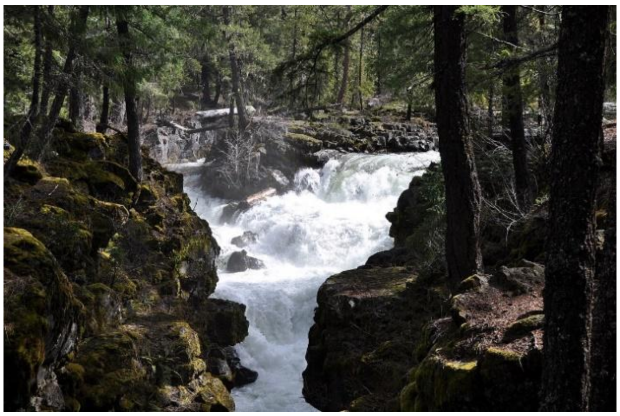
Rogue River Basin: A Hydrology Primer



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Rogue River Basin: A Hydrology Primer

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OREGON WATER RESOURCES DEPARTMENT

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Abbreviations and Definitions

Simplified definitions below are provided for convenience.

Ac-ft — Acre-feet. A unit of volume often used for water quantities, representing the volume of one acre covered by one foot of water.

Alluvial — Relating to sediment (sand, gravel, silt) deposited by flowing water. Alluvial materials can form productive aquifers near surface water in the Rogue Basin.

Allocation of Conserved Water — A program that allows a water user who reduces their water use through conservation improvements (such as irrigation efficiency upgrades) to retain rights to a portion of the water saved (OAR 690-018). The conserved water can be applied to additional lands, leased or sold, or dedicated to instream use. The state reserves a share of the conserved water as an instream water right. New certificates are issued for each share, generally retaining the priority date of the original water right.

Aquifer — An underground layer or interconnected layers of rock or sediment that holds and transmits groundwater in usable quantities.

Arc (volcanic) — A chain of volcanoes formed above a subducting tectonic plate. The Cascade Range is an example.

Baseflow — The portion of streamflow sustained by groundwater discharge between precipitation and snowmelt events. Baseflow maintains flows during dry periods.

Basin Program — A set of administrative rules governing how water within a specific river basin can be used, allocated, and protected. The Rogue Basin Program is described in Oregon Administrative Rules Chapter 690 Division 515.

cfs — Cubic feet per second. A unit commonly used to measure streamflow.

Curtailment — The reduction or stoppage of specific water users' diversions, ordered by OWRD when water supply is insufficient to satisfy senior water rights. Users are curtailed in reverse order of priority, with the most junior rights stopped first. (This differs from drought curtailment by cities, such as described in OAR 690-086-0160.)

CV — Coefficient of variation. The standard deviation as a percentage of the mean, providing a measure of how spread-out data are from the average that can be easily compared across datasets. For a normal distribution, 68% of values fall within 1 CV of the mean and 95% within 2 CVs of the mean.

Discharge — The volume of water flowing past a given point in a stream per unit of time, typically expressed in cubic feet per second (cfs). Also used to describe the movement of groundwater into a stream, spring, or other surface water body.

Diversion — The withdrawal of surface water from a stream or other surface water source for out-of-stream use such as irrigation or municipal supply.

Ecoregion — A geographic area characterized by relatively similar climate, geology, and biological community.

ET — Evapotranspiration. The loss of water through evaporation and plant water use (transpiration).

Flashiness — The tendency of a stream to rise and fall rapidly in response to rainfall or snowmelt.

Fracture density — The number and concentration of cracks within a rock unit. Higher fracture density generally means greater ability to store and transmit groundwater.

Fractured bedrock —Rock beneath the soil that has been broken by natural stresses over time. Groundwater in these settings moves primarily through the cracks in the rocks rather than through the rock material itself.

Granodiorite — A coarse-grained rock formed when magma (molten rock) rich in quartz cools slowly underground.

HUC — Hydrologic Unit Code. A hierarchical numbering system used by the U.S. Geological Survey to identify and classify watersheds. HUC-8 subbasins are mid-scale drainage areas typically encompassing hundreds to thousands of square miles.

Hydrograph — A graph showing streamflow or water levels over time at a specific location.

Hydraulic conductivity — A measure of how easily water moves through a material, specifically the volume of water that can move through a unit cross-sectional area in a set time under a unit hydraulic gradient.

Instream water right — A water right held in trust by OWRD for the benefit of the people of the State of Oregon to maintain water in-stream for public use (ORS 537.332). Instream rights may protect fish, minimize pollution effects, or maintain recreational uses (OWRD, 2024). An instream water right may establish flow levels in a specific reach to remain in the stream on a month-by-month basis. Instream water rights have a priority date and are regulated in the same way as other water rights.

Junior water right — A water right with a more recent priority date (OWRD, 2024). During shortages, junior (newer) rights are curtailed before senior (older) rights in most cases.

Logarithmic — A scale where each equal interval represents a multiplication rather than addition of values. In this report, some figures use a base-10 logarithmic scale for flows to better visually display flows spanning a wide range of values, meaning each major labeled tick represents a 10-fold increase. These figures are identified in their caption notes.

Mean — The average, calculated by adding up all data values and dividing the sum by how many data points there are.

Median — The middle value, calculated by ordering all values from least to greatest and finding the one that falls exactly in the center.

MAF — Mean annual flow. Describes the average volume of water that travels through a stream each year at a specific measuring point.

Magma — Melted rock that is underground.

Metamorphic — Describes rock that has been transformed from its original form by heat, pressure, or chemical processes, such as being deeply buried.

NHD — National Hydrography Dataset. A national database of surface water features, including streams, rivers, lakes, and other water bodies.

OAR — Oregon Administrative Rules.

ORS — Oregon Revised Statutes.

OWRD — Oregon Water Resources Department.

Permeable — Describes a material that allows water to pass through it. Highly permeable rocks or sediments transmit water more easily.

Pluton — A mass of rock formed when magma rose toward the surface but cooled and solidified underground rather than erupting. May be exposed at the surface through erosional or tectonic processes.

Primary porosity — Influences the ability of a rock to store water within the tiny pores or spaces originally within the rock material itself, as opposed to through fractures or cracks.

Prior appropriation — The principle that Oregon's water laws are based on, in which the first person to obtain a water right on a stream is the last one to be shut off (OWRD, 2024). During shortages, junior (newer) rights can be curtailed first to protect senior rights.

Priority date —Under Oregon's prior appropriation doctrine, priority date determines the order in which water users are served during shortages: earlier (more senior) dates can demand water first. The priority date reflects the date a completed application was accepted by the Department (OWRD, 2024). For vested rights established before 1909, priority dates are determined through a legal process known as adjudication processing (OWRD, 2024).

Province – A large, distinct spatial region characterized by similar geological features, history, structure, or surface landforms.

Quartile – The values that split data into four equal quarters, once sorted from least to greatest.

Q1 – The 25th percentile, or the point 25% of values fall below. The middle of the bottom half.

Q3 – The 75th percentile, or the point 75% of values fall below. The middle of the top half.

Regulation (dam operations) — The management of streamflow through reservoir storage and releases.

Regulation (water rights) — The act of curtailing junior water rights during shortages to protect senior rights or holding water rights holders accountable to their conditions and other rules of the Water Resources Commission.

Residence time — How long water spends underground between when it enters the groundwater system and when it exits.

Riparian — Relating to the banks and immediately adjacent area of a river or stream.

Scenic waterway — A waterbody or segment designated under the Oregon Scenic Waterways Act (ORS 390.805–390.925) due to scenic, wildlife, resource, or recreational values. If approving a water right application in or above a state scenic waterway, OWRD is required to find that the proposed use will not impair the recreational, fish, and wildlife values in the scenic waterway (OWRD, 2024). The Rogue River has state scenic waterway designations in both its upper and lower reaches (OAR 736-040-0045; OAR 736-040-0052).

SD — Standard deviation. A measure of how spread-out data are from the average value.

Sedimentary — Describes rock formed from layers of sediment (sand, mud, organic material) that have been compacted and cemented over time.

Senior water right — A water right with an earlier priority date, entitling its holder to receive their full allocation before any junior rights during periods of shortage (OWRD, 2024).

Serpentine — A rock type formed in subduction zones, and the unusual soil derived from it, characterized by naturally high concentrations of heavy metals and low nutrient levels. Supports specialized plant communities tolerant of these extreme conditions.

Slope — The difference between the high and low point of a specified area, divided by the length between the points. Lower slopes are flatter; higher slopes are steeper.

Snow water equivalent (SWE) — The amount of water contained in snow if it were melted. This is different than snow depth. SWE helps to account for the fact that some snowpack is powdery and light (holds less water per volume), while some snowpack is compact and dense (holds more water per volume).

Storativity — A measure of how much water an aquifer releases from or takes into storage when groundwater levels change.

Subduction — The process by which one of Earth's tectonic plates sinks beneath another plate when they meet. Subduction drives volcanic activity and mountain building.

TAF — Thousands of acre-feet. A unit often used to report volumes of water use or water stored in reservoirs.

Tectonic — Relating to the large-scale movement and deformation of the Earth's crust, which is divided into plates, including processes like plate collision, subduction, and faulting.

Terrane (accreted) — A landmass, originally formed elsewhere (such as an island or underwater plateau on the ocean floor), that has been added to the edge of a continent through plate tectonic movement over geologic time.

Transmissivity — A measure of how easily water can move through an aquifer and how deep the aquifer is. Higher transmissivity means water flows more freely through the formation.

USBR — U.S. Bureau of Reclamation.

USACE — U.S. Army Corps of Engineers.

USGS — U.S. Geological Survey.

Volcanism — Volcanic activity, including eruptions, lava flows, and ashfall.

Water year (WY) — A 12-month accounting period in hydrology running from October 1 through September 30. By starting in the fall, when streamflow and snowpack are near their annual minimum, it keeps each winter's precipitation and the resulting spring runoff within a single reporting period rather than splitting them across two calendar years.

Wild and Scenic River — A river or river segment designated under the federal Wild and Scenic Rivers Act (16 U.S.C. §§ 1271–1287) to protect outstanding natural, cultural, and recreational values by preserving free-flowing character. The Rogue River was among the original eight rivers designated at the Act's passage in 1968.

Introduction

"To the Takelma people, the Rogue River is the lifeblood of the Great Animal that is the World. The head of the animal is Crater Lake, the neck is Boundary Springs where the Rogue River starts, the ribs are the two Table Rocks just upriver from Ti'lomikh, the rear end is Gold Beach where the Rogue flows into the Pacific Ocean."
– Thomas Doty, as told by Cow Creek elder Chuck Jackson, "Ti'lomikh: Native Village"

"To me [Rogue River Valley] seems above all others the garden valley of Oregon and the most delightful place for a home." – John Muir, Steep Trails*, 1918*

Running west for about 215 miles from the flanks of Mount Mazama to the Pacific Ocean, the Rogue River flows through one of the world's most ecologically diverse temperate forests (Figure 1). Descending from the volcanic peaks of the Cascade Range, winding through the valleys of southern Oregon, and cutting through the coastal mountains before joining the sea, the Rogue connects alpine meadows and old-growth forests, Indigenous fishing grounds and pioneer farmsteads, bustling metro areas and spans of wilderness (Figure 2).

The Rogue River basin has witnessed dramatic chapters in Oregon's history, from millennia of ongoing Indigenous stewardship to the state's first gold rush in the 1850s. Today, the watershed continues to serve as the cultural and economic center of southern Oregon, supporting thriving urban and agricultural communities and providing world-renowned recreational opportunities. The river is one of the original eight waterways to receive designation as a National Wild and Scenic River in 1968. Its exceptional ecological and scenic value has earned it dual recognition as a scenic waterway under both state and federal law. These protections recognize the river's role as habitat for iconic Pacific Northwest species, including Chinook and Coho salmon, steelhead, and the threatened northern spotted owl, all of which depend on the river's diverse ecosystems. However, limited groundwater production potential in much of the basin and constraints around additional in-channel storage mean that meeting future water needs under a changing climate will require unique strategies.

This document serves as a primer on the hydrology (primarily water quantity, use and management) of the Rogue River basin, briefly synthesizing available information and analyzing recent data. The primer begins with an overview of basin-wide characteristics including climate, geology, and hydrology. Then, the primer examines the Rogue's five Hydrologic Unit Code (HUC) 8 subbasins[1] (Upper Rogue including

[1] A HUC is a unique numerical identifier for a watershed as part of a hierarchical system developed by the U.S. Geological Survey (USGS). This system divides the U.S. into progressively smaller drainage basins (regions, subregions, accounting units, cataloging units, etc.) with codes from 2 (largest watersheds) to 12 (smallest watersheds) digits. HUC-8 represents a subbasin or "medium-sized" watershed (average area of about 700 mi^2).

Little Butte Creek, Middle Rogue including Bear Creek, Applegate, Illinois, and Lower Rogue), providing high-level snapshots of their unique hydrological signatures and water management challenges. Overall, this primer seeks to support understanding of the basin's unique hydrology in support of informed water management for those who live and work in the basin.

Figure 1. Photo of the Rogue River from Hellgate Canyon Viewpoint.

Photo: Greg Shine (USBLM) via Flickr under CC BY 2.0. Photo cropped from original to fit space.

Rogue Basin Overview

The Rogue River Basin spans about 5,170 square miles (mi^2) in southwestern Oregon and northern California (Figure 2). In Oregon, which contains approximately 95 percent of the watershed area, the basin covers nearly all of Jackson and Josephine counties, large portions of Curry County, and parts of Klamath, Douglas, and Coos counties (OWRD, 1985). California counties include Siskiyou and Del Norte. Originating in the High Cascades near Crater Lake National Park, the Rogue River flows westward for about 215 miles before reaching the Pacific near Gold Beach (OWRD, 1985). This makes it one of the state's longest rivers (Bastasch, 2006).

The basin is bounded to the east by the Cascade Mountains, to the south by the Siskiyou Mountains, and to the north by the Umpqua Mountains (OWRD, 1985). The river crosses coastal Siskiyous[2] before entering the ocean. The basin extends along an east-west axis, with the river running along its northern side. Major northern tributaries include Elk, Evans, and Grave Creeks. Major southern tributaries drain much larger areas and include, roughly upstream to downstream, Big Butte, Little Butte, and Bear Creeks, as well as the Applegate and Illinois Rivers.

[2] Sometimes referred to as the Coast Range and included within the Coast Range ecoregion; however, the coastal mountains traversed by the Rogue are geologically distinct from the Coast Range proper, which comprises the Siletzia Terrane, while the Rogue's coastal mountains are Klamath terranes in origin (Young 1959; Orr & Orr, 2012).

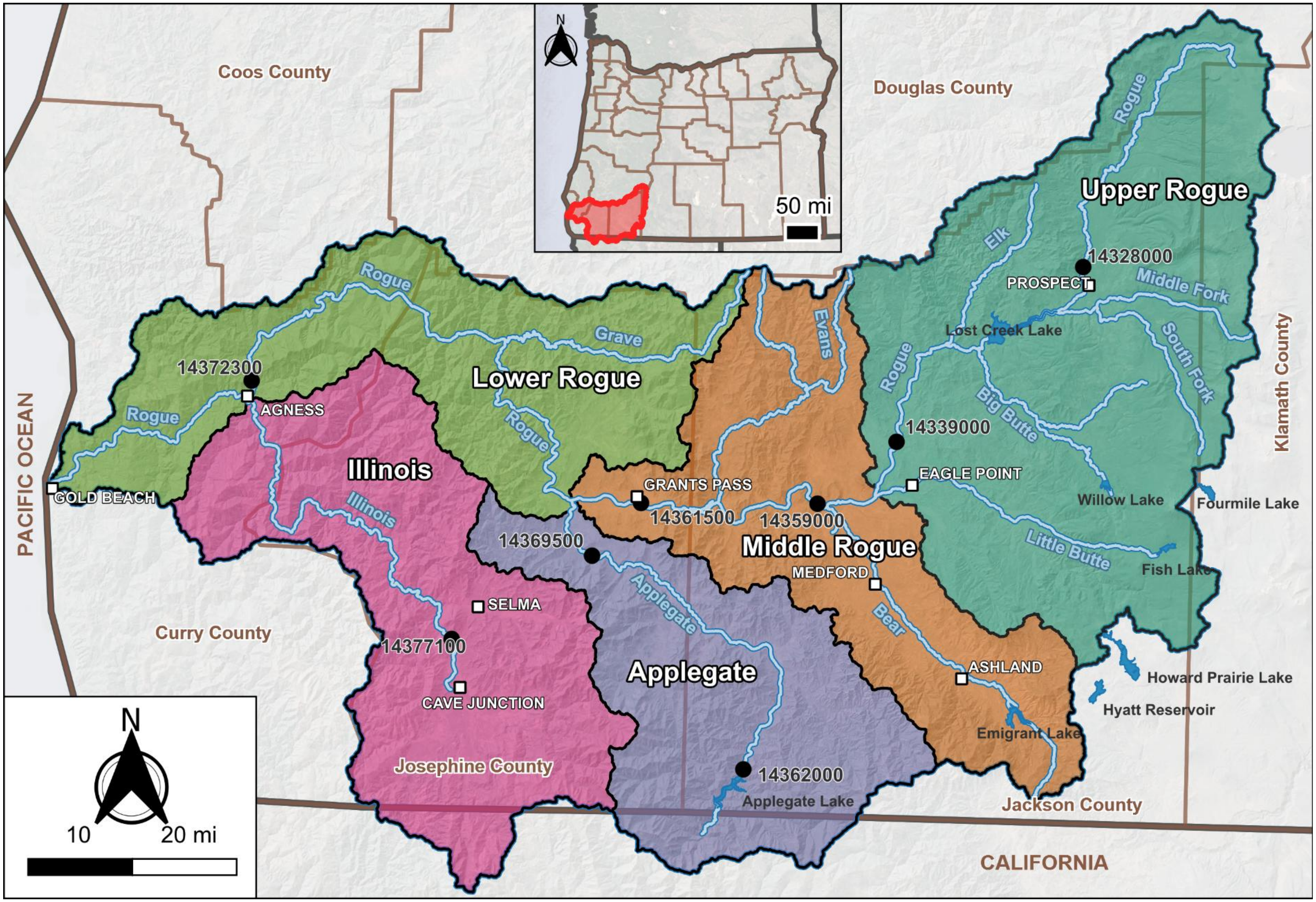


Figure 2. Map of Rogue Basin and HUC-8 subbasins with selected tributaries, reservoirs, cities, and stream gages.

Notes: This analysis uses U.S. Geological Survey HUC-8 subbasin boundaries, which differ from the subbasins used in OWRD's (1985) Rogue River Basin report and the Rogue Basin Program (OAR 690-515). The HUC-8 definitions combine Little Butte Creek into Upper Rogue and Bear Creek into the Middle Rogue.

History and Economy

For at least 15,000 years, Rogue River tribes lived in and around the basin, including Takelma, Shasta, and Tututni peoples (CTSI, n.d.; BLM, n.d.; RRWC, n.d.; OWRD, 1985; Linenberger, 1999; USFS, 1999). These diverse peoples practiced traditional forms of fishing, hunting, gathering, and artisanry uniquely adapted to the region (Figure 3). To the Takelma ("people along the river"), the course of the *Kelam* (Rogue River) symbolizes life: born "gushing" at Boundary Springs, fast and vigorous in early stretches, changing pace through middle reaches, slowing and widening prior to death at the ocean, then reborn as rain (Doty, n.d.). Federally recognized tribes active within the Rogue River Basin today include the Confederated Tribes of Siletz Indians, Coquille Indian Tribe, Tolowa Dee-ni' Nation, and others (USFS, 1999).

Early European settlement began in the 1820s with the arrival of Hudson's Bay Company fur trappers and explorers (OWRD, 1985; Linenberger, 1999; USFS, 1999). French-Canadian trappers called diverse Indigenous peoples *coquins*—"rogues"—eventually leading to the river's English name (Douthit, 1992). A gold rush started in the early 1850s after settlers found gold in the Rogue River Basin, particularly along tributaries in the Applegate and Illinois subbasins (OWRD, 1985; Linenberger, 1999, USFS, 1999). Mining operations damaged natural resources vital to Indigenous ways of life. Placer and hydraulic mining reshaped many streamsides (Jones et al., 2012). Tribal peoples resisted displacement. During the Rogue River Indian Wars of the mid-1850s, the U.S. Army forcibly relocated many tribal peoples to the Siletz Reservation and Grande Ronde Community on the northern Oregon coast. In the early 1860s, the gold rush began to wind down as miners moved on to other prospects.

Euro-American agricultural settlements began in the 1850s, with irrigation districts developing from the 1890s to the 1920s (USBR, 1983; Linenberger, 1999). The earliest filing for water was in the 1850s from Wagner Creek, a tributary of Bear Creek (RRVID, n.d.; OWRD, 1985). In the 1880s, the Oregon and California Railroad began transporting lumber and crops from the Grants Pass and Medford areas, propelling them as economic hubs for the basin (OWRD, 1985). Timber was a major industry throughout the basin, harvested in uplands and transported downstream to Gold Beach (OWRD, 1985). However, this sector precipitously declined after the listing of the northern spotted owl as federally threatened in 1990 (Ferris & Frank, 2021). Of historical industries, agriculture, particularly orchards, remains a significant economic and cultural presence in various parts of the basin.[3] Rogue Valley pears are especially prized and historically contributed to Oregon's status as the second-top pear producer in the United States, although 2020s droughts significantly reduced yields, threatening the industry's future (Oregon Encyclopedia, n.d.; Produce News, n.d.). Cannabis is an increasingly important crop, with the Rogue Valley supporting nearly half of the state's licensed producers (Tauer, 2024).

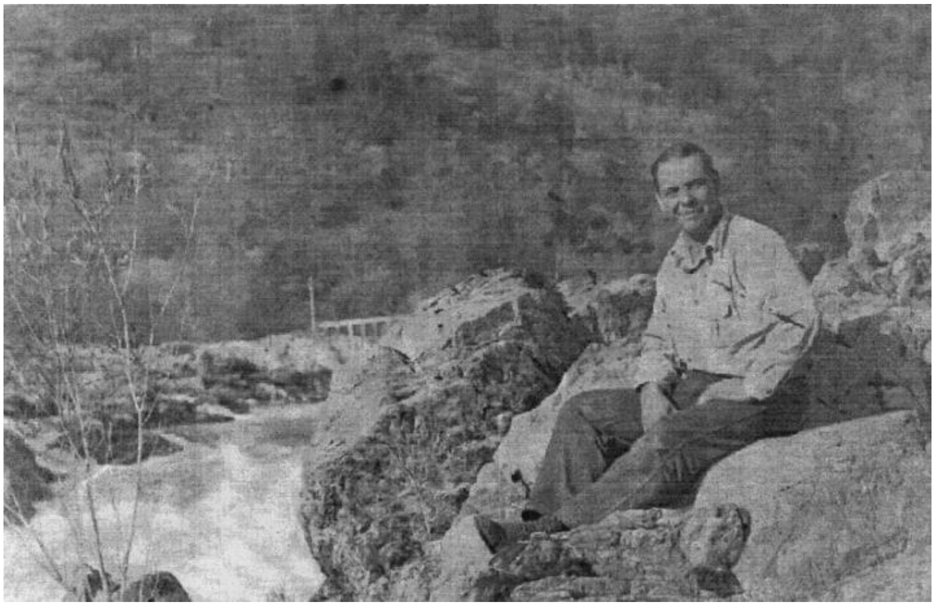


Figure 3. George Baker, father of Takelma elder Agnes "Grandma Aggie" Baker Pilgrim (Taowhywee), sits on the "Story Chair" at Ti'lomikh Falls, the site of the Sacred Salmon Ceremony. This annual ancient ceremony was halted in the 1850s following the Rogue River Indian Wars and was revived in 2007 by Grandma Aggie.

Photo: John Harrington, Bureau of American Ethnology, 1933. Scan and cultural context from Thomas Doty.

Today, recreational tourism is an important industry throughout the entire basin and the broader South Coast (Myer, 2013; Halofsky et al., 2022). This sector first emerged in the early twentieth century and expanded following the Rogue's Wild and Scenic designation in 1968 (OWRD, 1985; USFS, 1999). Whitewater rafting, sport fishing, hiking, skiing, and camping from headwaters to coast are all major attractions, with visitors drawn to the basin's famed national forests, mountain landscapes, free-flowing rivers, and salmonid runs. Recreational gold panning echoes the basin's gold mining history (DOGAMI, n.d.). With their larger populations and cities, Jackson and Josephine counties have also diversified into manufacturing, healthcare, retail, and real estate as top modern industries (OWRD, 1985; Myer, 2013).[4] In 2020, the Rogue

[3] In 2022, 77% of total crop value was in fruit/nut trees (USDA NASS, n.d.).
[4] In 2023, these industries each directly contributed at least 10% of each county's gross domestic product (BEA, n.d.).

Basin had over 300,000 residents (Figure 4).[5]

Tribal nations continue to lead land stewardship and management efforts within the Rogue River basin. This is exemplified by the Coquille Indian Tribe's cooperative management agreement with Oregon Department of Fish and Wildlife, which covers lower basin lands (Coquille Indian Tribe, n.d.; OSOS, n.d.). Under this agreement, traditional ecological knowledge is being incorporated into contemporary conservation practices. In 2013, the Cow Creek Band of Umpqua purchased the Rogue River Ranch along the base of Upper and Lower Table Rocks, where the 1853 treaty was signed (The Oregonian, 2013). In 2025, the Confederated Tribes of Siletz Indians purchased 2,000 acres adjacent to the Table Rocks (Barton-Smith, 2025).

Elevation and Climate

From its headwaters to its mouth, the Rogue River drops approximately 5,250 feet and traverses the Cascades and Klamath Mountains (OWRD, 1985). The overall basin has relief of about 9,500 feet, from the high point on Mount McLoughlin to the low point at sea level (Figure 5 and Figure 6a). The Rogue Basin is "upside down" in that watershed slopes[6] generally increase downstream (Figure 6b).

Climate in the basin is generally classified as Mediterranean, with mild, wet winters and hot, dry summers (OWRD, 1985; Halofsky et al., 2022). Across subbasins, about 80% of annual precipitation falls from November through April, while less than 5% occurs during key irrigation months of July through September. However, mean annual precipitation shows a distinct gradient traveling inland from the ocean (Figure 7). Annual precipitation reaches 100 to 200 inches in some coastal areas. Valleys in and adjacent to the Middle Rogue, particularly flanking Little Butte and Bear Creeks, show among the basin's lowest mean precipitation at 20 to 30 inches per year. Approaching higher elevations in the Cascades, precipitation reaches around 60 to 70 inches per year. Lower elevations are warmer, with mean annual temperatures typically above 50°F in major valleys, while areas near Cascades peaks are in the 30s °F (Figure 8).

Watershed-wide means are important for understanding overall hydrology and making broad comparisons, but they can mask large within-watershed differences (Figure 7 and Table 1). Differences in typical annual precipitation between the driest

[5] Population calculated using 2020 U.S. Census block data (USCB, 2021) intersected with HUC8 subbasin boundaries.
[6] A slope is the difference between the high and low point of a specified area, divided by the length between the points. Dividing Rogue Basin subbasins into 100-ft grid cells and calculating the slope for each cell, the average cell in downstream subbasins are steeper than the average cell in upstream subbasins.

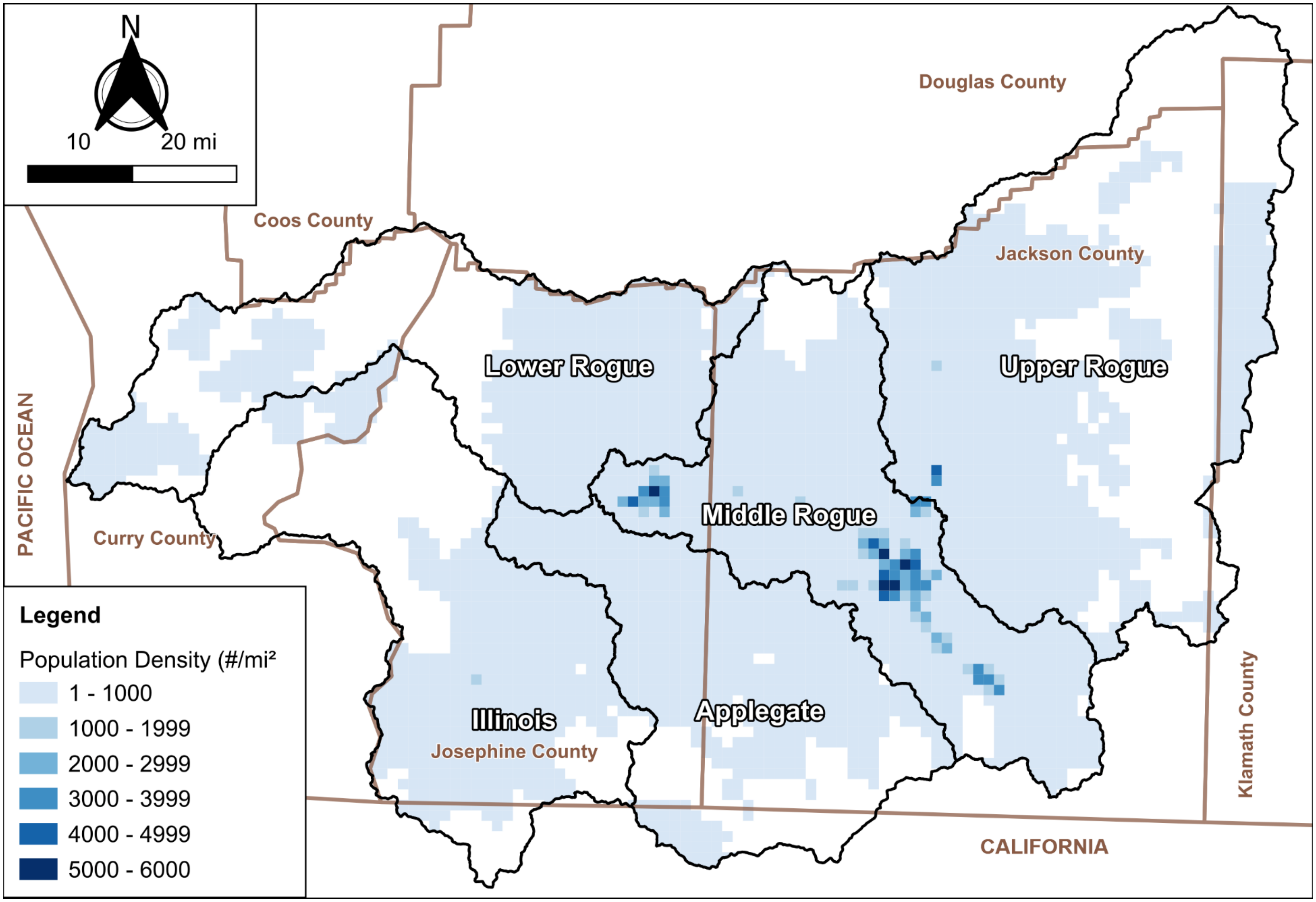


Figure 4. Map of 2020 population density in the Rogue Basin, showing HUC-8 subbasins.

Notes: Data from 2020 U.S. Census (USCB, 2021). Census block polygons were aggregated to a 100-foot grid and then averaged into a 1-mile grid.

and wettest points in a subbasin can exceed 100 inches (Table 1). Furthermore, watershed-wide total precipitation varies considerably from year to year (Table 2). The El Niño Southern Oscillation (ENSO) climate cycle strongly influences annual climate variations, with La Niña years associated with cooler, wetter winters (OCCRI, 2025). However, "Very Strong" El Niño events, though rare, can produce precipitation and snowpack levels exceeding those of La Niña years.

Seasonal precipitation patterns are similar in all subbasins, in that a majority of precipitation arrives in winter (Figure 9a). However, in the Lower Rogue and Illinois basins, markedly higher precipitation from late fall to early spring drives considerably higher annual precipitation. Summertime precipitation, on the other hand, is similarly low in all subbasins.

Following seasonal temperature differences (Figure 9b), the Rogue Basin experiences large changes in dominant precipitation type travelling from coastal to mountain areas. The warmer Lower Rogue is dominated by rainfall, while colder headwaters in the Upper Rogue have an important snow component (Figure 10 and Table 3).

Table 1. Spatial variability of mean annual precipitation of the Rogue River Basin and HUC-8 subbasins, 1991-2020.

Metric (in/yr)	Overall	U. Rogue	M. Rogue	Applegate	Illinois	L. Rogue
Min (Driest Area)	19.3	22.6	19.3	24.0	46.1	33.3
Q1	33.3	34.8	23.8	29.5	65.1	43.3
Median	46.0	43.9	30.0	34.6	80.2	73.1
Mean	53.8	44.4	29.9	39.4	83.3	74.0
Q3	65.6	54.6	33.8	47.7	96.0	90.2
Max (Wettest Area)	196.1	73.2	62.2	102.3	167.5	196.1

Notes: U. = Upper; M. = Middle; L. = Lower; Q1 = 25th percentile; Q3 = 75th percentile. Data aggregated from PRISM (2025) 30-year (1991-2020) 4-km climate normals raster.

Table 2. Annual variability in watershed-wide mean precipitation for Rogue River HUC-8 subbasins, 1991-2020.

Metric (in/yr)	Overall	U. Rogue	M. Rogue	Applegate	Illinois	L. Rogue
Min (Driest Year)	25.2	24.2	14.0	16.0	35.9	33.0
Q1	43.3	37.0	26.0	30.5	64.5	56.9
Median	49.2	42.8	28.8	35.7	73.1	63.7
Mean	53.8	44.4	29.9	39.4	83.3	74.0
Q3	59.6	49.2	35.2	44.4	92.4	75.9
Max (Wettest Year)	81.6	70.7	50.6	63.6	120.7	103.0
CV (%)	25	22	27	29	27	24

Notes: U. = Upper; M. = Middle; L. = Lower; Q1 = 25th percentile; Q3 = 75th percentile; CV is coefficient of variation (standard deviation as percentage of mean). Data aggregated from PRISM (2025) 4-km monthly rasters, except means from 30-year (1991-2020) normals raster (means may differ between time series and normals due to differing development processes).

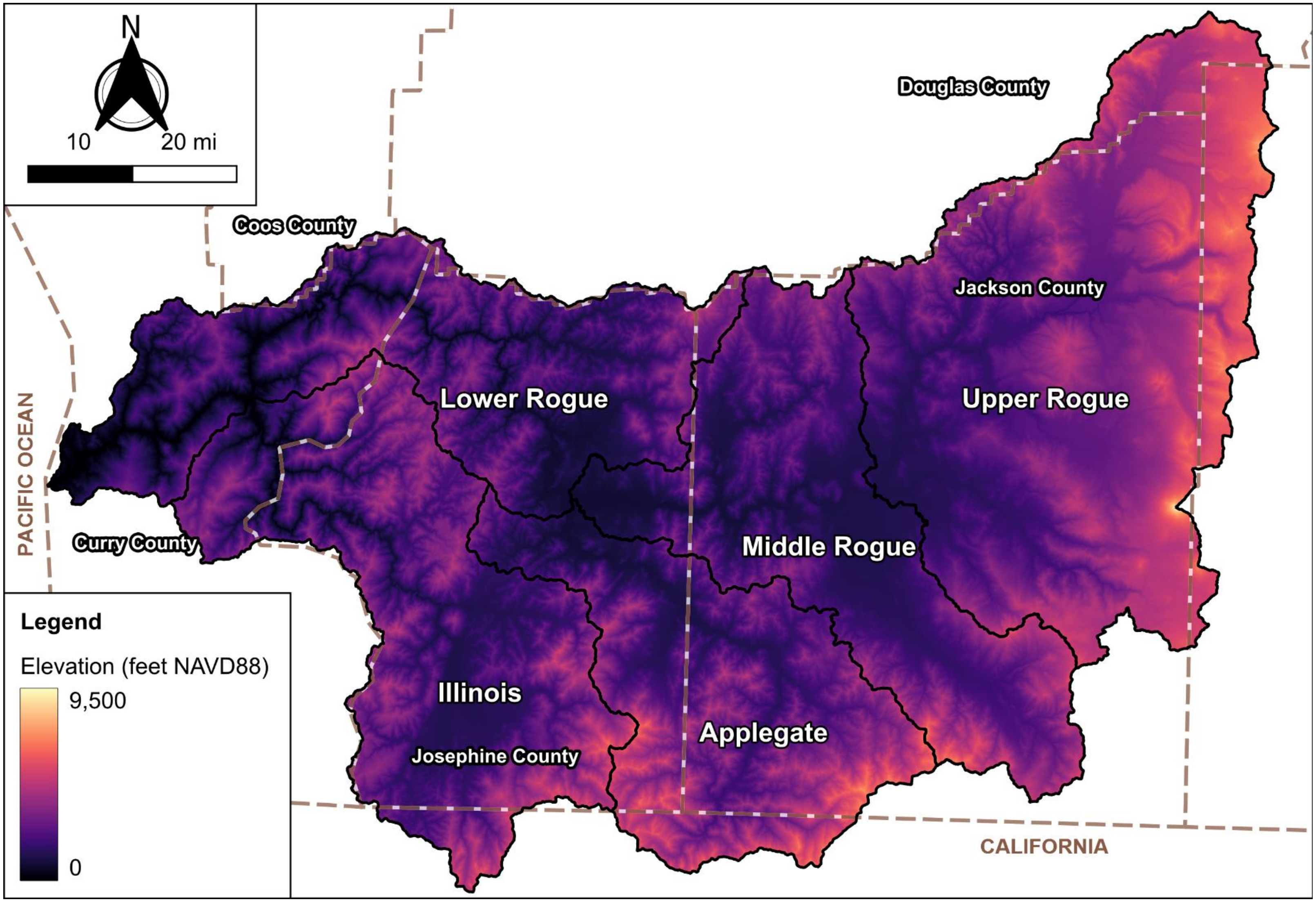


Figure 5. Map of elevation in the Rogue Basin, showing HUC-8 subbasins.

Notes: NAVD88 = North American Vertical Datum of 1988. Data from USGS (n.d.) 3D Elevation Program digital elevation model (DEM) database.

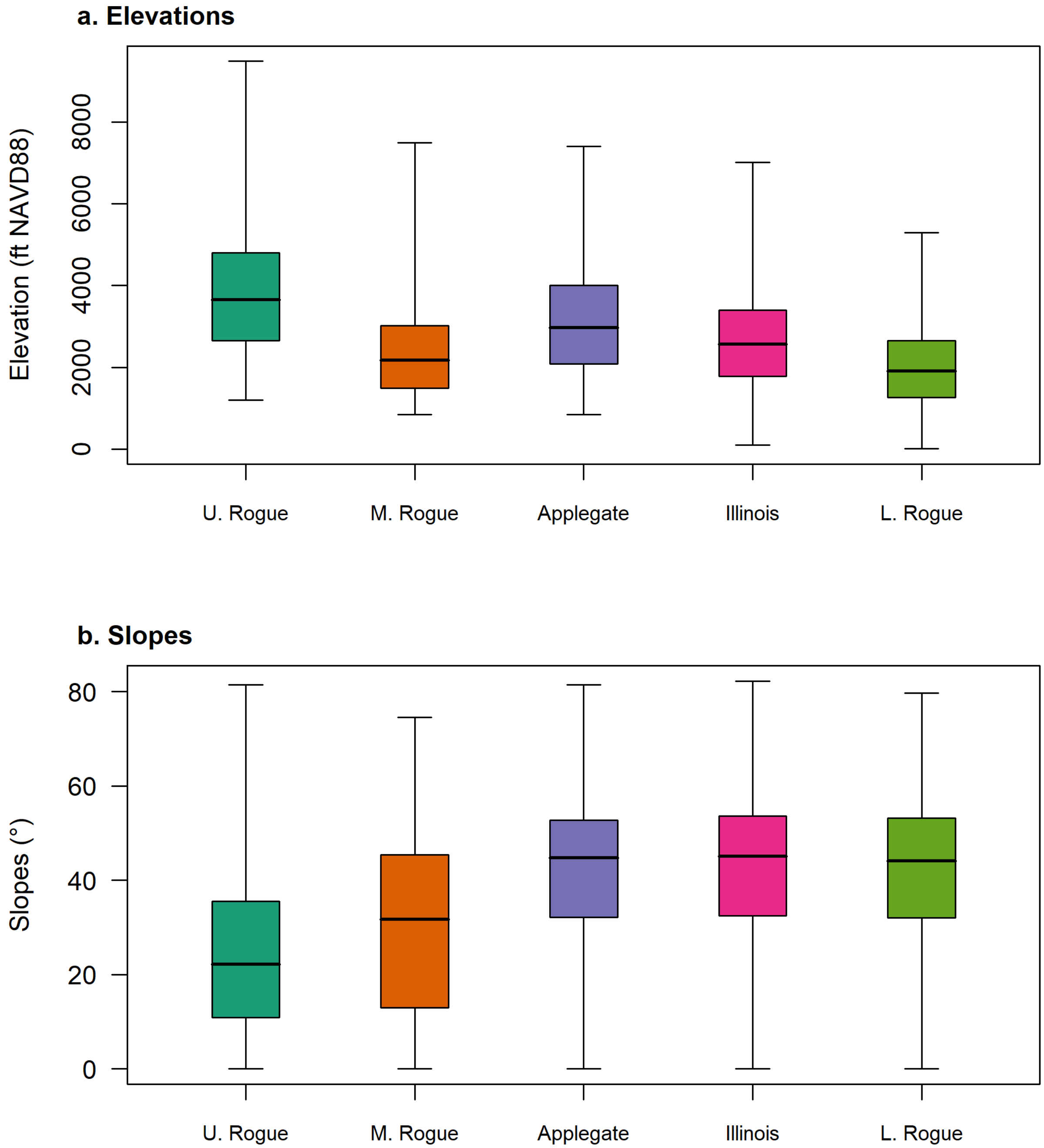


Figure 6. Boxplots of (a) elevations and (b) slopes for Rogue River HUC-8 subbasins.

Notes: Box plots show median (center line), interquartile range (box), and whiskers extending to minimum and maximum values rather than using the traditional 1.5×IQR outlier rule. Data aggregated from U.S. Geological Survey (n.d.) 3D Elevation Program digital elevation model (DEM) database, resampled to approximately 100-foot grid size.

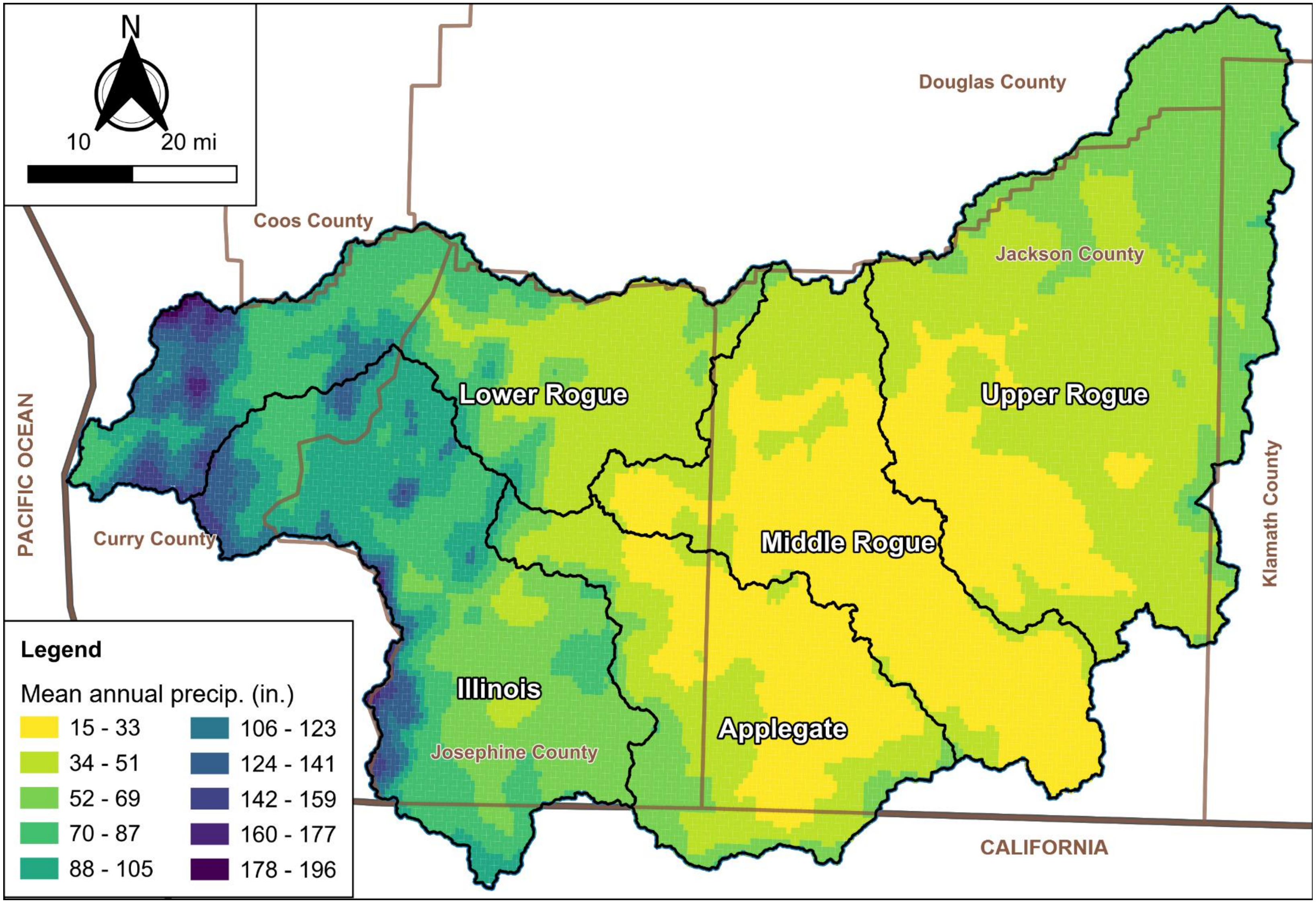


Figure 7. Map of mean annual precipitation in the Rogue Basin, showing HUC-8 subbasins.

Notes: Data from PRISM (2025) 30-year (1991-2020) 800-m climate normals raster. These are 30-year averages, so individual years can have much lower or higher values.

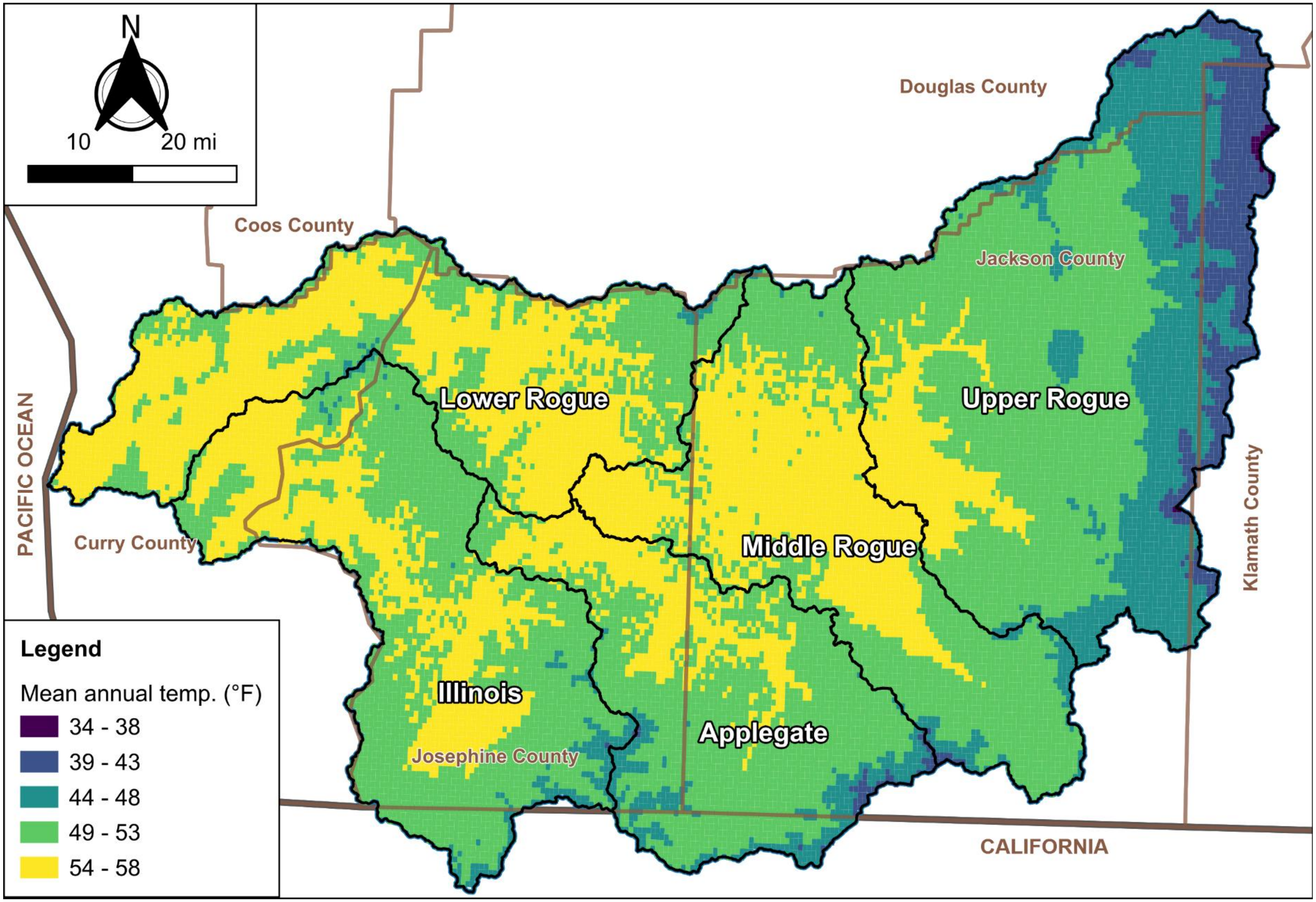


Figure 8. Map of mean annual temperature in the Rogue Basin, showing HUC-8 subbasins.

Notes: Data from PRISM (2025) 30-year (1991-2020) 800-m climate normals raster. These are 30-year averages, so individual years can have much lower or higher values.

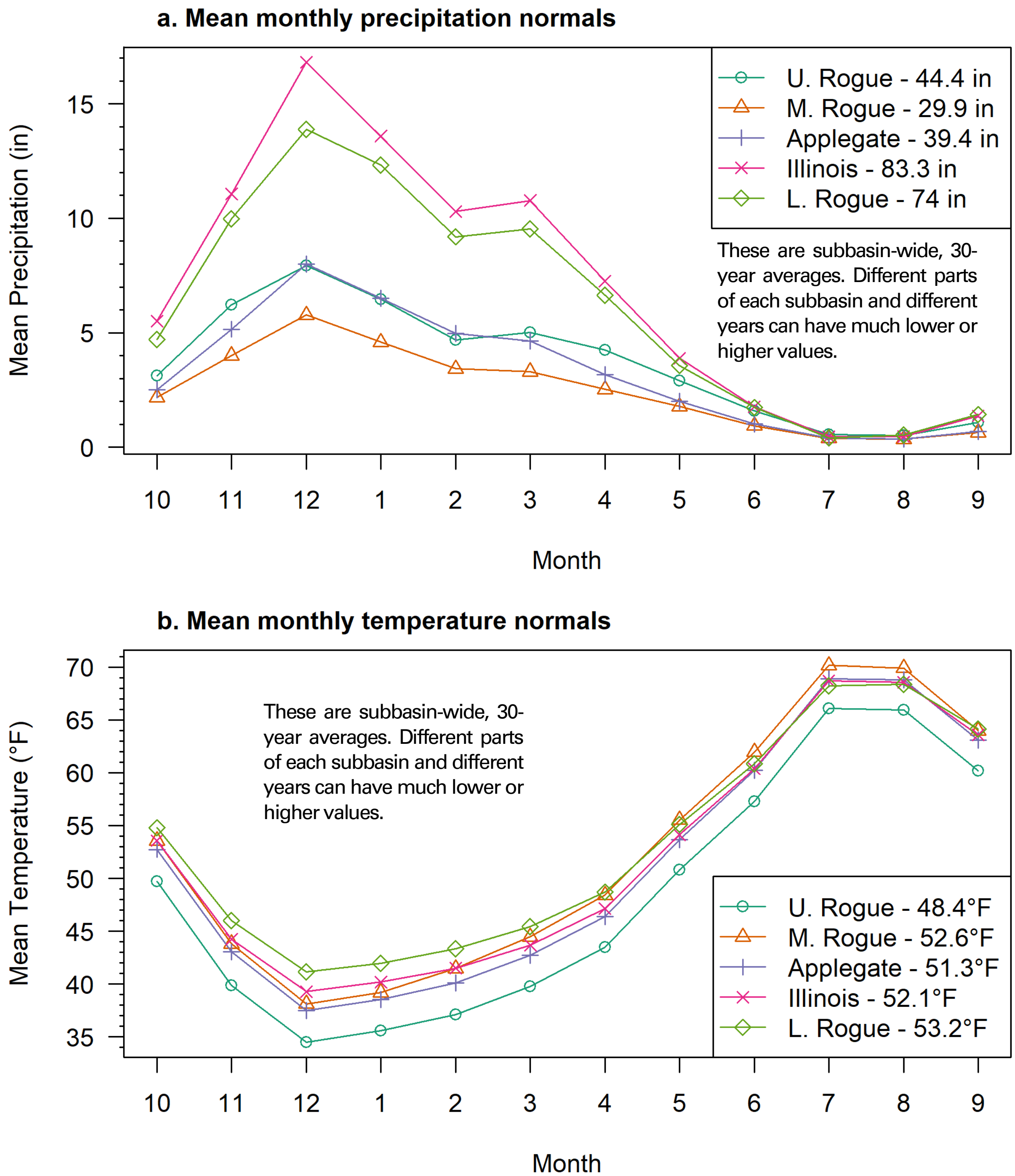


Figure 9. Watershed-wide monthly climate normals for (a) precipitation and (b) temperature, averaged spatially for Rogue River HUC-8 subbasins.

Notes: Text in legend shows annual mean for the entire subbasin. Data aggregated from PRISM (2025) 30-year (1991-2020) 4-km climate normals rasters. These are subbasin-wide averages, so different parts of each subbasin can have much lower or higher values (see Figure 7). They are also 30-year averages, so individual years can have much lower or higher values.

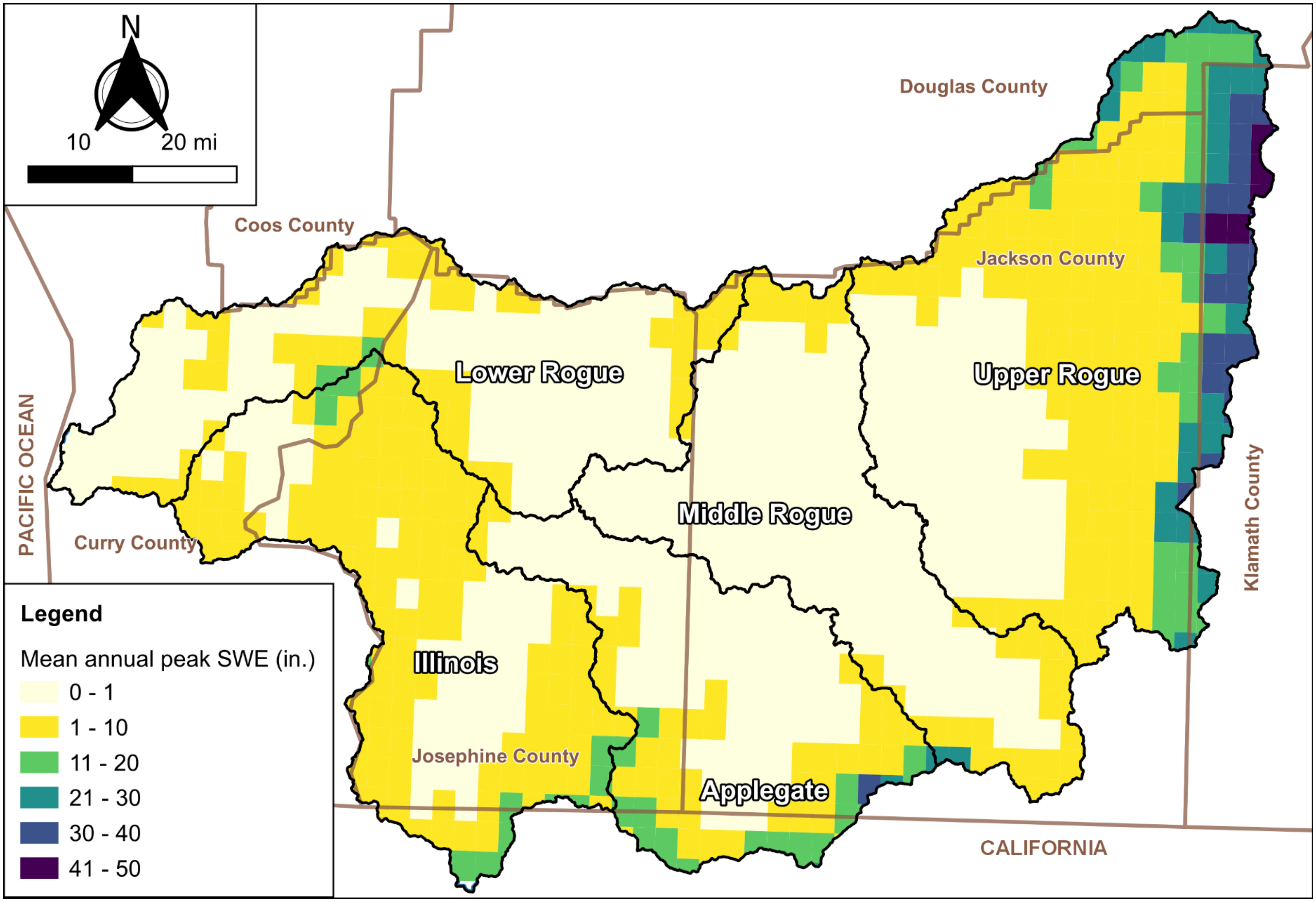


Figure 10. Map of mean annual peak snow water equivalent (SWE) in the Rogue Basin, showing HUC-8 subbasins.

Notes: Data aggregated from Broxton et al. (2019) for water years 1991-2020. These are 30-year averages, so individual years can have much lower or higher values.

Table 3. Ratio between watershed mean precipitation and maximum snow water equivalent (SWE) for Rogue River HUC-8 subbasins.

Time Period	Overall	U. Rogue	M. Rogue	Applegate	Illinois	L. Rogue
October-March	0.11	0.27	0.06	0.12	0.06	0.03
Annual	0.09	0.20	0.04	0.09	0.05	0.02

Notes: U. = Upper; M. = Middle; L. = Lower. SWE data aggregated from Broxton et al. (2019) 4-km gridded product for 1991-2020; precipitation data from PRISM (2025) climate normal for 1991-2020. Higher numbers indicate greater snow contribution to precipitation. October-March ratios < 0.1 indicate rain dominance (Hamlet, 2011). October-March ratios > 0.4 indicate snow dominance.

Ecoregions and Land Cover

The Rogue River Basin is noted for having some of the most botanically and genetically diverse flora in the nation (Sleeter et al., 2012; Halofsky et al., 2022). The basin is dominated by the highly biodiverse Klamath Mountains (including the Siskiyous) ecoregion, and also contains Cascades and Coast Range ecoregions (Thorson et al., 2003). An ecoregion is a geographic area characterized by relatively similar climate, geology, and biological community. Half of the plants found in Oregon can be found in the Klamath Mountains (ODFW, 2006).

The Rogue's ecoregions show a gradient from young, volcanic peaks to ancient, eroded terranes and from drier, inland conditions to wet, fog-influenced coastal conditions (Figure B1). The overall watershed is dominated by Inland Siskiyous, characterized by high, mountainous terrain with diverse forests of conifer, broadleaf evergreen, and deciduous species.

Individual subbasins exhibit distinctive ecological signatures that reflect their geographic positions and elevational gradients (Table B2). The Upper Rogue stands out as the geologically youngest, with headwater origins in the volcanic Southern Cascades ecoregion. The transitional Middle Rogue includes valley and foothill elements. The Applegate has the highest percentage of Inland Siskiyous. The Illinois features the largest Serpentine Siskiyous, with specialized plants that can tolerate the soil's naturally high metal concentrations. The Lower Rogue has high coverage of coastal mountains, with considerable marine influence as the river approaches the Pacific.

Modern land cover within the Rogue River Basin is dominated by evergreen forest (Table B1). Other major land covers include shrub/scrub and grassland/herbaceous areas. The Middle Rogue subbasin, which includes the basin's largest cities, features the most developed area, with 12 percent of the subbasin classified as developed. While about 60 percent of the overall basin is public land, in the Middle Rogue, public ownership is about 30 percent.

Hydrogeology

The Rogue River Basin's geology reflects several hundred million years of addition of exotic landmasses to the continent (terranes), sinking of the oceanic tectonic plate beneath the continent (subduction), sedimentation, erosion, and volcanic activity (OWRD, 1985; Carter & Resh, 2005; Madin, 2009; Orr & Orr, 2012; Figure B1). In the Mesozoic (252 to 66 million years ago), terranes rode eastward on subducting oceanic crust and accreted to the North American continent. This created Klamath Mountain rocks that dominate the middle and lower basin. These rocks were later intruded by magma that rose toward the surface but cooled underground (plutons). Plutons are most prevalent in the middle basin. Around 52 million years ago, the Cascade volcanic chain was initiated by subduction zone activity as an oceanic tectonic plate was forced beneath North America. As tectonic forces uplifted the coastal Siskiyous, the Rogue River kept pace, cutting through rising mountains. High Cascades volcanic activity, which dominates the upper basin, continues today.

This geological construction resulted in permeable young volcanic rocks in the upper basin and typically low-yield, older cracked rocks (fractured bedrock) elsewhere. Although groundwater and surface water are strongly connected throughout the Rogue River Basin, groundwater availability differs dramatically across the diverse geological settings (OWRD, 1985; Kemper & Thoma, 2019; Figure C2). Despite its complexity, the basin's hydrogeology can be generally characterized as a fractured bedrock aquifer system (Kemper & Thoma, 2019). Water moves predominantly through interconnected fracture networks rather than through primary rock porosity. The fractured-bedrock aquifer system exhibits three distinct vertical zones: an upper zone of weathered bedrock, a middle zone of moderate to highly fractured bedrock, and a deeper zone where fracture density decreases rapidly with depth (Kemper & Thoma, 2019). Fracture density is highest in the upper and middle zones, and the aquifer's ability to hold and transmit water typically decreases with depth. Low yields are common across the basin (Table 4; Figure C2).

Only limited areas in the basin are conducive to some groundwater development. The basin's steep, mountainous terrain and thin sedimentary deposits concentrate the most significant groundwater resources in major river valley (alluvial) deposits, though these deposits seldom exceed 100 feet thick (Kemper & Thoma, 2019). In the upper basin's volcanic terrain, highly permeable Cascade Range formations create the basin's most significant groundwater storage and discharge systems, exemplified by Big Butte Springs (OWRD, 1985; MWC, 1990). The middle basin presents more variable conditions, with the Grants Pass area providing some of the basin's most productive wells at around 5 to 50 gallons per minute (OWRD, 1985). However, most of the basin exhibits limited groundwater potential, characterized by low-yielding bedrock aquifers where most wells can only support domestic needs, and numerous dry wells occur in areas underlain by metamorphic rocks (OWRD, 1985).[7]

Upland wells sourcing water from the low-storage fractured bedrock aquifer show seasonal water level fluctuations that can be greater than 25 feet between the spring and fall. Groundwater levels in these wells generally follow annual precipitation trends, with elevated springtime levels in years with above-average precipitation and lower levels during drought periods. Alluvial wells tend to have more predictable seasonal fluctuations due to an efficient connection with nearby surface water sources (Figure 11).

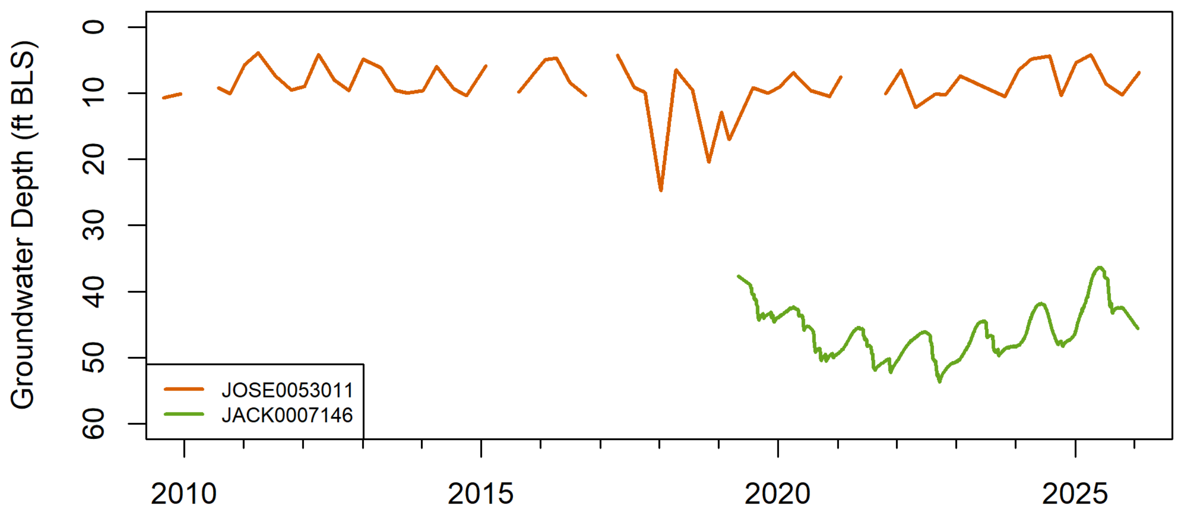


Figure 11. Groundwater level hydrographs showing water levels from 2010 to 2025 in a fractured bedrock well near Merlin, Oregon (orange, JOSE0053011) and in an alluvial well near Whetstone Creek north of Medford, Oregon (green, JACK0007146).

Notes: BLS = below land surface.

Groundwater flow throughout the basin generally follows surface topography, with hydraulic gradients directing flow from higher elevations toward adjacent valley floors where discharge occurs (Kemper & Thoma, 2019). The high-relief topography (large changes in elevation) and depth-decreasing transmissivity (deeper rocks transmit less water) create short, shallow flow paths concentrated within a few hundred feet below

[7] Additionally, in limited areas of the Rogue, wells drilled to greater depths will occasionally encounter saline groundwater unsuitable for most uses. In Grants Pass, saline groundwater has been found in some places where deep, old groundwater is believed to be forced upwards by geologic features such as faults (Wiley et al., 2006). A small number of wells have also encountered saline groundwater in other locations, such as the Illinois (e.g., well logs JOSE0053826 and JOSE0056240). The occurrence of saline groundwater throughout the greater Rogue is not yet well understood.

land surface. Alluvial groundwater levels show rapid response to precipitation patterns, rising shortly after autumn rains begin and declining after precipitation decreases in mid-spring, creating seasonal variations in streamflow and locations of stream inception (beginning) points (Kemper & Thoma, 2019).

Groundwater pumping from wells can impact surface water within relatively short time periods, as production primarily comes from upper fracture zones, inducing recharge from overlying sediments and reducing discharge to streams (Kemper & Thoma, 2019). Limited, variable groundwater productivity throughout the basin makes groundwater an unreliable source to augment or replace surface water. This introduces water management challenges. In many regions, drilling deeper may improve yields. However, this strategy is usually unviable in the Rogue River Basin, as transmissivities typically decrease with depth.

Table 4. Select hydrogeologic characteristics for the Rogue River Basin.

Parameter	Typical Value
Well yields	1 to 50 gallons per minute
Transmissivity	<1,000 ft^2/day
Storativity	<0.01
Alluvial deposit thickness	<100 feet
Groundwater flow path depth	Within a few hundred feet of land surface
Specific capacity	Low (large drawdowns, minimal yields)

Notes: Summarized from Kemper & Thoma (2019).

Hydrology

The Rogue River stretches about 215 miles from Boundary Springs in the Cascades to its mouth near Gold Beach. Key tributaries include Little Butte Creek in the Upper Rogue subbasin, Bear Creek in the Middle Rogue subbasin, Illinois River in the Illinois subbasin, Applegate River in the Applegate subbasin, and Grave Creek in the Lower Rogue subbasin (Figure 2).

Seasonal streamflow patterns reflect seasonal precipitation, with about 60-90% of annual flows occurring during the December through May period across most subbasins (Figure 12). Natural patterns can be modified by water management infrastructure, with particularly notable influences by the Upper Rogue's Lost Creek Reservoir and the Applegate Reservoir. Each subbasin exhibits distinctive flow characteristics that reflect differences in geology, climate, and water management. Upper Rogue headwaters maintain the most stable mainstem flows both seasonally and annually, reflecting higher snowmelt and baseflow contributions. The Illinois River, with no major reservoirs, shows pronounced seasonal variability with flows rapidly dropping from spring peaks to summer lows. The coastal Lower Rogue exhibits the largest annual changes in flow magnitudes, reflecting the integration of upstream processes plus local contributions from high coastal precipitation.

The overall basin has about 24,000 miles of streams, of which about 7,750 miles are perennial (year-round flow), within its 5,170 mi^2 watershed area (Table 5). For perennial streams, this results in a drainage density (length of streams per area) of about 1.5 miles per square mile.

Compared to other Rogue subbasins, the Upper Rogue subbasin has the lowest drainage density, reflecting higher infiltration in young volcanic geology. Conversely, compared to other Rogue subbasins, the Upper Rogue contributes above-average flow after accounting for its watershed area, reflecting higher baseflow. The Middle Rogue and Applegate, with the basin's lowest precipitation, provide below-average but nevertheless essential flow contribution per watershed area (Table 5). The Illinois and Lower Rogue, with the basin's highest precipitation (Figure 9), make the highest relative contributions to overall flows in the Rogue River.

Table 5. Drainage area and median natural flows of Rogue River HUC-8 subbasins.

Subbasin	Drainage Area (mi^2)	All Streams (mi)	Perennial Streams (mi)	Perennial Drainage Density (mi/mi^2)	Annual Natural Flow at Outlet (cfs)	Natural Flow Added in Subbasin (cfs)	Unit Flow (cfs/mi^2)
U. Rogue	1,620	6,110	1,640	1.0	2,624	2,624	1.6
M. Rogue	880	5,600	950	1.1	2,956	332	0.4
Applegate	770	4,140	920	1.2	582	582	0.8
Illinois	990	3,570	2,490	2.5	2,542	2,542	2.6
L. Rogue	910	4,560	1,750	1.9	7,873	1,794	2.0
Overall	5,170	24,000	7,750	1.5	7,873	-	1.5

Notes: U. = Upper; M. = Middle; L. = Lower. Natural flows estimated from Oregon Water Resources Department's Water Availability and Reporting System (accessed June 16, 2025) for Watershed IDs #207, #315, #249, #728, and #266, converting annual acre-feet values to cubic feet per second. Middle Rogue HUC-8 subbasin outlet does not exactly align with water availability basin outlet. Stream lengths estimated from National Hydrography Dataset. Natural flow added in subbasin was calculated as the difference between inlet and outlet flow for the Water Availability Basin, removing Applegate and Illinois flows for Lower Rogue. Drainage areas and streams rounded to nearest ten. Drainage density calculated using the National Hydrography Dataset (NHD) flowline layer within OWRD's database (accessed May 29, 2025).

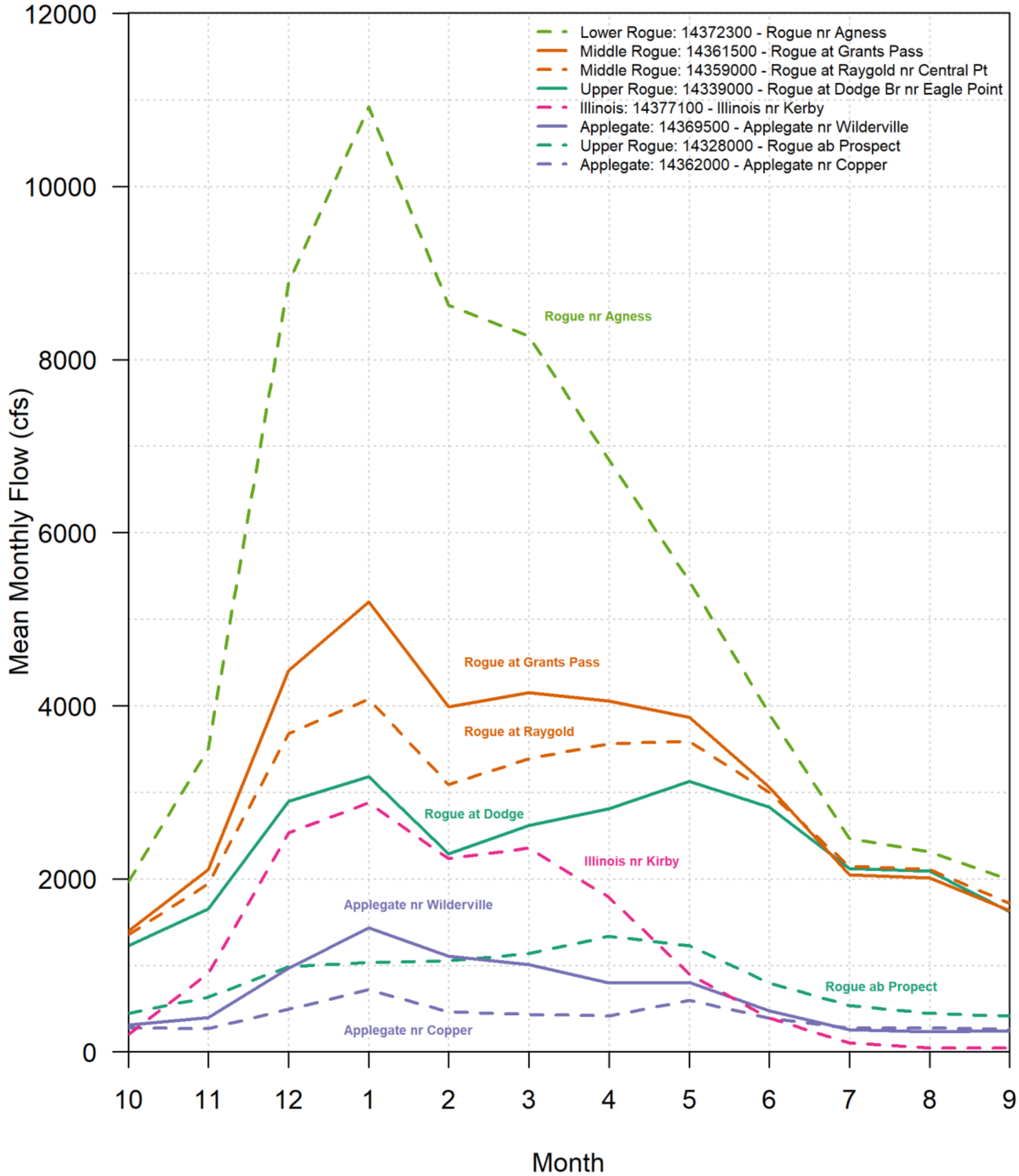


Figure 12. Mean monthly flows at selected stations in Rogue River HUC-8 subbasins, water years 1991-2020.

Notes: Gage locations shown in Figure 2. Legend prefix text indicates the subbasin that contains the gage. Only months with no missing data are included. Provisional and published data used (accessed 18 June 2025). Colored by subbasin. Solid lines are downstream gages within the subbasin, and dashed lines are upstream gages within the subbasin. These are 30-year averages, so individual years can have much lower or higher values.

As of June 2025, the Rogue River Basin includes 75 active stream gages with flow data operated by the Oregon Water Resources Department (OWRD), U.S. Geological Survey (USGS), U.S. Bureau of Reclamation (USBR), counties, or irrigation districts.[8] Spatial coverage varies significantly among subbasins, and the number of years covered varies among stations (Table D2). Measured streamflows throughout the basin demonstrate its climate signature of dry summers and wet winters, with influence from springtime snowmelt in higher-elevation subbasins and modifications from water management (Figure 12 and Figure 13). Monthly flows show broadly similar seasonal patterns across all subbasins (Figure 12), with peaks typically occurring in March and April. The Illinois River, largely unregulated, shows more pronounced seasonal variability than other subbasins, with flows rapidly dropping from spring into the summer.

The Upper Rogue maintains the most stable flows both seasonally and annually, reflecting its higher baseflow component and regulation from Lost Creek Dam. The Lower Rogue exhibits the largest absolute swings both annually and seasonally, with mean monthly flows at Agness ranging from around 2,000 cfs in late summer to over 10,000 cfs in winter (Table D3).[9] Water management infrastructure substantially alters natural flow patterns, with reservoirs sustaining summer flows above natural levels while attenuating winter flood peaks.

Year to year, flows vary considerably. The longest running active stream gage station is the Rogue at Raygold (#14359000), for which data begin 1905. Based on measured mean annual flows at this station (OWRD, 1985), the basin experienced its most extreme dry year in 1931 and some of its wettest years in 1964 and 1997 (Figure 14). Estimated or measured peak discharge exceeded 100,000 cfs—more than 35 times mean annual flow—in December 1861, February 1909, February 1927, and December 1955, and during the 1964 Christmas Day Flood (Figure 15; Hofmann and Rantz, 1963; USACE, 1966; Waananen et al., 1971; OWRD, 1985). The 1955 flood spurred the authorization and construction of the Lost Creek (completed 1976) and Applegate (completed 1980) dams for flood control, with the Christmas Day flood adding urgency. The dams helped to prevent catastrophic flooding in 1997, discussed later.

[8] Summarized from OWRD geospatial database attributes for station status and number of complete water years (accessed 18 June 2025). See Table D1.
[9] However, the Agness gage, located above the Illinois River confluence, does not capture the contributions of the Illinois or large portions of the basin's wettest coastal areas.

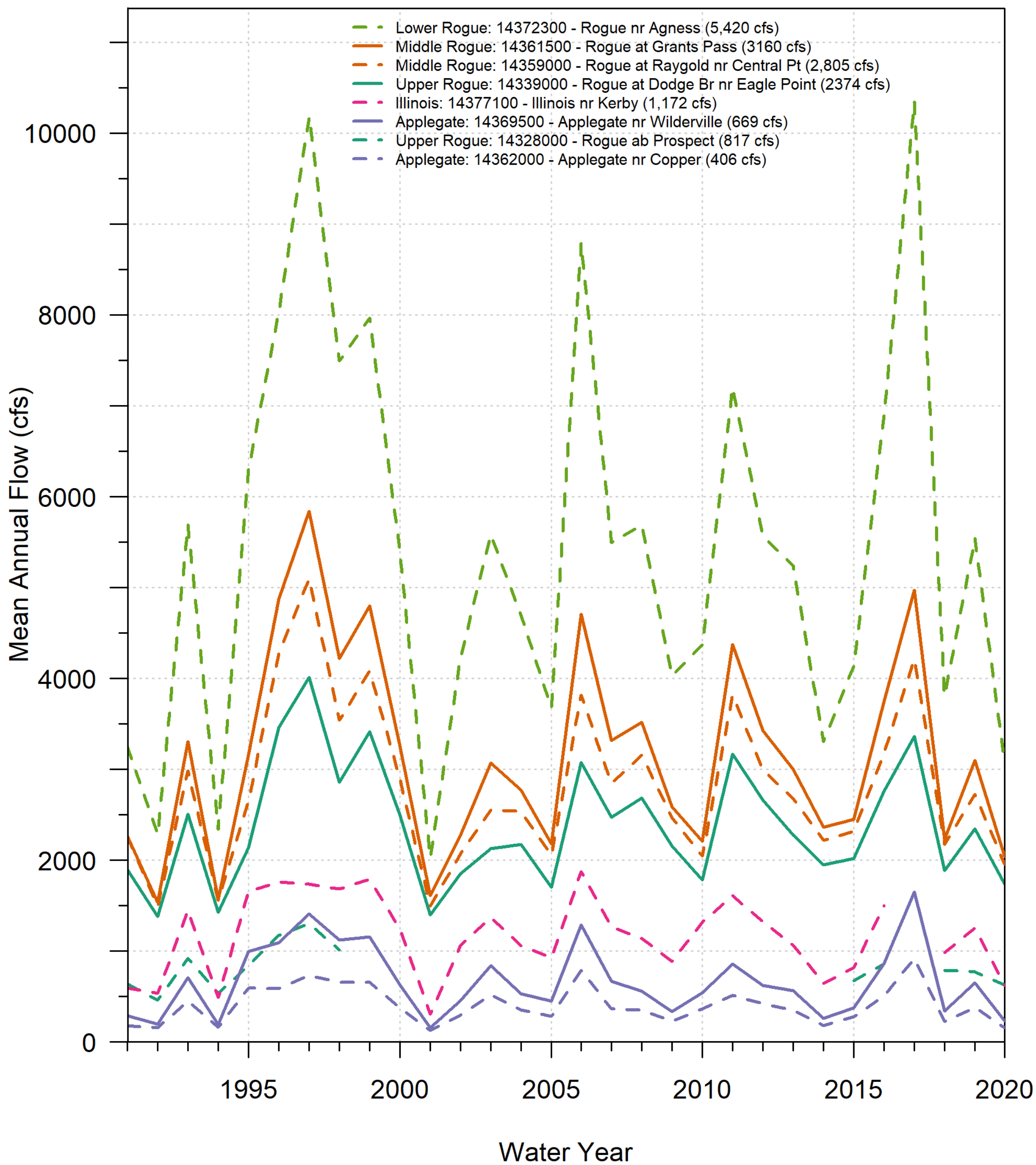


Figure 13. Mean annual flows at selected stations in Rogue River HUC-8 subbasins, water years 1991-2020.

Notes: Gage locations shown in Figure 2. Legend text prefix indicates the subbasin that contains the gage, while parenthetical indicates period mean. Only years with no missing data are included. Provisional and published data used (accessed 18 June 2025). Colored by subbasin. Solid lines are downstream gages within the subbasin, and dashed lines are upstream gages within the subbasin.

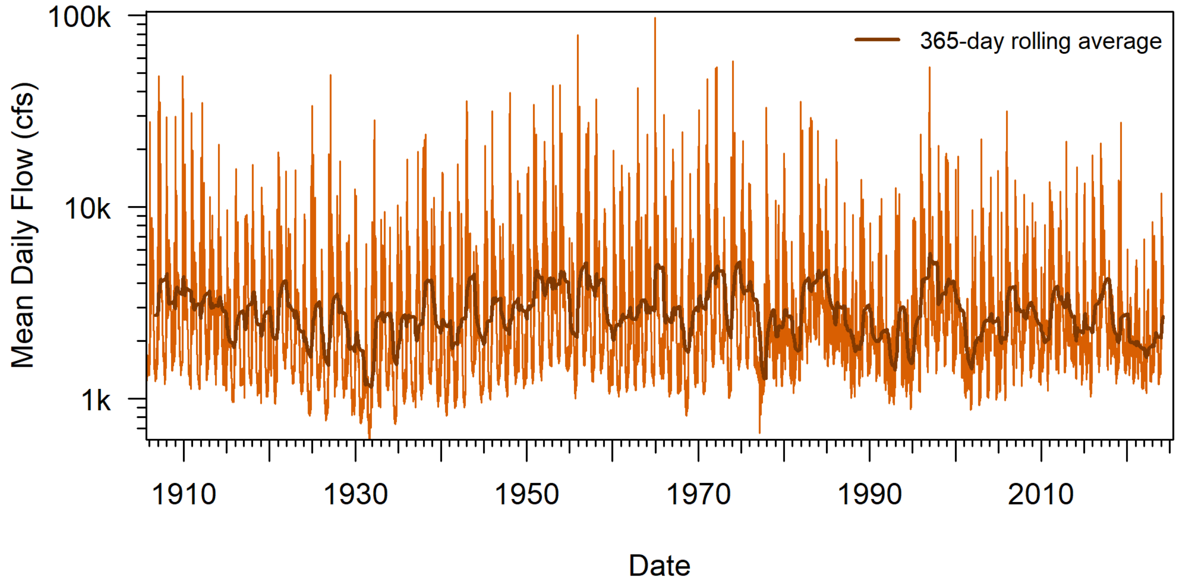


Figure 14. Period-of-record mean daily flows at the Rogue River at Raygold near Central Point (#14359000).

Note: Flow scale is logarithmic. Each major labeled tick represents a 10-fold increase.

Figure 15. Photos of Rogue River flooding and damage, December 1964.

Photos: USACE (1966).

Table 6. Mean annual flow (water years 1991-2020) at selected Rogue River Basin stations.

Station	Subbasin	Mean Flow (cfs)	Variability (±CV)
Rogue ab Prospect	Upper Rogue	817	30%
Rogue nr Eagle Point	Upper Rogue	2,374	28%
Rogue at Raygold	Middle Rogue	2,805	32%
Rogue at Grants Pass	Middle Rogue	3,160	35%
Applegate nr Copper	Applegate	406	51%
Applegate nr Wilderville	Applegate	669	58%
Illinois nr Kerby	Illinois	1,172	37%
Rogue nr Agness	Lower Rogue	5,420	41%

Notes: cfs = cubic feet per second; CV = coefficient of variation, a measure of how spread out data are from the mean. Data summarized from OWRD mean daily flow database (accessed 18 June 2025). Not all stations had data for all 30 years.

Mean annual flows along the mainstem Rogue increase from about 820 cfs above Prospect to about 2,400 cfs at Eagle Point to about 3,200 cfs at Grants Pass to about 5,400 cfs at Agness (Table 6). Despite highly variable hydrogeology, climate, and water management, mean annual streamflow within the basin generally scales proportionate to drainage area (Figure 16), although this does not capture highly seasonal variations.

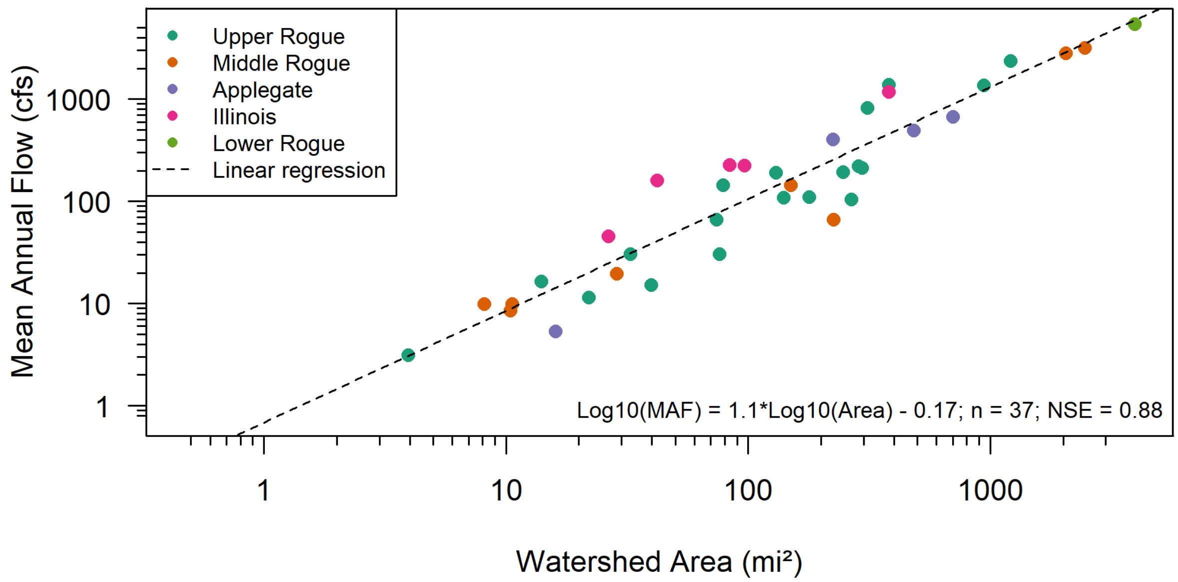


Figure 16. Mean annual flow versus watershed area (water years 1991-2020) for stream gages within the Rogue River basin (colored by HUC-8 subbasin as shown in legend).

Notes: MAF = mean annual flow; NSE = Nash-Sutcliffe efficiency. Different colors identify subbasins (see legend). Flow scale is logarithmic. Only water years with no missing data were included in calculations, but stations could have missing years within the 30-year base period. Watershed areas from OWRD station metadata. Provisional and published streamflow data used (accessed 18 June 2025). The equation produces a mean annual flow estimate of 7,877 cfs for the entire Rogue River basin area of about 5,170 mi^2 (outside of visual range of the plot), similar to the natural flow estimate of 7,873 cfs.

Water Use and Management

The Rogue River Basin supports a complex network of water users that has altered the hydrology through major infrastructure projects, extensive irrigation systems, and inter-basin transfers (USBR, 1983; OWRD, 1985; Linenberger, 1999). Upper and middle basins supply water to meet heavy agricultural and municipal demands that are concentrated in the Middle Rogue subbasin (Table 7; Figure 17). The Lower Rogue subbasin is relatively less developed. Five reservoirs each provide more than 5,000 acre-feet of storage volume for irrigation, water supply, and flood control (Table 8; Figure 2). Numerous smaller reservoirs throughout the basin support various purposes (OWRD, 1985; NID, n.d.).

Within the upper and middle basins, six major irrigation districts collectively manage over 50,000 acres of agricultural land (Figure 17). The largest is Talent Irrigation District (16,300 acres), followed by Medford (12,116 acres), Rogue River Valley (8,813 acres), Eagle Point (8,260 acres), Grants Pass (7,700 acres), and Gold Hill Irrigation Districts (EPID, n.d.; GPID, n.d.; MID, n.d.; TID, n.d.; RRVID, n.d.). These districts operate complex water management systems, many coordinating with municipal and federal authorities. Water management seeks to close seasonal mismatches between supply and demand, necessitating extensive storage (Table 8; Figure 18). Supply is also augmented through trans-basin diversions bringing about 29,000 acre-feet of water from the Klamath Basin through the Talent Project (MID, n.d.).

Farms are numerous in the basin, but most are relatively small operations. Median farm size in Jackson and Josephine counties is less than 20 acres, smaller than about 75% of Oregon's counties (USDA, 2024). Grapes, pears, other tree fruits, and cannabis are among the most regionally important crops.

Table 7. Estimated average annual evapotranspiration (ET) in thousand acre-feet (taf) for Rogue River HUC-8 subbasins.

Subbasin	2020 Population	Total ET (taf)	Agriculture ET (taf)	Irrigated Area (ac)	Agriculture ET (% of Total)	Irrigated Area (% of Total)
U. Rogue	24,000	2,730	70	29,990	2.4	2.9
M. Rogue	247,000	1,520	130	58,970	8.5	10.4
Applegate	15,000	1,460	40	19,490	3.0	4.0
Illinois	10,000	1,750	20	11,070	1.4	1.7
L. Rogue	16,000	1,680	10	4,760	0.6	0.8
Overall	312,000	9,140	270	124,280	3.0	3.8

Notes: ET = evapotranspiration; U. = Upper; M. = Middle; L. = Lower; taf = thousand acre-feet; ac = acre. Population estimates calculated using 2020 U.S. Census block data (USCB, 2021), intersected with HUC8 subbasin boundaries, rounded to nearest thousand. For blocks partially overlapping subbasins, population was weighted by the proportion of block area within each subbasin boundary. ET and irrigated acreage calculated based on mean annual values from OpenET ensemble data for actual ET for water years 1991-2020, developed in Huntington et al. (2025). Total ET was calculated using monthly rasters. Agriculture ET was calculated from field-level data, excluding non-agricultural crop codes such as open water, forests, wetlands, and development. Numbers may not sum exactly due to rounding. Acres and volumes rounded to the nearest ten, percentages to the nearest tenth. OWRD (1985) reports total irrigated and non-irrigated agricultural acreage in the Rogue River Basin as 101,000 and 27,150 acres, respectively.

Municipal and industrial demands are concentrated in the Bear Creek valley of the Middle Rogue subbasin (Figure 4). Medford operates the basin's largest regional water system, which serves over 150,000 residents (MWC, 2022). The system relies heavily on Big Butte Springs, supplemented by Rogue River flows in summer.

Water rights administration follows Oregon's prior appropriation doctrine, with curtailments based on priority dates (OWRD, 2024). Many streams are fully allocated during summer months. During shortages, the Oregon Water Resources Department issues regulation orders curtailing junior rights to protect senior ones. This includes instream and out-of-stream uses. Instream water rights have been an increasing focus of water management in recent years. Federal Endangered Species Act compliance requirements operate independently of state water law through agency biological opinions that guide target flows and rates at which water flows are increased or decreased (e.g., NMFS, 2012).

Table 8. Reservoirs in (or serving) the Rogue River Basin with normal storage more than 5,000 acre-feet.

Subbasin	Reservoir	Area (ac)	Active / Total Vol. (taf)	Average Depth (ft)	Year First Complete	Managed By
U. Rogue	Fish Lk.	480	8 / 8	20	1915	MID/RRVID/USBR
U. Rogue	Willow	350	/ 8	25	1952	MWC
U. Rogue	Lost Cr.	3,430	315 / 465	135	1976	USBR/ USACE
(Klamath)	Fourmile Lk.	760	15 / 40	55	1922	MID/RRVID
(Klamath)	Hyatt	960	16 / 17	20	1923	TID/USBR
(Klamath)	Howard Pr.	2,070	61 / 62	35	1958	TID/USBR
Applegate	Applegate	990	75 / 82	85	1980	USBR/ USACE
M. Rogue	Emigrant	880	39 / 41	55	1926	TID/USBR

Notes: Vol. = volume; taf = thousand acre-feet; U. = Upper; M. = Middle; Lk. = Lake; Pr. = Prairie; MID = Medford Irrigation District; RRVID = Rogue River Valley Irrigation District; MWC = Medford Water Commission; USACE = U.S. Army Corps of Engineers; USBR = U.S. Bureau of Reclamation; TID = Talent Irrigation District. Summarized from Johnson et al. (1985), USBR (n.d.), USACE (n.d.), and NID (n.d.). Area, volume, and depth rounded to nearest ten, whole number, and 5, respectively. Completion year approximate.

Management Challenges

The Rogue supports a complex operational system where state agencies, federal agencies, and a myriad of water users must coordinate for effective basin management. Water supply in many reaches is already strained, and climate change will further alter the basin’s hydrology, ecosystems, and water management practices.

Future precipitation changes are difficult to predict but may involve lower summer and higher winter precipitation, further exacerbating mismatches between water supply and demand (Halofsky et al., 2022; OCCRI, 2023, 2025). Wet and dry cycles may become longer and more extreme, worsening flood and drought impacts; the Rogue has already seen increasing drought frequency (Myer, 2013; OCCRI, 2025). Average annual temperatures are projected to rise several degrees Fahrenheit by the end of the century, on top of several degrees of warming already observed throughout the basin over the last century (Halofsky et al., 2022; OCCRI, 2025).

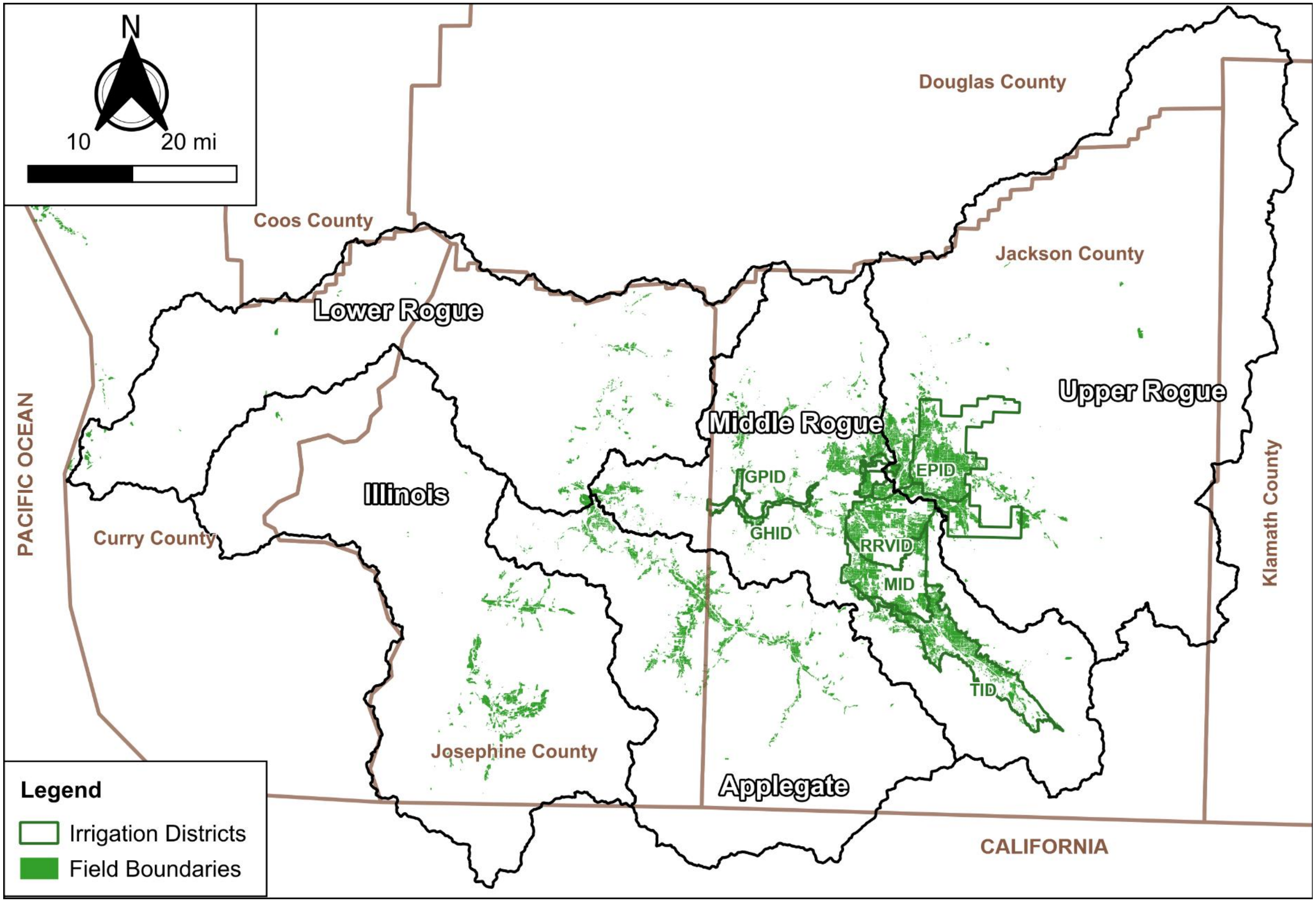


Figure 17. Map of agricultural fields and irrigation districts in the Rogue Basin, showing HUC-8 subbasins.

Notes: EPID = Eagle Point Irrigation District; GHID = Gold Hill Irrigation District; GPID = Grants Pass Irrigation District; MID = Medford Irrigation District; RRVID = Rogue River Valley Irrigation District; TID = Talent Irrigation District. Field boundaries representing agricultural areas from Huntington et al. (2025) for year 2022 (may not be irrigated in that year). Irrigation district data from Jackson County GIS (n.d.).

The basin's snowpack faces extreme decline as more precipitation falls as rain and snow melts earlier (Doppelt et al., 2008; Hamlet, 2011; OCCRI, 2015, 2023). This increases winter flood risk while reducing summer flows and threatens the viability of snow recreation such as skiing at Mount Ashland. A recent analysis of streamflow data that included two long-term streamflow stations in the Upper Rogue with relatively minimal management influences (diversions or dams) suggested that mean annual flows are generally not changing over time, but summer monthly flows may be decreasing (Cameron, 2026). These climate change impacts will affect local economies and infrastructure, particularly as water management systems struggle to balance flood risk with summer water demand (Doppelt et al., 2008).

Climate change may also affect water quality through increased storm and fire frequency, elevating sediment and nutrient loads and possibly raising water temperatures, which already frequently exceed recommended levels (ODEQ, 2008; Halofsky et al., 2022). For cold-water species like salmon, warmer temperatures and extended low flows will decrease dissolved oxygen, increase disease, and create more frequent lethal conditions (Myer, 2013). Releases from the Lost Creek and Applegate Reservoirs provide some temperature relief in summer, but these benefits may diminish with climate change (Halofsky et al., 2022).

The Rogue Basin's unique characteristics limit conventional adaptation strategies to water shortages, such as groundwater use and in-channel reservoir storage. The fractured bedrock geology offers minimal groundwater development potential. Meanwhile, in-channel storage, which was once a preferred strategy for matching water supply and demand (OWRD, 1985), now faces significant environmental constraints given the basin's critical salmon habitat. While off-channel storage may provide a promising alternative for capturing earlier snowmelt, funding and permitting routes may be less well-defined due to comparatively limited example projects.

Figure 18. Photo of Fish Lake Dam, looking toward Mount McLoughlin.
Photo: USBR.

Subbasin Summaries

As the Rogue River completes its roughly 215-mile journey from the High Cascades to the Pacific Ocean, it crosses diverse physiographic and climatic conditions (Table 9).

Beginning at high elevations in the volcanic terrain of Crater Lake National Park in the Upper Rogue Subbasin, the river is characterized by steep gradients, snowmelt-driven hydrology, and highly permeable volcanic soils. As the river descends into the Middle Rogue Subbasin, gradients moderate and the system transitions to a more managed hydrologic regime dominated by intensive agricultural water demands in summer. Tributaries provide cool waters that support a major fish corridor to the Pacific Ocean. In its final reaches in the Lower Rogue Subbasin, the Rogue enters steep coastal gorges, where it regains the energy for active sediment and large wood transport.

The following sections further explore hydrology and water management for individual Hydrologic Unit Code (HUC) 8 subbasins.[10] Unless otherwise noted, all averages refer to water years 1991-2020. However, values can differ greatly from averages in any given year or location (Table 2 and Table 6), and many subbasins exhibit notable spatial gradients in temperature and precipitation (Figure 7, Figure 8, and Table 1).

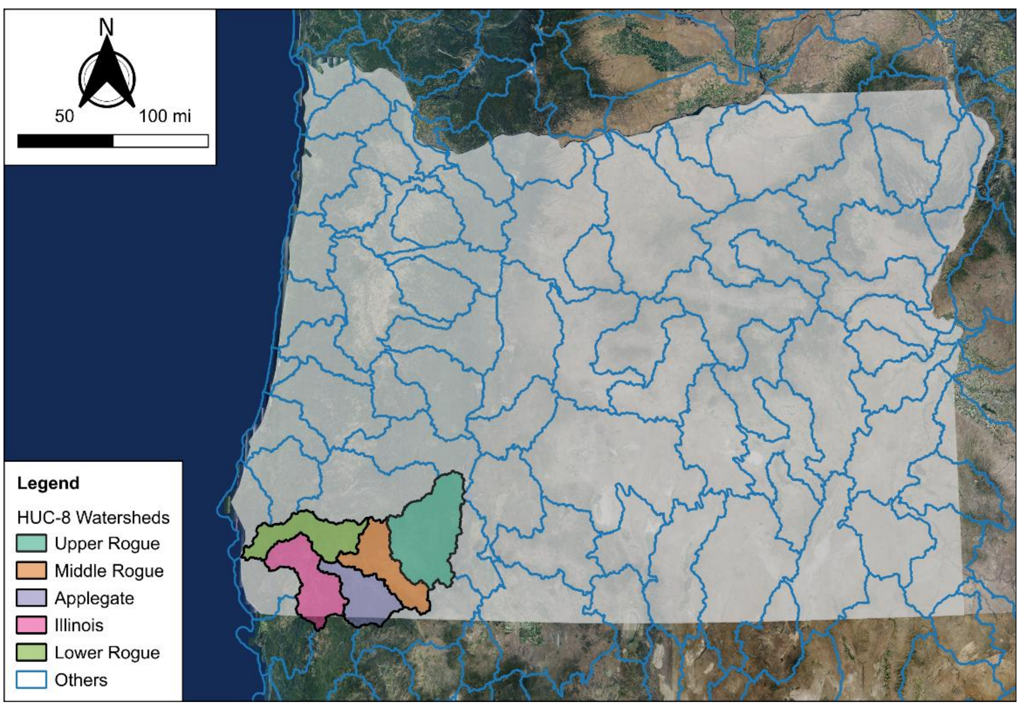
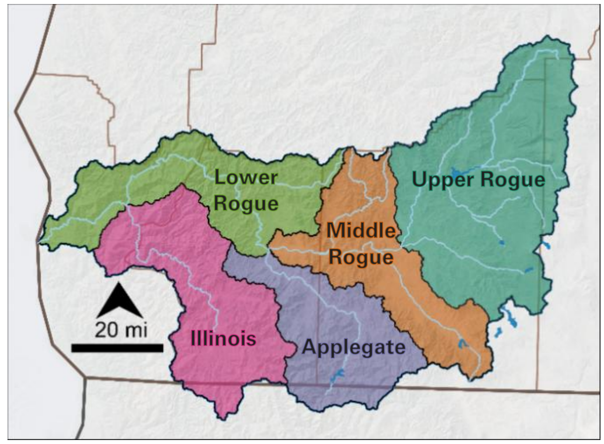


Figure 19. HUC-8 subbasins of Oregon and surrounding states, with Rogue highlighted.
Notes: Imagery from U.S. Geological Survey.

[10] This analysis uses U.S. Geological Survey HUC-8 subbasin boundaries, which differ from the subbasins used in OWRD's (1985) Rogue River Basin report and the Division 515 Rogue Basin Program. The HUC-8 definitions combine Bear Creek into Middle Rogue and Little Butte Creek into Upper Rogue.

Table 9. Summary of Rogue HUC-8 subbasin characteristics.



Upper Rogue Subbasin
Area: 1,620 mi²
Population: 24,000
Key Cities: Eagle Point, Butte Falls
Land Area Publicly Owned: 64%
Precipitation (annual mean): 44 (23-73) inches
Temperature (annual mean): 48 (35-55) °F
Est. Natural Flow at Outlet: 2,624 cfs
Annual Flow Variability (CV): ±28%
Typical Flow Portion December to May: 59%
Key Tributaries: Little Butte, Big Butte, Elk
Irrigated Area: 30,000 acres
Key Reservoirs: Lost Cr. (465 taf), Fish (8 taf)
Unique Character: Snowpack headwaters, most stable flows, Wild and Scenic portions, Cascades young volcanic geology, largest reservoir

Middle Rogue Subbasin
Area: 880 mi²
Population: 247,000
Key Cities: Medford, Grants Pass, Ashland
Land Area Publicly Owned: 29%
Precipitation (annual mean): 30 (19-62) inches
Temperature (annual mean): 53 (41-55) °F
Est. Natural Flow at Outlet: 2,956 cfs
Annual Flow Variability (CV): ±35%
Typical Flow Portion December to May: 68%
Key Tributaries: Bear, Evans
Irrigated Area: 59,000 ac
Key Reservoirs: Emigrant (41 taf), Reeder (0.85 taf)
Unique Character: Region's major urban and agricultural hub, driest subbasin with rain-shadow valleys

Applegate Subbasin
Area: 770 mi²
Population: 15,000
Key Cities: No incorporated municipalities
Land Area Publicly Owned: 60%
Precipitation (annual mean): 39 (24-102) inches
Temperature (annual mean): 51 (40-55) °F
Est. Natural Flow at Outlet: 582 cfs
Annual Flow Variability (CV): ±58%
Typical Flow Portion December to May: 76%
Key Tributaries: Little Applegate, Williams
Irrigated Area: 19,500 ac
Key Reservoirs: Applegate (82 taf)
Unique Character: Highly reservoir dependent, largest relative year-over-year flow swings, many ditches

Lower Rogue Subbasin
Area: 910 mi²
Population: 16,000
Key Cities: Gold Beach
Land Area Publicly Owned: 70%
Precipitation (annual mean): 74 (33-196) inches
Temperature (annual mean): 53 (45-56) °F
Est. Natural Flow at Outlet: 7,873 cfs
Annual Flow Variability (CV): ±41%
Typical Flow Portion December to May: 75%
Key Tributaries: Grave, Lobster
Irrigated Area: 4,800 ac
Key Reservoirs: None
Unique Character: Coastal wilderness and canyons, subbasin with the most Wild and Scenic miles

Illinois Subbasin
Area: 990 mi²
Population: 10,000
Key Cities: Cave Junction
Land Area Publicly Owned: 77%
Precipitation (annual mean): 83 (46-168) inches
Temperature (annual mean): 52 (43-56) °F
Est. Natural Flow at Outlet: 2,542 cfs
Annual Flow Variability (CV): ±37%
Typical Flow Portion December to May: 88%
Key Tributaries: Althouse, Deer, Sucker
Irrigated Area: 11,000 ac
Key Reservoirs: Selmac (1 taf)
Unique Character: Few dams, serpentine geology, Wild and Scenic portions, largest relative swings in seasonal flow

Notes: CV = coefficient of variation; taf = thousand acre-feet. Precipitation and temperature annual means show watershed-wide average for 1991-2020, with spatial range (differences moving across the watershed) in parentheses. Values can greatly differ from year to year and location to location. See data sources in Table 1 to Table 8 and Table D3.

Upper Rogue Subbasin (including Little Butte Creek)

The Upper Rogue (Figure 21) represents the Rogue River's headwater system. At 1,620 square miles, the Upper Rogue subbasin is the largest of the Rogue's five subbasins (Figure 19). This subbasin also sees the most snow and contains the youngest, volcanic geology among subbasins.

The Rogue River begins at Boundary Springs near Crater Lake at over 5,000 feet elevation, descending steeply before the landscape opens into flatter agricultural areas near Eagle Point. Little Butte Creek, which drains about a quarter of the subbasin from a separate southern valley, joins the Rogue near Eagle Point. The Rogue River has state and federal scenic designations approximately between river miles 173 and 213 (OAR 736-040-0052; NWSRS, n.d.).

Most of the subbasin sits within the Southern Cascades ecoregion, a landscape of young volcanic cones, lava plateaus, and Douglas fir, ponderosa pine, and white fir. Evergreen forests cover about 65% of the subbasin (Table B1). A small southwestern corner of the subbasin extends into the older Klamath Mountains (Table B2).

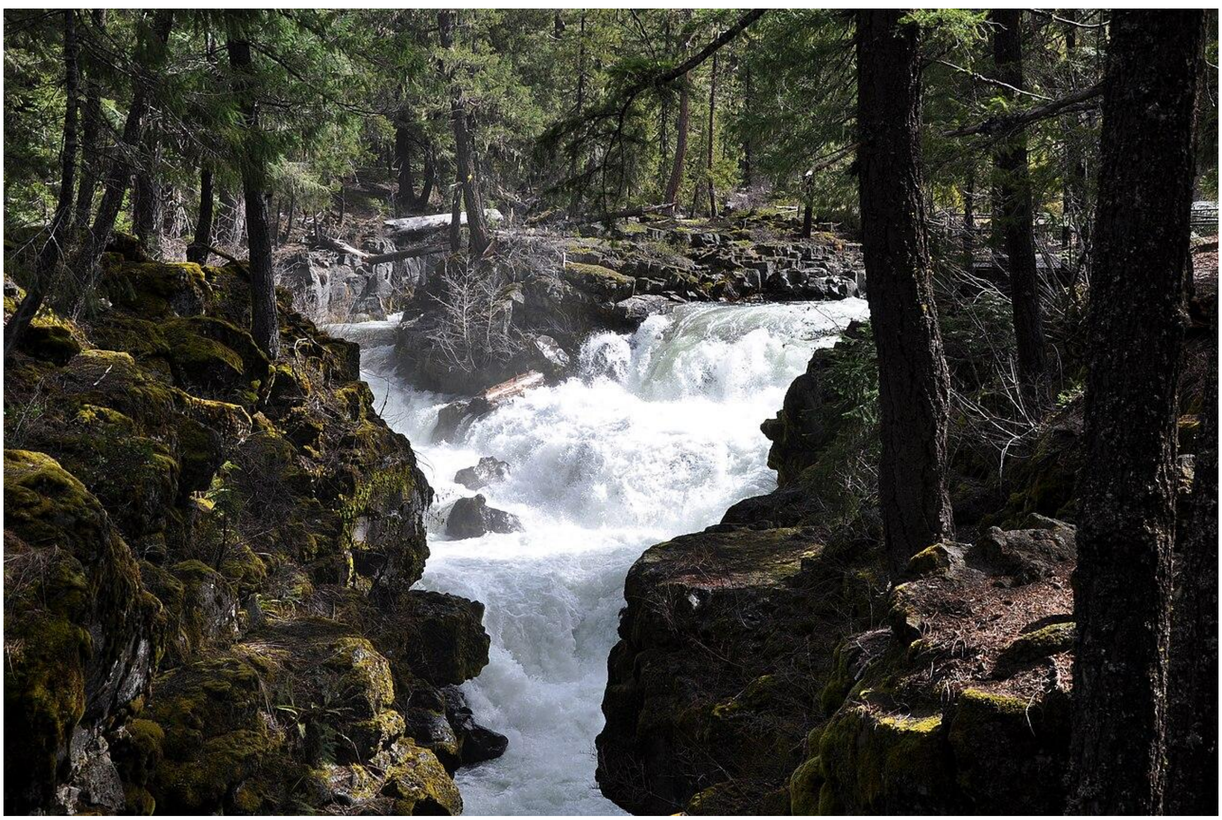


Figure 20. Photo of the Rogue River as it enters Rogue River Gorge, a narrow slot cut through lava beds at Union Creek.

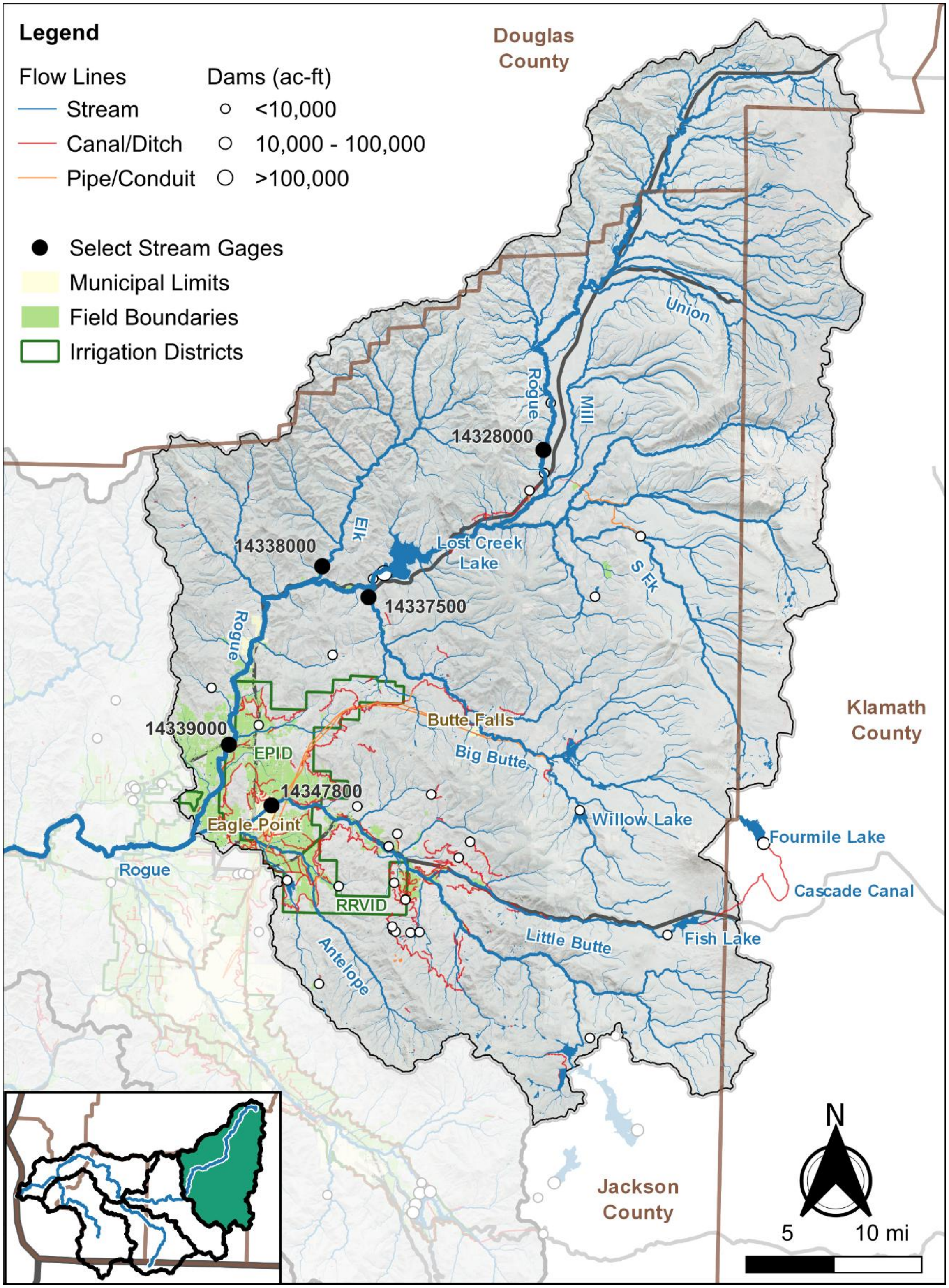


Figure 21. Map of Upper Rogue HUC-8 subbasin hydrologic features.

Notes: EPID = Eagle Point Irrigation District; RRVID = Rogue River Valley Irrigation District. Flow lines from National Hydrography Dataset Plus (version 2), line width continuously scaled to estimated mean annual flow. Dams from National Inventory of Dams (NID, n.d.), scaled to normal storage. Gages mentioned in the text are shown. Field boundaries representing agricultural areas from Huntington et al. (2025) for year 2022 (may not be irrigated in that year). Irrigation district data from Jackson County GIS (n.d.).

Permeable volcanic rocks absorb the subbasin's precipitation and snowmelt and release it through springs and streams. This gives the Upper Rogue more stable flows year-over-year compared to other subbasins (Table 6).

Although the subbasin features the largest elevation changes in the basin, from valley floors around 1,500 feet to peaks above 9,000 feet, its median slope is actually the lowest among subbasins, reflecting valleys and plateaus in middle elevations (Figure 5 and Figure 6).

Most soils above 3,000 feet are thin and rocky (OWRD, 1985). Lower elevation soils are deeper and more suited to agriculture but often contain clay layers that restrict drainage, a challenge for irrigation and septic systems (OWRD, 1985).

The subbasin's population is approximately 24,000 (Table 7); key communities include Eagle Point and Butte Falls. Agriculture is concentrated around Eagle Point, where orchard and pasture operations make use of deeper alluvial soils (OWRD, 1985).

Typical Climate Patterns

Watershed-wide annual precipitation averages 44 inches but has ranged from 24 to 71 inches over water years 1991 to 2020 (Table 2). Precipitation generally increases moving from west-northwest valley areas toward east-southeast mountainous areas. The driest portions of the subbasin average around 23-35 inches of precipitation a year, versus 55-73 inches in the wettest areas (Table 1; Figure 7 and Figure 22a). Almost 80% of precipitation typically occurs November through April, versus only 5% July to September (Table A2).

Mean annual temperatures span from 35°F in high-elevation areas to 55°F in valleys (Figure 8 and Figure 22b). The subbasin average temperature is 48°F, the coolest of all subbasins. The subbasin is snow-dominated in upper elevations, though mixed rain-snow overall (Table 3). During the winter, most of the subbasin is under snow, ranging from several inches at lower elevations to many feet near peaks (Figure 9 and Figure 22c). From June to November, snowpack is generally absent at all but extreme elevations.

Groundwater Resources

The upper Rogue River and its tributaries connect water production in high-precipitation montane areas to intensive valley water use. Young volcanic rocks absorb precipitation, which recharges groundwater, providing high baseflows to headwater streams (OWRD, 1985). Alluvial deposits are good water-bearing materials but are usually only a few feet thick.

In the upper watershed of Big Butte Creek, connected fracture pathways in the volcanic rock can rapidly transmit water with hydraulic conductivities of 700–2,000 feet per day (MWC, 1990). This results in relatively short residence times for spring discharge. Older rocks generally have low permeability and produce little groundwater.

Streamflow of the Upper Rogue River

In the Upper Rogue, the Rogue River mainstem shows the lowest relative year-over-year fluctuation compared to other subbasins (Table 6). This stability reflects both volcanic geology that sustains groundwater discharge and regulation from Lost Creek Reservoir; this subbasin has the Rogue's highest baseflow percentages (Stratton Garvin, 2026). Flow increases from an annual average of 817 cfs above Prospect (#14328000) to 2,374 cfs at Dodge Bridge near Eagle Point (#14339000).

The Upper Rogue subbasin has the largest number of lakes and reservoirs of any subbasin in the Rogue River drainage system (OWRD, 1985). Lost Creek Reservoir, completed in 1976, provides 465,000 acre-feet of storage capacity. Reservoir operations have fundamentally altered the Rogue's natural hydrograph (Figure 23). After construction, warm season flows at Dodge Bridge (#14339000) increased by 12-73% (June-September) while cool season flows decreased by 8-42% (October-May).[11]

Upstream of the dam, above Prospect (#14328000), Rogue monthly flows peak in spring, averaging 1,339 cfs in April, then reach a minimum of 416 cfs in September (Figure 22e). About two-thirds of annual flow occurs December through May. Below the dam, Dodge Bridge (#14339000) monthly flows range from 3,181 cfs in January to 1,622 cfs in September. About 60% of annual flow occurs December through May (Table D3).

Big Butte Creek joins the Rogue just downstream of the dam. Big Butte Creek is a significant gaining reach. Near the headwaters, Big Butte Springs typically flows at 40-65 cfs collectively among seven springs, fluctuating with hydrologic conditions (MWC, 1990; CH2M, 2017; MWC, 2022).[12] Within the springs' contributing area, about 36% of precipitation emerges as springflow, with a residence time of just 200-440 days (MWC, 1990). Closer to its mouth, Big Butte Creek near McLeod averages 194 cfs (#14337500).

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[11] Mann-Whitney U tests were used to compare mean monthly flows between pre-dam (data available prior to water year 1970, to allow for construction) and post-dam (water years 1991-2020) periods at Rogue at Dodge Bridge (#14339000). Holm (1979) adjustment for multiple comparisons was used. January was -15%, February was -42%, March was -23%, April was -18%, May was -8%, June was +12%, July was +41%, August was +73%, September was +42%, October was -9%, November was -18%, and December was -15%. Statistically significant changes occurred in February, July, August, and September. Climate influences were not assessed, but decreasing summer flows would generally be expected.

[12] Eleven OWRD miscellaneous measurements at "Spring Channel 1" from October 1925 to September 1927 show a range of 13-23 cfs.

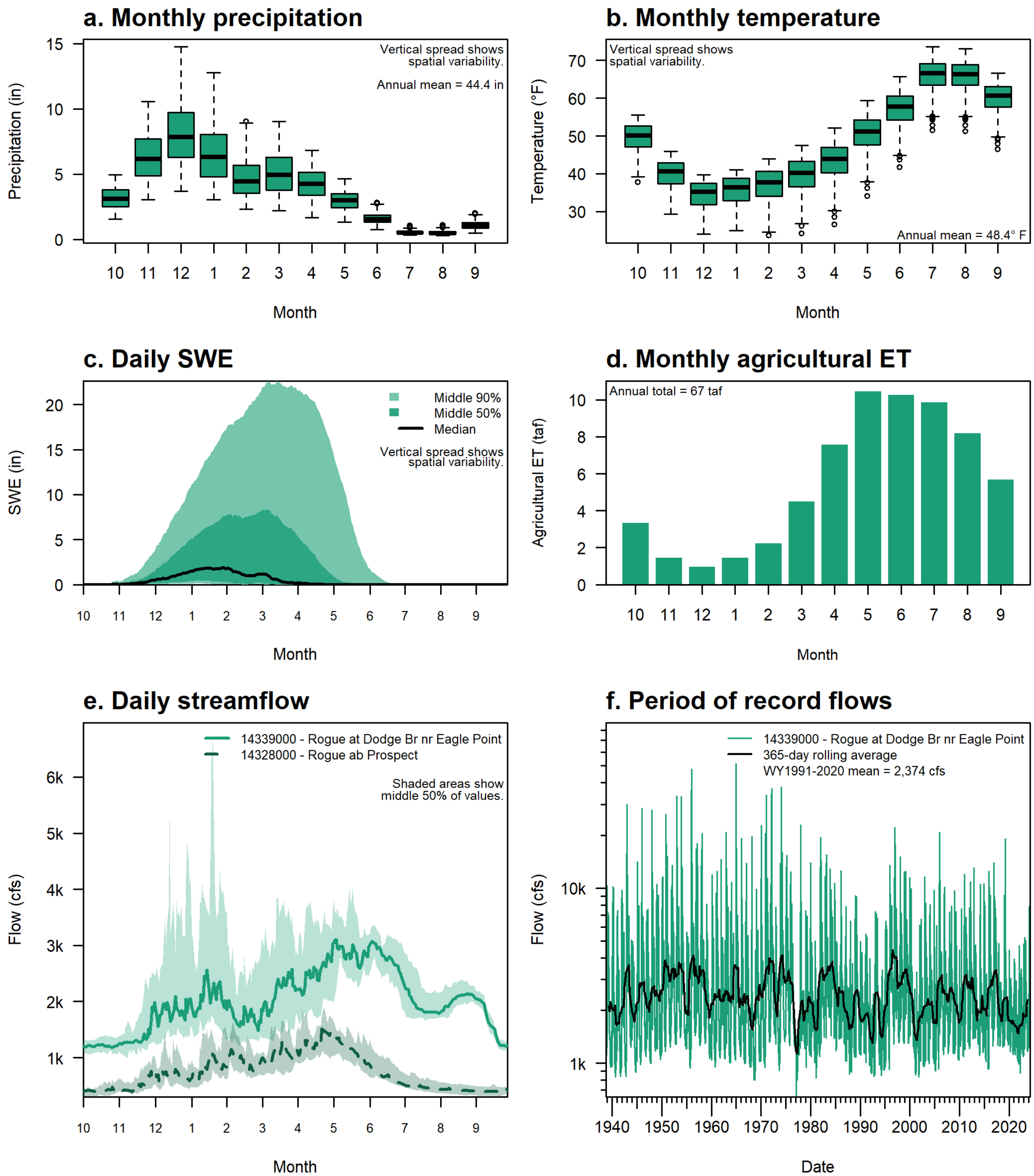

Figure 22. Hydrologic summary for Upper Rogue HUC-8 subbasin showing (a) mean monthly precipitation, (b) mean monthly temperature, and (c) median daily snow water equivalent (SWE), (d) mean monthly agricultural water use, (e) median daily streamflow at selected stations, and (f) period-of-record mean daily streamflow at selected station.

Notes: Period-of-record flow scale is logarithmic (subplot f). Monthly and daily values based on 30-year period (water years 1991-2020). Climate data from PRISM (2025) 1991-2020 normals. SWE data aggregated from Broxton et al. (2019) 4-km gridded product. Agricultural ET calculated from Huntington et al. (2025), described in the text. Boxplot spreads and SWE bands represent spatial variation across pixels within the subbasin; streamflow ribbons represent temporal variation across years.

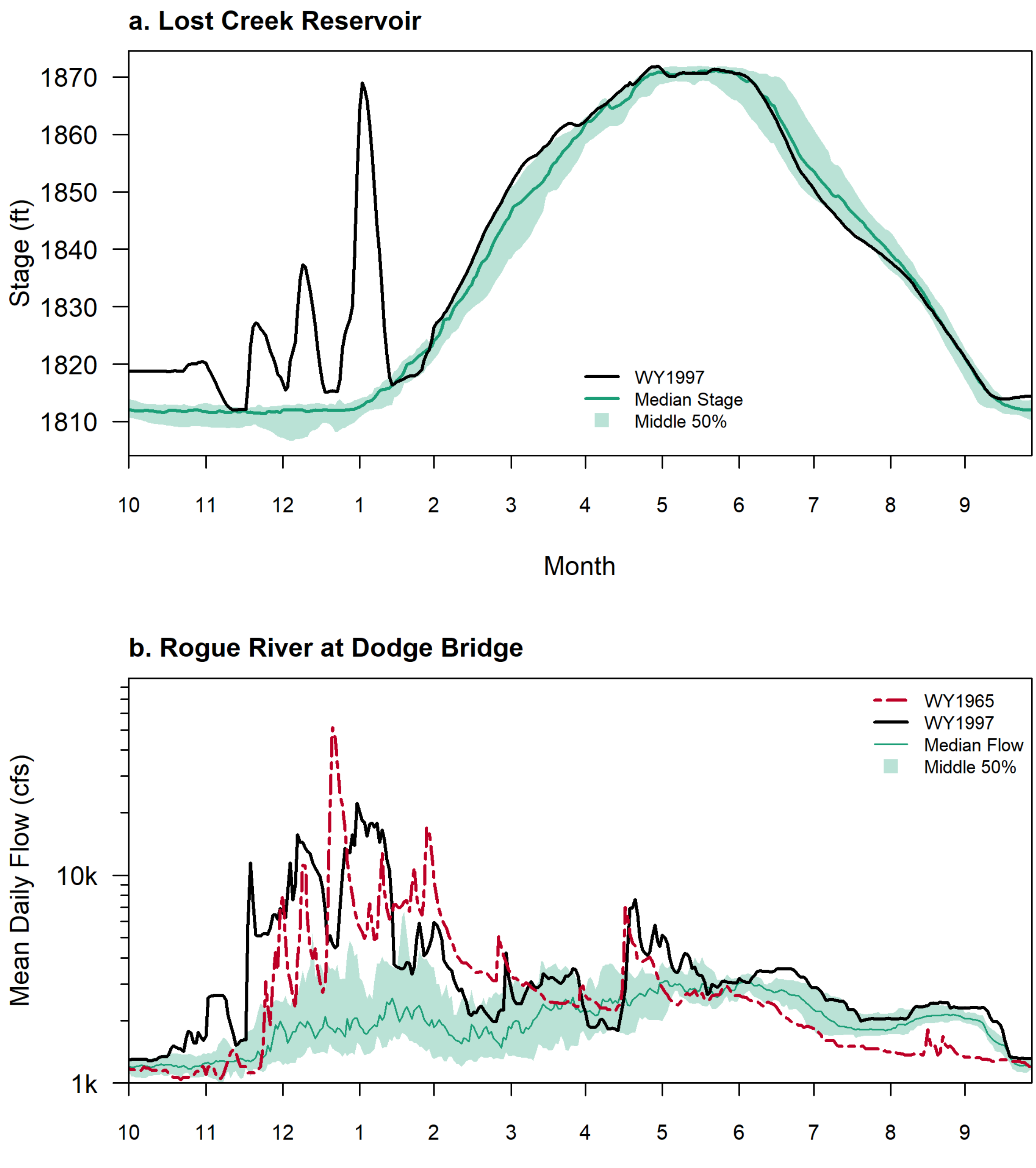

Figure 23. Hydrographs of (a) mean daily stage at Lost Creek Reservoir and (b) mean daily flow at Rogue River at Dodge Bridge near Eagle Point, showing typical values and values for water years 1965 (before reservoir construction; flow only) and 1997 (after reservoir construction), which included the biggest regional floods in the 1900s.

Notes: Flow scale is logarithmic (subplot b). Median and middle 50% of values based on water years 1991-2020. Both subplots show an example post-dam year (water year 1997, solid black line), with the upper plot (a) showing the large flow pulse to the reservoir, while the lower subplot (b) shows how reservoir storage and releases dampen the downstream hydrograph relative to the severely damaging water year 1965 flood (red dashed line). Twenty-two-day event flows at Dodge Bridge were 594 taf and 615 taf for the water year 1965 and 1997 events, respectively. See also Figure E1. Data from USGS for stations #14335040 and #14339000.

Elk Creek joins the Rogue between McLeod and Trail. Near Trail, Elk Creek has mean annual flow of 192 cfs (#14338000). Little Butte Creek joins the Rogue below the Dodge Bridge station. Little Butte Creek averages 220 cfs at Eagle Point (#14347800).

Water Use and Management

In the northern part of the Upper Rogue subbasin, water management is dominated by the Lost Creek reservoir, completed in 1976 (USACE, 2023). Providing 465,000 acre-feet capacity, this reservoir is the largest in the overall basin. Flood control is a primary purpose of the reservoir (Figure 23 and Figure E1), with 180,000 acre-feet allocated for flood risk management (USACE, 2023). The reservoir also serves fishery enhancement, irrigation, and municipal and domestic supply, with up to 180,000 acre-feet collectively available for May to October releases (USACE, 2023).

The U.S. Bureau of Reclamation manages water use for irrigation purposes through a combination of water contracts and use applications with OWRD. Water use allocations for municipal use are managed by the U.S. Army Corps of Engineers. The project maintains flood storage space during winter, fills February to April, and releases May to October (Figure 23). Minimum flows below the dam vary seasonally, from 700 cfs in portions of spring to 2,000 cfs in portions of summer (USACE, 2023). The reservoir averages about 41 inches of annual evaporation (Huntington et al., 2025; Table E1). Reservoir stage typically ranges about 60 feet annually, filling through mid-May then steadily declining to November lows (#14335040) (Figure 23).

In the middle part of the subbasin, the Big Butte Creek system serves as the main water source for the Medford Water Commission (Figure 24) and the Eagle Point Irrigation District (8,260 acres). Water rights owned by the commission and irrigation district have equal priority, but the commission holds 30 cfs and the irrigation district 100 cfs (CH2M, 2017). When flows are below this, the two rightsholders use a proportionate split (i.e., 77% for the irrigation district). Under a cooperative agreement, water from Willow Lake can be used for irrigation, allowing prioritization of spring water for municipal supply. Since 1925, the basin has been legislatively closed, preserving further water use exclusively for the Medford Water Commission (ORS 538.430).

The Upper Rogue subbasin has the second highest irrigated acreage among subbasins at almost 30,000 acres (Table 7). In the southern part of the subbasin, Fish Lake and Little Butte Creek serve as key water sources (Figure E2). Medford and Rogue River Valley Irrigation Districts own water rights and dams on Fourmile Lake and Fish Lake. The Cascade Canal (Figure 21) delivers an annual average of roughly 5,000 acre-feet of water to Fish Lake from the Klamath Basin's Fourmile Lake, after accounting for transportation losses (RRVID, n.d.). Without the Cascade Canal diversion, overflows from Fourmile Lake would enter Fourmile Creek, an intermittent tributary of Upper Klamath Lake. Talent Irrigation District operates Howard, Hyatt, and Emigrant Reservoirs, discussed in the section on the Middle Rogue subbasin, which also supply water for Talent, Rogue River Valley, and Medford Irrigation Districts (approximately 16,300, 8,813, and 12,116 acres, respectively; MID, n.d.; RRVID, n.d.; TID, n.d.).

PacifiCorp operates four hydroelectric facilities near Prospect and one near Eagle Point, constructed between 1911 and 1957, collectively licensed for 81 MW of capacity (PacifiCorp, n.d.; HRA, 2011). The subbasin's history includes the Elk Creek Dam project, which was partially built before legal battles over endangered fish halted construction in 1987 (USACE, 2022). In 2008, the dam was notched and Elk Creek returned to its original channel.

Figure 24. Photo of collection and overflow system at one of the Big Butte Springs. The box captures water springing from the hillside, which then enters a pipe or the overflow.

Figure 25. Aerial photo of Elk Creek dam after notching of the dam.
Photo: USACE (2022).

Middle Rogue Subbasin (including Bear Creek)

The Middle Rogue (Figure 26) is the most densely settled subbasin, home to roughly 247,000 people, almost 80% of the entire Rogue Basin's population (Figure 4; Table 7). It encompasses the mainstem Rogue River from the Little Butte Creek confluence to the Applegate River confluence, covering about 880 square miles (Figure 27). The watershed is dominated by Bear Creek to the south-southwest and Evans Creek to the north. The Bear Creek Valley contains the basin's largest cities, including Medford and Ashland. The Middle Rogue's land use pattern reflects its role as the region's population center and economic powerhouse. It has the Rogue Basin's highest percentage area of developed land and the lowest percentage publicly owned (Table B1).

The subbasin spans a transition between two different mountain ranges: the younger volcanic Cascades to the east and the older, more eroded Klamath-Siskiyou ranges to the south and west. The broad interior valleys and river terraces feature a warmer, drier climate than surrounding Siskiyou Mountains (Table B2). The Rogue Valley ecoregion, which covers a larger share of the Middle Rogue than any other subbasin, historically supported Oregon white oak savannas and grasslands. The diverse geology creates diverse soils, from shallow gravelly upland soils to the deep, agriculturally productive alluvial soils of the Bear Creek Valley floor (OWRD, 1985).

Figure 26. Photo of the Rogue River from Lower Table Rock.

Photo: User:Little Mountain 5 via Wikimedia.org under CC BY SA 3.0.

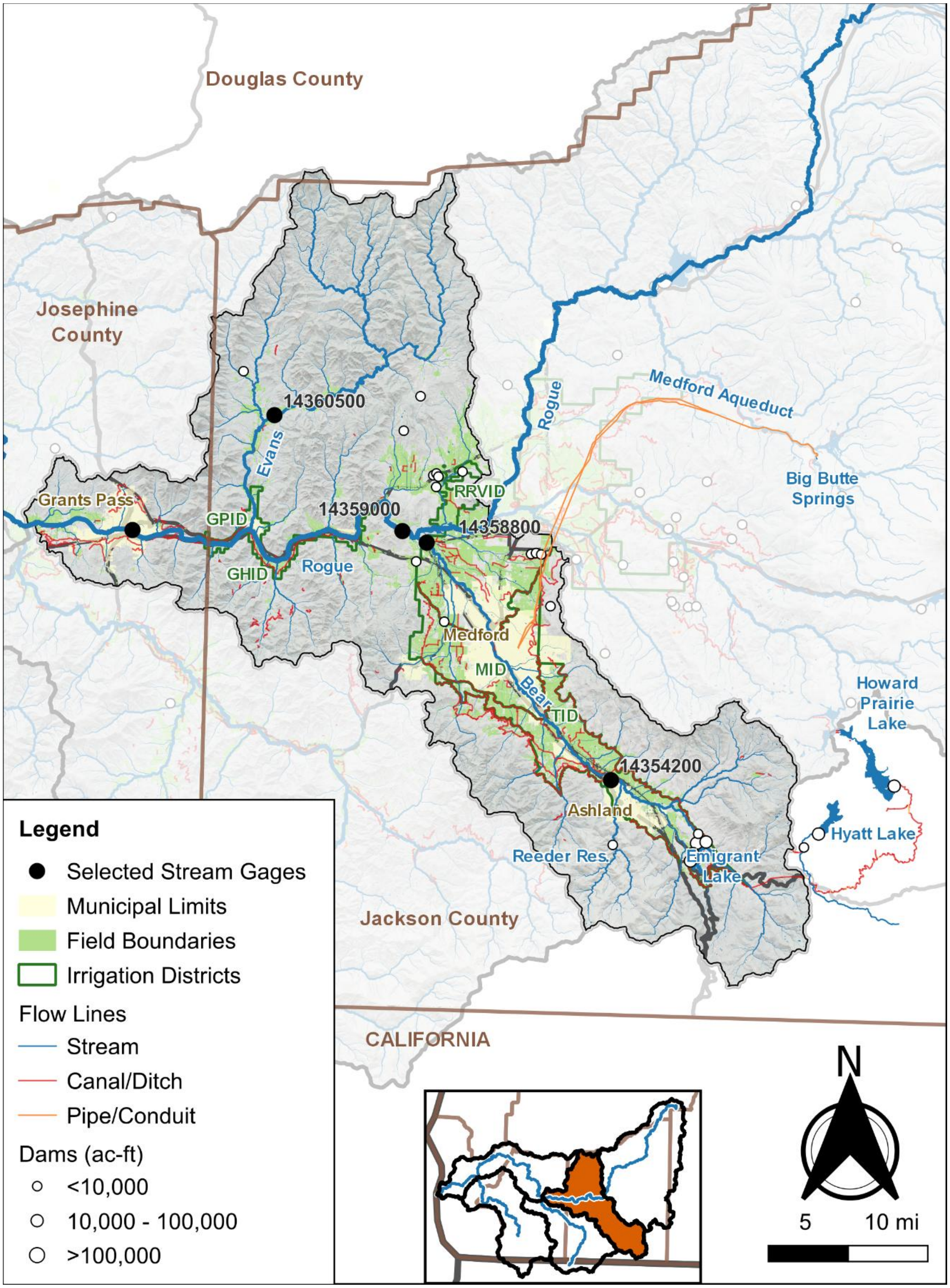

Figure 27. Map of Middle Rogue HUC-8 subbasin hydrologic features.

Notes: GHID = Gold Hill Irrigation District; GPID = Grants Pass Irrigation District; MID = Medford Irrigation District; RRVID = Rogue River Valley Irrigation District; TID = Talent Irrigation District. Flow lines from NHD Plus (version 2), line width continuously scaled to estimated mean annual flow. Dams from NID (n.d.), scaled to normal storage. Gages mentioned in the text are shown. Field boundaries representing agricultural areas from Huntington et al. (2025) for year 2022 (may not be irrigated in that year). Irrigation district data from Jackson County GIS (n.d.).

Stream gradients are relatively moderate, with the mainstem Rogue averaging about 9 feet per mile through this reach, and Bear Creek averaging about 30 feet per mile (OWRD, 1985).

The rain shadow cast by surrounding ranges makes this the driest subbasin in the Rogue. That combination of low precipitation, high population, and intensive agriculture means water demand consistently exceeds natural summer supply. Accordingly, the subbasin includes some of the most complex infrastructure and management operations in the Rogue Basin.

Typical Climate Patterns

The Middle Rogue, lying within the rain shadow of surrounding mountains, experiences the Rogue basin's driest conditions. Precipitation generally decreases moving southeast. Annual average precipitation ranges from as low as 19 inches in the Bear Creek Valley to as much as 62 inches in northernmost mountainous areas (Table 1; Figure 7 and Figure 28a). Watershed-wide annual precipitation averages 30 inches, the lowest of all subbasins, but has ranged from 14 to 51 inches over water years 1991 to 2020 (Table 2). Almost 79% of precipitation typically occurs November through April, versus only 4% July to September (Table A2).

The subbasin is the Rogue's second warmest with an average annual temperature of 53°F (Table A1), ranging from 41°F in uplands to 55°F in valleys (Figure 8 and Figure 28b). Peak snow water equivalent (the amount of liquid water contained in snow) rarely exceeds a quarter-inch across most of the subbasin, reflecting the subbasin's warmer temperatures and lower precipitation, with notable exceptions such as Mount Ashland (Figure 9 and Figure 28c). Most precipitation occurs as rain, making the overall watershed rain-dominated (Table 3).

Groundwater Resources

Groundwater availability is highly varied across the subbasin and depends on the rock formation accessed by wells (OWRD, 1985). Granodiorite rocks with fractures around Grants Pass provide the best yields, typically 5 to 50 gallons per minute (OWRD, 1985). Saline groundwater has been found in some places where deep, old groundwater is believed to be forced upwards by geologic features such as faults (Wiley et al., 2006). The occurrence of saline groundwater throughout the greater Rogue is not yet well understood.

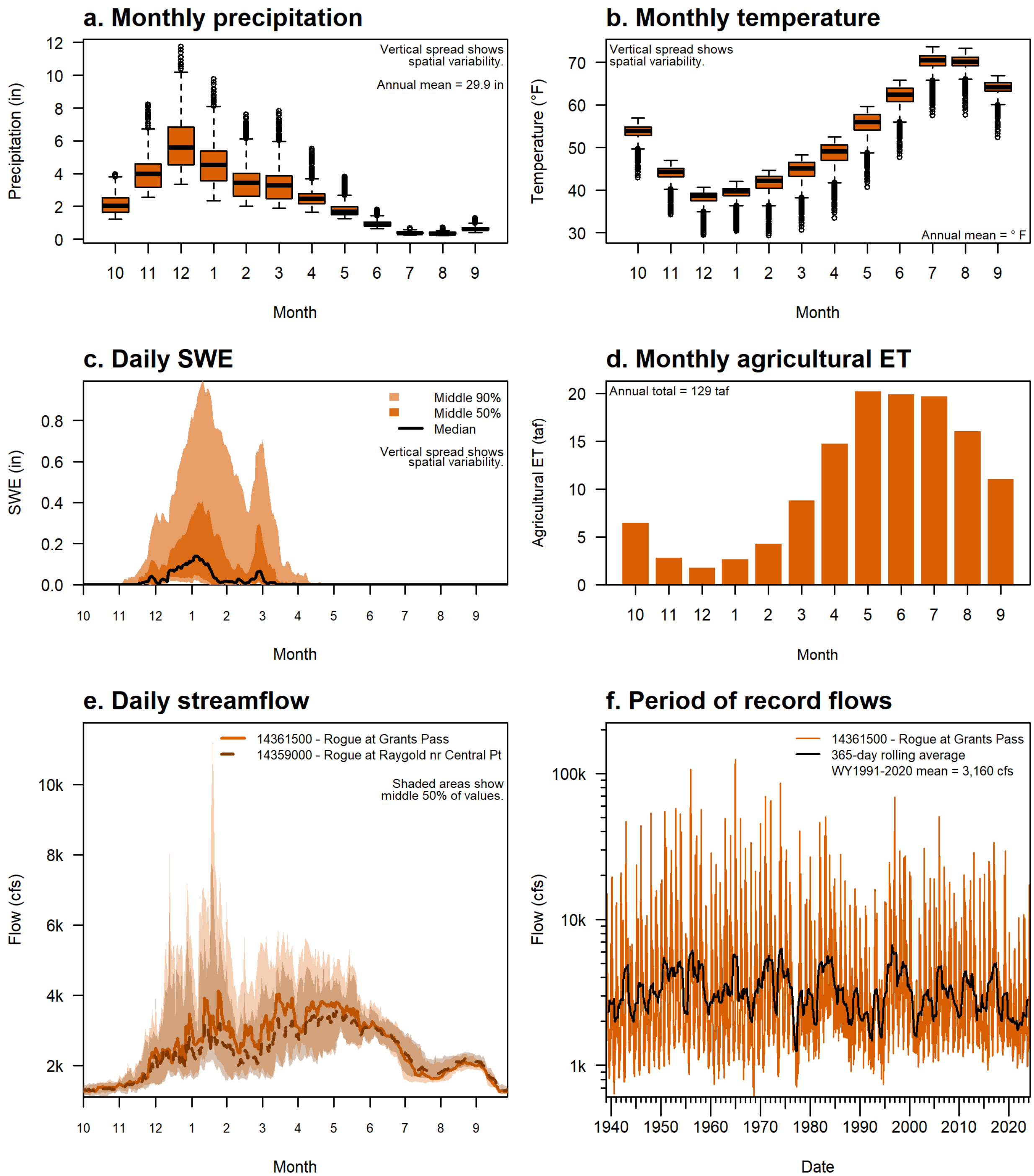

Figure 28. Hydrologic summary for Middle Rogue HUC-8 subbasin showing (a) mean monthly precipitation, (b) mean monthly temperature, and (c) median daily snow water equivalent (SWE), (d) mean monthly agricultural water use, (e) median daily streamflow at selected stations, and (f) period-of-record mean daily streamflow at selected station.

Notes: Period-of-record flow scale is logarithmic (subplot f). Monthly and daily values based on 30-year period (water years 1991-2020). Climate data from PRISM (2025) 1991-2020 normals. SWE data aggregated from Broxton et al. (2019) 4-km gridded product. Agricultural ET calculated from Huntington et al. (2025), described in the text. Boxplot spreads and SWE bands represent spatial variation across pixels within the subbasin; streamflow ribbons represent temporal variation across years.

Streamflow of the Middle Rogue River

The Middle Rogue demonstrates moderate flow variability with influence of intensive irrigation diversions and multiple reservoir operations. Average annual flows increase from 2,805 cfs at Raygold (#14359000) to 3,160 cfs at Grants Pass (#14361500). However, while gaining at the annual scale, the reach between these stations consistently loses flow during summer and gains flow during winter, a pattern that existed both before and after dam construction. The December 1964 flood produced maximum recorded discharge of 124,000 cfs at Grants Pass (Figure 28f).

Emigrant Lake regulates Bear Creek flows, providing 41,000 acre-feet of storage capacity (Table 8). The reservoir experiences approximately 44 inches of annual evaporation and stage fluctuations of about 55 feet annually, typically filling through spring and declining to October lows (Figure E3). Bear Creek, supplemented by inter-basin transfers from the Klamath Basin, has a mean annual flow of 81 cfs at Ashland (#14354200), increasing to 132 cfs at the mouth near Central Point (#14358800; Table D5). Mean annual flow for Evans Creek at Wimer (#14360500) is 144 cfs.

At the upstream Raygold station (#14359000), monthly flows are highest in January, averaging 4,077 cfs and lowest in October, averaging 1,356 cfs (Figure 28e). About 64% of average annual flow occurs December through May. At Grants Pass (#14361500), monthly flows peak in January averaging 5,201 cfs, then decline to August minimums of 2,011 cfs. About 68% of average annual flow occurs December through May (Table D3).

Water Use and Management

The Middle Rogue contains the basin’s most intensive water use between its irrigation, municipal, and industrial bases. The subbasin has the highest irrigated acreage among subbasins at about 59,000 acres (Table 7; Figure 17). The subbasin, particularly in the Bear Creek watershed, also faces the basin’s most severe water quality challenges related to urban and agricultural sources (ODEQ, 2007, 2008). Demand often exceeds natural water availability during warmer months. Accordingly, this subbasin also contains some of the most complex infrastructure and management operations. Stored water released from the Lost Creek Reservoir is sufficient to address both instream and out-of-stream water allocations during most years. Regulation occurs on a handful of tributaries, but mostly on Evans Creek for out-of-stream uses with priorities ranging from 1888 to 1912.

Many of the valley’s municipalities are supplied entirely by the Medford Water

Commission (CH2M, 2017; MWC, 2022). The commission relies foremost on Big Butte Springs. Two main pipes, each over 30 miles long, deliver water from the springs in the Upper Rogue to Medford in the Middle Rogue (Figure 27). When the water available from the springs is not sufficient to meet demand, typically in the warmer months, supply is augmented using the Duff Water Treatment Plant on the Rogue mainstem (CH2M, 2017). However, Ashland primarily manages its own water supply using Ashland Creek and the 850 acre-feet Reeder Reservoir (RH2, 2020).

The Middle Rogue subbasin supports multiple irrigation districts (Linenberger, 1999; Linenberger, 2000), including: Talent (16,300 acres), Medford (12,116 acres), Rogue River Valley (8,813 acres), Grants Pass (7,700 acres), and Gold Hill. Groundwater use for irrigation is relatively limited, except in Sams Valley due to lack of surface water. The Grants Pass and Gold Hill Irrigation Districts are the furthest downstream and divert directly from the Rogue River.

Talent, Medford, and Rogue River Valley Irrigation Districts (listed in order upstream to downstream along the Bear Creek Valley) mainly rely on water from tributaries of the Rogue. However, in addition to Upper Rogue diversions discussed in the previous section, Talent Irrigation District also diverts water from the Jenny Creek drainage in the Klamath Basin for storage in Howard Prairie (Figure 29), Hyatt, and Emigrant (Figure 30) Reservoirs (Table 8). These reservoirs provide water for Talent, Rogue River Valley, and Medford Irrigation Districts. Howard Prairie and Hyatt are located in the Klamath Basin (Figure 27). About 24,200 acre-feet is transferred each year from the Klamath Basin through these reservoirs to the Middle Rogue (MID, n.d.). Medford and Rogue River Valley also divert from Bear and Antelope Creeks.

The Middle Rogue subbasin has seen several significant dam removal projects to support fish passage. In 2009, the Savage Rapids Dam was removed from the Rogue mainstem (Tullos et al., 2014). On Evans Creek, a major tributary spanning the northern portion of the subbasin, three dams have been removed, the most recent in 2024. An Allocation of Conserved Water established an instream water right in Evans Creek with an 1896 priority date.[13]

[13] A program that allows a water user who reduces their water use through conservation improvements (such as irrigation efficiency upgrades) to retain rights to a portion of the water saved (OAR 690-018). The conserved water can be applied to additional lands, leased or sold, or dedicated to instream use. The state reserves a share of the conserved water as an instream water right. New certificates are issued for each share, generally retaining the priority date of the original water right.


Figure 29. Photo of Howard Prairie Lake.


Figure 30. Photo of Emigrant Lake.

Applegate Subbasin

The Applegate River (Figure 31) subbasin covers about 770 square miles of some of the most rugged terrain in the Rogue basin (Table B3). The river begins in northern California and flows north through the Siskiyou Mountains before joining the Rogue near river mile 95 (Figure 32). The Applegate is a subbasin of steep slopes, sharp ridgelines, and narrow canyon bottoms, with elevations ranging from about 850 feet at the river mouth to over 7,400 feet at Dutchman's Peak, with many peaks exceeding 5,000 feet (Figure 5) (OWRD, 1985). The Applegate River runs about 51 miles in total.

More than two-thirds of the subbasin falls within the Inland Siskiyous ecoregion (Table B2). This higher and more mountainous subregion of the broader Klamath Mountains range experiences longer summer droughts and higher fire frequency than neighboring ecoregions. It features a diverse, multi-layered mix of conifers, broadleaf evergreens, and deciduous trees and shrubs. About 70% of the subbasin is covered by evergreen forest, the highest among subbasins (Table B1).

The 2020 population living within the Applegate subbasin was approximately 15,000, or about 5% of the basin's total (Table 7). There are no incorporated municipalities in the subbasin. Soils throughout the watershed are mostly moderately deep and well-drained on forested upland slopes, with better agricultural soils restricted to river-related deposits (OWRD, 1985).

Figure 31. Photo of the Applegate River just north of Applegate Dam.
Photo: Gary Halvorson (Oregon State Archives) via Wikimedia.org under CC BY SA 4.0.

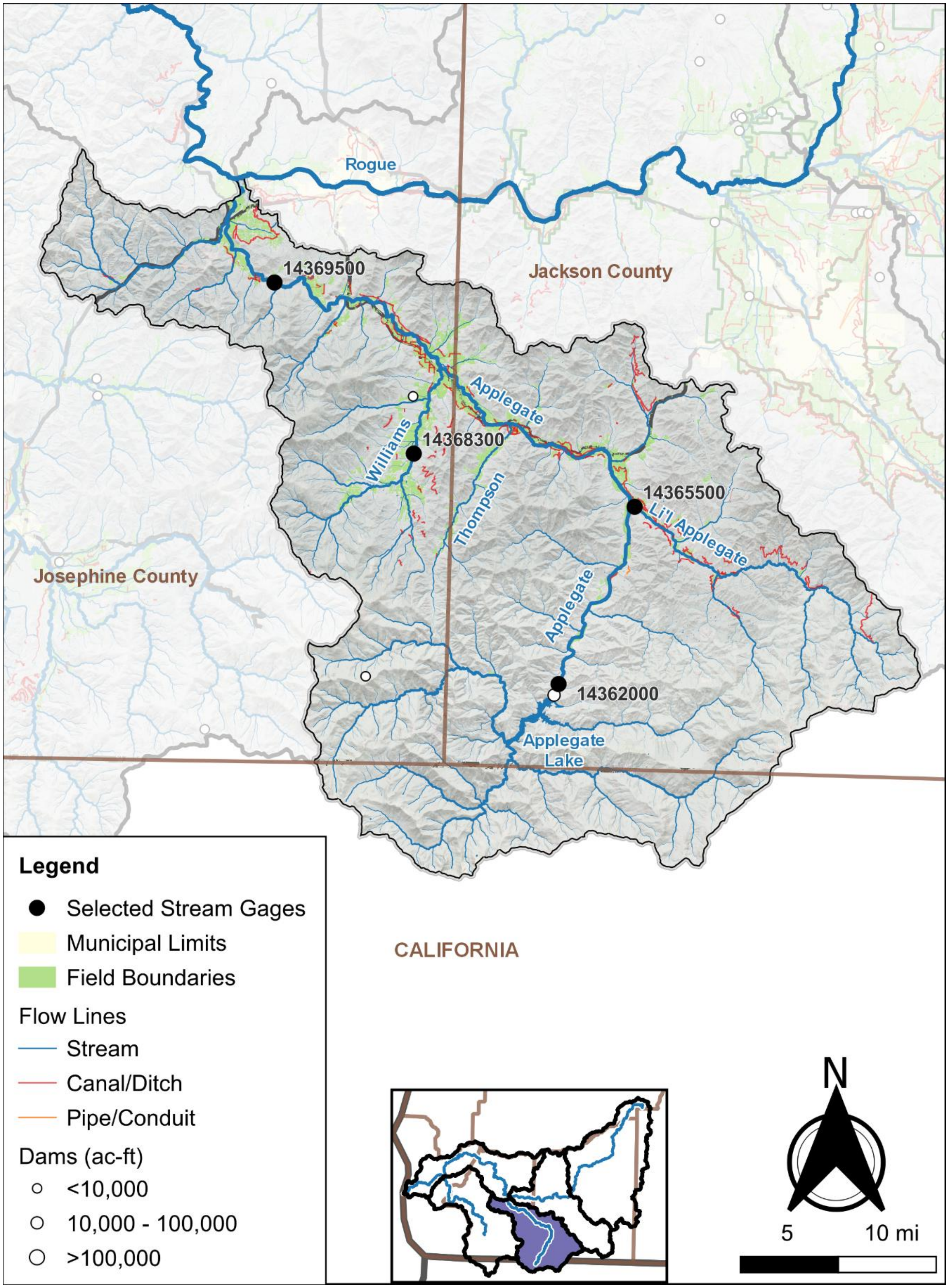

Figure 32. Map of Applegate HUC-8 subbasin hydrologic features.

Notes: Flow lines from National Hydrography Dataset Plus (version 2), line width continuously scaled to estimated mean annual flow. Dams from NID (n.d.), scaled to normal storage. Gages mentioned in the text are labeled. Field boundaries representing agricultural areas from Huntington et al. (2025) for year 2022 (may not be irrigated in that year).

Applegate River streamflow has been described as “erratic”, introducing water management challenges (OWRD, 1985). The Applegate Dam, completed in 1980, serves as major infrastructure for flood control and water supply reliability.

Typical Climate Patterns

Precipitation ranges from 24 inches near the mouth of the Applegate River to 102 inches at higher, mountainous elevations (Table 1; Figure 7 and Figure 33a). Watershed-wide annual precipitation averages 39 inches but has ranged from 16 to 64 inches over water years 1991 to 2020 (Table 2). About 82% of precipitation typically occurs November through April, versus only 4% July to September (Table A2).

Average temperatures range from 40°F in mountainous areas to 55°F in valleys, with a subbasin-wide mean of 51°F (Table 1; Figure 8 and Figure 33b).

Peak snow water equivalent exceeds 6 inches in higher elevations, though a third-inch or less is typical in most areas (Figure 9 and Figure 33c). Rain is dominant in lower elevations, with snow in higher elevations; the watershed as a whole is mixed rain-snow (Table 3).

Groundwater Resources

The ancient, deformed rocks of the Applegate subbasin transmit little water (OWRD, 1985). Deep rocks may contain brackish or saline water (OWRD, 1985), although occurrence of saline groundwater throughout the greater Rogue is not yet well understood. In most areas, yields are only enough to support domestic use.

Streamflow of the Applegate River

The Applegate River exhibits considerable seasonal flow variability, reflecting climate, water use, and reservoir operations. This subbasin has the highest relative year-over-year variation in mean annual flows (Table 6). Mean annual flow increases from 406 cfs near Copper below the dam (#14362000) to 669 cfs at Wilderville (#14369500). However, while gaining at the annual scale, the reach between the Copper and Wilderville stations consistently loses flow during summer and gains flow during winter, a pattern that existed both before and after dam construction.[14]

[14] Mean monthly upstream-downstream flow differentials were compared between pre-dam (data available prior to water year 1975, to allow for construction) and post-dam (water years 1991-2020) periods using the upstream Copper (#14362000) and downstream Wilderville (#14369500) gages. The reach was gaining in all months except July to September in both periods; no months changed gaining/losing status following construction.

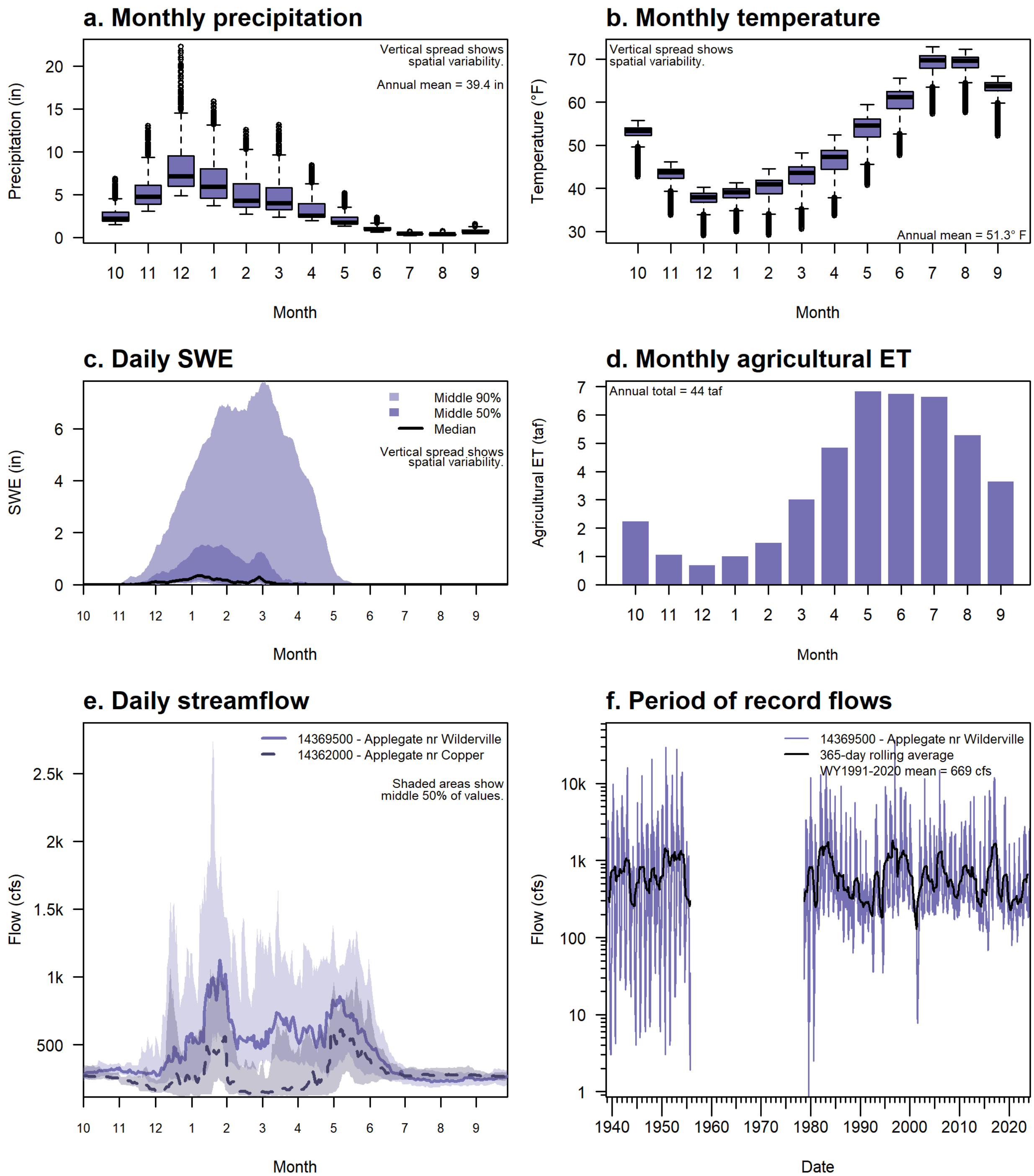

Figure 33. Hydrologic summary for Applegate HUC-8 subbasin showing (a) mean monthly precipitation, (b) mean monthly temperature, and (c) median daily snow water equivalent (SWE), (d) mean monthly agricultural water use, (e) median daily streamflow at selected stations, and (f) period-of-record mean daily streamflow at selected station.

Notes: Period-of-record flow scale is logarithmic (subplot f). Monthly and daily values based on 30-year period (water years 1991-2020). Climate data from PRISM (2025) 1991-2020 normals. SWE data aggregated from Broxton et al. (2019) 4-km gridded product. Agricultural ET calculated from Huntington et al. (2025), described in the text. Boxplot spreads and SWE bands represent spatial variation across pixels within the subbasin; streamflow ribbons represent temporal variation across years.

Applegate Dam, completed in 1980, provides 82,200 acre-feet of storage capacity (Table 8). The reservoir dramatically altered the Applegate's natural flow patterns. After construction, warm season flows near Copper increased by 125-469% (July-October), while cool season flows decreased by 1-45% (November-June).[15] Similar seasonal shifts occurred at the downstream Wilderville station (#14369500).[16]

Near Copper (#14362000), reservoir operations considerably moderate seasonal variability, with average summer flows around 275 cfs from July to October, versus the January average of 721 cfs (Figure 33e). Prior to the dam, daily flows historically dropped below 1 cfs during extreme drought conditions. About 64% of average annual flow occurs December through May. At the downstream Wilderville station (#14369500), flows demonstrate greater seasonality with January averaging 1,436 cfs versus August averaging 235 cfs. About 76% of average annual flow occurs December through May, with January alone contributing 18% (Table D3).

The Little Applegate River (Figure 35) averages about 54 cfs per year near its mouth (#14365500; Table D4). Williams Creek at Williams (#14368300) averages 75 cfs.

Water Use and Management

The subbasin faces high flow variability, with extreme swings in flow from one year to the next (Table 6), although the Applegate Reservoir helps to mitigate this variability. Completed in 1980, the reservoir provides primary storage with 82,200 acre-feet capacity (USACE, 2023).

Flood control is a primary purpose (Figure 34 and Figure E4), with 65,000 acre-feet allocated for flood risk management (USACE, 2023). In winter, the reservoir can be drafted down to provide capacity to capture large inflows that could otherwise cause downstream flooding. The project maintains flood storage space during winter, fills February to April, and releases May to October (Figure 34). Reservoir stage typically ranges about 90 feet annually. Reservoir annual evaporation averages about 45 inches (Huntington et al., 2025; Table E1).

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[15] Mann-Whitney U tests were used to compare mean monthly flows between pre-dam (data available prior to water year 1975, to allow for construction) and post-dam (water years 1991-2020) periods at Applegate near Copper (#14362000). Holm (1979) adjustment for multiple comparisons was used. January was -18%, February was -42%, March was -38%, April was -45%, May was -24%, June was -1%, July was +125%, August was +358%, September was +469%, October was +174%, November was -7%, and December was -20%. Statistically significant changes occurred in February, March, April, July, August, September, and October. Climate influences were not assessed, but decreasing summer flows would generally be expected.

[16] January was -13%, February was -30%, March was -8%, April was -27%, May was -16%, June was -6%, July was +151%, August was +724%, September was +598%, October was +45%, November was -20%, and December was -9%. Statistically significant changes occurred in July, August, September, and October.

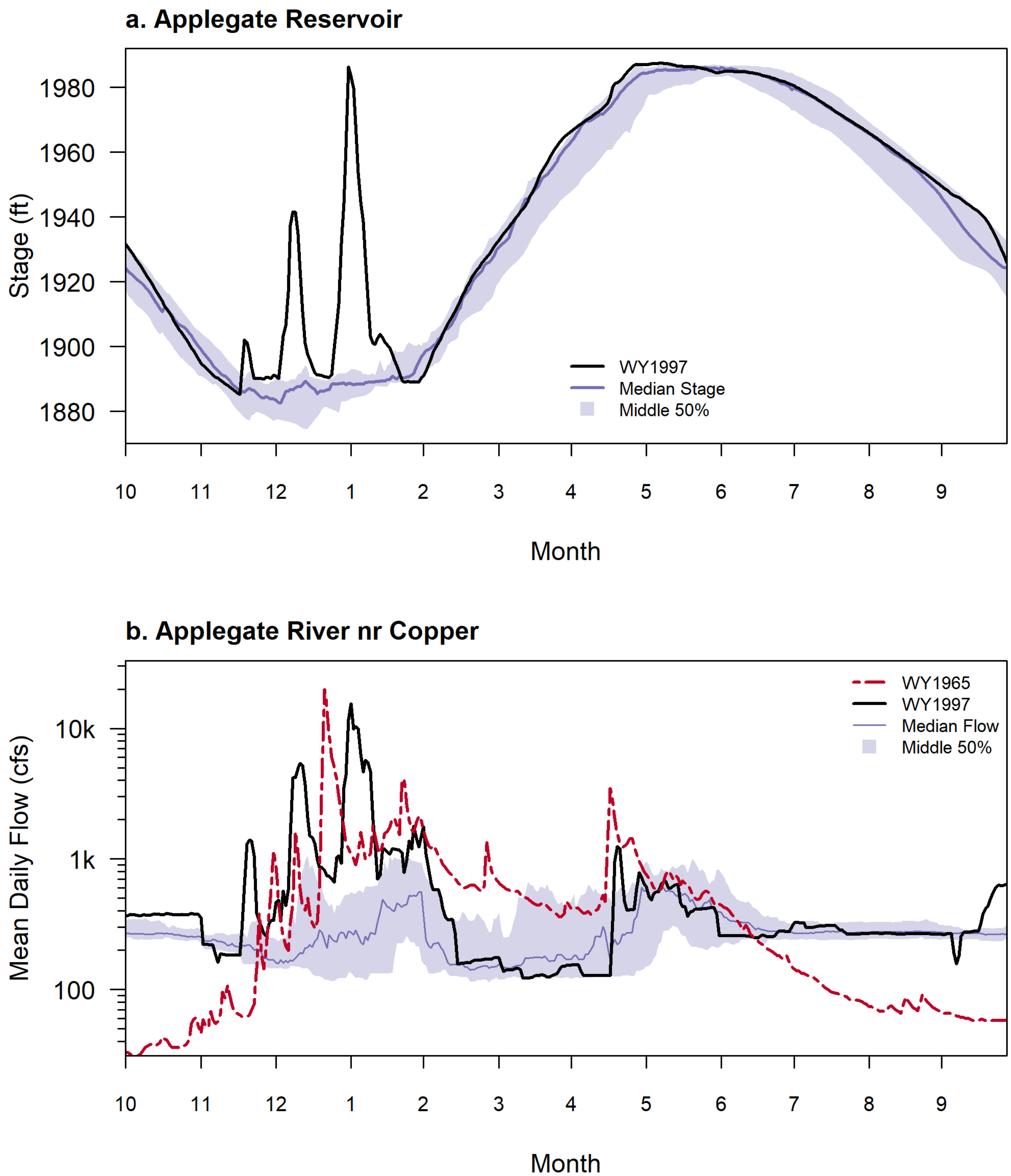

Figure 34. Hydrographs of (a) mean daily stage at Applegate Reservoir and (b) mean daily flow at Applegate River near Copper, showing typical values and values for water years 1965 (before reservoir construction; flow only) and 1997 (after reservoir construction), which included the biggest regional floods in the 1900s.

Notes: Flow scale is logarithmic (subplot b). Median and middle 50% of values based on water years 1991-2020. Both subplots show an example post-dam year (water year 1997, solid black line), with the upper plot (a) showing the large flow pulse to the reservoir, while the lower subplot (b) shows how reservoir storage and releases dampen the downstream hydrograph relative to the severely damaging water year 1965 flood (red dashed line). Fifteen-day event flows near Copper were 137 taf and 178 taf for the water year 1965 and 1997 events, respectively. See also Figure E4. Data from USGS for stations #14361900 and #14362000.

The reservoir also serves fishery enhancement and irrigation, with up to 66,000 acre-feet collectively available for May to October releases (USACE, 2023). The U.S. Bureau of Reclamation manages the use of reservoir water for irrigation purposes through water contracts and use applications with OWRD.

Stored water from the reservoir is sufficient to address both instream and out-of-stream water allocations during most years. On Little Applegate, regulation occurs each year beginning around early July back to 1857 priority instream water rights, which resulted from a series of restoration projects, totaling about 14 cfs. Therefore, many water users now rely on contracted water from the Applegate River. In the Williams Creek drainage, regulation occurs on a near-annual basis, typically beginning in July; at times, regulation occurs back to the oldest water rights with 1858 priority.

About 19,500 acres in the Applegate are irrigated (Table 7). Mining rights are prevalent, but most are no longer exercised (OWRD, 1985). The subbasin has numerous ditches, many converted from former mining operations (OWRD, 1985), maintained by voluntary associations serving individual rightsholders. Due to high soil porosity, irrigation water may infiltrate back to the river and may be reused downstream (OWRD, 1985).

To support fish passage in spawning tributaries, multiple dams have been removed on Welter and Slate Creeks since 2020 (WaterWatch, n.d.).

Figure 35. Photo of the Little Applegate River.

Photo: Kyle Sullivan (USBLM) via CC BY 2.0.

Illinois Subbasin

The Illinois River begins in northern California and flows north through deep canyons (Figure 36) before joining the Rogue at river mile 27. The river runs about 56 miles, roughly 50 of which are designated Wild and Scenic under federal law (NWSRS, n.d.). The subbasin covers about 990 square miles (Figure 37). The topography is steep throughout, with total relief of approximately 7,000 feet and narrow valley bottoms (OWRD, 1985).

Located within the Klamath-Siskiyou Mountains, the Illinois subbasin was a hotspot for gold mining from the 1850s to 1870s, and the magnetic mineral called josephinite has been found along Josephine Creek (OWRD, n.d.; Botto & Morrison, 1976). Today, the subbasin has remained relatively undeveloped. With about 10,000 residents, the Illinois is the least populated part of the Rogue basin (Table 7; Figure 4). Almost 80% of the land is publicly owned, the highest share in the basin (Table B1). Alluvial areas along the Illinois Valley near Cave Junction and Deer Creek Valley near Selma provide the primary areas suitable for agriculture and development (OWRD, 1985).

Much of the Illinois subbasin is underlain by rocks that contain serpentine (Table B2), a shiny green mineral. As serpentine weathers, it produces soils with high concentrations of heavy metals. Only specialized plants can survive these conditions. Serpentine areas stand out in the landscape as sparse, open patches of Jeffrey pine, shrubby chaparral, and bare rock set against otherwise dense forest. This patchwork helps explain why the Illinois subbasin has lower evergreen forest cover compared to other subbasins (Table B1). As the Illinois approaches the Rogue, the subbasin transitions into wetter, marine-influenced conditions and Coastal Siskiyou forests.

Figure 36. Photo of the Green Wall Rapids on the Illinois River.

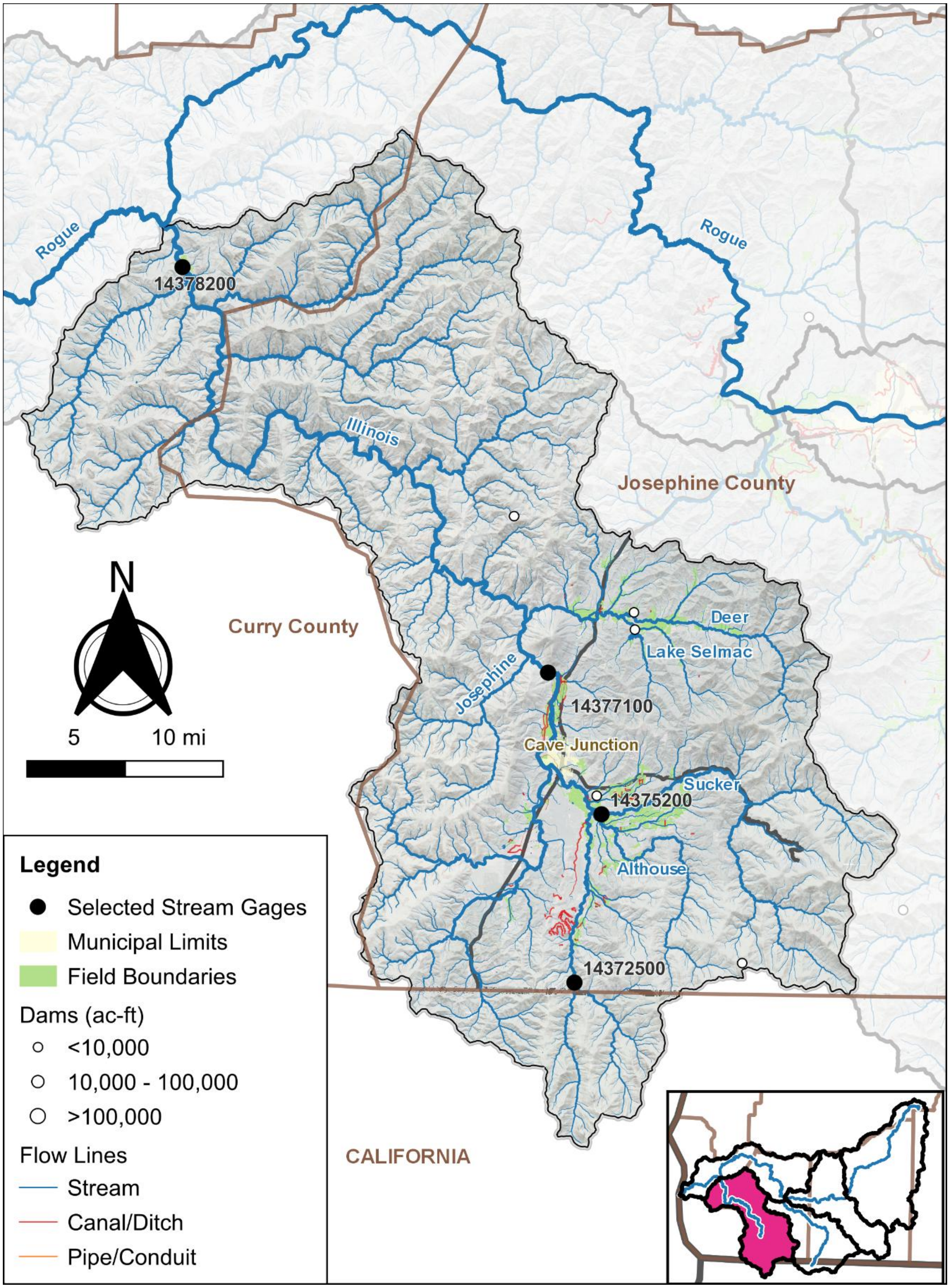

Figure 37. Map of Illinois HUC-8 subbasin hydrologic features.

Notes: Flow lines from National Hydrography Dataset Plus (version 2), line width continuously scaled to estimated mean annual flow. Dams from NID (n.d.), scaled to normal storage. Gages mentioned in the text are labeled. Field boundaries representing agricultural areas from Huntington et al. (2025) for year 2022 (may not be irrigated in that year).

Typical Climate Patterns

The Illinois subbasin experiences the Rogue basin's highest precipitation, with a watershed-wide annual average of 83 inches—nearly three times that of the Middle Rogue (Table 1; Figure 7 and Figure 38a). However, annual averages range from 46 inches in interior valleys to 168 inches in coastal mountains. Precipitation can also vary greatly from year to year; watershed-wide annual precipitation has ranged from 36 to 121 inches over water years 1991 to 2020 (Table 2). About 84% of precipitation typically occurs November through April and only 3% July to September (Table A2).

Average annual temperatures are moderate, ranging from 43°F in mountains to 56°F in valleys, with a subbasin-wide mean of 52°F, reflecting strong marine moderation (Figure 8 and Figure 38b).

The subbasin is highly rain-dominated (Table 3). Peak snow water equivalent peaks are less than an inch in most of the basin (Figure 9 and Figure 38c).

Groundwater Resources

Much of the bedrock in the Illinois River subbasin has limited groundwater potential (OWRD, 1985). Most of the pore spaces in rocks have been closed by metamorphism (transforming of rocks from pressure) or other geologic processes. Steep slopes and low porosity cause low recharge, despite high precipitation. However, many wells can support domestic use.

Near the bottom of older alluvial deposits in localized areas, wells may encounter brackish or saline water (OWRD, 1985). The occurrence of saline groundwater throughout the greater Rogue is not yet well understood, and water quality throughout the Illinois subbasin is generally good (OWRD, 1985).

Streamflow of the Illinois River

The Illinois River represents the basin's most free flowing (no major dams) hydrologic system and shows among the highest relative seasonal flow variability (Table D3). Near Kerby (#14377100), extreme mean daily flows have ranged from 12.4 cfs during severe drought (September 2014 and 2018) to 64,000 cfs during the December 1964 flood. Mean annual flow near Kerby averages 1,172 cfs based on water years 1991-2020. Closer to the mouth near Agness, historical data at a discontinued stream gage (#14378200) show mean annual flows of almost 4,100 cfs (Table D4).

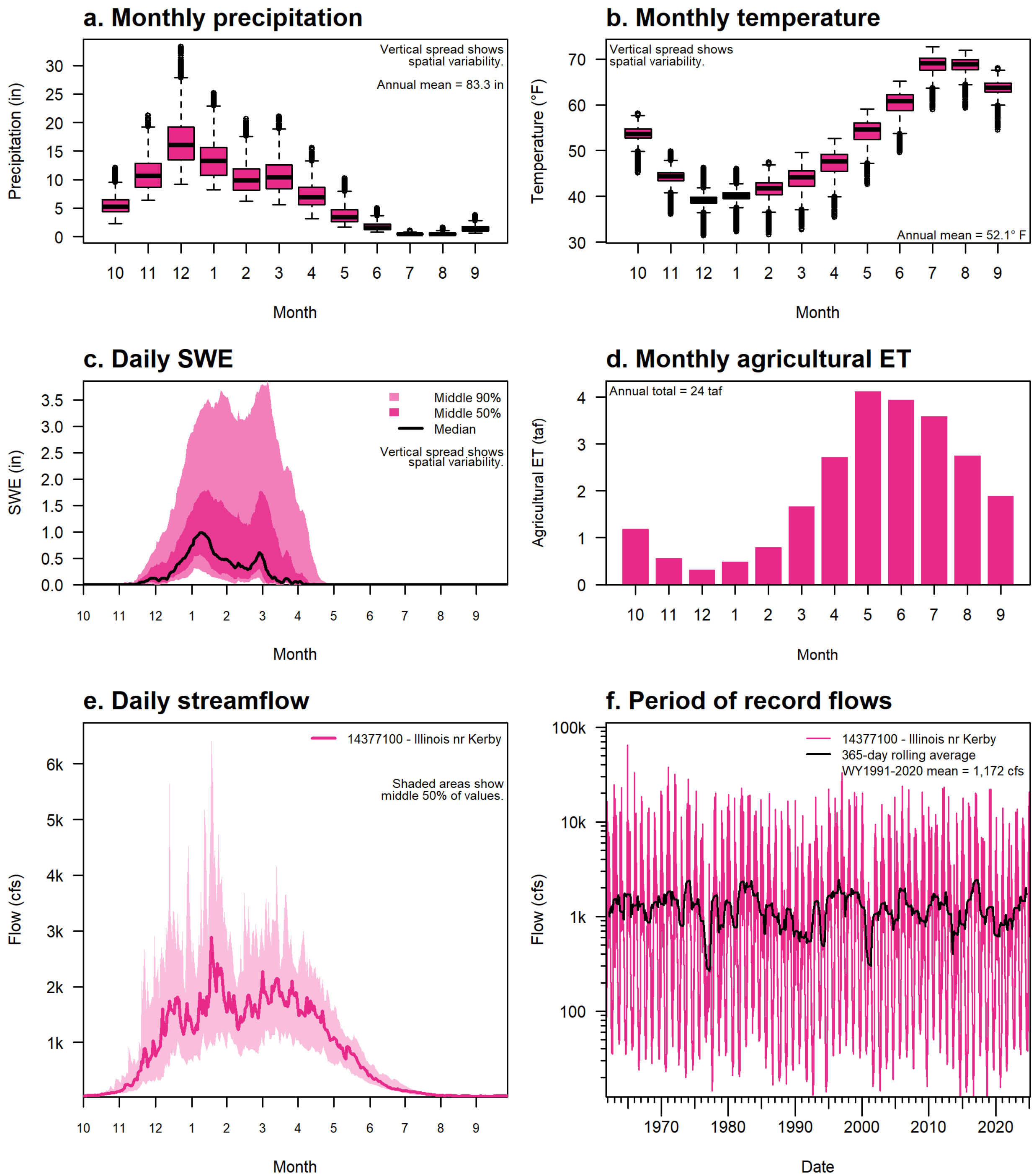

Figure 38. Hydrologic summary for Illinois HUC-8 subbasin showing (a) mean monthly precipitation, (b) mean monthly temperature, and (c) median daily snow water equivalent (SWE), (d) mean monthly agricultural water use, (e) median daily streamflow at selected stations, and (f) period-of-record mean daily streamflow at selected station.

Notes: Period-of-record flow scale is logarithmic (subplot f). Monthly and daily values based on 30-year period (water years 1991-2020). Climate data from PRISM (2025) 1991-2020 normals. SWE data aggregated from Broxton et al. (2019) 4-km gridded product. Agricultural ET calculated from Huntington et al. (2025), described in the text. Boxplot spreads and SWE bands represent spatial variation across pixels within the subbasin; streamflow ribbons represent temporal variation across years.

Monthly flows near Kerby are highly seasonal, with January daily flows averaging 2,878 cfs versus September averaging 43 cfs (Figure 38e). About 88% of annual flow occurs December through May, with January alone accounting for 20% of annual flow (Table D3). This seasonal proportion is the most extreme of any subbasin.

Many tributaries experience low flows or complete drying from July through September (OWRD, 1985). For example, the East Fork near Takilma (#14372500) averages 10 cfs in September versus 345 cfs in January, for a mean annual flow of 161 cfs (Table D3). Sucker Creek at Bridgeview (#14375200) averages 13 cfs in September versus 449 cfs in January, for a mean annual flow of 225 cfs.

Water Use and Management

The Illinois subbasin has seen several dam removals, such as the Takelma Creek Dam in 2023 and the Pomeroy Dam in 2024, the latter freeing 56 miles of the Illinois (WaterWatch, n.d.). This makes the Illinois River unique as a free-flowing major river system (Figure 39).

With little reservoir storage (Figure 37), the subbasin shows more natural hydrologic patterns. This positions the subbasin as a climate refuge for salmon and an indicator of hydrologic change (BLM, 1999; ODEQ, 2008; Halofsky et al., 2022).

However, low summer flows challenge agricultural use. About 11,000 acres are irrigated (Table 7). Key crops have changed over time with changing economics and irrigation practices. Grapes and cannabis have been important in recent years. Many former mining ditches around the subbasin are now defunct.

Figure 39. Photo of the Illinois River from Illinois River Road.

Lower Rogue Subbasin

The Lower Rogue subbasin covers 910 square miles, encompassing watershed areas below river mile 95 to the Pacific Ocean (Figure 40), excluding the Illinois (Figure 41). Approximately 84 miles of the river in this reach are designated as a federal and state scenic waterways, the highest of any subbasin (OAR 736-040-0045; NWSRS, n.d.).

In the Lower Rogue, the Klamath-Siskiyou range meets abundant marine fog and precipitation arriving from the Pacific. This supports productive Coastal Siskiyou forests, including tanoak, Douglas fir, and Port Orford cedar. Higher interior areas include more Inland Siskiyou ecoregion, with mixed conifer and broadleaf forest. About 70% of the subbasin is publicly owned and 70% is covered by evergreen forest, with another 4% mixed forest (Table B1). The subbasin features some of the Rogue's most wild and rugged terrain (Table B3). Its highest point is Brandy Peak at 5,316 feet (OWRD, 1985).

The subbasin's roughly 16,000 residents are concentrated around the coastal community of Gold Beach and in the basin's upper half (Table 7; Figure 4). Steep slopes and highly variable soils limit areas suitable for agriculture to certain alluvial areas (OWRD, 1985).

Moving through the Lower Rogue subbasin, the Rogue River transitions from a gradient of about 13 feet per mile in upper reaches to just 3.6 feet per mile in the lower 28 miles approaching the ocean, where it widens and slows before entering the sea (OWRD, 1985). Steep gradients in the canyon sections give the river the energy to move large amounts of sediment and wood.

Figure 40. Photo of the Isaac Lee Patterson Bridge over the Rogue River in Gold Beach.
Photo: User:Cacophony via Wikimedia.org under CC BY SA 3.0.

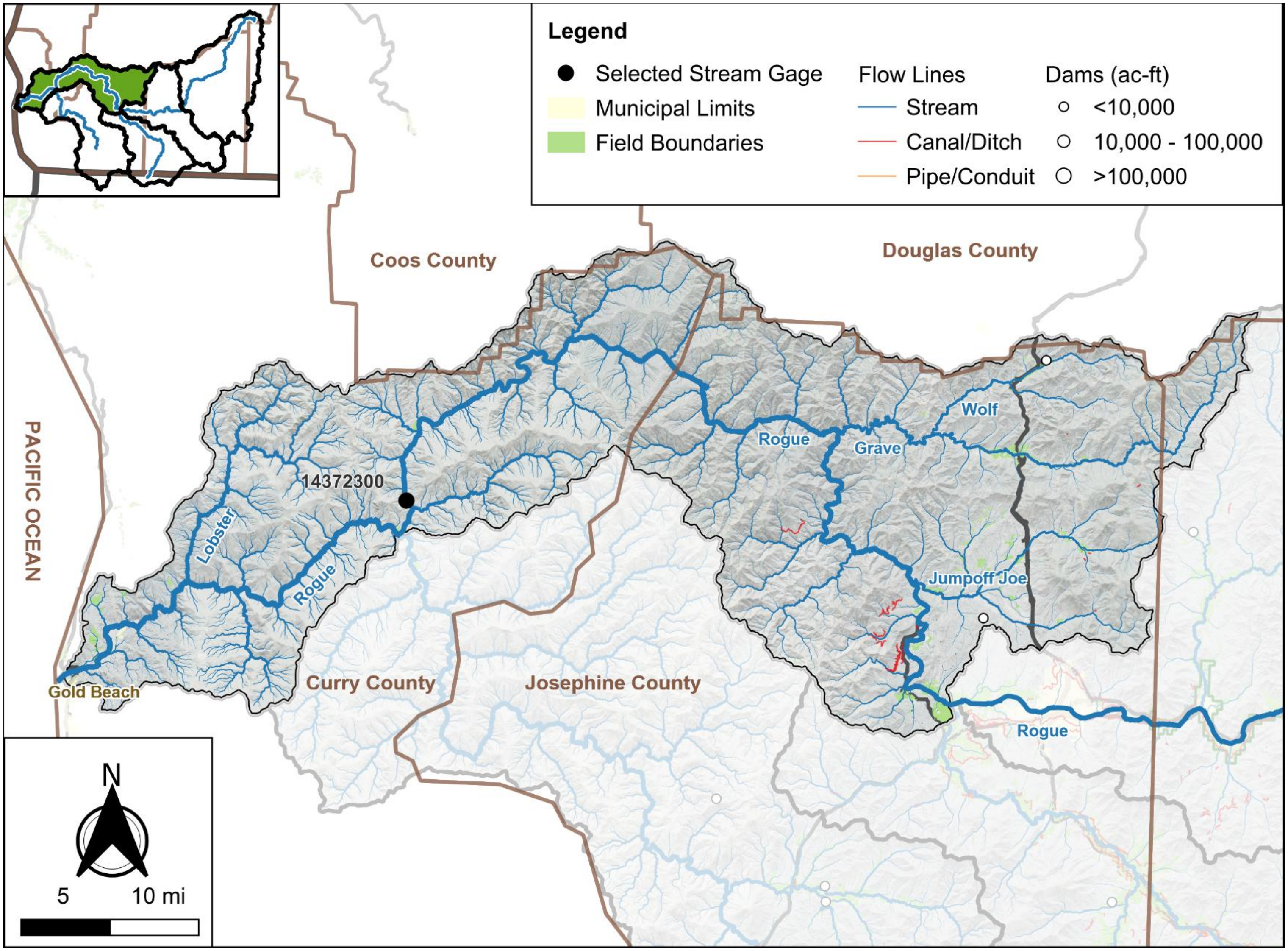

Figure 41. Map of Lower Rogue HUC-8 subbasin hydrologic features.

Notes: Flow lines from National Hydrography Dataset Plus (version 2), line width continuously scaled to estimated mean annual flow. Dams from NID (n.d.), scaled to normal storage. Gages mentioned in the text are labeled. Field boundaries representing agricultural areas from Huntington et al. (2025) for year 2022 (may not be irrigated in that year).

Typical Climate Patterns

The Lower Rogue's coastal location creates a mild, wet climate. Watershed-wide annual precipitation averages 74 inches but has ranged from 33 to 103 inches over water years 1991 to 2020 (Table 2). However, precipitation varies greatly across the subbasin, generally increasing toward the coast, where average annuals reach as high as 196 inches (Table 1; Figure 7 and Figure 42a). About 83% of precipitation typically occurs November through April and only 3% July to September (Table A2).

Temperatures are moderate year-round, reflecting strong marine influence (Figure 8 and Figure 42b). Annual average temperatures range from 45°F to 56°F, with a basin-wide mean of 53°F. The frost-free period extends over 200 days at higher elevations to more than 300 days near the coast, the longest in the basin (OWRD, 1985).

The Lower Rogue is the Rogue's most rain-dominated subbasin (Table 3). Snow water equivalent rarely exceeds 1 inch, and stays below a quarter-inch in most of the subbasin, reflecting warmer temperatures (Figure 9 and Figure 42c).

Groundwater Resources

Most of the primary pore spaces in rocks have been closed by metamorphism (transforming of rocks by pressure) or other geologic processes (OWRD, 1985). Water is therefore stored in porosity or fractures created after the rocks were deposited, but yields are still typically low. Furthermore, steep slopes and low permeability mean that most precipitation runs off into streams rather than recharging groundwater.

Between its geology and coastal setting, groundwater potential is generally very limited throughout the Lower Rogue subbasin (OWRD, 1985). Wells in the Agness-Illahe area typically produce less than 10 gallons per minute, enough for domestic uses. Alluvial deposits near Gold Beach and extending about six miles up the Rogue River can be productive, although these wells may be hydraulically connected to the river (OWRD, 1985).

Streamflow of the Lower Rogue River

As the most downstream basin, integrating all upstream flows, the Lower Rogue shows the highest overall flows, as well as the largest absolute year-over-year changes in mean annual flow. Mean annual flow is 5,420 cfs near Agness (#14372300) for water years 1991-2020. Flow exhibits strong seasonality, with about 75% of annual flow occurring December through May (Figure 42e; Table D3). Mean monthly flows peak at 10,918 cfs in January and decline to 1,996 cfs in September.

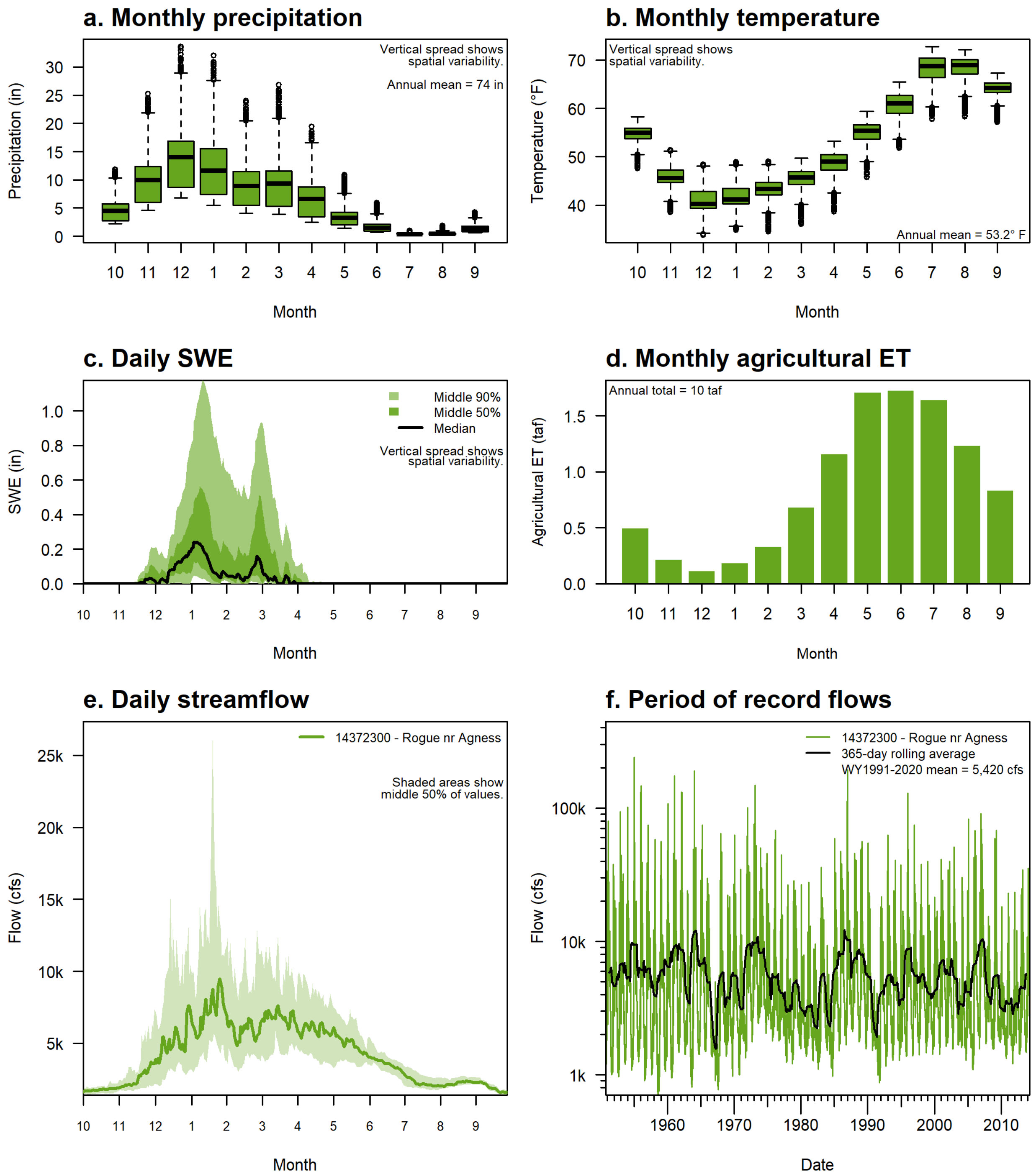

Figure 42. Hydrologic summary for Lower Rogue HUC-8 subbasin showing (a) mean monthly precipitation, (b) mean monthly temperature, and (c) median daily snow water equivalent (SWE), (d) mean monthly agricultural water use, (e) median daily streamflow at selected stations, and (f) period-of-record mean daily streamflow at selected station.

Notes: Period-of-record flow scale is logarithmic (subplot f). Monthly and daily values based on 30-year period (water years 1991-2020). Climate data from PRISM (2025) 1991-2020 normals. SWE data aggregated from Broxton et al. (2019) 4-km gridded product. Agricultural ET calculated from Huntington et al. (2025), described in the text. Boxplot spreads and SWE bands represent spatial variation across pixels within the subbasin; streamflow ribbons represent temporal variation across years.

Extreme flow ranges span from 704 cfs during drought to 240,000 cfs during the December 1964 flood event, the largest recorded flow in the basin (Figure 42f). Upstream regulation from Lost Creek and Applegate reservoirs moderates some historical extremes (OWRD, 1985).

Water Use and Management

More miles are designated as scenic in the Lower Rogue than any other subbasin (Figure 43). Less than 5,000 acres are irrigated, the lowest of any subbasin (Table 7). Poor options for groundwater production and reservoir storage and rugged terrain generally limit water use and development (OWRD, 1985). The Lower Rogue subbasin has limited streamflow monitoring relative to upstream subbasins (Table D1).

Limited regulation occurs in the subbasin below the confluence with Grave Creek. Mining rights are prevalent near Galice and along Grave Creek, but most are no longer exercised. Regulation occurs annually for Grave Creek and its tributaries, Wolf and Coyote Creeks, for instream water rights and less frequently senior calls for water. The Grave and Wolf Creek instream water rights have a priority date of September 29, 1969, and regulation affects about 50 water rights.

Water use below Grave Creek is comprised mainly of municipal and industrial uses near Gold Beach.

Figure 43. Photo of the Rogue River from Hellgate Canyon.

Photo: Greg Shine (USBLM) via Flickr under CC BY 2.0.

Summary

From its headwaters in the volcanic High Cascades to its mouth at the Pacific Ocean, the Rogue River crosses diverse geologic settings, climate and elevation gradients, and human development pressures. Each subbasin contributes distinct characteristics that collectively support one of Oregon's most ecologically significant watersheds.

The basin's Mediterranean climate, with wet winters and dry summers, creates seasonal mismatches between water availability and demand that have shaped ecosystems and water management patterns. Across subbasins, about 80% of annual precipitation falls from November through April, while less than 5% occurs during key irrigation months of July through September. Seasonal streamflow reflects this pattern, with about 60-90% of annual flows occurring December through May across most subbasins, although reservoirs influence this. However, each subbasin exhibits distinctive flow characteristics that reflect underlying differences in geology, climate, and water management.

Human water management has altered the basin's hydrology through major storage projects, complex irrigation operations, and trans-basin water transfers. These interventions have fueled agricultural productivity and municipal growth and provided flood control, but they have also created challenges for some aquatic ecosystems. Instream water rights and fish habitat restoration complement traditional storage and diversion infrastructure in balancing competing demands. Tribal nations remain active partners in shaping the basin's future.

Given the basin's limited groundwater production potential and environmental constraints around additional in-channel storage, unique strategies will be needed to supplement variable surface water supply under a changing climate. The success of future water management will depend on increasingly sophisticated coordination between multiple parties and objectives including agricultural productivity, municipal growth, environmental protection, and recreational values.

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Appendix A: Additional Climate Info

Table A1. Spatial variability of mean annual temperature (1991-2020) of the Rogue River Basin and HUC-8 subbasins.

Metric (°F)	Overall	U. Rogue	M. Rogue	Applegate	Illinois	L. Rogue
Min (Coolest Area)	34.7	34.7	40.5	40.4	42.5	45.1
Q1	49.6	45.6	51.6	50.3	51.1	52.4
Median	52.1	49.0	53.0	52.2	52.4	53.4
Mean	51.1	48.4	52.6	51.3	52.1	53.2
Q3	53.4	51.5	54.1	52.9	53.5	54.3
Max (Hottest Area)	56.3	55.2	55.4	55.3	56.3	56.3

Notes: U. = Upper; M. = Middle; L. = Lower; Q1 = 25th percentile; Q3 = 75th percentile. Data aggregated from PRISM (2025) 30-year (1991-2020) 4-km climate normals raster.

Table A2. Watershed-wide mean monthly precipitation normal (inches, 1991-2020) in Rogue River HUC-8 subbasins.

Month	Overall	U. Rogue	M. Rogue	Applegate	Illinois	L. Rogue
1	8.6	6.5	4.6	6.5	13.6	12.3
2	6.5	4.7	3.4	5.0	10.3	9.2
3	6.7	5.0	3.3	4.6	10.8	9.5
4	4.9	4.3	2.5	3.2	7.3	6.6
5	2.9	2.9	1.8	2.0	3.9	3.6
6	1.5	1.6	0.9	1.0	1.8	1.7
7	0.5	0.6	0.4	0.4	0.5	0.4
8	0.5	0.5	0.3	0.4	0.5	0.5
9	1.1	1.1	0.6	0.7	1.4	1.4
10	3.6	3.1	2.2	2.5	5.5	4.7
11	7.4	6.2	4.0	5.2	11.1	10.0
12	10.4	7.9	5.8	8.0	16.8	13.9

Notes: U. = Upper; M. = Middle; L. = Lower. Data aggregated from PRISM (2025) 30-year (1991-2020) 4-km climate normals raster.

Table A3. Watershed-wide mean peak snow water equivalent (inches, 1991-2020) in Rogue River HUC-8 subbasins.

Overall	U. Rogue	M. Rogue	Applegate	Illinois	L. Rogue
4.64	9.04	1.34	3.72	4.11	1.50

Notes: U. = Upper; M. = Middle; L. = Lower. SWE data aggregated from Broxton et al. (2019) 4km gridded product for 1991-2020.

Table A4. Watershed-wide mean monthly temperature normal (°F, 1991-2020) in Rogue River HUC-8 subbasins.

Month	U. Rogue	M. Rogue	Applegate	Illinois	L. Rogue
1	35.6	39.2	38.5	40.2	42.0
2	37.1	41.5	40.1	41.5	43.3
3	39.7	44.5	42.7	43.7	45.4
4	43.5	48.4	46.4	47.2	48.7
5	50.8	55.5	53.7	54.1	55.1
6	57.3	62.0	60.2	60.4	60.8
7	66.1	70.2	68.9	68.7	68.2
8	66.0	69.9	68.8	68.6	68.4
9	60.2	64.0	63.1	63.6	64.1
10	49.7	53.6	52.7	53.6	54.8
11	39.9	43.8	43.0	44.2	46.0
12	34.5	38.1	37.5	39.3	41.1

Notes: U. = Upper; M. = Middle; L. = Lower. Data aggregated from PRISM (2025) 30-year (1991-2020) 4-km climate normals raster.

Table A5. Start-of-month snow water equivalent (inches, water years 1991-2020) in Rogue River HUC-8 subbasins, showing spatial median and interquartile range.

Month	U. Rogue	M. Rogue	Applegate	Illinois	L. Rogue
1	1.47 (0.39 - 5.05)	0.11 (0.03 - 0.32)	0.22 (0.08 - 1.17)	0.71 (0.40 - 1.36)	0.18 (0.06 - 0.38)
2	1.78 (0.24 - 7.69)	0.02 (0.01 - 0.13)	0.17 (0.03 - 1.41)	0.47 (0.20 - 1.43)	0.05 (0.03 - 0.22)
3	1.16 (0.23 - 8.08)	0.06 (0.02 - 0.30)	0.29 (0.13 - 1.23)	0.61 (0.31 - 1.75)	0.15 (0.04 - 0.51)
4	0.16 (0.01 - 5.72)	0.0 (0.0 - 0.01)	0.02 (0.01 - 0.10)	0.06 (0.02 - 0.24)	0.01 (0.0 - 0.06)
5	0.0 (0.0 - 1.25)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)
6	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)
7	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)
8	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)
9	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)
10	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)
11	0.0 (0.0 - 0.06)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)
12	0.48 (0.14 - 1.48)	0.03 (0 - 0.11)	0.11 (0.04 - 0.37)	0.12 (0.04 - 0.36)	0.02 (0 - 0.10)

Notes: U. = Upper; M. = Middle; L. = Lower. SWE data aggregated from Broxton et al. (2019) 4km gridded product for water years 1991-2020.

Appendix B: Additional Land Cover and Ecoregion Info

Table B1. Estimated public ownership for 2025 and land cover for 2019 by percentage area for the Rogue River Basin and HUC-8 subbasins.

	Overall	U. Rogue	M. Rogue	Applegate	Illinois	L. Rogue
Public Ownership	61%	64%	29%	60%	77%	70%
Evergreen Forest	62%	70%	50%	71%	47%	70%
Shrub/Scrub	14%	14%	15%	12%	22%	8%
Grassland/Herbaceous	10%	8%	4%	4%	24%	9%
Pasture/Hay	4%	3%	12%	4%	2%	1%
Dev. Open Space	3%	1%	5%	5%	3%	5%
Dev. Low-High Intensity	2%	1%	7%	1%	1%	1%
Mixed Forest	2%	1%	4%	2%	1%	4%
Other	2%	2%	2%	2%	1%	1%

Notes: U. = Upper; M. = Middle; L. = Lower; Dev. = developed. Percentages may not sum to 100% due to rounding. Public ownership values calculated from OWRD geospatial data on public ownership of lands (accessed 2 June 2025). Land cover values summarized from National Land Cover Database for 2019 (Dewitz, 2021).

Table B2. Ecoregions of the Rogue River Basin and HUC-8 subbasins by percentage area.

Name	Overall	U. Rogue	M. Rogue	Applegate	Illinois	L. Rogue
Inland Siskiyous	35%	0%	56%	69%	39%	46%
Southern Cascades	18%	56%	4%	0%	0%	0%
Siskiyou Foothills	16%	25%	20%	13%	8%	6%
Coastal Siskiyous	9%	0%	0%	0%	19%	28%
Serpentine Siskiyous	6%	0%	0%	6%	21%	5%
Rogue/Illinois Valleys	6%	2%	18%	1%	7%	1%
High S. Casc. Mtn. Forest	5%	15%	0%	0%	0%	0%
S. Oregon Coastal Mtn.	2%	0%	0%	0%	0%	12%
Casc. Subalpine/Alpine	1%	2%	0%	0%	0%	0%
Coastal Uplands	0%	0%	0%	0%	0%	2%
S. Cascade Slope	0%	1%	0%	0%	0%	0%
California/Other	3%	0%	1%	12%	6%	0%

Notes: U. = Upper; M. = Middle; L. = Lower; S. = Southern; Casc. = Cascades; Mtn. = Montane or Mountains. Percentages may not sum to 100% due to rounding. Calculated from Oregon GIS Framework *ecoregions* layer (Oregon, 1995; accessed 2 June 2025).

Generalized ecoregion definitions, modified from Pater et al. (1998) and Thorson (2003):

Inland Siskiyous —Klamath Mountains ecoregion. Higher and more mountainous than neighboring foothill and valley ecoregions. Has a higher fire frequency, less annual precipitation, and longer summer droughts than the Coastal Siskiyous. Forest cover is a diverse and multi-layered mix of conifers, broadleaf evergreens, and deciduous trees and shrubs in contrast to the predominantly coniferous forests that occur in the Coast Range or Cascades.

Southern Cascades — Cascades ecoregion. Lower in elevation and less rugged than the more highly dissected Western Cascades Montane Highlands to the north. Mt. McLoughlin, at 9500 feet, is the highest peak in this ecoregion. The climate is drier than in the Western Cascades Lowlands and Valleys and the Western Cascades Montane Highlands, and the vegetation reflects it. Western hemlock and western red cedar decline southward in this ecoregion and are replaced by Sierra Nevada species such as incense cedar, white fir, and Shasta red fir that tolerate prolonged summer drought. Overall, stream discharge is also significantly lower than in systems to the north.

Siskiyou Foothills — Klamath Mountains ecoregion. Affected by a Mediterranean climate that is similar to the Rogue/Illinois Valleys. The driest area occurs east of Medford and is dominated by oak woodlands, ponderosa pine, and Douglas-fir. The wetter foothills adjacent to the Illinois Valley support Douglas-fir, madrone, and incense cedar.

Coastal Siskiyous — Klamath Mountains ecoregion. Wetter and milder maritime climate than elsewhere in the Klamath Mountains. Productive forests composed of tanoak, Douglas-fir, and some Port Orford cedar cover its mountainous landscape; tanoak is more common than elsewhere in Oregon. Broadleaf evergreens, such as tanoak and madrone, quickly colonize disturbed areas, making it difficult to regenerate conifer forest growth. Xeric soils derived from Siskiyou rock types are characteristic; udic soils which support western hemlock and Sitka spruce are much less common than in the wetter Coast Range.

Serpentine Siskiyous — Klamath Mountains ecoregion. Lithologically distinct from the rest of the broader Klamath Mountains. Many plants have difficulty growing in its serpentine soils due to a shortage of calcium and high levels of magnesium, nickel, and chromium. As a result, vegetation is often sparse and composed of specialist species. Jeffrey pine and endemic oak and ceanothus species have evolved to grow in the potentially toxic and nutrient-poor serpentine soils. Historic mines and associated water quality problems occur.

Rogue/Illinois Valleys — Klamath Mountains ecoregion. Supports Oregon white oak and California black oak woodland, ponderosa pine, and grassland. As in other highly developed valleys, little original vegetation remains. Remnants of oak savanna, prairie vegetation, and seasonal ponds persist on the mesa tops of the Table Rocks north of Medford. Elsewhere, land uses include orchards, cropland, and pastureland. Climate, vegetation, and resulting land use are more similar to northern California's inland valleys than to the Willamette Valley.

High Southern Cascades Montane Forest — Cascades ecoregion. An undulating, glaciated, volcanic plateau containing isolated buttes, cones, and peaks. The terrain is less dissected than the Southern Cascades. At 4,000 to 8,200 feet, maximum elevations are intermediate to those in the Southern Cascades and Cascades Subalpine/Alpine ecoregions. Cryic (very cold) soils support mixed coniferous forests dominated by mountain hemlock, lodgepole pine, and Pacific silver fir; they are colder than the mesic and frigid soils of the Southern Cascades. Grand fir, white fir, and Shasta red fir also occur and become more common toward the south and east. The High Southern Cascades Montane Forest has a longer summer drought and more intermittent streams than the Cascade Crest Montane Forest.

Southern Oregon Coastal Mountains — Coast Range ecoregion. A geologically and botanically diverse ecoregion that is a transition zone between the Coast Range and the Siskiyou Mountains. It has the climate of the Coast Range and the varied lithology of the higher, more dissected Siskiyou Mountains. Distributions of northern and southern vegetation blend together here and species diversity is high. Douglas-fir, western hemlock, tanoak, Port Orford cedar, and western redcedar occur.

Cascade Subalpine/Alpine — Cascades ecoregion. Contains the prominent volcanic peaks of the high Cascades. Pleistocene glaciation reshaped the mountains above 6500 feet, leaving moraines, glacial lakes, and U-shaped glacial canyons. Glaciers and permanent snowfields still occur on the highest peaks. The vegetation is adapted to high elevations, cold winter temperatures, short growing season, and deep winter snow pack. Herbaceous subalpine meadow vegetation and scattered patches of mountain hemlock, subalpine fir, and whitebark pine occur near timberline

Coastal Uplands — Coast Range ecoregion. Includes headlands and low mountains surrounding the Coastal Lowlands. The climate of is marine influenced with an extended winter rainy season and minimal seasonal temperature extremes. Abundant fog during the summer dry season reduces vegetation moisture stress. This ecoregion includes much of the historic distribution of Sitka spruce. Today, its Douglas-fir forests are managed for logging.

Southern Cascade Slope — Cascades ecoregion. A transitional zone between the Cascades and the drier Eastern Cascade Slopes and Foothills. This ecoregion is higher and moister than the Fremont Pine/Fir Forest ecoregion, and it has a greater mix of forest types. Ponderosa pine woodland becomes mixed with white fir, incense cedar, Shasta red fir, and Douglas-fir at higher elevations.

California/Other — Portions of the basin that extend into northern California or within ecoregion classifications with relatively small area in the basin.

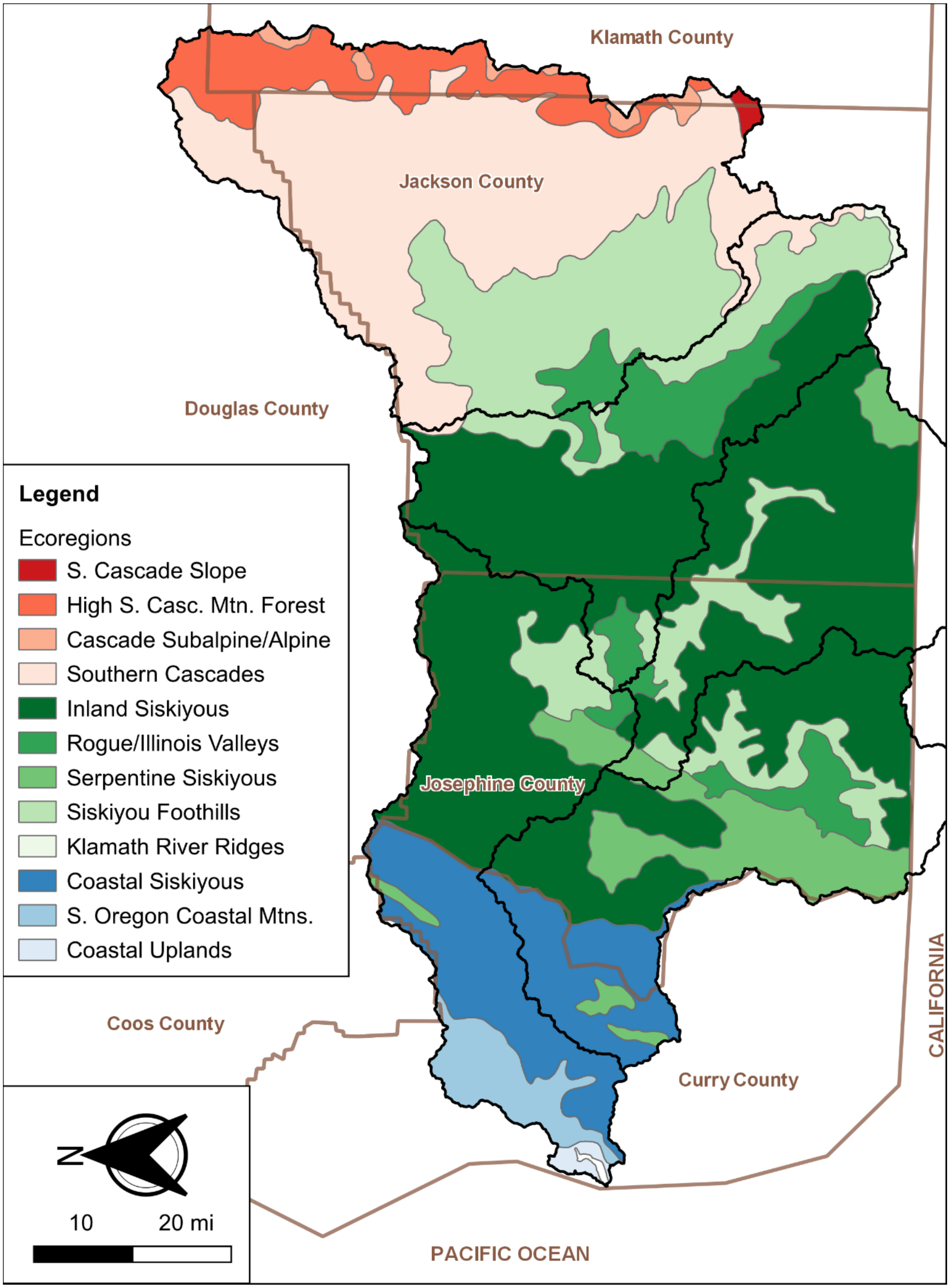


Figure B1. Ecoregions in the Rogue River Basin (HUC-8 subbasins shown).

Notes: North points left. S. = Southern; Casc. = Cascades; Mtn. = Montane or Mountains. Covers only the Oregon portion of the basin. Data from Oregon GIS Framework *ecoregions* layer (Oregon, 1995; accessed 2 June 2025).

Table B3. Vector Ruggedness Measure (VRM) for Rogue River HUC-8 subbasins.

Metric	Overall	U. Rogue	M. Rogue	Applegate	L. Rogue	Illinois
Bottom 10%	0.000	0.000	0.000	0.001	0.002	0.001
Bottom 25%	0.002	0.001	0.001	0.003	0.004	0.003
Median	0.006	0.002	0.005	0.009	0.010	0.008
Mean	0.018	0.011	0.019	0.025	0.028	0.024
Top 25%	0.017	0.008	0.016	0.025	0.027	0.023
Top 10%	0.044	0.021	0.042	0.060	0.066	0.056

Notes: U. = Upper; M. = Middle; L. = Lower. VRM is a dimensionless index (0 = flat, 1 = maximally complex) that captures variability in both slope and aspect into a single terrain complexity metric (Sappington et al., 2007). Natural terrain rarely exceeds 0.2. In the western United States, from ~0.01 to ~0.20 are considered low to moderate in ruggedness (Welty & Jeffries, 2018). Data aggregated from U.S. Geological Survey (n.d.) 3D Elevation Program digital elevation model (DEM) database, resampled to approximately 100-foot grid size.

Appendix C: Additional Geology Info

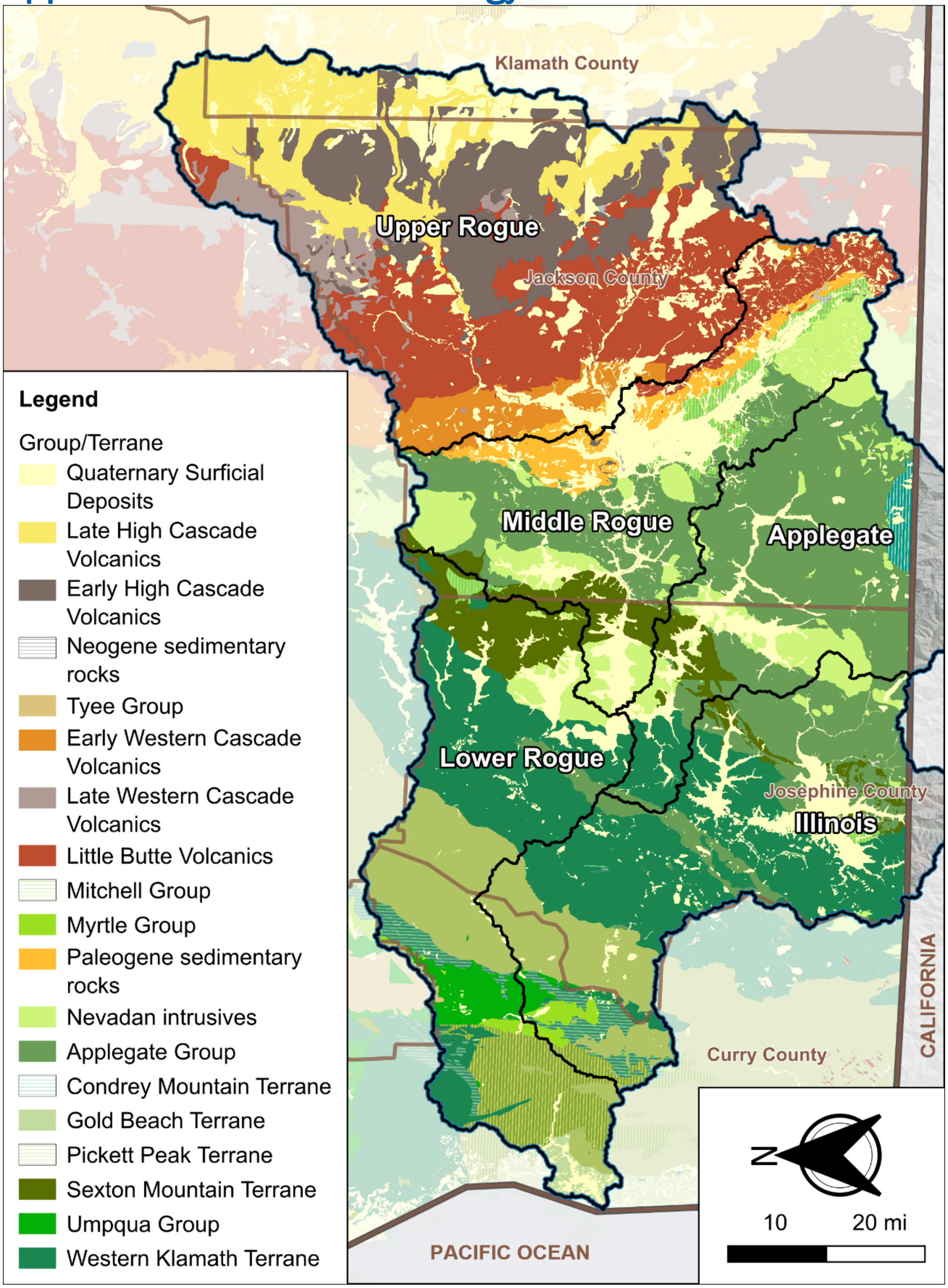


Figure C1. Terrane groups in the Rogue River Basin (HUC-8 subbasins shown).

Notes: North points left. Covers only the Oregon portion of the basin. Data from Oregon Department of Geology and Mineral Industries OGDC-6 database (DOGAMI, 2015).

Table C1. Geologic terranes of the Rogue River Basin and HUC-8 subbasins by percentage area.

Terrane Group	Overall	Upper Rogue	Middle Rogue	Applegate	Illinois	Lower Rogue
Applegate Group	18%	0%	28%	57%	20%	2%
Quaternary Surficial Dep.	14%	16%	24%	10%	11%	8%
Western Klamath Terrane	14%	0%	0%	6%	38%	31%
Little Butte Volcanics	11%	29%	10%	0%	0%	0%
Early High Cascade Volc.	8%	24%	0%	0%	0%	0%
Late High Cascade Volc.	7%	21%	0%	0%	0%	0%
Yolla Bolly Terrane	7%	0%	0%	0%	15%	21%
Nevadan Intrusives	6%	0%	19%	11%	2%	3%
Sexton Mtn. Terrane	4%	0%	7%	4%	2%	10%
Pickett Peak Terrane	3%	0%	0%	0%	2%	13%
Late West. Cascade Volc.	2%	7%	0%	0%	0%	0%
Early West. Cascade Volc.	2%	6%	1%	0%	0%	0%
Paleogene sed. rocks	2%	1%	9%	0%	0%	0%
Snow Camp Terrane	1%	0%	0%	0%	4%	4%
Umpqua Group	1%	0%	0%	0%	1%	5%
Mitchell Group	1%	0%	4%	0%	0%	1%
Condrey Mt. Terrane	1%	0%	0%	4%	0%	0%
California/Other	3%	0%	0%	10%	4%	3%

Notes: Dep. = Deposits; Volc. = Volcanics; West. = Western; sed. = sedimentary. Only covers portions of the Rogue Basin in Oregon. Percentages may not sum to 100% due to rounding. Summarized from DOGAMI (2015). California/Other = Portions of the basin that extend into northern California or within terranes with relatively small area in the basin.

Generalized definitions, from youngest to oldest, summarized from Madin's (2009) IMS-28:

Quaternary Surficial Deposits — Loose, uncemented gravel, sand, silt, and clay deposited by rivers, wind, ice, and gravity. Includes floodplains, alluvial fans, beach and dune deposits. Pleistocene to Holocene. *(IMS-28: "Lakes, Rivers, and Dunes")*

Late High Cascade Volcanics — Pliocene to Quaternary basalt and basaltic andesite lava flows from hundreds of small cinder cones and larger composite volcanoes. Still considered active. *(IMS-28: "High Cascade Volcanoes")*

Early High Cascade Volcanics — Older phase of the same High Cascade arc; basalt and basaltic andesite with minor andesite, now more dissected and eroded than the late unit. Pliocene. *(IMS-28: "High Cascade Volcanoes")*

Neogene sedimentary rocks — Miocene to Pliocene river, lake, and basin sandstone, siltstone, mudstone, and conglomerate deposited in sinking Basin and Range valleys and ancestral river systems including the early Willamette and Deschutes drainages. *(IMS-28: "Ancient Waterways")*

Tyee Group — Middle Eocene marine turbidite sandstone and siltstone deposited as deep-sea fans atop the newly accreted Siletz Terrane seafloor. *(IMS-28: "Coast Range Sediments")*

Early Western Cascade Volcanics — Eocene to early Miocene calc-alkaline arc basalt, andesite, dacite, rhyolite, tuffs, and lahars erupted as the subduction zone moved west and built a broad volcanic arc. Near-tropical climate; fossil beds preserved in associated lake sediments. *(IMS-28:*

"Early Volcanic Arc")

Late Western Cascade Volcanics — Early to late Miocene; younger phase of the same arc system with similar basaltic to andesitic composition. *(IMS-28: "Early Volcanic Arc")*

Little Butte Volcanics — Oligocene to early Miocene heterogeneous volcanogenic sequence of ash-flow tuffs, lahars, flow breccias, and tuffaceous sediments; part of the broad early volcanic arc. *(IMS-28: "Early Volcanic Arc")*

Mitchell Group — Early Cretaceous marine graywacke, shale, and conglomerate deposited along Oregon's first coastline. Coal beds and ammonite fossils present. *(IMS-28: "Early Sediments")*

Myrtle Group — Late Jurassic to Early Cretaceous conglomerate, sandstone, siltstone, and locally fossiliferous limestone; among Oregon's earliest coastal sedimentary deposits laid down as the exotic terranes settled into position. *(IMS-28: "Early Sediments")*

Paleogene sedimentary rocks — Eocene to Oligocene marine and coastal sandstones, siltstones, and shales; part of the long accumulation of Coast Range sediments deposited as sea level fluctuated and nearby volcanoes shed sediment. *(IMS-28: "Coast Range Sediments")*

Nevadan intrusives — Late Jurassic to Early Cretaceous granodiorite, granite, gabbro, diorite, and tonalite batholiths and plutons injected into the exotic terranes as they were plastered onto the continent. The first rocks truly "made in Oregon." Associated with gold mineralization near Grants Pass and Medford. *(IMS-28: "Batholiths and Plutons")*

Applegate Group — Triassic to Jurassic accreted island-arc terrane; metavolcanic (meta-andesite, metabasalt, spilite) and metasedimentary rocks (argillite, chert, tuff) that rode the Pacific Ocean floor and welded onto the North American margin. *(IMS-28: "Exotic Terranes")*

Condrey Mountain Terrane — Jurassic high-pressure/low-temperature metamorphic schist exposed in a structural window; oceanic protoliths including basaltic lavas and cherts subducted and metamorphosed during terrane accretion. *(IMS-28: "Exotic Terranes")*

Gold Beach Terrane — Late Cretaceous exotic terrane of turbidite sandstones, mudstones, and mélange transported a great distance northward on the Kula plate from a southerly latitude and accreted to Oregon in the Eocene. *(IMS-28: "Exotic Terranes")*

Pickett Peak Terrane — Early Cretaceous exotic terrane of high-pressure blueschist-facies rocks formed during subduction and accreted to the Klamath margin during the Pickett Peak tectonic episode. *(IMS-28: "Exotic Terranes")*

Sexton Mountain Terrane — Middle Jurassic supra-subduction zone ophiolite; serpentinized peridotite, serpentinite mélange, gabbro, and sheeted mafic dikes formed at the inception of a Jurassic subduction zone. Contains josephinite, a rare natural nickel-iron alloy found only in Klamath exotic terranes. *(IMS-28: "Exotic Terranes")*

Umpqua Group — Early to middle Eocene marine turbidite sandstones, siltstones, and shales with associated diabase intrusions; deposited atop the Siletz Terrane seafloor. Underlies the Tyee. *(IMS-28: "Coast Range Sediments")*

Western Klamath Terrane — Late Jurassic oceanic arc and forearc basin assemblage including metavolcanic rocks, mélange, and ophiolite fragments accreted during the Nevadan orogeny and regionally metamorphosed to greenschist facies. Includes serpentinite, the "shiny blue-green" rock. *(IMS-28: "Exotic Terranes")*

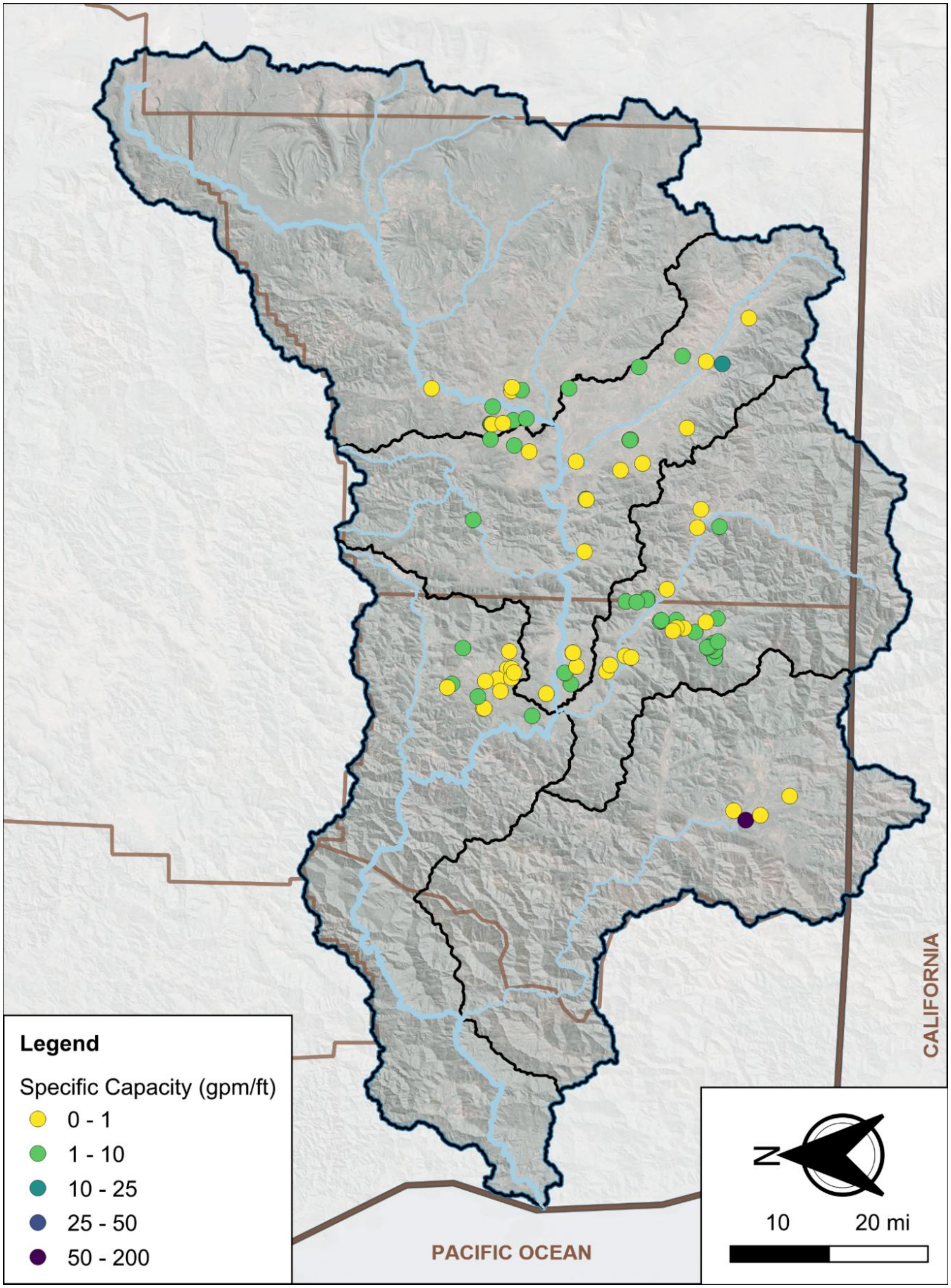


Figure C2. Map of specific capacity in the Rogue River Basin (HUC-8 subbasins shown), showing low yields (0-1 gpm/ft) across the basin.

Notes: North points left. Gpm/ft = gallons per minute per foot of drawdown. Data from OWRD pump test geodatabase (accessed 14 July 2025).

Appendix D: Additional Stream Gage Info

Table D1. Summary of active stream gages (stage and/or flow) in Rogue River HUC-8 subbasins.

Subbasin	Active Gages	Gages with Flow Data	Median Record Length for Flow Stations (yr)	Min Record Length for Flow Stations (yr)	Max Record Length for Flow Stations (yr)
U. Rogue	68	28	29	1	87
M. Rogue	44	32	5	1	118
Applegate	18	8	26.5	1	85
Illinois	21	5	57	21	86
L. Rogue	8	1	63	63	63
Overall	141	75	14.5	1	118

Notes: U = Upper; M. = Middle; L. = Lower. Includes stations operated by OWRD, USGS, USBR, counties, or irrigation districts. Data summarized from OWRD geospatial database attributes for station status and number of complete water years (accessed 18 June 2025). Stations may be "active" but only monitor stage, resulting in no flow data.

Table D2. Summary of active and historical stream gages (flow only) with ≥1 water years of flow data in Rogue River HUC-8 subbasins.

Subbasin	Gages	Median Record Length (yr)	Min Record Length (yr)	Max Record Length (yr)
U. Rogue	51	24	1	87
M. Rogue	36	5.5	1	118
Applegate	13	13	1	85
Illinois	14	22.5	3	86
L. Rogue	5	24	10	63
Overall	119	16	1	118

Notes: U = Upper; M. = Middle; L. = Lower. Includes stations operated by OWRD, USGS, USBR, counties, or irrigation districts. Data summarized from OWRD geospatial database attributes for station status and number of complete water years (accessed 18 June 2025). Only stations with at least one complete water year of data are included.

Table D3. Mean monthly flow (cubic feet per second ± coefficient of variation) (water years 1991-2020) at selected Rogue River Basin stations.

Month	Rogue ab Prospect	Rogue nr Eagle Point	Rogue at Raygold	Rogue at Grants Pass	Applegate nr Copper	Applegate nr Wilderville	Illinois nr Kerby	Rogue Nr Agness
1	1,037 (±48%)	3,181 (±64%)	4,077 (±68%)	5,201 (±71%)	721 (±104%)	1,436 (±98%)	2,878 (±55%)	10,918 (±68%)
2	1,055 (±41%)	2,291 (±51%)	3,088 (±55%)	3,985 (±62%)	464 (±122%)	1,105 (±104%)	2,235 (±55%)	8,625 (±66%)
3	1,139 (±38%)	2,615 (±48%)	3,387 (±46%)	4,150 (±51%)	434 (±100%)	1,009 (±76%)	2,354 (±52%)	8,272 (±53%)
4	1,339 (±33%)	2,813 (±49%)	3,563 (±48%)	4,057 (±51%)	416 (±82%)	800 (±66%)	1,789 (±53%)	6,839 (±51%)
5	1,225 (±41%)	3,124 (±29%)	3,587 (±32%)	3,867 (±35%)	596 (±61%)	803 (±61%)	902 (±50%)	5,438 (±37%)
6	799 (±39%)	2,828 (±20%)	2,999 (±24%)	3,060 (±26%)	388 (±58%)	479 (±69%)	394 (±88%)	3,912 (±32%)
7	535 (±30%)	2,118 (±30%)	2,143 (±30%)	2,047 (±33%)	274 (±33%)	256 (±45%)	106 (±55%)	2,465 (±32%)
8	446 (±27%)	2,089 (±15%)	2,106 (±17%)	2,011 (±18%)	275 (±32%)	234 (±42%)	43 (±48%)	2,313 (±20%)
9	416 (±25%)	1,622 (±8%)	1,721 (±10%)	1,638 (±10%)	265 (±32%)	245 (±39%)	43 (±73%)	1,996 (±14%)
10	446 (±33%)	1,228 (±17%)	1,356 (±21%)	1,398 (±20%)	275 (±28%)	315 (±36%)	204 (±188%)	1,968 (±44%)
11	636 (±47%)	1,652 (±44%)	1,944 (±48%)	2,110 (±52%)	268 (±54%)	395 (±66%)	908 (±85%)	3,500 (±61%)
12	983 (±67%)	2,895 (±66%)	3,680 (±75%)	4,406 (±79%)	492 (±97%)	966 (±109%)	2,531 (±72%)	8,894 (±86%)

Notes: Data summarized from OWRD mean daily flow database (accessed 18 June 2025). Not all stations had data for all 30 years.

Table D4. Mean annual flow at Rogue River Basin stations.

Subbasin	Station No.	Station Name	Start Year	End Year	MAF, POR (cfs)	MAF, WY1991-2020 (cfs)
U. Rogue	14335235	Bieberstedt Cr ab Willow Lk nr Butte Falls	2013	2025	2.9	3.1
U. Rogue	14347798	Little Butte Cr Mill Race at Eagle Point	2015	2025	2.8	3.4
U. Rogue	14342100	Tunnel at Fish Lake Dam nr Lakecreek	1929	1971	5.1	-
U. Rogue	14346600	Agate Res Feed Cn nr White City	1966	1996	7.7	5.0
U. Rogue	14335250	Willow Cr Dam Outlet nr Butte Falls	1926	2025	5.6	7.6
U. Rogue	11505000	Cascade Cn nr Fish Lake	1929	1996	6.9	-
U. Rogue	14338100	Rogue at Trail	1988	2000	8.4	8.5
U. Rogue	14346500	Rogue Valley Cn at Bradshaw Drp nr Brownboro	1959	1996	10.3	10.0
U. Rogue	14348080	Antelope Cr Bl Rogueiver Valley Irr Dist Div nr White City	2010	2025	10.3	12.0
U. Rogue	14335230	Willow Cr ab Willow Lk nr Butte Falls	2013	2025	11.1	11.4
U. Rogue	99000007	Big Draw Cr nr Ashland	1943	1943	11.6	-
U. Rogue	14341600	Rogue Valley Cn S Int nr Lakecreek	1923	1996	18.3	13.9
U. Rogue	14339500	S Fk L Butte Cr Big Elk Rngr Sta	1927	1962	17.6	-
U. Rogue	14337870	W Br Elk Cr nr Trail	1973	2000	19.2	16.5
U. Rogue	14335300	Willow Cr nr Butte Falls	1949	2025	21.8	15.3
U. Rogue	14346000	Medford I D Cn Bradshaw Drp nr Brownboro	1929	1996	21.3	27.1
U. Rogue	14335100	Fourbit Cr nr Butte Falls	1949	1978	25.8	-
U. Rogue	14348150	Antelope Cr nr Eagle Point	2008	2025	25.7	30.3
U. Rogue	14345000	Rogue Valley Cn at Intake nr Lakecreek	1959	1996	26.4	31.0
U. Rogue	14336700	N Fk Big Butte Cr nr Butte Falls	1929	2025	32.7	30.6
U. Rogue	14342500	N Fk Little Butte Cr at Fish Lake nr Lakecreek	1915	2025	34.5	32.1
U. Rogue	14331000	Imnaha Cr nr Prospect	1934	1949	43.0	-
U. Rogue	14345500	Rogue Valley Cn Bl Jct nr Lakecreek	1966	1996	42.6	44.6
U. Rogue	14340800	S Fk Little Butte Cr ab Soda Cr nr Lakecreek	2003	2025	52.4	54.6
U. Rogue	14329500	Mill Cr nr Prospect	1925	1935	54.6	-
U. Rogue	14344500	N Fk L Butte Cr ab Intake Cn Lakecreek	1921	1971	57.9	-
U. Rogue	14335400	Willow Cr Bl Big Butte Springs nr Butte Falls	1930	1979	60.1	-
U. Rogue	14343000	N Fk Little Butte Cr nr Lakecreek	1911	2025	70.1	64.5
U. Rogue	14341610	S Fk Little Butte Cr at Mouth nr Lakecreek	2008	2025	65.1	71.7
U. Rogue	14337830	Elk Cr Bl Alco Cr nr Trail	1986	2003	72.7	65.3
U. Rogue	14335200	S Fk Big Butte Cr ab Willow Cr nr Butte Falls	1935	2025	74.1	66.5
U. Rogue	14336100	Eagle Point I D Cn Bl C Rd nr Butte Falls	1960	2025	76.4	78.7
U. Rogue	14336000	Eagle Point I D Cn at Butte Falls	1929	1960	79.9	-
U. Rogue	14332000	S Fk Rogue nr Prospect	1925	2024	81.3	79.1
U. Rogue	14337000	Big Butte Cr Bl Butte Falls	2015	2025	96.7	109.7

Subbasin	Station No.	Station Name	Start Year	End Year	MAF, POR (cfs)	MAF, WY1991-2020 (cfs)
U. Rogue	14341500	S Fk L Butte Cr nr Lakecreek	1922	1983	103.4	-
U. Rogue	14331500	S Fk Power Cn nr Prospect	1966	1983	113.8	-
U. Rogue	14346900	Little Butte Cr at Brownsboro	2018	2025	125.3	105.2
U. Rogue	14333500	Red Blanket Cr nr Prospect	1925	1982	118.2	-
U. Rogue	14335500	S Fk Big Butte Cr nr Butte Falls	1911	2025	143.6	108.5
U. Rogue	14330500	S Fk Rogue ab Imnaha Cr nr Prospect	1932	1949	126.9	-
U. Rogue	14346700	Little Butte Cr at Lakecreek	1924	2025	134.6	127.0
U. Rogue	14337800	Elk Cr nr Cascade Gorge	1973	2000	142.7	144.7
U. Rogue	14347000	Little Butte Cr ab Eagle Point	1916	1929	178.8	-
U. Rogue	14332001	S Fk Rogue + S Fk Power Cn nr Prospect	1925	1983	181.8	-
U. Rogue	14333000	M Fk Rogue nr Prospect	1926	1955	184.3	-
U. Rogue	14338000	Elk Cr nr Trail	1946	2024	208.1	192.1
U. Rogue	14347800	Little Butte Cr at Eagle Point	2014	2025	185.9	219.9
U. Rogue	14337500	Big Butte Cr nr Mcleod	1946	2024	228.5	194.3
U. Rogue	14348000	Little Butte Cr Bl Eagle Point	1907	2023	215.2	212.6
U. Rogue	14334700	S Fk Rogue S of Prospect	1969	1993	367.4	208.9
U. Rogue	14335075	Rogue at Mcleod	1973	2000	323.3	-
U. Rogue	14327500	Rogue ab Bybee Cr, nr Union Cr	1930	1952	498.3	-
U. Rogue	14328000	Rogue ab Prospect	1908	2024	814.8	817.1
U. Rogue	14330000	Rogue Bl Prospect	1914	2024	1,285.4	1,378.7
U. Rogue	14335072	Rogue at Cole M Rivers F Hatchery nr Mcleod	2012	2024	1,373.2	1,474.6
U. Rogue	14337600	Rogue nr Mcleod	1966	2024	1,575.8	1,358.7
U. Rogue	14335000	Rogue Bl S Fk Rogue nr Prospect	1929	1965	1,796.8	-
U. Rogue	14339000	Rogue at Dodge Br nr Eagle Point	1939	2024	2,475.6	2,373.7
M. Rogue	14361140	Savage Lat at Intake nr Grants Pass	1925	1996	0.9	0.7
M. Rogue	14358610	Griffin Cr Bl Murphy Cr nr Medford	2010	2025	0.9	1.0
M. Rogue	14358725	Jackson Cr at Jacksonville	2010	2025	1.5	1.8
M. Rogue	14354950	Wagner Cr Bl Goose Cr nr Talent	2010	2025	1.7	2.0
M. Rogue	14361130	Evans Cr Lat nr Grants Pass	1925	1996	4.3	3.4
M. Rogue	14355875	Wagner Cr at Talent	2009	2025	4.7	5.5
M. Rogue	14350900	Neil Cr ab Dunn D nr Ashland	2010	2025	7.6	8.5
M. Rogue	14353000	W Fk Ashland Cr nr Ashland	1925	2024	9.1	10.0
M. Rogue	14353500	E Fk Ashland Cr nr Ashland	1925	2024	9.3	9.9
M. Rogue	14348500	Ashland Lat nr Ashland	1929	1996	10.3	9.6
M. Rogue	14361120	Tokay Cn nr Grants Pass	1925	1996	11.4	10.0
M. Rogue	14352000	Neil Cr at Mouth nr Ashland	2008	2025	10.1	11.4
M. Rogue	14358000	Bear Cr Cn at Medford	1929	1995	10.8	10.8
M. Rogue	14358680	Griffin Cr at Central Point	2009	2025	10.2	11.5
M. Rogue	14348400	Emigrant Cr ab Green Springs Powerplant nr Ashland	2006	2025	13.3	14.4
M. Rogue	14352500	Talent Lat nr Ashland	1929	1996	16.3	18.5
M. Rogue	14354100	Ashland Cr Bl Treatment Plant at	2008	2025	16.8	18.0

Subbasin	Station No.	Station Name	Start Year	End Year	MAF, POR (cfs)	MAF, WY1991-2020 (cfs)
		Ashland				
M. Rogue	14356500	Phoenix Cn at Talent	1929	1996	18.0	-
M. Rogue	14358750	Jackson Cr at Central Point	2009	2025	17.3	19.5
M. Rogue	14361110	S Highline Cn nr Grants Pass	1925	1996	25.5	22.4
M. Rogue	14352400	Bear Cr ab Ashland Cr at Ashland	1929	1932	26.2	-
M. Rogue	14361100	Gravity Cn nr Grants Pass	1926	1996	30.1	22.4
M. Rogue	14363600	L Applegate nr Talent	1940	1942	27.2	-
M. Rogue	14350500	Emigrant Cr Bl Walker Cr nr Ashland	1944	1945	30.2	-
M. Rogue	99000003	Bear Cr at Jackson Hot Springs	1929	1931	30.5	-
M. Rogue	14350000	Emigrant Cr nr Ashland	1920	2019	33.2	32.1
M. Rogue	14349500	East Lat nr Ashland	1929	1996	49.0	42
M. Rogue	11516100	Green Springs Powerplant Div nr Ashland	1961	1965	47.1	-
M. Rogue	14359400	Evans Cr ab W Fk nr Wimer	1942	1953	47.5	-
M. Rogue	14352001	Bear Cr Bl Neil Cr nr Ashland	2009	2025	47.0	53.1
M. Rogue	14357000	Bear Cr Bl Phoenix Cn nr Talent	2009	2025	58.8	66.4
M. Rogue	14354200	Bear Cr Bl Ashland Cr at Ashland	1990	2024	76.5	80.7
M. Rogue	14357503	Bear Cr at Jackson St Bridge at Medford	2008	2025	76.3	88.1
M. Rogue	14357500	Bear Cr at Medford	1915	2024	110.8	116.4
M. Rogue	14358800	Bear Cr ab Mouth nr Central Point	2008	2025	124.0	132.3
M. Rogue	14360500	Evans Cr at Wimer	2009	2025	128.8	144.0
M. Rogue	14359500	Evans Cr nr Bybee Springs nr Rogue	1926	1953	154.9	-
M. Rogue	14359000	Rogue at Raygold nr Central Pt	1905	2024	2,882.1	2,805.4
M. Rogue	14361500	Rogue at Grants Pass	1939	2024	3,310.6	3,159.8
Applegate	14363500	McDonald Cr Cn nr Talent	1929	1985	2.0	-
Applegate	14362250	Star G nr Ruch	1983	2024	4.8	5.3
Applegate	14363450	McDonald Cr nr Talent	2011	2025	7.1	7.4
Applegate	14368500	Powell Cr nr Williams	1947	1958	16.2	-
Applegate	14365500	Little Applegate nr Ruch	1925	2025	50.7	54.1
Applegate	14368300	Williams Cr at Williams	2015	2025	66.2	74.8
Applegate	14370000	Slate Cr at Wonder	1944	1957	81	-
Applegate	14361600	Elliott Cr nr Copper	1978	1988	108.4	-
Applegate	14361700	Carberry Cr nr Copper	1978	1988	153.5	-
Applegate	14363000	Applegate nr Ruch	1912	1953	389.1	-
Applegate	14362000	Applegate nr Copper	1939	2024	421.4	406.2
Applegate	14366000	Applegate nr Applegate	1939	2024	516.8	496.9
Applegate	14369500	Applegate nr Wilderville	1939	2024	679.7	669.1
Illinois	14372550	Long G nr Takilma	1941	1944	6.5	-
Illinois	14372570	Esterley Middle Cn nr Takilma	1926	1941	22	-
Illinois	14377600	Clear Cr nr Selma	1942	1943	42.2	-
Illinois	14373500	Althouse Cr nr Holland	1944	1953	71.5	-
Illinois	14377500	Deer Cr nr Dryden	1942	1956	74	-

Subbasin	Station No.	Station Name	Start Year	End Year	MAF, POR (cfs)	MAF, WY1991-2020 (cfs)
Illinois	14375400	Elk Cr nr Obrien	1970	1994	105.4	45.7
Illinois	14373600	Althouse Cr nr Kerby	1938	1942	97.1	-
Illinois	14373700	Cave Cr at Oregon Caves	1938	1942	97.1	-
Illinois	14372500	E Fk Illinois nr Takilma	1926	2025	166.4	161
Illinois	14376000	W Fk Illinois ab Obrien	1930	1947	201.5	-
Illinois	14375000	Sucker Cr nr Holland	1940	1965	211.5	-
Illinois	14375500	W Fk Illinois Bl Rock Cr nr Obrien	1955	1986	219.2	-
Illinois	14375200	Sucker Cr at Bridgeview	2001	2025	219.1	224.7
Illinois	14375100	Sucker Cr Bl L Grayback Cr nr Holland	1966	2024	224.0	226.5
Illinois	14376500	W Fk Illinois nr Obrien	1947	1954	259.3	-
Illinois	14376700	Rough and Ready Cr nr Obrien	1940	1943	259.9	-
Illinois	14377100	Illinois nr Kerby	1962	2025	1,219.8	1,172.4
Illinois	14377000	Illinois at Kerby	1926	1961	1,208.8	-
Illinois	14378000	Illinois nr Selma	1957	1968	2,335.1	-
Illinois	14378200	Illinois nr Agness	1961	1982	4,094.1	-
L. Rogue	14370400	Rogue nr Merlin	1974	1987	11.6	-
L. Rogue	14372250	Rogue at Marial	1974	1987	12.6	-
L. Rogue	14370800	Louse Cr nr Grants Pass	1937	1938	32.2	-
L. Rogue	14370500	Jumpoff Joe Cr nr Merlin	1929	1957	55.9	-
L. Rogue	14370600	Jumpoff Joe Cr nr Pleasant Valley	1970	1992	57.2	-
L. Rogue	14371500	Grave Cr at Pease Bridge nr Placer	1940	1990	57.5	-
L. Rogue	14372000	Grave Cr nr Placer	1913	1955	110.2	-
L. Rogue	14372300	Rogue nr Agness	1961	2024	5,604.2	5,419.7

Notes: cfs = cubic feet per second; MAF = mean annual flow; POR = period-of-record. Data summarized from OWRD mean daily flow database (accessed 18 June 2025), including provisional data. Only water years with complete data were included in means. For POR and WY1991-2020 means, not all stations had data for all years.

Table D5. Mean monthly flow (cubic feet per second) at active Rogue River Basin stations, water years 1991-2020.

Station No.	1	2	3	4	5	6	7	8	9	10	11	12
11505000	0.0	0.0	0.0	0.0	NA	5.9	NA	22.5	7.9	0.0	0.0	0.0
14328000	1037.1	1055.2	1138.8	1338.8	1225.4	799.4	535.4	445.6	415.9	445.9	636.4	982.6
14330000	1586.3	1627.1	1751.4	2005.0	1973.7	1501.4	1069.9	874.8	814.4	847.9	1071.9	1437.3
14332000	97.2	84.2	99.3	157.1	182.8	95.4	28.3	23.0	24.7	25.9	41.1	90.4
14335072	1108.5	1117.8	1434.4	2107.0	2261.2	2259.4	1520.6	1554.1	1087.0	894.0	1139.5	1602.8
14335200	95.5	85.1	98.9	109.7	95.1	68.0	46.1	36.4	33.9	36.0	44.5	75.4
14335230	18.0	23.3	30.4	27.0	11.3	4.3	1.4	0.7	0.8	1.6	3.7	13.4
14335235	6.0	6.9	8.6	6.6	2.0	0.7	0.2	0.1	0.1	0.3	1.0	4.8
14335250	1.8	1.9	2.0	2.1	2.2	2.3	13.2	24.3	25.3	6.5	1.9	1.8
14335300	8.4	19.5	32.7	33.5	14.0	4.7	13.8	22.1	23.4	6.9	2.2	2.4
14335500	125.4	144.8	186.8	190.1	147.1	105.1	75.9	69.5	69.8	56.2	63.3	98.5
14336100	81.3	81.5	88.7	92.2	87.2	84.3	85.3	85.1	81.5	35.1	72.6	81.4
14336700	67.0	61.8	67.1	52.4	16.2	6.5	3.4	2.8	3.1	5.4	10.0	47.5
14337000	178.1	192.6	224.0	172.9	82.9	44.8	36.0	36.0	36.6	78.6	48.5	124.7
14337500	376.9	333.0	354.0	311.1	197.1	105.4	59.9	51.5	56.9	98.8	102.0	289.9
14337600	1409.0	1066.6	1327.7	1637.7	1943.1	1885.4	1441.2	1368.4	1040.7	770.8	1004.3	1387.8
14338000	502.6	408.5	387.9	292.2	142.7	58.5	14.2	5.2	5.1	18.6	107.6	413.0
14339000	3180.7	2290.5	2615.0	2813.0	3123.8	2828.1	2117.6	2089.2	1622.5	1228.1	1651.9	2895.1
14340800	56.7	71.2	100.1	140.7	106.8	43.5	21.8	17.7	17.4	18.0	20.7	46.3
14341600	0.0	3.3	25.4	43.3	38.9	28.6	22.4	15.5	13.2	5.5	3.1	0.5
14341610	98.3	109.5	169.3	193.9	93.9	38.6	7.1	4.9	6.2	18.2	28.9	77.0
14342500	14.8	16.8	18.4	24.0	31.7	47.3	68.5	72.1	49.7	16.8	11.0	12.8
14343000	56.4	55.9	66.5	74.0	69.6	76.8	95.3	93.9	70.7	39.3	36.5	48.0
14345000	5.6	8.2	8.2	12.3	23.7	49.8	65.2	70.5	50.4	11.1	8.0	14.1
14345500	5.1	9.0	30.5	50.9	57.9	72.4	79.2	81.5	62.5	16.9	7.6	12.9
14346600	3.1	4.0	2.0	10.1	10.3	10.7	8.8	7.9	6.6	0.0	0.0	0.0
14346700	189.4	194.0	269.8	301.3	156.4	63.0	29.7	28.1	29.4	51.3	65.6	150.0
14346900	173.1	165.7	189.0	272.8	63.2	43.0	31.8	28.5	33.8	42.9	42.1	77.2
14347798	2.5	2.1	4.4	4.1	8.0	6.9	7.5	7.1	7.3	7.1	7.9	6.7
14347800	367.3	396.2	393.6	347.4	112.6	44.3	32.2	27.7	36.4	60.4	139.7	340.8
14348080	22.8	21.7	31.3	33.4	3.2	1.9	0.0	0.1	0.1	0.1	1.1	22.4
14348150	55.0	47.7	66.0	62.7	20.4	16.0	9.5	9.5	10.7	7.0	6.8	48.0
14348400	22.2	38.1	43.0	38.8	18.6	6.9	1.1	0.2	0.1	0.7	1.7	12.2
14348500	0.0	0.0	0.3	5.5	13.9	20.2	25.0	29.8	18.9	1.1	0.0	0.0
14349500	0.0	0.0	1.1	25.2	64.7	91.4	115.9	121.7	76.1	5.8	0.0	0.0
14350900	7.3	11.7	15.3	20.2	16.6	10.6	4.5	2.4	2.0	2.9	3.5	5.7
14352000	12.8	19.7	21.9	22.7	18.2	11.2	4.8	3.2	3.6	3.9	5.3	10.5
14352001	50.7	73.2	76.7	100.6	63.7	47.6	63.6	64.4	41.0	13.7	11.0	32.3
14352500	0.0	0.0	0.0	16.7	26.4	36.0	50.5	48.9	32.1	0.0	0.0	0.0
14353000	11.0	12.6	13.6	16.2	20.7	16.3	7.0	3.3	2.5	3.4	4.5	8.7
14353500	9.9	12.0	12.6	15.3	21.1	18.3	7.5	3.5	2.6	3.2	4.5	8.4

Station No.	1	2	3	4	5	6	7	8	9	10	11	12
14354100	19.0	28.3	26.5	31.8	30.8	25.4	9.8	6.2	5.6	7.2	9.8	16.5
14354200	134.4	122.0	121.9	139.9	113.3	66.4	51.4	47.9	30.5	19.1	30.3	93.1
14354950	1.8	2.4	2.7	3.6	3.8	3.7	2.2	0.7	0.3	0.4	0.5	1.1
14355875	7.8	9.3	10.7	10.8	5.4	3.8	1.9	1.7	2.0	2.3	3.0	6.3
14356500	0.0	NA	NA	20.3	24.5	32.4	37.8	35.9	21.0	4.6	0.0	0.0
14357000	91.7	126.8	129.5	155.0	81.0	43.8	19.6	16.7	17.8	24.6	30.7	63.9
14357500	212.3	190.3	176.3	197.1	154.4	79.9	44.0	45.0	44.2	39.8	58.8	158.7
14357503	129.6	167.3	169.0	190.4	100.3	54.6	15.1	15.1	25.8	44.3	45.4	106.3
14358000	0.0	0.0	0.0	6.6	19.6	22.5	27.7	25.7	20.9	5.7	0.0	0.0
14358610	2.1	3.0	3.5	2.3	0.6	0.5	0.0	0.0	0.0	0.0	0.1	1.4
14358680	14.0	15.3	13.5	13.6	13.4	11.5	7.4	9.3	17.0	8.5	4.9	10.6
14358725	4.7	5.1	5.3	2.8	0.6	0.2	0.0	0.0	0.0	0.1	0.2	2.9
14358750	18.9	19.4	17.8	20.0	32.6	24.3	19.9	22.6	25.8	8.9	4.0	14.5
14358800	192.7	211.8	213.1	232.3	166.8	105.6	42.0	49.2	76.0	78.7	76.7	149.1
14359000	4077.5	3088.1	3387.5	3563.3	3586.7	2999.4	2143.3	2106.3	1721.4	1356.1	1944.0	3679.6
14360500	374.9	349.7	363.5	201.6	69.1	39.1	10.1	3.5	5.8	23.9	47.5	249.4
14361100	0.0	0.0	0.0	1.2	35.6	53.0	56.7	56.9	49.5	14.5	0.0	0.0
14361110	0.0	0.0	0.0	0.0	38.0	53.9	59.1	57.5	53.2	13.5	0.0	0.0
14361120	0.0	0.0	0.0	0.3	14.6	21.1	24.7	24.9	25.1	8.6	0.0	0.0
14361130	0.0	0.0	0.0	0.0	4.3	7.0	8.8	8.8	8.5	2.6	0.0	0.0
14361140	0.0	0.0	0.0	0.0	1.0	1.8	1.8	1.7	1.8	0.5	0.0	0.0
14361500	5200.7	3985.2	4149.7	4056.7	3866.7	3059.9	2046.8	2010.7	1637.5	1398.2	2109.9	4406.5
14362000	721.2	464.5	433.9	415.8	596.5	388.3	274.3	275.2	265.4	274.6	267.6	492.4
14362250	14.4	13.5	12.3	7.2	3.5	1.8	0.8	0.3	0.3	0.8	1.8	7.6
14363450	4.3	8.0	9.8	15.5	21.0	12.3	4.2	2.3	2.1	2.5	2.7	4.1
14365500	60.0	87.6	88.5	109.8	105.5	73.2	24.4	10.2	8.7	14.8	20.6	42.8
14366000	938.6	673.4	625.3	562.5	730.1	452.6	269.7	255.5	249.5	280.5	299.5	626.5
14368300	185.9	207.5	162.1	113.9	48.2	21.0	8.9	5.4	6.2	23.4	35.5	88.4
14369500	1436.0	1104.9	1008.5	799.5	803.0	478.7	256.4	234.2	244.7	314.8	395.1	966.4
14372300	10917.9	8625.2	8272.2	6838.8	5438.3	3912.2	2464.5	2313.3	1995.5	1967.9	3499.9	8894.3
14372500	345.4	298.4	299.0	248.0	153.1	64.3	20.2	10.8	9.9	30.4	119.8	337.8
14375100	417.5	372.8	437.1	416.3	301.6	156.5	59.9	33.8	27.0	43.2	102.1	333.2
14375200	449.3	391.2	466.1	430.6	288.0	131.4	36.1	14.0	12.6	43.3	97.1	380.5
14377100	2878.1	2234.9	2353.8	1788.7	902.1	393.7	105.9	43.0	42.7	203.9	908.2	2531.3

Notes: Data summarized from OWRD mean daily flow database (accessed 18 June 2025), including provisional data. Only months with complete data in WY1991-2020 were included in means. Not all stations had data for all 30 years.

Appendix E: Reservoir Evaporation and Stage

Table E1. Mean monthly evaporation (inches ± coefficient of variation) at selected waterbodies in the Rogue River Basin for water years 1980-2021.

Month	Applegate	Emigrant	Fish	Howard Prairie	Hyatt	Lost Creek	Willow Creek
1	2.32 (±12%)	1.13 (±35%)	0.50 (±36%)	0.90 (±25%)	0.49 (±39%)	2.10 (±8%)	1.72 (±18%)
2	1.59 (±16%)	0.91 (±30%)	0.84 (±23%)	0.81 (±26%)	0.93 (±26%)	1.57 (±13%)	1.12 (±29%)
3	1.83 (±19%)	1.46 (±29%)	1.47 (±20%)	1.24 (±24%)	1.61 (±23%)	1.72 (±16%)	1.17 (±29%)
4	2.13 (±17%)	2.32 (±19%)	2.50 (±15%)	2.05 (±16%)	2.71 (±19%)	1.98 (±15%)	1.53 (±24%)
5	2.81 (±14%)	3.56 (±15%)	4.11 (±12%)	3.50 (±12%)	4.52 (±15%)	2.61 (±14%)	2.22 (±19%)
6	3.81 (±11%)	4.99 (±11%)	5.60 (±9%)	4.93 (±10%)	5.88 (±11%)	3.60 (±11%)	3.35 (±13%)
7	5.25 (±9%)	6.84 (±8%)	7.16 (±5%)	6.67 (±6%)	7.49 (±6%)	5.21 (±8%)	5.08 (±9%)
8	6.25 (±8%)	7.29 (±7%)	7.23 (±6%)	7.04 (±6%)	7.33 (±5%)	6.01 (±8%)	6.18 (±10%)
9	5.93 (±6%)	5.96 (±6%)	5.54 (±7%)	5.81 (±6%)	5.30 (±8%)	5.39 (±6%)	5.50 (±8%)
10	5.52 (±5%)	4.59 (±12%)	3.77 (±8%)	4.32 (±6%)	3.47 (±13%)	4.69 (±5%)	4.72 (±9%)
11	4.34 (±7%)	2.85 (±19%)	1.95 (±11%)	2.63 (±8%)	1.57 (±24%)	3.49 (±5%)	3.51 (±9%)
12	3.25 (±7%)	1.85 (±22%)	0.97 (±22%)	1.63 (±11%)	0.65 (±45%)	2.80 (±4%)	2.53 (±10%)
Annual	45.03	43.76	41.64	41.53	41.96	41.18	38.64

Notes: Pr. = Prairie; Cr. = Creek. Data from Huntington et al. (2025) Daily Lake Evaporation Model summaries.

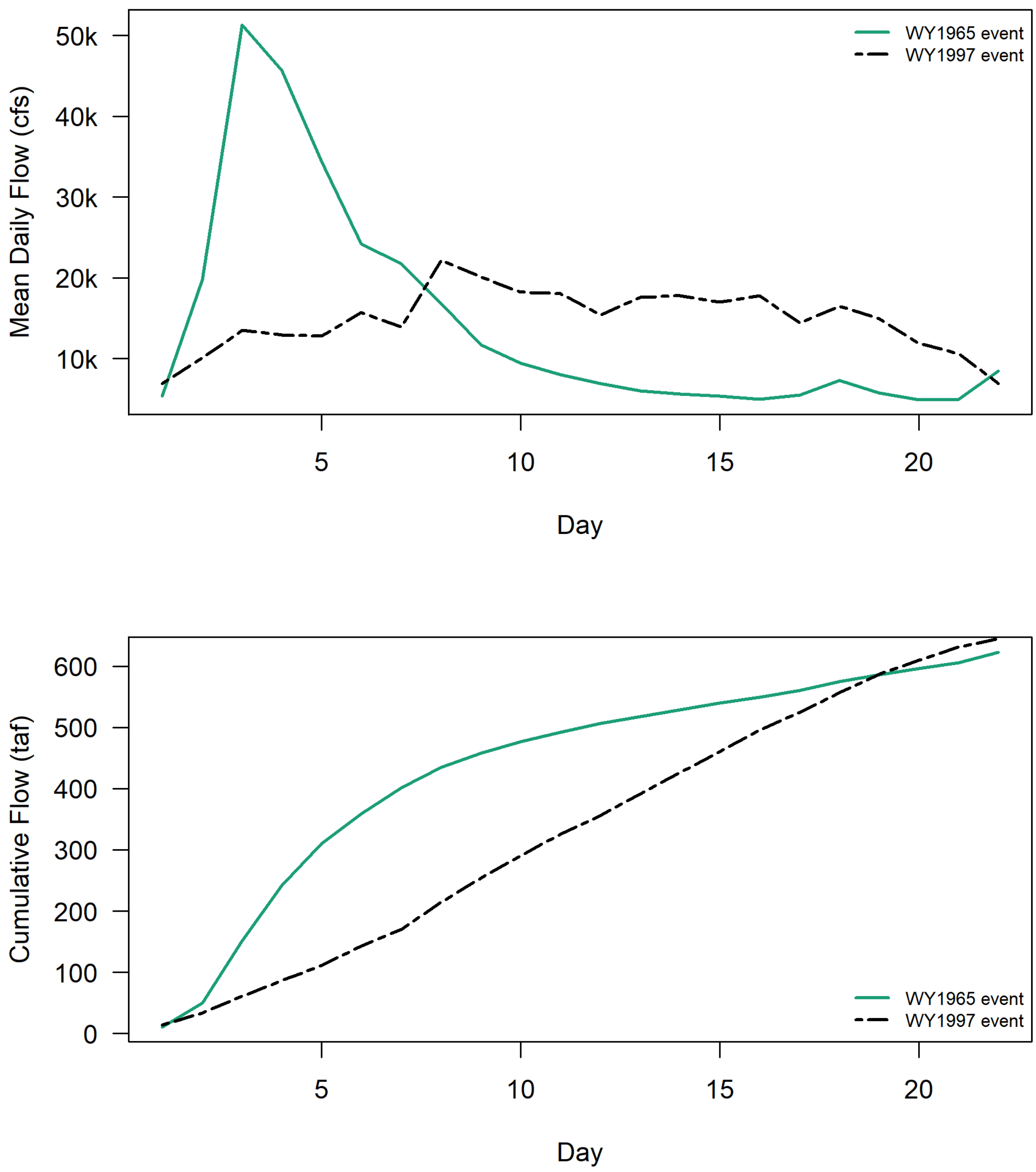


Figure E1. Hydrographs of (a) mean daily flow and (b) cumulative flow for water year 1965 (pre-dam) and 1997 (post-dam) flood events at the Rogue River at Dodge Bridge (#14339000).

Notes: cfs = cubic feet per second; taf = thousand acre-feet; WY = water year. Plotted dates are December 20, 1964 to January 10, 1965 (for WY 1965) and December 25, 1996 to January 15, 1997 (for WY 1997).

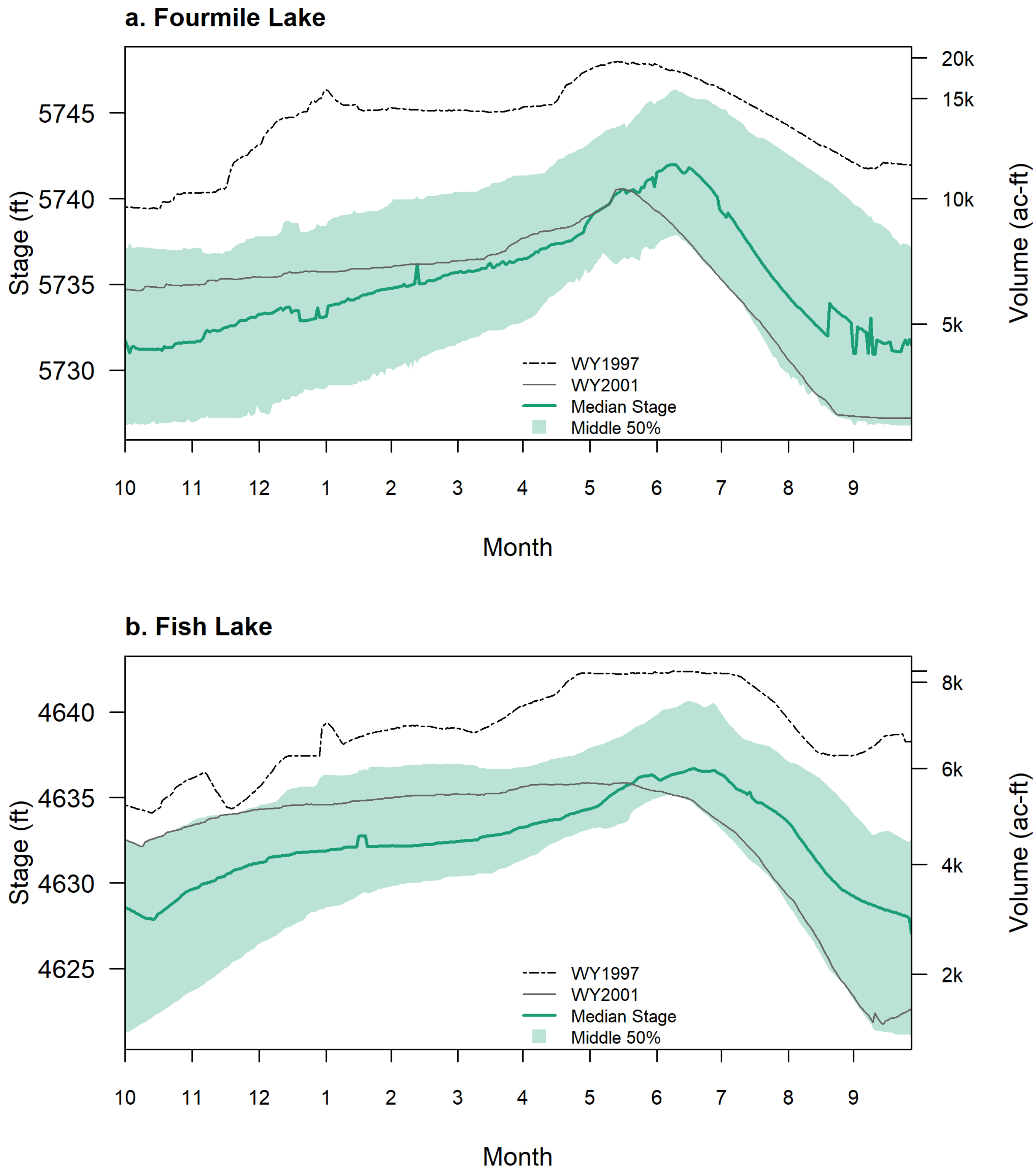


Figure E2. Hydrographs of mean daily stage at (a) Fourmile Lake and (b) Fish Lake, showing typical values and values for water years 1997 and 2001.

Notes: Median and middle 50% of values based on water years 1991-2020. Data from USBR for FOR and FIS stations.

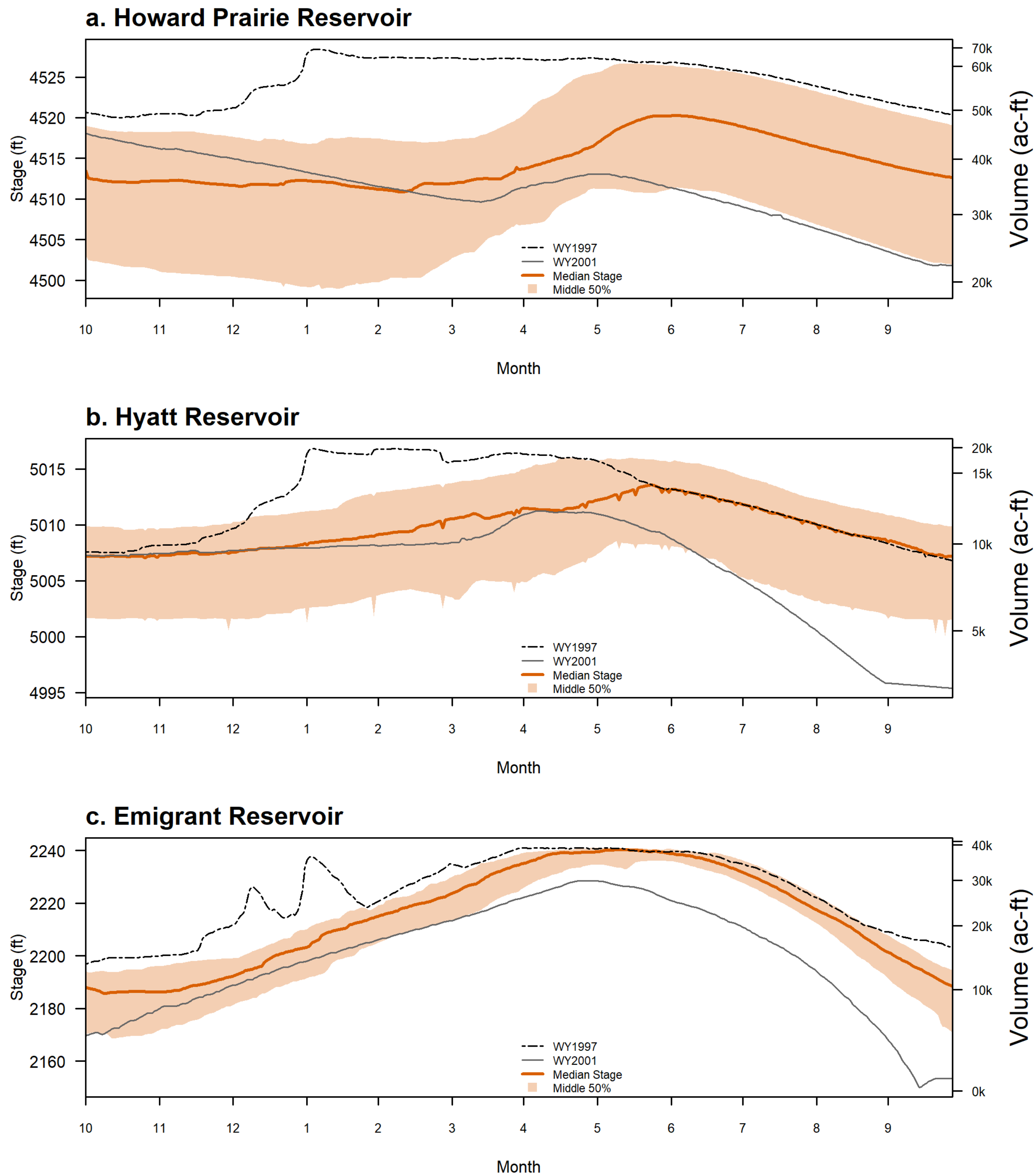
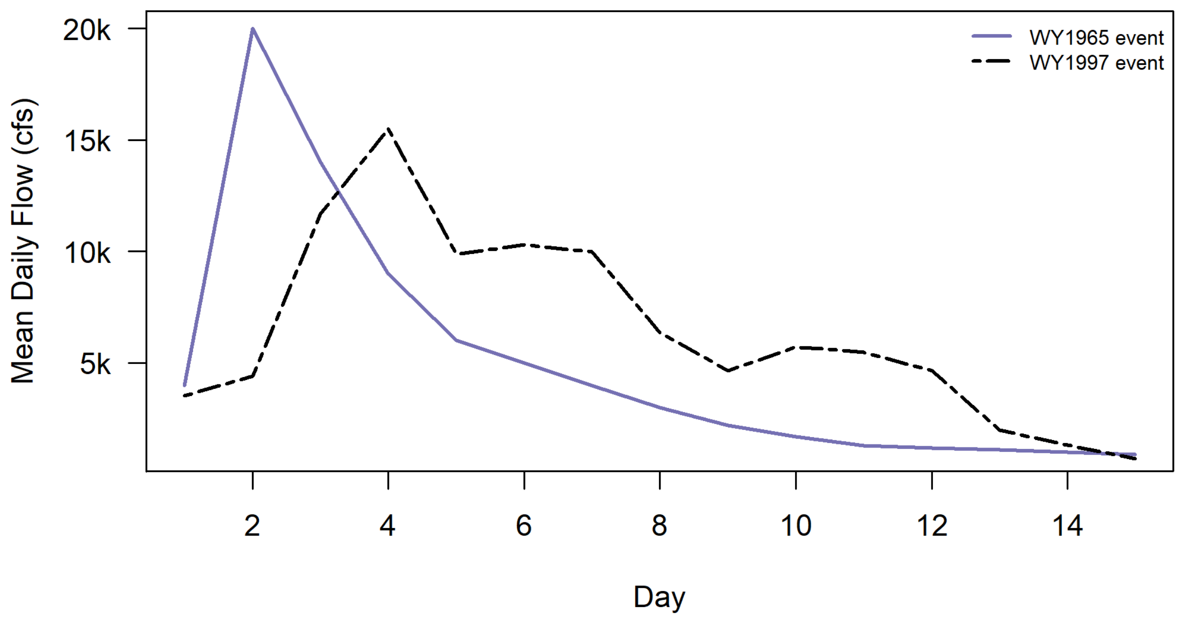


Figure E3. Hydrographs of mean daily stage at (a) Howard Prairie, (b) Hyatt, and (c) Emigrant Reservoirs, showing typical values and values for water years 1997 and 2001.

Notes: Median and middle 50% of values based on water years 1991-2020. Data from USBR for HPD, HYA, and EMI stations.



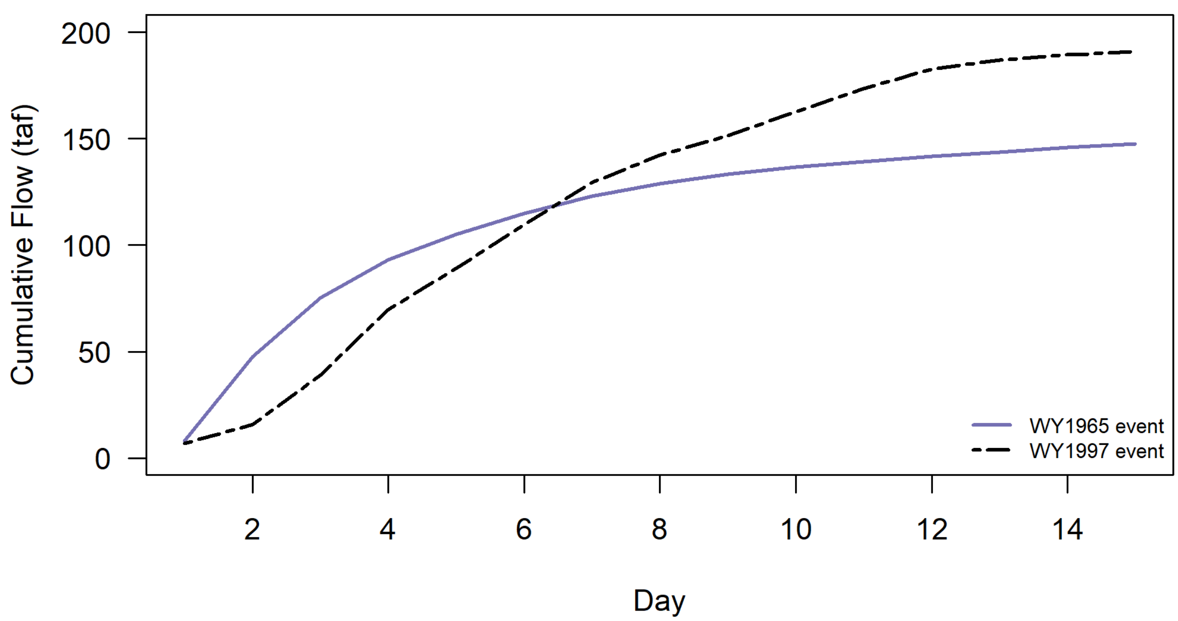


Figure E4. Hydrographs of (a) mean daily flow and (b) cumulative flow for water year 1965 (pre-dam) and 1997 (post-dam) flood events at the Applegate River near Copper (#14362000).

Notes: cfs = cubic feet per second; taf = thousand acre-feet; WY = water year. Plotted dates are December 21, 1964 to January 4, 1965 (for WY 1965) and December 30, 1996 to January 13, 1997 (for WY 1997).