UPPER GRANDE RONDE RIVER WATERSHED PARTNERSHIP
PLACE-BASED INTEGRATED WATER RESOURCES PLANNING

UNION COUNTY, OREGON

STATE OF WATER RESOURCES REPORT

February 2018

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Section 1.0: Introduction

This report describes the state of water resources in the Upper Grande Ronde River Watershed (UGRRW). The purpose of this report is to summarize the data collection and analysis that occurred as part of Step 2, "Characterize Water Resources, Water Quality, and Basin Conditions" of the Oregon Water Resources Department (OWRD) five-step planning process. Determining the quantity and quality of water available, as well as the ecological conditions of the region, will allow members of the UGRRW Partnership to be united as they move to Step 3, "Quantify Existing and Future Needs/Demands," to quantify demand on available water resources.

Section 2.0: Basin Overview

This section provides critical watershed-defining information for three primary characteristics of the UGRRW: physical, socio-cultural, and ecological health.

Physical Characteristics

The UGRRW is located in northeast Oregon and is closely aligned with the political boundary of Union County. The UGRRW is the portion of the Grande Ronde River Watershed above the confluence with the Wallowa River. The larger Grande Ronde River Watershed system drains to the Snake River, then the Columbia River. Elevations range widely, from the mountainous areas bounding the UGRRW that reach over 6,000 feet in elevation, to the central portion of the UGRRW, comprising the valley floor at only 2,700 feet in elevation. The climate is semi-arid with hot, dry summers and cold, moist winters. Mean annual precipitation is approximately 28.25 inches per year. The hydrology of the UGRRW is dominated by snowmelt runoff. Sixty percent of the UGRRW is forestland, 20 percent is rangeland, and the majority of the remaining acreage is used for field crops and pastureland, with a small percentage in residential areas. Geologically, the Grande Ronde Valley is surrounded by the Blue Mountains and drained by the Grande Ronde River, meaning there are portions of the UGRRW boundary dominated by Columbia River basalt and areas in the Grande Ronde Valley with a thick accumulation of valley-fill sediments.

Water is used in many ways in the UGRRW. Agricultural water uses dominate much of the Valley area, domestic uses are concentrated in city areas, and recreation/fish/wildlife uses are scattered through the UGRRW. There are water rights to three water source types in the UGRRW: groundwater, storage water, and surface water. For the purpose of this report, the UGRRW was divided into eight subwatersheds for analysis. The main waterbodies in the UGRRW are the Grande Ronde River and Catherine Creek; each of these systems has numerous tributaries that create a robust network of streams throughout the UGRRW. In addition, there are wetlands and waterbodies throughout the UGRRW, but they are more limited, as are dams and reservoirs in the UGRRW.

The UGRRW contains both alluvial aquifers, located near the ground surface, and deep basalt aquifers, located several thousand feet below ground surface.

Socio-Cultural Characteristics

Oregon represents the convergence of five prehistoric cultural regions that encompass similar subsistence strategies, technology, and community organization within common natural settings. Eastern Oregon is predominately characterized by two of these regions: southeastern Oregon comprises the Great Basin cultural area, which represents the earliest evidence of humans in the state, and northeastern Oregon is part of the Columbia Plateau cultural area. Historically, many tribes included the Grande Ronde Valley within their territories. The Cayuse homeland extended primarily along the Umatilla, Walla Walla, and Grande Ronde rivers, as well as north and east along the Touchet and Tucannon (Stern, 1998).

Euroamerican contact with the native peoples of the region first occurred in 1805, when Lewis and Clark and the Corps of Discovery navigated the Clearwater, Snake, and Columbia Rivers. The possible discovery of gold by a lost group of emigrants along the Malheur River spurred a greater exploration of northeastern Oregon. With miners and emigrants constantly passing through the area, settlements soon sprang up in the Grande Ronde Valley. In 1864, Union County was created from a portion of Baker County (Mead, 2006).

People have significantly modified waterbodies within the UGRRW, including the Hilgard sawmills and early placer mining operations on the Upper Grande Ronde River in the late 1800s, and the initial steps to create State Ditch in the 1880s (with additional work in the 1980s) to reroute the Upper Grande Ronde River to a straighter and more-channelized path.

The cities of Union County each have distinct water systems to serve their populations, which range from over 13,000 in La Grande to only 136 in Summerville. The communities rely on surface water and groundwater allocations and robust storage reservoir systems and distribution systems to meet municipal water needs. There are five primary industrial users in the UGRRW, and their water demands are accommodated through municipal systems. Agricultural residents in Union County are represented by approximately 800 farms and ranches that require irrigation from a combination of surface water and groundwater allocations. Agriculture is a primary economic driver in Union County, with timber, public sector jobs, and a service economy also providing economic opportunities in the region.

Ecological Health Characteristics

The UGRRW is home to numerous species that serve different roles in maintaining ecological health.

Focal species were identified in the Grande Ronde Subbasin Plan as representing species that will be most sensitive to threats and changes in the environment. Focal species are thought to encompass characteristics that represent the needs of other unlisted species as well. If a focal species is protected, these protections will benefit other species as well. Focal terrestrial species include Rocky Mountain elk (*Cervus elaphus nelsoni*), Rocky Mountain bighorn sheep (*Ovis canadensis*), American beaver (*Castor canadensis*), American marten (*Martes americana*), great blue heron (*Ardea herodias*), bald eagle (*Haliaeetus leucocephalus*), white-headed woodpecker (*Picoides albolarvatus*), olive-sided flycatcher (*Contopus cooperi*), yellow warbler (*Dendroica petechia*), sage sparrow (*Amphispiza belli*), western meadowlark (*Sturnella neglecta*), and Columbia spotted frog (*Rana luteiventris*) (Northwest Power and Conservation Council [NPCC], 2004).

Focal aquatic species include summer steelhead/redband trout (*Oncorhynchus mykiss*), spring Chinook salmon (*Oncorhynchus tshawytscha*), and bull trout (*Salvelinus confluentus*). Prior to the installation of dams in the area, coho salmon (*Oncorhynchus kisutch*) were also common (NPCC, 2004).

Federally endangered species in the UGRRW are monitored through recovery plans, and many restoration projects are ongoing to provide additional resources to these vulnerable species, many of which are aquatic, including steelhead, Chinook, and bull trout. State-listed species are also monitored and have protections in place to support population recovery.

Federally endangered species in the UGRRW are monitored through recovery plans, and many restoration projects are ongoing to provide additional resources to these vulnerable species, many of which are aquatic, such as steelhead, Chinook, and bull trout.

Section 3.0: Surface Water

This section provides a rationale for separating the UGRRW into eight subwatersheds and then describes surface water quantity and quality. The eight subwatersheds were created to better analyze surface water quantity and quality and were based on a combination of the U.S. Geological Survey hydrologic unit codes and Grande Ronde Model Watershed Biologically Significant Reaches.

Surface Water Quantity

Surface water flow is measured in select locations in the UGRRW by multiple agencies, including OWRD, which has eight active gaging stations in the UGRRW. Flow was analyzed in each subwatershed. Water volume was shown as an exceedance probability (chance that volume will be greater than a certain value) for each two-week period in the 1958 to 1987 base period of record. Exceedance probabilities were calculated for the base period to represent three different flow conditions: high water (10 percent exceedance), low water (90 percent exceedance), and median water (50 percent exceedance). Each subwatershed had the same general patterns of peak flows during springtime. Basin 1 (which includes all flow in the UGRRW) showed a maximum median flow in a two-week period is approximately 2222,700 cubic feet per second (80,000 acre-feet during the base period). Much of the flow in the UGRRW occurs during a brief period of time in the spring (April-May, generally). According to OWRD, locations where streamflow is available at 80 percent exceedance for live flows are limited to the central and northern portions of the UGRRW (and only for three to six months per year). An important source of uncertainty in planning for future water availability is the increasing frequency of differences in magnitude and timing of actual streamflow availability in the UGRRW compared to availability during the 1958 to 1987 base period. Water resources planning will need reasonably reliable estimates of future ranges in streamflow timing and magnitude to identify appropriate, flexible options and strategies that allow adaptation to varying conditions.

Surface Water Quality

Numerous waterbodies in the UGRRW have been identified as water quality limited by the Oregon Department of Environmental Quality (DEQ). This identification can be for one or multiple parameters over a short or long portion of the year. The primary parameters of concern in the UGRRW are temperature, pH, dissolved oxygen, and *E. coli*. Temperature is a limiting factor for aquatic life for many of the summer months, especially in the lower and central part of the UGRRW. In most subwatersheds, temperature and pH are concerns for the summer months. Generally, subwatersheds in the northern and central portion of the UGRRW (Subwatersheds 1 through 6) have more limiting factors than ones in the southern UGRRW (Catherine Creek area, Subwatersheds 7 and 8).

A set of total maximum daily loads and associated goals has been developed for the Upper Grande Ronde River. There are five point sources in the UGRRW with National Pollutant Discharge Elimination System Permits. Abundant non-point sources, including both anthropogenic and natural activities, impact water quality. Anthropogenic activities include timber harvesting, livestock grazing, agriculture, road construction and maintenance, rural residential development, and urban runoff. Natural activities include wildfire, drought, severe flood events, insects, and disease infestation of forests.

Landscape changes which alter the hydrology of the basin, such as channelization of streams, changes in vegetation, and a lowered water table, also contribute to water quality impairments.

Section 4.0: Groundwater

This section includes a discussion of groundwater subbasins, quantity, and quality. The eight surface water subwatersheds were used to analyze the different pumping rates for different parts of the UGRRW. Multiple scales of analysis were used because of a lack of long-term observation wells in the area.

Groundwater Quantity

There are five current State Observation Wells in the UGRRW; however, groundwater elevations have largely gone unmeasured. OWRD produced estimates of consumptive groundwater use based on maximum legal use of water rights. Subwatershed 6 has the highest groundwater use, followed by Subwatersheds 2 and 3. Subwatersheds 1, 4, 5, and 8 have little to no permitted groundwater use. Overall, groundwater wells are more densely concentrated in the central and northern parts of the UGRRW. Throughout the UGRRW, primary irrigation accounts for approximately 81,365 acre-feet per year of groundwater use, supplemental irrigation accounts for 41,070 acre-feet per year, and municipal uses account for 36,242 acre-feet per year. Currently, new groundwater allocations from sedimentary aquifer wells are restricted in the UGRRW because of the hydraulic connection to surface waters. Groundwater declines in well production have been documented in City of La Grande municipal basalt wells in previous decades, but these declines appear to have stabilized in recent years. Groundwater declines in the City of Imbler municipal alluvial well is an ongoing concern. More information is needed to determine overall groundwater trends.

Groundwater Quality

There is very limited groundwater quality data in the UGRRW. Groundwater quality was approximated using DEQ Environmental Cleanup Site Information database data and the Oregon Health Authority's real estate transaction database nitrate measurement data. Based on the location of sensitive aquifers in the UGRRW, it was observed that several potential sites associated with the City of La Grande could potentially impact aquifers in the central portion of the UGRRW (Subwatershed 6). Cleanup sites in the remainder of the UGRRW are sparse and seem to pose less of a risk of impact to aquifers. Nitrate data shows that near the City of La Grande/City of Island City (Subwatersheds 3 and 6), five wells have been reported to have nitrate concentrations over 8 milligrams per liter (mg/L). One well in Island City has concentrations over 51 mg/L. One well near Elgin (north part of Subwatershed 2) had concentrations of 11 to 50 mg/L, and one well near the City of Union (Subwatershed 6) reported a nitrate concentration of 8 to 10 mg/L. In this data set, the locations of higher concentrations of nitrates are also located in the central part of the UGRRW (Subwatershed 6) and within the City of La Grande.

Section 5. 0: Annual Water Balance

To understand the relative magnitude of components of the water cycle within the UGRRW, the OWRD has estimated the annual precipitation entering the basin, annual volumes of streamflow leaving the basin, and losses from land surface evapotranspiration. This analysis concluded that the UGRRW receives approximately 2,468,000 acre-feet per year of precipitation, has 696,000 acre-feet of natural streamflow (which makes up 28 percent of total precipitation), and has 1,498,000 acre-feet of water leaving the UGRRW annually as evapotranspiration (61 percent of total precipitation), leaving 274,000 acre-feet annually unaccounted for (11 percent of precipitation may be seeping into the ground). It appears that the highest evapotranspiration occurs in mountainous areas, and evapotranspiration is lower on the Grande Ronde Valley floor. The highest precipitation occurs in Subwatershed 5 and other mountainous areas.

Section 6.0: Potential Limiting Factors

This section discusses primary limiting factors (also understood as potential influencing factors) in the UGRRW that will likely affect the planning process: uncertainty due to non-stationarity, OWRD basin program rules, and other policies, for instance the system of water resources administration in Oregon such as those of Division 33 restrictions.

Non-Stationarity

Until recently, scientists assumed that variability in streamflow did not change substantially over time, so the range of variability remained "stationary." However, over time as more data were collected and analyzed over the years, and wider ranges in magnitude and timing of events occurred (or have been observed), it became clear that streamflow and other physical processes in hydrology and climate were inherently more variable than previously thought, or are actually "non-stationary." As a result, the statistical methods historically used in planning and design are no longer as reliable, necessitating use of newer, more appropriate approaches and methods. This planning effort seeks to develop more applicable process approaches and methods to provide resilience and sustainability in water resources and the communities through incorporating flexibility into the process. Non-stationarity affects quantities and timing of available water resources. This could affect how flow information is collected through this process, and more importantly, how it is analyzed. For example, when and how much water is actually available is projected to shift compared to the current irrigation and growing seasons, which could, thereby, challenge the UGRRW's ability to meet water rights. Flow volume may also change further. A 13 percent decrease in median annual water volume, and a 24 percent decrease in median monthly volumes in the UGRRW were noted between a 1945-1976 data set and a 1977 to 2016 data set. As water supply hydrographs continue to shift in time and change volumes in future years, water resources planning will need to be flexible and adaptable to conditions in order to meet the goals of resilience and sustainability in water resources and the associated communities.

Oregon Water Resources Department Basin Program and Other Rules Impacting Water Use

The OWRD Basin Program delineates when and where water can be used for consumptive or non-consumptive purposes. In the UGRRW, water may be stored for any beneficial use and the storage of up to 900 acre-feet of water for domestic or livestock purposes authorized under water rights with priority dates after November 6, 1992, shall be exempt from regulation for storage of reserved water. In terms of the irrigation season, if no other pertinent decrees, permits, certificates, orders, or basin programs set an irrigation season, the default season for un-adjudicated areas is March 1 through October 31. In addition to the Basin Program, three designated state scenic waterways (SWW) exist in the UGRRW, with one having some effect on water use in the UGRRW planning area. The Grande Ronde River from its confluence with the Wallowa River downstream to the Oregon-Washington border allows for an allocation of water in stream for the SWW.

Section 7.0: Subwatershed Summaries: Water Resource Contributions and Vulnerabilities

This section provides a summary of the information discussed in the previous sections, though summarized by basin. This information was used to assess the water resources of each area by summarizing the vulnerabilities of the resource as well as the resources available for meeting water needs of the basin. The following table summarizes the findings by subwatershed.

Table ES-1
Subwatershed Summary

Subwatershed	Land Use	Municipal Water Use	Surface Water Quantity (Natural Streamflow) (acre-feet per year)	Mean Annual Precipitation (inches)	Mean Annual Evapotranspiration (inches)	Surface Water Quality	Groundwater Quantity	Groundwater Quality
1	Predominantly Forested, Rural Municipal (40% public land)	Elgin	644,600	33	19	Impaired for 7 beneficial uses	Low to no use	Low risk
2	Half Forested/ Half Agriculture (23% public land)	Imbler, Summerville	523,380	29	18	Impaired for 7 beneficial uses	2nd highest use	Medium risk
3	Predominantly Agriculture (12% public land)	Island City	234,120	19	17	Impaired for 6 beneficial uses	3rd highest use	High risk
4	Predominantly Forested (56% public land)	No cities; limited out-of-stream water use, significant instream use	219,830	27	16	Impaired for 5 beneficial uses	Low use	Low risk

Subwatershed	Land Use	Municipal Water Use	Surface Water Quantity (Natural Streamflow) (acre-feet per year)	Mean Annual Precipitation (inches)	Mean Annual Evapotranspiration (inches)	Surface Water Quality	Groundwater Quantity	Groundwater Quality
5	Predominantly Forested (74% public land)	No cities; limited out-of-stream water use, significant instream use	153,740	28	16	Impaired for 5 beneficial uses	Low to no use	Low risk
6	Predominantly Agriculture (10% public land)	La Grande, Cove	116,240	22	18	Impaired for 6 beneficial uses	Highest use	High risk
7	Half Forested/ Half Agriculture (9% public land)	Union; limited out-of-stream water use, significant instream use	71,600	27	14	Impaired for 6 beneficial uses	4th highest use	Medium risk
8	Predominantly Forested (82% public land)	No cities; limited out-of-stream water use, significant instream use	127,840	41	16	Impaired for 1 beneficial use	Low to no use	Low risk

Groundwater quality risk ranked as a comparative risk between the subwatersheds.

Groundwater quantity use based on number of water rights per subwatershed.

Surface water quantity is the sum of the biweekly 50 percent exceedance calculation in acre-feet per year.

Information Gaps

Numerous data gaps were identified in this report. Consistent methodologies for hydrologic and water resources analyses that incorporate new advances in understanding in hydrology and climate, and can replace frequency analysis that assumes stationarity, are identified information gaps. Leadership at the state and national levels is necessary to support development of policies to address new information in hydrology and climate research. In addition, gaps in specific information about the UGRRW including sustainable groundwater use rates are noted throughout the document.

One general information gap is that the UGRRW Partnership did not independently validate data discussed in this report. Validation requires a comparison to independent data to get an estimation of the deviation between predicted and actual values. There was not a field validation/data verification component to this report and, as such, the information is only as reliable as the sources and studies from which it was obtained.

The objective of Step 2 in the water resources planning process is to develop a report on existing water supply conditions. The report is intended to include a supply analysis of the quantity and quality of surface water flows, ecological conditions, and groundwater availability on a weekly basis. Attempts to gather Information for the analysis established numerous information gaps that rendered the objective of a weekly water supply analysis unattainable. Surface water supply information is limited to eight gaging station locations within the entire watershed that are of varied accuracy and duration of data collection. Estimates of surface water usage reflect permitted use (maximum), not actual use. Groundwater supply also reflects permitted pumping levels, not actual pumping levels. Estimates of groundwater do not reflect the volume of water available, the depth at which it is being extracted, or the rate or source of recharge. Return flow to surface and groundwater after an initial use is unknown. As a result, report authors have relied heavily on previously prepared reports. Those reports, faced with the same information sources, contain assumptions designed to overcome information gaps and are typically not verified with data. It is recommended that the reader consider these limitations when assessing the conclusions of this report.

Section 8.0: Public Participation and Outreach

Fifteen meetings were held to work through Step 2. Outreach occurred in the form of radio interviews, newspaper articles, and Union County's website.

Section 9.0: Data Sources

Data sources not used in this report are listed for potential future use.

Section 10.0: References

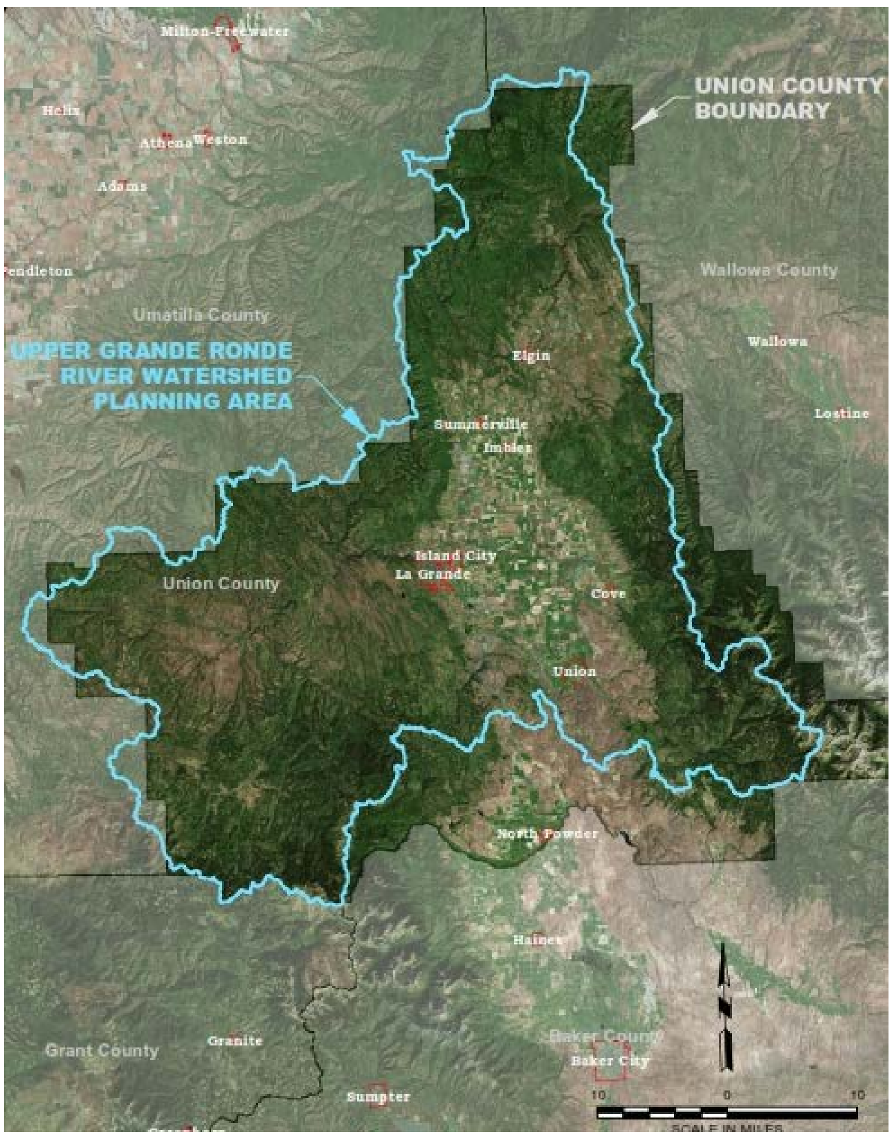
Report references are listed in this section.

1.0 - Introduction

Background and Purpose

In 2015, the Oregon State Legislature provided the Oregon Water Resources Department (OWRD) with funding to support Place-Based Integrated Water Resources Planning. Union County's proposal for the Upper Grande Ronde River Watershed (UGRRW) was accepted into the pilot program based on a strong history of basin-wide collaboration on water resources issues. See Figure 1-1 for the planning area.

Figure 1-1
Planning Area



The place-based planning 5-step process is described in Draft Guidelines produced by OWRD in 2015. The second step is *Characterize Water Resources, Water Quality and Ecological Issues*.

The purpose of this State of the Water Resources Report is to summarize the data collection and analysis that occurred as part of Step 2. This report is needed to help the planning partners collectively develop a common understanding of the water situation and to identify related challenges currently facing the community. This State of the Water Resources Report is needed because significant water supply shortages for instream and out-of-stream uses are already known to exist and will be intensified by climate change and increases in future demand. The UGRRW supports farmers, ranchers, urban residents, tribal, and ecological interests. The UGRRW is also home to numerous fish and wildlife species including Chinook salmon, steelhead, and bull trout. Developing a shared understanding of the quantity and quality of water available, as well as the ecological conditions of the region, will allow members of the UGRRW Partnership to be united as they move to Planning Step 3: *Quantify Existing and Future Water Needs and Demands.*

Project Vision

The original mission statement expressed in the Governance Agreement is:

"Through this Partnership, we will work collaboratively to determine basin-wide water supply, analyze basin-wide water demands, and develop an Integrated Water Resources Strategy (Integrated Strategy) to improve the sustainable management of water supplies in the Watershed for all users for the future."

The UGRRW Stakeholder Group met on June 21, 2017, and developed reasons why we care about the water in the UGRRW and determined several goals for this planning project.

Reasons We Care:

- Water is the lifeblood of our community – ecosystems, agriculture, economics
- Fish and agriculture and human communities
- Recreation – fishing opportunities, economic diversity, boating, hunting
- Jobs
- Intrinsic value
- This project gives us a space to partner and have a voice in our water future
- Cyclic and other types of non-stationarity in hydrology (and climate) are important to planning and design
- Finite resource – water is the lifeblood of agriculture, ecosystems, and municipalities
- When the river runs dry, irrigation is shut down
- Major user groups have beneficial needs

Goals:

- Optimizing use of groundwater and ensuring groundwater sustainability
- Characterizing socio-economic role of water in our region

- Ensuring sustainable sources of irrigation water, municipal water, and water to support important habitat
- Making area more aesthetically appealing
- Addressing current and future limiting factors
- Restoring native fish species, which requires additional and cooler water
- Finding community balance – looking at total watershed health (riparian, uplands, groundwater)

Acknowledgements

In a Stakeholder Committee meeting, including the entire UGRRW Partnership, Step 2 tasks were explained and membership in the Water Supply Technical Committee for Step 2 was solicited. Members of the Partnership volunteered to assist on the Water Supply Technical Committee. This team worked to compile data, draft reports, and, determine the most relevant and useful information to help describe the water supply (quantity and quality) and ecological issues in the UGRRW. The members of this team include:

- Smita Mehta, Tonya Dombrowski, Paige Evans, and Aaron Borisenko (Oregon Department of Environmental Quality)
- Steve Parrett, Rachel LovellFord, Bob Harmon, Jordan Beamer, Lindsay Croghan, Shad Hattan, and Phillip Marcy (OWRD)
- Connar Stone and Alex Borgerding (Grande Ronde Model Watershed)
- Donna Beverage, Darcy Carreiro, and Scott Hartell (Union County)
- Timothy Bailey, Adrienne Averett, and Nick Myatt (Oregon Department of Fish and Wildlife)
- Allen Childs and Anton Chiono (Confederated Tribes of the Umatilla Indian Reservation)
- Margaret Matter (Oregon Department of Agriculture)
- Brett Moore and Dana Kurtz (Anderson Perry & Associates, Inc.)
- Jed Hassinger (Union County Farm Bureau)
- Kyle Carpenter (City of La Grande)
- Maren Peterson (Eastern Oregon University)
- Rod McKee (City of Union)

Report Organization

This document is organized into ten sections. Section 1 introduces the report. Section 2 provides a general overview of the physical, cultural, and ecological health components of the basin. Section 3 discusses surface water quality and quantity. Section 4 discusses groundwater quality and quantity. Section 5 describes the water balance in the UGRRW. Section 6 lists limiting factors. Section 7 summarizes overall findings of the report by subwatershed. Section 8 details public participation and outreach activities. Section 9 catalogues relevant data sources. Section 10 includes references.

2.0 - Basin Overview

This section summarizes existing data available to describe the UGRRW and provides a general overview of the physical, cultural, and ecological health components of the basin. No new data were collected as part of this planning effort. Existing information was used to strengthen the Partnership's understanding of UGRRW characteristics.

Physical Characteristics

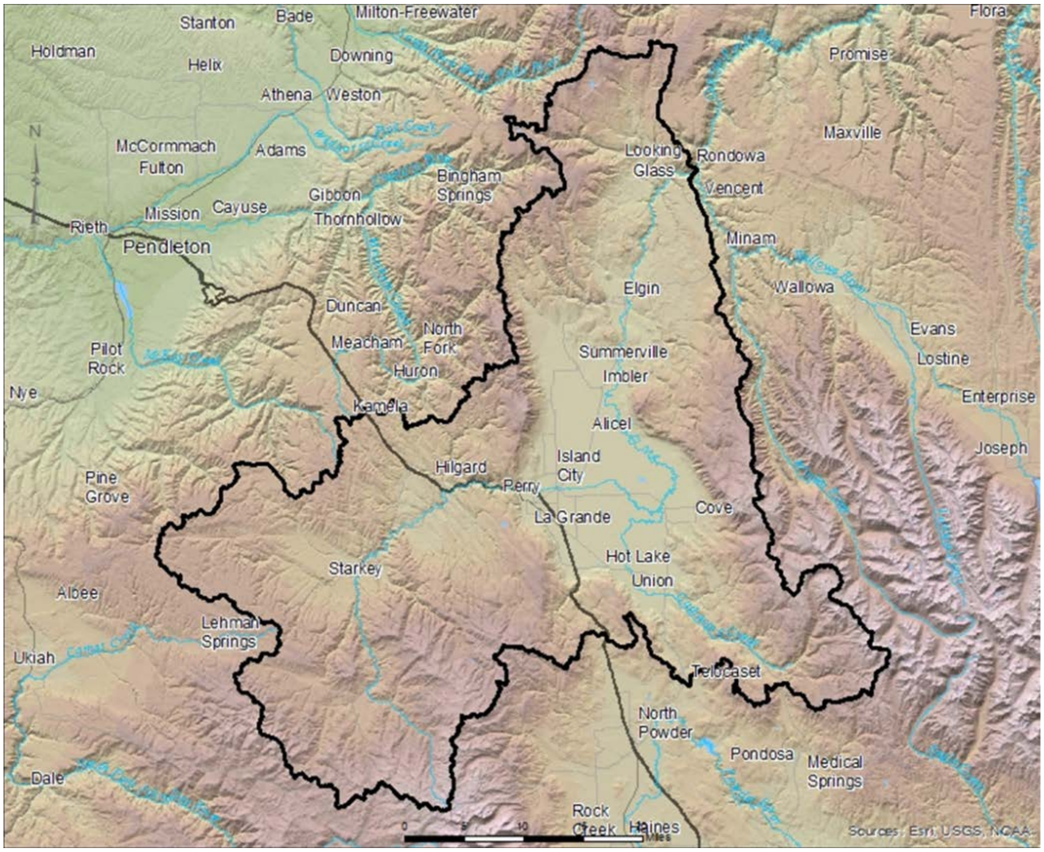
Location

The planning area is the Upper Grande Ronde River Watershed (UGRRW). The UGRRW boundary closely aligns with the Union County boundary. The UGRRW is the portion of the Grande Ronde River Subbasin above the confluence with the Wallowa River in northeast Oregon. This planning area watershed generally flows from south to north through the county and includes the Grande Ronde River, Catherine Creek, and their numerous tributaries. The UGRRW is a vital ecosystem that supports approximately 25,000 residents, ranchers, farmers, and rural residents, as well as travelers and visitors. The UGRRW also supports an array of fish and wildlife species including threatened and endangered species such as steelhead, bull trout, Chinook, and terrestrial species such as mountain goat and elk.

Topography

The study area is located within the Blue Mountain ecoregion and is bordered by the Blue Mountains to the west and northwest, specifically the Elkhorn Range to the southwest, and the Wallowa Mountains to the east and southeast. Elevations range from approximately 2,300 feet to 7,800 feet above mean sea level. The headwater areas originate in the rugged mountains with steep slopes that flow into the relatively flat 360 square mile Grande Ronde Valley (Grande Ronde Water Quality Committee [GRWQC], 2000). Figure 2-1 shows the relief of the area.

Figure 2-1
Relief Map

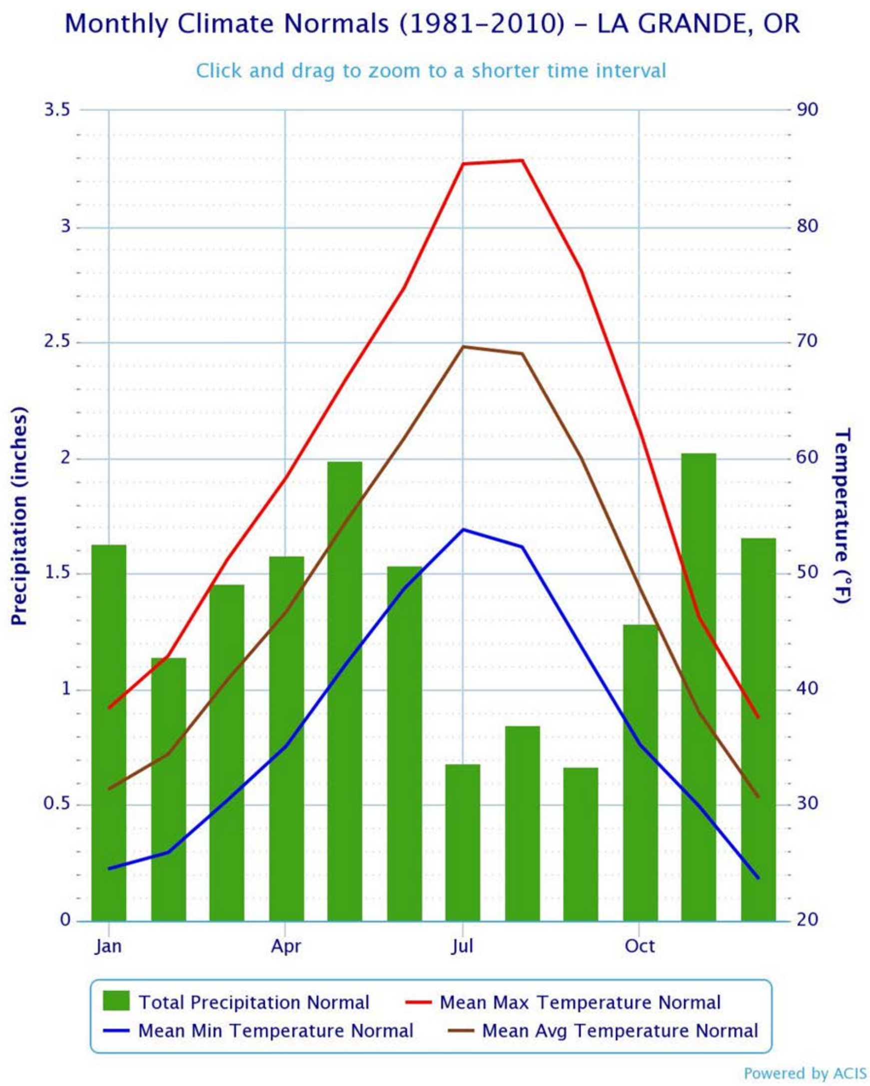


Climate (Precipitation and Temperature)

The climate is semi-arid with hot, dry summers and cold, moist winters. Annual precipitation ranges from 12 to 25 inches for elevations under 3,000 feet to over 50 inches above 5,000 feet. In the mid-elevation zone (3,000 to 5,000 feet), rain on snow frequently causes large runoff events, increasing peak flows and causing erosion (GRWQC, 2000).

Mean annual precipitation over the entire study area is approximately 28.25 inches per year. The Oregon Water Resources Department (OWRD) estimates approximately 2,468,000 acre-feet of water entering the basin each year as precipitation. July through September is generally the dry season. Otherwise, precipitation is fairly evenly distributed month to month as shown on Figure 2-2 below. A large amount of precipitation in the basin falls as snow, and the stream and river flows in the system are dominated by an annual cycle accumulating winter snow pack and spring melting and runoff. Peak runoff typically occurs in the months of April and May. Mean annual snowfall is approximately 82.70 inches per year (OWRD, 2017a). The estimated mean annual daily air temperatures using 1971 to 2000 data are 5° to 6° Celsius (41° to 42.8° Fahrenheit) (Sanford and Selnick, 2013). The estimated mean diurnal range in air temperature using 1971 to 2000 data is 12.1° to 13.0°C (53.6° to 55.4°F) (Sanford and Selnick, 2013). Monthly precipitation and temperature data for 1981 to 2010 for La Grande are shown on Figure 2-2. This figure shows that the UGRRW is a snow melt driven system.

Figure 2-2
Average Precipitation and Temperature



Physical and Landscape Characteristics

The watershed consists of 1,640 square miles and spans from the headwaters of the Grande Ronde River to its confluence with the Wallowa River. Sixty percent of the watershed is forestland, 20 percent is rangeland, and the majority of the remaining acreage is used for grain crops, hay, and pastureland, with a small percentage for residential areas.

According to the 2012 Agricultural Census, there are 829 farms in Union County, with a total of 411,671 acres engaged in farming. The average farm size is 497 acres, and the median is 70 acres (U.S. Department of Agriculture[USDA] Agricultural Census, 2012). These small farms may include horses, cattle, small orchards, mint, wheat, or other small operations (USDA, 2006).

Figure 2-3 below is a land ownership map showing publically owned lands in the UGRRW.

Figure 2-3
Publically Owned Lands of Union County

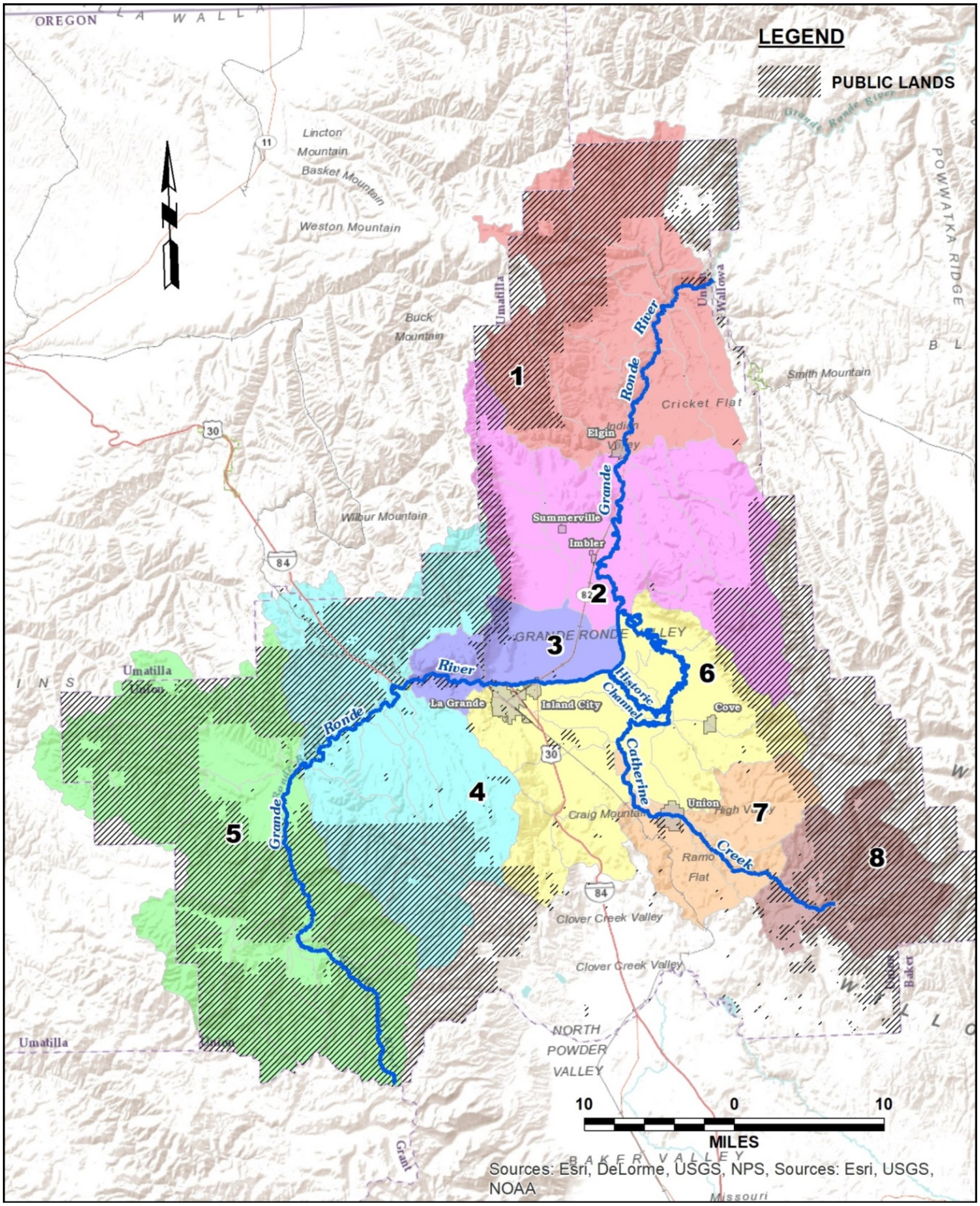


Table 2-1
Subwatershed Summary of Public Lands

Subwatershed	Total Acres	Public Acres	Percent Public
1	169,000	68,440	40
2	149,800	33,950	23
3	41,000	4,815	12
4	178,050	98,860	56
5	249,740	185,840	74
6	142,260	14,490	10
7	55,500	4,920	9
8	61,820	50,660	82
Total	**1,047,170**	**461,975**	**44**

**Note: Ownership is listed by County; therefore, these percentages are for Union County boundaries (not the UGRRW), so there are slight differences from actual UGRRW percentages.*

Unique Features or Attributes

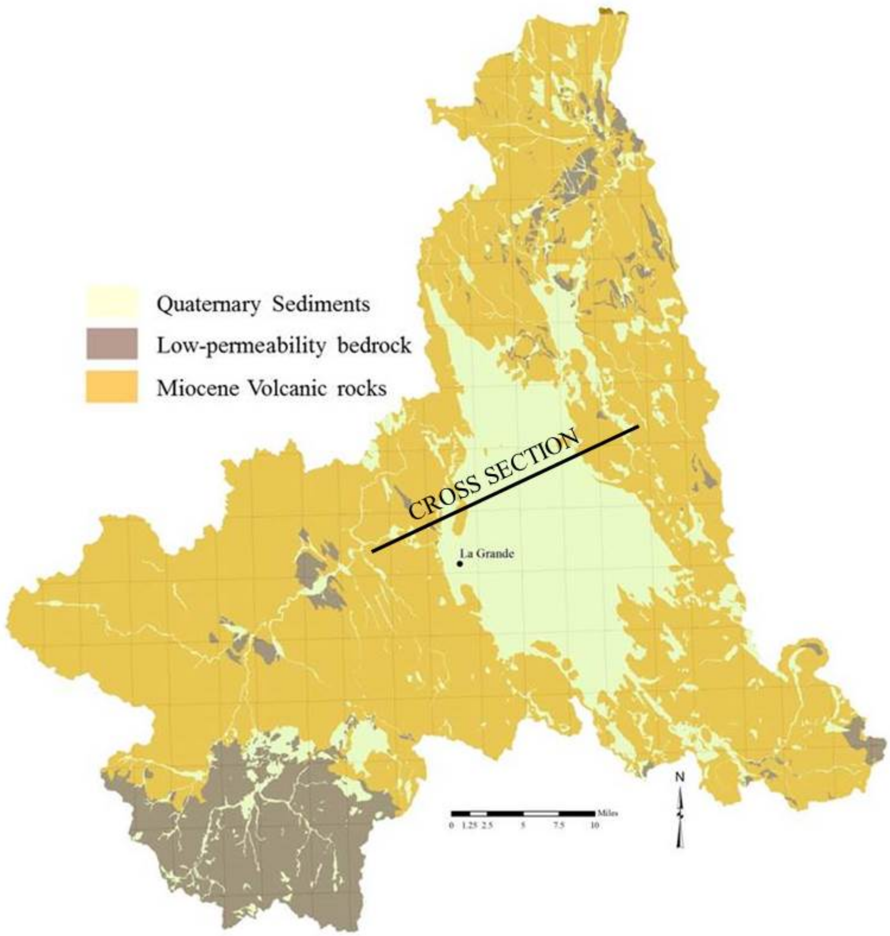
Grande Ronde Valley

The Grande Ronde Valley area is home to many agricultural and municipal activities. Unique features of the Grande Ronde Valleyinclude a large floodplain with high erosion potential as well as a variety of pollution sources from human activities. The Grande Ronde Valleyis flat and wide, creating an ideal setting for low velocity channels and substantial sediment deposition. The combination of a large, deep floodplain and low velocity channels creates erosion when banks are destabilized or channels artificially straightened. The human activities in the Grande Ronde Valley create higher levels of potential pollution sources in the Grande Ronde Valley as compared to the rest of the UGRRW (GRWQC, 2000).

Geologic Overview

The geology of the Upper Grande Ronde basin is a complex assemblage of Paleozoic and Mesozoic rock, overlain by locally erupted volcanic rocks from Oligocene to Pliocene in age. The geology of the Blue Mountain physiographic province, in which the study area is located, is characterized by thick accumulations of lavas, in combination with extensive tectonic deformation and subsequent erosion to create the landscape as it is today. Geology plays a very important role in the movement and availability of groundwater in all situations. The Upper Grande Ronde basin is no exception, presenting unique challenges and opportunities to gain an understanding of the factors that control this valuable resource. See Figure 2-4.

Figure 2-4
Geologic Overview



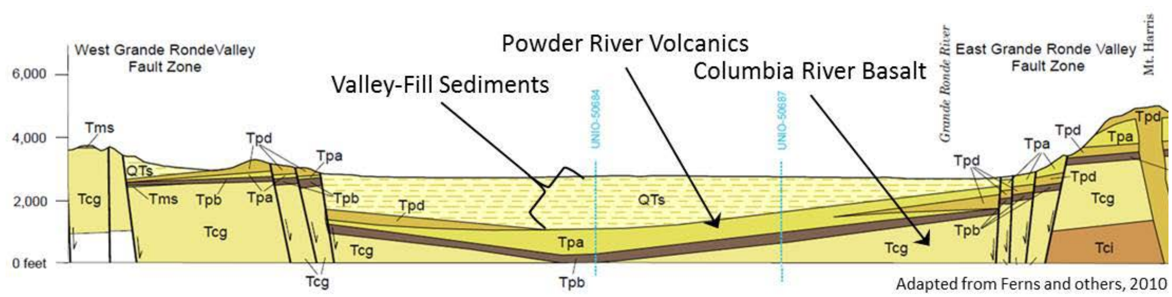
Geologic units in the Grande Ronde Valley fall into three general categories, each separated by significant spans of time. Figure 2-4 is a generalized geologic map of the upper Grande Ronde Valley, showing areas dominated by volcanic rock, including Columbia River basalt, areas where older, low-permeability bedrock is exposed, and drainage basins filled by younger sediments. Within the Grande Ronde Valley, the map shows a thick accumulation of valley-fill sediments, including sands and gravels, alluvial fans, and fine-grained silts and clays. Some or all of the older rock types are present beneath these sediments but are often buried more than 2,000 feet deep.

The oldest rocks, of Paleozoic to Mesozoic age, are distinct terranes that existed as volcanic archipelagos and ocean crust in areas much farther south before shifting, colliding, and assembling with North America in the late Paleozoic and Mesozoic eras to form the structure of the Blue Mountains (Orr and Orr, 2012). Also included within this group are intrusive rocks of the Wallowa and Bald Mountain Batholiths, each composed of many distinct magmatic episodes, that make up the cores of the Wallowa and Elkhorn Mountains, respectively (Ferns et al., 2010).

The most widespread rock type in the modern topography are the Miocene flood basalts of the Columbia River Basalt Group (CRBG), and slightly younger lavas of the Powder River Volcanic Field. Beginning roughly 17 million years ago, fluid lavas of the CRBG erupted from many large vents in northeast Oregon and southeast Washington, blanketing over 164,000 square kilometers (km^2) (Ferns et al., 2010) in flow upon flow of volcanic rock. The layer upon layer geometry of these deposits is distinctive when seen in mountains surrounding the Grande Ronde Valley and is responsible for widespread aquifer systems occurring at various depths within the flood basalt sequence. The later erupted Powder River Volcanic Field rocks (Powder River Volcanics) emerged from many local vents, encompassing a much broader range of compositions, thicknesses, and areal extents (Ferns et al., 2010).

Since the eruption of CRBG and Powder River Volcanics within the region, significant erosion has occurred, carving out the glacial and river valleys at higher elevations, and depositing the resulting sediments in the lowlands, such as the Grande Ronde Valley. The geologic cross-section shown on Figure 2-5 illustrates faults that border the Grande Ronde Valley and have allowed the basement rock here to subside, dropping by hundreds to thousands of feet. Continuous movement along these faults over time has provided a large basin to be filled by a mixture of sediments eroded from the nearby highlands and mountain basins (OWRD, 2017a). These sediments vary significantly in grain size, permeability, and overall thickness, factors determined by pre-existing topography and proximity to streams entering the valley. A water well drilled in 2013 near the center of the Grande Ronde Valley about 5 miles northeast of Island City encountered greater than 2,500 feet of sediments before drilling through a sequence of Powder River Volcanics, eventually reaching CRBG basalt at a depth of 3,507 feet (OWRD, 2017b).

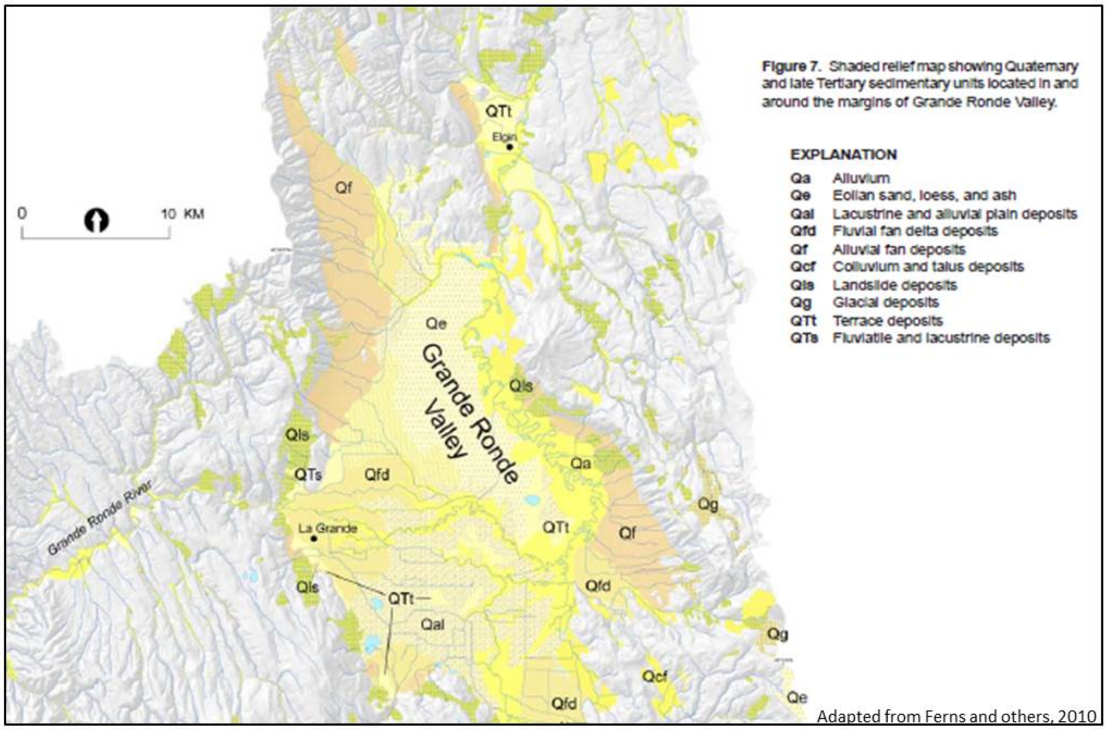
Figure 2-5
Geologic Cross Section



Groundwater occurs basin-wide in each of the three major rock types classified here; however, availability of groundwater for large-scale use and development varies widely. This depends on how groundwater interacts with surface water, local geologic factors, climate, and the degree of previous development of the resource (OWRD, 2012). Each geologic setting presents its own challenge to further development of groundwater.

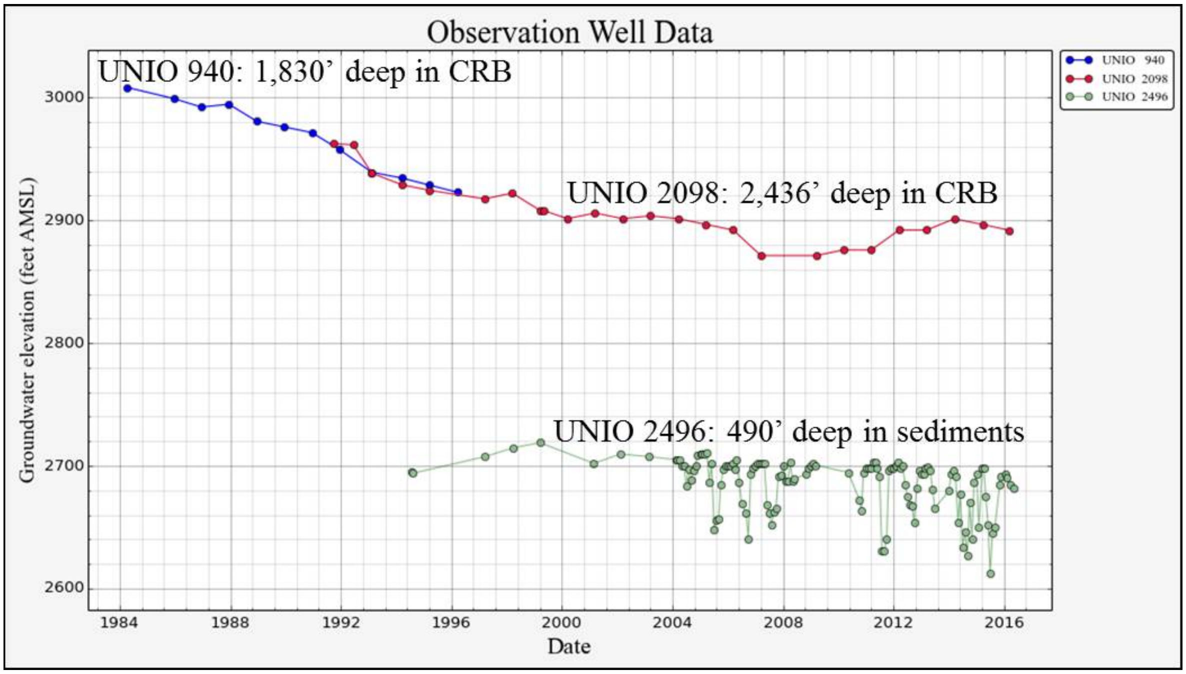
The most commonly utilized source of groundwater in the Grande Ronde Valley are the post-CRBG sediments, with the best production achieved from lenses of coarse-grained material within the alluvial sequence. The properties of the valley-fill sediments can vary significantly by location and depth (Figure 2-6), with water levels typically within 100 feet of land surface and occasional artesian flowing wells. Water levels often correspond to the stage of nearby surface waters, due to the interaction between the two. Within the confines of the valley, there does not exist a significant, widespread barrier to vertical movement of groundwater; therefore, continued removal of groundwater from the valley-fill aquifer system has a cumulative effect on river discharge.

Figure 2-6
Surficial Sediment Distribution



Productive volcanic aquifer systems are most commonly found in the CRBG in permeable zones between lava flows, and less often within the later erupted Powder River Volcanics. Often these aquifers are highly confined, under sufficient pressure to drive water to the surface from depths greater than 2,000 feet. It is common for wells producing from these volcanic systems to yield water at high rates, due to groundwater movement occurring primarily through fractures and broken rock. One key advantage of utilizing CRBG aquifers is that hydraulic connection with local surface water is thought to be minimal, with much more diffuse impacts over greater spans of time. The thick, dense flow interiors that prohibit hydraulic connection have the downside of preventing effective recharge to the rubbly, fractured flow tops and bottoms that comprise these aquifers. This factor, in addition to poor storage characteristics, are the key disadvantages of CRBG aquifers, often resulting in rapid groundwater declines, as seen on Figure 2-7.

Figure 2-7
Hydrograph of CRBG and Alluvial Wells

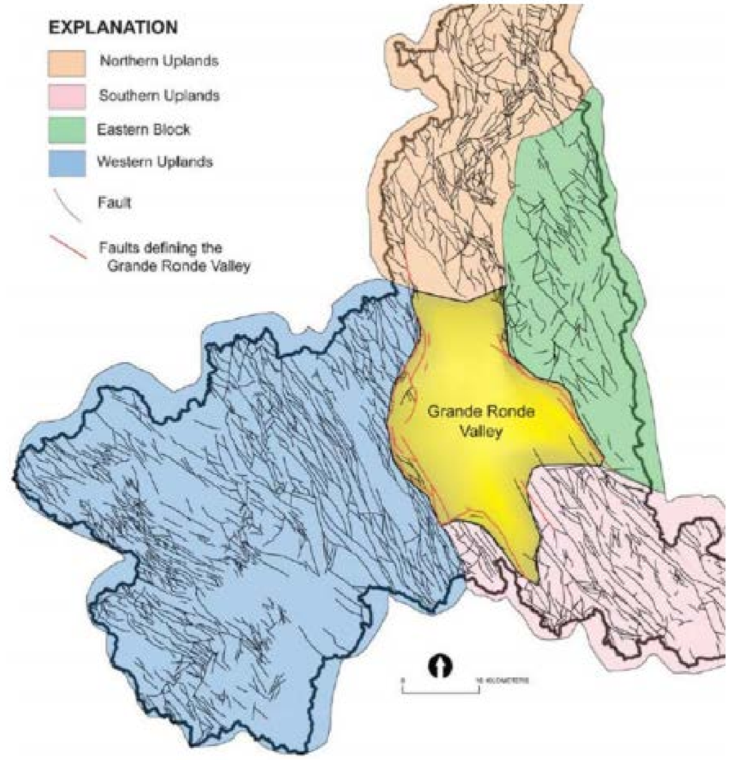


Low-permeability bedrock aquifers encompass various rock types within the basin but are typically older rocks that have very little pore space that groundwater can move through. Wells completed in these rocks yield little water, and the water may also be of poor quality. Fortunately, most arable land within the UGRRW sits on top of either valley-fill sediments, volcanic rocks, or both.

Structural Geology

Ongoing tectonic stresses have shaped the modern topography through development of a multitude of faults and folds during the past 15 million years, most notably expressed in the form of large, roughly northward-trending, fault-bounded valleys and depressions (Ferns et al., 2010). The Grande Ronde Valley is one of these depressions, referred to as a "graben" or "pull-apart basin," where large crustal blocks move vertically in respect to one another in response to changes in stress. Due to these tectonic movements, rock units observed along the valley margins can be greater than 1,000 meters higher in elevation than the same rock units beneath the valley floor. Another way to view the basin geologically is as divided into five areas as shown on Figure 2-8, duplicated from the Ferns et al., 2010, report. These include Northern Uplands, Southern Uplands, Eastern Block, Western Uplands, and the Grande Ronde Valley in the center. This depiction shows the complex network of geologic faulting with a generally northwest to southeast orientation.

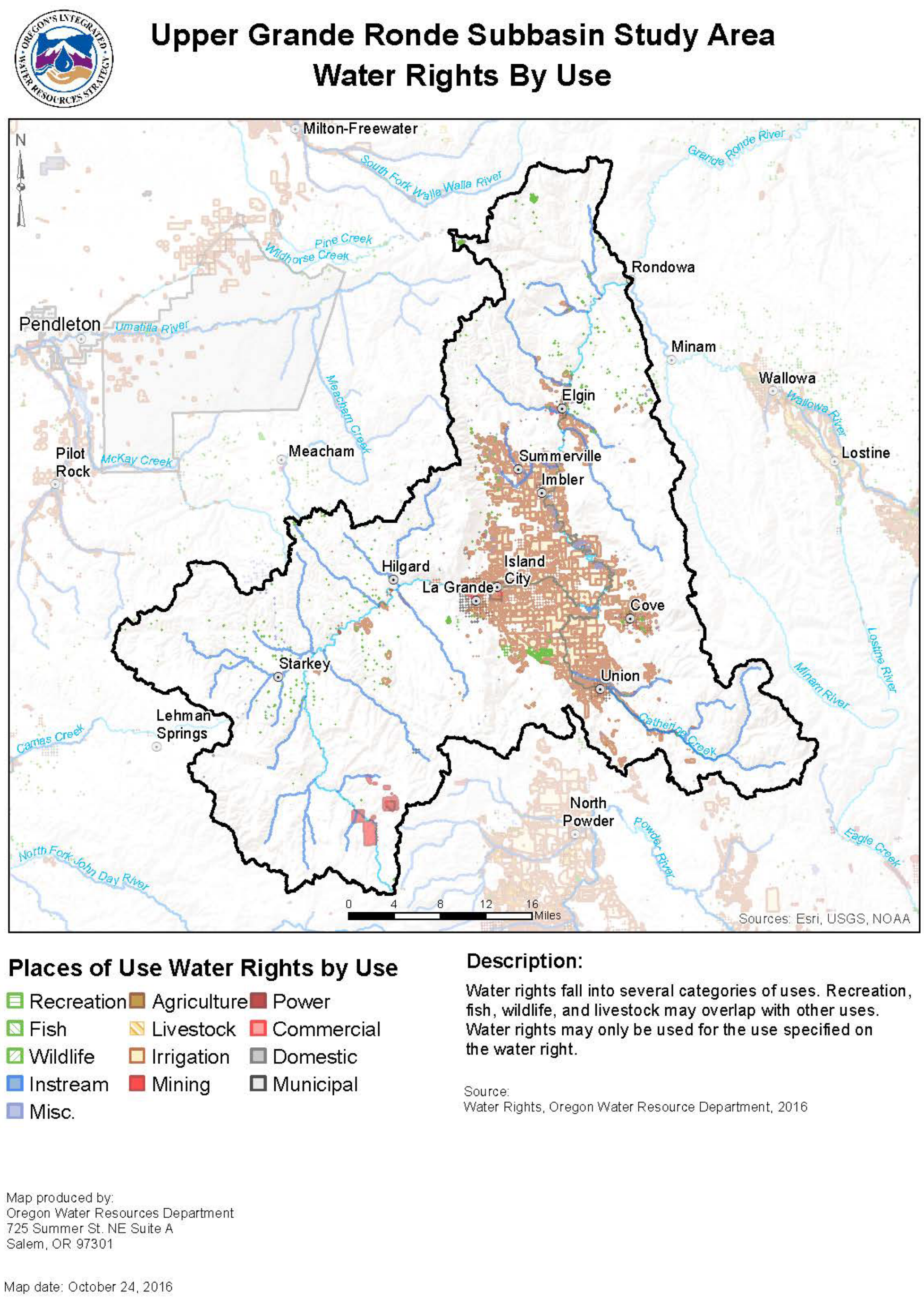
Figure 2-8
Structural Geology Map



Hydrology and Water Rights

The surface hydrology of the UGRRW is dominated by snowmelt runoff. Runoff timings and amounts vary significantly, but generally peak flow occurs in April or May and low flows occur during August through October (Northwest Power and Conservation Council [NPCC], 2004; U.S. Bureau of Reclamation [BOR], 2014). A portion of stream flows are often legally diverted from the channels for beneficial uses allowed by Oregon's system of water law and water rights. According to Shad Hattan, Watermaster, it is common for the entire available surface water flows into the Grande Ronde Valley to be consumed by legal water appropriations during the low flow periods. Figure 2-9 shows water rights by use.

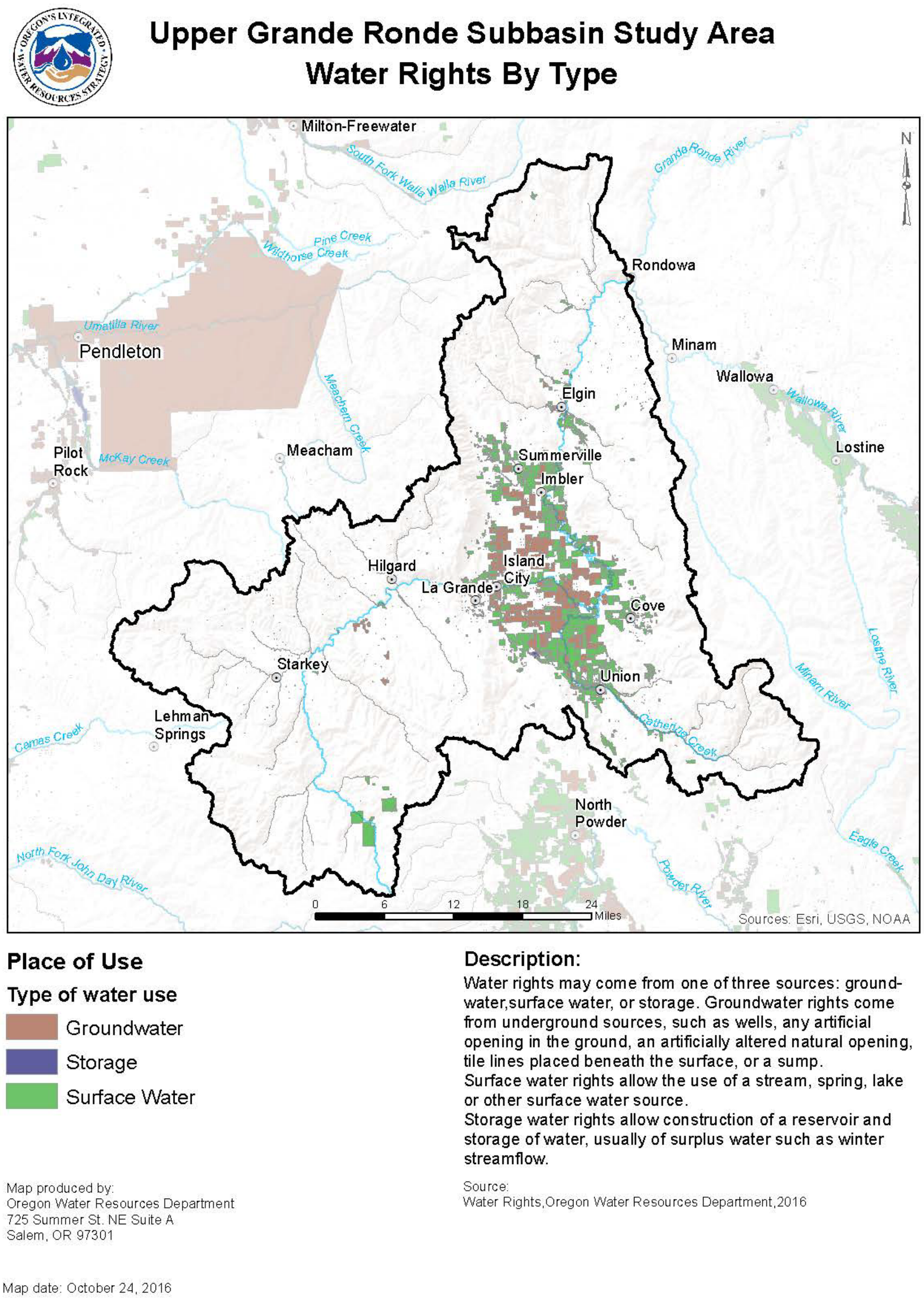
Figure 2-9
Water Rights by Use



Agricultural water uses dominate much of the valley area, domestic and municipal uses are concentrated in city areas, and recreation/fish/wildlife uses occur across much of the UGRRW.

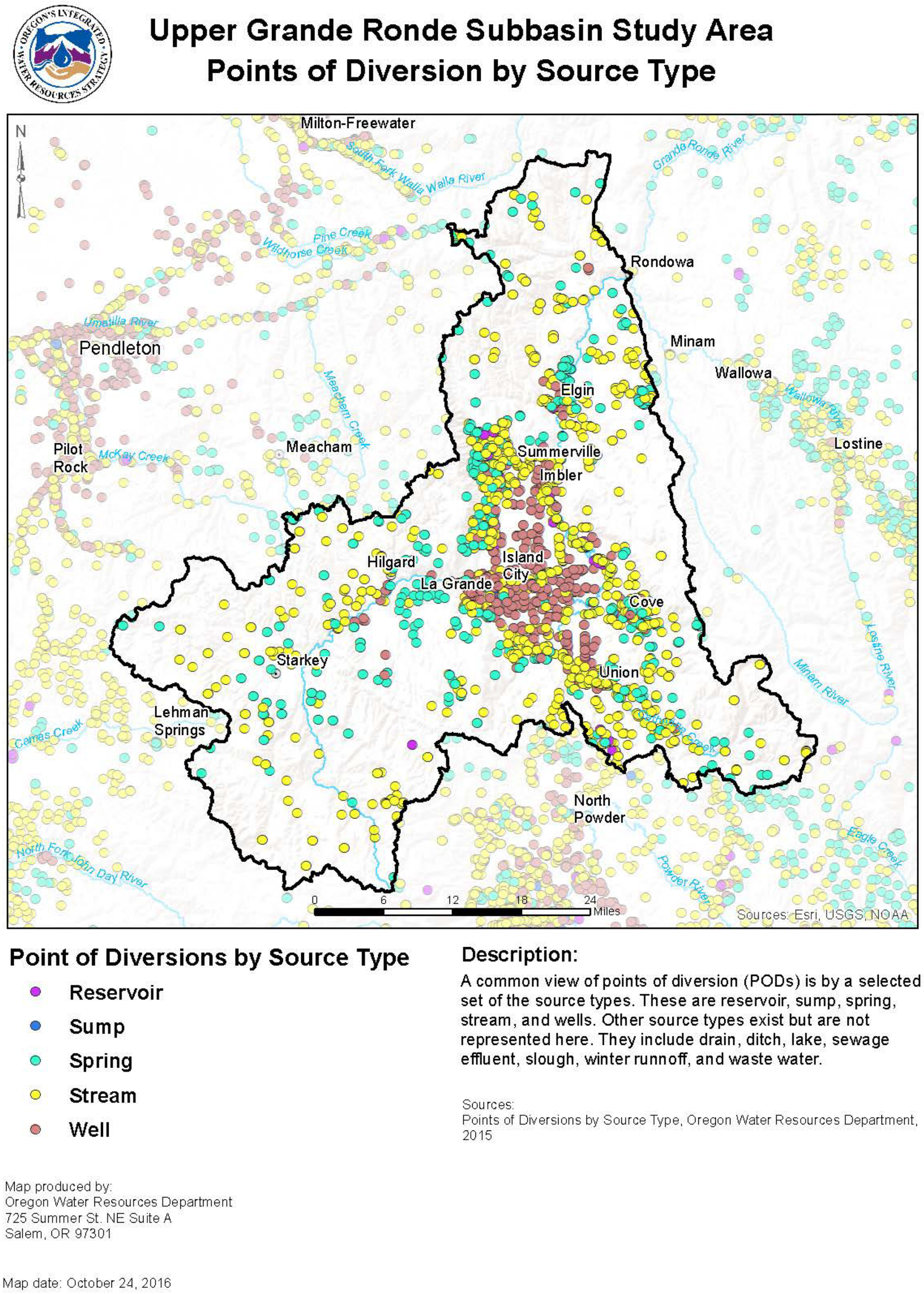
There are three sources for water rights in the UGRRW: groundwater, storage water, and surface water, as shown on Figure 2-10. There are very limited water storage rights in the UGRRW.

Figure 2-10
Water Rights by Type



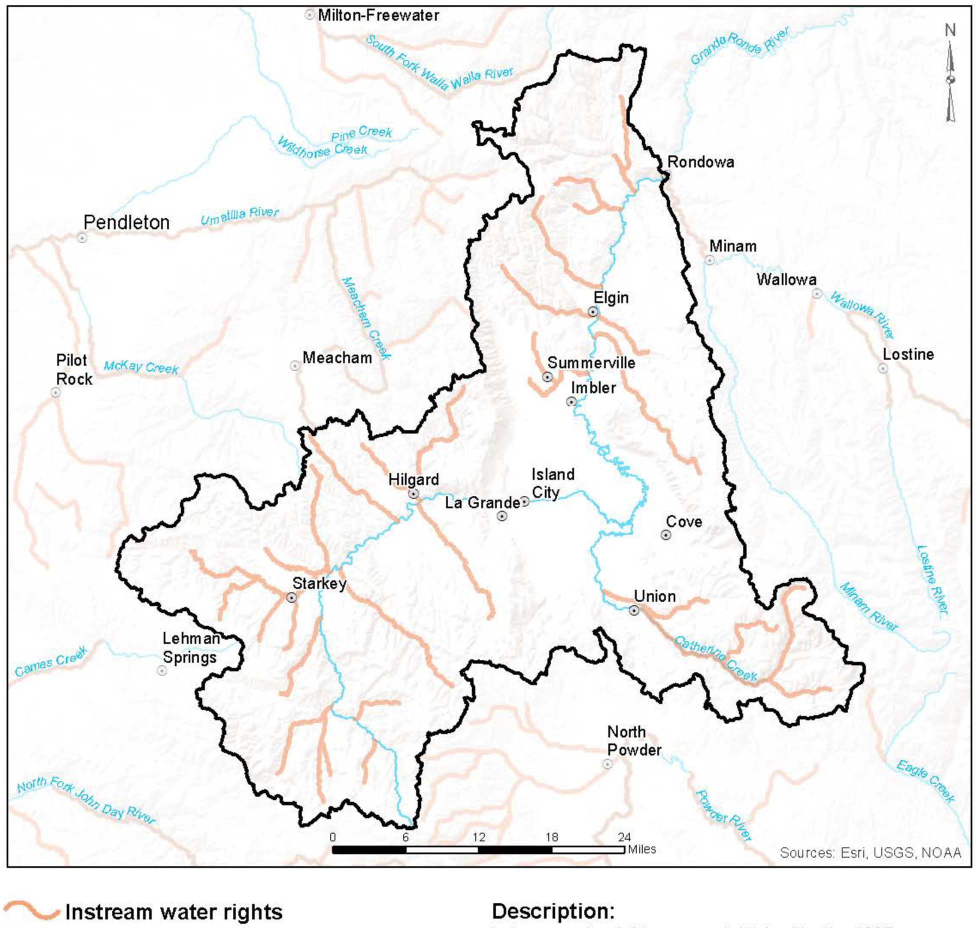
There are numerous points of diversion throughout the UGRRW from these water source types. The source types can be further broken down to include reservoirs, sumps, springs, streams, and wells. Many diversions are wells in the central part of the UGRRW, where the shallow alluvial aquifer is physically and economically accessible, with springs and streams as sources for many other diversions; see Figure 2-11.

Figure 2-11
Point of Diversion by Source Type



Instream water rights exist on many streams within the UGRRW to protect streamflow for fish and wildlife; see Figure 2-12.

Figure 2-12
Instream Water Rights



Description:
Instream water rights were established by the 1987 Legislature for protecting fish and wildlife, minimizing the effects of pollution, or maintaining recreational uses. Instream water rights establish flow levels to remain in a stream on a semi-monthly basis and are usually set for a certain stream reach and measured at a specific point on the stream. Instream water rights have a priority date and are regulated and enforced like all other water rights.

Map produced by:
Oregon Water Resources Department
725 Summer St. NE Suite A
Salem, OR 97301

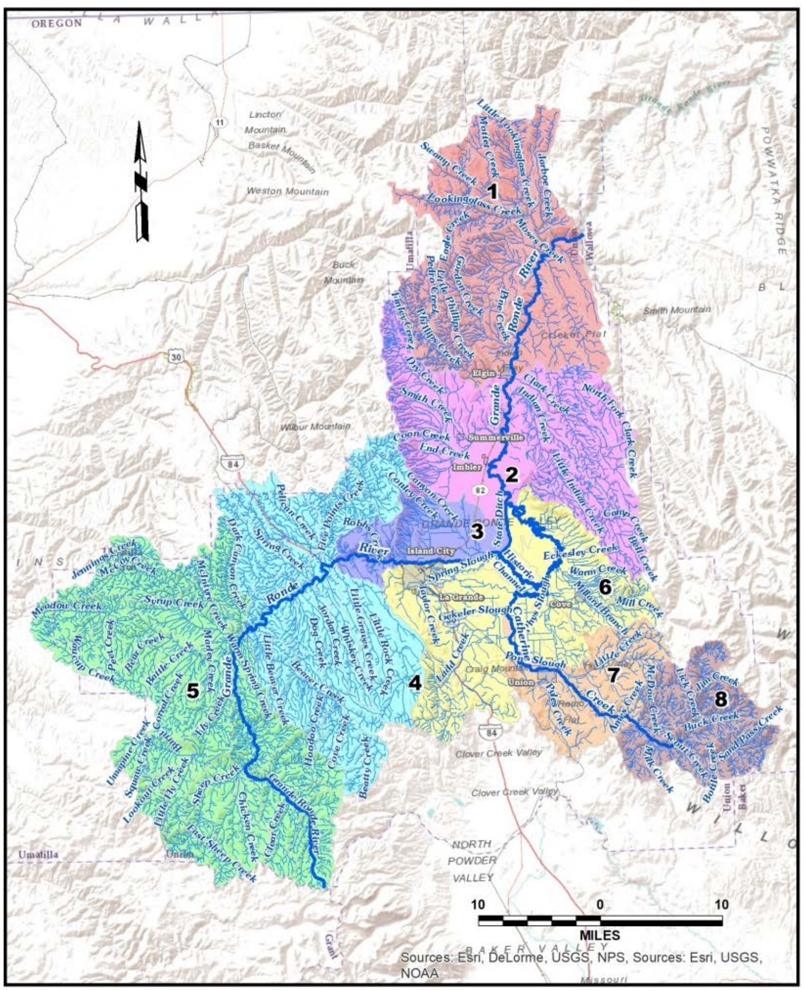
Source:
Instream Water Rights,Oregon Water Resources Department, 2015

Map date: October 24, 2016

Major Rivers and Tributaries

The UGRRW is approximately 1,650 square miles, with a perimeter of 264 miles, and 917 miles of streams, 221 of which are salmon habitat. The following sections generally describe water quality, water quantity, aquatic resources, habitat, historical improvements, and known issues for each stream. Figure 2-13 illustrates not only the major rivers and tributaries in the UGRRW, but the eight subwatersheds analyzed in this report. The UGRRW was divided into eight subwatersheds to provide for a more refined analysis. These subwatersheds were established to match the Biologically Significant Reaches (BSRs) identified by the Oregon Department of Fish and Wildlife (ODFW) and the natural geographic breaks in the study area. In order to facilitate analysis of water quality and quantity at scales and locations representative of both hydrologically unique sub-basins and distinct land use areas important to different water use types, the UGRRW basin was divided into eight subwatersheds. Initially, the UGRRW was divided by hydrologic units, or HUC-12 units, as determined by the U.S. Geological Survey (USGS). These subwatersheds were designated by the USGS because they signaled a significant change in hydrologic characteristic, either because a major tributary junction or a change in geologic or orthographic condition. Some of these areas were then combined based on BSR as determined by ODFW and Grande Ronde Model Watershed (GRMW) (see Figure 2-13).

Figure 2-13
Major Rivers and Tributaries



Grande Ronde River

In 1998, the Grande Ronde River was designated as a state scenic waterway from its confluence with the Wallowa River downstream approximately 43 miles to the Oregon-

Washington border. New appropriations after 1998 must be conditioned so use is not allowed when state scenic waterway flows are not being met. However, rights are not regulated to satisfy the state scenic waterway flows based on priority date. State scenic waterways protect flows whereas federal scenic waterways intend to preserve the free-flowing quality of a waterway but do not have flow targets. Oregon Revised Statutes, Chapter 390, describe scenic waterway laws.

This study focuses on the Upper Grande Ronde River, which spans from the headwaters of the Grande Ronde River in the southwest portion of the study area to its confluence with the Wallowa River. The headwaters originate out of the Blue Mountains near the Anthony Lakes recreation area approximately 20 miles south of La Grande. The river flows generally north and then northeast, receiving Catherine Creek east of La Grande. Approximately 10 miles northwest of Minam, the Upper Grande Ronde River receives the Wallowa River from the southeast.

Catherine Creek

Catherine Creek is the second-longest stream in the Grande Ronde Valley, at approximately 32 miles in length. The creek originates in the foothills of the Wallowa Mountains and flows generally northwest until it meets the Grande Ronde River near of the City of Imbler. Catherine Creek flows entirely within Union County and represents some of the highest quality habitat in the area for salmon and steelhead.

Tributaries

Notable tributaries to the Grande Ronde River are shown below. This information was compiled in the Grande Ronde Subbasin Plan (NPCC, 2004). The tributaries are listed with their points of confluence with larger streams and are in order from downstream toward the headwaters.

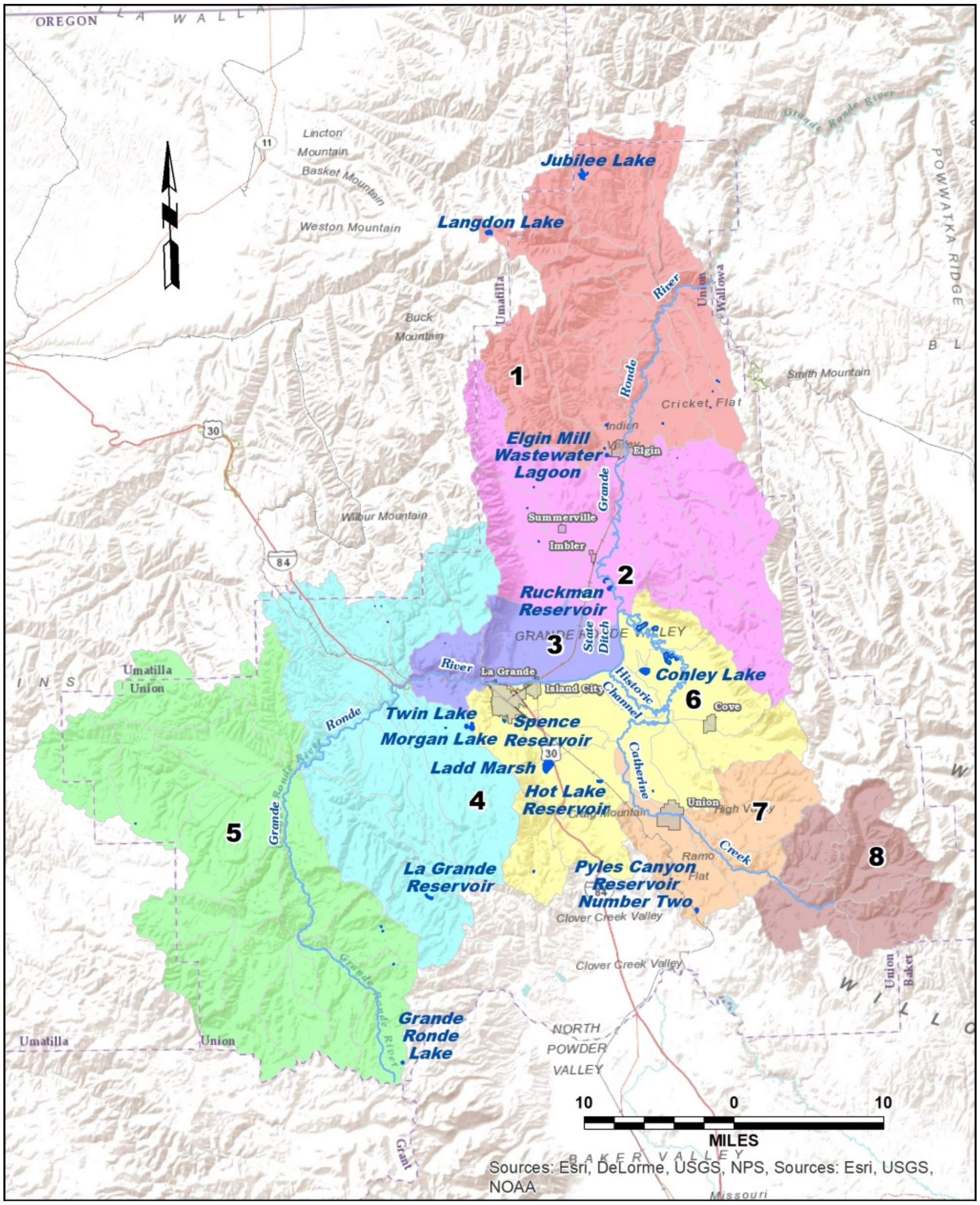
Table 2-2
Major Tributaries and Points of Confluence

- Lookingglass Creek – (85.1)
  - Jarboe Creek – (2.3)
  - Little Lookingglass Creek – (4.0)
- Gordon Creek – (95.5)
- Clark Creek – (98.7)
- Phillips Creek – (99.7)
- Indian Creek – (101.5)
- Willow Creek – (105.7)
- Catherine Creek – (143.9)
  - Mill Creek – (1.8)
  - Ladd Creek – (10.3)
  - Little Creek – (14.6)
  - Little Catherine Creek – (28.4)
  - N.F. Catherine Creek – (32.6)
- Fivepoint Creek – (169.3)
- Rock Creek – (169.7)
  - Little Rock Creek
- Spring Creek – (169.9)
- Whiskey Creek – (172.3)
- Jordan Creek – (174.7)
- Beaver Creek – (181.7)
- Meadow Creek – (183.2)
  - McCoy Creek – (2.1)
  - Waucup Creek – (18.4)
- Fly Creek – (184.5)
- Sheep Creek – (194.0)
  - Chicken Creek – (2.3)
- Limber Jim Creek – (197.5)

Major Wetlands, Lakes, and Reservoirs

Figure 2-14 illustrates waterbodies in the watershed.

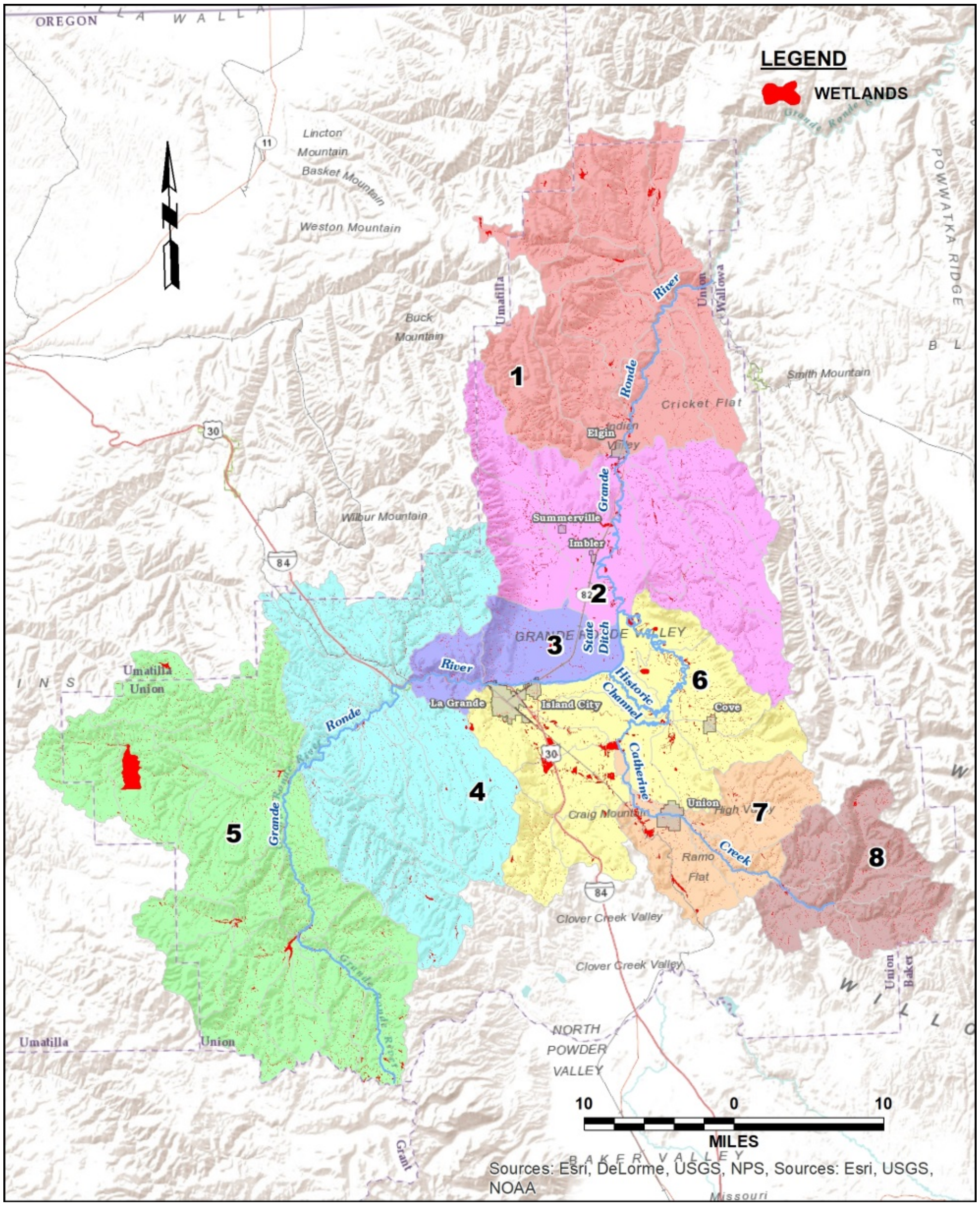
Figure 2-14
Major Wetlands, Lakes, and Reservoirs



Of note, Ladd Marsh contains a large constructed wetland, and Morgan Lake, Jubilee Lake, and Langdon Lake are used for recreation. Other small ponds exist and are more prevalent in the central Grande Ronde Valley part of the Watershed.

National Wetlands Inventory-mapped wetlands are shown on Figure 2-15 in red. There are several small scattered wetland areas throughout the UGRRW.

Figure 2-15
Wetlands



Wetlands have been altered in the basin due to modifications to allow for settlement and agriculture. Figure 2-16 below consists of an aerial map of the current Ladd Marsh area overlain with a survey of the area from 1863.

Figure 2-16
Ladd Marsh 1863 Survey Compared to Present Land Use

Dams and Reservoirs

Large dams and reservoirs in the study area requiring periodic safety inspections are shown on Figure 2-17 and described on Table 2-3. Most of the biggest reservoirs are built on stream channels. There are several in the Grande Ronde Valley that were constructed by severing a meander channel and using the severed portion to store water.

In the past, several government agencies have studied the feasibility of building reservoirs and have developed plans to do so. The common factors limiting reservoir construction have been protecting the salmon and steelhead runs in the UGRRW that need upstream access to rearing and spawning habitat and the financial costs of dam construction and maintenance. A study conducted by the BOR (BOR, 1981) identified 40 potential dam sites on tributaries in the headwaters of the Grande Ronde River and Catherine Creek. The BOR estimated that at least 20 small dams would be needed if control of a 10-year flood event was desired (BOR, 1996).

Existing reservoirs and their storage capacities are depicted on Figure 2-17 and on Table 2-3; their names, source streams, allowed secondary uses, and ownership are listed.

Figure 2-17
Dams by Storage Capacity

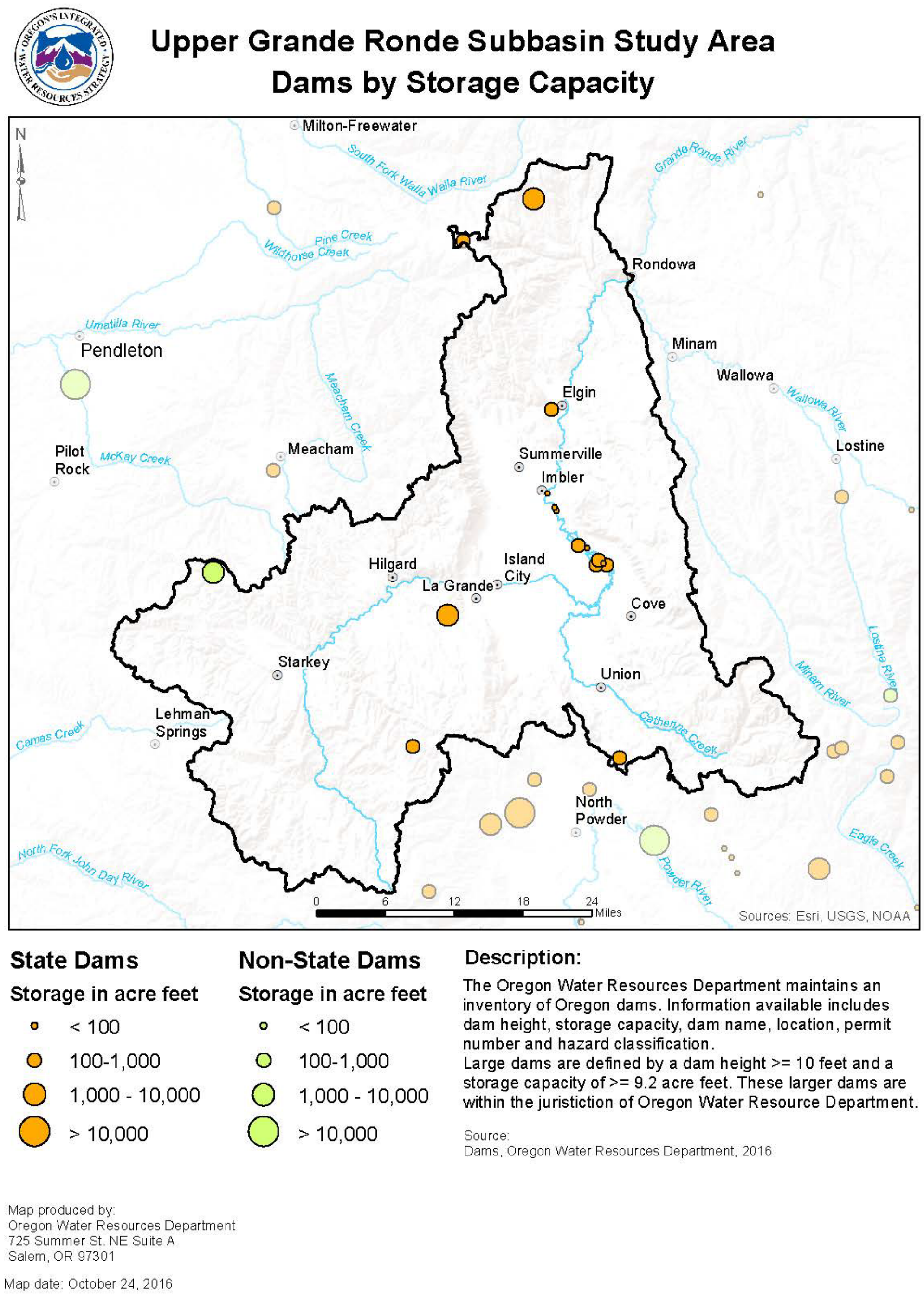


Table 2-3
Dam and Storage Uses

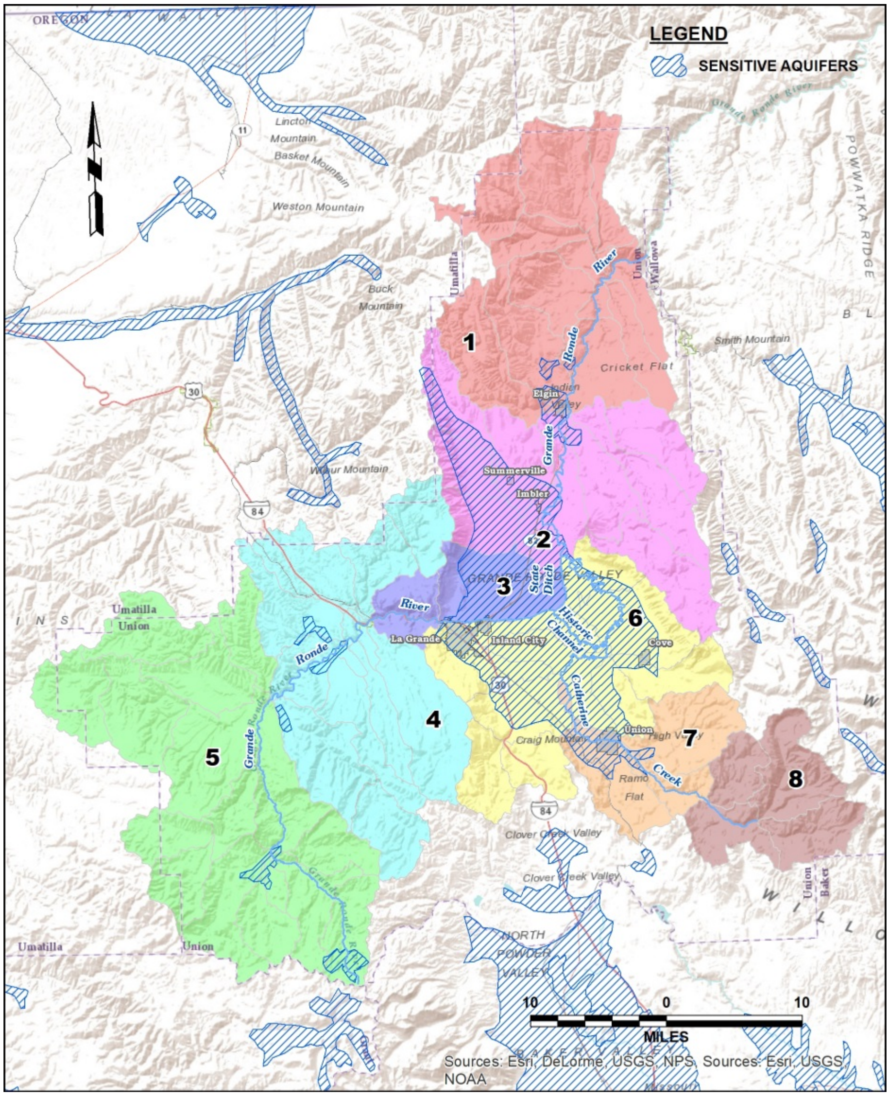
App/ Permit/ Cert	Dam Name	Water Source	Stored Water Use	Owner	Size in Acre-Feet
C 36683	Arnoldus Loop	Grande Ronde	Irrigation	Private	28.8
C 61437	Beaver Creek	Beaver Creek	Municipal	City of La Grande	510
C 58876	Elgin Mill Treatment Lagoon No. 1	Wastewater	Industrial	Boise Cascade	131
C 41585	Elmer Reservoir 1	Grande Ronde	Irrigation	Private	123
C 41586	Elmer Reservoir 2	Grande Ronde	Irrigation	Private	91
File E 32	Elmer Reservoir 3	Grande Ronde	Irrigation	Private	58
C 46521	Elmer Stoplog Dam	Grande Ronde	Irrigation	Private	298
C 64890	Fleet Reservoir 2	Grande Ronde	Irrigation	Private	78
C 40472	Fleets Loop	Grande Ronde	Irrigation	Private	246
C 58083	Howell	Grande Ronde	Irrigation	Private	56
	Indian Lake Dam	Jennings Creek	Exempt	CTUIR	1,214
C 40153	Jubilee Lake Dam	Mottet Creek	Recreation	ODFW	1,579
C 40151	Langdon Lake Dam	Lookingglass	Recreation	Langdon Lake Association	253
C 64461	Morgan Lake Dam	Sheep Creek	Recreation	City of La Grande	2,076
C 64478	Pyles Canyon 2	Pyles Creek	Irrigation	Private	221
C 40820	Ruckmans Reservoir	Grande Ronde	Irrigation	Private	76
Permit R-14464	Conley Farms	Catherine Creek	Multiple Purpose	Private	192
TOTAL					**7,230.8**

CTUIR = Confederated Tribes of the Umatilla Indian Reservation

Aquifer Systems and Springs

Springs are present throughout the UGRRW. The distribution of springs utilized with a water right are shown on Figure 2-11. Aquifers are present in the region and extend beyond the boundary of the UGRRW. Sensitive aquifers are defined as alluvial aquifers that could be vulnerable to impacts from surface contamination such as septic systems or leaking underground storage tanks (LUSTs). Septic systems can contaminate springs and groundwater but they are generally released into the shallow alluvium, not at the surface. Springs and shallow groundwater can be contaiminated from the surface by fecal matter from wild animals and livestock. Sensitive aquifers are shown on Figure 2-18.

Figure 2-18
Sensitive Aquifers



Larger regional aquifers are present at much greater depths than the alluvial aquifers described above. The main aquifer in the UGRRW is the Columbia Plateau Aquifer. Table 2-4 lists the main aquifers in the UGRRW (NPCC, 2004).

Table 2-4
Main Aquifers in the UGRRW

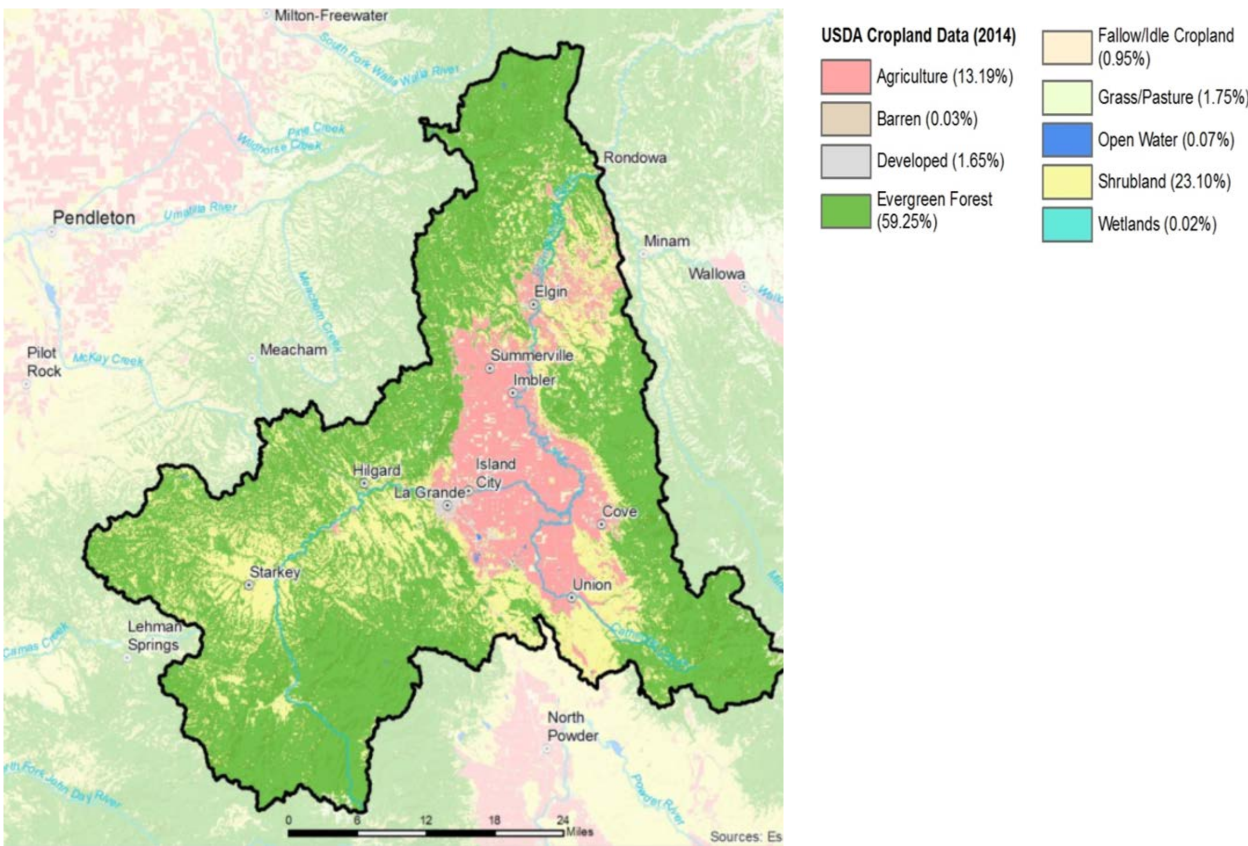
Aquifer Type	Rock Type	Percent of Watershed
Columbia Plateau Aquifer System	Basalt, Volcanic	72.2
Pacific Northwest Basin-Fill Aquifers	Unconsolidated Sand and Gravel	18.7
Volcanic and Sedimentary Rock Aquifers	Basalt, Volcanic	6.1
No Principal Aquifer	N/A	3.0

Current Land Use

The study area is predominantly forest, agriculture, shrub/pasture, and developed land. Management of these land types can affect the capture of precipitation on the land and timing of stream discharge (USDA, 2014).

Approximately 53 percent of the UGRRW is privately owned and used for agriculture, livestock, timber, and business/residential. Approximately 46 percent of the UGRRW is managed by the U.S. Forest Service (USFS) and a small portion is managed by Bureau of Land Management. Public lands are used for timber, livestock, wildlife, recreation, and municipal water supply (GRWQC, 2000). See Figure 2-19.

Figure 2-19
Land Use



Farms and Ranches

As shown on Figure 2-19, agriculture accounts for 13.19 percent of the land cover. Many of the crops require reliable irrgation water to maximize plant growth and economic viability. Access to irrigation water is a requisite condition for agriculture to be a top economic driver in Union County. Ranching is also an important practice in the Grande Ronde Valley. Livestock management and agricultural practices can have significant impacts on riparian vegetation, which can reduce shade and contribute to elevated stream temperature. However, properly managed grazing can improve and maintain the health of streambanks and riparian areas and provide excellent fishery habitat (Saunders and Fausch, 2007).

More importantly, properly managed grazing can increase soil organic matter (SOM) (Teague et al., 2011). Depending on soil type, each 1 percent increase in SOM can hold approximately 16,500 gallons of water (Sullivan, 2002).

Properly managed grazing will increase the soil water content and SOM (Weber and Gokhale, 2010). The extent that livestock and agriculture impact water quality depends on management strategies and riparian areas. Many land managers are employing best management practices.

Figure 2-20 shows the land cover for agriculture and non-agriculture as of 2016.

Figure 2-20
Crops by Type (2016)

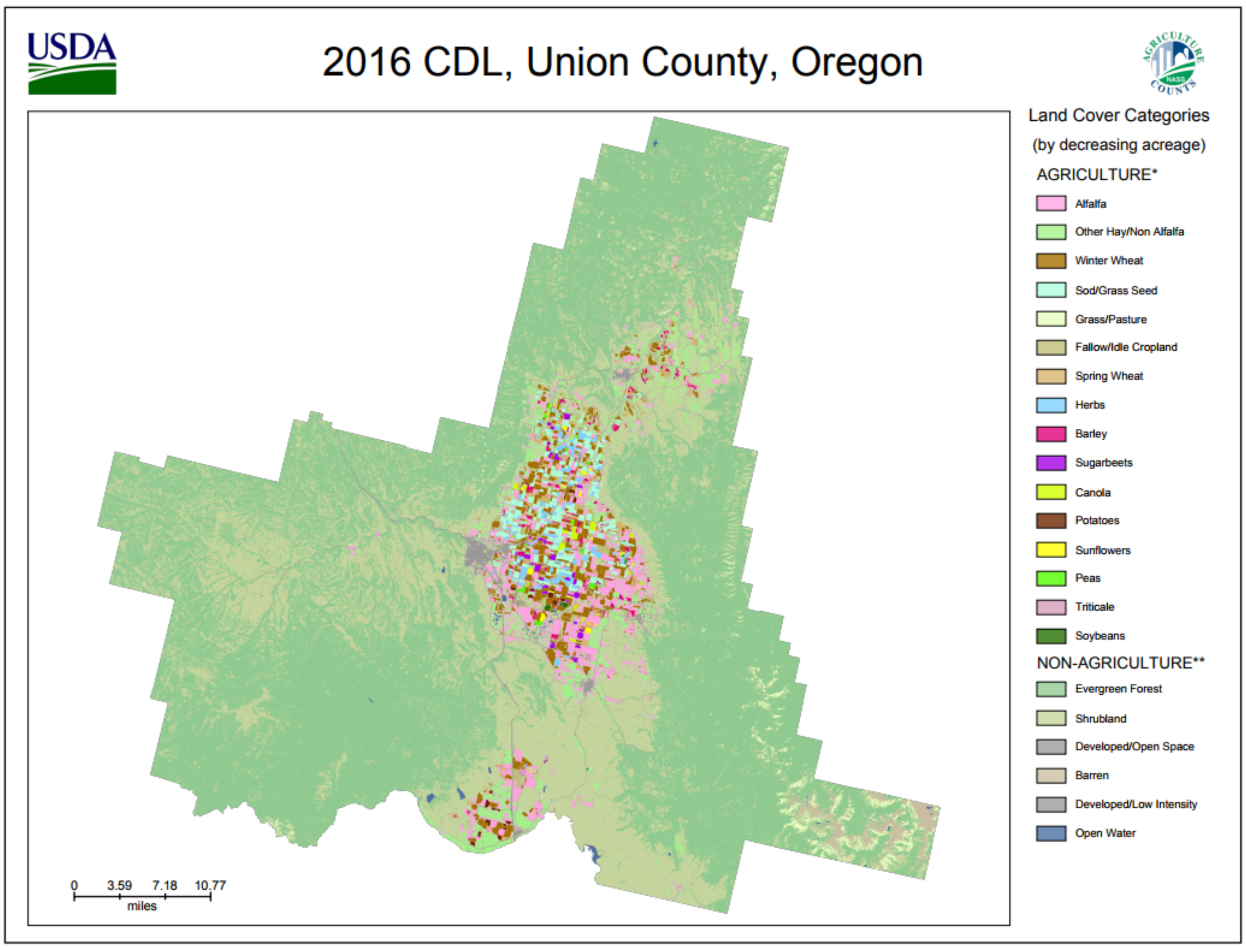
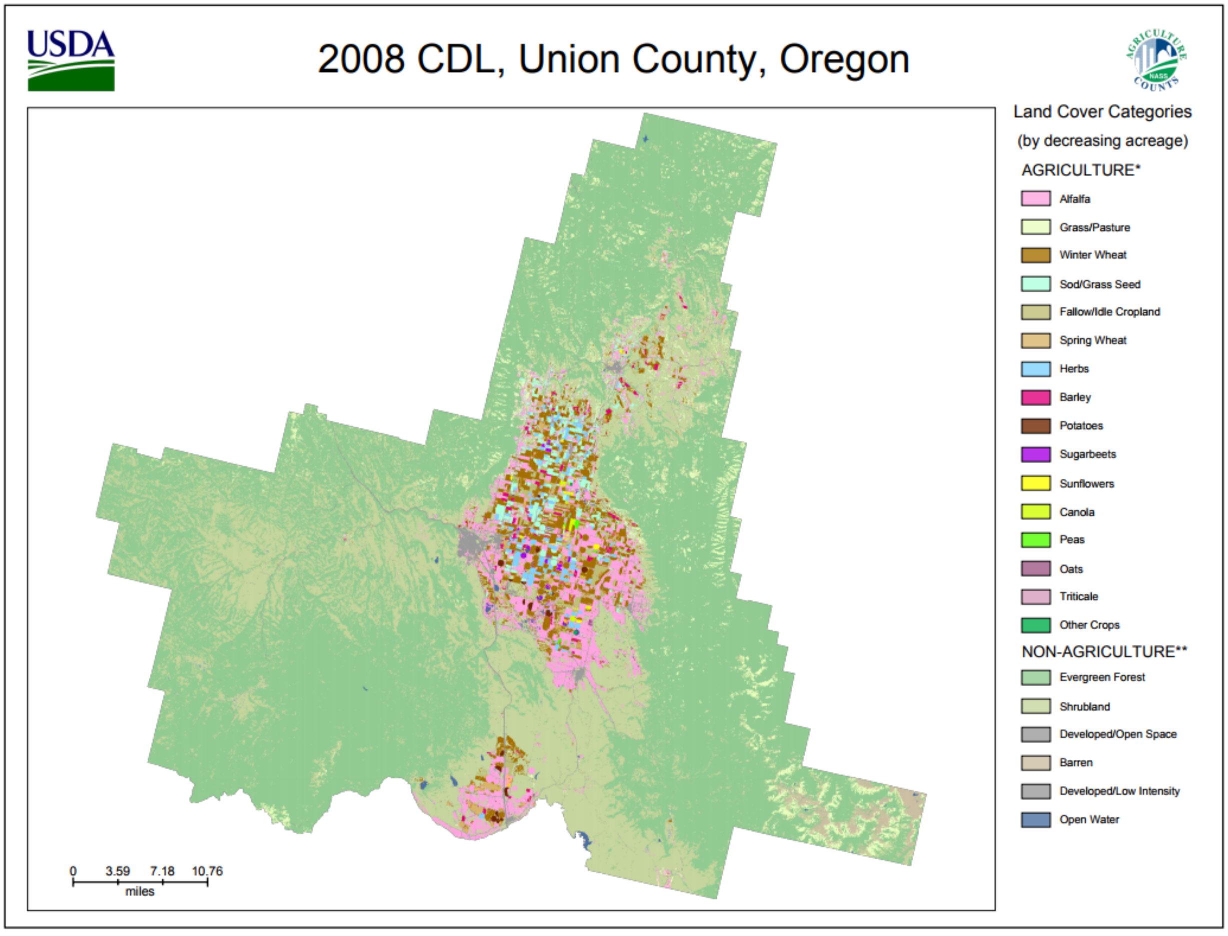


Figure 2-21 shows the same information for 2008, illustrating fairly similar land use in the 2008 to 2016 time frame. One change is that there appears to be a reduction in agricultural land use within this time period.

Figure 2-21
Crops by Type (2008)



Forestry Practices

Publically owned forest land is managed by the USFS for habitat use. Currently, there is very little commercial logging on federal forest lands in the UGRRW, although historically such activity was common. Privately managed forest land is used for commercial logging and timber production.

Forests play a role in water supply at an ecological level. Shade and cooling from mature forests allow water to remain in the system longer, rather than evaporate from hot temperatures in unvegetated areas. In addition, trees use water through transpiration and take some water out of the system. This complicated dynamic plays a role in the UGRRW because approximately one-third of the land in the system is forested. According to calculations by the USFS, about 70 percent of annual streamflow from all rivers and streams in the Blue Mountains emanates from the national forests. For the UGRRW, about 389,000 acre-feet out of 689,000 acre-feet (56 percent) of annual runoff originates in the national forests. Streamflow responds directly to the amount of precipitation and it rains or snows more on the national forests than it does on the surrounding lands. The area-wide average precipitation is about 18.7 inches per year, but is over 29 inches per year on the forests, and less than 10 inches per year in some areas off the forests. After evapotranspiration and precipitation, water use for irrigation is the third largest part of the water budget in most subbasins in the Blue Mountains. Nearly all of the water use occurs downstream of the national forests, and in many subbasins exceeds 90 percent of natural streamflow in the growing season. Irrigation in the Grande Ronde Valley consumes the equivalent of the annual runoff of Catherine Creek, or about 73 percent of July through September streamflow.

Municipalities

Municipalities account for a very small percentage of land cover but represent significant water use in the UGRRW. Additional information on municipalities is available in the Municipal Characteristics section below.

Socio-Cultural Characteristics

The following section presents the history of the UGRRW and describes current cultural characteristics as well.

Pre-Contact Overview

Oregon was first peopled by 14,500 B.P. The earliest indications of inhabitants in the Oregon Columbia Plateau region can be dated to between 13,200 and 12,800 cal B.P. (Aikens et al., 2011).

In Oregon's eastern Columbia Plateau, evidence of early occupation has been found at the Pilcher Creek site (35UN147) in the Blue Mountains between Baker City and La Grande. While no carbon-14 dates were possible at the Pilcher Creek site, similar Windust points and other artifacts were found at the Cooper's Ferry site (10IH73) in Idaho's lower Salmon River Canyon, a site that dates to approximately 13,000 cal B.P. (Aikens et al., 2011).

Representing slightly later occupations locally are the Stockhoff (35UN52) and Marshmeadow (35UN95) sites located in the uplands between the Grande Ronde and Baker Valleys. The key use periods of these sites date to circa 8,900 to 4,500 years ago and exhibit heavy tool production, hunting and meat processing, and gathering and plant processing (Aikens et al., 2011).

Ethnographic/Ethnohistory Overview

Oregon sits at the convergence of five cultural regions that encompass similar subsistence strategies, technology, and community organization within common natural settings (Aikens et al., 2011; Kroeber, 1939). Eastern Oregon is predominately characterized by two of these regions: southeastern Oregon comprises the Great Basin cultural area, which represents the earliest evidence of humans in the state, and northeastern Oregon is part of the Columbia Plateau cultural area.

By nature, the borders between cultural regions are somewhat blurred. Areas of the John Day River, Blue Mountains, and Grande Ronde and Powder River Valleys indicate the presence of people from both cultural regions, including the Nez Perce and other Sahaptin-speaking Plateau Indians and Great Basin Northern Paiutes and Shoshonean peoples (Suphan, 1974). By the early nineteenth century, the Northern Paiutes were living at the head of the John Day River and had camps in the Blue Mountains and Grande Ronde Valley. The Sahaptin-speaking peoples were expanding southward during this time, and from about 1820 to 1830 on, the John Day River and other areas were utilized jointly by both groups (Suphan, 1974; Zucker et al., 1983). Through the historic period, the Cayuse, Umatilla, Nez Perce, and Northern Paiute all continued to utilize these areas for access to gathering, fishing, or hunting areas (Steward and Wheeler-Voegelin, 1974; Suphan, 1974).

Historically, many of these tribes included the Grande Ronde Valley within their territories. The Cayuse homeland extended primarily along the Umatilla, Walla Walla, and Grande Ronde Rivers, as well as north and east along the Touchet and Tucannon Rivers (Stern 1998). The Cayuse have long shared cultural traditions and common territories with the Umatilla and Walla Walla peoples and, after the signing of the Treaty of 1855, became formally recognized as part of the CTUIR. The three groups traditionally traveled between village and camp sites to take advantage of fishing, hunting, and gathering opportunities as the seasons changed. Intermarriage between the groups and with other surrounding tribes was common, and villages often encompassed a composite of people from varying groups (Stern, 1998).

During the nineteenth century, the Nez Perce territory centered on the middle Snake, Clearwater, and Salmon Rivers of central Idaho and extended into southeastern Washington and northeastern Oregon. Multiple temporary village locations existed within the Grande Ronde Valley, and many of these sites were occupied jointly by the Nez Perce and other tribes. Villages were situated primarily along streams and rivers, and were relocated throughout the year to pursue seasonal fish, game, birds, berries, and roots. These villages were used as a basis for hunting large game, such as elk, deer, moose, mountain sheep, goat, bear, and bison, especially after the introduction of the horse in the early eighteenth century (Walker, 1998).

The Northern Shoshone and Bannock peoples occupied much of Idaho south of the Salmon River. Travel through the Snake River area and the easternmost portions of Oregon occurred frequently, especially among the Bannock, who descended from the Northern Paiute. Buffalo, antelope, elk, mountain sheep, salmon, camas, yampa, tobacco-root, and bitterroot were all staples of the groups' diet. Culturally, the groups possessed ties to Plains, Plateau, and Great Basin Indian cultural traditions (Murphy and Murphy, 1986).

Historic Overview

Euroamerican contact with the native peoples of the region first occurred in 1805, when Lewis and Clark and the Corps of Discovery navigated the Clearwater, Snake, and Columbia rivers. Trappers and traders soon followed, and through 1840, the British Northwest Fur Company (which would later merge with the Hudson’s Bay Company) and John Jacob Astor’s Pacific Fur Company would establish and acquire forts along the Columbia and Snake Rivers.

The establishment of Fort Walla Walla in 1818, along with the construction and acquisition of Fort Boise and Fort Hall in 1834 and 1837, further opened the region to Euroamerican settlement (Mead, 2006) and increased traffic on the trail between these outposts. Missionaries and, later, emigrants, would pass through the Grande Ronde Valley on this trail, which would become known as the Oregon Trail in the 1840s. Most people simply continued through northeastern Oregon, however, their sights set on lands farther west

The reported discovery of gold by a lost group of emigrants along the Malheur River spurred a greater exploration of northeastern Oregon. In 1861, gold was discovered southwest of what would become Baker City in an area known as Griffin's Gulch. A mining boom followed the discovery, and mining camps, and then towns, were established as people settled the area. This settlement, at the now-defunct town of Auburn, marked the first permanent eastern Oregon settlement southwest of the Blue Mountains (Gaston, 1912; Hiatt, 1893). The area's growing population prompted the creation of Baker County from the larger Wasco County, which at the time composed the entirety of eastern Oregon. Baker County then encompassed the area now comprising Baker, Malheur, Union, and Wallowa Counties. In 1864, Union County would be created from a portion of Baker County (Mead, 2006).

With miners and emigrants constantly passing through the area, settlements were soon established in the Grande Ronde Valley. These population centers predominately were established along the edge of the mountains rather than on the valley floor. This was due to the marshy conditions of the central valley and the need to remain close to timber supplies and accessible irrigation (Mead, 2006). In 1861, several settlers homesteaded the Mount Glen area before a severe winter prompted them to relocate across the Grande Ronde River the following year (Hug, 1961). This area quickly grew into a small town, which became known as Brownsville. When the post office was established in 1863, the need for a more unique name became clear due to the prior establishment of another Brownsville, in Linn County. As such, the town was renamed La Grande, likely for the Grande Ronde Valley and the surrounding scenery. In 1865, the town was incorporated, and in 1868, it was platted (Bailey, 1982; McArthur and McArthur, 2003). The town's location on the Oregon Trail, the arrival of the railroad in 1884, and the expansion of farming, stock raising, and logging in the area helped the town thrive in these early years (Bailey, 1982; Reavis, 2005).

Expanding populations and industry created growth in and around La Grande. In 1873, a post office was established at neighboring Island City (Bailey, 1982; McArthur and McArthur, 2003). The city was established on an island approximately eight miles long and one mile wide between the Grande Ronde River and an encircling slough, which has since been diverted (Reavis, 2005; McArthur and McArthur, 2003). A water power-operated grist mill was raised in Island City by John Caviness and M. Sterling and gave the city its commercial beginning. Stores and blacksmith shops followed, and in 1884, the Island City Mercantile and Milling Company was formed and the flouring mill became one of the largest enterprises in Union County at that time (Western Historical Publishing Company, 1902; Reavis, 2005).

Recent History

Historical activities by people living in the area of the UGRRW have impacted the river in terms of form and function, beginning in the 1800s and continuing to present time. Table 2-5, from the Upper Grande Ronde Tributary Assessment (BOR, 2014), details some of the more significant historical events as described by previous accounts of the area (Gildemiester, 1998).

Table 2-5
Significant Historical Events Impacting Waterbodies

Year or Period	Event
1820-1830	Systematic decimation of beaver populations by the Hudson's Bay Company and American trappers.
1862	Charles Fox completes sawmill and dam on Grande Ronde River at Oro Dell near RM 131.3 ,W.J. Snodgrass establishes a water-powered grist mill at Oro Dell. This dam was the first that obstructed upstream passage of salmon to the Upper Grande Ronde.
1862	Gold discovered in Tanner Gulch
1872	Placer mining operations are active upstream of Camp Carson in the headwater area of the Upper Grande Ronde River
1880	Hilgard is a thriving community serving stockmen, loggers, and miners. By 1881, Daniel Chaplin has sawmills in operation at Hilgard and Meacham
1887	Mill at Stumptown (Perry) destroyed by fire; S.F. Richardson buys a new mill and runs it there for a while before moving it to a new site about six miles above Hilgard on the Grande Ronde River. He continues operating the mill near the mouth of Spring Creek until selling it around 1881
1890	Grande Ronde Lumber Company acquires timberland up the Grande Ronde and begins constructing a series of splash dams (Beaver Creek, Meadow Creek, Dark Canyon, Fly Creek, and Vey Meadow) to add storage water for adding to spring snowmelt for annual log runs down the Grande Ronde River to the catch dam constructed at Perry. Each year 10-20 million board feet of mostly Ponderosa Pine logs are floated down the river
1890	Branch rail line of the O.R.&N. completed to Elgin on Oct 25th
1894	Dam about one mile upstream from La Grande blocks fish movement.
1896	French syndicate purchases old Camp Carson placer mines and renew operations with 200 men working the claims via hydraulic mining methods.
1900	An estimated 50 small sawmills are scattered around the valley and forest, producing railroad ties, fence rails, and lumber for homes, farms, businesses, and industry.
1900	Contracts are let for winter cutting and decking of 27 million board feet for the spring river run down the Grande Ronde to the mill at Perry and others in that vicinity
1900	Timber exports from the La Grande area are estimated at 32.5 million board feet.
1905	Placer mining still active on the Upper Grande Ronde River.
1925	The Grande Ronde River and its tributaries are adjudicated by the State Engineer: 1 cubic foot per second (cfs) was granted for 40 acres on a rotation basis equal to continuous flow of 1 cfs for 80 acres.
1926	Mt. Emily Lumber Co. purchases the timber holdings and mill site of the Grande Ronde Lumber Company. Extension of rail spurs continue in 1927 and 1928 into the upper Grande Ronde, with hauls up to 100 million board feet per company train to Hilgard, then transferred via UPRR to mill in La Grande.
1930s	Reports and plans made for water storage, flood control, and stream channel improvements. Sites under consideration are: three Grande Ronde River sites near mouth of Meadow Creek, on Meadow Creek, Sheep Ranch, Fly Creek, and Spring Creek.

Year or Period	Event
1934	Mt. Emily introduces log truck fleet to haul logs from landings to load out at the railhead at River Camp on the Grande Ronde.
1939	Ora Plata Mining Company begins dredging operations for gold on Tanner Gulch and down the Grande Ronde River, creating massive change to about two miles of creek and river channel and bottomland.
1955	Valsetz Lumber Co. purchase of Mt. Emily Lumber Co. brings the end to railroad logging in the Grande Ronde. Log transport converted entirely to trucks with construction of State Highway 244 up the Grande Ronde.
1960	Reconstruction of Old Oregon Trail Highway to interstate standards moves about 3.2 miles of the Grande Ronde River channel between Hilgard and the Oro Dell interchange west of La Grande.

Note: Additional historical information is being gathered by Eastern Oregon University students and may be avaliable in a later iteration of this report or in the Step 3 report.

Current Cultural Significance

The UGRRW is within the ancestral lands of the CTUIR. The natural resources of this area have had great cultural significance to the CTUIR since time immemorial and continue to be critically important today.

Along with numerous cherished cultural resources and sites throughout the basin, the CTUIR and various other tribes also hold treaty rights to a subsistence fishery in the basin and the water necessary to effectuate it.

Given the great cultural importance of the tribal fisheries, and the decades of legal decisions and case law associated with sustaining them, the CTUIR is recognized as a co-manager of these fisheries along with the ODFW. In the UGRRW, and throughout its historic territories, the CTUIR Department of Natural Resources works with stakeholders to manage and protect these important resources under its guiding "First Foods" policy. This policy integrates sustainable natural resource management with the critical importance of ecologically functioning landscapes in providing the traditional foods upon which the CTUIR’s culture depends. These traditional foods include robust, healthy populations of salmon and other fish, and the clean water upon which the fish rely. To advance the overall First Foods policy objectives, the CTUIR "river vision" guides the management of these riverine ecosystems and incorporates both scientific knowledge and traditional cultural experience to help direct resource decision making (CTUIR, 2016).

In addition to its great important in sustaining a tribal subsistence fishery, the UGRRW is also of great recreational importance to those who live in Union County. Its rivers and lakes offer ample sport fishing, boating, and hiking, and provide work and recreational opportunities for those living in the region broadly.

The waterbodies in the UGRRW are culturally significant to those who live in Union County, as they provide work and recreational opportunities.

Municipal Characteristics

The UGRRW is located within the approximate boundaries of Union County. This area is characterized by economic, social, and cultural components that impact water resources planning. Union County is located in northeast Oregon and has a population of 25,790 (U.S. Census Bureau, 2016). The following seven cities are located within Union County and the UGRRW boundary. Some of the cities are managed through existing Water System Master Plans (WSMP) and Water Management and Conservation Plans (WMCP).

Table 2-6
Union County WSMPs and WMCPs

City	WSMP	WMCP
La Grande	2013	2010
Island City	2011	2011
Elgin	2011	None
Union	2010	2011
Cove	2001	None
Summerville	None	None
Imbler	None	None

A brief discussion of each of these cities' water supply sources and current plans is presented below.

The 2015 Statewide Long-Term Water Demand Forecast stated that there are approximately 4.4 thousand acre-feet per year (TAF/yr) used for municipal demand, 1.2 TAF/yr used for unincorporated demand, and 8.9 TAF/yr used for industrial demand in Union County (OWRD, 2015).

La Grande

This city is the largest population center in the UGRRW, with a population of 13,229 (U.S Census Bureau, 2016). According to the 2013 WSMP, La Grande's water system consists of five groundwater wells. Two wells source their water from the basalt aquifer while the remaining three wells source their water from the alluvial aquifer. The total water supply quantity is adequate for current average day demand conditions and is slightly less than sufficient during peak day demand periods.

Two of the alluvial wells have seen reduced capacity since they were originally placed into service. The existing supply system is not adequate to meet short- and long-term needs as described in the WSMP. La Grande's water storage is adequate and the water distribution system is adequate with the exception of some areas where low fire flows are present (Anderson Perry & Associates, Inc. [AP], 2013).

Historically, La Grande used Beaver Creek Reservoir as its drinking water source; however, it was taken offline and placed in reserve status in 1992 due to the high cost of system upgrade requirements in response to changing regulatory requirements. This source is anticipated to be brought back online to service future demands of the City, and the required improvements are being planned for.

Table 2-7
La Grande Well Production Summary

Well	Water Right (gpm)	Current Pumping Rate (gpm)	Potential Available Unused Capacity (gpm)
Alluvial Wells			
Gekeler	1,499	1,000	499
Island City	1,495	1,000	495
Highway 30	2,002	1,700	302
Total Alluvial	4,996	3,700	1,296
Basalt Wells			
2nd and H	2,002	1,600	402
12th Street	2,603	1,600	1,003
Total Basalt	4,605	3,200	1,405
Total All Sources	**9,601**	**6,900**	**2,701**

gpm = gallons per minute

A water loss analysis was performed by the City to determine the percentage of total water lost between 2007 to 20012. Water loss by year ranged from 4 percent to 27.9 percent and averaged 17 percent. The City's loss amount exceeds the American Water Works Association's tolerance of 10 percent, precluding classification of the system as "good."

Island City

The City of Island City is located on the west side of the Grande Ronde Valley, east of the City of La Grande and generally south of the Grande Ronde River. It has a population of 1,016 (U.S. Census Bureau, 2016). Island City has five deep alluvial groundwater wells, all located within the city limits or urban growth boundary. The City's storage consists of two ground-level steel reservoirs, with storage capacities of 750,000 and 500,000 gallons, respectively. Currently, the City utilizes two booster pump stations to pressurize the distribution system. Based on data for water years 2000 through 2009, the City's average water use ranges between 220,000 and 300,000 gallons per day (AP 2011a, AP 2011b), which equates to 216 to 295 gallons per capita per day (gpcd).

Elgin

The City of Elgin is located in the northern portion of Union County. Principal employment in the area includes lumber, education, and agriculture. Elgin has a population of 1,756 (U.S. Census Bureau, 2016). Elgin obtains all of its drinking water supply from three wells. Currently, the City has a 650,000-gallon glass-fused-to-steel reservoir and a 1,000,000-gallon welded steel reservoir that serve the entire City of Elgin (AP, 2006).

Union

Union is located on the southern edge of the Grande Ronde Valley and has a population of 2,142 (U.S. Census Bureau, 2016). The average City water use is approximately 550,000 gallons per day or 256 gpcd. At this time, the City of Union obtains its water supply from two groundwater wells: Well No. 2 and Well No. 3. The City alternates its primary use between these two wells with the water from both wells pumping directly into the 750,000-gallon welded steel storage reservoir via separate transmission lines. The City of Union holds three groundwater rights issued by the State of Oregon for its municipal water wells. The City of Union also holds a surface water right to Catherine Creek for the surface water diversion that once supplied the City's water. This water right is for 3.0 cubic feet per second (cfs) (1,364 gpm) with a priority date of December 31, 1893 (AP, 2011c). The City diverts water through this system for stock watering and other non-potable uses. The City is considering using the surface water supply to augment irrigation uses in the community and the potential installation of a hydropower system.

Cove

Cove is located 14 miles east of La Grande and has a population of 625 (U.S. Census Bureau, 2016). According to Cove's 2001 WSMP, the City obtains its water from a groundwater well located adjacent to the City's storage reservoir north of the cemetery. The well is pumped at a rate of 400 gpm and is chlorinated. Cove holds municipal water rights for 550 gpm (1.11 cfs) with a priority date of 1981. The reservoir is a 200,000-gallon steel reservoir. Based on water years 1997 through 2000, the City's average gallons per capita per day was 188 (AP, 2001), which equates to approximately 117,500 gallons average daily demand. The City of Cove holds and uses their surface water right to operate a hydropower plant. They also recently constructed a new groundwater well; all residents rely on private wells.

Summerville

Located on the northern end of the Grande Ronde Valley, this city has a population of 136 (U.S. Census Bureau, 2016). Summerville does not have a community water system, so it does not have a plan documenting the water system.

Imbler

Imbler is located in the central part of the Grande Ronde Valley and has a population of 310 (U.S. Census Bureau, 2016). Imbler prepared a Water System Feasibility Study before the community water system was installed. Imbler has a well water right for 500 gpm. Imbler's well is deep basalt with artesian pressure, negating any need for a storage reservoir. The City uses a booster pump system to pressurize its distribution system. A decline in well shut-in pressure has been documented.

Agricultural Characteristics

There are approximately 800 farms and ranches in the UGRRW. Approximately 144,000 acres of the Grande Ronde Valley are designated as cropland, 49,000 acres are designated as irrigated land, and 42,000 acres are irrigated crops (Bach, 1995).

According to the 2012 Agricultural Census, there are 829 farms in Union County, with a total of 411,671 acres engaged in farming. The average farm size is 497 acres, and the median is 70 acres (USDA, 2012). Exploring water use by farm size may provide a useful lens into how the agricultural community utilizes water for different crops (see Table 2-8).

Table 2-8
Distribution of Farm Count by Farm Size

Farm Size	Count of Farms of Each Size
1 to 9 acres	147
10 to 49 acres	238
50 to 179 acres	169
180 to 499 acres	124
500 to 999 acres	62
1,000 acres or more	89

USDA, 2012

Union County's mild climate, good soils, and availability of irrigation water support diverse agriculture, which occurs primarily in Subwatersheds 2, 3, and 6. Field crops are among the top commodities and include peppermint, seed potatoes, sugar beets, grass seed, oilseed crops, grain crops, hay, and pasture (see Figure 2-20 and Figure 2-21, above).

Industrial User Characteristics

There are five National Pollutant Discharge Elimination System-designated point sources in the UGRRW (Oregon Department of Environmental Quality [DEQ], 2017a):

- Elgin Sewage Treatment Plant (STP)
- La Grande STP
- Union STP
- Boise Cascade
- Island City Particleboard

These systems all use water from municipal water systems. Some industrial users, including RD Mac and others, have water right permits for industrial water use within the UGRRW that are outside of municipal systems. The 2015 Statewide Long-Term Water Demand Forecast stated that approximately 4.4 TAF/yr is used for municipal demand, 1.2 TAF/yr is used for unincorporated demand, and 8.9 TAF/yr is used for industrial demand in Union County (OWRD, 2015). Additional analysis related to estimating water use will be completed in Step 3 to better characterize municipal use types so that areas where there is greatest water use within the system can be understood and savings areas can be found.

Economic Characteristics

In 2015, Union County had approximately 26,000 total residents. The total civilian workforce was approximately 12,000 (43 percent), with a 4.1 percent unemployment rate and relatively even gender distribution. The dominant county industries were healthcare, retail, manufacturing, and education (18 percent, 12 percent, 10 percent, and 9 percent of workforce, respectively). Most employment (70 percent) was provided by the private sector, with 20 percent government and 10 percent self-employed (U.S. Census Bureau, 2015).

Union County's median annual household income is below state ($51,243) and nationwide ($53,889) medians. Despite a 2015 average household income of $58,537, the county median income was significantly lower, at $43,822. More than half of Union County's households reported annual incomes below $50,000, over a quarter relied on cash or foodstamp public benefits during the reporting period, and 12 percent were below the federal poverty level (U.S. Census Bureau, 2015).

Union County has a total of 1,343 businesses, and the leading industries in Union County are retail (3,066 jobs at 291 establishments), healthcare and social services (3,010 jobs at 350 establishments), and public administration (1,494 jobs at 117 establishments). Most businesses in Union County have four or fewer employees (63 percent) (Business Oregon, 2017).

Traditionally, farming, ranching, and lumber harvest and processing have defined the economic base of Union County. According to the 2012 Agricultural Census, the market value of agricultural products sold in Union County was $68,370,000, and the total income (including wages) from farm-related sources (gross) was $3,628,000. In terms of sales, the following crops rated the highest: mint, cattle and calves, grains, and grass and legume seeds (USDA, 2012).

Ecological Health Characteristics

The ecological health of the planning area varies throughout the UGRRW. The UGRRW is home to a variety of plants and animals that live in differing ecological communities.

Key Species

Native species common to the region consist of a patchy mosaic of grasses (Idaho fescue [*Festuca idahoensis*], bluebunch wheatgrass [*Agropyron spicatum*], prairie Junegrass [*Koeleria cristata*], and Sandberg bluegrass [*Poa ampla*]), a variety of perennial forbs (yarrow [*Achillea millefolium*], arrowleaf balsamroot [*Balsamorhiza sagittata*], prairie smoke [*Geum triflorum var. ciliatum*], Pursh's silky lupine [*Lupinus sericeus*], and slender cinquefoil [*Potentilla gracilis*]), and shrubs (snowberry [*Symphoricarpos albus*], Nootka rose [*Rosa nutkana*], and Wood's rose [*Rosa woodsia*]) (Franklin and Dyrness, 1988).

Common wildlife in the UGRRW consists of a wide range of mammal, bird, and fish species, including numerous focal species. The Grande Ronde Subbasin Plan (NPCC, 2004) defines focal species as those used to develop management strategies to enhance the quality of the environment for all species. Focal terrestrial species include: Rocky Mountain elk (*Cervus elaphus nelsoni*), Rocky Mountain bighorn sheep (*Ovis canadensis*), American beaver (*Castor canadensis*), American marten (*Martes americana*), great blue heron (*Ardea herodias*), bald eagle (*Haliaeetus* *leucocephalus*), white-headed woodpecker (*Picoides albolarvatus*), olive-sided flycatcher (*Contopus cooperi*), yellow warbler (*Dendroica petechia*), sage sparrow (*Amphispiza belli*), western meadowlark (*Sturnella neglecta*), and Columbia spotted frog (*Rana luteiventris*) (NPCC, 2004).

Numerous resident and anadromous fish species inhabit the UGRRW. Focal aquatic species include: summer steelhead/redband trout (*Oncorhynchus mykiss*), spring Chinook salmon (*Oncorhynchus tshawytscha*), and bull trout (*Salvelinus confluentus*). Prior to the installation of dams on the Columbia and Snake Rivers, coho salmon (*Oncorhynchus kisutch*) were also common (NPCC, 2004).

Endangered Species Act Species

The following threatened, candidate, and endangered species are federally listed for Union County.

Table 2-9
Endangered Species Act-Listed Species in Union County

Species	ESU/DPS[1]	Federal Status[2]	State Status (OR)[3]	Designated Critical Habitat	Essential Fish Habitat
Steelhead (*Oncorhynchus mykiss*)	Snake River Basin DPS	T	SV	Yes	N/A
Chinook salmon (*Oncorhynchus tshawytscha*)	Snake River spring/ summer-run ESU	T	LT	Yes	Yes
Bull trout (*Salvelinus confluentus*)	Columbia River DPS	T	SC	Yes	N/A
Yellow-billed Cuckoo (*Coccyzus americanus*)	Western U.S. DPS	T	SC	Yes	N/A
Howell's spectacular thelypody (*Thelypodium howellii spectabilis*)	N/A	T	E	No	N/A
Whitebark pine (*Pinus albicaulis*)	N/A	C	N/A	N/A	N/A
North American wolverine (*Gulo gulo luscus*)	N/A	PT	LT	N/A	N/A

[1]*ESU = evolutionarily significant unit, DPS = distinct population segment*

[2]*T = Threatened, C= Candidate, PT= Proposed Threatened*

[3] *SV = Sensitive Vulnerable, LT = Listed Threatened, SC = Sensitive Critical, E = Endangered N/A = Not Applicable*

Snake River spring/summer run Chinook "critical habitat" includes all waterways presently or historically accessible to Chinook salmon, including the Grande Ronde River and its tributaries. Most waters in the UGRRW qualify. Snake River Basin steelhead critical habitat includes almost all of the UGRRW's streams.

Bull trout critical habitat includes fewer streams, mainly the large, cold ones (Grande Ronde River, Catherine Creek, Indian Creek, Lookingglass Creek, Five Points Creek, and numerous tributaries in the Wallowa and Elkhorn Mountains).

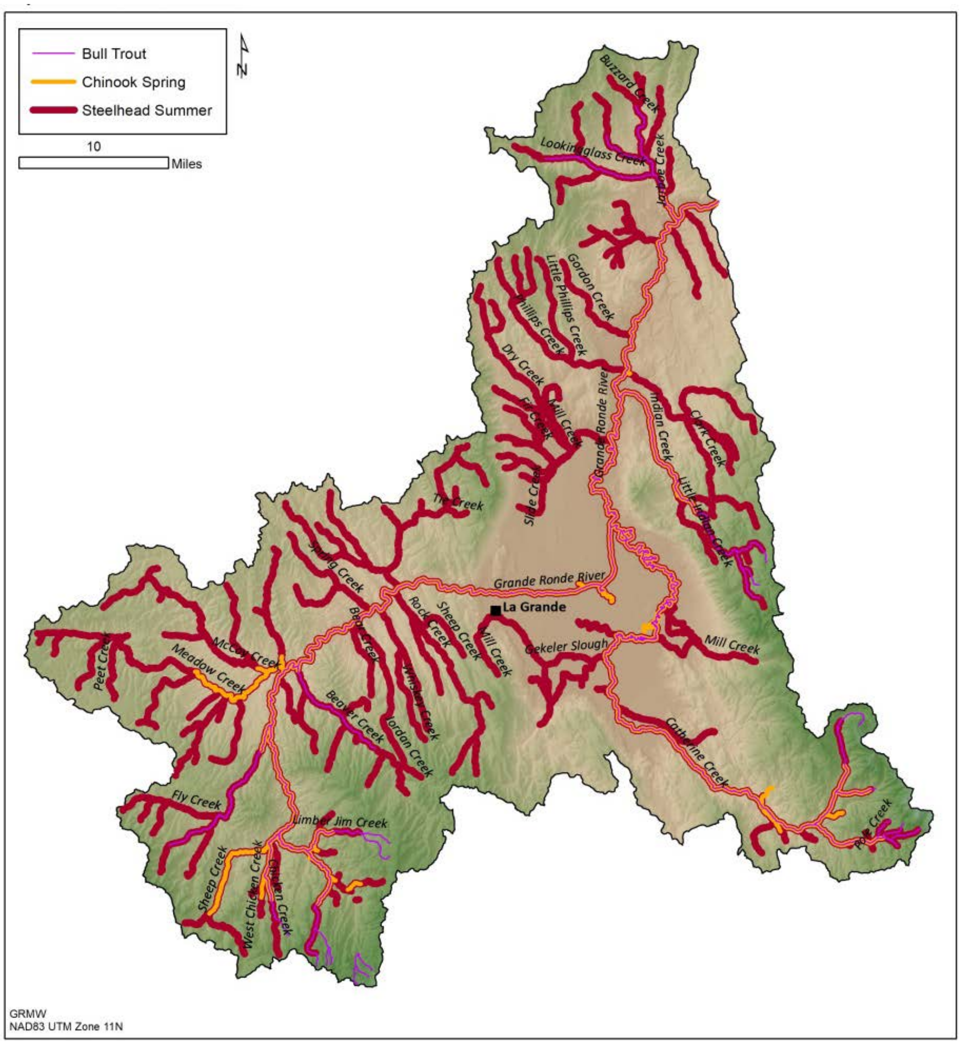
Yellow-billed cuckoo critical habitat is designated, but there is none in Oregon.

Wolves in Union County are not federally listed.

Essential Fish Habitat (National Oceanic Atmospheric Administration designation) is anywhere Chinook are located in the UGRRW, and Essential Salmonid Habitat (Oregon Department of State Lands designation) is in almost every stream where steelhead are located in the UGRRW.

Figure 2-22 shows the distribution of Endanged Species Act species in the UGRRW including bull trout, spring Chinook, and summer Steelhead.

Figure 2-22
Species Distribution



Oregon Department of Fish and Wildlife Sensitive Species List

Oregon-designated sensitive species are mapped by ODFW on the Compass mapping tool. The UGRRW is located in the Lower Snake Species Management Unit (SMU) (aquatic species) and the Blue Mountain (BM) ecoregion (wildlife species).

The following fish species are listed for either the Lower Snake SMU or the Blue Mountain (BM) ecoregion:

Table 2-10
ODFW Sensitive Species - Fish

Common Name	Scientific Name	Sensitive	Sensitive-Critical
Bull Trout	*Salvelinus confluentus*	Deschutes SMU (BM)	Hells Canyon SMU (BM)
		Grande Ronde SMU (BM)	John Day SMU (BM)
		Hood River SMU	Klamath Lake SMU
		Imnaha SMU (BM)	Malheur River SMU (BM)
		Walla Walla SMU (BM)	Odell Lake SMU
		Willamette SMU	Umatilla SMU (BM)
Chinook Salmon - Fall	*Oncorhynchus tshawytscha*	Mid-Columbia River SMU/ Deschutes ESU (BM)	Lower Columbia River SMU/ESU
Chinook Salmon - Spring	*Oncorhynchus tshawytscha*	Coastal SMU/ESU	Lower Columbia River SMU/ESU
		Middle Columbia SMU/ESU (BM)	Willamette SMU/Upper Willamette River ESU
		Rogue SMU/Southern Oregon/ Northern California Coasts ESU	
Great Basin Redband Trout	*Oncorhynchus mykiss newberrii*	Malheur Lakes SMU (BM)	
		Upper Klamath Basin SMU	
		Warner Lakes SMU	
Steelhead - Summer/ Columbia Basin Rainbow Trout	*Oncorhynchus mykiss/gairdneri*	Lower Snake SMU/Snake River Basin ESU (BM)	Middle Columbia SMU/ESU (BM)
		Upper Snake SMU/Snake River Basin ESU (BM)	
Western Brook Lamprey	*Lampetra richardsoni*	Range-Wide (BM)	
Westslope Cutthroat Trout	*Oncorhynchus clarki lewisi*		Range-Wide (BM)

The following amphibian species are listed for the BM ecoregion:

Table 2-11
ODFW Sensitive Species - Amphibians

Common Name	Scientific Name	Sensitive	Sensitive-Critical
Columbia Spotted Frog	*Rana luteiventris*		BM
Rocky Mountain Tailed Frog	*Ascaphus montanus*	BM	
Western Toad	*Anaxyrus boreas*	BM	

The following reptile species are listed for the BM ecoregion:

Table 2-12
ODFW Sensitive Species - Reptiles

Common Name	Scientific Name	Sensitive	Sensitive-Critical
Western Painted Turtle	*Chrysemys picta bellii*		BM

The following bird species are listed for the BM ecoregion:

Table 2-13
ODFW Sensitive Species - Birds

Common Name	Scientific Name	Sensitive	Sensitive-Critical
American Three-toed Woodpecker	*Picoides dorsalis*	BM	
Black-backed Woodpecker	*Picoides arcticus*	BM	
Bobolink	*Dolichonyx oryzivorus*	BM	
Columbian Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*		BM
Ferruginous Hawk	*Buteo regalis*	BM	
Flammulated Owl	*Psiloscops flammeolus*	BM	
Great Gray Owl	*Strix nebulosa*	BM	
Greater Sage-Grouse	*Centrocercus urophasianus*		BM
Lewis's Woodpecker	*Melanerpes lewis*		BM
Loggerhead Shrike	*Lanius ludovicianus*	BM	
Long-billed Curlew	*Numenius americanus*	BM	
Olive-sided Flycatcher	*Contopus cooperi*	BM	
Pileated Woodpecker	*Dryocopus pileatus*	BM	
Swainson's Hawk	*Buteo swainsoni*	BM	
Trumpeter Swan	*Cygnus buccinator*	BM	
Upland Sandpiper	*Bartramia longicauda*		BM
White-headed Woodpecker	*Picoides albolarvatus*		BM

The following mammal species are listed for the BM ecoregion:

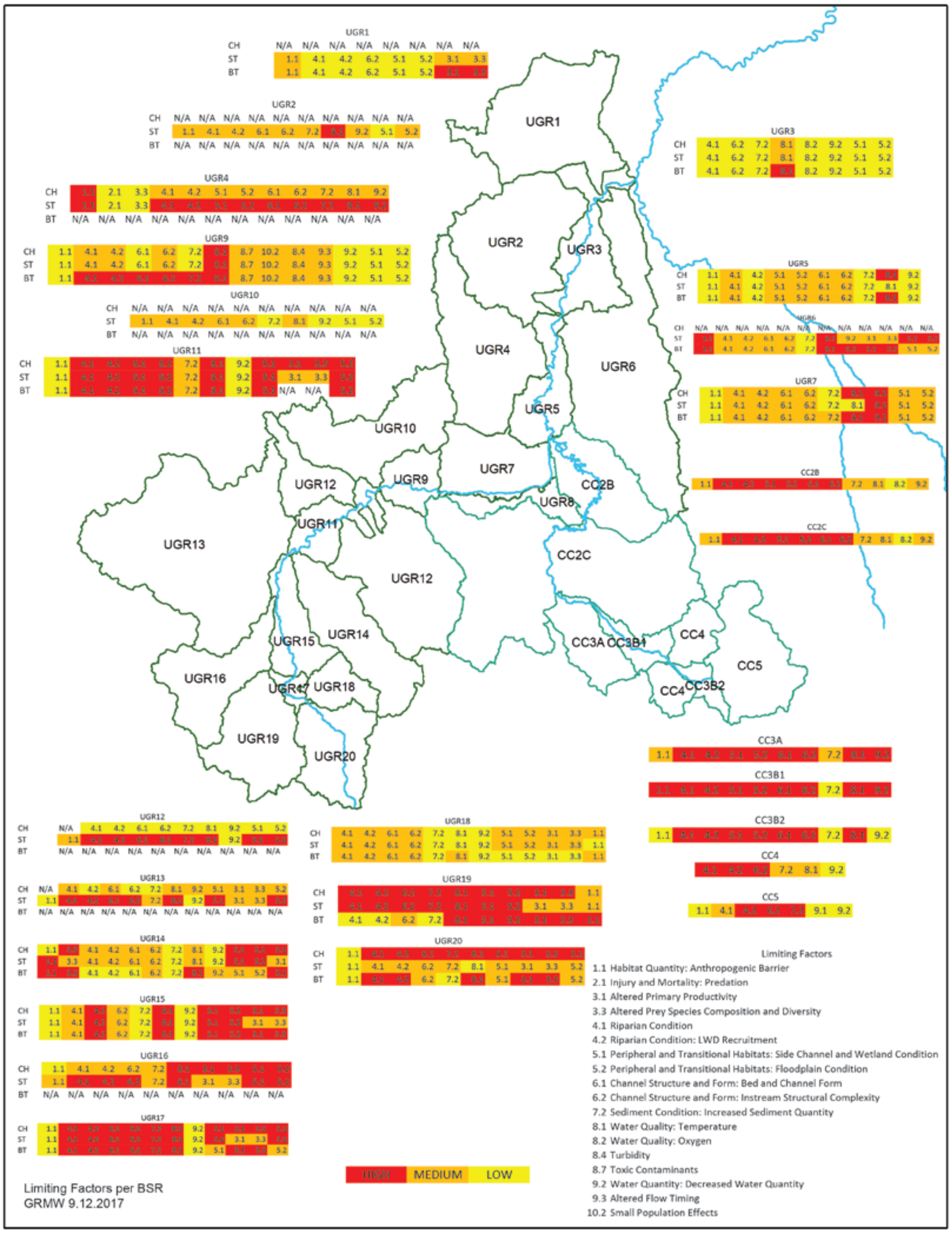
Table 2-14
ODFW Sensitive Species - Mammals

Common Name	Scientific Name	Sensitive	Sensitive-Critical
American Pika	*Ochotona princeps*	BM	
California Myotis	*Myotis californicus*	BM	
Fringed Myotis	*Myotis thysanodes*	BM	
Hoary Bat	*Lasiurus cinereus*	BM	
Long-legged Myotis	*Myotis volans*	BM	
Pacific Marten	*Martes caurina*	BM	
Pallid Bat	*Antrozous pallidus*	BM	
Rocky Mountain Bighorn Sheep	*Ovis canadensis canadensis*	BM	
Silver-haired Bat	*Lasionycteris noctivagans*	BM	
Spotted Bat	*Euderma maculatum*	BM	
Townsend's Big-eared Bat	*Corynorhinus townsendii*		BM

Key Habitats

There are numerous limiting factors that affect fish distribution and aquatic use in the UGRRW. BSRs are shown below and each limiting use is listed and ranked; see Figure 2-23.

Figure 2-23
Limiting Factors By BSRs



CH = Chinook, ST = Steelhead, BT = Bull trout

Data Gaps

The following data gaps were observed during this data analysis and collection effort for Section 2.0:

- Each agency and study uses different boundaries when mapping the UGRRW, so there is difficulty in interpreting results across agency databases (OWRD, DEQ, GRMW ATLAS).
- Aquifer depth and interaction with surface water is not well understood.
- Additional specific data may be needed to calculate and verify water quantity and quality questions. These data are not avaliable and need to be collected.

Section Summary

This section provides critical watershed-defining information for three primary characteristics of the UGRRW: physical, socio-cultural, and ecological health.

Physical Characteristics

The UGRRW is located in northeast Oregon and is closely aligned with the political boundary of Union County. The UGRRW is a portion of the larger Grande Ronde River Watershed system that eventually drains to the Snake River. Elevations range widely, from the mountainous areas that reach over 6,000 feet in elevation, to the central portion of the UGRRW, comprising the valley floor at only 2,700 feet in elevation. The climate is semi-arid with hot, dry summers and cold, moist winters. Mean annual precipitation is approximately 28.25 inches per year. The hydrology of the UGRRW is dominated by snowmelt runoff. Sixty percent of the UGRRW is forestland, 20 percent is rangeland, and the majority of the remaining acreage is used for grain crops, hay, and pastureland, with a small percentage for residential areas. Geologically, the Grande Ronde Valley is surrounded by the Blue Mountains and drained by the Grande Ronde River, meaning there are areas on the edges of the UGRRW dominated by Columbia River basalt and areas in the Grande Ronde Valley with a thick accumulation of valley-fill sediments.

Water is used in many ways in the UGRRW. Agricultural uses dominate much of the Grande Ronde Valley area, domestic uses are concentrated in city areas, and recreation/fish/wildlife uses are scattered through the UGRRW. There are three types of water rights in the UGRRW: groundwater, storage, and surface water. For the purpose of this report, the UGRRW was divided into eight subwatersheds for analysis. The main waterbodies in the UGRRW are the Grande Ronde River and Catherine Creek; each of these systems has numerous tributaries that create a robust network of streams throughout the UGRRW. In addition, there are wetlands, lakes, and reservoirs within the UGRRW, but they are more limited.

The UGRRW contains both alluvial aquifers, located near the ground surface, and deep basalt aquifers several thousand feet below ground surface.

Socio-Cultural Characteristics

Oregon is located at the convergence of five prehistoric cultural regions that encompassed similar subsistence strategies, technology, and community organization within common natural settings. Eastern Oregon is predominately characterized by two of these regions. Southeastern Oregon comprises the Great Basin cultural area, which represents the earliest evidence of humans in the state, and northeastern Oregon is part of the Columbia Plateau cultural area. Historically, many tribes included the Grande Ronde Valley within their territories. The Cayuse homeland extended primarily along the Umatilla, Walla Walla, and Grande Ronde Rivers, as well as north and east along the Touchet and Tucannon (Stern, 1998).

Euroamerican contact with the native peoples of the region first occurred in 1805, when Lewis and Clark and the Corps of Discovery navigated the Clearwater, Snake, and Columbia Rivers. The discovery of gold by a group of emigrants along the Malheur River spurred a greater exploration of northeastern Oregon. With miners and emigrants constantly passing through the area, settlements soon sprang up in the Grande Ronde Valley. In 1864, Union County was created from a portion of Baker County (Mead, 2006).

People have significantly modified waterbodies within the UGRRW, including the Hilgard sawmills and early placer mining operations on the Upper Grande Ronde River in the late 1800s, and the initial steps to create State Ditch in the 1880s (with additional work in the 1980s) to reroute the Upper Grande Ronde River to a straighter and more-channelized path as a flood control measure.

The cities of Union County each have distinct water systems to serve their populations, which range from over 13,000 in La Grande to only 136 in Summerville (which has no community water system). The communities rely on surface water and groundwater raw water sources, storage reservoirs, and distribution systems to meet municipal water needs. There are five primary industrial users in the UGRRW, and their water needs are met through municipal systems. Agricultural residents in Union County are represented by approximately 800 farms and ranches that require irrigation from a combination of surface water diversions and groundwater wells. Agriculture is a primary economic driver in Union County, with timber, public sector jobs, and a service economy also providing economic opportunities in the region.

Ecological Health Characteristics

The UGRRW is home to numerous species that serve different roles in maintaining ecological health. Focal terrestrial species include Rocky Mountain elk (*Cervus elaphus nelsoni*), Rocky Mountain bighorn sheep (*Ovis canadensis*), American beaver (*Castor canadensis*), American marten (*Martes americana*), great blue heron (*Ardea herodias*), bald eagle (*Haliaeetus leucocephalus*), white-headed woodpecker (*Picoides albolarvatus*), olive-sided flycatcher (*Contopus cooperi*), yellow warbler (*Dendroica petechia*), sage sparrow (*Amphispiza belli*), western meadowlark (*Sturnella neglecta*), and Columbia spotted frog (*Rana luteiventris*) (NPCC, 2004).

Focal aquatic species include summer steelhead/redband trout (*Oncorhynchus mykiss*), spring Chinook salmon (*Oncorhynchus tshawytscha*), and bull trout (*Salvelinus confluentus*). Prior to the installation of dams on the Columbia and Snake Rivers, coho salmon (*Oncorhynchus kisutch*) were also common (NPCC, 2004).

Federally endangered species in the UGRRW are monitored through recovery plans, and many restoration projects are ongoing to provide additional habitat resources to these vulnerable species, many of which are aquatic, including steelhead, Chinook, and bull trout. State listed species are also monitored and have protections in place to support population recovery.

3.0 - Surface Water

The surface water section describes the distribution of surface water quantity and state of water quality knowledge throughout the Upper Grande Ronde River Watershed's (UGRRW) eight major subwatersheds. This helps the planning group to understand how much water is present in the rivers and streams of the basin under natural conditions (without diversions). Following this picture of natural conditions is an assessment of water use within the basin, and an assessment of Oregon Water Resources Department (OWRD) water availability assessments. Where available, we have compared this to stream gage data for a dry, wet, and average precipitation year in order to assess how the surface water system and diversion timing interacts in these water year types.

Finally, in order to understand where water quality may be impacting both instream uses and limiting the ability to divert additional water even if water is available, we have characterized water quality concerns within the basin.

Surface Water Subwatersheds

This section describes how the eight study area subwatersheds were created to better analyze surface water quantity and quality. The eight subwatersheds were developed based on differences in each area that were expected to influence decisions and solutions developed in later steps of the planning process. A review of the United States Geological Survey (USGS) hydrologic unit maps found 63 HUC 12 units within the UGRRW. A review of the ecological data set compiled by the Grande Ronde Model Watershed (GRMW) found 10 Biologically Significant Reaches (BSRs) within the Catherine Creek area and 20 BSRs within the Grande Ronde River area for a total of 30 BSRs for the UGRRW. BSRs were developed by local biologists to determine each area's limiting factors. The eight subwatersheds are the result of combining BSRs into segments of the UGRRW that could be helpful in describing the area and creating beneficial water resources projects.

In order to facilitate analysis of water quality and quantity at scales and locations representative of both hydrologically unique sub-basins and distinct land use areas important to different water use types, we divided the Grande Ronde Basin into eight subwatersheds. Initially, the subwatershed was divided by hydrologic units, or HUC 12 units, as determined by the USGS. These subwatersheds were designated by the USGS because they signaled a significant change in hydrologic characteristic, either because a major tributary junction or a change in geologic or orthographic condition. Some of these areas were then combined based on BSRs as determined by the Oregon Department of Fish and Wildlife (ODFW) and GRMW.

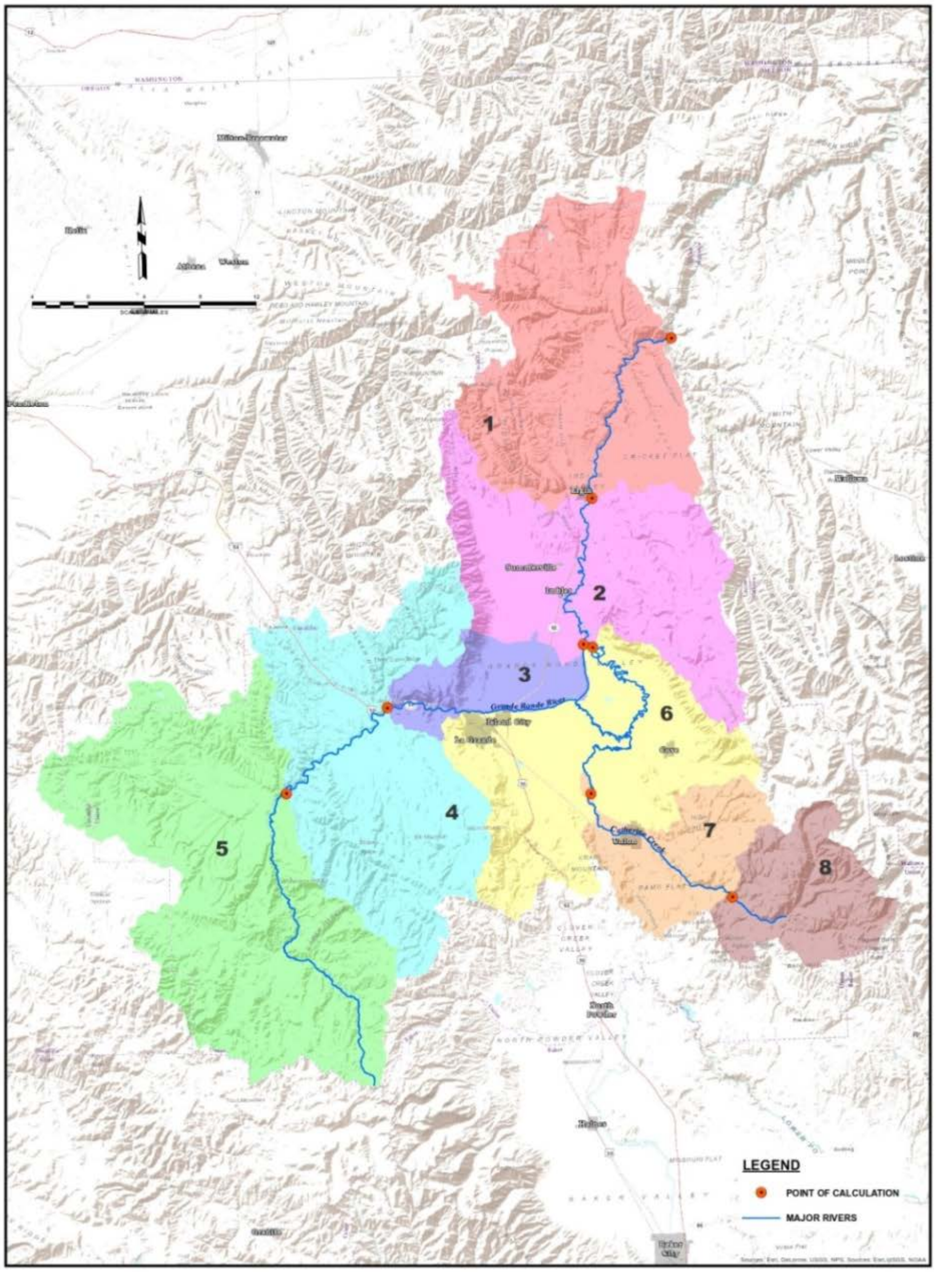
Eight associated points of calculation were developed to provide information about surface water flow for each of the subwatersheds.

- Subwatershed 1: This represents the northern-most point of the UGRRW. The Grande Ronde River flows north out of the UGRRW and makes its way to the Snake River. The southern part of this subwatershed is bounded by the City of Elgin. It includes primarily evergreen forest, with scattered shrub/scrub and grassland habitat to the west of the Grande Ronde River and cultivated crops to the east of the Grande Ronde River. In terms of land cover, Elgin is developed medium to low intensity (National Land Cover Dataset, 2011). This subwatershed was selected because of the uniformity of forest land on one side of the Grande Ronde River, cultivated crop area, and City of Elgin providing a transition to Area 2.

- Subwatershed 2: The central part of the subwatershed includes the communities of Summerville and Imbler and their associated cultivated crop farmland, as well as the Indian Creek Watershed and its associated shrub/scrub habitat. The outside edges of this subwatershed include evergreen forest and some grassland areas. To the east, Clark Creek and the network of streams is included. At the southern part of this subwatershed, there are two points of calculation: one for where State Ditch connects the Grande Ronde River to the flows from Catherine Creek, and one for where the historic Grande Ronde River containing flows from Catherine Creek meanders through cultivated croplands.
- Subwatershed 3: This subwatershed includes cultivated cropland and the City of Island City. The Grande Ronde River is channelized in this subwatershed. This subwatershed is bounded by State Ditch to the east.
- Subwatershed 4: This subwatershed is predominantly evergreen forest, with some shrub/scrub habitat. It includes Beaver Creek. It is sparsely populated and not used for cultivated crops.
- Subwatershed 5: This subwatershed is also undeveloped and includes the Meadow Creek, McCoy Creek, and Fly Creek Watersheds and the Grande Ronde River. The subwatershed is predominantly evergreen forest with patches of shrub/scrub habitat and grassland.
- Subwatershed 6: This subwatershed includes La Grande and Cove. It is where Catherine Creek flows into the Grande Ronde River, and where the Grande Ronde River turns to the north and then the west. This subwatershed includes predominantly cultivated cropland with areas of development in La Grande and Cove.
- Subwatershed 7: This subwatershed includes the City of Union which, in terms of land cover, represents low intensity development, and areas along Catherine Creek, which include cultivated cropland. This subwatershed is predominantly evergreen forest to the east and shrub/scrub habitat to the west.
- Subwatershed 8: This subwatershed is completely undeveloped and predominantly evergreen forest with patches of shrub/scrub habitat and grassland. Catherine Creek originates here.

Figure 3-1 below shows the locations of the eight subwatersheds.

Figure 3-1
Surface Water Subwatersheds

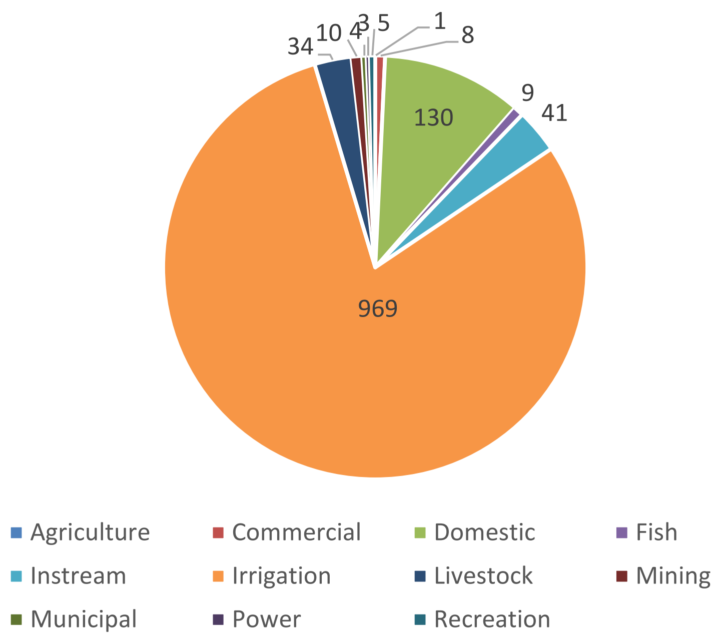


Additionally, these subwatersheds can be grouped by land use and human affects. This helps identify the areas that may be most susceptible to human-influenced changes.

- Subwatersheds 4, 5, 7, and 8 lack cultivated crops and population centers. These are defined as "natural" areas.
- Subwatersheds 2, 3, and 6 represent high use from cultivated crops and population centers. These are defined as "agricultural/populated" areas.

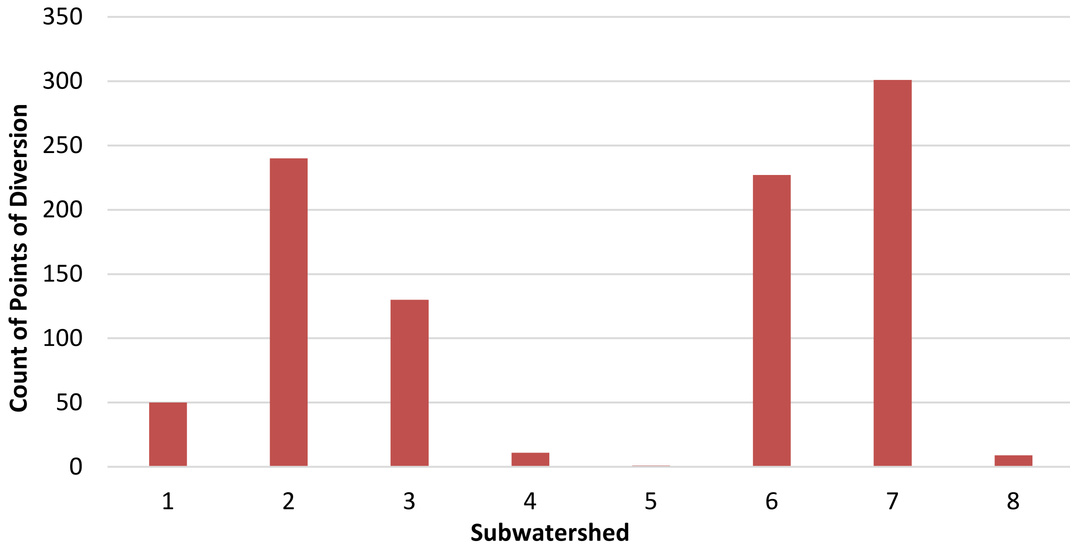
- Subwatershed 1 is a combination of natural and agricultural areas. This subwatershed is defined as a "combination" area.

Figure 3-2
Surface Water Diversions within the UGRRW



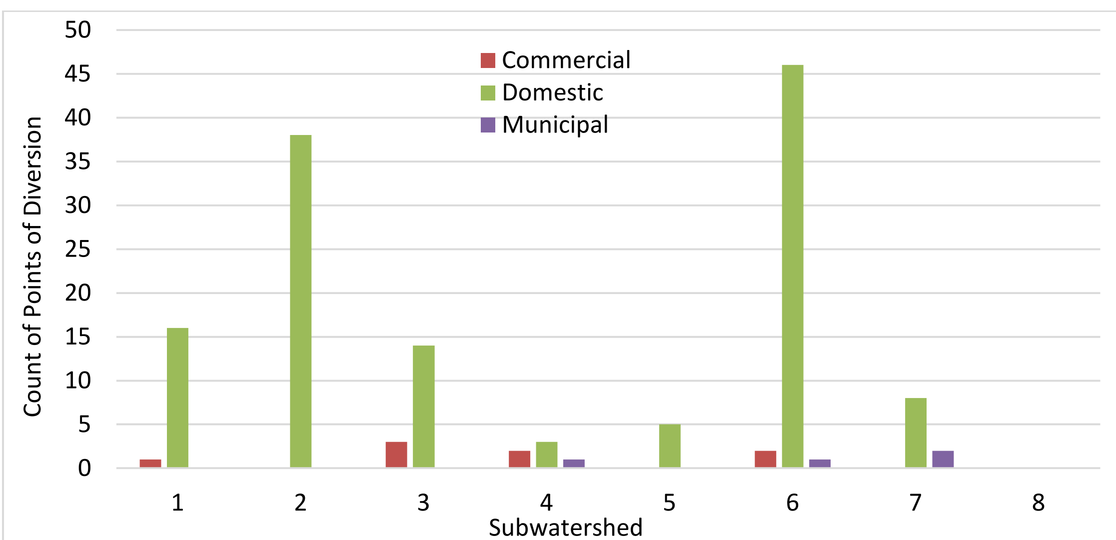
To understand how surface water is legally utilized within the UGR basin, we explored the points of diversion, or any approved diversion of water from a stream, within the basin and how they vary by character of use (see Figure 3-2). Further description of each category is avaliable in Oregon Administrative Rules (OAR) 690, Division 300. Character of use is determined on the water right itself and, in some cases, a water right is for more than one type of use. It is important to note that many points of diversion (PODs) may be associated with single water rights; as such, these numbers should be viewed as a relative estimate of the number of diversions and not as the total number of water rights within each use category. Within the larger UGR basin, the largest percent of water right PODs are associated with irrigation, then domestic uses, and third, instream water rights (not diverted). Though this does not clarify how much water is being used by each sector, we can identify that agriculture uses the most water rights of any group of water users in the basin.

Figure 3-3
Irrigation Surface Water Points of Diversion of Subwatershed



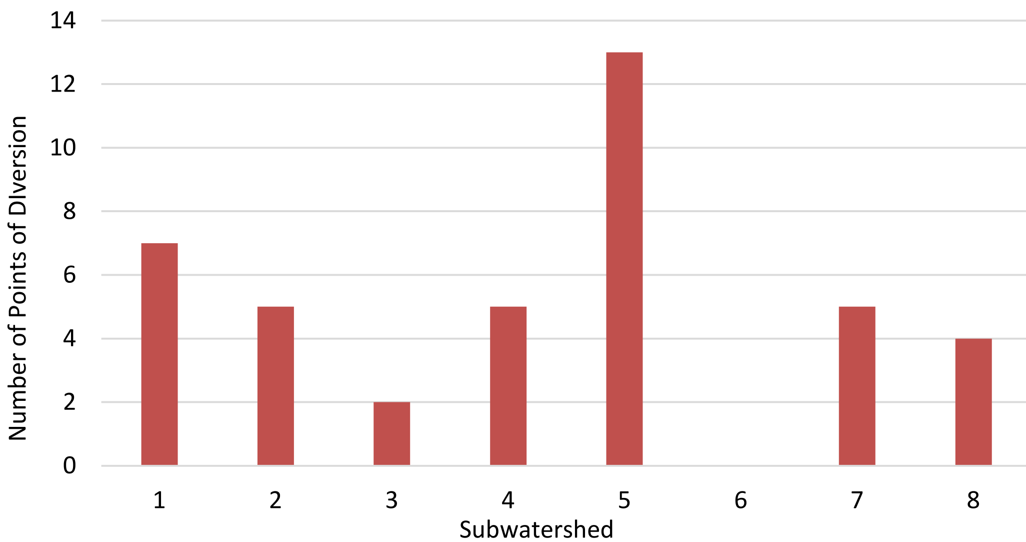
Because irrigation has the most diversions within the basin, it may be helpful to understand where those diversions are occurring in the subwatershed. Not surprisingly, the majority are in Subwatershed 6 and 7, around Catherine Creek, and Subwatershed 2, below the confluence of Catherine Creek and State Ditch. These are followed closely by Subwatershed 3, the area to the west of State Ditch. Subwatersheds 1, 4, 5, and 8, those in the headwaters and at the far downstream end of the basin, contain relatively few to no irrigation water rights.

Figure 3-4
Municipal, Domestic, and Commercial Surface Water Points of Diversion by Subwatershed



To get a picture of where human consumption of water for drinking or commercial uses outside of irrigation occur, we can identify commercial, domestic, and municipal rights within the basin. Subwatersheds with municipal water rights, 4, 6, and 7, are in the upper portions of the Grande Ronde Valley floor, possibly upstream of much of the irrigation use within the system, though this should be explored more fully. The count of domestic uses generally rises in the subwatershed without municipal systems, though this is not true in Subwatershed 6 where municipal use and domestic use are relatively high. Subwatershed 6 does have a great share of irrigation water rights, and it is likely that many of these surface diversions are permitted for both domestic and irrigation, though this should be verified. Commercial use outside of municipal systems is distributed between subwatersheds. Some commercial use is included in municipal systems, and some commercial use relies on self-supplied water systems. It is consistent with irrigation and is centered in the Grande Ronde Valley.

Figure 3-5
Instream Water Rights by Subwatershed



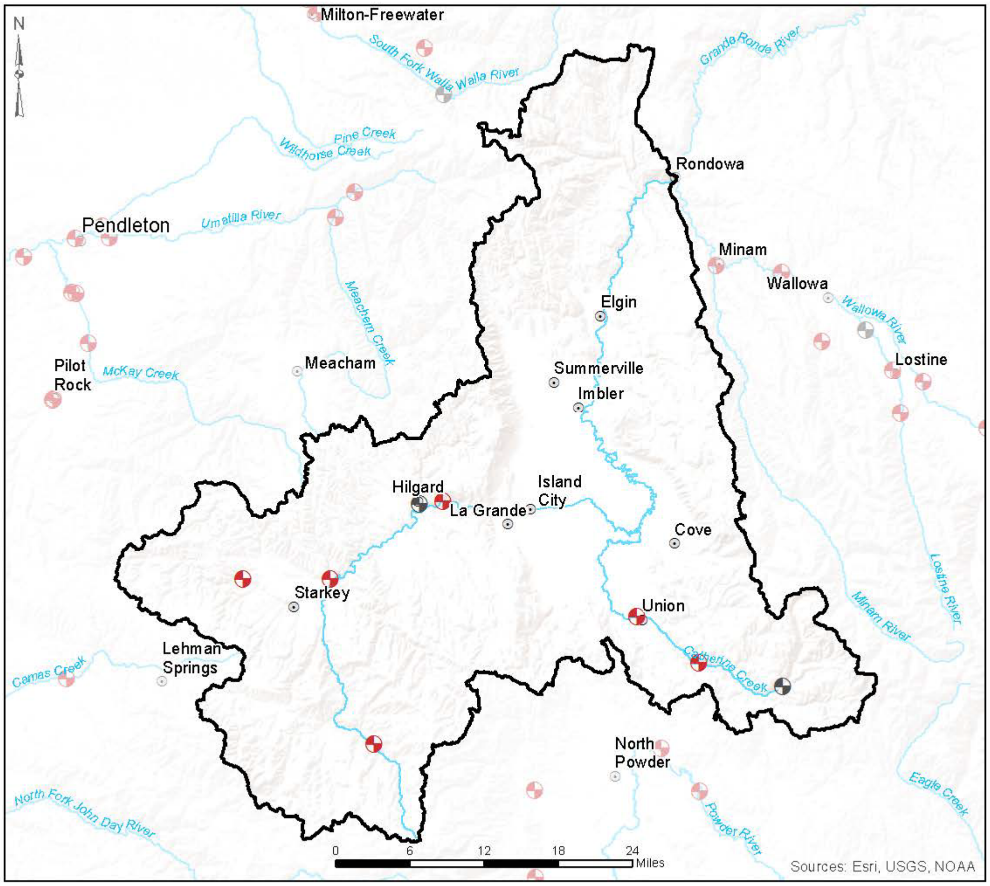
Instream water rights are distributed throughout the basin, though the largest number is within Subwatershed 5, the headwaters of the Grande Ronde River, and the next highest number is in the farthest downstream subwatershed, Subwatershed 1. There are no legal instream protections in Subwatershed 6, though the instream water rights downstream of Subwatershed 6 require water to be passed to the downstream reaches in accordance with water right priority dates.

Surface Water Measurements

The OWRD operates stream gaging stations. Some of the stations can be viewed online in near real time. Other agencies operate stations in the UGRRW as well. These stations typically measure water levels termed "stage height," which is rated to streamflow measurements in order to develop a stage discharge relationship curve. The stage discharge relationship curve allows for the calculation of stream discharge. Discharge is expressed as cubic feet per second (cfs). Some stream gaging stations also log stream, water stage, and temperature. Figure 3-6 shows the location of the current OWRD gaging stations.

Figure 3-6
Active Gaging Stations

Upper Grande Ronde Subbasin Study Area
Active Gaging Stations



Active Gaging Stations

- Stream gage
- Near real-time

Description:

The Oregon Water Resources Department operates more than 200 stream and reservoir gages throughout the state. More than160 of these gages are operated as near real-time. These gages transmit stream data once an hour. The data is received and downloaded to the Department's database where it is processed and updated on the agency's web page every hour.

Map produced by:
Oregon Water Resources Department
725 Summer St. NE Suite A
Salem, OR 97301

Map date: October 24, 2016

Source:
Active gaging stations,Oregon Water Resources Department, 2016

Surface Water Quantity

This section addresses surface water quantity in the UGRRW.

For the purposes of this report, surface water quantity is defined as the expected amount of water flowing instream before any diversions (pre-development conditions). Following are definitions for commonly used terms and concepts in this section:

- Gage flows: observed/measured streamflow (actual water quantity)
- Naturalized flows: gaged/observed flows adjusted for any upstream out-of-stream consumptive uses, diversions into/out of stream, and reservoir storage, regulation, etc. Naturalized flows are meant to represent prehistoric streamflow.
- Water availability: the water availability calculation is based on the definition of over appropriation for surface water found in OWRD's Water Allocation Policy (OAR 690-400-010 (11)(a)(A)). "Over appropriated means a condition of water allocation in which the quantity of surface water available during a specified period is not sufficient to meet the expected demands from all water rights at least 80% of the time."

  The water availability methodology defines three types of expected demands:

  1. Storage,

  2. Consumptive uses, and

  3. Instream demands (i.e., instream water rights and scenic waterway flows).

  Other uses of water that are instream and non-consumptive are not included as expected demands. Examples of these uses are mining, aquaculture, and hydroelectric.

  We can then define water availability in terms of this equation:

  WA = QNSF – ST – CU – IS

  Where:

  WA = The water available.

  QNSF = The natural streamflow at a specified point on the stream; for this study the 50 percent exceedance flow.

  ST = Storage in or from the stream and its tributaries upstream from the specified point.

  CU = Consumptive uses from the stream and its tributaries upstream from the specified point.

  IS = Instream flow demands for a stream reach that includes the specified point.

  (Cooper, 2002.)

Additionally, the following data sets and assumptions were used:

- A 30-year period streamflow record, 1958 to 1987, known as the base period, was analyzed statistically to determine for each basin the monthly 50 and 80 percent exceedance flow values. This is the volume of water in the stream that was determined to be exceeded or equaled in the stream 50 or 80 percent of the time during a given month during the base period.
- The same 30-year base period was used to estimate flows in ungaged streams.
- The statistical characteristics of the 1958 to 1987 record were assessed for a trend in the mean streamflow over that time period. No trend was found over that period throughout much of the state, so it was assumed that annual streamflow volumes did not change substantially over time, or remained stationary.

See details on the formula in the section below.

Determining Surface Water Quantity

To determine surface water quantity, the UGRRW Partnership decided to use OWRD's water availability natural streamflow model output, which had data available for pre-defined water availability basins (WABs). These WABs are typically located at gaging stations, major tributary confluences, or minimum flow points. Since the WABs did not overlap with the calculation points requested by the UGRRW Partnership, OWRD developed a set of scaling factors based on precipitation and watershed area to scale the monthly flow duration curves of natural streamflows from available gaging stations and determine low (90 percent exceedance), median (50 percent exceedance), and high (10 percent exceedance) flow values for all subwatersheds in the system. The sections below describe the data sets and process used to estimate these natural streamflows, the resulting streamflows, and gaps in the approach used here.

Natural Streamflow at Gaged Points in the Upper Grande Ronde River Watershed

Natural streamflow at gaged points was determined using OWRD's Water Availability model. The Water Availability model computes available water as the difference of natural streamflow minus reservoir storage, out-of-stream consumptive uses, and instream flow demands. OWRD bases the streamflow statistics on measured streamflow from gaging stations for many of the rivers in Oregon, both those with and without diversions above the stream gage. Where diversions were present, consumptive uses were added back in at the gage site before further streamflow calculations were made. For rivers without gaging stations, basin characteristics (e.g., watershed size, precipitation, etc.) were used along with corrected natural streamflow gage records in nearby or similar basins to estimate streamflow values. It is important to note that this analysis was done using a specific set of years, called a base period, so that streamflow values could be compared across the state. OWRD chose the 1958-1987 base period in part because there was no observable trends in the mean, annual streamflow over that period (average hydrologic conditions) and because that period was characterized by a wide coverage of long-term stream gages across the landscape (OWRD, 2002).

These "natural flow" records were analyzed statistically to determine the flow in the stream channel and the distribution of these streamflows across time. At points with stream gages, the full distribution of streamflows from 10 to 90 percent exceedance was calculated based on the stream gage record. At ungauged points, only the 50 and 80 percent exceedences were modeled based on regression equations developed with the points with gaging stations, meaning that another approach is needed for estimating the 10 and 90 percent exceedances at ungauged points in the system.

Table 3-1
OWRD Stream Gages in the UGRRW Used in this Analysis

Station Number	Station Name	Status	Lon (DD)	Lat (DD)	Elev (ft)	Operator	Area (sq. mi.)	Start	End	Complete WY
13318800	GRANDE RONDE R AT HILGARD, OR	D	-118.244	45.339	3000	USGS	543	10/1/1966	11/30/1981	15
13319000	GRANDE RONDE R AT LA GRANDE, OR	D	-118.130	45.345	2830	USGS	686	10/1/1903	9/30/1989	80
13320000	CATHERINE CR NR UNION, OR	A	-117.776	45.156	3100	OWRD	103	8/1/1911	9/30/2014	88
13323500	GRANDE RONDE R NR ELGIN, OR	D	-117.927	45.512	2670	USGS	1250	10/1/1955	10/31/1981	26

DD = decimal degrees

ft = feet

sq. mi. = square miles

WY = Water Year

Estimating Streamflow at Ungauged Points in the Basin

To estimate the exceedance flows at the eight points of calculation, information about basin area and annual precipitation was required to scale the gaged flows to ungaged points of calculation. To begin, each region of calculation was paired with a nearby upstream or downstream gage determined to be most representative by OWRD and Anderson Perry & Associates, Inc. Then the precipitation-area ratio between the ungaged and gaged watersheds was calculated.

RATIO = (Au/Ag) * (Pu/Pg)

Drainage areas (A) for the gaged and ungaged basins were calculated using GIS software (see Table 3-2). Area averaged mean annual precipitation (P) was calculated using Precipitation-elevation Regressions on Independent Slopes Model (PRISM) (Daly et al., 1994) 1961 to 1990 annual precipitation grids clipped to the drainage area. Then the precipitation-area ratio (RATIO) was calculated. In general, this approach is considered most accurate in cases where the ratio is between 0.5 and 1.5. From Table 3-2, only the ratio from Subwatershed 6 (0.33) falls significantly below these bounds.

The exceedance flows (QNSF) from the gage can then be scaled based on the precipitation-area ratio (RATIO).

Table 3-2
Summary of Watershed Characteristics Used to Estimate Streamflow Values in Ungaged Subwatersheds

Subwatershed Number	Drainage Area (acres)	Mean Annual Precipitation for Subwsatershed (feet)	Watershed Mean Annual Precipitation Volume (acre-feet)	Station Number	Station Name	Gaged Drainage Area (acres)	Mean Annual Precipitation for Gaged Area (feet)	Gage Mean Annual Precipitation Volume (acre-feet)	Precip-Area Ratio
1	1,050,000	2.36	2,470,000	13323500	GRANDE RONDE R NR ELGIN, OR	800,000	2.23	1,780,000	1.38
2	878,000	2.28	2,000,000	13323500	GRANDE RONDE R NR ELGIN, OR	800,000	2.23	1,780,000	1.12
3	468,000	2.25	1,050,000	13319000	GRANDE RONDE R AT LA GRANDE, OR	439,000	2.30	1,010,000	1.04
4	428,000	2.31	988,000	13319000	GRANDE RONDE R AT LA GRANDE, OR	439,000	2.30	1,010,000	0.98
5	250,000	2.35	586,000	13318800	GRANDE RONDE R AT HILGARD, OR	348,000	2.33	808,000	0.72
6	260,000	2.27	589,000	13320000	GRANDE RONDE R NR ELGIN, OR	800,000	2.23	1,780,000	0.33
7	117,000	2.84	333,000	13320000	CATHERINE CR NR UNION, OR	65,900	3.29	217,000	1.54
8	62,100	3.30	205,000	13320000	CATHERINE CR NR UNION, OR	65,900	3.29	217,000	0.95

See text above for descriptions of data sources.

Modeled Natural Subwatershed Flow (Volume)

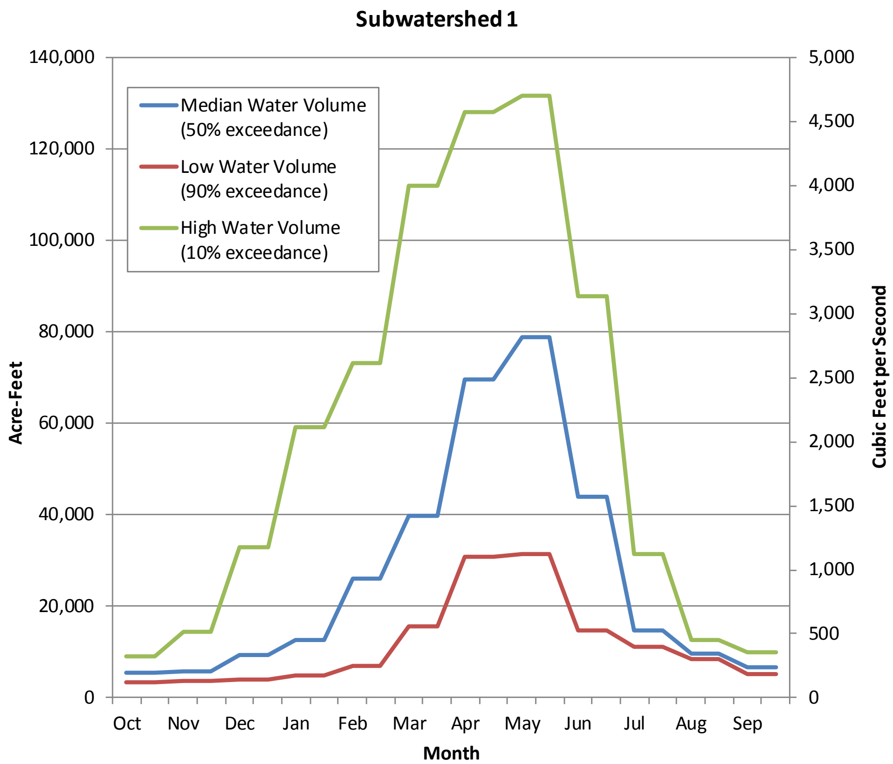
Using the stream gage data at four gages within the UGR basin, the natural flow methodology from the Water Availability Model, precipitation data, and the area of each basin, OWRD computed the 10, 50, and 90 percent exceedance natural monthly streamflows at the downstream point of all subwatersheds (see Table 3-2 and Figure 3-7). Initially, the stream gage data were naturalized using the Water Availability Model. These stream gages on the Grande Ronde River and Catherine Creek were selected based on their proximity to the "points of calculation," long period of record (greater than 15 years) during the base period, and flow duration curves (5 to 95 percent exceedance) and have been "naturalized" (upstream consumptive uses added back). To estimate the streamflow statistics at the subwatershed points that were not represented by a stream gage, precipitation and watershed area data were used to create scaling factors. For a point, say Subwatershed 8, the nearest stream gage was selected.

Water volume was divided in half by the UGRRW Partnership and is shown as an exceedance probability for each two-week period in a year, again assuming the base period accurately described current conditions. When reviewing Figure 3-7, note that the green line indicates that only 10 percent of the streamflow has exceeded that amount; in other words, streamflows of this magnitude do not happen often. The red line indicates that 90 percent of the streamflow records exceed that amount, or streamflows that are found in the stream 90 percent of time. The blue line indicates that 50 percent of the records exceed that amount. The blue line is the median, a type of average. Data are shown in both acre-feet per two-week period (volume) and cfs (rate). Each subwatershed has the same general patterns of peak flows during springtime since data are generally estimated using the same set of stream gages. Subwatershed 1 (which includes all flow in the UGRRW) showed a maximum median flow of approximately 2,700 cfs (80,000 acre-feet) in a two-week period.

Gaps

While it was common practice at the time to assume streamflow varied within a range captured by a "sufficiently long" or "representative" period of record, the assumption is considered by some to be no longer fitting – though it is still common practice. Recent advances in understanding of climate and hydrology show that variability inherent or built in to the climate system, as well as in streamflow, can have a significant impact on how water is used beneficially in a basin. Consequently, additional analyses are needed to identify and better understand causes behind changes in streamflow in the UGRRW.

Figure 3-7
Subwatersheds 1 through 8 Low, High, and Median Flow Volume by Month



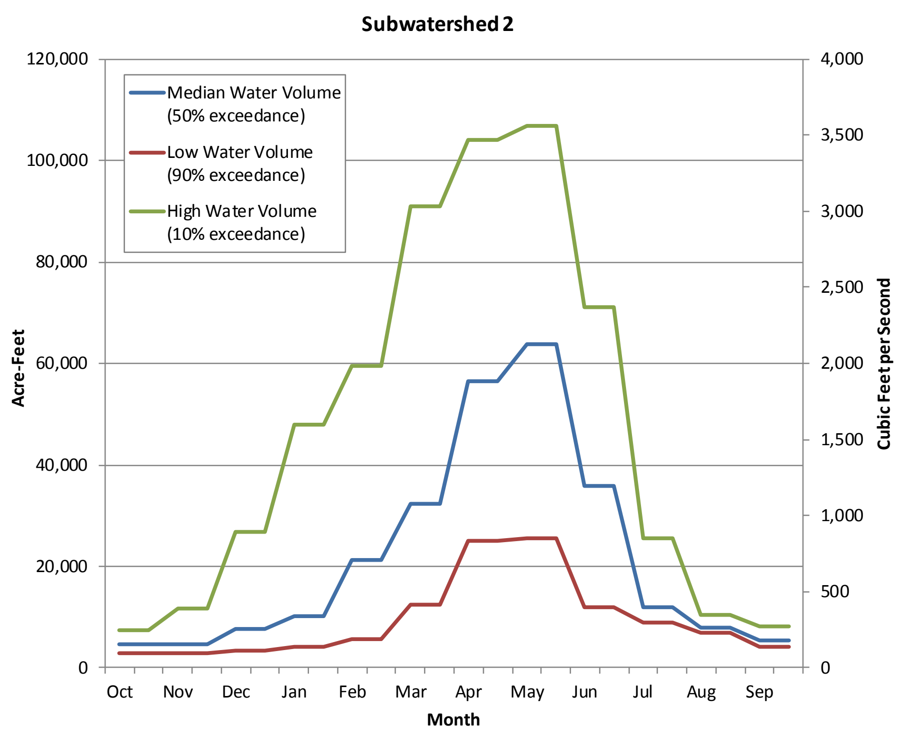


Figure 3-7
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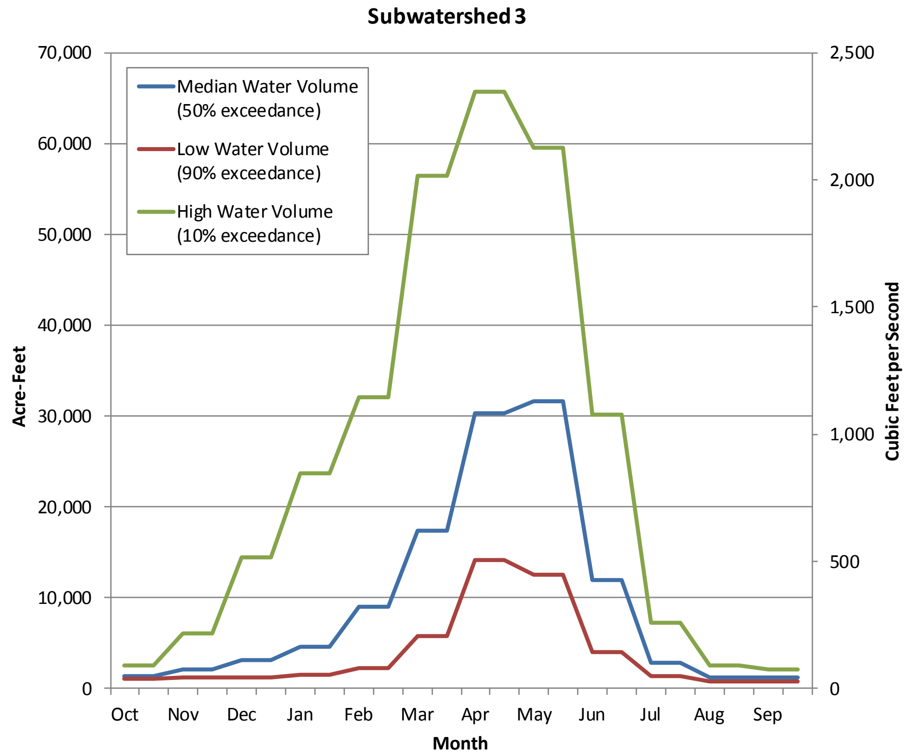

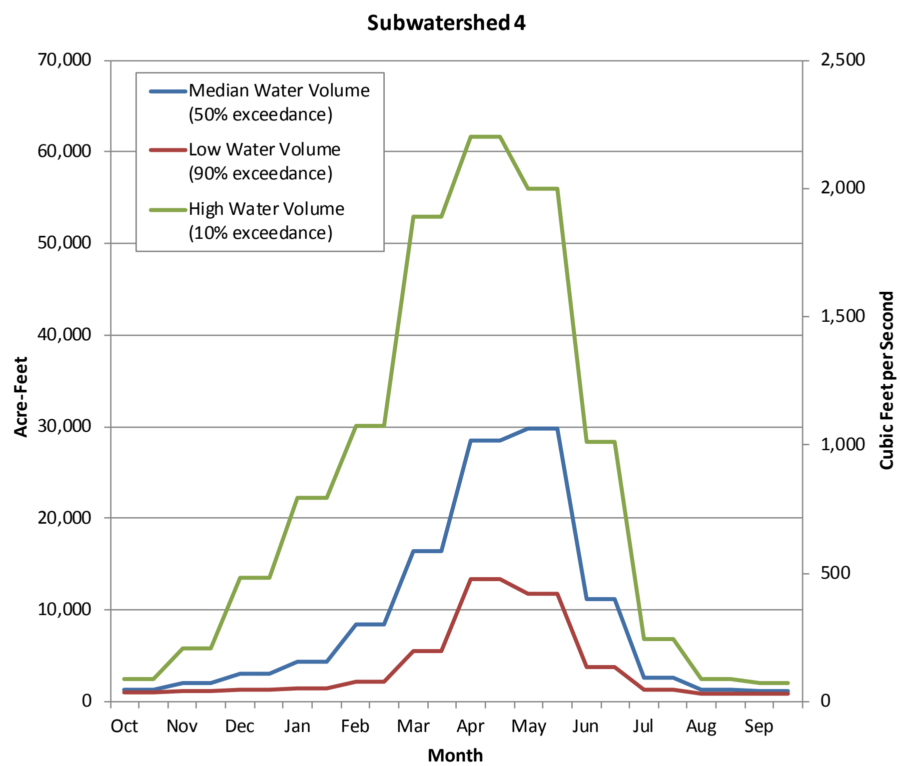

Figure 3-7
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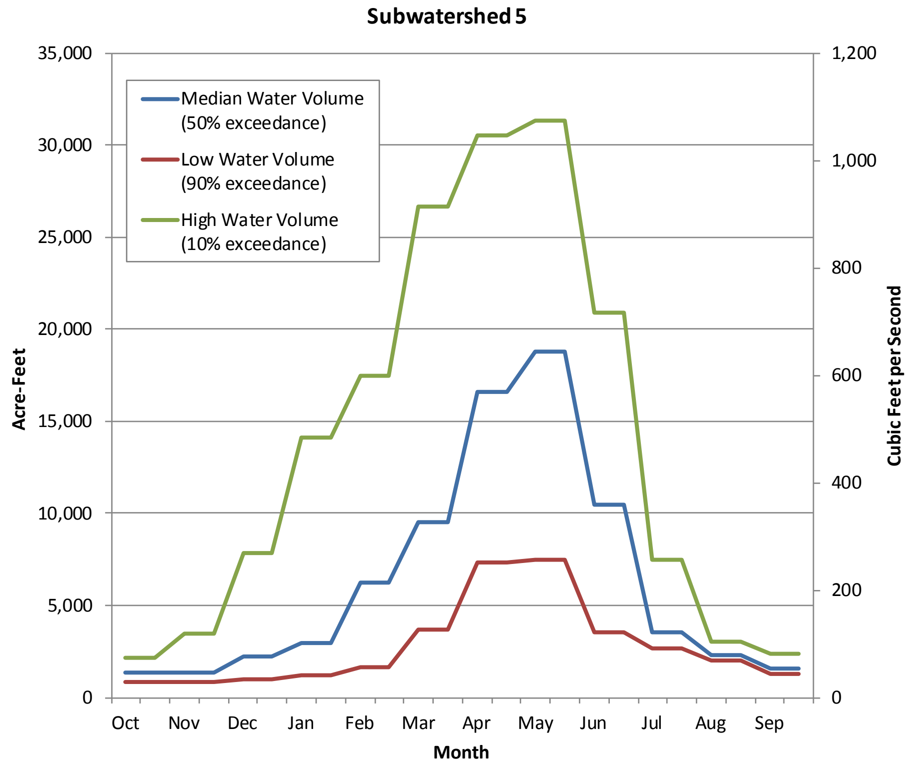

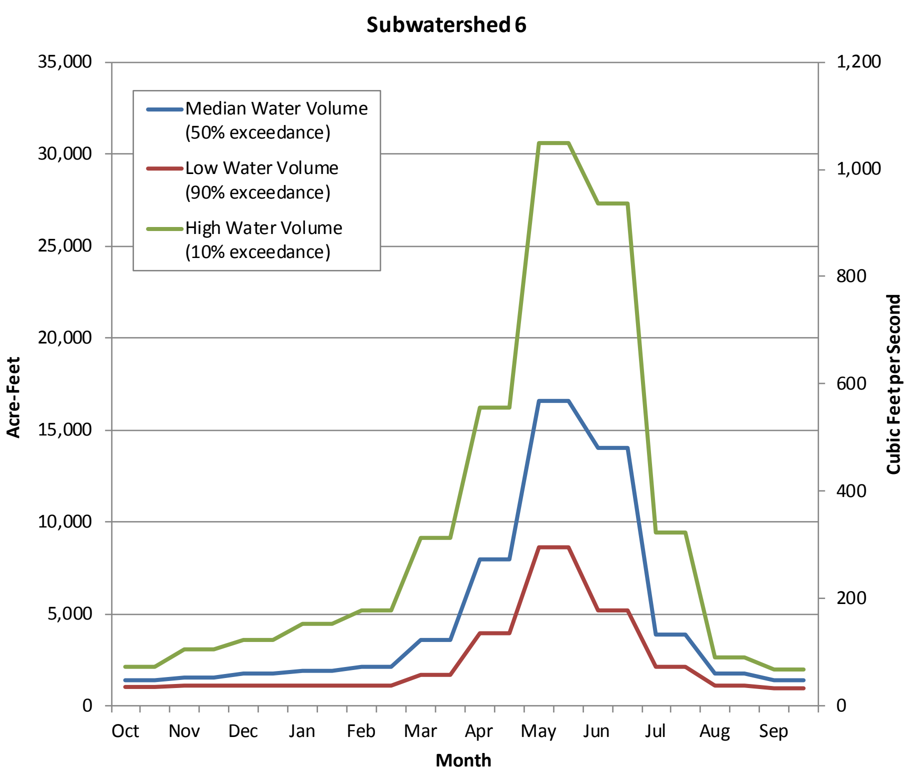

Figure 3-7
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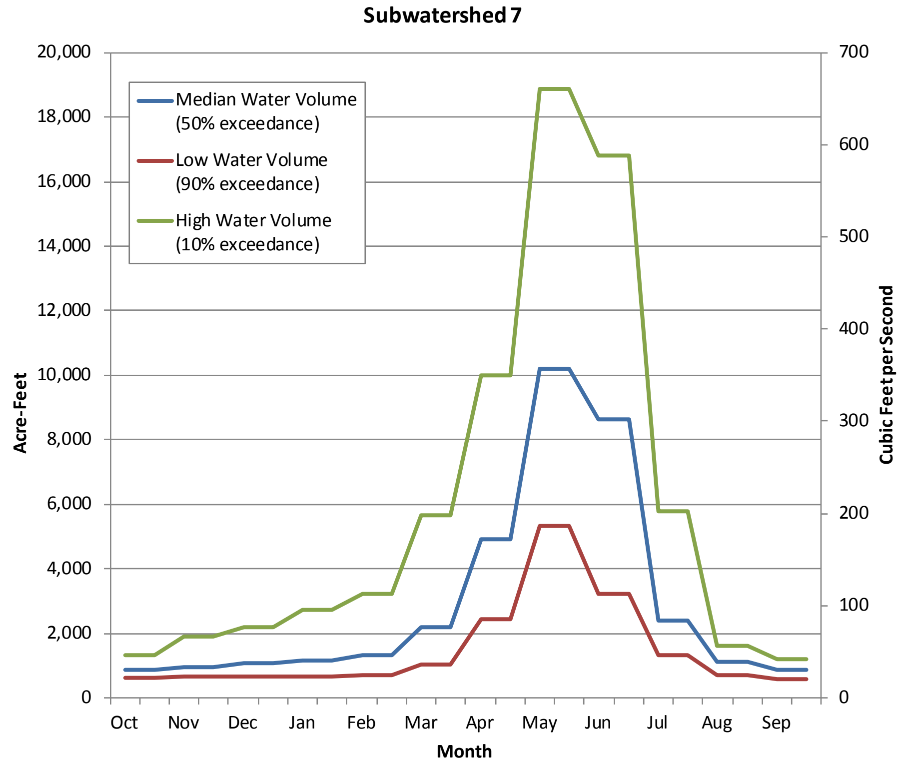
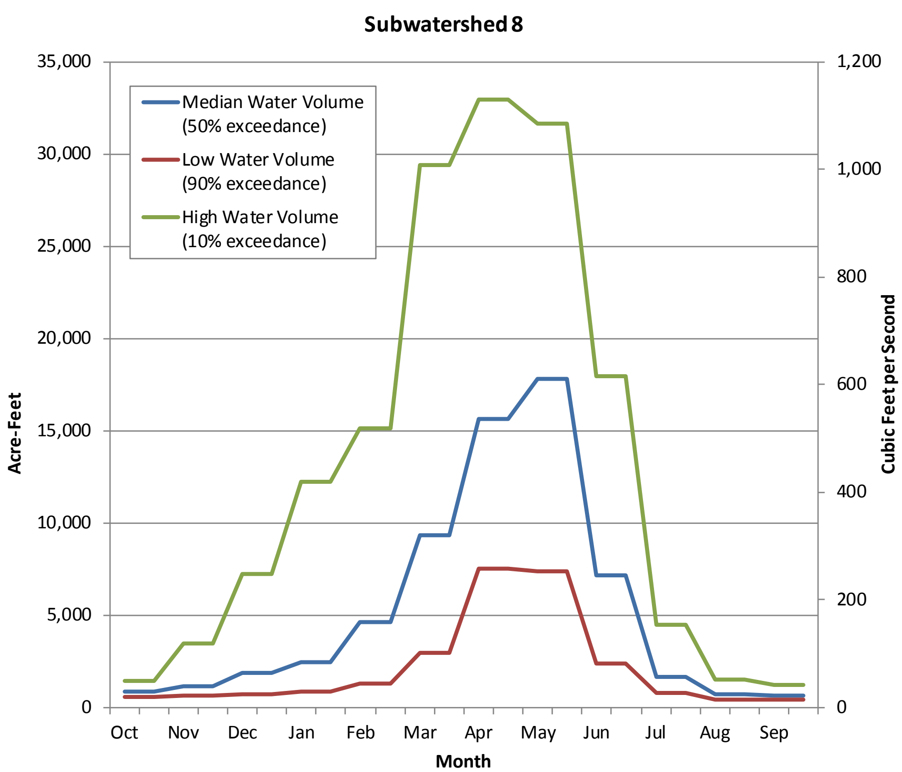




Basin-Wide Water Supply Availability

As indicated by the graphs above, much of the flow in the UGRRW occurs during a brief period of time in the spring. There is currently relatively little built water storage to capture and hold this runoff. Water needs during other periods of the year then may be vulnerable to shortage of available water. Based on the modeled water availability calculation, Figure 3-8 shows there are only a few places where water is available for new appropriations at the 80 percent exceedance level. OAR Chapter 690, Division 33 further limit when water can be appropriated. The 80 percent exceedance streamflow is the flow that occurs at least 80 percent of the time. As can be seen on Figure 3-8, some additional live flow water may be available for direct diversion and use during a few months of the year, but basically the basin is fully appropriated, based on the 1958 to 1987 period of record.

Figure 3-8
Months of Available Streamflow (Calculated at 80 Percent Exceedance)

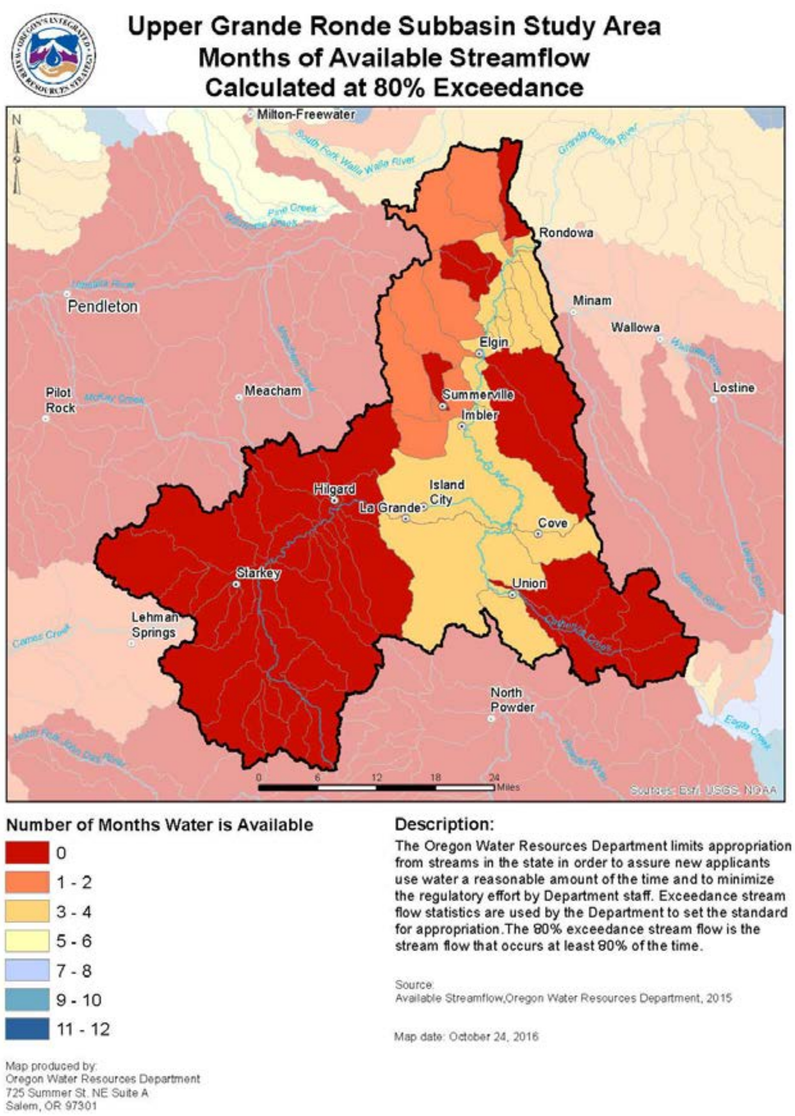
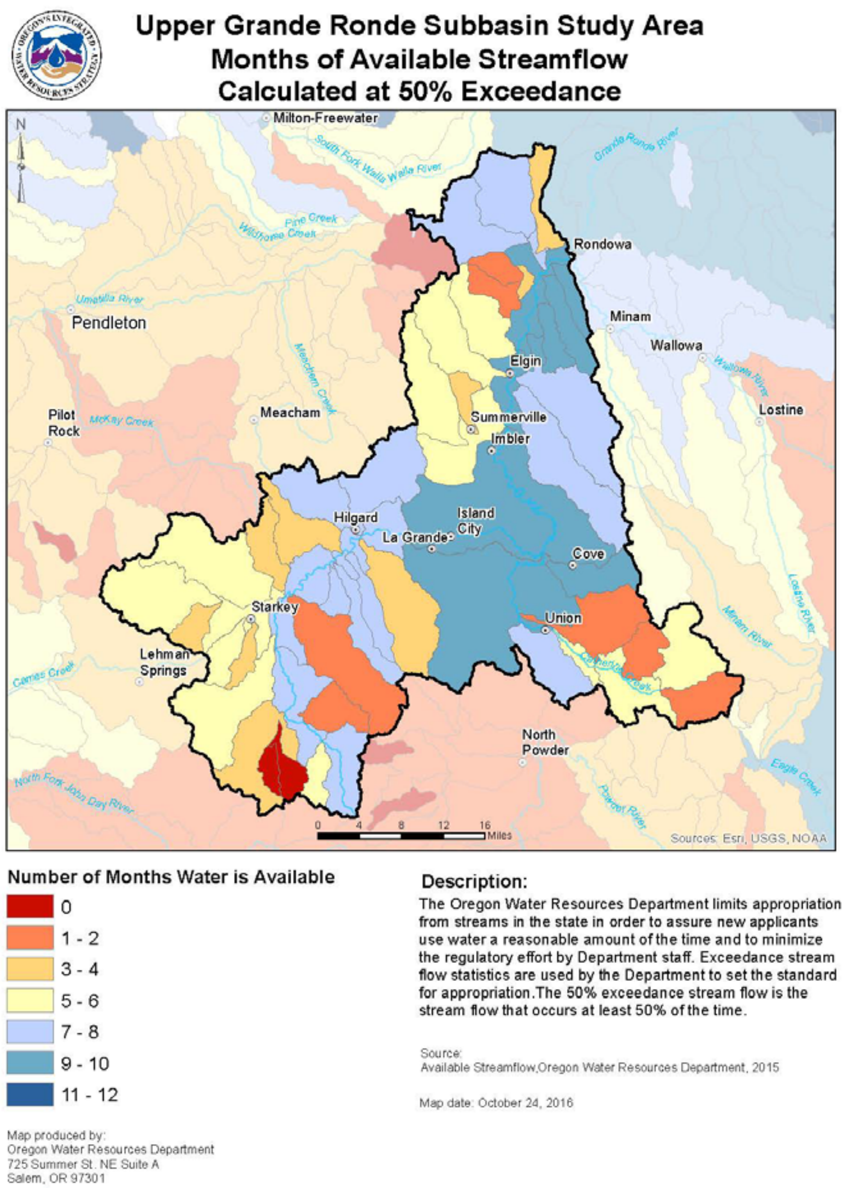


Figure 3-8 shows all months when water is available at 80 percent. More specific monthly values (particularly during the irrigation season) will be explored in Step 3. These values (Figure 3-8 and Figure 3-9 are for natural stream flow (the water that would be in the stream channel if there were no diversions).

Figure 3-9 shows some watersheds **may** have water available for storage, even above and beyond the "Reservations for Storage." The water available for storage is determined using the 50 percent exceedance calculations, which is the flow that occurs at least 50 percent of the time. However, Division 33 rules do not allow diversion for storage after April 15, so even areas identified on Figure 3-9 may not have water available for storage.

Figure 3-9
Months of Available Streamflow (Calculated at 50 Percent Exceedance)



Trends and Variability in Surface Water Quantity Over Time

Below we explore changes in streamflow as it relates to water supply. First, we explore mean, monthly streamflow over two base periods in Catherine Creek as a means of exploring OWRD's water availability model and the impact of including recent hydrologic information. Although the mean streamflow is a useful metric for planning, it may not help to explain vulnerabilities in water supply within the basin. To do this, it is helpful to explore changes in measured streamflow data over time and time scales that people use to plan for their water needs. Typically, consumptive water users consider the timing of delivery of precipitation during the year, the timing of snowmelt and therefore abundance of water in the basin for diversion or storage, and the total amount of water that falls in a year and the timing of that water delivery. Instream users are interested in trends in minimum flows across multiple years, about the magnitude of peak flows events that are important for maintaining Instream habitat by moving rocks and sediment and vegetation and pollutants, and the variation in the timing of flows ranging from base flows to high flows and how these relative magnitudes change in timing in the year and in relation to each other.

To explore these questions, the two hydrographs indicate the substantial differences between wet and dry periods. It is hoped this will help stakeholders become familiar with the river system as well as help identify what parts of the hydrograph are most interesting and important to people's interests. With this, we can then identify which components are most important to maintain and which are aspects that allow flexibility in the way water is managed within the basin.

The following two hydrographs (Figures 3-10 and 3-11) show comparisons between water years 1945 to 1976 and 1977 to 2016 (climate shift) 20th percentile, median, and 90th percentile. A noticeable change between these two hydrographs is that the spring melt occurs earlier and more steadily in the post-1976 data set.

Figure 3-10
Water Year 1945 to 1976 Monthly Flow Volumes

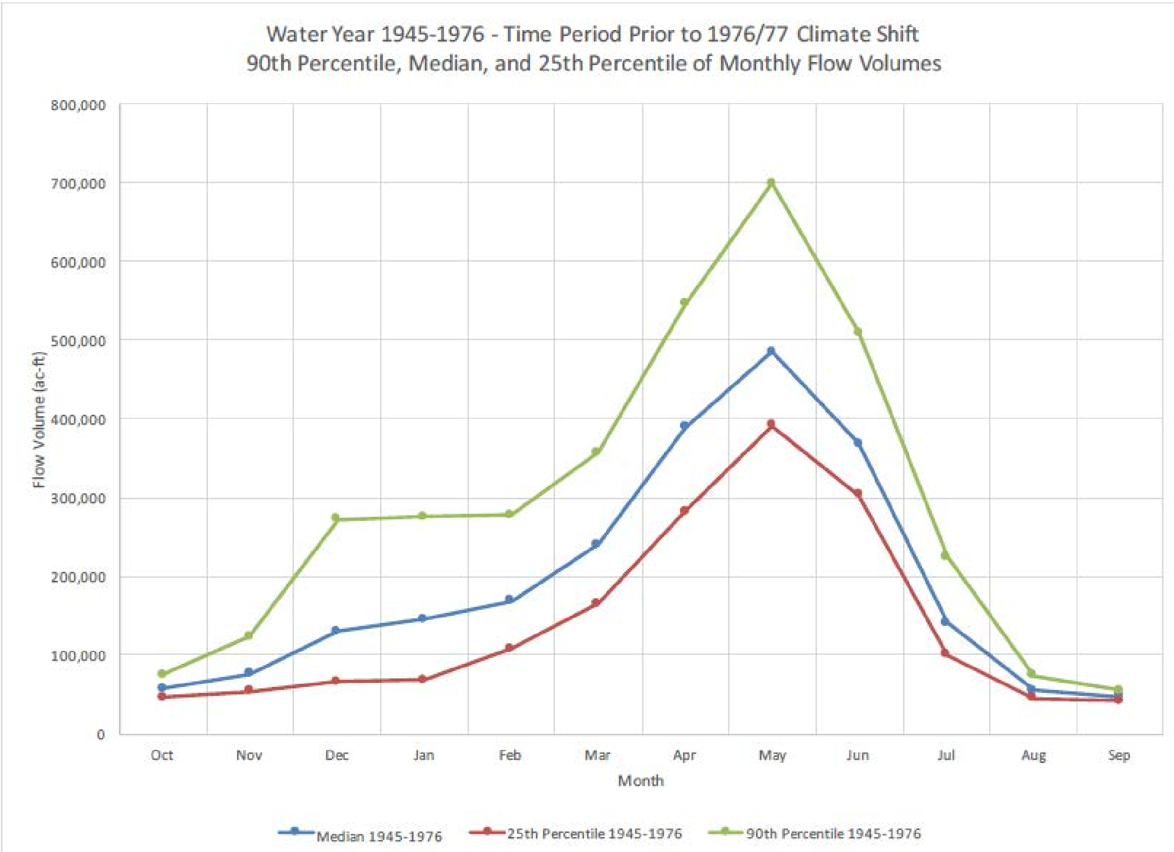
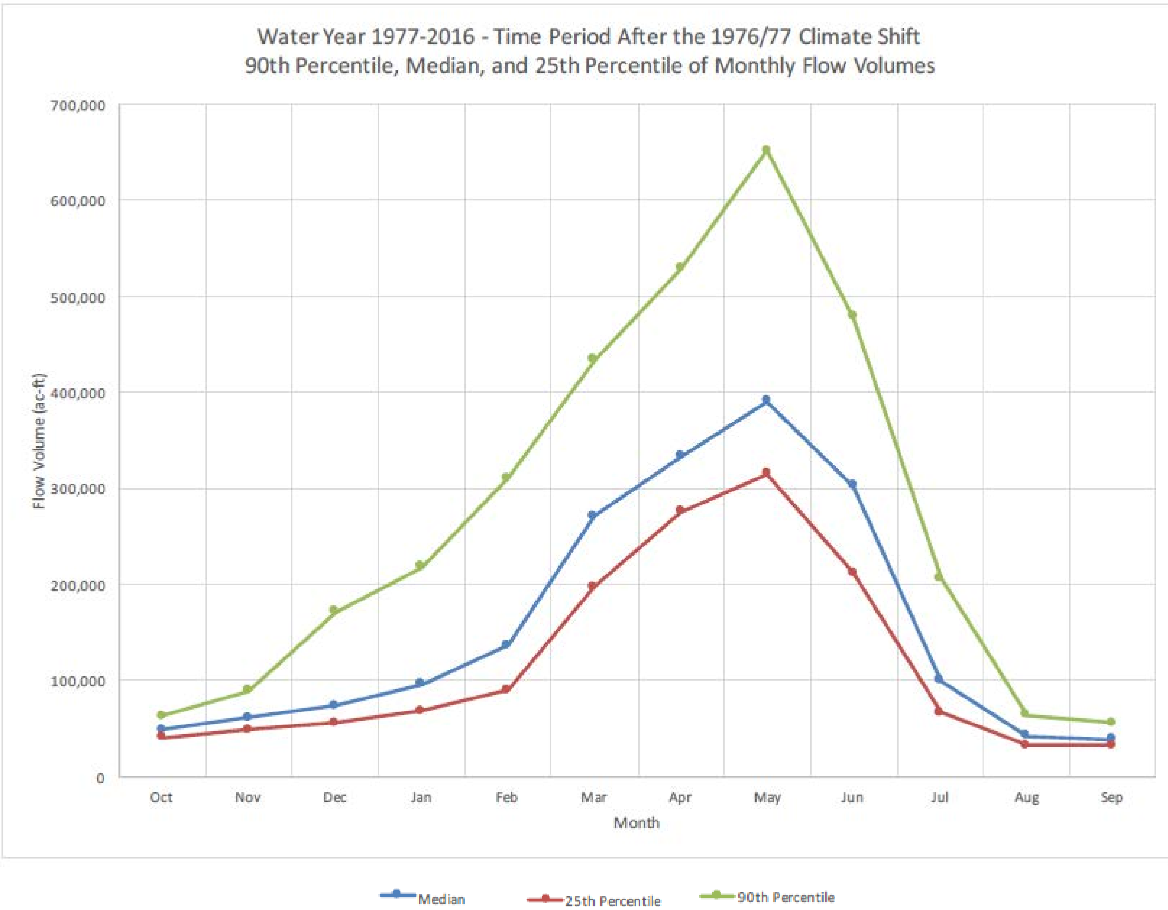


Figure 3-11
Water Year 1977 to 2016 Monthly Flow Volumes



Impact of Shifting the Period of Record on Median Monthly Flows: Catherine Creek Example

The OWRD Water Availability Reporting System (WARS) program uses streamflow data from the years 1958 to 1987 to compute statistics of water availability. Streamflow varies at several time scales, with shorter-term variations (hourly or seasonal) superimposed on longer-term variations (years or decades) and, as such, streamflow quantity for a single base period does not provide a complete picture of streamflow variability. In order to apply the water availability standards to all streams, the statistical streamflows used in the analysis must represent a time period that is sufficiently long to account for the expected variation in streamflow over the long term.

For several reasons, OWRD originally selected 1958 to 1987 for the base period used in the analysis. During that time period, there was a good balance between the number of wet years and the number of dry years, which suitably represented variability in precipitation across the time period. And finally, in order to maximize the amount of data for use in the analysis, the base period was chosen during the time period where the greatest number of gage records was available.

The WARS model developed in the 1990s does not account for current climate conditions and the resulting streamflow hydrographs. This report acknowledges the limitations of the WARS model; however, it is the only model available from OWRD and provides some helpful (if incomplete) assessments.

In the UGRRW, the Catherine Creek near Union, Oregon, gaging station (OWRD 13320000) is an active, long-term (index) stream gaging station with records from 1911 to present. A statistical analysis of mean daily streamflow time series at the Catherine Creek gaging station was used to help quantify hydrologic change resulting from shifting the 30-year base period from 1958 to 1987 to 1981 to 2010 using the Indicators of Hydrologic Alteration (IHA) statistical software package (The Nature Conservancy, 2009). Methods in IHA also assume stationarity, so the results should be interpreted in that context.

For this analysis, two time periods were compared (water years 1958-1987 and 1981-2010) in order to compute the monthly median (50 percent exceedance) streamflow values (Figure 3-9). The values between the two periods were compared using the IHA significance count value (Table 3-3). A value less than or equal to 0.05 indicates a significant change between base periods. There are no months with statistically significant change in median flows at this location. The annual volumes computed based on monthly median flow values increased slightly by approximately 1 percent. The IHA significance values are all over 0.05 in Table 3-3 below; however, the potential single-year variability in the basin (wet year versus dry year) has the potential to dwarf anything considered here.

A caveat to these data is that this analysis was performed for only one gage on Catherine Creek (not for all subwatersheds). Catherine Creek may be more dominated by high elevation snowmelt as evidenced by the later peak flows. There is the potential that there would be greater differences between the two study periods in subbasins with mid-level snowpack or more rain dominated systems. Just because this basin does not show significant change in median monthly flows does not mean that other basins will not as well. Also, looking at median monthly flows may mask differences in flows that occur during extreme events.

Figure 3-12
Exceedance Hydrographs Showing the Median Monthly Flows for Two Base Periods at the Catherine Creek Near Union, Oregon, Gaging Station

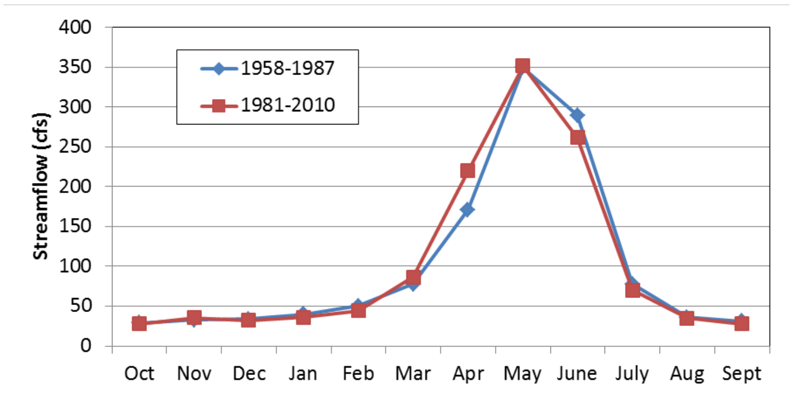


Figure 3-12
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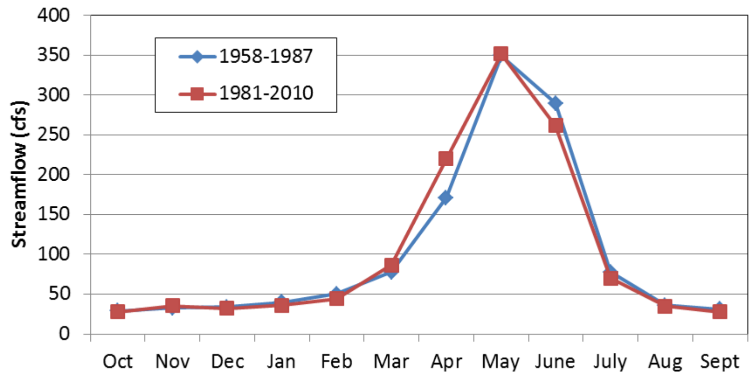


Table 3-3
Monthly Streamflow (in cubic feet per second) and Annual Volume (in acre-feet) at 50 Percent Exceedance for 1958 to 1987 and 1981 to 2010 Base Period Conditions in the UGRRW

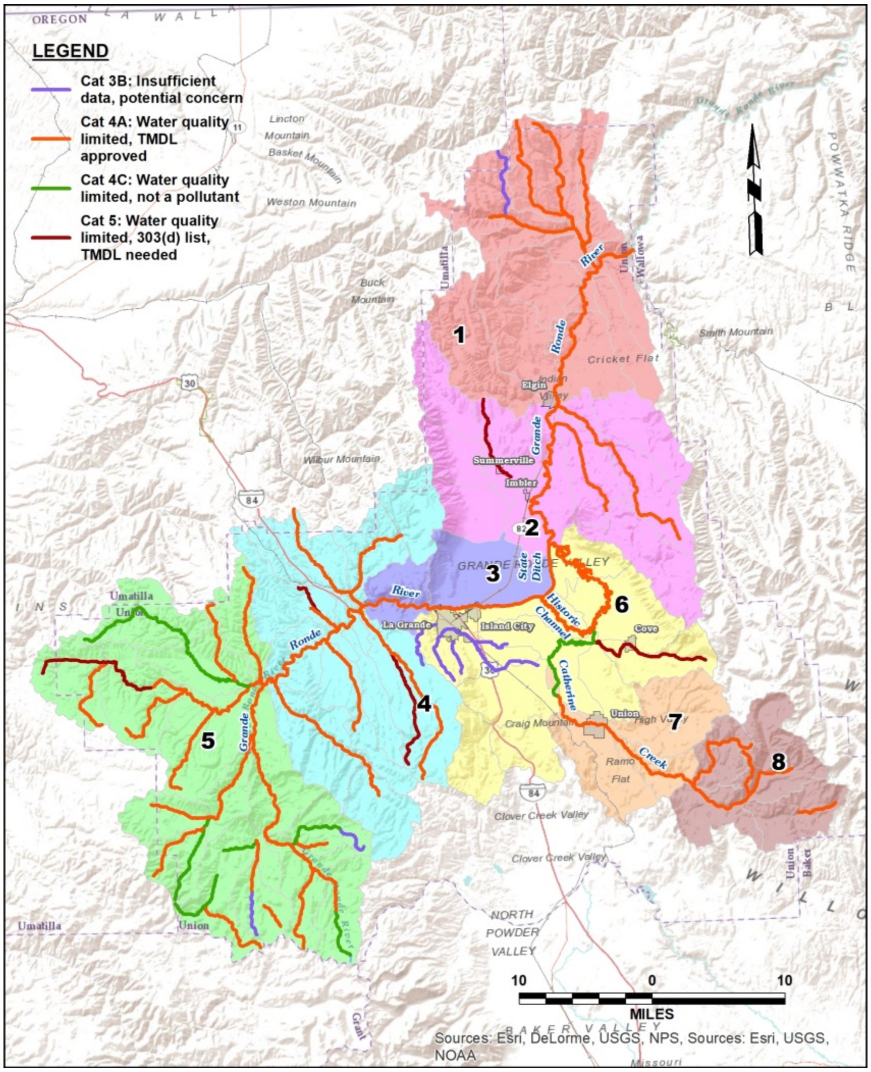
Month	Water Year 1958-1987 Median Flow (cfs)	Water Year 1981-2010 Median Flow (cfs)	IHA Deviation Factor Value	IHA Significance Count Value
October	29	28	-0.04	0.07
November	33	35	0.08	0.73
December	34	32	-0.06	0.65
January	40	36	-0.09	0.46
February	50	44	-0.12	0.23
March	78	87	0.12	0.45
April	171	220	0.28	0.12
May	350	352	0.01	0.92
June	290	262	-0.10	0.31
July	78	70	-0.10	0.38
August	36	35	-0.03	0.63
September	31	28	-0.10	0.27
Annual Volume	73,600	74,200	0.01	N/A

OWRD, 2017c

Surface Water Quality

Figure 3-13 shows the surface waterbodies that have been identified as water quality limited. This identification can be for one or multiple parameters over a short or long portion of the year.

Figure 3-13
Impaired Waterbodies



Description of Select Water Quality Parameters

Water quality represents the physical, chemical, and biological components of water. For certain beneficial uses such as salmonid spawning or swimming, it is not sufficient to just have water present. That water must also be cool, clean, and clear. Many agencies and organizations collect water quality data in the UGRRW. The Oregon Deprtment of Environmental Quality (DEQ) is the state agency responsible for implementing the Clean Water Act in Oregon. DEQ uses the available data to determine whether a waterbody supports its designated beneficial uses. Segments of a waterbody that do not have adequate water quality to support a use during the designated season of use are listed as impaired. DEQ has written total maximum daily loads (TMDLs) for some types of impairments. TMDLs describe the amount of each pollutant a waterbody can accept while still supporting all of the beneficial uses. TMDLs also describe the sources of pollution and steps to be taken to reduce pollution sources to levels that allow the waterbody to support all of its beneficial uses.

Assumptions and limitations of water quality data are as follows:

- Water quality limits are based on the most sensitive beneficial uses.
- Quality standards can exceed the natural potential of the waterbody.
- Data are from different years and times.
- Existing data cannot distinguish natural from anthropogenic sources of non-point source pollution, in some cases.
- There is enough information available to assess water quality in the basin at a general level. There is not enough information available to determine seasonal variations in water quality limitations in specific reaches at specific times.
- Temperature limitations can serve as a proxy for other impairments because most of them, such as pH, dissolved oxygen, algae, etc., are correlated to temperature.
- There may be additional types of water quality impairments that are not included in the list below.

For information about impairments on waterbodies, see the DEQ's Assessment of Water Quality in Oregon: http://www.oregon.gov/deq/wq/Pages/2012-Integrated-Report.aspx

The information below describes the types of impairments that exist on waterbodies in the Upper Grande Ronde subbasin (DEQ, 2017a).

Alkalinity

Alkalinity is related to pH. It is a measure of the water's ability to provide a stable pH level and to avoid rapid changes in pH that could adversely affect the health of aquatic life. Refer to the section on pH below for a discussion of the effects of extreme pH values on aquatic organisms.

Ammonia

Ammonia is a toxic form of nitrogen. Commercial fertilizers and decomposing organic wastes are common sources of ammonia that enter waterbodies through rainfall and runoff. Toxicity increases with higher pH and higher temperatures. In waterbodies with high levels of nutrients and algae, respiration and photosynthesis cause extreme diurnal swings in pH. When pH is highest during the day, ammonia toxicity is high. Ammonia enters the blood and tissues of fish and aquatic life and disrupts cell functions. When ammonia toxicity is high, fish and aquatic life experience reduced feeding, lowered reproduction, disrupted organ function, and even death.

Aquatic Weeds and/or Algae

Rooted aquatic plants and algae are a natural part of stream systems. They grow by taking in nutrients from the water column and sunlight. When water temperatures are warm enough and sufficient nutrients are present, excessive growth can occur; this can be a problem for both aquatic life and recreational beneficial uses. Excessive growth can affect aquatic life in several ways. During sunlight hours, plants and algae remove carbon dioxide from the water column as part of photosynthesis. With excessive growth, this can result in increased pH (alkaline conditions). During the night, plant growth removes oxygen from water and releases carbon dioxide, resulting in both low pH (acidic conditions) and low dissolved oxygen. In addition, when algae die and decompose they remove oxygen from the surrounding water. Low dissolved oxygen can lead to decreased fish habitat and even fish kills. Additionally, low dissolved oxygen levels can lead to changes in water chemistry that allow mercury to be more able to enter the food chain. Algal blooms also often create odors and coloration that are objectionable to recreational users. A reduction in stream flow would result in increased water temperature and increased nutrient concentrations, both of which would contribute to a greater risk of excessive plant growth and algal blooms. Reduced stream flow would also result in reduced flushing capacity (to remove decomposing plant and algal materials), which would exacerbate conditions in following years.

Biological Criteria

Oregon's biological criteria standards are based on the assemblage of species needed to maintain a healthy resident biological community. Resident biological communities are the local food webs that support fish. Macroinvertebrates are sensitive to chemical and physical impairments of the waterbody. A change or marked reduction in macroinvertebrates is an indicator that the waterbody is impaired. The type of impairment may be determined by the presence or absence of certain species that are sensitive to particular chemical or physical changes. In some cases, the impairment can be determined only through additional monitoring of specific water quality parameters such as temperature or sedimentation. Waterbodies are impaired for biocriteria when their species diversity or density is significantly smaller than predicted when compared to regional reference sites and DEQ's macroinvertebrate model (PREDATOR).

Dissolved Oxygen

Fish and other aquatic organisms require different concentrations of dissolved oxygen based on their species and life history stage. Oregon's dissolved oxygen standards are based on the most sensitive species and life history stage at the location and season of concern. Dissolved oxygen levels are affected by temperature, flow, nutrient loading, algae growth, and other factors. If dissolved oxygen drops to low enough levels, it can result in fish kills, as described above in the Aquatic Weeds and/or Algae section. In waterbodies where dissolved oxygen concentrations are known to be insufficient for fish habitat, any additional reduction in dissolved oxygen concentrations would result in the degradation of habitat.

E. Coli

E. coli is a bacteria that lives in the intestines of humans and animals. *E. coli* enters waterbodies from agricultural runoff, stormwater runoff, failing septic systems, and wildlife. Humans and animals can get sick from harmful types of *E. coli* by ingesting water while swimming or recreating in waterbodies. Higher concentrations of *E. coli* are linked to higher concentrations of harmful bacteria and viruses in the waterbody. High concentrations of *E. coli* and associated pathogens result in more illnesses, and more severe illnesses, in humans and animals in contact with the waterbody.

Iron

Iron is common in many rocks and is an important component of many soils. Iron is an essential trace element required by both plants and animals. Ferrous and ferric irons are the primary forms of concern in the aquatic environment. Ferrous iron is colorless (clear) while ferric iron will show up as a rust-colored stain in the water. Iron bacteria may also be present in streams associated with mining waste or groundwater recharge. A rust-colored slime often forms on rocks and other surfaces when iron bacteria are present. Iron and manganese often occur together. High concentrations of these metals can result in discolored water. Where water supplies are used for domestic purposes, elevated iron and manganese concentrations can result in stained plumbing fixtures and an unpleasant metallic taste to the water. Iron deposits can build up in pressure tanks, storage tanks, water heaters, and pipelines, decreasing capacity, reducing pressure, and increasing maintenance. Iron and manganese concentrations of concern are generally established on the basis of aesthetic and economic considerations (unpleasant tastes and coloration) rather than toxicity. A reduction in streamflow will lead to an increased concentration of iron and manganese in the water column. This may result in increased bacterial growth and an increase in aesthetic, recreational, and domestic water system impacts.

Manganese

Manganese is a metal found naturally in rocks and soil. It does not occur as a pure element in nature, but always combines with oxygen or other elements. Manganese is an essential trace element required by both plants and animals. Iron and manganese often occur together. Refer to the discussion of iron above for additional information about manganese.

pH

pH is a measure of how acidic or basic (alkaline) water is. Water with a pH greater than 7 is alkaline, and water with a pH less than 7 is acidic. Every species of fish has adapted to a specific range of pH. Fish exposed to changes in pH outside their normal range can be stressed or even die. Stress leaves fish vulnerable to disease, degrading their health. Additionally, alkaline conditions can transform nitrogen in the water column into a more toxic form of ammonia that can poison fish. A reduction in streamflow will reduce the stream's heat capacity and cause greater fluctuation in daytime and nighttime stream temperatures. When nutrients and sunlight are sufficiently present, higher stream temperatures lead to more algal growth. During the day, algae absorb carbon dioxide from the water for cell growth, raising pH. At night, photosynthesis stops and algae continue to respire, releasing carbon dioxide and lowering pH. This cycle creates day-night (diurnal) fluctuations in pH. Flow reductions in a stream that is already impaired for pH will lead to larger diurnal fluctuations in pH. Fish and aquatic insects are sensitive to imbalances in pH. Low pH levels (below 5) may lead to death, and high pH levels (9 to 14) can harm fish by denaturing cellular membranes. These pH imbalances result in the reduction of suitable fish habitat.

Phosphorus and Phosphate

Phosphorus is an essential plant nutrient, but an excess of phosphorus can be detrimental to aquatic life. High phosphorus concentrations can lead to eutrophication, a situation where aquatic plants grow so rapidly that dissolved oxygen concentrations drop below the levels needed to sustain fish and other aquatic life. Phosphate (also referred to as orthophosphate) is a chemical form of phosphorus that is very soluble and readily available for plant uptake, leading to rapid growth and, in the case of algae, rapid expansion of algal blooms. A reduction in streamflow will increase phosphorus concentrations. This would cause longer or more severe instances of oxygen depletion, resulting in a decrease in fish habitat water quality.

Sedimentation

While sediment is an essential part of healthy functioning stream systems, excessive sediment loads can have severe negative impacts on a stream ecosystem. Many fish species are adapted to high suspended sediment levels that occur for short periods of time, but longer exposure to high levels of suspended sediment can interfere with feeding behavior, damage gills, reduce available food, and reduce growth rates. Deposition and sedimentation (when sediment falls out of the water column and deposits on the streambed) can smother eggs and fry in the substrate and fill in pools within the stream channel (reducing or eliminating cold water refugia important to cold water aquatic life during periods of high water temperature). Because bacteria, nutrients, and other chemical substances are often attached to sediment particles, excessive sediment loading can also increase nutrient and toxics concentrations and contribute to decreased dissolved oxygen in both the water column and the spawning gravels. A reduction in streamflow will lead to locally increased deposition and sedimentationThis would result in the diminution of fish habitat water quality.

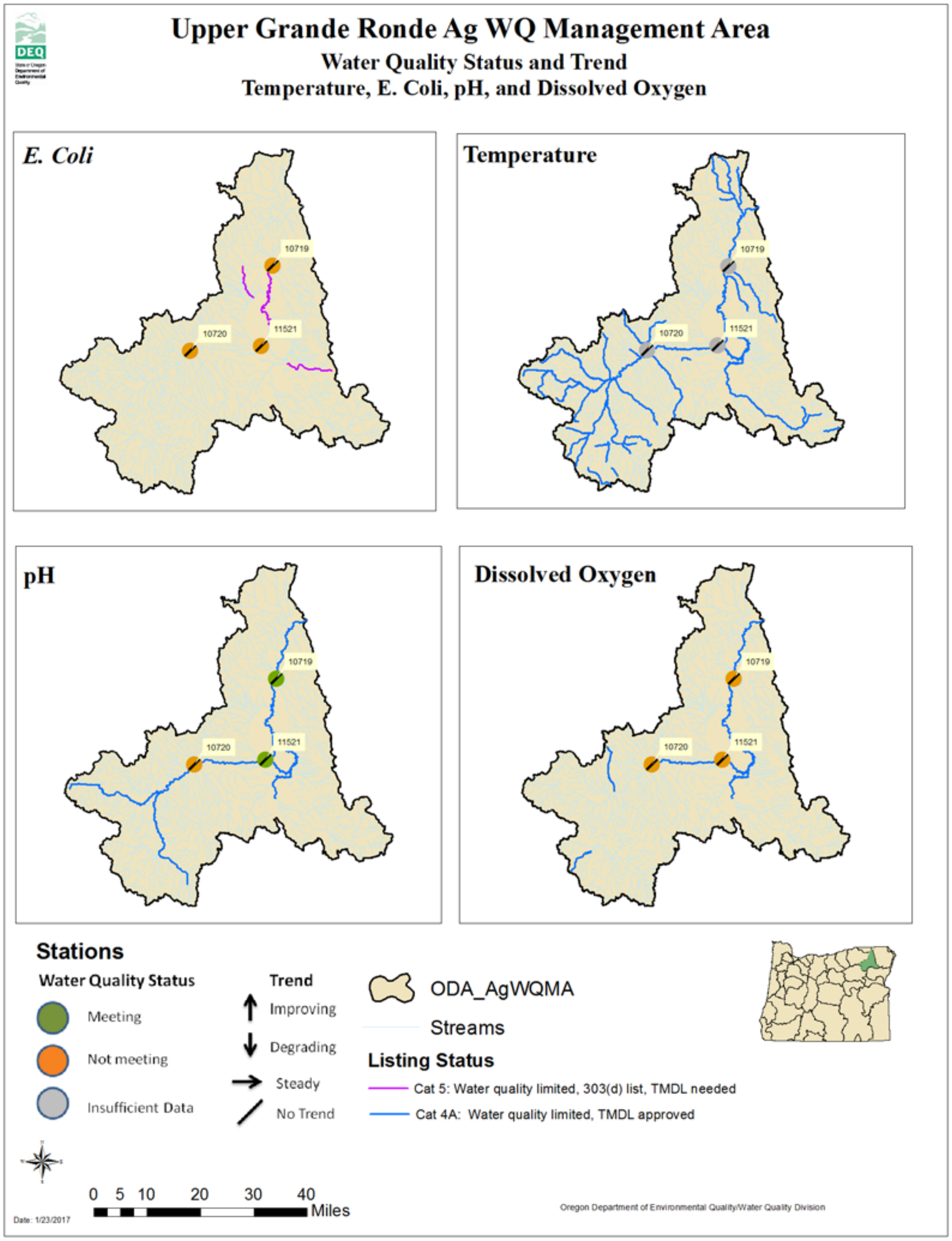
Temperature

Oregon's stream temperature standards are based on the life cycle needs of salmonids. Stream temperatures that exceed the standards can disrupt the life cycle of a sensitive, threatened, or endangered fish species and may even cause death. Low summertime streamflows reduce the stream's heat capacity and cause greater fluctuation in daytime and nighttime stream temperatures. Low non-summer flows reduce floodplain recharge from high flow events, thus reducing the volume of cool water released from floodplain storage into the stream throughout the year. This would result in the diminution of habitat of fish species.

Summary of Oregon Department of Environmental Quality Data

The most recent Agricultural Water Quality Report shows the following locations that are meeting or not meeting water quality goals in the UGRRW (see Figure 3-14).

Figure 3-14
Water Quality Trends

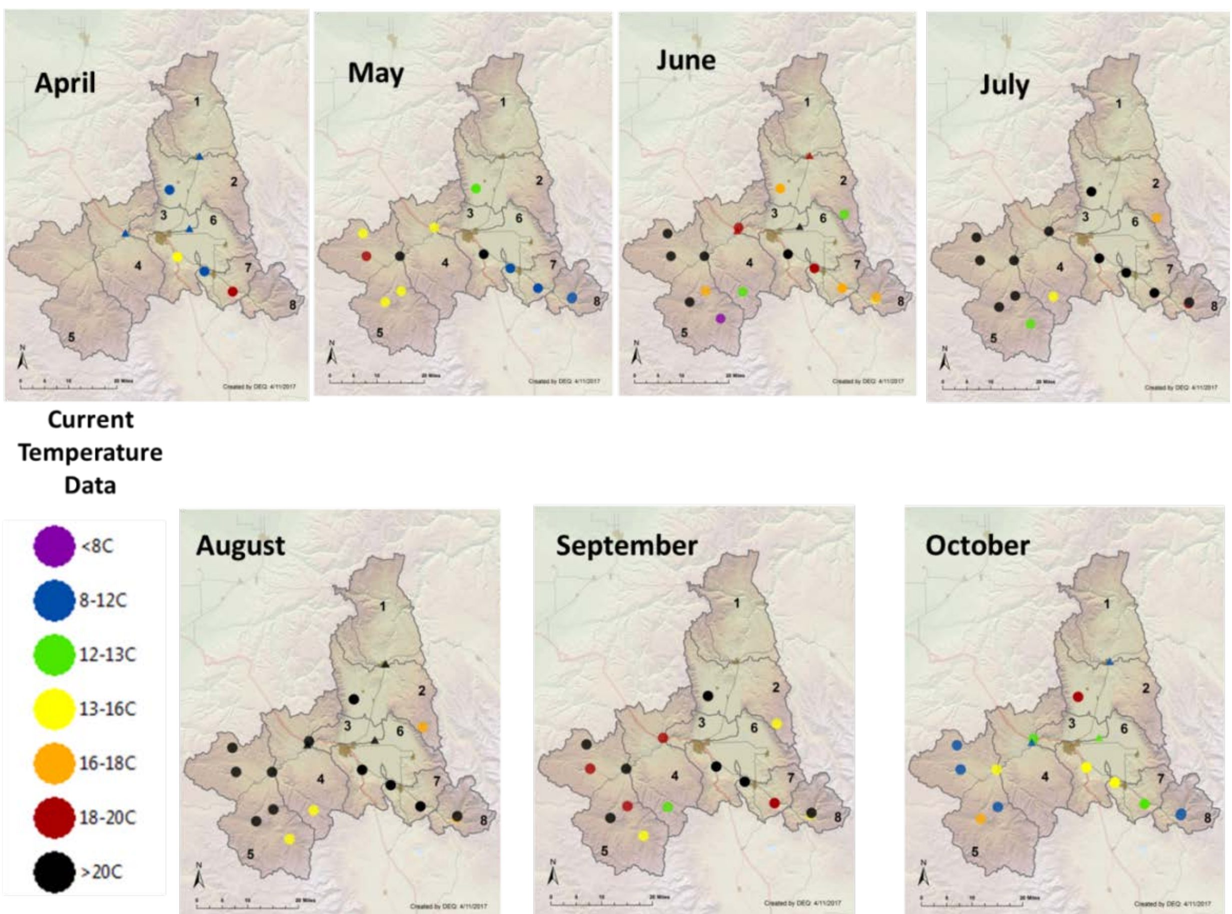


DEQ, 2017b

Focus on Temperature

Because of questions related to the lack of DEQ temperature measurements, additional research was conducted to determine whether other agencies had additional information about temperature in the UGRRW that could be used for a more complete understanding of when and for how long temperature is elevated. Elevated surface water temperatures are one of the most significant impairments to water quality in the UGRRW. Data were obtained from the DEQ, U.S. Forest Service (USFS), Confederated Tribes of the Umatilla Indian Reservation, and ODFW temperature data collection sites and compiled into these temporal graphs (DEQ, 2017a). Since these data sources have disparate sampling methods, intervals, and periods, they do not represent a complete data set, but can give some idea of how water temperatures in the basin change through the seasons. These data sources were all collected using temperature data loggers positioned to be near the bottom of, but not sitting on, the stream channel. These loggers are generally positioned low so as not to record surface temperatures and not to be exposed when water levels fluctuate. Temperature is a limiting factor for aquatic life for many of the summer months, especially in the lower and central part of the UGRRW. See Figure 3-15 below to view the aggregated temperature data from the collected sources.

Figure 3-15
Stream Surface Temperature by Month



It is important to note that elevated temperatures as shown above do not preclude many beneficial uses. For example swimming/recreational uses and agricultural irrigation are still supported when temperatures are elevated. Elevated temperatures primarily impact aquatic life. However, elevated temperatures are correlated to low flows and velocities and, therefore, temperature impairments often co-occur with other impairments such as pH, algae, and aquatic weeds that may affect additional beneficial uses. Non-spawning temperature standards for the area are as follows (DEQ, 2017a):

Figure 3-16
Non-spawning Temperature Standards

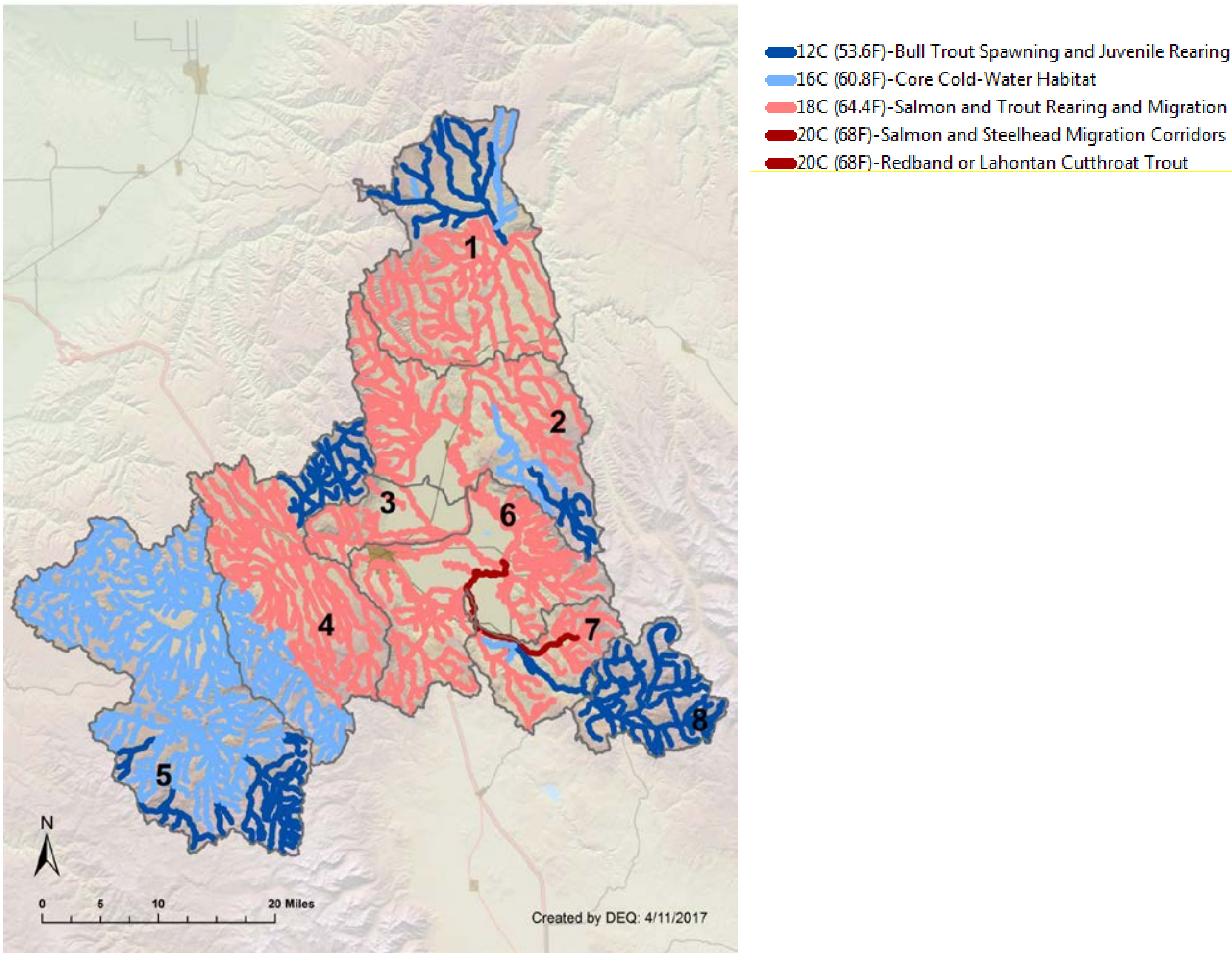


Figure 3-16 indicates locations where temperature is most critical for aquatic species. These designations are goals to be met. Many areas are not currently meeting these standards.

Upper Grande Ronde River Total Maximum Daily Loads

TMDLs are developed to show how much of each pollutant a stream can accept while still providing the water quality needed for all of the designated beneficial uses. TMDLs for the UGRRW were approved in 2000 and focus on temperature, dissolved oxygen, pH, and sedimentation.

The UGRRW TMDL was developed by the DEQ and approved by the U.S. Environmental Protection Agency. The TMDL can be accessed via the DEQ website: http://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Basin-Grande-Ronde.aspx (Oregon

Department of Agriculture [ODA], 2012). The Upper Grande Ronde River Subbasin Agricultural Water Quality Management Area Plan was then developed to work toward meeting these goals.

TMDLs and associated goals for the Upper Grande Ronde are listed below:

- Temperature (summer)
- Work to reduce solar heating and increase effective shade
- Dissolved oxygen/phosphorus (summer), aquatic weeds and algae (summer) and pH (summer),
- Nutrient reductions (20 to 60 percent)
- Temperature TMDL measures
- Bacteria (meeting criteria)
- Temperature TMDL measures
- Continued monitoring
- Sedimentation
- Temperature TMDL measures

(DEQ, 2017a)

Beneficial Use Overview

DEQ designates beneficial uses for all waterbodies, including irrigation, industrial water, municipal water, swimming, fishing, and aquatic life. Human health and aquatic life are the uses most sensitive to water quality. OWRD and DEQ have similar uses of the term "beneficial uses." OWRD beneficial uses refer to the purpose to which a water right may be used, such as irrigation, municipal, or instream.

The protection of beneficial uses is influenced by biological requirements, water volume, and water quality. Temperature, dissolved oxygen, pH, and sedimentation are water quality parameters highly influenced by the amount of streamflow (DEQ, 2017a).

Beneficial uses sit at the intersection of water supply, water quality, and needs of people/aquatic life (the most sensitive receptors) and require coordination between three natural resource agencies (OWRD, ODFW, DEQ) to ensure that each use is supported.

Oregon Deparment of Environmental Quality-Designated Beneficial Uses in the Upper Grande Ronde River Watershed

Upper Grande Ronde Basin Designated Beneficial Uses from OAR 340-041-0151, Table 151A (DEQ, 2017a):

- Public Domestic Water Supply*
- Private Domestic Water Supply*

- Industrial Water Supply
- Irrigation
- Livestock Watering
- Fish and Aquatic Life
- Bull Trout (12°C, 53.6°F)
- Core Cold Water (16°C, 60.8°F)
- Salmon and Trout (rearing and migration, 18°C, 64.4°F)
- Salmon and Steelhead (migration corridors, 20°C, 68°F)
- Wildlife and Hunting
- Fishing
- Boating
- Water Contact Recreation
- Aesthetic Quality
- Hydropower
- Commercial Navigation and Transportation

** With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards.*

The following tables show the times of year and impairments for the most sensitive beneficial uses. A waterbody is considered impaired when a beneficial use standard is exceeded any time within the period of record, which includes any measurement ever recorded by the DEQ.

In most subwatersheds, including those defined as "natural" areas, temperature and pH are of concern in the summer months. Flow is shown on some tables below and indicates physical flow issues such as blockages in the stream. It is not related to volume, which is discussed earlier in the report.

Table 3-4
Water Quality Impairments by Date and Beneficial Use (Subwatersheds 1 through 8)

Subwatershed 1

Surface Water Supply Limits to Beneficial Use											
Month	Days	Anadromous Fish Passage	Salmonid Fish Spawning	Salmonid Fish Rearing	Resident Fish and Aquatic Life	Aquatic Life	Human Health	Water Contact Recreation	Fishing	Aesthetic Quality
Oct	1st to 15th				Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Oct	16th to 31st				Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Nov	1st to 15th				Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Nov	16th to 30th				Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Dec	1st to 15th			Flow, Sedimentation	Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Dec	16th to 31st			Flow, Sedimentation	Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Jan	1st to 15th		Flow, Sedimentation	Flow, Sedimentation	Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Jan	16th to 31st		Flow, Sedimentation	Flow, Sedimentation	Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Feb	1st to 15th		Flow, Sedimentation	Flow, Sedimentation	Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Feb	16th to 28th		Flow, Sedimentation	Flow, Sedimentation	Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Mar	1st to 15th		Flow, Sedimentation		Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Mar	16th to 31st		DO		Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Apr	1st to 15th		DO		Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Apr	16th to 30th		DO		Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
May	1st to 15th		DO		Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
May	16th to 31st				Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Jun	1st to 15th				Flow, Sedimentation	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
Jun	16th to 30th	Temperature, pH		Temperature, pH	pH	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron	Algae, pH	Algae	Phosphorus, Algae
Jul	1st to 15th	Temperature, pH		Temperature, pH	pH	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron	Algae, pH	Algae	Phosphorus, Algae
Jul	16th to 31st	Temperature, pH		Temperature, pH	pH	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron	Algae, pH	Algae	Phosphorus, Algae
Aug	1st to 15th	Temperature, pH		Temperature, pH	pH	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron	Algae, pH	Algae	Phosphorus, Algae
Aug	16th to 31st	Temperature, pH		Temperature, pH	pH	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron	Algae, pH	Algae	Phosphorus, Algae
Sep	1st to 15th	Temperature, pH		Temperature, pH	pH	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron	Algae, pH	Algae	Phosphorus, Algae
Sep	16th to 30th	Temperature, pH		Temperature, pH	pH	Ammonia, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron	Algae, pH	Algae	Phosphorus, Algae

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Table 3-4
Continued
Subwatershed 2

Surface Water Supply
Limits to Beneficial Use

Month	Days	**Anadromous Fish Passage**	**Salmonid Fish Spawning**	**Salmonid Fish Rearing**	**Resident Fish, Aquatic Life**	**Aquatic Life**	**Human Health**	**Water Contact Recreation**	**Fishing**	**Aesthetic Quality**
Oct	1st to 15th									
	16th to 31st									
Nov	1st to 15th									
	16th to 30th									
Dec	1st to 15th									
	16th to 31st									
Jan	1st to 15th									
	16th to 31st									
Feb	1st to 15th			Flow, Sedimentation						
	16th to 28th		Flow, Sedimentation							
Mar	1st to 15th									
	16th to 31st									
Apr	1st to 15th									
	16th to 30th				Flow, Sedimentation					
May	1st to 15th		DO							
	16th to 31st									
Jun	1st to 15th									
	16th to 30th									
Jul	1st to 15th									
	16th to 31st									
Aug	1st to 15th									
	16th to 31st									
Sep	1st to 15th					Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron	Algae, E. Coli, pH		Phosphorus, Algae
	16th to 30th	Temperature, pH		Temperature, pH	pH				Algae	

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Table 3-4
Continued
Subwatershed 3

Surface Water Supply Limits to Beneficial Use							
Month	Days	Anadromous Fish Passage	Salmonid Fish Rearing	Resident Fish, Aquatic Life	Water Contact Recreation	Fishing	Aesthetic Quality
Oct	1st to 15th						
	16th to 31st						
Nov	1st to 15th						
	16th to 30th						
Dec	1st to 15th						
	16th to 31st						
Jan	1st to 15th						
	16th to 31st						
Feb	1st to 15th						
	16th to 28th						
Mar	1st to 15th						
	16th to 31st						
Apr	1st to 15th						
	16th to 30th						
May	1st to 15th						
	16th to 31st						
Jun	1st to 15th		Flow	Flow			
	16th to 30th						
Jul	1st to 15th						
	16th to 31st						
Aug	1st to 15th						
	16th to 31st						
Sep	1st to 15th						
	16th to 30th	Temperature, pH	Temperature, pH	pH	Algae, pH	Algae	Phosphorus, Algae

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Table 3-4
Continued
Subwatershed 4

Surface Water Supply Limits to Beneficial Use								
Month	Days	**Anadromous Fish Passage**	**Salmonid Fish Spawning**	**Salmonid Fish Rearing**	**Resident Fish, Aquatic Life**	**Aquatic Life**	**Human Health**	**Water Contact Recreation**
Oct	1st to 15th							
	16th to 31st							
Nov	1st to 15th							
	16th to 30th							
Dec	1st to 15th							
	16th to 31st							
Jan	1st to 15th							
	16th to 31st							
Feb	1st to 15th							
	16th to 28th							
Mar	1st to 15th			Sedimentation				
	16th to 31st							
Apr	1st to 15th							
	16th to 30th							
May	1st to 15th		Sedimentation					
	16th to 31st							
Jun	1st to 15th				Sedimentation			
	16th to 30th							
Jul	1st to 15th							
	16th to 31st							
Aug	1st to 15th							
	16th to 31st							
Sep	1st to 15th							
	16th to 30th	Temperature, pH		Temperature, pH	pH	Alkalinity. Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron	pH

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Table 3-4
Continued
Subwatershed 5

Surface Water Supply
Limits to Beneficial Use

Month	Days	Anadromous Fish Passage	Salmonid Fish Spawning	Salmonid Fish Rearing	Resident Fish, Aquatic Life	Aquatic Life	Human Health	Water Contact Recreation
Oct	1st to 15th		Sedimentation	Sedimentation	Sedimentation	Alkalinity, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron	
	16th to 31st							
Nov	1st to 15th							
	16th to 30th							
Dec	1st to 15th							
	16th to 31st							
Jan	1st to 15th							
	16th to 31st							
Feb	1st to 15th							
	16th to 28th							
Mar	1st to 15th							
	16th to 31st							
Apr	1st to 15th							
	16th to 30th							
May	1st to 15th							
	16th to 31st							
Jun	1st to 15th							
	16th to 30th	Temperature, pH	pH	Temperature, pH	pH			pH
Jul	1st to 15th							
	16th to 31st							
Aug	1st to 15th							
	16th to 31st							
Sep	1st to 15th							
	16th to 30th							

- Beneficial use is not supported.
- Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
- Insufficient data to determine if beneficial use is supported.

Flow data from OWRD; Beneficial Use data from DEQ

- Temperature and pH impairment measured
- pH impairment measured
- Temperature impairment measured
- Dissolved oxygen (DO) impairment measured

Table 3-4
Continued
Subwatershed 6

Surface Water Supply
Limits to Beneficial Use

Month	Days	Anadromous Fish Passage	Salmonid Fish Rearing	Resident Fish, Aquatic Life	Aquatic Life	Human Health	Water Contact Recreation	Fishing	Aesthetic Quality
Oct	1st to 15th			Flow, Sedimentation	Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron			
	16th to 31st								
Nov	1st to 15th								
	16th to 30th								
Dec	1st to 15th								
	16th to 31st		Flow, Sedimentation						
Jan	1st to 15th								
	16th to 31st								
Feb	1st to 15th								
	16th to 28th								
Mar	1st to 15th								
	16th to 31st								
Apr	1st to 15th								
	16th to 30th								
May	1st to 15th								
	16th to 31st								
Jun	1st to 15th								
	16th to 30th	Temperature, pH	Temperature, pH	pH			Algae, E. Coli, pH	Algae	Phosphorus, Algae
Jul	1st to 15th								
	16th to 31st								
Aug	1st to 15th								
	16th to 31st								
Sep	1st to 15th								
	16th to 30th								

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Table 3-4
Continued
Subwatershed 7

Surface Water Supply Limits to Beneficial Use							
Month	Days	**Anadromous Fish Passage**	**Salmonid Fish Rearing**	**Resident Fish, Aquatic Life**	**Water Contact Recreation**	**Fishing**	**Aesthetic Quality**
Oct	1st to 15th		Flow	Flow			
	16th to 31st						
Nov	1st to 15th						
	16th to 30th						
Dec	1st to 15th						
	16th to 31st						
Jan	1st to 15th						
	16th to 31st						
Feb	1st to 15th						
	16th to 28th						
Mar	1st to 15th						
	16th to 31st						
Apr	1st to 15th						
	16th to 30th						
May	1st to 15th						
	16th to 31st						
Jun	1st to 15th						
	16th to 30th	Temperature, pH, DO	Temperature, pH, DO	pH	Algae, pH	Algae	Phosphorus, Algae
Jul	1st to 15th						
	16th to 31st						
Aug	1st to 15th						
	16th to 31st						
Sep	1st to 15th						
	16th to 30th						

(pink)	Beneficial use is not supported.
(blue)	Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
(green)	Insufficient data to determine if beneficial use is supported.

Flow data from OWRD; Beneficial Use data from DEQ

(dark pattern)	Temperature, pH, and DO impairment measured
(horizontal lines)	pH impairment measured
(vertical lines)	Temperature impairment measured
(dotted)	Dissolved oxygen (DO) impairment measured

Table 3-4
Continued
Subwatershed 8

Surface Water Supply Limits to Beneficial Use		
Month	Days	**Salmonid Fish Rearing**
Oct	1st to 15th	
	16th to 31st	
Nov	1st to 15th	
	16th to 30th	
Dec	1st to 15th	
	16th to 31st	
Jan	1st to 15th	
	16th to 31st	
Feb	1st to 15th	
	16th to 28th	
Mar	1st to 15th	
	16th to 31st	
Apr	1st to 15th	
	16th to 30th	
May	1st to 15th	
	16th to 31st	
Jun	1st to 15th	
	16th to 30th	Temperature
Jul	1st to 15th	Temperature
	16th to 31st	Temperature
Aug	1st to 15th	Temperature
	16th to 31st	Temperature
Sep	1st to 15th	Temperature
	16th to 30th	Temperature

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

As these subwatershed tables indicate, depending on the location in the UGRRW, some areas face more limiting factors than others. Limiting factors are defined as those conditions or circumstances that limit the successful growth, reproduction, and/or survival of select species of concern. Generally, subwatersheds in the northern and central portion of the UGRRW (Subwatersheds 1 through 6) have more limits than ones in the southern portion of the UGRRW (Catherine Creek area and Subwatersheds 7 and 8).

Sources of Pollution

Point Sources

Permitted point sources are regulated by either individual or general National Pollutant Discharge Elimination System (NPDES) Permits or by Water Pollution Control Facilities Permits.

There are five NPDES designated point sources in the Watershed (DEQ, 2017a):

- Elgin sewage treatment plant (STP)
- La Grande STP
- Union STP
- Boise Cascade
- Island City Particleboard

Non-point Sources

Non-point sources are difficult to quantify, but they are abundant in the UGRRW and include anthropogenic as well as natural sources. Human activities such as timber harvesting, livestock grazing, crop agriculture, road construction and maintenance, rural residential development, and urban runoff contribute. Natural sources include wildfire, inputs from native soils, solar radiation, wildlife, severe flood events, insects, and disease infestation of forests.

Various agencies and groups have been collecting water quality data in the UGRRW for many years. These data indicate that point source pollution is not the only contributor to water quality degradation. For example, water quality problems begin upstream from the La Grande wastewater discharge point and continue well below both the La Grande and Union discharges.

Non-point source pollution is the result of many dispersed activities occurring in the basin. As rain or snowmelt moves over and through the ground, the water absorbs many pollutants it comes into contact with. Therefore, vegetation plays a major role in water quality. Healthy plant communities create soil stability, protect streambanks, provide shade to lower water temperatures, improve fish habitat, regulate the precipitation cycle, and filter nutrients.

Water temperatures affect most aspects of an aquatic environment. Out of 70 stream segments in the UGRRW, 36 are on the 303(d) list because their temperatures exceed the water quality standards. Research shows that water temperatures at 77°F or above can be lethal to Chinook salmon and steelhead while temperatures of 70°F can cause 50 percent mortality. Sub-lethal temperatures can reduce growth, increase susceptibility to disease, and increase competition from warm-water species.

Many factors influence stream temperatures. Some of the most important factors include solar radiation, rate of flow, depth of water, and groundwater discharge. Shade from riparian vegetation can reduce inputs from solar radiation.

Agricultural practices that could influence water quality include soil management, nutrient application, animal manure management, livestock management, and near stream management.

Other human influenced activities that can affect water quality include wastewater discharge, stormwater runoff from urban areas, septic tanks, poorly maintained roads and bridges, forestry activities, and many others. However, permitted discharge sources such as wastewater treatment plants and some stormwater systems are monitored and regulated and are not likely to cause impairments.

The geology of the watershed also influences both surface water and groundwater quality. One example includes high alkaline soils found in the UGRRW that can increase the pH of surface water and groundwater, such as those high alkaline soils in the southern end of the UGRRW and in the portion of Catherine Creek downstream from the City of Union. Climate and topography also have a profound influence on water quality. Because the Grande Ronde River originates in relatively low elevation mountains, and eastern Oregon's climate is hot and dry, water temperatures are naturally high and streamflows are low late in the summer. Low flows concentrate nutrient levels which, along with high temperatures, increase algae growth. Excessive algae growth is the main cause of the observed dissolved oxygen and pH fluctuations. If the future climate tends toward higher temperatures and/or reduced snowpack, these quality issues will be exacerbated.

Frequent flooding in the spring (from spring runoff) causes extensive damage to streambanks. This damage contributes to sedimentation, pH, and dissolved oxygen problems, as well as existing riparian vegetation damage and impediment of new vegetation establishment. The UGRRW lacks any significant built flood control infrastructure to mitigate these issues. Beavers also play a role in this ecosystem; through building dams they slow the water and reduce the intensity of flood events. Beaver populations declined last century due to trapping, and populations have not recovered to pre-trapping levels.

Another factor influencing current water quality is past management practices. For example, State Ditch was channelized and changed what was historically 33 miles of meandering river channel (ODA, 2012).

Elevated summertime stream temperatures attributed to sources in the Upper Grande Ronde River sub-basin result primarily from riparian vegetation disturbance. Reduction in stream surface shading (via decreased riparian vegetation height, width and/or density and increased channel width) increases the amount of solar radiation reaching the stream surface.

The Grande Ronde River, Catherine Creek, Meadow Creek, and the State Ditch experience dissolved oxygen and pH water quality standards violations related to excessive periphyton growth. Excessive growth is due to a number of factors including elevated nutrient concentrations, high water temperatures, excessive solar radiation, high width to depth ratios, and inadequate stream flow rates. Excessive periphyton activity causes large dissolved oxygen and pH fluctuations that result in dissolved oxygen standards violations at night and pH standards violations during the day (UGR TMDL p.30).

Data Gaps

- There is a lack of timing information from DEQ data sets (different parameters are collected on different schedules; however, most are collected every other month). The lack of standards for all but most restrictive beneficial use makes data difficult to interpret for some uses. Additional sources of data would be beneficial.
- Temperature data obtained from surface temperature measurements (such as FLIR measurements) may not all be representative of stream temperatures in reaches where thermal stratification occurs.
- Existing TMDL standards are referenced in this report. The existence of these standards does not mean they are achievable for every area in the UGRRW.
- Subwatersheds 7 and 8 have less temperature data than other subwatersheds described in this report; this data gap is to be evaluated as ODFW and USFS may have additional data for Catherine Creek.
- In some areas are diversions that export water from or import water to the UGRRW. These transbasin diversions are not accounted for in this report.
- Additional specific data are needed to calculate and verify water quantity and quality questions. These data are not available and need to be collected.

Section Summary

This section provides a rationale for separating the UGRRW into eight subwatersheds and then describes surface water quantity and quality. The eight subwatersheds were created to better analyze surface water quantity and quality and were based on a combination of the USGS hydrologic unit codes and GRMW BSRs.

Surface Water Quantity

Surface water flow is measured in select locations in the UGRRW by multiple agencies including OWRD, which has eight active gaging stations in the UGRRW. Flow was analyzed in each subwatershed. Water volume was shown as an exceedance probability for each two-week period in the 1958 to 1987 period of record. Three exceedance probabilities were calculated: high water volume (10 percent exceedance), low water volume (90 percent exceedance), and median water volume (50 percent exceedance). Each subwatershed had the same general patterns of peak flows during springtime. Additionally, in each basin the median flow was closer to the low flow than the high flow. Basin 1 (which includes all flow in the UGRRW) showed a maximum median flow of approximately 2,700 cfs (80,000 acre-feet) in a two-week period. Much of the flow in the UGRRW occurs during a brief period of time in the spring. With relatively little water storage capacity developed in the study area, most of this spring runoff leaves the study area without benefit for later summer uses. One factor that produces uncertainty in water quantity over time is the potential for shifting hydrographs in the future due to variability in climate and precipitation.

Surface Water Quality

Numerous waterbodies in the UGRRW have been identified as water quality limited by DEQ. This identification can be for one or multiple parameters over a short or long portion of the year. DEQ monitors the following water quality parameters: alkalinity, ammonia, aquatic weeds and/or algae, biological criteria, dissolved oxygen, *E. coli*, iron, manganese, pH, phosphorus and phosphate, sedimentation, and temperature. The primary parameters of concern in the UGRRW are temperature, pH, dissolved oxygen, and *E. coli*. Temperature is a limiting factor for aquatic life for many of the summer months, especially in the lower and central part of the UGRRW. In most subwatersheds, temperature and pH are concerns for the summer months. As expected, the downstream portions of the UGRRW (Subwatersheds 1 through 6) have more limits than ones in the upstream areas (Catherine Creek area, Subwatersheds 7 and 8) since pollutants accumulate as water moves downstream.

A set of TMDLs and associated goals has been developed for the Upper Grande Ronde River. There are five point sources in the UGRRW with NPDES Permits, which may potentially contribute to pH and dissolved oxygen issues in the UGRRW. Abundant non-point sources, including both human activities and natural conditions, impact water quality. Human activities include timber harvesting, livestock grazing, crop agriculture, road construction and maintenance, rural residential development, and urban runoff. Natural conditions or events include wildfire, severe flood events, solar radiation, natural mineral deposits, wildlife, insects, and disease infestation of forests.

4.0 - Groundwater

The purpose of this section is to describe what is known about groundwater resources in the basin, including groundwater-surface water interaction, to describe trends in water levels where data are available, and to characterize groundwater resources.

4.1 Groundwater-Surface Water Interaction

"Traditionally, management of water resources has focused on surface water or ground water as if they were separate entities. As development of land and water resources increases, it is apparent that development of either of these resources affects the quantity and quality of the other. Nearly all surface-water features (streams, lakes, reservoirs, wetlands, and estuaries) interact with ground water. These interactions take many forms. In many situations, surface-water bodies gain water and solutes from ground-water systems and in others the surface-water body is a source of ground-water recharge and causes changes in ground-water quality. As a result, withdrawal of water from streams can deplete ground water or conversely, pumpage of ground water can deplete water in streams, lakes, or wetlands. Pollution of surface water can cause degradation of ground-water quality and conversely pollution of ground water can degrade surface water. Thus, effective land and water management requires a clear understanding of the linkages between ground water and surface water as it applies to any given hydrologic setting."

- Robert M. Hirsch, Chief Hydrologist, U.S. Geological Survey, from USGS Circular 1139: Ground Water And Surface Water: A Single Resource (USGS, 2013).

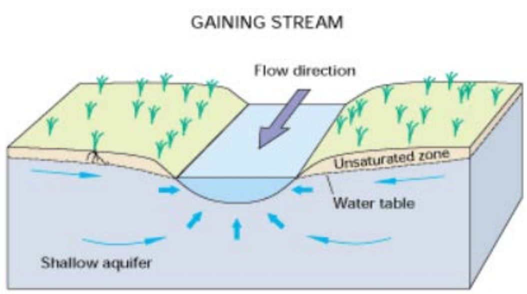
In the Grande Ronde Valley, the groundwater-surface water interaction varies from year to year, and month to month, depending on precipitation and water use within the Upper Grande Ronde River Watershed (UGRRW).

Flows observed in the Grande Ronde River and other local streams are influenced by the elevation of groundwater in the unconfined alluvial aquifer adjacent to the stream. The groundwater-surface water connection is also evident in Ladd Marsh, which is habitat for migratory birds. In the Grande Ronde Valley, groundwater-surface water interaction has helped agency scientists understand that depleting groundwater levels cannot be managed independent of surface water.

Catherine Creek Study

In 2011, Oregon Water Resources Department (OWRD), in partnership with the Bonneville Power Association through the National Fish and Wildlife Foundations, started a 2-year groundwater-surfacewater interaction study aimed at understanding to what degree groundwater and surface water interacted along the length of Catherine Creek. This included how that interaction varied in time and along the length of the stream. OWRD was also interested in identifying which points along the stream were receiving groundwater (gaining reaches) and which points were contributing surface water to the adjacent aquifer through the streambed (losing reaches) (Figure 4-1). Results identified vertical head gradients, based upon differences in water surface elevations that suggest interaction between Catherine Creek and the shallow groundwater system. That said, the magnitude of the fluxes was less than the uncertainty of the discharge measurements and stream gages, except in the lower reaches where gaining flows were identified. The upper and middle areas of the Catherine Creek study area were identified as losing reaches based on the water level differences (head gradient), but again it was smaller than the gaging and measurement uncertainty. The lower area was marked by minimal water level differences between groundwater and surface water under natural conditions. More study is needed to quantify the magnitudes of these interactions (OWRD, 2012).

Figure 4-1
Generalized Groundwater-Surfacewater Interaction



The figure above shows gaining streams receive water from the ground-water system (left), whereas losing reaches of a stream lose water to the ground-water system (USGS, 2013).

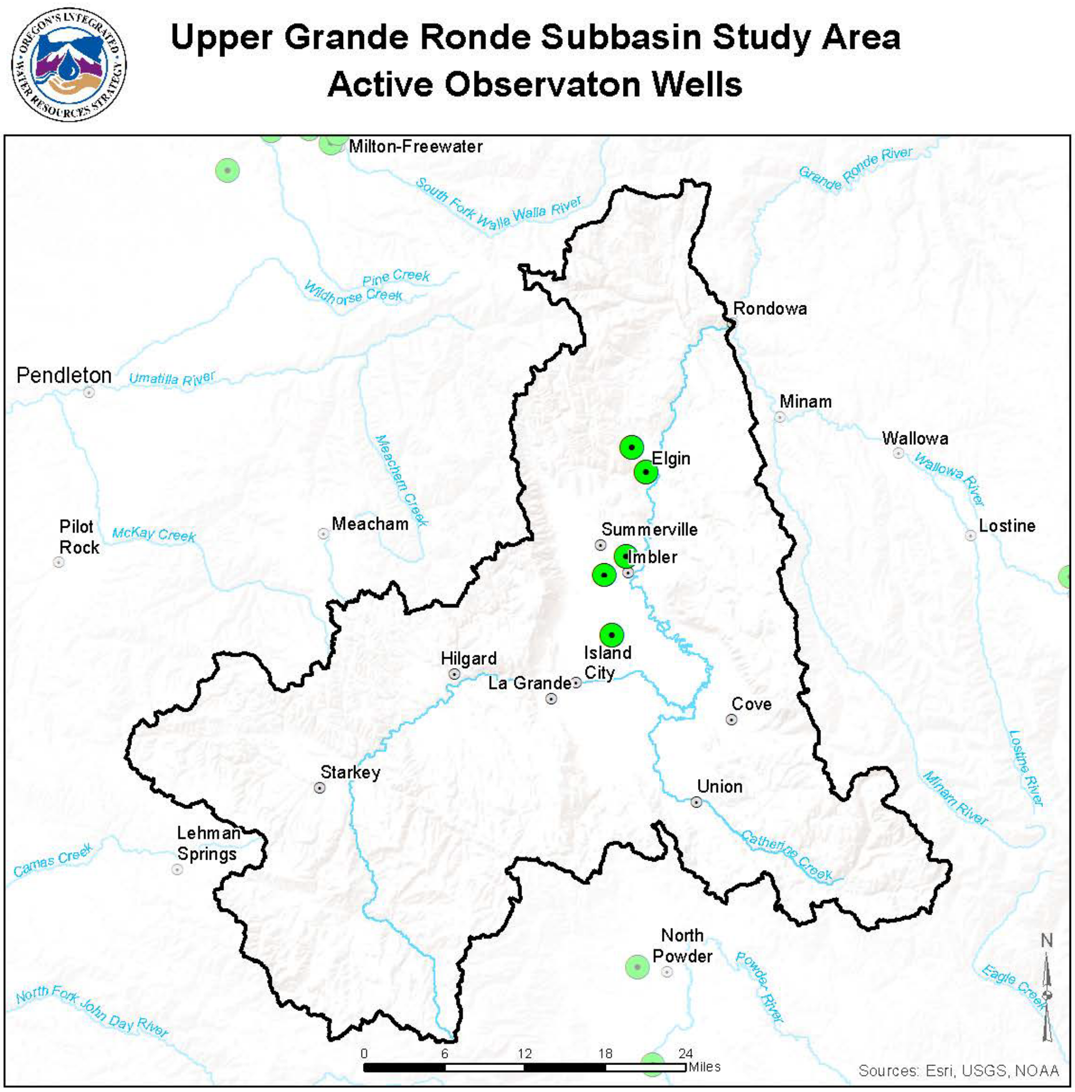
Gaps

There have been some studies aimed at understanding groundwater-surface water interactions in the basin, though more information is needed in order to understand where and at what time scales these interactions occur. Additional studies are needed to understand where gaining and losing areas may be, especially if mitigation needed for additional groundwater development needs to be targeted or to understand if aquifer recharge is an appropriate water storage or streamflow restoration solution.

Groundwater Subwatersheds

Because of the lack of data in the Upper Grande Ronde River Watershed (UGRRW) (i.e., lack of spatially distributed, long-term observation wells), the scale by which groundwater was evaluated, for some topics, was much coarser (a larger area was included) than surface water. The eight surface water subwatersheds were used to analyze the different pumping rates for different parts of the UGRRW. There are five active observation wells in the UGRRW, as shown on Figure 4-2.

Figure 4-2
Active Observation Wells



Description:

Current state observation wells are maintained by the Oregon Water Resources Department. These wells are used to monitor the health of Oregon's aquifers and are fitted with water-level recording devices. Department staff visit these wells several times throughout the year.

Source:
Observation wells, Oregon Water Resources Department, 2010

Map produced by:
Oregon Water Resources Department
725 Summer St. NE Suite A
Salem, OR 97301

Map date: October 24, 2016

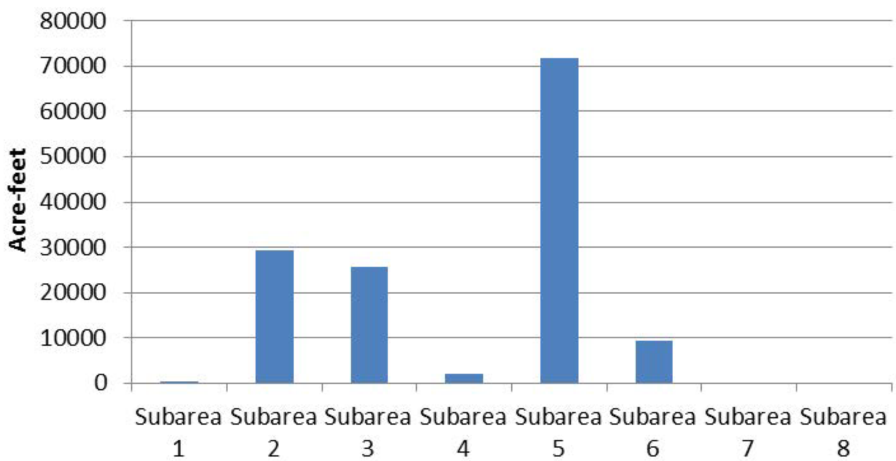
Groundwater Quantity

The quantity of groundwater use in the UGRRW has largely been unmeasured. All volume estimates are based on maximum theoretical water rights and ultimately need to be compared with trends in groundwater levels to understand whether pumping is occurring at a sustainable rate.

In order to estimate the amount of groundwater being utilized in the Upper Grande Ronde basin, several approaches may be used. OWRD utilized groundwater water rights to estimate the maximum, legal groundwater use within a basin (OWRD, 2017d). This analysis included primary and supplemental irrigation water rights as well as municipal water rights. These values should be considered a maximum because:

- Water rights may be unused in a given year
- Supplemental irrigation rights are used only if primary rights are not available
- Municipal water rights are often not fully developed

Figure 4-3
Groundwater Use by Subwatershed



On Figure 4-3, for maximum permitted groundwater use by region for all water use types, values are based on permitted water right acre-feet. In the case of irrigation, the permitted acres were multiplied by the regional duty (3 acre-feet per acre).

Figure 4-4 shows a breakdown of groundwater use based on the character of use associated with water right permits.

Figure 4-4
Groundwater Use by Type of Use

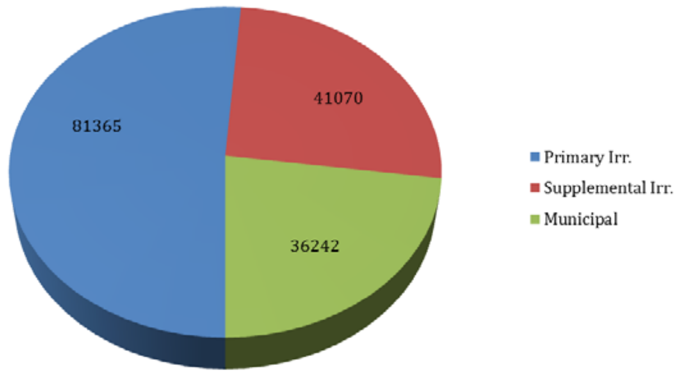
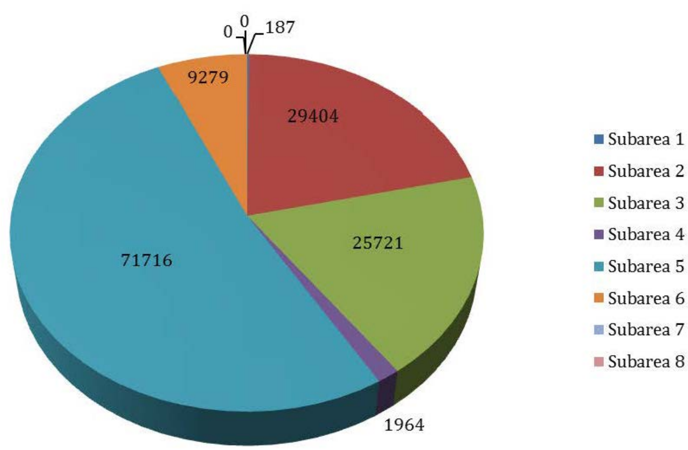


Figure 4-5 shows a breakdown of groundwater use by subwatershed area for all water use types.

Figure 4-5
Groundwater Use by Subwatershed Area

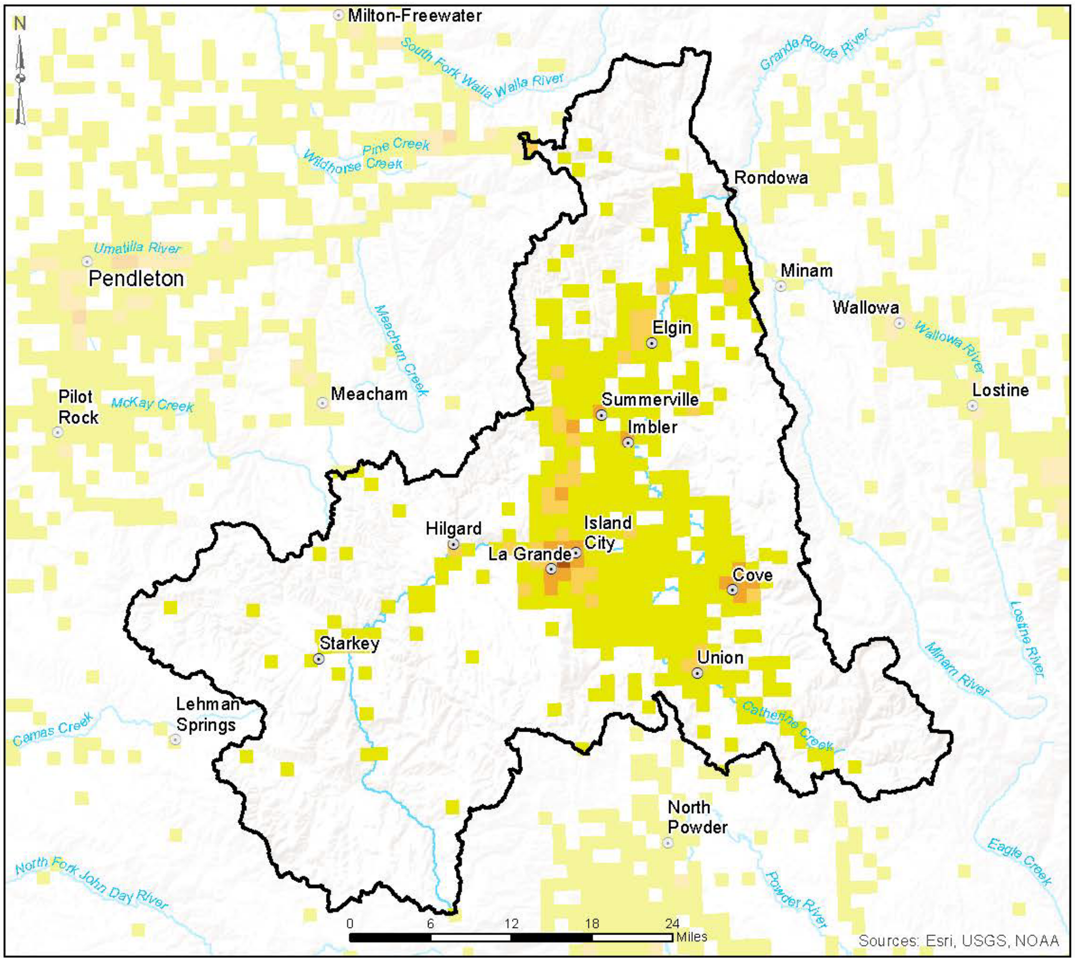


Groundwater Well Density

Groundwater wells are fairly sparse outside the valley floor, with the highest densities around the cities. This includes many wells that are exempt from the water right permitting system: domestic, stock water, and irrigation of 1/2 acre non-commercial lawn and garden. See Figure 4-6 for well density.

Figure 4-6
Well Density

Upper Grande Ronde Subbasin Study Area
Well Density



Well Density

Number of Wells by PLS Section

- 1 - 10
- 11 - 40
- 41 - 100
- 101 - 200
- > 200

Description:

A well log is a report provided by a well constuctor that describes the physical construction of the well, geologic materials and the water encountered.The Oregon Water Resources Department is the custodian of well logs filed by well drillers when they drill, deepen, or abandon a well. Location information provided by most well logs is defined by a Public Land Survey description. The number of wells per PLS section are combined to provide this well density map.

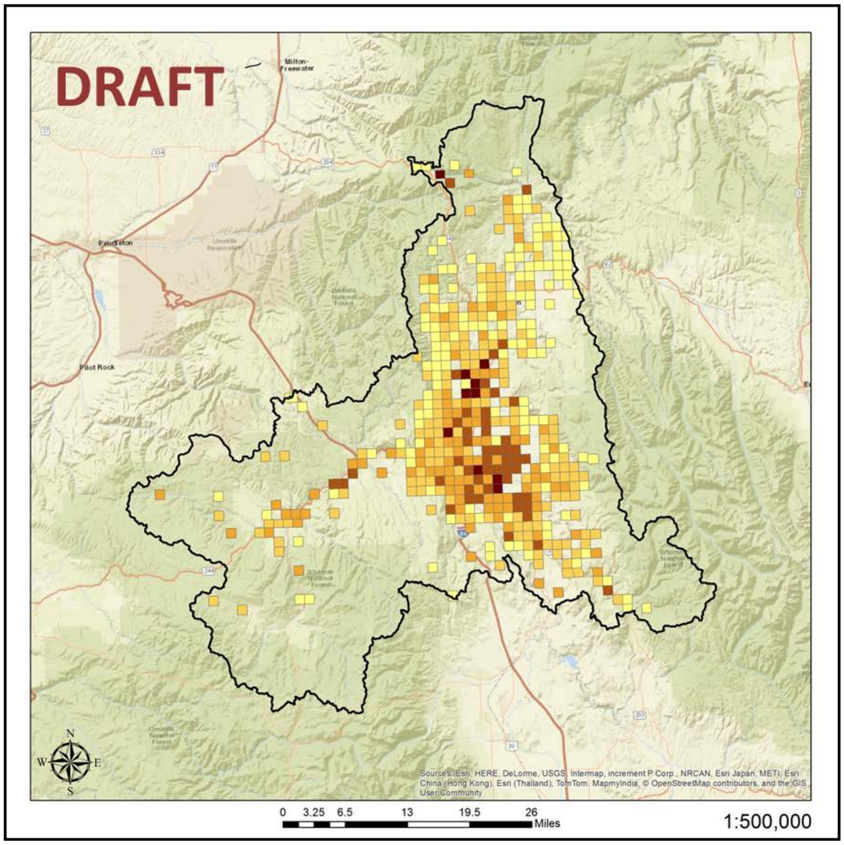
Source:
Well Logs,Oregon Water Resources Department, September 22, 2015

Map produced by:
Oregon Water Resources Department
725 Summer St. NE Suite A
Salem, OR 97301

Map date: October 24, 2016

Figure 4-7
Well Yield

Upper Grande Ronde Subbasin Study Area
Well Yield



Mean Well Yield by PLS Section

- 0-20 GPM
- 20-50 GPM
- 50–250 GPM
- 250–1000 GPM
- > 1000 GPM

Description:

Well yield tests are typically performed by the driller upon completion of a water well. These tests vary in methodology, and therefore accuracy, but taken as a whole give a rough estimate of potential for groundwater production.

Well logs submitted to OWRD are required to report a number of details about the well, including construction, lithologies encountered, and the capability to produce groundwater, referred to as "yield." Figure 4-7 displays the average yield of water wells per section across the study area. While a number of factors can influence the yield of any individual well, including diameter and depth, as a whole these data may indicate areas in which groundwater moves more easily, referred to as the "transmissivity" of an aquifer material. This analysis does not differentiate between aquifers. Generally, the darker locations are better for drilling a well. Additionally, it appears that groundwater-surfacewater interaction is lower on the outside boundaries of the UGRRW.

The number of wells in the Upper Grande Ronde Basin is estimated and categorized based on the intended use when drilled. A number of these wells may have changed use in the intervening years, however, and wells where no driller's log was found are also not counted here. Following is a summary of wells in the UGRRW by use:

- Domestic - 2,663
- Irrigation - 328
- Industrial - 45
- Livestock - 36
- Community - 28

Municipal Water

Table 4-1 breaks out municipal water use by type of water right. This includes surface water, alluvial groundwater, and basalt groundwater. Municipalities in the UGRRW primarily use groundwater resources for their water supply.

Table 4-1
Municipal Water Use - Water Right By Type

City	Date	Surface Water	Ground Water Alluvial	Ground Water Basalt
La Grande	1892	0.75		
	1909	7		
	1961			1.11
	1968		3.33	
	1969			1.33
510 Ac-Ft	1977		3.34	
	1984			4.46
	1992			5.8
	1998		4.46	
	2001		0.07	
Sum =		7.75	11.2	12.7
Island City	1977		1	
	1993		2.67	
	2000		0.31	
Sum =		0	3.98	0
Union	1874	0.85		
	1893	3		
	1963			0.45
	1983			4.01
	1989			5.57
Sum =		3.85		10.03
Cove	1914	0.1		
	1981			1.11
	2001			1.67
Sum =		0.1		2.78
Elgin	1917	0.75	(irrigation)	
	1949			5
	1967			3.3
Sum =		0.75		8.3
Imbler	1988		Muni	1.11
	1988		Fire Protection	4.46
Sum =				5.57

Limitations to Use

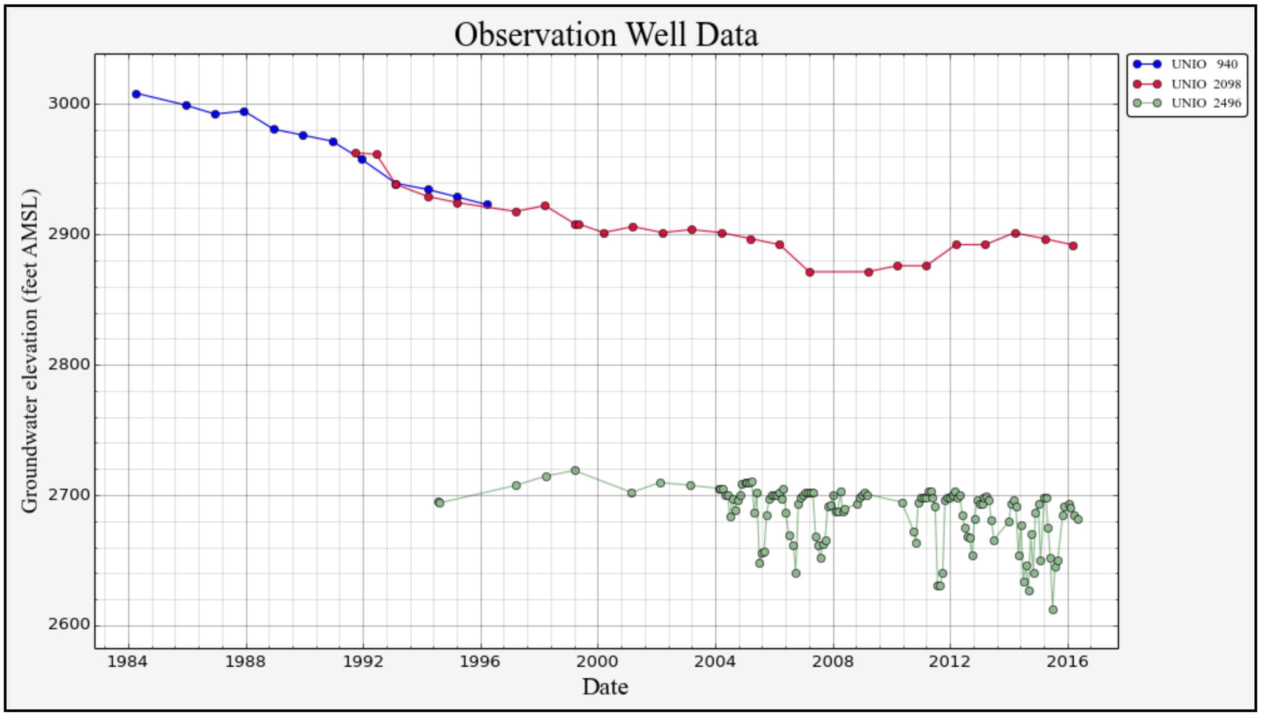
Part of the Grande Ronde River is designated as a wild and scenic river downriver of the UGRRW. Applications to appropriate additional water from groundwater sources hydraulically connected to surface water sources are generally denied by OWRD unless the surface water flows can be replaced through mitigation as determined by OWRD. The UGRRW is not in an OWRD-designated Groundwater Management Area; therefore, development of confined volcanic aquifers is possible, but at considerable expense and risk, due to the considerable depth and uncertainty of developing a functional well (OWRD, 2017a).

Well Use

The well log data shown on Figure 4-8 compare water level data for three wells in the La Grande area. The red and blue lines represent two wells drilled by the City of La Grande for municipal supply. These wells are both constructed to pump groundwater from an aquifer within the Columbia River Basalt Group (CRBG) and are both considered "artesian flowing wells," meaning the groundwater elevation is higher than land surface due to a high degree of confinement. The aquifer system these wells produce from has lost a significant degree of head elevation as pressure has been lost in this system. In the period between 1984 and 2016, groundwater elevations have declined in this aquifer system by about 120 feet, or about 3.75 feet per year, but the recent measurements appear to show a more stable water level. This is not unusual in CRBG aquifers, which often display high confining pressure, but low storage capability, further compounded by the lack of natural recharge to these systems.

The green line depicts the groundwater elevation trend of a well drilled by the City of Island City, a much shallower well (less than 500 feet) producing water from the alluvial sediments above hard volcanic rock. By comparison, this well shows a decline of about 20 feet in elevation in the past two decades, or about 1 foot per year. Declines observed in the shallower alluvial aquifer have not been as rapid as those in the basalt aquifers, likely buoyed by an efficient connection to surface water, thus having the potential to reduce flows in the Grande Ronde River and its tributaries near the Grande Ronde Valley floor.

Figure 4-8
Well Log Data



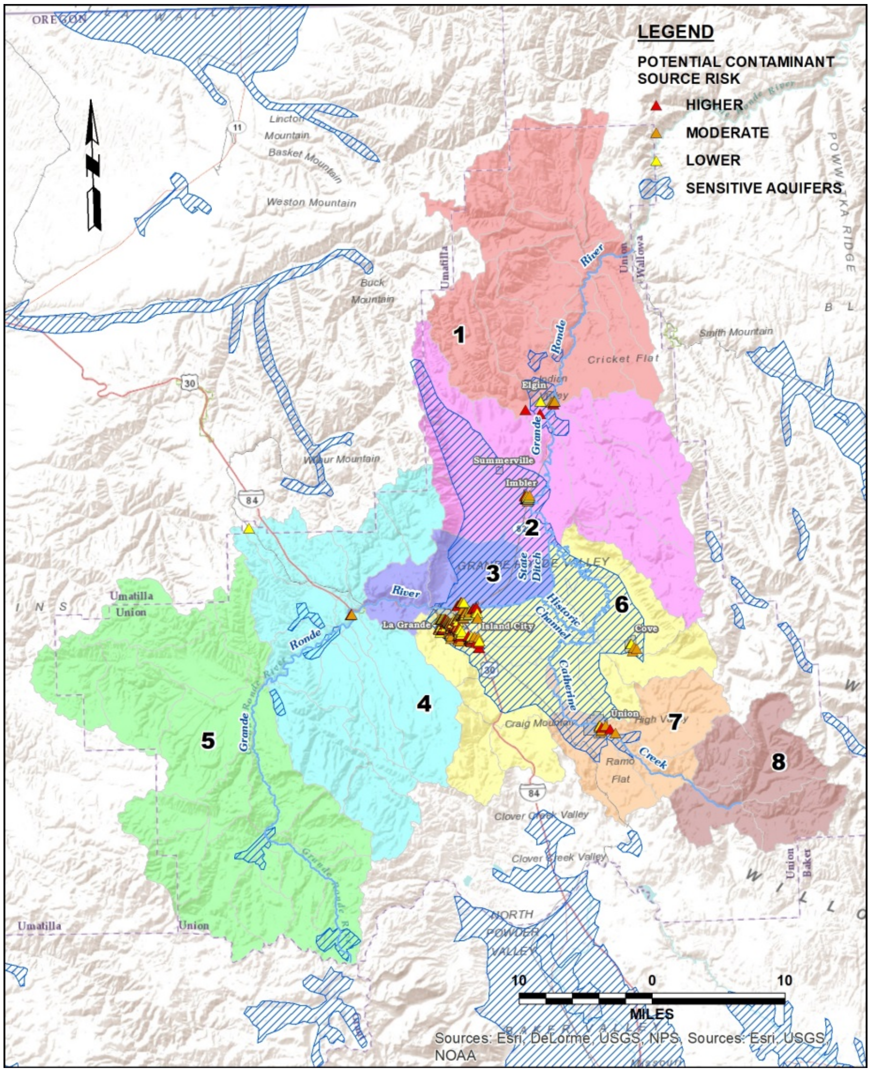
Groundwater Quality

Limited data in this area necessitates a more qualitative approach. There is the potential for groundwater to be contaminated and affect supplies for beneficial uses, including municipal and domestic drinking water.

Environmental Cleanup Site Information Database Information

OWRD has little information on groundwater quality; however, the Oregon Department of Environmental Quality (DEQ) has a database of contaminated sites known to exist, such as known leaking underground storage tanks (LUST) and other contaminant sources. The DEQ uses these data to generally assess risks to wells from known contaminant plumes. The known sites have been designated as high, medium, and low risk, and are shown on Figure 4-9.

Figure 4-9
ECSI Site Locations and Sensitive Aquifers



Contaminants are concentrated in urban areas. The sensitive aquifer layer is overlain in blue and indicates that these sites could impact the Upper Grande Ronde aquifer.

Subwatershed 1

Two high risk sites have been identified in Subwatershed 1. Both are located in Elgin in the southern portion of the subwatershed, close to the Subwatershed 2 boundary. The first site is a rural residence with private wells and septic systems (likely considered high risk due to potential nitrates contamination). The second is a substation owned by the Elgin Water Department and appears to be located within 200 feet of Phillips Creek, a tributary of the Grande Ronde River. Three moderate risk sites are located in the southern part of Subwatershed 1, close to the boundary of Subwatershed 2. One low risk site is in close proximity to the other sites on the southern edge of Subwatershed 1. One of these sites is located within the boundaries of a sensitive aquifer and could potentially impact it, depending on aquifer depth.

Subwatershed 2

Seven high risk sites have been identified in Subwatershed 2. All but one of the sites are located in the center of the subwatershed in the City of Imbler and consist of high density housing, underground storage tanks, and metal plating/fabrication. One rural residence with a private well and septic system identified as a high risk site is located in the northeastern part of the subwatershed. Four moderate risk sites, all associated with roads and the railroad, are located in the City of Imbler, as are 10 low risk sites. These sites are located within the boundaries of a sensitive aquifer and could potentially impact it, depending on aquifer depth.

Subwatershed 3

Six high risk sites have been identified in Subwatershed 3. The sites are located in the southern portion of the subwatershed near the boundary of Subwatershed 6. Three of the sites are owned by Flying K Trailer Ranch and are associated with high density housing, salvage yards, and septic systems. One of the sites is approximately 180 feet from Nesley Ditch, which connects to the Grande Ronde River. There are four moderate risk sites and three low risk sites. All are associated with either a gas station, an aboveground storage tank, septic systems, kennels, or horse stables. These sites are located within the boundaries of a sensitive aquifer and could potentially impact it, depending on aquifer depth.

Subwatershed 4

Two high risk sites have been identified in Subwatershed 4. The sites are located approximately in the middle of the subwatershed near Highway 224. Both sites are owned by Oregon Youth Authority, River Bend. One site is associated with wastewater storage lagoons and the other is related to sewer lines approximately 350 feet from the Grande Ronde River. There is one moderate risk site, also owned by Oregon Youth Authority, River Bend, located on Highway 224. There is one low risk site in the northern part of the subwatershed near Kamela; the site is owned by the City of Pendleton and is associated with the railroad. None of these sites are located within the boundaries of a sensitive aquifer.

Subwatershed 5

No contaminant sites have been identified in Subwatershed 5.

Subwatershed 6

Subwatershed 6 includes the Cities of La Grande and Cove and has numerous identified sites. There are approximately 60 high risk sites located in the City of La Grande. All are within city limits. One high risk site located near a waterbody, Gekeler Slough, is owned by the City of La Grande and is associated with machine shops and equipment maintenance. The rest of the sites do not appear to be located in or near a waterbody and are mostly associated with LUSTs, stormwater disposal wells, railroad contamination, automobile repair, gas stations, high density housing, power stations, salvage yards, sewer lines, and septic systems. There are approximately 50 moderate risk sites and approximately 25 low risk sites associated with gas station, dry cleaners, automobile repair, high density housing, aboveground storage tanks, schools, chemical processing, and storage facilities.

The City of Cove has no high risk sites, three moderate risk sites, and two low risk sites. One of the moderate sites is a cemetery located within 200 feet of Mill Creek. These sites are located within the boundaries of a sensitive aquifer and could potentially impact it, depending on aquifer depth.

Subwatershed 7

Three high risk sites have been identified in Subwatershed 7. Two of the sites are located in the City of Union and include a salvage yard for Baremore Logging and municipal/industrial wells. The wells are located within 200 feet of Pyles Creek, a tributary of Catherine Creek. The third site is a confined animal feeding operation owned by the City of Union. There are five moderate risk sites all associated with highway traffic, high density housing, a golf course, a cemetery, and crop irrigation. The site identified for highway traffic is located on Highway 203 and is approximately 70 feet from Catherine Creek. None of the other sites are located in or near a waterbody. There is one low risk site in the subwatershed, also located in the City of Union, approximately 60 feet from Brinker Creek, a tributary of Catherine Creek. These sites are located within the boundaries of a sensitive aquifer and could potentially impact it, depending on aquifer depth.

Subwatershed 8

No contaminant sites have been identified in Subwatershed 8.

1989 to 2010 Real Estate Nitrate Transaction Data

The Oregon Health Authority (OHA) tracks nitrate sampling in wells that is often required for property transactions. Sampling locations are shown on Figure 4-10. It appears that near the City of La Grande/City of Island City (Subwatersheds 3 and 6), five wells have been reported to have nitrate concentrations over 8 milligrams per liter (mg/L). One well in Island City has concentrations over 51 mg/L. One well near Elgin (north part of Subwatershed 2) had concentrations of 11 to 50 mg/L, and one well near the City of Union (Subwatershed 6) reported a nitrate concentration of 8 to 10 mg/L. Nitrates are present in groundwater for a variety of reasons, including natural occurrence reasons (soil type) and also anthropogenic reasons (septic tank leakage) reasons. Groundwater quality in the aquifers in the UGRRW appears to have a low risk of nitrate contamination in certain areas (near cities). Before being used for municipal purposes, groundwater is treated and, therefore, groundwater quality does not appear to be a major concern for municipal use in the UGRRW in areas where information is available.

Figure 4-10
1989 to 2010 Real Estate Nitrate Transaction Data

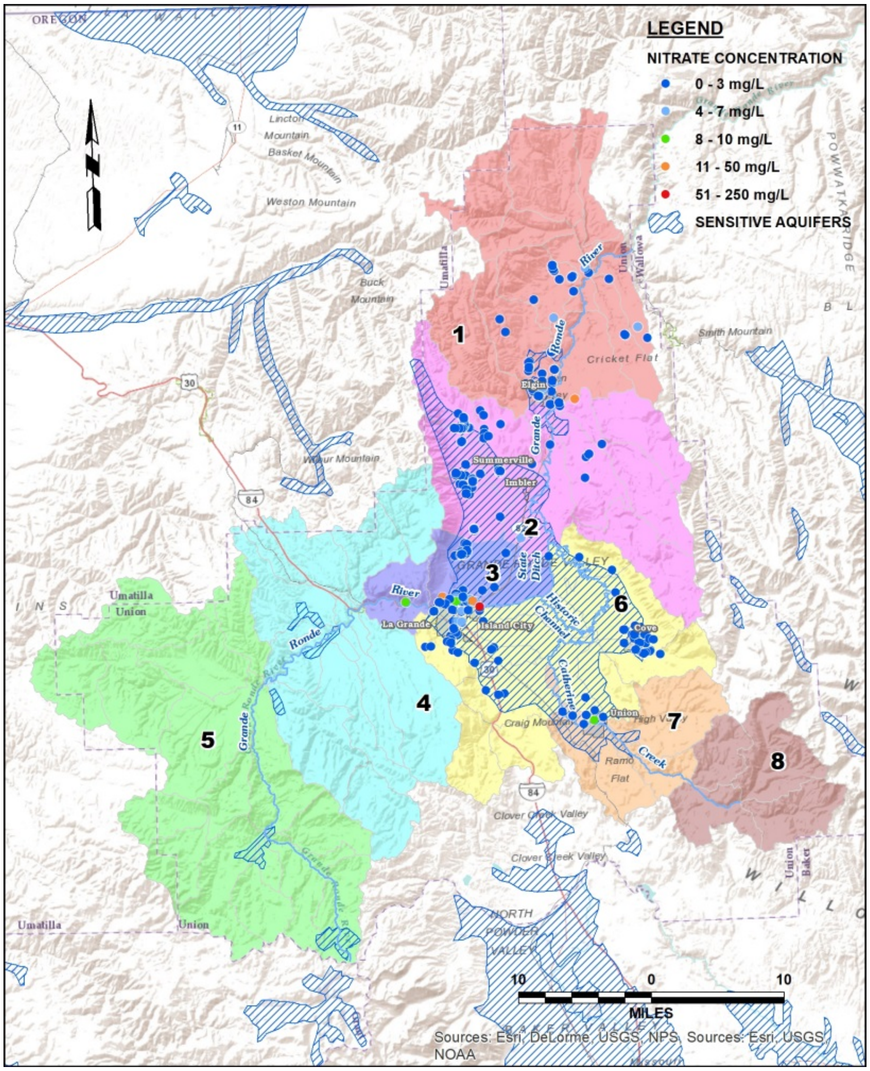


Figure 4-11 shows real estate transaction database results from private well sampling for nitrate. Red squares indicate elevated nitrate, so it is apparent that the La Grande/Island City area appears to be at risk for nitrate entering groundwater. Table 4-2 summarizes information from the real estate transaction database for Union County.

Two public water systems that have elevated nitrate in the Upper Grande Ronde Basin are Island City (Well No. 1 - "C" Street - which is now inactive) and Flying K Trailer Ranch. Island City's nitrate levels in the now inactive Well No. 1 were consistently high (ranging from 7 parts per million [ppm] to 10 ppm – the federal drinking water standard is 10 ppm). OHA Source Water Assessment information for these water systems is now somewhat dated; however, it indicates that several of Island City's wells are drawing from an aquifer that is highly sensitive. Flying K's nitrate levels are quite variable, anywhere from 2 to 7 ppm over the last 10 years, and the aquifer sensitivity is moderate. Any wells, public or private, that draw from sensitive aquifers are at greater risk from contamination on the surface that could potentially move to groundwater. Contamination sources for nitrate include fertilizer applications, seepage or runoff from animal waste, or septic systems.

Figure 4-11
Real Estate Nitrate Transaction Data and Public Drinking Water Systems

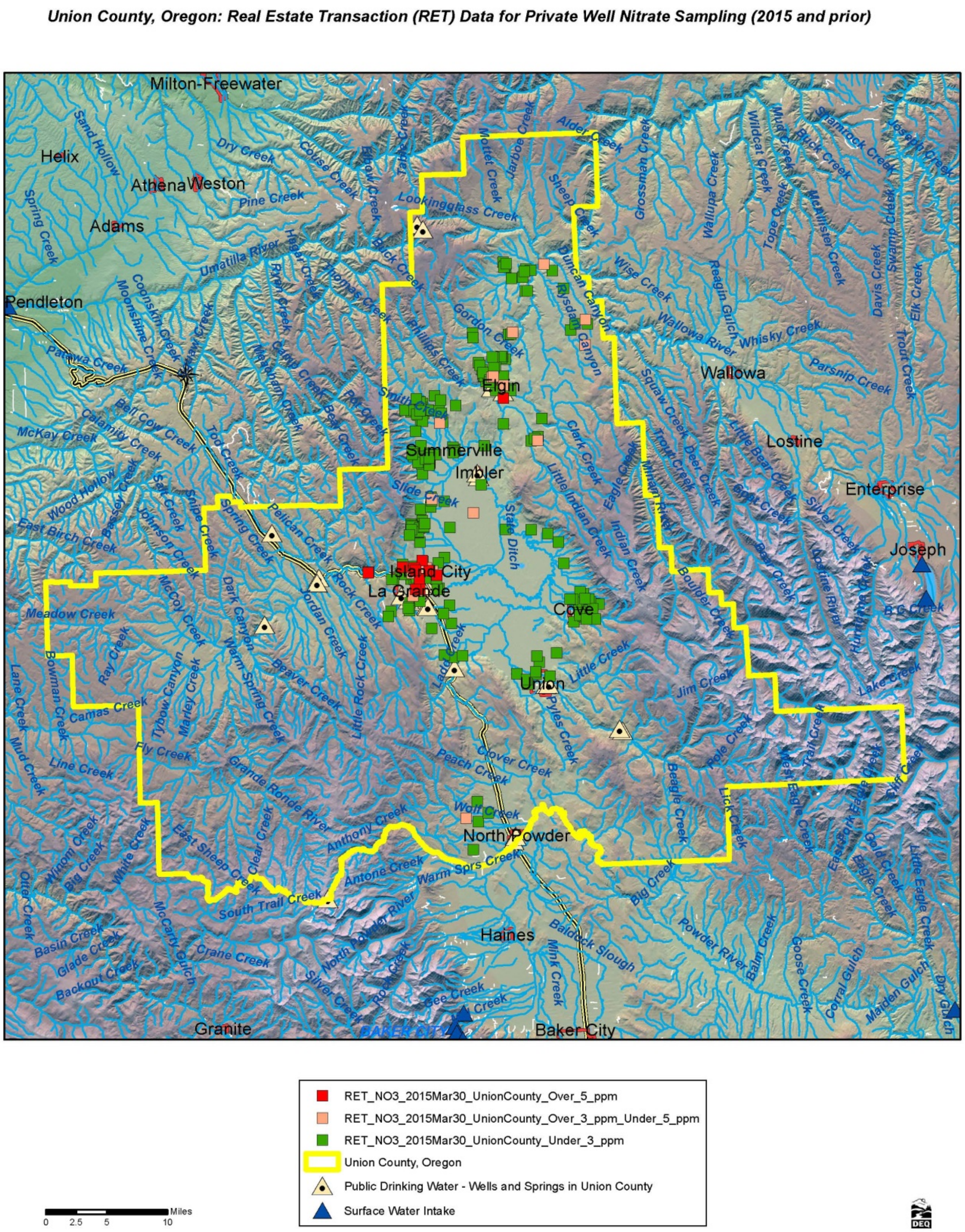


Table 4-2
Real Estate Transaction Database Results of Union County (Private Well Nitrate Samples)

County Name	Number of Test Results	Mean Test Result	Maximum Nitrate Test Result	Percent of Nitrate Test Results Over 10 ppm	Percent of Nitrate Test Results Over 3 ppm	Data Quantity
Union	326	1.498	92.7	1.84	10.12	Adequate

Data Gaps

- Additional groundwater quality data are needed, including groundwater temperature data and more information about nitrates and potential underground storage tank impacts to aquifers near La Grande and Union.
- Additional information is needed to determine whether wells at risk from potential contaminant sources are meeting water quality standards for drinking water or agricultural usage, depending on the use.
- More information is needed to determine overall groundwater level trends.
- Development of confined volcanic aquifers is possible, but at considerable expense and risk; this may be explored in Step 4.
- More information is needed to determine if legal water rights are an accurate representation of actual groundwater use.
- Additional specific data are needed to calculate and verify water quantity and quality questions. These data are not available and need to be collected.

Section Summary

This section includes a discussion of groundwater quantity and quality beneath the subwatersheds. The eight surface water subwatersheds were used to analyze the different pumping rates for different parts of the UGRRW. Multiple scales of analysis were used because of a lack of long-term observation wells in the area.

Groundwater Quantity

There are five active observation wells in the UGRRW; however, non-municipal groundwater use has largely been unmeasured. OWRD produced estimates based on maximum legal water rights. Subwatershed 6 has the highest estimated groundwater use, followed by Subwatersheds 2 and 3. Subwatersheds 1, 4, 5, and 8 have almost no groundwater use. Throughout the UGRRW, primary irrigation accounts for approximately 81,365 acre-feet per year of groundwater, supplemental irrigation accounts for 41,070 acre-feet per year, and municipal uses account for 36,242 acre-feet per year. Groundwater wells are more densely concentrated in the central and northern part of the UGRRW. Currently, the drilling of new alluvial wells is restricted in the UGRRW. Well declines have been documented by the City of La Grande in previous decades, but declines appear to have stabilized in recent years. More information is needed to determine overall groundwater trends.

Groundwater Quality

There is very limited groundwater quality data in the UGRRW. Groundwater quality was approximated using DEQ ECSI database data and DEQ real estate nitrate measurement data. Based on the location of sensitive aquifers in the UGRRW, it was observed that several potential contaminant cleanup sites associated with the City of La Grande could potentially impact aquifers in the central portion of the UGRRW (Subwatershed 6). Cleanup sites in the remainder of the UGRRW are sparse and seem to pose less of a risk of impact to aquifers. Nitrate data shows that near the City of La Grande/City of Island City (Subwatersheds 3 and 6), five wells have been reported to have nitrate concentrations over 8 mg/L. One well in Island City has concentrations over 51 mg/L. One well near Elgin (north part of Subwatershed 2) had concentrations of 11 to 50 mg/L, and one well near the City of Union (Subwatershed 6) reported a nitrate concentration of 8 to 10 mg/L. In this data set, the locations of higher concentrations of nitrates are also located in the central part of the UGRRW (Subwatershed 6) and are associated with the City of La Grande.

5.0 - Water Balance

Estimated Annual Water Balance within the Upper Grande Ronde Basin

In an effort to understand the relative magnitude of components of the water cycle within the Upper Grande Ronde River Watershed (UGRRW), the Oregon Water Resources Department (OWRD) has estimated the annual precipitation entering the basin, annual volumes of streamflow leaving the basin, and estimates of losses from land surface evapotranspiration (Table 5-1). These calculations are a useful, initial computation for understanding the relative distribution of water throughout the annual water cycle (see Figure 5-1).

Table 5-1
Estimates of the Annual Water Balance Fluxes in the Upper Grande Ronde River Watershed (Assuming Groundwater Inflow and Outflow are Negligible)

Water Cycle Component	Volume (acre-feet)	Rate (feet/year)	Percent of Precipitation
Mean Annual Precipitation Volume, acre-feet (1961 to 1990)	2,468,000	2.36	-
Mean Annual Natural Streamflow Volume, acre-feet (1961 to 1990)	696,000	0.67	28
Mean Annual Evapotranspiration, acre-feet (2000 to 2013)	1,498,000	1.43	61
Estimated Residual (unaccounted for precipitation)	274,000	0.26	11

Figure 5-1
Basic Water Cycle Showing Evapotranspiration from Plants and Open Water Surfaces, Precipitation, Groundwater Flow and Storage, and Surface Water Flow

Basic Water Cycle

Evapotranspiration and Precipitation by Region

One way to explore water movement throughout the larger Upper Grande Ronde landscape is to explore patterns in rainfall and evapotranspiration by region (see Tables 5-2 and 5-3 and Figures 5-2 through 5-4). Since the basin regions were identified as distinctly different hydrologic areas by the Planning Group, there may be other factors that the group would like to explore as they relate to these patterns across the landscape. It appears that the highest evapotranspiration occurs in mountainous areas, and evapotranspiration is lower on the Grande Ronde Valley floor. This could be more of a function of moisture supply than land use. Additionally,evapotranspiration appears to be greater than precipitation only in areas of agricultural use.

Table 5-2
Mean Annual Precipitation Totals by Subwatershed Within the Upper Grande Ronde Basin and Percentages of the Total Volume of Basin Precipitation

Subwatershed	Area (acres)	Precipitation (mean, inches)	Precipitation (mean, feet)	Precipitation Volume (acre-feet)	Precipitation (% total volume)
1	168,958	33	2.74	463,260	19
2	149,797	29	2.42	361,890	15
3	41,008	19	1.55	63,680	3
4	178,072	27	2.26	402,690	16
5	249,786	28	2.35	585,920	24
6	142,276	22	1.79	255,120	10
7	55,504	27	2.24	124,460	5
8	61,830	41	3.38	208,870	8

Table 5-3
Mean Annual Evapotranspiration Totals by Subwatershed Within the Upper Grande Ronde Basin and Percentages of the Total Volume of Basin Evapotranspiration

Subwatershed	Area (acres)	Evapotranspiration (mean, inches)	Evapotranspiration (mean, feet)	Evapotranspiration Volume (acre-feet)	Evapotranspiration (% total volume)
1	168,958	19	1.56	263,580	18
2	149,797	18	1.48	221,940	15
3	41,008	17	1.41	57,840	4
4	178,072	16	1.34	238,430	16
5	249,786	16	1.32	329,290	22
6	142,276	18	1.46	207,590	14
7	55,504	14	1.19	66,310	5
8	61,830	16	1.35	83,730	6

Figure 5-2
Mean Annual Precipitation and Evapotranspiration
Depth (inches) by Subwatershed

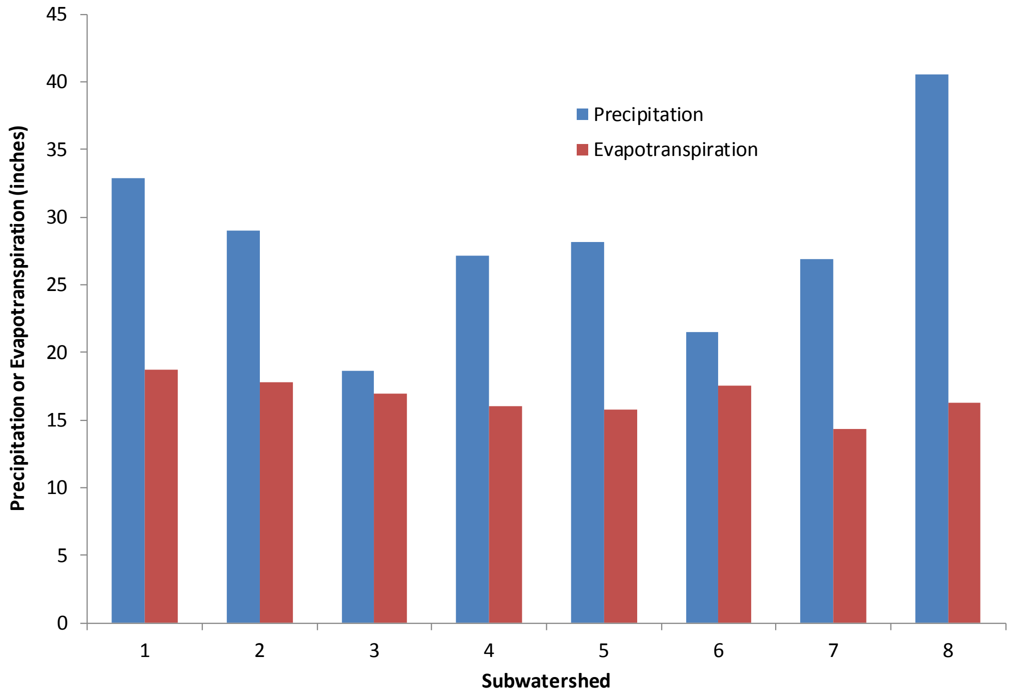


Figure 5-3
Mean Annual Precipitation and Evapotranspiration Volume
by Upper Grande Ronde Basin Subwatershed

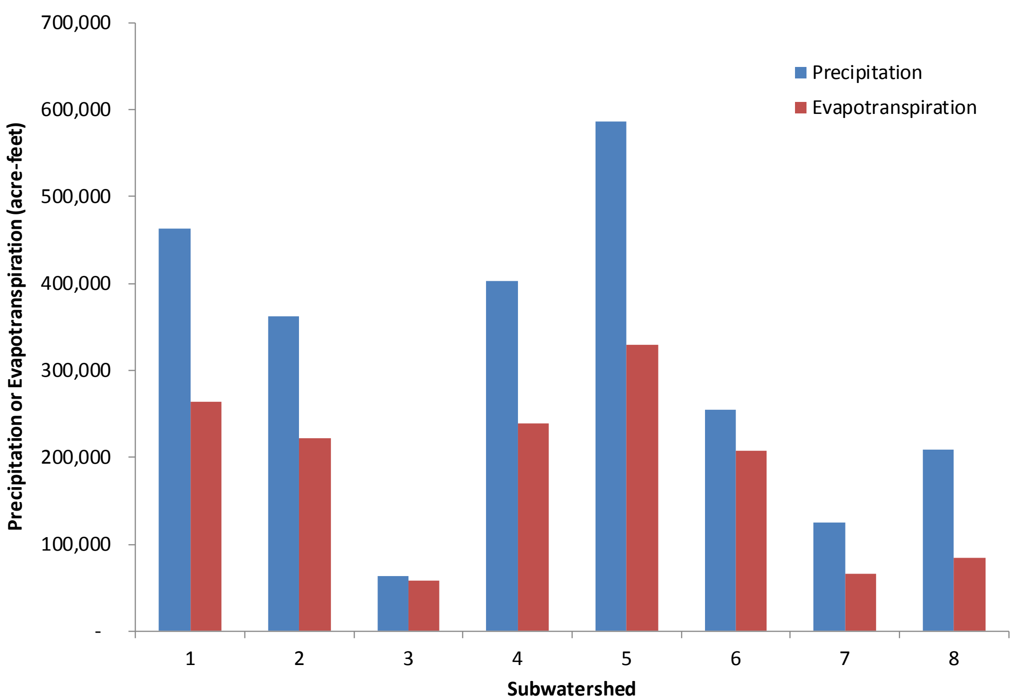
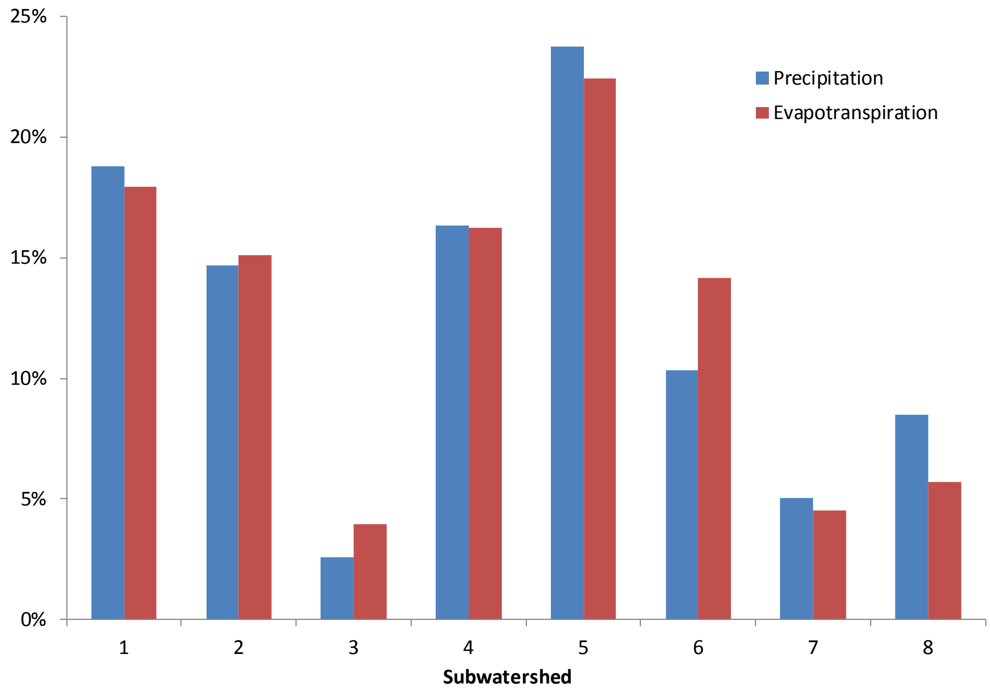


Figure 5-4
Regional Percentages of Entire Basin Mean Annual Precipitation and Evapotranspiration Volumes



Methods – Calculation of Water Balance Components

Precipitation

Annual precipitation volume input to UGRRW was estimated by computing the mean annual precipitation within the delineated basin using the PRISM data set (Daly et al., 1994) for total precipitation (rain and snow) over the time period from 1961 to 1990 (2.36 feet per year), and multiplying that value by the number of acres within the basin computed from a delineation of the basin using ArcGIS (1,047,000 acres).

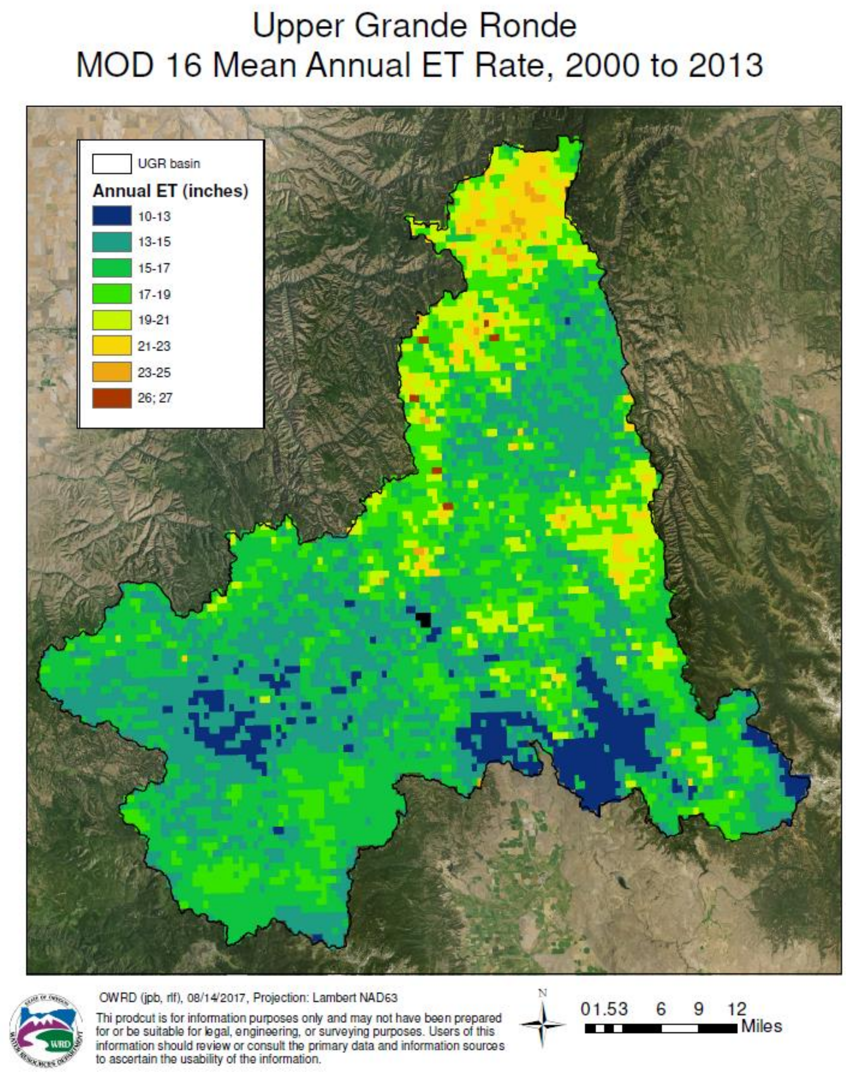
Streamflow

Mean annual streamflow volume leaving the UGRRW was estimated using a combination of stream gage records with minimal diversions above the gage and basin characteristics. Using long-term historic data from the Grande Ronde at LaGrande gage (13319000), OWRD computed the mean annual streamflow for the basin area above the gage for the period from 1961 to 1990. Once converted to an annual volume, this value was scaled to the basin outlet using the ratio of mean annual precipitation volume from the modeled basin to the gaged basin. For this conversion, OWRD used a ratio of 2,468,000 to 1,010,000 acre-feet or 2.44. Generally, the U.S. Geological Survey recommends using precip-area or area scaling when ratios are between 0.5 and 1.5. In order to check if the estimate using a ratio of 2.44 is reasonable, OWRD compared the computed mean to the median estimated natural flow for the basin from OWRD's Water Availability Model for the water availability basin at this same point (Grande Ronde R > Snake R - Ab Wallowa R) (OWRD, 2017e). The estimated median natural streamflow volume of 685,000 acre-feet is reasonably close to the estimated mean streamflow volume computed for this project (696,000 acre-feet).

Evapotranspiration

To estimate landscape evapotranspiration, OWRD utilized the MODIS Global Evapotranspiration Project (MOD16) calculations completed by the University of Montana's Numerical Terradynamic Simulation Group (University of Montana, 2017). This modeled data set uses the MODIS satellite remotely sensed data, meteorological inputs, and a series of physically based algorithms to compute daily evapotranspiration for 1 square kilometer (247-acre) grid cells across the earth's surface (Mu et al., 2011). Given that the entire Watershed is approximately 1,047,000 acres, each grid cell represents about 0.02 percent of the land area, for a total of 4,238 grid cells within the UGRRW (see Figure 5-5). This data set was validated against evapotranspiration calculations from flux towers located in different vegetation zones including evergreen forests and grasslands, though this was a validation performed on the larger data set. These data have not been calibrated or validated locally and, combined with the scale of the assessment, should be used as a first approximation of evapotranspiration and not for field-scale calculations of evapotranspiration. It is also important to note that this computation does not differentiate between croplands (irrigated or non-irrigated) and natural areas.

Figure 5-5
Annual Mean Evapotranspiration for the Upper Grande Ronde River Watershed



Residual and Improvements

The residual is the remaining precipitation input not otherwise attributed to streamflow or evapotranspiration. This component of the balance includes unaccounted variables (e.g., groundwater flow and storage changes) plus any error associated with the computation. For any further analysis, it is important to understand the error associated with each of the estimates involved in the computation and to quantify any fluxes important for the management of water in the basin (i.e., groundwater inflow and outflow).

Data Gaps

- Scale is a limiting factor in each section of analysis. For each different component of analysis (i.e., groundwater, surface water, etc.), the scale of evaluation is stated. Information derived from different scales of analysis is not able to be used quantitatively; however, it is provided in this section to share what existing information is available.

6.0 - Limiting Factors

This section discusses limiting factors (also understood as potential influencing factors) in the Upper Grande Ronde River Watershed.

Non-Stationarity in the Basin

Until recently, hydrologists and water resources engineers assumed that streamflow essentially varied within a range that did not change substantially over time, or the range in variability remained stationary. However, as time passed and more data were collected and analyzed, it became clear that streamflow as well as groundwater, climate, and hydrologic processes are, by nature,more variable than previously thought, or are actually "non-stationary." This new scientific understanding has two important effects:

A representative range of variability in streamflow cannot be captured in a *"representative"* or *"sufficiently long"* period of data record; and

Methods historically used in water resources protection, use and management, including policies governing water resources administration may no longer be adequate. Non-stationarity in quantity and timing of streamflow arises from both natural and human influences, including:

- Cyclic climate conditions, for instance lasting for multiple decades (e.g., 30 years);
- Long-term temperature trends (e.g., increasing trend associated with climate change);
- Abrupt, or steep, changes in climate (i.e., climate regime shifts); and
- Land use, land cover, and water use changes.

Natural and human influences can also interact with one another, resulting in compounding or confounding (i.e., opposing) effects.

Streamflow in the UGRRW has changed since the early to mid-twentieth century. Median annual water volume has decreased approximately 13 percent between the time periods, 1945 to 1976 and 1977 to 2016 (see Figure 6-1). Median monthly flow volumes have decreased approximately 24 percent during the same period. Possible causes of decreases in streamflow include both climate and human influences, and additional investigations into temperature and precipitation will provide more insight into causes.

Streamflow characteristics will continue to change in response to changes in landscape, water use, and climate conditions. Therefore, in order to meet the place-based planning goals of promoting resilient and sustainable water resources as well as communities supported by water resources:

- New perspectives, approaches, and method of analysis are required for water resources, and
- Flexibility is needed in planning strategies and solution options.

For instance, water demands may be projected and initial goals identified for 50 years into the future, however, it may also be necessary to reassess demands and influencing conditions on a more frequent basis, for example every 10 years, to better estimate demands and identify potential solutions.

This project seeks to develop a planning process for water resources management, use, and protection in the UGRRW that is both robust and flexible in order to promote resilient and sustainable water resources that are fundamental to the economic, social, cultural, and environmental strength of the community.

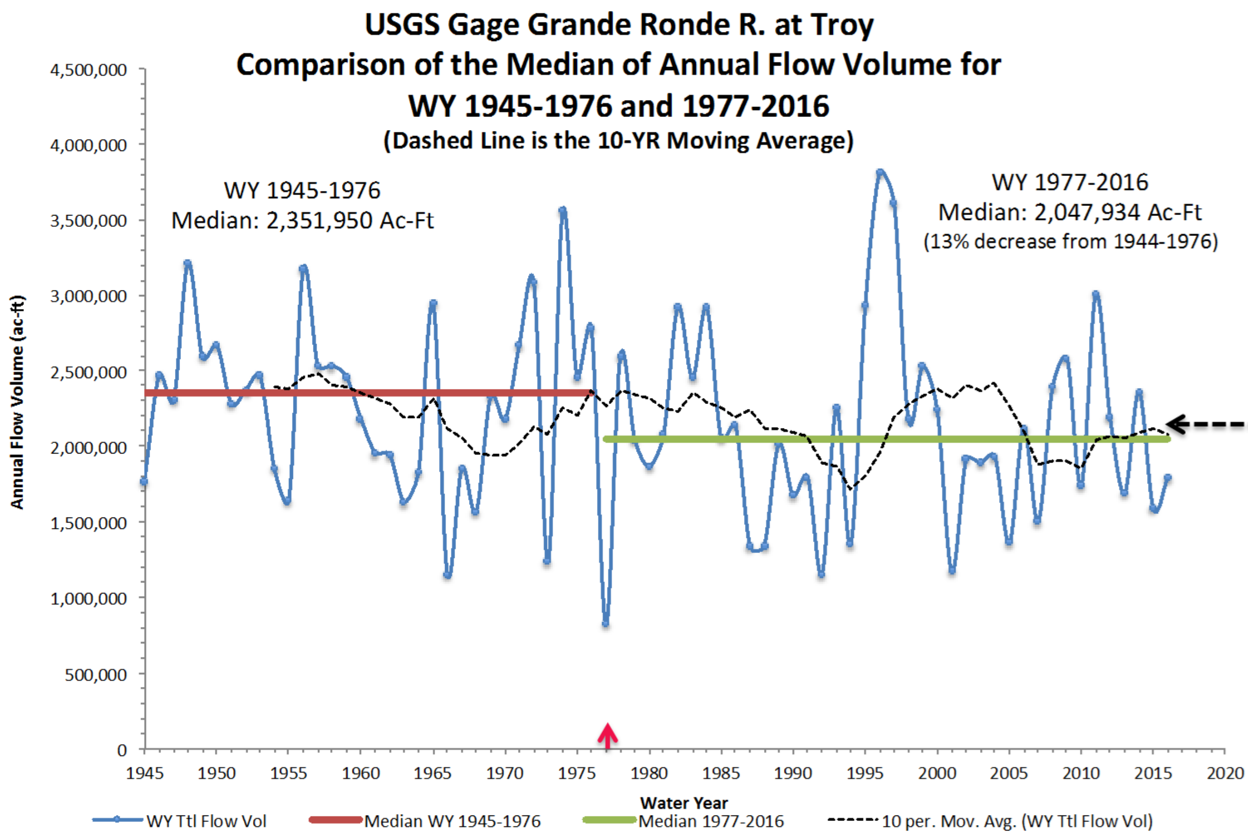
According to the National Climate Assessment (2014), a key finding is that "climate change is expected to affect water demand, groundwater withdrawals, and aquifer recharge, reducing groundwater availability in some areas."

Examples of how this planning effort could explore ways to plan for the effects of non-stationarity include:

- Adaptable Irrigation Seasons - Ability to shift the time of demand and supply (to meet the demand)
- Water Markets and Infrastructure - Ability to shift the location of supply and demand
- Updated Supply Forecasting and Administration Techniques - More timely and improved accuracy of water supply forecasting, and more flexible and adaptable methods to administer water resources

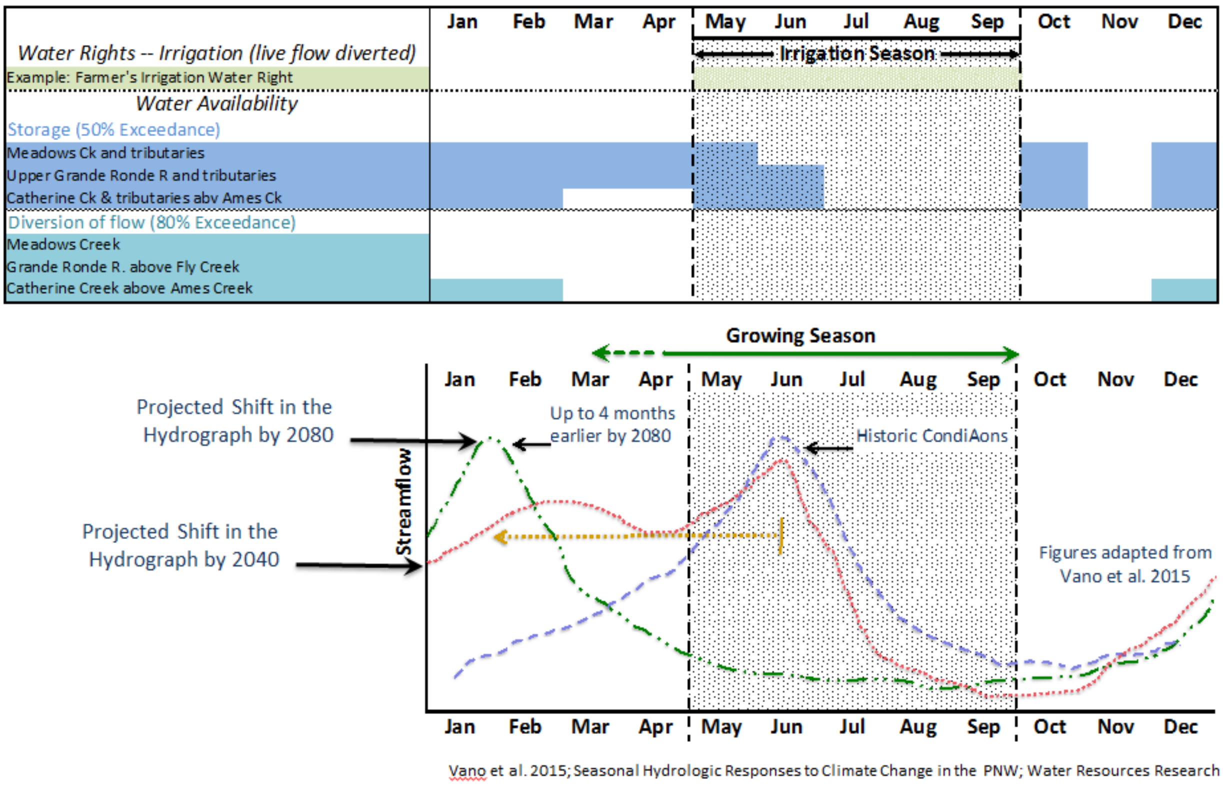
Non-stationarity affects quantities and timing of available water resources. This could impact the information collected through this process of flow and timing. Figure 6-2 shows water availability compared to the irrigation season and how an extreme potential projected shift could change when water is available and challenge our ability to meet water rights.

Figure 6-1
Comparison of Median of Annual Flow Volumes, 1945-2016



WY = Water year

Figure 6-2
Comparison of Water Availability to the Irrigation Season and Growing Season

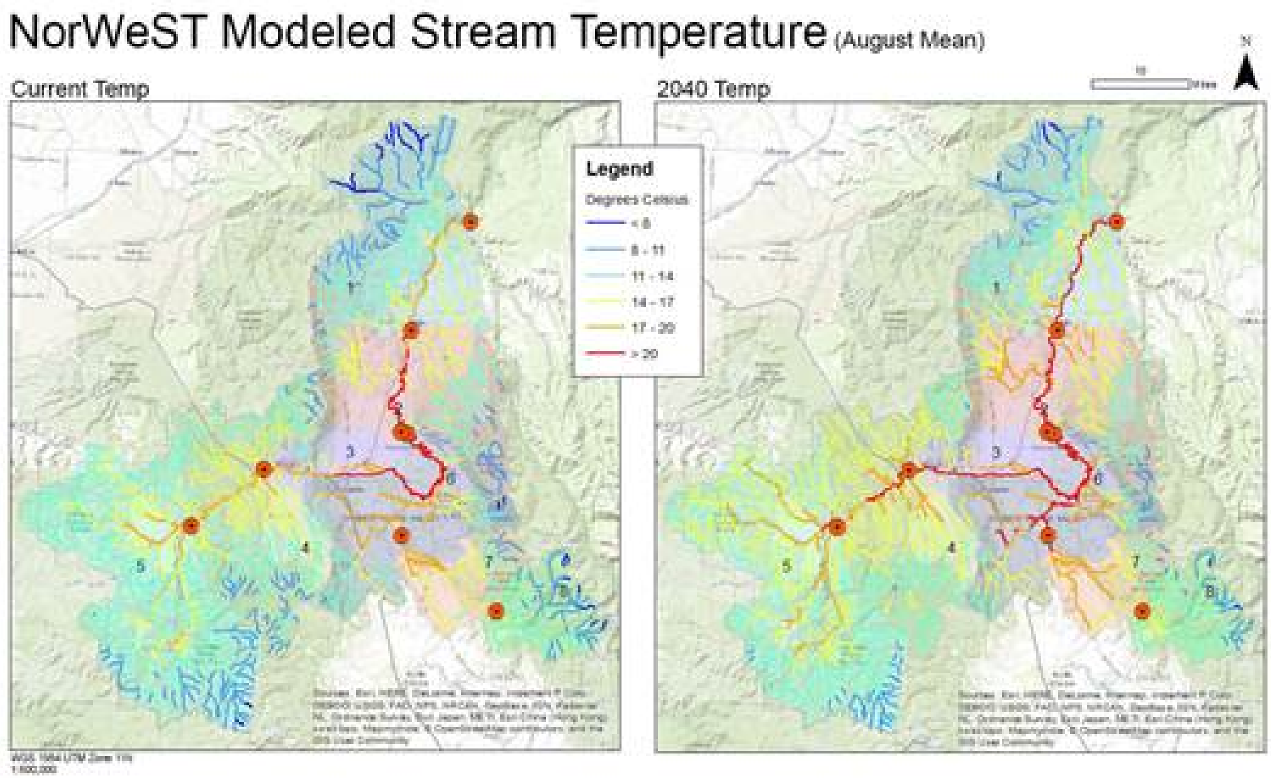


(Oregon Department of Agriculture, 2017)

In addition to a shift in time, looking at how total volume of flow changes over time will be important to evaluate total volumes available for competing needs.

Another limiting factor is projections for increased temperatures. Figure 6-3 shows predicted stream temperatures as modeled by NorWeST, showing increased temperatures throughout the basin over time.

Figure 6-3
NorWeST Modeled Stream Temperature



(Grande Ronde Model Watershed, 2017)

Key Rules Impacting Water Use in the Upper Grande Ronde River Watershed

To understand where and when water can be used for consumptive or non-consumptive uses, it is important to understand not just the hydrology of a basin, but also the laws and subsequent rules that govern its use. In Oregon, there are statewide as well as basin-specific rules that are important to understand when characterizing water resources in a basin. Below, we describe the major Oregon Administrative Rules (OAR) overseen by the Oregon Water Resources Department (OWRD) regarding when, where, and for what use permit applicants may receive a water right. This list is not exhaustive, as there may be rules related to specific rivers or subbasins, and there may be other federal or state laws overseen by other agencies that impacts water use. That said, understanding these rules is the first step to knowing how and when water may be used in the future within the UGRRW.

Authorized Uses of Water: Grande Ronde River Watershed Program in Union County

The Water Resources Commission is responsible for the establishment of policy and procedures for the use and control of the state's water resources. In executing this responsibility, the Commission develops, adopts, and periodically modifies programs for the state's major drainage basins.

Basin programs are administrative rules that establish water management policies and objectives and govern the appropriation and use of the surface water and groundwater within each of the respective basins. The Grande Ronde Basin Program is found in Division 508 of the OARs. The rules classify surface water and groundwater according to permitted uses, may establish preferences among uses, may withdraw surface water and groundwater from further appropriation, may reserve waters for specified future uses, and may establish minimum perennial streamflows. These rules are in addition to rules with statewide applicability that govern the allocation and use of water. In many cases, including for the Grande Ronde, the Basin Program details the process for accessing and storing reserved water (OAR 690-508-0100).

General classifications for use of water (shown on Table 6-1 below):

- Stored water may be used for any beneficial purpose.
- The storage of up to 900 acre-feet of water for domestic or livestock purposes authorized under water rights with priority dates after November 6, 1992, shall be exempt from regulation for storage of reserved water.

Table 6-1
General Classifications for use of Water

Subbasin	Classifications – Allowed Beneficial Uses[1]	Reservations for Multi-Purpose Storage, Priority Date November 6, 1992
Upper Grande Ronde (Upstream of La Grande)	Domestic, livestock, municipal, irrigation, flow augmentation, commercial, agriculture, power development[2], industrial[3], mining[3], recreation, wildlife, and fish life uses	14,900 acre-feet of Meadow Creek and tributaries and 12,000 acre-feet of the Grande Ronde River and tributaries, including Fly Creek and tributaries, upstream of river mile 184
Middle Grande Ronde (Catherine Creek and Valley Down to Elgin)	Domestic, livestock, municipal, irrigation, flow augmentation, commercial, agriculture, power development[2], industrial[3], mining[3], recreation, wildlife, and fish life purposes	9,000 acre-feet of Catherine Creek and tributaries above Ames Creek

[1]Structures or works for the utilization of the waters in accordance with the aforementioned classifications are also declared to be prejudicial to the public interest unless planned, constructed, and operated in conformity with applicable provisions of Oregon Revised Statutes (ORS) 536.310 and any such structures or works are further declared to be prejudicial to the public interest which do not give proper cognizance to the multiple-purpose concept.

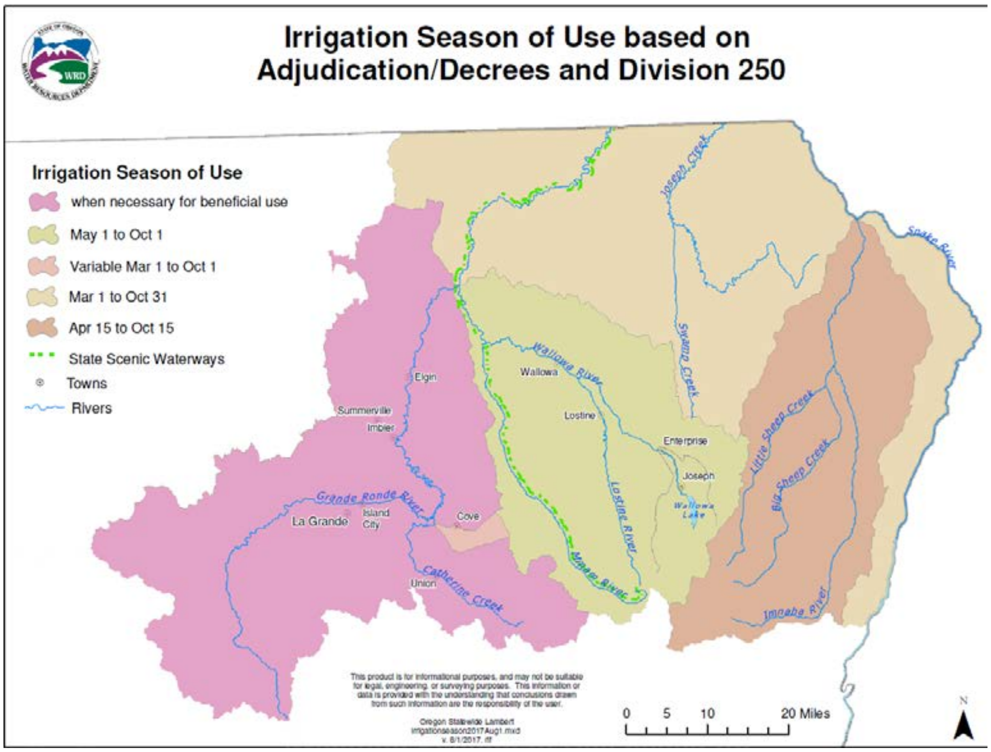
[2]Power Development: Water rights acquired for hydroelectric power purposes utilizing the waters of the Upper Grande Ronde Basin shall be subordinate in priority to future upstream beneficial uses of water except for hydroelectric power.

[3]Water Quality: Rights to use of water for industrial or mining purposes shall be issued only on condition that any effluents or return flows from such uses shall not interfere with other beneficial uses of water.

Irrigation Season: Division 250 and Decrees

Statewide, OAR 690-0250 sets rules for how OWRD should distribute water, especially providing guidance around regulatory activities. Within this rule (OAR 690-250-0070), a statewide, baseline irrigation season is established. This means that if no other pertinent decrees, permits, certificates, orders, or basin programs set an irrigation season, the default season for un-adjudicated areas is March 1 through October 31. For adjudicated basins (those with a court decree), the irrigation season is typically set through the decree. Note that other laws and rules may impact the results for any specific water right request.

Figure 6-4
Map of Likely Irrigation Season based on Division 250, Decrees, and Division 33 Rules



Scenic Waterways

The Oregon Scenic Waterways System (ORS 390.805 to 390.925) protects river sections that possess outstanding scenic, fish, wildlife, geological, botanical, historic, archaeologic, and outdoor recreation values of present and future benefit to the public. The selected rivers or sections thereof are to be preserved in a free-flowing condition to protect and preserve the natural setting and water quality of such rivers and fulfill other conservation purposes. This law and policy, among other things, impact how much water can be diverted within or above the scenic waterway, either from the river itself or from hydraulically connected groundwater. Only water rights issued after the date of scenic waterway designation are affected or restricted by scenic waterway flows.

Three designated state scenic waterways exist in the greater Grande Ronde Basin, with one having some effect on water use in the Upper Grande Ronde planning area: the Grande Ronde River from its confluence with the Wallowa River downstream to the Oregon-Washington border. Scenic waterway flows impact new water rights in two ways. Scenic waterway flows are to be considered before additional water is allocated within or above the scenic waterway (Table 6-2; also see Figure 6-4). Scenic Waterway Flows are not treated as an instream water right; in other words, they are not given a priority date and regulated for in the same way as another water right. That said, deference to the scenic waterway flows may be placed as a permit condition on a new permit.

Table 6-2
Scenic Waterway Flows for the Grande Ronde River from its Confluence with the Wallowa River Downstream to the Oregon-Washington Border

Month	Scenic Waterway Flow (cfs)
January	800
February	800
March	2,000
April	5,000
May	5,000
June	5,000
July	1,500
August	800
September	800
October	800
November	1,200
December	800

cfs = cubic feet per second

Timing of Appropriation of Direct Streamflow: Division 33

OAR Chapter 690, Division 33, establishes additional procedures and standards to aid the OWRD in determining whether a proposed new water use will impair or be detrimental to the public interest with regard to sensitive, threatened, or endangered fish species. Division 33 rules that implement statewide public interest reviews for all new water rights apply to water use permit applications filed after July 17, 1992, for which no permit has been granted or on which no contested case has been ordered, upstream from Bonneville Dam in the Columbia/Snake Basin including the Grande Ronde Basin.

To be consistent with the Columbia River Basin Fish and Wildlife Program flow management objectives adopted by the Northwest Power Planning Council in February 1994, appropriation of direct streamflow or of hydraulically connected groundwater with the potential for substantial interference is prohibited during the time period April 15 to September 30. If a proposed use is not consistent with the Columbia River Basin Fish and Wildlife Program, the applicant may propose mitigation to the Oregon Department of Fish and Wildlife (ODFW) Director in accordance with the ODFW rules regarding Implementation of Department Habitat Mitigation Recommendations, OAR 635-415-0025 adopted April 21, 2000, and effective May 1, 2000.

Data Gaps

- How a better understanding of hydrographs are shifting in the UGRRW Is needed, along with the expected magnitude of this shift.
- A better description of rules on instream rights, transfers, storage, aquifer recharge, and aquifer storage and recovery could be provided.

Section Summary

This section discusses two primary limiting factors in the UGRRW that will likely affect the planning process: uncertainty due to non-stationarity and OWRD basin program rules.

Non-Stationarity

Until recently, scientists assumed that variability in streamflow, for example, did not change substantially over time. As more data were collected and events occurred, it became clear that streamflow and other physical processes were inherently more variable than previously thought, or are actually "non-stationary." This project seeks to incorporate planning to provide resilience and sustainability through flexibility. Non-stationarity affects quantities and timing of available water resources. This could impact the information collected through this process on flow and timing. Water availability compared to the irrigation season is projected to shift, which could change when water is available and challenge the UGRRW's ability to meet water rights. Flow volume may also change with time. A 13 percent decrease in median water volume in the UGRRW was noted between a 1945 to 1976 data set and a 1977 to 2016 data set.

Oregon Water Resources Department Basin Program

The OWRD Basin Program delineates when and where water can be used for consumptive or non-consumptive purposes. In the UGRRW, water may be stored for any beneficial use and the storage of up to 900 acre-feet of water for domestic or livestock purposes authorized under water rights with priority dates after November 6, 1992, shall be exempt from regulation for storage of reserved water. In terms of the irrigation season, if no other pertinent decrees, permits, certificates, orders, or basin programs set an irrigation season, the default season for un-adjudicated areas is March 1 through October 31. Three designated state scenic waterways exist in the greater Grande Ronde Basin, with one having some effect on water use in the UGRRW planning area: the Grande Ronde River from its confluence with the Wallowa River downstream to the Oregon-Washington border.

7.0 - Subwatershed Summaries: Water Resource Contributions and Vulnerabilities

In this section, the above information is summarized by subwatershed to highlight the characteristics of each area and to identify the subwatershed's contributions to the Upper Grande Ronde River Watershed (UGRRW) water resource needs and vulnerabilities associated with each water user group's needs. As a reminder, the UGRRW was divided into eight subwatersheds to provide for a more refined analysis. These subwatersheds were established to match the Biologically Significant Reaches identified by the Oregon Department of Fish and Wildlife (ODFW) and the natural geographic breaks in the study area.

The summary of the subwatersheds' water resource contributions and vulnerabilities was compiled by performing the following assessments for each subwatershed:

- Summarizing streamflow quantity, groundwater level trends, and water quality biweekly to understand how and when water is present in the landscape and at what quality.
- Listing major water uses by user category, characterizing the ways in which users groups access and need water, and then identifying vulnerabilities for each user.

Note that in each of the tables below, "Surface Water Supply Avaliable" refers to estimated natural streamflow (meaning total surface water avaliable, with consumptive uses removed).

Subwatershed 1 - Lower Grande Ronde River (Downstream of Phillips Creek)

Subwatershed 1, the farthest downstream subwatershed in the area, is largely forested with agricultural uses centered around the City of Elgin and along the mainstem of the Grande Ronde River. Some of the forested area within this subwatershed is in the Wallowa-Whitman National Forest, though some is privately owned. Forty percent of the land in this subwatershed is publically owned.

Area Overview

Elgin is the largest community in the subwatershed and provides municipal water to the incorporated area. Most of the water use in the subwatershed is from surface water sources along the mainstem of the Grande Ronde River and major tributaries, though there is some groundwater development for the City of Elgin and the Boise lumber mill. Phillips Creek was identified as an area of importance for maintenance of Chinook populations. Large forested areas may provide natural resource harvest areas as well as habitat for sensitive species, both aquatic and terrestrial. Agricultural uses in the area appear to come largely from surface water, though hydraulically connected groundwater is also present. The subwatershed contains six major waterbodies: Jubilee Lake, Langdon Lake, Waller Reservoir, Cricket Flat, Roulet Pond, and Merrit Reservoir. These generally serve as important recreational and irrigation water sources.

Water Quantity and Water Quality

Within this area, there is limited surface water availability, though some water may still be available for direct appropriation and storage around Elgin. Groundwater may be available, though mitigation for groundwater withdrawals is required for unconfined aquifers that are connected to surface water due to the existence of a State Scenic Waterway downriver. That said, many beneficial uses are limited by water quality within this area, specifically salmon spawning and rearing, resident fish survival, water contact recreation, fishing, and aesthetics. Dissolved oxygen and *E. coli* levels within this area are above the approved total maximum daily load (TMDL) levels. It also appears that water temperature is a major concern in this subwatershed, making additional water supply development challenging if water temperature needs are not somehow mitigated. A few groundwater quality concerns near Elgin may require additional activities to protect sensitive groundwater resources from contamination. The table below summarizes the water quantity and quality in Subwatershed 1.

Table 7-1
Subwatershed 1

		Surface Water Supply Limits to Beneficial Use									**Surface Water Supply Available (Acre-feet)**			**Cubic Feet per Second**		
Month	Days	**Anadromous Fish Passage**	**Salmonid Fish Spawning**	**Salmonid Fish Rearing**	**Resident Fish and Aquatic Life**	**Aquatic Life**	**Human Health**	**Water Contact Recreation**	**Fishing**	**Aesthetic Quality**	**Median Water Volume (50% exceedance)**	**Low Water Volume (90% exceedance)**	**High Water Volume (10% exceedance)**	**Median Water Volume (50% exceedance)**	**Low Water Volume (90% exceedance)**	**High Water Volume (10% exceedance)**
Oct	1st to 15th										5,573	3,488	9,188	181	113	299
Oct	16th to 31st										5,573	3,488	9,188	181	113	299
Nov	1st to 15th										5,763	3,664	14,450	194	123	486
Nov	16th to 30th										5,763	3,664	14,450	194	123	486
Dec	1st to 15th										9,316	4,126	32,968	303	134	1,072
Dec	16th to 31st										9,316	4,126	32,968	303	134	1,072
Jan	1st to 15th										12,506	5,020	59,129	407	163	1,923
Jan	16th to 31st			Flow, Sedimentation							12,506	5,020	59,129	407	163	1,923
Feb	1st to 15th		Flow, Sedimentation								26,089	7,055	73,266	931	252	2,615
Feb	16th to 28th										26,089	7,055	73,266	931	252	2,615
Mar	1st to 15th										39,774	15,484	111,877	1,294	504	3,639
Mar	16th to 31st										39,774	15,484	111,877	1,294	504	3,639
Apr	1st to 15th										69,572	30,834	128,028	2,338	1,036	4,303
Apr	16th to 30th				Flow, Sedimentation						69,572	30,834	128,028	2,338	1,036	4,303
May	1st to 15th		DO			Ammonia, Phosphate Phosphorus, Iron, Biological criteria					78,697	31,394	131,445	2,560	1,021	4,276
May	16th to 31st										78,697	31,394	131,445	2,560	1,021	4,276
Jun	1st to 15th										44,048	14,861	87,685	1,481	500	2,947
Jun	16th to 30th										44,048	14,861	87,685	1,481	500	2,947
Jul	1st to 15th										14,804	11,060	31,436	482	360	1,023
Jul	16th to 31st										14,804	11,060	31,436	482	360	1,023
Aug	1st to 15th	Temperature, pH		Temperature, pH						Phosphorus, Algae	9,614	8,550	12,719	313	278	414
Aug	16th to 31st						Manganese, Iron				9,614	8,550	12,719	313	278	414
Sep	1st to 15th							Algae, pH	Algae		6,546	5,228	10,086	220	176	339
Sep	16th to 30th				pH						6,546	5,228	10,086	220	176	339

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Subwatershed 2 - Mainstem Grande Ronde River: Junction of Catherine Creek to Junction with Phillips Creek

Subwatershed 2, the next farthest downstream subwatershed in the area, is largely forested on the east and west sides, with agricultural uses centered around the Cities of Summerville and Imbler and along the mainstem of the Grande Ronde River in the center, as well as the Indian Creek Watershed and its associated shrub/scrub habitat. The outside edges of this subwatershed include evergreen forest and some grassland areas. To the east, Clark Creek and a network of streams is included. At the southern part of this subwatershed are two points of calculation: one for where State Ditch contributes the Grande Ronde River flows, and one for the historic Grande Ronde River contributes Cather Creek flows. Some of the forested area within this subwatershed is in the Wallowa-Whitman National Forest, though some is privately owned. Twenty-three percent of the land in this subwatershed is publically owned.

Area Overview

Imbler is the largest community in the subwatershed (population 310) followed by Summerville (population 136). Summerville does not have a community water system, and Imbler has a small system that does not have reporting requirements. Most of the water use in the subwatershed is from surface water sources along the mainstem of the Grande Ronde River and major tributaries. This water is used for agricultural purposes. Municipal and fire protection water supplies are from basalt groundwater wells. Groundwater use in this subwatershed is the second highest of all eight subwatersheds. Indian Creek was identified as an area of importance for maintenance of Chinook populations. Large forested areas may provide natural resource harvest areas as well as habitat for sensitive species, both aquatic and terrestrial. Agricultural uses in the area appear to come largely from surface water, though hydraulically connected groundwater is also present. The subwatershed contains one major waterbody, Ruckman Reservoir, which serves as an important recreational and irrigation water source.

Water Quantity and Water Quality

Within this area, there is limited surface water availability. Groundwater may be available, though mitigation for groundwater withdrawals is required. That said, many beneficial uses are limited by water quality within this area, specifically salmon spawning and rearing, resident fish survival, water contact recreation, fishing, and aesthetics. Dissolved oxygen and *E. coli* levels within this area are above the approved TMDL levels. It also appears that water temperature is a major concern in this subwatershed, making additional water supply development challenging if water temperature needs are not somehow mitigated. A few groundwater quality concerns near Imbler may require additional activities to protect sensitive groundwater resources from contamination. A summary is shown below.

Table 7-2
Subwatershed 2

		Surface Water Supply Limits to Beneficial Use									Surface Water Supply Available (Acre-feet)			Cubic Feet per Second		
Month	Days	Anadromous Fish Passage	Salmonid Fish Spawning	Salmonid Fish Rearing	Resident Fish, Aquatic Life	Aquatic Life	Human Health	Water Contact Recreation	Fishing	Aesthetic Quality	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)
Oct	1st to 15th				Flow, Sedimentation	Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron				4,525	2,832	7,460	147	92	243
	16th to 31st										4,525	2,832	7,460	147	92	243
Nov	1st to 15th										4,679	2,975	11,732	157	100	394
	16th to 30th										4,679	2,975	11,732	157	100	394
Dec	1st to 15th										7,564	3,350	26,768	246	109	871
	16th to 31st			Flow, Sedimentation							7,564	3,350	26,768	246	109	871
Jan	1st to 15th		Flow, Sedimentation								10,155	4,076	48,009	330	133	1,562
	16th to 31st										10,155	4,076	48,009	330	133	1,562
Feb	1st to 15th										21,183	5,728	59,488	756	204	2,123
	16th to 28th										21,183	5,728	59,488	756	204	2,123
Mar	1st to 15th										32,294	12,572	90,838	1,050	409	2,955
	16th to 31st		DO								32,294	12,572	90,838	1,050	409	2,955
Apr	1st to 15th										56,488	25,035	103,952	1,899	841	3,494
	16th to 30th										56,488	25,035	103,952	1,899	841	3,494
May	1st to 15th										63,897	25,490	106,726	2,078	829	3,471
	16th to 31st										63,897	25,490	106,726	2,078	829	3,471
Jun	1st to 15th										35,765	12,066	71,195	1,202	406	2,393
	16th to 30th	Temperature, pH		Temperature, pH	pH			Algae, E. Coli, pH	Algae	Phosphorus, Algae	35,765	12,066	71,195	1,202	406	2,393
Jul	1st to 15th										12,020	8,980	25,524	391	292	830
	16th to 31st										12,020	8,980	25,524	391	292	830
Aug	1st to 15th										7,806	6,942	10,327	254	226	336
	16th to 31st										7,806	6,942	10,327	254	226	336
Sep	1st to 15th										5,315	4,245	8,189	179	143	275
	16th to 30th										5,315	4,245	8,189	179	143	275

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Subwatershed 3 - Grande Ronde River: Junction of Graves Creek and Downstream Junction of State Ditch

Subwatershed 3 is located in the central portion of the UGRRW and includes cultivated cropland and a portion of the City of Island City. The Grande Ronde River is channelized in this subwatershed. This subwatershed lacks forested area. Twelve percent of the land in this subwatershed is publically owned.

Area Overview

Island City is the largest community in the subwatershed and provides municipal water to the incorporated area. Most of the water use in the subwatershed is from surface water sources along the mainstem of the Grande Ronde River, State Ditch, and major tributaries, though there has been some groundwater development in alluvial and basalt aquifers for Island City. Agricultural uses in the area appear to come largely from surface water, though hydraulically connected groundwater is also present. The subwatershed contains no major lakes or reservoirs.

Water Quantity and Water Quality

Within this area, there is limited surface water availability. Groundwater use is the third highest out of all eight subwatersheds. Additional groundwater may be available, though mitigation for groundwater withdrawals is required. That said, many beneficial uses are limited by water quality within this area, specifically salmon spawning and rearing, resident fish survival, water contact recreation, fishing, and aesthetics. Dissolved oxygen and *E. coli* levels within this area are above the approved TMDL levels. It also appears that water temperature is a major concern in this subwatershed during summer months, making additional water supply development challenging if water temperature needs are not somehow mitigated. Half of this subwatershed is located within a sensitive aquifer. A few groundwater quality concerns near Island City may require additional activities to protect sensitive groundwater resources from contamination. A summary is shown below.

Table 7-3
Subwatershed 3

Surface Water Supply Limits to Beneficial Use								Surface Water Supply Available (Acre-feet)			Cubic Feet per Second		
Month	Days	Anadromous Fish Passage	Salmonid Fish Rearing	Resident Fish, Aquatic Life	Water Contact Recreation	Fishing	Aesthetic Quality	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)
Oct	1st to 15th							1,441	1,025	2,627	47	33	85
	16th to 31st							1,441	1,025	2,627	47	33	85
Nov	1st to 15th							2,108	1,240	6,107	71	42	205
	16th to 30th							2,108	1,240	6,107	71	42	205
Dec	1st to 15th							3,203	1,313	14,383	104	43	468
	16th to 31st							3,203	1,313	14,383	104	43	468
Jan	1st to 15th							4,645	1,602	23,640	151	52	769
	16th to 31st							4,645	1,602	23,640	151	52	769
Feb	1st to 15th							8,962	2,306	32,110	320	82	1,146
	16th to 28th							8,962	2,306	32,110	320	82	1,146
Mar	1st to 15th							17,458	5,862	56,378	568	191	1,834
	16th to 31st							17,458	5,862	56,378	568	191	1,834
Apr	1st to 15th							30,286	14,167	65,719	1,018	476	2,209
	16th to 30th							30,286	14,167	65,719	1,018	476	2,209
May	1st to 15th							31,680	12,493	59,581	1,030	406	1,938
	16th to 31st							31,680	12,493	59,581	1,030	406	1,938
Jun	1st to 15th		Flow	Flow				11,966	4,030	30,193	402	135	1,015
	16th to 30th							11,966	4,030	30,193	402	135	1,015
Jul	1st to 15th							2,819	1,409	7,207	92	46	234
	16th to 31st							2,819	1,409	7,207	92	46	234
Aug	1st to 15th							1,313	865	2,627	43	28	85
	16th to 31st							1,313	865	2,627	43	28	85
Sep	1st to 15th							1,178	868	2,170	40	29	73
	16th to 30th	Temperature, pH	Temperature, pH	pH	Algae, pH	Algae	Phosphorus, Algae	1,178	868	2,170	40	29	73

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Subwatershed 4 - Grande Ronde River: Junction with Little Beaver Creek to Junction with Graves Creek

Subwatershed 4 is located in the western portion of the UGRRW. This subwatershed is predominantly evergreen forest with some shrub/scrub habitat. It is sparsely populated and not used for cultivated crops. Some of the forested area within this subwatershed is in the Wallowa-Whitman National Forest, though some is privately owned. Fifty-six percent of the land in this subwatershed is publically owned.

Area Overview

There are no communities in the subwatershed, and very little groundwater or surface water is used for out-of-stream needs. Beaver Creek, Five Points Creek, and others were identified by ODFW as areas of importance for maintenance of salmonid populations. Large forested areas may provide natural resource harvest areas as well as habitat for sensitive species, both aquatic and terrestrial. The subwatershed contains three major waterbodies: Twin Lake, Morgan Lake, and the La Grande Reservoir. Morgan Lake is an important recreation site and the La Grande Reservoir represents long-term redundant surface water supply for the City of La Grande.

Water Quantity and Water Quality

Within this area, there is surface water potentially available, and groundwater may be available, though mitigation for groundwater withdrawals is required. That said, many beneficial uses are limited by water quality within this area, specifically salmon spawning and rearing, resident fish survival, and water contact recreation. Dissolved oxygen and *E. coli* levels within this area are above the approved TMDL levels. It also appears that water temperature is a major concern in this subwatershed, making additional water supply development challenging if water temperature needs are not somehow mitigated. There are almost no groundwater quality concerns in this subwatershed due to the lack of development. A summary is shown below.

Table 7-4
Subwatershed 4

Surface Water Supply Limits to Beneficial Use									Surface Water Supply Available (Acre-feet)			Cubic Feet per Second		
Month	Days	Anadromous Fish Passage	Salmonid Fish Spawning	Salmonid Fish Rearing	Resident Fish, Aquatic Life	Aquatic Life	Human Health	Water Contact Recreation	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)
Oct	1st to 15th								1,354	962	2,466	44	31	80
Oct	16th to 31st								1,354	962	2,466	44	31	80
Nov	1st to 15th								1,979	1,164	5,734	67	39	193
Nov	16th to 30th								1,979	1,164	5,734	67	39	193
Dec	1st to 15th								3,008	1,233	13,505	98	40	439
Dec	16th to 31st								3,008	1,233	13,505	98	40	439
Jan	1st to 15th								4,361	1,504	22,198	142	49	722
Jan	16th to 31st								4,361	1,504	22,198	142	49	722
Feb	1st to 15th			Sedimentation					8,415	2,165	30,151	300	77	1,076
Feb	16th to 28th								8,415	2,165	30,151	300	77	1,076
Mar	1st to 15th					Alkalinity. Phosphate Phosphorus, Iron, Biological criteria			16,393	5,504	52,937	533	179	1,722
Mar	16th to 31st								16,393	5,504	52,937	533	179	1,722
Apr	1st to 15th		Sedimentation						28,438	13,302	61,709	956	447	2,074
Apr	16th to 30th								28,438	13,302	61,709	956	447	2,074
May	1st to 15th				Sedimentation				29,747	11,730	55,945	968	382	1,820
May	16th to 31st								29,747	11,730	55,945	968	382	1,820
Jun	1st to 15th								11,236	3,784	28,351	378	127	953
Jun	16th to 30th								11,236	3,784	28,351	378	127	953
Jul	1st to 15th								2,647	1,323	6,768	86	43	220
Jul	16th to 31st								2,647	1,323	6,768	86	43	220
Aug	1st to 15th	Temperature, pH		Temperature, pH			Manganese, Iron		1,233	812	2,466	40	26	80
Aug	16th to 31st								1,233	812	2,466	40	26	80
Sep	1st to 15th								1,106	815	2,038	37	27	68
Sep	16th to 30th				pH			pH	1,106	815	2,038	37	27	68

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Subwatershed 5 - Grande Ronde River: Headwaters to the Junction of Little Beaver Creek

Subwatershed 5 is the farthest upstream subwatershed on the Grande Ronde River. It is largely forested and lacks agricultural uses. Some of the forested area within this subwatershed is in the Wallowa-Whitman National Forest, though some is privately owned. Seventy-four percent of the land in this subwatershed is publically owned.

Area Overview

There are no communities in Subwatershed 5. Subwatershed 5 uses almost no groundwater, and very little surface water, for out-of-stream needs. Many tributaries to the Grande Ronde River in this subwatershed are of importance for maintenance of salmonid populations. Large forested areas may provide natural resource harvest areas as well as habitat for sensitive species, both aquatic and terrestrial. Agricultural uses in the area appear to come largely from surface water, though hydraulically connected groundwater is also present. The subwatershed contains one major waterbody, Grande Ronde Lake.

Water Quantity and Water Quality

Within this area, there is limited surface water availability, though some water may still be available for direct appropriation and storage. Groundwater may be available, though mitigation for groundwater withdrawals is required. That said, many beneficial uses are limited by water quality within this area, specifically salmon spawning and rearing, resident fish survival, and water contact recreation. It appears that water temperature is a summer concern in this subwatershed, making additional water supply development challenging if water temperature needs are not somehow mitigated. There are no groundwater quality concerns in this subwatershed because of the lack of development. A summary is shown below.

Table 7-5
Subwatershed 5

Surface Water Supply Limits to Beneficial Use									Surface Water Supply Available (Acre-feet)			Cubic Feet per Second		
Month	Days	Anadromous Fish Passage	Salmonid Fish Spawning	Salmonid Fish Rearing	Resident Fish, Aquatic Life	Aquatic Life	Human Health	Water Contact Recreation	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)
Oct	1st to 15th		Sedimentation	Sedimentation	Sedimentation	Alkalinity, Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron		1,329	832	2,191	43	27	71
	16th to 31st								1,329	832	2,191	43	27	71
Nov	1st to 15th								1,375	874	3,446	46	29	116
	16th to 30th								1,375	874	3,446	46	29	116
Dec	1st to 15th								2,222	984	7,863	72	32	256
	16th to 31st								2,222	984	7,863	72	32	256
Jan	1st to 15th								2,983	1,197	14,102	97	39	459
	16th to 31st								2,983	1,197	14,102	97	39	459
Feb	1st to 15th								6,222	1,683	17,474	222	60	624
	16th to 28th								6,222	1,683	17,474	222	60	624
Mar	1st to 15th								9,486	3,693	26,683	309	120	868
	16th to 31st								9,486	3,693	26,683	309	120	868
Apr	1st to 15th								16,593	7,354	30,535	558	247	1,026
	16th to 30th								16,593	7,354	30,535	558	247	1,026
May	1st to 15th								18,769	7,487	31,349	611	244	1,020
	16th to 31st								18,769	7,487	31,349	611	244	1,020
Jun	1st to 15th								10,505	3,544	20,913	353	119	703
	16th to 30th	Temperature, pH		Temperature, pH	pH			pH	10,505	3,544	20,913	353	119	703
Jul	1st to 15th								3,531	2,638	7,497	115	86	244
	16th to 31st								3,531	2,638	7,497	115	86	244
Aug	1st to 15th								2,293	2,039	3,033	75	66	99
	16th to 31st								2,293	2,039	3,033	75	66	99
Sep	1st to 15th		pH						1,561	1,247	2,405	52	42	81
	16th to 30th								1,561	1,247	2,405	52	42	81

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Subwatershed 6 - Catherine Creek: Junction with Ladd Creek to the State Ditch Junction

Subwatershed 6 includes the Cities of La Grande and Cove and part of Island City. It is located where Catherine Creek flows into the Grande Ronde River. This subwatershed includes predominantly cultivated cropland with areas of development in La Grande and Cove. A very limited forested area is located on the eastern border of the subwatershed. Ten percent of the land in this subwatershed is publically owned.

Area Overview

La Grande is the largest community in the subwatershed (population 13,000) and provides municipal water to the incorporated area. Cove (population 625) provides municipal water to its community and operates a hydropower plant. Most of the water use in the subwatershed is from surface water sources along the mainstem of the Grande Ronde River and Catherine Creek for agriculture, and from groundwater sources for municipal water. Catherine Creek was identified as an area of importance for maintenance of salmonid populations. Agricultural uses in the area appear to come largely from surface water, though hydraulically connected groundwater is also utilized. The subwatershed contains four major waterbodies: Conley Lake, Spence Reservoir, Ladd Marsh, and Hot Lake Reservoir. These generally serve as important recreational and irrigation water sources. Ladd Marsh serves as migratory bird habitat and as a wastewater reuse area.

Water Quantity and Water Quality

Within this area, there is limited surface water availability. This subwatershed uses the most groundwater of any of the eight subwatersheds. Groundwater may be available, though mitigation for groundwater withdrawals is required. That said, many beneficial uses are limited by water quality within this area, specifically salmon spawning and rearing, resident fish survival, water contact recreation, fishing, and aesthetics. Dissolved oxygen and E. coli levels within this area are above the approved TMDL levels. It also appears that water temperature is a major concern in this subwatershed, making additional water supply development challenging if water temperature needs are not somehow mitigated. Numerous groundwater quality concerns near the City of La Grande may require additional activities to protect sensitive groundwater resources from contamination. A summary is shown below.

Table 7-6
Subwatershed 6

		Surface Water Supply Limits to Beneficial Use								Surface Water Supply Available (Acre-feet)			Cubic Feet per Second		
Month	Days	Anadromous Fish Passage	Salmonid Fish Rearing	Resident Fish, Aquatic Life	Aquatic Life	Human Health	Water Contact Recreation	Fishing	Aesthetic Quality	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)
Oct	1st to 15th			Flow, Sedimentation	Phosphate Phosphorus, Iron, Biological criteria	Manganese, Iron				1,418	1,040	2,126	46	34	69
	16th to 31st									1,418	1,040	2,126	46	34	69
Nov	1st to 15th									1,555	1,098	3,110	52	37	105
	16th to 30th									1,555	1,098	3,110	52	37	105
Dec	1st to 15th									1,748	1,087	3,591	57	35	117
	16th to 31st		Flow, Sedimentation							1,748	1,087	3,591	57	35	117
Jan	1st to 15th									1,890	1,087	4,442	61	35	144
	16th to 31st									1,890	1,087	4,442	61	35	144
Feb	1st to 15th									2,153	1,120	5,211	77	40	186
	16th to 28th									2,153	1,120	5,211	77	40	186
Mar	1st to 15th									3,591	1,701	9,167	117	55	298
	16th to 31st									3,591	1,701	9,167	117	55	298
Apr	1st to 15th									8,003	3,933	16,234	269	132	546
	16th to 30th									8,003	3,933	16,234	269	132	546
May	1st to 15th									16,586	8,648	30,621	540	281	996
	16th to 31st									16,586	8,648	30,621	540	281	996
Jun	1st to 15th									14,039	5,213	27,301	472	175	918
	16th to 30th	Temperature, pH	Temperature, pH	pH			Algae, E. Coli, pH	Algae	Phosphorus, Algae	14,039	5,213	27,301	472	175	918
Jul	1st to 15th									3,922	2,126	9,404	128	69	306
	16th to 31st									3,922	2,126	9,404	128	69	306
Aug	1st to 15th									1,796	1,134	2,646	58	37	86
	16th to 31st									1,796	1,134	2,646	58	37	86
Sep	1st to 15th									1,418	960	1,966	48	32	66
	16th to 30th									1,418	960	1,966	48	32	66

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Subwatershed 7 - Catherine Creek: Ladd Creek Junction to Milk Creek Junction

Subwatershed 7, the second farthest upstream subwatershed on Catherine Creek, is partly forested with agricultural uses centered around the City of Union and along the mainstem of Catherine Creek. Some of the forested area within this subwatershed is in the Wallowa-Whitman National Forest, though some is privately owned. This subwatershed is predominantly evergreen forest to the east and shrub/scrub habitat to the west. Nine percent of the land in this subwatershed is publically owned.

Area Overview

Union (population 2,142) is the largest community in the subwatershed and provides municipal water to the incorporated area. The City holds a surface water diversion right for Catherine Creek that once supplied the City's water, but now groundwater is the primary municipal supply source. Catherine Creek was identified as an area of importance for maintenance of salmonid populations. Agricultural uses in the area appear to come largely from surface water, though hydraulically connected groundwater is also utilized. The subwatershed contains one major waterbody, Pyles Canyon Reservoir Number Two.

Water Quantity and Water Quality

Within this area, there is limited surface water availability. Groundwater may be available, though mitigation for groundwater withdrawals is required. That said, many beneficial uses are limited by water quality within this area, specifically salmon spawning and rearing, resident fish survival, water contact recreation, fishing, and aesthetics. Dissolved oxygen and *E. coli* levels within this area are above the approved TMDL levels. It also appears that water temperature is a major concern in this subwatershed during summer months, making additional water supply development challenging if water temperature needs are not somehow mitigated. A few groundwater quality concerns near the City of Union may require additional activities to protect sensitive groundwater resources from contamination. A summary is shown below.

Table 7-7
Subwatershed 7

Surface Water Supply Limits to Beneficial Use								Surface Water Supply Available (Acre-feet)			Cubic Feet per Second		
Month	Days	Anadromous Fish Passage	Salmonid Fish Rearing	Resident Fish, Aquatic Life	Water Contact Recreation	Fishing	Aesthetic Quality	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)	Median Water Volume (50% exceedance)	Low Water Volume (90% exceedance)	High Water Volume (10% exceedance)
Oct	1st to 15th							873	640	1,310	28	21	43
	16th to 31st							873	640	1,310	28	21	43
Nov	1st to 15th							958	676	1,915	32	23	64
	16th to 30th							958	676	1,915	32	23	64
Dec	1st to 15th							1,077	669	2,212	35	22	72
	16th to 31st							1,077	669	2,212	35	22	72
Jan	1st to 15th							1,164	669	2,736	38	22	89
	16th to 31st							1,164	669	2,736	38	22	89
Feb	1st to 15th							1,326	690	3,210	47	25	115
	16th to 28th							1,326	690	3,210	47	25	115
Mar	1st to 15th							2,212	1,048	5,647	72	34	184
	16th to 31st							2,212	1,048	5,647	72	34	184
Apr	1st to 15th							4,929	2,422	10,000	166	81	336
	16th to 30th							4,929	2,422	10,000	166	81	336
May	1st to 15th							10,217	5,327	18,861	332	173	614
	16th to 31st							10,217	5,327	18,861	332	173	614
Jun	1st to 15th		Flow	Flow				8,648	3,211	16,816	291	108	565
	16th to 30th							8,648	3,211	16,816	291	108	565
Jul	1st to 15th							2,416	1,310	5,792	79	43	188
	16th to 31st							2,416	1,310	5,792	79	43	188
Aug	1st to 15th							1,106	699	1,630	36	23	53
	16th to 31st							1,106	699	1,630	36	23	53
Sep	1st to 15th							873	592	1,211	29	20	41
	16th to 30th	Temperature, pH, DO	Temperature, pH, DO	pH	Algae, pH	Algae	Phosphorus, Algae	873	592	1,211	29	20	41

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature, pH, and DO impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

Subwatershed 8 - Catherine Creek: Headwaters to Milk Creek Junction

Subwatershed 8, the farthest upstream subwatershed in the area on Catherine Creek, is largely forested and lacks agricultural use. This subwatershed is completely undeveloped and comprises predominantly evergreen forest with patches of shrub/scrub habitat and grassland. Catherine Creek originates here. Most of the forested area within this subwatershed is in the Wallowa-Whitman National Forest, though some is privately owned. Eighty-two percent of the land in this subwatershed is publically owned.

Area Overview

There are no communities in this subwatershed, and very little surface or groundwater is used for out-of-stream needs. Catherine Creek was identified as an area of importance for maintenance of salmonid populations. Large forested areas may provide natural resource harvest areas as well as habitat for sensitive species, both aquatic and terrestrial. There are no agricultural uses in the area. The subwatershed contains no major lakes or reservoirs.

Water Quantity and Water Quality

Within this area, there is limited surface water availability. Groundwater may be available, though mitigation for groundwater withdrawals is required. That said, many beneficial uses are limited by water quality within this area and temperature in summer months. There are no groundwater quality concerns in this subwatershed due to the lack of development. A summary is shown below.

Table 7-8
Subwatershed 8

Surface Water Supply Limits to Beneficial Use			**Surface Water Supply Available (Acre-feet)**			**Cubic Feet per Second**		
Month	Days	**Salmonid Fish Rearing**	**Median Water Volume (50% exceedance)**	**Low Water Volume (90% exceedance)**	**High Water Volume (10% exceedance)**	**Median Water Volume (50% exceedance)**	**Low Water Volume (90% exceedance)**	**High Water Volume (10% exceedance)**
Oct	1st to 15th		846	557	1,470	28	18	48
	16th to 31st		846	557	1,470	28	18	48
Nov	1st to 15th		1,121	668	3,470	38	22	117
	16th to 30th		1,121	668	3,470	38	22	117
Dec	1st to 15th		1,848	713	7,216	60	23	235
	16th to 31st		1,848	713	7,216	60	23	235
Jan	1st to 15th		2,450	891	12,205	80	29	397
	16th to 31st		2,450	891	12,205	80	29	397
Feb	1st to 15th		4,607	1,299	15,161	164	46	541
	16th to 28th		4,607	1,299	15,161	164	46	541
Mar	1st to 15th		9,354	2,984	29,398	304	97	956
	16th to 31st		9,354	2,984	29,398	304	97	956
Apr	1st to 15th		15,669	7,543	32,976	527	254	1,108
	16th to 30th		15,669	7,543	32,976	527	254	1,108
May	1st to 15th		17,795	7,394	31,625	579	241	1,029
	16th to 31st		17,795	7,394	31,625	579	241	1,029
Jun	1st to 15th		7,199	2,414	17,953	242	81	603
	16th to 30th	Temperature	7,199	2,414	17,953	242	81	603
Jul	1st to 15th		1,648	802	4,521	54	26	147
	16th to 31st		1,648	802	4,521	54	26	147
Aug	1st to 15th		735	468	1,492	24	15	49
	16th to 31st		735	468	1,492	24	15	49
Sep	1st to 15th		647	453	1,207	22	15	41
	16th to 30th		647	453	1,207	22	15	41

Beneficial use is not supported.
Insufficient data to determine if beneficial use is supported; some data indicate a potential concern.
Insufficient data to determine if beneficial use is supported.
Flow data from OWRD; Beneficial Use data from DEQ
Temperature and pH impairment measured
pH impairment measured
Temperature impairment measured
Dissolved oxygen (DO) impairment measured

8.0 - Public Participation and Outreach

This section provides an overview of the total number of meetings held (broken down by work group/ committee), workshops/field trips held, associated conferences attended, and a web link to an archive of the meeting notes, etc.

It took hundreds of person hours to develop a plan, through deliberate examination of the range of water-related issues in the Upper Grande Ronde River Watershed, with representation and participation from over 20 diverse water interests. Meetings were publicized through newspaper advertisements, radio interviews, and on the Union County website. Project progress was presented at several meetings throughout the area, including a Union County Cattlemen's Association meeting, Union County Seed Growers meeting, and others.

Step 1 Meetings

- March 22, 2016
- June 29, 2016
- June 30, 2016
- August 4, 2016
- August 30, 2016 - Steering Committee Kickoff
- September 6, 2016
- September 20, 2016 - Steering Committee Meeting
- October 6, 2016 - Stakeholder Committee Meeting
- October 18, 2016 - Steering Committee Meeting
- November 2, 2016 - Stakeholder Committee Meeting
- November 29, 2016 - Steering Committee Meeting

Step 2 Meetings

- January 10, 2017 - Water Supply Technical Committee No. 1
- January 11, 2017 - Steering Committee Meeting
- January 24, 2017 - Water Supply Technical Committee No. 2
- February 21, 2017 - Water Supply Technical Committee No. 3
- February 22, 2017 - Stakeholder Committee Meeting No. 4
- March 14, 2017 - Water Supply Technical Committee No. 4
- March 16, 2017 - Steering Committee Meeting
- April 3, 2017 - Water Supply Technical Meeting and Steering Committee Meeting
- April 12, 2017 - Stakeholder Committee Meeting No. 5

- May 24-25, 2017 - Bend Meeting
- June 6, 2017 - Water Supply Technical Committee Meeting No. 6
- June 21, 2017 - Stakeholder Committee Meeting No. 6
- July 28, 2017 - Field trip
- August 8, 2017 - Technical Committee Meeting No. 7 and Steering Committee
- August 30, 2017 - Water Supply Technical Committee and Steering Committee Meeting
- September 6, 2017 - Stakeholder Meeting

Meeting materials and notes are avaliable at: http://union-county.org/planning/place-based-integrated-water-resources-planning/

9.0 - Data Sources

The following includes an annotated list of data sources that has been reviewed for this step and will be reviewed for future steps.

Reports

- 2000, 1999, 1998 Water Resources Data Oregon (State of Oregon)
- 1994-1998 Water Quality Monitoring Report by Teena Ballard
- 1997 Grande Ronde Basin Water Quality Monitoring Report for Six Key Subwatersheds by Teena Ballard
- 1991-1998 La Grande Ranger District Upper Grande Ronde Sub-basin Water Quality Assessment by Teena Ballard
- Grande Ronde Watershed Analysis (U.S. Forest Service [USFS])
- October 1966 Development Potential of Ground Water for Irrigation in the Grande Ronde Valley by Herbert H. Ham (U.S. Bureau of Reclamation)
- Bureau of Land Managment, 1993
- Clearwater BioStudies, 1993
- Morbrand Biometrics, 1997
- Oregon Department of Environmental Quality (DEQ), 1997
- Natural Resources Conservation Service/USFS/Union Soil and Water Conservation District, 1997
- USFS, 1994
- Grande Ronde River Basin Water Quality Technical Assessment - Temperature - DEQ (May 1998)
- Grande Ronde River Basin Water Quality Technical Assessment (Overview of Water Quality Conditions) (DEQ, May 1998.)

Guidance Plans and Assessments

- Federal Columbia River Power System Biological Opinion (2008)
- Grande Ronde Subbasin Plan - Grande Ronde Model Watershed (GRMW) and Northwest Power and Conservation Council (2004)
- Lower Snake River Compensation Plan - U.S. Fish and Wildlife Service (1975; with updates)
- Upper Grande Ronde Subbasin Water Quality Management Plan - Grande Ronde Water Quality Committee (2000)
- Upper Grande Ronde Subbasin Agricultural Water Quality Management Area Plan - Grande Ronde Water Quality Committee (2010)
- Grande Ronde River Basin Water Quality Technical Assessment: Temperature - DEQ (1998)
- Grande Ronde River Basin Water Quality Technical Assessment: Water Quality - DEQ (1998)

- Upper Grande Ronde River Sub-Basin Total Maximum Daily Load - DEQ (1999)
- Technical Review of Managed Underground Storage of Water Study of the Upper Catherine Creek Watershed - U.S. Geological Survey (2014)
- Catherine Creek Tributary Assessment - GRMW (2012)
- Upper Grande Ronde Tributary Assessment - GRMW (2014)

Groundwater Studies

- Hampton, E.R. and Brown, S.G., Geology and Ground-Water Resources of the Upper Grande Ronde River Basin, Union County, Oregon: U.S. Geological Survey Water Supply Paper 1597, 1964. Purpose of study: To compile an inventory of representative well logs, spring locations, geologic mapping, and observation wells with adequate records of water level measurements. "Surface water and groundwater are intimately interrelated and form the total water resources of an area."
- La Marche, J., Wozniak, K.C., Hattan, S., and Hackett, J.A., Groundwater and Surface Water Interactions in the Catherine Creek Watershed, Oregon – Results and Analysis from the 2011 Seepage Run: Water Resources Department Open File Report SW 2012-001, 2012. Purpose of study: To quantify exchanges between the shallow groundwater system and Catherine Creek downstream of a proposed aquifer storage and recovery (ASR) project located in the uplands of the watershed. "Catherine Creek is likely to gain water from the groundwater system in the steep highlands…but…where the creek enters the flat Grande Ronde Valley, the stream is expected to lose water through a permeable sand and gravel streambed…"
- Ferns, M.L., McConnell, V.S., Madin, I.P., and Johnson, J.A., Geology of the Upper Grande Ronde River Basin, Union County, Oregon, Oregon Department of Geology and Minerals Industries Bulletin 107, 2010. Purpose of study: To compose a map of geologic units, faults, and their corresponding geometry to better understand the geologic structures that control presence and movement of groundwater in the Upper Grande Ronde basin. "Movement and interactions between surface and subsurface waters in the upper Grande Ronde River basin appear to be influenced mainly by stratigraphy and only secondarily by structure."

Planning Studies

- Upper Grande Ronde River Watershed Storage Feasibility Study - GRMW and Anderson Perry & Associates, Inc. (2013)
- Gekeler Slough Surface Water Management Plan - Union County and AP (2013)
- Upper Catherine Creek Storage Feasibility Study - GRMW and AP (2010)

Baseline Information

- Dalton, M.M., K.D. Dello, L. Hawkins, P.W. Mote, and D.E. Rupp. 2017. The Third Oregon Climate Assessment.
- Report, Oregon Climate Change Research Institute, College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, OR, 99 p., http://www.occri.net/media/1042/ocar3_final_125_web.pdf
- Graves, D., 2012. A Simulation of Water Temperature in the Upper Grande Ronde Basin with Future Climate Change Scenarios: Columbia River Inter-Tribal Fish Commission Technical Report 12-09, 15 p., http://www.critfc.org/wp-content/uploads/2012/11/12_09report.pdf
- Hampton, E.R., and S.G. Brown. 1964. Geology and ground-water resources of upper Grande Ronde River Basin, Union County, Oregon: U.S. Geological Survey Water Supply Paper 1597, 99 p., https://pubs.er.usgs.gov/publication/wsp1597
- Justice, C., White, S.M., McCullough, D.A., Graves, D.S. and Blanchard, M.R., 2017. Can stream and riparian restoration offset climate change impacts to salmon populations? Journal of Environmental Management, 188:212-227.
- Kahle, S.C., Morgan, D.S., Welch, W.B., Ely, D.M., Hinkle, S.R., Vaccaro, J.J., and Orzol, L.L., 2011, Hydrogeologic framework and hydrologic budget components of the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho: U.S. Geological Survey Scientific Investigations Report 2011–5124, 66 p., https://pubs.usgs.gov/sir/2011/5124/
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