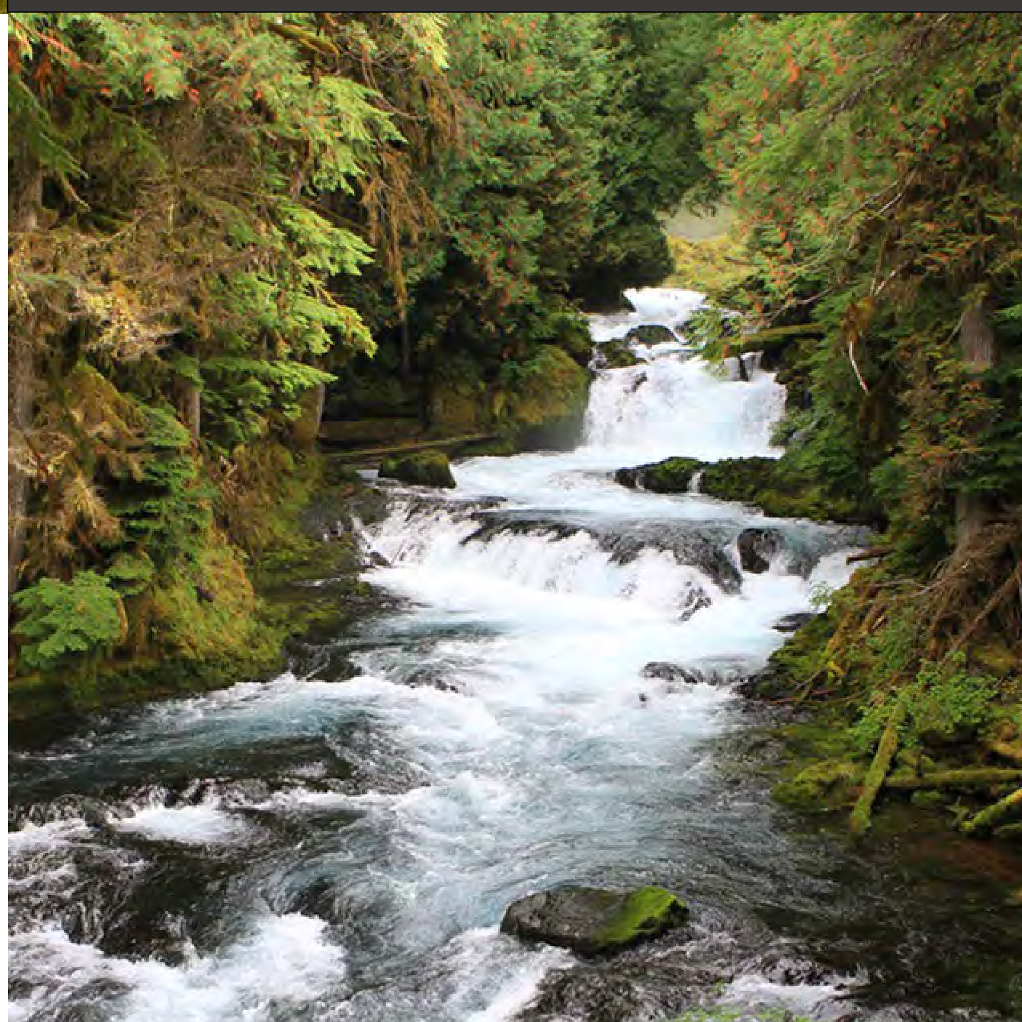
Total Maximum Daily Loads for the Willamette Subbasins

Technical Support Document

Temperature

Amended to include the Willamette River and major tributaries - DRAFT

August 2024



State of Oregon
DEQ Department of Environmental Quality

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Acronyms

Listed acronyms apply to this document and its appendices.

7DADM	7-Day Average Daily Maximum
7Q10	7-Day, 10-Year Low Flow
ADWDF	Average Dry Weather Design Flow
AU	Assessment Unit
AWQMS	Ambient Water Quality Monitoring System
BG	Background Source
BLM	U.S. Bureau of Land Management
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
DEM	Digital Elevation Model
DEQ	Oregon Department of Environmental Quality
DMA	Designated Management Agency
DMR	Discharge Monitoring Report
DOGAMI	Oregon Department of Geology and Mineral Industries
DOQ	Digital Orthophoto Quad
DQL	Data Quality Level
DSM	Digital Surface Model
EPA	Environmental Protection Agency
EQC	Oregon Environmental Quality Commission
ETL	Excess Thermal Load
EWEB	Eugene Water and Electric Board
GIS	Geographic Information System
GLO	General Land Office
GNIS	USGS Geographic Names Information System
HTML	Hyper Text Markup Language
HUA	Human Use Allowance
HUC	Hydrologic Unit Code
IMD	Internal Management Directive
LA	Load Allocation
LAC	Local Advisory Committee
LC	Loading Capacity
LiDAR	Light Detection and Ranging
LT50	Lethal Time 50
MF	Middle Fork
MGD	Millions of Gallons per Day
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
MWMT	Maximum Weekly Maximum Temperature
NA	Not Applicable

NHD	National Hydrography Dataset
NID	National Inventory of Dams
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NWI	National Wetland Inventory
OAR	Oregon Administrative Rules
ODA	Oregon Department of Agriculture
ODC	Oregon Department of Corrections
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish & Wildlife
ORS	Oregon Revised Statutes
OWRD	Oregon Water Resources Department
PCW	Protecting Cold Water
PGE	Portland General Electric
POD	Points of Diversion
POMI	Point of Maximum Impact
PRISM	Parameter-elevation Regressions on Independent Slopes Model
RC	Reserve Capacity
SCS	Soil Conservation Service
SF	South Fork
SIA	Strategic Implementation Area
SIC	Standard Industrial Classification
STP	Sewage Treatment Plant
SWCD	Soil and Water Conservation District
TIR	Thermal Infrared Radiometry
TMDL	Total Maximum Daily Load
TSD	Technical Support Document
USACE	U.S. Army Corps of Engineers
USFS	U.S. Department of Agriculture Forest Service
USGS	United States Geological Survey
WDOE	Washington Department of Ecology
WLA	Wasteload Allocation
WQMP	Water Quality Management Plan
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

1 Introduction

1.1 Document purpose and organization

This document provides comprehensive supporting information on technical analyses completed for the Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) for addressing temperature impairments in the waters of the Willamette Subbasins. This document provides explanations of TMDL concepts and analysis and support for conclusions and requirements included in the Willamette Subbasins TMDL and WQMP, which have been adopted by Oregon's Environmental Quality Commission (EQC), by reference, in Oregon Administrative Rules (OAR) 340-42-0090. EQC adopted revisions to the Willamette Subbasins TMDL and WQMP rule on [DATE TBA]. The TMDL and WQMP were revised to add temperature TMDLs for the Willamette River, Multnomah Channel, and tributaries to the Willamette River downstream of the following dams: River Mill Dam, Detroit Dam, Foster Dam, Fern Ridge Dam, Dexter Dam, Fall Creek Dam, Dorena Dam, and Cottage Grove Dam. The name of this project area is the Willamette River mainstem and major tributaries.

This document is organized into sections with titles reflective of the TMDL elements required by Oregon Administrative Rule OAR 340-042-0040(4) in the Willamette Subbasins TMDL for temperature. This organization is intended to assist readers in readily accessing the information relied on for TMDL element-specific determinations.

1.2 Overview of TMDL elements

According to OAR 340-042-0030(15) Definitions: Total Maximum Daily Load means a written quantitative plan and analysis for attaining and maintaining water quality standards and includes the elements described in OAR 340-042-0040. Determinations on each element are presented in the Willamette Subbasins TMDL for temperature. Technical and policy information supporting those determinations are presented in this report at the section headings that correspond to the TMDL elements for which complex analysis was undertaken.

In plain language, a TMDL is a water quality budget plan to ensure that the receiving waterbody can attain water quality standards that protect beneficial uses of the water. This budget calculates and assigns pollutant loads for discharges of point (end of pipe) and nonpoint (landscape) sources, in consideration of natural background levels, along with determination of a margin of safety and reserve capacity.

A margin of safety (MOS) accounts for the uncertainty in predicting how well pollutant reductions will result in meeting water quality standards and can be expressed either explicitly, as a portion of the allocations, or implicitly, by incorporating conservative assumptions into the analyses.

Reserve capacity (RC) sets aside some portion of the loading capacity for pollutant discharges that may result from future growth and new or expanded sources.

A key element of analysis is the amount of pollutant that a waterbody can receive and still meet the applicable water quality standard, and is referred to as the "loading capacity" (LC) of a waterbody. Because the loading capacity must not be exceeded by pollutant loads from all existing sources, plus the margin of safety and reserve capacity, it can be considered the maximum load. Hence, the loading capacity is often referred to as the TMDL. A loading capacity, or TMDL, is calculated on each assessment unit (AU) for each applicable temperature criteria in the TMDL project area. An AU is a partition (segment) of the state's waterbodies (streams, river, lakes, estuaries, etc.) into manageable units. The Integrated Report makes assessment conclusions for each AU.

Another key element of analysis is allocating portions of the loading capacity or TMDL to known sources. Allocations are quantified measures that assure water quality standards will be met and may distribute the pollutant loads between nonpoint and point sources. "Load allocations" are portions of the loading capacity that are attributed to: 1) nonpoint sources such as urban, agriculture, rural residential or forestry activities; and 2) natural background sources such as soils or wildlife. "Wasteload allocations" (WLAs) are portions of the total load that are allotted to point sources of pollution, such as permitted discharges from sewage treatment plants, industrial wastewater or stormwater. As noted above, allocations can also be reserved for future uses, termed "reserve capacity."

This general TMDL concept is represented by the following equation:

TMDL = ∑Wasteload Allocations + ∑Load Allocations + Reserve Capacity + Margin of Safety

Together, these elements establish the pollutant loads necessary to meet the applicable water quality standards for impaired pollutants and protect beneficial uses.

2 TMDL location and scope

The Willamette Subbasins comprise ten 8-digit hydrologic unit code (HUC) subbasins, including the Middle Fork Willamette Subbasin (HUC 17090001), Coast Fork Willamette Subbasin (HUC 17090002), Upper Willamette Subbasin (HUC 17090003), McKenzie Subbasin (HUC 17090004), North Santiam Subbasin (HUC 17090005), the South Santiam Subbasin (HUC 17090006), Middle Willamette Subbasin (HUC 17090007), Molalla-Pudding Subbasin (HUC 17090009), Clackamas Subbasin (HUC 17090011), and Lower Willamette Subbasin (HUC 17090012) (**Table 2-1**). ~~Waters excluded from the Willamette Subbasins TMDLs (**Table 2-2**) include the Willamette River, Multnomah Channel, and tributaries to the Willamette River downstream of the following dams: River Mill Dam, Detroit Dam, Foster Dam, Fern Ridge Dam, Dexter Dam, Fall Creek Dam, and Cottage Grove Dam.~~

Temperature TMDLs for the Willamette Subbasins address all Category 5 listed assessment units (AUs) impaired for temperature on Oregon's 2022 Section 303(d) list (identified in Section 2.1) and, as applicable, any AUs identified as temperature impaired in the future. Likewise, this TMDL includes a protection plan for all other assessment categories including AUs identified as a potential concern, attaining, or unassessed. The map in **Figure 2-1** provides an overview of where the temperature TMDLs are applicable. In total, the TMDL applies to ~~913~~958 AUs. Appendix D of the Willamette Subbasin Technical Support Document (TSD) provides a list of all AUs addressed by the TMDL.

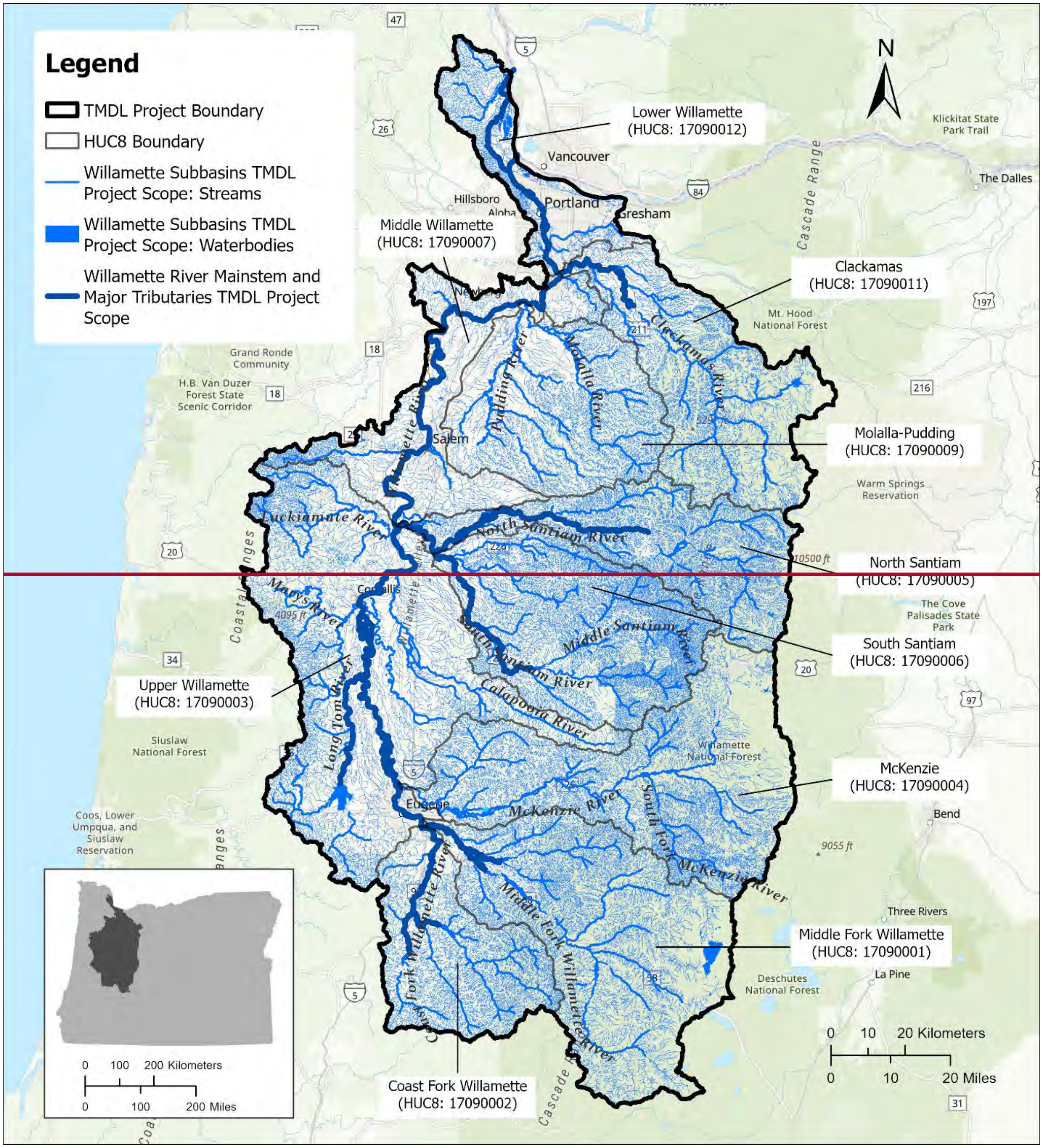
The loading capacity, allocations, surrogate measures, and implementation framework apply to all waters in the Willamette Subbasins determined to be waters of the state as defined under Oregon Revised Statutes ORS 468B.005(10), including all perennial and intermittent streams that have surface flow or residual pools during the TMDL allocation period. The rationale for applying TMDL allocations to intermittent streams (and potential exceptions) is summarized in Section 2.4.

Table 2-1: HUC8 codes and names in the Willamette Subbasins.

HUC8	Subbasin Name
17090001	Middle Fork Willamette
17090002	Coast Fork Willamette
17090003	Upper Willamette
17090004	McKenzie
17090005	North Santiam
17090006	South Santiam
17090007	Middle Willamette
17090009	Molalla-Pudding
17090011	Clackamas
17090012	Lower Willamette

~~**Table 2-2: Waters not included in the Willamette Subbasins temperature TMDLs.**~~

~~**Waterbody**~~	~~**Extent**~~
~~Willamette River~~	~~From the confluence of the Columbia River upstream to the confluence of Coast Fork of the Willamette and Middle Fork of the Willamette River.~~
~~Multnomah Channel~~	~~From the confluence of the Columbia River upstream to the Willamette River.~~
~~Clackamas River~~	~~From the confluence with the Willamette River upstream to River Mill Dam.~~
~~Santiam River~~	~~From the confluence with the Willamette River upstream to the confluence of the North and South Santiam Rivers.~~
~~North Santiam River~~	~~From the confluence with the Santiam River upstream to Detroit Dam.~~
~~South Santiam River~~	~~From the confluence with the Santiam River upstream to Foster Dam.~~
~~Long Tom River~~	~~From the confluence with the Willamette River upstream to Fern Ridge Dam.~~
~~Middle Fork Willamette River~~	~~From the confluence with the Willamette River upstream to Dexter Dam.~~
~~Fall Creek~~	~~From the confluence with the Middle Fork Willamette River upstream to Fall Creek Dam.~~
~~Coast Fork Willamette River~~	~~From the confluence with the Willamette River upstream to Cottage Grove Dam.~~
~~Row River~~	~~From the confluence with the Coast Fork Willamette River upstream to Dorena Dam.~~


Legend
TMDL Project Boundary
HUC8 Boundary
Willamette Subbasins TMDL Project Scope: Streams
Willamette Subbasins TMDL Project Scope: Waterbodies
Willamette River Mainstem and Major Tributaries TMDL Project Scope
Lower Willamette (HUC8: 17090012)
Middle Willamette (HUC8: 17090007)
Clackamas (HUC8: 17090011)
Molalla-Pudding (HUC8: 17090009)
North Santiam (HUC8: 17090005)
South Santiam (HUC8: 17090006)
Upper Willamette (HUC8: 17090003)
McKenzie (HUC8: 17090004)
Middle Fork Willamette (HUC8: 17090001)
Coast Fork Willamette (HUC8: 17090002)
Vancouver
Portland
Hillsboro
Gresham
Salem
Corvallis
Eugene
Bend
La Pine
Three Rivers
The Dalles
Klickitat State Park Trail
Mt. Hood National Forest
Warm Springs Reservation
The Cove Palisades State Park
Willamette National Forest
Deschutes National Forest
Siuslaw National Forest
Grand Ronde Community
H.B. Van Duzer Forest State Scenic Corridor
Coos, Lower Umpqua, and Siuslaw Reservation
Cascade Range
Coast Ranges
Luckiamute River
Marys River
Long Tom River
Pudding River
Molalla River
Clackamas River
North Santiam River
Middle Santiam River
South Santiam River
Calapooia River
McKenzie River
South Fork McKenzie River
Middle Fork Willamette River
Coast Fork Willamette River
10500 ft
9055 ft
4095 ft
N
0 10 20 Kilometers
0 10 20 Miles
0 100 200 Kilometers
0 100 200 Miles

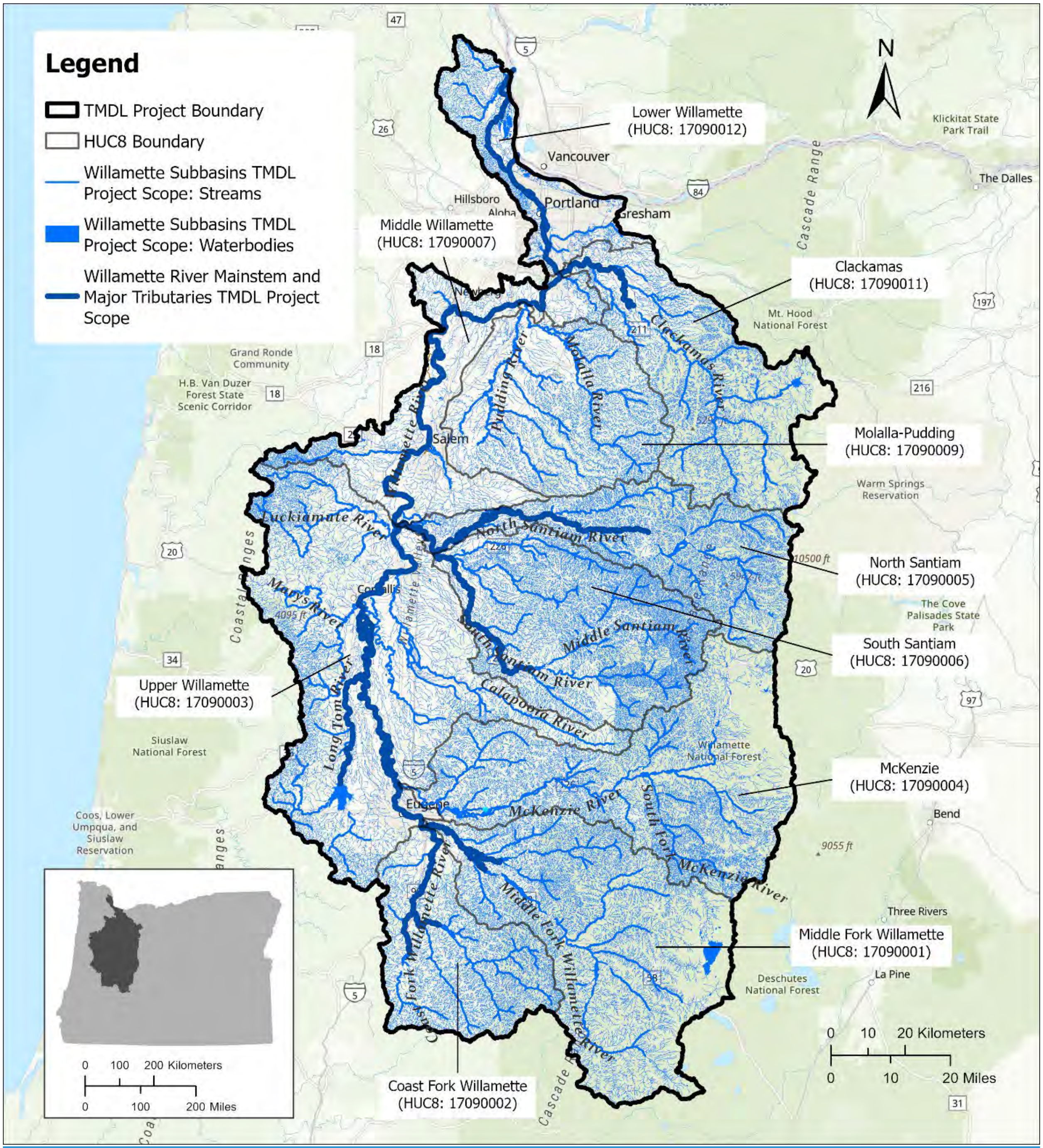


Figure 2-1: Willamette Subbasins temperature TMDLs project area overview.

2.1 Impaired waters

Table 2-~~3~~2 through **Table 2-~~12~~11** present stream AUs within the Willamette Subbasins that were listed as impaired for temperature on DEQ's 2022 Clean Water Act Section 303(d) List (as part of Oregon's Integrated Report), which was approved by the EPA on September 1, 2022. Status category designations are prescribed by Sections 305(b) and 303(d) of the Clean Water Act. AUs listed in Category 5 (designated use is not supported or a water quality standard is not

attained) require development of a TMDL. Locations of these listed AUs are depicted in **Figure 2-2**.

In total, the 2022 Integrated Report identifies ~~290~~321 Category 5 temperature impairments in the Willamette Subbasins. Some of these AUs have both year-round and spawning use designations impaired. If both use designations are impaired, it is considered two listings. Counting only AUs, there are ~~232~~253 unique AUs with Category 5 temperature impairments.

Table 2-2: Middle Fork Willamette Subbasin (17090001) Category 5 temperature impairments on the 2022 Integrated Report.

AU ID	AU Name	Use Period
OR_SR_1709000106_02_103722	Christy Creek	Spawning
OR_SR_1709000109_02_103735	Fall Creek	Year Round
OR_SR_1709000109_02_103735	Fall Creek	Spawning
OR_SR_1709000109_02_103736	Fall Creek	Year Round
OR_SR_1709000109_02_103736	Fall Creek	Spawning
OR_SR_1709000109_02_103737	Fall Creek	Year Round
OR_SR_1709000109_02_103737	Fall Creek	Spawning
OR_SR_1709000109_02_103743	Fall Creek	Year Round
OR_SR_1709000109_02_103743	Fall Creek	Spawning
OR_LK_1709000109_02_100701	Fall Creek Lake	Year Round
OR_SR_1709000109_02_103734	Hehe Creek	Year Round
OR_SR_1709000102_02_103715	Hills Creek	Year Round
OR_SR_1709000102_02_103715	Hills Creek	Spawning
OR_SR_1709000110_02_103749	Hills Creek	Year Round
OR_WS_170900010904_02_104219	HUC12 Name: Andy Creek-Fall Creek	Year Round
OR_WS_170900010502_02_104200	HUC12 Name: Buck Creek-Middle Fork Willamette River	Year Round
OR_WS_170900010501_02_104199	HUC12 Name: Coal Creek	Year Round
OR_WS_170900010608_02_104210	HUC12 Name: Dartmouth Creek-North Fork Middle Fork Willamette River	Year Round
OR_WS_170900010701_02_104211	HUC12 Name: Deception Creek-Middle Fork Willamette River	Year Round
OR_WS_170900010901_02_104216	HUC12 Name: Delp Creek-Fall Creek	Year Round
OR_WS_170900010703_02_104213	HUC12 Name: Dexter Reservoir-Middle Fork Willamette River	Year Round
OR_WS_170900010106_02_104190	HUC12 Name: Echo Creek-Middle Fork Willamette River	Year Round
OR_WS_170900010607_02_104209	HUC12 Name: Eighth Creek-North Fork Middle Fork Willamette River	Year Round
OR_WS_170900010505_02_104202	HUC12 Name: Gray Creek-Middle Fork Willamette River	Year Round
OR_WS_170900010702_02_104212	HUC12 Name: Lost Creek	Year Round
OR_WS_170900010202_02_104192	HUC12 Name: Lower Hills Creek	Year Round
OR_WS_170900010403_02_104198	HUC12 Name: Lower Salmon Creek	Year Round
OR_WS_170900010303_02_104195	HUC12 Name: Lower Salt Creek	Year Round
OR_WS_170900010303_02_104195	HUC12 Name: Lower Salt Creek	Spawning
~~OR_WS_170900010303_02_104195~~	~~HUC12 Name: Lower Salt Creek~~	~~Year Round~~
OR_WS_170900010302_02_104194	HUC12 Name: Middle Salt Creek	Year Round
OR_WS_170900010503_02_104201	HUC12 Name: Packard Creek-Middle Fork Willamette	Year Round
OR_WS_170900010105_02_104189	HUC12 Name: Staley Creek	Year Round
OR_WS_170900010102_02_104186	HUC12 Name: Tumblebug Creek	Year Round
OR_WS_170900010402_02_104197	HUC12 Name: Upper Salmon Creek	Year Round
OR_WS_170900010905_02_104220	HUC12 Name: Winberry Creek	Year Round
OR_SR_1709000108_02_103730	Little Fall Creek	Year Round
OR_SR_1709000108_02_103730	Little Fall Creek	Spawning
OR_SR_1709000109_02_103742	Logan Creek	Year Round

AU ID	AU Name	Use Period
OR_SR_1709000107_02_103727	Lost Creek	Year Round
OR_SR_1709000107_02_103727	Lost Creek	Spawning
OR_SR_1709000107_02_103728	Lost Creek	Year Round
OR_SR_1709000107_02_103728	Lost Creek	Spawning
OR_SR_1709000101_02_103713	Middle Fork Willamette River	Year Round
OR_SR_1709000105_02_104579	Middle Fork Willamette River	Year Round
OR_SR_1709000105_02_104580	Middle Fork Willamette River	Year Round
OR_SR_1709000105_02_104580	Middle Fork Willamette River	Spawning
OR_SR_1709000107_02_103725	Middle Fork Willamette River	Year Round
OR_SR_1709000107_02_103725	Middle Fork Willamette River	Spawning
OR_SR_1709000107_02_104583	Middle Fork Willamette River	Year Round
OR_SR_1709000107_02_104583	Middle Fork Willamette River	Spawning
OR_SR_1709000110_02_104584	Middle Fork Willamette River	Year Round
OR_SR_1709000110_02_104584	Middle Fork Willamette River	Spawning
OR_SR_1709000106_02_103721	North Fork Middle Fork Willamette River	Year Round
OR_SR_1709000106_02_103721	North Fork Middle Fork Willamette River	Spawning
OR_SR_1709000106_02_103723	North Fork Middle Fork Willamette River	Year Round
OR_SR_1709000109_02_103738	North Fork Winberry Creek	Year Round
OR_LK_1709000105_02_100684	Packard Creek	Year Round
OR_SR_1709000105_02_104578	Packard Creek	Year Round
OR_SR_1709000109_02_103741	Portland Creek	Year Round
OR_SR_1709000109_02_103744	Portland Creek	Year Round
OR_SR_1709000104_02_103719	Salmon Creek	Year Round
OR_SR_1709000104_02_103719	Salmon Creek	Spawning
OR_SR_1709000103_02_103716	Salt Creek	Year Round
OR_SR_1709000103_02_103716	Salt Creek	Spawning
OR_SR_1709000109_02_103745	South Fork Winberry Creek	Year Round
OR_SR_1709000109_02_103747	Winberry Creek	Year Round
OR_SR_1709000109_02_103747	Winberry Creek	Spawning
~~OR_SR_1709000109_02_103735~~	~~Fall Creek~~	~~Year Round~~
~~OR_SR_1709000109_02_103735~~	~~Fall Creek~~	~~Spawning~~
~~OR_SR_1709000107_02_104583~~	~~Middle Fork Willamette River~~	~~Year Round~~
~~OR_SR_1709000107_02_104583~~	~~Middle Fork Willamette River~~	~~Spawning~~
~~OR_SR_1709000110_02_104584~~	~~Middle Fork Willamette River~~	~~Year Round~~
~~OR_SR_1709000110_02_104584~~	~~Middle Fork Willamette River~~	~~Spawning~~

Table 2-3: Coast Fork Willamette Subbasin (17090002) Category 5 temperature impairments on the 2022 Integrated Report.

AU ID	AU Name	Use Period
OR_SR_1709000202_02_103771	Brice Creek	Year Round
OR_SR_1709000203_02_104585	Coast Fork Willamette River	Year Round
OR_SR_1709000203_02_104586	Coast Fork Willamette River	Year Round
OR_SR_1709000204_02_103787	Coast Fork Willamette River	Year Round
OR_LK_1709000202_02_100705	Dorena Lake	Year Round
OR_WS_170900020401_02_104238	HUC12 Name: Hill Creek-Coast Fork Willamette River	Year Round
OR_WS_170900020204_02_104230	HUC12 Name: King Creek-Row River	Year Round
OR_WS_170900020203_02_104229	HUC12 Name: Sharps Creek	Year Round
OR_SR_1709000202_02_103765	Layng Creek	Year Round
OR_SR_1709000202_02_103756	Martin Creek	Year Round
OR_SR_1709000201_02_103752	Mosby Creek	Year Round
OR_SR_1709000201_02_103752	Mosby Creek	Spawning
OR_SR_1709000202_02_103761	Row River	Year Round
OR_SR_1709000202_02_103766	Row River	Year Round
OR_SR_1709000202_02_103779	Row River	Year Round
OR_SR_1709000202_02_103755	Sharps Creek	Year Round
OR_SR_1709000202_02_103775	Sharps Creek	Year Round

AU ID	AU Name	Use Period
OR_SR_1709000202_02_103776	Sharps Creek	Year Round
~~OR_SR_1709000204_02_103787~~	~~Coast Fork Willamette River~~	~~Year Round~~
~~OR_SR_1709000203_02_104585~~	~~Coast Fork Willamette River~~	~~Year Round~~
~~OR_SR_1709000202_02_103779~~	~~Row River~~	~~Year Round~~

Table 2-4: Upper Willamette Subbasin (17090003) Category 5 temperature impairments on the 2022 Integrated Report.

AU ID	AU Name	Use Period
OR_SR_1709000303_02_103815	Calapooia River	Year Round
OR_SR_1709000303_02_103815	Calapooia River	Spawning
OR_SR_1709000303_02_103816	Calapooia River	Year Round
OR_SR_1709000303_02_103816	Calapooia River	Spawning
OR_SR_1709000304_02_103821	Calapooia River	Year Round
OR_SR_1709000303_02_103819	Courtney Creek	Year Round
OR_SR_1709000301_02_103796	Coyote Creek	Year Round
OR_SR_1709000301_02_103790	Ferguson Creek	Year Round
OR_WS_170900030109_02_104251	HUC12 Name: Bear Creek-Long Tom River	Year Round
OR_WS_170900030510_02_104284	HUC12 Name: Berry Creek	Year Round
OR_WS_170900030302_02_104265	HUC12 Name: Bigs Creek-Calapooia River	Year Round
OR_WS_170900030603_02_104290	HUC12 Name: Flat Creek	Year Round
OR_WS_170900030204_02_104256	HUC12 Name: Greasy Creek	Year Round
~~OR_WS_170900030301_02_104264~~	~~HUC12 Name: Hands Creek-Calapooia River~~	~~Spawning~~
OR_WS_170900030301_02_104264	HUC12 Name: Hands Creek-Calapooia River	Year Round
OR_WS_170900030301_02_104264	HUC12 Name: Hands Creek-Calapooia River	Spawning
OR_WS_170900030505_02_104279	HUC12 Name: Jont Creek-Luckiamute River	Year Round
OR_WS_170900030402_02_104273	HUC12 Name: Lower Oak Creek	Year Round
OR_WS_170900030503_02_104277	HUC12 Name: Maxfield Creek-Luckiamute River	Year Round
OR_WS_170900030504_02_104278	HUC12 Name: Pedee Creek-Luckiamute River	Year Round
OR_SR_1709000305_02_103822	Little Luckiamute River	Year Round
OR_SR_1709000301_02_103791	Long Tom River	Year Round
OR_SR_1709000305_02_103829	Luckiamute River	Year Round
OR_SR_1709000302_02_103804	Marys River	Year Round
OR_SR_1709000302_02_103812	Marys River	Year Round
OR_SR_1709000302_02_103813	Marys River	Year Round
OR_SR_1709000305_02_103825	Miller Creek	Year Round
OR_SR_1709000302_02_103806	Muddy Creek	Year Round
OR_SR_1709000306_02_103838	Muddy Creek	Year Round
OR_SR_1709000305_02_103828	North Fork Pedee Creek	Year Round
OR_SR_1709000305_02_103833	Ritner Creek	Year Round
OR_SR_1709000305_02_103832	Soap Creek	Year Round
OR_SR_1709000305_02_103824	Teal Creek	Year Round
~~OR_SR_1709000301_02_103791~~	~~Long Tom River~~	~~Year Round~~
~~OR_SR_1709000306_05_103854~~	~~Willamette River~~	~~Spawning~~
OR_SR_1709000306_05_103854	Willamette River	Year Round
OR_SR_1709000306_05_103854	Willamette River	Spawning

Table 2-5: McKenzie Subbasin (17090004) Category 5 temperature impairments on the 2022 Integrated Report.

AU ID	AU Name	Use Period
OR_SR_1709000403_02_103865	Augusta Creek	Year Round
OR_SR_1709000407_02_103889	Camp Creek	Year Round
OR_SR_1709000407_02_103889	Camp Creek	Spawning
OR_SR_1709000406_02_103875	Cartwright Creek	Year Round
OR_SR_1709000406_02_103875	Cartwright Creek	Spawning

AU ID	AU Name	Use Period
OR_SR_1709000407_02_103891	Cedar Creek	Year Round
OR_SR_1709000407_02_103891	Cedar Creek	Spawning
OR_SR_1709000407_02_103882	Deer Creek	Year Round
OR_SR_1709000407_02_103882	Deer Creek	Spawning
OR_SR_1709000403_02_103862	French Pete Creek	Year Round
OR_SR_1709000401_02_103855	Horse Creek	Year Round
OR_SR_1709000401_02_103856	Horse Creek	Year Round
OR_WS_170900040206_02_104310	HUC12 Name: Boulder Creek-McKenzie River	Year Round
OR_WS_170900040705_02_104336	HUC12 Name: Camp Creek	Year Round
OR_WS_170900040205_02_104309	HUC12 Name: Deer Creek	Year Round
OR_WS_170900040702_02_104333	HUC12 Name: East Fork Deer Creek-McKenzie River	Year Round
OR_WS_170900040702_02_104333	HUC12 Name: East Fork Deer Creek-McKenzie River	Spawning
OR_WS_~~170900040702~~170900040502_02_~~104333~~104326	HUC12 Name: ~~East Fork Deer~~Elk Creek-McKenzie River	Year Round
OR_WS_170900040502_02_104326	HUC12 Name: Elk Creek-McKenzie River	Spawning
~~OR_WS_170900040502_02_104326~~	~~HUC12 Name: Elk Creek-McKenzie River~~	~~Year Round~~
OR_WS_170900040209_02_104313	HUC12 Name: Florence Creek-McKenzie River	Year Round
OR_WS_170900040202_02_104306	HUC12 Name: Hackleman Creek-McKenzie River	Year Round
OR_WS_170900040601_02_104327	HUC12 Name: Headwaters Mohawk River	Year Round
OR_WS_170900040204_02_104308	HUC12 Name: Kink Creek-McKenzie River	Year Round
OR_WS_170900040403_02_104324	HUC12 Name: Lower Blue River	Year Round
OR_WS_170900040105_02_104304	HUC12 Name: Lower Horse Creek	Year Round
OR_WS_170900040104_02_104303	HUC12 Name: Middle Horse Creek	Year Round
OR_WS_170900040304_02_104317	HUC12 Name: Rebel Creek-South Fork McKenzie River	Year Round
OR_WS_170900040602_02_104328	HUC12 Name: Shotgun Creek-Mohawk River	Year Round
OR_WS_170900040203_02_104307	HUC12 Name: Smith River	Year Round
OR_WS_170900040402_02_104323	HUC12 Name: Upper Blue River	Year Round
OR_SR_1709000404_02_104571	Lookout Creek	Year Round
OR_SR_1709000404_02_104569	Lower Blue River	Year Round
OR_SR_1709000404_02_104569	Lower Blue River	Spawning
OR_SR_1709000406_02_103879	McGowan Creek	Year Round
OR_SR_1709000406_02_103879	McGowan Creek	Spawning

AU ID	AU Name	Use Period
OR_SR_1709000405_02_103866	McKenzie River	Year Round
OR_SR_1709000405_02_103866	McKenzie River	Spawning
OR_SR_1709000407_02_103884	McKenzie River	Year Round
OR_SR_1709000407_02_103884	McKenzie River	Spawning
OR_SR_1709000406_02_103873	Mill Creek	Year Round
OR_SR_1709000406_02_103874	Mill Creek	Year Round
OR_SR_1709000406_02_103870	Mohawk River	Year Round
OR_SR_1709000406_02_103870	Mohawk River	Spawning
OR_SR_1709000406_02_103871	Mohawk River	Year Round
OR_SR_1709000406_02_103871	Mohawk River	Spawning
OR_SR_1709000406_02_103877	Mohawk River	Year Round
OR_SR_1709000406_02_103877	Mohawk River	Spawning
OR_SR_1709000405_02_103867	Quartz Creek	Year Round
OR_SR_1709000404_02_104576	Quentin Creek	Year Round
OR_SR_1709000406_02_103872	Shotgun Creek	Year Round
OR_SR_1709000403_02_104590	South Fork McKenzie River	Year Round
OR_SR_1709000403_02_104590	South Fork McKenzie River	Spawning
OR_SR_1709000404_02_104574	Upper Blue River	Year Round
OR_SR_1709000404_02_104577	Upper Blue River	Year Round

Table 2-6: North Santiam Subbasin (17090005) Category 5 temperature impairments on the 2022 Integrated Report.

AU ID	AU Name	Use Period
OR_SR_1709000506_02_103928	Bear Branch	Year Round
OR_SR_1709000503_02_103907	Blowout Creek	Year Round
OR_SR_1709000503_02_103909	Blowout Creek	Year Round
OR_SR_1709000502_02_103902	Boulder Creek	Year Round
OR_SR_1709000506_02_103926	Chehulpum Creek	Year Round
OR_SR_1709000505_02_103923	Elkhorn Creek	Year Round
OR_WS_170900050602_02_104360	HUC12 Name: Bear Branch-North Santiam River	Year Round
OR_WS_170900050203_02_104345	HUC12 Name: Marion Creek	Year Round
OR_WS_170900050603_02_104361	HUC12 Name: Marion Creek-North Santiam River	Year Round
OR_WS_170900050603_02_104361	HUC12 Name: Marion Creek-North Santiam River	Spawning
~~OR_WS_170900050603_02_104361~~	~~HUC12 Name: Marion Creek-North Santiam River~~	~~Year Round~~
OR_WS_170900050504_02_104563	HUC12 Name: Middle Little North Santiam River	Year Round
OR_WS_170900050301_02_104351	HUC12 Name: Upper Blowout Creek	Year Round
OR_WS_170900050503_02_104567	HUC12 Name: Upper Little North Santiam River	Year Round
OR_SR_1709000505_02_104564	Little North Santiam River	Year Round
OR_SR_1709000505_02_104564	Little North Santiam River	Spawning
~~OR_SR_1709000506_02_103929~~	~~Stout Creek~~	~~Year Round~~
OR_SR_1709000504_02_103906	North Santiam River	Spawning
OR_SR_1709000506_02_103930	North Santiam River	Year Round
OR_SR_1709000506_02_103930	North Santiam River	Spawning
OR_SR_1709000506_02_103927	Santiam River	Year Round
OR_SR_1709000506_02_103927	Santiam River	Spawning

AU ID	AU Name	Use Period
OR_SR_1709000506_02_103929	Stout Creek	Year Round

Table 2-7: South Santiam Subbasin (17090006) Category 5 temperature impairments on the 2022 Integrated Report.

AU ID	AU Name	Use Period
OR_SR_1709000606_02_103973	Beaver Creek	Year Round
OR_SR_1709000607_02_103986	Bilyeu Creek	Year Round
OR_SR_1709000607_02_103989	Bilyeu Creek	Year Round
OR_SR_1709000602_02_103949	Canyon Creek	Year Round
OR_SR_1709000606_02_103978	Crabtree Creek	Year Round
OR_SR_1709000606_02_103978	Crabtree Creek	Spawning
OR_LK_1709000604_02_100772	Foster Lake	Year Round
OR_LK_1709000603_02_100771	Green Peter Lake	Year Round
OR_SR_1709000608_02_103993	Hamilton Creek	Year Round
OR_SR_1709000608_02_103993	Hamilton Creek	Spawning
OR_SR_1709000608_02_103996	Hamilton Creek	Year Round
OR_SR_1709000608_02_103996	Hamilton Creek	Spawning
OR_WS_170900060804_02_104398	HUC12 Name: Hamilton Creek	Year Round
OR_WS_170900060501_02_104384	HUC12 Name: Little Wiley Creek	Year Round
OR_WS_170900060705_02_104394	HUC12 Name: Lower Thomas Creek	Year Round
OR_SR_1709000602_02_103955	Latiwi Creek	Year Round
OR_SR_1709000608_02_103994	McDowell Creek	Year Round
OR_SR_1709000601_02_103934	Middle Santiam River	Year Round
OR_SR_1709000601_02_103936	Middle Santiam River	Year Round
OR_SR_1709000601_02_103938	Middle Santiam River	Year Round
OR_SR_1709000603_02_103965	Middle Santiam River	Year Round
OR_SR_1709000604_02_103969	Middle Santiam River	Spawning
OR_SR_1709000602_02_103954	Moose Creek	Year Round
OR_SR_1709000602_02_103954	Moose Creek	Spawning
OR_SR_1709000602_02_103941	Owl Creek	Year Round
OR_SR_1709000601_02_103935	Pyramid Creek	Year Round
OR_SR_1709000603_02_103957	Quartzville Creek	Year Round
OR_SR_1709000603_02_103960	Quartzville Creek	Year Round
OR_SR_1709000608_02_103997	Scott Creek	Year Round
OR_SR_1709000602_02_103953	Sheep Creek	Year Round
OR_SR_1709000602_02_103947	Soda Fork	Year Round
OR_SR_1709000607_02_103985	South Fork Neal Creek	Year Round
OR_SR_1709000602_02_103950	South Santiam River	Year Round
OR_SR_1709000602_02_103950	South Santiam River	Spawning
OR_SR_1709000604_02_103968	South Santiam River	Year Round
OR_SR_1709000604_02_103968	South Santiam River	Spawning
OR_SR_1709000608_02_103925	South Santiam River	Year Round
OR_SR_1709000608_02_103925	South Santiam River	Spawning
OR_SR_1709000607_02_103988	Thomas Creek	Year Round
OR_SR_1709000607_02_103991	Thomas Creek	Year Round
OR_SR_1709000607_02_103991	Thomas Creek	Spawning
OR_SR_1709000602_02_103942	Trout Creek	Year Round
OR_SR_1709000602_02_103948	Two Girls Creek	Year Round
OR_SR_1709000605_02_103971	Wiley Creek	Year Round
OR_SR_1709000605_02_103971	Wiley Creek	Spawning
OR_SR_1709000605_02_103972	Wiley Creek	Year Round
OR_SR_1709000605_02_103972	Wiley Creek	Spawning
~~OR_SR_1709000608_02_103925~~	~~South Santiam River~~	~~Year Round~~
~~OR_SR_1709000608_02_103925~~	~~South Santiam River~~	~~Spawning~~

Table 2-8: Middle Willamette Subbasin (17090007) Category 5 temperature impairments on the 2022 Integrated Report.

AU ID	AU Name	Use Period
OR_SR_1709000704_02_104017	Abernethy Creek	Year Round
OR_SR_1709000704_02_104594	Abernethy Creek	Year Round
OR_WS_170900070306_02_104417	HUC12 Name: Chehalem Creek	Year Round
OR_WS_170900070301_02_104413	HUC12 Name: Croisan Creek-Willamette River	Spawning
OR_WS_170900070301_02_104413	HUC12 Name: Croisan Creek-Willamette River	Year Round
OR_WS_170900070303_02_104415	HUC12 Name: Glenn Creek-Willamette River	Year Round
OR_WS_170900070304_02_104599	HUC12 Name: Lambert Slough-Willamette River	Year Round
OR_WS_170900070204_02_104412	HUC12 Name: Lower Mill Creek	Year Round
OR_WS_170900070203_02_104411	HUC12 Name: McKinney Creek	Year Round
OR_SR_1709000703_02_104007	Mill Creek	Year Round
OR_SR_1709000703_02_104007	Mill Creek	Spawning
OR_SR_1709000703_02_104012	Pringle Creek	Year Round
OR_SR_1709000701_02_104591	Rickreall Creek	Year Round
OR_SR_1709000703_02_104008	Shelton Ditch	Year Round
OR_SR_1709000703_02_104008	Shelton Ditch	Spawning
OR_SR_1709000701_05_104005	Willamette River	Year Round
OR_SR_1709000701_05_104005	Willamette River	Spawning
OR_SR_1709000703_04_104013	Willamette River	Year Round
OR_SR_1709000703_04_104013	Willamette River	Spawning
OR_SR_1709000703_88_104015	Willamette River	Year Round
OR_SR_1709000704_88_104020	Willamette River	Year Round
OR_LK_1709000703_02_100792	Willamette Slough	Year Round

Table 2-9: Molalla-Pudding Subbasin (17090009) Category 5 temperature impairments on the 2022 Integrated Report.

AU ID	AU Name	Use Period
OR_SR_1709000901_02_104062	Abiqua Creek	Year Round
OR_SR_1709000902_02_104070	Butte Creek	Year Round
OR_SR_1709000902_02_104072	Butte Creek	Year Round
OR_SR_1709000901_02_104069	Drift Creek	Year Round
OR_SR_1709000901_02_104069	Drift Creek	Spawning
OR_WS_170900090303_02_104470	HUC12 Name: Bear Creek	Year Round
OR_WS_170900090204_02_104467	HUC12 Name: Brandy Creek-Pudding River	Year Round
OR_WS_170900090101_02_104454	HUC12 Name: Headwaters Pudding River	Year Round
OR_WS_170900090202_02_104465	HUC12 Name: Middle Butte Creek	Year Round
OR_WS_170900090403_02_104474	HUC12 Name: Pine Creek-Molalla River	Year Round
OR_SR_1709000904_02_104086	Molalla River	Year Round
OR_SR_1709000904_02_104086	Molalla River	Spawning
OR_SR_1709000901_02_104067	Pudding River	Year Round
OR_SR_1709000905_02_104088	Pudding River	Year Round
OR_SR_1709000901_02_104595	Silver Creek	Year Round
OR_SR_1709000901_02_104066	South Fork Silver Creek	Year Round
OR_SR_1709000904_02_104087	Table Rock Fork	Year Round
OR_SR_1709000904_02_104087	Table Rock Fork	Spawning
OR_LK_1709000902_02_100830	Zollner Creek	Year Round

Table 2-10: Clackamas Subbasin (17090011) Category 5 temperature impairments on the 2022 Integrated Report.

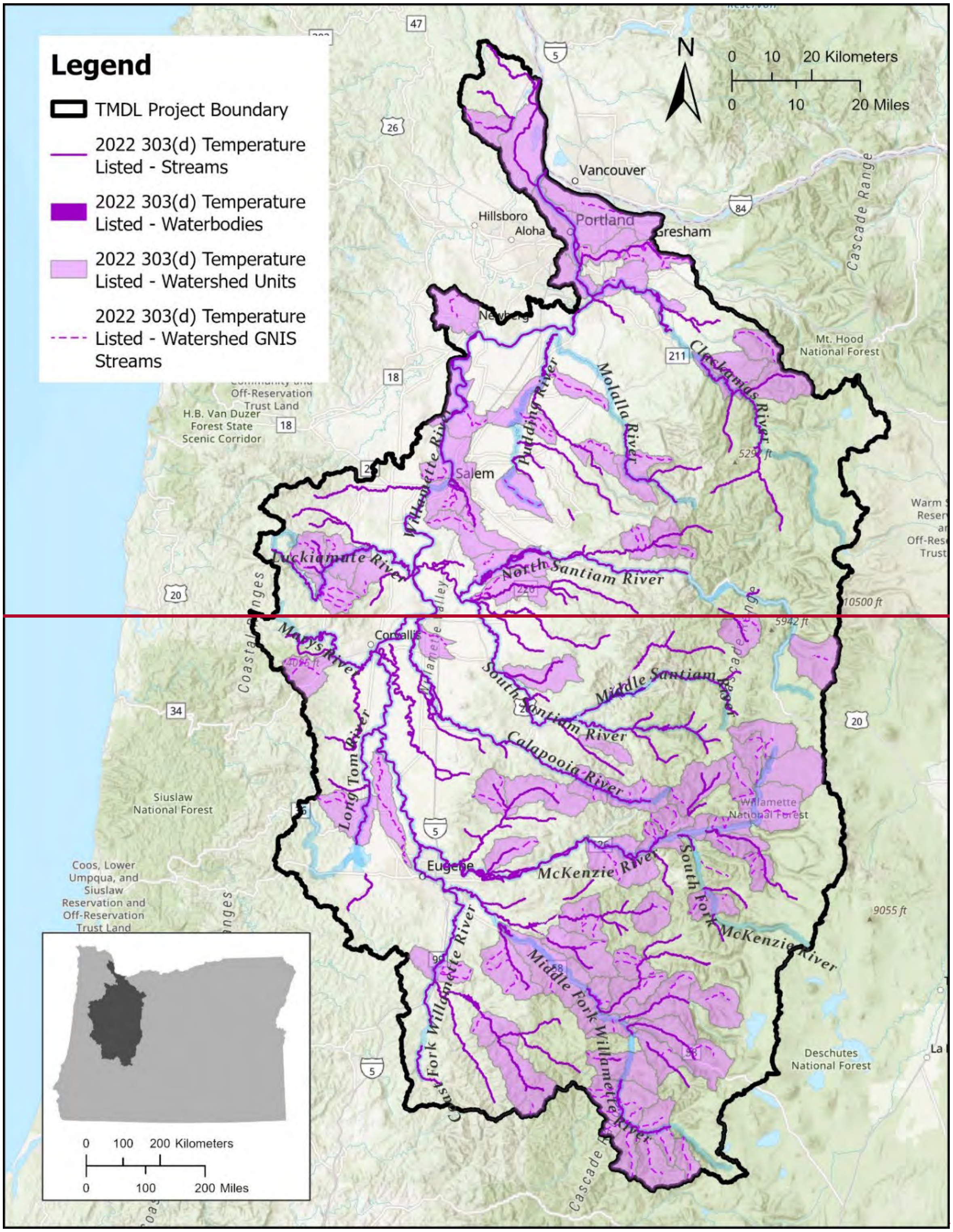
AU ID	AU Name	Use Period
OR_SR_1709001104_02_104154	Clackamas River	Year Round
OR_SR_1709001104_02_104154	Clackamas River	Spawning
OR_SR_1709001104_02_104155	Clackamas River	Year Round
OR_SR_1709001104_02_104155	Clackamas River	Spawning
OR_SR_1709001106_02_104597	Clackamas River	Year Round
OR_SR_1709001106_02_104597	Clackamas River	Spawning

AU ID	AU Name	Use Period
OR_SR_1709001101_02_104142	Collawash River	Year Round
OR_SR_1709001101_02_104142	Collawash River	Spawning
OR_SR_1709001101_02_104144	Collawash River	Year Round
OR_SR_1709001105_02_104163	Eagle Creek	Year Round
OR_SR_1709001105_02_104163	Eagle Creek	Spawning
OR_SR_1709001104_02_104156	Fish Creek	Year Round
OR_SR_1709001104_02_104161	Fish Creek	Year Round
OR_SR_1709001104_02_104161	Fish Creek	Spawning
OR_WS_170900110406_02_104539	HUC12 Name: Helion Creek-Clackamas River	Year Round
OR_WS_170900110405_02_104538	HUC12 Name: North Fork Clackamas River	Year Round
OR_WS_170900110402_02_104535	HUC12 Name: Roaring River	Year Round
OR_WS_170900110607_02_104549	HUC12 Name: Rock Creek-Clackamas River	Year Round
OR_WS_170900110501_02_104540	HUC12 Name: Upper Eagle Creek	Year Round
OR_SR_1709001101_02_104145	Nohorn Creek	Year Round
OR_SR_1709001101_02_104145	Nohorn Creek	Spawning
OR_SR_1709001104_02_104152	North Fork Clackamas River	Year Round
OR_SR_1709001105_02_104165	North Fork Eagle Creek	Year Round
OR_SR_1709001104_02_104160	Roaring River	Spawning
OR_SR_1709001104_02_104157	Trout Creek	Year Round
~~OR_SR_1709001106_02_104597~~	~~Clackamas River~~	~~Year Round~~
~~OR_SR_1709001106_02_104597~~	~~Clackamas River~~	~~Spawning~~

Table 2-11: Lower Willamette Subbasin (17090012) Category 5 temperature impairments on the 2022 Integrated Report.

AU ID	AU Name	Use Period
OR_WS_170900120202_02_104555	HUC12 Name: Balch Creek-Willamette River	Year Round
OR_WS_170900120201_02_104554.1	HUC12 Name: Columbia Slough (Lower)	Year Round
OR_WS_170900120201_02_104554.2	HUC12 Name: Columbia Slough (Upper)	Year Round
OR_WS_170900120103_02_104552	HUC12 Name: Lower Johnson Creek	Year Round
OR_WS_170900120103_02_104552	HUC12 Name: Lower Johnson Creek	Spawning
~~OR_WS_170900120103_02_104552~~	~~HUC12 Name: Lower Johnson Creek~~	~~Year Round~~
OR_WS_170900120305_02_104561	HUC12 Name: Multnomah Channel	Year Round
OR_WS_170900120104_02_104553	HUC12 Name: Oswego Creek-Willamette River	Year Round
OR_WS_170900120104_02_104553	HUC12 Name: Oswego Creek-Willamette River	Spawning
~~OR_WS_170900120104_02_104553~~	~~HUC12 Name: Oswego Creek-Willamette River~~	~~Year Round~~
OR_WS_170900120301_02_104557	HUC12 Name: South Scappoose Creek	Spawning
OR_WS_170900120101_02_104550	HUC12 Name: Upper Johnson Creek	Year Round
OR_WS_170900120101_02_104550	HUC12 Name: Upper Johnson Creek	Spawning
~~OR_WS_170900120101_02_104550~~	~~HUC12 Name: Upper Johnson Creek~~	~~Year Round~~
OR_SR_1709001201_02_104170	Johnson Creek	Year Round
OR_SR_1709001201_02_104170	Johnson Creek	Spawning
OR_SR_1709001203_02_104176	Milton Creek	Year Round
OR_SR_1709001203_02_104176	Milton Creek	Spawning
OR_SR_1709001203_88_104184	Multnomah Channel	Year Round
OR_SR_1709001203_02_104179	North Scappoose Creek	Year Round
OR_SR_1709001203_02_104179	North Scappoose Creek	Spawning
OR_SR_1709001203_02_104180	South Scappoose Creek	Year Round
OR_SR_1709001203_02_104180	South Scappoose Creek	Spawning
~~OR_SR_1709001203_88_104184~~	~~Multnomah Channel~~	~~Year Round~~
~~OR_SR_1709001202_88_104175~~	~~Willamette River~~	~~Year Round~~
OR_SR_1709001201_88_104019	Willamette River	Year Round
OR_SR_1709001202_88_104175	Willamette River	Year Round

The locations of the waterbodies listed as impaired for temperature on DEQ's 2022 Clean Water Act Section 303(d) List are depicted in **Figure 2-2**. The Watershed GNIS Streams layer identifies the impaired streams within an impaired Watershed AU. A watershed AU is a fixed AU that groups all streams within a HUC12 subwatershed with a Strahler Stream Order of 4 or less for impairment consideration. Individual monitoring stations within a Watershed Unit are assessed for impairment, then the impairment determination is rolled up into a single Watershed Unit conclusion in order to meet EPA reporting requirements. The Streams layer in **Figure 2-2** identifies the large streams or rivers listed as temperature impaired, and the Waterbodies layer identifies the lakes or reservoirs listed as temperature impaired in the project area. Please see the Final Assessment Methodology of Oregon DEQ's 2022 Integrated Report for more information about how Oregon's waterbodies are assessed for water quality impairment (DEQ, 2022).


Legend
TMDL Project Boundary
2022 303(d) Temperature Listed - Streams
2022 303(d) Temperature Listed - Waterbodies
2022 303(d) Temperature Listed - Watershed Units
2022 303(d) Temperature Listed - Watershed GNIS Streams
0 10 20 Kilometers
0 10 20 Miles
Vancouver
Portland
Gresham
Hillsboro
Aloha
Salem
Corvallis
Eugene
Clackamas River
Molalla River
Pudding River
Willamette River
Luckiamute River
North Santiam River
Marys River
Middle Santiam River
South Santiam River
Calapooia River
Long Tom River
McKenzie River
South Fork McKenzie River
Middle Fork Willamette River
Coast Fork Willamette River
Mt. Hood National Forest
Willamette National Forest
Deschutes National Forest
Siuslaw National Forest
0 100 200 Kilometers
0 100 200 Miles

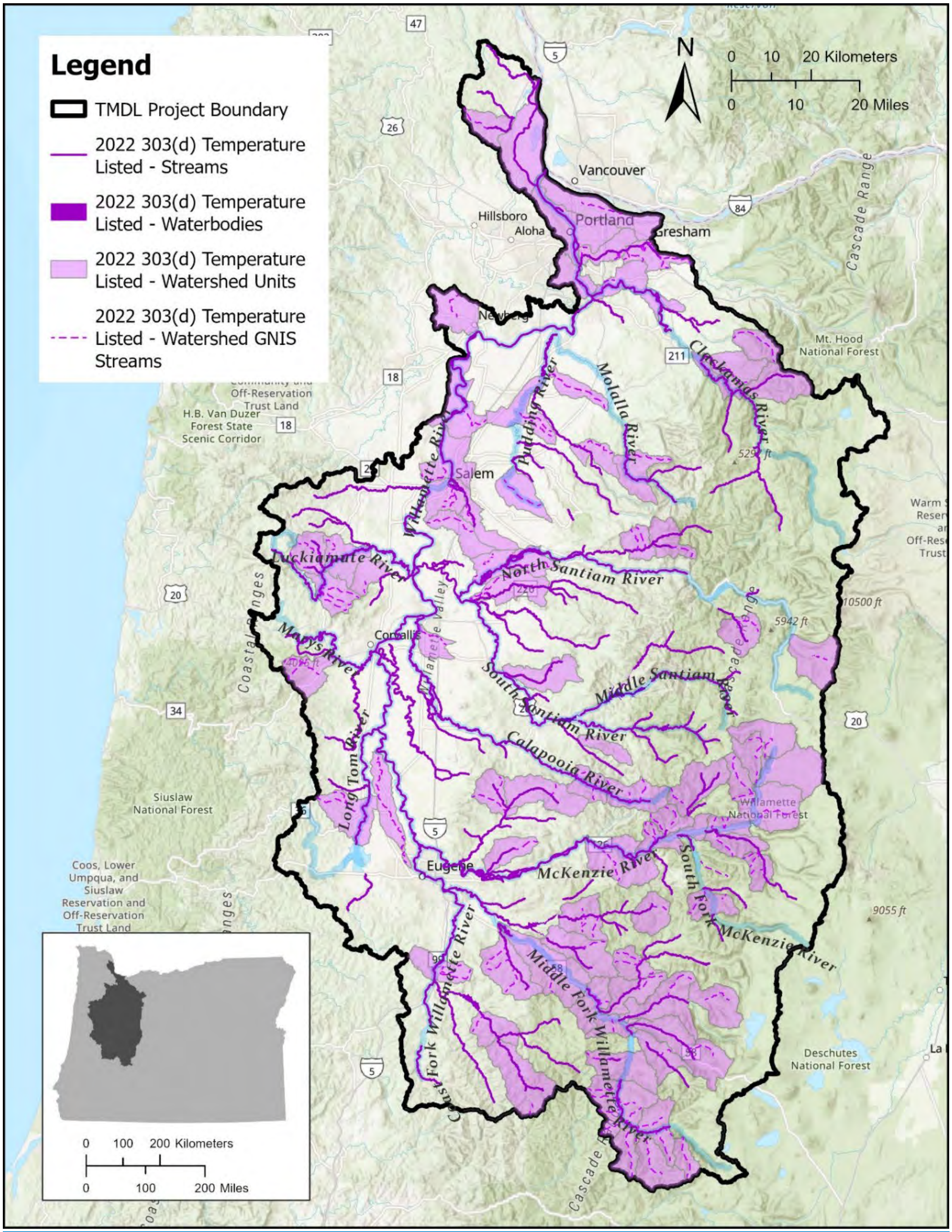
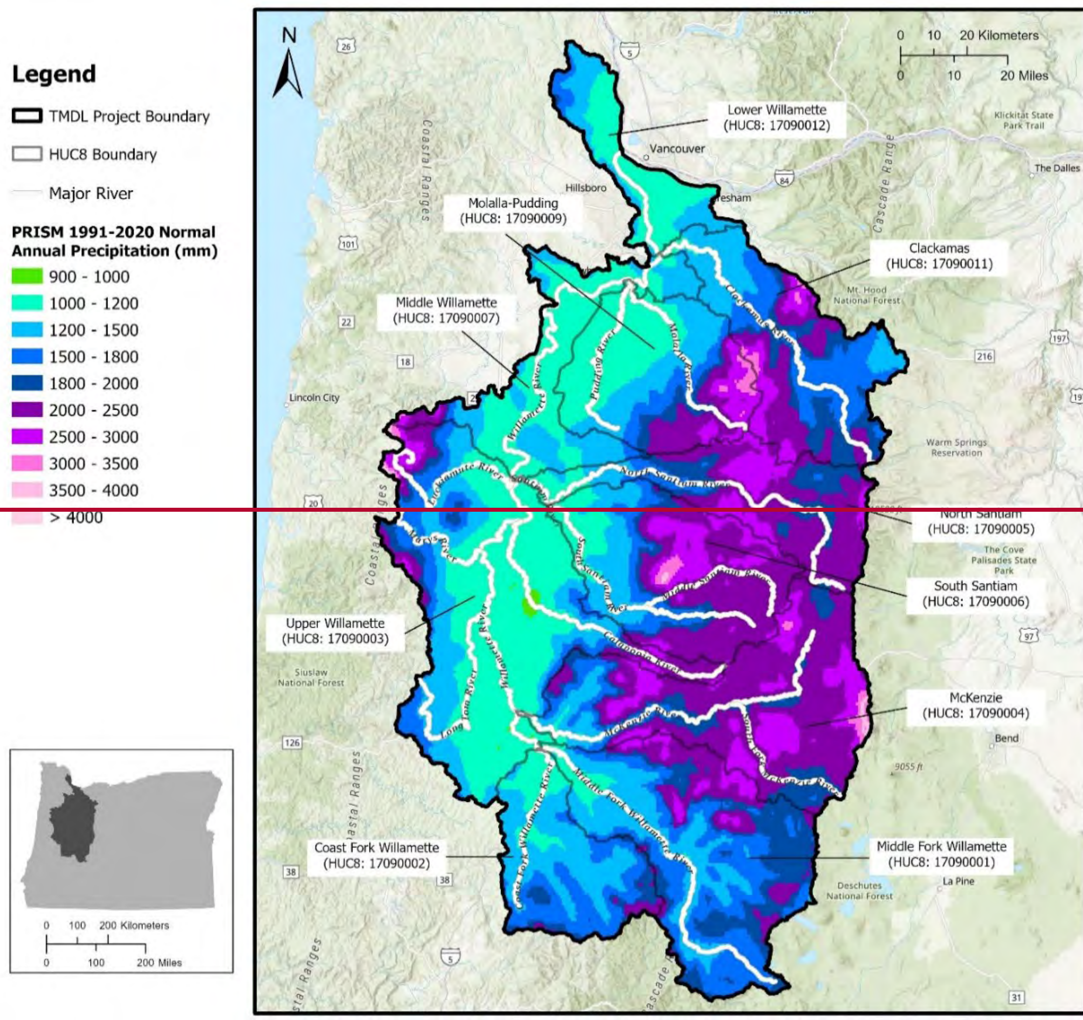


Figure 2-2: Willamette Subbasins and mainstem Category 5 temperature impairments on the 2022 Integrated Report.

2.2 Climate

The Willamette Basin has a temperate maritime climate with mild, wet winters and warm, dry summers. According to PRISM normals of annual conditions over the past 30 years (1991-2020), the average annual precipitation in the Willamette Basin ranges from around 985 mm (38") in the lower elevations of the Willamette Valley to over 4,160 mm (160") in the higher elevations of the Cascade Range (PRISM Climate Group, 2022) (**Figure 2-3**). The highest precipitation levels are typically seen during the winter months, with November to January being the wettest months. In contrast, the summer months are generally drier, with July and August being the driest months of the year.

In terms of temperature, the PRISM normals show that the average annual temperature in the Willamette Basin is around 15.3°C (59.6°F). However, temperatures can vary greatly depending on elevation and the time of year. The average annual maximum temperatures in the Willamette Basin range from 2.7°C (37°F) in the Willamette Valley to about 18°C (64°F) at the Cascade Range (**Figure 2-4**). The summer months are typically warm, with average temperatures of 26°C (78.8°F) in July and August. On the other hand, the winter months are cooler, with average temperatures of 6°C (42.8°F) in December and January.



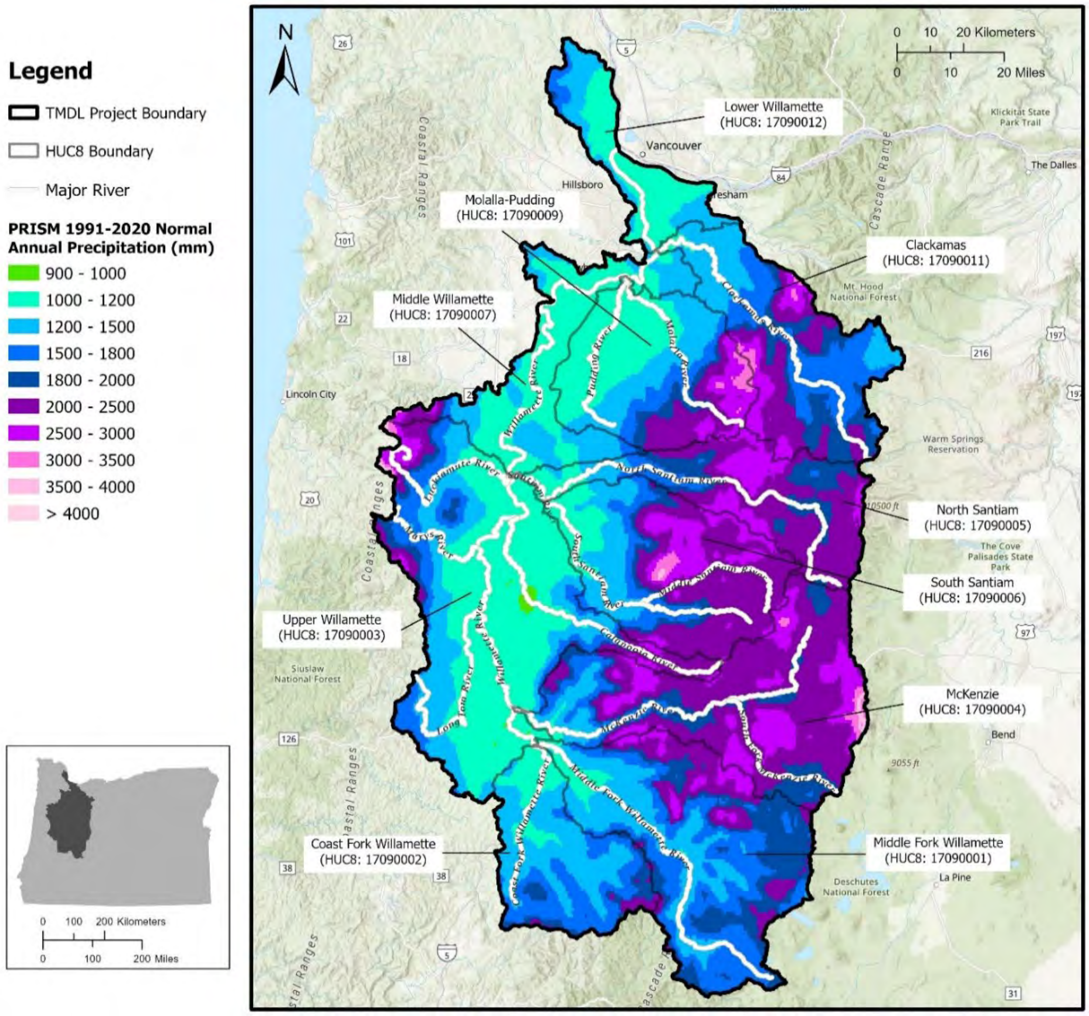
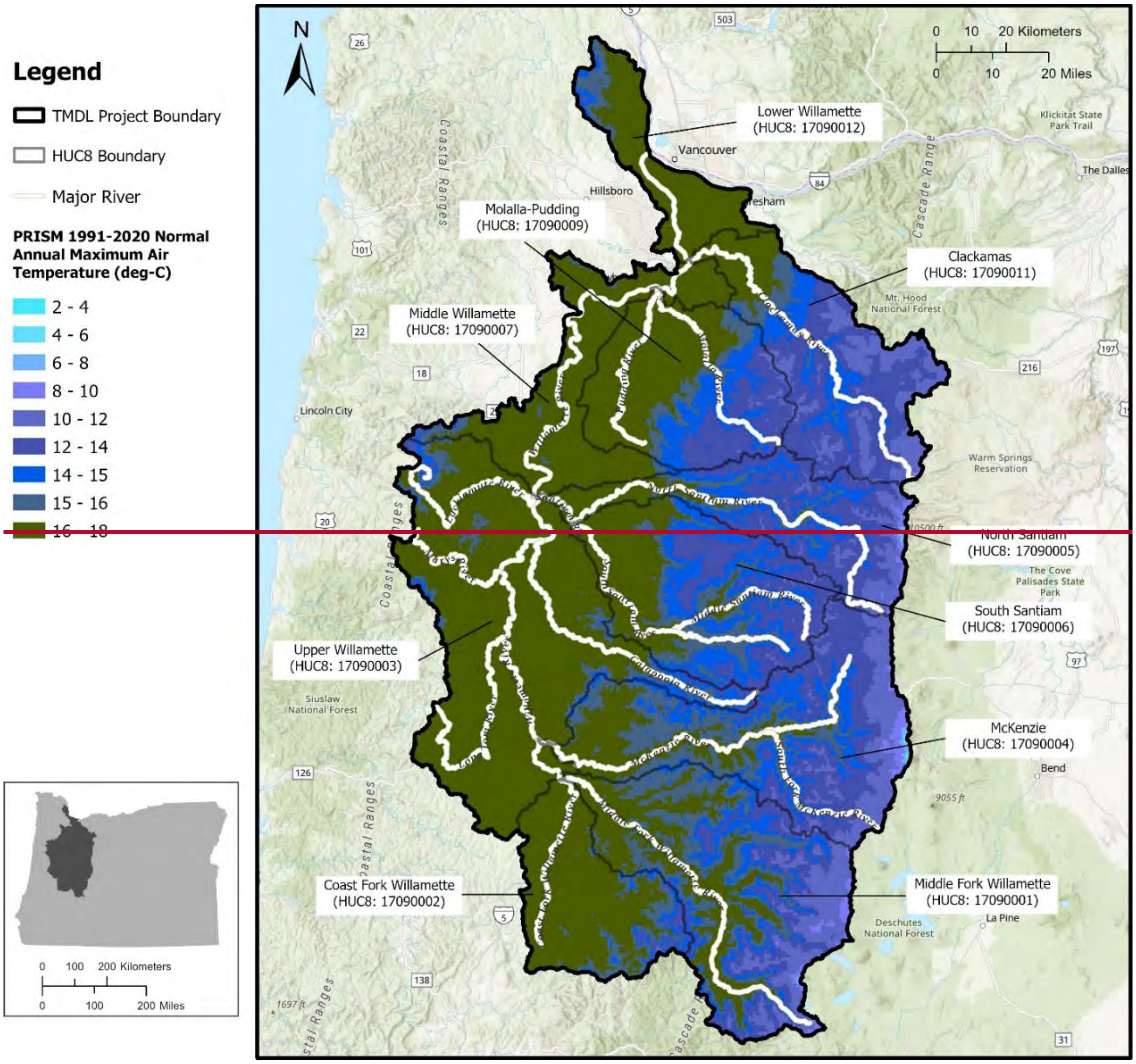


Figure 2-3: PRISM 1991-2020 Normal Annual Precipitation in the Willamette Subbasins temperature TMDL project area (Data Source: PRISM Climate Group, 2022).


Legend
TMDL Project Boundary
HUC8 Boundary
Major River
PRISM 1991-2020 Normal Annual Maximum Air Temperature (deg-C)
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
14 - 15
15 - 16
16 - 18
N
0 10 20 Kilometers
0 10 20 Miles
Lower Willamette (HUC8: 17090012)
Molalla-Pudding (HUC8: 17090009)
Clackamas (HUC8: 17090011)
Middle Willamette (HUC8: 17090007)
North Santiam (HUC8: 17090005)
South Santiam (HUC8: 17090006)
Upper Willamette (HUC8: 17090003)
McKenzie (HUC8: 17090004)
Coast Fork Willamette (HUC8: 17090002)
Middle Fork Willamette (HUC8: 17090001)
Vancouver
Hillsboro
Gresham
Lincoln City
The Dalles
Bend
La Pine
0 100 200 Kilometers
0 100 200 Miles

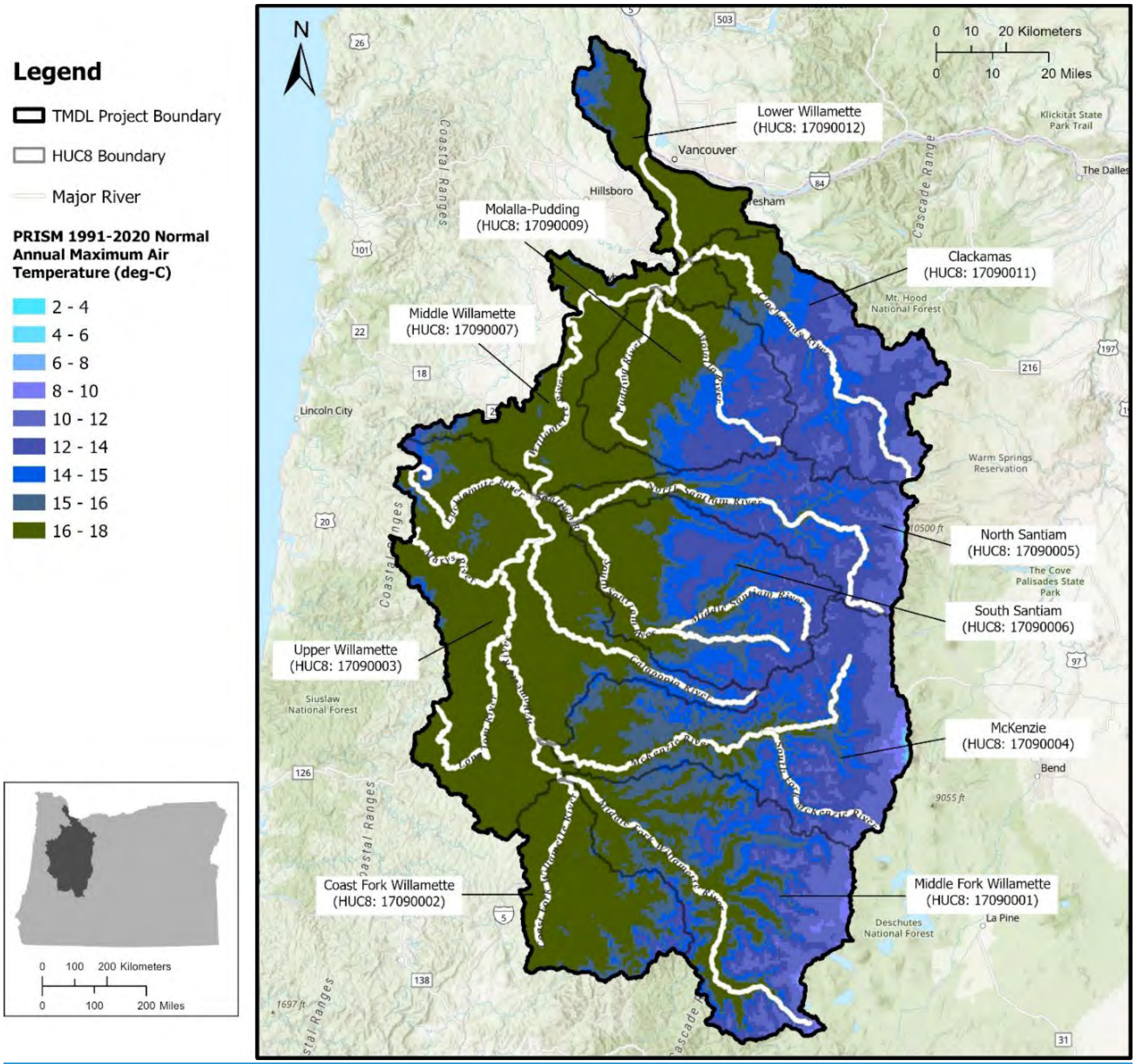


Figure 2-4: PRISM 1991-2020 Normal Annual Maximum Air Temperature in the Willamette Subbasins temperature TMDL project area (Data Source: PRISM Climate Group, 2022).

2.3 Hydrology

The Willamette Basin drains approximately 29,785 km^2 (11,500 mi^2) in northwestern Oregon between the Cascade and Coast Ranges. There are approximately 65,796 km (40,884 mi) of stream length in the Willamette Subbasins project area based on the National Hydrography Dataset (NHD). The Willamette River is formed by the confluence of two major tributaries, the Coast Fork Willamette River and the Middle Fork Willamette River. The Coast Fork originates in the foothills of the Cascade Mountains, while the Middle Fork originates in the high Cascades. These two rivers merge near the city of Eugene to form the Willamette River, which then travels about 187 miles before flowing into the Columbia River at river mile 101, at Portland.

The Willamette Basin includes numerous major tributaries, including the Coast Fork Willamette River, the Middle Fork Willamette River, the McKenzie River, the Long Tom River, the ~~Calapooia River~~North and South Santiam Rivers, the Santiam River, and the Clackamas River. The Willamette ~~River~~ Subbasins TMDL has been revised to include the Willamette River mainstem and lower reaches of major tributaries downstream from dams ~~are not included in this~~

~~TMDL; instead, they are covered by the Willamette River Mainstem and Major Tributaries TMDL~~.

The Willamette Basin also has many smaller tributaries. These include, but are not limited to, the Pudding River, Molalla River, Little North Santiam River, Luckiamute River, Marys River, Long Tom River upstream of Fern Ridge, and Mohawk River, which are covered in this TMDL.

Dams and reservoirs have a significant influence on the hydrology of the Willamette Basin. The U.S. Army Corps of Engineers (USACE) constructed a series of 11 dams with reservoirs and 2 re-regulating dams on major tributaries in the basin between 1941 and 1969, known as the Willamette Valley Project (**Table 2-~~13~~12**). USACE operates the Willamette Valley Project based on the purposes authorized by Congress with the Flood Control Act of 1938. Flood control is the highest priority of the Willamette Project, but other purposes include flow augmentation for navigation, irrigation, hydroelectric power production, fisheries, recreation, and water quality. The project provides the capacity of seasonal storage of nearly 1.6 million acre-feet of water and a production capacity of 2,100 megawatts (MW) of electric power (USACE, 2019).

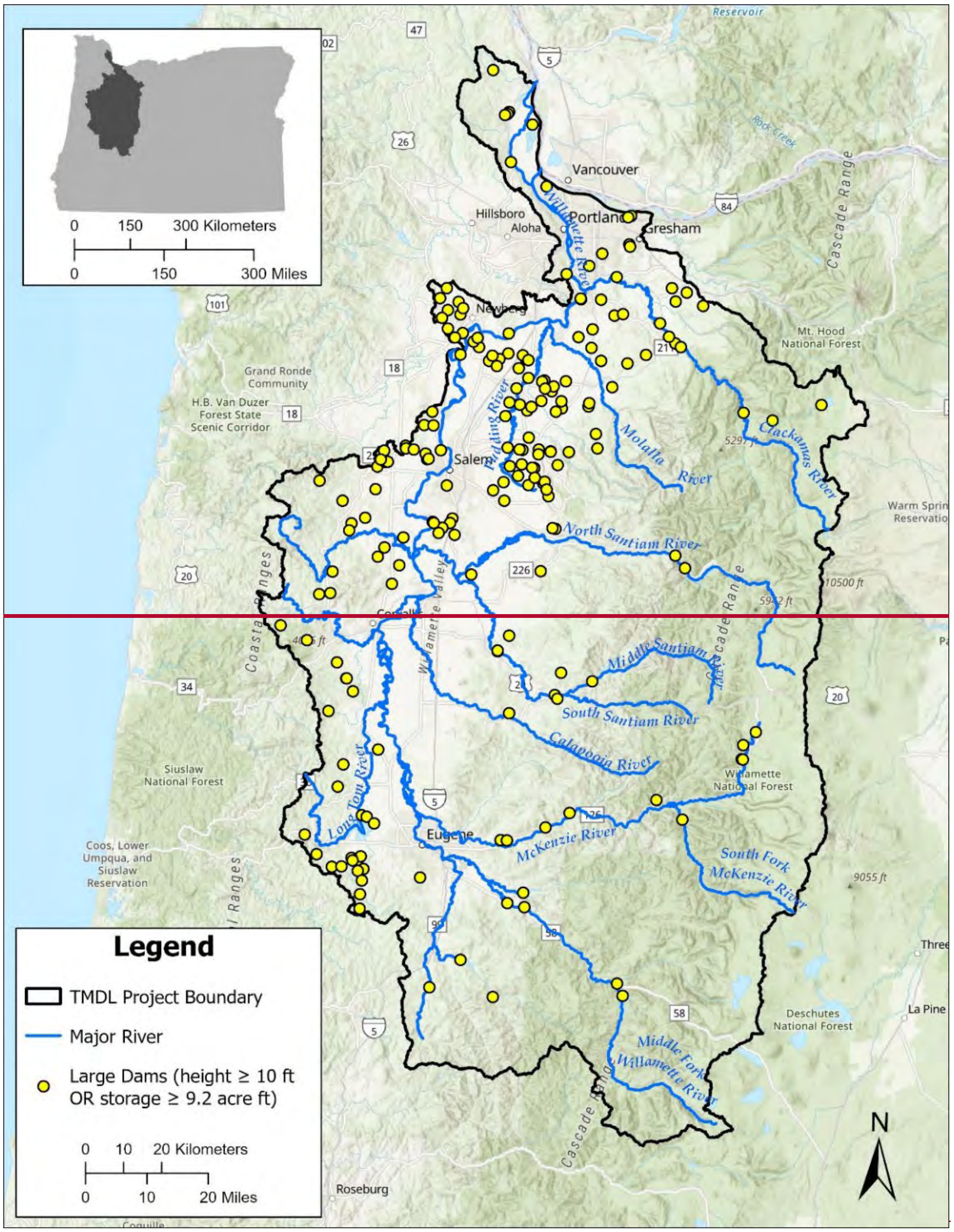
In addition to these large federal dams, there are Portland General Electric's (PGE) dams and reservoirs on the Clackamas River, Eugene Water and Electric Board (EWEB) operated projects in the McKenzie Subbasin, and over 350 smaller dams and reservoirs throughout the basin that are operated by local irrigation districts, municipalities, and private companies.

Table 2-12: Summary of USACE dams and reservoirs in the Willamette Basin.

Dam & Reservoir	Tributary Location	Year Complete	Total Storage in acre-feet	Summary Storage	# of Rec Areas	Power Generators	Draw-down Priority
Blue River	Blue River	1969	89,500	78,800	3	None	3rd
Cottage Grove	Coast Fork Willamette River	1942	32,900	28,700	5	None	5th
Fern Ridge	Long Tom River	1941	116,800	93,900	5	None	Last
Dexter	MF Willamette River	1954	NA, Reregulating	NA	2	1	NA
Lookout Point	MF Willamette River	1954	455,800	324,200	6	3	1st
Hills Creek	MF Willamette River	1961	355,500	194,000	5	2	4th
Fall Creek	MF Willamette River	1966	125,000	108,200	5	None	5th
Green Peter	Middle Santiam River	1968	428,100	249,900	3	2	5th
Big Cliff	North Santiam River	1953	NA, Reregulating	NA	None	1	NA
Detroit	North Santiam River	1953	455,100	281,000	7	2	Last
Dorena	Row River	1949	77,600	65,000	5	None	5th
Cougar	SF McKenzie River	1963	219,000	143,900	6	2	2nd
Foster	South Santiam River	1968	60,700	24,800	6	2	Last

Figure 2-5 shows the locations of large dams within the Willamette Subbasins temperature TMDL project area. This subset of dams was downloaded from two sources: the National

Inventory of Dams website (a repository maintained by USACE), and the Oregon Water Resources Department (OWRD) website (a repository listing only dams regulated by the State of Oregon). The 202 dams shown in the figure either meet or exceed ten feet in height or have storage capacities meeting or exceeding 9.2 acre-feet. They serve a variety of purposes, including but not limited to flood risk reduction, irrigation, water supply, hydroelectric power, recreation, and habitats for fish and wildlife. These dams are owned and operated by federal and local governments, state agencies, private entities, and public utilities. The first of these dams to be constructed was the Faraday Forebay dam, a PGE-owned dam for which construction was completed in 1907. The most recent dam to be constructed was the Sullivan Pond 3 dam near Lebanon, which was completed in 2009.



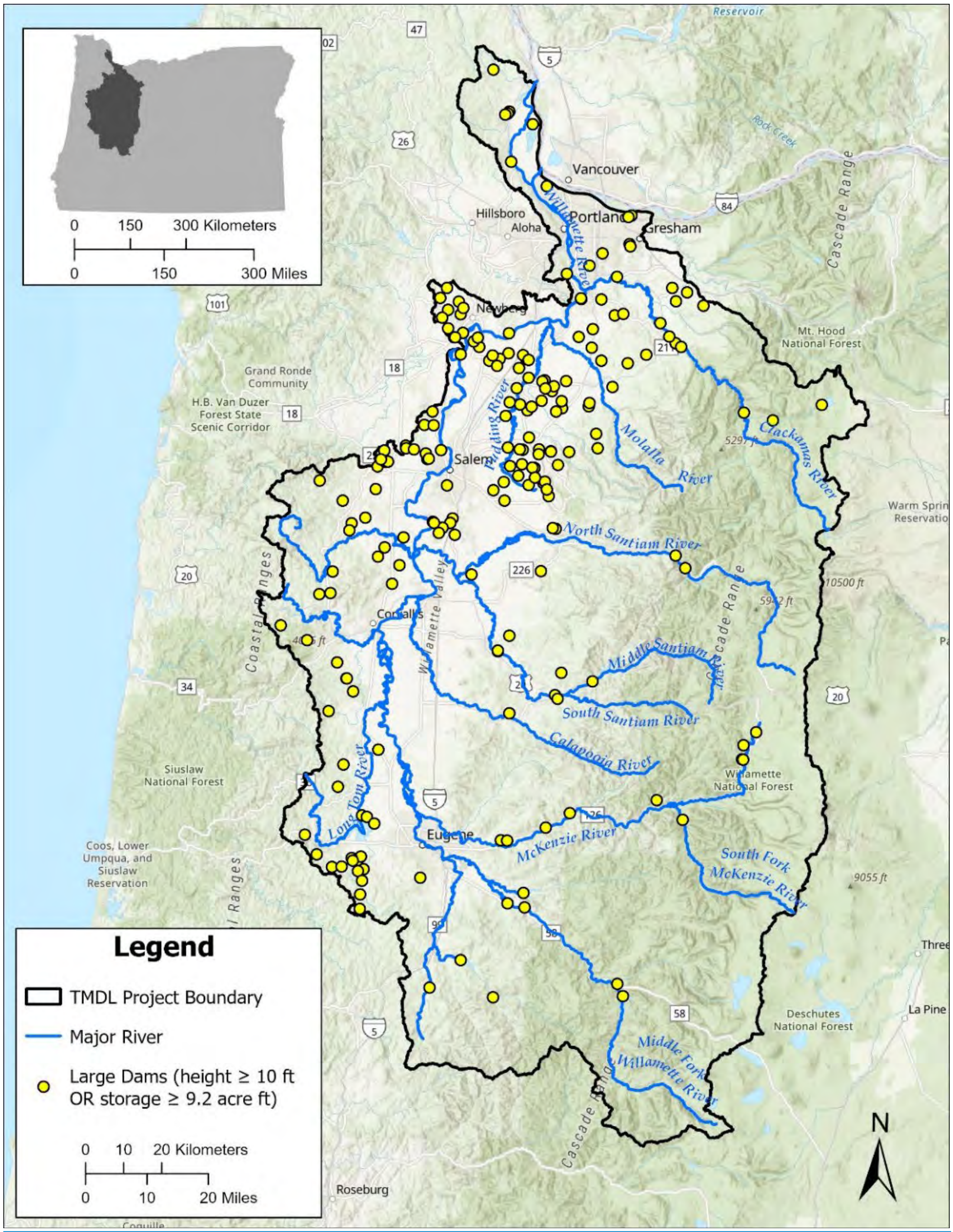


Figure 2-5: Large dams located within the Willamette Subbasins and mainstem temperature TMDL project area.

2.4 Intermittent streams

An intermittent stream as defined by Nadeau (2015) is a channel that contains water for only part of the year, typically during winter and spring when the streambed may be below the water table or when snowmelt from surrounding uplands provides sustained flow. The channel may or may not be well defined. The flow may vary greatly with stormwater runoff. An intermittent stream may lack the biological and hydrological characteristics commonly associated with the continuous conveyance of water. An intermittent stream may lack the biological and hydrological characteristics commonly associated with the continuous conveyance of water. Intermittent streams contribute to maintenance of cold water in downstream tributaries, even during periods when there is no surface flow (Ebersole et al., 2015).

The TMDL applies to intermittent streams for three primary reasons:

1) To protect aquatic life that may reside in intermittent streams. Intermittent streams can be “dry” but continue to support aquatic life in residual pools that remain during the dry periods. Residuals pools are often fed by sub surface flow. There is at least one published study in Oregon documenting the presence of juvenile salmonids in these residual pools over the summer (May and Lee, 2004). The temperature water quality standards apply to residual pools and the aquatic life that use them.

2) To protect downstream temperatures. Stream warming is cumulative and are not contained to just human activities within the reaches that are impaired. Activities in upstream tributaries, including intermittent streams, can influence stream temperatures downstream. For this reason, the EQC has developed standards protecting cold water (PCW) that already meets the biological based criteria and may not be currently listed as impaired (see OAR 340-0421-0028 (11)). In particular, intermittent streams are important for downstream temperatures because they can:

    a) Be flowing when temperature TMDLs apply. Streams classified as intermittent may only be “dry” in the summer or during low precipitation years. Temperature TMDLs apply to periods when downstream tributary temperatures exceed the applicable temperature standard. In the Willamette Subbasins the TMDL allocations apply May 1 – Oct 31 in most watersheds. Some watersheds require longer allocation periods (see Section 5). The TMDL allocation period includes months when intermittent streams may be flowing, such as in the spring or early fall when the spawning criterion apply.

    b) Become perennial or have longer periods of surface flow following timber harvest. Multiple studies have documented the increase to summer flow and annual water yield following a timber harvest (Hibbert, 1967; Rothacher, 1970; Harr et al., 1982; Keppeler and Ziemer, 1990; Bowling et al., 2000; Surfleet and Skaugset, 2013; Segura et al., 2020). Insufficient shade over these streams contributes to excessive solar loading, temperature increases, and may contribute to downstream warming.

    c) Be flowing subsurface because they are currently degraded. In Eastern Oregon there are examples of degraded intermittent streams becoming perennial after riparian restoration. Restoring the riparian vegetation will allow the system to aggrade, raising the water table and returning flow to the surface (Elmore and Beschta, 1987).

3) As a margin of safety to address the current inaccuracies associated with classification and mapping of intermittent streams, and their period of flow in relation to the period when TMDL allocations apply. There are multiple approaches used to identify and map stream flow permanence and duration. Some of the more recent methods used in Oregon (Nadeau, 2015; Jaeger et al., 2019) are improvements over previous methods; and the classifications included in past versions of the NHD. Fritz et al. (2013) demonstrated that the flow permanence classifications included in the NHD only had about a 50% agreement with field-based observations. DEQ believes the current classifications are not accurate enough for reliable application and use for the TMDL.

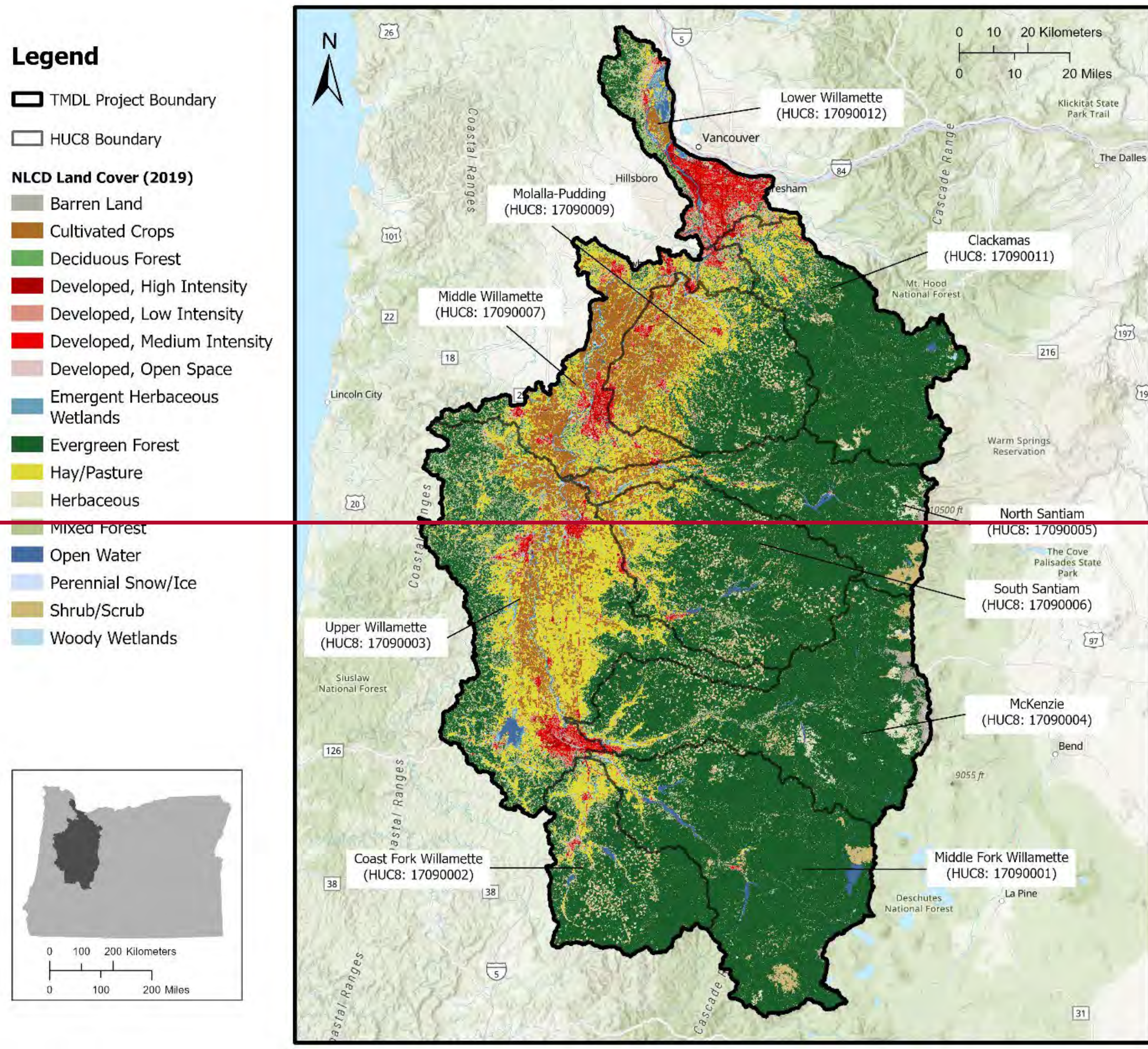
For these reasons the TMDL allocations apply to intermittent streams unless field-based data is assembled to document a stream does not contain residual pools and does not have surface flow during the entire period the TMDL applies.

2.5 Land Use

Forestry, agriculture and urban uses dominate land use in the Willamette Subbasins TMDL project area, which is summarized in **Table 2-~~14~~13** and **Figure 2-6** based on the 2019 National Land Cover Database (Dewitz and USGS, 2021). The majority of the basin is forestry, accounting for about 68% of the land in the basin. Forests are mainly located from the higher elevations to the foothills of the Coast and Cascade mountain ranges. These forests are primarily composed of Douglas fir and other conifers, and provide important habitat for a variety of wildlife, including salmon and steelhead. The land cover of the lower elevations of the basin is more heavily influenced by agriculture and urbanization. Agricultural land covers about 19% of the basin, including pasture and crops. Urban areas are prominent, with a total of 75 cities, including the three largest cities in the state (Portland, Eugene, and Salem). According to the 2010 census data, more than two million individuals, which accounts for over 50% of Oregon's overall population, reside in the Willamette Basin.

Table 2-13: Summary of land uses in the Willamette Subbasins TMDL project area based on the 2019 National Land Cover Database.

2019 NLCD Land Cover	Acres	Percent of Total Area
Evergreen Forest	3723099.4	58.30
Hay/Pasture	817292.4	12.80
Cultivated Crops	404290.1	6.30
Shrub/Scrub	346706.4	5.40
Mixed Forest	197931.8	3.10
Herbaceous	165112.3	2.60
Developed, Low Intensity	156196.8	2.40
Developed, Open Space	142817.1	2.20
Developed, Medium Intensity	130316.7	2.00
Open Water	75347.9	1.20
Woody Wetlands	63695.8	1.00
Developed, High Intensity	55271.5	0.90
Emergent Herbaceous Wetlands	54148.8	0.80
Barren Land	31091.2	0.50
Deciduous Forest	25684.6	0.40
Perennial Snow/Ice	2126.5	0.03


Legend
TMDL Project Boundary
HUC8 Boundary
NLCD Land Cover (2019)
Barren Land
Cultivated Crops
Deciduous Forest
Developed, High Intensity
Developed, Low Intensity
Developed, Medium Intensity
Developed, Open Space
Emergent Herbaceous Wetlands
Evergreen Forest
Hay/Pasture
Herbaceous
Mixed Forest
Open Water
Perennial Snow/Ice
Shrub/Scrub
Woody Wetlands
Lower Willamette (HUC8: 17090012)
Molalla-Pudding (HUC8: 17090009)
Clackamas (HUC8: 17090011)
Middle Willamette (HUC8: 17090007)
North Santiam (HUC8: 17090005)
South Santiam (HUC8: 17090006)
Upper Willamette (HUC8: 17090003)
McKenzie (HUC8: 17090004)
Coast Fork Willamette (HUC8: 17090002)
Middle Fork Willamette (HUC8: 17090001)
Vancouver
Hillsboro
The Dalles
Lincoln City
Bend
La Pine
0 10 20 Kilometers
0 10 20 Miles
0 100 200 Kilometers
0 100 200 Miles

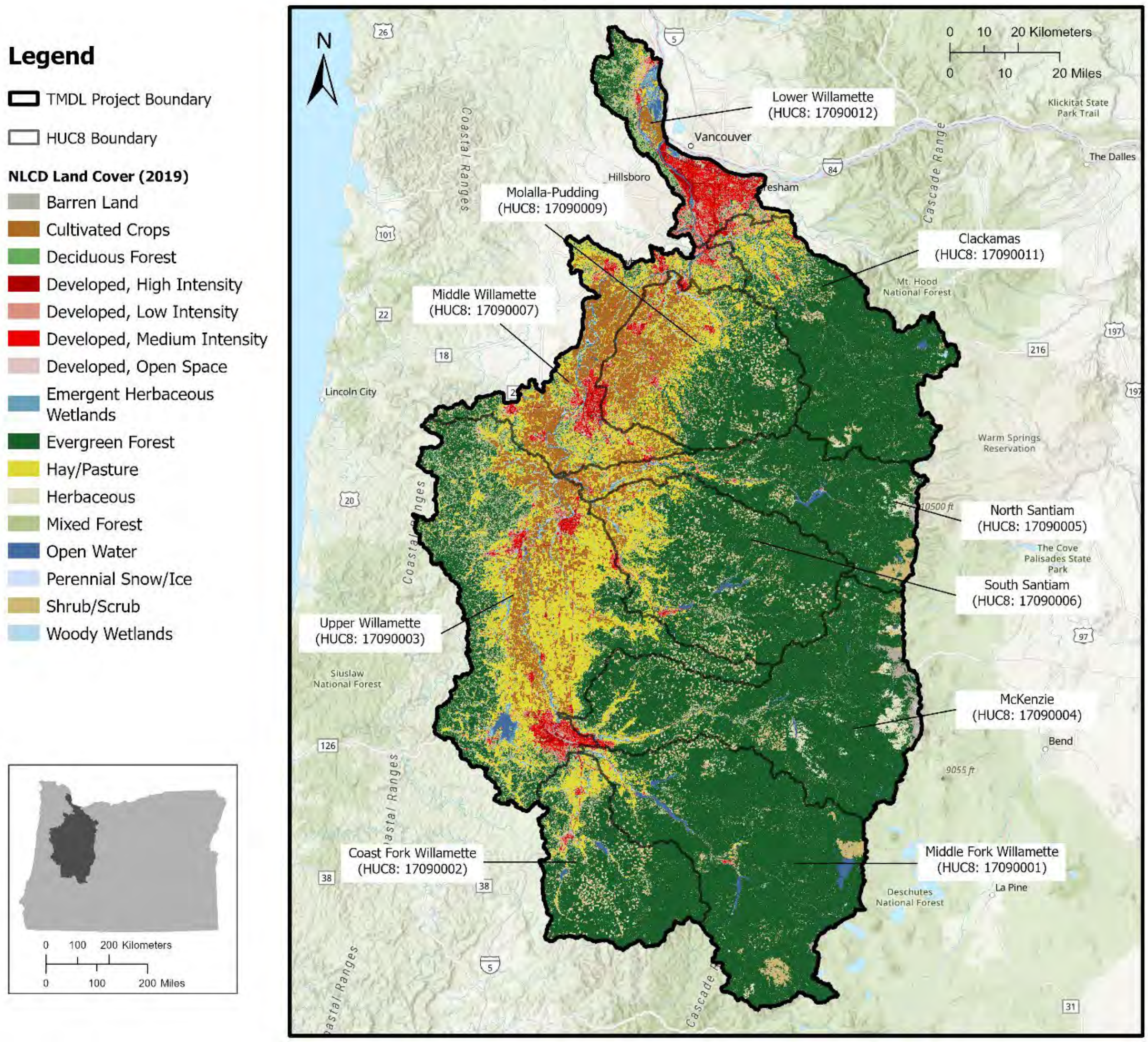
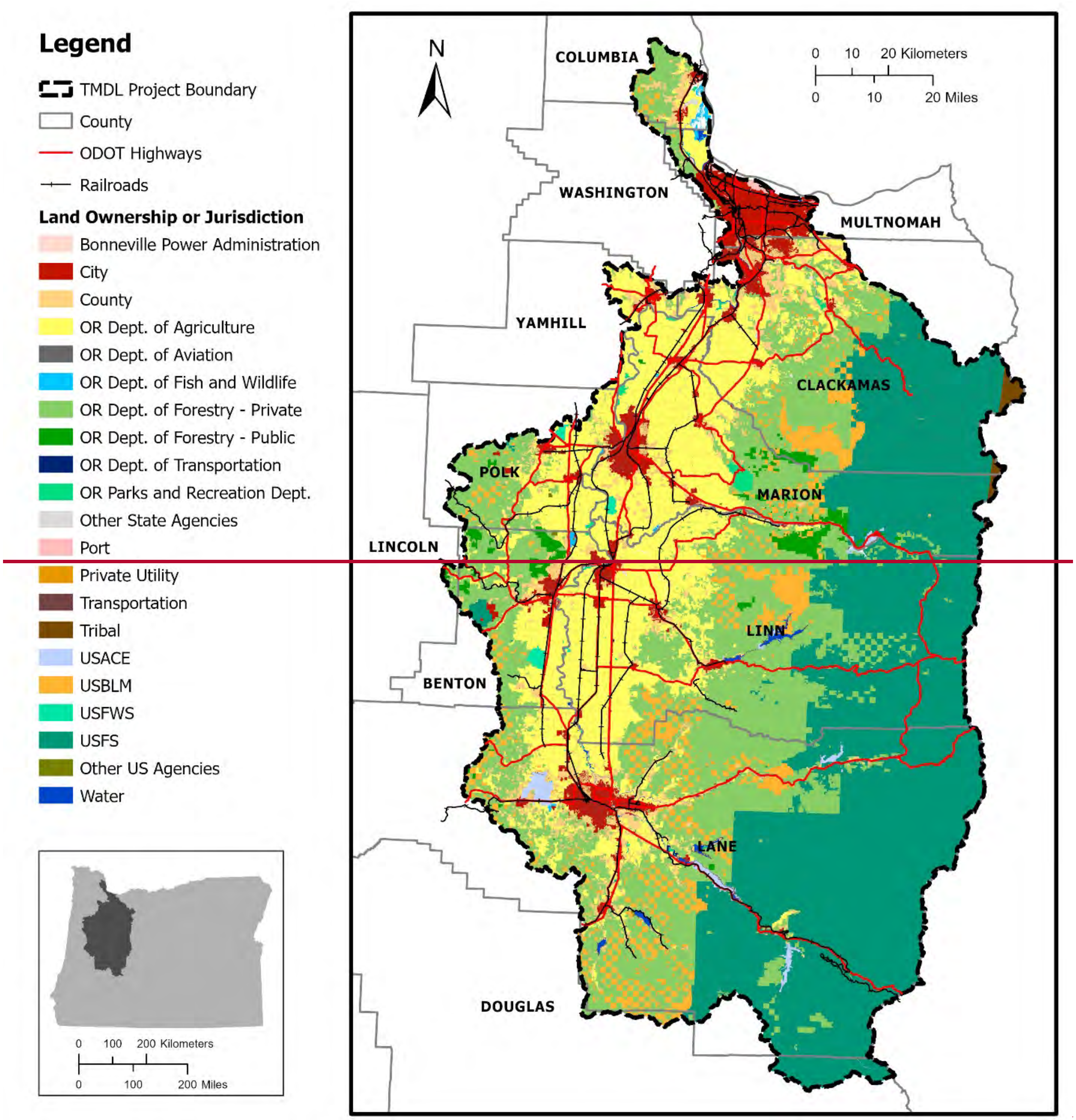


Figure 2-6: Land uses in the Willamette Subbasins TMDL project area based on the 2019 National Land Cover Database. (*Note: Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.)*

2.6 Land Ownership and Jurisdiction

The Willamette Subbasins TMDL project area is a complex landscape with a variety of landowners and jurisdictions (**Figure 2-7**). Land ownership and jurisdiction was determined using the Designated Management Agency (DMA) Geographic Information System (GIS) data described in Section 2.2 of the modeling report (TSD Appendix A). Land ownership within the subbasins includes private individuals, corporations, state and federal agencies, and tribal governments. Private individuals and corporations own the majority of the land in the basin, accounting for about 56%, particularly in the Willamette Valley where agriculture and urbanization are more prevalent. Federal agencies, such as the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM), own and manage those portions of forested lands, accounting for about 34.4% and 5.5% of the basin, respectively. The Oregon Department of Forestry (ODF) manages about 27% of the land in the basin, including both private and public lands. Tribal governments also have important land ownership and management roles within the basin. The Confederated Tribes of Warm Springs has land holdings within the basin and has treaty rights to fish and hunt in the area.



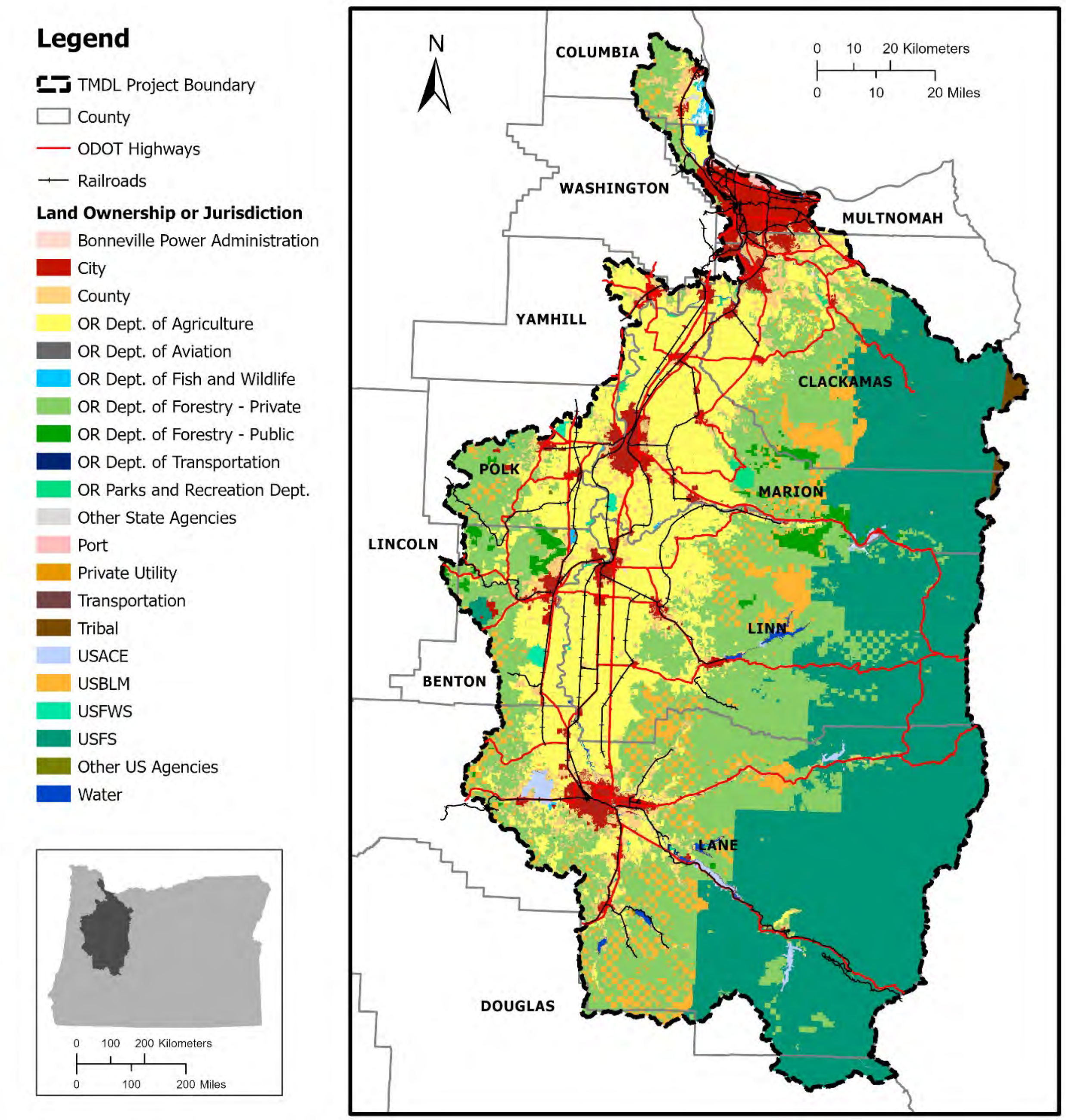


Figure 2-7: Land ownership and jurisdiction in the Willamette Subbasins temperature TMDL project area.

3 Pollutant identification

Temperature is the water quality parameter of concern, but heat or thermal loading, is the pollutant of concern causing impairment. Heat caused by human activities is of particular concern. Water temperature change (ΔTw) is a function of the heat transfer in a discrete volume and may be described in terms of changes in heat per unit volume. Conversely, a change in volume can also result in water temperature change for a defined amount of heat exchange.

$$\Delta Tw = \frac{\Delta Heat}{Density \times Specific\ Heat \times \Delta Volume}$$

The pollutants addressed by these temperature TMDLs are heat or thermal loads, with surrogate measures of effective shade.

EPA regulations (40 CFR 130.2(i)) and OAR 340-042-0040(O)(5)(b) allow for TMDLs to utilize other appropriate measures (or surrogate measures). Surrogate measures are defined in OAR 340-042-0030(14) as “substitute methods or parameters used in a TMDL to represent pollutants.” In accordance with OAR 340-042-0040(5)(b), DEQ used effective shade as a surrogate measure for thermal loading caused by solar radiation. Effective shade is the percent of the daily solar radiation flux blocked by vegetation and topography. Implementation of the surrogate measures ensures achievement of necessary pollutant reductions and the nonpoint load allocations for this temperature TMDL.

4 Temperature water quality standards and beneficial uses

EQC issued, and EPA approved, numeric and narrative water quality standards to protect designated *beneficial uses* in the Willamette (OAR 340-041-0344~0350, November 2003), and antidegradation policies to protect overall water quality. **Table 4-1** specifies the designated beneficial uses in the Willamette Subbasins surface water.

Table 4-1: Designated beneficial uses in the Willamette Subbasins as identified in OAR 340-041-0340 Table 340A.

Beneficial Uses	All Waterbodies
Public Domestic Water Supply	X
Private Domestic Water Supply	X
Industrial Water Supply	X
Irrigation	X
Livestock Watering	X
Fish and Aquatic Life	X
Wildlife and Hunting	X
Fishing	X
Boating	X

Beneficial Uses	All Waterbodies
Water Contact Recreation	X
Aesthetic Quality	X
Hydro Power	X
Commercial Navigation & Transportation	

Water quality criteria have been set at a level to protect the most sensitive beneficial uses. These TMDLs are designed such that meeting water quality standards for the most sensitive beneficial uses will be protective of all other uses. Fish and aquatic life are the most sensitive beneficial use for temperature. Oregon's water temperature criteria use salmonids' life cycles as indicators. If temperatures are protective of these indicator species, other species will share in this protection. The locations and periods of criteria applicability are determined from designated fish use maps in rule at OAR 340-041-0340 Figure 340A and Figure 340B. The maps from the rule have been reproduced and shown in **Figure 4-1** and **Figure 4-2**. **Figure 4-1** shows various designated fish uses and applicable criteria, while **Figure 4-2** shows salmon and steelhead spawning use designation, based on the NHD.

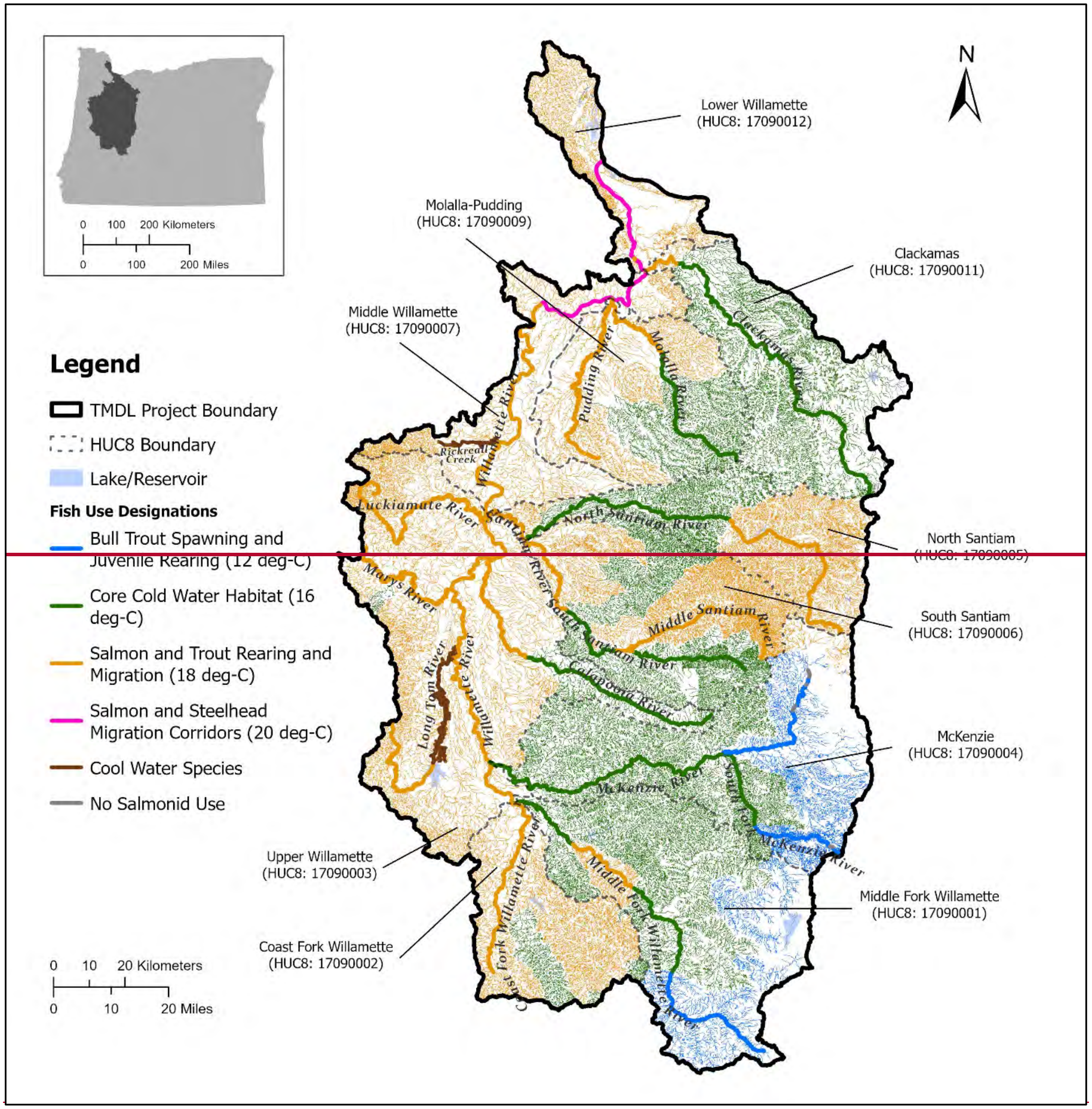
The temperature water quality standards for the Willamette Subbasins are based on the rolling seven-day average daily maximum (7DADM) and include the following numeric criteria:

- 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))
- Salmon and steelhead migration corridors: 20.0°C (68.0°F) (OAR 340-041-0028(4)(d))
- Bull trout spawning and juvenile rearing: 12°C (53.6°F) (OAR 340-041-0028(4)(f))

The following narrative temperature water quality standards and other rule provisions also apply in the Willamette Subbasins:

- Cool Water Species (OAR 340-041-0028(9))
- Human use allowance (OAR 340-041-0028(12)(b))
- Minimum duties (OAR 340-041-0028(12)(a))
- Natural Lakes (OAR 340-041-0028(6))
- Protecting cold water (OAR 340-041-0028(11))
- The three basin rule: Clackamas, McKenzie, and North Santiam (OAR 340-041-0350)
- Antidegradation (OAR 340-041-0004)

Details of each rule are described in the sections that follow.



Lower Willamette
(HUC8: 17090012)
Molalla-Pudding
(HUC8: 17090009)
Clackamas
(HUC8: 17090011)
Middle Willamette
(HUC8: 17090007)
North Santiam
(HUC8: 17090005)
South Santiam
(HUC8: 17090006)
McKenzie
(HUC8: 17090004)
Upper Willamette
(HUC8: 17090003)
Coast Fork Willamette
(HUC8: 17090002)
Middle Fork Willamette
(HUC8: 17090001)
N
0 100 200 Kilometers
0 100 200 Miles
0 10 20 Kilometers
0 10 20 Miles
Legend
TMDL Project Boundary
HUC8 Boundary
Lake/Reservoir
Fish Use Designations
Bull Trout Spawning and Juvenile Rearing (12 deg-C)
Core Cold Water Habitat (16 deg-C)
Salmon and Trout Rearing and Migration (18 deg-C)
Salmon and Steelhead Migration Corridors (20 deg-C)
Cool Water Species
No Salmonid Use
Rickreall Creek
Luckiamute River
Santiam River
North Santiam River
Marys River
Middle Santiam River
South Santiam River
Calapooia River
Long Tom River
Willamette River
McKenzie River
South Fork McKenzie River
Middle Fork Willamette River
Coast Fork Willamette River
Pudding River
Molalla River
Clackamas River

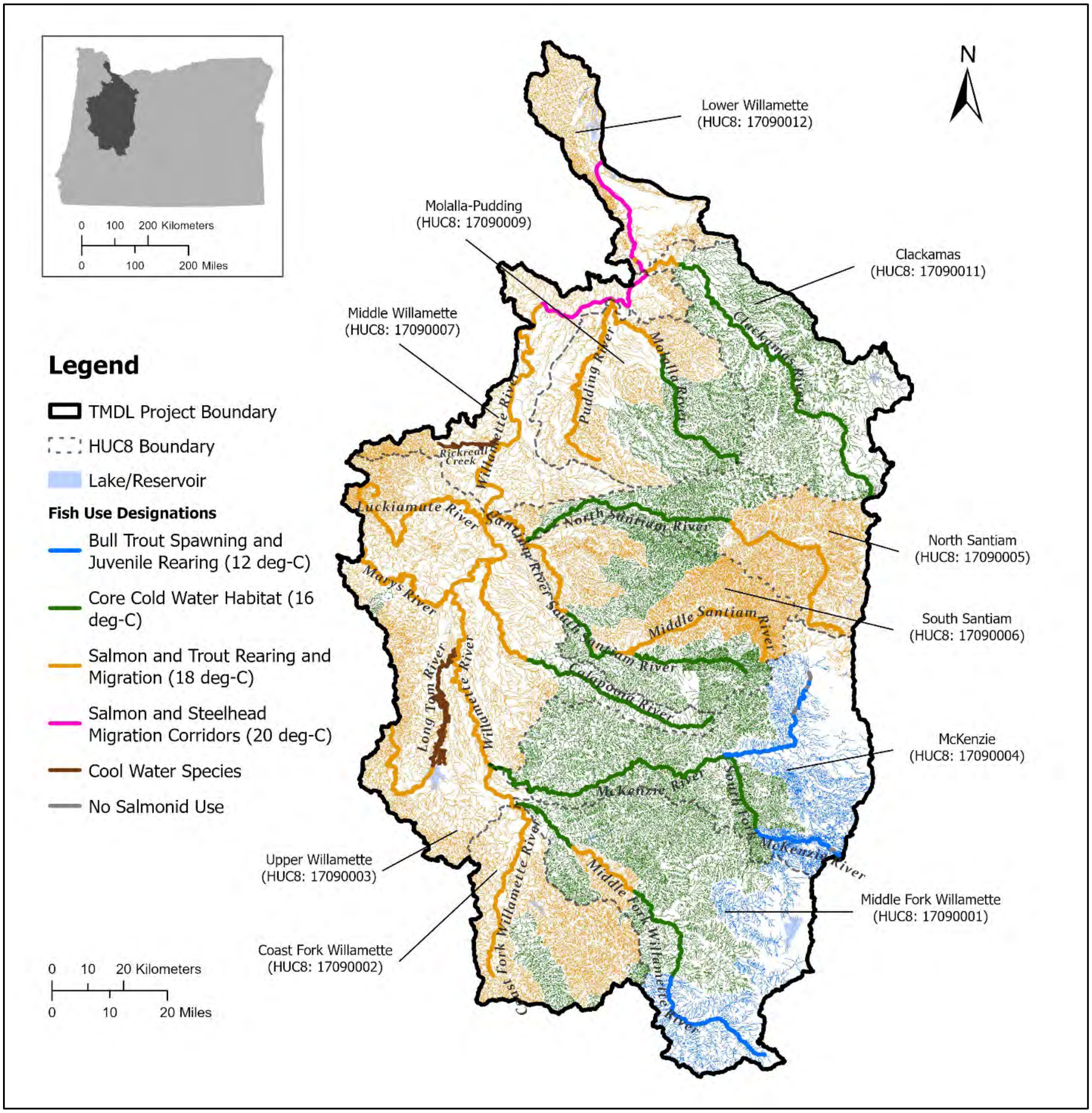
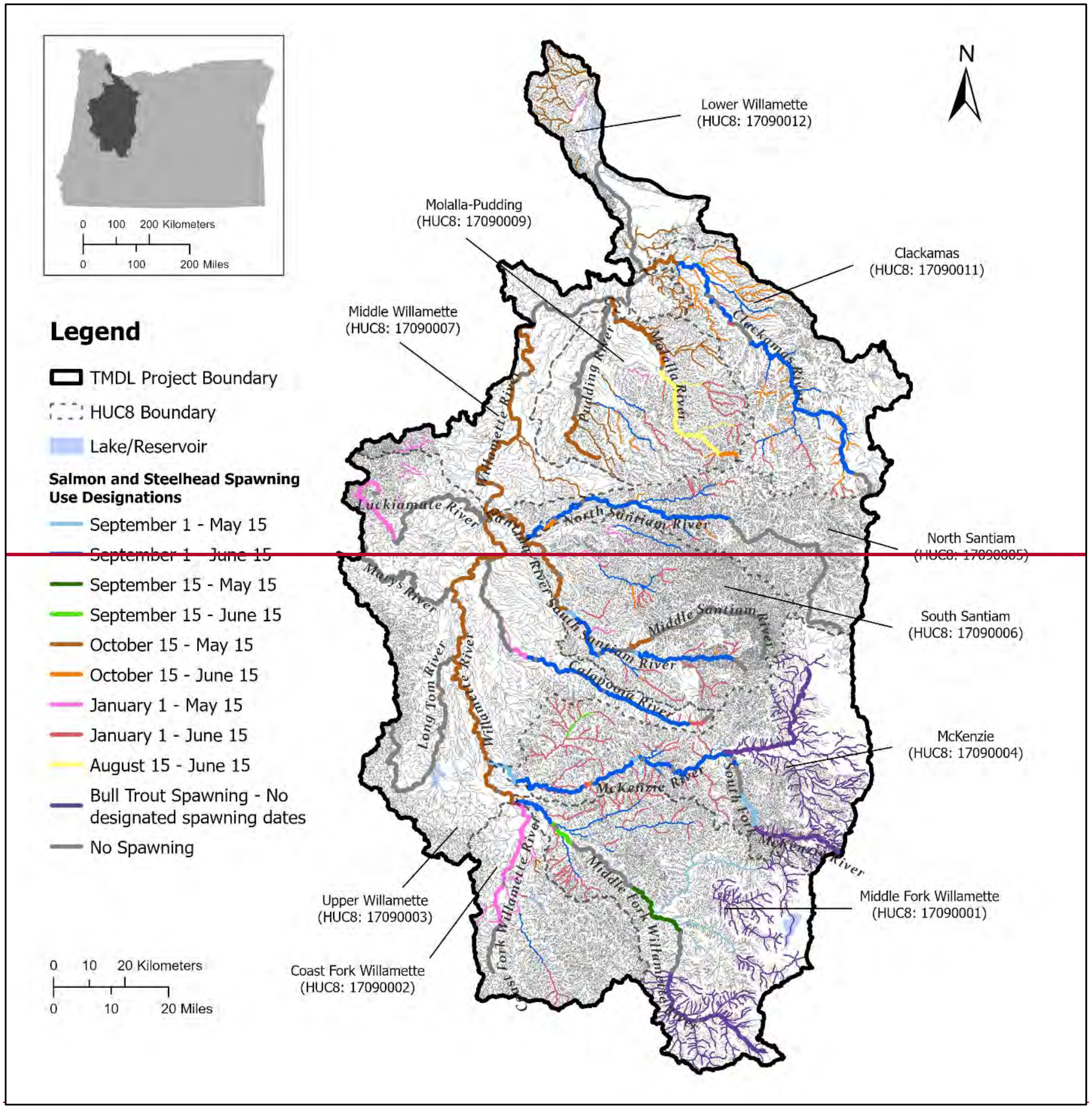


Figure 4-1: Fish use designations in the Willamette Subbasins TMDL project area.



N
0 100 200 Kilometers
0 100 200 Miles
Legend
TMDL Project Boundary
HUC8 Boundary
Lake/Reservoir
Salmon and Steelhead Spawning Use Designations
September 1 - May 15
September 1 - June 15
September 15 - May 15
September 15 - June 15
October 15 - May 15
October 15 - June 15
January 1 - May 15
January 1 - June 15
August 15 - June 15
Bull Trout Spawning - No designated spawning dates
No Spawning
0 10 20 Kilometers
0 10 20 Miles
Lower Willamette (HUC8: 17090012)
Molalla-Pudding (HUC8: 17090009)
Clackamas (HUC8: 17090011)
Middle Willamette (HUC8: 17090007)
North Santiam (HUC8: 17090005)
South Santiam (HUC8: 17090006)
McKenzie (HUC8: 17090004)
Middle Fork Willamette (HUC8: 17090001)
Upper Willamette (HUC8: 17090003)
Coast Fork Willamette (HUC8: 17090002)
Luckiamute River
Marys River
Long Tom River
Willamette River
Santiam River
North Santiam River
South Santiam River
Middle Santiam River
Calapooia River
McKenzie River
South Fork McKenzie River
Middle Fork Willamette River
Coast Fork Willamette River
Pudding River
Molalla River
Clackamas River

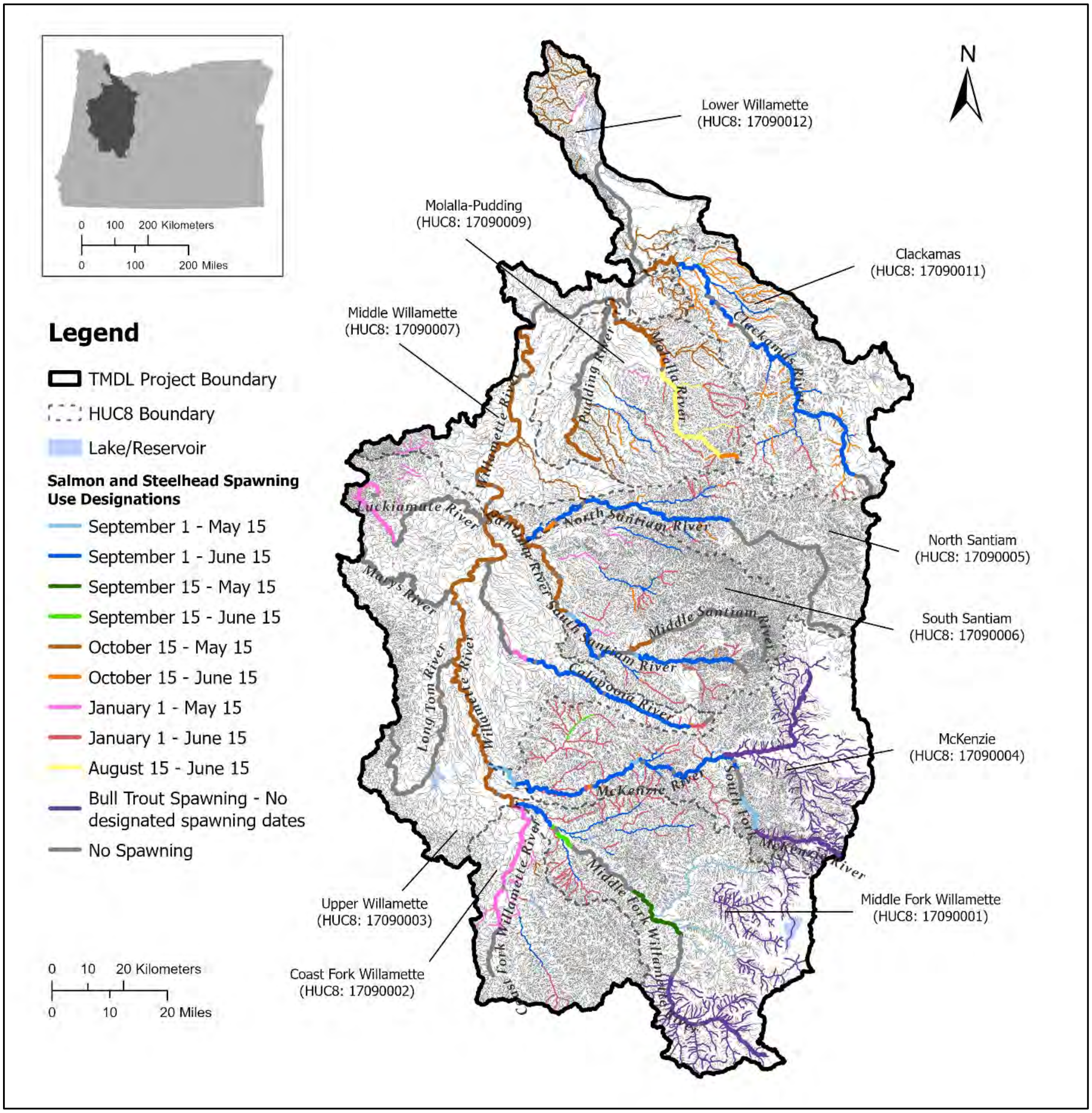


Figure 4-2: Salmon and steelhead spawning use designations in the Willamette Subbasins TMDL project area.

4.1 Salmon and steelhead spawning use

OAR 340-041-0028(4)(a). Waters that have been designated as having salmon and steelhead spawning use are identified in rule at OAR 340-041-0340 Figure 340B and shown in **Figure 4-2**. During the spawning period, these waters may not exceed 13.0°C (55.4°F) expressed as a 7DADM.

4.2 Core cold water habitat use

OAR 340-041-0028(4)(b). Waters that have been designated as having core cold water habitat use are identified in OAR 340-041-0340 Figure 340A and shown in **Figure 4-1**. These waters may not exceed 16.0°C (60.8°F) expressed as a 7DADM.

4.3 Salmon and trout rearing and migration

OAR 340-041-0028(4)(c). Waters that have been designated as having salmon and trout rearing and migration use are identified in OAR 340-041-0340 Figure 340A and shown in **Figure 4-1**. These waters may not exceed 18.0°C (64.4°F) expressed as a 7DADM.

4.4 Migration corridor use and cool water refugia

OAR 340-041-0028(4)(d). Waters that have been designated as having a migration corridor use are identified in OAR 340-041-0340 Figure 340A and shown in **Figure 4-1**. These waters may not exceed 20.0°C (68.0°F) expressed as a 7DADM. In addition, these waters must have cold water refugia that are sufficiently distributed so as to allow salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the water body. Cold water refugia is defined in OAR 340-041-0002(10) to mean those portions of a water body where or times during the diel temperature cycle when the water temperature is at least 2 degrees Celsius colder than the daily maximum temperature of the adjacent well-mixed flow of the water body.

~~4.4~~4.5 Bull trout spawning and juvenile rearing

OAR 340-041-0028(4)(f). Waters that have been designated as having salmon and trout rearing and migration use are identified in OAR 340-041-0340 Figure 340A and shown in **Figure 4-1**. These waters may not exceed 12.0°C (53.6°F) expressed as a 7DADM.

In addition, the rule states that below Carmen Reservoir on the Upper McKenzie River, there may be no more than a 0.3°C (0.5°F) increase between the water temperature immediately upstream of the reservoir and the water temperature immediately downstream of the spillway when the ambient 7DADM stream temperature is 9.0°C (48°F) or greater, and no more than a 1.0°C (1.8°F) increase when the 7DADM stream temperature is less than 9°C.

~~4.5~~4.6 Human use allowance

Oregon water quality standards have provisions for human use (OAR 340-041-0028(12)(b)). The human use allowance (HUA) is an insignificant addition of heat (0.3°C) authorized in waters that exceed the applicable temperature criteria. Following a temperature TMDL, or other cumulative effects analysis, wasteload 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 biological criterion after complete mixing in the waterbody, and at the point of maximum impact (POMI). The rationale behind selection of 0.3°C for the HUA and how DEQ implements this portion of the standard can be found in DEQ (2003) and the Temperature IMD (DEQ, 2008a).

~~4.6~~4.7 Natural lakes

OAR 340-041-0028(6). Natural lakes 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. Absent a discharge or human modification that would reasonably be expected to increase temperature, DEQ will presume that the ambient temperature of a natural lake is the same as its natural thermal condition.

~~4.7~~4.8 Cool water species

The narrative cool water species criterion in rule at OAR 340-041-0028(9)(a) states that "No increase in temperature is allowed that would reasonably be expected to impair cool water species." The Long Tom River (Upper Willamette Subbasin) and Rickreall Creek (Middle Willamette Subbasin) ~~is~~are the only ~~waterbody~~waterbodies designated for the cool water species use in the Willamette Subbasins~~ project area. The~~. On the Long Tom River, the designation applies from the mouth at the confluence with the Willamette River (river mile 0) to Fern Ridge Dam (approximate river mile 24.1). On Rickreall Creek, the designation applies from the mouth at the confluence of the Willamette River (river mile 0) to the east end of Dallas City Park at approximately river mile 14. ~~This reach of~~In the sections that follow, these reaches of the Long Tom River and Rickreall Creek ~~is~~are hereafter referred to as "the lower ~~reach". The Long Tom River below Fern Ridge Reservoir (Upper Willamette Subbasin) is also designated for cool water species use, but this reach of the Long Tom River is not addressed by the Willamette Subbasins TMDL.~~reaches".

DEQ uses a stepwise approach to implement ~~this~~the narrative ~~standard~~cool species water criterion (DEQ, 2008a). The Department bases its evaluations on the best available information and professional judgment. Pertinent information includes: the species present and their thermal requirements, physical characteristics of the waterbody, current ambient temperatures and the magnitude, duration and frequency of the proposed temperature increase.

DEQ followed the procedures of the Water Quality Standard Implementation IMD (DEQ, 2008a) to implement the narrative provision of the ~~Cool Water Species narrative~~cool water species criterion. First, DEQ considered if it would be reasonable to apply the Redband & Lahontan Cutthroat Trout criterion of 20°C plus the 0.3°C HUA to the reach. The rationale, as outlined in DEQ's temperature water quality standard implementation IMD is that a target temperature based on 20°C will not impair cool water species, which have more tolerance of warm temperatures than trout. This approach was rejected because 20°C does not appear to be attainable (see Section 4.~~7.3~~8.5) and, as discussed later in this section, there are periods when winter steelhead are migrating in lower Rickreall Creek~~, which~~; and juvenile spring chinook salmon may rear or forage in the lower reach of the Long Tom River, winter steelhead and spring chinook salmon require temperatures less than 20°C. Instead, DEQ determined what cool water species are present in Rickreall Creek and the Long Tom River and identified ~~a~~ target ~~temperature~~temperatures based on the thermal tolerance information available for those species. A temperature target was also identified for the peak periods when winter steelhead are migrating and when juvenile Chinook salmon are present.

4.8.1 Long Tom River temperatures

Continuous temperature data are available in the lower Long Tom River (**Figure 4-4** and **Figure 4-5**). The data show current temperatures peak between June and August and exceed 18°C from April 15 to October 30. Temperatures exceed 20°C from May 15 through the end of October. The plots include the selected lower Long Tom River temperature target for comparison.

Figure 4-3: Watershed boundaries (black line) and extent of the Cool Water Species use designation in the lower Long Tom River (brown line). Approximate location of USGS monitoring station 14170000 Monroe, OR (circle) and 14169000 Alvadore, OR (triangle) are shown.

DEQ has not modeled the background temperatures of the lower reach, so an estimate of background temperatures was derived using a nearby stream that was modeled. The background temperatures provide useful estimates of the range of potential temperature reductions possible in the lower Long Tom River and to estimate if a target temperature based on 20°C is attainable, as outlined in DEQ's temperature water quality standard implementation IMD (DEQ, 2008).

The Luckiamute River watershed is a tributary of the Willamette River, approximately 60 miles long, that drains the eastern Coast Range mountains with an outlet on the Willamette Valley floor. The mouth of the Luckiamute River is approximately 38 river miles north of the mouth of the Long Tom River along the Willamette River. DEQ estimated the background temperatures of the nearby Luckiamute River as part of the Willamette Subbasins TMDL. See the Willamette Subbasins TMDL Technical Support Document Appendix A for more details. A temperature reduction refers to the decrease to 7DADM temperatures from full restoration of streamside vegetation in a system free of dam and reservoir operations, such as the Luckiamute.

Thermal pollutant sources identified for the Luckiamute River include lack of sufficient shade-producing streamside vegetation, and background sources. Along the Luckiamute River model extent, lack of sufficient streamside vegetation was associated with a mean effective shade gap of 9%, corresponding to daily maximum water temperature increases of 3.56°C at the point of maximum impact at model kilometer 42.8 (~ river mile 26) and 0.34°C at the mouth. The Luckiamute background model suggests temperature reductions of approximately 3.5°C to 0.3°C are possible depending on the position of a site along the watershed.

The temperature reductions suggested by the Luckiamute background model at both the mouth and point of maximum impact indicate that a 20 °C temperature target may not be attainable in the lower reach of the Long Tom River between June and September. The configuration of Fern Ridge Dam may also limit the amount of temperature reduction that is feasible with restoration (Rounds 2010).

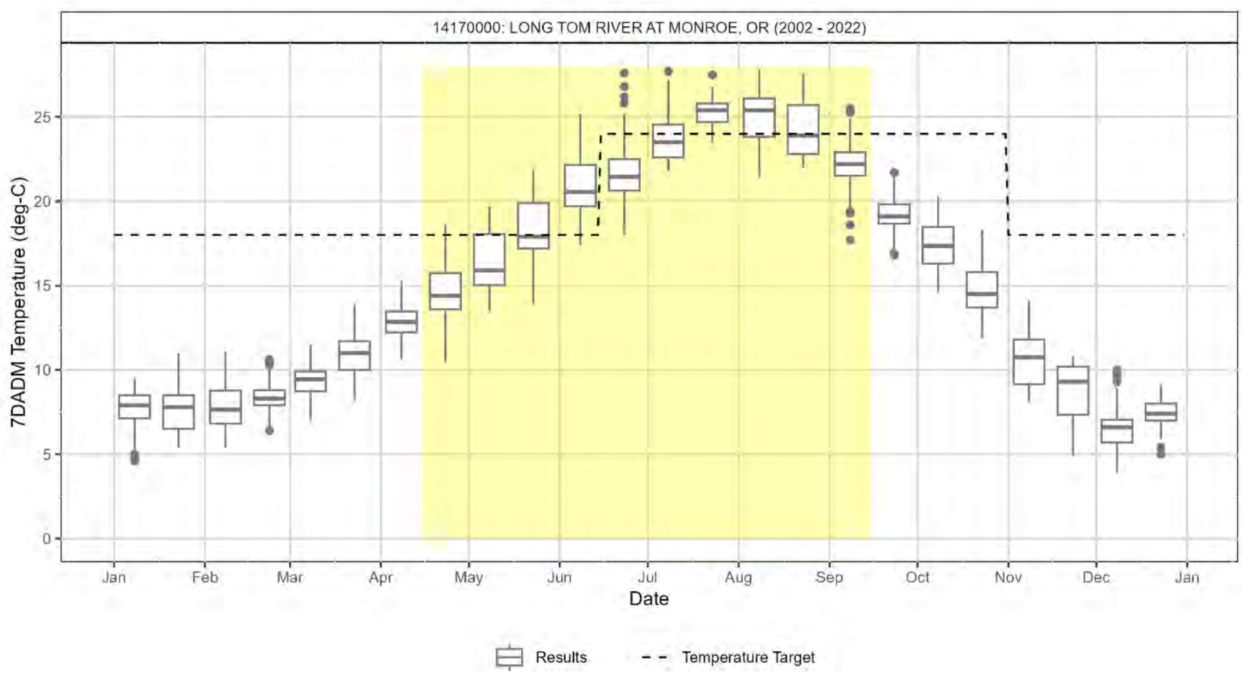


Figure 4-4: Box plots of bi-monthly 7DADM temperatures for the Long Tom River at USGS station 14170000 near Monroe, OR. Dashed line is the temperature targets of 24.0°C from June 1 to October 14 and 18.0°C from November 1 to June 14. Yellow shading indicates time periods when the targets are exceeded within the lower reach under current conditions.

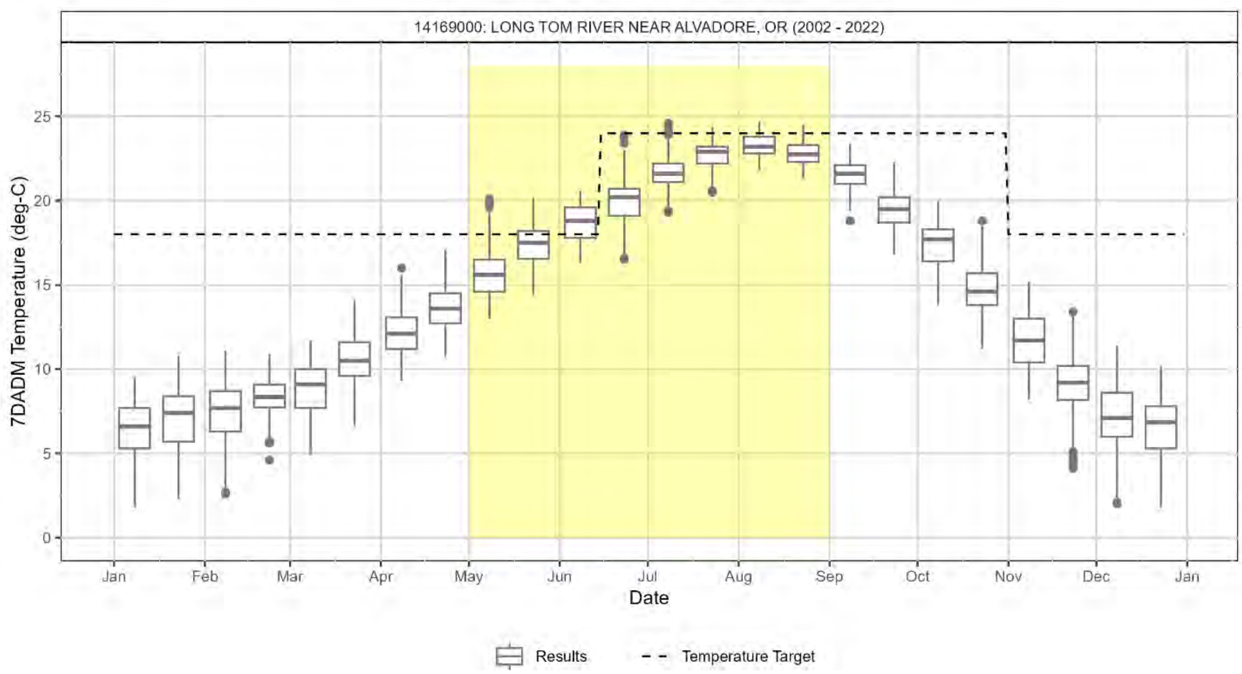


Figure 4-5: Box plots of bi-monthly 7DADM temperatures for the Long Tom River at USGS station 14169000 near Alvadore, OR. Dashed line is the temperature targets of 24.0ºC from June 1 to October 14 and 18.0ºC from November 1 to June 14. Yellow shading indicates time periods when the targets are exceeded under current conditions.

4.8.2 Long Tom River cool water species

DEQ reviewed the ODFW fish habitat distribution database and life stage timing tables for the Long Tom River watershed (ODFW, 2023) and consulted with the ODFW district biologist about the fish species in the lower Long Tom River. Based on this information, DEQ determined the resident cool water species that may be present in the lower Long Tom River are:

- Chiselmouth *(Acrocheilus alutaceus)* (An EPA RIS "Representative Important Species" for Oregon)
- Northern Pikeminnow *(Ptychocheilus oregonensis)*
- Redside Shiner *(Richardsonius balteatus)*
- Peamouth *(Mylocheilus caurinus)*
- Largescale Sucker (*Catostomus macrocheilus*)
- Mountain Sucker *(Catostomus platyrhynchus)*
- Sand Roller *(Percopsis transmontana)*
- Pacific Lamprey (*Entosphenus tridentatus*)

ODFW's information also shows that juvenile Spring Chinook salmon (*Oncorhynchus tshawytscha* may be present at least part of the year and Coastal Cutthroat trout (*Oncorhynchus clarkii*) are resident in tributaries to the lower reach and may utilize it for at least part of the year. Additionally, western pearlshell mussel (*Margaritifera falcata*) and western ridged mussel (*Gonidea angulate*) are present in the Willamette River side channels formed by the mouth of the Long Tom River, although these side channels receive flow from the Willamette mainstem and most of the side channel is designated for the 18.0ºC criterion for salmon and trout rearing and migration.

Based on review of available studies, Sand Roller and Redside shiner are the most temperature sensitive cool water species based on adult thermal tolerance and observed presence. Redside Shiner has an upper lethal temperature threshold between 22.8°C and 27.7°C (Black, 1953) and Sand Roller have preference temperatures of up 24.0 degrees Celsius and a recommended acute threshold of 27.0°C (Gray and Dauble 1979; Parsley et al. 1989, Tiffan et al. 2017).

Spawning of Chiselmouth, Northern Pikeminnow, Peamouth, and Mountain Sucker could occur in the lower reach between April and July, based on observations of spawning timing from the Columbia River, British Columbia, Montana, and Nevada. However, exact spawning timing for these species in the lower reach is unknown. These species initiate spawning when water temperatures exceed 12°C -18°C (Gadomski et al. 2001; Gray and Dabule 2001, Montana FWP, 2023, Roberge et al. 2001, Roberge et al. 2002, and Snyder 1983). Spawning habitat within the lower reach between Monroe and Fern Ridge Reservoir may also be limited (Hutchison 1966). DEQ could not identify documentation of lethal maximum temperatures for egg incubation for these species. Spawning in these species appears to be initiated as temperatures warm to a certain level, and the species may shift spawning to times when temperatures are favorable (Gadomski et al. 2001). Moodie found there was no survival of incubated Chiselmouth eggs unless temperatures were greater than 12°C (Moodie, 1966). Minimum, rather than maximum, thermal requirements may be the limiting factor for distribution of Chiselmouth (Rosenfeld, 2003).

No thermal tolerance studies for western pearlshell and western ridged mussels are available. Studies of thermal tolerance for 28 North American species belonging to the same order (*Unionida*) of freshwater mussels as the native Oregon species indicate a wide range of thermal tolerance between 21.4°C and 42.6°C with a mean tolerance of 32.8°C for juvenile and 36.3°C for adult life stages (Pandolfo et al. 2010, Fogelman et al. 2023). Black et al. documented western pearlshell growth in western Oregon, where maximum temperature averaged 25.1°C at one site, with annual range from 14.7°C to 26.8°C (Black et al. 2010). Western pearlshell and western ridged mussels are adapted to a wide geographic distribution on the west coast, from California to Alaska. They also have the capacity to burrow enabling them to occupy cooler micro-habitats or access thermal refuge, allowing them to tolerate unfavorable water temperature conditions to an extent (Blevins et al. 2019).

Table 4-2: Temperature tolerance endpoints for Long Tom River cool water species as reported in literature reviewed by DEQ.

Species	Acclimation Temperature (°C)	Endpoint	Endpoint Temperature (°C)	Source
Chiselmouth *(Acrocheilus alutaceus)*	NA	Observed absence in field	<20	Rosenfeld et. al. 2003
	NA	Adult preference	>20	Gray and Dabule, 2001
	NA	Spawning initiation	15	(Gray and Dauble, 2001
	NA	Spawning peak	13 – 20	(Gray and Dauble, 2001, Moodie 1966
	NA	100% mortality, eggs	≤12	Moodie 1966
Redside shiner *(Richardsonius balteatus)*	14	100% survival after 24 hours, adult	22.8	Black, 1953
		50% survival after 24 hours, adult	27.6	
		No survival after 24 hours, adult	30.3	
	NA	Spawning Initiation	14.5 – 18	Gray and Dauble, 2001
	NA	100% survival, egg incubation	21 – 23	Scharpf, 2008
Northern Pikeminnow	19-22	50% survival after 24 hours, adult	29.3	Black 1953

Species	Acclimation Temperature (°C)	Endpoint	Endpoint Temperature (°C)	Source
(Ptychocheilus oregonensis)	NA	Spawning Initiation (Columbia R. populations, May - June)	14 – 18	Gadomski et al. 2001, Gray and Dauble, 2001, Roberge et al. 2002
	NA	Adult preference	21.7 (“warmest available”)	Bartoo, 1972
Peamouth *(Mylocheilus caurinus)*	NA	Spawning Initiation	10 – 11	Gray and Dauble 2001
	NA	Spawning Initiation (Western Montana, May or June)	10 – 18	Roberge et al. 2001, Montana FWP 2023
	14	50% mortality after 24 hours	26.6	Black, 1953
	11.5	50% mortality after 24 hours, adult	27	
Largescale Sucker *(Catostomus macrocheilus)*	19	100% survival after 24 hours, adult	25.7	Black, 1953
	19	50% survival after 24 hours, adult	29.4	
	19	0% survival after 24 hours, adult	32.2	
Mountain Sucker *(Catostomus platyrhynchus)*	NA	Observed occurrence in field	10 – 28	Smith, 1966
	NA	Spawning Initiation (Truckee River, NV, May 1 – August 1)	11 – 19	Snyder, 1983
	20	Loss of Equilibrium	32.3 – 32.9	Schultz, 2011
	22.5	Loss of Equilibrium	32.6 – 33.2	
	25	Loss of Equilibrium	33.6 – 34	
	NA	Recommended Acute Tolerance (MDMT)	28	NVDEP 2016
Sand Roller *(Percopsis transmontana)*	NA	Observed presence in field (Columbia Basin)	2.5 – 24	Gray and Dauble 1979; Parsley et al. 1989
	NA	Adult preference, field observations	18-24	Tiffan et al. 2017

Black (1953) reported the upper lethal temperature for Redside Shiner as 27.6°C. The upper lethal temperature was based on 50% survival after 24 hours of exposure to various treatment temperatures. The treatment temperature at which all Redshide shiner survived after 24 hours was reported as 22.8°C. These results indicate that Redside Shiner have a reasonable margin of safety between complete survival and the point at which half the population died (4.8°C).

Oregon’s water quality criteria for temperature are based on a maximum 7DADM that reflects the highest average of maximum temperatures that fish are exposed to over a weeklong period for the year. Since most laboratory studies of thermal tolerance are based on continuous exposure to a single temperature, translation of the lab results to an equivalent 7DADM value is necessary to determine a temperature target consistent with Oregon’s water quality standards. Following EPA’s guidance for temperature standard development for Pacific Northwest States, a constant lab exposure temperature for 100% survival of Redside Shiner at 22.8°C corresponds to a 7DADM temperatures of 24.0°C (EPA 2003). The difference between weekly mean and weekly maximum temperatures in the lower Long Tom River is 2-3 degrees in the summer. Therefore, under a temperature target of 24.0°C as a 7DADM temperatures, fish would experience daily temperatures above the limit for 100% survival of Redshide Shiner (22.8°C) for only a small part of the day during the warmest 7-day period of the year. Given the wide margin between temperatures at 50% and 100% survival, exposure to maximum water temperatures greater than 22.8°C for just a few hours a day during this period will not likely cause harm to Redside Shiner.

Therefore, DEQ selected 24.0°C expressed as the instream seven-day average maximum temperature target plus an insignificant addition of heat for human use equal to 0.3°C as the target temperature. This target will approximate daily average temperatures that match the constant lab exposure temperature limit for 100% survival and reduce the risk of daily exposure to temperatures that could result in impairment to Redside shiner. This target will also ensure conditions within the preferred range for the next most sensitive species, Sand Roller and Mountain Sucker.

4.8.3 Long Tom River salmonid uses

ODFW's FHD and timing tables (**Table 4-3** and **Table 4-4**) indicate there is some limited Spring Chinook salmon rearing use of the lower reach with peak use from December 1 through May 15 downstream of the City of Monroe to the confluence with the Willamette River. At the time the use was designated, ODFW indicated the Long Tom River likely did not support a natural run of anadromous salmonids and juvenile Cutthroat trout were largely absent downstream of Fern Ridge Reservoir (Hutchison 1966, ODFW 1992). Hutchison et al. identified that Cutthroat trout are resident in tributaries of the lower reach, and appeared to have adapted to survive the high summertime temperatures typical of the lower river system. They also noted there is little spawning habitat between Monroe and Fern Ridge Reservoir (Hutchison 1966). Cutthroat trout are resident and regularly tagged in tributaries to the lower Long Tom River. (Bear Creek, Ferguson Creek, Owens Creek, Rattlesnake Creek, and Davidson Creek). Recapture data indicates that a minority of Cutthroat individuals migrate between these tributary creeks via the lower reach of the Long Tom River. However, no fish are sampled from the lower Long Tom River mainstem, and it is uncertain what months of the year these individuals use the lower reach to migrate (LTWC and ODFW, unpublished data).

In order to protect juvenile Chinook salmon and Cutthroat Trout that may be migrating or overwintering, DEQ will rely upon the 18.0°C target temperature established for protection of Salmon & Trout Rearing and Migration use suggested by EPA guidance (EPA, 2003) and adopted in Oregon's water quality standards (OAR 340-041-0028 (4)(c)). The 18.0°C temperature target is also fully protective of any life stage of Pacific Lamprey (Meeuwig et al. 2003, Whitesel 2023). This target is also within observed temperature ranges supporting spawning and egg incubation use by the cool water species Mountain Sucker, Peamouth, and Northern Pikeminnow which may occur within that timeframe.

Table 4-3: Anadromous salmonid species use in the Long Tom River subbasin (Source: ODFW 2003[1])

Long Tom R - Anadromous Species												
Waterway ID: MidWill06												
Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Upstream Adult Migration												
Spring Chinook salmon												
Adult Spawning												
Spring Chinook salmon												
Adult Holding												
Spring Chinook salmon												
Egg Incubation through Fry Emergence												
Spring Chinook salmon												
Juvenile Rearing												
Spring Chinook salmon												
Downstream Juvenile Migration												
Spring Chinook salmon												
	Represents periods of peak use based on professional opinion, survey data, or other inforr											
	Represents lesser level of use based on professional opinion,survey data, or other informa											
	Represents periods of presence OR uniformly distributed level of use											

Table 4-4: Resident salmonid species use of the Long Tom River (Source: ODFW).

Long Tom R - Non-Anadromous Species												
Waterway ID: MidWill06												
Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult Fluvial or Adfluvial Migration												
Cutthroat Trout - Resident												
Adult Spawning												
Cutthroat Trout - Resident												
Adult/Sub-Adult Rearing												
Cutthroat Trout - Resident												
Egg Incubation through Fry Emergence												
Cutthroat Trout - Resident												
Juvenile Rearing												
Cutthroat Trout - Resident												
Juvenile/Sub-Adult Migration												
Cutthroat Trout - Resident												
	Represents periods of peak use based on professional opinion, survey data, or other inforr											
	Represents lesser level of use based on professional opinion,survey data, or other informa											
	Represents periods of presence OR uniformly distributed level of use											

4.8.4 Long Tom River temperature target

Based on the literature review above the temperature targets for the lower Long Tom River are:

[1] ODFW Fish Life Stage Timing Tables https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=202&XMLname=42654.xml

1) 24.0°C + the 0.3°C human use allowance (HUA) from June 15 through October 31 (based on thermal preference for Sand Roller and Mountain Sucker and thermal tolerance for Redside Shiner);
2) 18.0°C + HUA from November 1 to June 14 (Based on Spring Chinook rearing and juvenile migration; spawning preferences for Mountain Sucker, Peamouth, and Chiselmouth).

The human use allowance (HUA) applies because the maximum 7DADM temperature of the Long Tom River exceeds both 24.0°C and 18.0°C during their respective time periods. From June 15 through October 31, where the cool water species criterion applies in the Long Tom River, warming from anthropogenic sources shall be limited to a cumulative increase of no greater than 0.3°C above 24.0°C after complete mixing in the water body, and at the point of maximum impact. During November 1 through June 14 the numeric benchmark protecting cool water fish and migrating juvenile Chinook salmon is an instream 7DADM target of 18.0°C plus an insignificant addition of heat for human use equal to 0.3°C after complete mixing in the water body, and at the point of maximum impact. A summary of the temperature targets is presented in **Table 4-5**.

The provisions of the PCW criterion at OAR 340-41-0028(11) are also incorporated into the temperature target. If ambient 7DADM temperatures trend to always being cooler than both temperature targets presented in **Table 4-5** and all exceptions outlined in OAR 340-41-0028(11)(c) are not applicable, the PCW criterion shall be applied with the 0.3°C HUA based on an increase above the cooler ambient temperature.

The mixing zone and thermal plume limitations in OAR 340-041-0053 (2)(E)(d) will provide further protections against potential migration blockages when temperatures exceed 21.0°C. The TMDL assumes assessment and application of thermal plume limitations, as necessary, will be completed during the NPDES permit renewal process.

Table 4-5: Summary of temperature targets implementing the cool water species narrative in the lower Long Tom River.

Time period	7DADM Temperature Target (°C)	Most Temperature Sensitive Species
June 15 – October 31	24.0 + 0.3 HUA	Redside shiner (*Richardsonius balteatus*)
November 1 – June 14	18.0 + 0.3 HUA	Chinook Salmon (*Oncorhynchus tshawytscha*)

~~4.7.1~~4.8.5 Rickreall Creek temperatures

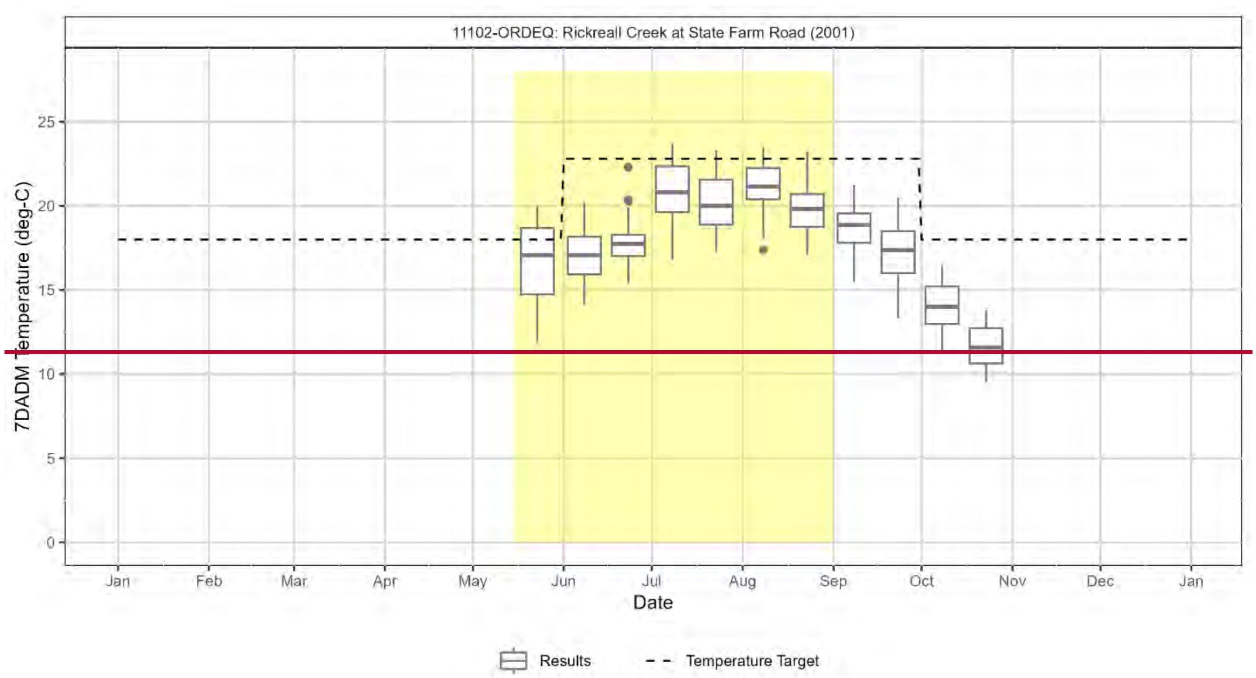
Continuous temperature data (**Figure 4-~~3~~6**) and instantaneous (grab) data (**Figure 4-~~4~~7** and **Figure 4-~~5~~8**) are available on lower Rickreall Creek. The data show temperatures peak in July and August and exceed 18°C from May 15 to September 30 near the mouth (**Figure 4-~~3~~6**), and into October near the midpoint of the lower reach (**Figure 4-~~5~~8**). Temperatures exceed 20°C from July through the end of September. The plots in **Figure 4-~~3~~6** through **Figure 4-~~5~~8** show boxplots of the seasonal variation of 7DADM and grab sample temperatures at monitoring locations on lower Rickreall Creek. Temperature data were grouped by the first and second half of each month. The month was split on the 15th with the first group including all results measured on the 1st through the 14th day and the second group including all results measured on the 15th through the end of the month. The boxplots are Tukey style boxplots with the middle line representing the median and ends of the box representing the temperature range between the first and third quartiles (25th – 75th percentile). The whiskers extend to values no further than 1.5 times the interquartile 7DADM temperature range (1.5 times the difference between 25th and

75th percentiles). The points represent individual 7DADM or grab sample temperatures values beyond 1.5 times the interquartile range. The dashed line corresponds the selected lower Rickreall Creek temperature target (Section 4.~~7.4~~8.8). The shaded yellow area identifies the period when temperatures exceed the temperature target.

DEQ has not modeled the background temperatures of lower reach of Rickreall Creek, so an estimate of possible background temperature was derived using a nearby stream that was modeled. This provides a useful estimate of the range of potential temperature reductions possible in Rickreall Creek and to evaluate if a target temperature based on 20°C is attainable, as outlined in DEQ's temperature water quality standard implementation IMD (DEQ, 2008a).

The Luckiamute River watershed is a tributary of the Willamette River, approximately 60 miles long, that drains the eastern Coast Range mountains with an outlet on the Willamette Valley floor. The mouth of the Luckiamute River is approximately 20 river miles south of the mouth of Rickreall Creek along the Willamette River. DEQ estimated the background temperatures of the nearby Luckiamute River as part of the Willamette Subbasins TMDL. See TSD Appendix A for more details. A temperature reduction refers to the decrease in 7DADM temperatures from full restoration of streamside vegetation in a system free of dam and reservoir operations.

Thermal pollutant sources identified for the Luckiamute River include lack of sufficient shade-producing streamside vegetation, and background sources. Along the Luckiamute River model extent, lack of sufficient streamside vegetation was associated with a mean effective shade gap of 9%, corresponding to daily maximum water temperature increases of 3.56°C at the POMI at model km 42.8 (~ river mile 26) and 0.34°C at the mouth. The Luckiamute background model suggests temperature reductions of approximately 3.5°C to 0.3°C are possible depending on the position of a site along the watershed. The temperature reductions suggested by the Luckiamute background model at the mouth, indicate that a 20°C temperature target may not be attainable in the lower reach of Rickreall Creek.



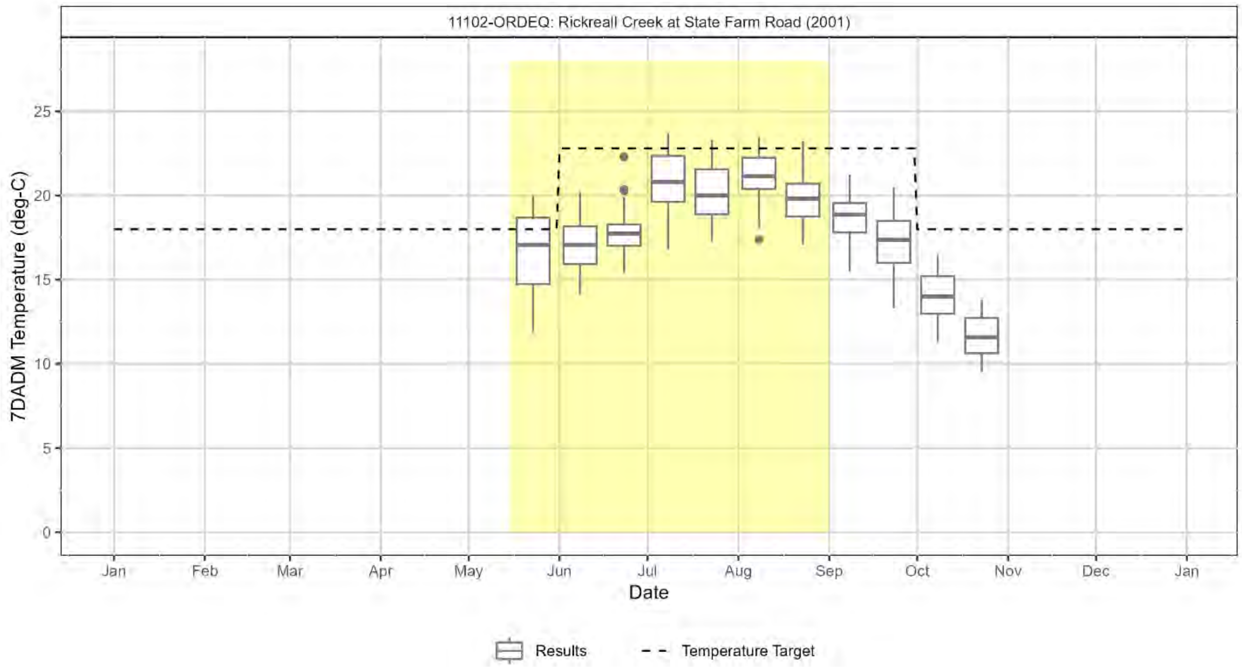
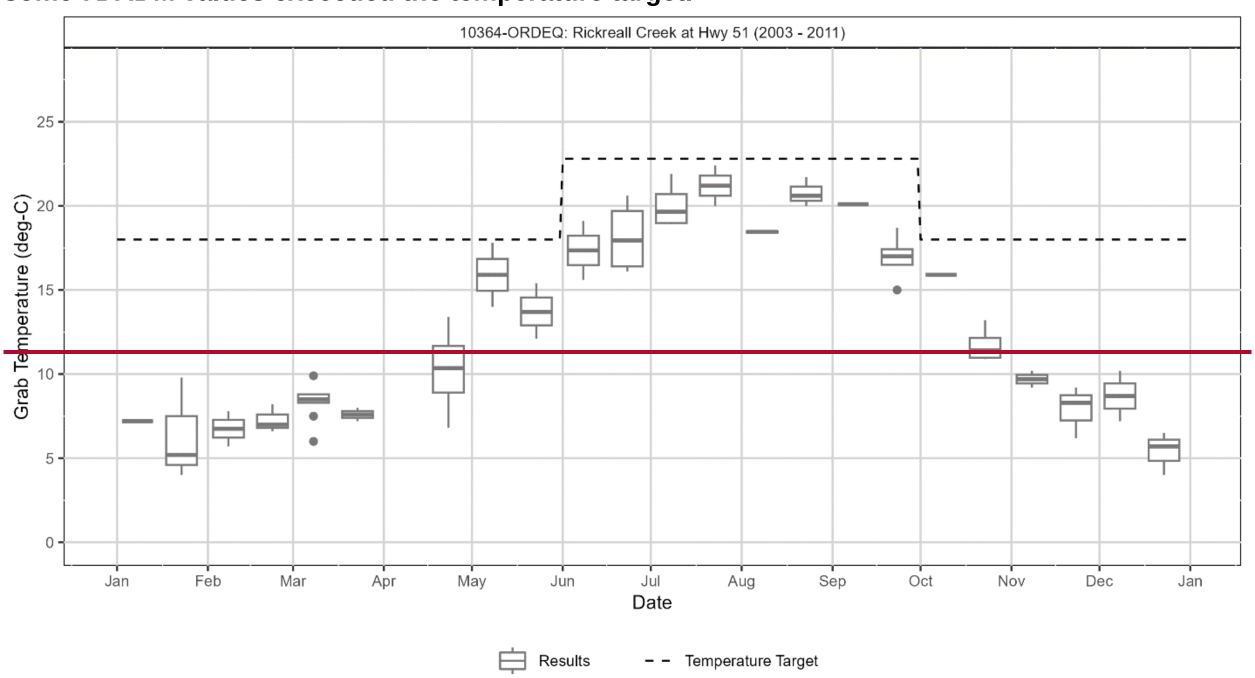


Figure 4-6: Distribution of 7DADM temperatures from continuously monitored temperature data from DEQ monitoring site 11102 (approximate river mile 0.9). The cool water species narrative temperature targets are shown as dashed lines. The yellow shading indicates time periods were some 7DADM values exceeded the temperature target.



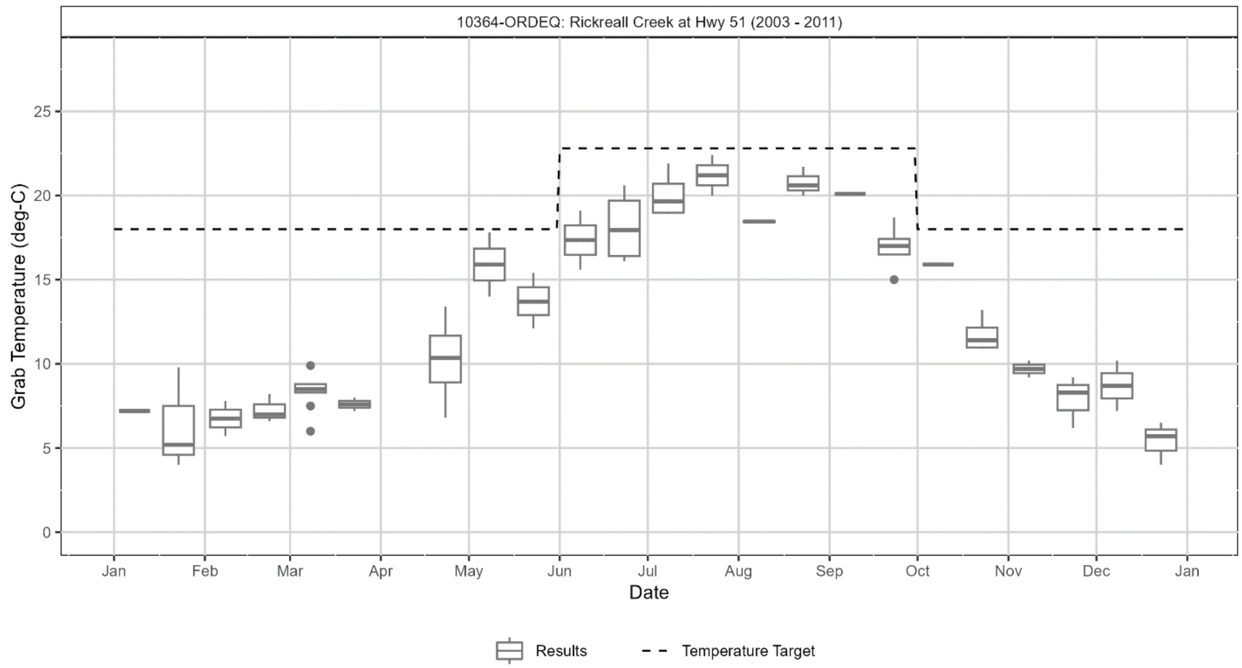
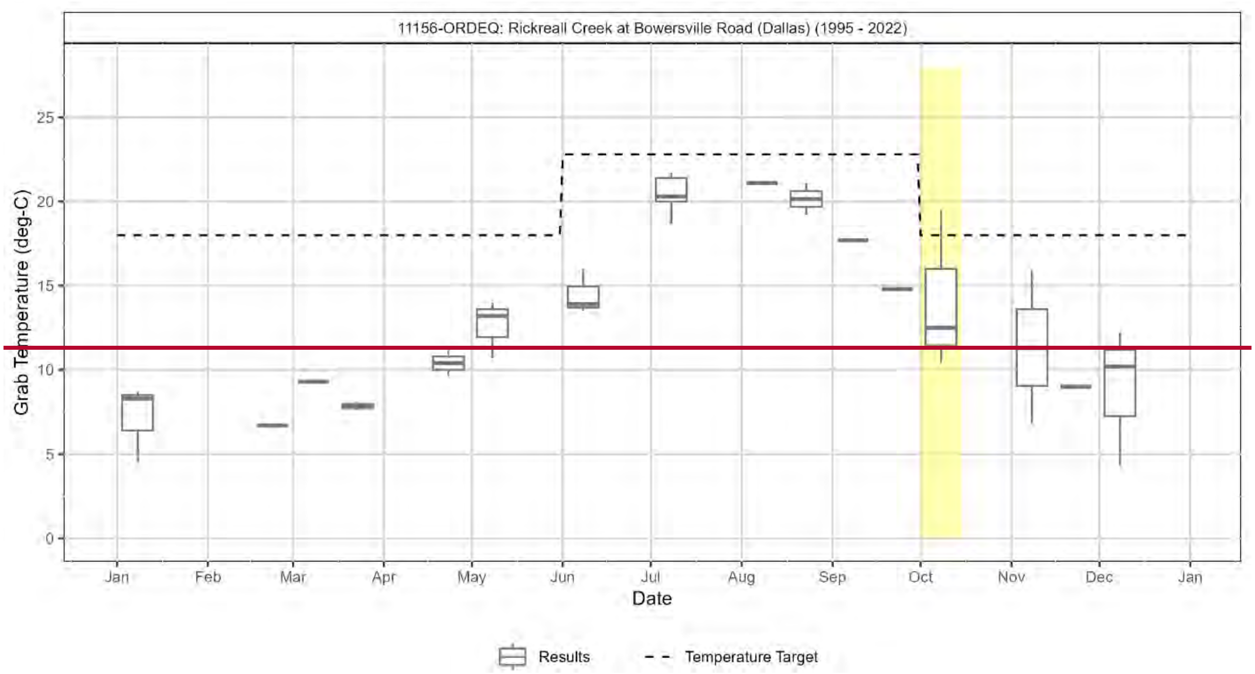


Figure 4-7: Distribution of temperatures from single sample grab data at DEQ monitoring site 10364 (approximate river mile 2.2) from 2003-2011. The cool water species narrative temperature targets are shown as dashed lines.



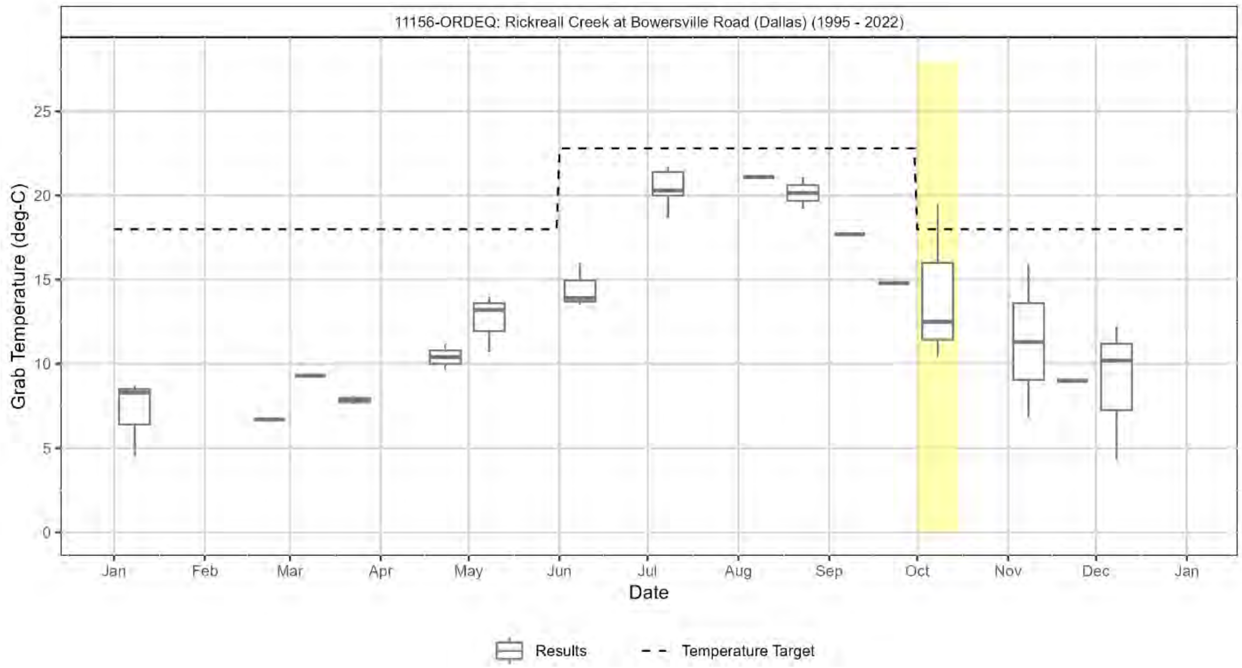


Figure 4-8: Distribution of temperatures from grab data collected at DEQ monitoring site 11156 (approximate river mile 10.7) from 1995-2022. The cool water species narrative temperature targets are shown as dashed lines. The yellow shading indicates time periods where some grab temperature exceeded the temperature target.

4.7.24.8.6 Rickreall Creek cool water species

DEQ reviewed the Oregon Department of Fish & Wildlife (ODFW) fish habitat distribution database and life stage timing tables for the Rickreall Creek watershed (ODFW, 2023) and consulted with the ODFW district biologist about the fish species in the lower reach. Based on this information, DEQ determined the resident cool water species that may be present in Rickreall Creek downstream of Dallas include Speckled dace (*Rhinichthys osculus*), Redside shiner (*Richardsonius balteatus*), Largescale sucker (*Catostomus macrocheilus*), Prickly sculpin (*Cottus asper*), and Pacific lamprey (*Entosphenus tridentatus*). The exact timing of cool water species use of Lower Rickreall Creek is not fully understood, but multiple cool water species have been observed in the reach from April to November (Chastain et al., 2002). ODFW's information also show that adult and juvenile winter steelhead (*Oncorhynchus mykiss*) migrate through lower Rickreall Creek. The peak migration period in ODFW's timing tables is February 15 through May 31 (ODFW, 2023).

A review of available studies evaluating the temperature tolerance of the cool water species present in Lower Rickreall Creek was completed in order to identify a target temperature to implement the cool water species narrative rule. We found temperature tolerance studies for all species except Largescale sucker. A summary of the studies follows.

Carveth et al. (2006) reported four endpoint thermal maxima for Speckled dace collected from Arizona rivers. The lowest temperature of all the endpoints reported is the initial loss of equilibrium (ILOE) at 34.7°C (95% confidence interval of 0.4°C) for fishes acclimated to 25°C waters. Other endpoints reported are summarized in **Table 4-26**.

Beitinger et al. (2000) conducted a review and summarized the results of several temperature tolerances studies of multiple North American freshwater species. For Speckled dace, a study by Castleberry and Cech (1993) reported a loss of equilibrium at 32.4°C with a standard deviation of 1.90°C. The acclimation temperature was 20°C (**Table 4-~~2~~6**).

John (1964) reported the ultimate incipient upper lethal temperature for Speckled dace is about 33°C for young fish and 32°C for older fish (**Table 4-~~2~~6**). The fish were not acclimated for this study.

Black (1953) evaluated the temperature tolerance for some freshwater fish found in the Okanagan Lakes in British Columbia, Canada. The upper lethal temperatures, defined as the temperature at which 50 percent of the fish died in 24 hours, was 24.1°C for Prickly sculpin and 27.6°C for Redside shiner. All fish survived after 24 hours at treatment temperatures of 22.8°C for both species. No fish survived after 24 hours at treatment temperatures of 26.5 and 30.3°C for Prickly sculpin and Redside shiner, respectively (**Table 4-~~2~~6**).

Whitesel and Uh (2023) reported the ultimate incipient upper lethal temperature after 7 days for larval Pacific lamprey was 28.3°C based on the time to death and 30.2°C based on the percent mortality approach (**Table 4-~~2~~6**). In experiments of direct acute exposure, larval were acclimated to different temperatures ranging from 19.8 to 23.3°C for 7-9 days and then placed in various treatment temperatures. The LT50 was calculated, which is the number of hours at which 50% of the larval survived. The LT50 was 1 hour or less at treatment temperatures ranging from 31.1 to 33.4°C. The LT50 ranged from 43.1 to 80.5 hours in treatment temperatures of 29 to 29.3°C. In experiments of acclimated chronic exposure over a 30 day period, 100% of the larval lamprey survived in the treatment temperatures of constant exposure ranging from 21 to 27°C. No larval lamprey survived in constant treatment temperatures of 30 and 33°C over the 30-day period.

Table 4-6: Temperature tolerance endpoints for cool water species as reported in literature reviewed by DEQ.

Species	Acclimation Temperature (°C)	Endpoint	Endpoint Temperature (°C)	Source
Speckled dace (Rhinichthys osculus)	20	Initial loss of equilibrium	32.4 ± 1.90	Castleberry and Cech (1993) via Beitinger et al. (2000)
	25	Initial loss of equilibrium	34.4 ± 0.4	Carveth et al. (2006)
		Final loss of equilibrium	34.4 ± 0.4	
		Flaring opercula	35.9 ± 0.2	
		Death	36.0 ± 0.4	
	30	Initial loss of equilibrium	35.8 ± 0.6	
		Final loss of equilibrium	36.9 ± 0.1	
		Flaring opercula	37.0 ± 0.1	
		Death	36.9 ± 0.3	
	NA	Ultimate incipient upper lethal temperature	33 (young fish) 32 (old fish)	John (1964)
Redside shiner (Richardsonius balteatus)	14	100% survival after 24 hours	22.8	Black (1953)
		50% survival after 24 hours	27.6	

Species	Acclimation Temperature (°C)	Endpoint	Endpoint Temperature (°C)	Source
		No survival after 24 hours	30.3	
Prickly sculpin (Cottus asper)	18–19	100% survival after 24 hours	22.8	
		50% survival after 24 hours	24.1	
		No survival after 24 hours	26.5	
Pacific lamprey (Entosphenus tridentatus)		Ultimate incipient upper lethal temperature (7 days) based on time to death	28.3	Whitesel and Uh (2023)
		Ultimate incipient upper lethal temperature (7 days) based on percent mortality	30.2	

Based on review of available temperature tolerance studies, Prickly sculpin are the most temperature sensitive cool water species. Black (1953) reported the upper lethal temperature as 24.1°C. The upper lethal temperature was based on 50% survival after 24 hours of exposure to various treatment temperatures. Other endpoints reported for Prickly sculpin include the treatment temperature at which all fish survived after 24 hours (22.8°C) and the treatment temperatures with no survival after 24 hours (26.5°C).

These results indicate that Prickly sculpin have a narrow temperature margin between complete survival and the point at which half the population died (1.3°C). This was taken into consideration when setting the target temperature. Exposure to water temperatures greater than 24.1°C for just a few hours will likely not cause significant harm, but it is unclear if exposure for just a few hours a day over the course of 7 or more days would have a similar impact as a constant 24 hour exposure. Due to this uncertainty, DEQ selected the more protective endpoint (22.8°C) expressed as the instream 7DADM temperature target plus an insignificant addition of heat for human use equal to 0.3°C. This target will limit the exposure time to temperatures that would result in impairment to Prickly sculpin. This target applies from June 1 through September 30. The following section will explain when the cool water species applies versus when salmonid species uses apply.

~~4.7.3~~4.8.7 Rickreall Creek salmonid uses

Rickreall Creek also provides habitat for cold water salmonid species, including steelhead trout (*Oncorhynchus mykiss*) and Coastal Cutthroat trout (*Oncorhynchus clarkii*). Various life stages are present in the watershed at certain times of year (ODFW, 2023). The following timing tables are for the entire Rickreall Creek basin. The lower reach is not spawning or egg incubation habitat and trout use is absent or limited during the warmer months.

Table 4-7: Anadromous salmonid species use in Rickreall Creek (Source: ODFW ~~2003~~2003[2])

[2] ODFW Fish Life Stage Timing Tables
https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=202&XMLname=42654.xml

Rickreall Cr - Anadromous Species

Waterway ID: MidWill18

Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Upstream Adult Migration												
Winter Steelhead												
Adult Spawning												
Winter Steelhead												
Adult Holding												
Winter Steelhead												
Egg Incubation through Fry Emergence												
Winter Steelhead												
Juvenile Rearing												
Winter Steelhead												
Downstream Juvenile Migration												
Winter Steelhead												

Represents periods of peak use based on professional opinion, survey data, or other inforr

Represents lesser level of use based on professional opinion,survey data, or other informa

Represents periods of presence OR uniformly distributed level of use

Rickreall Cr - Anadromous Species

Waterway ID: MidWill18

Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Upstream Adult Migration												
Winter Steelhead												
Adult Spawning												
Winter Steelhead												
Adult Holding												
Winter Steelhead												
Egg Incubation through Fry Emergence												
Winter Steelhead												
Juvenile Rearing												
Winter Steelhead												
Downstream Juvenile Migration												
Winter Steelhead												

Represents periods of peak use based on professional opinion, survey data, or other inforr

Represents lesser level of use based on professional opinion,survey data, or other informa

Represents periods of presence OR uniformly distributed level of use

Table 4-8: Resident salmonid species use of Rickreall Creek (Source: ODFW, 2003[1])

Rickreall Cr - Non-Anadromous Species

Waterway ID: MidWill18

Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult Fluvial or Adfluvial Migration												
Cutthroat Trout - Resident	Peak	Peak	Peak	Peak/Lesser	Lesser	Lesser				Lesser	Lesser/Peak	Peak
Adult Spawning												
Cutthroat Trout - Resident	Peak	Peak	Peak	Peak/Lesser	Lesser	Lesser/–					Lesser	Peak
Adult/Sub-Adult Rearing												
Cutthroat Trout - Resident	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence
Egg Incubation through Fry Emergence												
Cutthroat Trout - Resident	Peak	Peak	Peak	Peak	Peak/Lesser	Lesser	Lesser/–				Lesser	Peak
Juvenile Rearing												
Cutthroat Trout - Resident	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence
Juvenile/Sub-Adult Migration												
Cutthroat Trout - Resident	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence

Peak: Represents periods of peak use based on professional opinion, survey data, or other inforr
Lesser: Represents lesser level of use based on professional opinion,survey data, or other informa
Presence: Represents periods of presence OR uniformly distributed level of use

Rickreall Cr - Non-Anadromous Species

Waterway ID: MidWill18

Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult Fluvial or Adfluvial Migration												
Cutthroat Trout - Resident	Peak	Peak	Peak	Peak/Lesser	Lesser	Lesser				Lesser	Lesser/Peak	Peak
Adult Spawning												
Cutthroat Trout - Resident	Peak	Peak	Peak	Peak/Lesser	Lesser	Lesser/–					Lesser	Peak
Adult/Sub-Adult Rearing												
Cutthroat Trout - Resident	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence
Egg Incubation through Fry Emergence												
Cutthroat Trout - Resident	Peak	Peak	Peak	Peak	Peak/Lesser	Lesser	Lesser/–				Lesser	Peak
Juvenile Rearing												
Cutthroat Trout - Resident	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence
Juvenile/Sub-Adult Migration												
Cutthroat Trout - Resident	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence	Presence

Peak: Represents periods of peak use based on professional opinion, survey data, or other inforr
Lesser: Represents lesser level of use based on professional opinion,survey data, or other informa
Presence: Represents periods of presence OR uniformly distributed level of use

From the ODFW timing tables it is not clear what timing of use is specific to the lower reach versus within the watershed as a whole. The prime rearing habitat is likely upstream of the City of Dallas. Data on abundance of cold water species in the lower reach relative to the other waters of the Rickreall Creek watershed is limited. ODFW provided DEQ with some supplemental studies of fish presence in the Rickreall Creek Watershed.

A detailed survey of fish presence for multiple cool and cold-water species was conducted in Rickreall Creek in 2002 (Chastain et al., 2002). The authors sampled nine sites on the main stem of Rickreall Creek from river mile 0.56 to 28 monthly for a year, from April 2001 to March 2002. Four of the sites sampled (Sites #1-4) are within and representative of the lower reach (**Figure 4-~~6~~9**). A fifth site (Site #5) is located at or above the endpoint of the lower reach in

Dallas City Park, and therefore is not representative of the lower reach. The authors found the Rickreall Creek watershed has a relatively intact native fish community, and that sites #1-4 were dominated by cool water species (Chastain et al., 2002, Figure 2a).

No anadromous salmonid species were detected at site #1, near the mouth of Rickreall Creek, at any time of year (**Figure 4-~~7~~**10). Coho, Chinook, and steelhead salmon were detected at sites #2-4 sporadically between October 1 and May 31 (**Figure 4-~~8~~**11 through **Figure 4-~~10~~**13). Resident Cutthroat trout were detected sporadically between September 1 and April, but never in consecutive months except for Site #4 (**Figure 4-~~10~~**13). One detection of Cutthroat trout occurred in July at site #3 (**Figure 4-~~9~~**12). The total number of Cutthroat captured at site #3 and site #4 appears to be less than 10 individuals for the entire year (Chastain et al., 2002, Figure 7g).

In contrast, at site #6, approximately 2 stream miles upstream of Dallas City Park in the portion of Rickreall Creek designated for Salmon and Trout Rearing and Migration use, and expected to be more prime rearing habitat, anadromous salmon or resident Cutthroat trout were detected every month of the year. This suggests a low level or only sporadic use of the lower reach by cold water salmonid species, namely Cutthroat trout only, between June and October, consistent with the designated use of Cool Water Species (**Figure 4-~~11~~**14).

Chapman et al. (2003) also conducted a bi-weekly snorkel survey within the lower reach at Villwok's Ford (approximate river mile 7.7) from May to September 2003. This site is identical to site #3 sampled by Chastain et al. in 2002. They did not detect any anadromous salmon species, including juvenile steelhead, at the site between May and September. Cutthroat trout were detected downstream of the ford in May, July, August and September, but only sporadically upstream of the ford one week of May and one week of June (**Table 4-~~5~~**9). No counts of individuals detected were included in the study. The authors indicate that the ford is not a barrier to Cutthroat trout passage. Chastain et al. did not find Cutthroat trout at the same site during the same months in 2002, suggesting only low or sporadic levels of use by Cutthroat in the summer.

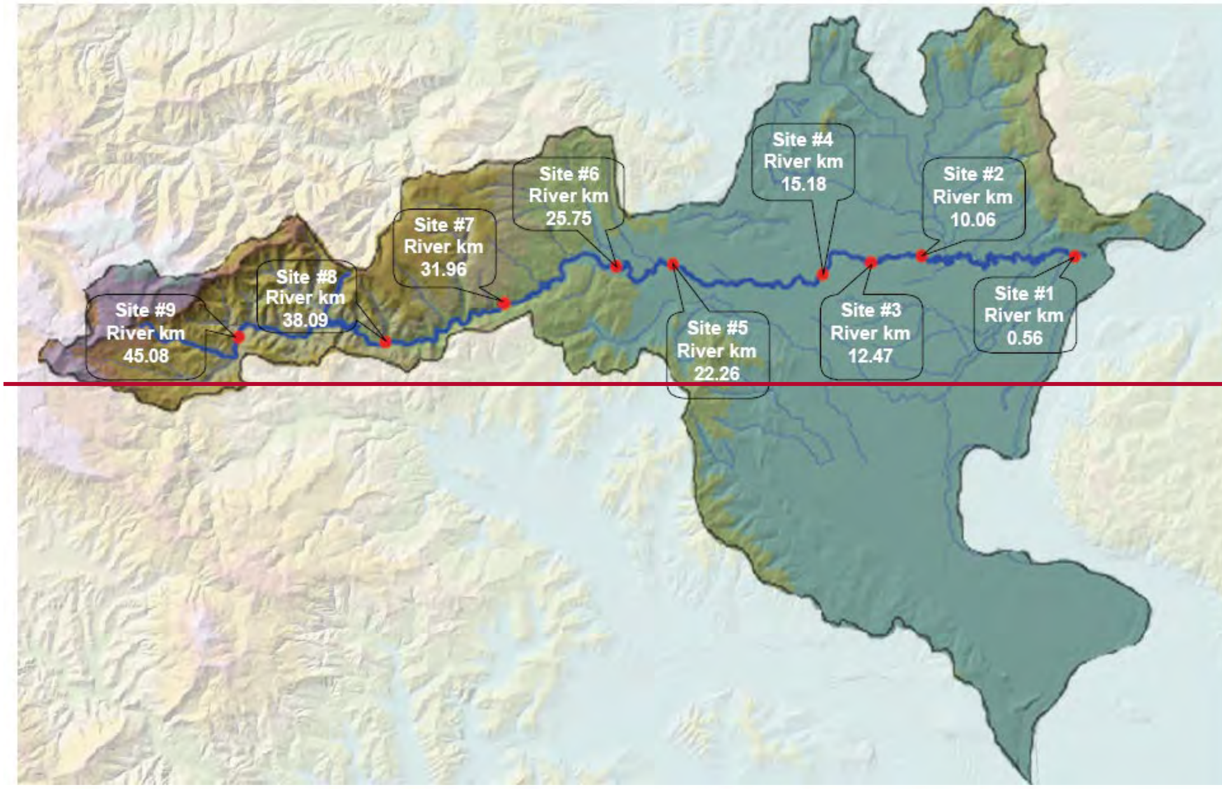
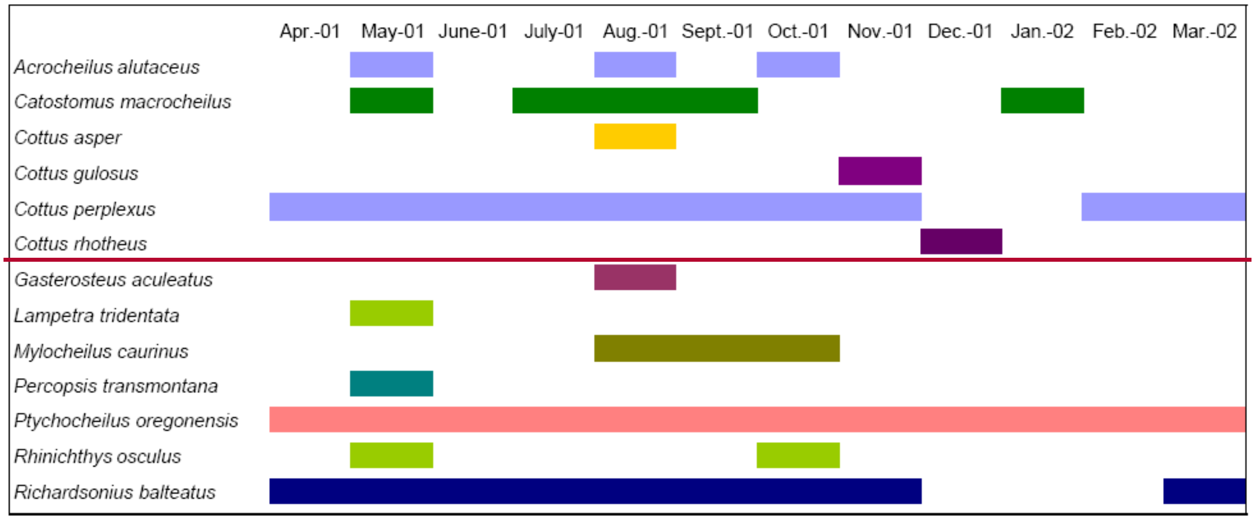


Figure 4-9: Sampling sites on the Rickreall Creek mainstem (from Chastain et al., 2002) Reaches below Site #5 are designated for cool water use.


Apr.-01
May-01
June-01
July-01
Aug.-01
Sept.-01
Oct.-01
Nov.-01
Dec.-01
Jan.-02
Feb.-02
Mar.-02
Acrocheilus alutaceus
Catostomus macrocheilus
Cottus asper
Cottus gulosus
Cottus perplexus
Cottus rhotheus
Gasterosteus aculeatus
Lampetra tridentata
Mylocheilus caurinus
Percopsis transmontana
Ptychocheilus oregonensis
Rhinichthys osculus
Richardsonius balteatus

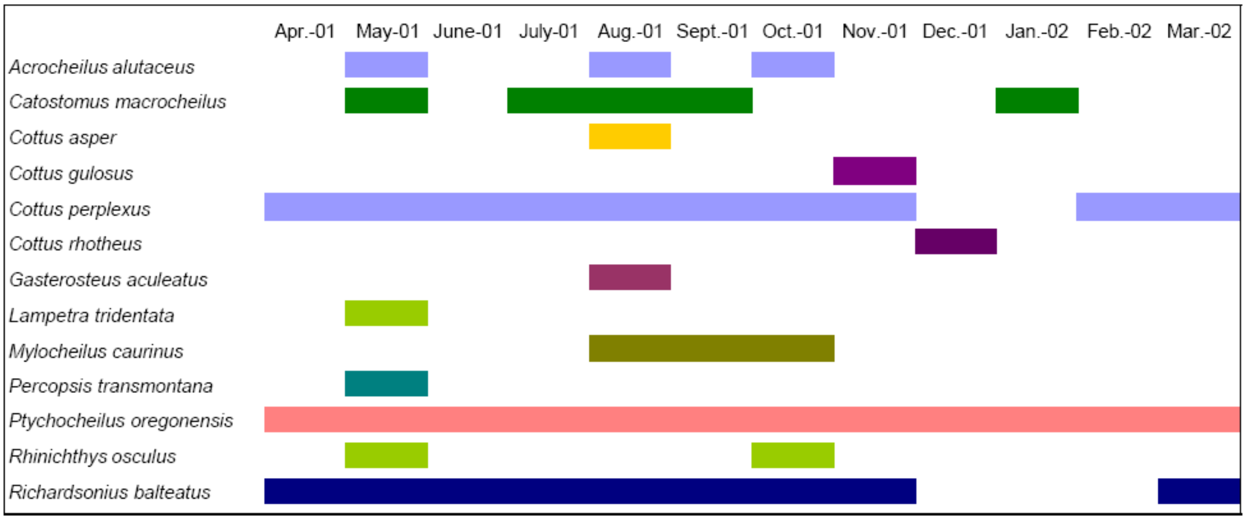
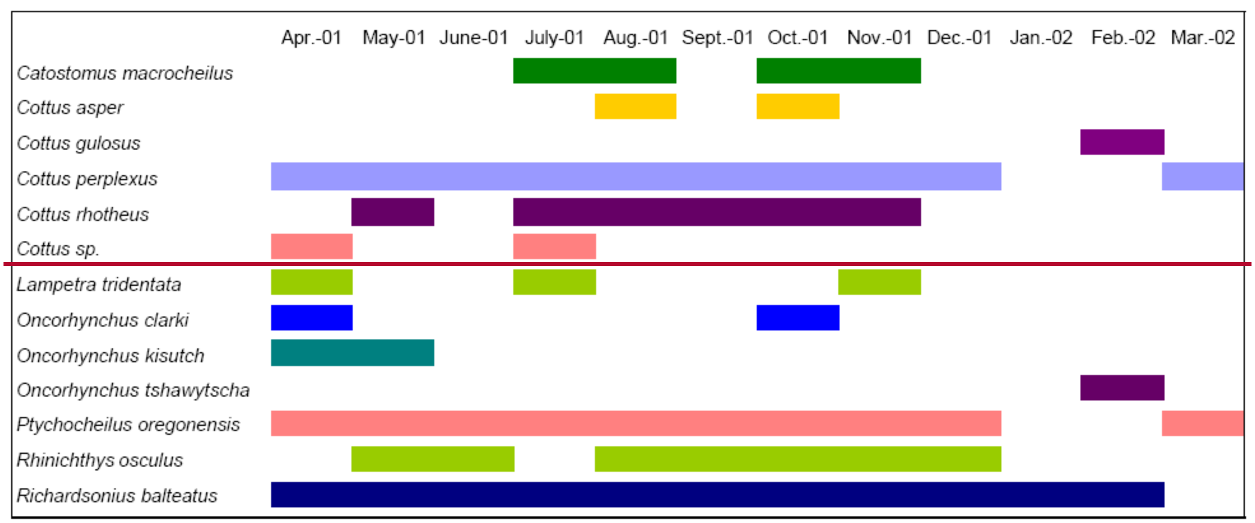


Figure 4-10: Temporal distribution of fish species encountered at approximately river mile 0.3 (Site #1) April 2001 – March 2002 (Chastain et al., 2002, Figure 3a). All species detected at this site are cool water species.



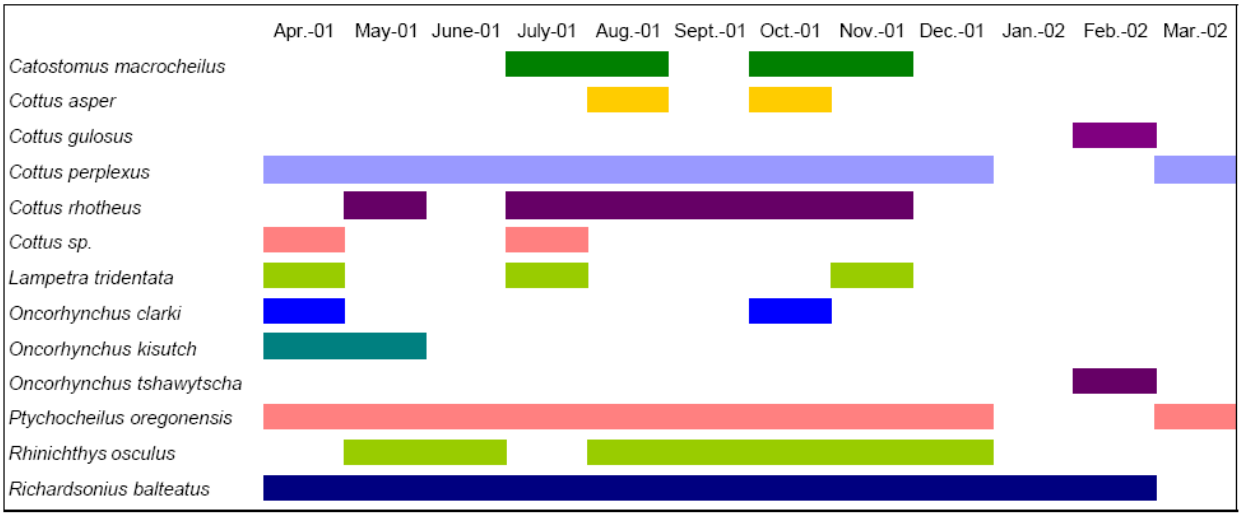
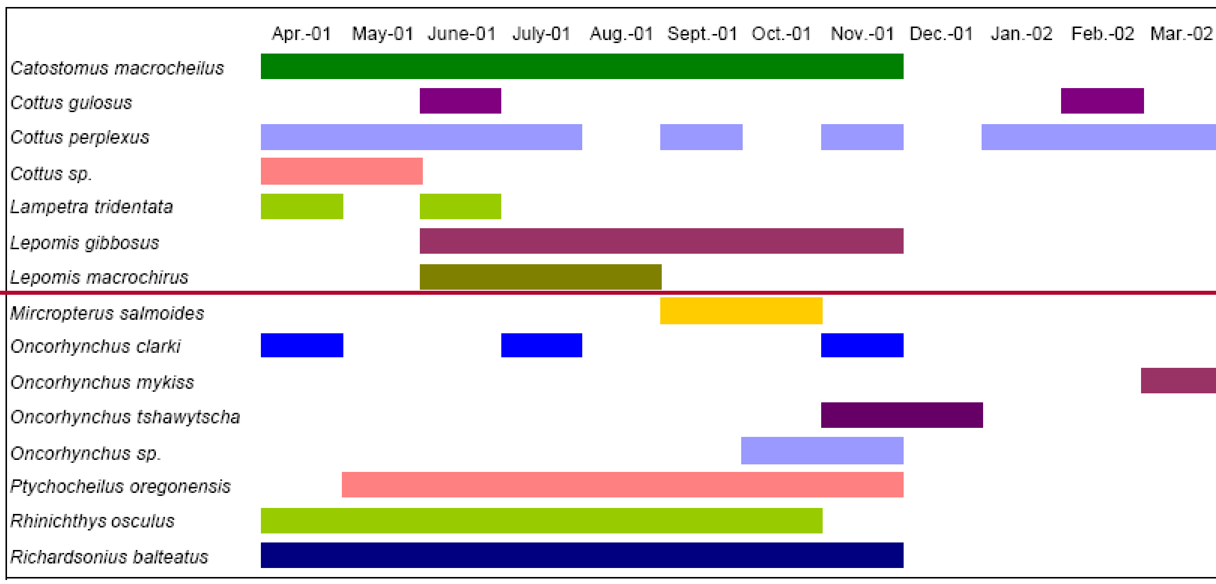


Figure 4-11: Temporal distribution of fish species encountered at approximately river mile 6.3 (Site #2) April 2001 – March 2002 (Chastain et al., 2002, Figure 3b). The salmonid species detected include: cutthroat trout (*O. clarkii*), Coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*).



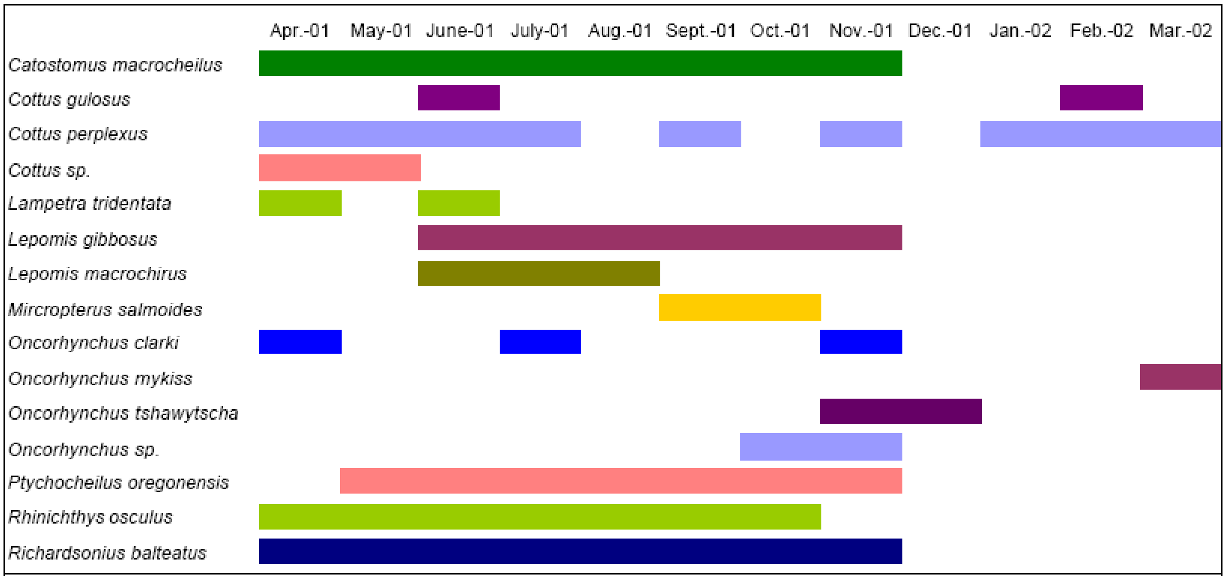


Figure 4-12: Temporal distribution of fish species encountered at approximately river mile 7.7 (Site #3) April 2001 – March 2002 (Chastain et al., 2002, Figure 3c). The salmonid species detected include: cutthroat trout (*O. clarkii*), steelhead/rainbow trout (*O. mykiss*), Coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*).

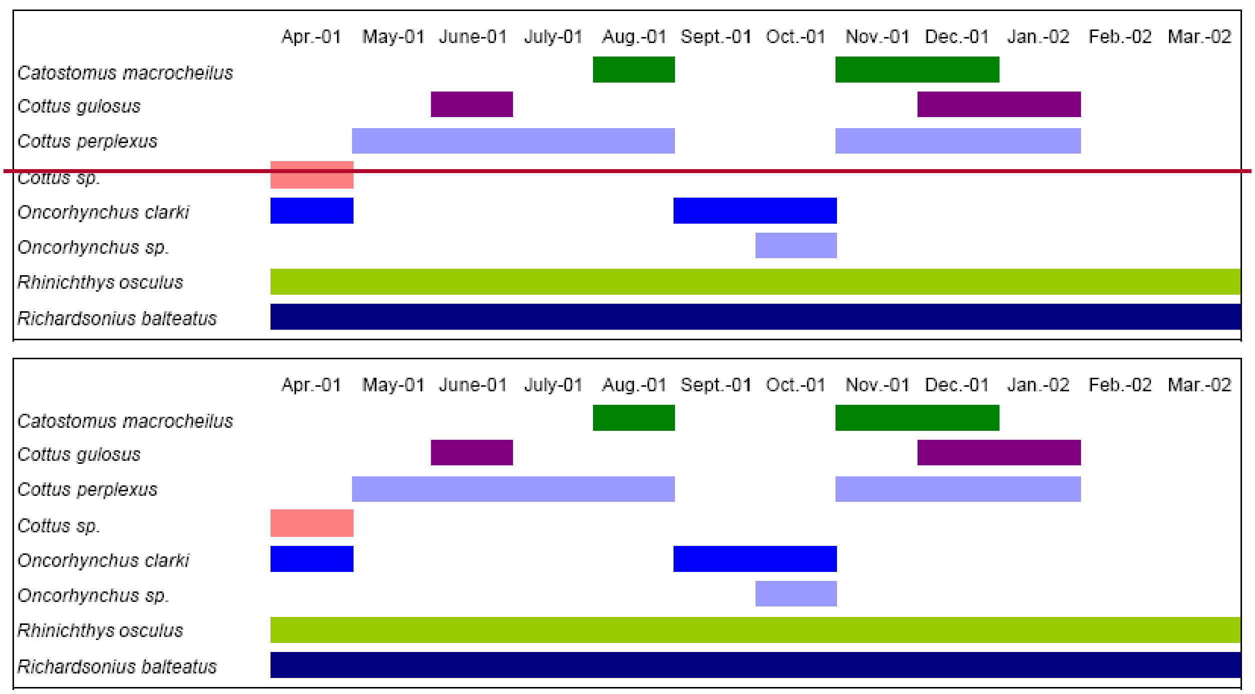
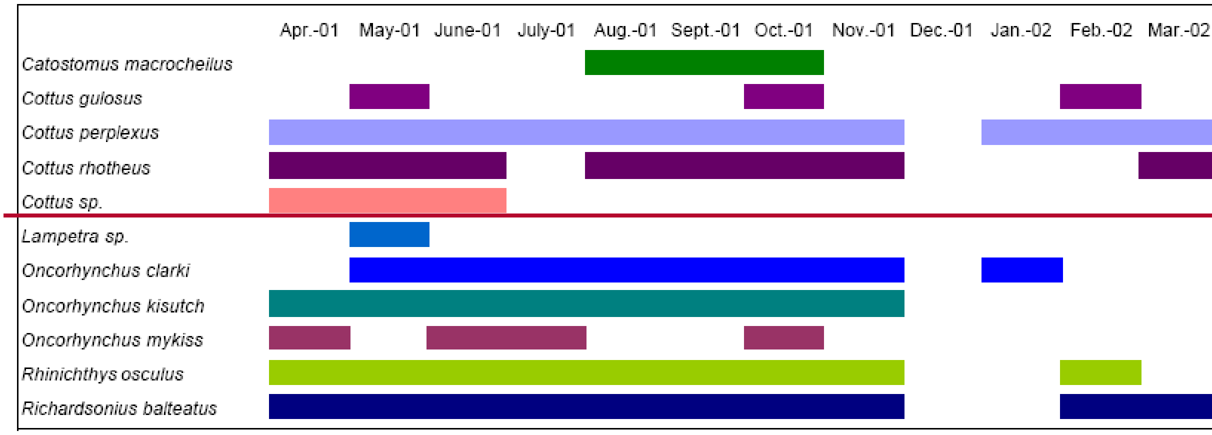


Figure 4-13: Temporal distribution of fish species encountered at approximately river mile 9.8 (Site #4) April 2001 – March 2002 (Chastain et al., 2002, Figure 3d). The salmonid species detected include: cutthroat trout (*O. clarkii*) and another salmonid (*Onchorhynchus spp*).



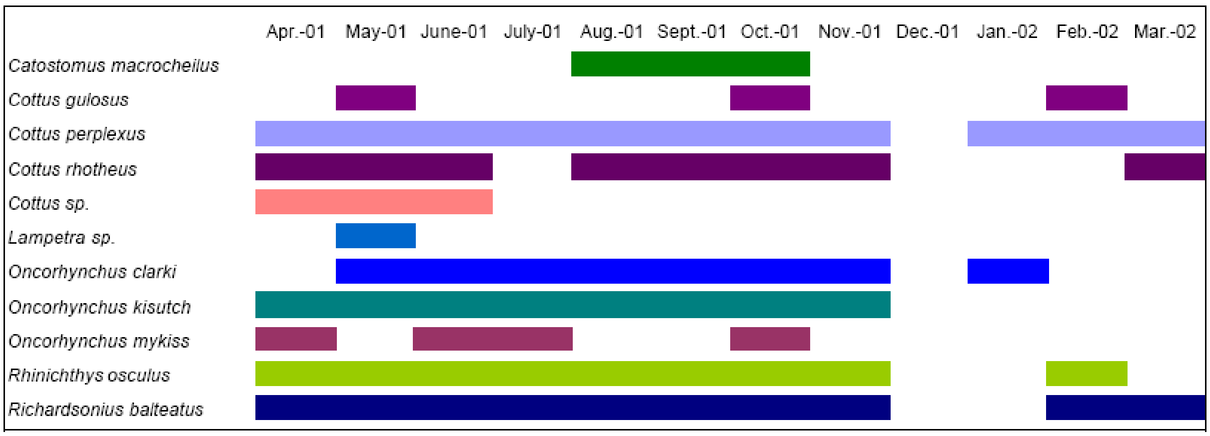


Figure 4-14: Temporal distribution of fish species encountered upstream of the lower reach for comparison, at approximately river mile 16 (Site #6) April 2001 – March 2002 (Chastain et al., 2002, Figure 3f).

Table 4-9: Species observed downstream and upstream of Villwok's Ford approximately river mile 12 (May – September 2003). (Chapman et al., undated, Table 10).

	Downstream of ford							
Species	May 23	June 1	June 6	June 27	July 12	July 26	Aug. 18	Sept. 6
Ptychocheilus oregonensis	No	Yes	No	Yes	Yes	Yes	Yes	No
Lepomis spp.	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Oncorhynchus clarki	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Catostomus machrocheilus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lampetra tridentata	No	Yes	No	No	No	No	No	No
	Upstream of ford							
Ptychocheilus oregonensis	No	No	No	No	No	No	Yes	No
Lepomis spp.	No	No	No	No	No	No	No	No
Oncorhynchus clarki	Yes	No	No	No	No	Yes	No	No
Catostomus machrocheilus	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Lampetra tridentata	No	No	No	No	No	No	No	No

Species	May 23	June 1	June 6	June 27	July 12	July 26	Aug. 18	Sept. 6
	Downstream of ford							
Ptychocheilus oregonensis	No	Yes	No	Yes	Yes	Yes	Yes	No
Lepomis spp.	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Oncorhynchus clarki	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Catostomus machrocheilus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lampetra tridentata	No	Yes	No	No	No	No	No	No
	Upstream of ford							
Ptychocheilus oregonensis	No	No	No	No	No	No	Yes	No
Lepomis spp.	No	No	No	No	No	No	No	No
Oncorhynchus clarki	Yes	No	No	No	No	Yes	No	No
Catostomus machrocheilus	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Lampetra tridentata	No	No	No	No	No	No	No	No

~~4.7.4~~4.8.8 Rickreall Creek temperature target

To protect the adult winter steelhead (*Oncorhynchus mykiss*), Coho salmon (*Oncorhynchus kisutch*), and Chinook salmon (*Oncorhynchus tshawytscha*) that may be migrating through the lower reach of Rickreall Creek, and juvenile winter steelhead or Coastal Cutthroat trout (*Oncorhynchus clarkii*) that may be rearing within the lower reach, DEQ will rely upon the 18.0°C target temperature established to protect salmon and trout rearing and migration uses suggested by EPA guidance (EPA, 2003) and adopted in Oregon's water quality standards (OAR 340-041-0028 (4)(c)). DEQ will apply the 18°C target plus the 0.3°C HUA from October 1 to May 31. This target temperature will also protect cool water fish.

To protect Prickly sculpin (*Cottus asper*), the most temperature sensitive cool water species in lower Rickreall Creek, DEQ will apply a temperature target of 22.8°C. DEQ will apply the 22.8°C target plus the 0.3°C HUA from June 1 to September 30. Warming from anthropogenic sources shall be limited to a cumulative increase of no greater than 0.3°C above the temperature targets after complete mixing in the waterbody, and at the POMI. A summary of the temperature targets is presented in **Table 4-~~6~~10**.

The provisions of the PCW criterion at OAR 340-41-0028(11) are also incorporated into the temperature target. If ambient 7DADM temperatures trend to always being cooler than both temperature targets presented in **Table 4-~~6~~10** and all exceptions outlined in OAR 340-41-0028(11)(c) are not applicable, the PCW criterion shall be applied with the 0.3°C HUA based on an increase above the cooler ambient temperature.

The mixing zone and thermal plume limitations in OAR 340-041-0053 (2)(E)(d) will provide further protections against potential migration blockages and acute thermal impacts. The TMDL assumes assessment and application of thermal plume limitations, as necessary, will be completed during the NPDES permit renewal process.

Table 4-10: Summary of temperature targets implementing the cool water species narrative in lower Rickreall Creek.

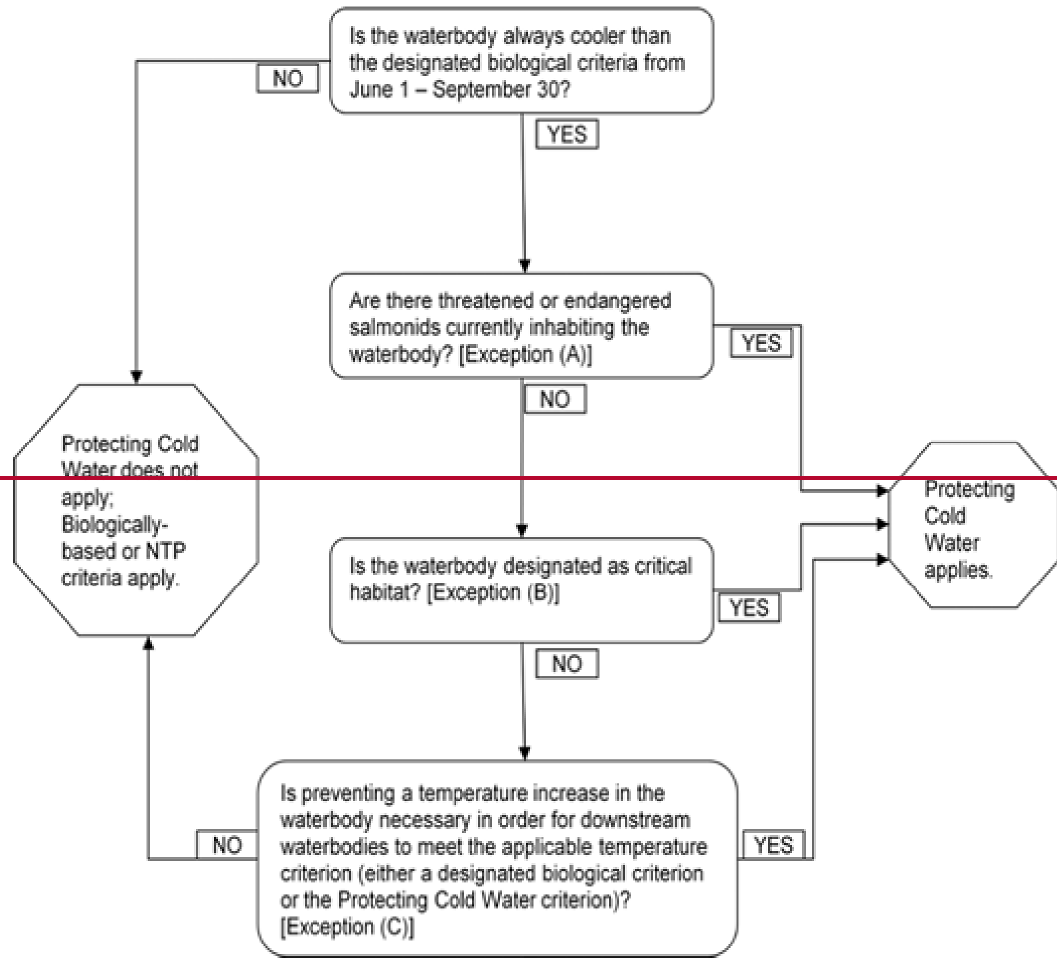
Time period	7DADM Temperature Target (°C)	Most Temperature Sensitive Species
June 1 – September 30	22.8 + 0.3 HUA	Prickly sculpin (*Cottus asper*)
October 1 – May 31	18.0 + 0.3 HUA	Winter steelhead (*Oncorhynchus mykiss*)

~~4.8~~4.9 Three basin rule: Clackamas, McKenzie, and North Santiam

The three basin rule OAR 340-41-0350 applies to the waters of the Clackamas River Subbasin (17090011), The McKenzie River subbasin (17090004) above the Hayden Bridge (river mile 15), and the North Santiam Subbasin (17090005). The rule prohibits new or increased waste discharges with some exceptions.

~~4.9~~4.10 Protecting cold water

The "protecting cold water" criterion in OAR 340-041-0028(11) applies to waters of the state that have summer ambient 7DADM temperatures that are colder than the biologically based criteria. With some exceptions (summarized in **Figure 4-~~12~~15**), these waters may not be warmed cumulatively by anthropogenic point and nonpoint sources by more than 0.3°C (0.5°F) above the colder water ambient temperature. This applies to all anthropogenic sources taken together at the POMI where salmon, steelhead or bull trout are present. A summary of how DEQ implements this portion of the standard can be found in the PCW IMD (DEQ, 2011) and the Temperature IMD (DEQ, 2008a).


Is the waterbody always cooler than the designated biological criteria from June 1 – September 30?
NO
YES
Are there threatened or endangered salmonids currently inhabiting the waterbody? [Exception (A)]
YES
NO
Protecting Cold Water does not apply; Biologically-based or NTP criteria apply.
Protecting Cold Water applies.
Is the waterbody designated as critical habitat? [Exception (B)]
YES
NO
Is preventing a temperature increase in the waterbody necessary in order for downstream waterbodies to meet the applicable temperature criterion (either a designated biological criterion or the Protecting Cold Water criterion)? [Exception (C)]
NO
YES

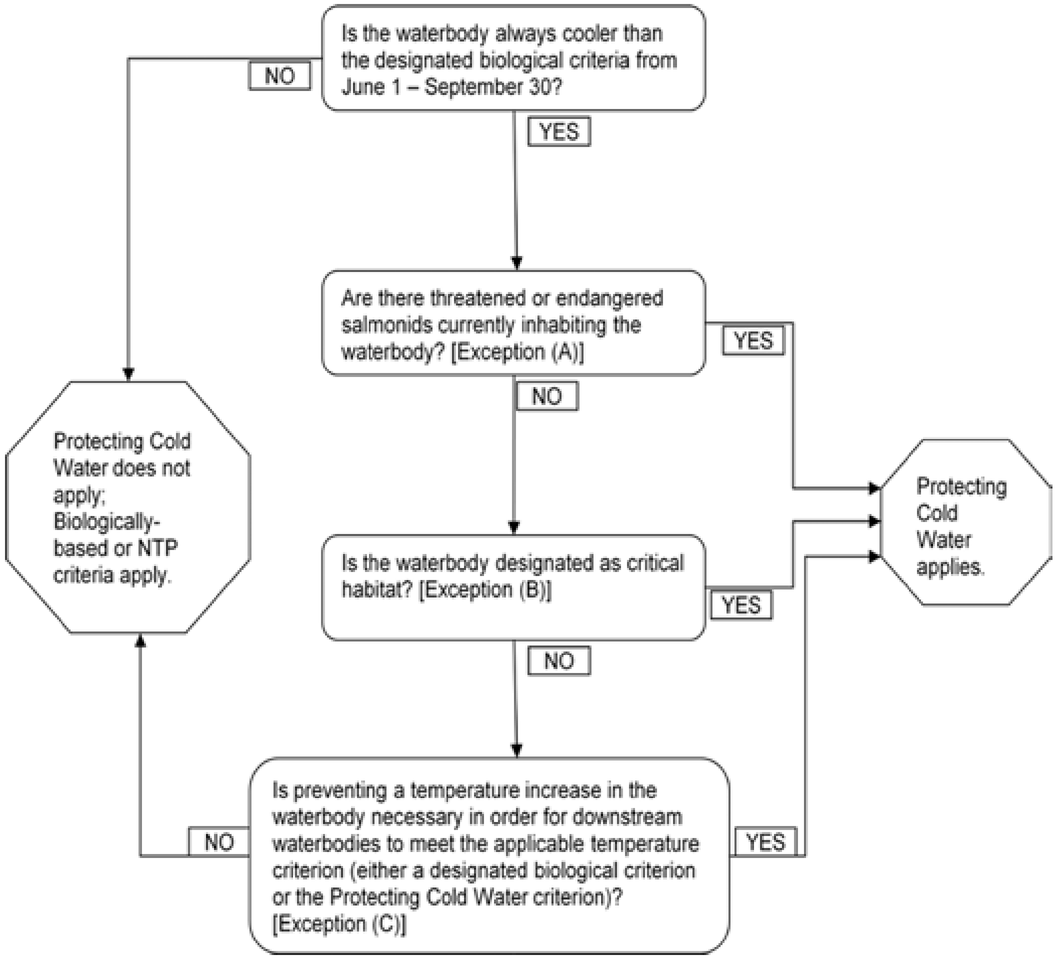


Figure 4-15: Flowchart to determine applicability of the PCW criterion. Extracted from DEQ, 2011.

~~4.10~~4.11 Statewide narrative criteria

Statewide narrative criteria at OAR 340-041-0007(1) apply to all waters of the state. 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.

5 Seasonal variation and critical period for temperature

Per OAR 340-042-0040(4)(j) and 40 CFR 130.7(c)(1), TMDLs must identify any seasonal variation and the critical condition or period of each pollutant, if applicable.

DEQ reviewed available temperature data to determine seasonal temperature variation and the critical period. The critical period is based on the frequency and period when 7DADM stream temperatures exceed the applicable temperature criteria. **Table 5-1** summarizes the water temperature monitoring data used to designate critical periods.

Figure 5-1 through **Figure 5-~~41~~53** show boxplots of the seasonal variation of 7DADM temperatures and the period of exceedance at select monitoring locations identified as having Category 5 temperature impairments on the 2022 Integrated Report. When multiple monitoring sites were available, the sites with multiple years of data were selected. Temperature data were grouped by the first and second half of each month. The month was split on the 15th with the first group including all results measured on the 1st through the 14th day and the second group including all results measured on the 15th through the end of the month. The boxplots are Tukey style boxplots with the middle line representing the median and ends of the box representing the temperature range between the first and third quartiles (25th – 75th percentile). The whiskers extend to values no further than 1.5 times the interquartile 7DADM temperature range (i.e., 1.5 times the difference between 25th and 75th percentiles). The points represent individual 7DADM temperature values beyond 1.5 times the interquartile range. The dashed line corresponds to the applicable temperature criteria. The shaded yellow area identifies the period when any 7DADM temperature exceeded the appliable temperature criteria.

The 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. The warmest median 7DADM temperatures were observed in the Middle Willamette. Monitoring data at Claggett Creek at Mainline Drive in the Middle Willamette Subbasin (**Figure 5-~~24~~34**) show the median 7DADM temperature from 2013 to 2019 was close to 25°C from July 1 to September 1.

The period and frequency of temperature criteria exceedance varies based on monitoring location. Monitoring locations in the Johnson Creek Watershed had the longest periods of exceedance. Near the mouth of Crystal Springs, 7DADM temperatures exceeded the applicable criteria approximately February 15 through November 15 (**Figure 5-~~31~~43**). Exceedances occurred approximately March 1 through November 15 in Johnson Creek near Milwaukie (**Figure 5-~~32~~44**). At other monitoring sites the earliest exceedances occurred in April (McKenzie Subbasin **Figure 5-~~15~~22**, or Lower Willamette Subbasin **Figure 5-~~33~~45**) and the latest occurred at the end of December (South Santiam Subbasin **Figure 5-~~22~~31**).

The seasonal variation downstream of some large dams and reservoirs show seasonal shifts in maximum temperatures relative to monitoring sites upstream of the dam and reservoir. For example, maximum 7DADM temperatures shift from July and August to September, October, and November downstream of Blue River Dam (**Figure 5-~~12~~19** and **Figure 5-~~13~~20**) Green Peter Dam (**Figure 5-~~20~~29**, **Figure 5-~~21~~30**, and **Figure 5-~~22~~31**), and Hills Creek Dam (**Figure 5-1**, **Figure 5-2**, and **Figure 5-3**). For this reason, the critical period applied to the AUs downstream of these dams extends into November or December (**Table 5-2**).

DEQ uses the critical period to determine when allocations apply. In setting the allocation period, DEQ relied upon monitoring sites with the longest period of exceedance. When downstream monitoring sites have longer exceedance periods relative to upstream waters, the longer period is used as the critical period for upstream waterbodies. For example, temperature data show the McKenzie River period of exceedance is typically May 1 – October 31 (**Figure 5-~~16~~23**); however in the Willamette River the period of exceedance is April 1 – November 15. Because of the significant flow and temperature influence the McKenzie River has on the

Willamette River, the critical period on the McKenzie River was set to be the same as the Willamette River. This is a margin of safety to ensure warming of upstream waters does not contribute to downstream exceedances.

The frequency of exceedance was also considered. If any individual 7DADM temperature values beyond 1.5 times the interquartile range exceeded the criterion (shown as points on the boxplots), that period was not usually included in the critical period. These 7DADM values represent approximately 2% or fewer of all observations in that 15-day period.

The critical periods for waterbodies in the Willamette Subbasins are presented in **Table 5-2**. Allocations presented in the TMDL apply during these periods.

Table 5-1: Water temperature monitoring locations and periods used to determine seasonal temperature variation and critical periods for the Willamette Subbasins.

Monitoring Location ID	Monitoring Location	Monitoring Period	Number of 7DADM values
14162200	Blue River at Blue River, OR	01/01/02 - 12/31/22	7592
14161100	Blue River Below Tidbits Creek, Nr Blue River, OR	10/29/08 - 10/23/22	4857
10896-ORDEQ	Butte Creek at Hwy 211	07/04/02 - 08/16/06	386
14164550	Camp Crk at Camp Crk Rd Bridge, Nr Springfield, OR	07/18/17 - 12/31/22	1912
14164700	Cedar Creek at Springfield, OR	07/17/17 - 12/31/22	1972
~~11102-ORDEQ~~14210000	~~Rickreall Creek at State Farm Road~~Clackamas River at Estacada, OR	~~05/22/~~01/01/02 - 10/~~23/01~~17/22	~~149~~7091
14211010	Clackamas River near Oregon City, OR	06/27/02 - 10/24/22	7326
CGT1	Claggett Creek at Mainline Dr NE	05/08/13 - 10/11/19	923
~~14144800~~14153500	~~Middle~~Coast Fork Willamette River ~~Nr Oakridge~~below Cottage Grove Dam, OR	~~07/29/10 - 10/26~~01/01/02 - 12/31/22	~~4107~~7488
14211546	Crystal Springs Creek at Mouth at Portland, OR	12/12/02 - 12/18/12	3490
14151000	Fall Creek below Winberry Creek, near Fall Creek, OR	01/01/02 - 12/22/22	7557
40089-ORDEQ	Ferguson Ck 0.1 Miles DS of Territorial Rd	05/21/17 - 10/28/20	638
40088-ORDEQ	Ferguson Ck 270 Meters DS SFK Mouth	05/21/17 - 10/28/20	638
40073-ORDEQ	Ferguson Creek 0.1 Miles Upstream of Eber Creek Confluence	05/21/17 - 10/28/20	638
MHNF-039	Fish Creek Temp Monitoring	07/30/09 - 06/02/20	1173
14144900	Hills Cr Ab Hills Cr Res, Nr Oakridge, OR	06/23/10 - 10/26/22	4462
14211550	Johnson Creek at Milwaukie, OR	01/01/02 - 12/31/22	7584
14182500	Little North Santiam River Near Mehama, OR	01/01/02 - 12/31/22	5546
14170000	Long Tom River at Monroe, OR	01/01/02 - 11/29/22	1777
14169000	Long Tom River near Alvadore, OR	01/01/02 - 11/27/22	7097

Monitoring Location ID	Monitoring Location	Monitoring Period	Number of 7DADM values
14164900	McKenzie River Abv Hayden Br, at Springfield, OR	07/01/09 - 12/31/22	4920
14145500	MF Willamette River Abv Salt Crk, Near Oakridge, OR	10/07/08 - 12/31/22	5138
14148000	MF Willamette River Blw N Fork, Nr Oakridge, OR.	11/20/08 - 10/25/22	4707
14152000	Middle Fork Willamette River at Jasper, OR	02/13/02 - 10/25/22	7198
14150000	Middle Fork Willamette River Near Dexter, OR	01/01/02 - 12/01/22	7606
14144800	Middle Fork Willamette River Nr Oakridge, OR	07/29/10 - 10/26/22	4107
14186200	Middle Santiam R Blw Green Peter Dam Nr Foster, OR	10/30/07 - 12/31/22	5222
14185800	Middle Santiam R Near Cascadia, OR	08/24/10 - 11/01/22	4441
39130-ORDEQ	Milton Cr DS of Old Portland Rd On Boise Cascade Side of Road	07/04/17 - 11/02/21	1035
14184100	North Santiam River at Greens Bridge, near Jefferson, Or	06/07/09 - 10/04/22	4841
14181500	North Santiam River at Niagara, OR	01/01/02 - 12/31/22	7587
14185900	Quartzville Creek Near Cascadia, OR	10/29/08 - 11/01/22	5023
11102-ORDEQ	Rickreall Creek at State Farm Road	05/22/01 - 10/23/01	149
14181750	Rock Creek Near Mill City, OR	10/07/05 - 01/04/09	1170
14154500	Row River Above Pitcher Creek, Near Dorena, OR	08/13/09 - 12/31/22	4589
UmpNF-069	Row River Above Sharps Creek LTWT	06/24/04 - 09/24/19	1337
14155500	Row River near Cottage Grove, OR	01/01/02 - 12/31/22	7607
WNF-099	Salmoncreek_Mouth_LTWT	07/15/09 - 10/09/19	800
WNF-100	Saltcreek_Mouth_LTWT	07/01/08 - 10/04/17	416
14189050	Santiam River Near Jefferson, OR	01/01/02 - 12/31/22	7474
23566-ORDEQ~~14158100~~	~~Willamette River at Owosso Bridge at Eugene, OR~~Scappoose Creek - North Scappoose Creek at Hwy 30	~~11/16/~~07/05/17 - 10~~- 10/24/22~~/05/21	~~4295~~1013
UmpNF-072	Sharps Creek at The Mouth LTWT	06/24/04 - 09/24/19	1291
UmpNF-073	Sharps Creek at The Quarry LTWT	06/24/04 - 09/26/17	1181
31879-ORDEQ	Silver Creek at Silverton, OR	07/09/02 - 09/22/05	428
14159500	South Fork McKenzie River Near Rainbow, OR	01/01/02 - 12/18/22	7563
~~14161100~~	~~Blue River Below Tidbits Creek, Nr Blue River, OR~~	~~10/29/08 - 10/23/22~~	~~4857~~
~~14162200~~	~~Blue River at Blue River, OR~~	~~01/01/02 - 12/31/22~~	~~7592~~
~~14164550~~	~~Camp Crk at Camp Crk Rd Bridge, Nr Springfield, OR~~	~~07/18/17 - 12/31/22~~	~~1912~~
~~14164700~~	~~Cedar Creek at Springfield, OR~~	~~07/17/17 - 12/31/22~~	~~1972~~
~~14164900~~	~~McKenzie River Abv Hayden Br, at Springfield, OR~~	~~07/01/09 - 12/31/22~~	~~4920~~

Monitoring Location ID	Monitoring Location	Monitoring Period	Number of 7DADM values
~~14166000~~	~~Willamette River at Harrisburg, OR~~	~~01/01/02 - 12/31/22~~	~~7620~~
~~14174000~~	~~Willamette River at Albany, OR~~	~~01/01/02 - 10/03/22~~	~~7451~~
~~14181750~~	~~Rock Creek Near Mill City, OR~~	~~10/07/05 - 01/04/09~~	~~1170~~
~~14182500~~	~~Little North Santiam River Near Mehama, OR~~	~~01/01/02 - 12/31/22~~	~~5546~~
14185000	South Santiam River Below Cascadia, OR	11/05/08 - 12/31/22	5088
~~14185800~~14187200	~~Middle~~South Santiam ~~R Near Cascadia~~River near Foster, OR	~~08/24/10 - 11/~~01/01/02 - 12/31/22	~~4441~~7430
40313-ORDEQ	South Scappoose 160 M Above Scappoose Vernonia Hwy	07/05/17 - 09/20/21	1055
~~14185900~~14174000	~~Quartzville Creek Near Cascadia, OR~~Willamette River at Albany, OR	01/01/02 - 10/~~29/08 - 11/01/~~03/22	~~5023~~7451
~~14186200~~14166000	~~Middle Santiam R Blw Green Peter Dam Nr Foster, OR~~Willamette River at Harrisburg, OR	~~10/30/07~~01/01/02 - 12/31/22	~~5222~~7620
14192015	Willamette River at Keizer, OR	01/01/02 - 09/30/19	6151
14197900	Willamette River at Newberg, OR	01/22/02 - 12/31/22	6235
14158100~~14211546~~	~~Crystal Springs Creek~~Willamette River at ~~Mouth~~Owosso Bridge at ~~Portland~~Eugene, OR	~~12/12/02 - 12/18/12~~11/16/10 - 10/24/22	~~3490~~4295
~~14211550~~	~~Johnson Creek at Milwaukie, OR~~	~~01/01/02 - 12/31/22~~	~~7584~~
14211720	Willamette River at Portland, OR	01/01/02 - 12/31/22	6335
~~23566-ORDEQ~~	~~Scappoose Creek - North Scappoose Creek at Hwy 30~~	~~07/05/17 - 10/05/21~~	~~1013~~
~~31879-ORDEQ~~	~~Silver Creek at Silverton, OR~~	~~07/09/02 - 09/22/05~~	~~428~~
~~39130-ORDEQ~~	~~Milton Cr DS of Old Portland Rd On Boise Cascade Side of Road~~	~~07/04/17 - 11/02/21~~	~~1035~~
~~40073-ORDEQ~~	~~Ferguson Creek 0.1 Miles Upstream of Eber Creek Confluence~~	~~05/21/17 - 10/28/20~~	~~638~~
~~40088-ORDEQ~~	~~Ferguson Ck 270 Meters DS SFK Mouth~~	~~05/21/17 - 10/28/20~~	~~638~~
~~40089-ORDEQ~~	~~Ferguson Ck 0.1 Miles DS of Territorial Rd~~	~~05/21/17 - 10/28/20~~	~~638~~
~~40313-ORDEQ~~	~~South Scappoose 160 M Above Scappoose Vernonia Hwy~~	~~07/05/17 - 09/20/21~~	~~1055~~
~~CGT1~~	~~Claggett Creek at Mainline Dr NE~~	~~05/08/13 - 10/11/19~~	~~923~~
~~MHNF-039~~	~~Fish Creek Temp Monitoring~~	~~07/30/09 - 06/02/20~~	~~1173~~
~~UmpNF-069~~	~~Row River Above Sharps Creek LTWT~~	~~06/24/04 - 09/24/19~~	~~1337~~
~~UmpNF-072~~	~~Sharps Creek at The Mouth LTWT~~	~~06/24/04 - 09/24/19~~	~~1291~~
~~UmpNF-073~~	~~Sharps Creek at The Quarry LTWT~~	~~06/24/04 - 09/26/17~~	~~1181~~
~~WNF-099~~	~~Salmoncreek_Mouth_LTWT~~	~~07/15/09 - 10/09/19~~	~~800~~
~~WNF-100~~	~~Saltcreek_Mouth_LTWT~~	~~07/01/08 - 10/04/17~~	~~416~~

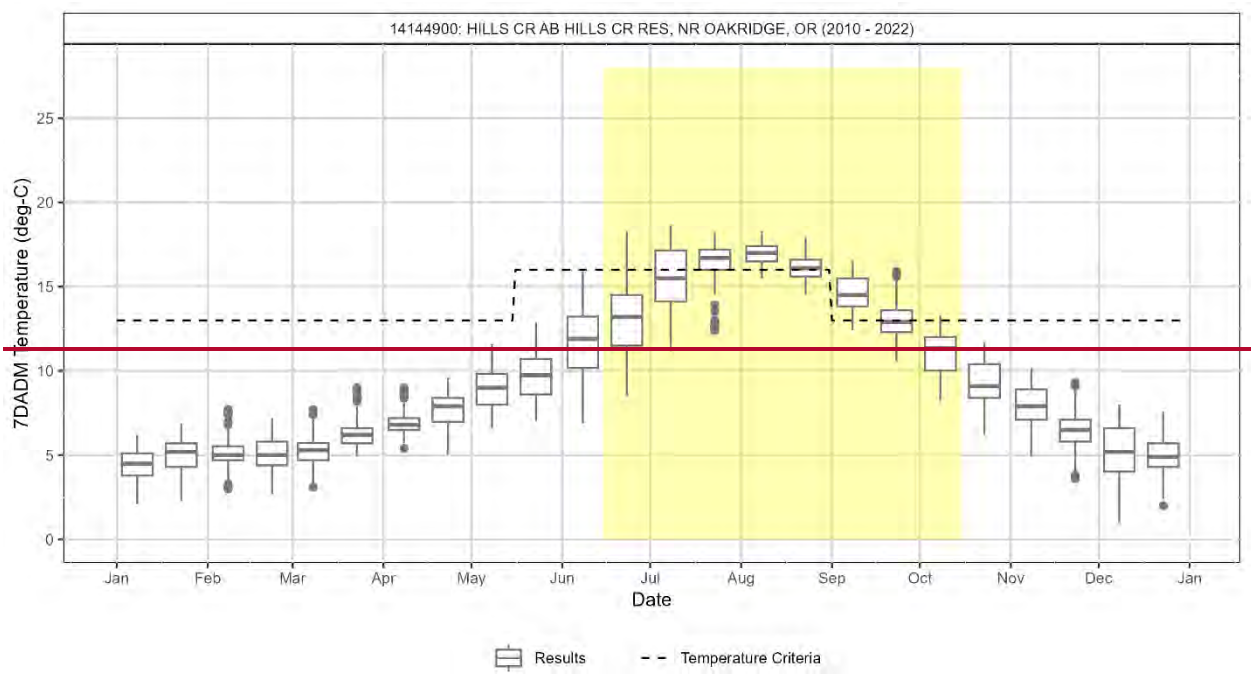
Table 5-2: Designated critical periods for waterbodies in the Willamette Subbasins.

HUCSubbasin	Watershed or Waterbody Name, AU ID	Critical Period
Middle Fork Willamette Subbasin 17090001	Middle Fork Willamette Subbasin excluding the Middle Fork Willamette River from Hills Creek Dam to Dexter DamAll waters, except those noted	May 1 – October 31
170900010505	Middle Fork Willamette River from Hills Creek Dam to North Fork Middle Fork Willamette River OR_SR_1709000105_02_104580, OR_SR_1709000105_02_103720	May 1 – November 30
170900010701	Middle Fork Willamette River from North Fork Middle Fork Willamette River to Dexter Reservoir OR_SR_1709000107_02_103725	May 1 – November 15
	Middle Fork Willamette River downstream from Dexter Reservoir OR_SR_1709000107_02_104583 OR_SR_1709000110_02_103750 OR_SR_1709000110_02_104584	April 1 – November 15
	Fall Creek downstream from Fall Creek Dam OR_SR_1709000109_02_103735	April 1 – November 15
170900010703	Lookout Point Lake OR_LK_1709000107_02_100700 Dexter Reservoir OR_LK_1709000107_02_100699	May 1 – November 15
Coast Fork Willamette Subbasin 17090002	Coast Fork Willamette SubbasinAll waters, except those noted	May 1 – October 31
	Coast Fork Willamette River downstream from Cottage Grove Dam OR_SR_1709000203_02_104585 OR_SR_1709000204_02_103787	April 1 – November 15
	Row River downstream from Dorena Dam. OR_SR_1709000202_02_103779	April 1 – November 15
Upper Willamette Subbasin 17090003	Upper Willamette SubbasinAll waters, except those noted	May 1 – October 31
	Long Tom River downstream of Fern Ridge Reservoir OR_SR_1709000301_02_10379	April 1 – November 15
	Willamette River	April 1 – November 15

HUCSubbasin	Watershed or Waterbody Name, AU ID	Critical Period
McKenzie River Subbasin 17090004	McKenzie River Subbasin excluding the Lower Blue River and McKenzie River WatershedAll waters, except those noted	May 1 – October 31
1709000407	McKenzie River Watershed (1709000407)	April 1 – November 15
170900040403	Lower Blue River from Blue River Dam to McKenzie River AU: OR_SR_1709000404_02_104569	May 1 – November 15
North Santiam Subbasin 17090005	North Santiam SubbasinAll waters, except those noted	May 1 – October 31
	North Santiam River downstream from Detroit Dam OR_SR_1709000504_02_103906 OR_SR_1709000506_02_103930	April 1 – November 15
South Santiam Subbasin 17090006	South Santiam Subbasin excluding Middle Santiam River from Green Peter Dam to Foster LakeAll waters, except those noted	May 1 – October 31
170900060402	Middle Santiam River from Green Peter Dam to Foster Lake AU: : OR_SR_1709000604_02_103969	May 1 – November 30
	South Santiam River downstream from Foster Dam OR_SR_1709000608_02_103925	April 1 – November 15
	Santiam River OR_SR_1709000506_02_10392	April 1 – November 15
Middle Willamette Subbasin 17090007	Middle Willamette SubbasinAll waters, except those noted	May 1 – October 31
	Willamette River upstream of the Yamhill River	April 1 – November 15
	Willamette River downstream of the Yamhill River	June 1 – September 30
Molalla-Pudding Subbasin 17090009	All watersMolalla-Pudding Subbasin	May 1 – October 31
Clackamas Subbasin 17090011	Clackamas SubbasinAll waters, except those noted	May 1 – October 31
	Clackamas River downstream of River Mill Dam OR_SR_1709001106_02_104597	April 1 – November 15
Lower Willamette Subbasin 17090012	Lower Willamette Subbasin excluding Johnson Creek WatershedAll waters, except those noted	April 1 – October 31

~~HUC~~Subbasin	Watershed or Waterbody Name, AU ID	Critical Period
~~1709001201~~	Johnson Creek Watershed (1709001201)	February 15 – November 15
	Willamette River downstream of the Yamhill River	June 1 – September 30
	Multnomah Channel OR_SR_1709001203_88_10418	June 1 – September 30

5.1 Middle Fork Willamette Subbasin seasonal variation



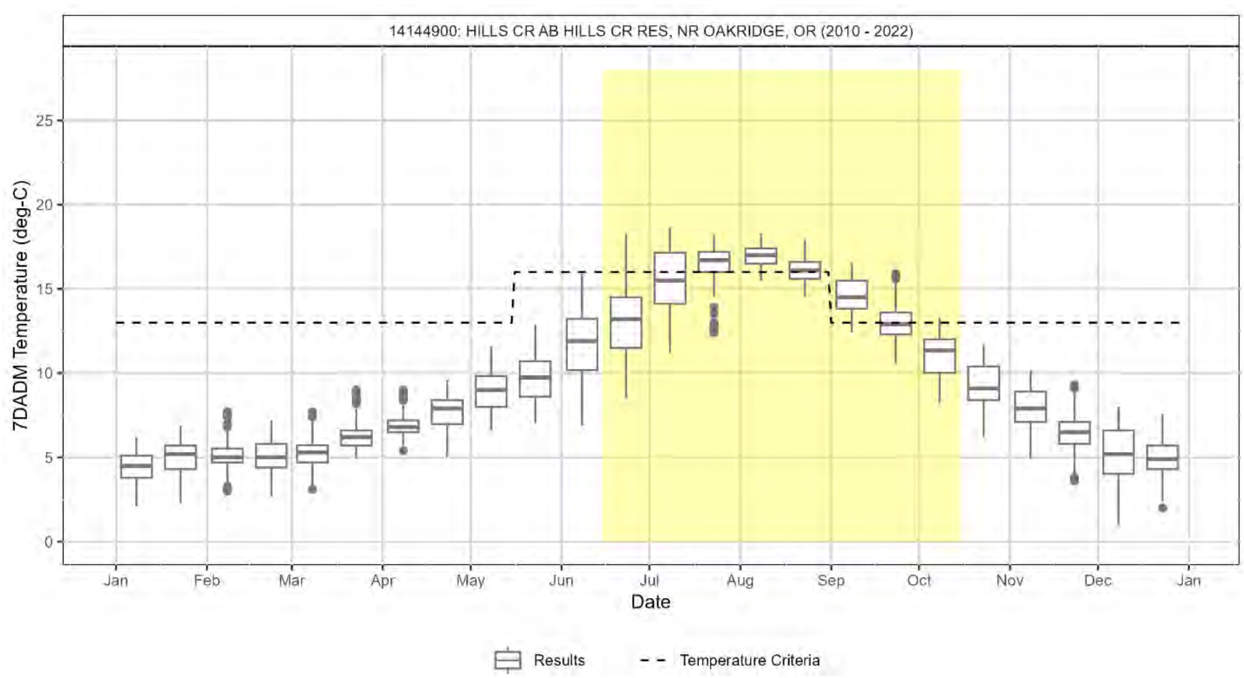


Figure 5-1: Seasonal variation on the Hills Creek Above Hills Creek Reservoir Near Oakridge temperature monitoring site in the Middle Fork Willamette Subbasin.

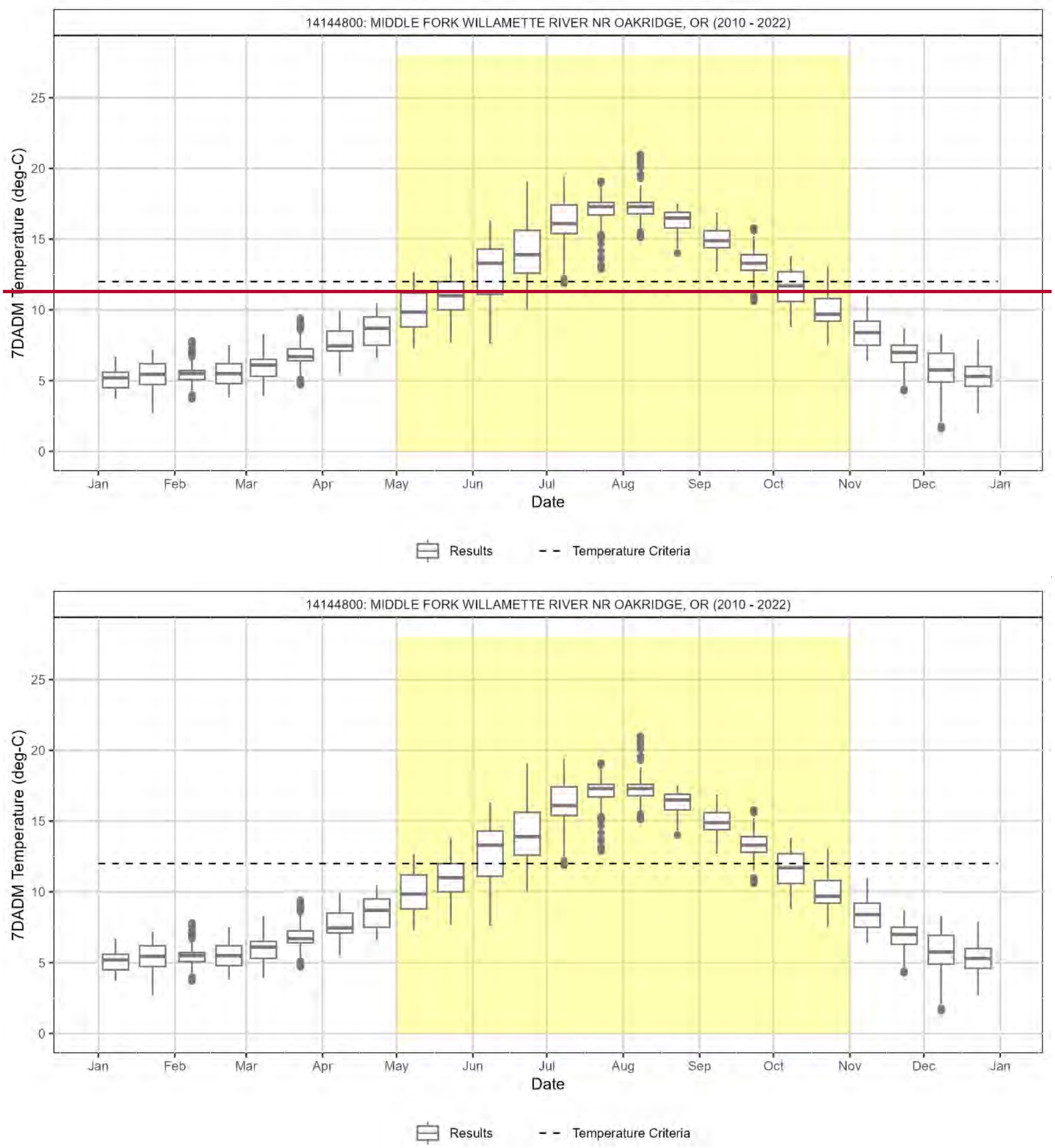


Figure 5-2: Seasonal variation on the Middle Fork Willamette River Near Oakridge temperature monitoring site (upstream from Hills Creek Reservoir) in the Middle Fork Willamette Subbasin.

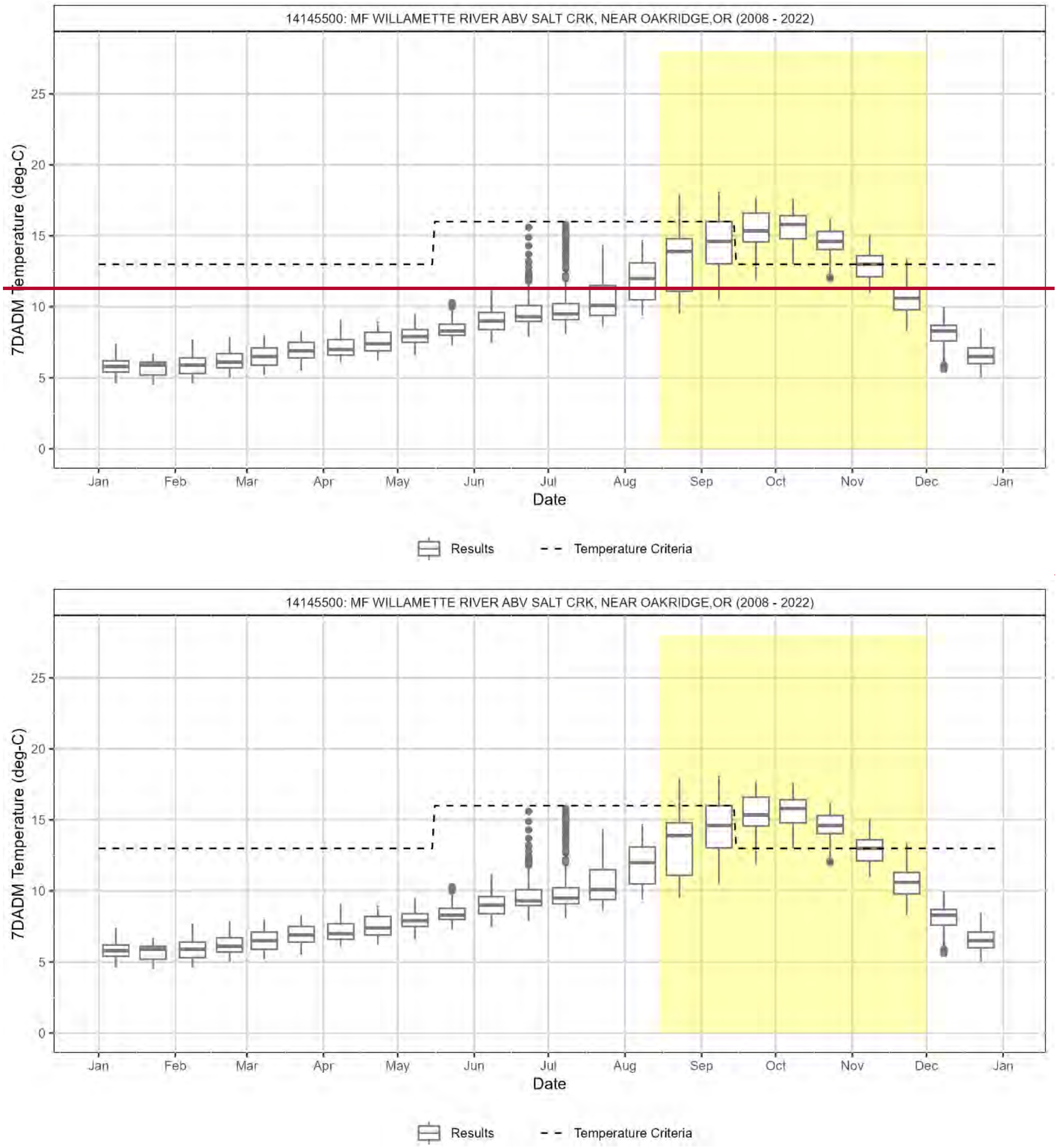
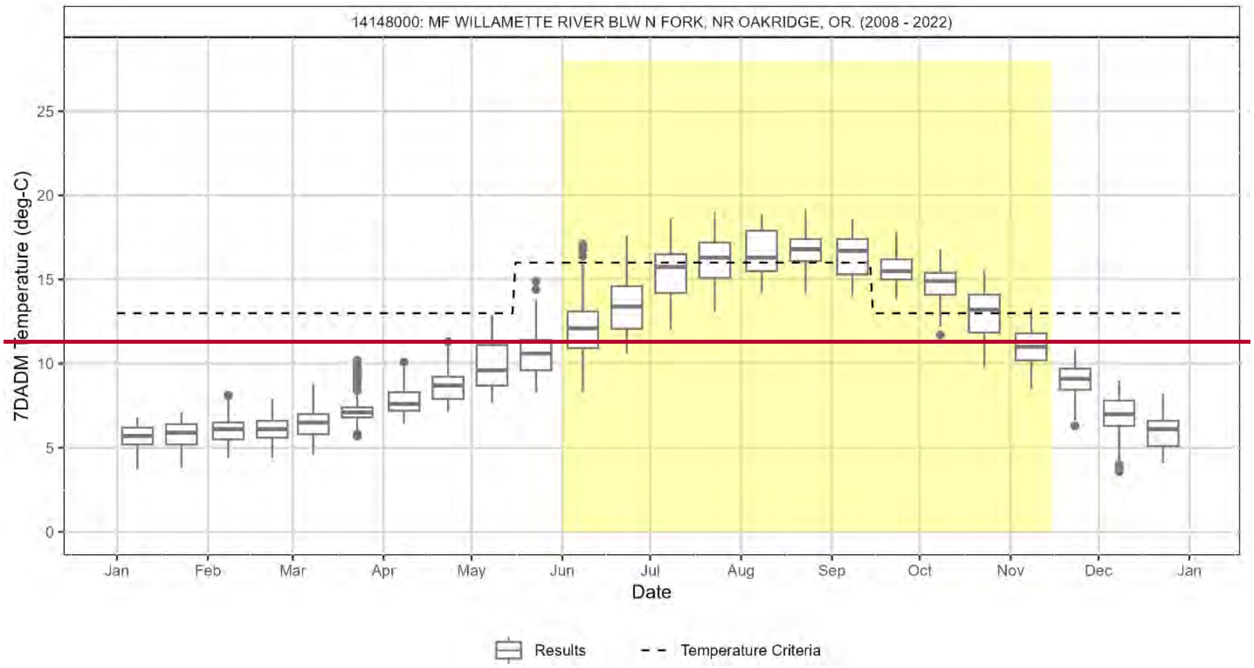


Figure 5-3: Seasonal variation on the Middle Fork Willamette River above Salt Creek monitoring site (downstream from Hills Creek Dam) in the Middle Fork Willamette Subbasin.



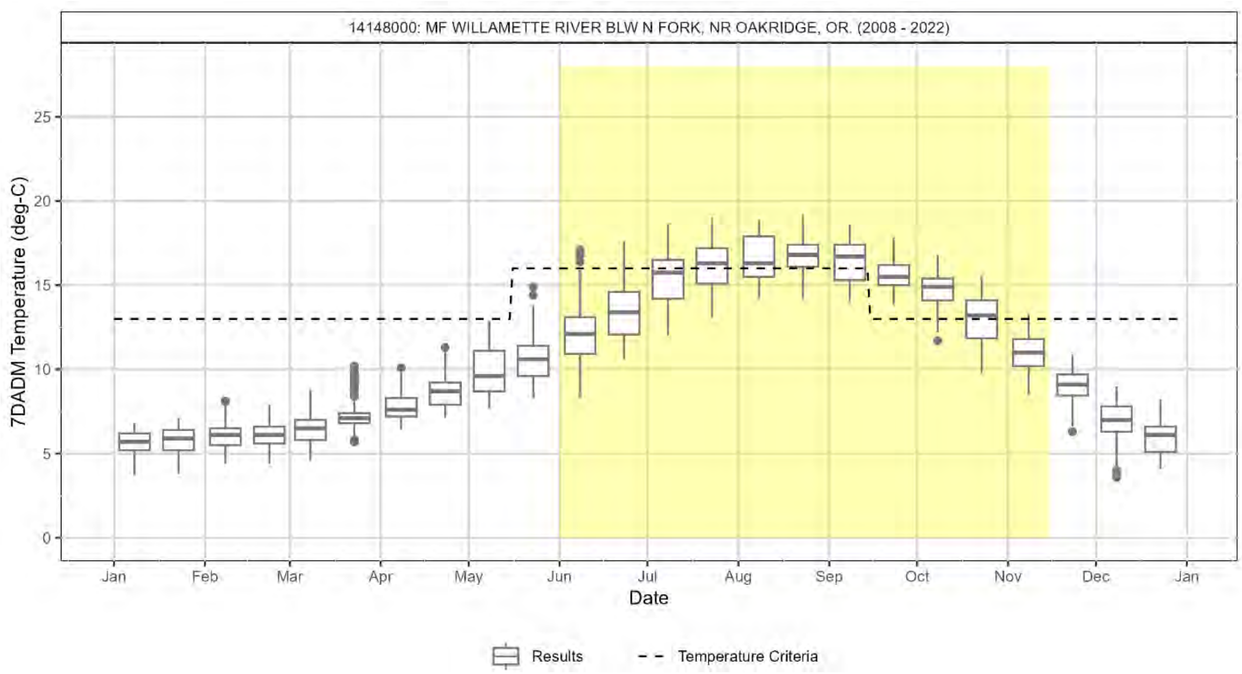


Figure 5-4: Seasonal variation on the Middle Fork Willamette River below North Fork near Oakridge monitoring site (Upstream from Green Peter Dam, downstream from Hills Creek Dam) in the Middle Fork Willamette Subbasin.

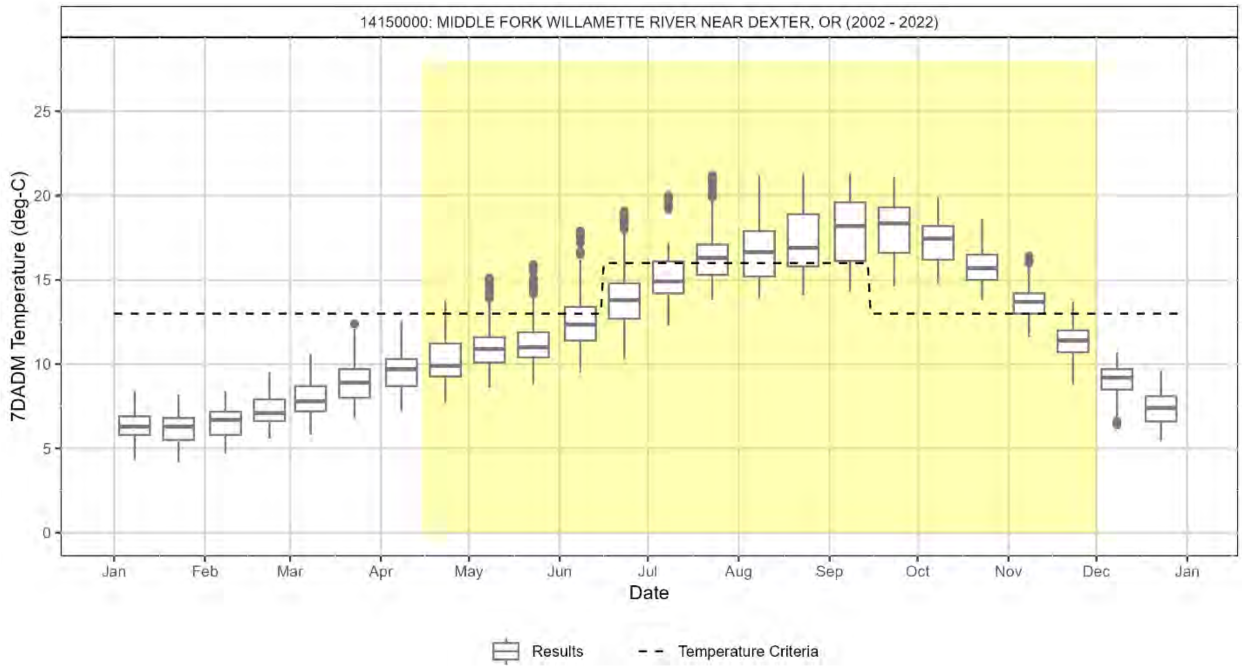


Figure 5-5: Seasonal variation on the Middle Fork Willamette River near Dexter, OR (downstream from Dexter Dam) in the Middle Fork Willamette Subbasin.

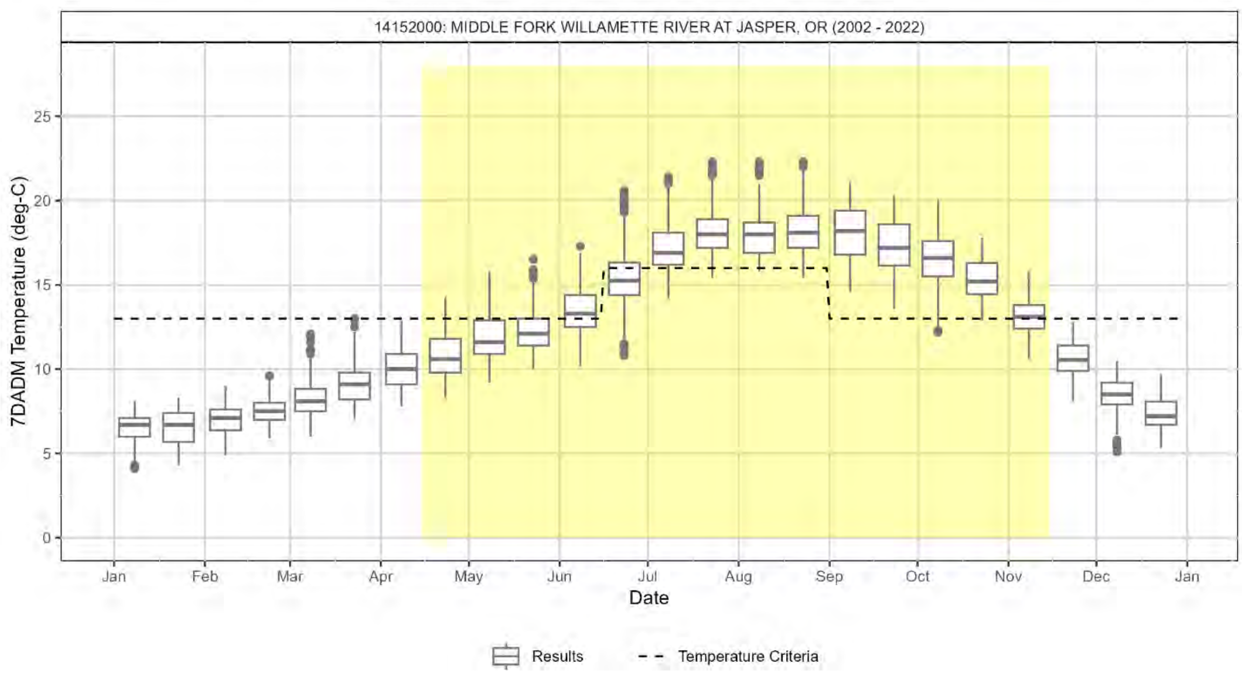


Figure 5-6: Seasonal variation on the Middle Fork Willamette River at Jasper, in the Middle Fork Willamette Subbasin.

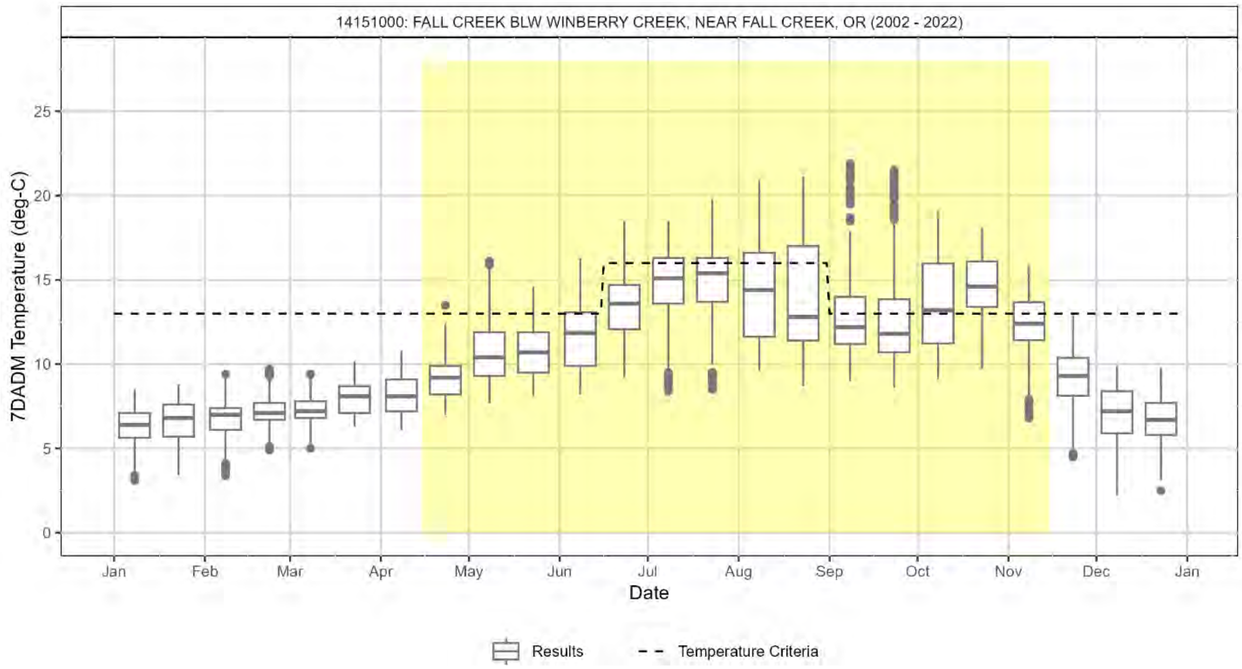


Figure 5-7: Seasonal variation on Fall Creek below Winberry Creek (downstream of Fall Creek Dam), in the Middle Fork Willamette Subbasin.

5.2 Coast Fork Willamette Subbasin seasonal variation

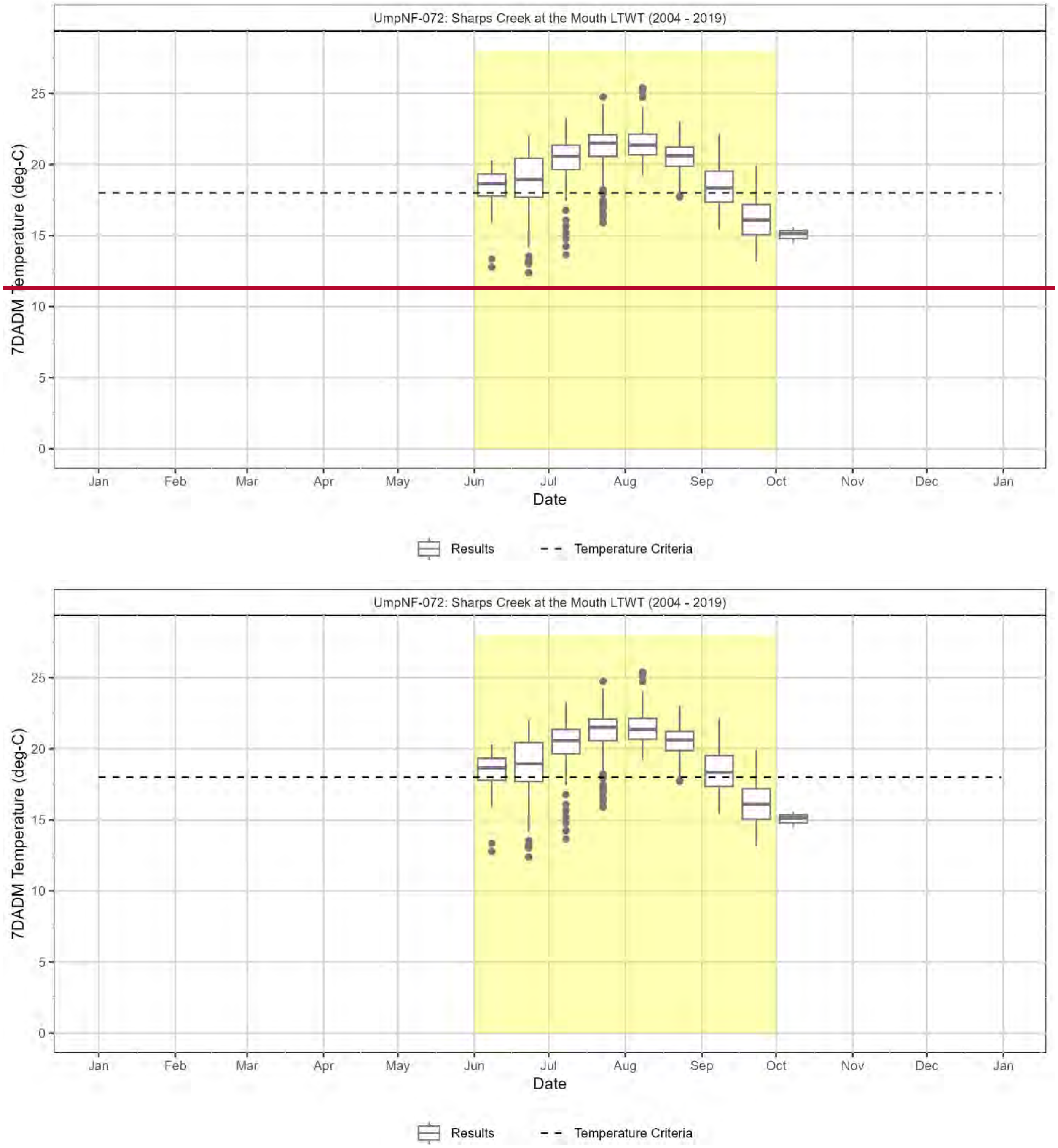


Figure 5-8: Seasonal variation at the Sharps Creek at mouth temperature monitoring site in the Coast Fork Willamette Subbasin.

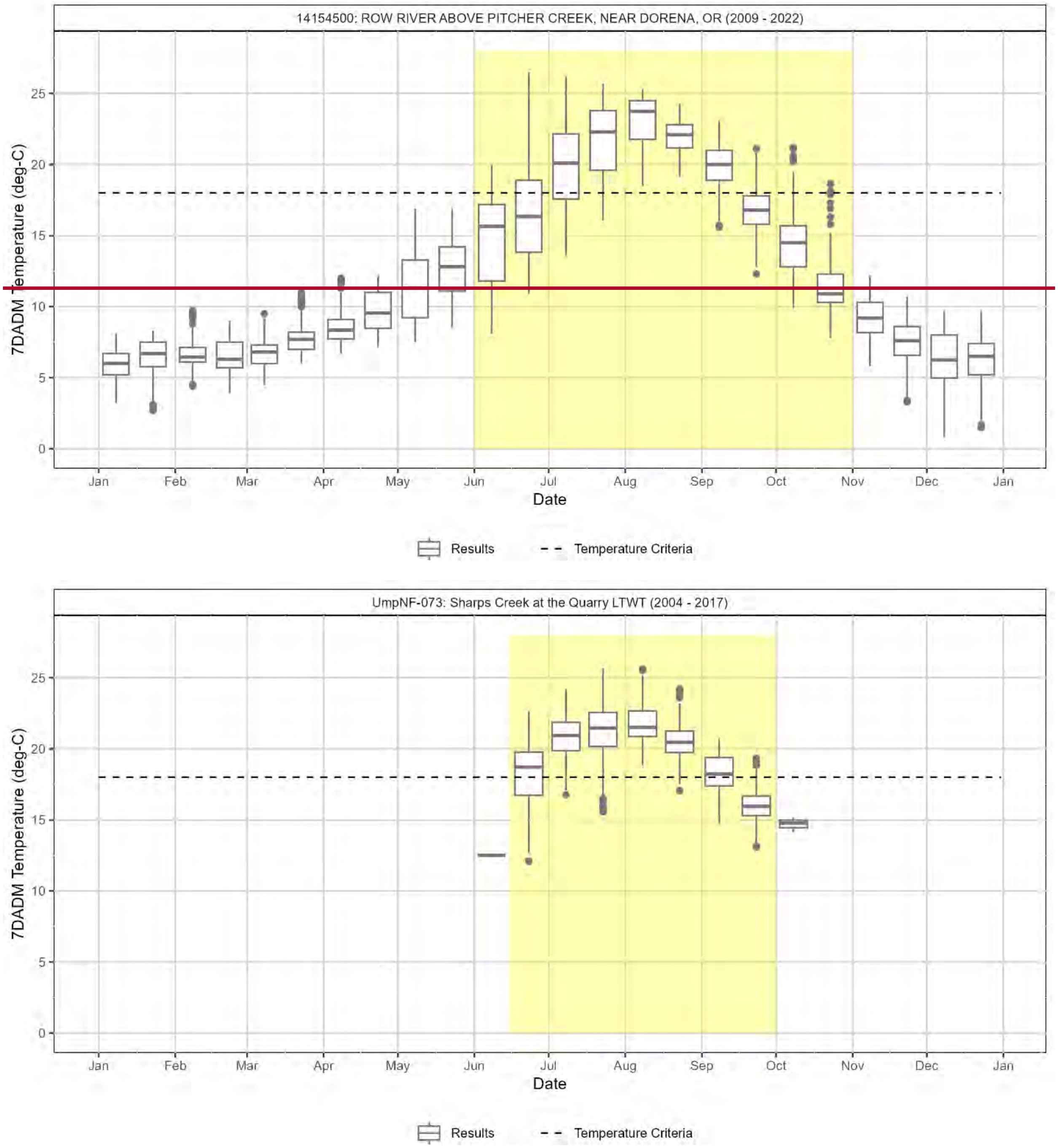


Figure 5-9: Seasonal variation at the Sharps Creek at quarry temperature monitoring site in the Coast Fork Willamette Subbasin.

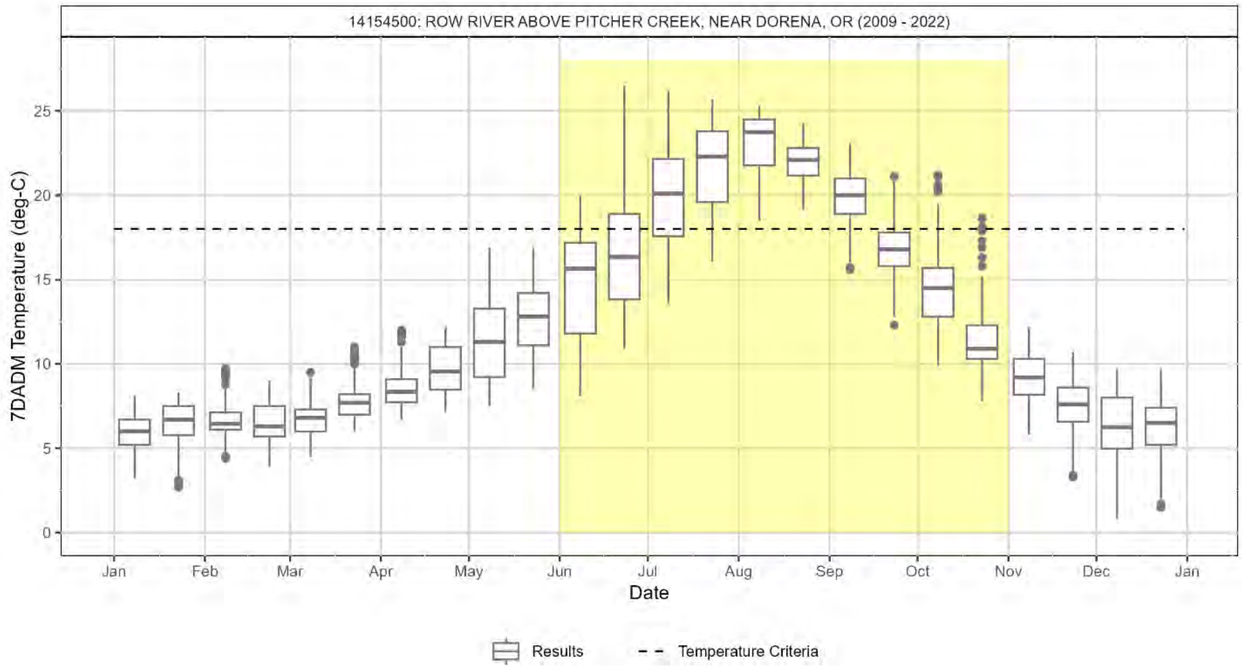
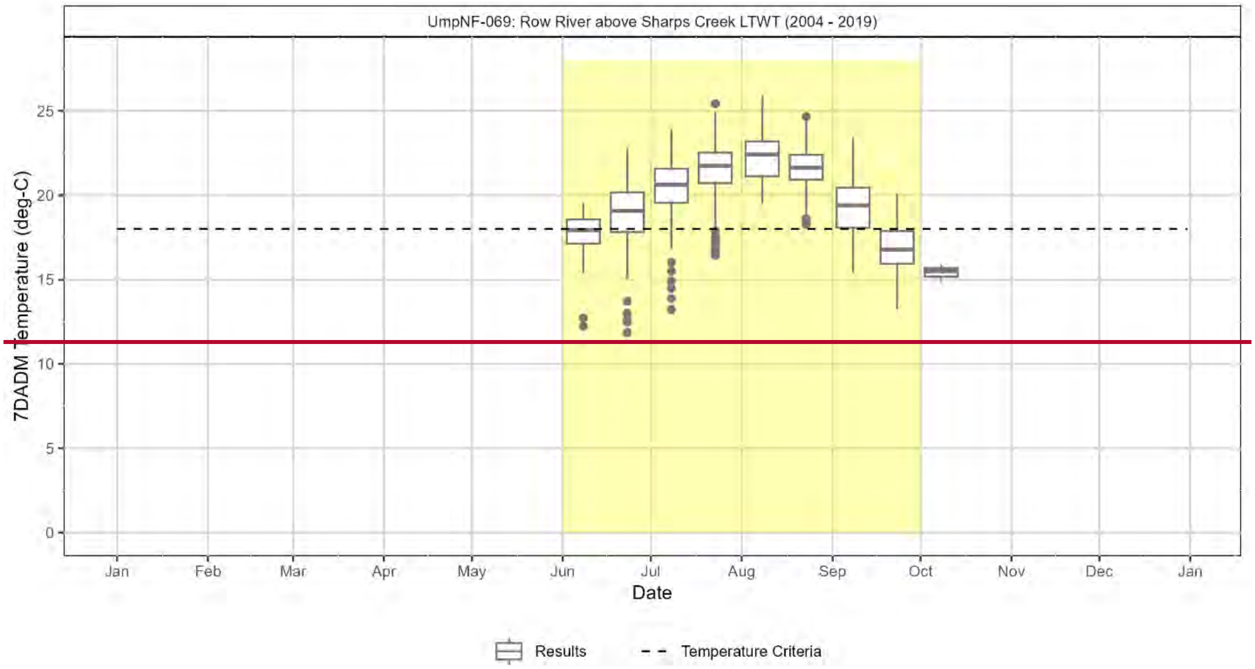


Figure 5-10: Seasonal variation at the Row River above Pitcher Creek temperature monitoring site in the Coast Fork Willamette Subbasin.



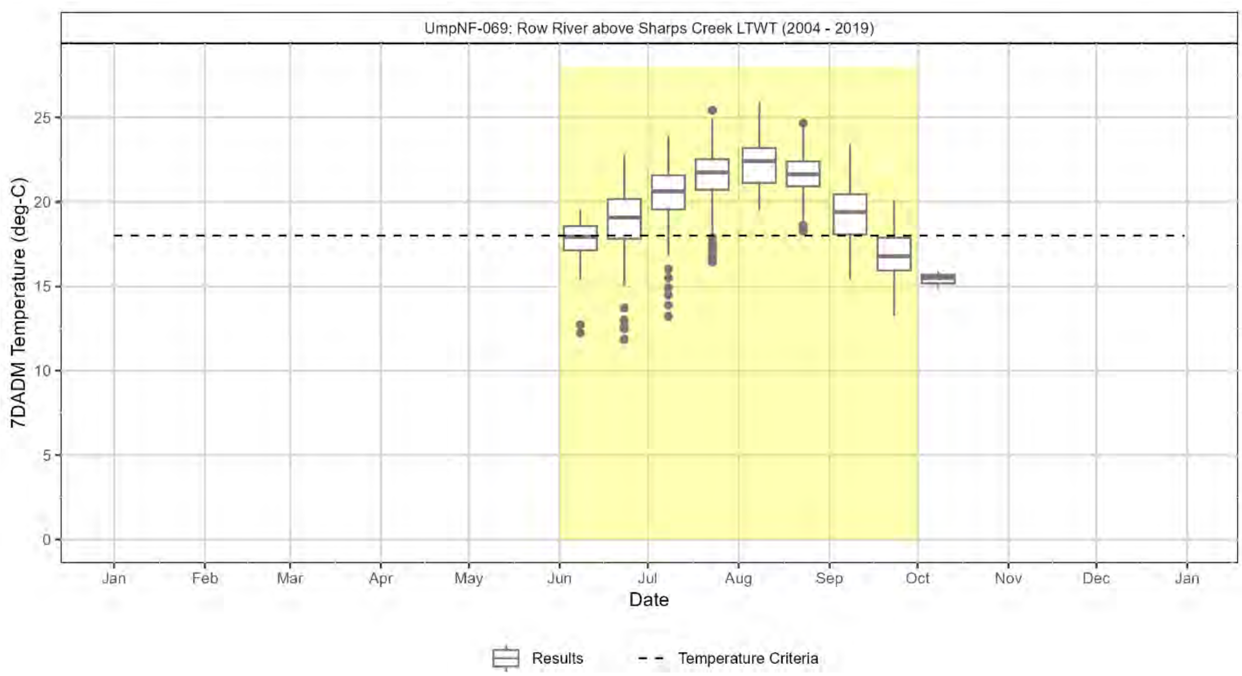


Figure 5-11: Seasonal variation at the Row River above Sharps Creek temperature monitoring site in the Coast Fork Willamette Subbasin.

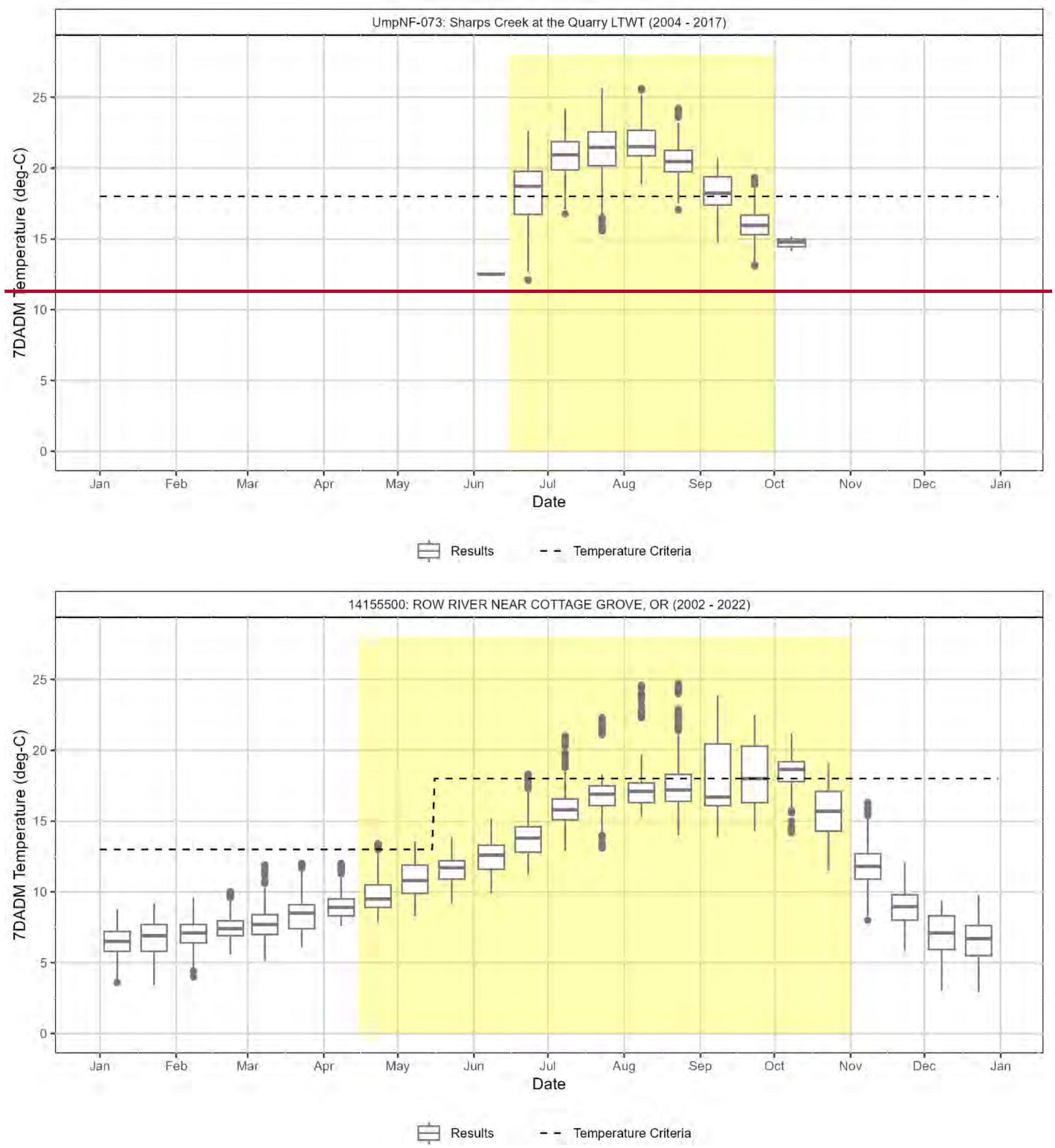


Figure 5-12: Seasonal variation ~~at~~on the ~~Sharps Creek at quarry temperature monitoring site~~Row River near Cottage Grove below Cottage Grove Dam in the Coast Fork Willamette Subbasin.

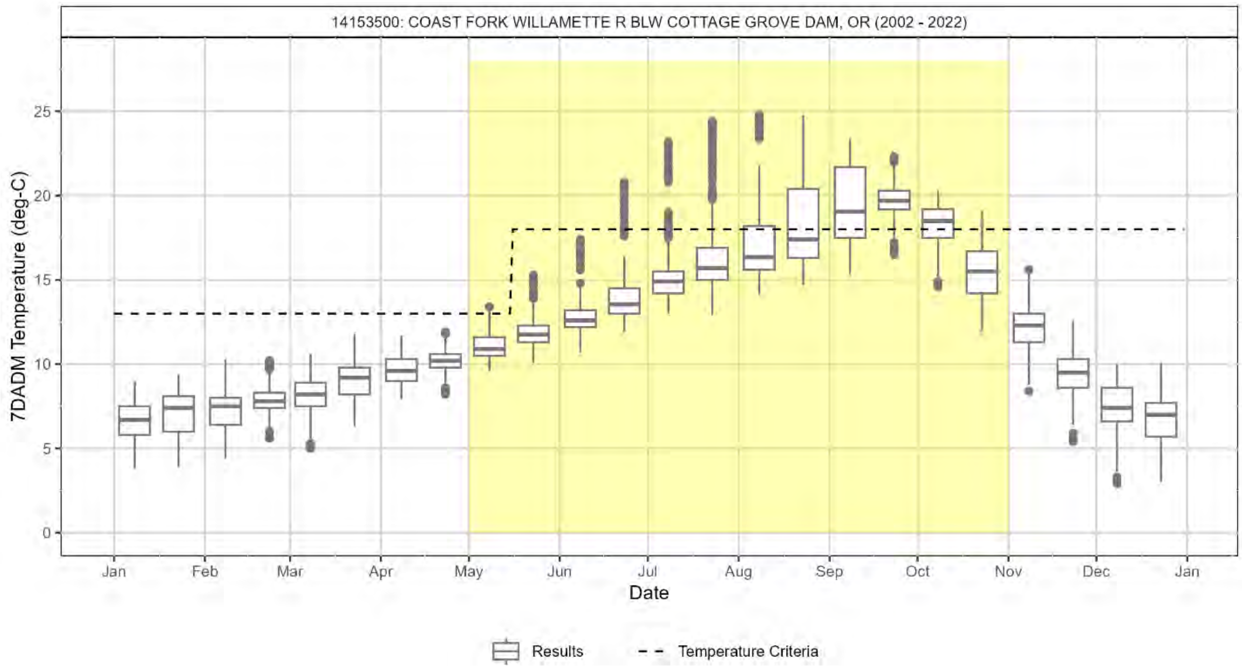
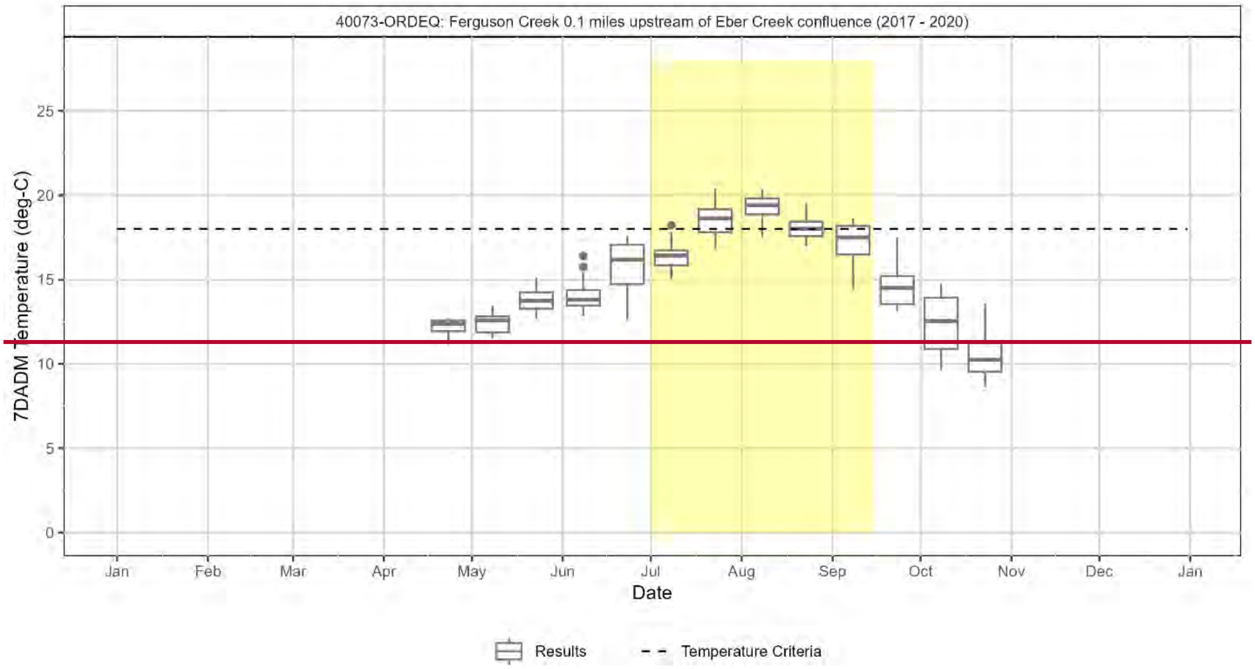


Figure 5-13: Seasonal variation on the Coast Fork Willamette River below Cottage Grove Dam in the Coast Fork Willamette Subbasin.

5.3 Upper Willamette Subbasin seasonal variation



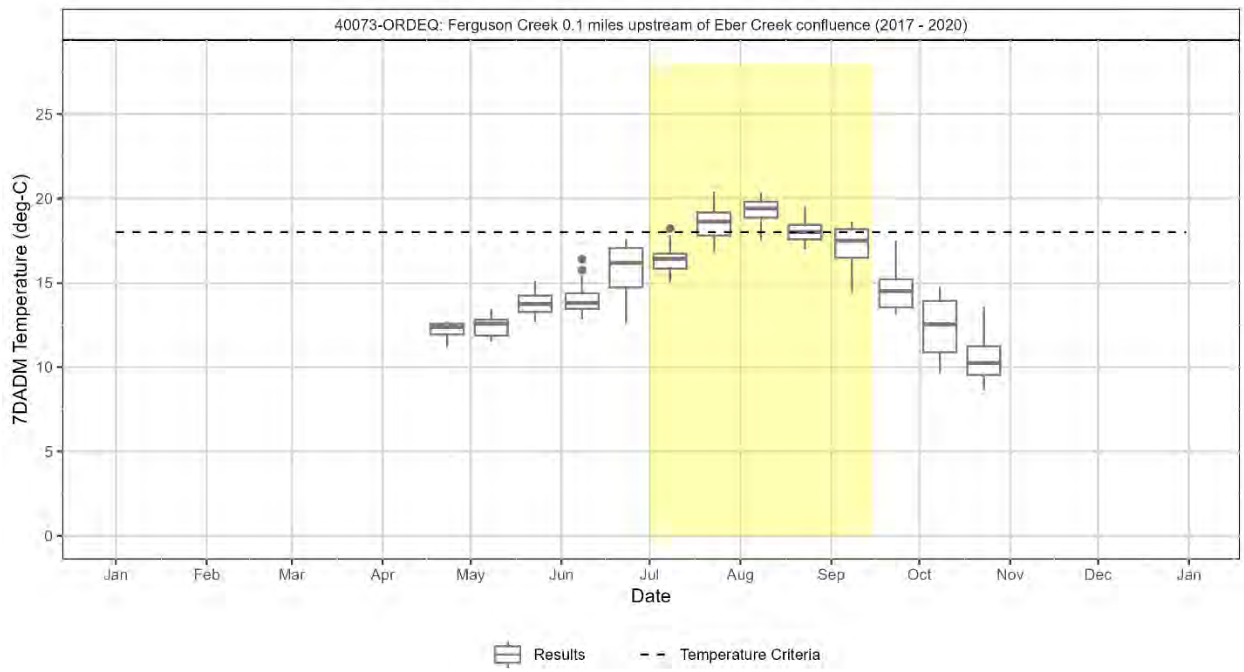


Figure 5-14: Seasonal variation at the Ferguson Creek upstream of Eber Creek confluence temperature monitoring site in the Upper Willamette Subbasin.

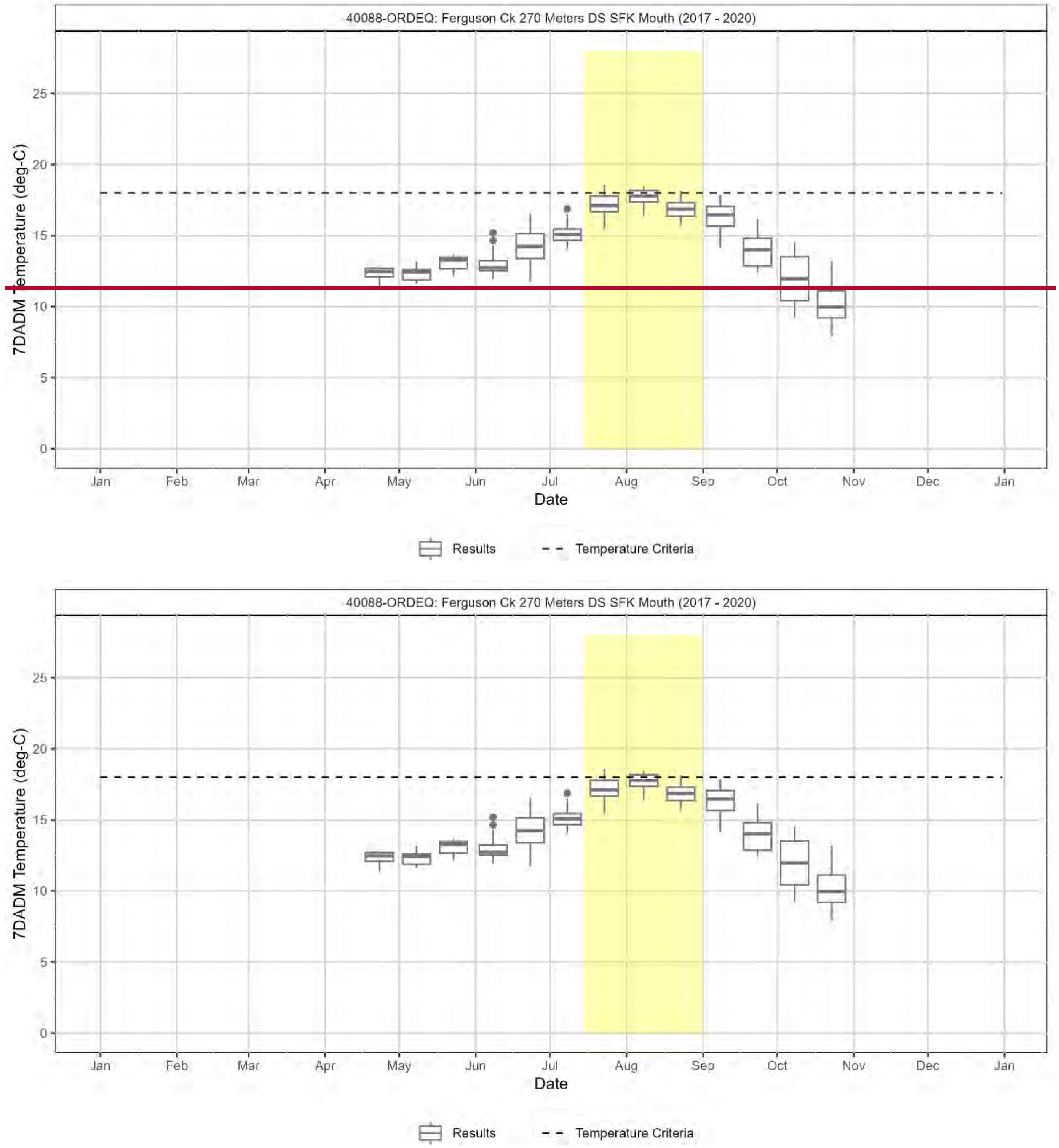


Figure 5-15: Seasonal variation at the Ferguson Creek downstream of South Fork Ferguson Creek temperature monitoring site in the Upper Willamette Subbasin.

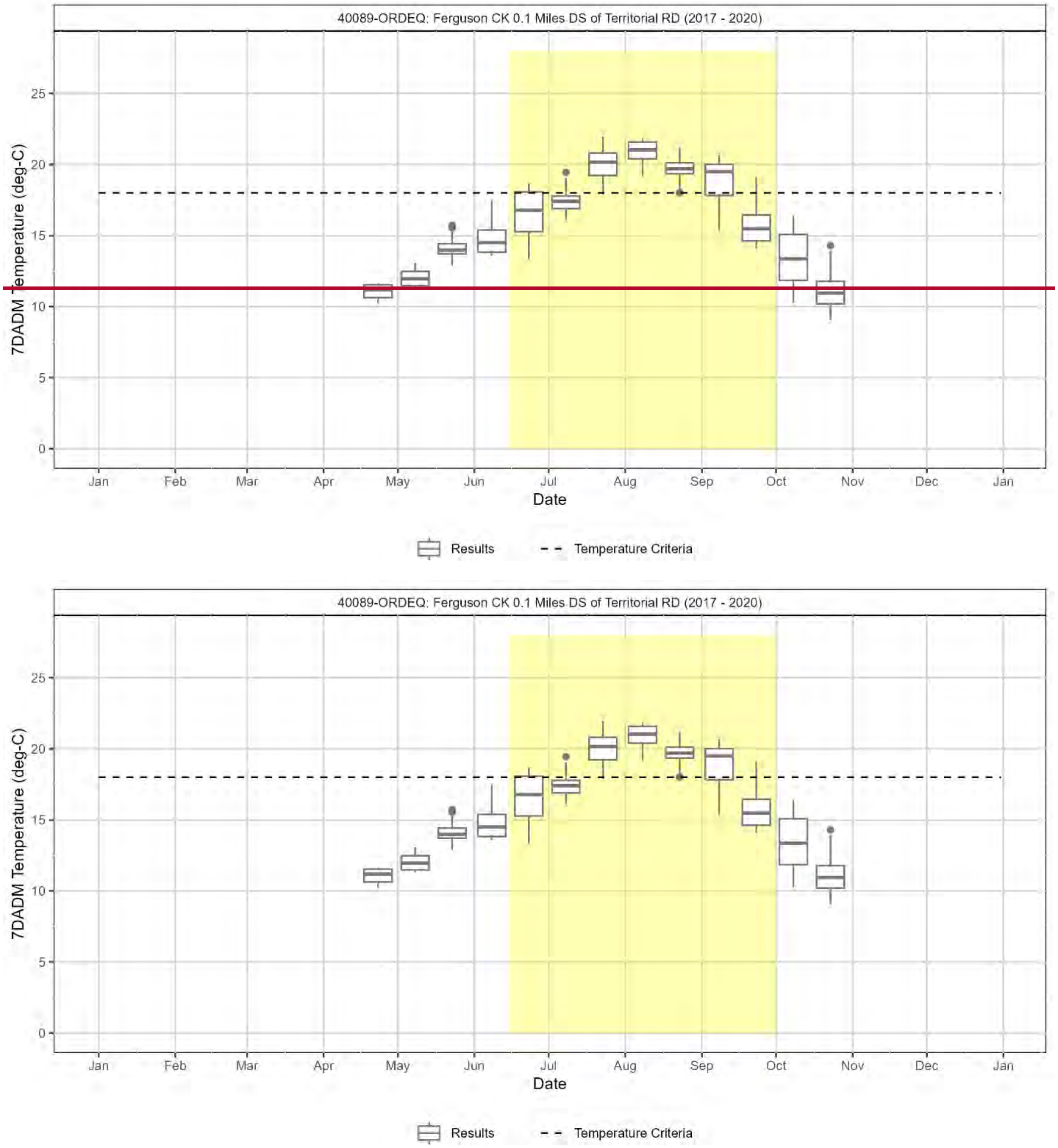


Figure 5-16: Seasonal variation at the Ferguson Creek downstream of Territorial Road temperature monitoring site in the Upper Willamette Subbasin.

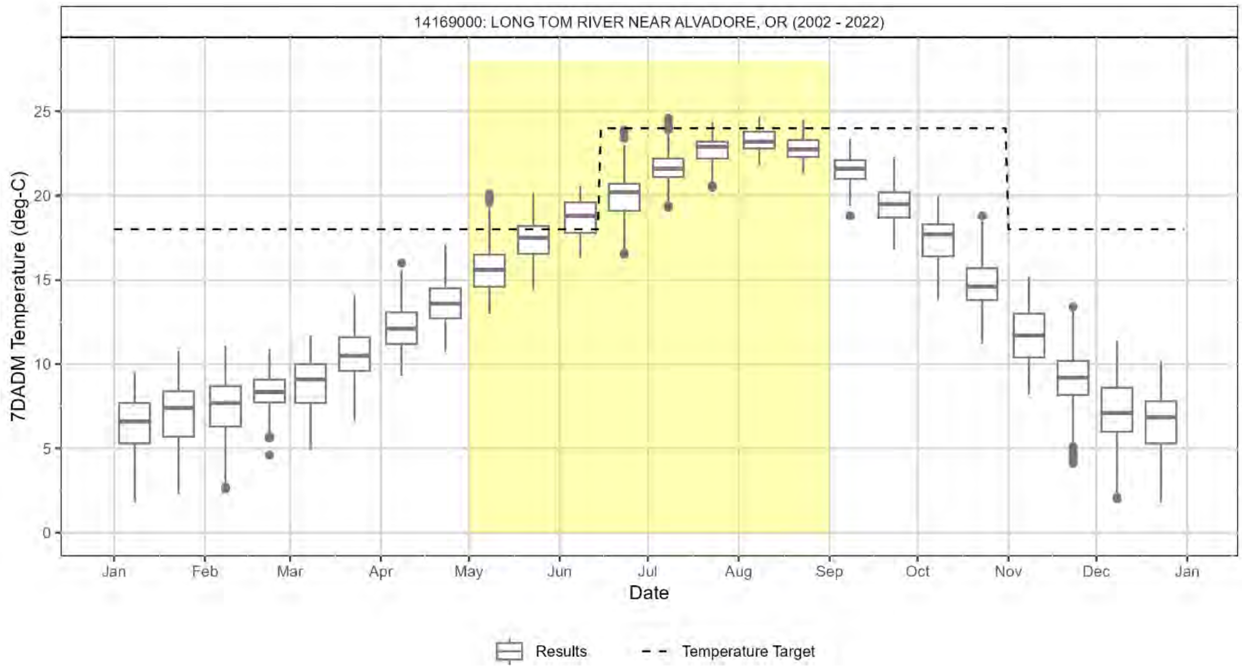


Figure 5-17: Seasonal variation on the Long Tom River near Alvadore, OR in the Upper Willamette Subbasin.

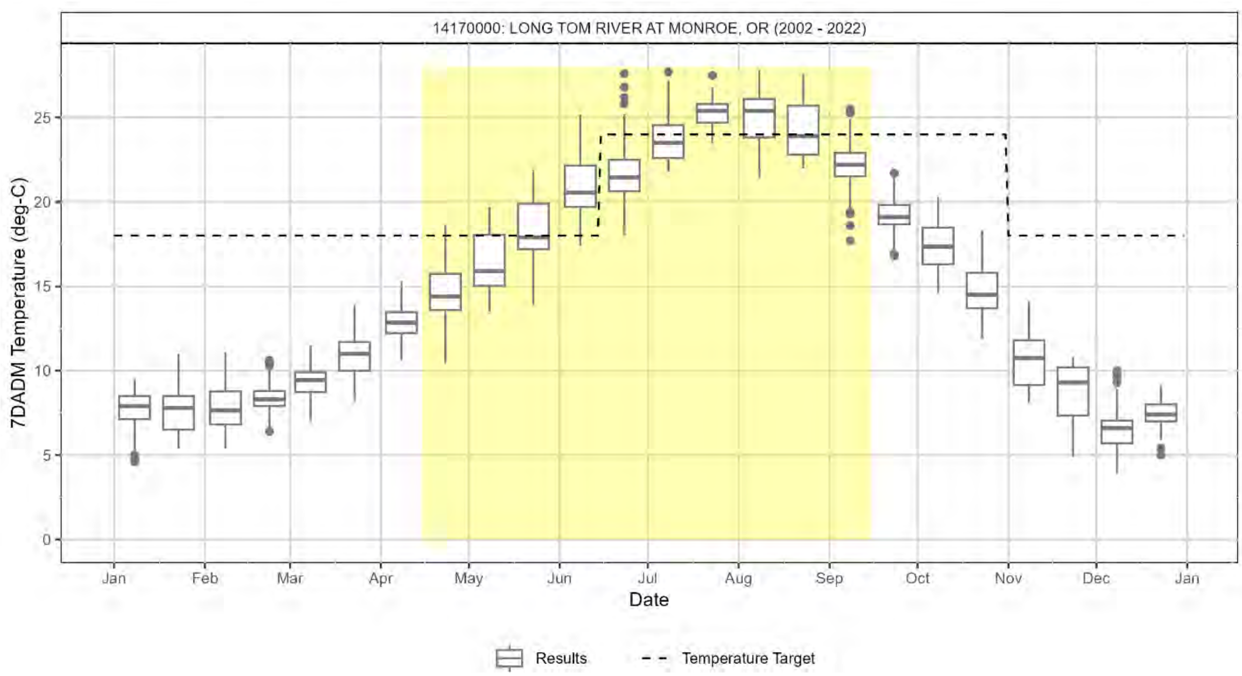
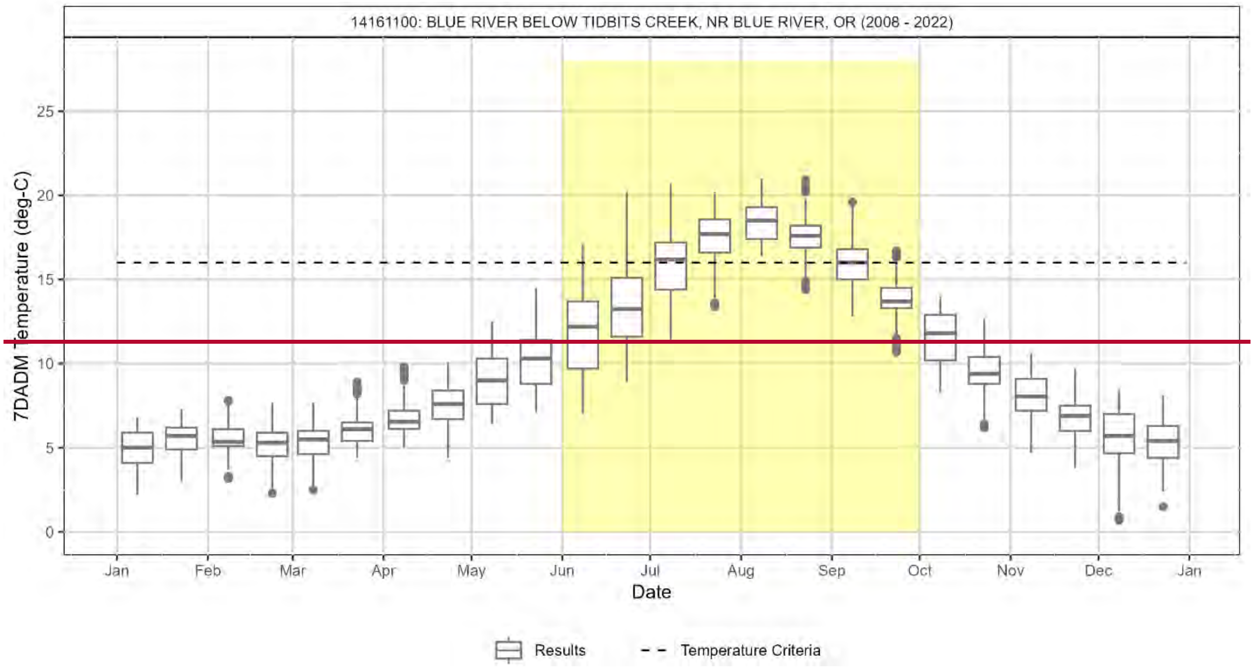


Figure 5-18: Seasonal variation on the Long Tom River at Monroe in the Upper Willamette Subbasin.

5.4 McKenzie Subbasin seasonal variation



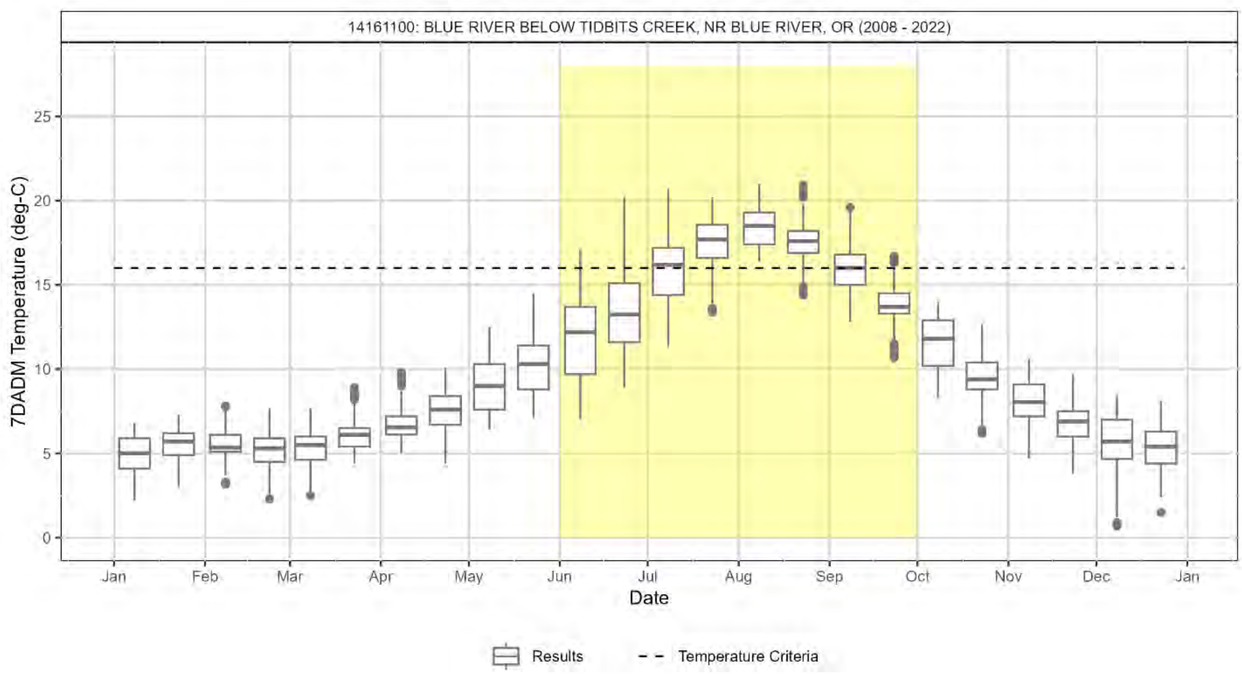
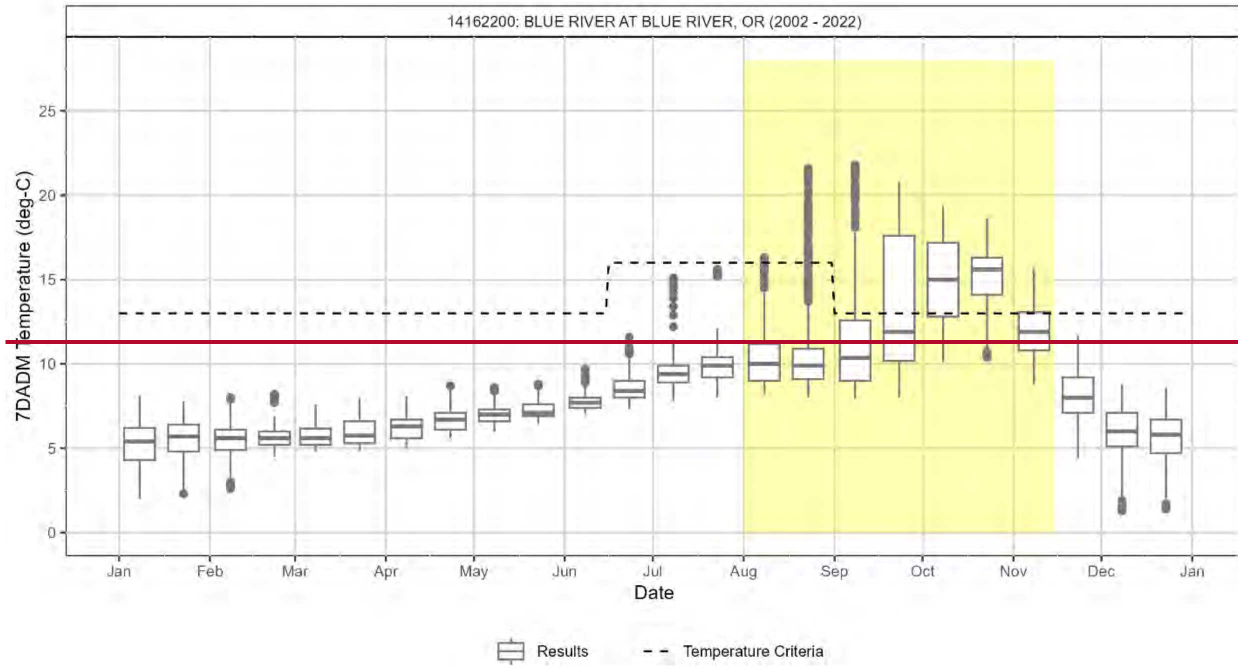


Figure 5-19: Seasonal variation at Blue River below Tidbits Creek, Oregon (upstream of Blue River Dam) in the McKenzie Subbasin.



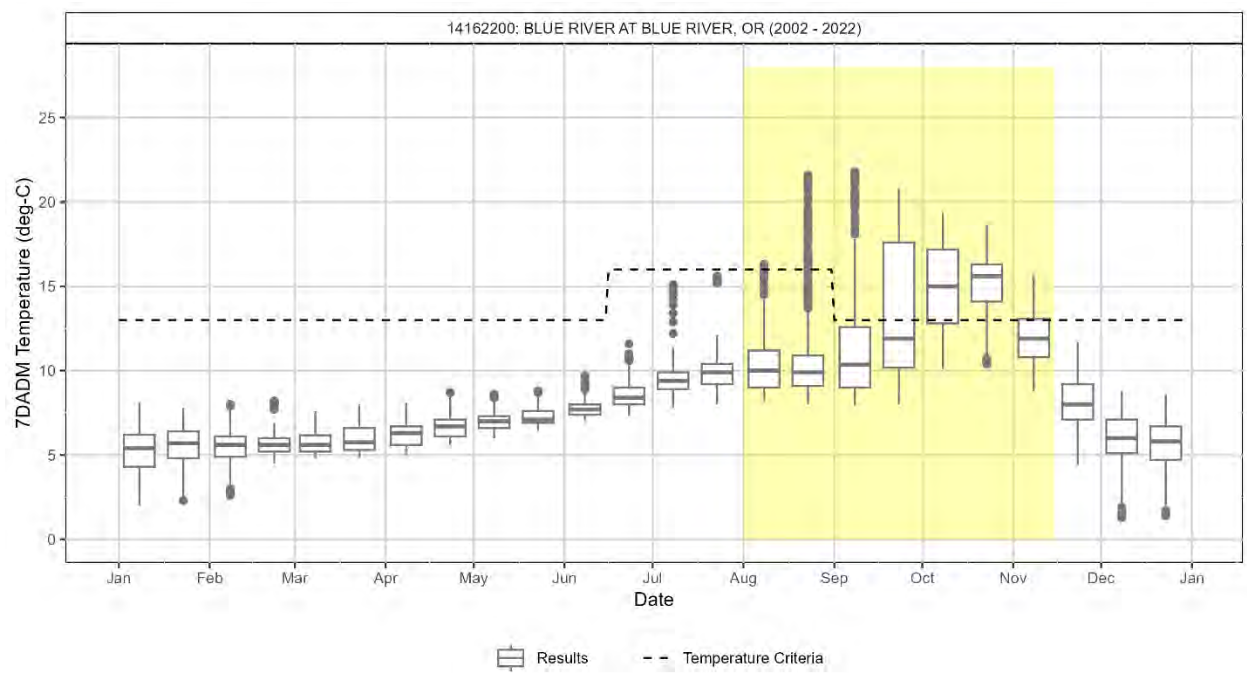


Figure 5-20: Seasonal variation at Blue River at Blue River, Oregon (downstream of Blue River Dam) in the McKenzie Subbasin.

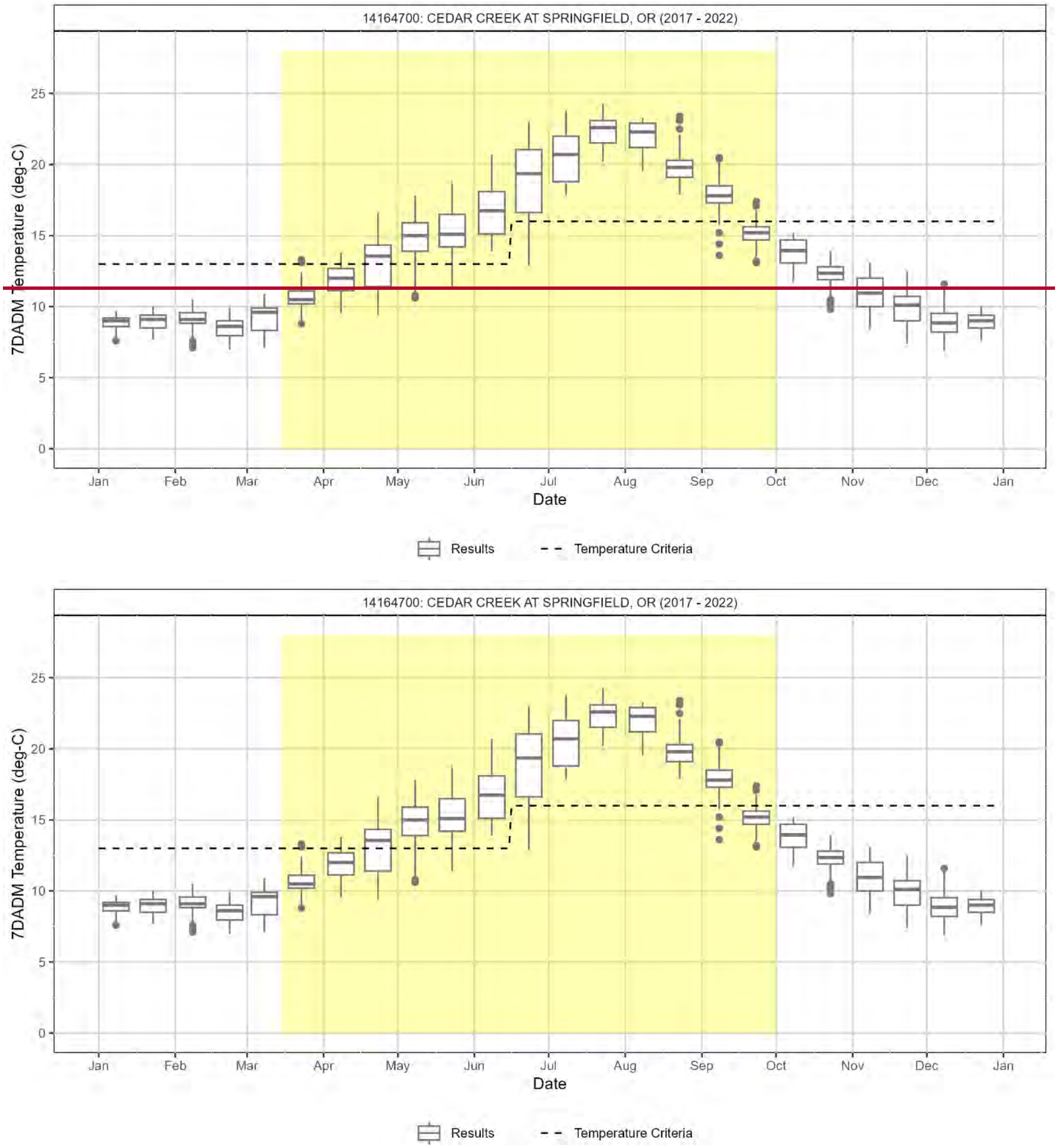
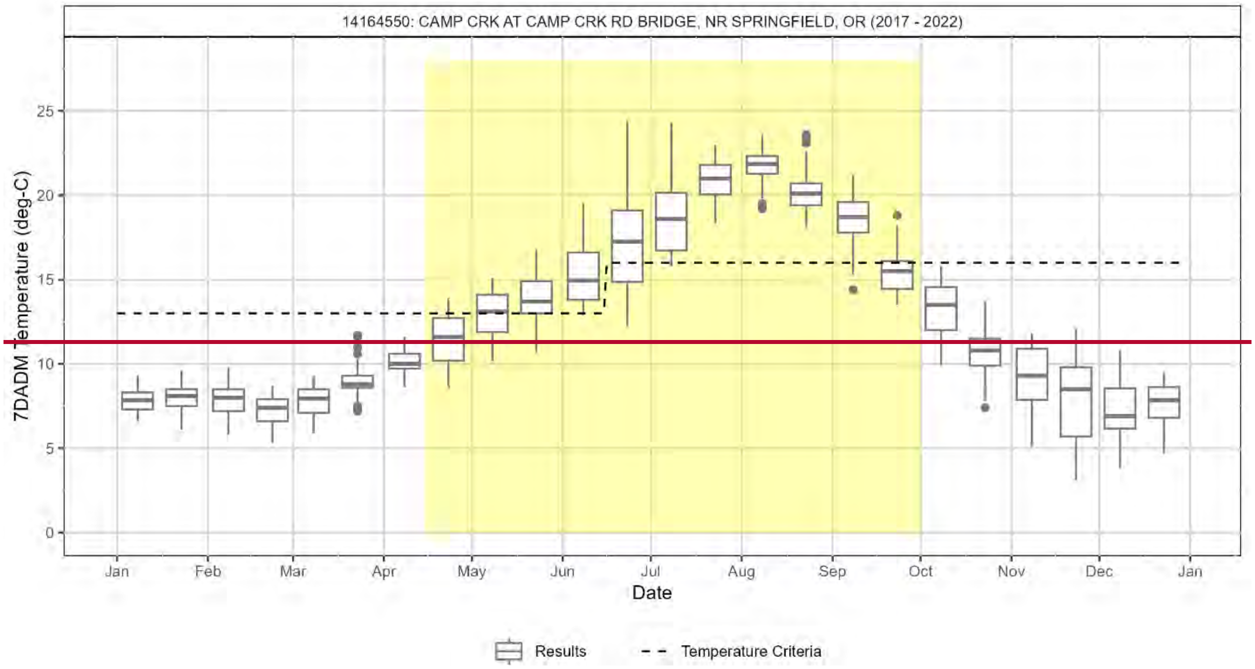


Figure 5-21: Seasonal variation at the Cedar Creek at Springfield, Oregon temperature monitoring site in the McKenzie Subbasin.



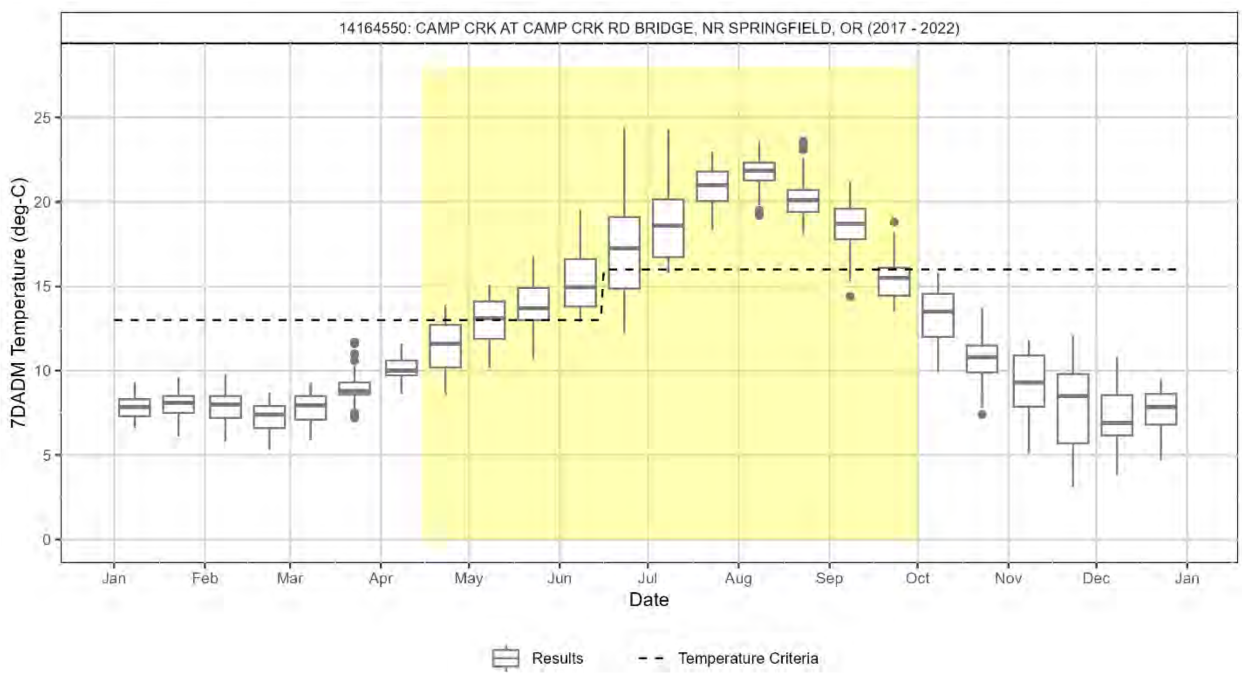
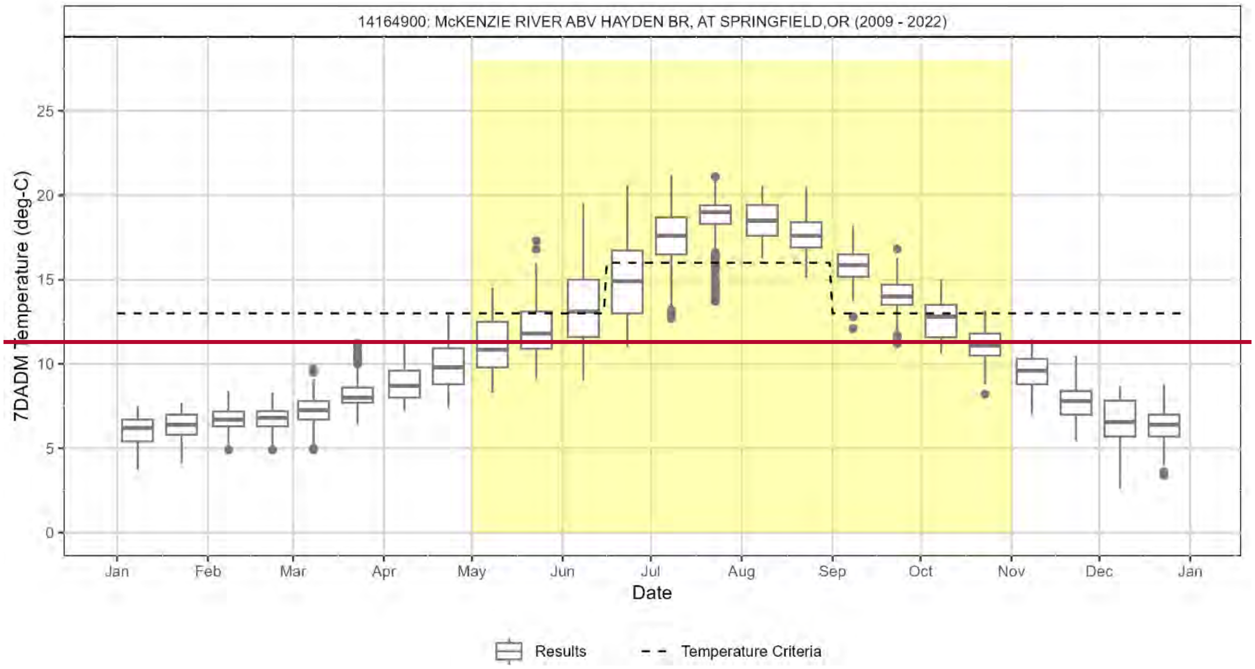


Figure 5-22: Seasonal variation at the Camp Creek at Camp Creek Road Bridge temperature monitoring site in the McKenzie Subbasin.



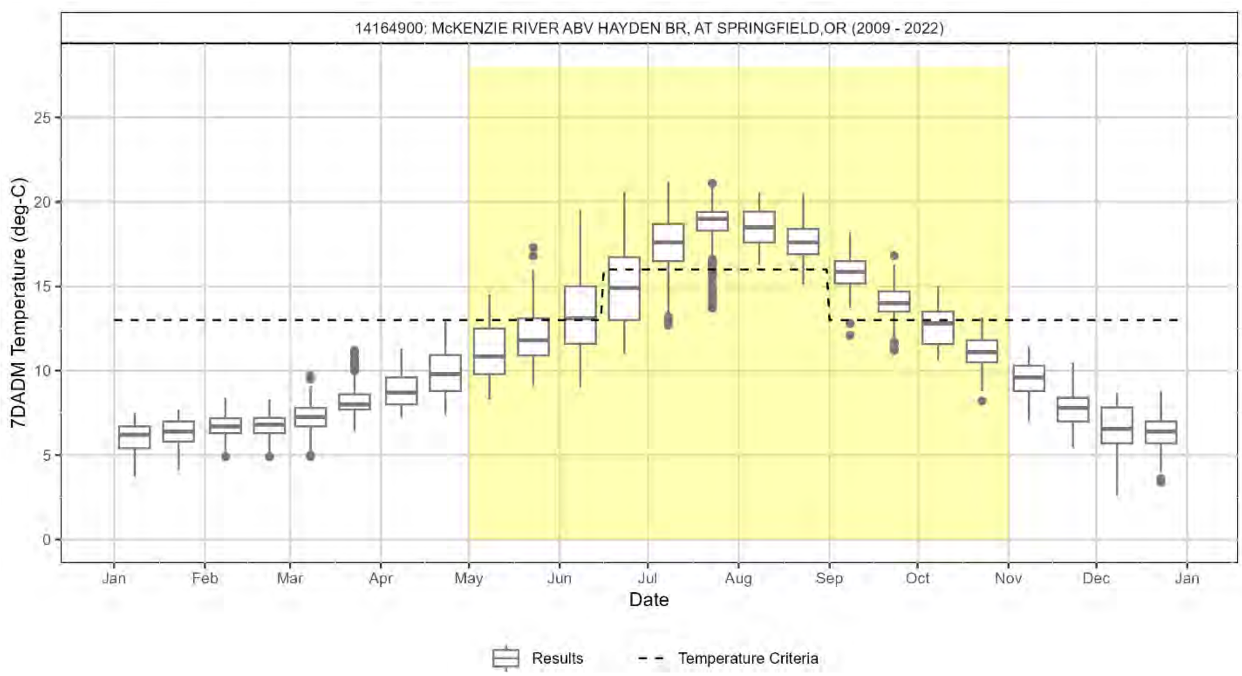
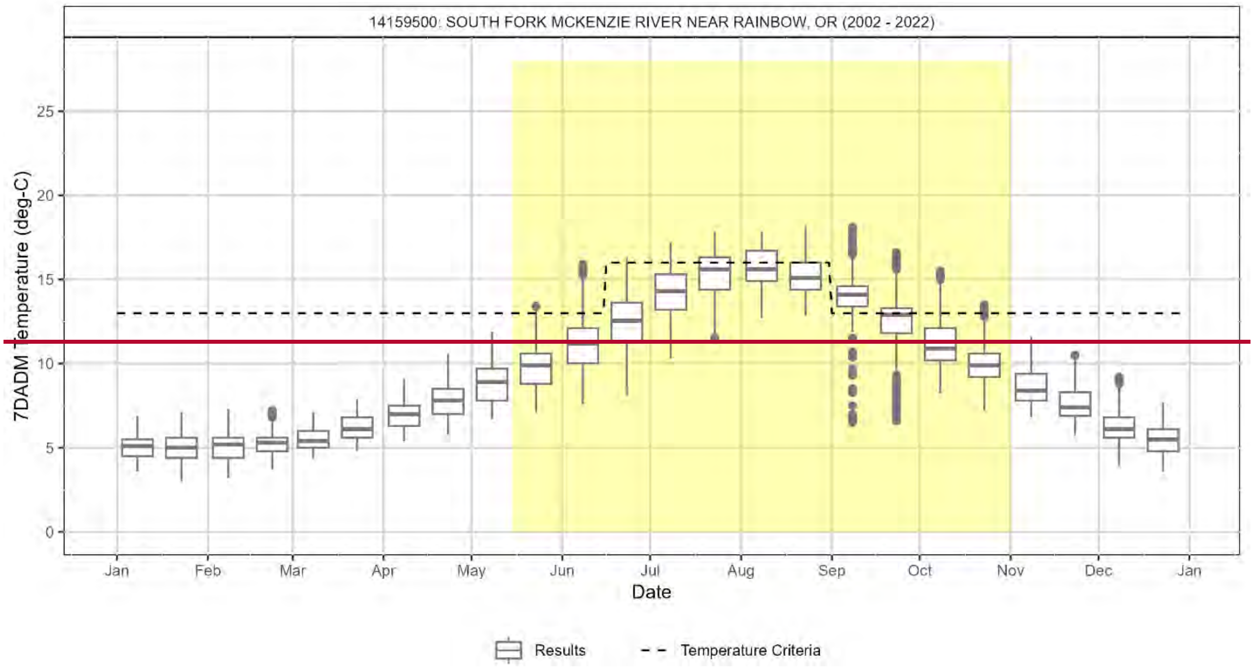


Figure 5-23: Seasonal variation at the McKenzie River above Hayden Bridge temperature monitoring site in the McKenzie Subbasin.



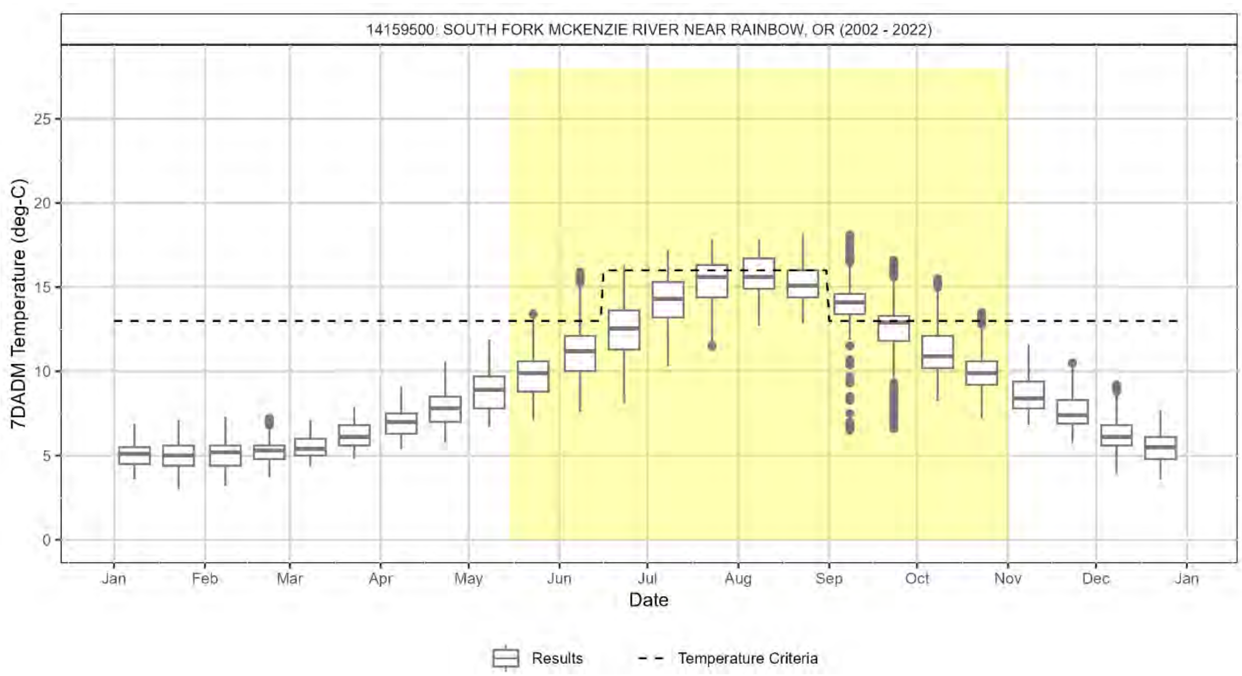
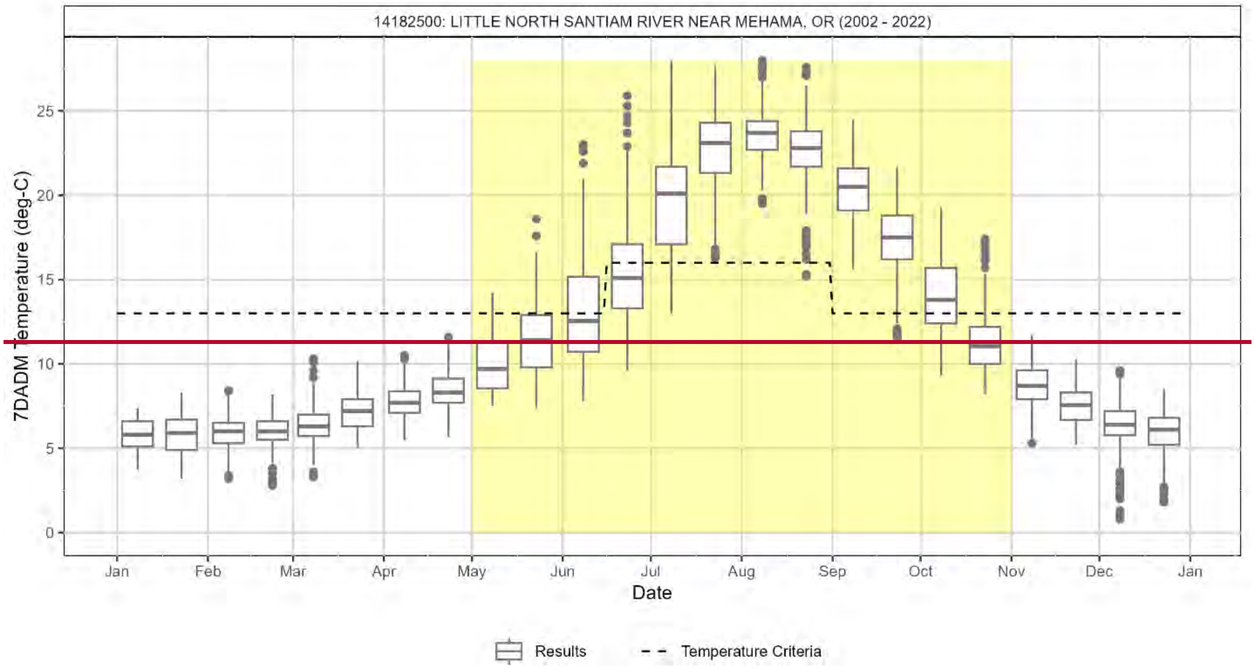


Figure 5-24: Seasonal variation on the South Fork McKenzie River near Rainbow temperature monitoring site in the McKenzie Subbasin.

5.5 North Santiam Subbasin seasonal variation



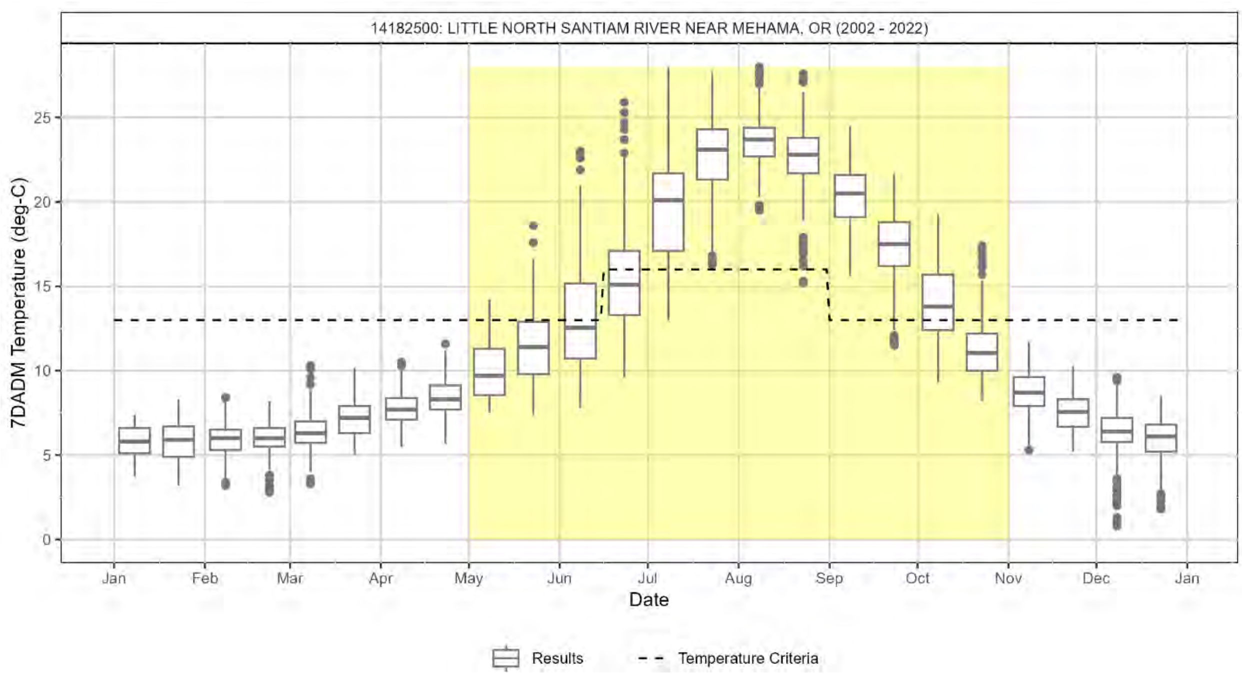
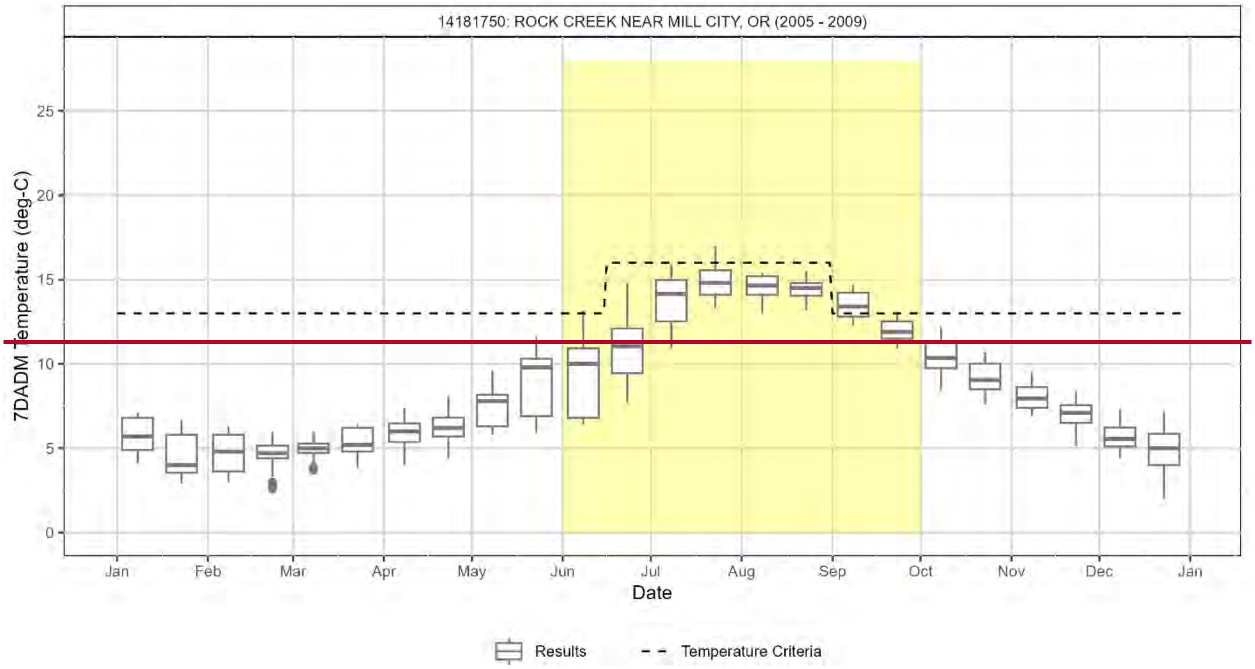


Figure 5-25: Seasonal variation at the Little North Santiam River near Mehama, Oregon temperature monitoring site in the North Santiam Subbasin.



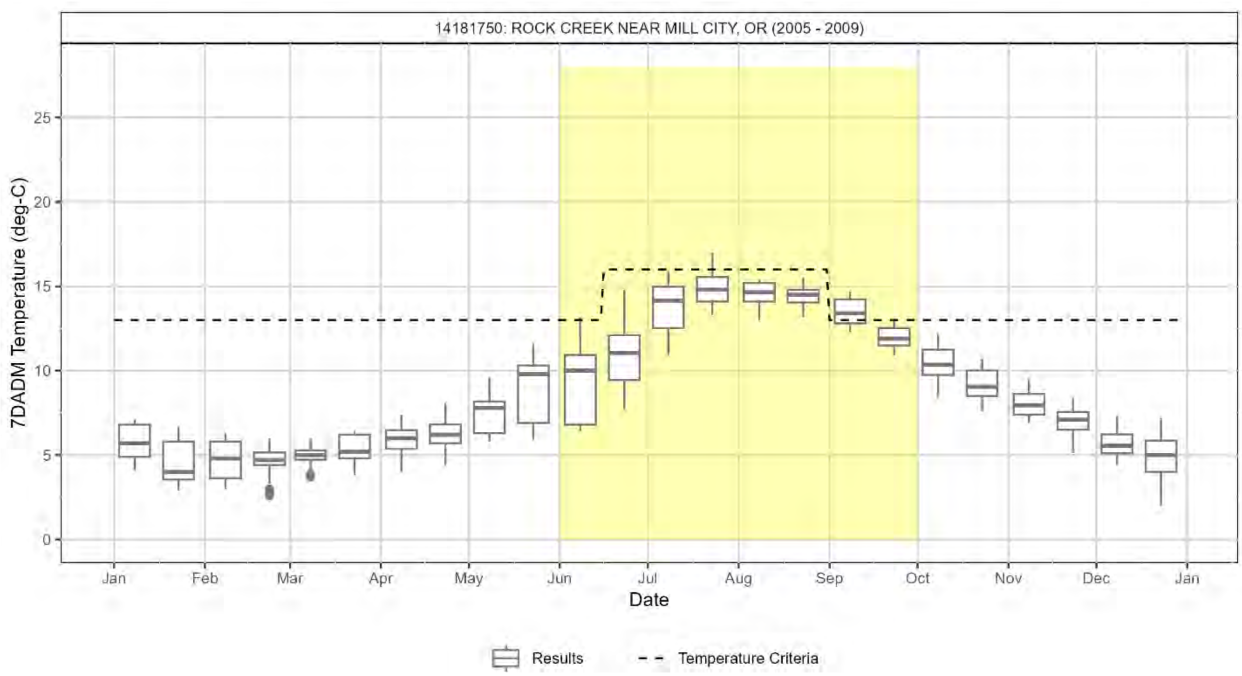


Figure 5-26: Seasonal variation at the Rock Creek near Mill City, Oregon monitoring site in the North Santiam Subbasin.

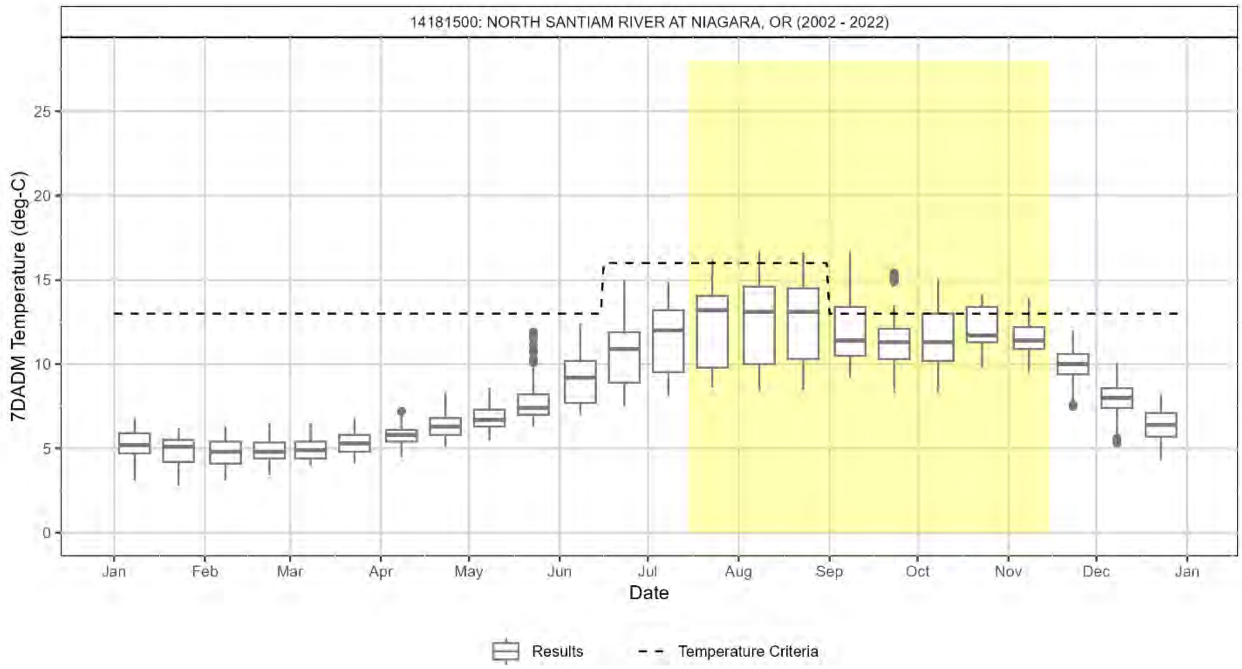


Figure 5-27: Seasonal variation on the North Santiam River at Niagara, Oregon in the North Santiam Subbasin.

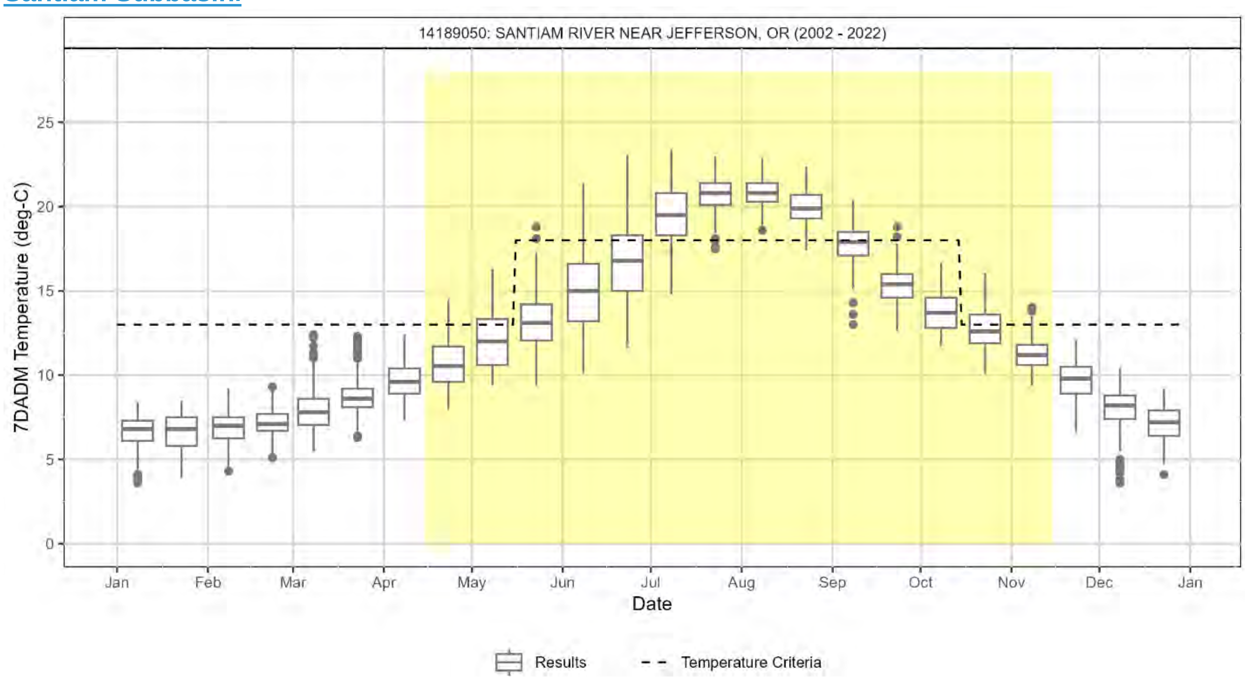
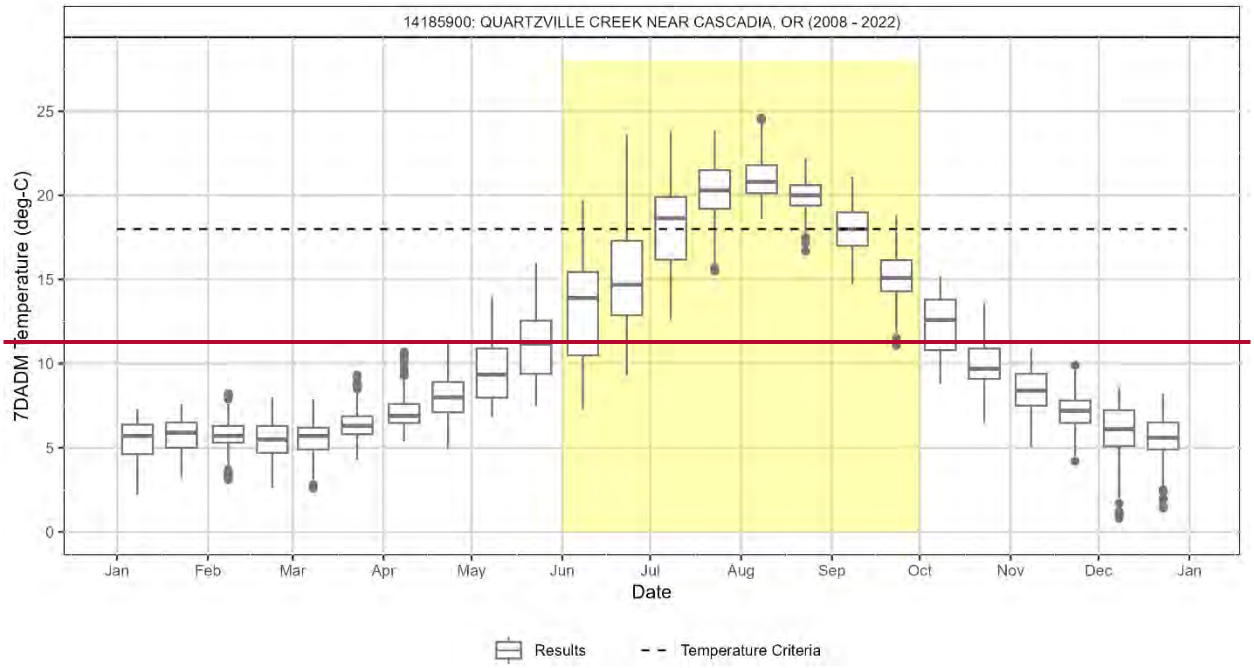


Figure 5-28: Seasonal variation on the Santiam River near Jefferson, Oregon in the North Santiam Subbasin.

5.6 South Santiam Subbasin seasonal variation



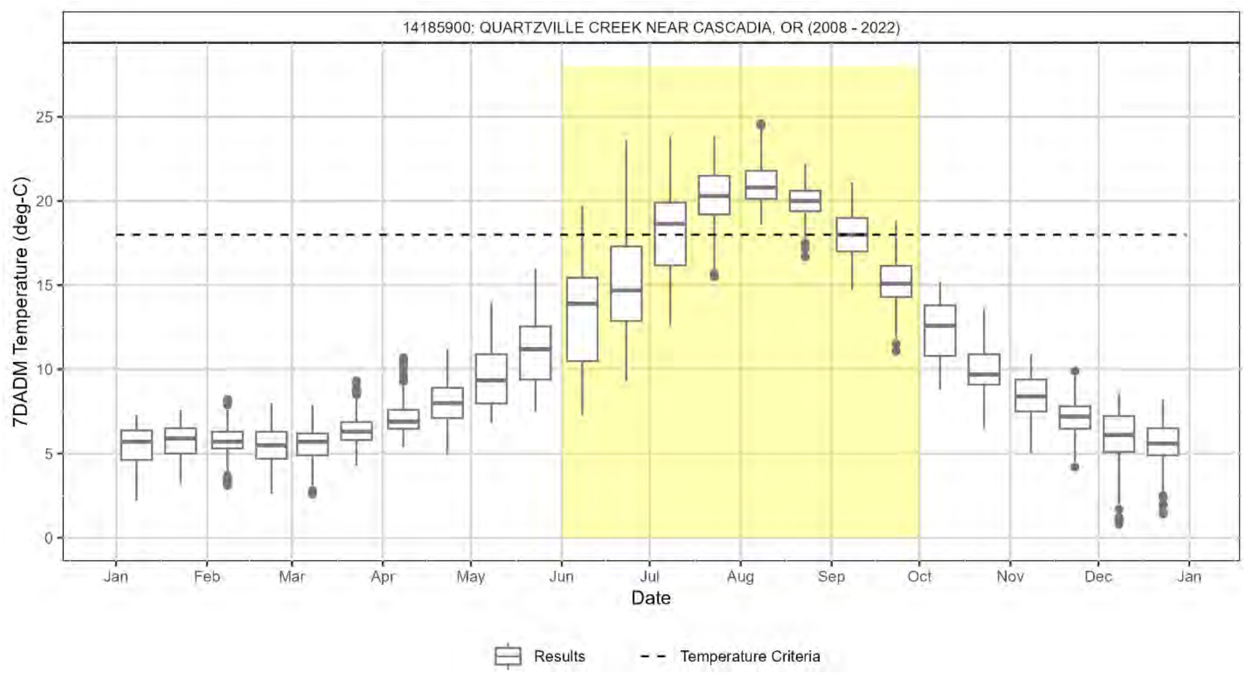
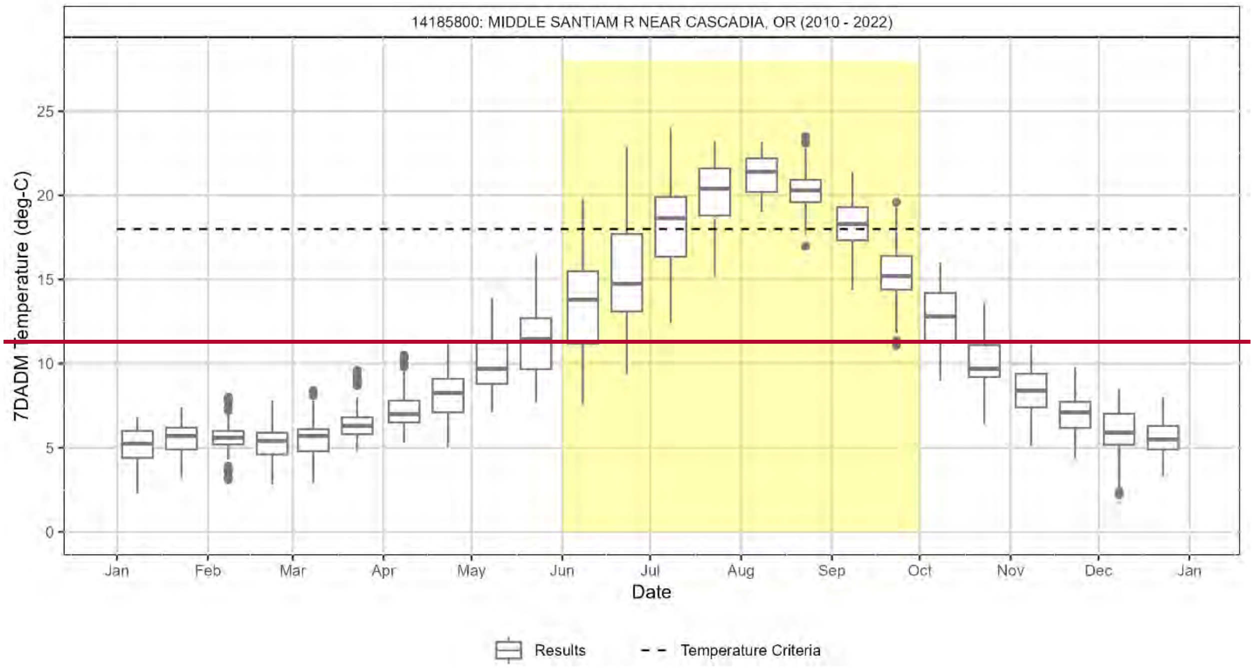


Figure 5-29: Seasonal variation at the Quartzville Creek Near Cascadia monitoring site (upstream of Green Peter Dam) in the South Santiam Subbasin.



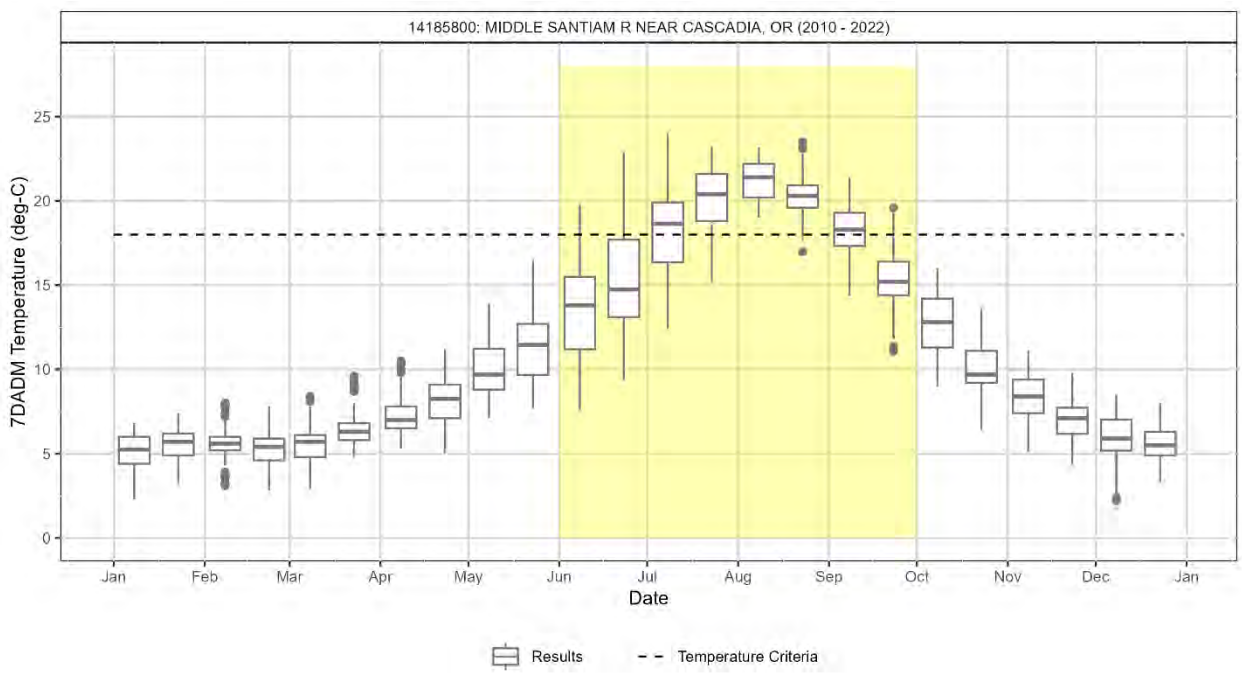
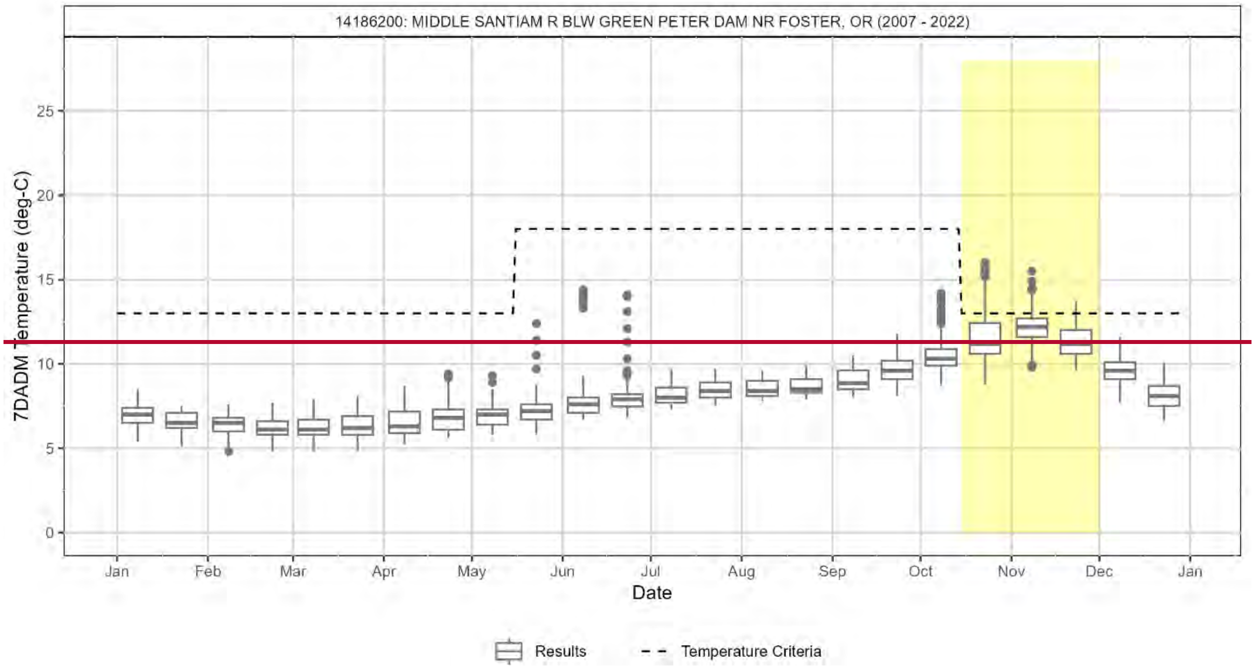


Figure 5-30: Seasonal variation at the Middle Santiam River Near Cascadia monitoring site (upstream of Green Peter Dam) in the South Santiam Subbasin.



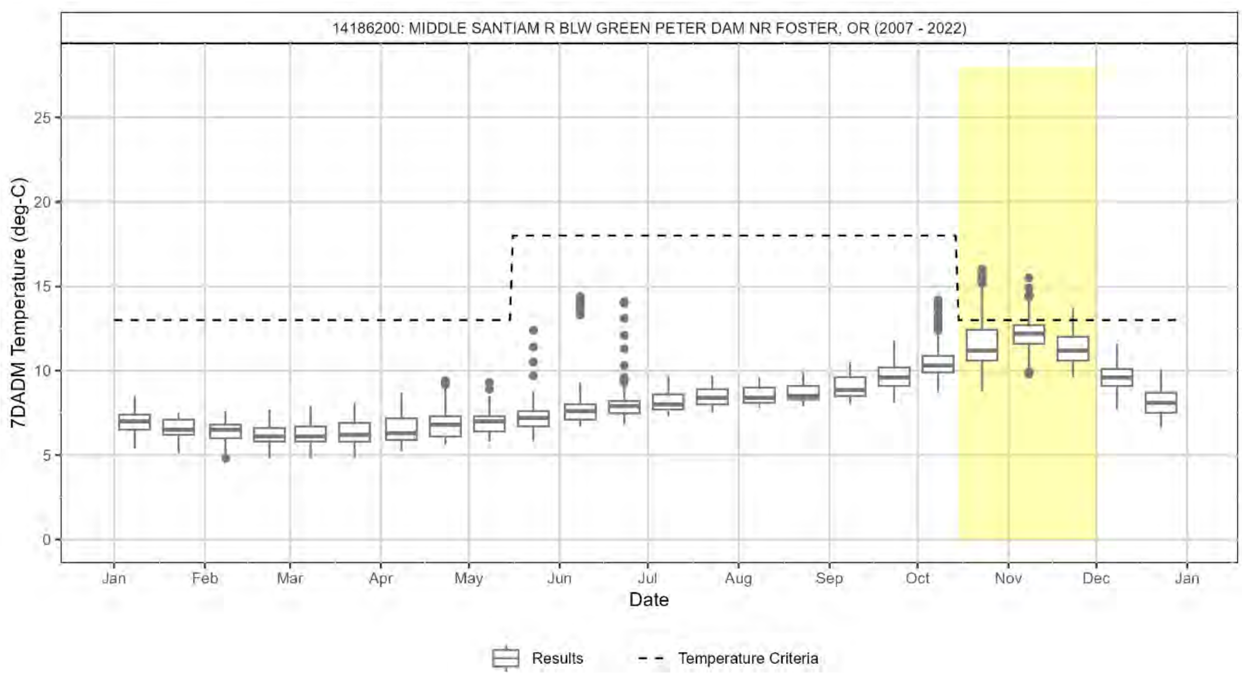


Figure 5-31: Seasonal variation at the Middle Santiam River below Green Peter Dam monitoring site in the South Santiam Subbasin.

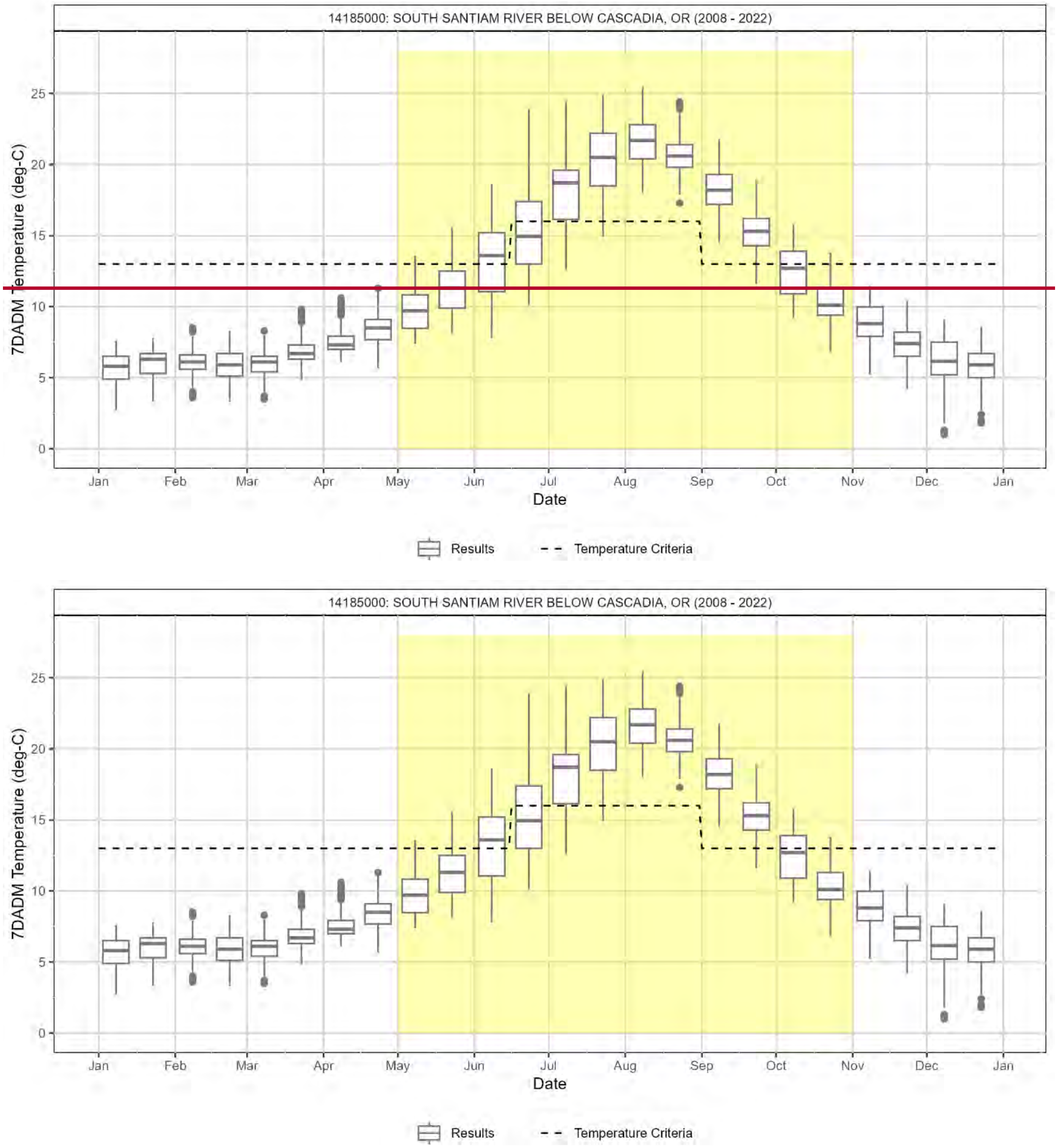


Figure 5-32: Seasonal variation at the South Santiam River below Cascadia, Oregon monitoring site in the South Santiam Subbasin.

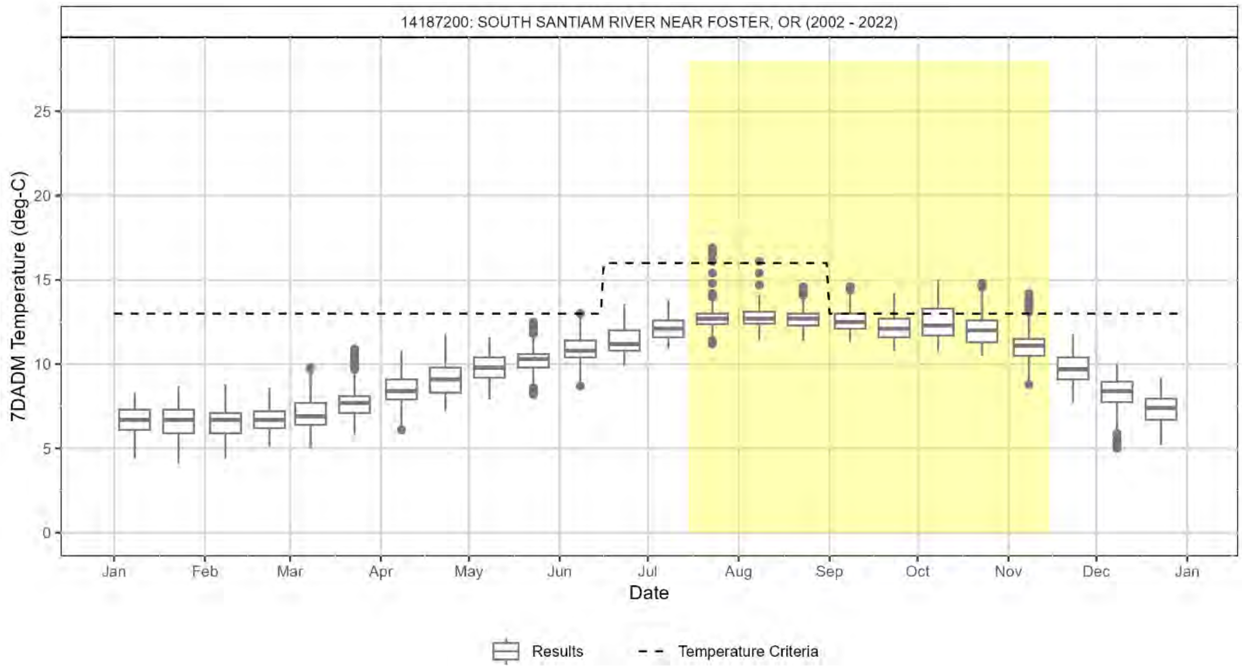
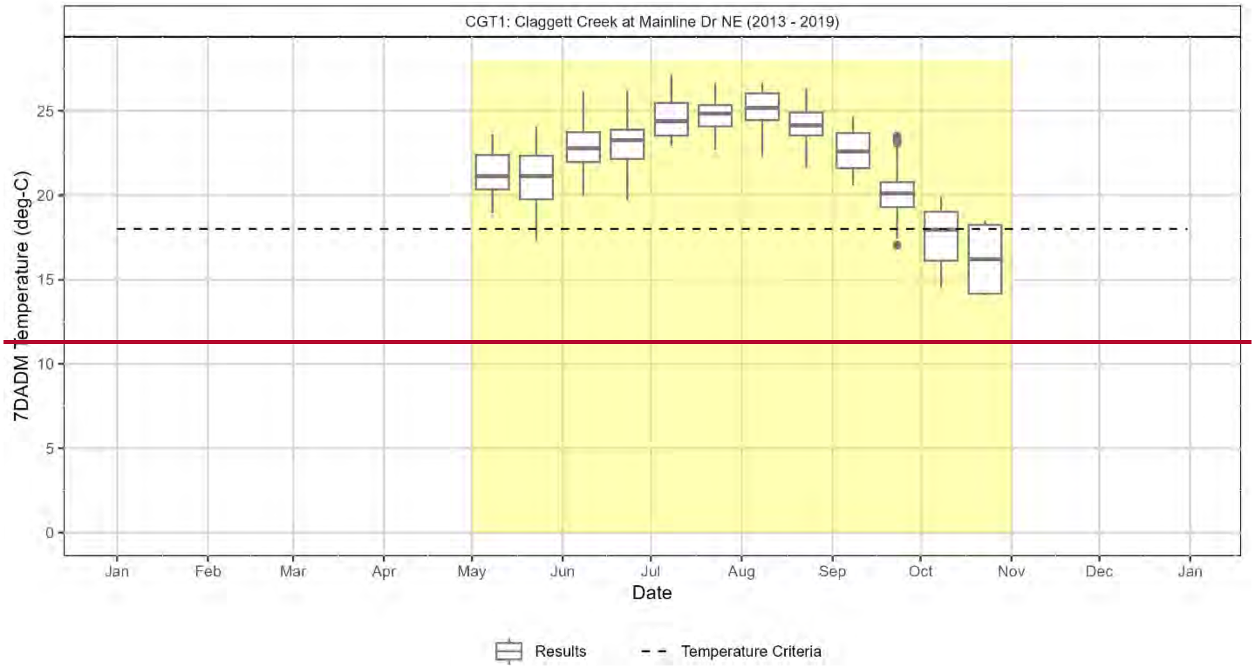


Figure 5-33: Seasonal variation on the South Santiam near Foster, Oregon (below Foster Dam) in the South Santiam Subbasin.

5.7 Middle Willamette Subbasin seasonal variation



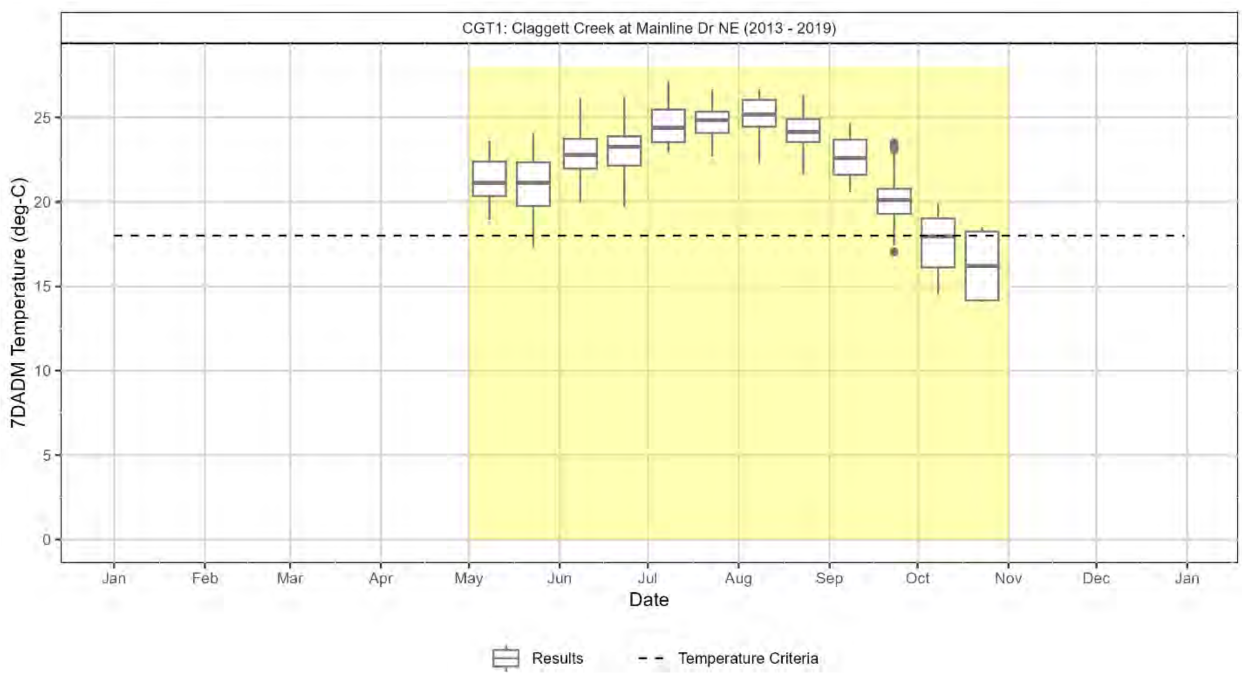


Figure 5-34: Seasonal variation at the Claggett Creek at Mainline Drive temperature monitoring site in the Middle Willamette Subbasin.

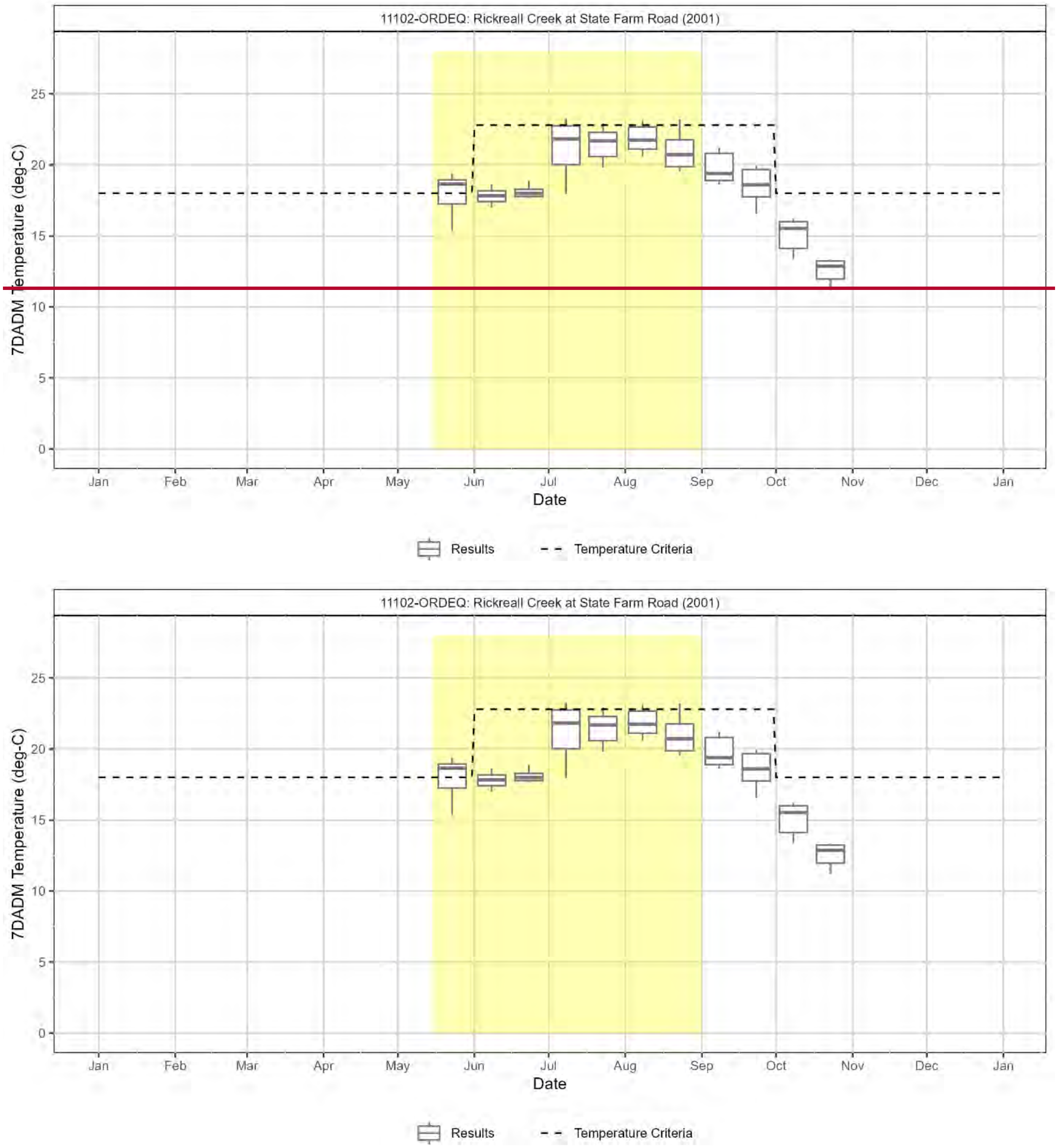


Figure 5-35: Seasonal variation at the Rickreall Creek at State Farm Road temperature monitoring site in the Middle Willamette Subbasin.

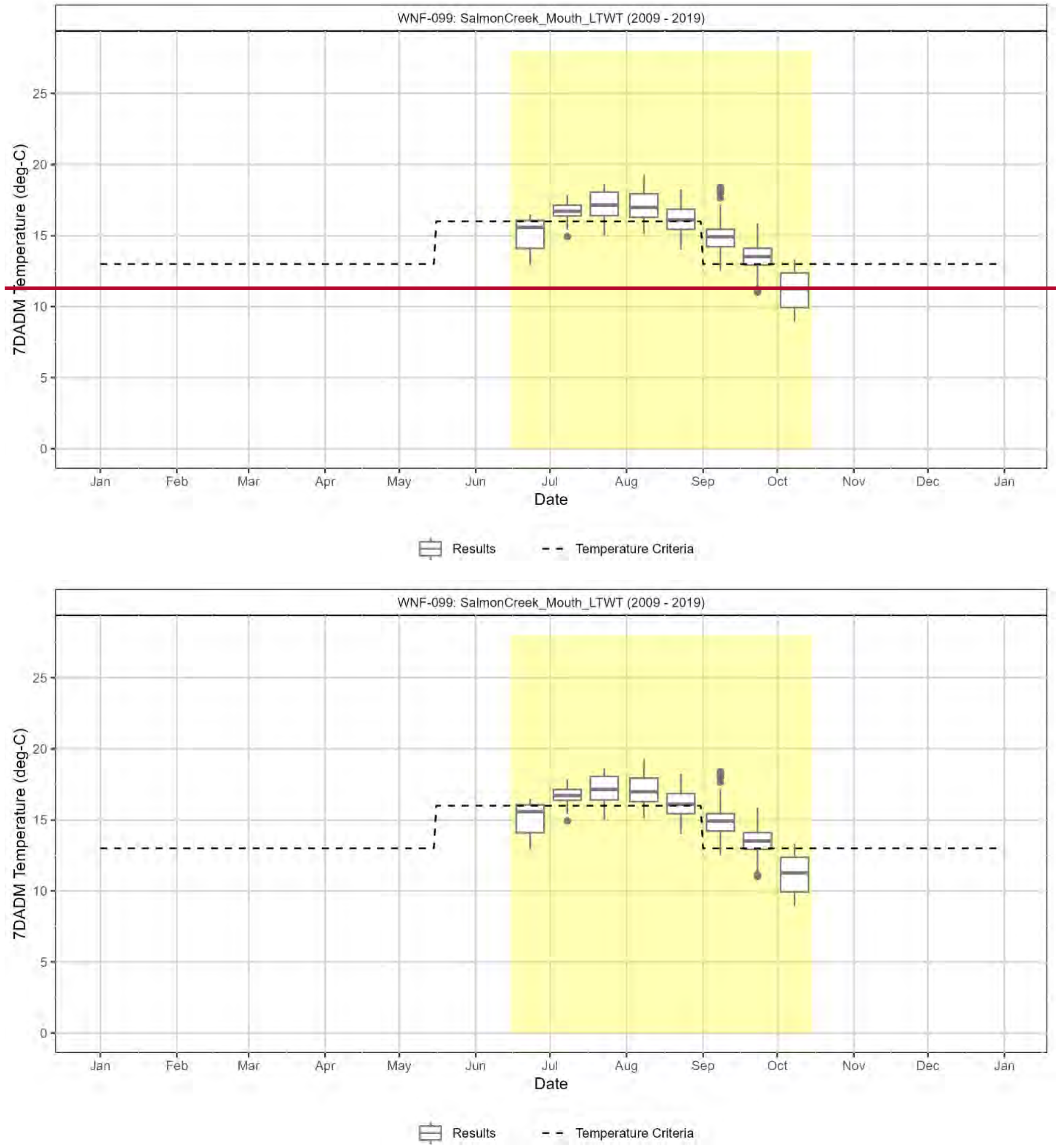
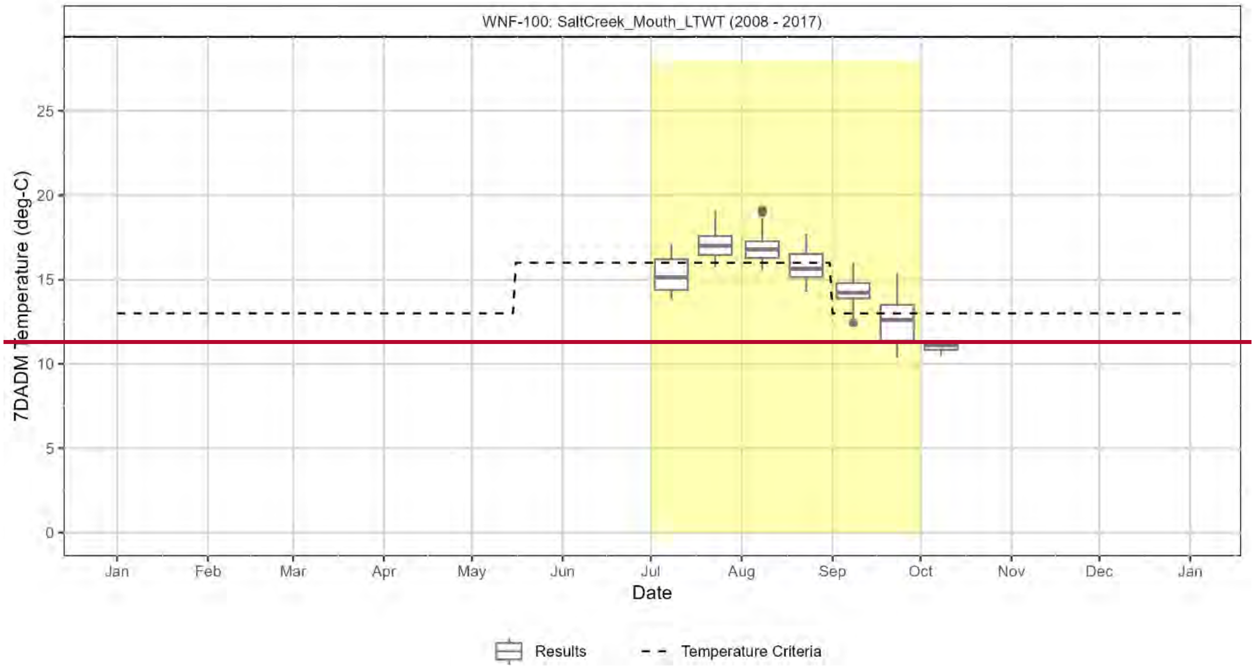


Figure 5-36: Seasonal variation at the Salmon Creek at mouth temperature monitoring site in the Middle Fork Willamette Subbasin.



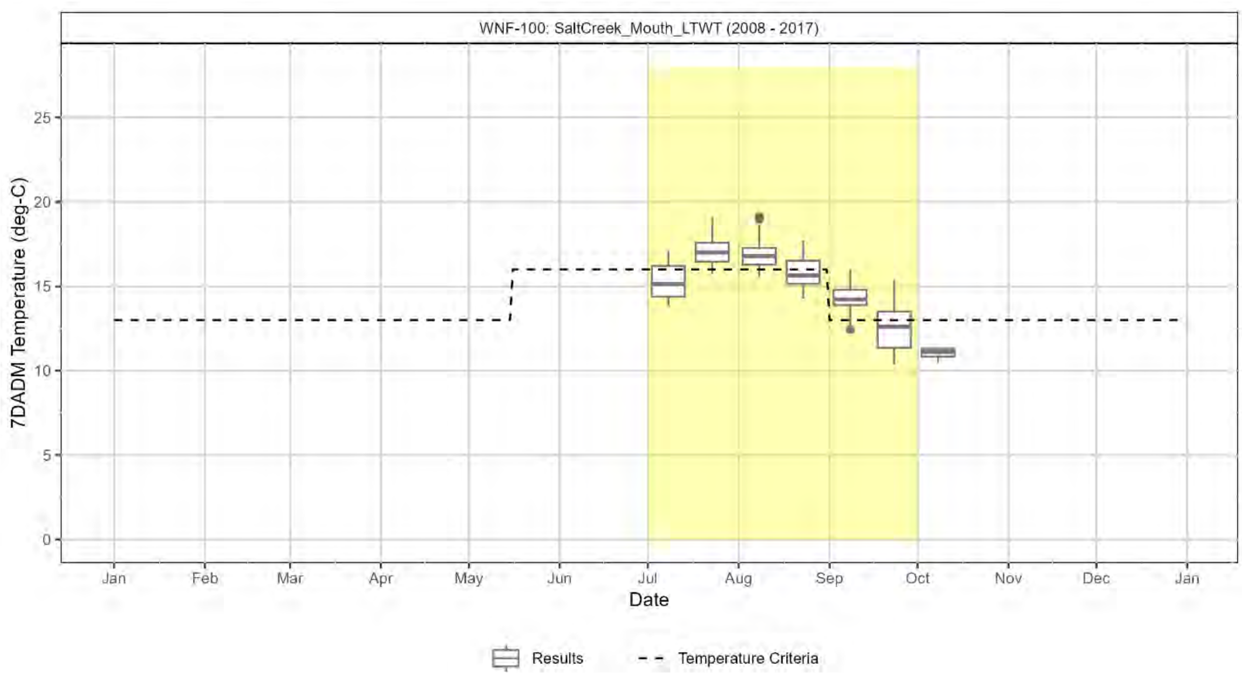
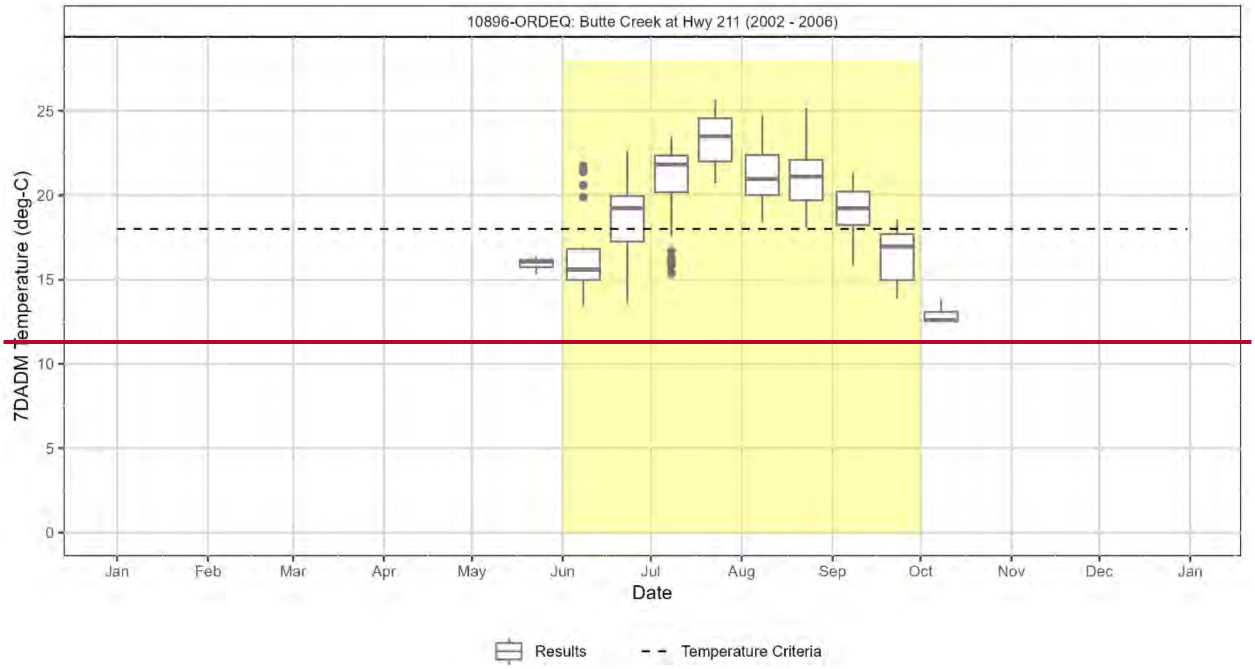


Figure 5-37: Seasonal variation at the Salt Creek at mouth temperature monitoring site in the Middle Fork Willamette Subbasin.

5.8 Molalla-Pudding Subbasin seasonal variation



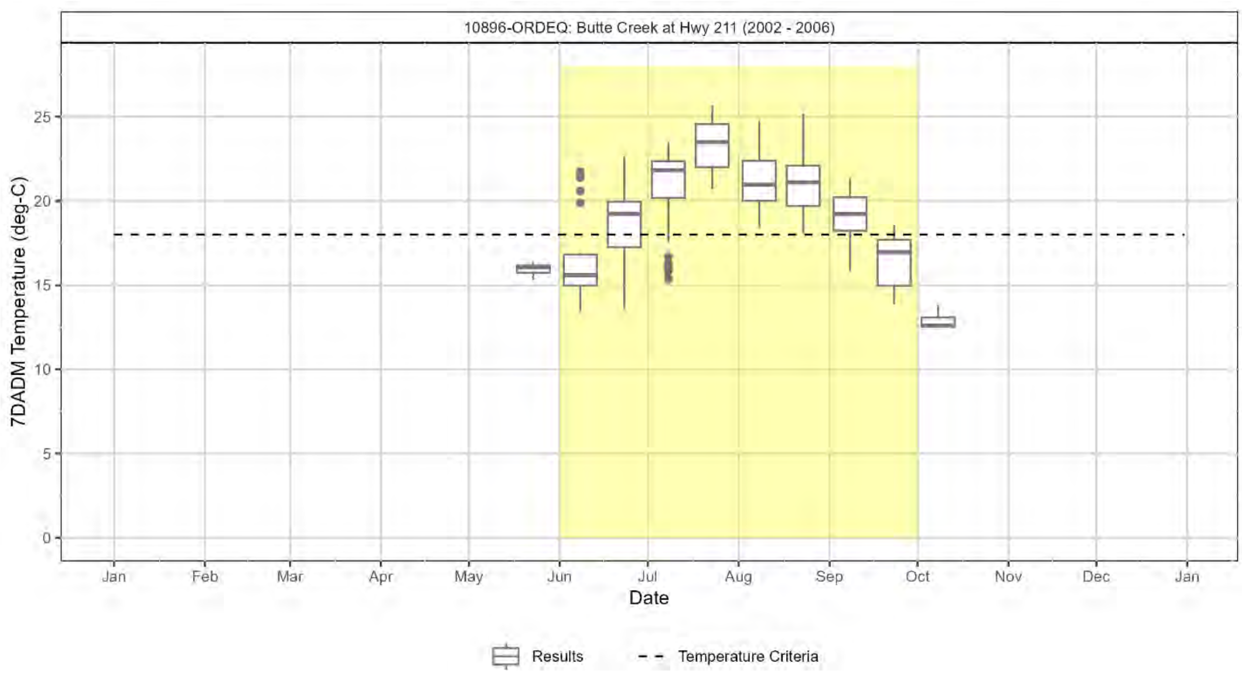
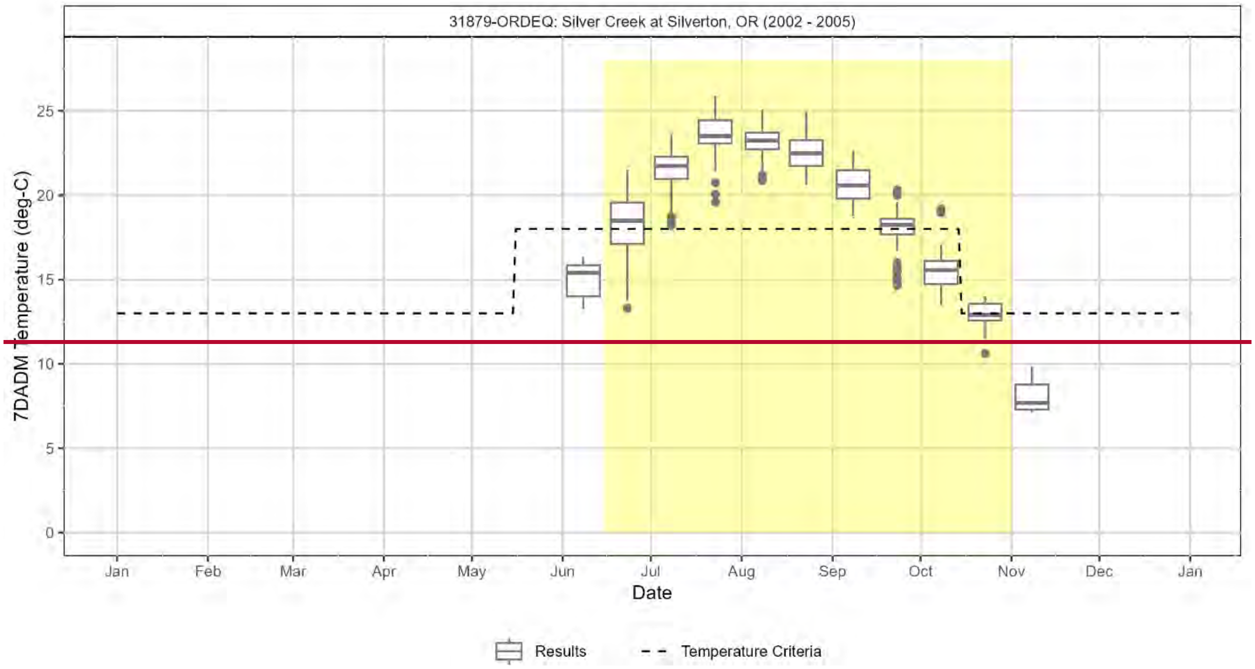


Figure 5-38: Seasonal variation at the Butte Creek at Highway 211 temperature monitoring site in the Molalla-Pudding Subbasin.



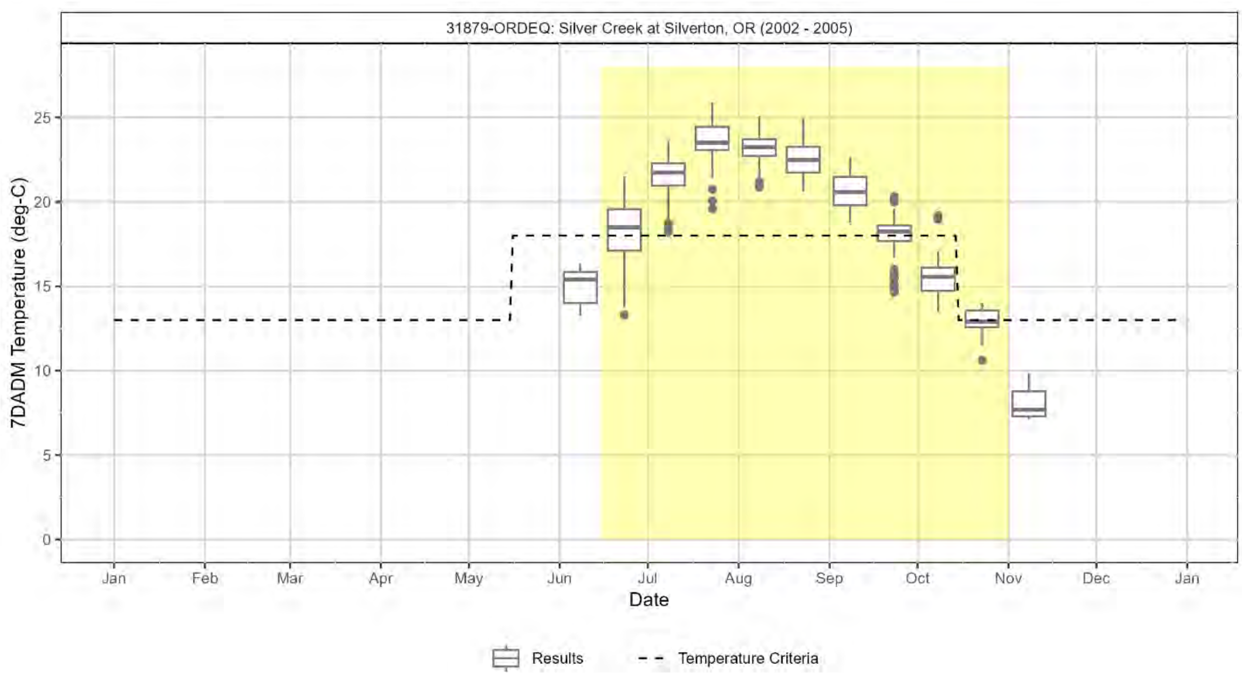
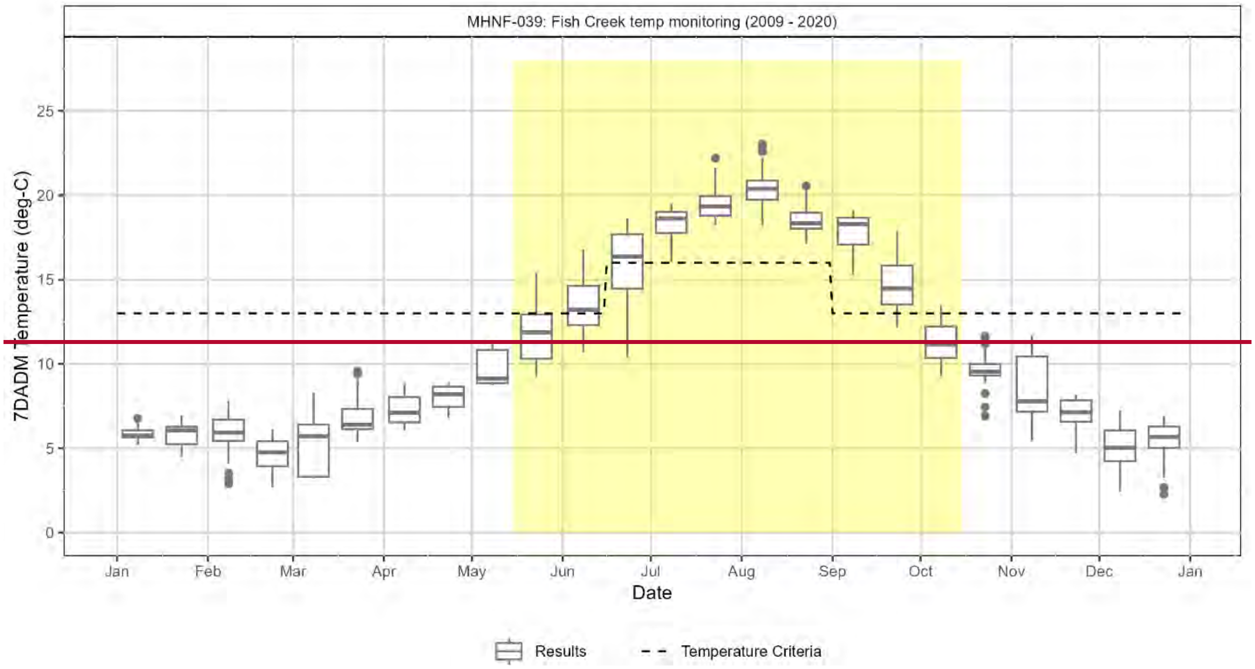


Figure 5-39: Seasonal variation at the Silver Creek at Silverton, Oregon temperature monitoring site in the Molalla-Pudding Subbasin.

5.9 Clackamas Subbasin seasonal variation



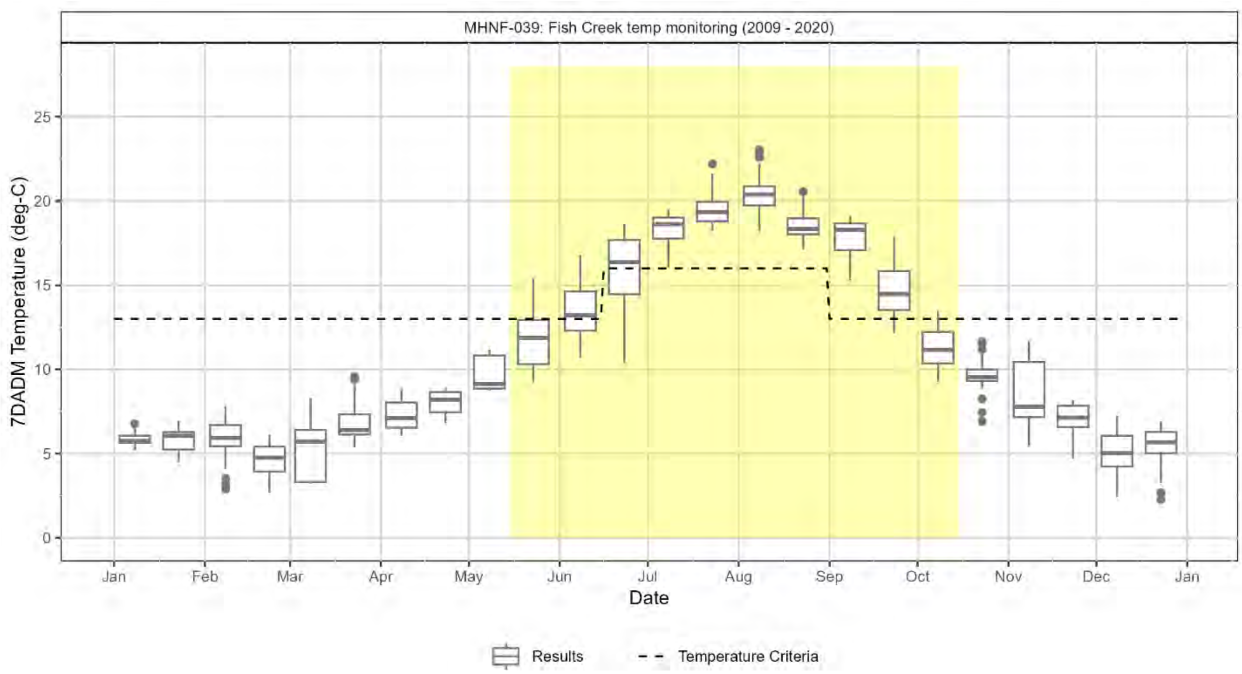


Figure 5-40: Seasonal variation at the Fish Creek temperature monitoring site in the Clackamas Subbasin.

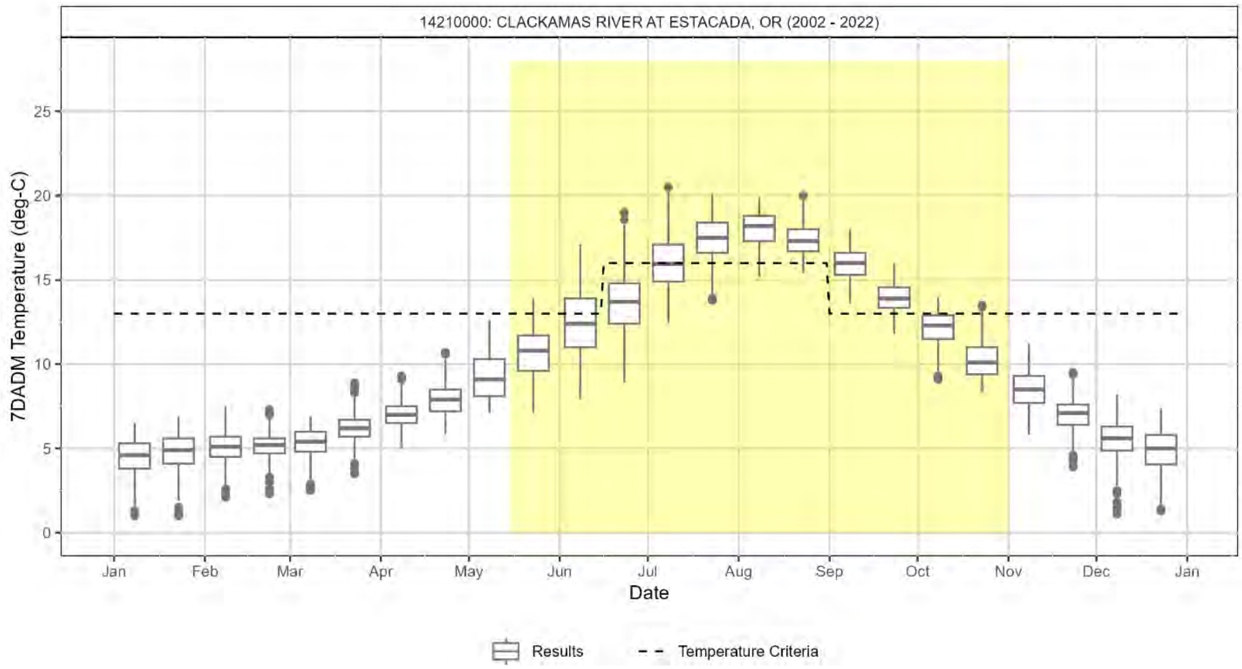


Figure 5-41: Seasonal variation on the Clackamas River at Estacada, Oregon (downstream of River Mill Dam) in the Clackamas Subbasin.

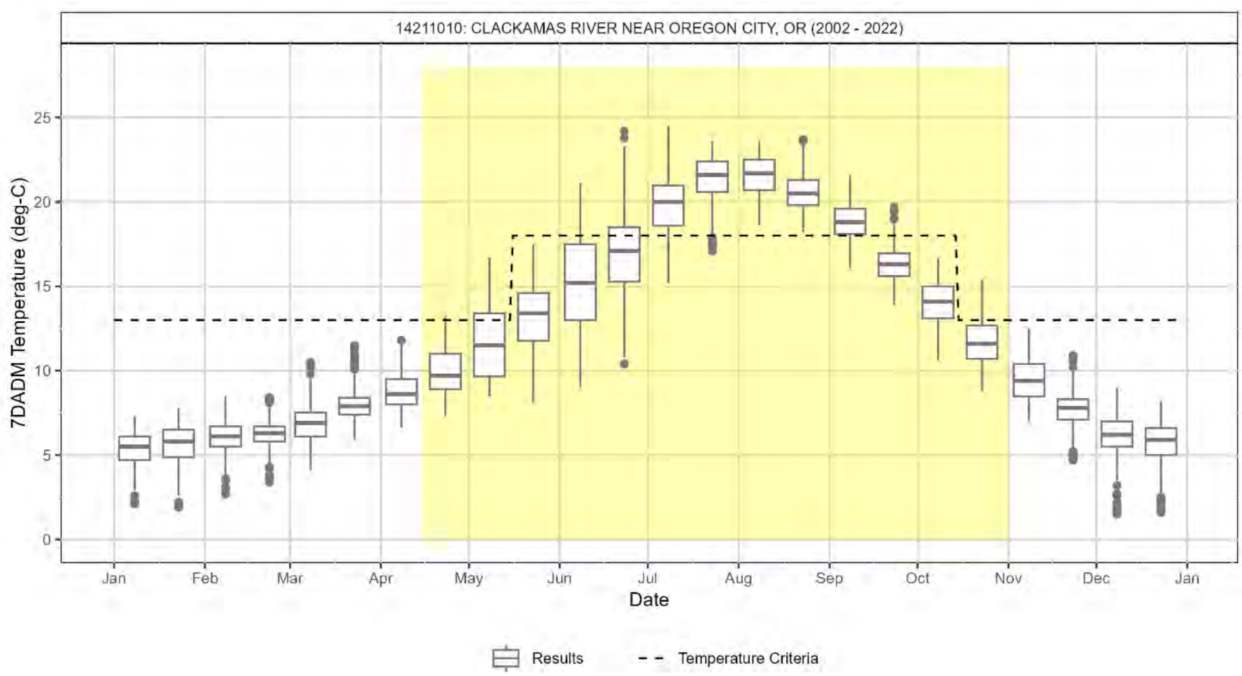


Figure 5-42: Seasonal variation on the Clackamas river near Oregon City, Oregon in the Clackamas Subbasin.

5.10 Lower Willamette Subbasin seasonal variation

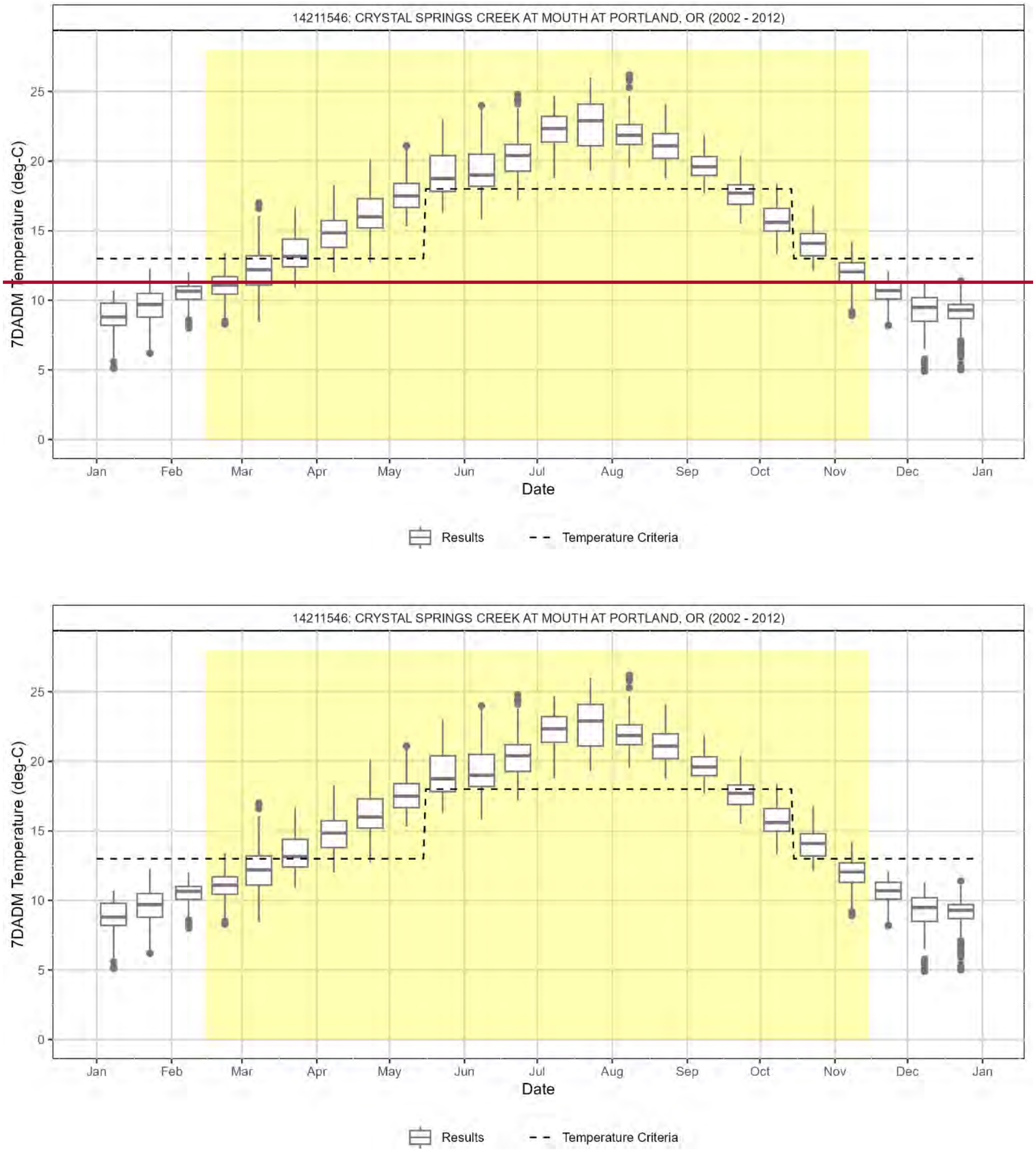


Figure 5-43: Seasonal variation at the Crystal Springs at mouth temperature monitoring site in the Johnson Creek Watershed (HUC 1709001201).

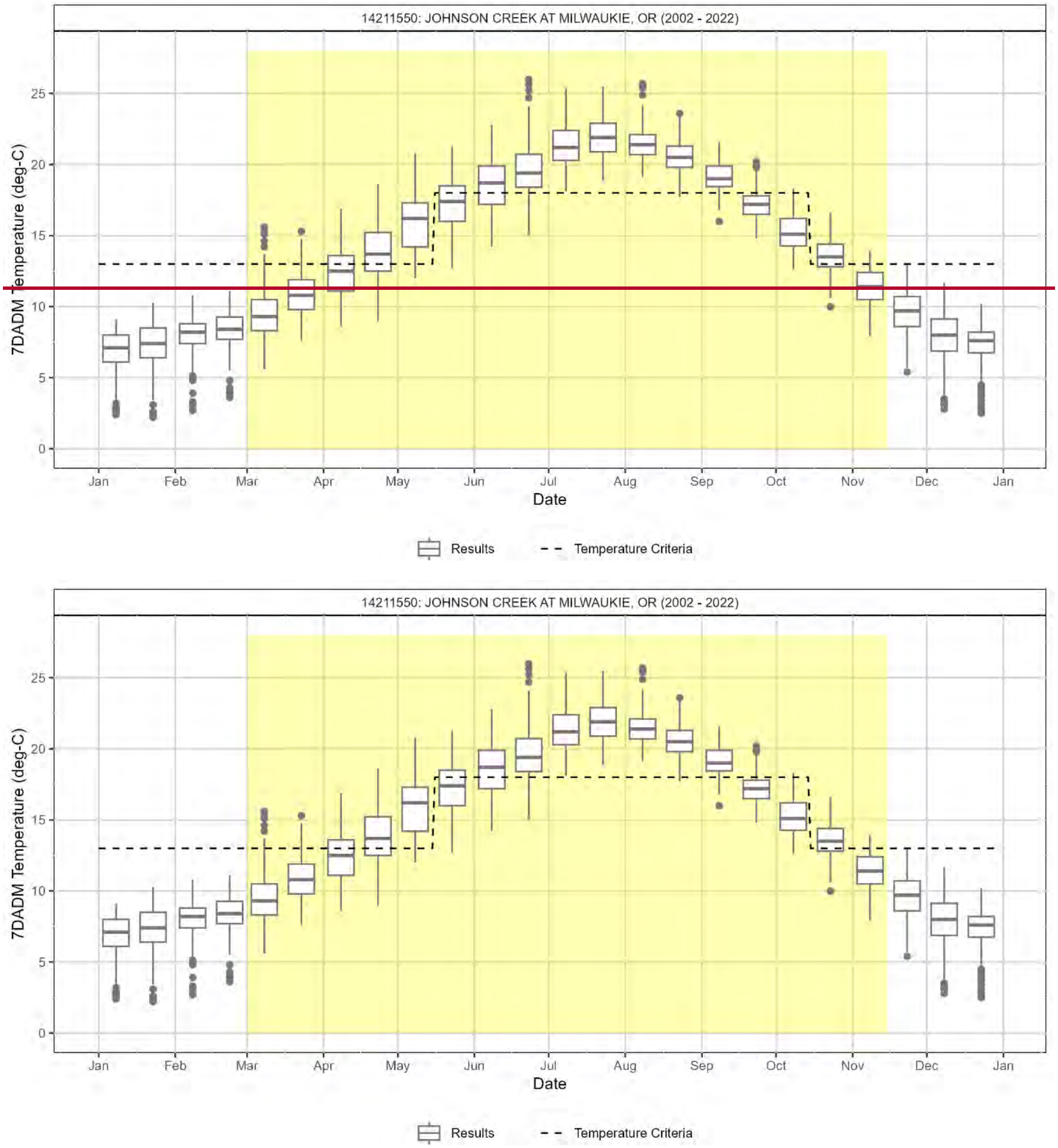


Figure 5-44: Seasonal variation at the Johnson Creek at Milwaukie temperature monitoring site in the Johnson Creek Watershed (HUC 1709001201).

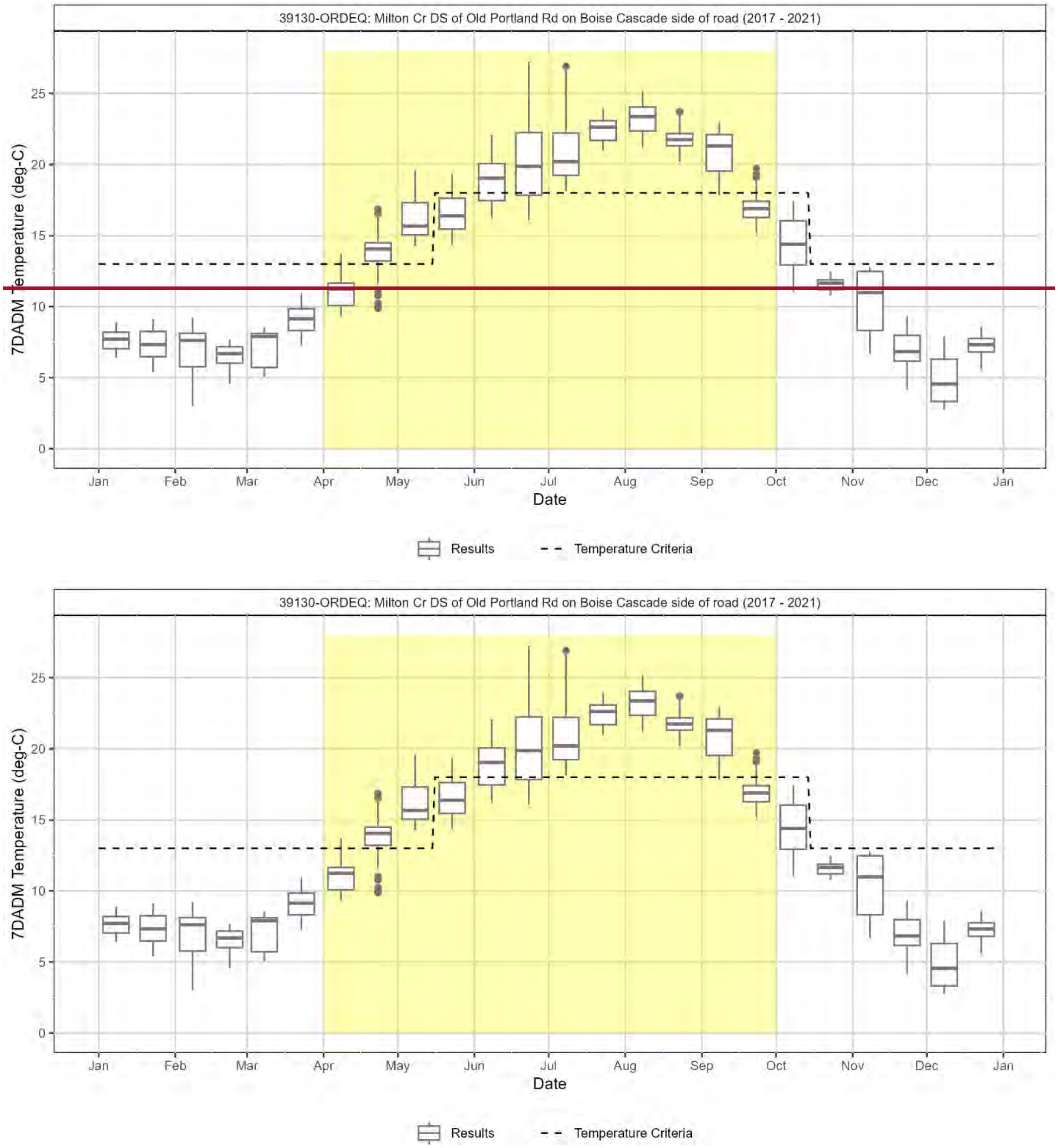
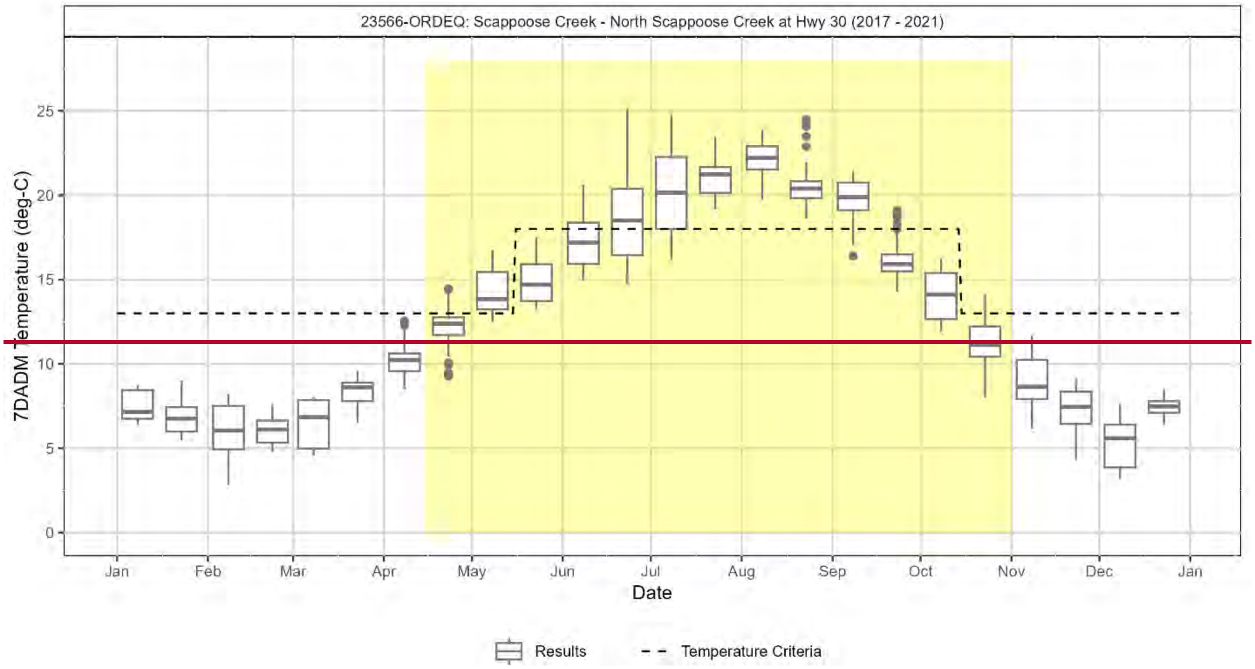


Figure 5-45: Seasonal variation at the Milton Creek upstream of Old Portland Road temperature monitoring site in the Lower Willamette Subbasin.



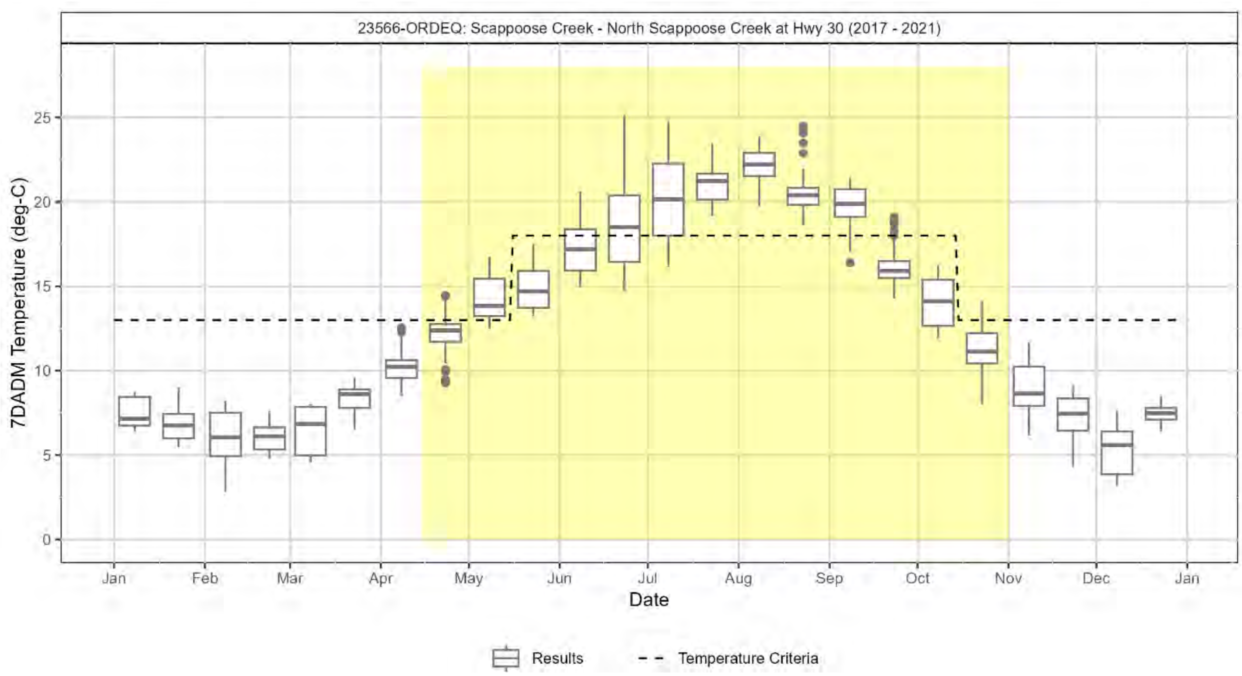
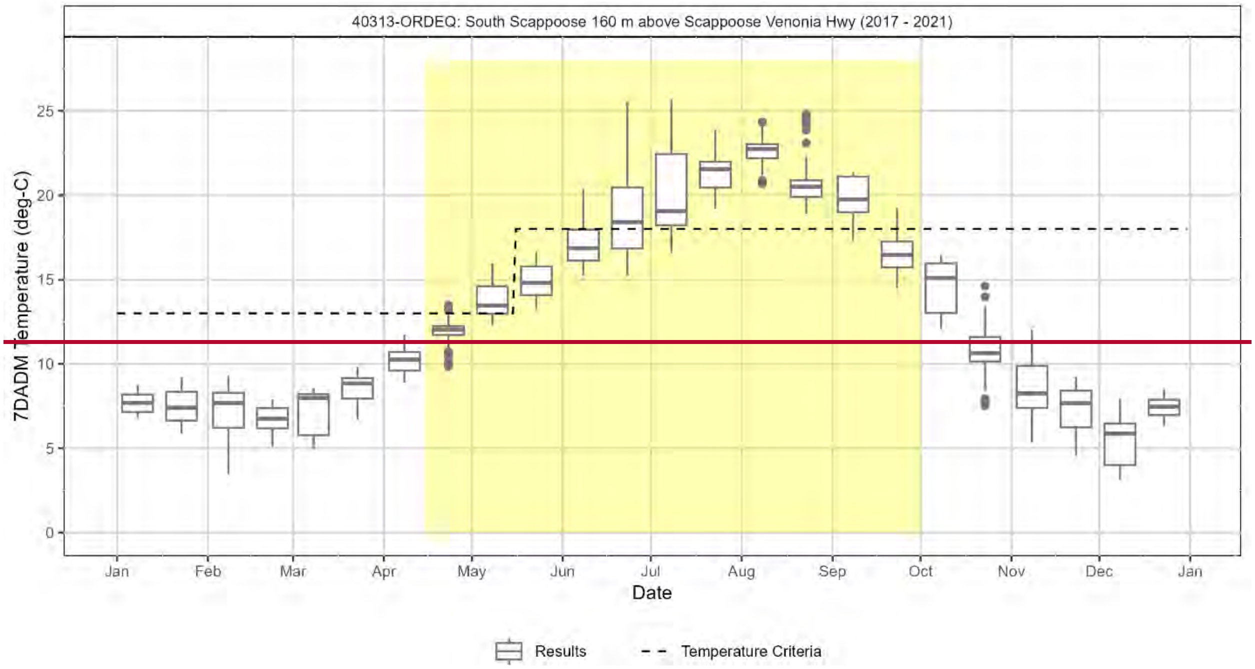


Figure 5-46: Seasonal variation at the North Scappoose Creek at Highway 30 temperature monitoring site in the Lower Willamette Subbasin.



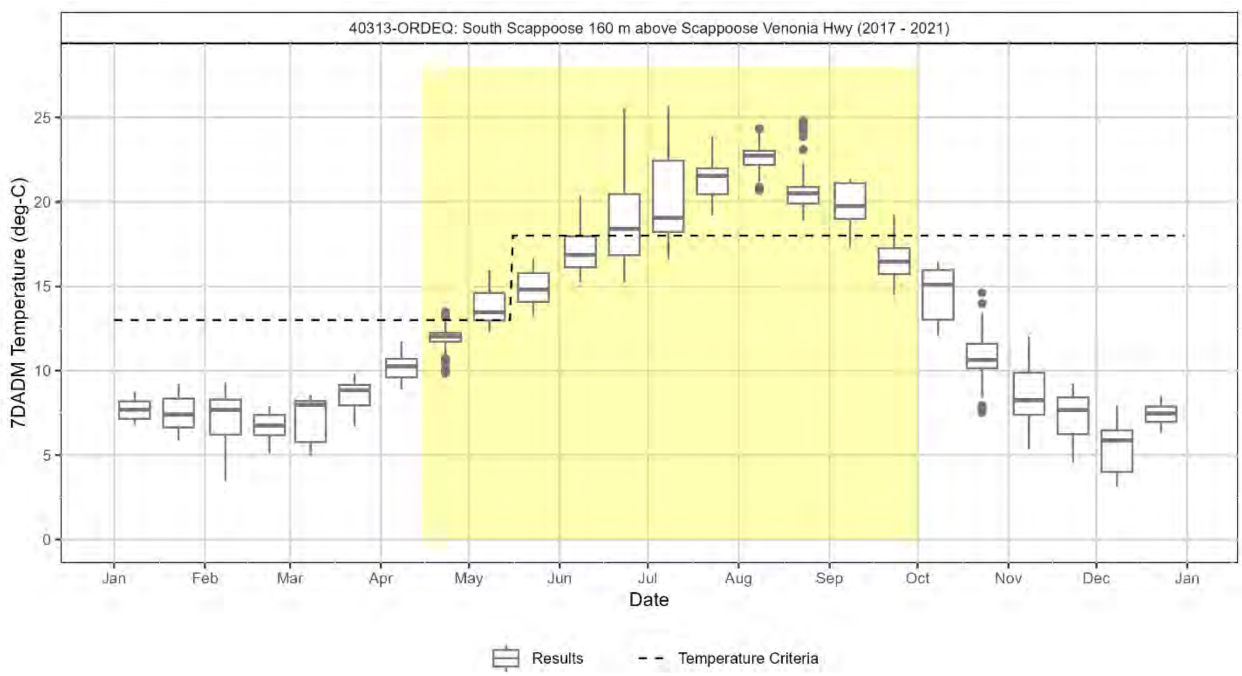
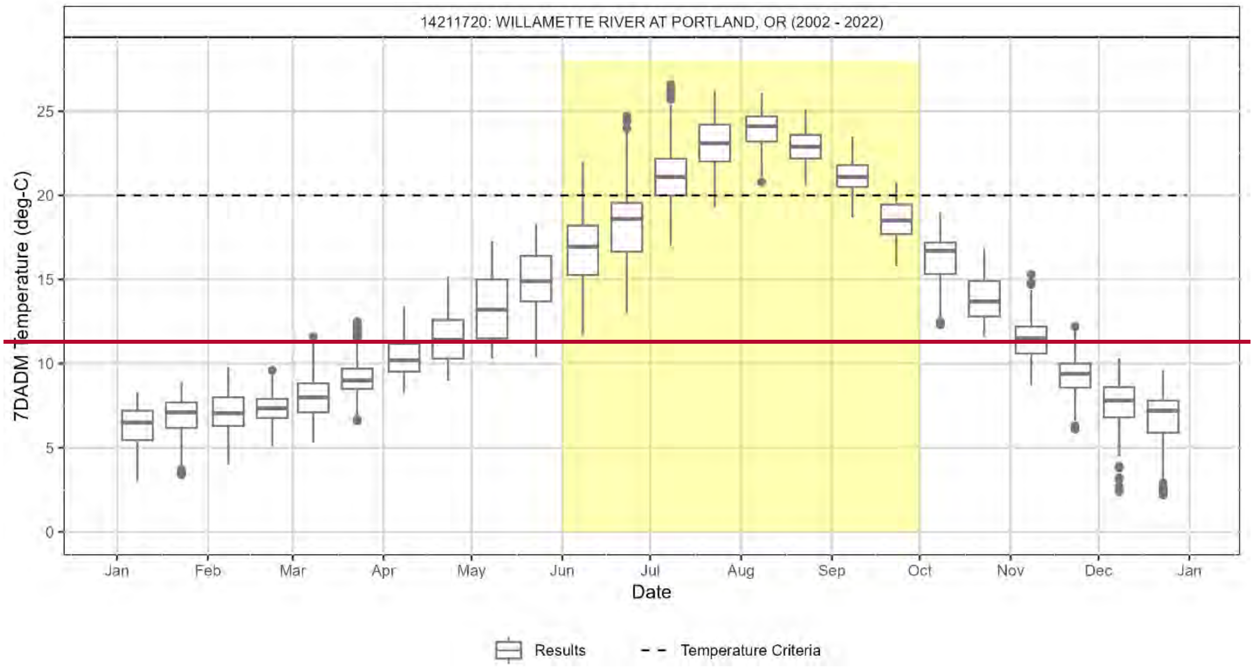


Figure 5-47: Seasonal variation at the South Scappoose Creek above Vernonia Highway temperature monitoring site in the Lower Willamette Subbasin.

5.11 Willamette River seasonal variation



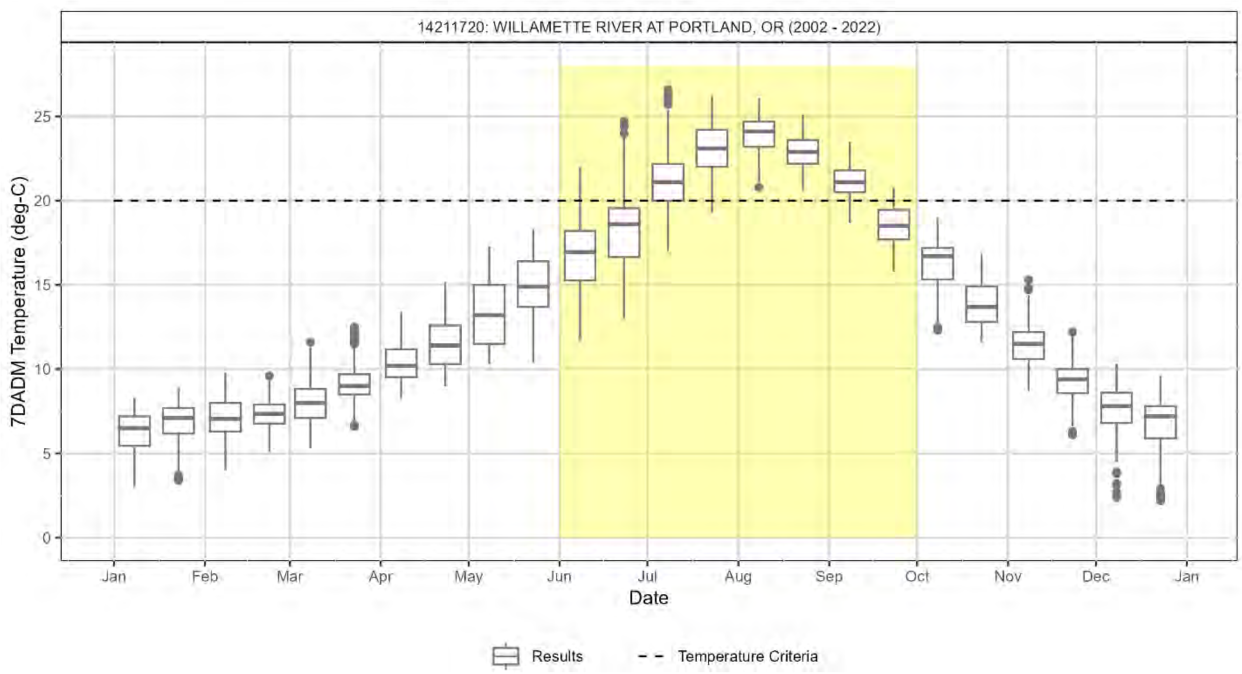


Figure 5-48: Seasonal variation on the Willamette River at Portland in the Lower Willamette Subbasin.

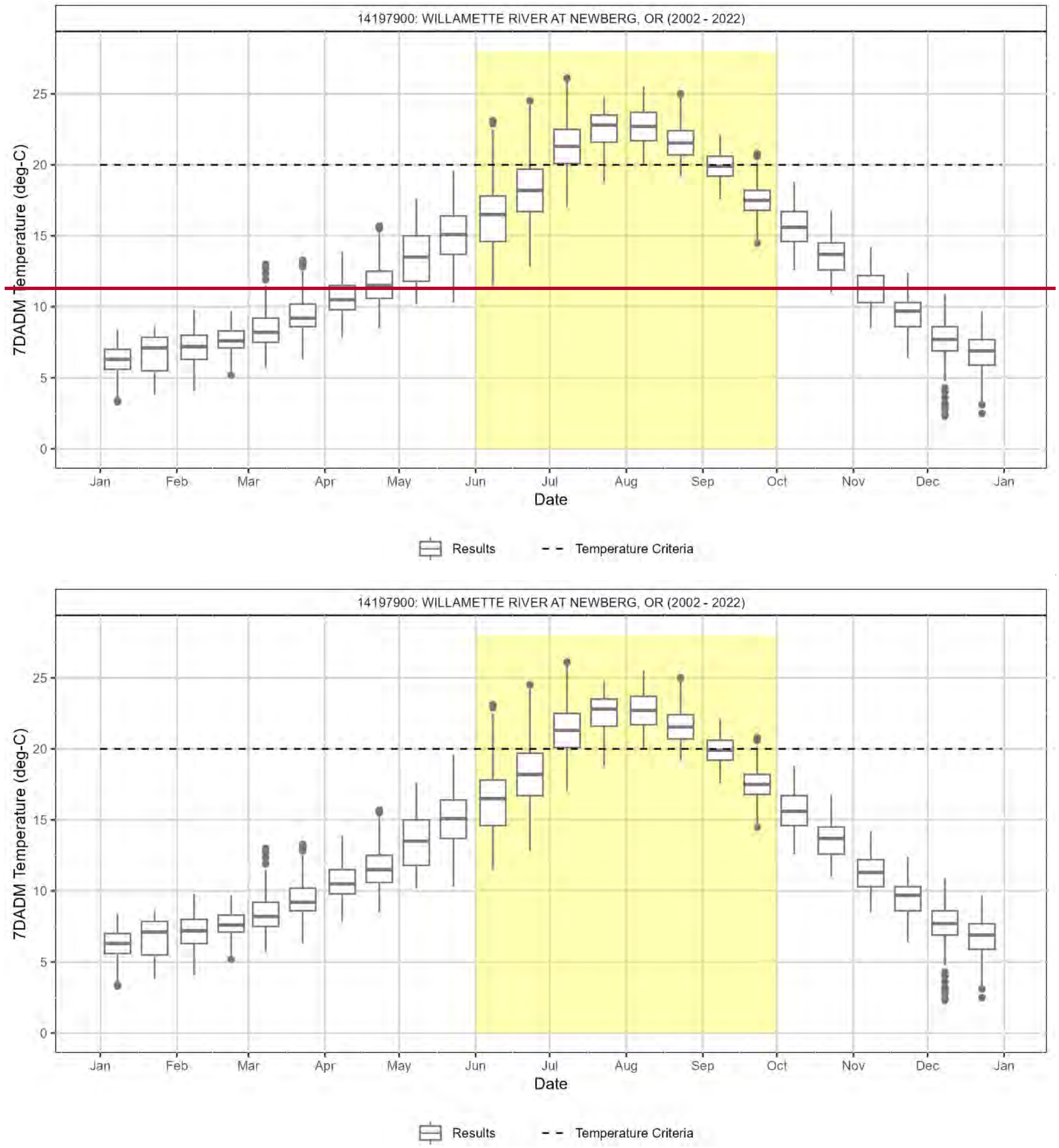


Figure 5-49: Seasonal variation on the Willamette River at Newberg in the Middle Willamette Subbasin.

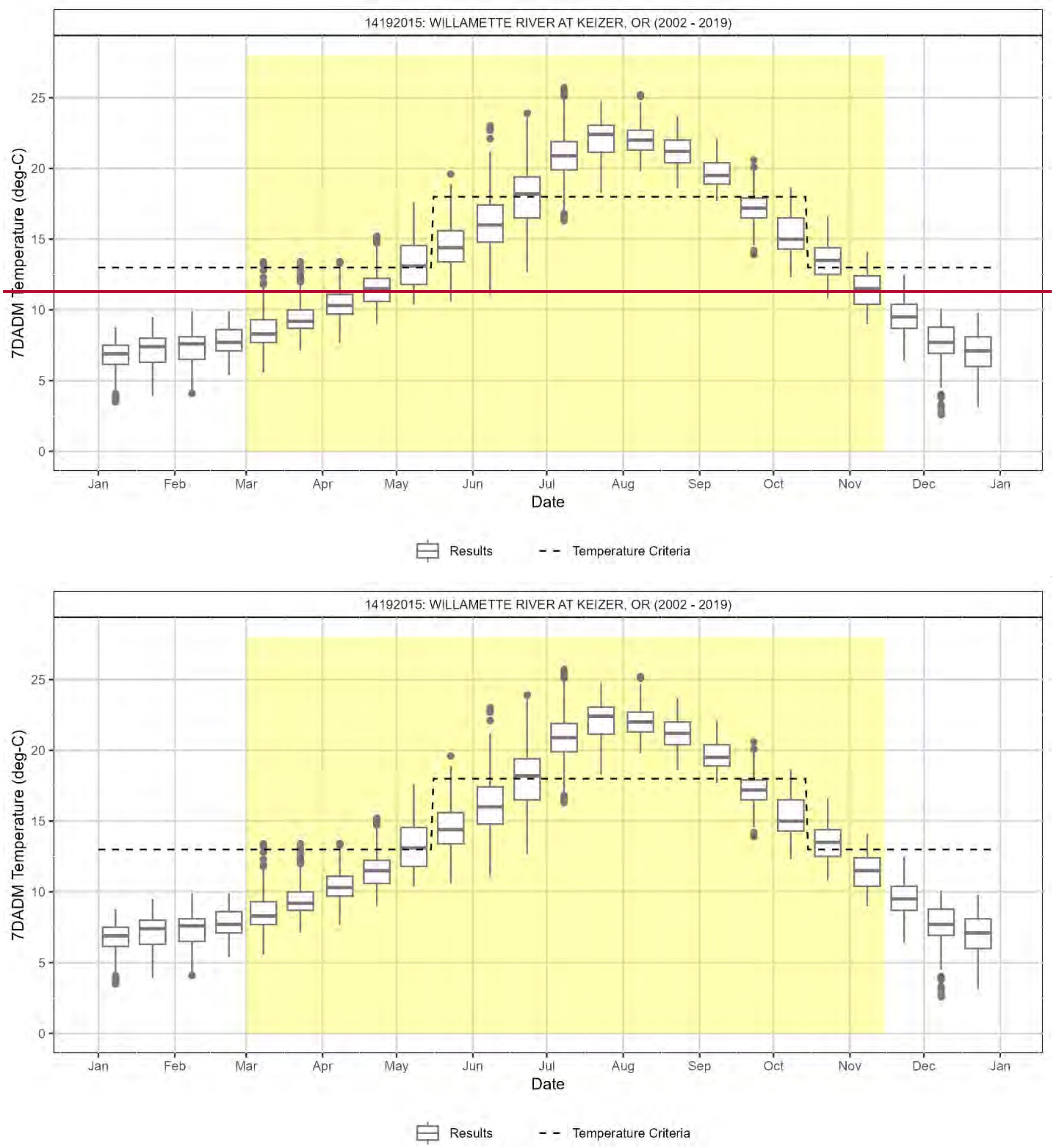
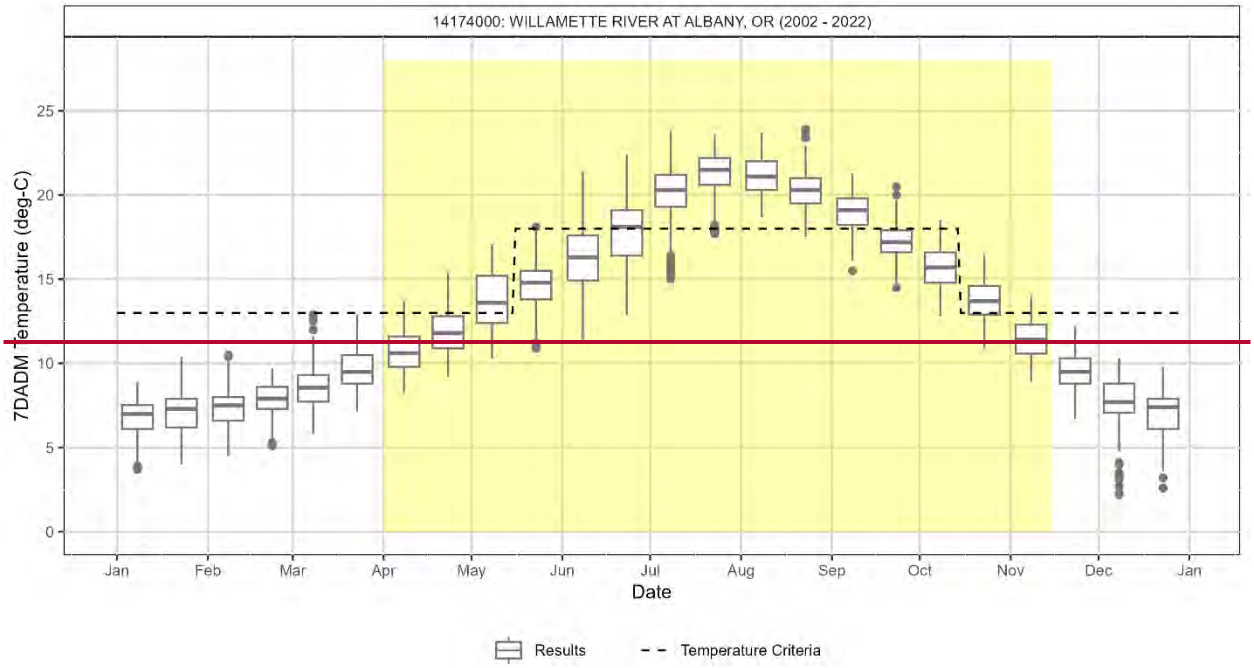


Figure 5-50: Seasonal variation on the Willamette River at Keizer in the Middle Willamette Subbasin.



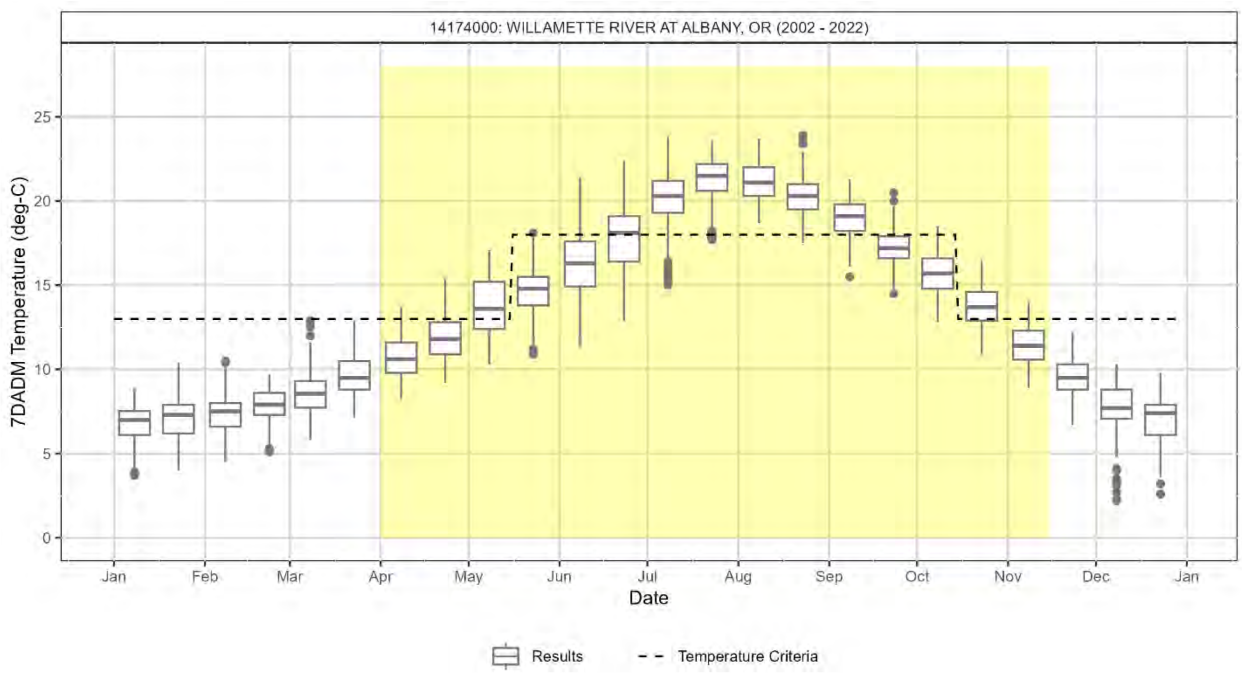


Figure 5-51: Seasonal variation on the Willamette River at Albany in the Upper Willamette Subbasin.

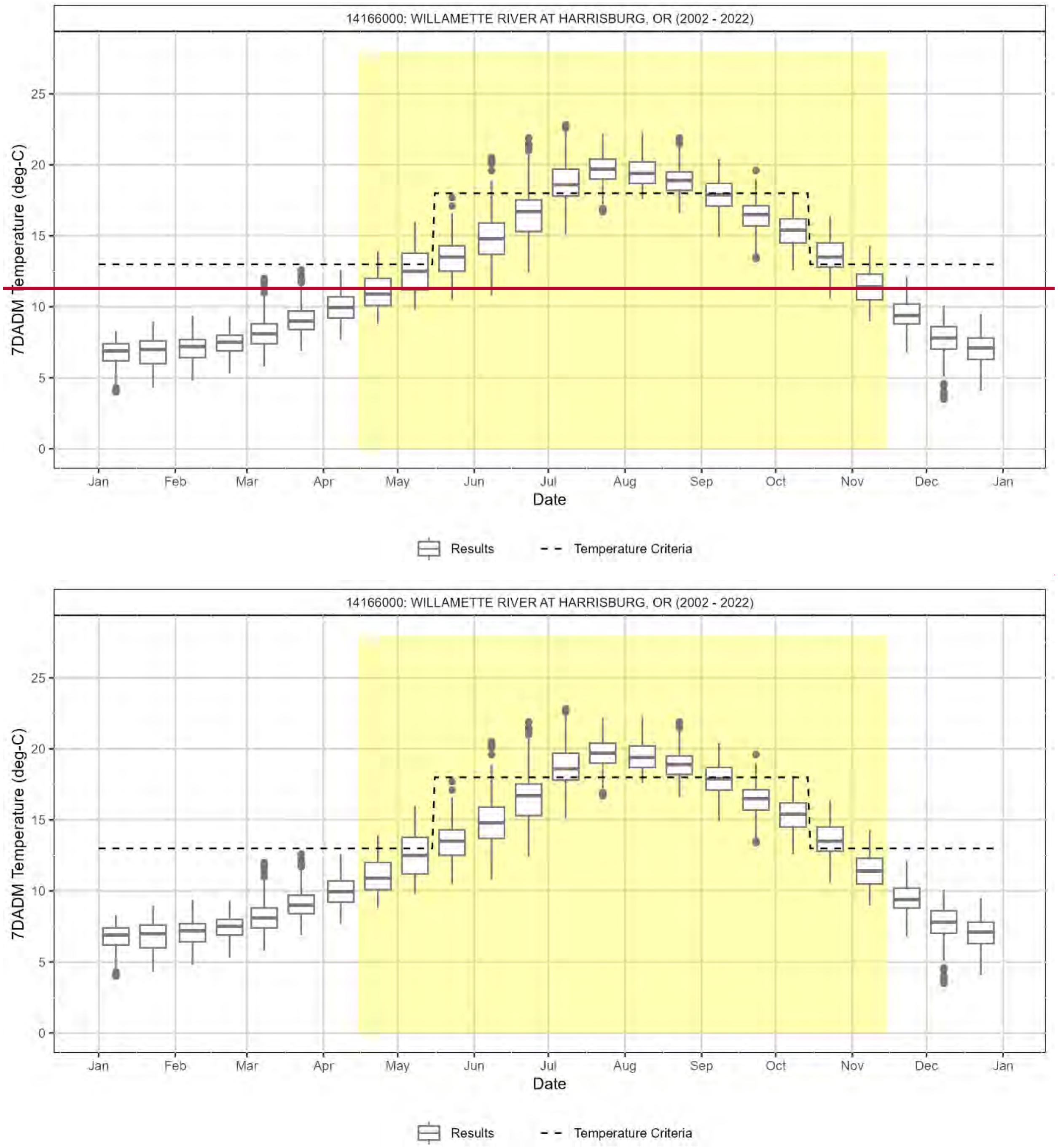


Figure 5-52: Seasonal variation on the Willamette River at Harrisburg in the Upper Willamette Subbasin.

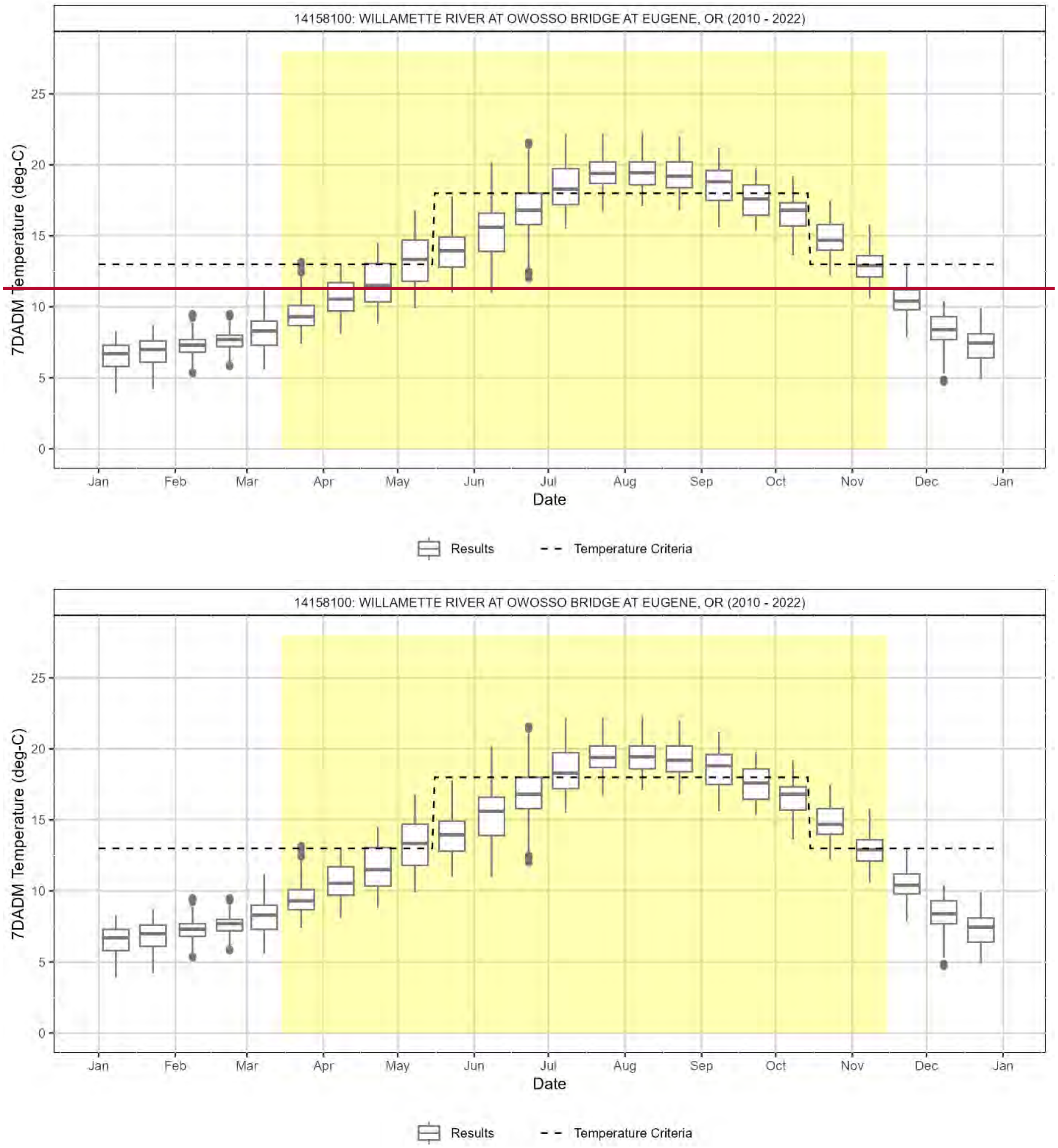


Figure 5-53: Seasonal variation on the Willamette River at Owosso Bridge at Eugene in the Upper Willamette Subbasin.

6 Temperature water quality data evaluation and analyses

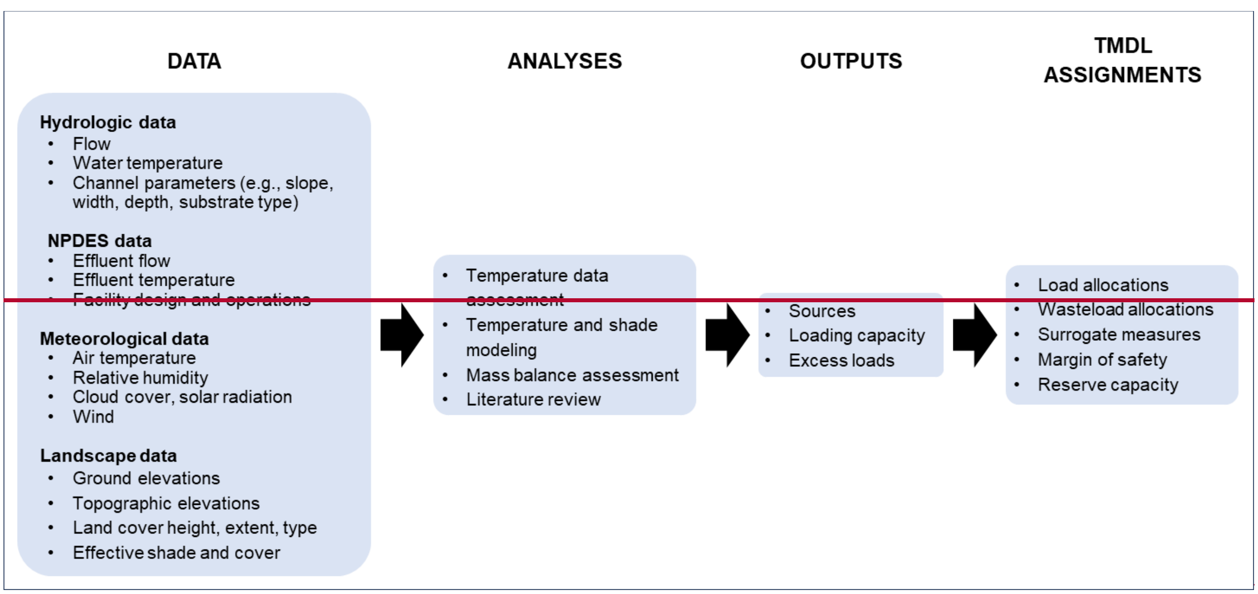
A critical TMDL element is water quality data evaluation and analysis to the extent that existing data allow. To understand the water quality impairment, assess potential pollutant sources, and evaluate the ability of various management scenarios in achieving the TMDL and applicable temperature water quality standards, the analysis requires a predictive component. DEQ uses models to evaluate potential stream warming sources and, to the extent existing data allow, their current and TMDL allocation pollutant loads. Heat Source and CE-QUAL-W2 models were used in this effort and are described in Appendices A-B and J-~~K~~L of this document.

6.1 Analysis overview

The analysis framework needs for this project included the abilities to predict/evaluate hourly:

1. Stream temperatures spanning months at ≤500 m longitudinal resolution.
2. Solar radiation fluxes and daily effective shade at ≤200 m longitudinal resolution.
3. Stream temperature responses due to changes in:
    a. Streamside vegetation,
    b. Water withdrawals and upstream tributaries’ stream flow,
    c. Channel morphology,
    d. Effluent temperature and flow discharge from NPDES permitted facilities.

Figure 6-1 provides an overview of the type of analyses completed for this TMDL. Water quality models were used to support analysis on many streams. These models have specific input and calibration data requirements. Data types and how they supported the TMDL analysis are summarized in **Figure 6-1** and are described more fully in Appendix A, Appendix B, Appendix J and Appendix K. All data are available to the public with a public records request.



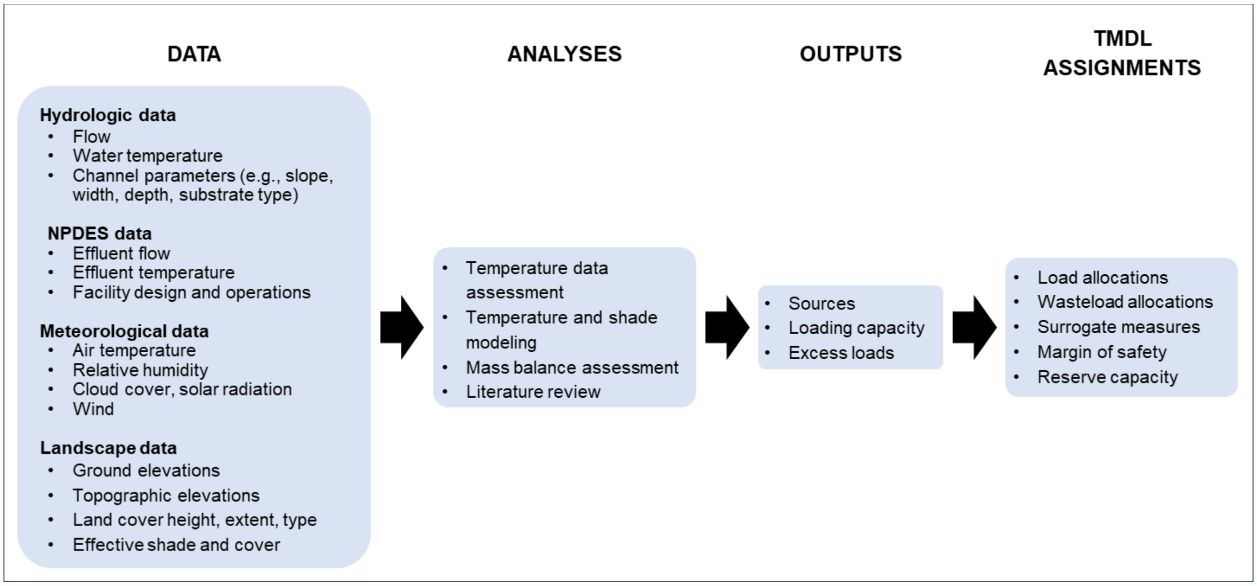


Figure 6-1: Willamette Subbasins temperature analysis overview.

6.2 Data overview

As illustrated in **Figure 6-1**, data for numerous hydrologic, meteorologic, and landscape/ geographic parameters within the spatial and temporal boundaries of the TMDL are required to conduct effective analysis for TMDL development. Section 2 of Appendix B to this document describes these parameters, their applications in this TMDL development, and provides information on the specific datasets and sources utilized for this effort. All data are available upon request.

Table 6-1: Data types used in the Willamette Subbasins Temperature TMDL modeling.

Data Source Type	Dataset Types	Data Sources
Field-acquired	• Continuous stream temperature • Stream flow rate: continuous & instantaneous • Point source discharge temperatures & flows	DEQ Ambient Water Quality Monitoring System (AWQMS); USGS National Water Information System (NWIS); DEQ data solicitation responses; NPDES Discharge Monitoring Reports
GIS and/or remotely sensed	• 3-ft Digital Elevation Model (DEM) • Light Detection and Ranging (LiDAR) • Aerial imagery: Digital Orthophoto Quads (DOQs) • Thermal Infrared Radiometry (TIR) temperature data	Oregon Department of Geology and Mineral Industries (DOGAMI); Oregon LiDAR Consortium (OLC); Watershed Sciences, Inc.
Derived from above data types via: (a) quantitative methods or (b) proxy substitution (for certain tributary flows & temps.)	• Stream position, channel width, channel bottom width, elevation, gradient • Topographic shade angles • Land cover mapping • Tributary flows & temperatures	DEMs, LiDAR, DOQs (for stream morphology, land cover, topography, & geography); USGS StreamStats, historical data, proxy site data, estimated data (for tributary flows & temperatures if direct monitoring data were unavailable)

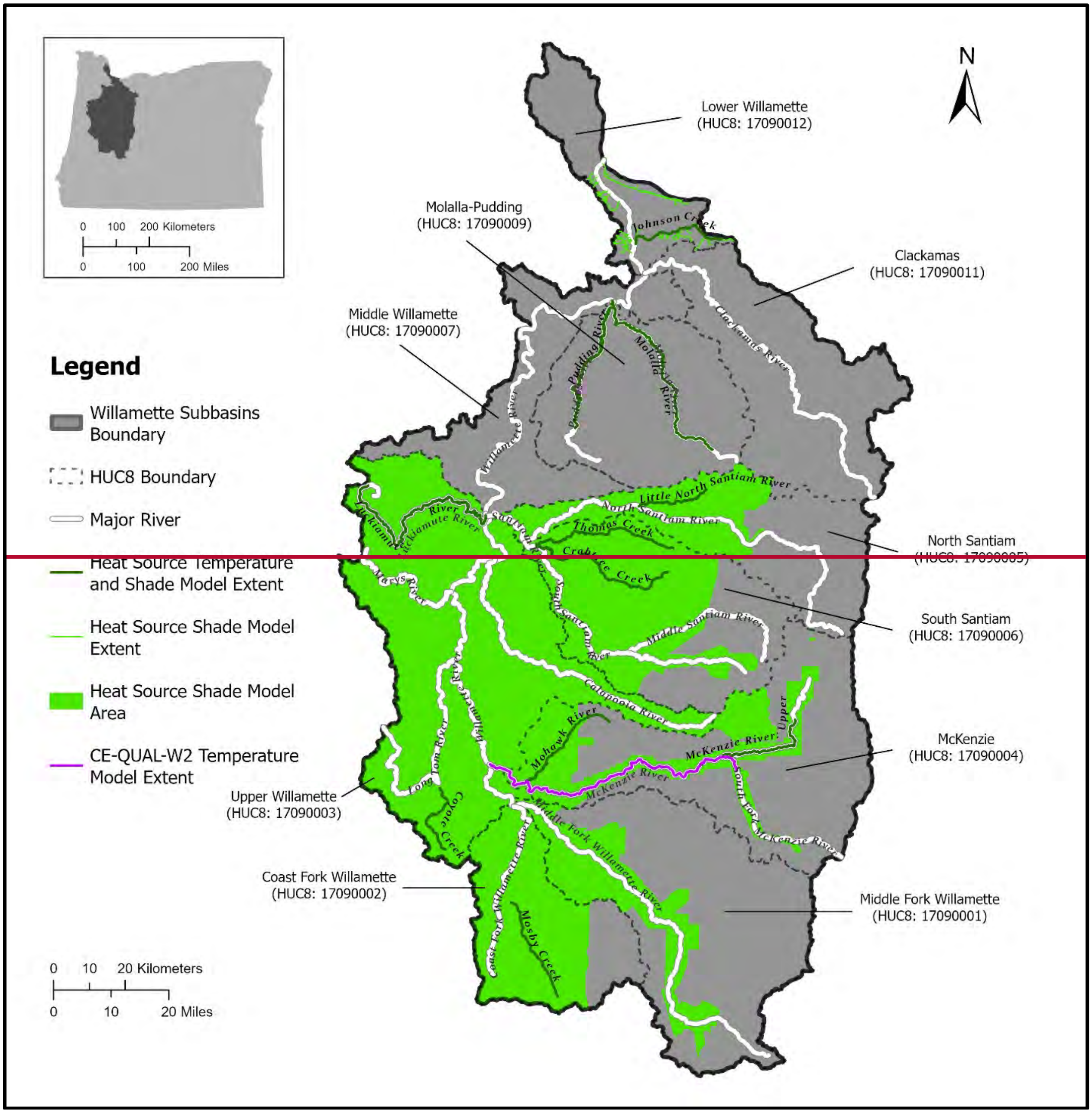
6.3 Model setup and application overview

As described in the TSD model report appendices (Appendix A, Appendix B, Appendix J, Appendix K, Appendix L, and Appendix ~~K~~M), DEQ and partners set up and calibrated temperature and shade models for numerous streams in the Willamette Subbasins (**Figure 6-2**). Temperature models were developed for:

- Johnson Creek (Lower Willamette Subbasin)
- Multnomah Channel (Lower Willamette Subbasin)
- Clackamas River (Clackamas Subbsin)
- Molalla River (Molalla-Pudding Subbasin)
- Pudding River (Molalla-Pudding Subbasin)
- Little North Santiam River (North Santiam Subbasin)
- North Santiam River (North Santiam Subbasin)
- Santiam River (North Santiam Subbasin)
- Thomas Creek (South Santiam Subbasin)
- Crabtree Creek (South Santiam Subbasin)
- South Santiam River (South Santiam Subbasin)
- Luckiamute River (Upper Willamette Subbasin)
- Mohawk River (McKenzie Subbasin)
- McKenzie River (McKenzie Subbasin)
- Coyote Creek (Upper Willamette Subbasin)
- Long Tom River (Upper Willamette Subbasin)
- Coast Fork Willamette River (Coast Fork Willamette Subbasin)
- Mosby Creek (Coast Fork Willamette Subbasin)
- Row River (Coast Fork Willamette Subbasin)
- Fall Creek (Middle Fork Willamette Subbasin)
- Middle Fork Willamette River (Middle Fork Willamette Subbasin)
- Willamette River (Lower Willamette, Middle Willamette, and Upper Willamette Subbasins)

Shade models were developed for:

- Select streams in the Lower Willamette Subbasin including Columbia Slough, Tryon Creek, and Johnson Creek Watersheds, and streams that flow to the Willamette River and Multnomah Channel on the west side of the Tualatin Mountains in the Balch Creek-Willamette River subwatershed (170900120202) and Multnomah Channel subwatershed (170900120305)
- Streams in the Southern portion of the Willamette Basin where LiDAR data were available.



0 100 200 Kilometers
0 100 200 Miles
Legend
Willamette Subbasins Boundary
HUC8 Boundary
Major River
Heat Source Temperature and Shade Model Extent
Heat Source Shade Model Extent
Heat Source Shade Model Area
CE-QUAL-W2 Temperature Model Extent
0 10 20 Kilometers
0 10 20 Miles
N
Lower Willamette (HUC8: 17090012)
Molalla-Pudding (HUC8: 17090009)
Clackamas (HUC8: 17090011)
Middle Willamette (HUC8: 17090007)
North Santiam (HUC8: 17090005)
South Santiam (HUC8: 17090006)
McKenzie (HUC8: 17090004)
Upper Willamette (HUC8: 17090003)
Coast Fork Willamette (HUC8: 17090002)
Middle Fork Willamette (HUC8: 17090001)
Johnson Creek
Clackamas River
Molalla River
Pudding River
Willamette River
Little North Santiam River
North Santiam River
Thomas Creek
Crabtree Creek
Luckiamute River
Marys River
Middle Santiam River
South Santiam River
Calapooia River
Mohawk River
McKenzie River
Upper McKenzie River
Long Tom River
Coyote Creek
Middle Fork Willamette River
Coast Fork Willamette River
Mosby Creek

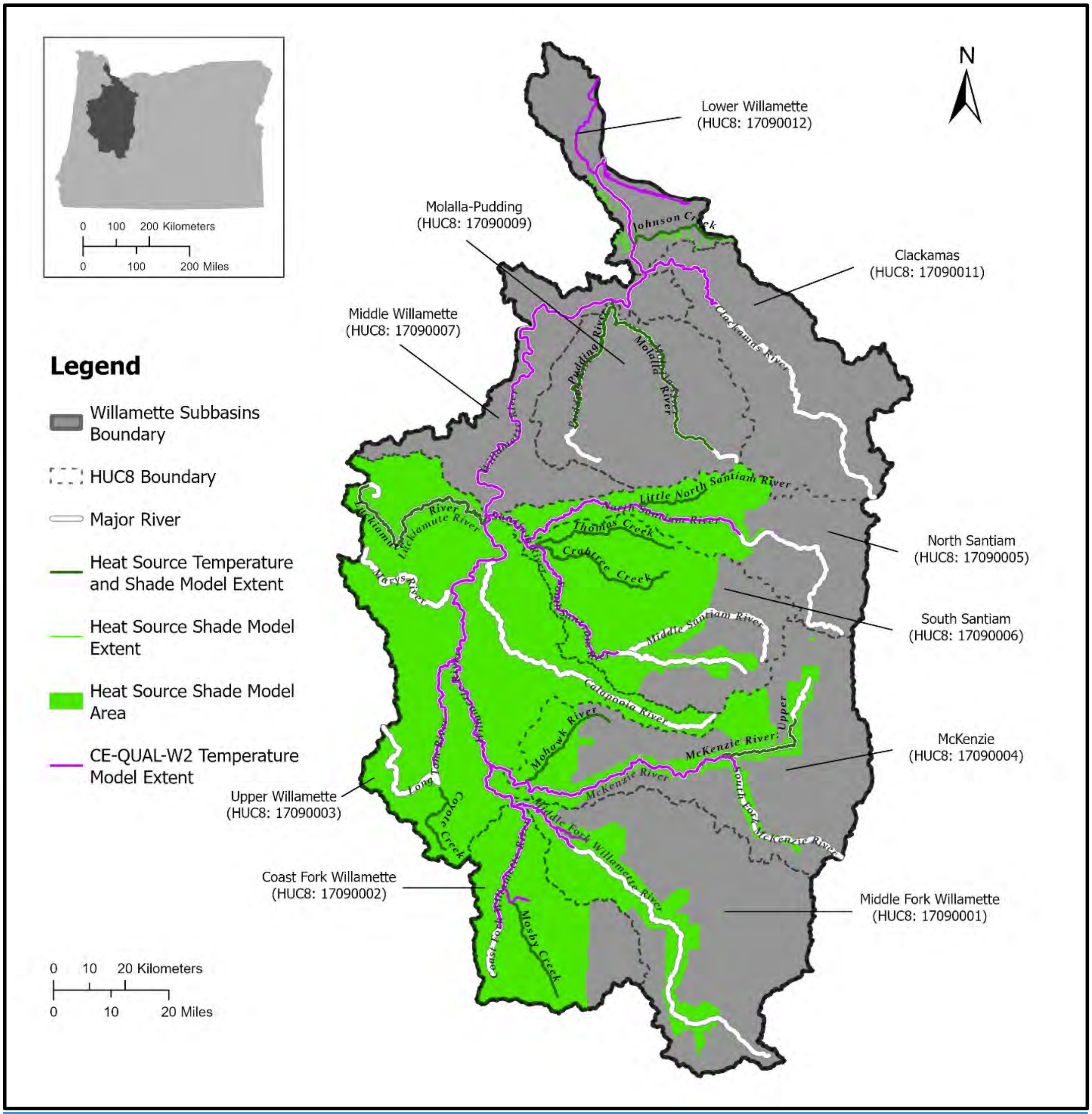


Figure 6-2: Overview of TMDL project area and model extents.

The setup and calibration for many of these models was completed by DEQ for the Willamette Basin TMDL and WQMP (DEQ, 2006) and Molalla-Pudding Subbasin TMDL (DEQ, 2008c). During development, the models were adjusted iteratively until acceptable goodness-of-fit was achieved relative to the observed current conditions. DEQ did not make adjustments to the original calibrated temperature models with the exception of a minor correction to the meteorological inputs on Johnson Creek. The Heat Source shade models and the CE-QUAL-W2 temperature model on the lower McKenzie River are new to this TMDL and were not available for the 2006 TMDL. DEQ and City of Portland developed the shade models. USGS updated the McKenzie River CE-QUAL-W2 model for the year 2015 (Stratton et al., 2022).

Adjustments were made to the various model scenarios developed for the 2006 and 2008 TMDL with some new scenarios developed. The adjustments were principally focused on updating point source effluent discharge inputs based on more recent data, adding new sources, removing sources no longer discharging, and assessment of various management scenarios such as changes in riparian conditions and water withdrawal rates.

The results of these models were used in tandem with applicable temperature criteria to complete a source assessment and cumulative effects analysis, determine TMDL allocations and surrogate measures that attain the applicable temperature criteria, and develop information that will support TMDL implementation and development of the TMDL WQMP. It was not possible to model all waters with a temperature listing, so the determination of sources and source categories is principally based on the findings from the streams that were modelled or were assessed using available data. Results from the modeled reaches and reaches with available data are relevant in the larger watershed context.

A summary of the source assessment finding can be found in Section 7. The detailed model calibration and scenario results are provided in the TSD model report appendices (Appendix A, Appendix B, Appendix J, and Appendix K).

6.4 The 7Q10 low-flow statistic

The “7Q10” is a summary low-flow statistic equal to the lowest seven-day average flow that occurs once every ten years (on average). For the Willamette Subbasins temperature TMDL, estimated 7Q10s were used to calculate numeric loading capacities and allocations. DEQ calculated annual 7Q10s for temperature-impaired streams in the Willamette Subbasins (**Table** 6-2), and for the receiving waterbodies that have NPDES permitted discharges with a WLA (**Table 6-3**).

The 7Q10 estimates were based on the following approaches:

1) If sufficient daily mean flow data from USGS or OWRD gaging stations were available for a given waterbody, 7Q10 estimates were calculated using these data. Available flow data were retrieved for up to a 30-year period (October 1, 1992 to September 31, 2022). DEQ relied on quality control protocols implemented by USGS and OWRD. Only data with a result status of “Approved” (USGS) or “Published” (OWRD) were included in 7Q10 calculations. 7Q10s were calculated by the method of EPA’s DFLOW program (Rossman, 1990), which computes extreme design flows using the log-Pearson Type III probability distribution. A minimum of 10 years of flow data were used with some exceptions. For ungaged locations, if there were sufficient gage data from confluent streams, 7Q10s were estimated from (a) the sum of daily mean flows (for upstream gages), or (b) the difference of mean daily flows (for downstream gages), prior to application of the DFLOW procedure. The 7Q10s calculated based on gage data are reported to the nearest tenth of a cubic foot per second (cfs) for values less than 10 cfs and to whole numbers for values greater than or equal to 10 cfs.

2) If insufficient daily mean flow data from USGS and OWRD stream flow gaging stations were available, the web-based tool StreamStats (USGS, 2019) was used to estimate 7Q10s. The 7Q10s are reported with the same level of significant figures as the values calculated using the gage method, except for values equal to or greater than 1000 cfs, which are reported to three significant figures. Details of StreamStats are described below.

3) 7Q10s calculated and reported elsewhere (e.g., consultant studies, water quality permits, TMDLs) may have been used. In such cases, DEQ relied on the source's data quality and reported the values as they were provided.

4) For tidally influenced streams, DEQ reviewed each situation and made 7Q10 estimates based on the best available data from the relevant gaging stations. Methods are described for each case.

5) 7Q10s immediately downstream of the USACE' projects at Cougar Dam, Detroit Dam, Green Peter Dam, Hills Creek Dam, and Lookout Point Dam were calculated based on a seasonal period corresponding to TMDL allocation period due to some low flows occurring outside the allocation period (**Table 6-3**). At Detroit Dam there were multiple days with missing flow records. Linear interpolation was used to estimate flow for the missing days.

StreamStats version 4 is a web-based GIS application developed by the USGS (https://streamstats.usgs.gov/ss/). StreamStats has a map-based interface that allows the user to determine drainage area delineations, basin characteristics, and estimates of stream flow statistics for user-selected locations along available streams. The program also provides users with access to stream monitoring data by selecting USGS data-collection stations in the map application and providing access to flow statistics and other information for the stations. StreamStats provides estimates of various stream flow statistics for user-selected sites by solving site-specific regression equations. The regression equations were developed through a process, known as regionalization, which involves use of regression analysis to relate stream flow statistics computed for a group of selected stream gages (usually within a state) to basin characteristics measured for the stream gages. Basin characteristics are used to obtain estimates of the stream flow statistics for ungaged sites.

StreamStats regression equations for Oregon were developed by Cooper (2005) and Risley et al. (2008). These equations were based on basin characteristics and flow statistics (e.g., historical percentile flow-exceedance values and annual and monthly 7Q10). Flow statistics were computed at 466 gaging stations across Oregon and proximal out-of-states areas. This study area was divided into 10 regions based on ecological, topographic, geologic, hydrologic, and climatic criteria. StreamStats includes 910 annual and monthly regression equations to estimate 7Q10s for ungaged stream sites in the 10 aforementioned regions. These equations were developed for unregulated streams (without major dams, constructed reservoirs, catchment development, or significant diversions/withdrawals). If the equations are applied to ungaged streams subject to such influences, the resultant estimates may require adjustment to approximate actual flows.

The StreamStats user selects a stream location of interest and the program estimates the associated drainage area and summary flow statistics. For this TMDL, DEQ's procedure specified that selected stream locations should be the most downstream location on each stream for which DEQ required flow estimates; the exception was if DEQ required 7Q10 estimates for NPDES permitted point source receiving waters, in which case the selected stream location was immediately upstream of the point source outfall. StreamStats also estimates basin characteristics for the selected catchment, including drainage area, mean annual precipitation, mean slope, and climatic characteristics (Cooper, 2005; Risley et al., 2008). If estimates are outside suggested parameter ranges, the warning message "extrapolated with uncertainty" appears in the StreamStats report.

Table 6-2: The 7Q10 low-flow estimates for modeled temperature-impaired rivers in the Willamette Subbasins.

AU Name	AU ID	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
Clackamas River	OR_SR_1709001106_02_104597	671	USGS: 14211010	45.379, -122.577	2001-06-01 ~ 2022-09-30
Coast Fork Willamette River	OR_SR_1709000203_02_104585	38	USGS: 14153500	43.721, -123.05	1992-10-01 ~ 2022-09-30
Coast Fork Willamette River	OR_SR_1709000204_02_103787	132	USGS: 14157500	43.98, -122.966	1992-10-01 ~ 2022-09-30
Coyote Creek	OR_SR_1709000301_02_103796	5.9	StreamStats	44.052, -123.269	
Crabtree Creek	OR_SR_1709000606_02_103978	25	StreamStats	44.673, -122.946	
Johnson Creek	OR_SR_1709001201_02_104170	11	USGS: 14211550	45.453, -122.643	1992-10-01 ~ 2022-09-30
Little North Santiam River	OR_SR_1709000505_02_104564	21	USGS: 14182500	44.792, -122.579	1992-10-01 ~ 2022-09-30
Long Tom River	OR_SR_1709000301_02_103791	22	USGS: 14170000	44.313, -123.296	1992-10-01 ~ 2022-09-30
Luckiamute River	OR_SR_1709000305_02_103829	16	USGS: 14190500	44.783, -123.235	1992-10-01 ~ 2022-09-30
McKenzie River	OR_SR_1709000405_02_103866	740	StreamStats	44.111, -122.422	
McKenzie River	OR_SR_1709000407_02_103884	1537	USGS: 14164900	44.071, -122.965	2007-03-22~ 2022-09-30
Middle Fork Willamette River	OR_SR_1709000107_02_104583	1002	USGS: 14150000	43.946, -122.837	1992-10-01 ~ 2022-09-30
Middle Fork Willamette River	OR_SR_1709000110_02_104584	1278	USGS: 14152000	43.998, -122.906	1992-10-01 ~ 2022-09-30
Mohawk River	OR_SR_1709000406_02_103870	4.3	StreamStats	44.191, -122.84	
Mohawk River	OR_SR_1709000406_02_103871	16	USGS: 14165000	44.093, -122.957	1992-10-01 ~ 2022-09-30
Mohawk River	OR_SR_1709000406_02_103877	3	StreamStats	44.213, -122.827	
Molalla River	OR_SR_1709000904_02_104086	38	StreamStats	45.083, -122.488	
Mosby Creek	OR_SR_1709000201_02_103752	11	StreamStats	43.779, -123.011	
North Santiam River	OR_SR_1709000504_02_103906	859	USGS: 14181500	44.754, -122.297	1992-10-01 ~ 2022-09-30
North Santiam River	OR_SR_1709000506_02_103930	914	USGS: 14183000	44.789, -122.619	1992-10-01 ~ 2022-09-30
Pudding River	OR_SR_1709000901_02_104067	3.1	StreamStats	45.0, -122.842	
Pudding River	OR_SR_1709000905_02_104088	10	USGS: 14202000	45.233, -122.75	1993-06-21 ~ 2022-09-30
Santiam River	OR_SR_1709000506_02_103927	1144	USGS: 14189000	44.715, -123.014	1992-10-01 ~ 2022-09-30
South Fork McKenzie River	OR_SR_1709000403_02_104590	220	USGS: 14159500	44.135, -122.248	1992-10-01 ~ 2022-09-30

AU Name	AU ID	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
South Santiam River	OR_SR_1709000608_02_103925	615	USGS: 14187500	44.498, -122.823	1992-10-01 ~ 2022-09-30
Thomas Creek	OR_SR_1709000607_02_103988	6.9	USGS: 14188800	44.712, -122.77	2002-10-01 ~ 2022-09-30
Thomas Creek	OR_SR_1709000607_02_103991	13	StreamStats	44.713, -122.719	
Willamette River	OR_SR_1709000306_05_103854	3877	USGS: 14174000	44.639, -123.107	1992-10-01 ~ 2022-09-30
Willamette River	OR_SR_1709000701_05_104005	5684	USGS: 14191000	44.944, -123.043	1992-10-01 ~ 2022-09-30
Willamette River	OR_SR_1709000703_88_104015	5734	USGS: 14197900	45.285, -122.961	2001-10-01 ~ 2022-09-30
Willamette River	OR_SR_1709000704_88_104020	5988	USGS: 14197900 + 14207500 + 14200000 + 14202000	45.285, -122.961 45.351, -122.676 45.244, -122.687 45.233, -122.750	2002-10-01 ~ 2022-09-30
Willamette River	OR_SR_1709001201_88_104019	6740	USGS: 14197900 + 14207500 + 14211010 + 14200000 + 14202000	45.285, -122.961 45.351, -122.676 45.379, -122.577 45.244, -122.687 45.233, -122.750	2002-10-01 ~ 2022-09-30
Willamette River	OR_SR_1709001202_88_104175	6740	USGS: 14197900 + 14207500 + 14211010 + 14200000 + 14202000	45.285, -122.961 45.351, -122.676 45.379, -122.577 45.244, -122.687 45.233, -122.750	2002-10-01 ~ 2022-09-30

Table 6-3: The 7Q10 low-flow estimates for NPDES permitted discharges receiving a numeric wasteload allocation in this TMDL.

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
Albany Water Treatment Plant (66584)	Calapooia River	24	StreamStats	44.635, -123.114	
Alpine Community (100101)	Muddy Creek	0.4	StreamStats	44.33, -123.352	
Arclin (16037)	28th Street Canal	0	StreamStats. The storm ditch is not represented on the StreamStats network. Used nearest location	44.058, -122.986	
Arclin (81714)	Columbia Slough	30	Based on permit mixing zone study (SECOR, 2002)		
ATI Albany Operations (64300)	Oak Creek	1.4	StreamStats	44.602, -123.107	
Aumsville STP (4475)	Beaver Creek	0.7	StreamStats	44.852, -122.872	

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
Aurora STP (110020)	Pudding River	10	USGS: 14202000	45.233, -122.750	1993-06-21 ~2022-09-30
Bakelite Chemicals LLC (32650)	Murder Creek	0	StreamStats	44.661, -123.069	
Bakelite Chemicals LLC (32864)	Amazon Creek	0	StreamStats	44.121, -123.19	
Blount Oregon Cutting Systems Division (63545)	Minthorne Creek	0	StreamStats	45.436, -122.612	
Boeing of Portland - Fabrication Division (9269)	Osburn Creek	0	StreamStats	45.541, -122.446	
Brownsville STP (11770)	Calapooia River	14	StreamStats	44.396, -122.998	
City of Silverton Drinking WTP (81398)	Unnamed Tributary to Abiqua Creek	0	StreamStats	44.008, -122.774	
Coburg Wastewater Treatment Plant (115851)	Muddy Creek	0	StreamStats	44.152, -123.058	
Coffin Butte Landfill (104176)	Roadside ditch to Soap Creek tributary	0	StreamStats	44.698, -123.23	
Columbia Helicopters (100541)	Unnamed Stream RM 1.8 (Trib to Pudding River)	0	Assumed zero	45.278, -122.733	
Corvallis Rock Creek WTP (20160)	Marys River	0	StreamStats	44.51, -123.456	
Creswell STP (20927)	Camas Swale Creek	0	StreamStats	43.928, -123.037	
Dallas STP (22546)	Rickreall Creek	4.2	StreamStats	44.92, -123.258	
Dallas WTP (22550)	Rickreall Creek	3.3	StreamStats	44.928, -123.363	
Deer Creek Estates Water Association	Mill Creek	0.7	StreamStats	45.235, -122.758	
Duraflake (97047)	Murder Creek	0	StreamStats	44.664, -123.066	
Estacada STP (27866)	River Mill Reservoir	317	StreamStats	45.296, -122.347	
EWEB Carmen-Smith (28393)	McKenzie River Outfall 001A/B	146	StreamStats	44.288, 122.035	
EWEB Carmen-Smith (28393)	McKenzie River Outfall 002A/B	496	USGS: 14158850	44.268, -122.050	1992-10-01 ~2022-09-30
EWEB Hayden Bridge Filter Plant (28385)	McKenzie River	1537	USGS: 14164900	44.071, -122.965	2007-03-22 ~2022-09-30

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
Falls City STP (28830)	Little Luckiamute River	5.3	StreamStats	44.865, -123.43	
Foster Farms (97246)	Camas Swale Creek	0	StreamStats	43.93, -123.027	
Fujimi Corporation - SW Commerce Circle (107178)	Coffee Lake Creek	0	StreamStats	45.338, -122.779	
Gervais STP (33060)	Pudding River	6.6	USGS: 14201340 - 14201300	45.151, -122.804 45.100, -122.822	1997-10-01 ~2022-09-30
Halsey STP (36320)	Muddy Creek	5.0	StreamStats	44.383, -123.136	
Hubbard STP (40494)	Mill Creek	0	StreamStats	45.186, -122.814	
Hull-Oakes Lumber Co. (107228)	Oliver Creek	0	StreamStats	44.36, -123.412	
International Paper - Springfield 108921 : ORG383548	Irving Slough	0	StreamStats. Irving Slough is not represented on the StreamStats network. Used nearest location.	44.065, -122.975	
International Paper Springfield Paper Mill (96244)	McKenzie River	Annual: 1537	USGS: 14164900	44.071, -122.965	2007-03-22 ~2022-09-30
		Spring Spawning (May 1- Jun. 15): 2442			
		Fall Spawning (Sep. 1- Oct. 31): 1630			
	Outfall 003 - Storm Ditch near 42nd St.	0	StreamStats. The storm ditch is not represented on the StreamStats network. Used nearest location on Q Street Canal	44.0623, -123.0069	
J.H. Baxter & Co., Inc. (6553)	Amazon Diversion Canal	0.6	StreamStats	44.062, -123.196	
JLR, LLC (32536)	Pudding River	6.9	USGS: 14201340	45.151, -122.804	1997-10-01 ~2022-09-30
Junction City STP (44509)	Flat Creek	0	StreamStats	44.218, -123.23	
Kingsford Manufacturing Company - Springfield Plant (46000)	Patterson Slough	0	StreamStats. Patterson Slough is not represented on the StreamStats network. Used nearest location.	44.062, -123.063	

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
Knoll Terrace Mhc (46990)	Mountain View Creek	0	StreamStats	44.625, -123.227	
Lakewood Utilities, Ltd (96110)	Mill Creek	0	StreamStats	45.206, -122.789	
Lane Community College (48854)	Russel Creek	0	StreamStats	44.009, -123.037	
Lowell STP (51447)	Dexter Reservoir (20 feet from penstock)	1002	USGS Gage 14150000. Assumed flow in the penstock as measured by USGS gage defined flow available for mixing.	43.946, -122.837	1992-10-01 ~2022-09-30
Mcfarland Cascade Pole & Lumber Co (54370)	Storm Ditch to Amazon Creek	0	StreamStats	44.092, -123.198	
Molalla Municipal Water Treatment Plant (109846)	Molalla River	0	StreamStats	45.129, -122.54	
Molalla STP (57613)	Molalla River	56	StreamStats	45.15, -122.544	
Mt. Angel STP (58707)	Pudding River	6.6	USGS: 14201340 - 14201300	45.151, -122.804 45.100, -122.822	1997-10-01 ~2022-09-30
Murphy Veneer, Foster Division (97070)	Wiley Creek	4.2	USGS: 14187000	44.372, -122.623	1992-10-01 ~2022-09-30
Norpac Foods- Plant #1, Stayton (84820)	Salem Ditch	0	StreamStats	44.799, -122.806	
Norpac Foods - Brooks Plant No. 5 (84791)	Fitzpatrick Creek	0	StreamStats	45.056, -122.955	
Oakridge STP (62886)	Middle Fork Willamette River	514	USGS: 14148000 - 14147500	43.801, -122.561 43.757, -122.505	1992-10-01 ~2022-09-30
ODC - Oregon State Penitentiary (109727)	Mill Creek	6.5	StreamStats	44.931, -123.007	
ODFW - Leaburg Hatchery (64490)	McKenzie River	Annual: 1537 Spring Spawning (May 1-Jun. 15): 2442 Fall Spawning (Sep. 1-Oct. 31): 1630	USGS: 14164900	44.071, -122.965	2007-03-22 ~2022-09-30

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
ODFW - Marion Forks Hatchery (64495)	Horn Creek	6.3	DEQ permit renewal fact sheet, Appendix D. (DEQ, 2022)	44.135, -122.610	
ODFW – McKenzie River Hatchery (64500)	McKenzie River	Annual: 1537 Spring Spawning (May 1- Jun. 15): 2442 Fall Spawning (Sep. 1- Oct. 31): 1630	USGS: 14164900	44.071, -122.965	2007-03-22 ~2022-09-30
ODFW - Roaring River Hatchery (64525)	Roaring River	0.5	StreamStats	44.627, -122.719	
ODFW - Willamette Fish Hatchery (64585)	Salmon Creek	110	StreamStats	43.748, -122.444	
Philomath WTP (100048)	Marys River	6.7	USGS: 14171000	44.525, -123.334	2000-09-30 ~2022-09-30
Philomath WWTP (103468)	Marys River	6.7	USGS: 14171000	44.525, -123.334	2000-09-30 ~2022-09-30
Row River Valley Water District	Layng Creek	12	StreamStats	43.704, -122.753	
RSG Forest Products - Liberal (72596)	Molalla River	0	StreamStats	45.191, -122.592	
Sandy WWTP (78615)	Tickle Creek	0.2	StreamStats	45.405, -122.347	
SCIO STP (79633)	Thomas Creek	6.9	USGS: 14188800	44.712, -122.770	2002-10-01 ~2022-09-30
Seneca Sawmill Company (80207)	Ditch to A-1 Amazon Channel	0	StreamStats	44.116, -123.174	
SFPP, L.P. (103159)	Flat Creek	0	StreamStats	44.092, -123.149	
Sherman Bros. Trucking (36646)	Little Muddy Creek	0.2	StreamStats	44.285, -123.06	
Silverton STP (81395)	Silver Creek	14	StreamStats	45.008, -122.803	
Sunstone Circuits (26788)	Milk Creek	10.5	Using 7Q10 reported in 2008 TMDL		
Tangent STP (87425)	Calapooia River	20	StreamStats	44.553, -123.147	
Timberlake STP (90948)	Clackamas River	254	StreamStats	45.087, -122.065	
USFW - Eagle Creek National Fish Hatchery (91035)	Eagle Creek	21	StreamStats	45.278, -122.196	

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
Veneta STP (92762)	Long Tom River	6.4	USGS: 14166500	44.050, -123.426	1992-10-01 ~2022-09-30
WES (Boring STP) (16592)	North Fork Deep Creek	0.24	2009 mixing zone study (WES, 2009).		Based off of four years of flow data measured at the facility
Westfir STP (94805)	N Fk Middle Fk Willamette R	174	StreamStats	43.759, -122.522	
Willamette Leadership Academy (34040)	Wild Hog Creek	0	StreamStats	43.991, -123.007	
Woodburn WWTP (98815)	Pudding River	6.9	USGS: 14201340	45.151, -122.804	1997-10-01 ~2022-09-30
U.S. Army Corp of Engineers, Cougar Project (126712)	South Fork McKenzie River	236	USGS: 14159500	44.131, -122.244	1992-10-01 ~2022-09-30
U.S. Army Corp of Engineers, Detroit Project (126716)	Big Cliff Reservoir	743	USACE flow data at Detroit Dam	44.723, -122.251	2004-10-01 ~2024-09-30
U.S. Army Corp of Engineers, Green Peter Project (126717)	Middle Santiam River	33	USACE flow data at Green Peter	44.449, -122.550	2004-01-01 ~2024-06-01
U.S. Army Corp of Engineers, Hills Creek Project (126699)	Middle Fork Willamette River	309	USGS: 14145500	43.711, -122.424	1992-10-01 ~2022-09-30
U.S. Army Corp of Engineers, Lookout Point Project (126700)	Dexter Reservoir	1145	USACE flow data at Lookout Point	43.915, -122.754	2004-01-01 ~2024-06-01
Adair Village STP (500)	Willamette River	Annual: 3877 Spring Spawning (Apr. 1 - May 15): 6308 Fall Spawning (Oct.15 - Nov.30): 4443	USGS: 14174000	44.639, -123.107	1992-10-1 ~ 2022-09-30
AM WRF (1098)	Willamette River	Annual: 3877 Spring Spawning (Apr. 1 - May 15): 6308	USGS: 14174000	44.639, -123.107	1992-10-1 ~ 2022-09-30

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
		Fall Spawning (Oct.15 - Nov.30): 4443			
ARKEMA (68471)	Willamette River	Tier 1: Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
		Tier 2: Annual: 6740			
Ash Grove Cement - Rivergate Lime Plant (3690)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
ATI Millersburg Teledyne Wah Chang (87645)	Willamette River	Annual: 3877	USGS: 14174000	44.639, -123.107	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 6308			
		Fall Spawning (Oct.15 - Nov.30): 4443			
BDC/Willamette LLC (109444)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
WES Blue Heron Discharge. (72634)	Willamette River	Annual: 5988	USGS: 14197900 + 14207500	45.285, -122.961 45.351, -122.676	2001-10-01 ~ 2022-09-30
Brooks Sewage Treatment Plant (100077)	Willamette River	Annual: 5684	USGS: 14191000	44.944, -123.043	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 10688			
		Fall Spawning (Oct.15 - Nov.30): 7133			
Canby Regency Mobile Home Park (97612)	Willamette River	Annual: 5790	USGS: 14197900 + 14200000 + 14202000	45.285, -122.961 45.244, -122.687 45.233, -122.750	2002-10-01 ~ 2022-09-30
Canby STP (13691)	Willamette River	Annual: 5790	USGS: 14197900 + 14200000 + 14202000	45.285, -122.961 45.244, -122.687 45.233, -122.750	2002-10-01 ~ 2022-09-30
Cascade Pacific Pulp, LLC (36335)	Willamette River	Annual: 3609		44.270, -123.174	1992-10-1 ~ 2022-09-30

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
		Spring Spawning (Apr. 1 - May 15): 5330	USGS/OWRD: 14166000 + 14170000	44.313, -123.296	
		Fall Spawning (Oct.15 - Nov.30): 4280			
Century Meadows Sanitary System (CMSS) (96010)	Willamette River	Annual: 5734	USGS: 14197900	45.285, -122.961	2001-10-01 ~ 2022-09-30
Corvallis STP (20151)	Willamette River	Annual: 3683	USGS: 14171600	44.566, -123.257	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 5800			
		Fall Spawning (Oct.15 - Nov.30): 4149			
Cottage Grove Lumber (96188)	Coast Fork Willamette River	Annual: 38	USGS: 14153500	43.721, -123.050	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 61			
		Fall Spawning (Jan.15 - NA): NA			
Cottage Grove STP (20306)	Coast Fork Willamette River	Annual: 38	USGS: 14153500	43.721, -123.050	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 61			
		Fall Spawning (Jan.15 - NA): NA			
Covanta Marion, Inc (89638)	Willamette River	Annual: 5684	USGS: 14191000	44.944, -123.043	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 10688			

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
		Fall Spawning (Oct.15 - Nov.30): 7133			
Dundee STP (25567)	Willamette River	Annual: 5734	USGS: 14197900	45.285, -122.961	2001-10-01 ~ 2022-09-30
Evraz Oregon Steel (64905)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
Forest Park Mobile Village (30554)	Willamette River	Annual: 5988	USGS: 14197900 + 14207500	45.285, -122.961 45.351, -122.676	2001-10-01 ~ 2022-09-30
Frank Lumber Co. Inc. (30904)	North Santiam River	Annual: 859	USGS: 14181500	44.754, -122.297	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - Jun. 15): 987			
		Fall Spawning (Sep.1 - Nov.30): 957			
Hollingsworth & Vose Fiber Co - Corvallis (28476)	Willamette River	Annual: 3683	USGS: 14171600	44.566, -123.257	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 5800			
		Fall Spawning (Oct.15 - Nov.30): 4149			
Halsey Mill (105814)	Willamette River	Annual: 3609	USGS/OWRD: 14166000 + 14170000	44.270, -123.174 44.313, -123.296	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 5330			
		Fall Spawning (Oct.15 - Nov.30): 4280			
	Willamette River	Annual: 3480	USGS: 14166000	44.270, -123.174	1992-10-1 ~ 2022-09-30

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
Harrisburg Lagoon Treatment Plant (105415)		Spring Spawning (Apr. 1 - May 15): 5204			
		Fall Spawning (Oct.15 - Nov.30): 3853			
Independence STP (41513)	Willamette River	Annual: 5684	USGS: 14191000	44.944, -123.043	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 10688			
		Fall Spawning (Oct.15 - Nov.30): 7133			
Jasper Wood Products, LLC (100097)	Middle Fork Willamette River	Annual: 1089	USGS: 1415000 + 14141000	43.946, -122.837 43.944, -122.775	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - Jun. 15): 1097			
		Fall Spawning (Sep.15 - Nov.30): 1589			
Jefferson STP (43129)	Santiam River	Annual: 1144	USGS: 14189000	44.715, -123.014	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 3275			
		Fall Spawning (Oct.15 - Nov.30): 2278			
Lebanon WWTP (49764)	South Santiam River	Annual: 506	USGS/OWRD: 14187500 - 14187600	44.498, -122.823 44.515, -122.865	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 1043			

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
		Fall Spawning (Oct.15 - Nov.30): 726			
Monmouth STP (57871)	Willamette River	Annual: 5684	USGS: 14191000	44.944, -123.043	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 9945			
		Fall Spawning (Oct.15 - Nov.30): 7133			
Monroe STP (57951)	Long Tom River	Annual: 22	USGS: 14170000	44.313, -123.296	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 31): 55			
		Fall Spawning (Dec.1 - Dec.31): 83			
MWMC - Eugene/Springfield STP (55999)	Willamette River	Annual: 1508	USGS/OWRD: 14157500 + 14152000	43.980, -122.966 43.998, -122.906	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 1906			
		Fall Spawning (Oct.15 - Nov.30): 1925			
Newberg OR, LLC (72615)	Willamette River	Annual: 5734	USGS: 14197900	45.285, -122.961	2001-10-01 ~ 2022-09-30
Newberg - Wynooski Road STP (102894)	Willamette River	Annual: 5734	USGS: 14197900	45.285, -122.961	2001-10-01 ~ 2022-09-30
NW Natural Gas Site Remediation (120589)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
Oak Lodge Water Services Water Reclamation Facility (62795)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
ODFW - Clackamas River Hatchery (64442)	Clackamas River	Annual: 627	USGS: 14210000	45.300, -122.354	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - Jun. 15): 1186			
		Fall Spawning (Sep.1 - Nov.30): 645			
ODFW - Dexter Ponds (64450)	Middle Fork Willamette River	Annual: 1002	USGS: 14150000	43.946, -122.837	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - Jun. 15): 986			
		Fall Spawning (Sep.15 - Nov.30): 1301			
ODFW - Minto Fish Facility (Marion Forks Hatchery) (64495)	North Santiam River	Annual: 859	USGS: 14181500	44.754, -122.297	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - Jun. 15): 987			
		Fall Spawning (Sep.1 - Nov.30): 957			
ODFW - South Santiam Hatchery (64560)	South Santiam River	Annual: 621	USGS: 14187200	44.412, -122.689	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - Jun. 15): 841			
		Fall Spawning (Sep.1 - Nov.30): 677			
OHSU Center For Health And Healing (113611)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
	Willamette River	Annual: 3683	USGS: 14171600	44.566, -123.257	1992-10-1 ~ 2022-09-30

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
OSU John L. Fryer Aquatic Animal Health Lab (103919)		Spring Spawning (Apr. 1 - May 15): 5800			
		Fall Spawning (Oct.15 - Nov.30): 4149			
Salem Willow Lake STP (78140)	Willamette River	Annual: 5684	USGS: 14191000	44.944, -123.043	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - May 15): 10688			
		Fall Spawning (Oct.15 - Nov.30): 7133			
Scappoose STP (78980)	Multnomah Channel	Annual: 10.4	StreamStats		
		Spring Spawning (Apr. 1 - May 15): 991			
		Fall Spawning (Jan.1 - NA): NA			
Siltronic Corporation (93450)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
SLLI (74995)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
Stayton STP (84781)	North Santiam River	Annual: 914	USGS: 14183000	44.789, -122.617	1992-10-1 ~ 2022-09-30
		Spring Spawning (Apr. 1 - Jun. 15): 1482			
		Fall Spawning (Sep.1 - Nov.30): 1018			
Sweet Home STP (86840)	South Santiam River	Annual: 621	USGS: 14187200	44.412, -122.689	1992-10-1 ~ 2022-09-30

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
		Spring Spawning (Apr. 1 - Jun. 15): 841			
		Fall Spawning (Sep.1 - Nov.30): 677			
Tryon Creek WWTP (70735)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
Univar USA Inc (100517)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
Vigor Industrial (70596)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
WES Blue Heron Discharge. (72634)	Willamette River	Annual: 5988	USGS: 14197900 + 14207500	45.285, -122.961 45.351, -122.676	2001-10-01 ~ 2022-09-30
WES (Kellogg Creek WWTP) (16590)	Willamette River	Annual: 6740	USGS: 14197900 + 14207500 + 14211010	45.285, -122.961 45.351, -122.676 45.379, -122.577	2001-06-01 ~ 2022-09-30
WES (Tri-City WPCP) (89700)	Willamette River	Annual: 5988	USGS: 14197900 + 14207500	45.285, -122.961 45.351, -122.676	2001-10-01 ~ 2022-09-30
Willamette Falls Paper Company (21489)	Willamette River	Annual: 5988	USGS: 14197900 + 14207500	45.285, -122.961 45.351, -122.676	2001-10-01 ~ 2022-09-30
Wilsonville STP (97952)	Willamette River	Annual: 5734	USGS: 14197900	45.285, -122.961	2001-10-01 ~ 2022-09-30

7 Pollutant sources and load contributions

A key element of TMDL development is a complete, comprehensive source assessment for the relevant water quality pollutant(s). This includes identification of all relevant point and nonpoint sources to the impaired waterbody, characterization/quantification of their pollutant load contributions, determination of seasonal variation, and delineation of periods when applicable temperature criteria are exceeded at various locations, to the extent that existing data allow. The TMDL report and its appendices describe the significant thermal pollutant sources identified within the Willamette Subbasins temperature TMDL area and the data sources that DEQ utilized for TMDL modeling.

7.1 Point sources

Individual and general NPDES permittees were identified as significant sources of thermal loading to streams in the Willamette Subbasins.

7.1.1 Individual NPDES permitted point sources

There are 69 domestic or industrial individual NPDES permitted point source discharges and 21 individual Municipal Separate Storm Sewer System (MS4) NPDES permittees within the Willamette Subbasins project area (**Table 7-1** and **Table 7-2**). The specific AUs where these NPDES permitted point source discharge is summarized in Appendix D.

The USACE submitted applications to DEQ for individual NPDES permits for non-contact cooling water, filter backwash, and powerhouse sump discharges at Big Cliff Dam, Cougar Dam, Detroit Dam, Dexter Dam, Foster Dam, Green Peter Dam, Hills Creek Dam, and Lookout Point Dam. These discharges were also evaluated and included.

The domestic or industrial individual NPDES permitted point sources are potential sources of thermal load and were assigned numeric WLAs in this TMDL. DEQ completed a review of published literature and other studies related to stormwater runoff and stream temperature in Oregon and found there is not sufficient evidence to demonstrate that stormwater discharges authorized under the current municipal (MS4s) Phase I individual permits or registrants under the MS4 phase II, construction (1200-C), and industrial (1200-A and 1200-Z) general stormwater permits contribute to exceedances of the temperature standard.
The substantive findings are summarized below.

A review of available studies from the midwestern and eastern United States indicated that, under certain conditions, runoff from impervious pavement or runoff retained in uncovered open ponds can produce short-duration warm discharges (Herb et. al., 2008; Jones and Hunt, 2009; UNH Stormwater Center, 2011; Winston et al., 2011; Hester and Bauman, 2013). Yet, runoff temperature changes are highly dependent on many factors including air temperature, dewpoint, pavement type, percent imperviousness, and the amount of impervious surface shielded 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; Zeiger and Hubbert, 2015). When they occur, such warmed runoff discharges can create “surges” associated with typically short-duration stream temperature increases (Hester and Bauman, 2013; Wardynski et al., 2014; Zeiger and Hubbert, 2015). However, studies that evaluated stormwater discharges over longer (e.g., 7-day) averaging periods such as those used in assessing TMDL attainment (i.e., 7DADM) did not indicate exceedances above biologically-based benchmarks (Wardynski et al., 2014; WDOE, 2011a and 2011b).

Additionally, DEQ evaluated rainfall, cloud cover, air temperature, and stream temperature data from warm seasons for three years in the Miles Creeks area of the Middle Columbia-Hood Subbasin (DEQ, 2008b). DEQ concluded that stormwater discharges likely do not to contribute to temperature standard exceedances in the study area. This is because (1) the standard is based on 7DADM temperatures such that a majority of days within each 7-day period would need have precipitation-runoff influences to affect the 7DADM, (2) exceedances are assessed for the critical summer period, and (3) 95% of summer time 7-day periods had fewer than 3 days of rain, while 80% had less than one day of rain. Thus, there are generally not enough runoff events to significantly influence 7DADMs for temperature in the critical period of this TMDL.

Portland International Airport is an individual NPDES permitted point source that only discharges stormwater during the TMDL allocation period. Portland International Airport is prohibited in the current NPDES permit from discharging from June 1 to September 30. Since Portland International Airport discharges entirely stormwater from April 1 to May 31, it is included in **Table 7-2** as a stormwater facility.

Table 7-1: Individual NPDES permitted point source discharges that have the potential to contribute thermal loads to Willamette Subbasins streams at a frequency and magnitude to cause exceedances to the temperature standard.

Permittee	Permit type	DEQ WQ File Number	EPA Number	Receiving water name (AU ID)	River mile
Adair Village STP	NPDES-DOM-Da	500	OR0023396	Willamette River (OR_SR_1709000306_05_103854)	122
Albany Millersburg WRF	NPDES-DOM-Ba	1098	OR0028801	Willamette River (OR_SR_1709000306_05_103854)	118
Alpine Community	NPDES-DOM-Db	100101	OR0032387	Muddy Creek (OR_SR_1709000302_02_103808)	25.6
Arclin	NPDES-IW-B10	81714	OR0000892	Columbia Slough (OR_WS_170900120201_02_104554.1)	6
Arclin	NPDES-IW-B16	16037	OR0021857	Patterson Slough (OR_WS_170900030601_02_104287)	1.8
Arkema	NPDES-IW-B14	68471	OR0044695	Willamette River (OR_SR_1709001202_88_104175)	7.2
Ash Grove Cement - Rivergate Lime Plant	NPDES-IW-B16	3690	OR0001601	Willamette River (OR_SR_1709001202_88_104175)	3.3
ATI Albany Operations	NPDES-IW-B08	64300	OR0001716	Oak Creek (OR_WS_170900030402_02_104273)	1.6
ATI Millersburg	NPDES-IW-B07	87645	OR0001112	Willamette River (OR_SR_1709000306_05_103854)	2
Aumsville STP	NPDES-DOM-Db	4475	OR0022721	Beaver Creek (OR_WS_170900070202_02_104410)	2.5
Aurora STP	NPDES-DOM-Db	110020	OR0043991	Pudding River (OR_SR_1709000905_02_104088)	8.8
Bakelite Chemicals LLC	NPDES-IW-B16	32864	OR0002101	Amazon Creek (OR_WS_170900030108_02_104250)	2.7
Bakelite Chemicals LLC	NPDES-IW-B16	32650	OR0032107	Murder Creek (OR_WS_170900030610_02_104298)	0.6
Blount Oregon Cutting Systems Division	NPDES-IW-B16	63545	OR0032298	Minthorne Creek (OR_WS_170900120102_02_104551)	0.9
Boeing Of Portland – Fabrication Division	NPDES-IW-B16	9269	OR0031828	Osburn Creek (OR_WS_170900120201_02_104554.2)	1.6
Brooks STP	NPDES-DOM-Db	100077	OR0033049	Willamette River (OR_SR_1709000703_04_104013)	71.7
Brownsville STP	NPDES-DOM-Db	11770	OR0020079	Calapooia River (OR_SR_1709000303_02_103816)	31.6

Permittee	Permit type	DEQ WQ File Number	EPA Number	Receiving water name (AU ID)	River mile
Canby Regency Mobile Home Park	NPDES-DOM-Da	97612	OR0026280	Willamette River (OR_SR_1709000704_88_104020)	31.6
Canby STP	NPDES-DOM-C1a	13691	OR0020214	Willamette River (OR_SR_1709000704_88_104020)	33
Cascade Pacific Pulp, LLC	NPDES-IW-B01	36335	OR0001074	Willamette River (OR_SR_1709000306_05_103854)	147.7
Century Meadows Sanitary System (CMSS)	NPDES-DOM-Da	96010	OR0028037	Willamette River (OR_SR_1709000704_88_104020)	42.8
Coburg Wastewater Treatment Plant	NPDES-DOM-Da	115851	OR0044628	Muddy Creek (OR_WS_170900030606_02_104294)	50.7
Coffin Butte Landfill	NPDES-IW-B15	104176	OR0043630	Roadside ditch to Soap Creek tributary (OR_WS_170900030511_02_104285)	4.5
Columbia Helicopters	NPDES-IW-B16	100541	OR0033391	Unnamed Stream (tributary to Pudding River) (OR_WS_170900090502_02_104481)	2
Corvallis STP	NPDES-DOM-Ba	20151	OR0026361	Willamette River (OR_SR_1709000306_05_103854)	130.8
Cottage Grove STP	NPDES-DOM-C2a	20306	OR0020559	Coast Fork Willamette River (OR_SR_1709000203_02_104585)	20.6
Covanta Marion, Inc	NPDES-IW-B16	89638	OR0031305	Willamette River (OR_SR_1709000703_04_104013)	72
Creswell STP	NPDES-DOM-Db	20927	OR0027545	~~Unnames~~Unnamed stream (tributary to Camas Swale Creek) (OR_WS_170900020403_02_104240)	4
Dallas STP	NPDES-DOM-C1a	22546	OR0020737	Rickreall Creek (OR_SR_1709000701_02_104591)	9.3
Dundee STP	NPDES-DOM-Db	25567	OR0023388	Willamette River (OR_SR_1709000703_04_104013)	51.7
Duraflake	NPDES-IW-B20	97047	OR0000426	Murder Creek (OR_WS_170900030610_02_104298)	0.57
Estacada STP	NPDES-DOM-Da	27866	OR0020575	Clackamas River (OR_LK_1709001106_02_100850)	23.3
Evraz Oregon Steel	NPDES-IW-B08	64905	OR0000451	Willamette River (OR_SR_1709001202_88_104175)	2.4
EWEB Carmen-Smith Trail Bridge Powerhouse	NPDES-IW-B16	28393	OR0000680	McKenzie River (OR_SR_1709000402_02_104588)	76
EWEB Carmen-Smith Carmen Powerhouse	NPDES-IW-B16	28393	OR0000680	Trail Bridge Reservoir/McKenzie River (OR_LK_1709000402_02_100742)	77
Falls City STP	NPDES-DOM-Da	28830	OR0032701	Little Luckiamute River (OR_SR_1709000305_02_103822)	12
Forest Park Mobile Village	NPDES-DOM-Da	30554	OR0031267	Willamette River (OR_SR_1709000704_88_104020)	28.2
Foster Farms	NPDES-IW-B04	97246	OR0026450	Camas Swale Creek (OR_SR_1709000204_02_103786)	3.3
Frank Lumber Co. Inc.	NPDES-IW-B19	30904	OR0000124	North Santiam River (OR_SR_1709000504_02_103906)	32.5

Permittee	Permit type	DEQ WQ File Number	EPA Number	Receiving water name (AU ID)	River mile
Fujimi Corporation – SW Commerce Circle	NPDES-IW-B15	107178	OR0040339	Coffee Lake Creek (OR_WS_170900070402_02_104419)	1.8
Gervais STP	NPDES-DOM-Db	33060	OR0027391	Pudding River (OR_SR_1709000902_02_104073)	28.2
GP Halsey Mill	NPDES-IW-B01	105814	OR0033405	Willamette River (OR_SR_1709000306_05_103854)	147.7
Halsey STP	NPDES-DOM-Db	36320	OR0022390	Muddy Creek (OR_SR_1709000306_02_103838)	23
Harrisburg Lagoon Treatment Plant	NPDES-DOM-Db	105415	OR0033260	Willamette River (OR_SR_1709000306_05_103854)	158.4
Hollingsworth & Vose Fiber Co - Corvallis	NPDES-IW-B15	28476	OR0000299	Willamette River (OR_SR_1709000306_05_103854)	132.5
Hubbard STP	NPDES-DOM-Da	40494	OR0020591	Mill Creek (OR_WS_170900090502_02_104481)	5.3
Hull-Oakes Lumber Co.	NPDES-IW-B19	107228	OR0038032	Oliver Creek (OR_SR_1709000302_02_103807)	4.8
Independence STP	NPDES-DOM-Db	41513	OR0020443	Willamette River (OR_SR_1709000701_05_104005)	95.5
International Paper – Springfield Paper Mill (Outfall 1 + Outfall 2)	NPDES-IW-B01	96244	OR0000515	McKenzie River (OR_SR_1709000407_02_103884)	8
International Paper – Springfield Paper Mill (Outfall 3)	NPDES-IW-B01	96244	OR0000515	Storm Ditch to Q Street Canal (OR_WS_170900030601_02_104287)	0
J.H. Baxter & Co., Inc.	NPDES-IW-B21	6553	OR0021911	Amazon Diversion Canal (OR_WS_170900030108_02_104250)	1.5
Jasper Wood Products, LLC	NPDES-IW-B21	100097	OR0042994	Middle Fork Willamette River (OR_SR_1709000110_02_104584)	9
Jefferson STP	NPDES-DOM-Da	43129	OR0020451	Santiam River (OR_SR_1709000506_02_103927)	9.2
JLR, LLC	NPDES-IW-B05	32536	OR0001015	Pudding River (OR_SR_1709000902_02_104073)	27
Junction City STP	NPDES-DOM-Db	44509	OR0026565	Flat Creek (OR_WS_170900030603_02_104290)	9.2
Kingsford Manufacturing Company – Springfield Plant	NPDES-IW-B20	46000	OR0031330	Patterson Slough (OR_WS_170900030601_02_104287)	3.7
Knoll Terrace MHC	NPDES-DOM-Db	46990	OR0026956	Mountain View Creek (OR_WS_170900030609_02_104297)	0.4
Lakewood Utilities, Ltd	NPDES-DOM-Da	96110	OR0027570	Mill Creek (Molalla-Pudding Subbasin) (OR_WS_170900090502_02_104481 _	3.9
Lane Community College	NPDES-DOM-Db	48854	OR0026875	Russel Creek (OR_WS_170900020405_02_104242)	0.7

Permittee	Permit type	DEQ WQ File Number	EPA Number	Receiving water name (AU ID)	River mile
Lebanon WWTP	NPDES-DOM-C1a	49764	OR0020818	South Santiam River (OR_SR_1709000608_02_103925)	17.4
Lowell STP	NPDES-DOM-Da	51447	OR0020044	Dexter Reservoir 20 ft upstream of the Dexter dam penstock (OR_LK_1709000107_02_100699)	
Mcfarland Cascade Pole & Lumber Co	NPDES-IW-B21	54370	OR0031003	Storm Ditch to Amazon Creek (OR_WS_170900030108_02_104250)	1.8
Molalla STP	NPDES-DOM-Db	57613	OR0022381	Molalla River (OR_SR_1709000906_02_104093)	8.2
Monmouth STP	NPDES-DOM-Db	57871	OR0020613	Willamette River (OR_SR_1709000701_05_104005)	95.5
Monroe STP	NPDES-DOM-Db	57951	OR0029203	Long Tom River (OR_SR_1709000301_02_103791)	6.9
Mt. Angel STP	NPDES-DOM-Da	58707	OR0028762	Pudding River (OR_SR_1709000901_02_104064)	37.5
Murphy Veneer, Foster Division	NPDES-IW-B20	97070	OR0021741	Wiley Creek (OR_SR_1709000605_02_103971)	0.9
MWMC - Eugene/Springfield STP	NPDES-DOM-A2	55999	OR0031224	Willamette River (OR_SR_1709000306_05_103854)	178
Newberg - Wynooski Road STP	NPDES-DOM-C1a	102894	OR0032352	Willamette River (OR_SR_1709000703_88_104015)	49.7
Newberg OR, LLC	NPDES-IW-B01	72615	OR0000558	Willamette River (OR_SR_1709000703_88_104015)	49.7
Norpac Foods – Brooks Plant No. 5	NPDES-IW-B04	84791	OR0021261	Fitzpatrick Creek (OR_WS_170900090109_02_104462)	1
Norpac Foods-Plant #1, Stayton	NPDES-IW-B04	84820	OR0001228	Salem Ditch (flows to Mill Creek) (OR_WS_170900070201_02_104409)	3.7
NW Natural Gas Site Remediation	NPDES-IW-B14	120589	OR0044687	Willamette River (OR_SR_1709001202_88_104175)	6.4
Oak Lodge Water Services Water Reclamation Facility	NPDES-DOM-C1a	62795	OR0026140	Willamette River (OR_SR_1709001201_88_104019)	20.1
Oakridge STP	NPDES-DOM-Da	62886	OR0022314	Middle Fork Willamette River (OR_SR_1709000105_02_103720)	39.8
ODC – Oregon State Penitentiary	NPDES-IW-B15	109727	OR0043770	Mill Creek (Middle Willamette Subbasin) (OR_SR_1709000703_02_104007)	2.5
ODFW - Clackamas River Hatchery	NPDES-IW-B17	64442	OR0034266	Clackamas River (OR_SR_1709001106_02_104597)	22.6
ODFW - Dexter Ponds	GEN 300-J	64450	ORG133514	North Santiam River (OR_SR_1709000504_02_103906)	41.1
ODFW – Leaburg Hatchery	NPDES-IW-B17	64490	OR0027642	McKenzie River (OR_SR_1709000407_02_103884)	33.7
ODFW – Marion Forks Hatchery	NPDES-IW-B17	64495	OR0027847	Horn Creek (OR_WS_170900050203_02_104345)	0.1

Permittee	Permit type	DEQ WQ File Number	EPA Number	Receiving water name (AU ID)	River mile
ODFW – McKenzie River Hatchery	NPDES-IW-B17	64500	OR0029769	McKenzie River (OR_SR_1709000407_02_103884)	31.5
ODFW - Minto Fish Facility	NPDES-IW-B17	64495	OR0027847	Middle Fork Willamette River (OR_SR_1709000107_02_104583)	
ODFW - South Santiam Hatchery	GEN 300-J	64560	ORG133511	South Santiam River (OR_SR_1709000608_02_103925)	
OHSU Center For Health and Healing	NPDES-IW-B16	113611	OR0034371	Willamette River (OR_SR_1709001202_88_104175)	14.5
OSU John L. Fryer Aquatic Animal Health Lab	NPDES-IW-B15	103919	OR0032573	Willamette River (OR_SR_1709000306_05_103854)	130.6
Philomath WWTP	NPDES-DOM-Db	103468	OR0032441	Marys River (OR_SR_1709000302_02_103813)	10.2
RSG Forest Products – Liberal	NPDES-IW-B19	72596	OR0021300	Unnamed ditch to Molalla River (OR_WS_170900090607_02_104488)	9.8
Salem Willow Lake STP	NPDES-DOM-A2	78140	OR0026409	Willamette River (OR_SR_1709000703_04_104013)	78.4
Sandy WWTP	NPDES-DOM-Da	78615	OR0026573	Tickle Creek (OR_WS_170900110604_02_104546)	3.1
Scappoose STP	NPDES-DOM-Da	78980	OR0022420	Multnomah Channel (OR_SR_1709001203_88_104184)	10.6
Scio STP	NPDES-DOM-Db	79633	OR0029301	Thomas Creek (OR_SR_1709000607_02_103988)	7.2
Seneca Sawmill Company	NPDES-IW-B19	80207	OR0022985	Ditch to A-1 Amazon Channel (OR_WS_170900030108_02_104250)	7.0
SFPP, L.P.	NPDES-IW-B15	103159	OR0044661	Unnamed tributary to Flat Creek (OR_WS_170900030603_02_104290)	7.9
Sherman Bros. Trucking	NPDES-DOM-Db	36646	OR0021954	Little Muddy Creek (OR_SR_1709000306_02_103838)	8
Siltronic Corporation	NPDES-IW-B14	93450	OR0030589	Willamette River (OR_SR_1709001202_88_104175)	6.6
Silverton STP	NPDES-DOM-C1a	81395	OR0020656	Silver Creek (OR_SR_1709000901_02_104595)	2.4
SLLI	NPDES-IW-B15	74995	OR0001741	Willamette River (OR_SR_1709001202_88_104175)	7
Stayton STP	NPDES-DOM-C2a	84781	OR0020427	North Santiam River (OR_SR_1709000506_02_103930)	14.9
Sunstone Circuits	NPDES-IW-B15	26788	OR0031127	Milk Creek (OR_SR_1709000906_02_104091)	5.3
Sweet Home STP	NPDES-DOM-C2a	86840	OR0020346	South Santiam River (OR_SR_1709000608_02_103925)	31.5
Tangent STP	NPDES-DOM-Db	87425	OR0031917	Calapooia River (OR_SR_1709000304_02_103821)	10.8
Timberlake STP	NPDES-DOM-Da	90948	OR0023167	Clackamas River (OR_SR_1709001104_02_104155)	51.1
Tryon Creek WWTP	NPDES-DOM-Ba	70735	OR0026891	Willamette River (OR_SR_1709001201_88_104019)	20.3
U.S. Army Corp of Engineers Big Cliff Project	NPDES-DOM-Da	126715	Not Assigned	North Santiam River (OR_SR_1709000504_02_103906)	45.2

Permittee	Permit type	DEQ WQ File Number	EPA Number	Receiving water name (AU ID)	River mile
U.S. Army Corp of Engineers Cougar Project	NPDES-DOM-Da	126712	Not Assigned	South Fork McKenzie River (OR_SR_1709000403_02_104590)	4.5
U.S. Army Corp of Engineers Detroit Project	NPDES-DOM-Da	126716	Not Assigned	Big Cliff Reservoir (OR_LK_1709000503_02_100770)	0
U.S. Army Corp of Engineers Dexter Project	NPDES-DOM-Da	126714	Not Assigned	Middle Fork Willamette River (OR_SR_1709000107_02_104583)	15.7
U.S. Army Corp of Engineers Foster Project	NPDES-DOM-Da	126713	Not Assigned	South Santiam River (OR_SR_1709000608_02_103925)	35.7
U.S. Army Corp of Engineers Green Peter Project	NPDES-DOM-Da	126717	Not Assigned	Middle Santiam River (OR_SR_1709000604_02_103969)	5.3
U.S. Army Corp of Engineers Hills Creek Project	NPDES-DOM-Da	126699	Not Assigned	Middle Fork Willamette River (OR_SR_1709000105_02_104580)	44.3
U.S. Army Corp of Engineers Lookout Point Project	NPDES-DOM-Da	126700	Not Assigned	Dexter Reservoir (OR_LK_1709000107_02_100699)	0
Univar USA Inc	NPDES-IW-B15	100517	OR0034606	Willamette River (OR_SR_1709001202_88_104175)	9
USFW – Eagle Creek National Fish Hatchery	NPDES-IW-B17	91035	OR0000710	Eagle Creek (OR_SR_1709001105_02_104162)	12.3
Veneta STP	NPDES-DOM-Db	92762	OR0020532	Long Tom River (OR_SR_1709000301_02_103789)	34.9
Vigor Industrial	NPDES-IW-B15	70596	OR0022942	Willamette River (OR_SR_1709001202_88_104175)	8.2
WES (- Boring STP)	NPDES-DOM-Db	16592	OR0031399	North Fork Deep Creek (OR_WS_170900110605_02_104547)	3
WES - Blue Heron Discharge	NPDES-IW-B01	72634	OR0000566	Willamette River (OR_SR_1709000704_88_104020)	27.8
WES - Kellogg Creek WWTP	NPDES-DOM-A3	16590	OR0026221	Willamette River (OR_SR_1709001201_88_104019)	18.5
WES - Tri-City WPCP	NPDES-DOM-A3	89700	OR0031259	Willamette River (OR_SR_1709000704_88_104020)	25.5
Westfir STP	NPDES-DOM-Da	94805	OR0028282	Nork Fork Middle Fork Willamette River (OR_SR_1709000106_02_103721)	1
Willamette Falls Paper Company	NPDES-IW-B01	21489	OR0000787	Willamette River (OR_SR_1709000704_88_104020)	27.5
Willamette Leadership Academy	NPDES-DOM-Db	34040	OR0027235	Wild Hog Creek (OR_WS_170900020405_02_104242)	2
Wilsonville STP	NPDES-DOM-C1a	97952	OR0022764	Willamette River (OR_SR_1709000704_88_104020)	38.5
Woodburn WWTP	NPDES-DOM-C1a	98815	OR0020001	Pudding River (OR_SR_1709000902_02_104073)	21.4

Table 7-2: Individual NPDES Municipal Separate Storm Sewer System (MS4) permittees and stormwater related individual permittees in the Willamette Subbasins.

Permittee	Permit type	DEQ WQ File Number	EPA Number
City of Eugene	NPDES-DOM-MS4-1	107989	ORS107989
City of Fairview	NPDES-DOM-MS4-1	108013	ORS108013
City of Gresham			
City Of Portland	NPDES-DOM-MS4-1	108015	ORS108015
Port of Portland			
City of Gladstone	NPDES-DOM-MS4-1	108016	ORS108016
City of Happy Valley			
City of Johnson City			
City of Lake Oswego			
City of Milwaukie			
City of Oregon City			
City of Rivergrove			
City of West Linn			
City of Wilsonville			
Clackamas County			
Oak Lodge Water Services			
WES (Clackamas Co. Service District #1)			
City of Salem	NPDES-DOM-MS4-1	108919	ORS108919
ODOT	NPDES-DOM-MS4-1	110870	ORS110870
Multnomah County	NPDES-DOM-MS4-1	120542	ORS120542
Portland International Airport	NPDES-IW-B15	107220	OR0040291

7.1.2 General NPDES permitted point sources

There are multiple categories of general NPDES permit types with registrants in the Willamette Subbasins including:

- 100-J Industrial Wastewater: NPDES cooling water
- 200-J Industrial Wastewater: NPDES filter backwash
- 300-J Industrial Wastewater: NPDES fish hatcheries
- 400-J Industrial Wastewater: NPDES log ponds
- 1200-A Stormwater: NPDES sand & gravel mining
- 1200-C Stormwater: NPDES construction more than 1-acre disturbed ground
- 1200-Z Stormwater: NPDES specific SIC codes
- 1500-A Industrial Wastewater: NPDES petroleum hydrocarbon cleanup
- 1700-A Industrial Wastewater: NPDES wash water
- MS4 – Phase ll – Stormwater: NPDES Municipal Separate Storm Sewer System

DEQ determined the following general permit categories may have potential to discharge thermal loads that contribute to exceedances of the applicable temperature criteria (**Table 7-3**):

- 100-J Industrial Wastewater: NPDES cooling water
- 200-J Industrial Wastewater: NPDES filter backwash
- 300-J Industrial Wastewater: NPDES fish hatcheries

Other registrants to the industrial wastewater general permits were found to have a de minimis temperature increase based on the permit requirements, available dilution, or frequency and magnitude of discharge. Discussion of the stormwater general permits is addressed in the stormwater review in Section 7.1.1.

Table 7-3: General NPDES permit registrants that have the potential to contribute thermal loads to Willamette Subbasins streams at a frequency or magnitude that contributes to exceedances of the temperature standard.

Registrant	General Permit	DEQ WQ File Number	EPA Number	Receiving water name (AU ID)	River mile
Americold Logistics, LLC	100-J	87663	ORG253544	Claggett Creek (OR_WS_170900070303_02_104415)	4.9
EWEB Leaburg	100-J	28391	ORG253525	Leaburg Canal (OR_SR_1709000407_02_103884)	34
EWEB Walterville	100-J	28395	ORG253526	Walterville Canal (OR_SR_1709000407_02_103884)	21
First Premier Properties - Spinnaker II Office Building	100-J	110603	ORG253511	Stone Quarry Lake (OR_LK_1709000703_02_100809)	0.8
Forrest Paint Co.	100-J	100684	ORG253508	Amazon Creek (OR_WS_170900030106_02_104248)	17.0
Holiday Plaza	100-J	108298	ORG253504	Stone Quarry Lake (OR_LK_1709000703_02_100809)	0.2
Malarkey Roofing	100-J	52638	ORG250024	Columbia Slough (OR_WS_170900120201_02_104554.1)	5.9
Miller Paint Company	100-J	103774	ORG250040	Columbia Slough OR_WS_170900120201_02_104554.2)	Un-known
Owens-Brockway Glass Container Plant	100-J	65610	ORG250029	Johnson Lake (OR_WS_170900120201_02_104554.2)	0
PCC Structurals, Inc.	100-J	71920	ORG250015	Mount Scott Creek (OR_WS_170900120102_02_104551)	2.3
Sundance Lumber Company, Inc.	100-J	107401	ORG253618	Ditch to Q Street Canal (OR_WS_170900030601_02_104287	14.0
Ventura Foods, LLC	100-J	103832	ORG250005	Unnamed tributary to Columbia Slough (OR_WS_170900120201_02_104554.2)	Un-known
Albany Water Treatment Plant	200-J	66584	ORG383501	Calapooia River (OR_SR_1709000304_02_103821)	0.1
~~Corvallis Rock Creek Water Treatment Plant~~City of Silverton Drinking WTP	200-J	81398~~2 0160~~	ORG383527 ~~ORG383513~~	Unnamed tributary to Abiqua Creek (OR_WS_170900090107_02_104460	Un-known
~~Dallas~~Corvallis Rock Creek Water Treatment Plant	200-J	~~22550~~2 0160	~~ORG383529~~ ORG383513	Rock Creek (OR_WS_170900030204_02_104256)	13.5
~~Deer Creek Estates~~Dallas Water ~~Association~~Treatment Plant	200-J	~~23650~~2 2550	~~ORG383526~~ ORG383529	Rickreall Creek (OR_SR_1709000701_02_104591)	17.0
Deer Creek Estates Water Association~~EWEB – Hayden Bridge Filter Plant~~	200-J	23650~~2 8385~~	ORG383526 ~~ORG383503~~	Mill Creek OR_WS_170900090502_02_104481)	7.1

Registrant	General Permit	DEQ WQ File Number	EPA Number	Receiving water name (AU ID)	River mile
EWEB – Hayden Bridge Filter Plant~~International Paper – Springfield~~	200-J	28385~~108921~~	ORG383503 ~~ORG383548~~	McKenzie River (OR_SR_1709000407_02_103884)	8
International Paper – Springfield~~Molalla Municipal Water Treatment Plant~~	200-J	108921 ~~109846~~	ORG383548 ~~ORG380014~~	Irving Slough (OR_WS_170900030601_02_104287)	Un-known
~~Philomath~~Molalla Municipal Water Treatment Plant	200-J	~~100048~~ 109846	~~ORG383536~~ ORG380014	Ditch to Molalla River (OR_WS_170900090607_02_104488)	Un-known
~~Row River Valley~~Philomath Water ~~District~~Treatment Plant	200-J	~~100075~~ 100048	~~ORG383534~~ ORG383536	Marys River (OR_SR_1709000302_02_103813)	12.2
~~Silverton~~Row River Valley Water ~~Treatment Plant~~District	200-J	100075 ~~81398~~	ORG383534 ~~ORG383527~~	Layng Creek (OR_SR_1709000202_02_103765)	1.4
ODFW - Dexter Ponds	300-J	64450	ORG133514	Middle Fork Willamette River (OR_SR_1709000107_02_104583)	15.7
ODFW - Roaring River Hatchery	300-J	64525	ORG133506	Roaring River (OR_SR_1709000606_02_103974)	1.1
ODFW - South Santiam Hatchery	300-J	64560	ORG133511	South Santiam River (OR_SR_1709000608_02_103925)	37.8
ODFW - Willamette Fish Hatchery	300-J	64585	ORG133507	Salmon Creek (OR_SR_1709000104_02_103719)	0.4

7.1.2.1 100-J Cooling water/heat pumps

The 100-J general permit issued on April 15, 2024 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. The 100-J permit requirements are summarized in **Table 7-4**.

Table 7-4: 100-J general permit requirements relevant for temperature.

Parameter	Limit	Notes
Effluent Flow	0.5 MGD daily maximum	No limit for hydropower facilities
Effluent Temperature	32°C daily maximum 13.3°C 7-day rolling average during periods where salmon and steelhead spawning is a designated use 9.3°C 7-day rolling average during periods where bull trout spawning is a designated use	
Excess Thermal Load Limit	Q_{ed} * S_{MZ}* 1.14 (as a 7-day rolling average in million kcal/day)	See permit Table A1-1 and Table A2-1 equation terms
Thermal Load Limit	25 daily maximum = Flow (MGD) x Effluent Temperature (°F)	No limit for hydropower facilities

To determine if registrants have potential to increase stream temperature, DEQ reviewed discharge data from available Discharge Monitoring Reports (DMRs). The effluent flows of DMRs reviewed ranged from no flow up to about 0.25 MGD. Reported temperatures ranged from 15°C to 25°C. For the TMDL analysis, DEQ used **Equation 9-3-** to estimate the temperature increase assuming 100% mix with different river flow ranges and effluent temperatures authorized by the permit. The 100-J permit requirements relevant for temperature are summarized in **Table 7-4**. Effluent flows were set between 0.005 MGD and the permit maximum of 0.5 MGD. Effluent temperatures were set at the maximum temperature allowed by the various permit limits summarized in **Table 7-4**, including the excess thermal load and thermal load limits. The thermal load limit of 25 usually determined the maximum effluent temperature at low 7Q10 flows. The river temperature was assumed to be at the applicable temperature criteria. Based on the results of this analysis, the current 100-J permit requirements authorize non-hydropower registrants to have potential thermal loads that increase stream temperatures up to a maximum of 0.30°C above the applicable temperature criteria. When river flow is 43 cfs and higher, the potential warming under all effluent cases is limited to 0.075°C or less. 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 up to 0.30°C when river flow is 68 cfs or less. Because these facilities have reasonable potential to increase stream temperature, they are provided a narrative wasteload allocation.

7.1.2.2 200-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.

To determine if registrants have potential to increase stream temperature, DEQ reviewed discharge data for all registrants using available DMRs and permit application information. Maximum effluent flows varied for each facility and ranged between 2,400 gallons/day (Deer Creek Estates Water Association) up to about 1.35 MGD (EWEB Hayden Bridge Filter Plant, June 2019). Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply and 17°C was used during the spawning period 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. During periods of no flow, the 200-J permit does not authorize discharge. If the annual 7Q10 was zero, 0.1 cfs was used for determination of a maximum effluent flow. If the DMR or permit application reported maximum effluent flow less than the dilution based effluent flow, the maximum effluent flow was used instead. An estimated change in temperature was calculated using the 7Q10 river flow, maximum reported or dilution based effluent flow, and the estimated effluent temperature and applicable temperature criteria. Based on the results, 200-J registrants have potential to increase stream temperatures up to a maximum of about 0.19°C above the year-round temperature criterion and 0.13°C above the spawning criterion (**Table 7-5**). Because these facilities have reasonable potential to increase stream temperature, they are provided a numeric WLA. It should be noted that the actual temperature increase from 200-J registrants may be less than estimated here, particularly during the spawning period when river flows are expected to be greater than the annual 7Q10.

Table 7-5: Summary of estimated temperature impacts from 200-J registrants located in the Willamette Subbasins.

NPDES Permittee WQ File# : EPA Number	Annual 7Q10* River flow (cfs)	Temp Criteria (°C)	Maximum DMR Effluent Flow (cfs)	Dilution Based or Reported Effluent Flow (cfs)	Estimated Maximum Effluent Temp (°C)	Change in Temp Year Round (°C)	Change in Temp Spawning Period (°C)
Albany Water Treatment Plant 66584 : ORG383501	24	18.0	1.3	0.80	24.0	0.19	NA
City of Silverton Drinking WTP 81398 : ORG383527	0*	18.0 13.0	0.077	0.077	24.0 17.0	0.19	0.13
Corvallis Rock Creek WTP 20160 : ORG383513	0*	18.0	0.371	0.03	24.0	0.19	NA
Dallas WTP 22550 : ORG383529	3.3	18.0 13.0	0.17	0.11	24.0 17.0	0.19	0.13
Molalla Municipal Drinking WTP 109846 : ORG380014	0*	18.0	0.080	0.16	24.0	0.19	NA
Philomath WTP 100048 : ORG383536	6.7	18.0	0.32	0.22	24.0	0.19	NA
Row River Valley Water District 100075 : ORG383534	12	18.0	0.77	0.38	24.0	0.02	NA
International Paper - Springfield 108921 : ORG383548	0*	18.0	0.77	0.77	24.0	0.19	NA
EWEB Hayden Bridge Filter Plant 28385 : ORG383503	1537	16.0 13.0	2.09	2.09	24.0 17.0	0.01	0.005
Deer Creek Estates Water Association 23650 : ORG383526	0.7	18.0	0.0037	0.0037	24.0	0.03	NA

*During periods of no flow, the 200-J permit does not authorize discharge. If the annual 7Q10 is zero, 0.1 cfs was used to calculate the 30:1 minimum dilution ratio.

7.1.2.3 300-J Fish hatcheries

The current 300-J general permit issued on 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.

DEQ reviewed effluent temperature and effluent flow data for ODFW hatcheries registered under the 300-J permit and determined they have potential thermal loads that could increase stream temperatures above the applicable temperature criteria. Because these facilities have reasonable potential to increase stream temperature, they are provided a numeric WLA.

7.2 Nonpoint and background sources

OAR 340-41-0002 (42) defines nonpoint sources as “diffuse or unconfined sources of pollution where wastes can either enter, or be conveyed by the movement of water, into waters of the state.” Generally, nonpoint thermal sources in the Willamette Subbasins include activities associated with agriculture, forestry, dam and reservoir management, and development.

Example sources and/or activities that contribute nonpoint thermal loads that increase stream temperature include:

- Human-caused increases in solar radiation loading to streams from stream-side vegetation disturbance or removal;
- Channel modification and widening;
- Dam and reservoir operation;
- Activities that modify flow rate or volume; and,
- Background sources, including natural sources and anthropogenic sources of warming through climate change and other factors.

Anthropogenically influenced thermal loads are targeted for reduction to attain the applicable temperature water quality criteria. The following actions are needed to attain the TMDL allocations:

- Restoration of stream-side vegetation to reduce thermal loading from exposure to solar radiation,
- Management and operation of dams and reservoirs to minimize temperature warming, and,
- Maintenance of minimum instream flows.

7.2.1 Background sources

By definition (OAR 340-042-0030(1)), background sources include all sources of pollution or pollutants not originating from human activities. Background sources may also include anthropogenic sources of a pollutant that DEQ or another Oregon state agency does not have authority to regulate, such as pollutants emanating from another state, tribal lands, or sources otherwise beyond the jurisdiction of the state. Stream temperature warming from climate change is a background source as the majority of the climate change causing pollutants emanate from outside of Oregon.

The background thermal loading a stream receives is influenced by a number of landscape and meteorological characteristics, 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, however, are influenced by anthropogenic impacts. As such, it was not possible to develop a model in which all human influences were controlled or accounted for. As a best estimate, background thermal sources were quantified for the modeled rivers with delineable anthropogenic influences (i.e., dams and reservoirs, vegetation alterations, point source discharges) accounted for, thus isolating the remaining background sources.

In some of the rivers modeled, thermal loading from background sources contributed to exceedances of the applicable temperature criteria and therefore were identified as significant source of thermal loading. Reductions from background sources will be required to attain the applicable temperature criteria. The contribution from background sources for each model stream is summarized in model river sections below.

7.2.2 Dams and reservoirs

Reservoirs attenuate flood flows and hold spring runoff. Stored water is released when reservoir capacity is met or to augment stream flows during the dry months of summer and early fall. As currently constructed and operated, the release of water from many reservoirs modifies natural temperature patterns downstream during late summer and early fall, but also during spring and early summer. The temperature seasonal shifts occur because stored water in reservoirs stratifies, and the reservoirs were typically constructed with regulating outlets near the bottom of each structure.

Seasonal pattern shifts are of concern because water temperature triggers aquatic life activities such as spawning, length of time needed for incubation, and fry emergence. The food supplies (macroinvertebrates) that salmonids rely on are also affected by seasonal temperature shifts. In late summer and early autumn, the reservoirs are drawn down to provide flood storage capacity for the coming winter precipitation. During this time, thermal stratification in the reservoirs breaks down but reservoir water temperatures remain warmer than inflowing upstream tributary temperatures. This is also the season when fall spawning fish have moved into reaches below the reservoirs to wait for spawning. Salmon and trout will hold in the coldest water they can find to wait for stream temperatures to cool enough to trigger their spawning migration.

Alternately, colder winter waters are released during spring and early summer when inflowing upstream tributary temperatures are warmer than stored reservoir waters. This is the season when fall-spawned fry should be emerging, but the colder water shifts the timing of their emergence. Spring spawning is also delayed until winter water temperatures warm up enough to trigger spawning. Late spring spawning can indicate that fry emergence occurs when summer water temperatures are too warm for emerging fry.

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). The temperature effects of each dam are specific to the characteristics and operation of each structure. In general, the larger, taller dams typically release water from a mid-depth or deeper outlet in the upstream impoundment, which tends to be colder in mid-summer than it would be without the dam. In September or October, a large amount of water is released from many of these dams to make room for flood storage, which can bring warmer surface waters down to the elevation of the outlet, thus releasing the warmest water of the year during a time period when the river without the dam would be cooler because of shorter days and colder air temperatures. 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°C to 1.0°C range near the mouth of the Willamette River (Rounds, 2010).

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°C to 6°C. Nine of the seventeen human constructed in channel ponds raised the median 7DADM stream temperature by greater than 1°C.

7.2.3 Water management and withdrawals

DEQ assessed the impact of consumptive use water withdrawals on stream temperature for four of the modeled streams.

- In Johnson Creek (Lower Willamette Subbsin) we evaluated stream temperature response to water withdrawals and found that a 4% reduction of natural streamflow resulted in a stream temperature increase equal to the portion of the HUA allocated to water withdrawals (0.05°C).
- In the Molalla River (Molalla-Pudding Subbasin) we evaluated stream temperature response to removing water withdrawals entirely and found that withdrawals were responsible for a 1.50°C temperature increase at the POMI.
- In the Pudding River (Molalla-Pudding Subbasin) we evaluated stream temperature response to removing water withdrawals entirely and found that withdrawals were responsible for a 4.01°C temperature increase at the POMI.
- In Thomas Creek (South Santiam Subbasin) we evaluated stream temperature response to removing water withdrawals entirely and found that withdrawals were responsible for a 1.83°C temperature increase at the POMI.

7.2.4 Channel simplificaiton

Stream channel simplification for flood control or navigation and watershed development also influences stream temperature. Historically, floodplains have not been treated as an integral part of the stream channel and this has lead to development in areas prone to channel migration and flooding (Kondolf and Keller, 1991). Channelization and bank armoring to protect these areas exacerbates erosion and flooding elsewhere in the basin unless much of the channel is armored (Sear 1994). Bank armoring and the loss of floodplain connectivity diminish over-bank flows that create and maintain channel complexity. Without access to floodplains high streamflows can cause channel down cutting and lower seasonal water tables. Riparian vegetation, off channel habitats and cold water refugia may all be negatively affected by such actions.

Upland and floodplain development also result in high levels of impervious areas in some areas of the basin. Increased impervious area within a watershed results in greater stormwater runoff and diminished groundwater recharge. Summer base flows are lower in small watersheds with substantial impervious area as a result of this loss of groundwater contribution during dry periods. This contributes to warmer stream temperatures and poorer water quality.

In the Willamette Basin, 150 years of river management for flood control and navigation has resulted in a loss of channel complexity, floodplain connectivity and other important stream processes. A consequence of channel simplification is the likely simplification of thermal regimes throughout the basin. Total stream channels in the Willamette river declined from 355 miles to 264 miles from the first surveys until 1995 (Gregory, et al 2002, p.18). The greatest loss of channel complexity was reported in the Upper Willamette Subbasin from Albany to Eugene. Here, nearly half the stream network was lost through channelization and other navigation improvement work. The loss of side channels, alcoves and other off-channel habitats, along with flood plain connectivity and hyporheic exchange likely has diminished water quality in the alluvial reaches of the upper Willamette (Lee and Risley 2002), the availability of cool water refugia, and perhaps even affected mainstem temperatures in the river itself (Landers, et al, 2002, p.27). An example of channel complexity loss for the Willamette River reach near Harrisburg (RM 162) is shown in **Figure 7-1**. As shown, most of the sinuosity and channel complexity that the channel had in 1850 has been lost.

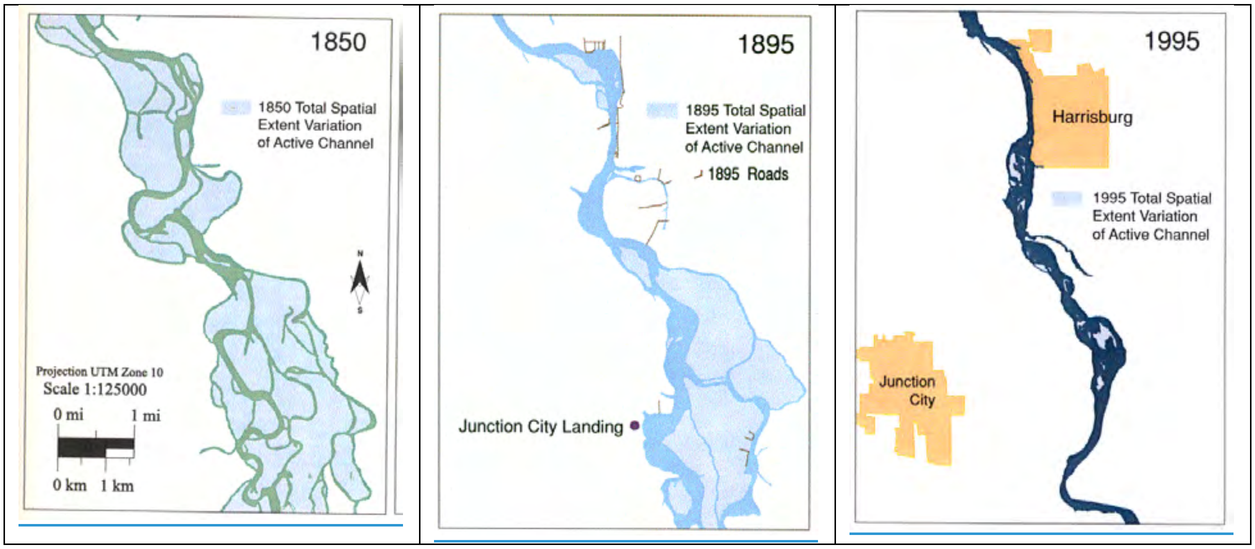


Figure 7-1: Changes in Willamette River channel complexity in the Harrisburg area (PNERC, 1998)

Narrow side channels or multi-braided channels may be more effectively shaded by vegetation than a single channel and the loss of this channel complexity may contribute to high stream temperatures. In addition, complex channels with floodplain connectivity have significantly greater hyporheic flow than simple channels. Water that flows through gravel remains cool because it is isolated from heating by solar radiation and atmospheric influences. Historic hyporheic connectivity may have been five times as great as current values, which would have resulted in a significantly greater percentage of river water flowing through hyporheic zones than today (PNERC, 2002).

Little specific information is available on historic channel bathymetry and because it is difficult to accurately model hyporheic flow, no attempts have been made to model historic channel complexity using the Willamette River models. However, the model utilized, CE-QUAL-W2, can model multiple channels and could be used to analyze the impact that potential side channel remediation projects might have on stream temperature.

~~7.2.4~~7.2.5 Climate change

DEQ completed a literature review to assess climate change-driven stream temperature impacts. Based on that review (Appendix G), stream temperature impacts from climate change can range from +0.05°C to +0.27°C per decade on unregulated streams and -0.48°C to +0.52°C per decade on regulated streams. Stream temperature trends in regulated systems are more variable, as upstream flow and temperature management can confound natural long-term warming trends in the data (Isaak et al., 2012).

~~7.2.5~~7.2.6 Johnson Creek

Thermal pollutant sources identified for Johnson Creek in the Lower Willamette Subbasin include lack of sufficient shade-producing streamside vegetation, consumptive use water withdrawals, tributaries to Johnson Creek with waters exceeding the temperature criteria, and background sources. See TSD Appendix A for details. Briefly, along the Johnson Creek model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 26 percentage points, corresponding to daily maximum water temperature increases of 8.27°C at the POMI at model km 18.9, and 3.76°C at the mouth.
- Warming from tributary waters that exceeded water quality criteria was associated with daily maximum water temperature increases of 1.52°C at the POMI at model km 2, and 1.40°C at the mouth.
- Reducing USGS estimated mean August stream flow for Johnson Creek by 4% resulted in a daily maximum water temperature increase equal to the portion of the HUA allocated to water withdrawals (0.05°C) at the flow reference site at model km 1.2. The greatest daily maximum temperature change between these two scenarios was 0.16°C at model km 25.5.
- Reducing USGS estimated mean August stream flow for Johnson Creek by 20% (the consumptive use rate above which OWRD assumes water quality impacts) resulted in daily maximum water temperature increases of 0.90°C at the POMI at model km 25.5, and 0.29°C at the flow reference site at model km 1.2.
- Background sources were associated with a water temperature standard exceedance of 1.83°C above the applicable numeric criteria at model km 11.7. This means that to attain the temperature criteria, background sources need to have a temperature reduction of 1.83°C.

~~7.2.6~~7.2.7 Molalla River

Thermal pollutant sources identified for the Molalla River include lack of sufficient shade-producing streamside vegetation, channel modification, consumptive use water withdrawals, and background sources. See TSD Appendix A for details. Briefly, along the Molalla River model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 14 percentage points, corresponding to 7DADM water temperature increases of 2.42°C at the POMI at model km 70.06, and 0.52°C at the mouth.
- Surface water withdrawals were associated with 7DADM water temperature increases of 1.50°C at the POMI at model km 19.86, and 1.07°C at the mouth.
- Channel modifications, such as decreases in channel width, were associated with 7DADM water temperature increases of 1.09°C at the POMI at model km 36.36, and 0.31°C at the mouth.
- WLAs for the Molalla STP have the potential to cool the river up to 0.3°C at their point of discharge at model km 34.08. This is due to the relatively high ambient temperatures of the Molalla River. All model scenarios indicate that Molalla River water temperatures are expected to exceed water temperature standards along most of the modeled reach.
- Background sources were associated with a water temperature standard exceedance of 9.16°C above the applicable numeric criteria at model km 35.76. This means that to attain the temperature criteria, background sources need to have a temperature reduction of 9.16°C.

~~7.2.7~~7.2.8 Pudding River

Thermal pollutant sources identified for the Pudding River include lack of sufficient shade-producing streamside vegetation, consumptive use water withdrawals, tributaries to Pudding River with waters exceeding the temperature criteria, and background sources. See TSD Appendix A for details. Briefly, along the Pudding River model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 11 percentage points, corresponding to 7DADM water temperature increases of 3.97°C at the POMI at model km 82.1, and 1.95°C at the mouth.
- Wasteload allocations for Woodburn WWTP and JLR have the potential to increase 7DADM water temperature by 0.03°C at the POMI at model km 24.8, but are not expected to have an impact at the mouth.
- Surface water withdrawals were associated with 7DADM water temperature increases of 4.01°C at the POMI at model km 82.9, and 1.68°C at the mouth.
- Reducing surface water withdrawals to 25% of normal consumptive use was associated with 7DADM water temperature increases of 0.61°C at the POMI at model km 82, and 0.3°C at the mouth relative to the 7DADM water temperature at natural stream flows.
- Reducing surface water withdrawals to 50% of normal consumptive use was associated with 7DADM water temperature increases of 1.37°C at the POMI at model km 82, and 0.69°C at the mouth relative to the 7DADM water temperature at natural stream flows.
- Reducing surface water withdrawals to 75% of normal consumptive use was associated with 7DADM water temperature increases of 2.51°C at the POMI at model km 82.4, and 1.15°C at the mouth relative to the 7DADM water temperature at natural stream flows.
- Warming from tributary waters that exceeded water quality criteria was associated with 7DADM water temperature increases of 8.65°C at the POMI at model km 84.6, and 1.19°C at the mouth.
- Background sources were associated with a water temperature standard exceedance of 3.86°C above the applicable numeric criteria at model km 11.4. This means that to attain the temperature criteria, background sources need to have a temperature reduction of 3.86°C.

~~7.2.8~~7.2.9 Litte North Santiam River

Thermal pollutant sources identified for the Little North River include lack of sufficient shade-producing streamside vegetation, and background sources. See TSD Appendix A for details. Briefly, along the Little North Santiam River model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 9 percentage points, corresponding to daily maximum water temperature increases of 1.72°C at the POMI at model km 13.7, and 0.65°C at the mouth.
- Background sources were associated with a water temperature standard exceedance of 8.89°C above the applicable numeric criteria at model km 1.0. This means that to attain the temperature criteria, background sources need to have a temperature reduction of 8.89°C.

~~7.2.9~~7.2.10 Thomas Creek

Thermal pollutant sources identified for Thomas Creek in the South Santiam Subbasin include lack of sufficient shade-producing streamside vegetation, consumptive use water withdrawals, tributaries to Thomas Creek with waters exceeding the temperature criteria, and background sources. See TSD Appendix A for details. Briefly, along the Thomas Creek model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of less than 1 percentage point, corresponding to daily maximum water temperature increases of 1.14°C at the POMI at model km 32.3. This indicates that current vegetation is nearly at site potential conditions.
- Surface water withdrawals were associated with daily maximum water temperature increase of 1.83°C at the POMI at model km 4.8, and 0.10°C at the mouth.
- Warming from tributary waters that exceeded water quality criteria was associated with daily maximum water temperature increases of 1.08°C at the POMI at model km 30.2, and 0.60°C at the mouth.
- Background sources were associated with a water temperature standard exceedance of 8.91°C above the applicable numeric criteria at model km 30.6. This means that to attain the temperature criteria, background sources need to have a temperature reduction of 8.91°C.

~~7.2.10~~7.2.11 Crabtree Creek

Thermal pollutant sources identified for Crabtree Creek in the South Santiam Subbasin include lack of sufficient shade-producing streamside vegetation, and background sources. See TSD Appendix A for details. Briefly, along Crabtree Creek model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 13 percentage points, corresponding to daily maximum water temperature increases of 3.78°C at the POMI at model km 5.2, and 1.93°C at the mouth.
- Background sources were associated with a water temperature standard exceedance of 7.39°C above the applicable numeric criteria at model km 35.1. This means that to attain the temperature criteria, background sources need to have a temperature reduction of 7.39°C.

~~7.2.11~~7.2.12 Luckiamute River

Thermal pollutant sources identified for the Luckiamute River in the Upper Willamette Subbasin include lack of sufficient shade-producing streamside vegetation, and background sources. See TSD Appendix A for details. Briefly, along the Luckiamute River model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 9 percentage points, corresponding to daily maximum water temperature increases of 3.56°C at the POMI at model km 42.8, and 0.34°C at the mouth.
- Background sources were associated with a water temperature standard exceedance of 7.18°C above the applicable numeric criteria at model km 2.1. This means that to attain the temperature criteria, background sources need to have a temperature reduction of 7.18°C.

~~7.2.12~~7.2.13 Mohawk River

Thermal pollutant sources identified for the Mohawk River in the McKenzie Subbasin include lack of sufficient shade-producing streamside vegetation, and background sources. See TSD Appendix A for details. Briefly, along the Mohawk River model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 13 percentage points, corresponding to daily maximum water temperature increases of 2.87°C at the POMI at model km 29.6, and 0.32°C at the mouth.
- Background sources were associated with a water temperature standard exceedance of 7.53°C above the applicable numeric criteria at model km 5.7. This means that to attain the temperature criteria, background sources need to have a temperature reduction of 7.53°C.

~~7.2.13~~7.2.14 McKenzie River

Thermal pollutant sources identified for the McKenzie River include lack of sufficient shade-producing streamside vegetation, point sources, and background sources. See TSD Appendix A for details regarding the Upper McKenzie River Model. See TSD Appendix K for details regarding the Lower McKenzie River model. Briefly, along the Upper McKenzie River model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 20 percentage points, corresponding to daily maximum water temperature increases of 0.43°C at the POMI at model km 10.0, and 0.36°C at just upstream of Quartz Creek at model km 0.0.
- WLAs for EWEB's Trail Bridge Powerhouse facility has the potential to warm the river 0.02°C at the point of discharge. The impact dissipates moving downstream. The impact is 0.015°C at the confluence with the South Fork McKenzie River.
- Background sources were not associated with a water temperature standard exceedance.

On the South Fork McKenzie River and McKenzie River downstream from the South Fork:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 14 percentage points, corresponding to a 7DADM temperature increase of 0.84°C at the POMI at model mile 17.5, and 0.74°C at the mouth.
- Wasteload allocations for EWEB's Trail Bridge Powerhouse facility, USACE Cougar facility, ODFW's Leaburg Fish Hatchery, ODFW's McKenzie Fish Hatchery, and International Paper – Springfield result in maximum 7DADM temperatures increases of 0.20°C (Spring spawning period), 0.22 °C (Summer non-spawning period), and 0.22 °C (Fall spawning period) at the POMI, located at the International Paper's outfall. Note that as discussed in Appendix K, the temperature impact was 0.23°C at the river mouth on two days when flow was less than 7Q10. When flow is greater than or equal to 7Q10, the impact of modeled point source impacts does not exceed 0.22°C.

~~7.2.14~~7.2.15 Coyote Creek

Thermal pollutant sources identified for Coyote Creek in the Upper Willamette Subbasin include lack of sufficient shade-producing streamside vegetation, and background sources. See TSD Appendix A for details. Briefly, along the Coyote Creek model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 23 percentage points, corresponding to daily maximum water temperature increases of 7.87°C at the POMI at model km 35, and 2.61°C at the mouth.
- Background sources were associated with a water temperature standard exceedance of 7.18°C above the applicable numeric criteria at model km 1.7. This means that to attain the temperature criteria, background sources need to have a temperature reduction of 7.18°C.

~~7.2.15~~7.2.16 Mosby Creek

Thermal pollutant sources identified for Mosby Creek in the Coast Fork Willamette Subbasin include lack of sufficient shade-producing streamside vegetation, and background sources. See TSD Appendix A for details. Briefly, along the Mosby Creek model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 4 percentage points, corresponding to daily maximum water temperature increases of 3.05°C at the POMI at model km 28.1, and 1.50°C at the mouth.
- Background sources were associated with a water temperature standard exceedance of 8.81°C above the applicable numeric criteria at model km 9.8. This means that to attain the temperature criteria, background sources need to have a temperature reduction of 8.81°C.

~~7.2.16~~7.2.17 Southern Willamette shade

Thermal pollutant sources identified for the Southern Willamette analysis include lack of sufficient shade-producing vegetation. See TSD Appendix A for details. Briefly, within the Southern Willamette model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 28 percentage points over the entire model assessment area (approximately 21,410 stream kilometers).
- ODF, Oregon Department of Agriculture (ODA), USFS, and BLM were the DMAs responsible for the largest number of assessed stream nodes totaling about 88% of the assessed stream network (18,986 km out of 21,410 total assessed kilometers).
- Of the four DMAs with the largest percentage of stream miles, ODA had the largest mean shade gap of 53 percentage points over the 4,823 stream kilometers of agricultural lands assessed.
- Private non-federal forestlands regulated by ODF have the largest number of assessed stream nodes (8603 km) with a mean shade gap of 26 percentage points.
- While individual cities typically have fewer assessed stream kilometers relative to other DMAs, streams within the city limits of 32 cities were assessed. 16 of the cities had mean shade gaps greater than 50 percentage points.

- The Muddy Creek-Willamette River Watershed (1709000306) had the largest number of assessed stream nodes (827 km out of 1398 total assessed kilometers) with effective shade gaps exceeding 50 percentage points.

~~7.2.17~~7.2.18 Lower Willamette shade

Thermal pollutant sources identified for the Lower Willamette analysis include lack of sufficient shade-producing vegetation. See TSD Appendix A and B for details. Briefly, within the Lower Willamette model extent:

- Lack of sufficient streamside vegetation was associated with a mean effective shade gap of 13 percentage points over the entire model assessment area (approximately 201 stream kilometers).
- The assessed streams in the Johnson Creek-Willamette River watershed (1709001201) had the largest mean shade gap of 14 percentage points over the 109 stream kilometers assessed.
- The streams on the westside of the Willamette River draining the Tualatin Mountains in the Multnomah Channel Watershed (1709001203) had the lowest mean shade gap of 3 percentage points over the 5 stream kilometers assessed.
- The City of Portland had the largest number of stream kilometers (5.6 km) with mean effective shade gaps exceeding 50 percentage points, followed by Clackamas County and ODA.

8 Loading capacity and excess loads

As described in the TMDL report, the pollutant load that a waterbody can receive and still meet water quality standards is called the loading capacity (LC). For temperature, a thermal loading capacity is assigned to all AUs in the Willamette Subbasins. Loading capacity is calculated using **Equation 8-1**.

$$LC = (T_C + \mathrm{HUA}) \cdot Q_R \cdot C_F$$ **Equation 8-1**

where,

$LC =$ Loading Capacity (kcal/day).

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

$\mathrm{HUA} =$ The 0.3°C human use allowance assigned to point sources, nonpoint sources, margin of safety, or reserve capacity.

$Q_R =$ The daily mean river flow rate in cubic feet per second (cfs).

$C_F =$ Conversion factor using flow in cfs: 2,446,665

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

Table 8-1 presents the loading capacity for select temperature impaired Category 5 AUs modeled for the TMDL analysis at the critical 7Q10 low flow. It is intended that **Equation 8-1** be used to calculate the loading capacity for any AU or stream location in the Willamette Subbasins not identified in **Table 8-1** or when river flows are greater than 7Q10. In cases when there are two year-round applicable temperature criteria that apply to the same AU, the more stringent criteria shall be used for the loading capacity.

Table 8-1: Thermal loading capacity (LC) for modeled AUs by applicable fish use period at 7Q10 flow.

AU Name and AU ID	Annual 7Q10 (cfs)	Year Round Criterion + HUA (°C)	Spawning Criterion + HUA (°C)	7Q10 LC Year Round (kilocalories/day)	7Q10 LC Spawning (kilocalories/day)
Clackamas River OR_SR_1709001106_02_104597	671	16.3	13.3	26,759.91E+6	21,834.77E+6
Coast Fork Willamette River OR_SR_1709000203_02_104585	38	18.3	13.3	1,701.41E+6	1,236.54E+6
Coast Fork Willamette River OR_SR_1709000204_02_103787	132	18.3	13.3	5,910.16E+6	4,295.37E+6
Coyote Creek OR_SR_1709000301_02_103796	5.9	18.3	NA	264.17E+6	NA
Crabtree Creek OR_SR_1709000606_02_103978	25	16.3	13.3	997.02E+6	813.52E+6
Johnson Creek OR_SR_1709001201_02_104170	11	18.3	13.3	492.51E+6	357.95E+6
Little North Santiam River OR_SR_1709000505_02_104564	21	16.3	13.3	837.49E+6	683.35E+6
Long Tom River OR_SR_1709000301_02_103791	22	24.3	18.3	1,307.99E+6	985.03E+6
Luckiamute River OR_SR_1709000305_02_103829	16	18.3	13.3	716.38E+6	520.65E+6
McKenzie River OR_SR_1709000407_02_103884	1537	16.3	13.3	61,296.54E+6	50,014.97E+6
Middle Fork Willamette River OR_SR_1709000107_02_104583	1002	16.3	13.3	39,960.4E+6	32,605.73E+6
Middle Fork Willamette River OR_SR_1709000110_02_104584	1278	16.3	13.3	50,967.46E+6	41,586.94E+6
Mohawk River OR_SR_1709000406_02_103871	16	16.3	13.3	638.09E+6	520.65E+6
Molalla River OR_SR_1709000904_02_104086	38	16.3	13.3	1,515.46E+6	1,236.54E+6
Mosby Creek OR_SR_1709000201_02_103752	11	16.3	13.3	438.69E+6	357.95E+6
North Santiam River OR_SR_1709000504_02_103906	859	16.3	13.3	34,257.47E+6	27,952.41E+6
North Santiam River OR_SR_1709000506_02_103930	914	16.3	13.3	36,450.9E+6	29,742.15E+6
Pudding River OR_SR_1709000905_02_104088	10	18.3	NA	447.74E+6	NA
Santiam River OR_SR_1709000506_02_103927	1144	18.3	13.3	51,221.42E+6	37,226.5E+6
South Santiam River OR_SR_1709000608_02_103925	615	16.3	13.3	24,526.59E+6	20,012.5E+6
Thomas Creek OR_SR_1709000607_02_103988	6.9	18.3	NA	308.94E+6	NA
Willamette River OR_SR_1709000306_05_103854	3877	18.3	13.3	173,588.68E+6	126,160.08E+6
Willamette River OR_SR_1709000701_05_104005	5684	18.3	13.3	254,495.24E+6	184,961.02E+6
Willamette River OR_SR_1709000703_88_104015	5734	20.3	NA	284,792.3E+6	NA
Willamette River OR_SR_1709000704_88_104020	5988	20.3	NA	297,407.79E+6	NA

AU Name and AU ID	Annual 7Q10 (cfs)	Year Round Criterion + HUA (°C)	Spawning Criterion + HUA (°C)	7Q10 LC Year Round (kilocalories/day)	7Q10 LC Spawning (kilocalories/day)
Willamette River OR_SR_1709001201_88_104019	6740	20.3	NA	334,757.6E+6	NA
Willamette River OR_SR_1709001202_88_104175	6740	20.3	NA	334,757.6E+6	NA

The excess load is the difference between the actual pollutant load in a waterbody and the loading capacity of that waterbody. In accordance with OAR 340-042-0040(4)(e), Oregon TMDLs must include the excess load to the extent existing data allow.

Because flow monitoring data were not available at most temperature monitoring locations, it was not possible to calculate the excess thermal load. Instead, the excess temperature and percent load reduction were calculated for each AU where temperature data were available. The extensive monitoring across the Willamette subbasin represents a wide range of waterbodies; however not all streams in the Willamette subbasins have monitoring data. **Equation 8-2** can be used to determine excess temperature and percent reduction for additional streams if data becomes available in the future. Temperature data collected in Willamette Subbasins between 1/1/2012 and 12/31/2022 were downloaded from DEQ's AWQMS database. Following data review and filtering for acceptable data quality there were 452 temperature monitoring stations available where excess temperature could be calculated. The maximum excess temperature and corresponding percent reduction were summarized in **Table 8-2** for each AU and each temperature criteria applicable on that AU.

The excess temperature is the maximum difference between the monitored 7DADM river temperature and the applicable numeric criterion including the HUA. The percent load reduction (**Equation 8-2**) represents the maximum portion of the actual thermal loading that must be reduced to attain the TMDL loading capacity.

The percent load reduction is mathematically equal to the percent temperature reduction calculated from the monitoring data. This is because the river flow rate used to calculate a thermal load is the same number in the numerator and denominator and is cancelled out when calculating the percent reduction. The percent load reductions shown in **Table 8-2** were calculated from temperatures in degrees Celsius.

$$\mathrm{PR} = \frac{(T_R - T_C - \mathrm{HUA})}{T_R} \cdot 100$$ **Equation 8-2**

where,

$\mathrm{PR} =$ Percent load reduction (%). If PR < 0, PR = 0

$T_R =$ The maximum 7DADM ambient river temperature (°C).

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

$\mathrm{HUA} =$ The 0.3°C human use allowance assigned to point sources, nonpoint sources, margin of safety, or reserve capacity.

Table 8-2: Excess temperature and percent load reduction for AUs with available temperature data in the Willamette Subbasins.

AU Name	AU ID	Maximum 7DADM River Temperature (°C)	Applicable Criterion + HUA (°C)	Excess Temperature (°C)	Percent Load Reduction
Alex Creek	OR_SR_1709000202_02_103762	16.7	18.3	0.0	0.0
Big Creek	OR_SR_1709001104_02_104153	13.7	16.3	0.0	0.0
Blowout Creek	OR_SR_1709000503_02_103907	21.0	18.3	2.7	12.9
Boulder Creek	OR_SR_1709000502_02_103902	19.3	18.3	1.0	5.3
Breitenbush River	OR_SR_1709000501_02_103892	17.5	18.3	0.0	0.0
Brice Creek	OR_SR_1709000202_02_103771	23.1	18.3	4.8	20.6
Calapooia River	OR_SR_1709000303_02_103815	16.0	16.3	0.0	0.0
Camp Creek	OR_SR_1709000407_02_103889	19.3	13.3	6.0	31.1
Camp Creek	OR_SR_1709000407_02_103889	22.4	16.3	6.1	27.2
Canyon Creek	OR_SR_1709000602_02_103949	20.7	16.3	4.4	21.4
Cedar Creek	OR_SR_1709000407_02_103891	20.9	13.3	7.6	36.4
Cedar Creek	OR_SR_1709000407_02_103891	24.3	16.3	8.0	32.9
Christy Creek	OR_SR_1709000106_02_103722	15.5	16.3	0.0	0.0
Clackamas River	OR_SR_1709000704_02_104597	17.7	13.3	4.4	24.9
Clackamas River	OR_SR_1709000704_02_104597	20.5	16.3	4.2	20.5
Clackamas River	OR_SR_1709000704_02_104597	24.5	18.3	6.2	25.3
Clackamas River	OR_SR_1709001104_02_104154	16.6	13.3	3.3	19.8
Clackamas River	OR_SR_1709001104_02_104154	18.5	16.3	2.2	11.9
Clackamas River	OR_SR_1709001104_02_104155	16.2	13.3	2.9	17.9
Clackamas River	OR_SR_1709001104_02_104155	19.5	16.3	3.2	16.5
Clackamas River	OR_SR_1709001106_02_104597	17.7	13.3	4.4	24.9
Clackamas River	OR_SR_1709001106_02_104597	20.5	16.3	4.2	20.5
Clackamas River	OR_SR_1709001106_02_104597	24.5	18.3	6.2	25.3
Coast Fork Willamette River	OR_SR_1709000203_02_104585	12.5	13.3	0	0.0
Coast Fork Willamette River	OR_SR_1709000203_02_104585	24.2	18.3	5.9	24.4
Collawash River	OR_SR_1709001101_02_104142	17.4	13.3	4.1	23.5
Collawash River	OR_SR_1709001101_02_104142	19.8	16.3	3.5	17.8

AU Name	AU ID	Maximum 7DADM River Temperature (°C)	Applicable Criterion + HUA (°C)	Excess Temperature (°C)	Percent Load Reduction
Collawash River	OR_SR_1709001101_02_104144	16.3	13.3	3.0	18.6
Collawash River	OR_SR_1709001101_02_104144	20.5	16.3	4.2	20.4
Fall Creek	OR_SR_1709000109_02_103737	21.6	13.3	8.3	38.3
Fall Creek	OR_SR_1709000109_02_103737	24.5	16.3	8.2	33.3
Fall Creek	OR_SR_1709000109_02_103743	18.6	13.3	5.3	28.5
Fall Creek	OR_SR_1709000109_02_103743	22.4	16.3	6.1	27.3
Fall Creek	OR_SR_1709000109_02_103735	21.9	13.3	8.6	39.3
Fall Creek	OR_SR_1709000109_02_103735	20.8	16.3	4.5	21.6
Fish Creek	OR_SR_1709001104_02_104161	19.1	13.3	5.8	30.4
Fish Creek	OR_SR_1709001104_02_104161	21.2	16.3	4.9	23.0
French Pete Creek	OR_SR_1709000403_02_103862	15.7	16.3	0.0	0.0
Grass Creek	OR_SR_1709000202_02_103780	15.6	16.3	0.0	0.0
Hamilton Creek	OR_SR_1709000608_02_103996	27.3	16.3	11.0	40.3
Hehe Creek	OR_SR_1709000109_02_103734	21.0	16.3	4.7	22.5
Hills Creek	OR_SR_1709000102_02_103715	16.5	13.3	3.2	19.4
Hills Creek	OR_SR_1709000102_02_103715	18.7	16.3	2.4	12.8
Horse Creek	OR_SR_1709000401_02_103856	13.8	12.3	1.5	10.9
HUC12 Name: Andy Creek-Fall Creek	OR_WS_170900010904_02_104219	18.3	16.3	2.0	10.7
HUC12 Name: Balch Creek-Willamette River	OR_WS_170900120202_02_104555	21.8	18.3	3.5	15.9
HUC12 Name: Boulder Creek-McKenzie River	OR_WS_170900040206_02_104310	14.4	12.3	2.1	14.8
HUC12 Name: Buck Creek-Middle Fork Willamette River	OR_WS_170900010502_02_104200	18.9	12.3	6.6	34.9
HUC12 Name: Canyon Creek	OR_WS_170900090601_02_104482	8.2	18.3	0.0	0.0
HUC12 Name: Columbia Slough (Lower)	OR_WS_170900120201_02_104554.1	26.8	18.3	8.5	31.8
HUC12 Name: Columbia Slough (Upper)	OR_WS_170900120201_02_104554.2	29.5	18.3	11.2	38.0
HUC12 Name: Cougar Creek-South Fork McKenzie River	OR_WS_170900040308_02_104321	15.0	16.3	0.0	0.0
HUC12 Name: Cougar Reservoir-South Fork McKenzie	OR_WS_170900040307_02_104320	14.6	16.3	0.0	0.0

AU Name	AU ID	Maximum 7DADM River Temperature (°C)	Applicable Criterion + HUA (°C)	Excess Temperature (°C)	Percent Load Reduction
HUC12 Name: Croisan Creek-Willamette River	OR_WS_170900070301_02_104413	19.6	13.3	6.3	32.0
HUC12 Name: Croisan Creek-Willamette River	OR_WS_170900070301_02_104413	24.8	18.3	6.5	26.2
HUC12 Name: Dartmouth Creek-North Fork Middle For*	OR_WS_170900010608_02_104210	16.5	16.3	0.2	1.2
HUC12 Name: Deer Creek	OR_WS_170900040205_02_104309	20.0	12.3	7.7	38.4
HUC12 Name: Echo Creek-Middle Fork Willamette River	OR_WS_170900010106_02_104190	15.6	12.3	3.3	21.1
HUC12 Name: Eighth Creek-North Fork Middle Fork Willamette	OR_WS_170900010607_02_104209	16.2	16.3	0.0	0.0
HUC12 Name: Elk Creek-McKenzie River	OR_WS_170900040502_02_104326	15.3	13.3	2.0	12.9
HUC12 Name: Elk Creek-McKenzie River	OR_WS_170900040502_02_104326	17.9	16.3	1.6	8.8
HUC12 Name: Elk Creek-South Fork McKenzie River	OR_WS_170900040301_02_104314	8.4	12.3	0.0	0.0
HUC12 Name: Fish Creek	OR_WS_170900110403_02_104536	16.0	16.3	0.0	0.0
HUC12 Name: Flat Creek	OR_WS_170900030603_02_104290	25.7	18.3	7.4	28.8
HUC12 Name: Glenn Creek-Willamette River	OR_WS_170900070303_02_104415	27.2	18.3	8.9	32.7
HUC12 Name: Greasy Creek	OR_WS_170900030204_02_104256	25.0	16.3	8.7	34.8
HUC12 Name: Greasy Creek	OR_WS_170900030204_02_104256	19.1	18.3	0.8	4.1
HUC12 Name: Hackleman Creek-McKenzie River	OR_WS_170900040202_02_104306	12.3			
HUC12 Name: Helion Creek-Clackamas River	OR_WS_170900110406_02_104539	16.5	16.3	0.2	1.2
HUC12 Name: Hill Creek-Coast Fork Willamette River	OR_WS_170900020401_02_104238	25.9	18.3	7.6	29.3
HUC12 Name: Kink Creek-McKenzie River	OR_WS_170900040204_02_104308	12.7	12.3	0.4	3.1
HUC12 Name: Last Creek-Pinhead Creek	OR_WS_170900110204_02_104526	10.4	16.3	0.0	0.0
HUC12 Name: Layng Creek	OR_WS_170900020201_02_104227	17.6	18.3	0.0	0.0
HUC12 Name: Lowe Creek-Clackamas River	OR_WS_170900110203_02_104525	15.6	16.3	0.0	0.0
HUC12 Name: Lower Johnson Creek	OR_WS_170900120103_02_104552	19.9	13.3	6.6	33.1
HUC12 Name: Lower Johnson Creek	OR_WS_170900120103_02_104552	23.1	18.3	4.8	20.8
HUC12 Name: Lower Mill Creek	OR_WS_170900070204_02_104412	25.9	18.3	7.6	29.3
HUC12 Name: Lower Quartzville Creek	OR_WS_170900060305_02_104379	23.7	18.3	5.4	22.8

AU Name	AU ID	Maximum 7DADM River Temperature (°C)	Applicable Criterion + HUA (°C)	Excess Temperature (°C)	Percent Load Reduction
HUC12 Name: Maxfield Creek-Luckiamute River	OR_WS_170900030503_02_104277	21.1	18.3	2.8	13.3
HUC12 Name: McKinney Creek	OR_WS_170900070203_02_104411	26.9	18.3	8.6	32.0
HUC12 Name: Middle Little Luckiamute River	OR_WS_170900030507_02_104281	17.5	18.3	0.0	0.0
HUC12 Name: Minto Creek-North Santiam River	OR_WS_170900050205_02_104347	11.4	18.3	0.0	0.0
HUC12 Name: Morgan Creek-North Santiam River	OR_WS_170900050604_02_104362	23.0	16.3	6.7	29.1
HUC12 Name: Multnomah Channel	OR_WS_170900120305_02_104561	18.5	18.3	0.2	1.2
HUC12 Name: North Fork Clackamas River	OR_WS_170900110405_02_104538	17.0	16.3	0.7	4.2
HUC12 Name: North Fork Eagle Creek	OR_WS_170900110502_02_104541	12.8	16.3	0.0	0.0
HUC12 Name: Oswego Creek-Willamette River	OR_WS_170900120104_02_104553	14.1	13.3	0.8	5.7
HUC12 Name: Oswego Creek-Willamette River	OR_WS_170900120104_02_104553	20.7	18.3	2.4	11.7
HUC12 Name: Owl Creek	OR_WS_170900060205_02_104371	15.5	16.3	0.0	0.0
HUC12 Name: Paddys Valley-Middle Fork Willamette *	OR_WS_170900010101_02_104185	10.0	12.3	0.0	0.0
HUC12 Name: Pedee Creek-Luckiamute River	OR_WS_170900030504_02_104278	19.5	18.3	1.2	6.3
HUC12 Name: Pot Creek-Clackamas River	OR_WS_170900110205_02_104527	10.1	16.3	0.0	0.0
HUC12 Name: Quartz Creek	OR_WS_170900040501_02_104325	11.7	13.3	0.0	0.0
HUC12 Name: Quartz Creek	OR_WS_170900040501_02_104325	16.3	16.3	0.0	0.2
HUC12 Name: Roaring River	OR_WS_170900110402_02_104535	24.0	16.3	7.7	32.1
HUC12 Name: Sauers Creek-North Santiam River	OR_WS_170900050208_02_104350	15.8	18.3	0.0	0.0
HUC12 Name: Sharps Creek	OR_WS_170900020203_02_104229	16.3	16.3	0.0	0.0
HUC12 Name: Smith River	OR_WS_170900040203_02_104307	23.4	12.3	11.1	47.4
HUC12 Name: Smith River	OR_WS_170900040203_02_104307	18.7			
HUC12 Name: South Fork Clackamas River	OR_WS_170900110404_02_104537	12.8	16.3	0.0	0.0
HUC12 Name: Staley Creek	OR_WS_170900010105_02_104189	16.4	12.3	4.1	25.0
HUC12 Name: Straight Creek-North Santiam River	OR_WS_170900050202_02_104344	14.2	18.3	0.0	0.0
HUC12 Name: Tumblebug Creek	OR_WS_170900010102_02_104186	15.4	12.3	3.1	20.2

AU Name	AU ID	Maximum 7DADM River Temperature (°C)	Applicable Criterion + HUA (°C)	Excess Temperature (°C)	Percent Load Reduction
HUC12 Name: Upper Canyon Creek	OR_WS_170900060204_02_104370	17.6	16.3	1.3	7.6
HUC12 Name: Upper Clear Creek	OR_WS_170900110601_02_104543	13.1	16.3	0.0	0.0
HUC12 Name: Upper Eagle Creek	OR_WS_170900110501_02_104540	17.7	16.3	1.4	8.0
HUC12 Name: Upper Johnson Creek	OR_WS_170900120101_02_104550	19.4	13.3	6.1	31.4
HUC12 Name: Upper Johnson Creek	OR_WS_170900120101_02_104550	29.3	18.3	11.0	37.5
HUC12 Name: Whitewater Creek	OR_WS_170900050206_02_104348	14.1	18.3	0.0	0.0
HUC12 Name: Winberry Creek	OR_WS_170900010905_02_104220	19.5	16.3	3.2	16.4
Johnson Creek	OR_SR_1709001201_02_104170	21.3	13.3	8.0	37.6
Johnson Creek	OR_SR_1709001201_02_104170	28.9	18.3	10.6	36.6
Junetta Creek	OR_SR_1709000202_02_103763	16.6	18.3	0.0	0.0
Layng Creek	OR_SR_1709000202_02_103765	24.3	18.3	6.0	24.8
Layng Creek	OR_SR_1709000202_02_103770	16.6	18.3	0.0	0.0
Little Fall Creek	OR_SR_1709000108_02_103730	16.1	13.3	2.8	17.2
Little Fall Creek	OR_SR_1709000108_02_103730	18.1	16.3	1.8	10.1
Little North Santiam River	OR_SR_1709000505_02_104564	23.0	13.3	9.7	42.2
Little North Santiam River	OR_SR_1709000505_02_104564	28.1	16.3	11.8	42.0
Long Tom River	OR_SR_1709000301_02_103791	24.7	24.3	0.4	1.6
Lookout Creek	OR_SR_1709000404_02_104571	20.9	16.3	4.6	22.0
Lower Blue River	OR_SR_1709000404_02_104569	21.8	13.3	8.5	39
Lower Blue River	OR_SR_1709000404_02_104569	21.6	16.3	5.3	24.5
Marion Creek	OR_SR_1709000502_02_103897	17.4	18.3	0.0	0.0
Martin Creek	OR_SR_1709000202_02_103756	19.9	18.3	1.6	8.0
McDowell Creek	OR_SR_1709000608_02_103994	21.7	18.3	3.4	15.6
McKenzie River	OR_SR_1709000402_02_104587	8.4	12.3	0.0	0.0
McKenzie River	OR_SR_1709000402_02_104588	11.8	12.3	0.0	0.0
McKenzie River	OR_SR_1709000407_02_103884	19.5	13.3	6.2	31.8
McKenzie River	OR_SR_1709000407_02_103884	21.2	16.3	4.9	23.1

AU Name	AU ID	Maximum 7DADM River Temperature (°C)	Applicable Criterion + HUA (°C)	Excess Temperature (°C)	Percent Load Reduction
Middle Fork Willamette River	OR_SR_1709000101_02_103713	13.4	12.3	1.1	8.1
Middle Fork Willamette River	OR_SR_1709000105_02_104579	21.0	12.3	8.7	41.4
Middle Fork Willamette River	OR_SR_1709000105_02_104580	17.7	13.3	4.4	24.9
Middle Fork Willamette River	OR_SR_1709000105_02_104580	18.1	16.3	1.8	9.9
Middle Fork Willamette River	OR_SR_1709000107_02_103725	17.8	13.3	4.5	25.3
Middle Fork Willamette River	OR_SR_1709000107_02_103725	19.2	16.3	2.9	15.1
Middle Fork Willamette River	OR_SR_1709000107_02_104583	21.1	13.3	7.8	37.0
Middle Fork Willamette River	OR_SR_1709000107_02_104583	21.3	16.3	5	23.5
Middle Fork Willamette River	OR_SR_1709000110_02_104584	21.1	13.3	7.8	37.0
Middle Fork Willamette River	OR_SR_1709000110_02_104584	22.3	16.3	6	26.9
Middle Santiam River	OR_SR_1709000601_02_103936	19.7	18.3	1.4	7.3
Middle Santiam River	OR_SR_1709000603_02_103965	24.0	18.3	5.7	23.8
Middle Santiam River	OR_SR_1709000604_02_103969	16.0	13.3	2.7	16.9
Middle Santiam River	OR_SR_1709000604_02_103969	14.4	18.3	0.0	0.0
Mill Creek	OR_SR_1709000702_02_104007	18.6	13.3	5.3	28.6
Mill Creek	OR_SR_1709000702_02_104007	25.3	18.3	7.0	27.8
Moose Creek	OR_SR_1709000602_02_103954	19.3	16.3	3.0	15.4
Nohorn Creek	OR_SR_1709001101_02_104145	17.1	16.3	0.8	4.7
North Fork Clackamas River	OR_SR_1709001104_02_104152	19.2	16.3	2.9	15.1
North Fork Middle Fork Willamette River	OR_SR_1709000106_02_103721	20.7	13.3	7.4	35.7
North Fork Middle Fork Willamette River	OR_SR_1709000106_02_103721	22.9	16.3	6.6	28.8
North Fork Pedee Creek	OR_SR_1709000305_02_103828	20.2	18.3	1.9	9.5
North Santiam River	OR_SR_1709000502_02_103899	17.9	18.3	0.0	0.0
North Santiam River	OR_SR_1709000503_02_103906	16.7	13.3	3.4	20.4
North Santiam River	OR_SR_1709000503_02_103906	16.7	16.3	0.4	2.4
North Santiam River	OR_SR_1709000504_02_103906	16.7	13.3	3.4	20.4
North Santiam River	OR_SR_1709000504_02_103906	16.7	16.3	0.4	2.4

AU Name	AU ID	Maximum 7DADM River Temperature (°C)	Applicable Criterion + HUA (°C)	Excess Temperature (°C)	Percent Load Reduction
North Santiam River	OR_SR_1709000506_02_103930	19.2	13.3	5.9	30.7
North Santiam River	OR_SR_1709000506_02_103930	21.1	16.3	4.8	22.7
Oak Grove Fork Clackamas River	OR_SR_1709001103_02_104149	12.2	16.3	0.0	0.0
Oak Grove Fork Clackamas River	OR_SR_1709001103_02_104150	12.6	13.3	0.0	0.0
Oak Grove Fork Clackamas River	OR_SR_1709001103_02_104150	13.8	16.3	0.0	0.0
Owl Creek	OR_SR_1709000602_02_103941	19.2	16.3	2.9	15.2
Portland Creek	OR_SR_1709000109_02_103741	22.5	16.3	6.2	27.4
Pringle Creek	OR_SR_1709000703_02_104012	25.1	18.3	6.8	27.1
Pyramid Creek	OR_SR_1709000601_02_103935	20.3	18.3	2.0	9.8
Quartz Creek	OR_SR_1709000405_02_103867	12.1	13.3	0.0	0.0
Quartz Creek	OR_SR_1709000405_02_103867	16.3	16.3	0.0	0.2
Quartzville Creek	OR_SR_1709000603_02_103957	19.3	18.3	1.0	5.2
Quartzville Creek	OR_SR_1709000603_02_103960	22.0	18.3	3.7	16.7
Rebel Creek	OR_SR_1709000403_02_103861	13.3	16.3	0.0	0.0
Ritner Creek	OR_SR_1709000305_02_103833	21.8	18.3	3.5	16.0
Roaring River	OR_SR_1709000403_02_103864	7.2	12.3	0.0	0.0
Roaring River	OR_SR_1709001104_02_104160	14.2	13.3	0.9	6.3
Roaring River	OR_SR_1709001104_02_104160	15.4	16.3	0.0	0.0
Row River	OR_SR_1709000202_02_103761	25.1	18.3	6.8	27.1
Row River	OR_SR_1709000202_02_103766	25.1	18.3	6.8	27.1
Row River	OR_SR_1709000202_02_103779	13.6	13.3	0.3	2.2
Row River	OR_SR_1709000202_02_103779	23	18.3	4.7	20.4
Salmon Creek	OR_SR_1709000104_02_103719	13.5	12.3	1.2	9.1
Salmon Creek	OR_SR_1709000104_02_103719	18.4	13.3	5.1	27.6
Salmon Creek	OR_SR_1709000104_02_103719	19.3	16.3	3.0	15.7
Salt Creek	OR_SR_1709000103_02_103716	16.1	13.3	2.8	17.1
Salt Creek	OR_SR_1709000103_02_103716	17.9	16.3	1.6	8.7

AU Name	AU ID	Maximum 7DADM River Temperature (°C)	Applicable Criterion + HUA (°C)	Excess Temperature (°C)	Percent Load Reduction
Santiam River	OR_SR_1709000506_02_103927	16.3	13.3	3	18.4
Santiam River	OR_SR_1709000506_02_103927	23.4	18.3	5.1	21.8
Separation Creek	OR_SR_1709000401_02_103857	10.0	12.3	0.0	0.0
Sharps Creek	OR_SR_1709000202_02_103755	24.0	18.3	5.7	23.8
Sharps Creek	OR_SR_1709000202_02_103775	19.2	18.3	0.9	4.6
Sheep Creek	OR_SR_1709000602_02_103953	20.9	16.3	4.6	21.9
Shelton Ditch	OR_SR_1709000703_02_104008	18.5	13.3	5.2	28.2
Shelton Ditch	OR_SR_1709000703_02_104008	23.8	18.3	5.5	23.1
Soda Fork	OR_SR_1709000602_02_103947	16.1	16.3	0.0	0.0
South Fork McKenzie River	OR_SR_1709000403_02_104589	8.7	12.3	0	0
South Fork McKenzie River	OR_SR_1709000403_02_104589	13.1	13.3	0	0
South Fork McKenzie River	OR_SR_1709000403_02_104589	14.9	16.3	0	0
South Fork McKenzie River	OR_SR_1709000403_02_104589	8.7	12.3	0.0	0.0
South Fork McKenzie River	OR_SR_1709000403_02_104589	13.1	13.3	0.0	0.0
South Fork McKenzie River	OR_SR_1709000403_02_104589	14.9	16.3	0.0	0.0
South Fork McKenzie River	OR_SR_1709000403_02_104590	16.2	13.3	2.9	17.9
South Fork McKenzie River	OR_SR_1709000403_02_104590	17.8	16.3	1.5	8.4
South Santiam River	OR_SR_1709000506_02_103925	15.0	13.3	1.7	11.3
South Santiam River	OR_SR_1709000506_02_103925	14.1	16.3	0.0	0.0
South Santiam River	OR_SR_1709000602_02_103950	18.1	13.3	4.8	26.4
South Santiam River	OR_SR_1709000602_02_103950	21.4	16.3	5.1	23.7
South Santiam River	OR_SR_1709000604_02_103968	21.8	13.3	8.5	39.0
South Santiam River	OR_SR_1709000604_02_103968	24.4	16.3	8.1	33.2
South Santiam River	OR_SR_1709000608_02_103925	15	13.3	1.7	11.3
South Santiam River	OR_SR_1709000608_02_103925	14.1	16.3	0	0.0
Teal Creek	OR_SR_1709000305_02_103824	20.3	18.3	2.0	9.9
Trout Creek	OR_SR_1709000602_02_103942	17.2	16.3	0.9	5.5

AU Name	AU ID	Maximum 7DADM River Temperature (°C)	Applicable Criterion + HUA (°C)	Excess Temperature (°C)	Percent Load Reduction
Trout Creek	OR_SR_1709001104_02_104157	16.3	16.3	0.0	0.0
Upper Blue River	OR_SR_1709000404_02_104574	20.6	16.3	4.3	20.9
Whitewater Creek	OR_SR_1709000502_02_103898	12.4	18.3	0.0	0.0
Willamette River	OR_SR_1709000306_05_103854	17.5	13.3	4.2	24.0
Willamette River	OR_SR_1709000306_05_103854	23.8	18.3	5.5	23.1
Willamette River	OR_SR_1709000703_04_104013	17.6	13.3	4.3	24.4
Willamette River	OR_SR_1709000703_04_104013	25.7	18.3	7.4	28.8
Willamette River	OR_SR_1709000703_88_104015	26.1	20.3	5.8	22.2
Willamette River	OR_SR_1709001202_88_104175	26.6	20.3	6.3	23.7
Winberry Creek	OR_SR_1709000109_02_103747	20.2	13.3	6.9	34.2
Winberry Creek	OR_SR_1709000109_02_103747	22.5	16.3	6.2	27.6

9 Allocation approach

Figure 9-1 provides three separate conceptual representations of the total load to a temperature-impaired water. The left (completely orange) block shows the total load, with the bisecting lines representing the load that would meet the biologically-based numeric criteria plus the HUA (the temperature standard). The middle block represents the portions of the total load contributed by the different source categories (point, nonpoint, and background). The right block illustrates how the loading capacity element of the TMDL defines the various allocations.

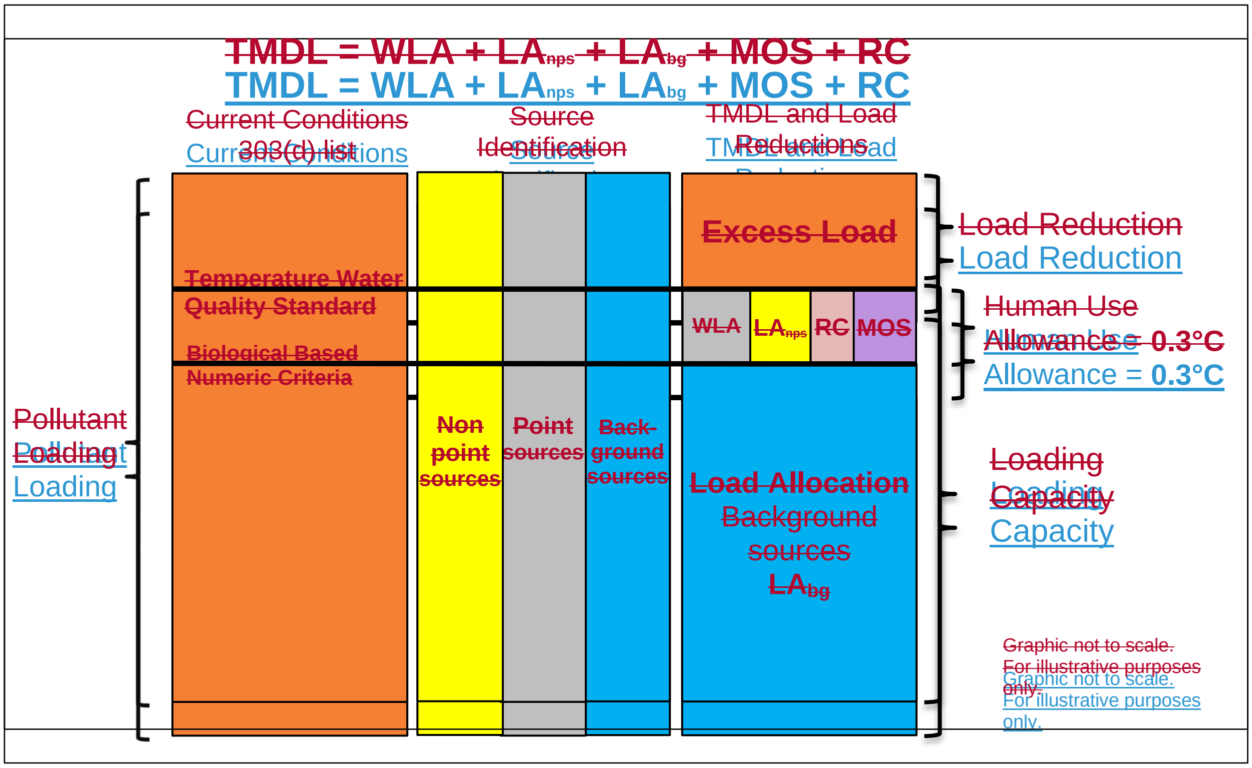


Figure 9-1: Conceptual representation and breakdown of total pollutant loading to a temperature-impaired waterbody.

Wasteload allocations (shown as WLA) are the portion of the TMDL loading capacity allocated to point sources and load allocations (shown as LA_{nps} and LA_{bg}) are the portion attributed to nonpoint sources, including background sources. OAR 340-042-0040(6) identifies the factors that DEQ or EQC may consider when distributing wasteload and load allocations.

The factors include:

a) Contributions from sources;
b) Costs of implementing measures;
c) Ease of implementation;
d) Timelines for attainment of water quality standards;
e) Environmental impacts of allocations;
f) Unintended consequences;
g) Reasonable assurances of implementation;
h) Any other relevant factor.

Oregon's temperature standard provides a framework for how the loading capacity is distributed between human sources of warming and background sources. The HUA at OAR 340-041-0028(12)(b)(B) identifies the portion of the loading capacity reserved 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 0.30°C (0.5°F) above the applicable criteria after complete mixing in the waterbody, and at the POMI. DEQ allocated a thermal load equivalent to a 0.30°C increase to human sources and the remainder of the loading capacity to background sources. Distribution of the human use allowance is discussed in 9.1.

9.1 Human use allowance (HUA)

When distributing the thermal loads associated with a 0.30°C increase, DEQ considered the magnitude of the thermal load contributed from known sources, ease of implementing the allocations, the environmental impact of those contributions including where the impact occurs, and how the source contribution impacts cumulative warming.

DEQ's approach to point sources was to assign an equal portion of the HUA equal to 0.075°C, up to a maximum of 0.20°C at the point of discharge from all NPDES permitted point sources in an AU, with some exceptions as described in Section 9.2. DEQ did not assign more than 0.20°C to any individual point source in order to have capacity available for nonpoint sources and reserve capacity. ~~This approach~~

As summarized in Section 7.2 lack of streamside vegetation is one of the largest sources of stream warming contributing multiple degrees of warming where it was assessed. Nonpoint sources of solar loading were assigned a zero human use allowance, meaning a reduction in streamside vegetation may not cause an increase in temperature above the applicable criterion.

The solar loading allocation 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 an extensive literature review, DEQ determined that a vegetation buffer width based on a slope distance of 120 ft would be sufficient in most cases to have no warming and attain the shade targets (TSD Appendix I). Effective shade surrogate measure targets represent a surrogate for the amount of solar loading that will attain the HUA and load allocations for nonpoint sources managing streamside vegetation.

DEQ choose to assign a portion of the human use allowance to existing infrastructure (roads, railroads, buildings, and utility corridors) over other land uses because moving, rebuilding, or modifying this infrastructure in addition to restoring streamside vegetation is a much more complex and potentially costly endeavor compared to restoring or protecting existing streamside vegetation in areas without infrastructure constraints. DEQ heard from municipalities commenting on the TMDL these land uses are difficult constraints to restore. In addition, other land uses without infrastructure constraints represent a much higher percentage of streamside area raising issues related to the appropriate amount of vegetation reduction that could occur spatially and over time while still maintaining a small increase such as < 0.05°C, that does not contribute to cumulative temperature impacts downstream.

Based on results presented in Appendix I, very small absolute changes in shade at a site level (not watershed mean) produce measurable temperature increases. We conclude from our data review that the vegetation reduction that will maintain a very small increase such as < 0.05°C, is going to be similar to what is required to maintain no temperature increase. Therefore, to limit the potential for cumulative warming, and as a margin of safety, the assigned human use allowance was set to zero. ~~Overall, the total assigned portion of the human use allowance to nonpoint sources is an increase relative to the 2006 Willamette Basin temperature TMDL (DEQ, 2006). DEQ set aside remaining human use allowance for reserve capacity to accommodate future growth or new sources.~~

DEQ assigned a load allocation and HUA of up to 0.05°C for temperature impacts associated with surface water withdrawals. This nonpoint source category accounts for warming from 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. DEQ Section 7.2.3 summarizes the temperature impacts from consumptive uses evaluated by DEQ.

DEQ assigned a load allocation and HUA of 0.00°C (no warming) to temperature impacts associated with dam and reservoir operations., except for the PGE Willamette Falls Hydroelectric Project. This nonpoint source category accounts for warming from dam impoundment and the release of the impounded water back into the natural channel. The no warming requirement is unchanged from the 2006 Willamette Basin TMDL (DEQ, 2006) except this TMDL includes requirements for additional dam and reservoir operators. The 2006 TMDL focused on USACE Willamette Project, EWEB projects, and PGE dam and reservoirs. A surrogate measure temperature target was developed to implement the dam and reservoir HUA and load allocation, (see Section 9.4.1). The PGE Willamette Falls Hydroelectric Project, which influences Willamette River reaches for which spawning is not a designated use, is provided a load allocation of 0.10°C. This is also unchanged from the 2006 TMDL.

In most AUs, the total assigned portion of the human use allowance assigned to nonpoint sources is an increase relative to the 2006 Willamette Basin temperature TMDL (DEQ, 2006).

DEQ set aside remaining human use allowance for reserve capacity to accommodate future growth or new sources., new sources, or to make allocation corrections to any existing source(s) that were assigned an erroneous allocation or may not have been identified during the development of this TMDL. Where possible, DEQ tried to maintain at least 0.01°C for reserve capacity.

9.2 Point source wasteload allocations (WLAs)

DEQ's approach to point sources which do not discharge to the Willamette River or major tributaries (Figure 9-2) was to assign an equal portion of the HUA (0.075°C) up to a maximum of 0.20°C at the point of discharge from all NPDES permitted point sources in an AU, with some exceptions described below. An HUA of 0.075°C to 0.20°C was selected because many of the current NPDES permit limits are based on this amount of allowed warming and it is consistent with the allocation approach in DEQ's 2006 Willamette Basin temperature TMDL (DEQ, 2006).

DEQ's approach to point sources which discharge to the Willamette River or major tributaries (Figure 9-3) was to estimate maximum current thermal loads of each discharge during spring spawning, summer non-spawning, and fall spawning periods. Evaluations were performed to determine if individual or cumulative impacts of current thermal loads exceed acceptable levels. For most cases, it was determined that thermal WLAs could be set equal to or slightly greater than current maximum current thermal loads. In several cases of relatively large thermal loads, WLAs were set to less than current thermal loads.

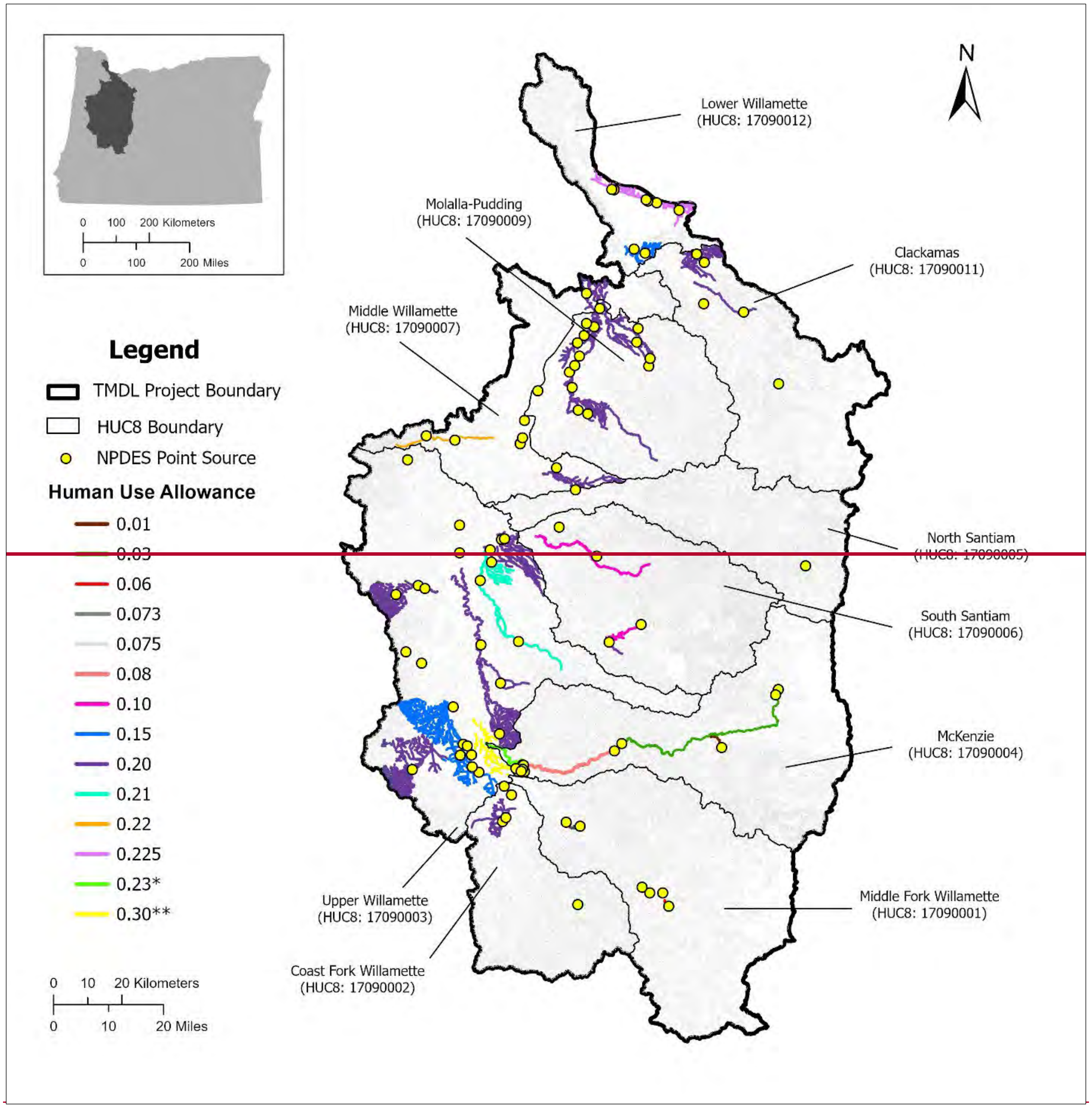
The following describes other factors DEQ considered when assigning an HUA to point sources:

- If a point source is not authorized to discharge in the current NPDES permit (maximum effluent flow = 0), for most facilities an HUA of 0.00°C was assigned during the no discharge period. A human use allocation of zero means there may be no warming above the applicable temperature criteria.

- When analysis completed for the TMDL indicated current thermal loads are less than 0.075°C, the HUA assigned was reduced to be consistent with the current thermal load.
- The assigned HUA was increased above 0.075°C to a maximum of 0.20°C for any single point source when analysis indicated that 0.075 would result in immediate noncompliance. DEQ only increased the HUA if there was sufficient loading capacity available. Point sources were not assigned more than 0.20°C in order to have capacity available for nonpoint sources and reserve capacity. An assessment of current thermal loading was not possible for all point sources due to project time constraints or lack of data. DEQ prioritized source assessment for point sources discharging to modeled streams; based on information DEQ received at TMDL Rule Advisory Committee meetings; based on comments received during the public comment period, or for facilities that DEQ staff knew or suspected an allocation based on an assigned 0.075 HUA would result in immediate noncompliance. These staff judgments were based on previous communications with the permittee, compliance history, review of DMRs, facility inspections, information contained in the permit or permit fact sheets, and previous analysis.
- On modeled streams, a characterization of point source discharge and cumulative effects analysis was completed. The results of the characterization and modeling informed the portion of the HUA assigned. Model based analysis were completed for point sources discharging to the McKenzie River, Pudding River, and Molalla River.
- On unmodeled streams where a cumulative effects modeling analysis was not completed, the total portion of the HUA allocated to the point source sector represents the sum of the individual HUA assignments. For example, a stream with two NPDES discharges that each have 0.075°C assigned at the point of discharge would have a point source sector allocation of 0.15°C cumulatively at the POMI. DEQ considered the sum of HUA assignments from upstream NPDES discharges when assigning the point source sector for downstream AUs. This was done to ensure there would be no exceedance to the allocated portion of the HUA. The approach is protective based on model results from other streams that show the temperature impacts dissipating moving downstream from the outfall.

Section 9.2.1 summarizes the assigned portion of the HUA for each point source, the findings from the assessment of current thermal loading, and the source of effluent discharge used in the wasteload allocation equation.

Figure 9-2 ~~shows~~and **Figure 9-3** show the portion of the HUA assigned to NPDES point sources for each AU within the Willamette subbasins TMDL project area~~.~~ and the Willamette mainstem and major tributaries TMDL project area, respectively. **Figure 9-~~3~~4** ~~illustrates~~ and **Figure 9-5** illustrate the total number of NPDES point sources discharging to each AU within the Willamette subbasins TMDL project area and the Willamette mainstem and major tributaries TMDL project area, respectively. The total count includes point sources discharging to a particular AU as well as those discharging to an AU directly upstream. For example, an AU with a total point source count of one could represent two potential scenarios, the first being that a single point source discharges directly to the AU with no immediate upstream sources. Alternatively, a point source count of one could indicate that no point sources discharge to the AU itself, but that a point source discharges to an AU directly upstream.



0 100 200 Kilometers
0 100 200 Miles
Legend
TMDL Project Boundary
HUC8 Boundary
NPDES Point Source
Human Use Allowance
0.01
0.03
0.06
0.073
0.075
0.08
0.10
0.15
0.20
0.21
0.22
0.225
0.23*
0.30**
0 10 20 Kilometers
0 10 20 Miles
N
Lower Willamette (HUC8: 17090012)
Molalla-Pudding (HUC8: 17090009)
Clackamas (HUC8: 17090011)
Middle Willamette (HUC8: 17090007)
North Santiam (HUC8: 17090005)
South Santiam (HUC8: 17090006)
McKenzie (HUC8: 17090004)
Middle Fork Willamette (HUC8: 17090001)
Upper Willamette (HUC8: 17090003)
Coast Fork Willamette (HUC8: 17090002)

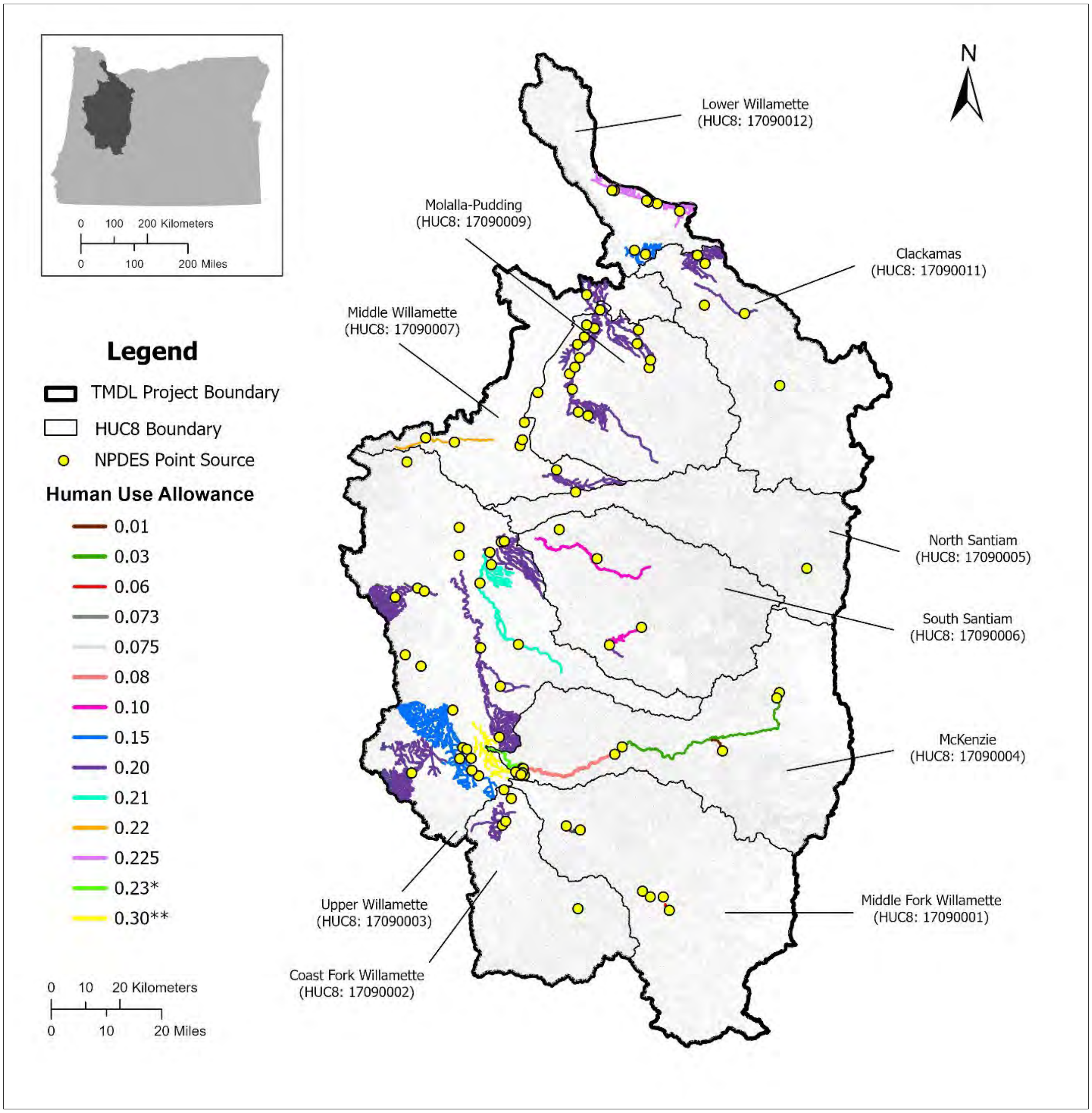
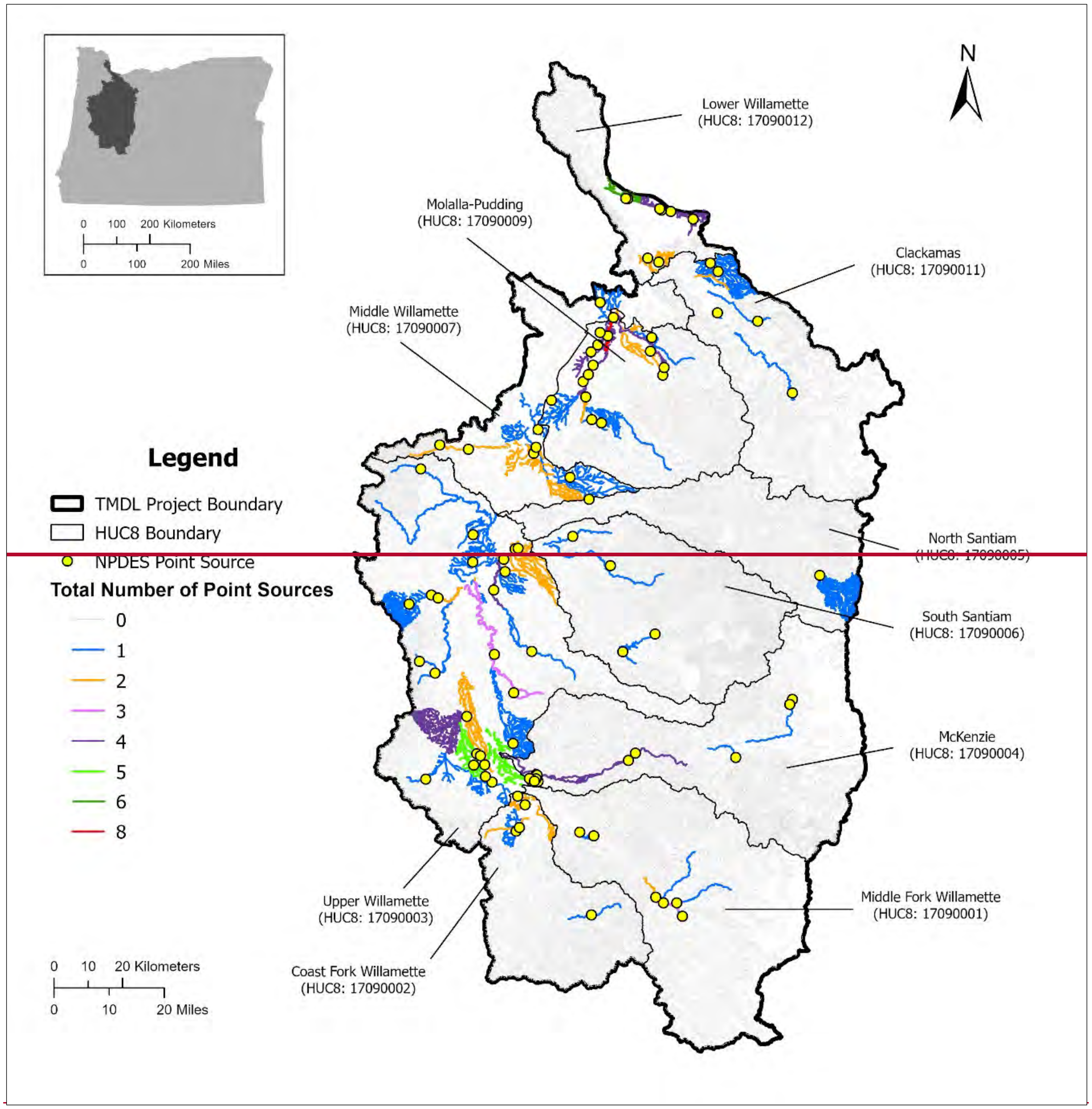


Figure 9-2: Assigned HUAs for NPDES point sources in each AU within the Willamette subbasins TMDL project area.

*HUA of 0.23 applies to the assessment unit OR_SR_1709000407_02_103884 (McKenzie River Mile 0 – 10.8) during the fall spawning period. During the spring spawning period and the summer non-spawning period, HUAs of 0.20 and 0.22 apply, respectively.

**HUA of 0.30 applies to the assessment unit OR_WS_170900030601_02_ 104287 between May 1 and May 31. From June 1 through October 31, the HUA is 0.225.


N
Lower Willamette
(HUC8: 17090012)
Molalla-Pudding
(HUC8: 17090009)
Clackamas
(HUC8: 17090011)
Middle Willamette
(HUC8: 17090007)
Legend
TMDL Project Boundary
HUC8 Boundary
NPDES Point Source
Total Number of Point Sources
0
1
2
3
4
5
6
8
North Santiam
(HUC8: 17090005)
South Santiam
(HUC8: 17090006)
McKenzie
(HUC8: 17090004)
Middle Fork Willamette
(HUC8: 17090001)
Upper Willamette
(HUC8: 17090003)
Coast Fork Willamette
(HUC8: 17090002)
0 10 20 Kilometers
0 10 20 Miles
0 100 200 Kilometers
0 100 200 Miles

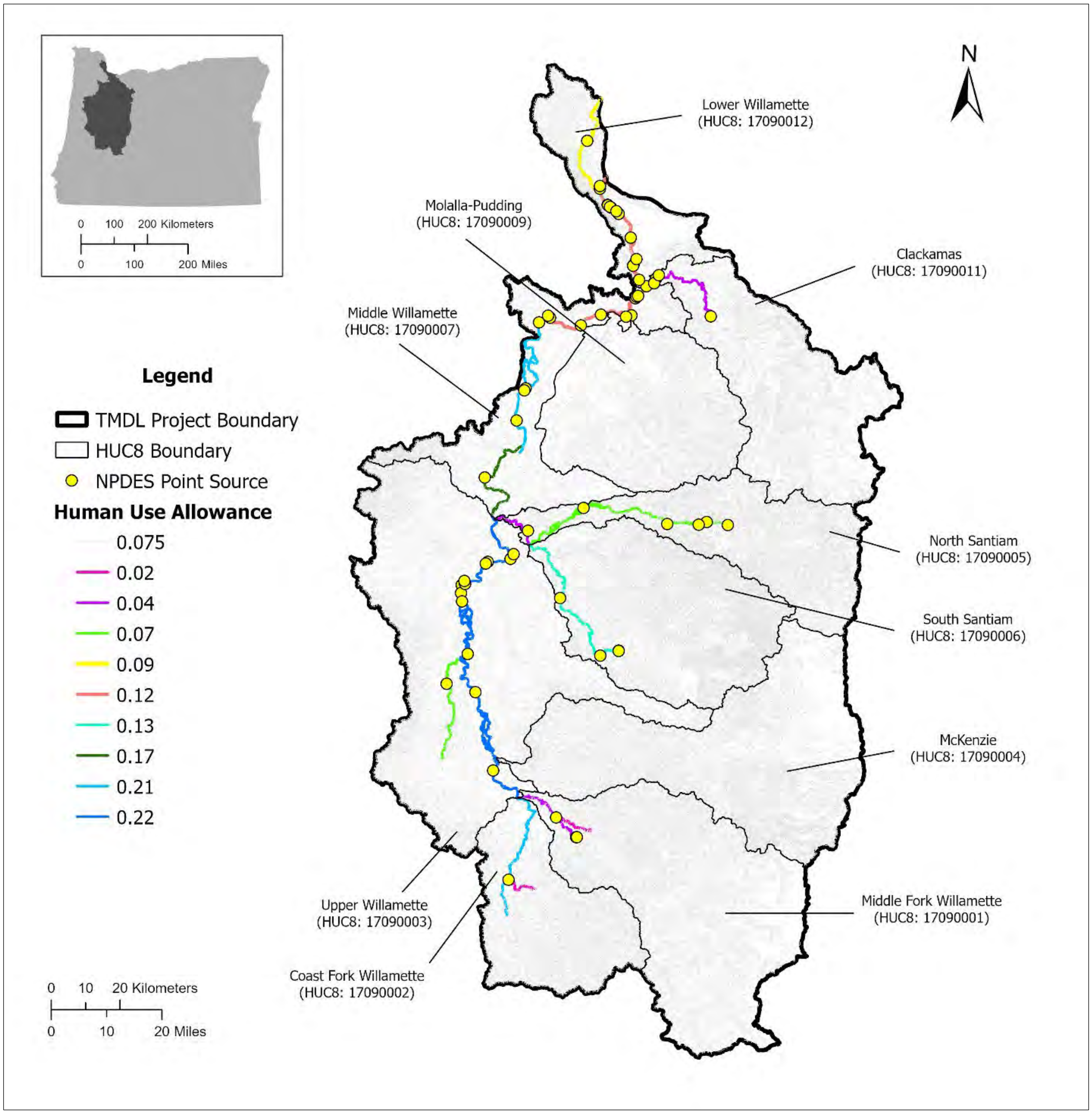


Figure 9-3: Assigned HUAs for NPDES point sources in each AU within the Willamette mainstem and major tributaries TMDL project area.

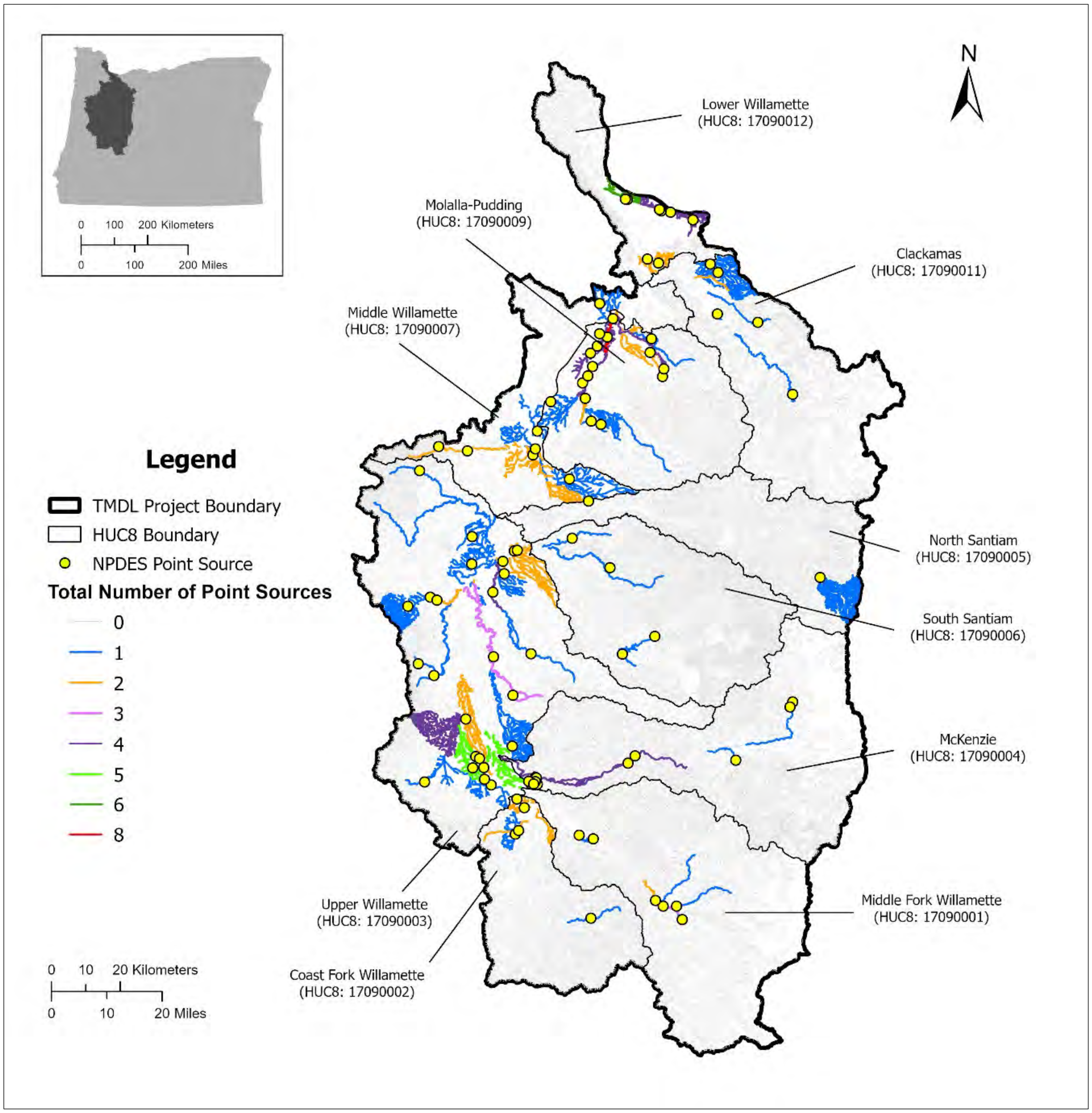


Figure 9-4: Total number of NPDES point sources discharging to each AU within the Willamette subbasins TMDL project area.

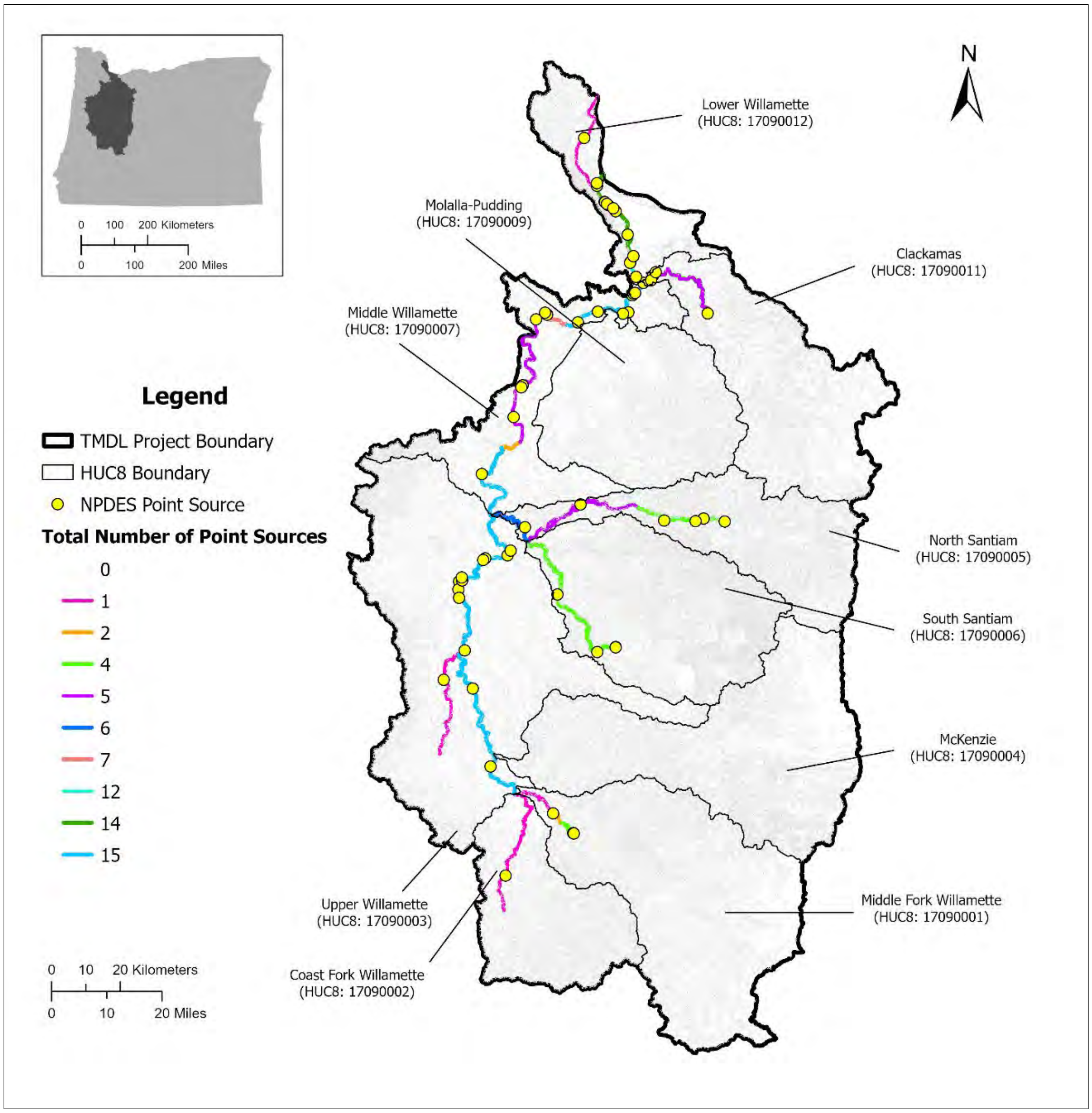


Figure 9-5: Total number of NPDES point sources discharging to each AU within the Willamette River mainstem and major tributaries TMDL project area.

9.2.1 HUA assignments to point sources

This section summarizes the assigned portion of the HUA for each point source, the rationale, the findings from the assessment of current thermal loading, and the source of effluent discharge used in the wasteload allocation equation. Unless noted, 7Q10 was assumed as the river flow for the loading assessments. 7Q10 details for each point source are summarized in Section 6.4 and **Table 6-3**.

For Willamette Mainstem reaches, the assigned portion of the HUA for each point source, the rationale, the findings from the assessment of current thermal loading, and the source of effluent discharge used in the wasteload allocation equation are described in Appendix M.

9.2.1.1 Albany Water Treatment Plant (66584)

The assessment of thermal loading for Albany Water Treatment Plant (WQ File#: 66584, EPA Number:ORG383501) found that an HUA of 0.075°C would result in noncompliance. The assigned HUA is increased to 0.20°C, which reduces the noncompliance days based on the data available. The effluent flow used in the wasteload allocation equation is based on the maximum effluent flow reported in DMRs, which is 0.81 MGD (1.3 cfs) from August 2018. Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply for estimation purposes. See Section 7.1.2.2 for additional details.

9.2.1.2 Alpine Community (100101)

Alpine Community (WQ File#: 100101, EPA Number: OR0032387) is assigned an HUA of 0.00°C based on no discharge requirements in the NPDES permit for the allocation period. The average dry weather design flow (ADWDF) reported in the permit is 0.02 MGD (0.03 cfs).

9.2.1.3 Arclin (16037)

Arclin (WQ File#: 16037, EPA Number: OR0021857) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is based on the maximum effluent flow allowed in the permit, which is 1.00 MGD (1.55 cfs).

9.2.1.4 Arclin (81714)

Arclin (WQ File#: 81714, EPA Number: OR0000892) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is from the NPDES Permit Evaluation and Fact Sheet dated July 21, 2009, which is 0.93 cfs.

9.2.1.5 ATI Albany Operations (64300)

ATI Albany Operations (WQ File#: 64300, EPA Number: OR0001716) is assigned an HUA of 0.01°C. Discharge is intermittent and effluent temperatures rarely exceed the temperature criterion because wastewater is mixed with cooler groundwater. An assessment of loading was completed for the period of May – October 2014-2020. During this period there were only two days reported on DMRs with daily maximum effluent temperatures warmer than the criterion. These two days did not result in warming over the 7-day averaging period (zero increase). DEQ assigned 0.01°C to allow for some warming in the event there is a ramp up of days with warmer temperatures. The effluent flow used in the wasteload allocation equation is based on the maximum effluent flow reported in DMRs, 2.278 MGD (3.5 cfs) on September 17, 2015.

9.2.1.6 Aumsville STP (4475)

Aumsville STP (WQ File#: 4475, EPA Number: OR0022721) is assigned an HUA of 0.00°C based on no discharge requirements in the NPDES permit for the allocation period. The ADWDF reported in the permit is 0.335 MGD (0.52 cfs).

9.2.1.7 Aurora STP (110020)

Aurora STP (WQ File#: 110020, EPA Number: OR0043991) is assigned an HUA of 0.00°C based on no discharge requirements in the NPDES permit for the allocation period. The ADWDF reported in the permit is 0.087 MGD (0.1 cfs)

9.2.1.8 Bakelite Chemicals LLC (32650)

Bakelite Chemicals LLC (WQ File#: 32650, EPA Number: OR0032107) is assigned an HUA of 0.00°C based on no discharge requirements in the NPDES permit for the allocation period.

9.2.1.9 Bakelite Chemicals LLC (32864)

Bakelite Chemicals LLC (WQ File#:32864, EPA Number: OR0002101) is assigned an HUA of 0.00°C during the no discharge period described in the NPDES permit (June 1 – October 31). When discharge is allowed during the allocation period, the assigned HUA is 0.075°C. The effluent flow used in the wasteload allocation equation for the discharge period is based on discharge reported on May 2019 and 2020 DMRs for Outfall 001, which is 0 cfs.

9.2.1.10 Blount Oregon Cutting Systems Division (63545)

The assessment of thermal loading for Blount Oregon Cutting Systems Division (WQ File#: 63545, EPA Number: OR0032298) found that an HUA of 0.075°C would not result in exceedances based on the data available. Therefore, the assigned HUA is 0.075°C. The effluent flow used in the wasteload allocation equation is the maximum flow from August 2009 to July 2012 reported in the Permit Evaluation Report dated August 19, 2010, which is the 0.19 cfs.

9.2.1.11 Boeing of Portland – Fabrication Division (9269)

Boeing of Portland – Fabrication Division (WQ File #: 9269, EPA Number: OR0031828) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is the average combined discharge flow for 2012 reported in the Permit Evaluation Report dated June 18, 2012, which is 0.46 cfs.

9.2.1.12 Brownsville STP (11770)

Brownsville STP (WQ File#: 11770, EPA Number: OR0020079) is assigned an HUA of 0.00°C based on no discharge requirements in the NPDES permit for the allocation period.

9.2.1.13 City of Silverton Drinking WTP (81398)

The City of Silverton Drinking WTP (WQ File#: 81398, EPA Number: ORG383527) is assigned an HUA of 0.20°C based on the assessment of loading and allocation in the 2008 TMDL. The effluent flow used in the wasteload allocation calculation is the maximum typical average monthly discharge reported between 2000 and 2007 in the 2008 TMDL (pages 2-28), which is 0.05 MGD (0.08 cfs). Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply and 17°C was used during the spawning period for estimation purposes. See Section 7.1.2.2 for additional details.

9.2.1.14 Coburg Wastewater Treatment Plant (115851)

The assessment of thermal loading for Coburg Wastewater Treatment Plant (WQ File#: 115851, EPA Number: OR0044628) found that an HUA of 0.075°C would result in noncompliance. The assigned HUA is increased to 0.20°C, which reduces the noncompliance days based on the data available. The effluent flow used in the wasteload allocation equation is the ADWDF reported in the NPDES permit, which is 0.44 MGD (0.68 cfs).

9.2.1.15 Coffin Butte Landfill (104176)

Coffin Butte Landfill (WQ File#:104176, EPA Number: OR0043630) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is based on a review of DMRs showing no discharge (0 MGD).

9.2.1.16 Columbia Helicopters (100541)

Columbia Helicopters (WQ File#: 100541, EPA Number: OR0033391) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is the peak design flow listed in the Permit Evaluation Report received 2/6/2007 (expired March 19, 2019), which is 0.01 cfs. Based on review of DMRs, Columbia Helicopters has very infrequent discharge.

9.2.1.17 Corvallis Rock Creek WTP (20160)

The assessment of thermal loading for Corvallis Rock Creek WTP (WQ File#: 20160, EPA Number: ORG383513) found that an HUA of 0.075°C would result in noncompliance. The assigned HUA was increased to 0.20°C, which reduces the noncompliance days based on the data available. The effluent flow used in the wasteload allocation equation is the maximum flow reported in recent DMRs, which is 0.24 MGD (0.37 cfs) reported in August 2019. Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply for estimation purposes. See Section 7.1.2.2 for additional details.

9.2.1.18 Creswell STP (20927)

Creswell STP (WQ File#: 20927, EPA Number: OR0027545) is assigned an HUA of 0.00°C during the no discharge period described in the NPDES permit (June 1 – October 31). The assessment of thermal loading for discharge during the allocation period found that an HUA of 0.075°C would result in noncompliance. When discharge is allowed during the allocation period, the assigned HUA is increased to 0.20°C, which reduces the noncompliance days based on the data available. The effluent flow used in the wasteload allocation equation for the discharge period is based on the maximum flow reported in DMRs for April and May in 2019 and 2020, which is 3.29 MGD (5.09 cfs). The ADWDF in the NPDES permit is 0.20 MGD (0.31 cfs).

The assigned HUA was increased to 0.20°C, which reduced the noncompliance days based on the data available.

9.2.1.19 Dallas STP (22546)

The assessment of thermal loading for Dallas STP (WQ File#: 22546, EPA Number: OR0020737) found that an HUA of 0.075°C would result in noncompliance. The assigned HUA is increased to 0.11°C, which reduces the noncompliance days based on the data available. The effluent flow used in the wasteload allocation equation is the ADWDF from the NPDES permit, which is 2.0 MGD (3.09 cfs).

9.2.1.20 Dallas WTP (22550)

The assessment of thermal loading for Dallas WTP (WQ File#: 22550, EPA Number: ORG383529) found that an HUA of 0.075°C would result in noncompliance. The assigned HUA is increased to 0.11°C, which reduces the noncompliance days based on the data available. The assigned HUA could not be increased because available capacity has been distributed to other NPDES permitted point sources. The effluent flow used in the wasteload allocation equation is the maximum flow reported in recent DMRs, which is 0.1111 MGD (0.17 cfs) from August 2020. Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply and 17°C was used during the spawning period for estimation purposes. See Section 7.1.2.2 for additional details.

9.2.1.21 Deer Creek Estates Water Association (23650)

The assessment of thermal loading for Deer Creek Estates Water Association (WQ File#: 23650, EPA Number: ORG383526) found that an HUA of 0.075°C would result in noncompliance. The assigned HUA is increased to 0.20°C, which reduces the noncompliance days based on the data available. The effluent flow used in the wasteload allocation equation is from the 1978 NPDES permit application, which is 2,400 gallons/day (0.004 cfs). Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply for estimation purposes. See Section 7.1.2.2 for additional details.

9.2.1.22 Duraflake (97047)

The assessment of thermal loading for Duraflake (WQ File#: 97047, EPA Number: OR0000426) found that an HUA of 0.075°C would result in noncompliance. The assigned HUA is increased to 0.20°C, which reduces the noncompliance days based on the data available. The effluent flow used in the wasteload allocation equation is the sum of the 95th percentile flows from outfall 002 and outfall 003 reported in the NPDES permit, which is 0.356854 MGD (0.55 cfs).

9.2.1.23 Estacada STP (27866)

Estacada STP (WQ File#: 27866, EPA Number: OR0020575) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is the maximum flow reported in the NPDES Permit Evaluation from May to October 2009, which is 0.84 cfs.

9.2.1.24 EWEB Carmen-Smith Carmen Powerhouse Outfalls 001A and 001B (28393)

EWEB Carmen-Smith Powerhouse Outfalls 001A and 001B (WQ File#: 28393, EPA Number: OR0000680) are assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is based on the NPDES permit requirement limiting Outfall 001 maximum flow to 1.73 MGD (2.68 cfs).

9.2.1.25 EWEB Carmen-Smith Trail Bridge Powerhouse Outfalls 002A and 002B (28393)

The assessment of thermal loading for EWEB Carmen-Smith Powerhouse Outfalls 002A and 002B (WQ File#: 28393, EPA Number: OR0000680) found that an HUA of 0.030°C would result in compliance based on data available. The effluent flow used in the wasteload allocation equation is based on the NPDES permit requirement limiting Outfall 002 average flow to 0.6 MGD (0.93 cfs). The WLA was also evaluated in the Upper McKenzie River Heat Source model and downstream of the South Fork McKenzie in the McKenzie River CE-QUAL-W2 model.

9.2.1.26 EWEB Hayden Bridge Filter Plant (28385)

The assessment of thermal loading for EWEB Hayden Bridge Filter Plant (WQ File#: 28385, EPA Number: ORG383503) found that an HUA of 0.010°C would result in compliance based on data available. Effluent temperatures were not available and estimated to be 24°C when year-round criterion apply and 17°C during spawning. The effluent flow used in the wasteload allocation equation is the maximum flow reported in recent DMRs, which is 1.35 MGD (2.09 cfs) from June 2019. Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply and 17°C was used during the spawning period for estimation purposes. See Section 7.1.2.2 for additional details.

9.2.1.27 Falls City STP (28830)

Falls City STP (WQ File#: 28830, EPA Number: OR0032701) is assigned an HUA of 0.00°C based on no discharge requirements in the NPDES permit for the allocation period.

9.2.1.28 Foster Farms (97246)

Foster Farms (WQ File#: 97246, EPA Number: OR0026450) is assigned an HUA of 0.00°C based on no discharge requirements in the NPDES permit for the allocation period.

9.2.1.29 Fujimi Corporation – SW Commerce Circle (107178)

The assessment of thermal loading for Fujimi Corporation (WQ File#: 107178, EPA Number: OR0040339) found that an HUA of 0.075°C would result in noncompliance. The assigned HUA is increased to 0.20°C, which reduces the noncompliance days based on the data available. The effluent flow used in the wasteload allocation equation is discharge reported on the Permit Evaluation and Fact Sheet dated September 4, 2012, which is 0.2 cfs.

9.2.1.30 Gervais STP (33060)

Gervais STP (WQ File#: 33060, EPA Number: OR0027391) is assigned an HUA of 0.00°C based on no discharge requirements in the NPDES permit for the allocation period. -The ADWDF reported in the NPDES permit is 0.22 MGD (0.34 cfs).

9.2.1.31 Halsey STP (36320)

Halsey STP (WQ File#: 36320, EPA Number: OR0022390) is assigned an HUA of 0.00°C based on no discharge requirements in the NPDES permit for the allocation period. The ADWDF reported in the NPDES permit is 0.197 MGD (0.30 cfs).

9.2.1.32 Hubbard STP (40494)

Hubbard STP (WQ File#:40494, EPA Number: OR0020591) is assigned an HUA of 0.20°C based on the assessment of loading and allocation in the 2008 Molalla-Pudding TMDL (DEQ, 2008c). The effluent flow used in the wasteload allocation equation is the maximum monthly dry weather design flow reported in the 2022 NPDES Permit Fact Sheet, which is 0.35 cfs.

9.2.1.33 Hull-Oakes Lumber Co. (107228)

The assessment of thermal loading for Hull-Oakes Lumber Co. (WQ File#: 107228, EPA Number: OR0038032) found that an HUA of 0.075°C would result in compliance based on the data available. The effluent flow used in the wasteload allocation equation is the maximum flow reported for Outfall 002 in recent DMRs, which is 0.05 MGD (0.08 cfs). The NPDES permit states that Outfall 001 does not discharge from July 1 to October 31.

9.2.1.34 International Paper – Springfield - 200-J (108921)

The assessment of thermal loading for International Paper – Springfield (WQ File#: 108921, EPA Number: ORG383548) found that an HUA of 0.075°C would result in noncompliance based on the data available. The assigned HUA could not be increased because all available capacity has been distributed to other NPDES permitted point sources that discharge to the canal and ditch network leading to Q Street Canal. The effluent flow used in the wasteload allocation equation is the maximum discharge reported in recent DMRs, which is 0.0045 MGD (0.01 cfs) from June 2020. Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply for estimation purposes. See Section 7.1.2.2 for additional details.

9.2.1.35 International Paper – Springfield Outfalls 001 and 002 (96244)

International Paper – Springfield Outfalls 001 and 002 (WQ File#: 96244, EPA Number: OR0000515) is assigned a HUA of 0.12°C during the Spring spawning period (April 1 – June 15), 0.20°C during the non-spawning period (June 16 – August 31), and 0.19°C during the Fall spawning period (September 1 – November 15). Cumulative effects modeling shows that these allocations will result in a maximum river temperature increases due to point sources of 0.22°C during the summer and fall and less during spring. The spawning and non-spawning periods given are relative to the wasteload allocation period for the point of discharge and are not representative of the entire spawning period for the McKenzie River. The April 1 – November 15 period during which wasteload allocations apply is based on the period of temperature criteria exceedance for the Willamette River upstream from Newberg Pool. This April 1 – November 15 is used because McKenzie River thermal loads impact Willamette River temperature. The effluent flow used in the wasteload allocation equation is 28.9 cfs. 28.9 cfs is the effluent flow rate that, along with effluent temperature, results in the greatest river temperature impact for conditions of 7Q10 design low river flow and river temperature equal to the applicable criteria (13°C during spawning periods and 16°C during non-spawning periods).

9.2.1.36 International Paper – Springfield Outfall 003 (96244)

International Paper – Springfield Outfall 003 (WQ File#: 96244, EPA Number: OR0000515) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is the maximum discharge reported in May – October in DMRs from 2013 to 2016, which is 2.0 MGD (3.09 cfs).

9.2.1.37 J.H. Baxter & Co (6553)

J.H. Baxter & Co (WQ File#: 6553, EPA Number: OR0021911) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is the average discharge flow reported in the NPDES Permit Evaluation dated 9/13/2010, which is 0.12 cfs. J.H. Baxter has stopped operation of wood treating, but their NPDES permit is still active and there remains a discharge associated with groundwater and stormwater treatment. It is expected discharge will continue until the site has been fully remediated.

9.2.1.38 JLR (32536)

JLR (WQ File#: 32536, EPA Number: OR0001015) is assigned an HUA of 0.01°C based on the assessment of loading and allocation in the 2008 Molalla-Pudding TMDL (DEQ, 2008c). The effluent flow used in the wasteload allocation equation is the maximum discharge reported in 2018-2020 DMRs from April to October, which is 0.5 cfs.

9.2.1.39 Junction City STP (44509)

Junction City STP (WQ File#: 44509, EPA Number: OR0026565) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit for the allocation period.

9.2.1.40 Kingsford Manufacturing Company – Springfield Plant (46000)

Kingsford Manufacturing Company - Springfield Plant (WQ File#: 46000, EPA Number: OR0031330) is assigned an HUA of 0.0°C when the no discharge requirements in the NPDES permit apply (June 1 – October 31). An HUA of 0.075°C is assigned when discharge is permitted during the allocation period (May 1 – May 31). When discharge is permitted, the effluent flow used in the wasteload allocation equation is the maximum effluent flow reported in recent DMRs, which is 0.08 cfs in April 2020.

9.2.1.41 Knoll Terrace Mhc (46990)

Knoll Terrace Mhc (WQ File#: 46990, EPA Number: OR0026956) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit. The ADWDF from the NPDES permit is 0.06 MGD (0.09 cfs).

9.2.1.42 Lakewood Utilities, Ltd (96110)

Lakewood Utilities, Ltd (WQ File#: 96110, EPA Number: OR0027570) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit.

9.2.1.43 Lane Community College (48854)

Lane Community College (WQ File#: 48854, EPA Number: OR0026875) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit. The ADWDF from the NPDES permit is 0.142 MGD (0.22 cfs)

9.2.1.44 Lowell STP (51447)

The assessment of thermal loading for Lowell STP (WQ File#: 51447, EPA Number: OR0020044) found that an HUA of 0.013 would result in compliance based on the data available. The effluent flow used in the wasteload allocation equation is the maximum discharge reported during the allocation period in DMRs from 2015 to 2020, which is 0.790 MGD (1.22 cfs) in July 2017.

9.2.1.45 Mcfarland Cascade Pole & Lumber Co (54370)

Mcfarland Cascade Pole & Lumber Co (WQ File#: 54370, EPA Number: OR0031003) is assigned an HUA of 0.0°C based on NPDES permit limitations requiring effluent temperatures to not exceed 17.8°C from May 1 to October 31. When this requirement is met, there are no stream temperature increases above the applicable temperature criterion.

9.2.1.46 Molalla Municipal Drinking WTP (109846)

Molalla Municipal Drinking WTP (WQ File#: 109846, EPA Number: ORG380014) is assigned an HUA of 0.20°C based on the assessment of thermal loading and allocation given in the 2008 Molalla-Pudding TMDL (DEQ, 2008c). The effluent flow used in the wasteload allocation equation is based on the maximum reported on recent DMRs, 0.1024 MGD (0.16 cfs) June 2021. Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply and 17°C was used during the spawning period for estimation purposes. See Section 7.1.2.2 for additional details.

9.2.1.47 Molalla STP (57613)

The assessment of thermal loading for Molalla STP (WQ File#: 57613, EPA Number: OR0022381) found that an HUA of 0.10°C would result in compliance based on the data available. The effluent flow used in the wasteload allocation equation is the maximum effluent flow reported between March and October in recent DMRs, which is 2.234 MGD (3.46 cfs).

9.2.1.48 Mt. Angel STP (58707)

Mt. Angel STP (WQ File#: 58707, EPA Number: OR0028762) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit for the allocation period. The ADWDF in the permit is 0.56 MGD (0.87 cfs).

9.2.1.49 Murphy Veneer, Foster Division (97070)

The assessment of thermal loading for Murphy Veneer found that an HUA of 0.075°C would result in noncompliance. This assessment was based on allocation period effluent data from 2019 and 2020 DMRs. The assigned HUA was increased to 0.20°C, which reduced the noncompliance days based on the data available. The effluent flow used in the wasteload allocation calculation is the 7-day average flow between June 1 and June 15 reported in the NPDES Permit Evaluation Report dated July 1, 2010, which is 1.11 cfs.

9.2.1.50 Norpac Foods- Plant #1, Stayton (84820)

The assessment of thermal loading for Norpac Foods – Plant #1 (WQ File#: 84820, EPA Number: OR0001228) found that an HUA of 0.075°C would result in noncompliance. This assessment was based on allocation period effluent data from 2019 and 2020 DMRs. The assigned HUA is increased to 0.20°C, which reduces the noncompliance days based on the data available. The effluent flow used in the wasteload allocation calculation is the peak processing flow reported in the NPDES Permit Evaluation Report, which is 6.19 cfs.

9.2.1.51 Oakridge STP (62886)

The assessment of thermal loading for Oakridge STP (WQ File#: 62886, EPA Number: OR0022314) found that an HUA of 0.075°C would result in compliance based on the data available. The effluent flow used in the wasteload allocation calculation is the ADWDF from the NPDES permit, which is 0.47 MGD (0.73 cfs).

9.2.1.52 ODC – Oregon State Penitentiary (109727)

The assessment of thermal loading for Oregon State Penitentiary (WQ File#:109727, EPA Number: OR0043770) found that an HUA of 0.075°C would result in compliance based on the data available. The effluent flow used in the wasteload allocation calculation is the maximum flow authorized in the NPDES permit, which is 1.6 MGD (2.48 cfs).

9.2.1.53 ODFW – Marion Forks Fish Hatchery (64495)

ODFW – Marion Forks Fish Hatchery (WQ File#: 64495, EPA Number: OR0027847) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is the maximum flow from data submitted by ODFW, which is 18.6 cfs.

9.2.1.54 ODFW – Roaring River Fish Hatchery (64525)

The assessment of thermal loading completed by ODFW for ODFW - Roaring River Hatchery (WQ File#:64525, EPA Number: ORG133506) found that an HUA of 0.10°C would result in compliance based on the data available. The effluent flow used in the wasteload allocation equation is the maximum flow from data submitted by ODFW, which is 14.2 cfs.

9.2.1.55 ODFW – Willamette Fish Hatchery (64585)

ODFW - Willamette Fish Hatchery (WQ File#: 64585, EPA Number: ORG133507) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is the maximum of the combined discharges from Outfalls 001 and 002 as summarized from data submitted by ODFW.

9.2.1.56 ODFW – Leaburg Fish Hatchery (64490)

ODFW Leaburg Fish Hatchery (WQ File#: 64490, EPA Number: OR0027642) is assigned an HUA of 0.074°C during the Spring spawning period (April 1 – June 15), 0.012°C during the non-spawning period (June 16 – August 31), and 0.026°C during the Fall spawning period (September 1 – November 15). The spawning and non-spawning periods given are relative to the wasteload allocation period for the point of discharge and are not representative of the entire spawning period for the McKenzie River. The effluent discharge used in the wasteload allocation equation for the spring spawning period is 92.4 cfs, the non-spawning period is 39.1 cfs, and the fall spawning period is 78.3 cfs. The effluent flows used in the wasteload allocation equations are from discharge data submitted by ODFW for the period of 2016 to 2023.

9.2.1.57 ODFW – McKenzie River Fish Hatchery (64500)

ODFW McKenzie River Fish Hatchery (WQ File#: 64500, EPA Number: OR0029769) is assigned an HUA of 0.002°C during the Spring spawning period (April 1 – June 15), 0.033°C during the non-spawning period (June 16 – August 31), and 0.002°C during the Fall spawning period (September 1 – November 15). The spawning and non-spawning periods given are relative to the wasteload allocation period for the point of discharge and are not representative of the entire spawning period for the McKenzie River. The effluent discharge used in the wasteload allocation equation for the spring spawning period is 12.7 cfs, the non-spawning period is 11.8 cfs, and the fall spawning period is 1.0 cfs. The effluent flows used in the wasteload allocation equations are from discharge data submitted by ODFW for the period of 2016 to 2023.

9.2.1.58 Philomath WTP (100048)

The assessment of thermal loading for Philomath WTP (WQ File#: 100048, EPA Number: ORG383536) found that an HUA of 0.075 would result in noncompliance. The assigned HUA is increased to 0.20°C. The effluent flow used in the wasteload allocation equation is the maximum daily discharge reported in the NPDES Permit Application dated 12/06/2001, which is 0.207 MGD (0.32 cfs). Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply and 17°C was used during the spawning period for estimation purposes. See Section 7.1.2.2 for additional details.

9.2.1.59 Philomath WWTP (103468)

Philomath WWTP (WQ File#: 103468, EPA Number: OR0032441) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit for the allocation period.

9.2.1.60 PNW Veg Co DBA Norpac Foods No. 5 (84791)

PNW Veg Co DBA Norpac Foods No. 5 (WQ File#: 84791, EPA Number: OR0021261) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit for the allocation period.

9.2.1.61 Row River Valley Water District (100075)

The assessment of thermal loading for Row River Valley Water District (WQ File#: 100075, EPA Number: ORG383534) found that an HUA assignment of 0.075°C would result in compliance based on the data available. The effluent flow used in the wasteload allocation equation is the maximum reported in DMRs between October 2012 and May 2013, which is 0.028 MGD (0.04 cfs). Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply for estimation purposes. See Section 7.1.2.2 for additional details.

9.2.1.62 RSG Forest Products – Liberal (72596)

RSG Forest Products – Liberal (WQ File#: 72596, EPA Number: OR0021300) is assigned an HUA of 0.20°C. An assessment of thermal loading was not completed for this facility due to a lack of discharge data. The HUA was increased from what was assigned in the 2008 Molalla-Pudding TMDL (0.16°C) to minimize the likelihood of noncompliance.

9.2.1.63 Sandy WWTP (78615)

Sandy WWTP (WQ File#: 78615, EPA Number: OR0026573) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit for the allocation period. DEQ is aware that a HUA of 0.0°C may result in noncompliance during wet weather periods. The City of Sandy WWTP is under an EPA consent decree to upgrade and add treatment capacity. At the time of writing, the city has provided DEQ with an NPDES permit application to upgrade and construct a new outfall to the Sandy River. DEQ evaluated this potential discharge in the Temperature TMDLs for the Lower Columbia-Sandy Subbasin (DEQ, 2024) and provided a wasteload allocation based on the discharge location proposed in the NPDES application. DEQ believes this allocation will be sufficient to allow summer and wet weather discharge.

9.2.1.64 Scio STP (79633)

Scio STP (WQ File#: 79633, EPA Number: OR0029301) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit for the allocation period. The ADWDF in the NPDES permit is 0.09 MGD (0.14 cfs).

9.2.1.65 Seneca Sawmill Company (80207)

Seneca Sawmill Company (WQ File#: 80207, EPA Number: OR0022985) is assigned an HUA of 0.0°C based on NPDES permit requirements limiting effluent temperature to no more than 18.0°C, which results in no increases above the applicable temperature criterion. The effluent flow reported in the Permit Evaluation and Fact Sheet dated June 15, 2006 is 1.19 cfs.

9.2.1.66 SFPP (103159)

SFPP (WQ File#: 103159, EPA Number: OR0044661) is assigned an HUA of 0.075°C. The effluent flow used in the wasteload allocation equation is flow reported in the Permit Evaluation Report dated August 19, 2009, which is 0.02 cfs.

9.2.1.67 Sherman Bros. Trucking (36646)

Sherman Bros. Trucking (WQ File#: 36646, EPA Number: OR0021954) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit for the allocation period. The ADWDF in the NPDES permit is 0.014 MGD (0.02 cfs).

9.2.1.68 Silverton STP (81395)

Silverton STP (WQ File#: 81395, EPA Number: OR0020656) is assigned an HUA of 0.20°C based on the assessment of loading and allocation in the 2008 Molalla-Pudding TMDL (DEQ, 2008c). The effluent flow used in the wasteload allocation equation is the ADWDF from the NPDES permit, which is 2.5 MGD (3.87 cfs).

9.2.1.69 Sunstone Circuits (26788)

Sunstone Circuits (WQ File#: 26788, EPA Number: OR0031127) is assigned an HUA of 0.04°C based on the assessment of loading and allocation in the 2008 Molalla-Pudding TMDL (DEQ, 2008c). The effluent flow used in the wasteload allocation equation is the design flow from the NPDES permit, which is 0.065 cfs.

9.2.1.70 Tangent STP (87425)

Tangent STP (WQ File#: 87425, EPA Number: OR0031917) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit for the allocation period. The ADWDF in the NPDES permit is 0.11 MGD (0.17 cfs).

9.2.1.71 Timberlake STP (90948)

Timberlake STP (WQ File#: 90948, EPA Number: OR0023167) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit for the allocation period. The ADWDF in the NPDES permit is 0.144 MGD (0.22 cfs).

9.2.1.72 USFW – Eagle Creek National Fish Hatchery (91035)

USFW - Eagle Creek National Fish Hatchery (WQ File#: 91035, EPA Number: OR0000710) is assigned an HUA of 0.20°C based on the assessment of loading and allocation in the 2006 Willamette Basin TMDL (DEQ, 2006). The effluent flow used in the wasteload allocation equation is the effluent flow reported in the 2006 TMDL, which is 52.6 cfs. The 7Q10 calculated upstream of the intake is 21 cfs. However, the NPDES permit fact sheet states the hatchery withdrawals all of the stream flow except for some small amount of leakage past the diversion structure at the intake. For this reason, the 7Q10 flow used to calculate the wasteload allocation was set to zero.

9.2.1.73 U.S. Army Corp of Engineers - Cougar Project (126712)

USACE Cougar Project (WQ File#: 126712) is assigned an HUA of 0.01°C based on an assessment of loading and cumulative effects modeling (TSD Appendix K). The estimated 7DADM temperature increase based on available data is about 0.002ºC during the year-round period and 0.003 ºC during spawning. There were limited effluent data available (one or two grab samples) so the HUA was increased to account for the uncertain characterization. The effluent flow used in the wasteload allocation equation is the sum of the maximum effluent flow rates (0.1368 MGD) reported for each outfall on the NPDES permit application dated 9/23/2019. For effluent temperature the maximum value used was either the flow weighted maximum effluent temperature from all outfalls on the permit application or the maximum 7DADM river temperature downstream of the dam (USGS 14159500) which approximates the temperatures being pulled from the intake and used for non-contact cooling water. River flows were assumed to be at seasonal 7Q10s. See Section 6.4 for 7Q10 details.

9.2.1.74 U.S. Army Corp of Engineers - Detroit Project (126716)

USACE Detroit Project (WQ File#: 126716) is assigned an HUA of 0.10°C based on an assessment of loading. The estimated maximum 7DADM temperature increase based on available data is about 0.082ºC during the year-round period. Spawning does not apply in Big Cliff Reservoir, the receiving stream. There were limited effluent data available (one grab sample per outfall) so the HUA was increased to account for the uncertain characterization. The effluent flow used in the wasteload allocation equation is the sum of the maximum effluent flow rates (5.13 MGD) reported for each outfall on the NPDES permit application dated 9/23/2019. For effluent temperature the maximum value (25.9°C) reported on the permit application was used. River flows were assumed to be at seasonal 7Q10. See Section 6.4 for 7Q10 details.

9.2.1.75 U.S. Army Corp of Engineers - Green Peter Project (126717)

USACE Green Peter Project (WQ File#: 126717) is assigned an HUA of 0.10°C based on an assessment of loading. Based on available effluent data Green Peter will not have a 7DADM temperature increase during the year-round period as temperatures do not exceed the applicable criterion. In the spawning period, the 7DADM temperature increase is estimated to be 0.075 ºC. There were limited effluent data available (one or two grab samples) so the HUA was increased to account for the uncertain characterization. The effluent flow used in the wasteload allocation equation is the sum of the maximum effluent flow rates (1.368 MGD) reported for each outfall on the NPDES permit application dated 9/23/2019. For effluent temperature the maximum value used was either the flow weighted maximum effluent temperature from all outfalls on the permit application or the maximum 7DADM river temperature downstream of the dam (USGS 14186200) which approximates the temperatures being pulled from the intake and used for non-contact cooling water. For the loading assessment seasonal 7Q10s were calculated for each designated use period using the total outflow from the dam including spillway, powerhouse, and regulating outlets 2004 – 2024 (data from USACE). Seasonal 7Q10s are 661 cfs (spring spawning, 5/1 – 5/15), 42 cfs (summer, 5/16-10/14), and 82 cfs (fall spawning, 10/15 – 11/30). See Section 6.4 for 7Q10 details. The maximum temperature increases of 0.075 ºC occurred in the fall spawning period.

9.2.1.76 U.S. Army Corp of Engineers - Hills Creek Project (126699)

USACE Hills Creek Project (WQ File#: 126699) is assigned an HUA of 0.06°C based on an assessment of loading. The estimated maximum 7DADM temperature increase based on available data is about 0.02ºC during the year-round period and 0.04 ºC during spawning. There were limited effluent data available (one or two grab samples) so the HUA was increased to account for the uncertain effluent characterization. The effluent flow used in the wasteload allocation equation is the sum of the maximum effluent flow rates (1.8432 MGD) reported for each outfall on the NPDES permit application dated 9/23/2019. For effluent temperature the maximum value used was either the flow weighted maximum effluent temperature from all outfalls on the permit application or the maximum 7DADM river temperature downstream of the dam (USGS 14145500) which approximates the temperatures being pulled from the intake and used for non-contact cooling water. River flows were assumed to be at seasonal 7Q10s. See Section 6.4 for 7Q10 details.

9.2.1.77 U.S. Army Corp of Engineers - Lookout Point Project (126700)

USACE Lookout Point Project (WQ File#: 126700) is assigned an HUA of 0.06°C based on an assessment of loading. The estimated maximum 7DADM temperature increase based on available data is about 0.008ºC during the year-round period. Spawning does not apply in Dexter Reservoir, the receiving stream. There were limited effluent data available (one or two grab samples) so the HUA was increased to account for the uncertain effluent characterization. The effluent flow used in the wasteload allocation equation is the sum of the maximum effluent flow rates (1.82 MGD) reported for each outfall on the NPDES permit application dated 9/23/2019. For effluent temperature the maximum value used was either the flow weighted maximum effluent temperature from all outfalls on the permit application or the maximum 7DADM river temperature at the outlet of Dexter Dam (DEXO USACE monitoring site). Temperature data at Green Peter Dam was more limited so Dexter was instead. River flows were assumed to be at seasonal 7Q10s calculated using the total outflow from the dam including spillway, powerhouse, and regulating outlets 2004 – 2024 (data from USACE). See Section 6.4 for 7Q10 details.

9.2.1.78 Veneta STP (92762)

Veneta STP (WQ File#: 92762, EPA Number: OR0020532) is assigned an HUA of 0.0°C from June 1 through September 30 based on no discharge requirements in the NPDES permit. The facility is permitted to discharge during the allocation period from May 1 to May 31 and from October 1 to October 31. The assessment of thermal loading during the discharge periods found that an HUA of 0.075°C would result in noncompliance. The assigned HUA was increased to 0.20°C for May 1 to May 31 and for October 1 to October 31, which reduced the noncompliance days based on the data available. The effluent flow used in the wasteload allocation equation is the maximum flow reported on DMRs from May and October in 2018, 2019 and 2020, which is 0.633 MGD (0.98 cfs). See Section 6.4 for 7Q10 details.

9.2.1.79 WES – Boring STP (16592)

The assessment of thermal loading for Boring STP (WQ File#: 16592, EPA Number: OR0031399) found that an HUA of 0.075°C would result in noncompliance. The assigned HUA was increased to 0.20°C, which eliminated the noncompliance days based on the data available. The effluent flow used in the wasteload allocation equation is the maximum flow reported on DMRs from April through October in 2019 and 2020, which is 0.036 MGD (0.06 cfs). DEQ estimated daily mean river flow of North Fork Deep Creek at Boring STP's outfall for the analysis period (2019-2020) using the drainage area ratio method. USGS 14211400 Johnson Creek at Regner Road (15.36 square miles) was used as the reference gage. The watershed area upstream of the outfall was estimated as 10.6 square miles using USGS StreamStats. The minimum estimated river flow during the 2019-2020 period was 0.3 cfs, which is close to the 7Q10 of 0.24 cfs.

9.2.1.80 Westfir STP (94805)

The assessment of thermal loading for Westfir STP (WQ File#: 94805, EPA Number: OR0028282) found that an HUA of 0.075°C would result in compliance based on the data available. The effluent flow used in the wasteload allocation equation is the ADWDF from the NPDES permit, which is 0.03 MGD (0.05 cfs).

9.2.1.81 Willamette Leadership Academy (34040)

Willamette Leadership Academy (WQ File#: 34040, EPA Number: OR0027235) is assigned an HUA of 0.0°C based on no discharge requirements in the NPDES permit for the allocation period. The ADWDF in the NPDES permit is 0.007 MGD (0.01 cfs).

9.2.1.82 Woodburn WWTP (98815)

Woodburn WWTP (WQ File#: 98815, EPA Number: OR0020001) is assigned an HUA of 0.20°C based on the assessment of thermal loading and allocation given in the Molalla-Pudding TMDL (DEQ, 2008c). The effluent flow used in the wasteload allocation equation is the ADWDF from the NPDES permit, which is 5.037 MGD (7.79 cfs).

9.2.2 Wasteload allocations

Wasteload allocations for NPDES permitted point sources listed in **Table 9-21** were calculated using **Equation 9-1-**. Wasteload allocations apply during the critical periods discussed in Section 5.

Wasteload allocations may be implemented in NPDES permits in any of the following ways:

1) Incorporate the 7Q10 wasteload allocation in **Table 9-21** as a static numeric limit. Permit writers may recalculate the static limit using different values for 7Q10 (Q_R) and effluent discharge (Q_E), if better estimates are available (including the use of seasonal values, as appropriate).

2) Incorporate **Equation 9-1-** 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 HUA (ΔT) is based on the value in **Table 9-21**. Permit writers may recalculate the 7Q10 using seasonal or annual values, as appropriate, if better estimates are available.

Table 9-1: Thermal wasteload allocations (WLA) for point sources.

NPDES Permittee WQ File# : EPA Number	Assigned HUA (°C)	WLA period start	WLA period end	7Q10 River flow (cfs)	Effluent discharge (cfs)	7Q10 WLA (kcals/day)

~~NPDES Permittee WQ File# : EPA Number~~	~~Assigned HUA (°C)~~	~~WLA period start~~	~~WLA period end~~	~~7Q10 River flow (cfs)~~	~~Effluent discharge (cfs)~~	~~7Q10 WLA (kcals/day)~~

~~NPDES Permittee~~ ~~WQ File# : EPA Number~~	~~Assigned HUA (°C)~~	~~WLA period start~~	~~WLA period end~~	~~7Q10 River flow (cfs)~~	~~Effluent discharge (cfs)~~	~~7Q10 WLA (kcals/day)~~

~~NPDES Permittee WQ File# : EPA Number~~	~~Assigned HUA (°C)~~	~~WLA period start~~	~~WLA period end~~	~~7Q10 River flow (cfs)~~	~~Effluent discharge (cfs)~~	~~7Q10 WLA (kcals/day)~~

~~NPDES Permittee WQ File# : EPA Number~~	~~Assigned HUA (°C)~~	~~WLA period start~~	~~WLA period end~~	~~7Q10 River flow (cfs)~~	~~Effluent discharge (cfs)~~	~~7Q10 WLA (kcals/day)~~

~~NPDES Permittee WQ File# : EPA Number~~	~~Assigned HUA (°C)~~	~~WLA period start~~	~~WLA period end~~	~~7Q10 River flow (cfs)~~	~~Effluent discharge (cfs)~~	~~7Q10 WLA (kcals/day)~~

NPDES Permittee WQ File Number : EPA Number	Assigned HUA ΔT (°C)	WLA period start	WLA period end	7Q10 River flow (cfs)	Effluent discharge (cfs)	7Q10 WLA[1] (kcals/day)
Adair Village STP 500 : OR0023396	0.001	4/1	5/15	6308	1.3	15.437E+6
	0.001	5/16	10/14	3877	0.2	9.486E+6
	0.002	10/15	11/30	4443	1.3	21.747E+6
Albany Millersburg WRF [2] 1098 : OR0028801	0.010	4/1	5/15	6308	14.3	154.686E+6
	0.017	5/16	10/14	3877	13.7	161.827E+6
	0.037	10/15	11/30	4443	25.1	404.482E+6

NPDES Permittee WQ File Number : EPA Number	Assigned HUA ΔT (°C)	WLA period start	WLA period end	7Q10 River flow (cfs)	Effluent discharge (cfs)	7Q10 WLA[1] (kcals/day)
Albany Water Treatment Plant 66584 : ORG383501	0.20	5/1	10/31	24	1.30	12.38E+6
Alpine Community 100101 : OR0032387	0.00	5/1	10/31	0.4	0.03	0
Arclin 16037 : OR0021857	0.075	5/1	10/31	0	1.55	0.284E+6
Arclin 81714 : OR0000892	0.075	4/1	10/31	30	0.93	5.675E+6
Arkema 68471 : OR0044695	0.001	6/1	9/30	6740	0.14	16.491E+6
Ash Grove Cement - Rivergate Lime Plant 3690 : OR0001601	0.00	6/1	9/30	5934	0	0
ATI Albany Operations 64300 : OR0001716	0.~~010~~01	5/1	10/31	1.4	3.52	0.12E+6
ATI Millersburg [2] 87645 : OR0001112	0.010	4/1	5/15	6308	5.2	154.463E+6
	0.011	5/16	10/14	3877	5.2	104.483E+6
	0.012	10/15	11/15	4443	5.4	130.605E+6
Aumsville STP 4475 : OR0022721	0.00	5/1	10/31	0.7	0.52	0
Aurora STP 110020 : OR0043991	0.00	5/1	10/31	10	0.1	0
Bakelite Chemicals LLC 32650 : OR0032107	0.00	5/1	10/31	0	0.0	0
Bakelite Chemicals LLC 32864 : OR0002101	0.075	5/1	5/31	0	0.0	0
	0.00	6/1	10/31	0	0.0	0
Blount Oregon Cutting Systems Division 63545 : OR0032298	0.075	2/15	11/15	0	0.19	0.034E+6
Boeing Of Portland - Fabrication Division 9269 : OR0031828	0.075	4/1	10/31	0	0.46	0.085E+6
Brooks STP 100077 : OR0033049	0.001	4/1	5/15	11955	1.6	29.254E+6
	0.001	5/16	10/14	5684	0.4	13.908E+6
	0.002	10/15	11/15	7133	1.6	34.912E+6
Brownsville STP 11770 : OR0020079	0.00	5/1	10/31	14	0.0	0
Canby Regency Mobile Home Park 97612 : OR0026280	0.001	6/1	9/30	5790	0.06	14.166E+6
Canby STP 13691 : OR0020214	0.004	6/1	9/30	5790	3.1	56.695E+6
Cascade Pacific Pulp, LLC 36335 : OR0001074	0.024	4/1	5/15	5330	16.5	313.946E+6
	0.049	5/16	10/14	3609	17.3	434.745E+6
	0.037	10/15	11/15	4280	14.5	388.767E+6

NPDES Permittee WQ File Number : EPA Number	Assigned HUA ΔT (°C)	WLA period start	WLA period end	7Q10 River flow (cfs)	Effluent discharge (cfs)	7Q10 WLA[1] (kcals/day)
Century Meadows Sanitary System (CMSS) 96010 : OR0028037	0.001	6/1	9/30	5734	0.6	14.031E+6
City of Silverton Drinking WTP 81398 : ORG383527	0.20	5/1	10/31	0	0.08	0.038E+6
Coburg Wastewater Treatment Plant 115851 : OR0044628	0.20	5/1	10/31	0	0.68	0.333E+6
Coffin Butte Landfill 104176 : OR0043630	0.075	5/1	10/31	0	0.0	0
Columbia Helicopters 100541 : OR0033391	0.075	5/1	10/31	0	0.01	0.002E+6
Corvallis Rock Creek WTP 20160 : ORG383513	0.20	5/1	10/31	0	0.37	0.182E+6
Corvallis STP 20151 : OR0026361	0.015	4/1	5/15	5800	15.3	213.421E+6
	0.015	5/16	10/14	3683	11.7	135.595E+6
	0.031	10/15	11/15	4149	24.0	316.508E+6
Cottage Grove STP 20306 : OR0020559	0.154	4/1	5/15	61	2.1	23.775E+6
	0.206	5/16	11/15	38	2.8	20.564E+6
Covanta Marion, Inc 89638 : OR0031305	0.001	4/1	5/15	10688	0.2	26.15E+6
	0.002	5/16	10/14	5684	0.3	27.815E+6
	0.001	10/15	11/15	7133	0.2	17.453E+6
Creswell STP 20927 : OR0027545	0.20	5/1	5/31	0	5.09	2.491E+6
	0.00	6/1	10/31	0	0.31	0
Dallas STP 22546 : OR0020737	0.11	5/1	10/31	4.2	3.09	1.963E+6
Dallas WTP 22550 : ORG383529	0.11	5/1	10/31	3.3	0.17	0.934E+6
Deer Creek Estates Water Association 23650 : ORG383526	0.20	5/1	10/31	0.7	0.004	0.344E+6
Dundee STP 25567 : OR0023388	0.002	6/1	9/30	5734	1.1	28.064E+6
Duraflake 97047 : OR0000426	0.20	5/1	10/31	0	0.55	0.270E+6
Estacada STP 27866 : OR0020575	0.075	5/1	10/31	317	0.84	58.323E+6
Evraz Oregon Steel 64905 : OR0000451	0.002	6/1	9/30	6740	1.2	32.987E+6
EWEB Carmen~~-Smith Carmen~~ Powerhouse (Outfalls 001A and 001B) 28393 : OR0000680	0.075	5/1	10/31	146	2.68	27.282E+6
EWEB ~~Carmen-Smith~~ Trail Bridge Powerhouse	0.030	5/1	10/31	496	0.93	36.475E+6

NPDES Permittee WQ File Number : EPA Number	Assigned HUA ΔT (°C)	WLA period start	WLA period end	7Q10 River flow (cfs)	Effluent discharge (cfs)	7Q10 WLA[1] (kcals/day)
(Outfalls 002A and 002B) 28393 : OR0000680						
EWEB Hayden Bridge Filter Plant 28385 : ORG383503	0.011	4/1	11/15	1538	2.09	41.449E+6
Falls City STP 28830 : OR0032701	0.00	5/1	10/31	5.3	0.0	0
Forest Park Mobile Village 30554 : OR0031267	0.001	6/1	9/30	5988	0.02	14.651E+6
Foster Farms 97246 : OR0026450	0.00	5/1	10/31	0	0.0	0
Frank Lumber Co. Inc. 30904 : OR0000124	0.04	4/1	6/15	987	3	96.888E+6
	0.04	6/16	8/31	859	3	84.361E+6
	0.04	9/1	11/15	957	4.4	94.089E+6
Fujimi Corporation - SW Commerce Circle 107178 : OR0040339	0.20	5/1	10/31	0	0.2	0.094E+6
Gervais STP 33060 : OR0027391	0.00	5/1	10/31	6.6	0.34	0
GP Halsey Mill 105814 : OR0033405	0.010	4/1	5/15	5330	5.3	130.537E+6
	0.016	5/16	10/14	3609	4.9	141.472E+6
	0.011	10/15	11/15	4280	4.0	115.297E+6
Halsey STP 36320 : OR0022390	0.00	5/1	10/31	5.0	0.30	0
Harrisburg Lagoon Treatment Plant 105415 : OR0033260	0.002	4/1	4/30	5204	1.9	25.474E+6
	0.004	5/1	10/31	3480	1.6	34.073E+6
	0.003	11/1	11/15	3853	1.9	28.295E+6
Hollingsworth & Vose Fiber Co – Corvallis 28476 : OR0000299	0.001	4/1	5/15	5800	0.1	14.191E+6
	0.001	5/16	10/14	3683	0.2	9.012E+6
	0.001	10/15	11/15	4149	0.1	10.151E+6
Hubbard STP 40494 : OR0020591	0.20	5/1	10/31	0	0.35	0.169E+6
Hull-Oakes Lumber Co. 107228 : OR0038032	0.075	5/1	10/31	0	0.08	0.014E+6
Independence STP 41513 : OR0020443	0.005	4/1	5/15	10688	3.9	130.797E+6
	0.005	5/16	10/14	5684	3.8	69.581E+6
	0.003	10/15	11/15	7133	6.2	52.402E+6
International Paper - Springfield 108921 : ORG383548 (200-J discharge)	0.075	5/1	10/31	0	0.01	0.001E+6
International Paper - Springfield (Outfall 001 + Outfall 002) 96244 : OR0000515	0.12	4/1	6/15	2,442	28.9	725.456E+6
	0.20	6/16	8/31	1,537	28.9	766.247E+6
	0.19	9/1	11/15	1,630	28.9	771.167E+6

NPDES Permittee WQ File Number : EPA Number	Assigned HUA ΔT (°C)	WLA period start	WLA period end	7Q10 River flow (cfs)	Effluent discharge (cfs)	7Q10 WLA[1] (kcals/day)
International Paper - Springfield (Outfall 003) 96244 : OR0000515	0.075	5/1	10/31	0	3.09	0.568E+6
J.H. Baxter & Co 6553 : OR0021911	0.075	5/1	10/31	0.6	0.12	0.132E+6
Jasper Wood Products 100097 : OR0042994	0.00	6/1	9/30	6691	0	0
Jefferson STP 43129 : OR0020451	0.002	4/1	5/15	3275	0.6	16.029E+6
	0.006	5/16	10/14	1144	0.8	16.806E+6
	0.003	10/15	11/15	2278	0.6	16.725E+6
JLR 32536 : OR0001015	0.01	5/1	10/31	6.9	0.5	0.181E+6
Junction City STP 44509 : OR0026565	0.00	5/1	10/31	0	0.0	0
Kingsford Manufacturing Company - Springfield Plant 46000 : OR0031330	0.075	5/1	5/31	0	0.08	0.015E+6
	0.00	6/1	10/31	0	0	0
Knoll Terrace Mhc 46990 : OR0026956	0.00	5/1	10/31	0	0.09	0
Lakewood Utilities, Ltd 96110 : OR0027570	0.00	5/1	10/31	0	0.0	0
Lane Community College 48854 : OR0026875	0.00	5/1	10/31	0	0.22	0
Lebanon WWTP 49764 : OR0020818	0.03	4/1	5/15	1043	4.1	76.857E+6
	0.05	5/16	10/14	506	4.9	62.50E+6
	0.08	10/15	11/15	726	12.3	144.51E+6
Lowell STP 51447 : OR0020044	0.013	5/1	11/15	1,002	1.22	31.909E+6
Mcfarland Cascade Pole & Lumber Co 54370 : OR0031003	0.00	5/1	10/31	0	0.0	0
Molalla Municipal Drinking WTP 109846 : ORG380014	0.20	5/1	10/31	0	0.16	0.078E+6
Molalla STP 57613 : OR0022381	0.10	5/1	10/31	56	3.46	14.547E+6
Monmouth STP 57871 : OR0020613	0.004	4/1	5/15	10688	5.8	104.657E+6
	0.005	5/16	10/14	5684	4.3	69.587E+6
	0.003	10/15	11/15	7133	5.8	52.399E+6
Monroe STP 57951 : OR0029203	0.08	4/1	4/30	55	1.2	11.00E+6
	0.03	5/1	10/31	22	0.2	1.629E+6
	0.03	11/1	11/15	55	1.2	4.125E+6
Mt. Angel STP 58707 : OR0028762	0.00	5/1	10/31	6.6	0.87	0
Murphy Veneer, Foster Division 97070 : OR0021741	0.20	5/1	10/31	4.2	1.11	2.598E+6

NPDES Permittee WQ File Number : EPA Number	Assigned HUA ΔT (°C)	WLA period start	WLA period end	7Q10 River flow (cfs)	Effluent discharge (cfs)	7Q10 WLA[1] (kcals/day)
MWMC - Eugene/Springfield STP 55999 : OR0031224	0.118	4/1	5/15	1906	42.6	562.573E+6
	0.093	5/16	10/14	1508	55.0	355.645E+6
	0.188	10/15	11/15	1925	86.3	925.144E+6
Newberg - Wynooski Road STP 102894 : OR0032352	0.006	6/1	9/30	5734	6.2	84.266E+6
Newberg OR, LLC 72615 : OR0000558	0.00	6/1	9/30	5934	0	0
Norpac Foods- Plant #1, Stayton 84820 : OR0001228	0.20	5/1	10/31	0	6.19	3.028E+6
NW Natural Gas Site Remediation 120589 : OR0044687	0.001	6/1	9/30	6740	0.7	16.492E+6
Oak Lodge Water Services Water Reclamation Facility 62795 : OR0026140	0.003	6/1	9/30	6740	4	49.501E+6
Oakridge STP 62886 : OR0022314	0.075	5/1	11/30	514	0.73	94.452E+6
ODC - Oregon State Penitentiary 109727 : OR0043770	0.075	5/1	10/31	6.5	2.48	1.647E+6
ODFW - Clackamas River Hatchery 64442 : OR0034266	0.072*	4/1	6/15	1186	42.1	216.342E+6*
	0.261*	6/16	8/31	627	41.0	426.571E+6*
	0.283*	9/1	11/15	645	42.0	475.683E+6*
ODFW - Dexter Ponds 64450 : ORG133514	0.036*	4/1	6/15	986	48.0	91.075E+6*
	0.189*	6/16	9/14	1002	48.0	485.541E+6*
	0.255*	9/15	11/15	1301	48.0	841.641E+6*
ODFW - Leaburg Hatchery 64490 : OR0027642	0.074*	4/1	6/15	2,442	92.4	458.861E+6*
	0.012*	6/16	8/31	1,537	39.1	46.274E+6*
	0.026*	9/1	11/15	1,630	78.3	108.671E+6*
ODFW - Marion Forks Hatchery 64495 : OR0027847	0.075*	5/1	10/31	6.3	18.6	4.562E+6*
ODFW - McKenzie River Hatchery 64500 : OR0029769	0.002	4/1	6/15	2442	12.7	12.012E+6
	0.033	6/16	8/31	1537	11.8	125.05E+6
	0.002	9/1	11/15	1,630	1.0	7.981E+6
ODFW - Minto Fish Facility 64495 : OR0027847	0.03*	4/1	6/15	987	30	74.648E+6*
	0.03*	6/16	8/31	859	36	65.693E+6*
	0.03*	9/1	11/15	957	41	73.253E+6*
ODFW - Roaring River Hatchery 64525 : ORG133506	0.10*	5/1	10/31	0.5	14.2	3.597E+6*
ODFW - South Santiam Hatchery 64560 : ORG133511	0.02*	4/1	6/15	841	10.6	41.672E+6*
	0.02*	6/16	8/31	621	25.9	31.655E+6*
	0.02*	9/1	11/15	677	28.5	34.522E+6*
ODFW - Willamette Fish Hatchery 64585 : ORG133507	0.075*	5/1	10/31	110	79.0	34.681E+6*

NPDES Permittee WQ File Number : EPA Number	Assigned HUA ΔT (°C)	WLA period start	WLA period end	7Q10 River flow (cfs)	Effluent discharge (cfs)	7Q10 WLA[1] (kcals/day)
~~ODFW Leaburg Hatchery 64490 : OR0027642~~	~~0.074*~~	~~4/1~~	~~6/15~~	~~2,442~~	~~92.4~~	~~458.861E+6*~~
OHSU Center For Health and Healing 113611 : OR0034371	0.~~012*~~001	6/~~16~~1	~~8/31~~9/30	~~1,537~~6740	~~39.1~~0.06	~~46.274E~~16.491E+6~~*~~
OSU John L. Fryer Aquatic Animal Health Lab 103919 : OR0032573	0.~~026*~~001	~~9~~4/1	~~11~~5/15	~~1,630~~5800	~~78.3~~0.9	~~108.671E~~14.193E+6~~*~~
~~ODFW McKenzie River Hatchery 64500 : OR0029769~~	~~0.002~~	~~4/1~~	~~6/15~~	~~2,442~~	~~12.7~~	~~12.012E+6~~
	0.~~033~~001	~~6~~5/16	~~8/31~~10/14	~~1,537~~3683	~~11.8~~1.2	~~125.05E~~9.014E+6
	0.~~002~~001	~~9/1~~10/15	11/15	~~1,630~~4149	~~1.~~0.9	~~7.981E~~10.153E+6
Philomath WTP 100048 : ORG383536	0.20	5/1	10/31	6.7	0.32	3.435E+6
Philomath WWTP 103468 : OR0032441	0.00	5/1	10/31	6.7	0.0	0
PNW Veg Co DBA Norpac Foods No. 5 84791 : OR0021261	0.00	5/1	10/31	0	0.0	0
Row River Valley Water District 100075 : ORG383534	0.075	5/1	10/31	12	0.04	2.~~21E~~210E+6
RSG Forest Products - Liberal 72596 : OR0021300	0.20	5/1	10/31	0	1.24	0.606E+6
Philomath WTP 100048 : ORG383536	0.20	5/1	10/31	6.7	0.32	3.435E+6
Salem Willow Lake STP 78140 : OR0026409	0.024	4/1	5/15	10688	52.9	630.705E+6
	0.036	5/16	10/14	5684	38.3	504.02E+6
	0.058	10/15	11/15	7133	80.2	1,023.60E+6
Sandy WWTP 78615 : OR0026573	0.00	5/1	10/31	0.2	0.00	0
Scappoose STP 78980 : OR0022420	NA	6/1	9/30	NA	0.9	21.00E+6
Scio STP 79633 : OR0029301	0.00	5/1	10/31	6.9	0.14	0
Seneca Sawmill Company 80207 : OR0022985	0.00	5/1	10/31	0	1.19	0
SFPP 103159 : OR0044661	0.075	5/1	10/31	0	0.02	0.004E+6
Sherman Bros. Trucking 36646 : OR0021954	0.00	5/1	10/31	0.2	0.02	0
Siltronic Corporation 93450 : OR0030589	0.007	6/1	9/30	6740	4.2	115.506E+6
Silverton STP 81395 : OR0020656	0.20	5/1	10/31	14	3.87	8.743E+6

NPDES Permittee WQ File Number : EPA Number	Assigned HUA ΔT (°C)	WLA period start	WLA period end	7Q10 River flow (cfs)	Effluent discharge (cfs)	7Q10 WLA[1] (kcals/day)
SLLI 74995 : OR0001741	0.001	6/1	9/30	6740	0.04	16.491E+6
Stayton STP 84781 : OR0020427	0.02	4/1	6/15	1482	1.8	72.607E+6
	0.02	6/16	8/31	914	1.9	44.818E+6
	0.02	9/1	11/15	1018	1.8	49.902E+6
Sunstone Circuits 26788 : OR0031127	0.04	5/1	10/31	10.5	0.065	1.034E+6
Sweet Home STP 86840 : OR0020346	0.02	4/1	6/15	841	2.6	41.28E+6
	0.03	6/16	8/31	621	2.1	45.736E+6
	0.04	9/1	11/15	667	3.5	65.62E+6
Tangent STP 87425 : OR0031917	0.00	5/1	10/31	20	0.17	0
Timberlake STP 90948 : OR0023167	0.00	5/1	10/31	254	0.22	0
Tryon Creek WWTP 70735 : OR0026891	0.004	6/1	9/30	6740	12.8	66.087E+6
Univar USA Inc 100517 : OR0034606	0.001	6/1	9/30	6740	0.04	16.491E+6
USFW - Eagle Creek National Fish Hatchery 91035 : OR0000710	0.20*	5/1	10/31	0	52.6	25.739E+6*
Veneta STP 92762 : OR0020532	0.20	5/1	5/31	6.4	0.98	3.611E+6
	0.00	6/1	9/30	6.4	0.00	0
	0.20	10/1	10/31	6.4	0.98	3.611E+6
U.S Army Corp of Engineers Big Cliff Project 126715 : Not assigned	0.004	4/1	11/15	859	1.1	8.418E+6
U.S. Army Corp of Engineers Cougar Project 126712: Not Assigned	0.01	5/1	10/31	236**	0.21	5.779E+6
U.S. Army Corp of Engineers Detroit Project 126716: Not Assigned	0.10	5/1	10/31	743**	7.94	183.729E+6
U.S Army Corp of Engineers Dexter Project 126714 : Not assigned	0.001	4/1	11/15	1002	0.7	2.453E+6
U.S Army Corp of Engineers Foster Project 126713 : Not assigned	0.003	4/1	11/15	621	1.4	4.568E+6
U.S. Army Corp of Engineers Green Peter Project 126717 : Not Assigned	0.10	5/1	11/30	33**	2.12	8.592E+6
U.S. Army Corp of Engineers Hills Creek Project 126699 : Not Assigned	0.06	5/1	11/30	309**	2.85	45.78E+6

NPDES Permittee WQ File Number : EPA Number	Assigned HUA ΔT (°C)	WLA period start	WLA period end	7Q10 River flow (cfs)	Effluent discharge (cfs)	7Q10 WLA[1] (kcals/day)
U.S. Army Corp of Engineers Lookout Point Project 126700 : Not Assigned	0.06	5/1	11/15	1145**	2.82	168.50E+6
~~Veneta STP~~ ~~92762 : OR0020532~~Vigor Industrial 70596 : OR0022942	0.~~20~~005	~~5~~6/1	~~5/31~~9/30	~~6.4~~6740	~~0.98~~2.4	~~3.611E~~82.482 E+6
WES - Blue Heron Discharge 72634 : OR0000566	0.00	6/1	9/30	~~6.4~~5988	0.~~00~~	0
	~~0.20~~	~~10/1~~	~~10/31~~	~~6.4~~	~~0.98~~	~~3.611E+6~~
WES - Boring STP 16592 : OR0031399	0.20	5/1	10/31	0.24	0.06	0.145E+6
WES - Kellogg Creek WWTP 16590 : OR0026221	0.007	6/1	9/30	6740	15.5	115.699E+6
WES - Tri-City WPCP 89700 : OR0031259	0.015	6/1	9/30	5988	18.4	220.435E+6
Westfir STP 94805 : OR0028282	0.075	5/1	10/31	174	0.05	31.937E+6
Willamette Falls Paper Company 21489 : OR0000787	0.007	6/1	9/30	5988	6.5	102.666E+6
Willamette Leadership Academy 34040 : OR0027235	0.00	5/1	10/31	0	0.01	0
Wilsonville STP 97952 : OR0022764	0.005	6/1	9/30	5734	4.2	70.197E+6
Woodburn WWTP 98815 : OR0020001	0.20	5/1	10/31	6.7	7.79	7.092E+6

~~[1] Listed WLAs were calculated based on the 7Q10 flow.~~
~~Notes:~~
~~WLA = wasteload allocation; kcals/day = kilocalories/day~~

[1] Listed WLAs were calculated based on the 7Q10 flow.

[2] ATI Millersburg and Albany-Millersburg Water Reclamation Facility discharge to the same outfall, but each holds an individual NPDES permit and is assigned its own thermal wasteload allocation

Notes:

WLA = wasteload allocation; kcals/day = kilocalories/day

* When the minimum duties provision at OAR 340-041-0028(12)(a) applies, ΔT = 0.0 and the WLA = 0 kilocalories/day.

** Listed 7Q10s calculated based on a seasonal period corresponding to WLA period.

9.2.3 Requirements for 100-J general permit registrants

The existing 100-J general permit requirements relevant to water temperature are described in Section 7.1.2.1. Because permit registrants have reasonable potential to increase stream temperature, the TMDL includes narrative wasteload allocation requirements for registrants to the 100-J general permit. The wasteload allocation for current and future registrants to the 100-J general permit is equal to loads permitted by the 100-J general permit and the TMDL requirements identified **Table 9-~~3~~2** and **Table 9-~~4~~3**.

With some exceptions, 100-J registrants have been assigned a cumulative HUA of 0.075°C (**Table 9-~~3~~2**). An HUA of 0.075°C will address any warming authorized by the 100-J (see Section 7.1.2.1 for analysis of warming). In addition, each AU has a maximum number of registrants that may discharge based on the 7Q10 stream flow at the discharge location. With some exceptions noted in **Table 9-~~3~~2,** watershed AUs may only have one registrant due to low flows. Limiting the maximum number of registrants is necessary to ensure the assigned HUA is attained. Additional registrants above the maximum require reserve capacity. The flow categories in **Table 9-~~3~~2** are set up so the combined sum of warming from each registrant at the point of discharge does not exceed the maximum warming allowed for that AU. As the river flow increases and provides increased dilution, the maximum number of registrants allowed also increases. On select AUs (Columbia Slough. McKenzie River, and Stone Quarry Lake) the maximum number of registrants and assigned HUA reflect the current number of 100-J registrants. Some AUs do not have sufficient loading capacity for new 100-J registrants because it has been assigned to other NPDES permittees. **Table 9-~~4~~3** identifies the AUs with insufficient loading capacity. On these AUs, the assigned HUA is zero and new 100-J registrants cannot increase stream temperature above the applicable temperature criteria. A maximum number of registrants is not needed as there is no temperature increase allowed.

Table 9-2: TMDL requirements for 100-J registrants in the Willamette Subbasins.

AU 7Q10 stream flow (cfs)	Assigned HUA (°C)*	Maximum number of registrants per AU
<= 149	0.075	1
> 149 and <= 297	0.075	2
> 297 and <= 521	0.075	3
> 521 and <= 652	0.075	4
> 652 and <= 990	0.075	5
> 990 and <= 1154	0.075	6
> 1154 and <= 1319	0.075	7
> 1319 and <= 1484	0.075	8
> 1484	0.075	9
McKenzie River OR_SR_1709000407_02_103884	0.02	2
Columbia Slough OR_WS_170900120201_02_104554.2	0.225	3
Other Watershed AUs	0.075	1
Stone Quarry Lake OR_LK_1709000703_02_100809	0.15	2
Other natural lake or pond AUs where the Natural Lakes temperature criterion apply (OAR 340-041-0028(6))	0.075	1
*Assigned HUA is zero for AUs listed in **Table 9-43**		

Table 9-3 AUs where new 100-J general permit registrants may not increase temperature above the applicable criteria.

AU ID	AU or Stream Name	Assigned HUA (°C)
OR_LK_1709000107_02_100699	Dexter Reservoir	0.00
OR_LK_1709000402_02_100742	Trail Bridge Reservoir	0.00
OR_LK_1709000503_02_100770	Big Cliff Reservoir	0.00
OR_LK_1709001106_02_100850	Estacada Lake	0.00
OR_LK_1709001202_02_100858	Fairview Lake	0.00
OR_SR_1709000104_02_103719	Salmon Creek	0.00
OR_SR_1709000105_02_103720	Middle Fork Willamette River	0.00
OR_SR_1709000105_02_104580	Middle Fork Willamette River	0.00
OR_SR_1709000106_02_103721	North Fork Middle Fork Willamette River	0.00
OR_SR_1709000202_02_103765	Layng Creek	0.00
OR_SR_1709000301_02_103789	Long Tom River	0.00
OR_SR_1709000302_02_103807	Oliver Creek	0.00
OR_SR_1709000302_02_103813	Marys River	0.00
OR_SR_1709000402_02_103858	McKenzie River	0.00
OR_SR_1709000402_02_104587	McKenzie River	0.00
OR_SR_1709000402_02_104588	McKenzie River	0.00

AU ID	AU or Stream Name	Assigned HUA (°C)
OR_SR_1709000403_02_104590	South Fork McKenzie River	0.00
OR_SR_1709000405_02_103866	McKenzie River	0.00
OR_SR_1709000405_02_103868	McKenzie River	0.00
OR_SR_1709000405_02_103869	McKenzie River	0.00
OR_SR_1709000605_02_103971	Wiley Creek	0.00
OR_SR_1709000606_02_103974	Roaring River	0.00
OR_SR_1709000701_02_104591	Rickreall Creek	0.00
OR_SR_1709000703_02_104007	Mill Creek	0.00
OR_SR_1709000901_02_104595	Silver Creek	0.00
OR_SR_1709000902_02_104073	Pudding River	0.00
OR_SR_1709001105_02_104162	Eagle Creek	0.00
OR_WS_170900020403_02_104240	Unnamed tributary to Camas Swale Creek	0.00
OR_WS_170900030108_02_104250	Amazon Creek, Amazon Diversion Canal	0.00
OR_WS_170900030204_02_104256	Rock Creek	0.00
OR_WS_170900030511_02_104285	Ditch to Soap Creek tributary	0.00
OR_WS_170900030603_02_104290	Unnamed tributary to Flat Creek	0.00
OR_WS_170900030606_02_104294	Muddy Creek	0.00
OR_WS_170900030610_02_104298	Murder Creek	0.00
OR_WS_170900050203_02_104345	Horn Creek	0.00
OR_WS_170900070201_02_104409	Salem Ditch	0.00
OR_WS_170900070402_02_104419	Coffee Lake Creek	0.00
OR_WS_170900090107_02_104460	Unnamed tributary to Abiqua Creek	0.00
OR_WS_170900090502_02_104481	Mill Creek	0.00
OR_WS_170900090607_02_104488	Unnamed tributary to Molalla River	0.00
OR_WS_170900110605_02_104547	North Fork Deep Creek	0.00

9.2.4 Wasteload allocation equation

Equation 9-1 was used to calculate the thermal wasteload allocations in **Table 9-21**.

$$WLA = (\Delta T) \cdot (Q_E + Q_R) \cdot C_F$$ **Equation 9-1-1**

where,

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

$\Delta T =$ The assigned portion of the HUA at the point of discharge. Represents the maximum temperature increase (ºC) above the applicable temperature criterion using 100% of river flow not to be exceeded by each individual source from all outfalls combined. When the minimum duties provision at OAR 340-041-0028(12)(a) applies, ∆T = 0.0. **Equation 9-6** was used to determine if the minimum duties provision applies.

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

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

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

$Q_R =$ The daily mean river flow rate, upstream (cfs).

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

$C_F =$ Conversion factor using flow in cfs: 2,446,899

$$\left(\frac{1\ m}{3.2808\ ft}\right)^3 \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{86400\ sec}{1\ day} \cdot \frac{1\ kcal}{1\ kg\ \cdot 1℃} = 2{,}446{,}899$$

9.2.5 WLA attainment equation

When evaluating current discharge, DEQ used **Equation 9-2** to calculate the excess thermal loading (ETL). The ETL was compared against the wasteload allocation (WLA) to assess attainment.

$$ETL = (T_E - T_{C,i}) \cdot Q_E \cdot C_F$$ **Equation 9-2-2**

where,

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

$T_{C,i} =$ The point of discharge applicable river temperature criterion (ºC) (T_c); or when the minimum duties provision at OAR 340-041-0028(12)(a) applies $T_{C,i}$ = the 7DADM measured at the facility intake (T_i). **Equation 9-6** was used to determine if the minimum duties provision applies.

$T_E =$ The daily maximum effluent temperature (ºC)

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

$C_F =$ Conversion factor for flow in 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

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

9.2.6 Calculating current change in temperature

~~Equation 9-3~~Equation 9-3 was used to assess the change in temperature based on point source effluent discharge, river flow, and the applicable temperature criteria.

$$\Delta T_{Current} = \left(\frac{Q_E}{Q_E + Q_R}\right) \cdot (T_E - T_C)$$ **Equation 9~~-3~~-3**

where,

$\Delta T_{Current} =$ The current river temperature increase (ºC) 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:

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

$Q_R =$ 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 (ºC)

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

9.2.7 Calculating acceptable effluent temperatures

Equation 9-4 was used to calculate the daily maximum effluent temperatures (ºC) acceptable under the allocated portion of the HUA (ΔT) and the wasteload allocation (WLA).

$$T_{E\_WLA} = \frac{(Q_E + Q_R) \cdot (T_C + \Delta T) - (Q_R \cdot T_C)}{Q_E}$$ **Equation 9-4a** (using ΔT)

$$T_{E\_WLA} = \frac{(WLA)}{Q_E \cdot C_F} + T_C$$ **Equation 9-4b** (using WLA)

where,

$T_{E\_WLA} =$ Daily maximum effluent temperature (ºC) allowed under the wasteload allocation.
When T_{E_WLA} is > 32°C, T_{E_WLA} = 32°C as required by the thermal plume limitations in OAR 340-041-0053(2)(d)(B).

$WLA =$ Wasteload allocation (kilocalories/day) from **Equation 9~~-1~~-**.

$\Delta T =$ The assigned portion of the HUA at the point of discharge. Represents the maximum temperature increase (ºC) above the applicable river temperature criterion using 100% of river flow not to be exceeded by each individual source from all outfalls combined. When the minimum duties provision at OAR 340-041-0028(12)(a) applies, ΔT = 0.0.

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

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

$Q_R =$ 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.

$T_{C,i} =$ The point of discharge applicable river temperature criterion (°C) (T_c); or when the minimum duties provision at OAR 340-041-0028(12)(a) applies $T_{C,i}$ = the 7DADM measured at the facility intake (T_i).

$C_F =$ Conversion factor for flow in cfs: 2,446,665

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

9.2.8 Calculating acceptable effluent flows

Equation 9-5 was used to calculate the daily mean effluent flow (cfs) acceptable under the allocated portion of the HUA (ΔT) and the wasteload allocation (WLA).

$$Q_{E\_WLA} = \frac{(Q_R \cdot T_C) - ((T_C + \Delta T) * Q_R)}{T_C + \Delta T - T_E}$$ **Equation 9-5a** (using ΔT)

$$Q_{E\_WLA} = \frac{(WLA)}{(T_E - T_C) * C_F}$$ **Equation 9-5b** (using WLA)

where,

$Q_{E\_WLA} =$ Daily mean effluent flow (cfs) allowed under the wasteload allocation.

$WLA =$ Wasteload allocation (kilocalories/day) from **Equation 9**~~-1~~-.

$\Delta T =$ The assigned portion of the HUA at the point of discharge. Represents 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. When the minimum duties provision at OAR 340-041-0028(12)(a) applies, ΔT = 0.0.

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

$Q_R =$ 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.

$T_{C,i} =$ The point of discharge applicable river temperature criterion (°C) (T_c); or when the minimum duties provision at OAR 340-041-0028(12)(a) applies $T_{C,i}$ = the 7DADM measured at the facility intake (T_i).

$C_F =$ Conversion factor for flow in cfs: 2,446,665

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

9.2.9 Determination of when minimum duties provision applies

The minimum duties provision at OAR 340-041-0028(12)(a) states that anthropogenic sources are only responsible for controlling the thermal effects of their own discharge or activity in accordance with its overall heat contribution.

For point sources, DEQ is implementing the minimum duties provision if a facility operation meets acceptable operation and design requirements. The facility must be operated as a “flow through” facility where intake water moves through the facility and is not processed as part of an industrial or wastewater treatment operation. If a facility mixes the intake water with other wastewater or as a method to cool equipment DEQ considers the thermal effects of this operation to be part of the facility’s own activity and the minimum duties provision is not applicable. The intake water must also be returned to the same stream where the intake is located. If the water is not returned to the same stream the thermal effects are not from the receiving stream and therefore attributed to the facility's own discharge.

When the minimum duties provision applies, the facility cannot add any additional thermal loading to the intake temperatures when the intake temperatures are warmer than the maximum effluent discharge temperatures allowed by the wasteload allocation. The purpose is to ensure the facility controls for thermal effects resulting from passing the water through and not from upstream sources.

In the Willamette Subbasins, DEQ determined that facilities listed in **Table 9-4** likely operate as ~~a~~ flow through ~~facility~~facilities.

For new facilities or facilities where the intake or outfall locations have been moved, DEQ will use the approach described above to determine if the minimum duties provision is applicable. For example, ODFW McKenzie ~~Fish~~River Hatchery ~~has two intakes, one on Leaburg Canal and one on Cogswell Creek, with a discharge location on~~, which discharges to the McKenzie River~~.~~, currently uses water from a tributary, Cogswell Creek. If the ODFW McKenzie ~~Fish~~River Hatchery ~~intakes~~intake(s) are moved to the same stream where the outfall is located, the minimum duties provision may be applied.

Table 9-4: NPDES permittees where the minimum duties provision may be implemented as part of the TMDL wasteload allocation.

NPDES Permittee	WQ File Number : EPA Number	Intake and Receiving Stream	AU
ODFW - Marion Forks Fish Hatchery	64495 : OR0027847	Horn Creek	OR_WS_170900050203_02_104345
ODFW - Roaring River Fish Hatchery	64525 : ORG133506	Roaring River	OR_SR_1709000606_02_103974
ODFW - Willamette Fish Hatchery	64585 : ORG133507	Salmon Creek	OR_SR_1709000104_02_103719
ODFW - Leaburg Fish Hatchery	64490 : OR0027642	McKenzie River	OR_SR_1709000407_02_103884
USFW - Eagle Creek National Fish Hatchery	91035 : OR0000710	Eagle Creek	OR_SR_1709001105_02_104162
ODFW - Clackamas River Hatchery	64442 - OR0034266	Clackamas River RM 22.6	
ODFW - Dexter Ponds	64450	Middle Fork Willamette River RM 15.7	
ODFW - Minto Fish Facility	64495 - OR0027847	North Santiam River RM 41.1	
ODFW South Santiam Hatchery	64560	South Santiam River RM 37.8	

When assessing the wasteload allocation for attainment, DEQ used the approach described in **Equation 9-6** to implement the minimum duties provision.

The minimum duties provision applies on days when $T_{E\_WLA} < T_i$. **Equation 9~~-6~~-6**

When the minimum duties applies, there may be no increase in temperature above the intake temperature (T_i) and the assigned portion of the HUA is zero (ΔT = 0.0).
where,

$T_{E\_WLA} =$ Daily maximum effluent temperature (ºC) allowed under the wasteload allocation as calculated using **Equation 9-4**.

$T_i =$ The daily maximum influent temperature (ºC) measured at the facility intake.

9.3 Nonpoint source load allocations (LAs)

Load allocations are assigned to background sources and anthropogenic nonpoint sources on all waters in the Willamette Subbasins. Load allocations for background sources are calculated using **Equation 9-7**.

$$LA_{BG} = (T_C) \cdot (Q_R) \cdot C_F$$ **Equation 9-7**

where,

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

$T_C =$ The applicable temperature criteria, not including the HUA. When there are two year-round applicable temperature criteria that apply to the same AU, the more stringent criteria shall be used.

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

$C_F =$ Conversion factor using flow in cfs: 2,446,665

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

Table 9-5 presents the load allocation assigned to background sources for temperature impaired Category 5 AUs that were modeled for the TMDL analysis. The load allocation presented is based on the critical 7Q10 low flow. **Equation 9-7** shall be used to calculate the load allocation to background sources for any AU or stream location in the Willamette Subbasins not identified in **Table 9-5** or when river flows are greater than 7Q10.

Equation 9-7 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.

Load allocations assigned to anthropogenic nonpoint sources on any AU or stream location in the Willamette Subbasins are calculated using **Equation 9-8**. The portions of the HUA (ΔT) assigned to nonpoint sources or source categories are presented in Section 9.1 HUA allocations of the Willamette Subbasins TMDL.

$$LA_{NPS} = (\Delta T) \cdot (Q_R) \cdot C_F$$ **Equation 9-8**

where,

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

$\Delta T =$ The portion of the HUA assigned to each nonpoint source or source category representing the maximum cumulative temperature increase (ºC) from the nonpoint source or 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 cfs: 2,446,665

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

Table 9-5: Thermal load allocations (LA) for background sources.

AU Name and AU ID	Annual 7Q10 (cfs)	Year Round Criterion (°C)	Spawning Criterion (°C)	LA period start	LA period end	7Q10 LA Year Round (kcal/day)	7Q10 LA Spawning (kcal/day)
Clackamas River OR_SR_1709001106_02_104597	671	16	13	4/1	11/15	26,267.4E+6	21,342.26E+6
Coast Fork Willamette River OR_SR_1709000203_02_104585	38	18	13	4/1	11/15	1,673.52E+6	1,208.65E+6
Coast Fork Willamette River OR_SR_1709000204_02_103787	132	18	13	4/1	11/15	5,813.28E+6	4,198.48E+6
Coyote Creek OR_SR_1709000301_02_103796	5.9	18	NA	5/1	10/31	259.84E+6	NA
Crabtree Creek OR_SR_1709000606_02_103978	25	16	13	5/1	10/31	978.67E+6	795.17E+6
Johnson Creek OR_SR_1709001201_02_104170	11	18	13	2/15	11/15	484.44E+6	349.87E+6
Little North Santiam River OR_SR_1709000505_02_104564	21	16	13	5/1	10/31	822.08E+6	667.94E+6
Long Tom River OR_SR_1709000301_02_103791	22	24	18	4/1	11/15	1,291.84E+6	968.88E+6
Luckiamute River OR_SR_1709000305_02_103829	16	18	13	5/1	10/31	704.64E+6	508.91E+6
McKenzie River OR_SR_1709000407_02_103884	1537	16	13	4/1	11/15	60,168.39E+6	48,886.81E+6
Middle Fork Willamette River OR_SR_1709000107_02_104583	1002	16	13	4/1	11/15	39,224.93E+6	31,870.26E+6
Middle Fork Willamette River OR_SR_1709000110_02_104584	1278	16	13	4/1	11/15	50,029.41E+6	40,648.89E+6
Mohawk River OR_SR_1709000406_02_103871	16	16	13	5/1	10/31	626.35E+6	508.91E+6
Molalla River OR_SR_1709000904_02_104086	38	16	13	5/1	10/31	1,487.57E+6	1,208.65E+6
Mosby Creek OR_SR_1709000201_02_103752	11	16	13	5/1	10/31	430.61E+6	349.87E+6
North Santiam River OR_SR_1709000504_02_103906	859	16	13	4/1	11/15	33,626.96E+6	27,321.91E+6
North Santiam River OR_SR_1709000506_02_103930	914	16	13	4/1	11/15	35,780.03E+6	29,071.27E+6
Pudding River OR_SR_1709000905_02_104088	10	18	NA	5/1	10/31	440.4E+6	NA
Santiam River OR_SR_1709000506_02_103927	1144	18	13	4/1	11/15	50,381.73E+6	36,386.8E+6
South Santiam River OR_SR_1709000608_02_103925	615	16	13	4/1	11/15	24,075.18E+6	19,561.09E+6
Thomas Creek OR_SR_1709000607_02_103988	6.9	18	NA	5/1	10/31	303.88E+6	NA
Willamette River OR_SR_1709000306_05_103854	3877	18	13	4/1	11/15	170,742.96E+6	123,314.36E+6
Willamette River OR_SR_1709000701_05_104005	5684	18	13	4/1	11/15	250,323.19E+6	180,788.97E+6
Willamette River OR_SR_1709000703_88_104015	5734	20	NA	6/1	9/30	280,583.54E+6	NA
Willamette River OR_SR_1709000704_88_104020	5988	20	NA	6/1	9/30	293,012.6E+6	NA

Willamette River OR_SR_1709001201_88_104019	6740	20	NA	6/1	9/30	329,810.44E+6	NA
Willamette River OR_SR_1709001202_88_104175	6740	20	NA	6/1	9/30	329,810.44E+6	NA

9.4 Surrogate measures

EPA regulations (40 CFR 130.2(i)) and OAR 340-042-0040(O)(5)(b) allow for TMDLs to utilize other appropriate measures (or surrogate measures). This section presents surrogate measures that implement the load allocations.

9.4.1 Dam and reservoir operations

Dam and reservoir operations (except for the PGE Willamette Falls Hydroelectric Project) have been assigned 0.~~00 °C~~00°C of the HUA and the equivalent load allocation as calculated using **Equation 9-8**. Monitoring stream temperature, rather than a thermal load, is easier and a more meaningful approach for reservoir management. Temperature increases are mathematically related to excess thermal loading and directly linked to the temperature water quality standard. For these reasons, DEQ is using a surrogate measure to implement the load allocation for dam and reservoir operations.

DEQ has developed the following surrogate measure temperature approach to implement the load allocation. The surrogate measure compliance point is located immediately downstream of the dam where impounded water is returned to the free-flowing stream. The surrogate measure is:

a) The 7DADM temperatures immediately upstream of the reservoirs. 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.

b) Additional adjustments to the surrogate temperature target 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 plus assigned HUA in the AU downstream of the dam;
   ii. The PCW criterion at OAR 340-041-0028(11) does not apply. DEQ has evaluated which dams the PCW criterion likely apply in Section 9.4.1.1;
   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 measure will attain the assigned HUA and load allocation because it targets 7DADM temperatures no warmer than those upstream of the reservoir. The surrogate measure also implements the minimum duties provision in rule at OAR 340-041-0028(12)(a). This provision states that anthropogenic sources are only responsible for controlling the thermal effects of their own discharge or activity in accordance with their overall heat contribution. For dam and reservoir operations, the surrogate measure reflects temperatures upstream of the reservoir (or no dam temperatures), thus ensuring dam operators are only responsible for temperature increases caused by the dam and reservoir operations.

For implementation of the low flow conditions provision at OAR 340-041-0028(12)(d), the 7Q10 shall be calculated at a gage upstream of the reservoir or at nearby monitoring gage that isn't influenced by the dam's operations.

9.4.1.1 Protecting cold water criterion and dams in the Willamette Subbasins

There are approximately 202 large instream dams located within the Willamette Subbasins temperature TMDL project area. The list of dams was obtained from the USACE National Inventory of Dams (NID) database and a similar database maintained by the OWRD, dam safety program. For each of these dams, DEQ was interested in determining whether the PCW criterion applied to immediate downstream and upstream reaches.

The PCW criterion has multiple components to determine applicability. These components include:

a) having summer 7DADM ambient temperatures that are always colder than the biologically based criteria;
b) salmon, steelhead, or bull trout presence;
c) no threatened or endangered salmonid presence;
d) no critical habitat designation; and
e) the colder ambient water is not necessary to ensure that downstream temperatures achieve and maintain compliance with the applicable temperature criteria.

DEQ evaluated components a) – d) using available information following the process outlined in **Figure 4-~~12~~15**.

Several sources were examined to determine if summer 7DADM ambient temperatures that are always colder than the biologically based criteria. The results of Oregon's 2022 Integrated Report were first used to determine whether the dam was located on a Category 5 temperature-impaired AU. A Category 5 temperature impairment (either year-round or spawning) precludes qualification for the PCW criterion. As such, if downstream or upstream AUs were listed as impaired for temperature, it was noted that the PCW did not apply. If an AU was identified as attaining for temperature (Category 2), it was assumed ambient 7DADM temperatures are always colder than the biologically based criteria.

The NorWeST SSN stream temperature models developed by Isaak et al. (2017) were also used to determine if temperatures are always colder than the biologically based criteria. These models use covariates derived from NHD and other sources to make temperature predictions to all river and stream reaches in various subregions in the Pacific Northwest. DEQ used the model outputs for the Oregon Coast processing unit. The specific model outputs were from the MWMT S2_02_11 composite scenario which is the prediction of the 10-year average (2002-2011) August Maximum Weekly Maximum (MWMT) stream temperature. The MWMT is similar to the 7DADM.

The NorWeST model outputs consists of point temperature predictions as well as reach average temperature predictions. Where available, NorWeST temperatures upstream and downstream of each reservoir were compared to the applicable year-round (non-spawning) 7DADM temperature criterion. If the MWMT S2_02_11 scenario temperatures exceeded the applicable temperature criterion immediately upstream or downstream of the dam and reservoir, it was reported that the PCW did not apply. Conversely, if the MWMT S2_02_11 temperature was less than the criterion both up and downstream, it was assumed ambient 7DADM temperatures are always colder than the biologically based criteria. In the rare instance of a discrepancy between the Integrated Report and the NorWeST data, priority for PCW determination was given to the Integrated Report. One major limitation in the Norwest data is that the model does not make predictions during the fall when the spawning criterion apply.

The applicability of the PCW criterion was not always immediately apparent. In multiple instances, while the NHD stream network showed an upstream reach flowing into a reservoir, no upstream NorWeST data existed. In these cases, it was noted that the applicability of the PCW criterion was unclear. For other dams, there existed a short downstream NHD line with no corresponding NorWeST data until the stream flowed into a connecting stream. In these cases, it was noted that the applicability of the PCW was unclear. For off-channel lagoons associated with treatment systems, N/A was reported. For reservoirs with no inflowing streams such as offstream irrigation ponds, N/A was selected for upstream and Integrated Report/NorWeST data were evaluated for the downstream reach. When it was unclear whether the reservoir connected to a downstream flowline, it was noted that the applicability of the PCW was unclear.

ODFW's fish habitat distribution (FHD) GIS database were used to evaluate presence of salmon, steelhead, or bull trout. NOAA's National Marine Fishery Service and U.S. Fish & Wildlife Service GIS features were used to evaluate threatened or endangered salmonid presence and critical habitat designations.

Based on these methods, DEQ determined that the PCW criterion likely applies at three dams in the Willamette Subbasins (**Table 9-6**).

Table 9-6: Dams where the protecting colder water criterion likely applies.

Dam name	NID ID	Dam owner	Latitude	Longitude	Stream	Notes
Carmen Diversion	OR00539	EWEB	44.3384	-122.0057	McKenzie River	Based on NorWest model S2_02_11 showing MWMT temperatures < 12°C, downstream SSBT presence, threatened Chinook and Bull Trout, and designated critical habitat
Harriet Lake	OR00546	PGE	45.0746	-121.9697	Oak Grove River	Based on attaining status on DEQ 2022 IR (OR_SR_1709001103_02_104150), downstream SSBT presence, threatened Steelhead, Chinook, and Coho, and designated critical habitat
Trail Bridge and Trail Bridge Saddle Dike	OR00540	EWEB	44.2734	-122.0507	McKenzie River	Based on attaining status on DEQ 2022 IR (OR_SR_1709000402_02_104588; OR_SR_1709000402_02_104587), upstream and downstream SSBT presence, threatened Chinook and Bull Trout, and designated critical habitat

9.4.2 Site specific effective shade surrogate measure

Effective shade surrogate measure targets shown in **Table 9-7** ~~through~~and **Table 9-~~11~~8** represent a surrogate for the amount of solar loading that will attain the HUA and load allocations for nonpoint sources managing streamside vegetation. The surrogate measure is the arithmetic mean of the effective shade values at all model nodes assigned to each DMA (**Equation 9-9**). **Equation 9-9** may be used to recalculate the mean effective shade targets if

DMA boundaries change or the DMA boundary needs to be corrected. **Equation 9-9** may also be used to recalculate the mean effective shade targets based on an updated shade gap assessments following the process and methods outlined in the WQMP.

Figure 9-~~4~~6 shows the gap between current and target effective shade at the subwatershed level in the Lower Willamette model area. **Figure 9-~~5~~7** shows the gap between current and target effective shade at the subwatershed level in the Southern Willamette model area.

Changes in the target effective shade from the values presented in **Table 9-7** ~~through~~and **Table 9-~~11~~8** may result in redistribution of the sector or source responsible for excess load reduction. If the shade target increases, the equivalent portion of the excess load is reassigned from background sources to nonpoint sources. If the shade target decreases, the portion of the excess load is reassigned from nonpoint sources to background sources. The exact portion reassigned can only be determined in locations where temperature models have been developed. In locations without temperature models, the reassignment remains unquantified. Changes to the target effective shade do not impact the loading capacity, HUA, or the load allocations. They remain the same as presented in this TMDL.

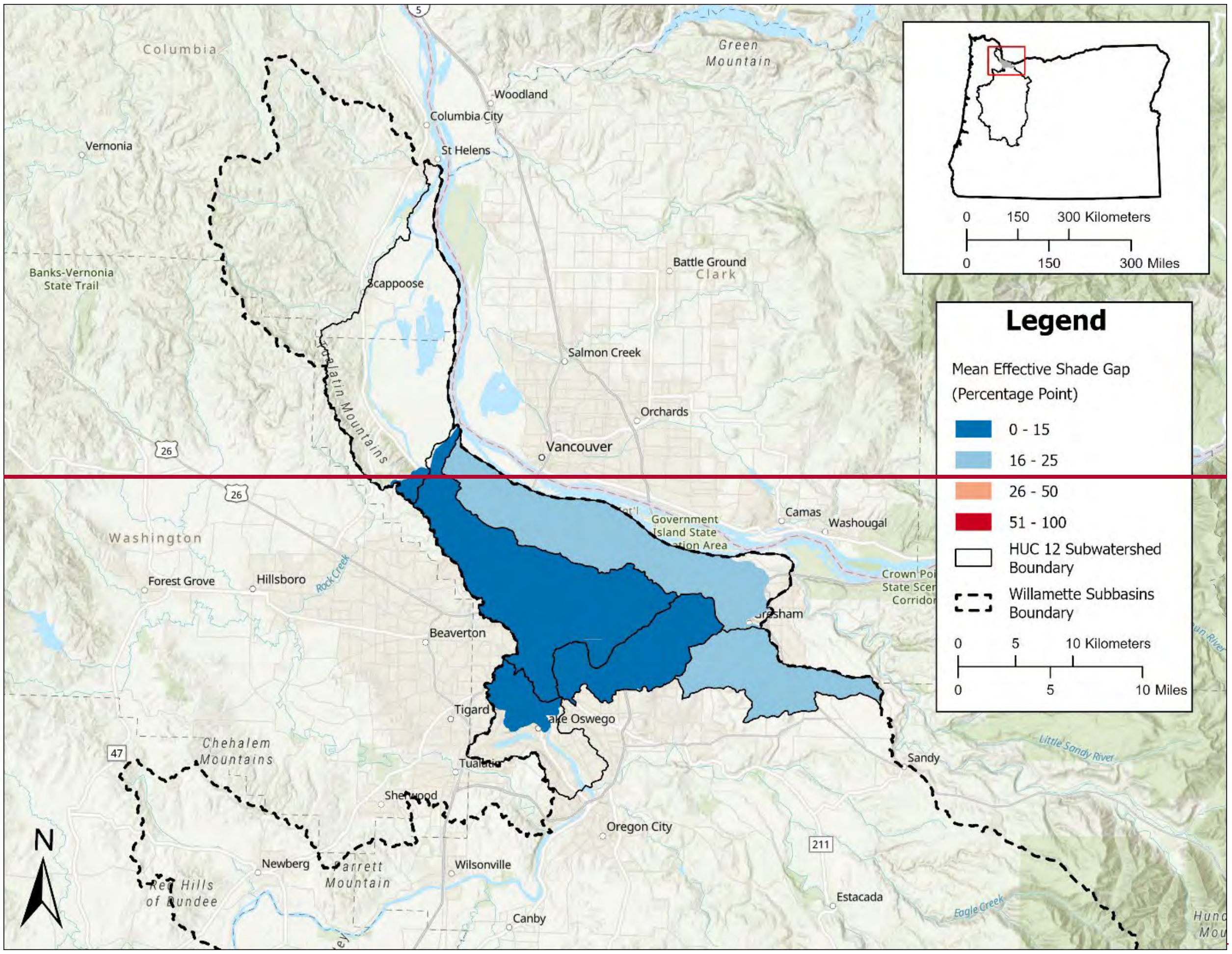
$$\overline{ES} = \frac{\sum ES_{n_i}}{n_i}$$ **Equation 9~~-9~~-9**

Where,

$\overline{ES} =$ The mean effective shade for DMA *i.*

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

$n_i =$ Total number of model nodes or measurement points assigned to DMA *i.*


Legend
Mean Effective Shade Gap
(Percentage Point)
0 - 15
16 - 25
26 - 50
51 - 100
HUC 12 Subwatershed Boundary
Willamette Subbasins Boundary
0 5 10 Kilometers
0 5 10 Miles
0 150 300 Kilometers
0 150 300 Miles
N
Columbia
Vernonia
Banks-Vernonia State Trail
Woodland
Columbia City
St Helens
Scappoose
Battle Ground
Clark
Salmon Creek
Orchards
Vancouver
Camas
Washougal
Washington
Forest Grove
Hillsboro
Beaverton
Tigard
Tualatin
Sherwood
Oregon City
Newberg
Wilsonville
Canby
Estacada
Sandy
Gresham
Chehalem Mountains
Green Mountain

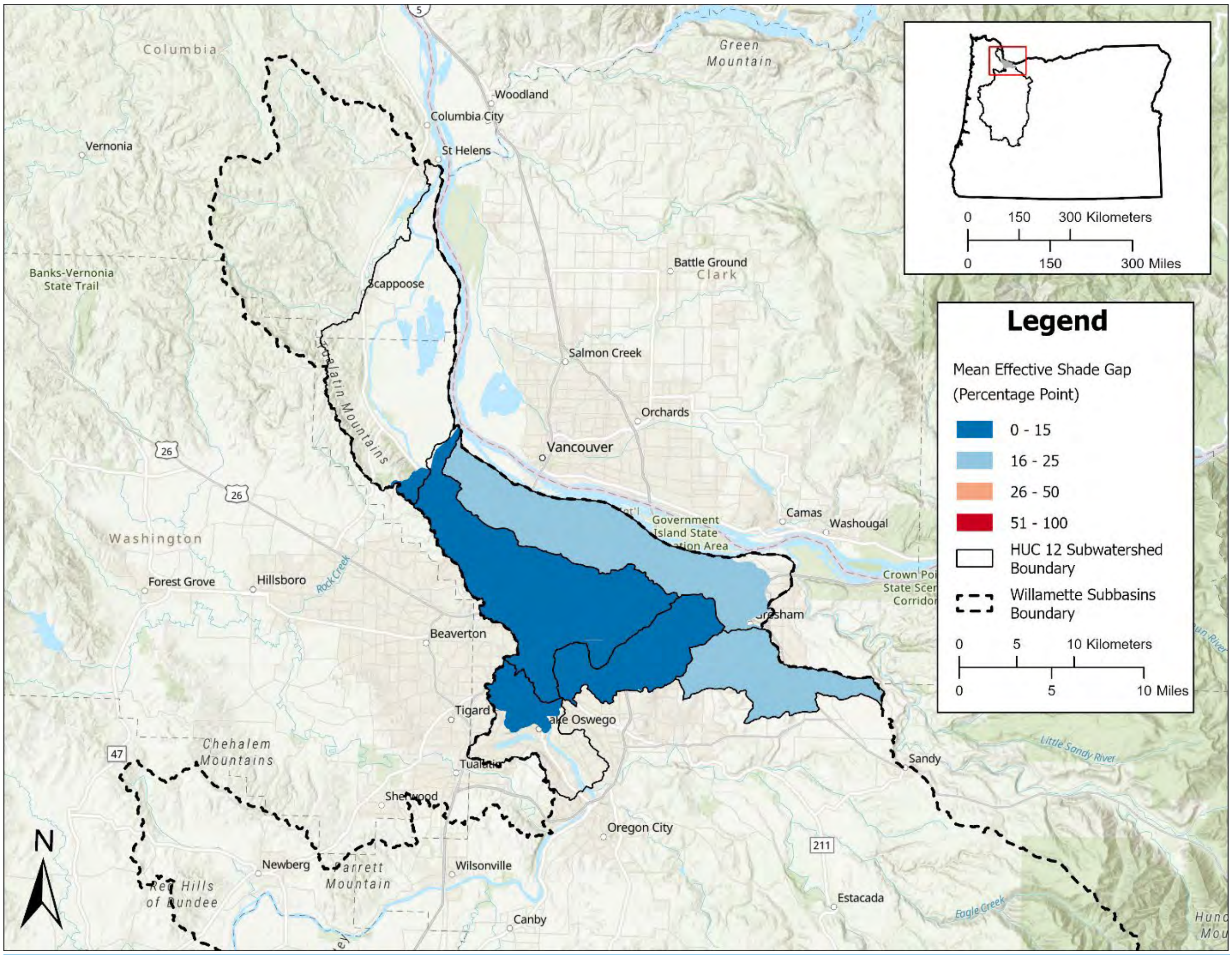


Figure 9-6: Lower Willamette Subbasin model area and mean effective shade gap for each HUC12 subwatershed within the model extent.

Table 9-7: ~~Effective~~Site specific effective shade surrogate measure targets to meet nonpoint source load allocations for ~~DMAs in the Lower Willamette Subbasin~~specific model ~~area~~extents.

~~DMA~~Model Stream	Total Kilometers Assessed	Assessed Effective Shade (%)	TMDL Target Effective Shade (%)	Shade Gap
Clackamas River	36.5	13	37	24
Coast Fork Willamette River	46.7	35	54	19
Fall Creek	11.5	29	47	18
Long Tom River	38.2	25	57	32
Middle Fork Willamette River	26.6	16	26	10
Molalla River	75.36	27	41	14
North Santiam River	79.6	19	34	15
Pudding River	85.55	44	52	8
Row River	12.2	24	54	30
Santiam River	19.5	11	19	8
South Santiam River	58.4	7	21	14
Willamette River	257.8	11	20	9

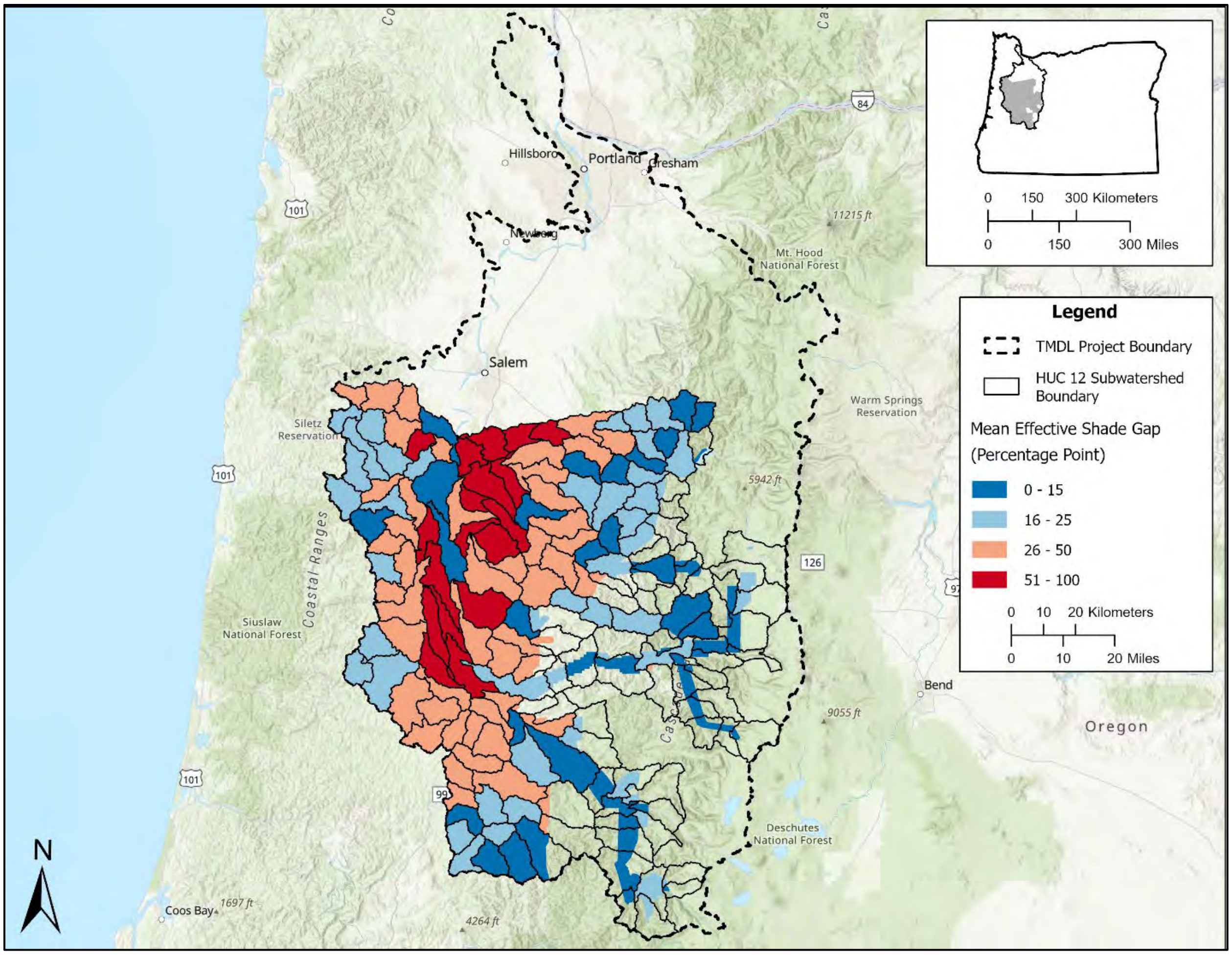


Figure 9-7: Southern Willamette model area and mean effective shade gap for each HUC12 subwatershed within the model extent.

Table 9-8: Site specific effective shade surrogate measure targets to meet nonpoint source load allocations for DMAs in all model areas in the Willamette Subbasins.

DMA	Total Kilometers Assessed	Assessed Effective Shade (%)	TMDL Target Effective Shade (%)	Shade Gap
Albany & Eastern Railroad	0.3	71	74	3
BNSF	0.1	35	42	7
Benton County	122.3	54	85	31
Bonneville Power Administration	2.3	34	94	60
Central Oregon & Pacific Railroad	0.2	32	75	43
City of Adair Village	2	27	93	66
City of Albany	54.4	27	55	28
City of Aurora	0.2	28	33	5
City of Brownsville	4	28	67	39
City of Canby	3.9	23	38	15
City of Coburg	2.8	22	91	69
City of Corvallis	76.4	40	63	23
City of Cottage Grove	19.1	40	67	27
City of Creswell	5.3	19	77	58
City of Dundee	0.1	19	16	-3
City of Eugene	161.7	21	62	41
City of Fairview	0.1	21	54	33
City of Falls City	9	56	96	40
City of Gates	8.2	30	60	30
City of Gladstone	3.8	11	35	24
City of Gresham	16	63	81	18
City of Halsey	1.6	8	87	79
City of Happy Valley	~~0.8~~2.7	~~79~~36	~~90~~58	~~11~~22
City of Harrisburg	4.1	10	27	17
City of Independence	2.4	14	22	8
City of Jefferson	5.9	22	40	18
City of Junction City	11.6	9	85	76
City of Keizer	3.1	12	18	6
City of Lake Oswego	5.8	83	90	7
City of Lebanon	18.8	25	61	36
City of Lowell	2.7	33	90	57
City of Lyons	4.4	21	43	22
City of McMinnville	0.1	15	20	5
City of Mill City	8	20	53	33
City of Millersburg	19.5	21	59	38
City of Milwaukie	2.9	62	80	18
City of Molalla	0.1	5	29	24
City of Monmouth	0.5	82	89	7
City of Monroe	3.5	27	50	23
City of Newberg	0.7	5	19	14
City of Oakridge	9.2	28	75	47
City of Oregon City	0.7	2	12	10
City of Philomath	7.6	37	88	51
City of Portland	127.4	61	73	12
~~Clackamas County~~	~~13.3~~	~~66~~	~~86~~	~~20~~
~~Multnomah County~~	~~9.7~~	~~75~~	~~90~~	~~15~~
~~Oregon Department~~City of ~~Agriculture~~Salem	~~13~~14.5	~~65~~12	~~85~~24	~~20~~12
~~Oregon Department of Forestry - Private~~	~~6.6~~	~~89~~	~~92~~	~~3~~
~~Oregon Parks and Recreation Department~~	~~0.1~~	~~91~~	~~91~~	~~0~~
~~Port of Portland~~	~~2.1~~	~~29~~	~~45~~	~~16~~
~~Portland & Western Railroad~~	~~<0.1~~	~~82~~	~~89~~	~~7~~
~~Roads~~	~~3.1~~	~~54~~	~~77~~	~~23~~

DMA	Total Kilometers Assessed	Assessed Effective Shade (%)	TMDL Target Effective Shade (%)	Shade Gap
Union Pacific Railroad	0.1	34	62	28

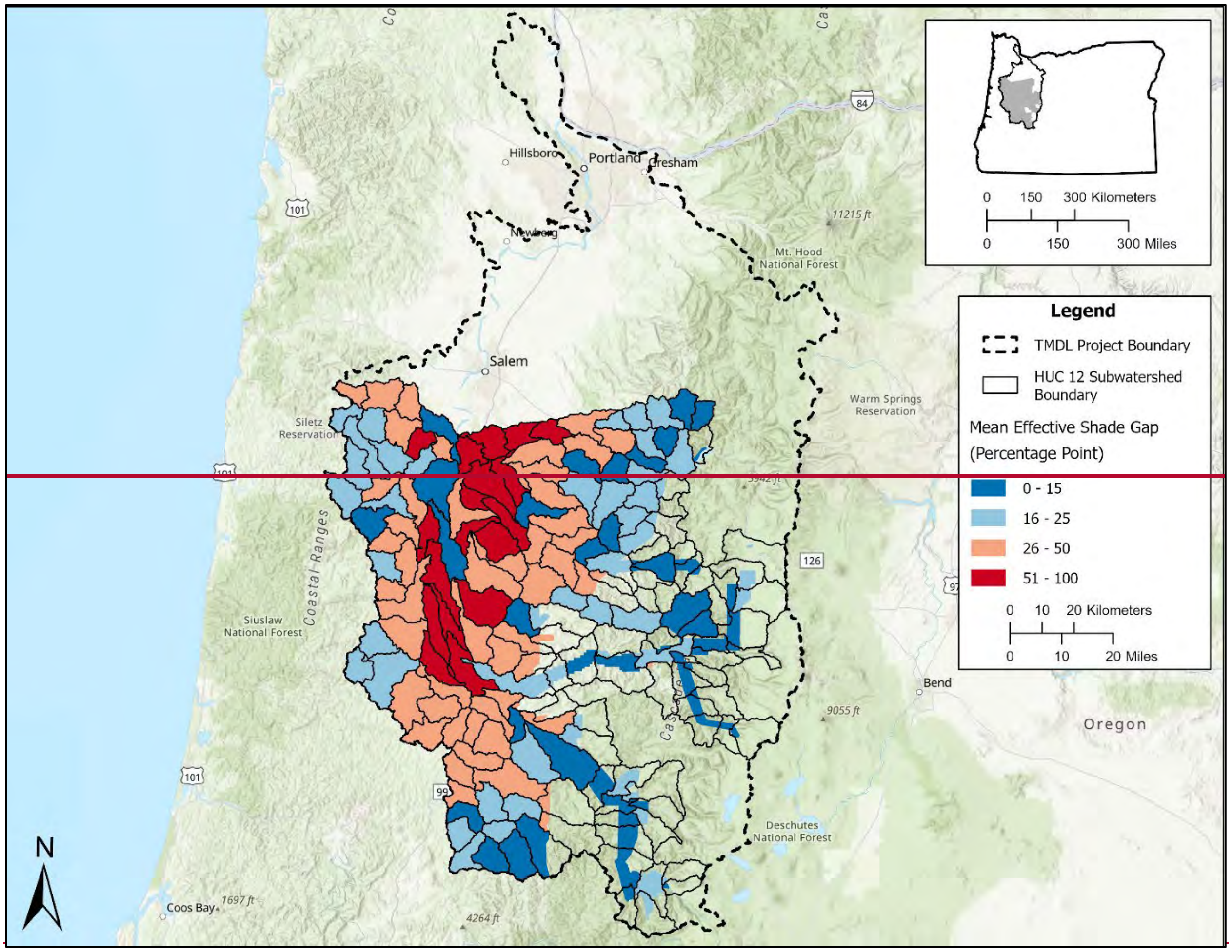


Figure 9-5: Southern Willamette model area and mean effective shade gap for each HUC12 subwatershed within the model extent.

~~Table 9-8: Effective shade surrogate measure targets to meet nonpoint source load allocations for DMAs in the Southern Willamette model area.~~

~~DMA~~	~~Total Kilometers Assessed~~	~~Assessed Effective Shade (%)~~	~~TMDL Target Effective Shade (%)~~	~~Shade Gap~~
~~Albany & Eastern Railroad~~	~~0.1~~	~~95~~	~~97~~	~~2~~
~~Benton County~~	~~119.3~~	~~57~~	~~89~~	~~32~~
~~Bonneville Power Administration~~	~~2.3~~	~~34~~	~~94~~	~~60~~
~~Central Oregon & Pacific Railroad~~	~~0.2~~	~~8~~	~~86~~	~~78~~
~~City of Adair Village~~	~~2~~	~~27~~	~~93~~	~~66~~
~~City of Albany~~	~~47.7~~	~~35~~	~~76~~	~~41~~
~~City of Brownsville~~	~~4~~	~~28~~	~~67~~	~~39~~
~~City of Coburg~~	~~2.8~~	~~22~~	~~91~~	~~69~~
~~City of Corvallis~~	~~63.8~~	~~59~~	~~86~~	~~27~~
~~City of Cottage Grove~~	~~6.2~~	~~38~~	~~85~~	~~47~~
~~City of Creswell~~	~~4.6~~	~~18~~	~~91~~	~~73~~
~~City of Eugene~~	~~139.4~~	~~27~~	~~81~~	~~54~~
~~City of Falls City~~	~~9~~	~~56~~	~~96~~	~~40~~
~~City of Gates~~	~~4.7~~	~~36~~	~~85~~	~~49~~
~~City of Halsey~~	~~1.6~~	~~8~~	~~87~~	~~79~~
~~City of Harrisburg~~	~~0.8~~	~~3~~	~~88~~	~~85~~
~~City of Jefferson~~	~~3.2~~	~~22~~	~~82~~	~~60~~
~~City of Junction City~~	~~11.6~~	~~9~~	~~85~~	~~76~~
~~City of Lebanon~~	~~16.2~~	~~37~~	~~85~~	~~48~~
~~City of Lowell~~	~~2.7~~	~~33~~	~~90~~	~~57~~
~~City of Lyons~~	~~2.3~~	~~32~~	~~88~~	~~56~~
~~City of Mill City~~	~~2.9~~	~~18~~	~~76~~	~~58~~
~~City of Millersburg~~	~~17.2~~	~~26~~	~~78~~	~~52~~
~~City of Monmouth~~	~~0.5~~	~~82~~	~~89~~	~~7~~
~~City of Monroe~~	~~1.2~~	~~26~~	~~75~~	~~49~~
~~City of Oakridge~~	~~9.2~~	~~28~~	~~75~~	~~47~~
~~City of Philomath~~	~~7.6~~	~~37~~	~~88~~	~~51~~
~~City of Salem~~	~~0.8~~	~~24~~	~~45~~	~~21~~
City of Scio	1.7	51	59	8
City of Springfield	~~45.9~~55.4	~~30~~21	~~83~~59	~~53~~38
City of Stayton	~~3.9~~10.2	~~41~~24	~~86~~43	~~45~~19
City of Sweet Home	~~26.2~~34.3	~~33~~17	~~87~~50	~~54~~33
City of Tangent	10.9	48	82	34
City of Veneta	8.7	50	95	45
City of Waterloo	0.45	~~48~~27	~~94~~46	~~46~~19
City of West Linn	2.1	4	11	7
City of Westfir	3.1	29	80	51
City of Wilsonville	4.3	10	13	3
Clackamas County	27.8	42	62	20
Lane County	~~773.3~~879.7	~~49~~41	~~84~~71	~~35~~30
Lincoln County	0.2	9	96	87
Linn County	~~180.7~~224.9	~~42~~30	~~88~~62	~~46~~32
Marion County	~~49~~60.8	~~42~~30	~~78~~53	~~36~~23
Multnomah County	9.7	75	90	15
Oregon Department of Agriculture	~~4823~~5505.7	~~32~~28	~~85~~69	~~53~~41
Oregon Department of Aviation	0.2	~~1~~4	~~92~~66	~~91~~62
Oregon Department of Fish and Wildlife	~~13~~21.8	~~37~~24	~~73~~58	~~36~~34
Oregon Department of Forestry - Private	~~8603.4~~8684.7	~~70~~69	~~96~~94	~~26~~25
Oregon Department of Forestry - Public	~~526.6~~530.1	~~85~~84	~~97~~96	12
Oregon Department of Geology and Mineral Industries	~~5~~8.2	~~40~~27	~~93~~57	~~53~~30
Oregon Department of State Lands	~~3.~~7	~~37~~25	~~56~~40	~~19~~15
Oregon Department of Transportation	~~54.9~~81.6	~~35~~26	~~78~~55	~~43~~29

~~DMA~~	~~Total Kilometers Assessed~~	~~Assessed Effective Shade (%)~~	~~TMDL Target Effective Shade (%)~~	~~Shade Gap~~
Oregon Military Department	0.2	0	86	86
Oregon Parks and Recreation Department	~~28.2~~95.7	~~48~~19	~~72~~30	~~24~~11
Polk County	~~64~~65.9	~~50~~47	~~93~~87	~~43~~40
Port of Coos Bay	1.9	56	93	37
Port of Portland	2.1	29	45	16
Portland & Western Railroad	~~1.9~~2.6	~~46~~37	~~74~~52	~~28~~15
State of Oregon (unidentified agency)	~~2~~12.5	~~63~~14	~~68~~25	~~5~~11
U.S. Army Corps of Engineers	~~73.6~~83.5	~~59~~46	~~81~~70	~~22~~24
U.S. Bureau of Land Management	~~2574.4~~2607.9	~~89~~87	~~97~~95	8
U.S. Department of Agriculture	1.2	~~30~~29	~~46~~49	~~16~~20
U.S. Department of Defense	1.5	47	85	38
U.S. Fish and Wildlife Service	~~39.7~~43.5	~~47~~36	~~77~~62	~~30~~26
U.S. Forest Service	2985.~~3~~4	84	95	11
U.S. Government (unidentified agency)	~~10.3~~15.8	~~59~~33	~~82~~53	~~23~~20
Union Pacific Railroad	7.5~~.4~~	~~65~~35	~~90~~52	~~25~~17
Yamhill County	2.1	11	12	1

~~**Table 9-9: Effective shade surrogate measure targets to meet nonpoint source load allocations for specific model extents.**~~

~~Model Stream~~	~~Total Kilometers Assessed~~	~~Assessed Effective Shade (%)~~	~~TMDL Target Effective Shade (%)~~	~~Shade Gap~~
~~Pudding River~~	~~85.55~~	~~44~~	~~52~~	~~8~~
~~Molalla River~~	~~75.36~~	~~27~~	~~41~~	~~14~~

~~**Table 9-10: Effective shade surrogate measure targets to meet nonpoint source load allocations for DMAs in the Pudding River model extent.**~~

~~DMA~~	~~Total Kilometers Assessed~~	~~Assessed Effective Shade (%)~~	~~TMDL Target Effective Shade (%)~~	~~Shade Gap~~
~~City of Aurora~~	~~0.2~~	~~28~~	~~33~~	~~5~~
~~Clackamas County~~	~~0.5~~	~~33~~	~~49~~	~~16~~
~~Marion County~~	~~0.2~~	~~43~~	~~63~~	~~20~~
~~Oregon Department of Agriculture~~	~~96.1~~	~~47~~	~~57~~	~~10~~
~~Oregon Department of Transportation~~	~~0.2~~	~~74~~	~~77~~	~~3~~
~~Oregon Parks and Recreation Department~~	~~1.6~~	~~36~~	~~42~~	~~6~~
~~State of Oregon~~	~~0.1~~	~~66~~	~~64~~	~~-2~~

~~**Table 9-11: Effective shade surrogate measure targets to meet nonpoint source load allocations for DMAs in the Molalla River model extent.**~~

~~DMA~~	~~Total Kilometers Assessed~~	~~Assessed Effective Shade (%)~~	~~TMDL Target Effective Shade (%)~~	~~Shade Gap~~
~~City of Canby~~	~~3.1~~	~~26~~	~~42~~	~~16~~
~~City of Molalla~~	~~0.1~~	~~5~~	~~29~~	~~24~~
~~Clackamas County~~	~~2.9~~	~~19~~	~~33~~	~~14~~
~~Oregon Department of Agriculture~~	~~26.8~~	~~13~~	~~27~~	~~14~~

~~DMA~~	~~Total Kilometers Assessed~~	~~Assessed Effective Shade (%)~~	~~TMDL Target Effective Shade (%)~~	~~Shade Gap~~
~~Oregon Department of Forestry - Private~~	~~13.8~~	~~40~~	~~51~~	~~11~~
~~Oregon Department of Transportation~~	~~0.1~~	~~16~~	~~51~~	~~35~~
~~Oregon Parks and Recreation Department~~	~~2.1~~	~~13~~	~~23~~	~~10~~
~~State of Oregon~~	~~0.7~~	~~16~~	~~24~~	~~8~~
~~U.S. Bureau of Land Management~~	~~24.4~~	~~51~~	~~65~~	~~14~~
~~U.S. Government~~	~~0.1~~	~~49~~	~~44~~	~~-5~~
~~Union Pacific Railroad~~	~~0.3~~	~~24~~	~~47~~	~~23~~

9.4.3 Effective shade curve surrogate measure

Effective shade curves are applicable to any stream that does not have site specific shade targets (Section 9.4.2). Effective shade curves represent the maximum possible effective shade for a given vegetation type. The values presented within the effective shade curves (**Figure 9-~~8~~10** to **Figure 9-~~29~~31**) represent the mean effective shade target for different mapping units, stream aspects, and active channel widths. The vegetation height, density, overhang, and buffer widths used for each mapping unit vegetation type is summarized in **Table 9-~~12~~9**. See TSD Appendix A and C for additional details on the model approach for shade curves and the methodologies used to determine the mapping units and vegetation characteristics. Section 14 of the TMDL provides tables of the plotted shade curve values. A map of all mapping units in the Willamette Basin can be found in the TSD Appendix H: Willamette Subbasins Interactive TMDL Map. This is an interactive HTML map that can be opened in an internet browser.

Local geology, geography, soils, climate, legacy impacts, natural disturbance rates, and other factors may prevent effective shade from reaching the target effective shade. No enforcement action will be taken by DEQ for reductions in effective shade caused by natural disturbances.

Table 9-9: Vegetation height, density, overhang, and horizontal distance buffer widths used to derive generalized effective shade curve targets for each mapping unit.

Mapping Unit	Height (m)	Height (ft)	Density (%)	Overhang (m)	Buffer Width (m)
Qff1	40.7	134	70	4.9	36.8
Qfc	37.7	124	64	4.5	36.8
Qalc	26.9	88	71	3.2	36.8
Qg1	21.6	71	64	2.6	36.8
Qau	22.6	74	69	2.7	36.8
Qalf	17.5	57	68	2.1	36.8
Qff2	21.5	71	66	2.6	36.8
Qbf	22.0	72	68	2.6	36.8
Tvc	27.8	91	65	3.3	36.8
Qtg	40.5	133	72	4.9	36.8
Tvw	35.1	115	65	4.2	36.8
Tcr	36.9	121	68	4.4	36.8
Tm	29.7	97	68	3.6	36.8
QTt	25.2	83	66	3.0	36.8
QTb	35.2	115	64	4.2	36.8
Qls	44.0	144	65	5.3	36.8
OW	1.9	6	74	0.2	36.8
Upland Forest	40.9	134	75	4.9	36.8

Mapping Unit	Height (m)	Height (ft)	Density (%)	Overhang (m)	Buffer Width (m)
1d/1f - Coast Range - Volcanics and Willapa Hills	36.0	118.1	75	3.9	36.8
3a -Willamette Valley - Portland/Vancouver Basin	26.0	85.3	75	1.9	36.8
3c -Willamette Valley - Prairie Terraces	33.2	108.9	75	1.9	36.8
3d - Willamette Valley – Valley Foothills	31.0	101.7	75	1.9	36.8

How to use a shade curve:

1. Determine the applicable mapping unit for the stream location you are applying a shade curve to.

   Example: Your site of interest is in the Rickreall Creek watershed, in the City of Independence, along the west bank of a tributary to the Willamette River. Open the Willamette Subbasins Interactive TMDL Map (TSD Appendix H) and select the Shade Curve Mapping Units Layer in the Map Legend to add it to the map. You may also want to select the City Boundaries Layer and the Stream Names Layer to help identify your site of interest. Once you have identified your site of interest, click that point on the map and you will see a pop-up box that identifies the Shade Curve Mapping Unit for that point. In this example, you identify the mapping unit at your site to be Qalc (Quaternary alluvium floodplain deposits) (**Figure 9-~~6~~8**).

2. Determine the stream aspect from north.

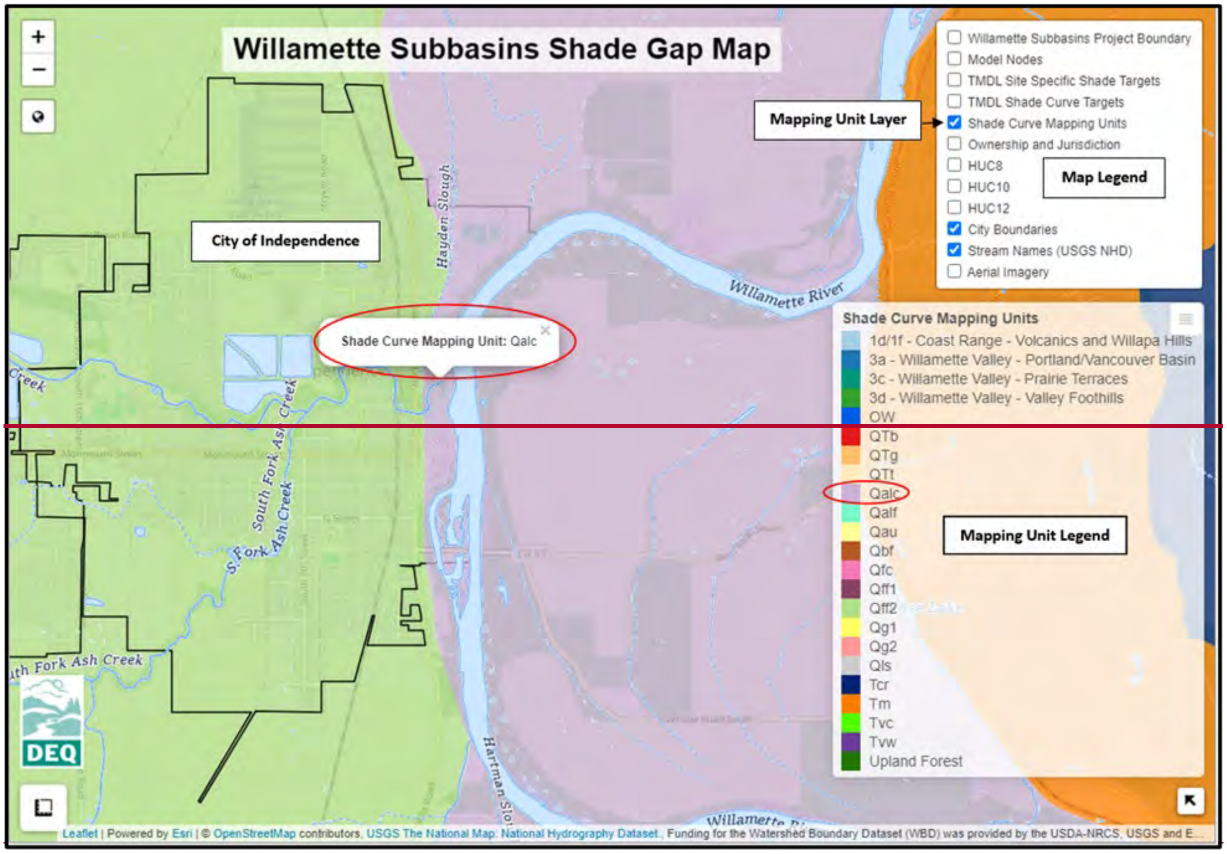
   Example: Standing in-stream mid-channel, facing north determine the river's aspect as 0º or 180º from north (this means the river reach runs south to north).

3. Determine the 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 determine that it is 25 ft.

4. Use the appropriate mapping unit shade curve, stream aspect line and active channel width (x-axis), to determine the percent effective shade of your site (y-axis). This is the non-point source load allocation of the stream reach at system potential vegetation.

   Example: You have determined that the appropriate shade curve mapping unit for your site is Qalc (**Figure 9-~~7~~9**). Since you are located on a tributary with an East-West stream aspect and an active channel width of 25 ft, you use the dotted line to determine the effective shade. By reading the y-axes, you determine that the effective shade to be ~83% when system potential vegetation is applied to the left and right bank of the stream reach. System potential vegetation defines the average riparian vegetation height as 88.2 ft (26.9 m), and the stand density (canopy density) as 71%.



Willamette Subbasins Shade Gap Map
Mapping Unit Layer
Willamette Subbasins Project Boundary
Model Nodes
TMDL Site Specific Shade Targets
TMDL Shade Curve Targets
Shade Curve Mapping Units
Ownership and Jurisdiction
HUC8
HUC10
HUC12
City Boundaries
Stream Names (USGS NHD)
Aerial Imagery
Map Legend
City of Independence
Shade Curve Mapping Unit: Qalc
Willamette River
Hayden Slough
South Fork Ash Creek
S. Fork Ash Creek
Hartman Slough
Shade Curve Mapping Units
1d/1f - Coast Range - Volcanics and Willapa Hills
3a - Willamette Valley - Portland/Vancouver Basin
3c - Willamette Valley - Prairie Terraces
3d - Willamette Valley - Valley Foothills
OW
QTb
QTg
QTt
Qalc
Qalf
Qau
Qbf
Qfc
Qff1
Qff2
Qg1
Qg2
Qls
Tcr
Tm
Tvc
Tvw
Upland Forest
Mapping Unit Legend
DEQ
Leaflet | Powered by Esri | © OpenStreetMap contributors, USGS The National Map: National Hydrography Dataset., Funding for the Watershed Boundary Dataset (WBD) was provided by the USDA-NRCS, USGS and E...

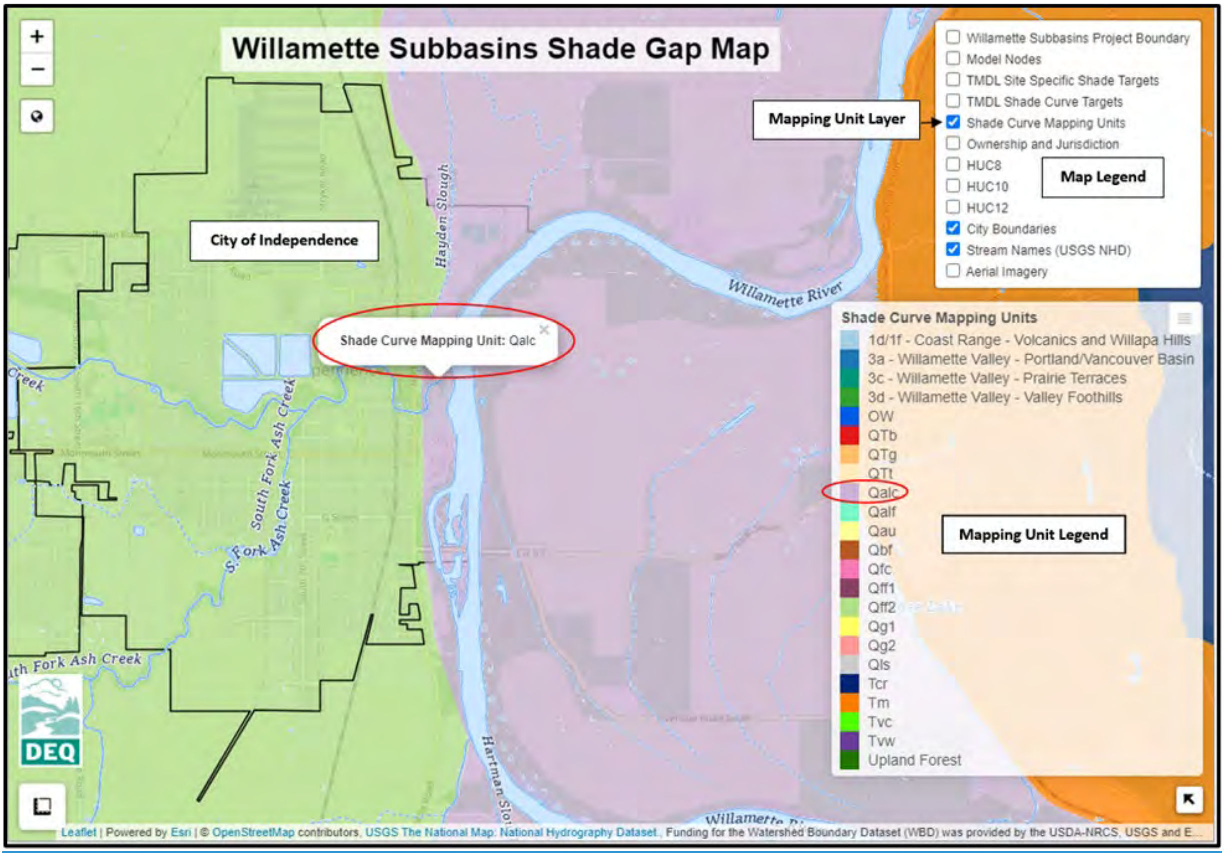
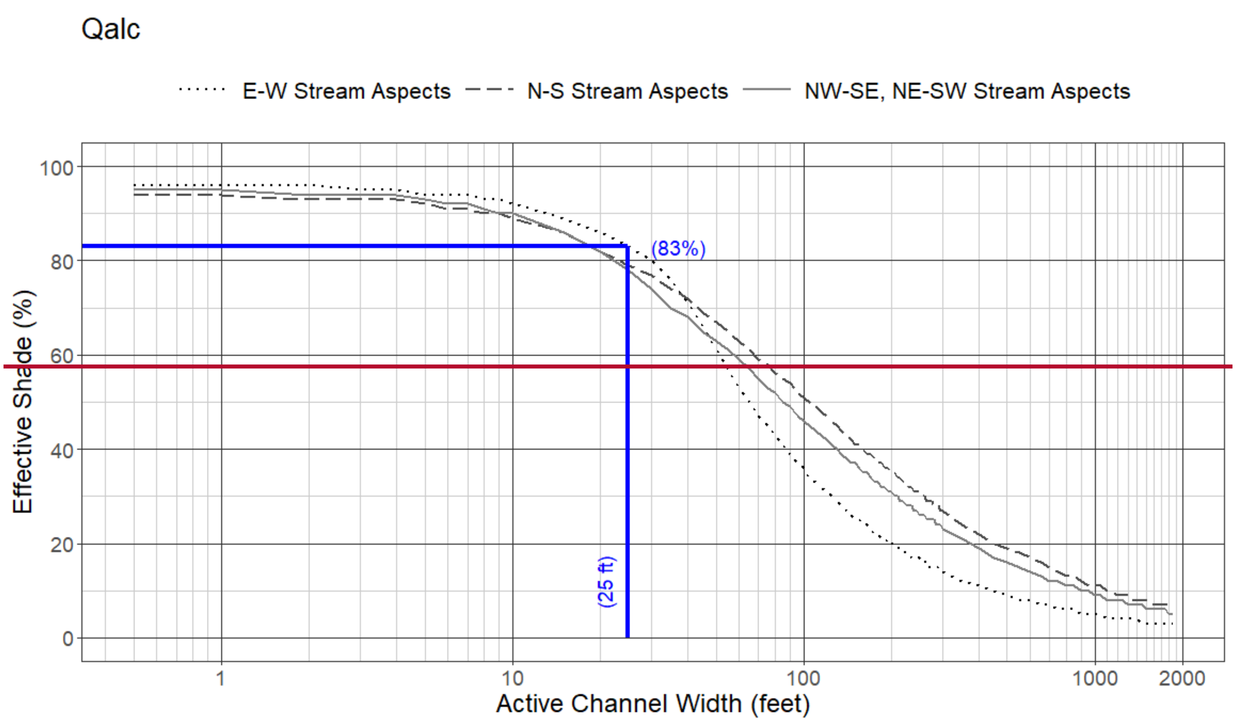


Figure 9-8: Mapping units in the example area of interest from the Willamette Subbasins Interactive TMDL Map.



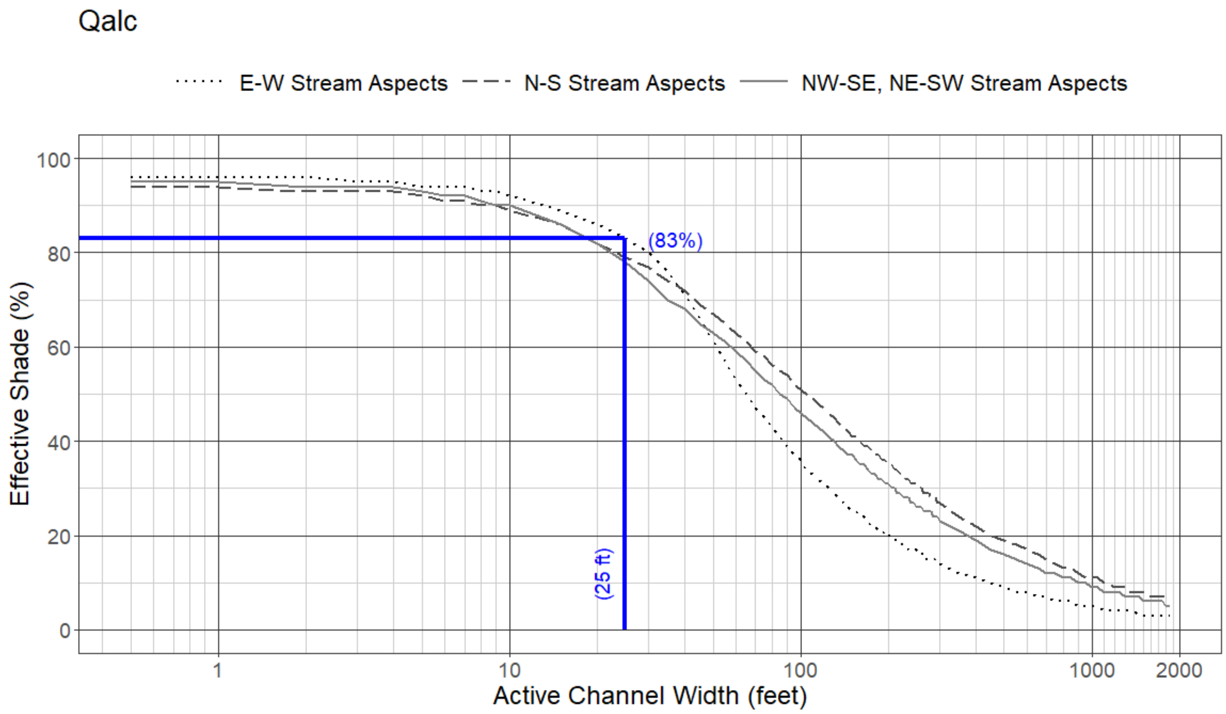
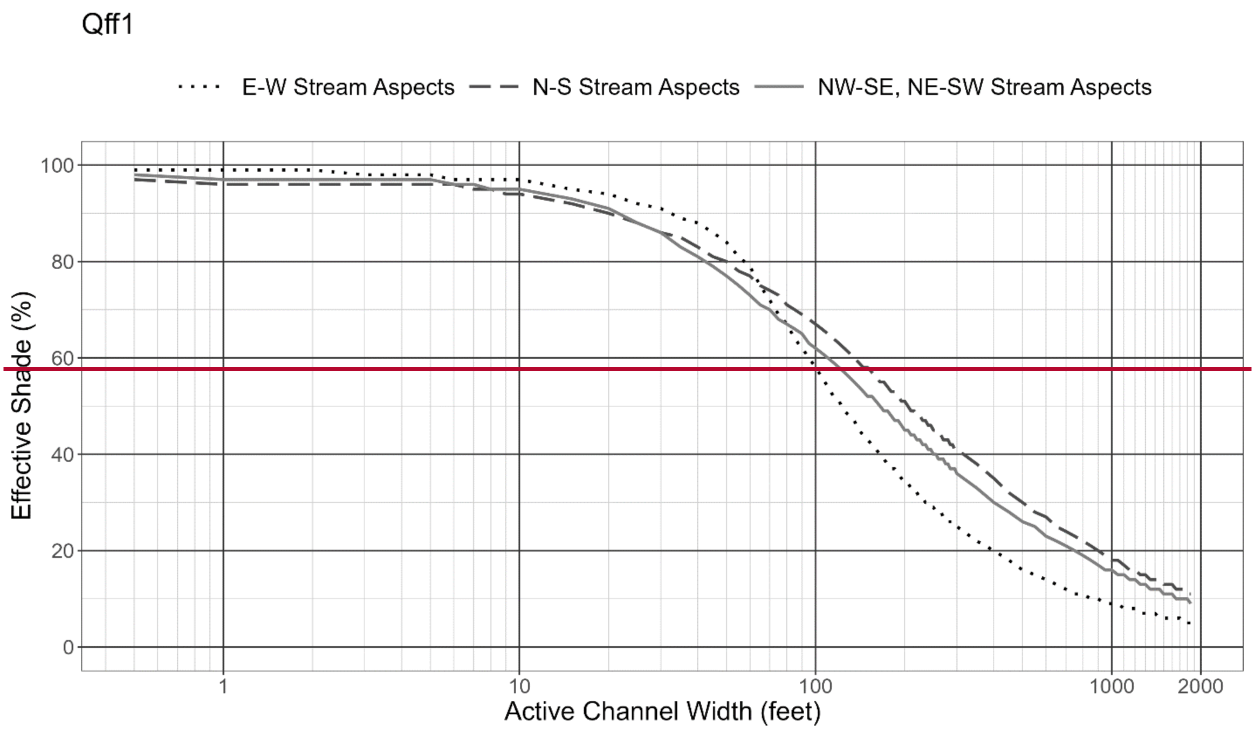
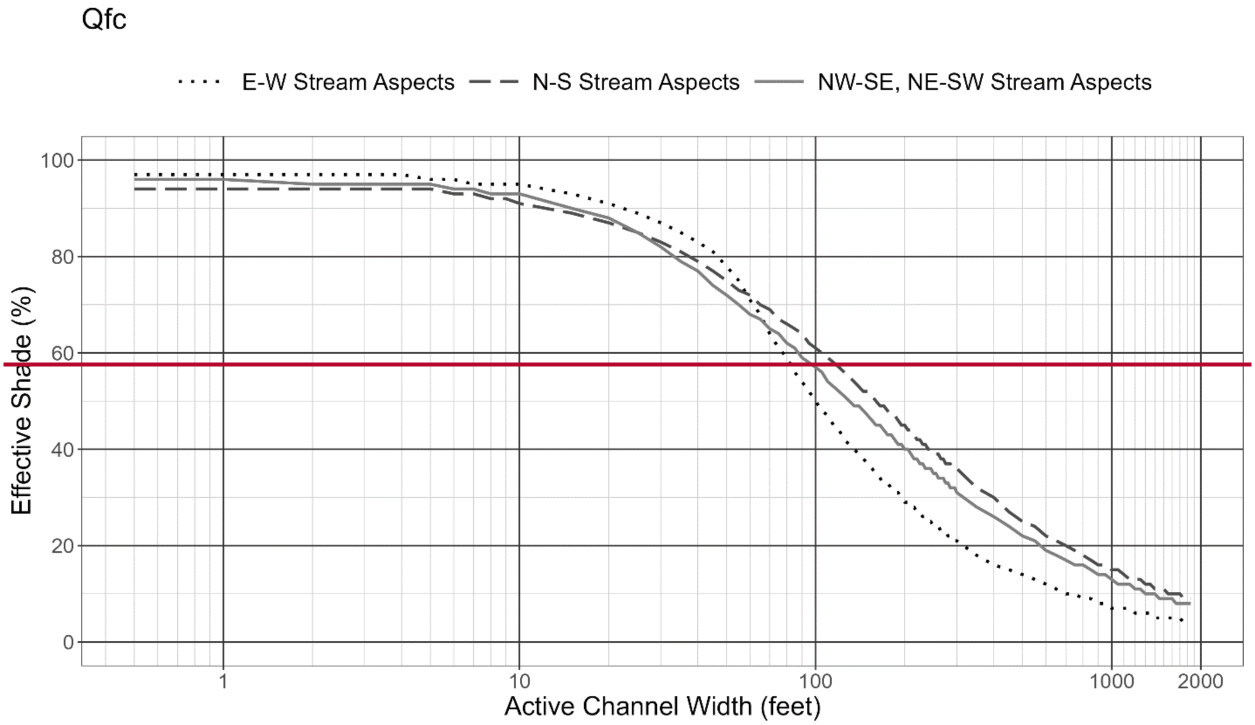


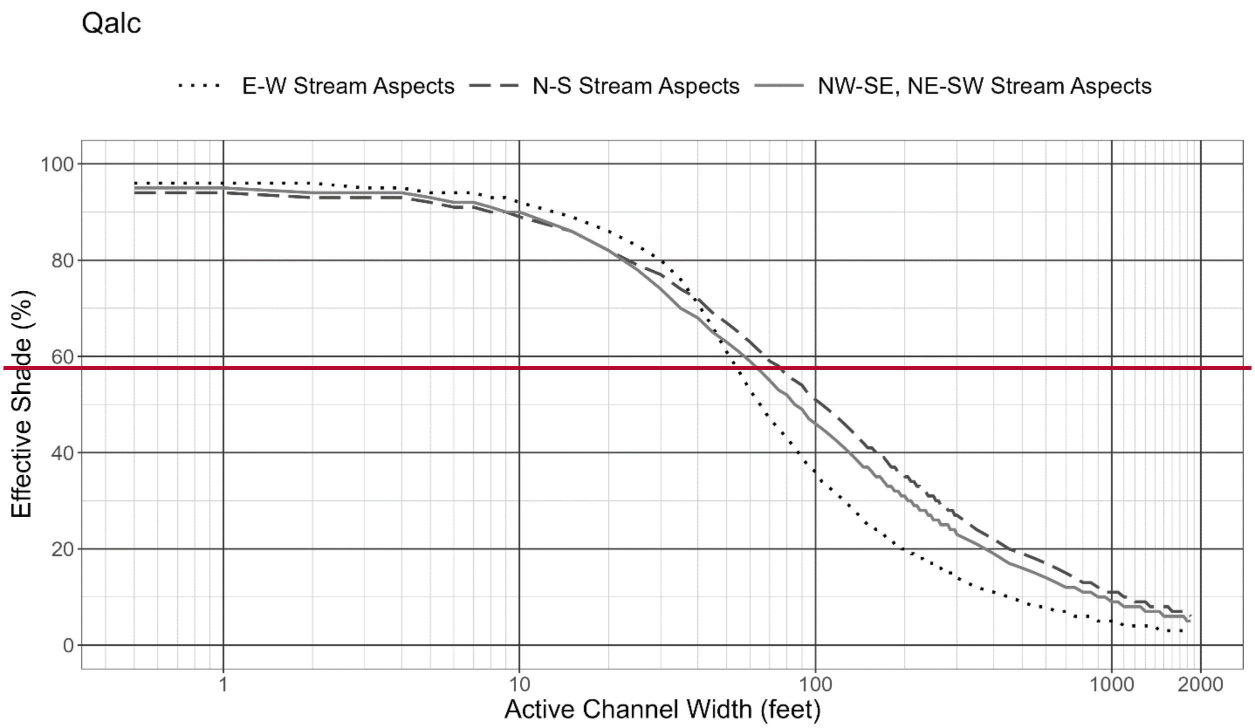
Figure 9-9: Example illustrating use of the shade curve for the Qalc mapping unit based on a north to south aspect and an active channel width of 25 ft.



~~**Figure 9-8: Effective shade targets for stream sites in the Qff1 mapping unit.**~~



~~**Figure 9-9: Effective shade targets for stream sites in the Qfc mapping unit.**~~



Qff1

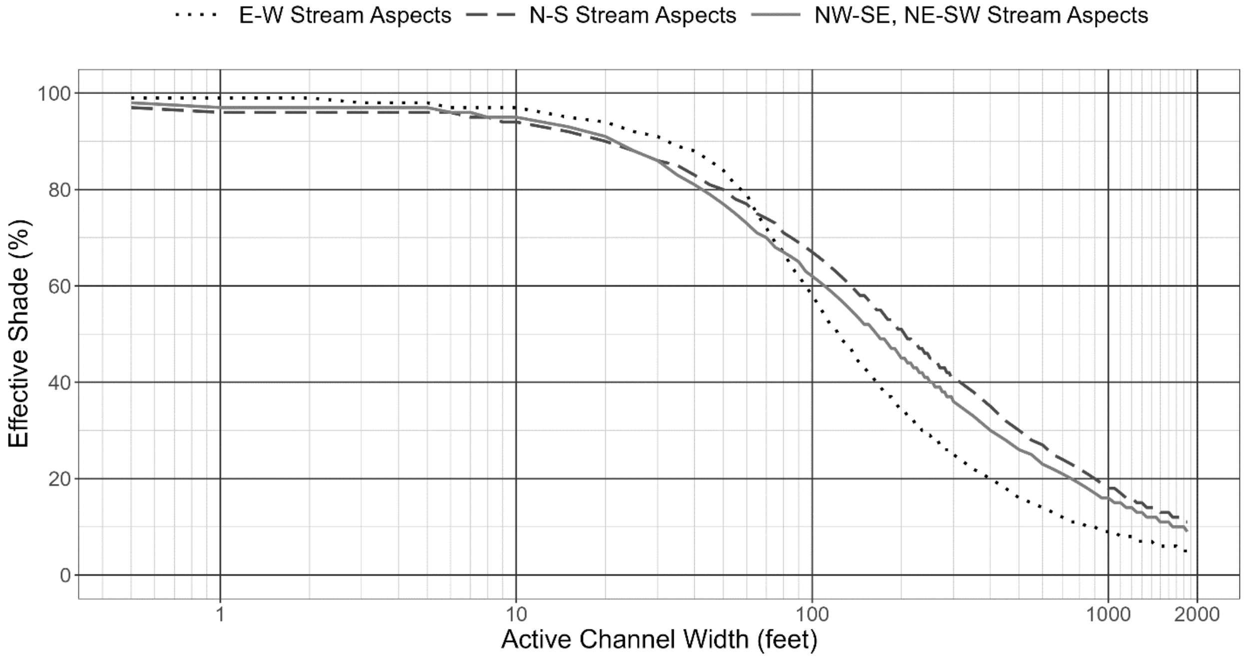
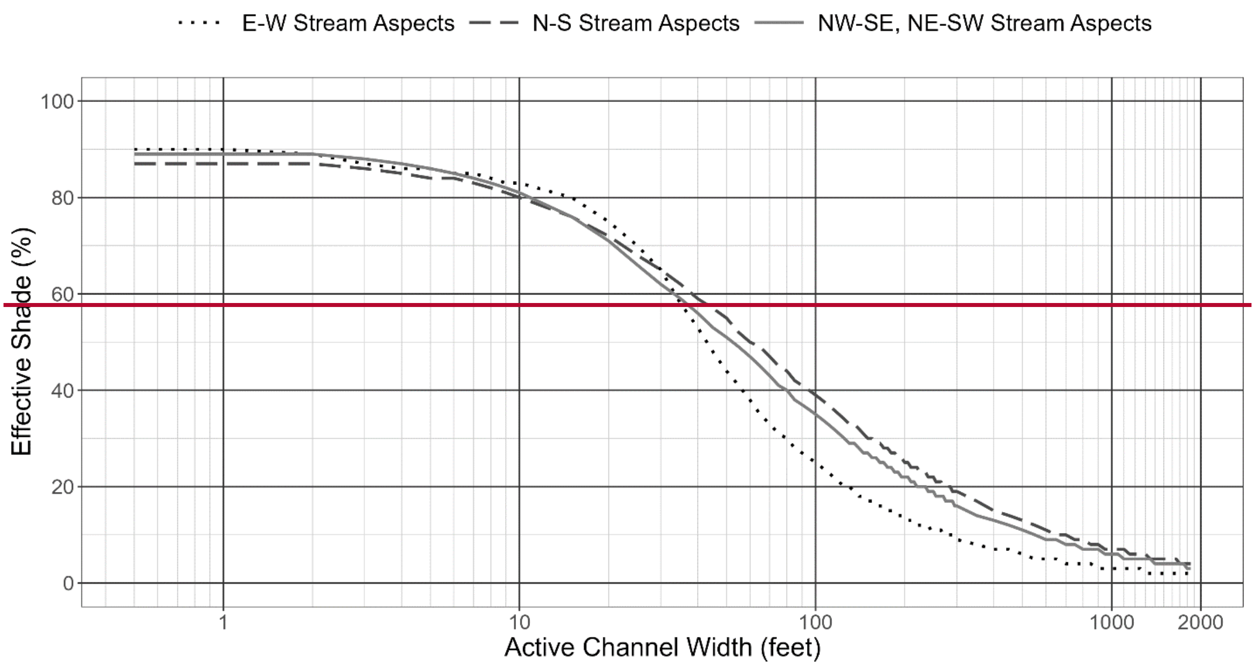


Figure 9-10: Effective shade targets for stream sites in the ~~Qalc~~Qff1 mapping unit.

Qg1



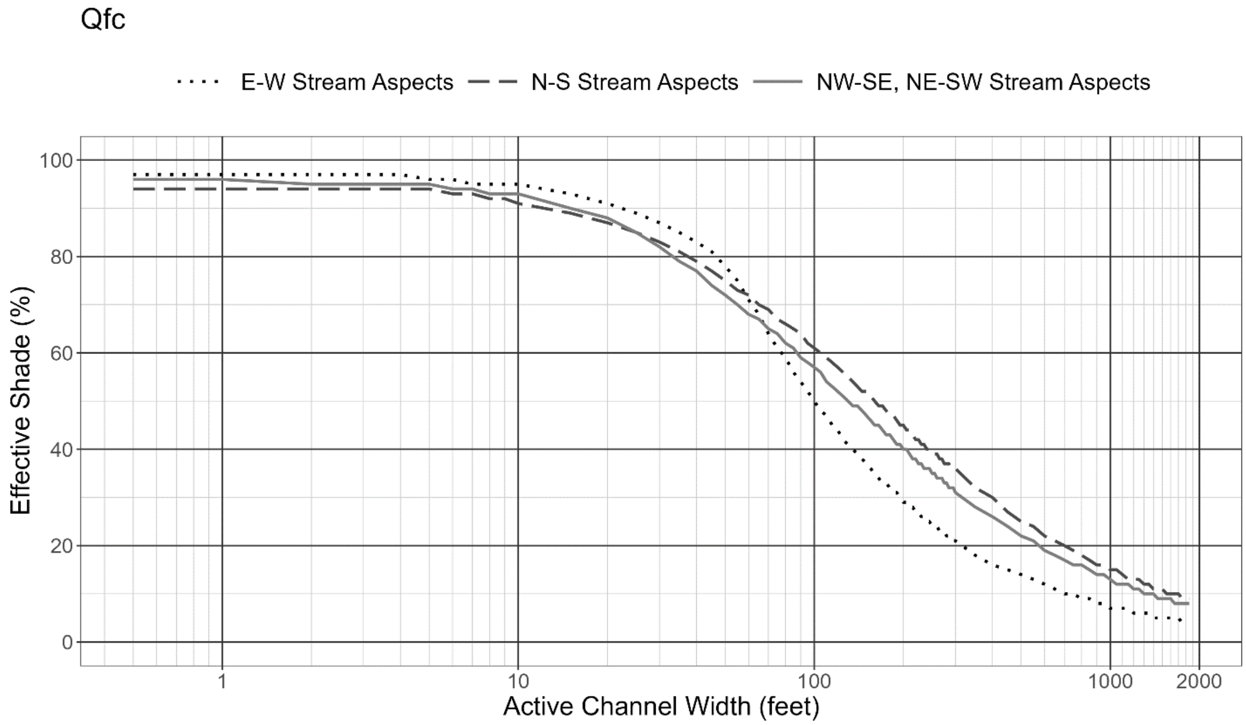
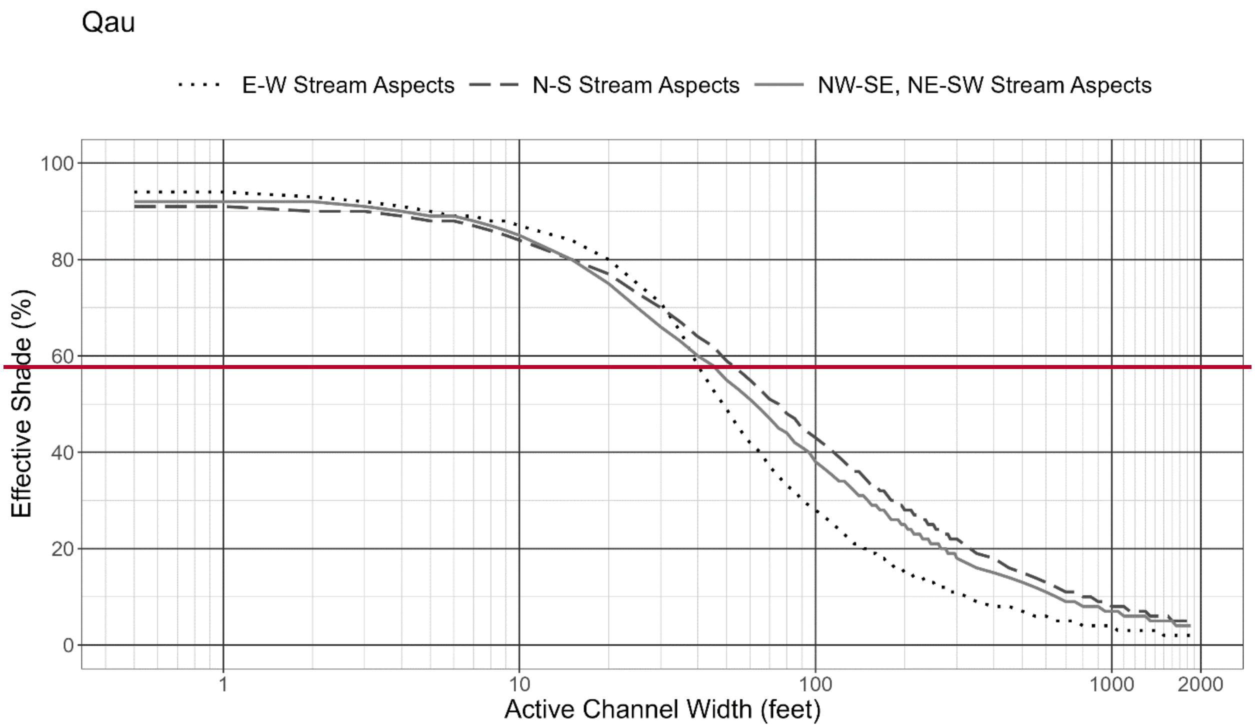


Figure 9-11: Effective shade targets for stream sites in the ~~Qg1~~Qfc mapping unit.



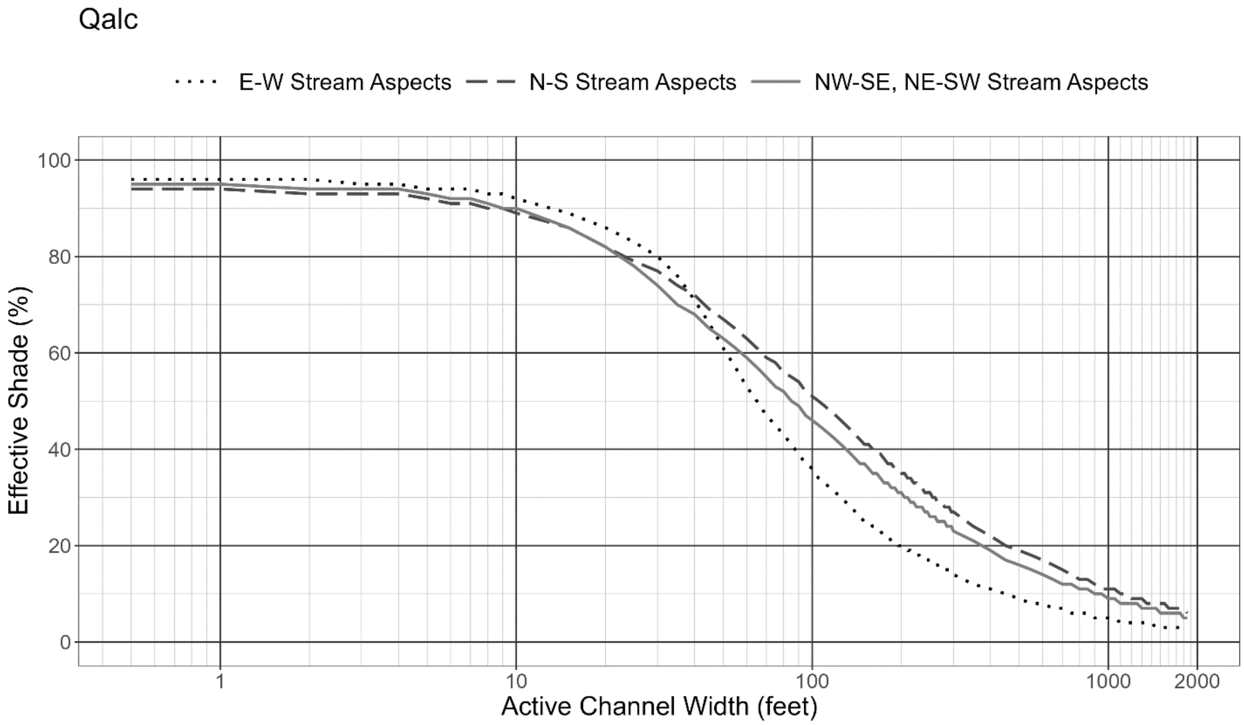
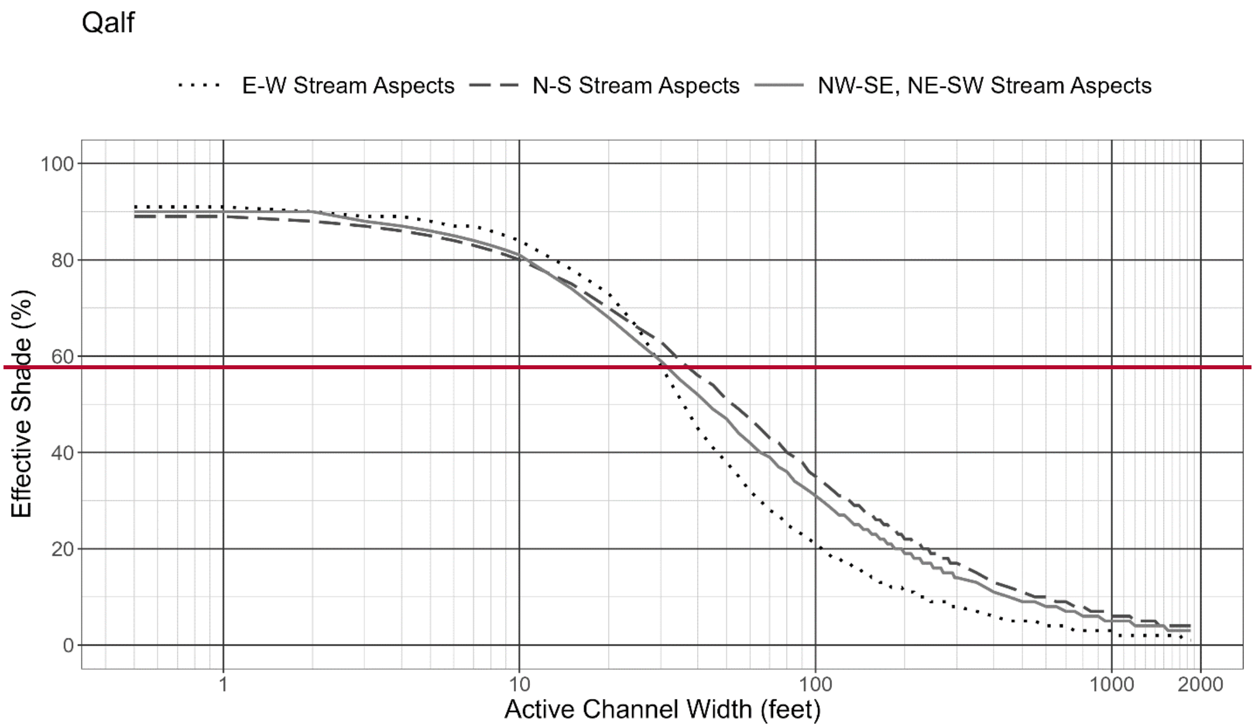


Figure 9-12: Effective shade targets for stream sites in the ~~Qau~~Qalc mapping unit.



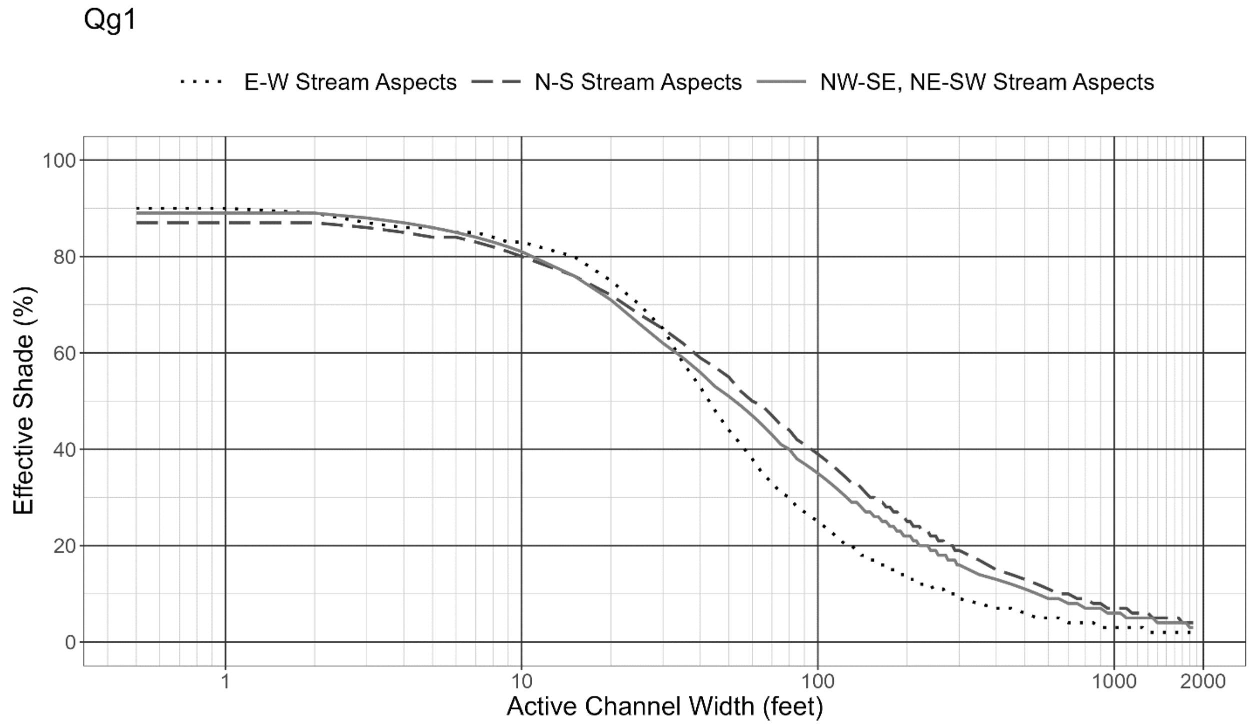
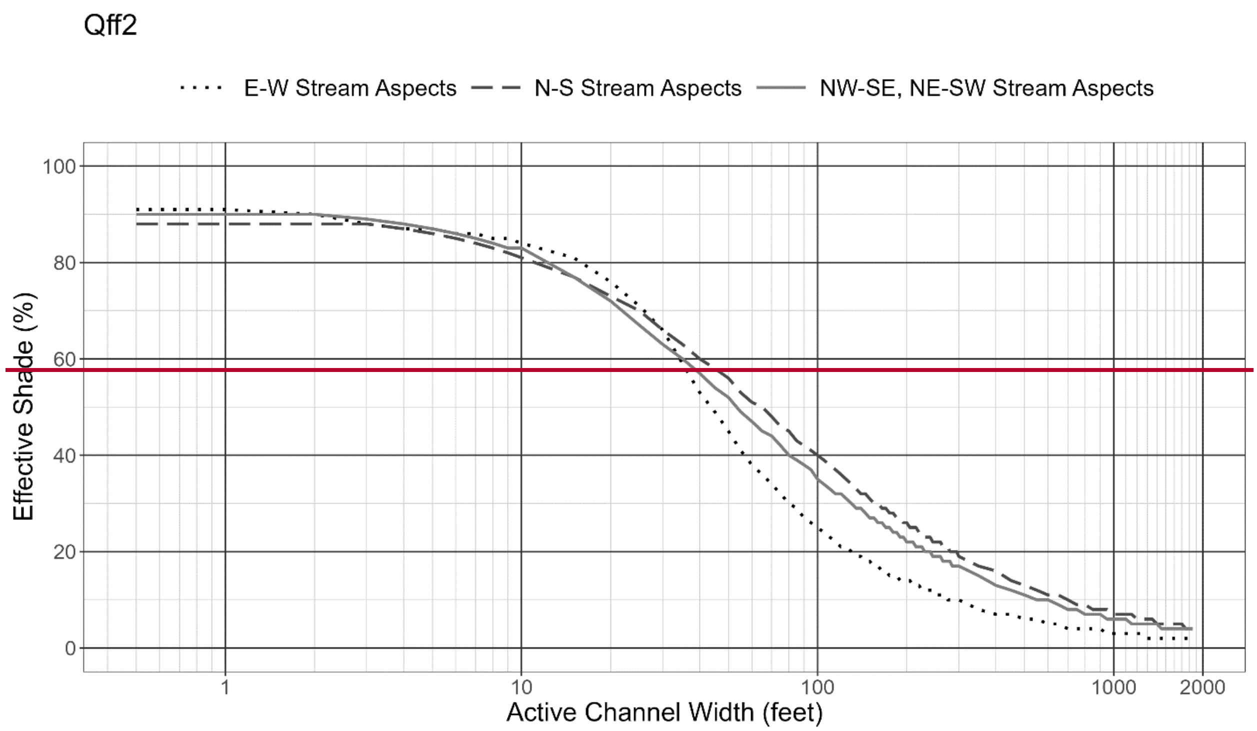


Figure 9-13: Effective shade targets for stream sites in the ~~Qalf~~Qg1 mapping unit.



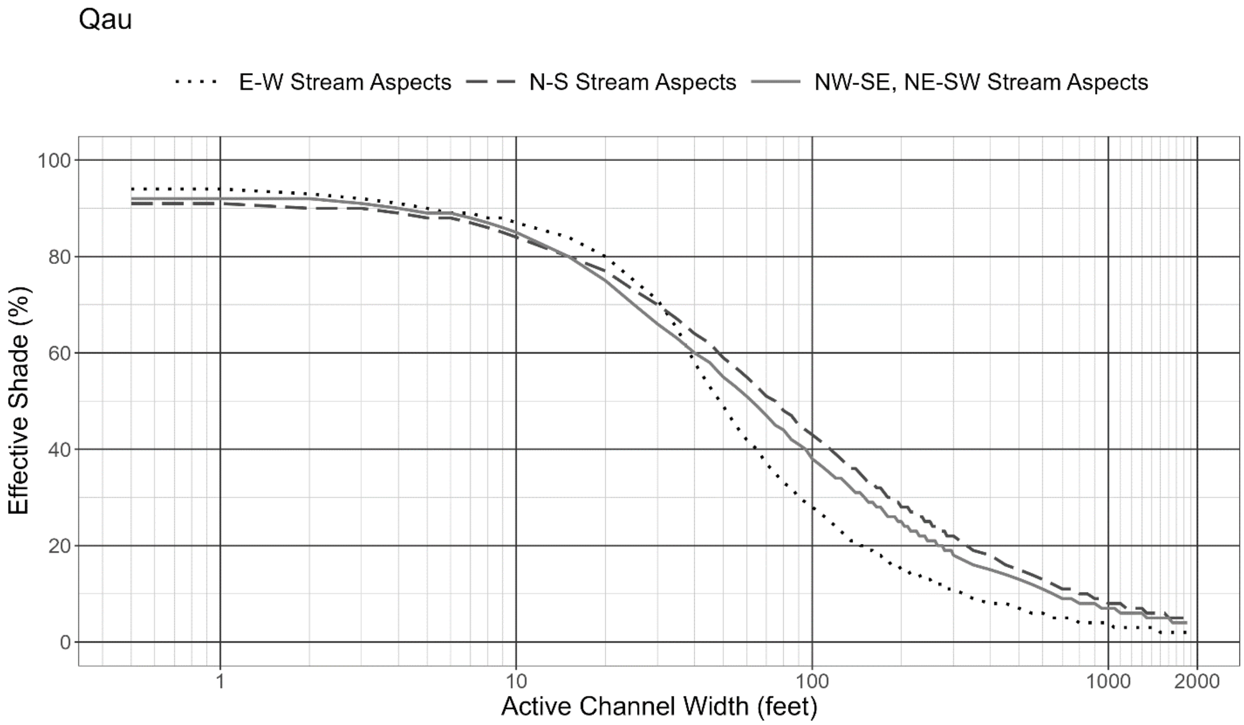
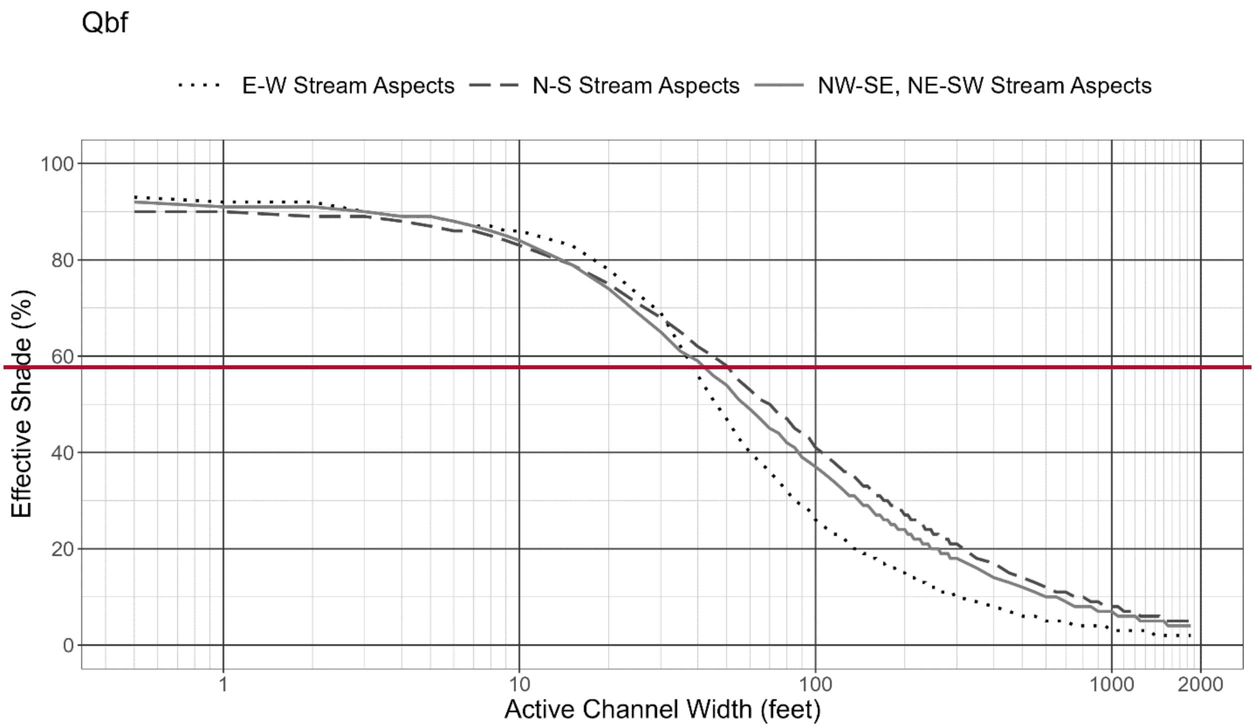


Figure 9-14: Effective shade targets for stream sites in the ~~Qff2~~Qau mapping unit.



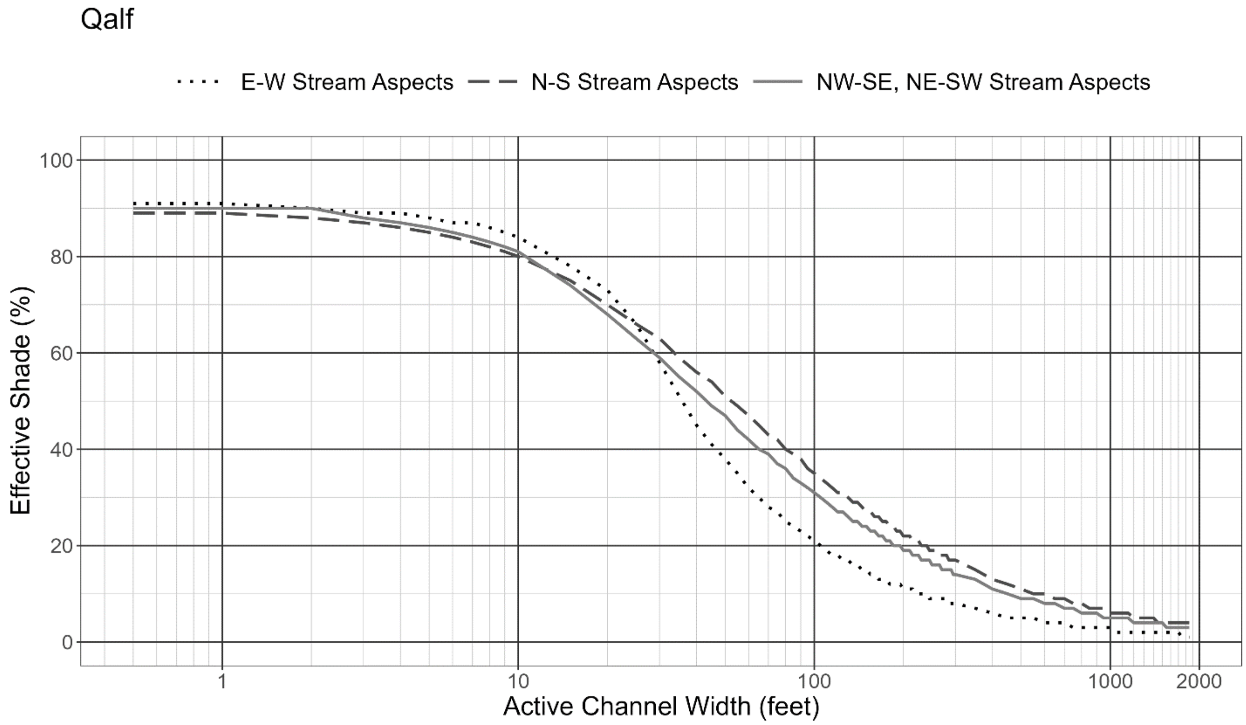
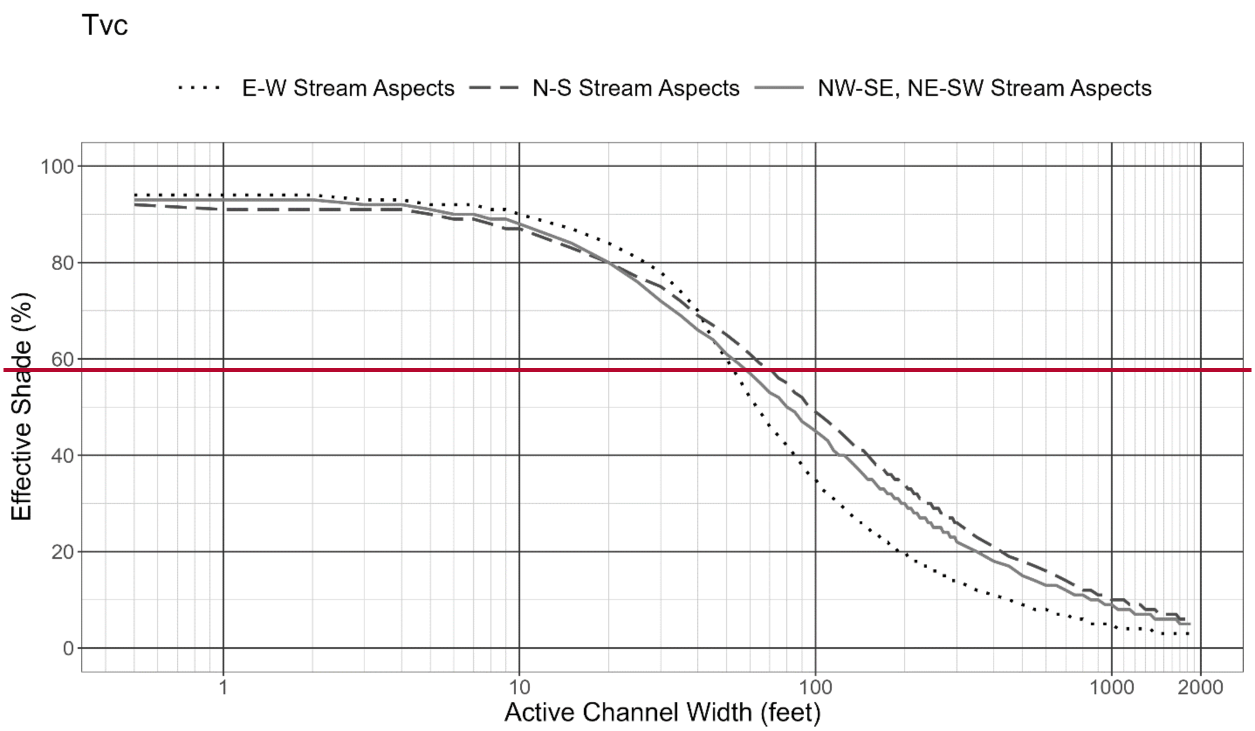


Figure 9-15: Effective shade targets for stream sites in the ~~Qbf~~Qalf mapping unit.



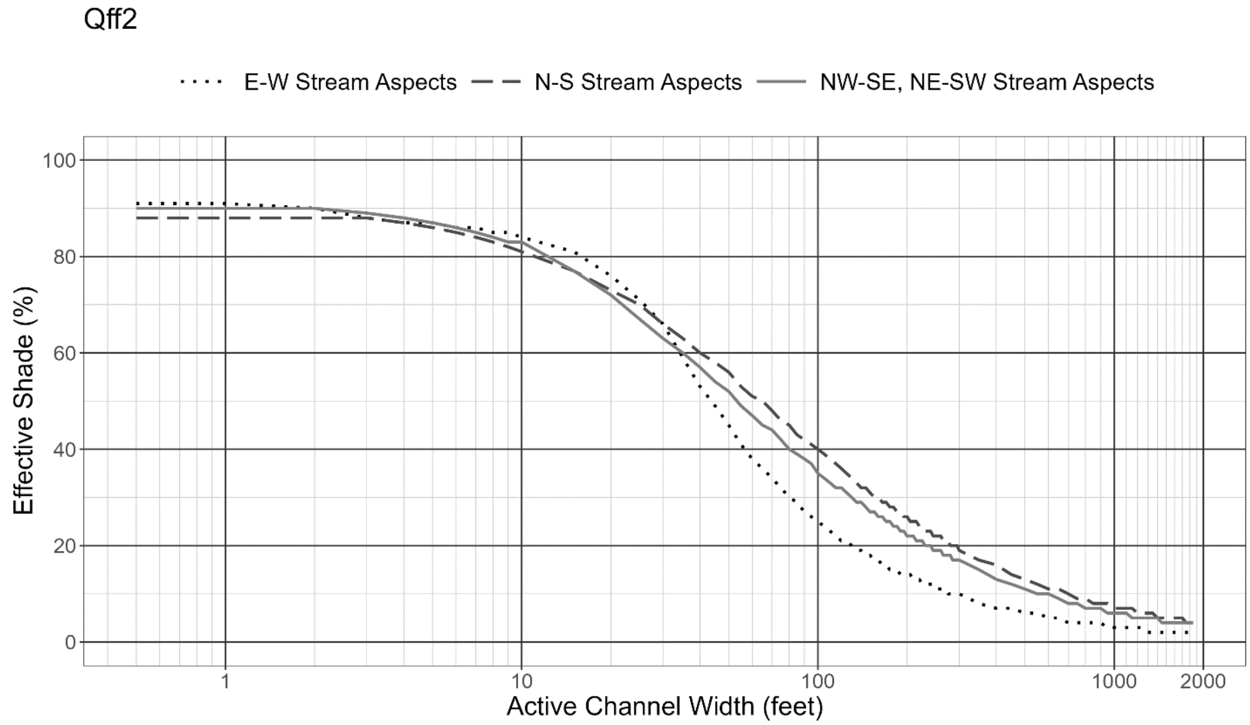
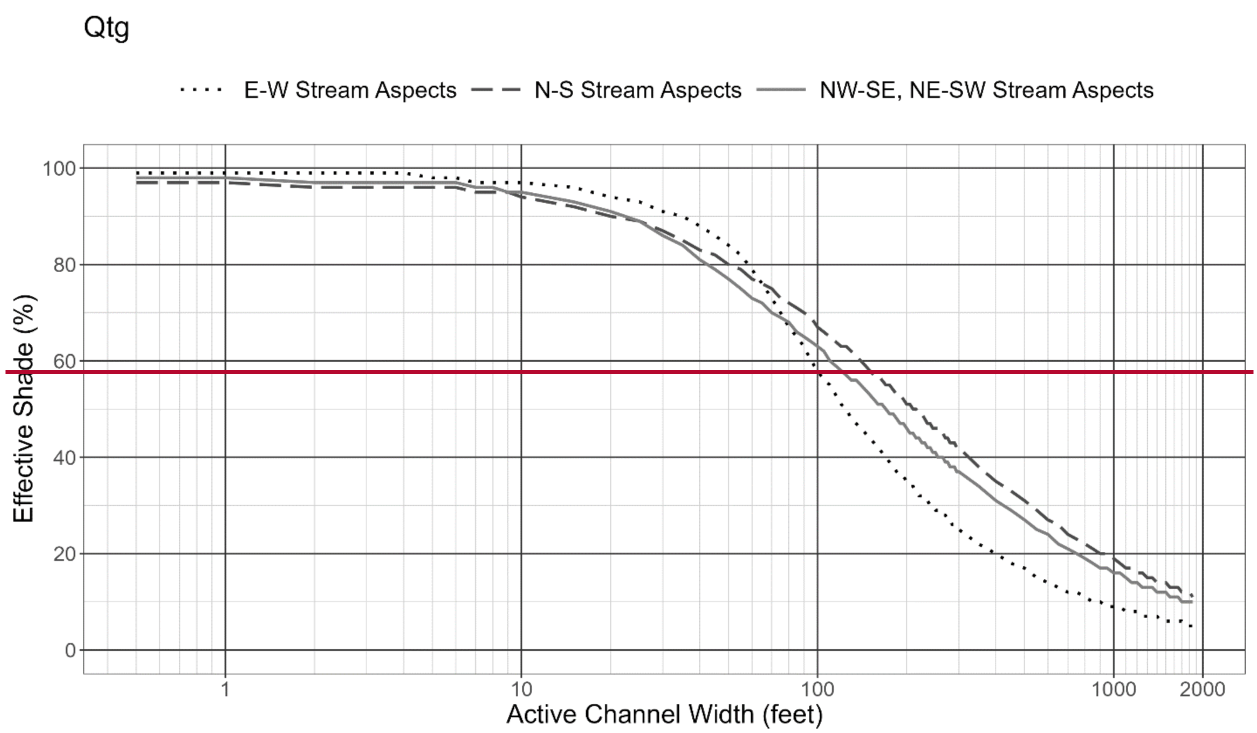


Figure 9-16: Effective shade targets for stream sites in the ~~Tvc~~Qff2 mapping unit.



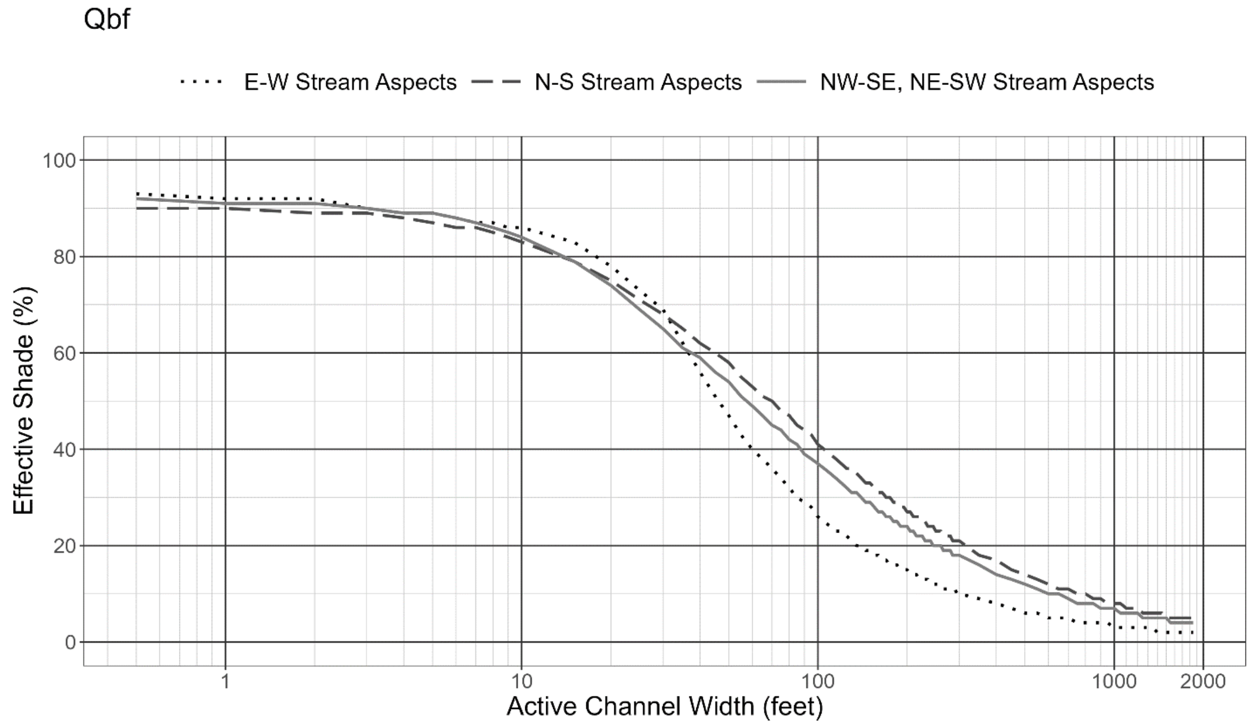
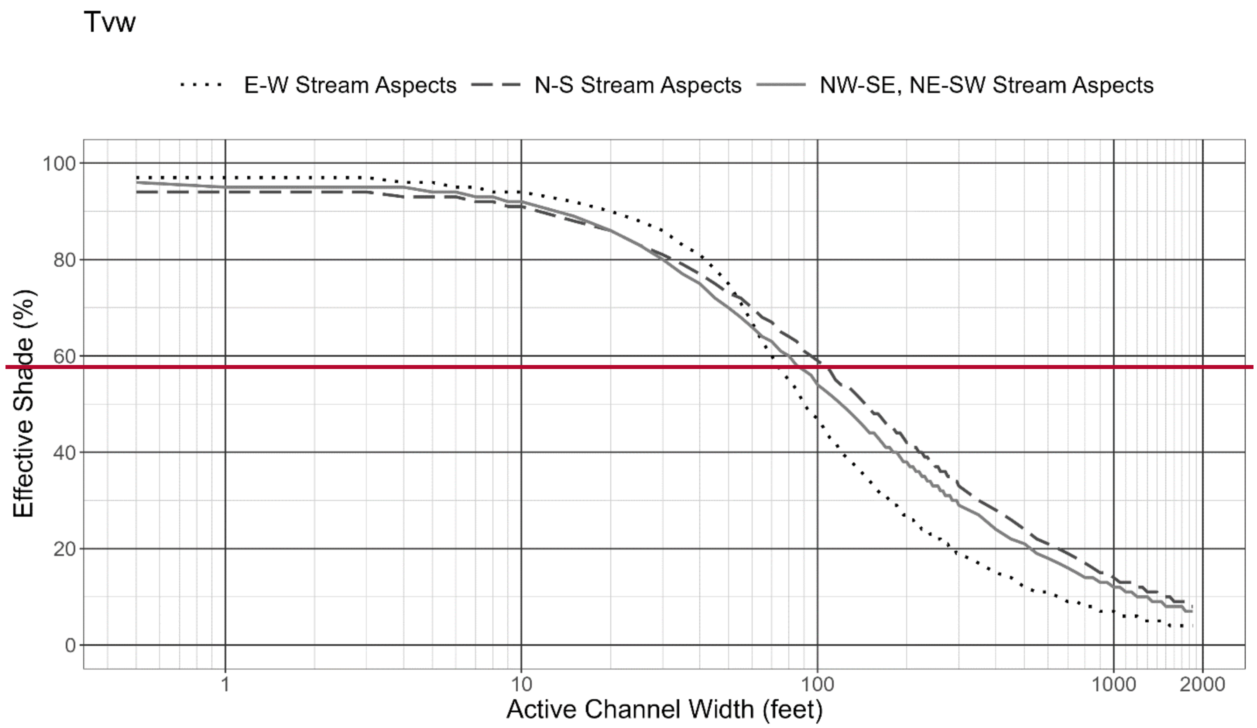


Figure 9-17: Effective shade targets for stream sites in the ~~Qtg~~Qbf mapping unit.



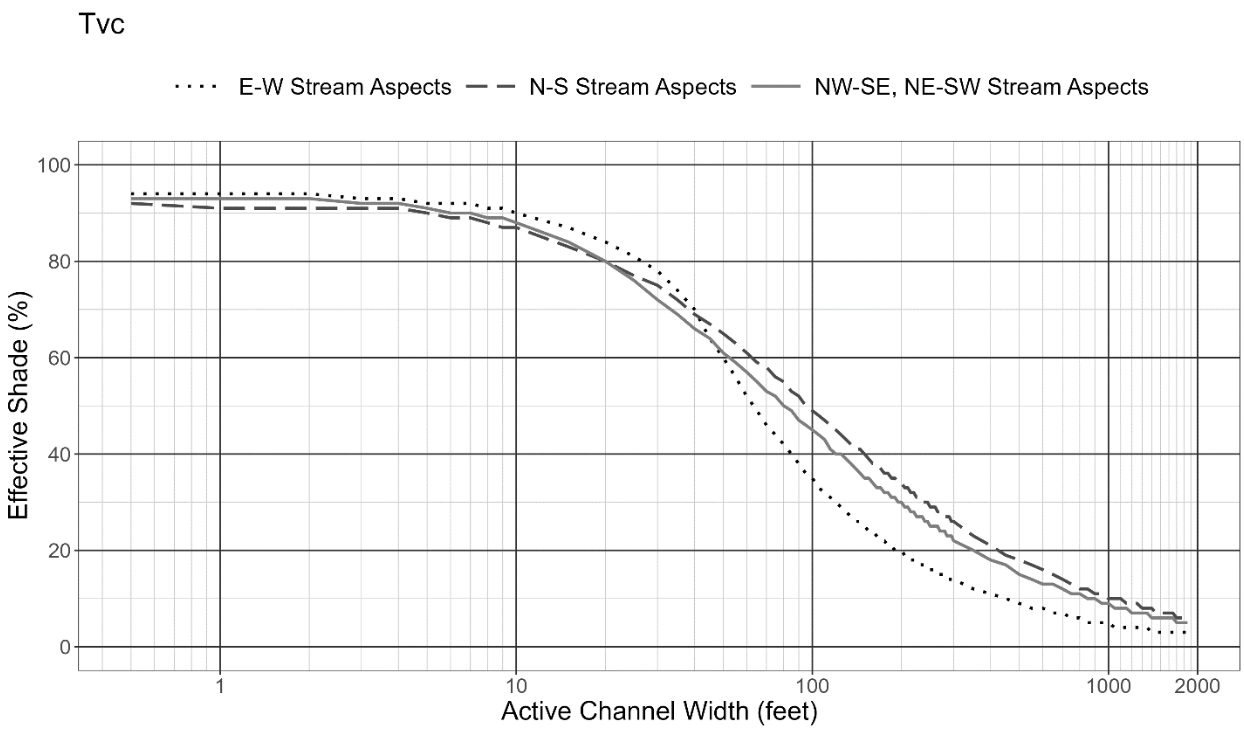
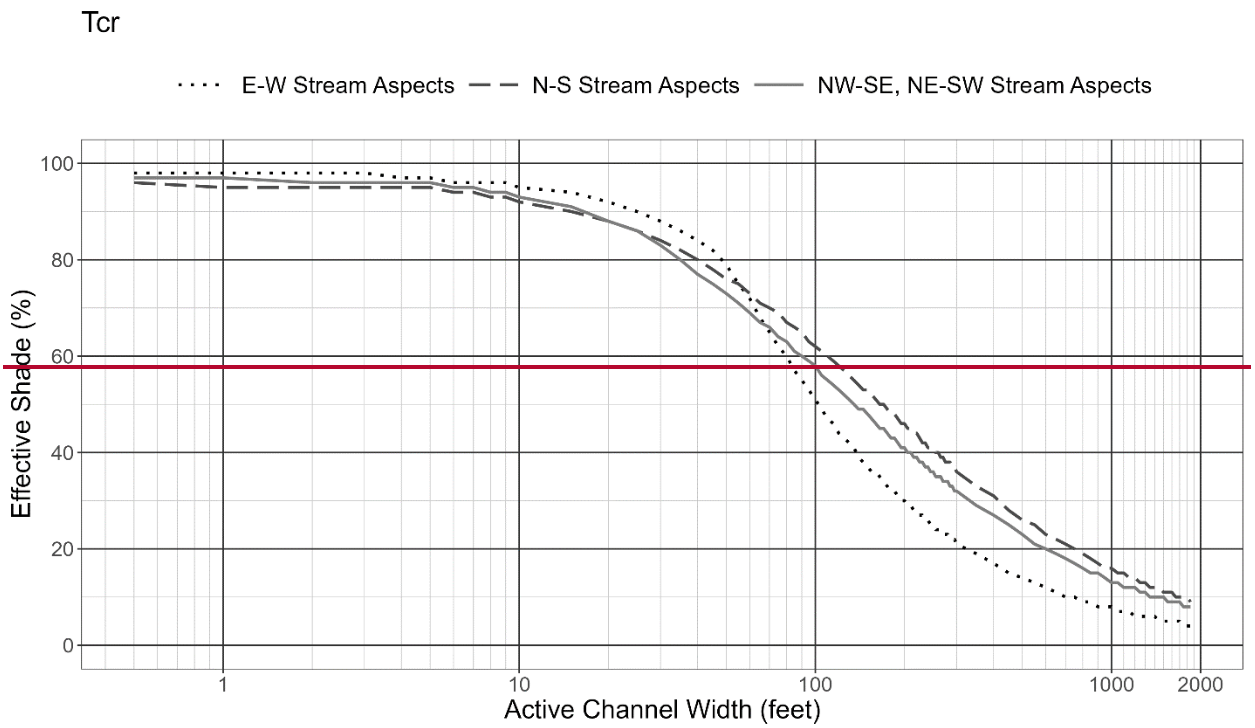


Figure 9-18: Effective shade targets for stream sites in the ~~Tvw~~Tvc mapping unit.



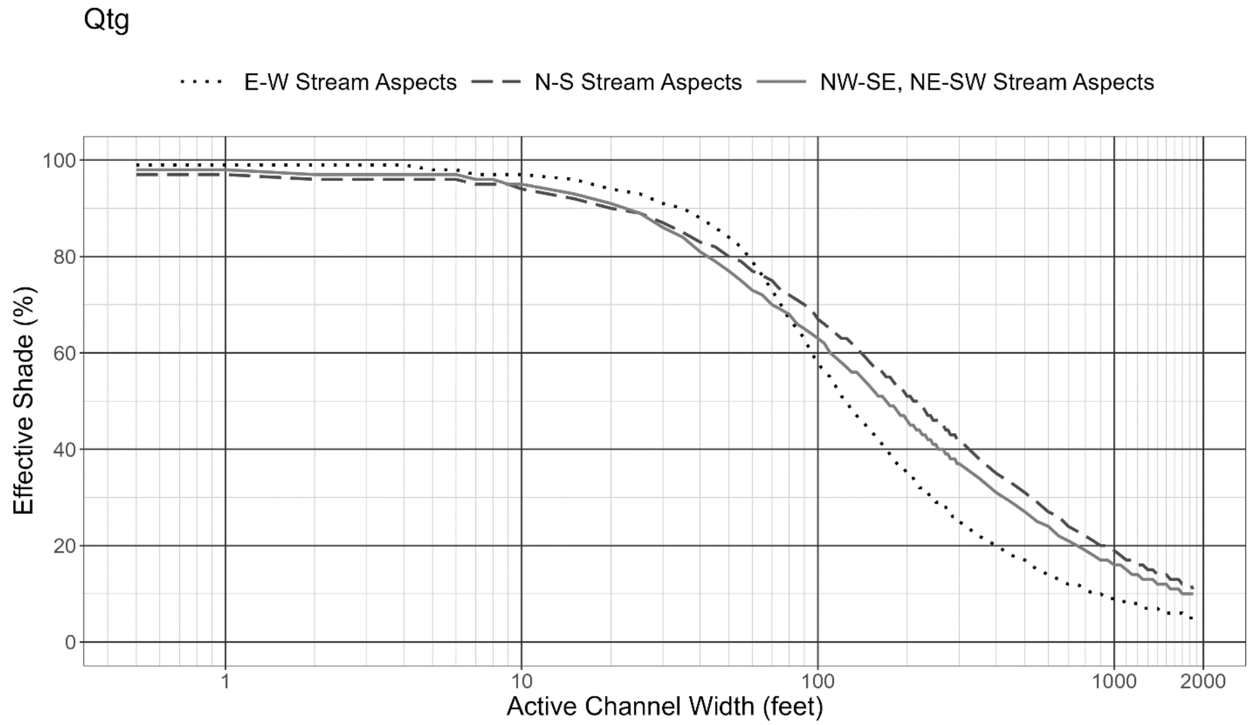
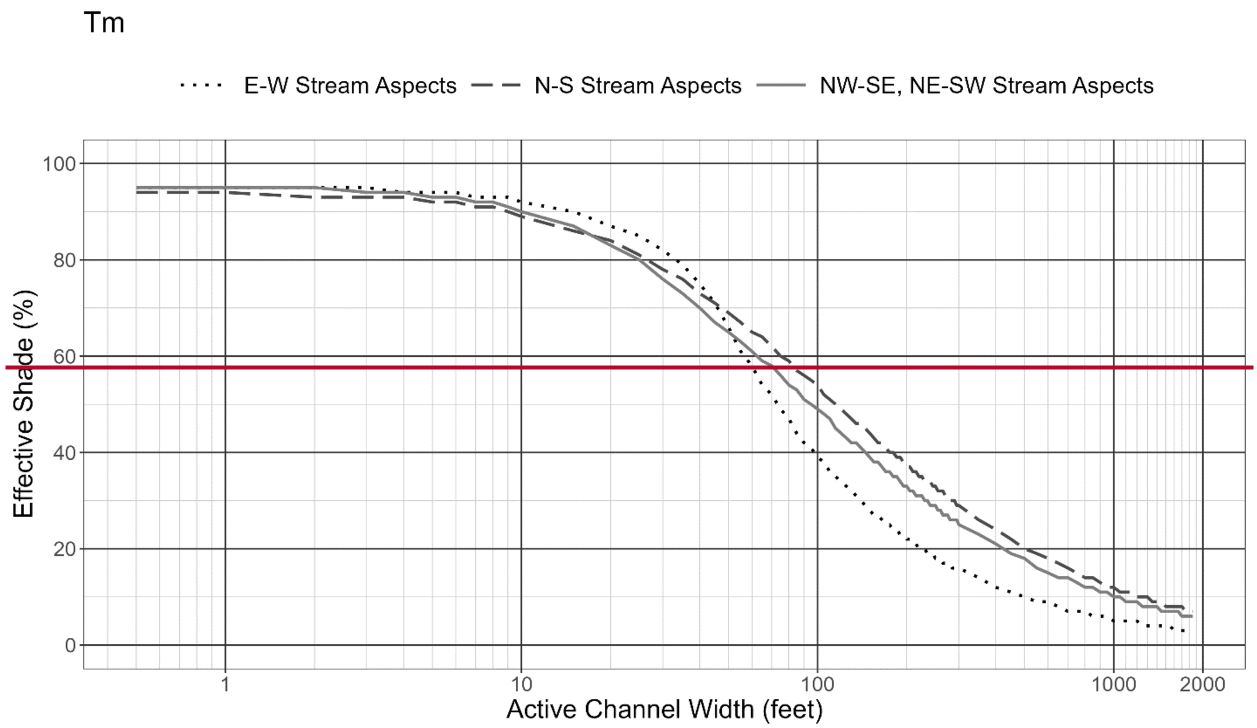


Figure 9-19: Effective shade targets for stream sites in the ~~Tcr~~Qtg mapping unit.



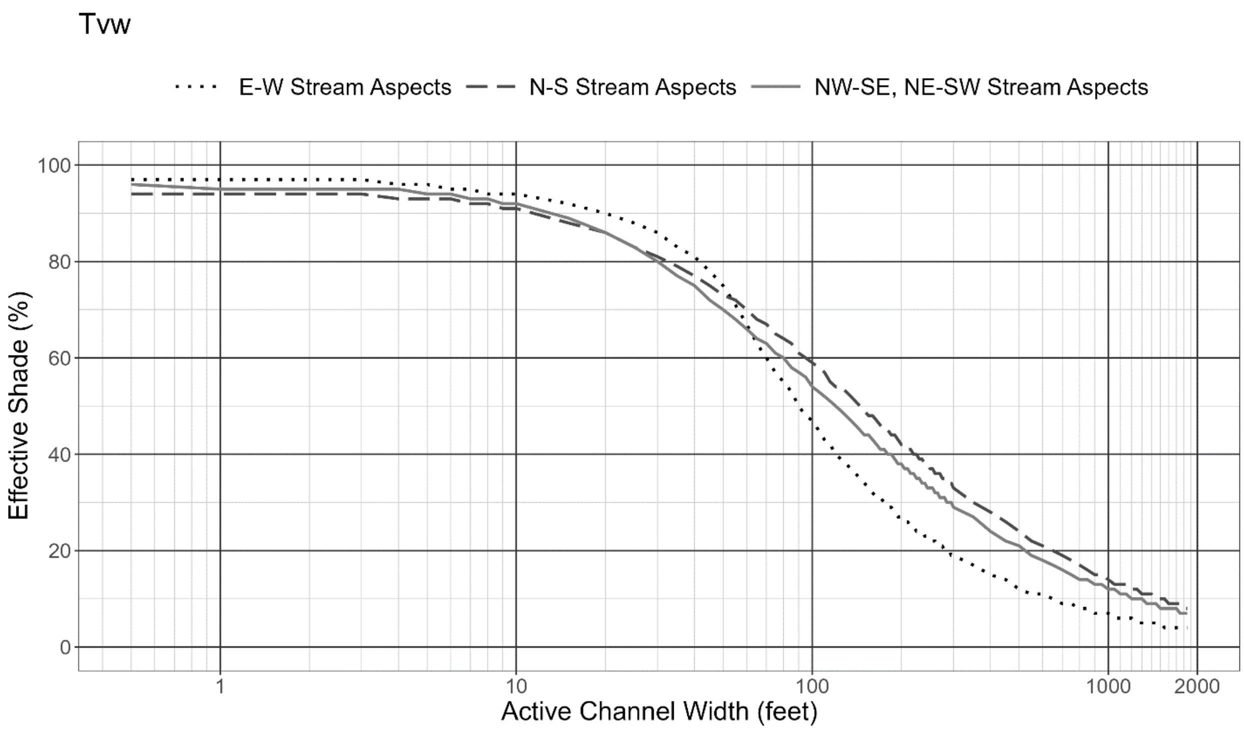
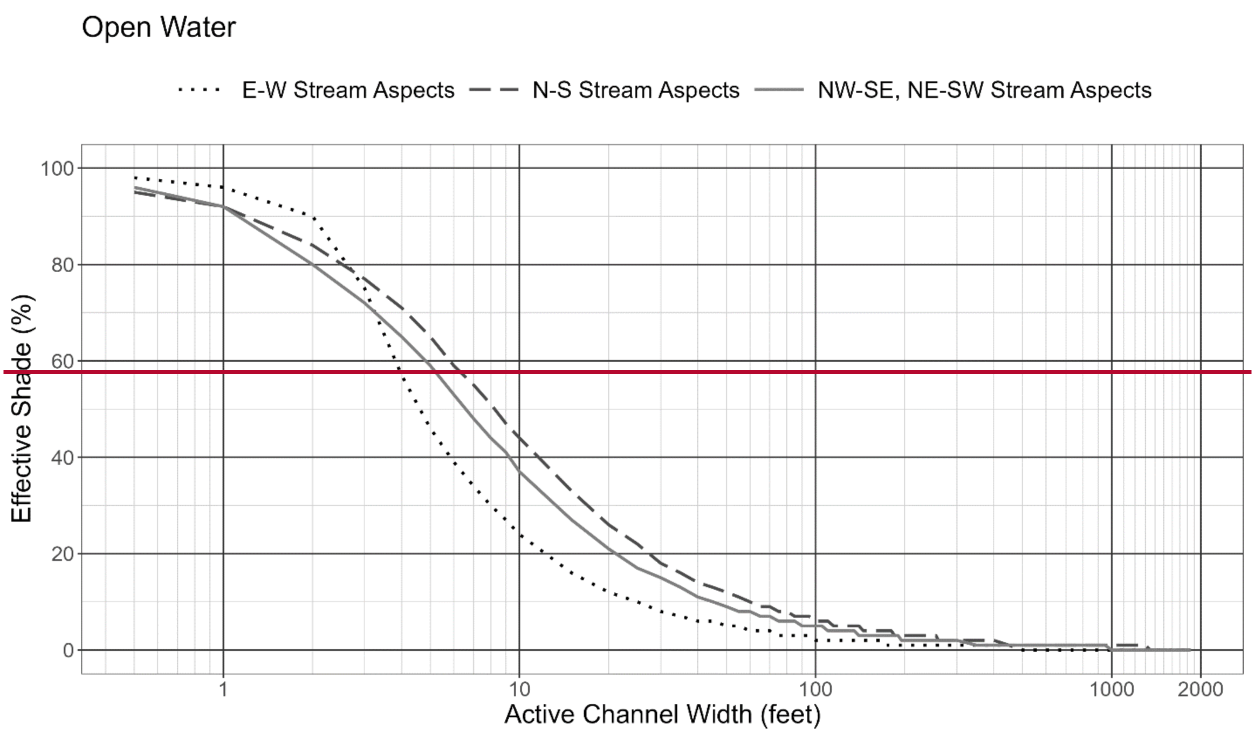


Figure 9-20: Effective shade targets for stream sites in the ~~Tm~~Tvw mapping unit.



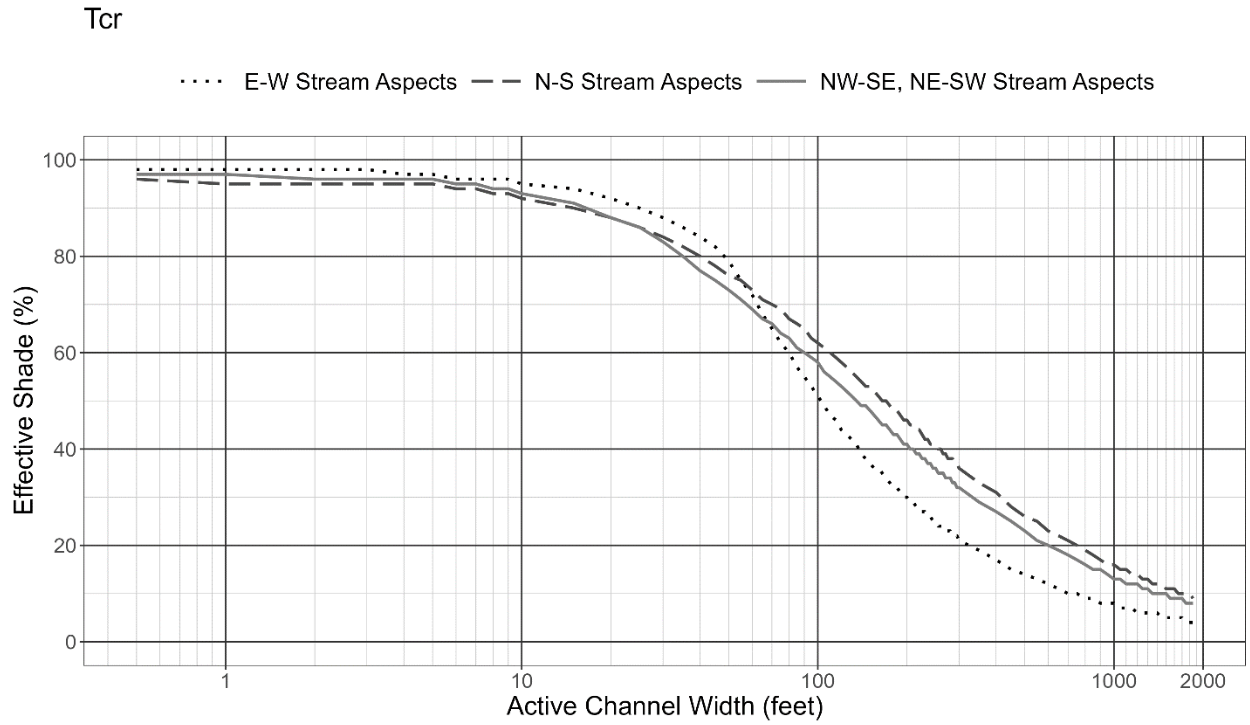
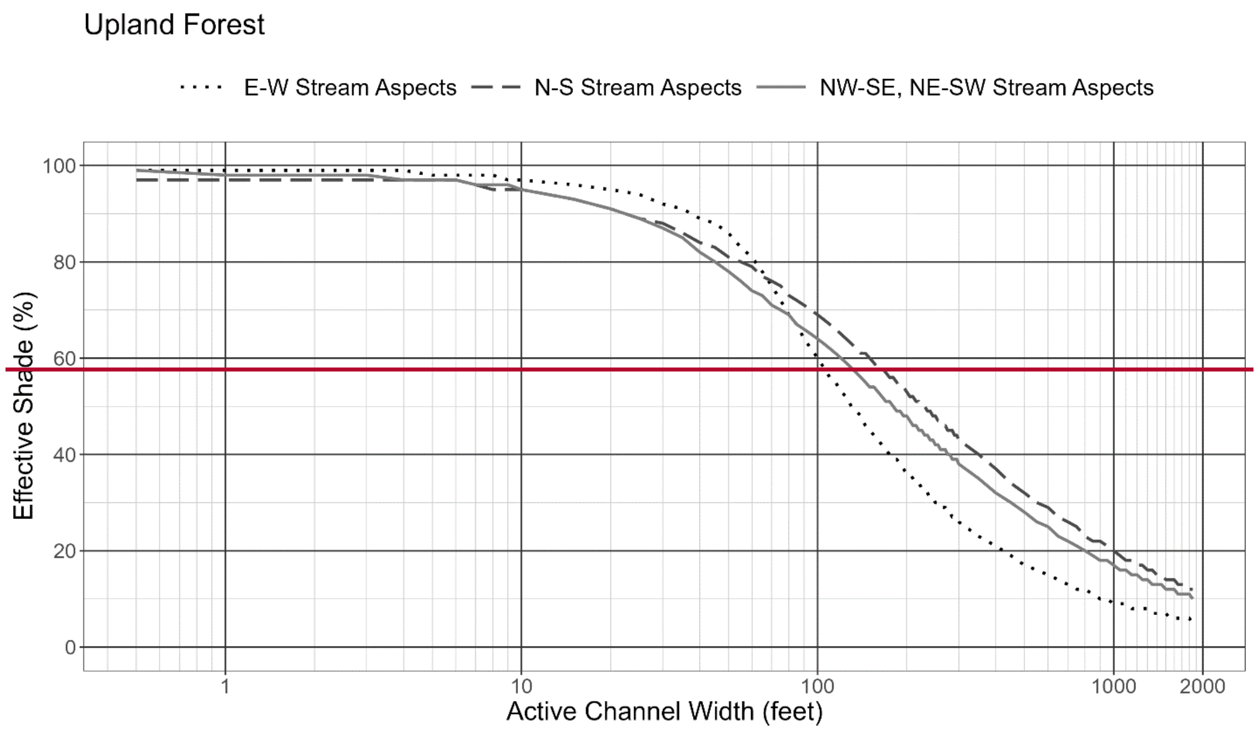


Figure 9-21: Effective shade targets for stream sites in the ~~Open Water (OW)~~Tcr mapping unit.



Tm

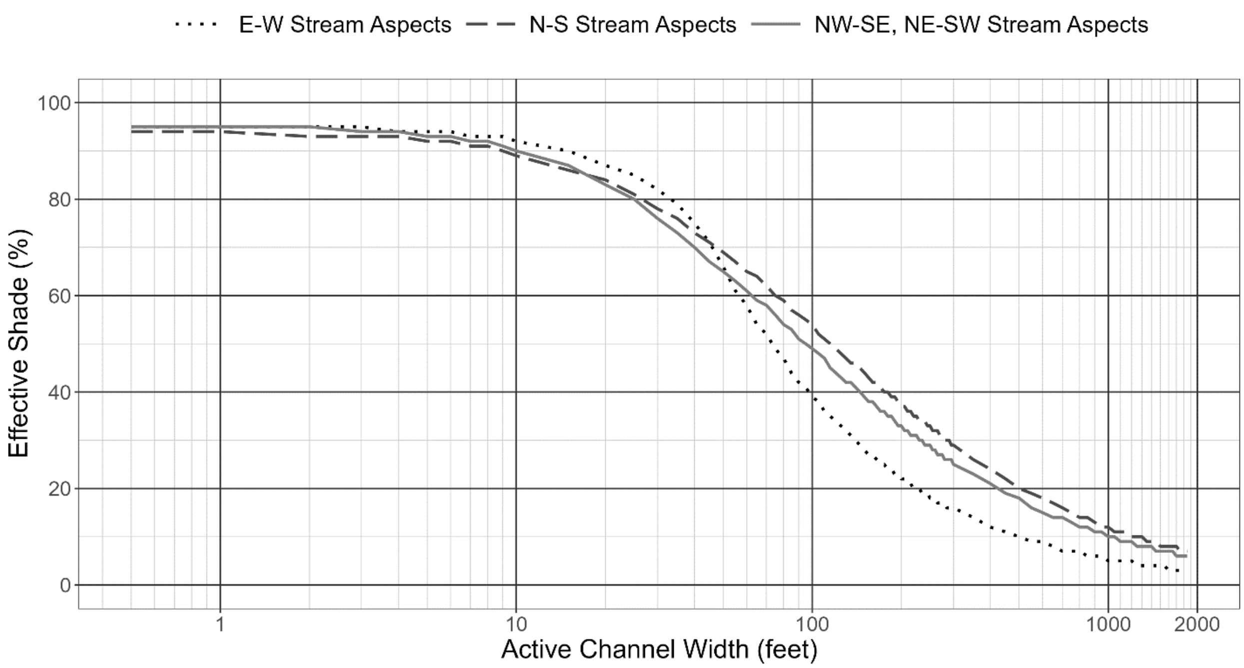
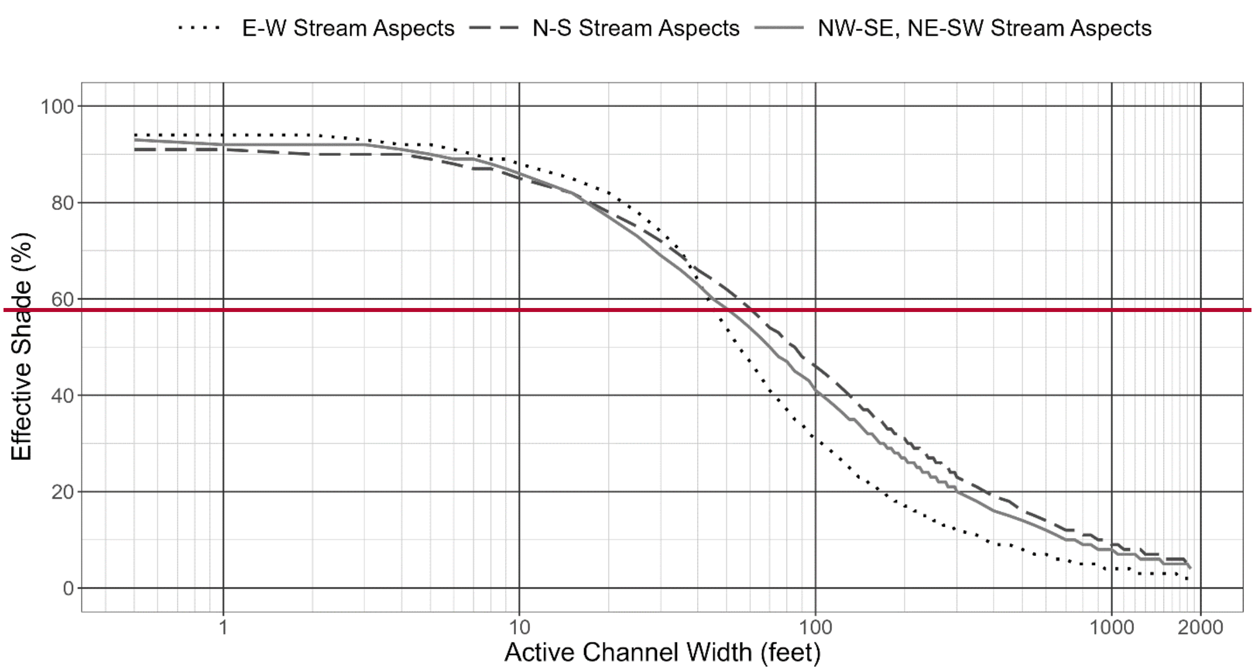


Figure 9-22: Effective shade targets for stream sites in the ~~Upland Forest~~Tm mapping unit.

QTt



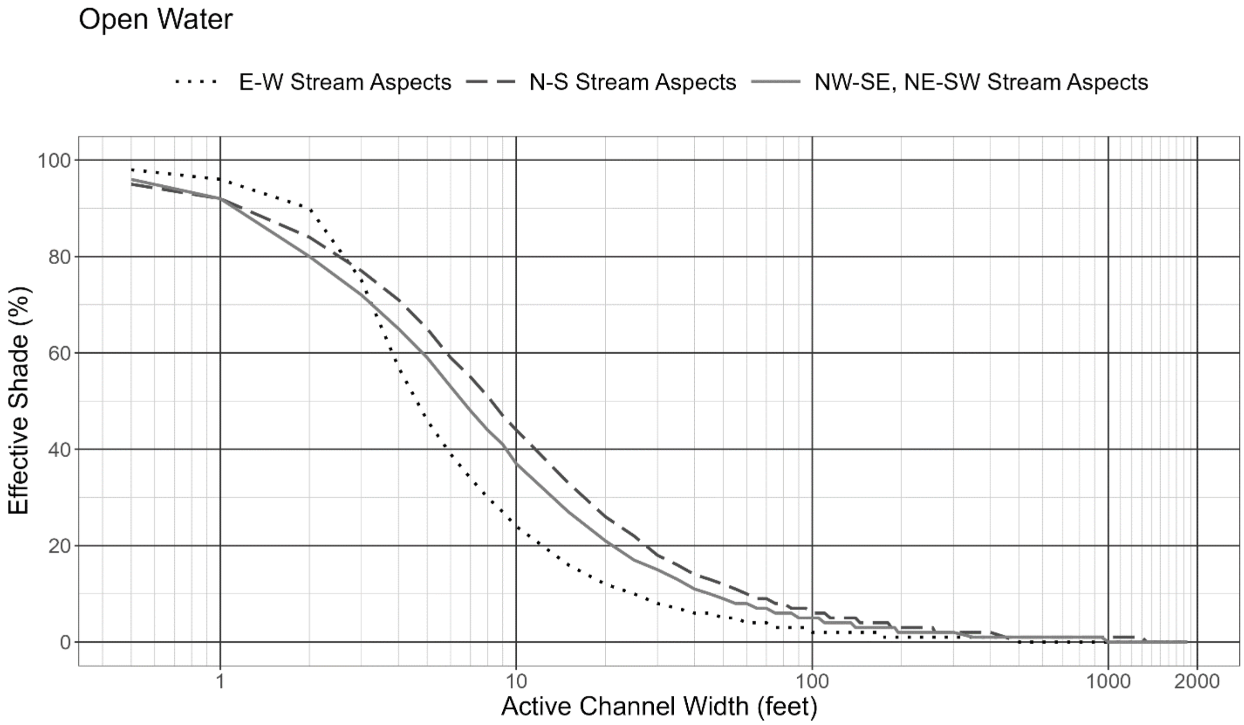
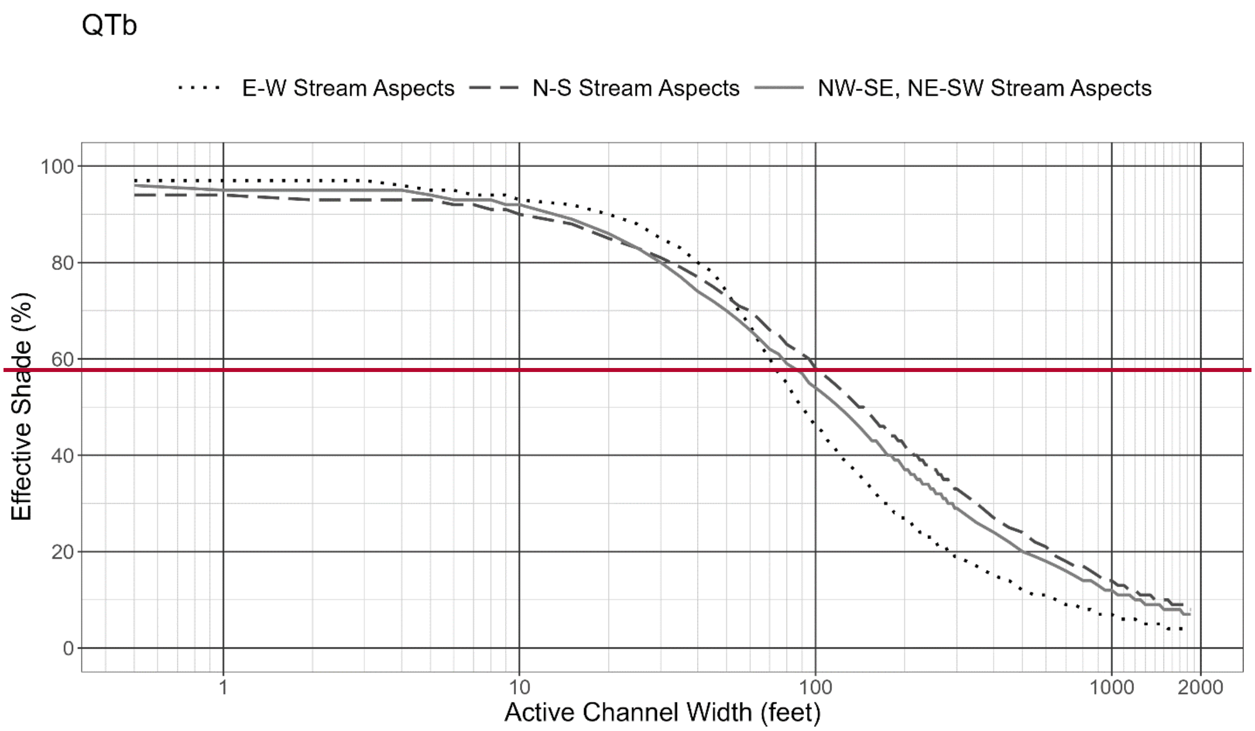


Figure 9-23: Effective shade targets for stream sites in the ~~QTt~~Open Water (OW) mapping unit.



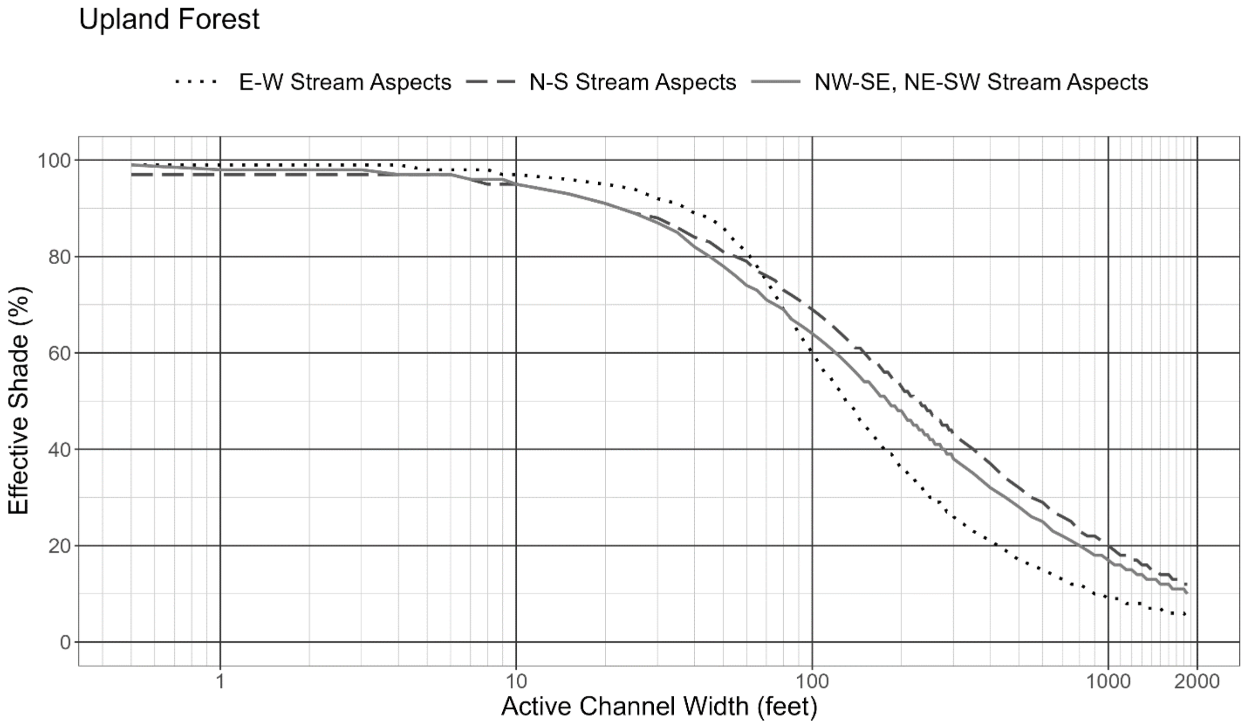
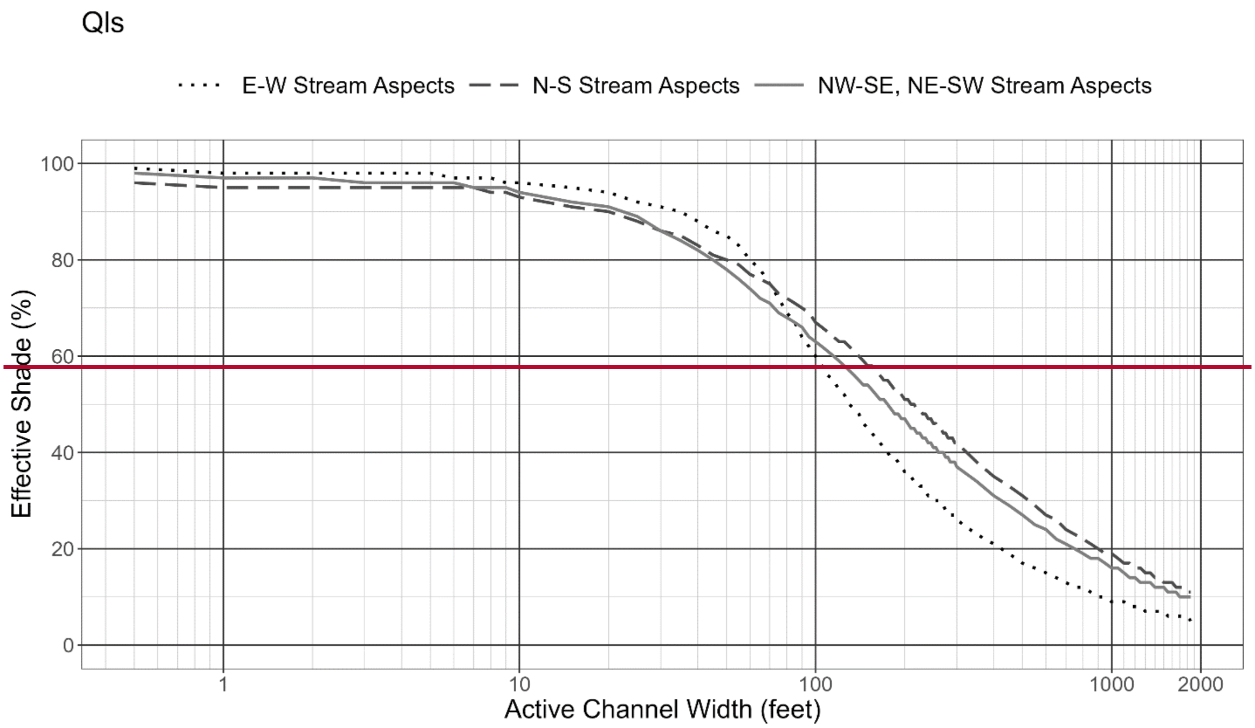


Figure 9-24: Effective shade targets for stream sites in the ~~QTb~~Upland Forest mapping unit.



QTt

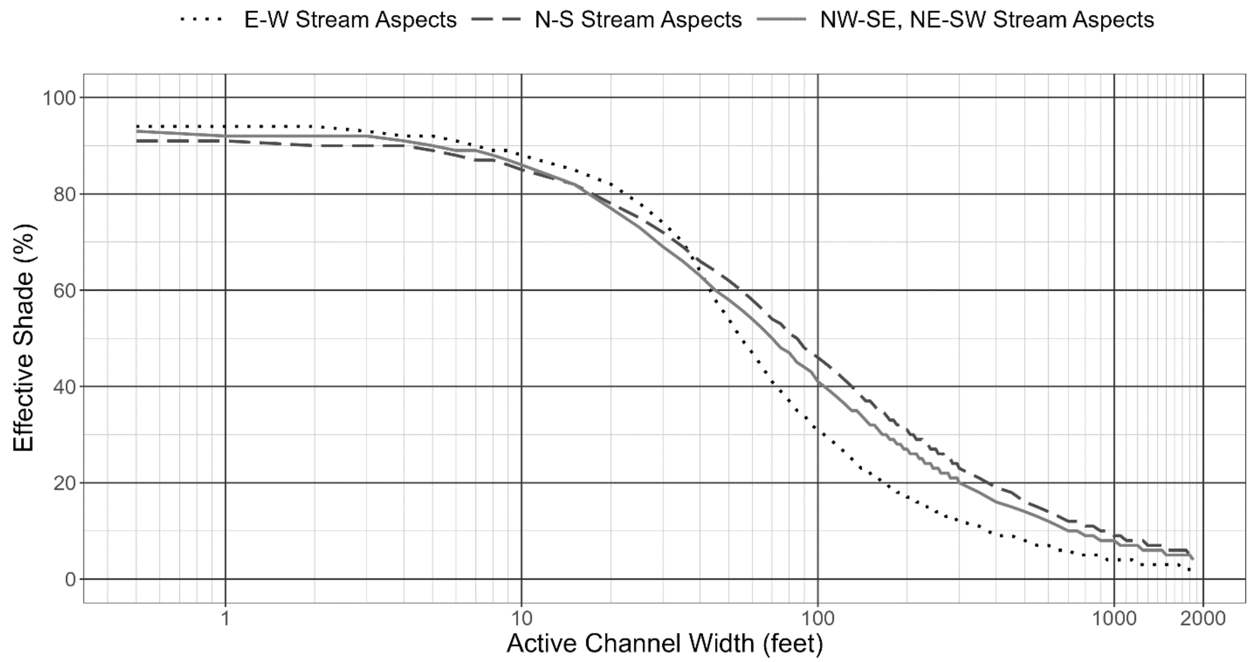
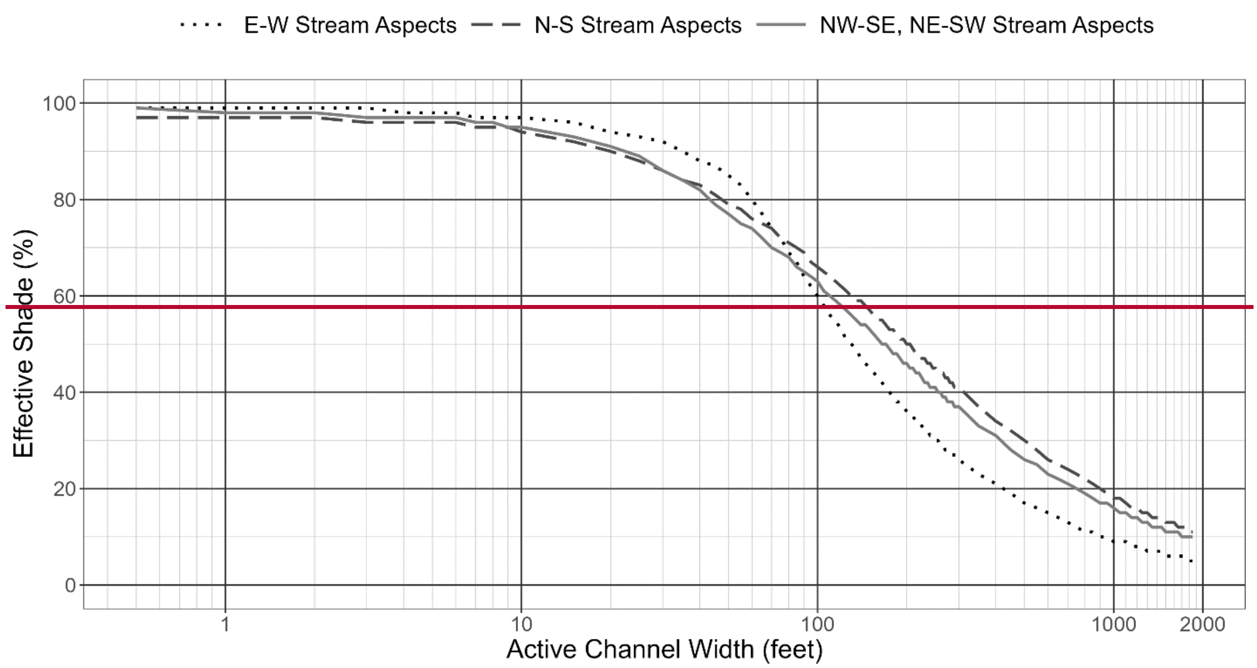


Figure 9-25: Effective shade targets for stream sites in the ~~QIs~~QTt mapping unit.

1d/1f - Volcanics and Willapa Hills



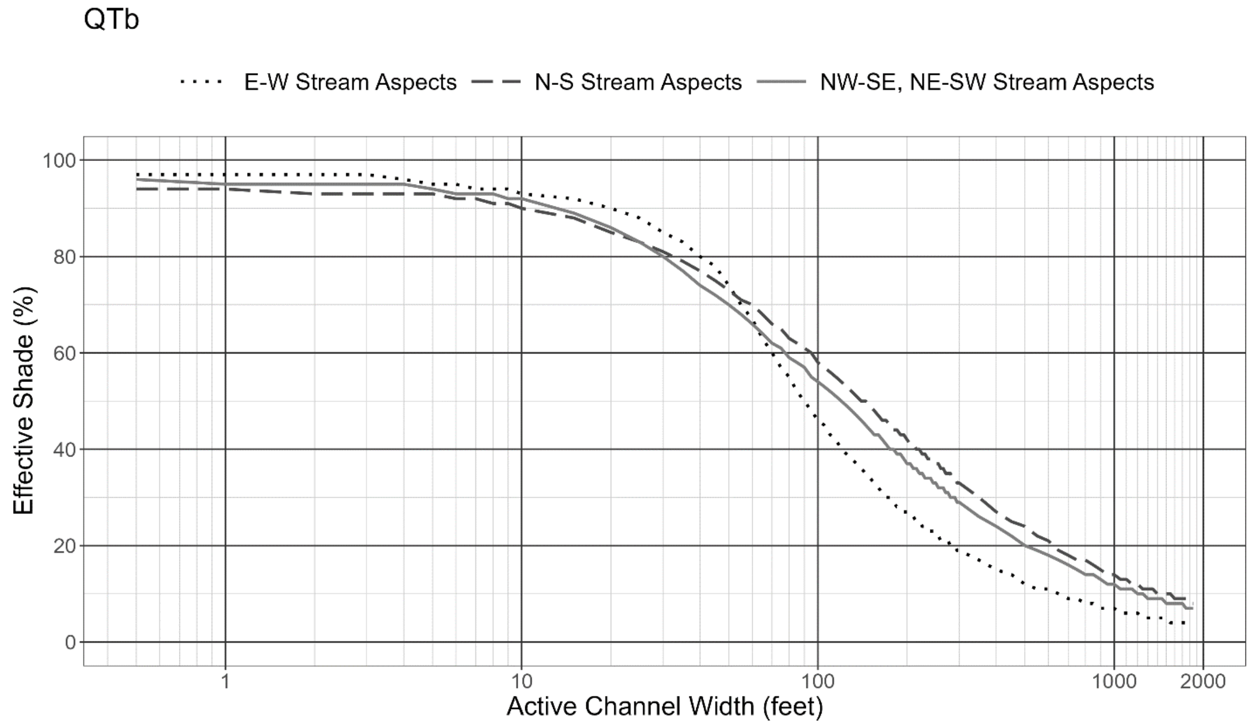
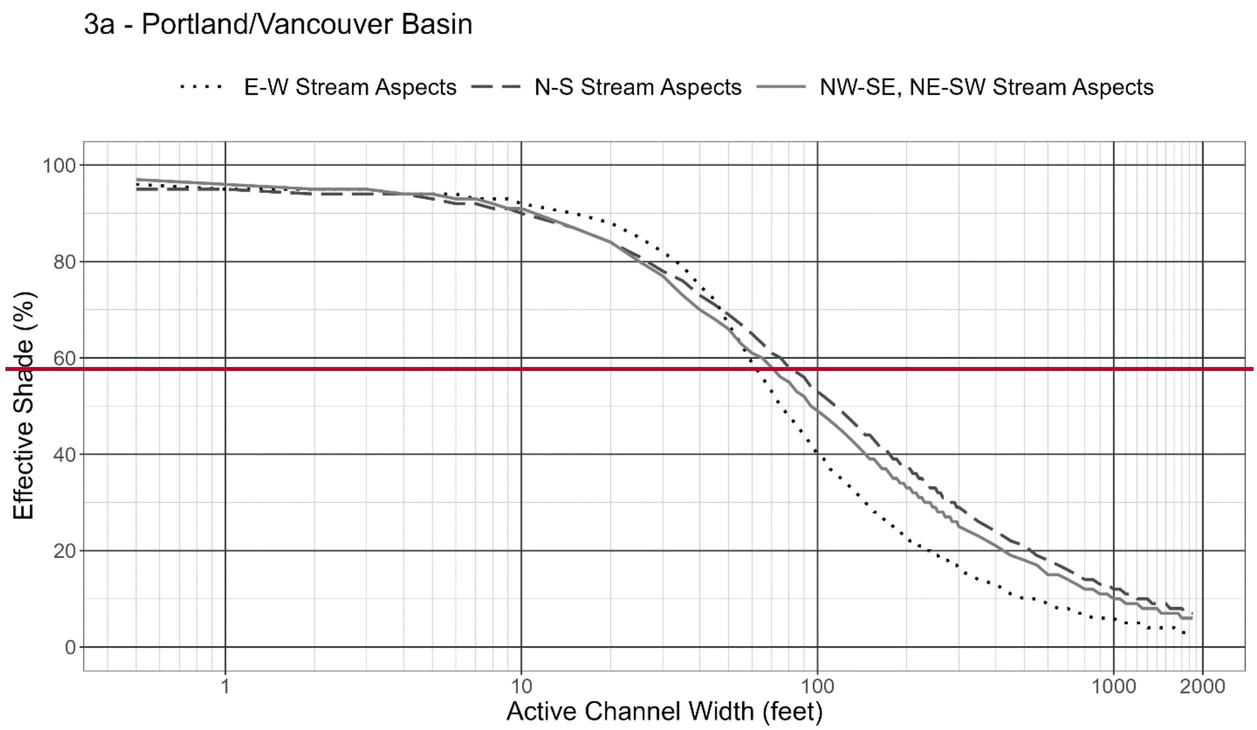


Figure 9-26: Effective shade targets for stream sites in ~~Ecoregion 1d/1f - Volcanics and Willapa Hills~~the QTb mapping unit.



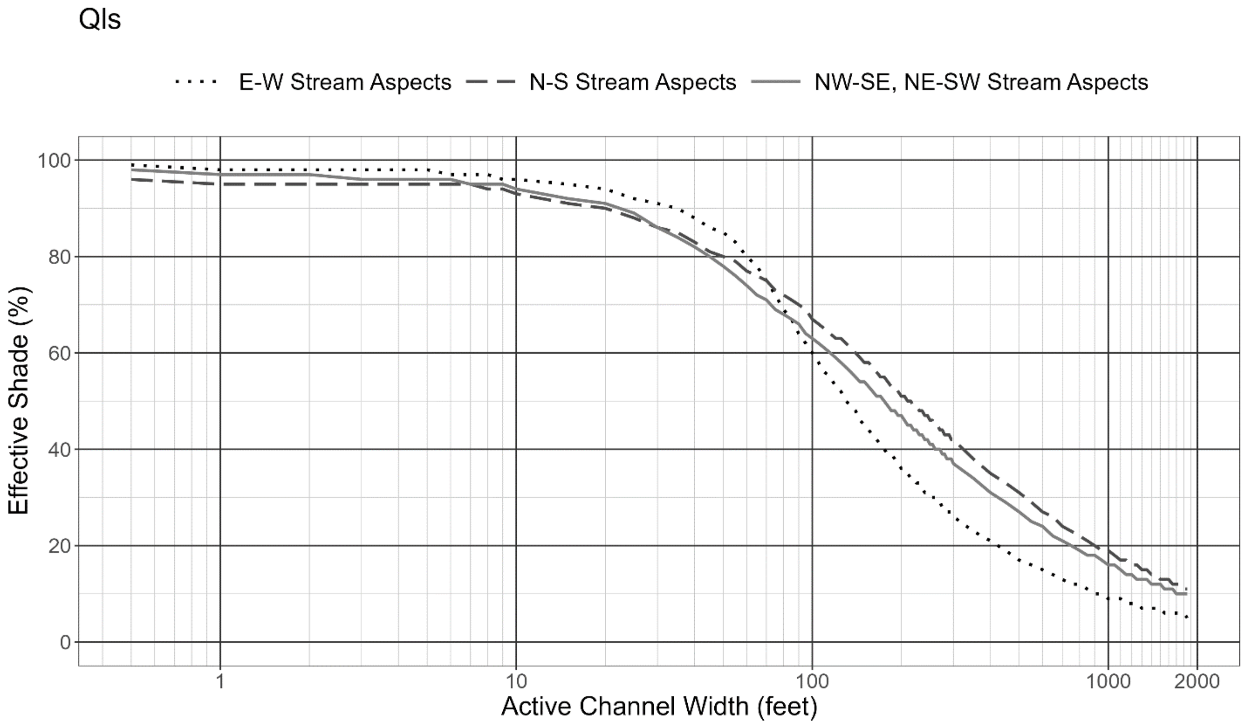
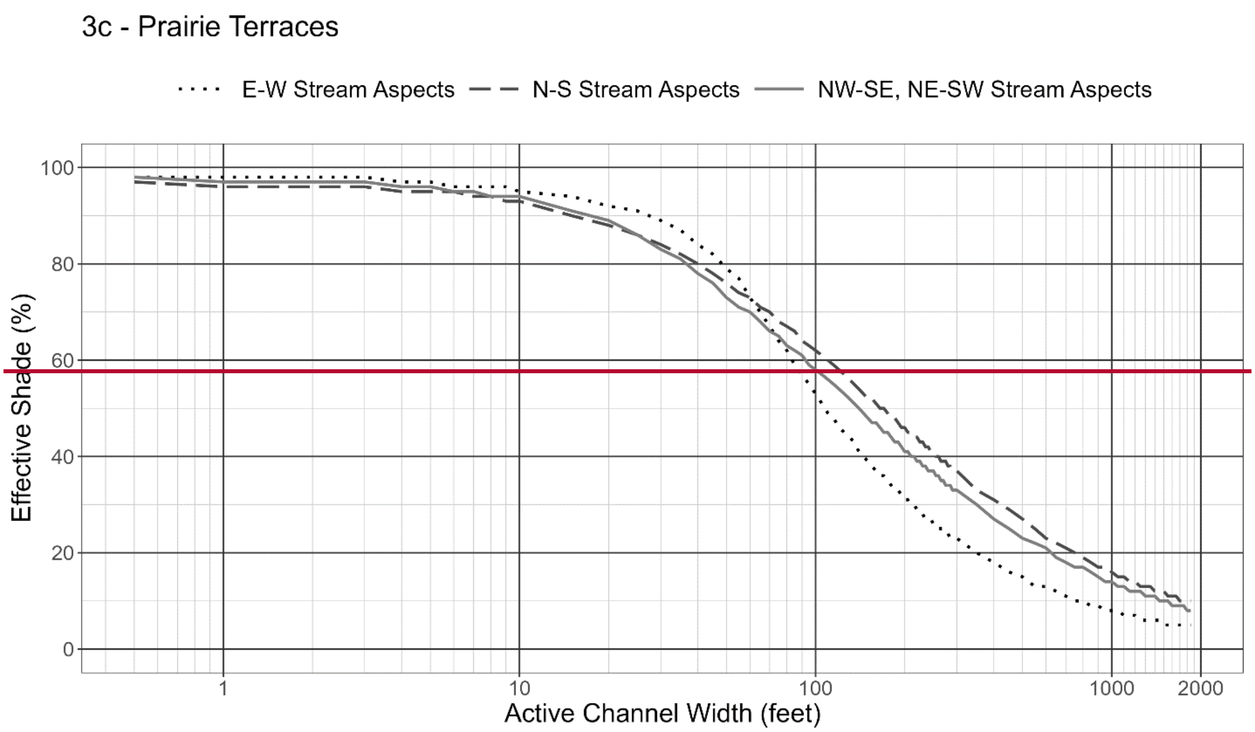


Figure 9-27: Effective shade targets for stream sites in ~~Ecoregion 3a - Portland/Vancouver Basin~~the Qls mapping unit.



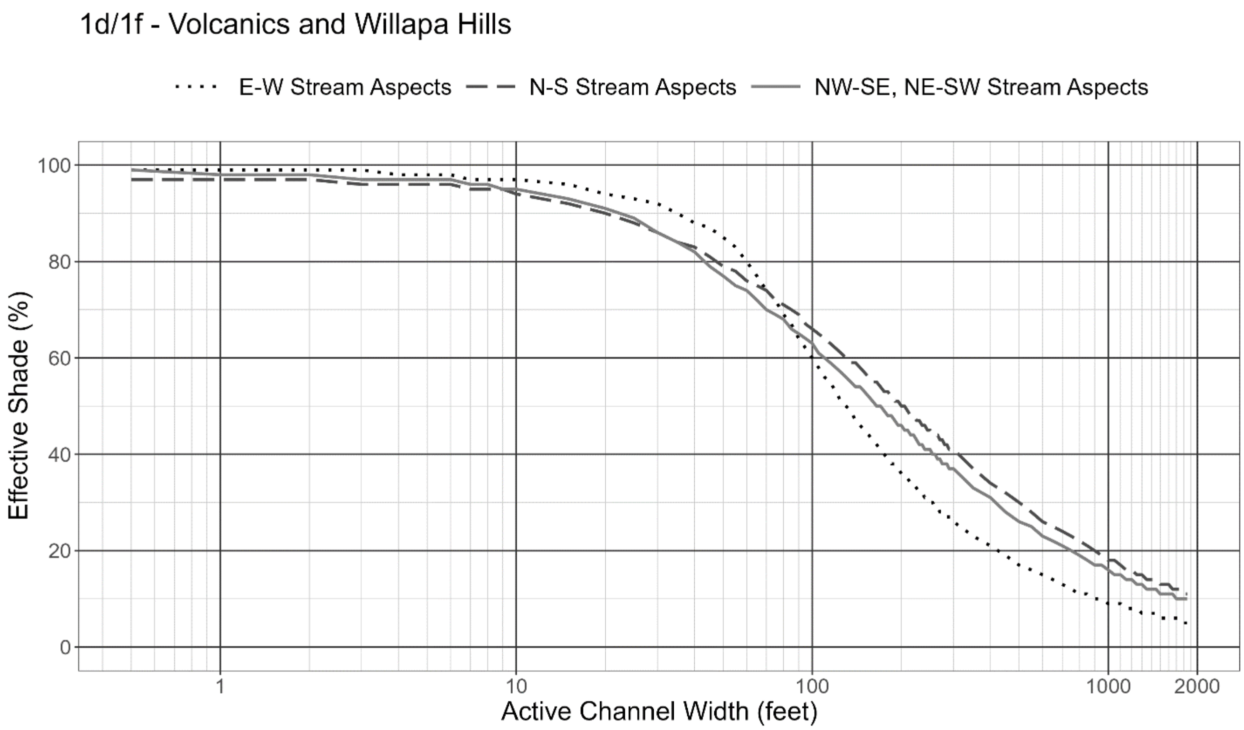


Figure 9-28: Effective shade targets for stream sites in Ecoregion 1d/1f - Volcanics and Willapa Hills.

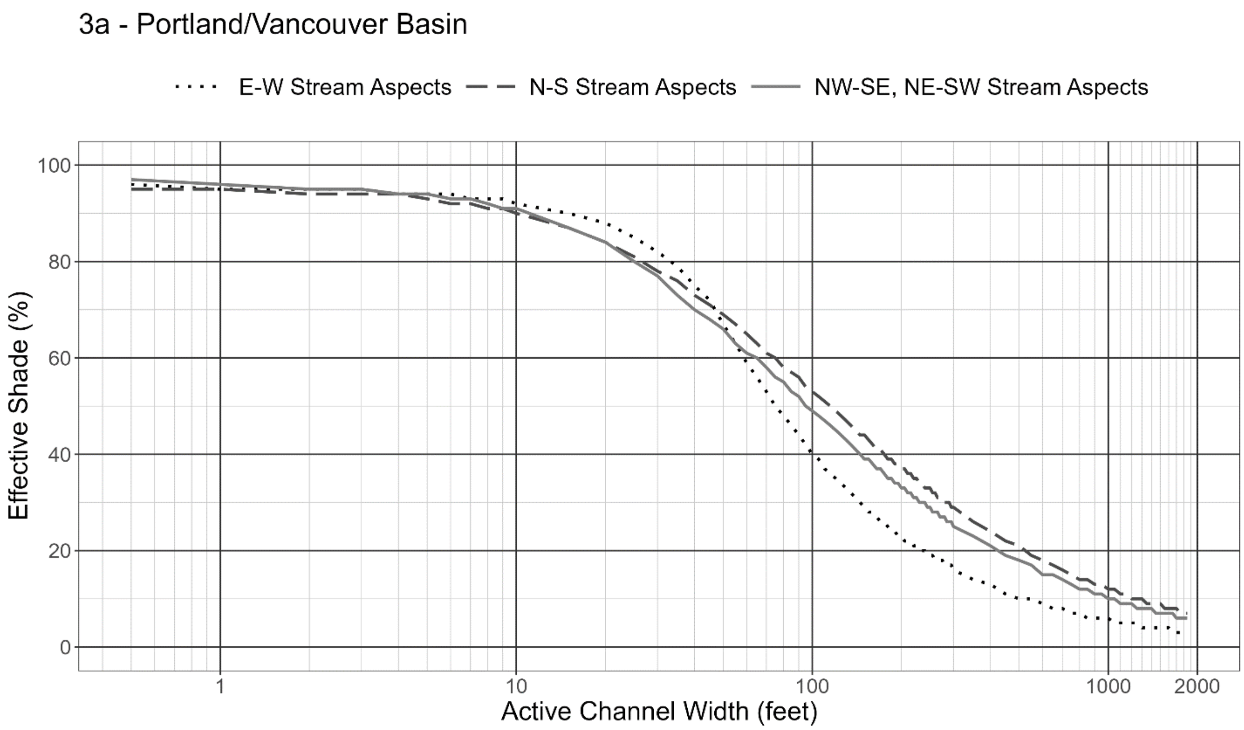


Figure 9-29: Effective shade targets for stream sites in Ecoregion 3a - Portland/Vancouver Basin.

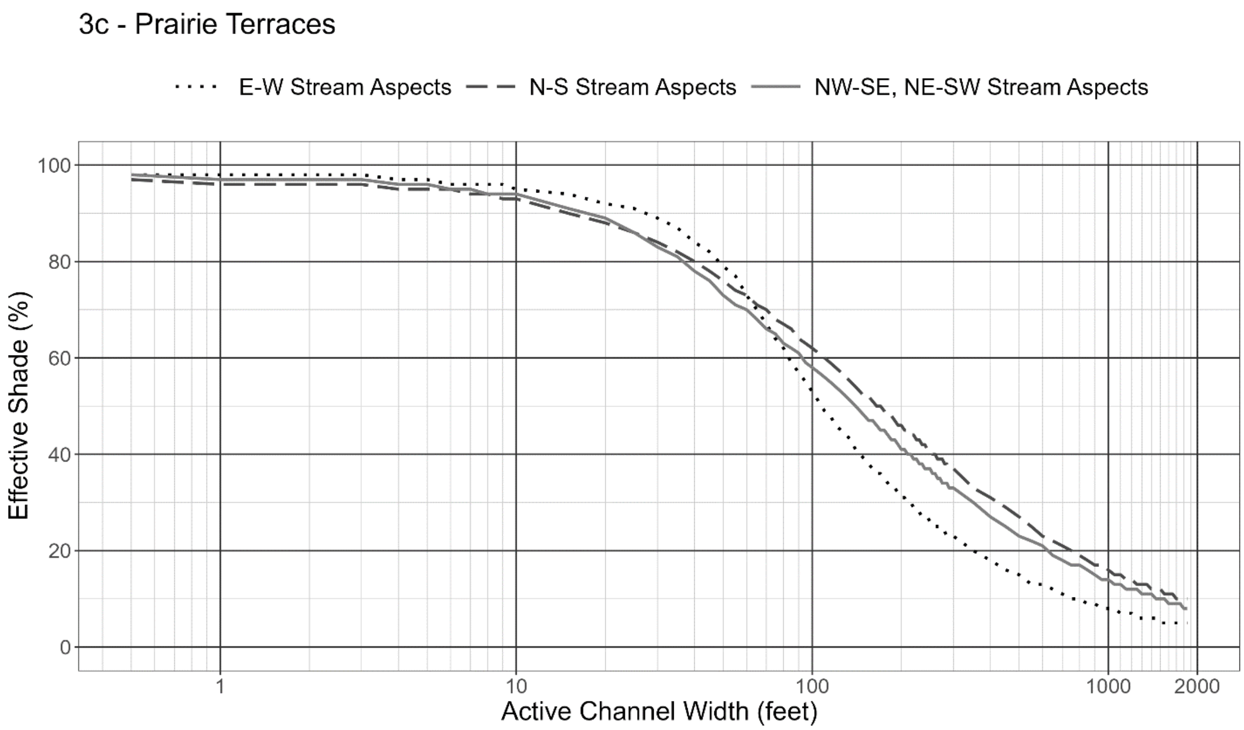
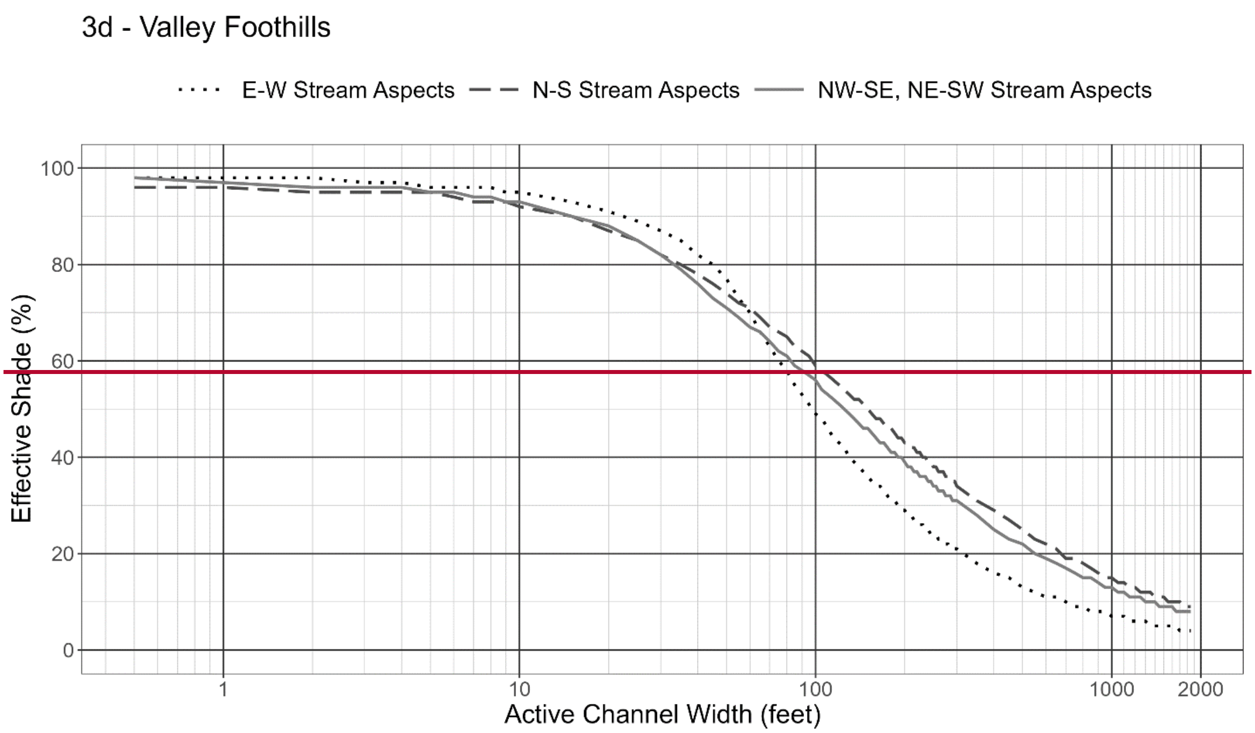


Figure 9-30: Effective shade targets for stream sites in Ecoregion 3c - Prairie Terraces.



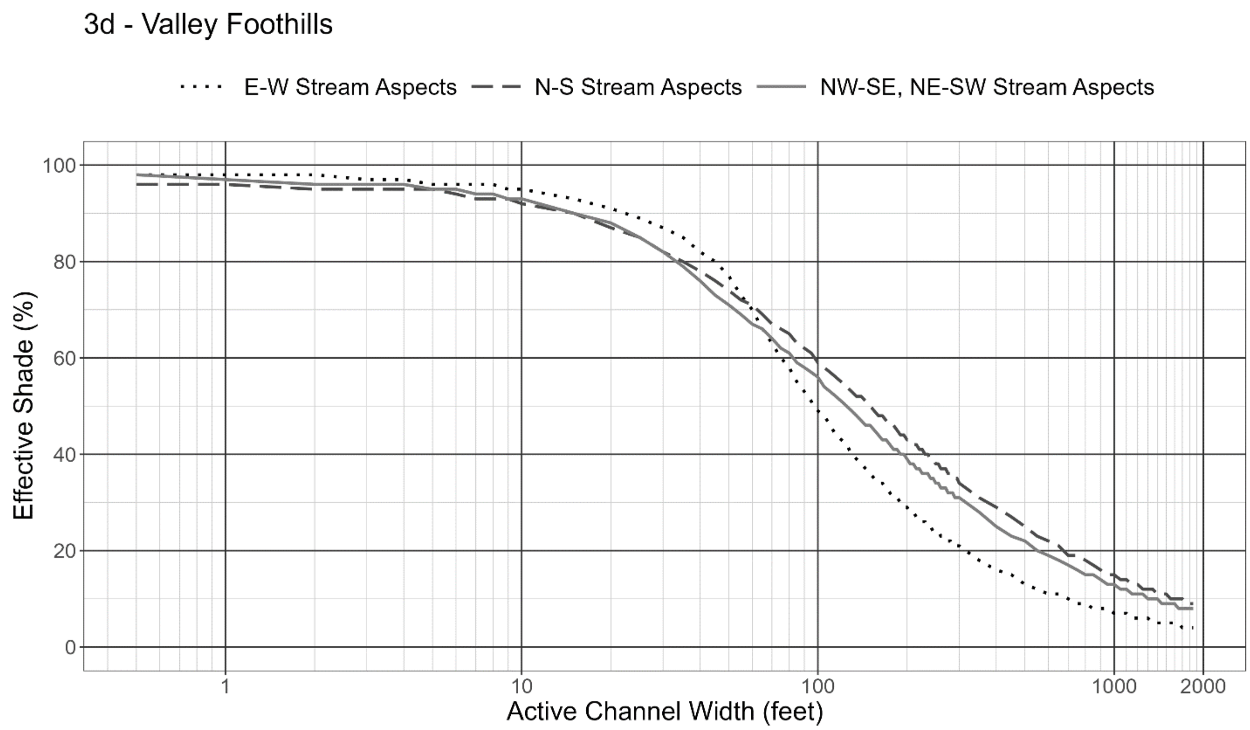


Figure 9-31: Effective shade targets for stream sites in Ecoregion 3d - Valley Foothills.

9.5 Allocation summary

Table 9-~~13~~10 through **Table 9-~~22~~19** present examples of allocation calculations for sources or source categories on select temperature impaired AUs. The allocations to background sources were calculated using **Equation 9-7** and were based on the applicable year-round criterion and the spawning criterion in the respective AU. In cases when there was more than one year-round criterion applicable in the AU, the minimum criterion was used. The allocations to NPDES point sources were calculated using **Equation 9-~~1~~-**. The allocations to nonpoint sources were calculated using **Equation 9-8**. All allocations presented in **Table 9-~~13~~10** through **Table 9-~~22~~19** were calculated using the annual 7Q10 river flow rate. As summarized in the TMDL, allocations may be dynamic and calculated using the relevant equations when river flow rates are greater than 7Q10.

The HUA assignments to anthropogenic sources or source categories are equal to 0.30°C. Wasteload allocations to point sources and load allocations to nonpoint sources are based on loads equivalent to the allowed 0.30°C increase. For some NPDES permitted point sources and nonpoint sources, the maximum cumulative impact at the POMI in an AU is less than the sum of the individual HUA assignments at their respective points of discharge or activity due to heat dissipation within the AU.

Table 9-10: Allocation summary for Coyote Creek (AU: OR_SR_1709000301_02_103796) based on an annual 7Q10 of 5.9 cfs and a year-round criterion of 18°C. The allocation period is May 1 through October 31.

Source or Source Category	Assigned HUA (°C)	7Q10 Allocation Year Round (kilocalories/day)	7Q10 Allocation Spawning (kilocalories/day)
Background	0.0	259.84E+6	NA
NPDES point sources	0.075	1.08E+6	NA
Nonpoint source dam and reservoir operations	0.0	0	NA
Water management activities and water withdrawals	0.05	0.72E+6	NA
Solar loading from existing transportation corridors and utility infrastructure	0.02	0.29E+6	NA
Solar loading from other nonpoint source sectors	0.0	0	NA
Reserve capacity	0.155	2.24E+6	NA
Total Allocated Load:		264.17E+6	NA
Loading Capacity:		264.17E+6	NA

Table 9-11: Allocation summary for Crabtree Creek (AU: OR_SR_1709000606_02_103978) based on an annual 7Q10 of 25 cfs, a year-round criterion of 16°C, and a spawning criterion of 13°C. The allocation period is May 1 through October 31.

Source or Source Category	Assigned HUA (°C)	7Q10 Allocation Year Round (kilocalories/day)	7Q10 Allocation Spawning (kilocalories/day)
Background	0.0	978.67E+6	795.17E+6
NPDES point sources	0.10	6.12E+6	6.12E+6
Nonpoint source dam and reservoir operations	0.0	0	0
Water management activities and water withdrawals	0.05	3.06E+6	3.06E+6
Solar loading from existing transportation corridors and utility infrastructure	0.02	1.22E+6	1.22E+6
Solar loading from other nonpoint source sectors	0.0	0	0
Reserve capacity	0.13	7.95E+6	7.95E+6
Total Allocated Load:		997.02E+6	813.52E+6
Loading Capacity:		997.02E+6	813.52E+6

Table 9-12: Allocation summary for Johnson Creek (AU: OR_SR_1709001201_02_104170) based on an annual 7Q10 of 11 cfs, a year-round criterion of 18°C, and a spawning criterion of 13°C. The allocation period is February 15 through November 15.

Source or Source Category	Assigned HUA (°C)	7Q10 Allocation Year Round (kilocalories/day)	7Q10 Allocation Spawning (kilocalories/day)
Background	0.0	484.44E+6	349.87E+6
NPDES point sources	0.075	2.02E+6	2.02E+6
Nonpoint source dam and reservoir operations	0.0	0	0
Water management activities and water withdrawals	0.05	1.35E+6	1.35E+6
Solar loading from existing transportation corridors and utility infrastructure	0.02	0.54E+6	0.54E+6
Solar loading from other nonpoint source sectors	0.0	0	0
Reserve capacity	0.155	4.17E+6	4.17E+6
Total Allocated Load:		492.51E+6	357.95E+6
Loading Capacity:		492.51E+6	357.95E+6

Table 9-13: Allocation summary for the Little North Santiam River (AU: OR_SR_1709000505_02_104564) based on an annual 7Q10 of 21 cfs, a year-round criterion of 16°C, and a spawning criterion of 13°C. The allocation period is May 1 through October 31.

Source or Source Category	Assigned HUA (°C)	7Q10 Allocation Year Round (kilocalories/day)	7Q10 Allocation Spawning (kilocalories/day)
Background	0.0	822.08E+6	667.94E+6
NPDES point sources	0.075	3.85E+6	3.85E+6
Nonpoint source dam and reservoir operations	0.0	0	0
Water management activities and water withdrawals	0.05	2.57E+6	2.57E+6
Solar loading from existing transportation corridors and utility infrastructure	0.02	1.03E+6	1.03E+6
Solar loading from other nonpoint source sectors	0.0	0	0
Reserve capacity	0.155	7.96E+6	7.96E+6
Total Allocated Load:		837.49E+6	683.35E+6
Loading Capacity:		837.49E+6	683.35E+6

Table 9-14: Allocation summary for the Luckiamute River (AU: OR_SR_1709000305_02_103829) based on an annual 7Q10 of 16 cfs, a year-round criterion of 18°C, and a spawning criterion of 13°C. The allocation period is May 1 through October 31.

Source or Source Category	Assigned HUA (°C)	7Q10 Allocation Year Round (kilocalories/day)	7Q10 Allocation Spawning (kilocalories/day)
Background	0.0	704.64E+6	508.91E+6
NPDES point sources	0.075	2.94E+6	2.94E+6
Nonpoint source dam and reservoir operations	0.0	0	0
Water management activities and water withdrawals	0.05	1.96E+6	1.96E+6
Solar loading from existing transportation corridors and utility infrastructure	0.02	0.78E+6	0.78E+6
Solar loading from other nonpoint source sectors	0.0	0	0
Reserve capacity	0.155	6.07E+6	6.07E+6
Total Allocated Load:		716.38E+6	520.65E+6
Loading Capacity:		716.38E+6	520.65E+6

Table 9-15: Allocation summary for the Mohawk River (AU: OR_SR_1709000406_02_103871) based on an annual 7Q10 of 16 cfs, a year-round criterion of 16°C, and a spawning criterion of 13°C. The allocation period is May 1 through October 31.

Source or Source Category	Assigned HUA (°C)	7Q10 Allocation Year Round (kilocalories/day)	7Q10 Allocation Spawning (kilocalories/day)
Background	0.0	626.35E+6	508.91E+6
NPDES point sources	0.075	2.94E+6	2.94E+6
Nonpoint source dam and reservoir operations	0.0	0	0
Water management activities and water withdrawals	0.05	1.96E+6	1.96E+6
Solar loading from existing transportation corridors and utility infrastructure	0.02	0.78E+6	0.78E+6
Solar loading from other nonpoint source sectors	0.0	0	0
Reserve capacity	0.155	6.07E+6	6.07E+6
Total Allocated Load:		638.09E+6	520.65E+6
Loading Capacity:		638.09E+6	520.65E+6

Table 9-16: Allocation summary for the Molalla River (AU: OR_SR_1709000904_02_104086) based on an annual 7Q10 of 38 cfs, a year-round criterion of 16°C, and a spawning criterion of 13°C. The allocation period is May 1 through October 31.

Source or Source Category	Assigned HUA (°C)	7Q10 Allocation Year Round (kilocalories/day)	7Q10 Allocation Spawning (kilocalories/day)
Background	0.0	1,487.57E+6	1,208.65E+6
NPDES point sources	0.20	18.59E+6	18.59E+6
Nonpoint source dam and reservoir operations	0.0	0	0
Water management activities and water withdrawals	0.05	4.65E+6	4.65E+6
Solar loading from existing transportation corridors and utility infrastructure	0.02	1.86E+6	1.86E+6
Solar loading from other nonpoint source sectors	0.0	0	0
Reserve capacity	0.03	2.79E+6	2.79E+6
Total Allocated Load:		1,515.46E+6	1,236.54E+6
Loading Capacity:		1,515.46E+6	1,236.54E+6

Table 9-17: Allocation summary for Mosby Creek (AU: OR_SR_1709000201_02_103752) based on an annual 7Q10 of 11 cfs, a year-round criterion of 16°C, and a spawning criterion of 13°C. The allocation period is May 1 through October 31.

Source or Source Category	Assigned HUA (°C)	7Q10 Allocation Year Round (kilocalories/day)	7Q10 Allocation Spawning (kilocalories/day)
Background	0.0	430.61E+6	349.87E+6
NPDES point sources	0.075	2.02E+6	2.02E+6
Nonpoint source dam and reservoir operations	0.0	0	0
Water management activities and water withdrawals	0.05	1.35E+6	1.35E+6
Solar loading from existing transportation corridors and utility infrastructure	0.02	0.54E+6	0.54E+6
Solar loading from other nonpoint source sectors	0.0	0	0
Reserve capacity	0.155	4.17E+6	4.17E+6
Total Allocated Load:		438.69E+6	357.95E+6
Loading Capacity:		438.69E+6	357.95E+6

Table 9-18: Allocation summary for the Pudding River (AU: OR_SR_1709000905_02_104088) based on an annual 7Q10 of 10 cfs, and a year-round criterion of 18°C. The allocation period is May 1 through October 31.

Source or Source Category	Assigned HUA (°C)	7Q10 Allocation Year Round (kilocalories/day)	7Q10 Allocation Spawning (kilocalories/day)
Background	0.0	440.4E+6	NA
NPDES point sources	0.20	4.89E+6	NA
Nonpoint source dam and reservoir operations	0.0	0	NA
Water management activities and water withdrawals	0.05	1.22E+6	NA
Solar loading from existing transportation corridors and utility infrastructure	0.02	0.49E+6	NA
Solar loading from other nonpoint source sectors	0.0	0	NA
Reserve capacity	0.03	0.73E+6	NA
Total Allocated Load:		447.74E+6	NA
Loading Capacity:		447.74E+6	NA

Table 9-19: Allocation summary for Thomas Creek (AU: OR_SR_1709000607_02_103988) based on an annual 7Q10 of 6.9 cfs, and a year-round criterion of 18°C. The allocation period is May 1 through October 31.

Source or Source Category	Assigned HUA (°C)	7Q10 Allocation Year Round (kilocalories/day)	7Q10 Allocation Spawning (kilocalories/day)
Background	0.0	302.18E+6	NA
NPDES point sources	0.075	1.26E+6	NA
Nonpoint source dam and reservoir operations	0.0	0	NA
Water management activities and water withdrawals	0.05	0.84E+6	NA
Solar loading from existing transportation corridors and utility infrastructure	0.02	0.34E+6	NA
Solar loading from other nonpoint source sectors	0.0	0	NA
Reserve capacity	0.155	2.6E+6	NA
Total Allocated Load:		307.22E+6	NA
Loading Capacity:		307.22E+6	NA

10 Water quality standards attainment

10.1 Point sources

DEQ's approach to point source allocations is to distribute an equal portion of the HUA (0.075°C) with some exceptions, as described below. An HUA of 0.075°C is selected because many of the current NPDES permit limits are based on this amount of allowed warming, and it is consistent with allocations provided in DEQ's 2006 Willamette Basin temperature TMDL.

Exceptions were made when the point source was not authorized to discharge in the current NPDES permit (maximum effluent flow = 0). For these point sources, an HUA of 0.0°C was assigned during the no discharge period. An HUA assignment of zero means there may be no warming above the applicable temperature criteria.

Exceptions were also made based on the results of thermal loading assessments completed by DEQ. In some cases, analysis indicated that current thermal loads are less than 0.075°C, so the allocation could be reduced to minimize cumulative effects. In other cases, analysis indicated that an HUA assignment of 0.075°C would result in immediate noncompliance, so DEQ increased the allocation where possible. Facility specific assessment summaries and HUA assignments are described in Section 9.2.1 HUA assignments to point sources.

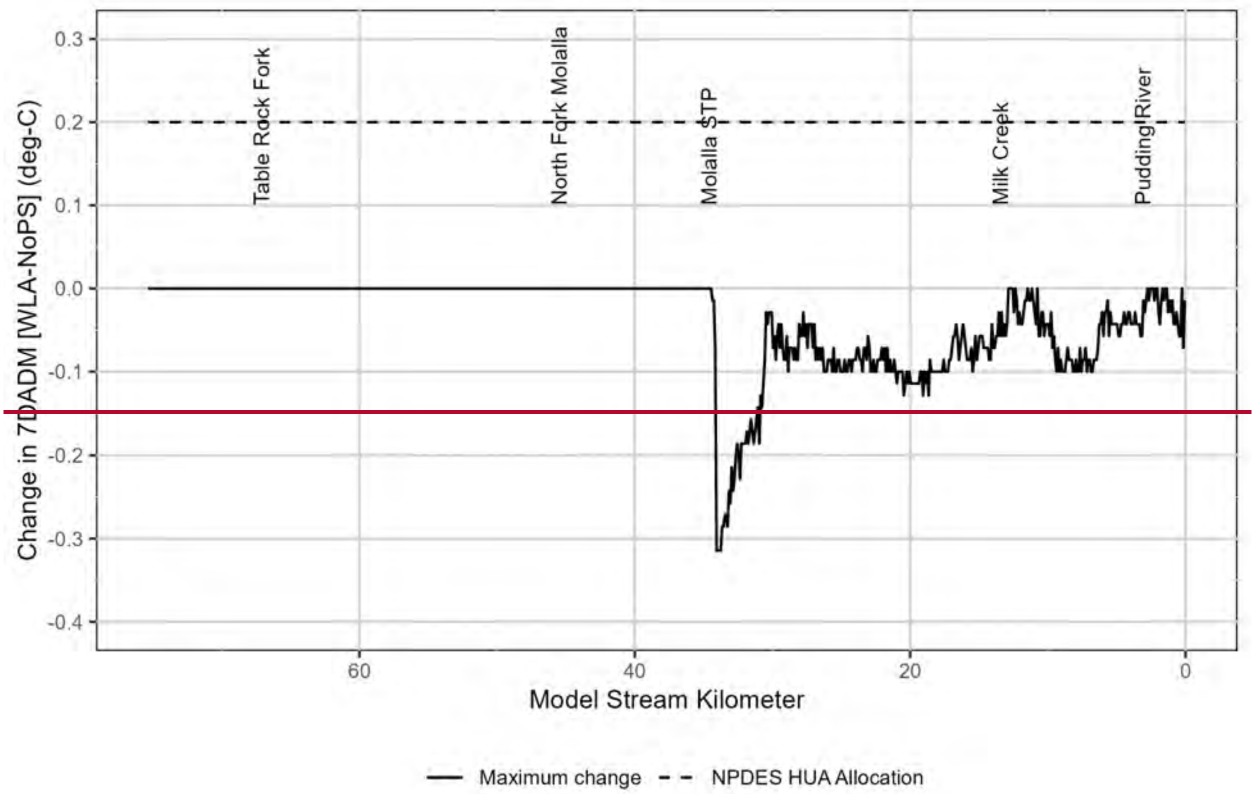
Cumulative warming effects were considered throughout the HUA assignment and wasteload allocation process. On unmodeled streams with more than one point source, and where a cumulative effects analysis was not completed, it was assumed that warming impacts from individual point sources did not dissipate with distance from the outfall. This means that the total portion of the HUA assigned to the point source sector represents the sum of the HUA assignments to individual point sources. For example, if a stream has two NPDES point sources that each have an HUA assignment of 0.075°C, the HUA assignment to all NPDES point sources at the POMI on that stream is 0.15°C. This approach is protective based on model results from other streams that show temperature impacts from point sources dissipating moving downstream from the outfall. DEQ also mapped the outfall locations to AUs and adjusted the HUA assignments on AUs that did not have point sources, but that were downstream of AUs with dischargers, to ensure that there would be no warming above the HUA assigned to point sources. This is a margin of safety that ensures cumulative warming from all point sources will not exceed the portion of the HUA assigned to the point source sector. See Willamette Subbasins Temperature TMDL Section 9.1 Thermal Allocations for stream specific HUA assignments to point sources.

On modeled streams, DEQ completed a cumulative effects analysis to determine the water temperature impacts of point sources discharging at their wasteload allocations. Modeling wasteload allocations allowed DEQ to assess how warming from point sources occurred over space and time, and to confirm that the applicable temperature criteria would be attained.

Cumulative effects model analyses were completed for the Molalla River, Pudding River, and McKenzie River. In the Molalla River and Pudding River, the point source sector is allocated 0.2°C of cumulative warming. In both rivers, wasteload allocations have a cooling effect due to the relatively high water temperatures of the receiving water bodies. The Molalla STP wasteload allocation has the potential to cool the Molalla River about 0.3°C at the point of discharge (**Figure 10-1**). Pudding River point source wasteload allocations have the potential to cool the river less than 0.1°C (**Figure 10-2**).

In the upper McKenzie River, the EWEB Trail Bridge Powerhouse wasteload allocation increases McKenzie River temperature no more than 0.02°C (**Figure 10-3**). In the lower McKenzie River the EWEB Trail Bridge Powerhouse, McKenzie River Hatchery, Leaburg Hatchery, and International Paper wasteload allocations increase river temperature cumulatively 0.19°C during the spring spawning period (**Figure 10-4**), 0.21°C during the summer period (**Figure 10-5**), and 0.21°C during the fall spawning period (**Figure 10-6**). Note that as discussed in TSD Appendix K, the temperature impact was slightly more than 0.21°C at the river mouth on two days when flow was less than 7Q10. When flow is greater than or equal to 7Q10, the impact of modeled point source impacts does not exceed 0.21ºC.

These model results confirm that cumulative warming from point sources will not exceed the portion of the HUA assigned to point sources on the Molalla River, Pudding River or McKenzie River.



10.1.1 Molalla and Pudding Rivers point source impacts

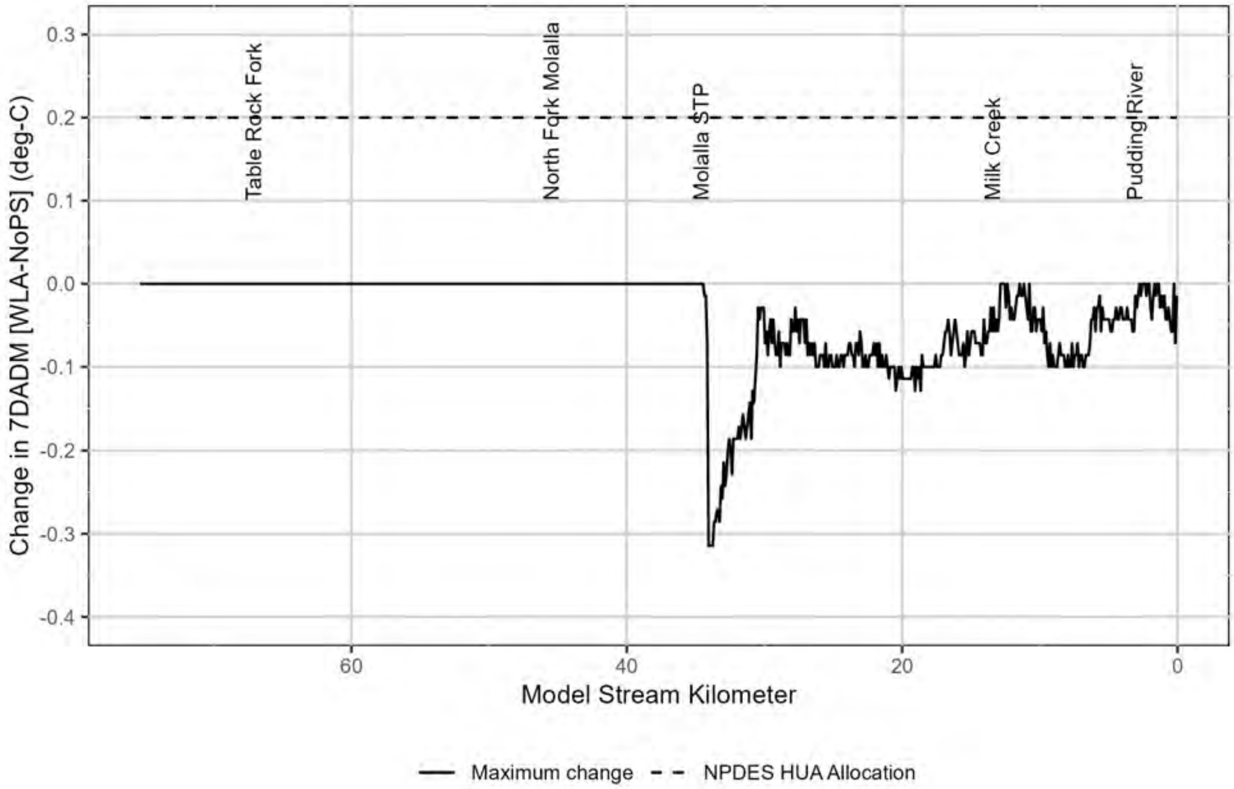
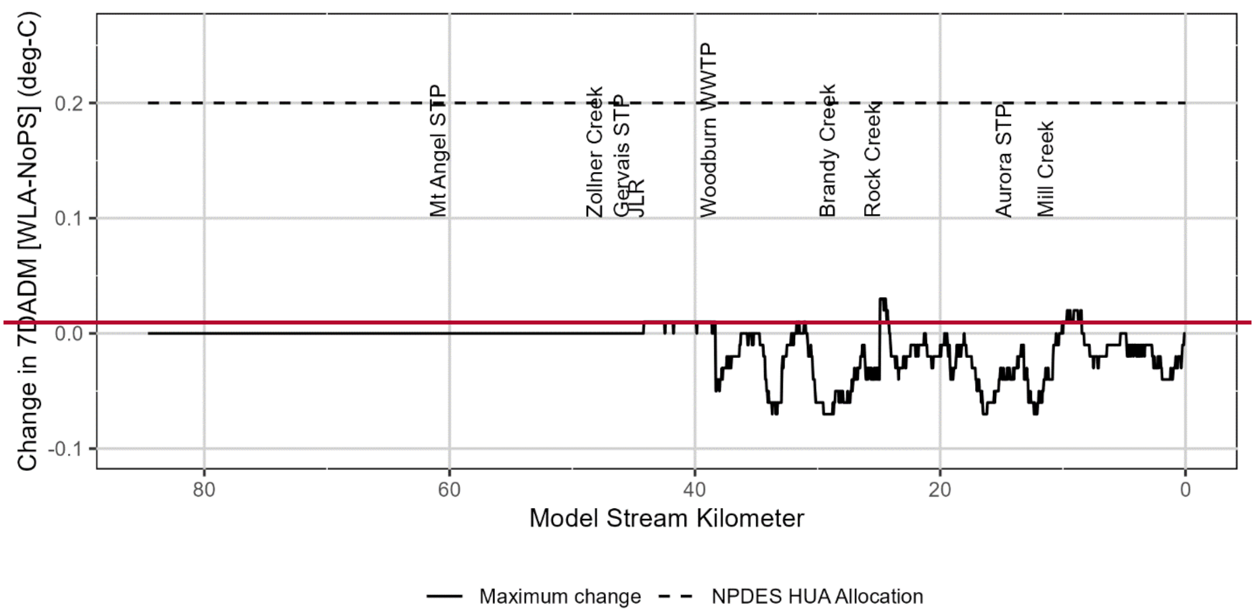


Figure 10-1: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the Molalla River over the entire model period.



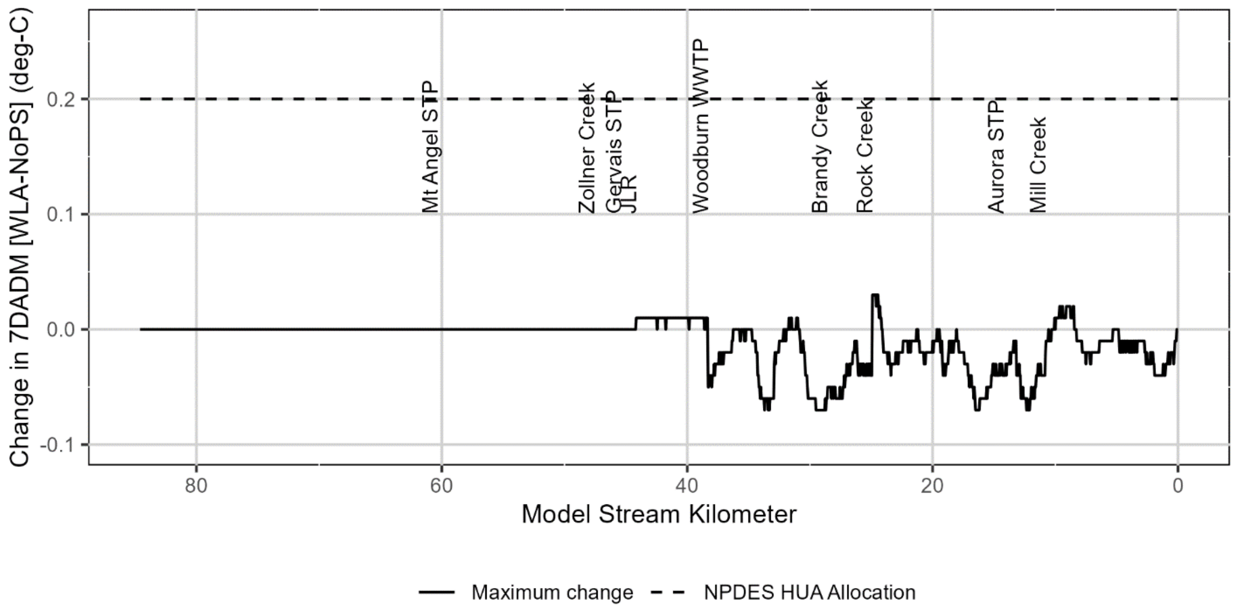
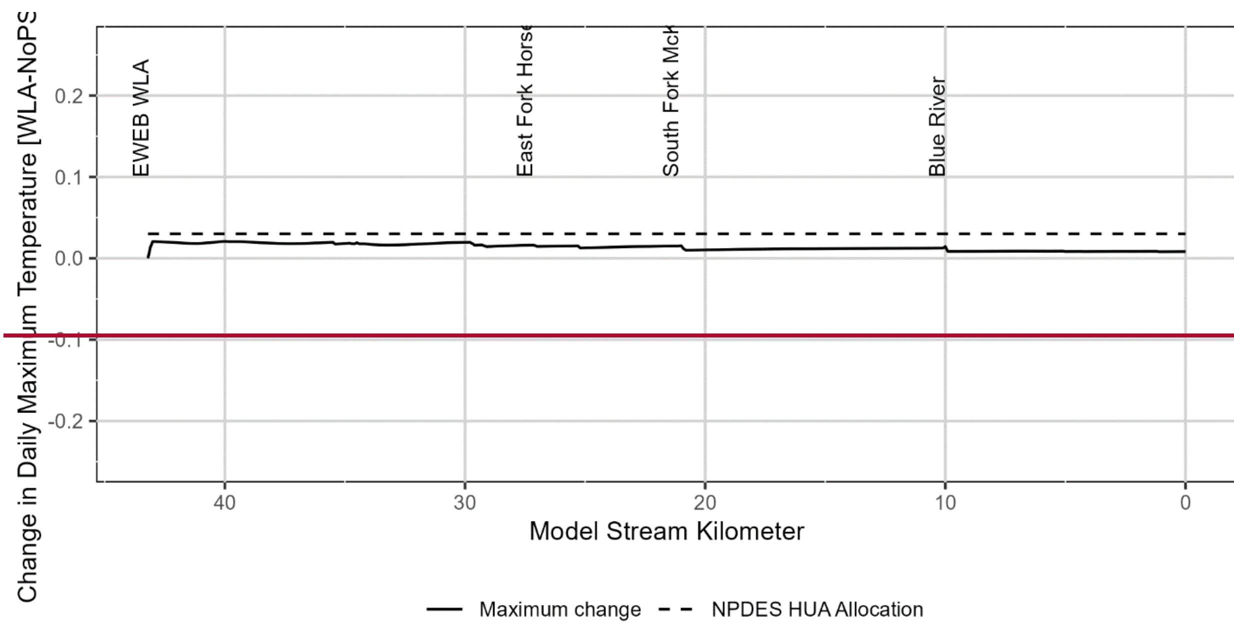


Figure 10-2: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the Pudding River over the entire model period.



10.1.2 McKenzie River point source impacts

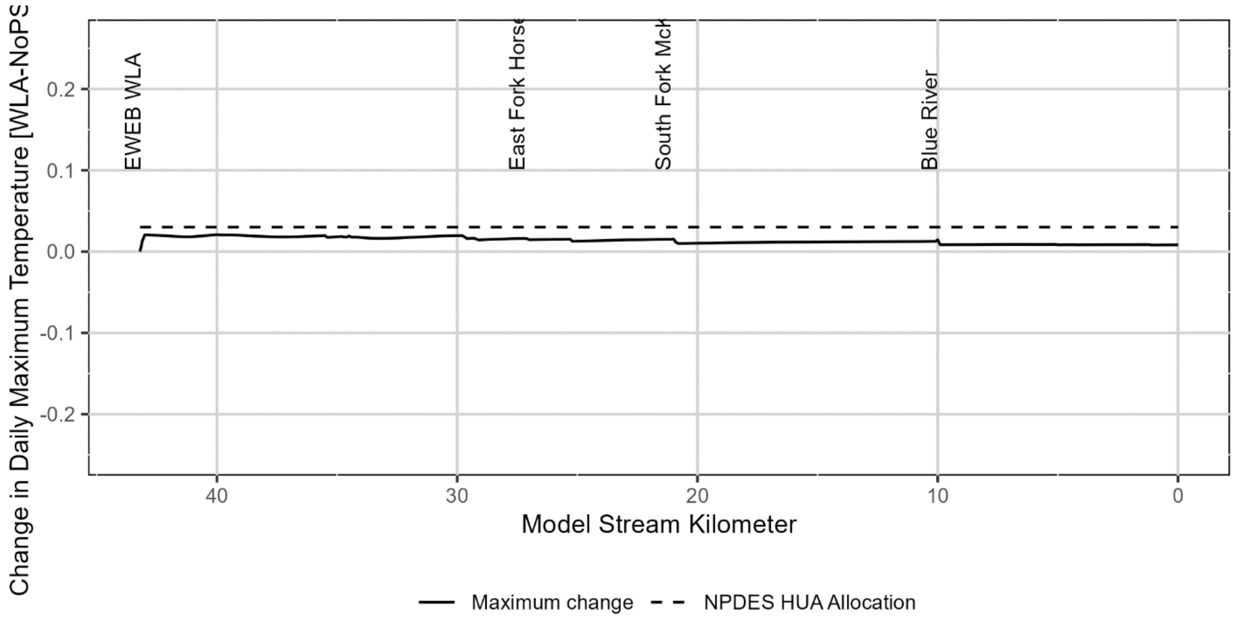
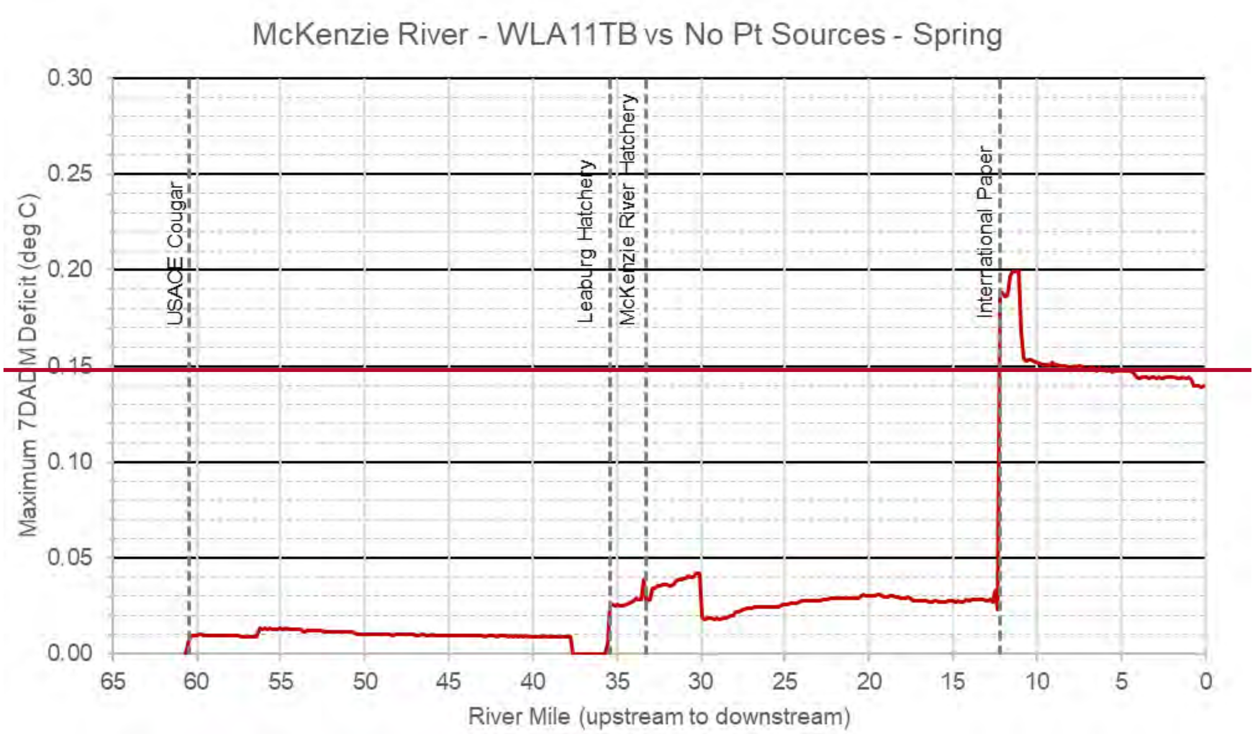


Figure 10-3: Change in daily maximum stream temperature between the Wasteload Allocations and No Point Sources model scenarios for the upper McKenzie River.



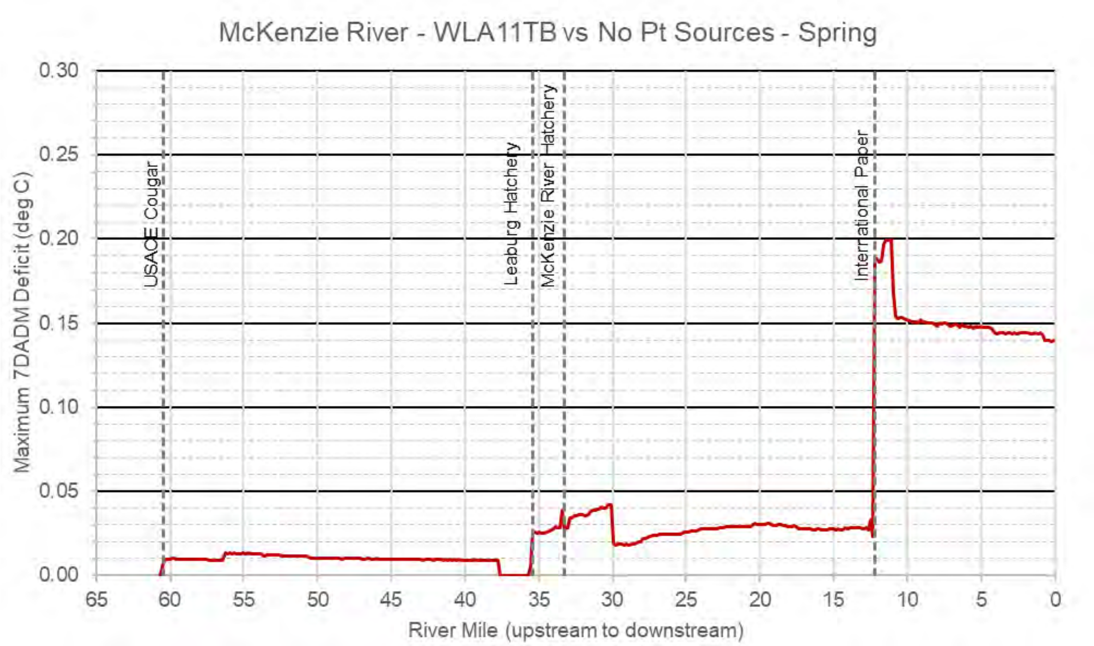
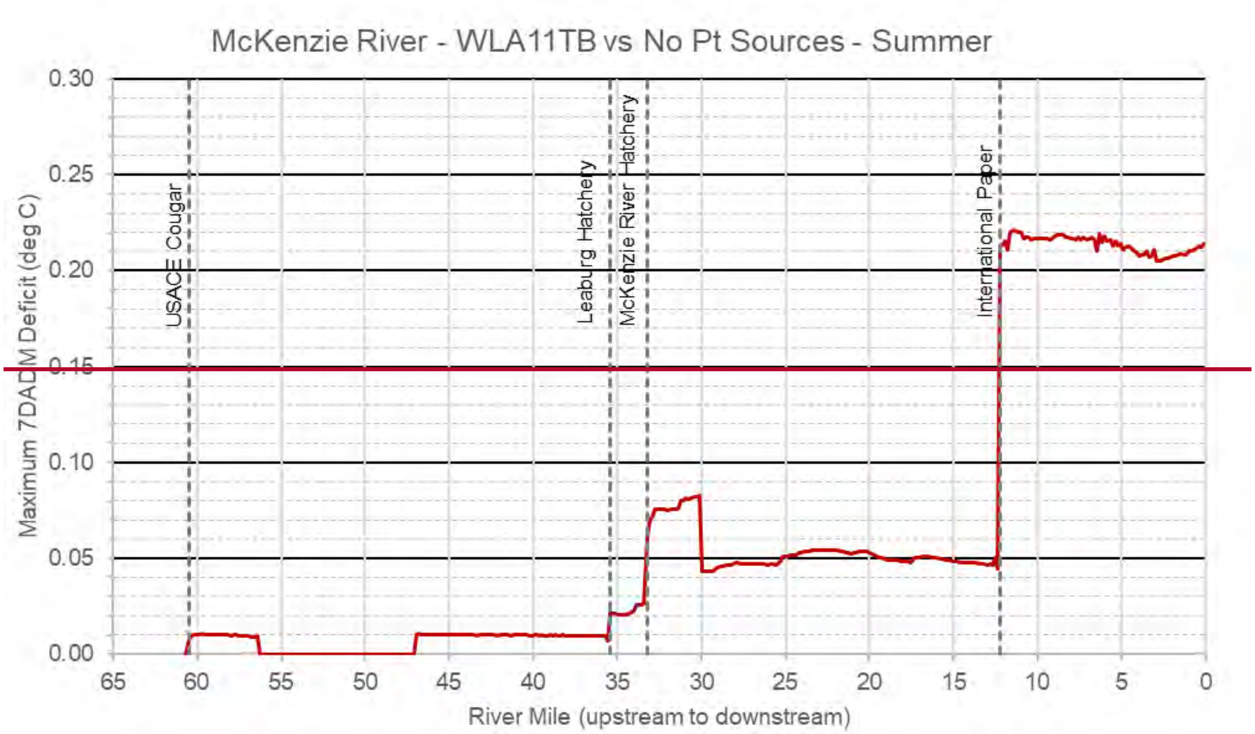


Figure 10-4: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the McKenzie River over the spring spawning period.



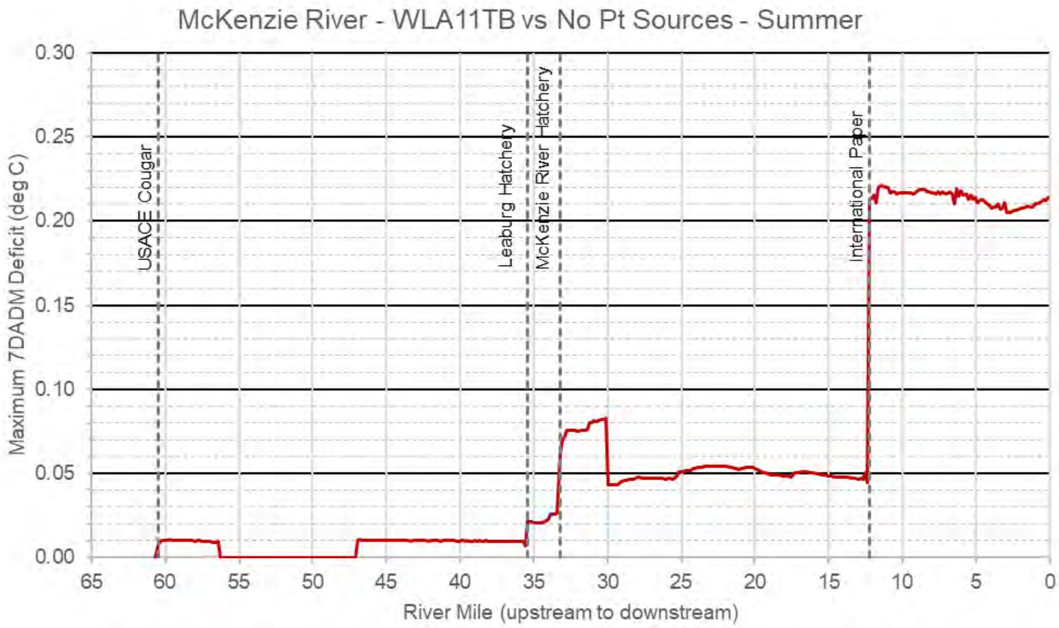
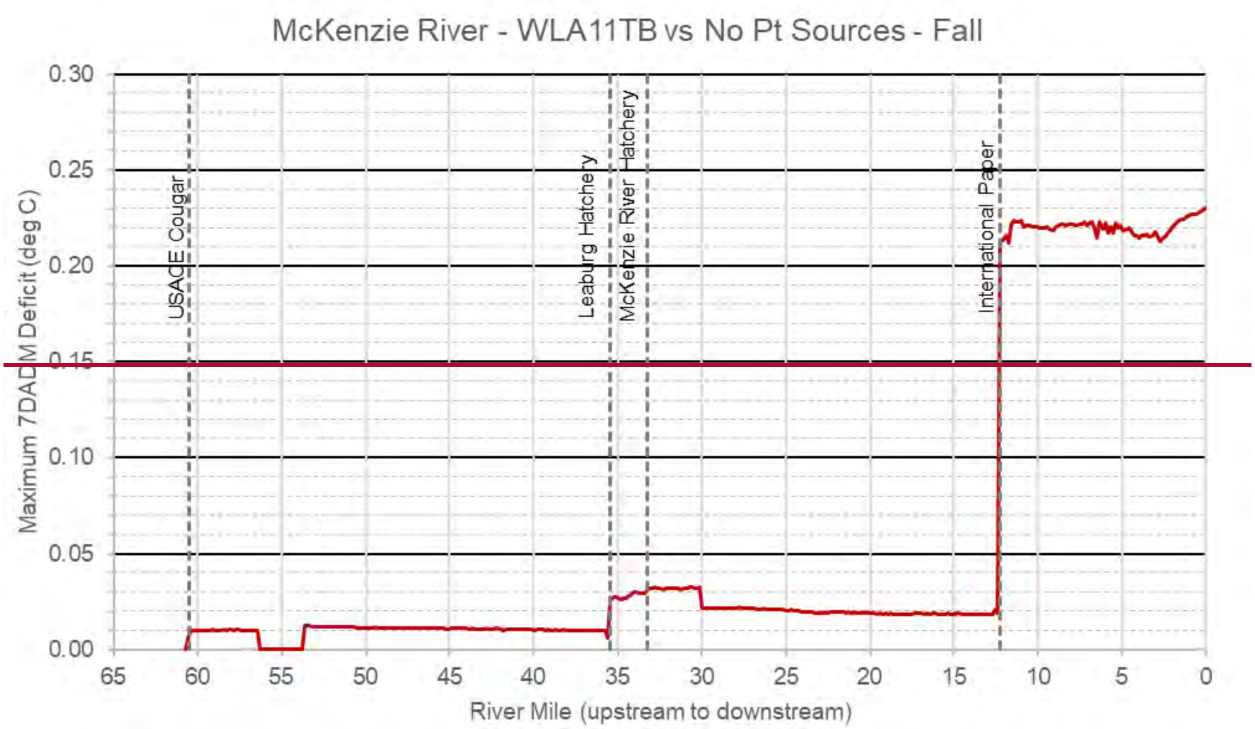


Figure 10-5: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the McKenzie River over the summer period.



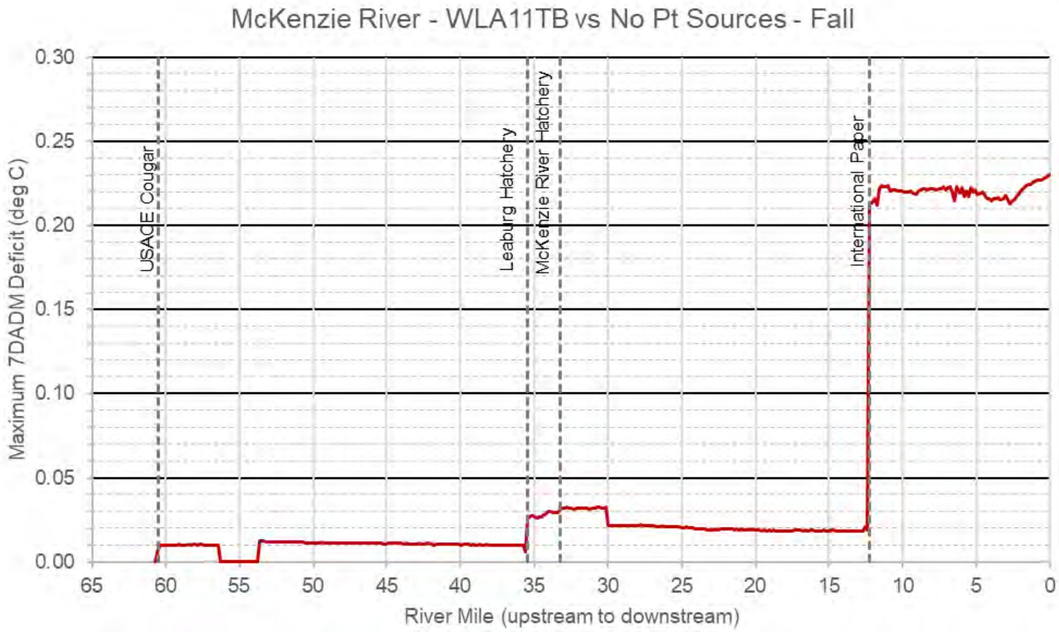


Figure 10-6: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the McKenzie River over the fall spawning period.

10.1.3 Long Tom River point source impacts

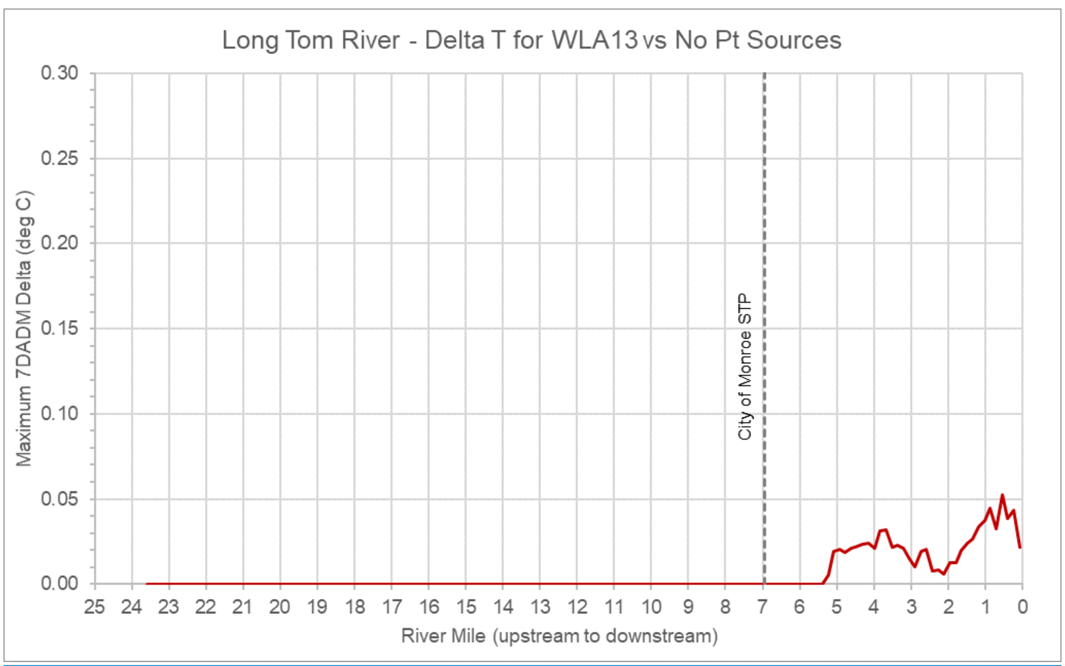


Figure 10-7: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the Long Tom River over all time periods

10.1.4 Santiam, North Santiam, and South Santiam River point source impacts

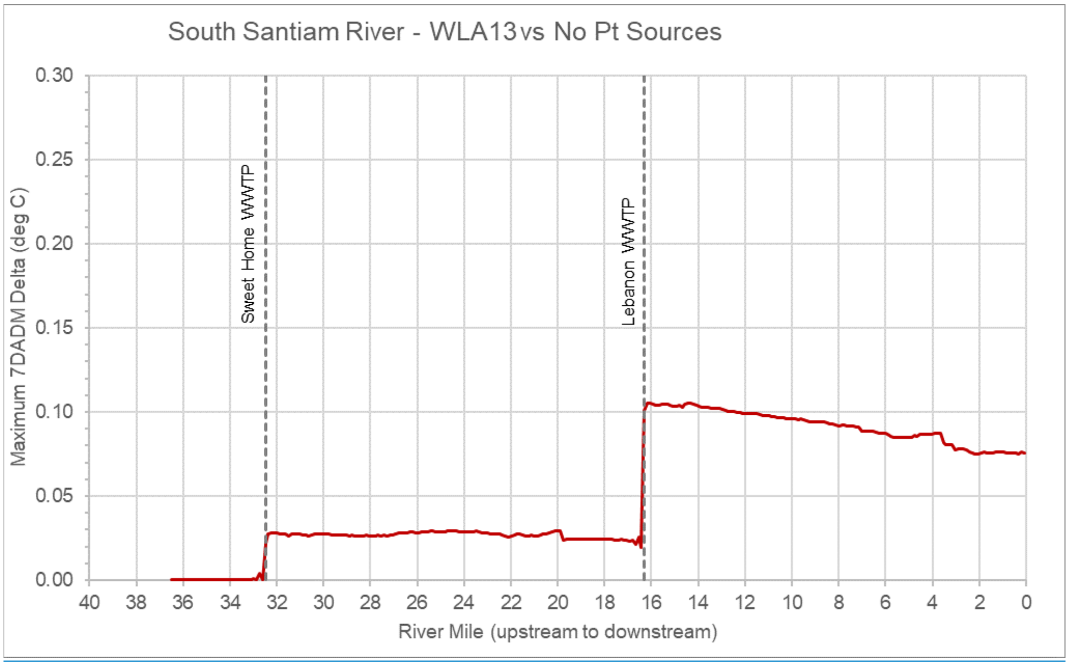


Figure 10-8: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the South Santiam River over all time periods

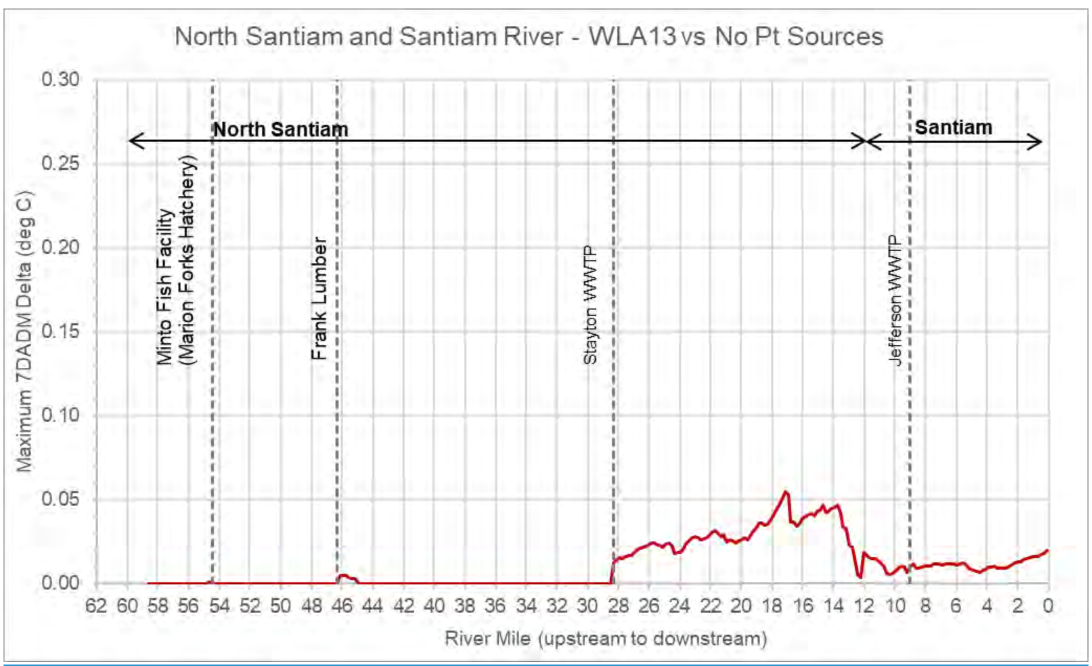


Figure 10-9: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the North Santiam and Santiam Rivers over all time periods

10.1.5 Clackamas River point source impacts

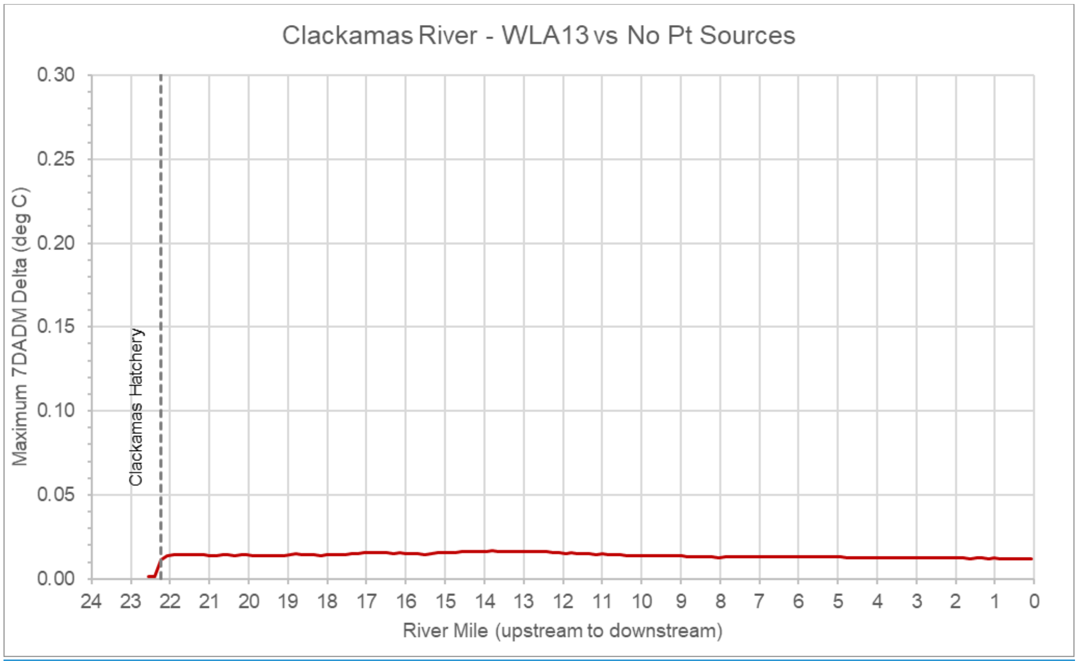


Figure 10-10: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the Clackamas River over all time periods

10.1.6 Coast and Middle Fork Willamette point source impacts

The impact of the City of Cottage Grove WWTP at its WLA on river temperature, while relatively large, does not exceed 0.20°C. The impact drops significant downstream from the confluence of the Row River. In addition to the individual point sources provided, up to 0.01°C of impact is assigned to point source discharges covered by General NPDES permits in this area, for a total HUA assignment to point sources of 0.21°C. Due to the relatively large point source impacts, reserve capacity upstream from Row River was reduced to 0.02°C in this AU (OR_SR_1709000203_02_104585).

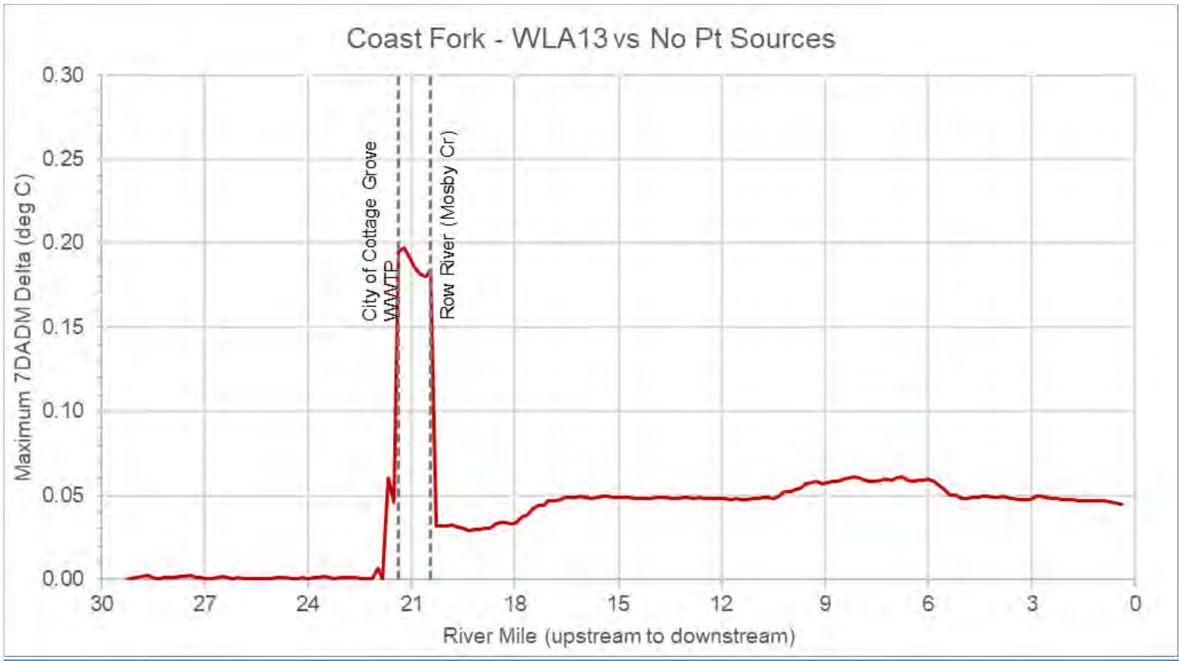


Figure 10-11: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the Coast Fork Willamette River over all time periods

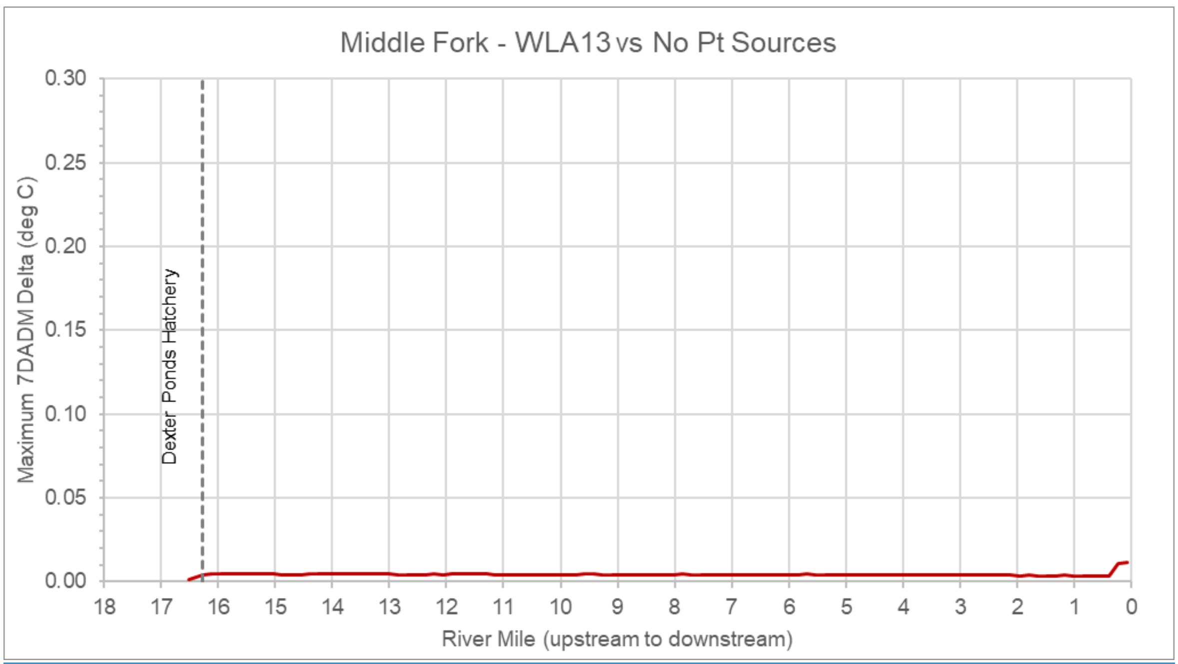


Figure 10-12: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the Middle Fork Willamette River over all time periods

10.1.7 Willamette River point source impacts

The upper Willamette River is the location of the point of maximum impact (POMI) of point sources for reaches modeled downstream from USACE reservoirs. The POMI is located upstream of the confluence of the Santiam River at RM 109. Major point sources which impact river temperature include MWMC WWTP which discharges upstream from the McKenzie River, IP Springfield which discharges to the McKenzie River, Cascade Pacific and GP Halsey Mills at RM 149, Cities of Corvallis and Albany WWTPs, and ATI Millersburg. Plots are provided for spring spawning, summer non-spawning, and fall spawning periods. The maximum impacts of point sources for wasteload allocations provided (McKenzie River WLA Scenario 11 and Willamette River WLA Scenario 13) are 0.16ºC during the spring spawning period, 0.22ºC during the summer, and 0.20ºC during the fall spawning period. In addition to the individual point sources provided, up to 0.01ºC of impact is assigned to point source discharges covered by General NPDES permits in this area, for a total HUA assignment to point sources of 0.23ºC. Due to the relatively large point source impacts at the POMI, reserve capacity was reduced to 0.02ºC in this AU (OR_SR_1709000306_05_103854).

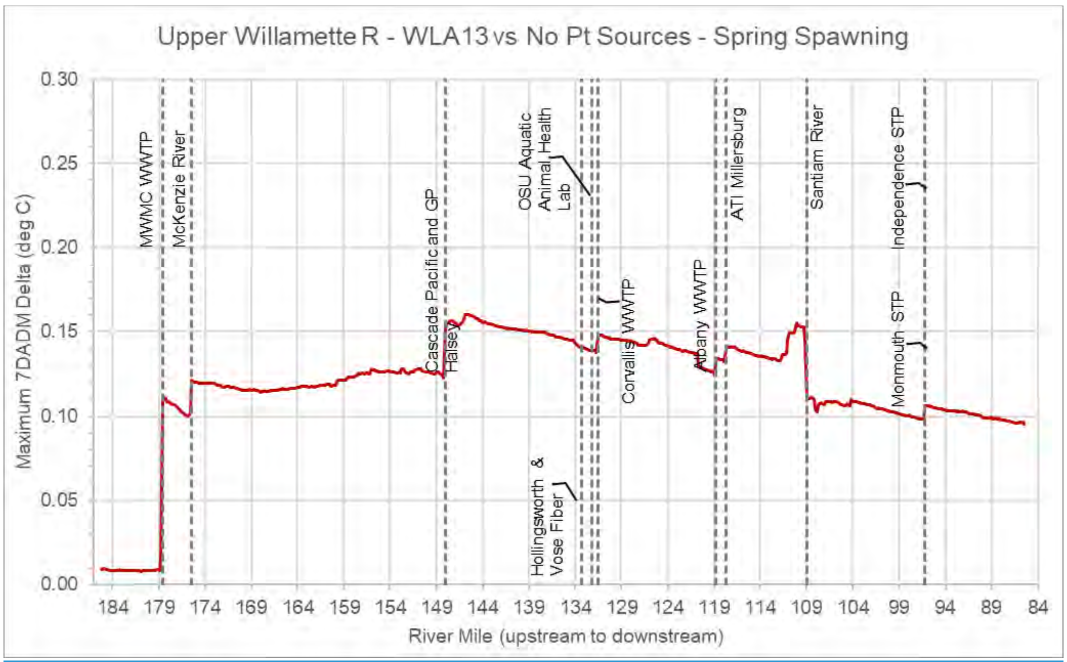


Figure 10-13: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the upper Willamette River over the spring spawning period.

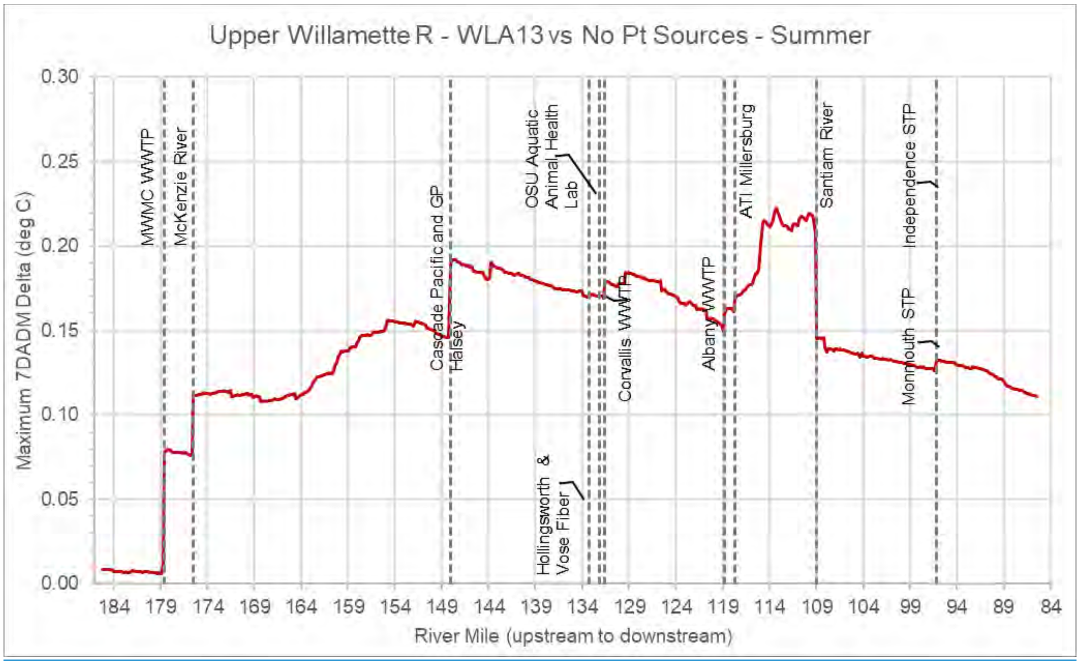


Figure 10-14: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the upper Willamette River over the summer non-spawning period.

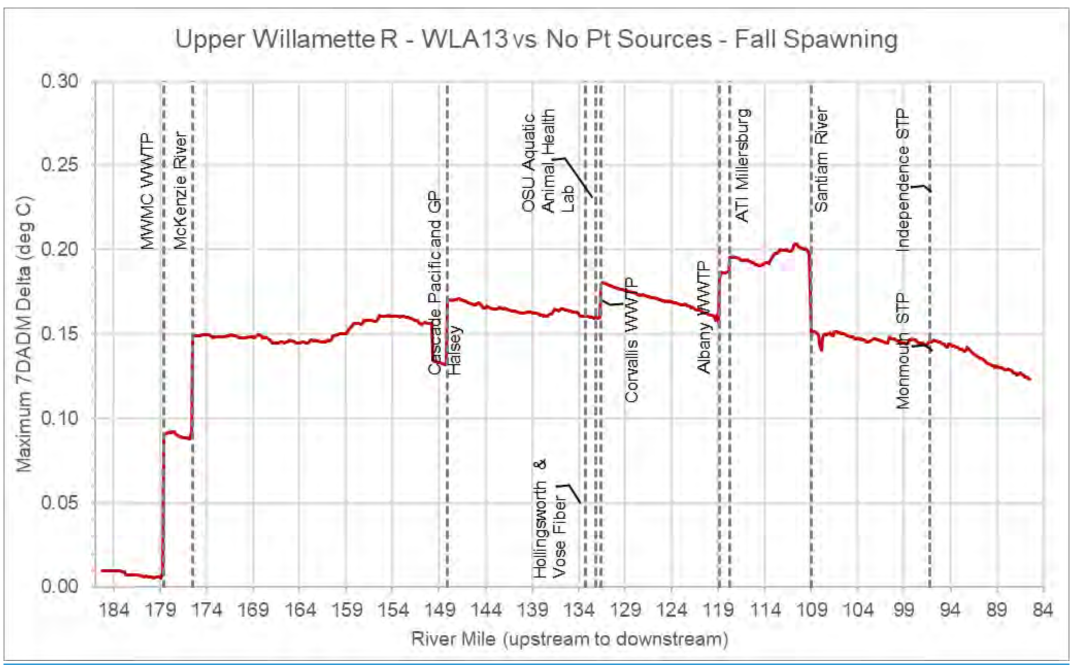


Figure 10-15: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the upper Willamette River over the fall spawning period.

Impacts in the middle Willamette River between RM 85 upstream from Salem and Willamette Falls are less. The maximum impact in this reach is 0.19°C. In addition to the individual point sources provided, up to 0.02ºC of impact is assigned to point source discharges covered by General NPDES permits in this area, for a total HUA assignment to point sources of 0.21ºC. Due to the relatively large point source impacts at the POMI, reserve capacity was reduced to 0.02ºC in this AU (OR_SR_1709000703_04_104013).

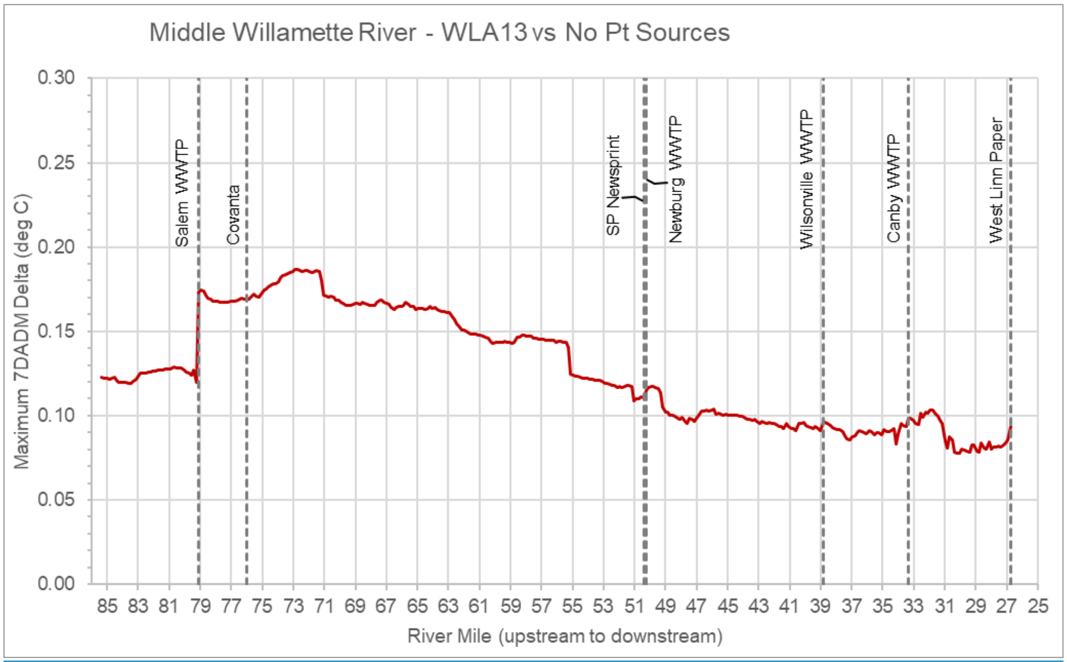


Figure 10-16: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the middle Willamette River over all time periods

The maximum impact of WLAs in the tidally influenced lower Willamette River downstream from Willamette Falls, including Portland Harbor, is up to 0.11ºC at Tri City WWTP and Kellogg Creek WWTP disharges and less than 0.10ºC elsewhere. Impacts in Multnomah Channel are less than 0.07ºC. Note that in addition to point source allocations, a load allocation of 0.10ºC has been assigned to PGE Willamette Falls Project, for a total impact of point sources at wasteload allocations (WLA13) and Willamette Falls of 0.21ºC. An allocation of 0.01ºC to General NPDES permits brings the impact of WLAs plus Willamette Falls LA to 0.22ºC.

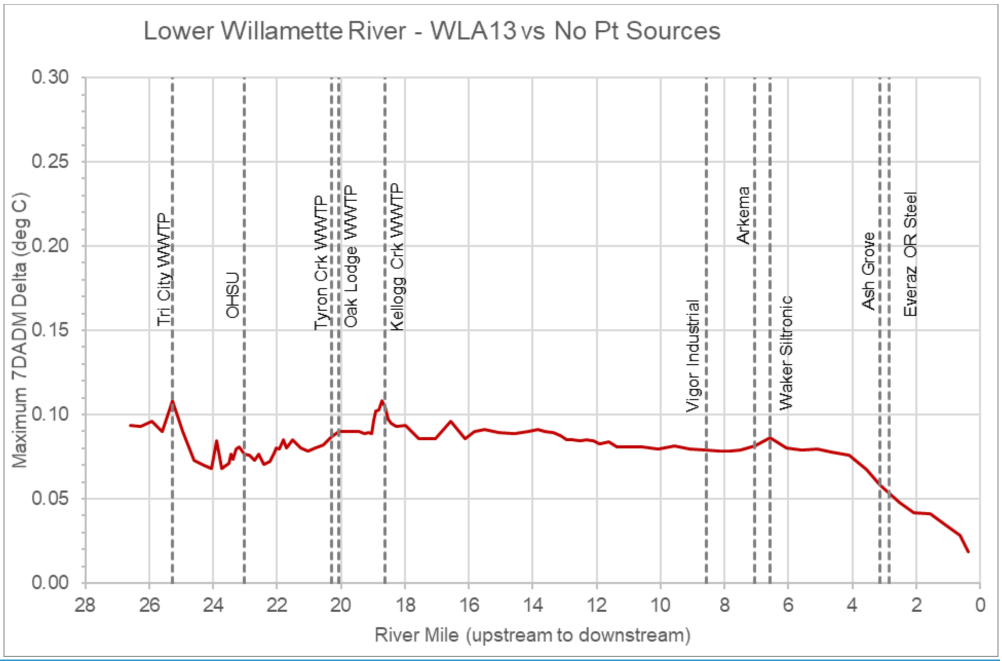


Figure 10-17: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the lower Willamette River over all time periods

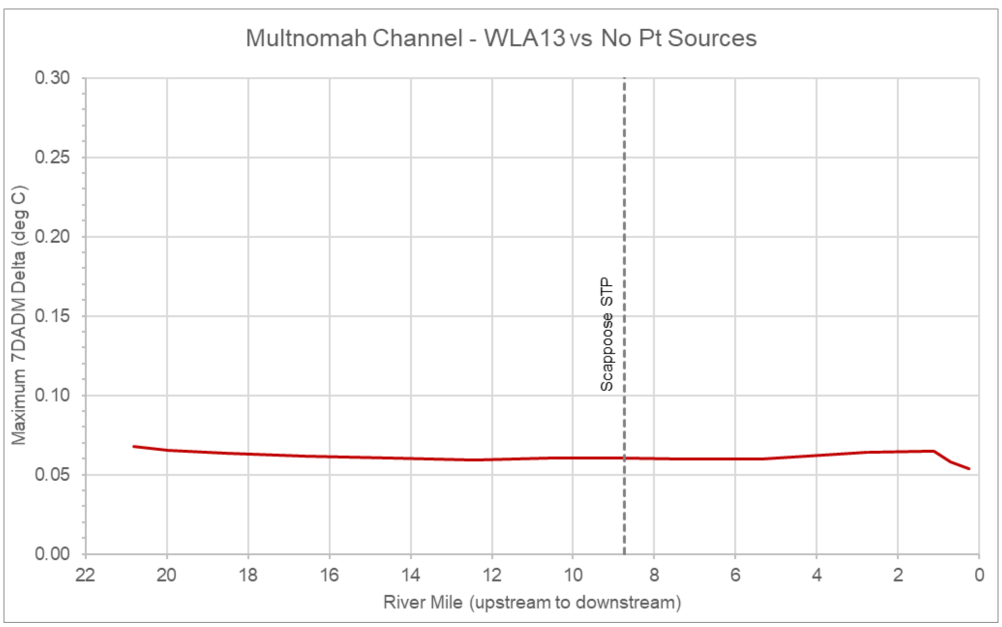


Figure 10-18: Change in maximum 7DADM stream temperatures between the Wasteload Allocations and No Point Sources scenarios for the Multnomah Channel over all time periods

10.2 Nonpoint sources

DEQ's approach to nonpoint source allocations is to distribute portions of the HUA to three nonpoint source categories. Water management activities and water withdrawals are allocated up to 0.05°C, solar loading from existing transportation corridors, existing buildings, and existing utility infrastructure is allocated 0.02°C, and solar loading from all other nonpoint source sectors is allocated 0.0°C of warming.

The portion of the HUA allocated to nonpoint source categories was set to ensure no more than 0.3°C of cumulative warming from all NPDES point sources and nonpoint sources on a given waterbody. The nonpoint source HUA allocation will be implemented by assessing the cumulative warming of a waterbody by all nonpoint sources. This ~~is a margin of safety that~~ ensures cumulative warming from all nonpoint sources will not exceed the portion of the HUA allocated to nonpoint sources.

DMAs responsible for nonpoint source categories are expected to meet their HUA assignments, which were calculated to attain water quality standards. The HUA allocations for nonpoint source categories are achieved through the implementation of load allocations and surrogate measures. DMAs are responsible for implementing management activities that achieve the surrogate measure targets appropriate to their source category and location. A DMA has achieved their load allocation when surrogate measure targets are met. When all DMAs within a nonpoint source category have met their surrogate measure targets and achieved their load allocations, the HUA allocation to that nonpoint source category is achieved.

The dam and reservoir surrogate measure will attain the assigned HUA and load allocation because it targets 7DADM temperatures no warmer than those upstream of the reservoir. The surrogate measure also implements the minimum duties provision in rule at OAR 340-041-0028(12)(a). This provision states that anthropogenic sources are only responsible for controlling the thermal effects of their own discharge or activity in accordance with their overall heat contribution. For dam and reservoir operations, the surrogate measure reflects temperatures upstream of the reservoir (or no dam temperatures), thus ensuring dam operators are only responsible for temperature increases caused by the dam and reservoir operations.

Effective shade surrogate measure targets are set at levels that assume no anthropogenic warming of the stream. When effective shade targets are met, the HUA assignments and load allocations to solar loading from nonpoint sources are achieved.

11 Water quality management plan support

11.1 Adequacy of Agricultural Water Quality Management programs in attaining TMDL load allocations and effective shade surrogate measures

The Oregon Legislature passed the Agricultural Water Quality Management Act in 1993, which directed ODA to adopt rules as necessary and to develop plans to prevent water pollution from agricultural activities (ORS 568.900 to 568.933 and ORS 561.191 and OAR chapter 603, divisions 90 and 95). Subsequently, ODA worked with Local Advisory Committees (LACs) and

Soil and Water Conservation Districts (SWCDs) to develop Agricultural Water Quality Area Rules and Area Plans for 38 watershed-based management areas across the state.

The Willamette Subbasins TMDL includes eight management areas: North Coast, Lower Willamette, Clackamas, Middle Willamette, Molalla-Pudding/French Prairie/North Santiam, South Santiam, Southern Willamette, and Upper Willamette/Upper Siuslaw. Each management area has agricultural water quality regulatory requirements, called Area Rules. Each management area also has an Agricultural Water Quality Management Area Plan, which is not regulatory but guides landowners in how to protect water quality from agricultural activities.

OAR 603-095 require agricultural activities to allow streamside vegetation to establish and grow to provide shade on perennial and some intermittent streams. **Table 11-1** summarizes the streamside management measures required by state law for the seven management areas included in this TMDL. Specific requirements differ depending on the management area; however, most management areas identify vegetation goals based on site capability, which is not clearly defined. However, in OAR 603-095 there are no requirements for streamside vegetation to be established on agricultural lands when streamside vegetation deficiency is not caused by an agricultural activity.

Table 11-1: Summary of OAR 603-095 for streamside management in seven management areas within the Willamette Subbasins Temperature TMDL project area.

Agricultural Water Quality Management Area	Prevention and Control Measures*
North Coast	Allow the natural and managed regeneration and growth of riparian vegetation trees, shrubs, grasses, and sedges along natural waterways to provide shade to moderate water temperatures and bank stability to maintain erosion near background levels. Management activities minimize the degradation of established native vegetation while allowing for the presence of nonnative vegetation. Management activities maintain at least 50% of each year’s new growth of woody vegetation -- both trees and shrubs.
Clackamas Subbasin	Allow the establishment, growth, and/or maintenance of native or non-native riparian vegetation appropriate to site capability, sufficient to encourage shade, protect streamside area during high stream flow events expected to occur in a 25-year, 24-hour storm event.
Lower Willamette	Allow the development of riparian vegetation along streams to provide shade for minimizing solar heating of the stream, streambank stability from flows in a 25-year, 24-hour storm event, filtration, settlement, and biological uptake of sediment, organic material, nutrients, and pesticides in surface runoff by intercepting or slowing overland flow, improvement to water storage capacity of the riparian zone, protection of streams from flashy flows by infiltrating runoff and overland flow. Riparian vegetation includes grasses, sedges, shrubs and trees that are consistent with site capability, and site development can be through allowing natural processes or active management. Management within the riparian area is allowed, and sufficient riparian width is site specific, and may vary by soil type, hydrology, climate, geology, man-made limitations, and other factors.

Agricultural Water Quality Management Area	Prevention and Control Measures*
	Drainage and irrigation ditches are not subject to these prevention control measures.
Molalla-Pudding/French Prairie/North Santiam	Allow natural or managed development of riparian vegetation and riparian function over time along all streams. Riparian width is site specific and may vary, for example by soil type, size of stream, and agricultural use. Natural or managed establishment and maintenance includes riparian vegetation, such as grasses, sedges, shrubs, and trees, appropriate to site capability, that in the normal course of time will provide shade and protect streambank stability from flows at or below those expected in a 25-year, 24-hour storm event.
South Santiam	Allow establishment and maintenance of riparian vegetation consistent with site capability that promotes infiltration of overland flows, moderation of solar heating, and streambank stability. Management within the riparian area is allowed, and minimal breaks in shade vegetation for essential management activities are considered appropriate.
Southern Willamette	Allow establishment and maintenance of vegetation along perennial streams consistent with capability of the site to provide riparian functions necessary to help moderate solar heating and for streambanks to withstand flows in a 25-year, 24-hour storm event.
Upper Willamette/Upper Siuslaw	Allow establishment and development of riparian vegetation along perennial and intermittent streams for streambank stability, shading, and proper riparian function, consistent with site capability. Legally constructed drainage and irrigation ditches are exempt.
Yamhill	Allow the establishment, growth, and/or maintenance of riparian vegetation appropriate to the site. Vegetation must provide shade, protect the streamside area to maintains its integrity during high stream flow events in a 25-year, 24-hour storm event. Any agricultural activity that degrades riparian vegetation will be replanted or restored as soon as practical. Indicator of non-compliance is active streambank sloughing or erosion from tillage, grazing, or destruction of vegetation by landowner or occupier.

*Prevention and Control Measures are identified in OAR for each management area for various agricultural activities. The ones summarized in this table are specific to streamside management.

Each management area has an Area Plan, which is not regulatory and does not establish prohibitions on agricultural activities that may impact water quality or require active restoration on agricultural lands. Instead, Area Plans rely on outreach and education, and voluntary landowner actions to implement conservation and management activities that protect water quality. ODA continues to work with LACs, SWCDs, DEQ and other watershed partners to implement, evaluate, and update Area Plans through their Biennial Review process for each of the management areas included in this TMDL.

As part of the biennial review process, DEQ prepares and submits to ODA specific feedback about water quality in the management areas. DEQ's assessments also address land conditions, agricultural activities, and implementation gaps that likely contribute to water quality impairments. DEQ has identified that a high priority for many management areas is to protect and reestablish riparian vegetation. The Area Plans for the eight management areas included in this TMDL have all been reviewed by DEQ within the last three years. Some of these reviews were completed as part of ODA's light biennial review process; during light reviews ODA convenes members of the LAC to report out on restoration and land management accomplishments and water quality status and trends within the management area, but ODA does not change or update plans during a light review. **Table 11-2** is a summary of the most recent updates for these Area Plans. Updates to Area Plans typically occur during the full biennial review process.

Table 11-2: Summary of the most recent updates to Area Plans, which occur during ODA's full biennial review process.

Agricultural Water Quality Management Area	Date of most recent Area Plan update
North Coast	2018
Clackamas	2022
Lower Willamette	2020
Middle Willamette	2020
Molalla-Pudding/French Prairie/North Santiam	2018
South Santiam	2019
Southern Willamette	2019
Upper Willamette/Upper Siuslaw	2023

ODA, through coordination with agency and local partners, identifies geographic areas of focus, called Strategic Implementation Areas, for targeted outreach to landowners, land condition assessment and enforcement. The SIA process includes an assessment and compliance evaluation of agricultural lands, outreach to landowners, technical assistance, monitoring of water quality and land conditions, and landowner follow up as needed. ODA identified 12 SIAs in the TMDL project area between 2014 and 2021. While ODA has conducted initial landowner outreach and facilitated local SIA planning meetings for some of these SIAs, as of 2023, ODA has reported limited restoration or enhancement projects as an outcome of the SIA process in this TMDL project area.

There continue to be water quality impairments in all seven of the management areas included in this TMDL. Specifically, water temperatures continue to be identified as impaired on Oregon's Section 303(d) list. In addition, results from the modeling and shade gap analyses DEQ completed for this TMDL indicate that extensive riparian areas are deficient in providing shade along streams. The shade gap results for the Southern Willamette model area and the Lower Willamette model area on land managed for agriculture is 53% and 20%, respectively. However, the shade gaps of specific HUC12 watersheds within the model area represent a broad range.

ODA assesses riparian vegetation against the Area Rules for streamside management. The Area Rules are regulatory requirements limited to agricultural activities and are not consistent with and do not include specific reference to the TMDL load allocations for temperature and surrogate shade measures. Area Rules do not apply to agricultural land conditions that are not directly impacted by agricultural activities. It is unclear what steps can be taken when landowners are in compliance with Area Rules, yet land conditions contribute to water quality standard exceedances and are unable to meet TMDL load allocations. There has been a lack of implementation of area plans to achieve TMDL allocations and there are no or few assurances that voluntary landowner action will be able to bridge the gap between current and needed riparian condition and function. ODA has also not been able to adequately incorporate or implement water quality priorities as identified in the 2006 TMDL or as part of the Biennial Review process. Therefore, ODA is required to develop a temperature TMDL implementation plan to be submitted to DEQ for review and approval.

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13 Appendices

The TSD includes the following list of the appendices.:

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Appendix B: City of Portland Shade Model Report
Appendix C: Potential Near-Stream Land Cover
Appendix D: Assessment Units addressed by Temperature TMDLs for the Willamette Subbasins
Appendix E: Southern Willamette Effective Shade Results
Appendix F: Lower Willamette Effective Shade Results
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Appendix I: Stream Buffer Width Literature Review
Appendix J: Tetra Tech McKenzie RiverModel Calibration Report
Appendix K: Tetra Tech Model Scenario Report
Appendix L: DEQ McKenzie River Model Scenario Report
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