Malheur River Subbasin Assessment and Management Plan For Fish and Wildlife Mitigation

Appendix A, Part 1 – Assessment, Subbasin Overview

Malheur Watershed Council

And

Burns Paiute Tribe

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For Fish and Wildlife Mitigation

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1 INTRODUCTION

The Malheur River Subbasin Assessment and Management Plan for Fish and Wildlife Mitigation is comprised of several documents. Because of the size of the documents the primary documents are further divided into sections for the purpose of saving as electronic files. This document, the Subbasin Overview, provides background information on the general subbasin characteristics and water resources. Other sections of the report include the Management Plan (of which this is an appendix), which provides a summary of the assessment and inventory and describes the strategies needed to protect and restore fish and wildlife habitats within the subbasin.

Two other sections of Appendix A are the Aquatic Assessment, which provides the detail on aquatic species within the subbasin, current status, and limiting factors; and the Terrestrial Assessment, which is a similar assessment for terrestrial wildlife.

An additional supporting document, the Inventory Document (Appendix B), provides a summary of and an assessment of existing programs implemented in the subbasin to protect and restore fish and wildlife habitats.

All references are included in a separate document.

2 SUBBASIN OVERVIEW

This purpose of this Subbasin Overview is to describe the macro-scale processes that affect hydrologic response within the Malheur Subbasin, and to provide a framework for understanding the hydrologic processes within watersheds throughout the Subbasin. This report is broken into two primary sections. Section 2.1 provides an overview of the physical and biological setting of the Malheur Subbasin. Section 2.2 summarizes the general hydrology of the Subbasin and watersheds.

2.1 Physical and Biological Setting

2.1.1 General Characteristics

The Malheur River Subbasin is situated in southeastern Oregon. The Malheur River is tributary to the Snake River, entering at approximately river mile (RM) 370. The majority of the Subbasin is located in northern Malheur County, with the remainder located in Harney, Grant, and Baker counties (Figure 1). The Malheur Subbasin is approximately 4,700 square miles in size. For the purposes of this assessment the subbasin has been subdivided into six watersheds. Subwatershed characteristics are given in Table 1. Elevations range from approximately 2,100 feet at the confluence with the Snake River to approximately 8,600 feet in the Strawberry Mountains, in the headwaters of the Upper Malheur watershed. Of the six watersheds that comprise the Malheur subbasin, the South Fork Malheur watershed has the lowest relief, with 55% of the total watershed area having slopes less then 10%, 44% having slopes between 10 and 50%, and only 2% of the watershed area having slopes greater than 50% (Table 1). Conversely, the North Fork Malheur watershed has the steepest relief (Table 1).

Table 1: General characteristics of the Malheur Subbasin and watersheds (USGS, (2004a).

Watershed	Area (sq.mi.)	Elevation (feet)			Slope (proportion of area by slope class)		
		Mean	Min	Max	<10%	10-50%	>50%
Main Malheur	1,012	3,593	2,133	5,968	46%	49%	5%
Upper Malheur	1,080	4,735	3,261	8,570	43%	54%	3%
Willow Creek	787	3,736	2,198	7,815	45%	52%	4%
Bully Creek	601	3,986	2,241	6,447	37%	60%	3%
North Fork Malheur	550	4,932	2,920	7,904	26%	68%	5%
South Fork Malheur	705	4,523	3,268	6,355	55%	44%	2%
Entire Malheur Subbasin	4,735	4,221	2,133	8,570	43%	54%	4%

The city of Vale, and a portion of the city of Ontario, are located within the subbasin. Adjacent cities include Burns to the west, John Day and Canyon City to the north west, Prairie City and Unity to the north, and Nyssa and Adrian to the east. Unincorporated population center within the subbasin include Brogan, Creston, Drewsey, Grove, Harper, Ironside, Jamieson, and Juntura. Federal highway 26 passes through the Willow Creek and lower portion of the Main Malheur watersheds. Federal Highway 20 follows the Malheur River from Vale to Juntura, and continues west through the subbasin to Burns. State Highway 78 passes through the southern portion of the South fork Malheur watershed.

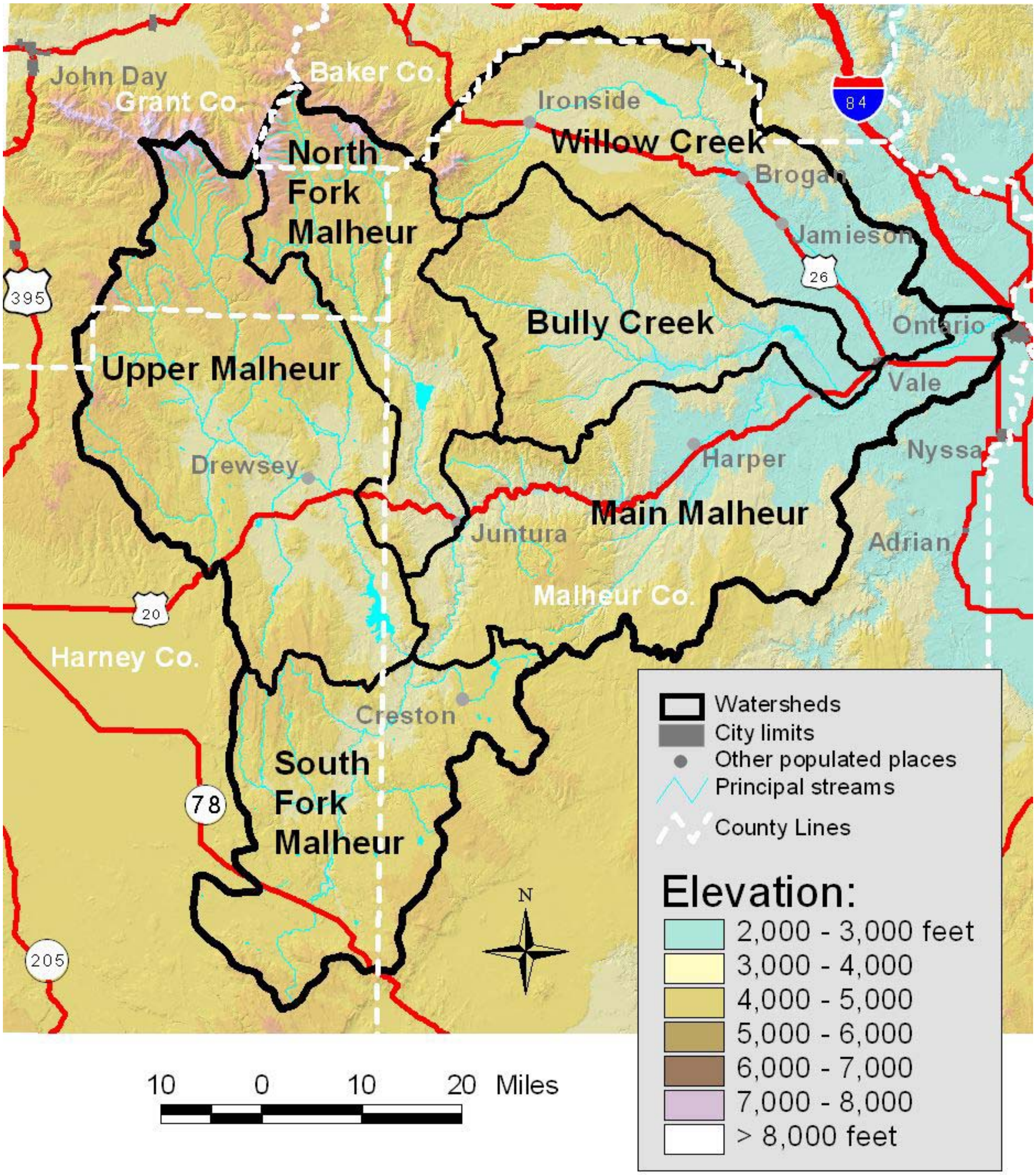
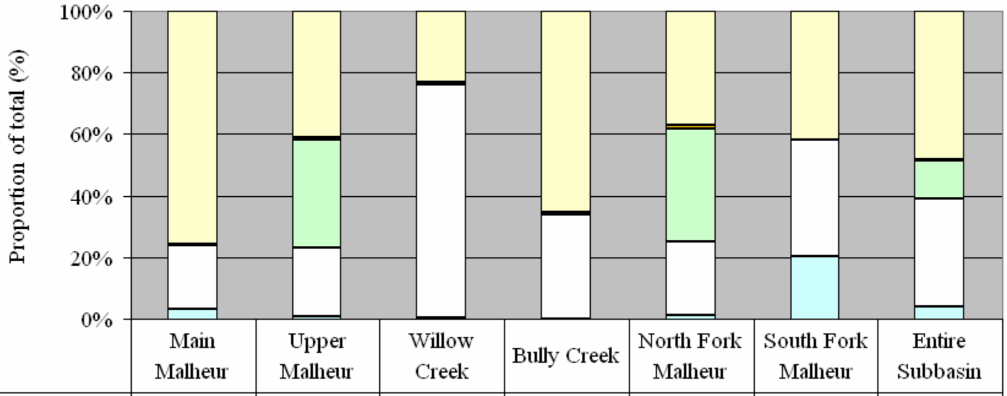


Figure 1: Malheur subbasin shaded-relief map. Data sources: USGS (2004a).

Property ownership with the subbasin is predominantly public, and management is primarily through federal agencies (Figure 2, Figure 3). The Bureau of Land Management (BLM) manages nearly one-half of the total watershed area, with the majority located within the Vale District (Figure 3). Lands managed by the US Forest Service (USFS) are located in the mountainous northwestern part of the Subbasin, within the Upper and North Fork Malheur watersheds. The Bureau of Reclamation (BOR) manages lands associated with its impoundment projects, and has holding within all watersheds except the South Fork Malheur (Figure 2). The Federal Energy Regulatory Commission (FERC) has several small holding along the mainstem Malheur River, and the North Fork Malheur. Most state lands in the Subbasin are located in the South Fork watershed, and are managed by the Division of State Lands primarily for livestock grazing. Oregon Department of Fish and Wildlife owns and manages approximately 4,000 acres distributed along 18 miles of the Malheur River, between Riverside and Juntura (Wayne Bowers, ODFW, pers. comm. 2001). The Burns Paiute Tribe has recently acquired Logan Valley Ranch, consisting of 1,760 deeded acres, and Jones Ranch, 6,385 deeded acres along the Mainstem Malheur, and associated state and BLM leased land for livestock grazing.



	Main Malheur	Upper Malheur	Willow Creek	Bully Creek	North Fork Malheur	South Fork Malheur	Entire Subbasin
🟨 BLM	75.7%	41.2%	23.2%	65.4%	37.0%	41.6%	48.2%
🟧 Bureau of Reclamation	0.3%	0.8%	0.1%	0.5%	1.1%	-	0.5%
🟥 Federal Energy Regulatory Commission	0.2%	-	-	-	0.1%	-	0.04%
🟩 United States Forest Service	-	34.8%	0.6%	-	36.8%	-	12.3%
□ Private	20.8%	22.5%	75.7%	33.9%	23.9%	38.1%	34.9%
🟦 State Agencies	3.0%	0.8%	0.4%	0.2%	1.1%	20.2%	4.1%

Figure 2. Land Ownership/management within the Malheur Subbasin. Values are proportion of watershed area. Data source: BLM (2003b).

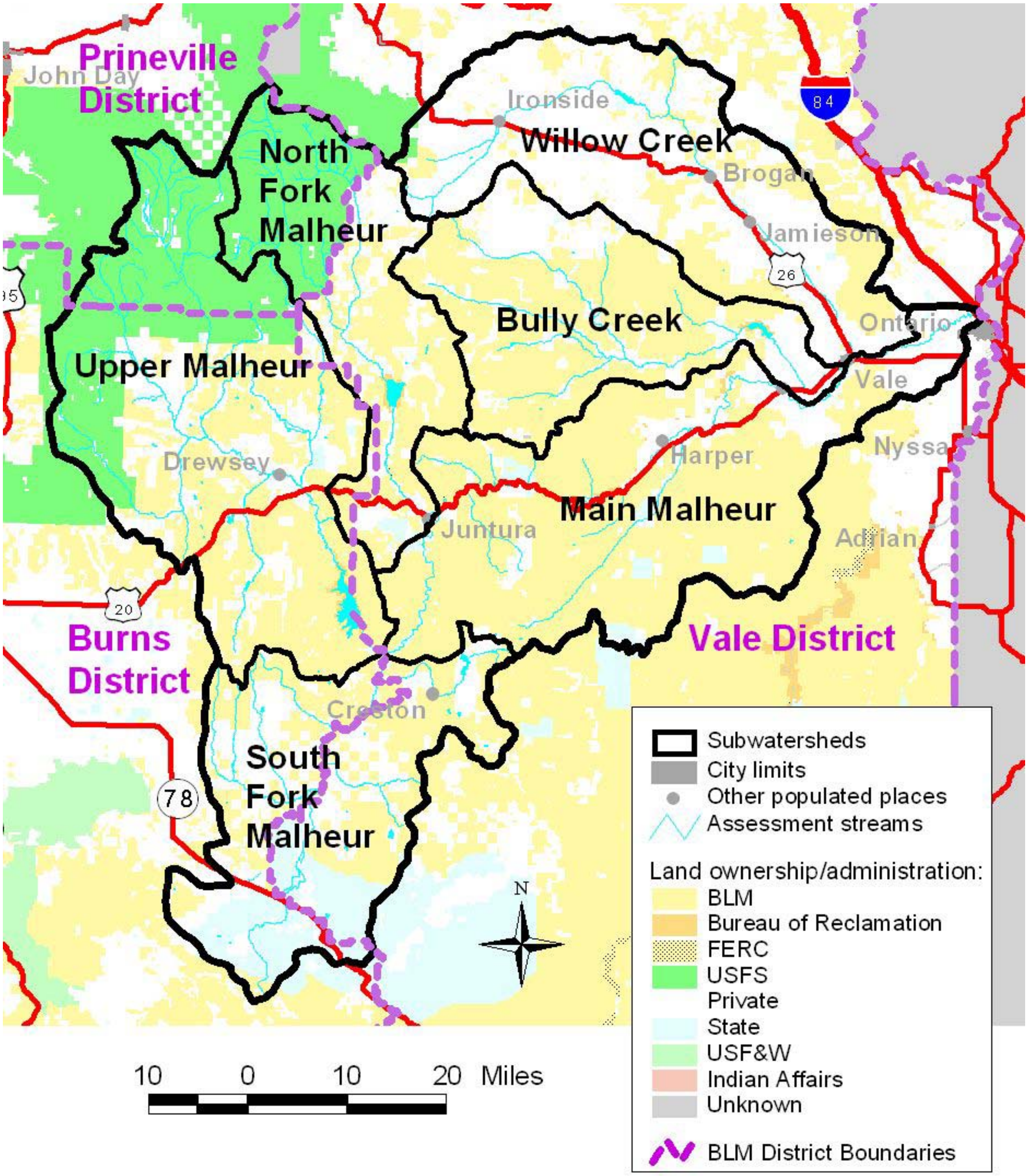


Figure 3: Land ownership within the Malheur Subbasin. Data source: BLM (2003b).

2.1.2 Ecoregions

Information on level III and level IV[1] Ecoregions found within the Malheur Subbasin was available from the US Environmental Protection Agency (EPA, 2003a; Figure 4). Ecoregions denote areas of general similarity in the type, quality, and quantity of environmental resources, and can serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components (Pater et al., 1998). Level III and IV ecoregions were used within the Aquatic Assessment to describe potential riparian conditions (WPN, 2001).

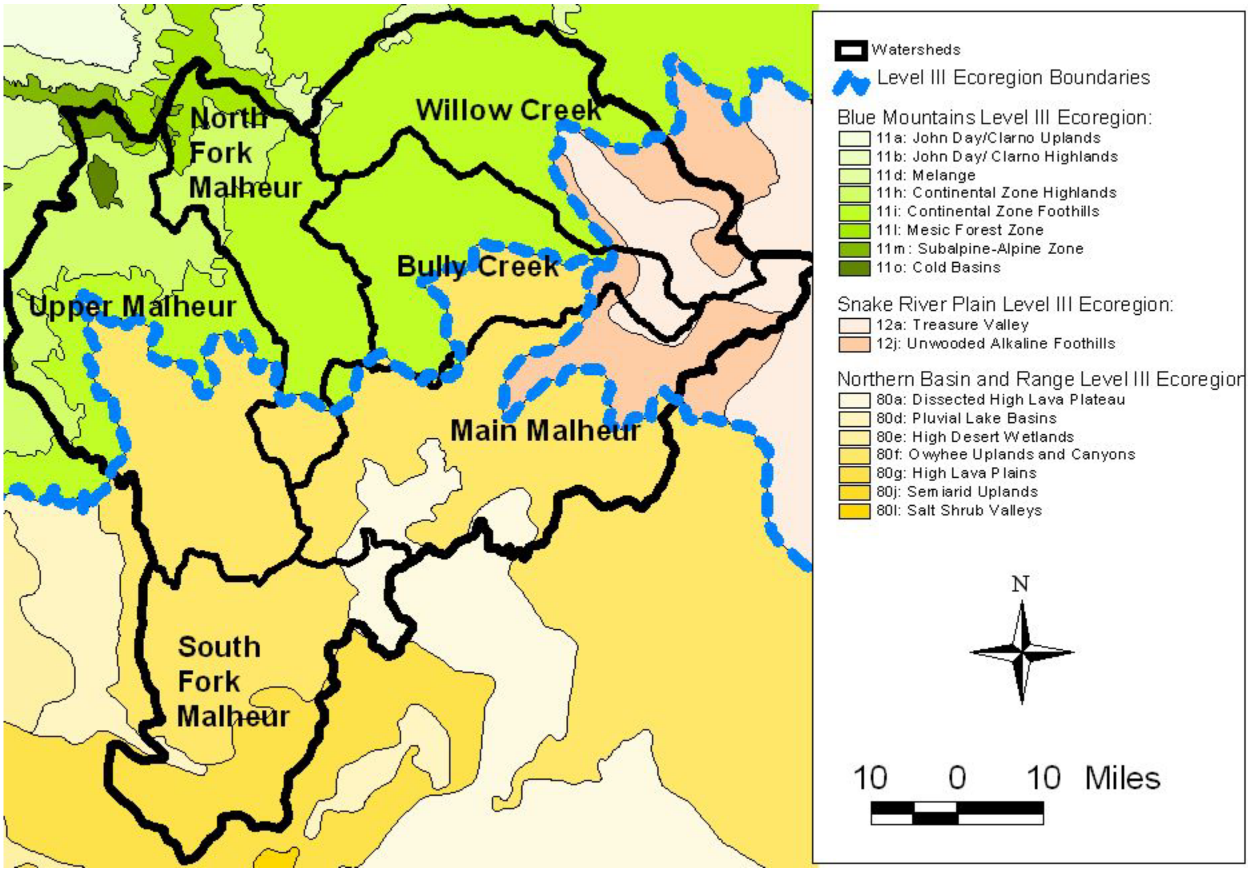


Figure 4: Level III and IV ecoregions in the vicinity of the Malheur Subbasin (EPA 2003a).

2.1.3 Geology & Soils

Most of the Malheur Subbasin consists of gently sloping to rolling lava plateau uplands dissected by river canyons or valleys (Figure 1). Topography in the Malheur Subbasin is the result of volcanic mountain building processes, limited alpine glaciation, erosion, deposition and faulting (USFS 2000). The Malheur River flows mostly through igneous rock terrain that is composed

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[1] Ecoregions are classified using a hierarchical system; Level III ecoregions are compiled at a coarser resolution than level IV ecoregions

principally of volcanic rocks. Sedimentary rocks, mostly tuffaceaous stream and lake deposits, also occur throughout the Subbasin (Laird 1964 *in* Fuste and McKenzie 1987). The watershed is bounded to the north by the Strawberry Mountain range, dominated by Tertiary Strawberry volcanics. An episode of glacial activity that ended about 11,000 years ago left glacial u-shaped valleys and limited areas of unsorted glacial deposits and moraines in this area (USFS 2000). Most the Malheur Subbasin consists of rolling, grass-shrub hills underlain by old lacustrine sedimentary formations of Tertiary age, as well as lava flows of Tertiary to Recent age (MOWC 1999). River canyons and valleys that dissect these hills result from block faulting and weathering of volcanic ash, basalts, and sediments. In the lower Subbasin, extensive low elevation floodplains and terraces parallel the Snake River and extend up the valleys of the Malheur River and Willow Creek (MOWC 1999).

Soils in this semi-arid Subbasin are generally young, thin, and poorly developed. Soils in the mountainous areas in the northwest part of the Subbasin are extremely diverse, depending on interactions with vegetation, topographic aspect, glacial history, and fluvial processes. Forested north slopes tend to have productive volcanic ash mantles (from the Mount Mazama eruption 6,500 years ago (USFS 2000). Less protected south slopes have eroded over time to soils of underlying silt loams. Ridges tend to be comprised of shallow residual soils. Logan Valley soils are shallow with cemented hardpan (USFS 2000). Many soils in the forested northwest portion of the Subbasin are of the Klicker series, underlain by basalt and andesite. These are stony, moderately deep, slightly acidic, and fine loamy soils (MOWC 1999). Within the rolling hills that comprise most of the Subbasin, a thin surface mantle of wind-born loess is present in places on top of the lacustrine sedimentary formation. Narrow alluvial floodplains may also occur along streams. These soils are light colored, low in organic matter, and generally calcareous (MOWC 1999). Floodplain soils in the lower watershed are diverse alluvial soils, generally easily eroded and alkali (MOWC 1999). In general, chemical and biological soil-building processes proceed slowly in this semi-arid Subbasin and disruption of soils can lead to long-term changes in ecological condition and productivity (MOWC 1999, USFS 2000).

2.1.4 Climate

The climate in the Malheur Subbasin is semiarid, characterized by hot dry summers and cold winters. Summer temperatures may exceed 100 Fahrenheit (F), and winter temperature may drop below –20 F. Summer nights are cool, however, due to the generally clear skies and dry air: even in the warmest months. Mean annual precipitation within the Malheur Subbasin varies with elevation, ranging from 49 inches in the upper mountains to seven inches in the lower reaches, and is 14 inches overall (Figure 5; Table 2). Precipitation results from short, intensive convection thunderstorms in the summer and from frontal storms in the winter and spring (Fuste and McKenzie 1987). Unlike most of Oregon, annual precipitation in the Malheur Subbasin is distributed rather evenly throughout the year, although winter months tend to have the highest total precipitation (OCS, 2004a). The driest month throughout the region is July.

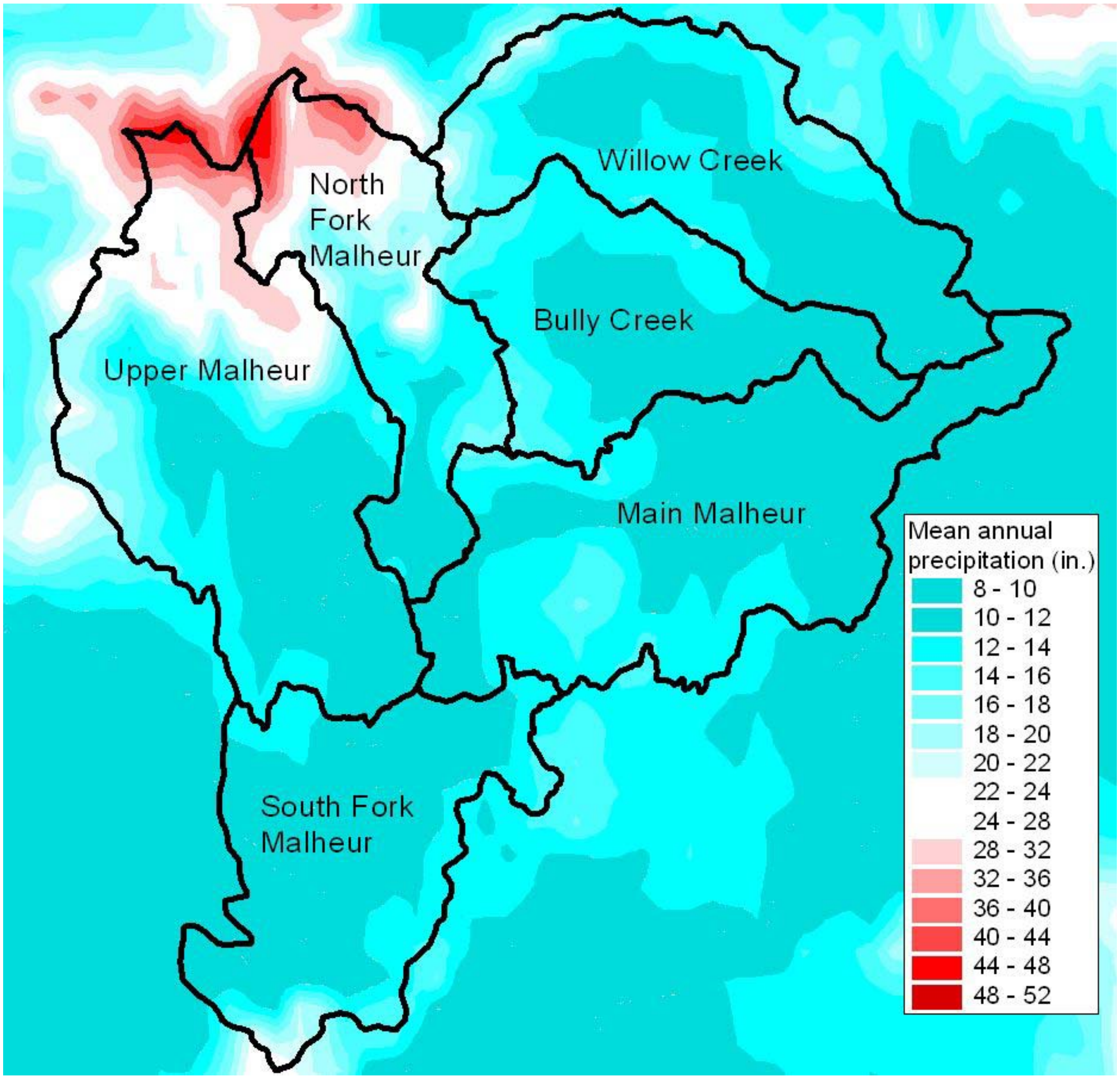

Figure 5. Mean annual precipitation in the Malheur Subbasin (OCS, 1998).

Table 2. Mean annual precipitation (inches) in the Malheur Subbasin (OCS, 1998).

Watershed	Area-weighted mean	Minimum	Maximum
Bully Creek	12.2	9	23
Main Malheur	11.3	7	17
Upper Malheur	16.5	9	49
North Fork Malheur	19.8	9	49
South Fork Malheur	11.4	9	25
Willow Creek	12.6	9	23
Entire Subbasin	13.8	7	49

Year-to-year variability in precipitation was assessed using long-term composite precipitation produced by the Oregon Climate Service (2003b) for climate zone #9 (Malheur County). The long-term records produced by the OCS use values from all climate stations within the region, and cover the period from 1895 to present. Total monthly precipitation data were used to calculate total precipitation by water year[2] (Figure 6; top graph).

The two primary patterns of climatic variability that occur in the Pacific Northwest are the El Niño/Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). The two climate oscillations have similar spatial climate fingerprints, but very different temporal behavior; PDO events persist for 20-to-30 year periods, while ENSO events typically persist for 6 to 18 months (Mantua, 2001). Changes in Pacific Northeast marine ecosystems have been correlated with PDO phase changes. Warm/dry phases have been correlated with enhanced coastal ocean productivity in Alaska and decreased productivity off the west coast of the lower 48 states, while cold/wet phases have resulted in opposite patterns of ocean productivity (Mantua, 2001). Several studies (Mantua et al., 1997; Minobe, 1997; and Mote et al., 1999) suggest that five distinct PDO cycles have occurred since the late 1800's:

- 1890-1924 (cool/wet)
- 1925-1946 (warm/dry)
- 1947-1976 (cool/wet)
- 1977 –1995 (warm/dry)
- 1995–present (cool/wet)

The long-term composite precipitation records produced by the Oregon Climate Service (2003b) for climate zone #9 were used to evaluate whether or not local trends follow the documented PDO cycles. These data were processed as follows:

- The mean and standard deviation was calculated for annual precipitation in each zone over the period of record
- A standardized departure from normal was calculated for each year by subtracting the mean annual precipitation from the annual precipitation for a given year, and dividing by the standard deviation
- A cumulative standardized departure from normal was then calculated by adding the standardized departure from normal for a given year to the cumulative standardized departure from the previous year (the cumulative standardized departure from normal for the first year in a station record was set to zero).

This approach of using the cumulative standardized departure from normal provides a way to better-illustrate patterns of increasing or decreasing precipitation over time by reducing year-to-year variations in precipitation, thus compensating for the irregular nature of the data set. Values for the cumulative standardized departure from normal increase during wet periods and decrease during dry periods.

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[2] Water year is defined as October 1 through September 30. The water year number comes from the calendar year for the January 1 to September 30 period. For example, Water Year 1990 would begin on October 1, 1989, and continue through September 30, 1990. This definition of water year is recognized by most water resource agencies

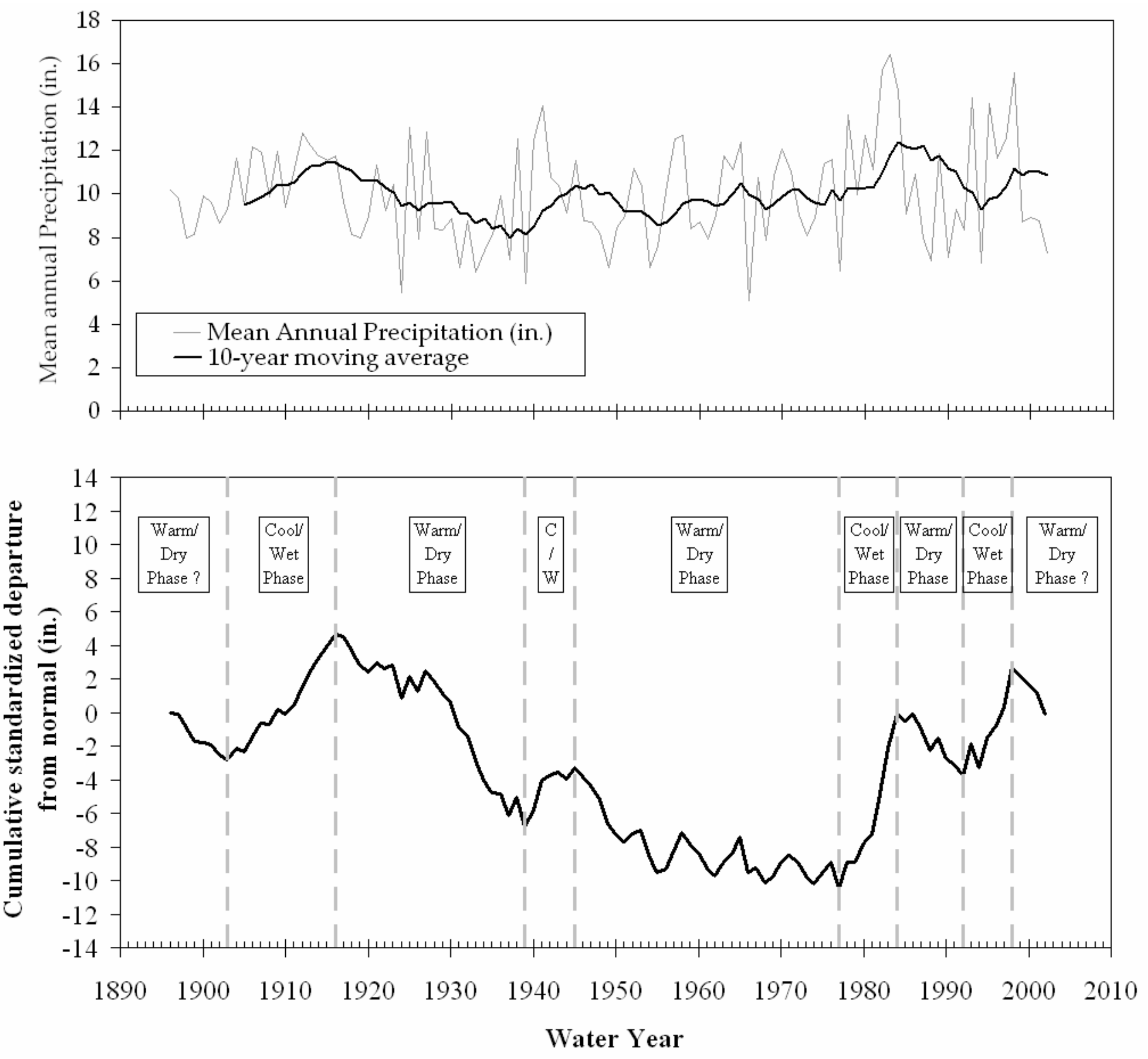

Figure 6. Composite annual precipitation record (top Graph; OCS, 2004b), and Cumulative standardized departure from normal of annual precipitation for Oregon Climate zones #9 (bottom). Local PDO cycles are shown as vertical dashed lines on bottom graph.

Results for the climate zone #9 are given in Figure 6 (bottom graph). The precipitation pattern from the composite record does not appear to follow the regional trends discussed above. There appears to have been a cool/wet phase from 1903-1916, followed by a long warm/dry phase that lasted until approximately 1977. There has been considerably more volatility in the period from

1977 to present, with phases lasting ten years or less. At present we appear to be in a warm/dry phase through the end of water year 2002[3].

2.1.5 Land Use / Land Cover

Vegetation of the Malheur Subbasin has changed dramatically since settlement by Euro-Americans began in the early 1800s. Beaver were trapped intensively by the Hudson's Bay Company in the early 1800s and probably largely extirpated by the mid-1800s (Ogden 1950,1961, 1971; USFS 2000). Most of the valley floors, including riparian shrub, wet meadow, and riparian habitats, were cleared for agriculture or pasture by the early 1900s. Sagebrush steppe, which covered much of the mid- and low-elevation portions of the watershed, has been altered by over 150 years of grazing, fire suppression, exotic invasive plant species, and by juniper encroachment (MOWC 1999). In the forested areas of the Subbasin, logging and fire suppression, beginning in the early 1900s, has resulted in a conversion of much of the Malheur National Forest from open stands of fire resistant large trees to dense, insect and fire-prone stands of shade tolerant trees (USFS 2000, USFS and BLM 1996). Aspen and cottonwood stands, which generally require fire for regeneration and are sensitive to excessive livestock and elk grazing, have been reduced to rare pockets of their former abundance throughout the forested portions of the Subbasin (USFS 2000).

Current land cover/land use within the Malheur Subbasin was estimated using GIS coverages available from the USGS (1999a; Figure 7). The USGS data is part of the National Land Cover Dataset, and was compiled from Landsat satellite captured in the early 1990's, and supplemented by other data where available. The data has a spatial resolution of approximately 30 meters. Current land cover / land use conditions are summarized by watershed and for the entire Malheur Subbasin in Figure 8 below. The majority of the total land area in all watersheds is "Shrubland", ranging from approximately half of the watershed area in the Upper and North Fork Malheur watersheds, to over 90% in the Willow Creek watershed (Figure 8). Evergreen forests make up approximately 1/3 of the Upper and North Fork Malheur watersheds, but comprise less then 5% of total area in the remaining watersheds.

The remainder of the area consists primarily of agricultural-related land uses including row crops, small grains, pasture/hay and grasslands. Agricultural production and processing are the primary economic activities within the Subbasin. River valleys from Harper eastward are devoted to intensive and diversified agriculture. Livestock production dominates river valleys in the upper portion of the Subbasin where irrigated lands are used primarily for growing hay and forage crops. Residential and commercial/industrial areas make up less then 0.3% of the total area in any watershed, and are 0.1% of the Entire Malheur Subbasin.

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[3] Presettlement (from ~1600 AD) climatic records have been produced for south central Oregon using regional tree ring data as a proxy data for presettlement climatic conditions (Miller and Rose, 1999).

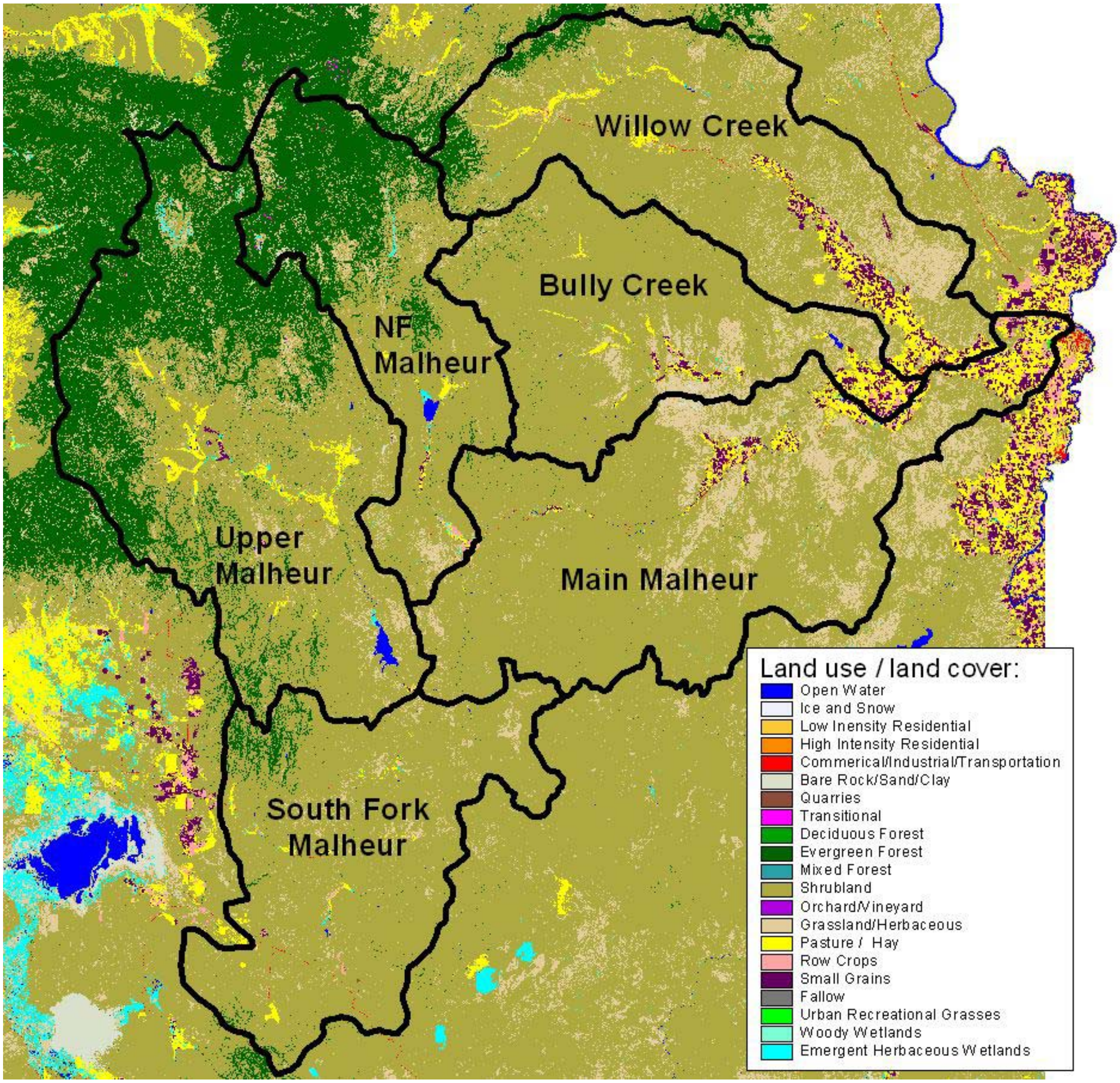

Figure 7: Land use / land cover in the Malheur Subbasin. USGS (1999a).

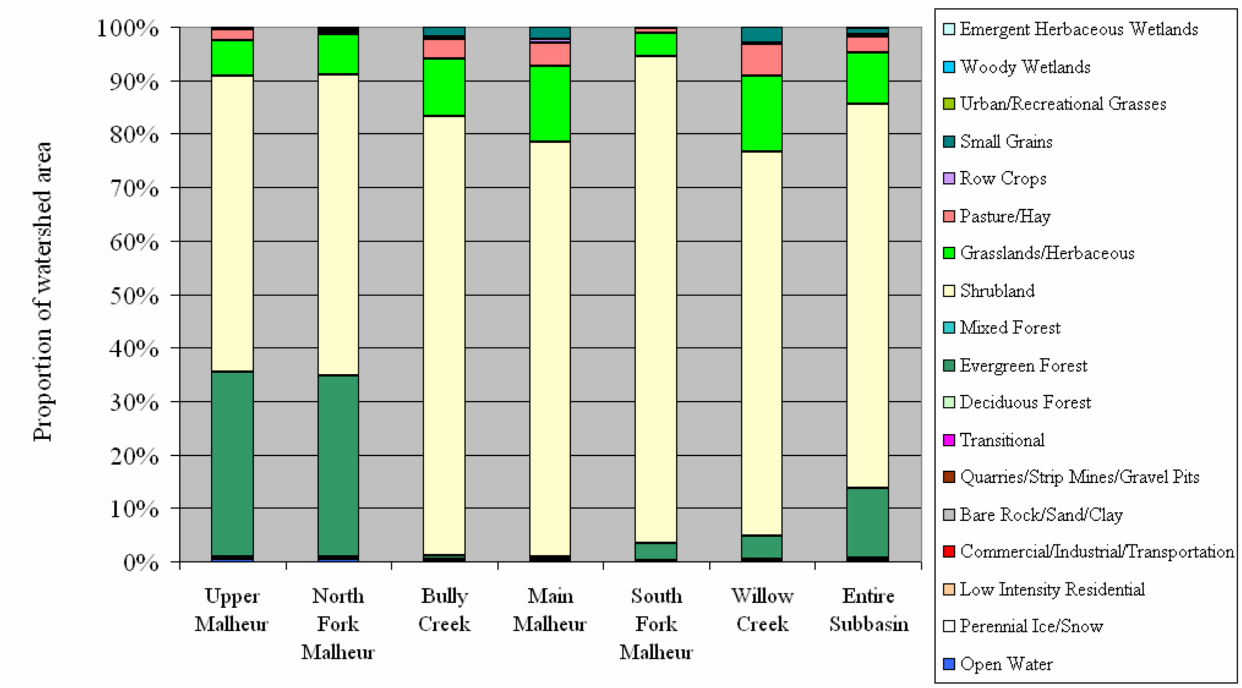

Figure 8. Summary of land cover within the Malheur Subbasin (USGS, 1999a).

2.2 Water Resources

2.2.1 Hydrologic Regime

The streams of the Malheur Subbasin reflect the semi-arid climate. On an average annual basis, low precipitation produces relatively low runoff although large variations can be expected on an annual and on a seasonal basis. Natural flow, except for that resulting from snowmelt in the spring, is usually quite low (Malheur County 1978). The hydrologic regime can best be described using EPA Level III and IV Ecoregions (Figure 4) as a framework to describe the natural variability in the various parts of the Subbasin. Important components of the hydrologic regime by ecoregion have been described in WPN (2001).

Snake River Plain and Northern Basin and Range level III ecoregions

The Snake River Plain and Northern Basin and Range level III ecoregions cover the largest proportion of the Malheur Subbasin (Figure 4), ranging from 13% of the total watershed area in the North Fork Malheur watershed to 100% of the South Fork Malheur watershed, and approximately 60% of the subbasin overall. Snowfall occurs often within these ecoregions during the cold winter months, with significant snowpack occurring at the highest elevations along the northern border with the Blue Mountains. Mean monthly streamflow is greatest during the spring months; however, drainage density is low within this area.

In the Snake River Plain ecoregion (Figure 4), peak flows occur typically in the winter months and can be generated by either rainstorms or rain-on-snow events. Frozen ground contributes to the winter flooding events. Spring peak flows associated with both rain and snowmelt can also occur in this area though less frequently. The magnitude of peak flow events having a 2-year recurrence interval is usually less than 10 cfs/mi^2; however, it can be as high as 100 cfs/ mi^2 where localized cloudburst storms are more common.

Peak flows in the Northern Basin and Range ecoregion (Figure 4) can occur in any season produced by many different processes, however, spring peak flows generated by snowmelt tend to be most common. Summer rainstorms also generate peak flows in this area although, infrequently. Winter rainstorms and winter rain-on-snow processes actively generate many of the winter peak flows, particularly in the northern area bordering the Blue Mountains Ecoregion. Spring peak flows are commonly generated by both rainfall and snowmelt in this area. The magnitude of peak flow events having a 2-year recurrence interval is usually less than 10 cfs/mi^2; however, it can be as high as 100 cfs/ mi^2 where localized cloudburst storms are more common.

Blue Mountains level III ecoregion

The remaining 40% of the Subbasin area falls within the Blue Mountains level III ecoregion (Figure 4). The majority of watershed area falls within the Blue Mountains ecoregion in the Upper Malheur (56%), Bully Creek (65%), Willow Creek (67%) and North Fork Malheur (87%) watersheds. Only 2% of the Main Malheur watershed, and none of the South Fork Malheur, is within the Blue Mountains ecoregion. Within this area the important components of the hydrologic regime have been described at the resolution of the level IV ecoregions (WPN, 2001; Figure 4).

Much of the winter precipitation occurs as snow, and snowpack generally increases with elevation among the level IV ecoregions of the Blue Mountains. At the highest elevations the normally heavy snowpack usually persists well into the summer. Mean monthly streamflows are highest in the spring months. The primary peak flow generating process that occur in these area include spring rain, spring rain-on-snow, and snowmelt. The magnitude of peak flow events having a 2-year recurrence interval ranges from 6 to 20 cfs/ mi^2.

Alterations to flow regime

The natural hydrology of the Subbasin has been dramatically altered by major impoundments and irrigation projects. High stream flows that historically occurred during winter and spring months have been reduced due to reservoir storage. These waters are now released for downstream irrigation in the summer months. Stream flows below the reservoirs are now extremely low from fall through spring and unnaturally high during the summer irrigation season.

2.2.2 Streams and Lakes

Streams within the Malheur Subbasin were characterized using GIS data available from StreamNet (2001). There are approximately 6,500 miles of stream within the Subbasin, 1,400 miles of which is classified as perennial, and 5,100 of which is classified intermittent. An additional 370 miles of irrigation-related canal and ditches are identified, located primarily in the lower portions of the Main Malheur and Willow Creek watersheds.

Approximately 1,110 miles of the total length of stream in the Malheur Subbasin were identified as being significant with respect to the aquatic focal species (i.e., redband trout, bull trout, and Spring Chinook) and was included in the aquatic assessment. These streams were grouped into 63 reaches[4] for the purpose of this assessment. Streams included in this assessment are shown in Figure 2 above. More detailed reach maps, and a summary of reach characteristics, can be found in attachments to the aquatic assessment.

Information on water bodies within the Malheur Subbasin was summarized using information from the Bureau of Land Management (BLM, 2003b; Table 3). Over 1,100 lakes and ponds have been identified within the Subbasin Table 3. The distribution of Lakes and Ponds among the subbasins is generally proportional to watershed area, with the exception of the North Fork Malheur watershed, which is identified as having only 8 lakes/ponds. Impoundments differ from lakes and ponds in that they are water bodies created by human-made structures (dams). Impoundments include reservoirs, dugouts, catchments, etc. The largest impoundments include Warm Springs Reservoir on the mainstem Malheru River (~4,000 acres), Beulah Reservoir on the North Fork Malheur (~1,800 acres), Bully Creek Reservoir on Bully Creek (~900 acres), and Malheur Reservoir on Willow Creek (~500 acres). Wetlands are probably underrepresented in the BLM data presented in Table 3. National Wetland Inventory (NWI) data would better-represent current conditions in the Subbasin, however, this data has not yet been digitized for the Malheur area.

Table 3. Summary of water bodies within the Malheur Subbasin (BLM, 2003b).

	Area (acres)			Frequency		
Watershed	Lakes and Ponds	Impound-ments	Wetlands	Lakes and Ponds	Impound-ments	Wetlands
Bully Creek	63	1,063	1	103	87	1
Main Malheur	70	318	2	101	320	2
Upper Malheur	329	4,725	0	398	58	0
North Fork Malheur	3	1,885	72	8	166	26
South Fork Malheur	182	1,067	79	343	159	5
Willow Creek	70	685	12	201	313	5
Entire Subbasin	718	9,742	165	1154	1103	39

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[4] A reach is defined as a linear segment of stream that is reasonably homogonous with respect to hydrologic and ecologic characteristics and functions. Further discussion on reach selection and characteristics can be foun in the aquatic assessment.

2.2.3 Water Use

Much of the river flow in the Malheur River Subbasin is controlled by reservoirs and by a complex system of diversions, canals, and siphons originating near Namorf (at ~RM 65; Figure 9) and extending downstream to the mouth of the Malheur River near Ontario. Warm Springs, Beulah, and Bully Creek reservoirs (Figure 9) are major components of the Bureau of Reclamation's Vale Project, which is operated and maintained by the Vale-Oregon Irrigation District. The Vale project provides irrigation water to about 35,000 acres located along the Malheur River and lower Willow Creek and around the town of Vale.

Dams built in the Malheur Subbasin, starting in the late 19th century and continuing through the early 20th century, blocked most of the Malheur River to access by anadromous and migratory fish species. Access to the Malheur from the Snake River was limited after 1881 due to the construction and operation of the Nevada diversion dam located on the Lower Malheur River immediately downstream of Vale (Figure 9) at about RM 19 (Buchanan et al. 1997).

Warm Springs Dam and Reservoir (Figure 9), on the Upper Malheur River, began operation in 1919. In a field tour of eastern Oregon watersheds conducted in 1925, the Deputy Fish Warden observed two fish-blocking dams: one at Vale (presumably the Nevada diversion dam) and the other "on the South Fork near Riverside" (possibly the author was referring to Warm Springs Dam on the Mainstem Malheur) (Curtis 1925). The following year, the Master Fish Warden inspected the newly constructed fish ladder at the Nevada diversion dam, which apparently worked, and mentioned that the dam at Warm Springs Reservoir blocked all salmon from accessing historic habitat (Ballagh 1926).

The Master Fish Warden noted that salmon continued to ascend the North Fork Malheur River "where the salmon can be seen at this time in numbers in the holes" (Ballagh 1926 [July 22nd letter]). Beulah Reservoir (Figure 9) began operating in 1935, completely blocking access to the North Fork Malheur River for migratory and anadromous fish (Pribyl and Hosford 1985).

Operation of the reservoir system radically altered the seasonal streamflow pattern along most of the Mainstem Malheur River and Bully and Willow Creeks. Stored water is released during the summer, keeping downstream flow high for use in irrigation. Reservoir gates are closed at the end of the irrigation season, usually by mid-October. Thereafter, the only flow immediately downstream is minor leakage through the gates (Fuste and McKenzie 1987). The South Fork Malheur River (Figure 9), which contains only small reservoirs, retains a relatively natural seasonal stream flow and provides most of the winter stream flow to the Mainstem Malheur River where it joins several miles below Warm Springs Reservoir.

The Harper Diversion Dam diverts the stored water from Warm Springs and Beulah Reservoirs, along with natural stream flow, from the Malheur River several miles upstream of Namorf to the Vale–Oregon Canal (Hanson et al. 1990). The canal water from the river is used for irrigation of lands within the Vale-Oregon Irrigation District, or alternatively diverted for storage in Bully Creek Reservoir (Figure 9). The Owyhee Irrigation District also transfers some water out of the Subbasin for it's use. Flow monitoring conducted by the U.S. Geological Survey from July to October, 1985 showed that stream flows were consistently high upstream of the Vale-Oregon Canal; the canal diverted 65 to 79 percent of the total flow from the river (Fuste and McKenzie

1987). Small increases in flow were observed between Namorf and Hope (Figure 9) as a result of irrigation return flows; large increase in flow below Hope included flow from Bully and Willow Creeks. When flows from irrigation reservoirs are curtailed and irrigation ceases, flows in the Malheur River were considerably lower (Fuste and McKenzie 1987).

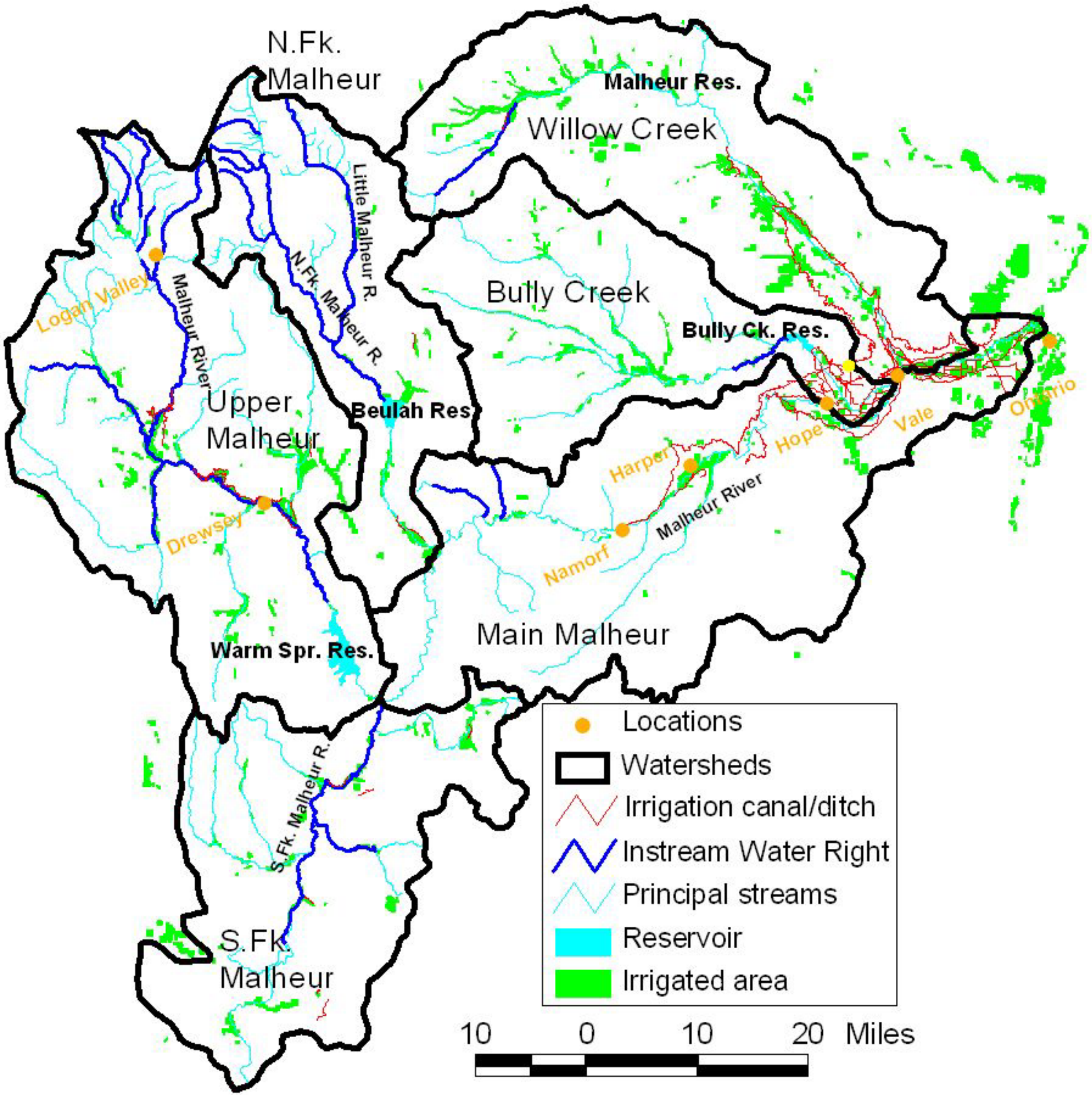

Figure 9: Principal irrigation canals, storage reservoirs, irrigated areas, and locations having instream water rights (StreamNet, 2001; BLM, 2003b; OWRD, 2003).

A total of about 132,000 acres are irrigated in the Malheur Subbasin, representing about 4.4 percent of the total Subbasin acreage (Mary Grainey, OWRD, pers. comm. 2001; Table 4). The primary method of irrigation is flood irrigation through ditch systems that divert water from the streams and rivers. Three irrigation districts in the Subbasin water about one-half of the total irrigated acreage (Table 4, Figure 9). The Oregon Water Resources Department (OWRD) has not completed their GIS data for irrigation district lands. Thus, Figure 9 only shows about 85,000 acres of the total irrigated acreage, some of which has recently been transferred to irrigation district water rights (Mary Grainey, OWRD, pers. comm. 2001).

Table 4. Irrigated acreage in the Malheur Subbasin (M. Grainey, OWRD, pers. comm. 2001).

Holder of water right	Acres irrigated	Percent of irrigated acreage	Percent of Subbasin
Vale-Oregon Irrigation District	38,000	28.8%	1.3%
Warm Springs Irrigation. District	20,000	15.2%	0.7%
Orchards Water Company	6,000	4.5%	0.2%
Individual water rights	68,000	51.5%	2.3%
Total	132,000	100.0%	4.4%

Although the major diversions of surface waters occur in the Lower Malheur River below Harper Dam and in the Drewsey Valley, diversions occur throughout the Malheur Subbasin (Figure 9). Water is diverted from headwater areas such as Logan Valley and along most stream valleys. Most of the diversions upstream of Namorf are ungaged and unscreened (Wayne Bowers, ODFW, pers. comm. 2001). Most of the diversions downstream of Namorf have continuous gauging stations operated by the State or irrigation districts (Fuste and McKenzie 1987).

The OWRD approves instream water rights for fish protection, minimizing the effects of pollution or maintaining recreational uses (OWRD, 2002). Instream water rights set flow levels to stay in a stream reach on a monthly basis, have a priority date, and are regulated the same as other water rights. Instream water rights do not guarantee that a certain quantity of water will be present in the stream; under Oregon law, an instream water right cannot affect a use of water with a senior priority date (OWRD, 2002). There are twenty-nine instream water rights, covering approximately 280 miles of stream, in the Malheur Subbasin (OWRD, 2003; Figure 9). All 29 instream water rights are for the purpose of fish rearing, and all have priority dates ranging from 4/19/1990 to 5/28/1991. Instream water rights at the three locations vary with date over the course of the year. Given that the Malheur Subbasin has no appreciable quantity of unappropriated water, and that it is likely that legal rights with earlier priority dates exceed yield in all years except those of unusually high streamflow (Hanson et al. 1990), it is unlikely that instream water rights are usually met.

2.2.4 Water Quality

The Oregon Department of Environmental Quality (ODEQ) has identified several water quality impaired water bodies within the Malheur Subbasin, and listed them under section 303(d) of the federal Clean Water Act. Most streams that have been sampled in the Subbasin are listed under section 303(d) for one or more parameters (Figure 10, Figure 11).

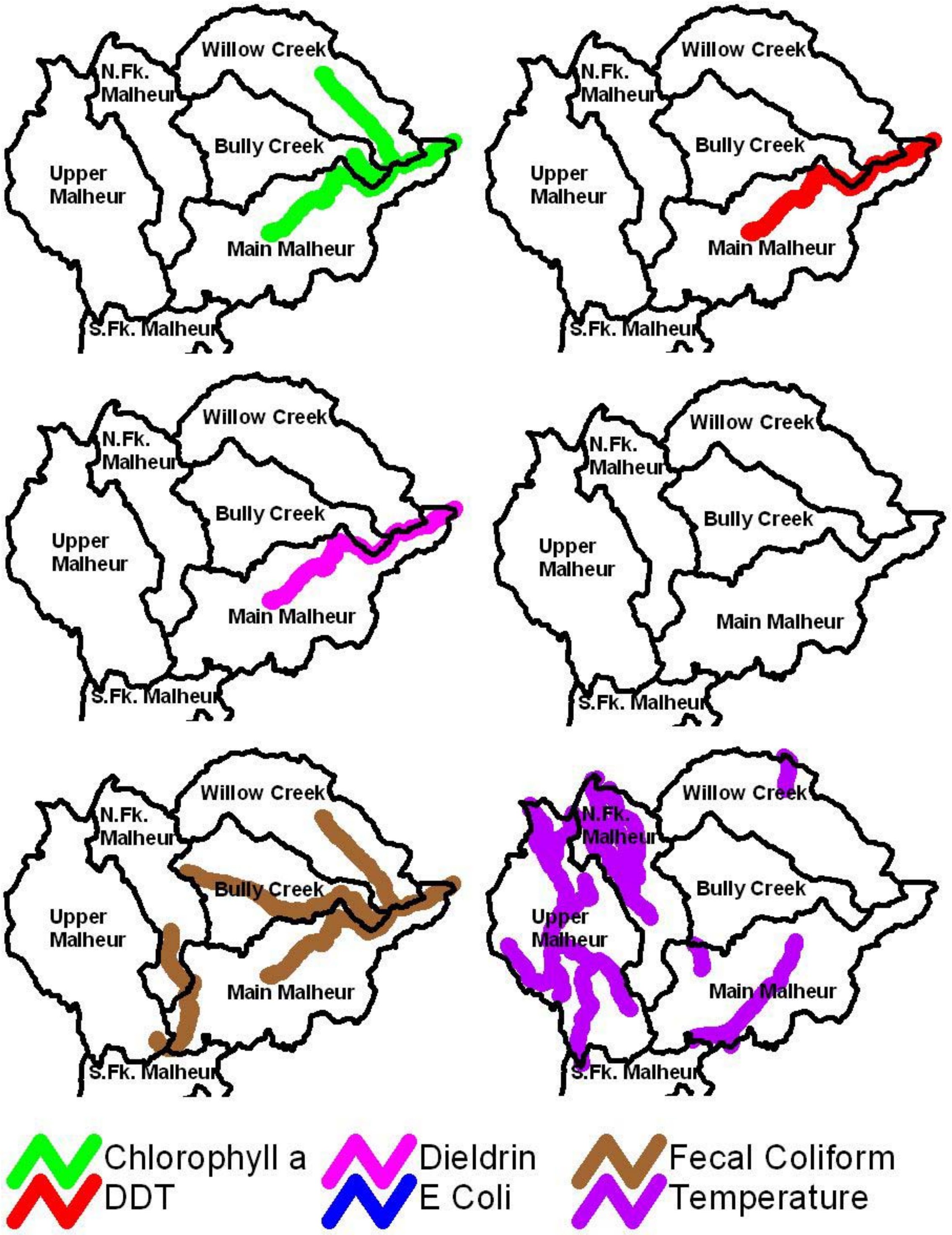

Figure 10. Locations of 303(d) listed streams by type of water quality impairment (ODEQ, 2002).

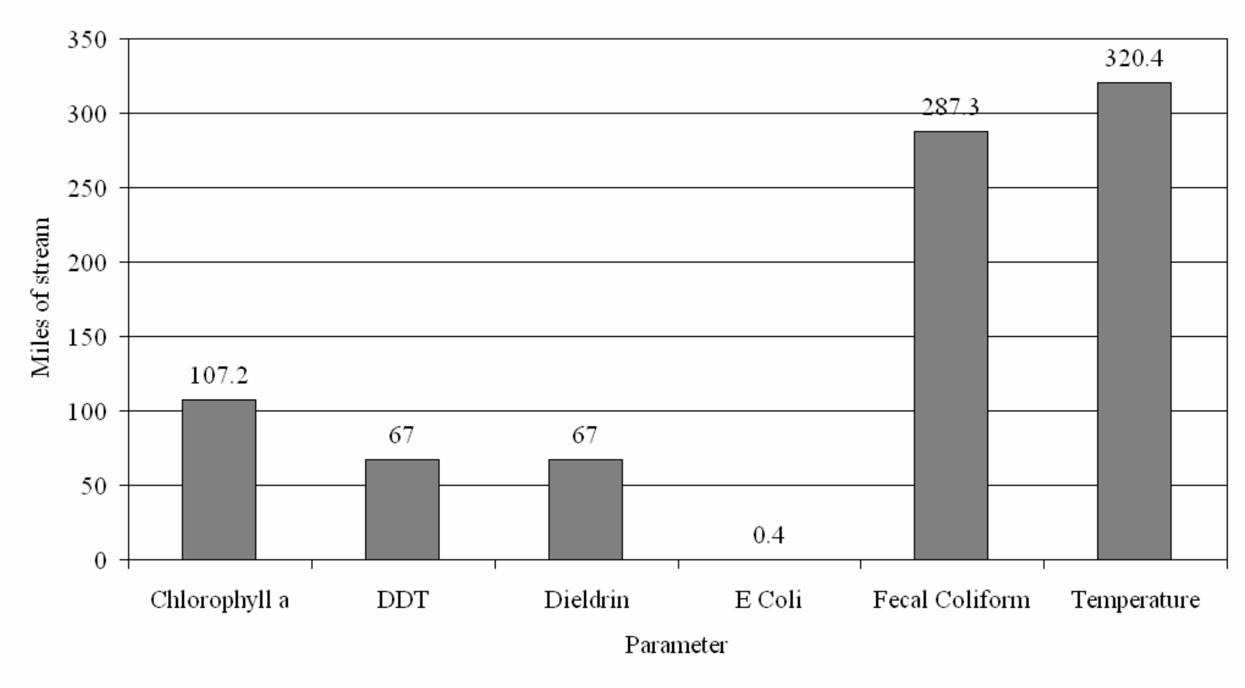

Figure 11: Miles of 303(d) listed stream by type of water quality impairment (ODEQ, 2002).

Although water quality data is being collected in the Malheur River Subbasin, the information has not been compiled and synthesized into comprehensive technical reports. Past studies, that are largely outdated, identified nonpoint source pollution associated with sedimentation, streambank erosion, elevated water temperature nuisance algae, and decreased stream flow (Malheur County 1978 *in* Hanson et al. 1990). DEQ identified turbidity and insufficient stream structure as problems throughout the Subbasin, whereas the Malheur River below Harper was found to have problems with nutrients, pesticides, salt water intrusion, bacteria, and viruses (DEQ 1988 in Hanson et al. 1990). A study by USGS in 1984-1985 synthesizes water quality and quantity measurements to provide an overview of the seasonal fluctuations in river flow and increasing downstream build up of pollutants due to irrigation methods (Fuste and McKenzie 1987).

The major tributaries to the Snake River, including the Malheur River, were included in the pollutant allocation that was part of the Mid-Snake River TMDL completed in 2002-03 (ODEQ, 2003). There are also plans to do a Malheur Subbasin TMDL, sometime around 2007. The Oregon Watershed Enhancement Board (OWEB) is currently funding water quality monitoring in the lower Malheur through the Watershed Council to improve the water quality data base.

3 REFERENCES

All references are included in a separate document