Umpqua River Basin Total Maximum Daily Load for Temperature

DRAFT

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1 Introduction

The Umpqua River Basin is comprised of three major rivers 1) North Umpqua, 2) South Umpqua, and 3) Umpqua, located in southwestern Oregon. These rivers, and numerous tributaries, are identified on the 2022 Oregon Clean Water Action (CWA) section 303(d) list of impaired waters due to elevated temperature (ODEQ, 2022b) and not supporting the aquatic life beneficial uses of salmon and steelhead spawning, salmon and trout rearing and migration, and core cold water habitat. The specific impaired waterbody assessment units (AU) are listed in Section 4.1.8. The CWA requires the development of Total Maximum Daily Loads (TMDLs) to restore impaired waters to fully support their beneficial uses. This document provides background and technical analyses relied upon by the U.S. Environmental Protection Agency (EPA) in the development of temperature TMDLs in the North Umpqua River, South Umpqua River, Umpqua River, and all associated tributaries.

In 2012 the U.S. District Court, District of Oregon found that the natural conditions criterion component of Oregon's temperature water quality standards was unlawful and no longer effective for use in CWA programs. Subsequently, in 2019 U.S. District Court, District of Oregon ordered the Oregon Department of Environmental Quality (ODEQ) and the EPA to establish new temperature TMDLs to replace fifteen previously approved temperature TMDL projects that included the now ineffective natural conditions criterion. This Umpqua River Basin Temperature TMDL project replaces the 2006 Umpqua Basin Temperature TMDL project, which the EPA approved on April 10, 2007. The remaining Umpqua Basin TMDLs, listed in Table 1 are not subject to the above-mentioned litigation. These TMDLs were established by ODEQ, and approved by the EPA on April 12, 2007, remain in effect. Additionally, the Little River Watershed TMDL approved by the EPA on January 29, 2002, remains in effect.

Table 1 EPA approved Umpqua Basin TMDLs that remain effective.

<table>
<tr><th>TMDL Action ID</th><th>TMDL Name</th><th>EPA Approval Date</th><th>Water Quality Impairments Addressed</th></tr>
<tr><td rowspan="4">30358</td><td rowspan="4">Umpqua Basin TMDLs</td><td rowspan="4">April 12, 2007</td><td>Bacteria</td></tr>
<tr><td>Chlorophyll *a,* aquatic weeds, phosphorus</td></tr>
<tr><td>pH and dissolved oxygen</td></tr>
<tr><td>Diamond Lake: aquatic weeds, pH, dissolved oxygen</td></tr>
<tr><td>2022</td><td>Little River Watershed TMDL</td><td>January 29, 2002</td><td>Temperature, Sediment, pH</td></tr>
</table>

2 Regulatory Background

Section 303(c) of the CWA requires states to establish water quality standards that identify each waterbody's designated use and establish water quality criteria necessary to support the identified uses. Section 303(d) of the CWA requires states to identify and list waters not meeting their water quality standards, even after implementing effluent limitations and other pollution control measures. TMDLs are required for impaired waters. The goal of a TMDL is to attain water quality standards, and 40 CFR sections 130.2 and 130.7 and Section 303(d) of the CWA describe elements of a TMDL.

A TMDL document is a written quantitative assessment of water quality problems and contributing pollutants. It identifies one or more numeric targets based on applicable water quality standards, specifies the maximum amount of a pollutant that can be discharged (or the amount a pollutant needs to be reduced) to meet water quality standards, allocates pollutants among sources in the watershed, and provides the basis for taking actions needed to meet numeric targets and water quality standards. TMDLs are implemented through existing regulatory and non-regulatory programs that limit pollutant discharges from point and nonpoint sources.

TMDL Elements

There are several informational and analytical elements that together comprise a TMDL document. Sections 4 through 12 of this document are organized around these elements and they present the analyses and findings. The TMDL document elements are summarized below:

- Section 4 Problem Identification. This section reviews data and information used to identify the waterbody as impaired and summarizes the waterbody's existing condition based on that data along with any new information acquired since the listing. This element identifies those designated uses that are not supported by the waterbody and the water quality standards designed to protect those uses.

- Section 5 Numeric Targets. The numeric targets identify the specific instream goals or endpoints for the TMDL that will signify attainment of the water quality standard. In some cases, multiple indicators and numeric target values may be necessary to interpret an individual water quality standard and/or account for seasonal differences in acceptable pollutant levels. Often when the applicable water quality standard is expressed numerically, it is appropriate to set the TMDL's numeric target equal to the numeric water quality standard.

- Section 7 Source Analyses. This section provides a quantitative estimate of pollutant loading from point and nonpoint sources to the waterbodies of concern and characterizes the pollutant loading sources, amounts and timing of pollutant delivery.

- Section 8 Loading Capacity. The loading capacity presents the quantitative link between the applicable water quality standards and the TMDL. The loading capacity is the maximum amount of a pollutant that can be delivered to the waterbody and still achieve the water quality standards.

- Section 9 Pollutant Allocation. Each pollutant source is allocated a quantitative load that it can discharge to meet the TMDL numeric targets and applicable water quality standards. Point sources are assigned waste load allocations (WLA) and nonpoint sources are assigned load allocations (LA). In some cases, it will be appropriate to reserve a portion of the TMDL loading capacity to provide for future sources in the watershed.

- Section 11 Margin of Safety. The TMDL document must describe explicit and/or implicit margin of safety to account for uncertainty in the TMDL analyses. An explicit margin of safety can be provided by not allocating a portion of the loading capacity for the pollutant of concern. An implicit margin of safety can be incorporated by making and documenting conservative assumptions used in the TMDL analyses.

- Section 12 Reasonable Assurance. Reasonable assurance in the TMDL context means that when a TMDL is developed for waters impaired by both point and nonpoint sources, and wasteload allocations include assumptions that nonpoint source reductions will occur, the TMDL needs to provide reasonable assurance that nonpoint source control measures will achieve the expected reductions. Reasonable assurance ensures that a TMDL's wasteload and load allocations together will meet the applicable water quality standards.

3 Umpqua River Basin Description

The Umpqua River basin is a large river system in southwestern Oregon and is one of only two Oregon rivers that extend from the Cascade mountains to the Pacific Ocean. The watershed boundary for the Umpqua River basin closely aligns with the Douglas County political boundary. The Umpqua River system drains a 12,103 km^2 mountainous basin with elevations from 2,799 meters (9,183 feet) to a low gradient broad floodplain (Figure 1). The two main tributaries to the Umpqua River are the North Umpqua River and the South Umpqua River. The headwaters of the North Umpqua River and the South Umpqua River are in the Umpqua National Forest. The North Umpqua River flows generally in a westward direction. The South Umpqua River flows west then north through the Umpqua Valley after its confluence with Cow Creek, a major tributary. The mainstem Umpqua River flows generally north then west where it enters the Pacific Ocean.

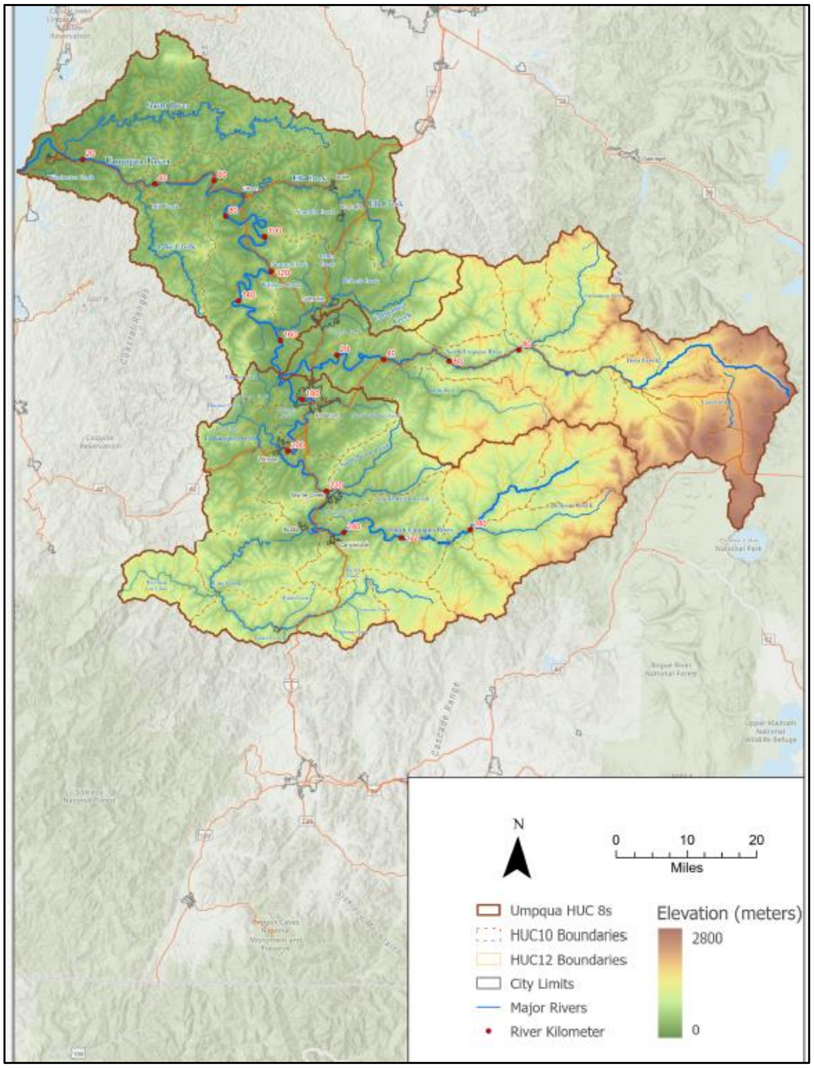

Figure 1 Umpqua River basin elevation.

Geology

The Umpqua Basin contains five distinct geomorphic provinces called the High Cascades, Western Cascades, Klamath Mountains, Coast Range, and the Coastal Plain (Figure 2). Each province is unique and distinguished from the other featuring different bedrock types and structure, topography, climate, and climatic history. At the scale of the geomorphic province, differences in regional geology, topography, and climate control the general geomorphic processes and the drivers of ecosystems sustaining aquatic habitats that develop on the landscape within the river setting (Montgomery, 1999). The soil and rocks – the mineral composition – also vary in each province posing unique influences on water quality. The North Umpqua River in the High Cascade province is characterized by highly permeable Pliocene and Quaternary volcanic rocks that result in little runoff and low rates of sediment production (Jefferson et al., 2010). The South Umpqua River headwaters are in the steeply dissected Western Cascades province. The deeply dissected, weathered volcanic rocks of the Western Cascades support higher rates of runoff with mass wasting being the dominant mechanism of hillslope sediment erosion (Stillwater Sciences, 2000). The middle reaches of the South Umpqua River flow through the Klamath Mountains terrain, which has a Cretaceous and Jurassic accretionary complex assemblage of meta-sedimentary, volcanic, and intrusive igneous rocks that produce variable amounts of sediment (Wallick et al., 2011).

As the South Umpqua River flows north downstream from the confluence with Cow Creek it enters the Paleocene and Eocene marine volcanic sedimentary rocks of the Coast Range province near Roseburg. The downstream reaches of the North Umpqua River also enter the Coast Range province. At the confluence of the North Umpqua and South Umpqua Rivers, the mainstem Umpqua River flows through the Coast Range sedimentary rock province. The Umpqua River meanders through a narrow valley that is predominantly incised into soft marine sediment of the Tyee and Elkton Formations, both of which are highly susceptible to land sliding and prone to incision. The entrenched nature of the mainstem Umpqua River valley is locally characterized by numerously flanked floodplains and terraces at various elevations along its course. The lowermost 40-kilometer stretch of the Umpqua River valley is tidally influenced where the estuary extends inland from the coast.

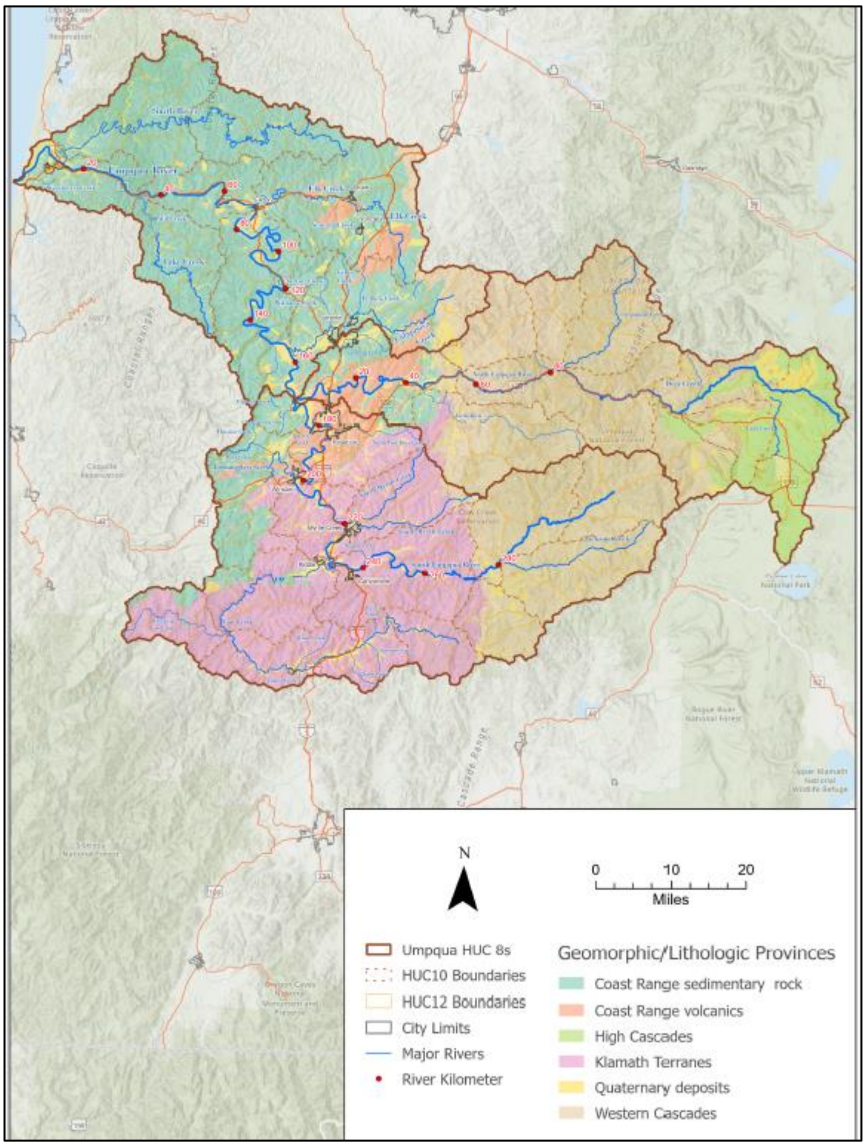

Figure 2 Umpqua River basin geomorphic provinces.

Climate and Hydrology

The Umpqua basin has a highly seasonal climate that consists of warm, dry summers and cool, wet winters with moderately low temperatures. Most precipitation occurs between October and April. Precipitation rates vary across the subbasin with annual precipitation ranges between 800 and greater than 2,500 mm; the basin-wide mean is 1,310 mm (Figure 3). Precipitation is greatest in the winter months due to significant amounts of snow in the Cascade mountains with annual averages ranging from 7,620 mm to as high as 13,970 mm in some years. The coastal area of the basin receives the greatest amount of precipitation and relatively little snow (25-76 mm) each year due to the low elevation.

Streams in the mountainous regions can be flashy and respond quickly to rainfall due to high stream density and steep topography. Runoff from the Cascades and Coast Range feeds the rivers year-round. The lowland valleys located within the lower North and South Umpqua subbasins are generally dry and hot in the summer, with some areas averaging less than 25 mm precipitation per month during the summer; in these areas, it is very common for streams to become dry in the summer (Figure 3).

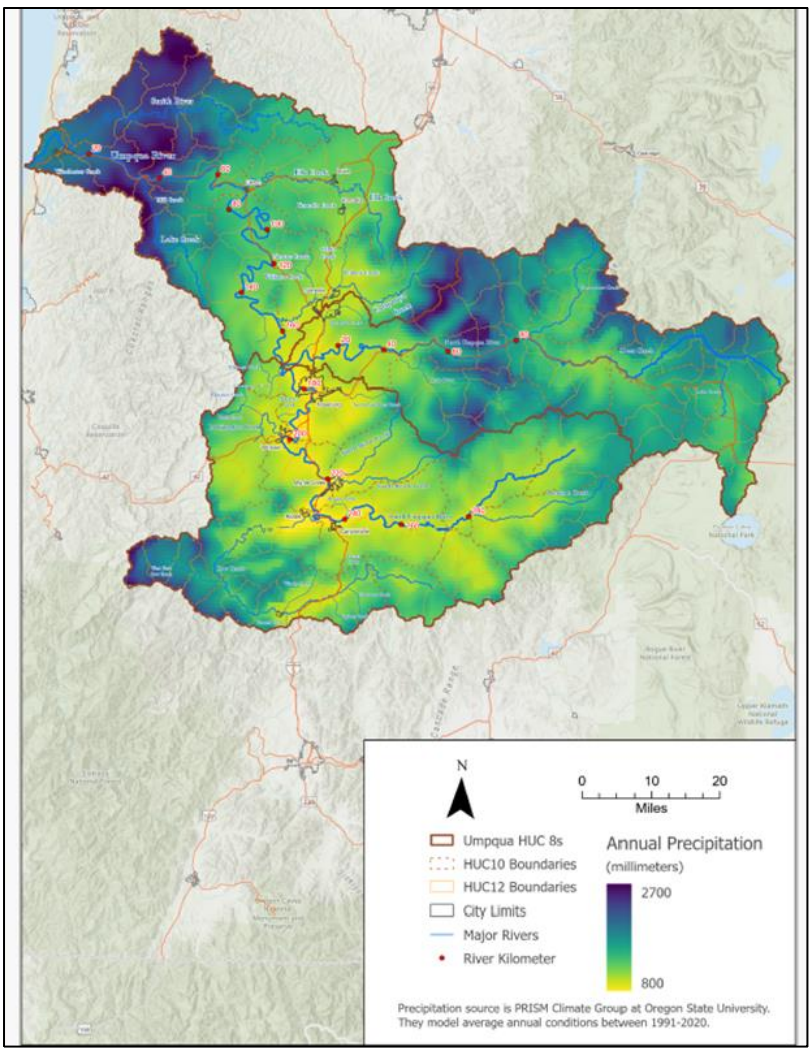

Figure 3 Umpqua River basin annual precipitation.

The U.S. Geological Survey gauging station on the Umpqua River near Elkton captures discharge from about 80% of the drainage basin, and the long term mean annual flow is about 7,400 cfs (Figure 4). Although, the North Umpqua subbasin is smaller than the South Umpqua subbasin, it supplies the majority of flow measured at Elkton (Figure 4 through Figure 6). Peak flows in the Umpqua basin typically derive from winter frontal systems, with the largest flows resulting from regional rain-on-snow events. The 2-year recurrence-interval flow is about 44,355 cfs for the North Umpqua River near Winchester, 45,626 cfs for the South Umpqua River at Brockway, and 93,937 cfs for the main stem Umpqua River at Elkton.

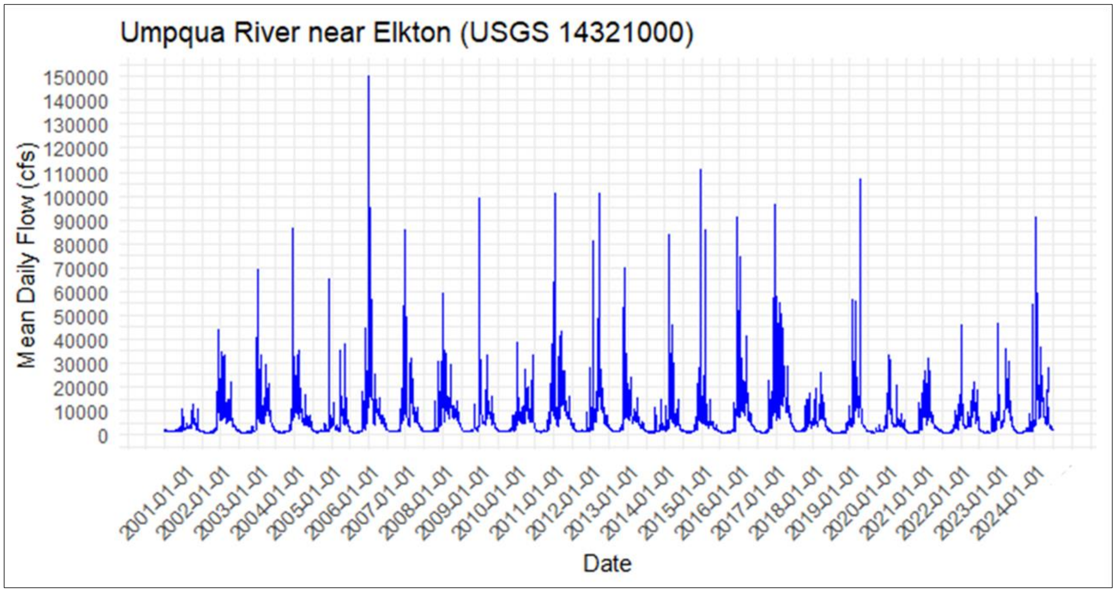

Figure 4 Umpqua River daily average discharge measured at the USGS gauge near Elkton Oregon (period of record July 1, 2000 – July 1, 2024).

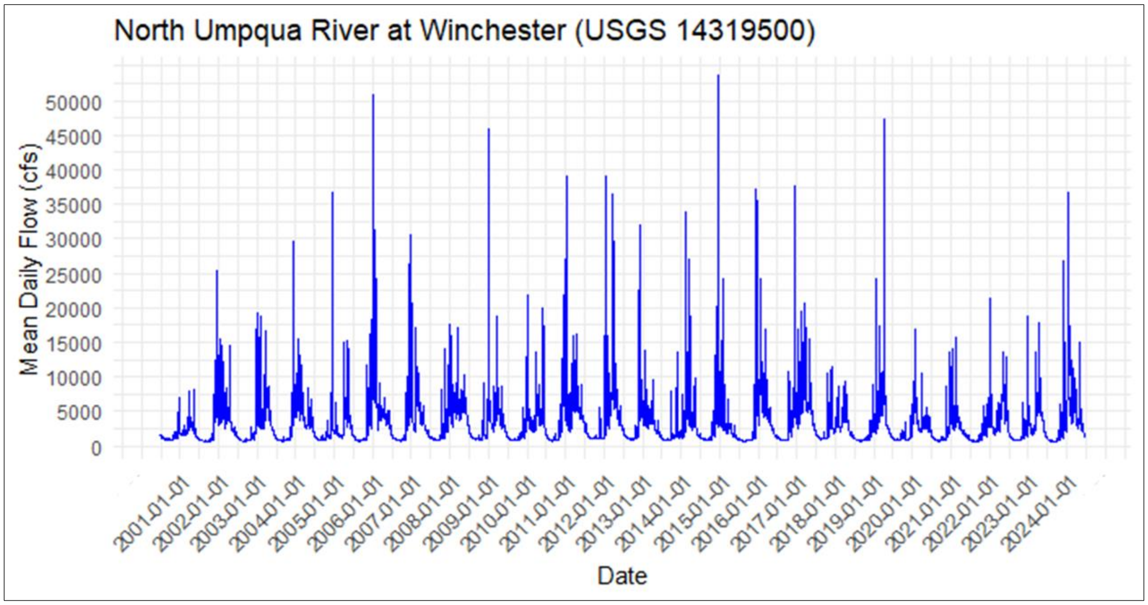

Figure 5 North Umpqua River daily average discharge measured at the USGS gauge near Winchester Oregon (period of record July 1, 2000 – July 1, 2024).

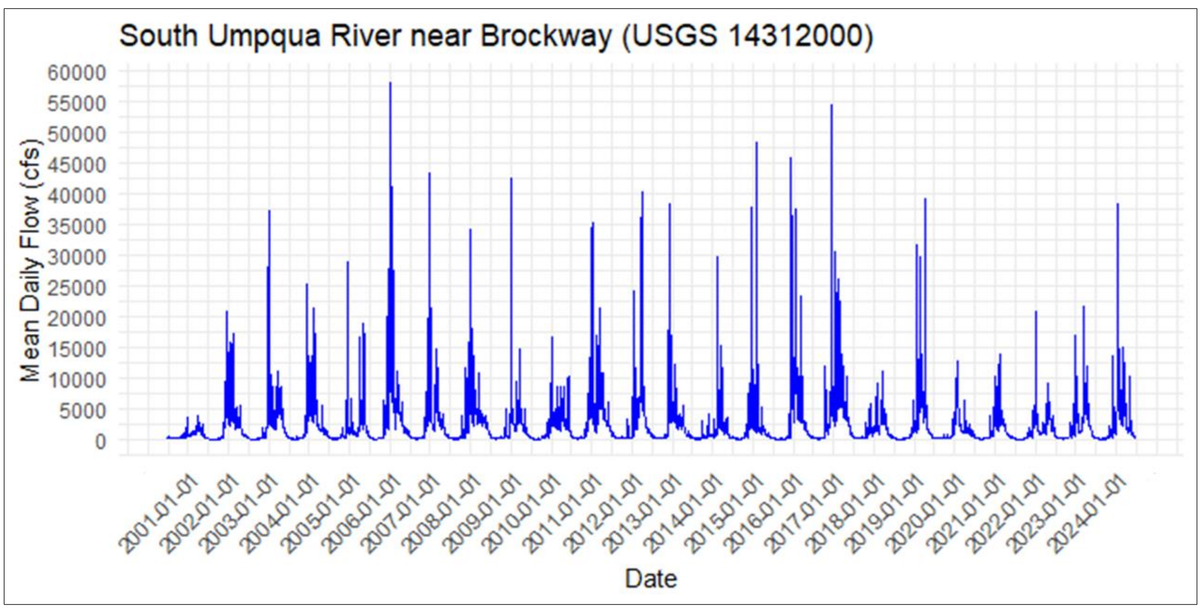

Figure 6 South Umpqua River daily average discharge from USGS gauge near Brockway Oregon (period of record July 1, 2000 – July 1, 2024).

Flow on the North Umpqua River has been regulated since the early 1950s by PacifiCorp hydroelectric projects, which include eight dams in the upper subbasin. These dams have limited effect on peak flows because they have limited storage, and much of their contributing area lies in the groundwater-dominated High Cascades terrain (Stillwater Sciences, 1998).

In the South Umpqua River subbasin, Galesville Reservoir, currently owned by Douglas County, was constructed in the upper Cow Creek watershed in 1985 to reduce flooding along the lower reaches of Cow Creek. Although Galesville Reservoir almost certainly has a pronounced effect on peak flows on Cow Creek, peak flows farther downstream on the South Umpqua River near Brockway did not show a marked decline following dam construction (Wallick et. al., 2011). It is unlikely that either Galesville Reservoir or the North Umpqua hydroelectric dams strongly influence peak flows as far downstream as the USGS gage near Elkton on the Umpqua River because they control only a small portion of the total drainage-area runoff at this gage (Wallick et. al., 2011).

Land Use and Ownership

The Umpqua River basin is densely forested throughout much of the watershed, which accounts for more than 80% of the basin (Figure 7). Agriculture, hay/pasture primarily grazing, is the second largest land use, with about 7% of the land area. Urbans areas are generally small and centrally located in the basin.

A significant portion of land in the Umpqua River Basin is managed by the federal government. The Umpqua National Forest encompasses nearly 1 million acres in the eastern portion of the basin (Figure 8). Several large sections of the basin have the alternating private/public checkerboard pattern. The interior basin is primarily privately-owned. Checkerboard ownership predominates on the remainder of the basin.

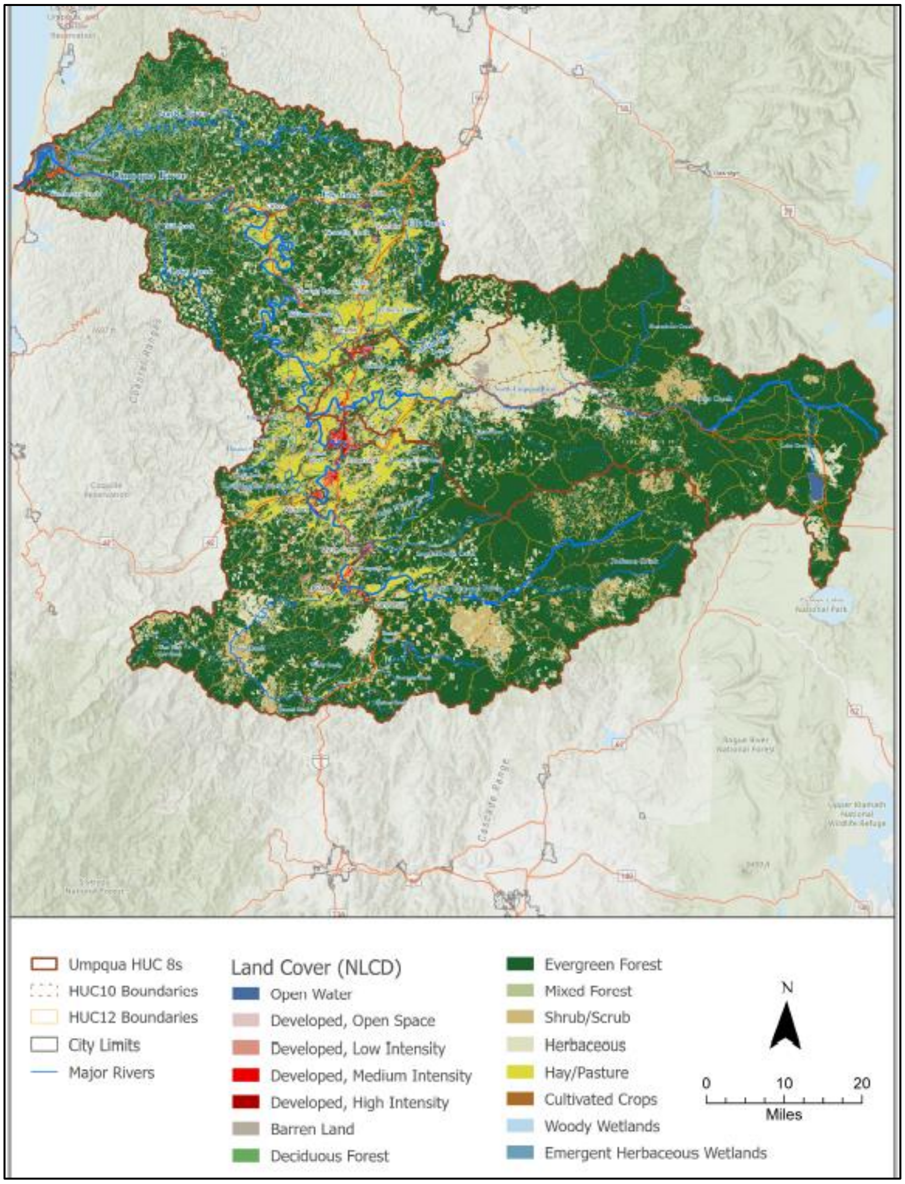

Figure 7 Umpqua River basin land cover based on the 2021 National Land Cover Database.

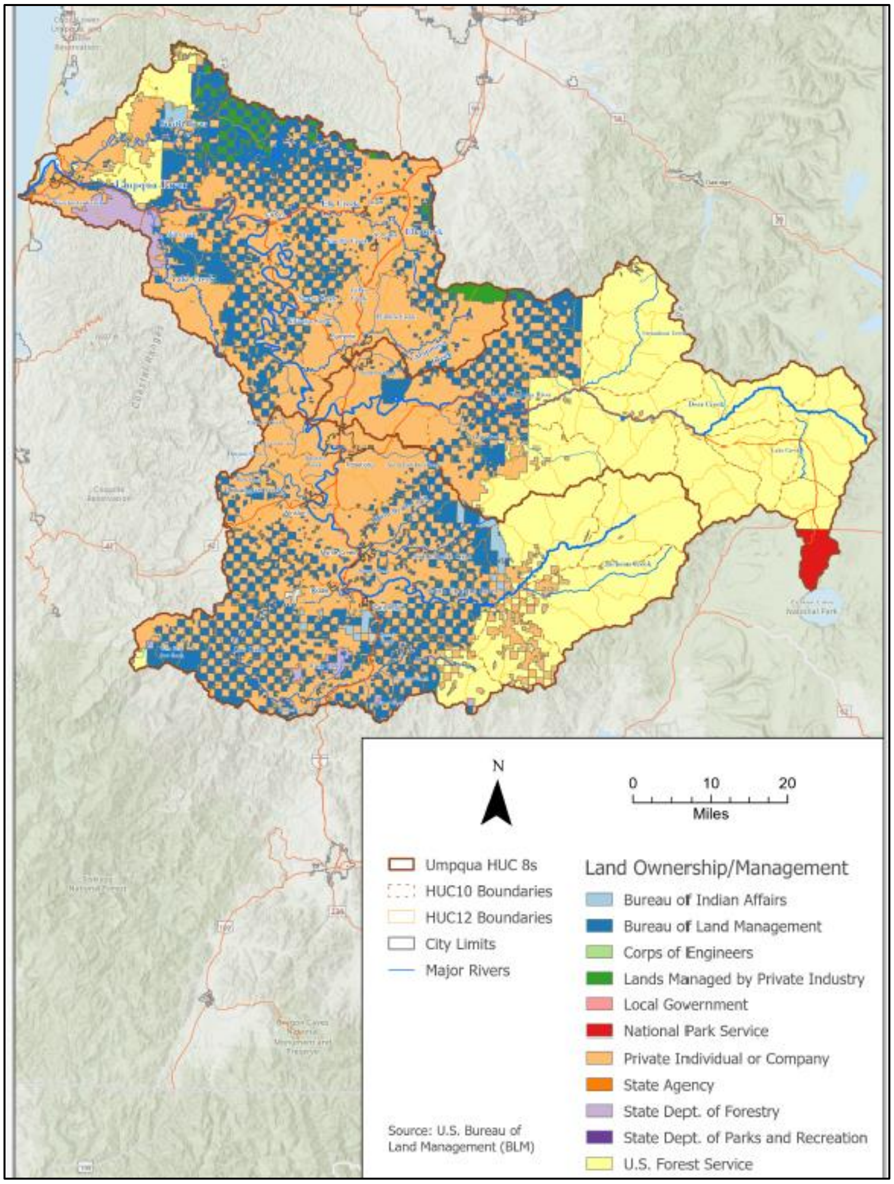

Figure 8 Umpqua River basin land ownership and/or management.

Fishery

The North Umpqua River is a renowned salmon fishery, and water-based recreation is important throughout the basin. In addition to salmon, a wide variety of fish species are present in the Umpqua River Basin. Fish species found within the basin are listed below (Table 2).

Table 2 List of fish species known to be present in the Umpqua basin.

Steelhead trout (*Onchorhyncus mykiss*)	Striped bass (*Morone saxatilis*)
Chinook salmon (*Oncorhynchus tshawytscha*)	Smallmouth bass (*Micropterus dolomieu*)
Coho salmon (*Onchorhyncus kisutch*)	Largemouth bass (*Micropterus salmoides*)
Coastal cutthroat trout (*Onchorhynchus clarki clarki*)	Pumpkinseed (*Lepomis gibbosus*)
Chum salmon (*Oncorhynchus keta*)	Rainbow trout (*Oncorhynchus mykiss*)
Pacific lamprey (*Lampetra tridentata*)	Yellow perch (*Perca flavescens*)
River lamprey (*Lampetra ayresi*)	Bluegill (*Lepomis macrochirus*)
Western brook lamprey (*Lampetra richardsoni*)	Sculpin (*Cottus sp.)*
American shad (*Alusa sapidissima*)	Redside shiner (*Richardsonius balteatus*)
Eastern brook trout (*Salvelinus frontinalis*)	Umpqua dace (*Rhinicthys cataractae*)
Brown trout (*Salmo trutta*)	Long-nose dace (*Rhinicthys cataractae*)
Largescale sucker (*Catostomus macrocheilus*)	Speckled dace (*Rhinichthys osculus*)
Umpqua chub (*Oregonichthuys kalawatseti*)	Umpqua pikeminnow (*Ptychocheilus umpquae*)
Fathead minnow (*Pimephales promelas*)	Brown bullhead (*Ameiurus nebulosus*)
Tui chub (*Gila bicolor*)	Mosquitofish (*Gambusia affinis*)
White sturgeon (*Acipenser transmontanus*)	White sturgeon (*Acipenser medirostrus*)
Umpqua squawfish (*Ptychocheilus umpquae*)	

Key species of interest to this TMDL project include the Steelhead Trout (*Onchorhyncus mykiss*), the Chinook Salmon (*Oncorhynchus tshawytscha),* Coho Salmon (*Onchorhyncus kisutch*) and the Coastal Cutthroat Trout (*Onchorhyncus clarki clarki*). Life stages periodicities for these key species are listed in Table 3. Note that the table below covers the entire Umpqua River Basin and fish use is different in the different subbasins. The information provided in Table 3 is based on the best data currently available and is subject to changing over time and is therefore provided for informational purposes only.

Table 3 Cold water fishes seasonal life stages in the Umpqua River basin (informational only, non-regulatory).

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Winter Steelhead	Adult migration	■	■	■	■								
	Adult Spawning	■	■	■	■	■	■						
	Adult Holding	■	■	■	■	■	■						
	Eggs to Fry	■	■	■	■	■	■	■					
	Juvenile Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile migration	■	■	■	■	■	■						
Summer Steelhead	Adult migration					■	■	■	■	■	■	■	■
	Adult Spawning	■	■	■	■					■	■	■	■
	Adult Holding	■	■	■	■					■	■	■	■
	Eggs to Fry	■	■	■	■	■	■				■	■	■
	Juvenile Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile migration	■	■	■	■	■	■						
Fall Chinook Salmon	Adult migration									■	■	■	■
	Adult Spawning	■								■	■	■	■
	Adult Holding									■	■	■	■
	Eggs to Fry	■	■	■							■	■	■
	Juvenile Rearing			■	■	■	■						
	Juvenile migration				■	■	■	■	■	■			
Spring Chinook Salmon	Adult migration		■	■	■	■	■	■	■	■			
	Adult Spawning								■	■	■	■	
	Adult Holding					■	■	■	■	■	■		
	Eggs to Fry	■	■	■					■	■	■	■	■
	Juvenile Rearing	■	■	■	■	■	■	■	■	■	■	■	■

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Juvenile migration				■	■	■	■	■	■			
Coho Salmon	Adult migration	■								■	■	■	■
	Adult Spawning	■									■	■	■
	Adult Holding										■	■	■
	Emergence	■	■	■							■	■	■
	Juvenile Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile migration			■	■	■	■						
Searun Cutthroat Trout	Adult migration	■	■	■	■								
	Adult Spawning	■	■							■	■	■	■
	Adult Holding		■	■	■	■	■	■	■	■			
	Emergence	■	■	■	■	■					■	■	■
	Juvenile Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile migration	■	■	■	■	■	■						

Information from ODFW 2023

4 Problem Identification

This section provides an overview of the temperature impairments of the North Umpqua, South Umpqua, and Umpqua Rivers and associated tributaries. This section includes background information on temperature water quality impacts and presents the beneficial uses and water quality standards applicable to waters addressed in this TMDL project. Finally, the section provides a review of water quality data characterizing current condition and confirming the temperature impairment of the waterbodies.

Temperature and Water Quality Impacts

Water temperature is a measure of the concentration of heat energy in a waterbody and the hotter a substance is the more heat energy it has. Natural temperature in rivers and streams is affected by both atmospheric and hydrologic processes that govern the movement of heat (Figure 9). Physical, chemical, and biological attributes of rivers are directly affected by temperature. For example, temperature impacts physical and chemical aspects of waterbodies such as water density, the solubility of oxygen, and rates of nutrient cycling. Temperature also influences critical biological processes including organism survival, growth, reproduction, and behavior. Temperature's role in detrimental biological impacts on salmonid fishes is the focus of this TMDL project because the fish and aquatic life beneficial uses: 1) salmon and steelhead spawning, 2) core cold water habitat, and 3) salmon and trout rearing and migration. These are the sensitive beneficial uses addressed by this TMDL (see section 4.1.1).

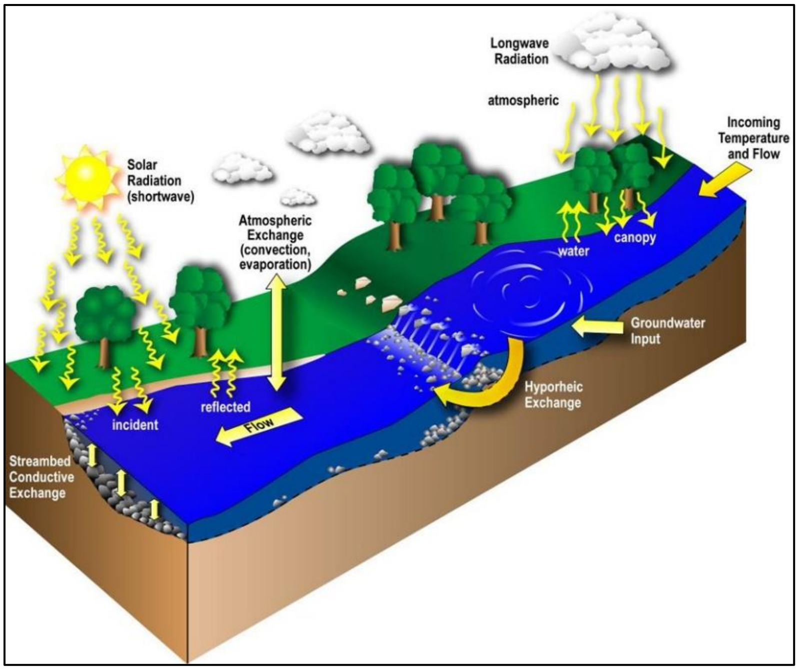

Figure 9 Key heat transfer processes in streams (EPA CADDIS, Adapted from Moore et al. (2005) and Johnson and Jones (2000))

Salmonid freshwater life history is connected to water temperatures and these fish require cold water distributed spatially and temporally across their habitats (EPA, 2001). Species of salmon mature to adulthood in the ocean and return to freshwater when ready to reproduce. Salmon and steelhead periods of migration can vary considerably between species and the fish can return to their freshwater habitats to spawn at any time of the year. Temperature is a crucial factor for fish during the spawning period (NOAA, 2022, EPA, 2001). Water temperature affects salmonid behavior and physiology and increased temperatures in rivers and tributaries can negatively impact fish in numerous ways. The EPA Summary of Technical Literature Examining the Physiological Effects of Temperature on Salmonid (McCullough, et. al., 2001) synthesizes scientific information on temperature impacts to salmonids. Negative temperature impacts include but are not limited to:

- death to adult fish and smolts due to high temperature conditions;
- delayed migration and spawning;
- depleted stored energy during the migration journey due to bioenergetic stress;
- decreased swimming speed;
- unfavorable conditions for incubation and fry development;
- reduced juvenile growth rates and poor smolt condition with reduced ocean survival;
- increased disease.

The rivers in the Umpqua River Basin naturally warm in the summer season due to increased solar radiation and warmer air temperatures. However, human actions and changes to the landscape have amplified the degree of river/tributary warming and this warming impairs fish beneficial uses. Increased water temperature can impact beneficial uses through many pathways. The conceptual diagram below outlines the interactions of (or among) human actions, sources and biological responses (Figure 10) (EPA, 2024).

Human activities can increase and/or alter river temperatures by increasing the heat load to the river. For example, riparian cover can considerably reduce the amount of solar radiation reaching the water surface, especially in small streams; however, when riparian cover and/or streamside vegetation is removed the solar heating of rivers and streams increases (Caissie, 2006). Other actions on the landscape such as, channeling, or straightening rivers often separates the river from the floodplain and reduces groundwater discharges to the river (Poole and Berman, 2001). These actions disconnect the river from cold groundwater discharges that can moderate warm summer temperatures. Water withdrawals from the river for various consumptive uses reduce the river thermal buffering capacity and leads to increased water temperatures (Poole and Berman, 2001). Likewise, warm wastewater discharges can directly add heat to the river. In addition, research has shown that historic atmospheric climate change impacts on air temperatures and precipitation has driven stream temperature increases across a variety of Oregon stream systems (Isaak et al., 2018, USFS 2022).

Dams and impoundments of various sizes may increase or decrease downstream water temperatures. Small impoundments and the near shore areas of larger reservoirs generally increase temperatures because these areas are exposed to greater solar radiation and serve as a source of warm water downstream (Rounds, 2010). Selective water withdrawals from the bottom of stratified reservoirs can reduce downstream water temperatures in the summer (Caissie, 2006). Conversely, by late summer-early fall, as the lower cool water has been depleted, withdrawals from these stratified reservoirs often discharge warmer water from near the reservoir surface and delay natural seasonal cooling. Ultimately, through a wide range of sources, actions, and processes increased temperature can have both behavioral and physiological impacts on salmonid fishes, which contributes to a temperature based aquatic life impairment.

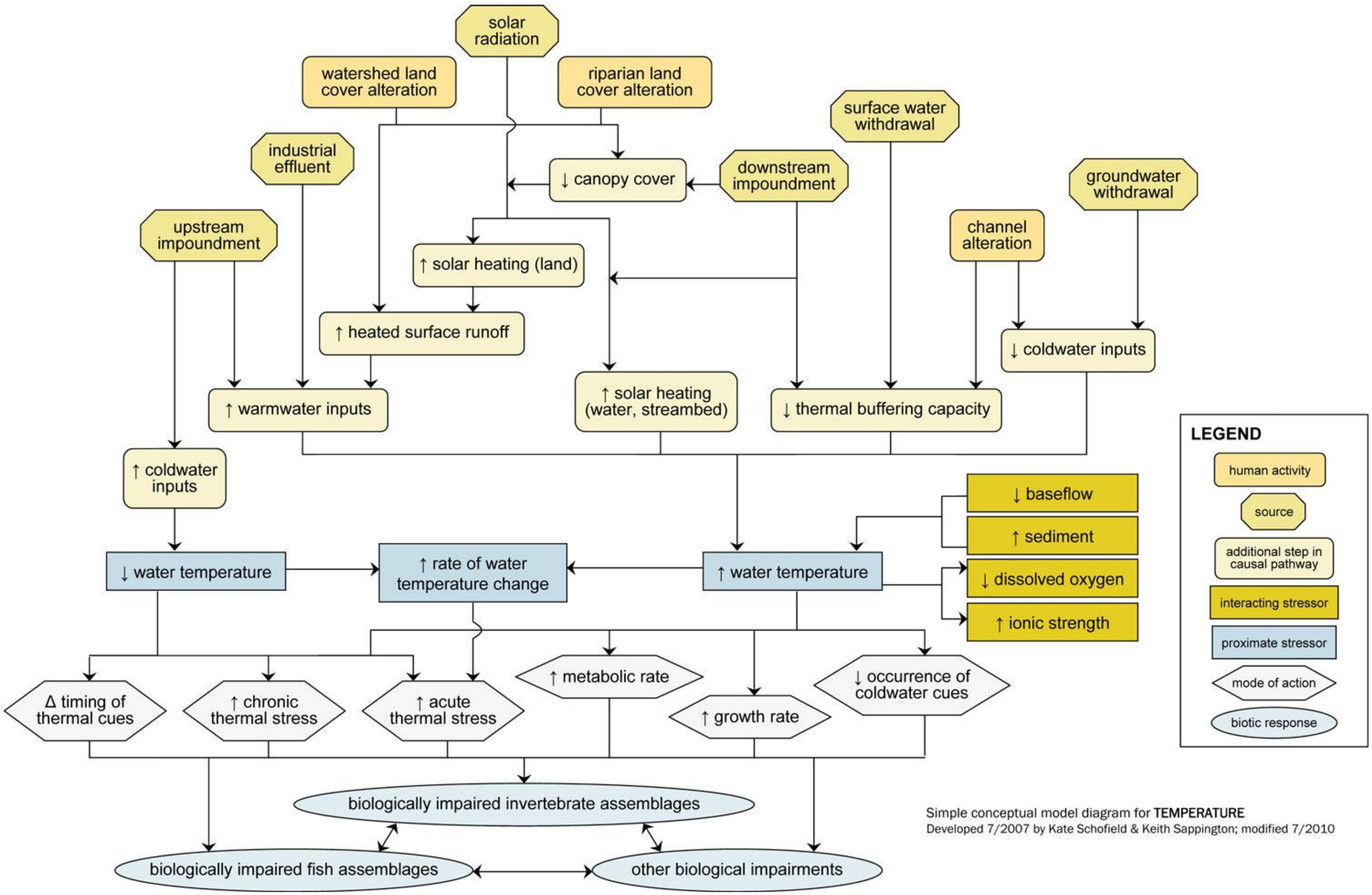

Figure 10 Conceptual model outlining the causal pathway from sources to biological impairments for temperature.

Water Quality Standards

Water quality standards (WQS) define the goals for a waterbody and work to safeguard human health and aquatic life by establishing limits on pollutants. Water quality standards are comprised of three elements: 1) a waterbody's beneficial uses, 2) water quality criteria to protect those uses, and 3) an antidegradation policy. Beneficial uses establish the water quality goals for the waterbody, criteria define the minimum water quality condition necessary to achieve those goals, and the antidegradation policy specifies the framework to be used in making decision regarding the intentional lowering of water quality (EPA, 2017). The Clean Water Act (§ 303(c)) and implementing regulations (40 C.F.R. § 131) establish the requirement for states to adopt water quality standards, which are reviewed and approved by EPA. Oregon's water quality standards are set forth in OAR 340-041 and include standards applicable to the Umpqua watershed.

4.1.1 Beneficial Uses

Oregon DEQ has designated beneficial uses for all waters of the state in accordance with Oregon Administrative Rules (OAR). Table 4 identifies all thirteen (13) designated beneficial uses in the Umpqua Basin, as defined in OAR 340-041-0320. This TMDL project however, seeks to restore and attain the fish and aquatic life beneficial uses; specifically salmon and steelhead spawning, core cold water habitat, and salmon and trout rearing and migration beneficial uses (Figure 11 and Figure 12). Across the Umpqua Basin these beneficial uses have different spatial and temporal applications (Figure 11 and Figure 12). When and where the salmon and steelhead spawning beneficial use applies it is the most sensitive beneficial use; seasonally this period is generally September 1st – June 15th. Thus, if the TMDLs protect this beneficial use other beneficial uses (i.e., core cold water habitat, and salmon and trout rearing and migration) sensitive to increased temperatures will also be protected. In locations and seasons that the salmon and steelhead spawning beneficial use does not apply the core cold water habitat and salmon and trout rearing and migration beneficial uses act as the most sensitive beneficial use, as applicable.

Table 4 Designated beneficial uses in the Umpqua Basin as identified in OAR 340-041-0320 Table 320A.

Beneficial Uses	Umpqua R. Estuary to Head of Tidewater and Adjacent Marine Waters	Umpqua R. Main from Head of Tidewater to Confluence of N. and S. Umpqua Rivers	North Umpqua River Main Stem	South Umpqua River Main Stem	All Other Tributaries to Umpqua, North and South Umpqua Rivers
Public Domestic Water Supply		X	X	X	X
Private Domestic Water Supply		X	X	X	X
Industrial Water Supply	X	X	X	X	X
Irrigation		X	X	X	X
Livestock Watering		X	X	X	X
Fish and Aquatic Life	X	X	X	X	X
Wildlife and Hunting	X	X	X	X	X

Beneficial Uses	Umpqua R. Estuary to Head of Tidewater and Adjacent Marine Waters	Umpqua R. Main from Head of Tidewater to Confluence of N. and S. Umpqua Rivers	North Umpqua River Main Stem	South Umpqua River Main Stem	All Other Tributaries to Umpqua, North and South Umpqua Rivers
Fishing	X	X	X	X	X
Boating	X	X	X	X	X
Water Contact Recreation	X	X	X	X	X
Aesthetic Quality	X	X	X	X	X
Hydro Power			X	X	X
Commercial Navigation & Transportation	X				

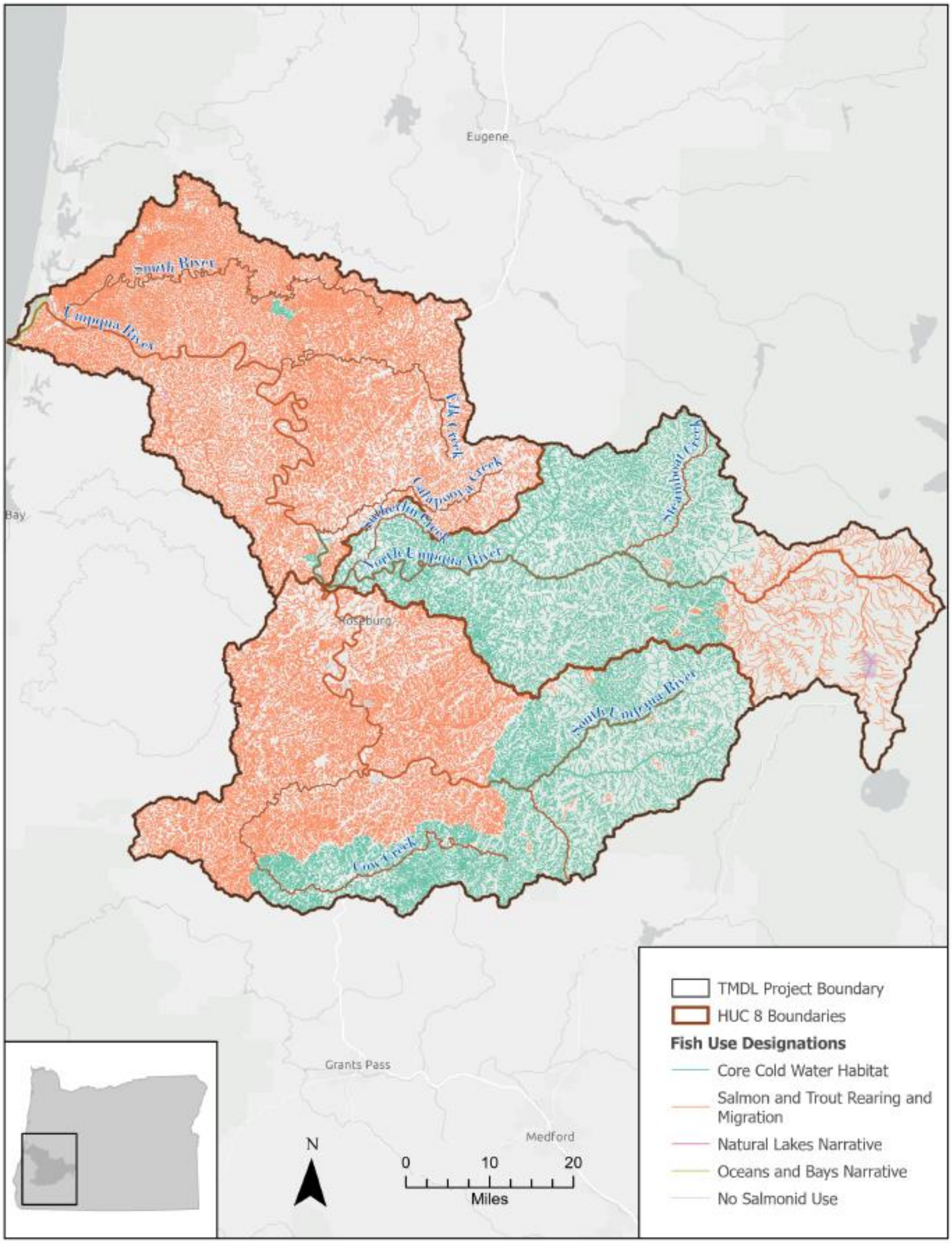

Figure 11 Fish use designations in the Umpqua Basin temperature TMDL project area.

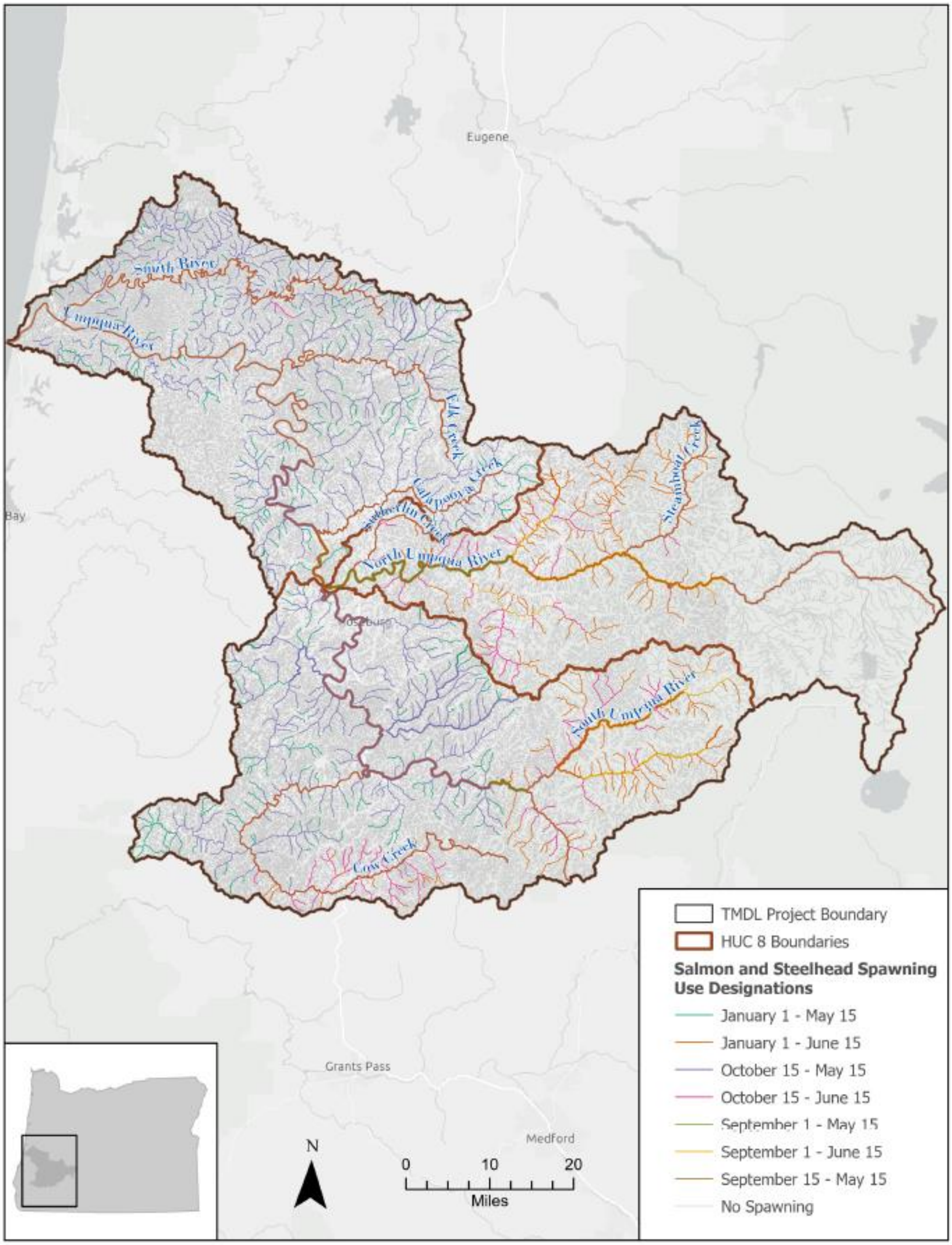

Figure 12 Seasonal salmon and steelhead spawning use designations in the Umpqua Basin project area.

4.1.2 Water Quality Criteria

The water quality criteria that protect the salmon and steelhead spawning, core cold water habitat, and salmon and trout rearing and migration beneficial uses have spatial and temporal applications that align with when and where the beneficial uses apply. The location and periods of criteria applicability are determined from designated fish use maps in rule at OAR 340-041-0320 Figure 320A and Figure 320B. The maps from the rule have been reproduced and shown in Figure 11 and Figure 12. Figure 11 shows various designated fish uses, while Figure 12 shows seasonal salmon and steelhead spawning use designations, based on the National Hydrography Dataset (NHD). The numeric temperature criteria to protect these designated beneficial uses are presented below and in Table 5.

- Salmon and steelhead spawning: 13.0°C (55.4°F) (OAR 340-041-0028(4)(a))
- Core cold water habitat: 16.0°C (60.8°F) (OAR 340-041-0028(4)(b))
- Salmon and trout rearing and migration: 18.0°C (64.4°F) (OAR 340-041-0028(4)(c))

These temperature water quality criteria are established as seven-day average daily maximum (7DADM) temperatures.

The following narrative temperature water quality criteria also apply in the Umpqua Basin and details for each criterion are presented in
Table 5.

- Statewide Narrative Criteria (OAR 340-041-0007(1)
- Natural Lakes (OAR 340-041-0028(6))
- Oceans and Bays (OAR 340-041-0028(7))
- Protecting Cold Water (OAR 340-041-0028(11))

Table 5 Applicable water quality criteria.

Parameter	Summary of applicable Criteria	Waters where standards are applicable	Rule Citation
Statewide Narrative Criteria	The highest and best practicable treatment and/or control of wastes, activities, and flows must in every case be provided so as to maintain dissolved oxygen and overall water quality at the highest possible levels and water temperatures, coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor and other deleterious factors at the lowest possible levels.	All waters of the state	OAR 340-041-0007(1)
	Salmon and steelhead spawning use: (a) The 7-day average maximum temperature may not exceed 13.0C (55.4˚F) at the times indicated on maps and tables	See OAR Figures 320A and 320B	OAR 340-041-0028(4) OAR 340-041-0320 Figures 320A and 320B

Parameter	Summary of applicable Criteria	Waters where standards are applicable	Rule Citation
Temperature	Core cold water habitat use: (b) The 7-day average maximum temperature may not exceed 16.0C (60.8F) Salmon and trout rearing and migration use: (c) The 7-day average maximum temperature may not exceed 18.0C (64.4˚F).		
	Natural Lakes: may not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the natural condition unless a greater increase would not reasonably be expected to adversely affect fish or other aquatic life.	Natural Lake	OAR 340-041-0028(6)
	Oceans and bays: waters may not be warmed by more than 0.3°C (0.5°F) above the natural condition unless a greater increase would not reasonably be expected to adversely affect fish or other aquatic life.	Oceans and Bays	OAR 340-041-0028(7)
	Protecting Cold Water: waters with a summer 7DADM temperature colder than the biologically based numeric criteria may not be warmed more than 0.3˚C (0.5˚F) above the colder water ambient temperature. Applies to all sources taken together at the point of maximum impact where salmon, steelhead, or bull trout are present.	All waters of the state	OAR 340-041-0028(11)

4.1.3 WQS Implementation Provisions

States may adopt various policies or provisions into their WQS that affect how the WQS are applied or implemented (40 CFR 131.13). Oregon WQS have implementation provisions adopted into state rule that are applicable for temperature water quality criteria. The following provisions apply in the Umpqua Basin:

- Minimum Duties (OAR 340-041-0028(12)(a))
- Human Use Allowance (OAR 340-041-0028(12)(b))

The minimum duties provision states that there is no duty for anthropogenic sources to reduce heating of the waters of the state below their natural condition. Similarly, each anthropogenic point and nonpoint source is responsible only for controlling the thermal effects of its own discharge or activity in accordance with its overall heat contribution. In no case may a source cause more warming than that allowed by the human use allowance.

The human use allowance provision states that insignificant additions of heat are authorized in waters that exceed the applicable temperature criteria. Upon completion of a TMDL or other cumulative effect analysis, waste load and load allocations will restrict all NPDES point sources and nonpoint sources to a cumulative increase of no greater than 0.3 °C (0.5 °F) above the applicable criteria after complete mixing in the waterbody and at the point of maximum impact. For additional information on the human use allowance and how ODEQ implements this provision please see the Temperature Internal Management Directive (DEQ 2008).

4.1.4 Antidegradation Policy

The purpose of Oregon's Antidegradation Policy (OAR 340-041-0004) is to guide decisions that impact water quality and prevent further unnecessary degradation from new or increased pollution. Likewise, the policy's goal is to protect, maintain, and enhance water quality to fully protect all existing beneficial uses. The Antidegradation Policy identifies some circumstances when an antidegradation review is not warranted. An insignificant increase in temperature, authorized by the human use allowance provisions (OAR 340-041-0028(12)), is deemed not a reduction in water quality and therefore an antidegradation review is not required. Additionally, riparian restoration activities (OAR 340-041-0004(5)(a)) that result in a net ecological benefit are not subject to antidegradation review.

The proposed TMDL will not degrade water quality and will in fact improve water quality as it is designed to achieve compliance with existing WQS in order to ensure that beneficial uses of the Umpqua Basin are fully supported.

Summary of Water Quality Conditions

In this section, EPA examines current temperature conditions in the Umpqua, North Umpqua and South Umpqua River Basins within the geographic scope of the TMDL. EPA also identifies reaches of the Umpqua, North Umpqua and South Umpqua Rivers and their tributaries impaired by temperature.

4.1.5 Current Water Quality Condition

Staff evaluated river and stream temperature data from the following sources:

- United States Geological Survey (USGS)
- United States Forest Service (USFS)

- Oregon Department of Environmental Quality (ODEQ)

The EPA derived daily maximum, minimum, average and seven day moving average daily maximum (7DADM) from continuous water temperature data from the sources referenced above. This continuous data had various set intervals depending on which agency collected the data: USGS data readings occurred every 15 minutes, while USFS and ODEQ data reading intervals were 30 minutes. The EPA removed outlier data, which were likely measurements of air temperature conditions, from the data set prior to the current condition evaluation. Outliers were identified as atypical values of 35 ^{o}C or greater. The EPA used the most recent 10 years of data, when available, to provide robust current condition estimates. For locations with less than 10-years of data available, the EPA used all data. Data assessed in this section was collected by USGS, USFS and ODEQ. The ODEQ and USFS data were provided to the EPA by ODEQ and EPA staff downloaded USGS data from the web-based database.

The EPA evaluated river and stream temperatures at 41 locations. Of those 15 locations were on the mainstems of the South Umpqua, North Umpqua, and Umpqua Rivers, while the remaining 26 locations were on tributaries of those rivers. The EPA selected nine locations (Figure 13, Table 6) to describe current temperature conditions observed within the South Umpqua, North Umpqua, and Umpqua Rivers. Specifically, Tables 7 through 15 present the daily maximum, minimum, and average temperatures for each location listed in Table 6 and Figures 14 through 32 plot this information. Results for all 41 locations are presented in Appendix A.

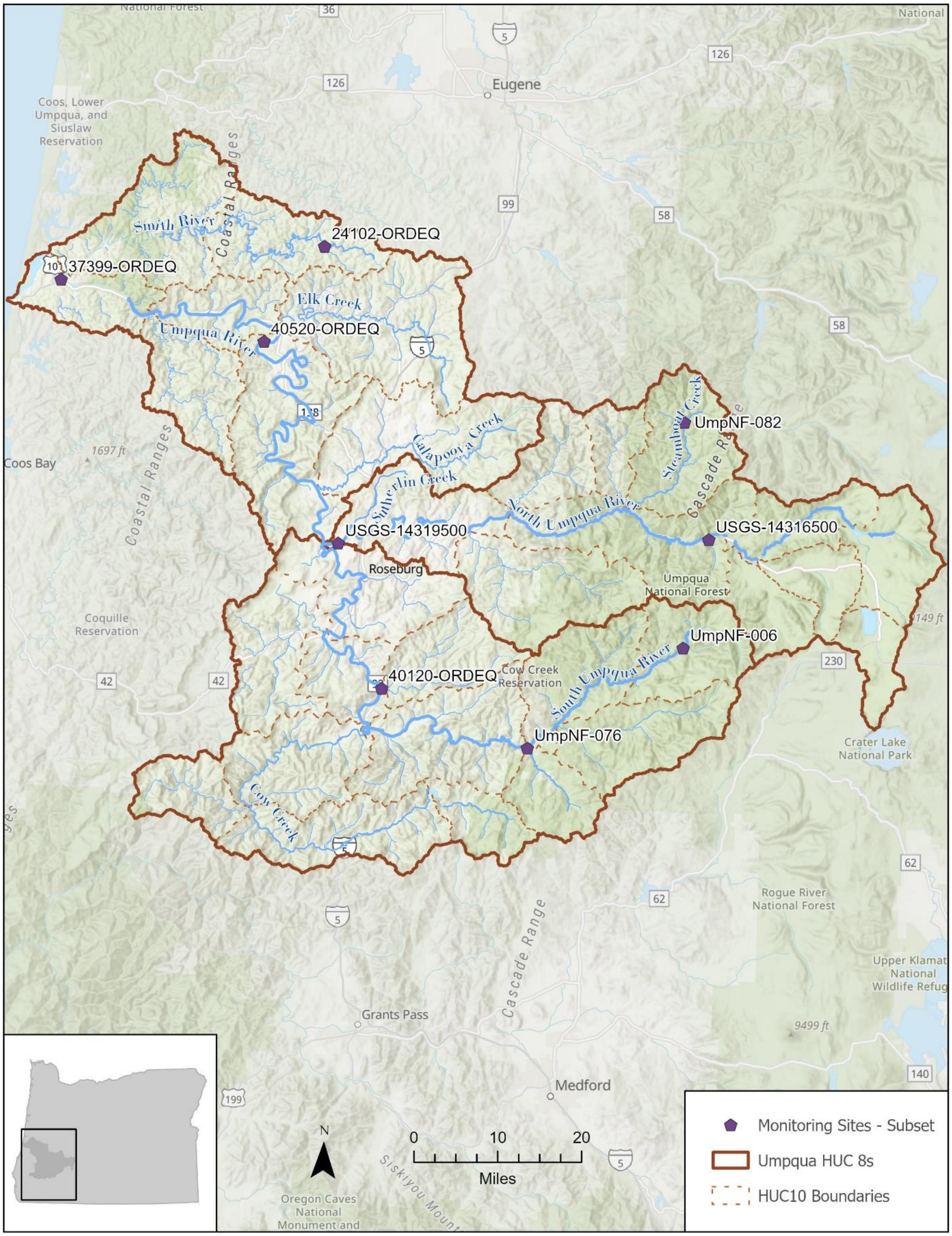

Figure 13 Map of the nine locations selected to represent the current conditions in the South Umpqua, North Umpqua, and Umpqua River Basins.

Table 6 TMDL Temperature Data Logger Locations Selected to Represent Current Conditions in the South Umpqua, North Umpqua, and Umpqua Rivers.

Monitoring Station	Location ID
South Umpqua River	
Black Rock Fork at the Mouth	UmpNF-006
South Umpqua at Tiller Ranger Station	UmpNF-076
South Umpqua 100m upstream of Myrtle Creek	40120-ORDEQ
North Umpqua River	
Upper Steamboat Below Little Rock, Headwater	UmpNF-082
North Umpqua Above Copeland Creek Near Toketee Falls	USGS-14316500
North Umpqua River at Winchester Or	USGS-14319500
Umpqua River	
Smith River Upstream South Fork Smith River	24102-ORDEQ
Umpqua River at River Mile 49.58	40520-ORDEQ
Umpqua River at Discovery Center Docks	37399-ORDEQ

South Umpqua Subbasin

Table 7 Minimum, Maximum, and Average Temperatures at Black Rock Fork at the Mouth (UmpNF-006) from 2008-2017

Month	Number of Samples	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)
June	7728	5.5	22.4	12.9
July	14880	8.9	23.3	16.3
August	14880	11.4	22.0	16.5
September	12144	7.9	18.2	13.7
October	432	6.4	10.2	8.2

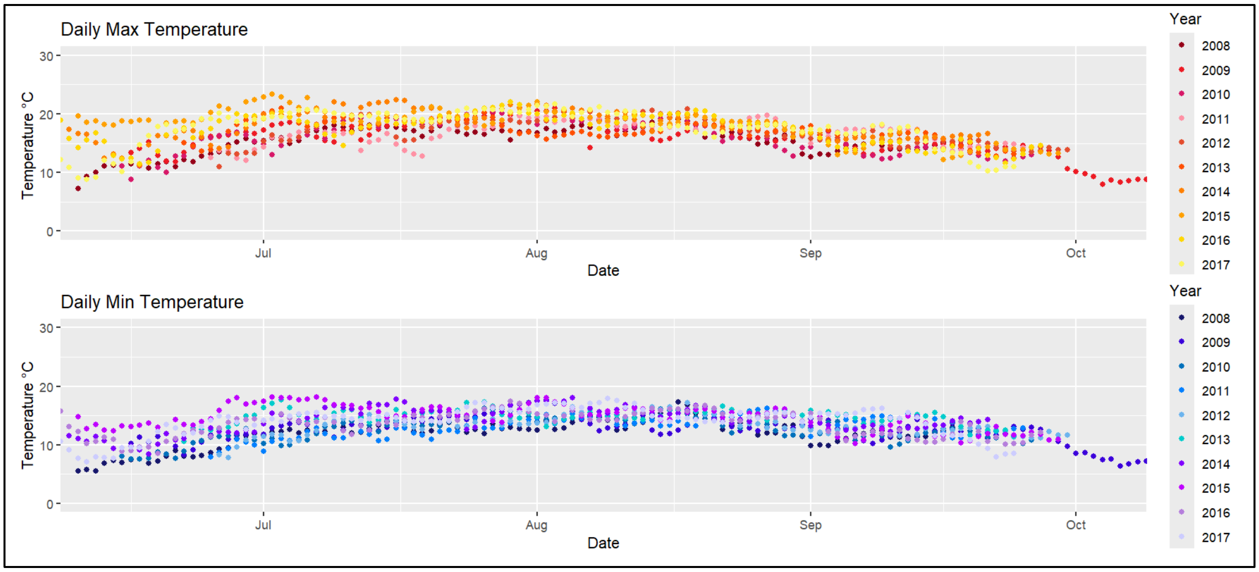

Figure 14 Daily Maximum and Minimum Temperatures at Black Rock Fork at the Mouth (UmpNF-006)

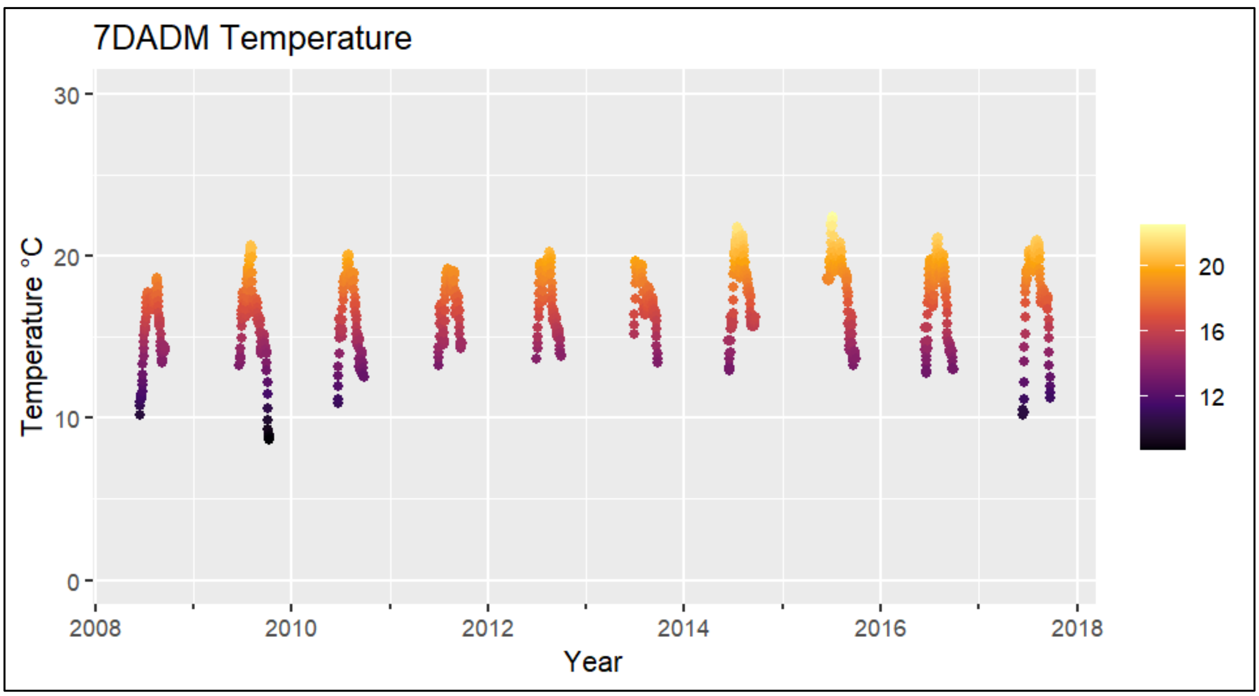

Figure 15 7DADM Temperature at Black Rock Fork at the Mouth (UmpNF-006)

Table 8 Minimum, Maximum, and Average Temperatures at South Umpqua at Tiller Ranger Station (UmpNF-076) from 2008-2017

Month	Number of Samples	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)
January	5952	0.4	9.0	4.7
February	5376	3.2	9.4	6.3
March	5952	4.2	11.8	7.5
April	5760	5.6	14.9	9.0
May	5952	7.1	20.6	12.9
June	8112	8.3	27.3	17.5
July	10416	14.5	29.1	22.6
August	10416	15.8	28.0	21.8
September	8640	11.9	24.4	18.0
October	5328	7.2	19.3	11.5
November	5760	2.6	11.8	8.3
December	5952	0.0	10.1	5.5

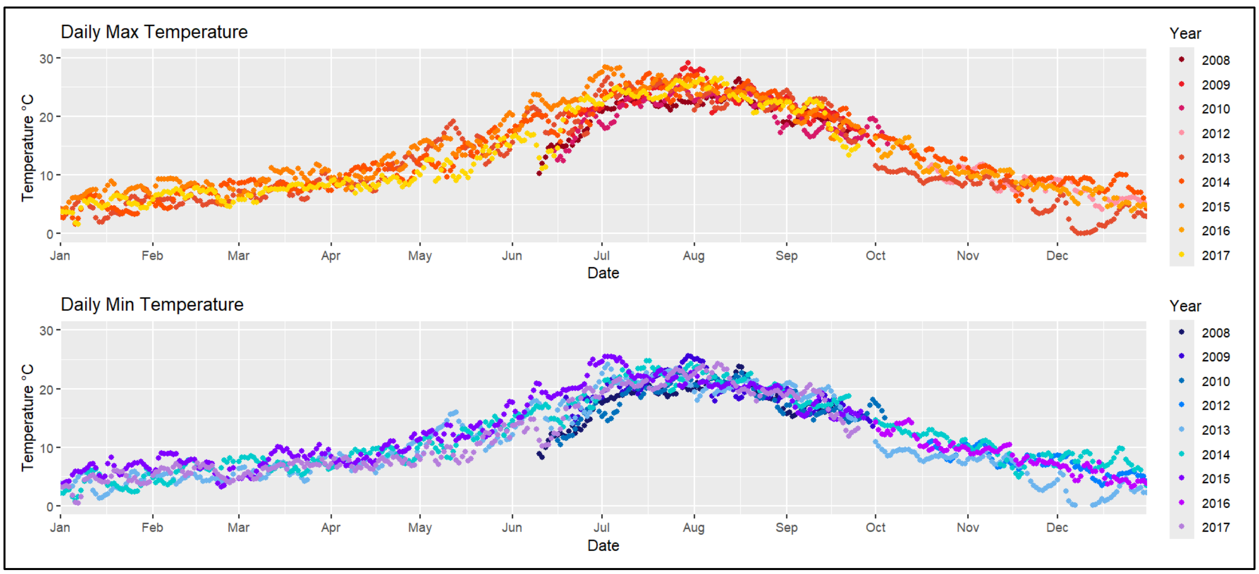

Figure 16 Daily Maximum and Minimum Temperatures at South Umpqua at Tiller Ranger Station (UmpNF-076)

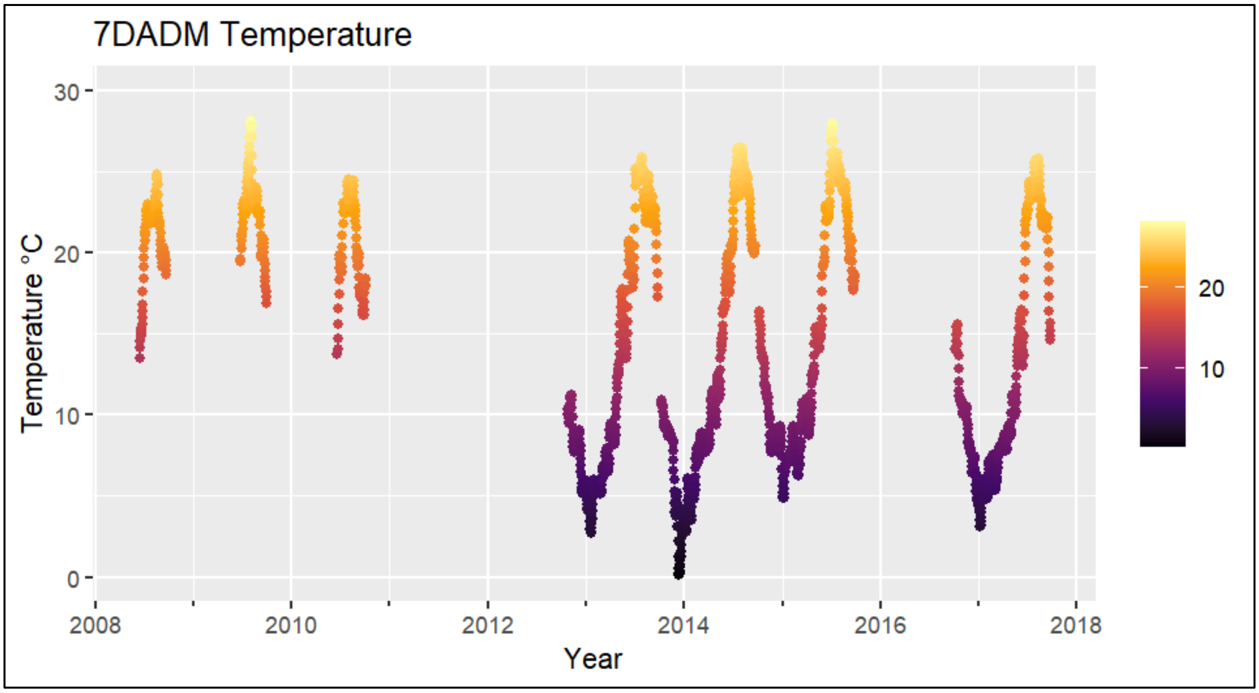

Figure 17 7DADM Temperature at South Umpqua at Tiller Ranger Station (UmpNF-076)

Table 9 Minimum, Maximum, and Average Temperatures at South Umpqua 100m Upstream of Myrtle Creek (40120-ORDEQ) from 2015-2018 and 2020-2022

Month	Number of Samples	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)
May	307	16.6	23.8	19.8
June	3043	17.9	31.6	23.9
July	9866	19.6	30.4	25.1
August	10416	20.2	29.4	24.3
September	7388	15.8	25.1	20.3
October	1135	11.5	18.3	14.5

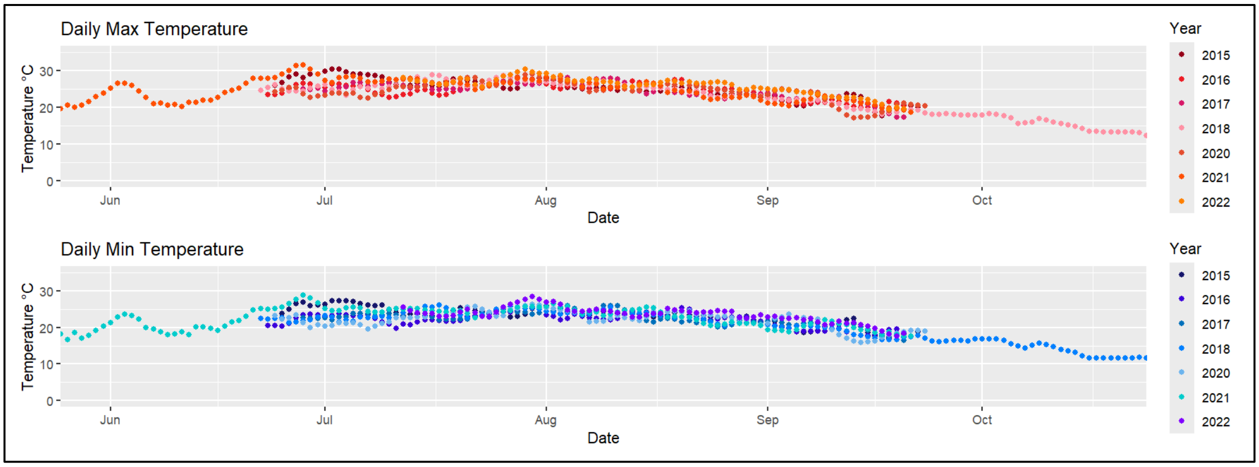

Figure 18 Daily Maximum and Minimum Temperatures at South Umpqua 100m Upstream of Myrtle Creek (40120-ORDEQ)

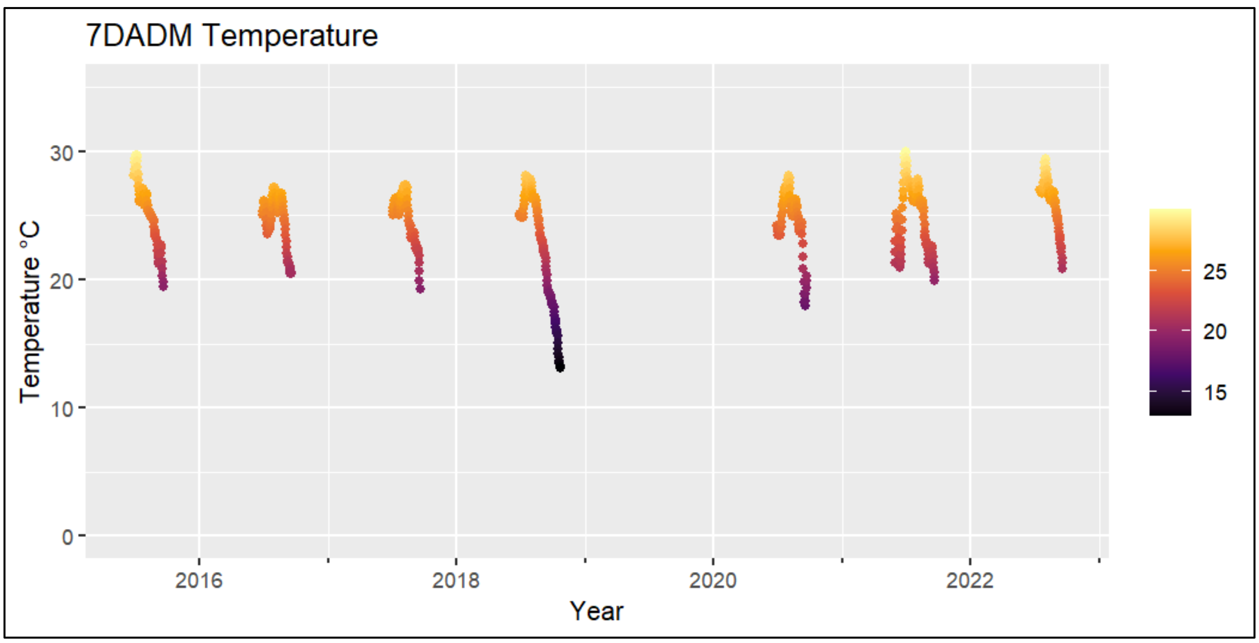

Figure 19 : 7DADM Temperature at South Umpqua 100m Upstream of Myrtle Creek (40120-ORDEQ)

North Umpqua Subbasin

Table 10 Minimum, Maximum, and Average Temperature at Upper Steamboat Below Little Rock Headwater (UmpNF-082) from 2008-2017

Month	Number of Samples	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)
June	6816	7.6	24.0	13.5
July	14495	10.1	24.8	16.8
August	14879	11.2	23.7	17.1

Month	Number of Samples	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)
September	12240	9.0	21.1	14.1
October	192	7.0	14.8	10.4

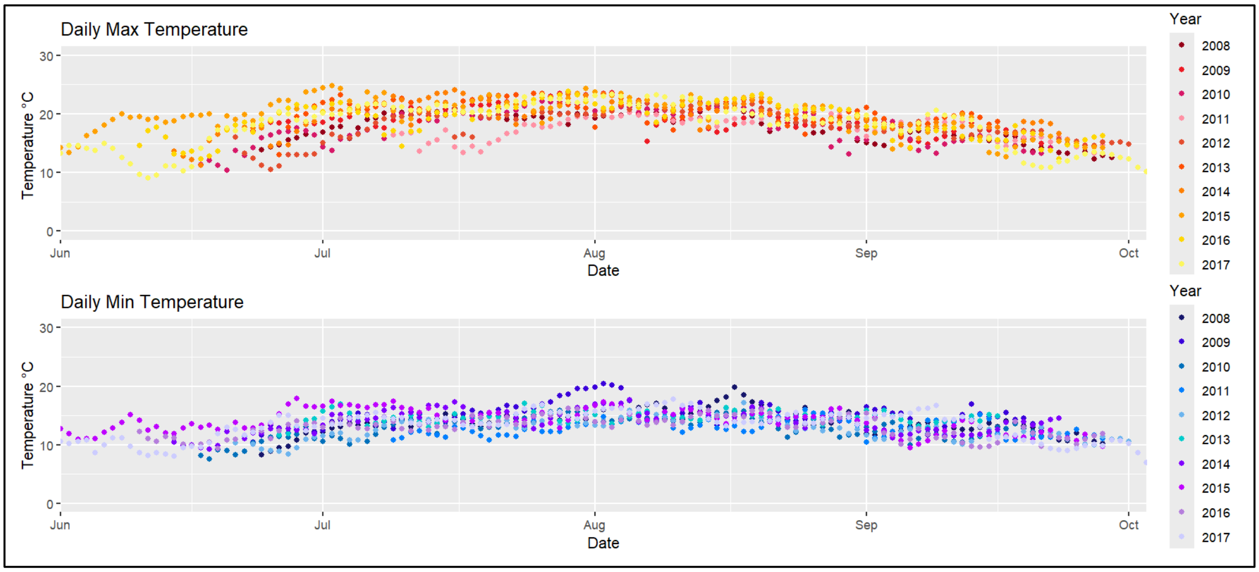

Figure 20 Daily Maximum and Minimum Temperatures at Upper Steamboat Below Little Rock Headwater (UmpNF-082)

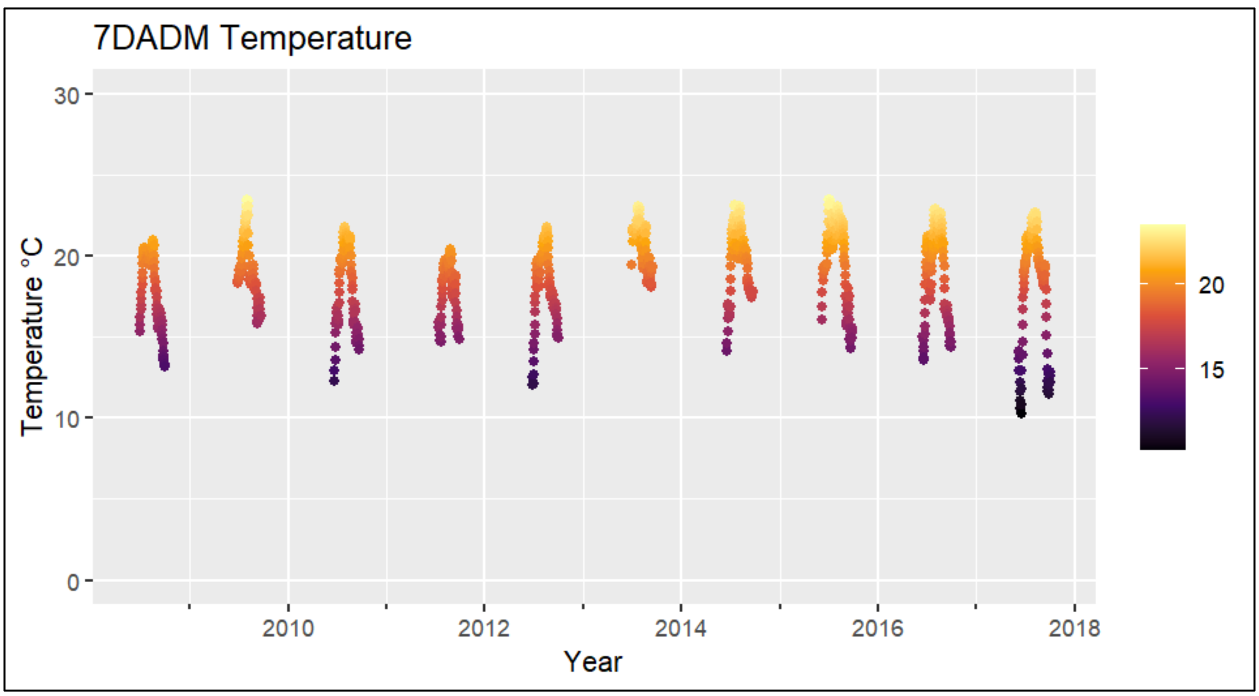

Figure 21 7DADM Temperature at Upper Steamboat Below Little Rock Headwater (UmpNF-082)

Table 11 Minimum, Maximum, and Average Temperatures at North Umpqua Above Copeland Creek near Toketee Falls (USGS 14316500) from 2014-2023

Month	Number of Samples	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)
January	28602	1.4	7.1	4.2
February	27035	1.4	7.2	4.5
March	29392	2.5	8.7	5.3
April	28648	3.2	10.6	6.5
May	29698	4.8	13.3	8.7
June	28454	5.7	16.9	11.1
July	29554	9.5	16.5	13.3
August	29724	10.1	15.6	12.9
September	28752	8.2	14.1	10.9
October	28740	4.2	11.2	8.2
November	28740	1.6	9.2	5.7
December	28704	0.8	7.3	4.1

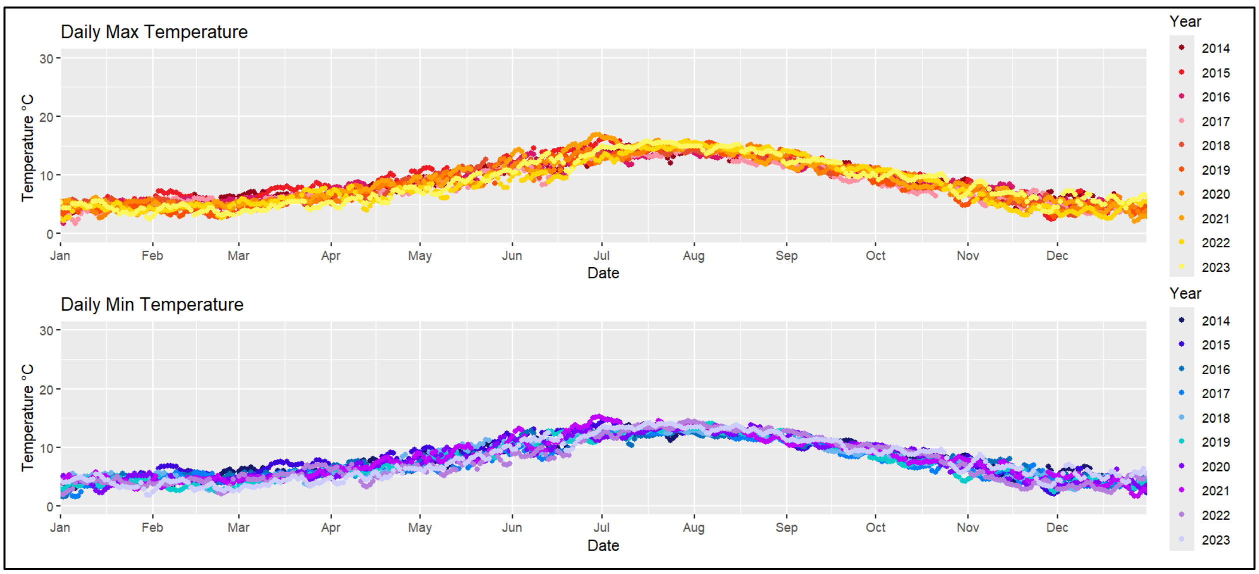

Figure 22 Daily Maximum and Minimum Temperatures at North Umpqua Above Copeland Creek Near Toketee Falls (USGS 14316500)

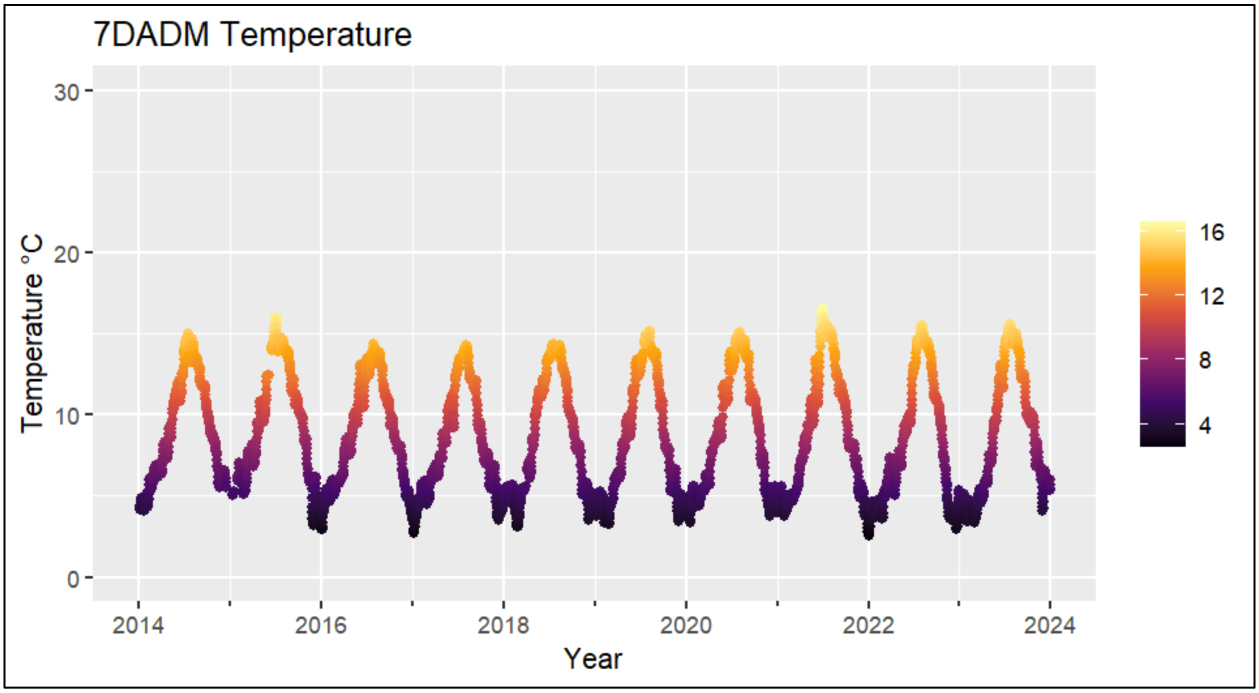

Figure 23 7DADM at North Umpqua Above Copeland Creek Near Toketee Falls (USGS 14316500)

Table 12 Minimum, Maximum, and Average Temperatures at North Umpqua River at Winchester Oregon (USGS 14319500) from 2016-2023.

Month	Number of Samples	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)
January	23799	1.1	9.5	6.3
February	21276	1.7	9.4	6.1
March	20801	4.5	12.3	7.4
April	20158	6.0	15.9	9.7
May	20826	7.3	20.9	13.6
June	20160	10.4	29.1	18.2
July	20832	17.2	27.1	22.3
August	20832	16.5	27.3	21.9
September	21066	12.0	23.8	17.2
October	23803	4.9	17.6	12.0
November	23071	2.9	12.2	7.9
December	23808	2.5	10.2	6.0

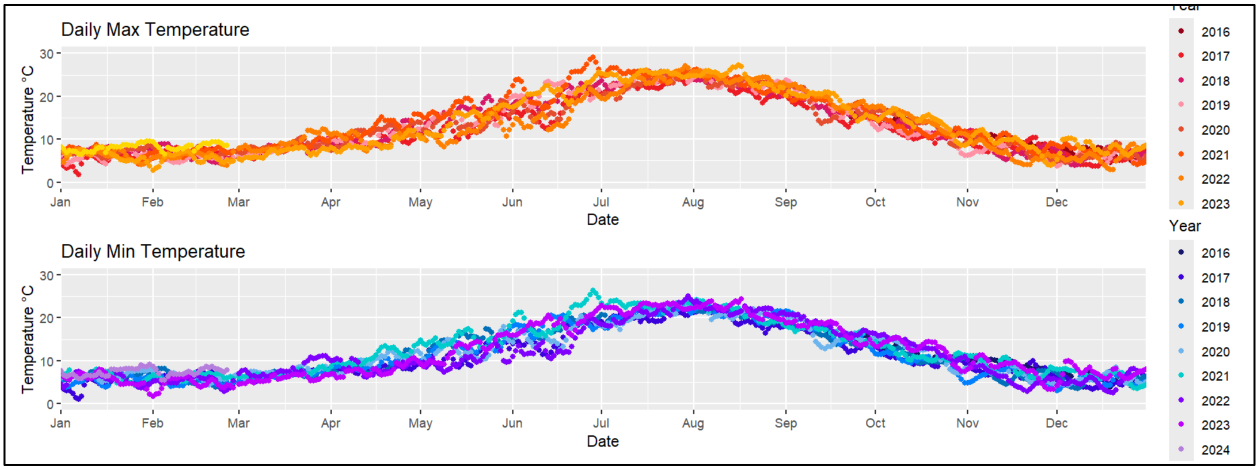

Figure 24 Daily Maximum and Minimum Temperatures at North Umpqua River at Winchester Oregon (USGS 14319500)

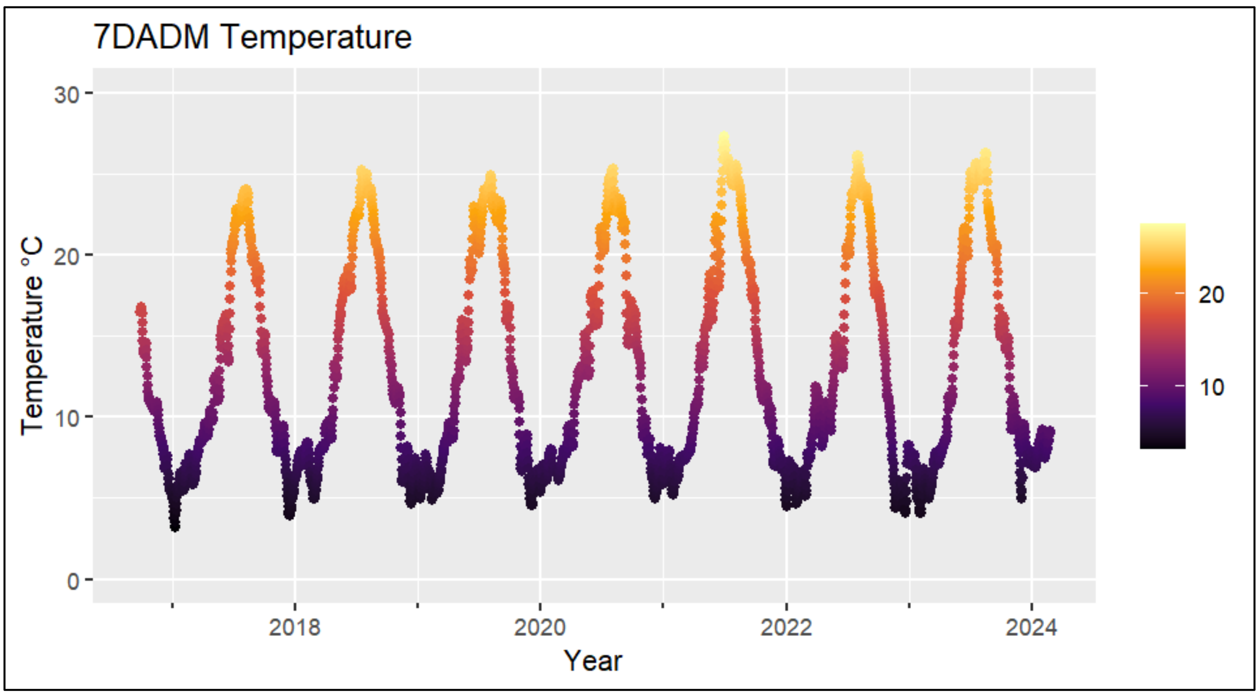

Figure 25 7DADM Temperature at North Umpqua River at Winchester Oregon (USGS 14319500)

Table 13 Minimum, Maximum, and Average Temperatures at Smith River Upstream South Fork Smith River (24102-ORDEQ) from 2000

Month	Number of Samples	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)
June	359	13.8	19.2	16.9
July	841	12.9	17.4	15.4

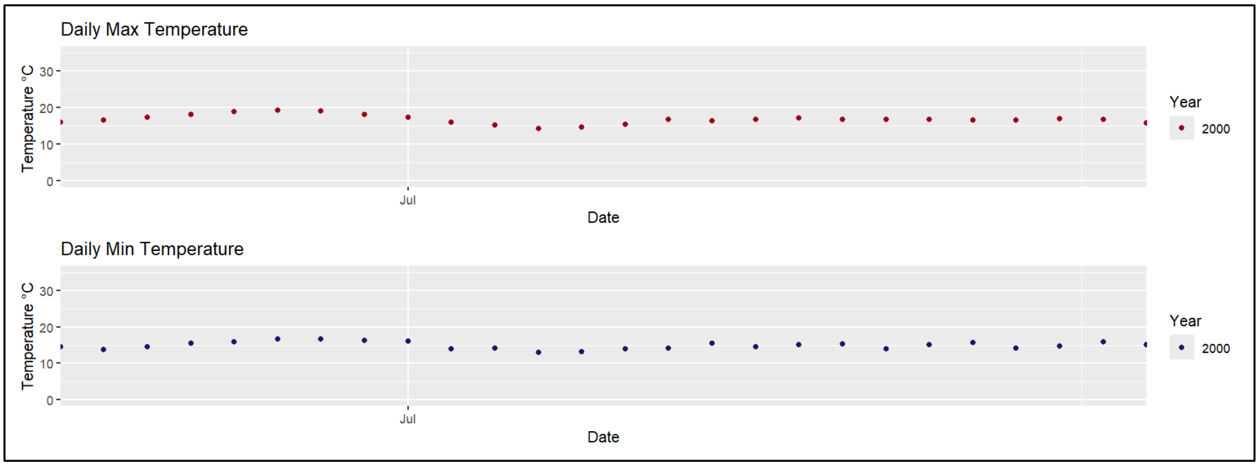

Figure 26 Daily Maximum and Minimum Temperatures at Smith River Upstream South Fork Smith River (24102-ORDEQ)

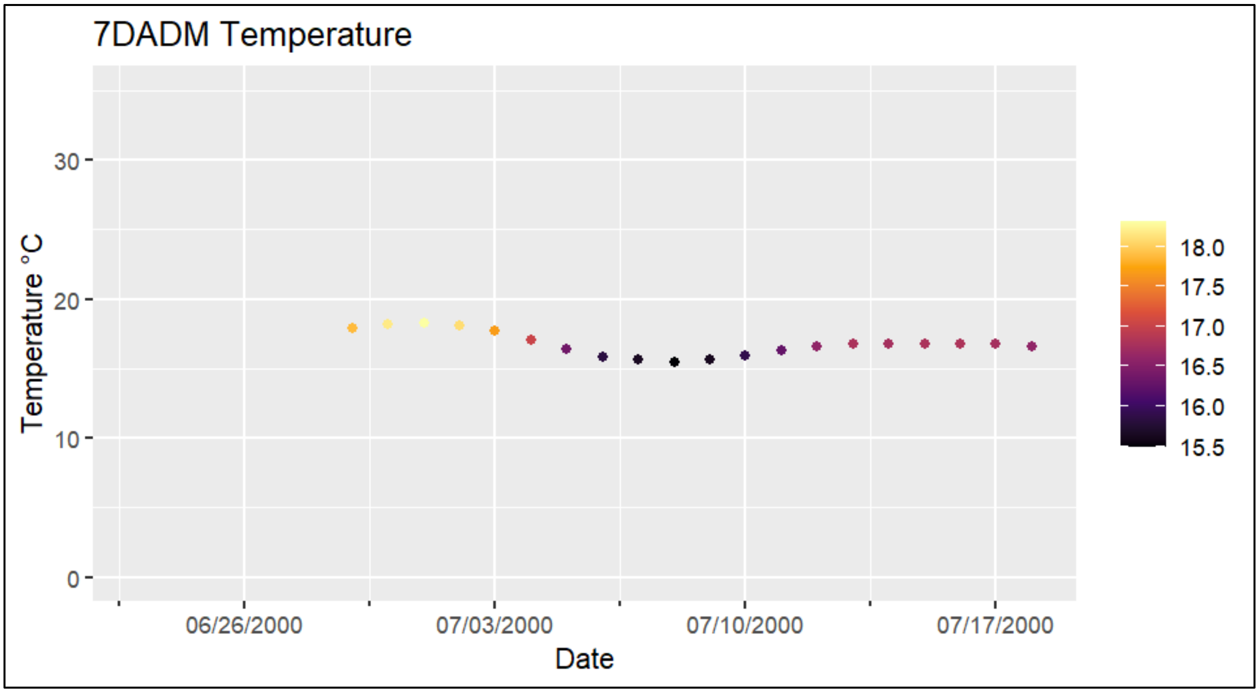

Figure 27 7DADM Temperature at Smith River Upstream South Fork Smith River (24102-ORDEQ)

Table 14 Minimum, Maximum, and Average Temperatures at Umpqua River at River Mile 49.58 (40520-ORDEQ) from 2016-2018, 2020, and 2022

Month	Number of Samples	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)
May	449	17.9	21.7	19.6
June	1840	18.0	26.0	22.1
July	6220	20.6	28.5	24.6
August	7440	21.0	28.3	24.7
September	6516	15.3	25.5	20.5
October	274	15.6	17.9	16.9

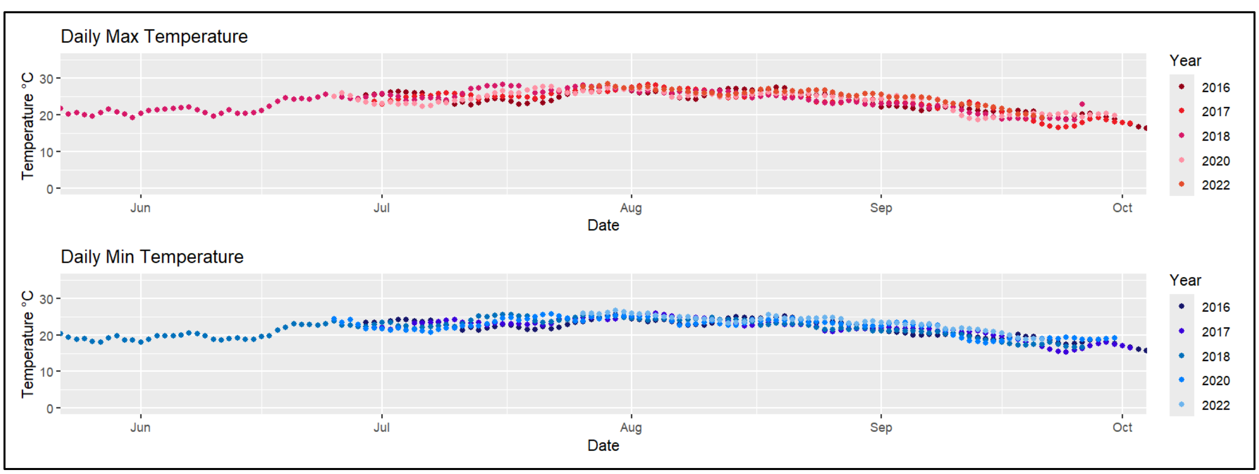

Figure 28 Daily Maximum and Minimum Temperatures at Umpqua River at RM 49.58 (40520-ORDEQ)

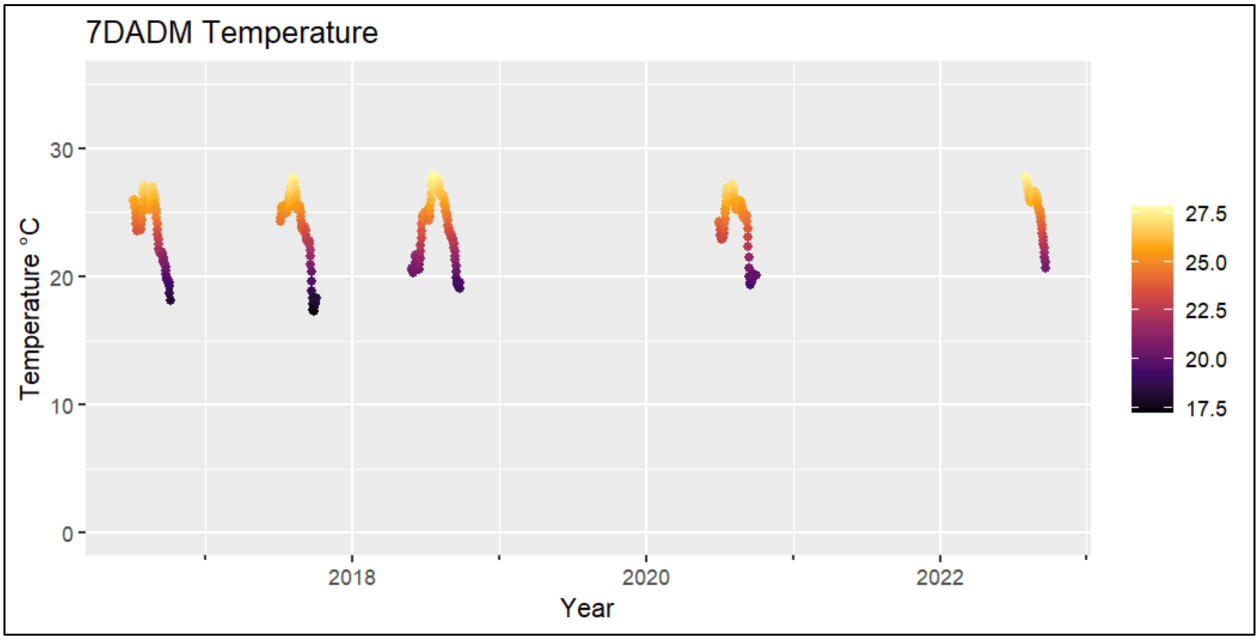

Figure 29 7DADM Temperature at Umpqua River at River Mile 49.58 (40520-ORDEQ)

Table 15 Minimum, Maximum, and Average Temperatures at Umpqua River at Discovery Center Docks (37399-ORDEQ) from 2019-2020

Month	Number of Samples	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)
January	1488	6.4	9.1	7.7
February	1392	6.7	9.3	7.5
March	1486	7.9	11.2	9.8
April	1440	8.3	16.0	12.9
May	1488	14.3	19.6	16.2
June	1726	15.1	22.7	19.2
July	1488	16.1	23.0	20.7
August	1488	16.6	23.4	20.7
September	1440	15.4	22.1	19.6
October	1488	9.7	17.0	13.7
November	1442	6.2	10.6	9.4
December	1488	6.1	8.4	7.3

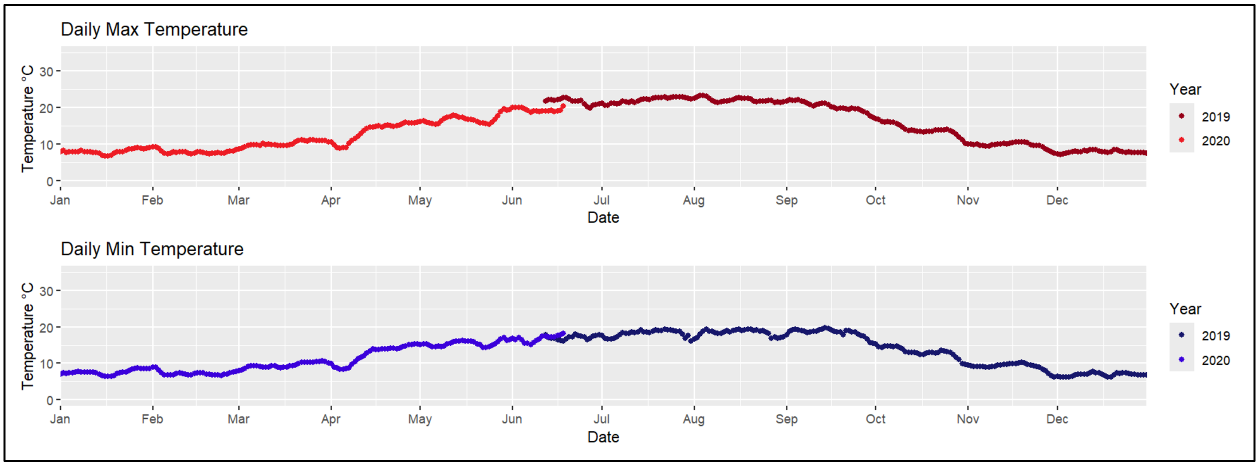

Figure 30 Daily Maximum and Minimum Temperatures at Umpqua River at Discovery Center Docks (37399-ORDEQ)

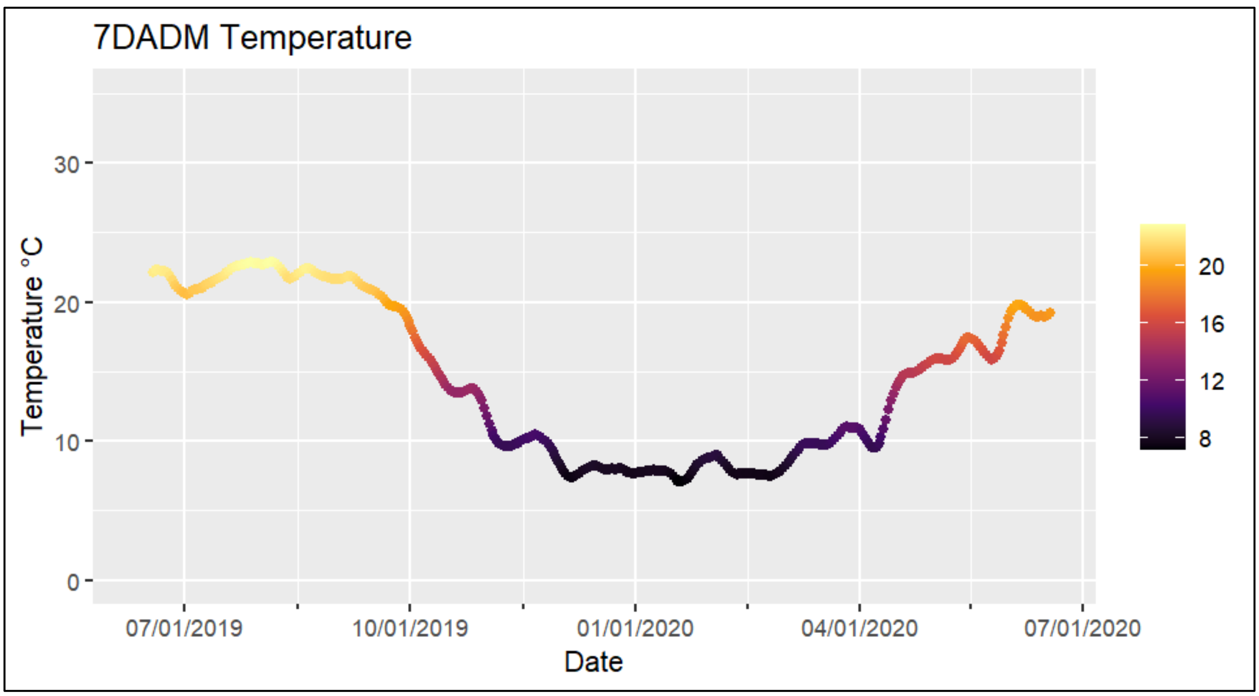

Figure 31 7DADM Temperature at Umpqua River at Discovery Center Docks (37399-ORDEQ)

4.1.6 Cold Water Assessment

The EPA assessed monitoring information for rivers and creeks upstream of the larger reservoirs in the Umpqua basin and evaluated whether the protecting cold water criterion applied. Other waters were ruled out from the protecting cold water evaluation due to a category 5 temperature impairment on Oregon's 2022 Integrated Report. The EPA determined that the protecting cold water criterion applied where temperatures upstream of reservoirs were lower than the biologically-based numeric criteria and where salmon or steelhead trout are present. The analyses indicates that the protect cold water criterion in Oregon water quality standards is potentially applicable in the upper North Umpqua basin in the area of the PacifiCorp Hydroelectric Project (Lemolo Dam, Toketee Dam, Slide Creek Dam, Soda Springs Dam and Stump Lake Dam). The table below provides the monitoring station upstream of a reservoir with measured temperatures that are always below applicable water quality criteria (18°C year-round). Note these analyses are preliminary and identify candidate waters where the protecting cold water criterion may apply. As part of TMDL implementation application of the protecting cold water criterion should be verified. The periods of record for available data are not consistent across the North Umpqua subbasin.

For three dams, Lemolo, Toketee, and Soda Springs, multiple monitored upstream waters enter the reservoir. While the protecting cold water criterion is applicable to the upper North Umpqua River, it does not apply to some other upstream contributing waters because summer7DADM values exceed the applicable narrative criterion of 18 °C. The EPA has not analyzed the mixed temperature of the combined inflows, so the dams in the table represent potential cold water protection locations (Table 16).

Table 16 Preliminary assessment of protecting cold water provision.

Dam	Upstream Waters Entering Reservoir	Monitoring Station	Protecting Cold Water Potentially Applies	Max Year- Round Temperature (°C)
Stump Lake	Clear River	36131-ORDEQ	Yes	8.6
Lemolo	North Umpqua	32144-ORDEQ	Yes	8.2
	Lake Creek	UmpNF-052	No	22.2
Toketee	North Umpqua	25694-ORDEQ	Yes	15.2
	Clearwater R	36132-ORDEQ	Yes	9.2
Slide Creek	North Umpqua	25696-ORDEQ	Yes	14.6
Soda Springs	North Umpqua	25696-ORDEQ[3]	Yes	14.6
	Fish Creek[2]	UmpNF-039	No	21.3
	Slide Creek[2]	25699-ORDEQ	No	20.2

Notes
NA = No spawning use
1 Timeframe: After September 1
2 Data not available
3 This station is the closest upstream station on the North Umpqua for both Slide Creek and Soda Springs.

For the largest reservoir in the basin, Galesville Reservoir, the results of Oregon's 2022 Integrated Report were used because a category 5 temperature impairment precludes the application of the protecting cold water criterion. Cow Creek is a category 5 impaired water so the protecting cold water criterion does not apply to the area of the Galesville Dam.

4.1.7 Basis for 303(d) listing

The basis for the temperature condition impairments in the South Umpqua, North Umpqua, and Umpqua River Basins are found in the 2022 Integrated Report (IR) conducted by ODEQ. Information concerning these listings is summarized below.

Every two years ODEQ evaluates water quality data and information regarding Oregon's waters. The IR categorizes all assessed waterbodies and those that exceed the protective water quality standards are identified as impaired (ODEQ 2022c). This list of impaired waterbodies is also called the 303(d) list.

Temperature remains one of the water quality criteria that leads to the most impairment classifications in Oregon; in fact, failure to meet temperature criteria leads to the greatest unsupported beneficial use, which is Fish and Aquatic Life beneficial use impairments (ODEQ 2022c). Information on Oregon's official 303(d) listing and details such as data quality and availability, minimum sample size, thresholds for impairment, and allowable number or frequency of exceedance are included in the 2022 IR (ODEQ 2022b).

The EPA compared observed temperatures to applicable temperature criteria to review current condition exceedances of the temperature criteria (Table 17). The EPA assessed the most recent 10 years of data and evaluated exceedances of observed temperatures at the locations evaluated in the previous section (4.1.5 Current Water Quality Condition). Temperatures from September 1st through June 15th were compared to 13°C for the salmon and trout spawning criteria. Depending on the location, temperatures from June 16th through August 31st were compared to 16 °C (core cold water habitat) or 18 °C (salmon and trout rearing and migration).

Table 17 Observed Temperature Exceedances for Temperature Criteria

Temperature Criteria	Count of Daily Values	Count of Daily Values Exceeded	Percent Exceeded
Salmon and Trout Spawning	24460	8299	33.9%
Cold Water Habitat	8580	7463	87.0%
Salmon and Trout Rearing and Migration	9089	6481	71.3%

4.1.8 Problem Statement & TMDL Geographic Scope

This data analyses demonstrates increased temperature water quality conditions and documents the exceedance of temperature criteria protecting salmonid and steelhead spawning, salmon and trout rearing and migration, and core cold-water habitat designated uses. This TMDL addresses all category 5 assessment units impaired for temperature in the Umpqua River Basin (Figures 32 and 33, Tables 18 and 19); the Little River watershed is not included in this TMDL. Likewise, because the TMDL is a watershed analyses the loading capacity and allocations, included surrogate measures apply to all waters of the state that are within the Umpqua Basin as defined by ORS 468B.005(10) (Figure 34). Therefore, this TMDL also addresses all other assessment categories, including unimpaired and unassessed and this TMDL is expected to address potential future temperature impairments for specific assessment units in the Umpqua Basin that are currently unimpaired or unassessed unless new information becomes available.

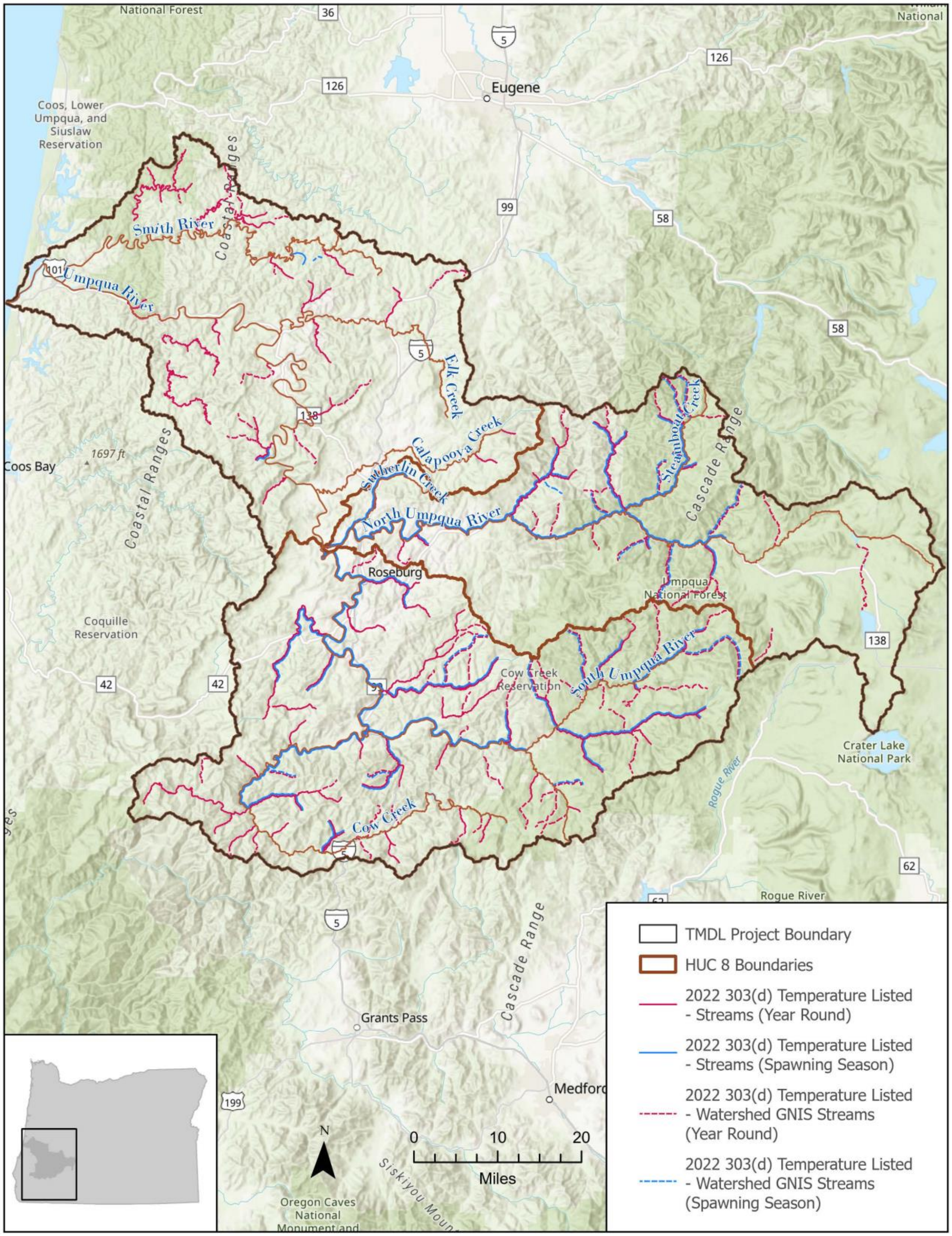

Figure 32 Umpqua Basin category 5 temperature impairments on the 2022 Integrated Report

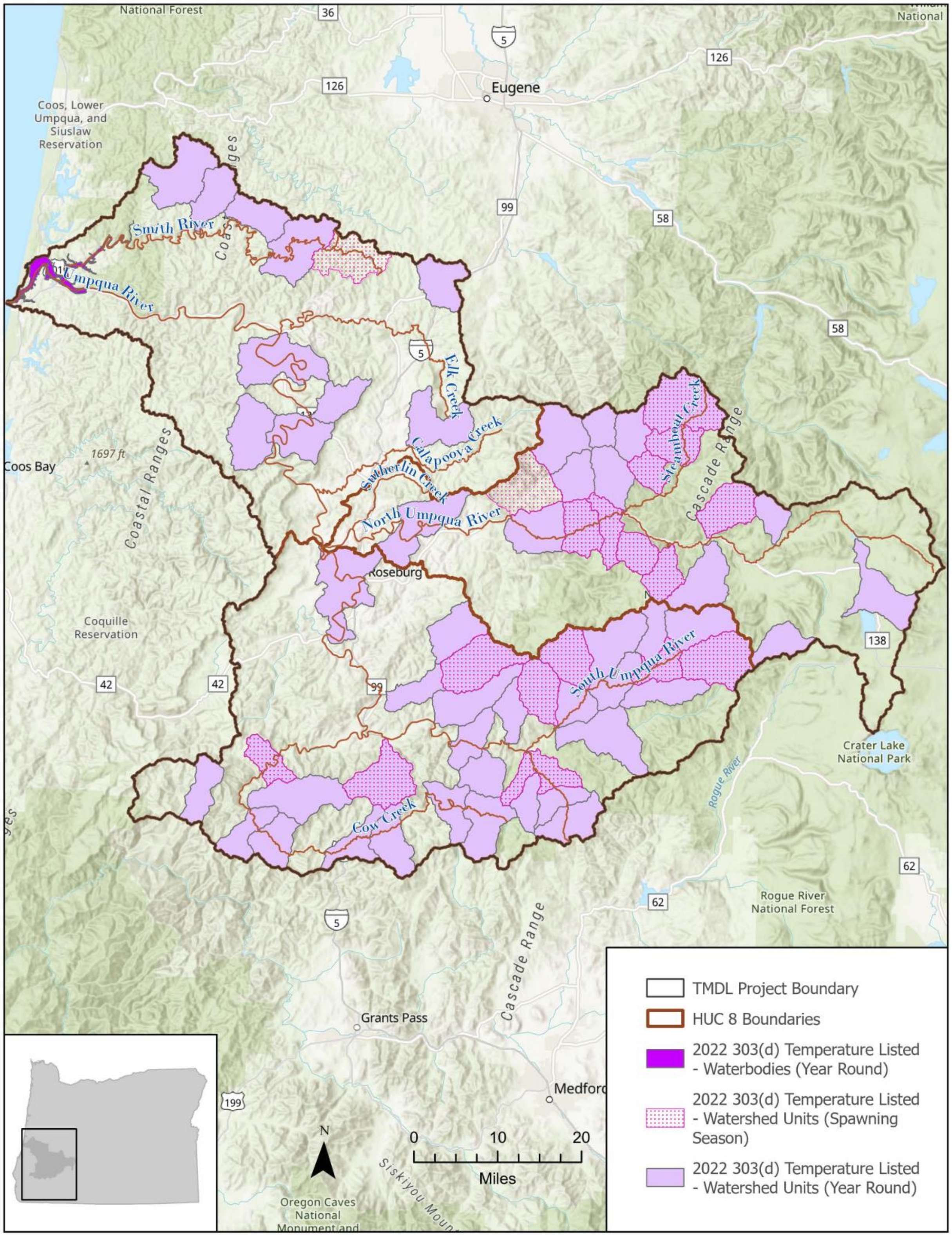

Figure 33 Umpqua Basin category 5 temperature impairments on the 2022 Integrated Report

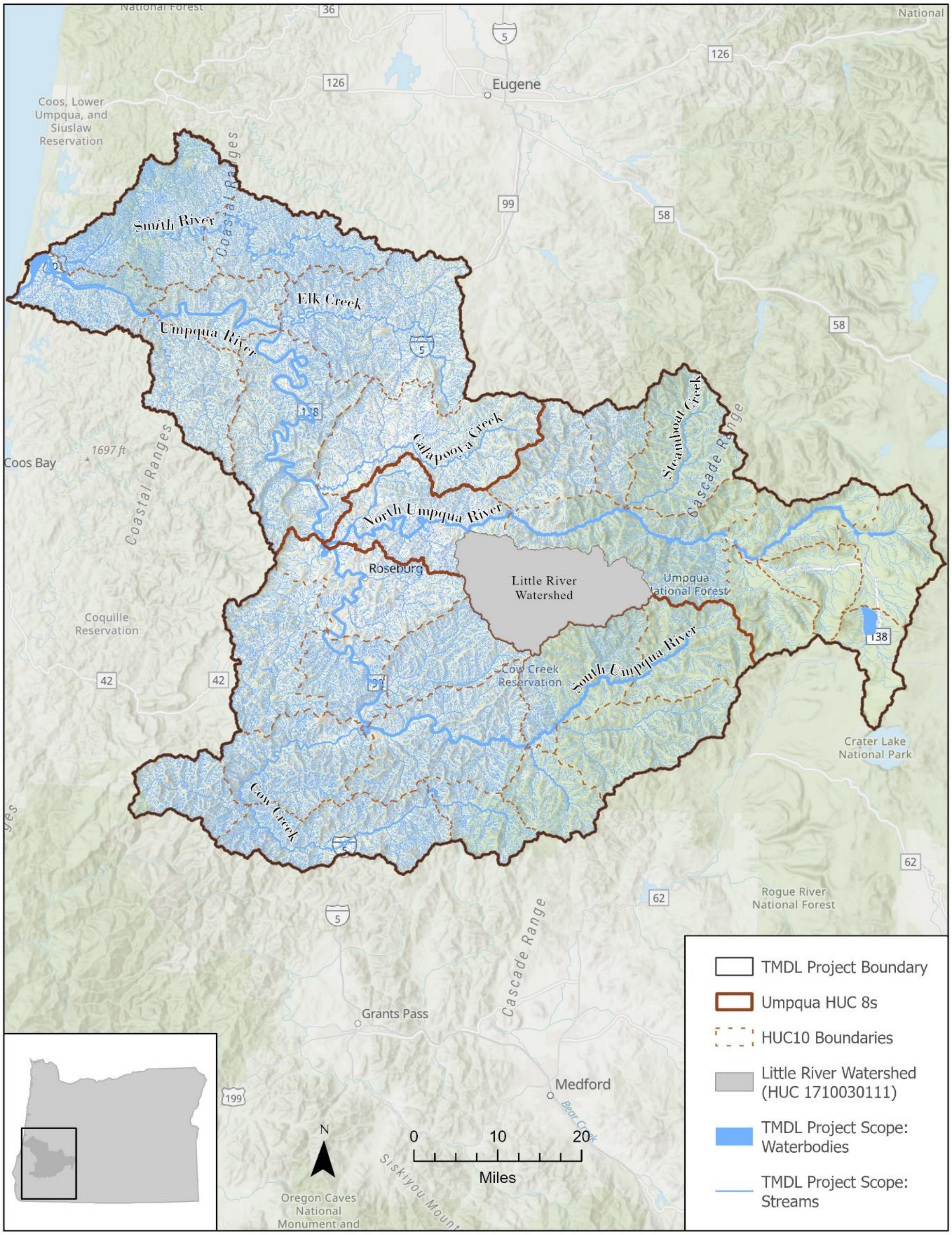

Figure 34 Umpqua Basin temperature TMDLs project area overview.

Table 18 Umpqua Basin category 5 temperature impairments on the 2022 Integrated Report

Assessment Unit Name	Assessment Unit ID	Use Period	
		Year Round	Spawn
Umpqua River	OR_EB_1710030307_01_107227	X	
Umpqua River	OR_EB_1710030308_01_100287	X	
Pass Creek	OR_SR_1710030106_02_105330	X	X
Canton Creek	OR_SR_1710030106_02_105331	X	X
Canton Creek	OR_SR_1710030106_02_105332	X	X
Little Rock Creek	OR_SR_1710030107_02_105333	X	X
Steamboat Creek	OR_SR_1710030107_02_105334	X	
Steamboat Creek	OR_SR_1710030107_02_105336	X	X
Big Bend Creek	OR_SR_1710030107_02_105337	X	X
Limpy Creek	OR_SR_1710030108_02_105338	X	X
North Umpqua River	OR_SR_1710030108_02_105339		X
North Umpqua River	OR_SR_1710030108_02_105340	X	X
Copeland Creek	OR_SR_1710030108_02_105341	X	X
North Umpqua River	OR_SR_1710030108_02_105342	X	X
Northeast Fork Rock Creek	OR_SR_1710030109_02_105343	X	
Harrington Creek	OR_SR_1710030109_02_105344	X	
Rock Creek	OR_SR_1710030109_02_105345	X	X
Rock Creek	OR_SR_1710030109_02_105346	X	
Rock Creek	OR_SR_1710030109_02_105347	X	X
East Fork Rock Creek	OR_SR_1710030109_02_105349	X	X
North Fork East Fork Rock Creek	OR_SR_1710030109_02_105350	X	
North Umpqua River	OR_SR_1710030111_02_105365	X	X
Oak Creek	OR_SR_1710030111_02_105367	X	X
Clover Creek	OR_SR_1710030111_02_105370	X	
Sutherlin Creek	OR_SR_1710030111_02_106414	X	X
North Umpqua River	OR_SR_1710030111_02_106415	X	X
Black Rock Fork	OR_SR_1710030201_02_105371	X	X
Buckeye Creek	OR_SR_1710030201_02_105373	X	X
South Umpqua River	OR_SR_1710030201_02_105374	X	X
Beaver Creek	OR_SR_1710030202_02_105375	X	X
Squaw Creek	OR_SR_1710030202_02_105376	X	
Falcon Creek	OR_SR_1710030202_02_105377	X	X
Jackson Creek	OR_SR_1710030202_02_105378	X	X
Jackson Creek	OR_SR_1710030202_02_105379	X	X
Dumont Creek	OR_SR_1710030203_02_105380	X	X
Deadman Creek	OR_SR_1710030203_02_105381	X	X
Boulder Creek	OR_SR_1710030203_02_105382	X	X

Assessment Unit Name	Assessment Unit ID	Use Period	
		Year Round	Spawn
Boulder Creek	OR_SR_1710030203_02_105386	X	
South Umpqua River	OR_SR_1710030203_02_105389	X	
Elk Creek	OR_SR_1710030204_02_105390	X	
Elk Creek	OR_SR_1710030204_02_105391	X	
Flat Creek	OR_SR_1710030204_02_105392	X	
Drew Creek	OR_SR_1710030204_02_105393	X	
Canyon Creek	OR_SR_1710030205_02_105394	X	X
Shively Creek	OR_SR_1710030205_02_105396	X	
Wood Creek	OR_SR_1710030205_02_105397	X	
Days Creek	OR_SR_1710030205_02_105399	X	
East Fork Stouts Creek	OR_SR_1710030205_02_105402	X	
Shively Creek	OR_SR_1710030205_02_105407	X	
Canyon Creek	OR_SR_1710030205_02_105410	X	
Coffee Creek	OR_SR_1710030205_02_105413	X	X
South Umpqua River	OR_SR_1710030205_02_106333	X	X
West Fork Canyon Creek	OR_SR_1710030205_02_106334	X	X
Snow Creek	OR_SR_1710030206_02_105414	X	
Applegate Creek	OR_SR_1710030206_02_105415	X	
Cow Creek	OR_SR_1710030206_02_105417	X	
Wood Creek	OR_SR_1710030207_02_104740	X	X
Skull Creek	OR_SR_1710030207_02_104741	X	
Dads Creek	OR_SR_1710030207_02_104742	X	
Riffle Creek	OR_SR_1710030207_02_104743	X	
Riffle Creek	OR_SR_1710030207_02_104747	X	
Windy Creek	OR_SR_1710030207_02_104748	X	X
Bull Run	OR_SR_1710030207_02_105422	X	
Quines Creek	OR_SR_1710030207_02_105423	X	
Quines Creek	OR_SR_1710030207_02_105425	X	
West Fork Cow Creek	OR_SR_1710030208_02_104751	X	
West Fork Cow Creek	OR_SR_1710030208_02_104752	X	
Bear Creek	OR_SR_1710030208_02_104754	X	
Union Creek	OR_SR_1710030209_02_104755	X	
South Fork Middle Creek	OR_SR_1710030209_02_104757	X	
Mitchell Creek	OR_SR_1710030209_02_104758	X	
Middle Creek	OR_SR_1710030209_02_104762	X	X
Martin Creek	OR_SR_1710030209_02_104763	X	X
Doe Creek	OR_SR_1710030209_02_106336	X	
Cow Creek	OR_SR_1710030209_02_106367	X	X

Assessment Unit Name	Assessment Unit ID	Use Period	
		Year Round	Spawn
Slide Creek	OR_SR_1710030210_02_105428	X	
North Myrtle Creek	OR_SR_1710030210_02_105431	X	
South Myrtle Creek	OR_SR_1710030210_02_105432	X	X
North Myrtle Creek	OR_SR_1710030210_02_106416	X	
Rice Creek	OR_SR_1710030211_02_105087	X	X
South Umpqua River	OR_SR_1710030211_02_105320	X	X
Lookingglass Creek	OR_SR_1710030212_02_105090	X	X
Olalla Creek	OR_SR_1710030212_02_105091	X	
Olalla Creek	OR_SR_1710030212_02_105094	X	
Thompson Creek	OR_SR_1710030212_02_105096	X	
South Umpqua River	OR_SR_1710030213_02_105102	X	X
Roberts Creek	OR_SR_1710030213_02_105104	X	
Middle Fork of South Fork Deer Creek	OR_SR_1710030213_02_105433	X	
North Fork Deer Creek	OR_SR_1710030213_02_105434	X	
Deer Creek	OR_SR_1710030213_02_106417	X	X
Hinkle Creek	OR_SR_1710030301_02_105436	X	
Calapooya Creek	OR_SR_1710030301_02_105442	X	
Calapooya Creek	OR_SR_1710030301_02_105443	X	
Calapooya Creek	OR_SR_1710030301_02_106418	X	
Rader Creek	OR_SR_1710030302_02_105112	X	
Little Wolf Creek	OR_SR_1710030302_02_105113	X	X
Hubbard Creek	OR_SR_1710030302_02_105115	X	
Yellow Creek	OR_SR_1710030302_02_105123	X	
Wolf Creek	OR_SR_1710030302_02_105124	X	
Umpqua River	OR_SR_1710030302_05_105126	X	
Brush Creek	OR_SR_1710030303_02_105132	X	
Brush Creek	OR_SR_1710030303_02_105133	X	
North Fork Tom Folley Creek	OR_SR_1710030303_02_105143	X	
Big Tom Folley Creek	OR_SR_1710030303_02_105144	X	
Elk Creek	OR_SR_1710030303_02_105453	X	
Elk Creek	OR_SR_1710030303_02_106420	X	
Sand Creek	OR_SR_1710030303_02_106435	X	
Lutsinger Creek	OR_SR_1710030304_02_105151	X	
Umpqua River	OR_SR_1710030304_05_105153	X	
Lake Creek	OR_SR_1710030305_02_105155	X	
Camp Creek	OR_SR_1710030305_02_105158	X	
Soup Creek	OR_SR_1710030305_02_105163	X	
Buck Creek	OR_SR_1710030305_02_105164	X	

Assessment Unit Name	Assessment Unit ID	Use Period	
		Year Round	Spawn
Smith River	OR_SR_1710030306_02_105167	X	
Burn Creek	OR_SR_1710030306_02_105169	X	
South Sister Creek	OR_SR_1710030306_02_105170	X	
Halfway Creek	OR_SR_1710030306_02_105173	X	
Cleghorn Creek	OR_SR_1710030306_02_105174		X
Smith River	OR_SR_1710030306_02_105175	X	
Smith River	OR_SR_1710030306_02_105180	X	
South Fork Smith River	OR_SR_1710030306_02_105181	X	
South Fork Smith River	OR_SR_1710030306_02_105182	X	
North Sister Creek	OR_SR_1710030306_02_105183	X	
Cedar Creek	OR_SR_1710030307_02_105185	X	
Middle Fork North Fork Smith River	OR_SR_1710030307_02_105186	X	
North Fork Smith River	OR_SR_1710030307_02_105187	X	
West Branch North Fork Smith River	OR_SR_1710030307_02_105189	X	
Middle Fork North Fork Smith River	OR_SR_1710030307_02_105192	X	
Smith River	OR_SR_1710030307_02_105196	X	
West Fork Smith River	OR_SR_1710030307_02_105197	X	
tributary to Middle Fork North Fork Smith River	OR_SR_1710030307_02_105201	X	
Franklin Creek	OR_SR_1710030308_02_105205	X	

Table 19 Umpqua Basin category 5 temperature impairments for watershed assessment units on the 2022 Integrated Report

Assessment Unit Name	Assessment Unit ID	Use Period	
		Year Round	Spawn
HUC12 Name: Lake Creek	OR_WS_171003010204_02_105809	X	
HUC12 Name: Upper Fish Creek	OR_WS_171003010401_02_105640	X	
HUC12 Name: Deer Creek	OR_WS_171003010504_02_105646	X	
HUC12 Name: Pass Creek	OR_WS_171003010602_02_105648	X	
HUC12 Name: Lower Canton Creek	OR_WS_171003010603_02_105649	X	X
HUC12 Name: Headwaters Steamboat Creek	OR_WS_171003010701_02_105650	X	X
HUC12 Name: Upper Steamboat Creek	OR_WS_171003010702_02_105651	X	X
HUC12 Name: Steelhead Creek	OR_WS_171003010705_02_105653	X	X
HUC12 Name: Boulder Creek	OR_WS_171003010801_02_105655	X	X
HUC12 Name: Copeland Creek	OR_WS_171003010802_02_105656	X	
HUC12 Name: Calf Creek	OR_WS_171003010804_02_105657	X	X
HUC12 Name: Panther Creek	OR_WS_171003010805_02_105658	X	X

Assessment Unit Name	Assessment Unit ID	Use Period	
		Year Round	Spawn
HUC12 Name: Williams Creek-North Umpqua River	OR_WS_171003010807_02_105660	X	X
HUC12 Name: Thunder Creek-North Umpqua River	OR_WS_171003010808_02_105661	X	X
HUC12 Name: Susan Creek-North Umpqua River	OR_WS_171003010809_02_105662	X	
HUC12 Name: Upper Rock Creek	OR_WS_171003010901_02_105663	X	
HUC12 Name: East Fork Rock Creek	OR_WS_171003010902_02_105664	X	
HUC12 Name: Lower Rock Creek	OR_WS_171003010903_02_105665		X
HUC12 Name: Cooper Creek-North Umpqua River	OR_WS_171003011103_02_106425	X	
HUC12 Name: Castle Rock Fork	OR_WS_171003020101_02_105675	X	X
HUC12 Name: Black Rock Fork	OR_WS_171003020102_02_105676	X	
HUC12 Name: Quartz Creek	OR_WS_171003020103_02_105677	X	
HUC12 Name: Buckeye Creek	OR_WS_171003020104_02_105678	X	
HUC12 Name: Skillet Creek-South Umpqua River	OR_WS_171003020105_02_105679	X	X
HUC12 Name: Lower Jackson Creek	OR_WS_171003020205_02_105684	X	
HUC12 Name: Boulder Creek	OR_WS_171003020301_02_105685	X	
HUC12 Name: Dumont Creek	OR_WS_171003020302_02_105686	X	X
HUC12 Name: Ash Creek-South Umpqua River	OR_WS_171003020303_02_105687	X	
HUC12 Name: Francis Creek-South Umpqua River	OR_WS_171003020304_02_105688	X	
HUC12 Name: Deadman Creek	OR_WS_171003020305_02_105689	X	X
HUC12 Name: Upper Elk Creek	OR_WS_171003020401_02_105691	X	
HUC12 Name: Middle Elk Creek	OR_WS_171003020402_02_105692	X	
HUC12 Name: Drew Creek	OR_WS_171003020403_02_105693	X	
HUC12 Name: Lower Elk Creek	OR_WS_171003020404_02_105694	X	X
HUC12 Name: Coffee Creek	OR_WS_171003020501_02_105695	X	
HUC12 Name: Stouts Creek	OR_WS_171003020503_02_105696	X	
HUC12 Name: Saint John Creek-South Umpqua River	OR_WS_171003020504_02_105814	X	
HUC12 Name: Days Creek	OR_WS_171003020505_02_105697	X	
HUC12 Name: Canyon Creek	OR_WS_171003020507_02_106347	X	X
HUC12 Name: Dismal Creek-Cow Creek	OR_WS_171003020602_02_105700	X	
HUC12 Name: McGinnis Creek-Cow Creek	OR_WS_171003020603_02_105701	X	
HUC12 Name: Quines Creek-Cow Creek	OR_WS_171003020702_02_106348	X	
HUC12 Name: Fortune Branch-Cow Creek	OR_WS_171003020703_02_106349	X	

Assessment Unit Name	Assessment Unit ID	Use Period	
		Year Round	Spawn
HUC12 Name: Dads Creek-Cow Creek	OR_WS_171003020706_02_104851	X	
HUC12 Name: Riffle Creek-Cow Creek	OR_WS_171003020707_02_104852	X	
HUC12 Name: Elk Valley Creek-West Fork Cow Creek	OR_WS_171003020803_00_104855	X	
HUC12 Name: Middle Creek	OR_WS_171003020901_02_104857	X	
HUC12 Name: Cattle Creek-Cow Creek	OR_WS_171003020903_02_104858	X	X
HUC12 Name: Upper South Myrtle Creek	OR_WS_171003021001_02_105703	X	X
HUC12 Name: Lower South Myrtle Creek	OR_WS_171003021002_02_105704	X	
HUC12 Name: Upper North Myrtle Creek	OR_WS_171003021003_02_105705	X	
HUC12 Name: Newton Creek-South Umpqua River	OR_WS_171003021305_02_105321	X	
HUC12 Name: Wolf Creek	OR_WS_171003030204_02_105278	X	
HUC12 Name: Lost Creek-Umpqua River	OR_WS_171003030205_02_105279	X	
HUC12 Name: Yellow Creek	OR_WS_171003030206_02_105280	X	
HUC12 Name: Mehl Creek-Umpqua River	OR_WS_171003030208_02_105318	X	
HUC12 Name: Upper Pass Creek	OR_WS_171003030304_02_105710	X	
HUC12 Name: Headwaters Smith River	OR_WS_171003030601_02_105295		X
HUC12 Name: Halfway Creek-Smith River	OR_WS_171003030602_02_105296	X	
HUC12 Name: South Sister Creek	OR_WS_171003030603_02_105297	X	
HUC12 Name: West Fork Smith River	OR_WS_171003030701_02_105299	X	
HUC12 Name: Upper North Fork Smith River	OR_WS_171003030705_02_105302	X	
HUC12 Name: Upper Canton Creek	OR_WS_171003010601_02_105647	X	
HUC12 Name: Oldham Creek	OR_WS_171003030104_02_105708	X	

5 Numeric Targets

This section identifies numeric targets that will be used to evaluate attainment of water quality criteria and the protection of the designated uses. For the pollutant (heat) addressed by this TMDL project the numeric targets are expressed as temperature and are consistent with the water quality criteria (OAR 340-014-0028). The Human Use Allowance (HUA) temperature implementation provision allows for 0.3 C increased warming from anthropogenic sources only in waters that exceed the applicable temperature criteria. Therefore, the TMDL targets for impaired assessment units is the numeric temperature criteria plus the 0.3 allowable warming (Table 20). For those waters that are not impaired, the TMDL target is set equal to and applies consistently with the temperature water quality criteria (Table 20).

Table 20 TMDL numeric targets

Parameter	Numeric Target (°C)	Averaging Period	Designated Use Protected	Notes
Waters that exceed applicable temperature criteria, HUA provision applies				
Temperature	13.3	7-day average maximum temperature	Salmon and steelhead spawning	Seasonally applies approximately from September 1st – June 15th. Specific spatial and temporal application is as required by OAR 340-041-0320, Figure 320B.
	16.3	7-day average maximum temperature	Core cold water habitat	
	18.3	7-day average maximum temperature	Salmon and trout rearing and migration	
Waters that do not exceed applicable temperature criteria				
Temperature	13	7-day average maximum temperature	Salmon and steelhead spawning	Seasonally applies approximately from September 1st – June 15th. Specific spatial and temporal application is as required by OAR 340-041-0320, Figure 320B.
	16	7-day average maximum temperature	Core cold water habitat	
	18	7-day average maximum temperature	Salmon and trout rearing and migration	
Natural Lakes Temperature	Natural condition plus 0.3 °C	Instantaneous maximum	Fish & aquatic life	Absent a discharge or other human modification expected to increase temperature, the lake's ambient temperature is considered the natural condition
Oceans and Bays	Natural condition plus 0.3°C	Instantaneous maximum	Fish & aquatic life	

6 Seasonal Variation and Critical Conditions

EPA reviewed available temperature data to evaluate seasonal temperature variation in the context of beneficial use protection and determined the critical period. The critical period is based on when the 7DADM stream temperatures exceed the criteria and when seasonal beneficial uses apply. The critical period for this TMDL project is May 1 through October 31 for all waterbodies in the Umpqua River basin except Rock Creek. The critical period for Rock Creek is April 15 through October 31. Critical conditions can only be determined from data collected along a stream segment determined to be a category 5 temperature impairment on the Oregon 2022 Integrated Report.

Critical conditions for a representative subset of monitoring locations (Figure 35) in the three subbasins (North Umpqua, South Umpqua, and Umpqua) are presented in Figures 36 through 42. Appendix B presents a critical condition assessment for all the monitoring locations in the Umpqua River Basin, as well as detailed description of elements of the box plots presented below in this section.

Figure 35 Subset of monitoring locations used to evaluate critical conditions.

The period of temperature criteria exceedance varies based on monitoring location. The shaded yellow area in these figures identifies the period when maximum 7DADM temperatures exceeded the applicable temperature criteria, and the dashed line corresponds to the applicable temperature criteria. These plots show that maximum stream temperatures typically occur in July or August. This period usually coincides with the lowest annual stream flows, maximum solar radiation fluxes, and warmest ambient air temperature conditions. There are several locations where the median 7DADM temperature exceeds 25°C (Figures 37-42 and Appendix B). Typically, the greatest magnitude and frequency of exceedances occurs from May through October. This period is identified as the critical period due to the frequency and magnitude of criteria exceedances and this period also coincides when natural environmental conditions (e.g., decreased annual stream flow, increased solar radiation) reduce thermal assimilative capacity.

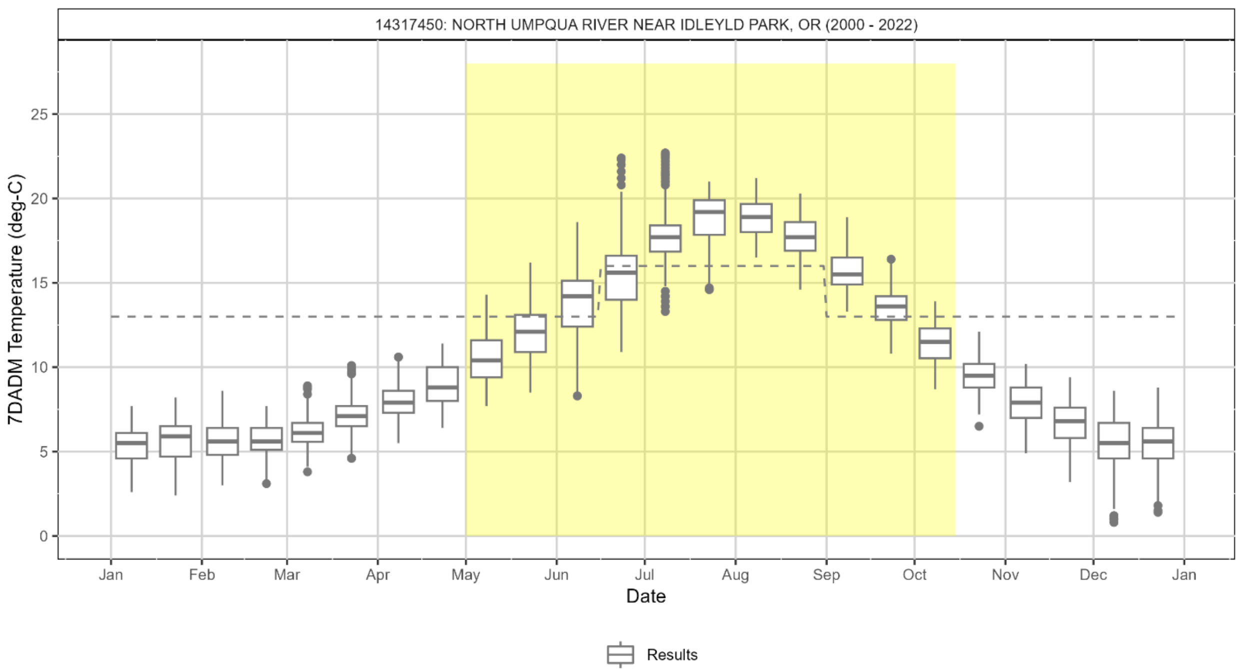

Figure 36 Seasonal variation and critical period at the North Umpqua River near Idleyld Park temperature monitoring site. (14317450)

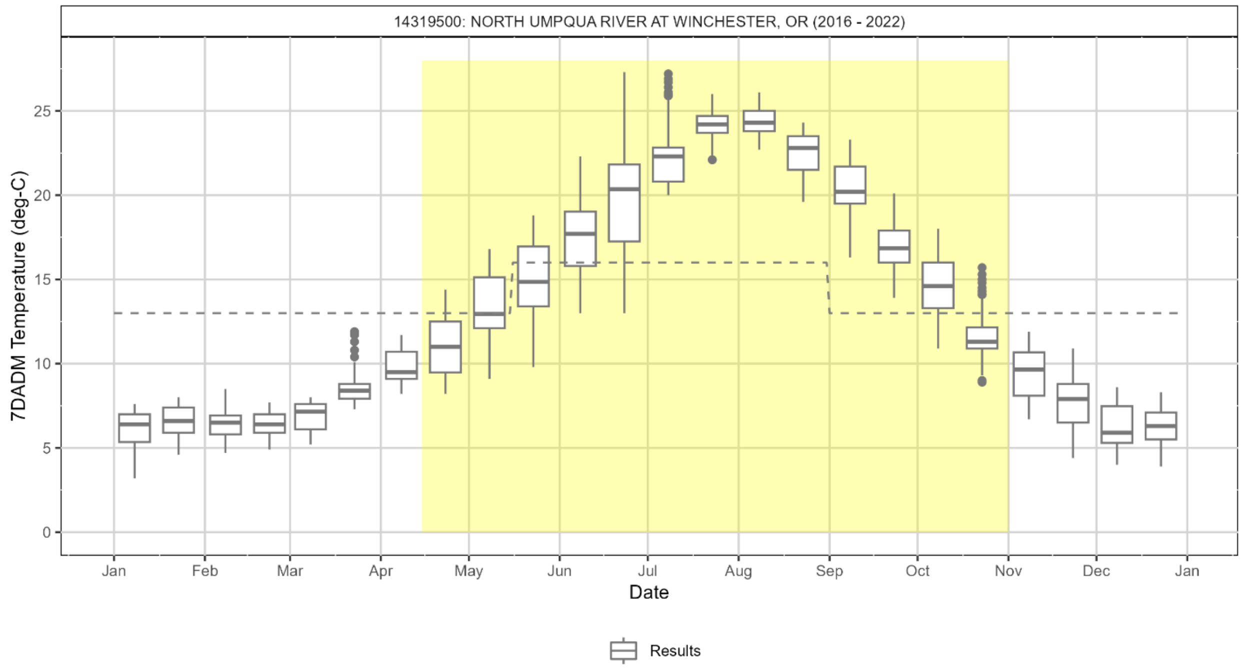

Figure 37 Seasonal variation and critical period at the North Umpqua River at Winchester temperature monitoring site (14319500)

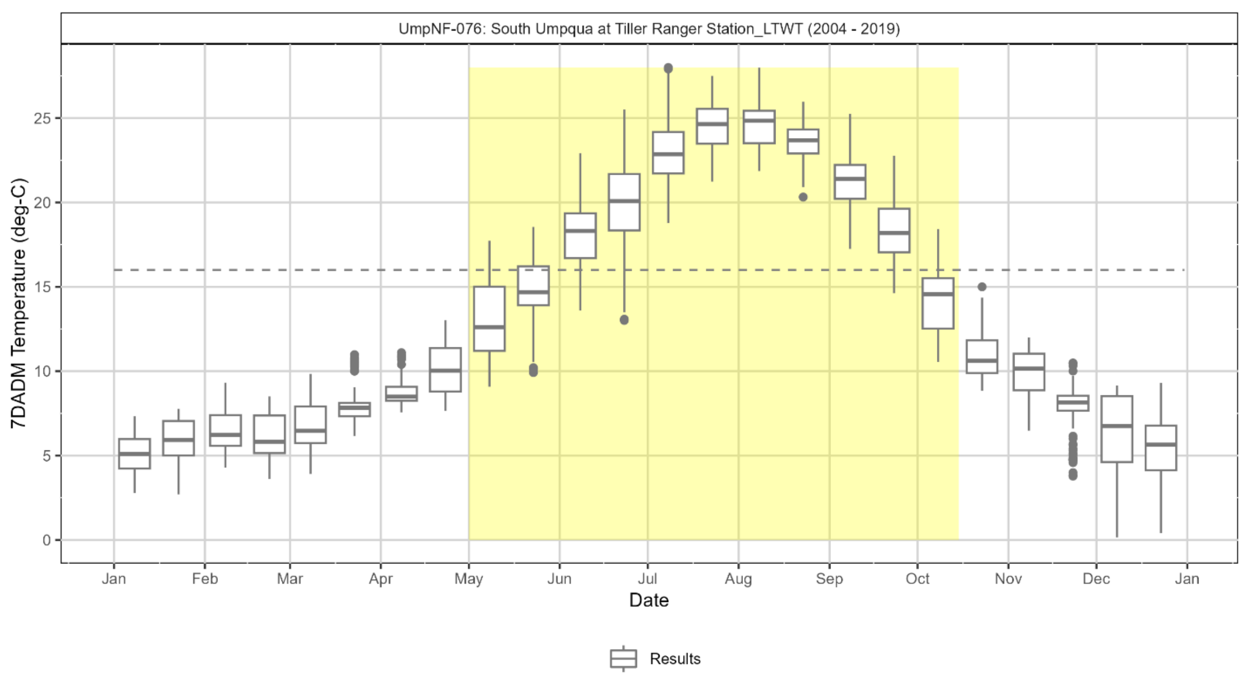

Figure 38 Seasonal variation and critical period at the South Umpqua River at Tiller Ranger station temperature monitoring site (UmpNF-076)

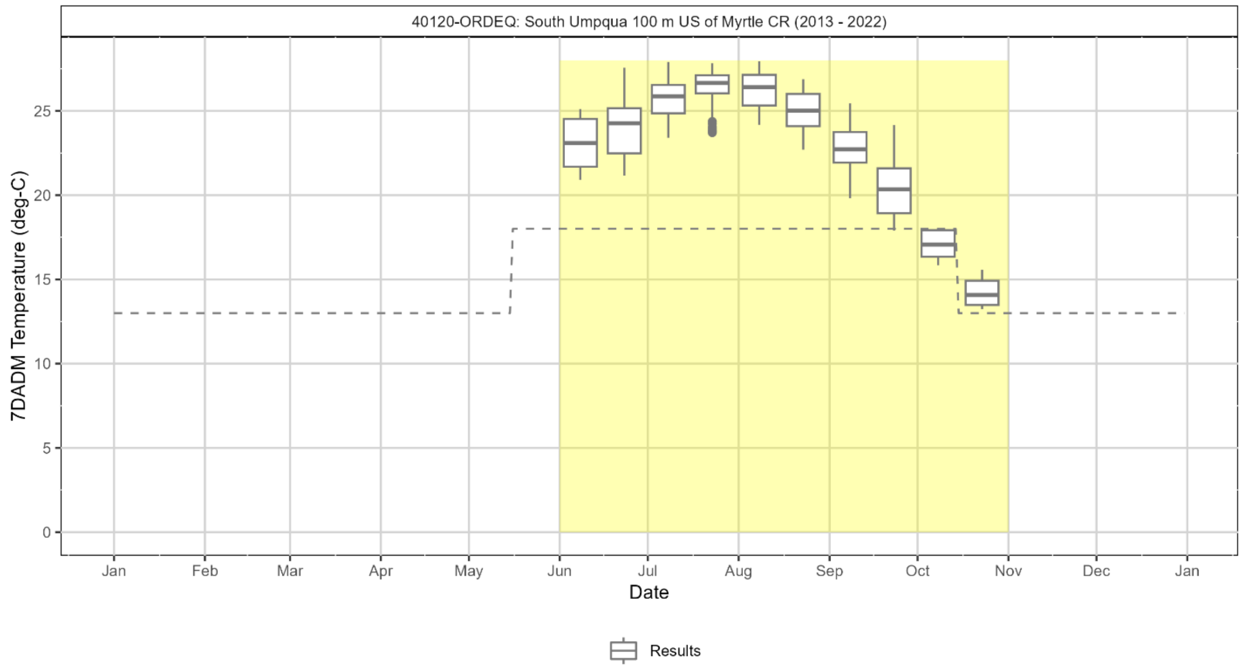

Figure 39 Seasonal variation and critical period at the South Umpqua River at 100 meter upstream of Myrtle Creek temperature monitoring site (40120-ORDEQ)

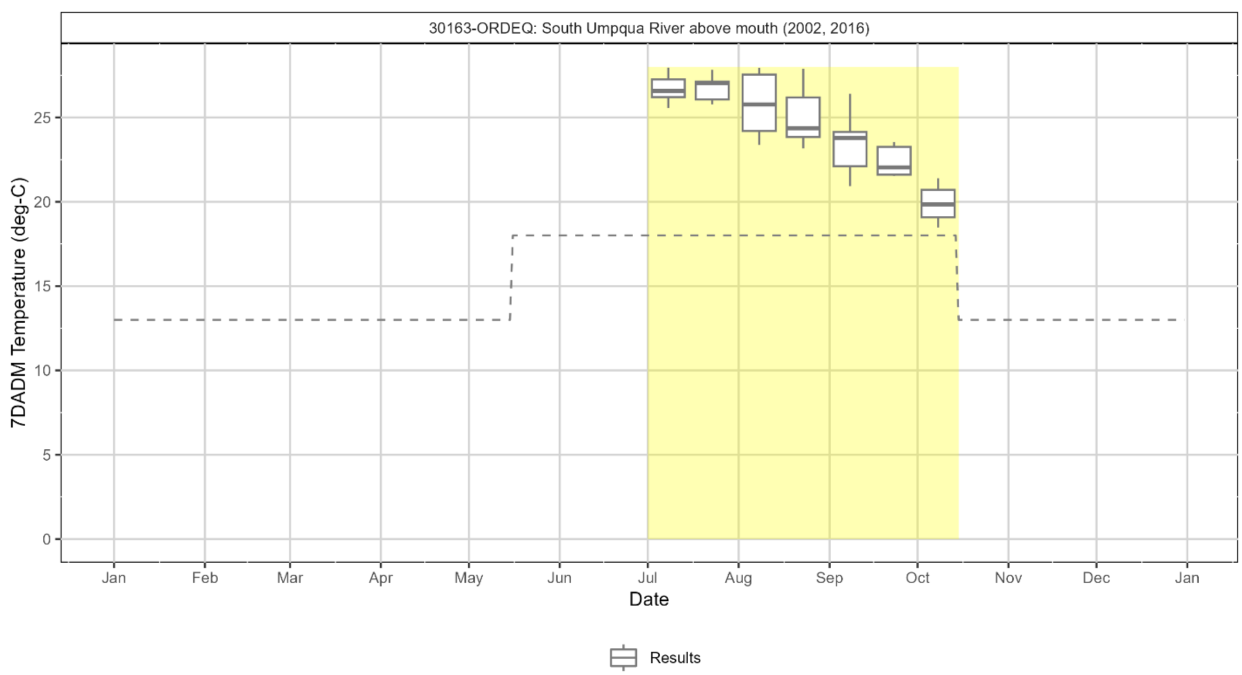

Figure 40 Seasonal variation and critical period at the South Umpqua River above the mouth temperature monitoring site (30163-ORDEQ)

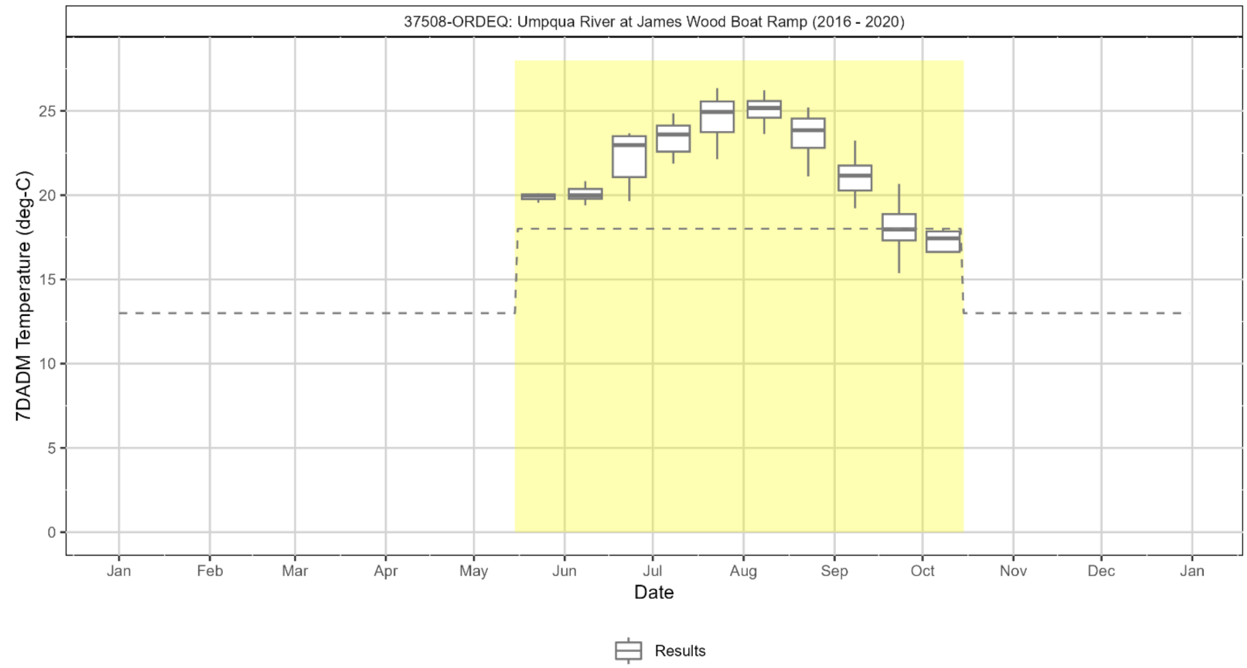

Figure 41 Seasonal variation and critical period at the Umpqua River at James Wood Boat Ramp station temperature monitoring site (37508-ORDEQ).

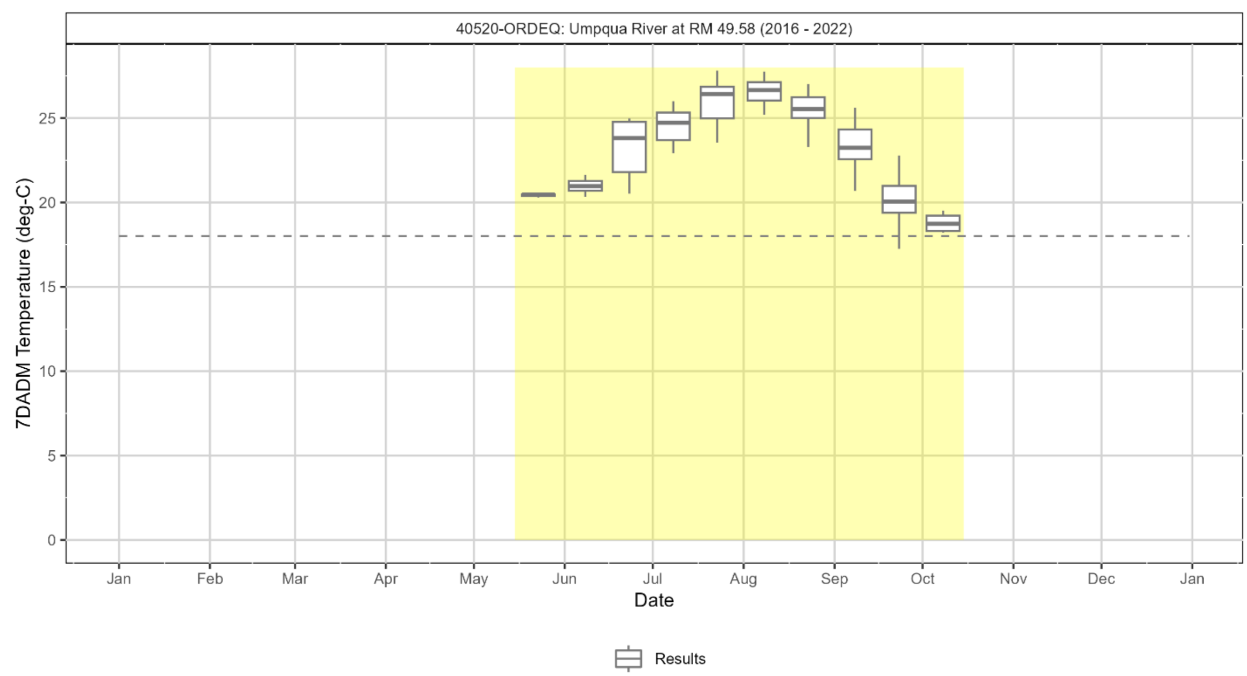

Figure 42 Seasonal variation and critical period at the Umpqua River at river mile 49.58 temperature monitoring site (40520-ORDEQ)

7 Source Assessment

This section identifies the sources of heat to rivers in the Umpqua River Basin. In the context of TMDLs, pollutant sources are classified as either point sources or nonpoint sources. Point sources include discharges from wastewater treatment plants and industrial facilities. The term “nonpoint source” means any source of water pollution that does not meet the legal definition of a “point source” in section 502(14) of the CWA. Nonpoint sources of heat generally originate from hydrologic modifications including, dam and reservoir operations, removal of streamside vegetation, and channel modification. Water withdrawals and actions that modify flow rate and/or volume can also be nonpoint source contributors of heat. Also, other additional heat sources, including natural sources and anthropogenic warming due to climate change, are categorized as nonpoint sources.

Point Sources

Individual National Pollutant Discharge Elimination System (NPDES) permittees and a variety of general permit enrollees were identified as sources of thermal loading to the Umpqua River Basin. The discharge of heated water from a variety of facility actions can influence temperatures in the receiving stream.

7.1.1 Individual NPDES Permitted Facilities

Nineteen individual NPDES permitted facilities were identified in the Umpqua River Basin. Table 21 lists all the facilities and Figure 43 is a map of facility location.

Table 21 Individually permitted NPDES facilities in the Umpqua Basin (excluding the Little River watershed).

Subbasin Name	Facility Name	EPA Permit Number	Design Flow	Discharge Season	Receiving Stream
Umpqua	Brandy Bar Landing, Inc.	OR0030864	< 1 MGD	Year Round	Umpqua River
	Drain STP	OR0029645	< 1 MGD	Nov. 1 – April 30	Elk Creek
	Oakland STP	OR0020494	< 1 MGD	Nov. 1 – May 31	Calapooya Creek
	Reedsport STP	OR0020826	1.9 MGD Dry Weather	Year Round	Umpqua River Estuary
	Rice Hill East Lagoon	OR0029564	< 1 MGD	Nov 1 – April 30	Yoncalla Creek
	Rice Hill West Lagoon	OR0028789	< 1 MGD	Nov 1 – April 30	Yoncalla Creek
	Sutherlin STP	OR0020842	< 1 MGD	Nov 1 – May 31	Calapooya Creek
	Winchester Bay STP	OR0022616	1.3 MGD	Year Round	Umpqua River Estuary
	Yoncalla STP	OR0022454	< 1 MGD	Nov 1 – April 30	Yoncalla Creek
North Umpqua	Glide-Idleyld Sanitary District	OR0030261	< 1 MGD	Year Round	North Umpqua River
South Umpqua	Canyonville STP	OR0020729	< 1 MGD	Year Round	South Umpqua
	Glendale STP	OR0022730	< 1 MGD	Year Round	Cow Creek

Subbasin Name	Facility Name	EPA Permit Number	Design Flow	Discharge Season	Receiving Stream
	Green Diamond Performance Materials, Inc.	OR0001627	NA	Wet Weather	Crawford Creek
	Hoover Treated Wood Products	OR0034380	No Discharge	NA	South Umpqua River
	Myrtle Creek STP	OR0028665	1.8 MGD Dry Weather	Year Round	South Umpqua River
	R.U.S.A. Roseburg STP	OR0031356	7.9 MGD Dry Weather	Nov 1 – April 30	South Umpqua River
	Riddle STP	OR0020630	< 1 MGD	Year Round	Cow Creek
	USFS Tiller Ranger Station STP	OR0023221	< 1 MGD	Year Round	South Umpqua River
	Winston-Green WWTF	OR0030392	1.6 MGD Dry Weather	Year Round	South Umpqua River

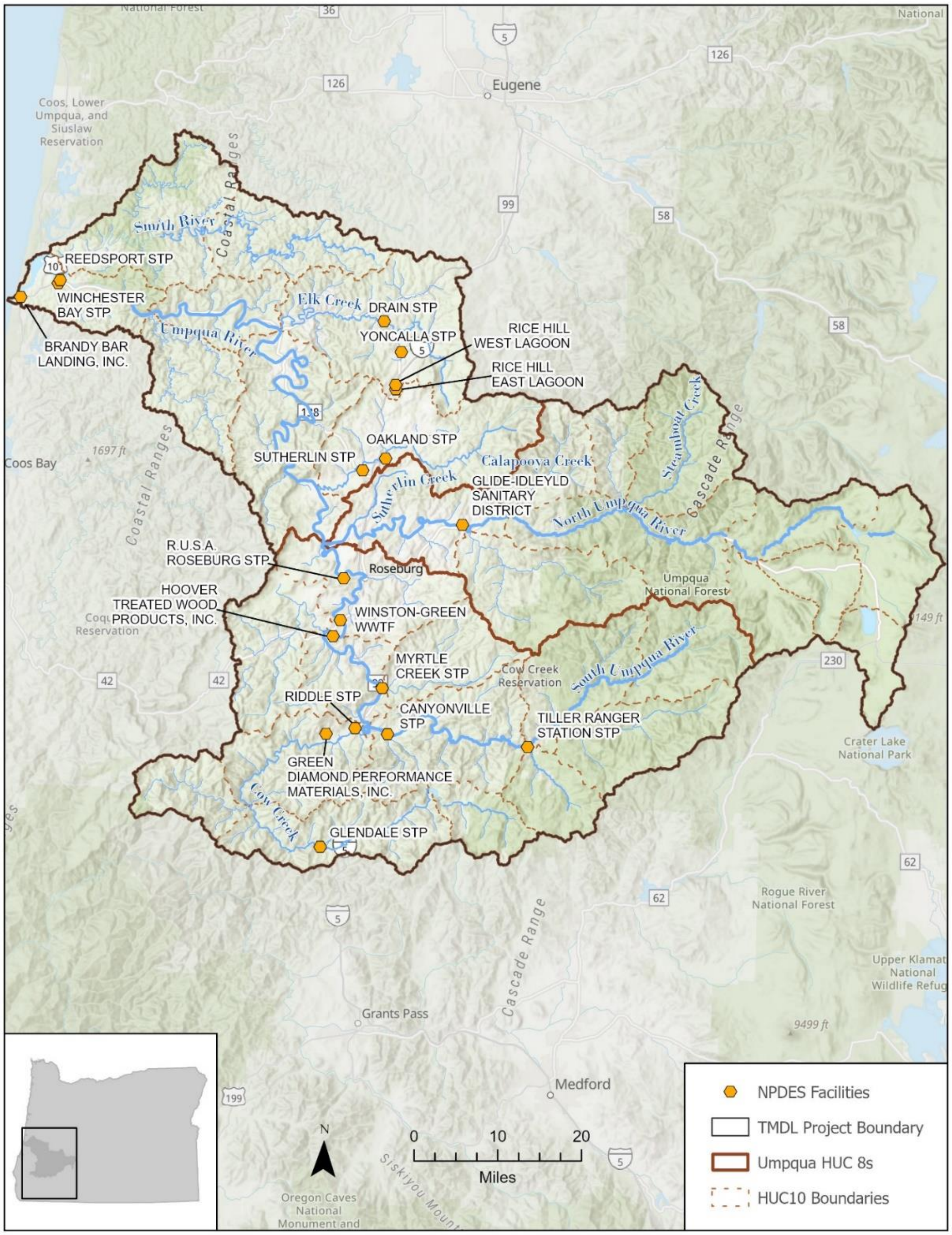

Figure 43 Individually permitted NPDES facilities in the Umpqua Basin (excluding the Little River subbasin).

The current excess thermal loading for each facility was calculated (Equation 1) individually using the facilities' effluent flow and temperature data obtained from the Discharge Monitoring Reports (DMR). Equation 2 was used to calculate the change in temperature relative to the applicable criterion based on facility discharge and river flow (7Q10 or mean daily flow if available). Table 22 presents the current maximum excess thermal loading (i.e., maximum loading in exceedance of the criteria load) and maximum instream temperature increase at the point of discharge for each individually permitted NPDES facility. These analyses provide an estimate of loading and temperature increases in exceedance of the criteria at the point of discharge. Cumulative impacts of point source discharges were evaluated using the water quality model (see Appendix G).

$$ETL = (T_E - T_C) \cdot Q_E \cdot C_F$$ **Equation 1**

where,

$ETL =$ The daily excess thermal load (kilocalories/day), expressed as a rolling seven-day average.

$T_C =$ The point of discharge applicable river temperature criterion (°C) (T_c)

$T_E =$ The daily maximum effluent temperature (°C)

$Q_E =$ The daily mean effluent flow (cfs or MGD)

$C_F =$ Conversion factor for flow in cubic feet per second (cfs): 2,446,665

$$\left(\frac{1\ \text{m}}{3.2808\ \text{ft}}\right)^3 \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{86400\ sec}{1\ day} \cdot \frac{1\ kcal}{1\ kg\ \cdot 1℃} = 2{,}446{,}665$$

Conversion factor for flow in millions of gallons per day (MGD): 3,785,411

$$\frac{1\ m^3}{264.17\ gal} \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{1000000\ gal}{1\ million\ gal} \cdot \frac{1\ kcal}{1\ \text{kg}\ \cdot 1℃} = 3{,}785{,}441$$

$$\Delta T_{Current} = \left(\frac{Q_E}{Q_E + Q_R}\right) \cdot (T_E - T_C)$$ **Equation 2**

where,

$\Delta T_{Current} =$ The current river temperature increase (°C) above the applicable river temperature criterion using 100% of river flow.

$Q_E =$ The daily mean effluent flow (cfs).
When effluent flow is in million gallons per day (MGD) convert to cfs:

$$\frac{1\ million\ gallons}{1\ day} \cdot \frac{1.5472\ ft^3}{1\ million\ gallons} = 1.5472$$

$Q_R =$ The daily mean river flow rate, upstream (cfs).
When river flow is <= 7Q10, Q_R = 7Q10. When river flow > 7Q10, Q_R is equal to the daily mean river flow, upstream.

$T_E =$ The daily maximum effluent temperature (°C)

$T_C =$ The point of discharge applicable river temperature criterion (°C). When the minimum duties provision at OAR 340-041-0028(12)(a) applies T_C = the 7DADM measured at the facility intake.

Table 22 Summary of existing maximum warming and thermal loading at the point of discharge from individual NPDES point sources in the Umpqua Basin project area.

Subbasin Name	Facility Name	EPA Permit Number	Maximum temp. increase at point of discharge (°C)	Maximum excess thermal load (kcals/day)	Receiving Stream
Umpqua	Brandy Bar Landing, Inc.	OR0030864	0.00	118,374	Umpqua River
	Drain STP	OR0029645	2.00	12,583,169,	Elk Creek
	Oakland STP	OR0020494	2.45	9,195,101	Calapooya Creek
	Reedsport STP	OR0020826	0.01	64,651,565	Umpqua River

Subbasin Name	Facility Name	EPA Permit Number	Maximum temp. increase at point of discharge (°C)	Maximum excess thermal load (kcals/day)	Receiving Stream
	Rice Hill East Lagoon	OR0029564	7.0	2,248,617	Yoncalla Creek
	Rice Hill West Lagoon[1]	OR0028789	-6.8	-1,000,000	Yoncalla Creek
	Sutherlin STP	OR0020842	5.55	48,152,198	Calapooya Creek
	Winchester Bay STP	OR0022616	0.00	1,725,454	Umpqua River
	Yoncalla STP	OR0022454	5.04	14,957,466	Yoncalla Creek
North Umpqua	Glide-Idleyld Sanitary District	OR0030261	0.1	20,551,752	North Umpqua River
South Umpqua	Canyonville STP	OR0020729	0.14	18,964,092	South Umpqua
	Glendale STP	OR0022730	0.09	15,856,913	Cow Creek
	Green Diamond Performance Materials, Inc.	OR0001627	No Discharge allowed June 16 – November 14. No DMR data available for discharge period		Crawford Creek
	Hoover Treated Wood Products	OR0034380	No Discharge of process wastewater allowed		South Umpqua River
	Myrtle Creek STP	OR0028665	0.17	49,578,215	South Umpqua River
	R.U.S.A. Roseburg STP	OR0031356	0.4	155,290,840	South Umpqua River
	Riddle STP	OR0020630	0.06	22,163,579	Cow Creek
	USFS Tiller Ranger Station STP	OR0023221	0.00	99,939	South Umpqua River
	Winston-Green WWTF	OR0030392	0.18	191,418,238	South Umpqua River

[1] This facility only discharges in the winter months (Nov 1 – April 30) and effluent temperatures a cooler than criterion value resulting in a negative temperature increase at the point of discharge.

7.1.2 General NPDES Permits

General permits can be issued to cover multiple facilities in a specific category; this approach allows several facilities to be covered by a single permit. There are 11 NPDES general permits with registrants in the Umpqua River Basin. Temperature data collection may or may not be required by general permits, so it was not possible for EPA to characterize potential wastewater impacts similar to the manner of individual permits. The Table 23 below provides basic information on the permits and number of registrants for each permit at the time of TMDL development.

The EPA evaluated industrial wastewater general permits and using five metrics assessed if discharges with thermal loading would cause or contribute to temperature criteria exceedance. The metrics used to evaluate permitted discharges and potential to cause or contribute to temperature criteria exceedances were 1) permit requirements, 2) permit dilution requirements, 3) frequency and magnitude of discharges, 4) location of discharge (i.e., estuarine discharge), and 5) seasonal discharge prohibition. Discharges under NPDES general permits found not to cause or contribute thermal loading greater than the criteria are listed in Table 23. However, if any new or additional data become available and indicate that industrial wastewater discharges previously identified as not a source of thermal loading are in fact a source of thermal loading, then the EPA or Oregon DEQ may access a portion of the HUA reserve allocation within the appropriate reach to explicitly account for industrial wastewater discharges authorized by general permits.

Stormwater discharges authorized under construction (1200-C) and industrial permits (1200-A and 1200-Z) were found unlikely to contribute to the exceedance of the temperature water quality criteria based on a literature review of stormwater runoff and stream temperature (Section 7.1.3). Therefore, existing permit requirements to control temperature impacts are expected to be sufficient; currently no additional TMDLs requirements are necessary. If any new or additional data become available and indicate that any stormwater discharges are a significant source of thermal loading, then the EPA or Oregon DEQ may access a portion of the HUA reserve allocation within the appropriate reach to explicitly account for discharge from stormwater.

Table 23 Summary of NPDES general permits with potential to contribute to thermal loading.

Permit Type	Permit Number	Discharges Authorized by the Permit*	Number of Registrants	Source of Thermal Loading
Industrial Wastewater				
Boiler Blowdown	500-J	Boiler blowdown that does not exceed 40 gallons/minute, infrequent discharge with dilution requirement (flow 4x discharge for each degree F)	3	No
Cooling Water	100-J	Non-contact cooling water, cooling tower blow down	9	Yes
Filter Backwash	200-J	Filter backwash, settling basin & reservoir cleaning	15	Yes
Fish Hatchery	300-J	Treated discharges from aquatic animal production facilities which produce at least 20,000 pounds of fish per year	1	Yes
Log Ponds	400-J	Wet storage facilities that do not receive domestic sewage or process wastewater; non-discharging evaporative ponds, runoff from log yard sprinkling. 50:1 dilution requirement and no discharge May 1st - October 31st	11	No
Seafood Processing	900-J	Comingled wastewater & stormwater from seafood processing actives, estuarine discharge	2	No
Vehicle and Equipment Wash Water	1700-A	Vehicle, equipment, building, and pavement washing activities	2	No

Permit Name	Permit Number	Discharges Authorized by the Permit*	Number of Registrants	Source of Thermal Loading
Stormwater				
Construction	1200-C	Construction activities that disturb one or more acres of land or any construction activity that may be a significant contributor of pollutants	39	No
Public Agency Construction	1200-CA	Construction activities that disturb one or more acres of land or any construction activity that may be a significant contributor of pollutants	2	No
Sand and Gravel	1200-A	Discharges of stormwater or mine dewatering water (permit specifies covered SIC codes)	11	No
Industrial	1200-Z	Discharges of industrial stormwater (permit specifies covered SIC codes)	37	No
* This table presents a summary of discharges authorized by the permit, please see the appropriate permit issued by Oregon DEQ for details on authorized discharges and permit requirements.				

Based on a review of the permits and discharge monitoring report (DMR) data, when available, registrants enrolled in the general permit categories listed below have the potential to contribute thermal loading that would cause or contribute to the exceedance of the applicable temperature criteria. Table 24 lists the registrants under these permits at the time of TMDL development. Temperature data collection may or may not be required by general permits; so, it was not possible for the EPA to characterize wastewater thermal loads similar to the manner of individual NPDES permits for 100-J and 200-J registrants.

- 100-J, Cooling water
- 200-J Filter backwash
- 300-J Fish hatchery

Table 24 Current general permit registrants that have the potential to contribute thermal loading.

Registrant	General Permit	DEQ WQ File Number	Receiving Water
PacifiCorp, Clearwater #1	100-J	66628	Clearwater River
PacifiCorp, Clearwater #2	100-J	66630	North Umpqua River
PacifiCorp, Fish Creek Plan	100-J	66632	North Umpqua River
PacifiCorp, Lemolo Plant	100-J	66634	North Umpqua River
PacifiCorp, Slide Creek	100-J	66640	North Umpqua River
PacifiCorp, Soda Springs	100-J	66642	North Umpqua River
PacifiCorp, Toketee Plant	100-J	66644	North Umpqua River
PacifiCorp, Lemolo Plant #2	100-J	66636	South Umpqua River
Roseburg Forest Products Co.	100-J	76790	South Umpqua River
Roberts Creek Water District	200-J	75660	Roberts Creek
City of Roseburg	200-J	76773	North Umpqua
City of Sutherlin	200-J	86664	Cooper Creek / Calapooya Creek

Registrant	General Permit	DEQ WQ File Number	Receiving Water
PacifiCorp	200-J	66645	North Umpqua
Umpqua Basin Water Association, Inc.	200-J	90684	North Umpqua
Clarks Branch Water Association	200-J	102878	Richardson Creek
City of Drain	200-J	25280	Billy Creek
City of Elkton	200-J	111261	Elk Creek/Umpqua River
Milo Adventist Academy	200-J	56978	South Umpqua
City of Riddle	200-J	110312	Cow Creek
City of Myrtle Creek	200-J	59644	Myrtle Creek
City of Sutherlin	200-J	86663	Calapooya Creek
City of Canyonville	200-J	103962	Canyon Creek
Winston-Dillard Water District	200-J	98330	South Umpqua
City of Yoncalla	200-J	99493	Yoncalla Creek
ODFW, Rock Creek Fish Hatchery	300-J	64530	Rock Creek

The 300-J general permit covers treated discharges from aquatic animal production facilities that produce at least 20,000 pounds of fish per year but have less than 300,000 pounds on hand at any one time. There is one registrant under the 300-J permit in the Umpqua basin (Table 25). The facility's current excess thermal loading was calculated using the facility effluent flow and temperature data from the DMR. This calculation provides an estimate of loading and temperature increases in exceedance of the criteria at the point of discharge.

Table 25 Summary of maximum warming and thermal loading at the point of discharge from 300-J general permit registrants in the Umpqua Basin project area

Subbasin	Facility	Permit & DEQ WQ File Number	Maximum temp. increase at point of discharge (°C)	Maximum excess thermal load (kcals/day)	Receiving Stream
North Umpqua	ODFW Rock Creek Hatchery	ORG1333509 64530	4.82	10,080,260	Rock Creek

7.1.3 MS4 Stormwater

There are no phase 1 or phase 2 municipal separate storm sewer system (MS4) permittees in the Umpqua basin; however, there are several small cities with non-permitted MS4s. Temperature data collection is not typically required by non-permitted MS4s, so it was not possible for EPA to characterize any potential thermal loading in a manner similar to individual NPDES point sources. In the summary below, EPA reviewed and evaluated the scientific literature on potential thermal impacts from stormwater and found that stormwater discharge impacts on temperature criteria exceedances are negligible. While these small cities occasionally discharge stormwater either through the MS4 or via overland flow, these discharges are not a temporally consequential source of thermal loading.

Under certain conditions, runoff from impervious pavement or runoff that is retained in uncovered open ponds can generate warm discharges for a short duration (Herb et. al. 2008, Jones and Hunt 2009, UNH Stormwater Center 2011, Winston et. al. 2011, Hester and Bauman 2013). However, several studies demonstrate that increases in runoff temperature are highly dependent on many factors including air temperature, dewpoint, pavement type, percent impervious and the amount of impervious surface blocked from solar radiation (Nelson and Palmer 2007, Herb et. al. 2008, Thompson et. al. 2008, Winston et. al. 2011, Jones et. al. 2012, Sabouri et. al. 2013, and Zeiger and Hubbert 2015). Warm runoff discharges can create “surges” that produce increases in stream temperature typically for short durations (Hester and Bauman 2013, Wardynski et. al. 2014, Zeiger and Hubbert 2015). Studies that evaluated stormwater discharges over weekly averaging periods did not indicate exceedances above biologically based critical thresholds (Wardynski et. al. 2014, WDOE 2011a and 2011b).

Based on the literature review of stormwater runoff and stream temperature summarized above the EPA determined that municipal stormwater discharges from non-permitted MS4s do not contribute to the exceedance of the temperature water quality criteria. Therefore, existing program measures to control temperature impacts are expected to be sufficient. If any new or additional data become available and indicate that any of the municipal stormwater discharges are a significant source of thermal loading, then the EPA or Oregon DEQ may access a portion of the HUA reserve allocation within the appropriate reach to explicitly account for discharge from stormwater.

Even though stormwater discharges from small non-permitted MS4s are not a temporally consequential source of thermal loading, Oregon DEQ has a procedure for non-permitted MS4s to meet Water Quality Management Plan (WQMP) requirements (DEQ Procedure 2022-03, 2022). The existing Umpqua Basin WQMP, established with the 2006 Umpqua Basin TMDL project, identified the incorporated cities in Douglas County and Douglas County as Designated Management Agencies (DMA). These cities are implementing stormwater best management practices (e.g., incentivize riparian area restoration, onsite stormwater treatment) that broadly protect and improve water quality and have specific strategies to enhance municipal forest canopy, especially in riparian areas, which promotes cooler stormwater runoff and instream water (S. Sauter, personal communication, May 15, 2024).

Nonpoint Sources

Sections 7.1.4 through 7.1.9 describe the nonpoint sources of thermal loading to rivers and streams in the Umpqua Basin. Sections 7.1.5 to 7.1.9 summarize the thermal loading, from applicable sources, for modeled representative reaches across the basin.

7.1.4 Dam and Reservoir Operation

Dam and reservoir operations contribute to nonpoint source thermal loads that increase stream temperature in the Umpqua Basin. The impacts of dams are complex and variable; dams can result in cooler or warmer downstream temperatures, depending on time of year, thermal stratification, dam size, and dam operations.

Dams change the hydrologic regime of rivers, and these changes can have impacts on river temperatures, depending on time of year and dam operations. Impoundments can cause higher, sustained river temperatures in the summer, higher temperatures at the water surface and in fish ladders, and delayed cooling in the fall. Storage reservoirs, on the other hand, may reduce downstream temperatures during the early summer. The typical purpose for storage dams is to create a reservoir that will attenuate flood flows and store spring runoff. The stored water is then released when the reservoir is at capacity or to augment stream flows during the summer months and/or early fall, and to produce hydroelectric power. Run-of-river dams are generally lower in height and create smaller reservoirs. Run-of-river dams pass the river flow entering the reservoir and maintain a constant, elevated water surface elevation (termed "head") to provide hydroelectric power. The release of water from many reservoirs modifies the downstream natural temperature patterns during the late summer to early fall, and during the spring and early summer. Deep reservoirs with temperature control structures can be used to release cold water and reduce temperatures over substantial distances downstream.

USGS evaluated the thermal effects of 14 dams in the Willamette River Basin and found that dams have a substantial and measurable effect on downstream streamflow and water temperature (Rounds, 2010). Since the Willamette River Basin and Umpqua Basin have some similar characteristics, the findings from this study, as well as the Holzer and Fairbairn studies below, are useful to characterize the Umpqua Basin as well. The modified temperature pattern occurs because large, tall dams are often constructed with release outlets at a mid-depth or near the bottom of the structure. Releases of cold water from lower in the water column results in summer waters that tend to be colder than they would be without dams. Later in the fall, these large dams release large quantities of stored water to make room for flood storage. This stored surface water has been exposed and has accumulated heat all summer. When released downstream the waters increase warming during a period where, without the presence of the dam, a river would be cooler because of shorter days, cooler air temperatures, and shallower depths. Figure 44 illustrates this late summer early fall temperature pattern for the Galesville Dam in the South Umpqua basin. Conversely, colder winter waters are released during the spring and early summer when inflows from upstream tributaries are often warmer than waters stored in the reservoir. USGS concluded that the thermal effects of the dams are greatest at the dam sites, where the 7DADM temperatures are as much as 6 to 10 °C cooler or warmer compared to what would occur without the dams. Downstream, the effects decrease, but are still in the 0.5 to 1.0 °C range near the mouth of the Willamette River (Rounds, 2010).

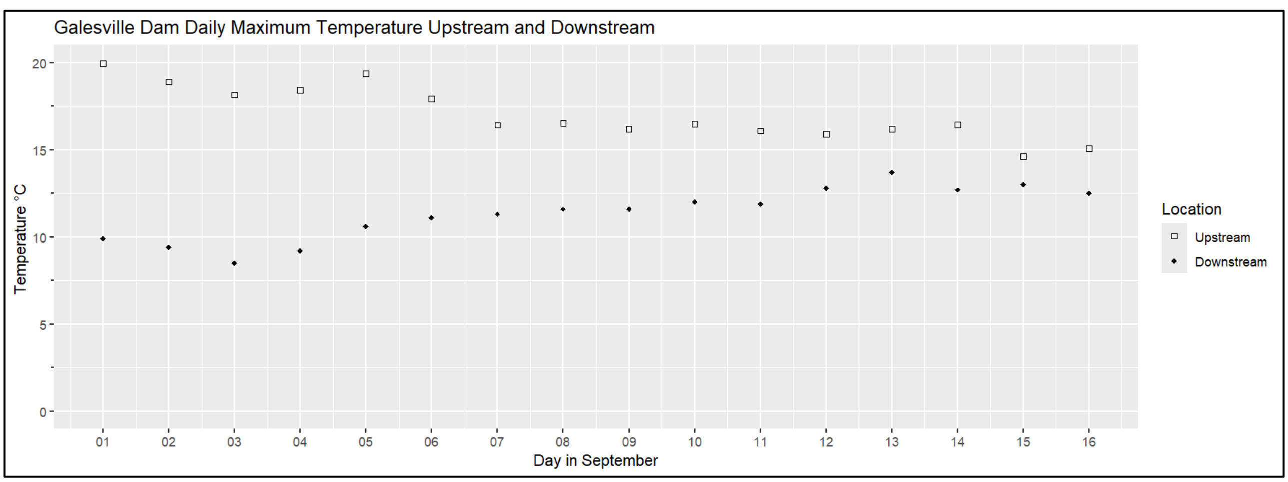

Figure 44 Galesville Dam Effects on Upstream and Downstream Temperatures

In the Lower Willamette Subbasin, multiple studies have examined the thermal impacts of in-channel ponds on water temperature and found that human-built in-channel ponds showed trends on raising downstream temperature (Holzer, 2020; Fairbairn, 2022). For example, Holzer (2020) demonstrated that most in-channel ponds increased the amount of time that a stream segment exceeded the temperature standard by several weeks. Fairbairn (2022) found that human constructed ponds in the Johnson Creek (n=14), Columbia Slough (n=1) and Sandy River (n=2) Watersheds increased median 7DADM stream temperatures by -1.0 to 6 degrees Celsius. Nine of the seventeen human constructed in channel ponds raised the median 7 Day Average Daily Maximum stream temperature by greater than 1 degree Celsius. Similar stream temperature changes may be expected in the Umpqua Basin, as well as other basins in Oregon.

There are currently 50 dams in the Umpqua Basin, as identified by the National Inventory of Dams and the Oregon Water Resources Department Dam Inventory Query (Figure 45). All of these dams are considered large dams, as they have a dam height of 10 feet or more and store at least 9.2 acre-feet (ac-ft) of water (OWRD). One dam, the Galesville dam, has a dam height above 150 feet. In the North Umpqua Subbasin, there is a 194-MW Hydroelectric Project that consists of 8 dams (PacifiCorp, 2024).

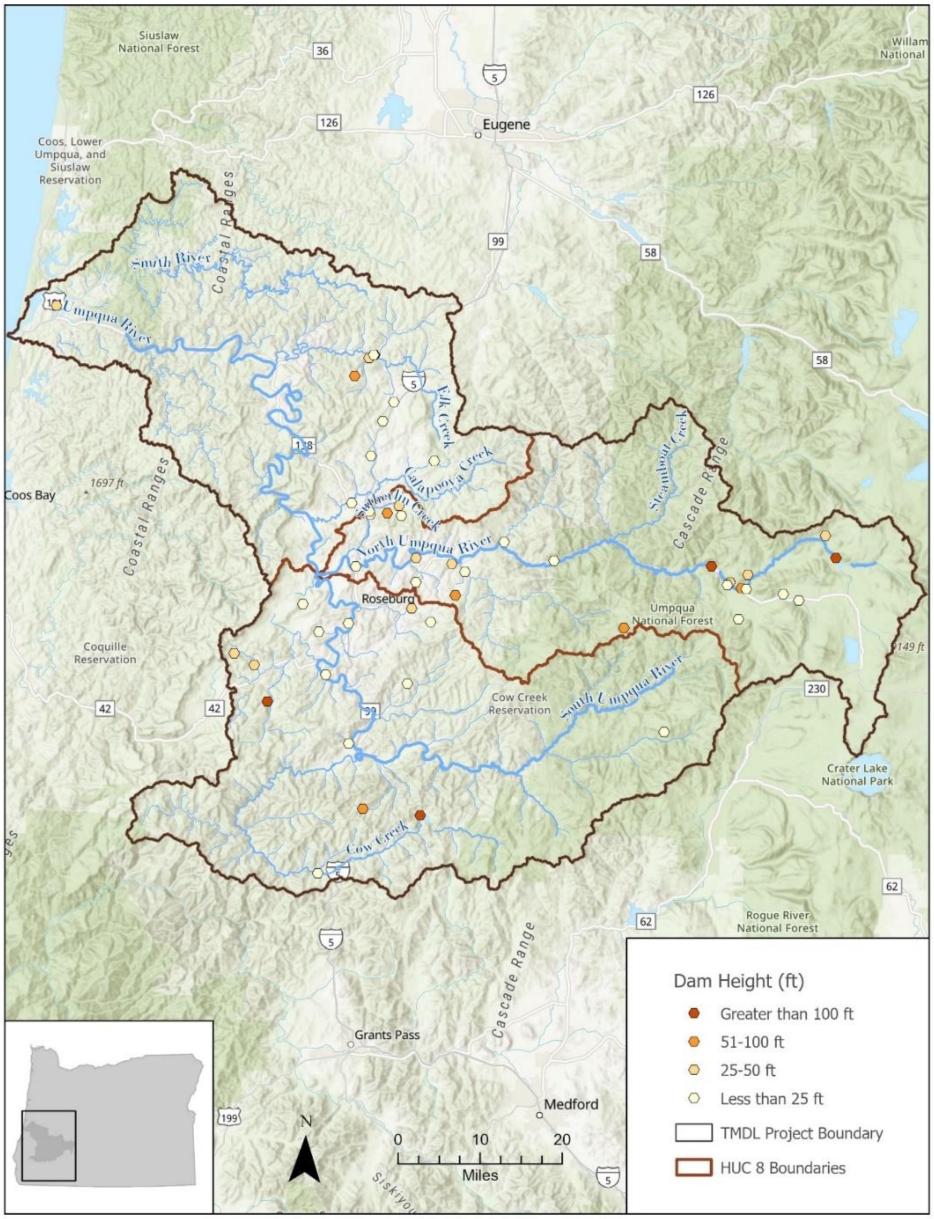

Figure 45 Location of dams in the Umpqua Basin

North Umpqua Hydroelectric Project

In the 2006 Umpqua Basin Temperature TMDL project, Oregon DEQ evaluated the impacts of PacifiCorp's hydroelectric project on the North Umpqua River. Highlights from the 2006 analysis are summarized here.

PacifiCorp's hydroelectric project was found to be responsible for elevated stream temperature. The hydroelectric project relies upon several large diversions that reduce flow volume within the bypass reach (i.e. the natural stream channel below the diversion). Small flow volumes are more sensitive to solar heating and therefore stream temperatures warm rapidly within the bypass reaches. Modeling conducted for the 2006 TMDL project included a "Flow Only" scenario where vegetation reflected the current conditions and estimated “natural” flows were used (assuming no dams, withdrawals, or diversions) this simulation resulted in cooler stream temperatures throughout the river system (2006 TMDL, page 3-23). The 2006 TMDL project also considered a modeling scenario that employed the minimum flow requirements in the facility’s 401 certification. While the minimum bypass flows in the 401 certification are considerably less than the estimated “natural” flows, the bypass flows do support cooler instream temperatures as compared to the 2006 TMDL project current conditions flows (2006 TMDL Appendix 2, page 50). These minimum bypass flows are still a requirement in the facilities current 401 certification and applicable in this TMDL project’s analysis (DEQ issued 401 Certification December 13, 2022, FERC Project No. 1927).

This TMDL project’s modeling analyses also included a scenario (“no dam”) to evaluate thermal impacts related to the dam complex. In all the modeled reaches the dams have a warming effect on the river meaning the current condition scenario simulates warmer water temperatures as compared to the no dam scenario (details in Appendix G). Although, the stream temperature warming is below the applicable criteria for all reaches upstream of the Soda Springs powerhouse. In the model reach below the Soda Springs powerhouse, stream temperatures greater than the spawning criterion are observed downstream in the North Umpqua River. The point of maximum impact (river km 38.10) was 2.9 °C observed in early September (Figure 46).

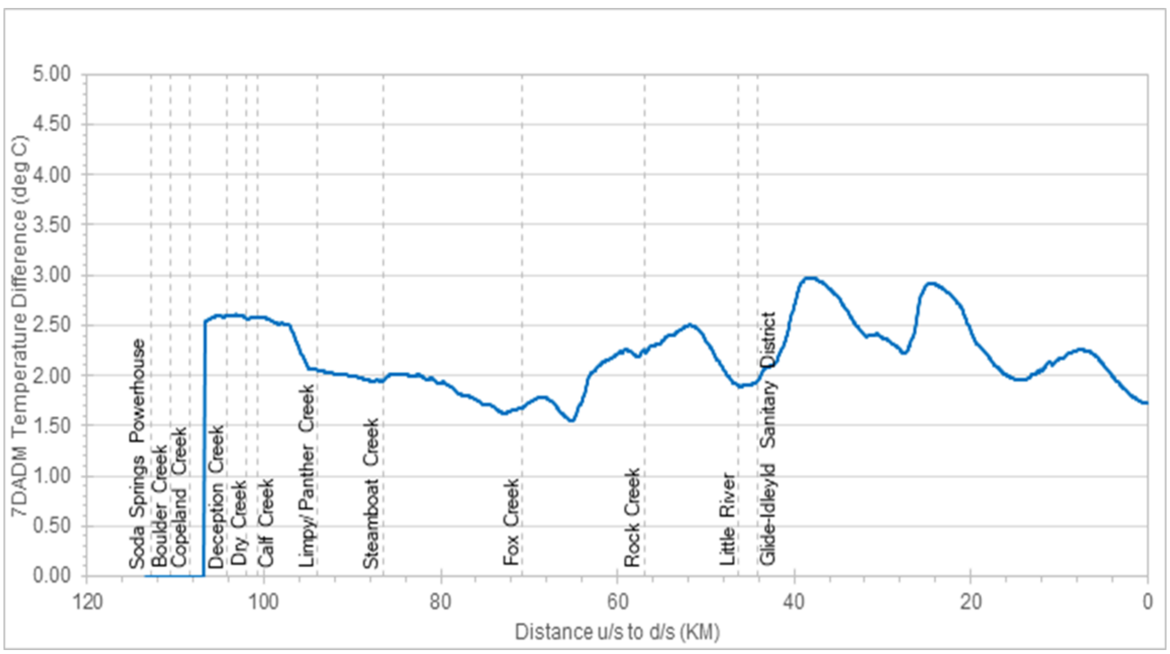

Figure 46 North Umpqua River simulated 7DADM temperature changes above the applicable criterion downstream of dam complex, maximum observed in September.

7.1.5 Riparian Habitat Removal

Riparian buffers are vegetated zones aligning a stream or wetland, typically containing a combination of trees, shrubs, and/or other perennial plants. Riparian areas are naturally occuring and are often utilized as a best management practice to improve the water quality of adjacent waters when they have become degraded. Riparian vegetation, and more specifically, riparian forest buffers, can provide shade, reducing the impacts of thermal loading from solar radiation on a stream. Solar radiation is the general term for electromagnetic radiation that is produced by the sun, which can provide a significant thermal load to stream through heat transfer processes. Appendix C (pages 3 – 6) describes heat transfer and the impacts of solar radiation on stream temperatures in greater detail.

The effects of riparian vegetation on shade and stream temperature have been studied extensively, and it is generally accepted that removing trees in riparian areas reduces the amount of shade which leads to increases in solar radiation loading to the stream (Groom et al 2011, Moore et al 2005). Increased solar radiation resulting from vegetation removal is generally the dominant component of the energy budget in terms of heat gain (Caissie 2006, Johnson, 2004). Appendix C describes thermal loading and the impact of riparian removal on stream temperature in more detail.

The removal or modification of trees in riparian areas can affect the spatial extent, duration, and quality of shade on a stream. Forest harvesting and other riparian removal activities may result in the narrowing or thinning of buffers. Studies analyzed in Appendix C found a correlation between stream temperatures increasing at a greater rate as buffer widths became smaller. Studies also indicated that riparian thinning actions can result in increased stream temperature, and that those effects depend on the intensity, scale, and spatial proximity of treatments to the stream.

The Heat Source model was used to evaluate current shade conditions for modeled reaches in the Umpqua basin. Figure 47 presents current shade as a percentage of shade that is possible for current vegetation conditions in the Umpqua basin. The low elevation plain of the Umpqua valley has the least amount of current shade and in the upper reaches of the North and South Umpqua Rivers there is considerably more established vegetation providing existing shade. Likewise, the shade targets (potential natural vegetation) are highest in the upper North and South Umpqua River subwatersheds and become lower as the river widens and natural topographic and vegetative transitions occur (Figure 48).

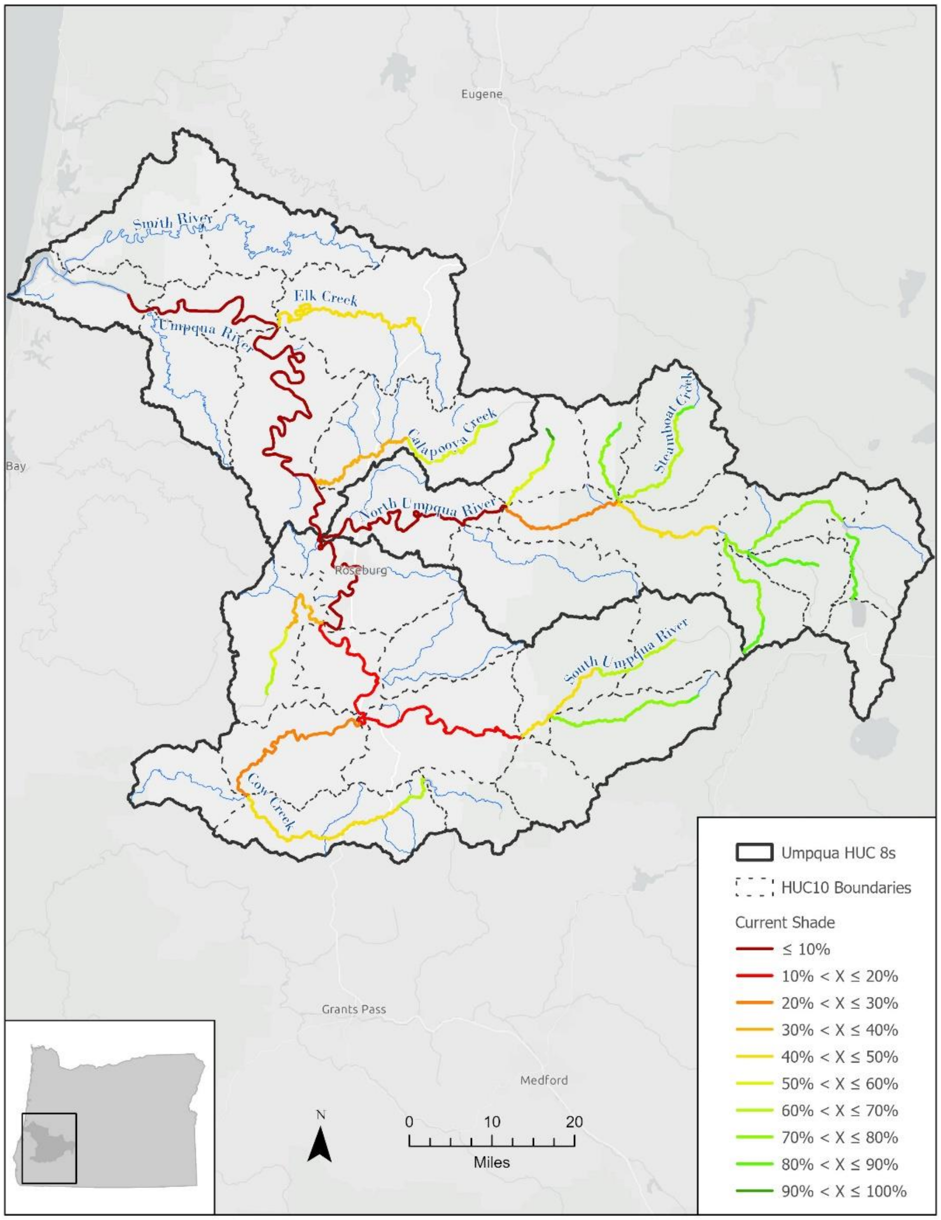

Figure 47 Current shade conditions on modeled assessment units.

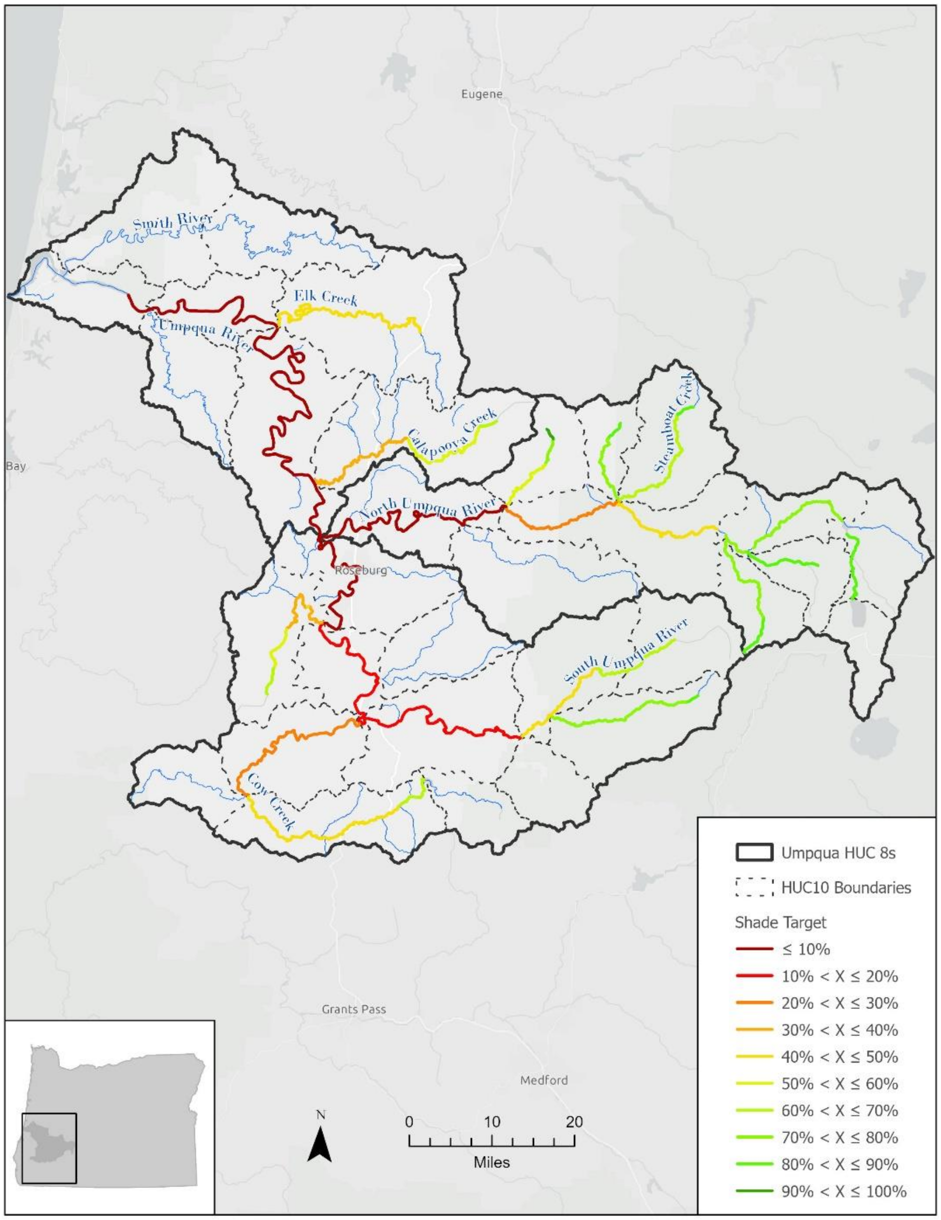

Figure 48 Target shade conditions on modeled assessment units.

As outlined in detail in Appendix C, field and modeling studies over the past several decades have demonstrated that shade loss is minimal when the retained buffer widths were greater than 110 feet, and stream temperature increase were not occurring when retained forest buffer widths were 120 feet. For these reasons EPA determined that a vegetation buffer width based on a slope distance of 120 feet would be sufficient in almost all cases to have no stream warming and therefore attain the TMDL shade targets.

The removal or modification of trees in riparian areas results in a calculable change on stream temperatures in the Umpqua basin. The table below presents the calculated maximum 7DADM water temperature increase above the applicable criteria associated with existing streamside vegetation removal/modification on representative modeled streams (Table 26). The calculated maximum temperature increase values are the difference between current condition streamside vegetation and fully restored conditions. See Appendix G for additional information.

Table 26 7DADM temperature increases above the applicable criteria associated with streamside vegetation reduction or removal during the summer and spawning periods.

Subbasin	Stream	Max Temp. increase (°C)	Point of max. impact (river km)	Max Temp. increase (°C)	Point of max. impact (river km)
		Summer		Spawning Period	
North Umpqua	Lake Creek	2.5	13.15	6.97	13.0
	Fish Creek	1.5	9.20	0	NA
	Clearwater Creek	0	NA	0	NA
	North Umpqua (downstream Lemolo Lake)	0	NA	0	NA
	North Umpqua (upstream Toketee Lake)	0	NA	0	NA
	North Umpqua (downstream Toketee Lake)	0	NA	0	NA
	North Umpqua (upstream Soda Springs Reservoir)	0	NA	0	NA
	North Umpqua (downstream Soda Springs Reservoir to Steamboat Creek)	0.1	21.9	0.5	42.7
	Steamboat Creek	1.83	4.45	5.5	5.5
	Canton Creek	2.70	12.45	3.9	3.3
	Rock Creek	3.90	14.60	2.3	11.8
	North Umpqua (Steamboat to mouth)	0.39	33.60	0.5	42.7
South Umpqua	Cow Creek	2.0	31.9	Not modeled	
	South Umpqua	1.6	128	1.8	123.8
Umpqua	Calapooya	3.3	55.7	Not modeled	
	Elk	3.7	41.6	Not modeled	
	Jackson	2.8	0	Not modeled	
	Olalla	2.9	22.2	Not modeled	
	Umpqua	0.1	98.05	Not modeled	
Note: a zero (0) value for maximum temperature increase means there was no temperature increase above the applicable criteria					

7.1.6 Channel Modification & Widening

Channel modification activities include projects that straighten, widen, and/or deepen/dredge stream channels. Projects may be undertaken for a variety of reasons such as flood control, sediment control, infrastructure protection, mining, and habitat improvement (Watson, 1999). Channel modification that results in channel widening can increase stream temperatures due to increased solar radiation exposure as a result of increased width to depth ratios. In addition, widened streams have also been shown to result in greater diurnal temperature extremes (O'Briain, 2017). Alternatively, narrowing channel widths back to pre-disturbance levels was shown through a water quality modeling assessment of several streams in the Upper Grande Ronde basin to result in reduced stream temperature, ranging from 0.6 to 2.2 °C (White. 2017).

The 2006 Umpqua Temperature TMDL project determined that one section of Cow Creek (river mile 50 – 41) had unusually wide channels, resulting possibly from human activities such as agriculture, road development, and/or reservoir operations (Figure 49). Specifically, channel widths are up to five times wider within this reach than other areas upstream and downstream. This is the only reach in the Umpqua basin that was identified in the 2006 Umpqua Temperature TMDL project as having considerably wider channel widths than what would be naturally expected.

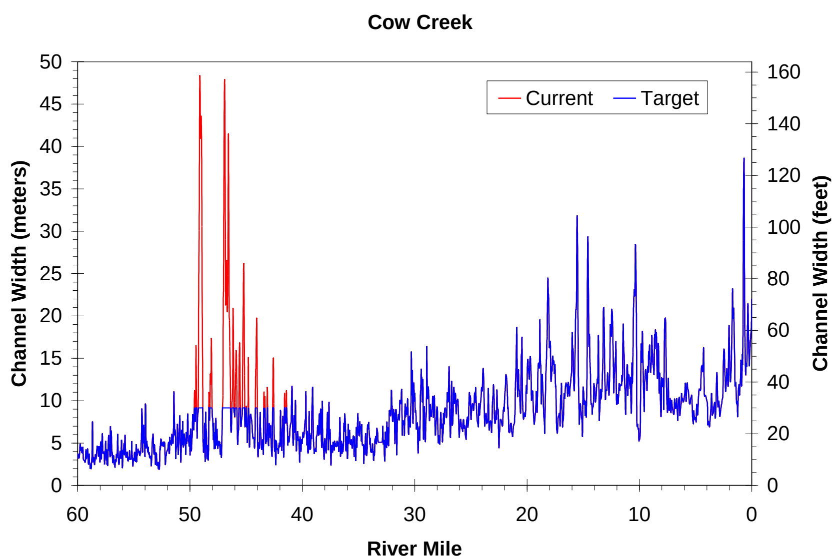

Figure 49 From the 2006 TMDL: Figure 3.16 Cow Creek channel widths.

7.1.7 Modifications To Flow/Discharge

Temperature is the metric used to measure the concentration of heat energy in water. An important variable determining how hot or cool the water is within a stream depends upon how much (i.e., the volume) water is present in the stream (Poole and Berman, 2001). Specifically, the same amount of heat energy in a smaller volume of water produces a hotter measured temperature whereas the same amount of heat energy in a larger volume of water produces a cooler temperature; processes or actions that alter the stream discharge will likely influence changes in stream temperature. Therefore, stream temperature is dependent on both the heat energy in the stream and the volume of the stream. Stream temperature response to changes in energy additions is often greater at low stream flow conditions due to the relatively lower water volume in the stream (Poole and Berman, 2001). Water withdrawals are often needed for municipal water supplies, agriculture, and/or industry and reduce flow in the stream, which also reduces the assimilative capacity of streams. The table below characterizes the calculated maximum 7DADM water temperature increase above the applicable criteria associated with flow modifications on representative modeled streams (Table 27). The calculated maximum temperature increase values are the difference between the background scenario (includes dam and water withdrawal) and natural flow scenario (i.e. no dams and/or water withdrawals). See Appendix G for additional information.

Table 27 7DADM temperature increases above the applicable criterion associated with flow modifications.

Subbasin	Stream	Temp. increase (°C)	Point of max. impact (river km)
North Umpqua	Fish Creek	1.8	0.6
	Clearwater Creek	0	NA
	North Umpqua (downstream Lemolo Lake)	0	NA
	North Umpqua (upstream Toketee Lake)	0	NA
	North Umpqua (downstream Toketee Lake)	0	NA
	North Umpqua (upstream Soda Springs Reservoir)	0	NA
	North Umpqua (downstream Soda Springs Reservoir to Steamboat Creek)	1.4	21.7
	North Umpqua (Steamboat to mouth)	0.3	1.7
South Umpqua	Cow Creek	0.12	33.6
	South Umpqua	0.87	4.5
Umpqua	Calapooya	1.75	7.1
	Jackson	0	NA
	Olalla	1.0	9.3
	Umpqua	0.3	125.3
Note: a zero (0) value for maximum temperature increase means there was no temperature increase above the applicable criteria			

7.1.8 Effects of Climate Change

Appendix D provides a literature synthesis examining the role of climate change in increasing stream temperatures in Oregon. In general, stream temperatures across Oregon have demonstrated an increasing trend. The publications reviewed report stream temperature trends ranging from +0.5 to +0.27 C° per decade on unregulated streams and -0.48 to +0.52 C° per decade on regulated streams over the last 30 years. Appendix D presents a wide range of studies of information for Oregon; however, river systems and their heat budges are heterogeneous and complex. Therefore, estimates of climate change impacts on ambient water temperature require rigorous site-specific analyses. A site-specific study was not conducted for this TMDL project, but a growing body of scientific research continues to indicate that climate change is a contributing factor to increased stream temperatures in the Umpqua basin.

7.1.9 Background Nonpoint Sources

The thermal loading a stream receives is influenced by several landscape and meteorological factors, such as substrate and channel morphology conditions, streambank and channel elevations, near-stream vegetation, groundwater, hyporheic flow, tributary inflows, precipitation, cloudiness, air temperature, relative humidity, and others. Many of these factors are influenced by anthropogenic actions and several of these are not quantified in the models and are aggregated in the background model scenario (Appendix G). The results from modeling delineable sources (e.g., point sources, vegetation alterations, channel alterations, flow alterations, dams and reservoirs) of thermal loading indicate that background sources contribute to exceedances of the applicable temperature criteria. Reductions from these background will be necessary to attain the applicable temperature criteria. Temperature increases from background sources on representative modeled streams are summarized below (Table28).

Table 28 7DADM temperature increases associated with background nonpoint sources.

Subbasin	Stream	Temp. increase (°C)	Point of max. impact (river km)
North Umpqua	Lake Creek	3.20	17.1
	Fish Creek	1.1	0.2
	Clearwater Creek	0	NA
	North Umpqua (downstream Lemolo Lake)	0	NA
	North Umpqua (upstream Toketee Lake)	0	NA
	North Umpqua (downstream Toketee Lake)	0	NA
	North Umpqua (upstream Soda Springs Reservoir)	0	NA
	North Umpqua (downstream Soda Springs Reservoir to Steamboat Creek)	1.7	0.5
	Steamboat Creek	8.7	23.05
	Canton Creek	6.5	10.5
	Rock Creek	4.9	5.93
	North Umpqua (Steamboat to mouth)	8.5	0.3
South Umpqua	Cow Creek	7.2	5.3
	South Umpqua	10.3	83.7
Umpqua	Calapooya	11.0	28.2
	Elk	10.4	44.5
	Jackson	7.5	0.9
	Olalla	12.5	4.9
	Umpqua	9.7	23.65
Note: a zero (0) value for maximum temperature increase means there was no temperature increase above the applicable criteria.			

8 Loading Capacity

The loading capacity is defined as the greatest amount of loading that a waterbody can receive without violating water quality standards (40 CFR 130.2(f)). The allowable thermal loading (kcal/day) is calculated according to the Equation 3. Loading capacity was evaluated under critical conditions (i.e., low flow) to ensure beneficial uses are protected; the 7Q10 was used as the critical low flow to calculate the loading capacities presented in Table 29. Although, thermal loading capacity is dynamic and will change with river flow, as flow increases the loading capacity will also increase. Thus, Equation 3 can be used to calculate loading capacity under various flow conditions by substituting a different value for Q_R. Equation 3 may also be used to calculate load loading capacity in the future the applicable temperature criteria are updated and approved by EPA.

$$LC = (T_C + HUA) \cdot Q_R \cdot C_F$$ **Equation 3**

where,

$LC =$ Loading Capacity (kcal/day), expressed as a rolling seven-day average.

$T_C =$ The applicable river temperature criterion (°C).

$HUA =$ The 0.30°C Human Use Allowance allocated to point sources, nonpoint sources, margin of safety, or reserve capacity.

$Q_R =$ The daily mean river flow rate (cfs). When river flow is <= 7Q10, Q_R = 7Q10. When river flow > 7Q10, Q_R is equal to the daily mean river flow.

$C_F =$ Conversion factor using flow in cubic feet per second (cfs): 2,446,665

$$\left(\frac{1\ \text{m}}{3.2808\ \text{ft}}\right)^3 \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{86400\ sec}{1\ day} \cdot \frac{1\ kcal}{1\ kg\ \cdot 1°\text{C}} = 2{,}446{,}665$$

The map below presents locations where loading capacity was calculated (Figure 50). These locations are spatially distributed across all three HUC 8 basins of the Umpqua watershed.

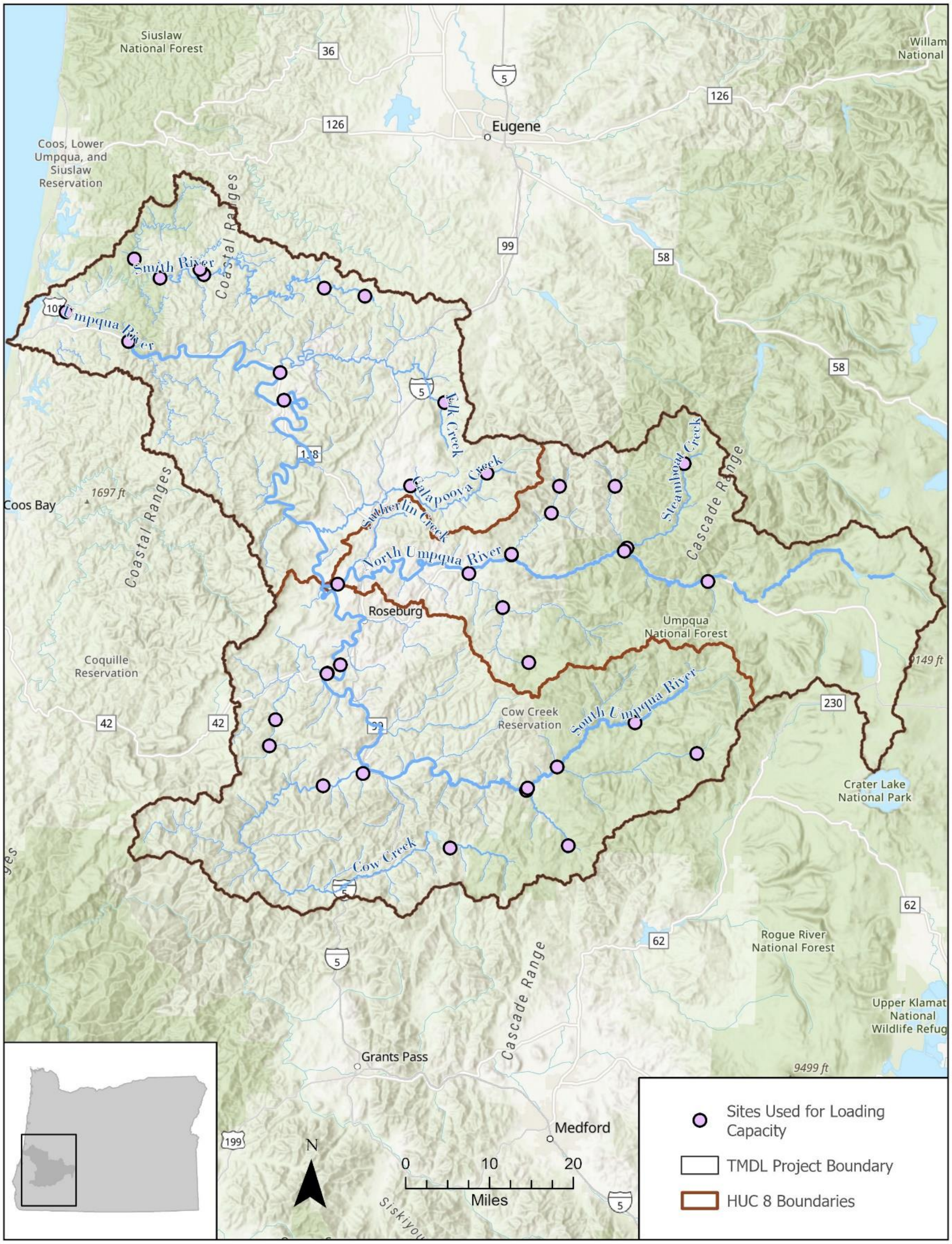

Figure 50 Representative monitoring location where loading capacity was calculated in the Umpqua Basin.

Table 29 presents loading capacity for representative assessment units calculated at the 7Q10 flow using Equation 1. These daily loading capacities represent the total maximum daily loads available for allocation for these assessment units. Equation 3 shall also be used to calculate thermal loading capacity for any assessment unit in the Umpqua basin not presented in Table 29, as necessary. In cases when two year-round temperature criteria apply to the same assessment unit, the more stringent criteria shall be used to determine loading capacity.

Table 29 Loading capacity calculated for representative assessment units in the Umpqua Basin.

			Criteria			
AU Name	**AU ID**	**Annual 7Q10 (cfs)**	**Year Round + HUA**	**Spawn + HUA**	**7Q10 LC Year Round (kcal/day)**	**7Q10 LC Spawn (kcal/day)**
Calapooya Creek	OR_SR_1710030301_02_105442	2.0	18.3	13.3	9.13E+07	6.64E+07
Calapooya Creek	OR_SR_1710030301_02_105443	1.6	18.3	13.3	7.12E+07	5.17E+07
Canton Creek	OR_SR_1710030106_02_105331	1.5	16.3	13.3	5.90E+07	4.82E+07
Canton Creek	OR_SR_1710030106_02_105332	7.0	16.3	13.3	2.81E+08	2.29E+08
Cavitt Creek	OR_SR_1710030110_02_105363	4.2	16.3	13.3	1.68E+08	1.37E+08
Cavitt Creek	OR_SR_1710030110_02_105364	1.3	16.3	13.3	5.06E+07	4.13E+07
Cow Creek	OR_SR_1710030206_02_105417	4.8	18.3	13.3	2.17E+08	1.58E+08
Cow Creek	OR_SR_1710030209_02_106367	30.2	18.3	13.3	1.35E+09	9.81E+08
Elk Creek	OR_SR_1710030204_02_105390	2.5	18.3	13.3	1.13E+08	8.20E+07
Elk Creek	OR_SR_1710030204_02_105391	0.2	18.3	13.3	1.04E+07	7.58E+06
Elk Creek	OR_SR_1710030303_02_105453	0.1	18.3	13.3	4.28E+06	3.11E+06
Elk Creek	OR_SR_1710030303_02_106420	2.8	18.3	13.3	1.25E+08	9.08E+07
Jackson Creek	OR_SR_1710030202_02_105378	13.0	16.3	13.3	5.18E+08	4.23E+08
Jackson Creek	OR_SR_1710030202_02_105379	2.6	16.3	13.3	1.03E+08	8.40E+07
Lookingglass Creek	OR_SR_1710030212_02_105090	5.1	18.3	13.3	2.30E+08	1.67E+08
North Fork Smith River	OR_SR_1710030307_02_105187	7.0	18.3	13.3	3.12E+08	2.26E+08
North Umpqua River	OR_SR_1710030108_02_105339	633.6	16.3	13.3	2.53E+10	2.06E+10
North Umpqua River	OR_SR_1710030108_02_105340	606.0	16.3	13.3	2.42E+10	1.97E+10
North Umpqua River	OR_SR_1710030108_02_105342	617.0	16.3	13.3	2.46E+10	2.01E+10
North Umpqua River	OR_SR_1710030111_02_105365	661.0	16.3	13.3	2.64E+10	2.15E+10
North Umpqua River	OR_SR_1710030111_02_106415	669.2	16.3	13.3	2.67E+10	2.18E+10
Olalla Creek	OR_SR_1710030212_02_105091	0.2	18.3	13.3	9.63E+06	7.00E+06
Olalla Creek	OR_SR_1710030212_02_105094	0.8	18.3	13.3	3.62E+07	2.63E+07
Rock Creek	OR_SR_1710030109_02_105345	5.8	16.3	13.3	2.30E+08	1.87E+08
Rock Creek	OR_SR_1710030109_02_105346	1.5	16.3	13.3	5.94E+07	4.85E+07
Rock Creek	OR_SR_1710030109_02_105347	16.1	16.3	13.3	6.42E+08	5.24E+08
Smith River	OR_SR_1710030306_02_105167	3.0	18.3	13.3	1.33E+08	9.63E+07
Smith River	OR_SR_1710030306_02_105175	0.0	18.3	13.3	1.71E+06	1.24E+06
Smith River	OR_SR_1710030306_02_105180	0.2	18.3	13.3	1.11E+07	8.04E+06
Smith River	OR_SR_1710030307_02_105196	6.0	18.3	13.3	2.69E+08	1.95E+08
South Umpqua River	OR_SR_1710030201_02_105374	16.4	16.3	13.3	6.54E+08	5.34E+08

			Criteria			
AU Name	**AU ID**	**Annual 7Q10 (cfs)**	**Year Round + HUA**	**Spawn + HUA**	**7Q10 LC Year Round (kcal/day)**	**7Q10 LC Spawn (kcal/day)**
South Umpqua River	OR_SR_1710030203_02_105389	31.1	16.3	13.3	1.24E+09	1.01E+09
South Umpqua River	OR_SR_1710030205_02_106333	57.0	16.3	13.3	2.27E+09	1.85E+09
South Umpqua River	OR_SR_1710030211_02_105320	120.0	18.3	13.3	5.37E+09	3.90E+09
South Umpqua River	OR_SR_1710030213_02_105102	56.6	18.3	13.3	2.54E+09	1.84E+09
Steamboat Creek	OR_SR_1710030107_02_105334	7.5	16.3	13.3	2.98E+08	2.43E+08
Umpqua River	OR_EB_1710030307_01_107227	12.1	18.3	NA	5.42E+08	NA
Umpqua River	OR_SR_1710030302_05_105126	820.4	16.3	13.3	3.27E+10	2.67E+10
Umpqua River	OR_SR_1710030304_05_105153	999.0	18.3	NA	4.47E+10	NA
West Fork Smith River	OR_SR_1710030307_02_105197	2.3	18.3	NA	1.03E+08	NA

9 Allocations

As presented in Section 8, the loading capacity, or the portion of thermal load available for allocation during the critical period (May 1st – October 31st) is determined by the numeric temperature criteria and the HUA of 0.3 °C increase above the temperature criteria. TMDLs include wasteload allocations (WLA) and load allocations (LA) that identify the portion of the loading capacity allocated to existing or future pollutant sources. WLAs are assigned to point sources and LAs are assigned to nonpoint sources. The 0.3°C HUA is the cumulative allowable thermal loading above the numeric criteria and apportioned among various individual sources or source categories. The assigned HUA allowance is used to directly calculate a facility or operation's thermal WLA and/or LA.

For this TMDL project, EPA's general approach to point source allocations was to assign an equal portion of the HUA (0.1 °C) at the point of discharge. This HUA of 0.1 °C for point sources was selected because it is consistent with the approach in Oregon DEQ's 2006 Umpqua Basin Temperature TMDL project and existing NPDES permit limits are based on this amount of allowable thermal loading. Moreover, modeling and analyses conducted for this TMDL project still confirm that the 0.1 °C HUA assignment to point sources will meet regulatory requirements. The NPS categories of 1) water management activities and water withdrawals and 2) solar loading from existing infrastructure (e.g., transportation, buildings, utility easements) were each allotted 0.05 °C thermal loading. Dams and activities associated with the North Umpqua Hydroelectric Project were allotted 0.225°C thermal loading in the upper North Umpqua basin. Thermal loading from all other nonpoint source sectors was allocated zero (0) degrees Celsius of thermal warming. A HUA allowance of 0.0°C means there may be no allowable warming above the applicable temperature criteria and results in a zero load allocation per Equation 6. Finally, an explicit HUA assignment of 0.1°C was allotted to reserve capacity to provide for new or increased loads from point or nonpoint sources or to correct any assignments to existing sources that either were not identified during the development of this TMDL project or given an erroneous allocation. The assignment of 0.1 °C to reserve capacity is consistent with the ODEQ 2006 Umpqua Basin Temperature TMDL project.

Human Use Allowance

Oregon's EPA-approved water quality standards have a provision entitled "human use allowance" (HUA) (OAR 340-041-0028(12)(b)(B)) which expressly authorizes a small increase in thermal loading for human uses. The rule requires that wasteload and load allocations restrict all NPDES point sources and nonpoint sources to a cumulative increase of no greater than 0.3 °C (0.5 °F) above the applicable criteria after complete mixing in the waterbody, and at the point of maximum impact (POMI). EPA assigned a thermal load equivalent to 0.3 °C (including a reserve capacity) to human sources in all subbasins within the Umpqua Basin (Tables 30 - 32 and figure 48). The assigned portion of the HUA represents the maximum allowable cumulative warming in the waterbody at the point of maximum impact from all point and nonpoint source activities within each source category. Due to heat dissipation, it is expected that the warming from any individual point source or nonpoint source activity will be less than the value shown in Tables 30 to 32. Modeling results from the attainment scenario demonstrates that the apportionment of 0.3 ^{o}C HUA to various subbasins within the total spatial area of the Umpqua Basin will not cause a cumulative exceedance of 0.3 ^{o}C at any location.

Tables 30 through 32 and Figure 51 present the assigned portion of the human use allowance to anthropogenic source categories and reserve capacity across HUC 10s and assessment units in the Umpqua Basin. Table 32 contains the HUA assignments for each HUC 10 not specifically identified in Tables 30 and 31. The HUA assignments in Table 32 apply to each HUC 10 in the Umpqua Basin not specifically identified in Table 30 and 31 and are not cumulative for all HUC 10s not specifically identified. The Rock Creek, Upper North Umpqua, and Clearwater River HUCs contain sources that require unique HUA assignments and are provided in separate tables (Table 30 and 31). The dam and reservoir operations source category accounts for nonpoint source temperature impacts associated with the dam impoundment and release of the impounded water back into the natural channel. The water management activities and water withdrawals source category accounts for nonpoint source temperature impacts associated with the withdrawal of water that is intended for consumptive uses (such as irrigation) and the warming that might occur as that water moves through a canal or ditch before being returned to the natural river.

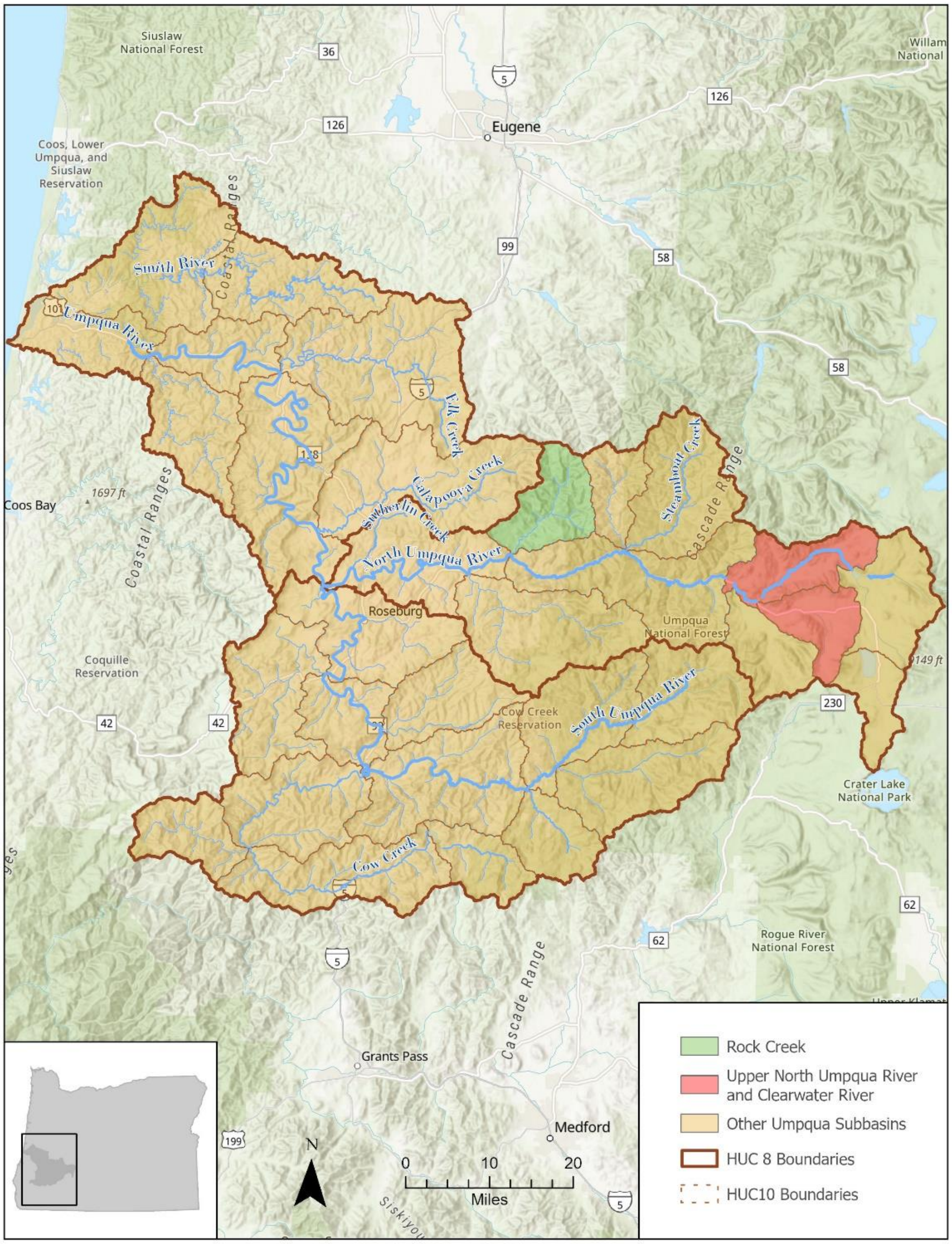

Figure 51 Subwatersheds with specific and general human use allowances in the Umpqua Basin.

Table 30 Human Use Allowance assignments for the Upper North Umpqua and Clearwater River subwatershed

Upper North Umpqua and Clearwater River subwatershed: (HUC 1710030105, Assessment Units: OR_SR_1710030105_02_105819, OR_SR_1710030105_02_105820, OR_LK_1710030105_02_100183 and HUC: 1710030103, Assessment Unit: OR_WS_171003010304_02_105639)	
Source or Source Category	**Portion of the HUA (°C)**
NPDES point sources	0.075
Water management and water withdrawals	0.0
Solar loading from existing infrastructure (e.g., transportation, buildings, utility easements)	0.0
Solar loading from other NPS source categories	0.0
Dam and reservoir operations (North Umpqua Hydroelectric Project)	0.225
Reserve capacity	0.0
Total	**0.3**

Table 31 Human Use Allowance assignments for the Rock Creek subwatershed

Rock Creek subwatershed: (HUC 1710030109, Assessment Units: OR_SR_1710030109_02_105343, OR_SR_1710030109_02_105344, OR_SR_1710030109_02_105345, OR_SR_1710030109_02_105346, OR_SR_1710030109_02_105347, OR_SR_1710030109_02_105348, OR_SR_1710030109_02_105349, OR_SR_1710030109_02_105350)	
Source or Source Category	**Portion of the HUA (°C)**
Rock Creek Fish Hatchery	0.3
Other NPDES point sources	0.0
Water management and water withdrawals	0.0
Solar loading from existing infrastructure (e.g., transportation, buildings, utility easements)	0.0
Solar loading from other NPS source categories	0.0
Dam and reservoir operations	0.0
Reserve capacity	0.0
Total	**0.3**

Table 32 Human Use Allowance assignments for each remaining other Umpqua HUC 10 watershed

Other Umpqua subbasins: HUA assignments for each HUC 10 not specifically identified in another table.	
Source or Source Category	**Portion of the HUA (°C)**
NPDES point sources	0.1
Water management and water withdrawals	0.05
Solar loading from existing infrastructure (e.g., transportation, buildings, utility easements)	0.05
Solar loading from other NPS source categories	0.0
Dam and reservoir operations	0.0
Reserve capacity	0.1
Total	**0.3**

Thermal Wasteload Allocations for Point Sources

Wasteload allocations assigned to the NPDES permitted point sources are listed in Table 33. Wasteload allocations for NPDES general permits are described in Section 9.1.1. The wasteload allocation for registrants under the general stormwater permits (MS4, 1200-A, 1200-C and 1200-Z) are equal to any existing thermal load authorized under the current permit. Per the analyses in section 7.1.3 no additional TMDL requirements are needed to control temperature, other than those included in the current permit. More specific wasteload allocations may be assigned if subsequent data and evaluation demonstrates a need and if reserve capacity is available.

WLAs were calculated using Equation 4 at the 7Q10. The effluent discharge used to calculate the wasteload allocations in Table 33 are based on maximum effluent flows reported in DMR available at the time of TMDL development.

One of the following options shall be selected to implement WLA in NPDES permits issued by ODEQ or appropriate permitting authority.

1. Incorporate the 7Q10-based wasteload allocation in Table 33 as a static numeric limit. Permit writers may recalculate the limit using Equation 4 with different values for 7Q10 (Q_R), and effluent flow (Q_E), if better estimates are available

2. Incorporate Equation 4 directly into the permit with effluent flow (Q_E), river flow (Q_R), and the wasteload allocation (WLA) being dynamic and calculated on a daily basis. The assigned portion of the Human Use Allowance (ΔT) is static and based on the Table 33 values.

$$WLA = (\Delta T) \cdot (Q_E + Q_R) \cdot C_F$$ **Equation 4**

where,

$WLA =$ Wasteload allocation (kilocalories/day), expressed as a rolling seven-day average.

$\Delta T =$ The allocated portion of the Human Use Allowance from Tables 30-32. It is the maximum temperature increase (°C) above the applicable river temperature criterion, using 100% of river flow, not to be exceeded by each individual source from all outfalls combined.

$Q_E =$ The daily mean effluent flow rate (cfs).

When effluent flow is in million gallons per day (MGD) convert to cfs: 1.5472

$$\frac{1{,}000{,}000\ gallons}{1\ day} \cdot \frac{0.13368 ft^3}{1\ \text{gallon}} \cdot \frac{1\ day}{86{,}400\ sec} = 1.5472$$

$Q_R =$ The daily mean river flow rate (cfs), upstream (of the NPDES discharge).

When river flow is <= 7Q10, Q_R = 7Q10. When river flow > 7Q10, Q_R is equal to the daily mean river flow, upstream.

$C_F =$ Conversion factor using flow in cubic feet per second (cfs): 2,446,665

$$\left(\frac{1\ \text{m}}{3.2808\ \text{ft}}\right)^3 \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{86400\ sec}{1\ day} \cdot \frac{1\ kcal}{1\ kg\ \cdot 1°\text{C}} = 2{,}446{,}665$$

For facilities that discharge to the Umpqua River Estuary, the future NPDES permit conditions for these facilities should be consistent with these assumptions; future permit conditions should apply relevant temperature water quality standards and mixing zone requirements at the point of discharge; this may include a static temperature effluent limit. For facilities that discharge to the Umpqua River Estuary, this TMDL project does not preclude alternative approaches and decisions by the Oregon NPDES permitting program in the future.

The wasteload allocation period for each facility is consistent with the critical period of the receiving waterbody, which is presented in Section 6. Note that the maximum cumulative impact of all point sources at the point of maximum impact is less than the sum of individual point source impacts at their respective points of discharge due to heat dissipation between point-source discharges. Supporting information and additional equations useful for NPDES permits are provided in Appendix E.

Table 33 Individual Thermal wasteload allocation for NPDES permitted facilities.

Subbasin Name	Facility Name	EPA Permit Number	Assigned HUA	River flow annual 7Q10 (cfs)	Effluent discharge (cfs)	WLA (kcal/day at 7Q10)	WLA start period	WLA end period
Umpqua	Brandy Bar Landing, Inc.	OR0030864	0.1	999	.01	2.4E+08	May 1st	Oct 31st
	Drain STP	OR0029645	0.1	1.3	1.3	6.30E+05	May 1st	Oct 31st
	Oakland STP	OR0020494	0.1	0.9	1.1	4.75E+05	May 1st	Oct 31st
	Reedsport STP[1]	OR0020826	0.1*	1010	6.4	2.49E+08	May 1st	Oct 31st
	Rice Hill East Lagoon	OR0029564	0.1	0	0.2	3.75E+04	May 1st	Oct 31st
	Rice Hill West Lagoon	OR0028789	0.1	0	0.1	2.55E+04	May 1st	Oct 31st
	Sutherlin STP	OR0020842	0.1	0.9	7.9	2.14E+06	May 1st	Oct 31st
	Winchester Bay STP[1]	OR0022616	0.1*	1010	0.3	2.47E+08	May 1st	Oct 31st
	Yoncalla STP	OR0022454	0.1	0.1	1.4	3.54E+06	May 1st	Oct 31st
North Umpqua	Glide-Idleyld Sanitary District	OR0030261	0.1	673	1.4	1.65E+08	May 1st	Oct 31st

Subbasin Name	Facility Name	EPA Permit Number	Assigned HUA	River flow annual 7Q10 (cfs)	Effluent discharge (cfs)	WLA (kcal/day at 7Q10)	WLA start period	WLA end period
	Rock Creek Fish Hatchery (300-J enrollee)	ORG133509	0.3	16.1	25.1	3.02E+07	April 15th	Oct 31st
South Umpqua	Canyonville STP	OR0020729	0.1	56	1.3	1.40E+07	May 1st	Oct 31st
	Glendale STP	OR0022730	0.1	24	1.4	6.14E+06	May 1st	Oct 31st
	Green Diamond Performance	OR0001627	0.1	0	0	0	May 1st	Oct 31st
	Hoover Treated Wood Products[2] (process wastewater)	OR0034380	0.1	0	0	0	May 1st	Oct 31st
	Myrtle Creek STP	OR0028665	0.1	118	6.1	3.04E+07	May 1st	Oct 31st
	R.U.S.A. Roseburg STP (South Umpqua outfall)	OR0031356	0.1	146	35	4.43E+07	May 1st	Oct 31st
	R.U.S.A. Roseburg STP (natural treatment system)	OR0031356	0.1	0	35	8.57E+06	May 1st	Oct 31st
	Riddle STP	OR0020630	0.1	30	1.5	7.75E+06	May 1st	Oct 31st
	USFS Tiller Ranger Station STP	OR0023221	0.1	31	0.02	7.61E+06	May 1st	Oct 31st
	Winston-Green WWTF	OR0030392	0.1	56	7.2	1.56E+07	May 1st	Oct 31st

Subbasin Name	Facility Name	EPA Permit Number	Assigned HUA	River flow annual 7Q10 (cfs)	Effluent discharge (cfs)	WLA (kcal/day at 7Q10)	WLA start period	WLA end period
[1]Ocean and Bays temperature criterion allowable 0.1°C increase								
[2] The WLA assigned to this facility applies to the process wastewater discharge								

NPDES permitted point sources discharging in the Umpqua Basin are allocated up to 0.1°C cumulative warming at the point of maximum impact under the HUA. Based on water quality modeling the point of maximum impact is located at 31.7 river kilometer of the Umpqua River and the cumulative observed warming did not exceed 0.1°C. Modeling analyses described in Appendix G indicates that the WLAs will attain the cumulative 0.1°C HUA assignment to point sources.

9.1.1 General Permits Wasteload Allocations

200-J Filter Backwash

The 200-J general permit covers discharge or land application of filter backwash, settling basin, and reservoir cleaning water which have been adequately treated prior to discharge. Flushing of raw water intakes after storm events and spring runoff are also allowed. The minimum dilution requirements for this permit requires a 30:1 minimum dilution ratio during periods of discharge.

EPA evaluated the impact of 200-J discharges on receiving streams at the critical low flow (7Q10) to assign wasteload allocations. The analysis was conducted for several facilities and utilized available DMRs; however, DMRs were not available for all general permit facilities. Maximum effluent flows varied for each facility and ranged between 0.0042 to 9.8 MGD. Temperature is not reported on 200-J DMRs so maximum effluent temperature for each facility could not be determined. An effluent temperature of 24° C was used for estimation purposes. The current 200-J permit requirement relevant for temperature is a 30:1 minimum dilution ratio between river and effluent flow. This dilution ratio was used to estimate the maximum effluent flow under critical condition 7Q10 river flows. If the DMR or permit application reported maximum effluent flow was less than the dilution based effluent flow, the maximum effluent flow was used instead.

The goal of the analysis was to calculate an estimated change in river temperature using the 7Q10 river flow, maximum reported or dilution based effluent flow, effluent temperature (24 °C) and applicable temperature criteria. The results indicate that 200-J registered facilities have the potential to increase in-stream temperatures up to about 0.19 °C above the year-round temperature criterion and 0.09 °C above the spawning criterion. This analysis indicates that when the 30:1 dilution requirement is met for the receiving stream, most discharges would be within the 0.1 °C HUA provided to NPDES point sources. There are circumstances, under critical conditions, where dischargers may need to reduce their thermal load to attain the allowable 0.1 °C HUA for point sources.

Facilities enrolled under the 200-J permit may utilize the 0.1 °C HUA provided to NPDES point sources and individual facility wasteload allocations shall be calculated according to Equation 2 incorporating the

30:1 dilution for variable Q_R as required by the 200-J permit. If an additional HUA allowance is needed, facilities may access a portion of the reserve capacity per ODEQ procedures and approval.

100-J Cooling water/heat pumps

The 100-J general permit issued on April 15, 2024, by ODEQ covers discharges of non-contact cooling water, defrost water, heat pump transfer water, and cooling tower blowdown. Also included are cooling and sump water discharges from hydropower facilities.

EPA evaluated the discharges from 100-J registered facilities and the impact on stream temperature using available DMRs. The goal of the analysis was to calculate river temperature increases above the applicable river temperature criterion using 100% of river flow. DMR data for non-hydropower facilities under this permit were not available. A general review of effluent flows and temperature conditions allowed by the permit indicated that even under extremely low river flows (e.g., 5 cfs), one registrant per assessment unit would not exceed 0.1 ^{o}C increase above the applicable criterion. However, depending on a given facility effluent flow, the allowable thermal load of the 100-J permit may be exceeded. When river flow is 43 cfs and higher, the potential warming, due to one registrant per assessment unit, under all allowed effluent flows is 0.075 ^{o}C or less. Therefore, for many streams under typical flow conditions it is likely that the 100-J permit conditions will limit warming to 0.075 ^{o}C or less and will be within the 0.1 ^{o}C HUA provided to NPDES point sources. If in the future there is more than one 100-J registrant per assessment unit, ODEQ will confirm that there is sufficient assimilative capacity such that the combined sum of warming from all registrants and individual permits at the point of discharge does not exceed the maximum warming allowed for the assessment unit. The maximum allowed warming per assessment unit is 0.075 ^{o}C, consistent with 100-J permit requirements. ODEQ may limit the maximum number of registrants allowed to discharge in each assessment unit. As the river flow increases and provides increased dilution, the maximum number of registrants allowed also increases.

Hydropower facilities covered under the permit do not have a maximum flow limit or a thermal load limit. Depending on actual effluent discharge rates, hydropower discharges may have temperature increases above 0.075 ^{o}C when river flow is 68 cfs or less. There are eight 100-J registrations associated with the PacifiCorp North Umpqua Hydroelectric Project[1] in the upper North Umpqua watershed. To control thermal loading, these registrants must comply with requirements set forth in the 100-J permit and are limited to the cumulative 0.075 ^{o}C HUA increase for NPDES permitted discharges presented in Table 30.

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[1] PacifiCorp 100-J Water Quality File Numbers:
66628
66630
66632
66640
66642
66644
66636

300-J Fish Hatcheries

The current 300-J general permit issued October 3, 2002, covers treated discharges from aquatic animal production facilities which produce at least 20,000 pounds of fish per year but have less than 300,000 pounds on hand at any time.

EPA reviewed effluent temperature and effluent flow data for the ODFW Rock Creek fish hatchery registered under the 300-J permit and determined this facility discharges thermal loads that could increase stream temperatures above the applicable temperature criteria (Section 7.1.2). Because this facility has reasonable potential to increase stream temperature, the ODFW Rock Creek fish hatchery is provided a numeric waste load allocation in Table 33. Facilities enrolled under the 300-J general permit also have the opportunity to select Equation 4 directly incorporated into the permit, as described above for individual NPDES permits, for the wasteload allocation to be implemented as a daily flow based allocation in their permit. Moreover, ODEQ or the appropriate permitting authority, may utilize the state's minimum duties provision (OAR 340-041-0028(12)(a)) and associated procedures, as applicable, when implementing wasteload allocations for facilities enrolled under the 300-J general permit. Any new future 300-J enrollees shall have facility specific WLAs calculated consistent with procedures in this TMDL (equation 2) and must seek an HUA allotment from the reserve capacity.

Thermal Load Allocations for Nonpoint Sources

Load allocations are assigned to nonpoint sources. Specified nonpoint sources are assigned a portion the HUA and provided an allowable thermal load; whereas other nonpoint sources are assigned a load allocation of zero (0) and are not included in the calculation of excess thermal loading to the streams and rivers in the Umpqua Basin. Likewise, as discussed in the Source Assessment (Section 7), there are a number of intertwined landscape and meteorological factors/sources exacerbated by anthropogenic actions that contribute thermal loading to the waters and these sources require reduction in order to attain and maintain the applicable WQS. These background nonpoint sources receive a load allocation to confirm water quality criteria attainment and protection of beneficial uses.

9.1.2 Background Nonpoint Sources

Load allocations for background nonpoint sources are calculated according to Equation 5. Table 34 presents the load allocation assigned to background nonpoint sources for temperature-impaired category 5 assessment units where loading capacity was calculated. The EPA calculated load allocations at locations that spatially represent the Umpqua basin. Allocations were calculated under critical conditions (i.e., low flow) to ensure beneficial uses are protected; the 7Q10 was used as the critical low flow for load allocations in Table 34. Moreover, Equation 5 shall be used to calculate the load allocation for background nonpoint sources on any assessment unit or stream location in the Umpqua subbasin not listed in Table 34 or when river flows are greater than 7Q10. Equation 5 may also be used to calculate the load allocations for background nonpoint sources if in the future the applicable temperature criteria are updated and approved by EPA.

$$LA_{BG} = (T_C) \cdot (Q_R) \cdot C_F$$ **Equation 5**

where,

$LA_{BG} =$ Load allocation to additional nonpoint sources (kilocalories/day).

$T_C =$	The applicable temperature criteria, not including the human use allowance. When there are two year-round applicable temperature criteria that apply to the same assessment unit, the more stringent criteria shall be used.
$Q_R =$	The daily average river flow rate (cfs).
$C_F =$	Conversion factor using flow in cubic feet per second (cfs): 2,446,665

$$\left(\frac{1\text{ m}}{3.2808\text{ ft}}\right)^3 \cdot \frac{1\ m^3}{35.31\ ft^3} \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{86400\ sec}{1\ day} \cdot \frac{1\ kcal}{1\ kg\ \cdot 1°\text{C}} = 2{,}446{,}665$$

Table 34 Load allocations calculated for representative assessment units in the Umpqua Basin.

AU_ID	AU Name	Load Allocation (YR)(kcal/day)	Load Allocation (Spawn) (kcal/day)
OR_SR_1710030301_02_105442	Calapooya Creek	8.98E+07	6.49E+07
OR_SR_1710030301_02_105443	Calapooya Creek	7.00E+07	5.06E+07
OR_SR_1710030106_02_105331	Canton Creek	5.79E+07	4.71E+07
OR_SR_1710030106_02_105332	Canton Creek	2.76E+08	2.24E+08
OR_SR_1710030110_02_105363	Cavitt Creek	1.65E+08	1.34E+08
OR_SR_1710030110_02_105364	Cavitt Creek	4.97E+07	4.04E+07
OR_SR_1710030206_02_105417	Cow Creek	2.13E+08	1.54E+08
OR_SR_1710030209_02_106367	Cow Creek	1.33E+09	9.59E+08
OR_SR_1710030204_02_105390	Elk Creek	1.11E+08	8.02E+07
OR_SR_1710030204_02_105391	Elk Creek	1.03E+07	7.41E+06
OR_SR_1710030303_02_105453	Elk Creek	4.21E+06	3.04E+06
OR_SR_1710030303_02_106420	Elk Creek	1.23E+08	8.87E+07
OR_SR_1710030202_02_105378	Jackson Creek	5.09E+08	4.13E+08
OR_SR_1710030202_02_105379	Jackson Creek	1.01E+08	8.21E+07
OR_SR_1710030212_02_105090	Lookingglass Creek	2.26E+08	1.63E+08
OR_SR_1710030307_02_105187	North Fork Smith River	3.07E+08	2.21E+08
OR_SR_1710030108_02_105339	North Umpqua River	2.48E+10	2.02E+10
OR_SR_1710030108_02_105340	North Umpqua River	2.37E+10	1.93E+10
OR_SR_1710030108_02_105342	North Umpqua River	2.42E+10	1.96E+10
OR_SR_1710030111_02_105365	North Umpqua River	2.59E+10	2.10E+10
OR_SR_1710030111_02_106415	North Umpqua River	2.62E+10	2.13E+10
OR_SR_1710030212_02_105091	Olalla Creek	9.47E+06	6.84E+06
OR_SR_1710030212_02_105094	Olalla Creek	3.56E+07	2.57E+07
OR_SR_1710030109_02_105345	Rock Creek	2.25E+08	1.83E+08
OR_SR_1710030109_02_105346	Rock Creek	5.83E+07	4.74E+07
OR_SR_1710030109_02_105347	Rock Creek	6.30E+08	5.12E+08
OR_SR_1710030306_02_105167	Smith River	1.30E+08	9.41E+07
OR_SR_1710030306_02_105175	Smith River	1.68E+06	1.22E+06
OR_SR_1710030306_02_105180	Smith River	1.09E+07	7.86E+06

AU_ID	AU Name	Load Allocation (YR)(kcal/day)	Load Allocation (Spawn) (kcal/day)
OR_SR_1710030307_02_105196	Smith River	2.64E+08	1.91E+08
OR_SR_1710030201_02_105374	South Umpqua River	6.42E+08	5.22E+08
OR_SR_1710030203_02_105389	South Umpqua River	1.22E+09	9.88E+08
OR_SR_1710030205_02_106333	South Umpqua River	2.23E+09	1.81E+09
OR_SR_1710030211_02_105320	South Umpqua River	5.28E+09	3.82E+09
OR_SR_1710030213_02_105102	South Umpqua River	2.49E+09	1.80E+09
OR_SR_1710030107_02_105334	Steamboat Creek	2.93E+08	2.38E+08
OR_EB_1710030307_01_107227	Umpqua River	5.33E+08	criteria not applicable
OR_SR_1710030302_05_105126	Umpqua River	3.21E+10	2.61E+10
OR_SR_1710030304_05_105153	Umpqua River	4.40E+10	criteria not applicable
OR_SR_1710030307_02_105197	West Fork Smith River	1.01E+08	criteria not applicable

9.1.3 Anthropogenic Nonpoint Sources

Load allocations assigned to anthropogenic nonpoint sources on any assessment unit or stream location in the Umpqua Basin are calculated using Equation 6. The portions of the human use allowance assigned to nonpoint source categories are presented in Tables 30 through 32.

$$LA_{NPS} = (\Delta T) \cdot (Q_R) \cdot C_F$$ **Equation 6**

where,

$LA_{NPS} =$ Load allocation to anthropogenic nonpoint sources (kilocalories/day).

$\Delta T =$ The portion of the Human Use Allowance assigned to each nonpoint source category representing the maximum cumulative temperature increase (°C) from all source activity in the nonpoint source category. When the minimum duties provision at OAR 340-041-0028(12)(a) applies, ΔT = 0.0.

$Q_R =$ The daily average river flow rate (cfs).

$C_F =$ Conversion factor using flow in cubic feet per second (cfs): 2,446,665

$$\left(\frac{1\ \text{m}}{3.2808\ \text{ft}}\right)^3 \cdot \frac{1\ m^3}{35.31\ ft^3} \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{86400\ sec}{1\ day} \cdot \frac{1\ kcal}{1\ kg\ \cdot 1℃} = 2{,}446{,}665$$

9.1.4 North Umpqua Hydroelectric Project (FERC Project No. 1927)

Support of the temperature criteria during the summer within and downstream of the North Umpqua River hydroelectric project is dependent upon implementation of the §401 certification bypass reach minimum flows. The North Umpqua Hydroelectric Project (FERC Project No. 1927) load allocation is set in accordance with the Clean Water Action §401 Certification Modification issued by ODEQ in 2004 and reissued on December 13, 2022, and the accompanying Clean Water Action §401 Certification Conditions requirement to maintain at least the minimum instantaneous instream flows prescribed in Exhibit A, Temperature Management Plan Table 1. For ease of information the minimum required flows from Exhibit A, Temperature Management Plan Table 1 are reproduced below (Table 35).

Table 35 Minimum bypass flows as required in the current North Umpqua Hydroelectric Project (FERC Project No. 1927) 401 Certification.

Minimum Bypass Reach Flows, Cubic Feet Per Second (CFS)									
	Lemolo No. 1	Lemolo No. 2	Clearwater No. 1	Clearwater No. 2	Toketee	Fish Creek	Slide Creek	Soda Springs	Deer Creek
January			30						Full Flow
February			30						Full Flow
March			30						Full Flow
April									Full Flow
May						50/130	80/240		Full Flow
June	80	70 -145	60			80/130	80/240		Full Flow
July	100	80 -180	40		80	80/130	80/240		Full Flow
August						80/130	80/240		Full Flow
September						80/130	80/240		Full Flow
October			30						Full Flow
November			30						Full Flow
December			30						Full Flow
KEY	x-y means range of minimum flows based on real-time monitoring (see condition 2 of this Exhibit A). x/y means flows before (x) and after (y) anadromous fish passage facilities are provided at Soda Springs Dam.								
	Minimum bypass reach flows are effective December 31, 2005 (if the new FERC License has been issued) or by the first anniversary of the new FERC License, whichever is earlier. Post-passage minimum flows in the Fish Creek and Slide Creek bypass reaches are effective on the seventh anniversary of the new FERC License if fish passage facilities have been provided at Soda Springs Dam in accordance with the North Umpqua Settlement Agreement. No diversion of Deer Creek is allowed after the first anniversary of the new FERC License; except that PacifiCorp may divert water from Deer Creek up to the OWRD water right in Deer Creek in order to aid fish salvage operations in the Lemolo No. 2 power canal when the Lemolo No. 2 powerhouse is shut down, as set forth in the North Umpqua Settlement Agreement Section 9.5.								

Analyses conducted as part of this TMDL project indicate that the North Umpqua Hydroelectric Project continues to contribute to downstream warming and exceedances of both the summer and spawning water quality criteria. It may be necessary to revise this facility's Clean Water Action §401 Certification, and modify the required minimum bypass reach flows. If additional implementation actions per the dam and reservoir operation surrogate measures below are not sufficient to fully protect beneficial uses, ODEQ may modify this facility's Clean Water Act §401 Certification to incorporate additional measures to reduce the project's contribution to exceedances of the temperature criteria. These measures may include modification of the minimum bypass reach flows or other feasible measures.

9.1.5 Surrogate Measures

EPA regulations (40 CFR 130.2(i)) allow for TMDLs to be expressed in terms of other appropriate measures (i.e., surrogate measures). This section presents surrogate measures that are used to express and implement the load allocations.

Riparian/Streamside Vegetation

As presented in the source assessment (Section 7.1.5) the lack of streamside vegetation is one of the largest sources of stream warming. Modeling finds that the lack of streamside vegetation contributes multiple degrees of warming to the streams. A zero (0) load allocation is assigned to entities that manage or have authority over streamside vegetation management actions and requires activities to not cause instream temperature increases (zero load allocation). The zero-load allocation (no warming) for streamside land management activities is implemented through an effective shade target. Effective shade can be easily measured in the field and is simpler to monitor relative to a thermal load. Based on a literature review, EPA determined that a vegetation buffer width based on a slope distance of 120 feet is sufficient in most cases to have no warming due to loss of shade and will attain the shade targets (Appendix C). Effective shade surrogate measure targets represent a surrogate for the amount of solar loading that will attain the human use allowance and load allocations for entities managing streamside vegetation.

In assigning load allocations to entities with streamside vegetation management authority, EPA considered the constraints in meeting this requirement where there is existing hardscape infrastructure (e.g., roads, railroad, buildings, utility corridors); therefore, a load allocation equivalent to 0.05°C HUA is provided to these streamside land uses. This load allocation (0.05°C of HUA) provides for a small amount of allowable loading from these land uses, which will lessen the need for infeasible approaches and cost to eliminate warming from these sources. Entities managing streamside land with this type of hardscape infrastructure may utilize a portion or all of the assigned HUA (0.05°C) when implementing measures to attain the load allocation.

9.1.5.1.1 Site Specific Effective Shade Targets

Effective shade targets shown in Table 36 represent a surrogate measure for the amount of solar loading that will attain the human use allowance and thermal load allocations for responsible entities managing streamside vegetation. Figure 52 presents the shade targets per modeled assessment units. The shade gap is the difference between the current shade and the shade target. The shade gap represents the amount of additional shade needed to achieve the TMDL shade target (Table 36 and Figure 53).

It appears that shade gap values reported in Figure 53 are generally lower along wider, higher stream order mainstem stream reaches, than observed along narrower headwater reaches. This seemingly contrarian finding is likely due lower proportional stream shade resulting from the riparian vegetation as the channel width increases. Specifically, stream vegetation loss associated with narrow streams can result in large changes in stream shade conditions because the riparian vegetation can cast a shadow across the entire wetted area of the stream, while the loss of the same sized tree along a wide channel might only provide small amount of stream shade because the shadow length is too short to cover the wetted width of the stream, and therefore the loss of this tree along the wide stream results in a proportionally lower amount of shade loss than what would be observed with the same tree loss along a narrow headwater stream.

The Heat Source models were used to calculate shade targets (Appendix G). The effective shade target is the arithmetic mean of the effective shade values at all model nodes assigned to each organization/agency (Equation). Equation may be used to recalculate the mean effective shade targets if organization/agency boundaries change or the organization/agency boundary needs to be corrected. Equation may also be used to recalculate the mean effective shade targets based on an updated shade gap assessment. Any updated shade gap assessment shall follow a process and methods outlined by ODEQ as part of TMDL implementation.

$$\overline{ES} = \frac{\sum ES_{n_i}}{n_i} \qquad \textbf{Equation 7}$$

Where,

$\overline{ES} =$ The mean effective shade for a particular organization/agency *i.*

$\sum ES_{n_i} =$ The sum of effective shade from all model nodes or measurement points assigned to a particular organization/agency *i.*

$n_i =$ Total number of model nodes or measurement points assigned to a particular organization/agency *i.*

Table 36 Shade surrogate measure targets to meet nonpoint source load allocations on model stream reaches.

Designated Management Agency	Current shade (%)	TMDL Target Shade (%)	Shade Gap (%)
Bonneville Power Administration	5	5	0
Central Oregon & Pacific Railroad	25	40	15
City of Drain	50	66	16
City of Elkton	27	30	3
City of Glendale	32	33	1
City of Myrtle Creek	12	15	3
City of Oakland	12	23	11
City of Riddle	7	10	3
City of Roseburg	4	5	1
City of Sutherlin	49	53	4
City of Winston	18	22	4
Cow Creek Band of Umpqua Indians	8	9	1
Douglas County	17	20	3
Oregon Department of Agriculture	19	23	4
Oregon Department of Fish and Wildlife	4	4	0
Oregon Department of Forestry -	31	38	7
Oregon Department of Transportation	18	20	2
Oregon Parks and Recreation	43	45	2
State of Oregon	16	17	1
U.S. Bureau of Land Management	28	33	5
U.S. Forest Service	60	67	7

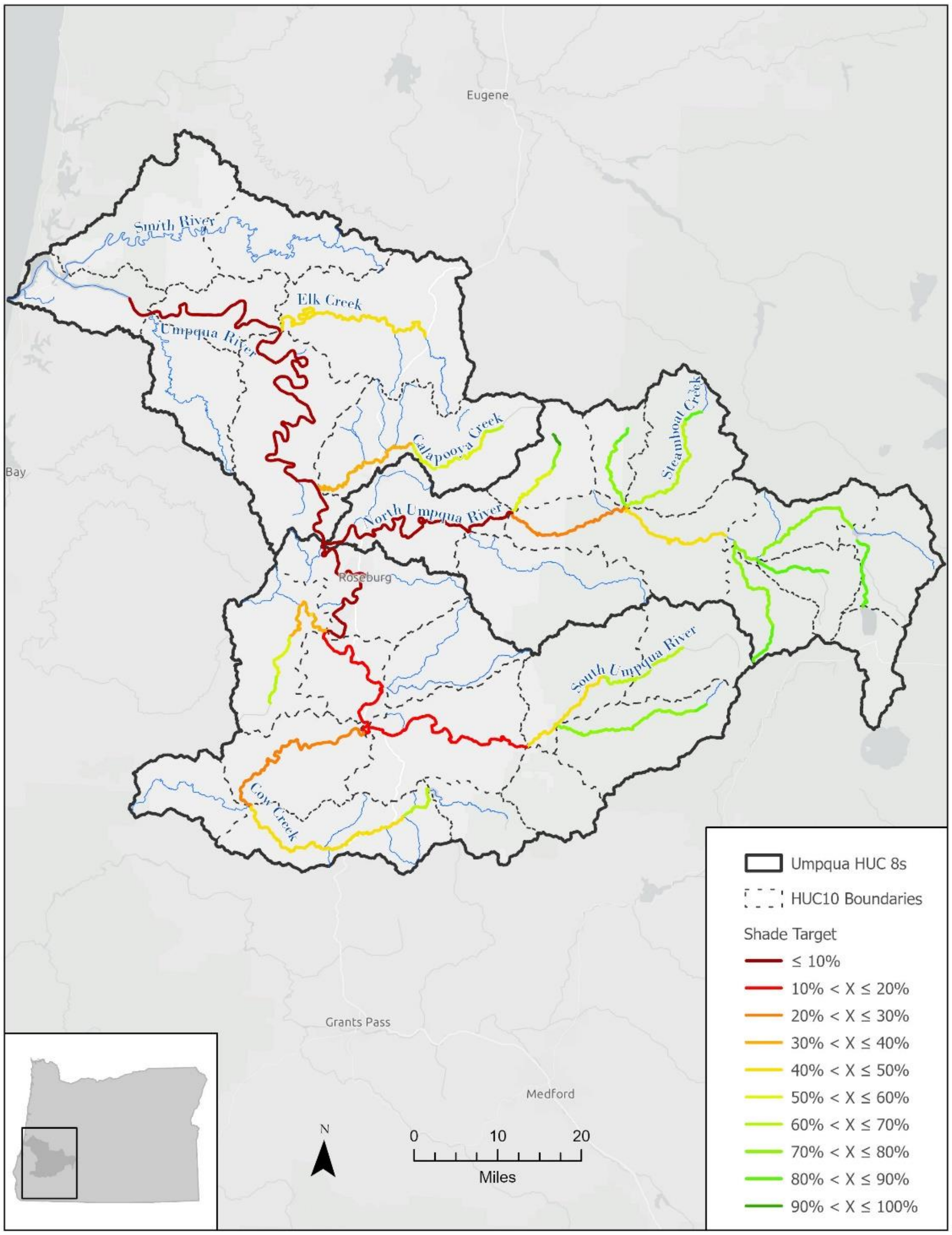


Figure 52 Shade surrogate measure targets to meet nonpoint source load allocations on modeled assessment units.

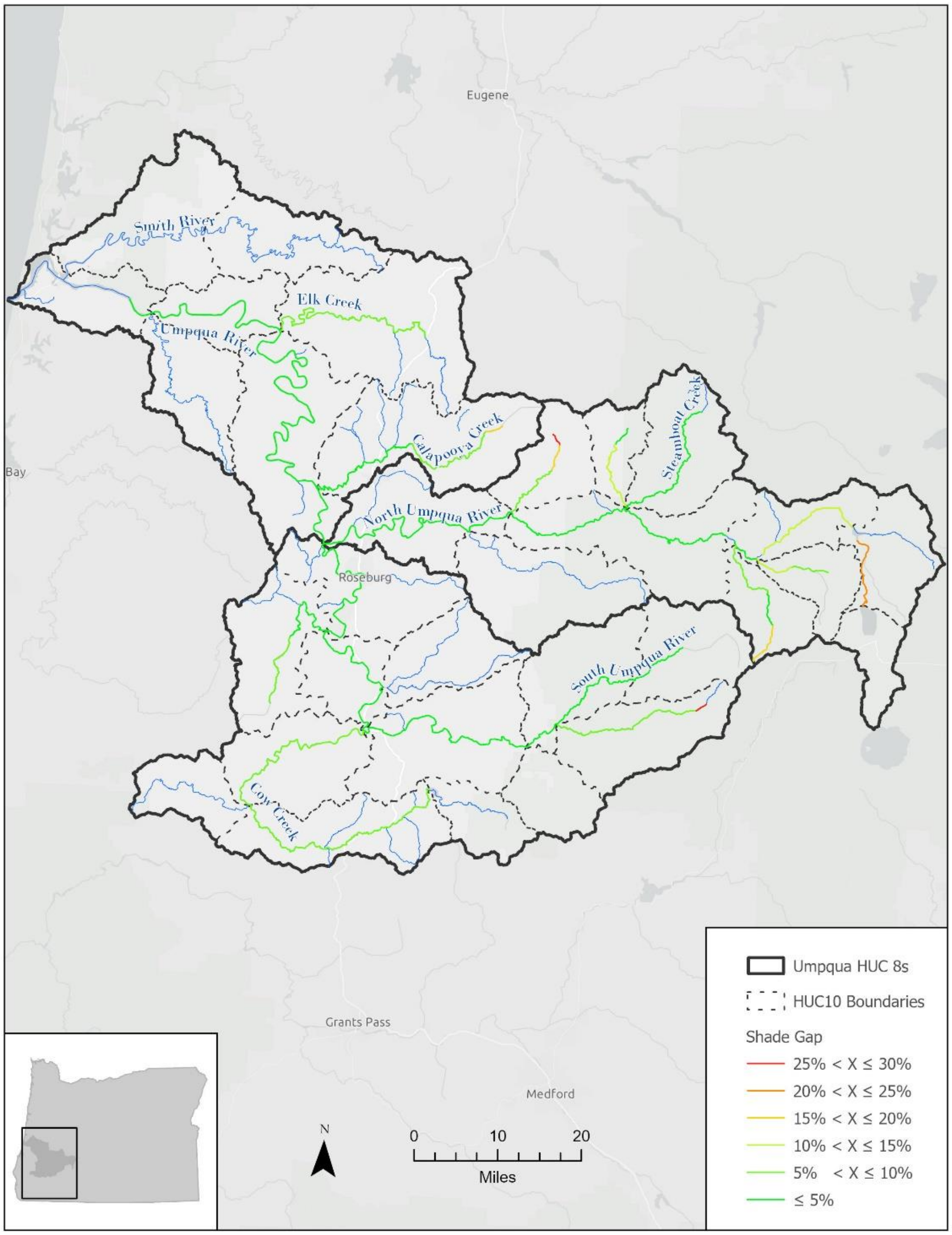


Figure 53 Shade gap percentages on modeled assessment units.

9.1.5.1.2 Effective Shade Curves

Effective shade curves are applicable to any stream that does not have site-specific shade targets (Section 9.1.5.1.1). Effective shade curves list the expected effective stream shade associated with targeted vegetation conditions for different vegetation zones. Effective shade curves were derived for the different EPA Level IV Ecoregions vegetation zones in the Umpqua basin (Figures 54 and 55). Stream shade values reported in these effective shade curves were calculated using Oregon Department of Environmental Quality HeatSource stream temperature model. The primary model input factors effecting stream shade estimates are 1) targeted potential vegetation conditions (i.e., vegetation height, canopy density and overhang), 2) stream width, and 3) stream aspect. Because identical model input values were used to describe targeted conditions during the 2024 and 2006 Umpqua Basin Temperature TMDL project efforts, shade curves reported during the 2006 effort are applicable for the 2024 effort. Of note, the potential vegetation types assigned to each ecoregion, and their associated height, density, and vegetation overhang attributes, were determined by a technical committee of local experts working on the 2006 Umpqua River Basin TMDL project (For additional information see the 2006 Umpqua River Basin Temperature TMDL Appendix, page 17).

Application of the shade curve can be accomplished through the following steps:

1. Determine the applicable vegetation zone for the stream location where you are applying a shade curve. This is accomplished through using the Ecoregion GIS layer illustrated in Figure 48. In addition, many of these Ecoregions are separated into distinct vegetation groups (i.e., “Conifer”, “Hardwood”, “Mixed”) and therefore it is necessary to determine the appropriate vegetation group for a particular location.

   Example: The theoretical stream location used in this example is situated along the mainstem Umpqua River several kilometers upstream from the Pacific Ocean and this theoretical location is situated within Ecoregion 1g (Figure 54). Ecoregion 1g represents the Mid-Coastal Sedimentary ecoregion group, and there are three distinct vegetation groups that comprised this Ecoregion and therefore there is a shade curve for each of these groups: 1) “Conifer”, 2) “Hardwood”, or 3) “Mixed” vegetation (Figure 55). In this example, it was hypothesized that the site is located within the “Hardwood” vegetation group associated with Ecoregion 1g. However, determining the appropriate vegetation group, and subsequently the appropriate shade curve to use in the assessment, will require additional analysis as outlined in the paragraph below.

   In this hypothetical example it is important to note that targeted vegetation for the “Hardwood” group of Ecoregion 1g is comprised of alder and big leaf maple trees, which is shorter and less dense (i.e., 90 feet and 70%) than expected vegetation conditions associated with the “Conifer” group of Ecoregion 1g (i.e., 170 feet and 80%). As a result, stream shade conditions within the shade curves are lower for the “Hardwood” vegetation group, than reported for the “Conifer” vegetation group shade curve. Accordingly, some level of analysis is needed to support designating riparian areas of Ecoregion 1g at something other than “Conifer”. (This would also apply to any other Ecoregion that also have multiple vegetation sub-classifications.) Without such analysis, the shade curve with the highest stream shade levels (i.e., conifer) must be used to determine target shade levels for the Ecoregion. USFS and/or state agencies often have detailed high spatial resolution GIS layers showing expected vegetation conditions and/or expected natural disturbance extent and this information can be used to determine areas of expected higher disturbance, which could be used to support assigning a “Hardwood” and/or

"Mixed" vegetation condition for areas for the Ecoregion. In addition, the extent of "Hardwood" and/or "Mixed" forest groups for a particular Ecoregion should not be greater than expected to occur at expected "natural background" disturbance conditions. Once again, GIS spatial datasets from the USFS and Oregon state agencies should be able to support the determination of the maximum extent and distribution of "Hardwood" and/or "Mixed" forest groups for a particular Ecoregion. Finally, this assessment needs to be documented.

2. Determine the stream aspect of the stream reach from north.

   Example: Standing in-stream mid-channel, facing north determine the river's aspect from north. In this example, the stream segment was hypothesized to be 0º or 180º from north (this means the river reach runs south to north).

3. Determine the expected active channel width of the stream reach.

   Example: At your location you measure the active channel width using a tape measure or laser range finder, and for this example active channel width was hypothesized to be at 90 feet.

   However, it is important to ensure that measured current active channel widths are not wider or narrower than what would be observed at undisturbed conditions. If it is determined that widths at the location deviate from targeted conditions due to anthropogenic factors (i.e., channel scour resulting from excessive sediment leading to excessively wide channels, channel narrowing from engineering features, etc.), then it will be necessary to estimate targeted channel width conditions, using methods such as regional curves, GIS assessments, and/or other channel modeling efforts.

4. Determine the percent effective shade value of your site based on 1) vegetation shade curve for your Ecoregion and vegetation group, 2) calculated stream aspect, and 3) active channel width. This determined shade value is the non-point source load allocation of the stream reach and represents stream shade at system potential vegetation.

   Example: You have determined that your stream reach is located within Ecoregion 1g – Mid-Coastal Sedimentary - Hardwood ecoregion (Figure 48). Using the appropriate shade curve for this Ecoregion (Figure 49), read the expected stream shade or solar flux (y-axis) based on the active channel width (for this example 90ft on the x-axis) and stream aspect (for this example read shade based on the light grey line in the shade curve which represents results associated with a North-South stream aspect). The 50% stream shade result associated with this example represents the stream shade associated with system potential vegetation conditions applied to the left and right bank of the stream reach. For this assigned Ecoregion, system potential vegetation was defined to have an average height of 90 feet, stand density (canopy density) of 70%, and overhang of 13 feet.

It is recognized that effective shade may be prevented from reaching effective shade targets by natural factors including local geology, geography, soils, climate, natural disturbance rates, and other natural phenomena.

Any updated shade curves and implementation of shade curve targets shall follow a process and methods outlined by ODEQ as part of TMDL implementation.

Please note, that the allocations within this TMDL do not apply to the Little River watershed. See the Little River Watershed TMDL document (ODEQ, 2001, approved by EPA in 2002) for those effective shade allocations.

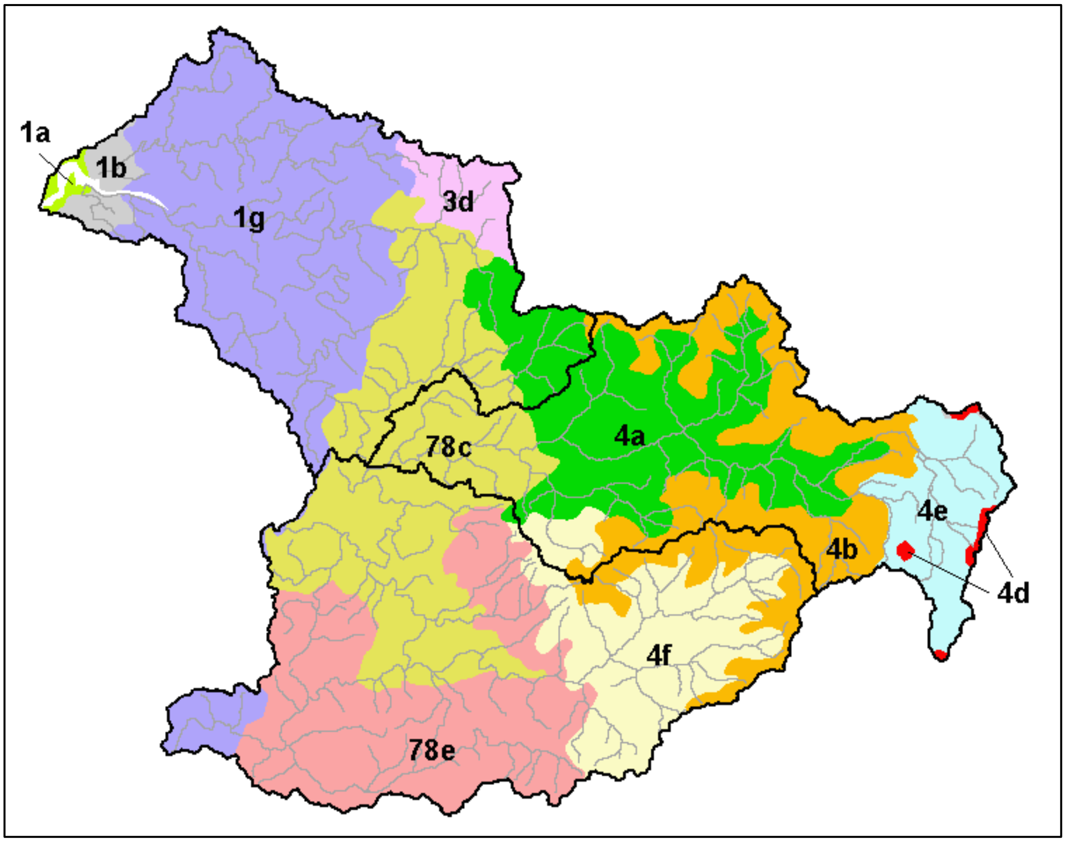
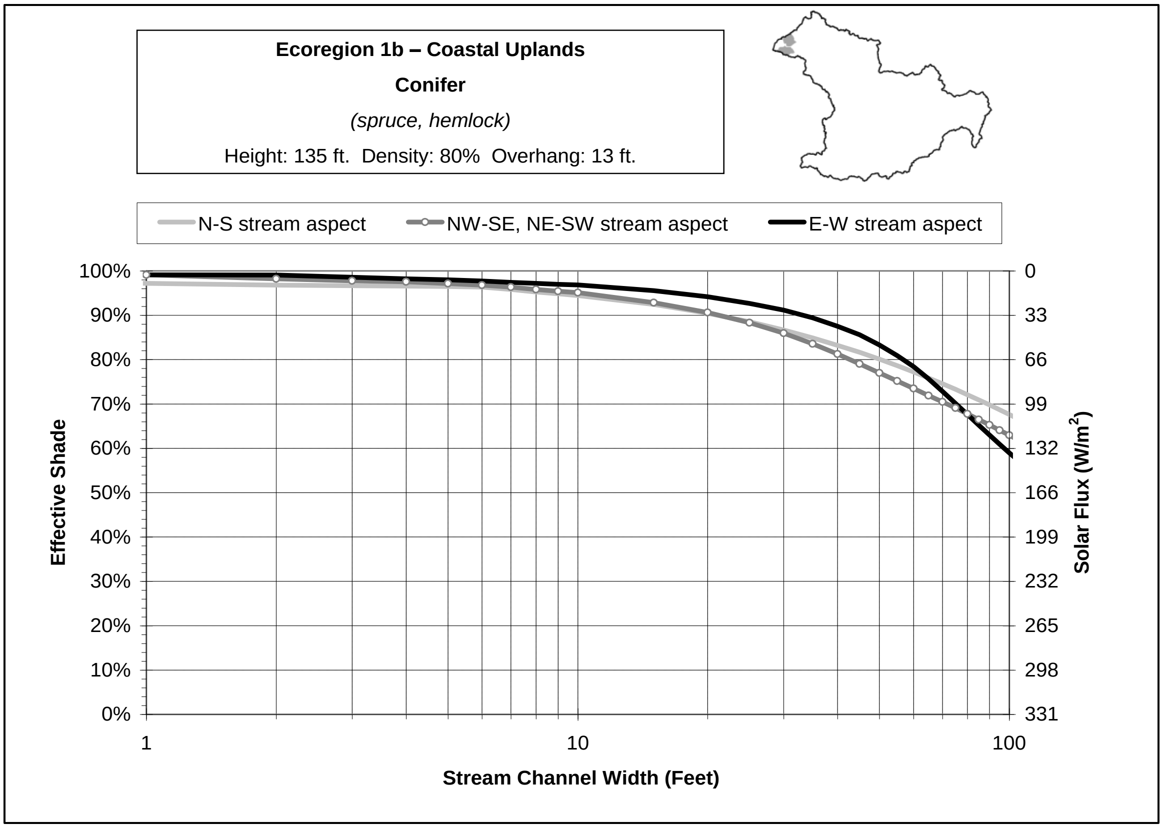
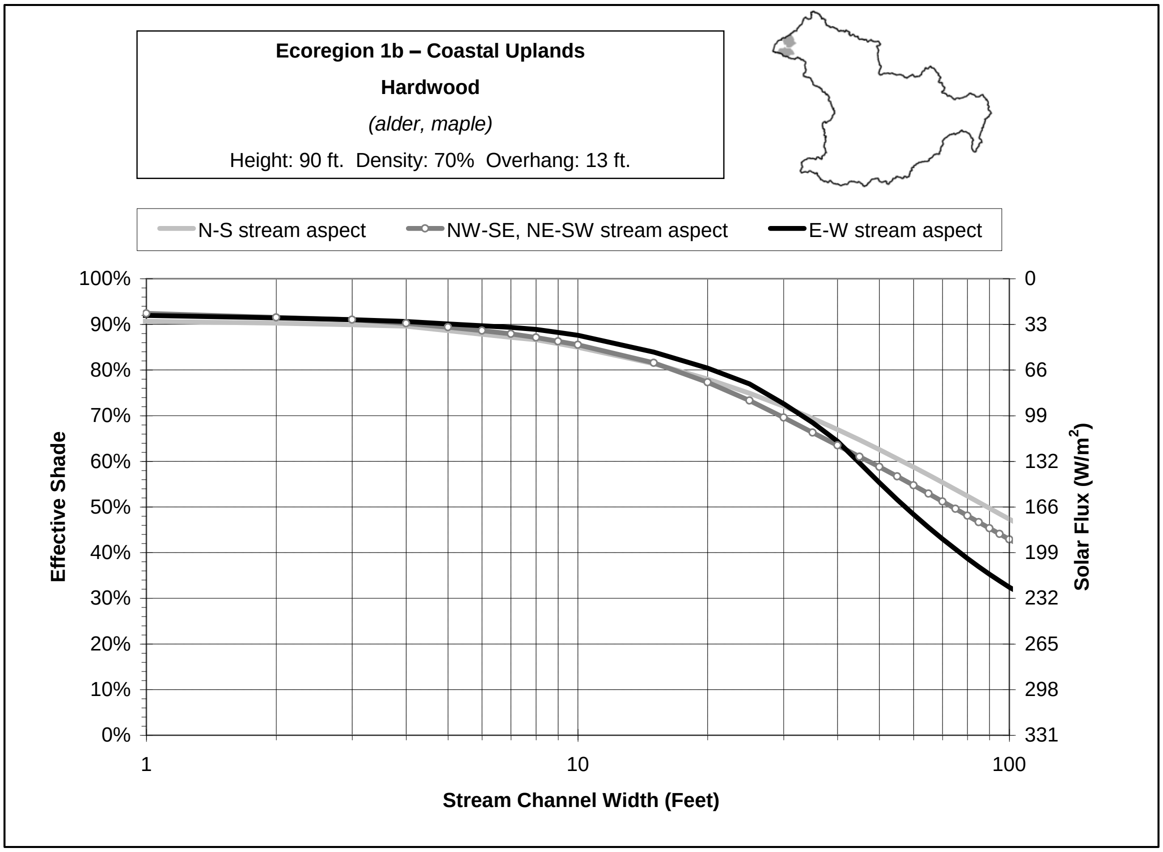
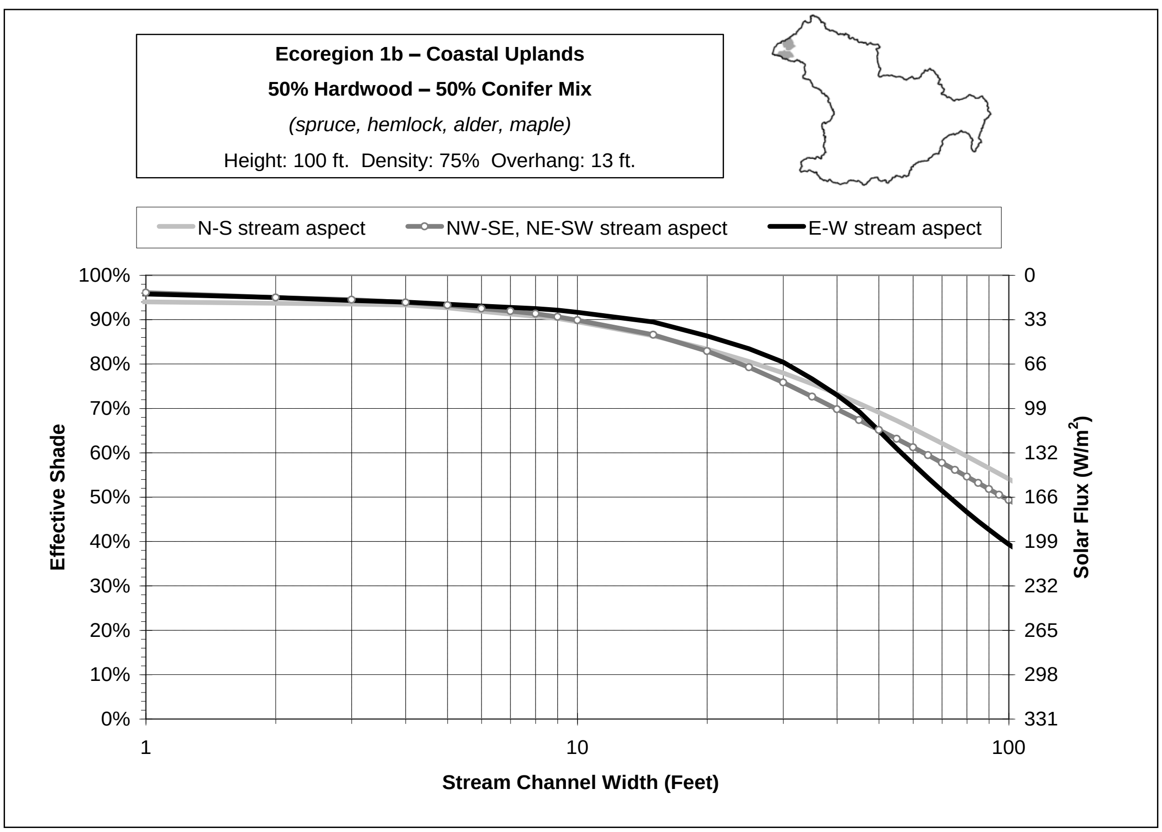
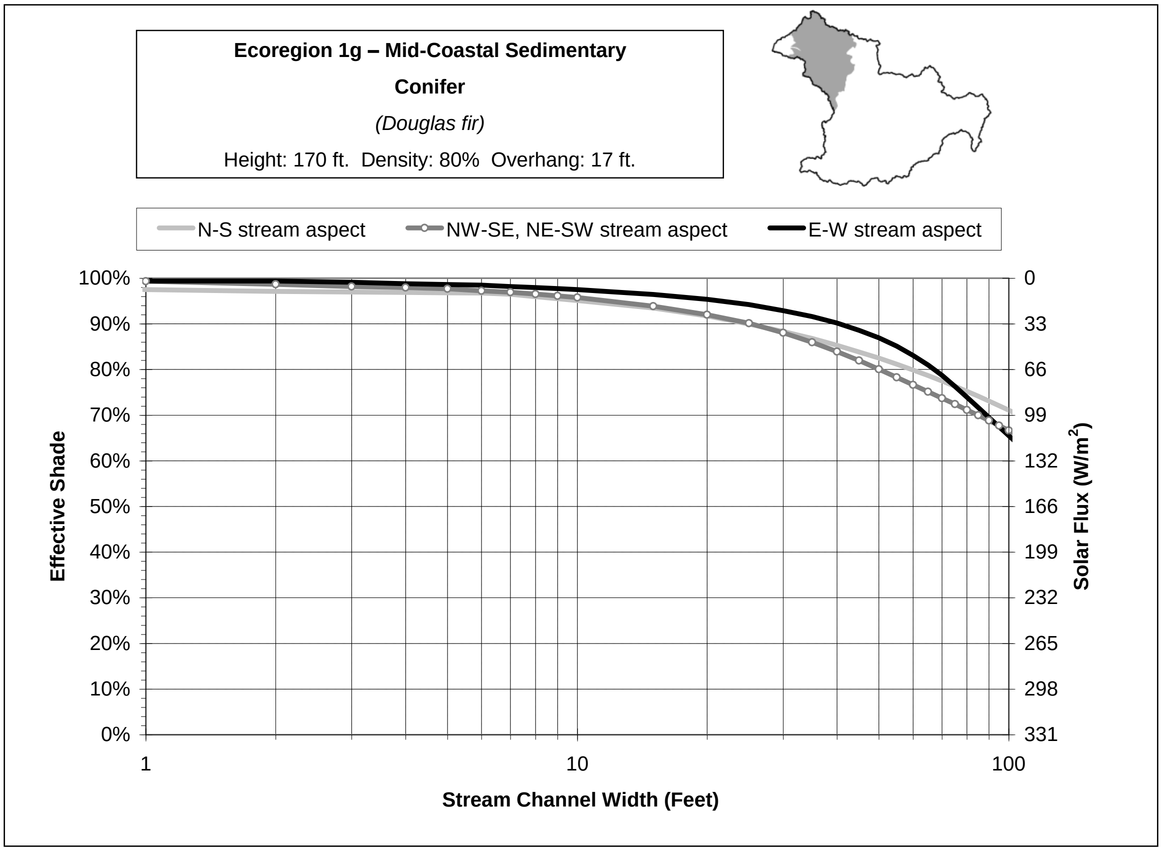


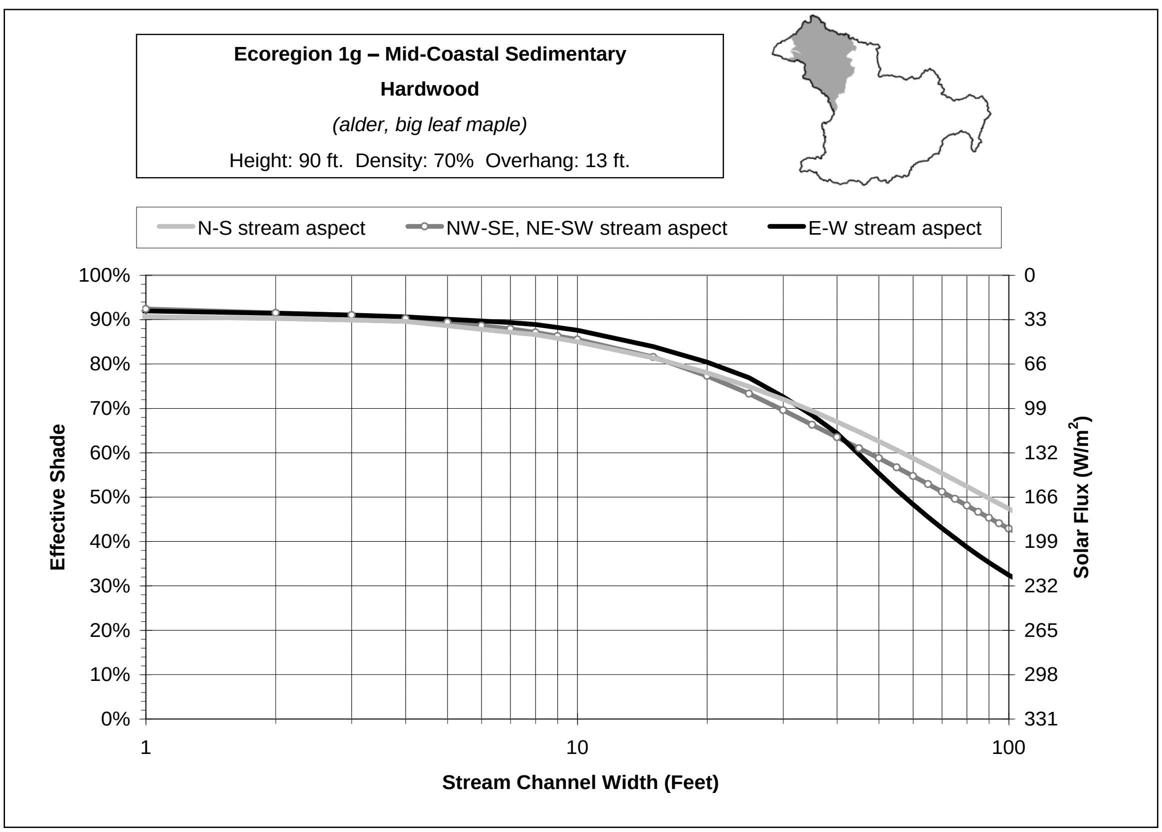
Figure 54 EPA Level IV Ecoregions used for the Effective Shade Curves

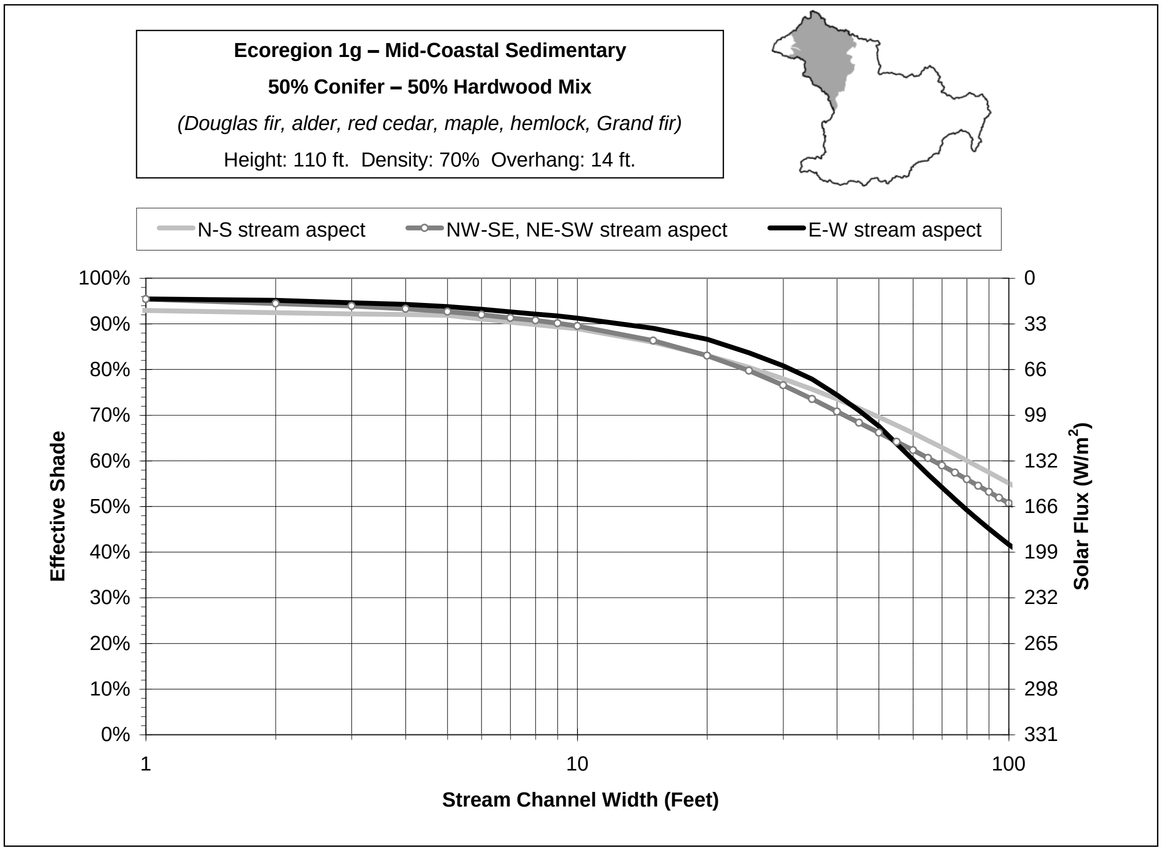

Ecoregion 1b – Coastal Uplands
Conifer
(spruce, hemlock)
Height: 135 ft. Density: 80% Overhang: 13 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

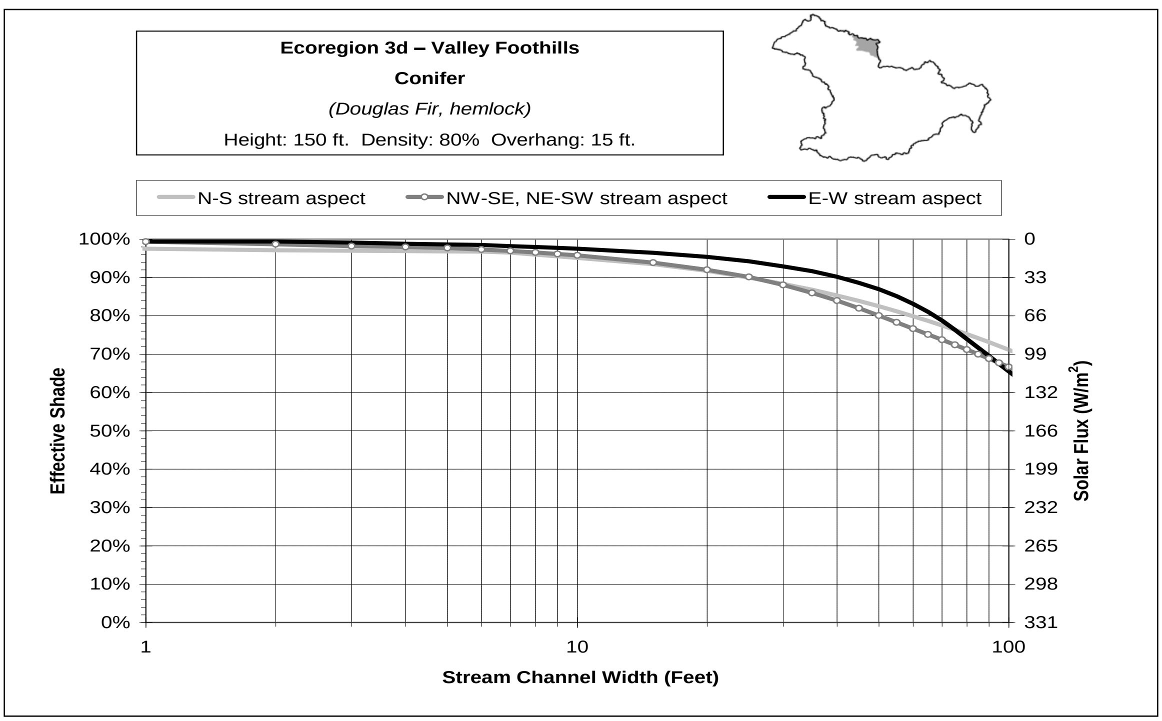

Ecoregion 1b – Coastal Uplands
Hardwood
(alder, maple)
Height: 90 ft. Density: 70% Overhang: 13 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

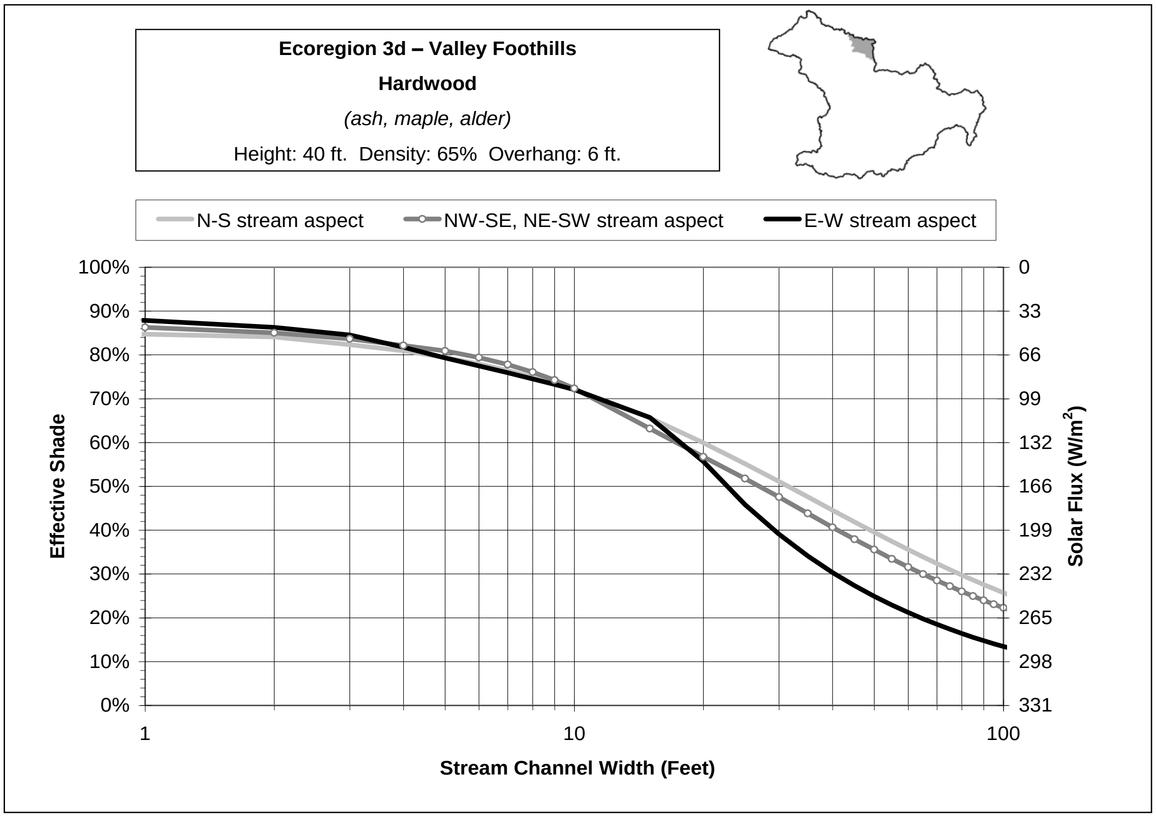

Ecoregion 1b – Coastal Uplands
50% Hardwood – 50% Conifer Mix
(spruce, hemlock, alder, maple)
Height: 100 ft. Density: 75% Overhang: 13 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

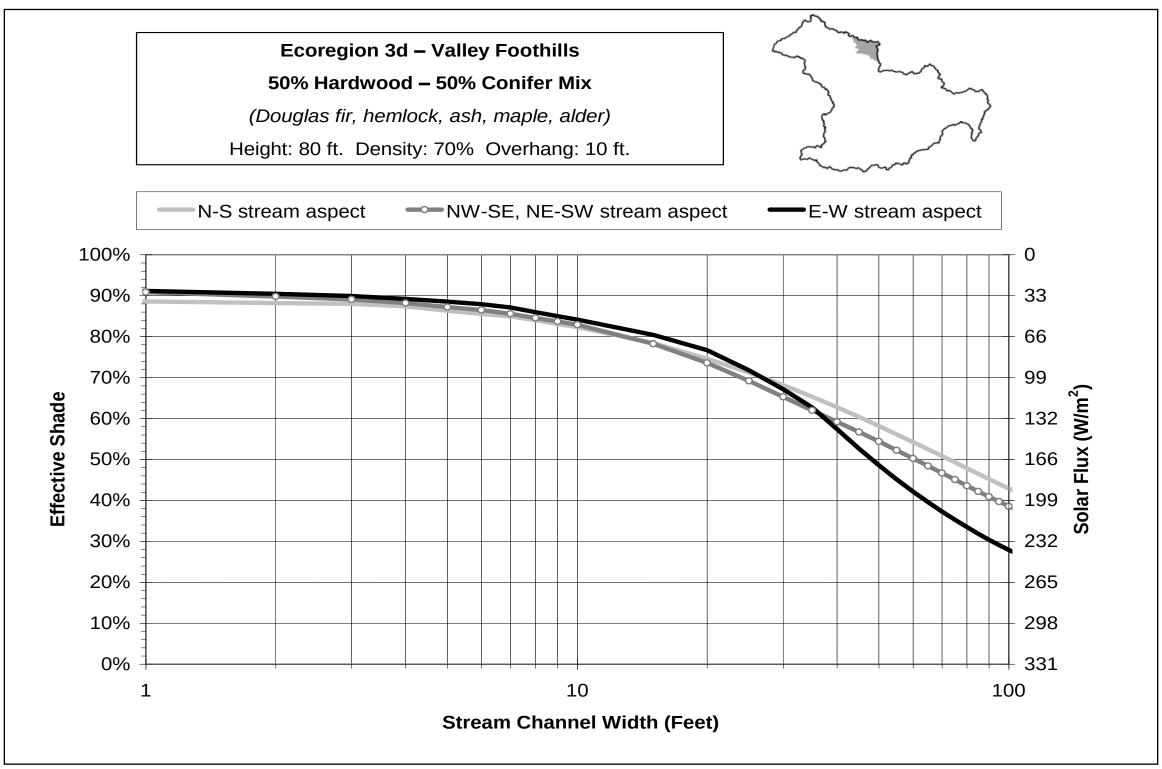

Ecoregion 1g – Mid-Coastal Sedimentary
Conifer
(Douglas fir)
Height: 170 ft. Density: 80% Overhang: 17 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

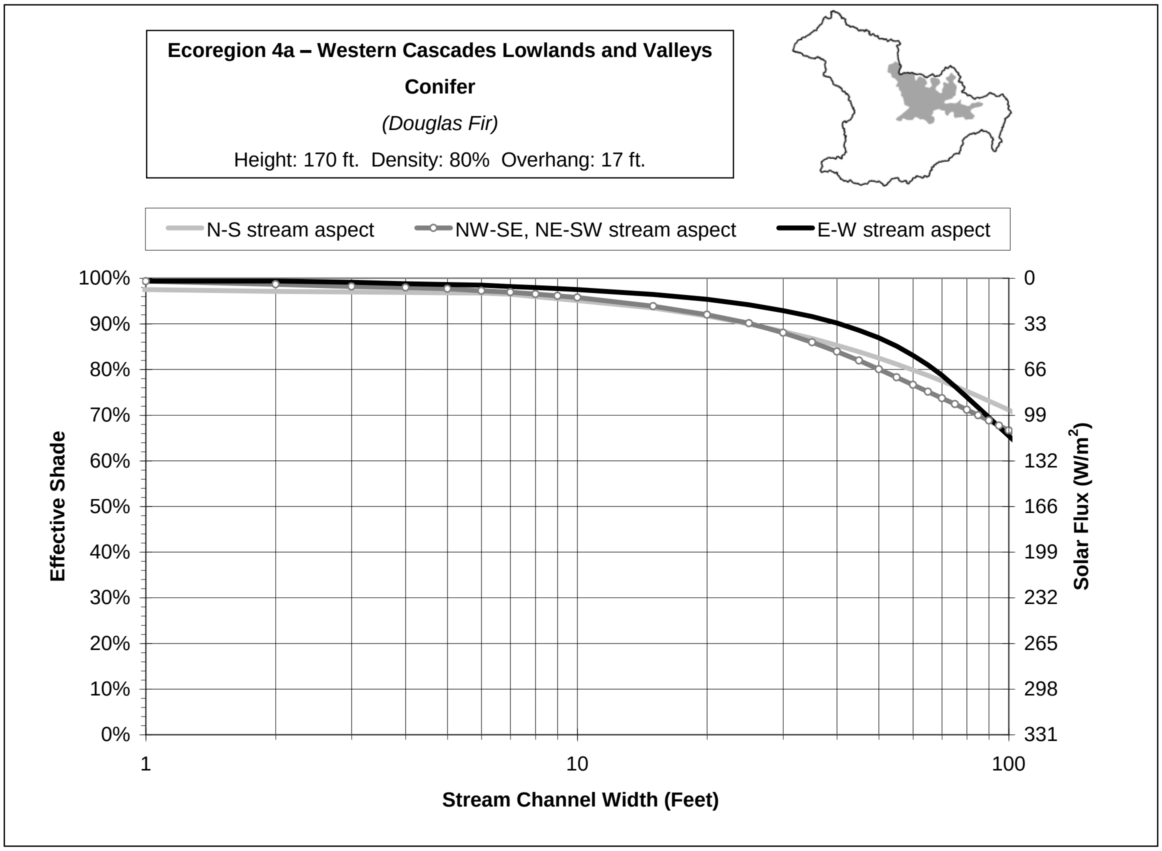

Ecoregion 1g – Mid-Coastal Sedimentary
Hardwood
(alder, big leaf maple)
Height: 90 ft. Density: 70% Overhang: 13 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

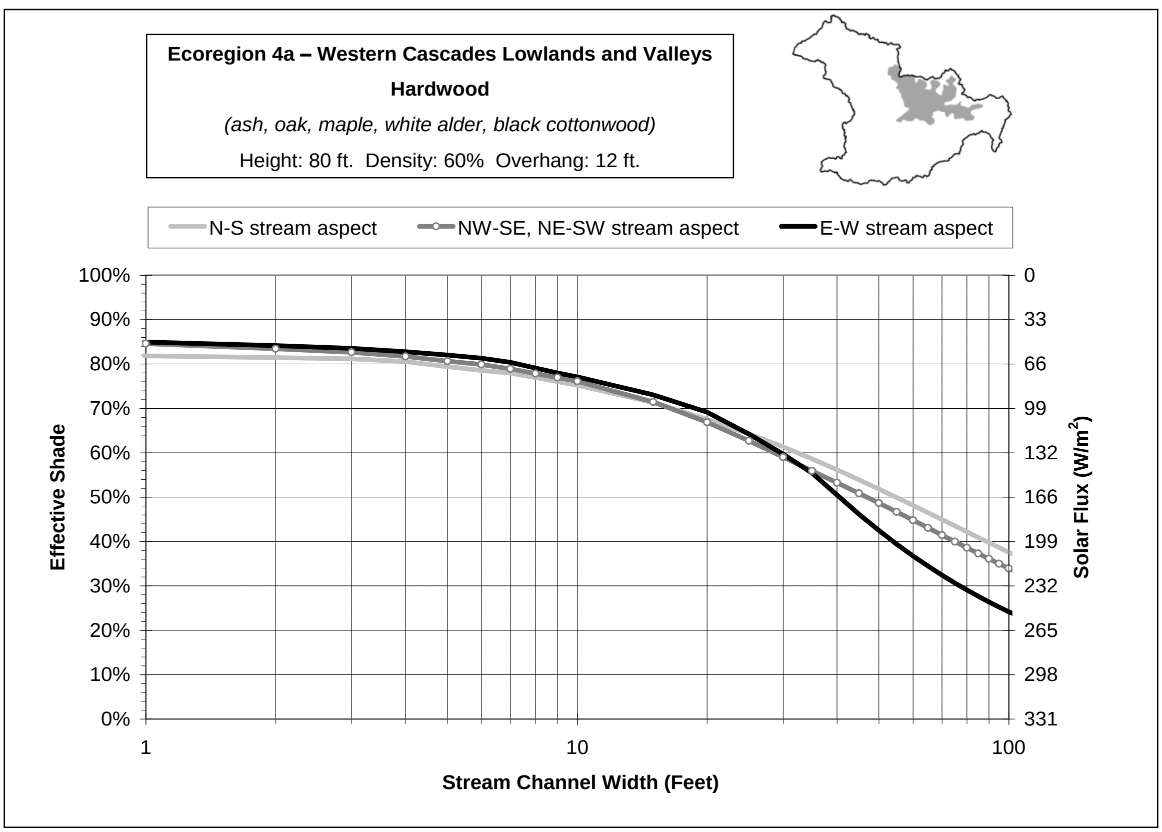

Ecoregion 1g – Mid-Coastal Sedimentary
50% Conifer – 50% Hardwood Mix
(Douglas fir, alder, red cedar, maple, hemlock, Grand fir)
Height: 110 ft. Density: 70% Overhang: 14 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

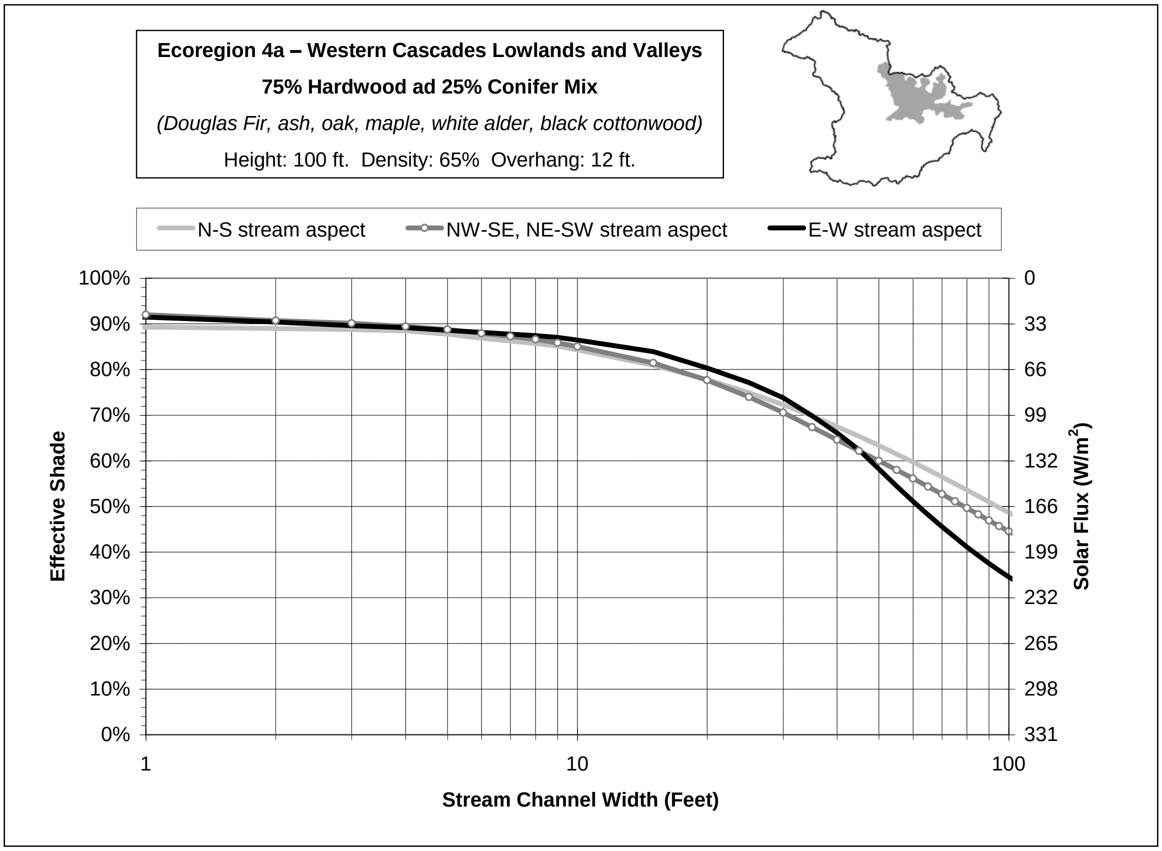

Ecoregion 3d – Valley Foothills
Conifer
(Douglas Fir, hemlock)
Height: 150 ft. Density: 80% Overhang: 15 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

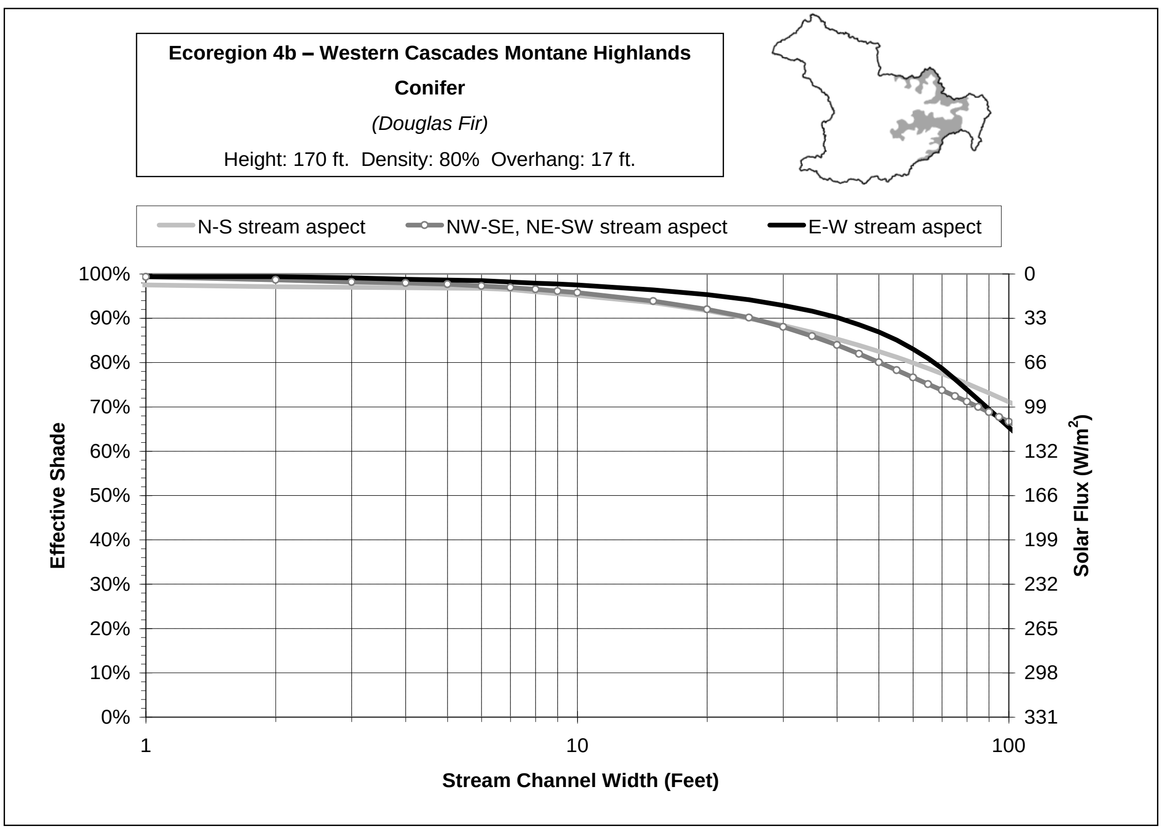

Ecoregion 3d – Valley Foothills
Hardwood
(ash, maple, alder)
Height: 40 ft. Density: 65% Overhang: 6 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

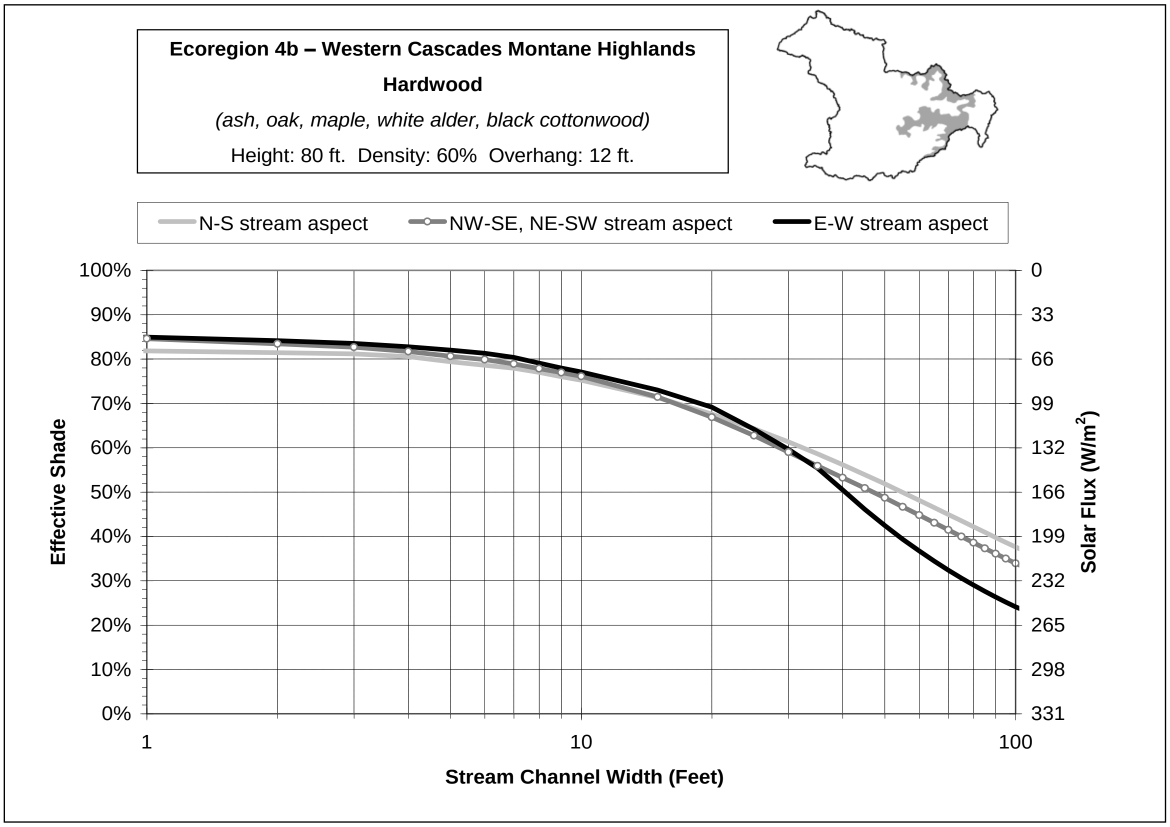

Ecoregion 3d – Valley Foothills
50% Hardwood – 50% Conifer Mix
(Douglas fir, hemlock, ash, maple, alder)
Height: 80 ft. Density: 70% Overhang: 10 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

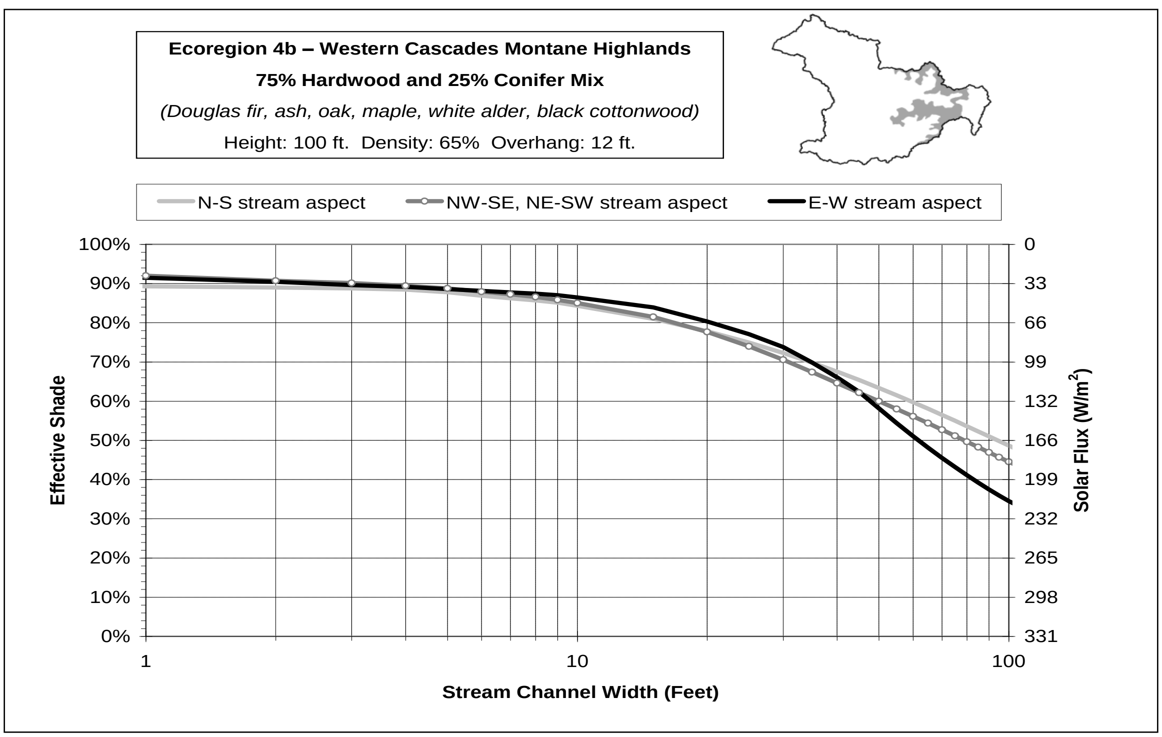

Ecoregion 4a – Western Cascades Lowlands and Valleys
Conifer
(Douglas Fir)
Height: 170 ft. Density: 80% Overhang: 17 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
Solar Flux (W/m2)
Stream Channel Width (Feet)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
33
66
99
132
166
199
232
265
298
331
1
10
100

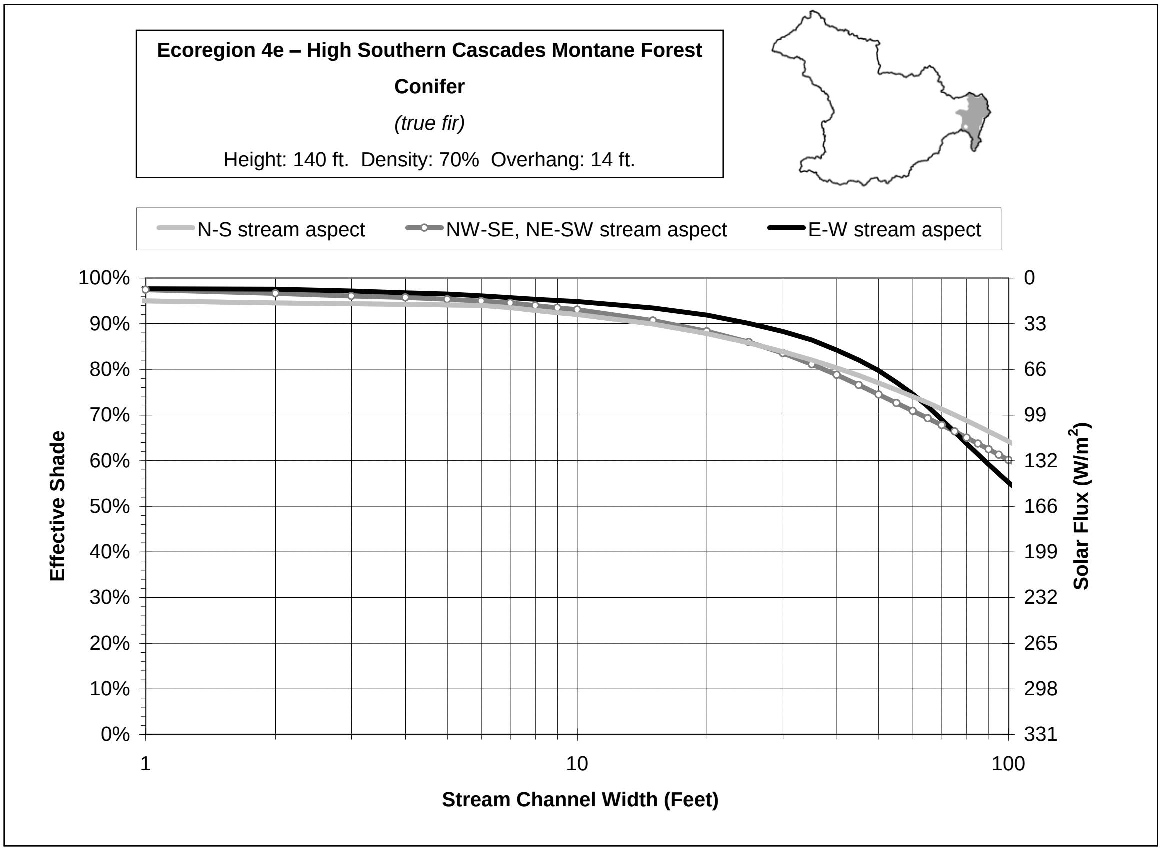

Ecoregion 4a – Western Cascades Lowlands and Valleys
Hardwood
(ash, oak, maple, white alder, black cottonwood)
Height: 80 ft. Density: 60% Overhang: 12 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
Solar Flux (W/m2)
Stream Channel Width (Feet)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
33
66
99
132
166
199
232
265
298
331
1
10
100


Ecoregion 4a – Western Cascades Lowlands and Valleys
75% Hardwood ad 25% Conifer Mix
(Douglas Fir, ash, oak, maple, white alder, black cottonwood)
Height: 100 ft. Density: 65% Overhang: 12 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

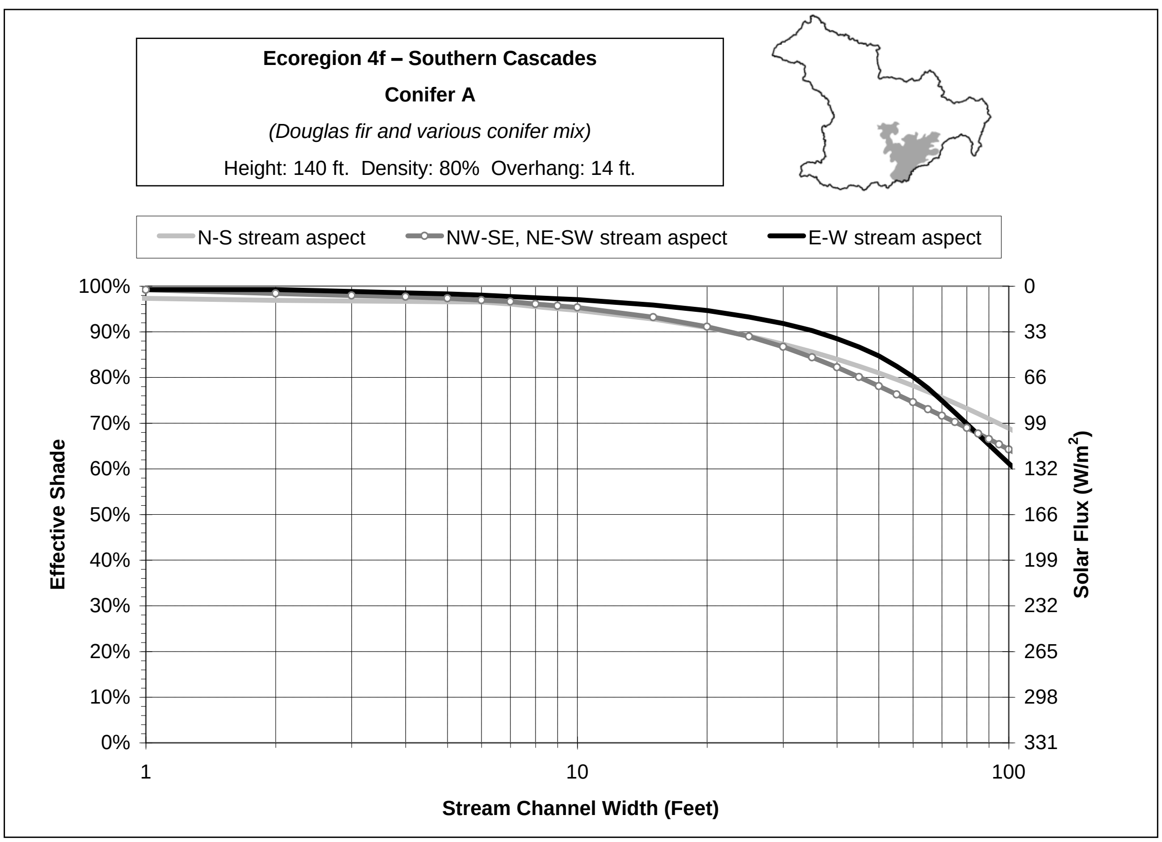

Ecoregion 4b – Western Cascades Montane Highlands
Conifer
(Douglas Fir)
Height: 170 ft. Density: 80% Overhang: 17 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)


Ecoregion 4b – Western Cascades Montane Highlands
Hardwood
(ash, oak, maple, white alder, black cottonwood)
Height: 80 ft. Density: 60% Overhang: 12 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

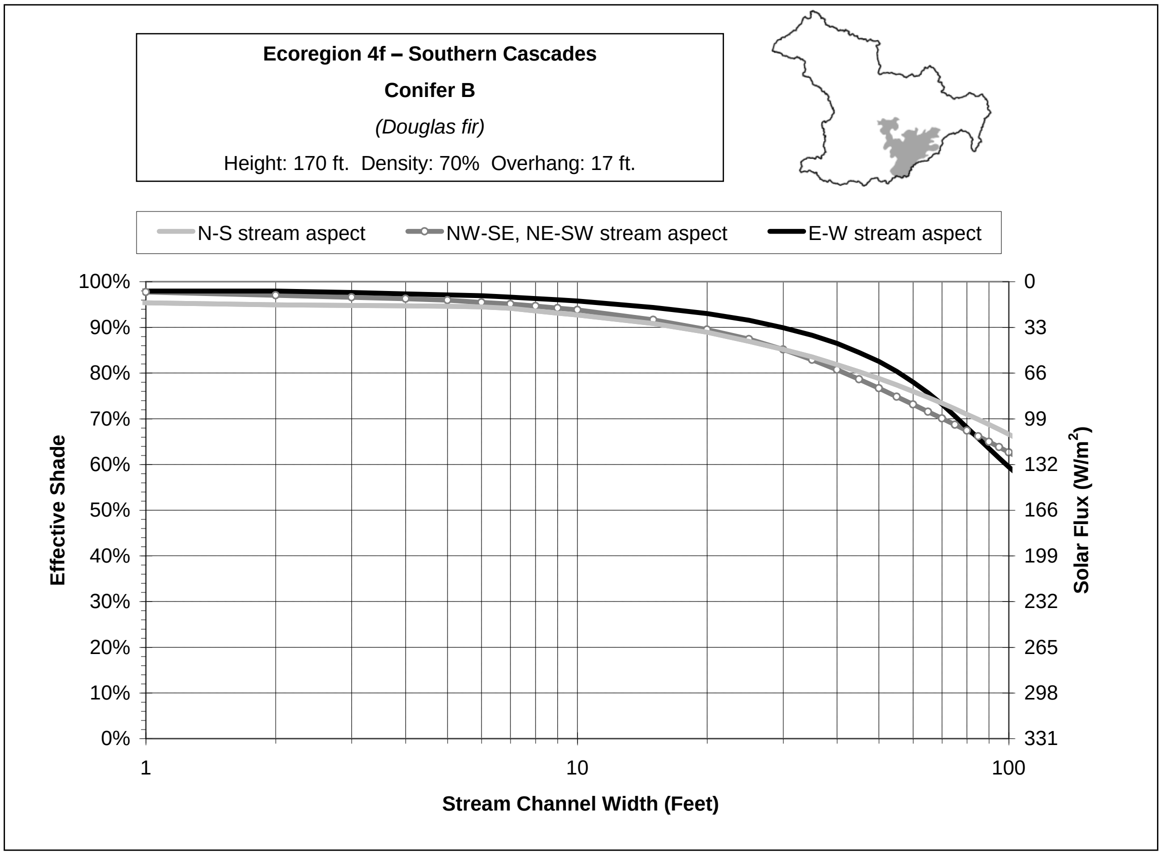

Ecoregion 4b – Western Cascades Montane Highlands
75% Hardwood and 25% Conifer Mix
(Douglas fir, ash, oak, maple, white alder, black cottonwood)
Height: 100 ft. Density: 65% Overhang: 12 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)



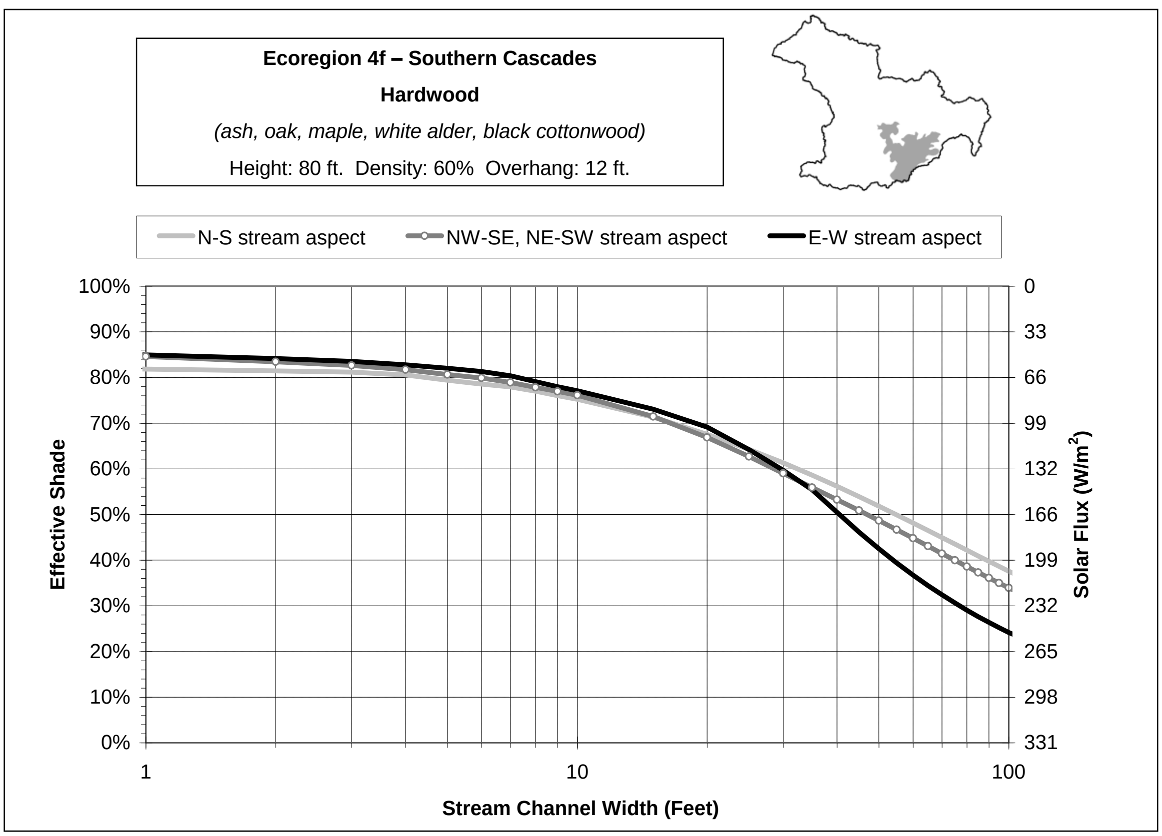
Ecoregion 4e – High Southern Cascades Montane Forest
Conifer
(true fir)
Height: 140 ft. Density: 70% Overhang: 14 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)



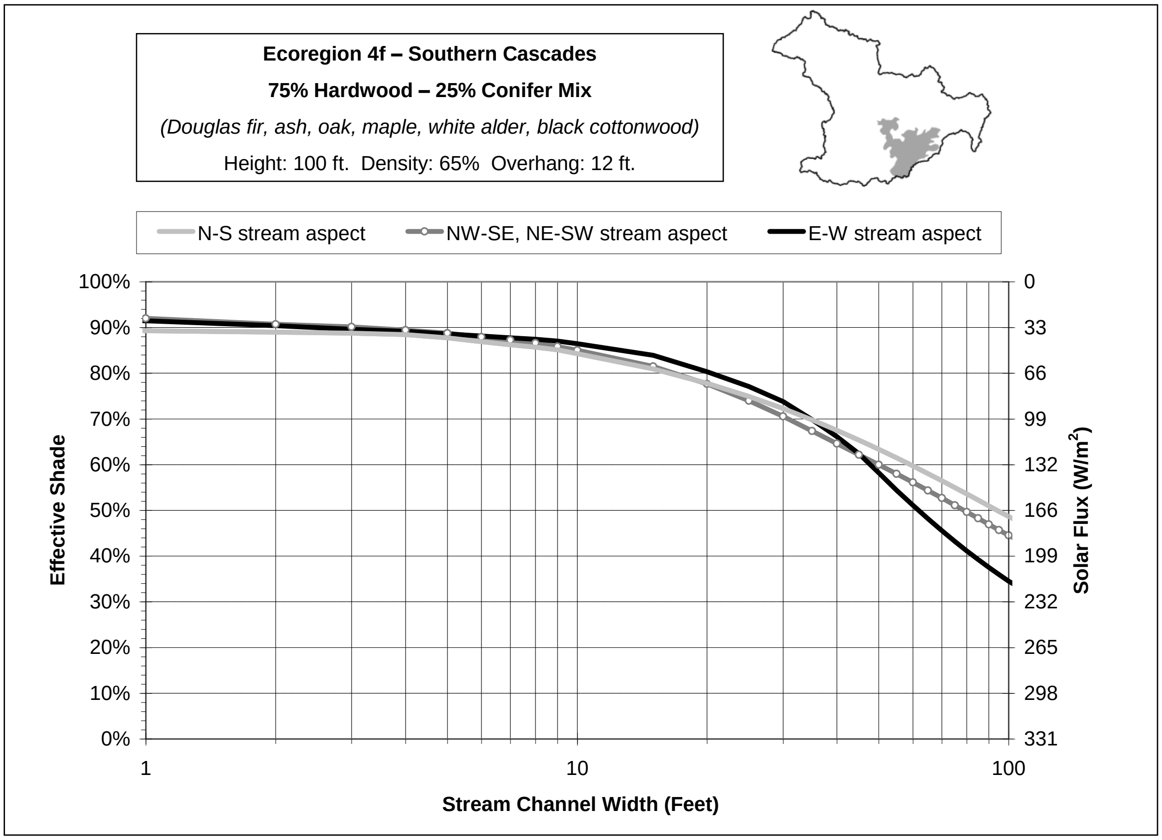
Ecoregion 4f – Southern Cascades
Conifer A
(Douglas fir and various conifer mix)
Height: 140 ft. Density: 80% Overhang: 14 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

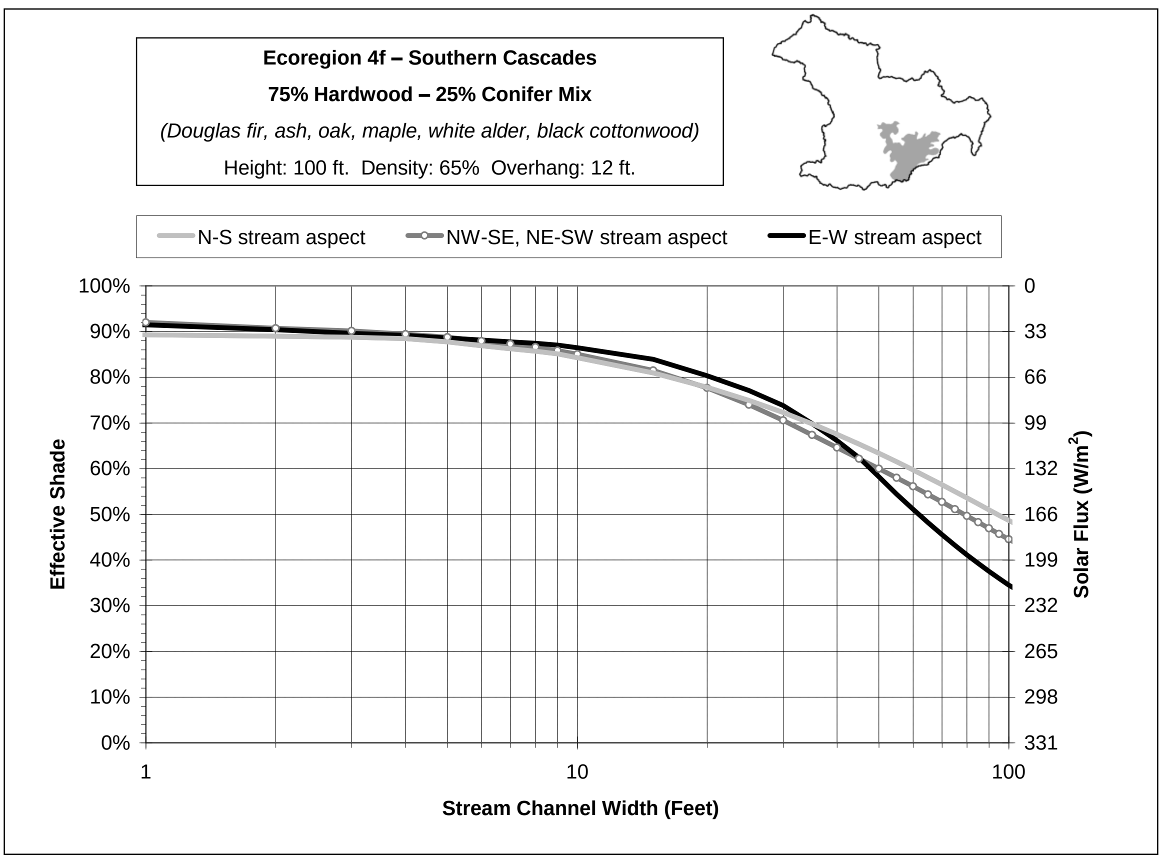


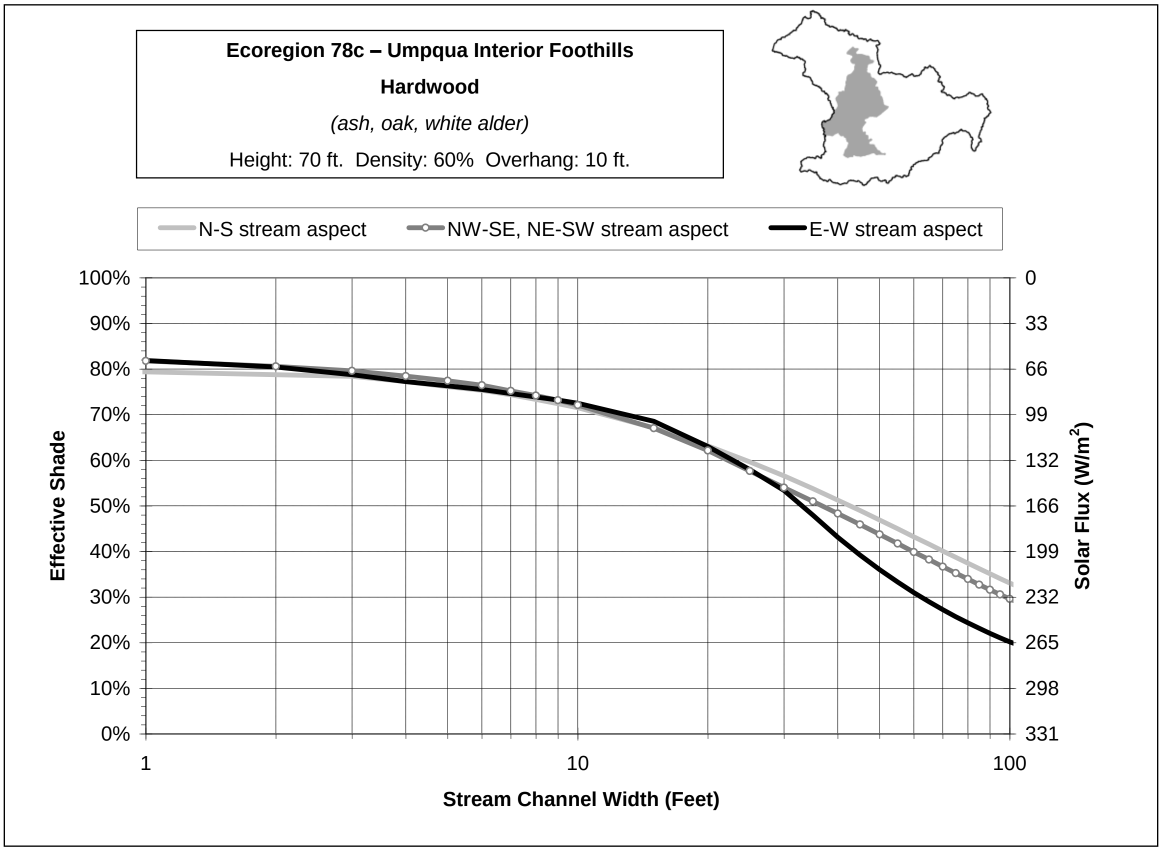
Ecoregion 4f – Southern Cascades
Conifer B
(Douglas fir)
Height: 170 ft. Density: 70% Overhang: 17 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

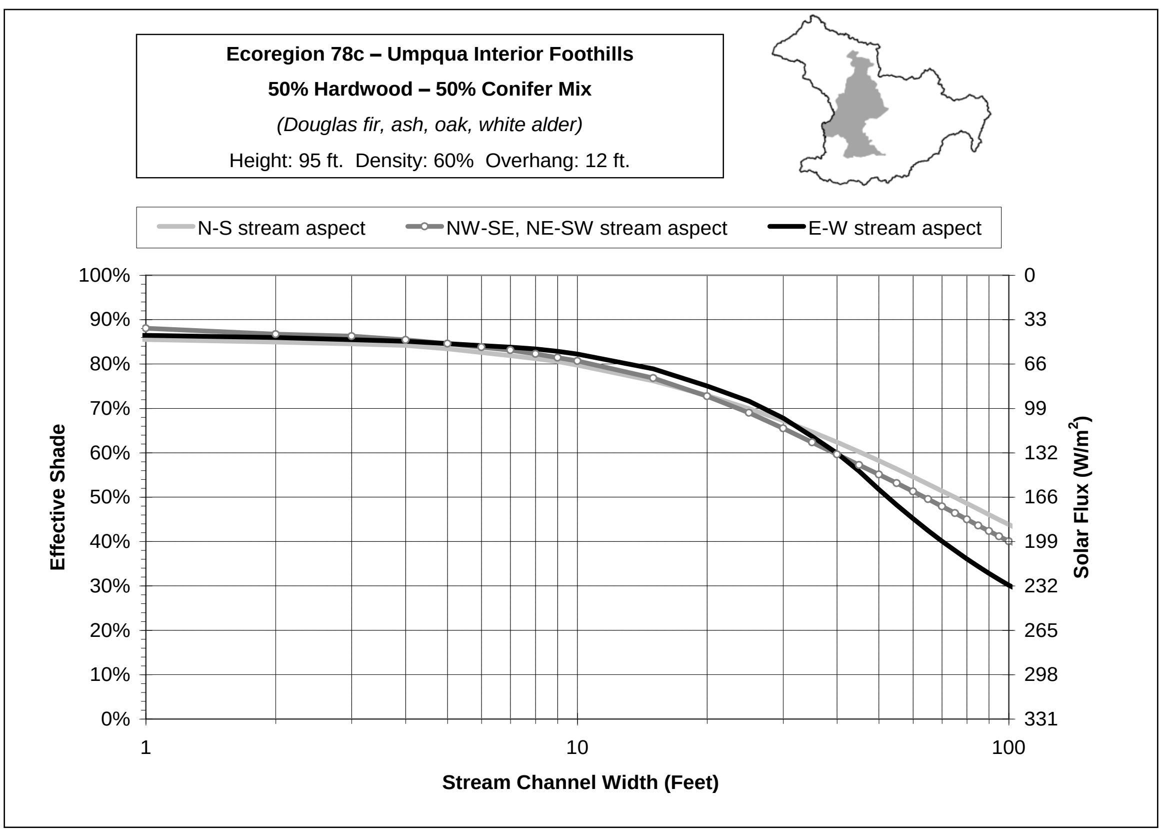


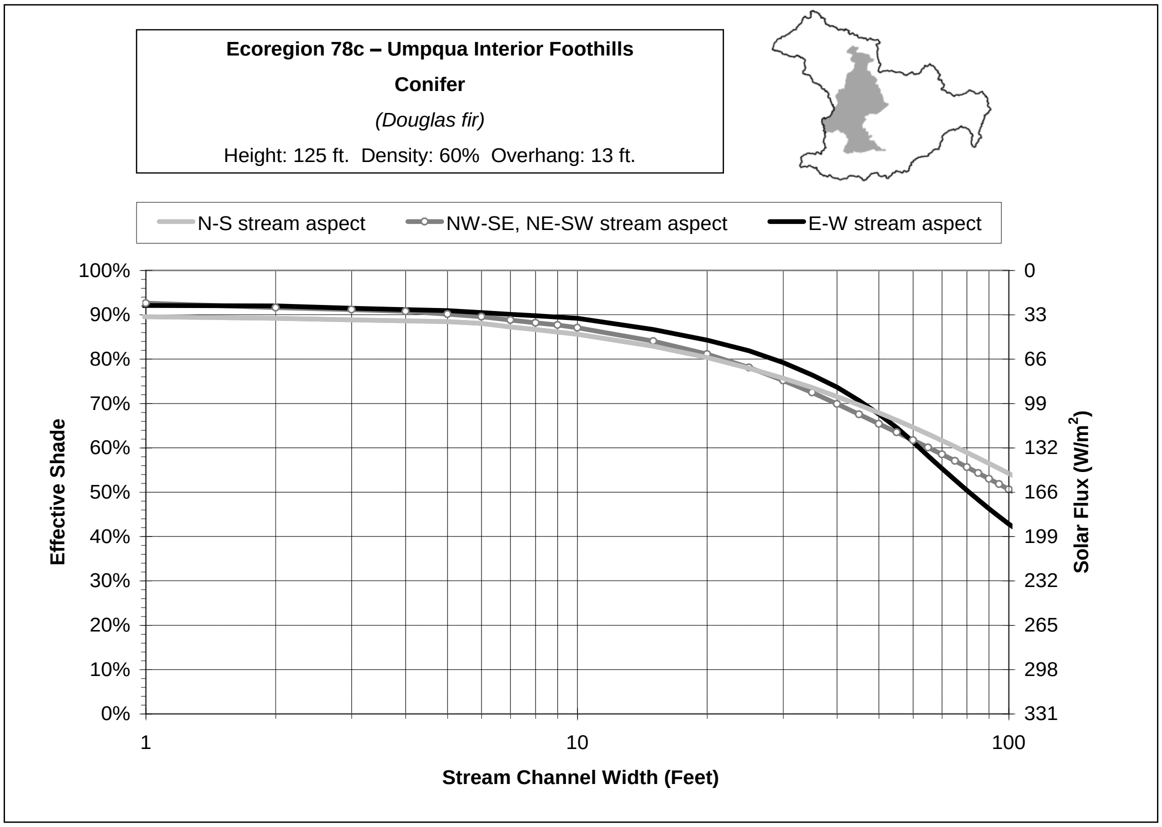
Ecoregion 4f – Southern Cascades
Hardwood
(ash, oak, maple, white alder, black cottonwood)
Height: 80 ft. Density: 60% Overhang: 12 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m2)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

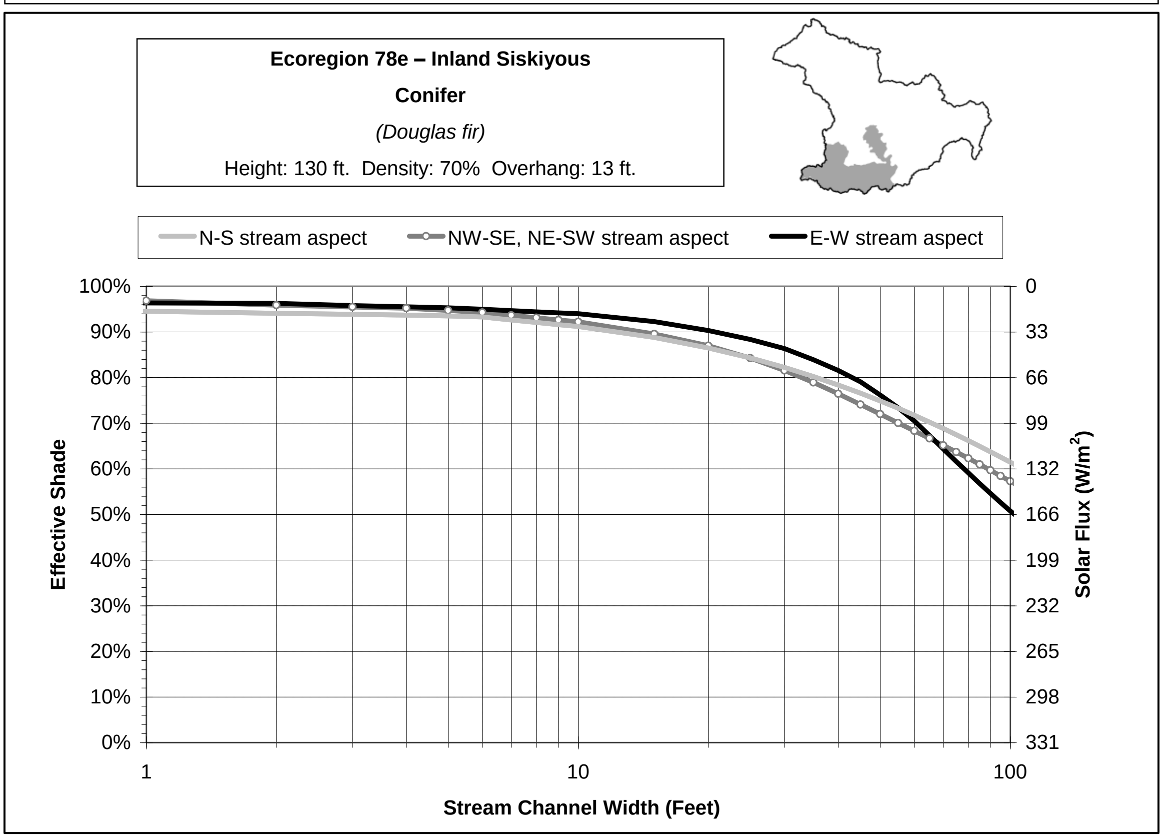

Ecoregion 4f – Southern Cascades
75% Hardwood – 25% Conifer Mix
(Douglas fir, ash, oak, maple, white alder, black cottonwood)
Height: 100 ft. Density: 65% Overhang: 12 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
Solar Flux (W/m2)
Stream Channel Width (Feet)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
33
66
99
132
166
199
232
265
298
331
1
10
100

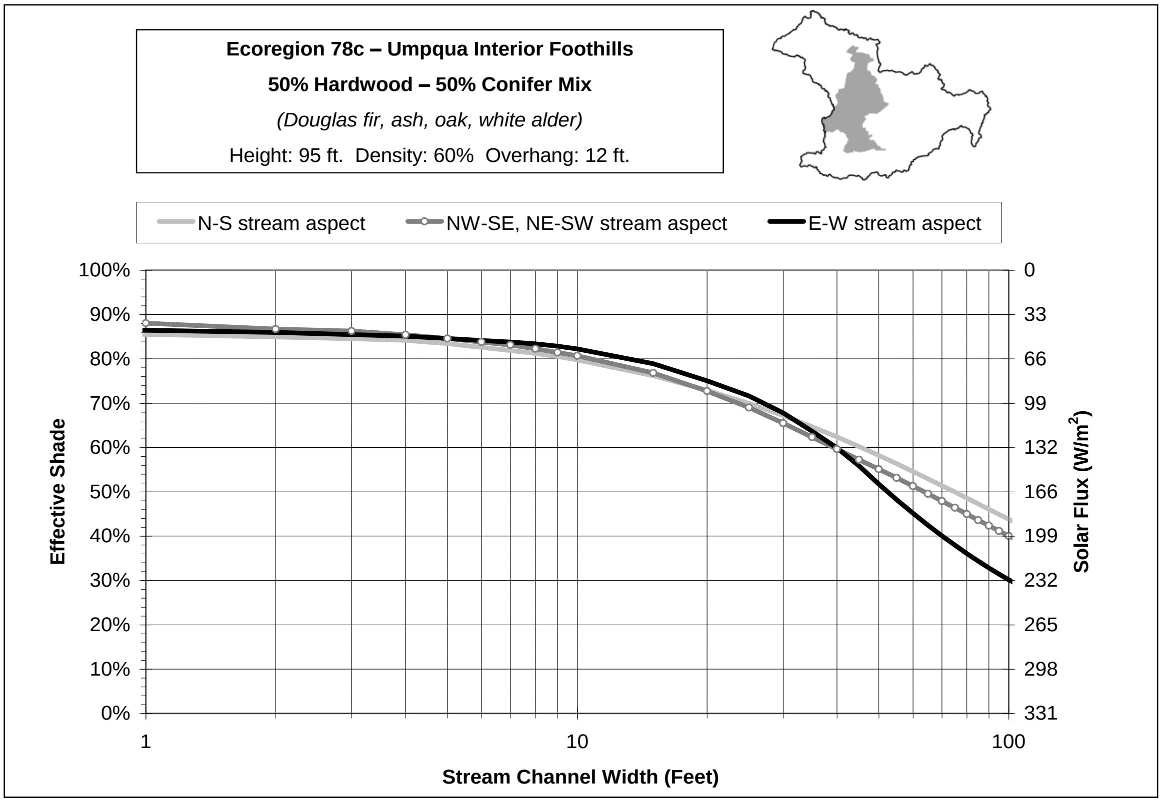

Ecoregion 4f – Southern Cascades
75% Hardwood – 25% Conifer Mix
(Douglas fir, ash, oak, maple, white alder, black cottonwood)
Height: 100 ft. Density: 65% Overhang: 12 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
Solar Flux (W/m2)
Stream Channel Width (Feet)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
33
66
99
132
166
199
232
265
298
331
1
10
100

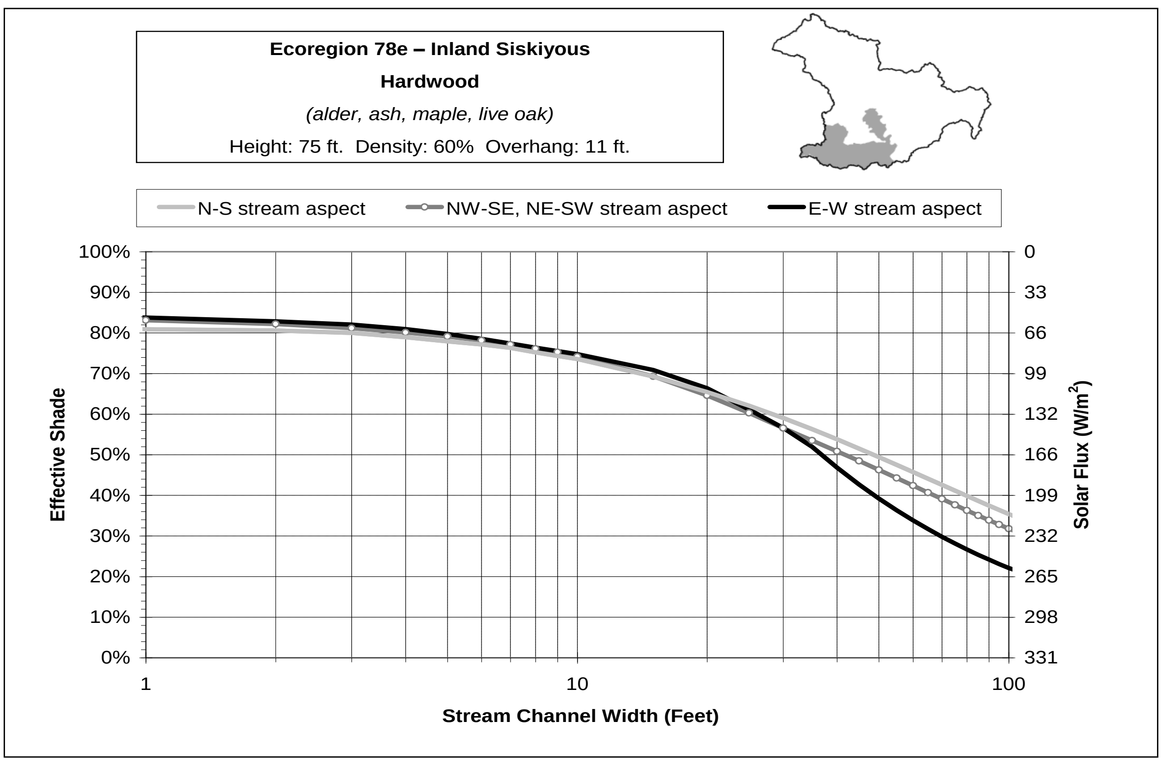

Ecoregion 78c – Umpqua Interior Foothills
Hardwood
(ash, oak, white alder)
Height: 70 ft. Density: 60% Overhang: 10 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m²)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)


Ecoregion 78c – Umpqua Interior Foothills
50% Hardwood – 50% Conifer Mix
(Douglas fir, ash, oak, white alder)
Height: 95 ft. Density: 60% Overhang: 12 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m²)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)


Ecoregion 78c – Umpqua Interior Foothills
Conifer
(Douglas fir)
Height: 125 ft. Density: 60% Overhang: 13 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
Solar Flux (W/m2)
Stream Channel Width (Feet)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
33
66
99
132
166
199
232
265
298
331
1
10
100


Ecoregion 78e – Inland Siskiyous
Conifer
(Douglas fir)
Height: 130 ft. Density: 70% Overhang: 13 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
Solar Flux (W/m2)
Stream Channel Width (Feet)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
33
66
99
132
166
199
232
265
298
331
1
10
100


Ecoregion 78c – Umpqua Interior Foothills
50% Hardwood – 50% Conifer Mix
(Douglas fir, ash, oak, white alder)
Height: 95 ft. Density: 60% Overhang: 12 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m²)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)


Ecoregion 78e – Inland Siskiyous
Hardwood
(alder, ash, maple, live oak)
Height: 75 ft. Density: 60% Overhang: 11 ft.
N-S stream aspect
NW-SE, NE-SW stream aspect
E-W stream aspect
Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Solar Flux (W/m²)
0
33
66
99
132
166
199
232
265
298
331
1
10
100
Stream Channel Width (Feet)

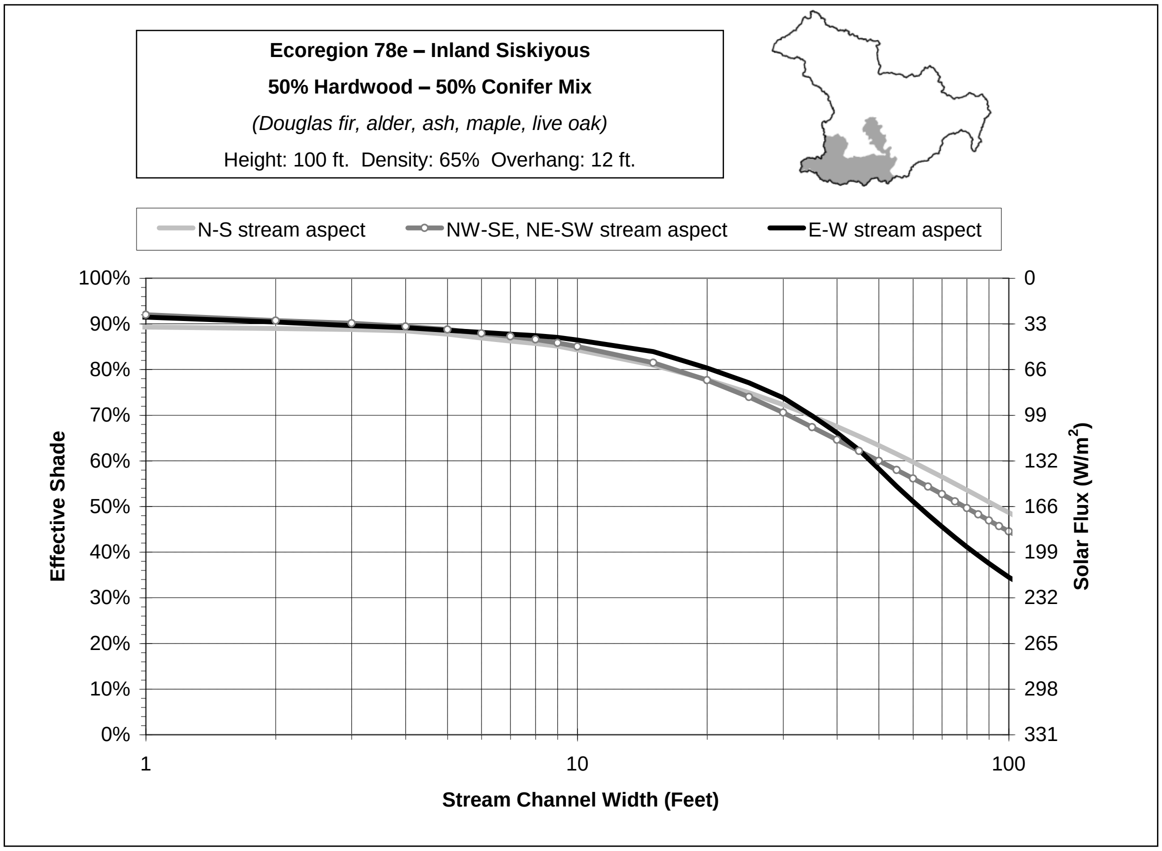


Figure 55 Ecoregion shade curves.

Dam and Reservoir Operations

EPA is using in-stream temperature as a surrogate measure to implement the thermal load allocation for dam and reservoir operations. Dam and reservoir operations have been assigned human use allowances per Tables 30 - 32 and the equivalent load allocation as calculated using Equation 6. However, monitoring stream temperature, rather than a thermal load, is easier and a more informative approach for reservoir management. Temperature increases are mathematically related to excess thermal loading and directly linked to the temperature water quality standard.

Consistent with other temperature TMDL projects in Oregon, EPA is applying the following surrogate measure temperature approach to implement the load allocation. The surrogate measure compliance point is located just downstream of the dam or just downstream of where impounded water is returned to the free-flowing stream. The surrogate measure is:

a) The 7DADM temperatures immediately upstream of the reservoir. If multiple streams flow into the reservoir, 7DADM temperatures upstream of the reservoirs may be calculated as a flow-weighted mean of temperatures from each inflowing tributary. The estimated free flowing (no dam) temperatures may be calculated using a mechanistic or empirical model to account for any warming or cooling that would occur through the reservoir reaches absent the dam and reservoir operations. The results may be applied as the temperature surrogate measure or to adjust the 7DADM temperatures monitored immediately upstream of the reservoirs. Use of the model approach for the surrogate measure must be approved by DEQ during implementation of the TMDL. Compliance with the surrogate measure is assessed daily.

b) Additional adjustments to the surrogate measure temperature value, calculated or measured, under item a) may be allowed when all the following are true:

    i. Monitoring data shows 7DADM temperatures do not exceed the applicable temperature criteria in the assessment unit downstream of the dam;
    ii. The protecting cold water criterion at OAR 340-041-0028(11) does not apply. See Section 4.1.6 for information on locations in the Umpqua basin related to this provision.
    iii. A cumulative effects analysis, approved by DEQ, demonstrates that dam release water temperatures warmer than the surrogate measure calculated or measured under item a) will result in attainment of the dam and reservoir assigned HUA above the applicable criteria in downstream waters.

The dam and reservoir surrogate measures are expected to attain the assigned human use allowance and load allocation because it targets 7DADM temperatures no warmer than those upstream of the reservoir. If further modeling and analyses during implementation demonstrate the need for additional measures to fully protect beneficial uses, DEQ may require and approve additional measures during TMDL implementation. For implementation the flow used in Equation 4 shall be calculated from monitoring gages upstream of the reservoir or at nearby gage that is not influenced by the dam operations.

Channel Modification & Widening

Based on allocation from the 2006 TMDL project, Figure 56 shows the existing and targeted channel widths for Cow Creek from Galesville Reservoir (river mile 60) to the mouth. In most reaches, the current and target channel widths are the same value. River miles 50 through 41 has current channel widths that are up to 5 times wider than similar upstream and downstream areas. It is the only reach within the Umpqua River Basin Temperature TMDL project area that was identified as having significantly wider channel widths than would be expected under natural conditions. Channel width targets have been developed as one of the surrogate measures. Channel widths are “capped” at 30 feet between river miles 50 and 41. This value is representative of the upper range of channel widths measured both upstream and downstream of this reach.

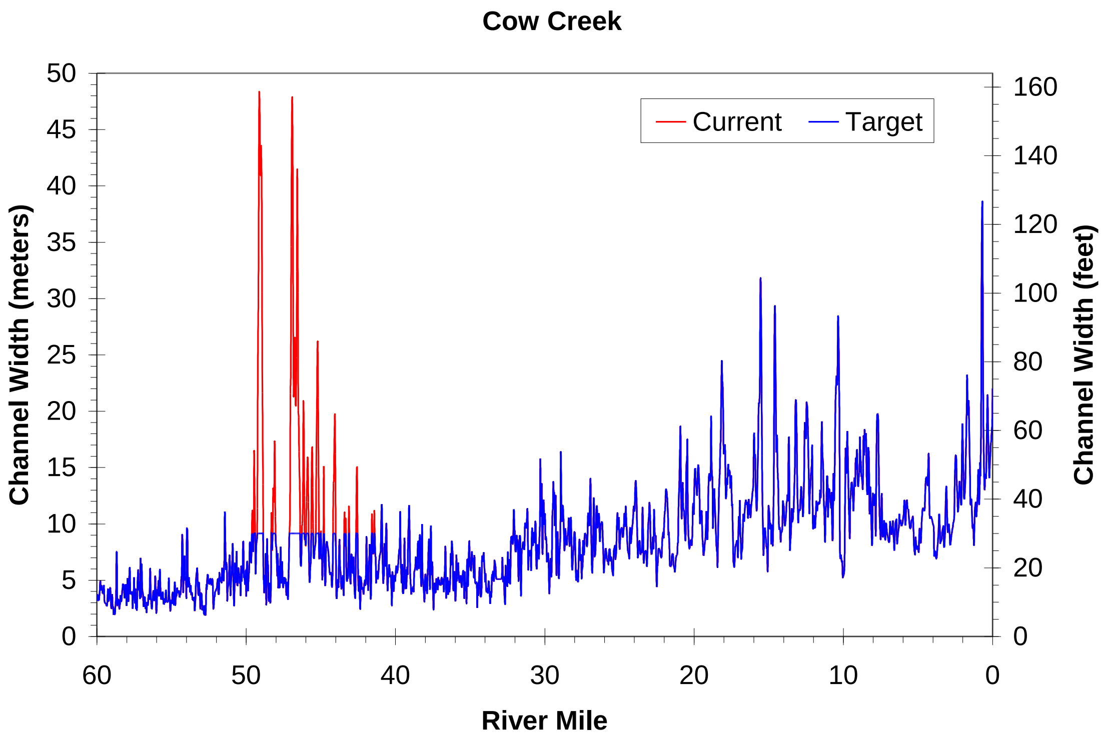


Figure 56 Cow Creek Channel Widths

Allocation Summary

Table 37 and 38 present examples of allocation calculations for source or source categories; detailed information and equations to calculate specific allocations are presented in the sections above. The allocations to background sources were calculated using Equation 3 and were based on the applicable year-round and spawning criteria. The allocations to NPDES point sources were calculated using Equation 2. The example allocations presented in Tables 37 and 38 were calculated using the annual 7Q10 river flow. As described above, allocations may be dynamic and calculated using the relevant equations when river flow rates are greater than the 7Q10.

Table 37 Example allocation summary for Deer Creek – South Umpqua (HUC 10: 1710030213)

Source or Source Category	Assigned HUA (°C)	7Q10 Year-Round Allocation (kcal/day)	7Q10 Spawning Allocation (kcal/day)
Background	0	5.28E+09	3.82E+09
NPDES point sources	0.1	2.94E+07	2.94E+07
Water management and water withdrawals	0.05	1.47E+07	1.47E+07
Solar loading from existing infrastructure	0.05	1.47E+07	1.47E+07
Solar loading from other NPS source categories	0	0	0
Dam and reservoir operations	0	0	0
Reserve capacity	0.1	2.94E+07	2.94E+07
Total allocated load		5.37E+09	3.90E+09
Loading capacity		5.37E+09	3.90E+09

Table 38 Example allocation summary for Upper North Umpqua and Clearwater (HUC 10: 1710030105 and 1710030103)

Source or Source Category	Assigned HUA (°C)	7Q10 Year-Round Allocation (kcal/day)	7Q10 Spawning Allocation (kcal/day)
Background	0	2.79E+10	Not applicable
NPDES point sources	0.075	1.16E+08	
Water management and water withdrawals	0	0	
Solar loading from existing infrastructure	0	0	
Solar loading from other NPS source categories	0	0	
Dam and reservoir operations	0.225	3.49E+08	
Total allocated load		2.84E+10	
Loading capacity		2.84E+10	

10 Allocation Attainment

EPA conducted modeling to evaluate if the assigned human use allowances and associated allocations will attain the allowable thermal increase (0.3°C Human Use Allowance) in the Umpqua Basin. Various modeling scenarios were developed to assess the individual TMDL components separately (e.g., separate scenarios for wasteload allocations, load allocations, etc). This section presents key results for the various scenarios. See Appendix G for detailed information on modeling.

Wasteload allocation attainment results

The current individual NPDES permitted facilities were ascribed wasteload allocations reflecting the maximum possible daily wasteload allocation. The cumulative maximum 7DADM temperature increase associated with wasteload allocations on the South Umpqua River was 0.086°C at the point of maximum impact (river km 32.8) (Figure 57). The cumulative maximum 7DADM temperature increase associated with wasteload allocations on Cow Creek was also 0.086°C at the point of maximum impact (river km 0.9) (Figure 58). In the North Umpqua the cumulative maximum 7DADM temperature increase associated with wasteload allocations was 0.04°C at the point of maximum impact (river km 42.4) (Figure 59). The cumulative thermal increase from point source WLA does not exceed the assigned 0.1°C.

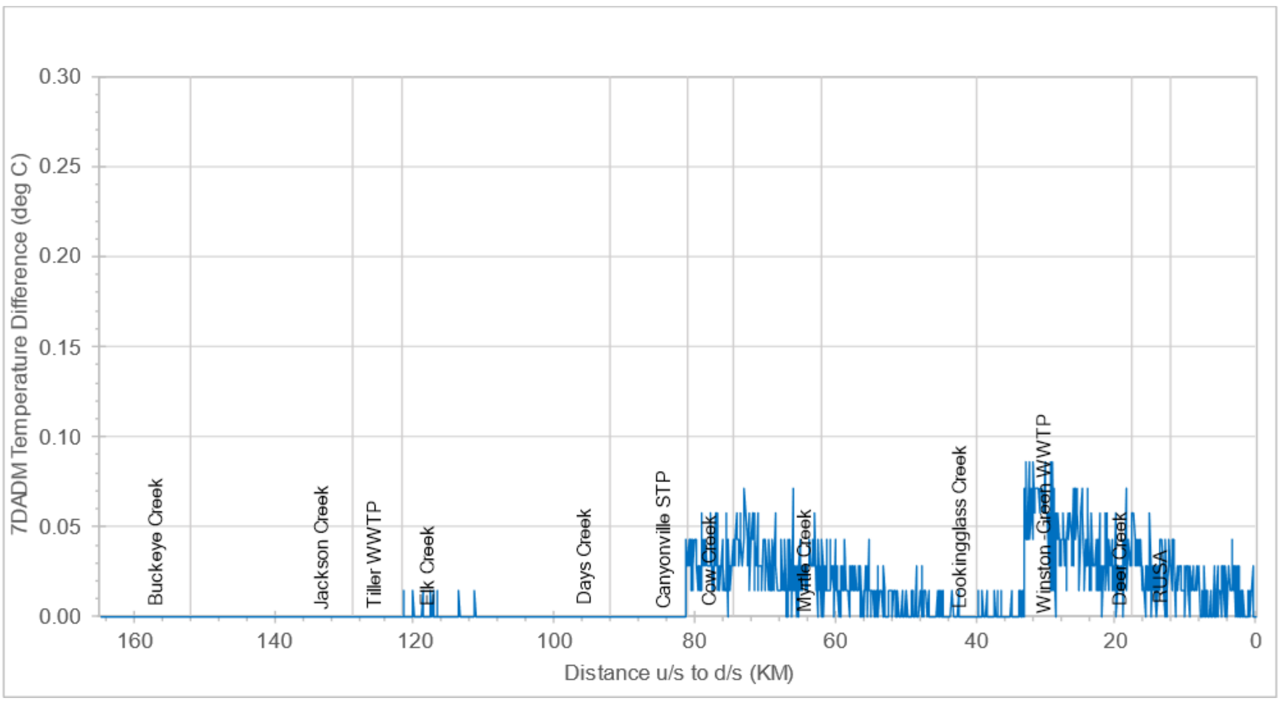


Figure 57 South Umpqua River, max 7DADM temperature change above the applicable criteria due to implementation of all human use allowances for WLAs.

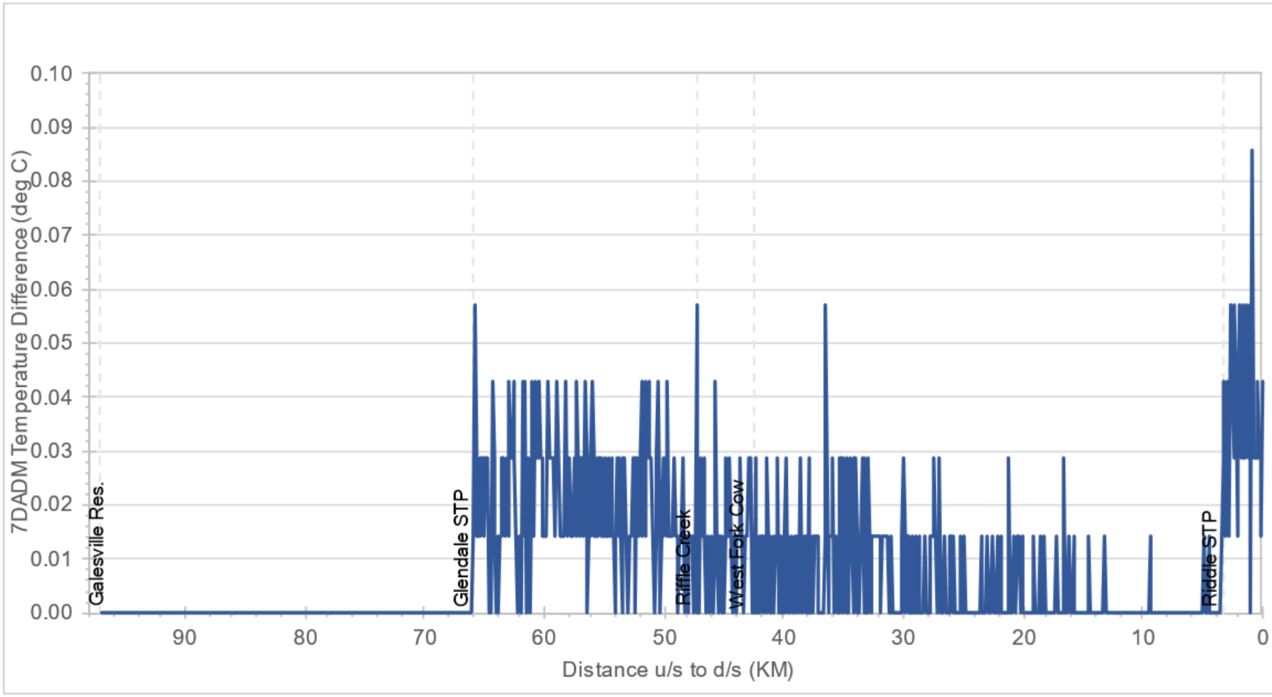


Figure 58 Cow Creek, max 7DADM temperature change above the applicable criteria due to implementation of all human use allowances for WLAs.

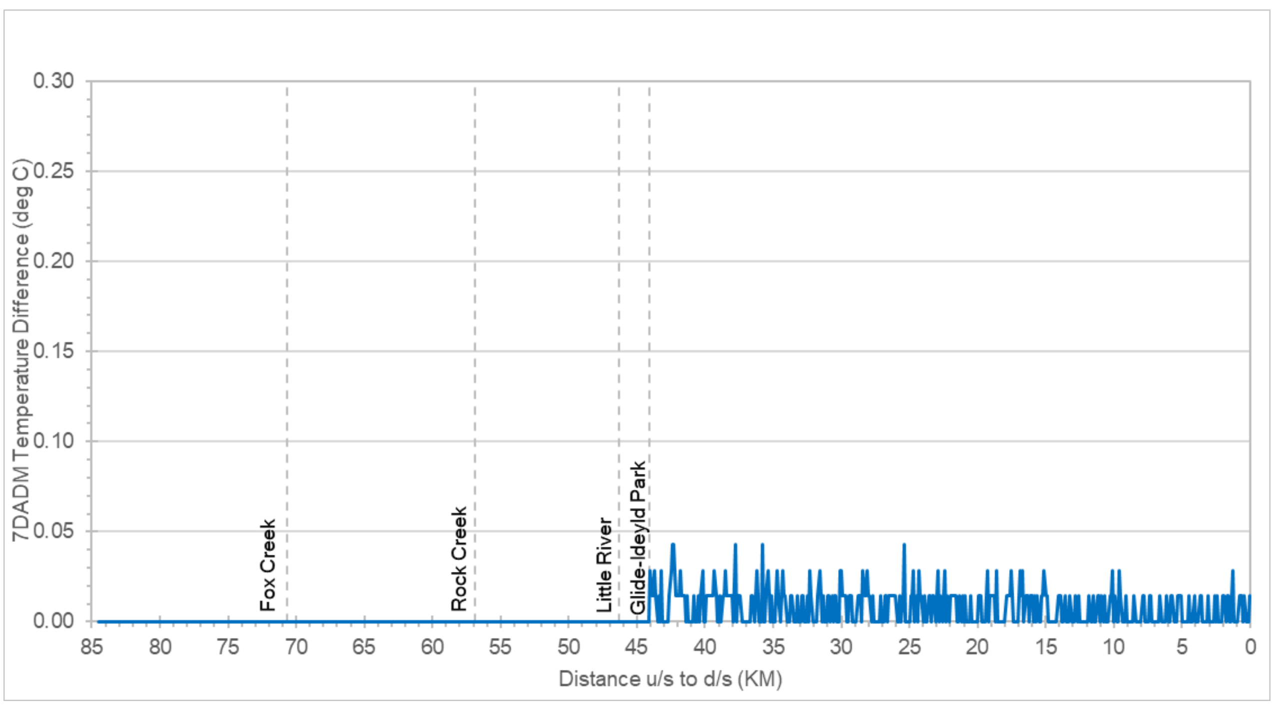


Figure 59 North Umpqua, max 7DADM temperature change above the applicable criteria due to implementation of all human use allowances for WLAs.

Comprehensive Wasteload and Load Allocation Assessment

To determine if the combined attainment of the various proposed individual Wasteload and Load Allocations would be sufficient to meet the cumulative Human Use Allowance (0.30°C), EPA conducted modeling that incorporated all such allocations for a comprehensive assessment. In this scenario point sources reflect maximum possible daily wasteload allocations and restored vegetation. The scenario employes linked modes from both North and South Umpqua rivers to ensure cumulative downstream impacts on the Umpqua does not exceed the 0.3 °C HUA. In the Umpqua river the cumulative maximum 7DADM temperature increase associated with wasteload, and load allocations was 0.1° C which occurred at multiple locations (Figure 60).

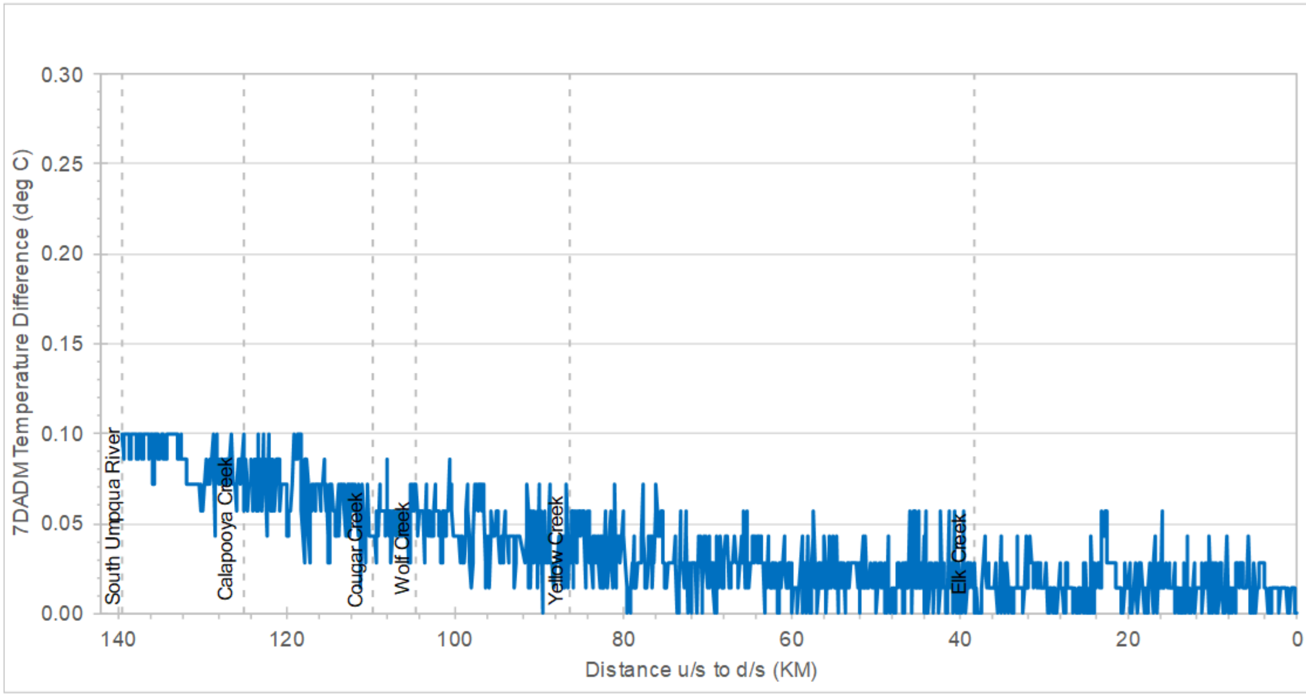


Figure 60 Umpqua River, the maximum 7DADM temperature change above the applicable criteria due to implementation of all human use allowances for WLAs and load allocation on the South and North Umpqua rivers.

North Umpqua Hydroelectric Project Surrogate Measure Attainment

To assess the temperature changes on the North Umpqua River due to the Hydroelectric Project dams and reservoirs with discharges reflecting the proposed 0.30 °C dam and reservoir Human Use Allowance, EPA compared the North Umpqua River background scenario to the North Umpqua River dam surrogate measure attainment scenario (Appendix G for details). Results (Figures 61 and 62) indicated that at the greatest maximum 7DADM temperature change was 0.14 °C at river kilometer 37.60 for the summer season. In the spawning season, maximum 7DADM temperature change was 0.1 °C at river kilometer 61.

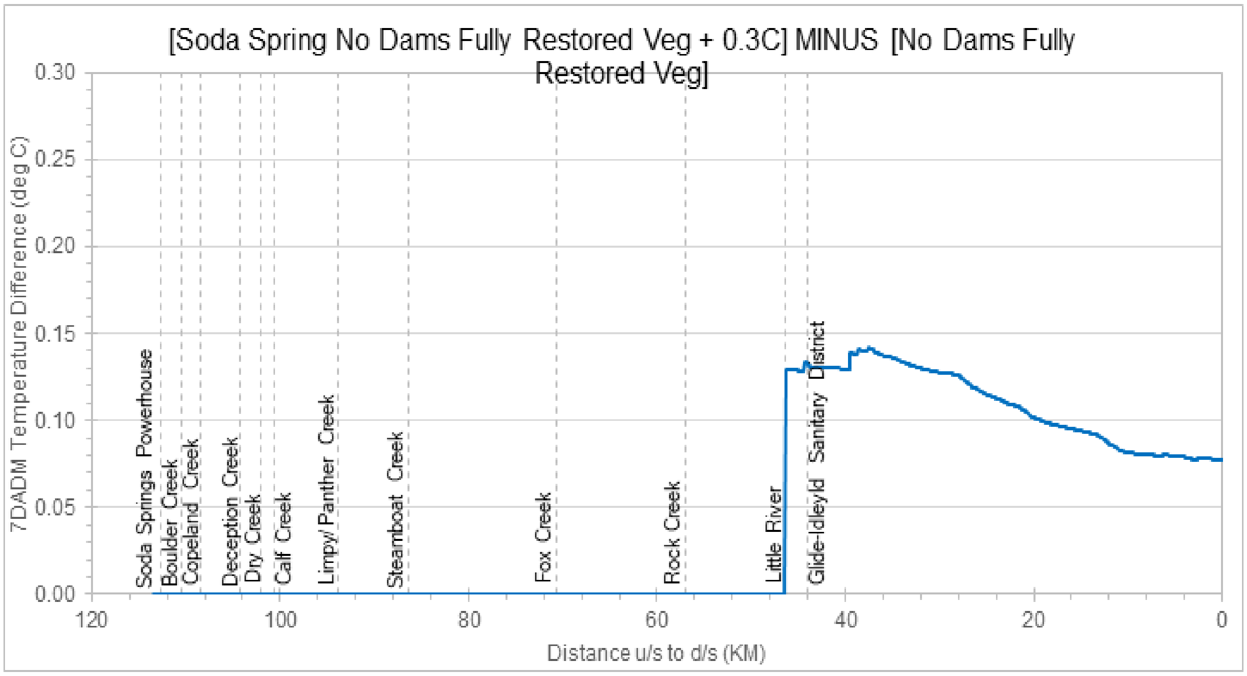


Figure 61 North Umpqua River, the maximum 7DADM temperature change above the applicable criteria due to implementation of the North Umpqua hydroelectric project surrogate measure (summer season).

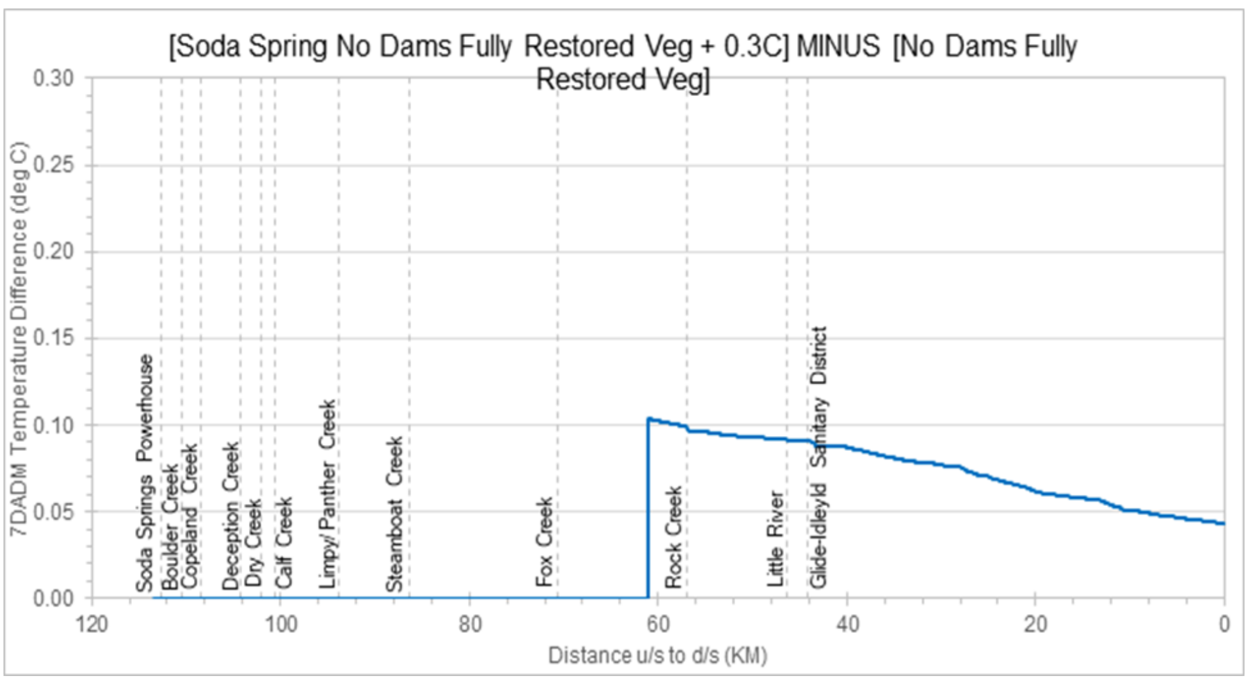


Figure 62 North Umpqua River, the maximum 7DADM temperature change above the applicable criteria due to implementation of the North Umpqua hydroelectric project surrogate measure (spawning season).

11 Margin of Safety

The CWA implementing regulations at CFR 130.7(c)(1) require a TMDL to include a margin of safety. The margin of safety accounts for lack of knowledge or uncertainty concerning the relationship between effluent limits and water quality. This may result from limited data; an incomplete understanding of the exact magnitude or quantity of thermal loading from various sources; or the actual effect controls will have on loading reductions. The margin of safety is intended to account for such uncertainties in a manner that is conservative and will result in environmental protection. A margin of safety can be achieved through two approaches: (1) by implicitly using conservative analytical assumptions to develop allocations, or (2) by explicitly specifying a portion of the TMDL loading capacity as a margin of safety.

In the Umpqua Basin, an implicit margin of safety was used to derive allocations. The primary conservative assumptions include:

- Setting effluent flow rates at a maximum flow obtained from discharge monitoring reports for the model assessing the wasteload allocations. It is rare that point sources discharge at this maximum flow for sustained and long periods of time all at the same time.

- Setting effluent temperatures as high as 32 degrees Celsius for the model scenario assessing the wasteload allocations. On days when the current thermal load was less than the wasteload allocation, the EPA increased the assumed effluent temperatures to either 32 or the effluent temperature that would fully utilize the wasteload allocation. Point sources are unlikely to discharge maximum effluent temperatures, and if they occurred, would not be sustained over multiple days or weeks.

- The EPA conducted a cumulative effects analysis assuming that all sources used their the maximum allowable increase of 0.3 °C. as the basis for determining attainment of allocations. Sources infrequently use the entire maximum allowable increase of 0.3 °C which means that a portion of the loading capacity reserved for human use will go unutilized most of the time. The cumulative effects analysis was performed for modeled reaches and is described in the modeling report (Appendix G).

12 Reasonable Assurance

CWA section 303(d) requires that a TMDL be "established at a level necessary to implement the applicable water quality standard." According to 40 C.F.R. §130.2(i), "[i]f best management practices or other nonpoint source pollution controls make more stringent load allocations practicable, then wasteload allocations can be made less stringent." Providing reasonable assurance that nonpoint source control measures will achieve expected load reductions increases the probability that the pollution reduction levels specified in the TMDL will be achieved, and therefore, that applicable standards will be attained.

In a state-issued TMDL, the state documents reasonable assurance in the TMDL (or an implementation plan) through a description of how the load allocations will be met. The TMDL or the implementation plan generally describes both the potential actions for achieving the load allocations and the state's authorities and mechanisms for implementing nonpoint source pollution reductions. A state's implementation plan for nonpoint and point sources provides reasonable assurance that more stringent allocations are not necessary in order to implement the applicable water quality standard.

While the EPA is issuing these TMDLs, ODEQ will be primarily responsible for implementation of both the LAs and WLAs. ODEQ addresses TMDL implementation for nonpoint sources through state Water Quality Management Plans (WQMPs) (OAR 340-042-0040(4)(l)), which provide the framework for management strategies to attain and maintain WQS and are designed to work in conjunction with detailed implementation plans prepared by designated management agencies (DMAs).

Nonpoint sources typically implement their load allocations through a wide variety of programs (which may be regulatory, non-regulatory, or incentive-based, depending on the state or tribal program) and voluntary actions. Implementation of this TMDL will depend on development of implementation plans by the State of Oregon and DMAs, dam requirements put in place through 401 certification conditions, NPDES permits, and international efforts addressing climate change. Oregon promotes land and forestry stewardship incentive programs that provide funding for restoration and conservation projects. The states' nonpoint source management programs award project funds to third parties to support program implementation. States and federal agencies use watershed-based funding to work with both private and public landowners to protect soil and water resources, including addressing nonpoint source control measures. Implementation of these projects has a positive impact on reducing heat loading in the Umpqua River basin.

Progress towards Implementing the 2006 Umpqua Basin TMDL project

Since this temperature TMDL is a replacement of the original 2006 Umpqua Basin temperature TMDL considerable implementation progress has already occurred under an existing Umpqua Basin WQMP. This work to date supports attainment of WQS for this TMDL. Below are a list of administrative actions, projects, and grants that DMAs have completed or are working on. This demonstrates the commitment of agencies and organizations to implement allocations in the 2006 Umpqua Basin WQMP.

- In 2022 ODEQ approved 5-year TMDL NPS implementation plans for 13 DMAs, including Douglas County and the cities of Canyonville, Drain, Elkton, Glendale, Myrtle Creek, Oakland, Reedsport, Riddle, Roseburg, Sutherlin, Winston, and Yoncalla.

- These DMAs TMDL implementation plans describe projects and monitoring actions that each DMA is committing to for meeting allocations. Examples of actions include mapping riparian areas that need restoration, developing partnerships to promote riparian restoration, enforcing current riparian ordinances and protective overlays, and developing stream-friendly design standards.

- In 2023 ODEQ accepted TMDL NPS implementation annual reports from 13 DMAs. ODEQ also expects to accept 13 annual reports in 2024 as well. These annual reports describe each DMA's progress towards meeting their 5-year TMDL NPS implementation plans.

- The 2022 Oregon Statewide Status and Trends Report includes a summary of the restoration actions that have occurred in the Umpqua Basin (see Appendix E). Examples include riparian planting and maintenance, placement of large woody debris, boulders, and spawning gravel, and streambank stabilization.

- In 2023 Oregon Department of Agriculture designated the South Umpqua as a Strategic Implementation Area. This designation provides technical and financial assistance to help landowners address water quality concerns – including riparian restoration.

- In 2023 the South Umpqua River Collaborative formed to strategically plan and implement Coho Salmon recovery actions. Many of the identified strategies are included in the WQMP including increased stream shade, identify and protect thermal refugia, increased streamflow and hyporheic flows.

- Extensive real-time temperature monitoring occurs throughout the basin by partners including USFS, BLM and the Partnership for Umpqua Rivers.

Watershed restoration actions in the Umpqua basin are conducted by federal and state agencies, Soil and Water Conservation Districts, watershed councils, and private land owners. Projects are funded mainly by the Oregon Water Enhancement Board and Clean Water Act Section 319 nonpoint source grants. Below are recipients of Clean Water Act Section 319 nonpoint source grants in the Umpqua basin who have completed or are slated to complete projects:

- 2024 Douglas SWCD: This project will address temperature impairments in Pheasant Creek by establishing vegetation to produce shade and stabilize banks, install beaver dam analogs and root wads to increase stream structure, stream material, summer hyporheic flow, thermal refugia, and connection with riparian wetland.

- 2023 City of Winston: This project enhanced stormwater management across seven small cities in Douglas County. The city hired a contractor to map stormwater systems and integrate these maps into the County's GIS platform. Prior to this project, many of the participating cities did not have updated digital maps of their stormwater infrastructure.

- 2006 Dawson Ranch Riparian Restoration Project: This project installed 10,500 ft of riparian fencing and plant 6.9 acres of native vegetation to protect and enhance riparian shade.

- 2008 Partnership for Umpqua Rivers WQ Monitoring: This project collected real-time temperature data used to guide the practices necessary to preserve, protect, enhance and create cold water refugia in the Umpqua River thereby addressing the TMDL temperature issue.

- 2009 Partnership for Umpqua Rivers WQ Monitoring and Thermal Refugia Investigation: This project gathered synoptic temperature data to identify thermal refugia and define the diurnal response of sites and their interactions with the river.

Work towards Implementing this TMDL project

12.1.1 Water Quality Management Plan for Nonpoint Sources

In addition to administrative and implementation actions for the 2006 Umpqua Basin TMDL project, ODEQ also plans to issue another WQMP that will implement this TMDL project. Beginning in 2024, ODEQ began issuing its TMDLs and WQMPs to be adopted into rule by Oregon's Environmental Quality Commission. As rules, TMDLs and WQMPs require that all DMAs complete implementation plans, including Oregon Department of Agriculture and Oregon Department of Forestry. In past TMDLs, ODA and ODF relied on existing regulations to meet TMDL requirements and were not required to develop their own implementation plans to meet TMDL allocations.

In ODEQ's WQMP for the Umpqua TMDL project, the WQMP will identify agencies responsible for meeting the TMDLs. It will also list general pollution reduction strategies, timelines to implement strategies, specific implementation requirements, monitoring, and accountability frameworks. Within 18 months of EQC adoption of the WQMP, DMAs must submit implementation plans to DEQ for review and approval. Historically, ODEQ has assisted DMAs in the Umpqua Basin and other basin TMDLs, as needed, to provide guidance on completing an implementation plan. If a DMA fails to submit a plan, they can be subject to enforcement action under OAR 340-012-0055(2)(e). After ODEQ has approved an implementation plan, DMAs submit annual plans on their progress, and ODEQ reviews these annual reports and conducts a 5-year review. ODEQ's commitment to completing a new WQMP plan for this TMDL project provide reasonable assurance that DMAs will take concrete steps to implement the TMDLs and track progress towards meeting allocations.

12.1.2 NPDES Program for Point Sources

In addition to the WQMP, the NPDES program requires that permit limits are consistent with the requirements and assumptions of a TMDL wasteload allocation under 40 CFR 122.44(d)(1)(vii)(B). EPA has authorized ODEQ to issue all NPDES permits for point sources that discharge to Oregon waters and upon permit renewal WLAs will be incorporated into permits consistent with the TMDLs. The WLAs in this TMDL project are established to attain criteria, and renewed permits must include limits consistent with the wasteload allocations in the TMDLs, unless the state approves a site-specific criterion, in which case the TMDLs would need to be revised to reflect the new water quality standard. ODEQ has a permit plan which includes the schedules for when all permits will be reissued. ODEQ has published a Statewide Permit Issuance Plan for Federal Fiscal Years 2024-2028 (ODEQ, 2024) and General Permit Issuance Plan for Federal Fiscal Years 2024-2028 (ODEQ, 2023b).

Table 39 shows a list of individual permittees in the Umpqua Basin and the anticipated dates for permit reissuance. General permits will also be periodically updated per the General Permit Issuance Plan and will need to ensure that wasteload allocations are addressed. Similar to other TMDLs, ODEQ reached out to point sources and offered to meet individually with permittees to assist them in understanding how WLAs in this TMDL project will be translated to proposed permit limits. EPA and ODEQ also presented preliminary wasteload allocations and translation to permit limits.

This provides reasonable assurances that the wasteload allocations in this TMDL project will be incorporated into NPDES permits.

Table 39 Anticipated Reissuance Dates for Individual Permits in Umpqua Basin

Facility Name	NPDES Permit Number	Anticipated Permit Issuance Date
Brandy Bar Landing, Inc.	OR0030864	2026
Drain STP	OR0029645	2025
Oakland STP	OR0020494	2028

Facility Name	NPDES Permit Number	Anticipated Permit Issuance Date
Reedsport STP*	OR0020826	2026
Rice Hill East Lagoon	OR0029564	2024
Rice Hill West Lagoon	OR0028789	2028
Sutherlin STP	OR0020842	2024
Winchester Bay STP*	OR0022616	2026
Yoncalla STP	OR0022454	2026
Glide-Idleyld Sanitary District	OR0030261	2028
Rock Creek Fish Hatchery	ORG133509	No information
Canyonville STP	OR0020729	2027
Glendale STP	OR0022730	2027
Green Diamond Performance Materials, Inc.	OR0001627	2028
Hoover Treated Wood Products	OR0034380	2028
Myrtle Creek STP	OR0028665	2025
R.U.S.A. Roseburg STP	OR0031356	2028
Riddle STP	OR0020630	2028
USFS Tiller Ranger Station STP	OR0023221	2027
Winston-Green WWTF	OR0030392	2028

Increased water temperatures resulting from greenhouse gas emissions and associated climate change effects are not allocated a portion of the 0.3°C allowable temperature increment. The impact of climate change on temperature loadings to rivers and streams in the Umpqua Basin will require continued efforts at local, state, national, and international levels to address the causes of, adapt to and mitigate the effects of climate change.

Through international collaboration, the Federal Government has made commitments relevant to responding to the adverse effects of climate change. In January 2021, the U.S. rejoined the Paris Agreement, the international treaty within the United Nations Framework Convention that aims to limit global warming, increase climate resiliency, and develop financial channels to assist developing countries implement emission reduction measures. As detailed in Executive Order 14008 (EOP 2021), the U.S. Government will make strategic use of multilateral and bilateral channels and institutions to assist developing countries in implementing ambitious emissions reduction measures, protect critical ecosystems, build resilience against the impacts of climate change, and promote the flow of capital toward climate-aligned investments and away from high-carbon investments.

The Federal Government also has committed to address climate change through a government-wide approach to mitigate and adapt to the adverse effects of climate change under EO 14008. A National Climate Task Force composed of cabinet-level secretaries and chaired by the National Climate Advisor was established to facilitate the organization and deployment of key federal actions to reduce climate pollution and to engage on climate matters with tribal, state, and local governments and leaders of various sectors of the economy (EOP 2021).

The regulatory and non-regulatory measures described above and described in more detail in the states' implementation plans provide adequate reasonable assurance for the temperature wasteload and load allocations in this TMDL.

13 Tribal Consultation & Public Participation

Consistent with the EPA's Policy on Consultation with Tribes, the EPA engages in government-to-government consultation with potentially affected Tribes, in addition to ensuring meaningful public and stakeholder participation throughout the TMDL development process. In addition, Executive Order 13175 directs federal agencies to establish regular and meaningful consultation with Tribal governments in the development of federal policies or actions that have Tribal implications.

During TMDL development and review, the EPA consults with potentially affected Tribes to consider their perspectives and any concerns they may have regarding water quality issues on and around their reservations directly or usual and accustomed areas that are relevant to the federal action being considered. Effective Tribal consultation processes are founded on the principles of open and transparent communication between the EPA and Tribal governments. During TMDL development, the EPA works with Tribes to provide timely and relevant information, allow for meaningful input, and consider their recommendations and concerns during the decision-making process. This process recognizes Tribal sovereignty and the government-to-government relationship between the EPA and Tribes.

In addition to Tribal consultation, the EPA also provides opportunities for meaningful participation by the wider public. This includes sharing information throughout the TMDL development process with the public, especially affected communities, the regulated community, and other directly impacted stakeholders. These steps help ensure development of TMDLs is a transparent and inclusive process.

Tribal Consultation

During development of the Umpqua Basin Temperature TMDL, EPA staff informally contacted (email and phone call) representatives of the Confederated Tribes of the Grand Ronde Community of Oregon, Confederated Tribes of Siletz Indians of Oregon, Burns Paiute Tribe, Cow Creek Band of Umpqua Tribe of Indians, Coquille Indian Tribe, Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians on several occasions to provide information, offer individual meetings, and address any questions. Letters offering government-to-government consultation were sent to the same tribes on October 9, 2024.

Public Outreach

Throughout the TMDL development period EPA and ODEQ hosted two informational public webinars; the online meetings, held in April and July and each were attended by about 75 participants. The format was generally a 30–45-minute presentation by both EPA and ODEQ staff followed by 45-60 minutes of comments, questions, and answers. Additionally, a public-facing website was developed to provide project updates, webinar summaries, and the opportunity to sign up for email updates and webinar meeting invitations.

14 References

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Appendix A: Water Quality Current Conditions

Appendix B: Critical Conditions

Appendix C: Stream Buffer Width Literature Review

Appendix D: Climate Change Literature Review

Appendix E: Supporting Information for NPDES Permit Writers

Appendix F: Summary of Restoration Actions in the Umpqua Basin

Appendix G: Water Quality Model Calibration & Scenario Reports