Chapter 3

Reference Conditions

Middle Fork Willamette River Downstream Tributaries Watershed

This chapter describes the historical physical, biological and social conditions of the Watershed.

The discussion about the reference conditions of the Middle Fork Willamette River Downstream Tributaries is specific to the major issues identified for the Watershed. Each issue discussion will answer key questions that relate to processes and functions in the Terrestrial, Aquatic and Social Domains. The parameters chosen represent a changing process or function in the MFWDT. They represent single measurements out of complex ecological processes. The summary chart is to help the reader get an overview of the interrelationships.

Issue (VM) Vegetation Manipulation

The timeframe for the historical setting of the MFWDT for vegetation manipulation is from 1835 until the late 1940's. Harvest of timber replaced natural fire as the largest factor shaping the landscape in the late 1940's.

Table 2: Reference Functions/Processes For Vegetation Manipulation

Domain	Question	Function Process	Mechanism/Cause	Parameter Measured
Terrestrial	VM1	Habitat Diversity	Natural Disturbances	% Seral Or Developmental Stage Species Composition
	VM1	Habitat Connectivity	Natural Disturbances	Distribution And Size Of Vegetation Patches
	VM1	Interior Habitat	Natural Disturbances	Distribution And Size Of Vegetation Patches
	VM2	Ecological Site Productivity	Fire Disturbances	Large Woody Material (LWM)
	VM5	Riparian Habitat	Natural Disturbances	Riparian Uses
	VM6	Vegetation Manipulation Potential	This Will Be Shown In Recommendations	
Aquatic	VM4	Landslides	Natural Disturbances	Debris Flow & Mass Movement Location & Occurrence
	VM3	Hydrologic Recovery	Natural Disturbances	% Riparian In Seral Stage < 35 Years Age Water Yield Flow Regime
	VM5	Wood Recruitment & Shading	Natural Disturbances	% Riparian Seral Stage >55 Years Stream Temperatures
	VM5	Habitat Complexity	Flood Events	Ave. Stream Width And Depth # Pools Per Mile Substrate Composition
Social	No Question			Social Relevance Is In Characterization

Terrestrial Domain

The important processes for the Terrestrial Domain are: Habitat Diversity, Habitat Connectivity, and Interior Habitat (VM1); Ecological Site Productivity (VM2); Riparian Habitat (VM5); and Vegetation Manipulation Potential (VM6). Chapter 5 and 6, Interpretations and Findings and Recommendations, address the potential acres available for vegetation manipulation.

Habitat Diversity

For effects to wildlife and plant species, the conifer series are grouped in forested habitat types. The **dominant forested habitat types** found in the MFWDT are Western hemlock/Douglas-fir, Mountain hemlock/True fir, and hardwoods.

Western hemlock/Douglas-fir forests composed the largest habitat type. This habitat type consisted of subsets of early seral forest, pole-size and small timber, mature and old-growth, ponderosa pine/Douglas-fir, pure conifer, and mixed hardwood and conifer habitats. Stands east of the MFW River showed a characteristic pattern of underburning and open mature, old-growth forest. Steeper south aspects had a higher percentage of open early seral forest habitats created by stand replacement fires.

The ponderosa pine/Douglas-fir habitat subset was notably different in species composition and habitat structure than the western hemlock/Douglas-fir habitat type. Pines were more prevalent in the Youngs Creek - Deadhorse Creek area. Sugar pine intermixed with the Douglas-fir habitats more commonly in the Buck Creek to Estep Creek area. This habitat is a dry site Douglas-fir and rarely has Western Hemlock in the stand.

Mountain hemlock and the true firs dominated the smallest area of the Watershed. These habitat types were at the higher elevations along the Calapooya Ridge, upper Coal Creek, and from the Warner Mountain area to the Groundhog Mountain area. Grand fir gained its own habitat type in upper Gold Creek where a small stand of old-growth still exists.

The major ridgelines extending westward from the main Cascade Crest provided disjuncted stands of mountain hemlock and true fir habitat types into the Watershed. This would have added diversity and range of wildlife species.

True fir habitats had infrequent fires of various intensities. This created early seral habitat underneath a scattering of residual old-growth. Moderate intensity fires characterize the true fir habitats in upper Coal Creek and the Calapooya Ridge. This left early seral habitat with a sparse residual overstory.

Riparian hardwood habitats formed by the edges of the Middle Fork Willamette River and many class II streams. Brush and hardwood trees were important components in the habitat diversity and determined the habitat suitability for many wildlife species. Small stands of white oaks (<2 acres) existed in the lower Packard Creek area. The assumption is that scattering of individual oaks were more common than seen today.

Four **seral stages** used in the analysis are Stem Initiation, Stem Exclusion, Understory Reinitiation and Old-growth as defined by Oliver and Larson, 1990. The stages indicate stand development that change over time by succession and disturbances. The length of time required to pass through each of these stages vary by species and habitat conditions.

Table 3 shows the vegetative stages from 1835 through 1947 for both public and private lands. The information was extrapolated from the 1947 Historical Vegetation map.

Table 3: Historical Seral Stage

Seral Stages Habitat Types	DBH In Inches	1835 – 1855 in Acres (Percent)	1876 – 1915 in Acres (Percent)	1947 in Acres (Percent)
Stem Initiation Early Habitat	1.0 -- 4.9	23,000 (21%)	18,447 (17%)	370 (<1%)
Stem Exclusion Pole Small Timber	5.0 -- 20.9	1,000 (<1%)	19,550 (18%)	11,568 (11%)
Understory Reinitiation Mature Timber	21.0 -- 31.9	82,328 (75%) This includes Mature Old-growth	67,581 (61%) This includes Mature, old-growth	16,333 (15%)
Mature, Old-Growth	>32.0	Acres Included in Mature Timber	Acres Included in Mature Timber	77,660 (71%)
Unsuited Non-forested		1132 (1%)	1132 (1%)	1132 (1%)
Meadows		1763 (2%)	1763 (2%)	1410 (1%)
Water		777 (<1%)	777 (<1%)	777 (<1%)
City		Unknown	378 <1%)	378 (<1%)
Other*		Unknown	372 (<1%)	372 (<1%)
Total		110,000	110,000	110,000

*Other is Roads, Administrative Sites and Special Use

Fires were the predominant disturbance mechanism for historical vegetation conditions. Between 1835 and 1855, most of the stem initiation forest habitat acreage was in large blocks. These blocks were in upper Packard Creek drainage and upper Coal Creek drainage. Most of the remaining few hundred acres of early seral habitat were east of the MFW River. Pole-size and small timber habitats evolved in areas of the 1850's fires.

The series of fires around the turn of the century created stem initiation forest habitats in a more mosaic pattern instead of in a large block. These fires concentrated heavily in the Larison and Packard Creek area.

In the early 1900's, emphasis on fire suppression resulted in a substantial reduction in early seral forest habitats. There was a gradual loss of meadow size and of open forest habitats as ingrowth of understory occurred.

The analysis for the MFWDT focuses on dominant habitat types. Within each dominant habitat are many subsets. Table 3 shows the relationship between seral stages and habitat types. Pure conifer habitat, mixed hardwood/conifer habitat, open forest habitat and dense forest habitat further define habitat types. Guilds of wildlife species are being developed for the Western Cascades.

The assumption is that most of the habitat types found in the Watershed today were in the Watershed prior to the 1940's.

Plant and wildlife species composition are directly linked to habitat types suitable for species to live and reproduce. No general regional surveys or site-specific surveys have been conducted for survey and manage species. The number of populations of riparian and old-growth dependent species were probably higher historically because more habitat existed for them.

Although only comprising 1% to 2% of the MFWDT, Special habitats contribute to the overall biodiversity of the landscape. The prevalent special habitats in the Watershed are dry rock gardens, mesic meadows, dry meadows, wet meadows and rock outcrops. The main processes affecting special habitats were slope instability, flood events, and fire. Fire played a large role in maintaining meadows. Fire suppression and grazing cessation may have resulted in gradual tree encroachment on dry and mesic meadows resulting in loss of meadow size (Walstad,1990).

The Calapooya Mountains are high in botanical diversity. Holland Meadows, Johnson Meadows, Gertrude Lake, Bristow Prairie, Bradley, and Loletta Lakes are some of the various meadows found between the high rocky talus ridgetops.

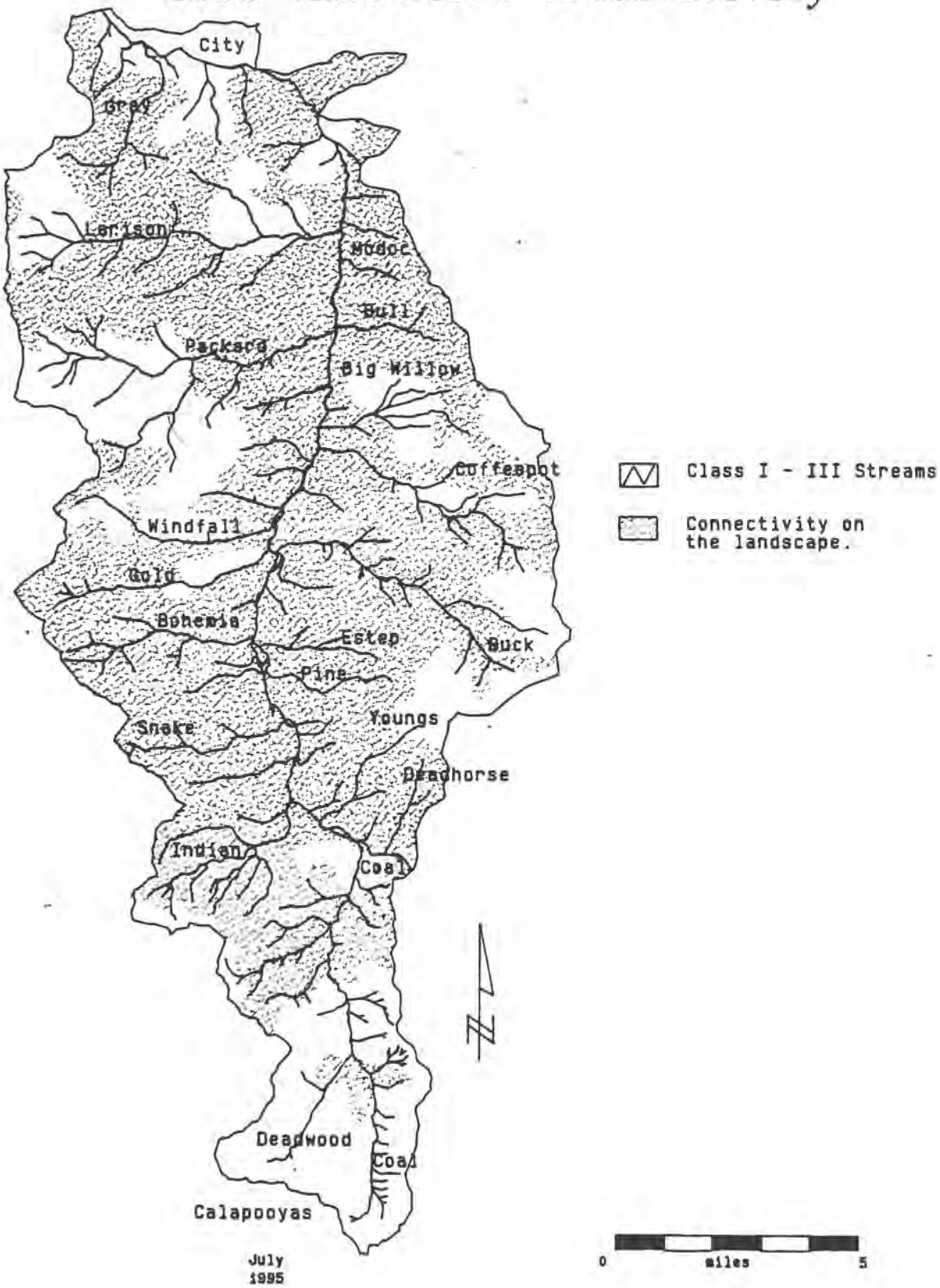
The area of the Watershed that is now a part of the designated Late Successional Reserve (LSR-0222) was mostly mature and old-growth forest. The area had the same distribution of western hemlock/Douglas-fir habitat types and Mountain hemlock and Noble fir/Pacific silver fir habitats as the rest of the MFWDT.

Habitat Connectivity

Connectivity is addressed in terms of mature and old-growth forest habitats and associated wildlife species. Functions of the habitat are foraging, dispersal of offspring, genetic interchange between populations, recolonizing areas, and expansion and retraction in population distribution or range. A way to measure connectivity is in the **distribution and size of the vegetation patches** (Figure 5).

Figure 5: Middle Fork Willamette Downstream Tributaries

1850 Historical Connectivity



Mature and old-growth habitats have been the dominant, long-term habitats on the landscape. Except for special habitats, early seral forest habitats were relatively short-term (15-25 years) at any given location.

Large blocks of interior habitat, existing after the turn of the century fires, were still interconnected with mature and old-growth forest habitats distributed across or around early seral habitats. In most situations, the mature and old-growth habitats' interconnectors were of adequate size and depth to serve as interior forest habitats. However, four riparian areas and their associated low saddle ridges which served as dispersal corridors into adjacent Watersheds were notably affected. The areas were: 1) Coal Creek mid and upper reaches, 2) Buck Creek upper-most reach, 3) Big Willow Creek mid and upper-most reach, and 4) Packard Creek upper-middle reach.

The saddle ridge routes were likely important for species associated with Class III and IV streams, seeps and similar riparian habitats higher on the slopes.

Overland dispersal occurred across the landscape over steep and gentle terrain. The gentler gradient terrain likely served the greater number of species. Dispersal across steeper gradient terrain was likely an essential factor for species as the tailed frog.

The Calapooya Mountains act as a high ridgeline corridor along which species can disperse and migrate. It can also act as a barrier for some species moving upslope.

Interior Habitat

Interior habitat is measured by the **distribution and size of vegetation patches.** After the stand replacement fires around 1850, large blocks of mature and old-growth interior forest habitats remained. These habitats probably had small, early seral openings resulting from previous underburn fires. On the landscape, these large blocks of mature and old-growth habitats functioned as contiguous forests (Table 4, Figure 6).

Table 4: Large Blocks of Interior Habitat after 1850

Area	Approximate Acres
Dinner Ridge, Larison Creek, Lower Packard, Lower Windfall Creek	13,440
Gold Creek South To Lower Coal Creek	19,200
Buck Creek To Youngs Creek	10,880
Modoc Creek, Bull Creek Area	2,560

Many of the remaining mature, old-growth habitats were interior habitats ranging in size between 2,000 acres to 100 acres and were distributed across the landscape. Areas such as Youngs Creek periodically burned. The sparseness of residual overstory canopy might have resulted in this area being characterized more of an open woodland, instead of interior forest habitat.

The 1876 - 1915 fires substantially reduced acreage sizes of interior mature, old-growth habitats. Table 5 shows the large blocks of interior mature, old growth habitats remaining around 1900. Numerous smaller interior habitat blocks, ranging in sizes of 1000 acres and less, were distributed across the Watershed.

Table 5: Large Blocks of Interior Habitat After 1876 - 1915

Area	Approximate Acres
Lower Packard Creek Drainage	7,600
Upper Dinner Ridge, Larison Creek	1,280
Mid. Larison Creek Area	1,920
Lower Pine Creek to Youngs Creek Area	4,500
Indian Creek, Lower Coal Creek Area	7,040
Upper Buck Creek Area	2,300
Cone Creek Area,	2,200

See Figure 7, the Interior Habitat after 1876--1915 map for a perspective of interior habitat.

Ecological Site Productivity

Ecological site productivity as addressed in this document relates to the functions of **large woody material (LWM).** Between 60 to 70 percent of the Watershed was of mature and old growth forest habitats that provided some level of LWM.

Fire, wind, insects, and disease were the main factors in creating LWM in the MFWDT. Fires affected thousands of acres and produced varied levels of LWM. Wind, insects, and disease affected small areas and produced varied levels of logs and snags.

In areas of stand replacement fires, levels of LWM remained high for many decades. The level gradually lowered until the forest matured and supplied a recruitment of new large logs and snags. The stand replacement fires of the mid-1850's and the turn of the century fires provided high levels of LWM. The overlap of the 1850 and 1900 fires in the Larison and Packard drainage's, left a low level of LWM.

The frequency and locations of underburning are not known. Assumptions are that areas of infrequent underburning gradually increased the level of LWM. Areas of frequent underburning probably had low levels of LWM.

Riparian Habitat

Riparian areas of the river, streams and wetlands **provide some of the most important habitat** for wildlife and plant species. Many of the wildlife species that either feed or reproduce in the aquatic area of the riparian are directly dependent on the adjoining riparian habitats.

Riparian areas also serve a landscape function of connectivity, for dispersal and genetic interchange of riparian associated species.

Fires, floods, debris slides, and deep-seated mass movements were factors affecting riparian habitats. Deep-seated mass movements occasionally created "slump" ponds and wetlands, with resulting riparian habitats around them. In the lower gradient river system, floods tended to cause changes in channel alignment, resulting in some loss of forested riparian habitat while the abandoned channel alignment revegetated. Floods also maintained a complex of side channels. Many of these provided ideal conditions for beavers to dam and create wetlands. The wetlands then provided habitat for associated wildlife and plant species. Photos from 1946 show evidence of this riparian condition.

The MFW River's average stream gradient is 2%. In 1946, the river had an alternating single to double thread channel from one bend to the next. The active floodplain width was roughly 2 to 5 times the wetted channel width. Islands of mature timber were present within the active channel. Mature conifers dominated the riparian area with hardwoods along the edge.

Aquatic Domain

The important processes for the Aquatic Domain are: Landslides (VM4); Hydrologic Recovery (VM3); Wood Recruitment and Shading (VM5); and Habitat Complexity (VM5).

Landslides

A review of older air photo sets (1946, 1955 and 1959) established reference conditions. Most of the analysis area was unroaded, particularly in the upper reaches of streams and on the ridgelines. Exceptions were Big Willow Creek, Coffeepot Creek, Buck Creek and the privately owned parcels in the lower reaches of Indian Creek.

Debris flow locations and occurrences were the primary evaluation mechanism for determining the reference or baseline condition of the MFWDT. Debris flows typically occur on steep ground with shallow, rocky soil. 66% of the Watershed meet these criteria. These soils are evenly distributed throughout the analysis area.

A comparison was made between debris slides that occurred in unroaded, unharvested areas that appeared in sequentially younger air photo sets. Of the 10 events noted, 9 appeared between 1959 and 1967, presumably in conjunction with the 1964 flood (a 100-year event). The single debris slide noted in the 1959 photos is not clearly natural. Road construction activity was nearby and equipment may have been driven up the channel. There was evidence of numerous pre-historic debris flows. There was no clear means of determining whether they occurred 100 years ago or 1000 years ago.

Bohemia Creek drainage contained 4 of the 10 naturally occurring debris slides. The remaining 6 were distributed evenly among Estep, Gold, Snake, Indian, Coal and Deadwood Creeks. None of the pre-historic debris flows were reinitiated and the areas that had the highest frequency of pre-historic events had no new initiations during this time span.

Since all but one of the slides occurred in conjunction with a non-periodic storm event, a further attempt was made to determine the frequency of debris slide events. This was done by enlarging the reconnaissance area to include the entire Rigdon Ranger District. Again, no recent naturally occurring debris slides were noted prior to the 1964 flood.

With two exceptions, active slope movements involving deep-seated failure mechanisms were not apparent. Field experience in the analysis area has shown that there are numerous deep-seated landslides that have been active during the span of time covered by the photo sets. The rate or size of movement was not great enough to exhibit signs obvious enough to been seen in the photos. The exceptions are large landslides located at the confluence of Powder Creek and Buck Creek; and the vicinity of Windfall Lake.

Hydrologic Recovery

The geology of the Western Cascades has determined the drainage network and **water yield characteristics** of the Watershed. This geologic character determines the rate at which water enters the groundwater and surface water systems. This is discussed under the section on water yield. Modification of this interaction occurs with a change in vegetation pattern.

Historically a change in vegetation occurred through natural fire and/or disease and bug infestation, all of which can result in reduced crown closure. Open

areas with **trees less than 35 years** of age evapotranspire less water than do forests with full canopy closure below a certain threshold of storm intensity. This introduces more water into the soil which can affect earthflow rates and surface erosion associated with ground water seepage. Open areas also accumulate greater quantities of snow than forests with full canopy closure. Snow accumulation and rain on snow events can cause rapid snow melt and high peak flows within the channel networks.

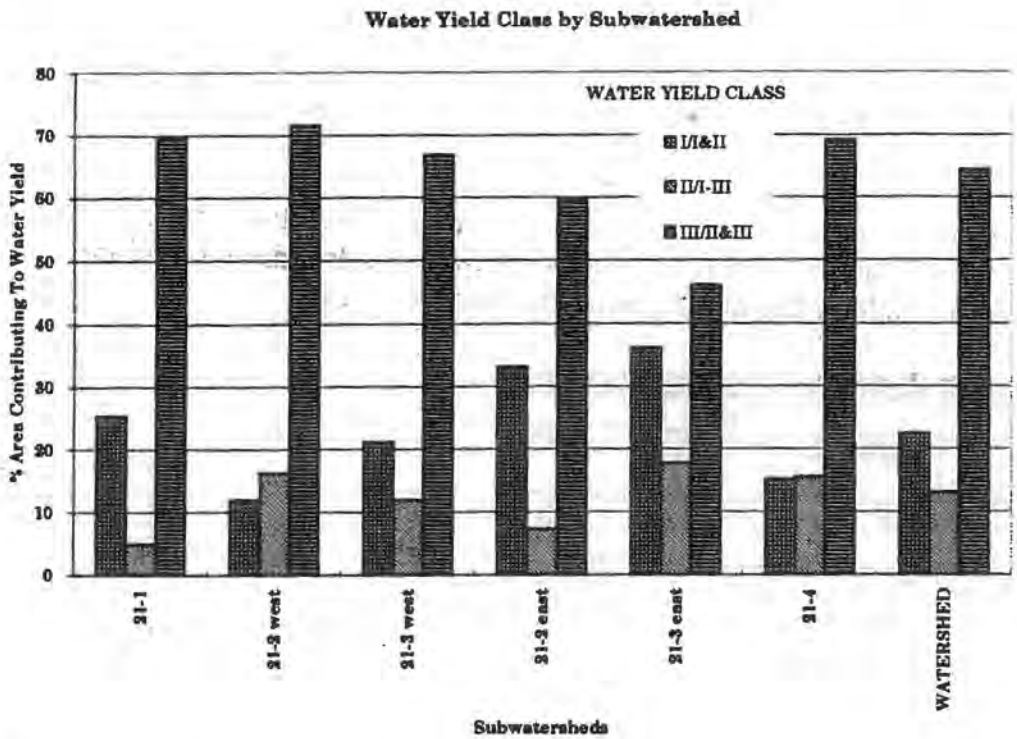
The historical range of hydrologically unrecovered forested land varies from 21% to less than 1% (Table 6). The reduction of hydrologically unrecovered forest to 1% results from modern fire suppression that began in 1910.

Table 6: Percent Hydrologically Unrecovered

	Years		
Seral Stage Habitat Type	**1835-1855**	**1876-1915**	**1947**
Stem Initiation Early Habitat	21%	17%	<1%
Rock outcrops, meadows, unsuited	3%	3%	2%
Total Unrecovered	24%	20%	3%

Landtypes with a Class III water yield dominate the MFWDT. This indicates streams are flashy and respond quickly to storm events and less water is detained in the soils as groundwater for contribution to summer low flow. Figure 8 reveals that streams on the west side of the MFW River show a potentially greater peak flow response to storm events as compared to streams on the east side.

Figure 8: Water Yield Class



The reference condition for **flow regime** is the same as the existing condition. Refer to Chapter 4 for information.

Two notable flood events occurred in the Willamette River Basin prior to this period of record. One flood event occurred in 1861 that exceeded the 1964 flood in magnitude. The second flood event occurred in 1890 that was of slightly lesser magnitude than the 1964 flood event. Floods of a smaller magnitude took place in 1923 and 1945 (Waananen, Harris, and Williams,1971).

Wood Recruitment And Shading

Functions that change with harvest in riparian areas are wood recruitment and shading. A reference condition for these parameters provides a measurement for existing conditions.

The assumption is that stands within the **riparian area older than 55 years** of age begin providing LWM to the riparian area, stream channel and floodplain. The reference condition for this parameter is a range of natural variation from 61% to 86% (Table 7). Another assumption is the reduction between the 1835--1855 and the 1876--1915 time periods primarily resulted from the large floods that occurred in those years. Floods of this magnitude were important

recruiting wood from the riparian zone and distributing it throughout the channel.

Table 7: Riparian Area >55 Years

Seral Stage	Reference Timeframes		
	1835 -- 1855	1876 -- 1915	1947
Percent >55 Years	75%	61%	86%

Cold **stream temperatures** characterized the MFW River prior to intensive timber management activities. The temperatures were in the low 40's during the winter time and from the upper 40's to upper 50's during the summer time. Temperature measurements taken during the 1937 U.S. Bureau of Fisheries (USBF) survey reveals a range of water temperatures. Near Simpson Creek, immediately upstream of the MFWDT boundary, the temperature was 50 Fahrenheit near Simpson Creek, to 58 F near Coffeepot Creek (Table 8).

Table 8: 1937 Water Temperatures MFW River

Location	Date	Time	Sky	Air Temp Fahrenheit	Water Temp Fahrenheit
MFW/Simpson	9/3	14:30	P. Cloudy	67	50
MFW/Estep	9/2	16:10	Fair	68.5	56
MFW/Coffeepot	8/28	16:40	Fair	64	58
MFW/Modoc	8/31	17:00	Fair	62	57

The late afternoon and late summer timing of these measurements are past the usual peak summer temperatures that occur from late July through mid-August. These values can be expected to be slightly lower than the maximum summer water temperature for 1937, but provide a good indication of the reference condition. Natural disturbance processes such as fire, debris flows, windthrow, and disease have periodically altered the thermal regime in various parts of the drainage network, primarily through tree mortality. In addition, some riparian harvest along the MFW River may have occurred by 1937. This would influence water temperatures and what we are considering to be the undisturbed condition.

It is likely the temperature of most tributaries was slightly cooler than the mainstem of the MFW River due to the greater amount of canopy closure and the overall higher elevation of the tributaries. The Bureau of Fisheries Survey, measured temperatures at the mouths of three tributaries in the lower, middle, and upper sections of the Watershed (Table 9).

Table 9: 1937 Water Temperatures in Tributaries of MFW River

Location	Date	Time	Sky	Air Temp Fahrenheit	Water Temp Fahrenheit
Simpson Creek	9/12	NA	NA	70	52
Buck Creek	7/10	NA	NA	70	54
Hills Creek	9/11	14:30	Clear	70	57

These values average 54.3 F, one degree cooler than the mainstem at 55.25 F. The data suggests a general trend of increasing temperatures in the downstream direction for both the mainstem and tributaries.

Habitat complexity

Historical floods, fires, and debris torrents were the primary factors affecting channel health of the streams in the MFWDT. The parameters available to represent reference condition for habitat complexity are **stream width and depth, the number of pools per mile, and bottom substrate type**. Table 10 summarizes these parameters.

Reference streams are from stream surveys completed by the U.S. Fish and Wildlife Service in 1937 and 1938 (USFWS,1938). Not all subwatersheds have reference streams for tributaries to the MFW River. In these cases, reference "reaches" within a subwatershed considered to be "unimpacted" by management or natural disturbances will be used for comparison under current conditions.

The reference streams used for the MFWDT are Coal Creek, Buck Creek and the MFW River. Coal Creek headwaters are on the northern slopes of the Calapooya Mountains and flow north to join the south bank of the MFW River.

The estimated flow for Coal Creek was 30 cfs. The water level fluctuated 5 to 6 feet. Very few small cutthroat trout were seen. The character of the Watershed was mountainous and densely wooded. Pools per mile increased upstream with an increase in "pocket pools" and decrease in full spawning pools.

Willow, alder, and maple grew densely along the margins of the stream. There was a scattering of hemlock and fir conifers. The ridges in the lower portion of the MFWDT supported oak, fir, cedar, a few pines, and maples occurring in areas denuded by fire. In the upper portion, yellow pines predominated with occasional sugar and white pines. One hundred and fifty Spring Chinook were noted between Camp Croft and Campers Flat. Two hundred and twenty-seven were seen from this point upstream to Echo Creek Ridge Trail. Fifty-five were documented above Echo Creek (USFWS,1938).

Water level fluctuated between 10 to 12 feet between Modoc Creek and Cold Springs on the MFW. Some silting and some slight domestic pollution from

Westfir and Oakridge occurred at this time. Five Chinook salmon were noted between the confluence with the North Fork and Oakridge in late August. In addition, suckers, dace and squawfish were abundant, with fair numbers of whitefish. The lower river had fair numbers of 2 to 4 inch rainbows. The upper reaches had fair numbers of 1 to 6 inch cutthroat along with 5 inch Dolly Varden (bull trout).

The area consisted of high hills enclosing a narrow valley. The banks steep and generally high, composed of solid rock in many places. This stretch was heavily wooded with fir forest growth. Along the banks were willow, alder, maples and berries. Large pools up to 400 yards long frequently alternated with riffles and rapids. Many fish were seen, including numerous suckers and dace and a few rainbows, cutthroat and whitefish.

Table 10: Reference conditions for MFWDT streams (USFWS, 1938).

Stream	Reach mile	Stream width (ft)	Stream depth (ft)	# Pools/ mile	% Large rubble	% Med. rubble	% Small rubble	% Mud and sand
Coal Crk	1	22.2		15	44	28	18	10
	2	21.9		19	44	25	21	10
	2.6	19.5		20	52	22	17	9
Buck Crk	0.5	18.3		100	50	12	19	19
MFW	Echo Crk Trail/Rigdon GS	10	2.5	17	32	38	27	3
	Campers Flat Bridge (Now called Staley Creek Bridge)	57	4	43	52	26	17	5
	Camp croft	42	20	26	49	28	19	4
	Cold Springs Forest Camp	120	9	34	51	27	16	6
	Modoc Creek Trail Crossing	81	3	29	45	28	22	5
	Confluence Salt Creek	105	1.5	31	48	26	21	5
	Oakrige salmon trap (old location)	180	3	48	43	30	16	11
	Above confluence w/ NF	150	16	34	31	36	23	10
	Shadydell	180	10	12	46	29	21	4

ISSUE (NF) Exclusion of Natural Fire

Modern day fire suppression began in the MFWDT around 1910. Reference conditions are considered between 1835 to 1910. To evaluate the changes in the landscape due to the exclusion of fire, several functions or processes relating to the key questions were evaluated. This issue relates to the vegetation manipulation issue since natural fires were the most significant impact to the vegetation landscape for historical conditions. Some of the parameters measured are the same for both issues. Information will not be repeated under this issue, but is referenced to the vegetation section.

Table 11: Reference Functions/Processes For Exclusion Of Natural Fire

Domain	Question	Function Process	Mechanism/Cause	Parameter Measured
Terrestrial	NF1	Fire Pattern, Behavior & Intensity	Natural Fires	% Seral Stage Size And Frequency Of Fires
	NF2	Habitat Diversity	Natural Fires	% Seral Stage Species Composition Habitat Types
	NF3	TE&S Species And Fire Dependent Species	Natural Fires	Species Composition
Aquatic	NF2	Riparian Structure	Natural Fires	Fire Intensity In Riparian Area Water Quality And Quantity
Social	NF1	Fire Pattern, Behavior & Intensity	Human Use Of Fires	Early Use Of Fire

Terrestrial Domain

The important processes for the Terrestrial Domain are: Fire Pattern, Behavior & Intensity (NF1); Habitat Diversity (NF2); and TE&S Species And Fire Dependent Species (NF3).

Fire Pattern, Behavior & Intensity

The four **seral stages** were predominately created by wildfires in reference conditions. Table 11 shows the vegetative stages from 1835 through 1947 in the MFWDT.

Table 11: Percent Seral Stage

	Ages/Percent		
Seral Stage Habitat Type	**1835 – 1855**	**1876 – 1915**	**1947**
Stem Initiation Early Habitat	21%	17%	<1%
Stem Exclusion Pole Small Timber	<1%	18%	11%
Understory Reinitiation Mature Timber	75% This Includes Mature Old-growth	61% This Includes Mature Old-growth	15%
Mature Old Growth	Included In The Mature	Included In The Mature	71%

Fire underburn occurrence on an 80 to 120 year interval maintained open multi-aged mature, old-growth forest habitats in the drier Douglas-fir sites, especially on gentler slopes. Stand replacement fires created a higher percentage of open seral forest habitats on steeper southern aspects.

In the early 1900's emphasis on fire suppression resulted in a substantial reduction in early seral forest habitats. There was a gradual loss of meadow size and of open forest habitats as ingrowth of understory occurred.

Periodic and reoccurring wild fires were relatively frequent and played a very important part in shaping the MFWDT. Fire has burned nearly the whole area at some point in time.

One probable scenario is a stand replacement type fire burned through an area. This resulted in creation of many snags and a large accumulation of fuels on the forest floor. Several years or decades later, a second fire came through burning more intensely than the first because of the heavy fuel loads. Table 13 shows the size and timeframe for some of the larger historical fires in the MFWDT. The acres are the total of numerous fires that occurred during that period of time. Figure 9 represents the historical fires.

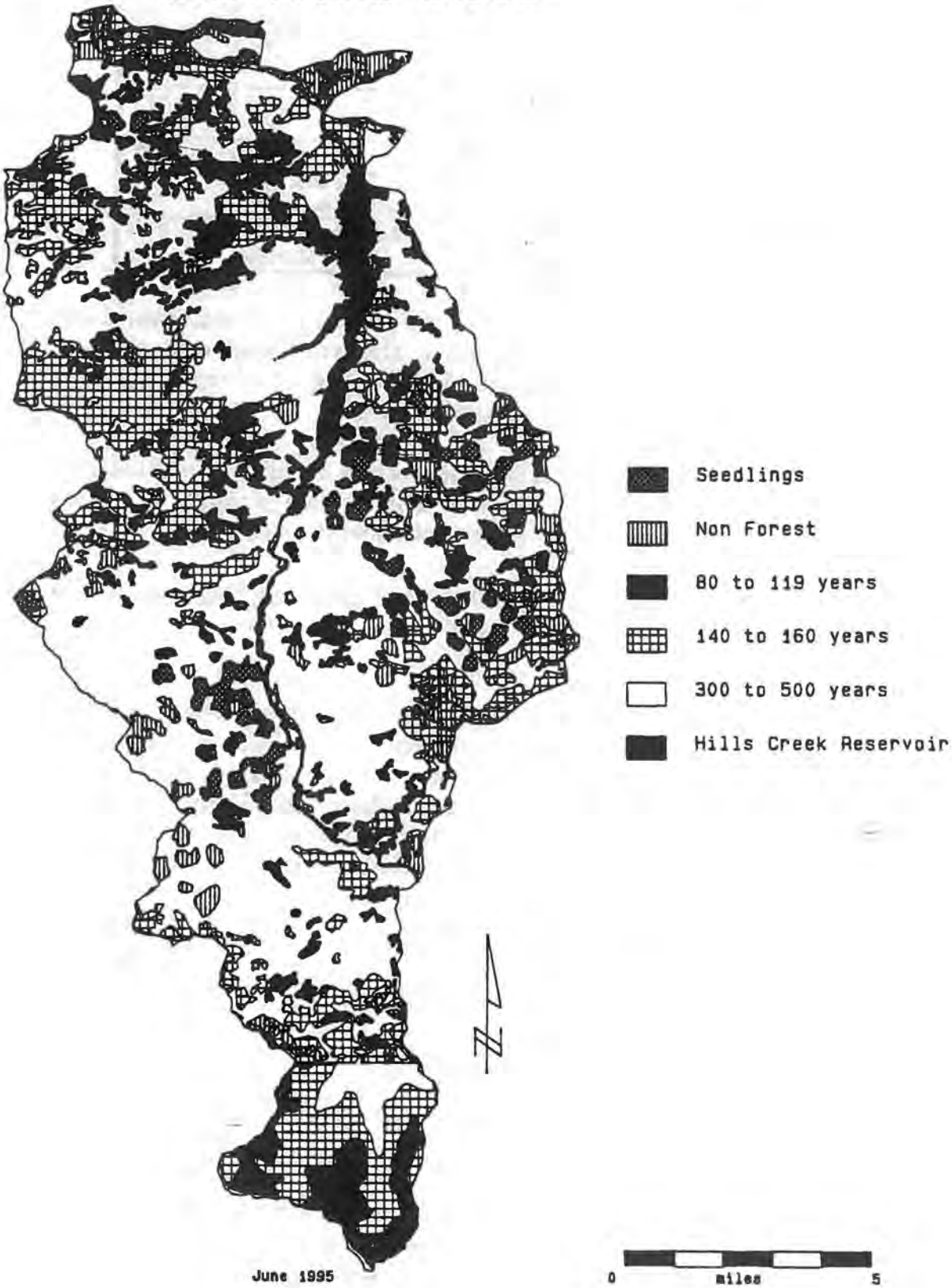
Table 13: Historical Fires for MFWDT

Year of Origin Range	Acres Burned	% of MFWDT
1495 -- 1695	61,726	56%
1835 -- 1855	23,583	23%
1876 -- 1915	13,780	11%

Means found, "that dry site stands are burned at intervals averaging 100 years,(and probably less), by fires that destroy only a portion of the canopy..." (Means,1980). The fact that such periodic, non-catastrophic fires are common on

Figure 9: Middle Fork Willamette Downstream Tributaries

Historical Fires



dry sites in the pre-fire suppression period suggests the possibility of intentional underburning by aboriginal peoples.

Early pioneers claim that the forest floor was so open that stock and horses could be driven or ridden through the timber in many places. By 1917 dense thickets of brush and saplings' growth made its appearance due to lack of fire (Winkler, 1984).

Habitat Diversity

Frequency and intensity of fires were the dominant factors affecting habitat diversity. Over the centuries most of the Watershed experienced fire.

Refer to Table 13 for the **percent seral stages.**

Species composition is one way to measure the diversity of habitat. The assumption made is most of the special habitats found in the Watershed today were found in the Watershed before 1910. The total acreage of dry and mesic meadows seen in 1947 were assumed higher in the past.

Fire was a factor in maintaining meadow areas. Meadow size often fluctuated as a result of and the absence of fires. Periodic intense fires would burn the encroaching trees, restoring the meadow's size. Frequency of fires determine the effectiveness of abating the tree encroachment.

More discussion on **habitat types** is found with the vegetation issue. Early seral habitats developed in small patches, complex mosaic patterns, and large acreage blocks. Large areas of early seral habitat created by stand replacement fires, as in the Packard Creek area, would have provided a greater species richness, or number of wildlife species, associated with early seral habitat (Bunnell, 1990). Such large areas generally have a greater diversity of habitat sites within them.

Early seral habitats regenerated in two scenarios of habitat structure and composition. One habitat is mostly pure conifers. The second is a mixed hardwood and conifer habitat.

Areas of frequent underburning would have shown a low concentration of large logs and snags. These areas typically had more open understory, with minor lower canopy structure. Such habitats of frequent underburning commonly existed on southern aspects.

Areas where fires were several hundred years apart, would have shown high concentrations of large logs and snags. A corresponding high concentration of

wildlife species associated with large logs and snags and multiple canopy structures probably existed.

Brush and hardwood trees upslope from the riparian areas were important components in habitat diversity. These areas provided suitable habitat for many wildlife species.

Brush occurred in several habitat forms. Ceanothus, a fire dependent species, occurred as brush 'fields' after high intensity stand replacement fires. Ceanothus brush habitats dominated the sites for decades by suppressing conifer regeneration. Vine maple and ocean spray brush habitats varied in densities, dependent on sites. More diversity of brush species at a given site added diversity to the habitat structures and wildlife species that utilized them.

Hardwood trees, as big-leaf maple, cottonwood, red alder, white oak, madrone and chinquapin, provided a mix of hardwood and conifer forest habitats across the landscape, commonly on the warmer sites. Hardwood trees tended to persist longer than brush habitats in the second growth conifer.

Flood events affected the hardwood riparian forest of the larger, low gradient river and streams more dramatically than fires. The hardwood riparian areas on steeper gradient streams had a greater variance in effects from fires.

TE&S Species and Fire Dependent Species

Measurements of **plant and wildlife species composition** assists in establishing a reference condition. Two rare plant species dependent on moderate intensity fires for germination are woodland milkvetch and branching montia. The assumption is there were more populations of these plants scattered through the Watershed when fires were allowed to comb the area.

The milkvetch, a Region 6 Sensitive species, was found in 1993 to the north of the MFWDT Watershed, in the Warner Creek fire area. It is assumed that some population(s) of milkvetch on the Umpqua NF were connected to populations within the North Fork of the Middle Fork Willamette Watershed through the MFWDT.

A few populations of Branching montia are found on the eastern edge of the MFWDT in the Shady Beach fire area. Similar habitats exist throughout the Watershed.

Several wildlife species currently listed as Threatened, Endangered or Sensitive, would have inhabited this Watershed up to the 1910's. The assumption is that fire affected habitats of American peregrine falcon, the northern spotted owl, and the northern red-legged frog. The northern bald eagle probably did not

inhabit the MFWDT for nesting It was likely an infrequent forager of the Watershed during non-nesting seasons.

For the peregrine falcon, the series of fires around the 1850's and the turn of the century created various habitat types. The diverse array of habitat conditions provided for a variety of bird prey.

For the northern spotted owl, the early fires tended to reduce its habitat acres, and the owl's population in the watershed probably fluctuated to a small extent as a result of the large fires. The great horned owl populations were probably at a higher level following the 1835--1855 and 1876-1915 fire series. The great horned owl probably caused a displacement of some spotted owl pairs.

The red-legged frog tends to favor a forested environment for foraging. A favored breeding habitat is "slump" ponds. These areas are generally on gentler terrain that incurred underburning, retaining a forested environment.

Aquatic Domain

Riparian Structure

The **intensity of fire** is highly variable due to such factors as topography, soil moisture, fuel moisture and loads, vegetation density and weather patterns. One assumption is that frequent lightning caused fires shaped the riparian stand structure. Stand replacement fires would consume riparian vegetation particularly in the upper slopes with intermittent streams. consumed in stand-replacement fires. As vegetation succession progressed, future less intense fires would primarily burn brush and limbs. The resulting structure would consist of surviving mature trees, a sparse understory of younger trees, with grassy ground cover and very little brush.

Mid-Windfall Creek and mid-Big Willow Creek experienced intense stand replacement fires in the mid-1850's. This left a high accumulation of snags, down logs, and early seral riparian forested habitat. A few riparian areas, as various reaches in mid and upper Packard experienced moderately intense fires. This resulted in sparse riparian overstory forest. Most riparian areas experienced underburns with intensity increasing the further the fire was from the creek.

We do not have information available at this time to measure the specific changes fire had on **water quantity and quality**. The assumption is the effects of fire on water quantity and quality of forested watersheds would be similar to current fire impacts. The resulting mosaic vegetation pattern resulting from the different types of fire intensity across a landscape affected hydrologic processes to various degrees.

Stand replacement fires that destroy overstory forest vegetation will generally increase annual water yields. This increase declines with time as regrowth of forest vegetation occurs. These fires may cause accelerated erosion impacts to the water quality of forested mountain watersheds. Erosional effects become increasingly greater as terrain steepness increases.

Where low-intensity fires occurred, much of the organic matter comprising the forest floor may have remained. The effects of these types of fires would generally be an insignificant factor in water quality and quantity.

Social Domain

The assumption is that **human use of fire** did not impact as much of the landscape as wildfires. People did utilize fire to manipulate vegetation. It seems likely that annual firing of the brush and underburning of the forest were intentionally utilized by native peoples throughout the MFWDT. This increased the range and abundance of game and edible and useful plants.

Settlers used fire extensively. Ranchers preferred fire to rejuvenate their fields: A rancher set fire on the lee side of ranch buildings and allowed it to burn across his field; "no effort whatever was made to prevent it from reaching the neighboring timber. "Fires were rarely extinguished before the fall rain or until they burn out for lack of material on which to feed." (Gorman,1899). These fires may have spread into Forest Service lands.

ISSUE (TR) Transportation System

The timeframe for reference conditions for the transportation system is from the mid-1850's until the 1940's.

Table 14: Reference Functions/Processes For Transportation System

Domain	Question	Function Process	Mechanism Cause	Parameter Measured
Terrestrial	TR7	Wildlife & Plant Habitat Quality	Natural Conditions	Plant and Animal TE&S Habitat Special Habitat Disturbance
	TR9	Fire Ignition And Suppression Response Time	Transportation System	Miles of Road
	TR10	Forest Use	Pre-1940's Condition	Miles of Road
	TR6	Riparian Habitat Quality	Roads In Riparian Reserves	Acres of Riparian Habitat Lost
Aquatic	TR1, TR2	Landslides	Natural Disturbances	Frequency Of Occurrence
	TR3	Surface Runoff & Routing	Natural Conditions	Drainage Network
	TR4	Culvert Carrying Capacity	Culvert Design	# Undersized Culverts and Risk Potential
	TR6	Species Distribution Migration Corridor	Natural Conditions	Fish Distribution Culvert Location And Size
Social	TR8	Sedimentation	Trails In Erosive Soils	# Miles Trails In Erosive SRI's

Terrestrial Domain

The important processes for the Terrestrial domain are: Special Habitats (TR7); Wildlife and Plant Habitat Quality (TR7); Fire Suppression Response Time (TR9); Forest Use (TR10); and Riparian Habitat (TR6).

Wildlife and Plant Habitat and Quality

The road system of the 1940's and before **had very little effect to wildlife**, other than as access for hunting and trapping. The OCMWR and the Willamette City residential area resulted in about 155 acres loss of riparian habitat. The consequence to riparian associated wildlife was insignificant.

An emphasis species in the MFWDT is the Roosevelt elk. An assumption is that elk numbers were moderate to low compared to current numbers. Another assumption is the elk predominately used the area on the east side of the MFW River. Especially from the Hills Creek confluence to Deadhorse Creek. Watershed.

The major factors involved in maintaining **sensitive plant habitats or special habitats** is stability of the hydrologic regime and keeping contiguous habitat for dispersal and pollination. The road system was confined to the Oakridge area

and along the MFW River. These roads and trails did not adversely affect sensitive plant habitats or special habitats.

Fire Ignition And Suppression Response Time

The reference condition for **miles of open roads** is considered about 22 miles. Most of the MFWDT was unroaded except for the area around the city of Oakridge and the OCMWR. Fire suppression response time would have been slow before construction of the extensive road system.

Forest Use

Over the centuries, Indian groups developed a **well-defined trail system** they used until after Euroamerican settlement in the MFWDT. Wheeled access to the area was first provided by the Free Emigrant Route that later became the OCMWR in the mid-1800's. During the summer of 1853 between 250 and 300 wagons used this route.

Roads within this Watershed were limited to the vicinity of the City of Oakridge, Willamette City, the Hills Creek community of Hilltop at the confluence of Hills Creek and the MFW River, and the OCMWR.

Large scale transportation system development in the MFWDT began in the 1940's. Roads were constructed for timber access of private lands by the Pope and Talbot Company, and by the Forest Service to access U.S. Government land.

Riparian Habitat Quality

A way to measure historical riparian habitat quality is measuring the **loss of riparian habitat**. The approximate length of the MFW River within the Watershed is 30 miles. Using current standards, a minimum 800-ft riparian width (400-ft each side) would provide about 2910 acres of riparian reserve.

The development of Willamette City along the river probably had the largest impact on riparian habitat for a single location. About 48 acres of riparian reserve would have been lost to residential areas. About 107 acres of riparian habitat was lost to roads. About 5% of the MFW River riparian area might have been lost by conversion to road, and residential settings. The assumption is other riparian areas were not affected.

Aquatic Domain

The processes in the Aquatic Domain measured for change were: Landslides (TR1, TR2) and Surface Runoff and Routing (TR3);

Landslides

A function that has changed in the Watershed as a result of road construction is mass failure resulting in landslides from side-cast road construction. A reference condition for landslides is under the Vegetation Manipulation issue (3-8,9).

Surface Runoff and Routing

The major streams that flow directly into the MFW River parallel each other and have a secondary **dendritic drainage pattern**. Stream density for the entire Watershed is 3.1 miles per square mile. Stream densities are 2.7 miles per square mile in the south end of the MFWDT and increase to 3.4 miles per square mile in the north end. Specific information regarding miles of stream by class, acres, square miles of land and stream density is in Chapter 4, Current Conditions and Appendix G, Hydrology Documents.

Culvert Carrying Capacity

The reference condition for road and stream crossings is considered to be zero. Roads that existed used low water fords or log stringer bridges at stream crossings.

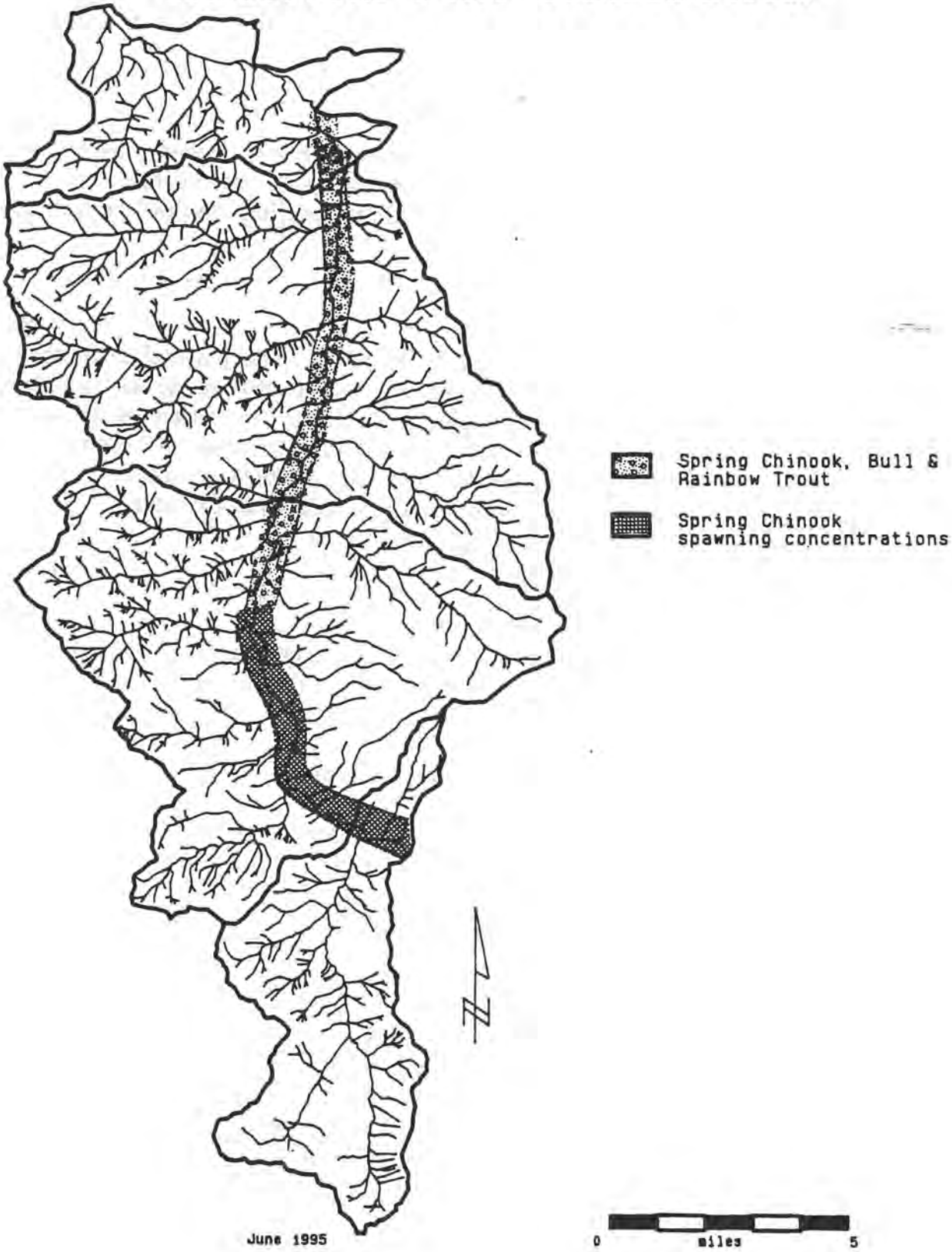
Species Distribution and Migration Corridor

A reference condition for **fish distribution** is from a historical report from the Bureau of Reclamation (1937), the USFWS (1938), Oregon State Water Resources Board (Hutchison, 1966), and from the Upper Willamette River Basin Management Plan (Connolly et. al 1991). See Figure 10.

Spring chinook were the only endemic anadromous fish in the Middle Fork of the Willamette sub-basin. The run in the sub-basin, while relatively small at approximately 2,550 fish, may have been the largest of any above Willamette Falls. In 1947, the run was estimated to account for 21 percent of the spawning population above Willamette Falls. Before construction of the impassable dams of Dexter and Fall Creek, the primary spawning areas for Spring Chinook were the North Fork of the Middle Fork Willamette, Salt Creek, Salmon Creek, Fall Creek, and the Upper Middle Fork Willamette. Chinook salmon were documented spawning as high as Tumblebug Creek.

Figure 10: Middle Fork Willamette Downstream Tributaries

Historical Fish Distribution



Since **culverts** were not a part of the historical landscape a reference condition for blocked passage due to culverts is considered zero.

Social Domain

Sedimentation

From a 1950 district map, this Watershed contained 120 miles of trail. There was approximately one trail per drainage for access to high ridges and mountain peaks, and fire lookouts. The impact of the trails to sedimentation was not significant since most trail treads were usually less than two feet in width and did not present a large bare surface. A visual review of **trail location** and SRI maps indicates most of the trails were not located **in highly erosive soil types**.

Issue (NS) Non-Native Species

The reference time frame for non-native species is from 1835 to the 1940's. The only function discussed is Introduced Species Composition in the Terrestrial Domain. The Hills Creek Dam and Lake Issue address aquatic non-native species.

Table 15: Reference Functions/Processes For Non-Native Species

Domain	Question	Function Process	Mechanism Cause	Parameter Measured
Terrestrial	NS1	Non-Native Species Composition	Natural Conditions	Abundance And Occurrence Of Non-Native Species
Aquatic		See Hills Creek Dam And Lake Issue		
Social		Not Applicable		

Terrestrial Domain

Non-Native Species Composition

A parameter that can be measured for change is the **abundance and occurrence** of non-native plant and wildlife species. Noxious weeds have dramatically increased in abundance since the turn of the century. Scotch broom was introduced as an ornamental shrub and an erosion control agent in the 1920's (Miller,1995). St. John's-wort has been a medicinal herb for many years; it was probably a garden escapee. Thistles traveled west as contaminant in alfalfa and other crop seed bags and came into Portland in the ballast of sea-faring vessels (Forcella and Harvey,1988).

Prior to European settlement in mid-1850's, introduction of non-native wildlife is considered non-existent. By the 1930's and 1940's, certain non-native wildlife species, such as the bullfrog had been introduced into the Pacific Northwest. Their presence or noticeable effects in the MFWDT were doubtful at that time.

ISSUE (EI) Infrastructure

The timeframe used for the existing infrastructure issue is from 1910 until 1963. The process analyzed is Resource Integrity and Function. The Social Domain seemed the appropriate place for the discussion.

Table 16: Reference Processes For Infrastructure

Domain	Question	Function Process	Mechanism Cause	Parameter Measured
Terrestrial		Not Applicable		
Aquatic		Not Applicable		
Social	EI1	Resource Integrity & Function	Lands Committed to Facilities	Miles of Trail Inventory of Facilities

Social Domain

Resource Integrity and Function

Measuring **miles of trails** is one parameter in assessing resource integrity and function. Early Euroamerican settlers widened Indian trails for the herds of livestock. Some of the trails including the Staley Ridge Trail and the trail that later became the Oregon Central Military Wagon Road.

Until the major road construction activities of the 1970's and 1980's, trails were the facilities that provided the access to much of the Watershed. In the early 1960's, much of western portion of the Watershed was unroaded. Many trails were the main transportation facilities. There were at least seventeen major trails, with some still in the current trail system (Table 17).

Except for Dead Horse, Moon Lake, Pine Creek, Star, and Tufti Mountain, the trails accessed the Calapooya Divide. These mileage's are approximate and taken from a 1950 district map. Already, roading was in the process of reducing trail mileage. At one time these historic trails, with many of the trails being built during the CCC era of the 1930's, were the only facilities available to provide access to much of the MFWDT

Another parameter that can be measured for change is the **number of facilities**. Although dispersed camping took place at an early date, the developed campgrounds in this Watershed were largely constructed in the mid to late 1960's. An exception was the Campers Flat area that was a well-established campground used extensively by Native Americans as late as 1910. Packard Creek, and Sand Prairie Campgrounds and CT Beach Boat Ramp and Picnic Area and Bingham Boat Ramp were built in response to the construction of Hills Creek Dam and pooling of Hills Creek Lake in 1961.

Table 17: Major Trails in the MFWDT Prior To 1960

Trail Name	Length (miles)
Larison Rock	4.3
Larison Creek (on ridgetop)	7.4
Minick Way (current Larison Creek)	5.8
Dinner Ridge	7.0
Packard Creek	5.8
Rocky Point Way	4.0
Grass Mountain	5.6
Johnson Meadows	4.2
Indian Creek	5.4
Bristow Trail	4.4
Staley Ridge	10.7
Coal Creek Way	5.8
Moon Lake Way Staley Ridge	3.0
Pine Creek Way	1.7
Star	2.3
Tufti Mountain	5.1
Holland Meadows	6.9
Total	**89.4**

Mining activities have not been a major activity within the Watershed. The MFWDT has always contained the largest number of mining claims on the Rigdon Ranger District due to its proximity to the Bohemia Mining District to the west. There has been prospecting but never any major location activities. According to a 1961 mining claim record, there were 89 claims scattered throughout the Watershed for both placer and hardrock. The search for types of minerals ranged from gold to uranium lodes.

ISSUE (HL) Hills Creek Dam and Lake

Hills Creek Dam and Lake affected landscape processes downstream and upstream of the reservoir and within the original stream syste (See Figure 11). The major affects from preparing to fill and filling the reservoir were: Loss of habitat connectivity for wildlife (HL1); Eradication of undesirable species (HL2); Inundation of river miles and creation of a lake which blocked migration for fluvial species, specifically Spring Chinook (HL2); and Introduction of exotic fish species (HL2).

Now that the lake has been filled, the major issues are: riparian integrity as related to management (HL1); and lake productivity as influenced from turbidity levels varying with wave action and drawdown levels (HL3).

Major issues affecting the downstream habitat are: Loss of habitat complexity as a result of the dam blocking stream transport of LWM (HL4,HL6); and loss of transport capability, flushing flows and floodplain processes as a result of unnatural flow releases (HL4,HL6). Some of the functions and processes are only appropriate for current conditions and will be discussed in Chapter 4.

Table 18: Reference Functions/Processes for Hills Creek Dam and Lake

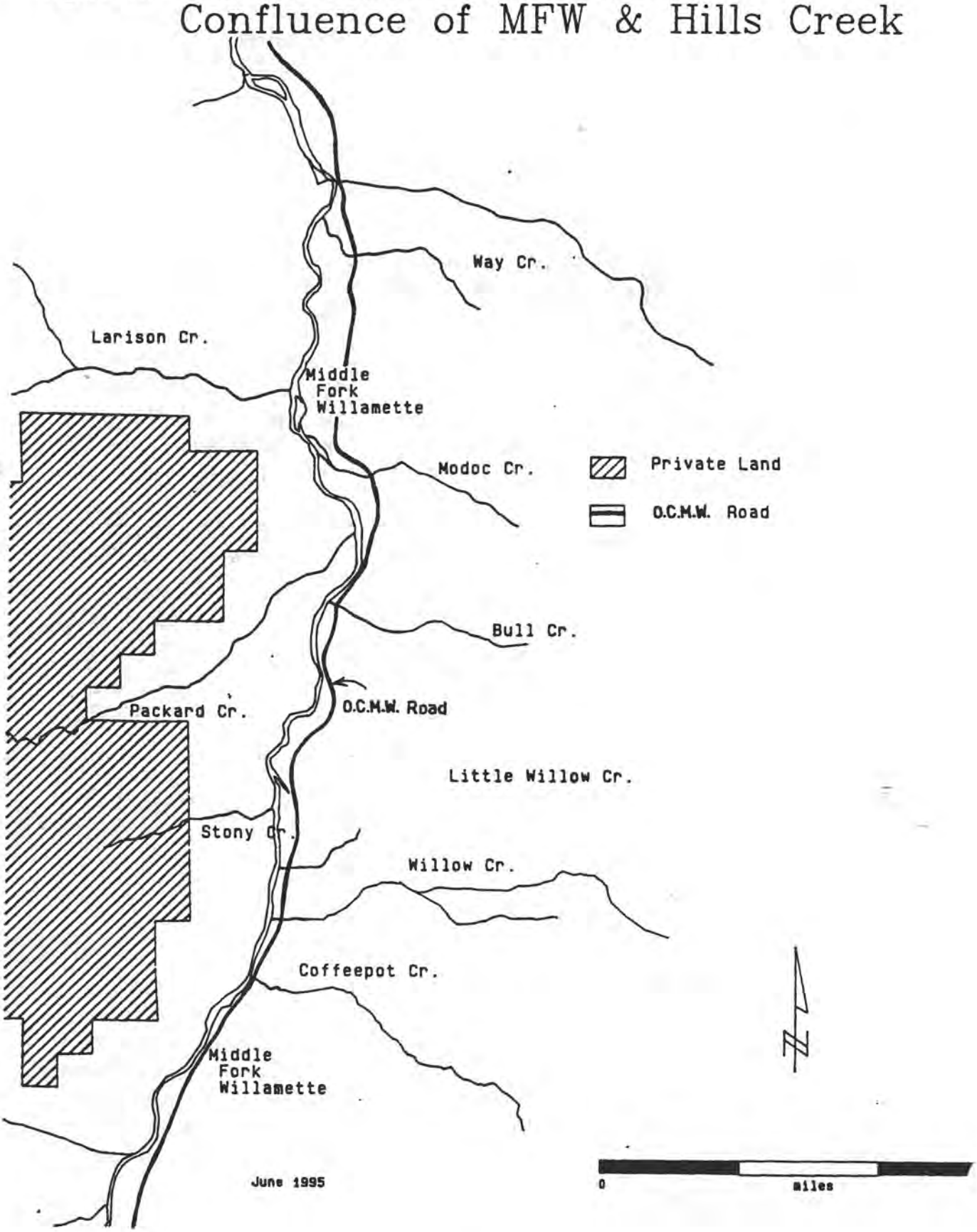
Domain	Question	Function Process	Mechanism Cause	Parameter Measured
Terrestrial and Aquatic	HL1	Riparian Habitat Quality	Stream System	Habitat Connectivity Riparian Plant Species
Aquatic	HL2	Species Composition	Stream System	Species Presence Spring Chinook, Bull Trout Passage
	HL3	Lake Turbidity	Not Applicable	Not Applicable
	HL4,HL6	Downstream Habitat Complexity Sediment Transport	Not Applicable	Not Applicable
Social	HL8	Facilities	Stream System	Number Of Sites Type Facilities
	HL8	Pattern Of Use	Stream System	Use Numbers

Terrestrial And Aquatic Domain

Riparian Habitat Quality

Twelve miles of river floodplain and riparian habitats served as wintering areas and migration routes for many terrestrial wildlife. It also served as part of the fuller riparian **connective corridor** of the river system and tributary systems as the Larison, Packard, Big Willow, and Bull Creek Drainage's. The riparian **associated species** inhabited the wide floodplain, providing a continual interpopulation genetic interchange. Figure 5 represents the stream system before Hills Creek Dam.

Figure 11: Middle Fork Willamette Downstream Tributaries



Aquatic Domain

Species Composition

Refer to the Transportation Issue (3-22,23) under Species Distribution and Migration Corridor.

Social Domain

Facilities

A measurement of change is the **number and type of facilities** around the area that would become Hills Creek Lake. Larison Creek, Minick Way, Dinner Ridge and Tufti Mountain Trails all had trailheads originating on the Middle Fork Willamette River in the area that is now Hills Creek Lake. During the summer of 1853 more than 1500 people with between 250 and 300 wagons used the OCMWR to cross the Upper Willamette Valley (Menefee and Tiller,1977). The lake inundated approximately 12 miles of the Oregon Central Military Wagon Road. There were hunting lodges initiated utilization of the area for recreational purposes (Jensen,1970).

Pattern Of Use

Ethnographic evidence from low elevation sites indicates Native Americans utilized this area. Through the late 1850's and early 1860's gold miners, emigrants, and others passed through this area of the MFWDT. Some logging was done in the 1870's utilizing the Middle Fork River.