early 1990s. The Utley Creek restoration project was completed in 1991. This restoration project included riparian exclusion fencing, off-channel watering through development of four springs, juniper removal from 35 acres of uplands, and riparian plantings. Ten check dams were also constructed on Utley Creek between stream mile 1.0 and 2.0; four more check dams were installed on Flat Creek in association with this project. Check dams are intended to raise the local water table to allow better regeneration of riparian vegetation and to increase pool habitat. Concurrent efforts by the USFS on upstream federal lands included spring enhancements, juniper and log riprap installation, and channel complexity enhancements (Grant SWCD 1991a).

The Corral Creek restoration project, also completed in 1991, included an agreement by the landowners to incorporate rest rotation into grazing management practices, upland off-channel watering site development, riparian planting, construction of 28 check structures, and replacement of an annual push-up diversion with a permanent irrigation diversion. On both Utley and Corral creeks, DEQ monitored water quality, physical habitat, and macroinvertebrate communities from 1990 to 1992 (Caton 1993). In 1990, ODFW sampled fish populations from two 100-foot reaches on Utley Creek in association with these restoration efforts (Grant SWCD 1991b).

South Fork of the John Day River – St. Clair & Keerins Ranches

Restoration work on the mainstem of the South Fork was initiated in 1988 by Phil St. Clair, a cattle rancher with 4000 acres in the watershed. With grant support from GWEB, check dams were

Table 9.5. Summary of stream restoration efforts through 1991 occurring in the South Fork of the John Day River watershed, Oregon (source: BOR 1994).

Stream Restoration Projects												
		Channel Activities					Riparian Activities					
Map No.	Stream	Instream Structure	Pools and off-channel	Streambank Stabilization	Fish Passage	Other	Fencing	Planting	Other or up slope	Grazing Plan	Agencies Involved[2]	Report Agency[2]
0286	Sunflower Creek						Yes				ODFW, USFS	ODFW
0297	Utley and Flat Creeks	Yes									ODFW, OWRD, SWCD	ODFW
1034	South Fork John Day River	Yes		Yes							USFS	USFS
1035	Utley Creek	Yes		Yes					Yes		USFS	USFS
1036	Lonesome Creek	Yes		Yes							USFS	USFS
1103	South Fork John Day River	Yes									BLM, BPA	BLM
1160	South Fork John Day River	Yes		Yes			Yes				OWRD, SCS, SWCD	OWRD

installed on the mainstem SFJDR running through the St. Clair property, to provide grade stabilization and raise the water table throughout the river on his property. In the early 1990s, additional support from the Grant Soil and Water Conservation District (SWCD) allowed installation of additional check structures on the St. Clair ranch and installation of juniper riprap and check structures on the Keerins ranch. The St. Clair ranch also adopted a rest-rotation management plan on valley floor pastures to promote recovery of riparian vegetation.

Later restoration activities on these two ranches have included additional check dam construction, corridor fencing, streambank stabilization, tree planting, and development of off-channel watering sources. Most of this work has been supported by OWEB, Partners for Wildlife (USFWS), and ODFW. In 1994–1995, the St. Clair ranch fenced all 2.5 miles of river corridor within their property to exclude cattle from the inner riparian zone and streambanks. With additional OWEB support, the St. Clair ranch lined 4000 linear feet, and the Keerins ranch lined 2500 linear feet, of eroding streambanks with juniper riprap. Each year between 1996 and 2000, the St. Clair ranch planted 100–150 bare-root poplars and conifers along the South Fork's riparian zone. Approximately 400 cuttings of native trees (willow species, cottonwood, and red-osier dogwood) have also been planted annually in the fenced-off riparian zone.

With support from ODFW, fish screens have been built at irrigation diversion intakes on both the St. Clair and Keerins ranches. The St. Clair ranch currently has two functional fish screens, the Keerins ranch currently operates one fish screen. All of these screens prevent fish from the SFJDR mainstem from entering irrigation ditches on these properties.

FISH PASSAGE

Numerous road crossings occurring in the USFJDR watershed are barriers to fish passage and have effectively reduced the number of stream miles available to resident trout. The numerous culverts preventing upstream movement of redband trout have likely fragmented the upper watershed population into smaller units that are at a much greater risk of local extinction than would be a larger, interconnected unit.

Three large-scale culvert inventories that included the watershed have been performed in recent years. In 1998, the Oregon Department of Transportation (ODOT) contracted with ODFW to survey all culverts associated with state and county roads in the John Day basin, Umatilla basin, Deschutes basin, and all Columbia River subbasin tributaries between Hood River and the Grande Ronde River (McDermott et al. 1999). The Malheur National Forest performed road crossing inventories during summer 2002 to identify problem fish-passage culverts, and in recent years, the Ochoco National Forest has been performing culvert assessments, including an assessment of culverts occurring in the Sunflower Creek subwatershed.

ODFW surveys of culverts occurring on county roads in the watershed were conducted between June and October 1998. In all, 21 county road crossings were assessed. Of these, 11 road crossings did not meet state fish-passage criteria and were assigned repair priorities of low or medium based on the number and status of species present, the population size and condition, and the estimated quantity and quality of habitat blocked (McDermott et al. 1999). When information related to these factors was insufficient, ratings are considered 'best guess' estimates. No culverts that failed to meet passage criteria within the upper watershed were assigned a high-priority rating (Table 9.6). McDermott et al. (1999) explain that high-priority rankings were assigned only to culverts where access by anadromous and/or resident fish species to extensive high-quality habitat was being limited or prevented. Only two culverts within the upper watershed on county roads were assigned medium priority for repair; both of these culverts occurred in the lower reaches of Lewis Creek and Venator Creek, two of the larger subwatersheds occurring in the USFJDR watershed. Nine culverts were assigned a low-priority rating. All of these culverts occurred in mid- to upstream reaches of subwatersheds, where habitat quality ranged from poor to fair, and presence of redband trout was frequently unknown.

Culvert surveys in the Ochoco National Forest have included identification of several culverts within the Sunflower Creek subwatershed that are

Table 9.6. Culverts surveyed by the Oregon Department of Fish and Wildlife for the Oregon Department of Transportation (ODOT) on county roads in the upper South Fork of the John Day River watershed in summer 1998.

ODOT ID	Road	Stream	Subbasin	Priority[1]	Habitat Quality[2]	Fish Species[3]
1698	68	Alsup Creek	South Fork			
1808	63	Antelope Creek	South Fork	L	P	rb
1656	67	Antelope Creek	South Fork			
1813	67	Cow Creek	Pine Creek	L	P	unk
1811	**68**	**Lewis Creek**	**South Fork**	**M**	**unk**	**rb**
1810	63	Lewis Creek	South Fork	L	F	rb
1807	63	Lewis Creek	South Fork	L	F	rb
1664	67	Morgan Creek	South Fork			
1794	67	Pine Creek	John Day R	L	P	unk
1790	67	Pine Creek	South Fork	L	F	rb
1675	67	Pine Creek	South Fork			
1667	67	Pine Creek	South Fork			
1666	67	Pine Creek	South Fork			
1789	67	Poison Creek	South Fork	L	unk	rb
1674	67	Poker Creek	Pine Creek			
1657	67	Rosebud Creek	South Fork			
1665	67	South Fork	John Day R			
1663	69	South Fork	John Day R			
1795	67	Spring Creek	Pine Creek	L	P	unk
1791	69	Un Creek	Brisbois Gl	L	P	unk
1809	**68**	**Venator Creek**	**South Fork**	**M**	**unk**	**rb**

[1] Priority rankings: L – low, M – medium, H – high.
[2] Habitat Quality: F – fair, P – poor, unk – unknown.
[3] Fish Species: rb – redband trout, unk – unknown

barriers to fish passage. Two culverts on Forest Road 5870 will be replaced by 2007; one occurs on Sunflower Creek, the other on Porcupine Creek. One culvert crossing Murray Creek on Forest Road 58 will be replaced by 2008.

Malheur National Forest personnel surveyed 43 culverts in the USFJDR watershed above Izee Falls during summer 2002. As of February 2003, the USFJDR data had not yet been analyzed or entered into a database, but NF staff were able to report that 85–90% of the surveyed culverts on Malheur NF are not passing fish at least under certain flow conditions (Mark Lysne, USFS, 2003, personal communication). A report detailing and summarizing the findings of these surveys is anticipated to be complete by spring 2003, but early results suggest that a large proportion of forest road culverts are likely not passing fish and are therefore contributing to fragmentation of the watershed's redband trout population.

SUMMARY AND RECOMMENDATIONS

The USFJDR watershed currently lacks sufficient data to provide a complete assessment of current fish community and habitat conditions. Key findings resulting from this assessment of current fish and fish habitat conditions in the USFJDR watershed include the following and are summarized by subwatershed in Table 9.7:

- Redband trout occur throughout the main-stem and many tributaries, although the distribution of the species is not well known in several of the subwatersheds. The population has been fragmented by culverts at road crossings, and the status of these smaller, fragmented populations is largely unknown.
- Instream habitat has been degraded throughout the watershed. Available data suggest that instream conditions most impaired include substrate embeddedness,

Table 9.7. Summary of fish and fish habitat conditions of subwatersheds occurring within the upper South Fork of the John Day River watershed, Oregon, as determined from existing information sources as of winter 2002–2003.

Subwatershed	Redband Distribution	Instream Habitat	Riparian Quality	Passage Barriers	Restoration projects	Surveys/Research
Mainstem below Bear Creek	Throughout	Deeply incised, homogeneous habitat, poor substrate, low LWD (ABR)	Poor – primarily heavily grazed pasture	Several push up dams; no known road crossings	St. Clair ranch – I, SS, FS, IS, RF, P, GP Keerins ranch – I, SS, FS, P, RF, OW Lower reaches (BLM and USFS) – I, SS, RF, P, GP	ABR monitoring ODOT culvert assessments
Sunflower	Known to occur in Wildcat, Cougar, and Sunflower (ODF)	Low-mod incision, low-mod bank stability, often adequate LWD (USFS)	Variable – well shaded to open meadow and pasture	Yes – on road crossings on Sunflower, Murray and Porcupine creeks	Sunflower (USFS) – RF Murray (USFS) – P	USFS BLS surveys Culvert surveys
Pine	Above second road crossing on CR 67 and in lower Brisbois – otherwise unknown (ODF)	Variable – no data	Variable – but generally low	Yes – 2 culverts on CR 67	Keerins ranch: P	ODOT culvert surveys
Indian	Throughout up to confl. with Frenchy Spring (ODF)	Unknown – no data	Variable		None known	None
Morgan	Known to occur in lower Morgan (local)	Unknown – no data	Variable	Unknown	None known	None
Poison/Rosebud/ Antelope	Through mid reaches of Poison and Antelope (ODF); Rosebud – upstream to FS boundary	Variable – no data	Variable	Poison: one culvert on private property in lower reaches; one on the county road corssing Antelope: one in mid reaches	Poison/ Rosebud: RF (St. Clair ranch)	ODOT culvert surveys Antelope/Poison: ODF fish surveys
Flat/Utley Creek	Flat to above Spoon, Spoon, Alder, and Utley (USFS, ODF)	Variable – poor in lower reaches, deep channel incision (DEQ)	Variable – heavy past grazing		Lower reaches: I, SS, P, GP	ODF fish surveys Utley: ODFW 1990 fish surveys DEQ NPS monitoring

Table 9.7. (Continued).

Subwatershed	Redband Distribution	Instream Habitat	Riparian Quality	Passage Barriers	Restoration projects	Surveys/Research
Corral Creek	To 2 miles above Rail Creek (ODF)	Variable – few data	Variable – heavy past grazing		Upper/Lower: I, SS, FP, P, GP	ODF fish surveys DEQ NPS monitoring
Lewis	Lewis, Tamarack, Officer, Grasshopper and Lonesome into headwaters (USFS)	Variable – few data. Channel incision and bank erosion severe in some reaches – few data (ABR, USFS, DEQ)	Variable	Yes- two culverts on CR 63 and one on CR 68 crossing Lewis Creek	Lonesome (by USFS): I, SS	Grasshopper: 2000 DEQ REMAP survey Tamarack: USFS stream survey ODOT culvert surveys
Venator	Through most of Venator (USFS,ODF)	Unknown – no data	Variable	Yes – one road crossing on CR 68	None known	ODOT culvert surveys
Bear/Upper SF	Bear Creek above Sally's Flat (ABR), upper S Fork above Rock Creek (ODF)	Variable – some reaches with severe incision and bank erosion – few data (ABR)	Variable	Yes	None known	ABR monitoring ODF fish surveys
Sheep/Brisbois	Brisbois - unknown, Sheep – unknown	No data	Variable – heavily grazed	Yes – culvert crossing CR 68 (ODOT #1791)	None known	None known

Restoration projects: I – instream structures, SS – streambank stabilization, FP – fish passage, RF – riparian fencing, P – planting, G – grazing plan, OW – Off-channel water source development, IS – irrigation diversion screening channel incision, bank erosion. Few or no data are available for most of the watershed streams.

- Fish passage barriers have been identified throughout the watershed on county roads (ODFW) and on public lands (USFS).
- Restoration activities have been occurring in parts of the watershed for decades, with an emphasis on restoration of riparian and channel conditions through exclusion fencing, streambank stabilization, and riparian planting. The effects of these efforts are largely unknown, with no known monitoring of most of these efforts occurring.

Most striking during data-gathering efforts for this assessment was the lack of information describing or quantifying fish communities or fish habitat in the watershed. The following significant data gaps were noted:

- Stream condition survey information was lacking, including instream physical habitat and riparian conditions for many of the subwatersheds. No physical data were available for the following subwatersheds: Pine Creek, Indian Creek, Morgan Creek, Poison/Rosebud and Antelope creeks, Venator Creek, Bear Creek, Sheep Creek. Additionally, few data were available for most other streams and subwatersheds. Stream surveys should follow standard protocols, such as ODFW aquatic inventory protocols, DEQ REMAP protocols, or the USFS Region 6 stream survey protocols.
- Data characterizing fish communities in the watershed are scarce. Recent data (<10 years) include only snorkel survey data from surveyed reaches in the mainstem on the St. Clair property.
- Distribution data on redband trout may be outdated and unreliable, as information from different sources sometimes showed very dissimilar distribution patterns within the watershed. Redband trout population size or abundance data are scarce, with abundance estimates produced only in Tamarack Creek in 1994 and Utley Creek in 1990.

As a first step towards maintaining and improving resident fish populations and their habitat, the following activities are recommended:

- Perform standardized surveys of fish populations and fish habitat quality across the watershed. We recommended randomly selecting stream reaches throughout each subwatershed to inventory these conditions. These stations should be established as permanent stations to monitor trends in watershed conditions. The data will also greatly assist in identifying priority restoration needs and locations within the watershed. A complete survey of redband trout distribution to better understand their current range within the watershed would also be useful.
- Develop plans and partnerships with local landowners to establish grazing practices that better promote recovery of riparian zone vegetation, which will increase streambank stability and stream shading, and to increase woody debris recruitment into streams. Continue implementing restoration projects in priority areas that focus on restoring riparian and stream channel conditions and reducing sediment loading into streams.
- Replace culverts that been identified as passage barriers to resident redband trout. Prioritize the replacement of these culverts by the amount of usable habitat occurring above impassable culverts.
- Develop and implement monitoring plans to measure the effects of restoration activities on stream and riparian conditions.

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CHAPTER 10: WATERSHED CONDITION SUMMARY

This section summarizes the findings of the upper South Fork of the John Day River watershed assessment, including summaries of major findings, identification of data gaps, and listing of recommendations that resulted from the assessment.

HISTORICAL CONDITIONS

Summary: Before European settlement of the USFJDR watershed, lush riparian areas with extensive marsh systems and moist meadows were common along the South Fork and its tributaries. Sage and juniper occurred in the transition zone between these grassy uplands and ponderosa pine and mixed conifer forested mountains. Today, riparian areas have less vegetation and have a smaller network of associated marshlands. Erosion in the area is common leading to sedimentation problems. Rangeland composition has been altered by aggressive colonizing vegetation, while forestland generally has more understory vegetation and debris.

A number of land use practices have contributed to this alteration of watershed conditions. Historically, a high percentage of land in the watershed was devoted to rangeland, as it is today. Livestock roamed freely, overgrazing some areas and damaging riparian zones in others as no rangeland management was practiced. Overgrazed areas that could no longer support livestock often provided enough forage for smaller animals such as sheep. As prime rangeland became increasingly scarce, range "wars" ensued between cattlemen and sheepherders. The introduction of the Forest Service brought peace and rangeland management practices to the watershed. Logging in forested potions of the watershed caused changes in forest composition, while agriculture contributed to the loss of marshland and other hydrological changes in the watershed.

DATA GAPS:

- Incomplete record of floodplain, riparian, channel, and wetland modifications, especially concerning the location and extent of these activities.
- Few historical accounts or data regarding fish populations and distribution patterns.

CHANNEL HABITAT TYPES

Summary: The upper reaches of the watershed consist primarily of constrained channels of moderate to steep gradient classes, including Very Steep Headwater channels (VH), Steep Narrow Valley channels (SV), and Moderately Steep Narrow Valley channels (MV). Proceeding downstream through the mid reaches of tributary networks in the watershed, channels become less constrained and gradients are low to moderate (LM, MM). The lower reaches of many tributary drainages, as well as most of the upper South Fork of the John Day River, consist of unconstrained, low-gradient systems on floodplains (FP2, FP3).

A total of 258.4 miles of streams were assigned Channel Habitat Types (CHTs) throughout the watershed. Among all stream reaches within the watershed, 36.2% (93.4 miles) of CHTs are considered to be highly sensitive to disturbance. More than half of the total watershed channel length classified as highly sensitive to disturbance was classified as FP3, indicating that floodplain channels occurring in the lowland areas of the watershed represent a large proportion of the most sensitive channels occurring in the watershed.

Moderately sensitive channels represented 35.3% (91.3 miles) of the total watershed channel length. These channels typically occurred midway through tributary drainage networks, where gradients begin to flatten from steeper headwater areas and channels become less (moderately) constrained. Finally, channels with low sensitivity to disturbance represented 28.5% (73.7 miles) of the total stream length in the watershed. These channels occurred exclusively in steep, confined headwater areas.

DATA GAPS:

- Further field verification of channel habitat types.
- Field-based surveys of channel dimensions and conditions.

RECOMMENDATIONS:

- Although channel habitat typing provides one source of information used in identifying restoration opportunities, we suggest that more intensive field-based surveys be performed to examine stream channel conditions to both produce baseline information and to better quantify channel conditions in various areas of the watershed for restoration prioritization.

- Although steep, narrow valley channels occurring in headwater reaches of the watershed are characterized as having low responsiveness to restoration efforts, attention to management activities in these areas will likely reduce sediment loading, bank erosion, and habitat degradation in these areas. Emphasis on active restoration efforts, including placement of instream structures, streambank stabilization techniques, and grade controls should continue to be placed on streams of moderate to low confinement lower in the drainage network.

HYDROLOGY AND WATER USE

Summary: The USFJDR watershed is characterized by very low summer streamflows and late winter/early spring peak flows. This screening-level assessment indicates that neither current forest canopy closure nor road densities are significantly altering watershed hydrology and streamflows. Despite the inability to formally assess the potential impact that grazing in the watershed has had on hydrology, the amount of the watershed used for grazing, and the obvious effects of grazing management on vegetation and soil conditions, suggest that this land use has clearly affected streamflows. Grazing practices have altered the timing and size of peak and low streamflows by reducing infiltration rates and increasing surface runoff into streams. Channel incision in the watershed also can be attributed partially to these changes in stream discharge.

Based on the water availability model run at an 80% exceedance level, water rights issued and used under the prior appropriation doctrine can result in more water consumed than what is naturally available during July and August in two WABs. A large portion of the Upper South Fork John Day watershed has been designated as a streamflow restoration priority by local ODFW and OWRD staff due to this issue as well as other considerations.

DATA GAPS:

- Complete soil survey information for the watershed to allow assessment of effects of agricultural and grazing practices on hydrology.
- No groundwater information for, or monitoring wells in, the upper watershed.

RECOMMENDATIONS:

- Best management practices on forest and range lands should include management techniques known to restore and maintain desirable hydrologic functions, including abatement of peak flows, increasing low flow volumes, and increasing groundwater recharge. Management of upland and riparian zones that promotes regeneration and maintenance of natural vegetative communities will enhance groundwater recharge and stabilize discharge.

RIPARIAN ZONE CONDITIONS

Summary: Fire suppression, logging, agriculture, and settlement patterns have altered riparian zone conditions throughout the USFJDR watershed. These changes have resulted in reductions in stream shading and riparian recruitment of large woody debris. Riparian zones occurring in upper reaches of stream networks primarily in forested areas are currently being limited by small tree sizes, or a lack of trees altogether. Riparian zones occurring on lower reaches and on the mainstem USFJDR are frequently devoid of trees and shrubby species and are dominated by grasses in those areas most intensively used for livestock grazing.

Riparian zones were assessed along 318 stream miles in the watershed. In non-forested ecoregions within the watershed, almost half (47%) of the riparian zone length is currently composed of grasses, indicating the degree to which riparian zone disturbance has occurred in the lower portions of the watershed. In contrast, 76% of the riparian areas occurring in the forested ecoregions within the watershed support stands of trees of varying composition and sizes.

Approximately 24% of these riparian areas support only shrubs or grasses. Among subwatersheds, Pine-Brisbois, Lewis-Lonesome, Poison-Rosebud-Antelope, and Sunflower creeks contained the most miles of treeless or shrubless riparian zones, indicating that these subwatersheds should be considered priority areas for riparian zone restoration and protection.

Riparian recruitment potential was adequate in only 30% of the total riparian area assessed, indicating that most of the watershed riparian zones do not support sufficient quantities of trees to provide adequate supplies of woody materials to stream channels. Among subwatersheds, Lewis-Sunflower, Pine-Brisbois, Poison-Rosebud-Antelope, and Sunflower creek watersheds contained the highest linear distances of riparian zones with inadequate riparian zone recruitment potential.

More than 89% of the riparian zone distance surveyed had stream shading of less than 40%. Nowhere in the basin did estimated riparian shade levels exceed 70%. Subwatersheds most lacking in stream shading included Corral Creek, Morgan-Dry Soda creeks, Pine-Brisbois creeks, Sheep-Pole-Sock creeks, and Poison-Rosebud-Antelope creeks.

DATA GAPS:

This watershed-wide screening-level assessment provides a starting point for characterizing riparian zone conditions in the watershed. A more thorough assessment could include examination of historic photographs and survey notes to better characterize historic riparian zone conditions to prescribe more specific targets for desirable riparian zone conditions. We also recommend collection of more field data to quantify current riparian zone conditions, particularly in areas of the watershed where conditions could be best improved by riparian restoration and replanting.

RECOMMENDATIONS:

Protection and restoration of riparian zones within the watershed would provide significant benefits to physical, chemical, and biological conditions. To this end, we recommend that landowners are encouraged to remove riparian areas from grazing and establish off-channel watering sources. Riparian fencing can effectively exclude livestock from riparian areas and allow vegetation to regenerate. Planting of woody riparian vegetation will expedite and enhance recovery of the riparian zone. In areas where severe channel incision has occurred and lowered the groundwater table, reestablishment of riparian species can be difficult. Under such circumstances, installment of check structures can help re-aggrade the stream channel and raise the water table.

In forested areas of the watershed, riparian zone conditions would benefit most from reducing the impacts of livestock grazing in riparian areas to allow shrub and hardwood regeneration. Such areas could be riparian fenced to further promote recovery of these areas. We suggest that where practical, these efforts be designed and monitored to allow comparison of these areas with areas that have not undergone restoration or management changes. In areas where small tree sizes are limiting riparian recruitment potential and stream shading, less frequent removal of riparian zone trees would allow these areas to provide better riparian functions than at present.

This watershed-wide screening-level assessment provides a starting point for characterizing riparian zone conditions in the watershed. A more thorough assessment could include examination of historic photographs and survey notes to better characterize historic riparian zone conditions to prescribe more specific targets for desirable riparian zone conditions. We also recommend collection of more field data to quantify current riparian zone conditions, particularly in areas of the watershed where conditions could be best improved by riparian restoration and replanting.

SEDIMENT SOURCES

Summary: Elevated sediment loading into streams of the USFJDR watershed occurs from a number of sources, including road runoff, pasture lands, and from within the stream channels themselves. Land use in the watershed is dominated by cattle grazing, hay production, and forestry, all of which can result in increased sediment loads into stream systems. Watershed wide, almost 40% of all stream miles in the watershed occur within 200 feet of roads. Other than lengths of Pine Creek, Antelope Creek, and certain reaches of the mainstem USFJDR, all of these roads occurring adjacent to rivers and streams of the watershed are unpaved and likely produce sediment-laden runoff during significant precipitation events. The Sunflower Creek subwatershed contains the greatest proportion of stream miles occurring within 200 feet of roads, at almost 57%. Indian Creek and Venator Creek subwatersheds also exceed 50%, while close to half of the total stream lengths within the Morgan-Dry Soda, Pine-Brisbois, and Donivan-Bear creek subwatersheds occur within 200 feet of roads. Subwatersheds with the lowest risk for elevated sediment delivery from road runoff include Flat-Utley, Sheep-Sock-Pole, and Corral creek systems.

ABR and DEQ data indicate that most of the stream segments assessed in two physical habitat studies were only moderately stable (40–80%) or worse (Tables 6.2 and 6.3). Streambanks were greater than 90% stable in only two of nine ABR study reaches. Seven of these reaches were less than 80% stable and, therefore, did not meet the ODFW habitat benchmark for streambank stability.

Riparian grazing occurs throughout the watershed on both publicly and privately managed lands. Both the BLM and USFS have numerous grazing allotments on lands under their jurisdiction and have established no riparian zone protection, thereby allowing cattle full access to riparian zones and stream channels. Livestock have at least seasonal access to most streams and riparian zones in the watershed, and most of these areas are not exclusion fenced. All of these areas, to various degrees, show signs of both riparian and streambank damage from grazing and trampling.

DATA GAPS:

- Field surveys of stream turbidity and sediment loads during high springtime flows.
- Landslides inventories or information.
- Stream habitat survey information that includes measures or ratings of streambank stability.

RECOMMENDATIONS:

- Provide riparian zones with greater protection through exclusion fencing and implementation of best management practices on bottomland pastures would likely reduce sediment loading from both riparian and channel sources. Prioritize implementation of such measures in areas that are clearly most heavily used and damaged by intensive cattle use. In other areas, other management practices and measures to consider include off-channel watering sources, riparian pastures, and implementation of grazing BMPs.
- Maintain forest roads with effective sediment traps, water bars, and restricted use during wetter months to help reduce sediment production and transport. Additionally, maintenance of roadside ditches should also be timed to allow vegetation to be present during high-flow events in spring.
- A more complete inventory of stream habitat in the watershed would provide valuable information that would both better characterize current streambank conditions and provide a baseline for comparison with future data to assess the effects of restoration activities.
- Future work aimed at further evaluating sediment sources and problem areas in the watershed should include some springtime field visits and data collection, particularly to better assess the effects rangeland management on sedimentation of streams during peak-flow events. Such visits would include visual inspections of ditches and streams for high sediment loading to determine where in the watershed stream sedimentation is most problematic.

CHANNEL MODIFICATION

Summary: Channel modifications are human alterations of stream channels that change their physical or hydrological properties. Twenty-five channel modifications were identified in the USFJDR watershed, including channelized stream segments, roads that restrict lateral channel migration, irrigation ditches, diversion dams, earthen impoundments and dikes. Of these modifications, dikes, diversion dams, and irrigation ditches were most common.

More than half of the channel modifications identified have occurred on the mainstem SFJDR; the others have occurred on tributaries throughout the watershed. Of the modifications identified, 34,993 feet (6.7 miles) occurred on the mainstem of the USFJDR. This proportion is 70% of all of the modifications in the watershed. Because most of the mainstem river is floodplain (see Chapter 3), the watershed's floodplain channels are being disproportionately affected by channel modifications.

DATA GAPS:

- Complete inventory of channel modifications on private lands and in smaller streams where aerial photographs are of limited use in identifying channel modifications.

RECOMMENDATIONS:

- Field check channel modifications to determine extent of modification to channel shape and function, fish habitat, and flows.
- Install fish screens on diversion intakes to prevent fish from passing into irrigation ditches.
- Install fish ladders to provide passage around small dams used for irrigation diversion.

WATER QUALITY

Summary: The USFJDR watershed lacks a single, cohesive, water-quality monitoring program, although a handful of organizations and agencies have collected water quality data in the past. These efforts have lacked coordination, causing water quality data to vary extensively among subwatersheds. Watersheds of this type, which lack sufficient monitoring programs, are especially prone to underestimating the degree and extent of water body impairment in their basin. However, from the water quality monitoring efforts that have been conducted in the watershed, temperature, dissolved oxygen (DO), and biological criteria, have been identified as areas of concern.

Six streams in the watershed, including the mainstem SFJDR, were listed on the 2002 303(d) list for temperature (4), biological criteria (2), and dissolved oxygen (1) standard violations. In addition, water temperature data indicates that water temperature standards are regularly exceeded between June and September, while dissolved oxygen data indicates that DO concentrations fall below the criterion in certain areas of the watershed. Phosphorus data, collected sporadically within the watershed, show exceedences of the criterion occurs in various streams. Although existing pH, turbidity, nitrate, and bacteria data all fall within the range, or below, the criterion established for the watershed, only a limited amount of samples were collected.

DATA GAPS:

- Water quality data for parameters such as temperature, dissolved oxygen, pH, nutrients, bacteria, turbidity, and biological criteria are lacking for most of the watershed.
- Contaminant data are lacking for the entire watershed.

RECOMMENDATIONS:

- Establish a comprehensive and cooperative water quality monitoring plan.
- Establish a set of monitoring sites to monitor water quality trends over time.
- Continuously and frequently monitor parameters, such as temperature and dissolved oxygen, in accordance with Oregon standards.

FISH AND FISH HABITAT

Summary: Sufficient data are currently lacking to provide a complete assessment of current fish community and habitat conditions in the USFJDR watershed. Key findings resulting from this assessment of current fish and fish habitat conditions in the USFJDR watershed include the following:

- Redband trout occur throughout the mainstem and many tributaries, although the distribution of the species is not well known in several of the subwatersheds. The population has been fragmented by culverts at road crossings, and the status of these smaller, fragmented populations is largely unknown.

- Instream habitat has been degraded throughout the watershed. Available data suggest that instream conditions most impaired include substrate embeddedness, channel incision, and bank erosion. Few or no data on physical habitat are available for most of the watershed streams.
- Fish passage barriers have been identified throughout the watershed on county roads (ODFW) and on public lands (USFS).
- Restoration activities have been occurring in parts the watershed for decades, with an emphasis on restoration of riparian and channel conditions through exclusion fencing, streambank stabilization, and riparian planting. The effects of these efforts are largely unknown as no known monitoring is occurring for some of these efforts.

DATA GAPS:

Most striking during data-gathering efforts for this assessment was the lack of information describing or quantifying fish communities or fish habitat in the watershed. The following significant data gaps were noted:

- Stream condition survey information, including instream physical habitat and riparian conditions for many of the subwatersheds. No physical data were available for the following subwatersheds: Pine Creek, Indian Creek, Morgan Creek, Poison/Rosebud, Antelope creeks, Venator Creek, Bear Creek, and Sheep Creek. Additionally, few data were available for most other streams and subwatersheds. Stream surveys should follow standard protocols, such as ODFW aquatic inventory protocols, DEQ REMAP protocols, or USFS Region 6 stream survey protocols.
- Data characterizing fish communities in the watershed are scarce. Recent data (<10 years) include only snorkel survey data from surveyed reaches in the mainstem on the St. Clair property.
- Redband trout distribution data may be outdated and unreliable, as information from different sources sometimes showed dissimilar distribution patterns within the watershed. Redband trout population or abundance data are scarce, with abundance estimates produced only in Tamarack Creek in 1994 and Utley Creek in 1990.

RECOMMENDATIONS:

As a first step towards maintaining and improving resident fish populations and their habitat, the following activities are recommended:

- Perform standardized surveys of fish populations and fish habitat quality across the watershed. We recommended randomly selecting stream reaches throughout each subwatershed to inventory these conditions. These stations should be established as permanent stations to monitor trends in watershed conditions. The data will also greatly assist in identifying priority restoration needs and locations within the watershed.
- Develop plans and partnerships with local landowners to establish grazing practices that better promote recovery of riparian zone vegetation to increase streambank stability and stream shading, and to increase woody debris recruitment into streams. Continue implementing restoration projects in priority areas that focus on restoring riparian and stream channel conditions and reducing sediment loading into streams.
- Replace culverts that have been identified as passage barriers to resident redband trout. Prioritize their replacement by the amount of usable habitat occurring above impassable culverts.
- Develop and implement monitoring plans to measure the effects of restoration activities on stream and riparian conditions.