TUALATIN RIVER FLOW MANAGEMENT TECHNICAL COMMITTEE

Tualatin River Basin, NW Oregon

2018
Annual Report

prepared by
Bernie Bonn for Clean Water Services

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https://solarsystem.nasa.gov/resources/786/blue-marble-2002/

Tualatin River Flow Management Technical Committee

2018 Annual Report

Prepared by: Bernie Bonn *For:* Clean Water Services

FLOW MANAGEMENT TECHNICAL COMMITTEE MEMBERS

Kristel Griffith, Chair	*City of Hillsboro Water Department*
John Goans	*Tualatin Valley Irrigation District*
Jake Constans	*Oregon Water Resources Department*
Jamie Hughes	*Clean Water Services*
Raj Kapur	*Clean Water Services*
Laura Porter	*Clean Water Services*
Chris Walsh	*Washington County — Emergency Management System*
Mark Rosenkranz	*Lake Oswego Corporation*
Brian Dixon	*City of Forest Grove*

ACRONYMS USED IN THIS REPORT

FULL NAME	ACRONYM
Facilities	
Spring Hill Pumping Plant	SHPP
Wastewater Treatment Facility	WWTF
Organization	
Barney Reservoir Joint Ownership Commission	BRJOC
Clean Water Services	CWS
Joint Water Commission	JWC
Lake Oswego Corporation	LOC
Oregon Department of Environmental Quality	ODEQ
Oregon Department of Fish and Wildlife	ODFW
Oregon Department of Forestry	ODF
Oregon Water Resources Department	OWRD
National Marine Fisheries Service	NMFS
Tualatin Valley Irrigation District	TVID
Tualatin Valley Water District	TVWD
Bureau of Reclamation	BOR
U.S. Fish and Wildlife Service	USFWS
U.S. Geological Survey	USGS

FULL NAME	ACRONYM
Units of Measurement	
Acre-Feet	ac-ft
Cubic Feet per Second	cfs
Micrograms per liter	μg/L
Milligrams per Liter	mg/L
Million Gallons per Day	MGD
Pounds	lbs
River Mile	RM
Water Year	WY
Water Quality Parameters	
Biochemical Oxygen Demand	BOD
Dissolved Oxygen	DO
Sediment Oxygen Demand	SOD
Other	
Biological Opinion	BiOp
Total Maximum Daily Load	TMDL
Wasteload Allocation	WLA

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A. Streamflow—Tables and hydrographs of daily data plus historical record and trends

B. Selected Releases & Withdrawals—Tables and graphs of daily data plus historical record and trends

C. Scoggins Dam Operations (Henry Hagg Lake)—Monthly data reports

D. Barney Reservoir Operations—Monthly data reports

E. Municipal Water Use Allocations—Monthly data tables

F. Temperature Records—Tables and graphs of daily data plus historical record and trends

G. Precipitation Records— Tables and graphs of monthly data plus historical record

H. Water Quality Data: Total Phosphorus— Tables and graphs of data plus historical record and trends

I. Water Quality Data: Nitrate/Nitrite— Tables and graphs of data plus historical record and trends

J. Water Quality Data: Copper & Zinc— Graphs of monthly data including historical record

K. River Mile Indices—River mile locations for the Tualatin River and its major tributaries

2018 SUMMARY

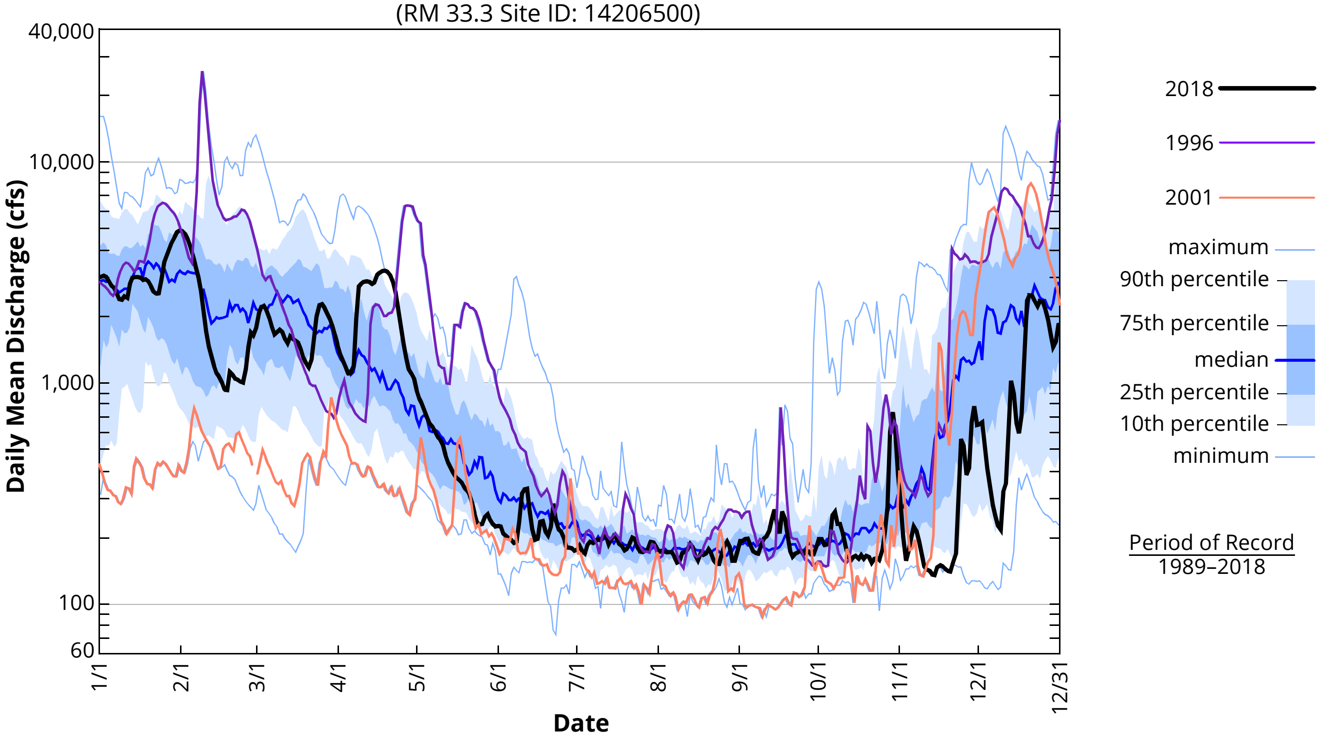
This is the thirtieth year that the Tualatin River Flow Management Technical Committee has prepared an annual report documenting the flow management of the Tualatin River. Members of the committee include Clean Water Services (CWS), Tualatin Valley Irrigation District (TVID), Joint Water Commission (JWC), Lake Oswego Corporation (LOC) and Oregon Water Resources Department (OWRD).

HIGHLIGHTS

- Both Scoggins and Barney Reservoirs effectively filled. The fill curves are on the following page.
- Regulation of river water began on May 26 and continued through November 25. It was briefly suspended October 29 through November 1. At 180 days regulated, 2018 ties 2015 for the second longest regulatory season. The 2001 season was 2 days longer (182 days, May 11–November 13, suspended November 1-5). The latest date of regulation was December 9 in 2002, however, that season was shorter.
- Clean Water Services' releases of stored water began on May 24, their earliest release date on record. Joint Water Commission released stored water for 187 days, their longest season on record.
- The lowest flows of the year in the mainstem Tualatin occurred in November. Lack of rain and smaller releases for flow augmentation and irrigation caused these abnormally late low flows.
- Weather highlights:
  —Late winter and spring were mostly dry. A single storm on April 8-9 accounted for more than a third of the monthly total and resulted in record-setting streamflow at some sites.
  —May was especially dry and set records for lowest monthly precipitation at several locations.
  —Overall, summer was dry and warm, although isolated, short-lived intense showers occurred sporadically. Obtaining data about these storms was difficult because they only affected one or two precipitation stations which may or may not have been located in the Tualatin Basin.
  —Most of November was unusually dry.
- Dissolved oxygen levels in some tributaries were particularly low in 2018. Sharp decreases in DO may have been caused by brief, intense rainstorms. Persistent low DO levels were more likely related to sediment oxygen demand and low flow.

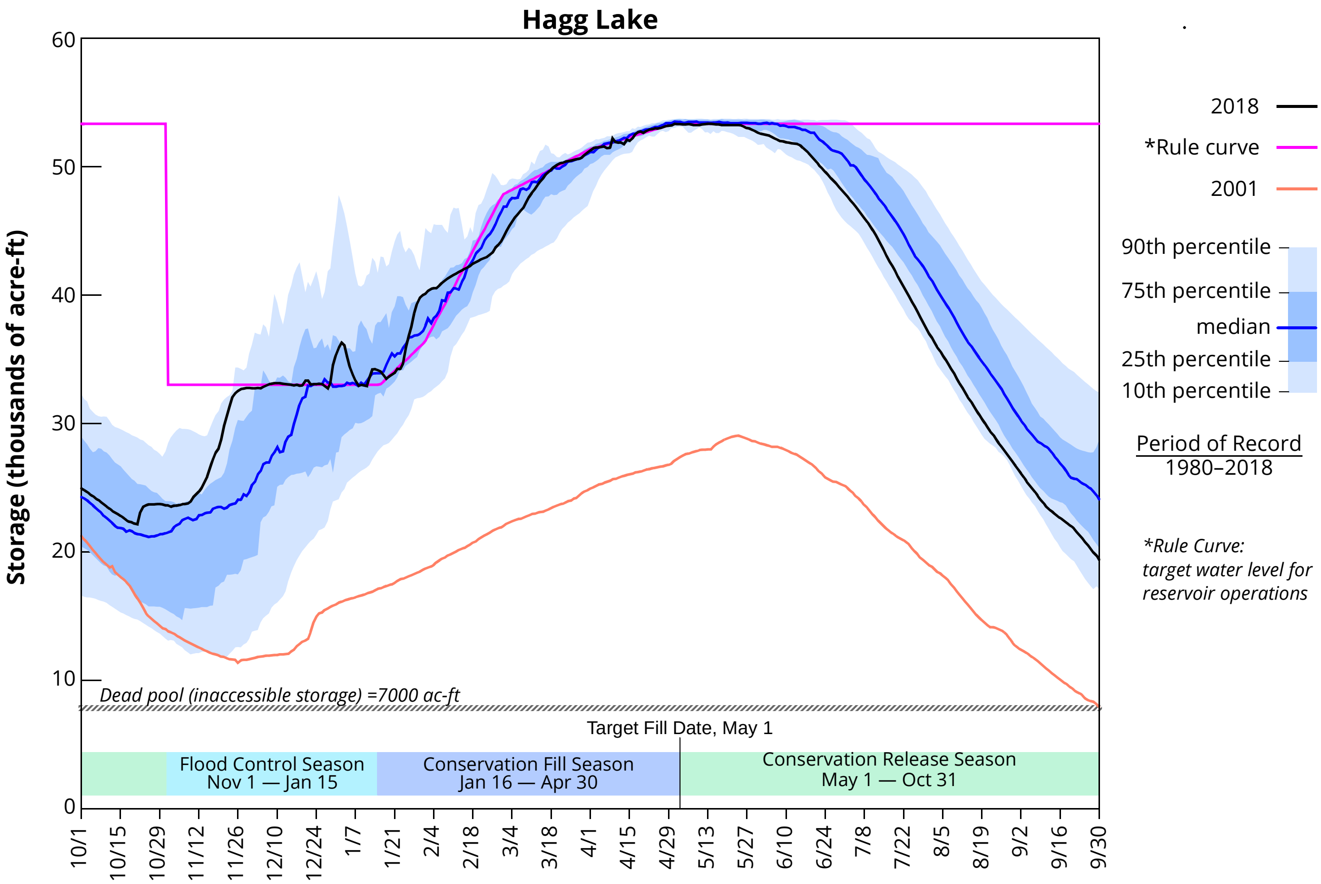
Tualatin River at Farmington 1989–2018

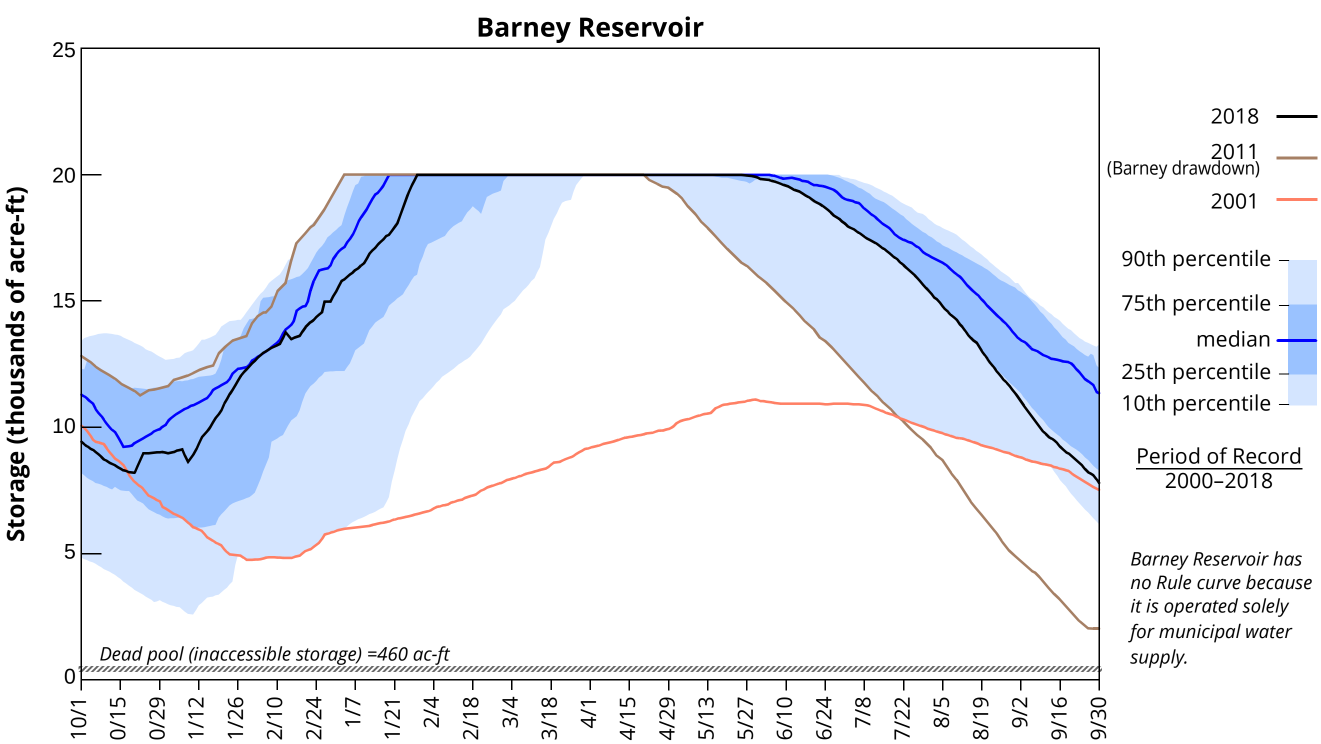
(RM 33.3 Site ID: 14206500)



Reservoir Status

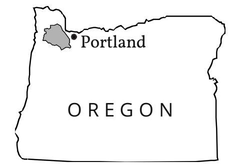
Barney Reservoir filled on January 29, 2018. Hagg Lake was at maximum on May 1, 2018 (53,311 ac-ft, only 12 ac-ft below full pool). The reservoir levels for WY 2018 and the filling histories are shown below.





BACKGROUND

Basin Description

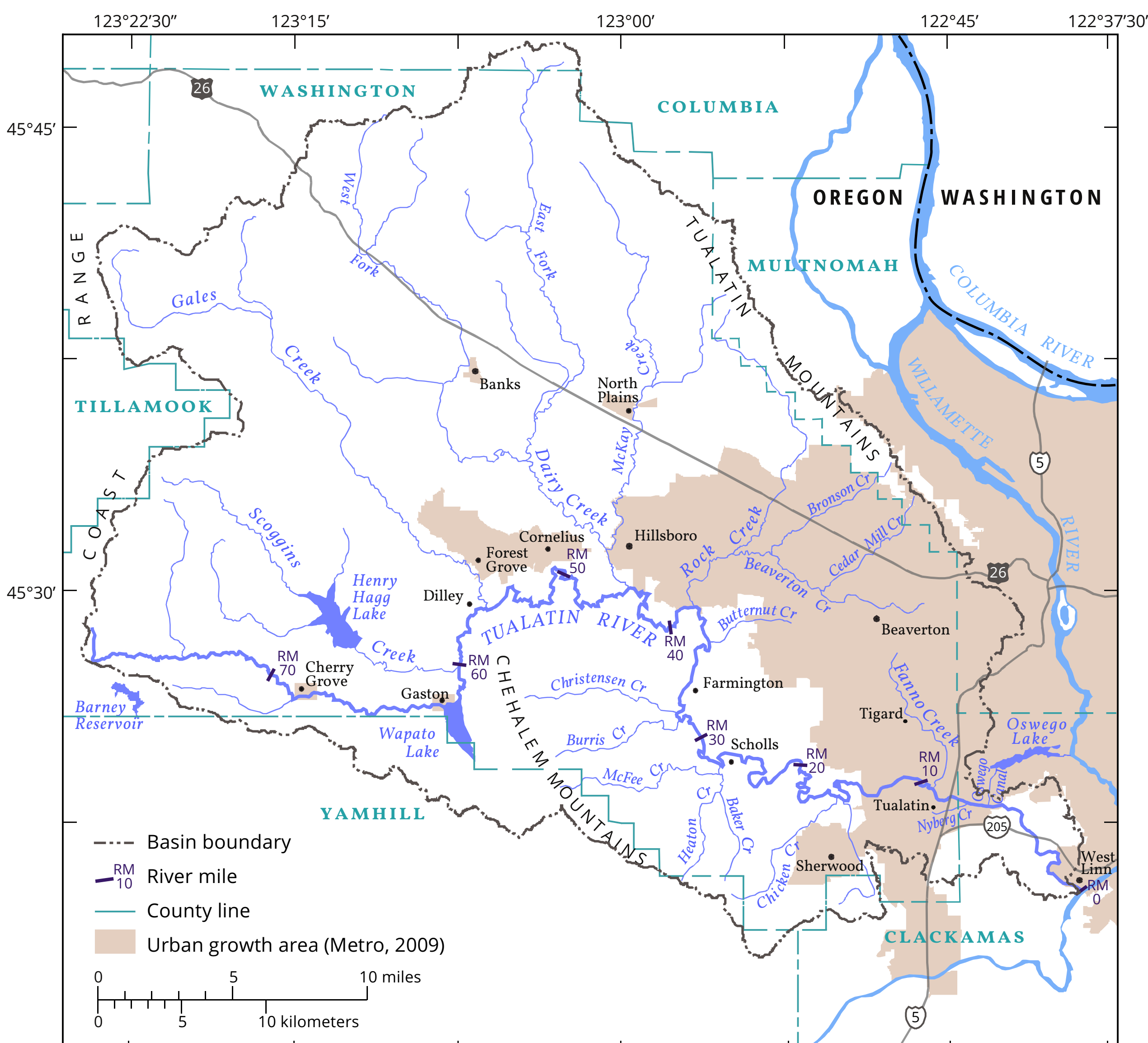


The Tualatin River Basin consists of 712 square miles in the northwest corner of Oregon and is a subbasin of the Willamette River. The basin lies almost entirely in Washington County. (See map below.)

The Tualatin River flows in a generally easterly direction from its headwaters in the Coast Range to its confluence with the Willamette River just upstream of Willamette Falls near West Linn. It can be divided into 4 different reaches.

Reach	Location	Width	Average Slope	Characteristics
Headwater	> RM 55	about 15 ft	74 ft/mi	fast moving, steep terrain
Meander	RM 55–33	about 20–50 ft	1.3 ft/mi	slow moving, meandering on valley bottom
Reservoir	RM 33–3.4	wide, up to 150 ft	0.08 ft/mi	slow moving, lake-like with deep pools
Riffle	RM 3.4–0	variable	10 ft/mi	short reservoir section to a narrow gorge

Tualatin River Basin



Base modified from U.S. Geological Survey 1:100,000 topographic quadrangles, 1978–84

Water sources to the Tualatin River

Precipitation: Seasonal rainfall accounts for most of the natural flow in the Tualatin Basin; streamflow from snowmelt is minimal. The amount of rainfall ranges from 110 inches on the eastern slopes of the Coast Range to 37 inches in the southeastern area of the drainage basin. Peak months for rainfall are November through February while the driest months are normally June through October. The peak streamflow month is usually February and the lowest streamflow month is August. Precipitation records can be found in Appendix G.

Barney Reservoir: Barney Reservoir is located behind Eldon Mills Dam on the Middle Fork of the North Fork of the Trask River (outside of the Tualatin Basin). A trans-basin aqueduct carries water over a low Coast Range divide to a pipeline that discharges into the Tualatin River at RM 78. Barney Reservoir has a capacity of 20,000 acre-feet and stores water for the Joint Water Commission (Cities of Hillsboro, Forest Grove and Beaverton, and the Tualatin Valley Water District) and Clean Water Services. The Barney Reservoir Joint Ownership Commission owns, operates and manages Barney Reservoir. Reservoir content is monitored through calibrated reservoir elevations; water releases are monitored using a stream gage located in the outlet flume. Water is released during the summer low-flow season to supplement shortages in natural flow. The water is used for municipal supply and for instream water quality. Storage in Barney Reservoir is also allocated to the Oregon Department of Fish and Wildlife. Those flows, to the Trask River, are measured using an instream weir. Reports on Barney Reservoir operation can be found in Appendix D.

Hagg Lake: In the early 1970s the Bureau of Reclamation built an earthen dam on Scoggins Creek (RM 5.1). Releases from Henry Hagg Lake (the reservoir behind Scoggins Dam) flow down Scoggins Creek and enter the Tualatin River at RM 60.0. Hagg Lake has an active storage capacity of 53,323 acre-feet. Its water is used for irrigation, municipal and industrial supply, and water quality enhancement.

Scoggins Dam is operated and maintained by the Tualatin Valley Irrigation District under contract with the Bureau of Reclamation. Flow into Scoggins Creek (RM 4.8) is monitored by a Bureau of Reclamation stream gage; Oregon Water Resources Department maintains the rating curve for this site. Reports on Scoggins Dam operation can be found in Appendix C.

Clean Water Services: Clean Water Services provides wastewater treatment, stormwater management, and watershed management services primarily in urban areas of Washington County. A watershed-based NPDES permit allows Clean Water Services to discharge treated wastewater into the Tualatin River from four wastewater treatment facilities (WWTFs). The Rock Creek and Durham WWTFs (RM 38.1 and 9.3, respectively) are the largest. The Forest Grove and Hillsboro WWTFs (RM 55.2 and 43.8, respectively) are much smaller and prior to 2017 did not discharge during the dry season (generally May–October). In 2017, Clean Water Services began treating wastewater from the Forest Grove and Hillsboro service areas during the dry season at the Forest Grove WWTF and then directing it through a 95-acre natural treatment system (NTS) at Forest Grove prior to discharge into the Tualatin River at RM 55.2. WWTF flow rates are continuously monitored at each WWTF. Clean Water Services also releases storage water from Hagg Lake and Barney Reservoir for flow augmentation during the summer and early fall. (River mile locations given here are based on USGS topographic maps and may be slightly different from those used in Clean Water Services' watershed-based NPDES permit which are from a different source.)

Water sources to the tributaries

Clean Water Services: Clean Water Services cooperates with the Tualatin Valley Irrigation District to deliver water to several tributaries for flow restoration in the summer. Approximately 1 to 2.5 cfs of water has been added to McKay Creek every year since 2005. Similar measures have been implemented for Gales Creek (2009), East Fork Dairy Creek (2010), and West Fork Dairy Creek (2011). The goal of the program is to improve water quality, specifically increasing the dissolved oxygen concentration and decreasing stream temperature. The flow augmentation water for the tributaries is from Clean Water Services' allocation in Hagg Lake and is delivered by TVID transmission lines.

Water diversions from the Tualatin River

Cherry Grove Intake (RM 73.2): The City of Hillsboro diverts water for municipal and industrial uses at the Cherry Grove Intake. This water is delivered to the rural residents of the Dilley and Cherry Grove areas (served by the City of Hillsboro), as well as the City of Gaston and the LA Water Cooperative (as Hillsboro wholesale customers). The diversion is less than 3 cfs and is monitored via metered flows.

Spring Hill Pumping Plant (RM 56.3): The Spring Hill Pumping Plant is the largest diversion facility on the river. It is owned by the Bureau of Reclamation (BOR) and operated jointly by the Tualatin Valley Irrigation District (TVID) and the Joint Water Commission (JWC). TVID, with a pumping capacity of approximately 90 MGD (140 cfs), delivers water to about 12,000 acres of irrigated cropland via a pressure pipeline. JWC, with a pumping capacity of approximately 86 MGD (133 cfs), delivers water to the Cities of Hillsboro, Forest Grove and Beaverton, to the Tualatin Valley Water District, and to the wholesale customers of these entities. Both TVID and JWC have natural flow water rights. When natural flow is not adequate, the Washington County Watermaster (part of the Oregon Water Resources Department) curtails some water rights. At that time, TVID and JWC release contracted stored water from Hagg Lake and Barney Reservoir to augment the low natural flow. Pumping rates are monitored by TVID and JWC using telemetry-equipped flow meters. Additional monitoring is provided by real-time stream gages on the Tualatin River located above and below the pumping plant and on Gales Creek.

Wapato Canal Diversion: Historically, TVID diverted water from the Tualatin River at the Wapato Canal Diversion (near RM 62), to the Wapato Improvement District and to surrounding TVID customers. The Wapato Improvement District drained Wapato Lake each year and its members farmed the lake bed. From 2007–2013, ownership of Wapato Lake transitioned to the US Fish and Wildlife Service who now manages it as the Wapato Lake National Wildlife Refuge. The duties of the now defunct Wapato Improvement District have been split between USFWS (to maintain the dike and levee system), and TVID (to operate and maintain the irrigation water delivery system). At this time flow in the Wapato Canal Diversion is not monitored.

Irrigation Withdrawals: Water is obtained directly from the Tualatin River for irrigation purposes by members of the TVID and by irrigators with natural flow water rights. About 5,000 acres of cropland served by TVID is irrigated with water obtained directly from the Tualatin River. Some of the discharge from the Rock Creek WWTF (RM 38.1) is contracted to TVID to be used by downstream irrigators.

Patton Valley Pump Plant: Tualatin Valley Irrigation District pumps water from Scoggins Creek (RM 1.71) into a low-pressure pipeline that serves customers along Patton Valley Road. Historically, this pipeline also diverted water into the upper Tualatin River (at RM 63.1 and RM 64.3) to supplement low flows in this reach, but this has not been needed in recent years due to releases from Barney Reservoir.

Oswego Lake Canal Diversion: The Lake Oswego Corporation (LOC) diverts a portion of the Tualatin flow into the Oswego Lake Canal at RM 6.7. A headwork structure regulates the flow into this mile long canal that feeds into Oswego Lake. The Lake Oswego Corporation has several natural flow water rights, including rights for hydropower generation, irrigation, and lake level maintenance. At RM 3.4, a combination diversion dam/fish ladder structure is used during low flow periods to elevate the Tualatin River enough to divert the flow into the canal. During most of the year, river elevation is adequate to allow diversion of the LOC water right. Historically, flash boards were installed to increase the water level during the summer, but they have not been used since 2003. The dam plus several natural basalt sills cause the water to pool in the reservoir reach. Flow in Oswego Lake Canal was monitored during the summer by a gaging station operated by the Oregon Water Resources Department, but that site was discontinued partway through 2011 and is not currently monitored.

Water diversions from the tributaries

Irrigation withdrawals: Water is obtained directly from some tributaries for irrigation by irrigators with natural flow water rights.

Tualatin River Water Management

Tualatin River Flow Management Technical Committee: The Tualatin River Flow Management Technical Committee provides a mechanism for the coordination and management of flow in the Tualatin River. The members of the committee are technical staff with detailed knowledge of the specific characteristics of flow in this river. The committee meets monthly from April through November. Meetings focus on the current status of the reservoirs. In addition, a variety of other water issues and any problems are discussed. Each member updates the committee on changes that could impact the flow management of the Tualatin. The communication, coordination and cooperation among the partner agencies has proven invaluable in managing the resource.

Data collection system: Water in the Tualatin Basin is monitored by gages on streams and flow meters on major diversions and wastewater treatment facility discharges. Stream gages are present along the mainstem Tualatin and all major tributaries that affect water distribution. Various water quality parameters are monitored at a several sites. Many of these monitors have telemetry, making the data available in real-time. Throughout the season, daily operations can be monitored by Clean Water Services (CWS), Joint Water Commission (JWC), Tualatin Valley Irrigation District (TVID), and the Lake Oswego Corporation (LOC). A map showing monitoring locations is shown on the next page. Selected data are in the appendices of this report.

A coordinated information system was developed to provide flow information to all members of the committee. Flow conditions and a summary of daily releases are reported via daily email by the superintendent of Scoggins Dam. The JWC provides a daily email containing information about the rate of intake at the Spring Hill Pump Plant, releases from Scoggins and Barney Reservoirs, and available natural flow. Because use or release of water by any one of the entities can impact the other users, coordination of flow information is an important aspect of the committee's work.

The monitoring effort makes it possible to proactively manage storage, instream flows, and diversions so that minimum instream flow requirements and general compliance with water rights and storage agreements are met. Flow data are also required to calculate pollutant loads, which are necessary for the Total Maximum Daily Load (TMDL) program. Monitoring includes temperature as well as flow at some sites. As water quality issues have come to the forefront, the monitoring system has provided information vital to understanding the Tualatin Basin, helped guide basin management, and been an excellent example of interagency cooperation. The members of the Flow Management Committee appreciate the efforts all those who provide data.

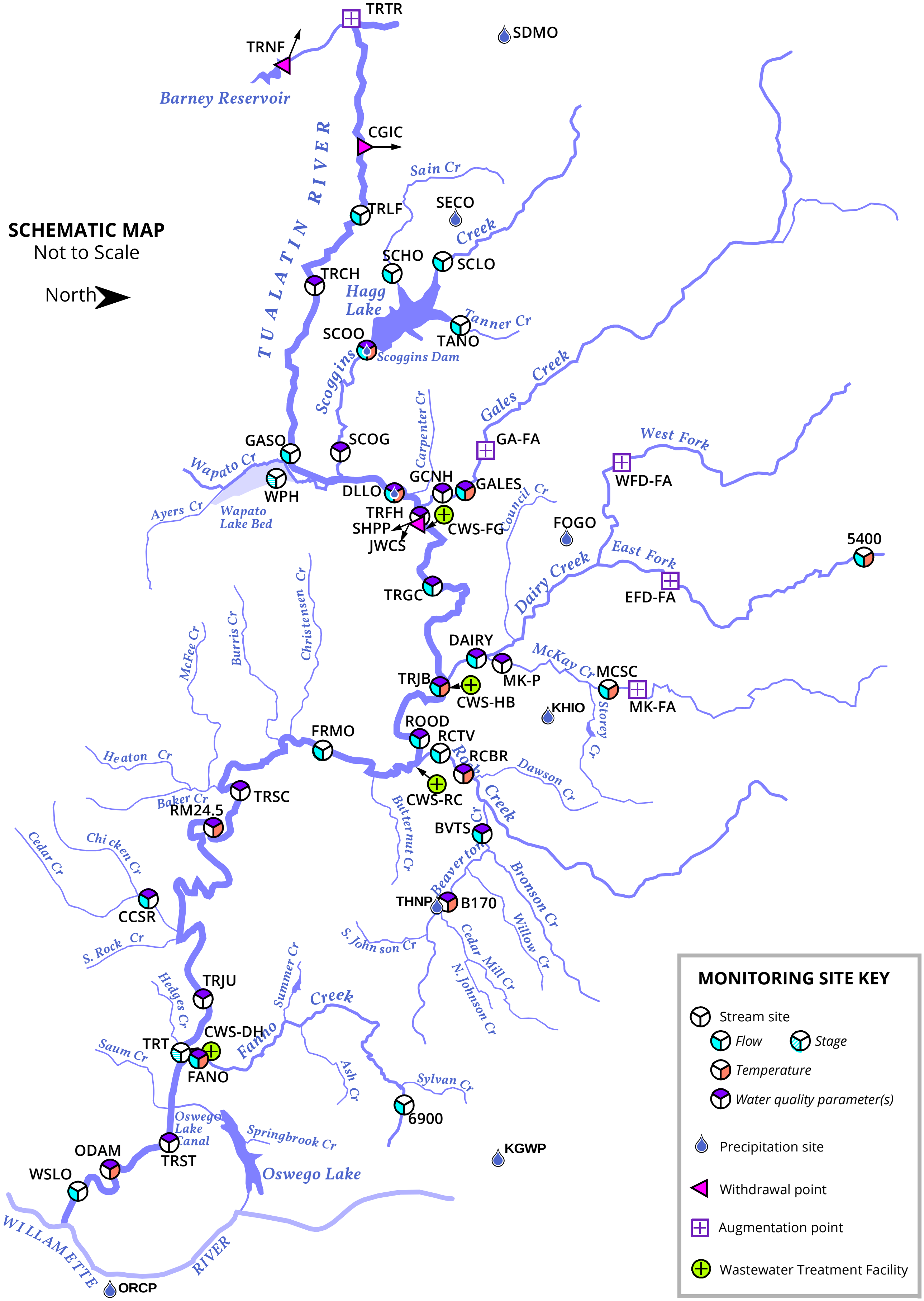
Some of the monitoring data for the Tualatin Basin can be accessed at the following web sites:

- Bureau of Reclamation data:
  `https://www.usbr.gov/pn/hydromet/tuatea.html`
- Jackson Bottom Wetlands Center data:
  `https://or.water.usgs.gov/cgi-bin/grapher/graph_setup.pl?basin_id=tualatin&site_id=14206241`
- Oregon Water Resources Department data:
  `https://apps.wrd.state.or.us/apps/sw/hydro_near_real_time/`
- USGS data:
  `https://or.water.usgs.gov/tualatin/monitors/`

Annual Tualatin Basin Flow Management Report: This report is published annually and describes water management, accounting, storage, stream gaging, diversions, and effluent discharge for the Tualatin Basin. Annual reports dating from 1992 are available at:

`https://www.co.washington.or.us/Watermaster/SurfaceWater/tualatin-river-flow-technical-committee-annual-report.cfm`

Tualatin Basin Monitoring Sites



2018 MONITORING SITES — ALPHABETICAL LISTING BY SITE CODE

Location in Report
- Main: Water Quality
- Appendix A
- Appendix B
- Appendix F
- Appendix G
- Appendix H
- Appendix I
- Appendix J
- □ Monitored, but not in report

Code	Site Name	Flow	Precipitation	Continuous Monitors: Temp	DO	pH	Cond	Turb	Chl-*a*	fDOM	Ambient Monitoring: Phos	NO3	Cu Zn
Stream monitoring sites													
5400	East Fork Dairy Creek near Meacham Corner, OR	A		F									
6900	Fanno Creek at 56th Avenue	A											
B170	Beaverton Creek at 170th Ave, Beaverton, OR			F	Main	□	Main	Main					
BVTS	Beaverton Creek at Cornelius Pass Road (near Orenco)	A									H	I	J
CCSR	Chicken Creek at Roy Rogers Rd near Sherwood, OR	A									H	I	J
DAIRY	Dairy Creek at Hwy 8 near Hillsboro, Oregon	A									H	I	J
DLLO	Tualatin River at Dilley, Oregon	A	G	F		□	□	□	□	□			
FANO	Fanno Creek at Durham Road near Tigard, Oregon	A		F	Main	Main	□	Main			H	I	J
FOGO	Forest Grove, Oregon AgriMet Weather Station (Verboort)		G										
FRMO	Tualatin River at Farmington, Oregon	A											
GALES	Gales Creek at Old Hwy 47 near Forest Grove, Oregon	A		F	Main	□	□	□		Main			
GASO	Tualatin River at Gaston, Oregon	A											
GCNH	Gales Creek at New Hwy 47										H	I	J
KGWP	KGW-TV Weather Station		G										
KHIO	Hillsboro Airport Weather Station		G										
MK-P	McKay Creek at Padgett Rd										H	I	J
MCSC	McKay Ck at Scotch Church Rd abv Waible Ck nr North Plains	A		F									
ODAM	Tualatin River at Oswego Dam near West Linn, Oregon			F	Main	Main	□	□	Main				
ORCP	Oregon City Precipitation Station		G										
RCBR	Rock Creek at Brookwood Avenue, Hillsboro, Oregon			F	Main	□	□	Main			H	I	J
RCTV	Rock Creek at Hwy 8 near Hillsboro, Oregon	A											
RM24.5	Tualatin River at RM 24.5 near Scholls, Oregon			F	Main	□	□						
ROOD	Tualatin River at Rood Bridge Road near Hillsboro, Oregon	A									H	I	J
SCHO	Sain Creek above Henry Hagg Lake near Gaston, Oregon	A											
SCLO	Scoggins Creek above Henry Hagg Lake near Gaston, Oregon	A											
SCOG	Scoggins Creek near Gaston										H	I	J
SCOO	Scoggins Creek below Henry Hagg Lake near Gaston, Oregon	A	G	F	Main	□	□	□					
SDMO	Saddle Mountain Precipitation Station (SNOTEL #726)		G										
SECO	Sain Creek Precipitation Station (SNOTEL #743)		G										
TANO	Tanner Creek above Henry Hagg Lake near Gaston, Oregon	A											
THNP	Tualatin Hills Nature Park Precipitation Station		G										
TRCH	Tualatin River at Cherry Grove (South Rd Bridge)										H	I	
TRFH	Tualatin River at Fern Hill Rd										H	I	J
TRGC	Tualatin River at Golf Course Road near Cornelius, Oregon	A									H	I	J
TRJB	Tualatin River at Hwy 219 Bridge	A		F	□	□	□	□			H	I	J
TRJU	Tualatin River at Jurgens Park										H	I	J
TRLF	Tualatin River below Lee Falls near Cherry Grove, Oregon	A											
TRSC	Tualatin River at Hwy 210 (Scholls Bridge)										H	I	J
TRST	Tualatin River at Stafford										H	I	
TRT	Tualatin River at Tualatin, Oregon	Stage											
WPH	Wapato Canal at Pumphouse at Gaston, Oregon	Stage											
WSLO	Tualatin River at West Linn	A											
Monitored withdrawals and releases													
CGIC	City of Hillsboro Withdrawal at Cherry Grove	B											
CWS-DH	CWS Durham WWTF Discharge	B											
CWS-FG	CWS Forest Grove WWTF Discharge (with Fernhill NTS)	B											
CWS-HB	CWS Hillsboro WWTF Discharge	B											
CWS-RC	CWS Rock Creek WWTF Release	B											
EFD-FA	CWS East Fork Dairy Flow Augmentation with TVID	B											
GA-FA	CWS Gales Creek Flow Augmentation with TVID	B											
JWCS	Joint Water Commission Withdrawal at Spring Hill Pump Plant	B											
MK-FA	CWS McKay Creek Flow Augmentation with TVID	B											
SHPP	TVID–Withdrawal at Spring Hill Pump Plant	B											
TRNF	Barney Reservoir Measured Flow to North Fork Trask River	B											
TRTR	Barney Reservoir (Trask River) Release to Tualatin River	B											
WFD-FA	CWS West Fork Dairy Flow Augmentation with TVID	B											

Abbreviations: Temp=water temperature, DO=dissolved oxygen, Cond=conductance, Turb=turbidity, chl-*a*= =chlorophyll-*a*, fDOM=fluorescent dissolved organic matter; Phos=total phosphorus & soluble reactive phosphorus; NO3=nitrate+nitrite, Cu=copper, Zn=zinc

CLEAN WATER SERVICES

by Raj Kapur and Jamie Hughes, Clean Water Services

Introduction

Clean Water Services (the District) provides wastewater treatment, stormwater management, and watershed management to more than 600,000 customers primarily in the urban areas of Washington County. The District implements these programs in cooperation with twelve cities (Banks, Beaverton, Cornelius, Durham, Forest Grove, Gaston, Hillsboro, King City, North Plains, Sherwood, Tigard, and Tualatin) and Washington County.

Wastewater treatment: The District owns and operates four wastewater treatment facilities (WWTFs) at sites in Forest Grove, Hillsboro, and Tigard. The Rock Creek and Durham WWTFs are large and discharge directly to the Tualatin River year-round.

Rock Creek Wastewater Treatment Facility

The Forest Grove and Hillsboro WWTFs are considerably smaller than the other two facilities. They discharge to the Tualatin River through their respective outfalls only during the wet season. During the dry season (typically May–October), wastewater from the Forest Grove and Hillsboro service areas is treated at the Forest Grove WWTF and then directed through a 95-acre natural treatment system (NTS) at Forest Grove before being discharged into the Tualatin River.

Durham Wastewater Treatment Facility

Stormwater management: Clean Water Services also implements the municipal separate storm sewer system (MS4) program in the urban parts of the Tualatin River watershed.

Watershed management: Activities occur across the entire Tualatin watershed and include streamflow enhancement in the mainstem Tualatin River and tributaries, and riparian and stream restoration.

Permits: The four WWTFs and the MS4 program are permitted by the Oregon Department of Environmental Quality (ODEQ) under a watershed-based National Pollutant Discharge Elimination System (NPDES) permit.

FLOW AUGMENTATION PROGRAM

During the summer low-flow season, Clean Water Services releases stored water to the Tualatin River and several tributaries. The District has rights to 24% of the water in Hagg Lake, which equates to 12,618 ac-ft. The District also owns 10% of the water in Barney Reservoir, which equates to 1,654 ac-ft after accounting for dead pool and required Oregon Department of Fish and Wildlife (ODFW) releases to the Trask River. In all, the District has 14,272 ac-ft of stored water available for use. The stored water releases serve multiple purposes including the following:

Maintain minimum stream flows: One of the purposes of the stored water releases is to maintain stream flows in the Tualatin River to ensure that the minimum dilutions are met at the WWTFs during summer and fall low flow conditions.

Offset thermal load from the District's WWTFs: The watershed-based permit provides Clean Water Services with a mechanism to offset a portion of the thermal load discharged from the Rock Creek and Durham WWTFs and the Forest Grove WWTF and NTS by releasing stored water from Scoggins and Barney Reservoirs. Stored water releases in July and August form the basis of the flow augmentation credit. The District offsets the remainder of its thermal load by planting riparian areas in the Tualatin River basin to increase shading of the stream channel.

Provide sustainable base flows in the upper Tualatin River: During the dry season, Clean Water Services' releases from Hagg Lake and Barney Reservoir can account for more than half of the flow in the Tualatin River in the 20-mile stretch between the Spring Hill Pump Plant (where water is withdrawn for municipal and irrigation uses) and the Rock Creek WWTF (where highly treated water discharged from the Rock Creek WWTF enters the river). The stored water releases provide sustainable base flows that provide habitat for aquatic life and result in cooler river temperatures and higher dissolved oxygen levels.

Improve dissolved oxygen levels and enhance overall water quality in the lower Tualatin River: During the low flow season (summer and early fall) oxygen levels in the lower Tualatin River are heavily influenced by sediment oxygen demand. Sediment oxygen demand is consumption of oxygen by decaying substances in river sediment. When days are long and sunny, photosynthetic production of oxygen by algae tends to offset the oxygen consumed by sediment oxygen demand. However, when days grow short (September-October), or when it is cloudy, photosynthetic production of oxygen does not keep up with consumption of oxygen by sediment oxygen demand, causing oxygen levels to decrease. Clean Water Services' stored water releases from Hagg Lake and Barney Reservoir decrease the effect of sediment oxygen demand, thereby limiting the declines in dissolved oxygen levels in the lower Tualatin River that usually occur during the late summer/early fall period when photosynthetic oxygen production wanes.

Maintaining adequate dissolved oxygen is important for aquatic life and the general health of the river. In addition, dissolved oxygen levels measured downstream of the WWTFs are used to calculate the ammonia limits specified in the watershed-based NPDES permit.

Restore stream flows in Tualatin River tributaries: Clean Water Services uses Tualatin Valley Irrigation District transmission lines to deliver stored water to select tributaries to restore flow and improve water quality. In 2018, Clean Water Services released stored water into Gales Creek, West Fork Dairy Creek, East Fork Dairy Creek, and McKay Creek. Details are in Appendix B.

WASTEWATER DISCHARGES

A watershed-based NPDES permit allows Clean Water Services to discharge treated wastewater into the Tualatin River from its WWTFs. A summary of the discharges is shown below. Details are in Appendix B.

WASTEWATER TREATMENT FACILITY DISCHARGES 2018

ROCK CREEK WWTF annual average	DURHAM WWTF annual average	FOREST GROVE WWTF AND NTS* annual average	HILLSBORO WWTF wet season average**
50.1 cfs [32.4 MGD]	32.0 cfs [20.7 MGD]	5.49 cfs [3.55 MGD]	7.55 cfs [4.88 MGD]

*Discharge during the dry season (generally May–October) is through the NTS. Discharge at other times could be either through the NTS or the WWTF outfall or both.
**Wet season is generally January–April plus November and December; dry season is generally May–October

2018 WATER RELEASES FOR FLOW AUGMENTATION

Clean Water Services released flow augmentation water for 176 days in 2018. The total average daily release (for days with releases) was 39.5 cfs. In all, 13,807 acre-feet were released. This is 97% of the District's allocation and almost as much as its water releases in 2015. The amount of water available to and released by Clean Water Services during 2018 is summarized below.

CLEAN WATER SERVICES WATER AVAILABILITY AND USE — 2018

RESERVOIR		MAXIMUM AVAILABLE (acre-ft)	AVAILABLE (acre-ft)	TOTAL CWS RELEASE (acre-ft)
Hagg Lake	Storage	12,618	12,618	12,132
	Natural flow credit	4,282	0	—
Barney Reservoir	Storage	2,000	1,654	1,674
	Summer storage*	—	0	—
Total		**18,900**	**14,272**	**13,807**
Percent of available				**96.7%**

*Summer storage is water from rain that is stored in Barney Reservoir after releases have begun for the season. Summer storage (when it occurs) is allocated among the members of the Barney Partnership.

Details by month and reservoir: Stored water releases from Hagg Lake for Clean Water Services began with 10 cfs on May 24. Releases increased over the course of the summer to a maximum of 60 cfs in late August. Average daily releases were 46.0 cfs (July/August period) and 60.3 cfs (September). Because the weather remained dry, releases persisted well into fall. The last day was November 26, the latest date since 2000. The District began releasing water from Barney Reservoir at a rate of 4 cfs on August 29 and increased the rate to 14 cfs on August 30. Releases from Barney Reservoir remained constant at 14 cfs for the remainder of the season. The last release day for Barney Reservoir was October 28. Details of releases by month are shown in the table below.

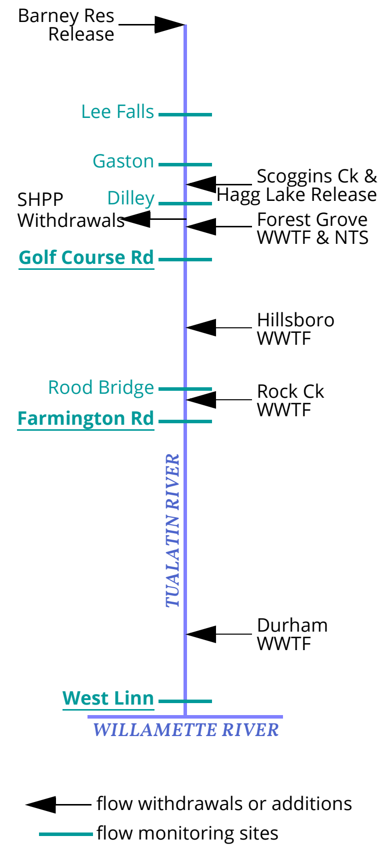
CLEAN WATER SERVICES WATER RELEASE SUMMARY — 2018

	UNITS	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV 1-26	TOTAL
Hagg Lake Release	acre-ft	159	417	2,411	3,254	2,758	2,381	754	12,132
	days	8	21	31	31	30	31	24	176
Barney Release	acre-ft	0	0	0	63	833	778	0	1,674
	days	0	0	0	3	30	28	0	61
Total Release	acre-ft	159	417	2,411	3,317	3,591	3,159	754	13,807
Daily Average Release (for days with releases)	cfs	10.0	10.0	39.2	53.9	60.3	51.4	23.8	39.5

Flow augmentation effects on Tualatin River flow— 2018

Clean Water Services monitors flow in the upper, middle and lower reaches of the river to inform the management of its stored water releases. The figure at the right illustrates the locations of several significant additions and withdrawals along with several key monitoring sites.

KEY SITES
MAINSTEM TUALATIN RIVER



Flow targets in the Tualatin River have evolved as the understanding of the river has changed and new objectives were added. The District began managing stored water releases in 1987 with a goal of preventing the large nuisance algal blooms that were then common during the summer. In the early 1990s, work by the US Geological Survey showed that releasing water in the late fall could improve low oxygen conditions by lessening the expression of sediment oxygen demand and the District increased late season flow targets. Flow targets changed again in 2004 when stored water releases were allowed to offset some of the thermal loads from the WWTFs. New mixing zone studies have also affected flow targets as have effluent load limits which are calculated from river flows. The current flow targets are used at three key sites and are applied for the entire dry season (May–October).

FLOW TARGETS AND MEASURED FLOWS AT KEY SITES — 2018

	Golf Course Rd	Rood Bridge Rd	Farmington Rd
Flow target	60 cfs	110 cfs	160 cfs
Daily mean flow (May–October)			
minimum	64 cfs	106 cfs	153 cfs
average	117 cfs	188 cfs	244 cfs

Low flow period: For the purposes of discharges from the WWTFs, the low flow period is defined as beginning on the first day after April 30 when the 7-day consecutive median flow in the Tualatin River at Farmington is less than 250 cfs or July 1, whichever is earlier. Similarly, the low flow period ends on the first day after September 30 when the 7-day consecutive median flow in the Tualatin River at Farmington is at least 350 cfs or November 15, whichever is earlier. The low flow period for the WWTFs was from May 30 through October 30 in 2018.

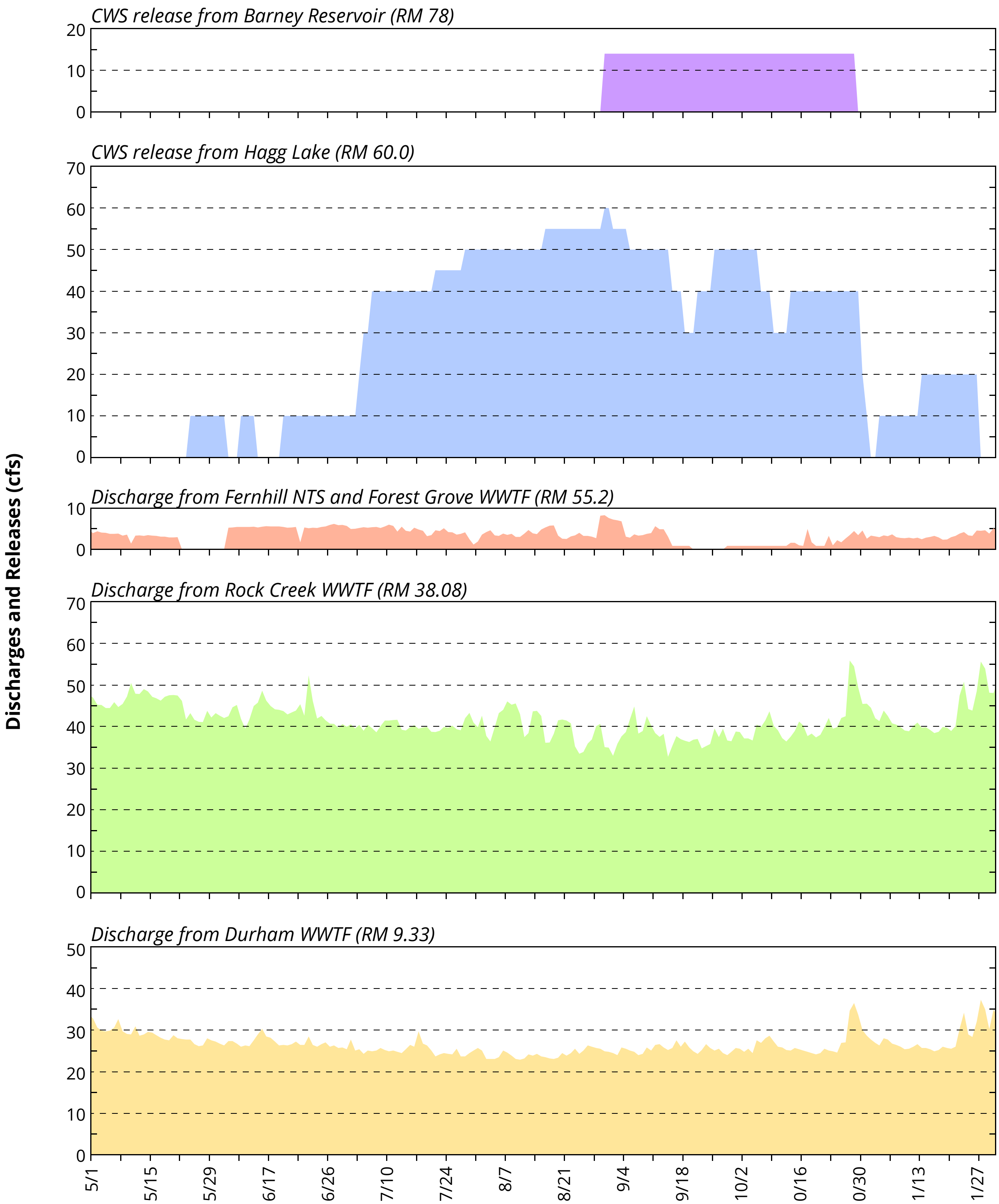
In 2018, flow decreased after October 30th, and although this did not alter the regulatory low flow period for the WWTFs, it did affect decisions regarding flow augmentation for water quality management. Releases from Hagg Lake continued through November 26.

With its releases of stored water and discharge from the WWTFs, the District generally was able to maintain minimum stream flows, offset thermal loads from the WWTFs, provide sustainable base flows in the upper Tualatin River and key tributaries and improve overall water quality. Flow management will continue to be vital as the population in Washington County increases.

Releases and discharges: The graph on the following page shows Clean Water Services' flow augmentation from Barney Reservoir and Hagg Lake, and discharges from the WWTFs and NTS for May through November 2018. Graphs on pages 17, 18 and 19 illustrate the importance of the District's contributions to total flow at three key sites:

- Golf Course Road (RM 51.5) is located downstream of major withdrawals by JWC and TVID at the Spring Hill Pump Plant (RM 56.3) and small discharges from the Fernhill NTS and Forest Grove WWTF (RM 55.2).
- Farmington Road (RM 33.3) is located downstream of the Rock Creek WWTF (RM 38.08) and includes flows from Dairy and Rock Creeks and their tributaries.
- West Linn (RM 1.75) is located downstream of the Durham WWTF (RM 9.33). Several small tributaries also enter the Tualatin River between Farmington and West Linn.

Clean Water Services Releases and Discharges to Tualatin River — 2018

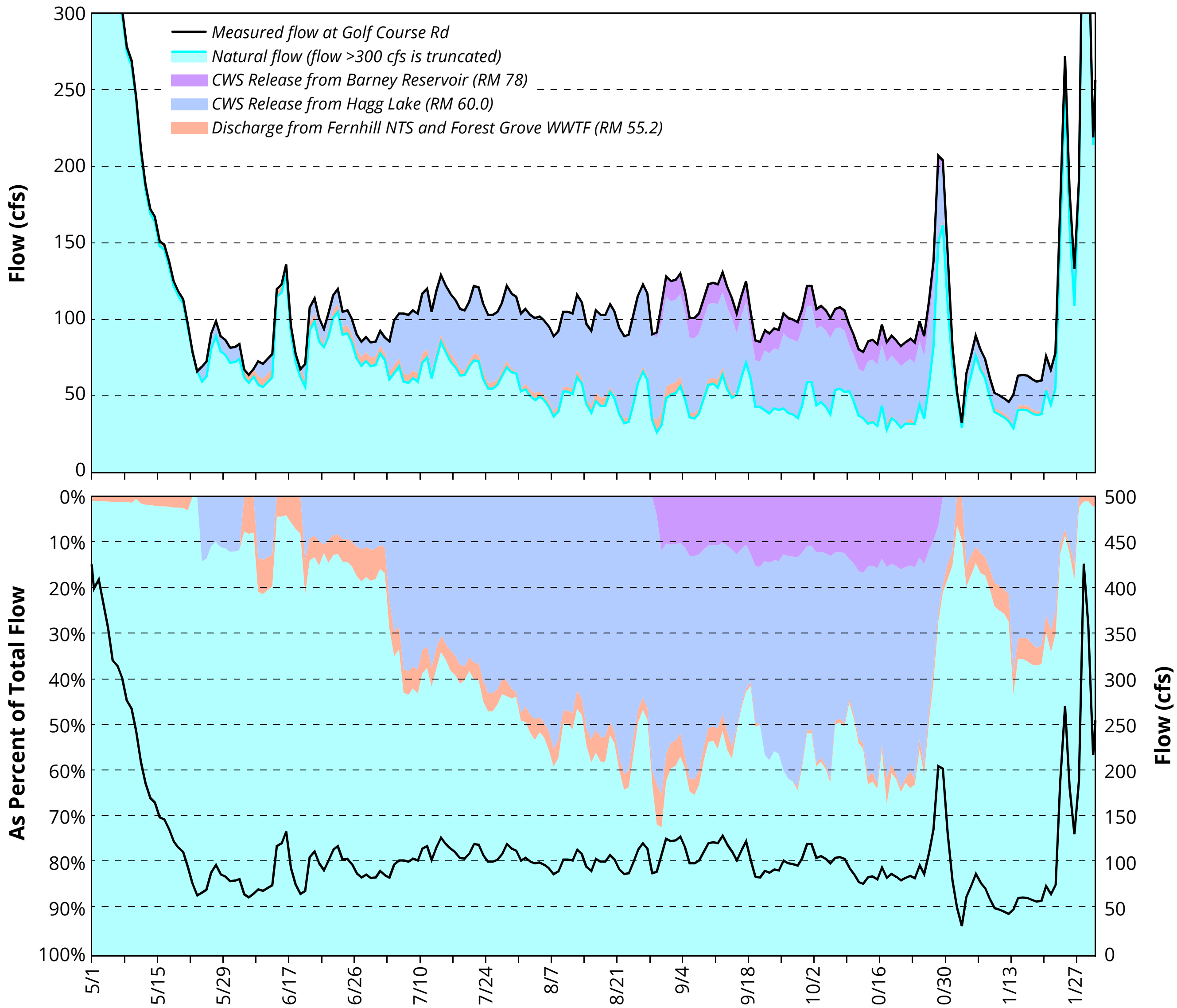


Upper Tualatin River — Golf Course Road site: The graph below shows flow at the Golf Course Rd site (RM 51.5). Flow at this site includes natural flow from the Tualatin River headwaters and Gales Creek plus storage water from Barney Reservoir and Hagg Lake that was not withdrawn at SHPP. The Forest Grove WWTF and Fernhill NTS (both RM 55.2) are upstream of this site. In 2018, the NTS discharged from May 1 through October 31. The District tries to maintain a minimum stream flow target of 60 cfs at this site. The site is unaffected by discharges from Clean Water Services' two large WWTFs (they are downstream).

During the dry periods between July and October, the District's stored water releases accounted for about 50% of the total flow in the upper Tualatin River. Without these releases, flow in the upper Tualatin would have dropped below 50 cfs, making the river considerably slower and warmer.

Note that flow at this site shows a wavy pattern with high flows and low flows repeating approximately every week. This pattern is due to decreased withdrawals by TVID from the SHPP that occur on Sundays, when the demand for irrigation water is generally lower than other days. Releases from Hagg Lake and Barney Reservoir are mostly influenced by weather conditions and do not exhibit a weekly cycle.

Calculated* Clean Water Services Releases in Tualatin River at Golf Course Rd (RM 51.5) — 2018



Natural Flow at Golf Course w/o CWS releases =
+ Measured flow at Golf Course (OWRD data)
– Calculated flow from Fernhill NTS or Forest Grove WWTF (= 0.978 x discharge from the same day)
– Calculated flow from Hagg Lake (= 0.979 x CWS Hagg Lake release from the same day)
– Calculated flow from Barney Reservoir (= 0.934 x CWS Barney Reservoir release from the same day)

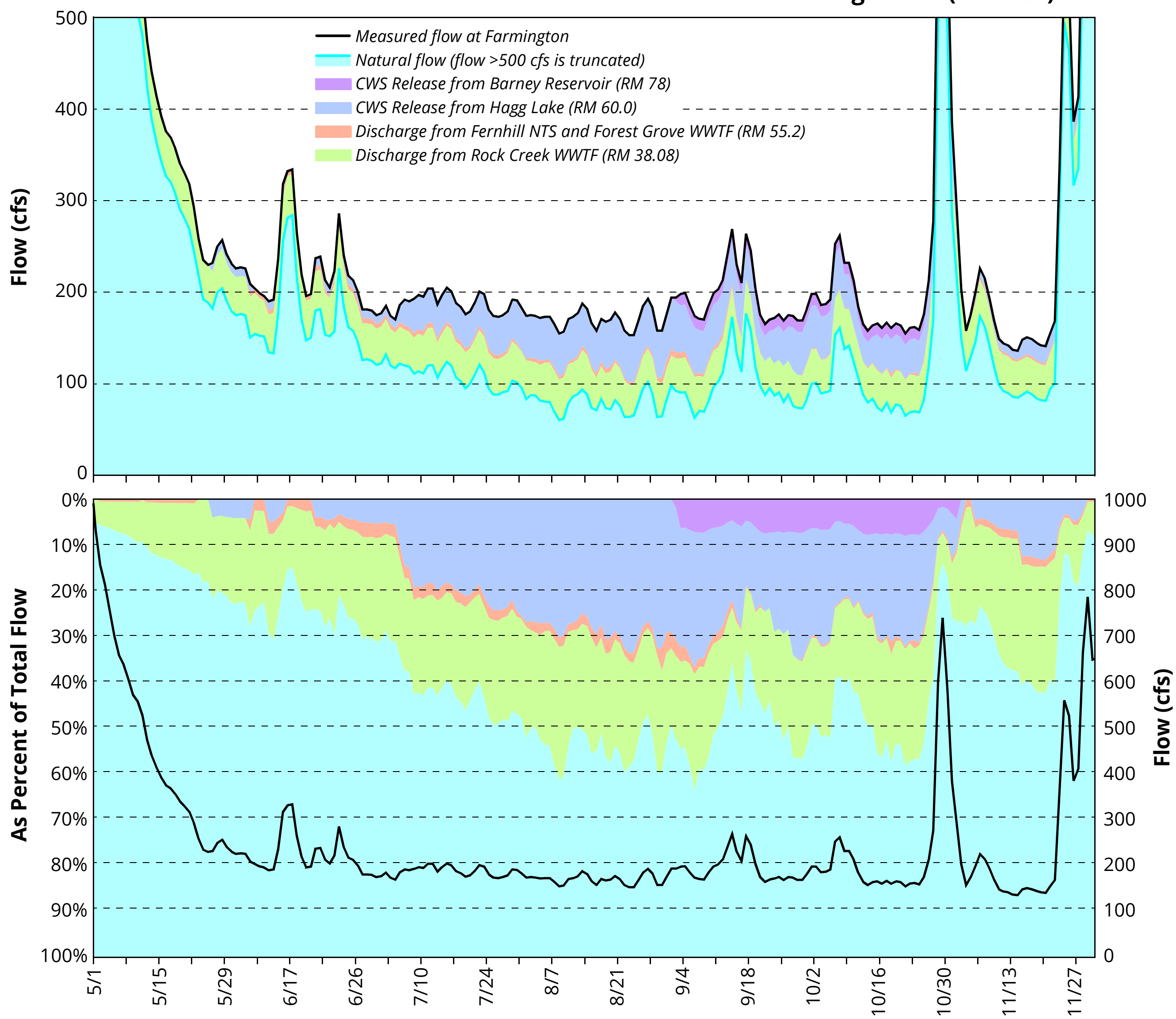
Middle Tualatin River — Farmington Road site: The graph below shows flows at the Farmington Road site (RM 33.3). Flow at this site affects water quality in the middle and lower parts of the river. Keeping Farmington flow from becoming very low (below 120 cfs) can mostly prevent the large scale algal blooms that were a recurring problem in the lower river in the 1990s.

Stream flow measurements at this site are also used to define ammonia limits at the treatment facilities, as well as when dry and wet season limits apply at the District's treatment facilities.

During the summer low flow period, the District's stored water releases plus the Rock Creek WWTF discharge accounted for 50-60% of the flow at the Farmington Road site. Without this additional water, flow in the Tualatin River at this site would average less than 100 cfs during the July-August period and drop to as low as 60–65 cfs on some days. Flows this low would almost certainly be associated with significant water quality problems down river, such as those that were common in the 1990s and before.

Note that the weekly cyclical signature of decreased irrigation withdrawals on Sundays is still clearly evident at this site.

Calculated* Clean Water Services Releases in Tualatin River at Farmington Rd (RM 33.3) — 2018



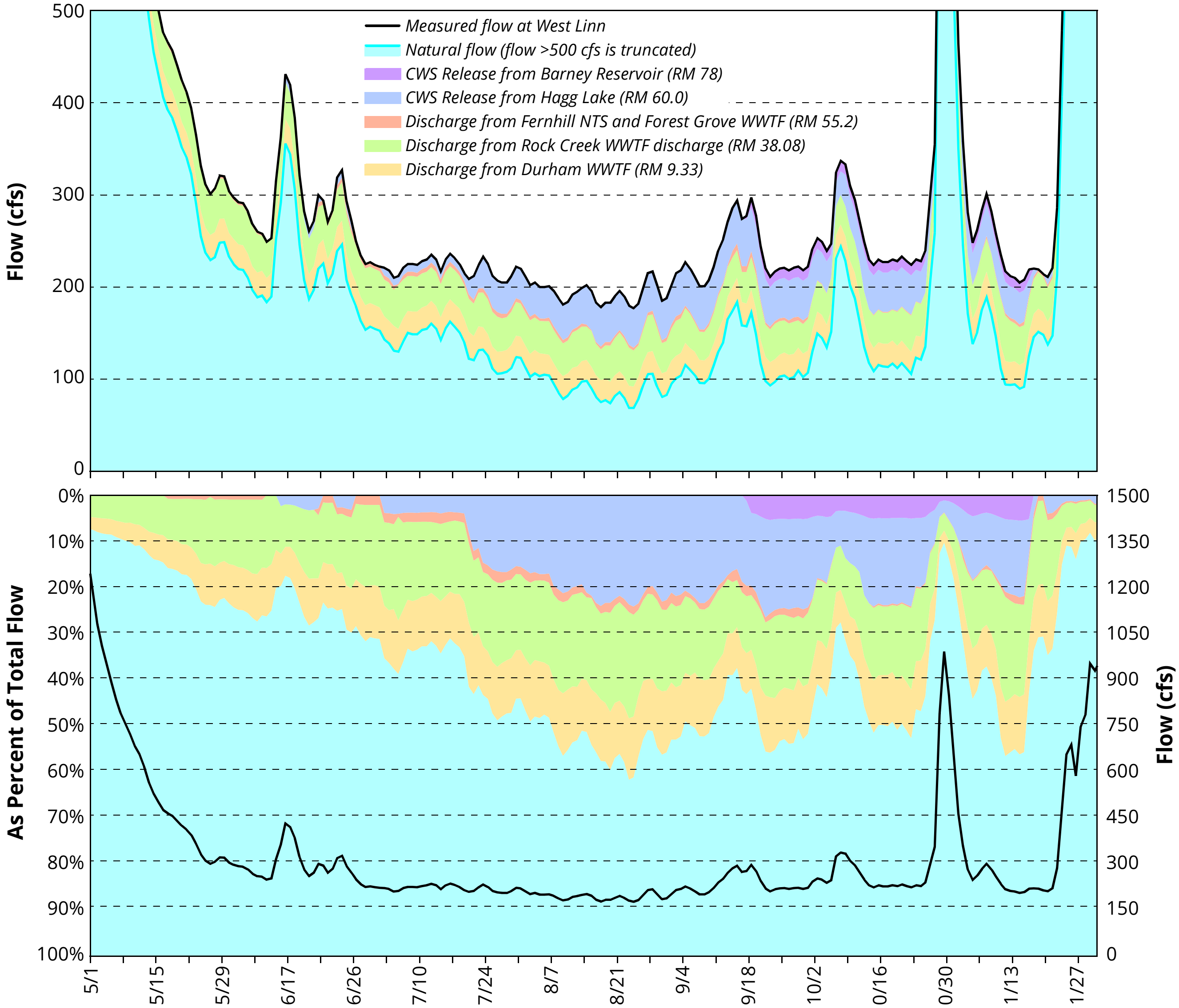
Natural Flow at Farmington w/o CWS releases =	+ Measured flow at Farmington (OWRD data)
	– Calculated flow from Rock Creek WWTF (= 0.988 x Rock Creek WWTF discharge from the same day)
	– Calculated flow from Fernhill NTS and Forest Grove WWTF (= 0.933 x discharge from 1 day before)
	– Calculated flow from Hagg Lake (= 0.933 x CWS Hagg Lake release from 2 days before)
	– Calculated flow from Barney Reservoir (= 0.888 x CWS Barney Reservoir release from 4 days before)

Lower Tualatin River — West Linn site: Flows at the West Linn site (RM 1.75) are shown below. Flow at this site during July–August averaged only 28 cfs higher than those at Farmington; almost 90% of that increase is discharge from the Durham WWTF.

The District's stored water releases account for more than 20% of the flow during the low flow season. When discharges from the WWTFs are included, Clean Water Services' contributions account for 50-60% of the flow. Without this additional water, at times flows at the West Linn site would drop below 100 cfs during the summer. Flows this low would be associated with significant water quality problems such as:

- high temperatures,
- severe algal blooms that would likely increase the pH to levels that exceed the criteria for aquatic health, and
- very low dissolved oxygen concentrations caused by an increased expression of sediment oxygen demand, especially during cloudy days when photosynthetic production of oxygen is decreased.

Calculated* Clean Water Services Releases in Tualatin River at West Linn (RM 1.75) — 2018



*The following formula was used to calculate flows in this figure, assuming constant travel time and a uniform evaporative loss (0.25% per mile).

Natural Flow at West Linn without CWS releases = + Measured flow at West Linn (USGS data)
– Calculated flow from Durham WWTF (= 0.981 x Durham WWTF discharge from 3 days before)
– Calculated flow from Rock Creek WWTF (= 0.909 x Rock Creek WWTF discharge from 14 days before)
– Calculated flow from Fernhill NTS and Forest Grove WWTF (= 0.854 x discharge from 16 days before)
– Calculated flow from Hagg Lake (= 0.854 x CWS Hagg Lake release from 17 days before)
– Calculated flow from Barney Reservoir (= 0.809 x CWS Barney Reservoir release from 19 days before)

HISTORICAL RECORD OF STORED WATER RELEASES

Hagg Lake: Water releases from Hagg Lake usually began in June or July and continued until high natural flow resumed. During the low-flow period, release rates were adjusted as needed to meet the flow targets at that time. Clean Water Services' allocation is 12,618 ac-ft at full pool.

CLEAN WATER SERVICES — HAGG LAKE RELEASES

YEAR	START DATE	END DATE	TOTAL RELEASE DAYS†	TOTAL RELEASE (acre-ft)	AVERAGE PER RELEASE DAY (cfs)	COMMENTS
1987	6/9	11/30	175	*16,722	48.2	*Bureau of Reclamation allowed Clean Water Services to release its entire allocation (stored and natural flow).
1988	7/2	11/4	126	*15,071	60.3	
1989	6/27	11/15	141	*16,586	59.3	
1990	7/12	11/1	113	11,889	53.0	
1991	7/12	11/4	116	13,024	56.6	
1992	6/5	11/19	168	12,730	38.2	
1993	7/3	12/1	150	11,486	38.6	
1994	6/21	10/27	129	10,917	42.7	
1995	6/24	11/8	138	9,824	35.9	
1996	7/27	11/10	114	10,952	48.4	
1997	7/4	10/2	91	6,716	37.2	
1998	8/12	11/7	87	9,407	54.5	
1999	7/27	11/12	109	12,001	55.5	
2000	7/21	11/27	130	15,275	59.2	CWS purchased additional water because low flow conditions persisted until late November
2001	9/25	11/14	50	2,403	24.0	Allocations were severely decreased because Hagg Lake did not fill in 2001
2002	6/12	11/9	151	12,618	42.0	
2003	7/11	11/17	130	11,765	52.4	
2004	7/1	11/2	125	8,650	34.9	
2005	7/8	10/31	116	9,918	43.1	
2006	7/1	11/3	126	9,634	38.5	
2007	7/3	11/13	119	10,134	42.9	
2008	7/1	11/4	127	11,896	47.2	
2009	7/1	10/27	119	10,614	45.0	
2010	7/24	10/25	94	8,392	45.0	
2011	7/23	11/18	119	10,464	44.3	
2012	7/7	10/22	106	10,950	52.1	
2013	7/2	11/4	103	6,884	33.7	
2014	7/1	10/22	114	9,037	40.0	
2015	6/9	11/5	150	12,307	41.4	CWS purchased an additional 600 ac-ft from TVID, but it was not released
2016	6/21	10/13	115	9,692	47.5	
2017	6/21	10/23	125	10,585	42.7	
2018	5/24	11/26	176	12,132	34.7	

†In some years, releases may temporarily lapse between the start date and end date.

Barney Reservoir: Water usually is released from Barney Reservoir during the late summer. Accounting for dead pool volume and the 15% allocation to the Oregon Department of Fish and Wildlife, Clean Water Services has 1,654 ac-ft available at full pool.

CLEAN WATER SERVICES — BARNEY RESERVOIR RELEASES

Year	Start Date	End Date	Total Release Days	Total Release (acre-ft)	Average per Release Day (cfs)	Comment
1998	7/12	8/27	47	2,779	24.6	extra water released to draw down reservoir
1999	9/1	10/19	49	1,025	10	10 cfs also released 6/4–6/10
2000	9/8	10/23	46	1,461	18	—
2001	9/18	10/29	42	1,416	17	1000 acre-ft purchased in addition to allocation; reservoir did not fill; 4,000 acre-ft held in reserve
2002	8/26	10/24	60	1,667	14.0	—
2003	8/15	10/14	61	1,742	14.0	—
2004	9/1	11/2	63	1,777	14.0	—
2005	9/1	11/8	69	1,874	14.0	miscommunication about end date; extra water released
2006	9/1	11/3	64	1,638	14.0	—
2007	9/1	10/30	60	1,667	14.0	—
2008	9/4	10/31	58	1,611	14.0	—
2009	9/1	10/30	60	1,667	14.0	—
2010	9/1	10/30	58	1,653	13.9	7 cfs on 9/1/2010 only, all other days 14 cfs
2011	7/1	8/30	61	1,089	9.0	Barney Reservoir was drawn down for maintenance which resulted in a reduced allocation
2012	8/31	10/29	60	1,667	14.0	—
2013	8/30	11/5	58	1,611	14.0	release suspended 9/30/2013 – 10/9/2013
2014	9/2	10/23	52	1,438	14.0	—
2015	8/14	10/28	76	1,569	10.4	14 cfs (8/14–8/22), 10 cfs (8/23–10/27), 5 cfs (10/28)
2016	8/31	10/14	45	1,250	14.0	
2017	9/1	10/24	54	1,524	14.2	
2018	8/29	10/28	61	1,674	13.8	4 cfs (8/29), 14 cfs (rest of season)

Natural flow credit

When Scoggins Dam was constructed, Clean Water Services was granted a natural flow credit of up to 4,282 acre-ft. The credit applies only in May, June, October and November, and only if the monthly mean daily natural flow in the Tualatin River measured at West Linn is less than the flow targets specified for each month. Natural flow is calculated as the monthly mean daily flow measured at West Linn minus Clean Water Services' mean daily release of stored water. Clean Water Services was not entitled to a natural flow credit in 2018 because the natural flow exceeded the target flow for months in question (see table below). Clean Water Services last received a natural flow credit in 1994.

BUREAU OF RECLAMATION NATURAL FLOW CREDIT 2018

Month	Mean Daily Measured Flow at West Linn (cfs)	Mean Daily CWS Release (cfs)	Calculated Natural Flow at West Linn (cfs)	Target Natural Flow at West Linn (cfs)	Maximum Possible CWS Natural Flow Credit (cfs)	Maximum Possible CWS Natural Flow Credit *[acre-ft]*	CWS Natural Flow Credit (cfs)
May	571	10	561	85	13	*[798]*	0
June	439	17	422	140	21	*[1,250]*	0
October	331	51	280	95	16	*[984]*	0
November	381	24	358	110	21	*[1,250]*	0

JOINT WATER COMMISSION

by Kristel Griffith, Water Resources Program Coordinator, Joint Water Commission/City of Hillsboro

Introduction

Over 365,000 people in Washington County receive at least a portion of their drinking water from the Joint Water Commission (JWC). The JWC provides water to its member agencies: the Cities of Hillsboro (the managing and operating agency), Forest Grove, Beaverton, and the Tualatin Valley Water District. JWC also provides wholesale service directly to the City of North Plains, and to Cornelius, Gaston, and the LA Water Cooperative as wholesale customers of Hillsboro.

JWC's water treatment plant (WTP) is supplied with water from the nearby Tualatin River. An intake facility at Spring Hill constructed by the Bureau of Reclamation, and shared with the Tualatin Valley Irrigation District (TVID), pumps river water to the JWC WTP.

Flows in the Tualatin River are supplemented during the summer with water from two impoundments—Hagg Lake and Barney Reservoir. Hagg Lake is located on Scoggins Creek behind Scoggins Dam. Scoggins Dam is owned by the Bureau of Reclamation (BOR) and operated by TVID under contract to the BOR. Barney Reservoir is located on the upper Trask River behind the Eldon S. Mills Dam. The reservoir and dam are owned and operated by the Barney Reservoir Joint Ownership Commission (BRJOC). The BRJOC includes the Cities of Hillsboro (the managing and operating agency), Forest Grove, and Beaverton, the Tualatin Valley Water District, and Clean Water Services.

The JWC WTP uses conventional dual media filtration plus disinfection to produce high quality potable water. Treated water is pumped from the plant to the member agencies either directly through finished water pipelines or via the Fern Hill Reservoirs. The Fern Hill Reservoirs are located about one-third mile to the east of the treatment plant and can store up to 40 million gallons of finished water (in two 20 million gallon covered concrete tanks). The JWC finished water pipelines include flow meters and pressure reducing stations at the connection points to the member agencies.

2018 Operations

Production and demands: In 2018 the JWC WTP produced an average of 41.3 million gallons per day (MGD) of finished water. A maximum day production of 61.2 MG occurred on July 27, which is slightly less than the 2017 maximum day production of 62.0 MG. A minimum day production of 14.25 MG occurred on December 12.

2018 Stored water releases: The amount of stored water released by JWC for 2018 is summarized in the tables below. In all, 76% of the total allocation was released (70% for Hagg Lake and 82% for Barney Reservoir). Typical average use is 40–60% of allocation, although higher usage has occurred in the recent past. Particularly warm weather in 2015 increased demand and usage that year was also 75% of allocation. What distinguished 2018 from all other years is the length of the regulated season.

STORED WATER RELEASE FROM EACH RESERVOIR — 2018

Description	Beginning Balance (acre-ft)	Amount Released (acre-ft)	Ending Balance (acre-ft)	Days of Release	Average Release	
					acre-ft/day	cfs
Barney (M&I)	14,886	12,159	2,727	187	65.0	32.8
Scoggins	13,500	9,513	3,987	181	52.6	26.5
Total	**28,386**	**21,672**	**6,714**	**187**	**115.9**	**58.4**

OWRD imposed regulation of natural flow on May 26, a little earlier than average. Because this date fell on a Saturday, JWC began releasing stored water from Barney Reservoir on Friday, May 25. Regulation continued until being lifted on October 29th, but high natural flow was short-lived and regulation was reinstated on November 2. JWC continued to release stored water from Barney Reservoir during the break in regulation. Early November was unusually dry and regulation continued until being lifted on November 26th. JWC releases from Barney continued through November 28th. This regulation season set records for the longest duration and the latest end date.

COMPARISON OF STORED WATER RELEASES— 10-YEAR RECORD

Year	Dates of Stored Water Use			Stored Water Release (acre-ft)			Average Release (acre-ft/day)
	First Day*	Last Day*	Days**	Barney	Scoggins	Total	
2018	5/26	11/28	187	12,159	9,513	21,672	116
2017	6/22	10/24	125	7,819	6,425	14,244	114
2016	5/11	10/12	153	7,476	9,465	16,941	111
2015	5/8	10/29	173	11,730	9,904	21,633	124
2014	6/5	10/24	142	6,548	9,090	15,638	110
2013	5/4	10/1	141	6,387	7,490	13,877	98
2012	6/23	10/30	129	6,557	7,016	13,573	105
2011	6/28	11/7	132	8,848	3,945	12,794	97
2010	6/30	10/22	114	5,647	5,171	10,818	95
2009	6/14	10/26	134	4,723	9,203	13,926	104
10-yr average	**6/4**	**10/26**	**143**	**7,789**	**7,722**	**15,512**	**107**

*First and last day of Regulated Use releases lag OWRD regulation dates by 1 day because releases are adjusted the day after OWRD imposed or lifted regulation.
**Days of Regulated Use does not equal the elapsed days between the start and end dates for regulation if regulation was temporarily suspended during the period.

STORED WATER RELEASE TO EACH AGENCY — 2018

Description	Beginning Storage (acre-ft)	Amount Released (acre-ft)			Ending Balance* (acre-ft)	Average Release (acre-ft/day)
		from Barney	from Scoggins	Total		
Hillsboro	10,127	4,965	4,789	9,753	374	52.2
Forest Grove	4,914	12	1,037	1,049	3,865	5.6
Beaverton	7,556	1,462	3,688	5,150	2,406	27.5
TVWD	5,789	5,720	0	5,720	69	30.6
Total	**28,386**	**12,159**	**9,513**	**21,672**	**6,714**	**115.9**

*North Plains and Tigard: usage is reflected in the values for JWC partners
No internal leases between JWC partner agencies occurred in 2018.

Efficiency: JWC maximizes the capture of released water by coordination with partner agencies to anticipate and track system demands, and by leveraging finished water storage at the Fern Hill Reservoirs. During the peak season, the JWC and Cherry Grove pump station (at the City of Hillsboro's slow sand filter plant) recovered an average of 97% of the water available for municipal use from natural flow rights and releases from impounded supplies.

ESTIMATED WATER CAPTURE RATES – 2018

Water Available		Raw Water Pumped			Finished Water Produced			
					Total		Average Daily	Peak Day
Source	(acre-ft)	Facility	(acre-ft)	(MG)	(acre-ft)	(MG)	(MGD)	(MGD)
Reservoir releases	21,672	JWC WTP* (Spring Hill)	24,315	7,923	23,935	7,799	41.3	61.2
Natural flow	3,410	Slow Sand Filter Plant (Cherry Grove)	476	155	278	91	0.08	1.1
Total	25,082		24,791	8,078	24,213	7,890		
		Capture rate	99%		97%			

*The values shown here were measured and reported by JWC.

Facility expansion

In order to meet increasing water demand, the JWC is expanding its WTP to increase peak capacity from 75 MGD to 85 MGD. Construction on the WTP expansion remained underway throughout 2018, with substantial completion scheduled for October 2019. The project scope, valued at around $27M, includes construction of two new filters, a new surge basin, two new solids drying beds, associated yard piping, upsizing existing pumps, seismic life safety improvements, several maintenance projects, and minor modifications to existing structures.

Expansion progress:

- Construction of the concrete surge basin and filters began in November 2017 and continued through 2018.
- Construction of the new filter structure walls started in 2018.
- Yard piping to facilitate the solids handling process for the filters was well underway in 2018.
- The sedimentation basins were modified in 2018 by the installation of new plate settlers. This modification will improve the performance and capacity of the sedimentation basins.
- Four new raw water pumps were delivered at the Spring Hill Pump Plant. Installation was in progress at the end of 2018.

Construction in 2018

Plate settlers installed at sedimentation basins

Raw water pumps were replaced

2018 Maintenance

Sludge removal: Sludge was removed at the JWC Spring Hill Pump Plant pumping bays in the spring.

Aquatic plant removal: Divers removed aquatic plants from the area in front of the intake screens. The plants were initially thought to be invasive European milfoil but were identified as *Elodea Canadensis* and *Lemna minor* (duckweed). Neither of these species are invasive and no other invasive species were found.

Samples of aquatic species removed from intake screens

Regulatory matters

Water Right Activity: In 2018, the Joint Water Commission applied for a water right to withdraw 44.0 cfs at the Spring Hill Pump Plant (application S-88506). Withdrawal under the new permit will be supplemental to the usage under permit S-54737, meaning the total combined usage will not exceed 75 cfs. Both of these permits are for usage between November 1 and April 30.

Mt. Hood Environmental at SHPP intake channel for fish survey

Fish trapping at the JWC intake channel

Fish Monitoring: Mt. Hood Environmental conducted fish surveys at the Spring Hill Pump Plant (SHPP) several times in Winter/Spring 2018. The work was done in order to comply with conditions imposed by Oregon Department of Fish & Wildlife regarding JWC's water rights (both currently held and applied for).

Multiple trapping methods were used in the intake facility and the intake channel in order to determine the presence of lamprey, trout and salmon species. In addition, velocity measurements were obtained at the front of the JWC's intake screens at the SHPP.

The JWC's intake screens at the SHPP do not meet the current size criteria and the approach/sweeping velocities are unknown. A final report detailing the monitoring methods and entrainment results is anticipated in 2019. This report will inform the development of a mitigation plan to offset any detrimental impacts that may be identified.

Acknowledgements

The Joint Water Commission appreciates the efforts of the Watermaster and our partners on the Tualatin River Flow Management Committee. We extend our thanks for their involvement and cooperation. The communication and coordination among the committee members is invaluable.

MILLS DAM/BARNEY RESERVOIR

by Kristel Griffith, Water Resources Program Coordinator, Joint Water Commission/City of Hillsboro

Overview

Mills Dam/Barney Reservoir is a rock and earth impoundment on the Middle Fork of the North Fork of the Trask River. The original structure, known as the Trask Dam, was built in 1970 by the Cities of Hillsboro and Forest Grove; the reservoir held 4,000 ac-ft of water. In 1999, the dam height was raised to accommodate 20,000 ac-ft of storage and renamed the Mills Dam. Barney Reservoir is named for J.W. Barney and Mills Dam is named for Eldon S. Mills, both former Hillsboro City Managers and key leaders in the original dam construction and its later expansion.

Water stored in Barney Reservoir is released to both the Trask and Tualatin Rivers. Flows to the Trask River include all storage overflows and 15% of the stored water, which is allocated to Oregon Department of Fish and Wildlife (ODFW). A gravity flow diversion pipeline conveys water from the Trask River to the headwaters of the Tualatin River. The additional flow in the Tualatin River is used for municipal purposes and flow augmentation to improve water quality.

Release from Barney Reservoir to the Trask River through a Howell-Bunger Valve

The current owners of Barney Reservoir are the Cities of Hillsboro, Forest Grove, Beaverton, the Tualatin Valley Water District (the same entities that form the Joint Water Commission) and Clean Water Services. Collectively they form the Barney Reservoir Joint Ownership Commission (BRJOC). As with the Joint Water Commission, the City of Hillsboro serves as the managing and operating agency for the BRJOC.

RESERVOIR OWNERSHIP AND WATER ALLOCATION FOR BARNEY RESERVOIR

		Water Allocation (percent)	Storage at Full Capacity (acre-ft)	Reservoir Ownership (percent)
Reserved	Dead pool	2.3%	460	—
	Oregon Department of Fish and Wildlife (ODFW)	15.0%	3,000	0.0%
BRJOC Partners	Clean Water Services	8.3%	1,654	10.0%
	JWC Partners	74.4%	14,886	90.0%
	City of Hillsboro	*25.6%*	*5,127*	*31.0%*
	City of Forest Grove	*2.1%*	*414*	*2.5%*
	City of Beaverton	*17.8%*	*3,556*	*21.5%*
	Tualatin Valley Water District (TVWD)	*28.9%*	*5,789*	*35.0%*
	TOTAL	100.0%	20,000	100.0%

2018 Operations

Barney Reservoir filled on January 29, 2018. By the end of the release season, 84% of the total allocated water was released.

Releases to the Tualatin River: The majority of the JWC's natural flow rights were regulated off on May 26, 2018. Releases from Barney Reservoir to the Tualatin River began on May 25 because May 26th was a Saturday. Natural flow rights were briefly reinstated from October 29–November 1 and finally restored on November 26, JWC releases from Barney Reservoir continued, uninterrupted through November 27th, for a total of 187 release days. Clean Water Services used their entire allotment and the JWC partners used 82%.

Releases to the Trask River: Releases from Barney Reservoir to the Trask River for ODFW began on May 31 and continued through December 12 for a total of 196 release days. All of the stored water for ODFW was released to the Trask River.

STORED WATER ALLOCATION AND RELEASES FOR BARNEY RESERVOIR — 2018

			BRJOC Partners					
					JWC Partners			
	Total Storage	Oregon Dept of Fish and Wildlife	Clean Water Services	JWC Total	*City of Hillsboro*	*City of Forest Grove*	*City of Beaverton*	*TVWD*
Water allocation (acre-ft)	20,000	3,000	1,654	14,886	*5,127*	*414*	*3,556*	*5,789*
Water released (acre-ft)	16,827	2,994	*1,674	12,159	*4,965*	*12*	*1,462*	*5,720*
Percent allocation used	84%	100%	*101%	82%	*97%*	*3%*	*41%*	*99%*
First day of release		May-31	Aug-29	May-25				
Last day of release		Dec-12	Oct-28	Nov-27				
Number of Days with Releases		196	61	187				
Average Daily Release (cfs)		7.7	13.9	32.8				

*CWS used 20 ac-ft beyond their allocated 1654 ac-ft due to their available storage ending on a weekend. The extra release will not affect CWS's beginning balance for storage for the 2019 release season.

Dam Inspection

Oregon Water Resources Department (OWRD) inspected Mills Dam on August 30, 2018 to assess the dam's exterior surfaces and identify conditions that may affect the safety of the dam. Mills Dam is classified as a high-hazard dam based on the downstream risk to people and property. OWRD did not identify any major issues or concerns and reported that the dam is very well maintained and operated. The crest and embankment show no signs of settlement, instability or internal erosion. OWRD intends to inspect the dam again in 2019.

Water Right Activity

All of the existing primary and secondary water rights for Barney Reservoir are certificated. The “primary” water right provides the ability to store the water. Currently, one primary water right certificate allows the storage of 20,000 acre feet of water in Barney Reservoir. The “secondary” water rights allow the stored water to be released for specified beneficial uses.

One secondary water right certificate allows for the release of water from Barney Reservoir into the Trask River. It is held by Oregon Department of Fish and Wildlife (ODFW) for fish and aquatic life. ODFW has 15% of stored water in Barney Reservoir.

Three secondary water right certificates allow the release of water from Barney Reservoir to the Tualatin River. Two of these rights are held by the drinking water providers (JWC) for domestic water supply; together, they authorize releases up to 38.7 cfs (25 MGD). The other secondary water right is held by Clean Water Services (CWS) for river flow augmentation to protect beneficial uses; it authorizes releases up to 30.0 cfs (19.4 MGD). The total authorized rate of 68.7 cfs (44.4 MGD) equals the pipeline capacity to convey stored water from Barney Reservoir to the Tualatin River.

In recent years, the drinking water providers occasionally released water at a higher rate than authorized by their water right. The higher release rate was possible because CWS was not releasing water at its maximum authorized rate at that time. To date, OWRD has not objected to these higher release rates because they involve stored water for municipal use.

The drinking water providers, under the name JWC, submitted an application to OWRD on December 27, 2017 for a change in the authorized release rate. The proposed maximum authorized release rate would vary and be calculated as 68.7 cfs (44.4 MGD) minus the actual CWS release at any given time. The change only would affect how releases are shared and would not affect allocations, total storage or use. CWS's access to their stored water or release capacity to the Tualatin River would not be hindered. Releases to the Trask River for ODFW would be unaffected.

After OWRD's initial review of the permit application (S-88492) was completed, the BRJOC requested that the application be placed on administrative hold. The purpose of the delay was to allow time for the completion of a fish monitoring survey of JWC's portion of the Spring Hill Pumping Plant and the development of a mitigation plan to offset any detrimental effects that were identified. Fish surveys were completed in 2018 and are described in the JWC section (page 22). A report describing the fish survey results is expected in 2019.

LAKE OSWEGO CORPORATION

by Mark Rosenkranz, Water Resource Specialist, Lake Oswego Corporation

INTRODUCTION

The Lake Oswego Corporation (LOC), a non-profit organization, owns and manages Oswego Lake, a 163-hectare (403 acre) reservoir located 10 miles south of Portland, Oregon. LOC was formed in 1942 when the Oregon Iron and Steel Company, then owner of the land around the Lake, deeded to LOC the land, three dam structures, and all water rights. The original dam was constructed in 1871 and later upgraded in 1921. Oswego Lake is a private water body whose primary water right is hydropower generation. Secondary uses include irrigation, aesthetic viewing, contact recreation, fishing, and boating.

OSWEGO LAKE AND WATERSHED MORPHOLOGY

The original natural lake, called Waluga, was formed 10,000 years ago by the Missoula glacial floods which altered the old Tualatin River channel. Today, the Lake has three basins: West Bay, the Main Lake, and Lakewood Bay. There are also two shallow, man-made canals, Blue Heron Canal and Oswego Canal. Oswego Canal is the 2.4-km conduit from the Tualatin River (RM 6.7). Total lake surface area and volume is 1.63 km^2 (403 acres) and 12.7 x 10^6 m^3 (10,300 acre-feet). Shoreline length, including bays and canals, is 18.62 km (11.56 mi). Oswego Lake has a 5.08-km (3.15-mi) fetch and a narrow 0.56-km width (0.34-mi). The hydraulic residence time is 390 days.

Oswego Lake's two watersheds include the natural, 7.5-mi^2 urban basin around the Lake (10:1 watershed to lake-area ratio) and the larger 700-mi^2 Tualatin River basin (1,000:1 ratio) when the LOC Headgate is open. Major inflows from the watershed include Springbrook Creek, Lostdog Creek, Blue Heron Creek, and 70-plus storm drains from the City of Lake Oswego.

Aerial view of the West Bay of Oswego Lake looking to the East

LOC WATER RIGHTS AND CONTRACTS

Hydropower Generation: The primary hydropower water right is 57.5 cubic feet per second (cfs) obtained in 1906 that allows year-round diversion. To guarantee this flow during the dry season, LOC owns and operates a diversion dam located downstream of the Oswego Canal (RM 3.4). Flaps are erected on an “as needed” basis. No flaps have been used since 2004.

Irrigation: A contract between LOC and the Bureau of Reclamation (Oct 20, 1972) provides for up to 500 acre-feet from Hagg Lake for irrigation use during March through November. The largest irrigator on the Lake is the Lake Oswego Country Club (approximately 175 acre-feet).

Maintenance/Evaporation: LOC also has a maintenance/evaporation water right of 3.36 cfs dating from 1985. This water can be diverted between September 16th and July 30th.

Oswego Lake Watershed Management Plan

Water quality improvements and safety are the top priorities for LOC. For many years, Oswego Lake has had issues with overgrowth of cyanobacteria that can impair lake aesthetics. Under extreme conditions cyanobacteria also can be harmful to health. The goal of the annual LOC Water Quality Management Plan is to reduce cyanobacteria productivity and maximize the aesthetic value of the Lake. In order to accomplish this goal and provide long-term water quality solutions, LOC conducts a variety of watershed activities as part of the management plan.

Conditions that favor cyanobacteria: All algae require sunlight and nutrients (nitrogen and phosphorus) in order to grow. Because cyanobacteria are capable of fixing nitrogen, they can outcompete other algal species when nitrogen is limited. Cyanobacteria grow better than other freshwater algae because they are adapted to higher temperatures and can adjust their buoyancy to optimize nutrient uptake. Cyanobacteria are present in Oswego Lake every year and without phosphorus control the lake would experience severe blooms. Nutrient control may become even more important in the future because warmer conditions caused by climate change favor cyanobacteria.

Role of phosphorus: To limit the growth of algae in general, and especially cyanobacteria, in Oswego Lake, LOC has focused its efforts on reducing the availability of phosphorus. The LOC has targeted 20 μg/L as the maximum phosphorus concentration in the lake that would substantially limit cyanobacteria growth. They use several strategies and have successfully decreased phosphorus concentrations in the lake, although not always to the target level of 20 μg/L. The strategies include:

- *Reduce phosphorus loading to the lake from the Tualatin River*— Oswego Lake is fed in part by water from the Tualatin River that is conveyed via the Oswego Canal. Flow into the lake from the Oswego Canal is regulated by a headgate. In recent years, LOC has tried to minimize or eliminate flow from the Tualatin River into the lake because the phosphorus concentrations in the Tualatin River exceed LOC's target level for the lake.

  The Tualatin River receives phosphorus from several sources. The highest total phosphorus concentrations often occur near the beginning of storms when high flow causes spikes in particulate phosphorus. High flow resuspends bed sediment and transports particles entrained in stormwater. Groundwater that is naturally high in phosphorus is a source of dissolved phosphorus that is particularly important during low flow. In addition, Clean Water Services (CWS) facilities discharge treated wastewater into the river. During the dry season, CWS employs strict phosphorus control at its wastewater treatment facilities (WWTFs) and their discharges have lower phosphate concentrations than the river at that time. More information about phosphorus concentrations in the Tualatin River can be found in Appendix H.

- *Reduce phosphorus loading to the lake from stormwater runoff*— Stormwater runoff contributes phosphorus directly to the lake. LOC discourages the use of phosphorus-containing fertilizers in the local area.

- *Decrease phosphorus release from sediment*— Sediment at the bottom of Oswego Lake contains phosphorus that is chemically bound to various mineral surfaces. When the oxygen level at the bottom of the lake (hypolimnion) is very low or zero, the minerals dissolve and the phosphorus is released. LOC has used hypolimnetic aeration to maintain oxygen levels, thereby reducing phosphorus release.

  Warm temperatures increase the rate of oxygen consumption by biological activity, including sediment oxygen demand at the sediment/water interface. The result is a rapid loss of oxygen in the hypolimnion and subsequent release of phosphorus. Although hypolimnetic aeration helps to counter this effect, it is not always able maintain dissolved oxygen concentrations high enough to prevent phosphorus release.

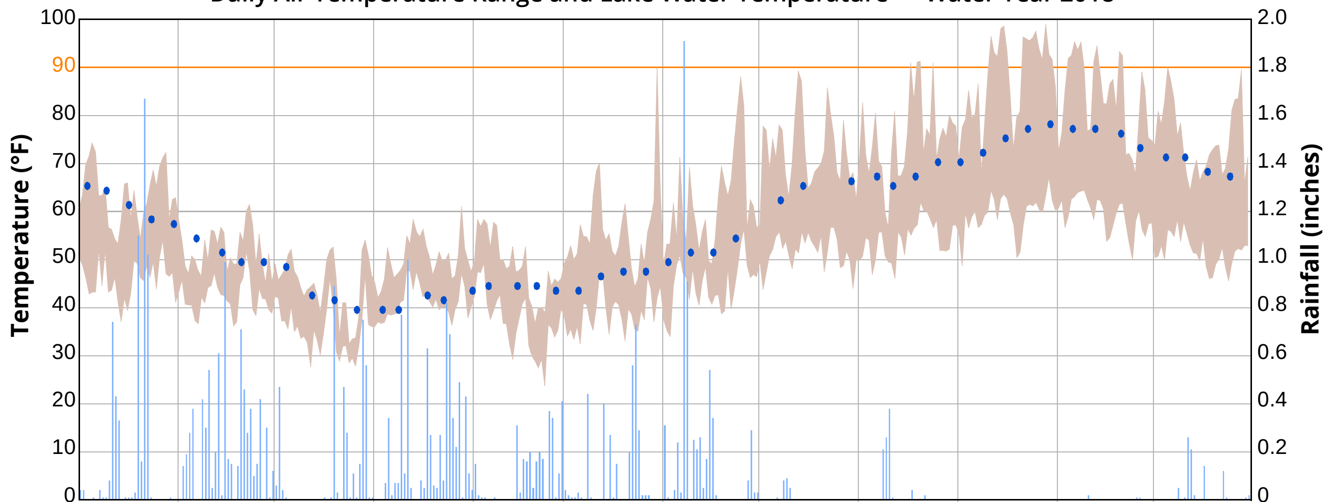
- *Reduce bioavailability of dissolved phosphorus*— Despite implementation of the strategies just described, dissolved phosphorus is still present in the water of Oswego Lake. The dissolved forms of phosphorus are highly bioavailable to algae and aquatic plants and can lead to significant algal blooms. LOC adds alum (aluminum sulfate) to the lake to decrease dissolved phosphorus. Alum forms tiny particles of aluminum hydroxide in the water. These particles bind to the dissolved phosphorus making it biologically unavailable and eventually sink to the bottom of the lake.

Conditions in 2018

Weather: Weather plays a particularly large role in water quality on Oswego Lake just as it does for other waterbodies. As climate change alters weather patterns, management of lakes and reservoirs is becoming more difficult. This was particularly true in 2018 for Oswego Lake.

Although April 2018 was relatively wet, the remainder of the spring was dry as were summer and fall. Only two inches of rain fell from May through September, which is less than 30% of normal. In addition to being dry, summer was particularly hot. The daily high air temperature was least 90°F on 34 days. The dry, warm weather led to heavy use of irrigation and evaporation of lake water.

Daily Air Temperature Range and Lake Water Temperature — Water Year 2018

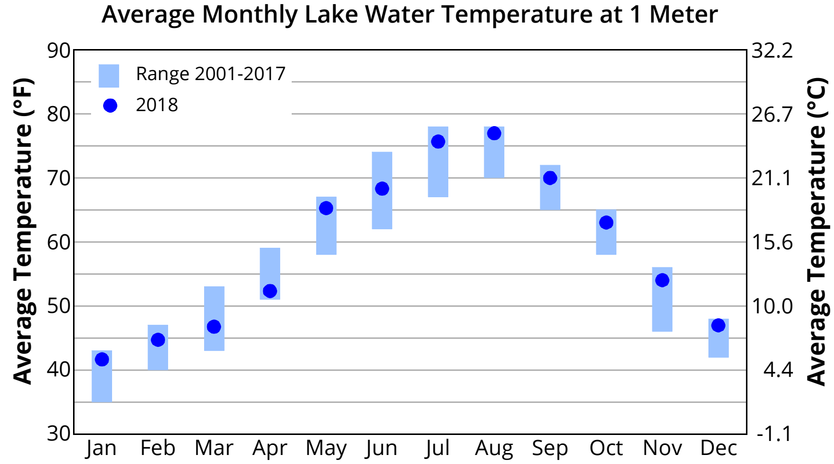


RAIN	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
WY-2018:	5.76″	7.51″	3.88″	7.14″	2.89″	3.24″	5.72″	0.23″	0.92″	0.00″	0.04″	0.85″
Normal:	3.09″	5.49″	5.94″	5.48″	3.98″	3.68″	2.70″	2.46″	1.77″	0.56″	0.91″	1.56″

Daily air temperature range Oswego Lake temperature (1 m) Daily rainfall

The warm summer weather led to high lake water temperatures (see graph at the right). The average lake water temperature in August was 77°F, tied for the second highest average over the past 18 years. The July and September averages were 76°F and 70°F, respectively.

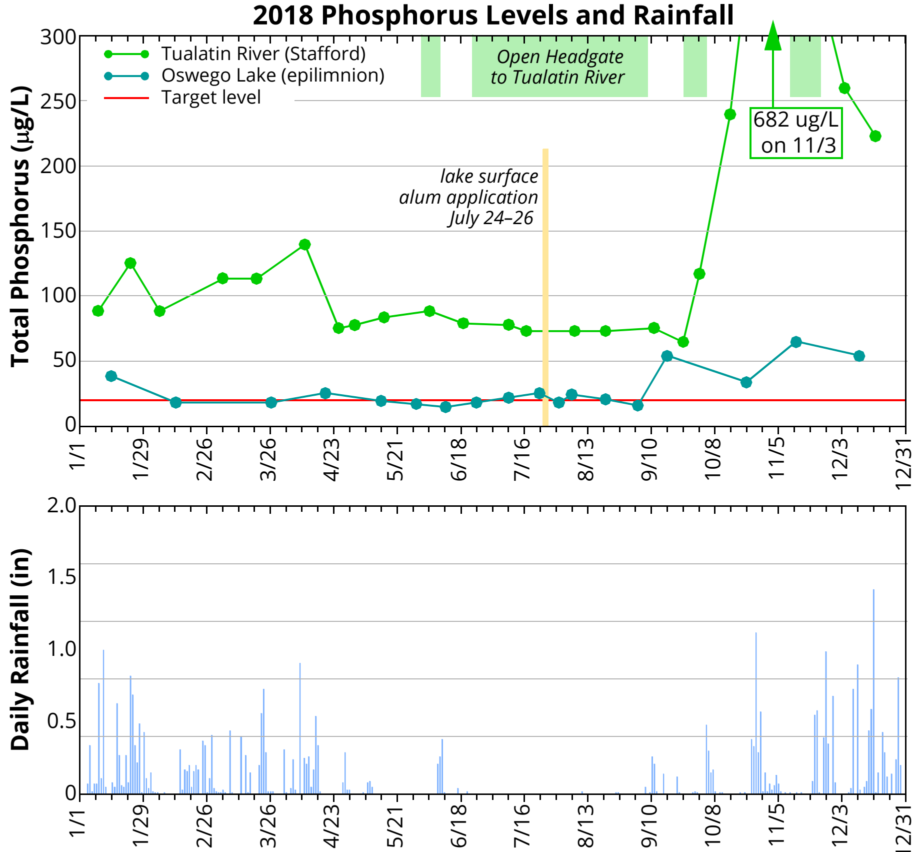
Average Monthly Lake Water Temperature at 1 Meter



2018 Lake Management

Inflow from Tualatin River: The lack of precipitation coupled with high temperatures resulted in a greater need for inflow to the lake than usual. The headgate to the Tualatin River was opened in mid-May, about two months sooner than the normal opening date. Because of the dry fall, the headgate was not closed until November 21, about two months later than normal. The headgate was open May-31–Jun-7, Jun-23 – Sep-7, Sep-21–31, Nov-8–21. Average flow in Oswego Canal was 4 cfs.

2018 Phosphorus Levels and Rainfall



An estimated 148 kg of phosphorus was imported into Oswego Lake when the headgate was open. About 72 kg was imported during May–September when conditions for algal growth are the most favorable. About 76 kg were imported in November when the headgate was open for 13 days when phosphorus levels were considerably higher. Active phosphorus removal by CWS had ended for the season and some short storms likely transported particulate phosphorus from the landscape. Fortunately, algae are not very active at this time, but this input is a bank of phosphorus that will be available in the future.

Alum treatment: Because of the early use of river water, the in-lake phosphorus target was exceeded by the third week of July. Alum was applied July 24–26 to prevent significant cyanobacteria blooms and reduce the phosphorus concentration to below target level (0.2 mg/L).

Water quality measurements

Data for nutrient concentrations in the lake and lake clarity are shown in the table below.

2018 OSWEGO LAKE WATER QUALITY — MEASUREMENT AVERAGES

	Location	Total P (µg/L)	SRP (µg/L)	Total N (µg/L)	Secchi (m)	Turbidity (NTU)
Summer	Lakewood Bay (depth 3.2 m)	51	1	564	0.88	8.6
	Main Lake (depth 16 m)	23	1	381	2.02	4.1
	West Bay (depth 1.4 m)	89	1	718	0.48	21
	Oswego Canal (depth 1.2 m)	93	9	4927	0.69	4.5
	Blue Heron Canal (depth 1.3 m)	169	1	1256	0.59	13
	Outlet (depth 6 m)	30	1	403	1.78	5.4
Annual	Main Lake (depth 16 m)	27	1	403	2.23	4.1
	Only Summer data are available for Lakewood Bay, West Bay, Oswego Canal, Blue Heron Canal, and Outlet sites. Drawdown beginning Fall-2017 at these sites prevented obtaining a full year of data.					

Boxed cell = highest average during summer; Shaded cell = lowest average during summer; Summer=June–September
Abbreviations: Total P = Total Phosphorus, SRP = Soluble Reactive Phosphorus, Total N = Total Nitrogen, Secchi = Secchi depth, µg/L = micrograms per liter, m = meters, NTU = nephelometric turbidity units

OREGON WATER RESOURCES DEPARTMENT

by Jake Constans, Watermaster, District 18

INTRODUCTION

The District 18 Watermaster's Office is a field office of the Oregon Water Resources Department (OWRD) (`www.wrd.state.or.us`) in cooperation with Washington County (`www.co.washington.or.us/index.htm`), and is responsible for water distribution management within the Tualatin, Oswego Lake, and Lower Willamette Drainage Basins in northwestern Oregon. District 18 covers approximately 1,111 square miles and serves the majority of the population in Washington and Columbia counties, as well as parts of Clackamas, Multnomah, and Yamhill counties. There are 2,806 total surface water rights in the district which cover 58,602 acres of land. As part of the surface water rights within the Tualatin River Basin, the following streams have instream water rights: Tualatin River, Gales Creek, Scoggins Creek, Rock Creek, West Fork Dairy Creek, and Fanno Creek. To assist in monitoring surface water in the basin we currently utilize 17 total gaging stations, 10 of which are on real time data.

WATERMASTER DISTRICT 18 GAGING STATIONS FOR 2018

Station Number	Stream	Stream Mile	Latitude	Longitude	Type
14206200	Dairy Creek at Hwy 8 near Hillsboro, OR	2.06	45°30′38″N	123°06′56″W	*Logger
14205480	E. Fk. Dairy Creek at Dairy Creek Rd near Mountaindale, OR	12.33	45°40′32″N	123°03′54″W	Staff
14205000	W. Fk. Dairy Creek @ Banks, OR	7.7	45°37′26″N	123°06′59″W	Staff
14205160	W. Fk. Dairy Creek @ Evers Rd near Roy, OR	1.96	45°34′34″N	123°05′34″W	Staff
14204530	Gales Creek @ Old Hwy 47 near Forest Grove, OR	2.36	45°30′39″N	123°06′56″W	*Logger
14204540	Gales Creek @ Clapshaw Hill Rd near Gales Creek, OR	12.36	45°35′39″N	123°12′38″W	Staff
14202920	Sain Creek above Hagg Lake near Gaston, OR	1.6	45°28′50″N	123°14′40″W	*Logger
14202850	Scoggins Creek above Hagg Lake near Gaston, OR	8.0	45°30′06″N	123°15′06″W	Logger
14202980	Scoggins Creek below Hagg Lake near Gaston, OR	4.8	45°28′10″N	123°11′56″W	*Logger
14202860	Tanner Creek above Hagg Lake near Gaston, OR	1.6	45°30′21″N	123°13′10″W	Staff
14206500	Tualatin River @ Farmington, OR	33.3	45°26′58″N	122°57′02″W	*Logger
14202510	Tualatin River @ Gaston, OR	62.3	45°26′21″N	123°07′85″W	*Logger
14204800	Tualatin River @ Golf Course Rd near Cornelius, OR	51.5	45°30′08″N	123°03′22″W	*Logger
14202450	Tualatin River below Lee Falls near Cherry Grove, OR	70.7	45°30′21″N	123°13′06″W	*Logger
14206295	Tualatin River @ Rood Bridge Rd near Hillsboro, OR	38.4	45°29′24″N	122°57′06″W	*Logger
14206956	Tualatin River @ Tualatin (stage only) (station number formerly 14206960)	8.9	45°23′14″N	122°45′46″W	*Logger
WAPO	Wapato Canal near Gaston, OR (from Tualatin River)	61.9	45°26′29″N	123°07′17″W	Staff

*Telemetry

Water Rights

All water in Oregon, by law, is publicly owned. With a few exceptions, a person or organization (such as a city, business, or other entity) must obtain an authorization from the state before they are allowed to divert water from its natural source, whether that water is from a stream, a lake or underground. This authorization is called a water right and they have been required for surface water since 1909. The Oregon Water Resources Department (OWRD) is responsible for issuing and managing water rights in Oregon.

Water right characteristics:

- Every water right establishes the following conditions:

  —the location where the water is being diverted,
  —how much water is being diverted,
  —where the water will be used,
  —and what the water will be used for.

  The use must be considered "beneficial" by the state and the water must be used in a way that is not considered wasteful. Changing any of these conditions requires legally changing the water right.

- Every water right has a "priority date" which is the date when it was issued.

- Water rights are usually associated with the land cited in the water right and when that land is sold, the water right usually goes with it. This is called "appurtenancy" which is a legal term for rights or restrictions that go with a property (an easement is a common example). It is possible, however, to sell or transfer a water right independent of the land. In such a case, a water right transfer must be applied for and granted by OWRD. Note that mere ownership of land does not confer the right to the water adjacent to or under that land; the land owner must own a water right.

- An instream water right is designed to retain a specified amount of flow in the stream for fish and wildlife, water quality or recreation. The Departments of Fish and Wildlife, Environmental Quality and Parks and Recreation may apply for instream water rights. An instream water right has a priority date and is not treated differently than other water rights.

- A water right remains in perpetuity as long as it is used at least once every 5 years. If it has not been used for 5 years, it may be forfeited or cancelled, but this is not automatic.

Prior Appropriation: In Oregon and throughout the western U.S., water is managed by a a system called "Prior Appropriation." Prior Appropriation is most simply explained as first come, first served, where "first" to "last" is in order of priority date.

A water source may not always be adequate to meet all of the water rights that have been issued for it. Because summers in the western U.S. are typically dry, surface water shortages in the summer are not uncommon. If a water source cannot meet all of the water rights associated with it, the entity with the oldest (most senior) priority date is entitled to all of the water documented in their water right. If water is still available after that water right has been fulfilled, then the entity with the next oldest priority date is entitled to water. This process continues on in order of priority date. The entities with more recent (junior) priority dates may exercise their water rights only after the more senior rights have been met.

The Oregon Water Resources Department monitors the availability of water throughout the season. Based upon flow, location and priority date, OWRD determines which, if any, water rights holders in the basin will be restricted from exercising their water rights. Note that the eventual use of the water (for example, irrigation, municipal supply, etc.) is taken into consideration only if two water rights have the same priority date or if a drought has been officially declared by the Governor.

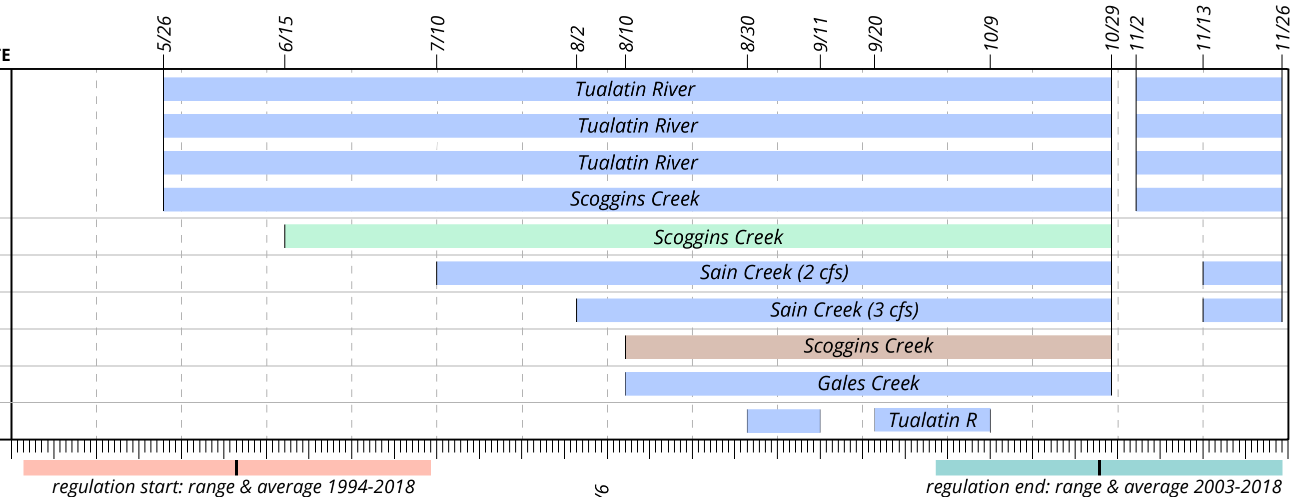
Regulatory Overview 2018

Regulation in 2018 began on May 26; the last day was November 25. Regulation was briefly suspended on October 29, but resumed on November 2. The 2018 regulation season was one of the longest (180 days) and persistent in recent history. The 2001 season was 2 days longer (182 days, May 11–November 13, suspended November 1-5). The latest date of regulation was December 9 in 2002, however, that season was shorter. Details of the regulation season are shown on the next page.

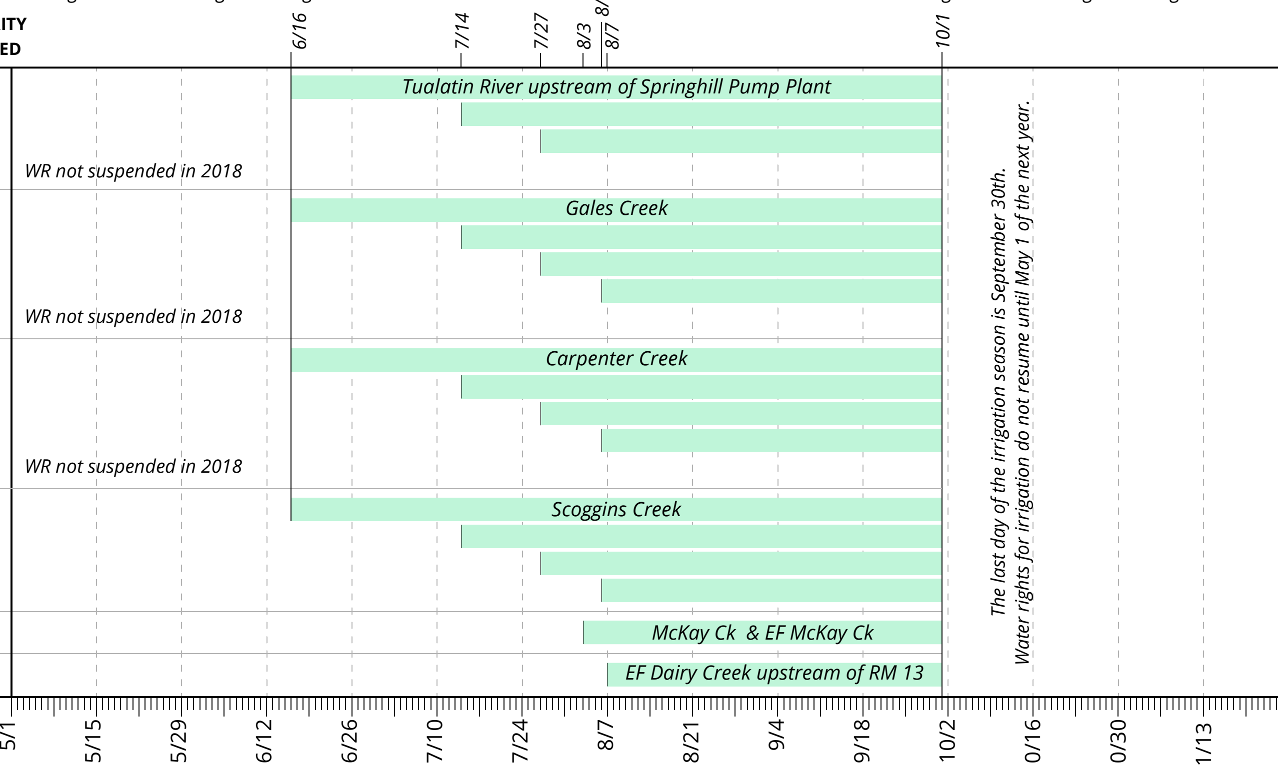
REGULATION OF WATER RIGHTS IN THE TUALATIN BASIN — 2018

Bars show period when water right is suspended

Entity	WR Certificate#	Priority Date
City of Beaverton	P-45455	7-15-1980
City of Forest Grove	P-40615	4-28-1976
City of Hillsboro	P-46423	2-6-1974
City of Hillsboro	P-50879	6-9-1988
TVID	P-35792	2-20-1963
City of Hillsboro	P-2443	5-1-2015
City of Hillsboro	P-1136	1-22-2012
Stimson Lumber Co	P-10633	4-1-1932
City of Forest Grove	P-12034	4-16-1935
City of Hillsboro	P-10408	1-22-1912



Location of Irrigation WRs	# of WRs regulated off	Earliest Priority Date Regulated	
Tualatin R upstream of SHPP	11	2-20-1963	
	18	4-14-1949	
	23	3-18-1936	
	3	8-26-1919	WR not suspended in 2018
Gales Ck	62	9-24-1963	
	38	4-18-1949	
	26	6-25-1935	
	5	9-6-1932	
	7	1-23-1923	WR not suspended in 2018
Carpenter Ck	4	7-10-1967	
	5	8-22-1949	
	6	12-14-1936	
	1	3-25-1935	
	1	10-21-1924	WR not suspended in 2018
Scoggins Ck	3	7-28-1975	
	5	4-15-1955	
	7	4-24-1939	
	1	4-1-1932	
McKay Ck & tribs abv Northrup Rd	8	5-25-1966	
EF Dairy Ck & tribs abv RM 13	12	3-6-1967	



Water Use

Municipal | Industrial-manufacturing | Irrigation

SCOGGINS DAM/HENRY HAGG LAKE

By John Goans, Reservoir Superintendent, TVID; Wally Otto, retired, TVID; Bernie Bonn

INTRODUCTION

Scoggins Dam

Scoggins Dam/Henry Hagg Lake is located on Scoggins Creek in the upper part of the Tualatin Basin. Scoggins Dam is an earthfill dam constructed during 1972–75 to store water during the winter for summer and fall use. The dam is owned by the Bureau of Reclamation (BOR) and managed by the Tualatin Valley Irrigation District (TVID). Stored water from Hagg Lake is used for irrigation, municipal and industrial use, and flow augmentation in the Tualatin Basin to support water quality and protect fish and wildlife.

Three tributaries flow into Hagg Lake—Sain, Scoggins and Tanner Creeks. Flows in Sain and Scoggins Creeks are monitored by Oregon Water Resources Department gages; flow in Tanner Creek is monitored by daily readings of a staff plate by TVID personnel. Outflow is measured by a BOR stream gage in Scoggins Creek at RM 4.8. Oregon Water Resources Department maintains the rating curves for these sites.

Scoggins Dam stores 53,323 acre-feet of water in Henry Hagg Lake as active storage—the amount of water that can be moved in or out of the reservoir between the intake structure and the top of the spillway gates. Another 7,000 acre-feet of stored water that is not engineered to be removed exists below the intake structure. It is reserved for the protection of fish if the lake were to be drafted down completely to the intake structure.

ALLOCATION OF WATER FROM HAGG LAKE

CONTRACTED TO	WATER USE	AVAILABLE VOLUME	
		ac-ft	AS PERCENT
Tualatin Valley Irrigation District	Irrigation (up to 17,000 acres)	26,705	50%
Joint Water Commission *City of Beaverton* *City of Forest Grove* *City of Hillsboro*	Municipal and industrial	13,500 4,000 4,500 5,000	25%
Clean Water Services	Instream water quality	12,618	24%
Lake Oswego Corporation	Irrigation	500	1%
Total		***53,323**	**100%**

The active storage in Hagg Lake was revised in 2011

Scoggins Dam is authorized by the U.S. Congress to provide flood control for communities located downstream, including Gaston, Cornelius and Forest Grove. The dam controls runoff from a 39 square mile watershed (about 5% of the Tualatin Basin). From November 1st to January 15th, 20,000 acre-feet are designated for flood control storage. The dam does not generate electricity.

Recreation is a major activity at Hagg Lake and the surrounding area, especially during summer. Washington County maintains and operates the 2,851 acre Scoggins Valley Park/Henry Hagg Lake recreational facility. In addition to the 1,100 acre lake, the park includes picnic areas, hiking trails, two boat launching facilities, and observation decks for bird and wildlife watching. The lake is stocked for fishing. Most of the park's facilities were designed to be accessible for disabled visitors. The park is open year round and is for day-use only.

http://www.co.washington.or.us/Support_Services/Facilities/Parks/Hagglake/index.cfm

2018 Water Use

Water year 2018 marks the 44th year since Scoggins Dam began storing and releasing water for downstream beneficial use. A total of 40,525 acre-feet were delivered in 2018 (calendar year) bringing the total delivery from the Project to more than 1.3 million acre-feet.

2018 flow regulation began on May 26 for the Joint Water Commission and June 16 for TVID. With the exception of TVID's extended season irrigators, all users were permitted to return to natural flow use in the Tualatin River on November 27, 2018. As usual, TVID continued to deliver a small amount of storage water primarily to nurseries and greenhouses beginning in March and continuing until the end of November as permitted by the Oregon Water Resources Department.

2018 WATER DELIVERIES FROM HAGG LAKE

Delivered to	Volume (ac-ft)
Tualatin Valley Irrigation District	17,413
Clean Water Services	12,129
Municipal Use (Cities of Beaverton, Forest Grove and Hillsboro)	9,513
Lake Oswego Corporation	500
Other (includes two golf courses, from TVID allocation)	972
Total	**40,525**

Events in 2018

Recreation: In 2018 there were 800,000 users recorded at Scoggins Valley Park/Henry Hagg Lake. In addition to the usual recreational uses, numerous races were held including triathlons.

Coho Salmon: Four Coho were spotted in Scoggins Creek below the dam in December.

Lake Fish Habitat: Over the previous years, the Oregon Panfish Club anchored a total of 350 fish habitat structures (8' diameter) in the upper reaches of Henry Hagg Lake. These have caused no problems in terms of operation and maintenance of Scoggins Dam. They have remained in place weighted down with concrete anchors.

Elk Mitigation: Roughly 50% of the fir trees planted in February 2012 remain standing and continue to form a visual barrier for the elk along the side of the Control House entry road. The field remains off limits to all trespassers including dogs. On numerous occasions, elk were observed grazing in the pasture.

Endangered species: As part of the consultation, BOR committed to avoid or minimize impacts to Fender's Blue Butterfly (FBB) and Kincaid's lupine. the Master Trail that traversed prairie patches containing FBB and Kincaid's lupine was relocated and trail maintenance practices modified to support these species. Reclamation has also committed to work with partner agencies to study and control invasive weeds.

Scoggins Dam Security

Department of Homeland Security Alert Levels: The Project follows the Department of Homeland Security (DHS) alert levels as required by BOR. No incidences of heightened security level occurred at Scoggins Dam in 2018 due to any specific terrorist alerts.

Scoggins Dam Safety

At Scoggins Dam, earthquake activity, weather including temperature and precipitation, river stage levels, and water surface elevation are reported and recorded electronically. In addition, key dam behavioral instruments report electronically over BOR's Hydromet system. The data are collected, stored and transmitted via satellite to BOR's Pacific Northwest Regional office in Boise, and are available on the Internet through both secure and non-secure channels. Many of these electronic reporting stations have alarms to alert operators if sudden or unusual conditions develop including earthquakes and flooding. While operators are not on site 24/7, the Project is monitored 24/7, both by BOR and TVID personnel.

Spills and Water Quality: No spills or accidents that jeopardized the water quality in Henry Hagg Lake occurred in 2018 and the BOR on-site Response Trailer was not needed for emergency response. No containment booms were deployed to contain any contaminant spills during 2018.

Drownings: No drownings were reported in 2018, thankfully! Loaner life jackets area available at several stations near swimming areas in the park.

Earthquakes: No earthquakes were recorded near the dam in 2018.

Future of the Project

Tualatin Basin Water Supply: In 2001, the water resource agencies in the Tualatin Basin (except TVID) began to explore and compare alternatives for providing the additional water needed to meet future needs. TVID was not part of this group because it is limited to serving 17,000 acres of irrigated land and the current supply is adequate. After studying many different options as well as seismic issues, the municipal and industrial water providers decided to focus on the Willamette River for future water supply.

Clean Water Services is continuing to collaborate with BOR on the Tualatin Basin Dam Safety and Water Supply Joint Project. The Project goals include developing alternatives to:

- strengthen the dam to reduce risk from a Cascadia Subduction Zone earthquake, and
- increase the storage capacity of Hagg Lake to ensure that future water supply needs are met for the maintenance and improvement of water quality in the Tualatin River.

In May 2016, Congress passed the Federal Energy and Water Appropriations Bill. The bill raised the funding cap for necessary safety upgrades to Scoggins Dam and granted BOR the statutory authority to pursue conservation storage and paved the way for the Joint Project. It earmarked $2 million for updates to Scoggins Dam. The alternatives under consideration for upgrading Scoggins Dam are:

- strengthening Scoggins Dam in its current location without increasing storage capacity
- strengthening and raising Scoggins Dam in its current location, and
- replacing the existing dam with a new dam located downstream at a narrow gap in the valley.

The preferred alternative is scheduled to be selected in 2019.

More information about the Tualatin Basin Water Supply Project and updates can be found at:
http://www.tualatinbasinwatersupply.org

HAGG LAKE MONITORING

By Bernie Bonn

Background

Stored water in Hagg Lake is used for several purposes, including drinking water supply, and its quality is of critical importance. Routine water quality monitoring of Hagg Lake occurred in 1999–2005 and the data were summarized in the Flow Reports for those years. That program was documented in a 2007 technical memorandum written by Flow Science Incorporated for Clean Water Services. In addition, the USGS produced a water quality model of Hagg Lake for 2000–2003. Results of the USGS modelling are described in two online reports: https://pubs.usgs.gov/sir/2004/5261/ and https://pubs.usgs.gov/sir/2006/5060/.

Recent monitoring program

Joint Water Commission and Clean Water Services partnered in 2014 to resume water quality monitoring of Hagg Lake. Monitoring began in October 2014 and continued through June 2017. Routine monitoring was carried out by JWC staff and entailed:

- sampling every other month (February, April, June, August, October, and December)
  —Sain Creek, upper Scoggins Creek and Tanner Creek,
  —vertical profiles in Hagg Lake at its deepest point, and
  —Scoggins Creek below the dam
- field parameters: temperature, specific conductance, pH, dissolved oxygen and turbidity,
- nutrient analyses: total phosphorus, orthophosphorus, ammonia, nitrate, nitrite, and total nitrogen,
- total organic carbon, dissolved organic carbon, and biochemical oxygen demand,
- bacteria, algae (species and biovolume), cyanobacteria, depth of photic zone and chlorophyll.

In order to assess the effects of the September 2014 fire in upper Scoggins Creek, three sites were sampled monthly for total suspended solids, dissolved organic carbon and iron.

Findings

Some highlights of the report include:

- BOD was almost nonexistent.
- TN:TP ratios (total phosphorus to total nitrogen) indicate that phosphorus is likely the limiting nutrient for algal growth in Hagg Lake in winter, but that nitrogen might be limiting at times in summer.
- Diatoms (mostly) and cryptophytes tended to be the dominant algal groups, although one large bloom of green algae occurred in May 2016.
- Cyanobacteria was detected at times, but microcystis was not detected. Anabaena was always present. Aphanizomenon was present for most of the study. Cyanobacteria densities always were less than the Oregon Health Authority trigger level, so no sampling or analysis was done for algal toxins. Anabaena made up more than half the algal biovolume in August 2015. (This is consistent with previous data collected by JWC, in which anabaena tended to be present in late summer.)
- No particularly anomalous measurements could be attributed to the 2014 fire.

Future monitoring and report recommendations

- Funding is available to continue the monitoring program (not the fire-effects monitoring) through 2020.
- Focus some sampling on the period just after storm events.
- Sample for hydrocarbons in the lake and downstream. (Boat use and local traffic constitute a source.)
- Sample for select metals in the tributaries, lake, and the lake hypolimnion.

TUALATIN VALLEY IRRIGATION DISTRICT

by Wally Otto, retired, TVID; updated by John Goans, Reservoir Superintendent, TVID

Tualatin Valley Irrigation District Overview

The Tualatin Valley Irrigation District (TVID), located in Forest Grove, Oregon, is the agricultural water service agency in the Tualatin Basin. In the early twentieth century, relatively little agricultural land was irrigated in Washington County: about 15 acres in 1915 and about 130 acres in 1933. By 1951, however, 18,455 acres had water rights registered in the county. When the TVID was formed in 1962, the total had grown to 33,885 acres. TVID was formed to assist in the delivery of irrigation water to about half of those acres (17,000) in the Tualatin Basin. The water was supplied from natural flow and return flows, and was extremely limited due to early summer withdrawals from the Tualatin River and increasing demands for water for irrigation and municipal use and for maintaining instream water quality and fish. The only storage at this time was Barney Reservoir which stored 4000 acre-feet for municipal use. Beginning in 1975, additional stored water became available behind the newly completed Bureau of Reclamation Project, Scoggins Dam. Approximately half of the water stored in Hagg Lake (Henry Hagg Lake) is allocated to TVID.

Most of the water supplied by TVID is pumped from the Tualatin River at the Spring Hill Pump Plant and delivered to TVID patrons via approximately 120 miles of pressurized pipeline. Additionally, water in both Scoggins Creek and the Tualatin River is withdrawn by irrigators for use on land abutting the river. They are known as “river users” and pay for their own pumping costs because they are not associated with the pressure pipeline or the Spring Hill Pumping Plant. When natural flow no longer meets demand, the District 18 Watermaster begins regulating water users with “junior” (or more recent) water rights off, starting with users with the most recent water right. The TVID storage right is dated 1963, so TVID patrons with water rights after that date must stop withdrawing natural and return flow water, and all water withdrawals must be supplied from storage. Storage water is discharged from Hagg Lake to either augment the river flow or supply the entire need of the TVID patrons, both the pump plant/pressure pipeline users and the river users. Water for some of the TVID members on the lower Tualatin River is supplied by water discharged from Clean Water Services’ Rock Creek Wastewater Treatment Facility. Crops irrigated with District water range from row crops including blueberries, blackcaps, corn, pumpkins and other vegetables to nursery stock.

TVID is allowed to use storage water early and late in the year because of an extended season for irrigation made possible by an agreement with the Oregon Water Resources Department. The early season begins March 1 and the extended season ends November 30. All water used outside the normal irrigation season (May through September) must come from TVID's annual contracted *storage* allotment of 27,022 acre-feet. TVID's total contracted amount with Reclamation is 37,000 acre-feet with the additional coming from natural and return flows in the Tualatin River and its tributaries.

The extension of the irrigation season for the Tualatin Valley Irrigation District has made growing specialty crops within the District much more appealing. During the extended spring season, the water is used primarily for berries and nurseries; during the extended fall season, water is primarily used for the nurseries. A more diverse nursery stock is now possible, including flowers which are raised well into November when protected by greenhouses. Water availability and moderate temperatures make the Tualatin Valley Irrigation District home to many small specialty nurseries along with several large operations.

2018 TVID Water Use

For the 2018 irrigation season (March through the end of November), TVID took delivery of 17,413 acre-feet of water from storage in Henry Hagg Lake—very similar to their usage in 2017 (17,223 ac-ft). The least amount was 8,333 ac-ft in 1993; the largest seasonal delivery was 25,852 ac-ft in 2015. TVID 2018 peak use from storage was 113 cfs on July 15.

WEATHER STATISTICS AT SCOGGINS DAM 2018

Month	Description	Precipitation 2018	Precipitation [average]*	Average Temperature Low	Average Temperature High	Other
January	warm	8.37″	[7.88″]	40°F	50°F	4 days ≥ 55°F, 2 days ≤ 32°F
February	dry & warm early cool & wet late	2.51″	[6.21″]	33°F	48°F	only 0.14″ rain 1st–13th
March	warm	4.75″	[5.78″]	35°F	53°F	2 days ≥ 65°F
April	average rain with 1 big storm; warm late	5.70″	[3.52″]	41°F	59°F	1.92″ rain on 8th 4 days ≥ 70°F, 2 days ≥ 80°F
May	extremely dry, warm	0.10″	[2.13″]	47°F	71°F	5 days with any rain, all ≤ 0.03" 4 days ≥80°F
June	mostly dry	0.78″	[1.45″]	48°F	73°F	0.72″ rain on 9th–11th (92%) 25 days with no rain
July	very dry, hot 2nd half	0.01″	[0.41″]	53°F	85°F	15 days ≥ 90°F, all after 13th
August	very dry, warm	0.02″	[0.64″]	53°F	83°F	21 days ≥80°F, 9 days ≥90°F
September	mostly dry, mild	1.13″	[1.51″]	47°F	73°F	only 6 days with rain > 0.03"
October	2 storms, warm	3.28″	[3.75″]	43°F	65°F	2.31″ of rain 25th–29th (70%)
November	unusually dry	3.75″	[7.80″]	38°F	54°F	18 days with ≤ 0.01" rain
December	somewhat dry	7.72″	[9.22″]	36°F	47°F	lowest temperature: 31°F

*average based on 1970–current year

2018 TVID Operation and Maintenance

The year was uneventful from an operations standpoint. A “moratorium” remains in place regarding new turn-out deliveries. No new deliveries were added to the delivery system during 2018.

Pipeline Maintenance: TVID delivers irrigation water by high pressure pipeline to customers from Gaston to North Plains and from west of Forest Grove to Highway 219 south of Hillsboro. The water is withdrawn from the Tualatin River at the Spring Hill Pump Plant and lifted by pumps to a water regulating tank off Winter’s Road. From there it flows under gravity pressure to all points of delivery through 120 miles of pipeline. Preventative maintenance continues to keep service delivery as dependable as possible. Several minor disruptions of service occurred during the year, but were quickly isolated and repaired. Service was restored in minutes in some cases or in up to a day if conditions did not allow quick access. There were no long term disruptions of service to District patrons.

Tributary Flow Restoration Projects: TVID and Clean Water Services continue their cooperative effort using the TVID water distribution network to supply water to West Fork Dairy Creek, Gales Creek, East Fork Dairy Creek, and McKay Creek. Each site consists of a metered pipeline with a diffuser at the outlet. All sites are located near delivery lines for the Irrigation District. Flow augmentation occurs during the summer and fall. The water not only adds to streamflow, but it cools the stream as well. The partnership between the Tualatin Valley Irrigation District and Clean Water Services is a novel way to improve the water quality of these streams at minimal cost.

WAPATO LAKE

by Kristel Griffith, Water Resources Program Coordinator, JWC
updated by John Goans, Reservoir Superintendent, TVID

The former Wapato Lake bed, located southeast of Gaston, Oregon, is a 780 acre wetland that was once the winter residence of the Atfalati indigenous people. Settlement of the area began in the 1830s and during the 1930s a levee and pump system was constructed by the Wapato Improvement District (WID) to drain the lake bed during spring so that the land could be farmed in summer. The levee protects the former lake bed from severe flooding during the winter, thereby allowing easier drainage in spring.

In 2011, the US Fish and Wildlife Service (USFWS) became the majority land-owner and the WID was dissolved. In 2013 Wapato Lake was established as a National Wildlife Refuge (NWR) as part of the Tualatin River NWR Complex.

LEVEE, PUMP AND DRAINAGE ISSUES

2007–2008: A levee failure in December 2007 resulted in flooding. By spring 2008, the lake was supporting a substantial population of algae and zooplankton. When the impounded water was discharged in June 2008, it created many water quality problems which affected drinking water treatment, agricultural irrigation, fish and wildlife, and recreational use. The State of Oregon issued a Public Health Advisory for recreational contact with the Tualatin River due to high levels of toxic algae. Detailed descriptions of these events can be found in USGS Report 2015-5178, "Upstream Factors Affecting Tualatin River Algae- Tracking the 2008 Anabaena Algae Bloom to Wapato Lake, Oregon."

2010: In 2010 when the primary pump failed, Clean Water Services led a collaborative effort to acquire temporary pumps to prevent a repeat of the 2008 problems. See the Tualatin River Flow Management Technical Committee's 2010 report for details.

2012 TMDL: Drainage from Wapato Lake was included in the 2012 Total Maximum Daily Load (TMDL) Implementation Plan. USFWS must limit pumping from the lakebed after April 30th each year to be in compliance with Department of Environmental Quality requirements (DEQ). This avoids draining the area during conditions favorable to algal blooms (low water and high temperature), and protects water quality in the Tualatin River.

2016: As in 2010, mechanical and electrical failures caused the primary pump to be non-operational in February 2016. Pump repairs could not have been completed soon enough to drain the lake bed by April 30th as mandated by the TMDL. The possibility of a repeat of the 2008 water quality problems was a serious concern. The water and natural resource managers in the Tualatin Basin, including CWS, USGS, JWC and USFWS, worked together to obtain emergency repairs and acquire auxiliary pumps. The lake was pumped out on May 1st, only 1 day late. No water quality problems were evident.

PUMPING OPERATIONS IN 2018

Summer water levels in the lake bed were higher than typical. The small pump was started on Monday, August 27 and ran until Thursday, August 30 to bring water down to appropriate levels to investigate potential leaks. After five days without rainfall, the water levels increased 1.5 feet and then stabilized. Two water control structures were found to be leaking. Temporary fixes were made, and permanent solutions will be implemented in 2019.

2018 PUMPING CAPACITY AND DATES OF OPERATION

PUMP	NOMINAL CAPACITY (GPM)	OPERATION PERIOD
USFWS PRIMARY	~10,000	3/1 – 4/27
USFWS SECONDARY	~3,000	3/1 – 5/31

WATER QUALITY

by Bernie Bonn

Concern about water quality in the Tualatin River is longstanding. Until the formation of Clean Water Services (formerly the Unified Sewerage Agency of Washington County), numerous small towns and cities discharged minimally treated sewage into the river and its tributaries. Water use by agricultural activities in the basin depleted river flow in the summer and contributed nutrients and sediment. By the 1960s, the local newspaper documented the poor water quality in the Tualatin River. In 1984, the Oregon Department of Environmental Quality (ODEQ) included sections of the Tualatin River on the 303d list as being water quality limited. Water quality issues in the Tualatin Basin have included elevated pH and nuisance algae, low dissolved oxygen, high temperatures, and excess bacteria. Many groups have worked to improve water quality in the Tualatin Basin, including Clean Water Services, the Tualatin River Watershed Council, the Tualatin Riverkeepers and others. Part of the reason for the formation of the Flow Committee is to manage river flow to improve and preserve water quality.

HISTORICAL WATER QUALITY CONCERNS

Algae and high pH: In the reservoir section (about RM 3.4-30), the Tualatin River is wide and slow moving. Because the river is so broad, streamside vegetation cannot adequately shade the full width and consequently much of the water surface is in exposed to the sun. Nutrients, both naturally occurring and anthropogenic, are ample. These conditions—slow movement, sunlight, and ample nutrients— are ideal for algal growth during summer. Most of the algae in the Tualatin River are phytoplankton that float in the upper few feet of the water. During the day, photosynthesis by algae converts carbon dioxide dissolved in the water into biomass. As the concentration of dissolved carbon dioxide decreases, the pH of the water increases. High pH values can negatively affect aquatic resources.

In the 1980s the lower section of the Tualatin River was listed by the ODEQ for elevated pH (>8.5) and degraded aesthetics due to nuisance algal growth. To address these water quality problems, the ODEQ developed a TMDL for phosphorus to limit nutrient availability. Target levels for instream total phosphorus concentrations have been established for the Tualatin River at various locations.

Some Tualatin tributaries also have had problems with algal growth, usually periphyton.

Dissolved oxygen: The amount of oxygen dissolved in water is the net result of processes that contribute oxygen and processes that consume oxygen. In the lower Tualatin River the primary sources of oxygen are:

—photosynthesis by algae during the daytime, and
—inflow of oxygen rich water.

The processes that consume oxygen are:

—biochemical oxygen demand (from substances in the water that decompose),
—sediment oxygen demand (from substances at the river bottom that decompose), and
—respiration by algae.

Because the lower section of the river moves slowly and is not turbulent, oxygen exchange with the atmosphere is slow. If dissolved oxygen becomes depleted, it cannot be quickly replenished from the air. Similarly, if dissolved oxygen is in excess, the river water stays supersaturated for a prolonged period of time.

In the 1980s the lower section of the Tualatin River was listed by the ODEQ for low dissolved oxygen that could impair fish health.The water quality criteria for this section of the river, which is considered 'Cool Water Habitat,' are:

- Grab samples: dissolved oxygen > 6.5 mg/L
- Continuous Monitoring:

—30-day average of daily mean dissolved oxygen > 6.5 mg/L (no credit for supersaturation)
—7-day average of daily minimum dissolved oxygen > 5.0 mg/L (no credit for supersaturation)
—Daily minimum dissolved oxygen > 4.0 mg/L

ODEQ also developed a TMDL for ammonia which consumes oxygen as it decomposes into nitrate.

Water quality monitoring

Clean Water Services obtains grab samples at numerous sites throughout the basin, including several on the Tualatin River as well as tributaries. Field parameters (dissolved oxygen, water temperature and pH) are measured in the stream at the time of sample collection. Other constituents, including chlorophyll-*a*, phosphorus, nitrate and ammonia, are analyzed in the laboratory.

Continuous water quality monitors have been deployed throughout the basin. Most are operated by the USGS as part of a cooperative agreement with Clean Water Services. The Tualatin River at Hwy 219 monitor is operated by personnel at Jackson Bottom Wetlands Preserve. Since October 2015, the Beaverton Creek at 170th monitor has been operated by Clean Water Services personnel, although the data are still reviewed by the USGS. All monitors record data at least hourly. The table below lists the currently operating continuous monitors that are not part of any special study.

LONG TERM CONTINUOUS WATER QUALITY MONITORS

Site	River Mile	Parameters*								Notes
		DO	pH	WT	SC	Tbdy	Chl	Phyc	fDOM	
Tualatin River at Oswego Dam	3.4	●	●	●	●	●	●			most parameters since 1991
Tualatin River at RM 24.5	24.5	●	●	●	●					since 1997, summer only
Tualatin River at Hwy 219	44.4	●	●	●	●	●				since 2004
Tualatin River at Dilley	58.8		●	●	●	●	●	●	●	since 2016
Fanno Creek at Durham		●	●	●	●	●				since 2003
Beaverton Creek at 170th		●	●	●	●	●				most parameters since 2001
Rock Creek at Brookwood		●	●	●	●	●				since 2004
Gales Creek at Old Hwy 47		●	●	●	●	●			●	most parameters since 2001
Scoggins Creek below Hagg Lake		●	●	●	●	●				most parameters since 2002

*Parameter abbreviations: DO=dissolved oxygen, WT=water temperature, SC=specific conductance, Tbdy=turbidity, Chl=chlorophyll-*a*, Phyc=phycocyanin (indicator of cyanobacteria), fDOM=fluorescent dissolved organic matter

Tualatin River water quality since the TMDL

Since the first TMDL, advanced wastewater treatment by Clean Water Services has decreased the amount of phosphorus and ammonia discharged to the river by its WWTFs during the summer low flow period. Median total phosphorus concentrations during low flow season in the Tualatin River at Elsner/Jurgens Park (0.086 μg/L) and at Stafford (0.087 μg/L) have been below the TMDL target levels (0.11 and 0.10 μg/L, respectively) since 1998. More details about phosphorus concentrations are in Appendix H.

Streamflow in the Tualatin River during the summer has increased since the TMDLs were instituted in 1988. Much of the increase is due to Clean Water Services' releases of stored water from Scoggins and Barney Reservoirs as well as increased discharge from the wastewater treatment facilities. In addition, coordinated water management among the members of the Tualatin Flow Committee has helped eliminate the very low flows that occasionally occurred during the summer in the early 1990s and before.

Algae and high pH: Chlorophyll-*a* concentrations indicate the amount of algae in the river. They have decreased substantially since the 1990s (see the figure on page 46). Because the algal population has declined, the high pH values that were problematic in the early 1990s have become non-existent in the lower Tualatin River (see the figure on page 46). Low pH values (<6.5) are not a problem in the Tualatin River system.

Dissolved oxygen: Increased river flow affects two different processes with opposite effects on oxygen. Faster river flow decreases the amount of time water is in contact with sediment, thereby decreasing the extent to which sediment oxygen demand can be exerted and the resultant amount of oxygen depleted. Faster river flow also decreases the time available for algal populations to grow, which in turn decreases photosynthetic oxygen production. The net effect of decreased oxygen consumption plus decreased oxygen production is variable and not well predicted. In general, low dissolved oxygen is still an issue in the lower Tualatin River, especially late summer through fall when low flows and warm water temperatures increase oxygen consumption by sediment oxygen demand and short days decrease photosynthetic oxygen production (see the figure on page 46).

Tualatin River water quality in 2018

Algae and pH: Chlorophyll-*a* levels in 2018 were the lowest since USGS began chlorphyll-*a* continuous monitoring in 2001. The maximum 3-month mean chlorophyll-*a* concentration in the Tualatin River at Oswego Dam in 2018 was 5.1 μg/L and occurred for June–August. Median total phosphorus concentrations for the 2018 summer season (May–October) were 0.086 μg/L at Jurgens Park and 0.078 μg/L at Stafford.

The maximum pH values measured by continuous monitors at the Oswego Dam and RM 24.5 sites (7.0 and 7.3, respectively) were well below ODEQ's 8.5 maximum and another sign of low algal activity in the river.

Dissolved oxygen: Dissolved oxygen conditions in the Tualatin River in 2018 were mixed. All criteria for DO were met throughout the dry season at RM 24.5, and the 7-day and daily criteria were met at the Oswego Dam. The 30-day criterion (30-day mean with no credit for supersaturation), however, was not met at the Oswego Dam for at least half of the time from June through September. In addition, the 30-day criterion was not met for 11 days in November.

NUMBER OF DAYS THAT DID NOT MEET DISSOLVED OXYGEN CRITERIA IN 2018

Criterion	May	June	July	Aug	Sept	Oct	May–October Percentage	Nov
Tualatin River at RM 24.5								
30 day	0	0	0	0	0	0	0%	0
7 day	0	0	0	0	0	0	0%	0
Daily	0	0	0	0	0	0	0%	0
Tualatin River at Oswego Dam (RM 3.4)								
30 day	0	25	17	15	28	0	46%	11
7 day	0	0	0	0	0	0	0%	0
Daily	0	0	0	0	0	0	0%	0

Low dissolved oxygen at Oswego Dam in late summer and early fall have been common in recent years. DO levels in 2018 were somewhat unusual in that the 30-day criterion was not met from August 17 through September 28, which is earlier than in most years. Typically, algal growth is sufficient in late July and early August to offset sediment oxygen demand. In 2018, algal activity was minimal all season. See page 46. The 30-day criterion was met throughout October, which is when low DO levels have often occurred.

DO concentrations in November 2018 did not meet the 30-day criterion for 11 days (10th through 20th). Although not typical, low dissolved oxygen levels in November have occurred before when flows were low. A storm in October 2018 briefly increased flows in the Tualatin River, but the increase was short-lived, and flows quickly decreased to base levels.

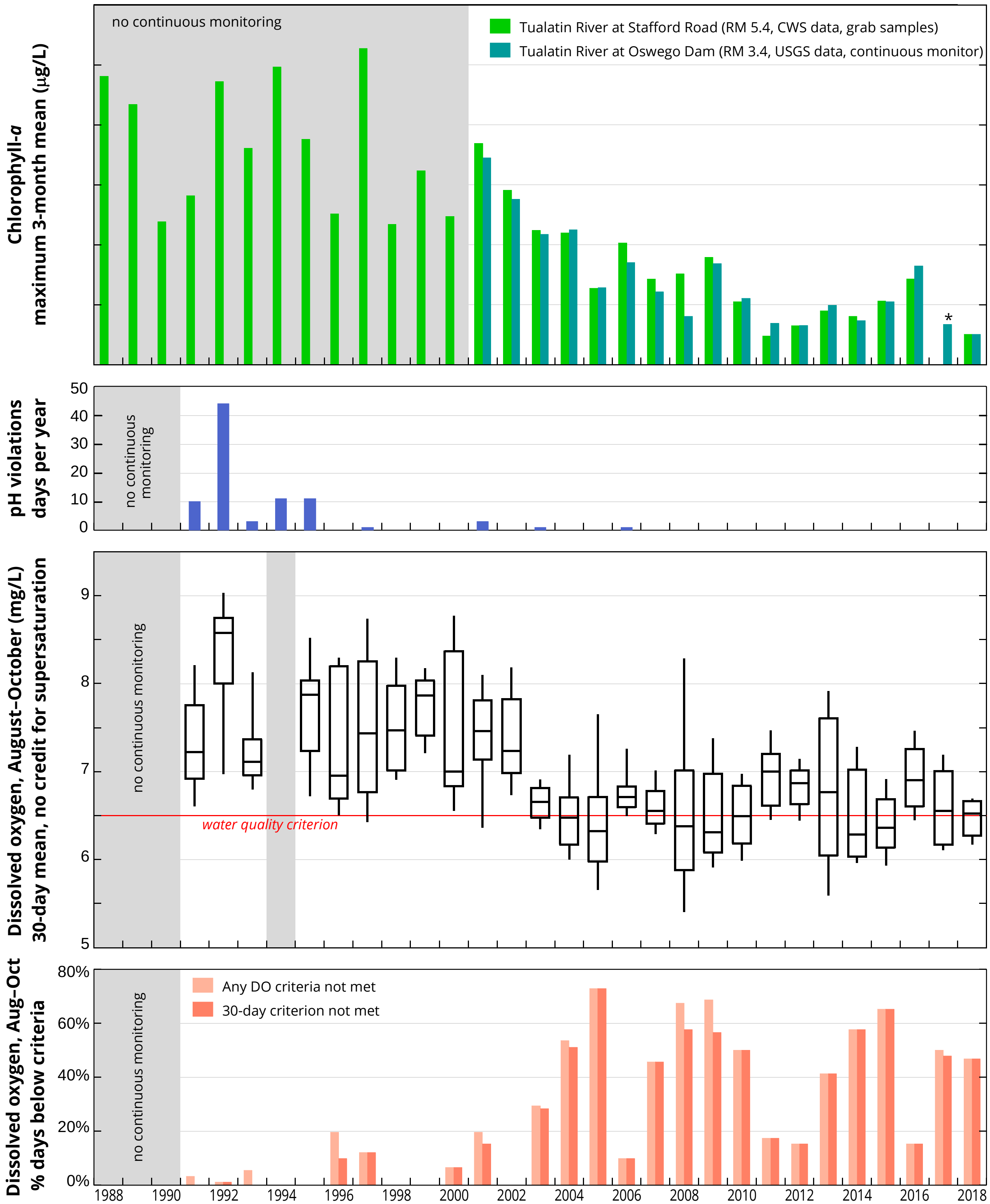
Early summer 2018 was unprecedented. In 2018, the 30-day dissolved oxygen criterion was not met from June 6 through July 17, 42 consecutive days. Prior to 2018, only two episodes occurred in the months before August in which a dissolved oxygen criterion was unmet: July 5-7, 1992 and July 25–27, 2007 when the 7-day mean minimum criterion was not met. Until 2018, the 30-day criterion had been met every day in June and July since continuous monitoring at Oswego Dam began in 1991.

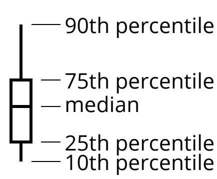
The graphs on page 47 show the conditions in early summer 2018 compared to the period of record (2001-2018). At the beginning of May 2018, DO concentrations, streamflow and temperature were all near long-term averages. Streamflow decreased through the month and temperature increased, which is normal.

Typically during the early summer, if it is not cloudy, longer days and lower flow promote algal growth. DO levels fluctuate as the balance between photosynthetic oxygen production and oxygen depletion by SOD changes. May 2018 was warm and dry, yet low chlorophyll-a concentrations show that algae did not proliferate. DO declined rapidly through the month as oxygen consumption by SOD increased due to longer contact time and higher temperatures. The lowest DO at Oswego Dam during the entire low flow season was 5.51 mg/L on May 25. The lowest value of the 30-day statistic at that site was 6.09 mg/L on June 15.

Although low flow and warm temperatures enhanced the expression of SOD in May 2018, they do not explain the low algal activity. Similar flow and temperatures occurred in 2015 and 2016 yet algal activity was moderate and DO levels, while low at times, met the 30-day criterion throughout the early summer.

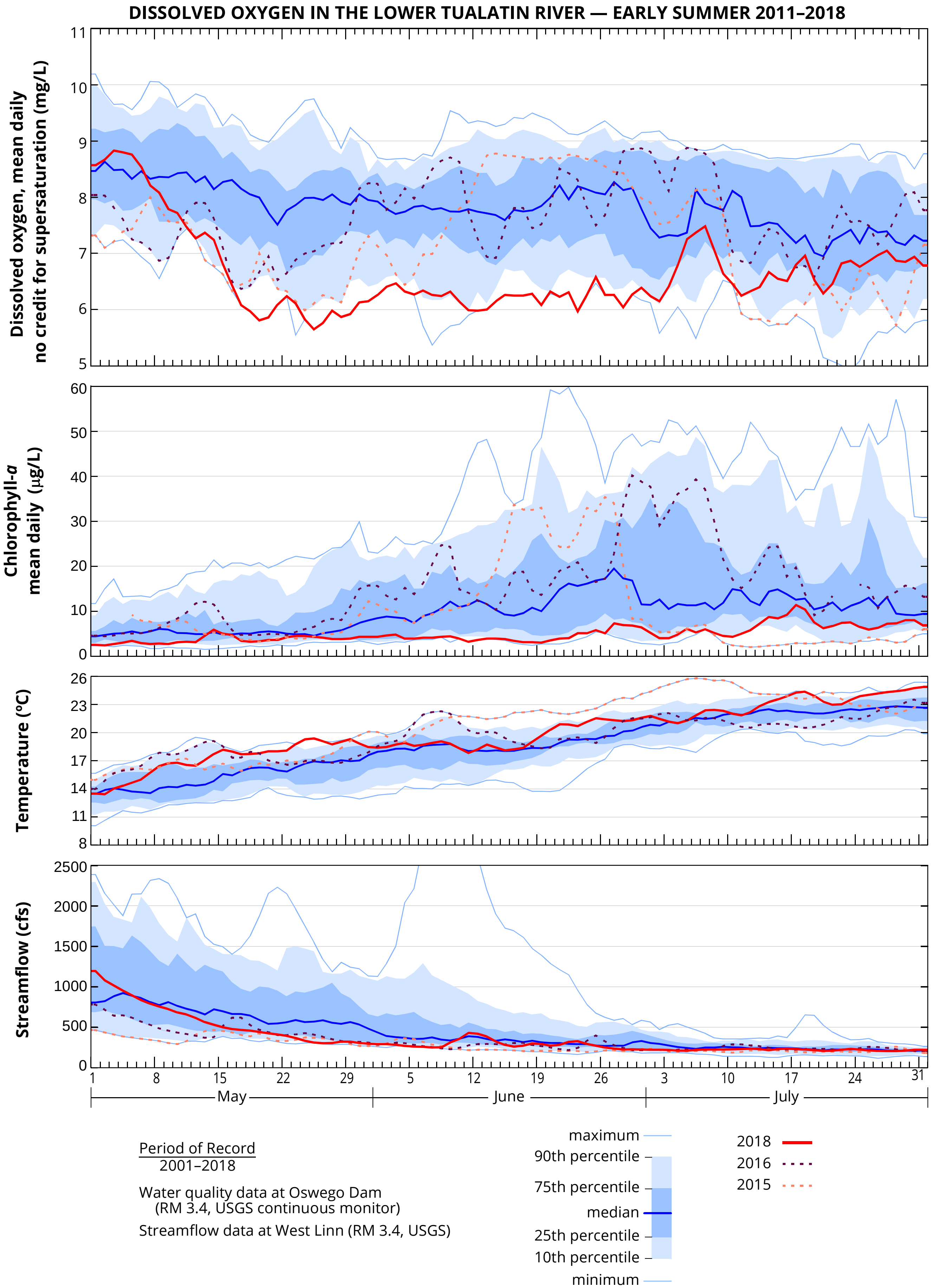
CHLOROPHYLL-*a*, pH & DISSOLVED OXYGEN IN THE LOWER TUALATIN RIVER — LATE SUMMER 1988–2018





All data for Tualatin River at Oswego Dam (RM 3.4, USGS data, continuous monitor) except chlorophyll-a data from Clean Water Services which were grab samples at Stafford

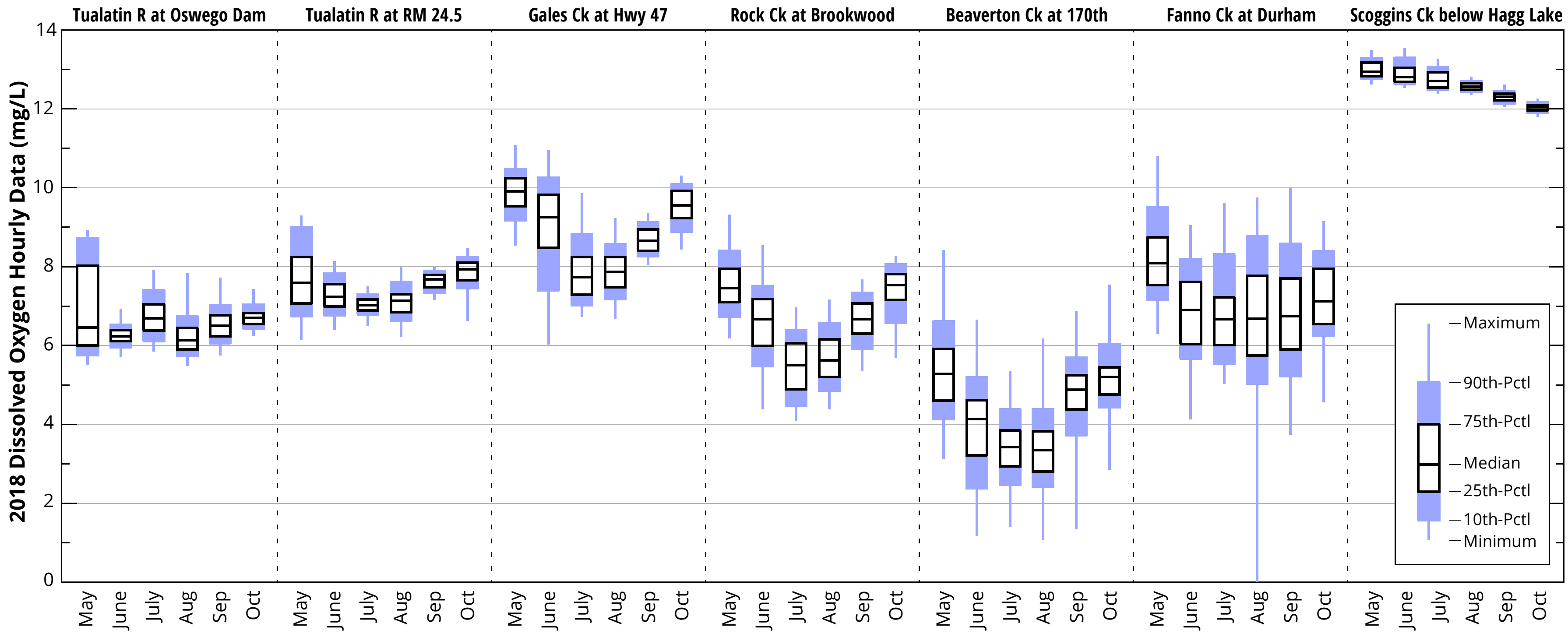
*Chlorophyll-a data from Clean Water Services were not available in 2017.


DISSOLVED OXYGEN IN THE LOWER TUALATIN RIVER — EARLY SUMMER 2011–2018
Dissolved oxygen, mean daily no credit for supersaturation (mg/L)
Chlorophyll-a mean daily (µg/L)
Temperature (ºC)
Streamflow (cfs)
May
June
July
Period of Record 2001–2018
Water quality data at Oswego Dam (RM 3.4, USGS continuous monitor)
Streamflow data at West Linn (RM 3.4, USGS)
maximum
90th percentile
75th percentile
median
25th percentile
10th percentile
minimum
2018
2016
2015

Dissolved oxygen throughout the Tualatin Basin

As previously discussed, low dissolved oxygen (DO) concentrations have been an ongoing problem in the lower Tualatin River. Some of the tributaries in the Tualatin Basin also have had low DO levels. In general, the slow moving valley bottom streams are more likely to have low DO than faster moving headwaters streams. It is thought that sediment oxygen demand is largely responsible for the low DO levels in the tributaries. Transport of material from the landscape and re-suspension of sediment are also thought to be important sources of biochemical oxygen demands to the tributaries. Continuous monitoring can provide insight into the processes that affect DO concentrations. A statistical summary of the data is shown below. More detailed descriptions for each site are provided on the following pages. Data are available at:
`https://or.water.usgs.gov/cgi-bin/grapher/table_setup.pl?basin_id=tualatin`

DISSOLVED OXYGEN LEVELS IN THE TUALATIN RIVER AND SELECTED TRIBUTARIES DURING LOW-FLOW SEASON — 2018

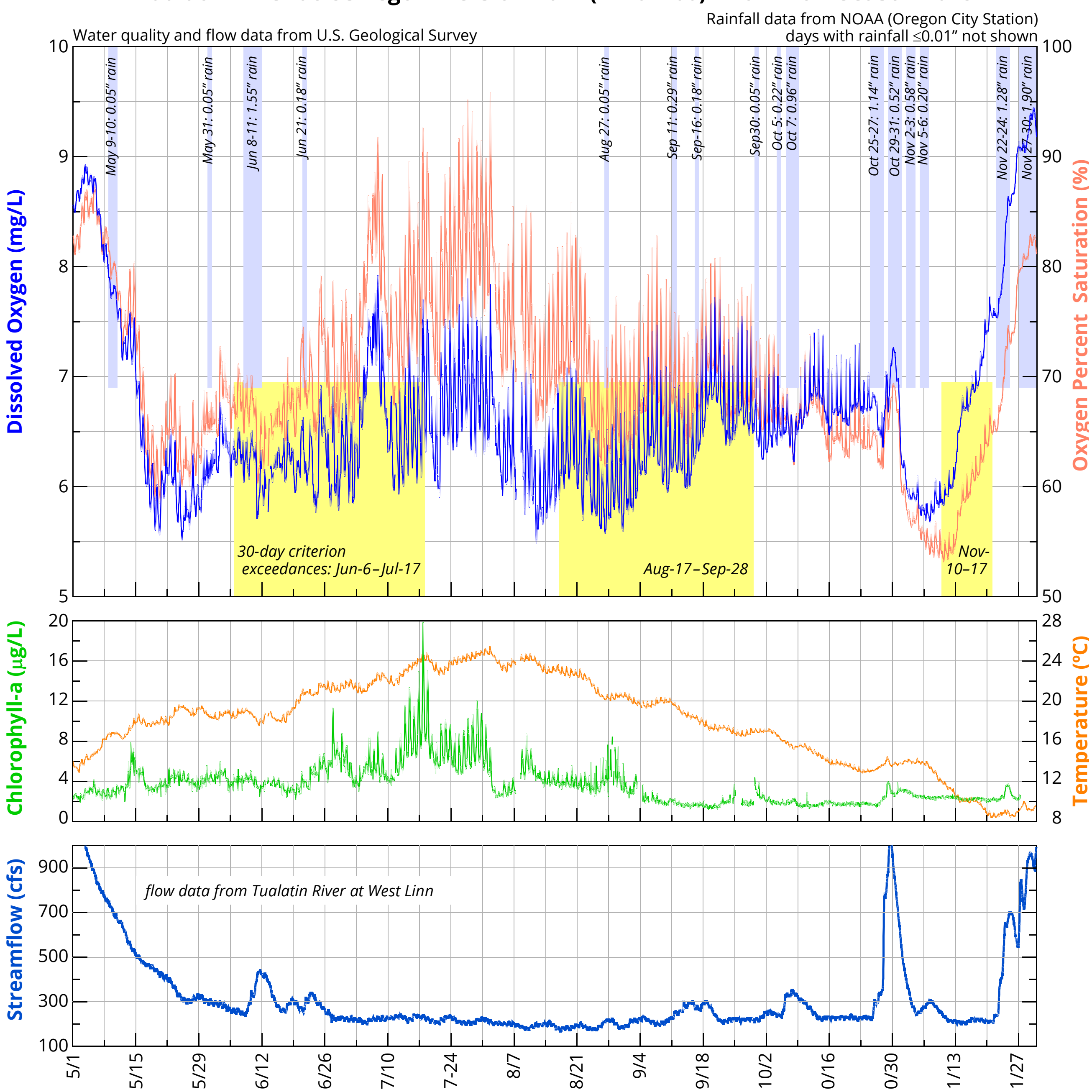


- At most tributary sites, DO concentrations are lowest in July and August when higher temperatures and lower flows increase the rate and effect of sediment oxygen demand.
- The lowest DO concentrations overall occurred in Beaverton and Rock Creeks. Both are slow-moving valley bottom streams that trap sediment.
- DO concentrations in a month can span a range of more than 4 mg/L at some sites.
- Because of releases from Hagg Lake, DO concentrations in Scoggins Creek are greater and show a different pattern than other sites.

Tualatin River – Oswego Dam

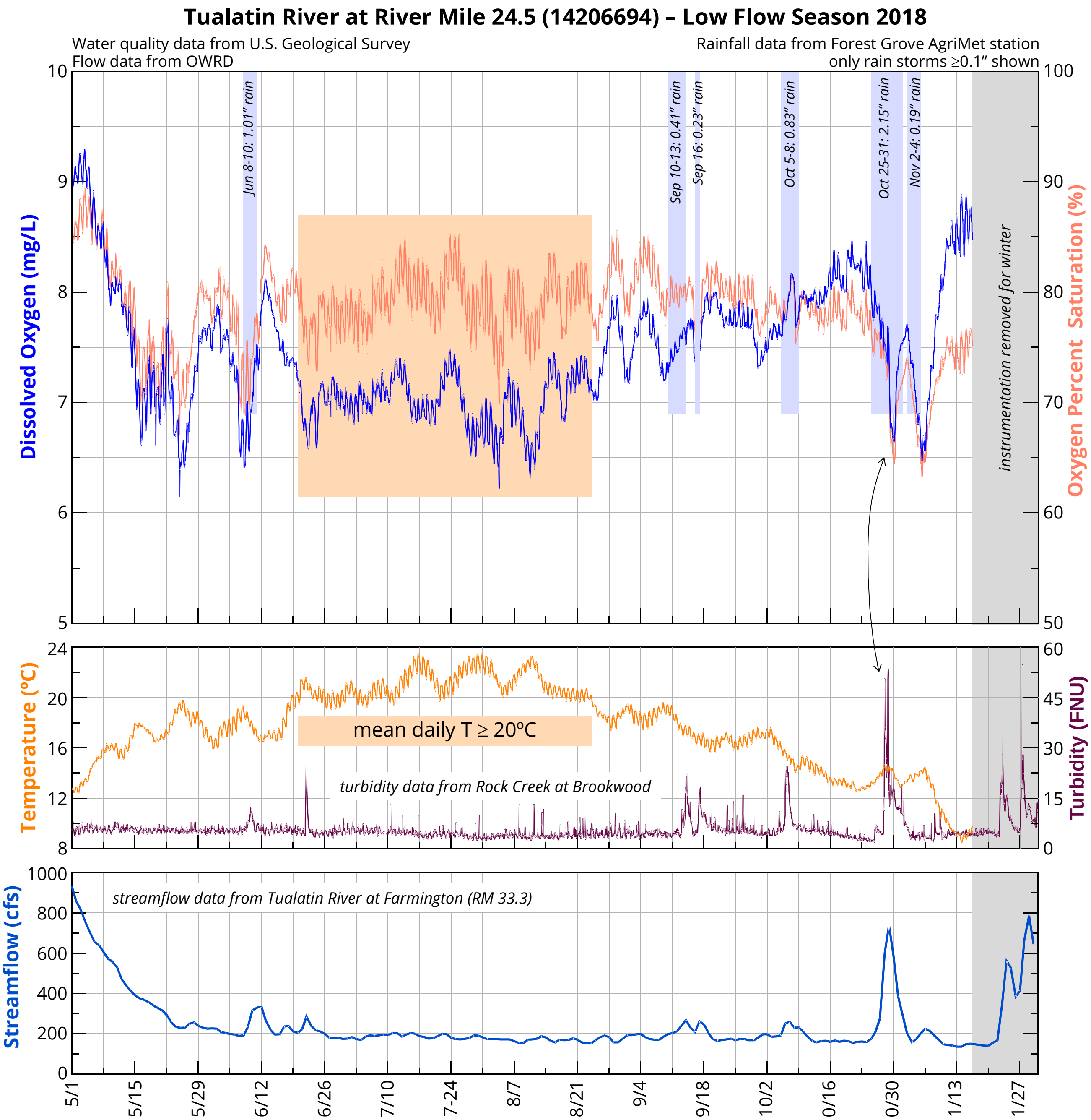
- Algal blooms at the Oswego Dam site strongly affect DO. They can be identified by high chlorophyll concentrations, large daily DO ranges and DO concentrations greater than 100% saturation. Algal activity in 2018 was minimal. DO never became supersaturated. For most of the summer, warm temperatures (>20ºC) increased the rate of sediment oxygen demand. A small bloom in mid-July was only able to increase DO saturation to 85% briefly, otherwise DO only at about 75% saturation, sometimes less.
- The 30-day DO criterion was not met during three distinct time periods in 2018.
- DO concentrations dropped sharply in May as flow decreased and temperature increased. Further discussion is on page 45; a more detailed graph is on page 47.
- From October 25–November 3, more than two inches of rain fell. The rain was intense enough to resuspend sediment in the tributaries and to create stormwater inflows. When those oxygen demands were transported to the Tualatin River, they likely contributed to the large oxygen sag during the first week of November. They were probably not sufficient to explain the extent and duration of the sag.

Tualatin River at Oswego Diversion Dam (14207200) – Low Flow Season 2018



Tualatin River – RM 24.5

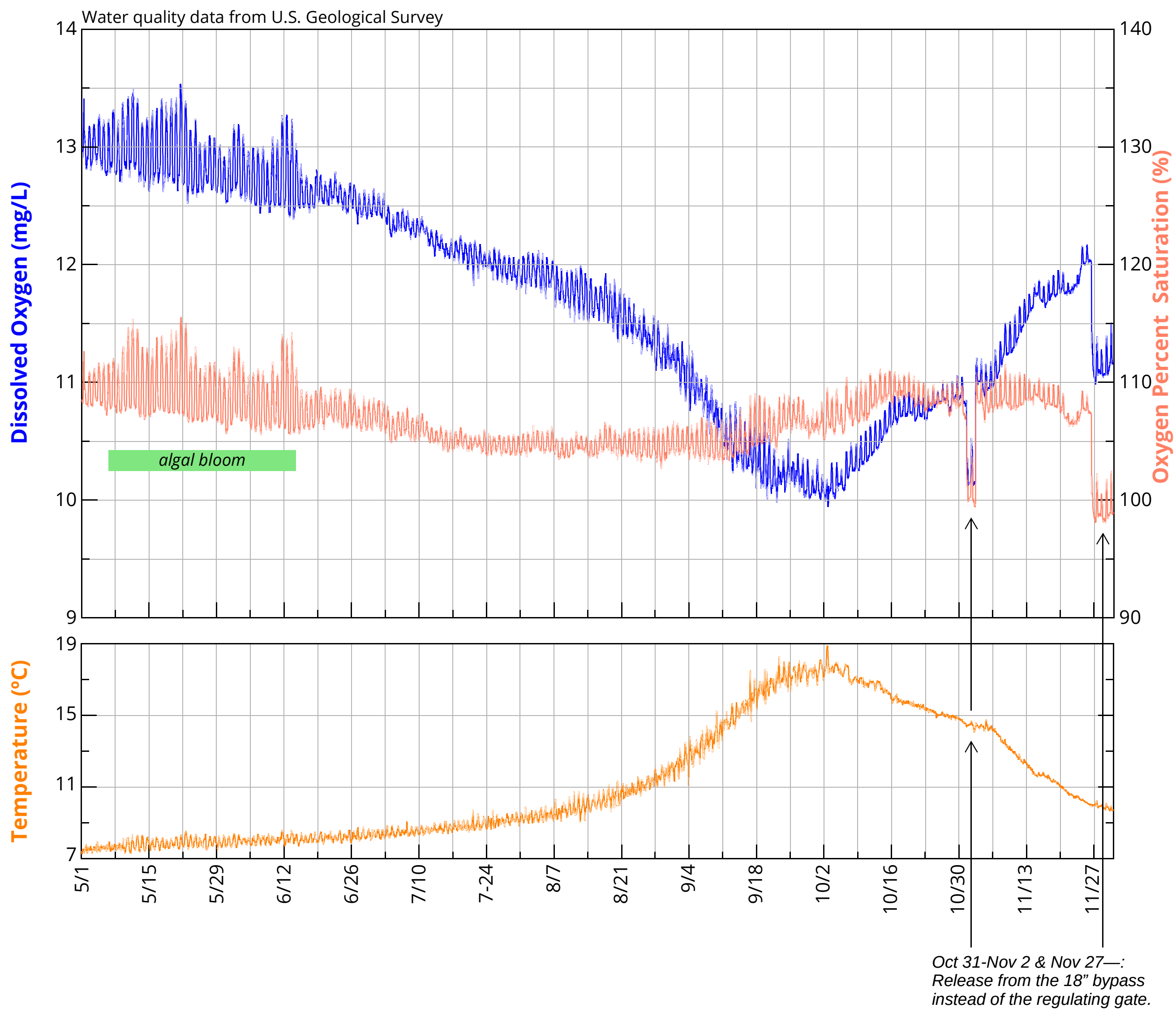
- DO concentrations at RM 24.5 were about 80% saturation for most of the summer which is typical for this site. Most of the lowest DO levels in 2018 occurred when the water temperature exceeded 20ºC.
- The daily DO range at RM 24.5 was small (<0.5 mg/L). Significant algal blooms are rare at this site.
- A sharp decline in DO through May is similar to the one at Oswego Dam. Although DO levels did not fall as low as those at the Dam, they were unusually low for May at this site. The decrease in DO can be at least partially explained by increased oxygen consumption by SOD that was caused by declining flow and increasing temperature.
- In late October, the decrease in DO was probably caused by rainfall which was sufficient to increase turbidity (marked by the arrow). Turbidity is associated with an increase in oxygen demanding substances—from resuspension of sediment and from stormwater inflows. Multiple sags likely indicate different tributary sources, such as Rock, Dairy or Gales Creeks and others.



Scoggins Creek below Hagg Lake

- The DO pattern through the low flow season at Scoggins Creek is very different from the other sites because of releases from Scoggins Dam—colder in summer and warming through fall.
- In mid-May–mid-June, photosynthetic activity by instream plants or periphyton upstream of the site was clearly evident. The daily DO range was about 0.8 mg/L, similar to what it was in 2017. DO saturation exceeded 110%. Photosynthetic oxygen production decreased through mid-summer and then increased slightly in September.
- As the reservoir is drawn down, more of the warmer water from the upper layers is released. Although the absolute concentration decreases, the percent saturation usually stays constant. In 2018, percent saturation decreased slightly during August.
- Short-term abrupt changes in DO can be caused by changes in dam operation. In 2018, this occurred twice late in the season. They are denoted by arrows on the graph. DO saturation is consistently about 100% when water is diverted through the bypass. When water is released through the regulating gate, air is entrained and DO saturation is greater than 100%.

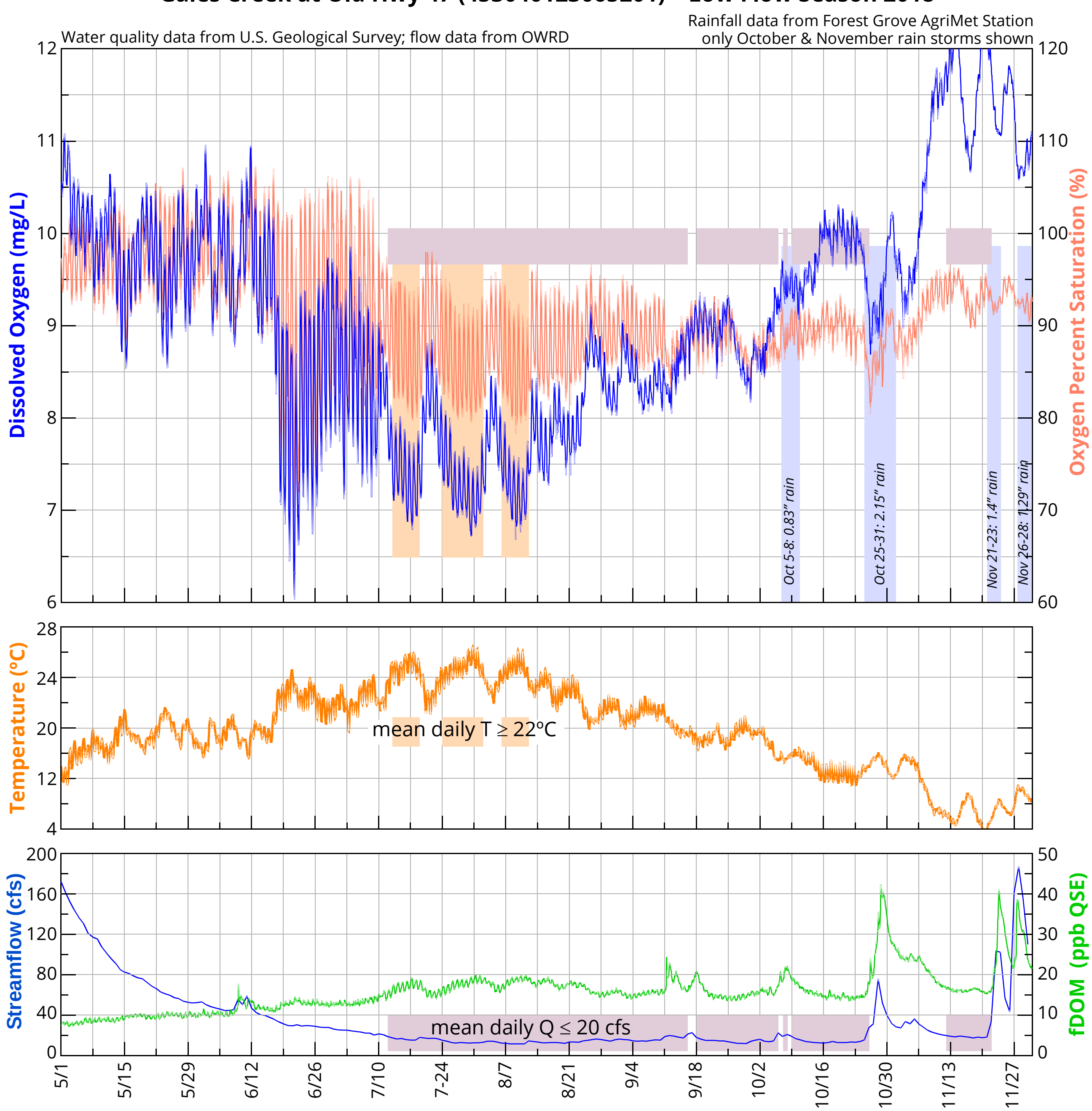
Scoggins Creek below Hagg Lake (14202980) – Low Flow Season 2018



Gales Creek at Old Hwy 47

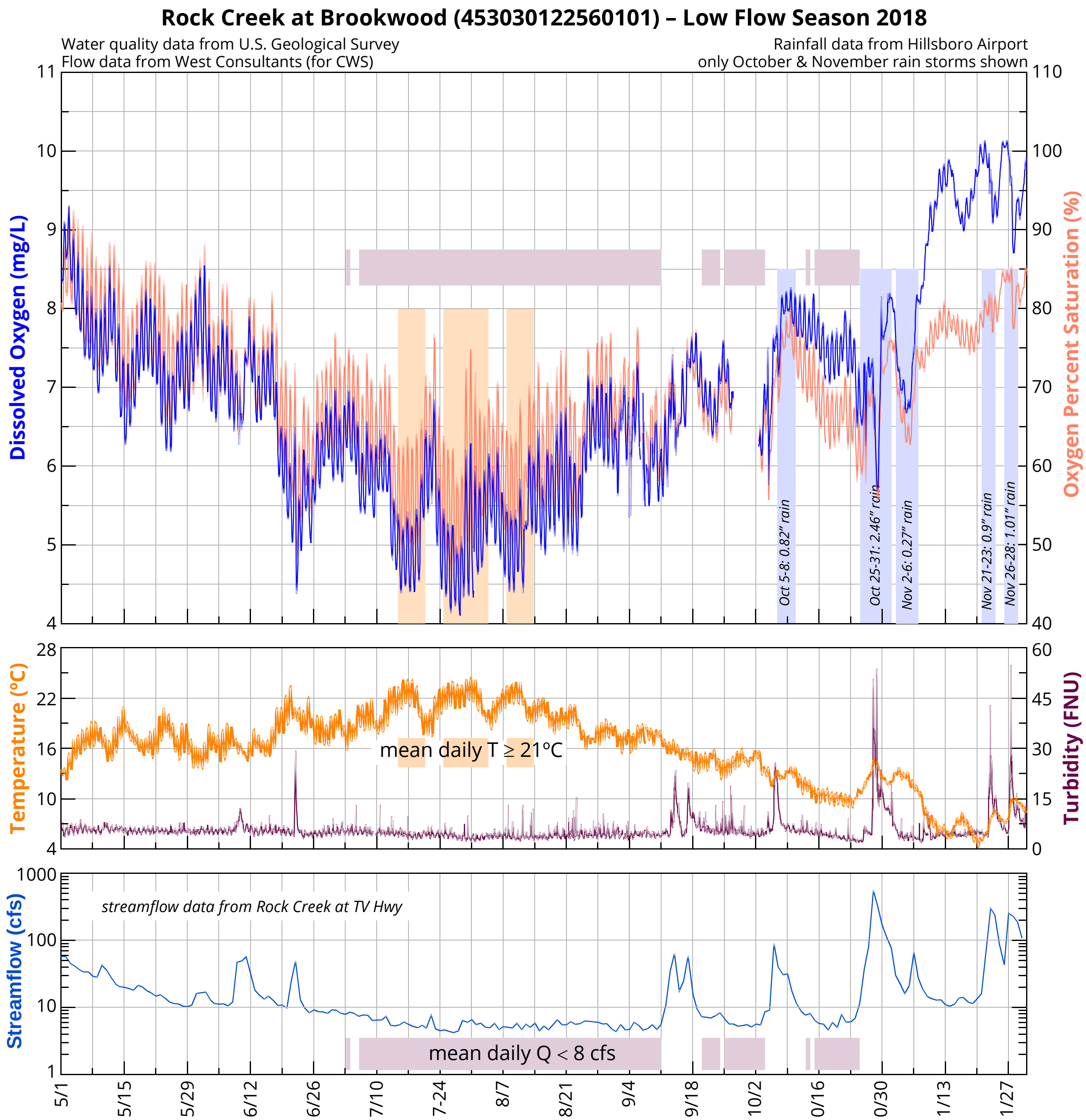
- Algal activity at Gales Creek was clearly evident by the daily DO range. From May through June, DO saturation was steady at about 95-100%. During the second half of June, a jump in temperature caused the absolute DO to decrease, but the average saturation concentration remained mostly unchanged. The rates of photosynthesis and respiration increase with temperature and resulted in a larger daily DO range— sometimes up to 2 mg/L.
- DO levels fell below 90% saturation when flows dropped below 20 cfs. Low flows exacerbate oxygen loss from sediment oxygen demand because they increase the time that a smaller volume of water is in contact with the sediment. The lowest absolute DO occurred during low flow when the water temperature exceeded 22ºC.
- Measurement of fDOM (fluorescent dissolved organic matter) began in 2016. The substances that contribute to fDOM include those that make up biochemical oxygen demand (BOD). Increases in flow often show increased fDOM a day or so later, indicating transport of BOD to the stream. Oxygen sags often occurred after an increase in fDOM.

Gales Creek at Old Hwy 47 (453040123065201) – Low Flow Season 2018



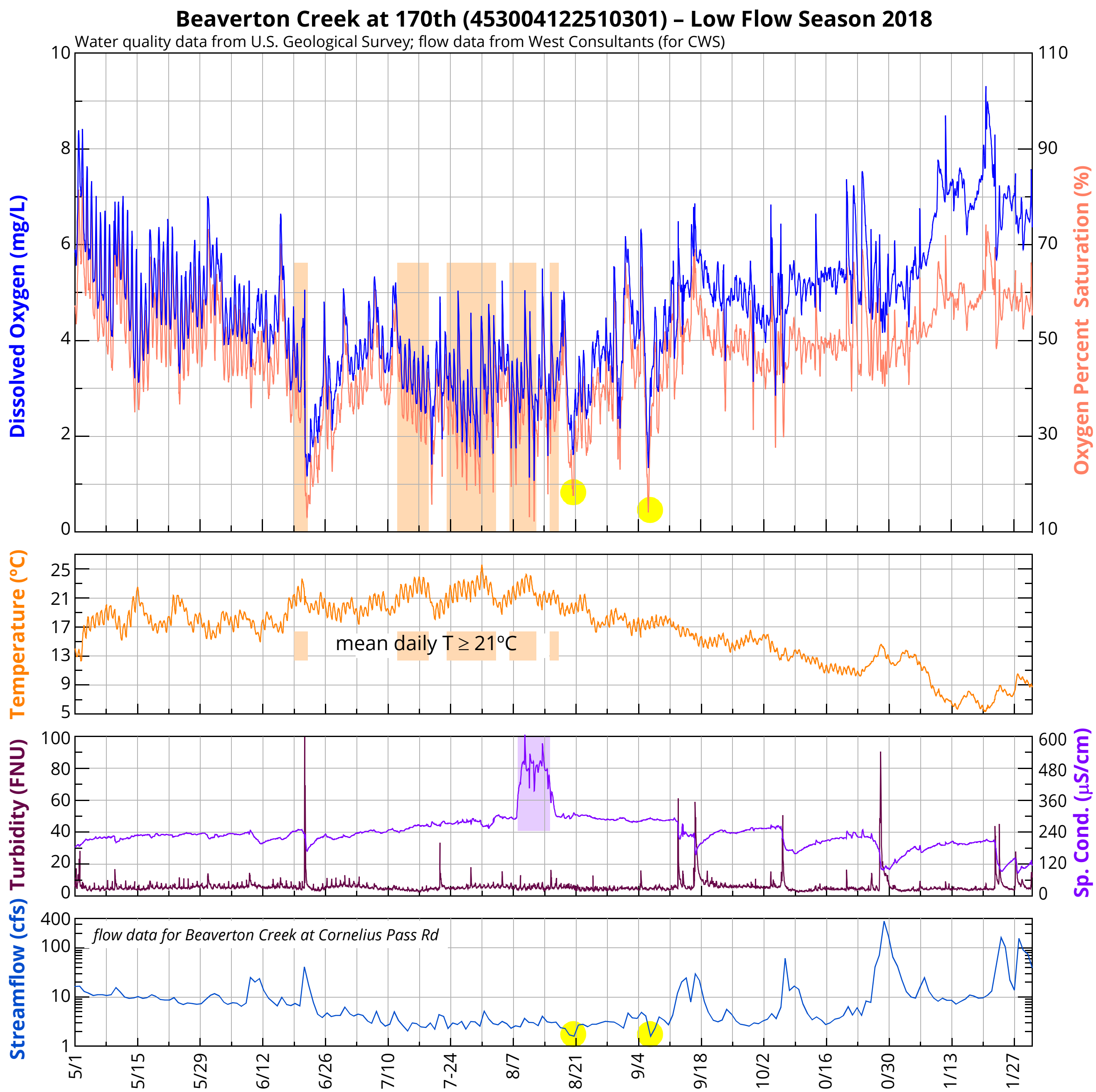
Rock Creek at Brookwood

- Dissolved oxygen in Rock Creek was lower overall than all other sites except Beaverton Creek. Like Beaverton Creek, Rock Creek is a valley bottom stream with high sediment oxygen demand and little reaeration. Algal activity in Rock Creek was present (daily DO range 0.5–0.7 mg/L), but not enough to offset SOD.
- Temperature strongly affects DO in Rock Creek. The lowest DO levels occurred on three episodes when daily mean water temperatures exceeded 21 ºC and flows were less than 8 cfs. Daily maximum DO levels were less than 5.5 mg/L, minimums were 4.5 mg/L or less. See orange bars.
- Intense rainfall can produce turbidity spikes from resuspended sediment and stormwater inflow. The oxygen demand associated with turbidity then causes a subsequent sag in DO, as occurred in late October and November at this site. Oxygen demand related to a sharp turbidity spike also likely contributed to the very low DO level on June 20. Rock Creek was probably affected by a short-lived, intense rainfall that missed both the Forest Grove and Hillsboro Airport stations. They each received less than 0.02" rain that day, while some stations in SW Portland received 0.1-0.2" rain in less than an hour.



Beaverton Creek at 170th

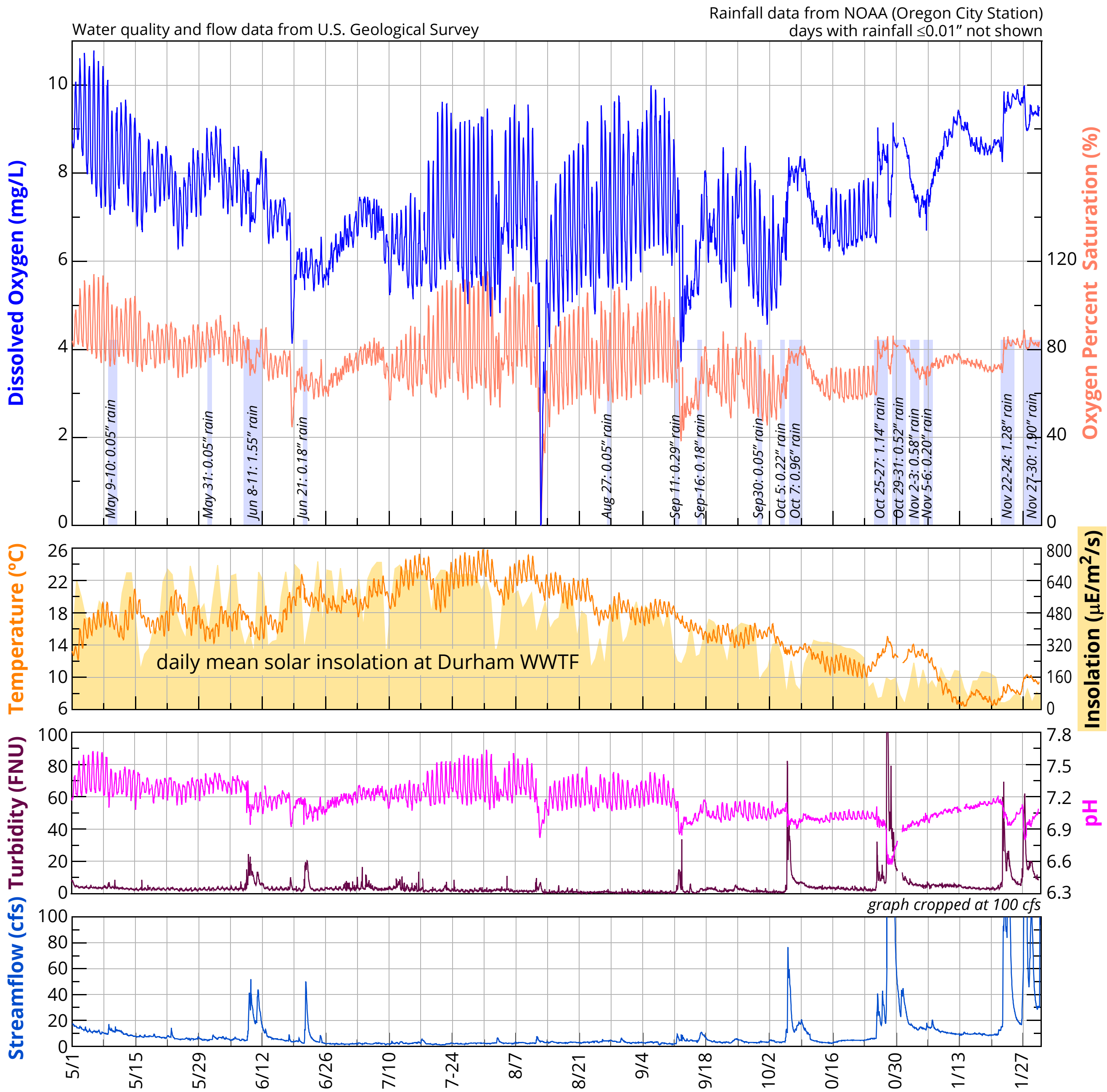
- The Beaverton Creek site has very low dissolved oxygen levels. The organic-rich, silty bottom and low flow of Beaverton Creek result in high sediment oxygen demand and little reaeration. Although algal activity is clearly present, photosynthetic oxygen production is not sufficient to offset sediment oxygen demand.
- The periods of lowest absolute and percent-saturated DO occur when stream temperatures are high (see orange shading). Rates of sediment oxygen demand are greater at higher temperature.
- Two of the lowest DO levels in 2018 occurred when flows were very low—below 2 cfs at the Cornelius Pass Rd site (see yellow highlights). Although flow at Cornelius Pass Rd is not an accurate estimate of flow at this site (Cornelius Pass Rd is 4 miles downstream), it does show the general flow pattern.
- The sharp drop in DO levels on June 20 was probably a combination of BOD associated with a turbidity spike and high temperature. Very intense, short-lived rainfall occurred in scattered areas that day.
- High specific conductance occurred August 8–14 (purple shading), suggesting an unknown discharge. The volume was small because flow, dissolved oxygen and temperature were not obviously affected.



Fanno Creek at Durham

- *Cladophora sp*. has been identified in Fanno Creek in recent years. Photosynthetic activity was considerable, although not as much as in 2017. The maximum pH year was 7.7, below the maximum criterion (8.5).
- Dissolved oxygen was dominated by the *Cladophora* bloom, especially in mid-summer. Sunlight had a greater effect on DO than temperature during low flow. Even in the last half of October, algal activity was evident, although with shorter days it could not increase DO above 70% saturation. Rainfall that added significant amounts of well-oxygenated water usually increased DO to 80% saturation.
- Three sharp drops in DO occurred over the summer (June 18, August 11 and September 12). During the most dramatic one (August 11), the DO dropped to 0 mg/L for 4 hours. All three instances were coincident with tiny increases in flow and turbidity, and decreases in pH and conductance (not shown), all of which indicate inflow. No rainfall was measured at the stations included in this report, but rainfall was measured at several sites in SW Portland (trace-0.08" in one hour). It is possible that small amounts of rain in isolated showers transported highly labile BOD to the creek or suspended it. BOD consumes oxygen while cloudy weather suppresses oxygen production by photosynthesis. Whatever the reason, the result is troubling.

Fanno Creek at Durham (14206950) – Low Flow Season 2018



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APPENDIX A
STREAMFLOW

SCOPE

This appendix shows data for streamflow at selected sites in the Tualatin River and its tributaries. It is intended to be a comprehensive listing of sites where daily data were collected in 2018. Historical streamflow data exist for other sites. Most of the data represent daily mean flows and have been subject to quality assurance tests by the collecting entity.

The following data and analyses are included for each site. A more detailed explanation of the analyses and graphics begins on page A-4:

- Table of 2018 data with summary statistics by month.
- Graph of 2018 data superimposed on percentile statistics for the period of record for the site.
- Color-coded chart of the distribution of streamflow by month for the period of record.
- Table of monthly median streamflows by year for the period of record.
- Graphs showing low-flow trends over the period of record, including the first day of sustained low flow and the distribution of streamflow during select low flow periods.
- Graphs showing high-flow trends over the period of record, including the first day of sustained high flow and the distribution of streamflow during December–January.
- A brief discussion of the graphs and tables.

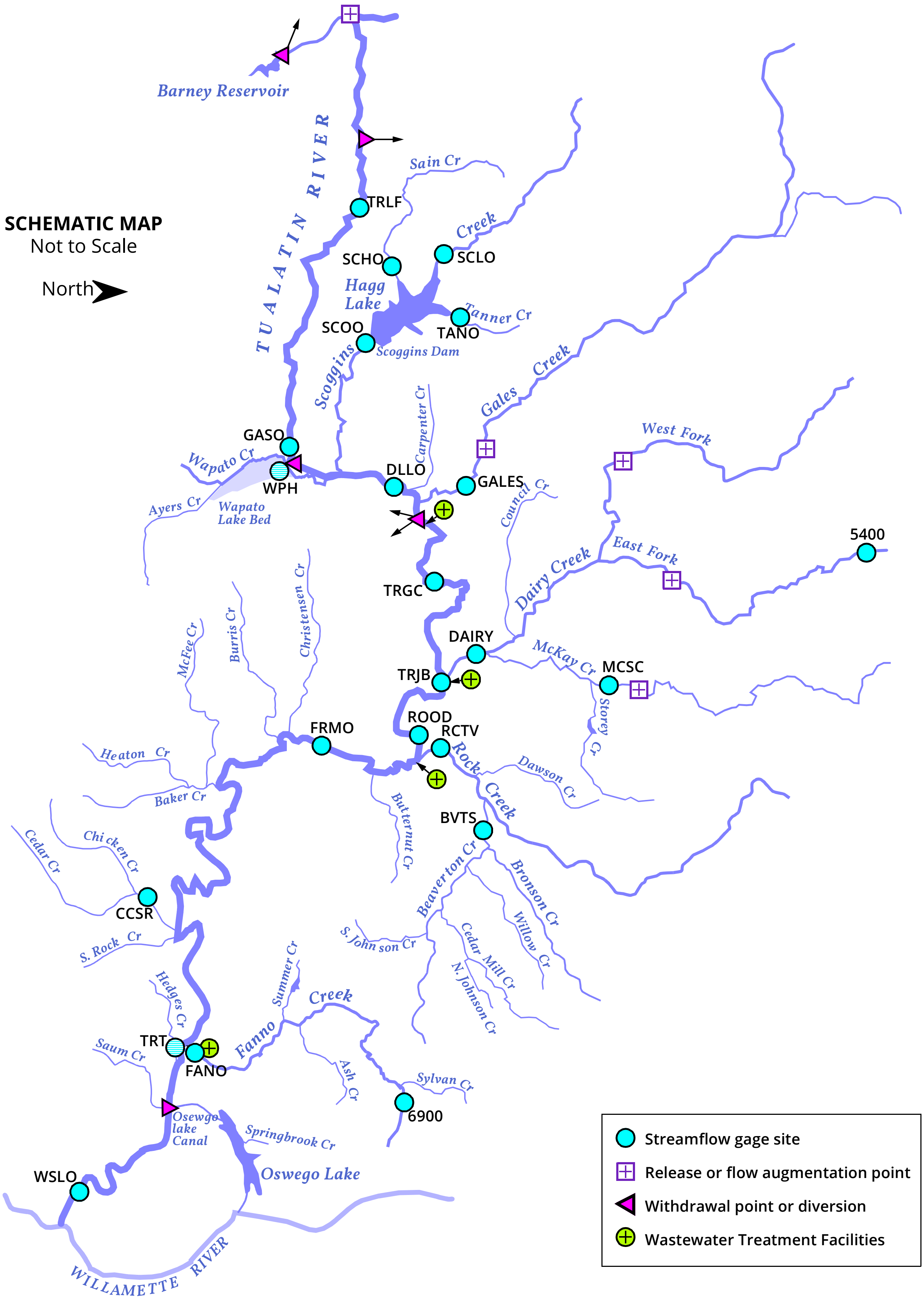
2018 HIGHLIGHTS

- Every site experienced high flow during the first half of April caused by heavy rain during that time. Mean daily flows during this time exceeded the 90th percentile at most sites and many were record high values for the period of record used in this report. The period of record for streamflow in this report is limited to after the construction of the reservoirs (Barney Reservoir and Hagg Lake).
- Streamflow in mid-November was very low due to lack of precipitation and many sites set records for low mean daily streamflow. Flows in the mainstem Tualatin River were lower in November than in the traditional low-flow season, July–October, at all sites except West Linn. November streamflow in the tributaries was also low, but not as low as summer baseflow.

TRENDS OF NOTE

- Flows in Scoggins Creek below Hagg Lake and in the Tualatin River at Dilley increased from 1975 through the early 1990s, mostly as a result of larger releases of stored Hagg Lake water by Joint Water Commission. Since the mid-1990s, any increases in flow have been small and difficult to discern from year-to-year variation.
- Flow in the Tualatin River at West Linn increased sharply around 1995 when water diversion through the Oswego Canal was decreased. Since then, trends in flow are small and difficult to isolate from year-to-year variation. The onset of low flow (defined as 7-day median streamflow < 250 cfs), however, is occurring later in the summer at this site. Reasons for the delay include earlier releases of flow augmentation water by Clean Water Services and increases in the fraction of total flow that is from wastewater treatment plants which does not decrease as quickly as natural baseflow in early summer.
- Flow in Fanno Creek is decreasing over the period of record (1991–present). The trend is evident at both the 56th Avenue and Durham Road sites. The reason is unknown.

Streamflow Gage Sites



STREAMFLOW GAGE SITES — ALPHABETICAL LISTING BY SITE CODE

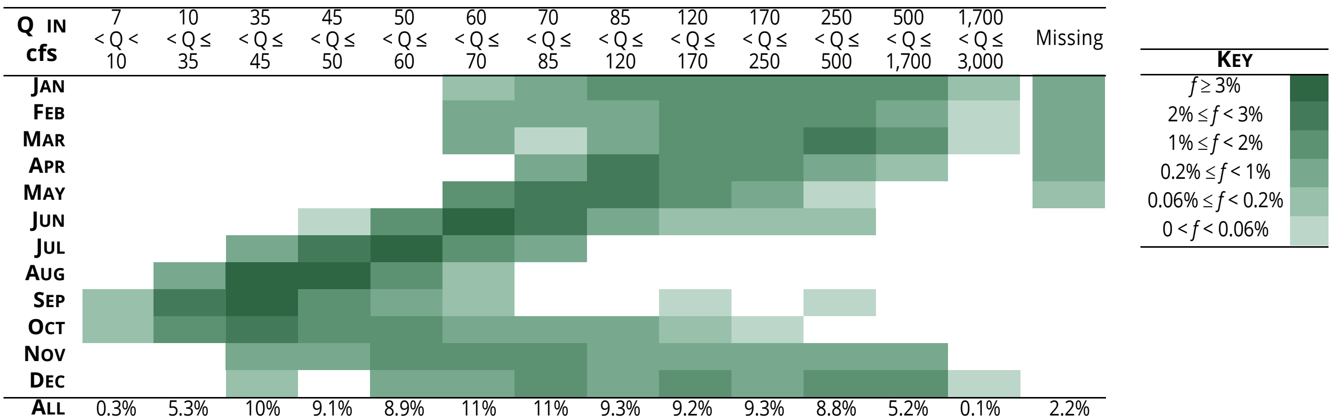
SITE CODE	SITE NAME	RIVER MILE	STATION ID	PAGE
5400	East Fork Dairy Creek near Meacham Corner, OR	12.4	14205400	A–44
6900	Fanno Creek at 56th Avenue	11.9	14206900	A–62
BVTS	Beaverton Creek at Cornelius Pass Road	1.2	14206435	A–53
CCSR	Chicken Creek at Roy Rogers Rd near Sherwood, OR	2.3	14206750	A-59
DAIRY	Dairy Creek at Hwy 8 near Hillsboro, Oregon	2.06	14206200	A–50
DLLO	Tualatin River near Dilley, Oregon	58.8	14203500	A–15
FANO	Fanno Creek at Durham Road near Tigard, Oregon	1.2	14206950	A–65
FRMO	Tualatin River at Farmington, Oregon	33.3	14206500	A–27
GALES	Gales Creek at Old Hwy 47 near Forest Grove, Oregon	2.36	14204530	A–41
GASO	Tualatin River at Gaston, Oregon	62.3	14202510	A–9
MCSC	McKay Creek at Scotch Church Rd above Waible Ck near North Plains, Oregon	6.3	14206070	A–47
RCTV	Rock Creek at Hwy 8 near Hillsboro, Oregon	1.2	14206451	A–56
ROOD	Tualatin River at Rood Bridge Road near Hillsboro, Oregon	38.4	14206295	A–24
SCHO	Sain Creek above Henry Hagg Lake near Gaston, Oregon	1.6	14202920	A–36
SCLO	Scoggins Creek above Henry Hagg Lake near Gaston, Oregon	9.3	14202850	A–36
SCOO	Scoggins Creek below Henry Hagg Lake near Gaston, Oregon	4.80	14202980	A–12
TANO	Tanner Creek above Henry Hagg Lake near Gaston, Oregon	1.6	14202860	A–39
TRGC	Tualatin River at Golf Course Road near Cornelius, Oregon	51.5	14204800	A–18
TRJB	Tualatin River at Hwy 219 Bridge	44.4	14206241	A–21
TRLF	Tualatin River below Lee Falls near Cherry Grove, Oregon	70.7	14202450	A–6
TRT	Tualatin River at Tualatin, Oregon	8.9	14206956	A–71
WPH	Wapato Canal at Pumphouse at Gaston, Oregon	—	14202630	A–68
WSLO	Tualatin River at West Linn	1.75	14207500	A–30

Explanation of Figures and Tables in this Appendix — pages 1-2

Page 1–current year data and graph: A table of mean daily streamflow for the current year is at the top of page 1. A graph at the bottom of the page shows the current year's data superimposed on shaded percentile ranges for the period of record, providing historical context. A legend, located to the right of the graph, includes the period of record for the site and definitions of lines and shading. If the period of record is too short to accurately calculate some percentiles, the appropriate shaded areas are omitted.

Page 2–Frequency Chart: A Frequency Chart for the site is at the top of page 2. This graphic can be used to determine the ranges of flow for each month, the percent of the time flow is within a particular range, and the importance of missing values. An example is shown below.

FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH FOR PERIOD OF RECORD



- *The top row* shows the ranges of streamflows (bins) corresponding to each column. The streamflow ranges do not change from year-to-year in the Flow Report. They were determined as follows:
  —round numbers were used for simplicity,
  —the first and last bins capture the extreme highs and lows (<0.5% of the distribution),
  —the second and second to last bins capture the highest and lowest 5% of the distribution,
  —the other rows each capture approximately 10% of the distribution,
  —a column for missing data is included if needed.
- *The first column* shows the months corresponding to each row.
- *The bottom row* shows the actual fraction of the distribution in the bin. Because the bins use round numbers and do not vary from year-to-year, the distribution totals will only approximate 5% and 10% as designed. The total distribution may not add to 100% due to round-off error.
- *Each cell is color coded* based on the fraction of the overall distribution of streamflow in the corresponding bin and month. A Key to the color code is at the right of the chart. All sites use the same color code.
- *Information that can be obtained* from the example chart above includes:
  —The all-time lowest flows at this site are 7–10 cfs, and occurred in September and October.
  —Although extremely low flows have occurred in October, flows as high as 250 cfs have also occurred.
  —Streamflow was less than 45 cfs about 15% of the time.
  —Streamflow in December has been highly variable, ranging from 35 to 3,000 cfs.
  —About 2% of the data were missing, all of which occurred in January–May. High flow occurs during several of these months, suggesting that some data may be missing because flow exceeded the rating curve. If this is the case, the highest flows may be over 3,000 cfs and the distribution fractions may be skewed with the fraction at low flow actually smaller and the fraction at high flow greater.

Page 2–color-coded table of monthly medians: A table of monthly medians of daily mean streamflow by year follows the Frequency Chart on page 2. Entries in this table are color-coded by percentiles calculated from the daily mean streamflow for the period of record. Two Keys are provided to the right of the table. The upper Key contains the values corresponding to the percentiles shown in the lower Key. Medians are not shown if more than 20% of the data are missing.

Explanation of Figures and Tables in this Appendix — page 3

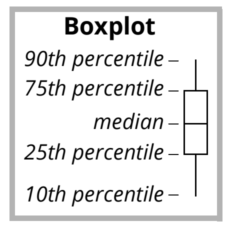
Page 3–discussion of graphs: The left side of the page contains a discussion of findings based on the graphs for each site. The narrative is divided into three sections:

- *Current year* describes the streamflow for the current year in the context of the historical record.
- *Low flow and Rainy season flow* describe the low flow and rainy season flow regimes, respectively, including when they occur and any trends over time.

Page 3–low flow season onset: The uppermost graph on the right side shows the first day of sustained low flow for the each year. The plot is arranged so that earlier dates are toward the bottom of the y-axis and later dates are toward the top. Although defining the onset of low flow is necessarily somewhat arbitrary, such a definition serves as a benchmark for comparing low flow conditions over time.

- *For mainstem sites,* low flow is defined as the first day after March 31 when the 7-day median streamflow in the Tualatin River at Farmington is less than 200 cfs. Correlations between each site and Farmington for the period of record through 2017 were used to obtain site-specific values. Flow at Farmington often has been used as a benchmark for low flow.
- *For tributary sites,* low flow is defined as a rounded number near the 25th percentile of mean daily flow.

Page 3–trends in low flow over time: Boxplots plotted versus year for selected low-flow periods show changes in flow magnitude over time. A boxplot is a graphical representation of the data distribution and is illustrated at the right.



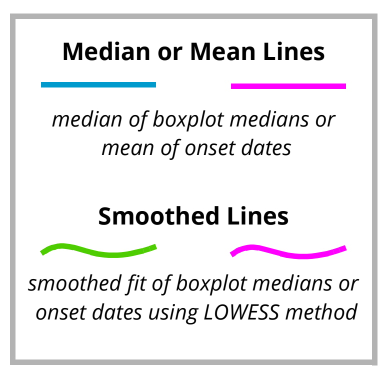
For most mainstem sites, two plots are shown: July/August and September. For a few mainstem sites, June data were shown if June had lower streamflow than July/August. For tributary sites, a plot of August/September is usually shown.

Page 3–rainy season onset: The second graph from the bottom is the high flow analog to the uppermost graph for low flow onset. The term “high flow” was not used because reservoir releases and short summer rainstorms can increase flow at mainstem and tributary sites, respectively, but do not signal the annual seasonal shift to rainy weather.

- *For mainstem sites,* rainy season flow is defined as the first day after August 31 when the 7-day median streamflow at Farmington is at least 350 cfs. Correlations between each site and Farmington for the period of record through 2017 were used to obtain site-specific values. A Farmington flow of 350 cfs was was used by ODEQ in the TMDL as a criterion for high flow.
- *For tributary sites,* rainy season flow is defined as a rounded number near the 75th percentile.
- *An additional criterion* was added to help ensure that the rainy season was not a short-term increase. The difference between the daily mean maximum and daily mean minimum flows within the 7-day median period was required to be at least 50% of their average.

Page 3–trends in high flow over time: The graph at the bottom right shows boxplots plotted versus year for the December/January (by water year), which is typically high flow.

Page 3–how trends are assessed: All of the graphs on page 3 show one or more lines that indicate trends and central tendencies of the data. The types of lines used vary with the graph and are shown at the right:



- *Median lines* were used for streamflow; *mean lines* for onset dates.
- *Smoothed lines* were calculated using the LOWESS method (LOcally WEighted Scatterplot Smoothing). LOWESS is a non-parametric method that fits a curve to data giving more weight to points closer to the point being fitted. LOWESS can be used to help visualize trends in data.
- *Statistically significant differences* were tested using non-parametric methods (Kendall’s tau for trends, Mood medians test for 2 groups). Magenta lines are used to show statistically significant results.

TRLF – Tualatin River below Lee Falls near Cherry Grove, Oregon – 14202450

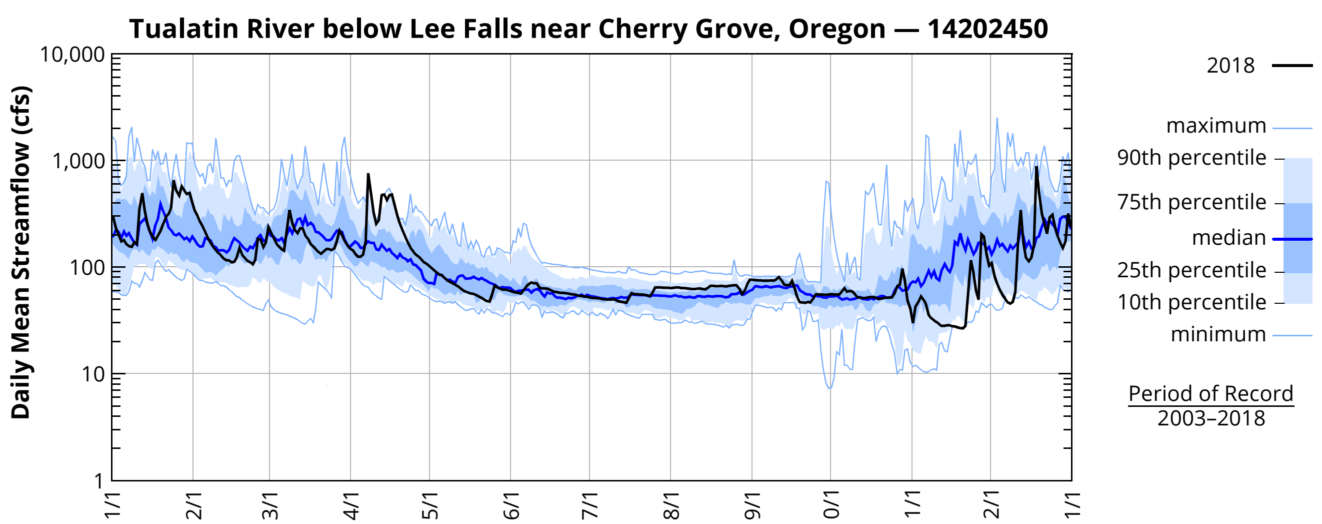
Data source: Oregon Water Resources Department

River mile: 70.7 *Latitude:* 45 30 21 *Longitude:* 123 13 06

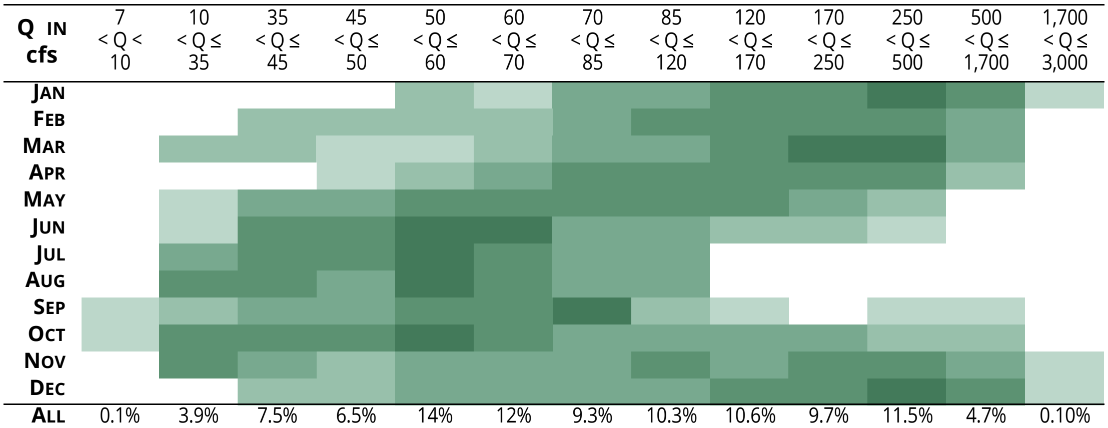
2018 — MEAN STREAMFLOW† (cfs) — TRLF

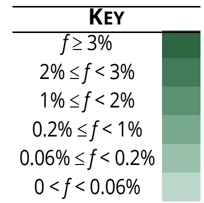
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	294	336	238	149	103	59.5	51.9	63.6	76.0	55.5	29.8	109
2	236	302	211	144	97.7	58.4	51.4	63.7	75.6	55.4	42.7	82.6
3	199	266	185	133	93.1	57.6	51.1	64.2	75.1	55.4	46.7	69.7
4	174	237	166	125	88.5	57.3	50.8	64.2	74.9	55.2	53.4	61.3
5	179	211	156	125	85.0	56.5	50.7	63.4	74.6	59.4	49.6	55.2
6	164	186	147	131	83.6	60.6	50.0	63.3	74.4	63.5	44.4	50.6
7	157	168	142	173	78.8	65.7	49.7	63.2	74.4	59.0	35.8	46.7
8	155	155	227	756	75.0	69.4	49.5	62.5	74.7	59.5	33.2	45.7
9	171	144	342	478	72.8	71.8	49.4	62.3	74.6	58.7	31.6	47.1
10	163	135	264	322	70.9	70.2	50.0	62.1	76.5	55.7	30.6	58.4
11	350	128	224	254	68.4	70.2	49.5	62.7	80.7	52.1	29.1	182
12	493	121	208	274	66.0	64.1	47.8	62.9	75.2	51.7	28.1	343
13	334	116	231	473	62.9	62.9	47.1	62.3	68.7	51.4	28.0	170
14	255	115	230	478	60.3	63.0	46.7	61.9	67.6	51.1	28.4	123
15	213	110	198	424	58.9	62.5	46.3	64.1	67.6	51.8	28.4	113
16	192	112	185	470	57.7	61.2	51.3	66.8	74.4	52.4	27.8	122
17	180	123	164	476	56.5	59.6	56.7	66.6	63.8	52.4	27.7	159
18	198	151	156	378	56.0	58.5	55.7	66.2	52.5	51.5	27.1	883
19	219	130	147	302	54.9	58.0	55.5	66.1	46.9	50.2	26.7	501
20	254	122	139	253	53.2	57.1	55.3	66.4	46.5	50.6	26.6	316
21	296	115	133	220	51.6	57.1	55.1	66.2	46.2	51.7	28.1	252
22	316	111	140	191	49.9	57.0	55.0	65.9	47.0	51.5	51.4	206
23	363	106	147	168	48.2	56.3	54.0	66.4	46.6	51.5	116	291
24	651	117	147	152	47.5	55.6	53.4	67.0	50.5	51.8	88.9	309
25	519	182	144	141	55.3	55.1	57.7	67.4	55.6	56.3	60.4	238
26	464	181	149	131	67.0	54.9	64.4	67.7	55.2	66.7	49.5	194
27	567	154	175	125	64.6	53.9	64.4	63.1	55.1	68.3	203	169
28	522	171	219	119	62.9	53.5	64.2	55.8	54.8	96.6	192	150
29	483	—	199	112	61.5	53.1	64.1	60.2	54.8	73.7	132	176
30	495	—	175	108	61.4	52.6	63.7	69.3	55.3	48.7	103	318
31	404	—	159	—	60.9	—	63.7	76.1	—	40.9	—	243
Mean	312	161	185	260	66.9	59.8	54.1	64.6	63.9	56.5	56.7	196
Max	651	336	342	756	103	72	64	76	81	97	203	883
Min	155	106	133	108	48	53	46	56	46	41	27	46
Ac-Ft	19160	8936	11399	15441	4114	3557	3324	3974	3800	3471	3372	12068

†All 2018 data are provisional—subject to revision



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — TRLF





Period of Record
2003–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — TRLF

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	206	177	350	165	45.8	48.5	51.1	67.2	55.9	39.2	38.0	182
2004	247	214	118	76.0	46.1	57.7	57.9	50.2	45.3	44.6	42.4	75.1
2005	88.2	60.4	40.0	134	62.6	44.3	41.1	50.1	65.4	51.4	119	116
2006	532	148	161	120	52.2	50.0	43.3	31.8	65.9	68.5	377	292
2007	169	144	206	91.6	47.4	40.7	40.7	29.9	45.7	40.5	47.1	306
2008	270	182	216	178	97.0	47.5	36.0	40.0	48.0	46.0	82.0	76.0
2009	251	80	181	119	102	47.0	50.0	43.0	52.0	43.0	211	116
2010	389	161	139	228	98.0	83.5	63.0	58.0	64.0	54.0	125	346
2011	207	110	359	306	150	107	89.0	87.0	74.0	26.0	39.5	58.0
2012	279	206	298	169	93.0	57.5	57.0	63.0	68.5	60.0	202	397
2013	164	152	138	107	80.0	64.5	50.0	53.0	59.0	56.0	76.5	81.0
2014	100	234	287	151	105	56.5	54.0	51.0	62.0	54.0	112	244
2015	171	145	97.0	74.0	72.0	65.0	62.0	58.0	79.0	51	108	523
2016	368	265	316	83.5	59.0	65.5	53.0	50.0	64.0	156	200	289
2017	165	398	401	203	106.0	53.0	68.0	62.0	79.0	50.0	246	139
2018	255	140	175	182	62.9	58.2	51.9	64.1	67.6	52.4	34.5	169
median	216	167	203	135	72.0	57.0	53.0	53.0	62.0	52.0	110	195

Key

Q in cfs
- Q ≤ 36.8
- 36.8 < Q ≤ 43.6
- 43.6 < Q ≤ 47.7
- 47.7 < Q ≤ 51.0
- 51.0< Q ≤ 58.0
- 58.0< Q ≤ 66.0
- 66.0 < Q ≤ 79.0
- 79.0< Q ≤ 176
- 176 < Q ≤ 342
- 342 < Q ≤ 494
- Q > 494

Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Flow in 2018 was typical, except for high flows in early April and low flows in November, both of which were weather-related.

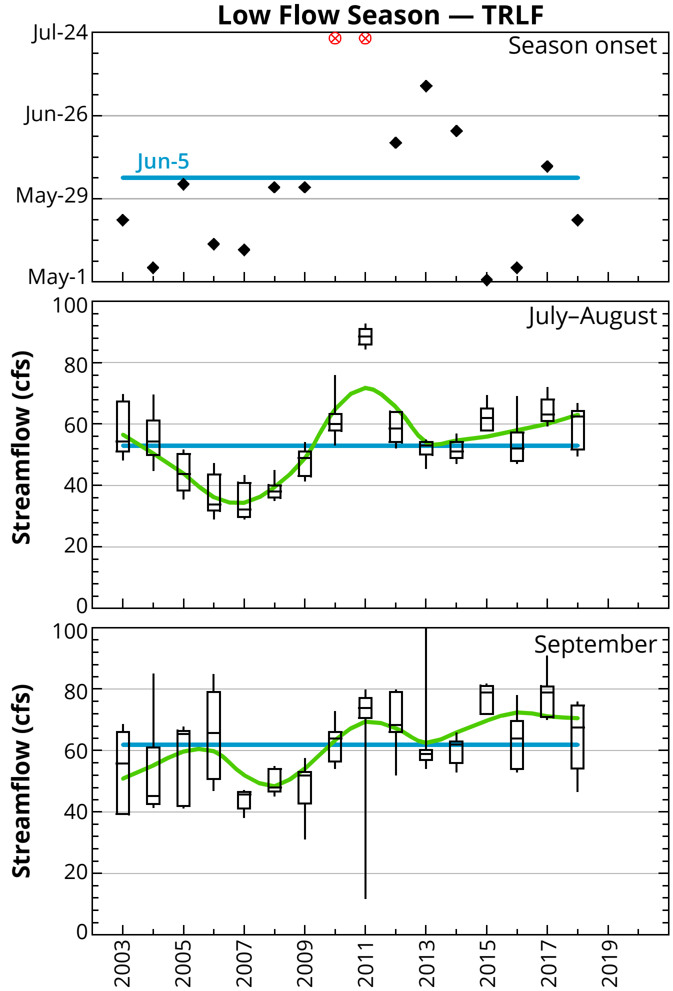
Low flow season

- The lowest flow months are July, August and October. Flow during this time is mostly controlled by releases from Barney Reservoir. Most of the released water is withdrawn downstream for municipal use.
- Higher flow during September (compared to July, August and September) is mostly due to Clean Water Services' releases from Barney Reservoir.
- Low flow criterion is: 7d-Q ≤ 55 cfs (~27th pctl)
- Low flow did not occur in 2010 which had a relatively rainy and cool summer.
- Higher than normal releases from Barney Reservoir occurred from mid-April through late-September 2011 so that repairs of Eldon Mills Dam could be done. Releases were temporarily discontinued in late September. The atypical release regime in 2011 was responsible for
  —high flows in July-August
  —the low-flow criterion not being met until 9/30
  —some very low flows in September
- Although flow during the dry season appears to be slightly greater in recent years, it is highly variable and there is no statistically significant trend.

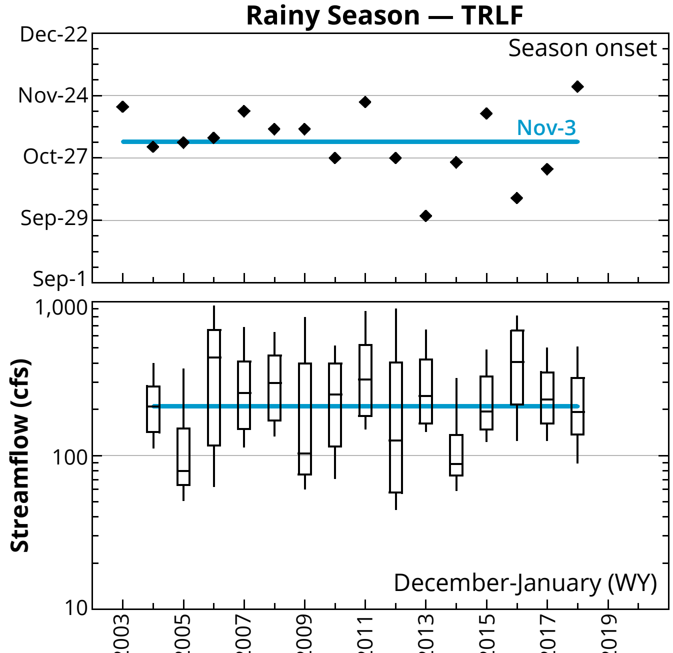
Rainy season

- The highest flow months are December through March due to normal patterns in rainfall.
- Rainy season criterion: 7d-Q ≥ 80 cfs (~50th pctl)
- Onset of the rainy season has been more variable in recent years than in the early 2000s. Onset has been substantially earlier than average in several recent years, but not in 2018.
- No trends are evident for the magnitude of December–January rainy season flow.

Low Flow Season — TRLF



Rainy Season — TRLF



GASO — Tualatin River at Gaston, Oregon — 14202510

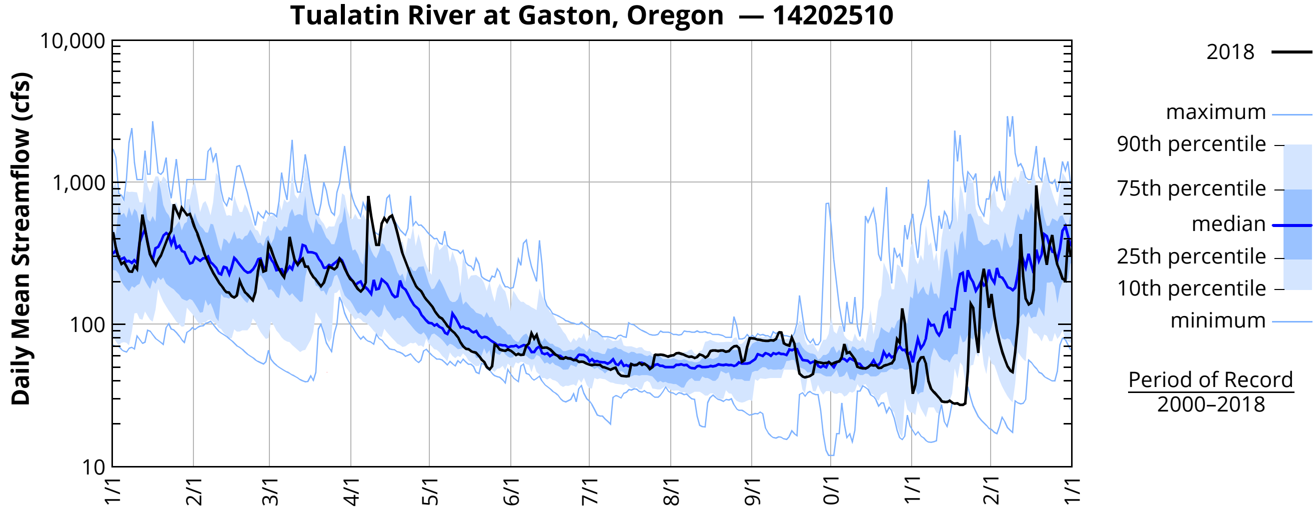
Data source: Oregon Water Resources Department
River mile: 62.3 *Latitude:* 45 26 21 *Longitude:* 123 07 85

2018 — MEAN STREAMFLOW† (cfs) — GASO

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	436	474	365	208	143	65.6	52.1	60.3	79.7	52.5	32.5	164
2	346	434	339	202	135	63.3	51.7	60.7	79.5	53.5	37.6	115
3	293	383	295	189	126	60.9	52.2	62.4	78.3	54.4	53.8	90.9
4	265	338	265	176	119	62.2	52.0	62.9	77.8	54.9	58.4	75.5
5	274	299	243	170	113	61.0	51.8	61.8	77.1	59.2	58.7	64.8
6	254	272	226	178	110	61.3	50.0	61.2	76.6	72.8	52.6	56.5
7	236	249	215	199	104	70.8	49.7	60.1	76.5	62.9	40.0	50.5
8	234	229	268	800e	96.9	73.5	49.1	59.2	77.4	63.7	35.4	47.6
9	258	212	413	578	93.5	86.1	48.1	59.4	77.0	60.3	33.4	46.3
10	245	199	336	453	89.5	79.3	49.0	58.1	78.9	57.0	32.0	63.6
11	378	189	283	362	85.7	84.5	49.6	59.2	88.0	50.3	30.6	104
12	593	177	262	362	81.4	72.6	45.3	61.5	87.5	49.5	28.8	433
13	473	168	276	516	74.7	68.3	43.4	60.5	73.9	49.1	28.5	219
14	376	167	289	561	70.1	68.8	43.2	58.6	72.0	49.0	28.5	151
15	308	158	255	529	67.3	68.8	43.1	59.9	70.9	50.1	29.1	138
16	283	155	255	568	66.8	66.9	43.2	64.9	80.8	51.8	28.1	142
17	261	160	229	583	65.0	64.1	52.6	65.5	73.2	51.4	27.7	174
18	285	202	215	512	64.0	61.7	51.7	65.4	56.4	51.6	27.8	950e
19	304	183	207	439	63.3	60.2	52.0	65.0	44.8	49.3	27.1	600e
20	339	168	195	369	60.0	57.7	53.4	65.4	43.0	49.5	27.1	434
21	382	162	186	313	56.5	57.3	51.8	65.4	42.5	51.2	27.9	331
22	426	155	197	277	54.3	58.7	53.0	64.3	42.8	52.0	46.7	263
23	456	148	223	248	50.0	57.5	51.4	64.9	43.5	52.6	139	357
24	700e	168	253	224	48.2	57.2	48.6	68.0	44.9	53.2	130	426
25	630e	235	251	205	50.8	56.2	50.0	70.1	55.1	56.7	85e	317
26	570e	286	244	188	72.3	56.0	61.1	70.3	54.1	79.0	63.3	261
27	660e	235	253	177	70.3	54.5	61.0	67.9	53.8	74.7	196	237
28	625	239	290	171	66.5	54.7	61.2	54.7	53.2	130	247	210
29	587	—	274	159	65.6	54.5	60.9	56.0	53.6	103	192	204
30	600	—	247	150	65.3	53.1	60.2	68.9	54.4	61.1	131	392
31	537	—	225	—	67.0	—	59.4	79.8	—	50.5	—	308
Mean	407	230	260	336	80.5	63.9	51.7	63.3	65.6	59.9	65.9	240
Max	700	474	413	800	143	86.1	61.2	79.8	88.0	130	247	950
Min	234	148	186	150	48.2	53.1	43.1	54.7	42.5	49.0	27.1	46.3
Ac-Ft	25019	12781	16015	19966	4949	3803	3177	3892	3902	3683	3919	14729

†All 2018 data are provisional—subject to revision; e=estimated

Tualatin River at Gaston, Oregon — 14202510



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — GASO

Q in cfs	10 < Q < 15	15 < Q ≤ 30	30 < Q ≤ 45	45 < Q ≤ 55	55 < Q ≤ 65	65 < Q ≤ 75	75 < Q ≤ 100	100 < Q ≤ 160	160 < Q ≤ 250	250 < Q ≤ 400	400 < Q ≤ 700	700 < Q ≤ 2,000	2,000 < Q ≤ 5,000
Jan													
Feb													
Mar													
Apr													
May													
Jun													
Jul													
Aug													
Sep													
Oct													
Nov													
Dec													
All	0.10%	2.2%	8.2%	12.3%	11.4%	8.5%	10.9%	10.3%	11.0%	10.7%	9.8%	4.1%	0.10%

Key

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
2000–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — GASO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	442	310	278	86.0	69.7	75.0	62.4	50.6	67.5	65.3	57.2	72.0
2001	78.2	103	81.2	71.5	68.0	38.3	31.7	30.0	23.5	35.6	95.3	571
2002	479	391	286	172	61.4	51.3	48.2	51.6	55.7	45.2	35.3	229
2003	353	315	545	307	97.6	57.4	54.1	72.5	64.9	41.5	47.0	320
2004	372	357	179	114	70.8	69.7	64.3	54.7	51.9	63.1	67.1	113
2005	123	78.0	51.5	179	99.2	57.3	44.5	51.9	71.5	84.7	184	235
2006	855	216	240	175	69.5	57.7	39.4	31.6	62.4	69.0	452	446
2007	256	189	300	120	56.5	41.9	40.2	34.6	48.3	55.3	76.7	426
2008	366	303	276	217	111	57.5	41.0	40.0	44.5	50.0	102	86.0
2009	379	102	248	155	126	62.0	50.0	40.0	48.0	47.0	284	199
2010	587	270	238	325	119	123	66.0	58.0	62.0	65.0	167	507
2011	385	296	583	482	260	123	87.0	85.0	68.5	24.0	41.5	64.0
2012	359	271	454	242	113	68.0	61.0	65.0	68.0	64.0	294	671
2013	224	181	180	126	83.0	72.0	49.0	50.0	58.5	61.0	103	102
2014	134	382	427	231	138	68.0	52.0	48.0	59.0	52.0	123	399
2015	255	231	152	101	72.0	62.0	58.0	54.0	76.5	47.0	149	840
2016	615	499	583	117	67.0	64.5	48.0	44.0	60.0	194	262	386
2017	248	538	511	300	150	63.0	63.0	55.0	78.0	55.0	348	197
2018	376	201	253	263	70.1	61.5	51.7	62.4	72.6	53.2	36.5	204
median	339	268	276	173	87.4	63.0	52.7	51.1	59.0	56.0	119	282

Key

Q in cfs

- $Q \leq 35.9$
- $35.9 < Q \leq 44.0$
- $44.0 < Q \leq 49.1$
- $49.1 < Q \leq 52.6$
- $52.6 < Q \leq 60.1$
- $60.1 < Q \leq 70.8$
- $70.8 < Q \leq 87.4$
- $87.4 < Q \leq 246$
- $246 < Q \leq 488$
- $483 < Q \leq 650$
- $Q > 650$

Q as percentile

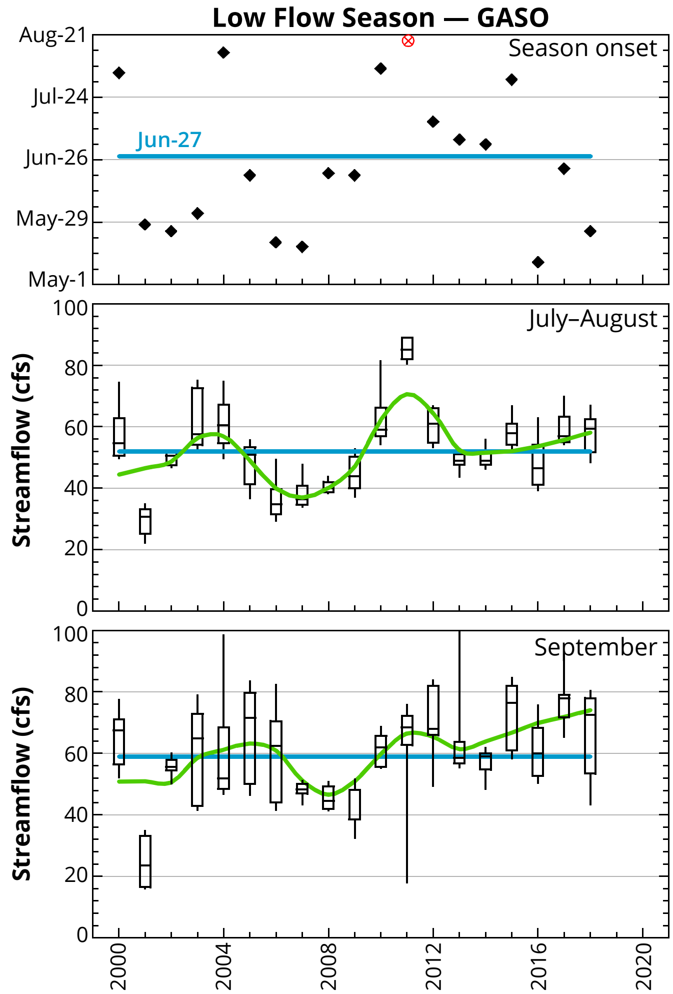
- $Q \leq$ 5th
- 5th $< Q \leq$ 10th
- 10th $< Q \leq$ 15th
- 15th $< Q \leq$ 20th
- 20th $< Q \leq$ 30th
- 30th $< Q \leq$ 40th
- 40th $< Q \leq$ 50th
- 50th $< Q \leq$ 75th
- 75th $< Q \leq$ 90th
- 90th $< Q \leq$ 95th
- $Q >$ 95th

2018

- Flow in 2018 was typical, except for high flows in early April and low flows in November, both of which were weather-related.

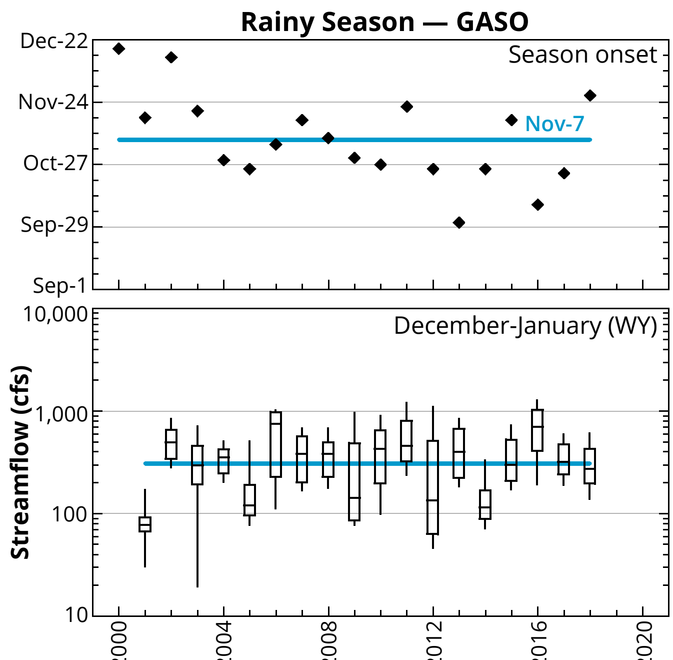
Low flow season

- The lowest flow months are July, August and October. Flow during this time is mostly controlled by releases from Barney Reservoir. Most of the released water is withdrawn downstream for municipal use.
- Higher flow during September (compared to July-August) is mostly due to Clean Water Services' releases from Barney Reservoir.
- Low flow criterion is: 7d-Q ≤ 55 cfs (~23th pctl)
- Higher than normal releases from Barney Reservoir occurred from mid-April through late-September 2011 so that repairs of Eldon Mills Dam could be done. Releases were temporarily discontinued in late September. The atypical release regime in 2011 was responsible for
  —high flows in July-August
  —the low-flow criterion not being met until 9/30
  —some very low flows in September
- Although flow during the dry season appears to be slightly greater in recent years, it is highly variable and there is no statistically significant trend.



Rainy season

- The highest flow months are December and January due to normal patterns in rainfall. Although low flows are less common during these months, they do occur, especially in December, and are probably related to reservoir filling.
- Rainy season criterion: 7d-Q ≥ 85 cfs (~48th pctl)
- Onset of the rainy season was earlier than average in many recent years, but not in 2018.
- No trends are evident for the magnitude of December–January rainy season flow.



SCOO – Scoggins Creek below Henry Hagg Lake near Gaston, Oregon – 14202980

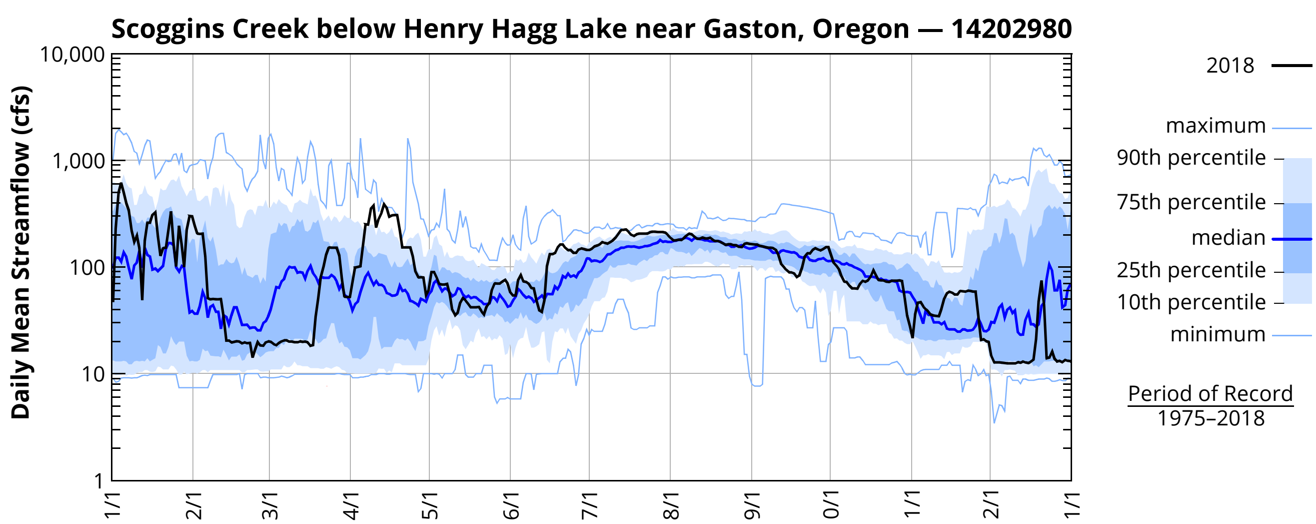
Data source: Bureau of Reclamation (in cooperation with District 18 Watermaster)

River mile: 4.8 *Latitude:* 45 28 10 *Longitude:* 123 11 56

2018 — MEAN STREAMFLOW† (cfs) — SCOO

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	48.0	245	20.1	52.3	61.0	58.6	144	186	164	131	21.6	14.7
2	230	205	19.9	71.1	89.4	54.0	148	178	162	110	36.0	12.8
3	497	205	19.0	98.9	89.5	54.1	156	178	162	103	46.1	12.8
4	615	205	18.5	100	79.8	75.9	159	180	158	95.7	46.9	12.8
5	500	127	19.5	101	69.5	84.3	163	179	156	81.1	42.8	12.7
6	398	51.2	20.2	155	68.7	73.2	171	186	154	73.1	40.3	12.6
7	341	50.0	20.6	252	68.5	72.4	169	197	152	72.6	38.2	12.5
8	218	50.2	20.6	250	69.4	69.4	166	205	152	66.4	35.7	12.5
9	172	50.0	20.0	353	56.0	63.5	172	203	151	63.0	35.0	12.5
10	199	50.0	20.0	377	39.8	63.2	178	191	145	62.9	34.8	12.5
11	151	50.1	19.8	233	35.2	49.3	188	184	128	62.6	34.6	12.9
12	48.9	34.8	19.8	285	37.4	39.4	203	184	107	69.2	40.4	12.7
13	178	20.4	20.1	324	46.4	38.0	222	188	101	74.4	50.7	13.0
14	260	20.5	19.9	387	51.3	48.4	224	185	94.1	73.0	56.7	12.8
15	259	19.6	20.0	359	48.6	102	224	185	89.3	74.8	58.7	12.6
16	308	19.9	19.7	297	45.1	132	215	188	89.1	80.9	57.5	13.0
17	326	20.2	18.3	305	41.9	132	201	181	86.9	93.5	55.4	13.6
18	194	20.0	18.6	308	41.8	136	195	176	80.9	83.9	55.4	21.2
19	128	19.4	34.4	307	41.9	152	202	175	83.8	75.2	59.7	47.9
20	150	19.7	50.8	224	42.1	163	205	171	100	75.1	59.4	74.8
21	152	19.4	80.0	152	38.7	162	206	167	126	75.0	58.8	44.2
22	226	19.5	102	152	36.0	150	205	161	134	72.8	60.2	14.0
23	332	14.2	131	152	42.6	143	205	164	133	72.2	59.7	14.2
24	165	17.0	152	152	46.2	145	211	163	145	74.3	59.0	16.3
25	102	19.9	152	124	61.6	136	214	160	151	74.4	58.9	13.8
26	244	18.4	152	90.5	70.2	136	214	160	147	74.5	35.1	13.0
27	165	18.3	152	79.7	70.0	146	213	154	144	74.9	20.7	13.2
28	100	19.7	128	80.1	69.9	150	213	154	147	73.7	21.0	12.9
29	223	—	78.1	79.8	73.3	147	213	165	154	52.4	20.2	13.5
30	300	—	52.6	54.8	76.0	144	209	167	153	35.1	19.9	13.2
31	299	—	52.4	—	69.7	—	199	165	—	27.7	—	13.1
Mean	243	58.1	53.9	199	57.3	104	194	177	132	75.1	44.0	17.6
Max	615	245	152	387	89.5	163	224	205	164	131	60.2	74.8
Min	48.0	14.2	18.3	52.3	35.2	38.0	144	154	80.9	27.7	19.9	12.5
Ac-Ft	14931	3229	3316	11819	3526	6187	11916	10870	7836	4618	2616	1079

†All 2018 data are provisional—subject to revision



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — SCOO

Q in cfs	1 < Q < 6	6 < Q ≤ 11	11 < Q ≤ 20	20 < Q ≤ 30	30 < Q ≤ 50	50 < Q ≤ 75	75 < Q ≤ 100	100 < Q ≤ 130	130 < Q ≤ 160	160 < Q ≤ 200	200 < Q ≤ 350	350 < Q ≤ 1,200	1,200 < Q ≤ 2,000
Jan													
Feb													
Mar													
Apr													
May													
Jun													
Jul													
Aug													
Sep													
Oct													
Nov													
Dec													
All	0.09%	4.6%	10.5%	8.7%	10.3%	10.8%	10.4%	10.8%	9.1%	10.2%	9.1%	5.1%	0.19%

Key

$f \geq 3\%$
$2\% \leq f < 3\%$
$1\% \leq f < 2\%$
$0.2\% \leq f < 1\%$
$0.06\% \leq f < 0.2\%$
$0 < f < 0.06\%$

Period of Record
1975–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — SCOO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	98.0	93.0	166	34.0	65.0	50.5	154	271	348	35.0	37.0	31.0
1976	86.0	24.0	124	85.0	45.0	31.0	95.0	94.0	171	140	23.0	14.0
1977	13.0	10.0	11.0	10.5	21.0	10.0	82.0	82.0	81.5	13.3	76.7	374
1978	181	41.7	28.6	60.3	76.7	33.3	84.8	122	215	173	16.0	14.0
1979	14.0	14.0	45.0	21.0	49.0	33.0	92.0	121	141	142	31.5	150
1980	205	22.0	135	74.0	35.0	29.0	80.0	117	123	84.0	78.5	123
1981	21.0	32.5	47.0	55.0	35.0	50.0	78.0	176	104	130	129	353
1982	228	217	199	142	74.0	73.0	82.0	107	103	150	131	341
1983	333	76.0	343	97.5	55.0	67.4	49.1	104	155	175	119	348
1984	65.1	66.1	59.1	60.0	76.0	68.7	108	157	107	112	212	126
1985	21.0	17.9	12.0	12.0	90.6	99.9	178	142	66.7	31.0	22.0	50.0
1986	11.0	51.0	98.1	13.0	45.9	91.8	149	158	88.4	27.0	19.0	9.0
1987	27.0	13.5	194	36.0	34.0	54.5	173	162	91.0	45.0	16.0	13.0
1988	15.0	13.0	14.0	41.0	52.0	47.5	143	166	136	90.0	27.0	27.0
1989	120	18.0	175	36.0	26.0	72.0	144	158	152	116	31.5	13.0
1990	12.0	63.5	150	15.0	33.0	54.0	188	177	114	98.0	19.0	9.9
1991	10.0	10.0	69.0	107	37.0	23.0	148	192	152	135	17.0	9.1
1992	9.9	11.0	11.0	10.5	30.0	105	164	175	102	66.0	22.0	11.0
1993	12.0	11.0	12.0	135	82.0	32.0	44.0	118	179	102	107	13.0
1994	14.0	12.0	76.0	36.0	30.0	30.0	201	188	132	83.0	22.0	17.0
1995	585	145	177	62.0	47.0	57.0	134	181	128	54.0	21.0	569
1996	334	609	32.0	202	116	38.5	181	204	93.0	75.0	24.0	57.0
1997	365	78.0	221	10.0	74.0	46.5	129	209	192	61.0	38.0	372
1998	211	172	193	35.5	59.0	50.0	133	149	199	104	39.0	121
1999	409	582	158	52.5	53.0	111	167	183	170	112	26.5	73.0
2000	191	25.0	94.0	15.5	37.0	89.0	133	173	135	113	51.0	10.0
2001	9.8	9.8	10.0	9.9	10.0	68.5	105	99.0	79.5	43.4	14.3	16.7
2002	230	54.6	92.0	80.8	46.9	122	154	160	169	134	29.5	9.7
2003	13.3	104	199	127	63.6	108	162	177	154	116	90.5	10.7
2004	10.7	117	50.5	51.0	39.7	90.6	158	204	103	95.0	20.8	10.7
2005	10.4	10.6	9.9	10.5	81.0	51.3	168	197	155	105	21.2	10.8
2006	688	75.1	33.7	66.1	45.0	60.4	176	205	156	79.2	20.8	201
2007	193	25.4	99.4	39.8	52.3	145	182	202	180	49.0	21.2	23.4
2008	289	107	33.2	96.0	73.6	50.2	186	178	174	105	22.3	19.6
2009	58.2	15.9	16.6	57.0	110	58.0	180	183	154	74.4	21.7	90.0
2010	207	99.1	68.6	169	87.4	154	139	174	98.9	79.0	27.2	318
2011	222	28.4	290	174	97.5	51.8	99.4	134	149	92.0	50.5	56.0
2012	309	82.5	249	113	100	55.0	158	187	167	63.0	113	386
2013	124	27.5	25.0	14.0	36.0	67.0	184	182	97.5	32.0	33.0	91.0
2014	47.0	48.5	299	98.0	111	89.5	178	198	164	82.0	26.0	24.0
2015	152	85.5	47.0	20.5	67.0	170	225	214	115	85.0	20.5	208
2016	292	105	290	59.0	36.6	124	167	194	120	22.0	26.1	397
2017	176	294	327	182	96.3	41.0	175	199	158	80.8	32.8	99.2
2018	223	20.3	20.2	154	56.0	117	203	178	145	74.4	44.4	13.0
median	100	32.0	74.0	57.0	54.0	61.6	149	170	134	89.0	27.0	41.9

Key

Q in cfs
$Q \leq 11.0$
$11.0 < Q \leq 13.4$
$13.4 < Q \leq 19.5$
$19.5 < Q \leq 23.5$
$23.5 < Q \leq 40.7$
$40.7 < Q \leq 62.0$
$62.0 < Q \leq 85.7$
$85.7 < Q \leq 158$
$158 < Q \leq 226$
$226 < Q \leq 356$
$Q > 356$

Q as percentile
Q ≤ 5th
5th < Q ≤ 10th
10th < Q ≤ 15th
15th < Q ≤ 20th
20th < Q ≤ 30th
30th < Q ≤ 40th
40th < Q ≤ 50th
50th < Q ≤ 75th
75th < Q ≤ 90th
90th < Q ≤ 95th
Q > 95th

2018

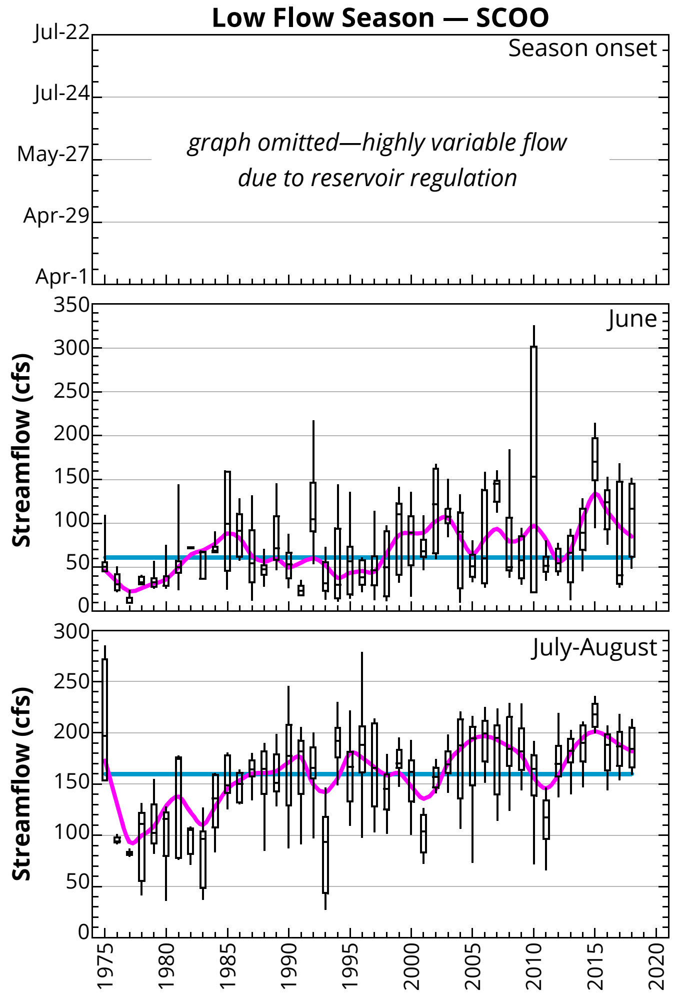
- Flow in 2018 was mostly in the typical range with the exception mid-April when higher than usual releases occurred during heavy rains.
- Flow in mid-June through July were often above the 90th percentile, but not record setting.

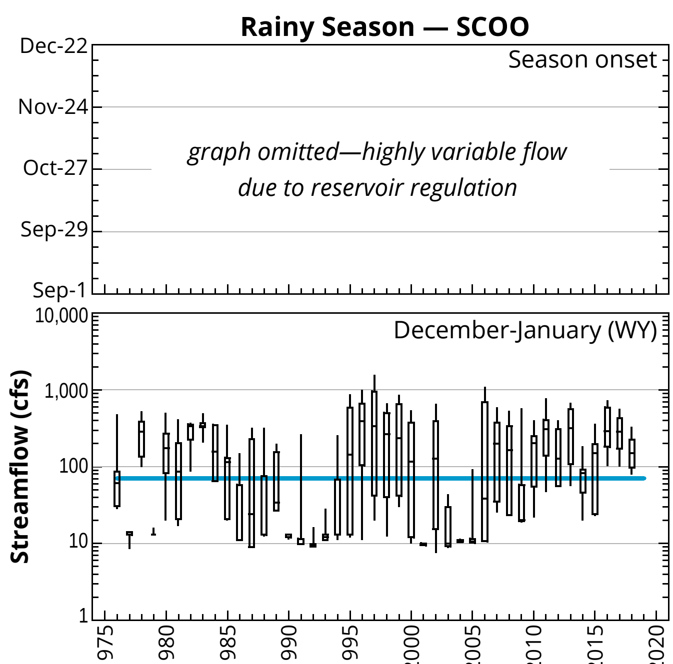
Reservoir effects

- Flow at this site is mostly controlled by the operation of Scoggins Dam and reservoir releases. Weather is secondary.
  —Seasonal, sustained low or high flow regimes driven by weather generally do not occur.
  —Both the lowest and highest flow extremes occur December through April and depend on whether on not Hagg Lake is filling.
  —The month with average lowest flow is November when little water is being released for municipal use or irrigation and the reservoir is filling.
  —Winter releases must be at least 10 cfs for the benefit of fish.

Release season

- Releases for irrigation and municipal use can begin in May and extend into November.
- The months with the highest average flow are July and August when releases are greatest due to high water demand.
- Flow during the release season varies substantially year-to-year depending on weather and other factors.
  —1993: Spring was very wet. Flow regulation did not start until July and releases in early July were low. Flow augmentation water was also being saved for use later in the year.
  —2001: The reservoir did not fill and water allocations were severely curtailed. The water users cooperated to conserve water.
  —2010: June was extremely wet.
  —2011: Joint Water Commission was releasing more water than usual from Barney Reservoir and therefore decreased their releases from Hagg Lake.
- Despite the variability, flow has increased over the period of record. The trend is statistically significant for June through August.





DLLO — Tualatin River near Dilley, Oreg. — 14203500

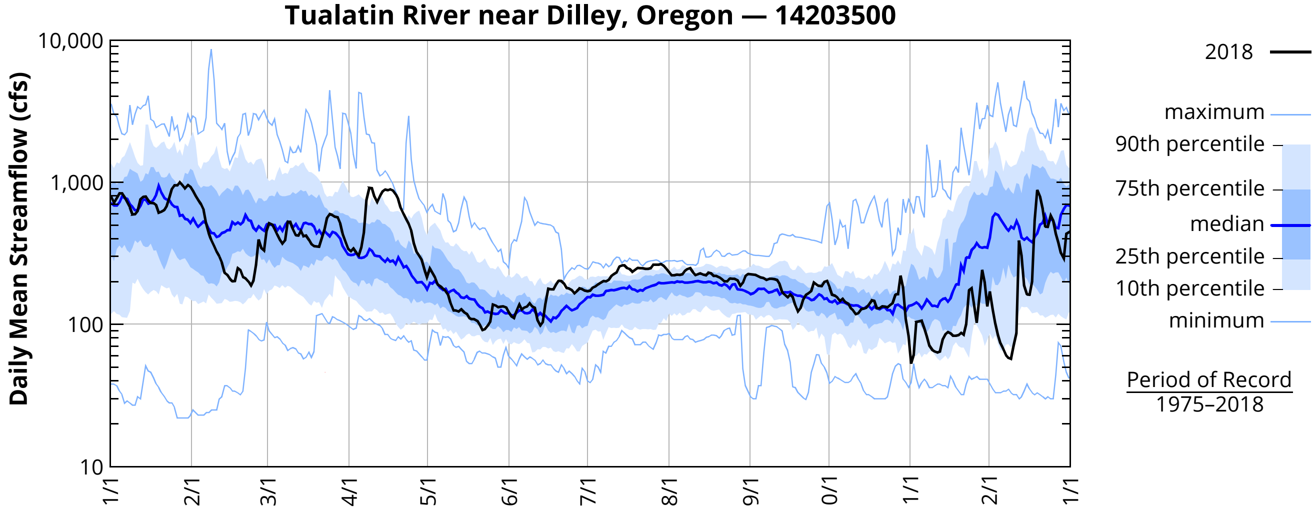
Data source: U.S. Geological Survey, Oregon Water Science Center

River Mile: 58.8 *Latitude:* 45 28 30 *Longitude:* 123 07 23 *Drainage area:* 125.00 sq mile *Datum:* 147.57 ft

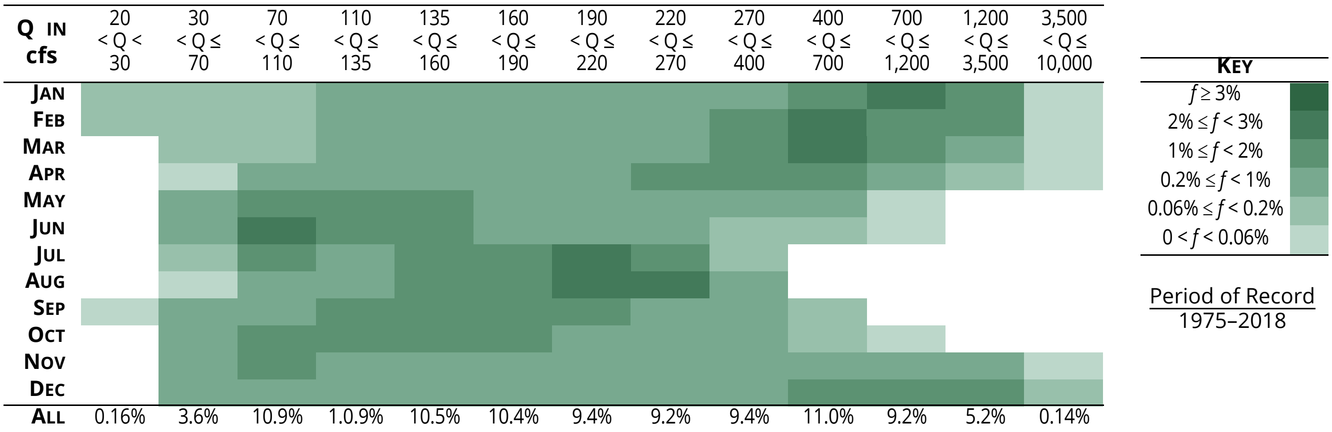
2018 — MEAN STREAMFLOW (cfs) — DLLO

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	782	866	458	339	216	122	171	233	225	183	52.9	171
2	718	799	516	327	247	114	173	221	224	161	60.9	127
3	774	747	505	342	229	111	182	221	222	159	104	101
4	833	698	466	319	213	125	186	224	218	154	105	84.5
5	834	639	427	306	191	138	191	222	213	146	106	73.3
6	784	513	394	348	186	127	196	225	211	152	94.0	66.8
7	724	441	369	443	178	132	202	238	206	144	82.2	60.9
8	664	392	392	747	172	134	201	246	209	140	70.8	58.2
9	592	354	526	910	162	141	206	249	209	130	66.3	57.4
10	596	323	525	905	140	134	219	233	208	125	64.6	70.5
11	628	301	468	788	125	131	226	222	205	118	63.4	86.7
12	760	273	422	724	125	106	232	226	191	120	64.5	389
13	788	230	420	801	123	98.1	256	228	169	128	78.9	305
14	790	223	455	860	128	104	260	224	161	129	85.5	188
15	744	209	417	889	122	139	260	221	155	131	88.7	162
16	713	201	420	877	119	178	250	231	162	138	86.7	161
17	711	202	393	894	111	176	246	228	156	148	83.2	201
18	688	248	365	872	109	176	234	219	136	146	83.3	539
19	610	241	354	825	109	190	242	219	123	130	83.9	882
20	621	216	353	761	106	203	250	215	131	130	87.3	786
21	636	211	351	656	99.3	202	248	208	150	134	84.4	652
22	681	201	405	595	91.5	193	248	201	161	133	100	486
23	777	188	464	547	92.9	180	245	201	166	132	174	484
24	898	204	562	507	98.1	179	245	210	172	137	180	580
25	948	262	595	454	105	174	248	209	196	141	137	534
26	951	396	586	371	138	166	262	209	190	162	103	435
27	1000	342	570	321	136	172	263	205	187	163	166	376
28	952	330	566	302	132	179	263	187	186	220	242	317
29	907	—	513	282	133	177	265	197	200	180	196	290
30	954	—	429	244	134	173	259	219	203	110	134	435
31	924	—	377	—	132	—	247	226	—	83.2	—	445
Mean	774	366	454	585	142	152	231	220	185	142	104	310
Max	1000	866	595	910	247	203	265	249	225	220	242	882
Min	592	188	351	244	91.5	98.1	171	187	123	83.2	52.9	57.4
Ac-Ft	47568	20331	27894	34822	8733	9073	14233	13521	10998	8742	6205	19050

Tualatin River near Dilley, Oregon — 14203500



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — DLLO



MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — DLLO

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1975	833	637	688	212	189	83.5	151	302	382	65.0	316	702
1976	1010	310	546	311	111	68.5	93.0	111	199	195	42.0	35.0
1977	30.0	33.5	247	85.0	74.0	58.0	90.0	83.0	102	49.0	307	1120
1978	885	617	245	284	233	90.0	103	141	275	222	77.5	232
1979	183	745	305	146	147	62.0	99.0	134	160	170	143	632
1980	963	452	475	336	109	67.0	102	134	145	111	175	660
1981	260	431	222	297	132	138	125	198	174	191	611	1210
1982	877	1081	725	597	157	103	90.5	123	123	206	307	1070
1983	913	1415	1010	440	139	103	88.6	119	202	210	785	748
1984	516	595	460	303	280	169	143	187	126	166	761	588
1985	194	291	196	222	150	184	196	151	71.5	62.9	144	158
1986	474	568	452	117	138	105	153	162	107	66.0	117	373
1987	604	536	943	180	79.0	79.0	180	168	111	83.0	41.5	254
1988	541	264	161	193	156	92.0	148	171	153	114	190	259
1989	569	288	616	219	81.0	106	171	174	163	140	116	96.0
1990	368	1053	494	128	90.0	111	170	174	124	123	132	203
1991	327	386	354	394	149	68.0	159	192	163	136	84.0	187
1992	248	377	153	177	94.0	132	150	152	109	83.0	86.0	328
1993	278	160	310	458	207	120	89.0	120	190	135	123	150
1994	494	188	356	179	84.0	73.5	193	185	145	100	293	1050
1995	1450	1050	611	282	160	115	149	178	140	93.0	332	1970
1996	1290	1210	350	597	437	145	184	205	127	114	162	1440
1997	976	537	887	261	187	112	162	266	277	280	359	723
1998	1320	1014	673	229	171	142	184	235	241	139	150	1280
1999	1450	2285	696	344	181	156	209	224	226	173	259	902
2000	856	463	495	124	123	189	211	238	218	205	128	130
2001	112	140	116	103	108	109	131	136	98.5	95.0	153	1270
2002	1310	571	461	300	116	179	202	207	224	177	110	317
2003	536	508	1020	480	153	159	201	225	195	151	153	340
2004	572	613	293	194	120	157	205	240	154	133	66.8	139
2005	195	122	81.8	266	203	123	196	232	188	146	244	326
2006	2430	491	481	307	124	128	211	226	206	165	659	1100
2007	571	252	521	196	128	165	197	209	198	105	142	755
2008	1050	663	455	393	231	137	255	202	212	135	125	108
2009	931	151	318	271	252	105	213	200	162	117	310	411
2010	920	466	440	585	248	441	181	193	141	150	238	1110
2011	823	323	807	654	325	162	176	216	194	114	130	162
2012	719	465	809	500	237	129	193	217	217	137	389	1260
2013	416	280	267	167	161	126	198	204	151	121	154	187
2014	187	822	882	468	259	134	199	206	186	130	162	537
2015	513	408	360	159	142	202	254	238	153	124	219	1570
2016	1190	732	986	240	93.9	159	189	241	182	305	483	964
2017	644	1125	890	639	317	126	222	231	208	137	641	454
2018	774	287	429	571	132	154	245	221	191	138	87.0	290
median	707	490	462	268	149	122	177	195	163	135	168	510

KEY

Q in cfs
- Q ≤ 77.0
- 77.0 < Q ≤ 95.0
- 95.0 < Q ≤ 110
- 110 < Q ≤ 122
- 122< Q ≤ 145
- 145< Q ≤ 169
- 169 < Q ≤ 200
- 200 < Q ≤ 408
- 408 < Q ≤ 888
- 888 < Q ≤ 1220
- Q > 1220

Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Flow in 2018 was mostly in the typical range with the exception mid-April when higher than usual releases occurred during heavy rains.
- Flow in mid-June through July was often above the 90th percentile, but not record setting.

Reservoir effects

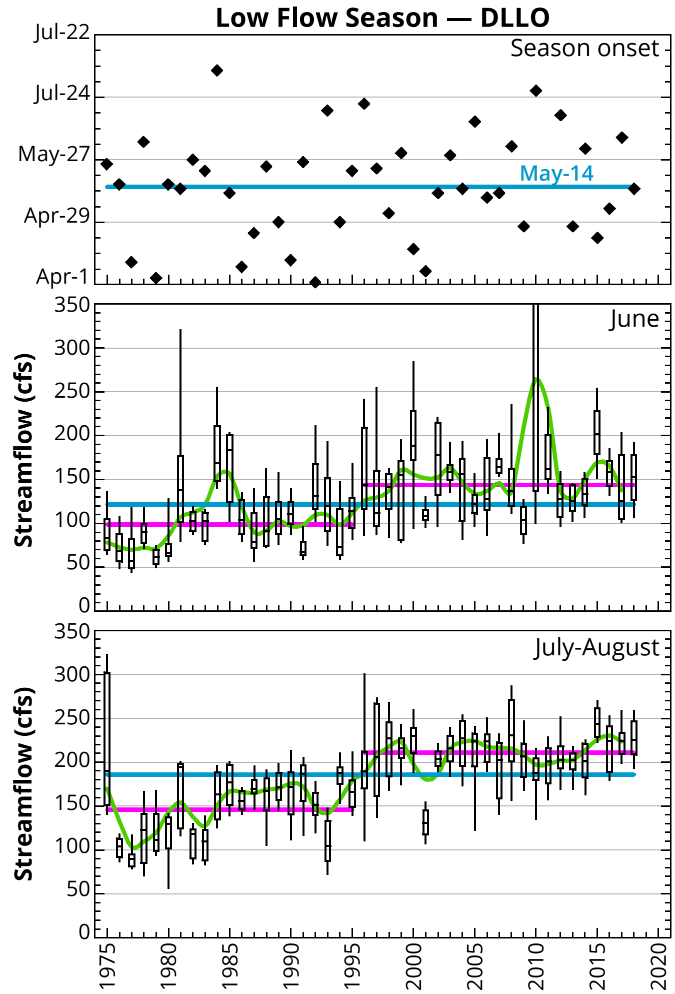
- Flow at this site is highly influenced by releases from Hagg Lake and Barney Reservoir.
  - —Releases for irrigation and municipal use can begin in May and extend into November.
  - —Onset of seasonal, sustained low or high flow regimes is highly variable.
  - —The frequency chart shows a weaker relationship between flow and season than most sites.

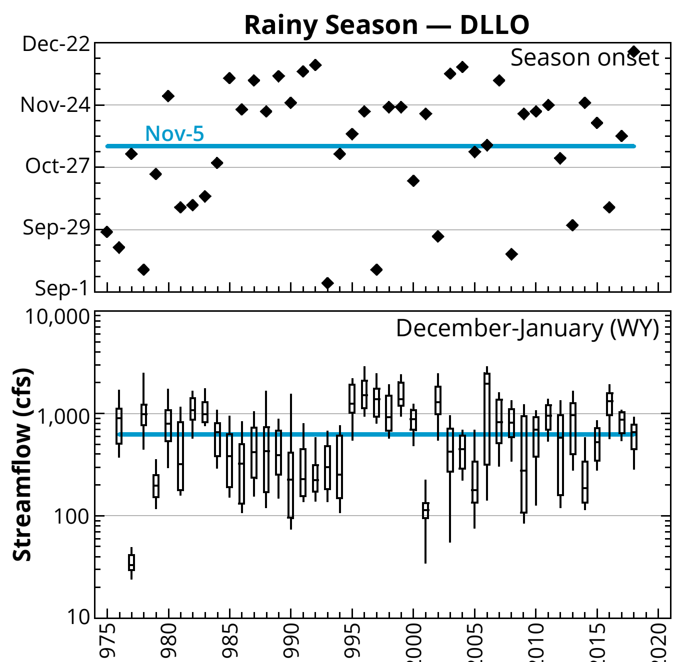
Low Flow

- The lowest average flows occur in May, June and October when reservoir releases are smaller than in mid-summer and rain is not prevalent.
- From 1975 through 1995, June–August flow increased markedly. The trend is statistically significant. Since 1995, no trend is evident. Several factors could contribute to the increase.
  - —Municipal water use increased due to population growth.
  - —Both the timing and amount of flow augmentation water released by Clean Water Services changed over time.
  - —Cooperation among water users and careful management of water resources increased.
- Low flow varies substantially year-to-year depending on weather and other factors.
  - —1993: Spring was very wet. Reservoir releases in early July were low.
  - —2001: The reservoir did not fill and water allocations were severely curtailed. The water users cooperated to conserve water.
  - —2010: June was extremely wet.
- Low flow criterion is: 7d-Q ≤ 130 cfs (~23th pctl)

Rainy season flow

- December through March are the months with the highest flows.
- High flow criterion is: 7d-Q ≥ 200 cfs (~50th pctl)





TRGC – Tualatin River at Golf Course Road near Cornelius, Oregon – 14204800

Data source: Oregon Water Resources Department

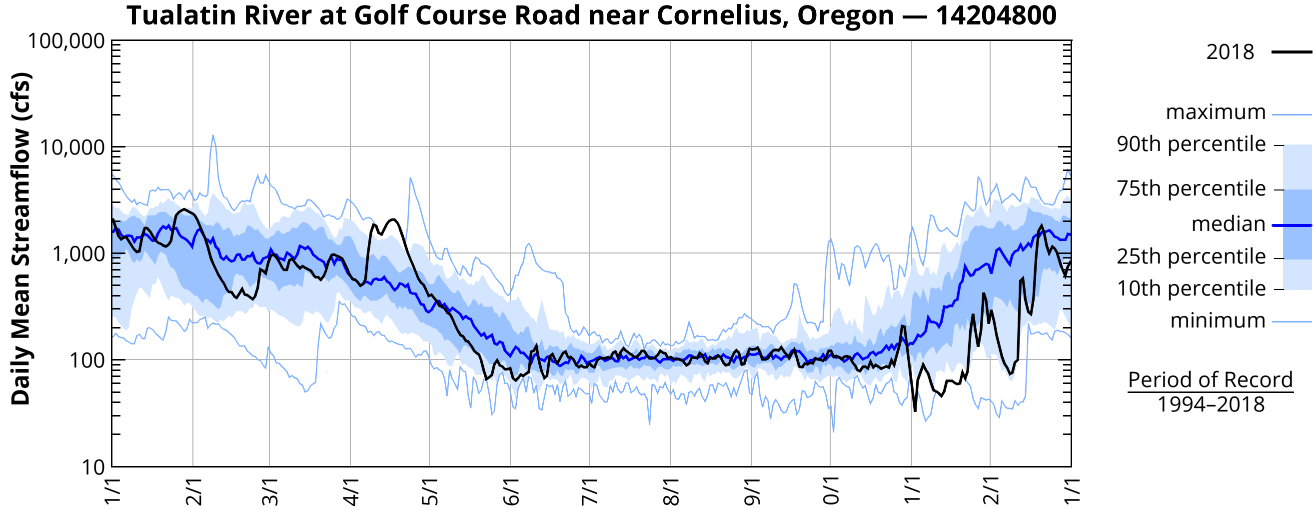
River mile: 51.5 *Latitude:* 45 30 08 *Longitude:* 123 03 22

2018 — MEAN STREAMFLOW† (cfs) — TRGC

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2070	2260	822	622	400	84.1	92.7	107	125	122	52.9	294
2	1750	2060	955	572	410	67.4	88.2	103	126	107	32.7	228
3	1450	1800	971	566	384	64.0	85.7	101	130	109	64.9	169
4	1360	1560	914	534	357	67.9	99.7	102	118	106	77.0	134
5	1400	1370	837	499	322	72.8	104	99.4	101	101	89.6	108
6	1410	1150	754	515	316	71.2	104	95.4	101	107	80.2	91.3
7	1290	932	701	579	302	74.3	103	89.2	104	108	74.2	83.7
8	1170	800	698	1010	278	77.4	106	92.5	114	106	61.8	73.8
9	1090	702	859	1580	269	120	104	105	123	96.5	52.2	76.2
10	1030	626	888	1850	245	123	117	105	124	89.7	50.6	94.7
11	1040	572	833	1810	211	136	120	104	123	80.7	48.6	100e
12	1450	530	765	1560	188	95.8	105	116	131	78.9	46.1	549
13	1730	465	723	1500	172	77.2	119	111	121	85.9	51.1	581
14	1720	435	762	1680	167	67.7	129	97.1	114	86.8	63.4	363
15	1610	431	734	1880	151	71.0	122	92.7	104	83.7	63.7	280
16	1450	398	714	2010	149	108	117	106	115	96.8	63.5	268
17	1320	384	690	2070	138	114	113	103	125	85.2	61.2	379
18	1260	422	636	2070	125	101	107	103	105	89.6	59.5	913
19	1230	464	598	1950	118	93.7	106	110	86.4	86.5	60.2	1630
20	1180	412	595	1730	113	104	112	105	85.5	82.6	76.2	1810
21	1160	404	563	1470	97.3	116	122	94.4	93.0	85.2	67.3	1570
22	1210	385	614	1210	78.6	120	121	89.2	91.0	87.4	78.3	1180
23	1310	369	703	1010	66.1	105	110	90.3	94.3	84.9	190	1010
24	1770	396	856	879	69.3	106e	103	103	93.3	98.9	272	1160
25	2280	476	959	774	72.6	100e	103	116	104	89.1	184	1100e
26	2440	709	972	674	91.4	90.0e	105	123	101	112	133	1000e
27	2520	687	947	577	99.2	85.5	111	117	100	138	191	834
28	2590	648	927	529	89.0	88.6	122	90.4	98.5	207	427	708
29	2520	—	895	505	86.8	85.1	117	91.8	107	204	360	612
30	2440	—	807	453	81.5	85.7	115	111	122	134	219	748
31	2370	—	710	—	82.1	—	104	128	—	82.5	—	828
Mean	1633	780	787	1156	185	92.4	109	103	109	104	112	612
Max	2590	2260	972	2070	410	136	129	128	131	207	427	1810
Min	1030	369	563	453	66.1	64.0	85.7	89.2	85.5	78.9	32.7	73.8
Ac-Ft	100403	43333	48401	68763	11363	5499	6719	6350	6506	6410	6647	37638

†All 2018 data are provisional—subject to revision; e=estimated

Tualatin River at Golf Course Road near Cornelius, Oregon — 14204800



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — TRGC

Q in cfs	20 < Q < 30	30 < Q ≤ 65	65 < Q ≤ 90	90 < Q ≤ 110	110 < Q ≤ 125	125 < Q ≤ 160	160 < Q ≤ 250	250 < Q ≤ 450	450 < Q ≤ 750	750 < Q ≤ 1,400	1,400 < Q ≤ 2,300	2,300 < Q ≤ 5,000	5,000 < Q ≤ 15,000
Jan													
Feb													
Mar													
Apr													
May													
Jun													
Jul													
Aug													
Sep													
Oct													
Nov													
Dec													
All	0.07%	3.8%	10.6%	11.8%	8.0%	9.0%	8.9%	10.2%	10.3%	11.9%	10.0%	5.1%	0.13%

Key

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
1994–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — TRGC

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1994	773	461	796	405	125	76.5	120	110	91.5	75.0	623	1780
1995	2051	1766	1550	591	240	94.3	77.3	117	96.0	88.4	616	2273
1996	2036	2709	613	1005	663	152	85.6	117	82.6	125	262	2922
1997	1905	963	1843	469	251	124	87.1	134	223	452	805	1174
1998	2431	1951	1188	469	278	128	114	106	131	135	248	2198
1999	2318	3448	1290	639	303	139	120	128	146	163	526	1410
2000	1637	846	835	244	181	149	110	142	170	184	147	231
2001	183	276	199	154	123	78.6	55.3	52.7	43.4	60.8	354	2256
2002	1693	1122	854	535	125	80.9	78.8	77.3	127	124	98.6	715
2003	1073	1042	1629	806	216	78.1	69.2	117	107	130	159	755
2004	1038	1168	546	316	127	68.3	83.4	116	84.9	131	91.4	247
2005	371	176	93.7	475	298	102	99.6	89.8	76.1	126	418	620
2006	2478	1183	864	530	140	102	103	99.9	111	93.1	1603	2058
2007	1172	382	998	328	112	100	107	109	113	83.3	145	1756
2008	1800	1435	790	647	244	123	133	106	126	125	192	175
2009	1810	286	597	454	427	68.5	117	116	112	104	575	646
2010	2070	845	799	994	376	621	110	102	105	119	468	2420
2011	1840	560	1990	1210	454	186	115	112	105	82.0	138	274
2012	1480	851	1490	740	313	139	111	101	113	113	656	2510
2013	748	487	531	326	154	127	105	97.0	106	143	244	271
2014	319	1545	1560	796	381	108	102	97.0	98.0	120	264	1170
2015	862	782	603	261	96.0	94.0	98.0	100	85.5	77.0	386	v
2016	2270	1300	1860	332	82.0	75.0	92.0	99.0	113	501	762	1470
2017	1010	1960	1600	1115	457	111	105	96.0	110	100	1057	703
2018	1450	551	765	1010	149	89.3	107	103	106	96.5	66.1	549
median	1484	966	896	508	219	102	102	104	109	120	324	1240

Key

Q in cfs
- Q ≤ 68.3
- 68.3 < Q ≤ 81.0
- 81.0 < Q ≤ 90.8
- 90.8 < Q ≤ 99.5
- 99.5 < Q ≤ 116
- 116 < Q ≤ 142
- 142 < Q ≤ 219
- 219 < Q ≤ 837
- 837 < Q ≤ 1813
- 1813 < Q ≤ 2330
- Q > 2330

Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

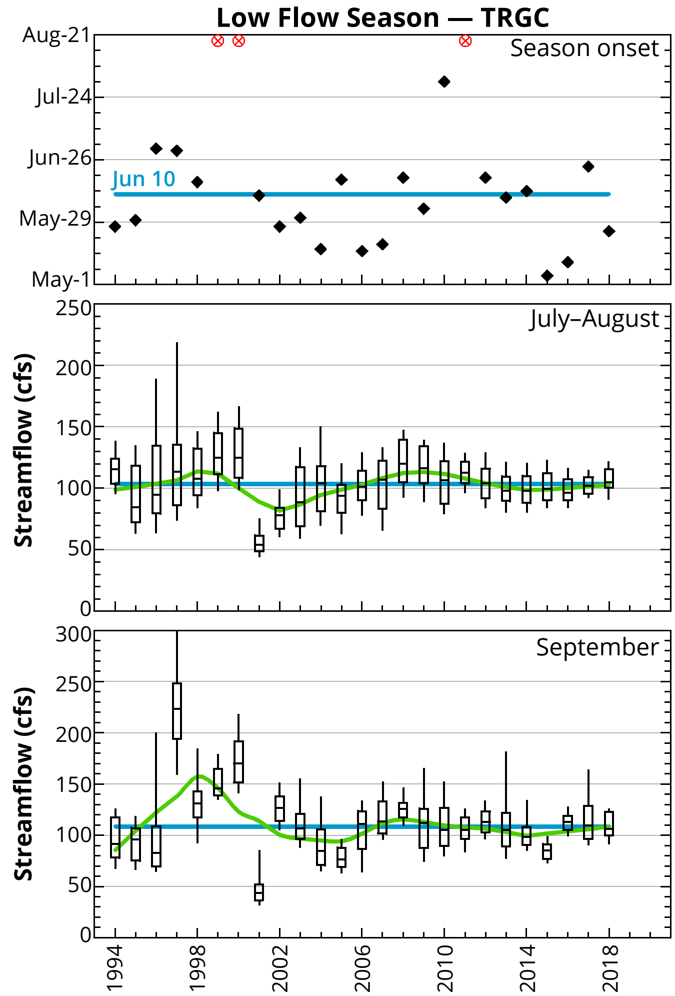
- Flow in 2018 was typical, except for high flows in early April and low flows in November, both of which were weather-related.

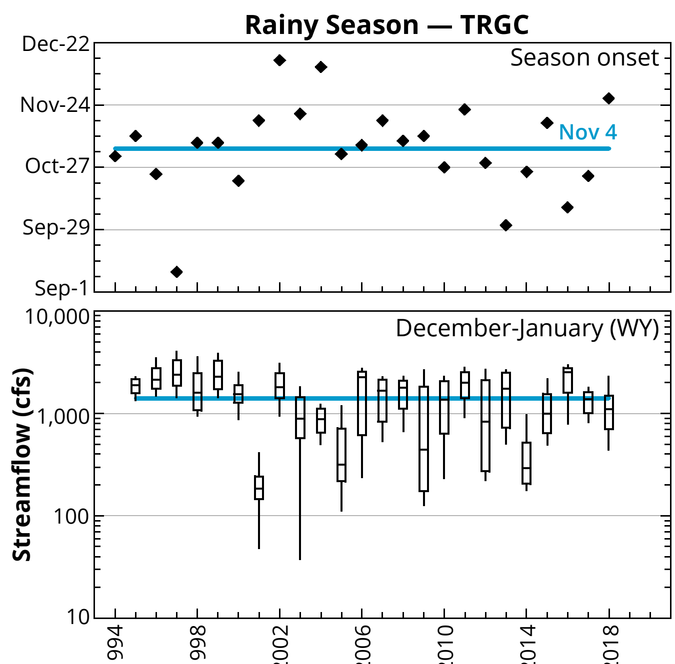
Low flow

- June through September are the months with the lowest average flow.
- Because flow at this site is highly influenced by releases from Hagg Lake and Barney Reservoir and withdrawals at Springhill Pump Plant, the frequency chart shows a weaker relationship between flow and season than most sites.
- Very low daily flows can occur anytime from early summer through December depending on weather and Scoggins Dam operations.
- Low flow criterion is: 7d-Q ≤ 95 cfs (~17th pctl)
- Low flow did not occur in 1999 and 2000.
- In 2011, low flow was delayed until 9/6 because Joint Water Commission was releasing more water than usual from Barney Reservoir so that repairs could be done on Eldon Mills Dam.
- No trends are evident in flow magnitude over time for July–September.
- A few years had higher or lower flow than usual due to weather or other factors.
  - —1997: September rainfall was higher than usual.
  - —2001: Hagg Lake did not fill and water allocations were severely curtailed. The water users cooperated to conserve water.

Rainy season flow

- December and January are the months with the highest average flow, although very high daily flows can occur from November through April. This pattern is consistent with normal rainfall.
- High flow criterion is: 7d-Q ≥ 170 cfs (~44th pctl)
- No trends are evident for the magnitude of the December–January rainy season flow.





TRJB — Tualatin River at Hwy 219 Bridge — 14206241

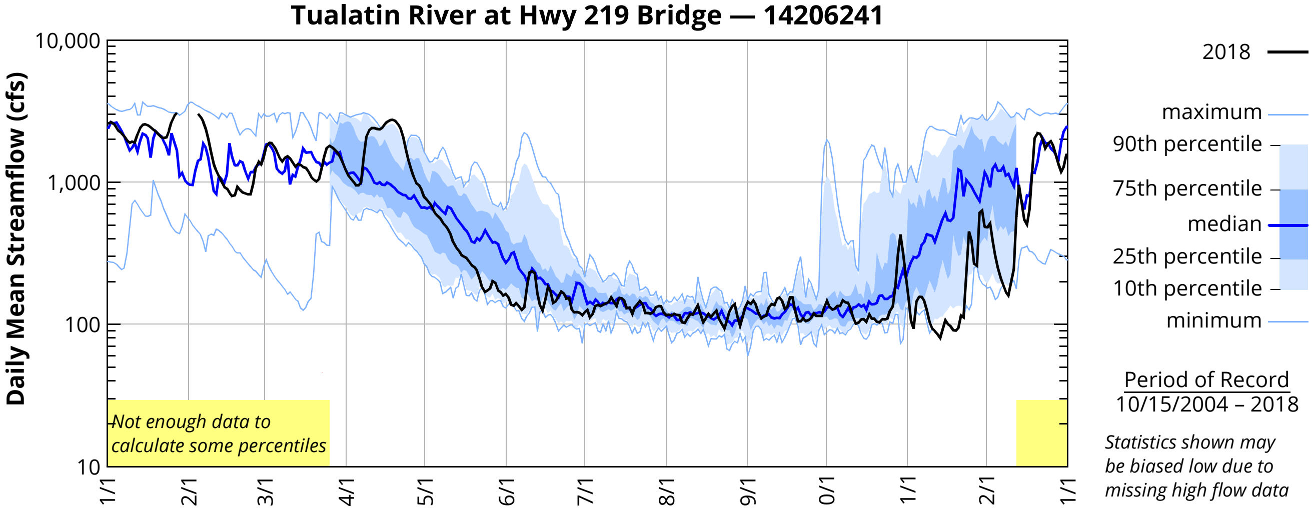
Data source: Jackson Bottom Wetland Education Center
River mile: 44.4 *Latitude:* 45 30 01 *Longitude:* 122 59 24

2018 — MEAN STREAMFLOW† (cfs) — TRJB

DAY	JAN*	FEB*	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2599		1495	1231	788	164	122	116	144	147	155	482
2	2642		1776	1128	750	155	126	117	139	132	106	516
3	2562		1888	1071	715	137	112	115	147	127	93	387
4	2414	3023	1879	1012	667	135	119	119	138	129	146	303
5	2281	2880	1780	950	612	141	135	116	121	135	156	251
6	2214	2665	1636	948	579	134	138	116	110	134	155	212
7	2105	2374	1490	995	557	127	135	103	114	148	146	188
8	1962	2010	1397	1472	522	132	137	102	116	142	127	169
9	1894	1610	1480	2112	496	181	141	111	132	142	104	160
10	1933	1344	1524	2317	467	232	143	118	139	129	93	194
11	1906	1198	1465	2403	427	237	155	117	137	112	90	245
12	2188	1097	1365	2403	378	229	144	127	152	101	86	576
13	2413	1001	1282	2365	351	165	134	136	155	103	80	960
14	2524	927	1346	2353	333	136	153	117	147	108	92	721
15	2554	899	1326	2410	308	125	153	104	129	109	107	539
16	2520	841	1278	2550	301	150	147	111	133	104	100	502
17	2430	798	1256	2665	295	183	130	119	155	117	97	645
18	2335	809	1178	2734	278	171	131	113	155	110	91	1176
19	2267	931	1093	2750	262	142	118	119	125	110	90	2043
20	2171	882	1045	2698	254	146	133	125	105	104	94	2212
21	2078	847	1009	2570	238	159	139	109	105	103	115	2186
22	2044	833	1052	2360	211	170	147	101	110	109	112	1987
23	2069	821	1246	2062	181	165	138	93	105	108	219	1735
24	2307	822	1513	1705	169	151	120	106	107	110	450	1871
25	2665	970	1740	1426	173	153	120	124	111	125	388	1940
26	2942	1257	1801	1241	179	128	119	134	119	134	267	1794
27	3072	1395	1762	1083	202	122	123	139	114	185	258	1562
28		1337	1689	981	196	122	133	113	115	311	613	1349
29		—	1616	951	174	121	134	98	115	430	635	1185
30		—	1506	884	169	116	134	113	132	319	485	1288
31		—	1368	—	160	—	121	132	—	213	—	1556
Mean	2337	1343	1461	1794	367	154	133	116	128	148	192	998
Max	3072	3023	1888	2750	788	237	155	139	155	430	635	2212
Min	1894	798	1009	884	160	116	112	93	105	101	80	160
Ac-Ft	125142	66588	89819	106775	22594	9176	8203	7105	7588	9107	11402	61360

†All values should be considered estimates because the rating curve has not been updated recently; *Incomplete record

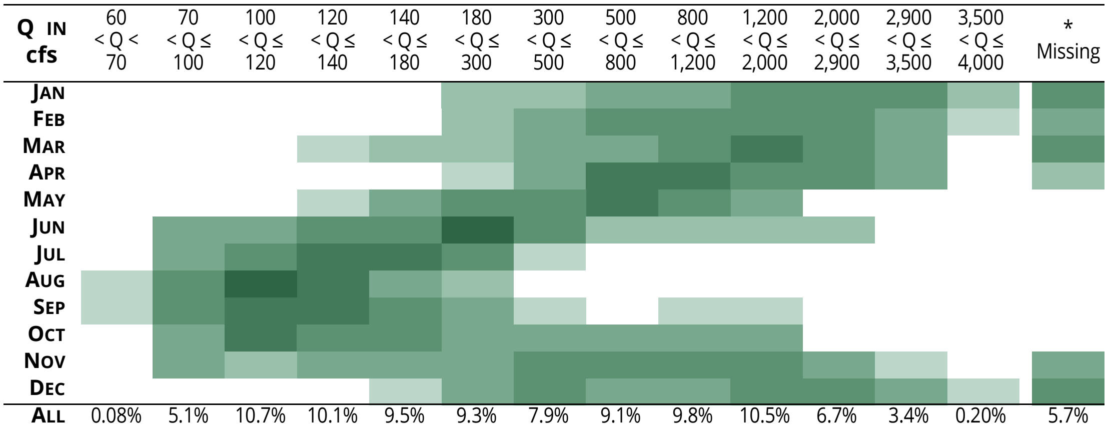
Tualatin River at Hwy 219 Bridge — 14206241

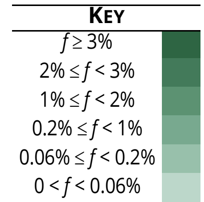


TRJB — Tualatin River at Hwy 219 Bridge — 14206241

Data source: Jackson Bottom Wetland Education Center

FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — TRJB





Period of Record
10/15/2004 – 2018

*Data from October – December 2004 not used to prevent skewing distribution. Because the missing values are likely high flow, the statistics underestimate both the magnitude and frequency of high flow.

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — TRJB

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004											176	451
2005	722	407	228	1003	802	232	127	92	88.9	154.5	780	1284
2006	3264	2395	1404	954	332	212	128	98	107	124	2264	2865
2007	2394	710	1604	638	235	152	124	118	123	118	275	2533
2008		2493	1380	1214	460	204	169	124	139	144	353	333
2009		527	1109	817	694	146	125	115	115	124	841	1088
2010		1678	1415	2081	667	995	187	120	128	127	676	
2011		1213		1901	808	316	176	135	119	117	182	415
2012		1507			597	294	157	119	121	159		
2013	1126	831	965	589	248	220	124	106	131	203	409	421
2014	563			1485	669	193	138	107	105	148	512	1721
2015	1517		1205	596	215	128	113	101	102	96	576	
2016		2254		650	193	127	117	114	132	812	1231	
2017				2019	926	247	151	117	132	139	1685	1305
2018	2307	1001	1480	1883	301	148	134	116	127	127	114	721
median	1933	1199	1429	986	480	197	134	115	120	139	535	1293

Key

Q in cfs
- Q ≤ 99
- 99 < Q ≤ 110
- 110 < Q ≤ 117
- 117 < Q ≤ 126
- 126< Q ≤ 148
- 148< Q ≤ 198
- 198 < Q ≤ 354
- 354 < Q ≤ 1149
- 1149 < Q ≤ 2251
- 2251 < Q ≤ 2786
- Q > 2786

Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

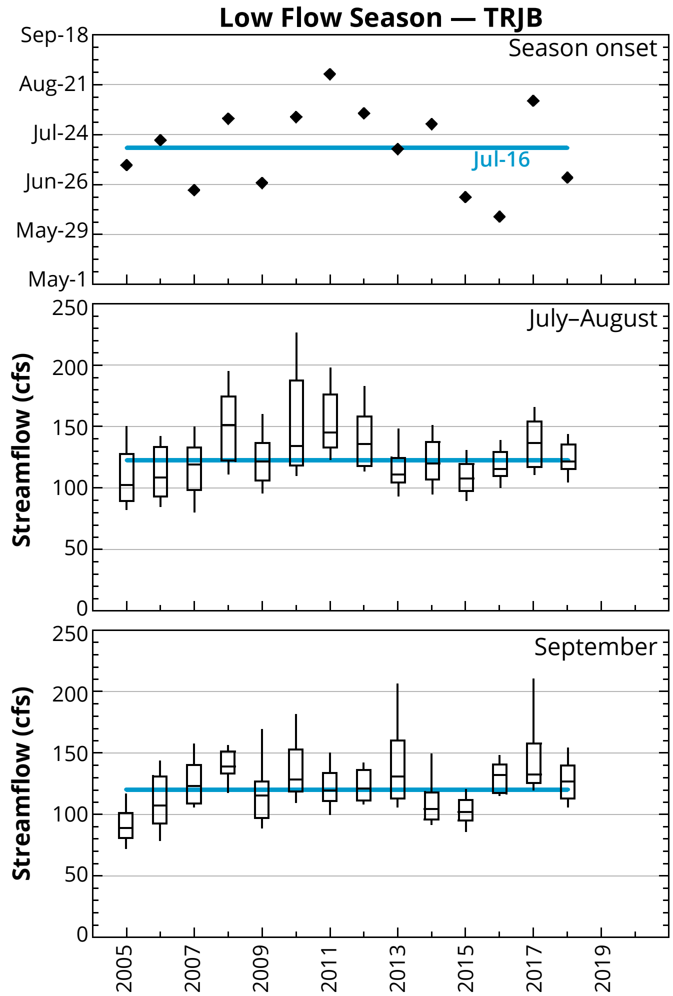
- Flow in 2018 was typical, except for high flows in early April and low flows in November, both of which were weather-related.

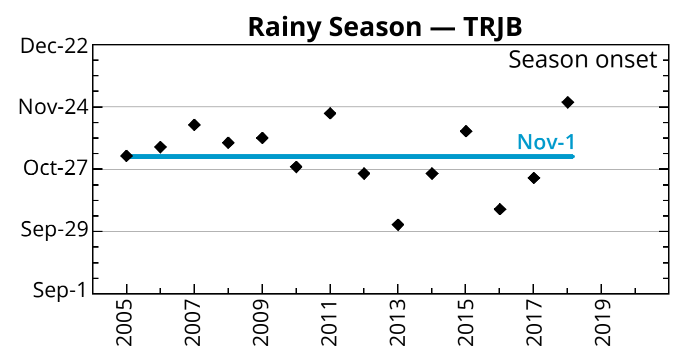
Low flow

- August and September are the months with the lowest average flow and the lowest daily flows.
- Low flow criterion is: 7d-Q ≤ 125 cfs (~19th pctl)
- No trends are evident in the magnitude of flow over time for July–September.

Rainy season flow

- December and January are the months with the highest average flow, although very high daily flows can occur from November through April. This pattern is consistent with normal rainfall.
- High flow criterion is: 7d-Q ≥ 200 cfs (~39th pctl)
- Much of the high flow data is missing because the rating curve has an upper limit. The frequencies and percentiles in tables on the previous page are therefore skewed with low values overrepresented.
- Boxplots were not shown for the December–January rainy season because too many data are missing.





ROOD – Tualatin River at Rood Bridge Road near Hillsboro, Oregon – 14206295

Data source: Oregon Water Resources Department

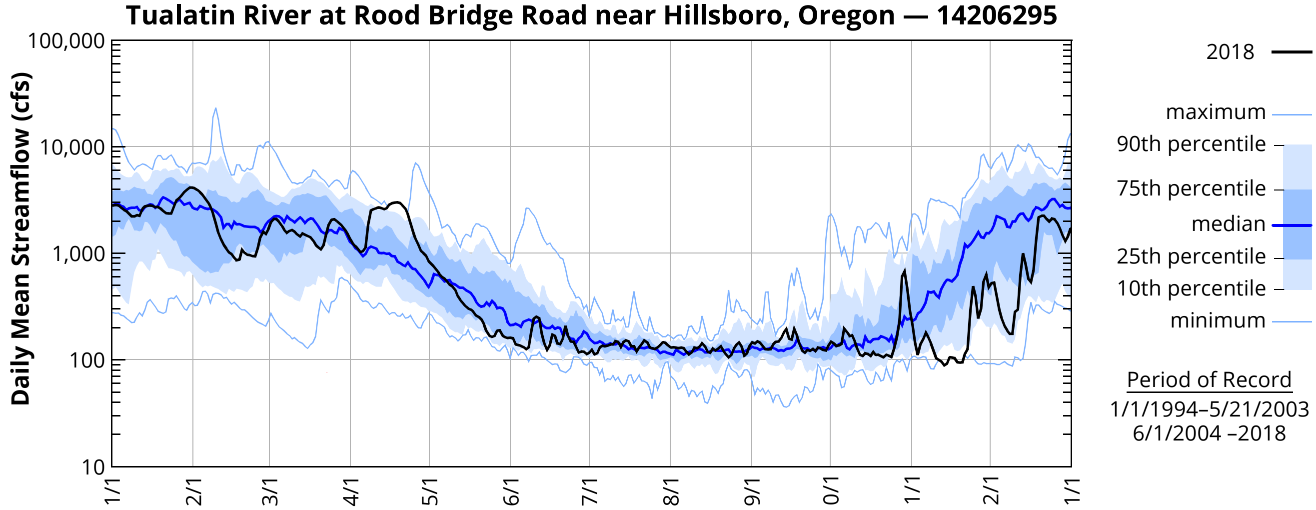
River mile: 38.4 *Latitude:* 45 29 24 *Longitude:* 122 57 06

2018 — MEAN STREAMFLOW† (cfs) — ROOD

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2800	4060	1680	1370	845	162	117	130	146	149	211	524
2	2850	3930	1960	1250	789	159	124	131	143	144	144	530
3	2800	3740	2090	1170	750	140	113	130	150	135	111	395
4	2670	3510	2090	1100	698	138	116	129	146	137	142	297
5	2560	3270	1990	1030	644	136	131	130	136	142	157	241
6	2500	3030	1840	1050	601	132	136	129	126	198	180	206
7	2360	2730	1670	1130	581	126	134	119	125	184	163	188
8	2220	2350	1560	1840	544	131	136	113	126	167	144	175
9	2210	1900	1620	2520	510	184	140	118	140	170	121	176
10	2280	1550	1660	2590	493	244	140	130	148	150	104	283
11	2240	1350	1600	2650	455	255	150	129	149	127	100	296
12	2590	1210	1490	2680	397	246	148	133	160	112	97	626
13	2740	1100	1430	2650	365	176	132	144	180	109	89	1000
14	2780	1020	1540	2590	343	142	148	134	195	115	93	798
15	2800	988	1490	2650	318	124	153	119	158	114	106	575
16	2780	917	1450	2870	304	138	150	117	155	109	105e	539
17	2710	860	1410	2940	297	173	134	128	195	119	104	690
18	2720	874	1320	2980	282	169	134	123	171	111	95e	1310
19	2640	1080	1200	3000	263	143	120	128	142	112	95	2180
20	2500	1010	1130	2960	253	141	131	134	122	109	95e	2250
21	2370	967	1090	2830	240	160	141	123	117	106	115e	2240
22	2350	961	1200	2630	216	209	153	114	124	112	127	2090
23	2350	939	1520	2330	185	167	147	106	122	110	296	1980
24	2700	936	1860	1950	168	149	131	111	127	107	490	2110
25	3120	1110	2060	1610	165	148	129	128	121	127	395	2080
26	3280	1410	2080	1370	169	132	127	139	130e	163	245	1930
27	3490	1590	2000	1200e	188	118	131	146	129e	230	301	1720
28	3740	1520	1910	1050e	189	120	138	132	124	607	554	1480
29	3940	—	1810	1000e	170	119	147	110	123	679	635	1300
30	4130	—	1690	950e	164	114	145	115	137	477	482	1430
31	4140	—	1530	—	160	—	137	135	—	287	—	1680
Mean	2818	1783	1644	1998	379	157	136	126	142	184	203	1075
Max	4140	4060	2090	3000	845	255	153	146	195	679	635	2250
Min	2210	860	1090	950	160	114	113	106	117	106	89	175
Ac-Ft	173276	98999	101097	118889	23298	9312	8356	7749	8463	11341	102090	66087

†All 2018 data are provisional—subject to revision

Tualatin River at Rood Bridge Road near Hillsboro, Oregon — 14206295



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — ROOD

Q in cfs	10 < Q < 45	45 < Q ≤ 100	100 < Q ≤ 120	120 < Q ≤ 140	140 < Q ≤ 180	180 < Q ≤ 280	280 < Q ≤ 500	500 < Q ≤ 900	900 < Q ≤ 1,600	1,600 < Q ≤ 2,800	2,800 < Q ≤ 4,500	4,500 < Q ≤ 12,000	12,000 < Q ≤ 25,000
JAN													
FEB													
MAR													
APR													
MAY													
JUN													
JUL													
AUG													
SEP													
OCT													
NOV													
DEC													
ALL	0.13%	5.1%	8.3%	10.2%	10.3%	9.6%	9.8%	10.3%	10.8%	10.6%	9.5%	5.2%	0.09%

KEY

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
1/1/1994–5/21/2003
6/1/2004 –2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — ROOD

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1994	1310	762	1480	656	205	123	107.0	96.0	91.5	82	1095	3590
1995	3903	4086	2810	1104	478	207	111.0	115.8	106.8	140.5	972	5587
1996	2880	4720	1123	1705	1421	317	145	147	138	257	523	4549
1997	3934	1931	3518	815	412	322	128	135	236	610	1748	2470
1998	4637	3079	2163	798	496	300	152	121	131	179	367	4046
1999	5027	6820	2665	1129	457	207		134	128	142	695	2582
2000	2626	1670	1584	412	297	200	120	124	155	196	144	375
2001	293	429	326	282	194	111	66	57	49	84	544	3823
2002	2941	2476	1516	701	239	134	111	99	123	122	121	1037
2003	2683	3123	3382	1777	424							
2004						134	105	122	114	196	212	468
2005	721	387	222	1067	905	256	124	91	85	156	899	1497
2006	5846	3111	1569	1017	332	202	139	117	122	118	2850	4187
2007	2928	815	1739	622	235	148	129	126	135	146	254	3230
2008	3560	2905	1410	1205	461	184	154	118	129	120	361	304
2009	3280	523	1140	865	768	163	126	126	130	152	1047	1110
2010	3230	1775	1530	2265	801	1100	197	136	166	169	886	3750
2011	3370	1375	3380	2090	916	342	190	146	133	133	256	418
2012	2940	1690	2900	1495	679	344	169	130	134	236	1175	4130
2013	1330	859	1020	622	264	257	138	121	175	215	434	420
2014	609	2735	2810	1680	739	201	144	114	114	181	612	2240
2015	1610	2250	1360	638	219	127	116	113	115	81	580	5570
2016	3800	2440	2860	646	188	129	114	97	115	964	1425	3240
2017	2290	5140	3570	2100	864	247	159	128	139	165	1770	1370
2018	2710	1280	1620	2140	304	143	136	129	139	135	135	798
median	2830	1922	1820	937	428	201	133	121	128	154	587	2430

KEY

Q in cfs
- Q ≤ 99
- 99 < Q ≤ 113
- 113 < Q ≤ 122
- 122 < Q ≤ 131
- 131< Q ≤ 159
- 159< Q ≤ 231
- 231 < Q ≤ 397
- 397 < Q ≤ 1628
- 1628 < Q ≤ 3385
- 3385 < Q ≤ 4557
- Q > 4557

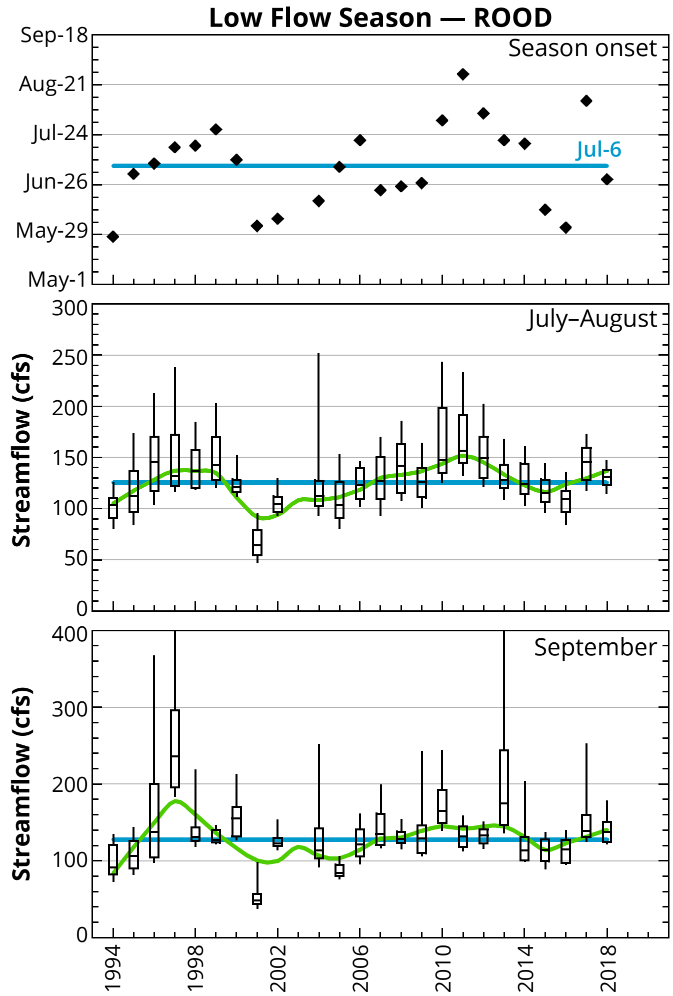
Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Flow in 2018 was typical, except for high flows in early April and low flows in November, both of which were weather-related.

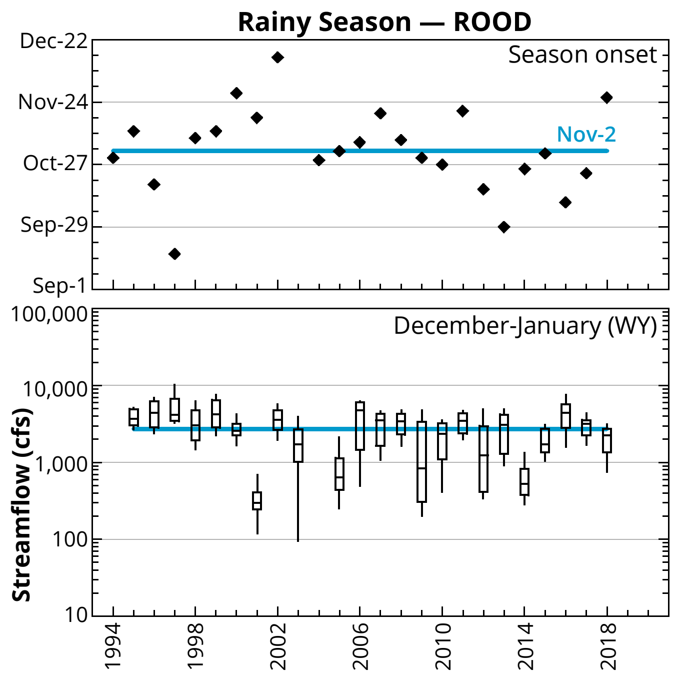
Low flow

- July through September are the months with the lowest average flow and the lowest daily flows.
- Low flow criterion is: 7d-Q ≤ 123 cfs (~21st pctl)
- In 2011, low flow was delayed until 8/27 because Joint Water Commission was releasing more water than usual from Barney Reservoir so that repairs could be done on Eldon Mills Dam.
- No trends are evident in the magnitude of flow over time for July–September.
- A few years had higher or lower flow than usual due to weather or other factors.
  - —1997: September rainfall was higher than usual.
  - —2001: Hagg Lake did not fill and water allocations were severely curtailed. The water users cooperated to conserve water.
  - —2003–4: All data are missing from June-2003 through May-2004 because the bridge was being rebuilt.



Rainy season flow

- December and January are the months with the highest average flow and the highest daily flows.
- Rainy season criterion: 7d-Q ≥ 240 cfs (~40th pctl)
- No trends are evident for the magnitude of the December–January rainy season flow.



FRMO — Tualatin River at Farmington, Oregon — 14206500

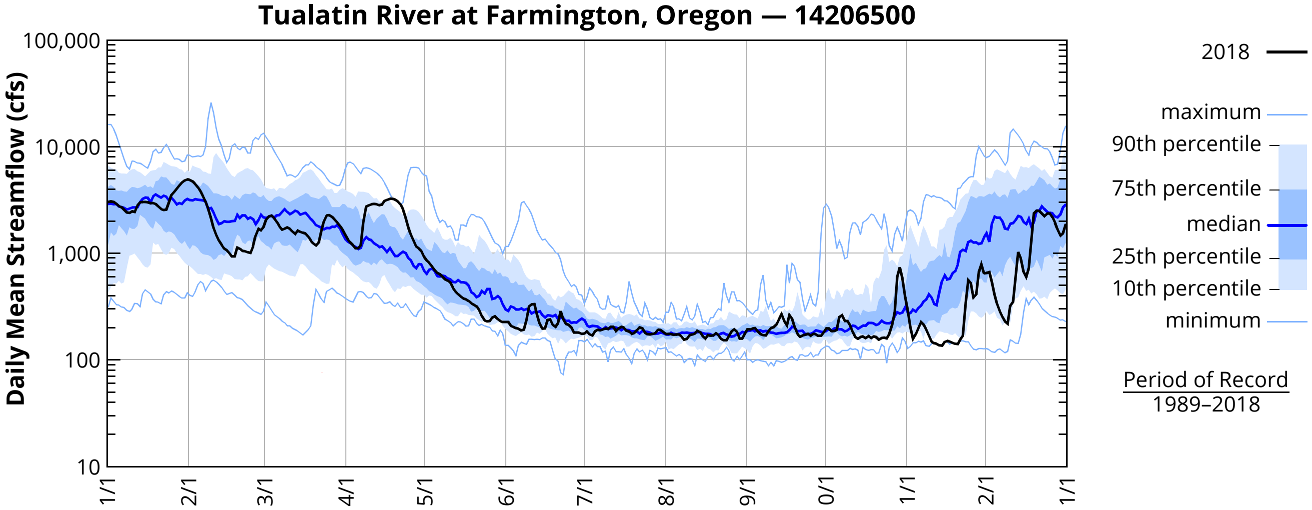
Data source: Oregon Water Resources Department
River mile: 33.3 *Latitude:* 45 26 58 *Longitude:* 122 57 02

2018 — MEAN STREAMFLOW† (cfs) — FRMO

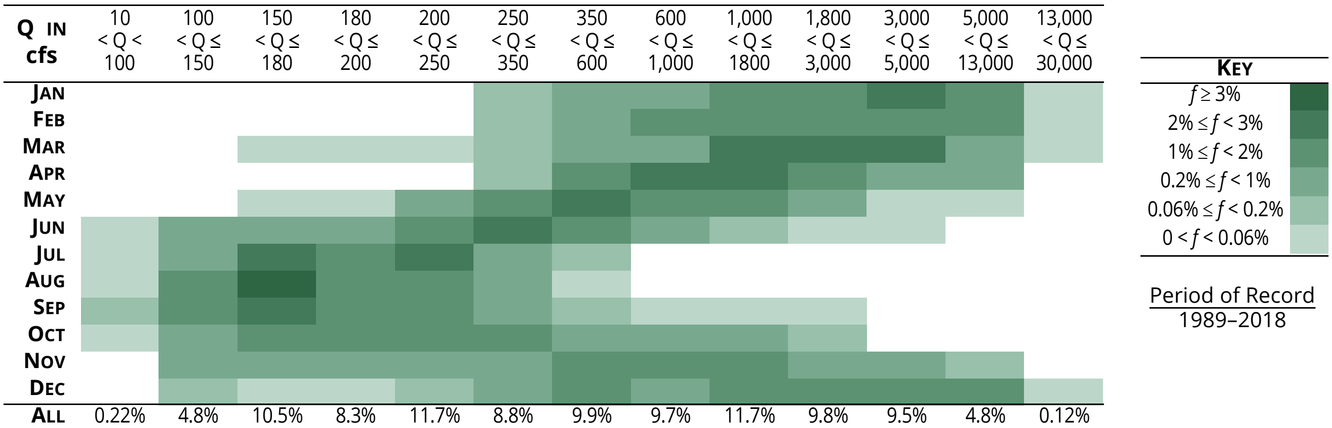
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	3030	4880	1770	1490	932	227	177	174	194	198	290	653
2	3070	4740	2070	1360	856	226	185	175	194	198	203	666
3	3030	4490	2220	1270	813	209	174	174	198	186	158	534
4	2900	4160	2240	1190	757	204	170	172	199	187	175	412
5	2770	3800	2140	1110	702	199	186	173	185	192	200	334
6	2710	3400	1980	1120	658	196	192	173	174	253	226	283
7	2560	3020	1800	1190	638	190	190	165	171	262	215	252
8	2410	2610	1670	1960	606	192	193	155	170	232	193	228
9	2390	2120	1710	2740	573	236	197	157	186	232	169	218
10	2480	1720	1750	2830	558	318	195	171	199	212	149	323
11	2440	1480	1700	2880	529	332	204	173	203	184	144	351
12	2820	1320	1590	2900	474	334	204	177	214	165	142	609
13	3010	1200	1520	2880	440	265	187	188	241	158	137	1030
14	3030	1110	1630	2820	414	219	197	182	269	164	136	899
15	3030	1070	1590	2860	392	196	205	166	230	166	148	664
16	3010	1010	1560	3100	376	198	201	158	210	161	151	596
17	2940	937	1530	3180	369	237	188	171	264	167	149	718
18	2960	934	1430	3230	357	239	184	168	245	161	145	1340
19	2900	1130	1310	3240	340	213	176	170	205	166	142	2360
20	2750	1100	1230	3200	330	205	179	178	175	164	141	2510
21	2600	1050	1180	3080	318	223	189	171	165	155	156	2500
22	2550	1040	1270	2880	293	286	201	158	170	161	169	2360
23	2560	1020	1620	2580	258	240	198	153	172	162	344	2230
24	2980	1010	2010	2170	235	218	181	153	176	159	561	2360
25	3520	1160	2260	1780	230	213	174	169	169	176	527	2350
26	3760	1460	2280	1510	232	201	173	185	175	213	386	2180
27	4040	1700	2200	1310	250	181	175	193	174	277	413	1940
28	4340	1650	2080	1160	257	181	179	183	169	602	666	1670
29	4600	—	1960	1110	241	180	192	158	169	741	787	1460
30	4850	—	1820	1050	231	175	191	158	182	585	650	1540
31	4930	—	1660	—	226	—	183	176	—	385	—	1840
Mean	3128	2011	1767	2173	448	224	188	170	195	239	269	1207
Max	4930	4880	2280	3240	932	334	205	193	269	741	787	2510
Min	2390	934	1180	1050	226	175	170	153	165	155	136	218
Ac-Ft	192337	111711	108654	129283	27540	13355	11544	10467	11597	14725	16011	74202

†All 2018 data are provisional—subject to revision

Tualatin River at Farmington, Oregon — 14206500



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — FRMO



Period of Record
1989–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — FRMO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989	3026	1135	3117	1154	332	157	169	186	149	185	223	390
1990	2923	5460	2514	552	406	417	203	174	164	224	419	968
1991	1349	2031	1940	2464	620	283	197	192	178	180	343	1020
1992	1184	3089	774	720	306	152	141	133	137	150	288	1763
1993	1618	723	1651	2111	938	450	200	155	202	193	217	799
1994	1797	969	1802	852	327	173	152	136	138	133	1349	3782
1995	3978	4361	2952	1296	590	264	186	180	170	215	1137	5537
1996	3520	5746	1421	2046	1794	379	200	200	196	299	600	5701
1997	4071	2127	3652	991	492	394	193	190	283	695	2069	2701
1998	5248	3584	2539	949	584	378	206	172	187	228	418	5136
1999	6113	8123	2929	1356	553	265	198	178	184	197	851	2802
2000	3002	1998	1870	503	370	252	172	172	205	255	207	375
2001	380	515	410	356	261	170	125	113	100	135	610	4827
2002	3552	2708	1803	850	299	186	148	130	166	170	172	1238
2003	2530	2870	3050	1790	535	207	148	169	170	219	219	1350
2004	2430	2555	1150	644	321	200	172	193	184	266	286	543
2005	920	505	286	1340	1180	344	180	145	144	239	1155	1910
2006	6010	3400	1800	1190	421	301	207	168	170	187	3100	4000
2007	3500	966	2120	823	339	219	190	180	190	223	397	3350
2008	4200	3360	1600	1400	587	263	223	193	204	210	430	361
2009	3830	630	1300	934	898	215	176	176	189	221	1170	1280
2010	3880	2020	1740	2590	930	1220	265	208	224	214	914	4500
2011	4110	1555	4140	2525	1060	450	257	212	193	190	299	497
2012	3560	2000	3720	1840	825	426	239	203	204	331	1455	5200
2013	1690	1105	1300	827	375	353	203	190	252	288	554	538
2014	731	3385	3550	1965	898	297	219	187	187	277	759	2670
2015	1910	2805	1660	777	307	202	178	173	183	169	793	8310
2016	4760	3020	3490	777	280	206	182	170	199	1170	1725	4060
2017	2860	7270	4550	2655	1070	334	198	167	182	222	2115	1610
2018	2960	1390	1710	2375	376	213	188	171	186	186	172	899
median	3000	2290	1994	1080	505	259	192	177	185	212	575	2140

Key

Q in cfs
- Q ≤ 149
- 149 < Q ≤ 167
- 167 < Q ≤ 179
- 51 < Q ≤ 190
- 190 < Q ≤ 220
- 220 < Q ≤ 291
- 291 < Q ≤ 470
- 470 < Q ≤ 1740
- 1740 < Q ≤ 3626
- 3626< Q ≤4950
- Q > 4950

Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

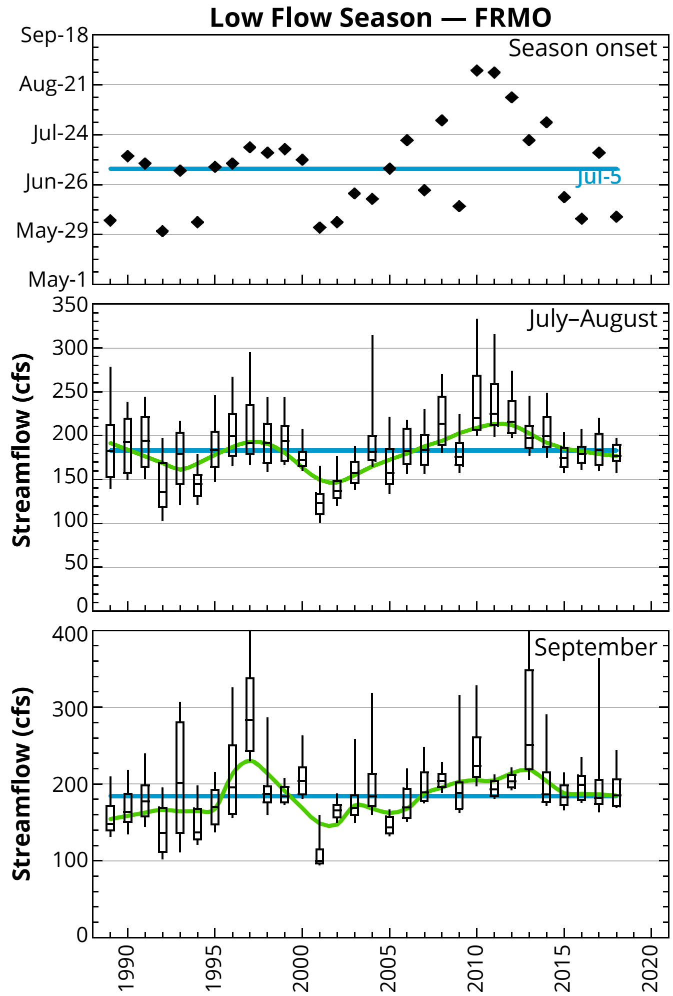
- Flow in 2018 was typical, except for high flows in early April and low flows in November, both of which were weather-related.

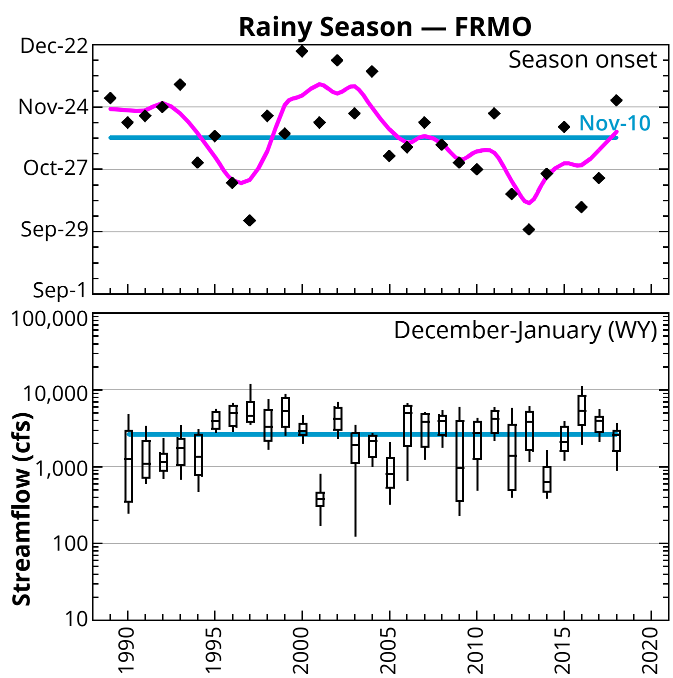
Low flow

- July through September are the months with the lowest average flow. The lowest daily flow can occur June through October.
- Low flow criterion is: 7d-Q ≤ 200 cfs (~24th pctl)
- In 2011, low flow was delayed until 8/27 because Joint Water Commission was releasing more water than usual from Barney Reservoir so that repairs could be done on Eldon Mills Dam.
- No trends are evident in the magnitude over time for July–September.
- A few years had higher or lower flow than usual that can be explained by weather or other factors.
  —1997: September rainfall was higher than usual.
  —2001: Hagg Lake did not fill and water allocations were severely curtailed. The water users cooperated to conserve water.

Rainy season flow

- December through March are the months with the highest average flow and the highest daily flows.
- Rainy season criterion: 7d-Q ≥ 350 cfs (~44th pctl)
- Although the onset of rainy season is quite variable, it appears to be occurring earlier. The trend is not monotonic, but it is statistically significant. Since 2005, rainy season onset occurred before November 10 (the POR mean) 10 out of 14 years (71%). Between 1989 and 2004, rainy season onset occurred before November 10, only 3 out of 16 years (19%).
- No trends are evident for the magnitude of the December–January rainy season flow.





WSLO — Tualatin River at West Linn, Oreg. — 14207500

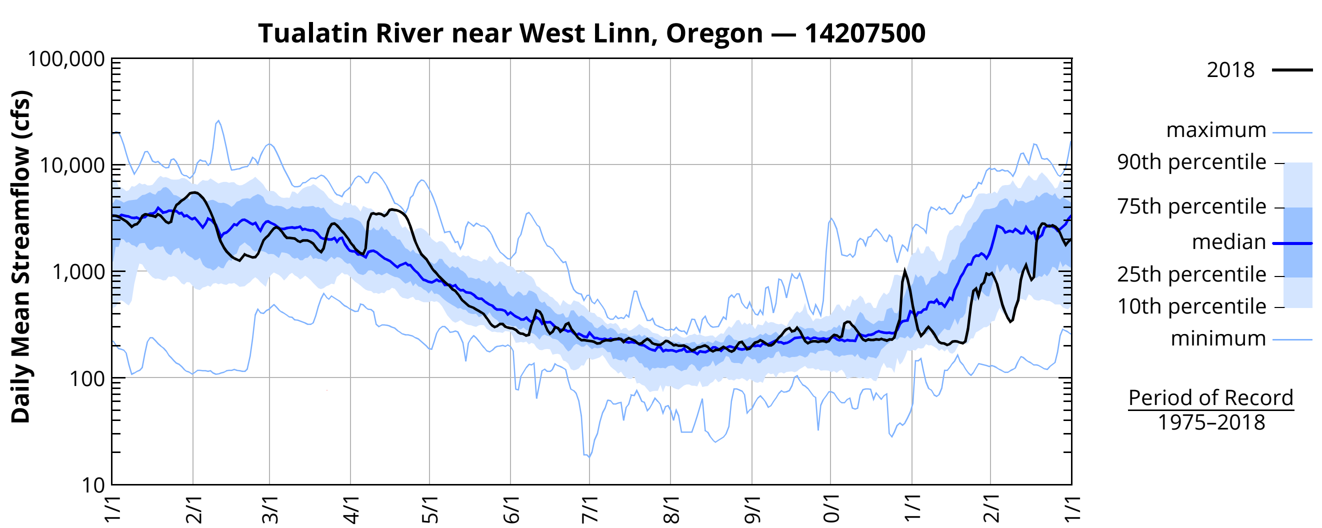
Data source: U.S. Geological Survey, Oregon Water Science Center

River Mile: 1.75 *Latitude:* 45 21 03 *Longitude:* 122 04 30 *Drainage area:* 706.00 sq mile *Datum:* 85.61 ft

2018 — MEAN STREAMFLOW (cfs) — WSLO

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	3310	5490	2170	1890	1190	292	222	211	202	242	464	961
2	3310	5410	2340	1760	1080	291	221	202	215	253	359	861
3	3270	5190	2530	1620	1010	282	218	205	218	249	281	756
4	3150	4870	2590	1540	951	268	210	200	227	239	248	606
5	3040	4470	2520	1470	892	260	212	200	220	247	262	493
6	2950	4040	2370	1450	835	258	221	201	211	325	284	414
7	2780	3600	2190	1660	790	249	225	196	201	337	301	365
8	2620	3160	2060	2960	754	253	225	188	201	333	282	335
9	2730	2660	2050	3440	722	315	224	181	208	310	258	350
10	2760	2190	2040	3490	682	363	228	184	222	295	235	453
11	2950	1870	2020	3430	656	431	230	192	240	273	217	537
12	3310	1680	1930	3470	615	419	235	195	252	249	212	825
13	3430	1540	1890	3430	563	384	230	199	271	230	210	1020
14	3400	1450	1950	3310	528	321	217	202	286	224	205	1150
15	3340	1380	1940	3430	500	282	230	196	294	230	208	950
16	3300	1330	1940	3750e	476	261	236	183	274	227	219	829
17	3240	1290	1890	3810e	465	272	231	178	277	227	220	883
18	3420	1260	1830	3750e	456	300	225	183	297	230	219	1870
19	3340	1350	1690	3720e	440	294	215	183	277	228	214	2530
20	3120	1440	1580	3650	424	271	209	190	244	233	211	2810
21	2930	1400	1520	3520	411	284	212	196	220	228	221	2780
22	2840	1380	1660	3310	394	319	224	190	211	224	286	2660
23	2920	1350	2090	3010	365	327	233	180	217	230	478	2640
24	3720	1360	2520	2620	331	293	225	177	220	228	657	2710
25	4180	1450	2770	2200	311	272	212	182	221	240	689	2640
26	4350	1670	2800	1860	301	250	207	199	218	301	587	2490
27	4600	1950	2690	1620	307	234	205	215	221	355	748	2270
28	4780	2070	2540	1450	321	225	205	217	222	789	788	1980
29	5000	—	2380	1380	320	227	212	202	218	991	952	1770
30	5370	—	2240	1300	304	224	222	185	222	849	929	1890
31	5450	—	2070	—	297	—	220	188	—	646	—	1980
Mean	3513	2439	2155	2643	571	291	221	194	234	331	381	1445
Max	5450	5490	2800	3810	1190	431	236	217	297	991	952	2810
Min	2620	1260	1520	1300	297	224	205	177	201	224	205	335
Ac-Ft	216020	135471	132496	157289	35090	17298	13569	11901	13938	20354	22699	88875

e=estimated



WSLO — Tualatin River at West Linn, Oreg. — 14207500

Data source: U.S. Geological Survey, Oregon Water Science Center

FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — WSLO

Q in cfs	15 < Q < 30	30 < Q ≤ 120	120 < Q ≤ 180	180 < Q ≤ 2400	240 < Q ≤ 300	300 < Q ≤ 500	500 < Q ≤ 800	800 < Q ≤ 1,200	1,200 < Q ≤ 2,000	2,000 < Q ≤ 3,500	3,500 < Q ≤ 6,000	6,000 < Q ≤ 15,000	15,000 < Q ≤ 30,000
Jan													
Feb													
Mar													
Apr													
May													
Jun													
Jul													
Aug													
Sep													
Oct													
Nov													
Dec													
All	0.05%	5.2%	8.0%	12.4%	9.0%	12.2%	9.4%	8.8%	10.2%	10.7%	9.7%	4.2%	0.09%

Key

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
1975–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — WSLO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	5390	4570	3560	946	737	235	213	298	387	232	1070	3330
1976	4920	1585	3090	1255	441	247	161	176	232	213	144	132
1977	164	118	1000	306	219	161	61	37	172	150	850	4240
1978	4470	3470	1300	1035	959	347	142	128	376	268	197	905
1979	852	4435	2040	695	600	142	89	117	191	238	622	2820
1980	4450	2740	2600	1950	483	318	125	89	220	163	588	3220
1981	1390	2035	1120	1465	557	510	153	184	195	382	1785	6660
1982	4250	4765	3400	3005	598	193	99	124	184	264	780	5260
1983	4070	6610	5470	2045	609	282	254	128	267	272	3040	3380
1984	2510	3375	2440	1620	1210	757	259	133	182	333	2710	2470
1985	964	1575	964	895	345	323	128	142	143	100	431	666
1986	2080	2980	2250	618	640	182	159	78	89	100	335	1540
1987	3630	3525	5000	840	329	183	178	111	79	72	138	1830
1988	2900	1245	866	1235	735	389	147	122	117	118	688	1150
1989	3060	1235	3540	1325	441	229	135	160	117	189	228	432
1990	3320	6530	2580	582	389	411	174	135	130	203	460	1220
1991	1620	2170	2080	3055	676	339	244	147	131	139	377	1140
1992	1350	3765	882	821	330	143	110	84	96	110	306	2230
1993	2010	917	2010	2495	1200	580	235	141	177	172	196	932
1994	2010	1015	1960	966	337	205	135	126	124	113	1560	4200
1995	5030	5410	3390	1550	769	302	177	151	155	265	1365	6620
1996	4320	6930	1750	2395	2280	443	264	233	257	474	799	6440
1997	5060	2445	4680	1305	682	549	235	226	374	867	2340	3250
1998	6170	4375	3100	1150	798	569	280	212	251	340	673	5890
1999	6790	8685	3740	1745	805	416	262	230	240	261	1085	3470
2000	3910	2525	2300	758	590	385	221	212	268	367	285	596
2001	543	709	603	564	425	250	150	130	128	201	934	5430
2002	4770	3715	2440	1150	511	296	234	158	204	225	264	1610
2003	3250	3960	4140	2385	766	311	173	188	215	285	288	1740
2004	3020	3165	1350	840	432	263	178	198	228	363	358	712
2005	1030	706	436	1520	1380	485	234	171	188	282	1330	1910
2006	8630	4175	2150	1505	578	389	235	195	219	239	3500	5410
2007	3980	1140	2440	1005	454	282	235	237	248	319	482	4380
2008	4930	3855	1880	1550	692	351	261	225	242	260	603	537
2009	4380	742	1490	1110	1050	292	216	215	222	249	1230	1470
2010	4680	2300	2050	3115	1120	1490	326	245	290	289	1028	5510
2011	4930	1915	5200	2925	1320	573	341	249	254	284	439	618
2012	3890	2210	4390	2205	1020	511	278	228	237	451	1425	5990
2013	1650	1070	1250	853	436	459	245	208	293	330	626	554
2014	798	3945	4040	2280	985	347	255	199	209	329	897	2690
2015	2000	3085	1840	930	362	218	202	188	218	213	907	8020
2016	5350	3290	3880	1065	433	280	228	208	257	1210	1820	4480
2017	2980	7800	5090	2760	1230	450	242	212	238	310	2190	1810
2018	3310	1675	2070	2985	476	282	222	195	221	247	272	1020
median	3365	2755	2295	1240	609	319	213	187	221	259	675	2450

Key

Q in cfs

- Q ≤ 117
- 117 < Q ≤ 155
- 155 < Q ≤ 190
- 190 < Q ≤ 213
- 213< Q ≤ 264
- 264< Q ≤ 363
- 363 < Q ≤ 580
- 580 < Q ≤ 1950
- 1950 < Q ≤ 4250
- 4250 < Q ≤ 5700
- Q > 5700

Q as percentile

- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

WSLO — Tualatin River at West Linn, Oreg. — 14207500

Data source: U.S. Geological Survey, Oregon Water Science Center

2018

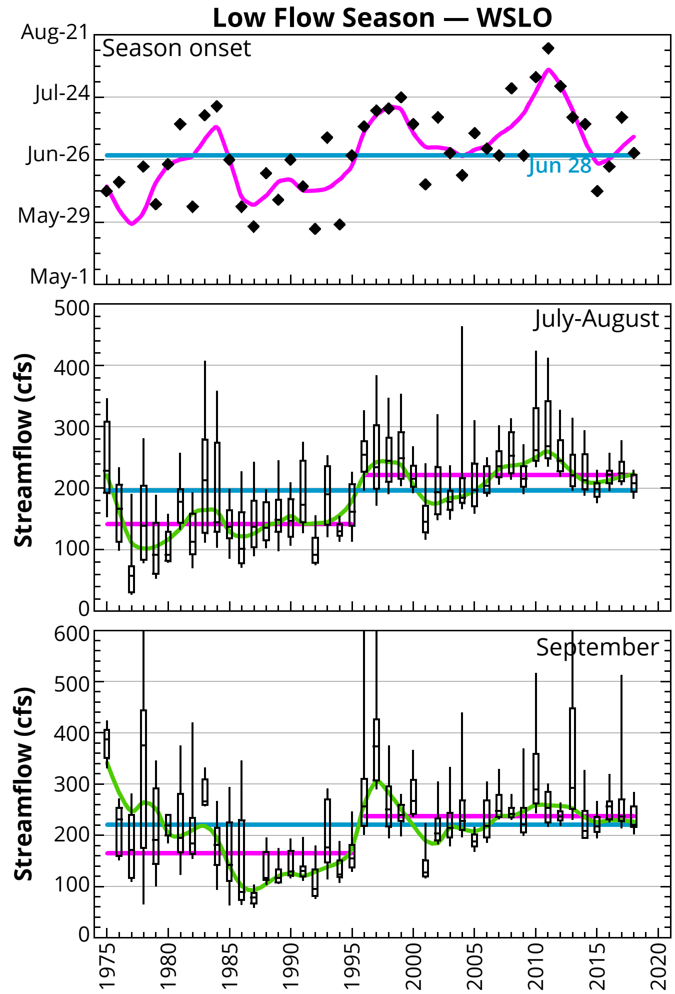
- Flow in 2018 was typical, except for high flows in early April and low flows in November, both of which were weather-related.

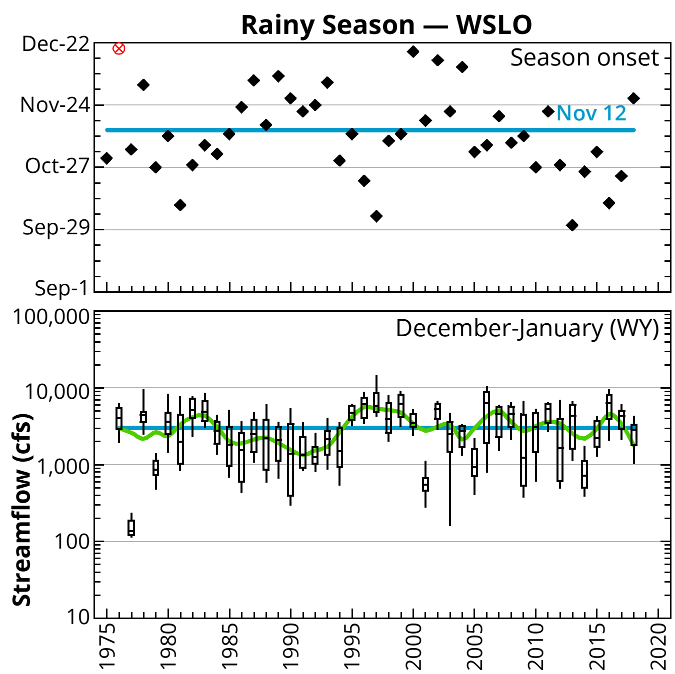
Low flow

- July through September are the months with the lowest average flow. The lowest daily flows can occur June through October.
- Low flow criterion is: 7d-Q ≤ 250 cfs (~28th pctl)
- The onset of low flow is becoming later. The trend is statistically significant. As natural flow decreases in the spring, a greater fraction of the flow is effluent from the WWTFs. WWTF discharges have increased over time which may account for an apparent delay of low flow conditions.
- Flows in July-August and September are higher since 1995 compared to 1995 and before. The difference is statistically significant despite year-to-year variability. The difference is likely due to a reduction of about 40 cfs in the diversion of water into the Oswego Canal that occurred at that time.
- A few years had higher or lower flow than usual that can be explained by weather or other factors.
  - —1997: September rainfall was higher than usual.
  - —2001: Hagg Lake did not fill and water allocations were severely curtailed. The water users cooperated to conserve water.

Rainy season flow

- December through March are the months with the highest average flow and the highest daily flows.
- Rainy season criterion: 7d-Q ≥ 500 cfs (~47th pctl)
- The onset of rainy season flow for 1976 did not occur until the following March (3/3/1977).
- No trends are evident in the magnitude of the flow in the December–January rainy season.
- Water year 1977 was a drought year which accounts for the low December-January flow.





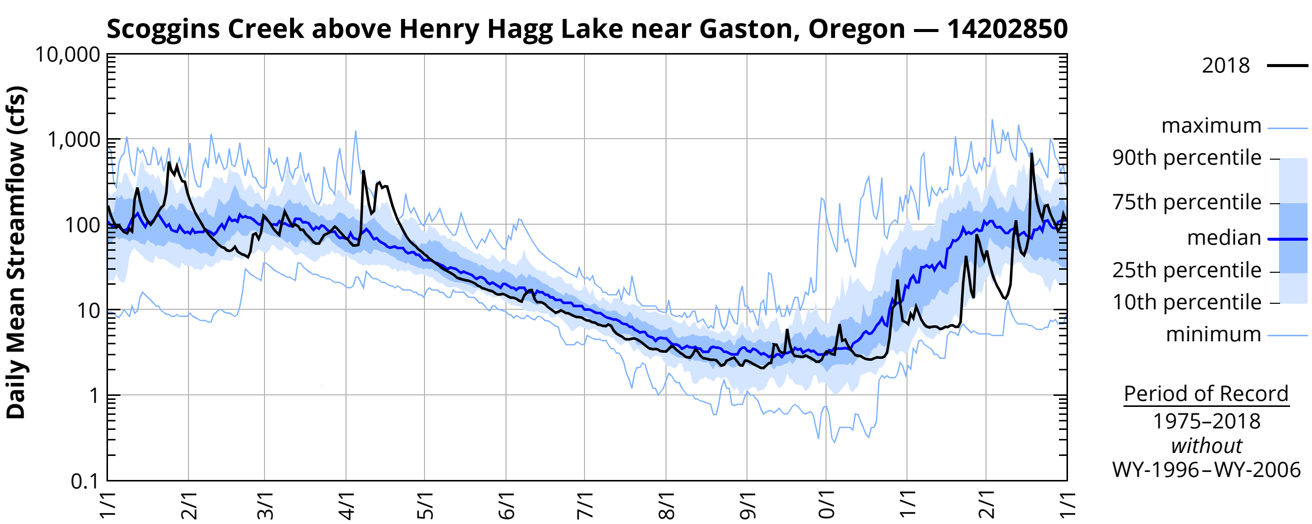
SCLO – Scoggins Creek above Henry Hagg Lake near Gaston, Oregon – 14202850

Data source: Oregon Water Resources Department
River Mile: 9.3 *Latitude:* 45 30 06 *Longitude:* 123 15 60

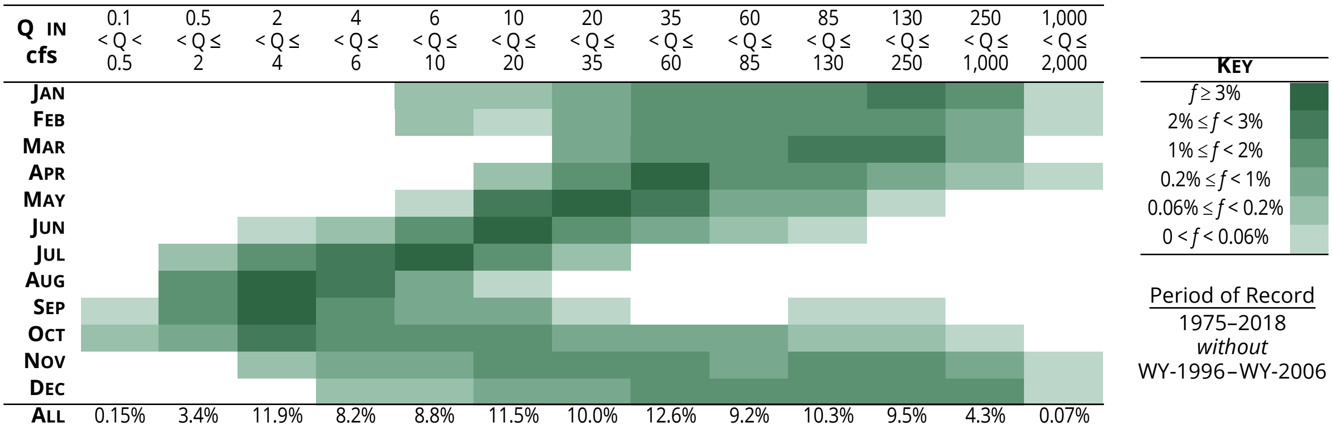
2018 — MEAN STREAMFLOW[†] (cfs) — SCLO

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	160	189	126	70.0	45.2	15.0	7.8	3.3	2.5	3.3	6.8	49.3
2	126	160	119	66.9	42.7	14.3	7.5	3.5	2.4	3.2	8.9	33.7
3	105	136	107	61.2	39.6	13.8	7.4	3.7	2.3	3.0	8.0	26.5
4	91.8	119	95.5	56.5	37.5	13.8	7.1	3.7	2.3	3.0	10.9	21.7
5	97.2	106	87.0	56.6	35.6	13.5	7.0	3.4	2.2	4.6	9.2	18.6
6	87.4	94.0	80.5	57.7	33.8	12.8	6.7	3.2	2.1	6.8	7.6	16.1
7	81.4	85.2	75.3	82.1	32.0	12.5	6.6	3.0	2.1	4.3	6.8	14.1
8	78.5	78.0	109	428	30.7	14.7	6.5	2.9	2.2	4.5	6.4	13.6
9	88.4	71.3	140	270	29.4	15.7	6.4	2.8	2.4	3.9	6.2	15.3
10	82.4	65.9	122	172	28.3	16.9	6.8	2.8	2.4	3.4	6.3	19.7
11	196	61.9	106	134	27.2	17.0	6.5	3.0	3.9	3.2	6.4	70.9
12	270	57.4	95.2	143	26.0	13.4	5.7	3.4	3.9	2.9	6.3	112
13	187	54.1	99.8	294	24.4	12.3	5.3	3.2	3.3	2.9	6.0	62.4
14	147	53.3	95.4	309	23.4	12.2	5.1	2.9	3.1	2.9	6.0	47.0
15	122	49.6	86.6	268	22.9	12.1	4.9	2.7	3.2	2.8	6.3	43.5
16	109	48.7	86.4	280	22.4	11.6	4.6	2.7	6.0	2.7	6.2	52.9
17	99.4	50.0	76.5	277	22.1	10.8	4.5	2.6	4.0	2.6	6.5	73.7
18	108	54.8	72.0	208	21.8	10.2	4.5	2.6	3.2	2.6	6.6	691
19	123	48.3	67.1	163	21.3	9.7	4.6	2.6	2.9	2.7	6.3	327
20	140	46.4	62.0	134	20.5	9.2	4.6	2.6	2.9	2.8	6.3	181
21	158	44.4	59.3	112	19.6	9.5	4.5	2.4	2.8	2.8	7.2	137
22	167	43.2	59.5	96.1	18.8	9.9	4.3	2.2	2.8	2.8	20.5	115
23	234	41.3	67.3	84.1	17.9	9.6	4.1	2.3	2.9	2.9	42.8	164
24	545	48.7	75.0	74.7	17.6	9.1	3.8	2.5	2.8	3.2	27.5	167
25	426	75.7	78.0	67.6	17.2	9.0	3.6	2.6	2.7	4.7	16.7	134
26	382	78.2	80.3	61.5	16.7	8.8	3.5	2.7	2.6	10.4	13.7	114
27	478	67.8	86.8	57.6	16.4	8.5	3.4	2.7	2.5	11.4	76.2	98.6
28	377	80.6	94.0	54.6	15.6	8.2	3.5	2.5	2.5	22.6	62.6	83.5
29	321	—	89.0	50.3	15.1	8.2	3.4	2.2	2.6	11.9	47.7	92.1
30	315	—	82.5	47.8	15.1	8.1	3.3	2.2	3.0	7.4	38.8	132
31	235	—	75.8	—	15.3	—	3.2	2.5	—	7.2	—	112
Mean	198	75.3	88.9	141	24.9	11.7	5.2	2.8	2.9	5.0	16.5	104
Max	545	189	140	428	45.2	17.0	7.8	3.7	6.0	22.6	76.2	691
Min	78.5	41.3	59.3	47.8	15.1	8.1	3.2	2.2	2.1	2.6	6.0	13.6
Ac-Ft	12174	4183	5466	8405	1531	695	319	173	171	308	979	6425

†All 2018 data are provisional—subject to revision



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — SCLO



Period of Record
1975–2018
without
WY-1996–WY-2006

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — SCLO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	179	133	123	53	33	11	5.4	3.0	1.9	4.9	79	147
1976	164	92	129	60	21	12	5.7	3.8	2.4	2.2	5.9	6.8
1977	9.1	9.1	59	21	16	12	4.5	1.5	4.5	6.2	72	144
1978	163	122	55	51	46	17	5.7	1.6	3.8	1.8	6.7	45
1979	31	190	68	37	29	11	4.0	3.0	2.8	4.0	24	127
1980	151	125	93	67	21	15	6.2	3.4	3.2	2.2	40	117
1981	59	106	51	69	26	24	8.4	3.6	2.2	20	96	215
1982	147	202	131	110	33	14	7.9	4.1	3.8	11	50	211
1983	158	304	160	74	29	12	11	3.3	5.9	5.3	154	96
1984	102	132	102	66	68	31	12	6.3	5.2	11	135	94
1985	44	79	69	67	24	19	7.4	3.7	4.4	8.4	29	47
1986	124	138	93	39	35	13	9.1	2.3	4.4	5.5	34	65
1987	117	114	154	43	19	9.7	5.8	2.3	2.1	4.7	15	75
1988	98	72	43	50	26	16	7.8	2.9	1.8	3.5	53	54
1989	121	51	136	53	19	8.4	3.7	1.8	0.7	0.6	11	17
1990	80	172	109	35	22	19	5.1	3.0	3.0	4.6	21	41
1991	68	102	82	78	30	15	9.1	4.3	2.2	1.2	11	46
1992	70	91	32	40	16	8.1	2.4	1.1	1.7	3.1	16	80
1993	67	45	71	94	44	25	9.8	5.1	2.8	3.5	5.0	37
1994	71	63	74	44	20	12	5.5	2.4	1.5	2.3	77	183
1995	153	121	120	57	26	13	7.4	3.5	3.9			
1996–2005												
2006										2.5	187	150
2007	86	64	104	44	21	10	5.1	3.2	2.9	10	29	178
2008	139	112	107	85	39	19	7.2	4.6	3.4	6.2	40	39
2009	129	40	92	54	52	17	6.6	4.4	3.7	9.8	104	90
2010	202	90	81	99	41	41	12	6.1	7.5	9.7	81	189
2011	105	69	175	118	45	24	13	6.6	4.1	8.3	24	39
2012	125	90	150	78	44	22	9.6	4.9	3.3	7.0	94	200
2013	75	69	64	44	21	18	6.9	4.8	4.7	19	33	27
2014	35	111	136	75	50	16	7.5	3.9	2.9	8.2	60	126
2015	84	73	50	32	16	7.8	4.2	2.6	3.0	3.8	52	331
2016	177	137	165	44	17	11	5.4	2.9	3.0	80	110	130
2017	76	225	210	104	44	19	6.9	3.7	3.2	4.4	129	64
2018	147	64	87	90	22	12	4.6	2.7	2.8	3.2	7.0	74
median	98	98	95	58	28	14	6.8	3.5	3.1	5.3	43	91

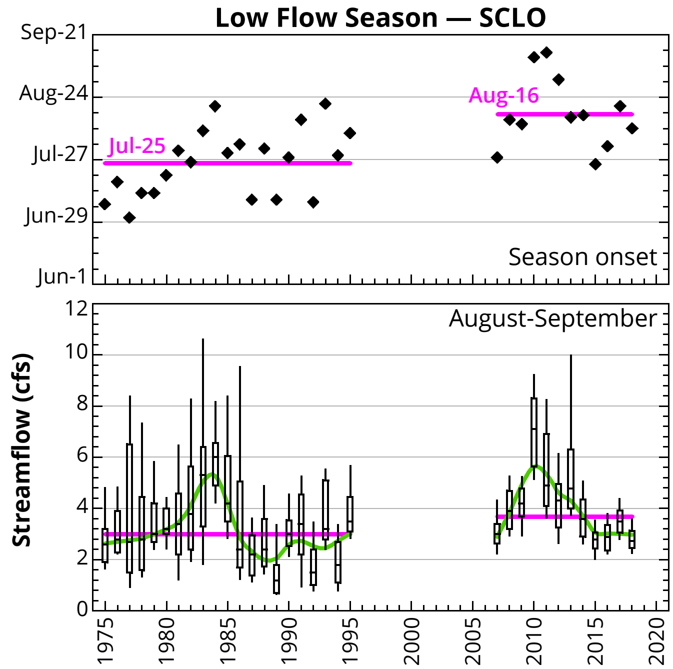
Key

Q in cfs
- Q ≤ 2.3
- 2.3 < Q ≤ 3.0
- 3.0 < Q ≤ 3.9
- 3.9 < Q ≤ 5.0
- 5.0 Q ≤ 8.7
- 8.7 < Q ≤ 16
- 16 < Q ≤ 28
- 28 < Q ≤ 82
- 82 < Q ≤ 163
- 163 < Q ≤ 235
- Q > 235

Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Flow in 2018 was typical for much of the year. Higher than usual flows in late January and early April and lower than usual flows in November and early December were weather-related.



Data gap

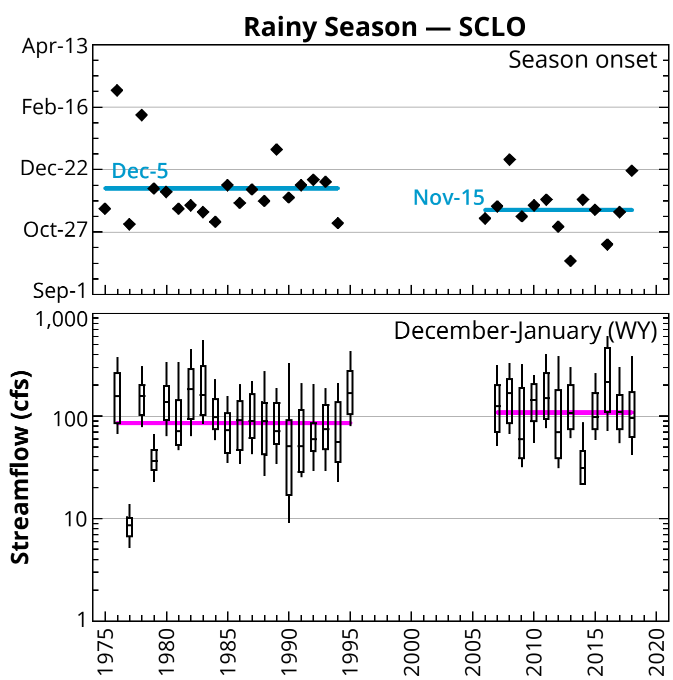
- Data from October-1995 through September-2006 are missing due to issues with OWRD data processing.
- Flows before and after the data gap have a statistically significant difference. Flows from the later period are about 1.25 times those in the earlier period. The factor is the same for both the August–September period and the December–January period.
- The difference may or may not indicate true changes in the flow regime. In particular, the later period may not have adequate representation of dry periods that were better captured by the longer early record.

Low flow

- August and September are the months with the lowest average flows. The lowest daily flows occur in September and October.
- Low flow criterion: 7d-Q ≤ 7 cfs (~26th pctl)
- Low flow onset after the data gap (1996-2006) is later than before. The difference is statistically significant and is consistent with higher flows in the more recent period.

Rainy season flow

- December through February are the months with the highest average flow.
- Rainy season criterion: 7d-Q ≥ 80 cfs (~70th pctl)
- Onset of the rainy season after the data gap may be earlier, but the trend is not statistically significant. An earlier onset of higher flow would be consistent with higher flows in the more recent period.
- Water year 1977 was a drought year which accounts for the low December-1976 to January-1977 flow.



SCHO – Sain Creek above Henry Hagg Lake near Gaston, Oregon – 14202920

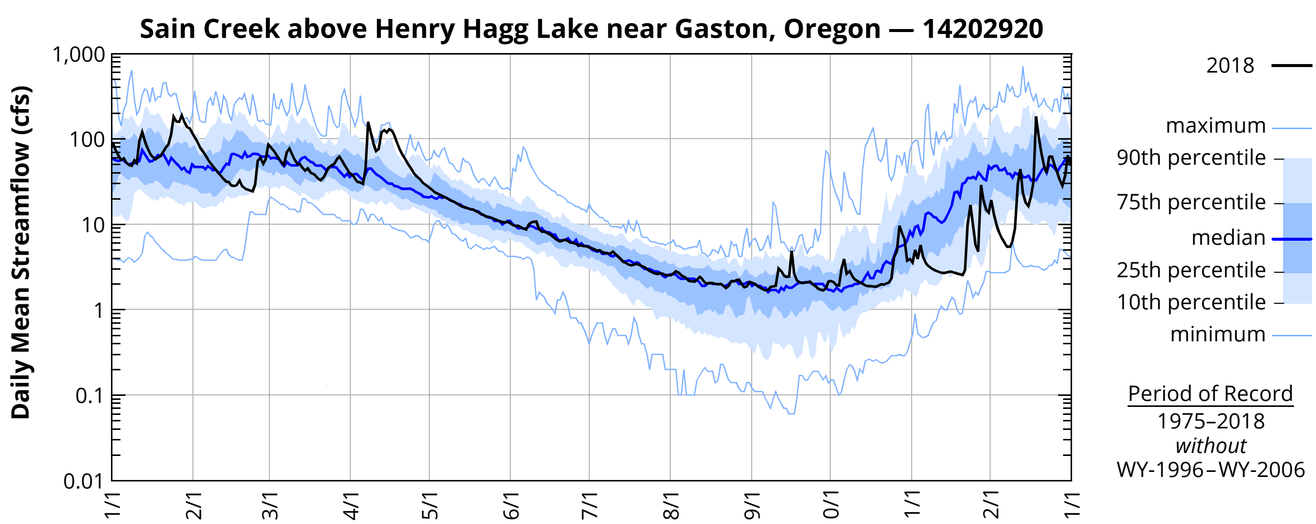
Data source: Oregon Water Resources Department

River Mile: 1.6 *Latitude:* 45 28 50 *Longitude:* 123 14 40

2018 — MEAN STREAMFLOW† (cfs) — SCHO

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	88.4	104	86.0	39.6	27.1	10.3	5.4	2.5	2.1	2.2	3.6	19.2
2	73.3	92.5	80.3	38.1	25.5	9.8	5.3	2.7	2.0	2.1	5.0	12.7
3	63.1	80.0	72.5	34.0	24.2	9.6	5.1	2.8	1.9	1.9	3.9	9.8
4	56.5	71.8	65.2	31.1	23.2	9.6	4.9	2.7	1.8	1.9	5.7	7.9
5	59.2	64.4	58.8	30.9	22.4	9.3	5.0	2.5	1.8	3.0	4.1	6.8
6	52.5	57.7	53.6	29.8	21.7	8.9	4.7	2.4	1.7	3.9	3.5	6.0
7	49.6	52.4	49.9	44.4	20.8	8.7	4.7	2.3	1.7	2.6	3.3	5.5
8	48.5	48.1	70.5	158	20.2	10.0	4.5	2.2	1.9	2.8	3.1	5.5
9	56.6	43.9	77.6	117	19.4	10.5	4.6	2.2	1.9	2.5	3.0	6.4
10	52.5	40.1	66.4	87.7	18.8	10.7	4.8	2.1	1.9	2.3	2.9	8.9
11	94.3	37.2	57.2	71.9	18.1	10.8	4.5	2.3	3.0	2.2	2.8	29.8
12	120	33.9	50.5	76.1	17.4	8.7	4.2e	2.4	2.8	2.1	2.7	44.5
13	95.1	31.4	50.8	120	16.6	8.2	3.9e	2.3	2.5	2.0	2.7	23.1
14	78.6	31.2	45.9	127	16.0	8.2	3.7	2.1	2.4	1.9	2.7	18.1
15	67.8	28.4	42.7	119	15.7	8.0	3.5	2.0	2.5	1.9	2.8	16.4
16	61.7	28.1	45.2	130	15.4	7.7	3.4	2.1	4.9	1.9	2.8	21.1
17	57.8	28.8	40.3	125	15.0	7.2	3.3	2.1	2.6	1.9	2.7	31.9
18	60.6	32.6	39.0	107	14.9	6.8	3.4	2.0	2.2	1.9	2.6	184
19	63.5	27.9	37.0	88.4	14.4	6.5	3.4	2.0	2.1	1.9	2.6	108
20	70.3	26.6	34.4	74.9	13.8	6.3	3.4	2.0	2.1	2.0	2.6	67.6
21	80.2	25.5	33.0	65.0	13.3	6.5	3.3	1.9	2.1	2.0	2.9	48.6
22	86.5	25.0	35.5	57.4	12.8	6.6	3.2	1.8	2.1	2.0	10.0	40.2
23	111	24.3	40.7	51.1	12.3	6.4	3.0	1.9	2.1	2.1	16.9	62.1
24	180	29.3	46.4	45.9	12.2	6.1	2.9	2.2	2.0	2.3	9.9	62.0
25	160	55.8	48.8	41.6	11.9	6.1	2.8	2.2	1.9	4.1	5.7	48.8
26	159	60.0	51.3	37.6	11.6	5.9	2.7	2.2	1.8	4.9	4.8	40.7
27	190	50.9	57.6	34.9	11.3	5.7	2.6	2.3	1.7	9.7	28.9	33.0
28	158	57.9	61.7	32.8	10.9	5.6	2.7	2.0	1.7	7.8	19.0	28.2
29	139	—	55.6	30.1	10.6	5.6	2.7	1.8	1.8	6.6	14.9	37.0
30	133	—	49.3	28.6	10.5	5.5	2.6	1.9	2.1	3.8	13.7	64.7
31	117	—	43.8	—	10.7	—	2.5	2.1	—	3.9	—	49.8
Mean	93.0	46.1	53.1	69.2	16.4	7.9	3.8	2.2	2.2	3.0	6.4	37.0
Max	190	104	86.0	158	27.1	10.8	5.4	2.8	4.9	9.7	28.9	184
Min	48.5	24.3	33.0	28.6	10.5	5.5	2.5	1.8	1.7	1.9	2.6	5.5
Ac-Ft	5720	2558	3268	4116	1009	468	231	135	129	187	380	2277

†All 2018 data are provisional—subject to revision; e=estimated



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — SCHO

Q in cfs	0.05 < Q < 0.1	0.1 < Q ≤ 0.5	0.5 < Q ≤ 2	2 < Q ≤ 3	3 < Q ≤ 5	5 < Q ≤ 10	10 < Q ≤ 20	20 < Q ≤ 30	30 < Q ≤ 45	45 < Q ≤ 65	65 < Q ≤ 120	120 < Q ≤ 400	400 < Q ≤ 2,000	Missing
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
All	0.10%	2.3%	10.9%	8.4%	10.2%	11.6%	12.5%	9.9%	9.7%	8.8%	9.5%	5.0%	0.12%	0.77%

Key

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
1975–2018
without
WY-1996–WY-2006

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — SCHO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	115	86	78	27	16	5.1	1.9	0.80	0.19	2.3	26	70
1976	81	39	65	31	11	6.0	2.8	2.2	1.4	1.6	3.0	3.2
1977	3.9	4.2	30	10	6.9	1.4	0.50	0.60	2.0	2.7	20	70
1978	92	67	38	27	25	13	4.1	1.1	4.1	2.7	2.6	19
1979	17	87	35	19	15	6.4	3.6	2.7	2.4	2.6	10	62
1980	75	57	46	25	8.9	3.9	2.2	1.8	1.7	1.8	14	39
1981	27	55	26	34	12	9.5	2.2	0.19	0.11	10	43	89
1982	83	107	71	66	16	6.5	3.0	1.1	1.2	3.1	17	93
1983	77	157	89	45	17	11	6.5	3.0	4.1	3.0	73	53
1984	52	67	57	36	32	16	6.4	3.7	3.0	5.4	56	51
1985	26	43	29	29	11	7.7	2.4	1.7	1.9	1.9	9.3	20
1986	57	69	44	19	17	6.5	3.0	0.45	0.72	2.2	7.4	28
1987	59	60	81	19	7.4	5.1	3.3	0.51	0.25	0.25	1.3	30
1988	51	38	25	30	16	12	4.7	1.5	0.88	1.7	23	23
1989	68	27	68	34	11	5.7	2.5	1.1	0.61	1.1	3.7	7.1
1990	53	91	57	19	11	9.5	2.0	1.2	1.1	2.1	9.0	24
1991	35	49	43	35	15	7.1	3.5	2.1	1.1	1.1	7.2	23
1992	28	44	18	24	8.9	4.3	1.2	0.76	0.78	1.2	7.5	45
1993	35	21	33	44	21	11	5.2	3.0	1.6	1.2	1.4	16
1994	32	27	35	22	10	5.8	1.7	0.63	0.43	0.29	33	90
1995	82	68	63	31	15	7.8	4.7	4.2	4.1			
1996–2005												
2006										2.1	72	67
2007	51	39	57	29	14	6.7	4.1	2.6	1.9			
2008	72	63	53	50	17	9.7	3.6	2.3	2.0	3.6	21	22
2009	68	21	41	26	30	11	4.8	3.0	2.4	3.5	52	36
2010	119	54	52	62	30	26	8.1	4.3	4.5	4.2	33	125
2011	64	35	117	61	27	13	7.4	3.9	2.6	3.8	7.2	14
2012	85	52	88	40	24	12	5.6	3.2	2.1	2.9	52	118
2013	36	30	31	22	11	8.2	3.9	2.8	2.4	6.6	15	16
2014	20	83	90	51	28	9.5	4.3	2.4	1.8	3.0	18	67
2015	45	49	30	22	8.8	4.5	2.5	1.6	2.0	1.8	23	206
2016	109	83	91	24	10	6.3	3.8	2.1	2.2	39	55	81
2017	51	129	115	68	26	12	5.3	3.0	2.4	3.4	68	37
2018	79	39	51	54	15	7.8	3.4	2.2	2.0	2.2	3.4	30
median	51	60	45	26	12	6.9	3.0	1.5	1.3	2.1	12	35

Key

Q in cfs

- Q ≤ 0.90
- 0.90 < Q ≤ 1.6
- 1.6 < Q ≤ 2.1
- 2.1 < Q ≤ 2.7
- 2.7< Q ≤ 4.4
- 4.4< Q ≤ 7.8
- 7.8 < Q ≤ 14
- 14 < Q ≤ 42
- 42 < Q ≤ 84
- 84 < Q ≤ 122
- Q > 122

Q as percentile

- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Flow in 2018 was typical for much of the year. Higher than usual flows in late January and early April and lower than usual flows in November and early December were weather-related.

Data gap

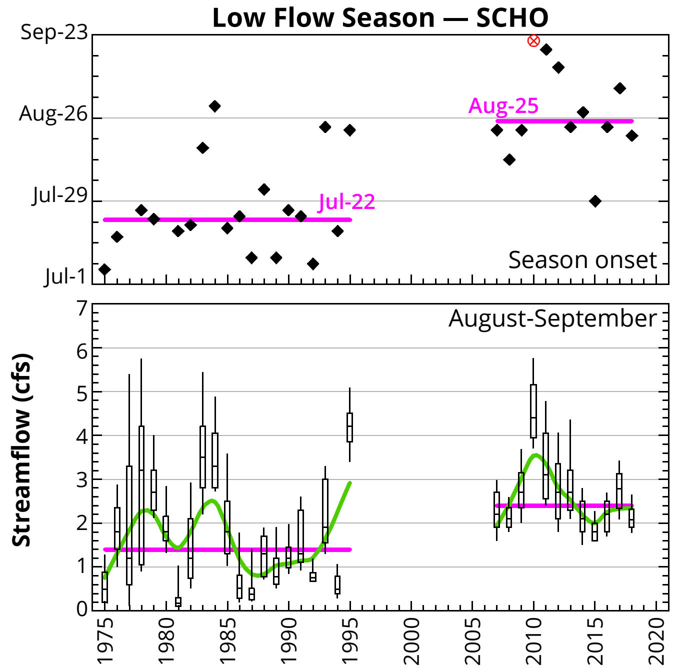
- Data from October-1995 through September-2006 are missing due to issues with OWRD data processing.
- Flows before and after the data gap have a statistically significant difference. For July–August, flows from the later period are about 1.7 times those in the earlier period. For December–January, flows from the later period are about 1.4 times those in the earlier period.
- The difference may or may not indicate true changes in the flow regime. In particular, the later period may not have adequate representation of dry periods that were better captured by the longer early record.

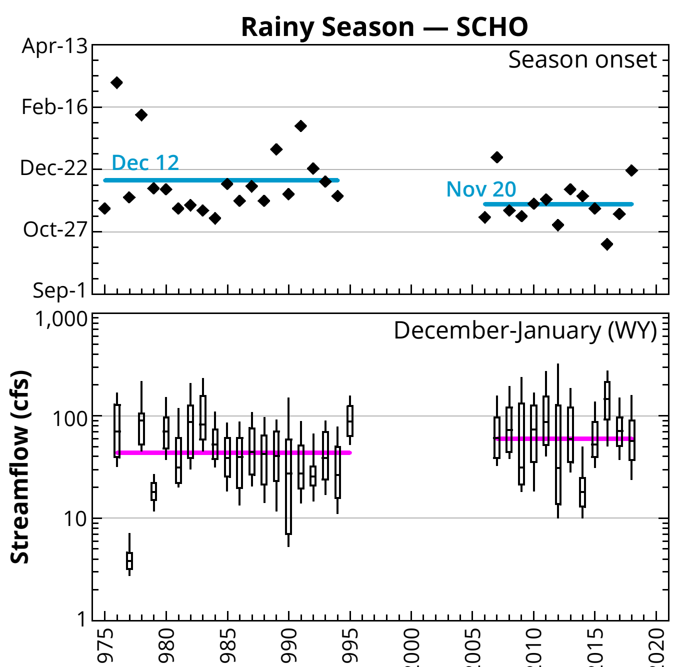
Low flow

- August and September are the months with the lowest average flows.
- Low flow criterion: 7d-Q ≤ 3.5 cfs (~25th pctl)
- Low flow onset after the data gap (1996-2006) is later than before. The difference is statistically significant and is consistent with higher flows in the more recent period.
- Low flow did not occur in 2010.

Rainy season flow

- December through February are the months with the highest average flow.
- Rainy season criterion: 7d-Q ≥ 40 cfs (~73th pctl)
- Onset of the rainy season after the data gap may be earlier, but the trend is not statistically significant. An earlier onset of higher flow would be consistent with higher flows in the more recent period.
- Water year 1977 was a drought year which accounts for the low December-1976 to January-1977 flow.





TANO – Tanner Creek above Henry Hagg Lake near Gaston, Oregon – 14202860

Data source: Oregon Water Resources Department

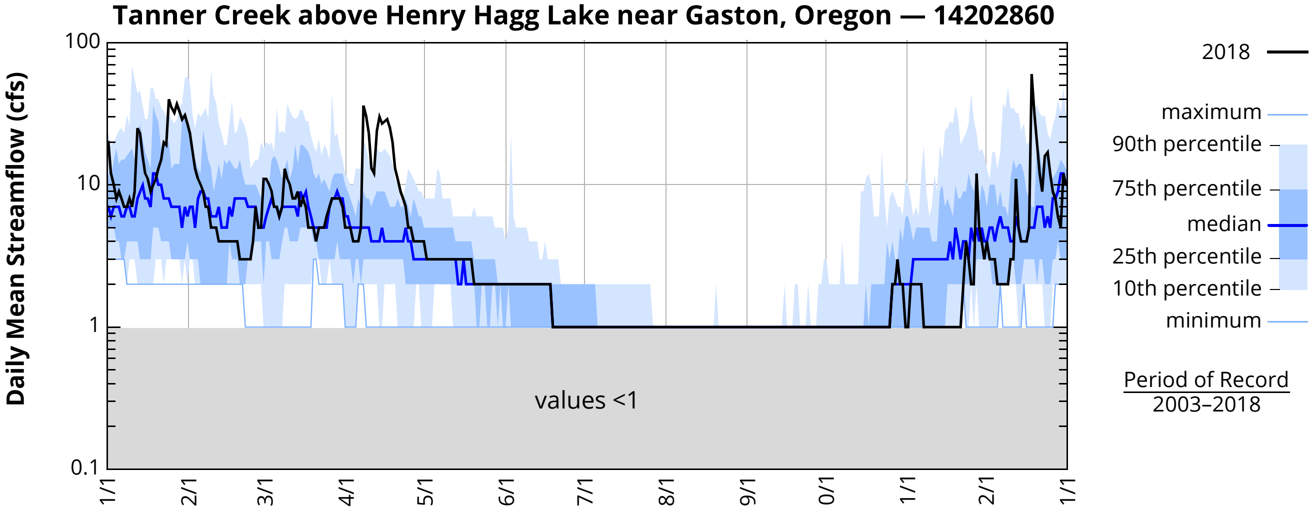
River mile: 1.6 *Latitude:* 45 30 21 *Longitude:* 123 13 10

2018 — MEAN STREAMFLOW* (cfs) — TANO

DAY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	20	23	11	5	4	2	1	1	1	1	1	4
2	12	17	11	5	3	2	1	1	1	1	2	3
3	10	13	10	5	3	2	1	1	1	1	2	3
4	8	11	9	4	3	2	1	1	1	1	2	3
5	9	10	7	4	3	2	1	1	1	1	2	2
6	8	9	7	4	3	2	1	1	1	1	2	2
7	7	7	6	5	3	2	1	1	1	1	1	2
8	7	7	7	36	3	2	1	1	1	1	1	2
9	8	5	13	30	3	2	1	1	1	1	1	2
10	7	5	11	23	3	2	1	1	1	1	1	3
11	9	5	10	13	3	2	1	1	1	1	1	3
12	25	4	8	12	3	2	1	1	1	1	1	11
13	23	4	8	24	3	2	1	1	1	1	1	5
14	16	4	9	30	3	2	1	1	1	1	1	4
15	12	4	7	27	3	2	1	1	1	1	1	4
16	11	4	8	28	3	2	1	1	1	1	1	4
17	9	4	7	29	3	2	1	1	1	1	1	5
18	10	4	5	25	3	2	1	1	1	1	1	60
19	11	4	5	20	3	1	1	1	1	1	1	33
20	13	3	5	13	2	1	1	1	1	1	1	20
21	15	3	4	11	2	1	1	1	1	1	1	12
22	20	3	5	9	2	1	1	1	1	1	2	9
23	19	3	5	8	2	1	1	1	1	1	4	16
24	40	3	5	7	2	1	1	1	1	1	3	17
25	35	4	6	5	2	1	1	1	1	1	2	12
26	32	7	7	5	2	1	1	1	1	2	2	9
27	37	5	8	4	2	1	1	1	1	2	12	8
28	33	5	8	4	2	1	1	1	1	3	5	6
29	29	—	8	4	2	1	1	1	1	2	4	5
30	31	—	8	4	2	1	1	1	1	2	3	12
31	27	—	7	—	2	—	1	1	—	1	—	10
Mean	18	6	8	13	3	2	1	1	1	1	2	9
Max	40	23	13	36	4	2	1	1	1	3	12	60
Min	7	3	4	4	2	1	1	1	1	1	1	2
Ac-Ft	1097	357	466	799	163	95	61	61	60	73	125	577

*Values are read from a staff plate. Values may be daily readings taken at about 8:00 a.m. or averages over several days.

Tanner Creek above Henry Hagg Lake near Gaston, Oregon — 14202860



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — TANO

Q in cfs	Q=1	Q=2	Q=3	Q=4	Q=5	6 ≤ Q ≤ 8	9 ≤ Q ≤ 14	15 ≤ Q ≤ 29	30 ≤ Q ≤ 49	50 ≤ Q ≤ 79	80 < Q ≤ 100	Missing
Jan												
Feb												
Mar												
Apr												
May												
Jun												
Jul												
Aug												
Sep												
Oct												
Nov												
Dec												
All	2.7%	35.7%	15.7%	8.6%	10.4%	8.3%	8.0%	4.8%	1.9%	0.4%	0.1%	3.4%

Key
$f \geq 3\%$
$2\% \leq f < 3\%$
$1\% \leq f < 2\%$
$0.2\% \leq f < 1\%$
$0.06\% \leq f < 0.2\%$
$0 < f < 0.06\%$

Period of Record
2003–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — TANO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	9	8	11	6	2	1	1	1	1	1	2	7
2004	10	8	4	3	2	1	1	0	1	1	2	2
2005	4	2	1	4	3	1	1	1	1	1	3	6
2006	25	5	3	2	1	1	1	1	0	1	10	9
2007	6	4	5	2	1	1	1	1	1	1	1	
2008	10	12	8	7	4	2	1	1	1	1	2	2
2009		2	5	1	1	0	1	1	1	1	3	2
2010				10	5	5	2	2	1	1		
2011		11	17	11	7	2	1	1	1	1	1	1
2012	5	4		4	2	2	2	1	1	1	6	5
2013	2	2	2	3	2	2	1	1	1	2	4	3
2014	4	6	6	5	4	1	1	1	1	1	4	9
2015	5	7	4	3	2	1	1	1	1	1	5	32
2016	27	19	19	4	2	1	1	1	1	7	9	12
2017	5	23	22	8	3	2	1	1	1	1	12	5
2018	13	5	7	9	3	2	1	1	1	1	1	5
median	7	7	7	4	2	1	1	1	1	1	3	5

Key: Q in cfs
Q = 0
Q = 1
1 < Q ≤ 2
2 < Q ≤ 5
5< Q ≤ 12
12< Q ≤ 20
Q > 20

Q as percentile
Q ≤ 3rd
3rd < Q ≤ 40th
40th < Q ≤ 56th
56th < Q ≤ 75th
75th < Q ≤ 90th
90th < Q ≤ 95th
Q > 95th

2018

- Flow in 2018 was typical, except for high flows in late January and early April and low flows in November, all of which were weather-related.

Low flow

- June through October are the months with the lowest average flows; however, low flow can occur almost any time of year.
- Tanner Creek drains a small watershed and therefore flows tend to be very low overall.
- Low flow measurements have only one significant digit and cannot be distinguished from one another.

Rainy season flow

- December through March are the months with the highest average flows. Because some data from these months are missing, the distribution likely under-represents the frequency and range of high flows.

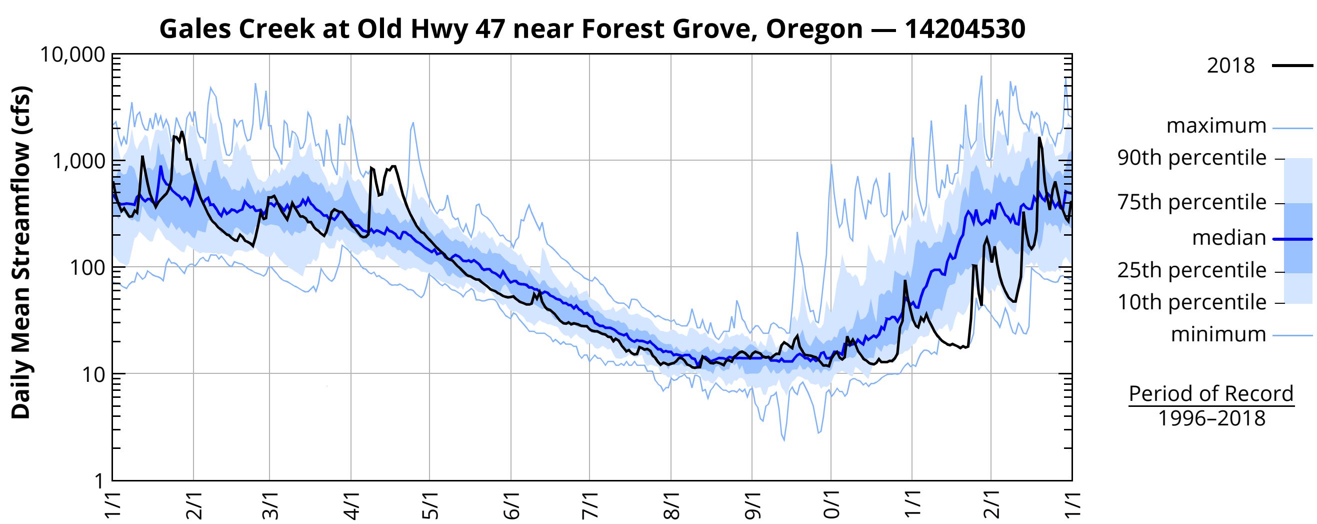
GALES – Gales Creek at Old Hwy 47 near Forest Grove, Oregon – 14204530

Data source: Oregon Water Resources Department
River Mile: 2.36 *Latitude:* 45 30 39 *Longitude:* 123 06 56

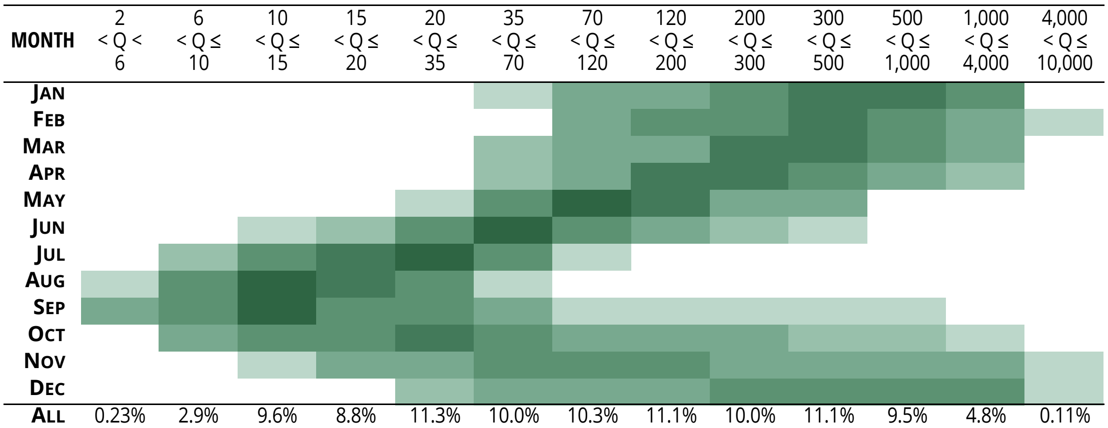
2018 — MEAN STREAMFLOW† (cfs) — GALES

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	620	657	447	237	172	53.0	25.4	12.6	16.2	15.2	28.3	157
2	465	552	463	228	161	50.1	25.0	13.1	15.8	16.0	27.3	106
3	383	456	417	210	152	48.2	25.0	14.1	15.5	14.2	33.5	81.4
4	333	396	369	196	143	46.9	24.3	14.0	14.5	13.6	31.4	67.8
5	354	352	331	190	136	45.8	23.7	13.3	14.2	14.3	36.2	58.7
6	324	314	304	192	130	44.6	23.3	12.3	14.4	22.5	31.3	53.0
7	296	285	279	202	121	44.5	22.2	12.0	14.0	19.0	28.2	49.8
8	299	264	326	845	117	45.4	22.0	11.5	14.8	20.8	24.9	47.4
9	337	249	397	819	115	55.1	20.2	11.4	15.4	19.0	23.0	47.4
10	322	233	360	600	107	50.5	21.3	11.5	15.3	16.5	21.7	63.0
11	523	223	325	471	101	58.3	20.6	11.5	18.6	15.3	20.5	81.0
12	1110	212	296	481	95.8	46.8	18.6	14.5	19.8	13.9	19.6	331
13	801	201	299	684	91.2	42.5	17.4	13.8	19.1	13.4	18.8	211
14	606	199	289	823	85.3	40.3	16.3	13.3	18.1	12.8	18.5	160
15	482	187	264	808	82.5	39.4	16.7	12.6	17.3	12.4	19.1	148
16	417	179	264	874	81.1	37.6	15.7	12.5	21.0	12.3	18.6	161
17	364	177	240	876	78.6	35.8	15.2	12.9	22.7	12.7	18.0	219
18	403	201	226	736	76.7	33.4	15.3	12.7	17.8	13.8	17.4	1660
19	429	192	219	592	75.8	31.2	17.8	12.4	16.0	12.9	18.2	1270
20	456	176	205	482	71.9	29.7	17.4	12.1	15.0	12.9	17.7	639
21	485	173	196	404	68.9	29.4	16.9	13.3	14.9	12.9	18.1	451
22	536	167	216	348	66.2	30.3	17.1	13.4	14.8	13.2	33.2	343
23	649	158	260	307	62.8	29.0	16.5	13.0	14.5	13.1	103	524
24	1670	189	327	276	60.9	29.7	14.8	14.5	14.3	13.9	102	634
25	1640	243	347	250	59.6	29.3	14.1	15.0	13.6	15.5	57.0	486
26	1500	324	338	229	57.2	28.9	12.9	15.8	12.8	27.6	43.3	382
27	1870	283	328	214	56.2	28.1	12.2	16.2	11.9	31.5	161	338
28	1530	289	326	208	53.6	27.8	12.7	15.7	12.0	75.8	187	289
29	1020	—	303	195	52.5	27.8	12.5	14.9	11.8	51.9	156	268
30	1020	—	278	182	51.9	26.2	12.2	14.1	14.0	39.5	110	404
31	805	—	256	—	52.4	—	12.4	15.5	—	31.9	—	359
Mean	711	269	306	439	91.5	38.9	18.0	13.4	15.7	20.3	48.1	325
Max	1870	657	463	876	172	058	025	016	023	076	187	1660
Min	296	158	196	182	51.9	26.2	12.2	11.4	11.8	12.3	17.4	47.4
Ac-Ft	43734	14938	18833	26100	5625	2312	1106	824	932	1250	2862	20012

†All 2018 data are provisional—subject to revision



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — GALES



KEY
- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
1996–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — GALES

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	634	751	256	336	231	70.1	26.2	12.6	18.1	32.9	87.7	1034
1997	645	356	725	195	97.1	71.5	28.9	15.5	26.3	146	342	314
1998	805	599	403	203	104	55.2	30.4	13.8	15.2	26.0	85.7	742
1999	628	1255	438	246	119	48.3	23.7	18.7	14.4	18.8	175	581
2000	527	337	310		88.3	61.9	26.0	14.2	11.1	15.2	30.7	101
2001	86.1	136	88.9	71.7	75.6	30.5	17.3	15.0	12.9	22.5	140	743
2002	648	474	298	185	78.2	40.3	15.0	7.7	7.6	9.5	67.9	239
2003	385	330	545	282	122	38.2	19.7	11.7	12.1	23.8	43.2	294
2004	431	429	255	168	87.0	45.0	20.6	13.5	20.4	28.5	88.0	141
2005	211	117	80.6	235	133	72.7	26.1	16.7	13.5	28.3	169	281
2006	986	279	279	215	99.1	60.1	21.5	10.0	8.7	10.7	538	512
2007	307	169	344	143	71.4	29.0	17.5	12.7	7.2	22.4	65.9	722
2008	581	465	333	274	119	38.0	15.0	13.0	11.0	15.0	76.5	82.0
2009	403	140	272	182	143	59.5	22.0	13.0	18.0	30.0	243	243
2010	745	321	285	349	146	145	41.0	25.0	28.5	29.0	190	758
2011	459	315	753	401	172	79.0	40.0	21.0	17.0	19.0	49.5	107
2012	461	376	566	275	141	65.5	27.0	16.0	12.0	21.0	271	1040
2013	291	226	233	142	86.0	54.5	20.0	15.0	15.0	65.0	113	116
2014	155	447	430	277	182	57.5	23.0	16.0	13.0	20.0	123	392
2015	283	283	207	150	62.0	22.5	13.0	13.0	14.0	16.0	167	1290
2016	732	518	656	132	60.0	28.0	19.0	10.0	10.0	194	309	578
2017	367	975	750	376	167	61.4	30.0	15.3	13.0	20.7	429	250
2018	485	228	304	328	82.5	39.9	17.4	13.1	15.2	14.2	27.8	211
median	502	337	324	207	115	54.0	23.4	14.6	14.0	23.9	118	365

KEY

Q in cfs
- Q ≤ 11.0
- 11.0 < Q ≤ 13.7
- 13.7 < Q ≤ 15.8
- 15.8 < Q ≤ 18.8
- 18.8< Q ≤ 29.8
- 29.8< Q ≤ 58.3
- 58.3 < Q ≤ 101
- 101 < Q ≤ 305
- 305 < Q ≤ 641
- 641 < Q ≤ 980
- Q > 980

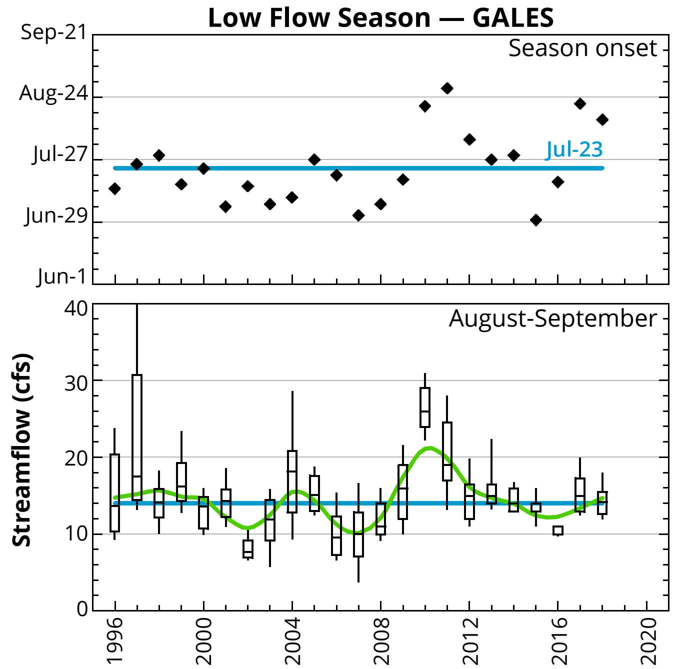
Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Flow in 2018 was typical for much of the year. Higher than usual flows in late January and early April and lower than usual flows in November and early December were weather-related.

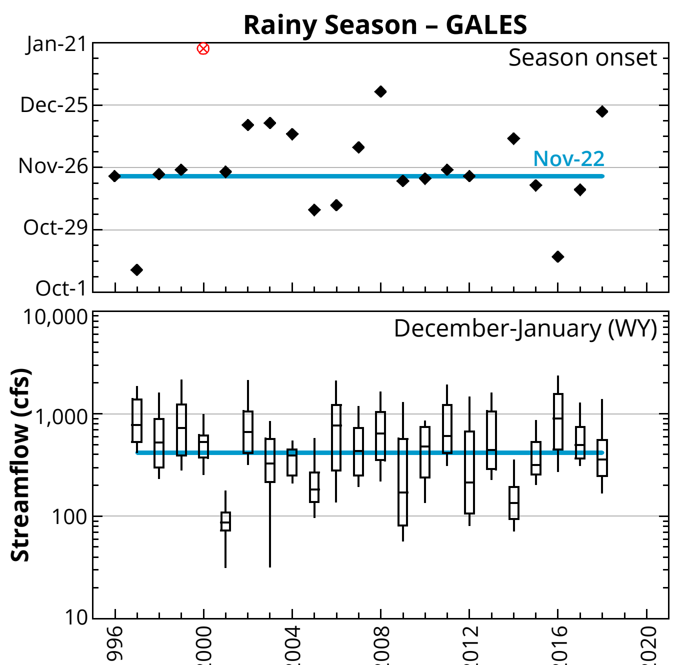
Low flow

- August and September are the months with the lowest average flow and the lowest daily flows.
- Low flow criterion: 7d-Q ≤ 25 cfs (~26th pctl)
- No trends are evident in the magnitude of the flow for August–September.
- Spring rainfall in both 2010 and 2011 was high, resulting in higher flows that persisted into summer.



Rainy season flow

- December through March are the months with the highest average flows.
- Rainy season criterion: 7d-Q ≥ 300 cfs (~74th pctl)
- No trend is evident in the magnitude of the flow for December–January.
- The fall/winter of 2000-2001 was very dry.
  —The rainy season criterion was not met in 2000.
  — Winter flows were low for WY 2001.

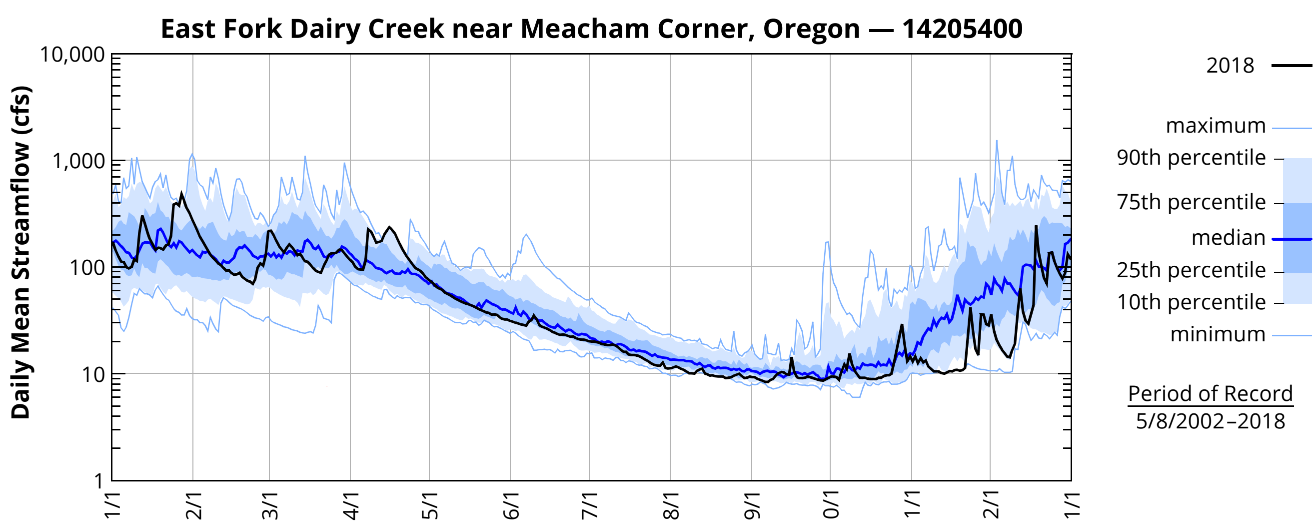


5400 – East Fork Dairy Creek near Meacham Corner, Oregon – 14205400

Data source: U.S. Geological Survey, Oregon Water Science Center
River Mile: 12.4 *Latitude:* 45 40 51 *Longitude:* 123 04 12 *Drainage area:* 32.92 sq mile *Datum:* 29.0 ft

2018 — MEAN STREAMFLOW (cfs) — 5400

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	168	248	217	117	75.7	31.4	20.1	11.3	9.31	9.42	13.0	36.0
2	142	219	218	111	72.2	30.7	20.0	11.5	9.33	9.44	14.6	25.0
3	124	192	197	101	69.0	30.1	20.0	11.8	8.97	9.26	12.6	20.6
4	112	173	175	95.4	65.1	29.7	19.7	11.5	8.83	8.82	14.0	18.4
5	111	157	158	94.7	63.0	29.1	19.5	11.1	8.64	10.6	12.8	16.9
6	100	142	147	94.4	61.1	28.6	19.0	10.9	8.44	12.3	13.3	15.6
7	97.1	130	138	113	58.0	28.2	18.8	10.5	8.40	11.1	11.7	14.5
8	101	122	153	225	56.5	30.9	18.5	10.1	8.81	15.5	11.1	14.3
9	118	115	163	214	54.8	31.7	18.5	10.1	8.95	12.2	10.5	17.0
10	114	108	154	192	53.0	35.3	18.8	9.99	9.63	10.7	10.5	19.4
11	208	104	141	169	51.0	32.6	18.4	10.7	10.2	9.94	10.5	38.6
12	305	98.0	129	172	49.6	28.7	17.7	11.0	10.4	9.24	10.2	63.0
13	256	91.9	133	177	48.1	27.7	16.7	11.1	10.3	9.22	9.99	38.4
14	212	93.4	122	201	46.9	27.1	16.1	10.0	9.92	9.22	10.3	31.5
15	181	87.6	113	219	45.7	26.5	16.0	9.89	9.77	8.99	10.6	29.4
16	164	84.0	112	235	44.9	25.6	15.2	9.64	14.4	8.87	10.5	35.7
17	144	85.5	105	225	43.9	24.7	15.0	9.67	10.4	8.90	10.8	43.6
18	152	88.6	98.2	208	43.1	24.3	15.0	9.47	9.32	8.92	10.9	245
19	151	80.9	93.1	184	41.9	23.6	14.9	9.37	9.13	9.20	10.7	139
20	146	77.5	90.0	163	40.4	23.1	14.7	9.44	9.05	9.23	10.8	101
21	160	74.3	88.6	146	39.4	23.3	14.3	9.36	9.18	9.45	11.4	78.0
22	163	73.1	103	132	38.6	23.2	13.8	9.07	9.40	9.66	20.7	69.9
23	196	69.3	114	122	37.6	22.6	13.3	9.17	9.30	9.66	41.8	135
24	384	76.9	130	113	37.0	22.2	12.8	9.29	9.09	10.0	24.9	137
25	395	99.6	135	105	35.7	22.3	12.4	9.55	8.99	12.7	16.9	111
26	375	108	135	98.1	36.0	21.6	12.1	9.80	8.80	17.3	15.0	96.9
27	480	103	138	94.7	35.6	21.1	11.9	10.0	8.70	22.7	35.9	86.2
28	416	128	145	91.2	33.8	20.8	11.9	9.52	8.62	29.3	35.8	78.2
29	354	—	144	85.8	32.8	20.8	12.8	9.05	8.85	19.0	29.3	88.8
30	318	—	135	79.7	32.3	20.6	11.4	9.18	9.23	13.2	28.4	131
31	279	—	125	—	32.2	—	11.2	9.44	—	14.5	—	120
Mean	214	115	137	146	47.6	26.3	15.8	10.1	9.41	11.9	16.3	67.6
Max	480	248	218	235	75.7	35.3	20.1	11.8	14.4	29.3	41.8	245
Min	97.1	69.3	88.6	79.7	32.2	20.6	11.2	9.05	8.40	8.82	9.99	14.3
Ac-Ft	13143	6406	8428	8684	2925	1563	973	620	560	731	971	4155



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — 5400

Q in cfs	5 < Q < 7.5	7.5 < Q ≤ 9.5	9.5 < Q ≤ 12	12 < Q ≤ 15.5	15.5 < Q ≤ 22	22 < Q ≤ 35	35 < Q ≤ 55	55 < Q ≤ 80	80 < Q ≤ 110	110 < Q ≤ 170	170 < Q ≤ 300	300 < Q ≤ 1,000	1,000 < Q ≤ 2,000	* Missing
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
All	0.24%	5.7%	10.6%	9.0%	8.9%	11.2%	10.5%	9.1%	9.2%	9.7%	8.7%	5.0%	0.13%	2.0%

*All the missing values date from January–May, 2002 before the gage was installed. Because higher flows are more common than low flows during those months, the statistics above likely under-represent high flow.

Key
- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
5/8/2002–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — 5400

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002					39.0	25.6	16.3	11.6	9.7	8.5	12.8	43.6
2003	98.7	142	201	126	59.5	28.4	17.8	12.8	9.9	11.1	15.2	69.3
2004	166	155	90.5	61.2	36.1	25.4	14.0	11.1	11.4	16.7	22.4	52.1
2005	65.6	45.7	29.4	93.5	93.3	39.9	22.1	10.8	10.5	12.5	38.2	82.0
2006	418	131	111	84.2	45.8	35.5	18.4	11.9	9.3	9.8	152	181
2007	148	85.6	126	69.0	38.3	22.5	15.5	10.6	7.9	12.0	19.5	239
2008	228	176	129	102	45.6	27.8	14.3	11.7	8.7	9.0	22.5	22.4
2009	161	56.1	86.7	75.8	64.4	27.6	17.0	11.8	9.0	9.3	45.6	50.6
2010	203	125	123	154	78.5	90.3	31.0	16.8	14.4	13.0	49.1	272
2011	181	109	303	156	85.8	45.8	28.9	17.8	12.9	14.3	26.4	33.0
2012	98.6	160	280	135	67.6	44.2	23.2	13.6	10.3	15.0	61.3	395
2013	120	77.9	89.1	68.1	35.2	31.2	14.8	11.4	10.6	21.7	37.3	44.5
2014	44.5	152	226	131	79.2	33.1	19.5	12.5	9.2	13.6	42.3	142
2015	108	121	93.4	66.4	35.5	16.7	13.0	10.0	10.3	8.7	29.9	260
2016	255	212	218	66.5	32.2	21.1	15.3	10.2	9.8	50.2	86.3	206
2017	146	302	238	150	80.9	40.4	21.0	13.6	10.6	12.6	83.1	82.5
2018	164	101	135	127	44.9	26.1	15.2	9.9	9.2	9.7	12.2	43.6
median	155	127	138	94.5	51.4	30.2	17.6	11.8	10.2	12.0	33.6	96.9

Key

Q in cfs
- Q ≤ 9.2
- 9.2 < Q ≤ 10.3
- 10.3 < Q ≤ 11.4
- 11.4 < Q ≤ 13.0
- 13.0< Q ≤ 18.0
- 18.0< Q ≤26.8
- 26.8 < Q ≤ 40.0
- 40.0 < Q ≤ 105
- 105 < Q ≤ 217
- 217 < Q ≤ 303
- Q > 303

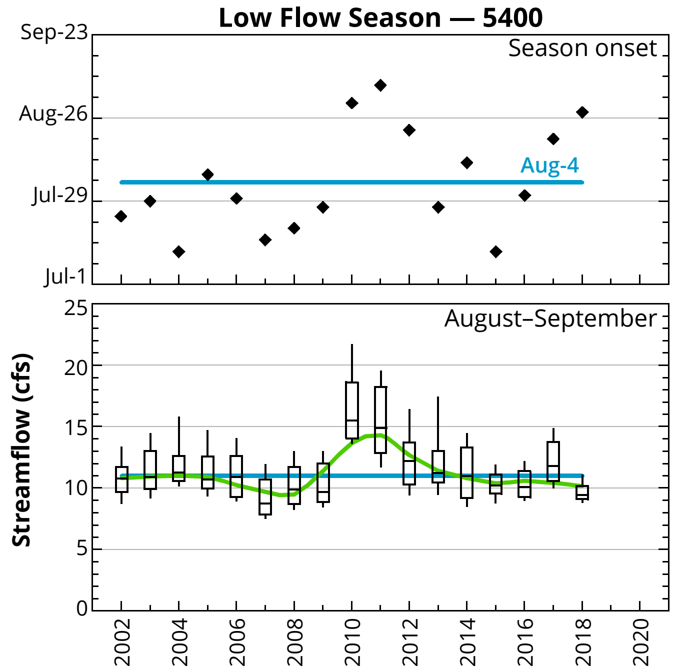
Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Flow in 2018 was typical for much of the year. Higher than usual flows in late January and early April and lower than usual flows in November and early December were weather-related.

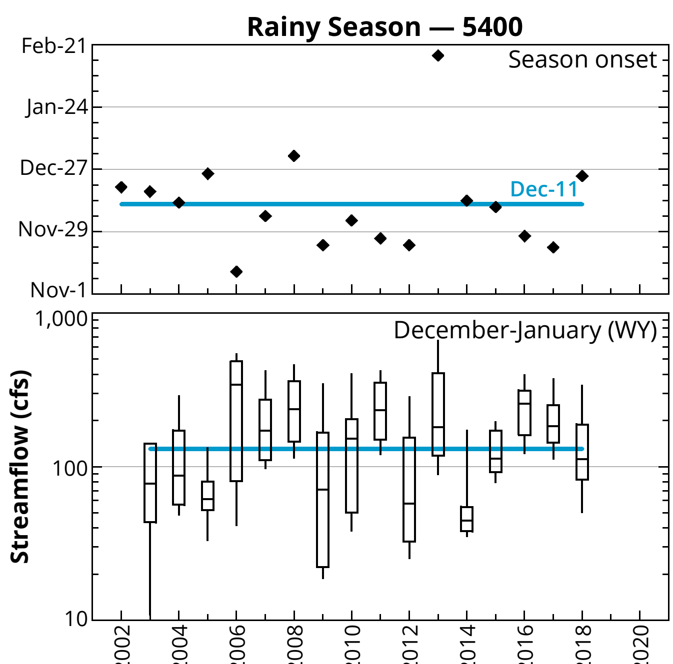
LOW FLOW

- August through October are the months with the lowest average flow and the lowest daily flows.
- Low flow criterion: 7d-Q ≤ 16 cfs (~26th pctl)
- No trends are evident in the magnitude of the flow for August–September.
- Spring rainfall in both 2010 and 2011 was high, resulting in later onset of low flow and higher flows that persisted into summer.



RAINY SEASON FLOW

- December through March are the months with the highest average flows.
- Rainy season criterion: 7d-Q ≥ 100 cfs (~74th pctl)
- No trend is evident in the magnitude of the flow for December–January.



MCSC – McKay Creek at Scotch Church Road above Waible Creek near North Plains, Oregon – 14206070

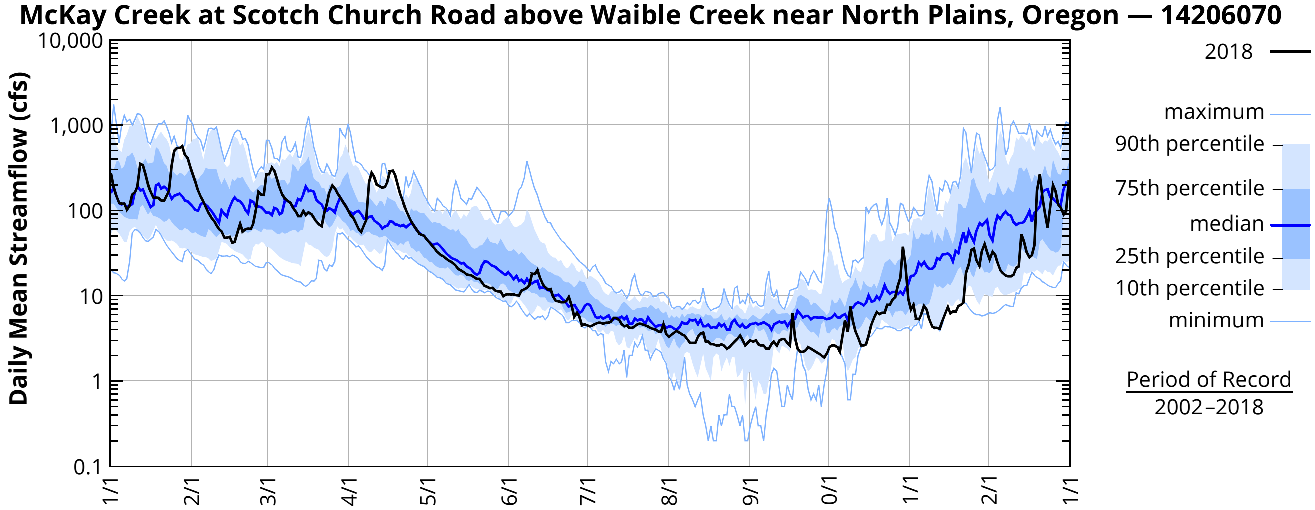
Data source: WEST Consultants for Clean Water Services
River Mile: 6.3 *Latitude:* 45 57 21 *Longitude:* 122 99 18

2018 — MEAN STREAMFLOW (cfs) — MCSC

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	265	266	266	87.6	42.0	10.3	4.36e	3.51e	2.91e	2.61e	7.86	33.1
2	186	217	320	81.7	38.7	10.4	4.48e	3.72e	2.98e	2.64e	5.38	30.4
3	145	172	292	69.8	35.7	10.1	4.74e	3.94e	2.74e	2.51e	5.31	24.0
4	122	144	235	60.7	32.5	9.95	4.80e	3.72e	2.64e	2.20e	6.22	20.1
5	120	126	184	56.1	30.4	11.5	4.81e	3.50e	2.55e	3.39e	7.56	18.2
6	120	108	154	66.3	29.4	11.9	4.72e	3.35e	2.41e	5.11e	6.88	17.2
7	102	93.0	137	77.9	27.7	12.4	4.77e	3.10e	2.40e	3.83e	5.28	16.8
8	115	83.3	129	216	26.1	13.3	4.83e	2.80e	2.74e	7.45e	4.41	16.8
9	154	75.7	124	274	25.2	18.1	5.00e	2.80e	2.91e	5.01e	4.18	17.6
10	163	66.8	109	245	23.8	17.9	5.53e	2.77e	2.56e	3.80e	4.21	21.3
11	193	60.0	97.9	201	22.5	20.0	5.46e	3.33e	2.96e	3.22e	4.12	22.1
12	351	56.4	85.6	192	20.5	16.1	5.15e	3.63e	3.10e	2.63e	5.23	52.9
13	340	47.4	85.3	185	19.8	13.8	4.56e	3.72e	3.05e	2.63e	6.17	43.6
14	268	48.1	97.8	187	18.8	12.6	4.37e	2.90e	2.78e	2.66e	7.35	32.0
15	202	49.3	87.9	217	17.8	11.7	4.49e	2.87e	2.60e	3.39e	6.21	28.1
16	166	41.6	94.9	286	17.5	12.0	4.16e	2.68e	6.32e	4.71	6.54	29.8
17	140	42.9	90.6	291	17.3	9.66	4.21e	2.72e	3.22e	5.58	6.47	38.8
18	141	55.3	82.1	254	16.6	8.70	4.40e	2.62e	2.36e	6.38	7.58	170
19	140	69.3	74.7	198	15.8	8.63	4.62e	2.56e	2.21e	6.12	7.77	264
20	130	56.6	68.6	151	15.7	8.37	4.69e	2.65e	2.16e	6.26	8.25	144
21	129	59.8	65.4	123	14.3	8.38	4.58e	2.63e	2.26e	6.27	18.4	92.6
22	149	60.9	93.3	101	13.0	8.70	4.47e	2.42e	2.47e	7.84	23.4	63.3
23	173	60.6	119	86.3	12.7	9.67	4.35e	2.52e	2.42e	7.78	34.5	117
24	334	70.9	165	74.7	12.2	7.60	4.15e	2.66e	2.25e	8.97	35.6	198
25	499	100	198	66.8	12.4	5.74	4.08e	2.88e	2.19e	9.60	25.8	167
26	536	166	181	59.5	11.5	6.31	3.95e	3.10e	2.05e	13.0	22.3	118
27	540	152	158	53.8	11.2	5.69	3.82e	3.36e	2.01e	16.1	33.8	108
28	569	151	142	51.7	11.1	4.52e	3.82e	2.99e	1.94e	37.8	40.7	89.4
29	453	—	127	50.7	9.86	4.62e	4.63e	2.63e	2.10e	22.6	32.4	98.4
30	411	—	114	45.9	10.3	4.54e	3.56e	2.75e	2.45e	9.13	26.9	218
31	326	—	99.8	—	10.4	—	3.34e	3.01e	—	6.86	—	224
Mean	248	96.4	138	137	20.1	10.4	4.48	3.03	2.66	7.36	13.9	81.8
Max	569	266	320	291	42.0	20.0	5.53	3.94	6.32	37.8	40.7	264
Min	102	41.6	65.4	45.9	9.86	4.52	3.34	2.42	1.94	2.20	4.12	16.8
Ac-Ft	15237	5355	8485	8153	1235	621	276	186	158	452	827	5027

e=estimated value of poor quality due to backwater issues; correlation with EF Dairy Creek (ID 14205400) flow used for correction

McKay Creek at Scotch Church Road above Waible Creek near North Plains, Oregon — 14206070



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — MCSC

Q in cfs	0.1 < Q < 0.3	0.3 < Q ≤ 3	3 < Q ≤ 5	5 < Q ≤ 7	7 < Q ≤ 11	11 < Q ≤ 20	20 < Q ≤ 40	40 < Q ≤ 65	65 < Q ≤ 100	100 < Q ≤ 170	170 < Q ≤ 350	350 < Q ≤ 1,200	1,200 < Q ≤ 2,000	Missing
Jan*														
Feb*														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
All	0.18%	4.2%	10.6%	11.1%	9.4%	10.5%	11.2%	9.8%	9.1%	9.2%	9.6 %	4.9%	0.13%	0.23%

*Fill-in values were used for discharge that was reported as greater than the rating curve in 2002–2004.

Key

$f \geq 3\%$
$2\% \leq f < 3\%$
$1\% \leq f < 2\%$
$0.2\% \leq f < 1\%$
$0.06\% \leq f < 0.2\%$
$0 < f < 0.06\%$

Period of Record
2002–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — MCSC

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002		130	91.8	46.1	17.0	9.18	3.18	0.45	0.69	4.15	7.67	52.7
2003	170	123	153	115	34.5	9.52	3.85	2.25	5.50	11.2	23.3	82.4
2004			86.9	41.4	14.9	8.67	4.30	3.45	5.40	10.6	16.5	31.4
2005	59.0	41.2	19.5	94.2	91.3	20.5	8.80	2.84	4.98	13.4	47.8	124
2006	573	82.4	94.8	72.9	26.5	18.2	6.24	5.49	5.35	29.8	140	
2007	95.9	65.9	94.4	53.3	21.6	9.63	5.37	4.61	7.93	5.61	11.0	230
2008	359	253	126	78.4	22.3	10.2	4.95	5.24	4.89	6.50	21.8	19.8
2009	109	29.4	61.3	43.9	35.3	12.4	5.20	3.62	4.19	5.86	39.1	29.6
2010	274	117	97.0	115	62.4	77.7	8.54	4.76	8.78	10.7	53.3	246
2011	149	88.3	311	117	54.3	20.4	8.86	5.62	3.60	4.49	9.20	22.0
2012	160	105	238	92.5	43.9	22.5	8.89	6.64	5.57	9.92	48.3	364
2013	75.4	57.7	75.7	39.6	15.2	18.7	7.10	6.44	9.52	10.1	33.6	25.8
2014	35.1	149	127	94.0	43.8	12.0	6.86	5.20	4.85	9.05	46.0	156
2015	87.3	96.3	82.5	45.7	13.7	6.35	5.12	5.32	6.62	5.51	19.2	540
2016	232	153	171	37.7	11.9	6.58	4.27	3.77	4.78	62.4	121	204
2017	146	447	278	145	67.1	11.5	4.51	4.20	4.93	10.4	104	122
2018	173	70.1	124	100	17.8	10.2	4.54	2.88	2.56	5.11	7.12	38.8
median	147	109	119	72.0	27.7	12.0	5.34	4.41	5.22	7.99	31.1	104

Key

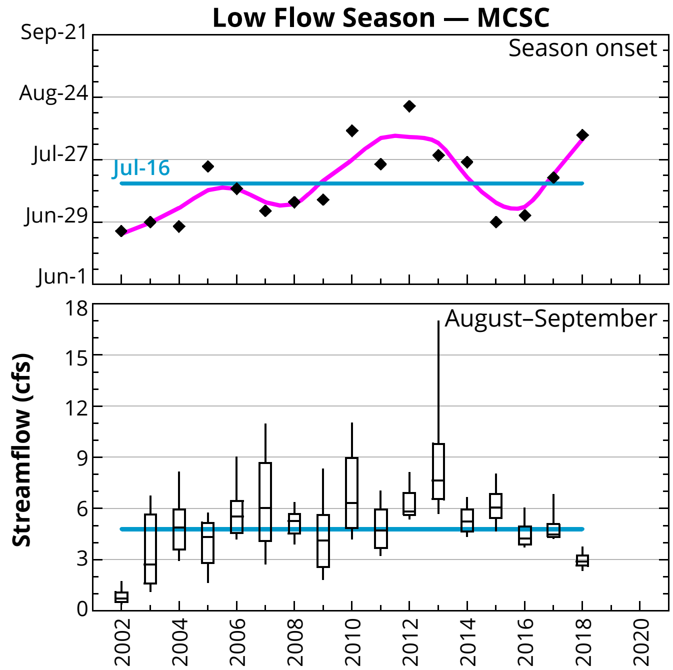
Q in cfs	Q as percentile
Q ≤ 3.27	Q ≤ 5th
3.27 < Q ≤ 4.30	5th < Q ≤ 10th
4.30 < Q ≤ 5.01	10th < Q ≤ 15th
5.01 < Q ≤ 5.72	15th < Q ≤ 20th
5.72< Q ≤ 8.20	20th < Q ≤ 30th
8.20< Q ≤ 13.9	30th < Q ≤ 40th
13.9 < Q ≤ 25.4	40th < Q ≤ 50th
25.4 < Q ≤ 94.6	50th < Q ≤ 75th
94.6 < Q ≤ 230	75th < Q ≤ 90th
230 < Q ≤ 350	90th < Q ≤ 95th
Q > 350	Q > 95th

2018

- Flow in 2018 was typical for much of the year. Higher than usual flows in late January and early April and lower than usual flows in November and early December were weather-related.

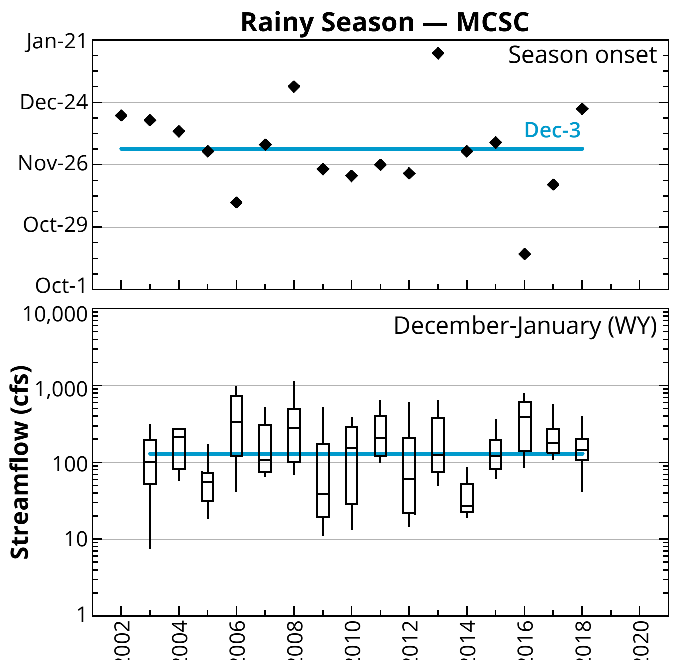
Low flow

- July through September are the months with the lowest average flow. The lowest daily flows occur in August and September.
- Low flow criterion: 7d-Q ≤ 7 cfs (~25th pctl)
- Low flow onset is becoming later. Although there is considerable variability, the trend is statistically significant. The period of record is rather short and more years will be needed to determine if this trend persists.
- July–August flows have been variable over the period of record. Understanding any trends at this site is complicated by:
  - —Monitoring of streamflow changed from OWRD (2002–2007) to West Consultants (2008–present).
  - —Various rates of flow augmentation have supplemented streamflow in McKay Creek during July–October since 2005. The augmentation point is about a mile upstream of this site since 2005. Flow augmentation rates have varied over the years from about 0.5 cfs in the early years to 1–3 cfs since 2012.



Rainy season flow

- December through March are the months with the highest average flows.
- Rainy season criterion: 7d-Q ≥ 90 cfs (~74th pctl)
- No trend is evident in the magnitude of the flow for December–January.



DAIRY – DAIRY CREEK AT HWY 8 NEAR HILLSBORO, OREGON – 14206200

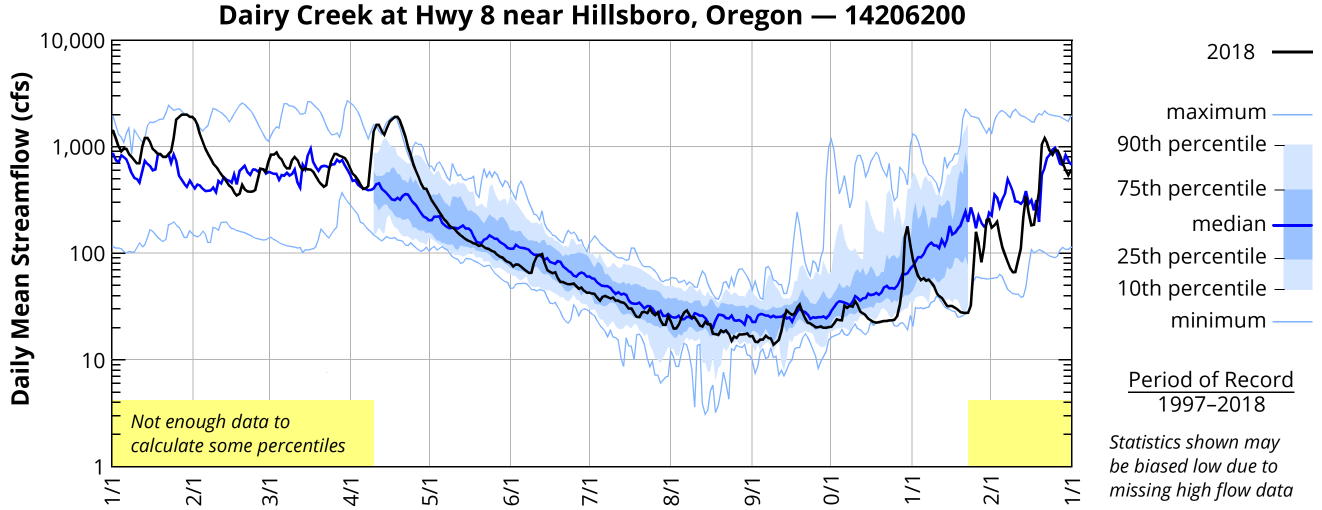
Data source: Oregon Water Resources Department
River Mile: 2.06 *Latitude:* 45 30 38 *Longitude:* 123 06 56

2018 — MEAN STREAMFLOW† (cfs) — DAIRY

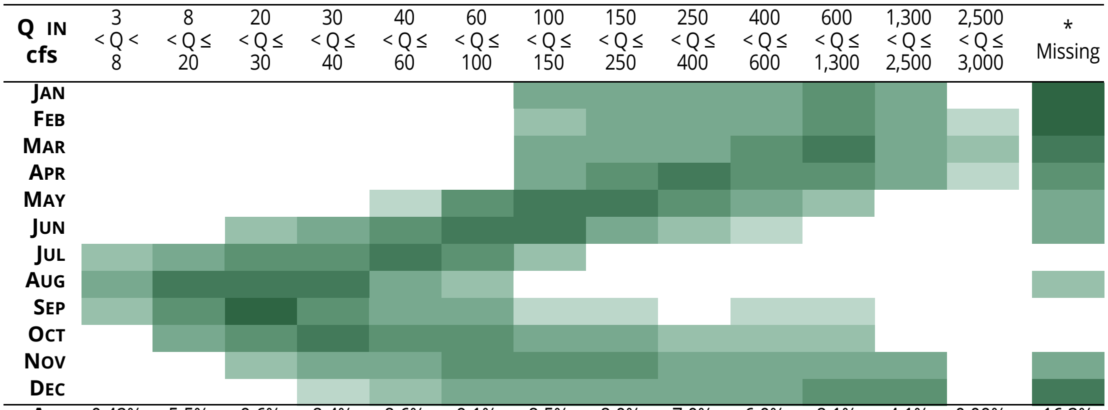
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1400e	1800e	720e	557e	314	75.6	42.0	19.6	14.8	21.9	72.6	184
2	1200e	1600e	842e	528e	288	78.5	41.6	19.7	14.7	24.1	61.4	198
3	1000e	1300e	880e	484	266	77.9	38.3	21.5	15.5	23.6	56.1	147
4	900e	1100e	798e	435	242	74.9	36.0	25.2	15.5	23.5	58.6	115
5	950e	950e	756e	401	222	71.5	39.2	27.8	16.9	32.2	55.4	96.1
6	950e	850e	675e	407	206	68.2	40.0	29.1	16.1	30.8	56.7	82.5
7	850e	775e	625e	426	194	65.4	38.8	26.6	15.8	32.3	53.5	72.1
8	800e	700e	625e	800e	180	65.9	37.9	25.0	13.9	31.6	48.9	66.3
9	750e	650e	749e	1400e	174	82.5	38.5	25.0	14.6	35.4	42.6	66.8
10	700e	600e	799e	1600e	166	93.4	36.0	23.0	15.4	32.5	39.8	87.7
11	700e	556e	749e	1600e	156	96.6	36.1	21.0	18.7	28.4	38.0	110
12	1000e	515e	649e	1400e	147	98.8	34.8	20.6	24.6	27.3	34.5	219
13	1200e	468	599e	1300e	141	81.0	34.3	22.8	29.1	26.2	31.8	346
14	1200e	429	630e	1500e	136	69.8	32.8	21.6	27.6	24.4	32.1	236
15	1100e	413	610e	1700e	131	67.1	30.4	21.6	26.4	23.7	32.1	182
16	950e	373	608e	1800e	128	65.2	30.4	17.5	27.3	22.7	30.9	185
17	900e	349	578e	1900e	124	66.5	27.4	17.4	31.0	22.3	29.5	263
18	850e	362	527e	1900e	122	58.4	25.4	17.2	33.1	22.5	28.1	380e
19	850e	436	480	1750e	117	53.6	25.1	18.9	27.7	22.9	27.7	1060e
20	800e	397	447	1500e	119	53.8	27.8	18.3	24.4	23.2	27.5	1200e
21	800e	380	421	1250e	114	52.3	28.2	19.0	22.2	23.1	27.7	1080e
22	850e	378	435	1000e	111	51.2	27.6	17.4	22.1	23.5	32.6	920e
23	900e	380	600e	850e	109	51.4	30.2	15.1	21.2	23.5	73.1	840e
24	1200e	393	750e	700e	105	51.9	27.5	16.6	20.1	23.8	159	940e
25	1800e	496e	850e	600e	103	49.3	26.2	16.2	20.3	25.8	125	920e
26	1900e	620e	850e	520e	96.6	46.6	27.9	17.3	20.7	32.9	82.3	820e
27	2000e	610e	826e	448	92.8	47.8	23.4	17.3	20.0	49.8	114	700e
28	2000e	580e	805e	405	91.1	44.5	21.3	17.4	20.0	141	207	600e
29	2000e	—	786e	402	86.2	42.4	21.3	17.8	20.3	179	208	540e
30	1900e	—	711e	360	83.1	42.8	25.7	16.6	20.4	119	174	600e
31	1900e	—	630e	—	81.1	—	22.6	16.7	—	87.8	—	680e
Mean	1171	659	678	997	150	64.8	31.4	20.2	21.0	40.7	68.7	450
Max	2000	1800	880	1900	314	98.8	42.0	29.1	33.1	179	208	1200
Min	700	349	421	360	81.1	42.4	21.3	15.1	13.9	21.9	27.5	66.3
Ac-Ft	72000	36615	41673	59351	9215	3857	1933	1243	1250	2501	4087	27643

†All 2018 data are provisional—subject to revision; e-estimated

Dairy Creek at Hwy 8 near Hillsboro, Oregon — 14206200



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — DAIRY



Q IN cfs	3 < Q < 8	8 < Q ≤ 20	20 < Q ≤ 30	30 < Q ≤ 40	40 < Q ≤ 60	60 < Q ≤ 100	100 < Q ≤ 150	150 < Q ≤ 250	250 < Q ≤ 400	400 < Q ≤ 600	600 < Q ≤ 1,300	1,300 < Q ≤ 2,500	2,500 < Q ≤ 3,000	* Missing
ALL	0.42%	5.5%	9.6%	8.4%	8.6%	9.1%	8.5%	8.0%	7.0%	6.0%	8.1%	4.1%	0.09%	16.3%

*Most of the missing values are known to be above the upper limit of the rating curve. Therefore the statistics above underestimate both the magnitude and frequency of high flow.

KEY
$f \geq 3\%$
$2\% \leq f < 3\%$
$1\% \leq f < 2\%$
$0.2\% \leq f < 1\%$
$0.06\% \leq f < 0.2\%$
$0 < f < 0.06\%$

Period of Record
1997–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — DAIRY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997				383	200	167	61.7	38.4	52.4	224		
1998				400	224	155	58.7	31.7	28.5	59.7	156	
1999				622	203	97.2	48.9	34.7	26.4	36.8	270	
2000				198	111	58.4	24.8	17.7	19.0	30.2	31.5	114
2001	140	207	157	142	92.7	45.5	16.4	13.9	16.3	44.2		
2002				388	115	54.9	27.0	19.3	19.0	36.3	64.6	
2003					171	70.9	30.7	16.5	27.3	52.0	62.7	
2004				210	90.7	57.9	21.0	13.0	26.2	46.8	69.2	114
2005		182	122			86.2	45.1	18.4	20.5	36.4	255	
2006				488	165	123	41.9	23.7	19.5	20.7		
2007				285	114	58.2	26.0	18.9	15.9	43.4	82.1	
2008				505	156	93.0	33.0	29.0	18.5	34.0	99.5	103
2009		198		300	216	82.5	34.0	27.0	30.0	60.0		
2010							85.0	39.0	53.5	47.0		
2011					309	130	71.0	40.0	34.0	38.0	70.5	136
2012	994	672	1240	620	254	137	54.0	34.0	27.0	55.0	388	1850
2013	552	367	460	255	116	103	35.0	30.0	41.5	76.0	149	136
2014	203	1245	1430	703	264	106	46.0	26.0	25.5	55.0	218	885
2015	697	740	603	266	103	44.0	23.0	17.0	25.0	26.0	157	1790
2016	1700	1010	1470	245	99.0	51.5	32.0	18.0	24.0	381	555	1080
2017	750	1475	1220	849	330	116	42.0	26.0	24.0	34.0	650	550
2018	950	536	675	825	128	65.7	30.4	19.0	20.3	25.8	51.2	263
median	644	515	623	363	162	83.4	38.0	25.0	26.0	41.4	134	498

KEY
Q in cfs
Q ≤ 17.9
17.9 < Q ≤ 22.4
22.4 < Q ≤ 26.8
26.8 < Q ≤ 31.0
31.0< Q ≤ 42.0
42.0< Q ≤ 62.7
62.7 < Q ≤ 100
100 < Q ≤ 344
344 < Q ≤ 835
835 < Q ≤ 1300
Q > 1300

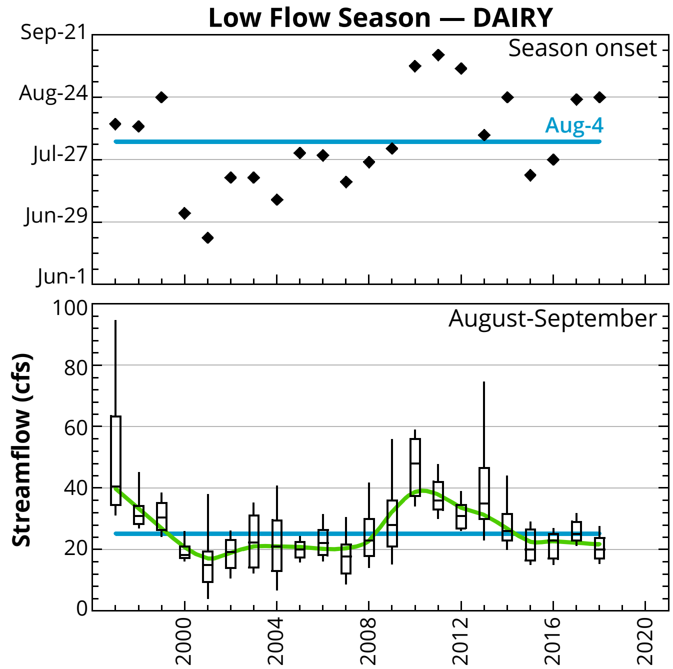
Q as percentile
Q ≤ 5th
5th < Q ≤ 10th
10th < Q ≤ 15th
15th < Q ≤ 20th
20th < Q ≤ 30th
30th < Q ≤ 40th
40th < Q ≤ 50th
50th < Q ≤ 75th
75th < Q ≤ 90th
90th < Q ≤ 95th
Q > 95th

2018

- Flow in 2018 was typical for much of the year. Higher than usual flows in late January and early April and lower than usual flows in November and early December were weather-related.

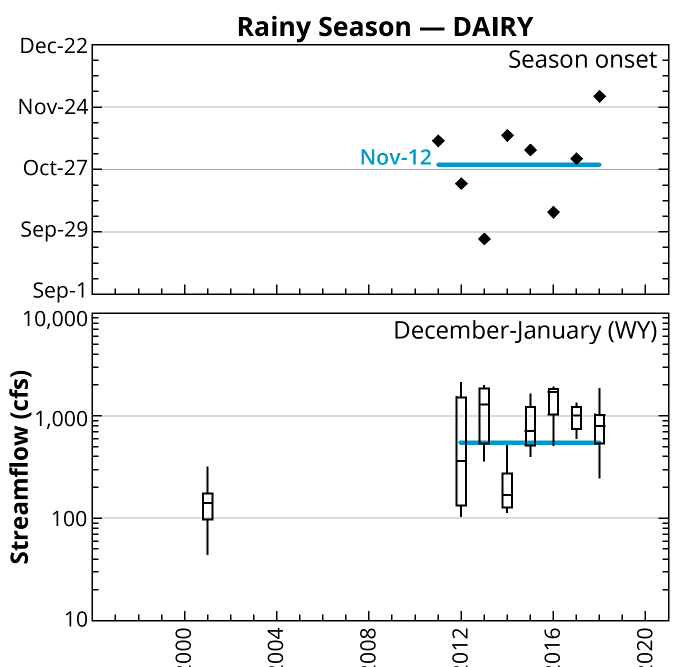
LOW FLOW

- August and September are the months with the lowest average flow and the lowest daily flows.
- Low flow criterion: 7d-Q ≤ 35 cfs (~24th pctl)
- Spring rainfall in both 2010 and 2011 was high, resulting in later onset of low flow and higher flows that persisted into summer.



RAINY SEASON FLOW

- December through March are the months with the highest average flows.
- A large portion of high flow data are missing for this site. Most of these data are known to be above the upper limit of the rating curve. These missing values will result in the under-representation of high flows in the frequency distribution as well as skewing the magnitude of high flow data.
- Too few high flow data are available to assess trends. No trends are evident in the onset of the rainy season or in the magnitude of the flow for December–January.
- Rainy season criterion: 7d-Q ≥ 350 cfs (~76th pctl)

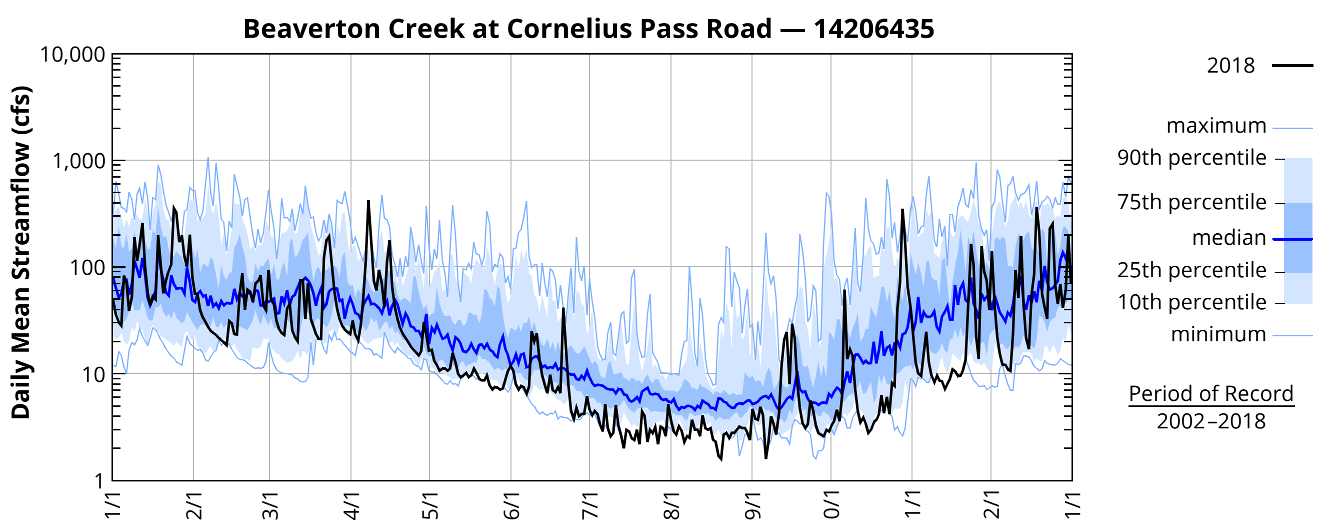


BVTS – Beaverton Creek at Cornelius Pass Road – 14206435

Data source: WEST Consultants for Clean Water Services
River Mile: 1.2 *Latitude:* 45 31 15 *Longitude:* 122 53 59

2018 — MEAN STREAMFLOW (cfs) — BVTS

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	47.9	56.0	93.3	23.4	16.5	11.8	4.58	3.60	4.74	3.25	22.6	140
2	35.6	56.2	48.7	31.6	16.7	10.6	4.11	2.86	3.78	3.56	12.8	43.1
3	30.4	39.7	44.2	23.1	13.0	7.92	4.49	2.74	3.68	4.62	9.96	22.0
4	28.3	33.4	31.1	20.5	12.0	7.12	4.21	3.20	4.92	3.64	9.51	15.3
5	83.0	30.2	26.1	28.4	10.7	7.71	3.28	2.85	4.11	6.22	15.5	12.2
6	71.3	27.4	23.9	52.0	11.2	7.48	2.91	2.31	1.59	61.4	24.8	12.1
7	38.8	25.2	23.0	117	11.2	6.54	5.17	2.58	2.30	13.7	12.9	11.0
8	52.8	24.1	41.0	423	10.7	7.55	3.11	2.46	3.98	16.8	9.68	10.7
9	192	23.1	45.4	183	11.2	25.0	2.56	3.65	3.41	14.6	8.25	23.3
10	114	21.7	25.4	74.0	15.7	20.2	2.80	3.04	2.74	7.16	9.55	94.4
11	161	20.6	22.0	60.6	12.8	24.0	5.05	3.00	4.26	4.47	8.60	51.3
12	259	19.7	20.2	94.4	9.96	13.2	3.31	2.63	12.0	3.45	8.52	196
13	102	18.6	75.0	69.3	9.32	9.56	2.55	4.07	20.7	3.93	7.15	44.6
14	58.7	31.2	74.9	41.8	9.61	7.89	2.04	3.13	24.7	3.41	8.06	21.6
15	43.6	29.6	32.8	112	10.2	6.59	2.99	3.00	7.99	2.76	8.98	17.0
16	53.2	23.4	70.6	178	9.33	9.83	2.88	3.10	29.5	2.98	11.0	55.3
17	49.8	23.3	32.6	65.8	9.66	6.99	2.47	2.38	21.5	3.54	10.5	84.8
18	199	57.6	27.9	41.4	11.2	6.66	2.41	2.30	8.19	3.71	9.51	368
19	101	87.2	23.5	32.5	10.2	7.45	2.99	1.70	4.78	4.22	9.57	215
20	56.9	39.9	21.2	26.7	8.95	6.58	2.20	1.59	3.38	6.32	10.9	55.5
21	76.2	61.4	21.1	23.7	8.70	41.5	4.38	2.69	3.13	4.31	13.5	41.9
22	92.6	58.4	123	21.4	8.72	17.8	3.99	2.78e	3.41	6.08	46.5	32.7
23	107	46.7	179	19.8	9.69	7.80	2.33	2.51e	5.60	4.20	163	231
24	351	69.9	194	18.1	7.73	4.49	2.96	2.78e	4.53	8.21	104	255
25	320	73.9	107	17.0	7.06	3.84	2.76	2.78e	3.32	7.74	22.3	68.6
26	172	84.1	58.4	15.9	7.53	4.79	3.18	3.02e	2.80	41.3	13.8	45.3
27	199	43.2	40.7	14.9	7.38	4.02	2.24	3.20e	2.70	71.6	158	69.2
28	126	39.1	32.3	16.4	7.14	4.19	3.15	3.14e	2.55	352	91.2	41.5
29	101	—	28.0	30.2	7.30	4.20	3.13	3.09e	2.98	172	74.6	61.1
30	201	—	25.9	23.2	8.79	6.18	2.55	2.76e	2.87	64.8	39.9	201
31	80.2	—	24.4	—	10.7	—	5.15	2.35e	—	42.1	—	70.7
Mean	116	41.6	52.8	63.3	10.4	10.3	3.29	2.82	6.87	30.6	31.8	84.2
Max	351	87.2	194	423	16.7	41.5	5.17	4.07	29.5	352	163	368
Min	28.3	18.6	20.2	14.9	7.06	3.84	2.04	1.59	1.59	2.76	7.15	10.7
Ac-Ft	7149	2310	3246	3767	636	614	202	173	409	1880	1894	5179



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — BVTS

Q in cfs	1 < Q < 2	2 < Q ≤ 4	4 < Q ≤ 6	6 < Q ≤ 9	9 < Q ≤ 13	13 < Q ≤ 20	20 < Q ≤ 30	30 < Q ≤ 40	40 < Q ≤ 60	60 < Q ≤ 100	100 < Q ≤ 250	250 < Q ≤ 700	700 < Q ≤ 1,100
Jan													
Feb													
Mar													
Apr													
May													
Jun													
Jul													
Aug													
Sep													
Oct													
Nov													
Dec													
All	0.13%	4.9%	10.3%	10.3%	9.9%	10.9%	11.2%	8.1%	9.8%	9.9%	10.2%	4.2%	0.14%

*Fill-in values were used for discharge that was reported as greater than the rating curve in 2002–2003.

Key
- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
2002–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — BVTS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002		61.9	52.9	25.8	12.8	8.77	5.97	4.24	4.56	9.48	15.5	
2003	77.1	48.3	82.9	74.1	24.0	10.5	7.43	6.78	5.87	13.8	20.6	93.3
2004	115	80.7	35.5	19.3	13.1	10.1	7.52	7.46	9.08	29.1	25.0	37.6
2005	31.4	17.8	15.1	44.6	45.0	25.4	10.7	6.85	6.14	23.4	57.2	79.8
2006	272	42.7	49.5	38.5	21.3	14.0	8.24	6.22	7.69	10.8	130	88.6
2007	53.5	60.0	51.7	35.3	16.9	10.8	6.23	5.00	4.52	19.3	22.6	126
2008	145	44.9	46.7	30.1	15.8	9.33	5.02	5.93	4.64	4.61	27.4	21.9
2009	32.1	18.6	30.1	21.5	25.9	9.54	4.32	4.67	4.22	13.3	77.9	25.8
2010	101	60.7	44.0	51.0	35.1	39.8	9.57	7.97	12.9	14.4	54.5	143
2011	65.4	50.8	114	57.2	33.6	18.7	14.3	8.81	5.23	7.60	43.7	16.7
2012	74.5	46.9	102	65.9	30.5	22.4	7.12	5.90	5.23	29.9	86.2	154
2013	36.5	29.3	23.0	20.2	16.3	13.8	5.58	4.74	17.1	13.2	24.7	14.6
2014	19.1	67.9	66.0	53.4	28.4	11.3	6.08	3.95	3.24	25.7	34.3	59.6
2015	26.5	35.2	28.5	23.3	10.2	4.33	4.07	3.24	5.06	6.06	27.5	269
2016	149	67.1	85.2	25.6	12.8	8.39	5.60	3.81	5.04	70.6	59.2	63.5
2017	58.7	265	136	49.8	19.0	11.4	5.20	4.44	6.00	14.8	94.1	36.4
2018	92.6	36.3	32.6	30.9	9.96	7.52	2.99	2.78	3.88	6.08	11.9	51.3
median	70.9	48.4	54.0	37.1	18.8	11.5	6.76	5.19	5.84	13.6	38.3	61.1

Key

Q in cfs
- Q ≤ 3.98
- 3.98 < Q ≤ 4.83
- 4.83 < Q ≤ 5.90
- 5.90 < Q ≤ 7.10
- 7.10< Q ≤ 10.5
- 10.5< Q ≤ 15.4
- 15.4 < Q ≤ 22.8
- 22.8 < Q ≤ 58.4
- 58.4 < Q ≤ 144
- 144 < Q ≤ 230
- Q > 230

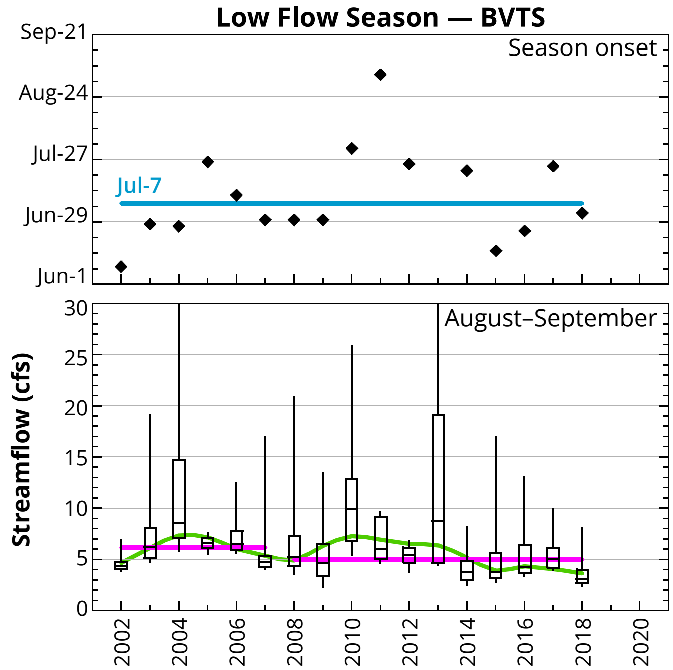
Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Low flow at this site was notable. Except for a few short-lived spikes due to storms, flows were near record minimums in late May and July through August. Record low flows were also intermittent from September through November.
- Storms in early April and late October caused the highest flows, which were near record maximums. The high flows were short-lived which is typical for this site.

CHANGE IN MEASUREMENT

- OWRD monitored flow at this site from 2002 through 2007. Beginning in 2008, monitoring was done by WEST Consultants.
- Flows from 2007 and before (OWRD) are higher than those from 2008 to present (WEST Consultants). Despite considerable variability, the difference is statistically significant and occurs for both high flow and low flow periods.
- Reasons for the difference include:
  —The rating curve and monitoring procedures may have changed.
  —2002–2007 could have been too short a period to capture a dry period.
  —The flow regime truly may have changed.

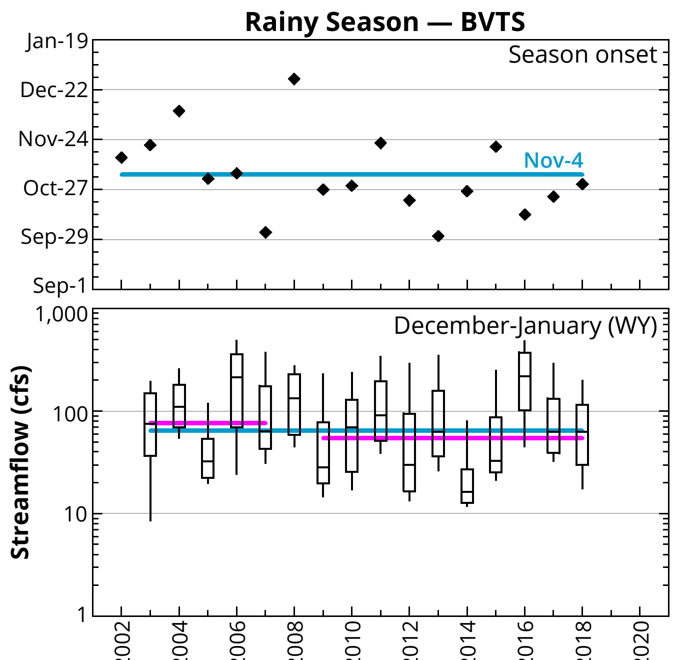


LOW FLOW

- July through September are the months with the lowest average flow and the lowest daily flows.
- Although the July–September median flows are low, higher flows in these months are not uncommon. The August–September boxplots show this variability. This pattern is typical of flashy urban streams such as Beaverton Creek.
- Low flow criterion: 7d-Q ≤ 9 cfs (~25th pctl)

RAINY SEASON FLOW

- December and January are the months with the highest average flows.
- Rainy season criterion: 7d-Q ≥ 60 cfs (~75th pctl)



RCTV – Rock Creek at Hwy 8 near Hillsboro, Oregon – 14206451**

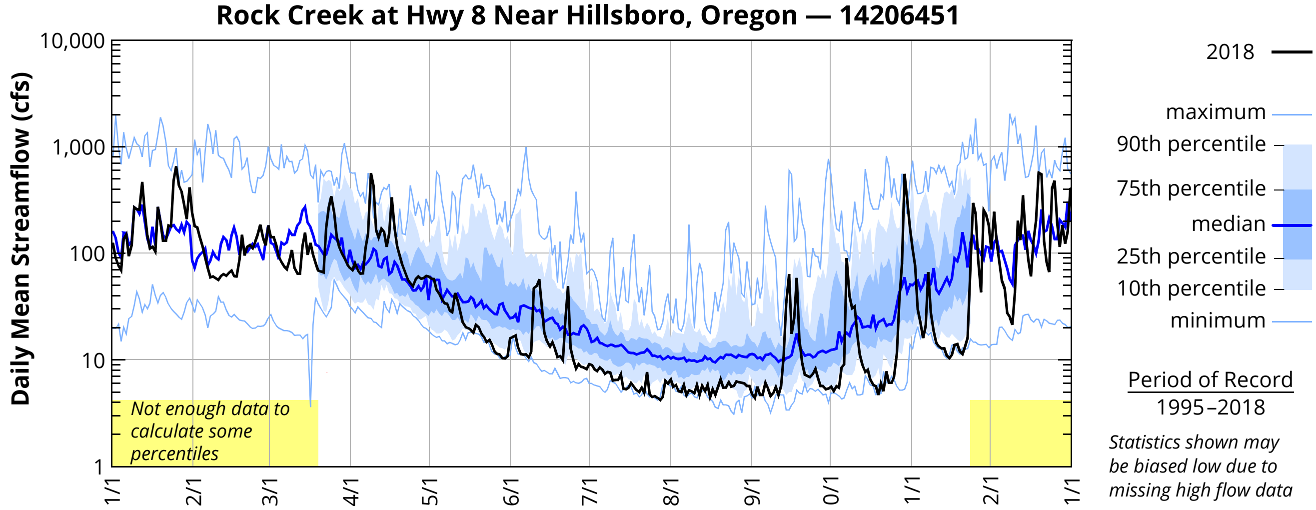
Data source: WEST Consultants for Clean Water Services
River Mile: 1.2 *Latitude:* 45 30 08 *Longitude:* 122 56 52

2018 — MEAN STREAMFLOW (cfs) — RCTV

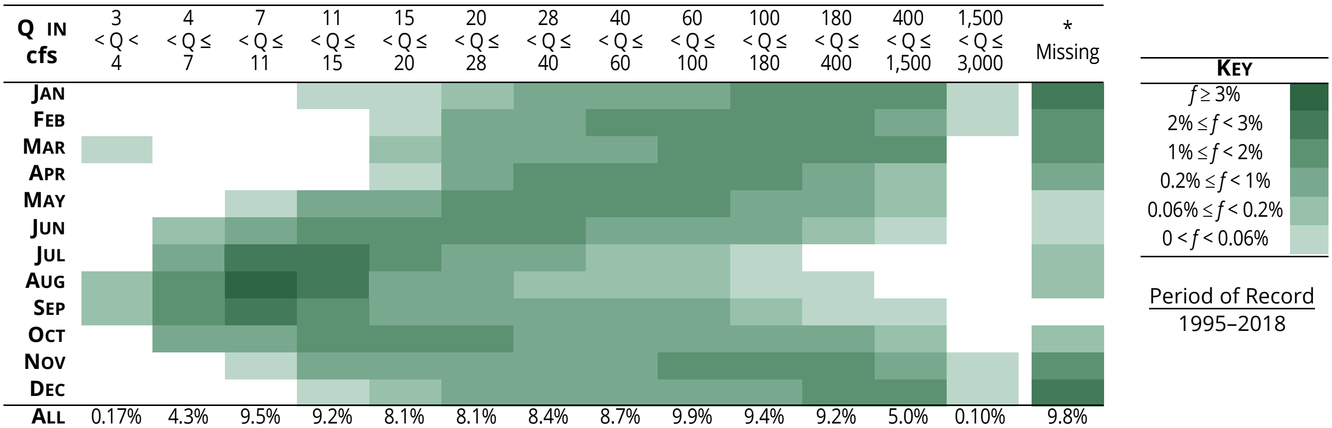
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	122	180	182	69.4e	57.7	16.5	9.04	5.58	4.39	5.13	76.3	246
2	89.5	175	141	80.9e	57.2	17.0	8.16	5.81	5.55	5.68	29.9	127
3	76.2	141	119	69.5e	45.2	13.0e	7.85	5.06	4.65	5.47	22.0	84.0
4	68.9	115	92.9	64.3e	41.7	11.4	8.47	5.01	4.71	8.52	16.0	55.6
5	137	90.5	82.4	64.6e	36.7	11.2	8.11e	5.83	6.07	9.12	20.9	46.8
6	150	72.6	75.2	112e	33.8	11.3	7.35	4.68	5.40	90.0	66.7	27.3
7	94.0	59.5	71.1	154e	33.7	10.6	7.74	5.19	4.60	39.4	27.8	25.1
8	119	60.7	84.9	565e	29.1	12.1	7.59	5.06	4.85	30.6	18.6	21.5
9	268	58.4	107	427e	28.1	47.3	6.39	4.93	5.58	31.8	14.5e	43.5
10	258	56.5	72.4	166e	42.4	49.3	6.52	5.83	4.74	17.5	13.4e	202
11	256	61.4	64.3	141e	35.9	57.2	6.50e	4.69	5.65	11.2	12.8e	133
12	467	63.8	64.2	170e	28.3	32.1	7.36	5.69	10.9	8.76	12.9e	350
13	243	61.6	117	159e	22.3	17.9	5.41	5.07	34.4	7.66	11.0e	155
14	146	65.8	157	115e	20.3	15.0	5.34	5.87	64.1	8.10	10.4e	86.2
15	111	68.8	96.5	153e	19.9	13.3	5.50	4.51	17.6	6.54	11.2e	60.9
16	115	60.7	125	335e	19.1	14.7	6.12	5.34	24.8	5.76	13.8e	131
17	103	60.5	96.9	172e	18.1e	12.7	5.60	4.67	58.9	5.65	14.1e	204
18	272	87.5	80.8	116	21.3e	10.7	5.23	5.59	15.8	4.65	12.0e	569
19	196	149	68.9	94.8	20.1	10.9	4.97	6.60	9.29	6.01	11.4e	553
20	131	95.6	67.7	77.4	17.7	9.86	5.47	5.51	7.25	5.05	13.3e	130
21	131	115	66.0	65.9	16.5	24.4	4.94	5.52	7.12	7.80	16.1e	82.7
22	182	120	174	56.9	14.7	49.2	7.67	6.19	6.93	6.07	65.4e	66.8
23	179	112	267	52.5	15.4	12.9	4.80	5.60	7.44	6.13	297	406
24	479	128	342	49.5	13.9	9.87e	4.49	5.74	8.31	6.95	236	480
25	656	151	240	56.9	12.0e	8.29	4.64	6.26	6.80	11.6	87.3	195
26	426	185	143	60.5	11.4e	9.17	4.37	6.22	5.69	37.8	43.2	115
27	378	139	113	57.8	11.3	8.61	4.24	6.09	5.66	80.8	253	184
28	286	119	99.5	58.6	10.4	8.52	4.46	5.98	5.29	554	229	123
29	209	—	89.9	61.3	10.3	8.16	6.41	5.70	5.37	321	184	160
30	416	—	78.6e	60.5	10.8	9.22	6.00	5.72	5.57	172	109	400
31	239	—	73.1e	—	16.1	—	6.62	4.79	—	110	—	271
Mean	226	102	118	130	24.9	18.1	6.24	5.49	12.1	52.5	65.0	185
Max	656	185	342	565	57.7	57.2	9.04	6.60	64.1	554	297	569
Min	68.9	56.5	64.2	49.5	10.3	8.16	4.24	4.51	4.39	4.65	10.4	21.5
Ac-Ft	13891	5659	7244	7708	1530	1076	384	338	721	3227	3866	11374

**Site moved 120 feet downstream in 2012, previous ID was 14206450; e=estimated

Rock Creek at Hwy 8 Near Hillsboro, Oregon — 14206451



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — RCTV



Period of Record
1995–2018

*All missing values date from before 2008 and most are known to exceed the upper limit of the rating curve. Therefore the statistics above underestimate the magnitude and frequency of high flow.

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — RCTV

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995				102	40.2	22.2	12.3	10.2	9.5	24.9		
1996					161	30.0	15.8	10.2	15.9	50.8		
1997				81.0	41.8	38.4	16.5	11.3	15.1			
1998				53.3	153	35.4	18.3	14.3	13.7	26.9		
1999				60.8	39.6	22.0	15.8	14.9	12.0	14.3		
2000		206	149	37.2	30.0	17.9		11.7	12.9	26.6	20.1	61.2
2001	37.5	41.1	35.9	38.1	17.9	16.0	9.8	9.5	8.6	13.7	83.6	
2002			125	41.1	22.8	16.8	13.2	10.0	9.4	17.7	27.0	133
2003			368	155	37.8	17.3	12.5	12.0	11.1	23.3	30.6	178
2004	288		61.6	30.4	18.8	16.2	11.5	11.3	14.0	31.4	30.6	50.5
2005	52.2	30.4	21.6	81.0	82.4	32.7	16.4	13.0	10.7	31.1	104	
2006			118	70.9	28.4	26.7	11.1	10.8	11.9	15.8	447	
2007		147	182	53.5	22.5	19.2	10.7		17.4	26.3	35.4	
2008	334	127	121	68.0	33.7	16.5	8.7	9.0	6.1	7.8	44.7	31.3
2009	102	45.1	71.3	49.7	54.7	28.1	7.6	7.0	8.0	25.2	177	59.9
2010	377	217	151	176	67.0	85.3	19.8	15.8	20.7	19.9	122	352
2011	231	103	265	118	64.8	29.9	19.5	9.0	6.8	18.6	43.8	30.0
2012	104	96.7	291	118	66.0	37.6	14.0	9.8	8.2	49.1	126	434
2013	91.1	70.7	56.0	41.5	24.2	32.4	9.6	7.3	28.2	19.8	42.2	26.8
2014	43.6	132	135	122	47.7	19.6	12.6	5.9	5.2	50.4	61.8	143
2015	54.0	53.4	53.7	55.5	18.2	7.8	5.8	4.5	8.1	10.5	68.4	433
2016	357	181	226	53.6	21.9	15.3	10.3	5.8	9.5	108	111	196
2017	147	404	295	137	62.5	20.8	8.2	7.2	8.1	24.2	146	92.0
2018	182	93.1	96.5	79.2	20.1	12.4	6.1	5.6	5.9	8.5	19.8	131
median	159	111	131	69.7	36.7	22.9	12.3	10.3	11.2	23.2	70.1	133

Key

Q in cfs
- Q ≤ 7.0
- 7.0 < Q ≤ 9.1
- 9.1 < Q ≤ 11.0
- 11.0 < Q ≤ 13.0
- 13.0< Q ≤ 17.0
- 17.0< Q ≤ 24.0
- 24.0 < Q ≤ 35.0
- .530 < Q ≤ 107
- 107 < Q ≤ 276
- 276 < Q ≤ 423
- Q > 423

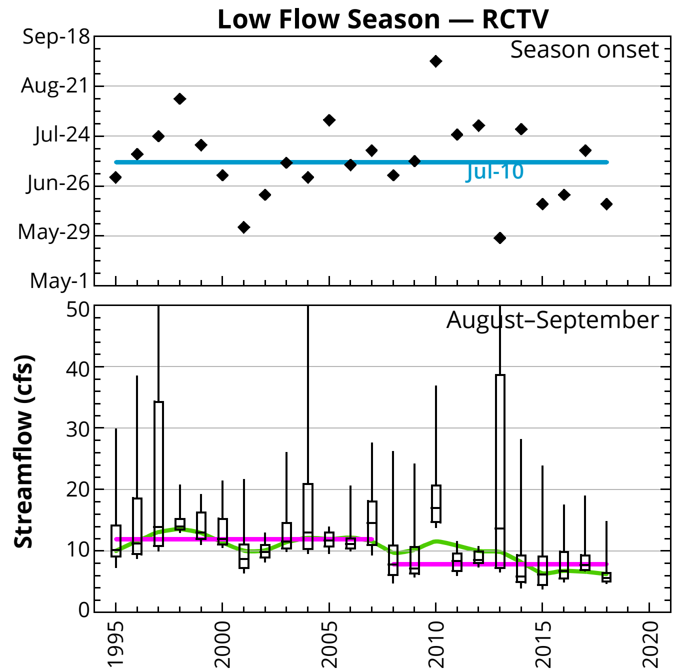
Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Low flow was notable. Flows were near record minimums in late May, mid-July through mid-August, mid-October, and much of November.
- Storms in early April and late October caused the highest flows, which were near record maximums. The high flows were short-lived which is typical for this site.

Change in Measurement

- OWRD monitored flow at this site from 1995 through 2007. Beginning in 2008, monitoring was done by WEST Consultants.
- Flows during the August–September period from 2007 and before (OWRD) are higher than those from 2008 to present (WEST Consultants). Despite considerable variability, the difference is statistically significant.
- Rainy season onset since 2008 is earlier than from 1999–2007. The difference is statistically significant.
- Reasons for these differences are most likely due to differences in rating curves and monitoring, although true changes in the flow regime are possible.

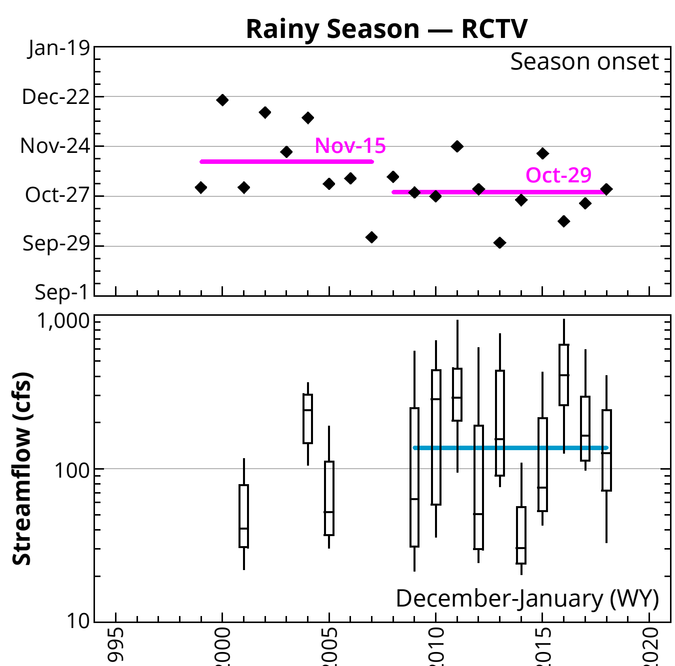


Low flow

- July through September are the months with the lowest average flow and the lowest daily flows.
- Although the July–September median flows are low, higher flows in these months are not uncommon. This pattern is typical of flashy urban streams such as Rock Creek.
- Low flow criterion: 7d-Q ≤ 15 cfs (~25th pctl)

Rainy season flow

- December through March are the months with the highest average flows.
- Rainy season criterion: 7d-Q ≥ 100 cfs (~74th pctl)
- Boxplots and onset of rainy season flow are not shown for years when too much data was missing.



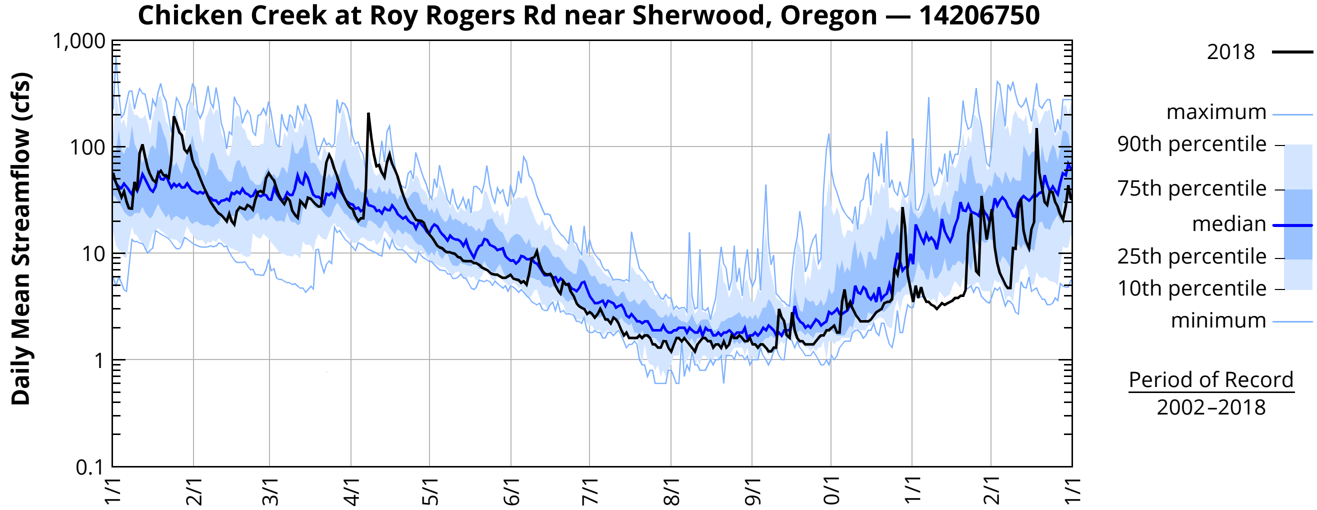
CCSR — Chicken Creek at Roy Rogers Rd near Sherwood, Oregon — 14206750

Data source: WEST Consultants for Clean Water Services
River Mile: 2.3 *Latitude:* 45 22 31 *Longitude:* 122 51 24

2018 — MEAN STREAMFLOW (cfs) — CCSR

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	55.4	65.2	56.3	26.9	15.3	6.26	2.75	1.22	1.43	1.99	3.46	25.9
2	45.9	59.0	52.0	25.9	14.1	5.75	2.66	1.35	1.43	2.05	4.98	11.4
3	38.7	50.5	48.3	22.2	12.9	5.68	2.53	1.56	1.32	1.81	3.76	8.08
4	33.5	43.3	40.4	20.0	11.8	5.55	2.65	1.57	1.38	1.79	4.81	6.53
5	38.2	38.2	34.8	21.3	11.3	5.28	2.95	1.45	1.38	3.54	3.91	5.78
6	30.6	33.5	31.0	21.3	11.1	5.47	2.66	1.64	1.29	4.56	3.45	5.12
7	26.4	30.0	29.0	41.3	10.5	5.09	2.36	1.54	1.20	3.05	3.46	4.68
8	26.2	27.6	33.2	208	10.2	6.35	2.35	1.36	1.21	3.49	3.30	4.71
9	46.7	25.2	31.2	122	10.2	8.98	2.22	1.34	1.34	3.00	3.15	11.2
10	38.5	23.8	25.0	83.8	9.96	9.24	2.51	1.23	1.34	2.65	3.04	11.0
11	86.4	22.9	22.9	65.7	9.79	10.5	2.36	1.43	2.96	2.53	3.17	26.6
12	105	21.6	21.5	67.3	9.18	7.88	2.18	1.53	2.46	2.34	3.39	32.5
13	80.8	20.0	30.9	56.8	9.07	6.85	1.89	1.58	2.34	2.32	3.26	16.3
14	63.8	23.4	29.3	51.6	8.47	6.50	1.68	1.62	1.74	2.26	3.42	12.8
15	54.3	20.0	27.2	71.9	8.40	6.31	1.80	1.49	1.62	2.34	3.48	11.1
16	48.8	18.7	33.0	84.8	8.36	6.41	1.60	1.49	2.84	2.44	3.64	17.2
17	46.2	25.0	32.4	68.9	8.39	5.91	1.63	1.27	1.89	2.63	3.80	19.9
18	55.9	27.0	30.4	60.1	8.07	5.04	1.56	1.42	1.57	2.81	3.79	149
19	58.9	26.3	28.7	52.4	8.12	4.51	1.60	1.42	1.48	2.93	3.97	57.4
20	54.1	25.8	27.3	43.4	7.83	4.21	1.68	1.26	1.45	2.97	4.01	40.4
21	53.3	28.5	27.6	35.9	7.42	5.53	1.63	1.49	1.37	3.39	4.58	30.3
22	50.8	27.4	48.0	30.5	7.20	5.07	1.74	1.31	1.41	3.52	15.2	28.5
23	75.4	25.6	72.5	26.9	6.95	5.10	1.67	1.44	1.44	3.48	23.8	38.1
24	193	32.2	84.1	24.9	6.60	4.27	1.58	1.72	1.41	3.73	12.8	37.2
25	167	37.8	74.7	22.4	6.42	3.88	1.41	1.61	1.49	7.25	6.82	30.0
26	136	38.5	60.9	20.6	6.32	3.41	1.40	1.63	1.57	6.26	6.44	27.1
27	128	36.9	52.9	20.2	6.32	3.18	1.31	1.66	1.67	8.42	34.6	23.0
28	94.4	50.8	44.2	20.1	6.07	3.14	1.27	1.60	1.74	27.0	20.6	20.6
29	88.0	—	37.3	19.3	5.85	2.99	1.46	1.46	1.89	17.4	13.5	27.7
30	99.3	—	32.7	16.8	5.86	2.72	1.53	1.54	1.87	6.28	19.1	43.7
31	74.5	—	28.9	—	6.11	—	1.28	1.56	—	4.60	—	32.4
Mean	70.8	32.3	39.6	48.4	8.84	5.57	1.93	1.48	1.65	4.67	7.69	26.3
Max	193	65.2	84.1	208	15.3	10.5	2.95	1.72	2.96	27.0	34.6	149
Min	26.2	18.7	21.5	16.8	5.85	2.72	1.27	1.22	1.20	1.79	3.04	4.68
Ac-Ft	4352	1794	2437	2882	544	331	119	90.8	98.2	287	458	1619

Chicken Creek at Roy Rogers Rd near Sherwood, Oregon — 14206750



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — CCSR

Q in cfs	0.5 < Q < 0.8	0.8 < Q ≤ 1.6	1.6 < Q ≤ 2.2	2.2 < Q ≤ 3.5	3.5 < Q ≤ 6	6 < Q ≤ 10	10 < Q ≤ 15	15 < Q ≤ 22	22 < Q ≤ 32	32 < Q ≤ 50	50 < Q ≤ 120	120 < Q ≤ 300	300 < Q ≤ 750	Missing
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
All	0.26%	5.2%	9.3%	10.6%	10.4%	9.6%	0.2%	9.9%	10.1%	11.1%	9.2%	4.3%	0.35%	0.40%

Key

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
2002–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — CCSR

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	65.0	48.5	46.5		9.80	5.00	2.20	1.70	1.70	2.70	6.95	30.0
2003	33.0	39.1	47.9	36.3	14.6	6.08	2.49	1.52	1.98	4.31	7.26	37.0
2004	45.2	43.2	21.7	12.8	6.82	4.22	1.50	1.27	1.93	4.47	5.68	14.7
2005	15.1	9.74	6.59	23.7	23.0	6.80	2.17	1.04	1.29	3.16	18.1	32.8
2006	180	31.2	30.2	20.8	9.49	5.37	2.33	1.47	1.26	2.50	54.0	62.4
2007	37.7	37.7	33.7	26.5	11.2	4.79	2.22	1.91	3.06	20.4	30.8	62.1
2008	61.1	44.9	41.9	27.2	14.4	7.23	2.92	3.16	3.51	4.37	7.97	8.68
2009	20.5	11.7	19.5	13.1	16.8	6.88	2.43	1.48	2.03	4.20	21.3	16.8
2010	66.6	36.7	36.5	28.0	16.4	21.2	4.05	1.82	2.83	4.29	27.7	77.3
2011	51.6	33.6	76.5	39.7	18.7	10.3	5.59	1.93	2.12	4.51	9.08	5.94
2012	40.5	34.8	67.7	43.0	22.9	11.9	5.59	2.33	1.83	10.1	25.7	102
2013	19.4	16.7	16.7	14.1	7.74	11.5	3.49	1.95	4.04	14.1	21.4	8.12
2014	15.5	42.0	43.2	30.1	14.9	6.04	3.38	2.15	2.18	4.02	15.7	39.3
2015	19.1	29.5	25.0	17.6	7.10	3.35	1.87	1.78	1.80	2.17	15.1	167
2016	74.0	43.5	49.1	15.3	7.34	4.52	2.57	1.84	2.12	26.5	32.9	53.2
2017	42.4	141	88.1	34.3	19.2	9.64	4.07	2.39	3.20	4.36	41.0	30.0
2018	55.4	27.5	32.7	33.2	8.39	5.50	1.68	1.49	1.47	3.00	3.86	23.0
median	44.5	34.8	36.8	24.2	12.0	6.26	2.65	1.81	2.05	4.39	18.4	35.1

Key

Q in cfs

- Q ≤ 1.56
- 1.56 < Q ≤ 1.83
- 1.83 < Q ≤ 2.20
- 2.20 < Q ≤ 2.72
- 2.72< Q ≤ 4.51
- 4.51< Q ≤ 7.31
- 7.31 < Q ≤ 12.2
- 12.2 < Q ≤ 32.1
- 32.1 < Q ≤ 64.2
- 64.2 < Q ≤ 113
- Q > 113

Q as percentile

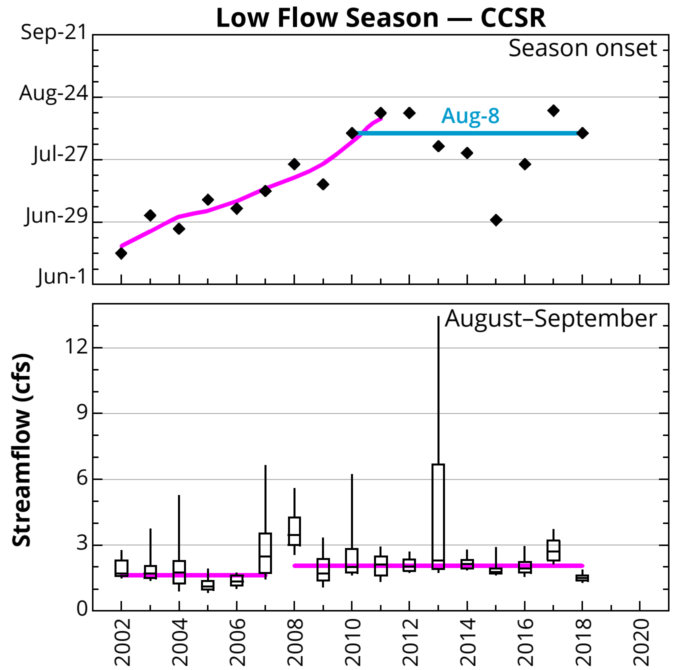
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Flow in the first half of November set record minimums. From early summer through fall, flows were also low, but not record-setting.
- A storm in early April caused the high flows which were near record maximums.

Change in Measurement

- OWRD monitored flow at this site from 2002 through 2007. Beginning in 2008, monitoring was done by WEST Consultants.
- Flows during the August–September period from 2007 and before (OWRD) are lower than those from 2008 to present (WEST Consultants). Despite considerable variability, the difference is statistically significant.
- This difference is most likely due to differences in rating curves and monitoring, although true changes in the flow regime are possible.

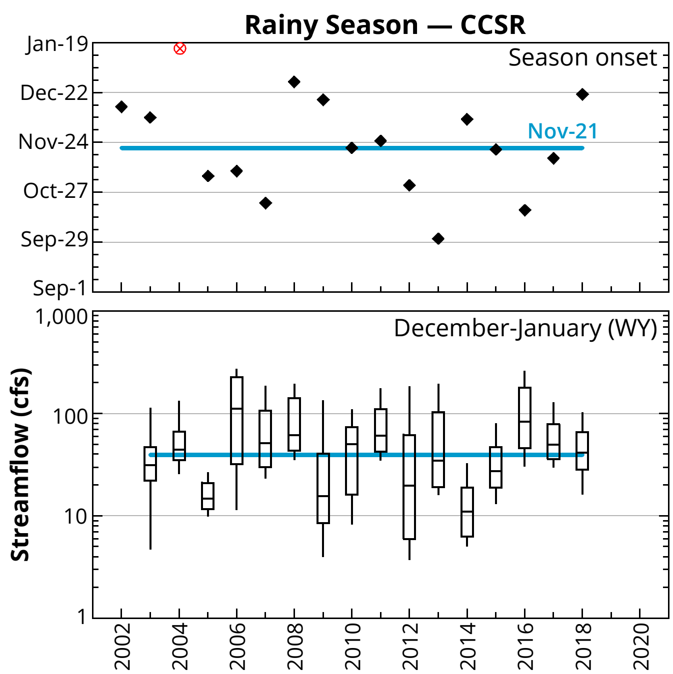


Low flow

- July through September are the months with the lowest average flows, with August consistently having the lowest of the three. The lowest daily flows occur in July and August.
- Although September often has very low flow, occasionally early fall rains cause high flows as was the case in 2013.
- Low flow criterion: 7d-Q ≤ 3.5cfs (~25th pctl)
- The onset of low flow became steadily later between 2002 and 2011. The trend is statistically significant for that time period. Since then, low flow onset has been variable with no trend.

Rainy season flow

- December through March are the months with the highest average flows.
- Rainy season criterion: 7d-Q ≥ 30 cfs (~73th pctl)
- Rainy season flow for 2004 did not occur until the following March (3/30/2005)



6900 – Fanno Creek at 56th Avenue – 14206900

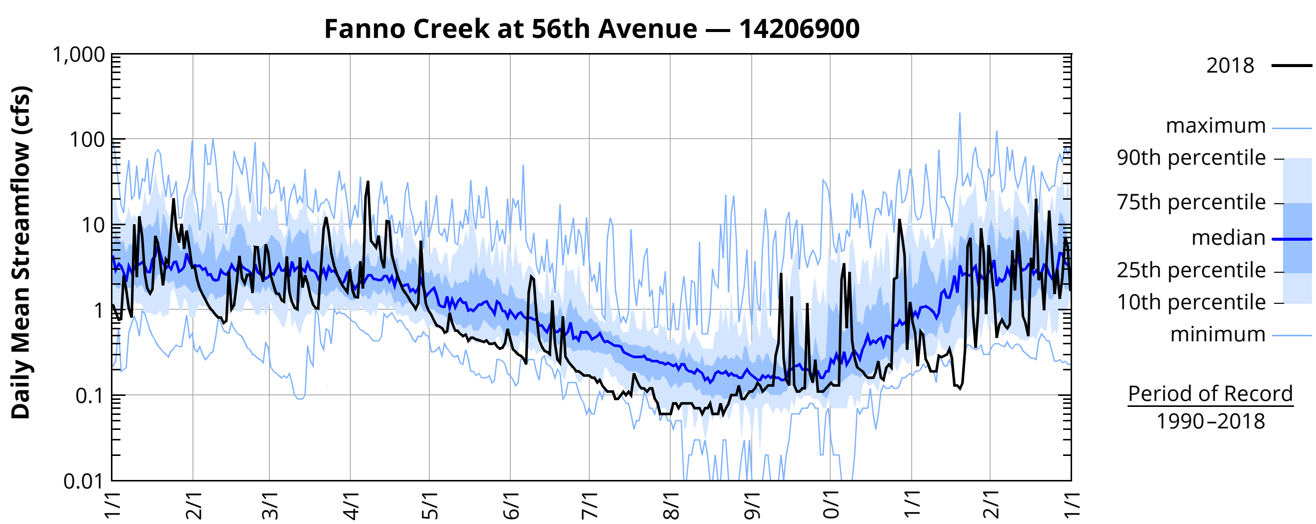
Data source: U.S. Geological Survey, Oregon Water Science Center

River Mile: 12.6 *Latitude:* 45 29 17 *Longitude:* 122 44 01 *Drainage area:* 2.37 sq mile

2018 — MEAN STREAMFLOW (cfs) — 6900

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1.12	3.16	4.62	2.97	0.97	0.46	0.17	0.06	0.11	0.14	0.71	2.94
2	0.93	2.23	2.48	1.71	0.86	0.34	0.16	0.08	0.12	0.13	0.54	1.39
3	0.76	1.76	1.90	1.41	0.74	0.32	0.16	0.08	0.14	0.13	0.22	0.47
4	0.78	1.50	1.54	1.39	0.65	0.30	0.14	0.07	0.13	0.13	0.56	0.67
5	2.52	1.31	1.53	3.70	0.64	0.29	0.15	0.08e	0.11	2.29	0.51	0.76
6	1.71	1.14	1.30	1.78	0.61	0.27	0.13	0.08e	0.12	3.50	0.26	0.66
7	1.04	1.02	1.25	20.7	0.54	0.23	0.12	0.08	0.13	0.61	0.23	0.61
8	0.81	0.96	4.20	32.2	0.56	1.60	0.11	0.08	0.13	2.75	0.19	0.68
9	10.0	0.87	1.61	6.44	0.92	2.43	0.11	0.08	0.13	0.44	0.19	4.97
10	2.41	0.81	1.22	5.92	0.69	2.27	0.11	0.07	0.29	0.27	0.19	1.68
11	12.4	0.81	1.06	5.35	0.57	0.89	0.09	0.07	0.41	0.21	0.29	8.51
12	7.12	0.70	1.01	7.37	0.57	0.44	0.09	0.07	2.68	0.20	0.28	3.54
13	2.64	0.74	4.09	3.85	0.52	0.37	0.10	0.06	0.27	0.19	0.29	0.83
14	1.76	2.81	1.83	3.06	0.49	0.33	0.11	0.07	0.15	0.17	0.30	0.69
15	1.55	1.02	2.52	10.9	0.51	0.32	0.10	0.07	0.13	0.16	0.35	0.49
16	1.74	1.13	2.04	10.7	0.43	0.30	0.11	0.08	1.43	0.16	0.27	4.05
17	7.35	1.98	1.43	4.45	0.47	1.28	0.10	0.06	0.13	0.16	0.13	2.98
18	6.01	4.29	1.15	3.32	0.47	0.41	0.18	0.06	0.11	0.19	0.13	19.9
19	3.51	2.32	1.05	2.55	0.45	0.26	0.15	0.06	0.11	0.25	0.12	2.23
20	1.94	2.03	1.03	2.11	0.44	0.24	0.13	0.08	0.12	0.16	0.14	2.74
21	3.85	2.56	2.69	1.76	0.43	0.84	0.12	0.06	0.12	0.15	0.34	0.99
22	3.48	2.60	8.83	1.58	0.42	0.28	0.12	0.07	1.19	0.21	5.51	4.47
23	8.87	1.58	12.2	1.42	0.44	0.25	0.11	0.08	0.18	0.23	6.95	14.5
24	20.3	5.41	8.22	1.26	0.40	0.23	0.12	0.10	0.14	0.21	0.88	4.82
25	9.43	5.36	4.55	1.15	0.40	0.21	0.12	0.10	0.26	2.30	0.36	1.53
26	6.11	2.90	3.26	1.02	0.41	0.19	0.09	0.10	0.11	2.39	0.97	3.02
27	10.2	2.13	2.66	1.20	0.37	0.19	0.08	0.13	0.11	11.6	9.00	1.35
28	5.18	5.83	2.22	6.44	0.35	0.18	0.06	0.09	0.11	7.40	4.76	2.35
29	8.50	—	1.97	1.95	0.36	0.17	0.06	0.09	0.12	4.35	0.89	7.07
30	5.20	—	1.79	1.15	0.41	0.17	0.06	0.10	0.13	0.34	5.70	5.42
31	3.11	—	1.62	—	0.60	—	0.06	0.11	—	1.24	—	1.72
Mean	4.91	2.18	2.87	5.03	0.54	0.54	0.11	0.08	0.31	1.38	1.38	3.48
Max	20.3	5.83	12.2	32.2	0.97	2.43	0.18	0.13	2.68	11.6	9.00	19.9
Min	0.76	0.70	1.01	1.02	0.35	0.17	0.06	0.06	0.11	0.13	0.12	0.47
Ac-Ft	302	121	176	299	33.1	31.9	6.98	4.90	18.7	84.6	81.8	214

e=estimated



FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — 6900

Q in cfs	0.01 < Q < 0.02	0.02 < Q ≤ 0.1	0.1 < Q ≤ 0.2	0.2 < Q ≤ 0.3	0.3 < Q ≤ 0.5	0.5 < Q ≤ 0.8	0.8 < Q ≤ 1.3	1.3 < Q ≤ 2	2 < Q ≤ 3	3 < Q ≤ 5	5 < Q ≤ 12	12 < Q ≤ 80	80 < Q ≤ 300
Jan													
Feb													
Mar													
Apr													
May													
Jun													
Jul													
Aug													
Sep													
Oct													
Nov													
Dec													
All	0.27%	3.8%	9.8%	8.0%	10.8%	9.6%	10.5%	11.4%	10.5%	9.9%	10.1%	5.4%	0.10%

*Data from October – December 1990 not used to prevent skewing distribution.

Key

- *f* ≥ 3%
- 2% ≤ *f* < 3%
- 1% ≤ *f* < 2%
- 0.2% ≤ *f* < 1%
- 0.06% ≤ *f* < 0.2%
- 0 < *f* < 0.06%

Period of Record
1990*–2018

MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — 6900

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990										0.46	1.50	2.10
1991	2.20	3.45	2.60	1.95	1.30	0.92	0.65	0.39	0.21	0.16	2.35	2.60
1992	2.50	2.95	1.50	1.70	0.50	0.26	0.14	0.09	0.08	0.19	0.85	1.60
1993	1.90	1.25	2.90	3.80	2.10	0.97	0.62	0.52	0.38	0.49	0.55	0.71
1994	1.30	1.50	1.40	1.60	0.70	0.49	0.34	0.19	0.13	0.15	2.05	5.30
1995	4.20	3.40	3.20	2.65	1.20	0.93	0.41	0.36	0.33	0.56	2.85	5.30
1996	6.40	9.55	2.20	2.75	2.30	0.75	0.43	0.22	0.20	1.70	4.10	12.0
1997	4.00	1.85	5.90	2.00	0.80	0.68	0.30	0.25	0.33	0.74	2.00	2.10
1998	6.50	4.85	3.30	1.20	2.80	1.00	0.44	0.27	0.21	0.41	4.85	7.30
1999	6.30	9.60	4.30	1.80	1.10	0.59	0.34	0.22	0.10	0.16	2.25	2.20
2000	4.80	3.35	2.70	1.05	1.00	0.50	0.28	0.20	0.20	0.37	0.60	1.00
2001	0.73	0.81	1.30	1.20	0.65	0.46	0.26	0.20	0.16	0.22	2.08	5.11
2002	4.71	3.21	2.76	1.24	0.65	0.46	0.20	0.14	0.19	0.21	0.40	2.92
2003	3.60	2.49	2.95	3.79	1.57	0.69	0.30	0.25	0.22	0.28	1.19	5.63
2004	6.56	3.93	1.67	0.69	0.27	0.20	0.13	0.16	0.24	0.44	0.90	2.35
2005	2.02	0.73	0.25	2.53	2.85	1.17	0.30	0.16	0.12	0.46	0.78	1.46
2006	8.45	2.41	2.47	1.99	1.03	0.78	0.30	0.14	0.12	0.24	6.16	3.46
2007	2.71	3.32	3.14	1.76	0.75	0.48	0.27	0.16	0.16	0.65	1.07	5.60
2008	5.28	3.16	3.42	1.84	0.79	0.57	0.19	0.21	0.11	0.16	1.44	1.56
2009	2.91	1.78	1.48	1.00	1.14	0.40	0.25	0.12	0.17	0.33	2.84	1.65
2010	5.31	2.58	1.93	2.60	2.01	2.05	0.42	0.21	0.27	0.43	2.53	4.60
2011	2.97	2.50	6.27	3.55	1.95	0.86	0.54	0.32	0.19	0.35	1.60	0.57
2012	2.70	1.95	6.18	3.60	1.89	1.17	0.38	0.11	0.08	0.53	2.03	5.63
2013	1.83	1.40	1.22	1.05	0.51	0.75	0.22	0.05	0.31	0.47	0.48	0.42
2014	0.43	1.96	3.27	3.45	2.08	0.74	0.54	0.09	0.07	0.40	1.42	3.15
2015	1.47	3.44	4.12	2.66	0.88	0.40	0.19	0.03	0.20	0.48	1.68	11.5
2016	6.76	5.53	5.12	1.50	1.03	0.37	0.09	0.03	0.12	3.12	2.24	3.00
2017	2.96	7.22	6.58	3.22	1.58	0.55	0.22	0.12	0.16	0.49	2.41	1.09
2018	3.48	1.87	1.90	2.76	0.49	0.30	0.11	0.08	0.13	0.21	0.32	2.23
median	3.38	2.76	2.80	2.12	1.14	0.66	0.31	0.19	0.18	0.40	1.60	2.90

Key

Q in cfs

- Q ≤ 0.11
- 0.11 < Q ≤ 0.16
- 0.16 < Q ≤ 0.21
- 0.21 < Q ≤ 0.26
- 0.26< Q ≤ 0.44
- 0.44< Q ≤ 0.70
- 0.70 < Q ≤ 1.13
- 1.13 < Q ≤ 3.00
- 3.00 < Q ≤ 7.34
- 7.34 < Q ≤ 12.5
- Q > 12.5

Q as percentile

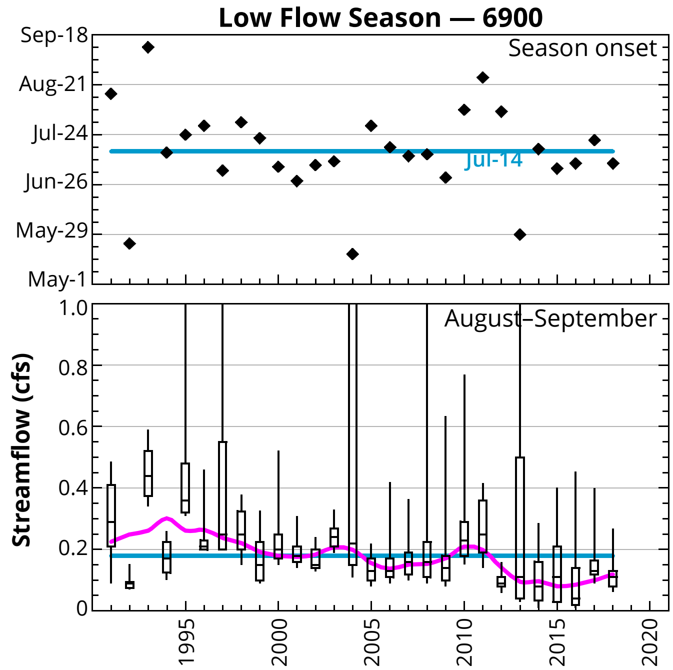
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Flow in the first half of November set record minimums. From May through August, flows were also low (except for during a few storms), but not record-setting.
- A storm in early April caused high flows which were near record maximums.

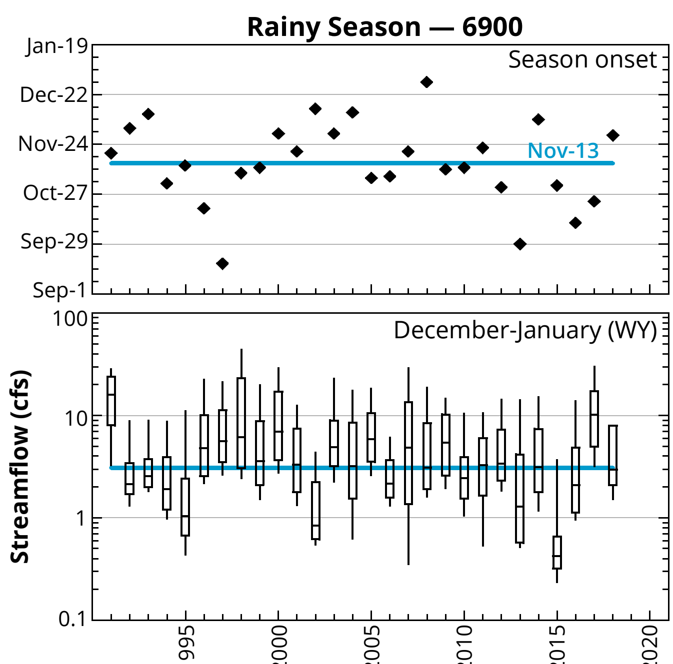
Low flow

- August and September are the months with the lowest average flow and the lowest daily flows.
- August–September flows show a statistically significant decreasing trend. The reason for the decrease is unknown. Monitoring protocols have not changed at this site.
- Low flow criterion: 7d-Q ≤ 0.4 cfs (~27th pctl)
- Spring rainfall in both 2010 and 2011 was high, resulting in later onset of low flow and higher flows that persisted into summer.



Rainy season flow

- December through March are the months with the highest average flows.
- No trends are evident in the magnitude of the flow for December–January.
- Rainy season criterion: 7d-Q ≥ 3.0 cfs (~74th pctl)
- Rainfall in the fall of 2014 was low compared to most years, resulting in low WY 2015 December–January flow.



FANO – Fanno Creek at Durham – 14206950

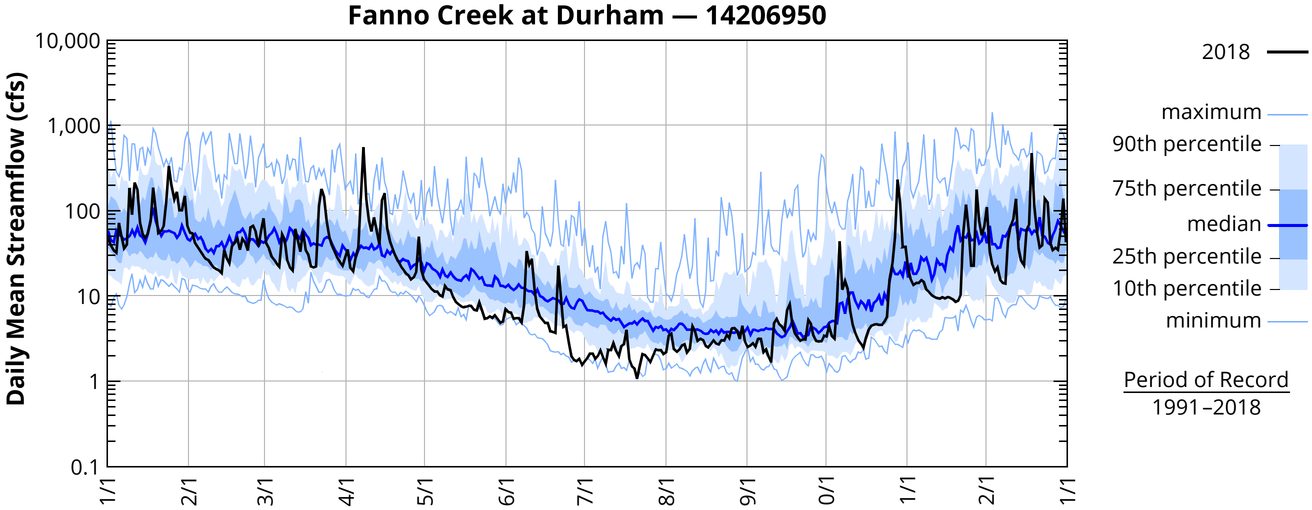
Data source: U.S. Geological Survey, Oregon Water Science Center

River Mile: 1.2 *Latitude:* 45 24 13 *Longitude:* 122 45 13 *Drainage area:* 31.50 sq mile

2018 — MEAN STREAMFLOW (cfs) — FANO

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	47.3	55.2	81.2	28.0	15.9	6.97	1.71	2.19	2.52	3.34	20.9	110
2	38.7	54.0	41.3	35.1	14.3	6.48	1.87	3.45	2.63	4.38	15.6	33.2
3	34.0	41.5	35.7	21.4	13.1	6.34	2.11	3.64	2.79	3.38	13.5	23.3
4	32.0	36.6	29.0	19.6	11.9	5.40	2.10	2.38	2.55	3.17	14.2	19.4
5	71.8	33.2	26.6	29.0	11.2	5.50	1.83	2.22	3.16	8.99	14.2	21.6
6	50.0	29.7	23.8	36.9	11.2	5.51	1.98	2.36	3.14	43.7	15.3	15.5
7	36.4	27.4	22.1	151	10.2	4.90	2.31	2.64	2.20	11.8	14.5	14.2
8	40.8	26.4	52.5	551	9.86	7.82	1.93	2.73	2.38	14.9	11.8	14.0
9	184	23.7	45.7	136	13.1	33.6	1.60	2.17	1.93	12.1	11.0	44.7
10	89.7	21.7	25.9	77.3	11.9	23.5	2.34	2.42	1.67	6.72	10.2	66.2
11	213	20.8	21.7	56.8	11.6	27.3	2.32	4.38	4.83	4.57	9.80	81.1
12	173	20.1	19.8	83.6	9.66	11.7	2.79	3.86	5.38	3.65	9.43	138
13	72.2	18.5	61.0	57.0	8.52	7.14	2.24	2.97	4.66	3.05	9.28	35.9
14	53.1	34.7	44.7	40.4	8.05	5.79	1.97	3.15	4.39	2.77	9.71	25.7
15	48.3	27.4	33.1	135	7.54	5.28	2.58	3.06	3.87	2.46	9.39	22.9
16	53.5	24.0	58.2	160	7.37	4.80	2.73	2.61	6.95	3.21	9.73	59.8
17	74.2	38.2	34.0	62.4	7.46	4.80	4.02	2.49	8.12	4.07	9.54	69.2
18	186	42.1	30.1	43.5	7.69	3.84	1.78	2.73	4.72	4.48	9.10	473
19	98.5	47.3	22.3	35.7	7.63	3.77	1.49	3.02	3.66	4.62	8.53	116
20	54.8	34.8	21.6	29.8	6.86	3.68	1.40	2.77	3.26	4.66	8.80	55.2
21	58.1	46.7	22.2	25.9	6.75	22.7	1.07	2.71	2.99	4.58	10.4	37.1
22	67.4	42.2	114	22.6	8.37	10.2	1.49	3.03	3.11	4.59	53.5	39.2
23	128	34.1	179	20.6	6.89	4.35	2.08	3.01	3.08	5.03	118	139
24	336	63.7	145	18.4	5.37	4.50	2.03	3.53	5.22	5.72	61.0	125
25	199	66.4	76.4	17.5	5.51	2.82	1.86	3.21	4.69	15.8	22.7	42.0
26	136	56.8	48.0	15.6	5.80	1.97	1.68	4.16	3.41	24.1	22.6	34.4
27	166	38.0	38.3	16.6	5.55	1.79	2.02	4.21	2.96	49.1	177	36.6
28	101	57.5	32.9	19.4	5.95	1.73	2.37	3.90	2.92	231	75.6	34.4
29	101	—	28.1	49.8	5.33	1.83	2.32	3.13	2.95	122	51.5	60.8
30	148	—	25.1	20.1	4.88	1.55	2.31	4.50	3.42	37.4	65.6	139
31	65.4	—	22.7	—	5.04	—	2.08	2.93	—	37.5	—	43.8
Mean	102	38.0	47.2	67.2	8.73	7.92	2.08	3.08	3.65	22.2	29.7	70.0
Max	336	66.4	179	551	15.9	33.6	4.02	4.50	8.12	231	177	473
Min	32.0	18.5	19.8	15.6	4.88	1.55	1.07	2.17	1.67	2.46	8.53	14.0
Ac-Ft	6262	2108	2900	3999	536	471	128	190	217	1362	1770	4305

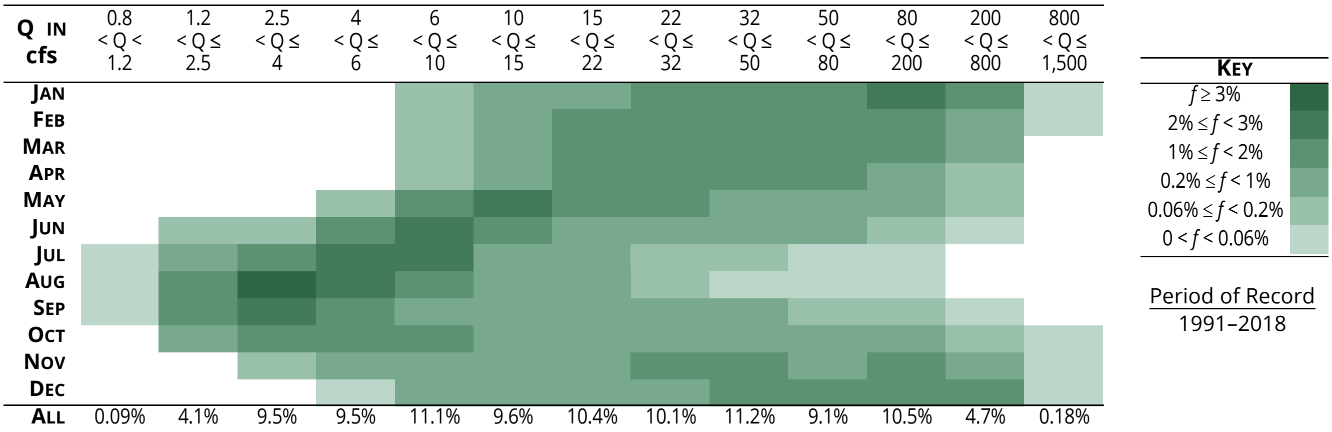
Fanno Creek at Durham — 14206950



FANO – Fanno Creek at Durham – 14206950

Data source: U.S. Geological Survey, Oregon Water Science Center

FREQUENCY OF MEAN DAILY STREAMFLOW BY MONTH — FANO



MEDIAN OF DAILY MEAN STREAMFLOW BY MONTH AND YEAR — FANO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	28	44	33	25	17	12	7.5	4.8	3.3	3.1	34	40
1992	42	50	22	33	12	5.2	3.4	2.8	2.9	3.7	20	56
1993	44	21	56	73	38	17	8.7	4.7	3.5	3.8	5.8	26
1994	41	37	34	25	12	8.7	3.8	3.8	3.4	3.6	49	68
1995	62	59	59	39	19	15	9.8	6.7	5.5	15	50	71
1996	95	124	25	37	25	7.8	6.6	5.9	7.5	19	80	221
1997	74	41	110	34	21	20	8.9	6.5	9.3	31	39	39
1998	100	73	58	21	54	18	9.2	7.8	24	34	70	100
1999	90	155	71	30	20	11	6.8	6.3	4.5	6.3	53	48
2000	61	68	52	17	17	7.5	5.6	3.9	3.8	12	8.9	21
2001	13	17	21	22	11	10	5.5	5.4	4.4	7.1	39	99
2002	86	54	44	19	11	7.9	5.5	3.8	4.0	4.1	8.5	66
2003	58	41	71	63	20	9.2	5.6	4.5	3.7	12	17	78
2004	100	64	25	12	9.1	6.7	3.8	5.2	6.5	17	15	25
2005	22	13	11	33	33	14	5.4	4.9	3.5	14	39	64
2006	195	32	42	33	15	9.5	4.3	3.0	2.7	4.4	117	65
2007	38	47	44	28	11	6.5	4.0	3.0	3.3	15	18	105
2008	109	34	54	29	16	9.0	4.5	4.6	3.4	4.9	19	17
2009	26	16	27	21	23	8.2	3.3	3.2	3.4	7.3	48	18
2010	86	41	31	36	21	28	6.0	3.5	6.5	5.6	46	96
2011	51	32	101	50	26	13	9.5	4.0	2.4	8.3	28	13
2012	50	35	81	46	23	15	5.5	2.7	2.0	21	49	137
2013	27	23	18	17	11	9.2	2.4	3.0	13	7.3	12	8.9
2014	20	50	67	48	21	7.6	4.8	2.2	2.2	17	26	53
2015	23	31	28	21	7.1	3.0	1.8	1.4	2.4	2.8	28	183
2016	84	55	67	16	11	6.9	3.5	1.7	3.6	58	48	55
2017	47	160	104	35	20	10	3.8	2.6	3.9	11	66	33
2018	72	36	33	35	7.7	5.3	2.0	3.0	3.2	4.7	14	42
median	55	43	45	30	17	10	5.1	3.9	3.9	9.4	31	54

Key

Q in cfs
- Q ≤ 2.6
- 2.6 < Q ≤ 3.4
- 3.4 < Q ≤ 4.2
- 4.2 < Q ≤ 5.2
- 5.2< Q ≤ 8.2
- 8.2< Q ≤ 13
- 13 < Q ≤ 19
- 19 < Q ≤ 49
- 49 < Q ≤ 119
- 119 < Q ≤ 196
- Q > 196

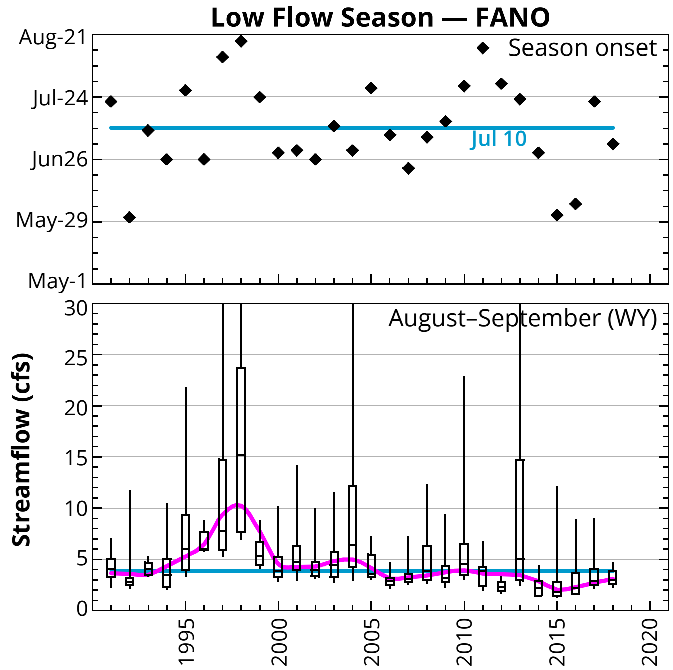
Q as percentile
- Q ≤ 5th
- 5th < Q ≤ 10th
- 10th < Q ≤ 15th
- 15th < Q ≤ 20th
- 20th < Q ≤ 30th
- 30th < Q ≤ 40th
- 40th < Q ≤ 50th
- 50th < Q ≤ 75th
- 75th < Q ≤ 90th
- 90th < Q ≤ 95th
- Q > 95th

2018

- Flow in 2018 was typical for much of the year. Flows in late May and late June were at or near record lows. High flows in early April approached record maximums.

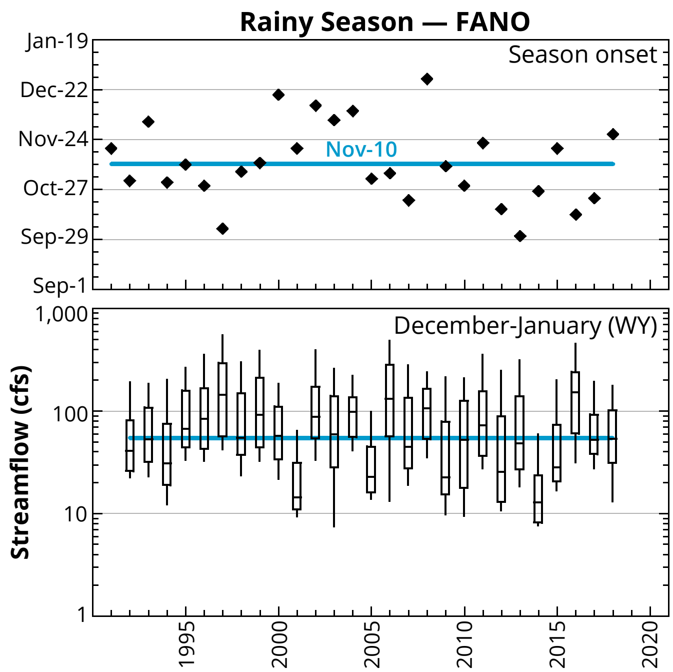
Low flow

- July through September are the months with the lowest average flow and the lowest daily flows.
- Although median flows usually are low during the July through September period, flows that are much higher are not uncommon. The August–September boxplots show this variability. This pattern is typical of flashy urban streams such as Fanno Creek.
- August–September flows show a statistically significant decreasing trend, despite considerable variability. The reason is unknown.
- Low flow criterion: 7d-Q ≤ 7 cfs (~26th pctl)



Rainy season flow

- December through March are the months with the highest average flows.
- Rainy season criterion: 7d-Q ≥ 50 cfs (~75th pctl)
- No trends are evident in the magnitude of the flow for December–January.
- Rainfall in the fall of 2004 was low compared to most years, resulting in low WY-2005 December–January flows.
- The winter of 2000–2001 was very dry as evident in the boxplots.



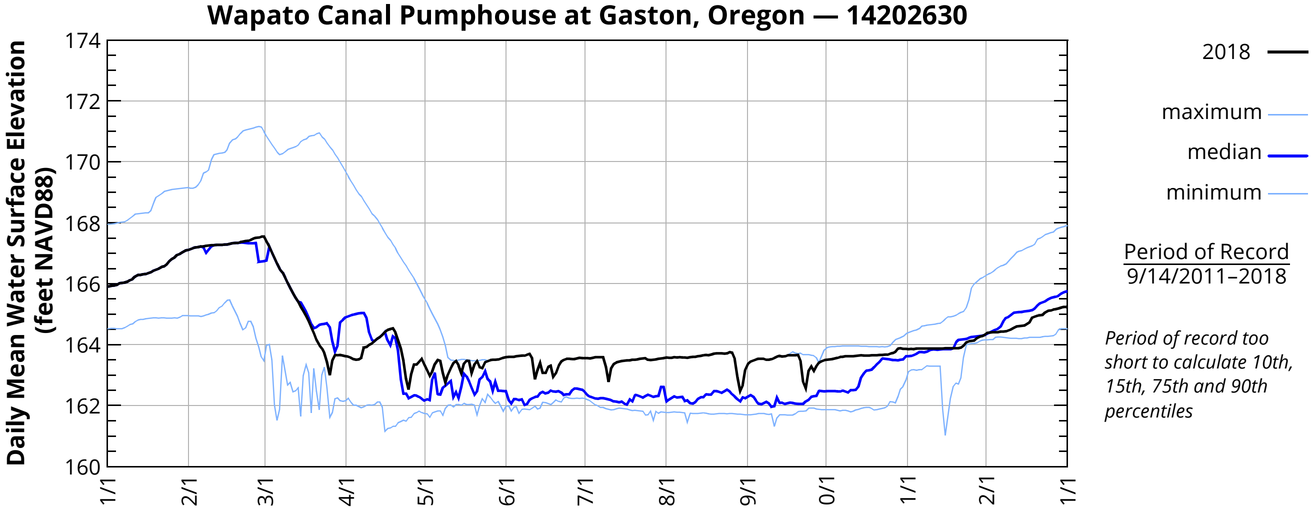
WPH – Wapato Canal Pumphouse at Gaston, Oreg. – 14202630

Data source: U.S. Geological Survey, Oregon Water Science Center
Latitude: 45 26 25   *Longitude:* 123 07 31

2018 — MEAN WATER SURFACE ELEVATION ABOVE NAVD88 (feet) — WPH

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	165.91	167.14	167.55	163.62	163.35	163.59	163.56	163.58	163.37	163.51	163.85	164.39
2	165.93	167.17	167.38	163.61	163.16	163.60	163.56	163.57	163.45	163.52	163.86	164.40
3	165.94	167.19	167.21	163.58	162.98	163.60	163.55	163.57	163.48	163.53	163.85	164.41
4	165.96	167.20	167.02	163.53	163.13	163.60	163.57	163.59	163.52	163.55	163.87	164.41
5	166.01	167.22	166.84	163.51	163.37	163.62	163.59	163.58	163.54	163.57	163.87	164.41
6	166.03	167.22	166.66	163.52	163.50	163.63	163.59	163.59	163.54	163.60	163.87	164.43
7	166.04	167.24	166.49	163.57	163.47	163.64	163.59	163.58	163.54	163.60	163.87	164.43
8	166.07	167.25	166.37	163.90	163.07	163.64	163.59	163.58	163.50	163.62	163.87	164.44
9	166.12	167.26	166.20	163.93	162.76	163.67	163.26	163.57	163.51	163.62	163.87	164.47
10	166.15	167.26	166.03	164.00	163.03	163.69	162.78	163.59	163.53	163.62	163.87	164.50
11	166.23	167.27	165.86	164.04	163.24	163.55	163.23	163.60	163.57	163.62	163.87	164.55
12	166.29	167.27	165.68	164.11	163.40	162.86	163.37	163.60	163.61	163.63	163.87	164.60
13	166.29	167.27	165.53	164.20	163.46	163.17	163.42	163.62	163.63	163.64	163.87	164.61
14	166.31	167.29	165.41	164.25	163.33	163.40	163.44	163.63	163.61	163.65	163.87	164.62
15	166.32	167.29	165.24	164.32	163.06	163.07	163.46	163.65	163.62	163.64	163.88	164.63
16	166.35	167.31	165.10	164.42	163.38	163.07	163.47	163.66	163.65	163.64	163.88	164.68
17	166.38	167.33	164.93	164.48	163.47	163.27	163.48	163.65	163.65	163.64	163.88	164.73
18	166.43	167.34	164.76	164.51	163.46	163.32	163.48	163.67	163.65	163.65	163.88	164.89
19	166.47	167.34	164.57	164.53	163.07	162.95	163.50	163.70	163.65	163.65	163.88	164.92
20	166.50	167.37	164.38	164.40	163.36	163.06	163.51	163.72	163.66	163.65	163.88	164.95
21	166.55	167.38	164.16	164.15	163.46	163.32	163.52	163.72	163.45	163.66	163.90	164.96
22	166.57	167.40	163.99	163.87	163.26	163.45	163.54	163.71	162.77	163.66	163.97	164.98
23	166.63	167.41	163.88	163.47	163.23	163.50	163.55	163.70	162.56	163.67	164.08	165.06
24	166.74	167.44	163.72	162.89	163.43	163.54	163.56	163.72	163.15	163.67	164.11	165.11
25	166.81	167.49	163.43	162.53	163.46	163.54	163.51	163.76	163.28	163.70	164.12	165.12
26	166.87	167.51	163.00	163.02	163.49	163.53	163.49	163.74	163.14	163.73	164.13	165.15
27	166.95	167.52	163.49	163.35	163.50	163.53	163.50	163.54	163.30	163.77	164.22	165.16
28	166.98	167.55	163.66	163.35	163.50	163.55	163.52	162.92	163.41	163.87	164.26	165.18
29	167.03	—	163.65	163.44	163.52	163.57	163.54	162.49	163.46	163.88	164.28	165.22
30	167.09	—	163.66	163.54	163.55	163.56	163.55	162.68	163.49	163.86	164.32	165.24
31	167.11	—	163.64	—	163.57	—	163.56	163.19	—	163.86	—	165.24
Mean	166.42	167.32	165.14	163.79	163.32	163.44	163.48	163.53	163.44	163.66	163.96	164.77
Max	167.11	167.55	167.55	164.53	163.57	163.69	163.59	163.76	163.66	163.88	164.32	165.24
Min	165.91	167.14	163.00	162.53	162.76	162.86	162.78	162.49	162.56	163.51	163.85	164.39

Wapato Canal Pumphouse at Gaston, Oregon — 14202630



FREQUENCY OF DAILY MEAN WATER SURFACE ELEVATION BY MONTH — WPH

Elev in ft	161.0 < EL < 161.3	161.3 < EL ≤ 161.8	161.8 < EL ≤ 162.0	162.0 < EL ≤ 162.2	162.2 < EL ≤ 162.4	162.4 < EL ≤ 162.8	162.8 < EL ≤ 163.5	163.5 < EL ≤ 1164.5	164.5 < EL ≤ 165.5	165.5 < EL ≤ 166.5	166.5 < EL ≤ 169.0	169.0 < EL ≤ 171.0	171.0 < EL ≤ 171.2
Jan													
Feb													
Mar													
Apr													
May													
Jun													
Jul													
Aug													
Sep													
Oct													
Nov													
Dec													
All	0.12%	3.5%	7.5%	10.4%	8.3%	8.2%	10.3%	17.6%	9.9%	8.3%	10.5%	4.6%	0.31%

Key
- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
9/14/2011–2018

MEDIAN OF DAILY MEAN WATER SURFACE ELEVATION BY MONTH AND YEAR — WPH

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011									163.66	163.43	163.33	164.25
2012	165.06	166.32	164.45	161.89	162.23	162.24	161.90	161.74	161.73	161.95	163.58	166.04
2013	167.47	165.73	162.59	162.12	162.59	162.20	162.14	162.46	162.36	163.94	164.21	164.48
2014	164.86	165.42	166.23	164.54	162.13	162.14	162.07	162.18	161.91	162.03	163.82	164.84
2015	165.89	167.33	165.24	162.47	162.15	162.29	162.75	162.37	161.97	161.94	163.58	166.18
2016	168.31	169.40	169.29	166.37	163.49	163.00	162.37	162.21	161.94	163.51	164.88	167.18
2017	168.33	170.36	170.55	167.75	162.74	162.35	162.24	162.95	162.81	162.85	164.22	165.35
2018	166.35	167.29	165.10	163.75	163.38	163.54	163.52	163.60	163.52	163.64	163.88	164.68
median	166.35	167.26	165.81	163.84	162.65	162.37	162.27	162.28	162.13	163.28	164.01	165.24

Key

EL in feet
- EL ≤ 161.85
- 161.85 < EL ≤ 161.97
- 161.97 < EL ≤ 162.07
- 162.07 < EL ≤ 162.17
- 162.17< EL ≤ 162.45
- 162.45< EL ≤ 162.96
- 162.96< EL ≤ 163.54
- 163.54 < EL ≤ 165.20
- 162.20 < EL ≤ 167.36
- 167.36 < EL ≤ 168.87
- EL > 168.87

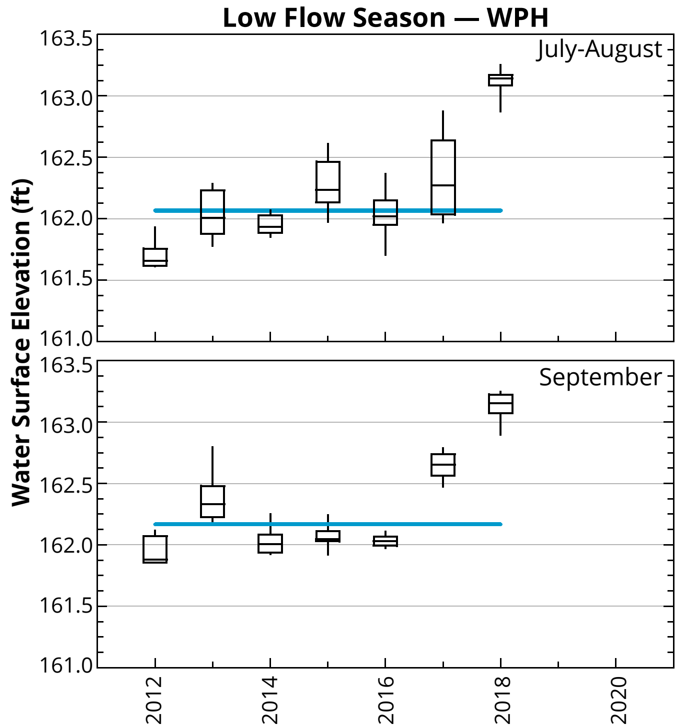
EL as percentile
- EL ≤ 5th
- 5th < EL ≤ 10th
- 10th < EL ≤ 15th
- 15th < EL ≤ 20th
- 20th < EL ≤ 30th
- 30th < EL ≤ 40th
- 40th < EL ≤ 50th
- 50th < EL ≤ 75th
- 75th < EL ≤ 90th
- 90th < EL ≤ 95th
- EL > 95th

2018

- Water levels from mid-May through September were higher than in any of the past 6 years. This was probably related to leaking water control structures. Permanent repairs are planned for 2019.

General

- Wapato Canal Pumphouse is located at Wapato Lake. Water surface elevation reflects lake level.
- During the rainy season, water accumulates in the lake from rainfall and groundwater seepage.
- During March and April, water is pumped out of the lake, lowering the surface elevation. Pumping has continued into May some years.
- Historically the lake was managed by the Wapato Improvement District who pumped enough water out of the lake to allow farming on the lake bed during the summer.
- From 2007–2013, ownership of Wapato Lake transitioned to the US Fish and Wildlife Service who now manages it as the Wapato Lake National Wildlife Refuge. Pumping and some farming still occur, but the management priorities are different than in the past and are evolving.

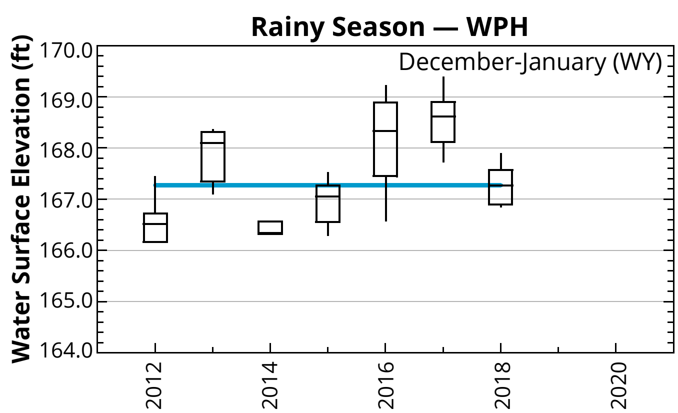


Low flow

- June through October are the months with the lowest average water levels.

Rainy season

- January through March are the months with the highest average water levels.



TRT – Tualatin River at Tualatin, Oregon – 14206956 (formerly 14206960)

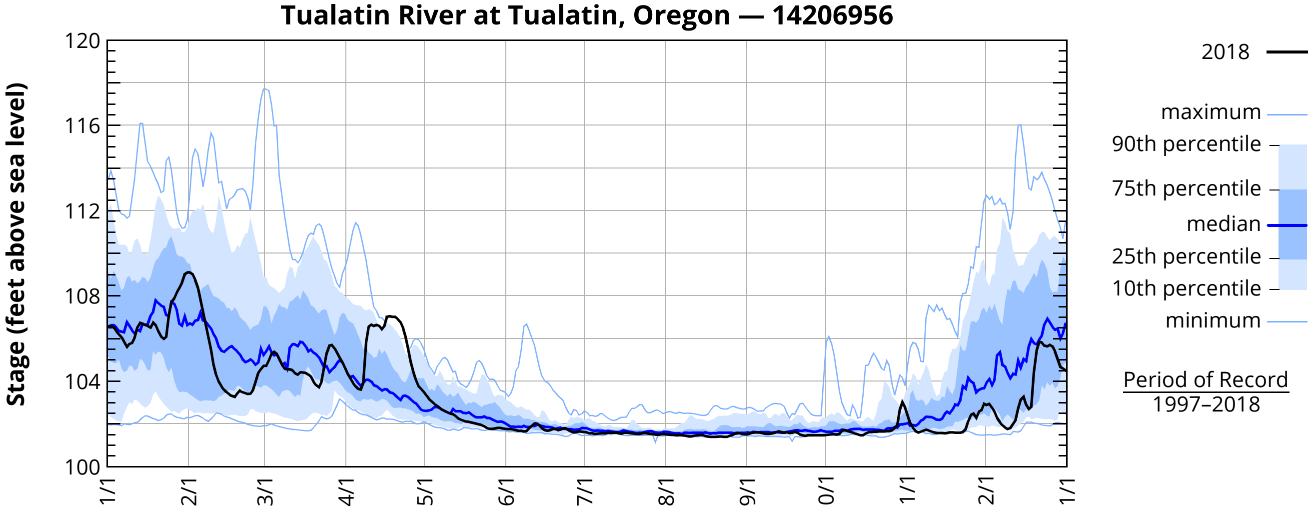
Data source: Oregon Water Resources Department

River mile: 8.9 *Latitude:* 45 23 14 *Longitude:* 122 45 46

2018 — MEAN WATER SURFACE ELEVATION (feet) — TRT

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	106.56	109.11	104.72	104.34	103.33	101.75	101.60	101.49	101.55	101.49	102.02	102.93
2	106.57	109.02	105.01	104.13	103.14	101.75	101.56	101.48	101.58	101.51	101.82	102.77
3	106.52	108.77	105.30	103.91	103.04	101.73	101.55	101.48	101.60	101.51	101.66	102.56
4	106.34	108.39	105.38	103.76	102.94	101.70	101.53	101.47	101.60	101.49	101.60	102.28
5	106.20	107.90	105.28	103.64	102.84	101.68	101.54	101.48	101.58	101.52	101.64	102.08
6	106.07	107.37	105.04	103.61	102.74	101.67	101.55	101.47	101.55	101.68	101.69	101.93
7	105.84	106.81	104.77	103.94	102.67	101.65	101.55	101.45	101.52	101.71	101.73	101.83
8	105.61	106.20	104.58	105.84	102.61	101.66	101.55	101.43	101.52	101.68	101.69	101.77
9	105.76	105.49	104.56	106.56	102.55	101.79	101.58	101.41	101.54	101.63	101.64	101.81
10	105.80	104.77	104.56	106.65	102.49	101.90	101.58	101.42	101.57	101.60	101.60	102.00
11	106.04	104.28	104.51	106.59	102.45	102.02	101.59	101.45	101.61	101.56	101.57	102.18
12	106.54	103.97	104.37	106.64	102.36	102.00	101.59	101.46	101.64	101.51	101.57	102.72
13	106.73	103.74	104.31	106.59	102.26	101.92	101.57	101.48	101.62	101.47	101.57	103.13
14	106.70	103.59	104.42	106.44	102.20	101.79	101.54	101.48	101.59	101.46	101.56	103.27
15	106.64	103.48	104.40	106.59	102.15	101.70	101.58	101.43	101.62	101.55	101.57	102.89
16	106.59	103.38	104.39	107.01	102.11	101.67	101.58	101.40	101.57	101.62	101.60	102.69
17	106.52	103.31	104.32	107.04	102.09	101.71	101.57	101.39	101.59	101.62	101.60	102.80
18	106.74	103.26	104.21	107.02	102.06	101.77	101.55	101.39	101.63	101.63	101.59	104.41
19	106.63	103.43	103.99	107.01	102.03	101.76	101.54	101.39	101.58	101.63	101.59	105.45
20	106.34	103.56	103.82	106.93	102.00	101.70	101.52	101.40	101.50	101.65	101.58	105.85
21	106.09	103.49	103.72	106.77	101.97	101.74	101.53	101.41	101.46	101.64	101.61	105.81
22	105.98	103.45	103.97	106.50	101.94	101.80	101.55	101.39	101.44	101.64	101.75	105.66
23	106.09	103.40	104.65	106.09	101.88	101.80	101.57	101.39	101.46	101.66	102.14	105.63
24	107.07	103.42	105.29	105.53	101.81	101.71	101.55	101.43	101.47	101.66	102.43	105.71
25	107.70	103.58	105.66	104.91	101.77	101.65	101.52	101.47	101.47	101.70	102.49	105.63
26	107.90	103.96	105.70	104.40	101.77	101.60	101.52	101.52	101.47	101.81	102.29	105.40
27	108.17	104.41	105.55	104.03	101.78	101.62	101.50	101.56	101.47	101.93	102.57	105.06
28	108.38	104.57	105.32	103.75	101.81	101.64	101.48	101.57	101.47	102.67	102.65	104.67
29	108.62	—	105.09	103.64	101.81	101.63	101.51	101.53	101.46	103.01	102.95	104.60
30	109.02	—	104.87	103.51	101.78	101.62	101.52	101.51	101.48	102.74	102.89	104.50
31	109.11	—	104.61	—	101.76	—	101.51	101.51	—	102.36	—	104.66
Mean	106.80	105.00	104.72	105.45	102.26	101.74	101.55	101.46	101.54	101.75	101.89	103.70
Max	109.11	109.11	105.70	107.04	103.33	102.02	101.60	101.57	101.64	103.01	102.95	105.85
Min	105.61	103.26	103.72	103.51	101.76	101.60	101.48	101.39	101.44	101.46	101.56	101.77

Tualatin River at Tualatin, Oregon — 14206956



FREQUENCY OF MEAN WATER SURFACE ELEVATION BY MONTH — TRT

ELEV IN FT	101.0 < EL < 101.3	101.3 < EL ≤ 101.5	101.5 < EL ≤ 101.6	101.6 < EL ≤ 101.7	101.7 < EL ≤ 101.9	101.9 < EL ≤ 102.1	102.1 < EL ≤ 102.6	102.6 < EL ≤ 103.3	103.3 < EL ≤ 104.5	104.5 < EL ≤ 106.5	106.5 < EL ≤ 110.0	110.0 < EL ≤ 116.0	116.0 < EL ≤ 120	Missing
JAN														
FEB														
MAR														
APR														
MAY														
JUN														
JUL														
AUG														
SEP														
OCT														
NOV														
DEC														
ALL	0.03%	4.1%	10.1%	9.8%	12.0%	9.2%	9.1%	9.1%	10.3%	10.5%	11.2%	3.8%	0.12%	0.70%

KEY

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
1997–2018

MEDIAN OF DAILY MEAN WATER SURFACE ELEVATION BY MONTH AND YEAR — TRT

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997											104.87	106.60
1998	109.86	108.00	106.40	103.50	102.61	102.27	102.47	102.56	102.67	102.03	102.26	109.61
1999	110.47	112.37	107.42	104.50	102.61	101.77	101.67	101.66	101.90	101.79	103.16	106.84
2000	107.35	105.61	105.25	102.36	102.20	101.86	101.61	101.78	102.11	101.92	101.71	102.34
2001	107.35	105.61	105.25	102.36	102.20	101.86	101.61	101.78	102.11	101.92	101.71	102.34
2002	107.35	105.61	105.25	102.36	102.20	101.86	101.61	101.78	102.11	101.92	101.71	102.34
2003	102.25	102.53	102.33	102.29	102.03	101.64	101.56	101.47	101.42	101.62	102.67	109.24
2004	108.39	107.15	105.46	103.33	102.09	101.79	101.73	102.23	102.05	101.78	101.71	103.82
2005	106.19	107.07	107.24	105.17	102.61	101.85	101.64	102.23	101.99	101.95	101.65	104.18
2006	106.17	106.45	103.86	102.78	101.99	101.70	101.53	101.60	101.64	101.88	101.89	
2007	103.05	102.39	101.91	103.92	103.66	102.06	101.70	101.47	101.46	101.77	103.45	104.39
2008		107.80	104.88	103.90	102.27	101.87	101.65	101.54	101.57	101.67	106.92	108.24
2009	107.89	103.45	105.51	103.21	102.07	101.79	101.70	101.69	101.72	101.91	102.14	108.04
2010	108.54	107.23	104.42	104.01	102.54	101.89	101.77	101.61	101.64	101.62	102.29	102.20
2011	107.77	102.47	103.79	103.20	103.06	101.73	101.57	101.54	101.54	101.62	103.31	103.78
2012	107.71	104.99	104.66	106.44	103.18	103.68	101.81	101.65	101.72	101.67	102.89	108.91
2013	108.30	104.35	108.52	105.78	103.55	102.17	101.74	101.62	101.59	101.59	101.85	102.21
2014	106.94	104.92	107.55	105.31	102.99	102.19	101.70	101.59	101.59	101.88	103.71	109.58
2015	104.18	103.18	103.62	102.82	101.97	102.01	101.58	101.51	101.72	101.83	102.30	102.30
2016	102.71	107.14	107.29	104.94	103.08	101.83	101.65	101.47	101.58	101.78	102.85	
2017	104.73	106.34	104.58	103.02	101.88	101.59	101.54	101.48	101.55	101.53	102.93	
2018	106.16	111.59	108.95	105.87	103.43	101.99	101.59	101.52	101.57	101.77	104.22	104.20
median	102.95	102.52	102.65	102.42	101.82	101.62	101.52	101.45	101.47	101.54	101.66	102.08

KEY

EL in feet

- EL ≤ 101.51
- 101.51 < EL ≤ 101.56
- 101.56 < EL ≤ 101.60
- 101.60 < EL ≤ 101.65
- 101.65< EL ≤ 101.78
- 101.78< EL ≤ 102.02
- 102.02 < EL ≤ 102.37
- 102.37 < EL ≤ 104.69
- 104.69 < EL ≤ 107.76
- 107.76 < EL ≤ 109.58
- EL > 109.58

EL as percentile

- EL ≤ 5th
- 5th < EL ≤ 10th
- 10th < EL ≤ 15th
- 15th < EL ≤ 20th
- 20th < EL ≤ 30th
- 30th < EL ≤ 40th
- 40th < EL ≤ 50th
- 50th < EL ≤ 75th
- 75th < EL ≤ 90th
- 90th < EL ≤ 95th
- EL > 95th

2018

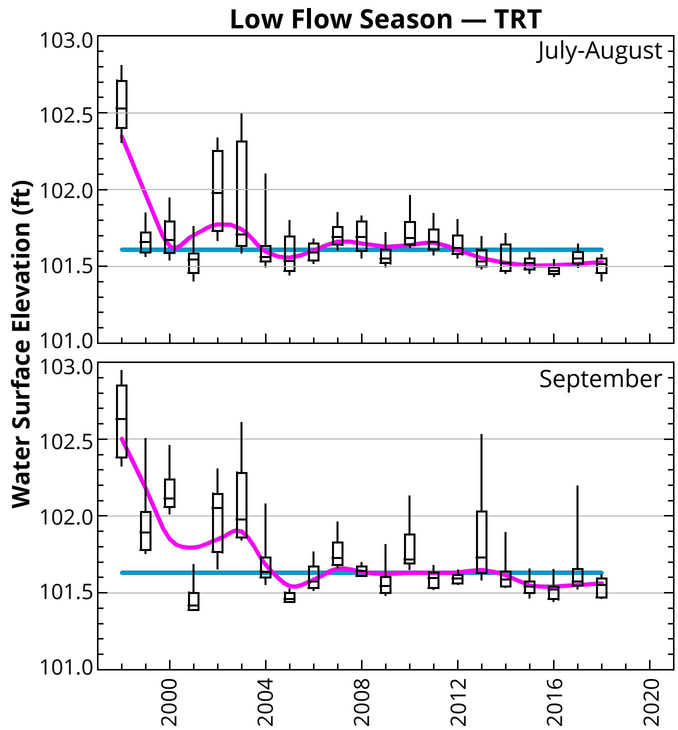
- Water surface elevation in 2018 was similar for much of the year.
- Water surface elevation in 2018 was typical for much of the year. Higher than usual stage in April and lower than usual stage in November were weather-related.

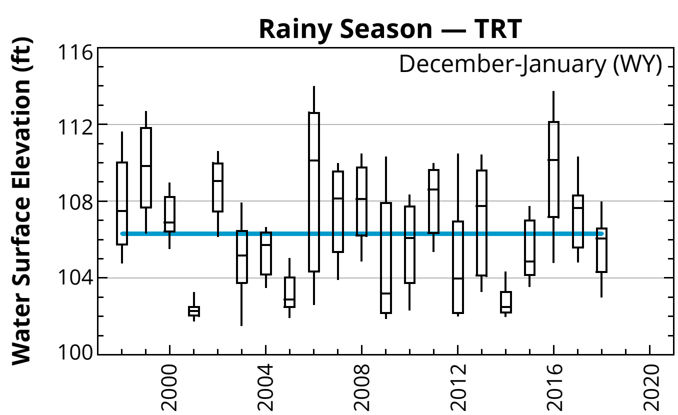
LOW FLOW

- July through September are the months with the lowest average water levels.
- July–August water levels show a statistically significant decreasing trend. The past 6 years all have median stage less than the period of record median.
- Water levels in September show a similar decreasing trend that is also statistically significant.
- The higher water levels in the late 1990s and early 2000s were likely due to the use of flash boards at the Oswego Dam, which has since been discontinued.

RAINY SEASON

- January through April are the months with the highest average water levels.





Data sources

Data were obtained from several sources. If more than one source had a value for the same date, the values were compared and the one judged as the best quality was used. In some cases, quality could not be determined and none were used. Because data collection changed (for example, different agencies, new rating curves), the measurements may not have been consistent over the period of record.

DATA SOURCES

SITEID	SITE NAME	START DATE	SOURCES OF DATA FOR DISTRIBUTION
14202450	Tualatin River below Lee Falls near Cherry Grove, Oregon	1/1/2003	previous Flow Reports: 2003–2007 OWRD database: 2008–present
14202510	Tualatin River at Gaston, Oregon	1/1/2000	CWS data warehouse: 2000–2007 (origin: OWRD Dist 18) OWRD database: 2008–present
14202630	Wapato Canal at Pumphouse at Gaston, Oregon	9/14/2011	USGS database: all
14202850	Scoggins Creek above Henry Hagg Lake near Gaston, Oregon	1/1/1975	OWRD database: all (no data WY-1997–WY-2006)
14202860	Tanner Creek above Henry Hagg Lake near Gaston, Oregon	1/12003	Wally Otto, TVID, pers. comm.: 2003 previous Flow Reports: 2004–present (Scoggins Dam Ops tables)
14202920	Sain Creek above Henry Hagg Lake near Gaston, Oregon	1/1/1975	OWRD database: all (no data WY-1997–WY-2006)
14202980	Scoggins Creek below Henry Hagg Lake near Gaston, Oregon	1/1/1975	USGS database: 1975–WY-2006 BOR: WY-2007–present (BOR has data back to 1941)
14203500	Tualatin River at Dilley, Oregon	1/1/1975	USGS database: 1975–present (USGS has data back to 1939)
14204530	Gales Creek at Old Hwy 47 near Forest Grove, Oregon	1/1/1996	CWS data warehouse: 1996–2007 (origin: ORWD Dist 18) OWRD database: 2008–present
14204800	Tualatin River at Golf Course Road near Cornelius, Oregon	1/1/1994	previous Flow Report: 1994 CWS data warehouse: 1995–2007 (origin: ORWD Dist 18) OWRD database: 2008–present
14205400	East Fork Dairy Creek near Meacham Corner, OR	5/8/2002	USGS database: all
14206070	McKay Creek at Scotch Church Rd above Waible Ck near North Plains, Oregon	1/1/2002	previous Flow Reports: all
14206200	Dairy Creek at Hwy 8 near Hillsboro, Oregon	1/1/1997	CWS data warehouse: 1997–2007 (origin: OWRD Dist 18) OWRD database: 2008–present
14206241	Tualatin River at Hwy 219 Bridge	10/15/2004	Stewart Rounds, USGS pers. comm.: all (origin: Jackson Bottom Wetland Education Center)
14206295 (old id= 14206440)	Tualatin River at Rood Bridge Road near Hillsboro, Oregon (new siteid in 2002)	1/1/1994	previous Flow Report: 1994 CWS data warehouse: 1995–2007 (origin: OWRD Dist 18) OWRD database: 2008–present
14206435	Beaverton Creek at NE Guston Court near Orenco, Oregon	1/1/2002	previous Flow Reports: all
14206450 14206451	Rock Creek at Hwy 8 near Hillsboro, Oregon (site moved 120 ft downstream in 2002)	1/1/1995	CWS data warehouse: 1995–2007 previous Flow Reports: 2008–present
14206500	Tualatin River at Farmington, Oregon	1/1/1989	CWS data warehouse: 1989–2002 (origin: OWRD Dist 18) previous Flow Reports: 2003–WY-2005 OWRD database: WY-2006–present
14206900	Fanno Creek at 56th Avenue	10/1/1990	USGS database: all
14206950	Fanno Creek at Durham, Oregon	1/1/1991	Stewart Rounds, USGS pers. comm.: 1991-WY-1993, 2/4/1996-WY-2000 USGS database: WY-1994-2/5/1996, WY-2001–present
14206956	Tualatin River at Tualatin, Oregon	10/22/1997	previous Flow Reports: 1997-1999 & 2002-2005 Stewart Rounds, USGS pers. comm.: 2000-2001 OWRD database: 2006–present
14207500	Tualatin River at West Linn, OR	1/1/1975	USGS database: all (USGS has data back to 1928)

Abbreviations: BOR=Bureau of Reclamation; CWS=Clean Water Services; OWRD=Oregon Water Resources Department; TVID=Tualatin Valley Irrigation District; USGS=United States Geological Survey; WY=water year

APPENDIX B
Selected Releases and Withdrawals

Scope

This appendix shows data for selected water releases to and withdrawals from the Tualatin River and its tributaries. It is not a comprehensive listing of releases and withdrawals. Some of the data represent daily mean flows and some represent instantaneous measurements.

Streamflow measurements are in Appendix A.

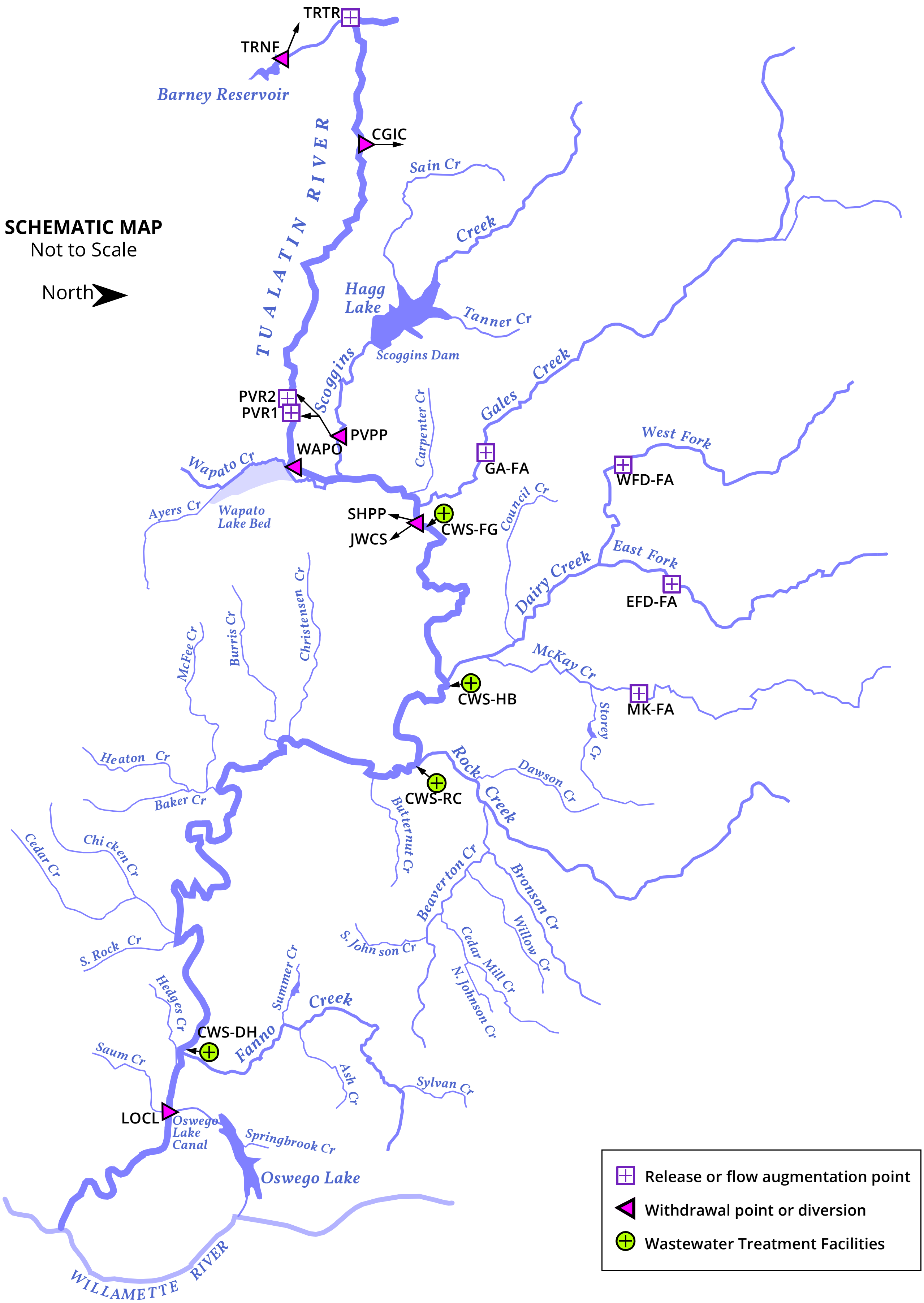
Highlights

- Clean Water Services' Fernhill Natural Treatment System (NTS) operated for most of the low flow period (May–October). During that time, all effluent from the FG-WWTF was discharged either to the NTS or transferred to the Rock Creek WWTF. Outside May–October, discharge from the FG-WWTF may be discharged directly to the Tualatin River, or be routed through the NTS.
- Clean Water Services continued its summer flow augmentation program to selected tributaries in cooperation with Tualatin Valley Irrigation District.

Trends of note

- Withdrawals in July-August by Joint Water Commission at the Springhill Pump Plant increased almost linearly from 1991 through about 2003. Similarly, July-August discharges from Clean Water Services' Rock Creek WWTF increased almost linearly from to 1991 to about 2003. Both JWC withdrawals and RC-WWTF discharges have been relatively constant since 2004, with only minor year-to-year variation.
- Withdrawals in July-August by Tualatin Valley Irrigation District at the Springhill Pump Plant have remained relatively constant over the period of record 1991–2018.

Selected Release and Withdrawal Sites



SELECTED RELEASE AND WITHDRAWAL SITES — ALPHABETICAL LISTING BY SITE CODE

SITE CODE	SITE NAME	RIVER MILE	PAGE
CGIC	City of Hillsboro Withdrawal at Cherry Grove	73.3	B-8
CWS-DH	CWS Durham WWTF Discharge	9.33	B-20
CWS-FG	CWS Forest Grove WWTF Discharge (with Fernhill NTS)	51.2	B-14
CWS-HB	CWS Hillsboro WWTF Discharge	43.8	B-16
CWS-RC	CWS Rock Creek WWTF Discharge	38.08	B-18
EFD-FA	CWS East Fork Dairy Creek Flow Augmentation with TVID	4.9	B-22
GA-FA	CWS Gales Creek Flow Augmentation with TVID	5.0	B-22
JWCS	Joint Water Commission Withdrawal at Spring Hill Pump Plant	56.1	B-12
LOCL	Lake Oswego Corp. Canal Diversion	6.7	*
MK-FA	CWS McKay Creek Flow Augmentation with TVID	7.0	B-22
PVPP	TVID Withdrawal at Patton Valley Pump Plant	1.71	**
PVR1	TVID—Patton Valley River Turnout #1 Release	63.13	**
PVR2	TVID—Patton Valley River Turnout #2 Release	64.26	**
SHPP	TVID–Withdrawal at Spring Hill Pump Plant	56.1	B-10
TRNF	Barney Reservoir Measured Flow to North Fork Trask River	—	B-4
TRTR	Barney Reservoir (Trask River) Release to Tualatin River	78.0	B-6
WAPO	Wapato Canal Diversion	62.0	**
WFD-FA	CWS West Fork Dairy Creek Flow Augmentation with TVID	5.2	B-22

*Monitoring of the Lake Oswego Canal Diversion was discontinued 8/23/2012.
**Withdrawals and releases at Patton Valley Pump Plant, Patton Valley River turnouts and Wapato Canal Diversion were not measured in 2018.

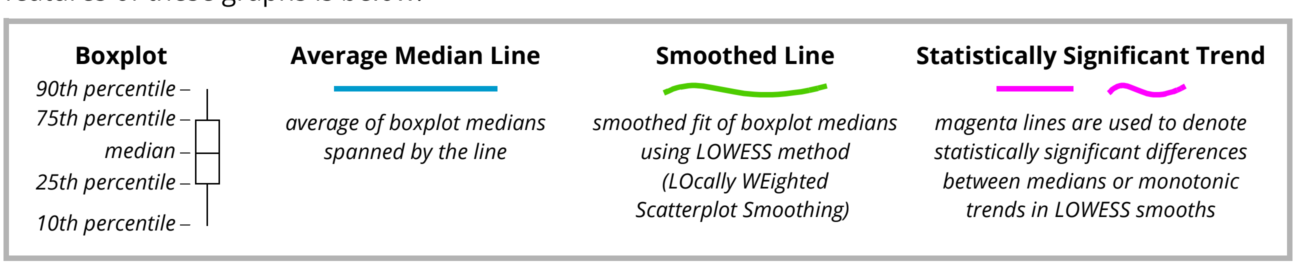
Explanation of Figures and Tables in this Appendix

Two pages of tables and graphs are included for every site.

Page 1–current year: Page 1 includes tabled data for daily releases or withdrawals plus a graph showing data for the current year compared to that of the previous year.

Page 2–statistical summary: A brief summary for the site is at the top of the page. The summary is followed by:

- a *color-coded table of the monthly medians* of daily mean releases or withdrawals for the period of record. The color-code is based on percentiles and is keyed to both cubic feet per second (cfs) and the equivalent percentile.
- a *graph showing boxplots for July-August* of daily releases or withdrawals by year for the period of record. July-August was chosen because it is typically a critical time for water management. An explanation of the features of these graphs is below.



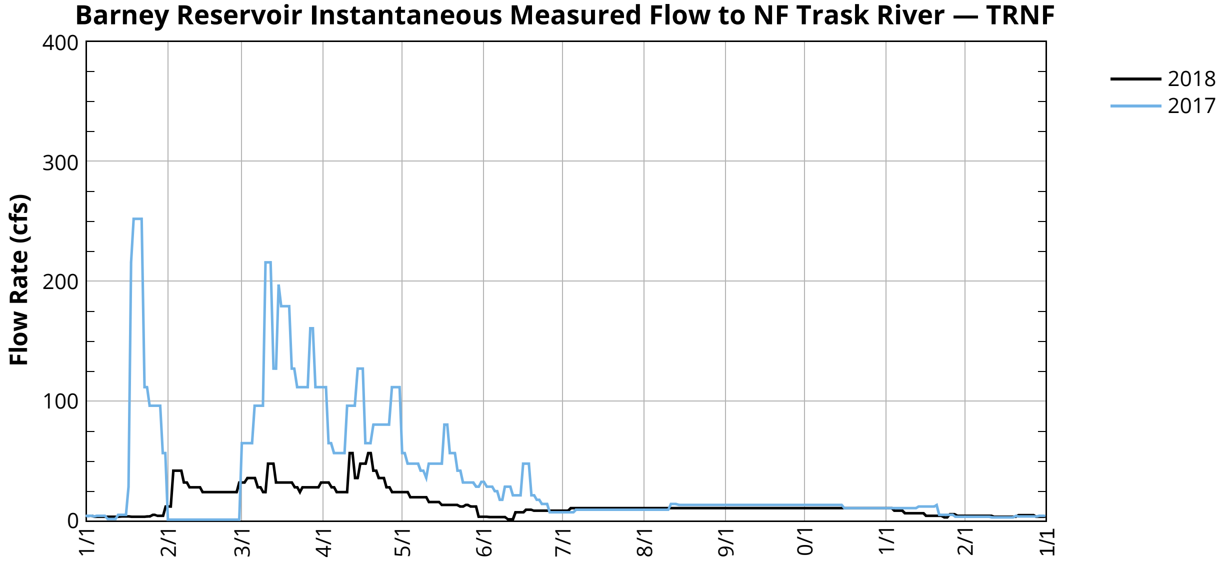
TRNF – Barney Reservoir Measured Flow to North Fork Trask River

Data source: Barney Reservoir Joint Ownership Commission

2018 — INSTANTANEOUS MEASURED FLOW (cfs) — TRNF

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1												
2												
3		41.0	35.0			2.0				9.8		
4	2.3			26.9	18.8		9.8	9.8			7.5	
5	2.3				18.8			9.8	9.8	9.8		3.2
6				22.9	18.8	2.0	9.8					
7	2.3	31.0	26.9	22.9					9.8	9.8	7.5	3.2
8						2.0	9.8	9.8			5.2	
9		26.9	22.9		18.8				9.8			3.2
10	2.3					0.4		9.8		9.8		
11		26.9	47.0	55.5	14.8		9.8				5.2	
12	2.3				14.8			9.8	9.8	9.8		2.5
13				35.0		6.4	9.8					2.5
14	2.8	22.9	31.0						9.8	9.8	5.2	
15				47.0		6.4	9.8					2.5
16		22.9	31.0		12.2			9.8	9.8		3.2	2.5
17						8.2		9.8		9.8		
18	2.3		31.0	55.5	12.2		9.8				3.2	
19	2.3							9.8	9.8	9.8		2.5
20	2.3			41.0	12.2	7.5	9.8		9.8			
21	2.3		26.9						9.8	9.8	3.2	3.8
22		22.9		35.0		7.5	9.8	9.8				
23		22.9	22.9		10.9				9.8		1.8	3.8
24	2.8		26.9			7.5		9.8		9.8		
25		22.9		26.9	12.3		9.8				4.5	
26	4.0							9.8	9.8	9.8		3.8
27				22.9	11.0	7.5	9.8					
28	3.4	31.0		22.9					9.8	9.8	3.2	2.5
29		—	26.9			7.5	9.8	9.8				
30		—			2.5				9.8		3.2	2.5
31	10.9	—	31.0	—		—		9.8	—	9.8	—	

Barney Reservoir Instantaneous Measured Flow to NF Trask River — TRNF



Summary

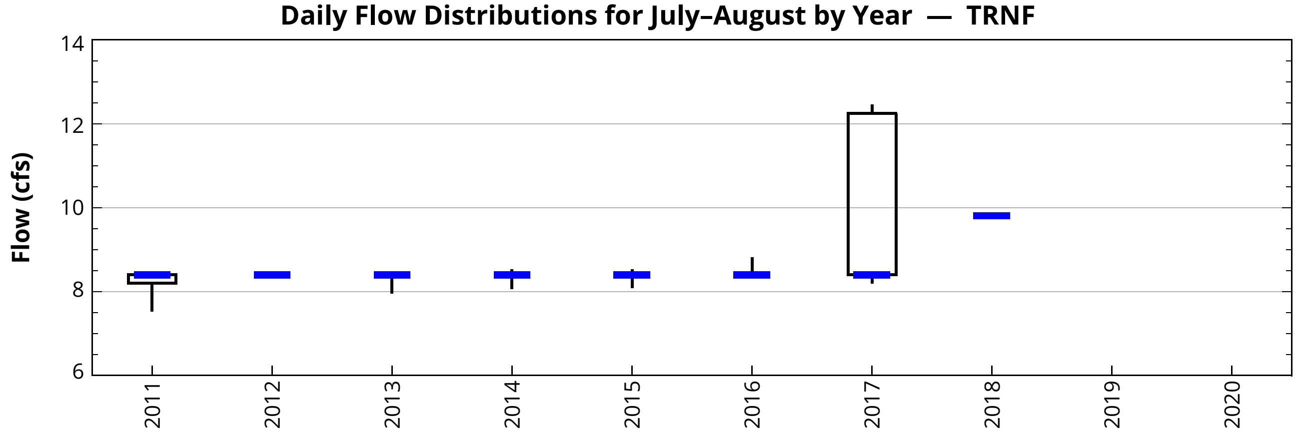
- Winter and spring releases from Barney Reservoir to the NF Trask River depend on inflow and whether or not the reservoir is filling. No trends are evident for 2011–2018.
- Winter and spring releases in 2018 were lower than usual due to the dry winter.
- Summer releases from Barney Reservoir to the North Fork Trask River have generally been constant (about 8.4 cfs). Releases were larger in 2018 (9.8 cfs) and in part of August and September 2017 (12.4 cfs).

MEDIAN OF INSTANTANEOUS MEASURED FLOW — TRNF

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	47.0	38.0	79.6	55.5	35.0	16.5	8.4	8.4	9.5	9.5	7.3	6.2
2012	7.3	4.0	4.0	47.0	35.0	14.8	8.4	8.4	8.4	8.4	9.0	6.2
2013	47.0	47.0	41.0	35.0	8.4	8.4	8.4	8.4	8.4	8.4	8.4	0.5
2014	0.5	2.3	79.6	41.0	35.0	8.4	8.4	8.4	8.4	8.4	6.2	1.1
2015	1.1	51.3	35.0	27.6	7.3	8.4	8.4	8.4	8.4	8.4	6.2	2.8
2016	2.3	64.0	79.6	33.2	6.2	8.4	8.4	8.4	8.4	8.4	8.4	1.7
2017	4.0	0.0	110.8	79.6	47.0	20.2	8.4	12.3	12.3	9.6	9.6	2.3
2018	2.3	22.9	31.0	31.0	12.3	6.4	9.8	9.8	9.8	9.8	4.9	3.2
median	3.2	30.5	60.3	38.0	23.7	8.4	8.4	8.4	8.4	8.4	7.9	2.6

Key	
Q in cfs	Q as percentile
0. < Q ≤ 2.5	Q ≤ 10th
2. < Q ≤ 8.4	10th < Q ≤ 25th
8.4 < Q ≤ 31	25th < Q ≤ 75th
31 < Q ≤ 56	75th < Q ≤ 90th
Q > 56	Q > 90th

Daily Flow Distributions for July–August by Year — TRNF



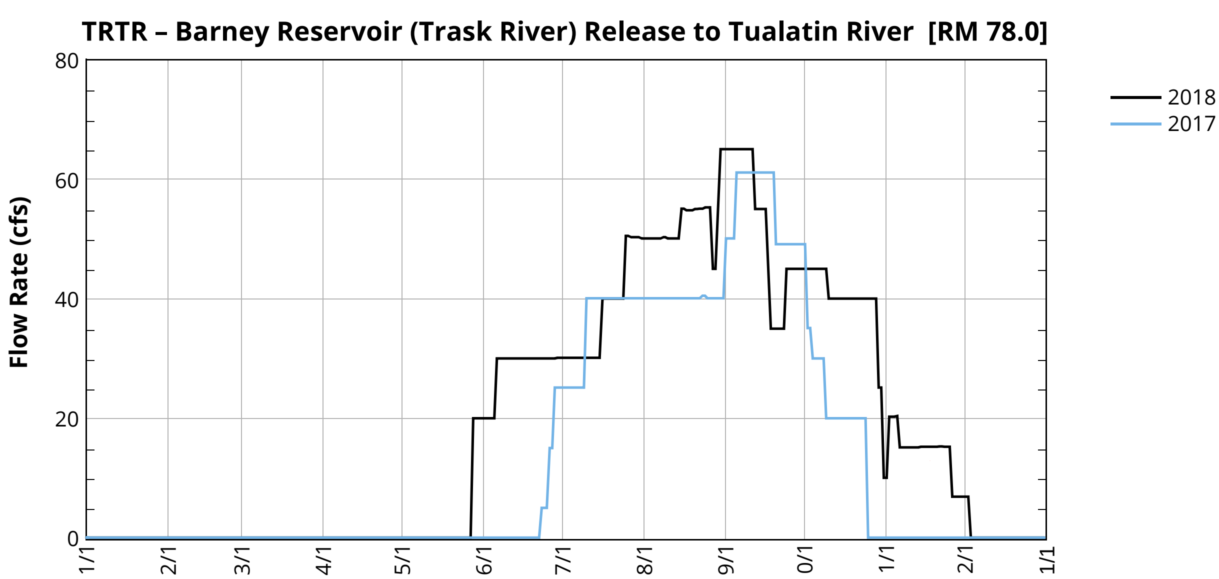
Note: Releases to the North Fork Trask River in the July–August period are often constant. Because the data vary little, the quartile boxes and whiskers are sometimes small or zero. Blue dashes are used to identify the median value.

TRTR — Barney Reservoir (Trask River) Release to Tualatin River [RM 78.0]

Data source: Barney Reservoir Joint Ownership Commission

2018 — INSTANTANEOUS MEASURED FLOW (cfs) — TRTR

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1			0.0			20.0				45.0		
2					0.0		30.1	50.1			20.3	
3	0.0	0.0	0.0	0.0	0.0			50.1	65.0	45.0		0.0
4	0.0				0.0	20.0	30.1					
5	0.0	0.0		0.0					65.0	45.0	20.4	0.0
6			0.0			30.0	30.1	50.1			15.1	
7				0.0	0.0				65.0			0.0
8		0.0	0.0			30.0		50.3		45.0		
9	0.0				0.0		30.1				15.1	
10		0.0	0.0	0.0	0.0			50.1	65.0	40.0		0.0
11	0.0					30.0	30.1					0.0
12		0.0		0.0					55.0	40.0	15.1	
13	0.0		0.0			30.0	30.1					0.0
14				0.0	0.0			50.1	55.0		15.2	0.0
15		0.0	0.0			30.0		55.1		40.0		
16			0.0		0.0		40.0				15.2	
17	0.0	0.0		0.0				54.8	45.0	40.0		0.0
18	0.0				0.0	30.0	40.0		35.0			
19	0.0	0.0		0.0					35.0	40.0	15.2	0.0
20			0.0	0.0		30.0	40.0	55.0				
21					0.0				35.0		15.3	0.0
22			0.0			30.0		55.1		40.0		
23	0.0	0.0			0.0		40.0				15.2	
24		0.0	0.0	0.0				55.3	45.0	40.0		0.0
25	0.0				0.0	30.0	50.5					
26		0.0		0.0					45.0	40.0	6.9	0.0
27	0.0		0.0	0.0		30.0	50.3	45.0				
28					20.0				45.0			0.0
29		—	0.0			30.1		55.0		25.1		
30	0.0	—			20.0		50.3	65.0				
31		—	0.0	—		—	50.1		—	10.0	—	



Summary

- July–September are the peak month for water releases from Barney Reservoir to the Tualatin River.
- Releases in 2018 began May 28, which was somewhat early (27th percentile) and continued through the November 27, which was very late (90th percentile).
- The capacity of Barney Reservoir increased when the dam was raised in 1999. Water releases before the dam raise were smaller. Since the dam raise, releases have varied year-to-year, but have no overall trend.

MEDIAN OF INSTANTANEOUS FLOW — TRTR

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	0	0	0	0	0	6	6	6	6	6	0	0
1992	0	0	0	0	0	0	1	8	8	8	0	0
1993	0	0	0	0	0	6	14	19	19	3	2	2
1994	0	0	0	0	0	2	12	18	18	2	0	0
1995	0	0	0	0	2	16	8	5	5	5	5	0
1996	0	0	0	10	0	0	10	20	30	7	0	0
1997	0	0	0	0	0	0	3	10	5	0	0	0
1998	0	0	0	0	0	0	60	68	5	0	0	0
1999	0	0	0	0	0	10	20	20	30	35	0	0
2000	0	0	0	0	0	20	39	39	57	57	39	0
2001	0	0	0	0	0	5	20	20	15	19	0	0
2002	0	0	0	0	0	24	36	48	54	39	0	0
2003	0	0	0	0	0	26	40	66	44	12	0	0
2004	0	0	0	0	0	23	38	34	24	14	0	0
2005	0	0	0	0	0	0	22	36	50	31	0	0
2006	0	0	0	0	0	21	20	20	40	49	0	0
2007	0	0	0	0	0	12	20	20	39	19	0	0
2008	0	0	0	0	0	0	18	24	30	24	0	0
2009	0	0	0	0	0	0	20	24	34	20	0	0
2010	0	0	0	0	0	0	26	34	40	30	0	0
2011	0	0	0	20	50	49	49	60	49	10	0	0
2012	0	0	0	0	0	0	30	40	30	18	0	0
2013	0	0	0	0	15	20	20	32	38	14	0	0
2014	0	0	0	0	0	15	30	30	44	30	0	0
2015	0	0	0	0	25	30	40	40	50	30	0	0
2016	0	0	0	0	20	30	30	35	49	19	0	0
2017	0	0	0	0	0	0	40	40	56	20	0	0
2018	0	0	0	0	0	30	40	50	55	40	15	0
median	0	0	0	0	0	8	21	31	36	19	0	0

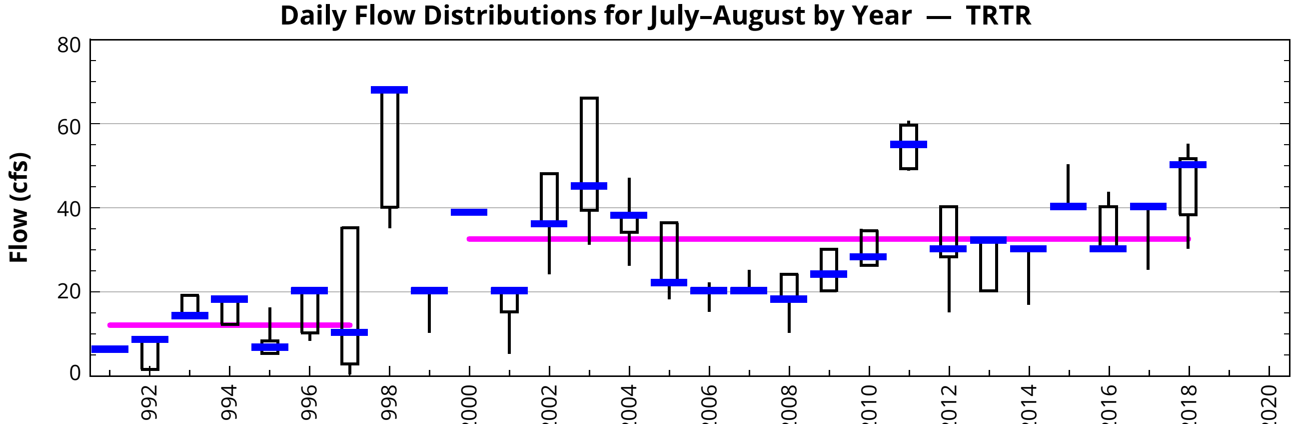
Key

Q in cfs
- 0 < Q ≤ 5
- 5 < Q ≤ 14
- 14 < Q ≤ 39
- 39 < Q ≤ 50
- Q > 50

Q as percentile
- Q ≤ 10th
- 10th < Q ≤ 25th
- 25th < Q ≤ 75th
- 75th < Q ≤ 90th
- Q > 90th

Only days with water releases were used to calculate percentiles

Daily Flow Distributions for July–August by Year — TRTR



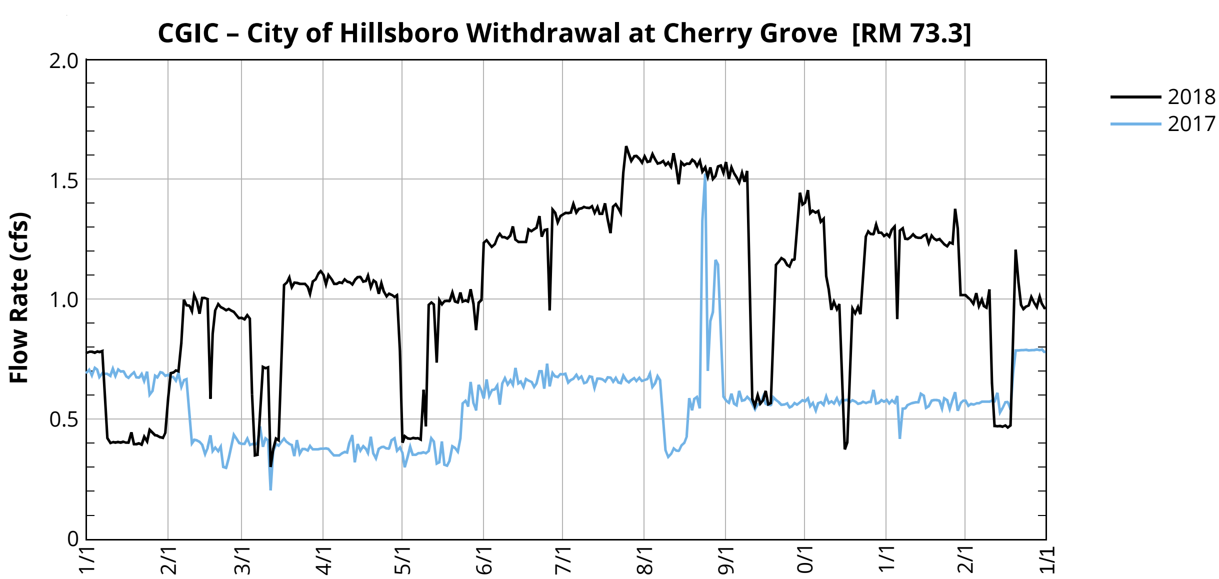
Note: Blue dashes are used to identify median values because quartile boxes and whiskers are sometimes small.

CGIC — City of Hillsboro Withdrawal at Cherry Grove [RM 73.3]

Data source: City of Hillsboro

2018 — MEAN WITHDRAWAL (cfs) — CGIC

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.78	0.59	0.92	1.10	0.40	1.23	1.35	1.60	1.57	1.40	1.27	1.01
2	0.78	0.69	0.91	1.06	0.43	1.25	1.36	1.57	1.50	1.45	1.26	1.00
3	0.78	0.69	0.93	1.10	0.41	1.23	1.36	1.58	1.55	1.36	1.29	0.99
4	0.78	0.70	0.92	1.08	0.41	1.22	1.36	1.60	1.52	1.37	1.30	0.98
5	0.78	0.70	0.60	1.06	0.42	1.23	1.40	1.58	1.51	1.36	0.91	1.02
6	0.78	0.82	0.35	1.06	0.41	1.26	1.36	1.57	1.49	1.37	1.29	0.97
7	0.78	1.00	0.35	1.07	0.42	1.27	1.38	1.57	1.53	1.32	1.30	1.00
8	0.57	0.97	0.52	1.07	0.41	1.26	1.38	1.58	1.49	1.33	1.25	0.97
9	0.42	0.97	0.71	1.08	0.62	1.26	1.38	1.56	1.53	1.10	1.25	0.96
10	0.40	0.95	0.71	1.07	0.47	1.25	1.38	1.57	1.01	1.04	1.26	1.04
11	0.40	1.01	0.71	1.07	0.97	1.26	1.38	1.55	0.58	0.95	1.27	0.65
12	0.40	0.99	0.30	1.06	0.98	1.30	1.39	1.61	0.55	0.99	1.26	0.47
13	0.40	0.94	0.37	1.08	0.97	1.25	1.36	1.55	0.60	0.96	1.25	0.47
14	0.40	1.00	0.41	1.09	0.73	1.24	1.38	1.48	0.56	0.98	1.25	0.47
15	0.40	1.00	0.41	1.09	0.99	1.24	1.36	1.57	0.58	0.69	1.27	0.46
16	0.40	1.00	0.73	1.07	0.98	1.24	1.36	1.56	0.62	0.37	1.27	0.47
17	0.40	0.58	1.06	1.07	0.99	1.24	1.40	1.57	0.56	0.40	1.23	0.46
18	0.44	0.85	1.07	1.10	0.99	1.29	1.33	1.56	0.56	0.70	1.27	0.47
19	0.39	0.95	1.09	1.05	0.99	1.28	1.27	1.58	0.89	0.96	1.25	0.89
20	0.39	0.98	1.05	1.08	1.03	1.29	1.39	1.58	1.14	0.94	1.25	1.21
21	0.39	0.97	1.07	1.07	0.99	1.30	1.40	1.55	1.16	0.97	1.25	1.07
22	0.39	0.96	1.07	1.02	0.98	1.35	1.38	1.58	1.17	0.94	1.24	0.97
23	0.42	0.95	1.06	1.06	1.03	1.26	1.36	1.53	1.17	1.10	1.23	0.96
24	0.40	0.96	1.06	1.03	0.99	1.29	1.53	1.55	1.14	1.26	1.22	0.97
25	0.45	0.95	1.06	1.01	0.99	1.29	1.64	1.51	1.14	1.28	1.24	0.97
26	0.44	0.95	1.05	1.02	0.99	0.95	1.61	1.55	1.16	1.27	1.23	1.01
27	0.43	0.93	1.02	1.02	1.04	1.37	1.58	1.50	1.17	1.27	1.38	0.98
28	0.43	0.92	1.07	1.01	0.98	1.36	1.60	1.51	1.29	1.31	1.30	0.96
29	0.42	—	1.08	1.01	0.87	1.32	1.60	1.55	1.44	1.28	1.01	1.01
30	0.42	—	1.10	0.78	0.98	1.35	1.59	1.56	1.39	1.28	1.01	0.98
31	0.44	—	1.12	—	0.99	—	1.57	1.53	—	1.26	—	0.96



Summary

- Withdrawals at Cherry Grove were greater in 2018 than in 2017.
- The average withdrawal rate for July-August for the period of record was 1.2 cfs.
- For most years withdrawal rates were greater in the summer than the rest of the year. The exceptions were 2016-2017 when withdrawal rates were lower in August.
- Withdrawal rates at Cherry Grove are operational decisions by Joint Water Commission.

MEDIAN OF DAILY MEAN WITHDRAWAL — CGIC

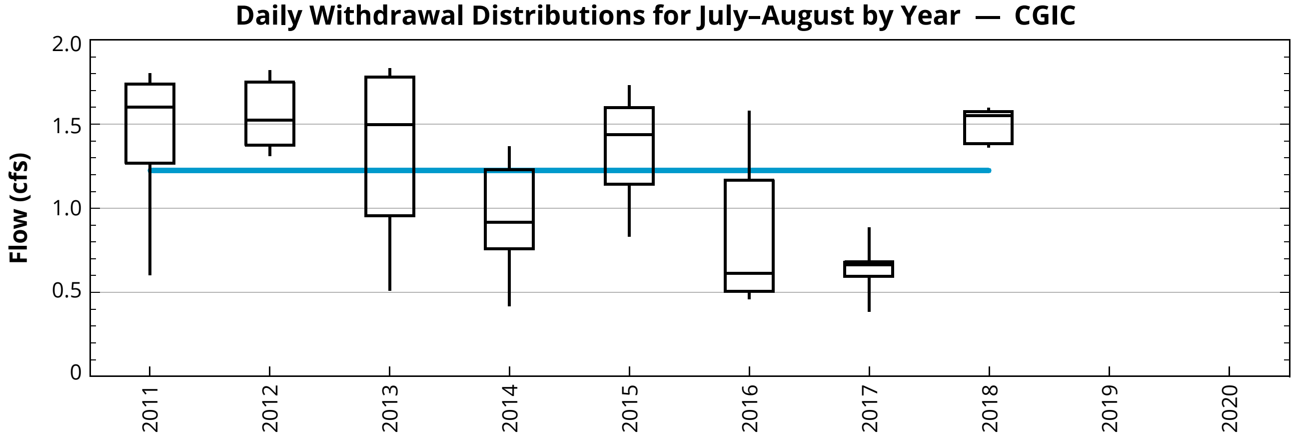
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	0.91	1.14	1.17	1.28	1.35	1.59	1.42	1.74	1.47	1.35	1.24	1.34
2012	1.00	1.30	1.26	1.34	1.33	1.37	1.60	1.47	1.27	0.98	0.86	0.97
2013	1.12	1.15	1.10	1.12	1.48	1.45	1.45	1.73	1.09	1.00	1.11	0.93
2014	0.84	0.80	0.32	0.49	0.00	0.37	1.22	0.89	0.82	0.74	0.32	0.88
2015	0.99	1.11	1.29	0.88	1.34	1.21	1.49	1.34	1.26	0.82	0.55	0.54
2016	0.54	0.59	0.58	0.83	0.74	0.57	1.14	0.50	0.94	0.60	0.82	0.72
2017	0.69	0.40	0.39	0.37	0.36	0.65	0.66	0.59	0.56	0.57	0.57	0.57
2018	0.42	0.95	0.93	1.07	0.98	1.26	1.38	1.56	1.16	1.26	1.25	0.97
median	0.88	1.03	1.02	0.98	1.16	1.24	1.40	1.41	1.13	0.90	0.84	0.91

Key

Q in cfs
0 < Q ≤ 0.4
0.4 < Q ≤ 0.6
0.4 < Q ≤ 1.3
1.3 < Q ≤ 1.5
Q > 1.5

Q as percentile
Q ≤ 10th
10th < Q ≤ 25th
25th < Q ≤ 75th
75th < Q ≤ 90th
Q > 90th

Daily Withdrawal Distributions for July–August by Year — CGIC



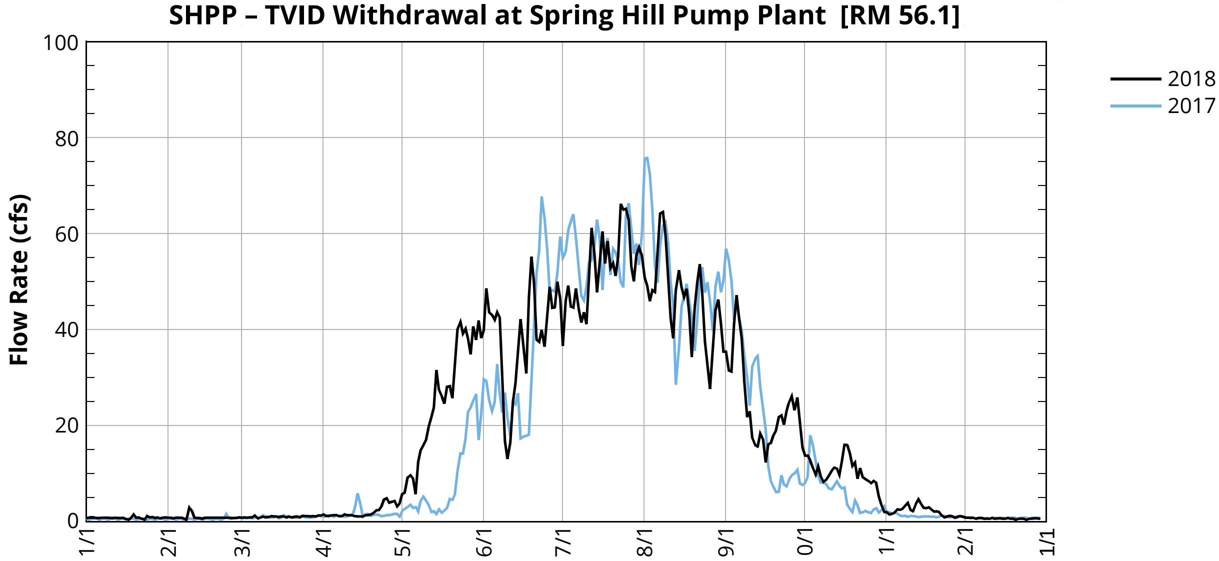
SHPP – TVID Withdrawal at Spring hill Pump Plant [RM 56.1]

Data source: US Geological Survey, Oregon Water Science Center

2018 — MEAN WITHDRAWAL (cfs) — SHPP

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.40	0.44	0.43	1.1	5.4	39.6	36.4	50.6	35.1	13.4	1.6	0.43
2	0.45	0.44	0.49	0.81	5.7	48.4	45.8	48.9	31.2	13.4	1.1	0.43
3	0.45	0.28	0.43	0.76	8.8	43.3	49.0	45.7	31.0	12.4	1.2	0.43
4	0.45	0.48	0.54	0.87	9.4	42.8	44.6	48.0	40.9	10.7	1.5	0.43
5	0.31	0.44	0.49	0.98	8.7	41.8	44.4	47.6	47.0	9.4	2.1	0.22
6	0.37	0.44	0.88	0.92	5.3	43.4	48.4	55.3	42.0	11.1	2.1	0.35
7	0.45	0.25	0.28	0.76	12.1	42.2	44.0	64.0	37.9	9.1	2.3	0.30
8	0.45	0.00	0.49	0.76	14.6	28.5	41.2	64.4	29.1	8.0	2.9	0.22
9	0.45	2.6	0.71	1.1	15.6	16.6	43.4	59.5	21.5	8.3	3.5	0.22
10	0.34	1.9	0.52	0.98	16.8	12.7	40.9	52.0	22.7	9.1	2.0	0.22
11	0.40	0.45	0.57	0.95	19.5	16.2	49.9	42.1	17.1	10.2	1.8	0.43
12	0.45	0.42	0.76	0.95	21.4	24.6	61.0	37.9	15.6	10.9	3.4	0.22
13	0.37	0.31	0.71	0.76	23.4	28.5	55.5	48.0	15.3	10.7	4.3	0.27
14	0.31	0.23	0.71	0.71	31.3	34.6	47.6	52.2	18.0	9.3	3.3	0.27
15	0.45	0.45	0.57	0.71	27.1	42.0	53.8	48.6	16.7	12.3	2.5	0.22
16	0.17	0.45	0.68	0.71	25.8	37.3	60.3	46.6	12.0	15.7	2.4	0.22
17	0.00	0.45	0.71	0.92	24.3	30.6	53.6	48.3	15.8	15.6	2.6	0.43
18	0.45	0.45	0.54	0.93	27.8	46.4	58.3	43.1	16.1	13.9	2.1	0.22
19	1.1	0.45	0.71	1.1	27.9	55.0	52.7	34.0	17.7	11.3	1.7	0.22
20	0.44	0.45	0.49	1.5	25.4	49.6	53.7	44.2	18.7	12.0	1.7	0.00
21	0.51	0.45	0.65	2.0	32.3	37.6	51.0	49.6	21.5	8.6	1.7	0.22
22	0.19	0.45	0.71	2.0	40.0	37.2	55.1	53.5	21.8	10.8	0.87	0.22
23	0.00	0.45	0.54	2.8	41.4	39.7	66.1	47.0	19.9	8.9	0.54	0.22
24	0.85	0.45	0.81	4.2	39.0	36.2	64.8	37.4	22.7	8.5	0.71	0.00
25	0.51	0.42	0.76	4.5	40.0	42.7	65.1	32.3	24.7	8.1	0.81	0.22
26	0.60	0.40	0.76	3.6	37.8	48.7	62.7	27.4	25.9	7.7	0.71	0.22
27	0.32	0.31	0.71	3.7	34.6	44.3	53.0	35.7	22.9	8.1	0.43	0.24
28	0.51	0.50	0.76	3.9	40.4	44.4	49.9	43.8	25.6	7.8	0.68	0.27
29	0.25	—	0.71	2.8	37.6	49.8	55.4	46.0	20.5	5.0	0.79	0.22
30	0.44	—	0.90	3.5	41.7	46.3	57.0	41.1	15.1	2.9	0.65	0.27
31	0.51	—	0.90	—	38.0	—	55.3	35.1	—	1.7	—	0.27

SHPP – TVID Withdrawal at Spring Hill Pump Plant [RM 56.1]



SHPP – TVID Withdrawal at Spring hill Pump Plant [RM 56.1]

Data source: US Geological Survey, Oregon Water Science Center

Summary

- TVID withdraws water at SHPP for irrigation. Peak season is July–August.
- The 2018 season was similar to others, although it began slightly earlier and ended later.
- Withdrawal rates in July–August have remained relatively steady from 1991–2018 (average 50.3 cfs). The incidence of higher withdrawal rates in the spring and fall has increased slightly.
- Historically, withdrawal rates in the winter were zero, but are now low volumes used to supply nurseries.

MEDIAN OF DAILY MEAN WITHDRAWAL — SHPP

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	0.0	0.0	0.0	0.0	1.1	10.5	49.0	45.0	25.5	12.0	0.1	0.0
1992	0.0	0.0	0.0	0.0	18.0	40.0	50.0	49.0	18.0	4.8	0.0	0.0
1993	0.0	0.0	0.0	0.6	1.8	4.4	28.0	43.0	28.5	8.8	0.8	0.0
1994	0.0	0.0	0.0	0.0	13.0	21.5	58.0	50.0	24.0	6.8	0.2	0.0
1995	0.0	0.0	0.0	0.0	6.0	13.2	44.5	46.2	20.1	3.1	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	25.2	62.0	54.0	9.1	2.1	0.0	0.0
1997	0.0	0.0	0.0	1.8	10.0	11.5	51.0	56.0	11.5	3.0	0.3	0.0
1998	0.0	0.0	0.0	1.5	1.9	14.5	49.0	52.0	28.5	4.2	0.6	0.3
1999	0.0	0.0	0.1	2.1	6.6	27.5	56.0	47.0	35.0	10.0	0.4	0.3
2000	0.3	0.3	0.3	4.8	5.9	20.5	49.0	45.0	21.5	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	9.6	29.5	42.0	36.0	24.5	3.5	0.8	0.0
2002	0.0	0.0	0.0	0.0	15.0	37.0	50.0	51.0	30.0	8.6	1.7	0.3
2003	0.5	0.0	0.0	0.9	3.3	52.3	64.4	45.3	24.7	3.3	0.0	0.0
2004	0.0	0.0	0.0	0.0	13.2	41.8	57.9	46.3	4.1	3.1	1.1	0.2
2005	0.3	0.3	1.8	1.3	1.7	15.2	43.7	59.3	30.7	5.1	0.8	0.3
2006	0.2	0.3	0.6	1.6	17.7	24.3	56.7	55.7	29.9	10.7	1.0	0.3
2007	0.3	0.3	0.5	2.3	18.8	45.7	51.3	42.7	29.7	3.4	2.2	0.3
2008	0.3	0.4	0.9	1.9	17.0	32.0	54.0	39.0	32.5	5.1	2.7	0.3
2009	0.3	0.3	0.9	2.9	3.9	39.1	62.0	43.5	23.3	3.7	1.7	1.0
2010	1.0	1.1	1.4	2.5	3.4	3.1	53.0	56.0	20.5	3.6	1.3	0.3
2011	0.3	0.3	0.7	1.2	2.8	17.1	40.6	51.1	27.2	4.7	2.8	0.4
2012	0.4	0.4	0.5	1.6	6.2	16.5	42.0	53.0	37.5	6.0	1.4	0.4
2013							54.0	48.0	19.5	0.0	0.0	0.0
2014	0.0	0.2	0.4	1.5	11.0	39.0	53.0	54.0	38.0	5.1	0.7	0.2
2015	0.2	0.2	0.8	2.1	36.0	59.5	63.0	52.0	25.0	12.0	1.0	0.2
2016	0.2	0.2	0.5	4.8	25.6	43.1	51.5	56.8	24.1	2.0	1.0	0.0
2017	0.2	0.2	0.5	0.9	3.9	27.9	56.2	49.6	21.1	6.4	0.7	0.5
2018	0.5	0.5	0.7	1.0	25.8	41.9	53.0	47.0	21.7	9.4	1.7	0.2
median	0.2	0.2	0.3	1.3	6.6	27.5	52.3	49.3	24.6	4.8	0.8	0.2

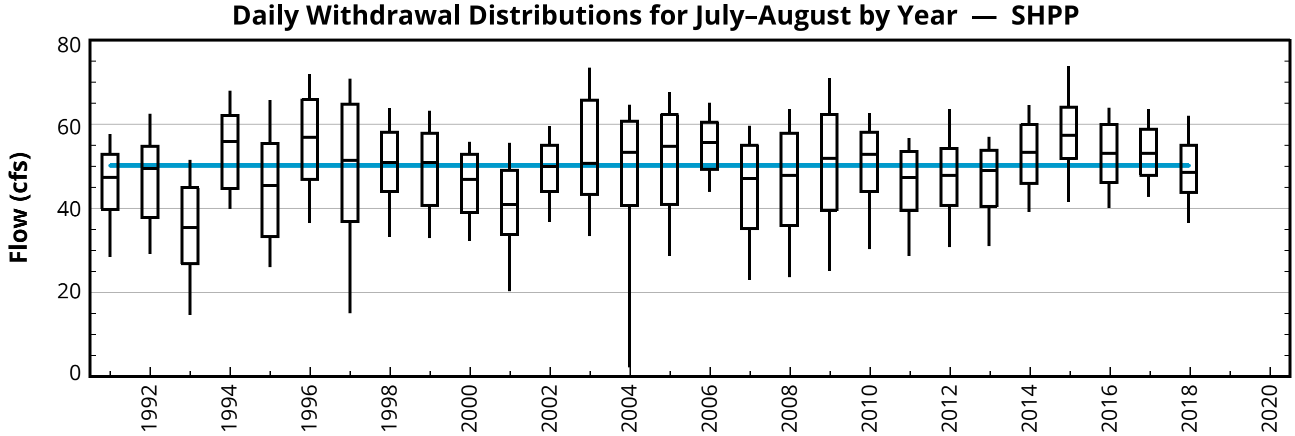
Key

Q in cfs
- Q=0
- 0 < Q ≤ 0.3
- 0.3 < Q ≤ 1.0
- 1.0 < Q ≤ 36
- 36 < Q ≤ 53
- Q > 53

Q as percentile*
- Q ≤ 10th
- 10th < Q ≤ 25th
- 25th < Q ≤ 75th
- 75th < Q ≤ 90th
- Q > 90th

Only days with withdrawals >0 were used to calculate percentiles

Daily Withdrawal Distributions for July–August by Year — SHPP



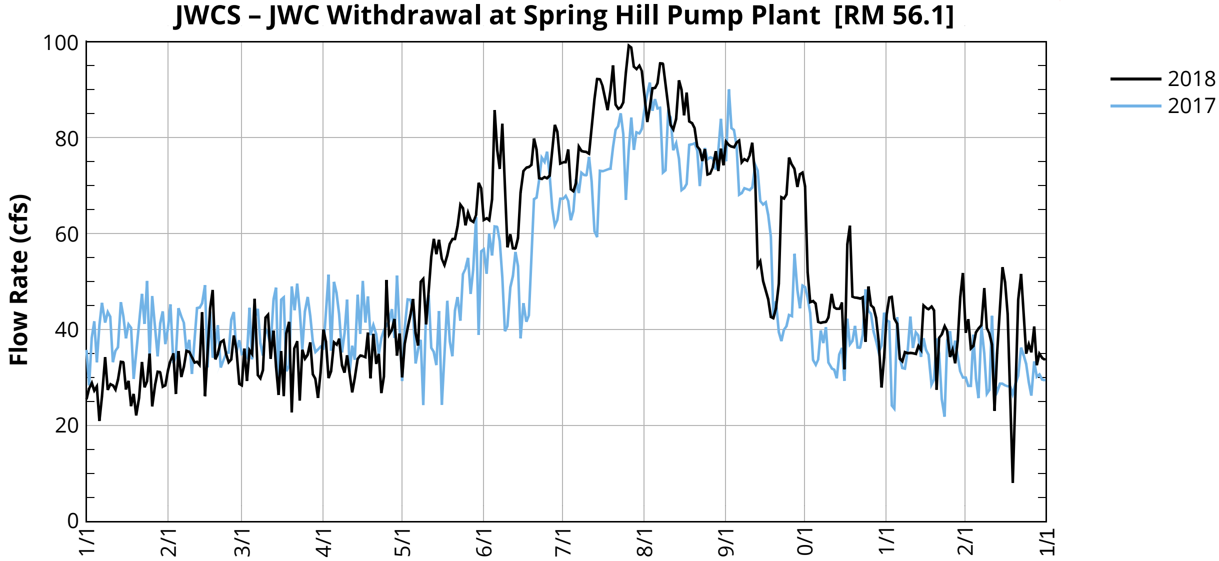
JWCS – JWC Withdrawal at Spring hill Pump Plant [RM 56.1]

Data source: Joint Water Commission

2018 — MEAN WITHDRAWAL (cfs) — JWCS

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	25.3	31.1	28.2	39.8	29.8	62.7	74.8	87.8	79.1	69.8	43.0	39.1
2	27.6	33.3	35.8	37.2	36.8	63.0	74.8	83.2	78.3	51.8	46.4	42.0
3	28.6	34.8	29.1	29.7	40.1	62.6	77.5	86.3	78.0	45.5	46.6	35.8
4	27.1	26.3	35.4	31.1	42.9	67.1	69.1	90.2	77.9	45.7	42.0	36.4
5	27.9	35.3	34.6	37.0	46.2	85.7	68.7	90.3	78.9	45.1	40.9	39.2
6	20.7	29.8	46.2	36.6	39.1	77.3	70.4	91.3	79.3	41.3	33.7	40.1
7	25.8	32.0	30.3	37.9	36.4	73.3	77.9	95.5	74.8	41.2	33.2	40.7
8	34.0	35.3	29.6	32.3	49.8	82.7	77.1	95.4	75.4	41.3	35.0	48.5
9	27.1	35.1	31.2	30.9	50.4	68.7	77.0	91.1	75.1	41.4	34.8	40.0
10	28.4	34.0	42.3	34.4	40.9	57.0	76.9	86.8	76.3	42.3	34.9	38.9
11	28.1	32.9	42.9	30.6	48.4	59.7	76.6	82.4	78.8	47.3	34.8	36.6
12	27.2	33.1	33.7	26.7	55.1	56.7	82.0	81.6	71.7	44.5	34.7	22.8
13	29.3	32.4	39.5	29.6	58.8	56.7	88.0	83.8	53.1	44.1	36.3	34.8
14	33.0	43.3	32.0	33.7	55.5	58.9	92.2	91.9	54.0	44.1	35.5	44.1
15	33.0	25.8	26.1	34.3	58.5	68.5	92.1	89.9	49.9	45.5	44.8	52.8
16	27.3	33.9	35.3	34.2	54.5	72.9	90.6	84.6	48.0	31.4	44.3	49.7
17	29.0	44.2	25.9	34.0	53.2	73.6	88.1	89.3	46.1	57.6	44.0	43.0
18	23.8	48.1	39.0	39.2	55.3	73.7	85.7	83.3	42.4	61.5	44.6	27.4
19	26.3	33.6	41.3	29.6	57.8	74.2	89.8	83.0	42.2	46.6	43.7	7.7
20	21.8	34.8	22.4	38.9	58.7	79.7	95.0	81.8	44.2	46.4	27.2	32.1
21	25.5	37.2	35.9	32.6	58.7	77.3	86.7	78.1	49.4	46.4	38.1	46.1
22	33.0	37.5	37.4	34.7	61.3	71.4	85.9	77.4	67.4	46.3	38.7	51.4
23	27.7	34.6	24.9	26.6	66.0	71.3	86.3	75.0	67.2	46.5	40.4	42.7
24	29.1	33.0	35.6	30.0	65.2	71.7	87.3	77.5	68.0	37.3	39.4	34.7
25	34.8	33.5	33.7	50.1	61.6	71.4	93.5	72.2	75.8	48.8	34.1	36.7
26	23.7	38.5	34.6	38.7	64.2	71.9	99.1	72.4	74.3	44.8	35.6	35.0
27	28.2	35.7	37.0	39.8	62.6	77.7	98.7	73.8	73.3	44.3	32.7	40.4
28	30.9	28.5	30.3	42.0	62.3	82.5	94.7	77.1	69.6	42.1	37.5	32.3
29	30.9	—	29.4	34.3	63.8	81.1	94.2	72.9	72.3	37.3	46.6	34.7
30	27.8	—	25.5	39.0	70.5	74.5	94.9	77.7	72.6	27.7	51.6	33.9
31	28.2	—	30.9	—	69.3	—	93.8	74.1	—	34.0	—	33.5

JWCS – JWC Withdrawal at Spring Hill Pump Plant [RM 56.1]



JWCS – JWC Withdrawal at Spring hill Pump Plant [RM 56.1]

Data source: Joint Water Commission

Summary

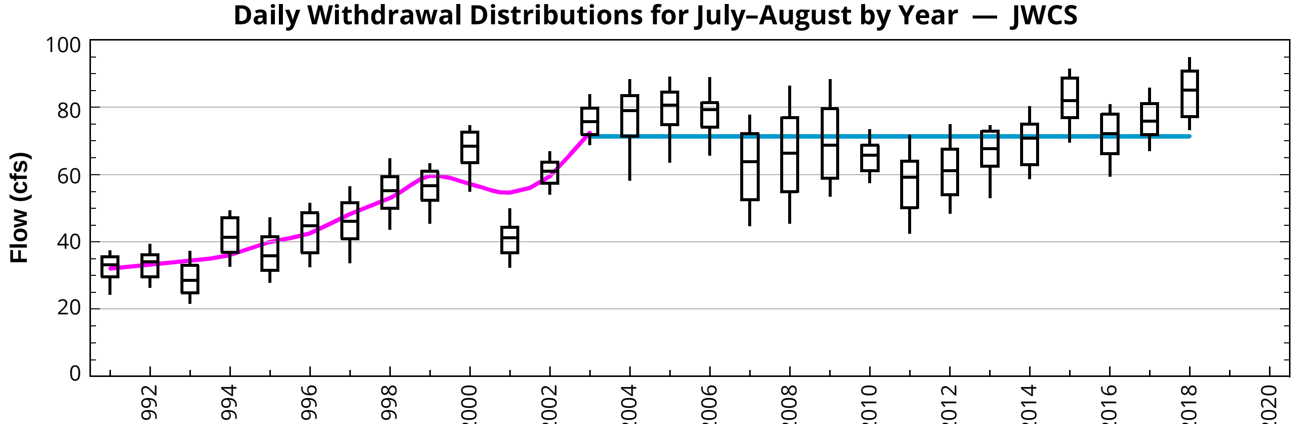
- JWC withdraws water at SHPP for municipal use. Peak season is July–August.
- The 2018 high use period was similar to recent years, although it began earlier and ended later than usual.
- Withdrawal rates in July–August increased from 1991 to the early-2000s. Withdrawal rates also increased for other months. Since 2003, no trend is evident. The average July-August withdrawal is 71.4 cfs.
- Hagg Lake did not fill in 2001, prompting strong conservation measures and lower withdrawals.

MEDIAN OF DAILY MEAN WITHDRAWAL — JWCS

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	19	19	19	19	17	21	33	34	29	23	20	16
1992	18	18	18	20	28	37	33	35	28	22	18	16
1993	17	16	17	16	20	25	25	33	32	19	17	18
1994	18	16	16	16	24	28	43	41	33	24	16	21
1995	21	21	22	21	24	30	38	35	33	24	24	23
1996	23	30	28	28	26	34	46	43	27	23	25	25
1997	24	23	28	26	43	39	48	45	33	26	25	27
1998	28	29	29	30	32	42	57	55	53	34	32	33
1999	33	30	31	30	38	46	56	58	54	41	35	42
2000	35	33	33	36	42	59	68	69	53	44	42	43
2001	43	43	45	39	37	33	38	43	39	29	35	37
2002	38	39	42	43	44	53	60	63	55	48	44	46
2003	47	48	48	50	53	66	79	73	58	50	47	49
2004	52	38	52	57	62	68	80	79	58	53	48	46
2005	48	49	54	54	50	59	75	84	78	49	47	46
2006	50	51	49	54	57	61	79	79	70	52	49	41
2007	45	44	44	42	51	57	63	65	65	39	44	47
2008	48	47	44	38	44	47	68	63	60	42	36	42
2009	44	44	42	40	43	56	73	66	54	39	32	38
2010	41	43	39	34	34	36	64	67	43	39	32	33
2011	35	38	35	35	32	41	50	62	61	36	31	31
2012	32	33	36	37	42	42	57	67	66	39	33	35
2013	38	37	33	30	46	44	63	72	46	44	43	34
2014	38	39	40	38	45	55	67	73	66	46	40	47
2015	47	39	37	45	54	72	86	78	56	42	39	36
2016	39	41	40	45	54	68	67	77	57	39	40	38
2017	41	38	39	40	44	57	73	77	66	37	35	29
2018	28	34	34	34	56	72	87	83	72	45	38	39
median	38	38	37	37	43	47	63	66	55	39	35	37

Key
Q in cfs
0 < Q ≤ 22
22 < Q ≤ 31
31 < Q ≤ 52
52 < Q ≤ 67
Q > 67
Q as percentile
Q ≤ 10th
10th < Q ≤ 25th
25th < Q ≤ 75th
75th < Q ≤ 90th
Q > 90th

Daily Withdrawal Distributions for July–August by Year — JWCS



CWS-FG – Clean Water Services Forest Grove WWTF Discharge [RM 55.2] with Fernhill NTS

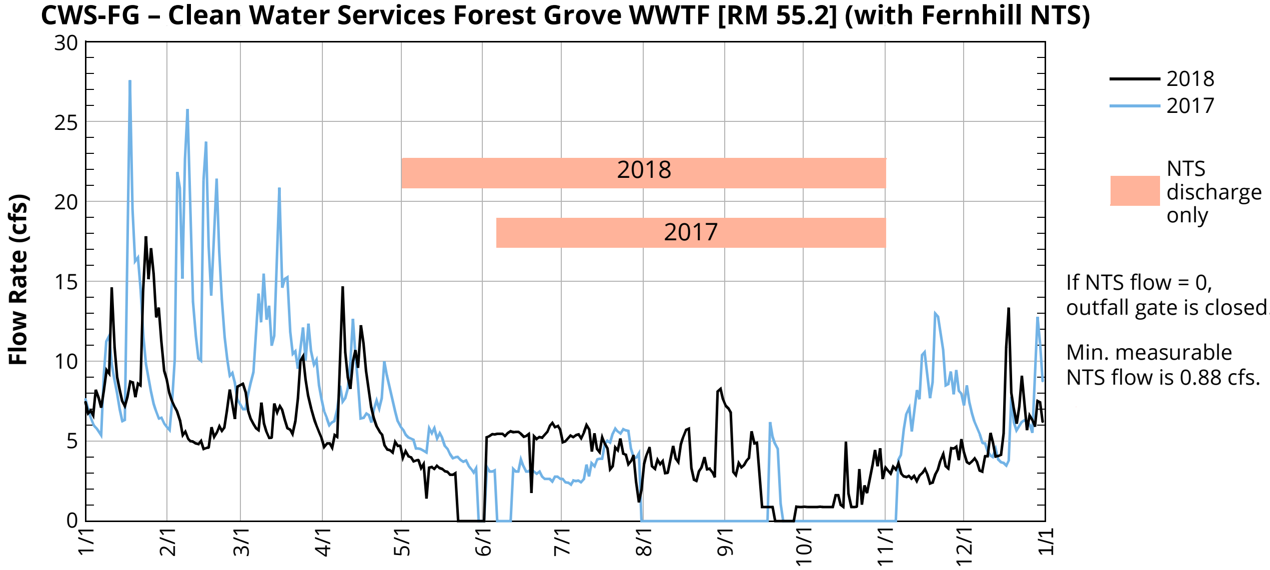
Data source: Clean Water Services

2018 — MEAN DISCHARGE (cfs) — CWS-FG

DAY	JAN	FEB	MAR	APR	MAY*	JUN*	JUL*	AUG*	SEP*	OCT*	NOV	DEC
1	7.43	8.86	8.60	4.64	3.98	closed	4.93	3.56	7.21	0.90	3.36	4.29
2	6.73	8.01	8.03	4.86	4.36	5.26	5.00	4.18	7.05	≤0.88	3.17	3.70
3	6.90	7.50	6.87	4.86	4.05	5.32	5.18	4.64	6.76	≤0.88	2.97	3.60
4	6.59	7.10	6.34	4.58	4.01	5.43	5.35	3.42	3.06	≤0.88	3.42	3.74
5	8.21	6.81	6.06	5.38	3.74	5.41	5.26	3.26	2.88	≤0.88	3.23	3.90
6	7.72	6.25	5.80	5.26	3.79	5.45	5.37	3.81	3.62	≤0.88	3.64	3.68
7	7.09	5.38	5.68	10.4	3.82	5.45	5.41	3.54	3.36	0.90	2.97	3.17
8	8.12	5.58	7.41	14.7	3.31	5.46	5.17	3.76	3.48	≤0.88	2.80	3.09
9	9.45	5.17	6.10	10.6	3.59	5.32	5.55	3.00	3.77	≤0.88	2.74	4.05
10	9.24	5.00	5.55	8.99	1.41	5.51	5.99	3.02	3.94	≤0.88	2.83	4.07
11	14.6	4.97	5.20	8.28	3.34	5.62	5.69	3.84	5.63	≤0.88	2.65	5.51
12	10.9	4.86	5.23	9.96	3.37	5.54	4.35	4.69	4.86	≤0.88	2.82	4.89
13	9.00	4.83	7.35	10.7	3.26	5.57	5.49	3.91	4.90	1.62	2.49	4.04
14	8.20	5.01	6.82	9.59	3.45	5.57	4.52	3.70	3.08	1.62	2.86	4.08
15	7.47	4.52	7.19	12.3	3.31	5.45	4.30	4.81	≤0.88	0.99	3.02	4.15
16	7.16	4.58	6.93	11.1	3.26	5.28	5.24	5.32	≤0.88	≤0.88	3.26	5.49
17	7.75	4.59	6.33	9.41	3.11	5.34	4.84	5.72	≤0.88	4.95	2.89	10.9
18	8.73	5.88	5.82	8.26	3.08	5.45	4.52	5.79	≤0.88	1.72	2.35	13.4
19	8.66	5.28	5.74	7.13	2.89	1.75	3.23	3.33	≤0.88	≤0.88	2.43	8.03
20	7.75	5.52	5.43	6.47	2.89	5.31	3.43	2.60	closed	≤0.88	2.95	7.02
21	8.60	5.93	6.23	5.86	2.99	5.14	4.61	2.52	closed	0.90	3.26	6.10
22	8.48	5.65	7.67	5.60	closed	5.26	4.44	3.12	closed	3.26	3.84	7.16
23	14.3	5.85	10.0	5.41	closed	5.21	5.15	3.37	closed	1.02	4.21	9.10
24	17.8	6.90	10.3	4.70	closed	5.40	4.21	4.01	closed	2.23	3.42	7.47
25	15.1	8.23	8.86	4.47	closed	5.57	4.16	3.25	closed	1.75	3.28	5.71
26	17.1	7.30	7.84	4.44	closed	5.94	3.56	3.28	closed	2.68	4.55	6.59
27	15.5	6.39	6.99	4.27	closed	6.14	3.76	3.06	closed	3.47	4.53	6.28
28	12.7	8.40	6.45	4.93	closed	5.86	4.13	2.72	0.90	4.46	4.66	5.91
29	13.4	—	5.96	4.69	closed	5.94	2.48	8.12	≤0.88	3.43	3.81	7.52
30	11.3	—	5.54	4.70	closed	5.69	1.19	8.28	≤0.88	4.56	5.12	7.43
31	9.39	—	5.17	—	closed	—	1.95	7.58	—	2.63	—	6.22

*Boxed area denotes discharge only from Fernhill NTS. Effluent from the Forest Grove WWTF was not discharged directly to the Tualatin River at that time. It was either routed to the NTS or transferred to the Rock Creek WWTF depending on operational needs.

CWS-FG – Clean Water Services Forest Grove WWTF [RM 55.2] (with Fernhill NTS)



CWS-FG – Clean Water Services Forest Grove WWTF Discharge [RM 55.2] with Fernhill NTS

Data source: Clean Water Services

Summary

- Beginning in 1995, the Forest Grove WWTF discontinued discharges to the Tualatin River during the low-flow season (May/June – October/November, depending on river flow). Effluent was transferred to the Rock Creek WWTF during the entire low-flow season until 2017.
- In 2017, the Forest Grove Natural Treatment System (NTS) at Fernhill Wetlands began trial operation during the low-flow season. Since then, the Forest Grove WWTF either discharges into the NTS or transfers effluent to the Rock Creek WWTF during the low-flow season. The choice of destination is an operational decision and may change day-to-day.
- Plans are for the Forest Grove WWTF to discharge exclusively to the NTS during the low-flow season.

MEDIAN OF DAILY MEAN DISCHARGE — CWS-FG

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	7.8	9.8	8.8	8.2	6.3	5.0	4.1	3.0	3.1	2.6	4.8	6.4
1992	7.1	7.7	5.4	5.7	3.9	2.9	2.6	2.4	2.5	2.9	4.3	7.8
1993	7.8	6.2	7.7	7.7	5.7	4.2	2.9	2.7	2.6	2.7	2.8	4.8
1994	6.4	5.8	5.2	3.1	2.2	1.2	1.1	1.0	1.0	1.4	2.8	5.6
1995	4.7	5.3	5.7	5.4	3.9	0	0	0	0	0	5.0	9.1
1996	8.5	9.8	4.9	5.4	5.0	0	0	0	0	0	2.9	10.0
1997	9.0	4.5	8.3	3.4	0	0	0	0	0	0	0	5.4
1998	10.7	8.9	6.6	1.9	0	2.0	0	0	0	0	0	10.5
1999	8.4	16.4	9.7	3.7	0	0	0	0	0	0	5.2	7.8
2000	9.5	6.9	6.1	0	0	0	0	0	0	0	0	4.0
2001	3.6	3.8	2.8	2.7	0	0	0	0	0	0	0	8.7
2002	7.3	5.5	4.6	0	0	0	0	0	0	0	0	0
2003	7.8	6.8	8.2	0	0	0	0	0	0	0	0	6.0
2004	7.3	7.7	5.0	0	0	0	0	0	0	0	0	0
2005	4.7	3.4	3.3	5.8	0	0	0	0	0	0	0	8.3
2006	12.8	6.0	6.4	5.6	0	0	0	0	0	0	8.1	10.9
2007	6.6	6.9	6.3	4.9	0	0	0	0	0	0	0	8.4
2008	8.8	5.1	5.6	4.6	3.2	0	0	0	0	0	3.5	4.2
2009	5.7	3.9	5.6	0	0	0	0	0	0	0	5.4	4.7
2010	9.2	7.1	5.9	5.3	0	0	0	0	0	0	0	11.1
2011	7.5	6.5	10.1	11.3	9.7	6.1	0	0	0	0	1.3	3.7
2012	8.3	6.4	10.2	6.3	5.6	0	0	0	0	0	5.8	12.3
2013	4.6	4.3	5.0	4.2	0	0	0	0	0	0	3.5	3.4
2014	4.2	8.1	8.3	6.1	4.0	0	0	0	0	0	4.1	8.8
2015	5.6	7.1	6.1	4.4	0	0	0	0	0	0	3.5	15.4
2016	11.0	8.5	10.0	4.4	0	0	0	0	0	0	0	9.3
2017	8.0	13.8	11.0	7.0	4.5	2.9	3.9	0	0	0	8.0	5.9
2018	8.7	5.7	6.3	5.7	3.1	5.4	4.6	3.7	0.9	0.90	3.2	5.5
median	7.8	6.7	6.2	4.8	0	0	0	0	0	0	2.9	7.1

Key

Q in cfs
- $0 < Q \le 2.8$
- $2.8 < Q \le 4.0$
- $4.0 < Q \le 8.3$
- $8.3 < Q \le 11.4$
- $Q > 11.4$

Q as percentile
- $Q \le$ 10th
- 10th $< Q \le$ 25th
- 25th $< Q \le$ 75th
- 75th $< Q \le$ 90th
- $Q >$ 90th

Only days with discharges were used to calculate percentiles

NTS discharge

Direct discharge to the Tualatin River from the Forest Grove WWTF does not occur in July-August, but since 2017, the FG-WWTF may discharge through the Fernhill NT during this time.

CWS-HB – Clean Water Services Hillsboro WWTF Discharge [RM 43.8]

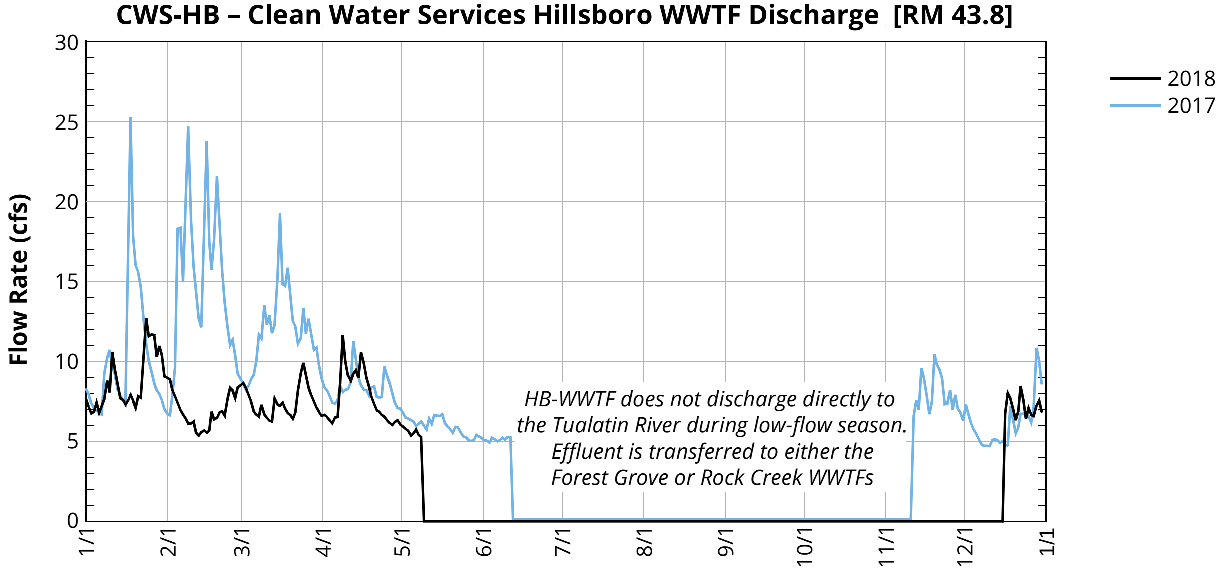
Data source: Clean Water Services

2018 — MEAN DISCHARGE (cfs) — CWS-HB

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	7.7	9.0	8.7	6.7	5.9	0	0	0	0	0	0	0
2	07.2	8.9	8.4	6.5	5.8	0	0	0	0	0	0	0
3	6.8	8.2	7.9	6.3	5.7	0	0	0	0	0	0	0
4	6.9	7.8	7.5	6.2	5.4	0	0	0	0	0	0	0
5	7.5	7.4	6.9	6.5	5.5	0	0	0	0	0	0	0
6	6.8	7.0	6.7	6.5	5.8	0	0	0	0	0	0	0
7	7.3	6.7	6.6	8.7	5.4	0	0	0	0	0	0	0
8	7.7	6.5	7.3	11.7	5.3	0	0	0	0	0	0	0
9	8.8	6.1	6.7	10	0	0	0	0	0	0	0	0
10	8.1	6.1	6.5	9.2	0	0	0	0	0	0	0	0
11	10.7	6.3	6.3	8.8	0	0	0	0	0	0	0	0
12	9.6	5.5	6.3	9.3	0	0	0	0	0	0	0	0
13	8.6	5.4	7.7	9.5	0	0	0	0	0	0	0	0
14	7.7	5.6	7.3	9.0	0	0	0	0	0	0	0	0
15	7.6	5.7	7.3	10.6	0	0	0	0	0	0	0	0
16	7.3	5.6	7.5	9.9	0	0	0	0	0	0	0	0
17	7.6	5.7	7.0	9.0	0	0	0	0	0	0	0	6.8
18	8.0	6.9	6.8	8.4	0	0	0	0	0	0	0	8.0
19	7.6	6.4	6.7	7.8	0	0	0	0	0	0	0	7.7
20	7.1	6.5	6.5	7.3	0	0	0	0	0	0	0	7.0
21	7.8	6.8	6.9	7.0	0	0	0	0	0	0	0	6.3
22	7.8	6.9	8.2	6.9	0	0	0	0	0	0	0	6.9
23	10.5	6.6	9.3	6.7	0	0	0	0	0	0	0	8.5
24	12.7	7.7	9.9	6.6	0	0	0	0	0	0	0	7.6
25	11.6	8.4	9.2	6.3	0	0	0	0	0	0	0	6.4
26	11.7	8.2	8.4	6.2	0	0	0	0	0	0	0	7.1
27	11.7	7.8	7.9	6.0	0	0	0	0	0	0	0	6.7
28	10.3	8.4	7.5	6.2	0	0	0	0	0	0	0	6.6
29	11.0	—	7.1	6.3	0	0	0	0	0	0	0	7.3
30	10.4	—	6.8	6.1	0	0	0	0	0	0	0	7.6
31	9.1	—	6.6	—	0	—	0	0	—	0	—	6.9

During the low-flow season the Hillsboro WWTF does not discharge directly to the Tualatin River. Effluent is transferred to either the Forest Grove or Rock Creek WWTFs depending on operational needs.

CWS-HB – Clean Water Services Hillsboro WWTF Discharge [RM 43.8]



Summary

- Beginning in 1995, the Hillsboro WWTF discontinued discharges to the Tualatin River during the low-flow season (May/June – October/November, depending on river flow). Effluent was transferred to the Rock Creek WWTF during the entire low-flow season until 2017.
- During the low flow season in 2017 and 2018, effluent was transferred from the Hillsboro WWTF to either the Forest Grove or Rock Creek WWTFs. Once at the Forest Grove WWTF, it was either discharged into the Natural Treatment System (NTS) at Fernhill Wetlands or transferred to the Rock Creek WWTF.

MEDIAN OF DAILY MEAN DISCHARGE — CWS-HB

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	4.2	4.8	4.3	4.5	3.8	3.5	3.1	3.8	3.7	4.4	5.0	6.6
1992	6.8	7.7	6.2	6.4	5.4	5.0	4.6	4.5	4.6	4.5	5.1	7.4
1993	7.3	6.0	6.9	7.7	6.4	6.1	4.7	4.4	4.6	3.9	4.2	5.7
1994	7.2	6.5	5.4	4.1	3.3	3.3	1.9	2.0	2.1	2.2	5.1	10.3
1995	8.3	7.6	7.4	5.6	4.5	0	0	0	0	0	5.2	9.2
1996	11.2	12.6	6.0	6.8	6.3	0	0	0	0	0	5.2	15.5
1997	9.9	6.8	9.9	5.1	4.4	0	0	0	0	0	2.4	6.2
1998	11.7	9.5	7.6	5.9	7.1	5.4	0	0	0	0	5.7	12.7
1999	11.3	15.5	9.6	7.1	0	0	0	0	0	0	6.9	8.7
2000	9.8	7.9	7.8	5.8	0	0	0	0	0	0	0	5.6
2001	5.8	5.8	5.6	5.4	0	0	0	0	0	0	0	10.9
2002	10.5	7.5	7.5	7.2	0	0	0	0	0	0	0	7.5
2003	9.4	10.3	10.5	9.3	0	0	0	0	0	0	0	7.9
2004	10.1	9.5	7.6	6.7	0	0	0	0	0	0	0	0
2005	7.1	6.9	0	6.9	7.8	0	0	0	0	0	7.2	8.7
2006	16.3	7.6	7.5	6.7	0	0	0	0	0	0	8.6	10.6
2007	7.2	7.1	6.2	5.5	0	0	0	0	0	0	0	10.6
2008	10.5	6.8	7.1	6.3	0	0	0	0	0	0	4.6	5.0
2009	6.4	5.1	6.0	3.8	4.9	0	0	0	0	0	6.0	5.8
2010	11.2	8.0	6.5	7.0	5.3	5.6	0	0	0	0	0	6.0
2011	8.7	6.9	10.4	0	0	0	0	0	0	0	0	4.9
2012	7.9	7.2	11.7	0	0	0	0	0	0	0	6.0	13.4
2013	5.8	5.5	5.8	0	0	0	0	0	0	0	4.7	4.4
2014	4.8	8.6	8.2	6.4	4.0	0	0	0	0	0	4.4	7.7
2015	5.8	7.1	6.8	5.6	0	0	0	0	0	0	0	17.1
2016	12.3	8.8	10.1	5.6	0	0	0	0	0	0	6.9	9.5
2017	8.6	15.3	11.7	8.1	5.9	0	0	0	0	0	6.9	5.8
2018	7.8	6.8	7.3	6.9	0	0	0	0	0	0	0	0
median	8.4	7.3	7.3	6.1	0	0	0	0	0	0	4.7	7.6

Key

Q in cfs
- $Q \le 4.3$
- $4.3 < Q \le 5.2$
- $5.2 < Q \le 8.8$
- $8.8 < Q \le 12.5$
- $Q > 12.5$

Q as percentile
- $Q \le$ 10th
- 10th $< Q \le$ 25th
- 25th $< Q \le$ 75th
- 75th $< Q \le$ 90th
- $Q >$ 90th

Only days with discharges were used to calculate percentiles

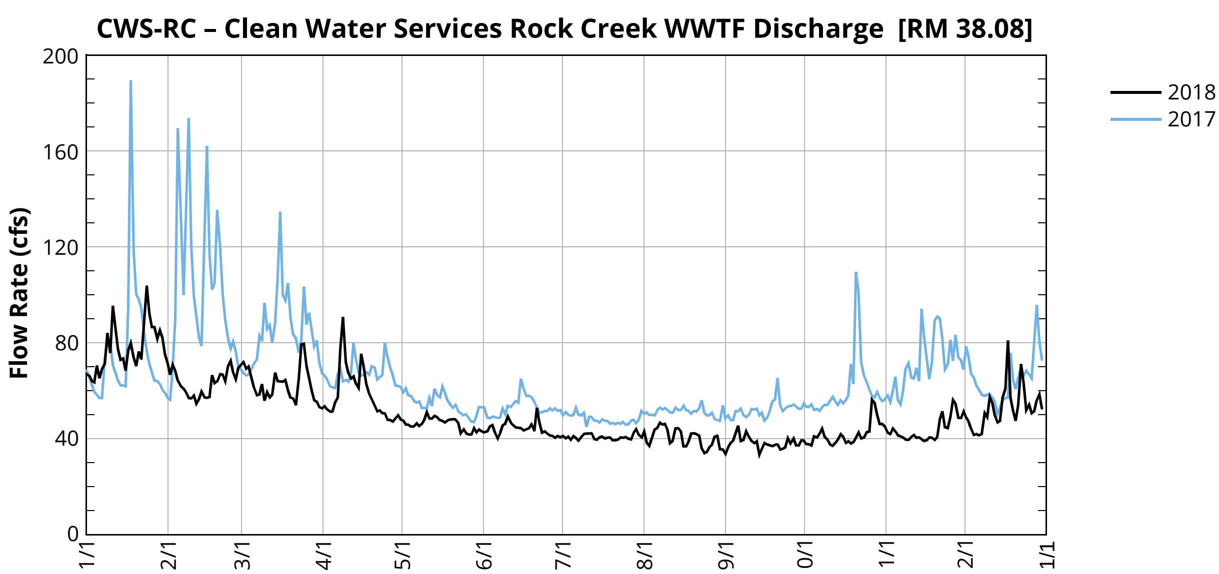
Direct discharge to the Tualatin River from the Hillsboro WWTF does not occur in July-August.

CWS-RC – Clean Water Services Rock Creek WWTF Discharge [RM 38.08]

Data source: Clean Water Services

2018 — MEAN DISCHARGE (cfs) — CWS-RC

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	66.4	71.1	71.5	53.0	47.0	42.1	40.5	42.6	33.0	38.7	44.5	50.8
2	65.8	66.2	68.7	51.5	45.2	42.5	39.5	37.7	35.8	37.2	42.0	48.2
3	63.6	70.2	69.7	50.7	45.2	44.6	40.4	36.4	37.7	37.1	41.3	46.5
4	63.0	67.8	64.9	50.5	44.5	45.2	39.0	39.8	38.7	36.7	43.8	43.4
5	70.1	63.6	60.6	54.8	44.4	41.9	40.5	43.2	41.8	40.4	42.5	41.0
6	64.7	61.2	57.6	56.9	45.8	39.5	39.6	44.0	44.8	39.9	40.8	41.4
7	68.6	60.2	57.9	77.4	44.7	41.7	38.6	46.1	38.3	41.5	40.5	40.9
8	70.9	58.7	62.3	90.4	45.4	45.0	40.1	45.2	38.9	43.7	39.9	41.4
9	83.8	56.5	55.4	71.4	47.2	45.7	41.4	45.5	42.5	40.2	39.1	50.1
10	75.3	56.2	58.8	66.6	50.5	48.6	41.4	43.0	40.2	39.1	38.9	48.3
11	95.1	57.4	56.7	64.6	47.9	46.3	41.6	37.5	38.4	37.2	40.1	56.8
12	86.3	54.1	57.8	65.5	47.8	44.9	41.6	38.4	37.5	36.4	40.9	54.3
13	76.9	55.9	67.2	62.3	49.0	44.2	39.2	43.7	38.2	37.5	39.7	48.9
14	72.5	59.1	63.4	60.5	48.4	44.0	39.1	43.8	32.7	39.0	39.8	46.2
15	72.9	56.7	63.3	74.9	47.1	43.7	39.8	42.5	35.4	41.2	39.2	46.8
16	67.9	56.5	63.2	69.4	46.8	42.9	40.4	36.1	37.7	40.3	38.5	56.5
17	76.4	57.0	64.1	62.3	46.3	43.4	39.5	36.2	37.0	37.7	38.7	60.4
18	79.4	66.0	59.7	58.0	47.1	43.8	39.8	38.3	36.6	38.3	39.9	80.5
19	73.3	62.7	56.6	55.4	47.5	45.4	39.9	41.5	36.3	37.4	39.7	56.4
20	69.8	63.4	56.3	53.2	47.6	42.6	38.8	41.7	36.8	38.0	38.9	51.1
21	75.9	66.3	53.4	50.9	47.4	52.3	38.7	41.4	37.0	39.9	40.1	46.9
22	72.6	66.1	64.5	51.4	46.2	46.1	39.0	40.8	34.8	42.1	47.5	53.7
23	90.1	63.3	78.9	50.1	41.7	41.9	39.9	35.2	35.3	39.5	50.8	70.6
24	103.4	69.9	79.1	50.0	43.2	42.5	39.7	33.5	35.8	39.8	44.2	62.5
25	91.9	72.0	69.9	47.4	41.6	41.5	40.2	33.9	39.5	42.1	43.8	51.4
26	86.1	66.9	64.7	47.2	41.1	40.7	39.3	35.9	37.4	42.5	48.5	53.7
27	86.1	64.1	59.7	46.6	41.1	40.7	39.1	36.9	39.5	55.8	55.6	50.1
28	81.1	69.1	55.6	47.9	43.8	39.7	42.0	40.1	36.7	54.5	53.9	50.9
29	84.8	—	54.9	49.2	42.2	40.6	43.3	40.7	36.5	49.4	48.1	55.7
30	81.7	—	52.7	47.5	43.2	40.0	41.0	35.1	38.8	45.5	48.0	58.2
31	74.6	—	52.1	—	42.6	—	39.9	34.9	—	45.5	—	52.1



Summary

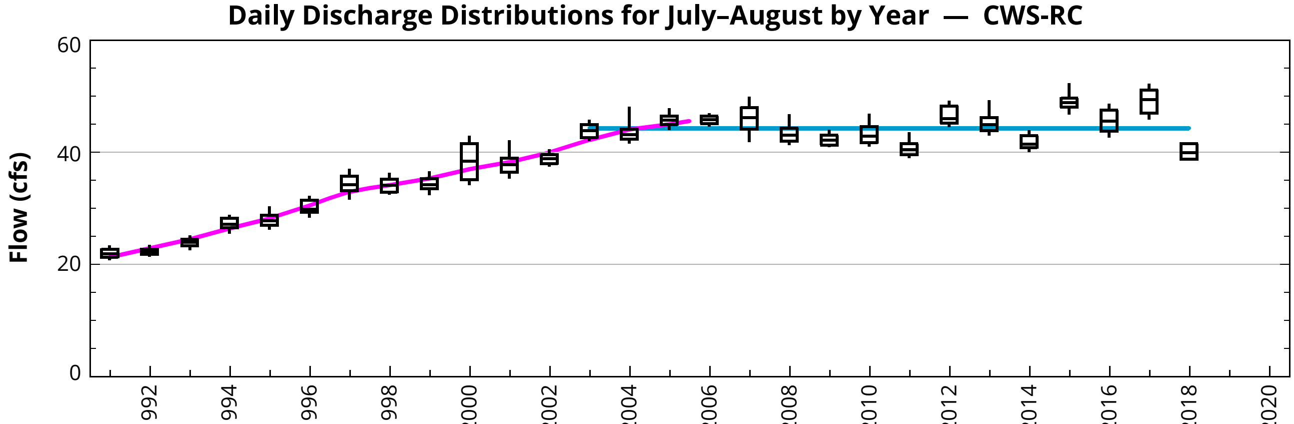
- Discharges from the Rock Creek WWTF in 2018 were somewhat lower than those in recent years. The decrease is likely related to lower rainfall in 2018, especially in the spring.
- Discharges in July–August steadily increased from1991 to the early-2000s. Discharges also increased for other months during this time period.
- From 2003–2018 discharges show no trend. The average discharge in July-August 2003–2018 was 44.3 cfs.

MEDIAN OF DAILY MEAN DISCHARGE — CWS-RC

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	27	33	34	30	29	24	21	22	21	21	28	30
1992	32	36	29	29	25	23	22	22	22	22	25	35
1993	38	31	37	40	29	27	24	23	22	22	21	27
1994	32	29	33	30	29	28	27	27	26	25	38	49
1995	55	51	53	37	33	29	28	27	27	29	34	71
1996	57	68	38	42	40	33	31	29	29	30	37	97
1997	63	38	61	35	35	37	35	33	34	39	48	40
1998	68	56	48	38	42	39	34	33	35	36	40	75
1999	73	89	56	39	39	38	34	34	32	31	45	51
2000	63	59	59	44	49	44	41	35	38	41	34	40
2001	38	40	39	39	38	37	37	38	39	41	48	71
2002	72	57	52	44	42	41	39	39	40	39	41	50
2003	59	58	63	63	47	46	44	44	40	41	40	52
2004	67	58	43	41	41	45	43	43	45	47	48	47
2005	45	42	38	49	57	48	46	46	46	48	50	58
2006	101	51	51	48	46	46	46	46	42	42	66	138
2007	56	56	52	48	48	44	46	46	42	47	47	74
2008	72	53	52	46	43	43	42	43	44	43	43	43
2009	50	41	47	46	50	47	42	43	43	45	51	46
2010	69	56	53	54	51	57	44	42	44	43	57	87
2011	62	51	73	60	45	41	41	40	40	42	46	38
2012	51	49	68	57	54	51	48	45	45	49	53	80
2013	48	45	43	47	47	49	44	46	50	50	46	43
2014	43	64	63	54	46	46	43	41	41	46	48	58
2015	49	58	59	52	52	50	49	49	51	52	59	100
2016	84	70	73	50	52	49	47	45	48	70	69	71
2017	67	99	82	66	54	52	47	51	51	56	70	65
2018	75	63	61	54	46	43	40	40	37	40	41	51
median	57	53	52	46	45	44	42	41	40	42	46	52

Key
Q in cfs
0 < Q ≤ 29
29 < Q ≤ 38
38 < Q ≤ 53
53 < Q ≤ 70
Q > 70
Q as percentile
Q ≤ 10th
10th < Q ≤ 25th
25th < Q ≤ 75th
75th < Q ≤ 90th
Q > 90th

Daily Discharge Distributions for July–August by Year — CWS-RC

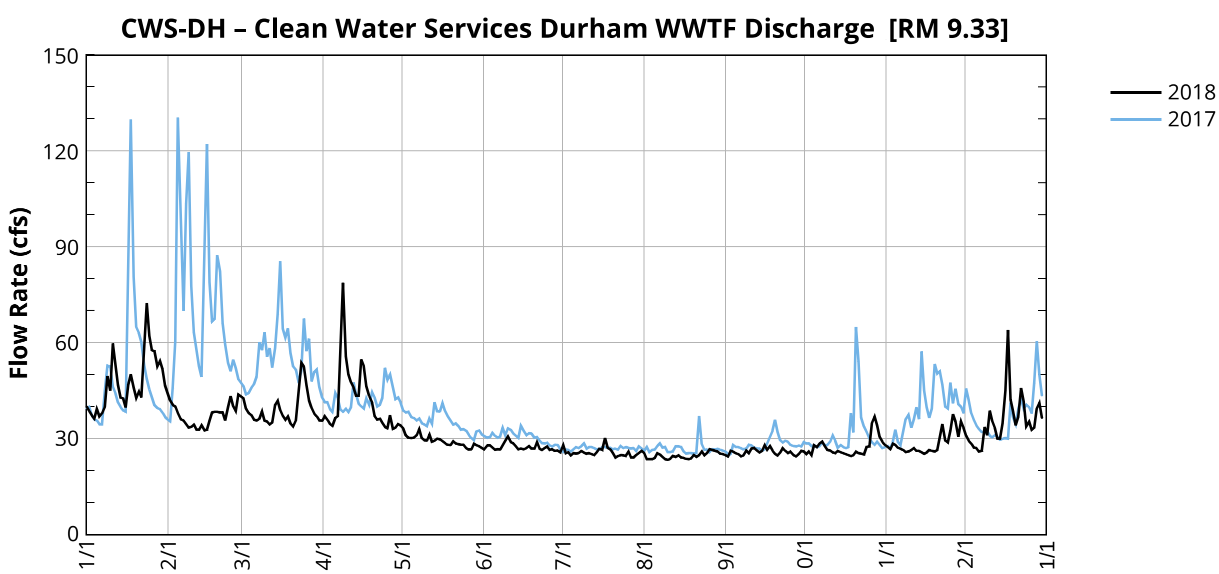


CWS-DH – Clean Water Services Durham WWTF Discharge [RM 9.33]

Data source: Clean Water Services

2018 — MEAN DISCHARGE (cfs) — CWS-DH

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	39.6	43.9	42.2	36.7	32.8	26.3	27.7	25.1	24.4	25.5	27.7	33.0
2	38.2	41.5	38.8	35.6	30.6	27.4	25.1	23.1	24.0	24.8	26.9	30.5
3	36.8	40.2	37.6	34.2	29.9	27.4	25.4	23.1	25.8	25.5	26.3	28.9
4	35.9	39.8	36.8	33.6	29.7	26.8	24.3	23.1	25.5	24.4	28.0	28.0
5	38.8	37.6	35.4	36.0	29.9	26.0	25.1	23.5	25.1	27.5	27.7	26.8
6	36.5	35.7	35.3	36.7	30.6	26.3	24.9	25.1	24.8	26.9	26.8	26.6
7	37.6	35.3	35.9	60.3	32.6	26.1	25.1	24.6	24.0	28.0	26.5	25.5
8	39.8	34.2	38.1	78.6	29.7	27.5	25.7	23.8	24.3	28.6	26.0	25.7
9	49.2	33.1	35.1	55.4	29.1	28.9	25.2	23.1	25.8	27.2	25.4	33.3
10	44.6	33.3	35.0	49.7	28.9	30.3	24.9	22.9	25.1	26.0	25.5	30.6
11	59.4	33.9	34.0	47.2	30.9	28.5	25.1	23.2	26.5	25.8	26.0	38.4
12	52.9	32.3	34.7	45.6	28.6	28.2	24.8	24.1	26.6	25.2	26.6	35.0
13	46.4	32.3	40.2	43.0	28.9	27.2	24.4	23.8	25.8	25.1	25.7	32.8
14	42.5	33.7	41.5	43.0	29.5	26.3	25.4	24.3	25.2	25.7	25.7	29.5
15	42.2	32.2	38.5	54.5	29.4	26.5	26.5	23.7	25.7	25.4	25.4	29.5
16	39.3	32.3	36.7	52.3	28.8	26.3	26.0	23.5	27.5	25.1	24.9	34.3
17	46.4	35.1	35.4	45.9	28.2	26.6	29.7	23.2	26.0	24.8	25.2	44.7
18	49.7	37.7	36.5	42.9	27.7	27.2	26.8	23.1	27.2	24.4	26.0	63.6
19	45.6	37.9	34.3	40.8	27.5	26.5	26.3	23.4	25.8	24.1	25.7	41.8
20	42.4	37.9	33.4	36.7	28.8	26.5	25.1	24.4	24.9	24.4	25.5	38.1
21	44.4	37.7	35.4	35.6	28.0	28.5	23.7	23.8	24.3	25.5	26.0	33.7
22	42.5	37.7	45.2	35.9	27.8	26.5	24.1	24.4	25.2	25.1	30.3	36.4
23	57.4	35.3	53.4	34.5	27.7	26.0	24.4	25.5	26.6	24.9	34.2	45.5
24	72.2	39.4	52.1	33.3	27.7	26.6	24.3	24.3	25.7	24.6	28.9	41.3
25	61.9	42.9	46.4	32.8	26.6	27.1	24.1	25.1	25.1	26.9	28.3	33.4
26	57.4	39.8	41.6	36.8	26.1	26.0	25.5	26.3	25.5	27.1	32.0	35.0
27	57.1	38.2	39.1	32.6	26.3	26.3	23.7	26.0	24.4	34.7	37.3	32.3
28	52.3	43.3	37.4	33.1	28.0	25.7	23.7	25.7	24.0	36.5	35.0	33.1
29	54.0	—	36.5	34.2	27.5	25.8	24.4	25.5	24.8	33.7	30.2	39.1
30	51.4	—	35.3	33.7	27.2	25.4	25.1	24.9	25.7	30.0	35.0	40.8
31	46.3	—	35.1	—	26.8	—	25.7	24.8	—	28.6	—	36.2



Summary

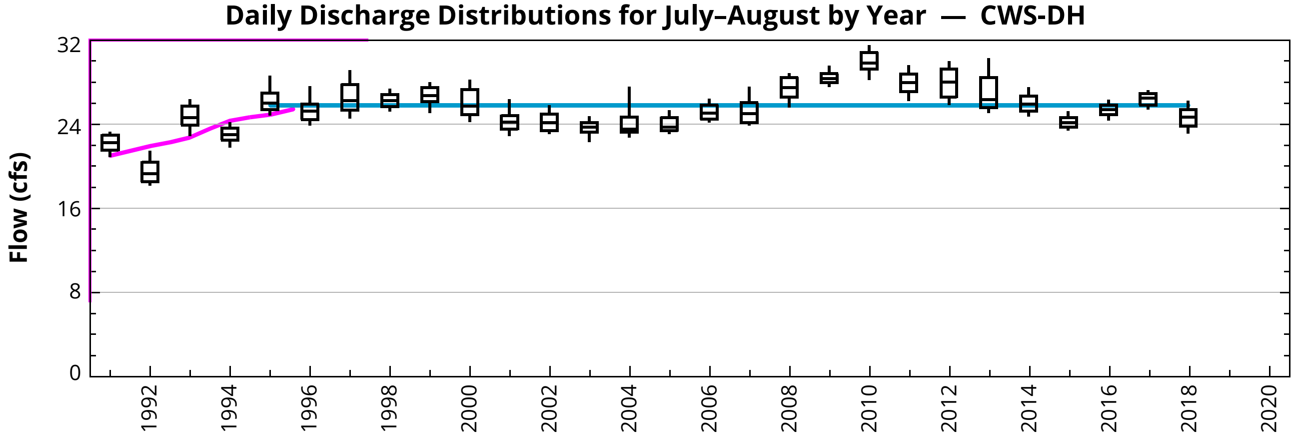
- Discharges from the Durham WWTF in 2018 were slightly lower than those in recent years. The decrease is likely related to lower rainfall in 2018, especially in the spring.
- Discharges before 1995 were lower than those after.
- Since 1995, discharges show no trend. Periods of lower and higher discharge repeatedly occur. The average discharge in July-August 1995–2018 was 25.8 cfs.

MEDIAN OF DAILY MEAN DISCHARGE — CWS-DH

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	28.9	32.8	29.4	30.7	28.2	25.4	22.3	22.0	21.5	21.5	27.0	28.1
1992	29.6	34.4	26.6	27.9	23.7	22.1	19.9	18.5	21.0	20.9	24.9	33.4
1993	33.0	26.7	30.9	39.1	31.4	24.9	24.9	24.6	23.5	24.5	21.1	27.7
1994	31.2	30.7	32.1	28.9	24.6	23.8	22.7	23.1	23.9	23.7	36.2	40.5
1995	40.3	41.7	41.3	35.6	31.5	28.2	25.9	26.1	26.0	28.8	37.4	44.4
1996	49.0	56.4	40.2	40.7	36.4	27.9	25.6	24.8	26.5	31.0	38.7	69.8
1997	60.9	36.5	51.4	34.9	30.0	30.1	26.4	25.8	28.0	30.4	34.9	33.1
1998	49.2	45.3	41.7	33.1	35.9	30.3	26.3	25.8	26.7	29.4	37.9	51.0
1999	54.7	63.1	47.4	36.9	31.1	28.5	26.7	26.8	26.2	26.8	36.7	39.8
2000	42.1	42.5	39.7	32.0	31.4	28.7	27.2	24.9	25.6	26.5	26.7	30.0
2001	28.2	28.0	28.4	28.8	25.9	25.4	24.1	24.3	24.5	25.0	30.2	42.9
2002	41.9	38.4	36.8	31.7	26.6	25.8	24.6	23.5	24.1	23.7	25.2	34.0
2003	38.2	37.1	42.5	39.3	30.9	25.5	23.5	23.8	23.6	25.2	27.2	39.0
2004	43.9	39.8	32.3	28.5	26.1	24.5	23.4	24.4	25.1	27.7	27.5	30.0
2005	30.2	27.0	25.8	33.7	34.5	28.6	24.6	23.4	23.7	28.2	34.3	40.7
2006	64.0	41.5	38.8	35.5	30.0	27.8	25.1	25.2	25.3	24.6	46.2	47.8
2007	38.7	36.1	37.0	34.3	28.6	25.8	24.4	25.5	24.1	27.4	29.8	48.6
2008	48.4	35.9	41.8	37.9	30.8	28.8	28.0	26.8	25.2	27.1	31.0	30.0
2009	37.3	33.1	36.8	34.2	33.0	29.8	28.3	28.5	29.0	29.5	38.3	35.3
2010	52.4	41.2	39.4	41.8	35.7	40.9	30.8	29.2	30.2	30.5	41.1	57.9
2011	46.4	40.2	54.3	44.9	33.7	29.9	27.2	28.0	28.2	26.3	30.6	30.2
2012	39.6	36.2	48.1	38.6	33.1	30.3	28.6	27.7	28.2	33.1	44.4	66.5
2013	39.0	36.5	35.4	35.1	31.9	32.7	28.5	25.7	29.2	28.2	30.9	29.2
2014	31.2	43.9	42.9	38.3	31.1	27.7	26.7	25.3	25.2	28.2	31.3	39.4
2015	32.2	37.3	34.5	31.7	26.9	25.4	24.0	24.3	25.7	26.0	31.3	61.4
2016	52.6	43.6	45.9	31.7	29.4	27.4	25.5	25.1	26.1	40.8	38.5	42.9
2017	40.8	64.4	52.3	41.0	34.5	30.2	26.6	26.1	27.1	28.0	39.0	36.0
2018	45.6	37.7	36.7	36.7	28.8	26.5	25.1	24.1	25.4	25.5	26.5	33.4
median	40.5	37.5	39.1	35.0	31.0	27.9	25.6	25.1	25.5	27.2	31.3	39.2

Key
Q in cfs
0 < Q ≤ 24
24 < Q ≤ 26
26 < Q ≤ 30
39 < Q ≤ 49
Q > 49
Q as percentile
Q ≤ 10th
10th < Q ≤ 25th
25th < Q ≤ 75th
75th < Q ≤ 90th
Q > 90th

Daily Discharge Distributions for July–August by Year — CWS-DH



Summary

- Since 2011, Clean Water Services has partnered with TVID to use the TVID pipeline to deliver flow augmentation water to selected tributaries that have conveniently located TVID release points.
- Typical rates of tributary flow augmentation range from 0.5 cfs to 2 cfs.
- Tributary flow augmentation usually begins sometime in July and ends sometime in October.

2018 RELEASES FOR TRIBUTARY FLOW AUGMENTATION

Site Name	River Mile	Start Date	End Date	Average Flow (cfs)	Average Daily Release (ac-ft)	Total Release (ac-ft)
McKay Creek	7.0			1.72	3.41	354.8
East Fork Dairy Creek	4.9	same start/end for all sites		0.81	1.61	167.1
West Fork Dairy Creek	5.2	7/18/2018	10/29/2018	0.91	1.80	187.7
Gales Creek	5.0			1.66	3.29	342.4

HISTORY OF TRIBUTARY FLOW RESTORATION

Year	Dates	McKay Creek #1 (RM 7.0)		EF Dairy Creek #2 (RM 4.9)		WF Dairy Creek #3 (RM 5.2)		Gales Creek #4 (RM 5.0)	
		Mean cfs	Total ac-ft	Mean cfs	Total ac-ft	Mean cfs	Total ac-ft	Mean cfs	Total ac-ft
2011	7/11 – 9/30	0.4	67	0.6	96	0.4	72	1.5	240
2012	7/20 – 10/16	2.2	388	0.7	118	0.8	146	na	177
2013	7/9 – 9/1	3.0	444	0.9	125	0.8	118	2.0	287
2014	7/11 – 10/21	1.6	319	1.0	205	0.7	151	1.9	384
2015	6/30 – 10/30	2.1	512	1.6	395	0.7	158	1.3	315
2016	7/16 – 10/13	2.0	348	1.5	274	0.7	122	1.7	303
2017	7/7 – 10/18	1.0	202	0.5	95	1.0	193	0.5	104
2018	7/18 – 10/29	1.7	355	0.8	167	0.9	188	1.7	342

Releases at sites that have been discontinued:
McKay Creek (RM (6.5): 2011 (118 ac-ft) 2012 (140 ac-ft)
WF Dairy Creek (RM7.5): 2011 (106 ac-ft) 2012 (175 ac-ft)
Blackjack Creek: 2013(144 ac-ft) 2014 (168 ac-ft) 2015 (234 ac-ft)

APPENDIX C
Scoggins Dam Operations — Monthly Reports

2018 Summary

- Maximum Hagg Lake storage: 53,311 ac-ft on May 11 (99.98% of full pool)
- First day of allocated releases: March 6
- Last day of allocated releases: December 21
- Days with allocated releases: 226
- Maximum daily allocated release: 213 cfs on July 15
- Minimum Hagg Lake storage: 13,198 ac-ft on November 26 (24.8% of full pool)

RELEASE SEASON — 2018

Details of releases for each month follow in this appendix.

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Release Season
Number of days of with allocated releases											
TVID	13	23	0	15	31	31	30	31	27	0	201
CWS	0	0	8	21	31	31	30	31	24	0	176
LO	0	0	0	0	19	31	30	4	0	0	84
JWC	0	0	6	30	31	31	29	29	25	0	181
Other	0	2	0	15	31	31	30	31	1	2	143
TOTAL	**13**	**23**	**8**	**30**	**31**	**31**	**30**	**31**	**27**	**2**	**226**
Allocation releases in acre-feet											
TVID	25.8	85.3	0	2,382	5,970	5,213	2,717	849	171	0	17,413
CWS	0	0	159	417	2,410	3,253	2,757	2,380	754	0	12,129
LO	0	0	0	0	113	184	179	24	0	0	500
JWC	0	0	389	1,876	2,386	1,553	1,672	899	738	0	9,513
Other	0	4.0	0	101	236	228	133	69	2	198	972
TOTAL	**25.8**	**89.3**	**547**	**4,776**	**11,115**	**10,431**	**7,458**	**4,221**	**16,64**	**198**	**40,525**

Abbreviations: TVID=Tualatin Valley Irrigation District; CWS=Clean Water Services; LO=Lake Oswego Corporation; JWC=Joint Water Commission

SCOGGINS DAM RESERVOIR OPERATIONS — JANUARY 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Tualatin Valley Irrigation District

DAY	INFLOW: SCHO (cfs) [1]	SCLO (cfs) [2]	TANO (cfs) [3]	TOTAL INFLOW (cfs) [4]	HENRY HAGG LAKE: W.S. ELEV (ft) [5]	STORAGE CONTENT (ac-ft) [6]	CHANGE STORAGE (ac-ft) [7]	CHANGE STORAGE (cfs) [8]	RELEASE (cfs) [9]	COMP INFLOW (cfs) [10]	TUALATIN RIVER: GASO (cfs) [11]	DLLO (cfs) [12]	GOLF (cfs) [13]	ROOD (cfs) [14]	FRMO (cfs) [15]	WSLO (cfs) [16]	WEATHER: PREC (in) [17]	MAX TEMP (°F) [18]	MIN TEMP (°F) [19]	WATER DELIVERIES: TVID (cfs) [20]	CWS (cfs) [21]	LO (cfs) [22]	JWC (cfs) [23]	OTHER (cfs) [24]
1	89	182	20	291	286.63	35914	539	272	48	320	453	865	1970	2580	3210	3270	0.00	48	29	0	0	0	0	0
2	70	141	12	223	287.04	36304	390	197	48	245	351	757	1680	2630	3260	3260	0.00	46	29	0	0	0	0	0
3	60	116	10	186	286.80	36076	-228	-115	333	218	291	818	1360	2610	3240	3240	0.00	44	34	0	0	0	0	0
4	52	98	8	158	285.90	35224	-852	-430	588	158	259	897	1230	2490	3110	3120	0.00	46	34	0	0	0	0	0
5	57	109	9	175	284.97	34351	-873	-440	594	154	266	900	1270	2350	2920	2970	0.41	47	38	0	0	0	0	0
6	50	96	8	154	284.35	33774	-577	-291	409	118	250	859	1310	2320	2890	2920	0.11	49	39	0	0	0	0	0
7	44	85	7	136	283.87	33330	-444	-224	345	121	228	794	1200	2200	2740	2740	0.00	48	39	0	0	0	0	0
8	46	83	7	136	283.44	32934	-396	-200	324	124	229	757	1100	2070	2570	2590	0.19	44	40	0	0	0	0	0
9	54	98	8	160	283.50	32989	55	28	146	174	260	631	1020	2020	2460	2670	0.49	45	42	0	0	0	0	0
10	49	89	7	145	283.46	32952	-37	-19	199	180	237	645	966	2130	2640	2720	0.04	49	39	0	0	0	0	0
11	57	107	9	173	283.40	32897	-55	-28	200	172	246	638	926	2020	2520	2710	0.43	50	41	0	0	0	0	0
12	126	288	25	439	284.11	33552	655	330	48	378	614	809	1270	2350	2930	3220	0.73	56	48	0	0	0	0	0
13	103	210	23	336	284.78	34174	622	314	50	364	490	843	1580	2520	3200	3380	0.00	51	43	0	0	0	0	0
14	82	165	16	263	284.83	34221	47	24	259	283	386	865	1600	2550	3220	3350	0.01	60	42	0	0	0	0	0
15	69	133	12	214	284.77	34165	-56	-28	259	231	304	813	1500	2580	3230	3290	0.00	58	41	0	0	0	0	0
16	64	123	11	198	284.65	34053	-112	-56	259	203	278	775	1340	2560	3210	3260	0.22	56	41	0	0	0	0	0
17	56	102	9	167	284.33	33756	-297	-150	329	179	249	780	1210	2510	3140	3160	0.03	54	42	0	0	0	0	0
18	62	114	10	186	284.04	33487	-269	-136	302	166	271	773	1160	2500	3130	3400	0.47	52	42	0	0	0	0	0
19	62	125	11	198	284.21	33644	157	79	105	184	293	659	1140	2450	3100	3350	0.34	46	40	0	0	0	0	0
20	72	151	13	236	284.38	33802	158	80	151	231	329	670	1090	2320	2940	3100	0.06	46	40	0	0	0	0	0
21	75	160	15	250	284.57	33979	177	89	152	241	345	683	1070	2190	2770	2880	0.12	47	41	0	0	0	0	0
22	97	185	20	302	284.88	34267	288	145	151	296	422	727	1100	2160	2700	2810	0.49	48	42	0	0	0	0	0
23	89	179	19	287	284.84	34230	-37	-19	332	313	397	823	1160	2140	2670	2740	0.20	49	41	0	0	0	0	0
24	212	509	40	761	285.33	34688	458	231	339	570	na	964	1520	2400	3030	3550	1.44	49	41	0	0	0	0	0
25	180	400	35	615	286.61	35895	1207	609	52	661	636	1050	2090	2860	3640	4070	0.41	48	38	0	0	0	0	0
26	168	347	32	547	287.55	36792	897	452	154	606	601	1050	2270	3060	3880	4300	0.60	46	38	0	0	0	0	0
27	223	448	37	708	288.31	37523	731	369	291	660	na	1150	2350	3270	4120	4570	0.84	48	39	0	0	0	0	0
28	180	364	33	577	389.39	38571	1048	528	100	628	632	1080	2440	3550	4400	4720	0.07	53	46	0	0	0	0	0
29	143	288	29	460	290.20	39364	793	400	102	502	578	968	2370	3780	4640	4840	0.00	59	46	0	0	0	0	0
30	145	315	31	491	290.61	39767	403	203	300	503	608	1070	2290	4010	4880	5300	0.61	50	39	0	0	0	0	0
31	131	254	27	412	290.88	40014	247	125	299	424	547	1040	2230	4050	4980	5350	0.06	49	37	0	0	0	0	0
TOTALS																	8.37 inches							
cfs	2967	6064	553	9584	—	—	2339		7268	9607	11050	26153	46812	81230	101370	106850	MAX:	60	48	0	0	0	0	0
ac-ft	5885	12028	1097	19010	—	—	4639		14416	19055	21918	51874	92852	161120	201067	211937	MIN:	44	29	0	0	0	0	0

Reservoir Storage Status on Jan-31

Comparison to fill curve: +3.97 ft
+3,830 ac-ft
Percent of full reservoir: 75.0%

Minimum Required Discharges

Dec-Sept: 10 cfs Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2018 on Jan-31

	SECO	SDMO
precip to date:	44.0″	65.4″
snow depth:	0″	0″
water content:	0″	0″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Jan-31

	ALLOCATION (cfs) USED	REMAINING
TVID	0	
CWS	0	12,615
LO	0	500
JWC	0	13,500
Other	0	

SCOGGINS DAM RESERVOIR OPERATIONS — FEBRUARY 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO (cfs) [1]	SCLO (cfs) [2]	TANO (cfs) [3]	TOTAL INFLOW (cfs) [4]	W.S. ELEV (ft) [5]	STORAGE CONTENT (ac-ft) [6]	CHANGE STORAGE (ac-ft) [7]	CHANGE STORAGE (cfs) [8]	RELEASE (cfs) [9]	COMP INFLOW (cfs) [10]	GASO (cfs) [11]	DLLO (cfs) [12]	GOLF (cfs) [13]	ROOD (cfs) [14]	FRMO (cfs) [15]	WSLO (cfs) [16]	PREC (in) [17]	MAX TEMP (°F) [18]	MIN TEMP (°F) [19]	TVID (cfs) [20]	CWS (cfs) [21]	LO (cfs) [22]	JWC (cfs) [23]	OTHER (cfs) [24]
1	113	210	23	346	290.96	40113	99	50	299	349	480	960	2130	3980	4950	5370	0.00	45	38	0	0	0	0	0
2	103	176	17	296	291.19	40341	228	115	205	320	442	870	1960	3840	4830	5330	0.13	48	42	0	0	0	0	0
3	85	149	13	247	291.32	40471	130	66	204	270	383	821	1710	3630	4630	5100	0.00	59	43	0	0	0	0	0
4	73	130	11	214	291.39	40540	69	35	205	240	332	768	1460	3380	4340	4810	0.00	57	44	0	0	0	0	0
5	67	114	10	191	291.38	40530	-10	-5	205	200	291	720	1280	3120	4000	4410	0.00	59	41	0	0	0	0	0
6	60	100	9	169	291.59	40739	209	105	52	157	262	566	1100	2850	3650	3970	0.00	58	34	0	0	0	0	0
7	54	89	7	150	291.79	40939	200	101	50	151	238	486	889	2560	3270	3530	0.00	51	34	0	0	0	0	0
8	50	81	7	138	292.00	41148	209	105	52	157	220	431	768	2230	2850	3080	0.00	56	38	0	0	0	0	0
9	47	73	5	125	292.16	41309	161	81	50	131	213	391	674	1810	2320	2580	0.00	56	36	0	0	0	0	0
10	43	68	5	116	292.27	41419	110	55	50	105	200	358	605	1450	1830	2090	0.01	49	30	0	0	0	0	0
11	42	63	5	110	292.41	41559	140	71	50	121	190	333	552	1250	1550	1740	0.00	49	31	0	0	0	0	0
12	38	58	4	100	292.50	41650	91	46	50	96	179	312	517	1120	1370	1540	0.00	48	29	0	0	0	0	0
13	35	54	4	93	292.62	41770	120	61	18	79	169	261	455	1020	1250	1400	0.00	47	25	0	0	0	0	0
14	37	54	4	95	292.76	41911	141	71	21	92	167	251	426	928	1120	1320	0.21	50	28	0	0	0	0	0
15	32	48	4	84	292.89	42043	132	67	20	87	158	241	434	905	1080	1250	0.03	49	33	0	0	0	0	0
16	31	47	4	82	293.00	42154	111	56	19	75	150	226	397	848	1030	1190	0.02	49	34	0	0	0	0	0
17	31	47	4	82	293.12	42275	121	61	21	82	153	227	384	784	938	1140	0.04	51	41	0	0	0	0	0
18	37	54	4	95	293.27	42427	152	77	20	97	205	277	397	759	910	1110	0.22	52	33	0	0	0	0	0
19	32	47	4	83	293.41	42569	142	72	19	91	184	276	478	983	1130	1180	0.22	38	31	0	0	0	0	0
20	30	44	3	77	293.51	42670	101	51	20	71	166	245	413	938	1130	1290	0.03	39	27	0	0	0	0	0
21	28	43	3	74	293.64	42802	132	67	19	86	162	245	408	875	1050	1260	0.27	37	28	0	0	0	0	0
22	28	41	3	72	293.73	42894	92	46	20	66	156	231	382	876	1050	1230	0.12	36	30	0	0	0	0	0
23	26	37	3	66	293.80	42965	71	36	19	55	146	219	369	866	1040	1200	0.01	38	21	0	0	0	0	0
24	31	45	3	79	293.97	43139	174	88	20	108	161	223	366	816	981	1200	0.49	37	24	0	0	0	0	0
25	38	56	4	98	294.13	43320	181	91	20	111	170	251	451	986	1140	1250	0.14	48	35	0	0	0	0	0
26	63	81	7	151	294.47	43650	330	166	18	184	289	448	713	1220	1410	1480	0.42	44	31	0	0	0	0	0
27	51	66	5	122	294.71	43896	246	124	19	143	233	381	695	1470	1770	1750	0.01	44	31	0	0	0	0	0
28	50	68	5	123	294.94	44133	237	119	19	138	221	354	643	1400	1720	1870	0.14	44	34	0	0	0	0	0
TOTALS																	2.51 inches							
cfs	1355	2143	180	3678	—	—	2077		1784	3861	6320	11372	21056	46894	58339	64670	**MAX:**	59	44	0	0	0	0	0
ac-ft	2688	4251	357	7295	—	—	4119		3539	7658	12536	22556	41765	93014	115715	128273	**MIN:**	36	21	0	0	0	0	0

Reservoir Storage Status on Feb-28		
Comparison to fill curve:	–3.26	ft
	–3,416	ac-ft
Percent of full reservoir:	82.8%	

Minimum Required Discharges	
Dec-Sept: 10 cfs	Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2018 on Feb-28	SECO	SDMO
precip to date:	47.1″	72.6″
snow depth:	4″	18″
water content:	1.5″	5″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Feb-28	ALLOCATION (cfs) USED	ALLOCATION (cfs) REMAINING
TVID	0	
CWS	0	12,615
LO	0	500
JWC	0	13,500
Other	0	

SCOGGINS DAM RESERVOIR OPERATIONS — MARCH 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO	SCLO	TANO	TOTAL INFLOW	W.S. ELEV	STORAGE CONTENT	CHANGE STORAGE		RELEASE	COMP INFLOW	GASO	DLLO	GOLF	ROOD	FRMO	WSLO	PREC	MAX TEMP	MIN TEMP	TVID	CWS	LO	JWC	OTHER
	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ac-ft)	(ac-ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(in)	(°F)	(°F)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]
1	78	128	11	217	295.34	44546	413	208	20	228	372	492	791	1470	1760	2000	0.67	44	36	0	0	0	0	0
2	75	125	11	211	295.77	44991	445	224	20	244	335	555	947	1780	2140	2140	0.40	43	34	0	0	0	0	0
3	70	111	10	191	296.15	45387	396	200	19	219	295	551	975	1910	2320	2350	0.10	47	36	0	0	0	0	0
4	64	100	9	173	296.47	45721	334	168	18	186	263	511	923	1940	2370	2440	0.00	51	30	0	0	0	0	0
5	57	89	7	153	296.76	46024	303	153	19	172	239	468	850	1850	2280	2380	0.01	48	38	0	0	0	0	0
6	53	83	7	143	297.01	46287	263	133	21	154	223	434	763	1720	2110	2240	0.00	51	28	1	0	0	0	0
7	50	75	6	131	297.25	46539	252	127	20	147	211	404	703	1560	1910	2060	0.00	55	32	0	0	0	0	0
8	55	83	7	145	297.48	46782	243	123	21	144	207	388	667	1420	1730	1880	0.30	54	40	0	0	0	0	0
9	81	151	13	245	297.91	47237	455	229	20	249	424	555	844	1470	1760	1890	0.33	55	36	1	0	0	0	0
10	66	130	11	207	298.27	47619	382	193	20	213	337	575	895	1530	1830	1880	0.00	53	31	0	0	0	0	0
11	57	111	10	178	298.57	47939	320	161	20	181	281	518	841	1480	1780	1870	0.01	59	36	1	0	0	0	0
12	51	99	8	158	298.84	48227	288	145	20	165	257	464	773	1380	1670	1790	0.00	67	38	0	0	0	0	0
13	50	96	8	154	299.09	48495	268	135	20	155	246	435	712	1280	1540	1670	0.08	69	43	1	0	0	0	0
14	47	101	9	157	299.38	48806	311	157	20	177	288	496	760	1420	1690	1780	0.39	52	39	0	0	0	0	0
15	43	90	7	140	299.61	49054	248	125	20	145	250	461	741	1380	1670	1790	0.01	52	32	1	0	0	0	0
16	46	92	8	146	299.87	49334	280	141	20	161	257	464	715	1330	1600	1810	0.39	51	37	0	0	0	0	0
17	42	80	7	129	300.09	49572	238	120	19	139	224	433	694	1310	1590	1730	0.03	51	38	1	0	0	0	0
18	39	74	5	118	300.27	49767	195	98	19	117	208	402	643	1220	1490	1700	0.00	52	38	0	0	0	0	0
19	39	70	5	114	300.46	49973	206	104	19	123	202	386	598	1110	1360	1560	0.08	49	33	1	0	0	0	0
20	38	64	5	107	300.59	50115	142	72	51	123	189	390	578	1040	1260	1440	0.00	56	31	0	0	0	0	0
21	36	60	4	100	300.69	50223	108	54	51	105	180	369	554	1000	1210	1370	0.00	60	33	1	0	0	0	0
22	40	66	5	111	300.75	50289	66	33	102	135	186	433	582	1050	1230	1460	0.48	49	36	0	0	0	0	0
23	39	62	5	106	300.83	50376	87	44	103	147	201	470	662	1340	1600	1840	0.56	49	33	1	0	0	0	0
24	44	74	5	123	300.86	50409	33	17	152	169	228	591	832	1660	2030	2310	0.45	42	33	0	0	0	0	0
25	49	78	6	133	300.91	50463	54	27	152	179	236	645	948	1890	2360	2600	0.43	40	36	1	0	0	0	0
26	52	84	7	143	300.95	50507	44	22	152	174	228	636	969	1920	2410	2650	0.02	51	34	0	0	0	0	0
27	57	90	8	155	300.98	50540	33	17	152	169	236	614	948	1860	2330	2560	0.01	50	39	1	0	0	0	0
28	64	101	8	173	301.03	50594	54	27	152	179	279	612	918	1770	2200	2410	0.00	56	37	0	0	0	0	0
29	58	97	8	163	301.14	50714	120	61	103	164	266	568	890	1680	2070	2266	0.00	57	34	1	0	0	0	0
30	51	90	8	149	301.32	50911	197	99	53	152	239	476	811	1570	1930	2100	0.00	60	36	0	0	0	0	0
31	46	82	7	135	301.49	51098	187	94	52	146	217	417	715	1420	1750	1940	0.00	58	38	1	0	0	0	0
TOTALS																	4.75 inches							
cfs	1637	2836	235	4708	—	—	3512		1650	5162	7804	15213	24242	46760	56980	61906	**MAX:**	69	43	13	0	0	0	0
ac-ft	3247	5625	466	9338	—	—	6965		3273	10238	15479	30175	48084	92748	113020	122791	**MIN:**	40	28	26	0	0	0	0

Reservoir Storage Status on Mar-31	
Comparison to fill curve:	−0.14 ft
	−150 ac-ft
Percent of full reservoir:	95.8%

Minimum Required Discharges	
Dec-Sept: 10 cfs	Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2018 on Mar-31	SECO	SDMO
precip to date:	53.3″	80.9″
snow depth:	0″	6″
water content:	0″	4″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Mar-31	ALLOCATION (cfs)	
	USED	REMAINING
TVID	26	
CWS	0	12,615
LO	0	500
JWC	0	13,500
Other	0	

SCOGGINS DAM RESERVOIR OPERATIONS — APRIL 2018

[See Appendix E for breakdown of municipal use by water provider.]

Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO	SCLO	TANO	TOTAL INFLOW	W.S. ELEV	STORAGE CONTENT	CHANGE STORAGE		RELEASE	COMP INFLOW	GASO	DLLO	GOLF	ROOD	FRMO	WSLO	PREC	MAX TEMP	MIN TEMP	TVID	CWS	LO	JWC	OTHER
	(cfs) [1]	(cfs) [2]	(cfs) [3]	(cfs) [4]	(ft) [5]	(ac-ft) [6]	(ac-ft) [7]	(cfs) [8]	(cfs) [9]	(cfs) [10]	(cfs) [11]	(cfs) [12]	(cfs) [13]	(cfs) [14]	(cfs) [15]	(cfs) [16]	(in) [17]	(°F) [18]	(°F) [19]	(cfs) [20]	(cfs) [21]	(cfs) [22]	(cfs) [23]	(cfs) [24]
1	41	74	5	120	301.64	51262	164	83	52	135	199	376	619	1270	1560	1760	0.00	62	37	0	0	0	0	0
2	40	72	5	117	301.78	51416	154	78	52	130	193	353	565	1160	1410	1630	0.22	51	32	1	0	0	0	0
3	38	64	5	107	301.83	51471	55	28	100	128	182	377	550	1080	1300	1640	0.00	52	30	0	0	0	0	0
4	35	59	4	98	301.85	51493	22	11	100	111	169	354	521	1020	1230	1550	0.00	52	32	1	0	0	0	0
5	32	53	4	89	301.87	51515	22	11	101	112	160	335	480	942	1130	1460	0.00	59	45	0	0	0	0	0
6	30	59	4	93	301.90	51548	33	17	101	118	171	349	494	958	1120	1450	0.28	51	45	1	0	0	0	0
7	32	66	5	103	301.79	51427	-121	-61	192	131	180	435	544	982	1150	1560	0.15	67	51	1	0	0	0	0
8	32	413	36	481	301.82	51460	33	17	303	320	619	738	888	1500	1820	2700	1.92	56	45	0	0	0	0	0
9	191	298	30	519	302.48	52188	728	367	154	521	608	983	1500	2330	2890	3390	0.26	51	38	1	0	0	0	0
10	92	202	23	317	302.21	51890	-298	-150	516	366	474	1030	1820	2380	2990	3500	0.05	62	40	1	0	0	0	0
11	70	150	13	233	302.16	51835	-55	-28	272	244	373	873	1850	2440	3040	3420	0.04	60	44	1	0	0	0	0
12	66	134	12	212	302.19	51868	33	17	196	213	326	768	1590	2470	3070	3470	0.29	53	39	0	0	0	0	0
13	108	228	24	360	302.08	51746	-122	-62	354	292	440	849	1470	2460	3070	3450	0.68	48	40	1	0	0	0	0
14	138	313	30	481	302.37	52067	321	162	296	458	574	918	1640	2400	2990	3330	0.20	51	44	1	0	0	0	0
15	114	264	27	405	302.31	52000	-67	-34	414	380	517	979	1840	2400	2980	3360	0.15	55	46	0	0	0	0	0
16	136	271	28	435	302.50	52210	210	106	297	403	540	948	2000	2630	3260	3740	0.71	48	39	1	0	0	0	0
17	132	290	29	451	302.76	52499	289	146	308	454	596	983	2050	2720	3380	3790	0.49	47	37	0	0	0	0	0
18	114	239	25	378	302.92	52676	177	89	308	397	527	964	2070	2750	3420	na	0.01	55	39	1	0	0	0	0
19	90	187	20	297	302.96	52721	45	23	307	330	453	904	1970	2780	3440	na	0.00	60	35	1	0	0	0	0
20	73	153	13	239	302.87	52621	-100	-50	305	255	379	849	1760	2740	3410	3680	0.00	66	35	1	0	0	0	0
21	64	127	11	202	303.01	52776	155	78	152	230	321	729	1500	2650	3300	3590	0.00	63	40	1	0	0	0	0
22	56	108	9	173	303.09	52865	89	45	152	197	282	655	1240	2470	3100	3370	0.00	59	36	1	0	0	0	0
23	51	94	8	153	303.14	52921	56	28	153	181	255	597	1020	2220	2790	3120	0.00	64	37	2	0	0	0	0
24	46	82	7	135	303.17	52954	33	17	152	169	231	554	882	1870	2350	2750	0.00	72	43	3	0	0	0	0
25	43	74	5	122	303.15	52932	-22	-11	151	140	212	511	773	1530	1900	2330	0.00	78	46	4	0	0	0	0
26	39	66	5	110	303.21	52999	67	34	102	136	195	418	670	1300	1590	1970	0.00	83	52	4	0	0	0	0
27	36	60	4	100	303.27	53066	67	34	80	114	183	354	565	1120	1370	1720	0.00	82	50	4	0	0	0	1
28	34	55	4	93	303.32	53122	56	28	80	108	177	334	511	na	1190	1540	0.11	54	44	4	0	0	0	0
29	32	51	4	87	303.36	53166	44	22	80	102	167	312	492	na	1120	1470	0.14	59	43	4	0	0	0	1
30	28	47	4	79	303.38	53189	23	12	80	92	156	287	444	na	1070	1380	0.00	58	45	3	0	0	0	0
TOTALS																	5.70 inches							
cfs	2033	4353	403	6789	—	—	1054		5910	6964	9859	19116	34318	52572	68440	72120	**MAX:**	83	52	43	0	0	0	2
ac-ft	4032	8634	799	13466	—	—	2091		11722	13814	19555	37917	68070	104277	135751	143050	**MIN:**	47	30	85	0	0	0	4

Reservoir Storage Status on Apr-30	
Comparison to fill curve:	–0.08 ft
	–89.5 ac-ft
Percent of full reservoir:	99.7%

Minimum Required Discharges	
Dec-Sept: 10 cfs	Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2018 on Apr-30		
	SECO	SDMO
precip to date:	61.8″	93.9″
snow depth:	0″	0″
water content:	0″	0″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Apr-30	ALLOCATION (cfs)	
	USED	REMAINING
TVID	111	
CWS	0	12,615
LO	0	500
JWC	0	13,500
Other	4	

SCOGGINS DAM RESERVOIR OPERATIONS — MAY 2018

[See Appendix E for breakdown of municipal use by water provider.]

Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO (cfs) [1]	SCLO (cfs) [2]	TANO (cfs) [3]	TOTAL INFLOW (cfs) [4]	W.S. ELEV (ft) [5]	STORAGE CONTENT (ac-ft) [6]	CHANGE STORAGE (ac-ft) [7]	CHANGE STORAGE (cfs) [8]	RELEASE (cfs) [9]	COMP INFLOW (cfs) [10]	GASO (cfs) [11]	DLLO (cfs) [12]	GOLF (cfs) [13]	ROOD (cfs) [14]	FRMO (cfs) [15]	WSLO (cfs) [16]	PREC (in) [17]	MAX TEMP (°F) [18]	MIN TEMP (°F) [19]	TVID (cfs) [20]	CWS (cfs) [21]	LO (cfs) [22]	JWC (cfs) [23]	OTHER (cfs) [24]
1	27	45	4	76	303.49	53311	122	62	32	94	151	225	384	781	946	1300	0.03	54	43	0	0	0	0	0
2	23	42	3	68	303.47	53289	-22	-11	90	79	144	276	402	711	844	1170	0.00	57	40	0	0	0	0	0
3	22	39	3	64	303.47	53289	0	0	90	90	136	254	372	681	807	1100	0.00	73	45	0	0	0	0	0
4	20	36	3	59	303.44	53256	-33	-17	89	72	128	244	348	629	743	1040	0.00	74	45	0	0	0	0	0
5	20	35	3	58	303.45	53267	11	6	70	76	122	212	309	575	688	987	0.00	66	50	0	0	0	0	0
6	19	32	3	54	303.46	53278	11	6	69	75	117	206	300	533	635	936	0.00	75	50	0	0	0	0	0
7	17	31	3	51	303.45	53267	-11	-6	69	63	114	197	310	523	616	887	0.03	69	47	0	0	0	0	0
8	17	30	3	50	303.42	53233	-34	-17	69	52	107	189	290	492	584	851	0.00	76	47	0	0	0	0	0
9	16	27	3	46	303.42	53233	0	0	69	69	104	187	282	459	543	828	0.01	74	52	0	0	0	0	0
10	16	29	3	48	303.41	53222	-11	-6	49	43	98	162	260	493	553	782	0.01	65	50	0	0	0	0	0
11	15	28	3	46	303.44	53256	34	17	34	51	96	139	236	469	531	765	0.02	61	42	0	0	0	0	0
12	15	27	3	45	303.46	53278	22	11	37	48	92	138	203	406	475	726	0.00	69	43	0	0	0	0	0
13	14	25	3	42	303.49	53311	33	17	37	54	87	129	188	377	438	662	0.00	80	47	0	0	0	0	0
14	13	24	3	40	303.49	53311	0	0	54	54	81	145	193	349	407	630	0.00	88	49	0	0	0	0	0
15	13	23	3	39	303.48	53300	-11	-6	48	42	77	134	171	331	388	600	0.00	89	49	0	0	0	0	0
16	13	22	3	38	303.45	53267	-33	-17	51	34	78	134	165	313	370	473	0.00	69	53	0	0	0	0	0
17	12	22	3	37	303.44	53256	-11	-6	42	36	76	120	160	313	363	459	0.00	67	54	0	0	0	0	0
18	12	21	3	36	303.43	53244	-12	-6	42	36	74	118	146	302	349	450	0.00	68	48	0	0	0	0	0
19	12	21	3	36	303.43	53244	0	0	42	42	74	118	144	278	334	436	0.00	63	49	0	0	0	0	0
20	12	20	2	34	303.43	53244	0	0	42	42	70	115	140	269	321	414	0.00	69	51	0	0	0	0	0
21	11	20	2	33	303.42	53233	-11	-6	42	36	68	110	123	263	312	401	0.00	71	41	0	0	0	0	0
22	11	19	2	32	303.42	53233	0	0	36	36	65	99	104	240	288	388	0.00	73	46	0	0	0	0	0
23	10	18	2	30	303.43	53244	11	6	36	42	60	96	88	205	256	364	0.00	86	52	0	0	0	0	0
24	10	17	2	29	303.41	53222	-22	-11	45	34	56	105	90	185	228	325	0.00	79	55	0	10	0	0	0
25	10	17	2	29	303.38	53189	-33	-17	46	29	58	105	95	184	223	303	0.00	73	55	0	10	0	0	0
26	10	17	2	29	303.29	53088	-101	-51	71	20	83	146	105	179	223	292	0.00	69	43	0	10	0	30	0
27	10	17	2	29	303.21	52999	-89	-45	70	25	81	145	122	201	237	296	0.00	66	43	0	10	0	30	0
28	9	16	2	27	303.15	52932	-67	-34	70	36	75	139	115	203	245	306	0.00	79	44	0	10	0	30	0
29	9	15	2	26	303.06	52832	-100	-50	70	20	76	138	106	186	234	314	0.00	71	40	0	10	0	30	0
30	9	15	2	26	302.97	52732	-100	-50	75	25	74	142	103	181	223	296	0.00	64	38	0	10	0	38	0
31	9	14	2	25	302.87	52621	-111	-56	76	20	76	142	102	171	214	289	0.00	66	47	0	10	0	38	0
TOTALS																	0.10 inches							
cfs	436	764	82	1282	—	—	-286		1762	1476	2798	4809	6156	11482	13618	19070	MAX:	89	55	0	80	0	196	0
ac-ft	865	1515	163	2543	—	—	-568		3495	2927	5550	9539	12210	22775	27011	37825	MIN:	54	38	0	159	0	389	0

Reservoir Storage Status on May-31		
Comparison to fill curve:	–0.63	ft
	–702	ac-ft
Percent of full reservoir:	98.7%	

Minimum Required Discharges	
Dec-Sept: 10 cfs	Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2018 on May-31	SECO	SDMO
precip to date:	62.1″	94.1″
snow depth:	0″	0″
water content:	0″	0″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on May-31	ALLOCATION (cfs) USED	ALLOCATION (cfs) REMAINING
TVID	111	
CWS	159	12,456
LO	0	500
JWC	389	13,111
Other	4	

SCOGGINS DAM RESERVOIR OPERATIONS — JUNE 2018

[See Appendix E for breakdown of municipal use by water provider.]

Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO (cfs) [1]	SCLO (cfs) [2]	TANO (cfs) [3]	TOTAL INFLOW (cfs) [4]	W.S. ELEV (ft) [5]	STORAGE CONTENT (ac-ft) [6]	CHANGE STORAGE (ac-ft) [7]	CHANGE STORAGE (cfs) [8]	RELEASE (cfs) [9]	COMP INFLOW (cfs) [10]	GASO (cfs) [11]	DLLO (cfs) [12]	GOLF (cfs) [13]	ROOD (cfs) [14]	FRMO (cfs) [15]	WSLO (cfs) [16]	PREC (in) [17]	MAX TEMP (°F) [18]	MIN TEMP (°F) [19]	TVID (cfs) [20]	CWS (cfs) [21]	LO (cfs) [22]	JWC (cfs) [23]	OTHER (cfs) [24]
1	8	14	2	24	302.81	52554	-67	-34	64	30	74	133	106	177	217	282	0.04	62	38	0	10	0	30	0
2	8	14	2	24	302.76	52499	-55	-28	53	25	73	120	90	176	220	282	0.00	69	44	0	0	0	30	0
3	8	13	2	23	302.72	52454	-45	-23	55	32	70	117	84	152	202	272	0.00	83	48	0	0	0	30	0
4	8	13	2	23	302.65	52377	-77	-39	53	14	71	119	83	155	192	262	0.00	70	43	0	0	0	30	0
5	8	13	2	23	302.56	52277	-100	-50	89	39	70	148	97	143	187	249	0.00	65	42	0	10	0	54	0
6	7	13	2	22	302.45	52155	-122	-62	81	19	68	139	97	148	189	246	0.00	70	43	0	10	0	47	0
7	7	12	2	21	302.37	52067	-88	-44	68	24	79	138	96	141	181	239	0.00	77	49	0	10	0	35	0
8	7	12	2	21	302.28	51967	-100	-50	75	25	79	142	90	141	179	236	0.00	71	54	0	10	0	43	0
9	9	15	2	26	302.24	51923	-44	-22	64	42	96	152	148	181	203	296	0.42	63	52	0	0	0	28	0
10	8	13	2	23	302.19	51868	-55	-28	64	36	85	140	145	264	307	333	0.10	61	49	0	0	0	28	0
11	9	17	2	28	302.16	51835	-33	-17	63	46	96	151	150	272	319	432	0.20	55	45	0	0	0	28	0
12	7	13	2	22	302.12	51790	-45	-23	41	18	82	117	107	285	339	410	0.00	70	42	0	0	0	15	0
13	7	12	2	21	302.11	51779	-11	-6	38	32	76	107	85	199	265	388	0.00	78	55	0	0	0	15	0
14	7	12	2	21	302.07	51735	-44	-22	38	16	76	105	80	166	218	325	0.00	66	44	0	0	0	15	0
15	7	12	2	21	301.99	51647	-88	-44	55	11	76	122	81	141	191	279	0.00	64	49	0	10	0	25	0
16	6	11	2	19	301.82	51460	-187	-94	131	37	74	187	121	138	185	255	0.00	69	48	68	10	0	30	4
17	6	11	2	19	301.64	51262	-198	-100	133	33	72	185	126	185	227	252	0.00	76	51	70	10	0	30	4
18	6	11	2	19	301.46	51065	-197	-99	131	32	69	183	122	185	234	285	0.00	88	52	68	10	0	30	4
19	6	10	1	17	301.26	50846	-219	-110	142	32	68	192	109	156	212	289	0.00	84	49	81	10	0	30	4
20	5	10	1	16	301.02	50538	-308	-155	162	7	65	211	122	151	200	265	0.00	89	56	94	10	0	38	4
21	5	10	1	16	300.77	50311	-227	-114	162	48	64	209	127	160	208	255	0.00	91	58	94	10	0	38	4
22	5	10	1	16	300.51	50028	-283	-143	162	19	65	211	131	248	297	296	0.00	71	57	75	10	0	30	3
23	5	10	1	16	300.29	49789	-239	-120	144	24	65	190	118	177	237	329	0.00	75	51	85	10	0	30	3
24	5	10	1	16	300.08	49561	-228	-115	144	29	64	188	112	155	215	289	0.00	74	50	85	10	0	30	3
25	4	9	1	14	299.87	49334	-227	-114	145	31	63	188	na	159	207	268	0.02	90	52	88	10	0	30	3
26	6	9	1	16	299.65	49097	-237	-119	129	10	63	171	na	127	201	246	0.00	69	44	70	10	0	30	3
27	6	9	1	16	299.45	48881	-216	-109	141	32	61	176	96	102	174	230	0.00	73	46	77	10	0	35	3
28	6	9	1	16	299.21	48624	-257	-130	150	20	60	187	97	106	176	212	0.00	74	44	81	10	0	40	3
29	6	9	1	16	298.97	48366	-258	-130	150	20	61	190	96	106	174	215	0.00	73	46	81	10	0	40	3
30	6	9	1	16	298.76	48142	-224	-113	145	32	60	182	94	99	170	215	0.00	75	49	84	10	0	32	3
TOTALS																	0.78 inches							
cfs	198	345	48	591	—	—	-2258		3072	814	2145	4800	3010	4995	6526	8432	**MAX:**	91	58	1201	210	0	946	51
ac-ft	393	684	95	1172	—	—	-4479		6093	1614	4255	9521	5970	9908	12944	16725	**MIN:**	55	38	2382	417	0	1876	101

Reservoir Storage Status on Jun-30		
Comparison to fill curve:	–4.74	ft
	–5,181	ac-ft
Percent of full reservoir:	90.3%	

Minimum Required Discharges	
Dec-Sept: 10 cfs	Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2018 on Jun-30		
	SECO	SDMO
precip to date:	63.2″	95.0″
snow depth:	0″	0″
water content:	0″	0″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Jun-30		
	ALLOCATION (cfs)	
	USED	REMAINING
TVID	2,493	
CWS	576	12,039
LO	0	500
JWC	2,265	11,235
Other	105	

SCOGGINS DAM RESERVOIR OPERATIONS — JULY 2018

[See Appendix E for breakdown of municipal use by water provider.]

Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO	SCLO	TANO	TOTAL INFLOW	W.S. ELEV	STORAGE CONTENT	CHANGE STORAGE		RELEASE	COMP INFLOW	GASO	DLLO	GOLF	ROOD	FRMO	WSLO	PREC	MAX TEMP	MIN TEMP	TVID	CWS	LO	JWC	OTHER
	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ac-ft)	(ac-ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(in)	(°F)	(°F)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]
1	6	9	1	16	298.54	47907	-235	-118	144	26	58	180	98	100	171	209	0.00	77	57	83	10	0	32	3
2	6	8	1	15	298.31	47662	-245	-124	145	21	57	178	103	112	178	209	0.00	76	50	84	10	0	32	3
3	5	8	1	14	298.05	47385	-277	-140	153	13	57	188	97	99	170	209	0.00	66	41	79	20	0	37	3
4	5	8	1	14	297.80	47120	-265	-134	159	25	58	196	108	93	161	204	0.00	76	54	85	30	0	27	3
5	5	8	1	14	297.55	46856	-264	-133	159	26	58	198	115	114	176	201	0.00	78	52	85	30	0	27	3
6	5	7	1	13	297.29	46581	-275	-139	169	30	56	204	115	117	187	212	0.00	84	52	85	40	0	27	4
7	5	7	1	13	296.99	46266	-315	-159	166	7	50	212	110	113	184	218	0.00	77	51	73	40	0	36	4
8	5	7	1	13	296.71	45972	-294	-148	166	18	49	210	115	115	185	218	0.00	79	50	73	40	0	36	4
9	5	7	1	13	296.41	45658	-314	-158	166	8	48	210	117	122	190	218	0.00	83	49	73	40	0	36	4
10	5	8	1	14	296.11	45345	-313	-158	174	16	50	228	131	118	187	227	0.01	69	55	80	40	0	36	4
11	5	8	1	14	295.80	45022	-323	-163	182	19	51	236	135	130	196	227	0.00	75	60	88	40	0	36	4
12	4	7	1	12	295.46	44670	-352	-177	189	12	45	235	120	133	200	233	0.00	86	57	92	40	0	41	4
13	4	7	1	12	295.08	44277	-393	-198	219	21	44	266	132	108	184	233	0.00	95	56	113	40	3	47	4
14	4	6	1	11	294.67	43855	-422	-213	223	10	43	272	139	123	190	215	0.00	91	52	113	40	3	52	4
15	4	6	1	11	294.27	43445	-410	-207	224	17	43	272	133	130	201	224	0.00	91	56	114	40	3	52	4
16	4	6	1	11	293.86	43026	-419	-211	223	12	42	269	138	127	197	239	0.00	97	58	113	40	3	52	4
17	4	6	1	11	293.45	42609	-417	-210	206	-4	53	262	126	115	187	230	0.00	96	56	103	40	3	45	4
18	4	6	1	11	293.08	42235	-374	-189	193	4	51	245	120	115	178	227	0.00	90	54	100	40	3	35	4
19	4	6	1	11	292.70	41851	-384	-194	197	3	52	249	112	101	170	224	0.00	82	52	96	40	3	43	4
20	4	6	1	11	292.27	41419	-432	-218	205	-13	53	262	123	103	168	218	0.00	70	44	99	40	3	48	4
21	4	6	1	11	291.87	41018	-401	-202	205	3	52	261	129	113	180	218	0.00	77	45	103	45	3	39	4
22	4	6	1	11	291.48	40630	-388	-196	206	10	53	259	136	124	193	233	0.00	78	51	104	45	3	39	4
23	3	5	1	9	291.09	40242	-388	-196	205	9	51	257	128	124	194	249	0.00	92	54	105	45	3	39	4
24	3	5	1	9	290.71	39866	-376	-190	205	15	50	256	117	106	178	242	0.00	94	53	105	45	3	39	4
25	3	5	1	9	290.29	39452	-414	-209	214	5	48	261	119	103	166	227	0.00	94	55	108	45	3	45	4
26	3	5	1	9	289.89	39059	-393	-198	214	16	61	274	122	102	169	221	0.00	95	55	108	45	3	45	4
27	3	5	1	9	289.47	38649	-410	-207	213	6	60	274	125	104	170	218	0.00	96	52	112	45	3	40	4
28	3	5	1	9	289.06	38249	-400	-202	213	11	61	276	137	104	169	218	0.00	91	53	112	50	3	35	4
29	3	5	1	9	288.63	37832	-417	-210	211	1	61	276	129	116	187	224	0.00	90	58	110	50	3	35	4
30	3	5	1	9	288.22	37436	-396	-200	213	13	61	276	135	117	187	236	0.00	99	61	112	50	3	35	4
31	3	5	1	9	287.80	37032	-404	-204	201	-3	59	263	119	112	179	239	0.00	91	56	100	50	3	35	4
TOTALS																	0.01 inches							
cfs	128	198	31	357	—	—	-5601		5962	361	1635	7505	3783	3513	5632	6920	MAX:	99	61	3010	1215	57	1203	119
ac-ft	254	393	61	708	—	—	-11110		11826	715	3243	14886	7504	6968	11171	13726	MIN:	66	41	5970	2410	113	2386	236

Reservoir Storage Status on Jul-31		
Comparison to fill curve:	–15.70	ft
	–16,291	ac-ft
Percent of full reservoir:	69.4%	

Minimum Required Discharges	
Dec-Sept: 10 cfs	Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2018 on Jul-31	SECO	SDMO
precip to date:	63.2″	95.1″
snow depth:	0″	0″
water content:	0″	0″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Jul-31	ALLOCATION (cfs) USED	REMAINING
TVID	8,464	
CWS	2,985	9,630
LO	113	387
JWC	4,652	8,848
Other	341	

SCOGGINS DAM RESERVOIR OPERATIONS — AUGUST 2018

[See Appendix E for breakdown of municipal use by water provider.]

Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO (cfs) [1]	SCLO (cfs) [2]	TANO (cfs) [3]	TOTAL INFLOW (cfs) [4]	W.S. ELEV (ft) [5]	STORAGE CONTENT (ac-ft) [6]	CHANGE STORAGE (ac-ft) [7]	CHANGE STORAGE (cfs) [8]	RELEASE (cfs) [9]	COMP INFLOW (cfs) [10]	GASO (cfs) [11]	DLLO (cfs) [12]	GOLF (cfs) [13]	ROOD (cfs) [14]	FRMO (cfs) [15]	WSLO (cfs) [16]	PREC (in) [17]	MAX TEMP (°F) [18]	MIN TEMP (°F) [19]	TVID (cfs) [20]	CWS (cfs) [21]	LO (cfs) [22]	JWC (cfs) [23]	OTHER (cfs) [24]
1	3	5	1	9	287.42	36667	-365	-184	195	11	60	252	118	100	169	230	0.00	88	52	99	50	3	30	4
2	3	5	1	9	287.05	36314	-353	-178	180	2	60	235	112	104	169	221	0.00	86	53	90	50	3	24	4
3	3	5	1	9	286.70	35981	-333	-168	175	7	62	231	110	121	170	224	0.00	72	57	79	50	3	30	4
4	3	5	1	9	286.34	35639	-342	-172	179	7	62	237	114	117	165	221	0.00	76	51	78	50	3	35	4
5	3	5	1	9	285.98	35299	-340	-171	179	8	61	234	111	116	166	218	0.00	84	53	78	50	3	35	4
6	2	5	1	8	285.63	34970	-329	-166	179	13	60	232	111	120	169	221	0.00	90	55	79	50	3	35	4
7	2	4	1	7	285.26	34622	-348	-175	192	17	59	247	101	113	165	218	0.00	91	56	88	50	3	40	4
8	2	4	1	7	284.86	34249	-373	-188	200	12	58	255	110	104	152	213	0.00	95	58	96	50	3	40	4
9	2	4	1	7	284.44	33858	-391	-197	208	11	59	265	123	104	154	204	0.00	94	58	109	50	3	35	4
10	2	4	1	7	284.04	33487	-371	-187	200	13	57	253	114	120	166	204	0.00	96	60	106	50	3	30	4
11	2	4	1	7	283.65	33127	-360	-182	183	1	57	234	111	121	169	188	0.00	90	60	94	50	3	25	4
12	2	5	1	8	283.26	32768	-359	-181	183	2	61	237	121	122	170	193	0.02	74	53	93	50	3	25	4
13	2	5	1	8	282.87	32411	-357	-180	183	3	61	237	129	136	181	193	0.00	75	52	93	50	3	25	4
14	2	4	1	7	282.49	32064	-347	-175	191	16	58	242	na	128	179	188	0.00	89	55	92	50	3	35	4
15	2	4	1	7	282.12	31728	-336	-169	181	12	59	230	100	113	165	188	0.00	93	57	83	50	3	35	4
16	2	4	1	7	281.74	31384	-344	-173	188	15	64	245	119	108	155	172	0.00	89	54	89	55	3	25	4
17	2	4	1	7	281.33	31015	-369	-186	187	1	64	247	117	120	164	162	0.00	82	44	89	55	3	30	4
18	2	4	1	7	280.56	30683	-332	-167	176	9	64	233	115	112	165	170	0.00	82	46	85	55	3	22	4
19	2	4	1	7	280.60	30361	-322	-162	175	13	64	232	117	115	164	167	0.00	87	51	84	55	3	22	4
20	2	4	1	7	280.23	30031	-330	-166	175	9	65	230	121	126	171	175	0.00	87	55	84	55	3	22	4
21	2	4	1	7	279.87	29712	-319	-161	168	7	65	223	107	122	174	180	0.00	86	55	82	55	3	17	4
22	2	4	1	7	279.53	29412	-300	-151	164	13	65	217	101	106	154	177	0.00	90	54	78	55	3	17	4
23	2	4	1	7	279.21	29130	-282	-142	158	16	64	209	99	98	152	167	0.00	92	50	77	55	3	12	4
24	2	4	1	7	278.83	28797	-333	-168	168	0	66	223	109	99	144	165	0.00	72	47	83	55	3	17	3
25	2	4	1	7	278.47	28483	-314	-158	160	2	69	221	127	113	161	165	0.00	70	43	83	55	3	10	3
26	2	4	1	7	278.14	28196	-287	-145	160	15	70	221	130	127	176	180	0.00	71	51	83	55	3	10	3
27	2	5	1	8	277.81	27911	-285	-144	158	14	71	222	132	139	187	199	0.00	67	55	80	55	3	10	3
28	2	4	1	7	277.50	27643	-268	-135	149	14	56	196	98	130	184	199	0.00	77	49	63	55	3	20	3
29	2	3	1	6	277.16	27351	-292	-147	157	10	55	202	99	103	150	188	0.00	87	49	70	55	3	20	3
30	2	3	1	6	276.79	27034	-317	-160	170	10	69	235	124	102	149	167	0.00	84	51	73	60	3	25	3
31	2	3	1	6	276.44	26736	-298	-150	164	14	83	244	na	124	169	167	0.00	72	57	68	60	3	25	2
TOTALS																	0.02 inches							
cfs	67	130	31	228	—	—	-191		5485	294	1948	7221	3300	3583	5128	5924	**MAX:**	96	60	2628	1640	93	783	115
ac-ft	133	258	61	452	—	—	-10296		10879	583	3864	14323	6546	7107	10171	11750	**MIN:**	67	43	5213	3253	184	1553	228

Reservoir Storage Status on Aug-31

Comparison to fill curve:	–27.06	ft
	–26,587	ac-ft
Percent of full reservoir:	50.1%	

Minimum Required Discharges

Dec-Sept: 10 cfs Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2018 on Aug-31

	SECO	SDMO
precip to date:	63.3″	95.4″
snow depth:	0″	0″
water content:	0″	0″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Aug-31

	ALLOCATION (cfs) USED	REMAINING
TVID	13,676	
CWS	6,238	6,377
LO	298	202
JWC	6,205	7,295
Other	569	

SCOGGINS DAM RESERVOIR OPERATIONS — SEPTEMBER 2018

[See Appendix E for breakdown of municipal use by water provider.]

Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO (cfs) [1]	SCLO (cfs) [2]	TANO (cfs) [3]	TOTAL INFLOW (cfs) [4]	W.S. ELEV (ft) [5]	STORAGE CONTENT (ac-ft) [6]	CHANGE STORAGE (ac-ft) [7]	CHANGE STORAGE (cfs) [8]	RELEASE (cfs) [9]	COMP INFLOW (cfs) [10]	GASO (cfs) [11]	DLLO (cfs) [12]	GOLF (cfs) [13]	ROOD (cfs) [14]	FRMO (cfs) [15]	WSLO (cfs) [16]	PREC (in) [17]	MAX TEMP (°F) [18]	MIN TEMP (°F) [19]	TVID (cfs) [20]	CWS (cfs) [21]	LO (cfs) [22]	JWC (cfs) [23]	OTHER (cfs) [24]
1	2	3	1	6	276.07	26422	-314	-158	163	5	81	239	136	140	189	175	0.00	74	44	66	55	3	31	2
2	2	3	1	6	275.70	26109	-313	-158	162	4	82	239	134	136	189	193	0.00	72	45	65	55	3	31	2
3	2	2	1	5	275.35	25815	-294	-148	162	14	80	237	145	138	189	196	0.00	81	49	66	55	3	31	2
4	2	2	1	5	274.98	25505	-310	-156	161	5	80	235	134	141	195	199	0.00	77	43	65	55	3	31	2
5	2	2	1	5	274.62	25205	-300	-151	156	5	80	226	114	130	181	199	0.00	81	49	65	50	3	31	2
6	2	2	1	5	274.29	24931	-274	-138	156	18	79	227	113	127	169	188	0.00	89	51	65	50	3	31	2
7	2	2	1	5	273.95	24650	-281	-142	152	10	79	219	118	117	165	177	0.00	86	47	65	50	3	26	3
8	2	2	1	5	273.60	24362	-288	-145	152	7	80	224	120	112	164	177	0.01	81	51	65	50	3	26	3
9	2	3	1	6	273.25	24075	-287	-145	151	6	80	224	130	126	176	180	0.00	73	49	63	50	3	26	3
10	2	2	1	5	272.92	23806	-269	-136	150	14	80	222	134	141	190	196	0.02	77	53	63	50	3	26	3
11	2	3	1	6	272.58	23530	-276	-139	143	4	84	219	126	141	195	204	0.11	69	52	50	50	3	31	3
12	3	5	1	9	272.34	23336	-194	-98	120	22	93	212	140	154	202	221	0.38	65	52	29	50	3	26	3
13	3	4	1	8	272.12	23158	-178	-90	101	11	77	180	134	193	217	233	0.29	63	47	30	50	3	7	3
14	2	3	1	6	271.88	22965	-193	-97	101	4	75	178	126	215	257	249	0.02	66	46	32	50	3	7	2
15	2	3	1	6	271.66	22789	-176	-89	89	0	74	167	107	158	229	265	0.01	68	47	31	40	3	7	2
16	7	9	1	17	271.47	22637	-152	-77	89	12	75	167	118	141	198	242	0.16	62	50	20	40	3	7	2
17	3	5	1	9	271.28	22485	-152	-77	89	12	80	172	139	210	256	236	0.07	66	43	28	40	3	7	2
18	2	4	1	7	271.06	22309	-176	-89	87	-2	62	153	116	178	242	262	0.00	68	41	44	30	3	0	2
19	2	3	1	6	270.87	22158	-151	-76	78	2	49	131	90	144	206	246	0.00	71	43	28	30	3	8	2
20	2	3	1	6	270.67	21999	-159	-80	87	7	46	137	89	122	171	218	0.00	71	45	31	30	3	15	2
21	2	3	1	6	270.42	21800	-199	-100	111	11	46	154	98	109	161	193	0.00	71	45	35	40	3	25	2
22	2	3	1	6	270.10	21547	-253	-128	133	5	46	172	96	115	164	180	0.00	74	50	35	40	3	47	2
23	2	3	1	6	269.79	21302	-245	-124	133	9	48	181	99	109	168	185	0.02	66	42	35	40	3	47	2
24	2	3	1	6	269.48	21058	-244	-123	133	10	46	175	100	120	171	185	0.01	67	40	35	40	3	47	2
25	2	3	1	6	269.12	20775	-283	-143	155	12	59	213	na	113	166	188	0.00	71	43	42	50	3	52	2
26	2	3	1	6	268.77	20502	-273	-138	147	9	59	206	109	126	174	182	0.00	80	45	41	50	3	45	2
27	2	3	1	6	268.42	20229	-273	-138	147	9	58	204	109	126	171	188	0.00	84	47	41	50	3	45	2
28	2	3	1	6	268.08	19965	-264	-133	140	7	58	197	109	117	169	185	0.00	86	48	39	50	3	40	2
29	2	3	1	6	267.73	19695	-270	-136	154	18	57	214	112	113	166	180	0.00	85	50	48	50	3	45	2
30	2	3	1	6	267.33	19387	-308	-155	154	-1	59	218	123	123	176	182	0.03	60	52	48	50	3	45	2
TOTALS																	1.13 inches							
cfs	68	95	30	193	—	—	$\underbrace{\quad}$ -3705		3956	251	2052	5942	3418	4135	5666	6104	**MAX:**	89	53	1370	1390	90	843	67
ac-ft	135	188	60	383	—	—	-7349		7847	498	4070	11786	6780	8202	11239	12107	**MIN:**	60	40	2717	2757	179	1672	133

Reservoir Storage Status on Sep-30

Comparison to fill curve:	–36.17 ft
	–33,936 ac-ft
Percent of full reservoir:	36.4%

Minimum Required Discharges

Dec-Sept: 10 cfs   Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2018 on Sep-30

	SECO	SDMO
precip to date:	64.8″	97.7″
snow depth:	0″	0″
water content:	0″	0″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Sep-30

	ALLOCATION (cfs) USED	REMAINING
TVID	16,394	
CWS	8,995	3,620
LO	476	24
JWC	7,877	5,623
Other	702	

SCOGGINS DAM RESERVOIR OPERATIONS — OCTOBER 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO (cfs) [1]	SCLO (cfs) [2]	TANO (cfs) [3]	TOTAL INFLOW (cfs) [4]	W.S. ELEV (ft) [5]	STORAGE CONTENT (ac-ft) [6]	CHANGE STORAGE (ac-ft) [7]	CHANGE STORAGE (cfs) [8]	RELEASE (cfs) [9]	COMP INFLOW (cfs) [10]	GASO (cfs) [11]	DLLO (cfs) [12]	GOLF (cfs) [13]	ROOD (cfs) [14]	FRMO (cfs) [15]	WSLO (cfs) [16]	PREC (in) [17]	MAX TEMP (°F) [18]	MIN TEMP (°F) [19]	TVID (cfs) [20]	CWS (cfs) [21]	LO (cfs) [22]	JWC (cfs) [23]	OTHER (cfs) [24]
1	2	4	1	7	266.95	19096	-291	-147	153	6	57	214	133	141	194	199	0.00	66	54	46	50	3	45	2
2	2	4	1	7	266.68	18890	-206	-104	115	11	57	175	113	142	202	210	0.00	69	54	28	50	3	25	2
3	2	3	1	6	266.40	18677	-213	-107	106	-1	59	173	114	130	187	249	0.00	65	39	28	50	3	17	2
4	2	3	1	6	266.14	18480	-197	-99	100	1	60	170	110	133	187	233	0.00	65	43	22	50	3	17	2
5	2	3	1	6	265.90	18299	-181	-91	92	1	60	162	105	132	187	233	0.00	64	41	18	50	0	17	1
6	5	9	1	15	265.76	18194	-105	-53	73	20	84	165	106	185	233	325	0.54	55	46	5	40	0	12	1
7	3	5	1	9	265.57	18051	-143	-72	72	0	67	155	113	179	275	325	0.01	63	42	10	40	0	12	1
8	3	6	1	10	265.38	17908	-143	-72	73	1	70	157	107	162	235	333	0.20	53	46	10	40	0	12	1
9	3	5	1	9	265.23	17796	-112	-56	63	7	67	145	101	171	239	306	0.00	64	49	11	30	0	12	1
10	2	4	1	7	265.07	17676	-120	-61	63	2	63	139	95	151	220	292	0.00	65	45	13	30	0	12	1
11	2	4	1	7	264.91	17557	-119	-60	63	3	56	131	88	130	190	268	0.01	67	41	13	30	0	12	1
12	2	3	1	6	264.75	17438	-119	-60	61	1	55	131	85	114	170	242	0.00	69	40	12	30	0	12	1
13	2	3	1	6	264.54	17282	-156	-79	75	-4	55	144	92	107	161	224	0.00	72	42	16	40	0	12	1
14	2	3	1	6	264.32	17119	-163	-82	73	-9	55	144	93	112	168	215	0.00	67	39	14	40	0	12	1
15	2	3	1	6	264.12	16971	-148	-75	73	-2	55	145	91	114	170	221	0.00	68	38	14	40	0	12	1
16	2	3	1	6	263.89	16802	-169	-85	75	-10	57	151	87	112	168	218	0.00	75	39	11	40	0	17	1
17	2	3	1	6	263.67	16641	-161	-81	86	5	57	161	89	127	173	218	0.00	78	40	15	40	0	23	1
18	2	3	1	6	263.39	16436	-205	-103	98	-5	58	174	92	111	166	221	0.00	75	38	21	40	0	30	1
19	2	3	1	6	263.18	16283	-153	-77	75	-2	54	147	90	115	170	218	0.00	72	38	16	40	0	12	1
20	2	3	1	6	262.99	16145	-138	-70	75	5	49	147	84	110	173	224	0.00	74	39	16	40	0	12	1
21	2	3	1	6	262.75	15971	-174	-88	74	-14	51	151	85	105	160	224	0.00	72	36	15	40	0	12	1
22	2	3	1	6	262.54	15820	-151	-76	74	-2	52	151	90	123	164	215	0.00	69	38	15	40	0	12	1
23	2	3	1	6	262.33	15669	-151	-76	71	-5	53	149	85	114	169	221	0.00	69	39	12	40	0	12	1
24	2	4	1	7	262.13	15525	-144	-73	75	2	54	156	84	110	165	224	0.00	55	41	10	40	0	17	1
25	2	5	1	8	261.92	15375	-150	-76	74	-2	54	157	88	132	181	218	0.10	60	49	13	40	0	17	1
26	6	12	2	20	261.77	15268	-107	-54	75	21	79	181	103	153	210	292	0.54	57	51	3	40	0	12	1
27	5	10	2	17	261.61	15154	-114	-57	74	17	74	184	143	199	281	333	0.18	62	53	5	40	0	12	1
28	13	30	3	46	261.58	15133	-21	-11	74	63	160	257	165	561	583	782	1.11	61	51	5	40	0	12	1
29	10	15	2	27	261.47	15054	-79	-40	73	33	103	219	216	710	810	1010	0.48	62	47	5	40	0	12	1
30	7	10	2	19	261.38	14991	-63	-32	40	8	66	138	156	519	645	887	0.00	57	41	3	20	0	0	1
31	6	9	1	16	261.32	14948	-43	-22	34	12	50	104	94	291	410	683	0.11	50	43	3	10	0	0	1
TOTALS																	3.28 inches							
cfs	103	181	37	321	—	—	-2238		2402	164	1991	4977	3297	5695	7646	10063	**MAX:**	78	54	428	1200	12	453	35
ac-ft	204	359	73	637	—	—	-4439		4764	325	3949	9872	6540	11296	15166	19960	**MIN:**	50	36	849	2380	24	899	69

Reservoir Storage Status on Oct-31	
Comparison to fill curve:	–42.18 ft
	–38,375 ac-ft
Percent of full reservoir:	28.0%

Minimum Required Discharges	
Dec-Sept: 10 cfs	Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2019 on Oct-31	SECO	SDMO
precip to date:	4.5″	6.4″
snow depth:	0″	0″
water content:	0″	0″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Oct-31	ALLOCATION (cfs) USED	ALLOCATION (cfs) REMAINING
TVID	17,243	
CWS	11,376	1,239
LO	500	0
JWC	8,775	4,725
Other	772	

SCOGGINS DAM RESERVOIR OPERATIONS — NOVEMBER 2018

[See Appendix E for breakdown of municipal use by water provider.]

Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO (cfs) [1]	SCLO (cfs) [2]	TANO (cfs) [3]	TOTAL INFLOW (cfs) [4]	W.S. ELEV (ft) [5]	STORAGE CONTENT (ac-ft) [6]	CHANGE STORAGE (ac-ft) [7]	CHANGE STORAGE (cfs) [8]	RELEASE (cfs) [9]	COMP INFLOW (cfs) [10]	GASO (cfs) [11]	DLLO (cfs) [12]	GOLF (cfs) [13]	ROOD (cfs) [14]	FRMO (cfs) [15]	WSLO (cfs) [16]	PREC (in) [17]	MAX TEMP (°F) [18]	MIN TEMP (°F) [19]	TVID (cfs) [20]	CWS (cfs) [21]	LO (cfs) [22]	JWC (cfs) [23]	OTHER (cfs) [24]
1	6	9	1	16	261.30	14934	-14	-7	23	16	33	70	66	220	318	482	0.02	57	50	2	0	0	0	1
2	7	11	2	20	261.31	14941	7	4	21	25	31	62	42	145	220	372	0.15	62	56	2	0	0	12	0
3	6	10	2	18	261.23	14884	-57	-29	46	17	58	126	73	101	165	285	0.00	65	48	6	10	0	12	0
4	7	12	2	21	261.15	14828	-56	-28	47	19	51	120	84	129	173	236	0.20	56	49	3	10	0	12	0
5	6	12	2	20	261.06	14764	-64	-32	46	14	60	131	114	145	206	252	0.01	61	44	4	10	0	12	0
6	5	10	2	17	260.96	14694	-70	-35	40	5	55	115	87	176	234	272	0.01	57	40	6	10	0	7	0
7	4	9	1	14	260.85	14617	-77	-39	40	1	41	104	85	159	227	296	0.00	56	38	14	10	0	2	0
8	3	8	1	12	260.76	14553	-64	-32	37	5	37	91	71	144	204	282	0.00	51	31	3	10	0	10	0
9	3	8	1	12	260.68	14497	-56	-28	35	7	35	85	59	115	179	252	0.01	57	29	3	10	0	10	0
10	3	8	1	12	260.61	14448	-49	-25	35	10	33	84	59	93	157	230	0.00	54	34	3	10	0	10	0
11	3	8	1	12	260.53	14392	-56	-28	34	6	32	82	56	90	150	213	0.00	54	31	2	10	0	10	0
12	3	8	1	12	260.46	14343	-49	-25	34	9	30	81	55	87	146	207	0.00	56	36	2	10	0	10	0
13	3	8	1	12	260.34	14259	-84	-42	45	3	30	97	57	81	143	201	0.00	56	31	3	20	0	10	0
14	3	8	1	12	260.18	14148	-111	-56	54	-2	30	105	63	81	138	199	0.01	48	32	5	20	0	17	0
15	3	8	1	12	260.04	14051	-97	-49	59	10	31	112	71	100	149	199	0.01	49	40	5	20	0	22	0
16	3	8	1	12	259.86	13926	-125	-63	59	-4	29	110	71	99	157	210	0.00	57	38	5	20	0	22	0
17	3	8	1	12	259.74	13843	-83	-42	55	13	29	105	71	94	154	213	0.00	58	44	2	20	0	22	0
18	3	8	1	12	259.59	13739	-104	-52	55	3	29	106	68	86	152	213	0.00	57	37	2	20	0	22	0
19	3	8	1	12	259.40	13609	-130	-66	55	-11	28	105	69	85	147	207	0.00	56	33	2	20	0	22	0
20	3	8	1	12	259.23	13492	-117	-59	63	4	28	113	64	84	147	204	0.00	58	30	1	20	0	22	0
21	3	8	1	12	259.10	13403	-89	-45	58	13	28	107	66	107	157	204	0.05	54	34	2	20	0	16	0
22	7	15	2	24	258.97	13314	-89	-45	60	15	35	116	72	100	164	236	0.42	48	41	2	20	0	18	0
23	18	47	4	69	259.00	13334	20	10	60	70	140	182	152	267	319	410	0.77	49	44	2	20	0	18	0
24	11	31	3	45	258.99	13328	-6	-3	59	56	146	226	291	520	567	641	0.49	50	34	1	20	0	18	0
25	6	17	2	25	258.91	13273	-55	-28	59	31	88	169	199	457	569	694	0.00	44	33	1	20	0	18	0
26	5	14	2	21	258.80	13198	-75	-38	60	22	68	147	139	294	418	600	0.04	42	33	2	20	0	18	0
27	57	132	12	201	258.99	13328	130	66	21	87	90	97	94	291	359	748	0.98	53	42	0	0	0	0	0
28	18	65	5	88	259.30	13540	212	107	21	128	250	283	447	621	641	716	0.30	58	45	0	0	0	0	0
29	17	55	4	76	259.56	13719	179	90	20	110	212	250	398	764	830	949	0.24	49	39	1	0	0	0	0
30	11	35	3	49	259.68	13801	82	41	20	61	132	165	233	479	695	918	0.04	51	38	0	0	0	0	0
TOTALS																	3.75 inches							
cfs	233	596	63	892	—	—	-578		1321	743	1919	3746	3476	6214	8285	11141	MAX:	65	56	86	380	0	372	1
ac-ft	462	1182	125	1769	—	—	-1147		2620	1473	3806	7430	6895	12325	16433	22098	MIN:	42	29	171	754	0	738	2

Reservoir Storage Status on Nov-30	
Comparison to fill curve:	–23.82 ft
	–19,188 ac-ft
Percent of full reservoir:	25.9%

Minimum Required Discharges	
Dec-Sept: 10 cfs	Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2019 on Nov-30	SECO	SDMO
precip to date:	10.5″	16.0″
snow depth:	0″	0″
water content:	0″	0″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Nov-30	ALLOCATION (cfs) USED	ALLOCATION (cfs) REMAINING
TVID	17,413	
CWS	12,129	486
LO	500	0
JWC	9,513	3,987
Other	774	

SCOGGINS DAM RESERVOIR OPERATIONS — DECEMBER 2018

[See Appendix E for breakdown of municipal use by water provider.]

Source: Tualatin Valley Irrigation District

	INFLOW				HENRY HAGG LAKE						TUALATIN RIVER						WEATHER			WATER DELIVERIES				
DAY	SCHO	SCLO	TANO	TOTAL INFLOW	W.S. ELEV	STORAGE CONTENT	CHANGE STORAGE		RELEASE	COMP INFLOW	GASO	DLLO	GOLF	ROOD	FRMO	WSLO	PREC	MAX TEMP	MIN TEMP	TVID	CWS	LO	JWC	OTHER
	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ac-ft)	(ac-ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(in)	(°F)	(°F)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]
1	21	56	4	81	259.94	13981	180	91	13	104	189	224	296	464	630	994	0.68	48	41	0	0	0	0	0
2	14	38	3	55	260.10	14092	111	56	13	69	124	161	242	511	685	863	0.01	44	37	0	0	0	0	0
3	11	29	3	43	260.20	14162	70	35	13	48	98	132	177	365	552	776	0.04	40	33	0	0	0	0	0
4	9	23	3	35	260.27	14211	49	25	13	38	81	112	138	255	421	625	0.00	47	33	0	0	0	0	0
5	7	19	2	28	260.32	14246	35	18	13	31	70	99	113	192	338	502	0.00	47	32	0	0	0	0	0
6	7	17	2	26	260.36	14273	27	14	13	27	60	91	91	150	285	418	0.00	45	30	0	0	0	0	0
7	6	14	2	22	260.39	14294	21	11	13	24	53	84	84	127	250	364	0.00	45	29	0	0	0	0	0
8	6	14	2	22	260.42	14315	21	11	13	24	49	81	72	107	225	333	0.07	40	31	0	0	0	0	0
9	6	13	2	21	260.46	14343	28	14	13	27	45	78	75	92	207	310	0.00	41	34	0	0	0	0	0
10	10	21	3	34	260.55	14406	63	32	13	45	65	93	91	195	301	450	0.43	39	37	0	0	0	0	0
11	9	21	3	33	260.62	14455	49	25	13	38	69	100	96	200	337	473	0.18	44	38	0	0	0	0	0
12	50	130	11	191	261.13	14814	359	181	13	194	519	443	539	400	513	828	0.71	50	36	0	0	0	0	0
13	24	74	5	103	261.50	15076	262	132	13	145	246	371	629	921	1040	949	0.01	48	36	0	0	0	0	0
14	18	49	4	71	261.69	15211	135	68	13	81	162	231	393	731	941	1180	0.00	52	35	0	0	0	0	0
15	17	46	4	67	261.90	15360	149	75	13	88	149	201	293	483	680	981	0.22	49	35	0	0	0	0	0
16	19	49	4	72	262.09	15496	136	69	13	82	139	181	255	413	575	805	0.37	44	33	0	0	0	0	0
17	24	67	5	96	262.37	15679	183	92	13	105	180	233	385	552	687	851	0.36	49	42	0	0	0	0	0
18	249	914	60	1223	263.61	16597	918	463	25	488	na	503	672	975	1080	1810	2.35	50	45	0	0	0	0	0
19	139	335	33	507	265.46	17968	1371	691	22	713	647	995	1570	2100	2300	2440	0.11	55	42	0	0	0	0	0
20	69	187	20	276	266.21	18533	565	285	79	364	455	881	1840	2180	2500	2770	0.03	51	42	0	0	0	0	50
21	51	142	12	205	266.63	18852	319	161	74	235	361	743	1650	2190	2510	2790	0.20	55	32	0	0	0	0	50
22	38	106	9	153	267.03	19157	305	154	15	169	279	549	1250	2070	2400	2680	0.00	45	32	0	0	0	0	0
23	64	164	16	244	267.54	19549	392	198	13	211	334	497	983	1900	2210	2650	0.81	45	38	0	0	0	0	0
24	62	176	17	255	268.19	20051	502	253	16	269	455	625	1150	2030	2330	2700	0.32	50	43	0	0	0	0	0
25	51	140	12	203	268.75	20486	435	219	15	234	343	591	1180	2030	2370	2670	0.01	48	33	0	0	0	0	0
26	40	110	9	159	269.17	20814	328	165	13	178	273	477	992	1890	2210	2510	0.04	45	33	0	0	0	0	0
27	34	97	8	139	269.55	21113	299	151	14	165	254	418	860	1680	1980	2300	0.19	45	33	0	0	0	0	0
28	29	78	6	113	269.85	21349	236	119	13	132	221	351	731	1420	1700	2020	0.05	48	34	0	0	0	0	0
29	27	71	5	103	270.12	21563	214	108	13	121	204	314	630	1230	1480	1770	0.04	46	41	0	0	0	0	0
30	66	137	12	215	270.61	21951	388	196	12	208	436	455	715	1260	1460	1910	0.49	51	40	0	0	0	0	0
31	51	110	10	171	271.08	22325	374	189	13	202	332	490	841	1600	1830	1940	0.00	48	31	0	0	0	0	0
TOTALS																	7.72 inches							
cfs	1228	3447	291	4966	—	—		4298	558	4856	6892	10804	19033	30713	37027	44662	**MAX:**	55	45	0	0	0	0	100
ac-ft	2436	6837	577	9850	—	—		8524	1107	9631	13670	21430	37752	60919	73443	88587	**MIN:**	39	29	0	0	0	0	198

Reservoir Storage Status on Dec-31		
Comparison to fill curve:	−12.42	ft
	−10,664	ac-ft
Percent of full reservoir:	41.9%	

Minimum Required Discharges	
Dec-Sept: 10 cfs	Oct-Nov: 20 cfs

SNOWTEL Summary for WY 2019 on Dec-31		
	SECO	SDMO
precip to date:	22.0″	33.5″
snow depth:	0″	0″
water content:	0″	0″

The allocations (used & remaining) shown in this table are provisional.

Reservoir Delivery Status on Dec-31		
	ALLOCATION (cfs)	
	USED	REMAINING
TVID	17,413	
CWS	12,129	486
LO	500	0
JWC	9,513	3,987
Other	972	

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APPENDIX D
BARNEY RESERVOIR OPERATIONS — MONTHLY REPORTS

2018 SUMMARY

- Maximum Barney Reservoir storage: 20,000 ac-ft on January 29 (100% of full pool)
- First day of allocated releases: May 25
- Last day of allocated releases: December 12
- Days with allocated releases: 202
- Maximum daily allocated release: 75 cfs on August 30 – September 11
- Minimum Barney Reservoir storage: 4,630 ac-ft on November 26 (23.2% of full pool)

RELEASE SEASON — 2018

Details of releases for each month follow in this appendix.

	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	RELEASE SEASON
Number of days of with allocated releases									
JWC	7	30	31	31	30	31	27	0	187
CWS	0	0	0	3	30	28	0	0	61
ODFW (Trask)	1	30	31	31	30	31	30	12	196
TOTAL	**7**	**30**	**31**	**31**	**30**	**31**	**30**	**12**	**202**
Allocated releases in acre-feet									
JWC	278	1,686	2,301	3,180	2,261	1,652	801	0	12,137
CWS	0	0	0	63	833	778	0	0	1,674
ODFW (Trask)	2	328	605	615	595	615	206	33	2,994
TOTAL	**280**	**2,014**	**2,906**	**3,858**	**3,689**	**3,045**	**1,007**	**33**	**16,832**

Abbreviations: JWC=Joint Water Commission; CWS=Clean Water Services; ODFW=Oregon Department of Fish and Wildlife; Trask=Trask River

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF JANUARY 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN			
				RAIN	TEMP min	TEMP max	TRASK	TUALATIN			CWS		MUNICIPAL	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1									0	0	0	0	0	0
2	1630.1	15,788	825	0.00	25	52	2.3		0	0	0	0	0	0
3	1630.3	15,863	75	0.00	32	40	2.3	0.0	0	0	0	0	0	0
4								0.0	0	0	0	0	0	0
5	1630.8	16,050	187	0.76	30	44	2.3	0.0	0	0	0	0	0	0
6									0	0	0	0	0	0
7									0	0	0	0	0	0
8	1631.5	16,313	263	0.46	33	45	2.3		0	0	0	0	0	0
9								0.0	0	0	0	0	0	0
10	1632.0	16,500	187	0.69	30	44	2.3		0	0	0	0	0	0
11								0.0	0	0	0	0	0	0
12	1633.0	16,875	375	2.51	33	50	2.8		0	0	0	0	0	0
13								0.0	0	0	0	0	0	0
14									0	0	0	0	0	0
15									0	0	0	0	0	0
16	1634.3	17,343	468	0.39	34	50	2.3		0	0	0	0	0	0
17	1634.5	17,438	95	0.07	35	44	2.3	0.0	0	0	0	0	0	0
18	1634.9	17,588	150	0.97	34	50	2.3	0.0	0	0	0	0	0	0
19	1635.0	17,625	37	0.56	30	50	2.3	0.0	0	0	0	0	0	0
20									0	0	0	0	0	0
21									0	0	0	0	0	0
22	1636.2	18,100	475	1.87	32	43	2.8		0	0	0	0	0	0
23								0.0	0	0	0	0	0	0
24	1637.4	18,700	600	2.86	34	45	4.0		0	0	0	0	0	0
25								0.0	0	0	0	0	0	0
26	1638.8	19,320	620	1.76	25	42	3.4		0	0	0	0	0	0
27								0.0	0	0	0	0	0	0
28									0	0	0	0	0	0
29	1640.6	20,000	680	1.68	26	52	10.9		0	0	0	0	0	0
30								0.0	0	0	0	0	0	0
31	1640.8	20,000	0	1.53	27	50	47.0		0	0	0	0	0	0
Monthly Totals			5,037	16.11						0		0		0
Year to Date Totals			5,037	16.11						0		0		0

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF FEBRUARY 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN			
				RAIN	TEMP min	TEMP max	TRASK	TUALATIN			CWS		MUNICIPAL	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1	1640.8	20,000	0	0.07	31	43	41.0	0.0	0	0	0	0	0	0
2									0	0	0	0	0	0
3								0.0	0	0	0	0	0	0
4									0	0	0	0	0	0
5	1640.7	20,000	0	0.60	34	52	31.0		0	0	0	0	0	0
6								0.0	0	0	0	0	0	0
7	1640.7	20,000	0	0.00	32	46	26.9		0	0	0	0	0	0
8								0.0	0	0	0	0	0	0
9	1640.7	20,000	0	0.03	32	50	26.9		0	0	0	0	0	0
10								0.0	0	0	0	0	0	0
11									0	0	0	0	0	0
12	1640.7	20,000	0	0.02	26	44	22.9		0	0	0	0	0	0
13								0.0	0	0	0	0	0	0
14	1640.7	20,000	0	0.30	23	43	22.9		0	0	0	0	0	0
15								0.0	0	0	0	0	0	0
16									0	0	0	0	0	0
17								0.0	0	0	0	0	0	0
18									0	0	0	0	0	0
19									0	0	0	0	0	0
20	1640.7	20,000	0	2.09	18	45	22.9		0	0	0	0	0	0
21	1640.7	20,000	0	0.26	21	37	22.9	0.0	0	0	0	0	0	0
22								0.0	0	0	0	0	0	0
23	1640.6	20,000	0	0.13	17	34	22.9		0	0	0	0	0	0
24								0.0	0	0	0	0	0	0
25									0	0	0	0	0	0
26	1640.7	20,000	0	2.63	20	38	31.0		0	0	0	0	0	0
27								0.0	0	0	0	0	0	0
28	1640.7	20,000	0	0.42	24	37	26.9		0	0	0	0	0	0
Monthly Totals			0	6.55						0		0		0
Year to Date Totals			5,037	22.66						0		0		0

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF MARCH 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN			
				RAIN	TEMP min	TEMP max	TRASK	TUALATIN			CWS		MUNICIPAL	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1	1640.8	20,000	0	1.04	25	37	35.0	0.0	0	0	0	0	0	0
2									0	0	0	0	0	0
3								0.0	0	0	0	0	0	0
4									0	0	0	0	0	0
5	1640.7	20,000	0	0.81	24	40	26.9		0	0	0	0	0	0
6								0.0	0	0	0	0	0	0
7	1640.7	20,000	0	0.01	24	42	22.9		0	0	0	0	0	0
8								0.0	0	0	0	0	0	0
9	1640.8	20,000	0	1.55	26	45	47.0		0	0	0	0	0	0
10								0.0	0	0	0	0	0	0
11									0	0	0	0	0	0
12	1640.7	20,000	0	0.02	26	52	31.0		0	0	0	0	0	0
13								0.0	0	0	0	0	0	0
14	1640.7	20,000	0	0.71	31	57	31.0		0	0	0	0	0	0
15								0.0	0	0	0	0	0	0
16	1640.7	20,000	0	0.36	26	42	31.0	0.0	0	0	0	0	0	0
17									0	0	0	0	0	0
18									0	0	0	0	0	0
19	1640.7	20,000	0	0.19	32	44	26.9		0	0	0	0	0	0
20								0.0	0	0	0	0	0	0
21	1640.7	20,000	0	0.00	28	48	22.9		0	0	0	0	0	0
22	1640.7	20,000	0	0.56	32	44	26.9	0.0	0	0	0	0	0	0
23									0	0	0	0	0	0
24								0.0	0	0	0	0	0	0
25									0	0	0	0	0	0
26									0	0	0	0	0	0
27	1640.7	20,000	0	1.53	27	40	26.9	0.0	0	0	0	0	0	0
28									0	0	0	0	0	0
29	1640.7	20,000	0	0.12	28	48	31.0	0.0	0	0	0	0	0	0
30									0	0	0	0	0	0
31								0.0	0	0	0	0	0	0
Monthly Totals			0	6.90						0		0		0
Year to Date Totals			5,037	29.56						0		0		0

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF APRIL 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN			
				RAIN	TEMP min	TEMP max	TRASK	TUALATIN			CWS		MUNICIPAL	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1									0	0	0	0	0	0
2	1640.7	20,000	0	0.49	30	52	26.9		0	0	0	0	0	0
3								0.0	0	0	0	0	0	0
4	1640.7	20,000	0	0.03	26	44	22.9		0	0	0	0	0	0
5	1640.7	20,000	0	0.03	36	51	22.9	0.0	0	0	0	0	0	0
6									0	0	0	0	0	0
7								0.0	0	0	0	0	0	0
8									0	0	0	0	0	0
9	1640.9	20,000	0	4.98	34	41	55.5		0	0	0	0	0	0
10								0.0	0	0	0	0	0	0
11	1640.7	20,000	0	0.35	36	51	35.0		0	0	0	0	0	0
12								0.0	0	0	0	0	0	0
13	1640.9	20,000	0	2.05	32	42	47.0		0	0	0	0	0	0
14								0.0	0	0	0	0	0	0
15									0	0	0	0	0	0
16	1640.9	20,000	0	2.36	30	45	55.5		0	0	0	0	0	0
17								0.0	0	0	0	0	0	0
18	1640.8	20,000	0	0.88	32	45	41.0		0	0	0	0	0	0
19								0.0	0	0	0	0	0	0
20	1640.7	20,000	0	0.01	32	52	35.0	0.0	0	0	0	0	0	0
21									0	0	0	0	0	0
22									0	0	0	0	0	0
23	1640.7	20,000	0	0.07	30	56	26.9		0	0	0	0	0	0
24								0.0	0	0	0	0	0	0
25	1640.7	20,000	0	0.00	43	66	22.9		0	0	0	0	0	0
26	1640.6	20,000	0	0.00	42	66	22.9	0.0	0	0	0	0	0	0
27								0.0	0	0	0	0	0	0
28									0	0	0	0	0	0
29									0	0	0	0	0	0
30	1640.6	20,000	0	0.30	36	71	18.8		0	0	0	0	0	0
Monthly Totals			0	11.55						0		0		0
Year to Date Totals			5,037	41.11						0		0		0

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF MAY 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN			
				RAIN	TEMP min	TEMP max	TRASK	TUALATIN			CWS		MUNICIPAL*	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1									0	0	0	0	0	0
2	1640.6	20,000	0	0.02	50	53	18.8	0.0	0	0	0	0	0	0
3	1640.6	20,000	0	0.00	42	60	18.8	0.0	0	0	0	0	0	0
4	1640.6	20,000	0	0.00	41	62	18.8	0.0	0	0	0	0	0	0
5									0	0	0	0	0	0
6									0	0	0	0	0	0
7	1640.6	20,000	0	0.26	41	64	18.8	0.0	0	0	0	0	0	0
8									0	0	0	0	0	0
9	1640.6	20,000	0	0.04	45	65	14.8	0.0	0	0	0	0	0	0
10	1640.6	20,000	0	0.06	39	56	14.8	0.0	0	0	0	0	0	0
11									0	0	0	0	0	0
12									0	0	0	0	0	0
13									0	0	0	0	0	0
14	1640.6	20,000	0	0.11	40	72	12.2	0.0	0	0	0	0	0	0
15									0	0	0	0	0	0
16	1640.6	20,000	0	0.00	41	72	12.2	0.0	0	0	0	0	0	0
17									0	0	0	0	0	0
18	1640.6	20,000	0	0.01	53	59	12.2	0.0	0	0	0	0	0	0
19									0	0	0	0	0	0
20									0	0	0	0	0	0
21	1640.6	20,000	0	0.00	40	59	10.9	0.0	0	0	0	0	0	0
22									0	0	0	0	0	0
23	1640.6	20,000	0	0.00	42	71	12.3	0.0	0	0	0	0	0	0
24									0	0	0	0	0	0
25	FIRST DAY OF STORED WATER RELEASE FOR MUNICIPAL USE													
	1640.6	20,000	0	0.00	48	68	11.0	0.0	0	0	0	0	20	40
26									0	0	0	0	20	40
27									0	0	0	0	20	40
28	1640.4	19,960	-40	0.00	40	66	2.5	20.0	0	0	0	0	20	40
29									0	0	0	0	20	40
30	1640.3	19,920	-40	0.00	36	62	2.0	20.0	0	0	0	0	20	40
31	FIRST DAY OF STORED WATER RELEASE TO TRASK RIVER FOR FISH USE													
									1.1	2.2	0	0	20	40
Monthly Totals			-80	0.50						2.2		0		278
Year to Date Totals			4,957	41.61						2.2		0		278

*In this table (Reservoir Operations), the amount of water released is recorded on the day it was released from the reservoir. In the Municipal Use tables (Appendix E), the released water is recorded on the day that it was available for use which is one day later.

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF JUNE 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN			
				RAIN	TEMP min	TEMP max	TRASK	TUALATIN			CWS		MUNICIPAL*	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1	1640.1	19,840	-80	0.00	36	57	2.0	20.0	1.1	2.2	0	0	20	40
2									1.1	2.2	0	0	20	40
3									1.1	2.2	0	0	20	40
4	1640.0	19,800	-40	0.00	40	76	2.0	20.0	1.1	2.2	0	0	20	40
5									1.1	2.2	0	0	20	40
6	1639.8	19,720	-80	0.00	40	60	2.0	30.0	1.1	2.2	0	0	30	59
7									1.1	2.2	0	0	30	59
8	1639.6	19,640	-80	0.00	46	64	0.4	30.0	1.1	2.2	0	0	30	59
9									6.0	12	0	0	30	59
10									6.0	12	0	0	30	59
11	1639.3	19,520	-120	1.27	40	51	6.4	30.0	6.0	12	0	0	30	59
12									6.0	12	0	0	30	59
13	1639.0	19,400	-120	0.04	39	66	6.4	30.0	6.0	12	0	0	30	59
14									6.0	12	0	0	30	59
15	1638.8	19,320	-80	0.00	38	52	8.2	30.0	6.0	12	0	0	30	59
16									8.2	16	0	0	30	59
17									8.2	16	0	0	30	59
18	1638.3	19,120	-200	0.00	53	66	7.5	30.0	8.2	16	0	0	30	59
19									8.2	15	0	0	30	59
20	1637.9	18,950	-170	0.00	48	74	7.5	30.0	8.2	15	0	0	30	59
21									8.2	15	0	0	30	59
22	1637.7	18,850	-100	0.00	47	74	7.5	30.0	8.2	15	0	0	30	59
23									8.2	15	0	0	30	59
24									8.2	15	0	0	30	59
25	1637.2	18,600	-250	0.07	47	76	7.5	30.0	8.2	15	0	0	30	59
26									8.2	15	0	0	30	59
27	1636.8	18,400	-200	0.00	41	62	7.5	30.0	8.2	15	0	0	30	59
28									8.2	15	0	0	30	59
29	1636.5	18,250	-150	0.00	42	63	7.5	30.1	8.2	15	0	0	30	59
30									8.2	15	0	0	30	59
Monthly Totals			-1,670	1.38						328		0		1,686
Year to Date Totals			3,287	42.99						330		0		1,964

*In this table (Reservoir Operations), the amount of water released is recorded on the day it was released from the reservoir. In the Municipal Use tables (Appendix E), the released water is recorded on the day that it was available for use which is one day later.

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF JULY 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TULATIN			
				RAIN	TEMP min	TEMP max	TRASK	TUALATIN			CWS		MUNICIPAL*	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1									7.5	15	0	0	30	59
2	1635.9	17,963	-287	0.00	46	66	9.8	30.1	7.5	15	0	0	30	59
3									10	20	0	0	30	59
4	1635.6	17,850	-113	0.00	39	64	9.8	30.1	10	20	0	0	30	59
5									10	20	0	0	30	59
6	1635.2	17,700	-150	0.00	48	66	9.8	30.1	10	20	0	0	30	59
7									10	20	0	0	30	59
8									10	20	0	0	30	59
9	1634.6	17,475	-225	0.00	46	67	9.8	30.1	10	20	0	0	30	59
10									10	20	0	0	30	59
11	1634.3	17,363	-112	0.03	52	62	9.8	30.1	10	20	0	0	30	59
12									10	20	0	0	30	59
13	1633.9	17,213	-150	0.00	54	80	9.8	30.1	10	20	0	0	30	59
14									10	20	0	0	30	59
15									10	20	0	0	30	59
16	1633.3	16,988	-225	0.00	50	80	9.8	40.0	10	20	0	0	40	79
17									10	20	0	0	40	79
18	1632.8	16,800	-188	0.00	51	81	9.8	40.0	10	20	0	0	40	79
19									10	20	0	0	40	79
20	1632.3	16,613	-187	0.00	38	71	9.8	40.0	10	20	0	0	40	79
21									10	20	0	0	40	79
22									10	20	0	0	40	79
23	1631.5	16,313	-300	0.00	38	76	9.8	40.0	10	20	0	0	40	79
24									10	20	0	0	40	79
25	1631.0	16,125	-188	0.00	52	79	9.8	50.5	10	20	0	0	50	99
26									10	20	0	0	50	99
27	1630.4	15,900	-225	0.00	52	80	9.8	50.3	10	20	0	0	50	99
28									10	20	0	0	50	99
29									10	20	0	0	50	99
30	1629.4	15,525	-375	0.00	50	80	9.8	50.3	10	20	0	0	50	99
31	1629.1	15,413	-112	0.00	51	76	9.8	50.1	10	20	0	0	50	99
Monthly Totals			-2,837	0.03						605		0		2,301
Year to Date Totals			450	43.02						935		0		4,265

*In this table (Reservoir Operations), the amount of water released is recorded on the day it was released from the reservoir. In the Municipal Use tables (Appendix E), the released water is recorded on the day that it was available for use which is one day later.

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF AUGUST 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN			
				RAIN	TEMP min	TEMP max	TRASK	TUALATIN			CWS		MUNICIPAL*	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1									10	20	0	0	50	99
2	1628.4	15,150	-263	0.00	51	74	9.8	50.1	10	20	0	0	50	99
3	1628.2	15,075	-75	0.02	50	60	9.8	50.1	10	20	0	0	50	99
4									10	20	0	0	50	99
5									10	20	0	0	50	99
6	1627.1	14,663	-412	0.00	58	75	9.8	50.1	10	20	0	0	50	99
7									10	20	0	0	50	99
8	1626.5	14,438	-225	0.00	53	79	9.8	50.3	10	20	0	0	50	99
9									10	20	0	0	50	99
10	1626.0	14,250	-188	0.00	56	80	9.8	50.1	10	20	0	0	50	99
11									10	20	0	0	50	99
12									10	20	0	0	50	99
13									10	20	0	0	50	99
14	1624.5	13,688	-562	0.07	51	74	9.8	50.1	10	20	0	0	50	99
15	1624.1	13,538	-150	0.00	54	74	9.8	55.1	10	20	0	0	55	109
16									10	20	0	0	55	109
17	1623.6	13,350	-188	0.00	44	76	9.8	54.8	10	20	0	0	55	109
18									10	20	0	0	55	109
19									10	20	0	0	55	109
20	1622.3	12,863	-487	0.00	56	74	9.8	55.0	10	20	0	0	55	109
21									10	20	0	0	55	109
22	1621.5	12,563	-300	0.00	56	77	9.8	55.1	10	20	0	0	55	109
23									10	20	0	0	55	109
24	1620.7	12,263	-300	0.00	48	78	9.8	55.3	10	20	0	0	55	109
25									10	20	0	0	55	109
26									10	20	0	0	55	109
27	1619.6	11,866	-397	0.05	38	62	9.8	45.0	10	20	0	0	45	89
28									10	20	0	0	45	89
	FIRST DAY OF STORED WATER RELEASE FOR TUALATIN RIVER WATER QUALITY													
29	1618.9	11,633	-233	0.00	54	72	9.8	55.0	10	20	4.0	8	51	101
30	1618.5	11,500	-133	0.00	48	71	9.8	65.0	10	20	14	28	51	101
31									10	20	14	28	51	101
Monthly Totals			-3,913	0.14						615		63		3,180
Year to Date Totals			-3,463	43.16						1,550		63		7,444

*In this table (Reservoir Operations), the amount of water released is recorded on the day it was released from the reservoir. In the Municipal Use tables (Appendix E), the released water is recorded on the day that it was available for use which is one day later.

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF SEPTEMBER 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN			
				RAIN	TEMP min	TEMP max	TRASK	TUALATIN			CWS		MUNICIPAL*	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1									10	20	14	28	51	101
2									10	20	14	28	51	101
3	1616.6	10,866	-634	0.00	42	65	9.8	65.0	10	20	14	28	51	101
4									10	20	14	28	51	101
5	1615.7	10,566	-300	0.00	58	65	9.8	65.0	10	20	14	28	51	101
6									10	20	14	28	51	101
7	1614.8	10,266	-300	0.00	47	72	9.8	65.0	10	20	14	28	51	101
8									10	20	14	28	51	101
9									10	20	14	28	51	101
10	1613.3	9,825	-441	0.12	46	77	9.8	65.0	10	20	14	28	51	101
11									10	20	14	28	51	101
12	1612.5	9,625	-200	0.93	46	56	9.8	55.0	10	20	14	28	41	81
13									10	20	14	28	41	81
14	1611.9	9,475	-150	0.22	36	54	9.8	55.0	10	20	14	28	41	81
15									10	20	14	28	41	81
16									10	20	14	28	41	81
17	1610.5	9,125	-350	0.97	40	53	9.8	45.0	10	20	14	28	31	61
18	1610.1	9,025	-100	0.00	42	54	9.8	35.0	10	20	14	28	21	42
19	1609.9	8,966	-59	0.00	40	46	9.8	35.0	10	20	14	28	21	42
20									10	20	14	28	21	42
21	1609.3	8,766	-200	0.02	42	57	9.8	35.0	10	20	14	28	21	42
22									10	20	14	28	21	42
23									10	20	14	28	21	42
24	1608.4	8,466	-300	0.23	40	59	9.8	45.0	10	20	14	28	31	61
25									10	20	14	28	31	61
26	1607.7	8,233	-233	0.00	46	53	9.8	45.0	10	20	14	28	31	61
27									10	20	14	28	31	61
28	1607.3	8,100	-133	0.00	52	66	9.8	45.0	10	20	14	28	31	61
29									10	20	14	28	31	61
30									10	20	14	28	31	61
Monthly Totals			-3,400	2.49						595		833		2,261
Year to Date Totals			-6,863	45.65						2,145		897		9,705

*In this table (Reservoir Operations), the amount of water released is recorded on the day it was released from the reservoir. In the Municipal Use tables (Appendix E), the released water is recorded on the day that it was available for use which is one day later.

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF OCTOBER 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN			
				RAIN	TEMP min	TEMP max	TRASK	TUALATIN			CWS		MUNICIPAL*	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1	1605.9	7,633	-467	0.14	47	65	9.8	45.0	10	20	14	28	31	61
2									10	20	14	28	31	61
3	1605.1	7,366	-267	0.03	40	56	9.8	45.0	10	20	14	28	31	61
4									10	20	14	28	31	61
5	1604.7	7,233	-133	0.06	42	51	9.8	45.0	10	20	14	28	31	61
6									10	20	14	28	31	61
7									10	20	14	28	31	61
8	1603.7	6,925	-308	0.89	41	54	9.8	45.0	10	20	14	28	31	61
9									10	20	14	28	31	61
10	1602.5	6,625	-300	0.05	41	54	9.8	40.0	10	20	14	28	26	51
11									10	20	14	28	26	51
12	1602.1	6,525	-100	0.01	39	55	9.8	40.0	10	20	14	28	26	51
13									10	20	14	28	26	51
14									10	20	14	28	26	51
15	1600.6	6,150	-375	0.00	43	53	9.8	40.0	10	20	14	28	26	51
16									10	20	14	28	26	51
17	1599.8	5,950	-200	0.00	44	57	9.8	40.0	10	20	14	28	26	51
18									10	20	14	28	26	51
19	1599.0	5,750	-200	0.00	40	59	9.8	40.0	10	20	14	28	26	51
20									10	20	14	28	26	51
21									10	20	14	28	26	51
22	1597.9	5,475	-275	0.00	41	59	9.8	40.0	10	20	14	28	26	51
23									10	20	14	28	26	51
24	1597.7	5,425	-50	0.00	38	54	9.8	40.0	10	20	14	28	26	51
25									10	20	14	28	26	51
26	1597.0	5,250	-175	1.11	42	52	9.8	40.0	10	20	14	28	26	51
27									10	20	14	28	26	51
28									10	20	14	28	26	51
	LAST DAY OF STORED WATER RELEASE FOR TUALATIN RIVER WATER QUALITY													
29	1595.7	4,948	-302	2.69	40	52	9.8	25.1	10	20	0	0	25	50
30									10	20	0	0	25	50
31	1595.3	4,882	-66	0.42	40	48	7.5	10.0	10	20	0	0	10	20
Monthly Totals			-3,218	5.40						615		778		1,652
Year to Date Totals			-10,081	51.05						2,760		1,674		11,358

*In this table (Reservoir Operations), the amount of water released is recorded on the day it was released from the reservoir. In the Municipal Use tables (Appendix E), the released water is recorded on the day that it was available for use which is one day later.

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF NOVEMBER 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY RAIN	TEMP min	TEMP max	MEASURED FLOW TO TRASK	MEASURED FLOW TO TUALATIN	STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN CWS		MUNICIPAL*	
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1									7.5	15	0	0	10	20
2	1595.3	4,882	0	0.94	42	55	7.5	20.3	7.5	15	0	0	20	40
3									7.5	15	0	0	20	40
4									7.5	15	0	0	20	40
5	1595.1	4,849	-33	1.25	38	50	7.5	20.4	7.5	15	0	0	20	40
6	1595.0	4,833	-16	0.29	39	45	5.2	15.1	7.5	15	0	0	15	30
7									5.0	10	0	0	15	30
8									5.0	10	0	0	15	30
9	1595.4	4,899	66	0.09	32	44	5.2	15.1	5.0	10	0	0	15	30
10									5.0	10	0	0	15	30
11									5.0	10	0	0	15	30
12	1594.6	4,766	-133	0.00	31	44	5.2	15.1	5.0	10	0	0	15	30
13									5.0	10	0	0	15	30
14	1594.4	4,733	-33	0.06	32	44	3.2	15.2	1.4	2.8	0	0	15	30
15									1.4	2.8	0	0	15	30
16	1594.2	4,699	-34	0.08	36	48	3.2	15.2	1.4	2.8	0	0	15	30
17									1.4	2.8	0	0	15	30
18									1.4	2.8	0	0	15	30
19	1593.9	4,648	-51	0.88	33	50	3.2	15.2	1.4	2.8	0	0	15	30
20									1.4	2.8	0	0	15	30
21	1593.8	4,630	-18	0.21	32	44	1.8	15.3	1.4	2.8	0	0	15	30
22									1.4	2.8	0	0	15	30
23	1594.0	4,666	36	2.27	40	41	4.5	15.2	1.4	2.8	0	0	15	30
24									1.4	2.8	0	0	15	30
25									1.4	2.8	0	0	15	30
26	1594.2	4,699	33	0.66	31	42	3.2	6.9	1.4	2.8	0	0	7.0	14
27									1.4	2.8	0	0	7.0	14
	LAST DAY OF STORED WATER RELEASE FOR MUNICIPAL USE													
28	1595.0	4,833	134	2.06	40	51	3.2		1.4	3	0	0	0	0
29									1.4	3	0	0	0	0
30	1595.5	4,915	82	0.58	38	42	3.2		1.4	3	0	0	0	0
Monthly Totals			33	9.37						206		0		801
Year to Date Totals			-10,048	60.42						2,966		1,674		12,159

*In this table (Reservoir Operations), the amount of water released is recorded on the day it was released from the reservoir. In the Municipal Use tables (Appendix E), the released water is recorded on the day that it was available for use which is one day later.

BARNEY RESERVOIR OPERATIONS FOR THE MONTH OF DECEMBER 2018

[See Appendix E for breakdown of municipal use by water provider.] Source: Barney Reservoir Joint Ownership Commission

DAY	SURFACE ELEVATION	STORAGE	CHANGE IN STORAGE	WEATHER @ BARNEY			MEASURED FLOW TO		STORAGE RELEASED TO TRASK—ODFW		STORAGE RELEASED TO TUALATIN			
				RAIN	TEMP						CWS		MUNICIPAL	
					min	max	TRASK	TUALATIN						
	feet	ac-ft	ac-ft	in.	°F	°F	cfs	cfs	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
1									1.4	2.8	0	0	0	0
2									1.4	2.8	0	0	0	0
3	1596.7	5,175	260	1.10	30	42	3.2	0.0	1.4	2.8	0	0	0	0
4									1.4	2.8	0	0	0	0
5	1596.4	5,100	-75	0.00	31	36	3.2	0.0	1.4	2.8	0	0	0	0
6									1.4	2.8	0	0	0	0
7	1597.1	5,275	175	0.00	26	34	3.2	0.0	1.4	2.8	0	0	0	0
8									1.4	2.8	0	0	0	0
9									1.4	2.8	0	0	0	0
10	1597.0	5,250	-25	0.95	31	38	2.5	0.0	1.4	2.8	0	0	0	0
11	1597.1	5,275	25	0.52	34	40	2.5	0.0	1.4	2.8	0	0	0	0
12									1.4	2.8	0	0	0	0
	LAST DAY OF STORED WATER RELEASE TO TRASK RIVER FOR FISH USE													
13	1598.3	5,575	300	1.90	36	44	2.5	0.0	0	0	0	0	0	0
14	1598.6	5,650	75	0.00	34	43	2.5	0.0	0	0	0	0	0	0
15									0	0	0	0	0	0
16									0	0	0	0	0	0
17	1599.4	5,850	200	1.48	34	44	2.5	0.0	0	0	0	0	0	0
18									0	0	0	0	0	0
19	1602.6	6,650	800	4.96	38	44	3.8	0.0	0	0	0	0	0	0
20									0	0	0	0	0	0
21	1603.8	6,950	300	0.84	32	44	3.8	0.0	0	0	0	0	0	0
22									0	0	0	0	0	0
23									0	0	0	0	0	0
24	1605.1	7,366	416	1.73	32	39	3.8	0.0	0	0	0	0	0	0
25									0	0	0	0	0	0
26	1605.9	7,633	267	0.10	32	34	2.5	0.0	0	0	0	0	0	0
27									0	0	0	0	0	0
28	1606.5	7,833	200	0.56	34	38	2.5	0.0	0	0	0	0	0	0
29									0	0	0	0	0	0
30									0	0	0	0	0	0
31	1607.7	8,233	400	0.00	30	45	2.5		0	0	0	0	0	0
Monthly Totals			3,318	14.14						33		0		0
Year to Date Totals			-6,730	74.56						2,999		1,674		12,159

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APPENDIX E
MUNICIPAL WATER USE ALLOCATIONS — MONTHLY REPORTS

2018 SUMMARY

• 2018 was the longest release season in JWC history:	187 days
• First day of stored water delivery for municipal use:	99.2 acre-feet (32.3 MG) on May 26
• Last day of stored water delivery for municipal use:	13.9 acre-feet (4.52 MG) on November 28
• Mean daily used allocation of stored water:	116 acre-feet per day (37.8 MGD)
• Maximum daily used allocation of stored water:	188 acre-feet per day (61.2 MGD) on July 26

2018 MUNICIPAL WATER USE ALLOCATIONS

Details of releases for each month follow in this appendix.

	MAY	JUN	JUL	AUG	SEP	OCT	NOV	RELEASE SEASON*
Barney Reservoir (acre-feet)								
Hillsboro	30	343	575	1,470	869	1,134	543	4,965
Forest Grove	0	0	0	0	5	5	2	12
Beaverton	22	246	334	460	283	39	78	1,462
TVWD	186	1,077	1,352	1,248	1,144	516	198	5,720
TOTAL	**238**	**1,666**	**2,261**	**3,178**	**2,301**	**1,694**	**821**	**12,159**
Hagg Lake (acre-feet)								
Hillsboro	217	1,074	1,373	640	999	239	247	4,789
Forest Grove	12	91	220	267	196	148	101	1,037
Beaverton	160	711	792	646	477	511	390	3,688
TOTAL	**389**	**1,876**	**2,386**	**1,553**	**1,672**	**899**	**738**	**9,513**

*The Release Season total may not equal the sum of the Monthly Allocations because of round-off error.
Abbreviations: TVWD=Tualatin Valley Water District

MUNICIPAL ALLOCATIONS FOR THE MONTH OF MAY 2018

Source: Joint Water Commission

DAY	TOTAL MUNICIPAL USE	MUNICIPAL USE BY RESERVOIR		BREAKDOWN OF MUNCIPAL USE BY WATER PROVIDER†						
				HILLSBORO		FOREST GROVE		BEAVERTON		TVWD
		Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24				FIRST DAY OF STORED WATER RELEASE FOR MUNICIPAL USE						
25				Barney Reservoir: May 25		Hagg Lake: May 26				
26	50	20	30	3.1	16.3	0.0	1.1	2.3	12.5	14.6
27	50	20	30	3.0	17.1	0.0	0.6	2.2	12.3	14.8
28	50	20	30	2.4	16.2	0.0	1.0	1.9	12.8	15.7
29	50	20	30	2.6	15.6	0.0	1.4	2.2	13.0	15.2
30	58	20	38	2.2	21.6	0.0	1.5	1.5	14.9	16.3
31	58	20	338	1.8	22.4	0.0	0.6	1.2	15.0	16.9
Monthly Summary (May)										
Mean daily cfs	52.7	20.0	32.7	2.5	18.2	0.0	1.0	1.9	13.4	15.6
Total ac-ft	627	238	389	30	217	0.0	12	22	160	186
Stored Water Use Summary to Date (May 26–May 31)										
Mean daily cfs	52.7	20.0	32.7	2.5	18.2	0.0	1.0	1.9	13.4	15.6
Total ac-ft	627	238	389	30	217	0.0	12	22	160	186

† In this table (Municipal Use), the amount of water allocated to each provider is recorded on the day that it was available. In the Barney Reservoir Operations table (Appendix D), the amount of water released is recorded on the day it was released from the reservoir, which is one day earlier than its availability.

MUNICIPAL ALLOCATIONS FOR THE MONTH OF JUNE 2018

Source: Joint Water Commission

DAY	TOTAL MUNICIPAL USE	MUNICIPAL USE BY RESERVOIR		BREAKDOWN OF MUNCIPAL USE BY WATER PROVIDER†						
				HILLSBORO		FOREST GROVE		BEAVERTON		TVWD
		Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	50	20	30	1.8	17.1	0.0	0.4	1.3	12.5	16.9
2	50	20	30	1.7	15.9	0.0	1.1	1.4	13.0	16.8
3	50	20	30	2.2	15.6	0.0	1.2	1.8	13.1	16.0
4	50	20	30	1.3	15.2	0.0	0.6	1.2	14.1	17.4
5	74	20	54	-5.1	33.8	0.0	1.6	0.0	18.6	25.1
6	67	20	47	-1.5	29.8	0.0	1.4	0.0	15.8	21.5
7	65	30	35	5.0	20.6	0.0	1.3	3.2	13.0	21.8
8	73	30	43	4.6	27.2	0.0	0.6	2.6	15.2	22.8
9	58	30	28	6.9	16.2	0.0	0.4	4.9	11.4	18.2
10	58	30	28	8.3	17.3	0.0	0.5	4.9	10.2	16.8
11	58	30	28	8.5	16.4	0.0	0.4	5.8	11.1	15.7
12	45	30	15	9.6	7.4	0.0	1.4	8.0	6.2	12.5
13	45	30	15	10.4	8.0	0.0	1.0	7.8	6.0	11.9
14	45	30	15	9.7	7.9	0.0	0.4	8.2	6.7	12.1
15	55	30	25	7.7	14.2	0.0	1.0	5.3	9.8	16.9
16	60	30	30	7.3	16.7	0.0	1.3	5.3	12.0	17.4
17	60	30	30	6.9	15.4	0.0	2.0	5.6	12.6	17.5
18	60	30	30	7.0	15.9	0.0	1.9	5.4	12.2	17.6
19	60	30	30	7.1	16.2	0.0	2.3	5.0	11.5	17.9
20	68	30	38	5.6	22.5	0.0	2.3	3.3	13.2	21.1
21	68	30	38	6.9	23.2	0.0	2.1	3.8	12.7	19.3
22	60	30	30	7.9	18.6	0.0	1.9	4.0	9.6	18.1
23	60	30	30	6.7	16.6	0.0	2.2	4.5	11.1	18.8
24	60	30	30	6.5	16.3	0.0	2.4	4.5	11.3	18.9
25	60	30	30	6.7	16.5	0.0	2.1	4.7	11.4	18.6
26	60	30	30	6.7	16.0	0.0	2.3	4.9	11.7	18.4
27	65	30	35	6.6	19.7	0.0	2.5	4.3	12.8	19.1
28	70	30	40	6.4	24.2	0.0	2.1	3.6	13.6	20.1
29	70	30	40	6.4	23.4	0.0	2.4	3.9	14.2	19.7
30	62	30	32	7.0	17.4	0.0	2.8	4.7	11.8	18.2
Monthly Summary (June)										
Mean daily cfs	59.5	28.0	31.5	5.8	18.0	0.0	1.5	4.1	12.0	18.1
Total ac-ft	3,543	1,666	1,876	343	1,074	0.0	91	246	711	1,077
Stored Water Use Summary to Date (May 26–June 30)										
Mean daily cfs	58.4	26.7	31.7	5.2	18.1	0.0	1.5	3.8	12.2	17.7
Total ac-ft	4,169	1,904	2,265	373	1,290	0.0	104	268.2	871	1,263

‡In this table (Municipal Use), the amount of water allocated to each provider is recorded on the day that it was available. In the Barney Reservoir Operations table (Appendix D), the amount of water released is recorded on the day it was released from the reservoir, which is one day earlier than its availability.

MUNICIPAL ALLOCATIONS FOR THE MONTH OF JULY 2018

Source: Joint Water Commission

DAY	TOTAL MUNICIPAL USE	MUNICIPAL USE BY RESERVOIR		BREAKDOWN OF MUNCIPAL USE BY WATER PROVIDER†						
				HILLSBORO		FOREST GROVE		BEAVERTON		TVWD
		Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	62	30	32	6.8	18.3	0.0	2.0	4.3	11.7	18.9
2	62	30	32	6.6	17.9	0.0	2.1	4.4	12.0	19.0
3	67	30	37	6.6	21.8	0.0	2.9	3.7	12.3	19.6
4	57	30	27	8.4	14.7	0.0	1.9	6.0	10.5	15.6
5	57	30	27	8.4	14.3	0.0	2.1	6.2	10.5	15.4
6	57	30	27	8.6	13.8	0.0	3.0	6.3	10.2	15.1
7	66	30	36	8.0	20.5	0.0	2.3	5.2	13.3	16.9
8	66	30	36	8.1	20.1	0.0	3.3	5.1	12.5	16.8
9	66	30	36	7.7	20.8	0.0	2.4	4.8	12.8	17.5
10	66	30	36	7.0	21.1	0.0	2.3	4.1	12.6	18.9
11	66	30	36	7.8	21.1	0.0	3.0	4.4	11.9	17.8
12	71	30	41	6.5	23.8	0.0	3.3	3.8	13.9	19.7
13	77	30	47	5.2	28.0	0.0	3.8	2.8	15.2	22.1
14	82	30	52	4.3	31.8	0.0	3.0	2.3	17.2	23.4
15	82	30	52	4.0	31.5	0.0	3.3	2.2	17.1	23.9
16	82	30	52	4.2	31.4	0.0	3.9	2.2	16.6	23.6
17	85	40	45	11.4	27.3	0.0	4.3	5.6	13.3	23.0
18	75	40	35	12.8	19.8	0.0	5.1	6.6	10.1	20.6
19	83	40	43	10.1	25.0	0.0	4.1	5.6	13.9	24.2
20	88	40	48	9.6	28.6	0.0	4.2	5.1	15.1	25.3
21	79	40	39	8.9	21.6	0.0	3.8	5.6	13.7	25.4
22	79	40	39	8.9	21.2	0.0	4.2	5.7	13.6	25.4
23	79	40	39	8.3	20.1	0.0	4.5	5.9	14.4	25.8
24	79	40	39	11.4	22.8	0.0	4.7	5.8	11.5	22.8
25	85	40	45	9.7	26.8	0.0	4.7	4.9	13.5	25.4
26	95	50	45	14.3	26.4	0.0	4.8	7.5	13.8	28.2
27	90	50	40	16.3	23.8	0.0	4.6	7.9	11.5	25.8
28	85	50	35	14.5	19.4	0.0	3.9	8.7	11.7	26.8
29	85	50	35	14.6	19.5	0.0	4.2	8.4	11.3	27.0
30	85	50	35	15.0	19.4	0.0	4.5	8.6	11.2	26.4
31	85	50	35	16.2	19.7	0.0	4.8	8.6	10.4	25.3
Monthly Summary (July)										
Mean daily cfs	75.6	36.8	38.8	9.4	22.3	0.0	3.6	5.4	12.9	22.0
Total ac-ft	4,647	2,261	2,386	575	1,373	0.0	220	334	792	1,352
Stored Water Use Summary to Date (May 26–July 31)										
Mean daily cfs	66.3	31.3	35.0	7.1	20.0	0.0	2.4	4.5	12.5	19.7
Total ac-ft	8,817	4,165	4,651	948	2,664	0.0	324	602	1,663	2,615

†In this table (Municipal Use), the amount of water allocated to each provider is recorded on the day that it was available. In the Barney Reservoir Operations table (Appendix D), the amount of water released is recorded on the day it was released from the reservoir, which is one day earlier than its availability.

MUNICIPAL ALLOCATIONS FOR THE MONTH OF AUGUST 2018

Source: Joint Water Commission

DAY	TOTAL MUNICIPAL USE	MUNICIPAL USE BY RESERVOIR		BREAKDOWN OF MUNCIPAL USE BY WATER PROVIDER†						
				HILLSBORO		FOREST GROVE		BEAVERTON		TVWD
		Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	80	50	30	16.3	16.7	0.0	3.9	9.1	9.4	24.6
2	74	50	24	18.5	13.0	0.0	3.8	10.3	7.2	21.1
3	80	50	30	17.6	17.3	0.0	3.9	8.9	8.8	23.5
4	85	50	35	16.3	20.4	0.0	3.9	8.6	10.8	25.2
5	85	50	35	15.9	19.8	0.0	4.3	8.8	10.9	25.3
6	85	50	35	19.7	15.7	0.0	4.6	4.9	14.8	25.3
7	90	50	40	18.5	20.6	0.0	4.6	4.6	14.8	26.9
8	90	50	40	18.5	20.1	0.0	4.8	4.6	15.1	26.9
9	85	50	35	20.2	16.0	0.0	4.9	5.0	14.1	24.8
10	80	50	30	23.0	12.9	0.0	4.7	5.8	12.4	21.2
11	75	50	25	24.8	8.6	0.0	4.1	6.2	12.4	18.9
12	75	50	25	24.7	8.6	0.0	4.0	6.2	12.4	19.1
13	75	50	25	24.4	8.7	0.0	3.9	6.1	12.4	19.5
14	85	50	35	20.0	15.4	0.0	5.5	5.0	14.1	25.0
15	85	50	35	20.5	15.8	0.0	5.4	5.1	13.7	24.4
16	80	55	25	28.6	8.8	0.0	4.5	7.2	11.7	19.2
17	85	55	30	27.6	12.9	0.0	4.4	6.9	12.8	20.5
18	77	55	22	28.2	6.0	0.0	4.2	7.0	11.8	19.8
19	77	55	22	28.2	5.6	0.0	4.5	7.1	11.9	19.7
20	77	55	22	28.5	5.2	0.0	4.7	7.1	12.1	19.4
21	72	55	17	29.0	2.5	0.0	4.6	7.2	9.9	18.8
22	72	55	17	29.6	3.5	0.0	4.4	7.4	9.1	18.0
23	67	55	12	31.8	0.0	0.0	4.2	8.0	7.8	15.2
24	72	55	17	31.6	4.1	0.0	4.2	7.9	8.7	15.5
25	65	55	10	28.3	4.0	0.0	4.1	14.0	2.0	12.7
26	65	55	10	27.6	4.0	0.0	4.0	14.2	2.0	13.2
27	65	55	10	26.8	4.1	0.0	3.6	14.4	2.2	13.8
28	65	45	20	22.4	5.7	0.0	4.4	5.6	9.9	17.0
29	65	45	20	22.1	6.4	0.0	4.1	5.5	9.5	17.4
30	76	51	25	25.7	8.9	0.0	5.2	6.4	11.0	18.9
31	76	51	25	26.3	11.4	0.0	3.6	6.6	10.0	18.1
Monthly Summary (August)										
Mean daily cfs	76.9	51.7	25.3	23.9	10.4	0.0	4.3	7.5	10.5	20.3
Total ac-ft	4,731	3,178	1,553	1,470	640	0	267	460	646	1,248
Stored Water Use Summary to Date (May 26–August 31)										
Mean daily cfs	69.7	37.8	31.9	12.4	17.0	0.0	3.0	5.5	11.9	19.9
Total ac-ft	13,547	7,343	6,204	2,418	3,303	0.0	591	1,062	2,310	3,863

†In this table (Municipal Use), the amount of water allocated to each provider is recorded on the day that it was available. In the Barney Reservoir Operations table (Appendix D), the amount of water released is recorded on the day it was released from the reservoir, which is one day earlier than its availability.

MUNICIPAL ALLOCATIONS FOR THE MONTH OF SEPTEMBER 2018

Source: Joint Water Commission

DAY	TOTAL MUNICIPAL USE	MUNICIPAL USE BY RESERVOIR		BREAKDOWN OF MUNCIPAL USE BY WATER PROVIDER†						
				HILLSBORO		FOREST GROVE		BEAVERTON		TVWD
		Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	82	51	31	22.9	15.1	0.0	4.2	5.7	11.7	22.4
2	82	51	31	22.7	15.5	0.0	3.9	5.7	11.6	22.6
3	82	51	31	22.8	15.0	0.0	3.7	5.7	12.3	22.5
4	82	51	31	22.5	14.9	0.0	4.8	5.6	11.4	22.8
5	82	51	31	21.2	17.9	0.0	3.9	5.3	9.2	24.4
6	82	51	31	21.5	18.2	0.0	4.1	5.4	8.7	24.2
7	77	51	26	22.8	14.6	0.0	3.9	5.7	7.5	22.6
8	77	51	26	22.8	13.3	0.0	3.7	5.7	9.0	22.5
9	77	51	26	21.7	12.8	0.0	3.4	5.4	9.8	23.9
10	77	51	26	22.8	13.3	0.0	3.9	5.7	8.8	22.5
11	82	51	31	25.3	17.9	0.0	3.4	6.3	9.7	19.4
12	77	51	26	27.4	16.3	0.0	2.7	6.9	7.0	16.7
13	48	41	7	20.9	2.8	0.0	2.8	10.4	1.4	9.6
14	48	41	7	21.1	2.5	0.0	3.2	10.5	1.3	9.4
15	48	41	7	21.4	2.9	0.0	2.6	10.8	1.5	8.8
16	48	41	7	21.7	3.2	0.0	2.3	10.5	1.5	8.8
17	48	41	7	21.0	3.5	0.0	1.7	10.9	1.8	9.1
18	31	31	0	13.9	0.0	2.4	0.0	8.4	0.0	6.4
19	29	21	8	8.7	3.2	0.0	2.8	5.6	2.1	6.7
20	36	21	15	6.7	7.2	0.0	3.0	4.5	4.8	9.8
21	46	21	25	7.7	14.7	0.0	3.3	1.9	7.0	11.4
22	68	21	47	-3.1	34.1	0.0	2.9	0.0	10.0	24.1
23	68	21	47	-3.0	33.9	0.0	3.0	0.0	10.2	24.0
24	68	21	47	-3.0	33.4	0.0	3.4	0.0	10.1	24.0
25	83	31	52	1.6	35.8	0.0	3.8	0.0	12.4	29.4
26	76	31	45	4.5	29.6	0.0	4.1	0.0	11.3	26.5
27	76	31	45	4.7	28.8	0.0	4.2	0.0	12.0	26.3
28	71	31	40	6.9	24.8	0.0	3.7	0.0	11.4	24.1
29	76	31	45	4.7	29.4	0.0	3.2	0.0	12.4	26.3
30	76	31	45	5.8	29.3	0.0	3.1	0.0	12.6	25.2
Monthly Summary (September)										
Mean daily cfs	66.8	38.7	29.1	14.6	17.4	0.1	3.4	4.8	8.3	19.2
Total ac-ft	3,973	2,301	1,672	869	999	4.7	196	283	477	1,144
Stored Water Use Summary to Date (May 26–September 30)										
Mean daily cfs	69	38	31	12.9	17.1	0.0	3.1	5.3	11.1	20
Total ac-ft	17,520	9,644	7,876	3,288	4,303	4.7	787	1,345	2,787	5,006

†In this table (Municipal Use), the amount of water allocated to each provider is recorded on the day that it was available. In the Barney Reservoir Operations table (Appendix D), the amount of water released is recorded on the day it was released from the reservoir, which is one day earlier than its availability.

MUNICIPAL ALLOCATIONS FOR THE MONTH OF OCTOBER 2018

Source: Joint Water Commission

DAY	TOTAL MUNICIPAL USE	MUNICIPAL USE BY RESERVOIR		BREAKDOWN OF MUNCIPAL USE BY WATER PROVIDER†						
				HILLSBORO		FOREST GROVE		BEAVERTON		TVWD
		Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	76	31	45	7.8	28.6	0.0	3.5	0.0	12.8	23.2
2	56	31	25	18.1	11.1	0.0	3.5	0.0	10.5	12.9
3	48	31	17	23.4	5.1	0.0	3.1	0.0	8.8	7.6
4	48	31	17	22.9	4.1	0.0	3.2	0.0	9.8	8.1
5	48	31	17	22.7	4.8	0.0	2.9	0.0	9.3	8.3
6	43	31	12	23.8	2.0	0.0	2.2	0.0	7.8	7.2
7	43	31	12	23.6	1.5	0.0	2.5	0.0	8.0	7.4
8	43	31	12	23.7	1.5	0.0	2.4	0.0	8.1	7.3
9	43	31	12	23.6	1.1	0.0	2.7	0.0	8.2	7.4
10	43	31	12	17.1	2.1	0.0	3.5	4.3	6.4	9.6
11	38	26	12	17.9	0.2	0.0	2.8	0.0	9.0	8.1
12	38	26	12	18.0	0.6	0.0	2.5	0.0	8.9	8.0
13	38	26	12	18.0	0.9	0.0	2.5	0.0	8.6	8.0
14	38	26	12	18.3	1.7	0.0	1.9	0.0	8.3	7.7
15	38	26	12	18.4	1.6	0.0	2.1	0.0	8.4	7.6
16	43	26	17	16.9	3.2	0.0	3.0	0.0	10.8	9.1
17	49	26	23	17.1	10.0	0.0	2.4	0.0	10.6	8.9
18	56	26	30	16.0	15.7	0.0	3.0	0.0	11.3	10.0
19	38	26	12	18.9	2.0	0.0	2.1	0.0	7.9	7.1
20	38	26	12	17.8	0.7	0.0	2.4	0.0	8.9	8.2
21	38	26	12	18.5	1.0	0.0	2.0	0.0	9.0	7.5
22	38	26	12	18.9	1.9	0.0	1.9	0.0	8.1	7.1
23	38	26	12	12.6	0.4	0.0	3.2	3.2	8.4	10.2
24	43	26	17	18.7	7.0	0.0	1.9	0.0	8.1	7.3
25	43	26	17	17.0	4.9	0.0	2.7	0.0	9.4	9.0
26	38	26	12	17.8	1.6	0.0	2.2	0.0	8.3	8.2
27	38	26	12	17.5	1.0	0.0	2.3	0.0	8.7	8.5
28	38	26	12	17.7	1.5	0.0	2.2	0.0	8.3	8.3
29	38	26	12	20.0	3.0	0.0	2.0	0.0	7.0	6.0
30	25	25	0	13.5	0.0	1.3	0.0	6.7	0.0	3.5
31	25	25	0	15.7	0.0	1.4	0.0	5.4	0.0	2.5
Monthly Summary (October)										
Mean daily cfs	42.2	27.5	15.6	18.4	4.2	0.1	2.6	0.6	8.9	8.4
Total ac-ft	2,592	1,694	899	1,134	239	5.5	148	39	511	516
Stored Water Use Summary to Date (May 26–October 31)										
Mean daily cfs	63.8	35.9	28.4	14.0	14.7	0.0	3.0	4.4	10.7	17.5
Total ac-ft	20,113	11,338	8,775	4,422	4,542	10.2	935	1,384	3,298	5,522

†In this table (Municipal Use), the amount of water allocated to each provider is recorded on the day that it was available. In the Barney Reservoir Operations table (Appendix D), the amount of water released is recorded on the day it was released from the reservoir, which is one day earlier than its availability.

MUNICIPAL ALLOCATIONS FOR THE MONTH OF NOVEMBER 2018

Source: Joint Water Commission

DAY	TOTAL MUNICIPAL USE	MUNICIPAL USE BY RESERVOIR		BREAKDOWN OF MUNCIPAL USE BY WATER PROVIDER†						
				HILLSBORO		FOREST GROVE		BEAVERTON		TVWD
		Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney	Hagg Lake	Barney
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	10	10	0	6.6	0.0	0.6	0.0	1.8	0.0	1.0
2	22	10	12	6.7	3.6	0.0	1.8	0.0	6.7	3.3
3	32	20	12	11.7	2.2	0.0	2.3	2.9	7.4	5.4
4	32	20	12	11.3	1.5	0.0	2.4	2.8	8.1	5.8
5	32	20	12	11.3	1.3	0.0	2.5	2.8	8.2	5.9
6	27	20	7	8.4	2.9	0.0	1.8	6.6	2.3	5.0
7	17	15	2	4.4	0.1	0.0	1.6	6.9	0.2	3.7
8	25	15	10	8.3	1.9	0.0	2.1	2.1	5.9	4.6
9	25	15	10	10.3	0.4	0.0	1.7	0.0	7.8	4.7
10	25	15	10	8.5	2.0	0.0	1.8	2.1	6.2	4.3
11	25	15	10	8.3	2.0	0.0	1.8	2.1	6.2	4.6
12	25	15	10	7.7	1.0	0.0	2.0	1.9	7.0	5.4
13	25	15	10	8.1	1.8	0.0	2.1	2.0	6.1	4.9
14	32	15	17	8.2	7.7	0.0	2.1	2.0	7.2	4.8
15	37	15	22	11.7	10.4	0.0	2.1	0.0	9.5	3.3
16	37	15	22	11.4	9.5	0.0	2.6	0.0	10.0	3.6
17	37	15	22	11.5	10.5	0.0	2.1	0.0	9.4	3.5
18	37	15	22	11.6	8.3	0.0	3.2	0.0	10.5	3.4
19	37	15	22	11.4	10.7	0.0	1.7	0.0	9.5	3.6
20	37	15	22	9.7	10.9	0.0	1.8	0.0	9.3	5.3
21	31	15	16	11.7	4.7	0.0	2.2	0.0	9.2	3.3
22	33	15	18	11.9	5.2	0.0	2.3	0.0	10.5	3.1
23	33	15	18	12.0	6.9	0.0	1.4	0.0	9.7	3.0
24	33	15	18	11.7	7.5	0.0	1.4	0.0	9.1	3.3
25	33	15	18	11.6	6.6	0.0	1.5	0.0	9.9	3.4
26	33	15	18	18.6	4.8	0.0	2.5	0.0	10.7	-3.6
27	7	7	0	4.2	0.0	0.5	0.0	1.9	0.0	0.5
28	7	7	0	4.8	0.0	0.0	0.0	1.5	0.0	0.7
29	LAST DAY OF STORED WATER RELEASE FOR MUNICIPAL USE									
30	Barney Reservoir: November 27				Hagg Lake: November 26					
Monthly Summary (November)										
Mean daily cfs	28.1	14.8	14.9	9.8	5.0	0.0	2.0	1.4	7.9	3.6
Total ac-ft	1559	821	738	543	247	2.1	101	78	390	198
Stored Water Use Summary to Date (May 26–November 28)										
Mean daily cfs	58.4	32.8	26.5	13.4	13.3	0.0	2.9	3.9	10.3	15.4
Total ac-ft	21,672	12,159	9,513	4,965	4,789	12.3	1,037	1,462	3,688	5,720

†In this table (Municipal Use), the amount of water allocated to each provider is recorded on the day that it was available. In the Barney Reservoir Operations table (Appendix D), the amount of water released is recorded on the day it was released from the reservoir, which is one day earlier than its availability.

APPENDIX F
STREAM TEMPERATURE

SCOPE

This appendix shows data for stream temperature at selected sites in the Tualatin River and its tributaries. Most of the data were obtained by continuous monitoring at a resolution of 15 minutes to 1 hour. Resolution may have changed over time for an individual site. The data have been subject to quality assurance tests by the collecting entity.

The following data and analyses are included for each site. A more detailed explanation of the analyses and graphics begins on page F-4:

- Table of 2018 data with summary statistics by month.
- Graph of 2018 data superimposed on percentile statistics for the period of record for the site.
- Color-coded chart of the distribution of stream temperature by month for the period of record.
- Table of monthly median stream temperatures by year for the period of record.
- Graphs showing trends in stream temperature for selected summer months over the period of record.
- Graphs showing the number of days that the State of Oregon rearing and migration temperature standard was exceeded over the period of record and the period when that exceedance occurred. The spawning standard may apply at some sites, but data were not evaluated relative to that standard in this report.
- A brief discussion of the graphs and tables.

2018 HIGHLIGHTS

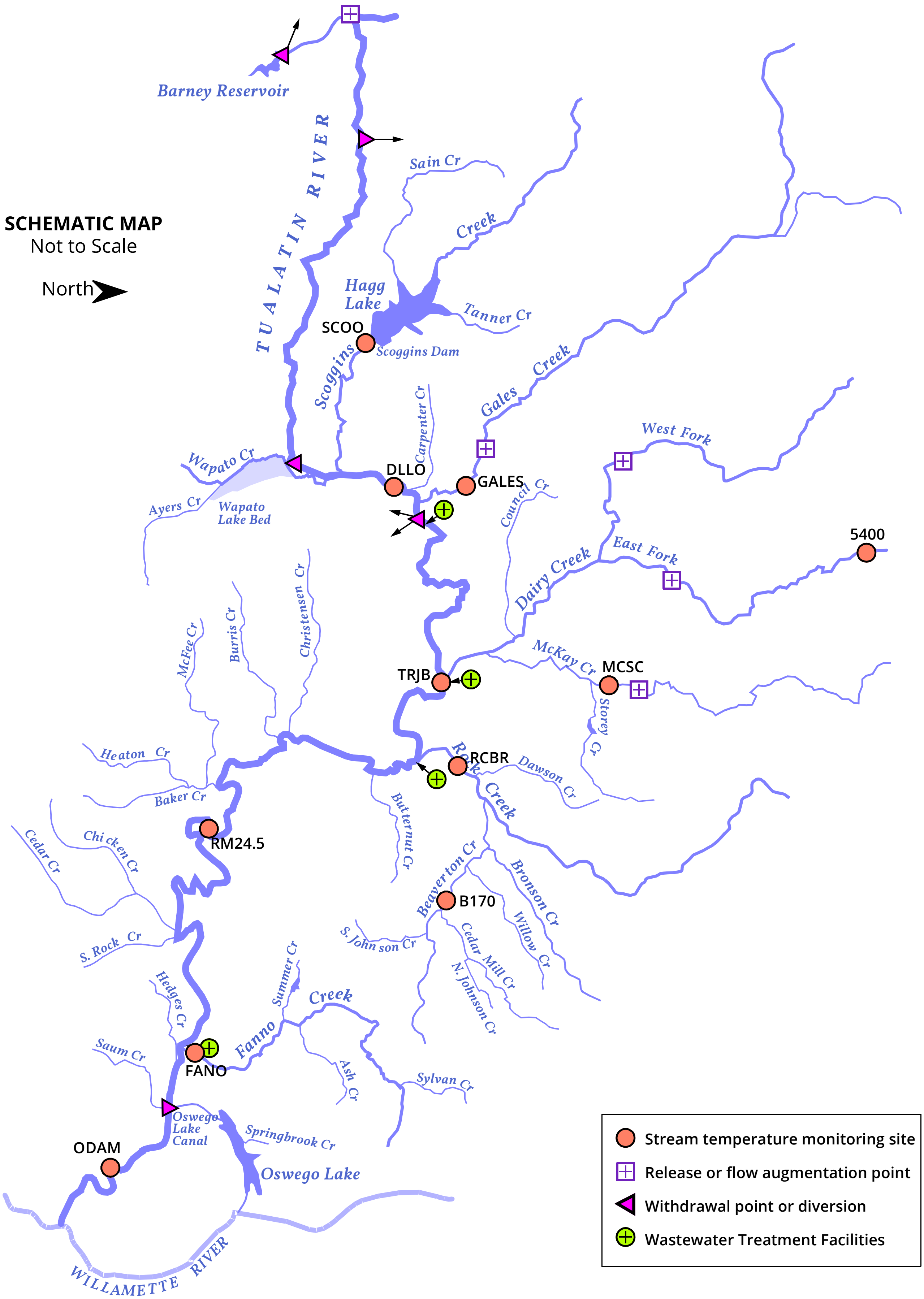
- Temperatures in 2018 were well above average at most sites in mid-January through early February, during most of May and from late October through early November. In many cases record highs were set for daily mean temperature during these time periods.
- Temperatures in the summer were intermittently high and new record highs for the daily mean were set at most sites in June, July and August. Temperatures in McKay Creek were near long-term averages from July onward, which was notably different than other sites.

EXCEEDANCES OF OREGON REARING AND MIGRATION TEMPERATURE STANDARD

Site	Number of Days		Date range of Exceedances*		Percent of Years with Exceedances
	2018	Median	2018	Average (mean)	
Mainstem Tualatin River and Scoggins Creek sites					
Scoggins Creek below Hagg Lake	6	9	Oct-2–Oct-7	Sep-22 – Oct-6	47%
Tualatin River at Hwy 219 Bridge	0	14	did not occur	Jun-25 – Aug-2	71%
Tualatin River at RM 24.5	105	93	May-25 – Sep-16	Jun-8 – Sep-18	100%
Tualatin River at Oswego Dam	126	109	May-19 – Sep-21	Jun-4 – Sep-24	100%
Tributary sites					
Gales Creek at Old Hwy 47	87	87	Jun-19 – Sep-13	Jun-17– Sep-17	100%
East Fork Dairy Creek near Meacham Corner	42	34	Jul-14– Aug-24	Jul-15– Aug-31	100%
McKay Creek at Scotch Church Rd above Waible Ck	20	34	Jul-16– Aug-4	Jul-3– Aug-26	100%
Beaverton Creek at 170th	133	116	Apr-27– Sep-13	May-16– Sep-19	100%
Rock Creek at Brookwood Ave	110	94	May-9 – Sep-12	May-30– Sep-13	100%
Fanno Creek at Durham Road	116	103	May-9 – Sep-14	May-27– Sep-14	100%

*Date range may include days when the standard was not exceeded (7-day average daily maximum ≤ 18 ºC).

Stream temperature monitoring sites



STREAM TEMPERATURE MONITORING SITES — ALPHABETICAL LISTING BY SITE CODE

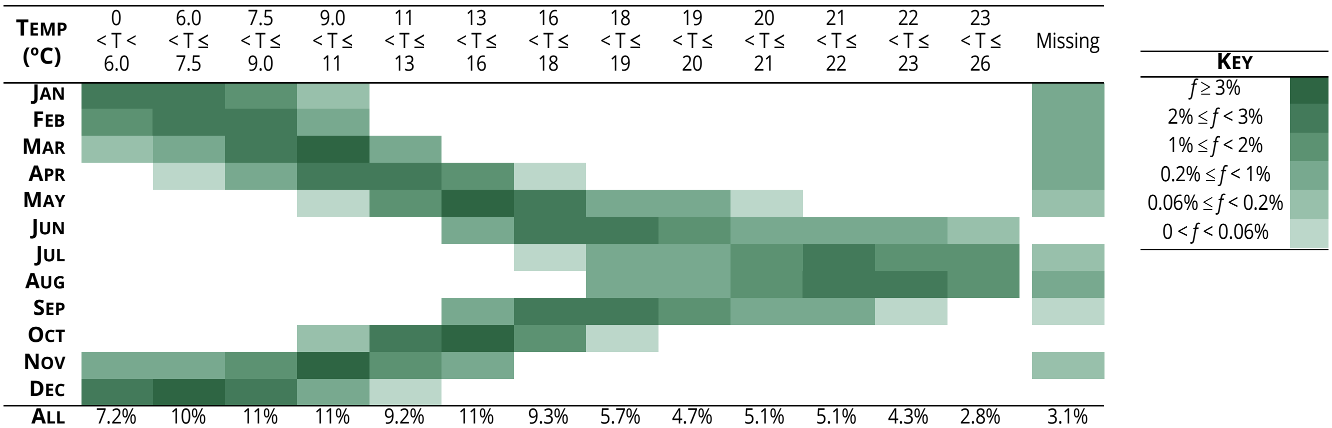
SITE CODE	SITE NAME	RIVER MILE	STATION ID	PAGE
5400	East Fork Dairy Creek near Meacham Corner, OR	12.4	14205400	F-24
B170	Beaverton Creek at 170th	4.9	453004122510301	F-30
DLLO	Tualatin River near Dilley, Oregon	58.8	14203500	F-10
FANO	Fanno Creek at Durham Road near Tigard, Oregon	1.2	14206950	F-36
GALES	Gales Creek at Old Hwy 47 near Forest Grove, Oregon	2.36	453040123065201 OWRD#: 14204530	F-21
MCSC	McKay Creek at Scotch Church Rd above Waible Ck near North Plains, Oregon	6.3	14206070	F-27
ODAM	Tualatin River at Oswego Dam near West Linn, Oregon	3.4	14207200	F-18
RCBR	Rock Creek at Brookwood Avenue, Hillsboro, Oregon	2.4	453030122560101	F-33
RM24.5	Tualatin River at RM 24.5 near Scholls, Oregon	24.5	14206694	F-15
SCOO	Scoggins Creek below Henry Hagg Lake near Gaston, Oregon	4.80	14202980	F-6
TRJB	Tualatin River at Hwy 219 Bridge	44.4	14206241	F-12

Explanation of Figures and Tables in this Appendix — pages 1-2

Page 1–current year data and graph: A table of mean daily stream temperature for the current year is at the top of page 1. A graph at the bottom of the page shows the current year's data superimposed on shaded percentile ranges for the period of record, providing historical context. A legend, located to the right of the graph, includes the period of record for the site and definitions of lines and shading. If the period of record is too short to accurately calculate some percentiles, the appropriate shaded areas are omitted.

Page 2–Frequency chart: A Frequency Chart for the site is at the top of page 2. This graphic can be used to determine the temperature ranges for each month, the percent of the time stream temperature is within a particular range, and the importance of missing values. An example is shown below.

FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — ODAM



- *The top row* shows the ranges of stream temperatures (bins) corresponding to each column. The temperature ranges do not change from year-to-year in the Flow Report. They were determined as follows
  - —round numbers were used for simplicity,
  - —the last bin captures the extreme high temperatures,
  - —the first half of the bins capture the low temperatures, about 5-10% of the distribution per bin,
  - —the other bins capture the higher temperatures, approximately 5% of the distribution per bin,
  - —a column for missing data is included if needed.
- *The first column* shows the months corresponding to each row.
- *The bottom row* shows the actual fraction of the distribution in the bin. Because the bins use round numbers and do not from vary year-to-year, the distribution totals will only approximate 5% and 10% as designed. The total distribution may not add to 100% due to round-off error.
- *Each cell is color coded* based on the fraction of the overall distribution of temperature in the corresponding bin and month. A Key to the color code is at the right of the chart. All sites use the same color code.
- *Information that can be obtained* from the example chart above includes:
  - —The all-time highest temperatures at this site are 23-26°C, and occurred in June, July and August.
  - —Temperature was above 18°C about 27.7% of the time.
  - —Mean daily temperature in August at this site has exceeded 18°C every day for the period of record.
  - —About 3% of the data were missing, most of which occurred in January–April, a time when temperatures would be low. Consequently, the percentages for the low temperature bins are likely too small.

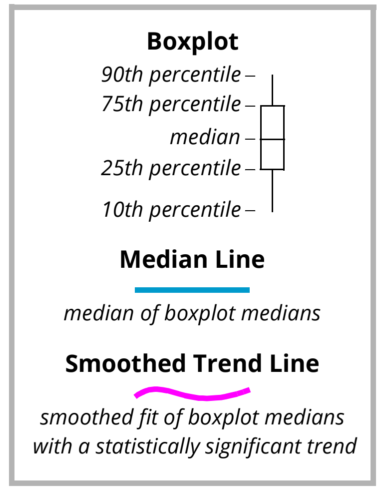
Page 2–color-coded table of monthly medians: —A table of monthly medians of daily mean stream temperature by year follows the Frequency Chart on page 2. Entries in this table are color-coded by percentiles calculated from the daily mean temperature for the period of record. Two Keys are provided to the right of the table. The upper Key contains the values corresponding to the percentiles shown in the lower Key. Medians are not shown if more than 20% of the data are missing.

Explanation of Figures and Tables in this Appendix — page 3

Page 3–discussion of graphs: The left side of the page contains a discussion of findings based on the graphs for each site. The narrative is divided into three or four sections:

- *Distribution and Current year* describes stream temperatures for the current year in the context of the historical record, when the highest and lowest temperatures occur, and data shortcomings.
- *Reservoir effects* is included if stream temperature is influenced by an upstream reservoir.
- *Trends* describes any trends in stream temperature over time.
- *Oregon water temperature standard* describes the frequency and timing of exceedances of the standard.

Page 3–temperature trends: The top three graphs on the right side show changes in stream temperature over time for the warmest times of the year. Boxplots of daily mean temperature are plotted versus year for June, July/August and September. A boxplot is a graphical representation of the data distribution and is illustrated at the right.



These graphs include one or more lines that indicate trends and central tendencies of the data over time. The types of line used vary with the graph and are shown at the right,

Smoothed lines were calculated using the LOWESS method (LOcally WEighted Scatterplot Smoothing). LOWESS is a non-parametric method that fits a curve to data giving more weight to points closer to the point being fitted. LOWESS can be used to help visualize trends in data.

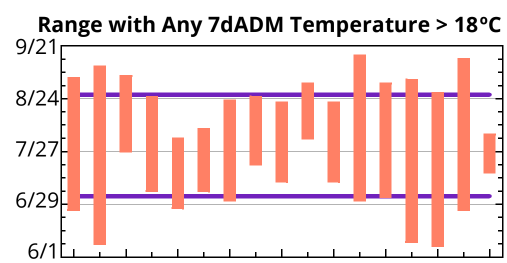
Statistically significant differences were tested using non-parametric methods (Kendall's tau). Magenta lines are used to show trends that are statistically significant. Note that a statistically significant trend may or may not indicate a meaningful environmental trend. Temperature is influenced by long-term weather patterns, such as the El Niño Southern Oscillation and the Pacific Decadal Oscillation. Especially for sites with short periods of record, an apparent trend may be statistically significant, but disappear over a longer period of record.

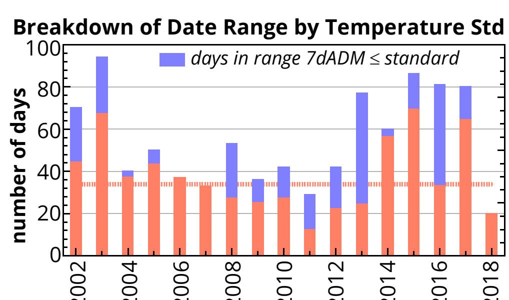
Page 3–Oregon temperature standard: The two lower graphs on page 3 assess each site with regard to the State of Oregon water-quality standard for temperature. The Oregon standard for salmonid rearing and migration applies in the Tualatin Basin. The standard is:

The seven day average of the daily maximum temperature (7dADM) is not to exceed 18 °C.

Daily maximum temperature and the 7dADM were computed for sites with data of at least hourly frequency.

Example graphs pertaining to the temperature standard are shown at the right.





The upper graph shows a bar for each year that begins on the first day of the year when the 7dADM exceeded 18ºC and ends on the last day that the 7dADM exceeded 18ºC. Some of the 7dADM within this date range may be less than 18ºC. Purple lines, if present, show the mean date range for exceedance of the temperature standard for the period of record.

The bottom graph shows the number of days in the date range from the upper graph when the standard was exceeded (orange), and the number of days it was not (blue). Missing values, if they occurred within the date range, are shown in grey. A dotted orange line, if present, shows the median number of days that the standard is exceeded in a year.

A trend is shown in magenta as a smoothed trend line (LOWESS) if it is statistically significant.

SCOO – Scoggins Creek below Henry Hagg Lake near Gaston, Oregon – 14202980

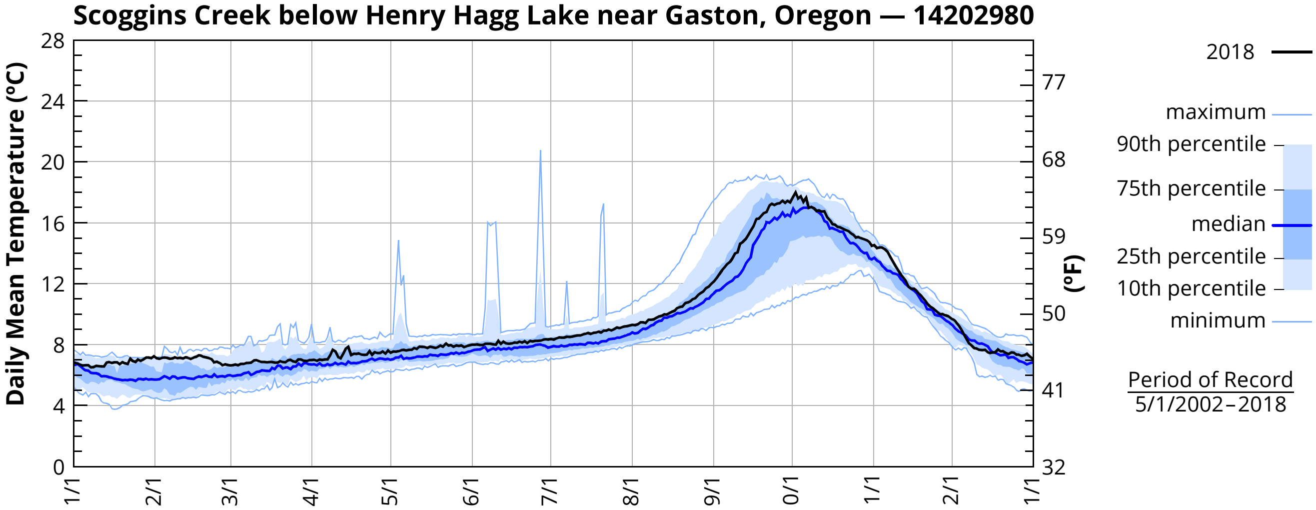
Data source: U.S. Geological Survey, Oregon Water Science Center

River mile: 4.80 *Latitude:* 45 28 10 *Longitude:* 123 15 61

2018 — DAILY MEAN WATER TEMPERATURE (°C) — SCOO

DAY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	6.82	7.11	6.64	6.98	7.48	8.00	8.37	9.29	12.15	17.69	14.52	9.65
2	6.76	7.07	6.66	7.00	7.55	7.99	8.34	9.28	12.36	18.00	14.34	9.50
3	6.70	7.14	6.70	6.95	7.53	8.02	8.42	9.33	12.62	17.59	14.39	9.29
4	6.64	7.15	6.66	7.04	7.58	7.97	8.48	9.46	12.88	17.75	14.39	8.98
5	6.65	7.14	6.73	6.98	7.63	7.97	8.46	9.46	13.07	17.39	14.28	8.66
6	6.66	7.08	6.73	7.03	7.66	8.06	8.45	9.43	13.29	17.66	14.11	8.37
7	6.50	7.09	6.79	7.04	7.62	8.05	8.53	9.63	13.42	16.98	13.76	8.07
8	6.53	7.17	6.79	7.30	7.67	8.05	8.51	9.63	13.69	17.04	13.46	7.94
9	6.60	7.12	6.81	7.68	7.65	8.02	8.53	9.66	14.01	16.96	13.16	7.77
10	6.58	7.13	6.97	7.58	7.78	8.00	8.57	9.77	14.07	16.78	12.90	7.74
11	6.57	7.10	6.99	7.20	7.72	8.26	8.61	9.85	14.63	16.81	12.61	7.65
12	6.56	7.17	6.93	7.12	7.86	8.05	8.60	9.89	14.73	16.74	12.41	7.63
13	6.81	7.13	6.87	7.41	7.84	8.21	8.67	10.00	14.93	16.76	12.15	7.65
14	6.87	7.08	6.87	7.75	7.85	8.08	8.70	9.97	15.19	16.40	11.79	7.51
15	6.79	7.16	6.84	7.87	7.78	8.05	8.77	10.08	15.50	16.18	11.67	7.44
16	6.84	7.19	6.86	7.32	7.88	8.07	8.70	10.17	15.76	15.92	11.68	7.49
17	6.85	7.31	6.87	7.41	7.83	8.14	8.78	10.23	16.25	15.87	11.55	7.50
18	6.72	7.29	6.82	7.38	7.78	8.12	8.79	10.42	16.28	15.73	11.34	7.69
19	6.86	7.20	6.83	7.43	7.84	8.20	8.85	10.47	16.46	15.71	11.19	7.55
20	6.78	7.15	6.93	7.35	7.95	8.14	8.79	10.50	16.64	15.63	10.95	7.58
21	6.74	7.11	6.87	7.32	7.88	8.23	8.93	10.72	16.71	15.54	10.71	7.48
22	7.10	7.05	6.84	7.35	8.09	8.11	8.93	10.76	17.13	15.48	10.53	7.39
23	6.93	6.85	6.96	7.57	7.93	8.24	9.00	10.85	17.25	15.32	10.44	7.49
24	6.86	6.88	7.01	7.32	7.98	8.20	8.94	10.99	17.17	15.23	10.28	7.47
25	7.04	6.80	6.91	7.51	7.87	8.25	9.03	11.07	17.26	15.04	10.12	7.34
26	6.94	6.65	6.86	7.44	7.95	8.24	9.12	11.28	17.27	15.07	10.00	7.34
27	7.02	6.72	7.02	7.45	7.91	8.27	9.08	11.39	17.44	15.00	10.02	7.27
28	7.15	6.67	7.03	7.55	7.96	8.33	9.16	11.50	17.31	14.93	9.92	7.31
29	7.15	—	6.95	7.41	7.85	8.36	9.20	11.72	17.45	14.87	9.87	7.40
30	7.12	—	6.93	7.61	7.92	8.34	9.21	11.81	17.34	14.73	9.75	7.25
31	7.24	—	6.98	—	7.95	—	9.26	12.00	—	14.49	—	7.10
Mean	6.82	7.06	6.86	7.35	7.80	8.13	8.77	10.34	15.34	16.17	11.94	7.82
Max	7.24	7.31	7.03	7.87	8.09	8.36	9.26	12.00	17.45	18.00	14.52	9.65
Min	6.50	6.65	6.64	6.95	7.48	7.97	8.34	9.28	12.15	14.49	9.75	7.10

Scoggins Creek below Henry Hagg Lake near Gaston, Oregon — 14202980



FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — SCOO

Temp (°C)	3.0 < T < 5.5	5.5 < T ≤ 6.5	6.5 < T ≤ 7.0	7.0 < T ≤ 7.5	7.5 < T ≤ 8.0	8.0 < T ≤ 8.5	8.5 < T ≤ 9.0	9.0 < T ≤ 10	10 < T ≤ 12	12 < T ≤ 14	14 < T ≤ 16	16 < T ≤ 18	18 < T ≤ 21	Missing
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
All	5.5%	13%	9.3%	11%	9.6%	8.4%	5.8%	7.2%	9.0%	6.4%	5.2%	4.4%	1.2%	3.4%

Key

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
2002–2018

MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — SCOO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002					7.1	7.4	8.0	9.5	14.6	16.2	10.6	8.0
2003	6.9	7.1	7.4	7.9	8.2	8.5	9.1	11.0	18.2	18.5	10.3	7.5
2004	4.9	5.6	6.3	6.7	7.1		7.8	10.2	14.9	16.9	11.7	8.4
2005	5.8	5.9	6.4	7.1	7.5	7.9	8.2	9.3	11.8	15.5	10.7	6.3
2006	7.1	6.8	6.3	6.7	7.2	7.5	8.0	10.2	17.0	16.3	10.9	7.5
2007	5.6	5.2	5.9	6.3	6.8	7.1	8.0	10.1	17.0	15.0	10.9	7.0
2008	5.6	4.6	5.2	5.8	6.6	6.9	7.5	9.2	14.3	15.6	11.9	7.0
2009	5.1	4.6	5.4	6.4	6.8	7.1	7.5	9.1	12.4	15.0	10.7	6.1
2010	5.7	6.3	7.0	7.8	8.2	9.0	9.1	9.9	11.4	13.1	12.0	8.2
2011	6.2	6.1	6.7	6.7	7.3	7.8	8.1	8.6	10.0	11.8	11.7	7.3
2012	6.0	5.9	6.5	7.0	7.2	7.5	7.8	8.6	10.5	14.5	11.7	8.7
2013	5.7	5.5	6.2	6.8	6.8	7.2	7.6	9.1	12.4	14.2	12.1	6.5
2014	5.6	5.0	5.9	6.7	7.2	7.8	8.5	9.8	13.3	17.2	11.1	8.6
2015	7.2	7.6	8.0	8.4	8.6	8.9	9.6	12.8	18.8	17.3	11.9	8.0
2016	6.0	6.3	7.5	7.8	8.2	8.3	8.9	11.0	18.0	14.8	12.5	7.7
2017	4.5	5.2	6.1	6.8	7.7	8.3	8.7	10.0	13.6	15.8	11.3	7.7
2018	6.8	7.1	6.9	7.4	7.8	8.1	8.8	10.2	15.6	15.9	11.7	7.6
median	5.9	5.9	6.4	6.9	7.3	7.8	8.2	9.8	13.7	15.4	11.3	7.8

Key

T in °C

- T ≤ 5.4
- 5.4 < T ≤ 5.9
- 5.9 < T ≤ 6.2
- 6.2 < T ≤ 6.5
- 6.5< T ≤ 7.1
- 7.1< T ≤ 7.5
- 7.5 < T ≤ 8.0
- 8.0< T ≤ 10.4
- 10.4 < T ≤ 14.4
- 14.4 < T ≤ 16.4
- T > 16.4

T as percentile

- T ≤ 5th
- 5th < T ≤ 10th
- 10th < T ≤ 15th
- 15th < T ≤ 20th
- 20th < T ≤ 30th
- 30th < T ≤ 40th
- 40th < T ≤ 50th
- 50th < T ≤ 75th
- 75th < T ≤ 90th
- 90th < T ≤ 95th
- T > 95th

Distribution and 2018

- Temperatures in 2018 were higher than the long term median during most of the year, but not record-setting.
- The highest temperatures occur in September and October which is unusual because that is after the warmest period of the summer.
- The lowest temperatures occur in January and February.

Reservoir effects

- Hagg Lake is thermally stratified in the summer. During most of the summer, water is released from the lower, cooler, level of the reservoir. As the reservoir is drawn down, eventually the water from the upper, warmer level reaches the outlet and is released. The overall effect is to trap heat during the summer and release it at the end of summer through fall.
- Exactly when warm water reaches the outlet depends on the depth of the warm water layer and how much water has been released during the season. In a cool summer (such as 2011), the upper layer is thinner, less water is released for irrigation and municipal use, and water from the upper warm layer may not be released at all. The opposite occurs for a hot summer such as 2015. This process accounts for the wide variability in the September temperatures.
- Temperatures at this site sometimes spike for a day or so in the spring and early summer. These spikes mark the occasional times when water is released over the spillway.

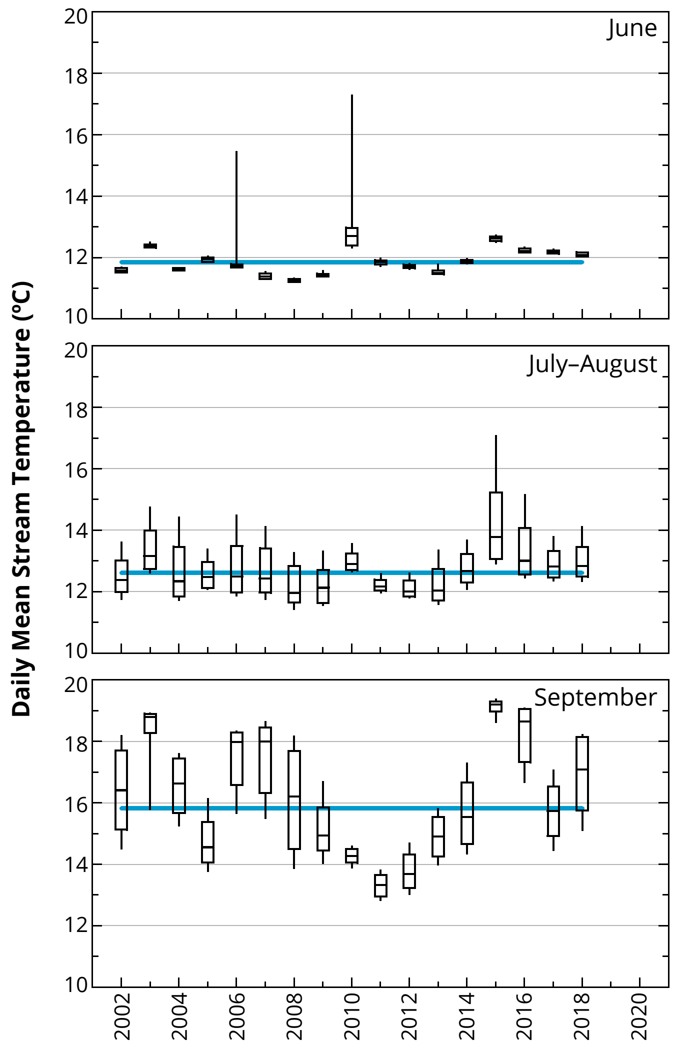
Trends

- Water temperatures in July through September do not show any trend.
- No trend was evident in the timing of or number of days with temperature standard exceedances.

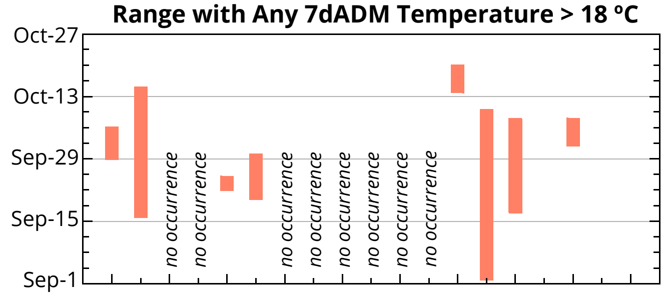
Oregon water temperature standard

- Exceedances of the water temperature standard occurred in about half of the years. They have never occurred before September.

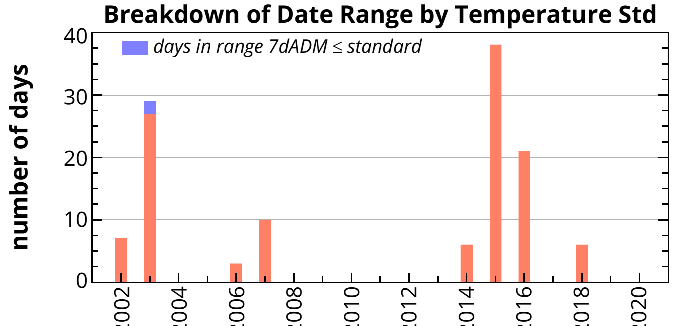
fraction of years with any exceedance	47%
median days/year exceeding standard	9
average first day of exceedance (if it occurred)	Sep-22
average last day of exceedance (if it occurred)	Oct-6



Range with Any 7dADM Temperature > 18 °C



Breakdown of Date Range by Temperature Std



DLLO – Tualatin River near Dilley, Oregon – 14203500

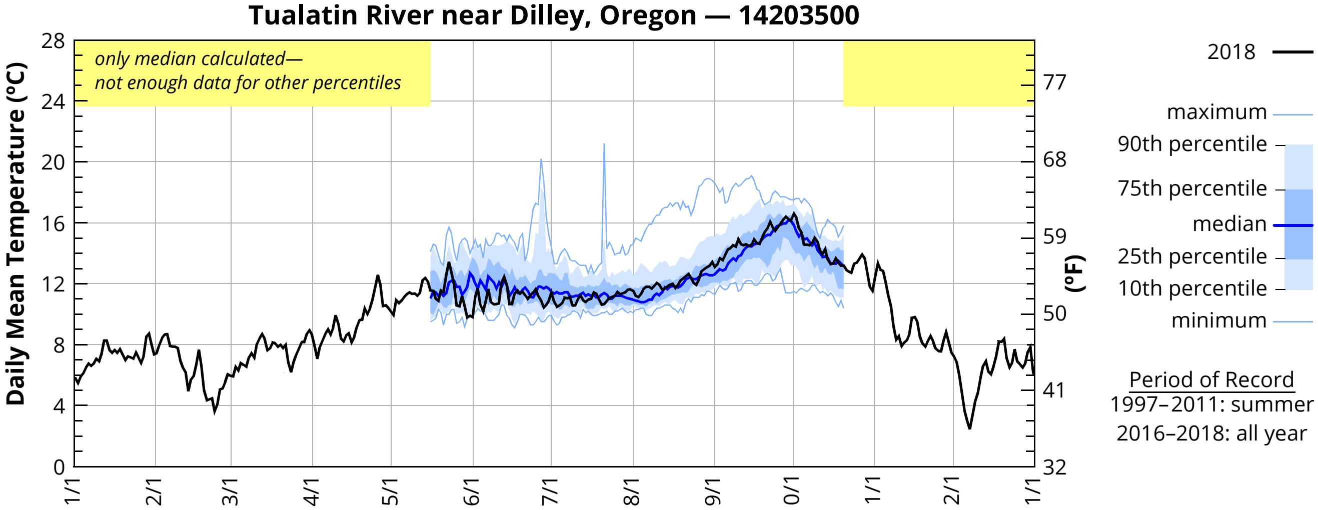
Data source: U.S. Geological Survey, Oregon Water Science Center

River mile: 58.8   *Latitude:* 45 28 30   *Longitude:* 123 07 23

2018 — DAILY MEAN WATER TEMPERATURE (°C) — DLLO

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	5.80	7.46	5.95	8.64	10.19	9.82	11.43	11.54	13.10	16.60	12.43	7.20
2	5.47	8.03	5.91	7.84	9.94	11.13	10.79	11.21	13.26	16.34	13.33	6.84
3	5.90	8.45	6.55	7.07	10.91	11.69	10.49	11.13	13.69	15.64	12.92	6.00
4	6.10	8.66	6.31	7.90	10.73	10.63	10.57	11.33	13.57	15.35	12.85	4.75
5	6.51	8.68	6.80	8.30	10.89	10.18	10.72	11.68	13.92	14.54	12.12	3.63
6	6.76	7.91	6.67	8.74	11.12	10.85	11.08	11.80	14.26	14.57	11.25	2.98
7	6.60	7.86	6.54	9.00	11.32	11.66	11.05	11.80	14.34	14.52	10.50	2.45
8	6.75	7.86	7.15	8.67	11.44	10.78	11.12	11.68	14.52	14.68	9.18	3.45
9	7.08	7.78	7.42	9.10	11.34	10.65	10.56	11.86	14.45	15.03	8.34	4.31
10	6.91	6.97	7.14	9.93	11.35	10.66	10.58	12.04	14.91	14.77	8.56	4.82
11	7.41	6.44	8.06	9.34	11.20	10.71	11.02	11.92	14.60	14.17	7.92	5.77
12	8.27	6.15	8.41	8.40	11.39	12.11	11.22	11.60	14.52	13.97	8.15	6.58
13	8.26	4.95	8.69	8.22	12.24	12.48	10.91	11.70	14.60	14.27	8.30	6.93
14	7.64	5.70	8.39	8.62	12.38	11.91	10.82	11.82	14.48	13.59	8.71	6.24
15	7.47	5.96	7.63	8.75	12.15	10.67	10.95	11.94	14.58	13.28	9.77	6.06
16	7.66	6.71	7.76	8.17	11.56	10.66	11.03	12.00	14.92	13.34	9.80	6.56
17	7.47	7.69	8.14	8.50	11.53	11.36	11.45	11.71	14.68	13.66	9.48	7.22
18	7.70	6.58	8.11	9.17	11.00	11.57	11.36	11.93	14.62	13.40	8.55	8.20
19	7.33	5.01	7.88	9.61	10.87	11.35	10.98	12.21	15.05	13.18	8.07	8.19
20	6.99	4.37	7.99	9.63	11.57	11.49	10.63	12.35	15.39	13.19	7.89	8.40
21	7.23	4.42	7.78	10.37	11.47	11.26	10.67	12.50	15.61	12.91	8.26	7.11
22	7.17	4.48	7.99	10.02	12.61	11.01	10.88	12.64	16.09	12.80	8.56	6.53
23	7.09	3.64	6.86	10.36	13.43	11.25	11.09	12.37	15.71	12.73	8.22	6.83
24	7.49	4.14	6.19	10.93	12.72	11.41	11.15	12.05	15.47	13.33	7.75	7.70
25	7.16	5.07	6.88	11.81	11.95	11.65	11.21	11.92	15.70	13.39	7.57	6.91
26	6.79	5.15	7.37	12.58	10.59	11.18	11.46	12.30	15.94	13.64	7.55	6.73
27	7.23	5.55	7.74	11.93	10.51	10.88	11.31	12.82	16.20	13.92	8.26	6.51
28	8.55	6.07	8.18	10.54	11.18	10.44	11.37	12.96	16.39	13.65	8.82	6.78
29	8.73	—	8.17	10.57	10.54	10.62	11.44	13.07	16.24	12.73	8.07	7.54
30	8.02	—	8.71	10.42	9.80	10.89	11.61	13.18	16.16	11.77	7.44	7.84
31	7.36	—	8.95	—	9.90	—	11.62	13.42	—	11.52	—	6.14
Mean	7.19	6.35	7.49	9.44	11.28	11.10	11.05	12.08	14.90	13.89	9.29	6.23
Max	8.73	8.68	8.95	12.58	13.43	12.48	11.62	13.42	16.39	16.60	13.33	8.40
Min	5.47	3.64	5.91	7.07	9.80	9.82	10.49	11.13	13.10	11.52	7.44	2.45

Tualatin River near Dilley, Oregon — 14203500



DLLO – Tualatin River near Dilley, Oregon – 14203500

Data source: U.S. Geological Survey, Oregon Water Science Center

FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — DLLO

Temp (°C)	5 < T < 10	10 < T ≤ 10.5	10.5 < T ≤ 11.0	11.0 < T ≤ 11.5	11.5 < T ≤ 12.0	12.0 < T ≤ 12.5	12.5 < T ≤ 13.0	13.0 < T ≤ 13.5	13.5 < T ≤ 14.0	14 < T ≤ 15	15 < T ≤ 16	16 < T ≤ 18	18 < T ≤ 22	Missing
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
All	4.1%	6.3%	11%	11%	11%	11%	7.8%	6.3%	4.7%	9.1%	4.9%	5.1%	0.8%	7.3%

Key

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
1997–2011
2016–2018

MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — DLLO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997					12.9	13.2	10.6	10.8	14.1			
1998					10.4	13.8	12.0	12.5	13.7	15.3		
1999					12.0	10.8	10.5	11.5	15.9	15.0		
2000					12.2	11.5	10.7	10.8	14.8	14.5		
2001				9.2	12.0	11.6	13.2	17.0	18.1	12.9		
2002	6.3	6.0	6.8	8.8	10.6	10.8	10.9	11.3	14.6	14.3	9.1	
2003	7.4	7.1	8.6	9.5	11.1	11.6	11.5	12.3	15.6	15.1	10.1	
2004								12.0	14.4	15.1		
2005						12.4	11.1	11.3	12.2	14.0		
2006					11.0	12.3	10.3	11.3	14.7	13.6		
2007					10.9	9.8	10.4	11.6	15.7	12.1		
2008					11.2	11.3	11.3	11.3	14.4	12.9		
2009					10.8	14.0	10.4	11.1	13.4	13.3		
2010					11.2	12.3	12.6	12.1	12.7	11.5		
2011					10.0	12.2	12.4	12.4	12.3	11.6		
2012												
2013												
2014												
2015												
2016			8.8	11.6	12.9	11.5	11.5	12.7	16.4	11.7	10.5	5.9
2017	4.1	6.0	8.3	9.2	12.4	12.2	11.7	12.1	13.9	13.0	8.8	5.8
2018	7.2	6.3	7.7	9.1	11.3	11.1	11.1	11.9	14.7	13.7	8.6	6.6
median	6.5	6.3	7.9	9.4	11.3	11.7	11.2	11.8	14.5	13.5	9.4	6.1

Key

T in °C

- T ≤ 6.3
- 6.3 < T ≤ 7.9
- 7.9 < T ≤ 9.0
- 9 < T ≤ 9.9
- 10 < T ≤ 10.6
- 10.6 < T ≤ 11.1
- 11.1 < T ≤ 11.6
- 11.6 < T ≤ 13.1
- 13.1 < T ≤ 14.9
- 14.9 < T ≤ 16.0
- T > 16.0

T as percentile

- T ≤ 5th
- 5th < T ≤ 10th
- 10th < T ≤ 15th
- 15th < T ≤ 20th
- 20th < T ≤ 30th
- 30th < T ≤ 40th
- 40th < T ≤ 50th
- 50th < T ≤ 75th
- 75th < T ≤ 90th
- 90th < T ≤ 95th
- T > 95th

Distribution and 2018

- Temperatures in 2018 were near the period of record median. No record were set.
- Because of the influence of reservoir releases, the highest average temperatures occur in September and October, after the warmest period of the summer.
- Individual days with high temperatures have occurred in June through October.
- Little data is available outside of the summer season. The lowest temperatures occur in December through February.
- No temperature data were collected in 2012–2015.

Reservoir effects

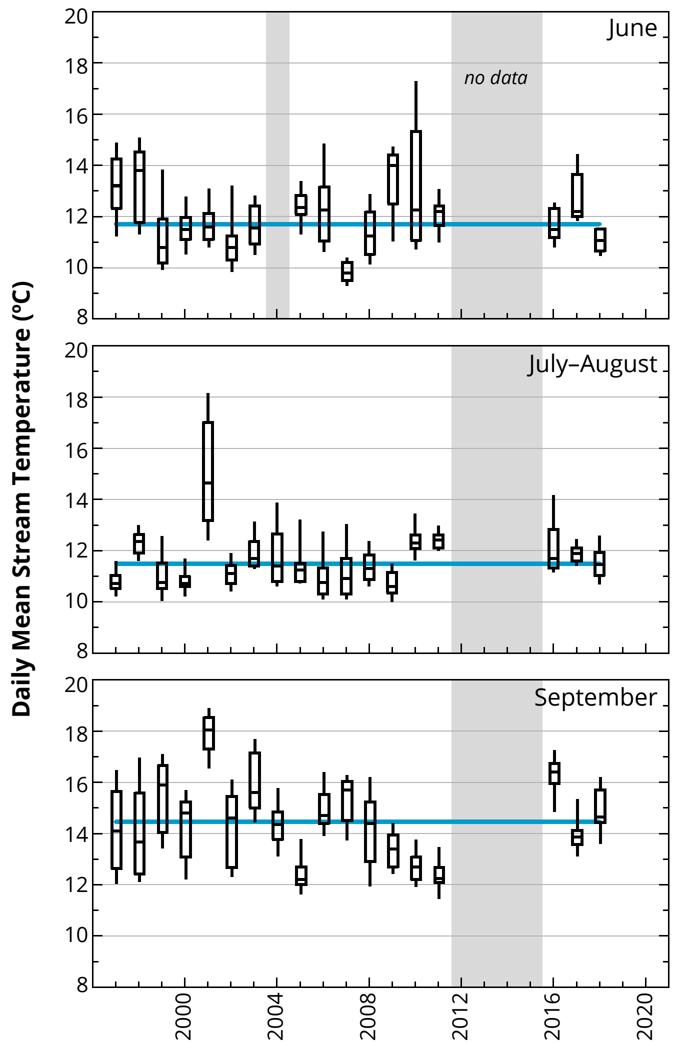
- During the summer season, a substantial fraction of the water at Dilley originates in Hagg Lake. Reservoir releases account for warm temperatures in September and October. The reservoir traps heat in the upper warm layer during the summer and releases it at the end of summer through fall.
- Hagg Lake did not fill in 2001 and less cold water was available in the lower layer of the lake. By July/August, the upper warmer lake water was being released and is responsible for the high water temperatures at Dilley in 2001.
- Reservoir release is also responsible for occasional temperatures spikes at this site. The spikes occur when warm water from the upper layer of the lake is released over the spillway.

Trends

- Water temperatures in June through September do not show any trend.

Oregon water temperature standard

- Exceedance of the water temperature standard can be assessed only for 2016–2018 because those are the only years when daily maximum temperatures were measured.
- The water temperature standard was not exceeded during 2016–2018.



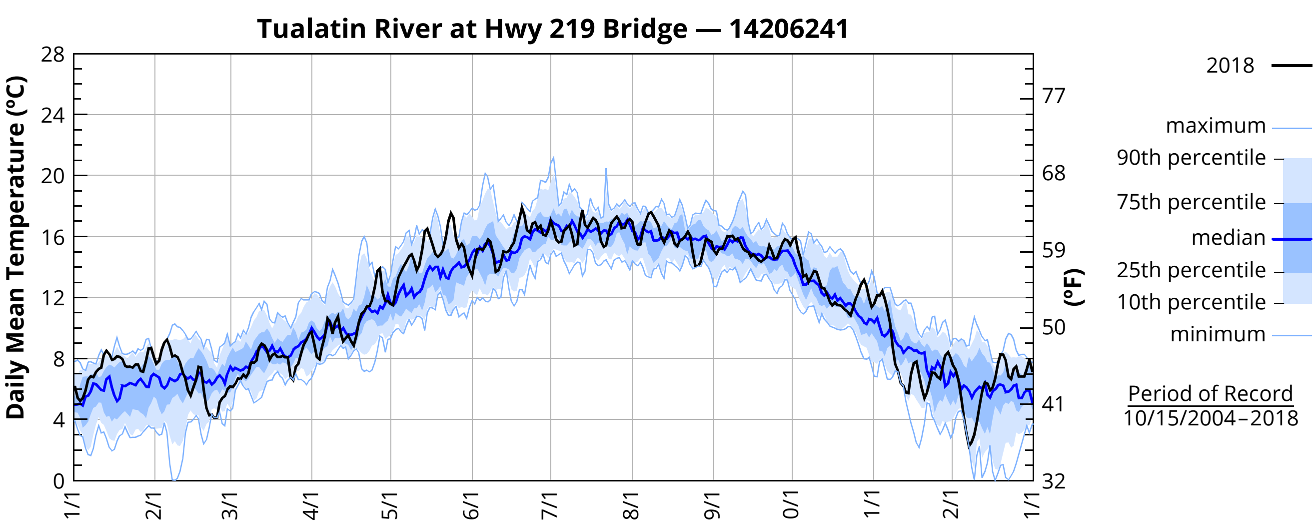
TRJB – Tualatin River at Hwy 219 Bridge – 14206241

Data source: Jackson Bottom Wetlands Education Center

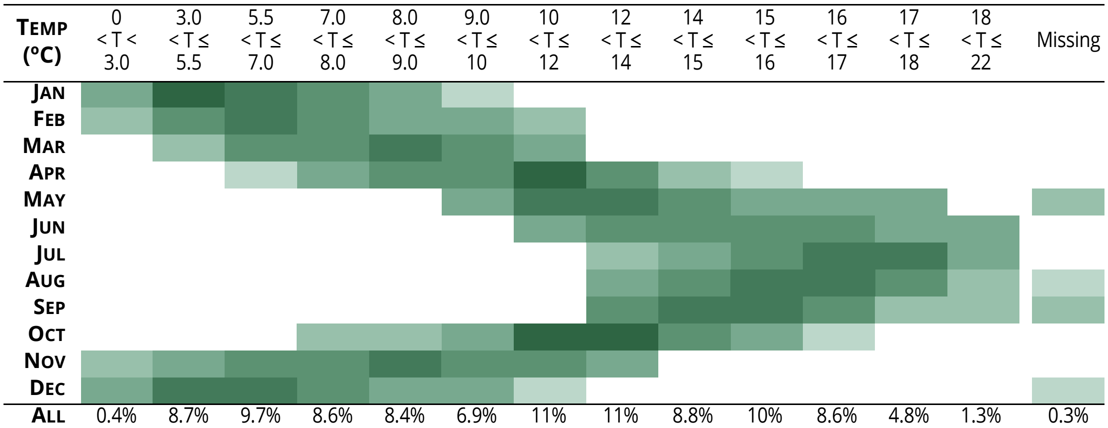
River mile: 44.4 *Latitude:* 45 30 01 *Longitude:* 123 59 24

2018 — DAILY MEAN WATER TEMPERATURE (°C) — TRJB

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	6.13	7.66	6.16	9.74	11.58	13.42	17.03	16.97	15.07	15.80	11.61	7.52
2	5.43	7.84	6.12	8.93	11.51	14.38	16.43	16.03	14.87	15.96	12.14	7.24
3	5.23	8.58	6.36	8.09	12.34	15.17	15.81	15.46	15.19	15.07	12.13	6.61
4	5.40	9.05	6.72	7.94	13.35	15.19	15.62	15.48	15.18	14.57	12.43	5.45
5	5.91	9.23	6.66	8.75	13.70	15.12	15.66	16.36	15.58	13.37	11.93	4.21
6	6.63	8.78	6.95	9.46	14.05	15.37	16.36	16.99	15.99	13.50	11.24	3.13
7	6.85	8.15	6.78	10.63	14.33	15.80	16.55	17.49	15.99	13.04	10.28	2.29
8	6.78	8.20	7.06	10.36	14.69	15.67	16.73	17.59	16.03	13.38	8.74	2.56
9	7.12	8.10	7.74	9.62	14.84	14.91	16.16	17.32	15.79	13.72	7.59	3.01
10	7.33	7.74	7.73	10.40	14.41	13.68	15.41	17.01	15.88	13.67	7.19	3.84
11	7.41	7.05	7.86	10.77	13.79	13.80	15.52	16.70	15.59	13.15	6.41	4.86
12	8.25	6.65	8.73	9.71	14.13	14.23	16.92	15.91	15.25	12.61	6.21	5.79
13	8.52	5.89	8.98	9.14	15.11	15.01	17.74	15.60	15.06	12.59	5.77	6.44
14	8.30	5.56	8.88	9.33	16.33	14.97	16.77	16.01	15.00	12.22	5.72	6.35
15	7.91	6.13	8.55	9.51	16.50	15.06	16.59	16.42	14.66	11.71	6.96	5.91
16	7.97	6.58	7.94	9.11	16.02	15.36	16.90	16.21	14.83	11.48	7.71	6.08
17	8.14	7.44	8.23	8.84	15.43	15.61	17.22	15.53	14.63	11.68	7.81	6.67
18	8.10	7.41	8.34	9.47	14.86	16.42	17.06	15.37	14.45	11.50	6.94	7.68
19	7.96	5.98	8.10	10.38	14.68	17.13	16.74	15.72	14.37	11.48	6.10	8.26
20	7.54	4.72	8.11	10.95	14.83	17.89	15.67	15.80	14.50	11.36	5.42	8.25
21	7.46	4.27	8.18	11.10	15.13	17.37	15.33	16.01	14.66	11.17	5.80	7.88
22	7.48	4.35	8.09	11.41	15.93	16.40	15.43	16.31	15.41	11.05	6.42	6.81
23	7.40	4.12	8.09	11.45	17.01	16.26	16.18	16.01	15.04	10.84	7.07	6.65
24	7.61	4.14	6.77	11.83	17.50	16.86	16.89	14.92	14.56	11.39	7.06	7.31
25	7.60	5.14	6.59	12.67	17.19	16.95	17.11	14.07	14.60	11.98	6.77	7.47
26	7.18	5.41	7.48	13.73	15.82	16.51	17.29	14.06	15.08	12.38	6.66	6.83
27	7.13	5.54	7.67	13.89	15.26	16.72	17.04	14.38	15.58	12.89	7.47	6.81
28	7.86	5.97	8.36	12.37	15.52	16.13	16.54	15.12	15.84	13.16	8.21	6.81
29	8.65	—	8.91	11.75	15.27	16.06	16.59	15.84	15.75	12.72	8.41	7.31
30	8.69	—	9.21	11.78	14.37	16.40	17.02	15.77	15.43	11.97	8.01	7.93
31	8.12	—	9.62	—	13.79	—	17.15	15.67	—	11.38	—	7.18
Mean	7.36	6.63	7.77	10.44	14.82	15.66	16.50	15.94	15.20	12.67	8.07	6.17
Max	8.69	9.23	9.62	13.89	17.50	17.89	17.74	17.59	16.03	15.96	12.43	8.26
Min	5.23	4.12	6.12	7.94	11.51	13.42	15.33	14.06	14.37	10.84	5.42	2.29



FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — TRJB



Key
- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
2005–2018
(Oct-Dec 2004 omitted)

MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — TRJB

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004										11.8	7.7	5.8
2005	5.0	5.4	9.0	10.3	13.1	14.6	17.1	15.5	13.6	13.2	7.3	5.6
2006	7.5	6.6	7.6	10.7	13.2	15.6	16.3	14.9	15.4	12.4	8.7	6.1
2007	4.7	7.2	9.0	10.0	13.5	14.3	15.8	14.9	15.4	11.6	8.3	5.9
2008	4.9	6.1	7.1	8.3	12.7	14.8	15.0	15.1	14.8	11.5	8.9	4.3
2009	4.6	4.7	7.0	10.1	12.0	16.5	16.5	14.8	14.8	12.3	8.2	3.9
2010	7.4	8.1	8.8	10.6	11.8	13.2	17.0	16.3	14.6	11.2	8.6	7.1
2011	6.7	5.6	8.0	9.1	11.2	14.1	16.1	16.3	15.0	12.1	7.8	4.7
2012	6.0	6.7	7.1	10.6	12.3	14.9	16.6	16.0	13.6	11.6	8.8	6.7
2013	4.6	6.6	8.2	11.0	13.2	15.5	16.4	16.2	15.9	10.5	9.0	4.0
2014	4.8	6.3	9.3	10.9	13.7	15.9	17.4	16.6	15.5	14.4	8.8	8.1
2015	7.2	9.1	10.4	10.9	14.2	16.9	17.1	17.3	16.1	14.5	8.9	7.4
2016	7.3	8.4	9.4	12.2	14.6	16.4	16.0	16.4	16.0	12.1	11.1	5.3
2017	3.6	6.5	9.1	10.2	13.5	16.0	17.3	16.7	15.7	11.6	8.8	5.2
2018	7.5	6.6	7.9	10.4	14.8	15.6	16.6	15.9	15.1	12.6	7.3	6.7
median	5.9	6.7	8.3	10.3	13.3	15.3	16.5	16.0	15.1	12.1	8.5	6.0

Key

T in °C
- T ≤ 4.4
- 4.4 < T ≤ 5.4
- 5.4 < T ≤ 6.3
- 6 < T ≤ 7.0
- 7 < T ≤ 8.2
- 8.2 < T ≤ 9.4
- 9.4 < T ≤ 11.2
- 11.2 < T ≤ 15.0
- 15.0 < T ≤ 16.5
- 16.5 < T ≤ 17.2
- T > 17.2

T as percentile
- T ≤ 5th
- 5th < T ≤ 10th
- 10th < T ≤ 15th
- 15th < T ≤ 20th
- 20th < T ≤ 30th
- 30th < T ≤ 40th
- 40th < T ≤ 50th
- 50th < T ≤ 75th
- 75th < T ≤ 90th
- 90th < T ≤ 95th
- T > 95th

TRJB – Tualatin River at Hwy 219 Bridge – 14206241

Data source: Jackson Bottom Wetlands Education Center

Distribution and 2018

- Temperatures in 2018 were well above average in mid-January through early February, late April through most of May and late October through early November. New record high daily mean temperatures were set for multiple days in all three of these time periods.
- The highest average temperatures occur in July and August, but individual days with high temperatures can occur from June through September.
- The lowest average temperatures occur in December and January.

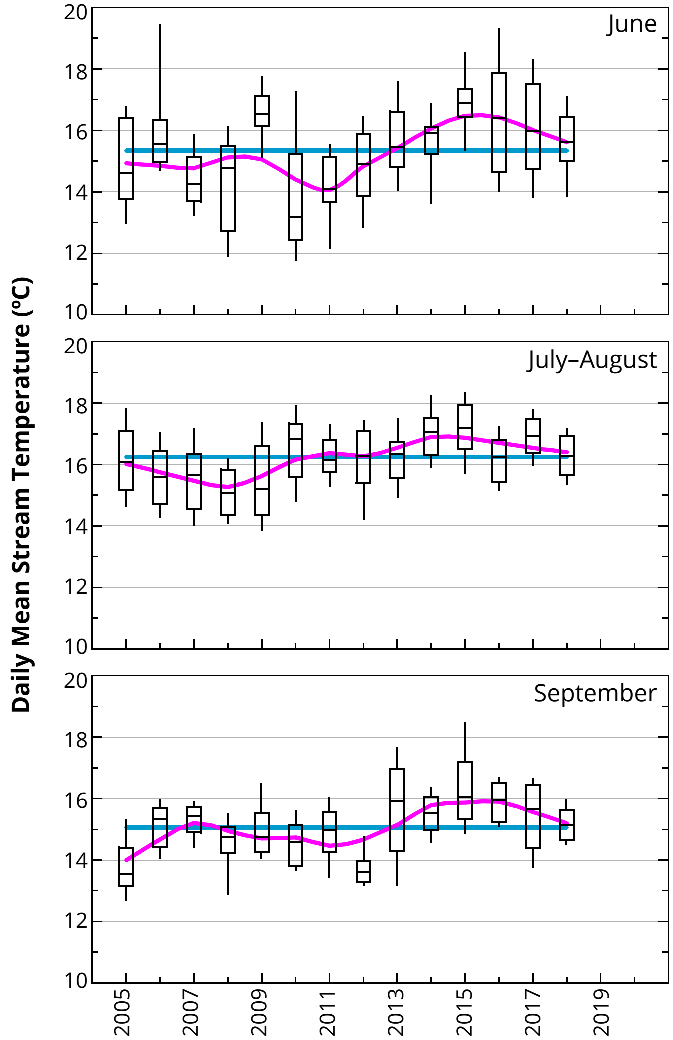
Trends

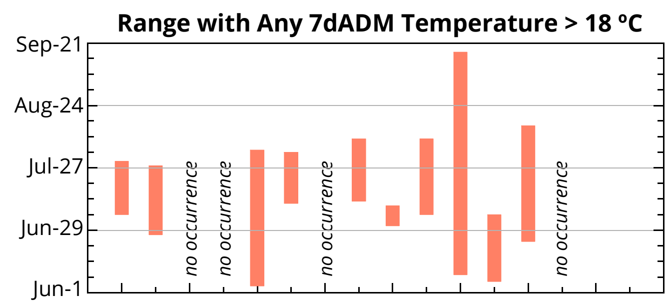
- Water temperatures showed increasing trends in June, July–August, and September that were statistically significant. Because the period of record is short, the trend may be related to long-term weather patterns such as the Pacific Decadal Oscillation and the El-Niño Southern Oscillation. More years will be required to know if this trend persists.
- No trend was evident in the timing of or number of days with temperature standard exceedances.

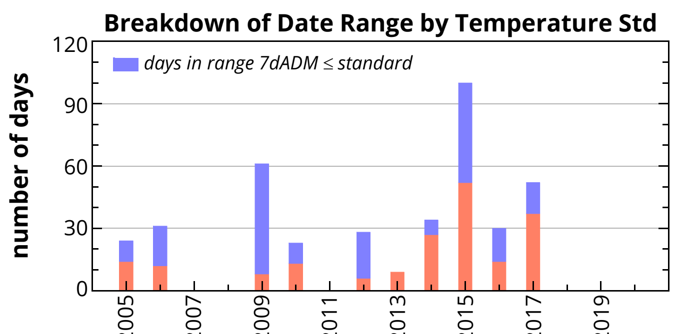
Oregon water temperature standard

- Exceedances of the water temperature standard occurred in about three-quarters of the years.
- The temperature standard was not exceeded in 2018.
- Days when the 7dADM did not exceed the standard were common within the date range of exceedances.

fraction of years with any exceedance	71%
median days/year exceeding standard	14
average first day of exceedance (if it occurred)	Jun-25
average last day of exceedance (if it occurred)	Aug-2





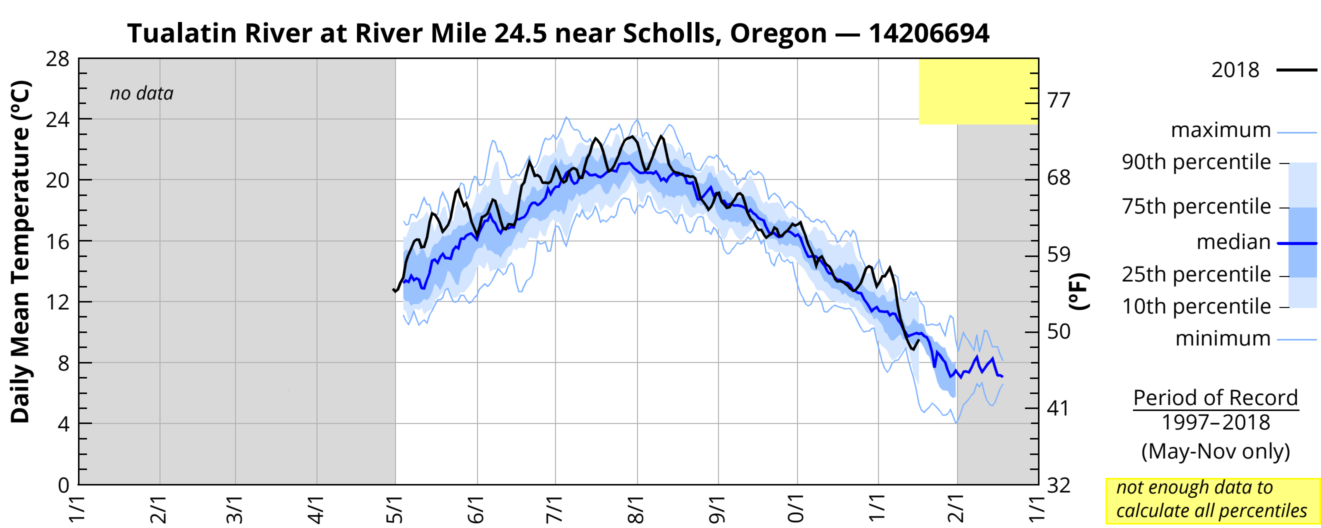


RM24.5 – Tualatin River at River Mile 24.5 nr Scholls, Oregon – 14206694

Data source: U.S. Geological Survey, Oregon Water Science Center
River mile: 24.5 *Latitude:* 45 24 06 *Longitude:* 122 53 38

2018 — DAILY MEAN WATER TEMPERATURE (°C) — RM24.5

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1					12.67	16.35	20.79	22.46	19.17	17.09	13.26	
2					12.80	16.87	20.48	21.86	18.59	17.22	13.66	
3					13.26	17.58	20.02	21.11	18.39	16.72	13.67	
4					13.61	17.63	19.85	20.64	18.17	16.30	13.95	
5					14.60	17.78	19.95	20.72	18.21	15.74	14.23	
6					15.11	18.26	20.51	21.19	18.49	15.32	13.72	
7					15.50	18.71	20.72	21.65	18.71	14.96	13.00	
8					15.96	18.62	20.77	22.13	19.07	14.38	11.76	
9					16.08	17.97	20.66	22.52	19.10	14.85	10.89	
10					16.07	17.32	20.11	22.87	18.96	14.96	10.37	
11					15.57	16.79	20.14	22.67	18.46	14.65	9.69	
12					15.60	16.75	20.88	21.80	17.80	14.42	9.29	
13					16.21	17.08	21.46	20.99	17.43	14.29	8.97	
14					17.20	17.06	21.75	20.72	17.31	13.99	8.87	
15					17.80	17.02	22.36	20.53	16.97	13.53	9.19	
16					17.73	17.46	22.72	20.47	16.71	13.34	9.54	
17					17.43	18.58	22.57	20.42	16.72	13.35		
18					17.08	19.64	22.37	20.34	16.41	13.32		
19					16.61	19.84	21.91	20.26	16.21	13.16		
20					16.79	20.53	21.14	20.26	16.36	13.05		
21					17.02	21.15	20.56	20.19	16.47	12.85		
22					17.53	20.80	20.64	20.23	16.87	12.73		
23					18.42	20.26	20.90	20.09	16.78	12.79		
24					19.17	20.30	21.26	19.50	16.32	13.01		
25					19.33	20.18	21.69	18.81	16.34	13.24		
26					18.77	19.80	22.19	18.58	16.52	13.71		
27					18.28	19.82	22.56	18.35	16.67	14.19		
28					18.46	19.77	22.69	18.04	16.88	14.34		
29		—			17.99	19.88	22.76	18.23	17.12	14.26		
30		—		12.84	17.23	20.28	22.84	18.63	17.01	13.59		
31		—		—	16.79	—	22.67	19.10	—	13.01	—	
Mean					16.54	18.67	21.35	20.50	17.47	14.27		
Max					19.33	21.15	22.84	22.87	19.17	17.22		
Min					12.67	16.35	19.85	18.04	16.21	12.73		



FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — RM24.5

Temp (°C)	0 < T < 8	8 < T ≤ 10	10 < T ≤ 12	12 < T ≤ 14	14 < T ≤ 16	16 < T ≤ 17	17 < T ≤ 18	18 < T ≤ 19	19 < T ≤ 20	20 < T ≤ 21	21 < T ≤ 22	22 < T ≤ 23	23 < T ≤ 25	Missing
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
All	1.9%	4.2%	7.5%	11%	13%	10%	11%	10%	8.4%	9.6%	6.1%	2.4%	0.6%	1.2%

Key

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
1997–2018
(May–Nov only)

MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — RM24.5

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997					16.0	16.9	20.1	20.0	16.8	12.0		
1998					12.9	17.2	20.4	19.4	17.2	13.4	10.4	
1999					12.4	16.2	18.8	19.2	16.9	12.8	10.5	
2000					14.6	17.6	19.8	18.0	16.2	14.0	7.1	
2001					15.1	17.6	21.1	21.0	19.1	13.7	9.9	
2002					14.5	17.9	21.1	19.7	16.9	14.0	10.0	7.0
2003					13.6	18.4	21.8	19.5	17.6	15.0	8.6	8.0
2004					15.7	18.8	21.6	20.1	17.7	15.0	9.4	
2005			9.8	10.7	14.0	16.1	20.5	20.4	16.8	14.5		
2006					14.4	17.3	20.2	19.2	17.2	13.6	9.1	
2007					15.2	17.5	20.5	18.9	17.5	13.4	9.8	6.6
2008					14.5	16.5	19.3	18.6	17.1	12.8	10.2	
2009					13.2	18.9	21.3	18.7	17.3	13.4	9.4	
2010					13.0	14.1	19.6	19.8	16.8	12.8	10.5	
2011					12.1	15.6	18.8	19.9	17.9	13.9	9.3	
2012					13.5	16.7	19.9	20.2	16.8	13.3	9.5	8.3
2013					14.8	17.6	20.7	20.2	18.6	11.9	10.1	
2014					15.2	18.2	21.3	21.1	18.4	16.1	9.6	8.1
2015					16.1	20.7	21.6	21.1	17.9	16.0	10.4	
2016					16.4	18.9	20.1	20.4	17.5	12.9	12.1	
2017					14.3	17.8	20.9	21.0	18.3	12.8	9.9	
2018					16.8	18.6	21.1	20.5	17.1	14.2	11.3	
median					14.6	17.6	20.5	20.0	17.3	13.7	9.8	

Key

T in °C

- T ≤ 8.6
- 8.6 < T ≤ 10.3
- 10.3 < T ≤ 11.5
- 12 < T ≤ 12.4
- 12 < T ≤ 14.0
- 14.0 < T ≤ 15.6
- 15.6 < T ≤ 16.7
- 16.7 < T ≤ 19.2
- 19.2 < T ≤ 20.9
- 20.9 < T ≤ 21.6
- T > 21.6

T as percentile

- T ≤ 5th
- 5th < T ≤ 10th
- 10th < T ≤ 15th
- 15th < T ≤ 20th
- 20th < T ≤ 30th
- 30th < T ≤ 40th
- 40th < T ≤ 50th
- 50th < T ≤ 75th
- 75th < T ≤ 90th
- 90th < T ≤ 95th
- T > 95th

DISTRIBUTION AND 2018

- Temperatures in 2018 were well above average in most of May and late October through early November. New record high daily mean temperatures were set for multiple days in both of these time periods.
- Above average temperatures also occurred during several episodes through the summer. New record high daily mean temperatures were set in both July and August.
- The highest temperatures occur in July and August.
- Temperature is not routinely measured at this site during high flow which is when low temperatures would occur. Consequently, the percentiles are skewed and under-represent low temperatures.

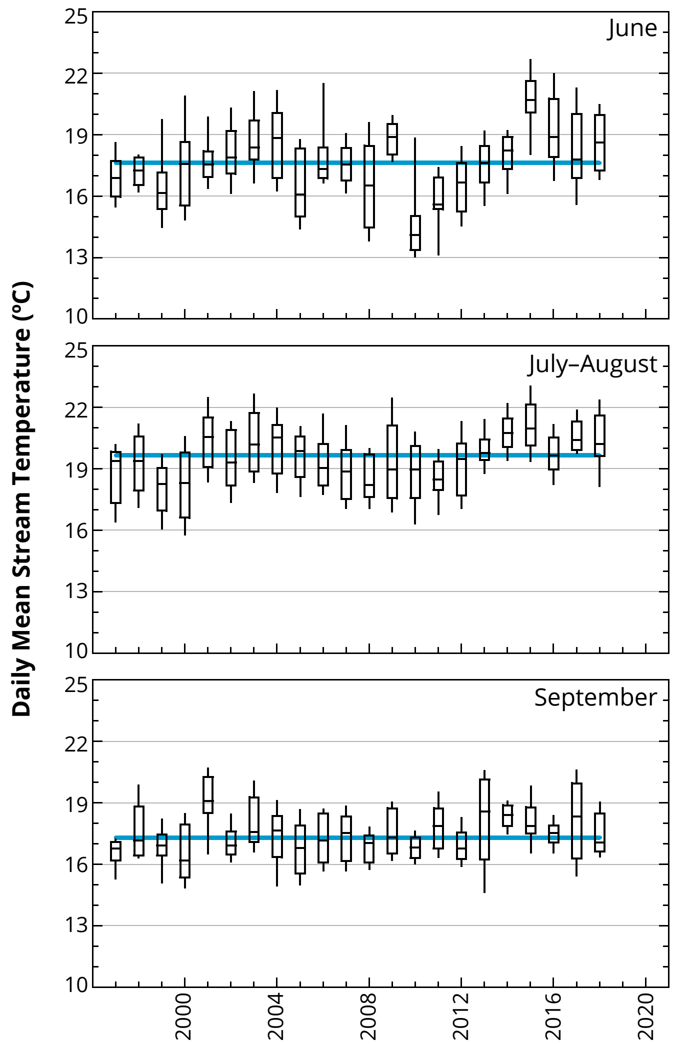
TRENDS

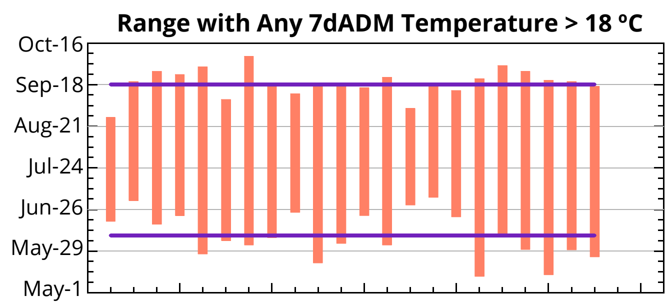
- Water temperatures in June through September do not show any statistically significant trends. The year-to-year variability is considerable and appears somewhat cyclical.
- Since 2013, the more than half of the temperatures in July–August have exceeded the period of record median.
- No trend was evident in the timing of days with temperature standard exceedances.
- The number of days exceeding the temperature standard shows an overall increasing trend that is statistically significant, although considerable variability exists year-to-year.

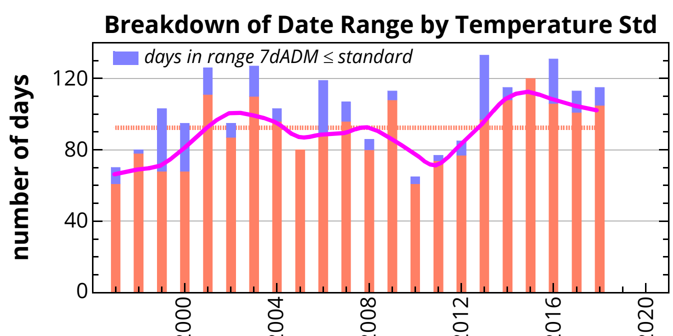
OREGON WATER TEMPERATURE STANDARD

- Exceedances of the water temperature standard occurred in all years.
- Days when the 7dADM did not exceed the standard usually occurred within the date range of exceedances, but were a minor fraction.

fraction of years with any exceedance	100%
median days/year exceeding standard	93
average first day of exceedance (if it occurred)	Jun-8
average last day of exceedance (if it occurred)	Sep-18







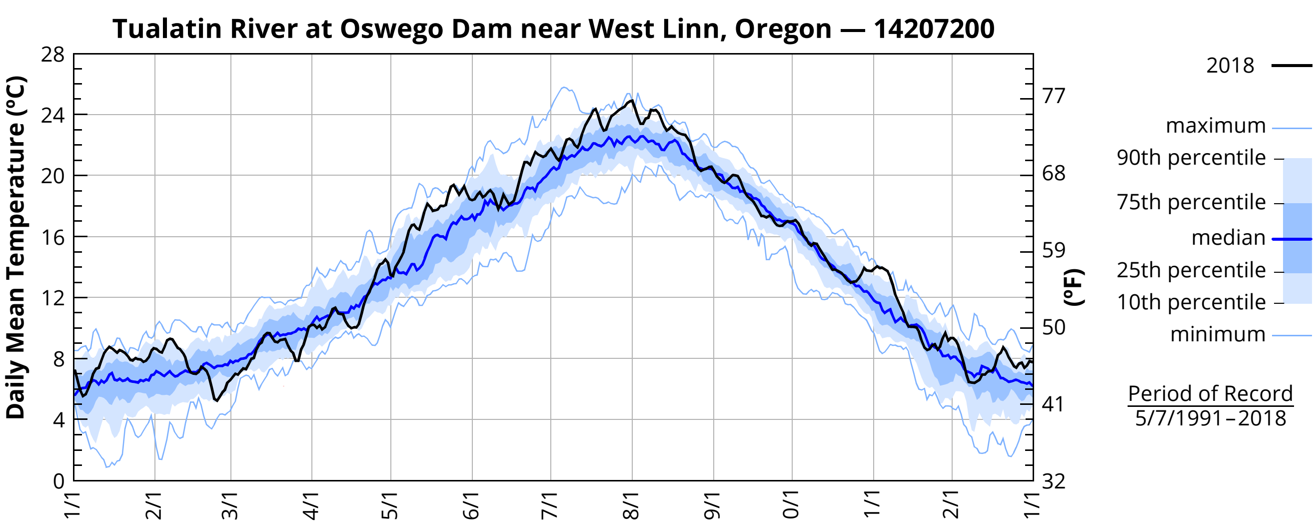
ODAM – Tualatin River at Oswego Dam near West Linn, Oregon – 14207200

Data source: U.S. Geological Survey, Oregon Water Science Center

River mile: 3.4 *Latitude:* 45 21 24 *Longitude:* 122 41 02

2018 — DAILY MEAN WATER TEMPERATURE (°C) — ODAM

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	7.20	8.62	6.59	10.21	13.49	18.39	21.76	24.90	20.31	17.00	13.90	9.33
2	6.55	8.45	6.79	10.21	13.41	18.46	21.45	24.45	19.97	17.08	14.04	9.17
3	5.92	8.40	7.00	10.02	14.03	18.72	21.17	23.84	19.80	16.90	13.91	8.83
4	5.54	8.76	6.94	10.16	14.33	18.89	21.00	23.39	19.61	16.57	13.96	8.26
5	5.67	9.19	7.15	9.91	14.66	18.58	21.30	23.39	19.53	16.10	13.85	7.68
6	6.04	9.29	7.35	10.05	15.01	18.69	21.84	23.73	19.65	15.90	13.76	6.97
7	6.46	9.26	7.30	10.50	15.71	18.90	22.36	23.79	19.83	15.53	13.34	6.46
8	7.03	8.99	7.61	10.80	16.41	19.05	22.42	24.30	20.04	15.38	12.84	6.42
9	7.32	8.70	7.97	11.25	16.73	18.81	22.32	24.25	20.02	15.56	12.17	6.39
10	7.38	8.62	8.04	11.34	16.77	18.31	22.00	24.30	19.97	15.51	11.80	6.50
11	7.89	8.37	8.60	10.96	16.55	17.83	21.84	24.11	19.67	15.23	11.35	6.61
12	8.33	8.03	8.92	10.92	16.47	18.21	22.20	23.65	19.23	14.95	11.01	6.95
13	8.56	7.40	9.04	10.90	17.07	18.72	22.82	23.22	18.82	14.69	10.43	6.94
14	8.78	7.09	9.50	10.41	17.72	18.40	23.27	22.95	18.59	14.40	10.09	7.13
15	8.67	7.01	9.68	10.13	18.16	18.09	23.55	23.06	18.43	14.08	10.07	7.18
16	8.52	6.98	9.65	10.00	17.98	18.23	23.89	23.22	18.29	13.81	10.08	7.23
17	8.37	7.12	9.36	10.05	17.68	18.36	24.26	22.99	17.97	13.83	10.04	7.56
18	8.54	7.48	9.10	10.04	17.71	19.00	24.36	22.84	17.65	13.78	9.73	8.23
19	8.47	7.37	9.06	10.26	17.79	19.67	23.94	22.76	17.34	13.67	9.17	8.37
20	8.38	7.17	9.22	10.96	18.01	20.31	23.30	22.70	17.34	13.51	8.72	8.76
21	8.19	6.78	9.23	11.65	18.00	20.88	22.96	22.65	17.26	13.32	8.56	8.53
22	7.92	6.10	9.27	12.10	18.07	20.87	23.02	22.40	17.37	13.11	8.62	8.07
23	7.88	5.37	8.85	12.36	18.77	20.70	23.49	22.16	17.23	12.97	8.85	7.81
24	8.03	5.24	8.50	12.84	19.28	21.15	23.89	21.56	16.95	13.03	8.94	7.51
25	7.95	5.49	8.36	13.32	19.38	21.54	24.02	20.90	16.76	13.05	8.59	7.41
26	7.93	5.76	7.85	13.88	19.08	21.40	24.16	20.46	16.69	13.25	8.80	7.66
27	7.79	5.94	7.85	14.20	18.75	21.31	24.32	20.31	16.72	13.52	9.33	7.73
28	7.86	6.42	8.62	14.26	19.01	21.23	24.41	20.38	16.89	13.93	9.67	7.39
29	8.07	—	8.94	14.50	19.30	21.32	24.53	20.43	17.01	13.78	9.18	7.54
30	8.50	—	9.49	14.29	18.85	21.57	24.75	20.55	16.97	13.76	9.34	7.83
31	8.67	—	10.09	—	18.46	—	24.86	20.57	—	13.74	—	7.77
Mean	7.69	7.48	8.45	11.42	17.18	19.52	23.08	22.72	18.40	14.55	10.80	7.62
Max	8.78	9.29	10.09	14.50	19.38	21.57	24.86	24.90	20.31	17.08	14.04	9.33
Min	5.54	5.24	6.59	9.91	13.41	17.83	21.00	20.31	16.69	12.97	8.56	6.39



FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — ODAM

Temp (°C)	0 < T < 6.0	6.0 < T ≤ 7.5	7.5 < T ≤ 9.0	9.0 < T ≤ 11	11 < T ≤ 13	13 < T ≤ 16	16 < T ≤ 18	18 < T ≤ 19	19 < T ≤ 20	20 < T ≤ 21	21 < T ≤ 22	22 < T ≤ 23	23 < T ≤ 26	Missing
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
All	7.2%	10%	11%	11%	9.2%	11%	9.3%	5.7%	4.7%	5.1%	5.1%	4.3%	2.8%	3.1%

Key

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
1991–2018

MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — ODAM

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991					13.0	16.1	21.5	21.8	18.5	14.8	9.8	6.9
1992	6.4	8.5	11.2	12.5	16.6	20.8	21.4	21.1	17.5	14.1	10.5	5.6
1993	4.0	5.9	8.3	10.0	16.3	16.7	18.9	20.6	16.5	14.7	8.3	6.9
1994	7.5	5.6	9.3	11.6	16.3	17.8	21.7		18.6	13.5	7.0	7.6
1995	6.7	9.5			14.7	18.5	22.1	20.1	18.7	14.1	11.0	7.9
1996	8.0				13.6	18.1	21.2	20.8	16.9	14.5	9.6	7.1
1997		7.5	8.7	11.3	17.4	18.1	20.8	22.4	17.6	12.4	9.9	6.8
1998	7.1	8.6	9.9	11.1	13.5	18.4	21.8	22.0	19.6	14.0	10.8	7.1
1999	7.0	7.1	8.6	11.2	12.9	17.5	20.1	21.1	18.1	13.7	10.6	8.2
2000	6.0	7.5			15.2	18.1	21.1	20.6	17.6	14.4	8.2	6.7
2001	6.5	6.6	9.8	10.8	15.8	18.6	21.0	21.1	19.5	14.3	10.8	7.2
2002	6.6	6.7	7.5	11.7	15.3	19.3	22.4	21.3	18.6	14.0	9.7	7.5
2003	7.6	8.1	9.8	11.5	13.8	20.0	22.9	21.4	18.4	15.3	9.2	7.8
2004	6.0	7.3	10.6	12.5	16.5	18.7	23.0	23.1	18.6	15.6	9.5	7.8
2005	6.0	6.7			14.9	17.0	21.2	22.5	18.5	15.0	8.8	6.0
2006	7.8	7.0	8.1	11.5	15.4	18.2	22.3	21.3	18.2	14.1	9.3	6.1
2007	5.3	7.6	9.9	11.1	15.7	18.9	21.6	20.6	18.8	13.8	10.2	6.5
2008	5.3	6.6	8.4	9.5	15.3	16.6	21.7	20.8	18.6	13.6	11.3	4.9
2009	5.0	5.6	7.7	11.0	13.3	19.6	21.8	20.8	18.9	14.0	9.0	4.8
2010	7.6	8.3	9.4	11.8	13.3	14.5	21.0	21.6	17.8	14.3	10.2	7.3
2011	7.0	6.7			12.9	16.7	19.7	21.4	19.4	14.4	9.5	5.5
2012	6.3	7.2	7.5	11.5	14.5	17.2	21.3	22.2	18.4	13.8	10.1	7.5
2013	4.7	7.4	8.8	12.3	16.5	18.7	22.4	22.0	20.0	12.2	10.5	5.6
2014	5.8	6.6	9.9	12.3	15.4	18.8	22.7	23.0	19.5	16.5	9.8	8.6
2015	7.5	9.5	11.2	12.3	16.7	21.9	24.1	22.6	18.9	16.2	10.7	7.7
2016	7.5	8.7	10.0	13.7	17.2	19.6	21.5	22.3	18.4	13.8	12.1	5.7
2017	4.1	7.2	9.6	10.8	14.7	18.9	22.5	22.4	19.9	12.9	9.8	6.1
2018	7.9	7.4	8.6	10.9	17.7	18.9	23.3	23.0	18.4	13.9	10.1	7.6
median	6.5	7.3	9.1	11.5	15.3	18.5	21.8	21.6	18.5	14.2	9.9	6.9

Key

T in °C
- T ≤ 5.4
- 5.4 < T ≤ 6.4
- 6.4 < T ≤ 7.1
- 7 < T ≤ 7.7
- 8 < T ≤ 9.1
- 9.1 < T ≤ 10.8
- 10.8 < T ≤ 12.9
- 12.9 < T ≤ 18.7
- 18.7 < T ≤ 21.5
- 21.5 < T ≤ 22.4
- T > 22.4

T as percentile
- T ≤ 5th
- 5th < T ≤ 10th
- 10th < T ≤ 15th
- 15th < T ≤ 20th
- 20th < T ≤ 30th
- 30th < T ≤ 40th
- 40th < T ≤ 50th
- 50th < T ≤ 75th
- 75th < T ≤ 90th
- 90th < T ≤ 95th
- T > 95th

Distribution and 2018

- Temperatures in 2018 were well above average in mid-January through early February, late April through most of May and late October through early November. New record high daily mean temperatures were set in all three time periods.
- Above average temperatures also occurred during several episodes through the summer which set new record high daily mean temperatures.
- The highest temperatures occur in July and August.
- The lowest temperatures occur in December and January.

Trends

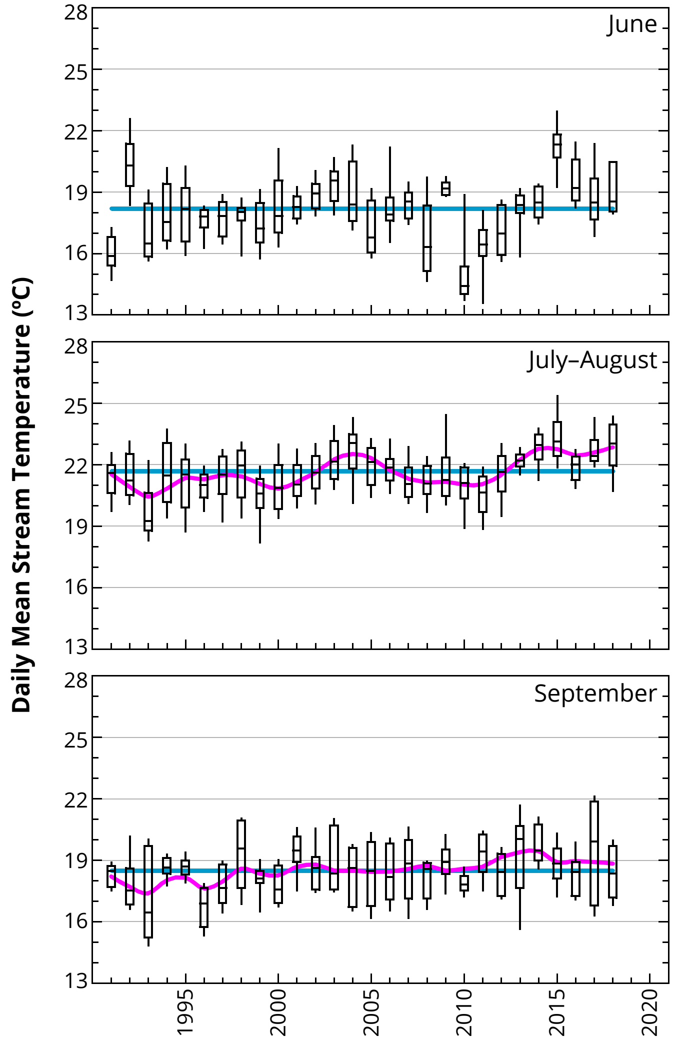
- Water temperatures in June do not show any statistically significant trends.
- Water temperatures in July–August and September show an increasing trend. The trend is statistically significant even though the increase is small.
- The year-to-year variability in June and July–August is considerable and appears to be somewhat cyclical. Year-to-year variability is less in September than in the earlier summer months.
- This site illustrates the importance of a long period of record, especially when long-term patterns such as the Pacific Decadal Oscillation and the El Niño Southern Oscillation may be active.
- No trend was evident in the timing of temperature standard exceedances. The number of days with exceedances had a weak increasing trend that was not statistically significant.

Oregon water temperature standard

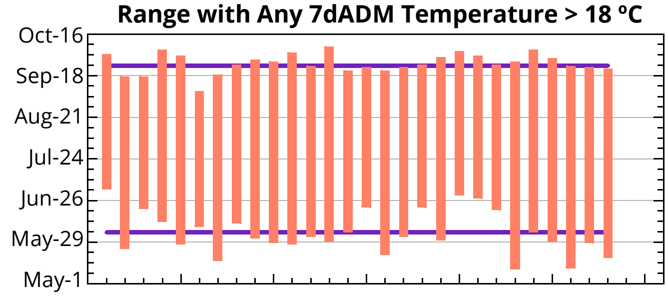
- Exceedances of the water temperature standard occurred in all years.
- Days when the 7dADM did not exceed the standard occurred sporadically within the date range of exceedances. When they occurred, they were a minor fraction of the range.

fraction of years with any exceedance	100%
median days/year exceeding standard	109
average first day of exceedance (if it occurred)	Jun-4
average last day of exceedance (if it occurred)	Sep-24

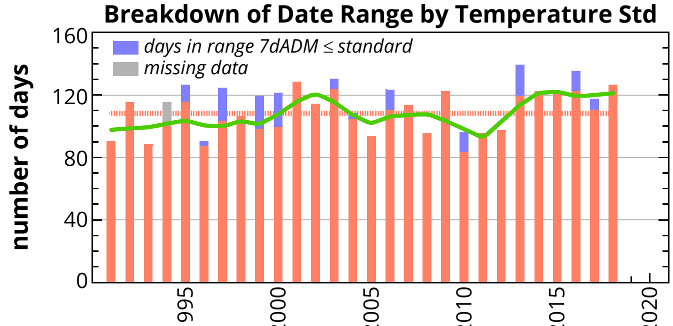
- In 1994, 14 days in August did not have temperature data. The 7dADMs exceeded 20°C on days before and after the data gap.



Range with Any 7dADM Temperature > 18 °C



Breakdown of Date Range by Temperature Std

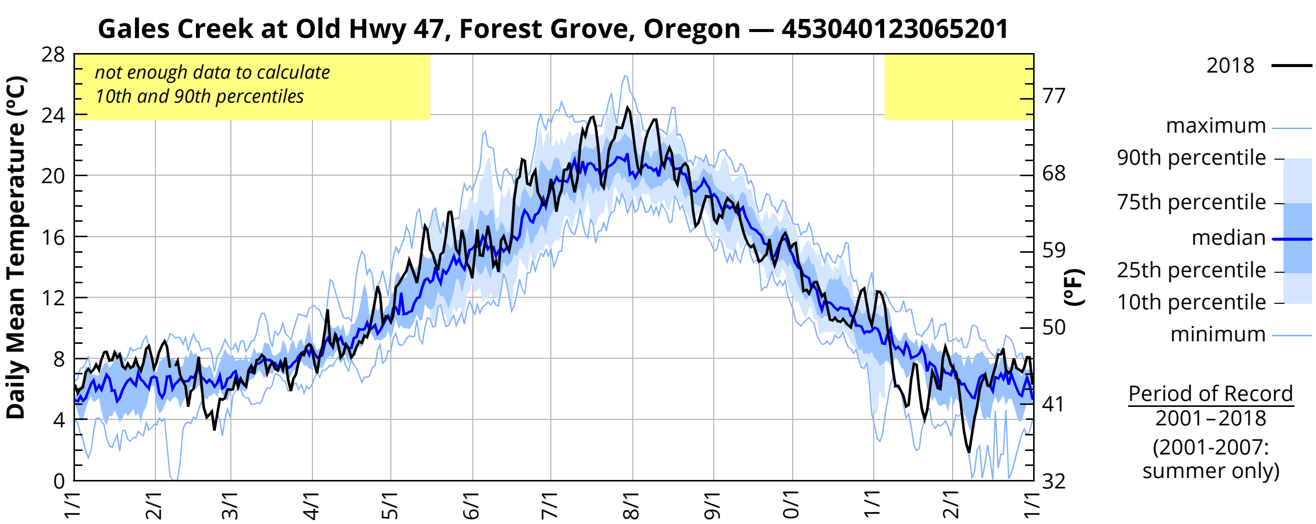


GALES – Gales Creek at Old Hwy 47, Forest Grove, Oregon – 453040123065201

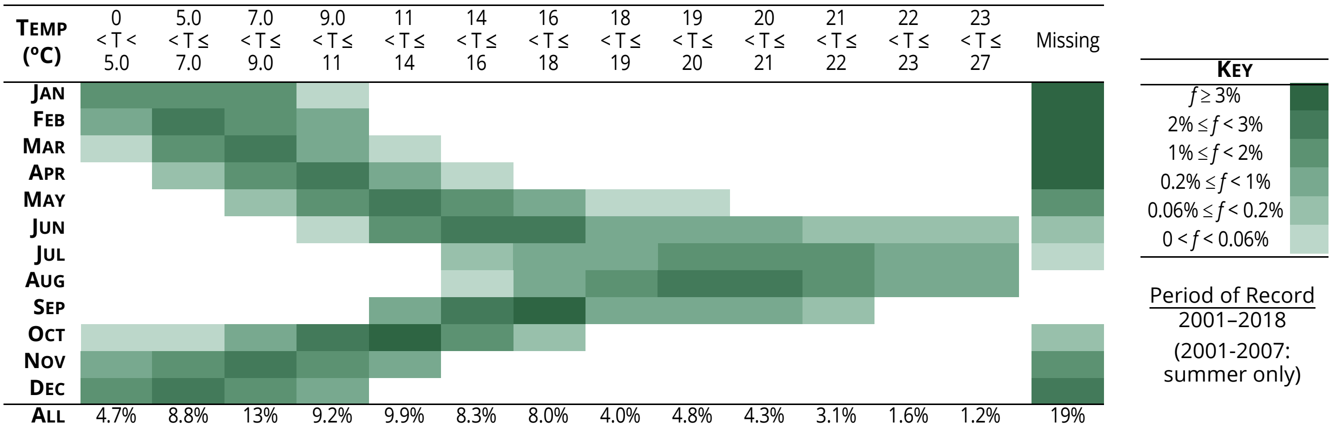
Data source: U.S. Geological Survey, Oregon Water Science Center
River mile: 2.36 *Latitude:* 45 28 40 *Longitude:* 123 06 52

2018 — DAILY MEAN WATER TEMPERATURE (°C) — GALES

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	6.21	7.77	5.96	8.76	10.40	13.27	19.78	23.03	17.14	15.50	11.10	7.31
2	5.75	8.49	5.99	7.67	10.84	14.93	18.94	21.67	16.90	15.57	12.38	7.11
3	6.04	8.87	6.68	7.03	12.68	16.47	17.64	20.47	17.40	14.32	12.37	6.30
4	6.13	9.12	6.12	8.18	12.92	14.78	18.59	20.18	17.23	13.88	12.08	4.71
5	7.11	8.75	6.66	8.72	13.21	14.74	19.05	21.47	18.10	12.42	11.45	3.26
6	7.32	7.41	6.31	9.94	13.49	15.69	20.37	22.41	18.51	12.52	9.93	2.35
7	7.10		6.17	11.24	13.72	16.71	20.38	22.99	18.35	12.25	8.83	1.83
8	7.28	7.51	7.23	9.01	14.45	15.81	20.85	23.35	18.20	12.66	7.26	2.97
9	7.59	7.88	7.54	8.76	13.97	14.10	19.70	23.67	17.75	12.99	6.19	4.11
10	7.23	6.90	6.98	9.63	13.50	14.40	18.90	23.67	18.12	13.02	6.21	4.82
11	7.97	6.48	7.90	8.89	12.95	13.68	19.81	22.48	17.06	12.55	5.86	5.95
12	8.42	6.14	7.97	8.08	13.88	15.77	21.96	20.91	16.42	12.08	5.51	6.55
13	8.44	4.85	8.22	8.29	15.47	16.02	22.97	20.58	15.83	12.24	4.87	6.95
14	7.88	5.86	8.08	8.91	16.67	15.44	22.57	21.39	15.45	11.41	4.97	6.23
15	7.90	6.02	7.05	8.66	16.40	15.05	23.28	21.83	15.31	10.55	6.66	6.24
16	8.37	6.99	7.51	8.09	15.14	15.85	23.79	21.43	15.46	10.50	7.66	6.89
17	8.05	8.13	7.74	8.29	14.84	18.43	23.86	19.73	14.90	10.68	7.59	7.46
18	8.27	6.43	7.35	8.77	14.24	19.74	23.19	19.41	14.37	10.46	5.98	8.26
19	7.48	4.77	7.22	9.13	13.79	19.93	21.81	20.28	14.45	10.41	4.75	8.27
20	7.32	4.16	7.65	9.02	14.84	21.05	19.45	20.63	14.68	10.61	4.03	8.67
21	7.66	4.33	7.23	9.50	14.96	20.98	19.21	20.81	14.85	10.40	4.62	7.26
22	7.38	4.54	8.06	9.40	16.09	19.47	20.28	20.58	15.84	10.19	5.90	7.05
23	7.49	3.29	6.66	9.90	17.59	19.39	21.67	19.46	14.74	10.03	7.13	7.24
24	7.96	4.38	5.88	10.74	17.62	20.03	22.17	17.72	14.12	10.80	6.76	7.99
25	7.48	5.36	6.69	11.84	16.46	20.33	22.42	16.69	14.61	11.20	6.07	7.39
26	7.17	5.30	6.98	12.74	15.14	18.88	23.17	16.90	15.39	11.90	6.00	7.28
27	7.72	5.42	7.76	12.17	14.85	18.49	23.12	17.49	15.99	12.44	8.04	7.11
28	8.65	5.99	8.29	10.37	16.43	18.08	23.12	18.12	16.22	12.60	8.75	7.44
29	8.81	—	8.22	10.77	15.78	18.13	23.76	18.64	15.87	11.62	8.18	8.09
30	8.17	—	8.79	10.73	14.24	18.70	24.43	18.61	15.20	10.66	7.57	8.07
31	7.36	—	8.95	—	13.92	—	24.17	18.57	—	10.20	—	6.38
Mean	7.54	6.34	7.29	9.44	14.53	17.14	21.43	20.49	16.15	11.89	7.49	6.37
Max	8.81	9.12	8.95	12.74	17.62	21.05	24.43	23.67	18.51	15.57	12.38	8.67
Min	5.75	3.29	5.88	7.03	10.40	13.27	17.64	16.69	14.12	10.03	4.03	1.83



FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — GALES



Period of Record
2001–2018
(2001-2007: summer only)

MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — GALES

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001					13.9	15.8	19.9	20.0	17.1	10.8		
2002					12.2	17.1	21.2	19.6	16.3	11.5	7.9	5.9
2003					14.4	16.8	21.0	20.3	17.4	13.7		
2004					14.9	17.3	21.9	21.3	16.6	12.7		
2005						14.7	20.1	20.3	15.4	12.6		
2006					13.3	15.8	20.8	19.3	15.9	11.3	8.7	
2007					14.3	16.8	20.8	19.1	16.3	10.9	7.6	6.2
2008	5.5		6.8	7.8	12.9	15.4	20.0	19.5	16.7	10.7	8.7	4.8
2009	4.6	4.6	6.6	9.3	12.0	16.7	21.6	19.5	16.5	11.3	8.2	4.3
2010	7.5	7.8	8.0	9.7	11.1	12.5	19.1	19.1	16.4	10.9	8.1	7.4
2011	6.6	5.6	7.2	8.1	10.6	14.5	17.8	19.3	17.1	12.1	6.9	4.7
2012	6.1	6.4	7.0	9.4	12.0	14.8	19.6	20.0	16.3	11.1	8.9	7.2
2013	4.7	6.4	7.7	10.1	13.3	16.2	20.5	19.9	18.1	10.3	8.6	3.9
2014	5.1	6.3	8.2	10.0	12.6	16.7	21.2	20.7	17.5	13.9	8.5	8.1
2015	7.3	8.7	9.6	10.1	14.4	20.1	22.0	20.3	16.0	13.9	8.4	8.0
2016	7.4	8.2	8.7	11.3	14.6	18.1	19.4	20.0	16.4	11.6	10.2	6.1
2017	4.1	6.3	7.9	8.9	12.8	16.2	20.2	20.9	16.7	10.6	8.5	5.4
2018	7.5	6.1	7.2	9.0	14.5	16.6	21.8	20.6	15.9	11.9	6.9	7.1
median	6.2	6.5	7.6	9.4	13.1	16.1	20.3	20.0	16.5	11.6	8.3	6.3

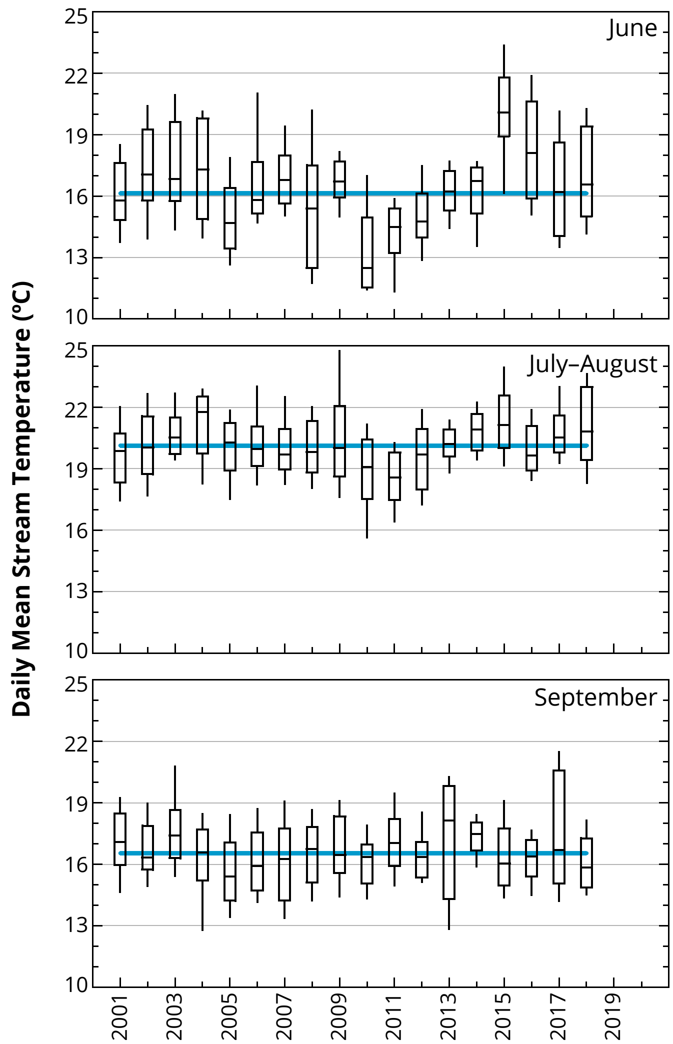
Key

T in °C
- T ≤ 4.8
- 4.8 < T ≤ 6.0
- 6.0 < T ≤ 6.8
- 6.8 < T ≤ 7.4
- 7.4 < T ≤ 8.6
- 8.6 < T ≤ 10.3
- 10.3 < T ≤ 12.4
- 12.4 < T ≤ 17.7
- 17.7 < T ≤ 20.5
- 20.5 < T ≤ 21.5
- T > 21.5

T as percentile
- T ≤ 5th
- 5th < T ≤ 10th
- 10th < T ≤ 15th
- 15th < T ≤ 20th
- 20th < T ≤ 30th
- 30th < T ≤ 40th
- 40th < T ≤ 50th
- 50th < T ≤ 75th
- 75th < T ≤ 90th
- 90th < T ≤ 95th
- T > 95th

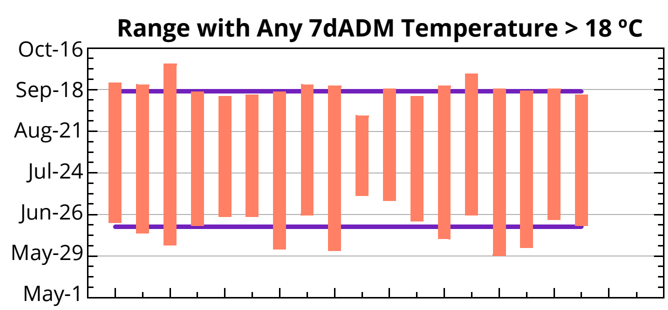
DISTRIBUTION 2018

- Temperatures in 2018 were well above average in mid-January through early February, late April through most of May and late October through early November. New record high daily mean temperatures were set in all three of these time periods.
- Above average temperatures also occurred during several episodes through the summer. New record high daily mean temperatures were set in June, July and August.
- The highest temperatures occur in July and August.
- Before 2008, temperature was not measured at this site during high flow which is when low temperatures would occur. Consequently, the percentiles are skewed and under-represent low temperatures.



TRENDS

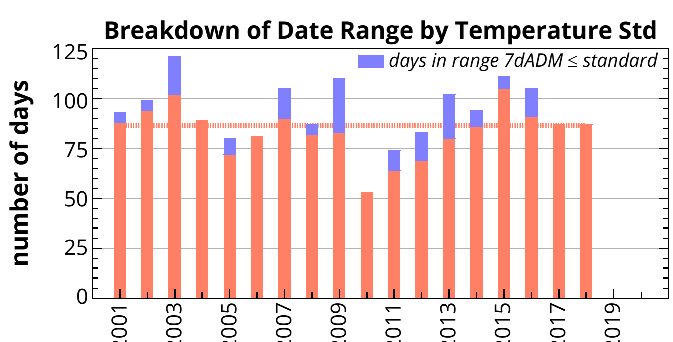
- Water temperatures in June, July–August and September do not show any statistically significant trends.
- The year-to-year variability is considerable, especially in June and appears somewhat cyclical. Year-to-year variability is less in September than in early summer.
- No trend was evident in the timing of or number of days with temperature standard exceedances.



OREGON WATER TEMPERATURE STANDARD

- Exceedances of the water temperature standard occurred in all years.
- Days when the 7dADM did not exceed the standard frequently occurred within the date range of exceedances, but were a minor fraction. They have not occurred in the past two years.

fraction of years with any exceedance	100%
median days/year exceeding standard	87
average first day of exceedance (if it occurred)	Jun-17
average last day of exceedance (if it occurred)	Sep-17



5400 – East Fork Dairy Creek near Meacham Corner, OR – 14205400

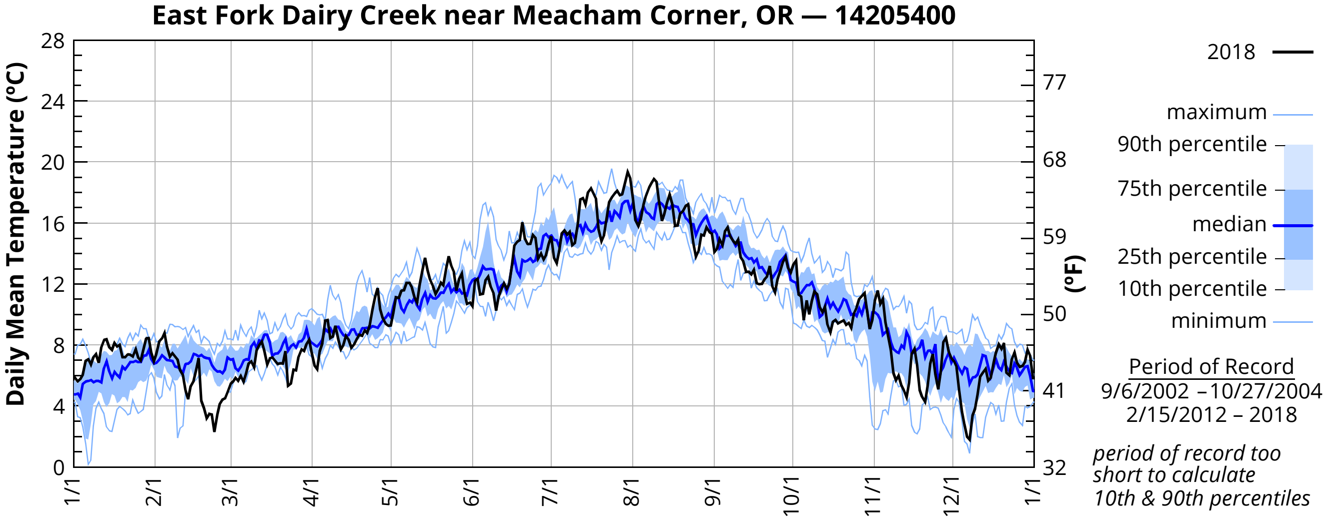
Data source: U.S. Geological Survey, Oregon Water Science Center

River mile: 12.4 *Latitude:* 45 30 40 *Longitude:* 123 06 52

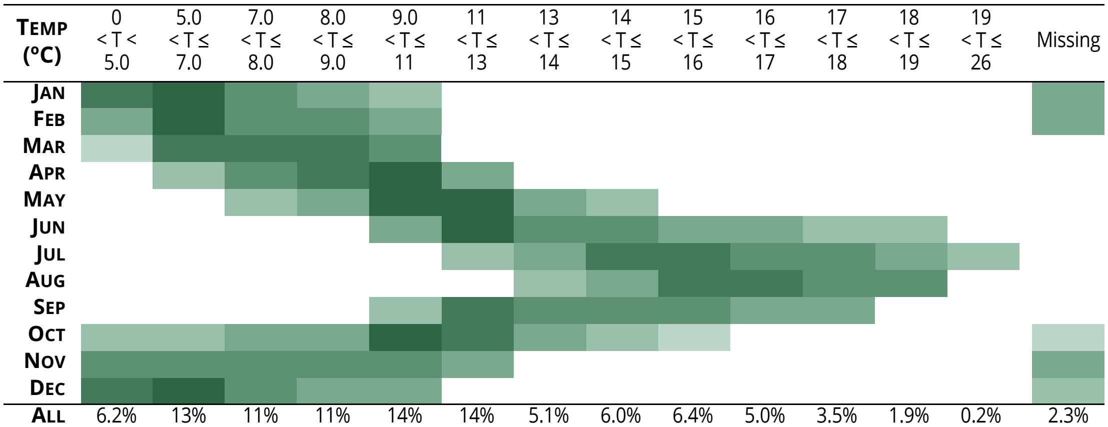
2018 — DAILY MEAN WATER TEMPERATURE (°C) — 5400

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	5.85	7.46	5.43	7.50	9.28	10.55	15.14	17.67	14.10	13.31	10.91	6.94
2	5.62	8.25	5.61	6.66	10.13	12.21	13.68	16.17	14.32	13.54	11.56	6.56
3	5.78	8.44	5.85	6.43	11.13	12.35	13.36	15.78	14.93	11.30	10.71	5.08
4	6.06	8.82	5.67	7.60	11.09	11.32	14.16	16.27	14.54	11.17	11.04	3.66
5	6.97	7.90	5.98	8.10	11.57	11.36	15.33	17.18	15.47	9.63	9.51	2.76
6	7.07	7.25	5.59	9.59	11.59	12.27	15.51	17.81	15.73	10.93	8.63	1.99
7	6.72	7.47	6.13	9.64	12.08	12.49	15.24	18.31	15.11	10.02	7.67	1.81
8	7.21	7.27	6.80	8.45	12.08	11.82	15.43	18.63	14.83	10.87	6.17	3.38
9	7.40	7.06	6.93	8.56	11.75	11.39	14.55	18.90	14.66	11.50	5.71	3.83
10	6.85	6.31	6.52	9.25	11.12	10.27	14.69	18.71	14.92	11.31	6.01	4.78
11	7.90	6.01	7.68	8.38	10.77	11.19	15.91	17.39	13.73	10.46	5.34	5.95
12	8.34	5.02	7.99	7.73	11.93	11.66	17.55	16.15	13.48	10.17	4.99	6.20
13	8.37	4.44	8.22	8.02	12.92	12.05	17.64	16.66	12.78	10.53	4.56	6.45
14	7.85	5.31	7.62	8.60	13.72	11.69	17.20	17.34	12.81	9.32	5.55	5.67
15	7.69	5.64	6.73	8.38	12.90	12.04	18.01	17.86	12.63	8.82	7.44	5.85
16	8.14	6.37	7.13	7.82	12.27	13.17	18.27	17.26	12.94	9.53	7.77	6.74
17	7.92	7.13	7.20	8.03	11.85	14.54	17.94	15.82	12.05	9.65	6.70	7.50
18	8.02	4.36	6.98	8.38	11.35	14.79	17.58	15.84	11.99	9.43	5.06	8.05
19	7.21	3.90	6.76	8.68	11.68	14.88	15.59	16.62	12.02	9.54	4.57	7.74
20	7.21	3.21	6.80	8.60	12.10	16.06	14.82	16.78	12.30	9.62	4.27	8.15
21	7.39	3.48	6.77	8.96	11.92	14.95	15.23	17.13	12.50	9.32	5.35	6.17
22	7.37	3.44	7.60	8.80	13.01	14.62	16.28	17.24	13.18	9.45	6.78	6.00
23	7.26	2.31	5.33	9.28	13.82	14.64	17.38	15.94	11.83	9.11	7.42	7.11
24	7.75	3.43	5.47	10.25	13.19	15.22	17.67	14.70	11.44	10.11	6.09	7.54
25	7.18	4.16	6.39	11.14	12.79	15.04	17.94	13.82	12.31	10.48	5.10	6.83
26	6.99	4.42	6.34	11.74	11.56	13.66	18.09	14.23	12.83	11.02	6.27	6.58
27	7.66	4.51	7.27	10.34	12.36	14.01	17.82	15.24	13.45	11.22	8.20	6.63
28	8.43	4.93	7.73	9.74	12.70	13.61	17.89	15.19	13.79	11.41	8.49	6.91
29	8.47	—	7.61	9.39	11.45	13.93	18.65	15.70	13.04	10.29	7.54	7.68
30	7.49	—	8.08	9.25	10.70	14.62	19.33	15.41	12.75	9.04	7.13	7.28
31	6.94	—	8.35	—	10.80	—	18.92	15.30	—	9.64	—	5.84
Mean	7.33	5.65	6.79	8.78	11.86	13.08	16.54	16.55	13.42	10.38	7.08	5.92
Max	8.47	8.82	8.35	11.74	13.82	16.06	19.33	18.90	15.73	13.54	11.56	8.15
Min	5.62	2.31	5.33	6.43	9.28	10.27	13.36	13.82	11.44	8.82	4.27	1.81

East Fork Dairy Creek near Meacham Corner, OR — 14205400



FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — 5400



Key

- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
9/2002–10/2004
2/2012–2018

MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — 5400

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002									13.5	9.6	7.2	6.2
2003	7.0	6.6	7.9	8.7	9.8	12.9	15.7	15.7	14.3	11.4	5.7	6.5
2004	5.7	7.0	8.4	9.5	11.2	13.6	16.8	16.7	13.9	12.1		
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012		6.1	6.6	8.8	10.3	11.8	15.0	15.9	13.6	9.7	8.1	7.2
2013	4.9	6.2	7.4	9.2	11.0	12.9	15.6	16.3	15.2	9.3	6.0	3.8
2014	4.7	6.4	7.9	9.0	11.0	12.6	16.2	17.2	14.8	12.2	7.9	7.9
2015	6.9	8.4	8.9	8.8	11.7	15.1	17.4	16.7	13.3	12.1	8.2	7.7
2016	7.4	8.1	8.4	10.0	11.7	13.6	15.1	16.6	13.5	11.0	9.8	5.8
2017	4.6	6.5	7.8	8.5	11.0	12.7	15.0	17.0	14.0	9.8	8.0	5.3
2018	7.4	5.5	6.8	8.6	11.9	12.8	17.2	16.6	13.1	10.2	6.7	6.5
median	6.2	6.9	7.8	8.9	11.2	13.0	15.7	16.5	13.8	10.7	7.8	6.5

Key

T in °C

- T ≤ 4.6
- 4.6 < T ≤ 5.8
- 5.8 < T ≤ 6.5
- 6.5 < T ≤ 7.0
- 7.0 < T ≤ 8.0
- 8.0 < T ≤ 8.8
- 8.8 < T ≤ 10.0
- 10.0 < T ≤ 13.7
- 13.7 < T ≤ 16.2
- 16.2 < T ≤ 17.2
- T > 17.2

T as percentile

- T ≤ 5th
- 5th < T ≤ 10th
- 10th < T ≤ 15th
- 15th < T ≤ 20th
- 20th < T ≤ 30th
- 30th < T ≤ 40th
- 40th < T ≤ 50th
- 50th < T ≤ 75th
- 75th < T ≤ 90th
- 90th < T ≤ 95th
- T > 95th

Distribution and 2018

- Temperatures in 2018 were above average in mid-January, late April through most of May, and late October through early November. New record high daily mean temperatures were set in all three of these time periods.
- Above average temperatures also occurred during several episodes through the summer. New record high daily mean temperatures were set in June, July and August. One episode in July was particular long with 6 consecutive days of record high daily mean temperatures (July 12-17).
- The highest temperatures occur in July and August.
- Temperature was not monitored at this site from November 2004 through January 2012.

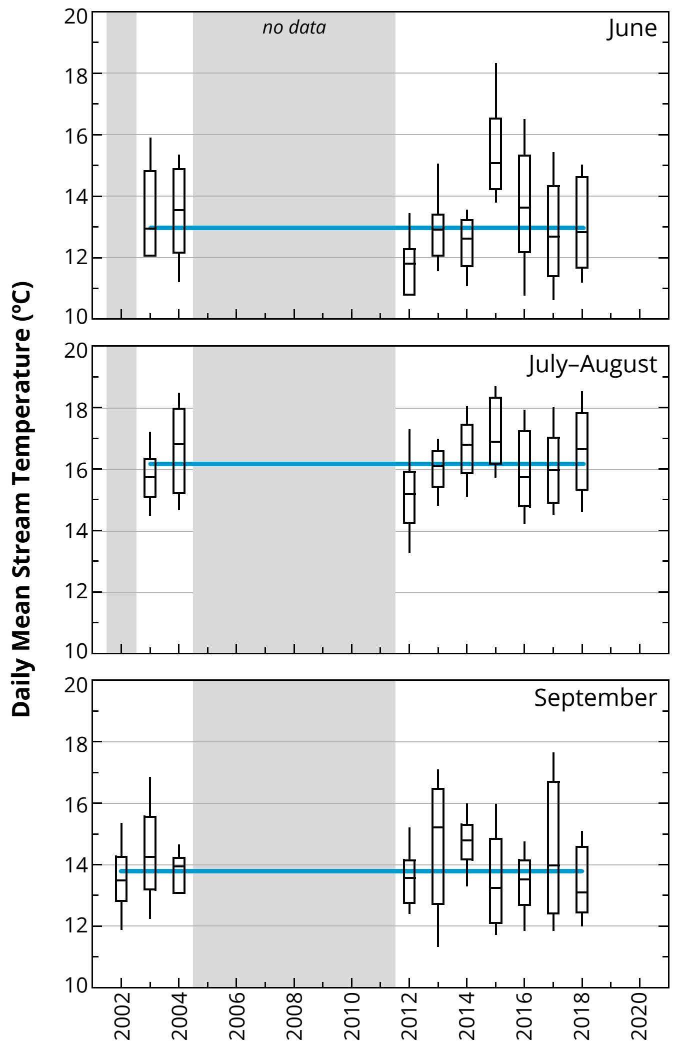
Trends

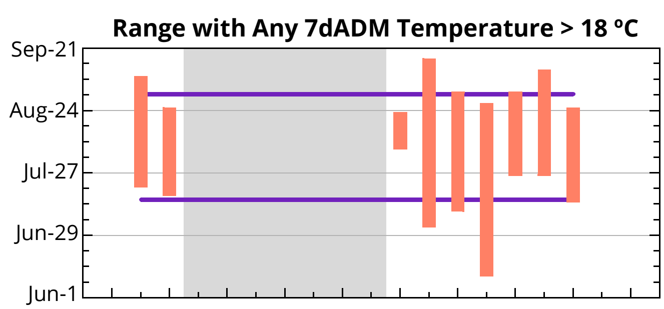
- Water temperatures in June, July–August and September do not show any statistically significant trends.
- The year-to-year variability is considerable, especially in June. Year-to-year variability is less in September than in the earlier summer months.
- No trend was evident in the timing of or number of days with temperature standard exceedances.

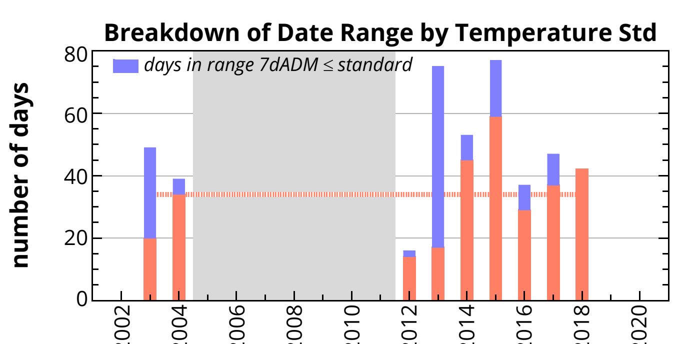
Oregon water temperature standard

- Exceedances of the water temperature standard occurred in all years for which data were available.
- Days when the 7dADM did not exceed the standard frequently occurred within the date range of exceedances, although not in 2018. Days that did not exceed the standard but occurred within the range when exceedances occurred varied from just a few to more than half the range.

fraction of years with any exceedance	100%
median days/year exceeding standard	34
average first day of exceedance (if it occurred)	Jul-15
average last day of exceedance (if it occurred)	Aug-31







MCSC – McKay Creek at Scotch Church Road above Waible Creek near North Plains, Oregon – 14206070

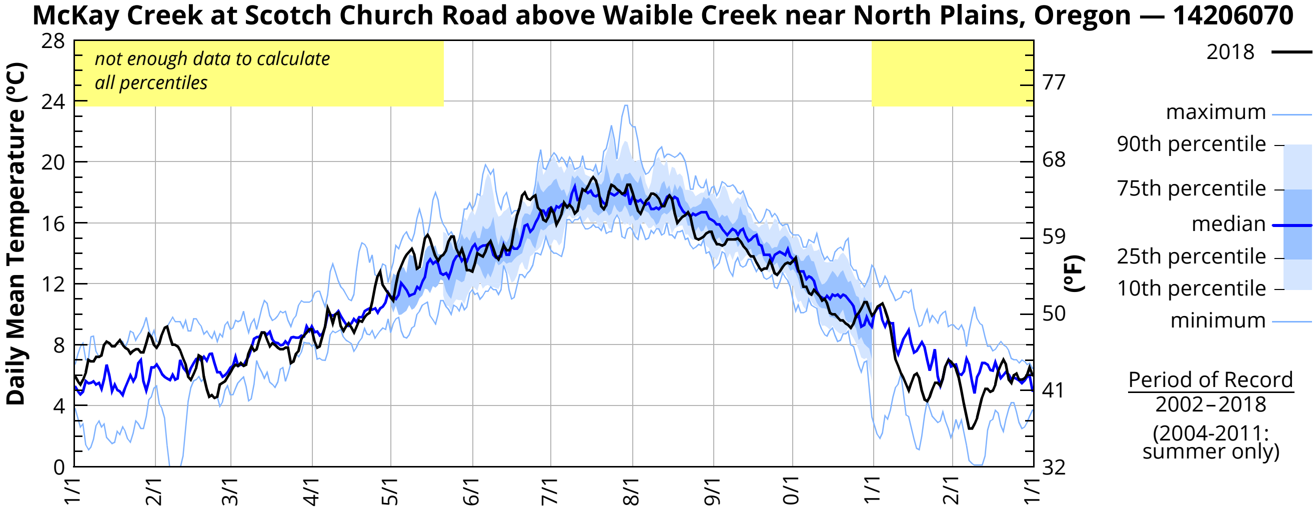
Data source: WEST Consultants for Clean Water Services

River mile: 6.3 *Latitude:* 45 57 21 *Longitude:* 122 99 18

2018 — DAILY MEAN WATER TEMPERATURE (°C) — MCSC

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	5.9	7.8	6.2	9.0	11.1	12.8	16.9	18.0	14.9	13.5	10.1	6.7
2	5.6	8.1	6.5	8.2	10.9	13.3	16.6	17.4	14.6	13.7	10.5	6.4
3	5.4	8.7	6.7	7.8	11.9	14.0	15.9	16.8	14.6	12.9	10.6	5.9
4	5.7	9.1	6.6	7.9	12.8	13.9	16.2	16.6	14.5	12.5	10.7	5.0
5	6.2	9.2	6.8	8.5	13.2	13.8	16.6	17.0	14.6	11.8	10.3	4.1
6	7.0	8.5	6.6	9.2	13.6	14.1	17.3	17.4	14.9	11.8	9.8	3.3
7	6.9	8.0	6.7	10.4	13.9	14.6	17.0	17.6	14.9	11.4	9.1	2.5
8	6.9	8.0	7.5	10.0	14.1	14.8	17.2	17.9	14.9	11.3	8.1	2.5
9	7.2	7.9	7.9	9.4	14.3	14.3	17.0	17.9	14.9	11.6	7.0	2.8
10	7.2	7.6	7.6	10.0	13.9	13.8	16.6	17.8	15.0	11.4	6.6	3.2
11	7.3	7.1	7.7	10.1	13.0	13.6	16.8	17.6	14.8	11.2	6.1	3.9
12	8.0	6.7	8.3	9.2	13.1	14.0	17.6	17.1	14.5	10.9	5.8	4.6
13	8.2	5.9	8.8	8.9	14.1	14.5	18.2	17.1	14.3	11.0	5.4	5.1
14	8.1	5.7	8.8	9.2	15.0	14.2	18.1	17.5	14.0	10.7	5.0	5.1
15	7.9	6.1	8.3	9.4	15.2	14.2	18.4	17.8	13.8	10.1	5.5	4.9
16	7.9	6.5	7.9	9.1	14.9	14.6	18.8	17.6	13.8	10.0	6.0	5.0
17	8.1	7.3	8.1	8.8	14.3	15.6	19.0	16.6	13.4	10.0	6.1	5.4
18	8.3	7.2	8.0	9.2	13.8	16.5	18.8	16.0	13.1	9.8	5.8	6.3
19	8.0	5.9	7.8	9.6	13.5	17.0	18.2	16.2	12.9	9.6	5.0	6.7
20	7.8	5.1	7.7	9.5	13.8	17.8	17.1	16.4	13.0	9.6	4.4	7.0
21	7.7	4.6	7.7	9.8	13.9	18.0	16.9	16.5	13.0	9.4	4.3	6.7
22	7.4	4.7	7.8	10.0	14.2	17.6	17.2	16.7	13.5	9.3	4.6	5.7
23	7.6	4.5	7.8	10.1	14.8	17.5	18.0	16.4	13.2	9.1	5.1	5.5
24	7.7	4.6	6.8	10.8	15.1	17.7	18.5	15.6	12.7	9.4	5.5	6.0
25	7.7	5.4	6.9	11.8	15.1	17.8	18.4	15.0	12.6	9.9	5.5	6.1
26	7.5	5.5	7.4	12.5	14.3	17.0	18.2	14.9	12.8	10.1	5.3	5.7
27	7.5	5.6	7.6	12.8	13.9	16.8	18.1	15.0	13.1	10.4	5.8	5.7
28	8.1	5.9	8.4	11.9	14.3	16.2	17.9	15.1	13.3	10.8	6.6	5.8
29	8.7	—	8.6	11.6	13.8	16.1	18.0	15.3	13.4	10.8	7.0	6.0
30	8.5	—	8.8	11.4	12.9	16.4	18.5	15.4	13.3	10.3	6.9	6.5
31	8.0	—	9.0	—	12.9	—	18.5	15.4	—	9.9	—	6.0
Mean	7.4	6.7	7.7	9.9	13.7	15.4	17.6	16.6	13.9	10.8	6.8	5.2
Max	8.7	9.2	9.0	12.8	15.2	18.0	19.0	18.0	15.0	13.7	10.7	7.0
Min	5.4	4.5	6.2	7.8	10.9	12.8	15.9	14.9	12.6	9.1	4.3	2.5

McKay Creek at Scotch Church Road above Waible Creek near North Plains, Oregon — 14206070



FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — MCSC

Temp (°C)	−0.1 < T < 5.0	5.0 < T ≤ 7.0	7.0 < T ≤ 9.0	9.0 < T ≤ 11	11 < T ≤ 13	13 < T ≤ 14	14 < T ≤ 15	15 < T ≤ 16	16 < T ≤ 17	17 < T ≤ 18	18 < T ≤ 19	19 < T ≤ 20	20 < T ≤ 24	Missing
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														
All	4.2%	7.3%	8.5%	8.9%	8.1%	5.7%	5.8%	6.0%	6.4%	5.5%	3.6%	1.6%	0.9%	27%

Key
- $f \geq 3\%$
- $2\% \leq f < 3\%$
- $1\% \leq f < 2\%$
- $0.2\% \leq f < 1\%$
- $0.06\% \leq f < 0.2\%$
- $0 < f < 0.06\%$

Period of Record
2002–2018
(2004-2011: summer only)

MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — MCSC

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	5.8	5.7	6.3	9.5	12.1	15.9	18.3	16.7	14.1	9.8	7.0	5.9
2003	6.7	6.2	7.9	9.4	11.0	15.7	18.4	17.5	15.2	12.4	5.3	6.3
2004							20.5	19.3	15.4	12.5		
2005					13.7	14.2	18.2	17.4	13.8	12.2		
2006					12.8	15.1	17.7	16.1	14.8	11.2		
2007					12.9	14.8	17.9	16.6	15.2	10.5		
2008					13.3	13.9	17.5	16.5	14.6	10.4		
2009							19.5	16.9	15.0	10.8		
2010					11.2	12.3	16.7	16.3	14.6	10.3		
2011					10.7	13.7	16.2	16.7	15.2	11.9		
2012	5.6	6.2	6.5	9.7	11.8	14.0	17.1	16.3	13.8	11.0	8.3	7.1
2013	4.0	6.0		10.5	12.9	14.7	17.1	16.7	16.8	9.5	8.6	2.9
2014	3.9	4.6	8.8	10.4	13.5	15.2	18.2	17.9	15.6	13.3	8.3	7.5
2015	7.0	8.6	9.7	10.0	13.8	17.0	18.4	17.7	15.1	13.7	8.7	7.6
2016	7.4	8.4	9.1	11.4	13.8	15.9	16.9	16.7	14.8	12.0	10.6	5.5
2017	3.7	6.2	8.6	9.2	12.3	15.4	17.5	18.0	15.7	10.3	8.2	4.5
2018	7.7	6.6	7.7	9.6	13.9	14.7	17.9	16.7	13.8	10.7	6.1	5.7
median	5.6	6.5	8.2	9.8	12.7	14.9	17.7	17.0	14.8	11.3	7.9	6.0

Key

T in °C
- T ≤ 4.7
- 4.7 < T ≤ 5.9
- 5.9 < T ≤ 6.8
- 6.8 < T ≤ 7.8
- 7.8 < T ≤ 9.3
- 9.3 < T ≤ 11.0
- 11.0 < T ≤ 12.8
- 12.8 < T ≤ 15.9
- 15.9 < T ≤ 17.7
- 17.7 < T ≤ 18.5
- T > 18.5

T as percentile
- T ≤ 5th
- 5th < T ≤ 10th
- 10th < T ≤ 15th
- 15th < T ≤ 20th
- 20th < T ≤ 30th
- 30th < T ≤ 40th
- 40th < T ≤ 50th
- 50th < T ≤ 75th
- 75th < T ≤ 90th
- 90th < T ≤ 95th
- T > 95th

Distribution and 2018

- Temperatures in 2018 were above average in mid-January and late April through most of May. New record high daily mean temperatures were set in both time periods.
- Above average temperatures also occurred during a prolonged period in June during which new record high daily mean temperatures were set for six consecutive days (June 19-24).
- Unlike most other tributary sites, temperatures were near average or below from July through mid-November. No record high daily mean temperatures were set after June 24th at this site.
- The highest temperatures occur in July and August.
- From 2004 through 2011, temperature was not measured at this site during high flow which is when low temperatures would occur. Consequently, the percentiles are skewed and underrepresent low temperatures.

Trends

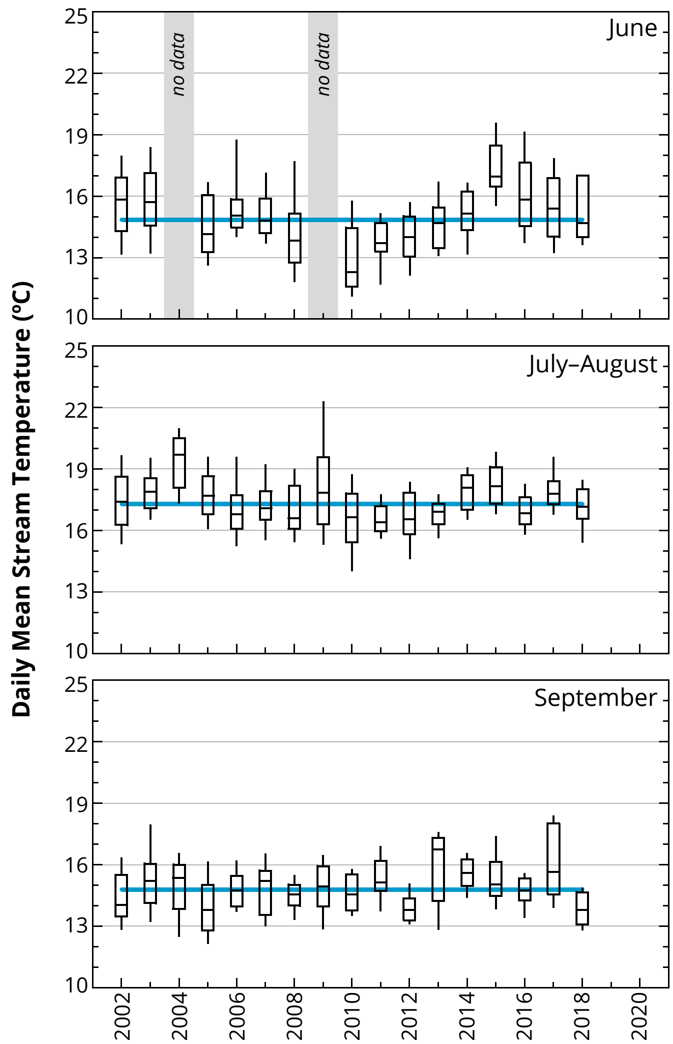
- Water temperatures from June through September do not show any statistically significant trends. The year-to-year variability is considerable, especially in June.
- No trend was evident in the timing of temperature standard exceedances.

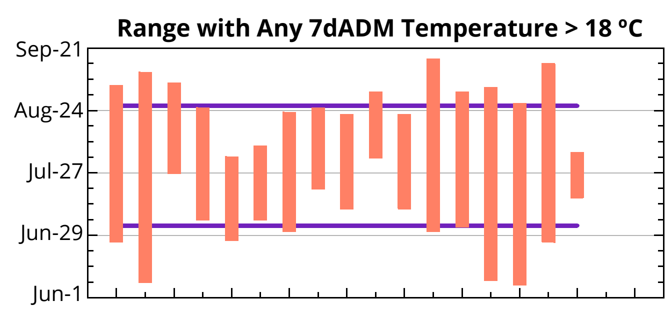
Oregon water temperature standard

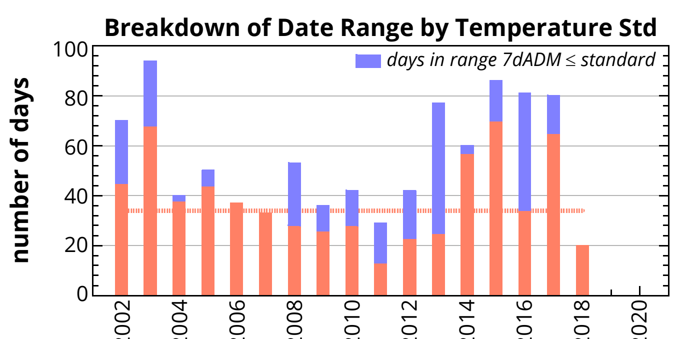
- Exceedances of the water temperature standard occurred in all years.
- Days when the 7dADM did not exceed the standard frequently occurred within the date range of exceedances, although not in 2018. Days that did not exceed the standard but occurred within the date range of exceedances varied from just a few to more than half the range.

fraction of years with any exceedance	100%
median days/year exceeding standard	34
average first day of exceedance (if it occurred)	Jul-3
average last day of exceedance (if it occurred)	Aug-26

Note: In the 2017 Flow Report, the graphs associated with temperature standard exceedance for this site are incorrect due to a miscalculation in the 7dADM for 2014-2017. A decreasing trend in exceedances was shown, which is not the case.







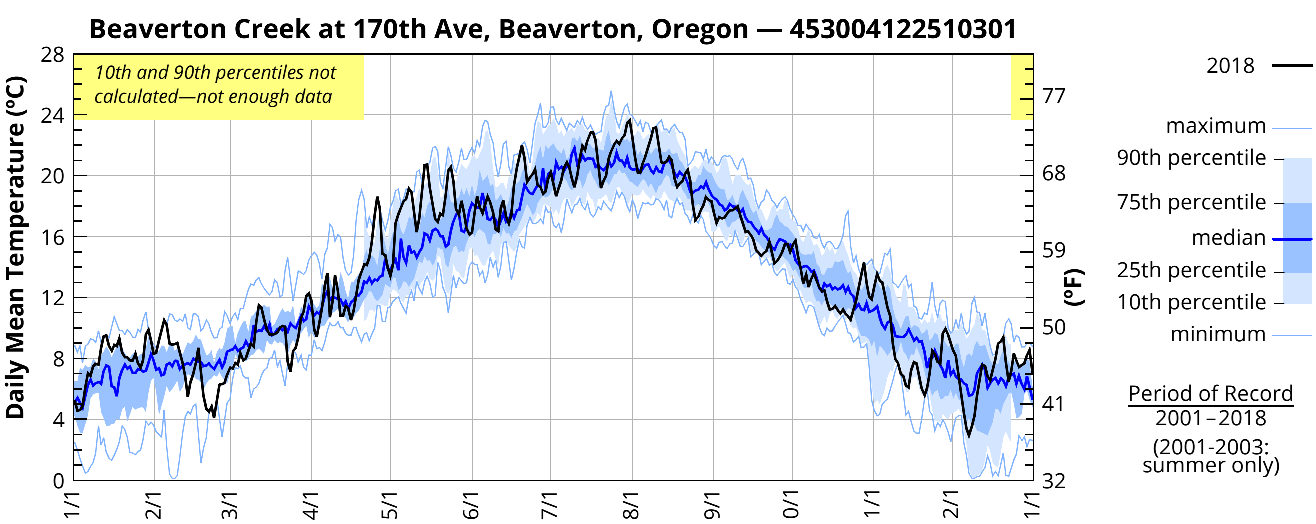
B170 – Beaverton Creek at 170th Ave, Beaverton, OR – 453004122510301

Data source: U.S. Geological Survey, Oregon Water Science Center

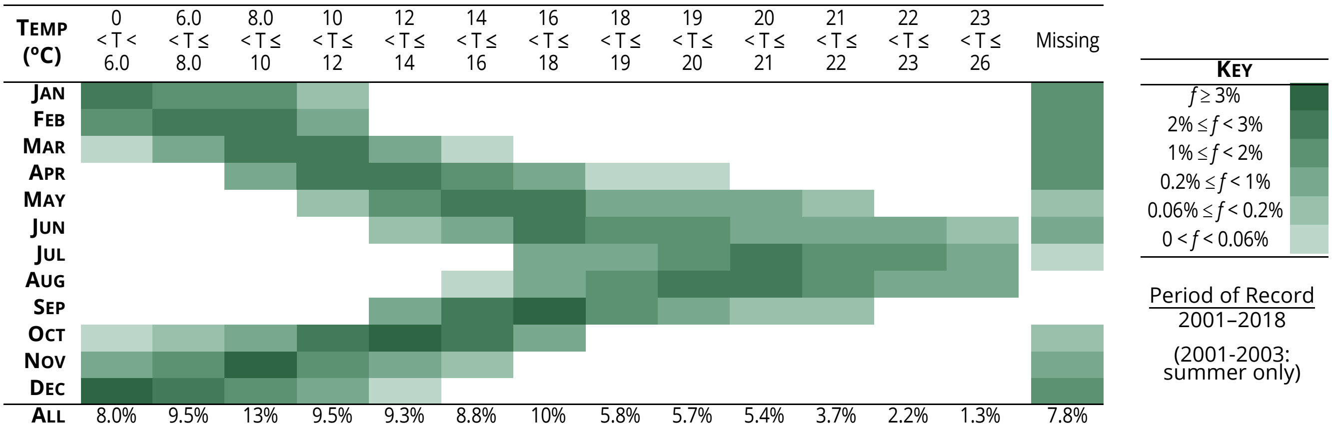
River mile: 4.9 *Latitude:* 45 28 04 *Longitude:* 122 51 03

2018 — DAILY MEAN WATER TEMPERATURE (°C) — B170

DAY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	5.21	8.38	7.41	11.81	13.41	16.28	20.25	22.56	17.56	15.50	12.72	8.47
2	4.57	9.19	7.35	9.90	14.14	17.55	19.42	21.26	16.90	15.75	13.54	8.15
3	4.61	9.85	7.71	9.43	16.85	18.64	18.64	20.19	17.27	14.68	13.09	6.98
4	4.86	10.49	7.57	10.40	17.46	17.94	19.19	20.20	17.20	13.92	12.99	5.62
5	6.14	10.20	8.36	11.28	17.93	17.52	19.70	20.88	17.25	12.93	12.17	4.42
6	7.03	8.99	7.87	12.76	18.33	18.11	20.51	21.30	17.52	13.50	11.36	3.42
7	6.87	8.90	8.00	13.60	18.46	18.62	20.87	21.90	17.71	12.69	10.77	2.95
8	7.47	8.94	8.49	10.71	19.15	18.22	20.53	22.44	17.71	13.24	8.98	3.55
9	7.63	9.03	8.97	11.72	18.91	17.57	19.82	23.11	17.84	13.63	7.94	4.22
10	7.59	8.40	8.78	13.47	17.57	16.45	19.23	23.19	18.00	13.08	7.69	5.57
11	8.69	7.69	10.42	12.42	16.30	16.34	20.03	22.03	17.41	12.66	6.98	6.63
12	9.45	6.80	11.48	10.80	17.15	17.87	21.15	20.84	16.90	12.40	6.81	7.59
13	9.52	5.50	11.33	10.80	18.93	18.37	21.94	20.83	16.30	12.46	6.21	7.52
14	8.80	6.42	10.60	11.42	20.69	17.27	21.67	20.93	16.33	11.77	6.09	6.83
15	8.50	6.98	9.88	11.29	20.73	16.84	22.35	21.25	16.11	11.22	7.21	6.55
16	8.90	7.69	9.57	10.52	19.23	17.42	22.82	21.02	15.79	11.26	7.77	7.23
17	8.81	8.70	9.58	11.12	18.12	19.33	22.84	19.80	15.09	11.44	7.69	7.92
18	9.29	7.21	9.60	12.17	17.16	20.49	22.33	19.25	14.92	11.18	6.81	8.98
19	8.35	5.54	9.72	13.16	16.96	21.22	20.88	19.48	14.73	10.95	6.02	9.10
20	8.09	4.67	10.04	13.74	17.52	21.99	19.20	19.63	14.93	11.20	5.59	9.40
21	8.08	4.52	10.14	14.17	17.41	21.15	19.68	20.14	15.06	10.92	6.07	7.79
22	7.88	4.87	10.07	14.12	18.74	19.61	20.00	20.39	15.66	10.77	7.03	6.48
23	7.84	4.11	7.79	14.62	20.34	19.89	21.10	19.65	14.97	10.54	8.52	7.18
24	8.33	5.30	7.12	15.66	20.57	20.10	21.63	18.09	14.26	11.18	8.31	8.34
25	7.69	6.30	8.49	17.42	19.63	20.42	22.04	17.08	14.41	11.77	7.77	7.85
26	7.38	6.31	8.69	18.63	17.79	19.37	22.28	17.33	14.66	12.60	7.64	7.43
27	7.87	6.40	9.37	17.82	17.43	19.24	22.09	17.77	15.04	13.43	9.65	7.58
28	9.59	6.96	10.69	14.89	18.34	18.80	22.44	18.05	15.52	14.30	9.96	7.69
29	9.88	—	11.11	14.78	17.58	18.97	22.65	18.60	15.51	12.98	9.52	8.22
30	9.18	—	12.10	13.95	16.50	19.80	23.45	18.39	15.02	12.08	9.00	8.58
31	8.32	—	12.28	—	16.13	—	23.63	18.32	—	11.89	—	7.12
Mean	7.82	7.30	9.37	12.95	17.92	18.71	21.11	20.19	16.12	12.51	8.73	6.95
Max	9.88	10.49	12.28	18.63	20.73	21.99	23.63	23.19	18.00	15.75	13.54	9.40
Min	4.57	4.11	7.12	9.43	13.41	16.28	18.64	17.08	14.26	10.54	5.59	2.95



FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — B170



MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — B170

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001					17.6		20.4	20.4	17.9	12.6		
2002					15.2	18.7	21.6	19.7	17.1	12.7	9.3	
2003					14.5	20.0	21.8	20.4	17.4	14.3	7.3	
2004		8.2	11.3	13.2	16.3	19.0	22.4	22.1	17.7	14.3	9.0	6.9
2005	5.7	6.9	10.3	11.7	15.7	17.1	21.1	20.6	16.1	13.9	8.1	5.7
2006	8.3	7.3	8.7	12.6	15.8	18.3	21.6	19.5	16.4	12.3	9.4	6.3
2007	5.1	7.8	10.6	12.0	16.3	18.3	20.9	18.9	16.6	12.1	8.4	6.2
2008	5.3	7.1	8.8	10.4	14.9	16.8	19.8	19.1	16.5	11.4	9.5	5.5
2009	4.7	5.8	8.2	12.0	15.0	18.8	20.7	19.0	17.1	11.7	8.7	3.5
2010	8.1	8.9	9.9	12.4	13.9	15.5	19.7	19.2	16.6	12.2	9.5	7.6
2011	7.4	6.4	9.0	10.5	13.4	17.2	19.2	20.0	17.3	12.9	8.5	4.3
2012	6.4	7.5	8.5	12.3	15.2	17.0	20.4	20.2	16.5	12.7	9.6	7.3
2013	4.6	7.6	9.5	12.3	15.7	18.2	20.6	20.2	18.1	11.4	10.0	4.5
2014	5.5	7.1	10.2	12.5	16.8	18.3	21.8	20.8	17.8	14.7	9.8	8.3
2015	7.5	9.9	11.5	12.5	16.6	19.9	21.3	19.7	15.9	13.9	9.6	8.0
2016	8.0	9.5	10.9	14.6	16.8	18.8	19.5	19.6	16.2	13.5	11.9	5.9
2017	3.6	7.2	10.1	11.9	17.3	19.4	21.2	20.2	16.9	12.3	9.5	5.0
2018	8.1	7.1	9.6	12.6	17.8	18.6	21.1	20.2	16.0	12.5	7.9	7.4
median	6.7	7.6	9.7	12.3	15.8	18.3	20.8	20.0	16.8	12.9	9.1	6.6

Key

T in °C
- T ≤ 4.7
- 4.7 < T ≤ 6.3
- 6.3 < T ≤ 7.3
- 7.3 < T ≤ 8.2
- 8.2 < T ≤ 9.5
- 9.5 < T ≤ 11.3
- 11.3 < T ≤ 13.3
- 13.3 < T ≤ 18.2
- 18.2 < T ≤ 20.6
- 20.6 < T ≤ 21.6
- T > 21.6

T as percentile
- T ≤ 5th
- 5th < T ≤ 10th
- 10th < T ≤ 15th
- 15th < T ≤ 20th
- 20th < T ≤ 30th
- 30th < T ≤ 40th
- 40th < T ≤ 50th
- 50th < T ≤ 75th
- 75th < T ≤ 90th
- 90th < T ≤ 95th
- T > 95th

Distribution and 2018

- Temperatures in 2018 were above average in mid-January, late April through most of May, and late October through early November. New record high daily mean temperatures were set in all three of these time periods.
- New high daily mean temperature records were set for seven days between April 25 and May 15.
- Intermittent periods of high temperature also occurred from June through early August, although they were not usually record-setting.
- The highest temperatures occur in July and August.
- The lowest temperatures occur in December and January.

Trends

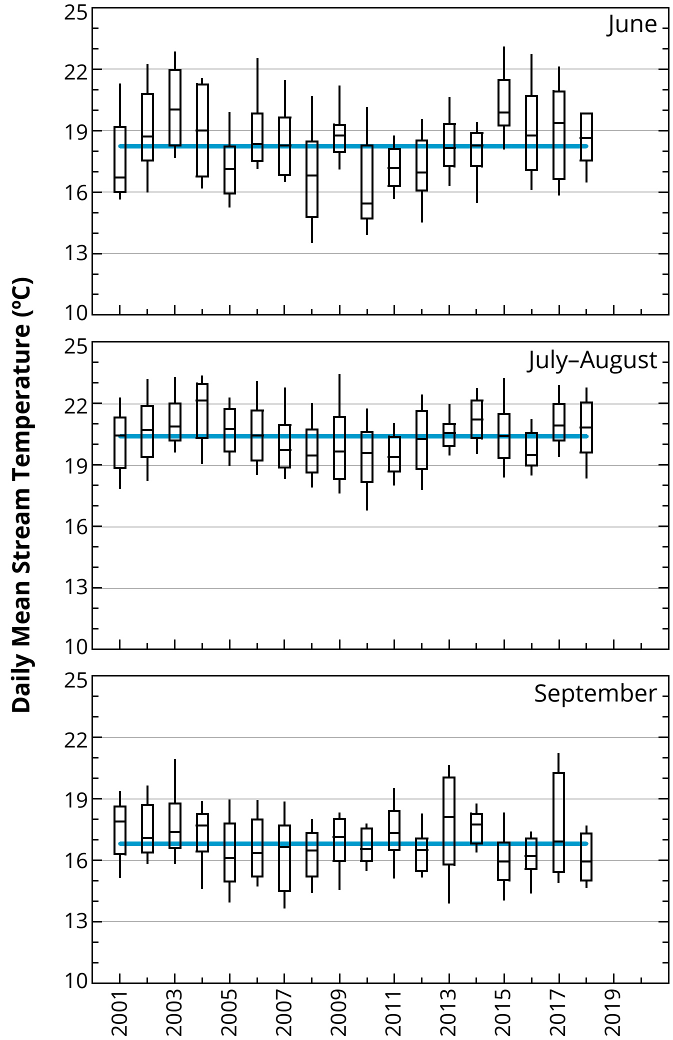
- Water temperatures in June, July–August and September do not show any statistically significant trends.
- The year-to-year variability is considerable, especially in June.
- The first day when the temperature standard is exceeded appears to be occurring earlier. The trend is statistically significant.
- No trend was evident in number of days with temperature standard exceedances.

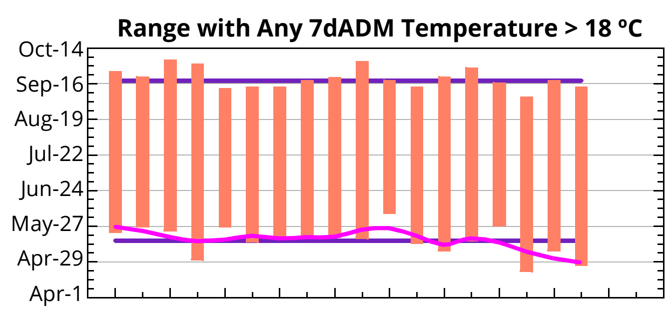
Oregon water temperature standard

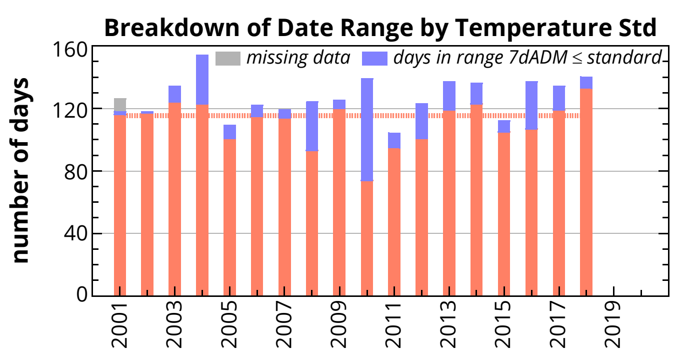
- Exceedances of the water temperature standard occurred in all years.
- Days when the 7dADM did not exceed the standard always occurred within the date range of exceedances, but in most years were a minor fraction.

fraction of years with any exceedance	100%
median days/year exceeding standard	116
average first day of exceedance (if it occurred)	May-16
average last day of exceedance (if it occurred)	Sep-19

- In 2001, 7dADM could not be computed for 8 days in June because of gaps in the temperature data. Based on data from the surrounding days, most of these days likely had 7dADMs that exceeded the temperature standard.







RCBR – ROCK CREEK AT BROOKWOOD AVENUE, HILLSBORO, OR – 453030122560101

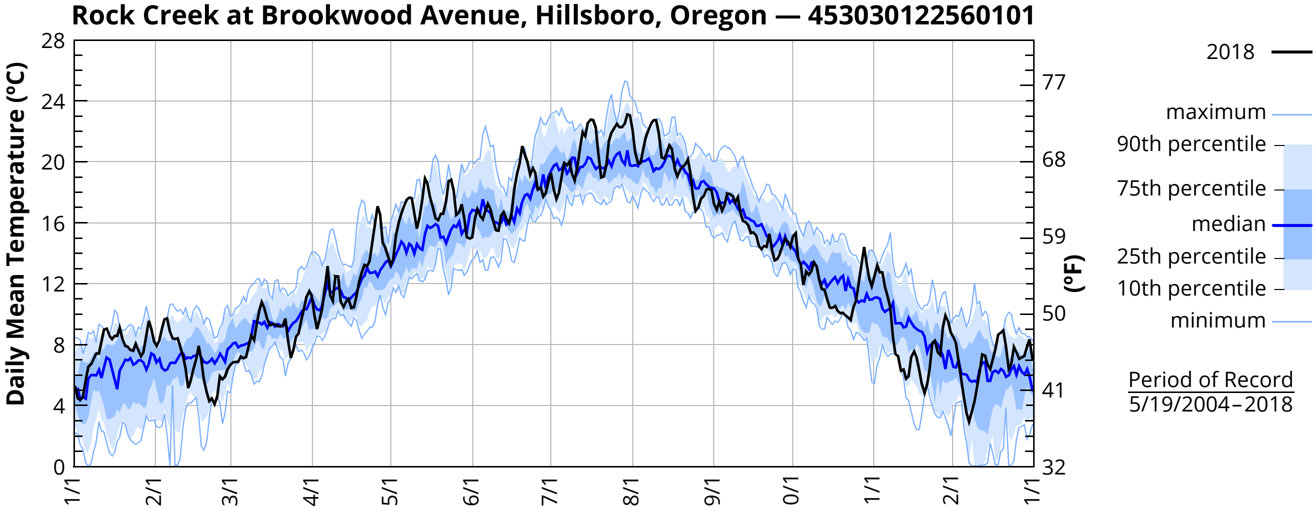
Data source: U.S. Geological Survey, Oregon Water Science Center

River mile: 2.4 *Latitude:* 45 30 30 *Longitude:* 122 56 01

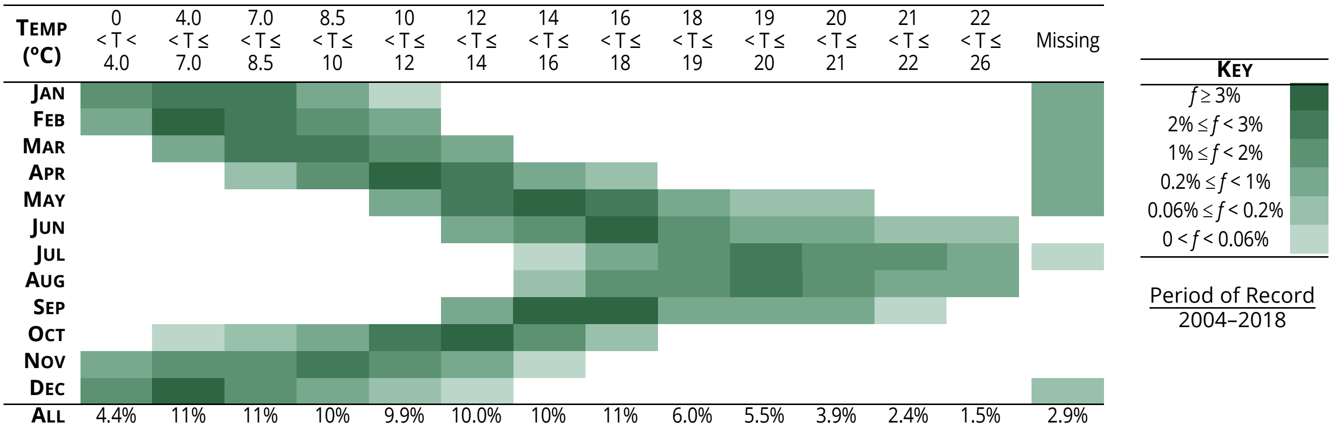
2018 — DAILY MEAN WATER TEMPERATURE (°C) — RCBR

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	5.23	7.92	6.70	11.21	13.24	15.06	19.27	22.12	17.19	15.14	12.49	8.47
2	4.49	8.32	6.84	9.89	13.65	16.23	18.17	20.66	16.84	15.33	13.21	8.08
3	4.39	9.05	6.86	9.03	15.12	16.87	17.57	19.91	17.39	13.62	12.75	6.96
4	4.59	9.67	6.89	9.67	15.99	16.49	18.02	19.91	16.81	13.25	12.75	5.70
5	5.70	9.74	7.23	10.40	16.59	16.23	18.97	20.78	17.21	11.93	11.79	4.50
6	6.55	8.83	7.11	11.80	17.08	16.77	19.92	21.59	17.90	12.81	11.18	3.53
7	6.71	8.41	7.19	13.16	17.48	17.24	19.77	22.14	17.88	12.60	10.40	2.93
8	7.08	8.37	7.91	11.21	17.66	16.88	20.04	22.53	17.77	12.83	8.50	3.63
9	7.42	8.43	8.58	10.86	17.62	16.11	19.20	22.73	17.34	13.39	7.36	4.28
10	7.40	7.87	8.29	12.50	16.67	15.49	18.76	22.71	17.70	13.11	7.25	5.25
11	8.18	7.25	9.34	12.48	15.63	15.47	19.72	21.87	16.69	12.21	6.30	6.22
12	9.00	6.43	10.23	10.80	16.33	16.49	20.94	20.31	16.12	11.63	6.38	7.37
13	9.06	5.17	10.79	10.48	17.55	16.72	21.94	20.23	16.05	11.60	5.77	7.28
14	8.59	5.66	10.40	10.84	18.89	16.22	21.66	20.61	15.83	11.01	5.94	6.65
15	8.37	6.44	9.68	11.00	18.57	15.96	22.55	21.09	15.32	10.42	7.20	6.37
16	8.58	7.05	9.28	10.42	17.68	16.62	22.79	20.83	15.37	10.44	7.55	7.00
17	8.57	7.93	9.35	10.45	17.01	18.19	22.75	19.54	15.15	10.54	7.14	7.68
18	9.11	7.00	9.33	11.17	16.30	19.21	22.26	19.07	14.48	10.20	6.36	8.66
19	8.34	5.70	9.22	12.11	16.17	19.91	20.57	19.47	14.28	10.05	5.43	8.80
20	7.92	4.87	9.19	12.76	16.59	21.03	18.98	19.67	14.48	10.09	4.83	8.94
21	7.87	4.30	9.25	13.25	16.58	20.49	19.04	19.84	14.42	9.91	5.41	7.94
22	7.66	4.47	9.72	13.17	17.39	20.03	19.76	20.18	15.29	9.78	6.47	6.43
23	7.59	4.08	8.32	13.49	18.72	19.16	21.35	19.28	14.19	9.61	8.12	6.75
24	8.05	4.61	7.14	14.61	18.83	19.60	21.92	17.72	13.54	10.51	8.27	7.84
25	7.64	5.94	7.65	15.93	18.10	19.25	22.24	16.78	13.62	10.94	7.51	7.50
26	7.24	5.72	8.55	17.09	16.52	18.18	22.51	17.03	13.94	12.06	7.32	7.08
27	7.52	5.90	8.74	16.55	16.69	18.31	22.27	17.57	14.53	13.15	9.12	7.18
28	8.62	6.41	9.66	14.67	17.22	17.72	22.28	17.75	14.97	14.42	9.90	7.27
29	9.57	—	10.35	14.29	16.32	17.98	22.52	18.19	14.78	13.28	9.48	7.84
30	9.03	—	11.16	13.80	15.05	18.69	23.12	18.23	14.41	12.35	8.77	8.36
31	8.21	—	11.50	—	14.97	—	23.06	18.13	—	11.84	—	7.08
Mean	7.56	6.84	8.79	12.30	16.72	17.62	20.77	19.95	15.72	11.94	8.37	6.76
Max	9.57	9.74	11.50	17.09	18.89	21.03	23.12	22.73	17.90	15.33	13.21	8.94
Min	4.39	4.08	6.70	9.03	13.24	15.06	17.57	16.78	13.54	9.61	4.83	2.93

Rock Creek at Brookwood Avenue, Hillsboro, Oregon — 453030122560101



FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — RCBR



MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — RCBR

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2004						18.4	21.3	20.5	16.5	13.7	8.5	6.4
2005	5.4	6.1	9.8	11.3	15.3	16.4	20.0	19.8	15.1	13.4	7.6	5.7
2006	8.1	6.6	8.3	12.4	15.0	17.6	20.3	18.4	15.7	11.5	9.2	6.0
2007	4.3	7.6	9.9	11.4	14.9	16.8	19.8	18.3	16.0	11.8	8.0	6.3
2008	4.4	6.5	8.3	9.9	14.7	15.6	19.0	18.8	15.9	10.5	9.4	4.9
2009	4.3	4.8	7.9	11.6	14.6	18.0	20.4	19.0	16.6	11.4	8.6	3.2
2010	7.9	8.6	9.3	11.9	13.6	15.0	18.6	18.3	16.3	11.5	9.3	7.3
2011	7.1	6.0	8.6	10.1	12.9	16.2	18.1	18.9	16.8	12.8	8.0	3.9
2012	6.0	7.1	7.9	11.6	14.4	16.4	19.5	19.5	15.7	12.1	9.2	7.1
2013	4.0	7.0	9.2	12.1	15.0	17.4	19.5	19.9	18.1	10.6	9.6	3.9
2014	4.9	6.9	9.7	12.3	16.1	17.4	20.9	20.4	17.4	14.6	9.5	8.2
2015	7.1	9.4	11.2	12.0	15.5	19.1	21.0	19.7	15.4	13.4	9.5	7.6
2016	7.7	8.8	10.4	13.7	15.8	17.7	18.9	19.1	15.8	13.4	11.9	5.5
2017	3.0	6.8	9.7	11.3	16.0	18.2	20.0	20.0	16.3	11.7	9.1	4.7
2018	7.9	6.7	9.2	12.0	16.7	17.1	20.9	19.9	15.3	11.9	7.5	7.1
median	6.1	7.0	9.2	11.7	15.1	17.2	19.8	19.4	16.1	12.4	8.9	6.1

KEY

T in °C
- T ≤ 4.2
- 4.2 < T ≤ 5.7
- 5.7 < T ≤ 6.8
- 6.8 < T ≤ 7.6
- 7.6 < T ≤ 8.9
- 8.9 < T ≤ 10.4
- 10.4 < T ≤ 12.4
- 12.4 < T ≤ 17.2
- 17.2 < T ≤ 19.7
- 19.7 < T ≤ 20.7
- T > 20.7

T as percentile
- T ≤ 5th
- 5th < T ≤ 10th
- 10th < T ≤ 15th
- 15th < T ≤ 20th
- 20th < T ≤ 30th
- 30th < T ≤ 40th
- 40th < T ≤ 50th
- 50th < T ≤ 75th
- 75th < T ≤ 90th
- 90th < T ≤ 95th
- T > 95th

Distribution and 2018

- Temperatures in 2018 were above average in mid-January, late April through most of May, and late October through early November. New record high daily mean temperatures were set in all three of these time periods.
- New high daily mean temperature records were set for nine days between April 25 and May 25.
- Intermittent periods of high temperature also occurred from June through early August. Record were set for high daily mean temperature in June (1 day), July (4 days) and August (3 days).
- The highest temperatures occur in July and August.
- The lowest temperatures occur in December and January.

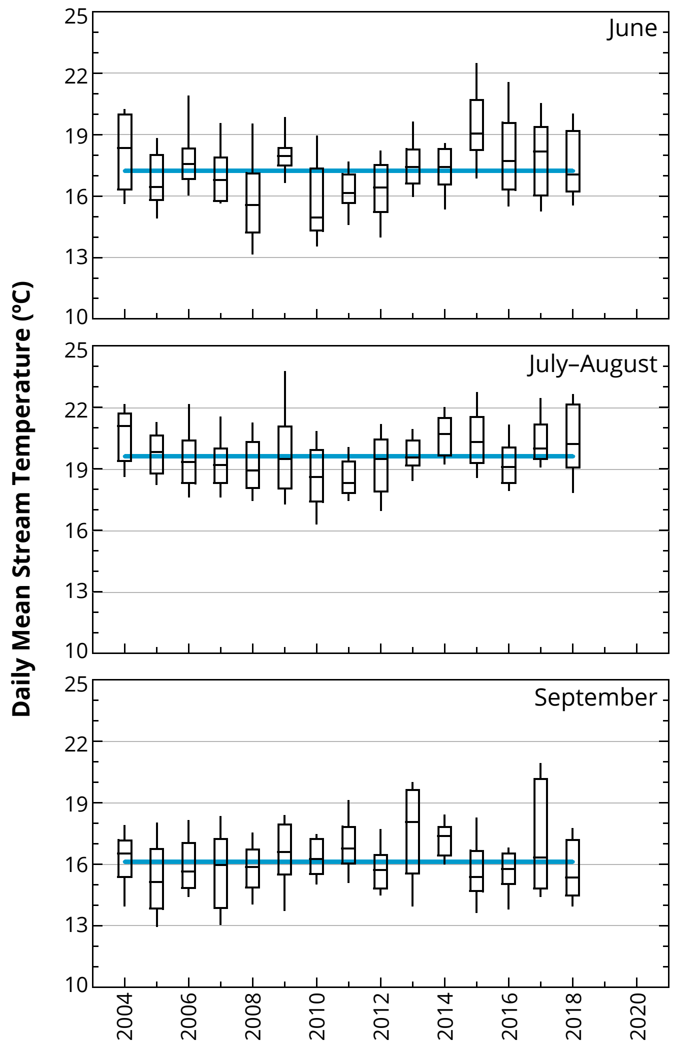
Trends

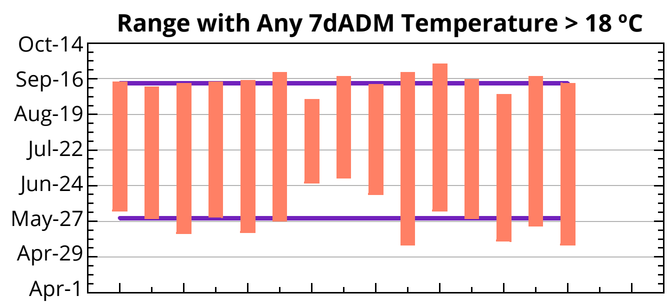
- Water temperatures in June, July–August and September do not show any statistically significant trends.
- No trend was evident in the timing of or number of days with temperature standard exceedances.

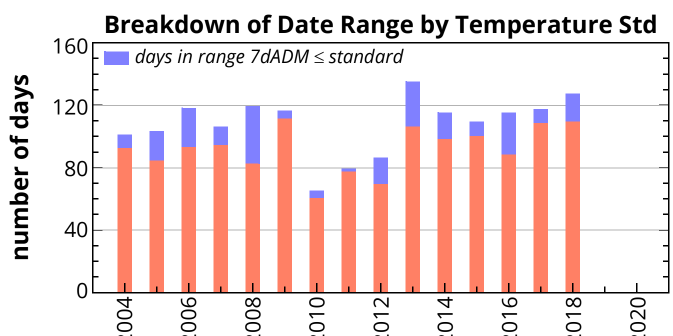
Oregon water temperature standard

- Exceedances of the water temperature standard occurred in all years.
- Days when the 7dADM did not exceed the standard frequently occurred within the date range of exceedances, but were a minor fraction.

fraction of years with any exceedance	100%
median days/year exceeding standard	94
average first day of exceedance (if it occurred)	May-30
average last day of exceedance (if it occurred)	Sep-13







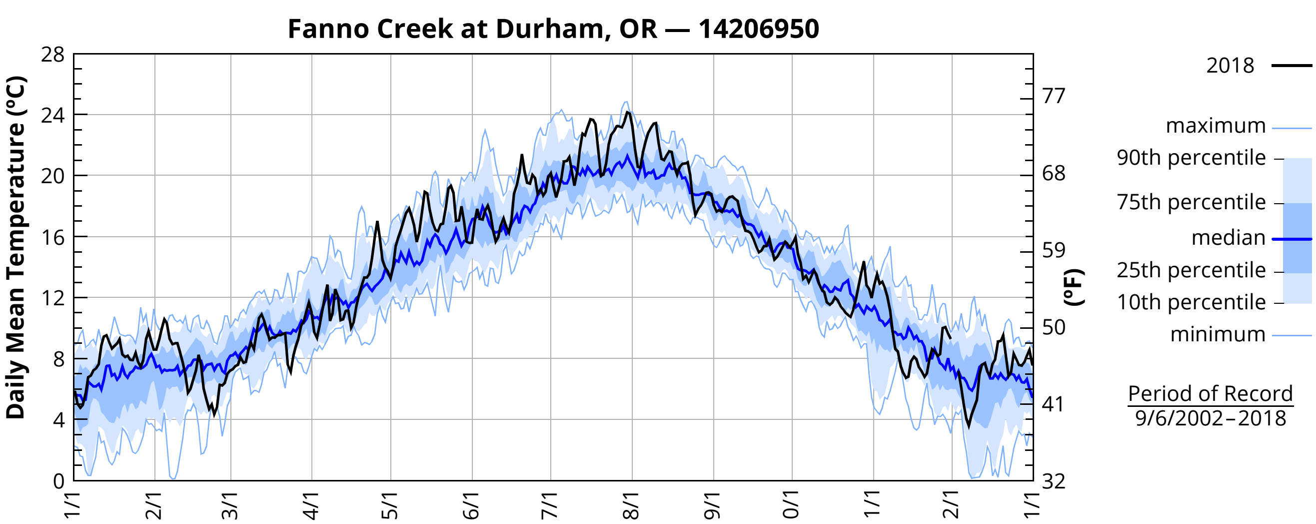
FANO – Fanno Creek at Durham, OR – 14206950

Data source: U.S. Geological Survey, Oregon Water Science Center

River mile: 1.2 *Latitude:* 45 24 13 *Longitude:* 122 45 13

2018 — DAILY MEAN WATER TEMPERATURE (°C) — FANO

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	5.82	8.59	7.22	11.04	13.24	15.60	20.16	23.24	18.02	15.63	12.80	
2	5.01	9.24	7.31	9.70	13.99	16.96	19.23	21.80	17.63	15.98	13.52	
3	4.76	9.94	7.51	9.34	15.35	17.81	18.55	20.58	17.74	14.83	12.91	7.19
4	4.95	10.55	7.59	10.11	15.98	17.16	19.14	20.52	17.62	14.27	13.04	6.13
5	5.71	10.31	8.05	11.05	16.46	17.12	19.80	21.50	17.93	13.23	12.63	4.99
6	6.77	9.26	7.73	12.07	17.02	17.72	20.91	22.20	18.41	13.41	12.07	4.06
7	6.88	8.95	7.79	12.85	17.57	18.04	20.96	22.83	18.59	13.02	11.12	3.61
8	7.22	9.01	8.56	10.47	17.85	17.55	21.23	23.13	18.63	13.39	9.75	4.36
9	7.35	9.00	9.03	10.97	17.35	16.38	20.30	23.40	18.45	13.78	8.62	4.82
10	7.63	8.41	8.60	12.56	16.71	15.68	19.33	23.44	18.33	13.47	8.45	5.29
11	8.83	7.71	9.61	12.04	15.64	15.97	20.26	22.15	17.60	12.87	7.51	6.97
12	9.44	6.93	10.67	10.52	16.28	16.77	21.71	21.10	16.93	12.51	7.03	7.60
13	9.52	5.78	10.89	10.57	17.72	17.21	22.75	21.01	16.37	12.35	6.74	7.71
14	9.04	6.02	10.48	11.12	18.93	16.63	22.61	21.33	16.33	11.68	6.83	7.13
15	8.65	6.66	9.83	11.15	18.84	16.26	23.15	21.58	16.20	11.53	7.82	6.90
16	8.81	7.21	9.23	10.03	17.71	17.01	23.69	21.54	15.85	11.68	8.12	7.67
17	8.99	8.24	9.39	10.41	16.87	18.79	23.65	20.55	15.34	12.01	7.95	7.95
18	9.28	7.58	9.36	11.40	16.43	19.38	23.33	20.07	14.96	11.85	7.41	9.10
19	8.24	6.02	9.52	12.13	16.35	20.18	21.63	20.55	15.07	11.47	7.15	9.15
20	8.10	5.28	9.53	12.78	16.80	21.42	19.99	20.77	15.36	11.25	6.79	9.56
21	8.18	4.70	9.61	13.32	16.84	20.28	20.08	20.78	15.37	10.99	7.05	8.25
22	7.91	5.00	9.65	13.32	17.90	19.53	20.78	20.88	15.88	10.85	8.00	6.86
23	7.90	4.37	7.58	13.56	19.14	19.47	22.03	20.00	15.20	10.74	8.61	7.13
24	8.39	4.87	7.12	14.55	19.31	20.05	22.67	18.35	14.48	11.26	8.46	8.32
25	7.76	6.27	8.15	15.98	18.86	19.85	22.92	17.43	14.66	11.90	8.17	7.96
26	7.43	6.24	8.79	17.02	17.03	18.82	23.25	17.82	14.95	12.77	8.30	7.58
27	7.90	6.40	9.29	15.88	17.04	19.11	23.23	18.03	15.31	13.57	10.02	7.53
28	9.28	7.01	10.19	14.46	17.99	18.69	23.15	18.41	15.66	14.38	10.08	7.76
29	9.78	—	10.44	13.94	16.99	18.94	23.60	18.85	15.51	12.80	9.62	8.21
30	9.14	—	11.09	13.69	15.66	19.88	24.15	18.89	15.28	12.57	9.28	8.58
31	8.58	—	11.67	—	15.57	—	24.06	18.79	—	11.96	—	7.61
Mean	7.85	7.34	9.08	12.27	16.95	18.14	21.69	20.69	16.46	12.71	9.20	7.10
Max	9.78	10.55	11.67	17.02	19.31	21.42	24.15	23.44	18.63	15.98	13.52	9.56
Min	4.76	4.37	7.12	9.34	13.24	15.60	18.55	17.43	14.48	10.74	6.74	3.61



FREQUENCY OF DAILY MEAN TEMPERATURE BY MONTH — FANO

TEMP (°C)	0 < T < 5.0	5.0 < T ≤ 7.0	7.0 < T ≤ 8.5	8.5 < T ≤ 10	10 < T ≤ 12	12 < T ≤ 14	14 < T ≤ 16	16 < T ≤ 18	18 < T ≤ 19	19 < T ≤ 20	20 < T ≤ 21	21 < T ≤ 22	22 < T ≤ 25	Missing
JAN														
FEB														
MAR														
APR														
MAY														
JUN														
JUL														
AUG														
SEP														
OCT														
NOV														
DEC														
ALL	5.5%	8.8%	11%	11%	11%	10%	11%	11%	6.1%	5.2%	4.9%	4.2%	0.8%	0.03%

KEY
$f \geq 3\%$
$2\% \leq f < 3\%$
$1\% \leq f < 2\%$
$0.2\% \leq f < 1\%$
$0.06\% \leq f < 0.2\%$
$0 < f < 0.06\%$

Period of Record
2003–2018

MEDIAN OF DAILY MEAN TEMPERATURE BY MONTH AND YEAR — FANO

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2002									15.7	12.0	9.1	7.1
2003	7.8	7.8	10.0	11.9	14.0	17.8	20.3	19.5	16.5	14.1	7.1	7.6
2004	6.3	7.9	11.0	12.5	15.5	18.1	21.1	20.8	16.7	13.8	9.0	6.9
2005	5.6	6.7	10.0	11.5	15.4	16.3	20.0	19.7	15.6	13.7	8.0	5.9
2006	8.3	7.0	8.6	12.3	15.1	17.4	20.3	18.6	15.8	11.8	9.6	6.4
2007	5.0	7.6	10.3	11.6	14.8	16.9	20.0	18.6	16.6	12.1	8.8	6.6
2008	5.6	7.2	8.5	9.8	14.5	15.8	19.4	18.9	16.1	11.2	9.9	5.6
2009	4.9	5.8	8.0	11.7	14.9	18.0	20.8	19.1	17.0	11.8	8.9	4.1
2010	8.1	8.8	9.7	12.0	13.7	15.0	19.1	19.0	16.4	12.1	9.6	7.4
2011	7.6	6.2	8.8	10.4	13.1	16.2	18.1	19.5	17.1	13.2	8.6	4.5
2012	6.6	7.5	8.2	12.2	14.8	16.6	19.7	19.6	16.4	12.6	9.8	7.4
2013	4.2	7.5	9.4	12.3	15.2	17.8	20.0	20.3	18.2	11.4	9.9	4.9
2014	5.8	7.0	10.0	12.6	16.5	17.7	21.4	21.0	17.9	14.7	9.8	8.2
2015	7.4	9.8	11.7	12.5	15.7	20.0	21.8	20.4	16.2	14.2	9.6	8.0
2016	7.9	9.4	10.6	14.1	16.2	18.4	19.3	20.3	16.6	13.5	11.9	6.0
2017	3.2	7.0	9.9	11.6	15.9	18.4	20.5	20.5	17.0	12.4	9.6	5.4
2018	8.1	7.1	9.3	12.1	17.0	17.9	21.7	20.8	16.0	12.6	8.5	7.6
median	6.7	7.5	9.6	12.0	15.2	17.5	20.2	19.8	16.6	12.8	9.2	6.7

KEY
T in °C
T ≤ 4.9
4.9 < T ≤ 6.2
6.2 < T ≤ 7.1
7.1 < T ≤ 7.8
7.8 < T ≤ 9.1
9.1 < T ≤ 10.6
10.6 < T ≤ 12.5
12.5 < T ≤ 17.2
17.2 < T ≤ 19.9
19.9 < T ≤ 21.0
T > 21.0

T as percentile
T ≤ 5th
5th < T ≤ 10th
10th < T ≤ 15th
15th < T ≤ 20th
20th < T ≤ 30th
30th < T ≤ 40th
40th < T ≤ 50th
50th < T ≤ 75th
75th < T ≤ 90th
90th < T ≤ 95th
T > 95th

FANO – Fanno Creek at Durham, OR – 14206950

Data source: U.S. Geological Survey, Oregon Water Science Center

Distribution and 2018

- Temperatures in 2018 were above average in mid-January, late April through most of May, and late October through early November. New record high daily mean temperatures were set in all three of these time periods.
- Intermittent periods of high temperature also occurred from June through early August. New record high daily mean temperatures were set in all three months, including for seven consecutive days in July (13-18).
- The highest temperatures occur in July and August.
- The lowest temperatures occur in December and January.

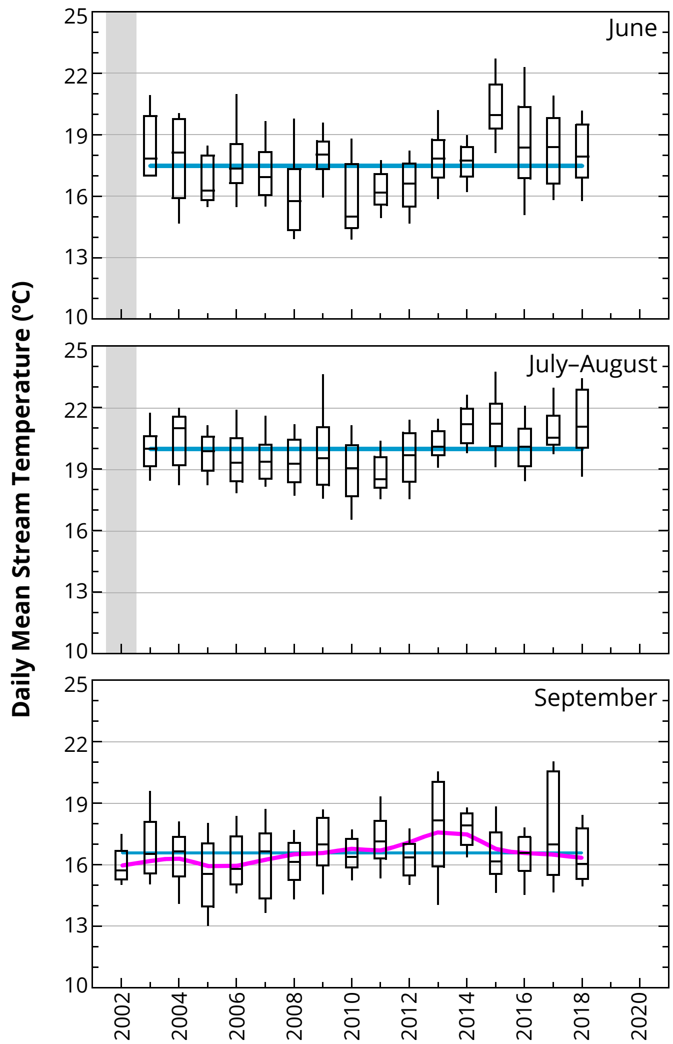
Trends

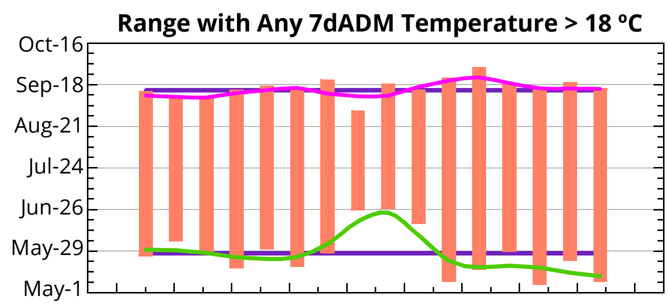
- Water temperatures in June and July–August do not show any statistically significant trends.
- Water temperatures showed an increasing trend in September that was weak, but statistically significant. The increase is small and the period of record is relatively short. More years will be required to know if this trend persists.
- Both the timing of and number of days with temperature standard exceedances may be trending. Whether the trends will persist is unknown.
- The first day when the temperature standard is exceeded is highly variable and may be occurring earlier, although the trend is not statistically significant. The last day when the temperature standard is exceeded is becoming slightly later and this trend is statistically significant.
- The number of days when the temperature standard is exceeded may be increasing, but the trend is not statistically significant.

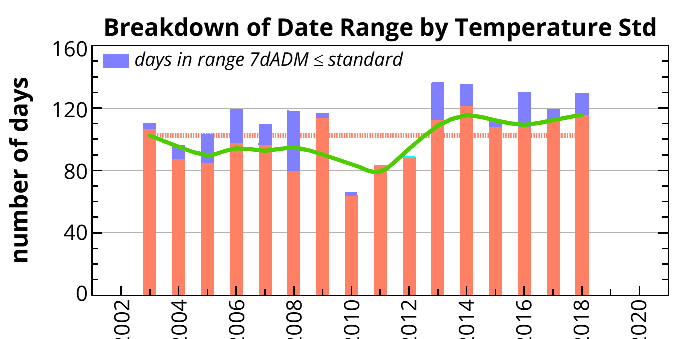
Oregon water temperature standard

- Exceedances of the water temperature standard occurred in all years.
- Days when the 7dADM did not exceed the standard frequently occurred within the date range of exceedances, but were a minor fraction.

fraction of years with any exceedance	100%
median days/year exceeding standard	103
average first day of exceedance (if it occurred)	May-27
average last day of exceedance (if it occurred)	Sep-14







DATA SOURCES

Data for the statistical distributions were obtained from the USGS database and from previous Tualatin River Flow Management Reports. For some sites, the data were collected by different organizations over the period of record; it is not known if these data are fully comparable with one another.

DATA SOURCES

SITE ID	SITE NAME	START DATE	SOURCES OF DATA FOR DISTRIBUTION
Mainstem Tualatin River and Scoggins Creek sites			
14202980	Scoggins Creek below Henry Hagg Lake near Gaston, Oregon	4/30/2002	USGS database: all (data collected by USGS)
14203500	Tualatin River at Dilley, Oregon	5/16/1997	USGS database: 2016–present; previous Flow Reports: 1997–2000 (data collected by: OWRD 1997—2007, consultant 2008–2011, USGS 2016–present)
14206241	Tualatin River at Hwy 219 Bridge	10/15/2004	Stewart Rounds, USGS pers. comm.: all (data collected by: Jackson Bottom Wetland Education Center)
14206694	Tualatin River at RM 24.5 near Scholls, Oregon	5/31/1997	USGS database: all (data collected by USGS; no data collection in winter)
14207200	Tualatin River at Oswego Dam near West Linn, Oregon	5/7/1991	USGS database: all (data collected by USGS)
Tributary sites			
453040123065201 OWRD#: 14204530	Gales Creek at Old Hwy 47 near Forest Grove, Oregon	5/9/2001	USGS database: all (data collected by USGS)
14205400	East Fork Dairy Creek near Meacham Corner, OR	9/6/2002	USGS database: all (data collected by USGS) (no data from 10/28/2004–2/15/2012)
14206070	McKay Creek at Scotch Church Rd above Waible Ck near North Plains, Oregon	1/1/2002	previous Flow Reports: all (data collected by: OWRD 2002—2007, consultant 2008–present)
453004122510301	Beaverton Creek at 170th, Beaverton, Oregon	5/11/2001	USGS database: all (data collected by: USGS 2001–WY2015, CWS WY2016–present)
453030122560101	Rock Creek at Brookwood Ave, Hillsboro, Oregon	5/19/2004	USGS database: all (data collected by USGS)
14206950	Fanno Creek at Durham Road near Tigard, Oregon	9/6/2002	USGS database: all (data collected by USGS)

Abbreviations: CWS=Clean Water Services; OWRD=Oregon Water Resources Department; USGS=United States Geological Survey; WY=water year

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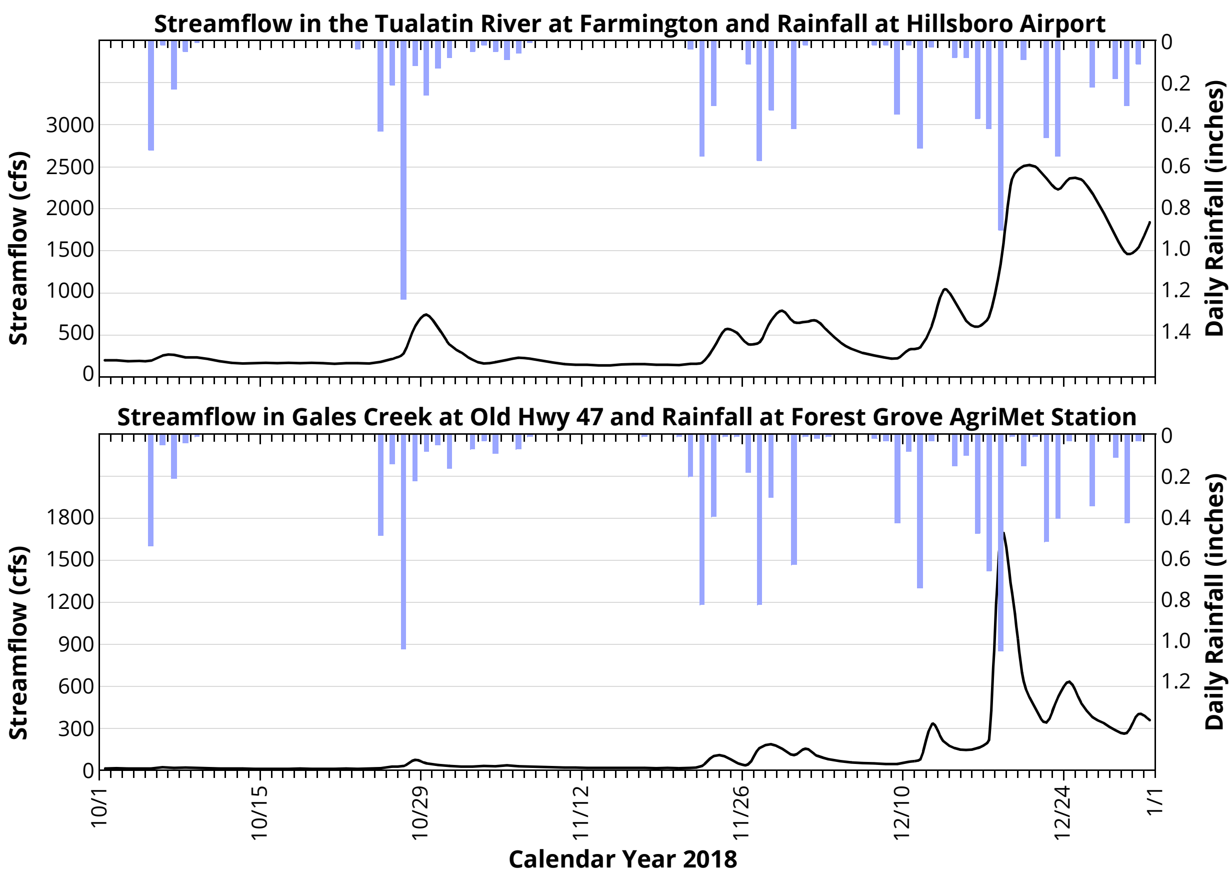
APPENDIX G
PRECIPITATION

SCOPE

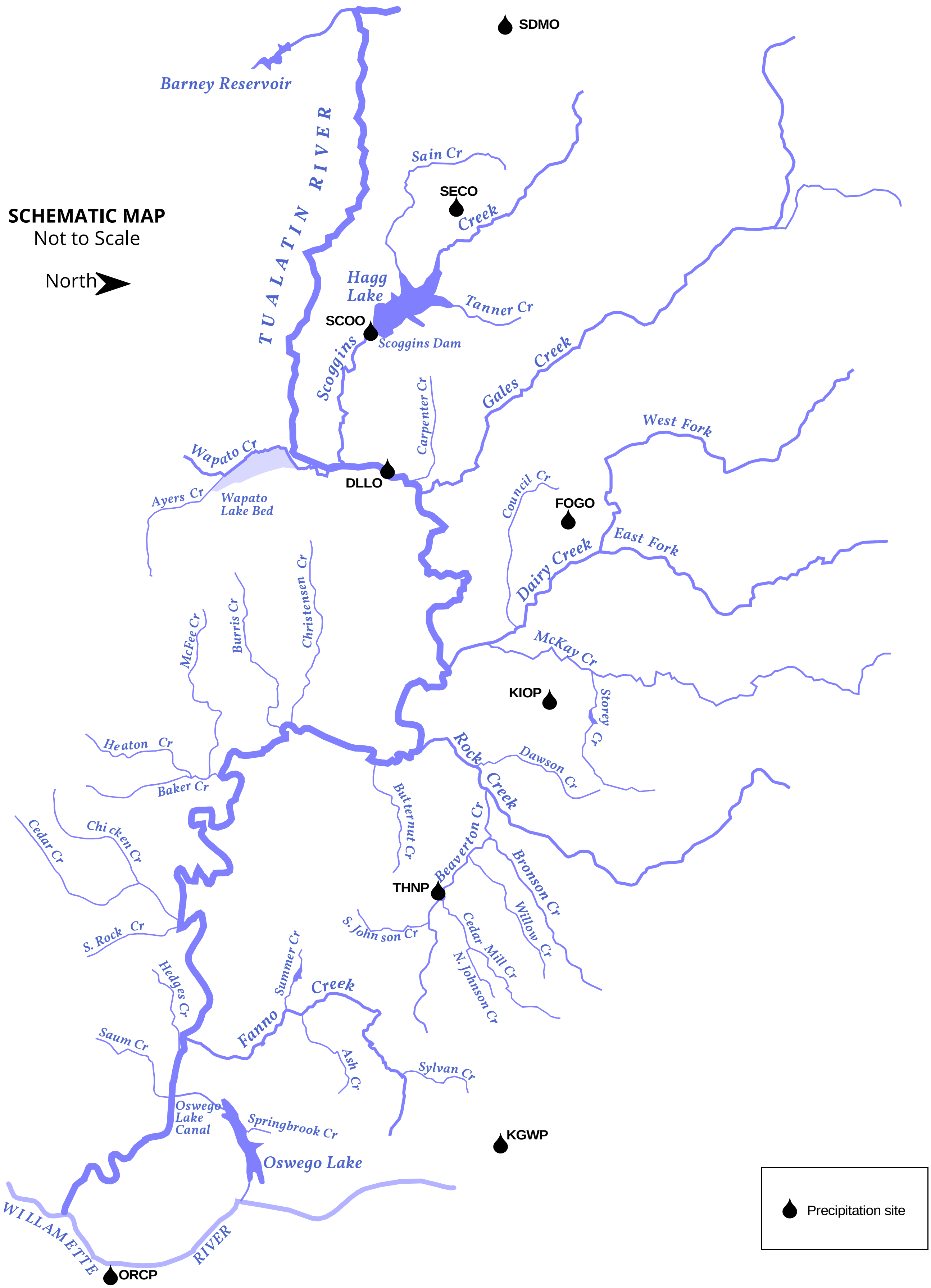
This appendix shows precipitation data for selected sites the Tualatin River Basin. Because relatively few active precipitation monitoring stations with an adequate period of record are located in the basin, three sites are located just outside the basin boundaries. Precipitation may be monitored at other sites in the basin that are not included in the Appendix. Streamflow measurements are in Appendix A.

2018 HIGHLIGHTS

- Four new precipitation sites were added to the 2018 Flow Report: Hillsboro Airport, Tualatin Hills Nature Park, KGW-TV and Oregon City. They provide data for the middle and lower parts of the basin. All are part of the NOAA-National Weather Service COOP program.
- Rainfall early in the water year (October–November 2017) was slightly above average and followed by a relatively dry December. Rainfall in February and March (2018) was slightly lower than average.
- April 2018 was wet, with precipitation generally greater than the 75th-percentile at most sites.
- May was very dry, setting the record for lowest May rainfall at some sites. June–September were also drier than average. No rainfall fell at all during July and August at most sites.
- Total rainfall for October 2018 was generally in the middle 50% of the record. November 2018 was drier than average, although not record-setting. The timing of rainfall at the beginning of WY-2019 was unusual in that the "switch" to a consistently rainy weather pattern occurred later than normal. Early storms were sporadic and followed by prolonged dry periods during which streamflows returned to dry season baseflow levels. Because of the low streamflows, water right regulation did not end until late November.



Selected Precipitation Monitoring Sites



SELECTED PRECIPITATION MONITORING SITES — ALPHABETICAL LISTING BY SITE CODE

SITE CODE	SITE NAME	ELEVATION	PAGE
DLLO	Dilley Precipitation Station (COOP ID#352325)	170	G-10
FOGO	Forest Grove, Oregon AgriMet Weather Station (Verboort)	180	G13
KHIO	Hillsboro Airport Weather Station (WBAN ID#94261)	204	G-15
KGWP	*KGW-TV Weather Station – Portland (COOP ID#356749)	159	G-19
ORCP	*Oregon City (COOP ID#356334)	167	G-21
SCOO	Scoggins Creek below Henry Hagg Lake	215	G-8
SDMO	*South Saddle Mountain Precipitation Station (SNOTEL #726)	3250	G-4
SECO	Sain Creek Precipitation Station (SNOTEL #743)	2000	G-6
THNP	Tualatin Hills Nature Park (COOP ID#355945)	185	G-17

*Stations that are not within the Tualatin Basin boundary.

Sites outside of Tualatin Basin

- South Saddle Mountain is located in the Coast Range and indicative of conditions in the headwaters and Barney Reservoir area. Because this site is at a higher elevation and on the western side of the Coast Range divide, it will receive greater rainfall than most areas in the basin.
- KGW-TV is located in downtown Portland and indicative of conditions in the northeastern part of the basin. Because this site is in the rain shadow of the Tualatin Mountains (east side), it likely receives less rain than locations in the basin which are on the west side.
- Oregon City is directly across the Willamette River from West Linn. This site is representative of the far southeastern part of the basin.

Explanation of Figures and Tables in this Appendix

One table and two graphs are included for every site. Water year, rather than calendar year, is used for precipitation data.

Page 1 (-2) –historic record: Tabled data for precipitation by month and year for the period of record.

- The monthly total was not reported if more than 3 days of data were missing.
- Data for October–December of the next water year are included to provide compatibility with the other parts of the flow report that use calendar year. This line is shaded in gray and these data were not used to compute any statistics in this appendix.
- A statistical summary for each month is at the bottom of the table. Data in the gray shaded line were not used to compute these statistics.
- In some cases this table continues on a second page.

Page 2 (3) –graphical summary: Two graphs showing the distribution of precipitation by month and year:

- *A graph of expanded boxplots of monthly total precipitation* for the period of record is at the top of the page. An explanation of the features of this graph is shown next to the graph on the right side.
- *A graph of total precipitation for each water year* for the period of record is at the bottom of the page.
  - —Bars shown in blue have up to 3 days of missing data per month.
  - —Gray bars have more than 3 days of missing data in at least one month and up to 36 days in a year.
  - —The extent to which the gray bars underestimate the total annual precipitation is unknown. If the missing data occurred during the rainy season, the bar could be significantly less than the true total. If the missing data occurred during the dry months (July–August), the bar is likely a close estimate of the total.

SDMO – South Saddle Mountain Precipitation Station

Data source: Natural Resources Conservation Service (SNOTEL #726)

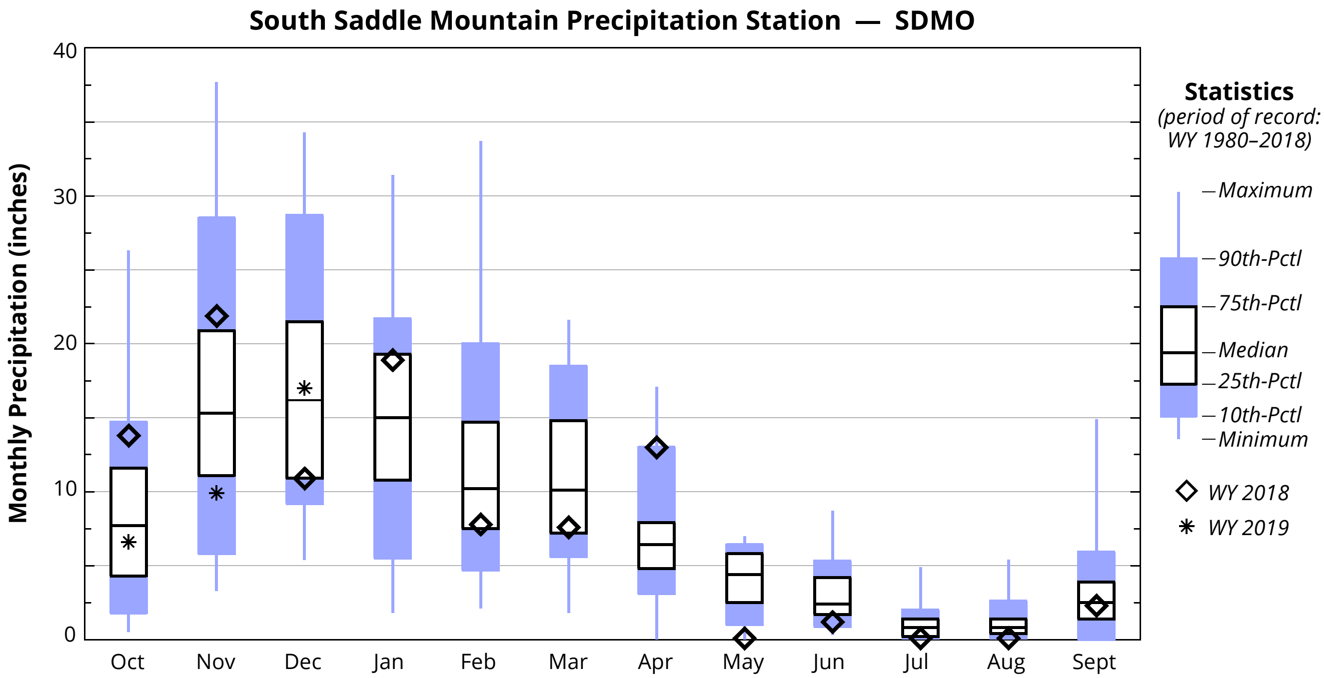
https://wcc.sc.egov.usda.gov/nwcc/rgrpt?report=precsnotelmon&state=OR

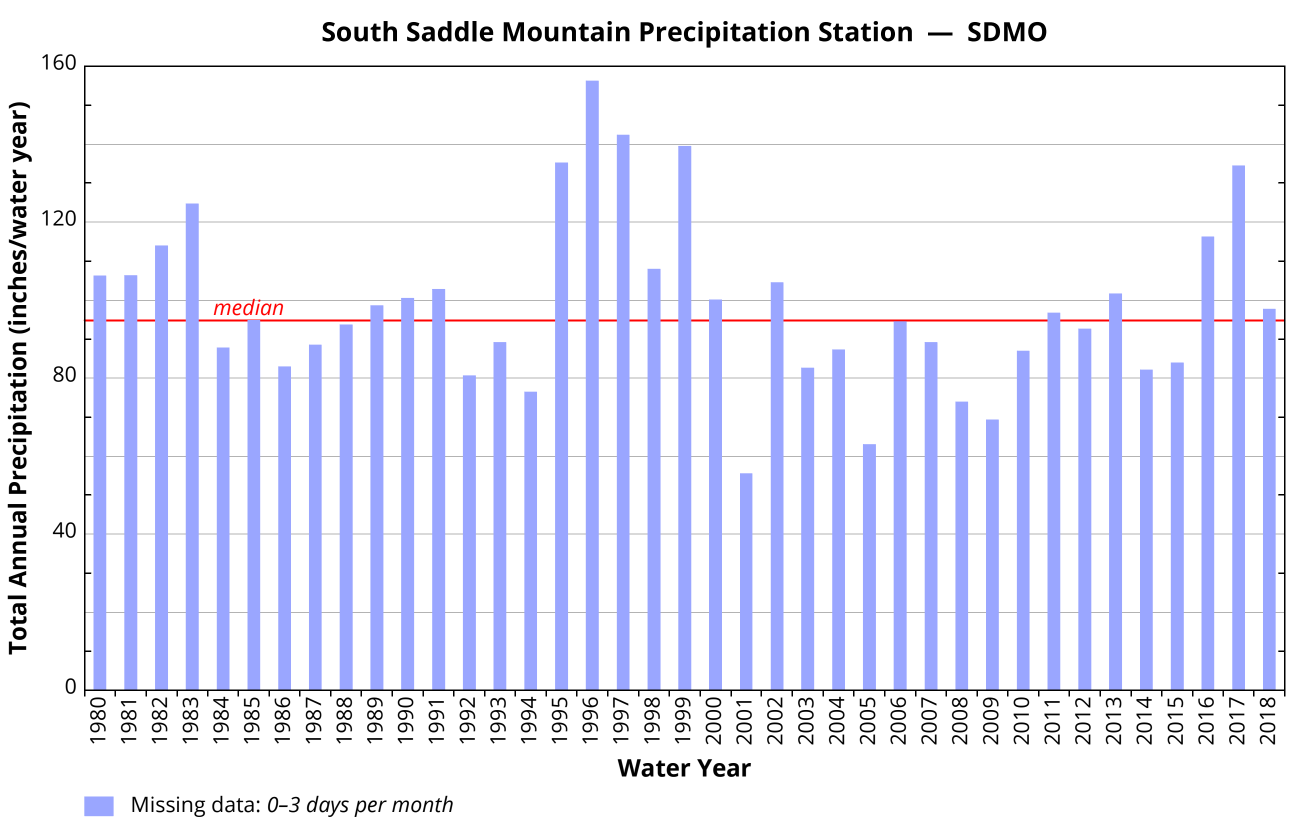
Elevation: 3250 ft Latitude: 45 31 48 Longitude: 123 22 12

MONTHLY TOTAL PRECIPITATION (inches) — SDMO

Water Year*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1980	10.8	7.5	19.2	19.3	11.2	10.1	6.5	6.4	8.7	1.0	0.6	4.9
1981	4.2	19.3	26.8	5.2	18.6	7.5	7.9	4.1	7.2	0.4	0.7	4.4
1982	13.0	14.9	26.6	19.3	17.2	7.5	7.2	0.0	2.0	1.1	1.9	3.3
1983	13.4	16.7	21.5	17.3	15.2	11.5	7.1	4.3	4.7	4.9	3.4	4.7
1984	1.7	23.3	11.8	8.3	12.6	8.1	6.3	6.4	3.8	0.6	1.1	3.8
1985	11.4	28.6	12.9	1.8	10.2	11.8	4.8	1.5	4.3	0.2	1.4	5.9
1986	12.2	11.1	5.4	15.8	13.4	7.2	5.7	3.2	1.1	1.4	0.2	6.2
1987	5.3	20.2	11.1	17.1	7.7	16.0	2.3	4.9	1.1	1.7	0.2	0.9
1988	0.7	10.8	22.2	14.1	9.6	15.0	7.8	6.1	2.4	2.0	0.3	2.7
1989	2.5	28.5	11.4	14.9	10.2	17.4	5.3	2.8	1.7	1.9	2.0	0.0
1990	5.8	9.6	8.6	31.4	20.8	7.0	6.4	3.3	4.9	0.4	0.8	1.5
1991	11.4	18.7	10.0	12.7	12.7	12.1	15.3	4.4	2.7	1.0	1.2	0.6
1992	2.8	14.4	11.8	19.1	8.8	1.8	10.5	2.4	1.2	1.4	1.1	5.3
1993	6.8	13.8	16.2	10.8	3.3	12.4	13.7	6.4	3.2	1.6	0.9	0.0
1994	2.7	3.3	18.8	11.0	15.2	9.3	5.5	3.6	4.2	0.9	0.5	1.5
1995	14.7	20.9	31.0	19.7	13.5	14.8	6.8	1.5	4.3	3.0	1.3	3.7
1996	8.5	34.8	21.7	21.2	32.6	6.0	17.1	6.4	2.0	1.2	1.0	3.7
1997	11.6	16.9	34.3	17.2	7.3	20.1	8.3	5.9	5.3	2.1	2.6	10.7
1998	19.8	15.3	9.3	24.2	14.7	10.4	3.3	6.1	1.6	0.2	0.4	2.7
1999	7.7	25.9	28.7	20.3	33.7	12.9	2.8	5.0	0.9	0.2	1.3	0.0
2000	6.1	23.6	18.6	17.7	10.1	6.3	2.9	4.9	6.0	0.1	0.6	3.2
2001	4.3	5.6	9.2	5.5	4.8	6.2	6.1	5.2	3.3	1.4	3.1	0.8
2002	6.6	23.0	20.3	21.7	7.5	10.7	7.6	2.9	3.6	0.2	0.3	0.1
2003	0.5	5.8	17.2	21.5	5.4	19.5	7.5	2.3	0.3	0.3	0.4	1.9
2004	9.4	12.1	13.5	15.0	8.7	5.4	4.4	4.9	2.7	0.1	5.4	5.7
2005	7.4	5.0	10.9	9.3	2.1	11.0	6.5	5.8	2.2	1.0	0.4	1.4
2006	9.4	12.4	18.2	29.8	6.1	7.3	3.4	3.1	2.0	0.7	0.0	2.1
2007	1.9	37.7	15.1	9.0	10.3	4.9	3.7	0.5	2.0	0.9	1.1	2.1
2008	7.7	9.5	21.9	11.5	4.7	7.6	4.9	1.1	2.3	0.3	2.4	0.0
2009	6.6	11.9	10.7	11.6	4.4	7.1	4.8	7.0	0.8	0.5	1.3	2.6
2010	7.8	15.5	9.2	14.5	8.5	9.7	7.2	4.8	5.0	0.5	0.5	3.8
2011	9.1	14.1	19.1	12.3	8.2	13.8	10.0	5.1	1.7	1.4	0.1	1.8
2012	5.8	14.6	12.2	17.3	9.6	18.0	5.9	5.0	3.7	0.2	0.0	0.3
2013	14.8	19.4	19.4	4.8	5.9	5.6	6.1	6.5	2.0	0.3	1.9	14.9
2014	1.8	9.9	6.6	9.5	15.3	18.5	9.1	5.5	1.8	0.8	0.8	2.5
2015	13.5	12.1	18.4	8.8	11.4	8.3	3.7	2.5	0.6	0.2	2.0	2.4
2016	11.1	17.5	34.2	15.7	12.1	15.3	3.1	1.0	2.5	0.9	0.5	2.4
2017	26.3	18.0	14.4	11.1	20.0	21.6	11.7	4.2	3.1	0.0	0.2	3.9
2018	13.8	21.9	10.9	18.9	7.8	7.6	13.0	0.1	1.2	0.1	0.1	2.3
2019	6.6	9.9	17.0	*Data in this row are not included in statistics because water year is incomplete.*								
MIN	0.5	3.3	5.4	1.8	2.1	1.8	2.3	0.0	0.3	0.0	0.0	0.0
MAX	26.3	37.7	34.3	31.4	33.7	21.6	17.1	7.0	8.7	4.9	5.4	14.9
MEDIAN	7.7	15.3	16.2	15.0	10.2	10.1	6.4	4.4	2.4	0.8	0.8	2.5
MEAN	8.48	16.52	16.91	15.03	11.57	10.85	6.98	4.03	2.93	0.95	1.13	3.09

*Water Year (WY) begins October 1st of the previous calendar year and ends September 30th of current year.


South Saddle Mountain Precipitation Station — SDMO
Monthly Precipitation (inches)
0
10
20
30
40
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Statistics
(period of record: WY 1980–2018)
Maximum
90th-Pctl
75th-Pctl
Median
25th-Pctl
10th-Pctl
Minimum
WY 2018
WY 2019


South Saddle Mountain Precipitation Station — SDMO
Total Annual Precipitation (inches/water year)
0
40
80
120
160
median
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Water Year
Missing data: *0–3 days per month*

SECO – Sain Creek Precipitation Station

Data source: Natural Resources Conservation Service (SNOTEL #743)

https://wcc.sc.egov.usda.gov/nwcc/rgrpt?report=precsnotelmon&state=OR

Elevation: 2000 ft Latitude: 45 31 12 Longitude: 123 16 48

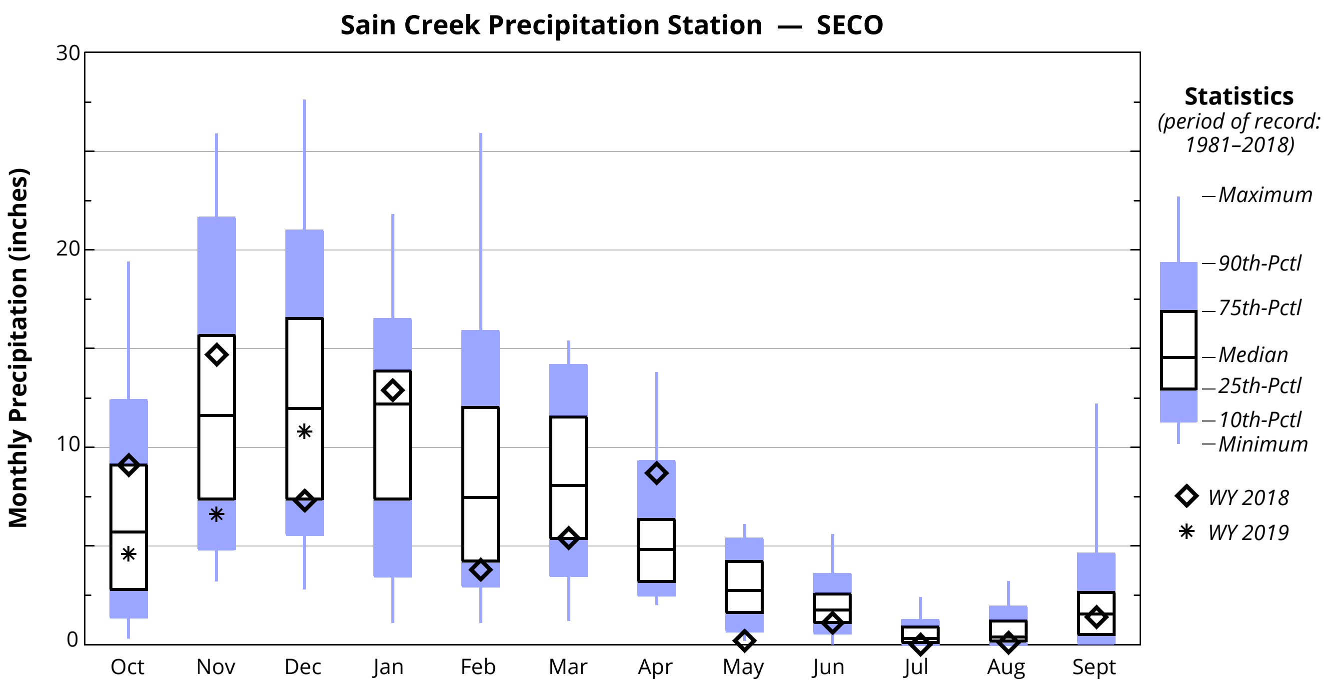
MONTHLY TOTAL PRECIPITATION (inches) — SECO

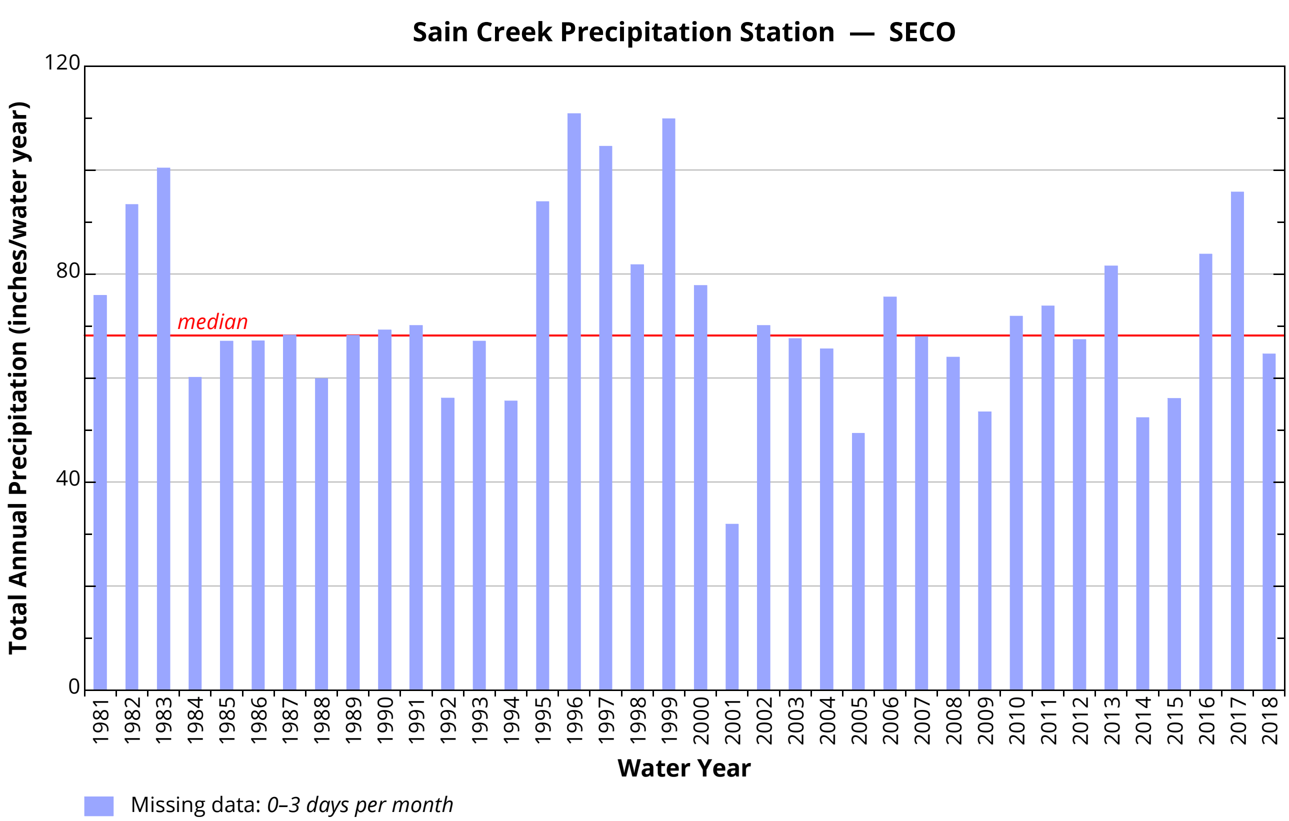
Water Year*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1981	2.3	13.5	17.8	5.8	12.8	5.3	6.0	3.6	5.6	0.0	0.2	3.0
1982	10.3	11.8	20.8	13.2	14.9	7.9	6.4	0.7	2.0	1.1	1.9	2.4
1983	11.1	11.4	17.0	15.5	17.3	14.5	6.3	2.5	3.1	1.6	0.0	0.1
1984	1.4	16.7	3.5	3.5	12.1	9.1	2.5	5.3	3.3	0.0	0.0	2.8
1985	10.4	22.6	7.0	1.1	4.0	7.9	4.3	1.4	3.5	0.1	1.6	3.2
1986	9.3	4.9	2.8	13.2	15.1	2.9	5.2	6.1	0.2	1.0	0.2	6.3
1987	4.5	15.3	8.4	12.4	6.4	12.3	3.6	3.3	0.4	1.2	0.2	0.3
1988	0.7	6.8	15.8	12.2	2.8	9.1	4.4	4.0	2.0	0.7	0.0	1.4
1989	1.3	21.5	7.4	9.1	7.3	11.6	3.7	1.7	1.9	0.9	1.7	0.1
1990	4.5	6.2	5.8	21.8	14.5	6.4	3.2	2.6	2.5	0.3	0.7	0.8
1991	8.4	10.9	6.1	7.4	9.1	8.3	12.9	2.8	2.1	0.8	0.8	0.5
1992	2.5	9.7	8.4	12.2	6.7	1.2	9.2	1.1	1.1	0.6	0.4	3.1
1993	5.0	9.3	11.9	8.9	2.0	8.8	9.9	5.7	2.7	2.4	0.5	0.0
1994	1.7	4.5	12.7	8.5	10.7	5.9	4.2	3.1	2.4	0.1	0.2	1.6
1995	13.0	13.4	16.6	16.0	9.3	11.2	5.2	1.9	2.9	1.1	0.8	2.5
1996	6.6	24.6	15.7	15.3	21.9	3.4	13.8	4.8	1.4	0.4	0.4	2.6
1997	8.4	12.7	27.6	13.3	4.7	13.7	5.6	4.8	3.4	0.4	1.9	8.1
1998	13.0	12.0	6.4	19.8	12.0	8.5	2.5	5.1	0.8	0.0	0.2	1.5
1999	5.6	20.5	22.3	16.1	25.9	11.1	2.0	4.0	1.0	0.2	1.2	0.0
2000	4.6	18.3	15.4	13.5	8.5	5.3	2.6	3.8	4.0	0.0	0.2	1.6
2001	2.9	3.7	6.4	3.2	3.1	3.7	3.7	2.4	1.1	0.3	1.2	0.2
2002	3.8	16.7	13.3	14.9	5.1	6.6	5.1	2.0	2.0	0.1	0.0	0.5
2003	0.3	7.8	16.5	15.8	4.3	14.1	5.9	1.4	0.0	0.0	0.0	1.5
2004	5.8	7.3	12.0	12.2	7.6	3.9	4.7	2.3	2.0	0.2	3.2	4.4
2005	5.6	3.2	8.3	8.4	1.1	8.5	4.9	5.3	2.5	0.4	0.2	1.0
2006	9.1	10.4	14.7	21.8	3.7	6.9	3.0	3.2	1.5	0.2	0.0	1.1
2007	1.8	25.9	12.0	6.1	9.5	4.0	3.2	0.4	1.1	1.2	0.9	1.9
2008	4.7	7.5	20.0	11.2	5.0	7.5	4.5	0.5	0.6	0.6	1.9	0.0
2009	5.8	7.4	11.3	7.9	3.0	5.9	2.9	5.3	0.8	0.0	1.3	1.9
2010	6.2	12.5	7.7	13.0	7.2	8.2	6.7	3.3	4.1	0.1	0.2	2.7
2011	7.0	10.1	16.1	7.3	6.6	12.3	7.7	2.7	1.4	1.4	0.0	1.3
2012	4.8	10.2	7.7	13.4	6.5	15.4	4.0	2.7	2.0	0.0	0.4	0.3
2013	12.3	16.8	16.6	2.1	4.0	3.5	5.3	5.9	1.2	0.2	1.5	12.2
2014	1.4	6.1	2.9	4.7	11.4	13.0	5.8	3.1	1.4	0.6	0.4	1.6
2015	9.0	7.1	11.7	6.0	8.9	6.3	2.1	1.3	0.9	0.2	1.1	1.5
2016	6.2	11.9	25.0	12.9	8.5	11.5	2.5	0.7	1.6	0.9	0.6	1.6
2017	19.4	12.7	10.2	8.7	15.7	15.1	7.7	2.1	1.3	0.3	0.1	2.5
2018	9.1	14.7	7.3	12.9	3.8	5.4	8.7	0.2	1.1	0.0	0.1	1.4
2019	4.6	6.6	10.8	*Data in this row are not included in statistics because water year is incomplete.*								
MIN	0.3	3.2	2.8	1.1	1.1	1.2	2.0	0.2	0.0	0.0	0.0	0.0
MAX	19.4	25.9	27.6	21.8	25.9	15.4	13.8	6.1	5.6	2.4	3.2	12.2
MEDIAN	5.7	11.6	12.0	12.2	7.5	8.1	4.8	2.8	1.8	0.3	0.4	1.6
MEAN	6.31	12.07	12.34	11.09	8.76	8.32	5.31	2.98	1.92	0.52	0.69	2.09

*Water Year (WY) begins October 1st of the previous calendar year and ends September 30th of current year.

SECO – Sain Creek Precipitation Station

Data source: Natural Resources Conservation Service (SNOTEL #743)





SCOO – Scoggins Creek below Henry Hagg Lake Precipitation Station

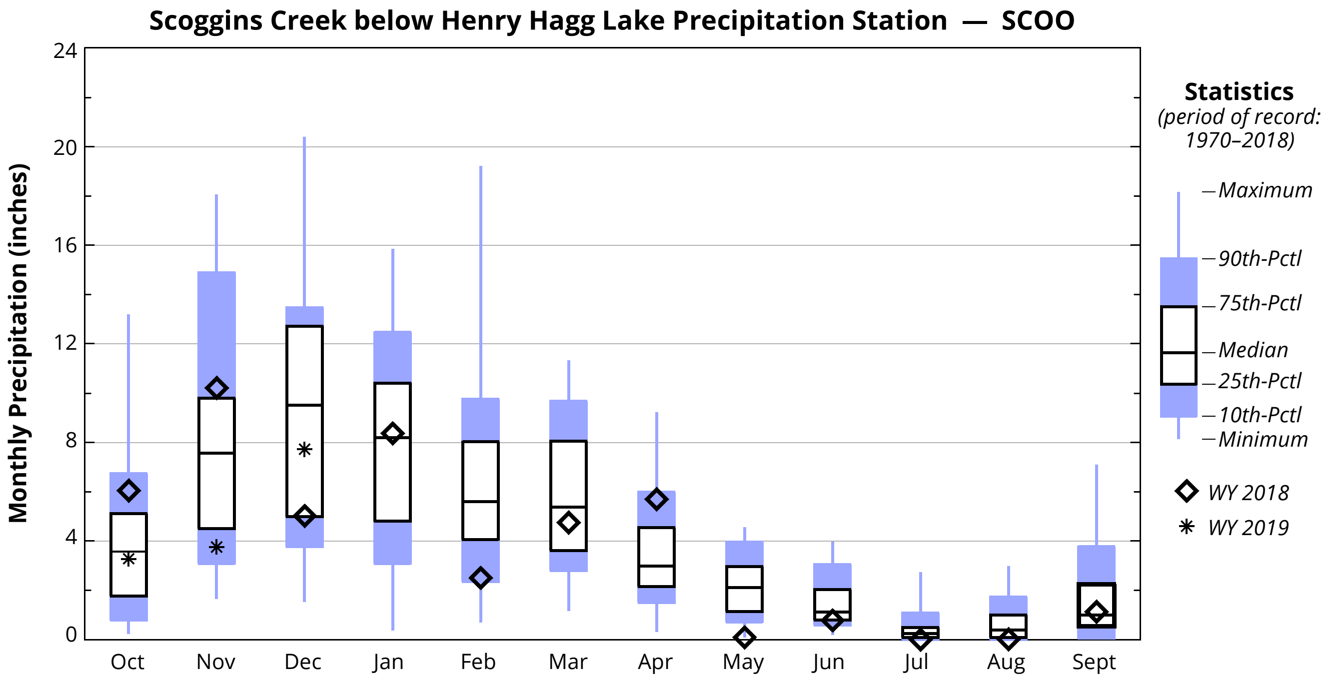
Data source: Tualatin Valley Irrigation District
data not available online

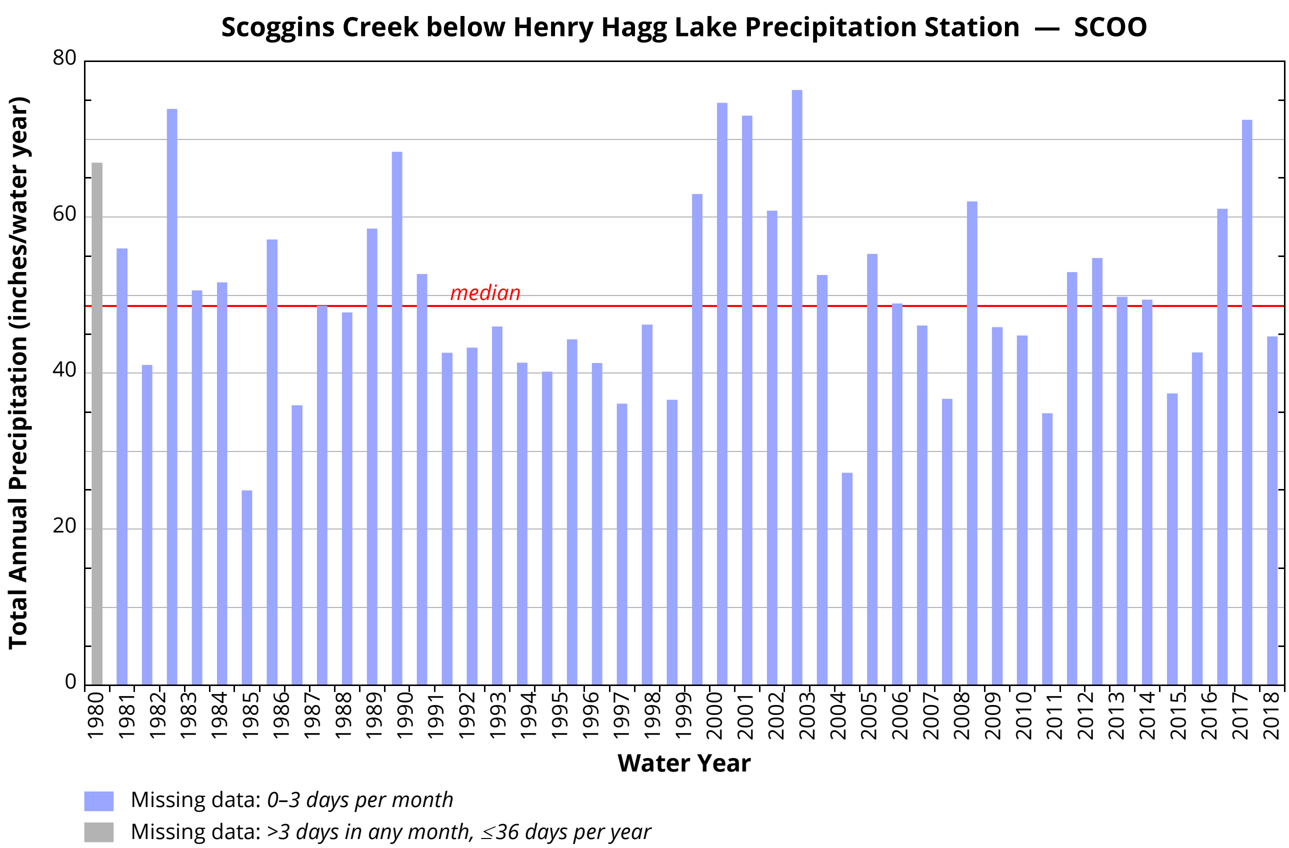
Elevation: 187.5 ft   Latitude: 45 28 10   Longitude: 123 11 56

MONTHLY TOTAL PRECIPITATION (inches) — SCOO

Water Year*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1970			8.53	15.85	6.30	3.47	3.49	1.27	0.77	0.01	0.00	1.10
1971	4.40	6.86	16.85	10.82	5.60	10.30	3.96	1.54	2.03	0.14	0.52	3.92
1972	4.02	8.68	12.12	10.20	5.05	6.79	3.92	0.92	0.58	0.28	0.25	3.12
1973	0.72	6.31	12.28	6.44	2.36	3.75	2.15	1.19	1.37	0.04	0.86	3.54
1974	3.82	18.05	14.64	12.46	7.92	9.31	3.98	1.31	0.86	1.38	0.02	0.06
1975	1.33	8.02	9.94	10.45	8.11	5.71	2.00	2.12	0.67	0.47	1.72	0.03
1976	6.69	6.38	9.50	7.68	8.25	5.98	1.81	1.63	0.48	0.70	1.80	0.69
1977	1.26	1.65	1.54	1.05	3.37	5.33	0.32	2.50	1.11	0.41	2.99	3.42
1978	2.76	8.11	13.47	7.92	6.66	2.47	5.04	2.95	1.00	0.65	2.11	3.94
1979	0.81	4.29	3.77	3.16	9.75	3.30	2.83	2.99	0.68	0.15	1.71	2.42
1980	6.69	4.25	9.21	8.30	7.13	4.09	4.38	1.10	1.81	0.22	0.05	1.37
1981	1.76	8.71	11.80	3.60	6.07	3.22	2.88	2.67	3.14	0.08	0.06	3.77
1982	5.55	6.77	13.00	7.21	8.43	4.85	6.45	0.51	1.41	0.37	1.46	2.49
1983	5.82	6.90	13.00	8.13	13.46	9.93	2.88	1.54	2.10	2.73	1.19	0.67
1984	1.34	15.16	7.91	3.09	7.92	4.81	4.05	3.95	3.34	0.00	0.00	1.13
1985	5.16	14.86	4.88	0.37	4.03	5.22	1.50	0.73	2.58	0.41	0.68	2.17
1986	4.48	4.55	2.93	9.23	8.42	4.13	2.57	2.65	0.59	1.07	0.00	2.60
1987	3.43	7.85	5.96	8.19	6.67	8.51	1.80	2.10	0.31	0.79	0.11	0.23
1988	0.23	3.09	12.51	9.46	1.67	4.50	3.32	2.78	2.59	0.15	0.09	0.89
1989	0.27	12.19	4.64	4.61	4.59	8.21	1.26	1.63	0.89	0.48	0.83	0.55
1990	2.74	4.39	3.52	13.00	8.87	2.60	2.20	3.01	2.02	0.26	1.18	0.49
1991	4.35	4.49	3.87	4.69	4.72	5.38	9.03	2.29	1.44	0.22	0.54	0.23
1992	1.80	6.31	5.74	7.72	4.66	1.16	5.63	0.09	0.71	0.42	0.35	1.47
1993	2.84	5.94	8.85	6.25	1.21	5.40	6.71	3.95	2.26	2.59	0.17	0.04
1994	1.21	1.92	9.97	6.47	7.71	3.41	2.49	0.96	1.30	0.00	0.13	0.98
1995	4.94	9.30	11.54	12.00	5.36	7.88	4.53	1.47	2.44	0.58	1.01	1.89
1996	3.70	12.24	12.17	11.53	13.61	2.81	9.23	4.49	1.59	0.58	0.34	2.32
1997	5.44	8.73	20.40	10.71	2.98	9.22	3.38	2.68	3.34	0.29	1.28	4.52
1998	8.57	9.32	4.41	14.18	9.08	6.26	2.31	4.56	0.96	0.24	0.00	0.91
1999	4.51	15.20	13.27	11.84	19.20	6.25	1.77	2.15	0.93	0.08	0.96	0.06
2000	3.13	12.68	9.50	9.02	6.51	4.08	1.40	2.94	2.26	0.03	0.19	0.81
2001	3.24	3.08	5.11	2.30	2.36	3.05	2.19	2.20	1.79	0.23	1.12	0.52
2002	3.28	12.10	11.86	11.36	4.11	5.84	2.79	1.58	1.46	0.13	0.19	0.57
2003	0.73	4.37	13.26	9.33	4.20	9.29	5.17	0.86	0.20	0.01	0.62	0.86
2004	3.34	5.26	9.92	8.84	5.96	3.11	3.12	1.63	0.90	0.00	2.01	2.00
2005	4.60	2.75	4.95	4.92	0.70	7.73	3.34	4.52	1.99	0.38	0.39	0.38
2006	5.54	8.57	12.92	15.72	4.10	6.13	3.63	2.96	1.53	0.15	0.00	0.75
2007	0.83	17.64	7.76	4.37	6.42	2.79	2.15	0.90	0.76	0.69	0.58	0.99
2008	3.91	4.68	13.42	8.69	3.30	5.03	2.50	0.92	1.25	0.02	0.98	0.09
2009	2.89	6.29	4.58	6.36	2.20	4.13	1.99	3.95	0.76	0.21	0.66	0.82
2010	3.73	8.95	5.11	10.29	5.16	5.72	5.79	3.20	3.04	0.36	0.05	1.54
2011	4.53	7.24	12.96	4.99	4.78	9.67	5.35	2.96	0.78	1.11	0.00	0.35
2012	2.29	8.12	3.93	9.33	4.53	11.32	2.99	2.94	3.98	0.25	0.02	0.04
2013	6.95	9.95	11.78	1.19	2.35	2.61	1.93	3.79	0.94	0.00	0.79	7.10
2014	1.04	3.33	2.06	3.28	8.96	9.39	4.56	2.01	0.94	0.33	0.10	1.37
2015	7.15	3.75	9.16	4.36	7.79	5.42	1.49	0.54	0.65	0.23	0.77	1.33
2016	3.35	8.38	19.38	10.36	4.97	9.21	2.39	0.72	0.97	0.29	0.29	0.71
2017	13.19	10.43	7.82	6.41	14.24	9.75	5.99	1.85	0.86	0.00	0.15	1.74
2018	6.05	10.21	5.02	8.37	2.51	4.75	5.70	0.10	0.78	0.01	0.02	1.13
2019	3.28	3.75	7.72	*Data in this row are not included in statistics because water year is incomplete.*								
MIN	0.23	1.65	1.54	0.37	0.70	1.16	0.32	0.09	0.20	0.00	0.00	0.03
MAX	13.19	18.05	20.40	15.85	19.20	11.32	9.23	4.56	3.98	2.73	2.99	7.10
MEDIAN	3.57	7.55	9.50	8.19	5.60	5.38	2.99	2.10	1.11	0.25	0.39	0.99
MEAN	3.76	7.88	9.24	7.88	6.21	5.78	3.52	2.13	1.45	0.41	0.64	1.51

*Water Year (WY) begins October 1st of the previous calendar year and ends September 30th of current year.


Scoggins Creek below Henry Hagg Lake Precipitation Station — SCOO
Monthly Precipitation (inches)
0
4
8
12
16
20
24
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Statistics
(period of record: 1970–2018)
Maximum
90th-Pctl
75th-Pctl
Median
25th-Pctl
10th-Pctl
Minimum
WY 2018
WY 2019


Scoggins Creek below Henry Hagg Lake Precipitation Station — SCOO
Total Annual Precipitation (inches/water year)
0
20
40
60
80
median
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Water Year
Missing data: *0–3 days per month*
Missing data: *>3 days in any month, ≤36 days per year*

DLLO – Dilley Precipitation Station

Data source: National Weather Service COOP Program (COOP ID#352325)
http://scacis.rcc-acis.org

Elevation: 170 ft   Latitude: 45 27 48   Longitude: 123 06 49

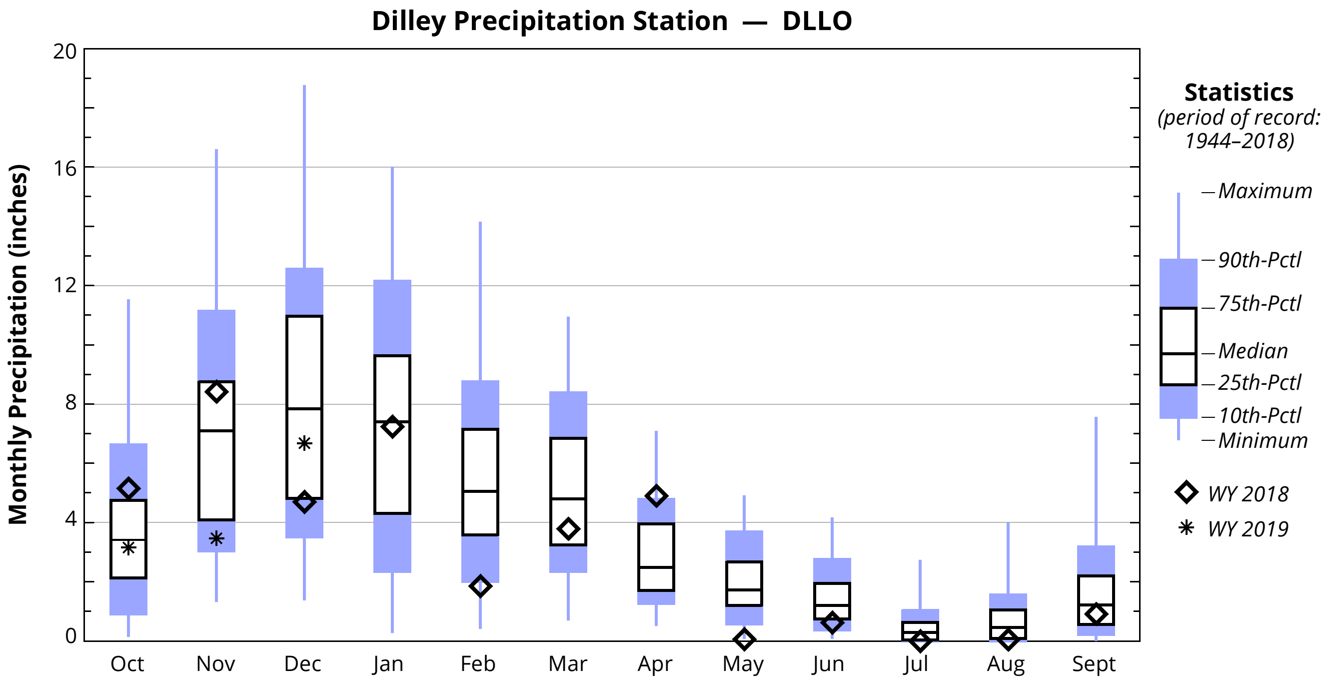
MONTHLY TOTAL PRECIPITATION (inches) — DLLO

Water Year*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1944			4.08		3.98	3.22	3.93	0.94	0.74	1.06	0.20	2.80
1945	1.56	5.50	2.74	4.13	6.99	7.18	2.09	3.71	0.22	0.20	0.13	3.17
1946	1.45	11.82	7.56	7.21	7.61	6.09	1.41	1.51	1.74			
1947			5.38	5.47	4.46	4.69	1.30	0.09	3.12	0.86	0.50	1.28
1948	9.68	4.08	4.99	7.28	7.52	4.55	3.97	4.92	0.90	0.59	1.35	2.72
1949	2.52	8.67	10.59	2.06	11.83	2.99	0.55	2.98	0.55	0.82	0.03	0.58
1950	2.48	7.55	5.93	10.43	6.58	6.77	1.46	0.48	2.19	0.54	0.84	1.13
1951	9.62	9.55	8.93	11.03	5.01	4.74	0.88	1.67	0.15	0.11	0.15	2.38
1952	6.96	7.89	9.70	7.08	5.65	4.20	1.35	0.77	2.62	0.00	0.03	0.38
1953	0.61	2.29	9.28	14.98	4.86	5.36	2.74	2.87	1.25	0.10	1.51	1.60
1954	3.55	7.37	7.40	13.80	7.32	2.95	3.26	1.33	2.06	0.56		1.97
1955	3.92	7.61	7.66	4.36	4.36	5.23	4.56	0.77	1.78	1.41	0.00	2.65
1956	6.97	10.49	12.90	13.36	4.43	7.27	0.64	1.42	1.29	0.03	1.32	1.84
1957	4.83	1.98	4.55	3.02	5.77	7.09	2.09	3.03	1.52	0.27	0.47	0.75
1958	3.55	3.77	10.90	9.29	8.50	2.62	4.24	1.05	2.96	0.02	0.00	0.59
1959	2.34	8.74	6.90	12.18	5.10	4.42	1.76	2.55	2.57	0.92	0.08	2.75
1960	2.71	4.44	4.86	6.56	6.94		4.65	4.37	4.16	0.00	0.74	0.53
1961	4.24	10.95	3.64	7.05	11.15	10.02	2.94	2.36	0.24	0.48	0.52	0.46
1962	5.98	4.95	7.67	1.61	4.14	5.78	4.79	2.43	0.44	0.00	1.43	2.08
1963	4.57	11.23	3.48	1.91	5.39	6.65	4.03	2.82	1.94	1.01	1.64	1.42
1964	3.68	7.10	5.24	16.01	1.47	5.23	1.34	0.85	1.53	0.66	0.54	0.23
1965	1.87	9.80	14.38	9.04	2.72	0.69	2.21	1.14	0.91	1.02	0.87	0.00
1966	1.92	8.73	9.87	9.62	2.67	8.47	0.66	1.28	1.84	1.10	0.46	1.39
1967	3.62	6.98	11.57	10.14	1.83	6.07	2.63	0.64	0.76	0.00	0.00	0.65
1968	6.35	3.28	7.17	7.94	9.00	5.53	1.41	3.01	2.10		4.01	2.08
1969	5.45	7.48	12.91	9.61	4.33	1.21	2.19	1.72	2.01	0.02	0.00	2.14
1970	4.64	3.26	11.18	14.21	5.81	3.12	2.64	1.26	0.57	0.01	0.00	1.26
1971	4.01	5.89	14.28	8.96	4.74	8.29	3.68	1.22	1.61	0.13	0.36	3.19
1972	3.21	8.35	10.45	8.19	4.90	7.32	4.41	1.39	0.56	0.28	0.25	3.12
1973	0.61	4.78	11.33	5.37	2.18	3.40	1.57	1.40	1.27	0.05	0.76	3.30
1974	3.36	16.59	12.01	11.25	6.75	8.51	2.96	1.46	0.65	1.25	0.00	0.07
1975	1.32	7.50	8.64	8.99	7.00	4.86	1.75	1.94	0.62	0.44	1.60	0.00
1976	6.42	5.16	8.59	6.85	7.20	5.54	2.31	1.30	0.39	0.82	2.41	0.79
1977	1.30	1.32	1.60	1.05	2.98	4.46	0.51	2.50	1.12	0.60	3.07	3.18
1978	2.94	7.21	11.39	7.37	5.92	2.27	3.70	2.67	0.99	0.99	1.65	3.23
1979	0.71	3.85	3.77	3.06	8.00	2.49	2.41	2.07	0.58	0.13	0.94	2.54
1980	6.67	3.93	7.50	8.14	6.25	4.02	3.70	1.21	2.24	0.22	0.06	1.36
1981	1.63	8.35	11.43	2.65	5.17	2.98	2.17	1.96	3.00	0.15	0.05	3.83
1982	5.90	5.89	12.15	9.42	7.75	3.89	4.83	0.44	1.31	0.36	1.24	2.40
1983	4.87	5.36	11.16	7.40	12.20	8.23	2.49	1.40	1.65	2.74	1.38	0.54
1984	1.32	13.07	6.87	2.70	5.95	4.29	3.95	3.36	3.88	0.00	0.00	1.21
1985	4.63	12.83	3.87	0.27	3.18	4.56	1.20	0.36	2.94	0.45	1.45	1.63
1986	3.97	3.95	2.77	8.38	7.35	3.81	1.59	1.99	0.37	0.85	0.00	2.74
1987	3.31	6.52	5.47	8.00	5.18	7.47	1.72	1.85	0.19	0.85	0.15	0.20
1988	0.20	3.66	10.41	8.14	1.16	3.67	2.60	2.23	2.27	0.07	0.17	1.16
1989	0.14	10.98	3.81	4.14	3.51	7.05	0.81	1.62	0.78	0.36	0.93	0.51
1990	2.47	4.02	3.47	10.42	7.14	2.08	1.71	2.98	1.82	0.27	0.93	0.72
1991	4.14	4.15	3.36	3.97	4.46	5.07	6.36	2.19	1.39	0.29	0.39	0.24
1992	1.91	6.26	4.91	6.62	3.97	1.19	4.79	0.07	0.80	0.31	0.51	1.28
1993	2.79	5.44	7.42	5.39	0.78	5.00	6.76	3.79	1.95	1.76	0.08	0.00

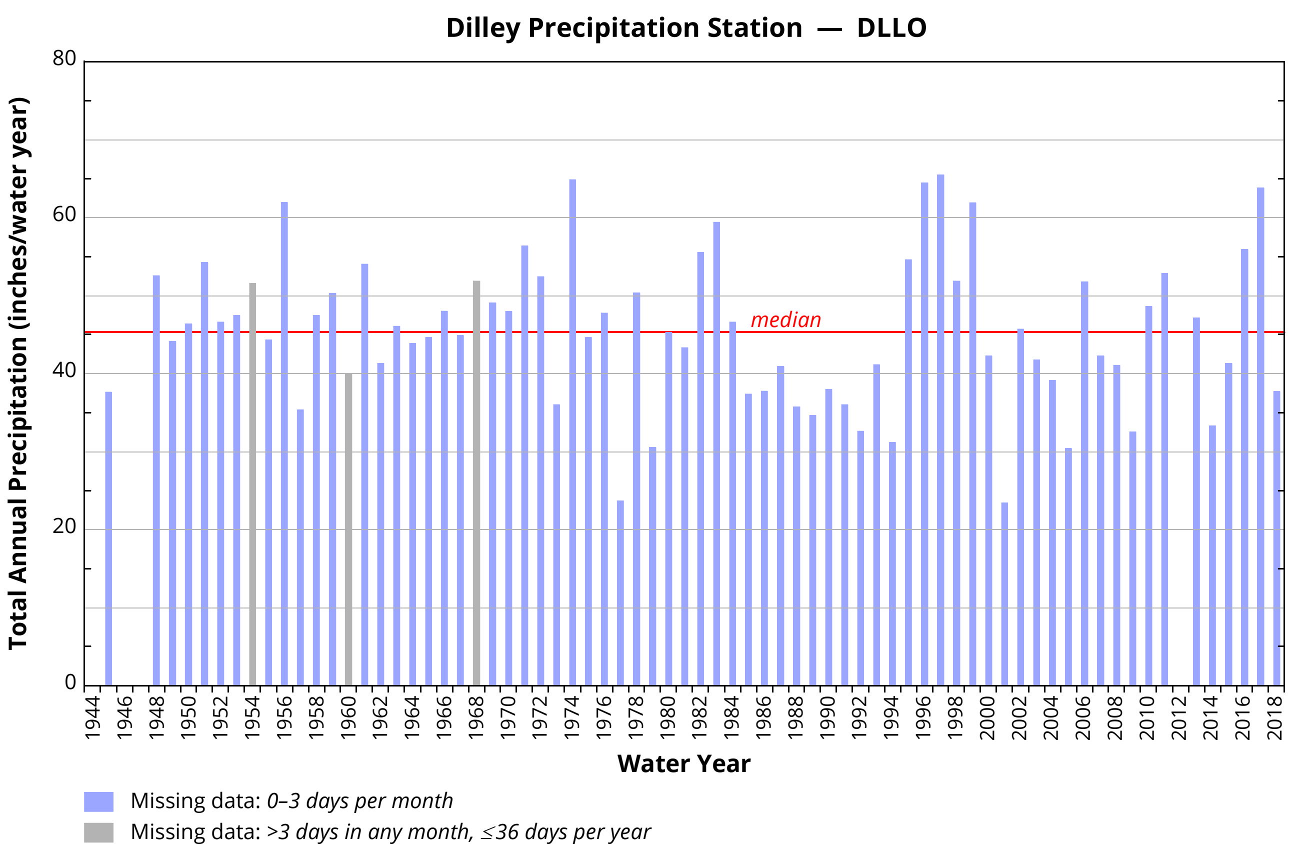
MONTHLY TOTAL PRECIPITATION (inches) — DLLO (continued)

WATER YEAR*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1994	1.26	1.49	9.12	5.67	6.45	3.14	1.41	0.89	0.95	0.00	0.24	0.58
1995	4.64	8.12	10.29	10.56	5.02	6.53	3.74	1.29	1.76	0.45	0.49	1.74
1996	3.41	9.78	10.09	9.69	12.68	2.46	7.09	4.84	1.12	0.60	0.26	2.43
1997	5.37	8.05	18.46	9.63	2.51	8.29	2.98	2.65	2.38	0.47	1.38	3.33
1998	6.58	8.36	3.54	12.10	7.66	5.20	1.76	4.82	1.05	0.09	0.00	0.73
1999	3.24	13.00	10.81	10.29	14.15	4.85	1.90	1.71	0.76	0.02	1.14	0.04
2000	2.55	10.10	7.10	7.81	5.46	3.25	1.52	2.15	1.21	0.00	0.22	0.89
2001	3.09	2.46	4.20	2.17	1.98	2.25	1.72	1.60	1.84	0.32	1.27	0.54
2002	2.91	10.26	10.66	9.00	3.61	4.04	1.93	1.14	1.32	0.19	0.07	0.57
2003	0.59	3.35	12.22	8.61	3.69	7.41	4.24	0.46	0.07	0.01	0.32	0.79
2004	2.87	4.10	9.01	7.70	5.21	2.32	2.24	1.25	1.21	0.00	1.66	1.56
2005	3.80	2.53	3.89	4.25	0.41	5.97	2.79	4.26	1.84	0.29	0.13	0.24
2006	4.16	7.58	11.79	14.09	3.38	4.21	2.58	2.26	0.92	0.17	0.00	0.63
2007	1.01	15.05	8.03	4.03	4.62	2.48	2.32	1.22	0.83	0.82	0.63	1.21
2008	3.80	4.35	10.41	7.03	2.93	4.66	2.91	2.72	0.97	0.00	0.96	0.32
2009	2.42	6.01	4.85	5.53	2.04	3.43	1.72	3.53	0.23	0.17	1.29	1.32
2010	3.67	8.41	4.48	8.95	4.91	5.26	4.82	3.36	3.03	0.16	0.08	1.50
2011	4.00	7.00	13.55	5.63	4.36	8.93	4.62	2.47	0.84	0.98	0.07	0.42
2012	2.56	8.00				10.95	2.54	2.30	2.52	0.37	0.07	0.04
2013	5.86	8.87	11.29	1.96	2.17	2.38	1.66	3.66	1.17	0.00	0.54	7.57
2014	0.85	2.92	1.37	2.87	7.64	8.69	3.98	1.80	1.05	0.37	0.54	1.23
2015	7.66	3.21	8.18	3.91	7.90	4.87	1.96	0.87	0.59	0.43	0.66	1.09
2016	2.71	6.52	18.77	10.09	4.22	7.54	3.22	0.71	0.69	0.35	0.27	0.82
2017	11.53	9.66	5.97	5.91	12.83	8.70	4.53	1.99	1.18	0.00	0.09	1.42
2018	5.15	8.42	4.70	7.24	1.86	3.79	4.91	0.06	0.62	0.00	0.05	0.92
2019	3.15	3.47	6.68	*Data in this row are not included in statistics because water year is incomplete.*								
MIN	0.14	1.32	1.37	0.27	0.41	0.69	0.51	0.06	0.07	0.00	0.00	0.00
MAX	11.53	16.59	18.77	16.01	14.15	10.95	7.09	4.92	4.16	2.74	4.01	7.57
MEDIAN	3.41	7.1	7.85	7.4	5.06	4.795	2.49	1.72	1.21	0.29	0.46	1.22
MEAN	3.68	6.96	8.12	7.41	5.50	5.06	2.78	1.97	1.40	0.43	0.65	1.46

*Water Year (WY) begins October 1st of the previous calendar year and ends September 30th of current year.



Dilley Precipitation Station — DLLO
Monthly Precipitation (inches)
0
4
8
12
16
20
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Statistics
(period of record: 1944–2018)
Maximum
90th-Pctl
75th-Pctl
Median
25th-Pctl
10th-Pctl
Minimum
WY 2018
WY 2019



Dilley Precipitation Station — DLLO
Total Annual Precipitation (inches/water year)
0
20
40
60
80
median
Water Year
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Missing data: *0–3 days per month*
Missing data: *>3 days in any month, ≤36 days per year*

FOGO – Forest Grove Precipitation Station (Verboort)

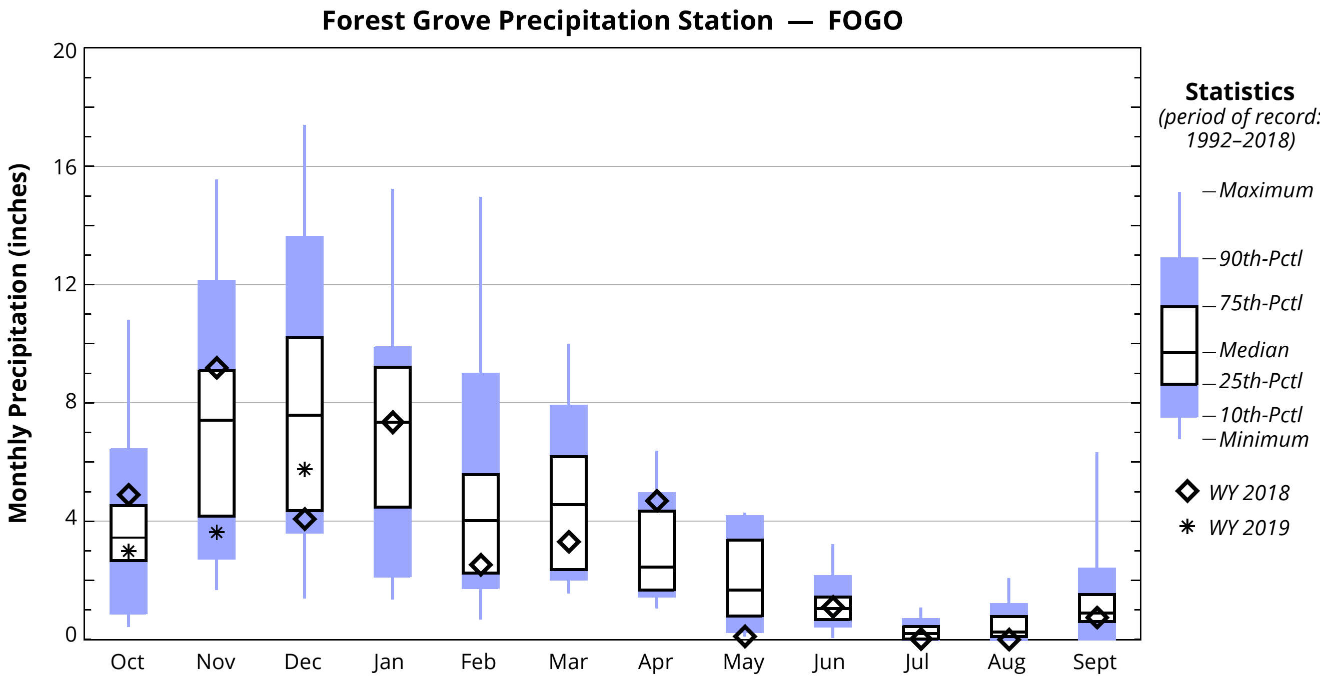
Data source: Bureau of Reclamation – AgriMet
https://www.usbr.gov/pn/agrimet/webarcread.html

Elevation: 180 ft   Latitude: 45 33 11   Longitude: 123 05 01

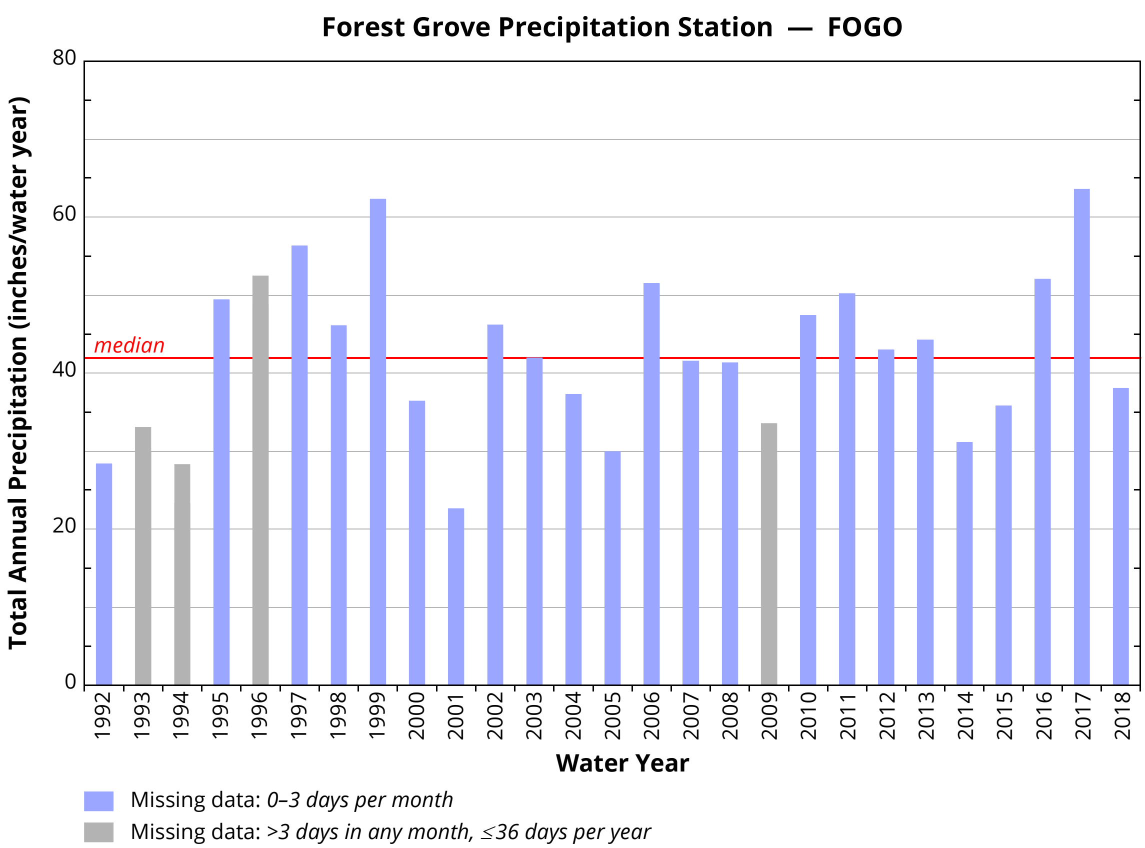
MONTHLY TOTAL PRECIPITATION (inches) — FOGO

Water Year*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1992	1.50	5.10	3.68	5.93	3.56	1.56	4.35	0.10	0.94	0.26	0.28	1.08
1993	2.41	4.17	6.00		2.22	4.15	4.88	4.22	0.57	1.09	0.14	0.00
1994	1.08	1.68	7.61		5.75	2.34	1.49	1.31	1.04	0.02	0.23	0.77
1995	6.26	7.51	7.56	9.72	4.05	5.78	3.09	1.57	1.23	0.53	0.50	1.62
1996	3.08	11.72	8.55	9.06		2.33	6.37	4.14	0.85	0.48	0.26	1.99
1997	4.53	7.99	14.96	7.64	1.78	7.76	3.27	1.83	1.80	0.18	1.32	3.25
1998	6.99	7.08	3.47	9.12	7.20	4.57	1.44	4.28	1.06	0.07	0.00	0.80
1999	3.44	13.67	9.83	9.65	14.97	5.39	1.69	1.68	0.98	0.35	0.66	0.02
2000	2.78	7.84	5.89	7.72	3.99	2.37	1.05	2.06	1.58	0.09	0.13	0.92
2001	3.08	2.63	4.30	1.66	1.74	2.13	1.68	1.07	2.11	0.44	1.15	0.63
2002	2.79	11.22	9.74	9.30	3.45	4.60	1.61	1.16	1.20	0.20	0.03	0.90
2003	0.43	3.02	12.24	10.06	3.18	6.19	5.13	0.55	0.07	0.00	0.35	0.73
2004	3.49	4.62	7.87	6.09	5.23	1.93	2.55	1.10	0.81	0.00	2.08	1.50
2005	3.80	2.78	4.38	2.47	0.67	6.00	2.60	4.08	1.56	0.21	0.11	1.28
2006	4.32	7.44	11.35	15.24	2.15	4.38	2.19	2.91	0.69	0.20	0.07	0.58
2007	0.95	15.55	8.57	3.88	4.24	2.45	2.12	0.78	0.59	0.57	0.50	1.32
2008	3.14	4.51	13.02	8.81	2.70	4.13	2.46	0.71	0.78	0.01	0.97	0.11
2009	2.66	5.69		6.06	1.91	3.69	1.77	3.43	1.17	0.13	1.06	1.22
2010	3.78	7.70	5.34	7.44	4.78	5.28	4.24	3.37	3.23	0.51	0.23	1.52
2011	4.39	7.42	11.53	5.08	5.52	7.35	4.38	2.37	0.62	1.05	0.00	0.48
2012	2.75	8.28	3.82	7.25	4.17	10.00	2.16	2.15	2.22	0.08	0.08	0.02
2013	6.25	9.20	9.56	1.36	2.24	2.08	1.67	3.36	1.44	0.00	0.78	6.33
2014	0.68	2.96	1.39	2.98	7.57	7.73	3.70	1.30	0.87	0.29	0.10	1.55
2015	6.13	3.19	7.45	3.61	5.90	4.67	1.48	0.80	0.44	0.28	1.02	0.84
2016	4.12	5.50	17.40	9.42	4.58	7.09	1.97	0.31	0.46	0.24	0.32	0.61
2017	10.82	9.09	6.96	6.15	12.26	8.37	4.49	1.74	1.41	0.00	0.11	2.16
2018	4.90	9.19	4.08	7.35	2.53	3.31	4.70	0.11	1.11	0.02	0.00	0.75
2019	2.99	3.62	5.76	*Data in this row are not included in statistics because water year is incomplete.*								
MIN	0.43	1.68	1.39	1.36	0.67	1.56	1.05	0.10	0.07	0.00	0.00	0.00
MAX	10.82	15.55	17.40	15.24	14.97	10.00	6.37	4.28	3.23	1.09	2.08	6.33
MEDIAN	3.44	7.42	7.59	7.35	4.02	4.57	2.46	1.68	1.04	0.20	0.26	0.90
MEAN	3.72	6.92	7.94	6.92	4.55	4.73	2.91	1.94	1.14	0.27	0.46	1.22

*Water Year (WY) begins October 1st of the previous calendar year and ends September 30th of current year.



Forest Grove Precipitation Station — FOGO
Monthly Precipitation (inches)
0
4
8
12
16
20
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Statistics
(period of record: 1992–2018)
Maximum
90th-Pctl
75th-Pctl
Median
25th-Pctl
10th-Pctl
Minimum
WY 2018
WY 2019



Forest Grove Precipitation Station — FOGO
Total Annual Precipitation (inches/water year)
0
20
40
60
80
median
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Water Year
Missing data: *0–3 days per month*
Missing data: *>3 days in any month, ≤36 days per year*

KHIO – Hillsboro Airport Precipitation Station

Data source: National Weather Service COOP Program (WBAN ID#94261)

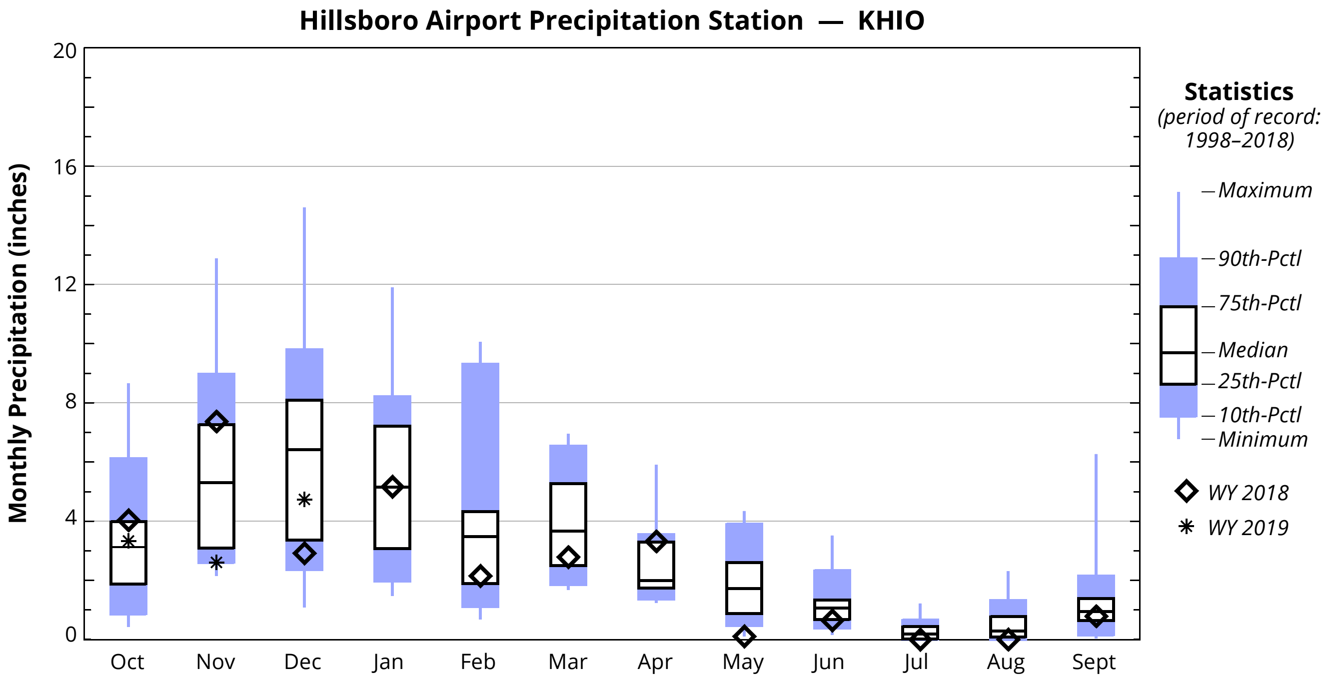
http://scacis.rcc-acis.org

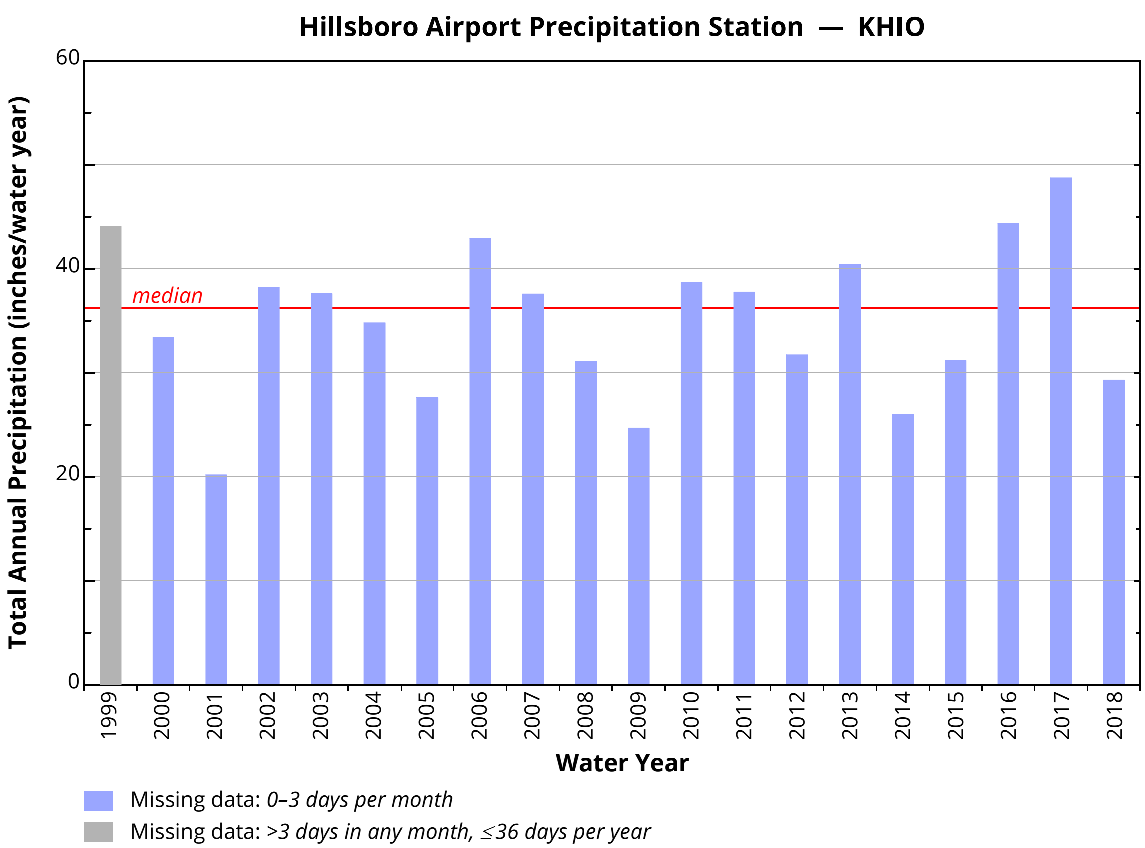
Elevation: 204 ft Latitude: 45 32 26 Longitude: 122 56 55

MONTHLY TOTAL PRECIPITATION (inches) — KHIO

Water Year*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1998										0.32	0.00	0.87
1999		9.03	7.07	7.48	9.78	4.29	1.50	1.74	1.55	0.66	0.84	0.14
2000	2.49	6.91	3.91	6.92	4.35	3.02	1.36	1.91	1.04	0.08	0.15	1.27
2001	3.00	2.16	3.24	1.94	1.58	2.33	1.86	0.85	1.20	0.45	0.79	0.79
2002	3.13	8.54	6.98	7.31	3.13	3.49	1.71	1.44	1.30	0.32	0.05	0.83
2003	0.43	2.61	9.88	8.29	2.93	5.16	5.91	0.75	0.15	0.00	0.55	0.94
2004	3.07	4.43	7.93	5.90	4.27	1.68	1.79	1.24	0.82	0.00	2.31	1.37
2005	3.55	2.61	3.72	2.27	0.68	4.42	2.56	4.35	1.55	0.24	0.32	1.36
2006	3.68	6.09	9.09	11.90	1.99	3.57	2.02	2.70	1.08	0.14	0.08	0.59
2007	0.90	12.88	7.49	3.24	3.80	2.39	1.96	1.29	0.97	0.40	0.53	1.73
2008	3.12	3.90	8.94	5.38	1.49	3.31	1.94	0.97	0.36	0.09	1.37	0.22
2009	1.69	4.51	2.77	4.36	1.08	2.40	1.24	2.92	1.34	0.13	0.72	1.51
2010	3.32	5.72	3.96	5.14	4.06	3.76	3.22	3.16	3.52	0.45	0.17	2.21
2011	3.98	5.23	8.16	3.59	3.83	5.39	3.42	2.10	0.59	1.23	0.00	0.26
2012	1.88	5.38	2.33	5.79	2.48	6.59	2.38	2.34	2.42	0.09	0.02	0.04
2013	5.45	7.59	7.50	1.47	1.87	1.81	2.33	3.98	1.31	0.00	0.85	6.27
2014	0.87	2.73	1.08	2.41	5.06	6.07	3.42	1.70	0.92	0.52	0.14	1.10
2015	6.12	2.83	5.88	3.01	4.57	4.68	1.41	0.44	0.54	0.32	0.55	0.86
2016	3.42	4.00	14.60	7.53	3.96	5.31	1.88	0.80	1.33	0.33	0.25	0.93
2017	8.66	6.25	4.77	4.11	10.06	6.96	3.56	1.82	1.05	0.00	0.13	1.39
2018	4.04	7.38	2.92	5.17	2.15	2.79	3.32	0.11	0.65	0.00	0.00	0.79
2019	3.33	2.61	4.74	*Data in this row are not included in statistics because water year is incomplete.*								
MIN	0.43	2.16	1.08	1.47	0.68	1.68	1.24	0.11	0.15	0.00	0.00	0.04
MAX	8.66	12.88	14.60	11.90	10.06	6.96	5.91	4.35	3.52	1.23	2.31	6.27
MEDIAN	3.13	5.31	6.43	5.16	3.47	3.67	1.99	1.72	1.07	0.19	0.29	0.94
MEAN	3.31	5.54	6.11	5.16	3.66	3.97	2.44	1.83	1.18	0.27	0.49	1.23

*Water Year (WY) begins October 1st of the previous calendar year and ends September 30th of current year.


Hillsboro Airport Precipitation Station — KHIO
Monthly Precipitation (inches)
0
4
8
12
16
20
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Statistics
(period of record: 1998–2018)
Maximum
90th-Pctl
75th-Pctl
Median
25th-Pctl
10th-Pctl
Minimum
WY 2018
WY 2019


Hillsboro Airport Precipitation Station — KHIO
Total Annual Precipitation (inches/water year)
0
20
40
60
median
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Water Year
Missing data: 0–3 days per month
Missing data: >3 days in any month, ≤36 days per year

THNP – Tualatin Hills Nature Park Precipitation Station

Data source: National Weather Service COOP Program (COOP ID#355945)
http://scacis.rcc-acis.org

Elevation: 185 ft   Latitude: 45 29 53   Longitude: 122 50 22

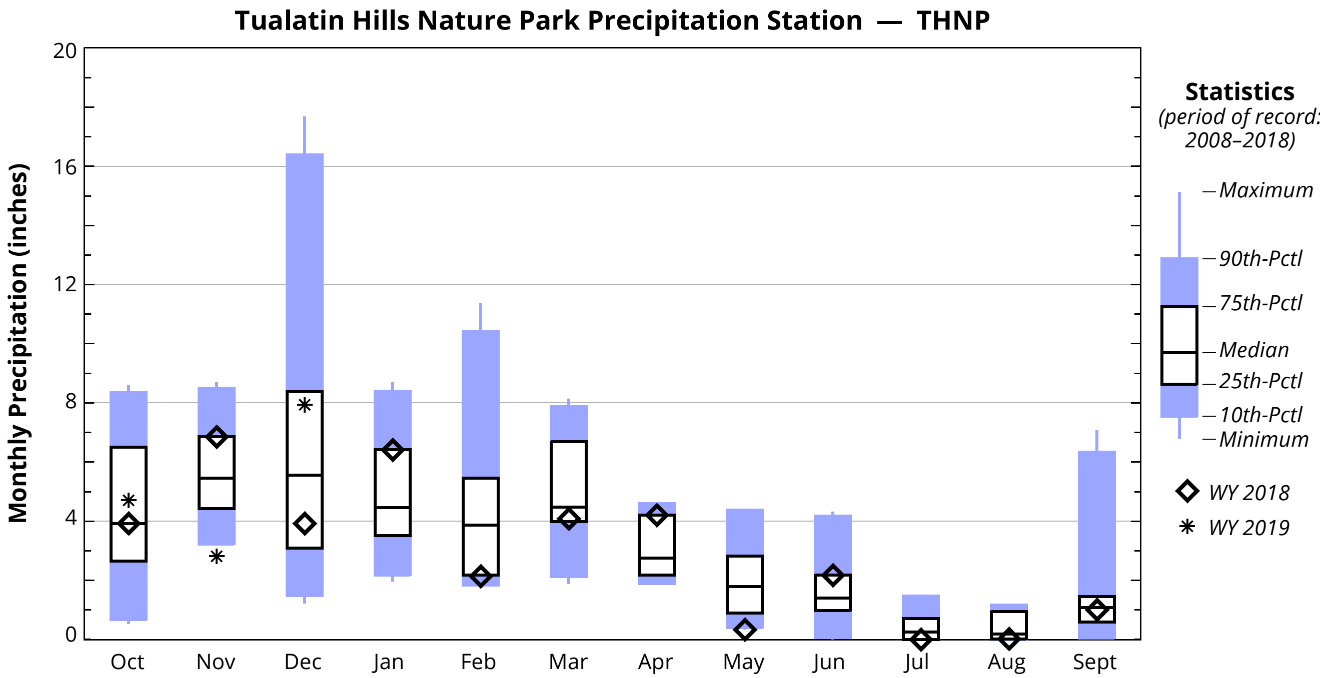
MONTHLY TOTAL PRECIPITATION (inches) — THNP

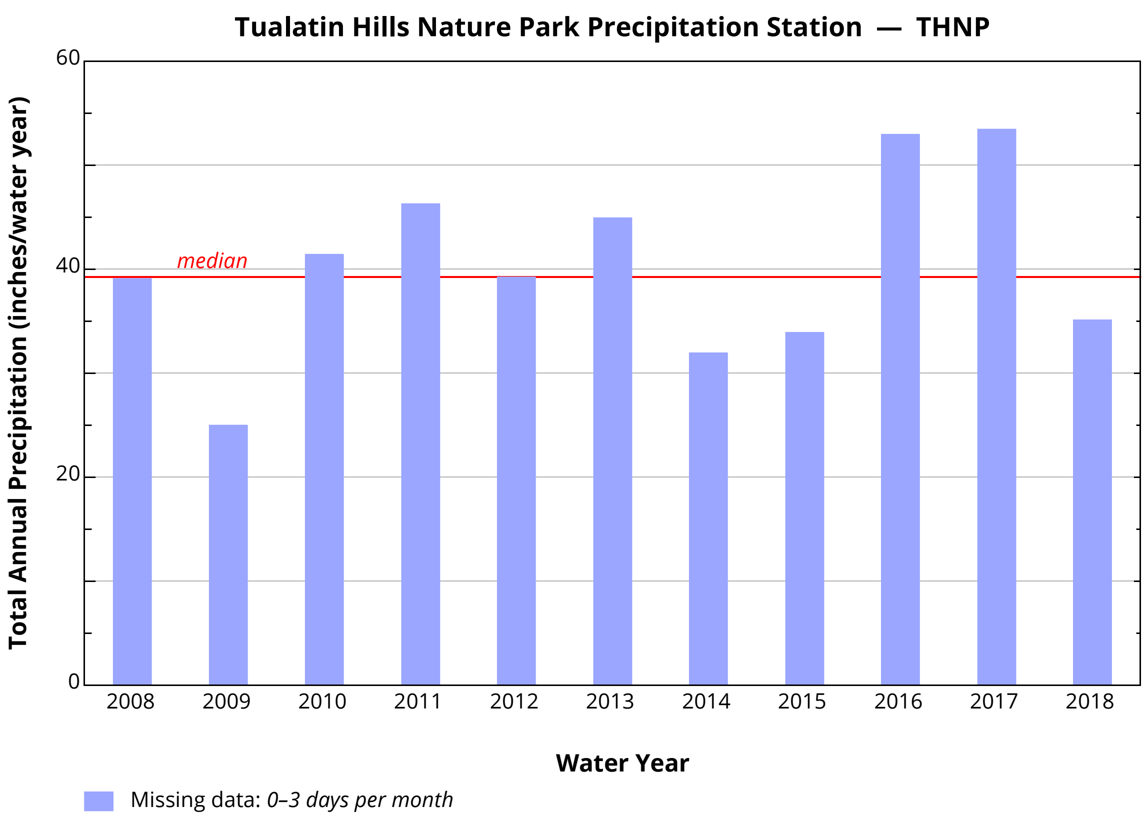
Water Year*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2008	3.92	4.43	11.17	6.38	2.18	3.98	2.18	1.30	0.99	1.50	0.94	0.13
2009	1.38	4.65	3.26	4.46	2.31	3.16	2.73	0.90	0.00	0.00	0.70	1.45
2010	3.62	6.41	3.08	5.22	3.87	4.07	2.76	4.26	4.33	0.42	0.01	3.39
2011	4.86	6.60	8.38	4.28	5.45	6.08	4.41	2.83	1.40	1.37	0.03	0.60
2012	2.65	5.46	2.50	7.08	3.36	8.15	3.60	2.70	3.52	0.19	0.00	0.04
2013	6.51	8.71	8.22	1.96	1.76	1.87	2.11	4.41	1.21	0.00	1.11	7.07
2014	0.52	3.21	1.23	3.12	6.51	6.77	4.65	2.47	1.53	0.72	0.12	1.09
2015	7.32	3.37	5.56	3.52	4.03	4.48	1.85	0.70	0.33	0.26	1.17	1.34
2016	4.23	5.32	17.69	8.72	4.21	5.81	2.42	1.37	1.74	0.53	0.19	0.76
2017	8.61	7.60	6.29	4.25	11.37	6.69	3.92	1.80	1.34	0.01	0.24	1.33
2018	3.93	6.86	3.93	6.41	2.14	4.09	4.21	0.34	2.18	0.00	0.03	1.01
2019	4.71	2.81	7.94	*Data in this row are not included in statistics because water year is incomplete.*								
MIN	0.52	3.21	1.23	1.96	1.76	1.87	1.85	0.34	0.00	0.00	0.00	0.04
MAX	8.61	8.71	17.69	8.72	11.37	8.15	4.65	4.41	4.33	1.50	1.17	7.07
MEDIAN	3.93	5.46	5.56	4.46	3.87	4.48	2.76	1.8	1.4	0.26	0.19	1.09
MEAN	4.32	5.69	6.48	5.04	4.29	5.01	3.17	2.10	1.69	0.45	0.41	1.66

*Water Year (WY) begins October 1st of the previous calendar year and ends September 30th of current year.

THNP – Tualatin Hills Nature Park Precipitation Station

Data source: National Weather Service COOP Program (COOP ID#355945)





KGWP – KGW-TV Precipitation Station

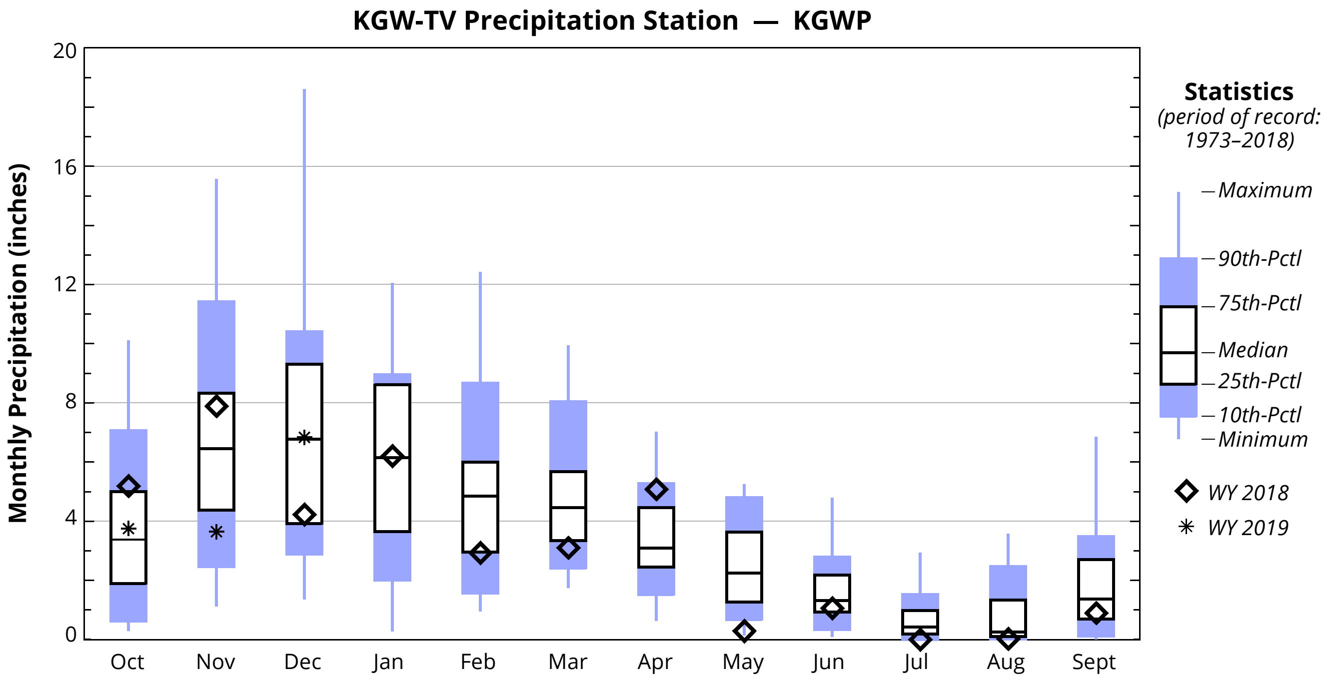
Data source: National Weather Service COOP Program (COOP ID#356749)
http://scacis.rcc-acis.org

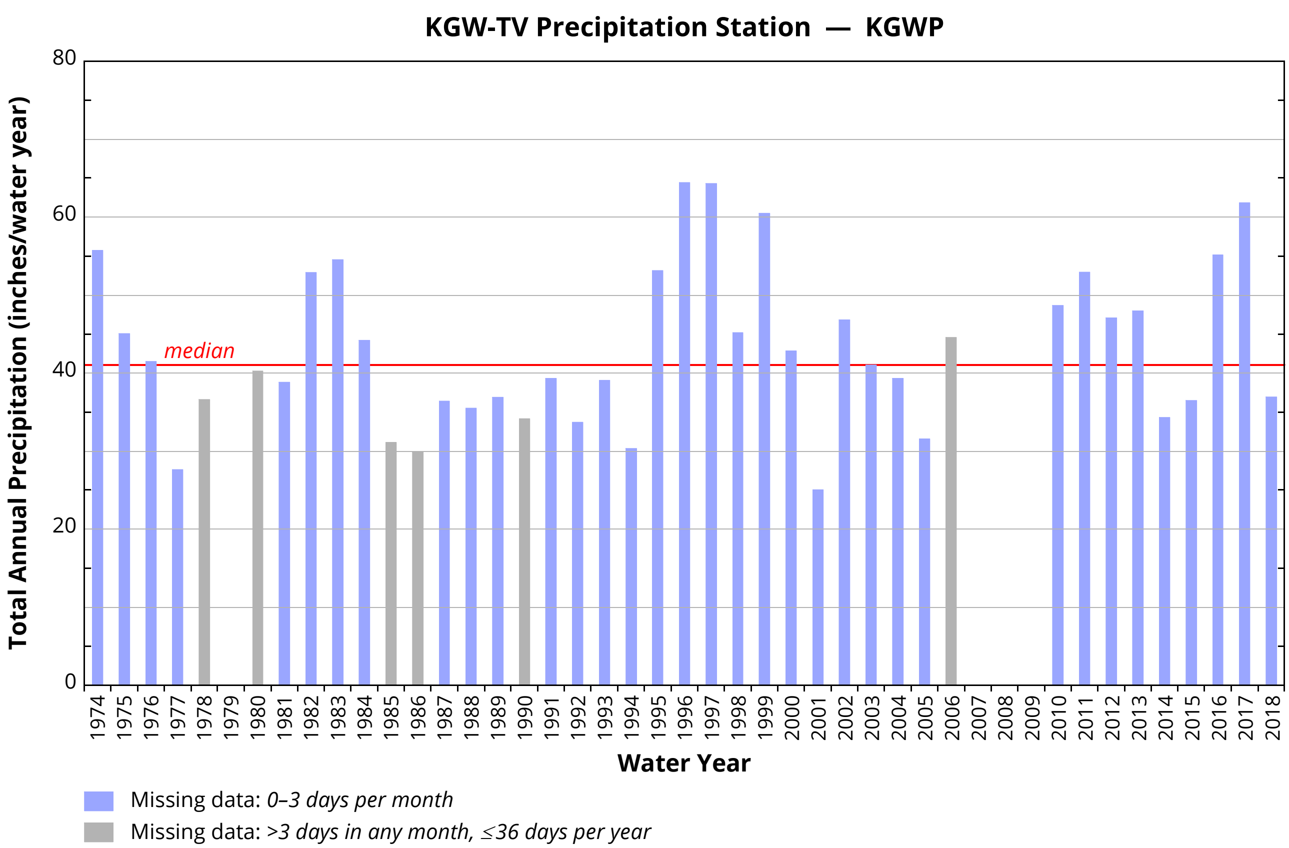
Elevation: 159 ft   Latitude: 45 31 05   Longitude: 122 41 22

MONTHLY TOTAL PRECIPITATION (inches) — KGWP

WATER YEAR*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1973											1.66	3.76
1974	3.81	13.46	9.88	9.07	4.85	6.43	2.64	2.17	0.86	2.27	0.14	0.15
1975	2.22	7.13	6.93	8.83	6.03	5.02	2.48	1.97	1.22	0.41	2.84	0.00
1976	5.67	4.71	6.74	6.07	5.41	3.41	2.63	1.74	0.92	0.75	2.50	0.93
1977	1.73	1.13	1.36	1.26	2.71	4.10	0.63	4.39	0.99	1.05	3.57	4.69
1978	3.51	5.87		5.93	3.81	1.73	3.53	3.70	1.41	1.17	2.36	3.58
1979	0.48	4.08	2.85	3.04	7.00	2.58	2.83	2.18	0.39	0.25		
1980		4.58	7.35	8.88	4.51	4.45	3.11	2.16	2.77	0.18	0.21	2.06
1981	1.25	7.09	10.27	1.67	3.84	2.74	3.11	1.81	4.03	0.21	0.04	2.76
1982	4.57	5.99	10.34	8.76	7.10	3.61	4.89	0.59	0.99	0.83	1.92	3.33
1983	4.96	3.84	9.40	7.71	9.05	7.31	2.44	2.38	2.04	2.94	2.01	0.47
1984	1.92	10.73	5.78	2.38	4.05	4.32	4.38	4.09	4.48	0.00	0.08	1.99
1985	4.60	10.69	3.38	0.27		4.06	1.14	0.88	2.28	0.12	0.99	2.71
1986	3.05		2.20	5.87	7.15	2.78	1.32	2.33	0.32	1.86	0.04	2.96
1987	2.09	6.36	4.23	7.33	2.99	6.50	2.45	1.88	0.20	1.56	0.46	0.36
1988	0.28	1.97	9.19	6.31	1.38	4.08	5.08	2.97	2.20	0.26	0.11	1.66
1989	0.33	8.34	3.04	4.43	2.64	8.74	1.63	3.53	0.97	1.01	1.11	1.13
1990	1.68	4.46	3.82	8.51	5.44	2.68	3.01		1.89	1.10	1.04	0.52
1991	5.87	4.88	3.74	3.66	4.92	4.52	4.02	4.13	2.43	0.12	0.93	0.10
1992	2.17	7.44	4.88	5.04	4.58	1.78	5.06	0.13	0.56	0.45	0.25	1.33
1993	3.17	5.45	6.84	3.60	0.96	5.20	6.31	4.02	1.94	1.42	0.18	0.00
1994	1.44	1.79	6.86	4.95	6.11	2.72	2.31	1.23	1.10	0.07	0.14	1.63
1995	9.02	7.49	6.53	7.44	5.22	5.02	4.19	1.13	2.29	0.98	1.69	2.14
1996	4.35	11.71	7.84	8.56	12.43	4.46	5.95	4.84	0.09	0.49	0.50	3.22
1997	6.17	9.72	16.28	8.86	2.14	8.24	3.78	2.46	1.62	0.64	1.55	2.84
1998	7.58	5.19	4.01	7.76	6.80	4.21	1.49	5.18	1.61	0.34	0.00	1.02
1999	3.57	13.36	9.21	8.97	11.39	5.67	1.61	2.59	2.45	0.38	1.12	0.19
2000	2.89	7.67	7.67	8.08	4.96	3.62	2.39	2.51	0.90	0.25	0.15	1.76
2001	3.19	2.91	3.85	1.99	1.79	3.73	3.09	1.12	1.40	0.46	0.87	0.66
2002	4.37	7.44	7.83	8.03	4.92	5.40	3.60	1.57	2.19	0.19	0.01	1.31
2003	0.32	2.49	10.48	9.14	3.17	5.16	7.03	1.60	0.11	0.00	0.06	1.50
2004	2.30	5.38	10.43	5.02	4.86	2.01	2.16	1.17	1.03	0.00	3.20	1.76
2005	3.27	2.46	4.58	2.02	0.99	4.73	4.44	5.06	2.03	0.39	0.22	1.37
2006	4.26	6.54	10.20	12.05	2.38	3.63	2.52		1.12	0.19	0.07	1.12
2007	1.83	15.56										
2008								1.22				
2009												1.63
2010	3.54	7.21	4.99	6.68	3.96	5.62	3.99	4.63	4.79	0.30		2.94
2011	5.16	7.39	10.23	5.13	5.79	7.59	5.37	3.25	0.87	1.36	0.10	0.70
2012	2.64	8.32	3.37	8.74	3.71	9.95	3.85	3.21	2.78	0.51	0.00	0.01
2013	6.59	8.53	9.14	3.11	1.51	2.37	2.59	5.26	1.43	0.00	0.63	6.85
2014	0.93	3.52	1.77	3.34	5.95	7.58	4.51	2.79	1.84	0.92	0.13	1.05
2015	7.26	3.58	6.78	3.69	4.11	5.12	2.61	0.64	0.44	0.60	0.78	0.87
2016	4.39	5.61	18.61	8.93	4.87	5.71	2.46	1.30	1.11	0.75	0.16	1.26
2017	10.11	8.74	6.12	5.65	12.18	8.40	4.63	2.25	1.12	0.00	0.09	2.53
2018	5.19	7.90	4.23	6.21	2.93	3.11	5.08	0.29	1.06	0.00	0.03	0.90
2019	3.75	3.65	6.84	*Data in this row are not included in statistics because water year is incomplete.*								
MIN	0.28	1.13	1.36	0.27	0.96	1.73	0.63	0.13	0.09	0.00	0.00	0.00
MAX	10.11	15.56	18.61	12.05	12.43	9.95	7.03	5.26	4.79	2.94	3.57	6.85
MEDIAN	3.39	6.45	6.78	6.14	4.85	4.455	3.1	2.25	1.31	0.43	0.25	1.37
MEAN	3.66	6.64	6.91	6.02	4.89	4.76	3.39	2.50	1.58	0.64	0.83	1.72

*Water Year (WY) begins October 1st of the previous calendar year and ends September 30th of current year.


KGW-TV Precipitation Station — KGWP
Monthly Precipitation (inches)
0
4
8
12
16
20
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Statistics
(period of record: 1973–2018)
Maximum
90th-Pctl
75th-Pctl
Median
25th-Pctl
10th-Pctl
Minimum
WY 2018
WY 2019


KGW-TV Precipitation Station — KGWP
Total Annual Precipitation (inches/water year)
0
20
40
60
80
median
Water Year
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
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2015
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2017
2018
Missing data: 0–3 days per month
Missing data: >3 days in any month, ≤36 days per year

ORCP – Oregon City Precipitation Station

Data source: National Weather Service COOP Program (COOP ID#356334)

http://scacis.rcc-acis.org

Elevation: 167 ft Latitude: 45 21 21 Longitude: 122 36 17

MONTHLY TOTAL PRECIPITATION (inches) — ORCP

Water Year*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1948					7.57	4.70	4.27	4.73	1.15	0.91	2.07	3.46
1949	2.70	8.46	10.26	1.48	13.09	3.34	1.16	2.69	1.25	0.94	0.22	2.60
1950	3.17	6.92	6.50	11.44	6.97	6.29	3.13	1.09	2.05	1.35	0.45	2.26
1951	10.34	12.70	7.48	10.50	5.93	5.63	1.06	2.58	0.09	0.16	0.34	3.71
1952	5.55	6.25	7.29	6.20	4.72	4.51	1.75	0.89	3.30	0.00	0.09	0.42
1953	0.87	1.32	7.70	16.77	4.76	4.96	2.52	4.15	1.50	0.04	2.53	1.40
1954	3.39	7.46	9.04	11.25	5.06	3.46	3.88	2.17	3.76	0.69	2.18	1.01
1955	3.91	5.61	6.49	3.02	3.62	5.32	6.30	1.45	1.37	1.39	0.00	3.46
1956	7.68	9.71	11.20	14.25	4.44	7.61	0.68	2.30	1.99	0.02	3.57	1.67
1957	7.69	1.81	4.53	3.26	4.81	9.43	1.66	3.10	1.95	0.43	0.37	0.68
1958	3.97	4.02	10.60	9.43	6.93	2.67	5.38	0.61	3.26	0.00	0.04	1.40
1959	1.73	8.21	7.12	10.41	5.75	5.07	1.65	3.76	2.00	0.83	0.17	3.81
1960	4.17	3.34	3.86	4.91	4.94	6.64	4.09	5.80	0.64	0.00	1.33	1.20
1961	3.49	12.68	4.18	5.22	11.74	7.01	3.47	4.14	0.60	0.57	0.85	0.84
1962	4.04	6.01	6.65	2.13	4.33	5.88	4.05	3.62	1.15	0.06	1.37	2.43
1963	4.36	11.78	3.00	1.96	4.99	6.33	5.06	4.36	1.74	1.30	0.54	1.46
1964	3.68	7.73	4.22	13.64	1.22	4.43	1.85	1.07	2.90	0.76	0.95	1.72
1965	1.22	9.65	14.78	10.67	1.99	1.47	3.42	1.91	0.75	0.24	1.50	0.03
1966	2.54	7.28	8.87	9.75	2.19	6.43	1.29	1.31	1.67	1.26	0.31	1.72
1967	3.32	6.60	8.29	8.65	2.76	6.08	3.54	2.52	1.17	0.00	0.00	0.81
1968	6.36	2.74	6.24	5.53	8.87	3.60	1.95	3.23	3.44	0.50	4.95	3.83
1969	7.09	7.89	14.56	10.47	3.92	2.99	9.44	2.23	4.48	0.09	0.11	4.50
1970	5.00	3.77	9.15	14.05	6.03	3.01	3.76	1.81	0.69	0.09	0.00	2.15
1971	3.59	8.69	9.36	10.08	4.50	6.27	4.33	2.41	3.16	0.37	1.50	3.79
1972	4.37	7.66	10.25	9.17	6.71	6.53	4.81	2.87	0.73	0.50	0.71	4.41
1973	1.04	6.47	9.79	5.90	2.34	4.00	1.79	1.62	2.23	0.08	1.40	3.18
1974	4.00	14.21	11.93	9.57	6.70	8.04	2.81	2.63	1.18	2.82	0.06	0.40
1975	2.44	7.21	6.87	8.28	5.51	5.67	2.44	1.93	2.12	0.73	3.31	0.00
1976	6.25	5.53	7.79	6.33	8.11	3.64	3.55	2.12	0.67	0.87	2.30	1.25
1977	1.20	0.93	1.69	1.65	3.52	4.20	0.77	4.31	1.41	0.68	3.01	3.41
1978	2.92	7.17	11.49	5.96	4.53	1.88	5.84	4.45	1.71	1.53	2.36	2.88
1979	0.61	4.73	3.27	2.90	8.99	3.30	3.94	2.49	0.70	0.52	0.98	3.14
1980	5.70	3.75	7.73	11.38	4.38	3.71	3.91	1.30	3.79	0.18	0.22	1.65
1981	1.56	7.60	12.61	1.84	4.51	3.13	2.55	1.83	4.52	0.28	0.00	2.84
1982	4.79	5.49	11.42	7.76	8.22	5.18	4.37	1.66	1.05	0.22	1.27	3.76
1983	4.25	5.42	10.39	8.70	8.93	7.87	2.50	2.11		4.24	2.57	0.53
1984	2.16	9.82	6.78	3.29	5.53		3.82	5.19	4.60	0.00	0.03	
1985	6.24	12.34	4.27	0.46	3.64	4.39	1.38	0.93	2.51	0.43	0.52	2.65
1986	3.59	6.47	3.05	6.56	7.99	3.19	2.40	2.89	0.57	1.92		
1987	2.08	6.93		7.92	4.44	6.00	2.71	2.11	0.49	1.62	0.23	0.84
1988	0.29	2.25	10.77	9.17	2.04	4.91	5.85	3.58	1.94	0.59	0.08	1.51
1989	0.18	11.24	3.43	5.18	3.18	7.08	2.02	2.23	1.05	0.58	1.45	1.10
1990	2.25	3.69	3.98	9.65	4.58	2.78	2.59	1.92	2.46	0.48	1.00	0.47
1991	5.94	4.94	3.31	3.50	4.26	3.71	4.63	4.40	2.32	0.06	1.61	0.15
1992	2.98	7.65	5.99	5.24	4.48	1.12	5.10	0.16	0.41	0.26	0.76	1.86
1993	4.19	4.46	6.51	3.74	1.11	5.24	6.15	4.24	1.73	2.23	0.23	0.00
1994	1.43	1.91	6.48	5.38	6.33	4.12	2.14	1.71	1.53	0.08	0.00	1.10
1995	7.22	8.74	6.62	7.61	5.44	4.23	3.88	1.54	1.97	0.76	1.62	2.93
1996	4.82	11.00	8.36	9.17	12.05	3.86	5.63	5.00	0.91	0.63	0.11	2.25
1997	5.33	9.96	16.13	8.45	2.20	8.63	4.91	2.37	2.38	1.01	1.54	4.02

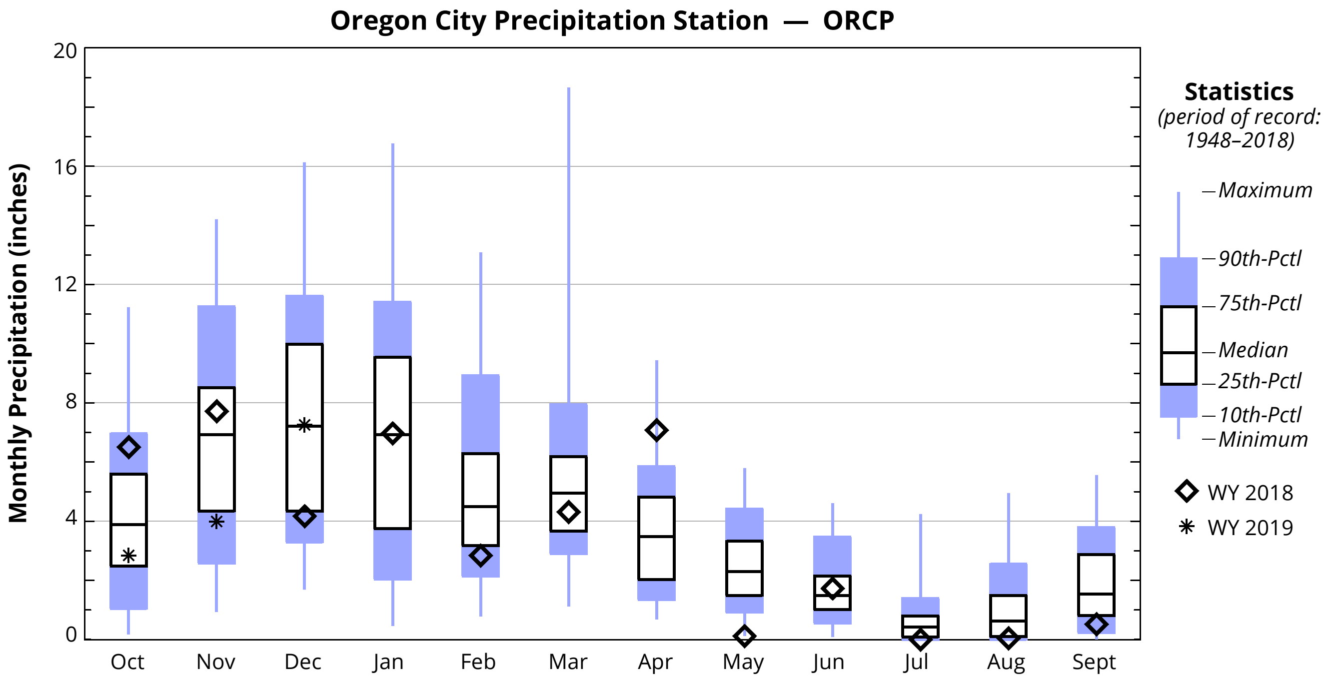
MONTHLY TOTAL PRECIPITATION (inches) — ORCP (continued)

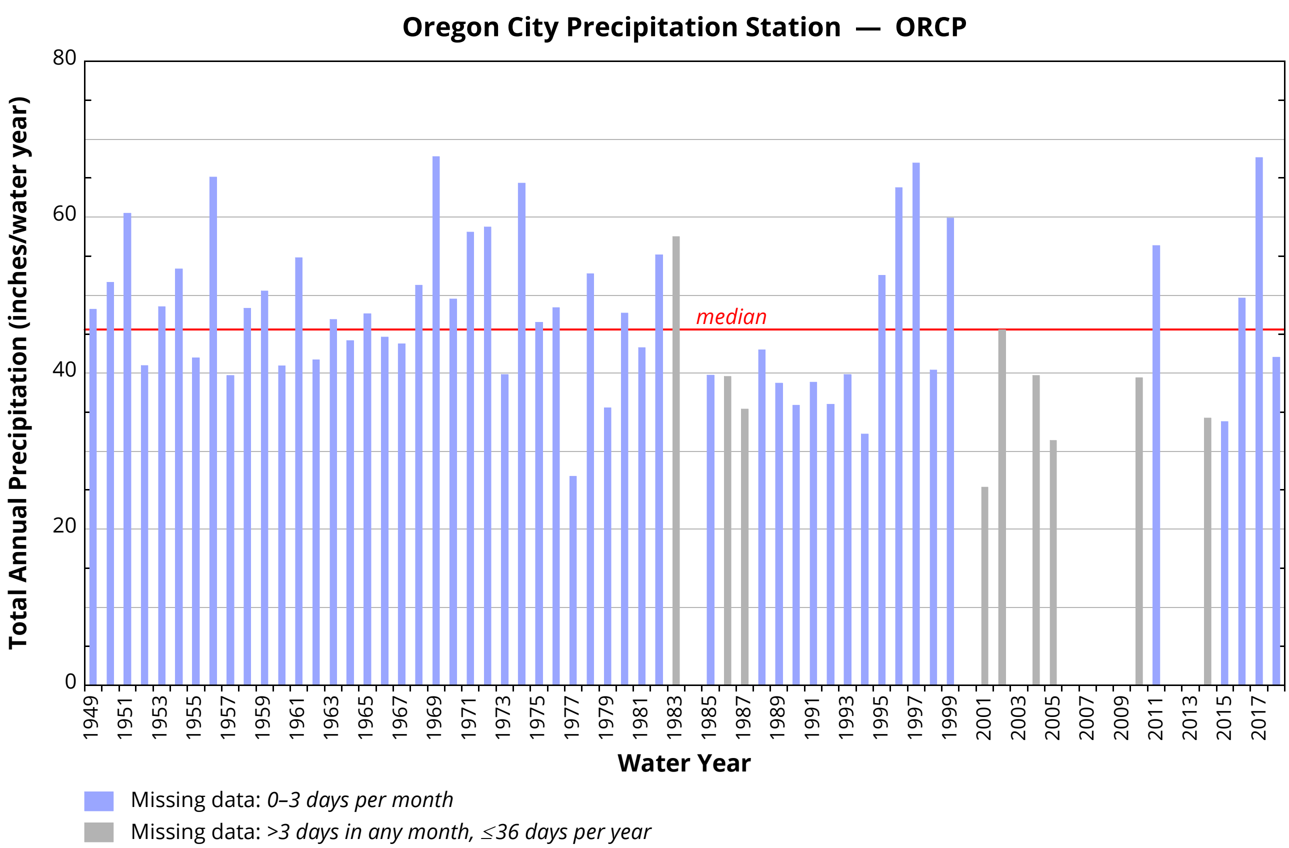
Water Year*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1998	5.70	3.97	3.47	8.91	4.86	4.68	1.19	4.99	1.03	0.43	0.02	1.13
1999	4.21	11.32	9.74	9.14	10.01	5.60	3.43	3.41	1.78	0.20	0.84	0.19
2000	2.70		5.01		6.29	3.08	2.26		1.41	0.46	0.02	0.48
2001	3.88		2.98		1.33	5.02		1.60		0.73	1.05	0.80
2002	2.85	6.52	9.54		3.96	5.55	3.58	1.50	2.09	0.37	0.29	
2003	0.47	2.81	10.18		3.86		5.58	0.52	0.70	0.00		1.02
2004	3.02	6.20	9.30	5.98	3.33		1.74	2.38	2.15	0.15	3.20	2.27
2005	5.62	1.89	4.35	2.15	0.78	5.43	2.88		2.06	0.57		1.58
2006	3.19	6.73	9.91	13.20	2.60	3.70	6.28		1.01	0.08	0.00	1.25
2007				1.01	2.13		1.39	0.61		0.32	0.00	0.32
2008					3.08				0.40		1.53	0.25
2009		7.13		6.86	3.06	4.88	1.38	0.98	1.05	0.17	0.69	1.60
2010	2.74	6.35	5.05	5.39	3.65	5.06		2.85		0.22	0.17	2.24
2011	5.73	7.91	11.43	5.35	5.17	8.25	5.58	3.32	1.48	1.10	0.00	1.04
2012		9.14	4.30	9.24	3.11		4.84	3.16	3.54			0.09
2013		9.00	9.74	3.56	2.48	1.95		2.69	0.12	0.00		5.56
2014	1.05	3.94	2.08		3.83	9.02	3.93	2.59	1.33	0.91	0.77	1.56
2015	6.86	3.39	5.08	3.28	3.99	5.52	2.35	1.00	0.32	0.26	0.80	0.96
2016	4.31	7.50	14.15	7.35	3.43	5.47	3.45	1.12	1.49	0.43	0.10	0.82
2017	11.24	7.56	5.98	3.75	9.17	18.65	5.16	1.29	1.38	0.00	0.23	3.22
2018	6.51	7.72	4.18	6.98	2.85	4.32	7.08	0.12	1.73	0.00	0.05	0.52
2019	2.85	3.99	7.26	*Data in this row are not included in statistics because water year is incomplete.*								
MIN	0.18	0.93	1.69	0.46	0.78	1.12	0.68	0.12	0.09	0.00	0.00	0.00
MAX	11.24	14.21	16.13	16.77	13.09	18.65	9.44	5.80	4.60	4.24	4.95	5.56
MEDIAN	3.88	6.925	7.205	6.92	4.5	4.96	3.47	2.3	1.5	0.43	0.615	1.535
MEAN	3.97	6.78	7.56	7.06	4.98	5.16	3.50	2.47	1.73	0.60	0.95	1.82

*Water Year (WY) begins October 1st of the previous calendar year and ends September 30th of current year.

ORCP – Oregon City Precipitation Station

Data source: National Weather Service COOP Program (COOP ID#356334)





APPENDIX H
WATER QUALITY: PHOSPHORUS

SCOPE

This appendix shows data for total phosphorus (TP) and soluble reactive phosphorus (SRP) concentrations at selected sites in the Tualatin River and its tributaries. The data were collected and analyzed by Clean Water Services. Other data on these parameters collected by other agencies may exist, but are not shown here. An explanation of the tables and figures is on page 4.

PATTERNS AND PROCESSES

- *Seasonal pattern, Tualatin River sites*—TP had a distinctive seasonal pattern that was evident at all Tualatin River sites except Cherry Grove where concentrations below the detection limit obscured any pattern.
  - —Winter concentrations of TP were higher than those in summer.
  - —Baseline summer concentrations at Golf Course Rd and Fern Hill were at or near the detection limit of 0.025 mg/L. Downstream of Golf Course Rd, baseline summer concentrations were higher, but still relatively low (0.06–0.08 mg/L). Even at sites downstream of the Rock Creek WWTF, summer median TP concentrations rarely exceeded 0.10 mg/L. Flow augmentation water from Hagg Lake and low-phosphorous effluent from the WWTFs probably account for the low and near-constant concentrations in the lower Tualatin River in the summer.
  - —TP concentrations increased in the fall when releases from Hagg Lake were discontinued. TP concentrations at sites downstream of the Rock Creek WWTF sometimes increased dramatically in the fall, often in November, when phosphorus treatment was suspended but streamflow was still low.

- *Seasonal pattern, tributary sites*— SRP had a clear, strong seasonal pattern at all of the tributary sites. TP exhibited the same pattern, but its strength varied among sites depending on how much the SRP contributed to TP.
  - —SRP was lowest around mid-winter to early-spring and increased steadily through the summer.
  - —Maximum SRP occurred anytime between July and September, depending on rainfall, and then decreased through late fall and into winter.
  - —This pattern is consistent with SRP entering the creek from groundwater. SRP has been measured in groundwater in the Tualatin Basin and concentrations are relatively constant: 0.1–0.3 mg/L in shallow groundwater and 1–3 mg/L in deeper regional groundwater. Rainfall contains almost no phosphorus. As rainfall decreases in early summer, groundwater accounts for an increasing fraction of the water in the tributary and the SRP concentration increases. The maximum concentration occurs when almost all of the water in the stream is from groundwater.

- *Concentration spikes*— Short-lived spikes in TP and SRP were relatively common, although the timing varied among sites. Sometimes a TP spike was accompanied by a coincident SRP spike, and sometimes it was not.
  - —In the Tualatin River, many TP spikes occurred November through March and did not have coincident SRP spikes. These spikes generally occurred during or shortly after a storm which probably caused high flows that resuspended bed sediment or transported phosphorus-containing particulate to the stream.
  - —In the tributaries, many TP spikes occurred near the end of summer and through early fall. TP and SRP spikes occurred in Fanno Creek throughout the year. The TP spikes in the tributaries had coincident SRP spikes more often than those in the Tualatin River. Both the TP and SRP spikes usually occurred during or shortly after storms which likely increased particulate phosphorus as in the Tualatin River, but also transported SRP to the stream through stormwater discharges or tile drains.
  - —Occasionally, a TP or SRP spike did not coincide with high flow. Several TP spikes with coincident SRP spikes were observed in the Tualatin River and could be traced to the annual pumpout of Wapato Lake. Some TP and SRP spikes in various tributaries were of unexplained origin.
  - —Evaluating trends involving TP or SRP spikes was compromised by inconsistent sampling frequency. For short-lived concentration spikes, frequent and consistent sampling is needed to characterize any change related to the incidence or magnitude of spikes over time.

2018 CONCENTRATIONS

Median monthly concentrations for each site are shown in the tables below. Points from 2018 include:

- Concentrations of TP and SRP were high in November and December at Tualatin River sites downstream of the Rock Creek WWTF. After a large storm in October, fall rain was sparse in 2018. River flow was unusually low in November and December after phosphorus treatment was discontinued.
- The high median concentrations in the summer at the Beaverton and Rock Creek sites were due to SRP from groundwater combined with low flow.
- The high concentration in November at the Fanno Creek site was due to particulate phosphorus related to high flow. On November 27, flow was 177 cfs, total suspend solids was 141 mg/L and TP was 0.342 mg/L.
- A few anomalous data values occurred which may indicate an unusual event or a lab or database error:
  —McKay Cr, TP, August: 0.061 mg/L and <0.01 mg/L (6th and 20th, respectively). The <0.01 mg/L value is lower than any value in the period of record. The next lowest value in 2018 was 0.04 mg/L.
  —Scoggins Cr, SRP, October: <0.005 and 0.058 (17th and 3rd, respectively). Other SRP in 2018 were <0.005.

2018 MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P)

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Tualatin River sites upstream of Rock Creek WWTF and Scoggins Creek site													
Scoggins Creek	22	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.019	<0.010	<0.010	<0.025	<0.025	<0.025
TR at Cherry Grove	20	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.010	<0.025	<0.025	<0.025	<0.025	<0.025
TR at Fern Hill Rd	22	0.041	0.053	0.092	0.091	0.031	0.033	0.031	0.035	0.025	0.045	0.041	0.085
TR at Hwy 219	12	0.048	0.048	0.054	0.046	0.055	0.072	0.096	0.027	0.062	0.061	0.073	0.099
TR at Rood Bridge Rd	23	0.071	0.060	0.083	0.096	0.061	0.067	0.077	0.066	0.063	0.061	0.081	0.088
Tualatin River sites downstream of Rock Creek WWTF													
TR at Hwy 210	23	0.090	0.078	0.102	0.095	0.065	0.085	0.105	0.079	0.081	0.109	0.347	0.275
TR at Jurgens Park	23	0.094	0.076	0.105	0.097	0.077	0.086	0.083	0.089	0.077	0.098	0.457	0.192
TR at Stafford Rd	23	0.107	0.088	0.113	0.108	0.081	0.084	0.076	0.073	0.070	0.179	0.502	0.243
Tributary sites													
Gales Creek	22	0.055	0.040	0.037	0.052	0.038	0.039	0.065	0.023	0.047	0.046	0.044	0.073
Dairy Creek	22	0.078	0.076	0.061	0.066	0.089	0.083	0.127	0.114	0.125	0.109	0.106	0.109
McKay Creek	22	0.057	0.050	0.054	0.052	0.078	0.107	0.200	0.036	0.133	0.108	0.103	0.082
Beaverton Creek	22	0.122	0.104	0.093	0.103	0.155	0.195	0.268	0.236	0.172	0.180	0.208	0.138
Rock Creek	22	0.119	0.101	0.088	0.101	0.158	0.198	0.264	0.233	0.216	0.196	0.198	0.150
Chicken Creek	21	0.089	0.052	0.049	0.057	0.087	0.123	0.118	0.132	0.133	0.112	0.153	0.078
Fanno Creek	21	0.143	0.095	0.088	0.101	0.119	0.135	0.160	0.120	0.125	0.125	0.249	0.110

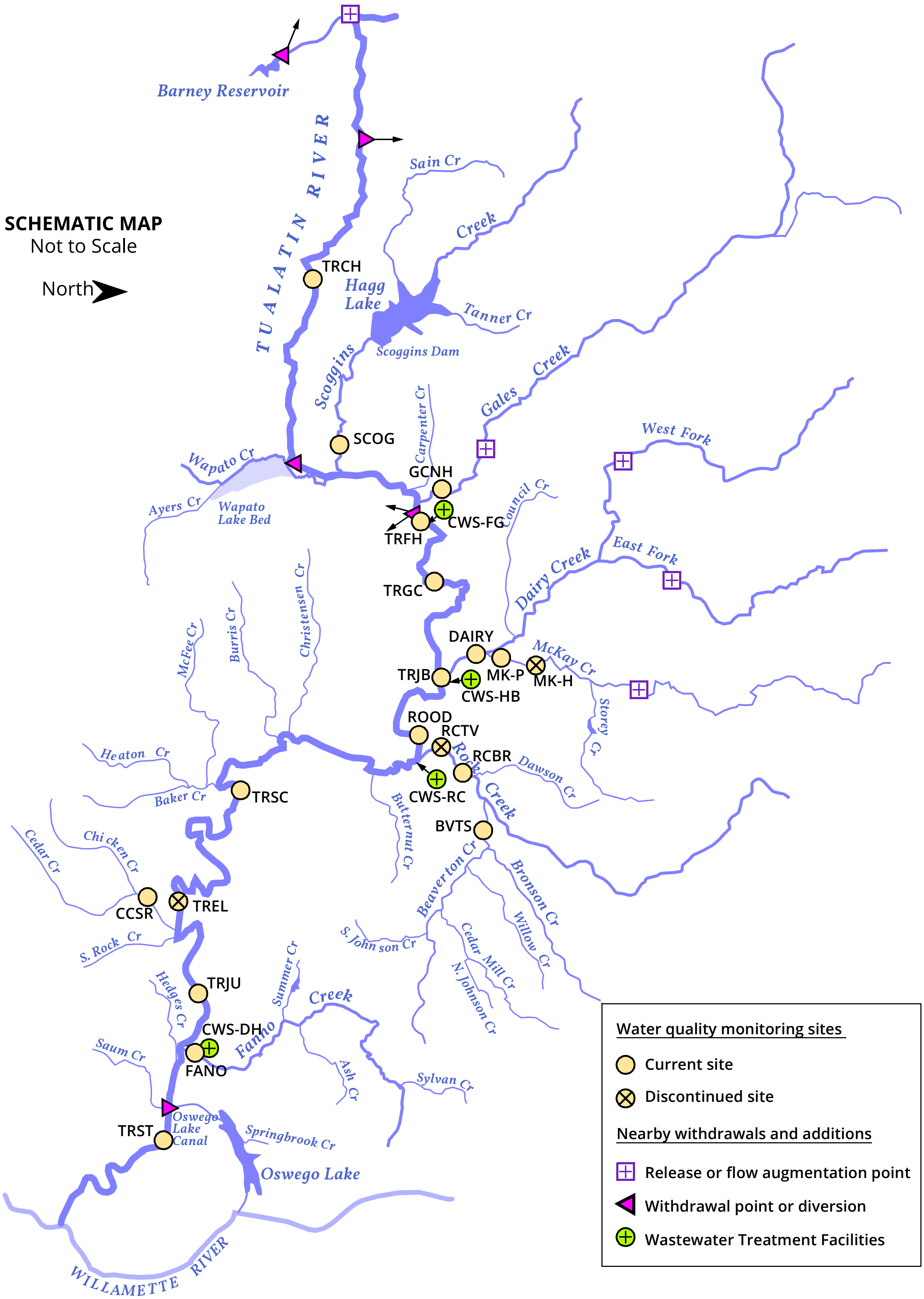
KEY:	TP ≤ 0.04	0.04 < TP ≤ 0.08	0.08 < TP ≤ 0.12	0.12 < TP ≤ 0.18	0.18 < TP ≤ 0.22	TP > 0.22

2018 MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P)

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Tualatin River sites upstream of Rock Creek WWTF, and Scoggins Creek													
Scoggins Creek	23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.032	<0.005	<0.005
TR at Cherry Grove	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TR at Fern Hill Rd	23	0.012	0.010	0.046	0.023	0.013	0.009	0.007	0.007	0.006	0.007	0.009	0.014
TR at Hwy 219	12	0.018	0.022	0.022	0.018	0.018	0.032	0.021	0.024	0.022	0.022	0.021	0.025
TR at Rood Bridge Rd	23	0.019	0.018	0.030	0.020	0.025	0.032	0.027	0.029	0.026	0.025	0.030	0.027
Tualatin River sites downstream of Rock Creek WWTF													
TR at Hwy 210	23	0.044	0.030	0.059	0.025	0.028	0.038	0.035	0.037	0.034	0.062	0.275	0.160
TR at Jurgens Park	23	0.041	0.026	0.052	0.031	0.039	0.042	0.034	0.048	0.042	0.055	0.384	0.140
TR at Stafford Rd	23	0.049	0.034	0.056	0.040	0.037	0.043	0.036	0.041	0.045	0.120	0.430	0.148
Tributary sites													
Gales Creek	23	0.017	0.016	0.014	0.016	0.016	0.016	0.029	0.031	0.025	0.037	0.017	0.016
Dairy Creek	23	0.023	0.025	0.017	0.019	0.036	0.041	0.066	0.062	0.063	0.032	0.050	0.032
McKay Creek	23	0.026	0.021	0.021	0.021	0.036	0.049	0.073	0.057	0.062	0.063	0.055	0.032
Beaverton Creek	23	0.043	0.048	0.043	0.056	0.096	0.135	0.196	0.159	0.118	0.112	0.081	0.058
Rock Creek	23	0.040	0.041	0.036	0.049	0.092	0.123	0.174	0.151	0.125	0.106	0.080	0.064
Chicken Creek	22	0.025	0.015	0.011	0.015	0.024	0.045	0.039	0.037	0.032	0.028	0.044	0.023
Fanno Creek	22	0.031	0.036	0.026	0.034	0.056	0.071	0.094	0.072	0.056	0.056	0.055	0.036

KEY:	SRP ≤ 0.015	0.015 < SRP ≤ 0.03	0.03 < SRP ≤ 0.06	0.06 < SRP ≤ 0.09	0.09 < SRP ≤ 0.15	SRP > 0.15

PHOSPHORUS SAMPLING SITES



PHOSPHORUS SAMPLING SITES — ALPHABETICAL LISTING BY SITE CODE

SITE CODE	SITE NAME	RIVER MILE	PAGE
BVTS	Beaverton Creek near Orenco / at Guston Ct	1.2 / 1.2	H–57
CCSR	Chicken Creek at Scholls-Sherwood Rd (Roy Rogers Rd)	2.3	H–61
DAIRY	Dairy Creek at Hwy 8	2.06	H–45
FANO	Fanno Creek at Durham Rd	1.2	H–65
GCNH	Gales Creek at New Hwy 47	2.36	H–41
MK-H & MK-P	McKay Creek at Hornecker Rd / Padgett Rd	2.2 / 1.3	H–49
RCTV & RCBR	Rock Creek at Hwy 8 / Brookwood	1.2 / 2.4	H–53
ROOD	Tualatin River at Rood Bridge Rd	38.4	H–25
SCOG	Scoggins Creek near Gaston	1.71	H–5
TRCH	Tualatin River at Cherry Grove (South Rd Bridge)	67.83	H–9
TREL & TRJU	Tualatin River at Elsner Rd / Jurgens Park	16.2 / 10.8	H–33
TRFH	Tualatin River at Spring Hill Pump Plant / Fern Hill Rd	55.3	H–13
TRGC	Tualatin River at Golf Course Rd	51.5	H–17
TRJB	Tualatin River at Hwy 219	44.4	H–21
TRSC	Tualatin River at Hwy 210 (Scholls Bridge)	26.9	H–29
TRST	Tualatin River at Stafford	5.38	H–37

Explanation of Figures and Tables in this Appendix

Four pages of tables and graphs are included for every site.

Page 1–discussion: A short summary of sample collection is at the top of the page, including the period of record, sampling frequency during that time. and any changes in site location. That section is followed by a series of observations about the data, including concentration ranges, seasonality and trends.

Page 2–times series: Page 2 includes time series graphs of total phosphorus and soluble reactive phosphorus for the period of record plus color-coded charts showing the frequency of data collection by year. Note that data points in the time series graphs are connected with a line to make them easier to follow. In some cases considerable time elapsed between data points. The line should not be construed to indicate concentrations between sample points.

Page 3–color-coded table of medians: Page 3 contains two tables of monthly median concentrations by year—one for total phosphorus and one for soluble reactive phosphorus. The tables are shaded by concentration range with a key to the right of each table. The color code is somewhat arbitrary and chosen for each site to help illustrate any seasonal data patterns.

Page 4–graphs of July–September data: Page 4 contains graphs of July–September total phosphorus and soluble reactive phosphorus concentrations and shows any trends that occurred over the period of record. If the 2001 TMDL had a loading capacity for total phosphorus at the site, it is shown on the graph. This time period was chosen because phosphorus is often implicated in nuisance algal growth and the July–September period is when such growth is favored due to ample sunlight and low flows.

SCOG – Scoggins Creek near Gaston – 14203000

Data source: Clean Water Services

Sampling frequency

- The period of record is November 2000 through present. No data were collected in the summer of 2002.
- Sampling frequency varied, but mostly was about every two weeks. Sampling was weekly during the summer from 2003–2011.

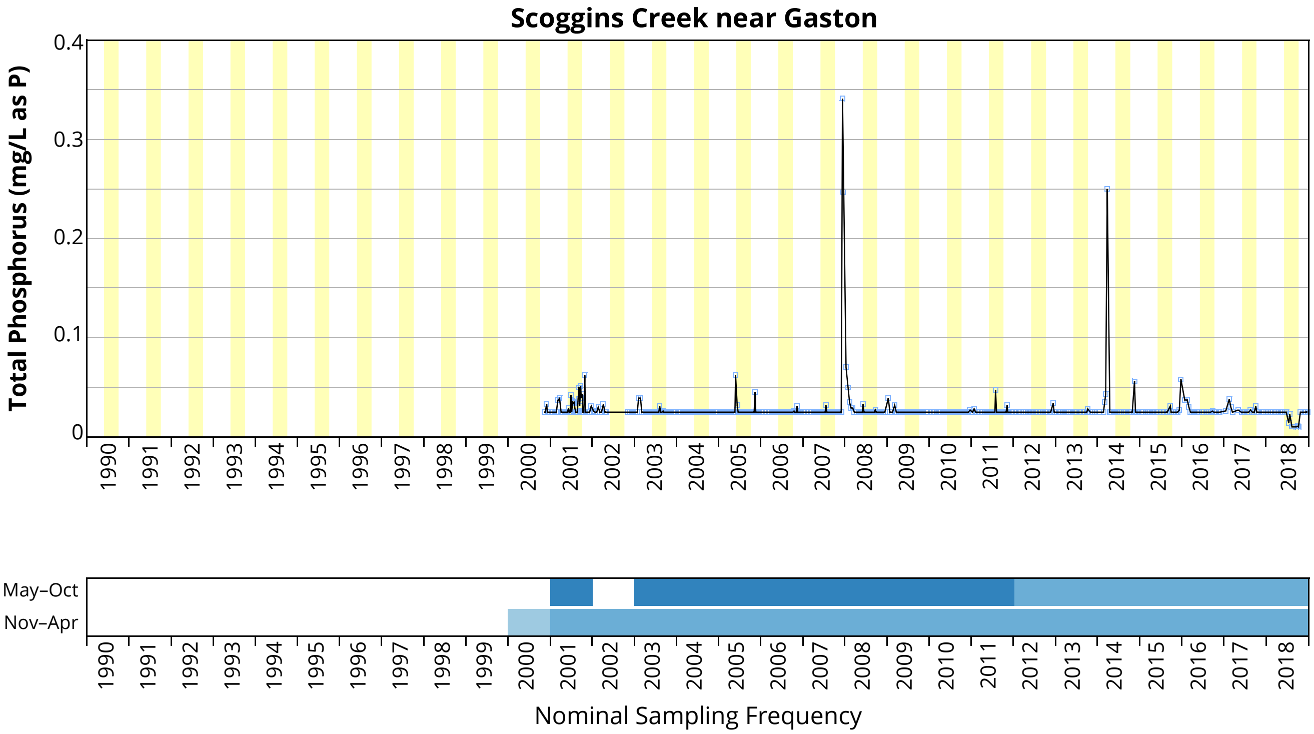
Concentrations & trends

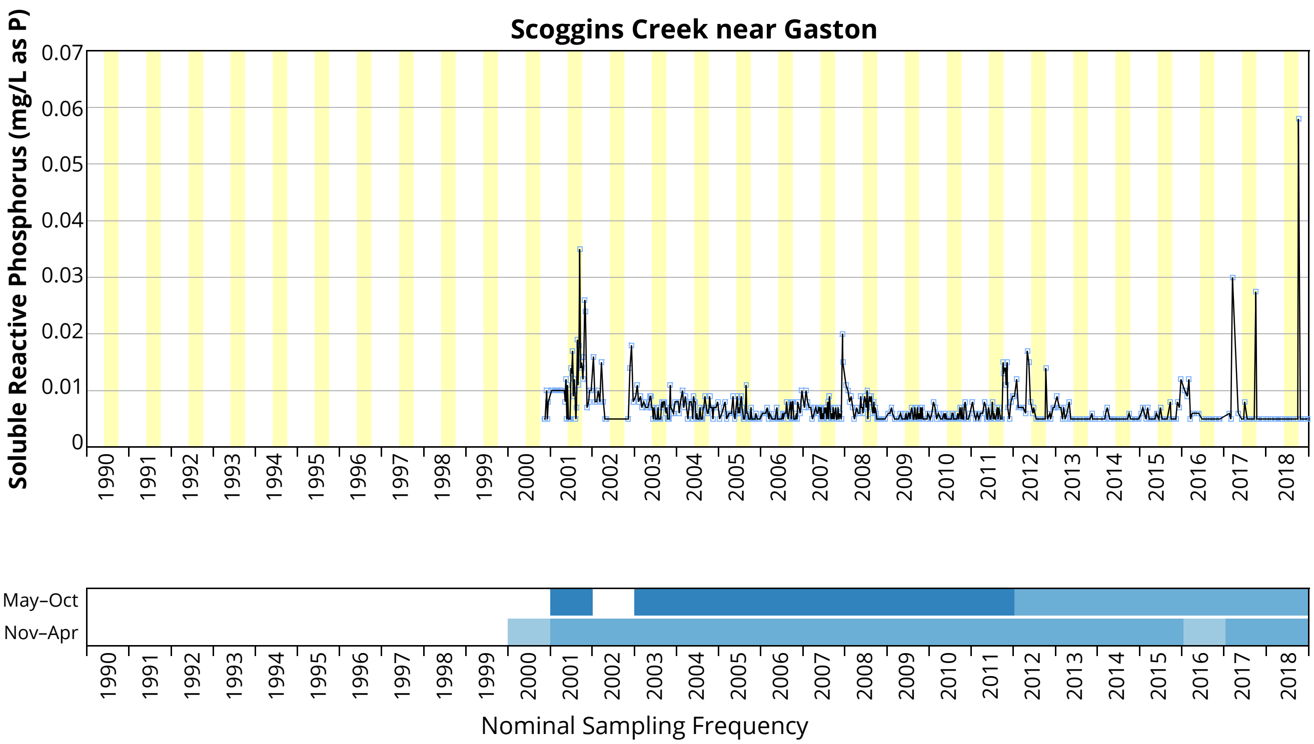
- Both total phosphorus (TP) and soluble reactive phosphorus (SRP) concentrations in Scoggins Creek were generally very low, with most values at or below the detection limits (commonly, 0.025 mg/L and 0.005 mg/L, respectively).
- Median July–September TP concentrations were lower than the TMDL loading capacity concentration of 0.04 mg/L throughout the period of record.
- Spikes in TP concentration generally occurred from November through March and were probably due to an increase in the particulate form of phosphorus that occurred during or shortly after a storm. During heavy rains, landslides have occurred in the Scoggins Creek drainage that transport extra sediment to Hagg Lake and then to Scoggins Creek.
- The highest TP concentrations coincided with a large storm in early December 2007. Elevated concentrations persisted for weeks afterward due to storm-derived suspended sediment in Hagg Lake.
- Because the high flows that trigger TP concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency, especially November–April and from 2012 to present.
- Other than spikes that occurred during high flow, TP concentrations in Scoggins Creek do not appear to have any seasonal pattern.
- SRP concentrations tend to be higher in winter than in summer, possibly due to uptake by algae in summer.
- Elevated SRP concentrations sometimes occur with TP concentrations spikes, but not always.
- Recent SRP data show anomalous spikes of an unexplained origin, often in September–October.
- July–September SRP concentrations show a decreasing trend over the period of record. Because recent data are near the detection limit, further evaluation of the trend is not possible without a decrease in that detection limit.

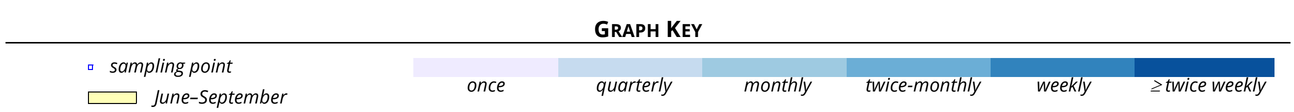
SCOG – Scoggins Creek near Gaston – 14203000

Data source: Clean Water Services

Time series







SCOG – Scoggins Creek near Gaston – 14203000

Data source: Clean Water Services

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — SCOG

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2000	5											<0.025	<0.025
2001	39	<0.025	<0.025	0.038	<0.025	<0.025	0.027	0.034	<0.025	0.045	<0.025	<0.025	0.028
2002	13	0.026	0.028	<0.025	<0.025							<0.025	<0.025
2003	38	<0.025	0.039	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2004	38	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2005	39	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2006	39	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2007	40	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.294
2008	38	0.060	0.032	0.027	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2009	37	0.032	<0.025	0.029	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2010	37	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.026
2011	39	0.027	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2012	24	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.030
2013	23	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.027	<0.025	<0.025
2014	24	<0.025	0.030	0.147	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.041	<0.025
2015	23	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.028	<0.025	<0.025	0.043
2016	20	0.037	0.034	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
2017	20	0.026	0.034	<0.025	0.027	<0.025	<0.025	<0.025	0.026	0.028	<0.025	<0.025	<0.025
2018	22	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.019	0.010	0.011	0.018	<0.025	<0.025
POR MEDIAN		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025

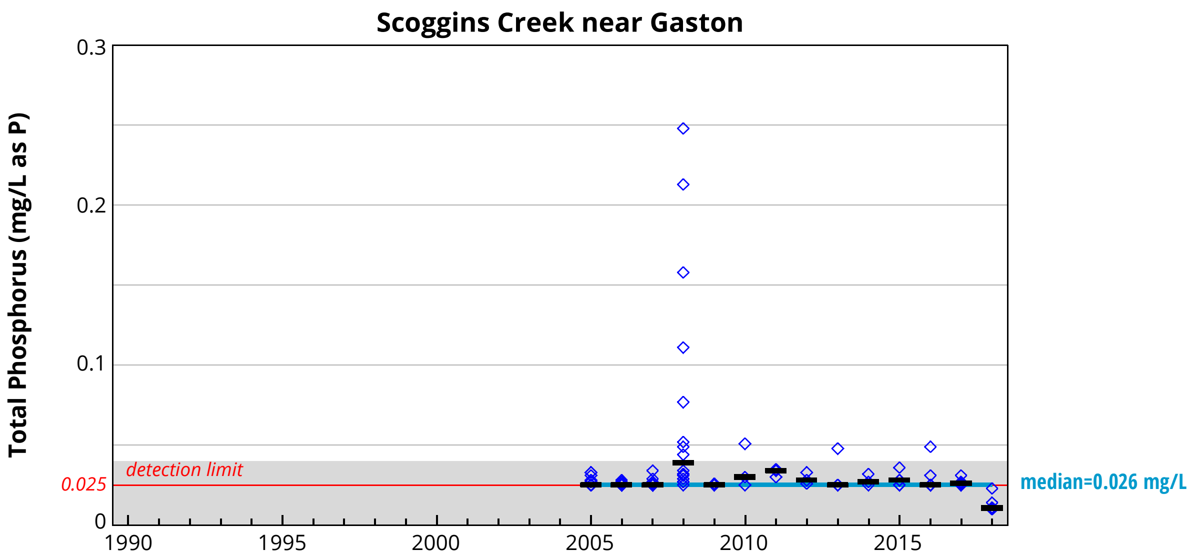
KEY
total P in mg/L as P
TP ≤ 0.025
0.025 < TP ≤ 0.030
0.03 < TP ≤ 0.05
0.05 < TP ≤ 0.08
TP > 0.08

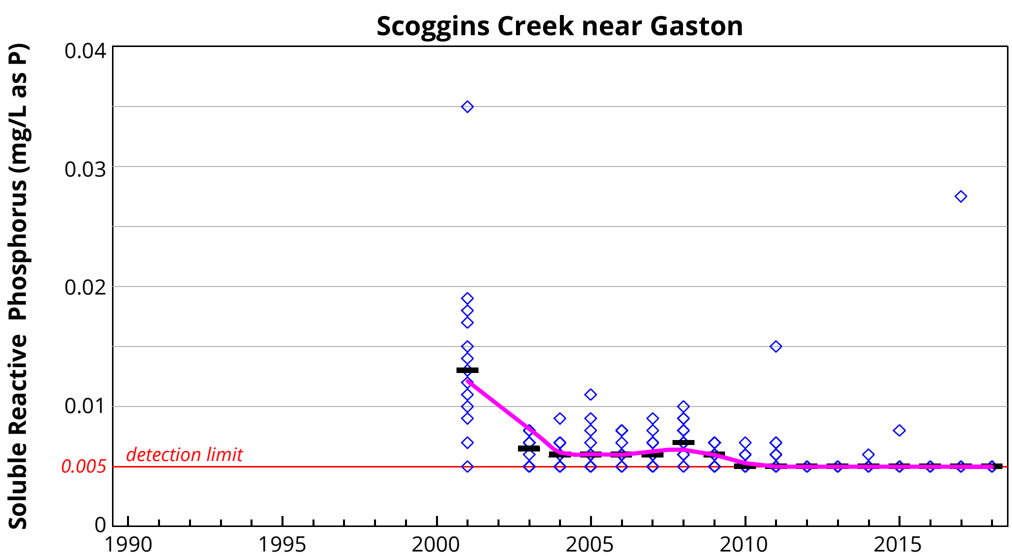
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — SCOG

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2000	5											<0.005	0.007
2001	39	<0.010	<0.010	<0.010	<0.010	0.010	<0.005	0.012	0.009	0.017	0.016	0.008	0.010
2002	13	0.012	0.009	0.012	<0.005							0.010	0.013
2003	38	0.010	0.009	0.008	0.007	0.009	0.007	<0.005	0.006	0.007	<0.005	0.009	0.007
2004	38	0.007	0.009	0.008	0.007	0.008	0.006	<0.005	0.007	0.006	0.007	0.007	0.008
2005	39	0.006	0.008	0.006	0.006	0.006	0.007	0.008	0.006	<0.005	<0.005	<0.005	<0.005
2006	39	0.006	0.007	0.006	<0.005	<0.005	<0.005	0.006	0.006	0.008	<0.005	0.006	0.008
2007	40	0.009	0.008	0.006	0.007	0.006	0.006	0.007	0.007	0.006	0.006	<0.005	0.018
2008	38	0.011	0.009	0.006	0.007	0.007	0.008	0.008	0.008	0.006	<0.005	<0.005	<0.005
2009	37	0.006	0.007	<0.005	0.006	<0.005	<0.005	0.006	0.006	<0.005	0.006	<0.005	0.006
2010	37	0.006	0.008	0.006	<0.005	0.006	<0.005	0.006	<0.005	<0.005	0.006	0.007	0.006
2011	39	0.007	0.006	0.006	0.007	0.006	0.006	<0.005	0.006	<0.005	0.014	0.007	0.009
2012	24	0.011	0.007	0.007	0.012	0.012	0.007	<0.005	<0.005	<0.005	0.010	0.006	0.007
2013	23	0.008	0.006	0.006	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005
2014	24	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.005
2015	23	0.007	<0.005	0.006	<0.005	0.006	0.006	<0.005	<0.005	0.007	<0.005	0.007	0.010
2016	18	0.010	0.011	0.006		0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
2017	19		0.006	0.030	0.006	<0.005	0.007	<0.005	<0.005	0.016	<0.005	<0.005	<0.005
2018	23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.032	<0.005	<0.005
POR MEDIAN		0.007	0.007	0.006	0.006	0.006	0.006	<0.005	0.006	0.006	<0.005	0.006	0.007

KEY
SRP in mg/L as P
SRP ≤ 0.005
0.005<SRP≤0.006
0.006<SRP≤0.007
0.007<SRP≤0.010
SRP > 0.010

JULY-SEPTEMBER TREND (LOW-FLOW HIGH-SUNLIGHT PERIOD)





GRAPH KEY

- ◇ value
- — Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS) - no statistically significant trend
- POR Jul-Sep trend line (LOWESS) - statistically significant trend
- TMDL loading capacity— acceptable range for summer median

TRCH – Tualatin River at Cherry Grove (South Road Bridge)

Data source: Clean Water Services

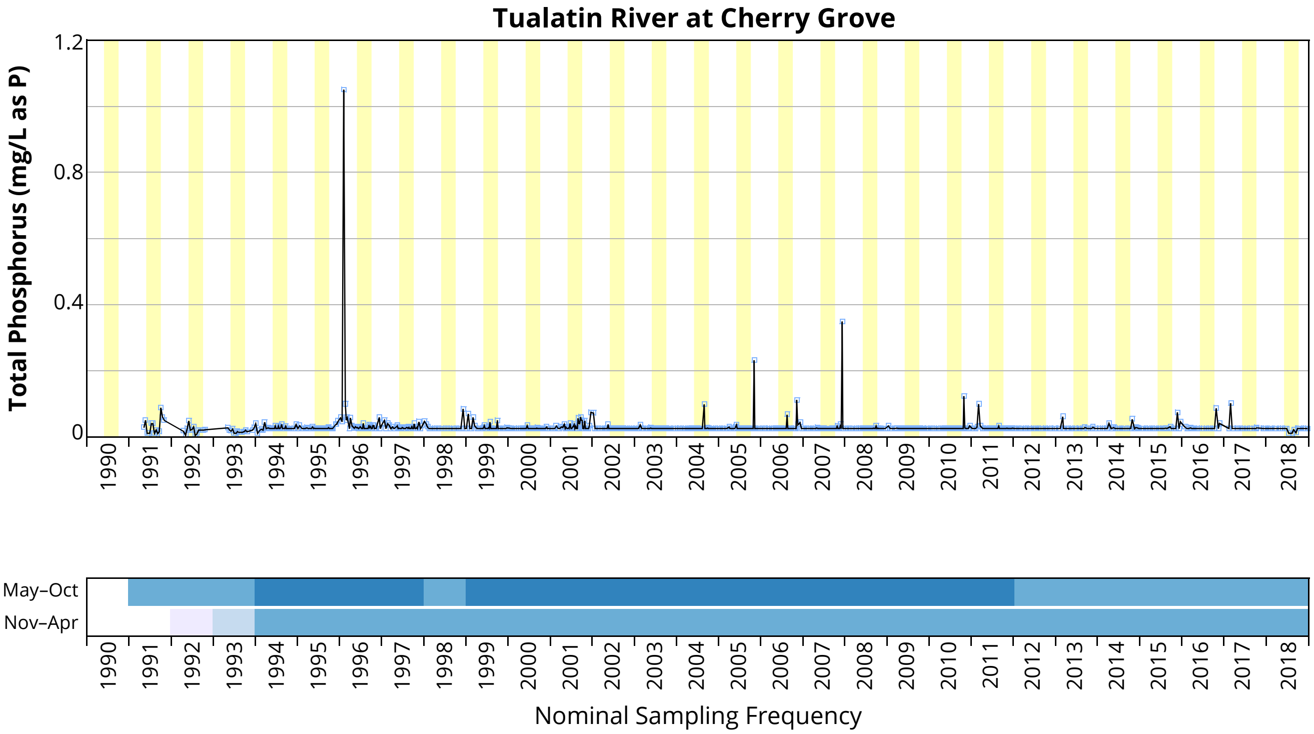
Sampling frequency

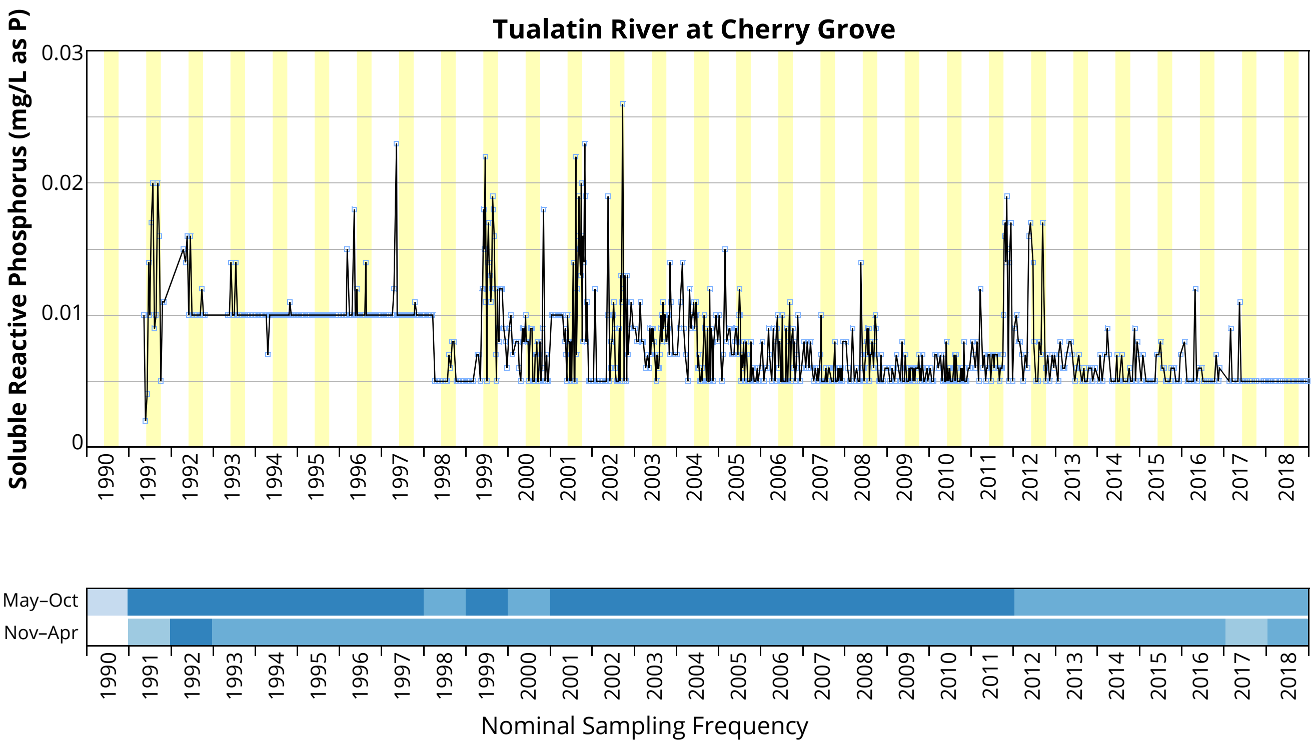
- The period of record is May 1991 through present.
- Sampling frequency varied, but was about every two weeks during winter and up to weekly during summer.
- Sampling frequency likely was not adequate to fully characterize the conditions associated with high flows.

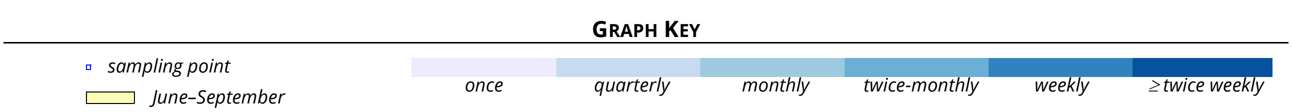
Concentrations & trends

- Total phosphorus (TP) concentrations at Cherry Grove were generally very low, with most values at or below the detection limit (commonly, 0.025 mg/L).
- Median July–September TP concentrations were lower than the TMDL loading capacity concentration of 0.04 mg/L.
- Spikes in TP concentration generally occurred from November through March and were probably due to an increase in the particulate form of phosphorus that occurred during or shortly after a storm.
- The highest concentration was measured on February 6, 1996 and coincided with large storms that caused major flooding downstream. The second highest concentration coincided with the large storm in early December 2007.
- Because the high flows that trigger the concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency, especially during May–October since 2012 and November–April for the entire period of record.
- Other than spikes that occurred during high flow, phosphorus concentrations in the Tualatin River at Cherry Grove do not appear to have any seasonal pattern.
- Soluble reactive phosphorus (SRP) concentrations are generally low, between 0.005 and 0.026 mg/L.
- July–September SRP concentrations show a decreasing trend since 1998. The trend is statistically significant, although not monotonic. Any trend before 1997 cannot be evaluated due to a higher detection limit.

Time series


Tualatin River at Cherry Grove
Total Phosphorus (mg/L as P)
1.2
0.8
0.4
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
May–Oct
Nov–Apr
Nominal Sampling Frequency


Tualatin River at Cherry Grove
Soluble Reactive Phosphorus (mg/L as P)
0.03
0.02
0.01
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
May–Oct
Nov–Apr
Nominal Sampling Frequency


Graph Key
sampling point
June–September
once
quarterly
monthly
twice-monthly
weekly
≥ twice weekly

TRCH – Tualatin River at Cherry Grove (South Road Bridge)

Data source: Clean Water Services

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — TRCH

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	14					0.039	0.010	0.040	0.015	0.013	0.059		
1992	14				0.018	0.015	0.022	0.018	0.016	0.020	0.021		
1993	15					0.024	0.018	0.014	0.014	0.015	0.018		0.024
1994	37	<0.025	0.022	0.032	0.026	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.031
1995	38	0.030	<0.025	0.026	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.038	0.043
1996	37	0.052	0.099	0.042	0.045	0.028	0.027	<0.025	<0.025	0.030	<0.025	<0.025	0.042
1997	37	0.046	0.033	0.030	<0.025	0.029	<0.025	<0.025	0.027	<0.025	0.027	0.036	0.029
1998	24	0.043	0.027	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.055
1999	37	0.048	<0.025	0.046	<0.025	<0.025	<0.025	0.027	<0.025	<0.025	<0.025	<0.025	0.026
2000	38	0.026	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.028	<0.025
2001	40	<0.025	0.029	<0.025	0.029	<0.025	0.026	0.030	0.029	0.046	<0.025	<0.025	0.53
2002	39	0.049	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2003	38	<0.025	0.031	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2004	37	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2005	40	<0.025	<0.025	0.027	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2006	38	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.074	0.034
2007	38	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.187
2008	37	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2009	39	0.029	<0.025	0.026	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2010	38	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.033
2011	40	<0.025	0.027	0.066	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.026
2012	24	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2013	23	<0.025	0.043	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.027	<0.025	0.027	<0.025
2014	24	<0.025	<0.025	<0.025	0.033	0.027	<0.025	<0.025	<0.025	<0.025	0.039	0.027	0.026
2015	23	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.026	0.028	<0.025	0.049	0.036
2016	20	0.031	<0.025	0.026	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.056	0.033	
2017	18		0.063	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.027	<0.025	<0.025
2018	20	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.010	0.016	0.019	<0.025	<0.025	<0.025
POR Median		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.026

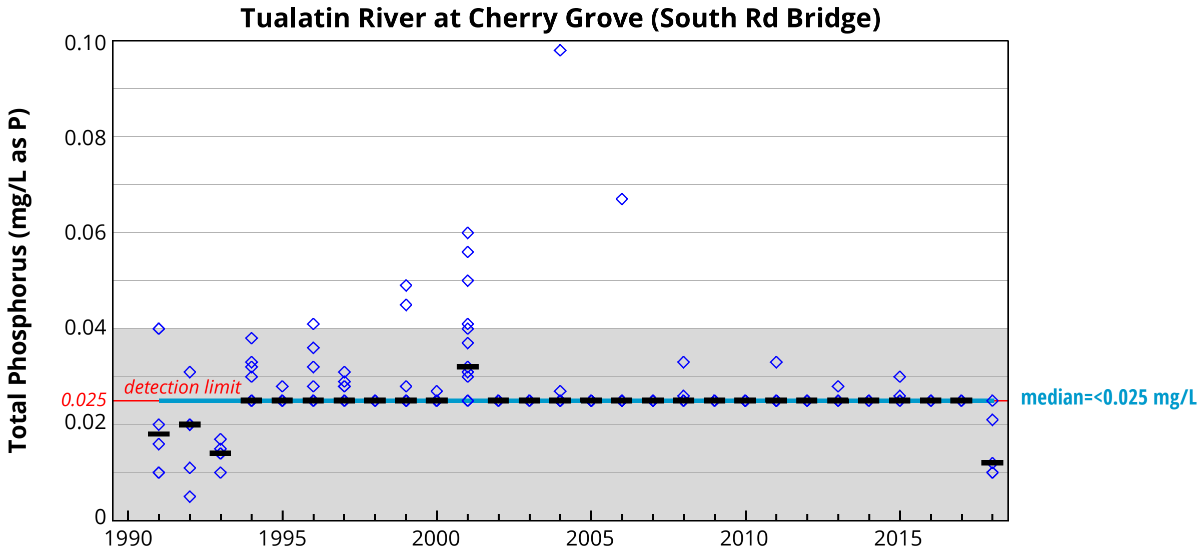
Key
total P in mg/L as P
TP ≤ 0.25
0.025 < TP ≤ 0.30
0.03 < TP ≤ 0.05
0.05 < TP ≤ 0.10
TP > 0.10

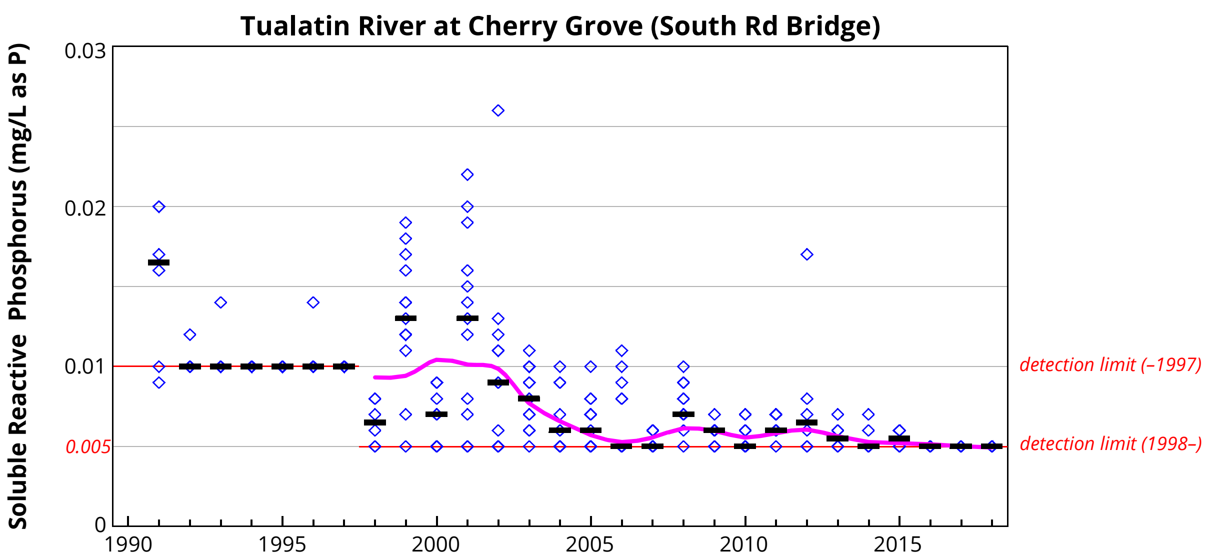
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — TRCH

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	14					0.006	0.010	0.019	0.010	0.018	0.011		
1992	14				<0.015	<0.015	<0.012	<0.010	<0.010	<0.011	<0.010		
1993	15					<0.010	0.010	0.012	<0.010	<0.010	<0.010		<0.010
1994	37	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1995	38	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1996	37	<0.010	<0.010	0.013	<0.010	0.011	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010
1997	36	<0.010	<0.010	<0.010	<0.012	<0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1998	24	<0.010	<0.010	<0.010	<0.005	<0.005	<0.005	<0.005	0.007	0.008	<0.005	<0.005	<0.005
1999	35	<0.005	<0.005	<0.005	0.007	0.012	0.015	0.014	0.016	0.010	0.011	0.011	0.007
2000	37	0.010	0.007	0.008	0.006	0.009	0.008	0.009	<0.005	0.006	0.008	0.006	<0.005
2001	40	<0.010	<0.010	<0.010	<0.010	0.008	0.008	0.005	0.014	0.017	0.016	0.008	<0.005
2002	39	0.009	<0.005	<0.005	<0.005	0.010	0.008	0.006	<0.005	0.013	0.011	0.008	0.010
2003	37	0.009	0.010	0.008	0.007	0.008	0.008	0.006	0.009	0.010	0.009	0.013	0.007
2004	37	0.008	0.013	0.008	0.009	0.010	0.010	0.006	0.008	<0.005	0.007	0.008	0.009
2005	40	0.008	0.011	0.009	0.008	0.008	0.009	0.007	0.007	<0.005	0.006	<0.005	0.006
2006	38	0.007	0.006	0.008	0.007	0.008	0.007	<0.005	0.007	0.008	0.006	0.009	0.006
2007	39	0.007	0.007	0.007	<0.005	0.006	0.005	0.005	0.006	<0.005	<0.005	0.006	0.007
2008	37	0.007	<0.005	0.007	0.006	0.007	0.006	0.008	0.007	0.008	<0.005	0.005	0.006
2009	39	0.006	0.006	0.006	0.006	<0.005	0.005	0.006	0.006	0.006	0.006	0.005	0.006
2010	38	0.006	0.006	0.007	0.006	0.006	0.005	0.005	0.006	0.005	0.006	0.005	0.006
2011	40	0.008	0.007	0.009	0.007	0.006	0.007	0.007	0.006	0.006	0.016	0.014	0.011
2012	24	0.010	0.008	0.006	0.007	0.017	0.011	0.005	0.008	0.012	0.006	0.006	0.007
2013	23	0.006	0.007	0.006	0.008	0.008	0.006	0.007	0.006	<0.005	0.006	0.006	0.006
2014	24	0.006	0.006	0.008	0.006	0.005	0.006	0.006	0.005	0.006	<0.005	0.007	0.008
2015	23	0.006	<0.005	0.005	<0.005	0.006	0.008	0.006	<0.005	0.006	0.006	<0.005	0.006
2016	20	0.008	<0.005	<0.005	0.009	0.006	0.006	<0.005	<0.005	<0.005	0.006	0.006	
2017	18		0.007	<0.005	<0.005	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005
2018	20	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
POR Median		0.007	0.006	0.007	0.006	0.008	0.007	0.006	0.006	0.006	0.006	0.006	0.006

Key
SRP in mg/L as P
SRP ≤ 0.005
0.005<SRP≤0.006
0.006<SRP≤0.009
0.009<SRP≤0.014
SRP > 0.014

July-September trend (low-flow high-sunlight period)





Graph Key

◇ value	POR Jul-Sep median
Jul-Sep median	POR Jul-Sep smooth line (LOWESS)
	POR Jul-Sep trend line (LOWESS) - statistically significant
	TMDL loading capacity— acceptable range for summer median

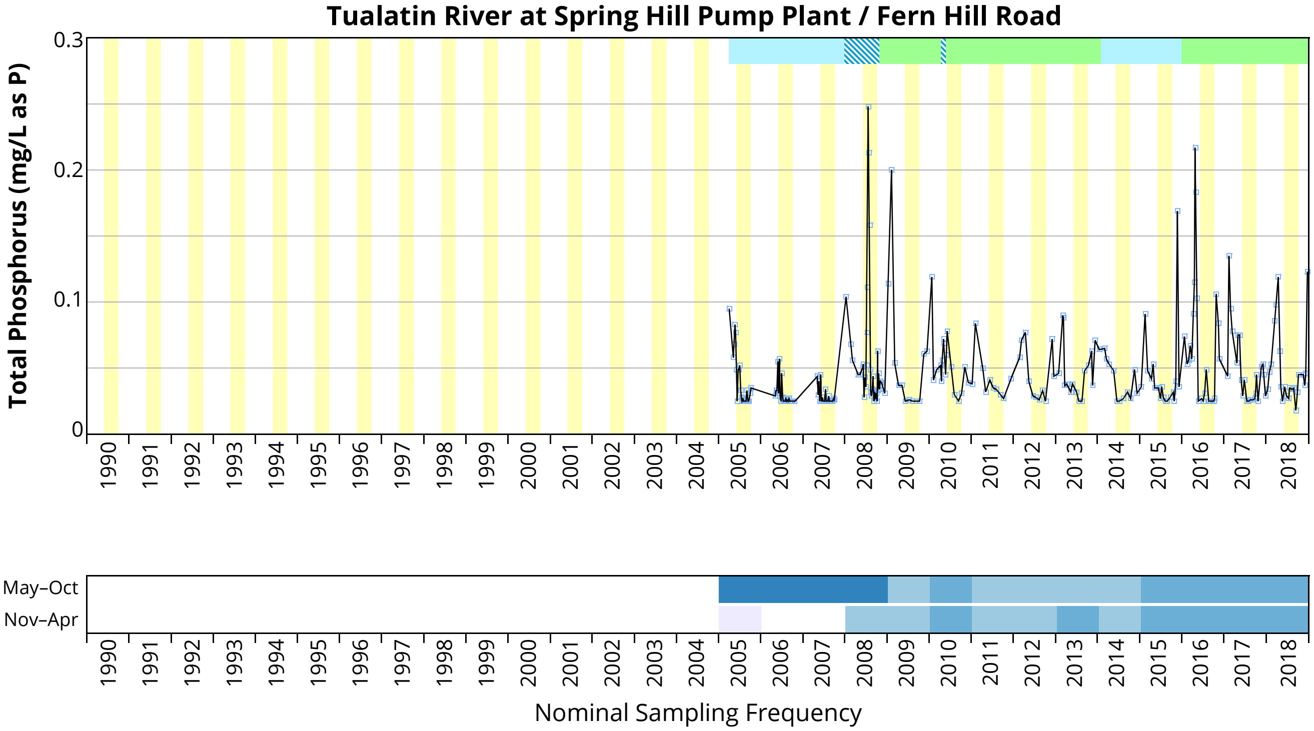
Sampling frequency & location

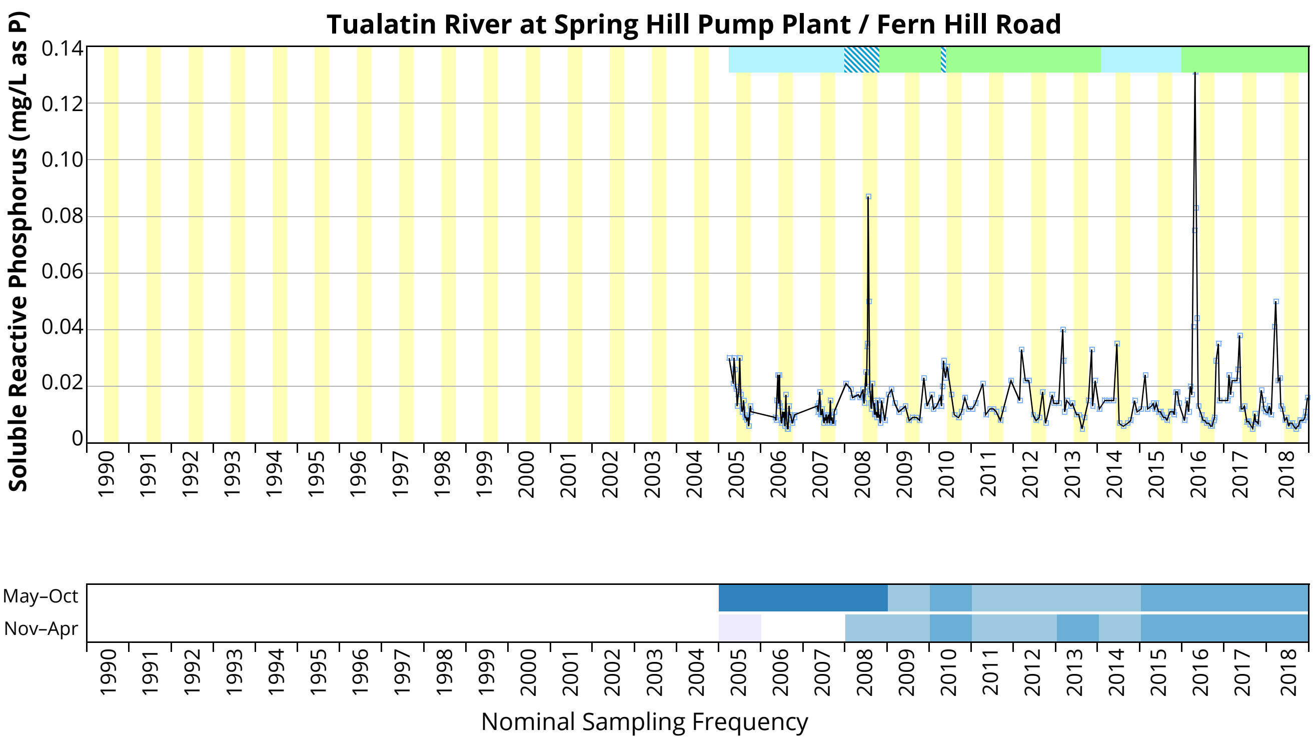
- The period of record is March 2005 through present.
- Sampling frequency was variable and except for May–October 2005–2008, no more than twice a month and often less.
- Sampling frequency likely was not adequate to fully characterize the conditions associated with high flows.
- The sampling location switched between two sites, sometimes as often as every other sample. These two sites are close to each other, so the site changes may not be important.

Concentrations & trends

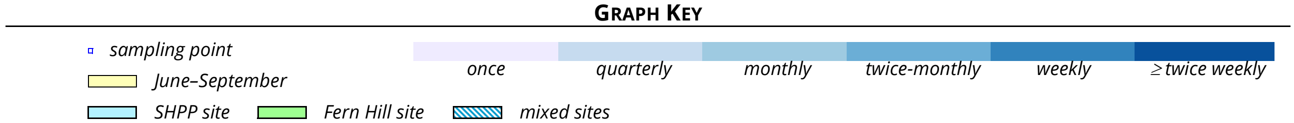
- Total phosphorus (TP) concentrations were generally low, and values at or below the detection limit (typically, 0.025 mg/L) were not uncommon.
- Median July–September TP concentrations were lower than the TMDL loading capacity concentration of 0.04 mg/L.
- In general, TP concentrations were higher in the high flow season (November through May) due to increases in the particulate form of phosphorus that occur during or shortly after storms.
- Because the high flows that trigger concentration spikes are shorter-lived than the usual sampling frequency for this site, the data likely under-represent spike frequency, especially in 2009–2014.
- Soluble reactive phosphorus (SRP) concentrations are generally low, between 0.005 and 0.04 mg/L, although occasional spikes occur.
- SRP concentrations tend to be lower in the summer, possibly due to releases of water from Hagg Lake.
- The highest TP and SRP concentrations are associated with discharges from Wapato Lake.
  - —The highest TP and second-highest SRP spikes occurred in July 2008 caused by unusual summertime discharges from Wapato Lake.
  - —The second-highest TP and highest SRP spikes occurred in April 2016 when high Wapato Lake pumping rates coincided with low Tualatin River flows at the end of the month.
  - —TP and SRP spikes also occurred in late spring 2017 and 2018. It is unknown if the spikes were caused by Wapato Lake pumpout, but the timing coincided with the use of Wapato pumps and generally declining river flows.
- July–September SRP concentrations show a decreasing trend since 2005. Although the decrease in concentration is small, the trend is statistically significant.

Time series





Graph Key



MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — TRFH

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2005	23			0.095		0.073	0.049	0.028	<0.025	<0.025	0.035		
2006	24					0.033	0.031	<0.025	0.026	<0.025	<0.025		
2007	22					0.040	<0.025	<0.025	<0.025	0.026			
2008	34	0.104	0.068	0.056	0.045	0.045	0.043	0.135	0.034	0.027	0.037	0.039	0.031
2009	12	0.114	0.200	0.054	0.037	0.037	<0.025	0.026	<0.025	<0.025	<0.025	0.061	0.063
2010	17	0.119	0.041	0.049	0.052	0.065	0.078	0.051	0.030	<0.025	0.031	0.045	
2011	10	0.038	0.084		0.050	0.032	0.041	0.035	0.034	0.030	0.027		0.042
2012	11		0.058	0.071	0.077	0.040	0.029	0.028	0.026	0.033	<0.025	0.072	0.044
2013	15	0.046	0.090	0.063	0.038	0.035	0.032	<0.025	<0.025	0.048	0.052	0.050	0.071
2014	12	0.064	0.065	0.057	0.053	0.048	<0.025	<0.025	0.027	0.032	0.027	0.049	0.031
2015	19	0.036	0.091	0.048	0.048	0.035	0.031	0.032	<0.025	0.028	0.029	0.105	0.036
2016	23	0.074	0.055	0.062	0.149	0.064	0.026	0.040	<0.025	<0.025	0.067	0.071	
2017	23	0.044	0.115	0.078	0.065	0.058	0.035	<0.025	0.026	0.029	0.035	0.052	0.037
2018	22	0.041	0.053	0.092	0.091	0.031	0.033	0.031	0.035	<0.025	0.045	0.041	0.085
POR MEDIAN		0.055	0.068	0.062	0.052	0.040	0.032	0.028	0.026	0.026	0.031	0.051	0.042

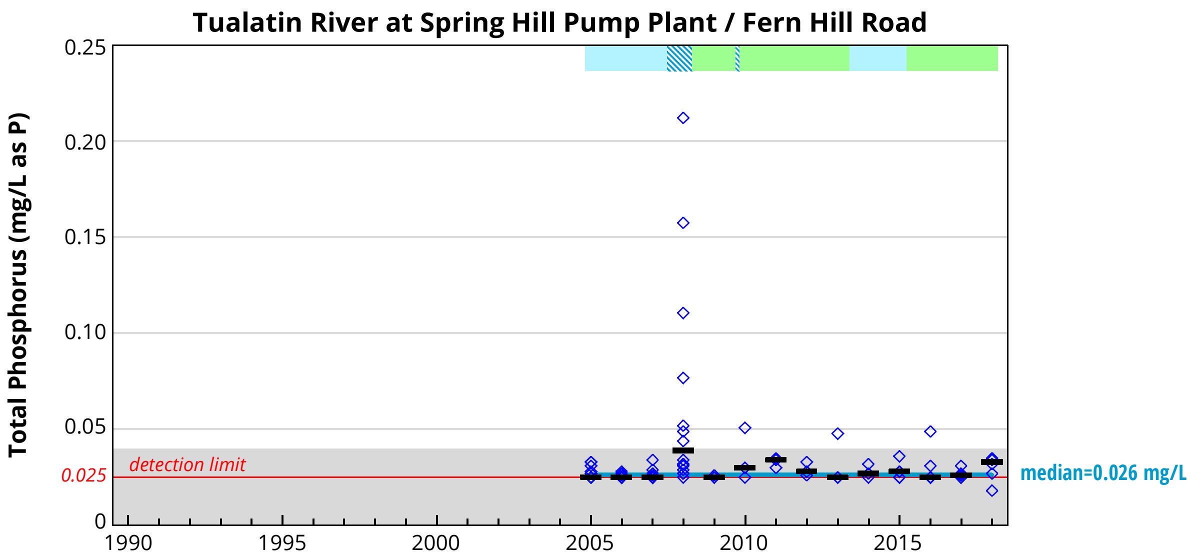
KEY
total P in mg/L as P
TP ≤ 0.03
0.03 < TP ≤ 0.04
0.04 < TP ≤ 0.06
0.06 < TP ≤ 0.10
TP > 0.10

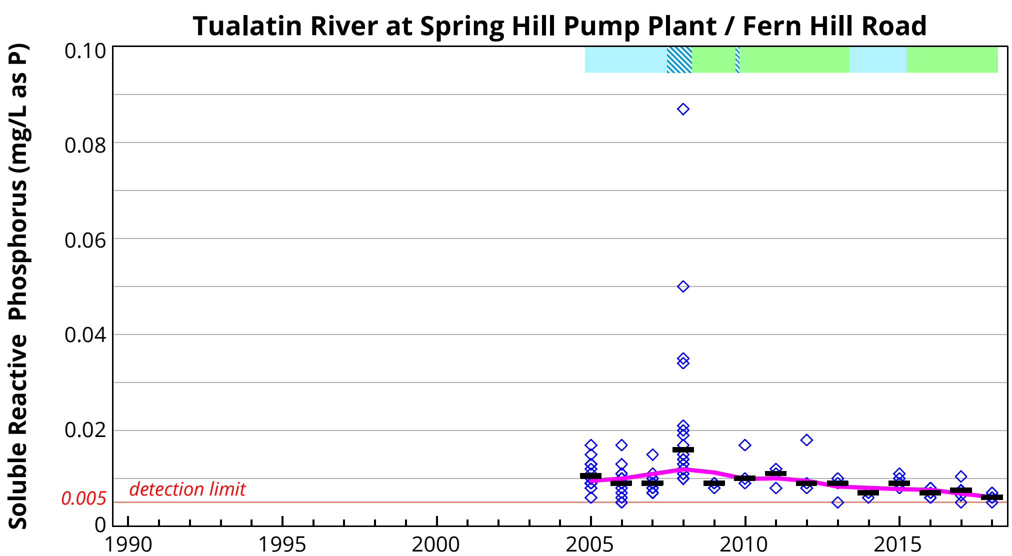
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — TRFH

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2005	23			0.030		0.024	0.018	0.013	0.009	0.009	0.011		
2006	24					0.012	0.013	0.010	0.009	0.009	0.010		
2007	22					0.013	0.010	0.009	0.009	0.008			
2008	34	0.021	0.019	0.016	0.017	0.016	0.018	0.035	0.015	0.011	0.010	0.015	0.008
2009	12	0.017	0.019	0.014	0.011	0.012	0.013	0.008	0.009	0.009	0.008	0.023	0.013
2010	17	0.017	0.012	0.013	0.016	0.026	0.027	0.017	0.010	0.009	0.011	0.014	
2011	10	0.012	0.014		0.021	0.010	0.012	0.012	0.011	0.008	0.012		0.022
2012	11		0.015	0.033	0.022	0.022	0.010	0.008	0.009	0.018	0.007	0.017	0.014
2013	15	0.014	0.040	0.020	0.015	0.014	0.010	0.010	0.005	0.009	0.015	0.023	0.022
2014	12	0.012	0.015	0.015	0.015	0.015	0.035	0.007	0.006	0.007	0.008	0.015	0.011
2015	19	0.012	0.024	0.012	0.014	0.013	0.011	0.010	0.009	0.011	0.011	0.018	0.014
2016	23	0.008	0.013	0.019	0.079	0.029	0.009	0.008	0.007	0.007	0.019	0.025	
2017	22	0.015	0.021	0.022	0.024	0.025	0.013	0.008	0.006	0.009	0.007	0.017	0.012
2018	23	0.012	0.010	0.046	0.023	0.013	0.009	0.007	0.007	0.006	0.007	0.009	0.014
POR MEDIAN		0.013	0.015	0.019	0.017	0.014	0.012	0.009	0.009	0.009	0.010	0.017	0.014

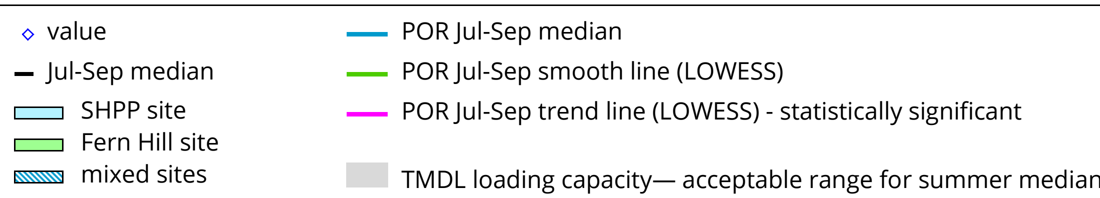
KEY
SRP in mg/L as P
SRP ≤ 0.007
0.007<SRP≤0.009
0.009<SRP≤0.017
0.017<SRP≤0.026
SRP > 0.026

July-September trend (low-flow high-sunlight period)





Graph Key



TRGC – Tualatin River at Golf Course Road – 14204800

Data source: Clean Water Services

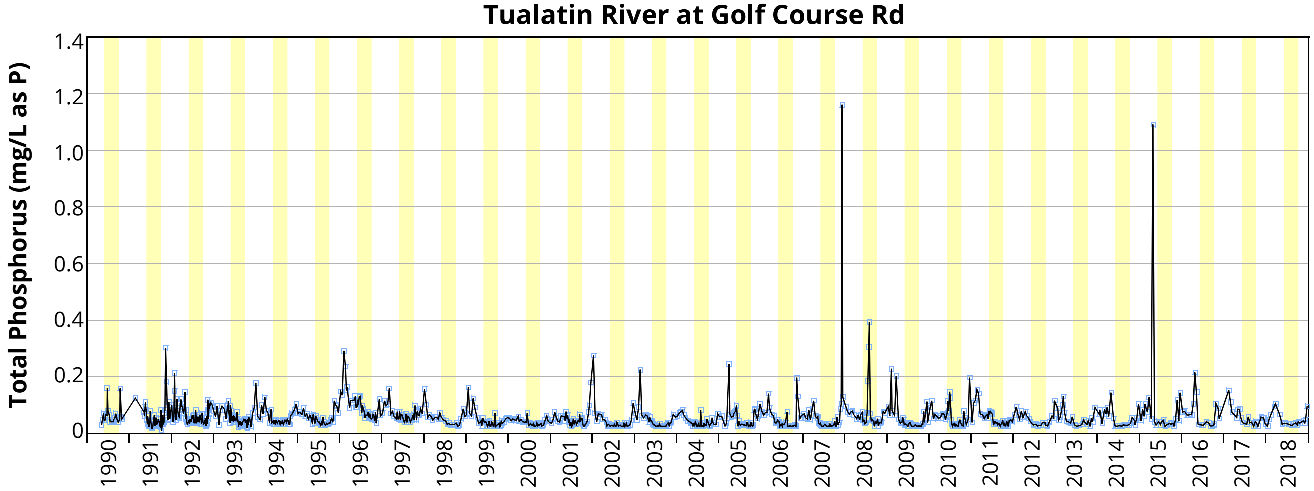
Sampling frequency

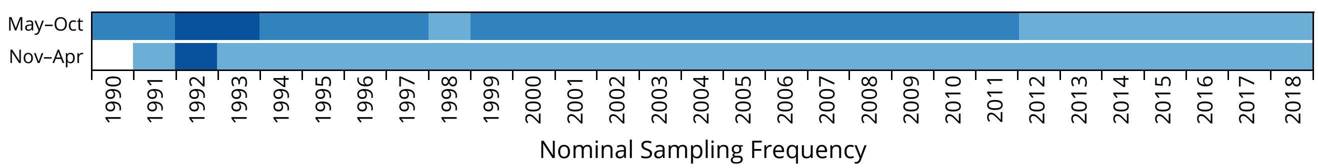
- The period of record is May 1990 through present.
- Sampling frequency was quite varied, with dense sampling for a couple of years and less frequent sampling at other times.
- Except for 1992, sampling frequency likely was not adequate to fully characterize the conditions associated with high flows.

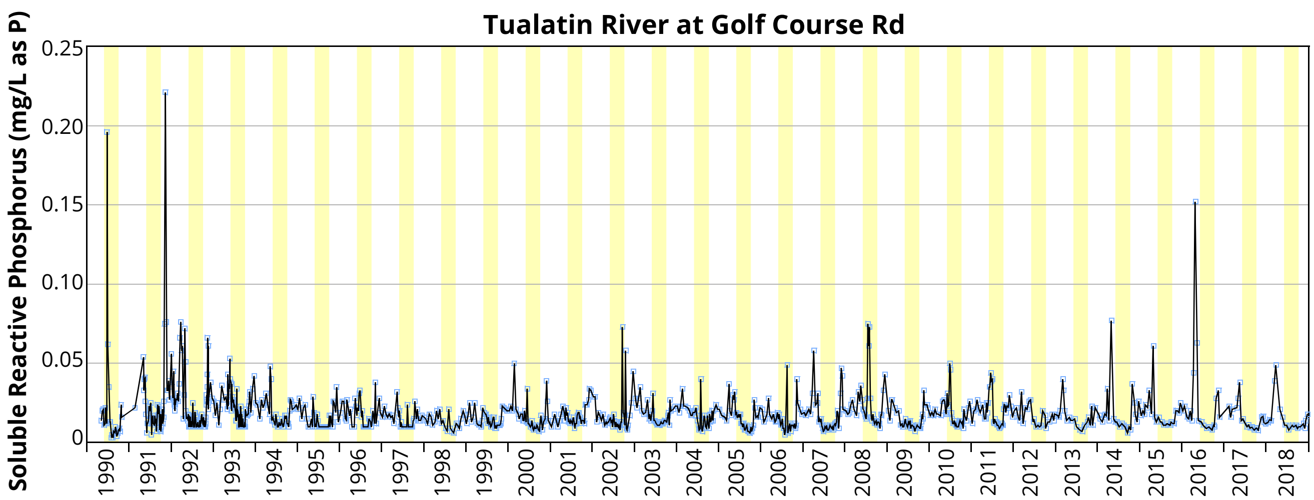
Concentrations & trends

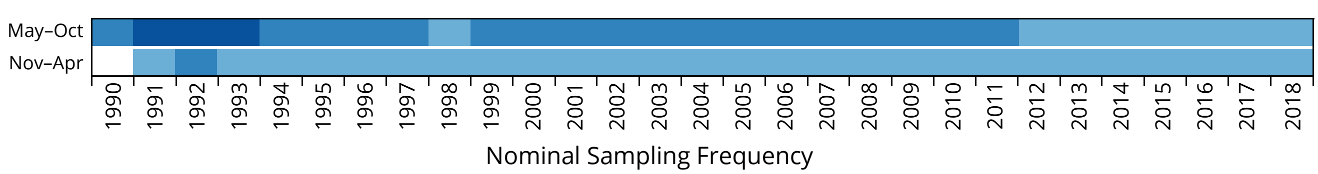
- Total phosphorus (TP) concentrations ranged from 0.01–1.16 mg/L with an annual median of 0.05 mg/L over the period of record.
- Since 2001, median July–September TP concentrations were lower than the TMDL loading capacity concentration of 0.04 mg/L in every year except 2001 (which had very low flow) and 2008 (which had late season discharges from Wapato Lake).
- In general, TP concentrations were higher in the high flow season (November through May) due to increases in the particulate form of phosphorus that occur during or shortly after storms. The highest TP concentration coincided with a very large storm in early December 2007.
- Because the high flows that trigger the concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency especially during May–October since 2012 and November–April since 1993.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.003–0.221 mg/L with an annual median of 0.015 mg/L over the period of record.
- SRP concentrations tend to be lower in the summer, possibly due to releases of water from Hagg Lake.
- Some high TP and SRP concentrations are associated with discharges from Wapato Lake.
  - —TP and SRP spikes occurred in July 2008 caused by unusual summertime discharges from Wapato Lake.
  - —The highest SRP spike (and a smaller TP spike) occurred in late April and early May 2016 when high Wapato Lake pumping rates coincided with low Tualatin River flows at the end of the month.
  - —TP and SRP spikes also occurred in late spring 2017 and 2018. It is unknown if the spikes were caused by Wapato Lake pumpout, but the timing coincided with the use of Wapato pumps and generally declining river flows.
- July–September TP concentrations show a decreasing trend since 1990, but the trend may be partly an artifact of sampling frequency. TP concentrations from the early to mid-1990s were generally greater than those from 1998 and later. Since 1998, median TP concentrations have not changed. During 1991-1993, the bi-weekly sampling probably captured storms that would have been missed by more recent twice-monthly sampling. TP concentrations associated with storm samples would have been higher than those collected at base flow conditions. High concentrations in 1996 were probably related to the flooding earlier in the year. High concentrations in 2008 were related to late pumping from Wapato Lake.
- July–September SRP concentrations do not show any increasing or decreasing trend, although the concentrations appear have a repeating pattern.

Time series









Graph Key

sampling point
June–September

once *quarterly* *monthly* *twice-monthly* *weekly* *≥ twice weekly*

TRGC – Tualatin River at Golf Course Road – 14204800

Data source: Clean Water Services

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — 14204800

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	25					0.047	0.064	0.064	0.042	0.054	0.053		
1991	45		0.124			0.084	0.037	0.033	0.036	0.039	0.039	0.141	0.050
1992	88	0.091	0.080	0.082	0.090	0.040	0.043	0.050	0.044	0.051	0.038	0.059	0.103
1993	68	0.068	0.063	0.088	0.067	0.083	0.058	0.050	0.033	0.044	0.038	0.047	0.081
1994	39	0.118	0.074	0.098	0.075	0.052	0.043	0.041	0.034	0.045	0.044	0.068	0.094
1995	40	0.072	0.078	0.065	0.057	0.051	0.051	0.035	0.036	0.034	0.039	0.099	0.084
1996	38	0.141	0.236	0.127	0.116	0.105	0.121	0.081	0.064	0.057	0.057	0.055	0.092
1997	38	0.093	0.101	0.078	0.059	0.052	0.066	0.047	0.055	0.048	0.061	0.065	0.079
1998	24	0.129	0.061	0.053	0.057	0.061	0.052	0.037	0.033	0.031	0.031	0.040	0.074
1999	38	0.115	0.065	0.107	0.046	0.041	0.040	0.028	0.025	0.029	0.029	0.040	0.053
2000	39	0.049	0.049	0.052	0.046	0.040	0.038	0.031	0.026	0.029	0.027	0.046	0.047
2001	40	0.042	0.065	0.041	0.060	0.059	0.039	0.032	0.040	0.048	0.032	0.042	0.139
2002	39	0.173	0.056	0.067	0.048	0.029	0.027	0.025	0.028	0.025	0.027	0.027	0.076
2003	38	0.058	0.158	0.059	0.063	0.044	0.029	0.025	0.025	0.025	0.034	0.037	0.062
2004	39	0.065	0.078	0.060	0.043	0.035	0.025	0.029	0.027	0.035	0.033	0.037	0.050
2005	39	0.059	0.026	0.140	0.062	0.074	0.037	0.031	0.029	0.027	0.029	0.068	0.082
2006	38	0.070	0.073	0.115	0.065	0.038	0.031	0.033	0.025	0.026	0.027	0.163	0.058
2007	41	0.062	0.066	0.067	0.060	0.036	0.025	0.028	0.025	0.027	0.029	0.062	0.645
2008	37	0.085	0.071	0.072	0.057	0.066	0.037	0.244	0.047	0.038	0.037	0.041	0.071
2009	39	0.078	0.154	0.132	0.043	0.043	0.031	0.034	0.025	0.025	0.026	0.038	0.075
2010	38	0.103	0.059	0.057	0.062	0.062	0.113	0.033	0.027	0.038	0.029	0.049	0.197
2011	40	0.073	0.135	0.105	0.058	0.064	0.071	0.040	0.034	0.034	0.028	0.033	0.044
2012	24	0.079	0.057	0.067	0.069	0.047	0.031	0.029	0.028	0.038	0.028	0.051	0.084
2013	22	0.067	0.079	0.102	0.041	0.047	0.028	0.027	0.040	0.036	0.035	0.047	0.090
2014	24	0.075	0.060	0.080	0.102	0.039	0.025	0.026	0.029	0.029	0.045	0.038	0.080
2015	24	0.064	0.081	0.100	0.570	0.035	0.036	0.044	0.028	0.034	0.030	0.084	0.094
2016	21	0.076	0.064	0.066	0.159	0.088	0.029	0.040	0.032	0.027	0.068	0.070	
2017	20		0.132	0.074	0.070	0.070	0.037	0.045	0.038	0.034	0.032	0.056	0.044
2018	20	0.037	0.064	0.099	0.066	0.033	0.035	0.032	0.030	0.033	0.039	0.040	0.072
POR Median		0.074	0.072	0.078	0.062	0.047	0.037	0.033	0.032	0.034	0.033	0.048	0.079

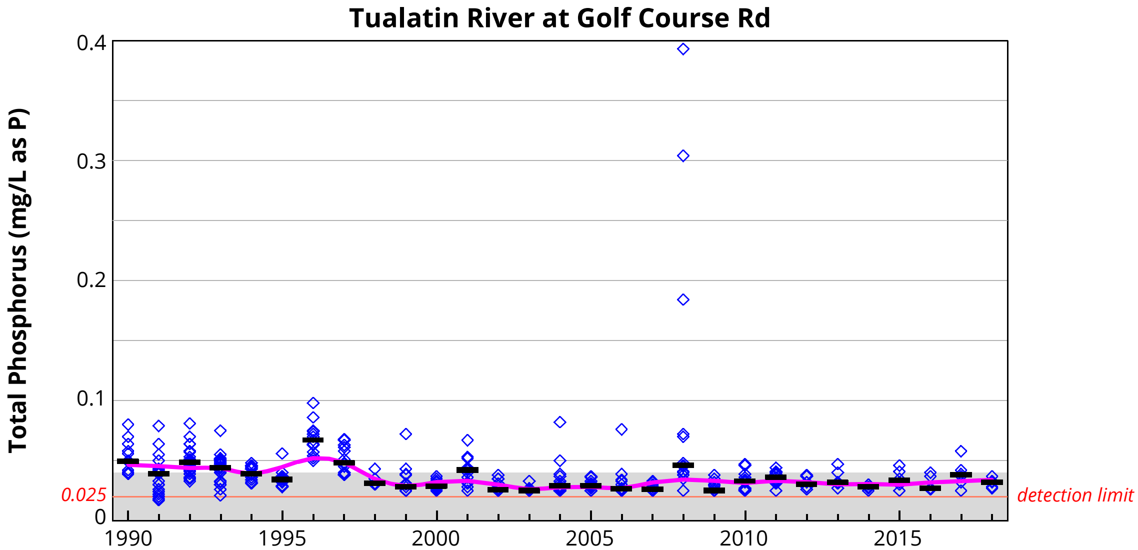
Key
total P in mg/L as P
TP ≤ 0.03
0.03 < TP ≤ 0.04
0.04 < TP ≤ 0.07
0.07 < TP ≤ 0.10
TP > 0.10

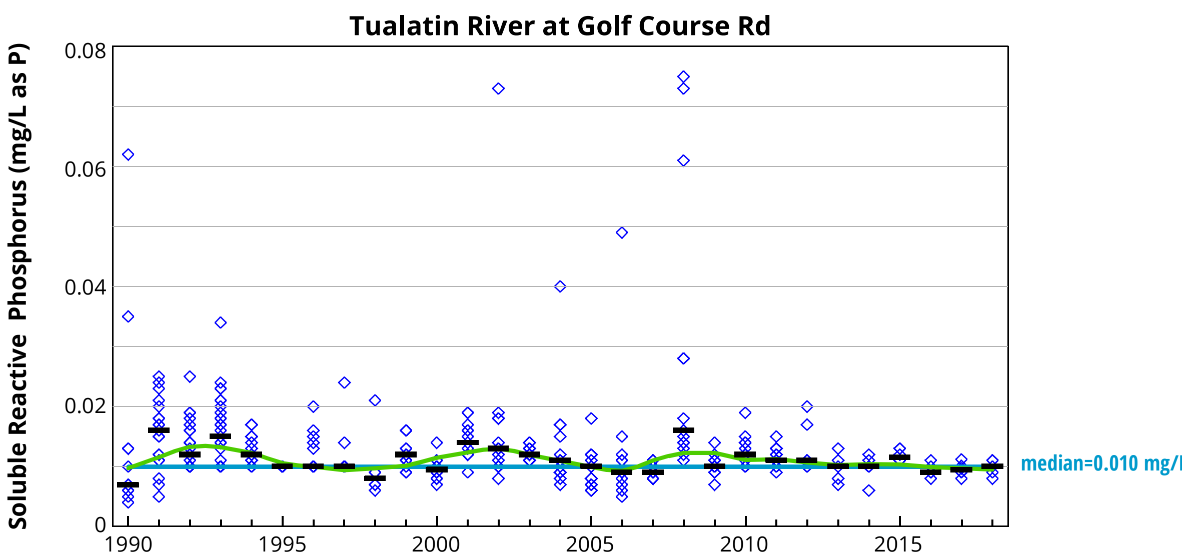
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — 14204800

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	26					0.017	0.017	0.024	0.005	0.007	0.009		
1991	47		0.022			0.037	0.014	0.016	0.012	0.019	0.016	0.076	0.033
1992	88	0.028	0.027	0.052	0.058	0.016	0.013	0.016	0.010	0.014	0.012	0.030	0.033
1993	68	0.022	0.018	0.029	0.028	0.036	0.027	0.021	0.017	0.011	0.018	0.025	0.038
1994	39	0.025	0.021	0.024	0.028	0.029	0.014	0.011	0.011	0.016	0.012	0.024	0.023
1995	40	0.025	0.019	0.020	0.010	0.015	0.013	0.010	0.010	0.010	0.013	0.025	0.024
1996	38	0.023	0.015	0.022	0.016	0.020	0.027	0.013	0.010	0.013	0.015	0.025	0.024
1997	36	0.020	0.017	0.017	0.012	0.022	0.012	0.010	0.010	0.010	0.015	0.017	0.016
1998	24	0.015	0.015	0.014	0.017	0.018	0.013	0.008	0.015	0.007	0.012	0.012	0.019
1999	38	0.015	0.019	0.021	0.012	0.013	0.018	0.013	0.013	0.010	0.011	0.022	0.021
2000	39	0.022	0.035	0.020	0.017	0.015	0.013	0.011	0.009	0.009	0.013	0.015	0.020
2001	39	0.012	0.016	0.012	0.019	0.018	0.014	0.013	0.015	0.016	0.014	0.024	0.034
2002	39	0.029	0.016	0.016	0.013	0.013	0.014	0.013	0.011	0.018	0.010	0.014	0.035
2003	38	0.025	0.032	0.019	0.023	0.017	0.014	0.011	0.012	0.013	0.015	0.024	0.022
2004	39	0.021	0.029	0.023	0.021	0.018	0.019	0.010	0.011	0.011	0.014	0.020	0.023
2005	39	0.019	0.016	0.026	0.019	0.027	0.016	0.012	0.010	0.007	0.010	0.017	0.019
2006	38	0.017	0.017	0.023	0.017	0.015	0.014	0.009	0.009	0.011	0.011	0.033	0.020
2007	41	0.018	0.020	0.025	0.025	0.014	0.010	0.009	0.010	0.010	0.013	0.025	0.032
2008	37	0.019	0.022	0.024	0.025	0.027	0.018	0.067	0.017	0.013	0.013	0.018	0.043
2009	39	0.017	0.027	0.021	0.016	0.011	0.012	0.012	0.010	0.010	0.011	0.024	0.023
2010	38	0.018	0.019	0.018	0.022	0.023	0.031	0.014	0.011	0.013	0.013	0.017	0.026
2011	40	0.016	0.024	0.021	0.020	0.025	0.040	0.013	0.011	0.011	0.023	0.023	0.020
2012	24	0.021	0.015	0.022	0.022	0.027	0.014	0.011	0.011	0.019	0.011	0.016	0.016
2013	22	0.017	0.030	0.027	0.015	0.014	0.013	0.008	0.009	0.012	0.014	0.017	0.022
2014	24	0.016	0.016	0.026	0.046	0.014	0.013	0.011	0.011	0.008	0.023	0.022	0.020
2015	24	0.019	0.021	0.028	0.040	0.015	0.015	0.012	0.012	0.012	0.012	0.020	0.022
2016	21	0.022	0.016	0.017	0.098	0.039	0.012	0.009	0.010	0.010	0.019	0.025	
2017	20		0.020	0.021	0.025	0.026	0.015	0.011	0.009	0.009	0.008	0.016	0.012
2018	20	0.014	0.014	0.044	0.021	0.016	0.011	0.008	0.011	0.010	0.010	0.011	0.016
POR Median		0.019	0.019	0.022	0.021	0.018	0.014	0.011	0.011	0.011	0.013	0.022	0.022

Key
SRP in mg/L as P
SRP ≤ 0.010
0.010<SRP≤0.011
0.011 < SRP ≤ 0.21
0.021 < SRP ≤ 0.03
SRP > 0.03

July-September trend (low-flow high-sunlight period)





Graph Key

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant
- TMDL loading capacity— acceptable range for summer median

TRJB – Tualatin River at Hwy 219 – 14206241

Data source: Clean Water Services

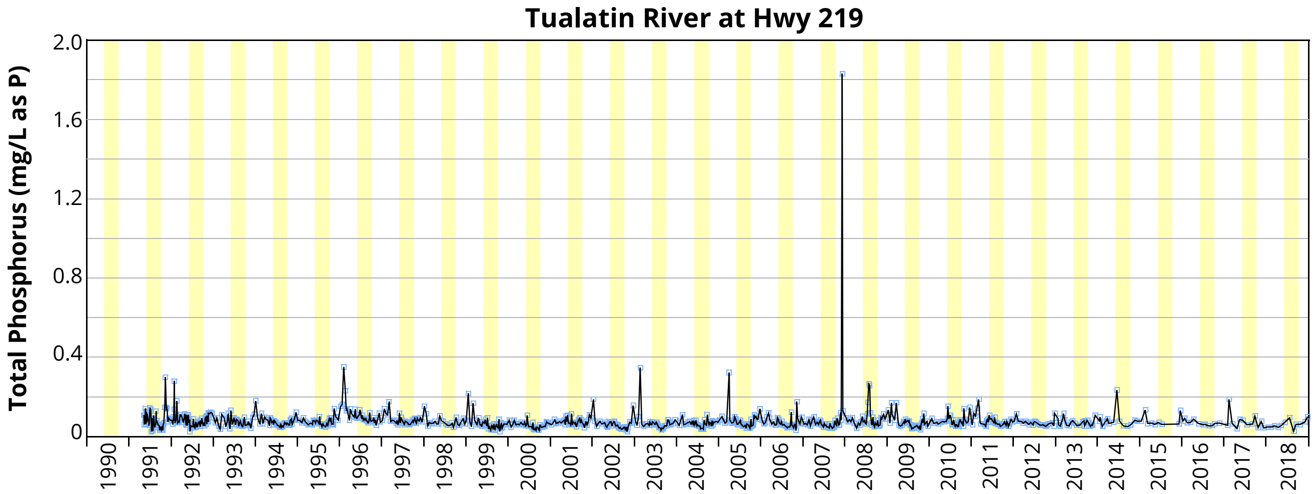
Sampling frequency

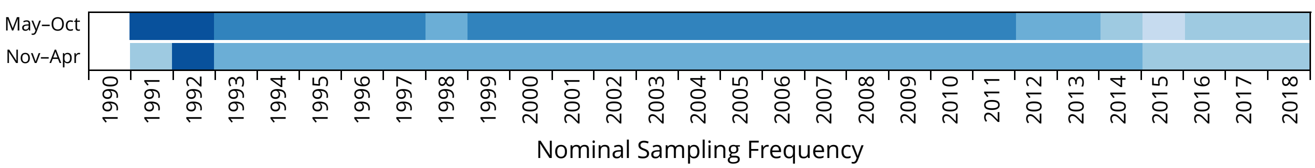
- The period of record is May 1991 through present.
- Sampling frequency was quite variable—from every few days in 1991–1992 to only once a month or less in recent years.
- Except for 1991–1992, sampling frequency likely was not adequate to fully characterize the conditions associated with high flows. The chance of obtaining samples during storms became even smaller since 2015, when sampling frequency decreased to monthly or less.

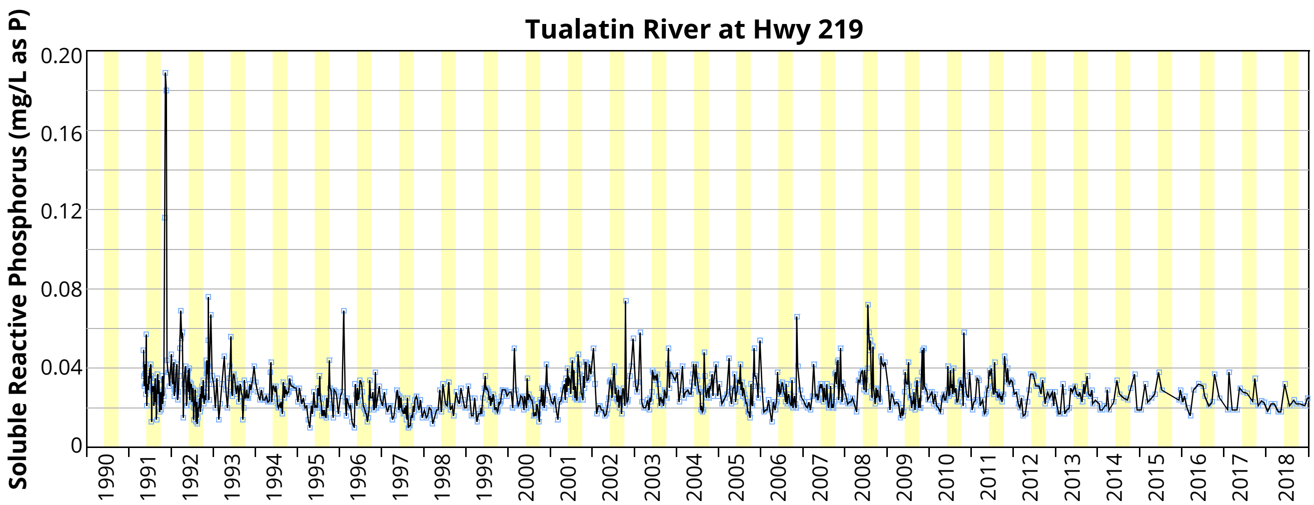
Concentrations & trends

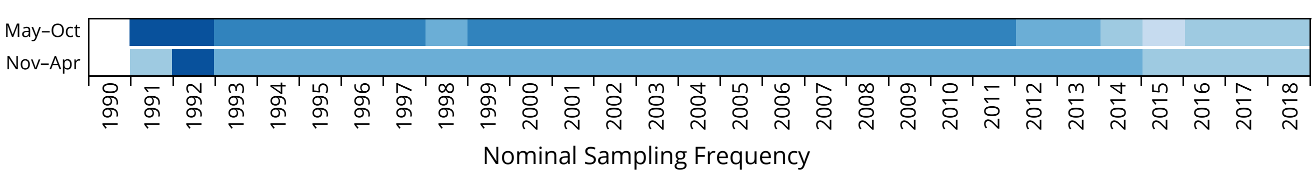
- Total phosphorus (TP) concentrations ranged from 0.025–1.83 mg/L with an annual median of 0.07 mg/L over the period of record.
- Median July–September TP concentrations were lower than the TMDL loading capacity concentration of 0.09 mg/L throughout the period of record.
- In general, TP concentrations were higher in the high flow season (November through May) due to increases in the particulate form of phosphorus that occur during or shortly after storms. The highest TP concentration coincided with a very large storm in early December 2007.
- Because the high flows that trigger the concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency during most of the November–April period and all times of the year since 2015.
- TP concentrations were generally lower in July and August. Possible reasons for this seasonality include uptake by algae, low particulate phosphorus due to few storms and low flows, and water releases from Hagg Lake.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.01–0.19 mg/L with an annual median of 0.03 mg/L over the period of record.
- SRP concentrations tend to be lower in April. The reason is unknown.
- Some high TP and SRP concentrations are associated with discharges from Wapato Lake.
  - —TP and SRP spikes occurred in July 2008 caused by unusual summertime discharges from Wapato Lake.
  - —Elevated SRP concentrations occurred in late April and early May 2016 when high Wapato Lake pumping rates coincided with low Tualatin River flows at the end of April.
- Neither July–September median concentrations of TP nor SRP show a trend, although the SRP concentrations in 1995–1998 and 2000 appear to be lower than those in other years.

Time series

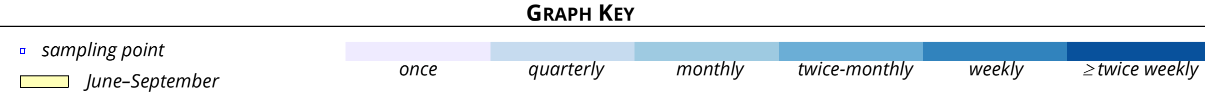








Graph Key



MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — 14206241

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	52					0.108	0.082	0.058	0.070	0.047	0.045	0.147	0.086
1992	89	0.081	0.081	0.094	0.090	0.085	0.054	0.056	0.066	0.069	0.066	0.092	0.121
1993	40	0.082	0.073	0.074	0.070	0.077	0.091	0.081	0.070	0.064	0.058	0.063	0.104
1994	39	0.139	0.090	0.082	0.085	0.079	0.074	0.056	0.049	0.066	0.066	0.077	0.106
1995	40	0.082	0.082	0.073	0.063	0.078	0.078	0.064	0.056	0.061	0.080	0.100	0.089
1996	38	0.158	0.231	0.111	0.126	0.098	0.108	0.092	0.083	0.077	0.081	0.070	0.096
1997	38	0.112	0.114	0.082	0.079	0.070	0.091	0.072	0.066	0.072	0.081	0.084	0.084
1998	24	0.134	0.062	0.065	0.070	0.084	0.078	0.062	0.057	0.058	0.079	0.064	0.078
1999	38	0.151	0.064	0.125	0.078	0.059	0.068	0.048	0.053	0.049	0.043	0.064	0.062
2000	39	0.065	0.073	0.061	0.066	0.063	0.059	0.051	0.036	0.043	0.048	0.052	0.069
2001	40	0.066	0.076	0.073	0.077	0.089	0.067	0.071	0.067	0.086	0.061	0.077	0.102
2002	39	0.133	0.060	0.070	0.066	0.062	0.069	0.063	0.046	0.040	0.040	0.060	0.112
2003	38	0.069	0.224	0.056	0.064	0.060	0.066	0.060	0.044	0.053	0.078	0.061	0.075
2004	39	0.063	0.095	0.062	0.074	0.070	0.059	0.053	0.043	0.071	0.065	0.073	0.075
2005	39	0.093	0.067	0.199	0.075	0.079	0.066	0.062	0.056	0.053	0.060	0.095	0.114
2006	39	0.073	0.085	0.107	0.069	0.064	0.067	0.058	0.049	0.057	0.053	0.133	0.081
2007	41	0.065	0.073	0.067	0.072	0.071	0.058	0.056	0.051	0.048	0.077	0.072	0.980
2008	37	0.085	0.080	0.082	0.055	0.073	0.074	0.215	0.084	0.059	0.057	0.095	0.089
2009	39	0.101	0.141	0.127	0.056	0.067	0.076	0.059	0.047	0.050	0.061	0.069	0.065
2010	37	0.091	0.067	0.069	0.074	0.075	0.107	0.072	0.060	0.074	0.070	0.078	0.147
2011	38	0.088	0.123	0.127	0.062	0.079	0.088	0.070	0.064	0.056	0.065	0.063	0.080
2012	25	0.096	0.077	0.072	0.074	0.067	0.073	0.069	0.058	0.057	0.057	0.068	0.085
2013	23	0.075	0.073	0.101	0.056	0.076	0.061	0.057	0.077	0.067	0.062	0.059	0.107
2014	15	0.089	0.061	0.085	0.065	0.072	0.234	0.077	0.054	0.051	0.059	0.082	0.078
2015	9	0.077	0.134	0.066	0.067	0.061	0.071	0.062					0.097
2016	12	0.086	0.070	0.071	0.088	0.066	0.060	0.061	0.054	0.055	0.065	0.067	
2017	12	0.056	0.187	0.065	0.040	0.086	0.083	0.060	0.063	0.104	0.045	0.076	0.044
2018	12	0.048	0.048	0.054	0.046	0.055	0.072	0.096	0.027	0.062	0.061	0.073	0.099
POR Median		0.085	0.077	0.073	0.070	0.073	0.073	0.062	0.056	0.058	0.061	0.073	0.089

Key
total P in mg/L as P
TP ≤ 0.055
0.055 < TP ≤ 0.065
0.065 < TP ≤ 0.090
0.090 < TP ≤ 0.11
TP > 0.11

MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — 14206241

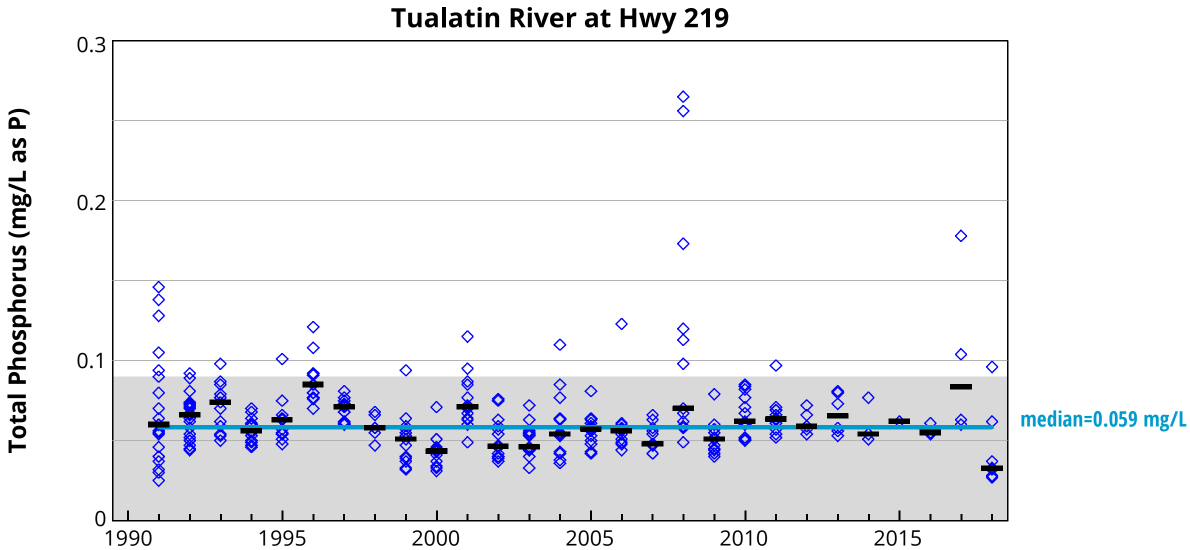
	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	55					0.037	0.032	0.031	0.024	0.028	0.027	0.148	0.038
1992	89	0.033	0.032	0.043	0.039	0.033	0.030	0.023	0.020	0.026	0.026	0.040	0.052
1993	40	0.026	0.025	0.027	0.038	0.031	0.037	0.031	0.030	0.023	0.025	0.029	0.038
1994	39	0.031	0.027	0.024	0.025	0.031	0.031	0.022	0.022	0.028	0.028	0.031	0.030
1995	40	0.027	0.024	0.021	0.012	0.021	0.021	0.025	0.018	0.021	0.029	0.028	0.022
1996	38	0.027	0.023	0.023	0.017	0.024	0.028	0.025	0.017	0.025	0.023	0.029	0.028
1997	36	0.025	0.020	0.021	0.016	0.027	0.023	0.019	0.013	0.015	0.024	0.021	0.020
1998	24	0.017	0.018	0.016	0.018	0.024	0.025	0.022	0.026	0.019	0.026	0.026	0.022
1999	38	0.026	0.021	0.021	0.015	0.019	0.030	0.027	0.025	0.020	0.023	0.029	0.028
2000	39	0.028	0.035	0.025	0.024	0.023	0.026	0.024	0.016	0.019	0.024	0.024	0.031
2001	40	0.023	0.023	0.019	0.029	0.032	0.033	0.039	0.028	0.035	0.030	0.035	0.040
2002	39	0.041	0.019	0.020	0.017	0.024	0.032	0.030	0.025	0.026	0.025	0.030	0.048
2003	38	0.030	0.046	0.022	0.022	0.024	0.036	0.033	0.024	0.025	0.036	0.038	0.035
2004	39	0.031	0.035	0.027	0.028	0.035	0.036	0.028	0.021	0.028	0.031	0.034	0.034
2005	39	0.027	0.025	0.036	0.025	0.030	0.033	0.031	0.025	0.018	0.031	0.036	0.040
2006	39	0.024	0.019	0.022	0.018	0.023	0.030	0.028	0.026	0.023	0.022	0.054	0.027
2007	41	0.022	0.022	0.023	0.027	0.028	0.030	0.026	0.024	0.021	0.038	0.032	0.028
2008	37	0.024	0.023	0.024	0.026	0.037	0.034	0.054	0.041	0.026	0.026	0.043	0.043
2009	39	0.025	0.027	0.023	0.019	0.019	0.033	0.026	0.022	0.028	0.032	0.031	0.026
2010	37	0.028	0.025	0.021	0.022	0.025	0.029	0.031	0.028	0.031	0.031	0.027	0.038
2011	38	0.021	0.030	0.028	0.021	0.030	0.036	0.028	0.028	0.026	0.037	0.034	0.034
2012	24	0.028	0.021	0.021	0.020	0.033	0.037	0.031	0.029	0.028	0.026	0.027	0.025
2013	23	0.018	0.025	0.023	0.020	0.029	0.029	0.027	0.028	0.032	0.027	0.026	0.024
2014	15	0.021	0.020	0.025	0.019	0.023	0.034	0.027	0.025	0.024	0.030	0.037	0.019
2015	9	0.019	0.032	0.023	0.025	0.027	0.038	0.029					0.027
2016	12	0.025	0.020	0.016	0.029	0.032	0.031	0.026	0.021	0.023	0.037	0.025	
2017	12	0.019	0.038	0.019	0.019	0.030	0.028	0.027	0.023	0.035	0.021	0.024	0.023
2018	12	0.018	0.022	0.022	0.018	0.018	0.032	0.021	0.024	0.022	0.022	0.021	0.025
POR Median		0.025	0.024	0.023	0.021	0.027	0.031	0.027	0.024	0.025	0.027	0.030	0.028

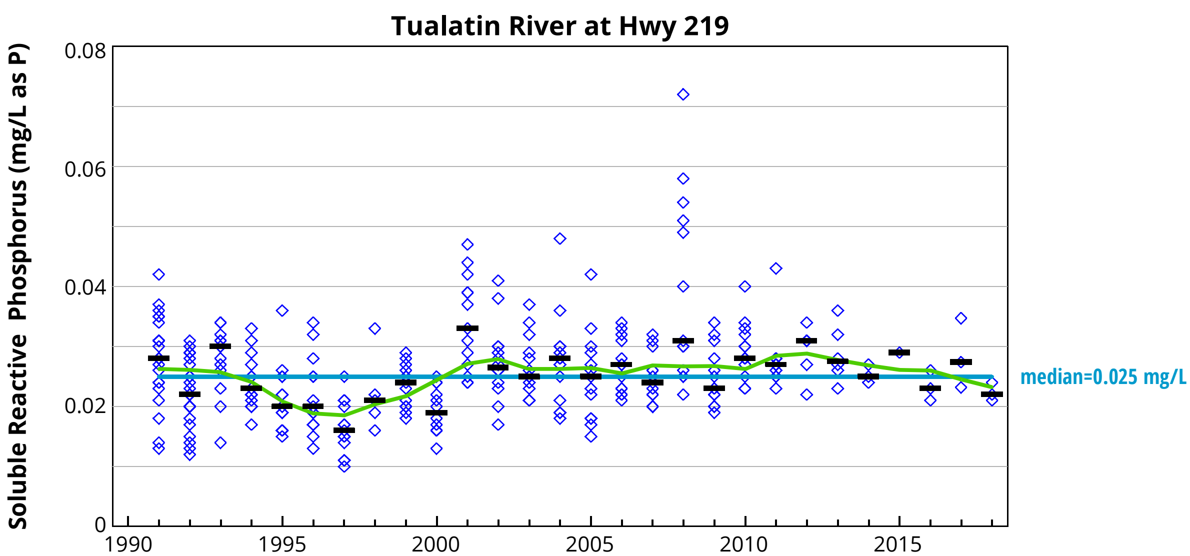
Key
SRP in mg/L as P
SRP ≤ 0.019
0.019 < SRP ≤ 0.022
0.022 < SRP ≤ 0.032
0.032 < SRP ≤ 0.038
SRP > 0.038

TRJB – Tualatin River at Hwy 219 – 14206241

Data source: Clean Water Services

July-September trend (low-flow high-sunlight period)





Graph Key

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant
- TMDL loading capacity— acceptable range for summer median

ROOD – Tualatin River at Rood Bridge Rd – 14206295

Data source: Clean Water Services

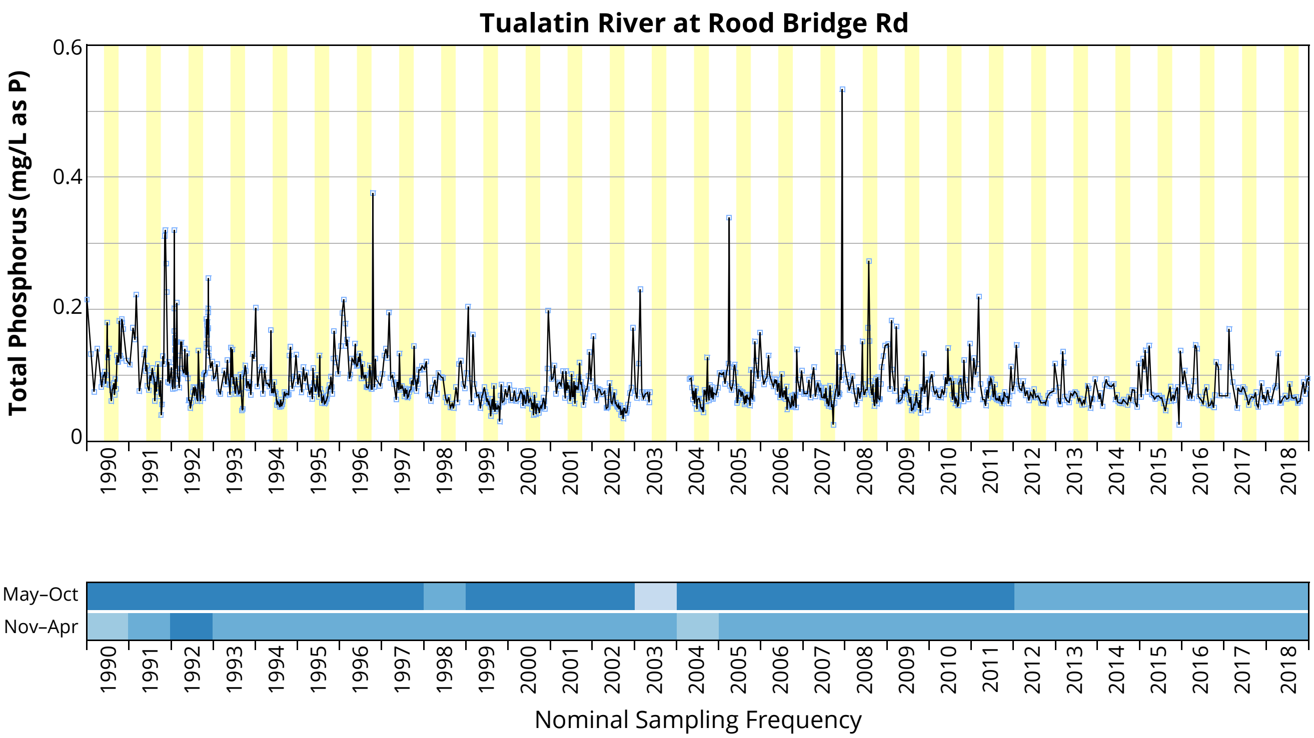
Sampling frequency

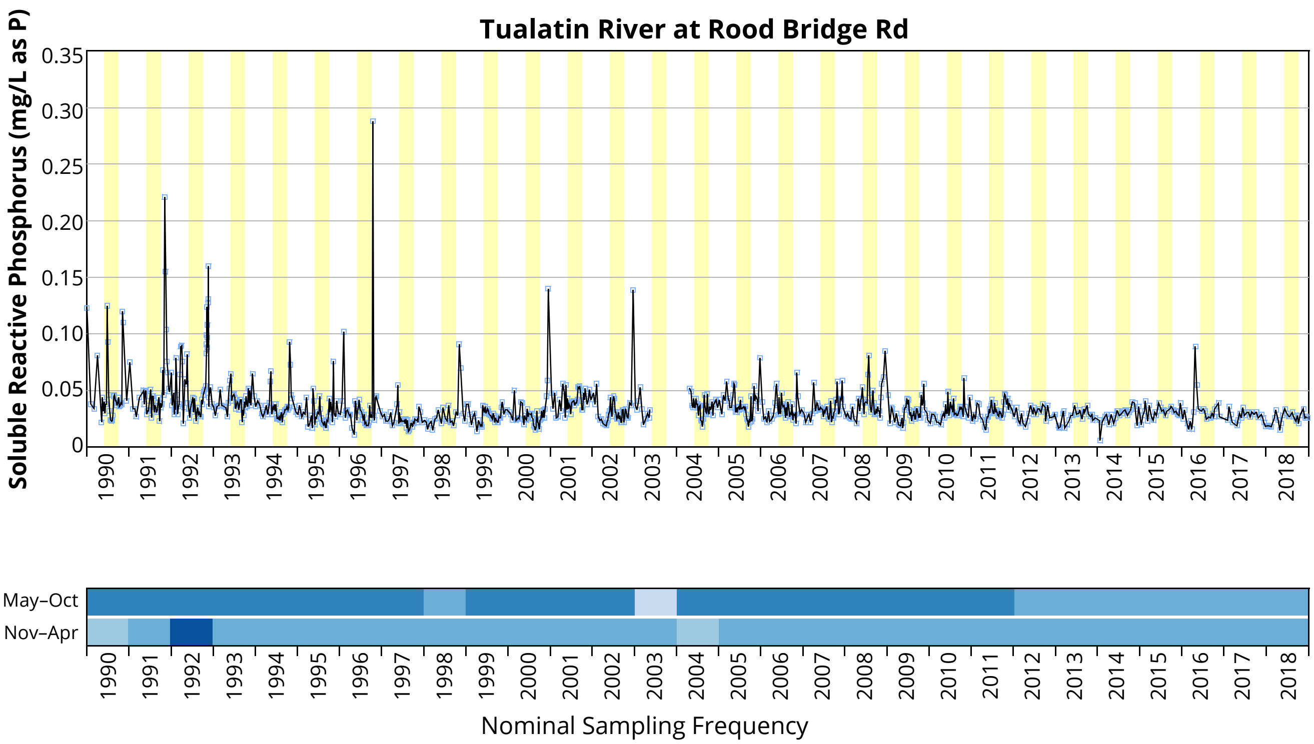
- The period of record is January 1990 through present, except for June-2003 through March-2004 when sampling was suspended due to bridge construction.
- Sampling frequency was variable. In winter, sampling was usually twice a month. In summer, sampling was usually weekly until 2012 when it was decreased to twice a month.
- Except for a brief time in 1992, sampling frequency likely was not adequate to fully characterize the conditions associated with high flows.

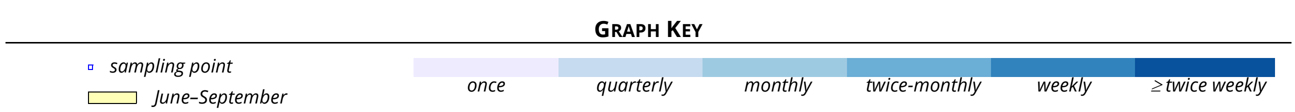
Concentrations & trends

- Total phosphorus (TP) concentrations ranged from 0.025–0.53 mg/L with an annual median of 0.08 mg/L over the period of record.
- Median July–September TP concentrations were lower than the TMDL loading capacity concentration of 0.09 mg/L in every year except 1991 and 1996, both of which predate the 2001 TMDL.
- In general, TP concentrations were higher in the high flow season (November through May) due to increases in the particulate form of phosphorus that occur during or shortly after storms. The highest TP concentration coincided with a very large storm in early December 2007.
- Because the high flows that trigger the concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency during most of the November–April period and all times of the year since 2012.
- TP concentrations were generally lower in July and August. Possible reasons for this seasonality include uptake by algae, low particulate phosphorus due to few storms and low flows, and water releases from Hagg Lake.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.006–0.29 mg/L with an annual median of 0.032 mg/L over the period of record.
- SRP concentrations did not show any clear seasonality. Spikes in concentration occurred occasionally, but not in any particular season.
- Some high TP and SRP concentrations are associated with discharges from Wapato Lake.
  - —TP and SRP spikes occurred in July 2008 caused by unusual summertime discharges from Wapato Lake.
  - —TP and SRP spikes also occurred in late April and early May 2016 when high Wapato Lake pumping rates coincided with low Tualatin River flows at the end of April.
- July–September TP concentrations in the early to mid-1990s were generally greater than those from 1998 and later. Since 1998, median TP concentrations have not changed. Higher-than-usual concentrations in 1996, 2001 and 2008 are explainable by:
  - —1996: increased particulate, and therefore TP, due to flooding early in the year;
  - —2001: a greater than usual proportion of groundwater containing SRP during this drought year;
  - —2008: later pumping from Wapato Lake.
- Median July–September SRP did not show a statistically significant trend, although the SRP concentrations in 1995–1998 and 2000 appear to be lower than those in other years.

Time series


Tualatin River at Rood Bridge Rd
Total Phosphorus (mg/L as P)
0.6
0.4
0.2
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
May–Oct
Nov–Apr
Nominal Sampling Frequency


Tualatin River at Rood Bridge Rd
Soluble Reactive Phosphorus (mg/L as P)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
May–Oct
Nov–Apr
Nominal Sampling Frequency


Graph Key
sampling point
June–September
once
quarterly
monthly
twice-monthly
weekly
≥ twice weekly

ROOD – Tualatin River at Rood Bridge Rd – 14206295

Data source: Clean Water Services

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — 14206295

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	32	0.215	0.132	0.075	0.140	0.095	0.103	0.106	0.079	0.107	0.130	0.175	0.122
1991	35	0.116	0.163	0.222	0.076	0.131	0.084	0.100	0.083	0.086	0.087	0.290	0.090
1992	63	0.112	0.131	0.112	0.125	0.102	0.061	0.078	0.078	0.079	0.102	0.171	0.116
1993	39	0.097	0.096	0.072	0.097	0.094	0.097	0.082	0.073	0.074	0.098	0.084	0.129
1994	39	0.143	0.110	0.090	0.088	0.087	0.075	0.057	0.056	0.071	0.072	0.088	0.115
1995	40	0.094	0.093	0.098	0.077	0.082	0.081	0.073	0.062	0.067	0.082	0.126	0.111
1996	37	0.169	0.178	0.125	0.113	0.119	0.124	0.098	0.091	0.086	0.093	0.110	0.084
1997	38	0.116	0.133	0.100	0.087	0.084	0.082	0.075	0.072	0.085	0.093	0.095	0.111
1998	23	0.115	0.070	0.071	0.083	0.103	0.097	0.063	0.059	0.054	0.071	0.120	0.084
1999	38	0.154	0.077	0.125	0.070	0.064	0.073	0.058	0.055	0.049	0.053	0.061	0.073
2000	39	0.074	0.070	0.062	0.073	0.068	0.067	0.059	0.048	0.051	0.053	0.061	0.154
2001	40	0.096	0.094	0.088	0.084	0.083	0.074	0.068	0.081	0.094	0.072	0.079	0.113
2002	39	0.120	0.071	0.075	0.072	0.059	0.061	0.059	0.053	0.044	0.045	0.065	0.127
2003	10	0.071	0.174	0.070	0.073	0.067							
2004	32				0.094	0.079	0.063	0.062	0.052	0.074	0.071	0.073	0.076
2005	41	0.102	0.096	0.118	0.081	0.104	0.069	0.074	0.065	0.065	0.085	0.122	0.130
2006	39	0.095	0.096	0.116	0.087	0.088	0.079	0.071	0.065	0.056	0.056	0.116	0.091
2007	41	0.072	0.083	0.082	0.083	0.083	0.067	0.065	0.064	0.054	0.075	0.083	0.337
2008	37	0.096	0.082	0.088	0.069	0.076	0.075	0.162	0.080	0.063	0.065	0.112	0.145
2009	39	0.113	0.146	0.125	0.061	0.074	0.075	0.061	0.055	0.059	0.069	0.080	0.070
2010	38	0.098	0.076	0.072	0.073	0.083	0.095	0.080	0.062	0.090	0.073	0.070	0.148
2011	40	0.102	0.109	0.153	0.063	0.074	0.089	0.070	0.063	0.061	0.067	0.068	0.095
2012	23	0.116	0.086	0.084	0.073	0.068	0.073	0.068	0.062	0.059	0.063	0.073	0.097
2013	23	0.071	0.096	0.094	0.061	0.071	0.074	0.063	0.059	0.070	0.065	0.064	0.094
2014	24	0.069	0.069	0.091	0.084	0.075	0.065	0.058	0.062	0.062	0.070	0.069	0.085
2015	24	0.096	0.124	0.110	0.070	0.066	0.067	0.062	0.053	0.072	0.067	0.079	0.081
2016	22	0.097	0.074	0.071	0.119	0.104	0.060	0.078	0.055	0.056	0.095	0.091	
2017	22	0.069	0.141	0.090	0.066	0.076	0.081	0.061	0.066	0.070	0.055	0.076	0.065
2018	23	0.071	0.060	0.083	0.096	0.061	0.067	0.077	0.066	0.063	0.061	0.081	0.088
POR MEDIAN		0.098	0.096	0.090	0.081	0.082	0.074	0.069	0.063	0.066	0.071	0.082	0.097

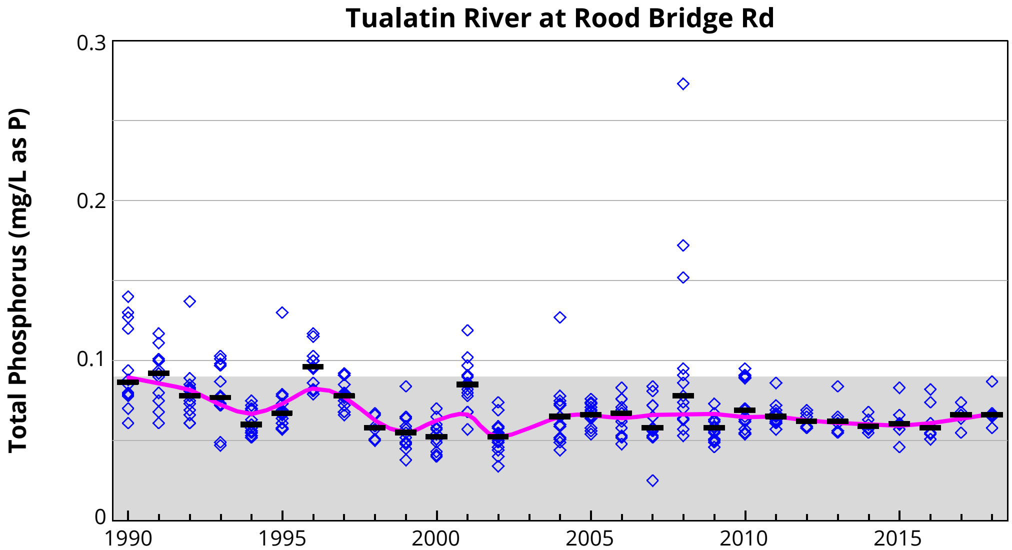
KEY
total P in mg/L as P
TP ≤ 0.060
0.060 < TP ≤ 0.070
0.07 < TP ≤ 0.11
0.11 < TP ≤ 0.13
TP > 0.13

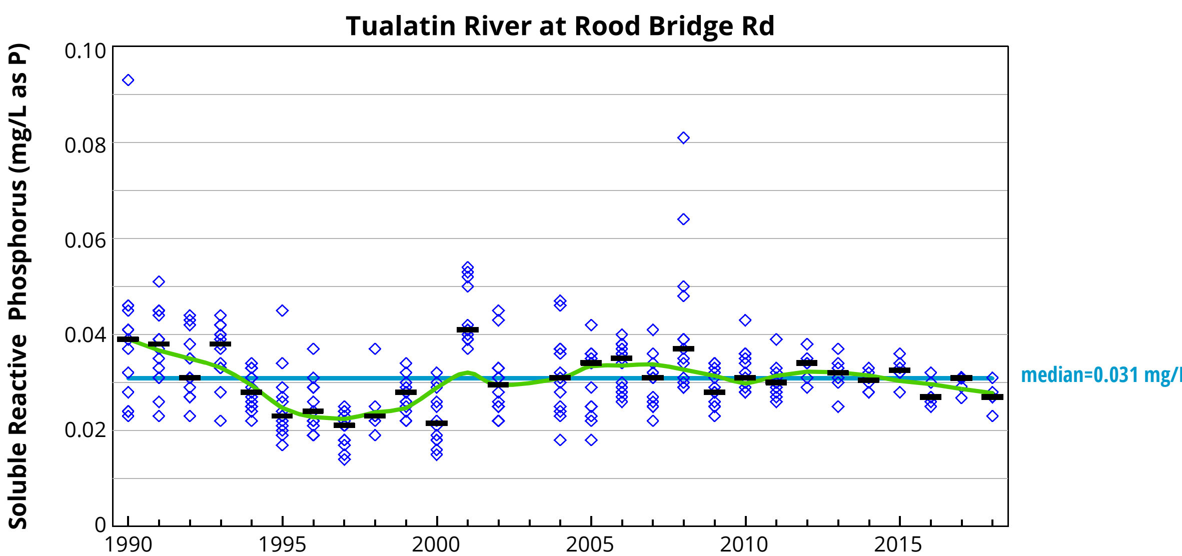
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — 14206295

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	33	0.123	0.038	0.034	0.081	0.036	0.038	0.032	0.037	0.040	0.038	0.115	0.041
1991	38	0.075	0.034	0.027	0.044	0.050	0.032	0.045	0.033	0.039	0.042	0.130	0.052
1992	64	0.037	0.038	0.051	0.060	0.056	0.034	0.039	0.031	0.033	0.050	0.099	0.046
1993	40	0.032	0.037	0.044	0.036	0.046	0.046	0.039	0.039	0.031	0.037	0.045	0.055
1994	39	0.039	0.034	0.029	0.033	0.049	0.035	0.026	0.028	0.033	0.036	0.045	0.034
1995	40	0.033	0.029	0.037	0.020	0.028	0.028	0.029	0.021	0.024	0.031	0.030	0.036
1996	37	0.035	0.032	0.031	0.023	0.031	0.035	0.029	0.020	0.026	0.027	0.045	0.032
1997	36	0.028	0.023	0.025	0.022	0.038	0.024	0.024	0.016	0.021	0.024	0.025	0.027
1998	23	0.023	0.019	0.019	0.026	0.033	0.028	0.024	0.030	0.021	0.030	0.081	0.027
1999	38	0.038	0.025	0.029	0.019	0.020	0.032	0.031	0.028	0.023	0.026	0.035	0.033
2000	39	0.030	0.037	0.025	0.033	0.025	0.029	0.028	0.018	0.022	0.026	0.034	0.100
2001	40	0.041	0.037	0.035	0.049	0.038	0.035	0.040	0.041	0.051	0.042	0.043	0.047
2002	39	0.043	0.042	0.025	0.020	0.027	0.037	0.031	0.027	0.022	0.030	0.033	0.088
2003	10	0.035	0.047	0.027	0.028	0.030							
2004	32				0.052	0.040	0.038	0.032	0.025	0.032	0.035	0.038	0.039
2005	41	0.036	0.044	0.043	0.035	0.046	0.034	0.035	0.034	0.023	0.037	0.042	0.056
2006	39	0.033	0.025	0.028	0.027	0.039	0.037	0.036	0.036	0.030	0.028	0.056	0.032
2007	41	0.026	0.028	0.026	0.039	0.034	0.034	0.032	0.029	0.027	0.040	0.037	0.048
2008	37	0.029	0.026	0.031	0.032	0.043	0.040	0.056	0.036	0.030	0.032	0.056	0.085
2009	39	0.034	0.035	0.026	0.020	0.024	0.038	0.030	0.028	0.032	0.034	0.039	0.027
2010	38	0.025	0.028	0.022	0.024	0.030	0.033	0.036	0.029	0.033	0.034	0.031	0.044
2011	40	0.026	0.032	0.033	0.021	0.027	0.035	0.031	0.031	0.030	0.041	0.039	0.034
2012	23	0.031	0.023	0.026	0.021	0.034	0.032	0.032	0.033	0.037	0.030	0.026	0.028
2013	23	0.018	0.024	0.025	0.022	0.028	0.033	0.032	0.030	0.034	0.028	0.027	0.026
2014	24	0.015	0.025	0.028	0.025	0.024	0.032	0.029	0.033	0.030	0.037	0.037	0.028
2015	24	0.024	0.037	0.030	0.026	0.030	0.037	0.033	0.030	0.035	0.032	0.031	0.034
2016	22	0.029	0.019	0.020	0.060	0.045	0.033	0.029	0.027	0.029	0.035	0.033	
2017	22	0.024	0.033	0.022	0.022	0.028	0.032	0.031	0.029	0.030	0.029	0.027	0.020
2018	23	0.019	0.018	0.030	0.020	0.025	0.032	0.027	0.029	0.026	0.025	0.030	0.027
POR MEDIAN		0.031	0.032	0.028	0.026	0.033	0.034	0.031	0.029	0.030	0.033	0.038	0.034

KEY
SRP in mg/L as P
SRP ≤ 0.02
0.02 < SRP ≤ 0.03
0.03 < SRP ≤ 0.04
0.04 < SRP ≤ 0.05
SRP > 0.05

JULY-SEPTEMBER TREND (LOW-FLOW HIGH-SUNLIGHT PERIOD)





GRAPH KEY

- ◇ value
- ▬ Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant
- TMDL loading capacity— acceptable range for summer median

TRSC – Tualatin River at Hwy 210 (Scholls Bridge) – 14206690

Data source: Clean Water Services

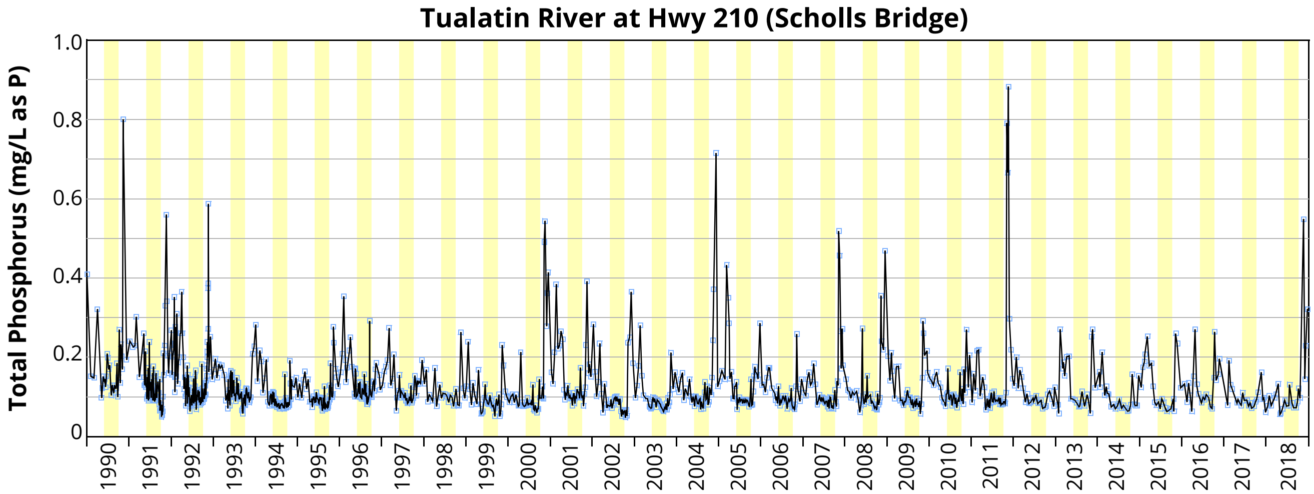
Sampling frequency

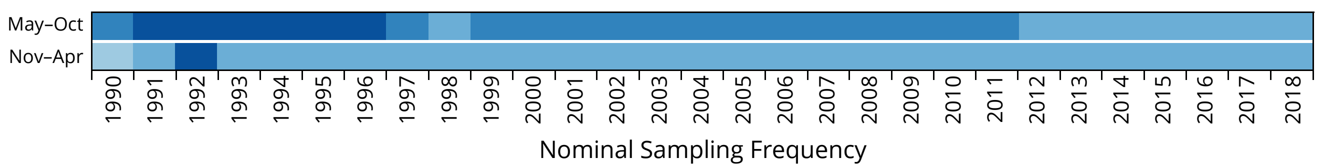
- The period of record is January 1990 through present.
- Sampling frequency was quite variable during May–October, ranging from two or more times a week to twice a month. November–April sampling was usually twice a month.
- Except for a brief time in 1992, sampling frequency likely was not adequate to fully characterize the conditions associated with high flows, especially in winter.

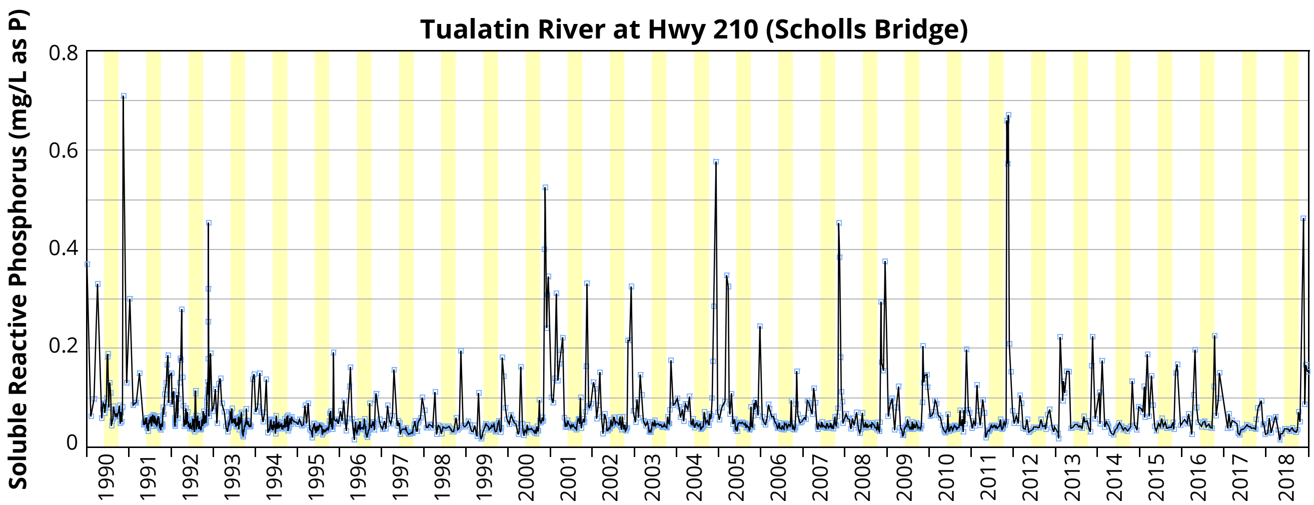
Concentrations & trends

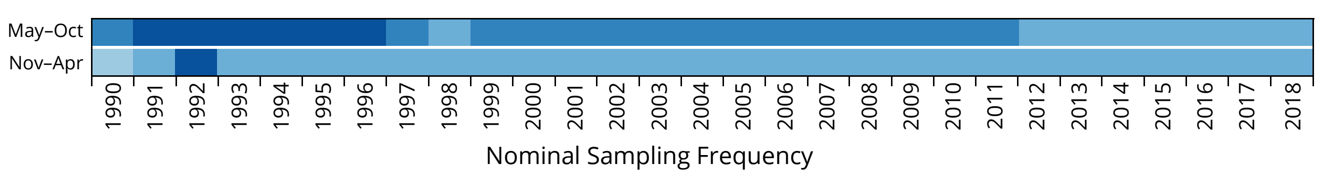
- Total phosphorus (TP) concentrations ranged from 0.048–0.88 mg/L with an annual median of 0.10 mg/L over the period of record.
- Median July–September TP concentrations were lower than the TMDL loading capacity concentration of 0.11 mg/L in every year except 1990 which predates the 2001 TMDL.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.015–0.71 mg/L with an annual median of 0.048 mg/L over the period of record.
- In general, both TP and SRP concentrations were higher in November and December, although high concentrations occurred in January–April as well.
- Over the period of record, SRP exceeded 0.40 mg/L nine times, all of which coincided with high TP concentrations. SRP accounted for most of the TP (76%–97%). Every incidence occurred between October 30 and December 6, a time when phosphorus removal by the Rock Creek WWTF might be suspended for the season. In each case, fall rainfall that year was not sustained. Flows increased sometime in October/November, but then dropped back to baseflow levels. Dissolved phosphorus discharges by the WWTF into the smaller volume of river water resulted in these high SRP and TP concentrations.
- High TP concentrations were not always coincident with high SRP concentrations. In such cases, high TP was due to increases in the particulate form of phosphorus that occur during or shortly after storms.
- July–September TP concentrations show a statistically significant decreasing trend, but the trend may be partly an artifact of sampling frequency. TP decreased from 1991–1995, a period when sampling frequency was consistent and frequent. This was a time when WWTF phosphorus discharge was changing and the decreasing trend captures that. From 1994–2011, median TP concentrations and sampling frequency varied, and no trend is evident. Beginning in 2012, the sampling frequency decreased to twice a month. The time series graph shows fewer points with high TP from 2012 onward with monthly medians usually less than the 1994–present median. This apparent decrease in median TP concentration between 1998–2011 and 2012–present could reflect the decreasing sampling density rather than a decrease in ambient concentrations.
- July–September SRP did not show a statistically significant trend, although the SRP concentrations in 1990 and possibly 1991 appear to be greater than those in other years, while SRP concentrations in 1995–1998 appear to be lower.

Time series









Graph Key

sampling point

June–September

once | *quarterly* | *monthly* | *twice-monthly* | *weekly* | *≥ twice weekly*

TRSC – Tualatin River at Hwy 210 (Scholls Bridge) – 14206690

Data source: Clean Water Services

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — 14206690

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	32	0.410	0.152	0.148	0.321	0.131	0.149	0.175	0.125	0.122	0.203	0.485	0.194
1991	76	0.240	0.228	0.302	0.150	0.133	0.105	0.126	0.101	0.092	0.071	0.336	0.204
1992	114	0.230	0.179	0.230	0.200	0.122	0.086	0.108	0.100	0.094	0.105	0.214	0.198
1993	68	0.183	0.166	0.177	0.123	0.105	0.142	0.108	0.104	0.083	0.109	0.100	0.218
1994	66	0.211	0.203	0.129	0.142	0.099	0.088	0.079	0.079	0.084	0.086	0.129	0.137
1995	66	0.117	0.121	0.142	0.116	0.093	0.095	0.095	0.074	0.076	0.105	0.204	0.138
1996	68	0.186	0.193	0.196	0.214	0.106	0.114	0.116	0.099	0.107	0.126	0.178	0.137
1997	38	0.147	0.185	0.146	0.207	0.105	0.113	0.100	0.092	0.091	0.131	0.139	0.164
1998	23	0.151	0.097	0.094	0.125	0.131	0.103	0.104	0.095	0.087	0.100	0.171	0.109
1999	38	0.183	0.100	0.121	0.125	0.062	0.096	0.086	0.079	0.076	0.072	0.179	0.107
2000	39	0.094	0.097	0.092	0.146	0.078	0.085	0.084	0.069	0.071	0.097	0.491	0.388
2001	40	0.148	0.299	0.226	0.246	0.106	0.100	0.098	0.107	0.107	0.102	0.231	0.167
2002	39	0.223	0.119	0.172	0.093	0.078	0.079	0.097	0.092	0.064	0.059	0.244	0.275
2003	38	0.114	0.229	0.129	0.096	0.074	0.093	0.090	0.078	0.070	0.082	0.159	0.141
2004	39	0.121	0.153	0.107	0.124	0.098	0.092	0.088	0.088	0.094	0.109	0.242	0.421
2005	40	0.153	0.144	0.350	0.155	0.127	0.090	0.092	0.092	0.087	0.114	0.162	0.216
2006	38	0.131	0.130	0.174	0.121	0.101	0.089	0.096	0.088	0.090	0.074	0.189	0.117
2007	40	0.107	0.153	0.134	0.132	0.092	0.094	0.086	0.096	0.073	0.117	0.361	0.226
2008	35	0.131	0.106	0.109	0.104	0.085	0.087	0.126	0.089	0.072	0.093	0.240	0.469
2009	39	0.172	0.189	0.136	0.134	0.087	0.099	0.093	0.083	0.082	0.086	0.260	0.189
2010	38	0.142	0.141	0.149	0.111	0.087	0.105	0.095	0.088	0.100	0.105	0.124	0.205
2011	40	0.122	0.166	0.161	0.137	0.079	0.095	0.094	0.091	0.083	0.088	0.666	0.182
2012	24	0.164	0.145	0.137	0.098	0.085	0.094	0.093	0.090	0.073	0.092	0.105	0.101
2013	23	0.069	0.222	0.170	0.202	0.095	0.089	0.076	0.100	0.092	0.076	0.262	0.123
2014	24	0.144	0.159	0.118	0.091	0.076	0.077	0.083	0.076	0.065	0.119	0.080	0.116
2015	23	0.150	0.198	0.216	0.156	0.083	0.079	0.091	0.068	0.070	0.080	0.248	0.123
2016	21	0.133	0.111	0.084	0.212	0.120	0.092	0.100	0.086	0.110	0.203	0.177	
2017	22	0.079	0.162	0.120	0.090	0.082	0.101	0.085	0.079	0.082	0.103	0.128	0.080
2018	23	0.090	0.078	0.102	0.095	0.065	0.085	0.105	0.079	0.081	0.109	0.347	0.275
POR Median		0.147	0.153	0.142	0.132	0.093	0.094	0.095	0.089	0.083	0.102	0.204	0.174

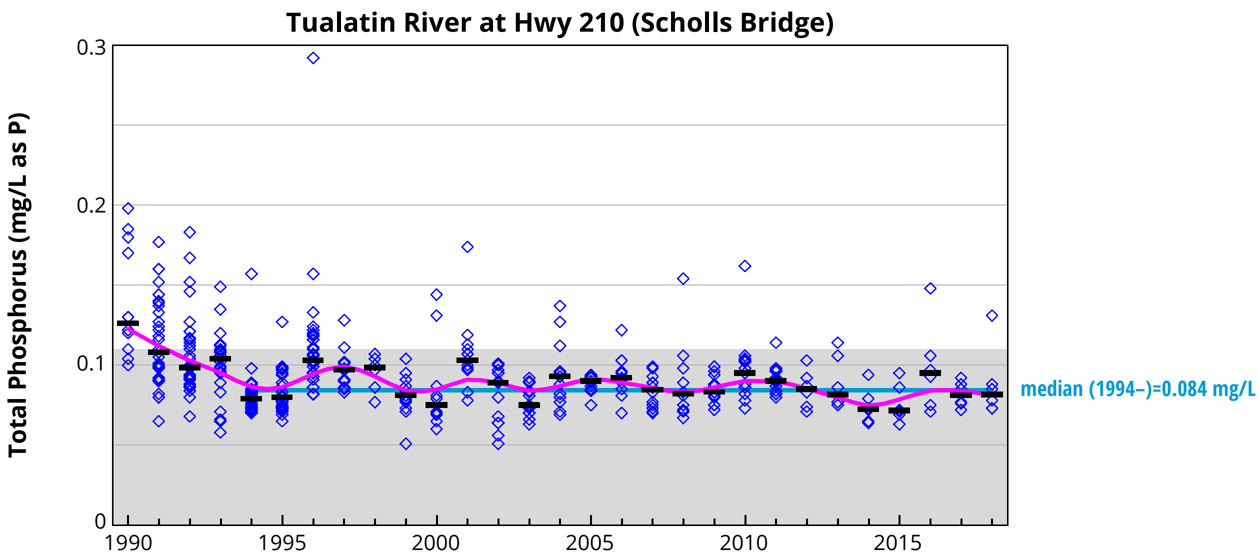
Key
total P in mg/L as P
TP ≤ 0.080
0.080 < TP ≤ 0.090
0.09 < TP ≤ 0.15
0.15 < TP ≤ 0.20
TP > 0.20

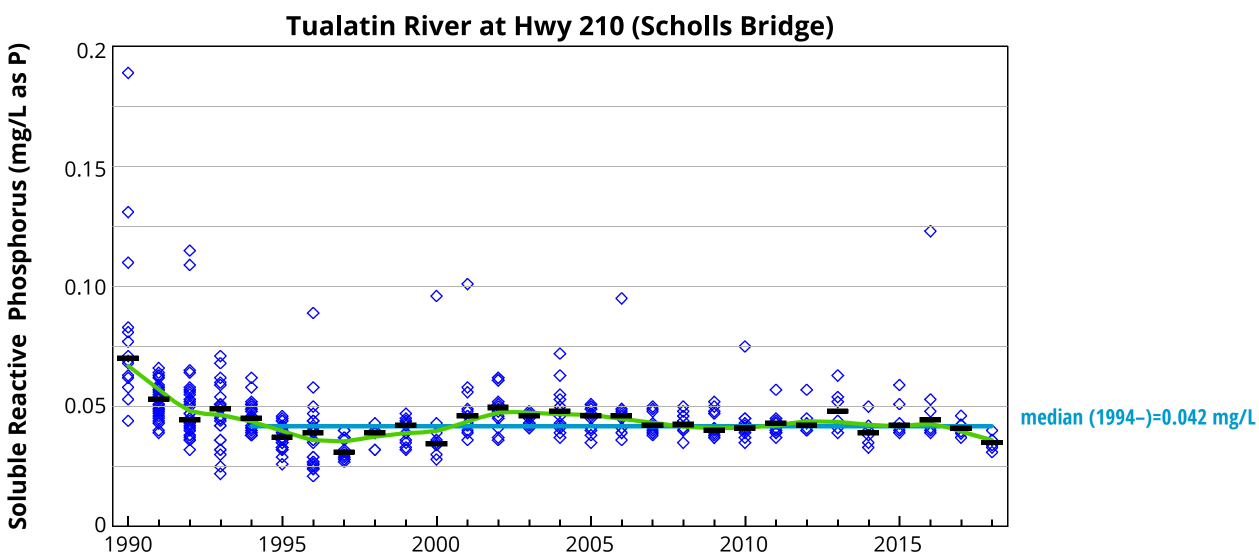
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — 14206690

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	34	0.370	0.063	0.098	0.330	0.082	0.091	0.110	0.071	0.066	0.071	0.396	0.130
1991	80	0.300	0.088	0.091	0.150	0.051	0.046	0.056	0.051	0.049	0.048	0.124	0.146
1992	114	0.087	0.051	0.154	0.084	0.054	0.043	0.054	0.044	0.042	0.056	0.107	0.132
1993	68	0.101	0.089	0.115	0.058	0.048	0.056	0.049	0.051	0.032	0.052	0.045	0.143
1994	66	0.078	0.111	0.062	0.084	0.045	0.042	0.046	0.044	0.048	0.050	0.056	0.052
1995	65	0.052	0.045	0.067	0.063	0.039	0.038	0.043	0.033	0.038	0.047	0.056	0.053
1996	68	0.064	0.052	0.091	0.110	0.033	0.041	0.040	0.026	0.040	0.046	0.103	0.052
1997	36	0.046	0.062	0.056	0.157	0.044	0.036	0.037	0.029	0.030	0.046	0.050	0.081
1998	24	0.058	0.044	0.043	0.070	0.043	0.035	0.040	0.041	0.032	0.048	0.118	0.044
1999	38	0.049	0.040	0.039	0.067	0.024	0.045	0.041	0.044	0.034	0.044	0.144	0.069
2000	39	0.057	0.054	0.038	0.098	0.035	0.037	0.036	0.032	0.039	0.054	0.400	0.327
2001	40	0.096	0.226	0.152	0.196	0.046	0.046	0.043	0.045	0.052	0.052	0.164	0.085
2002	39	0.126	0.072	0.107	0.055	0.036	0.046	0.052	0.049	0.041	0.039	0.216	0.200
2003	38	0.074	0.104	0.080	0.048	0.033	0.049	0.047	0.046	0.043	0.049	0.126	0.088
2004	39	0.091	0.069	0.071	0.090	0.048	0.045	0.045	0.042	0.052	0.061	0.174	0.324
2005	40	0.069	0.093	0.325	0.088	0.047	0.049	0.050	0.046	0.040	0.064	0.078	0.155
2006	39	0.057	0.052	0.083	0.063	0.046	0.039	0.045	0.044	0.048	0.040	0.111	0.051
2007	40	0.059	0.092	0.073	0.090	0.043	0.044	0.042	0.042	0.039	0.062	0.283	0.071
2008	35	0.063	0.048	0.052	0.056	0.045	0.042	0.045	0.046	0.040	0.044	0.172	0.376
2009	39	0.074	0.097	0.058	0.082	0.030	0.045	0.039	0.040	0.044	0.042	0.145	0.135
2010	38	0.064	0.084	0.077	0.053	0.034	0.038	0.040	0.041	0.043	0.051	0.076	0.070
2011	40	0.047	0.085	0.060	0.084	0.032	0.041	0.043	0.043	0.042	0.052	0.573	0.114
2012	24	0.057	0.077	0.064	0.047	0.033	0.039	0.041	0.049	0.044	0.052	0.059	0.037
2013	23	0.024	0.159	0.122	0.154	0.040	0.047	0.043	0.051	0.053	0.037	0.195	0.058
2014	24	0.080	0.108	0.050	0.036	0.031	0.041	0.046	0.038	0.036	0.088	0.045	0.059
2015	23	0.075	0.092	0.126	0.116	0.039	0.046	0.051	0.045	0.041	0.044	0.160	0.045
2016	21	0.057	0.058	0.039	0.152	0.066	0.047	0.047	0.044	0.081	0.145	0.125	
2017	22	0.039	0.054	0.055	0.039	0.032	0.038	0.044	0.041	0.038	0.068	0.070	0.038
2018	23	0.044	0.030	0.059	0.025	0.028	0.038	0.035	0.037	0.034	0.062	0.275	0.160
POR Median		0.064	0.072	0.071	0.084	0.040	0.043	0.044	0.044	0.041	0.051	0.125	0.083

Key
SRP in mg/L as P
SRP ≤ 0.03
0.03 < SRP ≤ 0.04
0.04 < SRP ≤ 0.06
0.06 < SRP ≤ 0.11
SRP > 0.11

July-September trend (low-flow high-sunlight period)





Graph Key

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant
- TMDL loading capacity— acceptable range for summer median

TREL / TRJU – Tualatin River at Elsner Rd / Jurgens Park

Data source: Clean Water Services

Sampling frequency & location

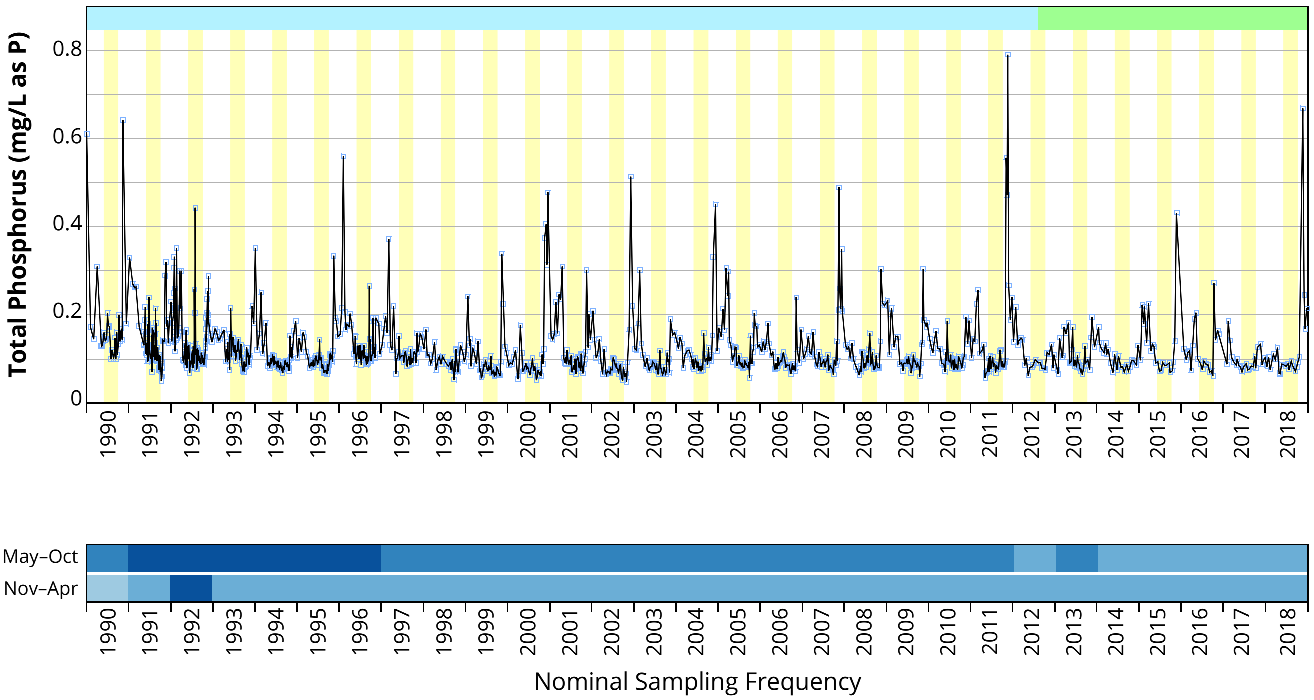
- The period of record is January 1990 through present.
- Sampling frequency was quite variable during May–October, ranging from two or more times a week to twice a month. November–April sampling was usually twice a month.
- Except for a brief time in 1992, sampling frequency likely was not adequate to fully characterize the conditions associated with high flows, especially in winter.
- In 2012, the site location moved from Elsner Road (RM 16.2) to Jurgens Park (RM 10.8). Two tributaries (Chicken and South Rock Creeks) enter the Tualatin River between the two sites. In addition, the Tualatin River flows past a National Wildlife Refuge that supports wetland areas used by migratory birds and under a major road (US Hwy 99W). The extent to which the tributaries, the wetland, or the highway affect nutrient concentrations in the river is unknown.

Concentrations & trends

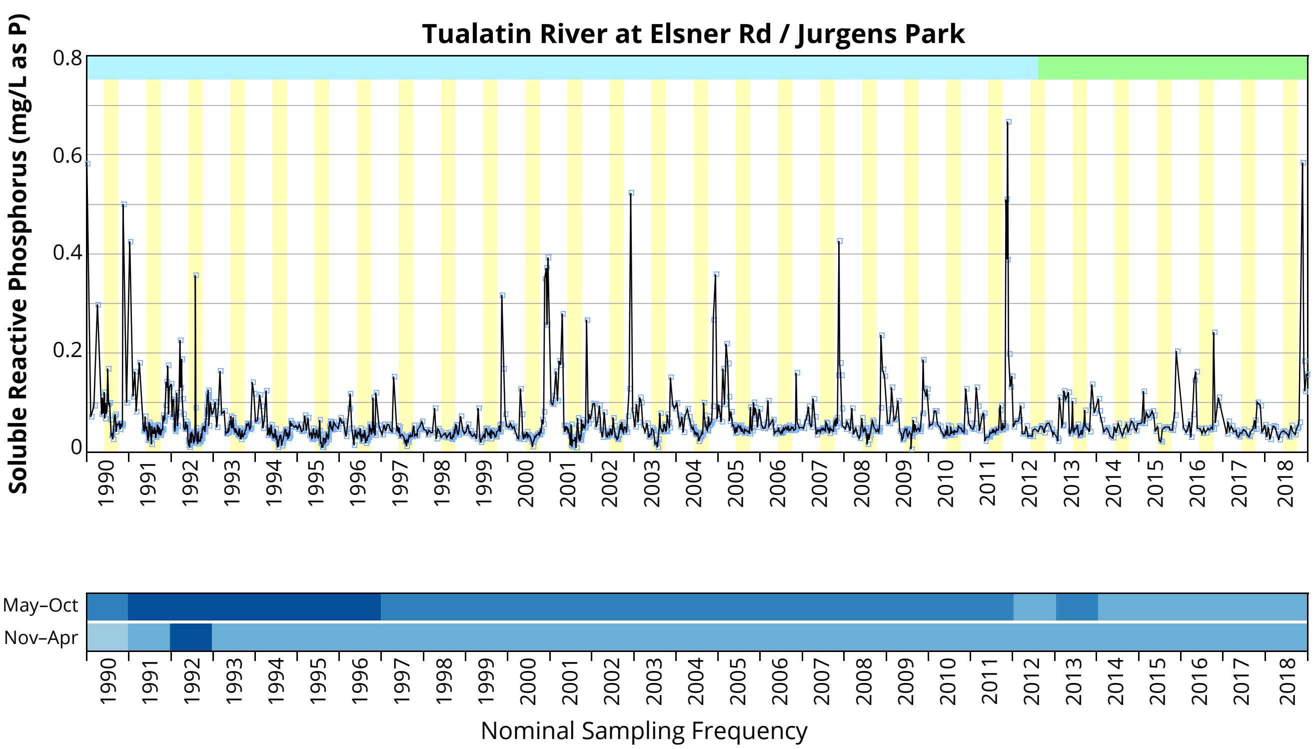
- Total phosphorus (TP) concentrations ranged from 0.048–0.79 mg/L with an annual median of 0.10 mg/L over the period of record.
- Median July–September TP concentrations were lower than the TMDL loading capacity concentration of 0.11 mg/L in every year except 1990 which predates the 2001 TMDL.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.006–0.67 mg/L with an annual median of 0.045 mg/L over the period of record.
- In general, both TP and SRP concentrations were higher in November and December, although high concentrations occurred in January–April as well.
- Over the period of record, SRP exceeded 0.40 mg/L eight times, all of which coincided with high TP concentrations. SRP accounted for about 80% or more of the TP. Two incidences occurred in January, early in the period of record (1990 and 1991). The other six occurred between October 31and December 2, a time when phosphorus removal by the Rock Creek WWTF might be suspended for the season. In all six cases, fall rainfall that year was not sustained. Flows increased sometime in October/November, but then dropped back to baseflow levels. Dissolved phosphorus discharges by the WWTF into the smaller volume of river water resulted in these high SRP and TP concentrations.
- High TP concentrations were not always coincident with high SRP concentrations. In such cases, high TP was due to increases in the particulate form of phosphorus that occur during or shortly after storms.
- A moderately high spike in TP and SRP occurred in late July 1992. This spike was not evident at the Hwy 210 site. The origin of the spike is unknown. It could have been a short-lived discharge from the Rock Creek WWTF which was transitioning to full phosphorus treatment that year. If that was the case, it shows that grab samples can miss short-lived concentration changes. The spike could also have been caused by some unknown discharge between Hwy 210 and Elsner.
- July–September TP concentrations show a statistically significant decreasing trend from 1990–1995 which is consistent with phosphorus treatment implementation at the Rock Creek WWTF. Since 1995, July–September TP concentrations have not changed. Note that determining a recent trend would be difficult at this site because of the decrease in sampling frequency and change in sampling location.
- July–September SRP concentrations showed a sharp decrease 1990–1992 as phosphorus treatment was implemented at the Rock Creek WWTF. Since 1994, July–September SRP concentrations show an increasing trend that is statistically significant.

Time series

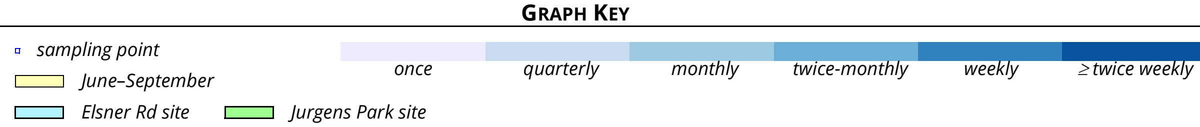
Tualatin River at Elsner Rd / Jurgens Park



Tualatin River at Elsner Rd / Jurgens Park



Graph Key



TREL / TRJU – Tualatin River at Elsner Rd / Jurgens Park

Data source: Clean Water Services

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — TREL / TRJU

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	32	0.610	0.172	0.145	0.310	0.135	0.148	0.174	0.113	0.129	0.160	0.393	0.180
1991	75	0.330	0.266	0.264	0.174	0.156	0.130	0.113	0.122	0.082	0.082	0.232	0.180
1992	115	0.230	0.161	0.193	0.115	0.122	0.097	0.121	0.109	0.101	0.102	0.185	0.148
1993	68	0.160	0.152	0.150	0.130	0.110	0.133	0.116	0.124	0.077	0.096	0.102	0.200
1994	66	0.236	0.205	0.124	0.133	0.093	0.095	0.084	0.080	0.086	0.084	0.104	0.175
1995	66	0.125	0.138	0.133	0.093	0.088	0.098	0.100	0.078	0.074	0.101	0.155	0.169
1996	68	0.186	0.207	0.176	0.191	0.116	0.117	0.104	0.099	0.100	0.112	0.148	0.146
1997	38	0.151	0.179	0.132	0.220	0.101	0.106	0.111	0.100	0.091	0.113	0.123	0.153
1998	41	0.145	0.110	0.095	0.107	0.101	0.097	0.091	0.084	0.084	0.082	0.111	0.105
1999	40	0.176	0.130	0.120	0.114	0.068	0.088	0.077	0.076	0.066	0.067	0.225	0.121
2000	39	0.089	0.097	0.087	0.119	0.079	0.081	0.081	0.078	0.065	0.072	0.375	0.396
2001	47	0.148	0.193	0.202	0.235	0.097	0.094	0.076	0.100	0.087	0.087	0.126	0.173
2002	39	0.177	0.107	0.120	0.069	0.071	0.075	0.092	0.077	0.066	0.064	0.129	0.367
2003	38	0.121	0.241	0.122	0.093	0.080	0.090	0.074	0.080	0.067	0.097	0.130	0.157
2004	39	0.133	0.142	0.094	0.120	0.100	0.088	0.082	0.081	0.096	0.100	0.153	0.285
2005	41	0.161	0.190	0.298	0.137	0.108	0.090	0.091	0.088	0.082	0.116	0.176	0.130
2006	39	0.128	0.130	0.158	0.112	0.078	0.092	0.106	0.086	0.075	0.078	0.181	0.129
2007	41	0.106	0.137	0.113	0.106	0.098	0.092	0.094	0.082	0.077	0.095	0.237	0.279
2008	39	0.127	0.115	0.118	0.078	0.077	0.091	0.105	0.104	0.082	0.081	0.226	0.221
2009	42	0.172	0.209	0.139	0.120	0.089	0.091	0.088	0.095	0.086	0.087	0.188	0.178
2010	40	0.137	0.129	0.144	0.107	0.088	0.095	0.097	0.085	0.098	0.088	0.134	0.187
2011	40	0.124	0.182	0.185	0.127	0.070	0.085	0.089	0.081	0.107	0.090	0.472	0.215
2012	23	0.178	0.137	0.146	0.093	0.072	0.084	0.098	0.092	0.079	0.095	0.122	0.095
2013	35	0.071	0.126	0.141	0.171	0.094	0.093	0.088	0.075	0.093	0.087	0.172	0.127
2014	24	0.155	0.118	0.123	0.107	0.090	0.081	0.094	0.077	0.080	0.090	0.094	0.109
2015	22	0.160	0.199	0.181	0.126	0.110	0.083	0.083	0.085	0.081	0.084	0.287	
2016	21	0.123	0.107	0.097	0.161	0.153	0.082	0.092	0.078	0.067	0.208	0.161	
2017	23	0.088	0.164	0.098	0.093	0.084	0.077	0.083	0.081	0.094	0.103	0.111	0.100
2018	23	0.094	0.076	0.105	0.097	0.077	0.086	0.083	0.089	0.077	0.098	0.457	0.192
POR Median		0.148	0.142	0.133	0.119	0.093	0.091	0.092	0.085	0.082	0.090	0.161	0.173

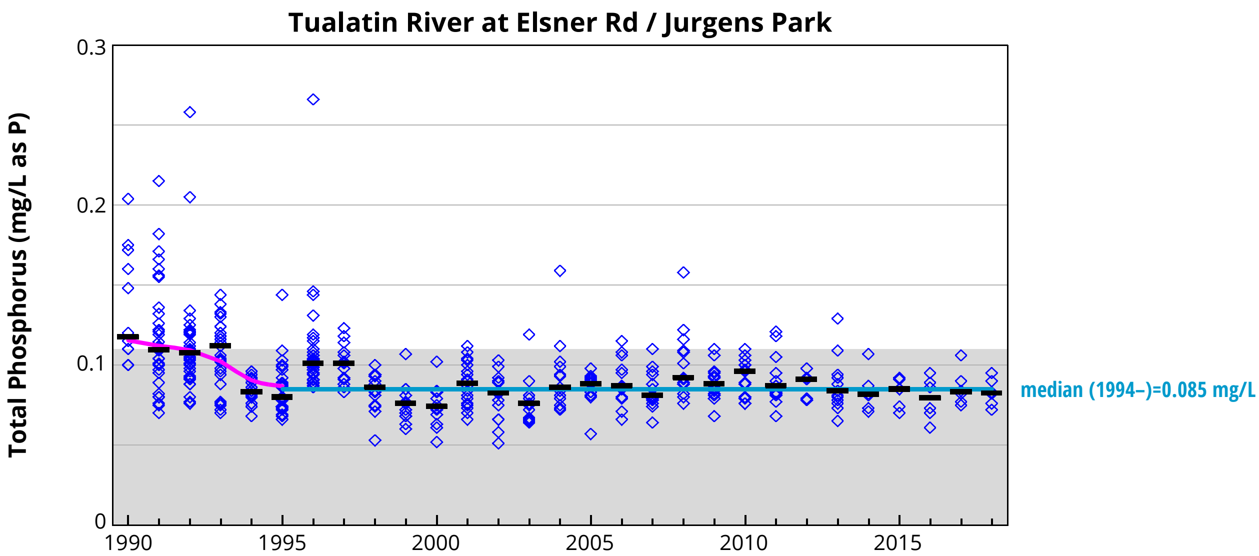
Key
total P in mg/L as P
TP ≤ 0.08
0.08 < TP ≤ 0.09
0.09 < TP ≤ 0.14
0.14 < TP ≤ 0.20
TP > 0.20

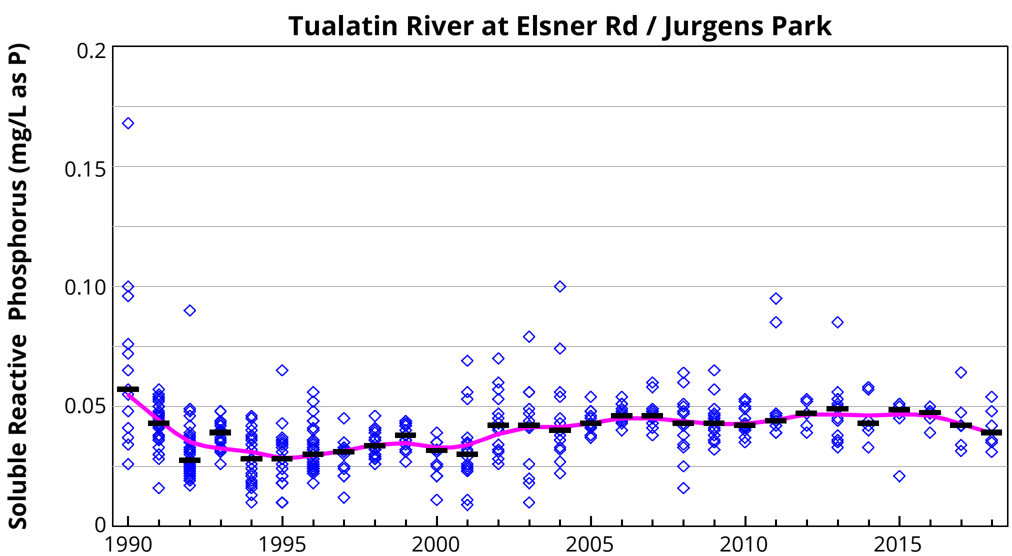
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONC. (mg/L as P) — TREL/TRJU

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	33	0.582	0.071	0.094	0.298	0.094	0.083	0.096	0.043	0.056	0.057	0.278	0.100
1991	79	0.425	0.137	0.082	0.181	0.048	0.041	0.043	0.043	0.044	0.046	0.113	0.131
1992	115	0.071	0.050	0.118	0.076	0.052	0.024	0.031	0.025	0.028	0.051	0.104	0.089
1993	68	0.093	0.076	0.121	0.060	0.046	0.058	0.042	0.036	0.035	0.051	0.052	0.130
1994	65	0.063	0.105	0.058	0.079	0.042	0.034	0.022	0.024	0.040	0.034	0.056	0.052
1995	65	0.052	0.043	0.059	0.052	0.035	0.036	0.028	0.021	0.032	0.052	0.052	0.050
1996	68	0.065	0.042	0.067	0.083	0.033	0.037	0.032	0.025	0.041	0.046	0.077	0.051
1997	36	0.046	0.050	0.044	0.152	0.042	0.035	0.028	0.023	0.032	0.037	0.046	0.058
1998	41	0.045	0.040	0.039	0.058	0.045	0.033	0.034	0.036	0.033	0.046	0.059	0.042
1999	40	0.049	0.038	0.035	0.058	0.027	0.042	0.037	0.042	0.034	0.044	0.168	0.064
2000	39	0.054	0.051	0.035	0.078	0.035	0.035	0.024	0.028	0.035	0.044	0.350	0.325
2001	47	0.098	0.139	0.144	0.176	0.049	0.037	0.023	0.035	0.031	0.050	0.060	0.072
2002	39	0.098	0.058	0.069	0.042	0.033	0.039	0.041	0.031	0.045	0.049	0.100	0.304
2003	38	0.074	0.086	0.077	0.051	0.034	0.045	0.019	0.048	0.044	0.059	0.100	0.093
2004	39	0.087	0.061	0.056	0.079	0.050	0.039	0.030	0.040	0.050	0.058	0.092	0.213
2005	41	0.079	0.132	0.179	0.073	0.051	0.050	0.048	0.043	0.042	0.067	0.074	0.069
2006	39	0.052	0.054	0.078	0.063	0.042	0.041	0.045	0.050	0.046	0.046	0.111	0.050
2007	41	0.055	0.081	0.054	0.071	0.044	0.046	0.048	0.048	0.045	0.060	0.168	0.071
2008	38	0.054	0.049	0.063	0.042	0.042	0.047	0.029	0.047	0.048	0.045	0.167	0.154
2009	42	0.058	0.109	0.067	0.073	0.033	0.044	0.036	0.045	0.046	0.050	0.129	0.120
2010	40	0.055	0.070	0.069	0.047	0.036	0.035	0.041	0.042	0.050	0.044	0.084	0.058
2011	40	0.047	0.095	0.068	0.076	0.030	0.039	0.043	0.044	0.066	0.052	0.389	0.143
2012	23	0.057	0.064	0.066	0.045	0.033	0.039	0.047	0.048	0.046	0.053	0.053	0.038
2013	35	0.025	0.082	0.090	0.114	0.044	0.045	0.044	0.042	0.053	0.045	0.116	0.079
2014	24	0.096	0.054	0.048	0.039	0.041	0.042	0.050	0.039	0.049	0.057	0.054	0.051
2015	22	0.060	0.091	0.075	0.079	0.058	0.039	0.034	0.051	0.048	0.051	0.140	
2016	21	0.049	0.043	0.046	0.111	0.105	0.043	0.044	0.047	0.049	0.151	0.103	
2017	23	0.037	0.053	0.047	0.039	0.036	0.042	0.038	0.037	0.056	0.074	0.068	0.049
2018	23	0.041	0.026	0.052	0.031	0.039	0.042	0.034	0.048	0.042	0.055	0.384	0.140
POR Median		0.057	0.061	0.067	0.073	0.042	0.041	0.037	0.042	0.045	0.051	0.100	0.072

Key
SRP in mg/L as P
SRP ≤ 0.03
0.03 < SRP ≤ 0.04
0.04 < SRP ≤ 0.06
0.06 < SRP ≤ 0.10
SRP > 0.10

JULY-SEPTEMBER TREND (LOW-FLOW HIGH-SUNLIGHT PERIOD)





GRAPH KEY

- ◇ value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant
- TMDL loading capacity— acceptable range for summer median

TRST – Tualatin River at Stafford Rd – 14207050

Data source: Clean Water Services

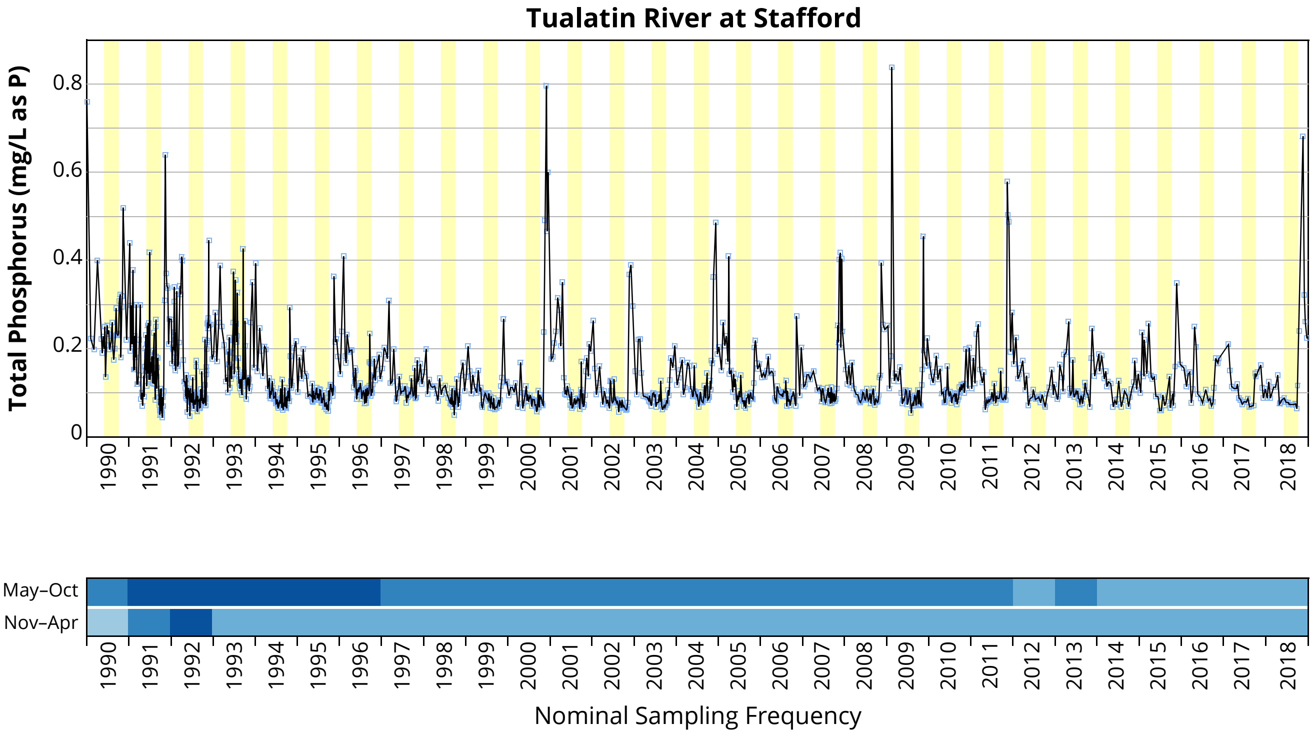
Sampling frequency & location

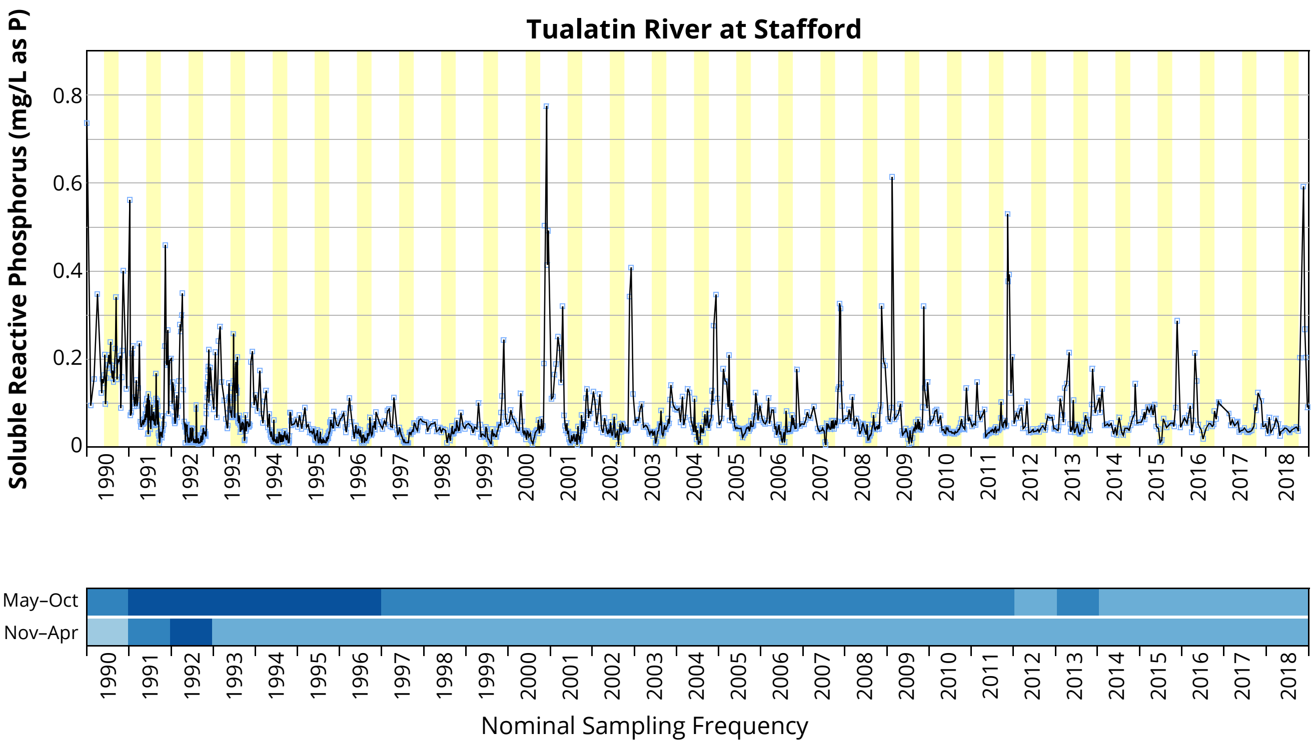
- The period of record is January 1990 through present.
- Sampling frequency was quite variable during May–October, ranging from two or more times a week to twice a month. November–April sampling was usually twice a month.
- Except for a brief time in 1992, sampling frequency likely was not adequate to fully characterize the conditions associated with high flows, especially in winter.

Concentrations & trends

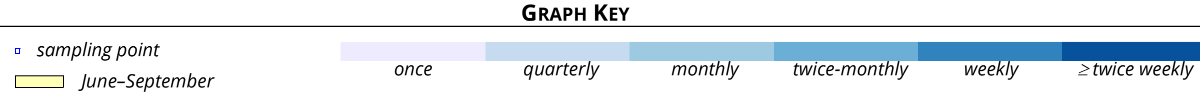
- Total phosphorus (TP) concentrations ranged from 0.044–0.84 mg/L with an annual median of 0.10 mg/L over the period of record.
- Median July–September TP concentrations were lower than the TMDL loading capacity concentration of 0.10 mg/L in every year except 1990, 1991 and 1993 which predate the 2001 TMDL.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.005–0.78 mg/L with an annual median of 0.046 mg/L over the period of record.
- In general, both TP and SRP concentrations were higher in November and December, although high concentrations occurred in January–April as well.
- Over the period of record, SRP exceeded 0.40 mg/L twelve times, all of which coincided with high TP concentrations. SRP accounted for 70% or more of the TP. Two incidences occurred in January, early in the period of record (1990 and 1991); one occurred in February 2009. The remaining nine instances occurred between November 12 and December 11, a time when phosphorus removal by the Rock Creek and Durham WWTFs might be suspended for the season. In all cases, fall rainfall that year was not sustained. Flows increased sometime in October/November, but then dropped back to baseflow levels. Dissolved phosphorus discharges by the WWTFs into the smaller volume of river water resulted in these high SRP and TP concentrations.
- High TP concentrations were not always coincident with high SRP concentrations. In such cases, high TP was due to increases in the particulate form of phosphorus that occur during or shortly after storms.
- July–September TP concentrations show a statistically significant decreasing trend from 1990–1995 which is consistent with phosphorus treatment implementation at the Rock Creek and Durham WWTFs. Since 1995, July–September TP concentrations have not changed. Note that determining a recent trend would be difficult at this site because of the decrease in sampling frequency.
- July–September SRP concentrations showed a sharp decrease 1990–1992 as phosphorus treatment was implemented at the Rock Creek and Durham WWTFs. Since 1994, July–September SRP concentrations show an increasing trend that is statistically significant. The increasing trend may be related to decreasing algal growth in the same time period.

Time series





Graph Key



MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — 14207050

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	32	0.760	0.223	0.198	0.400	0.211	0.229	0.226	0.200	0.231	0.295	0.420	0.220
1991	88	0.254	0.180	0.130	0.100	0.151	0.186	0.151	0.148	0.090	0.069	0.357	0.267
1992	115	0.230	0.190	0.269	0.174	0.104	0.095	0.079	0.084	0.082	0.085	0.246	0.216
1993	67	0.235	0.216	0.320	0.167	0.161	0.205	0.229	0.130	0.131	0.120	0.128	0.254
1994	66	0.272	0.221	0.172	0.154	0.103	0.092	0.076	0.077	0.074	0.095	0.117	0.210
1995	66	0.141	0.166	0.141	0.095	0.090	0.097	0.092	0.078	0.069	0.103	0.162	0.202
1996	65	0.191	0.183	0.213	0.197	0.119	0.108	0.099	0.100	0.106	0.128	0.141	0.160
1997	38	0.179	0.185	0.126	0.199	0.097	0.109	0.107	0.093	0.105	0.093	0.130	0.143
1998	41	0.173	0.114	0.115	0.107	0.108	0.104	0.108	0.077	0.082	0.090	0.108	0.137
1999	39	0.171	0.124	0.128	0.126	0.088	0.094	0.084	0.077	0.067	0.081	0.135	0.124
2000	39	0.103	0.107	0.095	0.123	0.087	0.089	0.086	0.079	0.066	0.087	0.491	0.533
2001	47	0.179	0.226	0.302	0.206	0.102	0.093	0.079	0.082	0.084	0.082	0.149	0.203
2002	40	0.210	0.109	0.134	0.086	0.077	0.104	0.083	0.077	0.071	0.064	0.224	0.344
2003	38	0.123	0.222	0.119	0.090	0.080	0.097	0.078	0.089	0.067	0.088	0.154	0.182
2004	39	0.126	0.164	0.104	0.165	0.100	0.102	0.084	0.084	0.099	0.099	0.173	0.337
2005	41	0.178	0.234	0.229	0.146	0.113	0.089	0.092	0.082	0.091	0.088	0.203	0.160
2006	38	0.140	0.144	0.163	0.147	0.088	0.097	0.100	0.092	0.084	0.092	0.274	0.149
2007	36	0.117	0.141	0.130	0.149	0.109	0.107	0.088	0.096	0.090	0.098	0.309	0.322
2008	38	0.136	0.140	0.140	0.096	0.082	0.089	0.089	0.096	0.083	0.088	0.254	0.244
2009	40	0.181	0.511	0.136	0.142	0.084	0.089	0.089	0.077	0.083	0.090	0.196	0.193
2010	38	0.150	0.135	0.157	0.127	0.091	0.103	0.090	0.093	0.097	0.119	0.110	0.202
2011	40	0.144	0.177	0.205	0.135	0.078	0.086	0.091	0.087	0.095	0.088	0.503	0.238
2012	24	0.196	0.137	0.165	0.123	0.079	0.099	0.087	0.085	0.084	0.083	0.133	0.107
2013	35	0.089	0.150	0.145	0.227	0.104	0.098	0.087	0.091	0.108	0.082	0.212	0.138
2014	24	0.169	0.159	0.132	0.123	0.076	0.080	0.098	0.094	0.081	0.099	0.149	0.125
2015	23	0.169	0.179	0.200	0.135	0.114	0.076	0.078	0.076	0.102	0.085	0.254	0.164
2016	20	0.156	0.129	0.112	0.179	0.151	0.082	0.107	0.085	0.075	0.145	0.173	
2017	22		0.181	0.112	0.115	0.086	0.077	0.083	0.069	0.108	0.142	0.137	0.099
2018	23	0.107	0.088	0.113	0.108	0.081	0.084	0.076	0.073	0.070	0.179	0.502	0.243
POR MEDIAN		0.170	0.166	0.140	0.135	0.097	0.097	0.089	0.085	0.084	0.090	0.173	0.202

KEY
total P in mg/L as P
TP ≤ 0.080
0.080 < TP ≤ 0.090
0.09 < TP ≤ 0.15
0.15 < TP ≤ 0.23
TP > 0.23

MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — 14207050

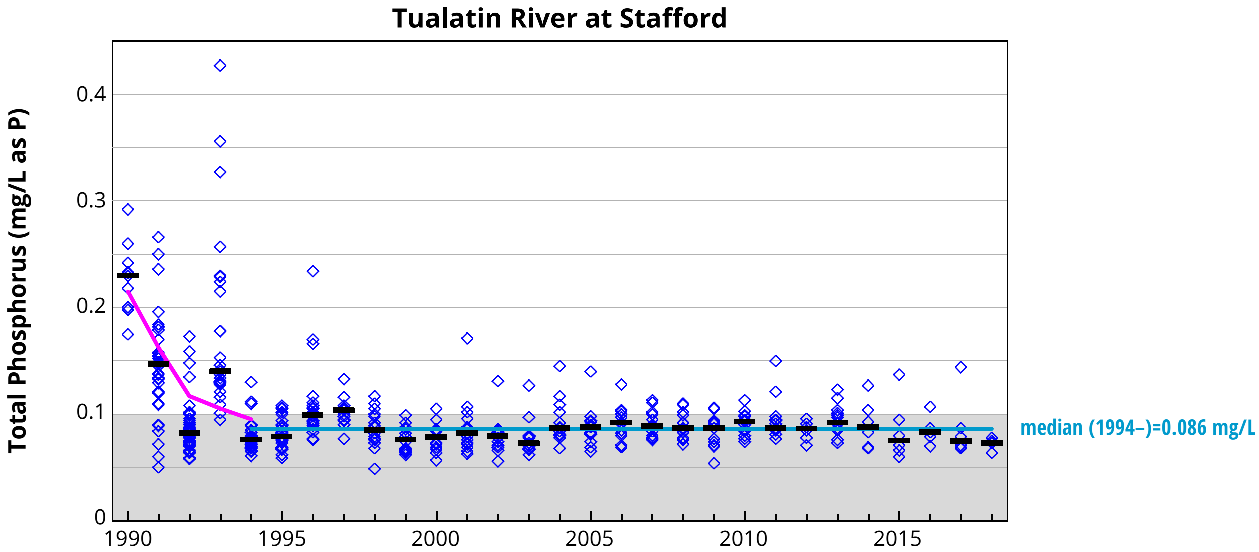
	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	33	0.736	0.095	0.155	0.348	0.151	0.168	0.188	0.165	0.213	0.195	0.311	0.133
1991	92	0.146	0.113	0.121	0.058	0.063	0.078	0.067	0.073	0.034	0.031	0.210	0.197
1992	114	0.099	0.061	0.207	0.131	0.032	0.023	0.016	0.010	0.013	0.030	0.133	0.153
1993	68	0.151	0.154	0.211	0.085	0.083	0.097	0.135	0.055	0.053	0.056	0.052	0.157
1994	66	0.101	0.125	0.080	0.087	0.033	0.016	0.020	0.022	0.025	0.025	0.051	0.058
1995	65	0.060	0.054	0.068	0.043	0.033	0.026	0.015	0.011	0.020	0.049	0.055	0.050
1996	62	0.067	0.046	0.082	0.074	0.033	0.033	0.019	0.018	0.033	0.046	0.060	0.055
1997	36	0.051	0.068	0.047	0.113	0.032	0.033	0.012	0.010	0.035	0.054	0.046	0.062
1998	41	0.057	0.042	0.053	0.047	0.042	0.038	0.025	0.030	0.037	0.045	0.059	0.045
1999	39	0.053	0.049	0.040	0.072	0.030	0.034	0.018	0.027	0.027	0.050	0.117	0.061
2000	39	0.071	0.063	0.045	0.081	0.034	0.029	0.014	0.028	0.040	0.046	0.503	0.453
2001	47	0.113	0.177	0.238	0.147	0.043	0.015	0.023	0.027	0.023	0.052	0.112	0.079
2002	40	0.115	0.067	0.082	0.044	0.035	0.034	0.033	0.030	0.040	0.040	0.191	0.264
2003	38	0.059	0.074	0.072	0.048	0.034	0.034	0.032	0.053	0.041	0.052	0.125	0.092
2004	39	0.086	0.086	0.059	0.129	0.049	0.039	0.012	0.040	0.055	0.060	0.128	0.229
2005	41	0.058	0.165	0.148	0.081	0.049	0.043	0.037	0.033	0.043	0.049	0.091	0.078
2006	38	0.061	0.057	0.083	0.084	0.041	0.033	0.020	0.037	0.045	0.048	0.177	0.051
2007	36	0.057	0.074	0.066	0.093	0.040	0.039	0.037	0.044	0.051	0.059	0.230	0.077
2008	38	0.066	0.073	0.081	0.062	0.038	0.041	0.022	0.038	0.046	0.047	0.196	0.186
2009	40	0.062	0.352	0.066	0.088	0.033	0.034	0.018	0.039	0.043	0.044	0.134	0.119
2010	38	0.058	0.074	0.070	0.056	0.037	0.036	0.033	0.034	0.043	0.048	0.059	0.067
2011	40	0.051	0.100	0.070	0.081	0.030	0.037	0.040	0.039	0.058	0.056	0.392	0.164
2012	24	0.066	0.074	0.067	0.077	0.034	0.038	0.039	0.040	0.044	0.058	0.067	0.043
2013	35	0.042	0.092	0.096	0.180	0.043	0.042	0.034	0.039	0.063	0.044	0.138	0.078
2014	24	0.096	0.091	0.052	0.052	0.038	0.035	0.051	0.035	0.041	0.057	0.110	0.056
2015	23	0.061	0.072	0.086	0.084	0.072	0.027	0.041	0.049	0.055	0.051	0.189	0.045
2016	20	0.066	0.064	0.064	0.138	0.101	0.029	0.044	0.054	0.050	0.073	0.101	
2017	22		0.064	0.056	0.058	0.037	0.042	0.034	0.037	0.069	0.104	0.076	0.050
2018	23	0.049	0.034	0.056	0.040	0.037	0.043	0.036	0.041	0.045	0.120	0.430	0.148
POR MEDIAN		0.064	0.074	0.070	0.081	0.037	0.035	0.033	0.037	0.043	0.050	0.125	0.078

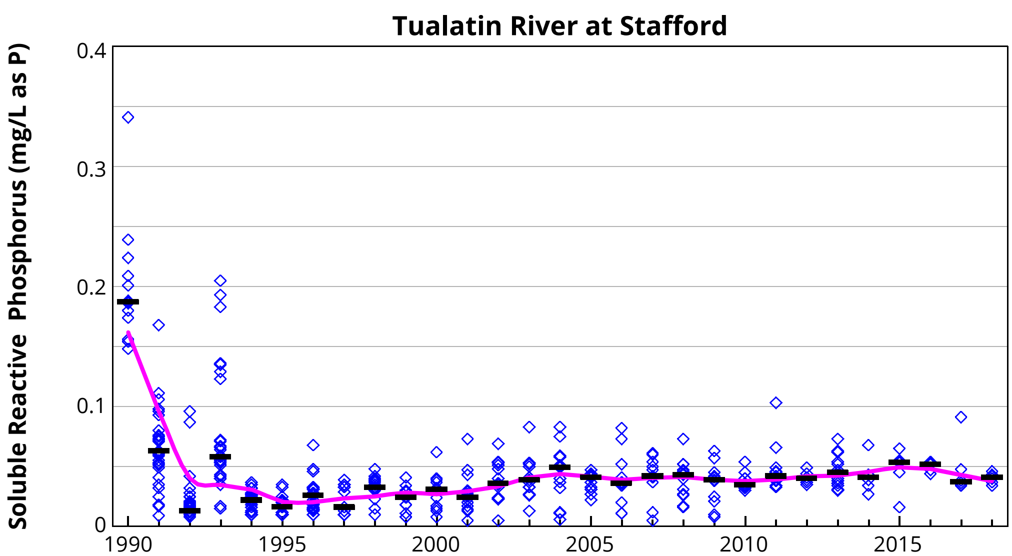
KEY
SRP in mg/L as P
SRP ≤ 0.02
0.02 < SRP ≤ 0.03
0.03 < SRP ≤ 0.07
0.07 < SRP ≤ 0.13
SRP > 0.13

TRST – Tualatin River at Stafford Rd – 14207050

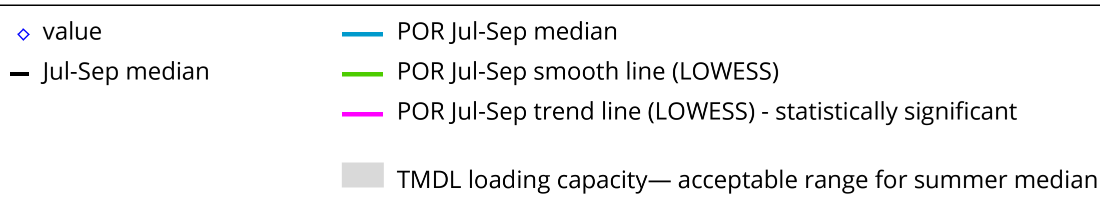
Data source: Clean Water Services

July-September trend (low-flow high-sunlight period)





Graph Key



GCNH – Gales Creek at New Hwy 47

Data source: Clean Water Services

Sampling frequency

- The period of record is January 1990 through present.
- The sampling frequency was mostly weekly for May–October and every two weeks for November–April. Since 2012, the May–October sampling frequency decreased to every two weeks.
- Except for a brief time in 1992, sampling frequency likely was not adequate to fully characterize the conditions associated with high flows, especially in winter.

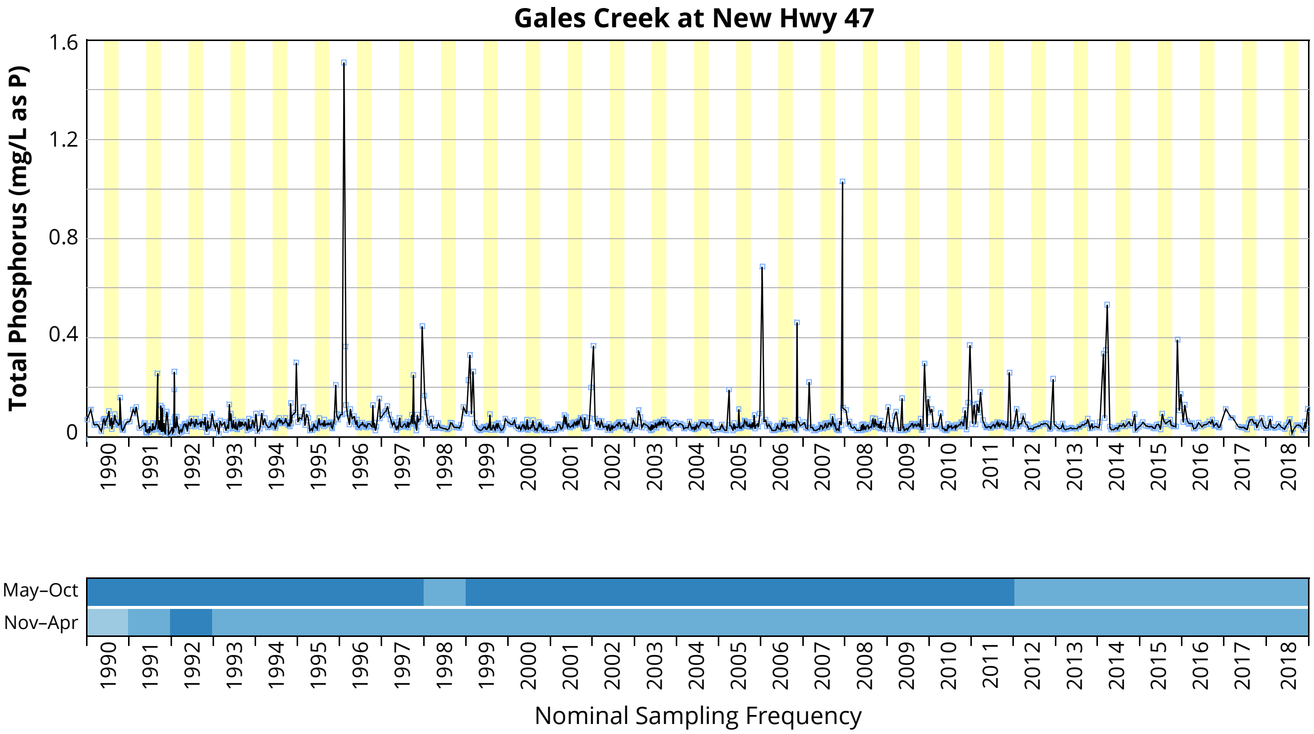
Concentrations & trends

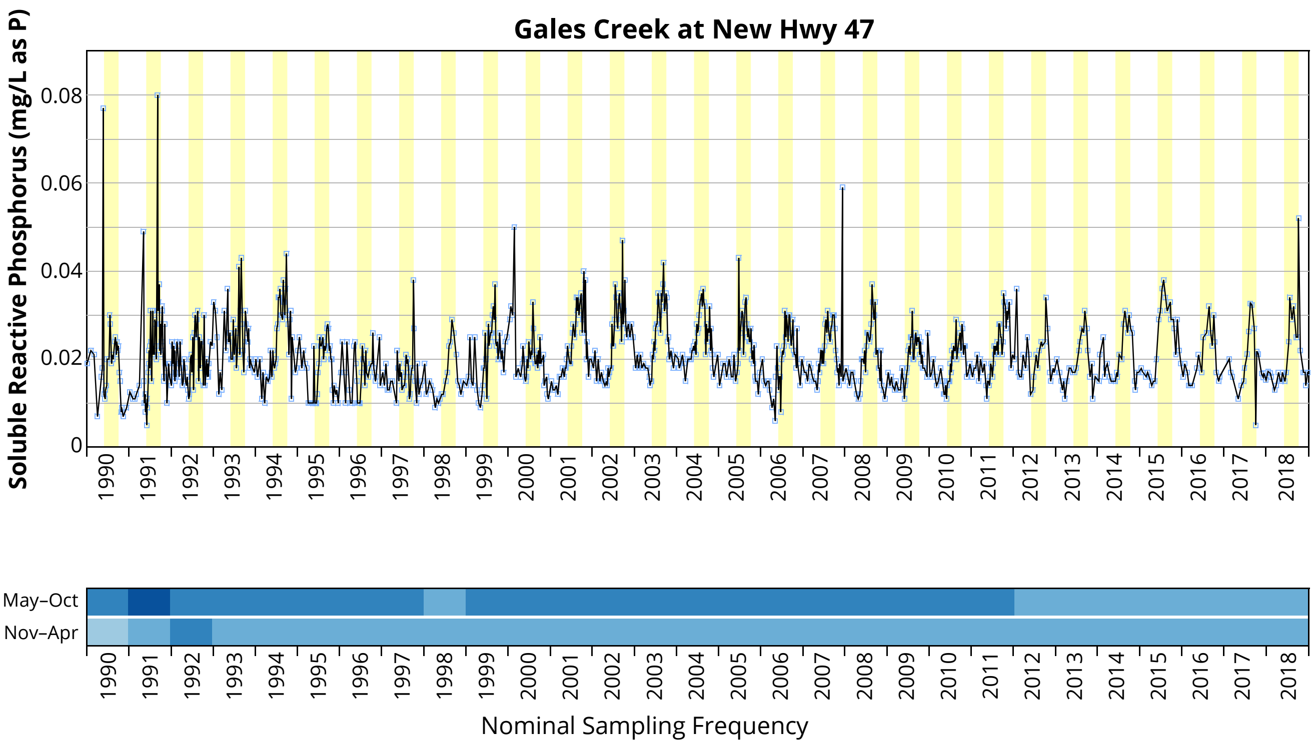
- Total phosphorus (TP) and soluble reactive phosphorus (SRP) concentrations in Gales Creek are generally low, but not as low as in Scoggins Creek or the upstream Tualatin River sites from Cherry Grove to Fern Hill Road.
- TP concentrations ranged from 0.010–1.51 mg/L with an annual median of 0.046 mg/L over the period of record. SRP concentrations ranged from 0.005–0.080 mg/L with an annual median of 0.020 mg/L over the period of record.
- Median July–September TP concentrations were greater than the TMDL loading capacity concentration of 0.04 mg/L for all years in the period of record except 1991 and 1998–2000.
- Spikes in TP concentration generally occurred from November through March and were probably due to an increase in the particulate form of phosphorus that occurred during or shortly after a storm.
- The highest concentration was measured on February 6, 1996 and coincided with large storms that caused major flooding downstream. The second highest concentration coincided with the large storm in early December 2007.
- Because the high flows that trigger concentration spikes are short-lived, the data likely under-represent spike frequency, especially since 2012 and during winter months for most of the period of record.
- TP concentration spikes were superimposed on a small, but distinct, seasonal baseline pattern. The baseline pattern generally was lowest April–May, increased steadily through the summer, reaching a maximum near September, and then decreasing through late fall and into winter. This pattern is consistent with soluble reactive phosphorus (SRP) entering the creek from groundwater. The difference between the pattern's minimum and maximum is only about 0.03 mg/L at this site.
- SRP concentrations have a clear seasonal pattern than is lowest April–May and highest in August–October, suggesting that a groundwater source may be important.
- June–October, SRP accounts for about 50% of the TP.
- SRP spikes occurred occasionally. They were not well correlated any time of year or with TP spikes. They may indicate unknown short-term local sources, such as pond pump out or drainage tile discharges.
- Neither July–September median concentrations of TP nor SRP show a trend. SRP concentrations appear to have a repeating pattern, with higher concentrations in 1994 and 2002–2004 and lower concentrations in 1996–1997 and 2010–2012.

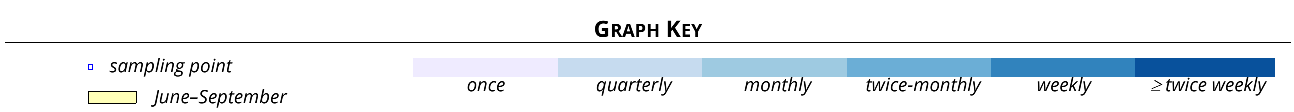
GCNH – Gales Creek at New Hwy 47

Data source: Clean Water Services

Time series







GCNH – Gales Creek at New Hwy 47

Data source: Clean Water Services

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — GCNH

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	31	0.070	0.110	0.048	0.050	0.055	0.065	0.074	0.063	0.060	0.050	0.027	0.060
1991	49	0.062	0.102	0.121	0.035	0.049	0.025	0.029	0.044	0.037	0.030	0.054	0.015
1992	57	0.040	0.053	0.028	0.042	0.045	0.055	0.052	0.053	0.059	0.053	0.039	0.067
1993	40	0.044	0.034	0.056	0.043	0.057	0.044	0.034	0.050	0.048	0.043	0.040	0.052
1994	39	0.058	0.064	0.062	0.043	0.047	0.045	0.065	0.056	0.061	0.049	0.088	0.199
1995	40	0.069	0.096	0.070	0.051	0.041	0.039	0.052	0.050	0.052	0.051	0.060	0.080
1996	35	0.089	0.363	0.072	0.093	0.064	0.040	0.049	0.043	0.053	0.043	0.033	0.114
1997	38	0.094	0.114	0.080	0.052	0.041	0.041	0.049	0.050	0.062	0.052	0.071	0.259
1998	23	0.131	0.051	0.054	0.037	0.047	0.035	0.031	0.054	0.039	0.038	0.042	0.119
1999	37	0.161	0.211	0.160	0.032	0.030	0.037	0.045	0.036	0.040	0.040	0.029	0.067
2000	39	0.053	0.059	0.037	0.036	0.044	0.037	0.037	0.038	0.038	0.038	0.028	0.025
2001	40	0.025	0.029	0.049	0.036	0.051	0.043	0.049	0.056	0.067	0.044	0.036	0.138
2002	39	0.220	0.054	0.051	0.042	0.034	0.039	0.042	0.055	0.047	0.040	0.035	0.051
2003	38	0.043	0.093	0.046	0.047	0.036	0.039	0.051	0.059	0.059	0.052	0.037	0.053
2004	38	0.050	0.050	0.035	0.049	0.039	0.041	0.047	0.058	0.049	0.051	0.032	0.031
2005	39	0.039	0.030	0.108	0.044	0.036	0.039	0.042	0.058	0.043	0.045	0.049	0.067
2006	39	0.374	0.055	0.048	0.026	0.032	0.032	0.050	0.041	0.048	0.045	0.068	0.048
2007	40	0.047	0.127	0.038	0.025	0.031	0.041	0.047	0.053	0.056	0.032	0.047	0.574
2008	38	0.079	0.051	0.038	0.025	0.026	0.037	0.042	0.047	0.052	0.044	0.044	0.029
2009	38	0.083	0.033	0.093	0.026	0.040	0.032	0.044	0.048	0.047	0.037	0.162	0.096
2010	37	0.105	0.042	0.044	0.065	0.028	0.040	0.038	0.042	0.049	0.057	0.069	0.254
2011	39	0.091	0.092	0.139	0.057	0.039	0.041	0.047	0.052	0.052	0.045	0.052	0.034
2012	24	0.085	0.047	0.068	0.050	0.033	0.034	0.043	0.048	0.053	0.052	0.032	0.142
2013	23	0.037	0.043	0.032	0.033	0.035	0.033	0.041	0.049	0.054	0.054	0.045	0.043
2014	24	0.048	0.205	0.441	0.035	0.033	0.034	0.044	0.048	0.057	0.045	0.059	0.037
2015	23	0.054	0.044	0.042	0.039	0.042	0.041	0.078	0.056	0.058	0.043	0.216	0.140
2016	21	0.094	0.058	0.054	0.034	0.050	0.044	0.051	0.062	0.052	0.051	0.038	
2017	19	0.112	0.077	0.077	0.041	0.037	0.037	0.043	0.070	0.056	0.045	0.063	0.039
2018	22	0.055	0.040	0.037	0.052	0.038	0.039	0.065	0.023	0.047	0.046	0.044	0.073
POR Median		0.069	0.055	0.054	0.042	0.039	0.039	0.047	0.050	0.052	0.045	0.044	0.067

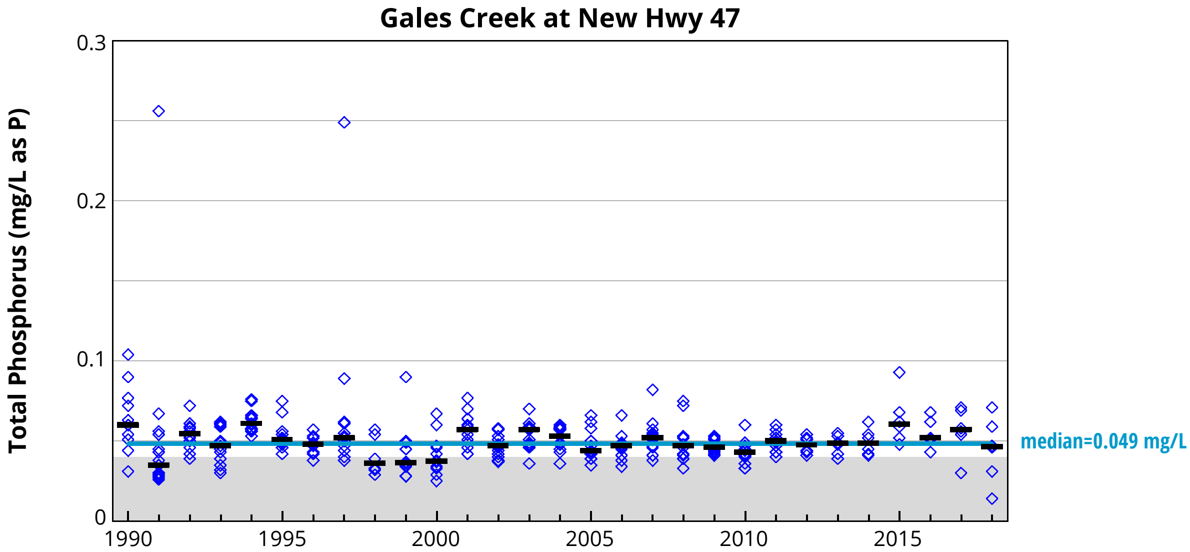
Key
total P in mg/L as P
TP ≤ 0.035
0.035 < TP ≤ 0.045
0.045 < TP ≤ 0.06
0.06 < TP ≤ 0.09
TP > 0.09

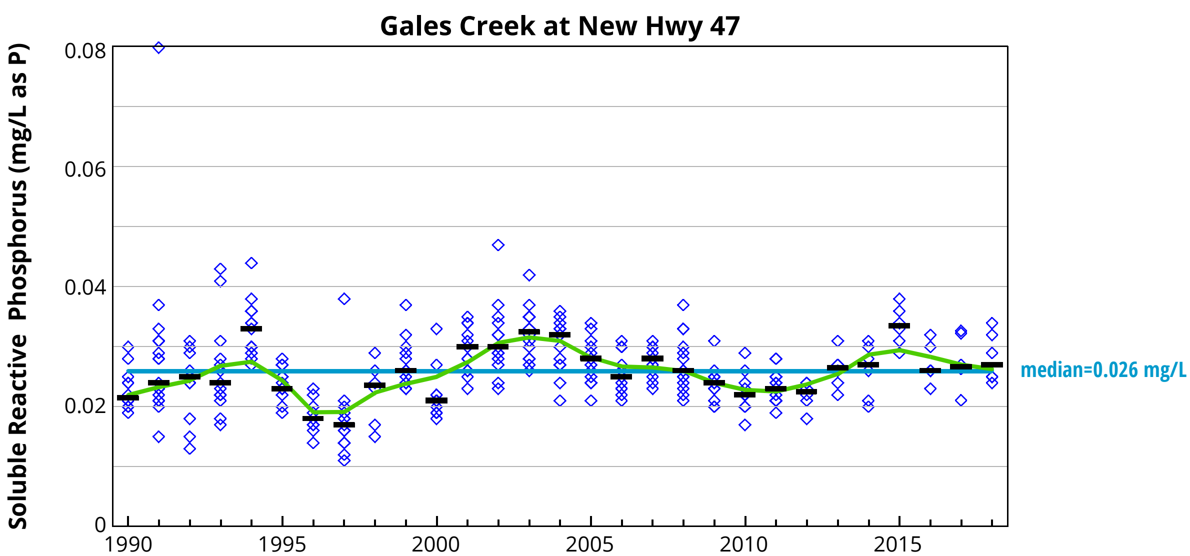
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — GCNH

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	32	0.019	0.022	0.021	0.007	0.017	0.014	0.028	0.021	0.023	0.015	0.008	0.009
1991	51	0.013	0.011	0.012	0.014	0.011	0.017	0.023	0.023	0.032	0.023	0.019	0.016
1992	58	0.019	0.018	0.019	0.017	0.015	0.017	0.026	0.025	0.024	0.016	0.017	0.024
1993	40	0.032	0.019	0.015	0.027	0.025	0.020	0.023	0.031	0.023	0.027	0.020	0.018
1994	39	0.018	0.016	0.014	0.016	0.017	0.019	0.031	0.030	0.035	0.029	0.025	0.018
1995	40	0.024	0.020	0.019	0.010	0.010	0.011	0.023	0.023	0.027	0.020	0.012	0.012
1996	35	0.021	0.017	0.019	0.010	0.021	0.010	0.020	0.017	0.017	0.019	0.016	0.020
1997	36	0.016	0.016	0.014	0.015	0.017	0.017	0.015	0.018	0.018	0.015	0.015	0.015
1998	23	0.016	0.014	0.014	0.010	0.011	0.012	0.016	0.024	0.026	0.018	0.013	0.015
1999	37	0.015	0.020	0.020	0.012	0.012	0.018	0.025	0.029	0.024	0.022	0.020	0.025
2000	39	0.031	0.040	0.017	0.017	0.019	0.019	0.021	0.021	0.020	0.020	0.015	0.012
2001	40	0.014	0.014	0.014	0.017	0.018	0.020	0.026	0.033	0.033	0.029	0.020	0.020
2002	39	0.020	0.018	0.016	0.015	0.017	0.021	0.029	0.032	0.029	0.028	0.027	0.027
2003	38	0.020	0.020	0.019	0.018	0.015	0.022	0.028	0.032	0.035	0.025	0.022	0.020
2004	38	0.019	0.020	0.017	0.020	0.022	0.024	0.032	0.033	0.026	0.027	0.018	0.021
2005	39	0.016	0.019	0.018	0.018	0.017	0.021	0.030	0.028	0.025	0.021	0.016	0.015
2006	39	0.018	0.015	0.014	0.010	0.016	0.016	0.023	0.027	0.026	0.022	0.019	0.017
2007	40	0.017	0.017	0.017	0.015	0.017	0.021	0.027	0.027	0.030	0.020	0.016	0.037
2008	38	0.017	0.016	0.016	0.012	0.018	0.020	0.025	0.031	0.029	0.018	0.014	0.011
2009	38	0.016	0.015	0.014	0.013	0.016	0.017	0.024	0.022	0.025	0.021	0.018	0.021
2010	37	0.017	0.018	0.015	0.017	0.012	0.015	0.021	0.022	0.024	0.025	0.020	0.018
2011	39	0.017	0.020	0.018	0.018	0.015	0.016	0.022	0.024	0.025	0.033	0.031	0.020
2012	24	0.028	0.017	0.019	0.022	0.017	0.015	0.020	0.023	0.024	0.031	0.016	0.018
2013	23	0.019	0.014	0.013	0.017	0.018	0.018	0.023	0.027	0.029	0.019	0.015	0.016
2014	24	0.018	0.021	0.019	0.016	0.015	0.017	0.021	0.030	0.028	0.027	0.014	0.017
2015	23	0.018	0.016	0.017	0.015	0.018	0.030	0.037	0.033	0.031	0.028	0.025	0.021
2016	19	0.018	0.016	0.014		0.020	0.021	0.026	0.032	0.026	0.021	0.016	
2017	19		0.019	0.016	0.011	0.014	0.017	0.024	0.033	0.016	0.021	0.016	0.016
2018	23	0.017	0.016	0.014	0.016	0.016	0.016	0.029	0.031	0.025	0.037	0.017	0.016
POR Median		0.018	0.017	0.016	0.015	0.017	0.017	0.024	0.027	0.026	0.022	0.017	0.018

Key
SRP in mg/L as P
SRP ≤ 0.013
0.013<SRP≤0.016
0.013<SRP≤0.025
0.025< SRP ≤0.03
SRP > 0.03

July-September trend (low-flow high-sunlight period)





Graph Key

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant
- TMDL loading capacity— acceptable range for summer median

DAIRY – Dairy Creek at Hwy 8 – 14206200

Data source: Clean Water Services

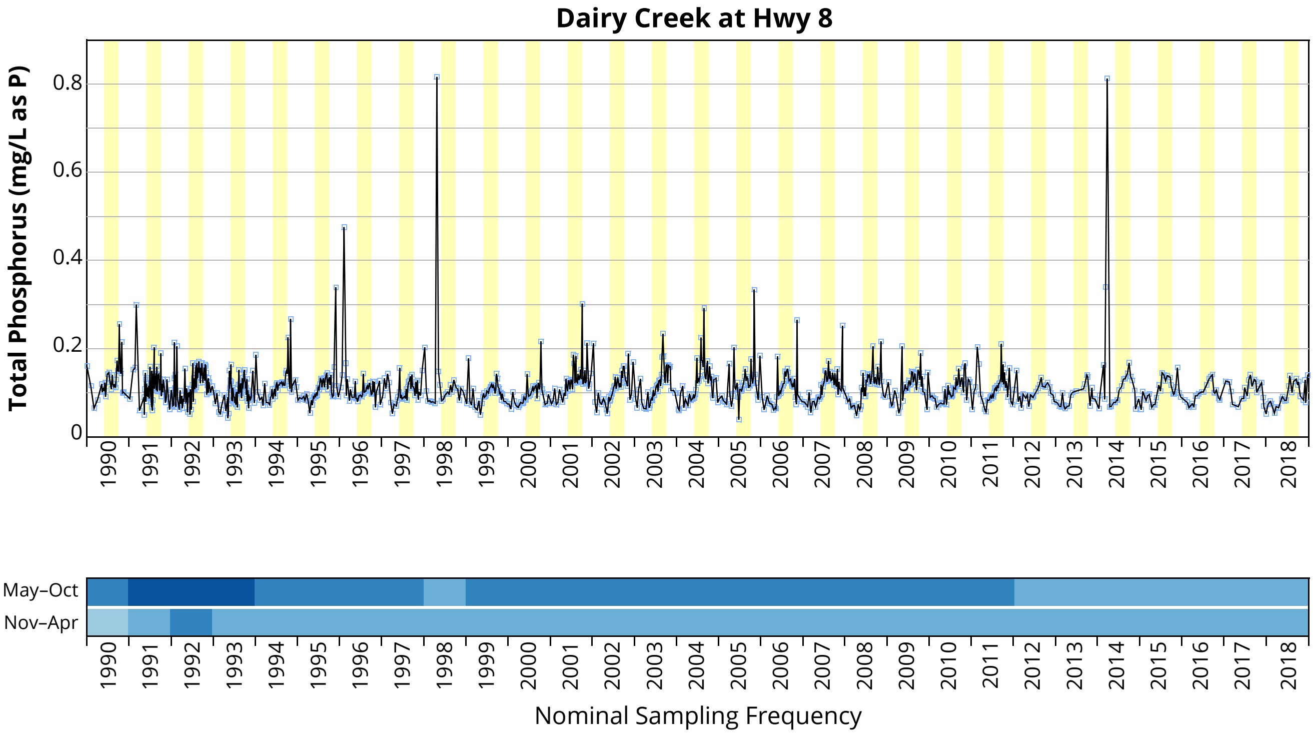
Sampling frequency

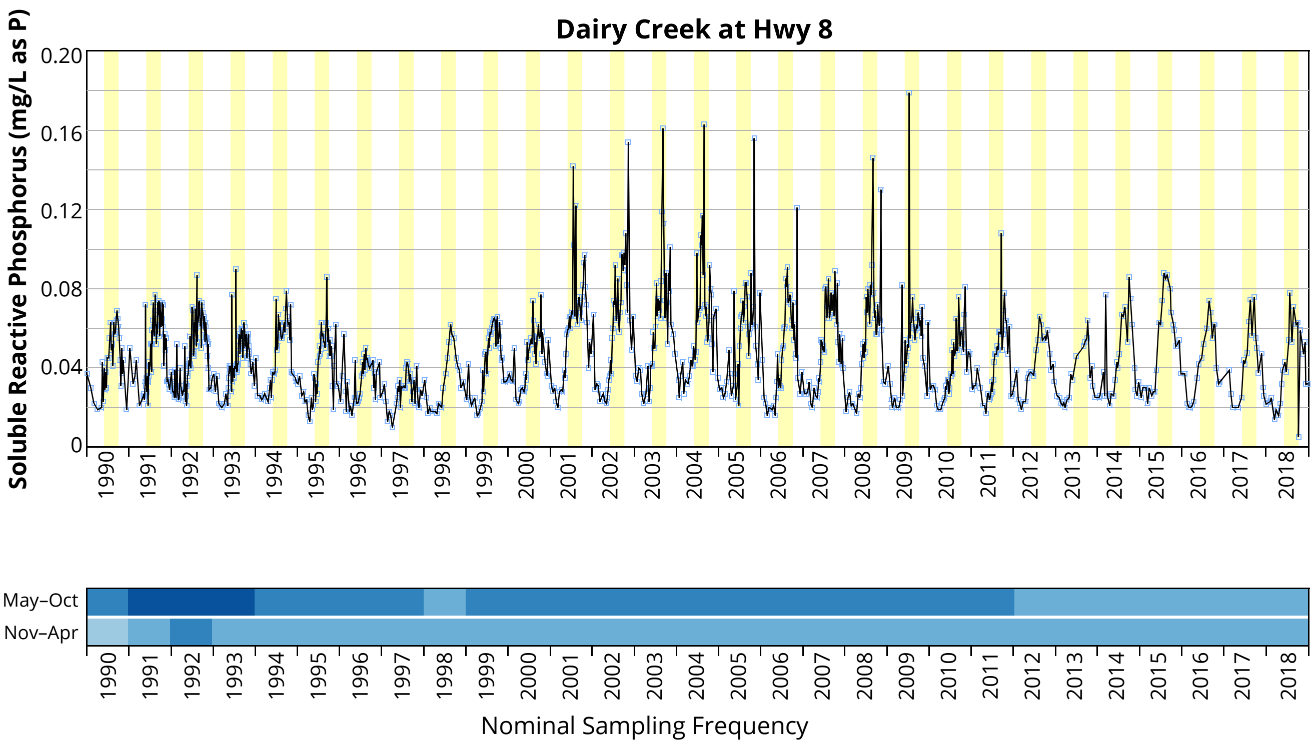
- The period of record is January 1990 through present.
- The sampling frequency was mostly weekly for May–October and every two weeks for November–April. Since 2012, the May–October sampling frequency decreased to every two weeks.
- Except for a brief time in 1992, sampling frequency likely was not adequate to fully characterize the conditions associated with high flows, especially in winter.

Concentrations & trends

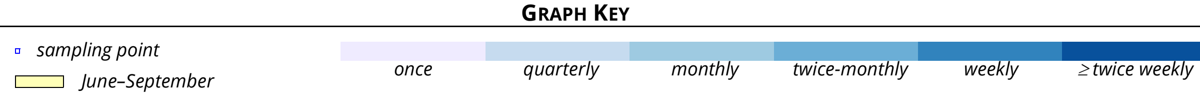
- Total phosphorus (TP) concentrations ranged from 0.039–0.82 mg/L with an annual median of 0.11 mg/L over the period of record.
- Median July–September TP concentrations were greater than the TMDL loading capacity concentration of 0.09 mg/L throughout the period of record.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.010–0.179 mg/L with an annual median of 0.044 mg/L over the period of record.
- TP concentrations show a distinct seasonal baseline pattern superimposed with mostly small spikes.
- Most TP spikes occurred from September through March; many were in the fall. Some of these spikes were probably due to an increase in the particulate form of phosphorus that occurred during or shortly after storms. In this case, the SRP remained at baseline levels. Other TP spikes had coincident SRP spikes, especially in 2004–2008. In these cases, the SRP was double to triple the baseline SRP and accounted for 50–60% of the TP, but not the entire TP increase. Farmland with tile drains is prevalent in the Dairy Creek basin. Elevated TP with SRP suggests that inputs of both particulate phosphorus and dissolved phosphorus from tile drains may be important.
- Because the high flows that trigger the concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency. Since 2012, when sampling frequency decreased to twice a month, only one concentration spike was captured by the data, suggesting that the decrease in sampling frequency resulted in missing any concentration spikes that occurred in the fall.
- The baseline TP pattern generally was lowest around March–April, increased steadily through the summer, reached a maximum near September, and then decreased slowly through late fall and into winter. This pattern is consistent with soluble reactive phosphorus (SRP) entering the creek from groundwater. The difference between the pattern's minimum and maximum is on the order of 0.06–0.08 mg/L.
- SRP concentrations have a clear seasonal pattern than is lowest April–May and highest in August–October, suggesting that a groundwater source may be important.
- In July–October, SRP accounts for about 50% of the TP.
- SRP spikes occurred occasionally in late summer through fall. During 2001–2011, they were far more prevalent and at much higher concentrations than other years. It is impossible to know if these spikes have occurred since 2012 because decreased sampling frequency may not have captured them. They may indicate unknown short-term local sources, such as pond pump out or drainage tile discharges.
- Neither July–September median concentrations of TP nor SRP show a trend. SRP concentrations appear to have a repeating pattern, with higher concentrations in 2002–2008 and lower concentrations in 1996–1997 and 2010–2011.

Time series





Graph Key



DAIRY – DAIRY CREEK AT HWY 8 – 14206200

Data source: Clean Water Services

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — 14206200

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	31	0.160	0.116	0.065	0.084	0.107	0.123	0.131	0.120	0.140	0.150	0.101	0.094
1991	56	0.086	0.155	0.300	0.060	0.108	0.099	0.092	0.133	0.125	0.120	0.098	0.086
1992	82	0.106	0.090	0.074	0.086	0.091	0.095	0.127	0.156	0.151	0.144	0.121	0.109
1993	68	0.088	0.078	0.062	0.077	0.100	0.103	0.091	0.102	0.128	0.108	0.087	0.114
1994	39	0.144	0.087	0.096	0.078	0.090	0.103	0.118	0.122	0.131	0.135	0.116	0.121
1995	40	0.086	0.089	0.091	0.068	0.088	0.098	0.124	0.129	0.135	0.118	0.158	0.104
1996	36	0.126	0.167	0.107	0.098	0.089	0.091	0.099	0.108	0.116	0.101	0.085	0.100
1997	38	0.114	0.127	0.101	0.064	0.087	0.092	0.092	0.119	0.115	0.104	0.102	0.123
1998	23	0.154	0.082	0.080	0.447	0.133	0.084	0.100	0.102	0.129	0.111	0.097	0.101
1999	37	0.127	0.077	0.089	0.072	0.076	0.094	0.107	0.114	0.121	0.106	0.084	0.078
2000	37	0.069	0.092	0.069	0.075	0.084	0.095	0.102	0.115	0.111	0.112	0.075	0.087
2001	40	0.079	0.092	0.093	0.087	0.104	0.127	0.126	0.134	0.133	0.124	0.128	0.132
2002	39	0.146	0.078	0.077	0.079	0.077	0.095	0.117	0.124	0.142	0.127	0.137	0.135
2003	38	0.076	0.120	0.072	0.083	0.077	0.095	0.117	0.135	0.161	0.161	0.132	0.102
2004	39	0.062	0.108	0.076	0.085	0.086	0.107	0.135	0.173	0.141	0.137	0.095	0.106
2005	39	0.090	0.081	0.120	0.083	0.109	0.099	0.108	0.137	0.117	0.135	0.132	0.134
2006	39	0.076	0.086	0.079	0.067	0.090	0.102	0.121	0.146	0.125	0.117	0.096	0.083
2007	40	0.077	0.085	0.068	0.075	0.089	0.116	0.138	0.132	0.132	0.118	0.109	0.181
2008	38	0.087	0.077	0.071	0.061	0.086	0.102	0.136	0.137	0.125	0.136	0.126	0.090
2009	38	0.108	0.072	0.100	0.061	0.105	0.110	0.124	0.140	0.136	0.133	0.102	0.104
2010	37	0.092	0.087	0.070	0.076	0.084	0.096	0.094	0.118	0.127	0.128	0.125	0.127
2011	38	0.083	0.159	0.131	0.072	0.083	0.090	0.105	0.117	0.149	0.123	0.113	0.077
2012	24	0.129	0.086	0.082	0.091	0.082	0.091	0.107	0.127	0.114	0.121	0.106	0.088
2013	19	0.074	0.084	0.068	0.070	0.098	0.104		0.109	0.130	0.103	0.099	0.085
2014	24	0.079	0.124	0.577	0.069	0.079	0.084	0.111	0.132	0.156	0.133	0.084	0.080
2015	23	0.083	0.083	0.096	0.070	0.081	0.111	0.143	0.133	0.127	0.098	0.135	0.095
2016	20	0.083	0.073	0.073	0.081	0.096	0.102	0.118	0.132	0.137	0.103	0.086	
2017	20	0.126	0.114	0.073	0.068	0.086	0.100	0.111	0.128	0.128	0.105	0.106	0.061
2018	22	0.078	0.076	0.061	0.066	0.089	0.083	0.127	0.114	0.125	0.109	0.106	0.109
POR MEDIAN		0.087	0.087	0.079	0.075	0.089	0.099	0.117	0.128	0.129	0.120	0.106	0.102

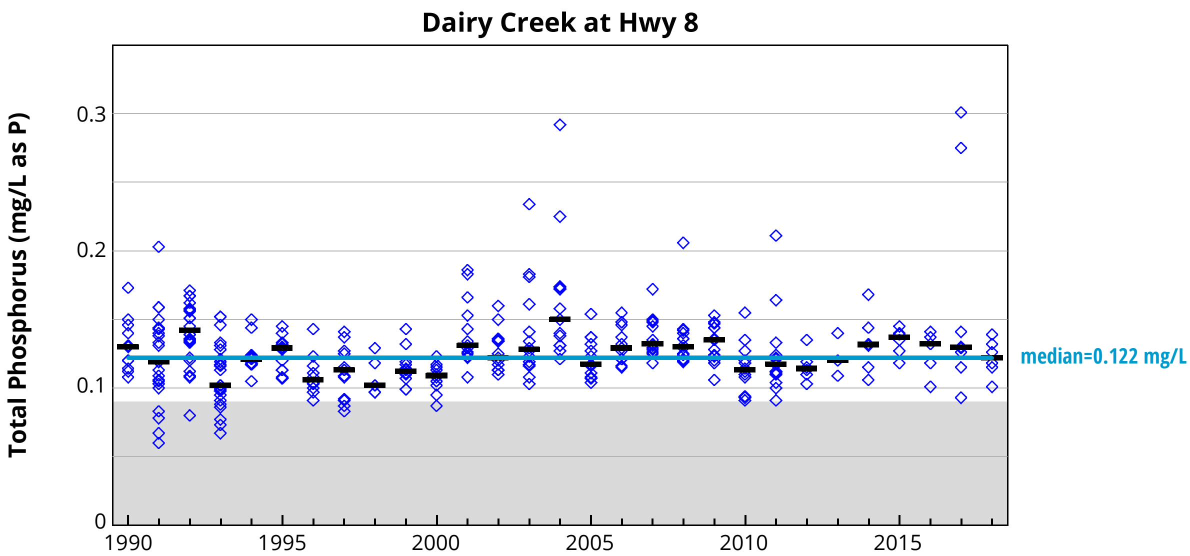
KEY
total P in mg/L as P
TP ≤ 0.090
0.090 < TP ≤ 0.10
0.10 < TP ≤ 0.13
0.13 < TP ≤ 0.15
TP > 0.15

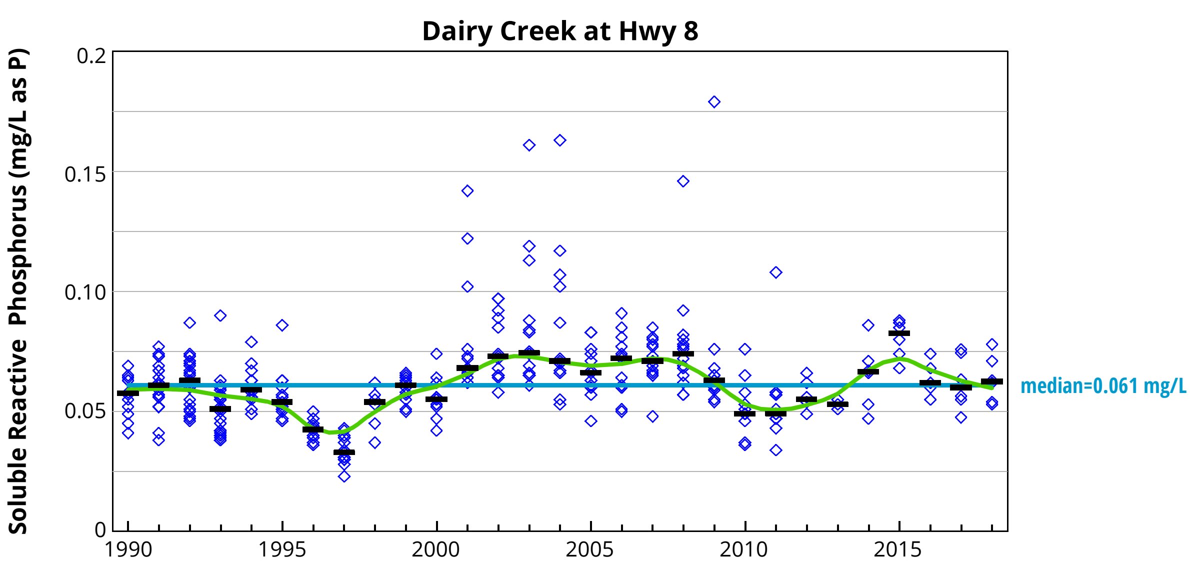
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — 14206200

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	32	0.037	0.030	0.022	0.019	0.032	0.034	0.052	0.055	0.065	0.050	0.041	0.019
1991	60	0.050	0.034	0.044	0.021	0.029	0.035	0.052	0.061	0.067	0.062	0.052	0.032
1992	83	0.028	0.032	0.028	0.028	0.032	0.043	0.060	0.066	0.065	0.063	0.052	0.033
1993	68	0.033	0.029	0.021	0.025	0.036	0.038	0.040	0.055	0.057	0.054	0.048	0.037
1994	39	0.036	0.025	0.026	0.024	0.034	0.038	0.055	0.056	0.067	0.063	0.038	0.034
1995	40	0.034	0.027	0.024	0.015	0.025	0.030	0.049	0.054	0.062	0.046	0.041	0.032
1996	36	0.030	0.028	0.026	0.019	0.025	0.024	0.040	0.045	0.041	0.042	0.031	0.034
1997	36	0.030	0.018	0.017	0.010	0.027	0.031	0.031	0.041	0.031	0.034	0.021	0.028
1998	23	0.030	0.019	0.018	0.018	0.022	0.025	0.041	0.057	0.055	0.043	0.035	0.033
1999	37	0.033	0.023	0.024	0.017	0.023	0.037	0.055	0.063	0.063	0.054	0.044	0.034
2000	37	0.036	0.042	0.023	0.026	0.030	0.047	0.053	0.053	0.056	0.057	0.040	0.045
2001	40	0.030	0.027	0.024	0.029	0.047	0.063	0.068	0.070	0.071	0.082	0.063	0.050
2002	39	0.048	0.032	0.024	0.023	0.032	0.050	0.072	0.067	0.093	0.092	0.109	0.058
2003	38	0.035	0.040	0.025	0.034	0.036	0.050	0.069	0.079	0.088	0.076	0.082	0.052
2004	39	0.030	0.040	0.031	0.034	0.043	0.048	0.070	0.102	0.061	0.079	0.052	0.053
2005	39	0.030	0.026	0.041	0.032	0.034	0.037	0.067	0.076	0.059	0.067	0.056	0.056
2006	39	0.035	0.019	0.020	0.020	0.030	0.033	0.056	0.081	0.068	0.058	0.045	0.033
2007	40	0.027	0.031	0.021	0.028	0.033	0.052	0.073	0.071	0.071	0.070	0.043	0.048
2008	38	0.022	0.025	0.021	0.022	0.036	0.050	0.072	0.087	0.065	0.065	0.059	0.032
2009	38	0.037	0.022	0.023	0.022	0.037	0.050	0.063	0.063	0.061	0.063	0.043	0.045
2010	37	0.030	0.030	0.020	0.021	0.027	0.033	0.043	0.049	0.058	0.056	0.060	0.048
2011	37	0.030	0.036	0.030	0.021	0.027	0.027	0.045	0.051	0.057	0.067	0.059	0.027
2012	24	0.036	0.023	0.021	0.029	0.038	0.037	0.052	0.064	0.055	0.057	0.043	0.038
2013	19	0.026	0.022	0.022	0.025	0.036	0.046		0.051	0.054	0.050	0.036	0.025
2014	24	0.026	0.032	0.052	0.024	0.030	0.042	0.057	0.069	0.070	0.069	0.035	0.030
2015	23	0.028	0.030	0.026	0.027	0.034	0.063	0.081	0.086	0.074	0.061	0.052	0.046
2016	19	0.037	0.021	0.021	0.023	0.039	0.049	0.060	0.074	0.062	0.051	0.033	
2017	19		0.033	0.020	0.020	0.025	0.043	0.056	0.065	0.065	0.044	0.039	0.024
2018	23	0.023	0.025	0.017	0.019	0.036	0.041	0.066	0.062	0.063	0.032	0.050	0.032
POR MEDIAN		0.030	0.028	0.023	0.023	0.032	0.041	0.056	0.063	0.063	0.058	0.044	0.034

KEY
SRP in mg/L as P
SRP ≤ 0.02
0.02 < SRP ≤ 0.03
0.03 < SRP ≤ 0.06
0.06 < SRP ≤ 0.07
SRP > 0.07

JULY-SEPTEMBER TREND (LOW-FLOW HIGH-SUNLIGHT PERIOD)





GRAPH KEY

- ◇ value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant
- TMDL loading capacity— acceptable range for summer median

MK-H /MK-P – McKay Creek at Hornecker Rd / Padgett Rd

Data source: Clean Water Services

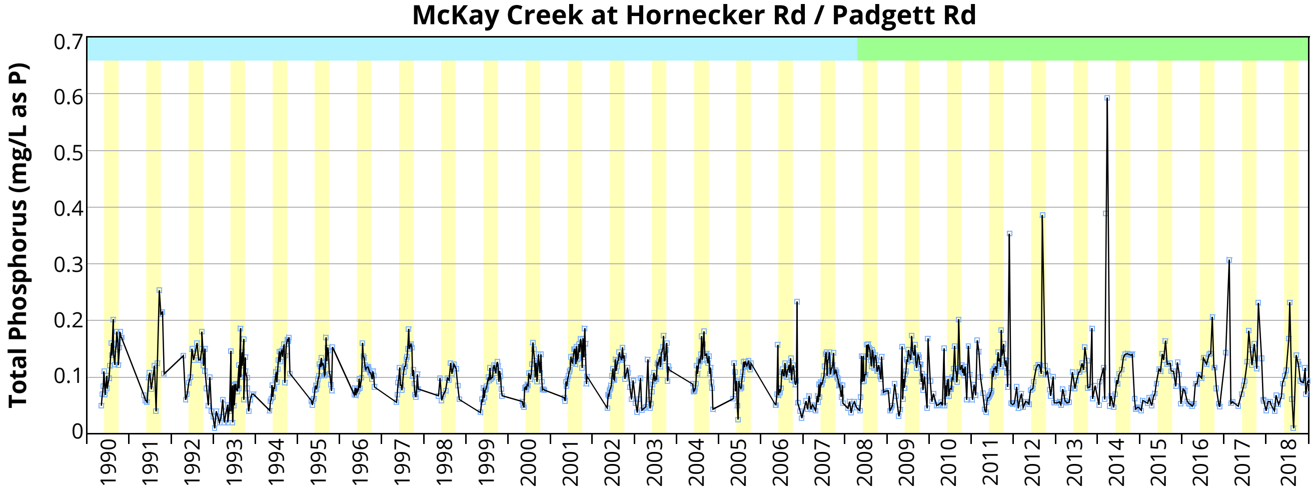
Sampling frequency

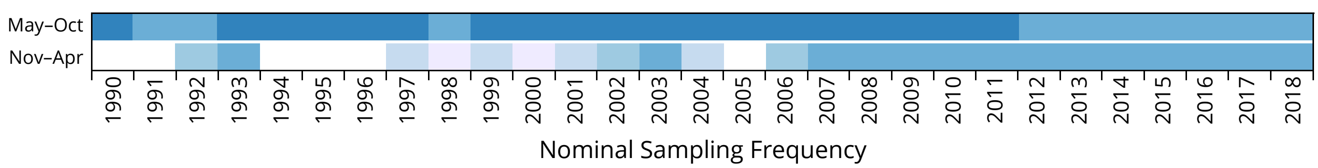
- The period of record is January 1990 through present.
- The sampling frequency ranged from weekly to every two weeks for May–October 1990–2011. Since 2012, it has been every two weeks. Sampling in November–April was intermittent between 1990 and 2007; in some years no samples were collected in these months. Since 2008, sampling in November–April has been every two weeks.
- Sampling frequency likely was not adequate to fully characterize the conditions associated with high flows. Before 2007, sampling was too infrequent to characterize baseline conditions in winter.
- The site location changed during 2008. The distance between the sites is about one mile. The data show no obvious difference between sites with regard to phosphorus concentrations.

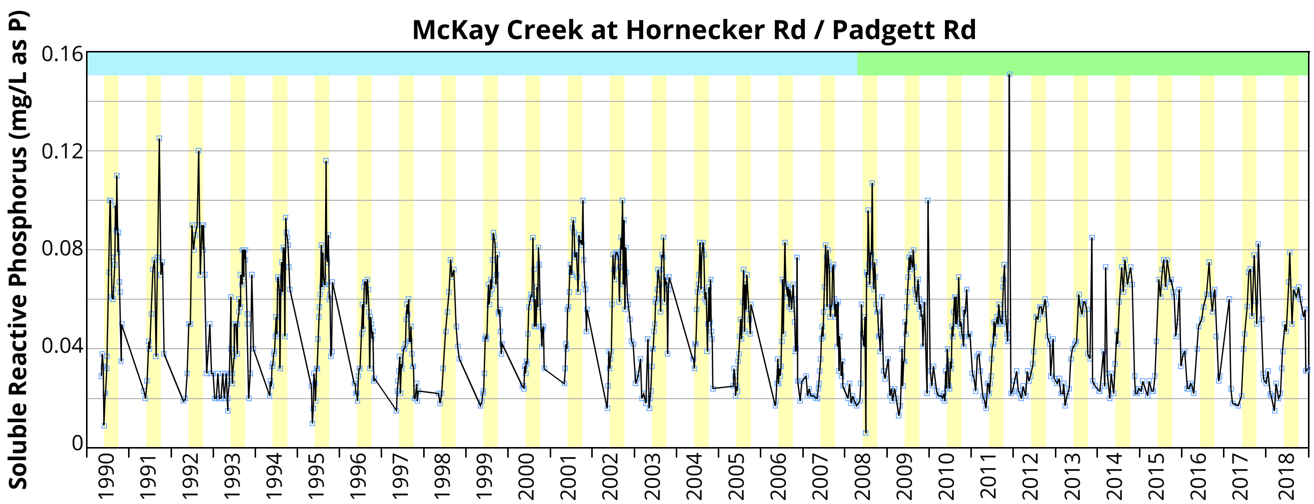
Concentrations & trends

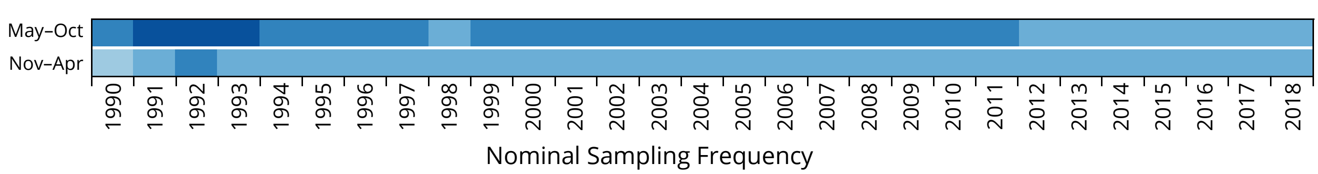
- Total phosphorus (TP) concentrations ranged from 0.010–0.59 mg/L with an annual median of 0.10 mg/L over the period of record.
- Median July–September TP concentrations were greater than the Dairy Creek TMDL loading capacity concentration of 0.09 mg/L throughout the period of record.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.006–0.151 mg/L with an annual median of 0.049 mg/L over the period of record.
- Both TP and SRP concentrations show a distinct seasonal baseline pattern that generally was lowest around March–April, increased steadily through the summer, reached a maximum near August–September, and then decreased slowly through late fall and into winter. This pattern is consistent with soluble reactive phosphorus (SRP) entering the creek from groundwater. The difference between the pattern's minimum and maximum is on the order of 0.10–0.14 mg/L for TP and 0.06–0.08 mg/L for SRP.
- A few, mostly small spikes were superimposed on the TP pattern. Most, but not all, of these TP spikes occurred from September through November. Only the spike on November 11, 2011 was coincident with a spike in SRP. The other spikes were not, including spikes that did not occur in the fall. Most TP spikes were probably due to an increase in the particulate form of phosphorus that occurred during or shortly after storms.
- Because the high flows that trigger the concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency.
- In July–November, SRP accounts for about 50% of the TP.
- Neither July–September median concentrations of TP nor SRP show a trend. SRP concentrations appear to have a repeating pattern, with higher concentrations in 2001–2002 and lower concentrations in 1997 and 2010–2011.

Time series

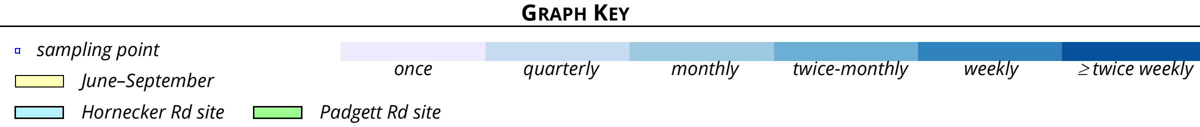








Graph Key



MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — MK-H / MK-P

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	24					0.077	0.080	0.109	0.141	0.159	0.170		
1991	14					0.064	0.099	0.090	0.080	0.189	0.211		
1992	22				0.138	0.065	0.100	0.136	0.145	0.150	0.125	0.065	0.040
1993	38	0.025	0.025	0.045	0.030	0.044	0.068	0.080	0.111	0.132	0.105	0.050	0.070
1994	26					0.062	0.089	0.122	0.144	0.148	0.165		
1995	27					0.061	0.086	0.121	0.121	0.150	0.105		
1996	25					0.075	0.080	0.136	0.118	0.111	0.103		
1997	27					0.080	0.086	0.119	0.150	0.152	0.074	0.092	
1998	13					0.083	0.064	0.087	0.106	0.123	0.100	0.061	
1999	26					0.056	0.079	0.100	0.099	0.115	0.106	0.073	
2000	27					0.057	0.086	0.108	0.129	0.121	0.092	0.077	
2001	29					0.084	0.112	0.137	0.132	0.159	0.159	0.095	
2002	30					0.068	0.094	0.111	0.133	0.134	0.108	0.095	0.078
2003	34	0.046	0.080	0.044	0.090	0.057	0.097	0.122	0.140	0.148	0.116		
2004	26					0.082	0.089	0.129	0.158	0.134	0.112	0.062	
2005	22					0.092	0.083	0.090	0.123	0.118	0.124		
2006	31					0.061	0.079	0.109	0.113	0.110	0.104	0.093	0.034
2007	39	0.058	0.055	0.047	0.044	0.067	0.093	0.130	0.130	0.119	0.107	0.085	0.070
2008	36	0.045	0.047	0.055	0.046	0.079	0.104	0.152	0.137	0.132	0.113	0.096	0.075
2009	38	0.059	0.048	0.078	0.037	0.089	0.127	0.138	0.145	0.130	0.114	0.089	0.107
2010	36	0.075	0.071	0.051	0.053	0.076	0.080	0.098	0.110	0.116	0.112	0.089	0.130
2011	39	0.074	0.117	0.123	0.058	0.060	0.073	0.115	0.128	0.144	0.130	0.108	0.053
2012	24	0.069	0.053	0.059	0.057	0.065	0.086	0.120	0.114	0.253	0.107	0.073	0.078
2013	23	0.056	0.065	0.065	0.056	0.095	0.087	0.109	0.119	0.141	0.082	0.124	0.085
2014	24	0.072	0.089	0.491	0.058	0.059	0.092	0.110	0.137	0.141	0.140	0.053	0.047
2015	22	0.050		0.059	0.058	0.080	0.112	0.136	0.144	0.118	0.107	0.105	0.079
2016	21	0.078	0.055	0.051	0.071	0.096	0.116	0.123	0.140	0.142	0.099	0.051	
2017	20	0.143	0.181	0.057	0.049	0.070	0.089	0.155	0.135	0.146	0.173	0.097	0.050
2018	22	0.057	0.050	0.054	0.052	0.078	0.107	0.200	0.036	0.133	0.108	0.103	0.082
POR Median		0.058	0.055	0.056	0.056	0.070	0.089	0.120	0.130	0.134	0.108	0.089	0.075

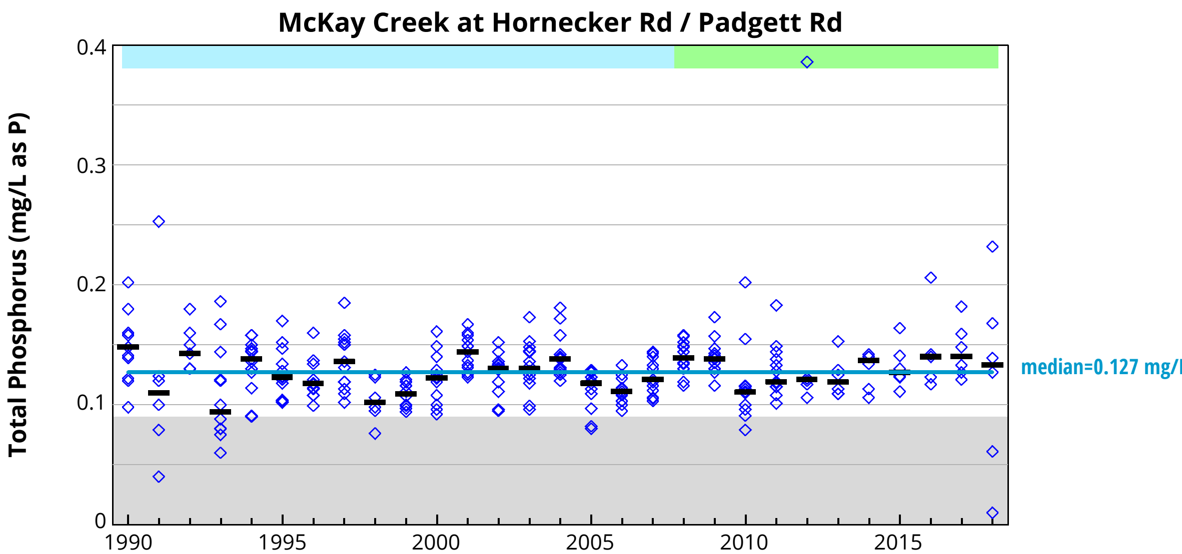
Key
total P in mg/L as P
TP ≤ 0.070
0.070 < TP ≤ 0.090
0.09 < TP ≤ 0.13
0.13 < TP ≤ 0.15
TP > 0.15

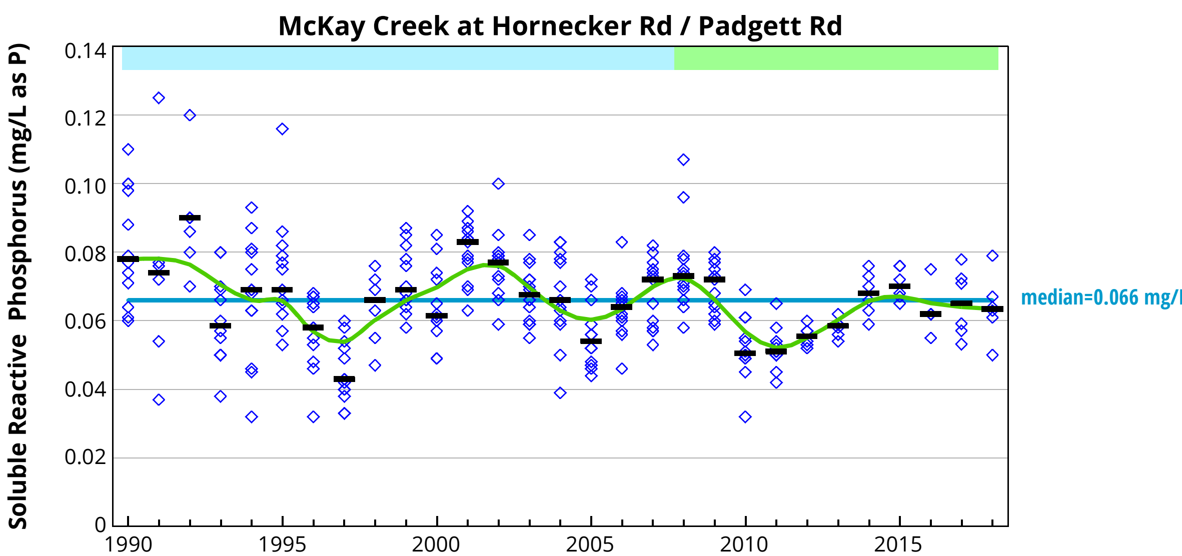
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONC. (mg/L as P) — MK-H / MK-P

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	25					0.031	0.027	0.100	0.064	0.093	0.063		
1991	14					0.022	0.040	0.063	0.057	0.101	0.070		
1992	22				0.019	0.025	0.050	0.083	0.105	0.090	0.075	0.035	0.030
1993	38	0.020	0.025	0.025	0.025	0.024	0.039	0.050	0.059	0.075	0.065	0.025	0.055
1994	26					0.027	0.042	0.066	0.069	0.084	0.078		
1995	27					0.025	0.032	0.060	0.066	0.082	0.060		
1996	25					0.024	0.031	0.053	0.067	0.054	0.044		
1997	26					0.025	0.033	0.041	0.056	0.038	0.020	0.021	
1998	13					0.020	0.027	0.051	0.069	0.072	0.045	0.036	
1999	26					0.019	0.044	0.062	0.076	0.074	0.055	0.040	
2000	27					0.025	0.041	0.061	0.060	0.070	0.049	0.032	
2001	29					0.040	0.067	0.087	0.074	0.084	0.076	0.052	
2002	30					0.029	0.049	0.077	0.075	0.083	0.071	0.055	0.043
2003	34	0.027	0.033	0.021	0.031	0.022	0.044	0.064	0.069	0.069	0.066		
2004	26					0.036	0.042	0.068	0.078	0.055	0.058	0.034	
2005	22					0.027	0.035	0.050	0.066	0.052	0.058		
2006	31					0.023	0.032	0.068	0.065	0.061	0.056	0.040	0.023
2007	39	0.029	0.023	0.021	0.021	0.026	0.047	0.071	0.072	0.067	0.058	0.031	0.030
2008	36	0.020	0.022	0.020	0.017	0.036	0.042	0.071	0.079	0.067	0.045	0.047	0.028
2009	38	0.029	0.022	0.022	0.015	0.035	0.057	0.076	0.073	0.062	0.055	0.050	0.061
2010	36	0.028	0.033	0.022	0.021	0.023	0.033	0.047	0.054	0.051	0.046	0.059	0.046
2011	39	0.029	0.030	0.035	0.020	0.024	0.029	0.048	0.053	0.052	0.061	0.046	0.023
2012	24	0.029	0.023	0.023	0.026	0.028	0.037	0.053	0.057	0.057	0.052	0.036	0.036
2013	23	0.027	0.022	0.022	0.023	0.038	0.043	0.060	0.057	0.058	0.037	0.056	0.025
2014	24	0.023	0.032	0.052	0.025	0.028	0.045	0.066	0.070	0.068	0.070	0.026	0.023
2015	22	0.025		0.024	0.023	0.036	0.065	0.074	0.071	0.068	0.062	0.048	0.049
2016	20	0.039	0.024	0.026	0.022	0.045	0.055	0.062	0.075	0.062	0.055	0.028	
2017	19		0.042	0.018	0.017	0.021	0.043	0.064	0.063	0.069	0.066	0.041	0.027
2018	23	0.026	0.021	0.021	0.021	0.036	0.049	0.073	0.057	0.062	0.063	0.055	0.032
POR Median		0.027	0.024	0.022	0.021	0.026	0.042	0.064	0.067	0.068	0.058	0.040	0.030

Key
SRP in mg/L as P
SRP ≤ 0.02
0.02 < SRP ≤ 0.03
0.03 < SRP ≤ 0.06
0.06 < SRP ≤ 0.08
SRP > 0.08

July-September trend (low-flow high-sunlight period)





Graph Key

- value
- Jul-Sep median
- Hornecker Rd site
- Padgett Rd site
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant
- TMDL loading capacity— acceptable range for summer median

Sampling frequency

- The period of record is January 1990 through present.
- The sampling frequency was mostly weekly for May–October and every two weeks for November–April. Since 2012, the May–October sampling frequency decreased to every two weeks.
- Sampling frequency likely was not adequate to fully characterize the conditions associated with high flows, especially in winter.
- The site location changed during 2003. The distance between the sites is about 1.2 miles. The data show no obvious difference between sites with regard to phosphorus.

Concentrations & trends

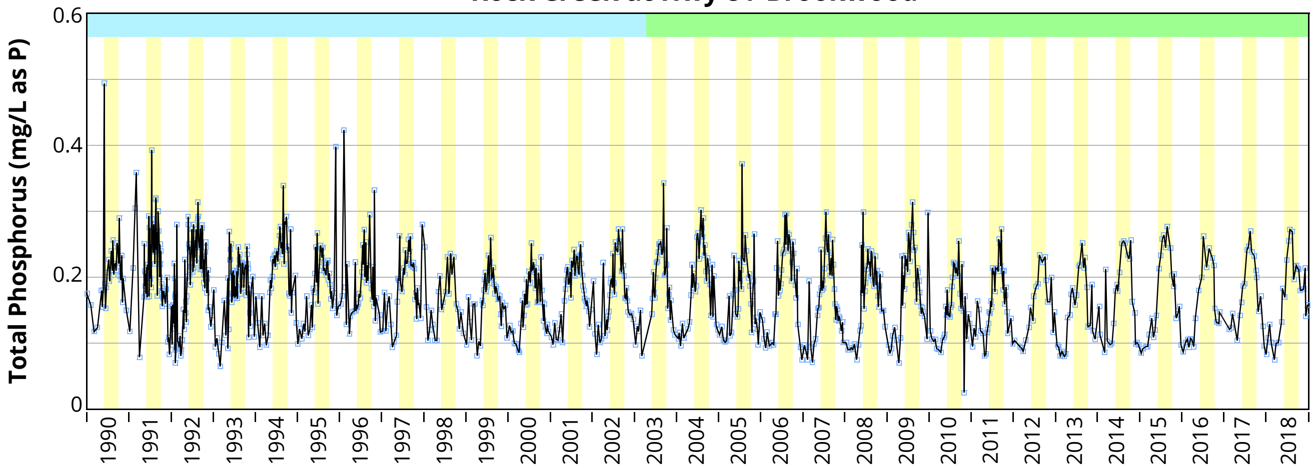
- Total phosphorus (TP) concentrations ranged from 0.025–0.49 mg/L with an annual median of 0.18 mg/L over the period of record.
- Median July–September TP concentrations were greater than the TMDL loading capacity concentration of 0.19 mg/L throughout the period of record.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.031–0.24 mg/L with an annual median of 0.10 mg/L over the period of record.
- Both TP and SRP concentrations show a distinct seasonal pattern that has been remarkably consistent over the nearly 30-year period of record. The minimum concentrations occur December–April, and the maximum in July–early September. The pattern is inversely related to streamflow which is consistent with soluble reactive phosphorus (SRP) entering the creek from groundwater. The difference between the pattern's minimum and maximum is the same for both TP and SRP, about 0.14–0.16 mg/L.
- The fraction of TP that was due to SRP had a similar pattern. SRP accounted for about 40–45% of the TP in December–April and about 70% of the TP in July–August.
- Very few spikes were superimposed on the TP pattern that could be attributed to an increase in the particulate form of phosphorus that was associated with storms. Because the high flows that trigger the concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency. No such spikes were observed since 2012 when the sampling frequency decreased to every two weeks.
- Neither July–September median concentrations of TP nor SRP show a trend. SRP concentrations appear to have a repeating pattern, with higher concentrations in 2002–2004 and 2015, and lower concentrations in 2010.

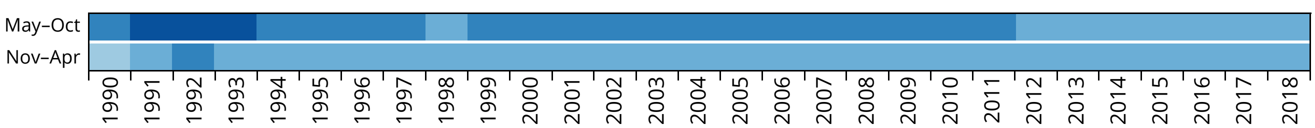
RCTV / RCBR – Rock Creek at Hwy 8 / Brookwood

Data source: Clean Water Services

Time series

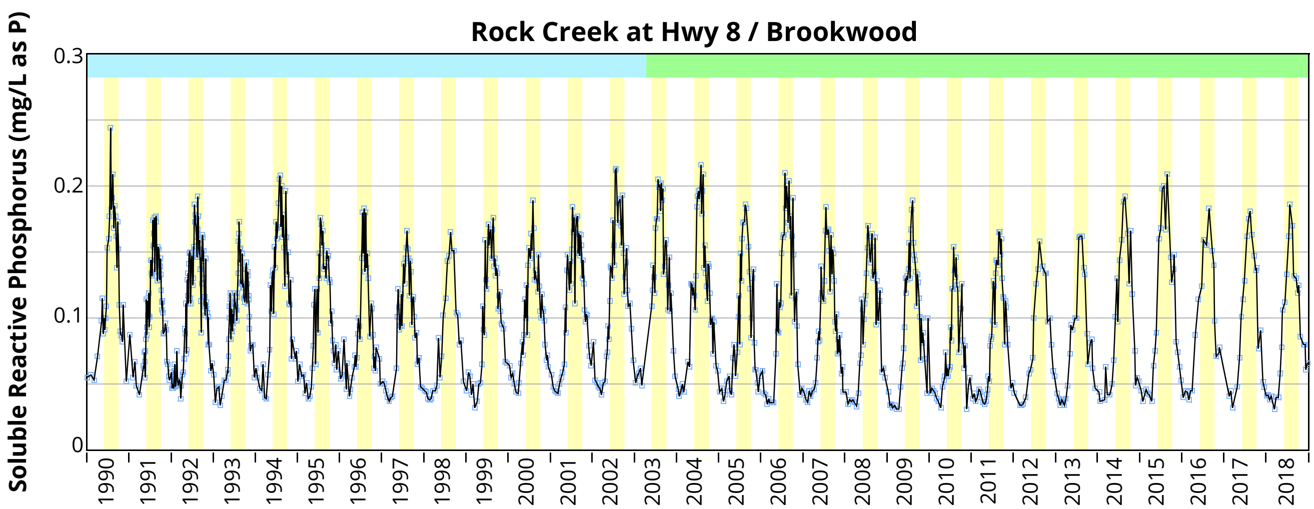
Rock Creek at Hwy 8 / Brookwood

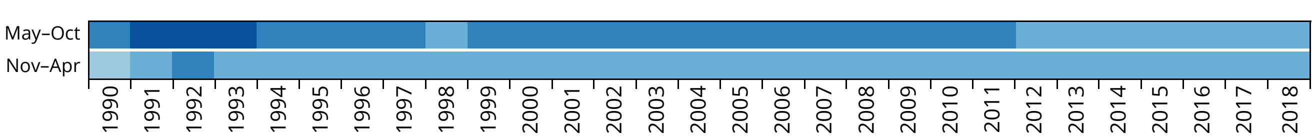




Nominal Sampling Frequency

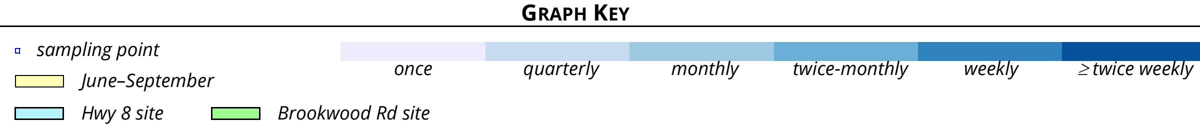
Rock Creek at Hwy 8 / Brookwood





Nominal Sampling Frequency

Graph Key



RCTV / RCBR – Rock Creek at Hwy 8 / Brookwood

Data source: Clean Water Services

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — RCTV / RCBR

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	31	0.175	0.158	0.118	0.124	0.181	0.188	0.227	0.215	0.233	0.221	0.180	0.150
1991	57	0.118	0.260	0.359	0.079	0.200	0.215	0.244	0.254	0.235	0.180	0.176	0.102
1992	83	0.158	0.122	0.097	0.121	0.183	0.241	0.238	0.256	0.257	0.227	0.187	0.134
1993	68	0.138	0.096	0.083	0.139	0.213	0.203	0.186	0.219	0.208	0.217	0.161	0.156
1994	39	0.151	0.133	0.121	0.105	0.196	0.227	0.239	0.253	0.283	0.208	0.177	0.167
1995	40	0.111	0.119	0.145	0.117	0.177	0.219	0.233	0.214	0.213	0.179	0.176	0.149
1996	36	0.166	0.185	0.167	0.144	0.153	0.165	0.234	0.209	0.245	0.183	0.152	0.130
1997	38	0.148	0.140	0.150	0.098	0.179	0.189	0.218	0.234	0.219	0.172	0.161	0.209
1998	23	0.201	0.112	0.139	0.104	0.190	0.157	0.205	0.204	0.231	0.155	0.135	0.115
1999	37	0.134	0.119	0.160	0.092	0.157	0.187	0.223	0.200	0.179	0.167	0.152	0.133
2000	39	0.122	0.110	0.094	0.108	0.158	0.194	0.211	0.213	0.178	0.163	0.125	0.123
2001	40	0.104	0.119	0.113	0.123	0.196	0.191	0.221	0.225	0.228	0.180	0.156	0.138
2002	38	0.154	0.106	0.104	0.136	0.144	0.195	0.217	0.255	0.214	0.169	0.145	0.141
2003	32	0.112	0.134	0.081		0.144	0.173	0.224	0.248	0.219	0.180	0.150	0.117
2004	38	0.112	0.113	0.108	0.127	0.195	0.195	0.258	0.261	0.217	0.182	0.202	0.124
2005	36	0.119	0.104	0.138	0.114	0.178	0.173	0.220	0.240	0.199	0.165	0.134	0.123
2006	39	0.121	0.105	0.098	0.100	0.172	0.195	0.240	0.265	0.233	0.218	0.169	0.085
2007	40	0.093	0.135	0.083	0.103	0.154	0.189	0.253	0.229	0.211	0.151	0.138	0.117
2008	37	0.096	0.092	0.095	0.087	0.152	0.186	0.219	0.218	0.209	0.180	0.150	0.125
2009	38	0.091	0.102	0.115	0.089	0.193	0.228	0.257	0.257	0.194	0.155	0.145	0.202
2010	37	0.113	0.105	0.092	0.095	0.128	0.144	0.193	0.210	0.175	0.154	0.139	0.137
2011	38	0.109	0.137	0.135	0.098	0.119	0.155	0.208	0.214	0.213	0.179	0.131	0.119
2012	20	0.104	0.095	0.091	0.105	0.139	0.153	0.188	0.234	0.227	0.179	0.182	0.132
2013	23	0.096	0.085	0.082	0.141	0.179	0.166	0.218	0.233	0.208	0.126	0.154	0.106
2014	23	0.135	0.086	0.158	0.099	0.155	0.184	0.229	0.254	0.231	0.210	0.123	0.099
2015	23	0.089	0.095	0.104	0.124	0.131	0.223	0.261	0.261	0.224	0.196	0.141	0.127
2016	19	0.094	0.100	0.106	0.117	0.180	0.231	0.215	0.244	0.224	0.143	0.139	
2017	20		0.122	0.145	0.104	0.152	0.189	0.244	0.254	0.221	0.174	0.149	0.090
2018	22	0.119	0.101	0.088	0.101	0.158	0.198	0.264	0.233	0.216	0.196	0.198	0.150
POR Median		0.118	0.112	0.108	0.105	0.172	0.189	0.224	0.234	0.219	0.179	0.152	0.129

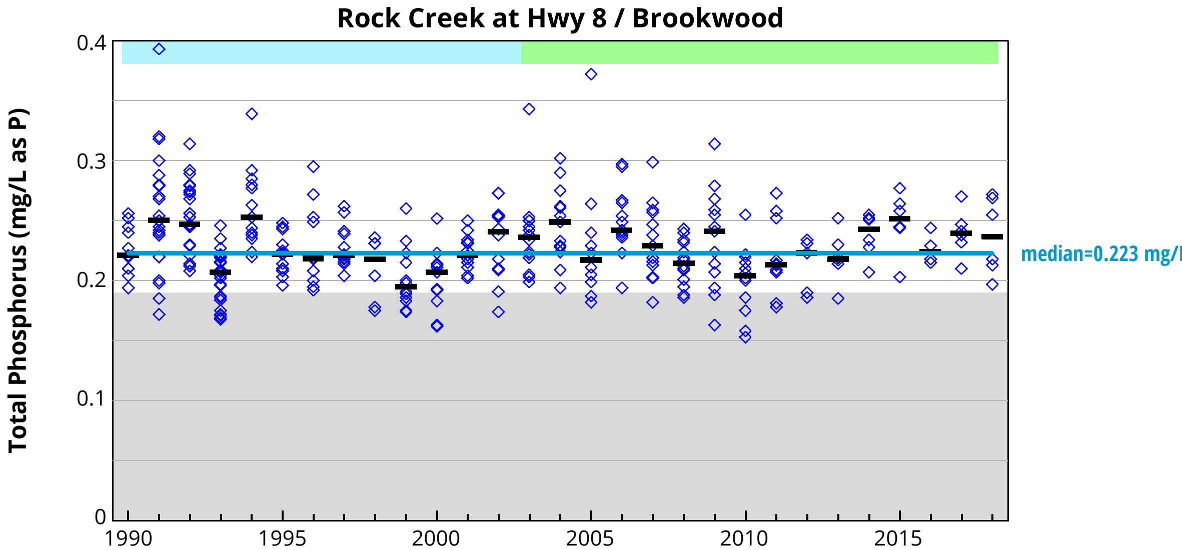
Key
total P in mg/L as P
TP ≤ 0.12
0.12 < TP ≤ 0.17
0.17 < TP ≤ 0.23
0.23 < TP ≤ 0.25
TP > 0.25

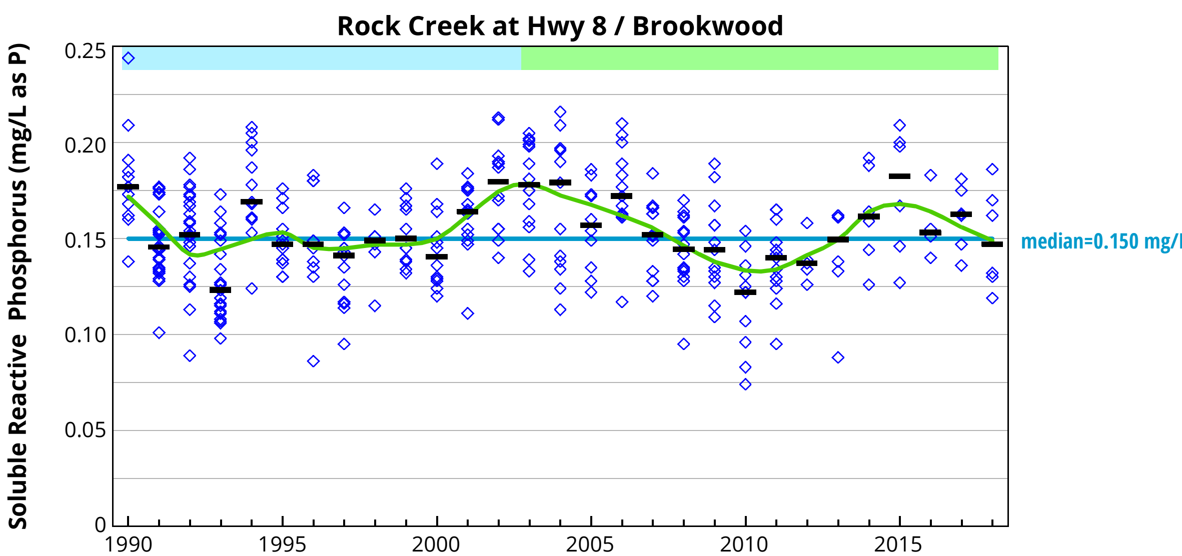
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONC. (mg/L as P) — RCTV / RCBR

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	32	0.055	0.057	0.053	0.071	0.099	0.105	0.180	0.188	0.168	0.090	0.096	0.052
1991	60	0.088	0.061	0.049	0.042	0.071	0.100	0.139	0.164	0.145	0.109	0.091	0.056
1992	83	0.054	0.053	0.051	0.059	0.111	0.145	0.163	0.158	0.142	0.130	0.103	0.063
1993	68	0.047	0.048	0.038	0.053	0.092	0.096	0.111	0.152	0.123	0.129	0.097	0.068
1994	39	0.059	0.046	0.053	0.048	0.125	0.146	0.178	0.178	0.157	0.122	0.084	0.072
1995	40	0.059	0.057	0.047	0.040	0.079	0.100	0.160	0.139	0.146	0.105	0.075	0.068
1996	36	0.056	0.056	0.054	0.051	0.067	0.091	0.165	0.144	0.108	0.087	0.069	0.060
1997	36	0.051	0.043	0.039	0.041	0.105	0.094	0.143	0.149	0.116	0.089	0.068	0.048
1998	23	0.045	0.039	0.042	0.047	0.070	0.087	0.129	0.151	0.151	0.103	0.082	0.052
1999	37	0.052	0.049	0.041	0.044	0.065	0.122	0.165	0.167	0.136	0.112	0.095	0.067
2000	39	0.060	0.054	0.044	0.059	0.087	0.133	0.151	0.136	0.126	0.105	0.080	0.068
2001	40	0.053	0.045	0.047	0.057	0.108	0.131	0.165	0.172	0.159	0.126	0.102	0.068
2002	38	0.068	0.050	0.045	0.052	0.089	0.139	0.184	0.188	0.163	0.131	0.110	0.080
2003	32	0.054	0.060	0.049		0.109	0.126	0.175	0.195	0.156	0.136	0.112	0.066
2004	38	0.044	0.047	0.044	0.065	0.124	0.132	0.197	0.179	0.129	0.109	0.097	0.062
2005	36	0.046	0.040	0.054	0.044	0.070	0.091	0.155	0.183	0.135	0.115	0.061	0.050
2006	38	0.052	0.039	0.038	0.036	0.090	0.112	0.163	0.189	0.165	0.132	0.094	0.045
2007	40	0.041	0.041	0.043	0.049	0.083	0.117	0.165	0.163	0.141	0.090	0.074	0.054
2008	37	0.040	0.038	0.037	0.038	0.089	0.105	0.153	0.148	0.133	0.107	0.061	0.055
2009	38	0.039	0.034	0.033	0.040	0.072	0.130	0.162	0.153	0.127	0.091	0.079	0.072
2010	37	0.045	0.044	0.038	0.040	0.056	0.062	0.122	0.131	0.096	0.081	0.055	0.052
2011	38	0.041	0.039	0.045	0.036	0.044	0.084	0.126	0.144	0.139	0.111	0.086	0.049
2012	20	0.043	0.034	0.035	0.040	0.060	0.085	0.132	0.158	0.137	0.116	0.090	0.058
2013	23	0.041	0.036	0.037	0.061	0.093	0.100	0.162	0.150	0.111	0.073	0.073	0.047
2014	23	0.041	0.038	0.053	0.046	0.085	0.114	0.152	0.190	0.145	0.142	0.062	0.054
2015	23	0.041	0.046	0.043	0.051	0.082	0.164	0.199	0.188	0.137	0.143	0.078	0.058
2016	18	0.043	0.041	0.045	0.087	0.114	0.142	0.155	0.183	0.146	0.085	0.076	
2017	20		0.043	0.032	0.048	0.086	0.121	0.169	0.172	0.142	0.107	0.071	0.044
2018	23	0.040	0.041	0.036	0.049	0.092	0.123	0.174	0.151	0.125	0.106	0.080	0.064
POR Median		0.046	0.044	0.044	0.048	0.087	0.114	0.162	0.163	0.139	0.109	0.080	0.058

Key
SRP in mg/L as P
SRP ≤ 0.04
0.04<SRP≤0.06
0.06 < SRP ≤ 0.14
0.14 < SRP ≤ 0.17
SRP > 0.17

July-September trend (low-flow high-sunlight period)





Graph Key

- value
- Jul-Sep median
- Hwy 8 site
- Brookwood site
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant
- TMDL loading capacity— acceptable range for summer median

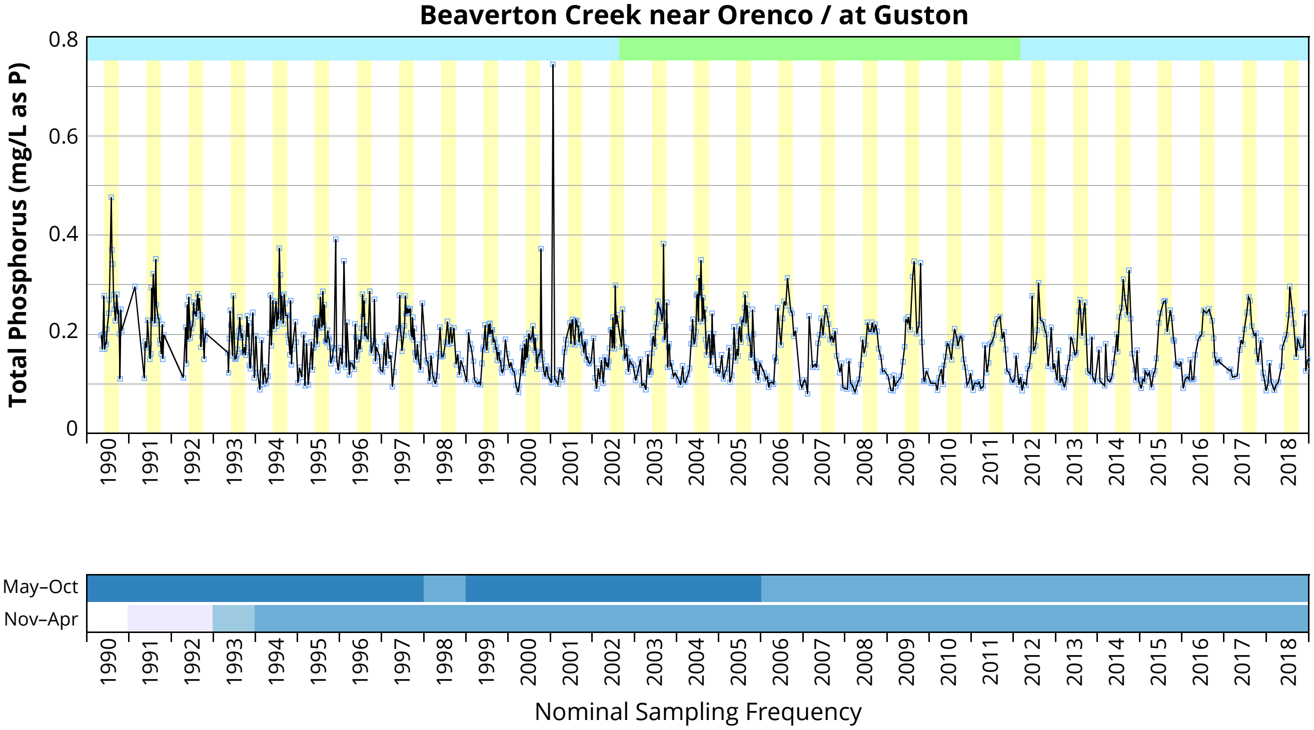
Sampling frequency & location

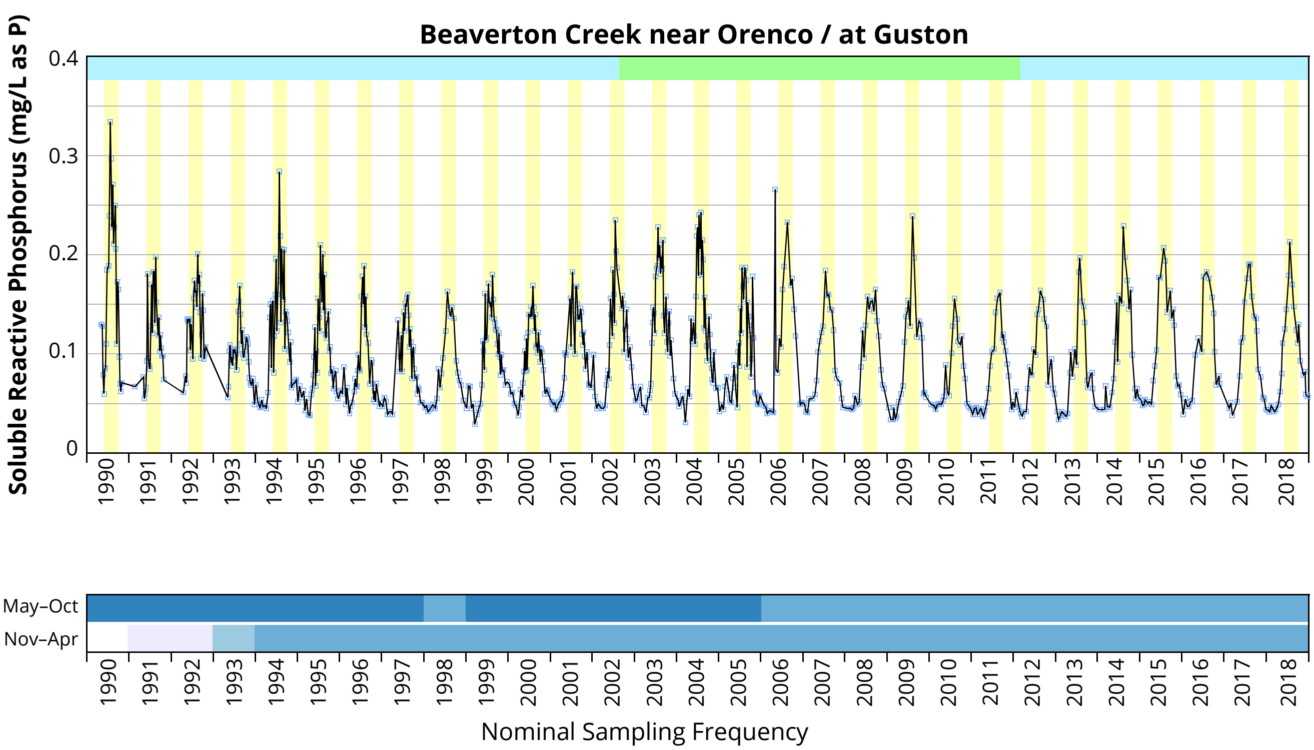
- The period of record is January 1990 through present.
- The sampling frequency was mostly weekly for May–October through 2005 and every two weeks since. Sampling frequency for November–April was very sparse through 1993 and about every two weeks since.
- Sampling frequency likely was not adequate to fully characterize the conditions associated with high flows, especially in winter.
- The site location changed twice. The distance between the sites is very small. The data show no obvious difference between sites with regard to phosphorus.

Concentrations & trends

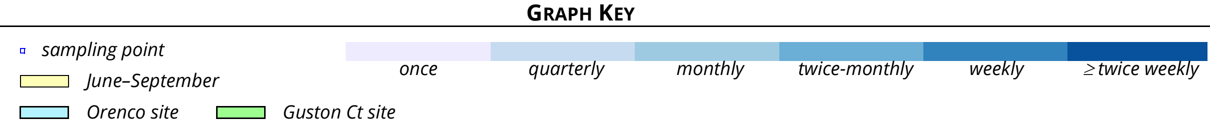
- Total phosphorus (TP) concentrations ranged from 0.08–0.74 mg/L with an annual median of 0.18 mg/L over the period of record.
- Median July–September TP concentrations were greater than the Rock Creek TMDL loading capacity concentration of 0.19 mg/L throughout the period of record.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.029–0.33 mg/L with an annual median of 0.10 mg/L over the period of record.
- Both TP and SRP concentrations show a distinct seasonal pattern that has been consistent over the period of record. The minimum concentrations occur December–April, and the maximum in July–early September. The pattern is inversely related to streamflow which is consistent with soluble reactive phosphorus (SRP) entering the creek from groundwater. The difference between the pattern's minimum and maximum is the same for both TP and SRP, about 0.14–0.17 mg/L.
- The fraction of TP that was due to SRP had a similar pattern: low in December–April (40–45%) and high in July–August (about 70%).
- Very few spikes were superimposed on the TP pattern that could be attributed to an increase in the particulate form of phosphorus that was associated with storms. Because the high flows that trigger the concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency. No such spikes were observed since 2012 when the sampling frequency decreased to every two weeks.
- Before 2006 when the sampling frequency was greater, both SRP and TP concentrations varied considerably within the seasonal pattern, making the graph appear "noisy". The cause of this variability is unknown. Because the variability in both SRP and TP was similar, it is consistent with inputs from stormwater inflows or tile drains. This variability has only been observed rarely since sampling has become less frequent.
- Neither July–September median concentrations of TP nor SRP show a trend. SRP concentrations appear to have a repeating pattern, with higher concentrations in 2003–2004 and lower concentrations in 2010.

Time series





Graph Key



MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — BVTS

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	24					0.199	0.182	0.270	0.312	0.249	0.207		
1991	24		0.296			0.173	0.180	0.227	0.271	0.209	0.180		
1992	26				0.112	0.202	0.216	0.244	0.262	0.215	0.196		
1993	31					0.177	0.197	0.154	0.207	0.169	0.194	0.151	0.178
1994	39	0.160	0.138	0.116	0.108	0.217	0.240	0.238	0.247	0.250	0.191	0.170	0.205
1995	40	0.118	0.156	0.139	0.117	0.174	0.216	0.227	0.219	0.191	0.151	0.173	0.139
1996	35	0.156	0.169	0.171	0.142	0.172	0.172	0.252	0.196	0.239	0.176	0.160	0.142
1997	36	0.154	0.168	0.154	0.109	0.213	0.201	0.229	0.248	0.203	0.162	0.153	0.196
1998	23	0.170	0.125	0.138	0.108	0.187	0.156	0.205	0.182	0.213	0.150	0.133	0.132
1999	37	0.154	0.176	0.127	0.102	0.141	0.180	0.220	0.201	0.172	0.156	0.131	0.176
2000	38	0.139	0.125	0.090	0.110	0.149	0.182	0.193	0.188	0.153	0.163	0.125	0.122
2001	35	0.424	0.108	0.114	0.117	0.172	0.202	0.213	0.223	0.200	0.181	0.149	0.144
2002	34	0.152	0.111	0.129	0.135	0.145	0.209	0.220		0.204	0.155	0.135	0.139
2003	38	0.114	0.141	0.099	0.124	0.126	0.185	0.245	0.244	0.216	0.178	0.139	0.119
2004	39	0.108	0.117	0.105	0.125	0.200	0.205	0.296	0.250	0.182	0.171	0.201	0.128
2005	38	0.139	0.117	0.151	0.110	0.170	0.189	0.211	0.254	0.195	0.180	0.126	0.124
2006	22	0.123	0.113	0.098	0.102	0.154	0.193	0.250	0.286	0.246	0.202		0.098
2007	22	0.105	0.159	0.134	0.137	0.191	0.215	0.246	0.205	0.190	0.182	0.132	0.092
2008	23	0.118	0.100	0.087	0.105	0.165	0.170	0.215	0.215	0.212	0.189	0.140	0.127
2009	23	0.101	0.102	0.098	0.112	0.160	0.227	0.222	0.332	0.210	0.264	0.106	0.127
2010	23	0.101	0.101	0.100	0.115	0.147	0.179	0.166	0.201	0.186	0.171	0.115	0.114
2011	23	0.094	0.101	0.098	0.137	0.133	0.182	0.210	0.234	0.191	0.187	0.125	0.105
2012	24	0.134	0.106	0.095	0.114	0.153	0.222	0.193	0.267	0.219	0.168	0.193	0.135
2013	23	0.137	0.107	0.100	0.143	0.191	0.161	0.258	0.222	0.224	0.123	0.155	0.104
2014	23	0.138	0.096	0.146	0.110	0.156	0.183	0.245	0.292	0.284	0.196	0.118	0.138
2015	23	0.100	0.116	0.120	0.106	0.139	0.233	0.266	0.237	0.241	0.188	0.140	0.141
2016	19	0.101	0.111	0.129	0.135	0.192	0.225	0.243	0.251	0.210	0.151	0.147	
2017	20		0.128	0.113	0.116	0.179	0.195	0.260	0.242	0.200	0.155	0.156	0.099
2018	22	0.122	0.104	0.093	0.103	0.155	0.195	0.268	0.236	0.172	0.180	0.208	0.138
POR Median		0.129	0.116	0.114	0.113	0.172	0.195	0.229	0.239	0.209	0.180	0.140	0.132

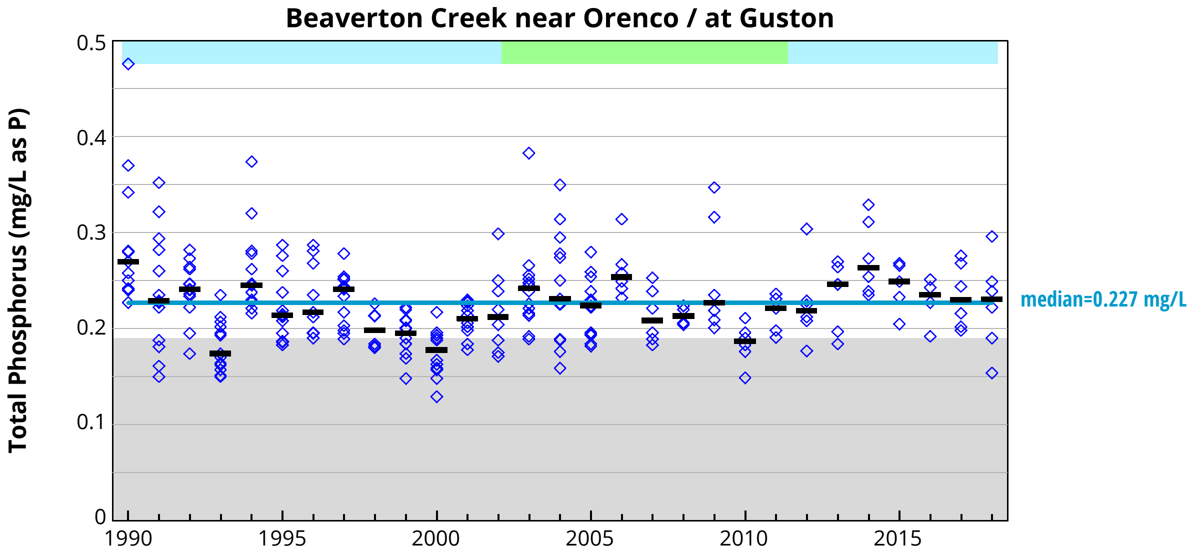
Key
total P in mg/L as P
TP ≤ 0.12
0.12 < TP ≤ 0.16
0.16 < TP ≤ 0.23
0.23 < TP ≤ 0.25
TP > 0.25

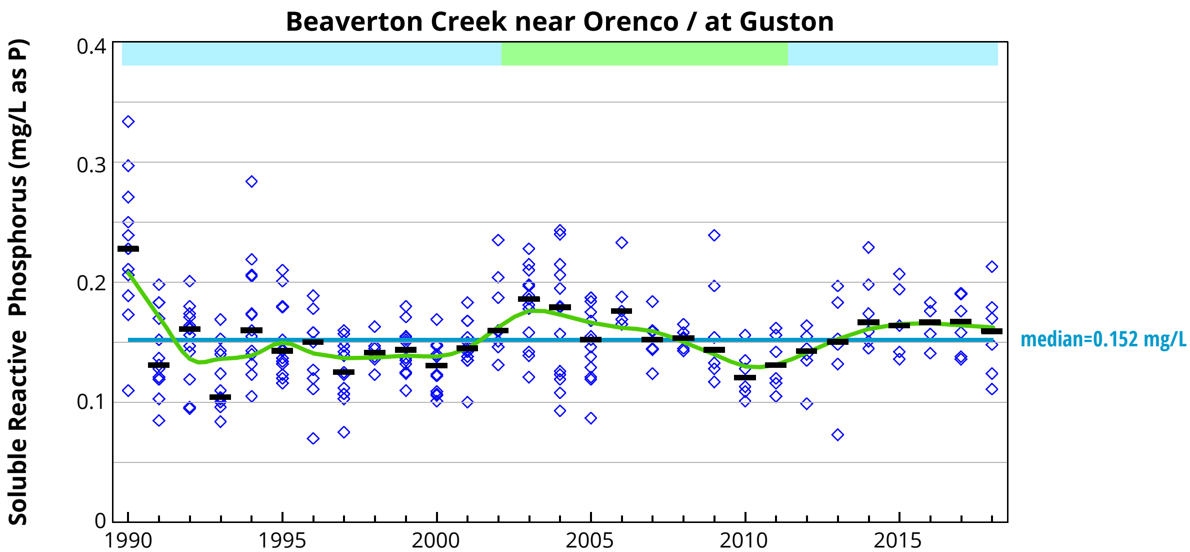
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — BVTS

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	25					0.104	0.098	0.268	0.228	0.190	0.071		
1991	26		0.067			0.063	0.095	0.128	0.168	0.119	0.098		
1992	26				0.061	0.106	0.133	0.159	0.171	0.131	0.104		
1993	32					0.085	0.097	0.102	0.143	0.102	0.113	0.074	0.062
1994	39	0.061	0.050	0.048	0.053	0.150	0.139	0.167	0.173	0.142	0.113	0.069	0.073
1995	40	0.060	0.060	0.049	0.039	0.079	0.092	0.158	0.152	0.133	0.085	0.076	0.059
1996	35	0.062	0.062	0.053	0.049	0.068	0.084	0.168	0.127	0.091	0.070	0.061	0.049
1997	34	0.052	0.046	0.042	0.039	0.124	0.090	0.145	0.148	0.107	0.077	0.064	0.051
1998	23	0.047	0.043	0.048	0.050	0.076	0.088	0.143	0.145	0.136	0.087	0.071	0.053
1999	37	0.057	0.056	0.040	0.042	0.069	0.114	0.154	0.152	0.125	0.099	0.084	0.071
2000	38	0.065	0.056	0.043	0.055	0.082	0.119	0.138	0.140	0.108	0.092	0.062	0.062
2001	35	0.051	0.048	0.050	0.057	0.099	0.132	0.149	0.159	0.140	0.109	0.097	0.068
2002	34	0.078	0.048	0.046	0.048	0.080	0.148	0.187		0.151	0.125	0.102	0.077
2003	38	0.054	0.064	0.048	0.049	0.067	0.137	0.189	0.192	0.142	0.122	0.106	0.068
2004	39	0.050	0.055	0.041	0.061	0.127	0.158	0.223	0.180	0.114	0.107	0.074	0.066
2005	38	0.046	0.056	0.069	0.052	0.076	0.095	0.157	0.175	0.134	0.106	0.060	0.054
2006	21	0.048	0.044	0.043	0.042	0.085	0.112	0.177	0.233	0.173	0.132		0.050
2007	22	0.046	0.048	0.055	0.066	0.108	0.125	0.172	0.153	0.134	0.079	0.063	0.046
2008	23	0.045	0.045	0.052	0.051	0.106	0.113	0.152	0.154	0.154	0.126	0.077	0.065
2009	23	0.040	0.040	0.036	0.056	0.090	0.141	0.141	0.218	0.125	0.123	0.061	0.056
2010	23	0.049	0.046	0.050	0.051	0.073	0.061	0.115	0.146	0.111	0.103	0.063	0.046
2011	24	0.042	0.043	0.044	0.040	0.058	0.095	0.124	0.159	0.118	0.108	0.084	0.048
2012	24	0.054	0.044	0.040	0.054	0.083	0.092	0.120	0.155	0.145	0.099	0.092	0.063
2013	23	0.038	0.040	0.038	0.061	0.090	0.097	0.190	0.151	0.103	0.073	0.073	0.047
2014	23	0.044	0.044	0.058	0.054	0.094	0.122	0.155	0.214	0.160	0.132	0.060	0.061
2015	23	0.051	0.052	0.051	0.061	0.096	0.177	0.207	0.168	0.150	0.137	0.073	0.064
2016	18	0.047	0.047	0.053	0.099	0.116	0.140	0.183	0.176	0.149	0.086	0.074	
2017	20		0.048	0.038	0.052	0.095	0.134	0.183	0.175	0.137	0.104	0.067	0.049
2018	23	0.043	0.048	0.043	0.056	0.096	0.135	0.196	0.159	0.118	0.112	0.081	0.058
POR Median		0.050	0.048	0.048	0.053	0.090	0.114	0.158	0.159	0.134	0.104	0.073	0.059

Key
SRP in mg/L as P
SRP ≤ 0.04
0.04<SRP≤0.06
0.06 < SRP ≤ 0.14
0.14 < SRP ≤ 0.17
SRP > 0.17

July-September trend (low-flow high-sunlight period)





Graph Key

- value
- Jul-Sep median
- Orenco site
- Guston site
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant
- TMDL loading capacity— acceptable range for summer median

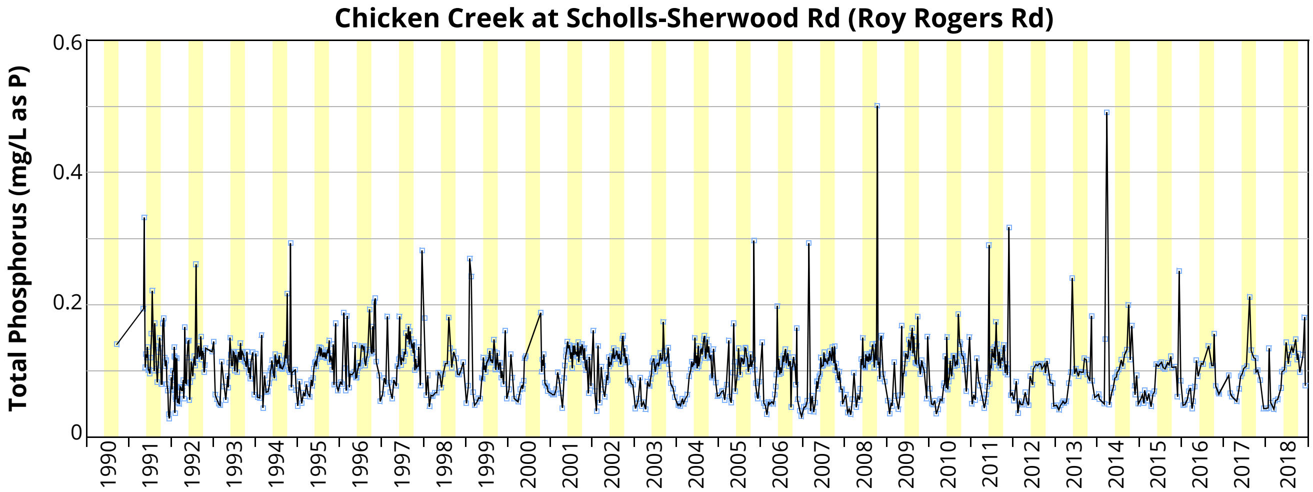
Sampling frequency

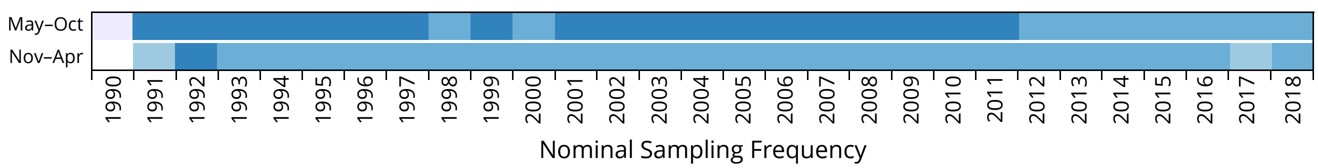
- The period of record is effectively May 1991 through present. Only two samples were collected in 1990.
- The sampling frequency was mostly weekly for May–October and every two weeks for November–April. Since 2012, the May–October sampling frequency decreased to every two weeks.
- Sampling frequency likely was not adequate to fully characterize the conditions associated with high flows, especially in winter.

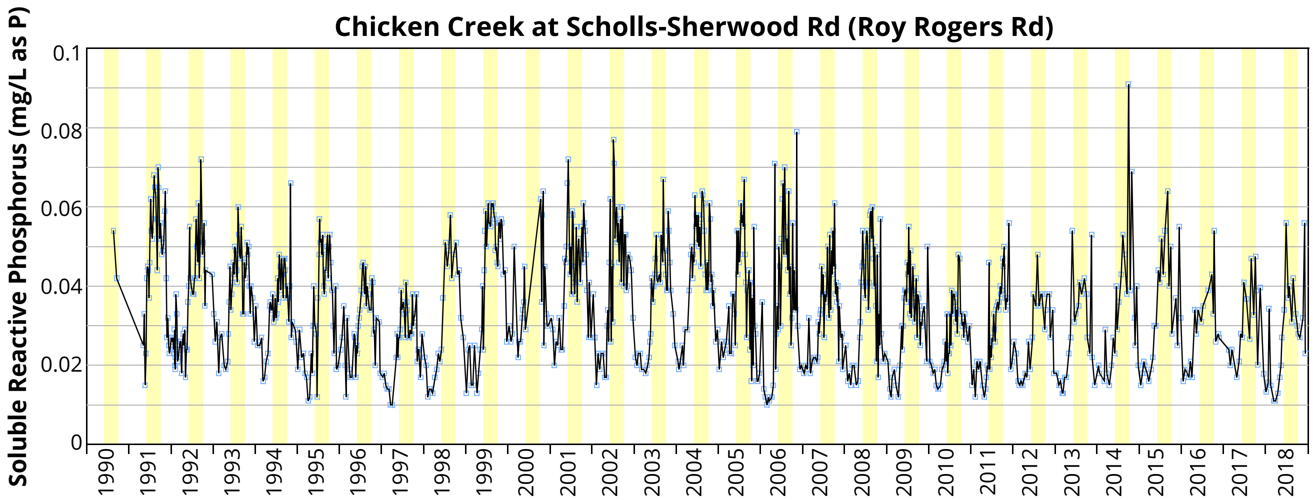
Concentrations & trends

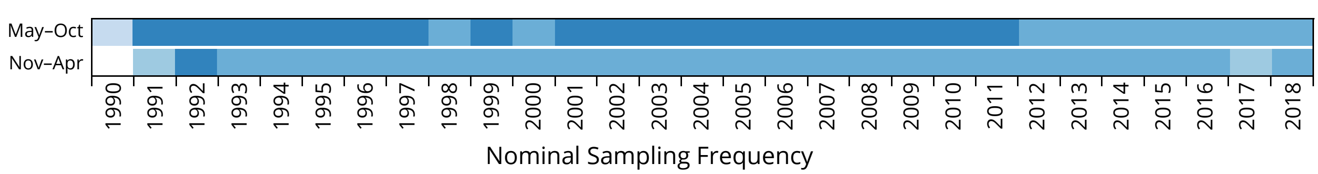
- Total phosphorus (TP) concentrations ranged from 0.03–0.50 mg/L with an annual median of 0.11 mg/L over the period of record.
- Median July–September TP concentrations were less than the TMDL loading capacity concentration of 0.14 mg/L throughout the period of record.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.010–0.091 mg/L with an annual median of 0.034 mg/L over the period of record.
- Both TP and SRP concentrations show a seasonal pattern that has been consistent over period of the record. The minimum concentrations occur January–April, and the maximum in July–early October. The pattern is consistent with soluble reactive phosphorus (SRP) entering the creek from groundwater. The difference between the pattern's minimum and maximum is on the order of 0.10 mg/L for TP and 0.04 mg/L for SRP.
- The fraction of TP that was due to SRP was unusual in that its seasonal pattern was minimal. SRP accounted for about 30–34% of the TP in December–April and about 38% of the TP in July–August. The relatively low fractional contribution of SRP in the summer despite the clear seasonal pattern associated with groundwater, suggests that some dissolved phosphorus in groundwater may become associated with particles when it enters Chicken Creek.
- Several spikes were superimposed on the TP pattern that could be attributed to an increase in the particulate form of phosphorus that was associated with storms. These spikes did not exhibit coincident spikes in SRP. Because the high flows that trigger the concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency.
- TP, and especially SRP, concentrations varied considerably within the seasonal pattern, making the graph appear "noisy". The cause of this variability is unknown. Because the variability in both SRP and TP was similar, it is consistent with inputs from stormwater inflows or tile drains. This variability has become less obvious since 2012 when sampling became less frequent.
- July–September median concentrations of TP did not show a trend.
- July–September median concentrations of SRP show a statistically significant decreasing trend, but it may not persist over time. SRP appears to have a repeating pattern, with higher concentrations in 2002 and 2004, and lower concentrations in 1997 and 2010.

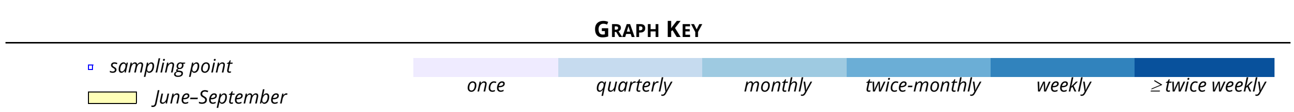
TIME SERIES


Chicken Creek at Scholls-Sherwood Rd (Roy Rogers Rd)
Total Phosphorus (mg/L as P)
0
0.2
0.4
0.6
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018


May–Oct
Nov–Apr
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Nominal Sampling Frequency


Chicken Creek at Scholls-Sherwood Rd (Roy Rogers Rd)
Soluble Reactive Phosphorus (mg/L as P)
0
0.02
0.04
0.06
0.08
0.1
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018


May–Oct
Nov–Apr
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Nominal Sampling Frequency


GRAPH KEY
sampling point
June–September
once
quarterly
monthly
twice-monthly
weekly
≥ twice weekly

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — 14206750

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	1									0.140			
1991	32					0.160	0.111	0.138	0.124	0.115	0.134	0.112	0.034
1992	50	0.100	0.065	0.067	0.070	0.101	0.099	0.110	0.134	0.123	0.118		0.129
1993	40	0.104	0.054	0.081	0.066	0.102	0.124	0.110	0.122	0.125	0.112	0.101	0.096
1994	39	0.093	0.107	0.069	0.069	0.104	0.106	0.114	0.104	0.118	0.107	0.098	0.087
1995	40	0.066	0.059	0.071	0.063	0.089	0.116	0.133	0.125	0.127	0.115	0.140	0.075
1996	36	0.082	0.104	0.129	0.095	0.095	0.106	0.138	0.117	0.163	0.129	0.162	0.074
1997	37	0.077	0.131	0.075	0.072	0.107	0.120	0.127	0.148	0.139	0.112	0.107	0.180
1998	23	0.122	0.070	0.063	0.067	0.095	0.085	0.111	0.134	0.129	0.107	0.097	0.113
1999	37	0.065	0.257	0.058	0.056	0.088	0.108	0.120	0.117	0.118	0.112	0.089	0.110
2000	21	0.099	0.074	0.053	0.067	0.085					0.113	0.082	0.073
2001	40	0.065	0.068	0.092	0.055	0.122	0.133	0.128	0.127	0.126	0.133	0.101	0.099
2002	39	0.115	0.089	0.079	0.072	0.100	0.117	0.124	0.121	0.135	0.121	0.087	0.080
2003	38	0.047	0.074	0.050	0.063	0.083	0.114	0.109	0.118	0.120	0.120	0.088	0.067
2004	39	0.049	0.053	0.054	0.078	0.109	0.112	0.124	0.136	0.127	0.123	0.092	0.072
2005	39	0.066	0.063	0.113	0.057	0.106	0.110	0.117	0.122	0.108	0.115	0.092	0.071
2006	39	0.097	0.041	0.052	0.052	0.094	0.101	0.119	0.121	0.110	0.110	0.079	0.036
2007	40	0.046	0.174	0.051	0.045	0.085	0.108	0.117	0.120	0.122	0.101	0.086	0.061
2008	38	0.051	0.038	0.077	0.054	0.091	0.107	0.122	0.123	0.120	0.111	0.150	0.084
2009	38	0.045	0.050	0.088	0.053	0.096	0.122	0.144	0.140	0.112	0.107	0.105	0.105
2010	37	0.062	0.052	0.039	0.056	0.079	0.092	0.106	0.112	0.143	0.123	0.086	0.128
2011	39	0.057	0.088	0.082	0.052	0.070	0.107	0.122	0.129	0.116	0.122	0.104	0.065
2012	24	0.070	0.045	0.049	0.061	0.070	0.091	0.109	0.111	0.107	0.106	0.087	0.064
2013	23	0.045	0.050	0.053	0.068	0.169	0.100	0.096	0.098	0.118	0.090	0.134	0.060
2014	23	0.061	0.050	0.320	0.058	0.082	0.095	0.110	0.116	0.166	0.143	0.071	0.072
2015	23	0.061	0.061	0.061	0.056	0.090	0.109	0.109	0.108	0.116	0.105	0.084	0.168
2016	19	0.049	0.063	0.059	0.065	0.104	0.111		0.138	0.108	0.117	0.067	
2017	18		0.080	0.061	0.054	0.083	0.100	0.107	0.172	0.120	0.100	0.086	0.043
2018	21	0.089	0.052	0.049	0.057	0.087	0.123	0.118	0.132	0.133	0.112	0.153	0.078
POR Median		0.065	0.063	0.063	0.061	0.094	0.108	0.117	0.122	0.121	0.112	0.092	0.075

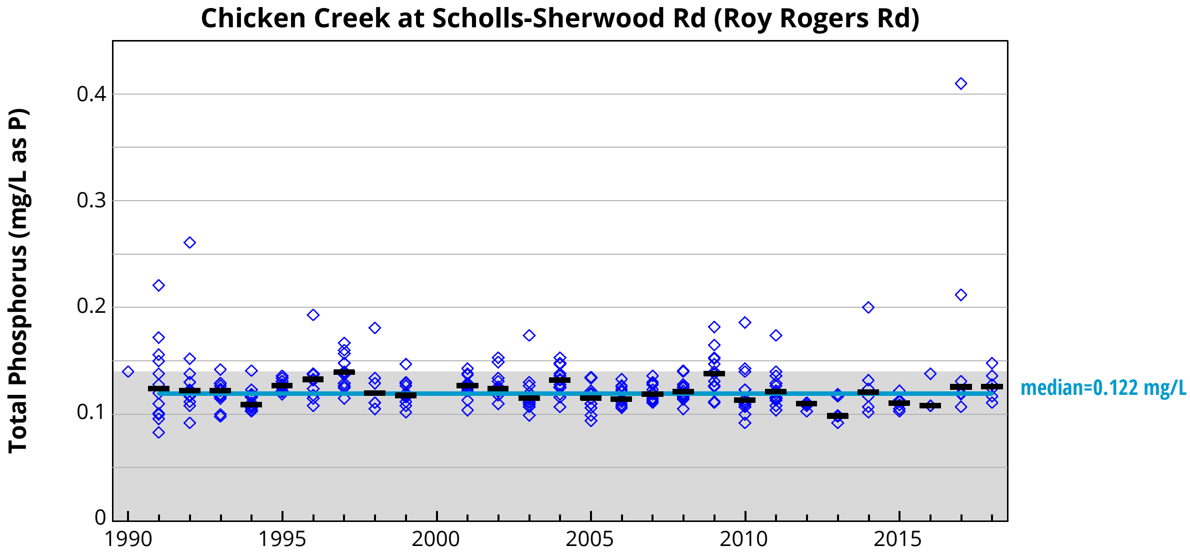
Key
total P in mg/L as P
TP ≤ 0.07
0.07 < TP ≤ 0.10
0.10 < TP ≤ 0.13
0.13 < TP ≤ 0.15
TP > 0.15

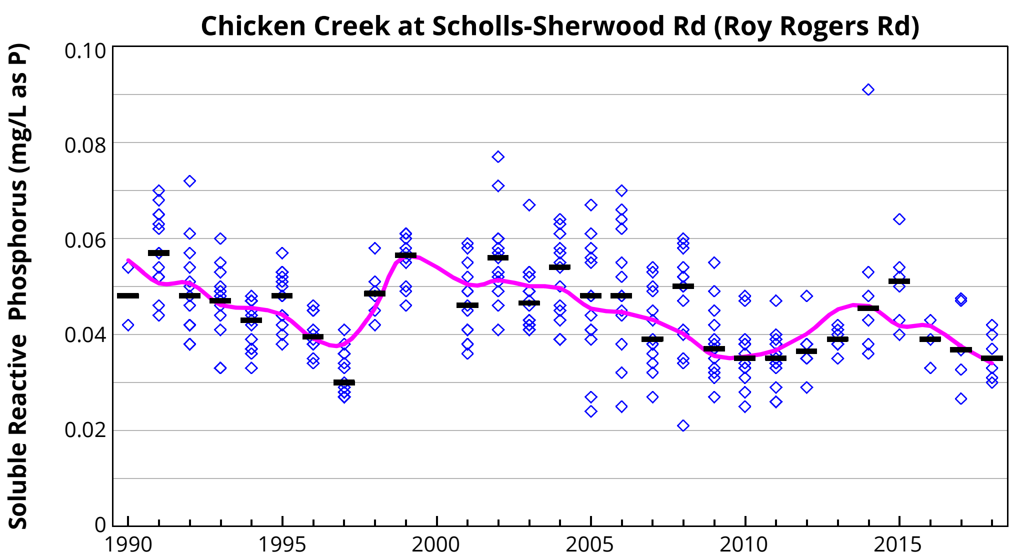
MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — 14206750

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	2								0.054	0.042			
1991	33					0.024	0.043	0.054	0.064	0.059	0.051	0.051	0.025
1992	50	0.027	0.022	0.025	0.025	0.024	0.041	0.040	0.054	0.051	0.048		0.043
1993	40	0.030	0.025	0.028	0.020	0.032	0.041	0.047	0.053	0.040	0.047	0.040	0.032
1994	39	0.030	0.026	0.017	0.022	0.035	0.032	0.039	0.043	0.046	0.039	0.031	0.028
1995	40	0.024	0.023	0.018	0.012	0.030	0.029	0.052	0.044	0.047	0.046	0.030	0.020
1996	36	0.026	0.020	0.026	0.017	0.026	0.031	0.043	0.039	0.036	0.034	0.026	0.025
1997	36	0.018	0.015	0.012	0.010	0.025	0.032	0.035	0.031	0.029	0.033	0.024	0.023
1998	23	0.021	0.013	0.014	0.018	0.022	0.031	0.048	0.049	0.048	0.047	0.038	0.027
1999	37	0.019	0.020	0.020	0.016	0.029	0.050	0.056	0.060	0.050	0.054	0.056	0.035
2000	21	0.028	0.039	0.022	0.026	0.034					0.060	0.033	0.030
2001	40	0.031	0.023	0.029	0.024	0.047	0.054	0.041	0.047	0.048	0.055	0.039	0.034
2002	39	0.033	0.019	0.021	0.017	0.032	0.038	0.060	0.052	0.053	0.040	0.048	0.038
2003	38	0.021	0.023	0.019	0.019	0.027	0.040	0.042	0.048	0.049	0.047	0.043	0.029
2004	39	0.020	0.023	0.025	0.034	0.048	0.055	0.053	0.061	0.041	0.050	0.039	0.028
2005	39	0.023	0.023	0.031	0.023	0.036	0.050	0.057	0.048	0.040	0.029	0.029	0.017
2006	39	0.025	0.011	0.012	0.014	0.029	0.048	0.064	0.052	0.035	0.039	0.034	0.020
2007	40	0.019	0.026	0.020	0.022	0.028	0.041	0.037	0.039	0.047	0.040	0.027	0.024
2008	38	0.021	0.017	0.020	0.016	0.036	0.043	0.050	0.059	0.040	0.029	0.028	0.023
2009	38	0.018	0.015	0.017	0.016	0.030	0.039	0.041	0.038	0.037	0.031	0.034	0.036
2010	37	0.021	0.019	0.015	0.017	0.021	0.023	0.036	0.034	0.047	0.031	0.031	0.028
2011	39	0.017	0.017	0.020	0.014	0.018	0.025	0.028	0.035	0.040	0.041	0.037	0.020
2012	24	0.025	0.016	0.016	0.018	0.023	0.033	0.042	0.037	0.034	0.036	0.033	0.026
2013	23	0.017	0.015	0.015	0.020	0.041	0.032	0.038	0.039	0.040	0.025	0.038	0.015
2014	23	0.019	0.016	0.024	0.018	0.025	0.035	0.040	0.051	0.065	0.054	0.029	0.030
2015	23	0.017	0.021	0.017	0.021	0.030	0.043	0.048	0.059	0.045	0.028	0.031	0.044
2016	18	0.018	0.018	0.019	0.034	0.031	0.033		0.039	0.038	0.040	0.028	
2017	18		0.022	0.024	0.017	0.025	0.034	0.037	0.037	0.040	0.030	0.040	0.016
2018	22	0.025	0.015	0.011	0.015	0.024	0.045	0.039	0.037	0.032	0.028	0.044	0.023
POR Median		0.021	0.020	0.020	0.018	0.029	0.039	0.042	0.047	0.042	0.040	0.034	0.027

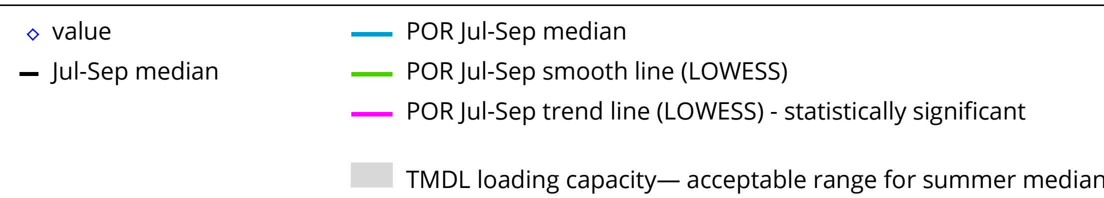
Key
SRP in mg/L as P
SRP ≤ 0.02
0.02 < SRP ≤ 0.03
0.03 < SRP ≤ 0.045
0.045<SRP≤0.055
SRP > 0.055

July-September trend (low-flow high-sunlight period)





Graph Key



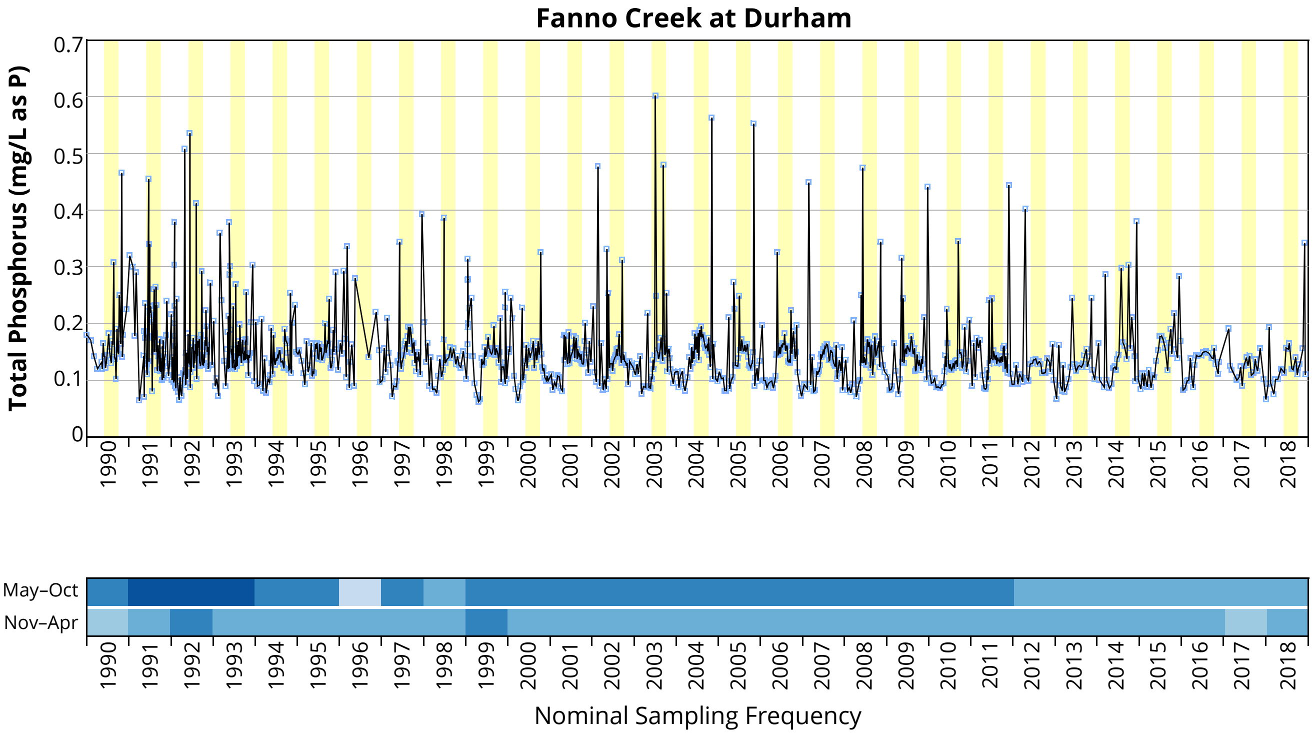
SAMPLING FREQUENCY

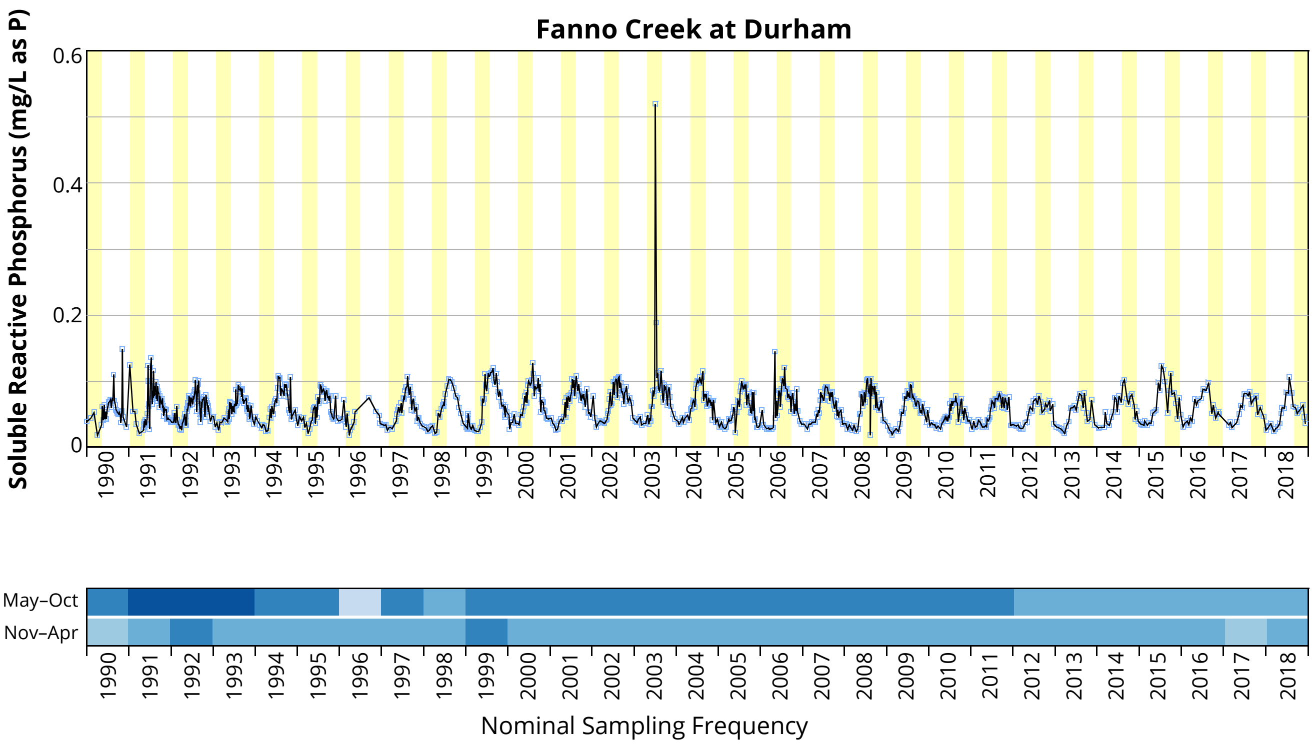
- The period of record is January 1990 through present.
- The sampling frequency was mostly weekly for May–October and every two weeks for November–April. Since 2012, the May–October sampling frequency decreased to every two weeks.
- Except for a brief time in May–October 1991–1993, sampling frequency likely was not adequate to fully characterize the conditions associated with high flows.

CONCENTRATIONS & TRENDS

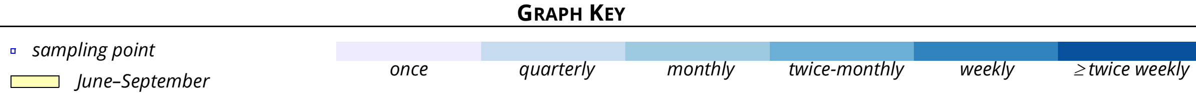
- Total phosphorus (TP) concentrations ranged from 0.062–0.60 mg/L with an annual median of 0.14 mg/L over the period of record.
- Median July–September TP concentrations were greater than the TMDL loading capacity concentration of 0.13 mg/L throughout the period of record.
- Soluble reactive phosphorus (SRP) concentrations ranged from 0.018–0.52 mg/L with an annual median of 0.062 mg/L over the period of record.
- TP concentrations show a distinct, but noisy, seasonal baseline pattern superimposed with numerous spikes.
- The baseline TP pattern generally was lowest around April, increased to a maximum in late summer, and then decreased slowly through late fall and into winter. This pattern is consistent with soluble reactive phosphorus (SRP) entering the creek from groundwater. The difference between the pattern's minimum and maximum is on the order of 0.1 mg/L.
- Unlike other sites, TP concentration spikes at Fanno Creek occurred throughout the year and were not predominantly in fall or winter. Fanno Creek also appears to have more frequent concentration spikes than other tributary sites. In most, but not all, cases, SRP remained at baseline levels, suggesting that the spike was related to an increase in the particulate form of phosphorus that occurred during or shortly after storms. The timing and prevalence of TP spikes at this site may be due to the extreme flashy nature of this highly urban stream.
- Because the high flows that trigger the concentration spikes are shorter-lived than the usual sampling frequency, the data likely under-represent spike frequency, especially during winter and since 2012 when sampling frequency decreased to twice a month.
- The largest TP spike was on July 1, 2003 and was coincident with an extremely large SRP spike. In this instance, SRP accounts for more than 80% of the TP. Elevated SRP and TP concentrations persisted when the next sample was obtained a week later. The cause is unknown, but the behavior suggests some sort of unusual discharge into Fanno Creek. This site is an urban/industrial area and unusual discharges have been observed historically in specific conductance data from continuous monitors.
- SRP concentrations have a clear seasonal pattern that is lowest in April and highest in July–August, suggesting that a groundwater source may be important.
- In July–October, SRP accounts for about 58% of the TP.
- Neither July–September median concentrations of TP nor SRP show a trend.

Time series





Graph Key



FANO – Fanno Creek at Durham – 14206950

Data source: Clean Water Services

MEDIAN MONTHLY TOTAL PHOSPHORUS CONCENTRATION (mg/L as P) — 14206950

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	31	0.180	0.170	0.142	0.120	0.137	0.138	0.151	0.166	0.145	0.190	0.161	0.225
1991	57	0.320	0.239	0.290	0.064	0.175	0.133	0.206	0.182	0.130	0.127	0.163	0.124
1992	83	0.200	0.121	0.081	0.110	0.124	0.132	0.145	0.158	0.134	0.145	0.155	0.200
1993	68	0.147	0.088	0.301	0.112	0.199	0.146	0.125	0.152	0.148	0.145	0.142	0.201
1994	39	0.146	0.150	0.110	0.090	0.111	0.137	0.142	0.132	0.170	0.134	0.201	0.192
1995	40	0.149	0.123	0.130	0.120	0.115	0.160	0.154	0.144	0.160	0.136	0.188	0.136
1996	15	0.156	0.173	0.212	0.148	0.185				0.140		0.220	0.125
1997	38	0.129	0.162	0.137	0.080	0.115	0.137	0.158	0.171	0.168	0.140	0.141	0.252
1998	26	0.167	0.128	0.112	0.081	0.123	0.131	0.134	0.141	0.156	0.136	0.124	0.151
1999	46	0.197	0.236	0.118	0.068	0.127	0.142	0.156	0.150	0.148	0.148	0.123	0.131
2000	40	0.154	0.158	0.074	0.080	0.130	0.147	0.148	0.157	0.147	0.146	0.104	0.104
2001	40	0.097	0.093	0.107	0.083	0.143	0.141	0.150	0.160	0.144	0.131	0.140	0.151
2002	39	0.172	0.287	0.128	0.084	0.188	0.129	0.141	0.150	0.139	0.133	0.113	0.125
2003	38	0.120	0.127	0.083	0.153	0.089	0.128	0.152	0.160	0.151	0.153	0.129	0.104
2004	39	0.101	0.112	0.087	0.123	0.141	0.154	0.180	0.176	0.158	0.149	0.164	0.100
2005	39	0.109	0.093	0.146	0.092	0.176	0.132	0.157	0.153	0.134	0.130	0.113	0.116
2006	39	0.149	0.093	0.096	0.093	0.145	0.153	0.165	0.152	0.142	0.166	0.150	0.079
2007	39	0.092	0.267	0.116	0.082	0.116	0.145	0.158	0.153	0.144	0.124	0.126	0.120
2008	38	0.109	0.083	0.149	0.078	0.115	0.137	0.159	0.152	0.145	0.156	0.155	0.114
2009	38	0.094	0.087	0.141	0.088	0.188	0.156	0.156	0.152	0.126	0.131	0.170	0.271
2010	37	0.104	0.100	0.088	0.089	0.119	0.130	0.122	0.131	0.149	0.136	0.155	0.170
2011	39	0.128	0.140	0.164	0.097	0.094	0.139	0.139	0.135	0.137	0.149	0.123	0.102
2012	24	0.110	0.102	0.101	0.253	0.114	0.133	0.133	0.131	0.113	0.126	0.123	0.132
2013	23	0.115	0.086	0.103	0.095	0.184	0.122	0.126	0.126	0.149	0.133	0.182	0.101
2014	23	0.133	0.087	0.194	0.090	0.123	0.128	0.222	0.164	0.221	0.184	0.120	0.241
2015	24	0.098	0.101	0.103	0.098	0.120	0.165	0.175	0.137	0.178	0.182	0.147	0.226
2016	20	0.085	0.100	0.121	0.107	0.143	0.146	0.151	0.148	0.139	0.143	0.122	
2017	19		0.158	0.118	0.100	0.115	0.108	0.133	0.126	0.125	0.122	0.156	0.084
2018	21	0.143	0.095	0.088	0.101	0.119	0.135	0.160	0.120	0.125	0.125	0.249	0.110
POR Median		0.131	0.121	0.118	0.093	0.124	0.137	0.152	0.152	0.145	0.138	0.147	0.128

Key

total P in mg/L as P

TP ≤ 0.11
0.11 < TP ≤ 0.13
0.13 < TP ≤ 0.17
0.17 < TP ≤ 0.20
TP > 0.20

MEDIAN MONTHLY SOLUBLE REACTIVE PHOSPHORUS CONCENTRATION (mg/L as P) — 14206950

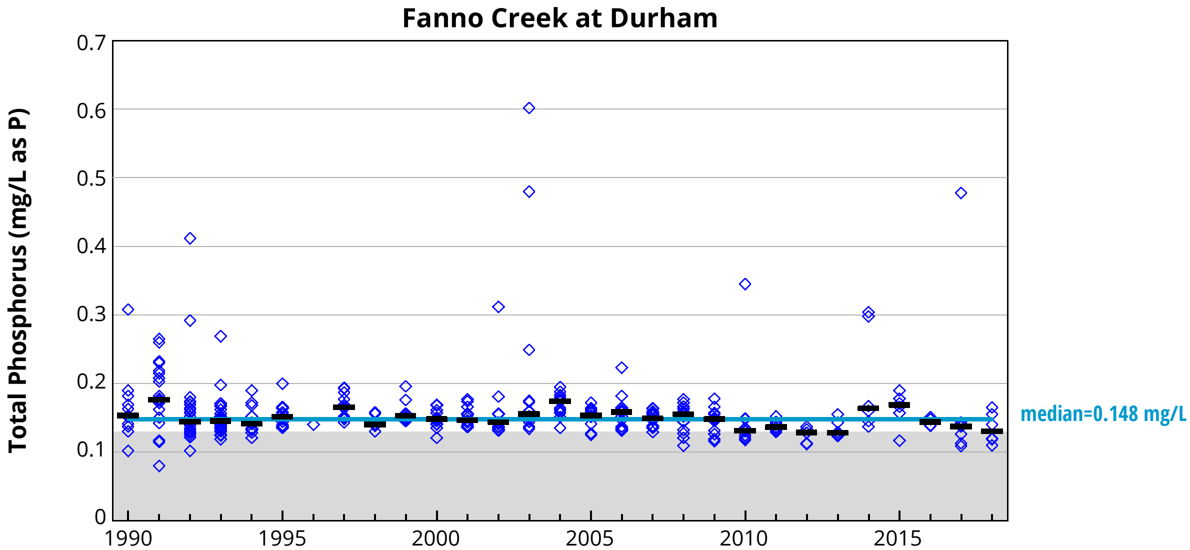
	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	32	0.039	0.044	0.053	0.018	0.052	0.049	0.069	0.071	0.055	0.050	0.098	0.031
1991	60	0.125	0.054	0.035	0.021	0.035	0.057	0.080	0.084	0.077	0.067	0.057	0.042
1992	83	0.038	0.042	0.033	0.039	0.051	0.071	0.078	0.082	0.060	0.072	0.065	0.043
1993	67	0.039	0.032	0.038	0.043	0.053	0.059	0.066	0.087	0.072	0.068	0.055	0.039
1994	39	0.043	0.032	0.034	0.025	0.055	0.068	0.097	0.086	0.093	0.066	0.047	0.050
1995	40	0.040	0.043	0.033	0.025	0.056	0.053	0.081	0.084	0.081	0.053	0.044	0.042
1996	15	0.042	0.039	0.035	0.029	0.046				0.075		0.054	0.042
1997	36	0.034	0.030	0.030	0.028	0.053	0.055	0.081	0.091	0.074	0.061	0.044	0.034
1998	26	0.030	0.025	0.032	0.022	0.049	0.064	0.087	0.102	0.090	0.076	0.056	0.036
1999	46	0.039	0.030	0.029	0.024	0.038	0.085	0.108	0.113	0.099	0.083	0.064	0.053
2000	40	0.037	0.044	0.036	0.042	0.062	0.089	0.097	0.092	0.090	0.068	0.055	0.044
2001	40	0.040	0.030	0.034	0.041	0.060	0.076	0.090	0.095	0.082	0.075	0.076	0.050
2002	39	0.061	0.034	0.040	0.037	0.053	0.075	0.099	0.098	0.084	0.083	0.072	0.056
2003	38	0.039	0.045	0.035	0.043	0.042	0.082	0.113	0.097	0.088	0.082	0.069	0.047
2004	39	0.037	0.042	0.041	0.045	0.063	0.089	0.099	0.097	0.071	0.070	0.069	0.040
2005	39	0.035	0.029	0.037	0.041	0.054	0.065	0.092	0.090	0.073	0.054	0.042	0.032
2006	39	0.045	0.029	0.028	0.029	0.067	0.084	0.103	0.088	0.075	0.068	0.055	0.038
2007	39	0.035	0.031	0.037	0.038	0.052	0.078	0.090	0.082	0.074	0.058	0.053	0.038
2008	38	0.032	0.032	0.029	0.026	0.065	0.067	0.085	0.093	0.083	0.059	0.064	0.039
2009	38	0.029	0.022	0.027	0.030	0.053	0.077	0.089	0.075	0.068	0.054	0.060	0.047
2010	37	0.035	0.034	0.031	0.032	0.043	0.045	0.066	0.069	0.054	0.053	0.054	0.040
2011	39	0.033	0.031	0.040	0.031	0.037	0.057	0.067	0.074	0.075	0.070	0.067	0.034
2012	24	0.033	0.032	0.028	0.038	0.056	0.063	0.070	0.073	0.056	0.064	0.063	0.050
2013	22	0.030	0.027	0.023	0.036	0.060	0.060	0.078	0.069	0.067	0.041	0.072	0.034
2014	23	0.030	0.030	0.045	0.040	0.064	0.063	0.073	0.100	0.070	0.079	0.052	0.047
2015	24	0.035	0.037	0.035	0.044	0.055	0.092	0.121	0.076	0.099	0.082	0.055	0.062
2016	19	0.034	0.037	0.042	0.073	0.068	0.081	0.086	0.098	0.058	0.051	0.052	
2017	19		0.036	0.030	0.038	0.057	0.071	0.079	0.075	0.074	0.063	0.060	0.036
2018	22	0.031	0.036	0.026	0.034	0.056	0.071	0.094	0.072	0.056	0.056	0.055	0.036
POR Median		0.036	0.032	0.034	0.036	0.054	0.069	0.087	0.087	0.074	0.066	0.056	0.041

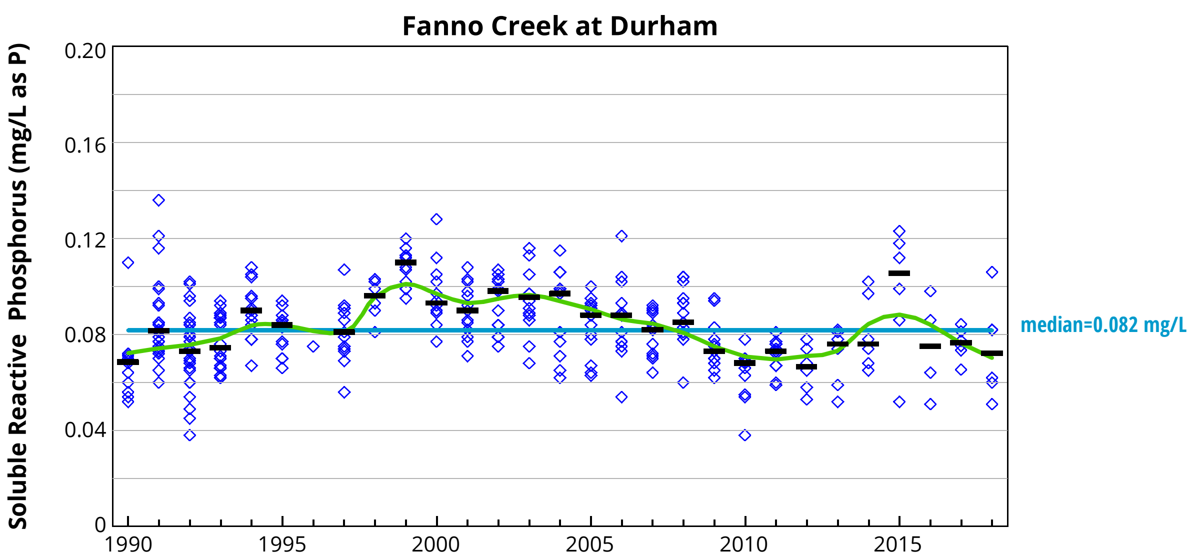
Key

SRP in mg/L as P

SRP ≤ 0.03
0.03 < SRP ≤ 0.04
0.04 < SRP ≤ 0.08
0.08 < SRP ≤ 0.09
SRP > 0.09

JULY-SEPTEMBER TREND (LOW-FLOW HIGH-SUNLIGHT PERIOD)





GRAPH KEY

◇ value
— Jul-Sep median
POR Jul-Sep median
POR Jul-Sep smooth line (LOWESS)
POR Jul-Sep trend line (LOWESS) - statistically significant
TMDL loading capacity— acceptable range for summer median

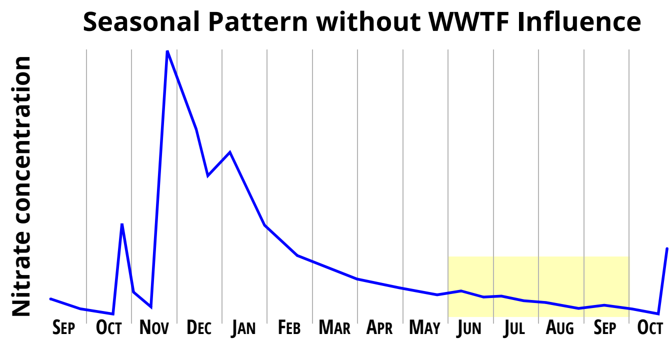
APPENDIX I
WATER QUALITY: NITRATE

SCOPE

This appendix shows data for nitrate (NO3) concentrations at selected sites in the Tualatin River and its tributaries. The data were collected by Clean Water Services. Data for both total nitrate and dissolved nitrate were combined. The only difference between total and dissolved nitrate analyses is a filtration step which should not affect nitrate concentration. Nitrate data collected by other agencies may exist, but are not shown here. An explanation of the tables and figures is on page I-4.

PATTERNS AND PROCESSES

- *Seasonal pattern 1: sites without WWTF influence*— All tributary sites and Tualatin River sites above the Rock Creek WWTF (RC-WWTF) had a similar seasonal pattern with some site-specific and year-to-year variation.



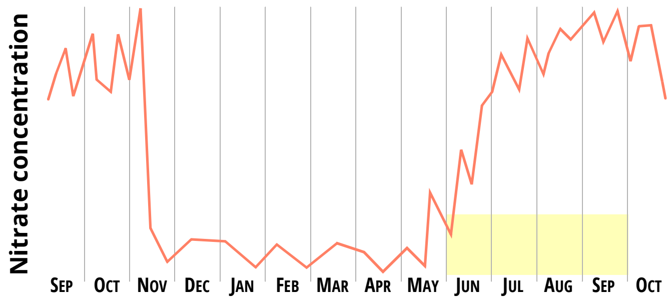
- The seasonal minimum occurred in fall, often October, and lasted no more than a few weeks.
- NO3 increased very sharply, to the seasonal maximum, usually in November in conjunction with the first soaking rainfall of the season.
- NO3 declined quickly through winter, sometimes with many small spikes.
- NO3 continued to slowly decline through the summer to seasonal minimum.
- The pattern reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.The primary source of NO3 to most of these streams is rainfall that leaches NO3 as it passes through soil. The earliest storms in the fall may produce only enough rain to wet the soil. Once the soil is saturated, the next storm quickly transports NO3 to the stream, causing the sharp late-fall increase in NO3 concentration. As the winter progresses, NO3 decreases due to higher streamflow and depleted soil-nitrogen stores. Once the dry season arrives, little NO3 is transported to the stream. At that time, warm weather and long days encourage the growth of phytoplankton and other aquatic plants that require nitrogen. The NO3 concentration decreases further and remains low until it is replenished in the next rainy season.
- Although the overall pattern was similar among sites, differences existed.
  —Many sites had small spikes in NO3 concentrations superimposed on the overall pattern.
  —Some sites, especially urban ones, had so many concentration spikes that the overall pattern was nearly obscured. This was especially true for Fanno Creek and to a lesser extent Beaverton Creek.
  —The seasonal minimum at Chicken Creek occurred in August and NO3 concentrations increased slowly through the remainder of the summer until sharply increasing with the fall rain. This is the only site with this behavior and suggests an additional NO3 source, possible groundwater.
  —The pattern at Scoggins Creek was affected by the fact that it is downstream of Hagg Lake. The high concentration period persisted winter through early summer because water is stored in the lake.
- The maximum concentration often appeared as a short-lived spike corresponding to the first soaking rainstorm of the season. Frequent sampling is needed to characterize this spike as well as other smaller spikes. The sampling frequency often was not sufficient to reliably assess spike magnitude or frequency. Very infrequent sampling resulted in data that missed concentration spikes and inconsistent sampling frequency compromised trend analyses.

- *Seasonal pattern 2: sites influenced by WWTFs*—The Tualatin River sites downstream of the RC-WWTF shared a similar seasonal pattern that was different from the other sites. This pattern was characterized by two regimes largely based on nitrification at the RC and Durham WWTFs.

- The lowest concentrations occur late fall through spring and vary with streamflow.

- Concentrations increase quickly in early summer as the WWTFs implement nitrification. As flows decline through the summer, NO3 concentrations in the river increase due to decreasing dilution by river water. Maximum concentrations usually occur in the fall when temperatures at the WWTF are high enough to sustain nitrification and when river flows are lowest.

Seasonal Pattern with WWTF Influence



- The NO3 discharge from the WWTFs is large enough to swamp out the NO3 increase associated with the first rains of the season, and the sharp increase in NO3 concentration in the fall is not seen.

2018 Concentrations

Median monthly concentrations for each site are shown in the tables below. Points from 2018 include:

- After a large storm in the last half of October, the weather in 2018 remained mostly dry and streamflow decreased to baseflow levels through most of November and early December. The seasonal maximum concentrations at the sites unaffected by the WWTFs were delayed until December–January when more typical rainy season conditions resumed. Similarly, high concentrations at the sites affected by WWTFs persisted into fall and early winter because of minimal dilution by river flow.

- April had particularly high streamflow which accounts for the lower NO3 concentrations at the sites affected by WWTFs.

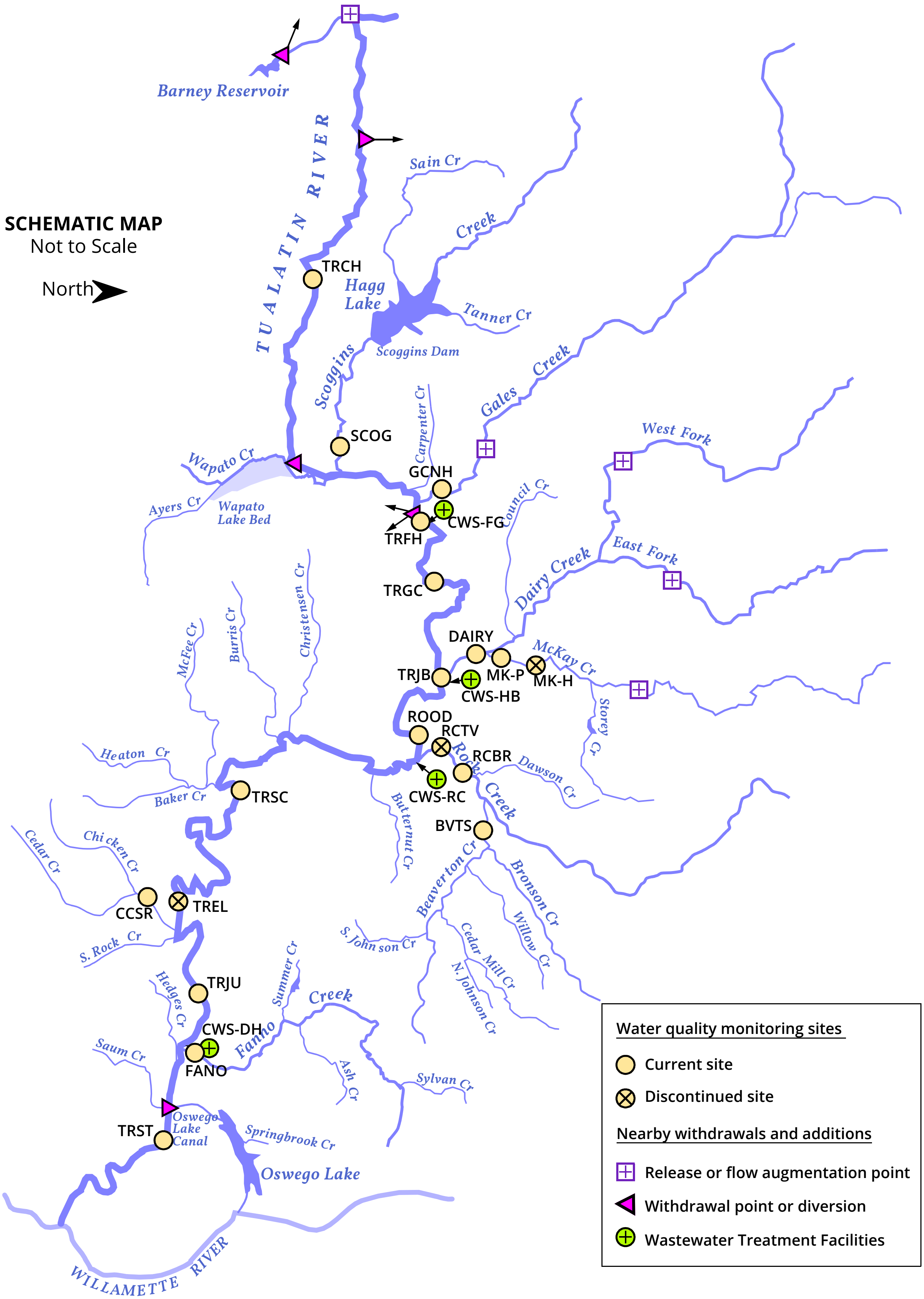
- A comparison of January–July NO3 concentrations at Scoggins Creek with those at Tualatin River at Cherry Grove clearly shows the effect of more constant releases of NO3 from Hagg Lake.

2018 MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N)

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Tualatin River sites upstream of Rock Creek WWTF and Scoggins Creek site													
Scoggins Creek	21	0.20	0.20	0.20	0.21	0.22	0.24	0.23	0.15	0.05	0.02	0.05	0.10
TR at Cherry Grove	18	0.19	0.19	0.16	0.15	0.12	0.08	0.07	0.06	0.04	0.03	0.13	0.23
TR at Fern Hill Rd	21	0.54	0.63	0.44	0.37	0.27	0.19	0.19	0.11	0.06	0.02	0.12	0.65
TR at Hwy 219	10	1.24	1.06	1.11	0.03	0.55	0.39	0.24		0.13		0.33	1.16
TR at Rood Bridge Rd	21	1.26	1.25	0.98	0.36	0.55	0.34	0.26	0.12	0.09	0.07	0.21	1.02
Tualatin River sites downstream of Rock Creek WWTF													
TR at Hwy 210	22	1.53	1.37	1.38	0.90	1.53	3.21	3.54	2.79	5.08	3.76	3.46	2.11
TR at Jurgens Park	21	1.45	1.28	1.35	0.89	1.38	2.42	3.01	3.19	3.31	2.51	2.28	1.65
TR at Stafford Rd	22	1.60	1.37	1.32	1.01	1.81	2.76	3.70	3.53	4.18	3.96	4.16	1.69
Tributary sites													
Gales Creek	21	0.58	0.52	0.41	0.36	0.22	0.13	0.13	0.08	0.05	0.04	0.33	0.99
Dairy Creek	23	2.03	1.48	1.24	1.04	0.59	0.49	0.48	0.35	0.25	0.36	0.55	2.10
McKay Creek	23	2.41	1.91	1.51	1.24	0.59	0.41	0.31	0.25	0.17	0.34	0.28	2.21
Beaverton Creek	22	0.54	0.87	0.57	0.47	0.38	0.43	0.48	0.19	0.36	0.31	0.25	0.54
Rock Creek	22	0.71	0.97	0.63	0.44	0.21	0.28	0.36	0.16	0.25	0.38	0.19	0.48
Chicken Creek	21	1.36	1.32	1.31	1.15	0.37	0.55	0.38	0.31	0.47	0.47	0.39	0.72
Fanno Creek	21	0.74	0.92	0.63	0.66	0.29	0.43	0.37	0.25	0.39	0.43	0.30	0.49

KEY:						
	N ≤ 0.2	0.2 < N ≤ 0.4	0.4 < N ≤ 0.8	0.8 < N ≤ 1.2	1.2 < N ≤ 2	N > 2

Nitrate sampling sites



NITRATE SAMPLING SITES — ALPHABETICAL LISTING BY SITE CODE

SITE CODE	SITE NAME	RIVER MILE	PAGE
BVTS	Beaverton Creek near Orenco / at Guston Ct	1.2 / 1.2	I–31
CCSR	Chicken Creek at Scholls-Sherwood Rd (Roy Rogers Rd)	2.3	I–33
DAIRY	Dairy Creek at Hwy 8	2.06	I–25
FANO	Fanno Creek at Durham Rd	1.2	I–35
GCNH	Gales Creek at New Hwy 47	2.36	I–23
MK-H & MK-P	McKay Creek at Hornecker Rd / Padgett Rd	2.2 / 1.3	I–27
RCTV & RCBR	Rock Creek at Hwy 8 / Brookwood	1.2 / 2.4	I–29
ROOD	Tualatin River at Rood Bridge Rd	38.4	I–15
SCOG	Scoggins Creek near Gaston	1.71	I–5
TRCH	Tualatin River at Cherry Grove (South Rd Bridge)	67.83	I–7
TREL & TRJU	Tualatin River at Elsner Rd / Jurgens Park	16.2 / 10.8	I–19
TRFH	Tualatin River at Spring Hill Pump Plant / Fern Hill Rd	55.3	I–9
TRGC	Tualatin River at Golf Course Rd	51.5	I–11
TRJB	Tualatin River at Hwy 219	44.4	I–13
TRSC	Tualatin River at Hwy 210 (Scholls Bridge)	26.9	I–17
TRST	Tualatin River at Stafford	5.38	I–21

Explanation of Figures and Tables in this Appendix

Two pages of tables and graphs are included for every site.

Page 1–discussion: A short summary of sample collection is at the top of the page, including the period of record, sampling frequency during that time. and any changes in site location. That section is followed by a series of observations about the data, including concentration ranges, seasonality and trends.

–times series: A time series graph of nitrate for the period of record plus color-coded charts showing the frequency of data collection by year is at the bottom of the page. Note that data points in the time series graphs are connected with a line to make them easier to follow. In some cases considerable time elapsed between data points. The line should not be construed to indicate concentrations between sample points.

Page 2–color-coded table of medians: The upper half of page 2 contains a table of monthly median nitrate concentrations by year. The tables are shaded by concentration range with a key to the right of each table. The color code is somewhat arbitrary and chosen for each site to help illustrate any seasonal data patterns.

–graph of July–September data: The lower half of page 2 contains a graph of July–September nitrate concentrations that shows any trend that occurred over the period of record. This time period was chosen because nitrogen is an essential nutrient required for algal growth and the July–September period is when such growth is favored due to ample sunlight and low flows.

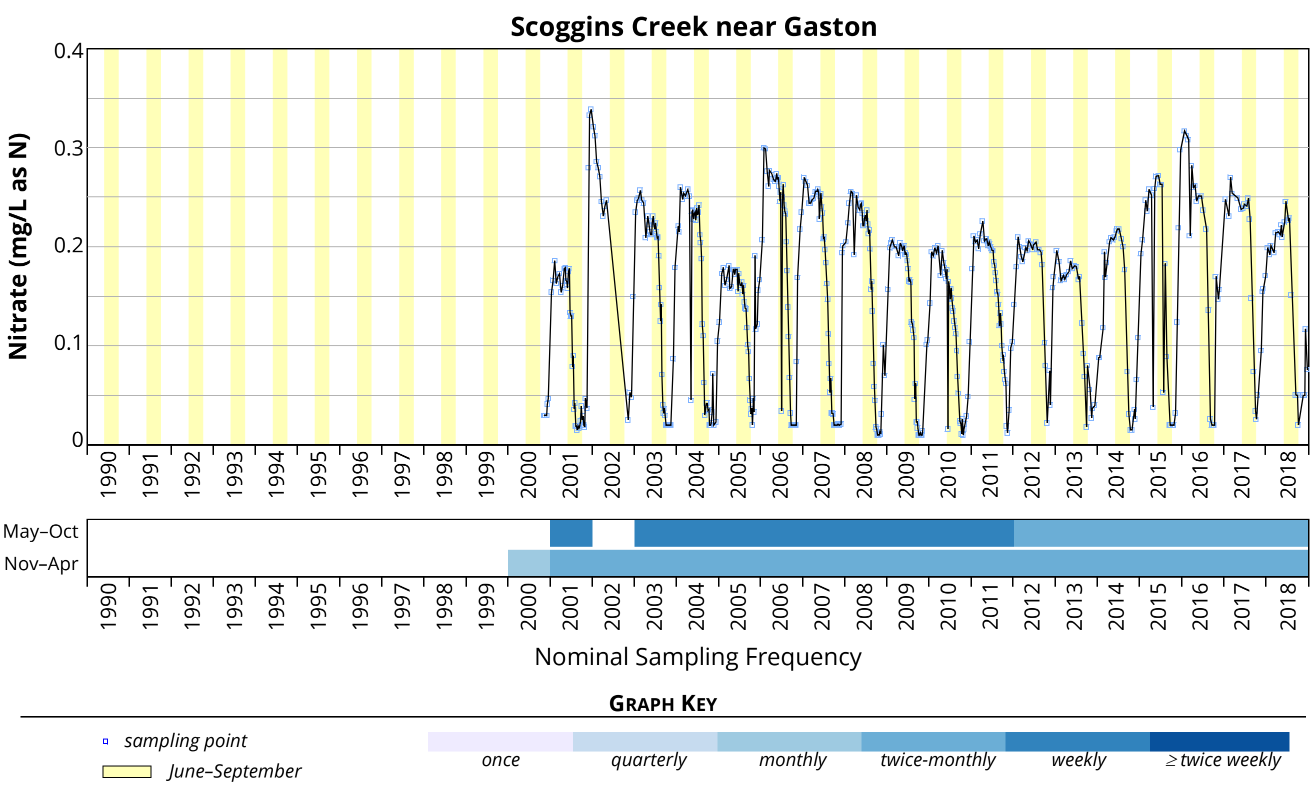
Sampling frequency

- The period of record is November 2000 through present. No data were collected in the summer of 2002.
- Sampling frequency varied, but mostly was about every two weeks. Sampling was weekly during the summer from 2003–2011.

Concentration and trends

- Nitrate (NO3) concentrations in Scoggins Creek followed a seasonal pattern that reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.
  —Seasonal minimum (≤ 0.02–0.05 mg/L), October–November, duration of a few weeks
  —Sharp increase to seasonal maximum (0.15–0.35 mg/L), usually January–February
  —Slow decline through early summer
  —Quick decrease beginning late July–August to the seasonal minimum
- The high concentration period was much longer—about 6 months— at Scoggins Creek compared to less than a month at other sites. The prolonged maximum was because water that contains NO3 enters the lake during winter and remains there through the summer.
- No trends were evident.

Time series



SCOG – Scoggins Creek near Gaston – 14203000

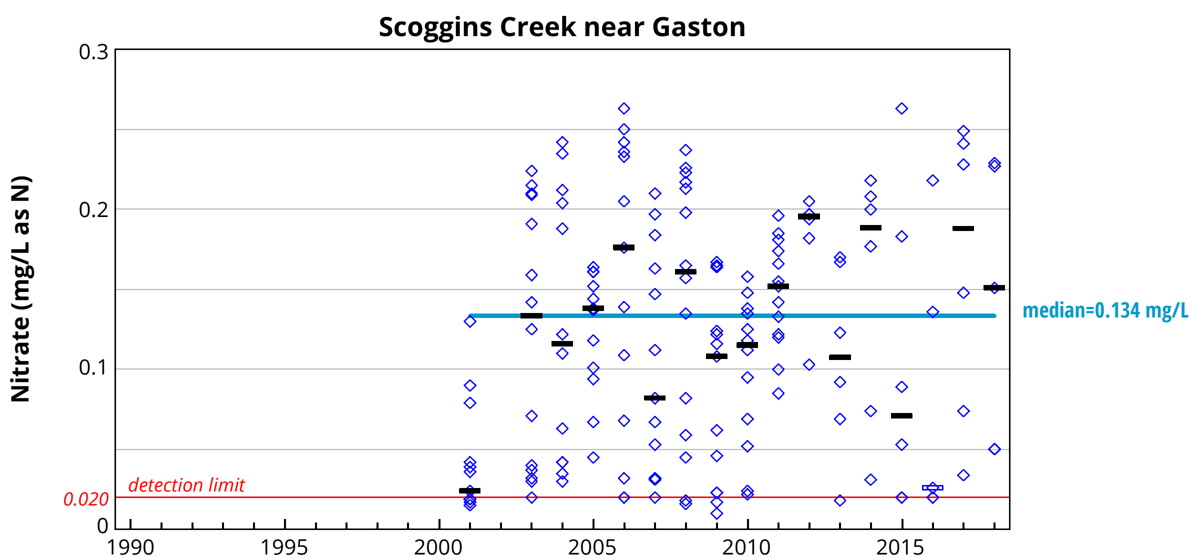
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — SCOG

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	5											0.03	0.04
2001	39	0.16	0.17	0.17	0.16	0.17	0.15	0.08	0.02	0.02	0.03	0.16	0.34
2002	13	0.32	0.28	0.26	0.24							0.04	0.10
2003	38	0.24	0.25	0.25	0.22	0.21	0.22	0.21	0.13	0.03	0.02	0.02	0.13
2004	38	0.22	0.25	0.25	0.25	0.23	0.23	0.22	0.11	0.04	0.02	0.03	0.06
2005	39	0.15	0.17	0.17	0.16	0.18	0.17	0.16	0.14	0.08	0.03	0.12	0.16
2006	39	0.25	0.29	0.27	0.27	0.27	0.25	0.25	0.18	0.03	0.02	0.08	0.23
2007	40	0.27	0.25	0.25	0.25	0.26	0.24	0.19	0.08	0.03	0.02	0.02	0.20
2008	38	0.21	0.25	0.22	0.25	0.24	0.23	0.22	0.16	0.05	0.01	0.03	0.07
2009	37	0.18	0.21	0.20	0.20	0.20	0.19	0.16	0.11	0.02	0.01	0.01	0.10
2010	37	0.17	0.20	0.20	0.18	0.18	0.16	0.14	0.11	0.02	0.01	0.03	0.08
2011	39	0.19	0.21	0.21	0.22	0.21	0.20	0.18	0.15	0.11	0.07	0.02	0.10
2012	24	0.16	0.21	0.19	0.20	0.20	0.20	0.20	0.20	0.14	0.05	0.06	0.16
2013	23	0.19	0.17	0.17	0.17	0.18	0.18	0.17	0.11	0.04	0.07	0.03	0.04
2014	24	0.09	0.16	0.18	0.21	0.21	0.22	0.21	0.19	0.05	0.02	0.03	0.09
2015	23	0.20	0.25	0.25	0.15	0.27	0.27	0.16	0.14	0.02	0.02	0.08	0.26
2016	20	0.32	0.31	0.25	0.26	0.25	0.24	0.22	0.14	0.02	0.10	0.15	
2017	20	0.25	0.25	0.25	0.25	0.24	0.24	0.25	0.19	0.05	0.04	0.13	0.16
2018	21	0.20	0.20	0.20	0.21	0.22	0.24	0.23	0.15	0.05	0.02	0.05	0.10
POR Median		0.20	0.23	0.21	0.21	0.21	0.22	0.20	0.14	0.04	0.02	0.03	0.10

Key
nitrate in mg/L as N
N ≤ 0.03
0.03 < N ≤ 0.16
0.16 < N ≤ 0.22
0.22 < N ≤ 0.25
N > 0.25

July-September trend (low-flow high-sunlight period)



Graph Key

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

TRCH – Tualatin River at Cherry Grove (South Rd Bridge)

Data source: Clean Water Services

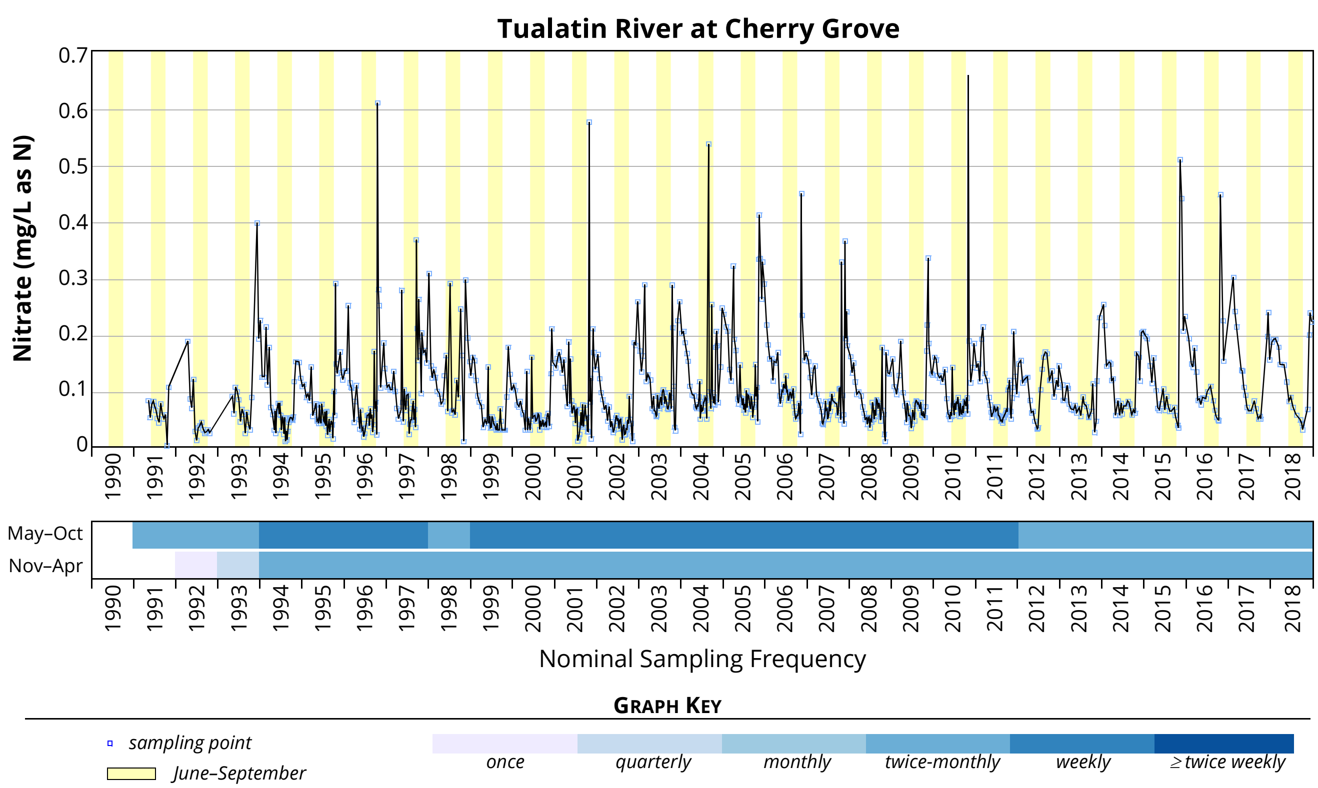
Sampling frequency

- The period of record is May 1991 through present.
- Sampling frequency varied, but was about every two weeks during winter and up to weekly during summer.
- Sampling frequency likely was not adequate to fully characterize short-lived concentration spikes.

Concentrations & trends

- Nitrate (NO3) concentrations in the Tualatin River at Cherry Grove followed a seasonal pattern that reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.
  —Seasonal minimum (0.01–0.05 mg/L), usually October, duration of no more than a few weeks
  —Sharp increase to seasonal maximum (0.2–0.7 mg/L), usually November
  —Quick decline through winter (with many small spikes) to spring concentrations < 0.1 mg/L
  —Slow decline through the summer to seasonal minimum
- About half the years had a very sharp NO3 concentration spike, sometimes exceeding 0.5 mg/L, immediately after the seasonal minimum. These timing of these spikes at the beginning of the rainy season indicates the importance of the first major rainstorms of the season. Because peak concentrations were shorter-lived than the usual sampling frequency, the graph below likely underestimates the maximum concentrations and may have missed spikes since 2012 when frequency decreased to every two weeks.
- The years before 2003 appear to have lower July–September NO3 concentrations than the years after 2003, but the difference is small and not statistically significant. From 2003 to 2018, July–September NO3 concentrations have a small decreasing trend that is statistically significant.

Time series



TRCH – Tualatin River at Cherry Grove (South Rd Bridge)

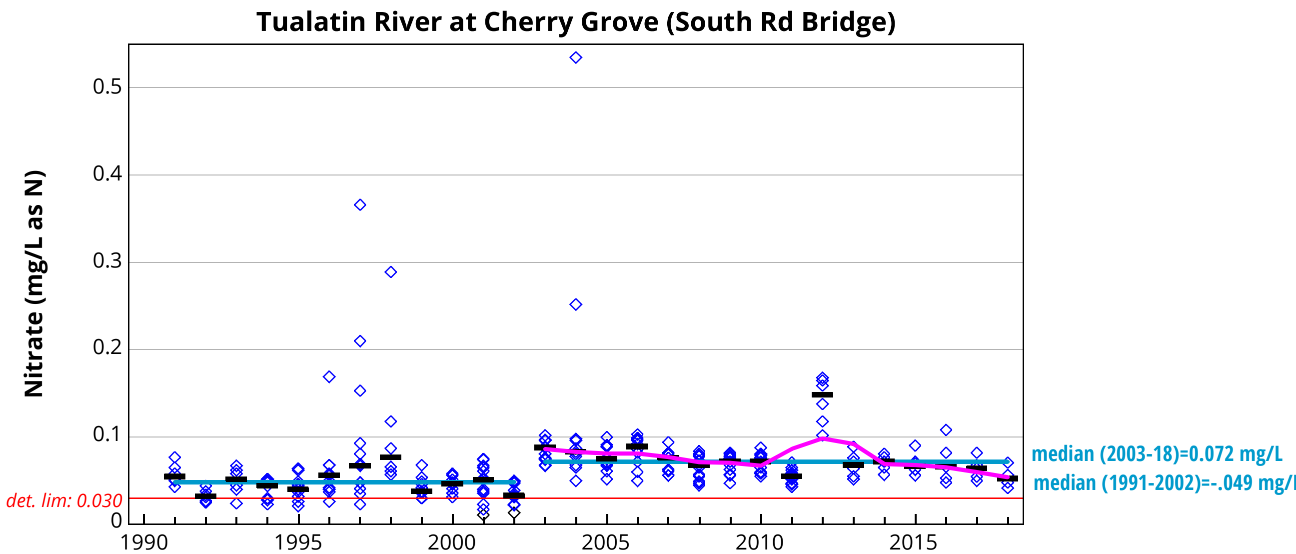
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — TRCH

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1991	14					0.07	0.08	0.06	0.06	0.05	0.06		
1992	14				0.19	0.08	0.03	0.04	0.04	0.03	0.03		
1993	15					0.07	0.10	0.06	0.04	0.05	0.06		0.29
1994	36	0.17	0.17	0.14	0.06	0.05	0.07	0.04	0.03	0.05	0.05	0.15	0.14
1995	38	0.11	0.09	0.11	0.06	0.05	0.05	0.05	0.03	0.04	0.13	0.17	0.13
1996	37	0.14	0.11	0.07	0.10	0.05	0.03	0.06	0.05	0.05	0.25	0.11	0.16
1997	37	0.11	0.10	0.10	0.05	0.07	0.08	0.04	0.06	0.15	0.18	0.18	0.16
1998	24	0.23	0.13	0.11	0.09	0.10	0.11	0.18	0.06	0.10	0.20	0.15	0.17
1999	37	0.14	0.14	0.09	0.05	0.05	0.04	0.05	0.03	0.04	0.03	0.13	0.11
2000	38	0.10	0.07	0.07	0.04	0.04	0.05	0.05	0.05	0.04	0.04	0.08	0.18
2001	40	0.15	0.16	0.14	0.09	0.08	0.07	0.02	0.05	0.05	0.05	0.12	0.15
2002	39	0.14	0.09	0.07	0.05	0.03	0.05	0.05	0.03	0.03	0.04	0.10	0.22
2003	38	0.15	0.22	0.12	0.09	0.06	0.07	0.09	0.09	0.08	0.16	0.03	0.24
2004	37	0.20	0.18	0.13	0.09	0.07	0.07	0.08	0.09	0.10	0.08	0.18	0.19
2005	40	0.22	0.17	0.22	0.18	0.09	0.08	0.07	0.09	0.07	0.11	0.33	0.31
2006	38	0.20	0.16	0.13	0.16	0.09	0.11	0.10	0.09	0.06	0.06	0.34	0.16
2007	38	0.14	0.11	0.12	0.08	0.05	0.07	0.08	0.08	0.07	0.10	0.13	0.21
2008	37	0.15	0.13	0.10	0.08	0.05	0.05	0.06	0.07	0.07	0.06	0.13	0.13
2009	39	0.13	0.10	0.16	0.08	0.06	0.05	0.07	0.08	0.06	0.06	0.22	0.13
2010	38	0.16	0.12	0.12	0.11	0.06	0.07	0.08	0.06	0.08	0.08	0.14	0.18
2011	40	0.14	0.15	0.17	0.10	0.06	0.07	0.06	0.05	0.06	0.10	0.11	0.11
2012	24	0.15	0.12	0.12	0.07	0.05	0.03	0.12	0.16	0.14	0.13	0.10	0.13
2013	23	0.10	0.10	0.09	0.07	0.07	0.06	0.08	0.06	0.06	0.07	0.08	0.23
2014	24	0.23	0.15	0.13	0.09	0.07	0.07	0.07	0.08	0.06	0.11	0.14	0.20
2015	23	0.19	0.14	0.14	0.08	0.07	0.08	0.08	0.06	0.06	0.04	0.47	0.22
2016	20	0.19	0.14	0.15	0.08	0.08	0.09	0.11	0.07	0.05	0.25	0.19	
2017	18		0.27	0.21	0.14	0.10	0.07	0.06	0.07	0.05	0.05	0.20	0.20
2018	18	0.19	0.19	0.16	0.15	0.12	0.08	0.07	0.06	0.04	0.03	0.13	0.23
POR MEDIAN		0.15	0.14	0.12	0.08	0.07	0.07	0.07	0.06	0.06	0.07	0.14	0.18

KEY
nitrate in mg/L as N
N ≤ 0.05
0.05 < N ≤ 0.07
0.07 < N ≤ 0.15
0.15 < N ≤ 0.20
N > 0.20

July-September trend (low-flow high-sunlight period)



GRAPH KEY

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

TRFH – Tualatin River at Spring Hill Pump Plant/Fern Hill Road

Data source: Clean Water Services

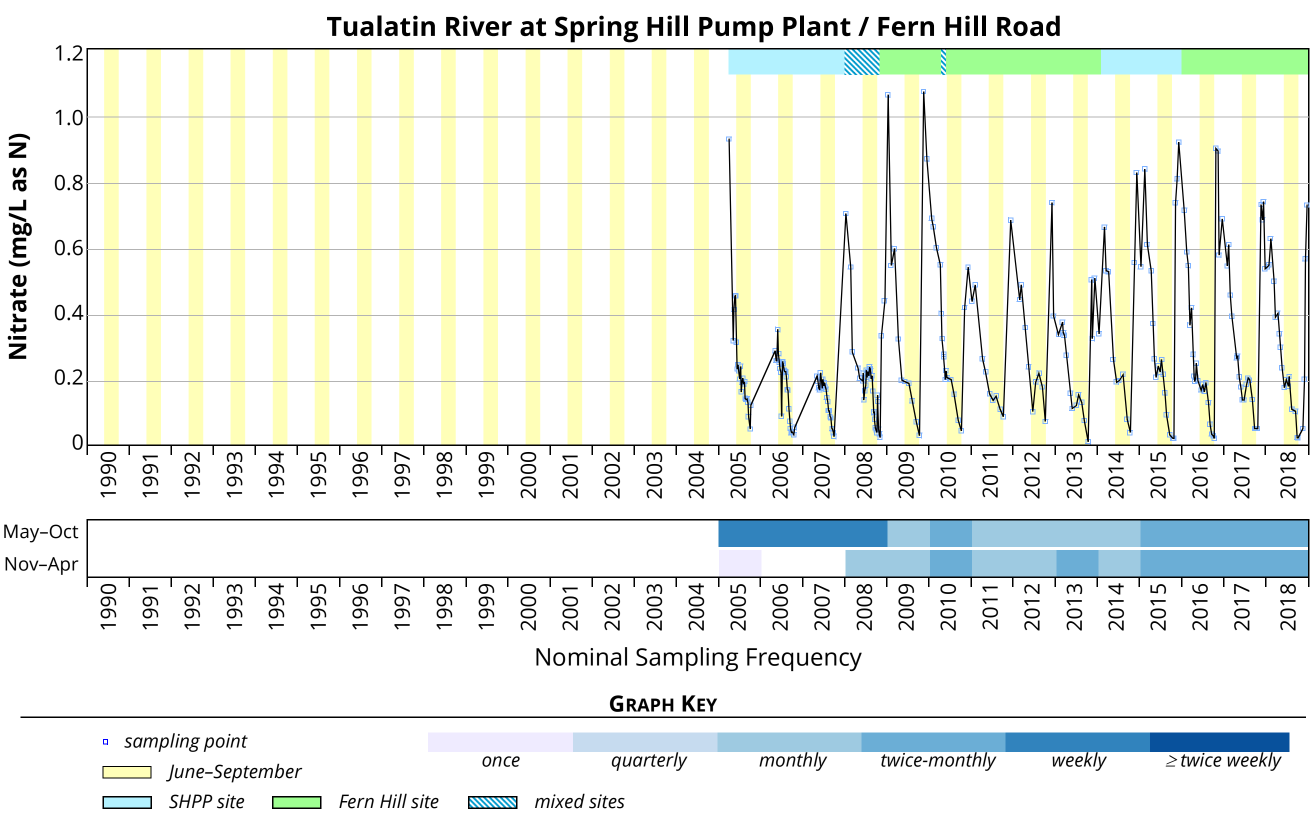
Sampling frequency & location

- The period of record is March 2005 through present.
- Sampling frequency was variable and except for May–October 2005–2008, no more than twice a month
- Sampling frequency likely was not adequate to fully characterize short-lived concentration spikes.
- The sampling location switched between two sites, sometimes as often as every other sample. These two sites are close to each other, so the site changes may not be important.

Concentrations & trends

- Nitrate (NO3) concentrations in the Tualatin River at Fern Hill followed a seasonal pattern that reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.
  —Seasonal minimum (0.01–0.05 mg/L), usually October
  —Sharp increase to seasonal maximum (about 0.5–1.0 mg/L), November
  —Quick decline through winter to June (about 0.2 mg/L)
  —Slow decline through the summer to seasonal minimum
- The seasonal maximum concentration was generally pronounced and occurred at the beginning of the rainy season which indicates the importance of the first major rainstorm of the season. Because peak concentrations were shorter-lived than the sampling frequency, the graph below likely under-represents their magnitude. Targeted sampling of the first major rainstorm could determine if that is the case.
- No spikes in the NO3 concentration were observed at this site. That could be because they didn't exist or because the sampling frequency was not sufficient to capture them.
- No trends were evident.

Time series



TRFH – Tualatin River at Spring Hill Pump Plant/Fern Hill Road

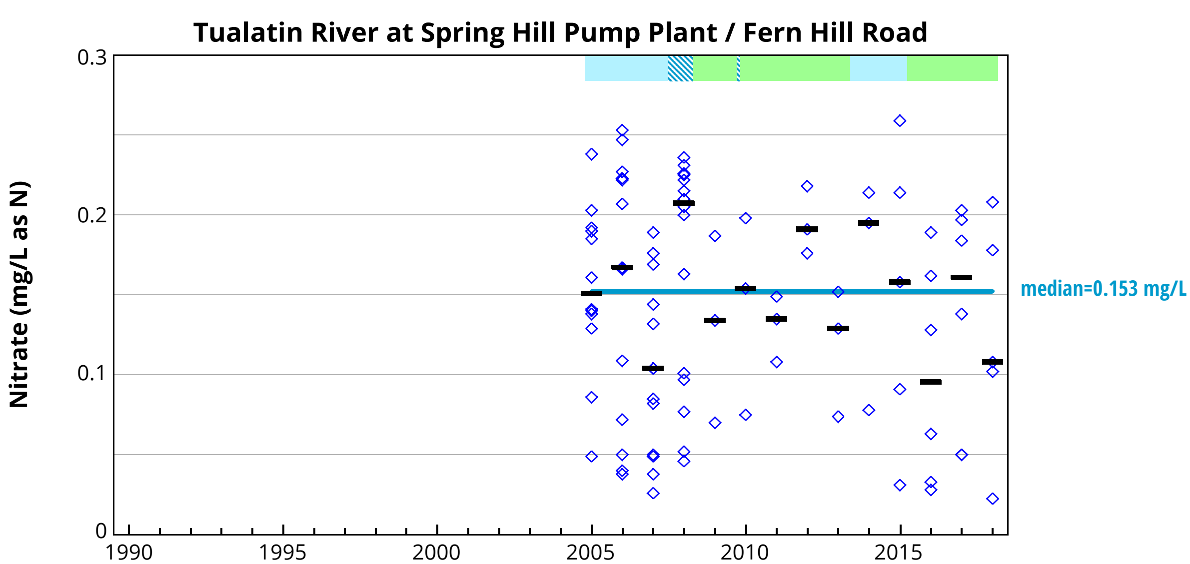
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — TRFH

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	23			0.93		0.43	0.23	0.20	0.14	0.09	0.12		
2006	24					0.27	0.23	0.24	0.17	0.05	0.04		
2007	22					0.19	0.19	0.17	0.10	0.04			
2008	34	0.70	0.54	0.28	0.23	0.20	0.18	0.22	0.21	0.08	0.04	0.33	0.44
2009	12	1.06	0.54	0.60	0.32	0.20	0.19	0.19	0.13	0.07	0.03	1.07	0.87
2010	17	0.69	0.66	0.60	0.40	0.25	0.20	0.20	0.15	0.08	0.04	0.48	
2011	10	0.44	0.49		0.26	0.22	0.16	0.14	0.15	0.11	0.09		0.68
2012	11		0.44	0.49	0.36	0.24	0.10	0.19	0.22	0.18	0.07	0.73	0.39
2013	15	0.34	0.37	0.34	0.27	0.13	0.12	0.15	0.13	0.07	0.01	0.41	0.51
2014	12	0.34	0.66	0.53	0.53	0.26	0.19	0.20	0.21	0.08	0.04	0.55	0.83
2015	19	0.54	0.84	0.61	0.45	0.23	0.23	0.24	0.12	0.03	0.02	0.77	0.92
2016	24	0.71	0.56	0.39	0.21	0.22	0.18	0.18	0.10	0.03	0.46	0.73	0.69
2017	22	0.54	0.53	0.39	0.27	0.19	0.14	0.19	0.17	0.05	0.05	0.71	0.64
2018	21	0.54	0.63	0.44	0.37	0.27	0.19	0.19	0.11	0.06	0.02	0.12	0.65
POR Median		0.54	0.54	0.49	0.32	0.23	0.19	0.19	0.15	0.07	0.04	0.63	0.66

Key
nitrate in mg/L as N
N ≤ 0.1
0.1 < N ≤ 0.2
0.2 < N ≤ 0.4
0.46 < N ≤ 0.6
N > 0.6

July-September trend (low-flow high-sunlight period)



Graph Key

- SHPP site
- Fern Hill site
- mixed sites
- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

TRGC – Tualatin River at Golf Course Road – 14204800

Data source: Clean Water Services

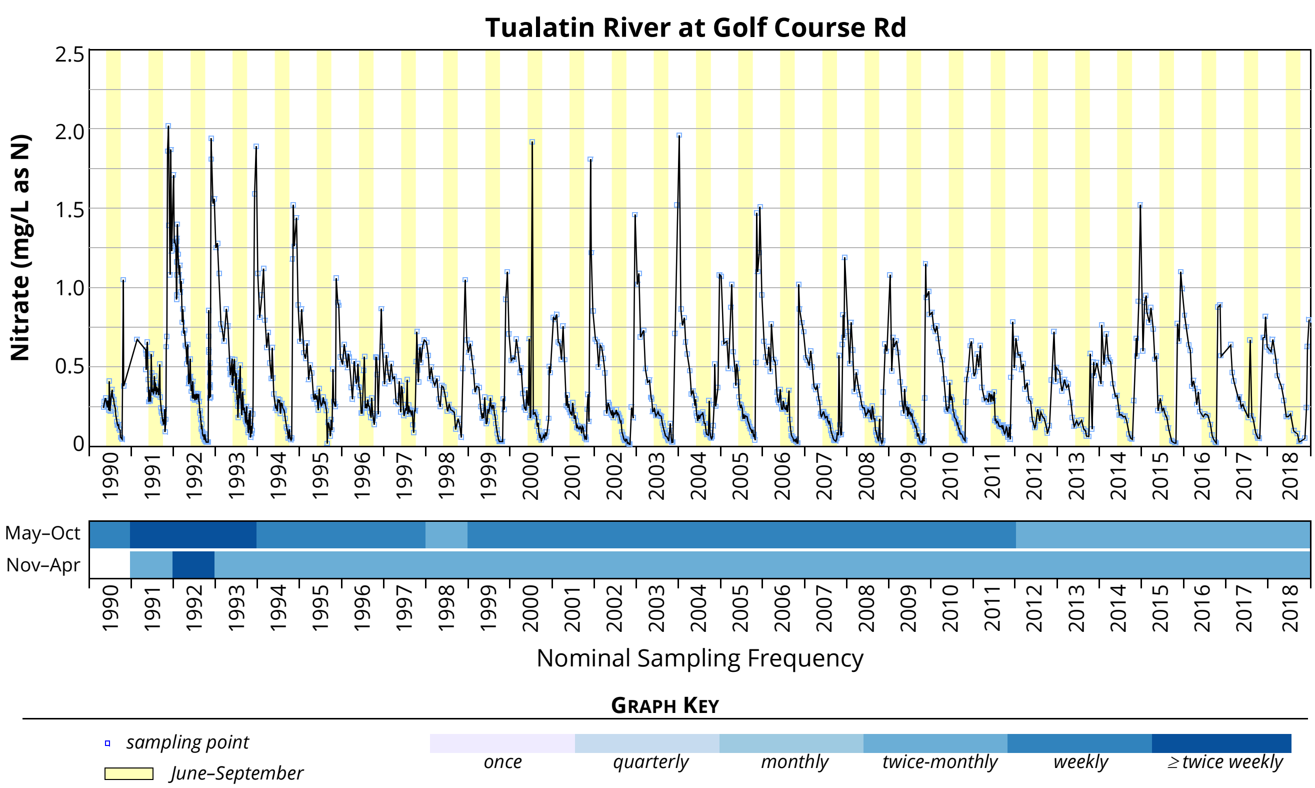
Sampling frequency

- The period of record is May 1990 through present.
- Sampling frequency was quite varied, with dense sampling in 1992 and less frequent sampling recently.
- Except for 1992, sampling frequency likely was not adequate to fully characterize short-lived concentration spikes.

Concentrations & trends

- Nitrate (NO3) concentrations in the Tualatin River at Golf Course Road followed a seasonal pattern that reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.
  —Seasonal minimum (0.01–0.05 mg/L), usually October, duration of no more than a few weeks
  —Sharp increase to seasonal maximum (0.7–2.0 mg/L), usually November
  —Quick decline through winter (with many small spikes) to spring concentrations (<0.3 mg/L)
  —Slow decline through the summer to seasonal minimum
- The seasonal maximum concentration was generally pronounced and occurred at the beginning of the rainy season which indicates the importance of the first major rainstorm of the season. Because peak concentrations were shorter-lived than the usual sampling frequency, the graph below likely under-represents their magnitude. Targeted sampling of the first major rainstorm could determine if that is the case.
- A high concentration spike occurred in July 2000 that did not appear at other sites.
- July–September NO3 concentrations show a statistically significant decreasing trend that was most pronounced from 1992 to 2001. After 2001, the trend is less clear. The decreasing trend could be related to increased flow augmentation in July that began in the early 2000s.

Time series

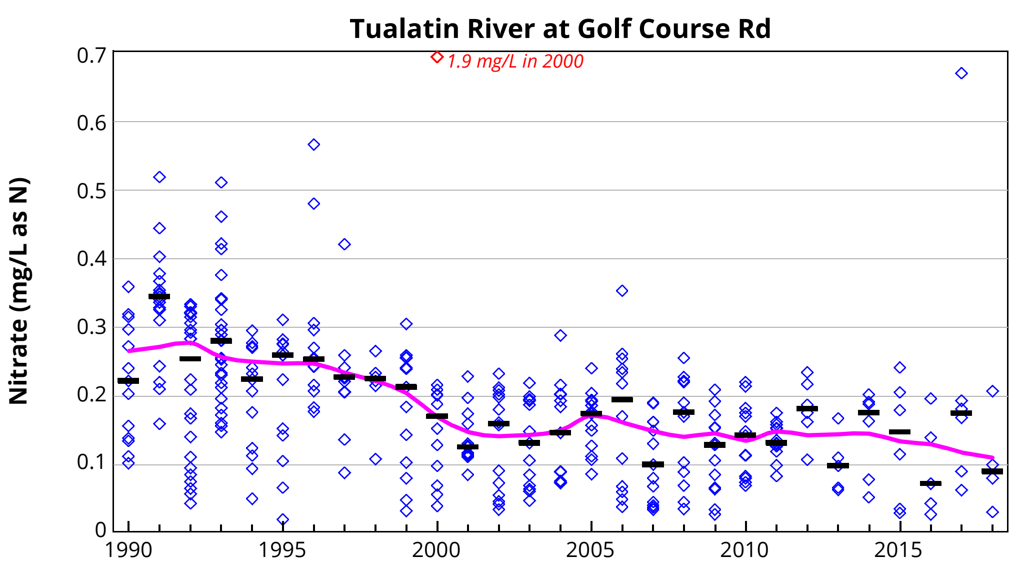


MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — 14204800

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	26					0.28	0.27	0.32	0.24	0.12	0.06		
1991	47		0.67			0.57	0.35	0.35	0.34	0.23	0.17	1.63	1.23
1992	88	1.26	1.23	0.92	0.64	0.44	0.36	0.32	0.22	0.07	0.03	0.52	1.55
1993	68	1.27	0.93	0.70	0.81	0.49	0.46	0.30	0.29	0.21	0.15	0.09	1.74
1994	38	0.95	1.04	0.71	0.62	0.43	0.24	0.27	0.23	0.10	0.05	1.39	1.17
1995	40	0.76	0.57	0.53	0.49	0.31	0.28	0.27	0.24	0.12	0.27	0.91	0.73
1996	38	0.58	0.57	0.47	0.42	0.41	0.26	0.37	0.25	0.21	0.38	0.33	0.75
1997	38	0.48	0.44	0.44	0.28	0.29	0.31	0.23	0.22	0.22	0.51	0.60	0.65
1998	24	0.61	0.46	0.40	0.36	0.31	0.35	0.24	0.23	0.16	0.16	0.27	0.86
1999	38	0.62	0.51	0.36	0.31	0.19	0.19	0.25	0.21	0.06	0.03	0.30	0.90
2000	39	0.55	0.61	0.53	0.41	0.25	0.22	0.21	0.17	0.06	0.06	0.09	0.48
2001	40	0.80	0.74	0.60	0.55	0.26	0.21	0.17	0.12	0.11	0.06	0.33	1.04
2002	39	0.67	0.57	0.59	0.27	0.23	0.21	0.21	0.16	0.04	0.02	0.13	0.82
2003	38	1.06	0.70	0.61	0.41	0.26	0.21	0.20	0.14	0.06	0.08	0.02	1.11
2004	39	1.41	0.79	0.62	0.40	0.31	0.19	0.20	0.14	0.08	0.06	0.26	0.72
2005	39	0.86	0.66	0.68	0.81	0.49	0.26	0.19	0.18	0.11	0.07	1.22	1.23
2006	38	0.61	0.57	0.62	0.54	0.31	0.25	0.24	0.17	0.05	0.03	0.94	0.75
2007	41	0.55	0.56	0.44	0.36	0.20	0.21	0.16	0.09	0.04	0.09	0.36	0.94
2008	37	0.62	0.69	0.41	0.35	0.24	0.21	0.20	0.20	0.07	0.05	0.34	0.60
2009	39	0.78	0.65	0.63	0.34	0.25	0.22	0.18	0.13	0.05	0.03	0.94	0.90
2010	38	0.80	0.74	0.64	0.48	0.24	0.29	0.20	0.14	0.08	0.05	0.48	0.66
2011	40	0.46	0.54	0.50	0.30	0.30	0.32	0.16	0.13	0.11	0.09	0.12	0.64
2012	24	0.63	0.53	0.44	0.35	0.23	0.12	0.20	0.20	0.14	0.10	0.57	0.45
2013	22	0.44	0.38	0.39	0.33	0.15	0.15	0.17	0.10	0.06	0.35	0.49	0.53
2014	24	0.58	0.61	0.55	0.46	0.32	0.22	0.19	0.18	0.06	0.16	0.62	1.22
2015	24	0.75	0.90	0.83	0.64	0.39	0.26	0.22	0.15	0.03	0.02	0.72	1.05
2016	21	0.79	0.62	0.40	0.31	0.28	0.20	0.19	0.10	0.03	0.45	0.73	
2017	20		0.55	0.41	0.30	0.26	0.23	0.42	0.18	0.07	0.05	0.68	0.72
2018	18	0.60	0.67	0.49	0.38	0.29	0.19	0.21	0.10	0.05	0.03	0.15	0.71
POR Median		0.65	0.62	0.53	0.40	0.29	0.23	0.21	0.18	0.07	0.06	0.49	0.82

Key
nitrate in mg/L as N
N ≤ 0.1
0.1 < N ≤ 0.25
0.25 < N ≤ 0.6
0.6 < N ≤ 0.9
N > 0.9

July-September trend (low-flow high-sunlight period)



Graph Key

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

TRJB – Tualatin River at Hwy 219 – 14206241

Data source: Clean Water Services

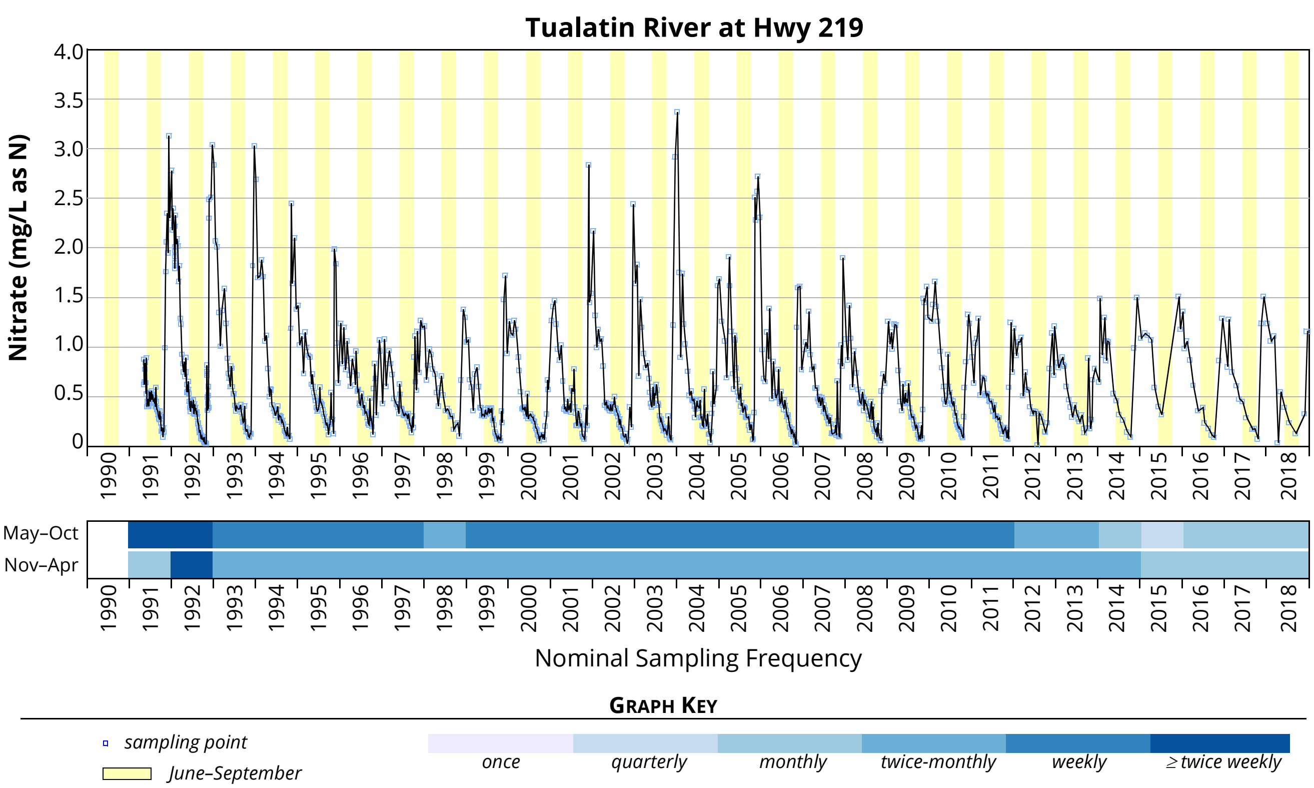
Sampling frequency

- The period of record is May 1991 through present.
- Sampling frequency was variable—every few days in 1991–1992, no more than once a month recently.
- Except for 1991–1992, sampling frequency likely was not adequate to fully characterize short-lived concentration spikes.

Concentrations & trends

- Nitrate (NO3) concentrations at Hwy 219 followed a seasonal pattern that reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.
  —Seasonal minimum (0.05–0.1 mg/L), usually October, duration of no more than a few weeks
  —Sharp increase to seasonal maximum (1.0–3.5 mg/L), usually November–January
  —Quick decline through winter (with many small spikes) to spring concentrations (<0.5 mg/L)
  —Slow decline through the summer to seasonal minimum
- The seasonal maximum concentration was generally pronounced and occurred at the beginning of the rainy season which indicates the importance of the first major rainstorm of the season. Because peak concentrations were shorter-lived than the usual sampling frequency, the graph below likely under-represents their magnitude. Targeted sampling of the first major rainstorm could determine if that is the case.
- The graph below suggests that annual maximum NO3 concentrations may have decreased in recent years. That conclusion is probably incorrect. Because peak NO3 concentrations are short-lived and occur in the November–April coarser sampling period, the chances of sampling exactly on the peak day are remote. If so, the graph below underestimates the magnitude of the high concentrations in general and may have missed the peak concentrations altogether in recent years.
- Median July–August NO3 concentrations show a decreasing trend, but it may be an artifact of less frequent sampling in recent years.

Time series



TRJB – Tualatin River at Hwy 219 – 14206241

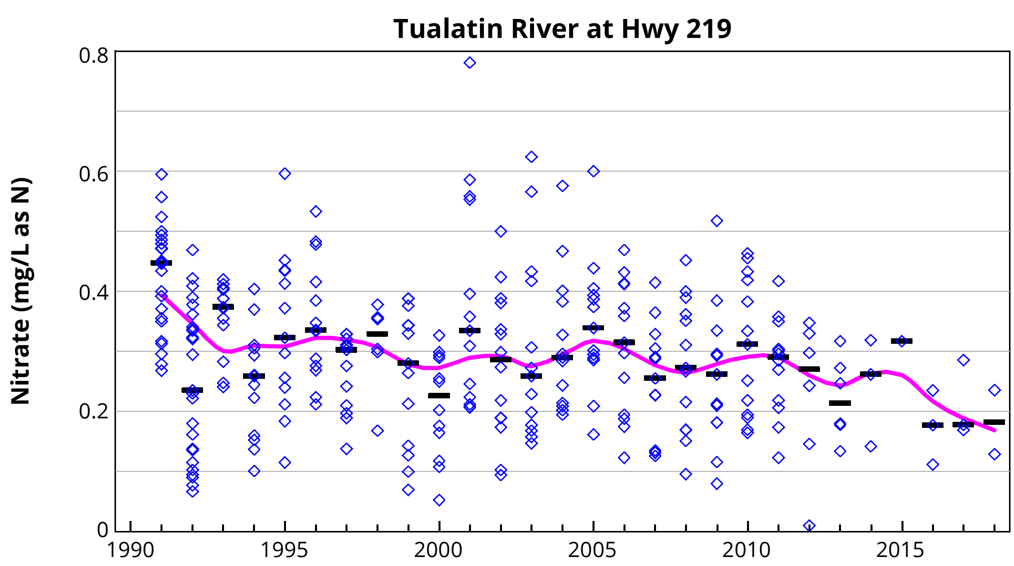
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — 14206241

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1991	55					0.71	0.44	0.49	0.45	0.31	0.16	1.91	2.30
1992	89	2.18	2.03	1.48	0.83	0.60	0.42	0.38	0.24	0.10	0.04	0.60	2.78
1993	40	2.46	1.68	1.19	1.42	0.71	0.60	0.40	0.37	0.27	0.16	0.11	2.43
1994	38	2.20	1.80	1.39	0.95	0.53	0.34	0.34	0.26	0.15	0.11	2.05	1.74
1995	40	1.22	0.92	1.07	0.91	0.60	0.38	0.44	0.31	0.20	0.27	1.84	0.84
1996	38	1.04	0.86	0.89	0.75	0.73	0.49	0.45	0.34	0.27	0.39	0.50	1.02
1997	38	0.76	0.72	0.83	0.48	0.40	0.45	0.32	0.29	0.20	0.77	0.94	1.24
1998	24	0.94	0.90	0.85	0.63	0.49	0.61	0.37	0.33	0.24	0.23	0.38	1.34
1999	38	1.06	0.63	0.54	0.70	0.35	0.33	0.36	0.28	0.11	0.08	0.36	1.33
2000	39	1.20	1.20	1.04	0.66	0.38	0.30	0.30	0.23	0.11	0.10	0.20	0.62
2001	40	1.34	1.35	0.92	0.66	0.38	0.37	0.56	0.27	0.24	0.10	0.39	1.50
2002	39	1.75	1.09	1.07	0.44	0.38	0.40	0.39	0.29	0.17	0.08	0.23	1.32
2003	38	1.74	1.09	1.07	0.82	0.49	0.51	0.50	0.27	0.17	0.15	0.07	2.07
2004	39	2.56	1.32	1.13	0.64	0.47	0.40	0.39	0.28	0.23	0.12	0.43	1.10
2005	39	1.48	1.06	1.30	1.39	0.79	0.52	0.42	0.37	0.25	0.19	2.51	2.52
2006	39	0.83	0.90	1.13	0.67	0.53	0.47	0.41	0.31	0.18	0.10	1.40	1.19
2007	41	1.01	1.17	0.85	0.59	0.46	0.45	0.33	0.24	0.13	0.22	0.48	1.35
2008	37	0.97	1.26	0.78	0.65	0.44	0.43	0.33	0.38	0.17	0.12	0.56	0.64
2009	39	1.15	1.07	1.23	0.61	0.44	0.48	0.36	0.26	0.15	0.09	1.45	1.46
2010	37	1.26	1.55	1.34	0.87	0.46	0.54	0.44	0.31	0.18	0.11	0.85	1.24
2011	38	0.77	1.07	0.90	0.69	0.53	0.45	0.35	0.29	0.19	0.15	0.17	1.00
2012	24	1.05	1.05	0.80	0.66	0.48	0.34	0.18	0.31	0.19	0.19	0.96	0.96
2013	23	0.82	0.87	0.82	0.54	0.34	0.38	0.26	0.25	0.16	0.53	0.47	0.78
2014	15	1.07	1.11	0.96	1.05	0.53	0.46	0.32	0.26	0.14	0.09	0.99	1.50
2015	9	1.09	1.14	1.12	1.07	0.59	0.40	0.32					1.35
2016	13	1.17	1.06	0.87	0.61	0.36	0.39	0.24	0.18	0.11	0.09	0.86	1.29
2017	12	0.80	1.28	0.75	0.61	0.48	0.45	0.29	0.17	0.18	0.07	1.24	1.51
2018	10	1.24	1.06	1.11	0.03	0.55	0.39	0.24		0.13		0.33	1.16
POR MEDIAN		1.15	1.09	1.04	0.66	0.48	0.44	0.36	0.29	0.18	0.12	0.56	1.32

KEY	
nitrate in mg/L as N	
N ≤ 0.2	
0.2 < N ≤ 0.4	
0.4 < N ≤ 0.8	
0.8 < N ≤ 1.3	
N > 1.3	

July-September trend (low-flow high-sunlight period)



GRAPH KEY

- ◇ value
- — Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

ROOD – Tualatin River at Rood Bridge Rd – 14206295

Data source: Clean Water Services

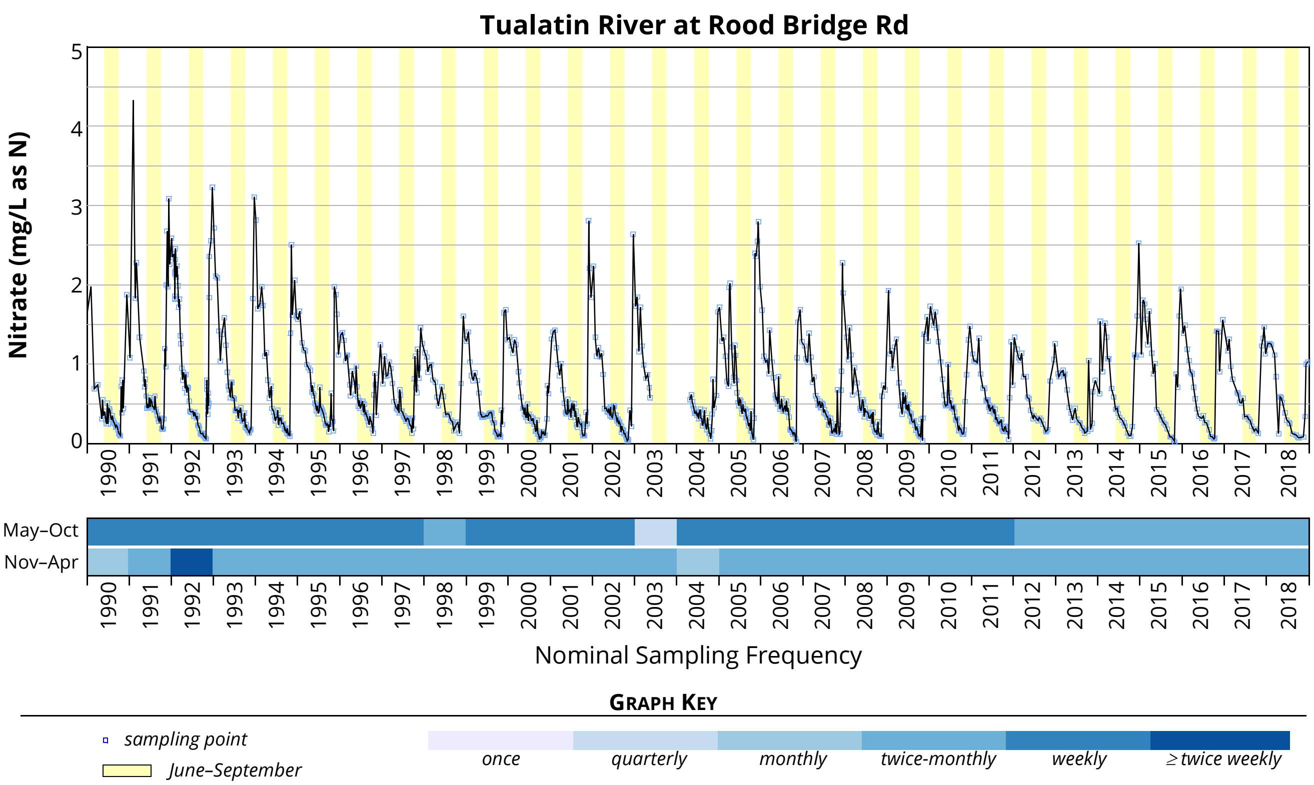
Sampling frequency

- The period of record is January 1990 through present, except for June-2003 through March-2004 when sampling was suspended due to bridge construction.
- Sampling frequency was variable. In winter, sampling was usually twice a month. In summer, sampling was usually weekly until 2012 when it was decreased to twice a month.

Concentrations & trends

- Nitrate (NO3) concentrations followed a seasonal pattern that reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.
  —Seasonal minimum (0.05–0.1 mg/L), usually October, duration of no more than a few weeks
  —Sharp increase to seasonal maximum (1.5–3.5 mg/L), usually November–December
  —Quick decline through winter (with many small spikes) to spring concentrations (<0.5 mg/L)
  —Slow decline through the summer to seasonal minimum
- The seasonal maximum concentration was generally pronounced and occurred at the beginning of the rainy season which indicates the importance of the first major rainstorm of the season. Because peak concentrations were shorter-lived than the usual sampling frequency, the graph below likely under-represents their magnitude. Targeted sampling of the first major rainstorm could determine if that is the case.
- The graph below suggests that peak NO3 concentrations may have decreased in recent years. That conclusion is unwarranted because the sampling frequency decreased at the same time.
- July–September NO3 concentrations show a statistically significant decreasing trend. Interpretation is complicated because the lower concentrations occurred since 2013 when sampling was less frequent than in previous years. The medians in recent years may be lower because the less frequent sampling missed short-lived spikes in NO3 concentrations that, although small, still occur during the summer.

Time series



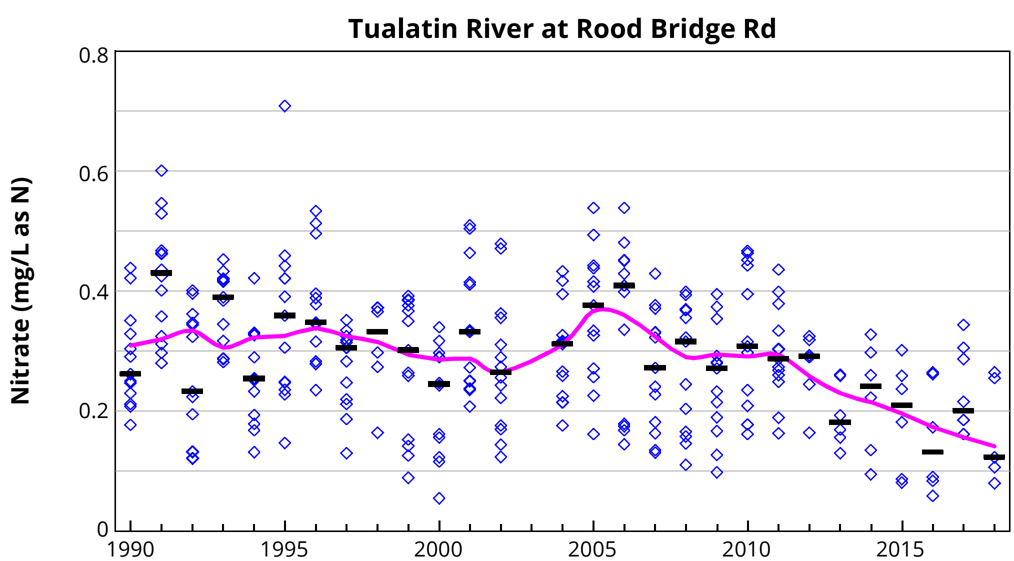
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — 14206295

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	33	1.64	1.98	0.69	0.74	0.38	0.33	0.33	0.28	0.21	0.13	0.62	1.88
1991	38	1.08	3.08	2.28	1.34	0.76	0.47	0.47	0.43	0.31	0.19	1.60	2.26
1992	64	2.35	2.17	1.54	0.87	0.71	0.41	0.38	0.23	0.13	0.08	0.64	2.90
1993	40	2.42	1.76	1.21	1.42	0.70	0.58	0.42	0.39	0.29	0.19	0.17	2.47
1994	38	2.26	1.88	1.42	0.98	0.61	0.34	0.33	0.26	0.17	0.13	2.07	1.83
1995	40	1.62	1.23	1.08	0.94	0.63	0.44	0.44	0.33	0.23	0.28	1.88	1.38
1996	37	1.39	1.10	0.93	0.76	0.74	0.51	0.50	0.36	0.28	0.40	0.55	1.25
1997	38	0.93	0.86	0.95	0.53	0.43	0.51	0.32	0.31	0.21	0.77	0.96	1.36
1998	23	1.12	0.94	0.90	0.68	0.48	0.66	0.37	0.34	0.22	0.26	0.44	1.47
1999	38	1.35	0.95	0.84	0.72	0.35	0.35	0.38	0.30	0.13	0.10	0.42	1.50
2000	39	1.29	1.23	1.08	0.68	0.44	0.35	0.30	0.20	0.12	0.13	0.11	0.68
2001	40	1.37	1.32	0.93	0.68	0.39	0.40	0.46	0.29	0.25	0.11	0.40	2.03
2002	39	1.79	1.16	1.12	0.45	0.40	0.35	0.36	0.27	0.17	0.07	0.24	1.43
2003	10	1.79	1.44	1.11	0.85	0.64							
2004	32				0.55	0.50	0.38	0.36	0.27	0.21	0.13	0.45	1.13
2005	41	1.51	1.22	0.79	1.62	0.84	0.54	0.47	0.41	0.24	0.15	2.40	2.39
2006	39	1.39	1.04	1.15	0.93	0.59	0.48	0.43	0.43	0.17	0.12	1.31	1.49
2007	41	1.15	1.21	0.93	0.60	0.49	0.48	0.37	0.26	0.15	0.23	0.40	2.09
2008	37	1.20	1.29	0.79	0.70	0.45	0.42	0.35	0.36	0.16	0.13	0.60	0.68
2009	39	1.53	1.06	1.27	0.62	0.52	0.49	0.36	0.27	0.16	0.10	1.38	1.45
2010	38	1.67	1.58	1.37	0.92	0.49	0.55	0.46	0.31	0.18	0.13	0.87	1.48
2011	40	1.09	1.03	1.10	0.70	0.53	0.44	0.39	0.27	0.23	0.16	0.15	1.01
2012	23	1.27	1.07	0.99	0.72	0.49	0.33	0.30	0.31	0.20	0.16	0.79	1.16
2013	23	0.86	0.91	0.87	0.57	0.34	0.38	0.26	0.18	0.14	0.61	0.46	0.80
2014	24	1.08	1.21	1.21	0.88	0.51	0.41	0.31	0.24	0.12	0.16	1.11	2.07
2015	24	1.47	1.67	1.46	1.01	0.72	0.36	0.28	0.21	0.08	0.03	0.79	1.78
2016	23	1.44	1.12	0.89	0.64	0.39	0.33	0.26	0.13	0.07	0.75	1.16	1.56
2017	22	1.17	1.15	0.81	0.64	0.52	0.46	0.33	0.25	0.17	0.15	1.28	1.30
2018	21	1.26	1.25	0.98	0.36	0.55	0.34	0.26	0.12	0.09	0.07	0.21	1.02
POR MEDIAN		1.38	1.22	1.04	0.72	0.51	0.42	0.36	0.28	0.17	0.14	0.63	1.47

KEY
nitrate in mg/L as N
N ≤ 0.25
0.25 < N ≤ 0.4
0.4 < N ≤ 0.9
0.9 < N ≤ 1.5
N > 1.5

JULY-SEPTEMBER TREND (LOW-FLOW HIGH-SUNLIGHT PERIOD)



GRAPH KEY

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

TRSC – Tualatin River at Hwy 210 (Scholls Bridge) – 14206690

Data source: Clean Water Services

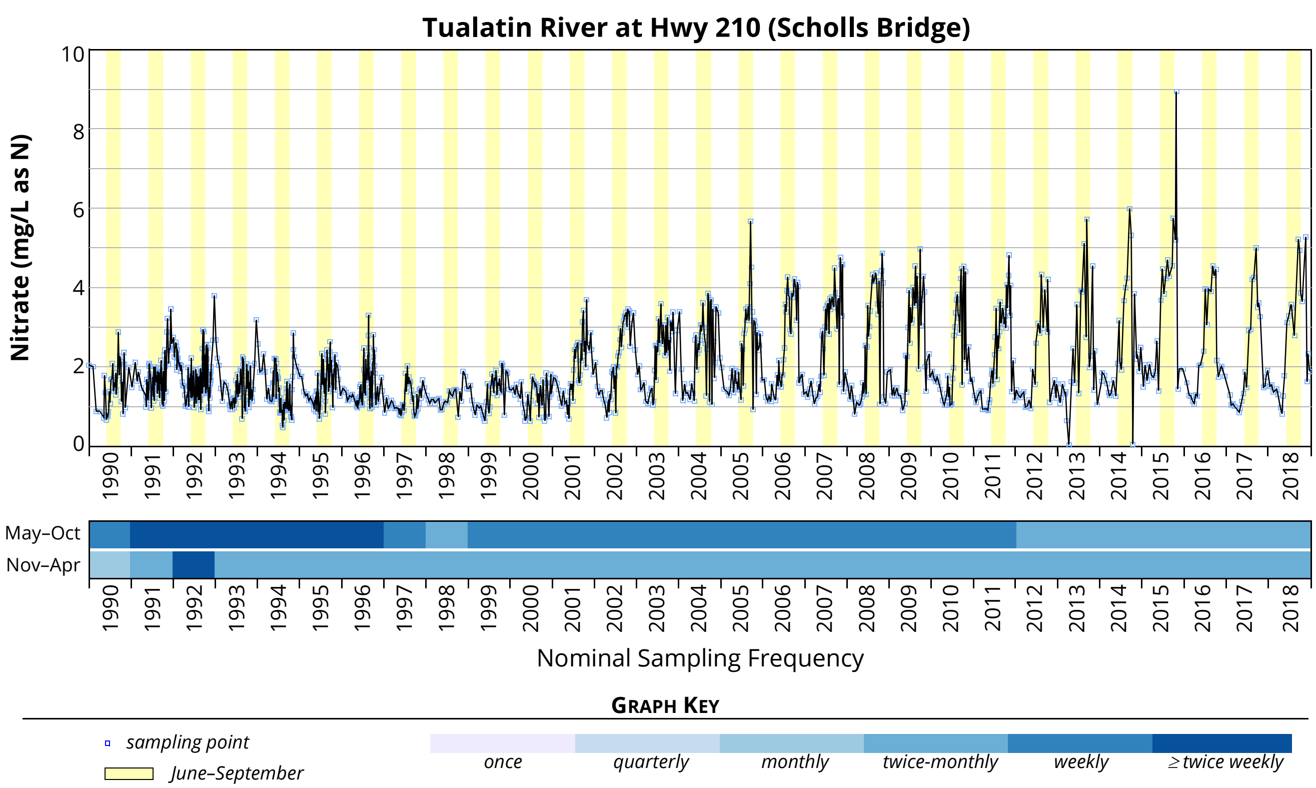
Sampling frequency

- The period of record is January 1990 through present.
- Sampling frequency was quite variable during May–October, ranging from two or more times a week to twice a month. November–April sampling was usually twice a month.

Concentrations & trends

- Nitrate (NO3) concentrations in the Tualatin River at Hwy 210 were considerably higher than those at upstream sites. This site is strongly influenced by effluent from the Rock Creek WWTF (RC-WWTF). Concentrations have a seasonal pattern that changed over the period of record.
- Before 1997, the RC-WWTF had not yet been expanded. NO3 concentrations followed a seasonal pattern somewhat similar to that of the upstream sites, but far noisier.
  —Minimum NO3 concentrations in late spring rather than October: NO3 from effluent was large enough to mask the natural concentration decrease in summer
  —Maximum concentrations often in early winter: rainstorms were still important
  —Sample-to-sample variability often as much as seasonal variation: WWTF operations affected NO3
- From 1997–2001, the RC-WWTF was being expanded and the data have no obvious seasonal pattern.
- By 2001, discharges from the RC-WWTF had doubled and effluent accounted for about 20% of river flow. The new seasonal pattern is dominated by NO3 releases from the RC-WWTF that swamp other sources.
  —Lowest NO3 concentrations in winter: minimal nitrification at WWTF and dilution by high river flow
  —Highest NO3 concentrations in summer: nitrification at RC-WWTF and less dilution during low river flow
- The July–September NO3 concentration shows a marked increasing trend over the period of record that can be explained by RC-WWTF expansion. Low NO3 concentrations in 2010–2012 were because wet spring weather caused higher summer streamflow which increased the dilution of RC-WWTF effluent.

Time series



TRSC – Tualatin River at Hwy 210 (Scholls Bridge) – 14206690

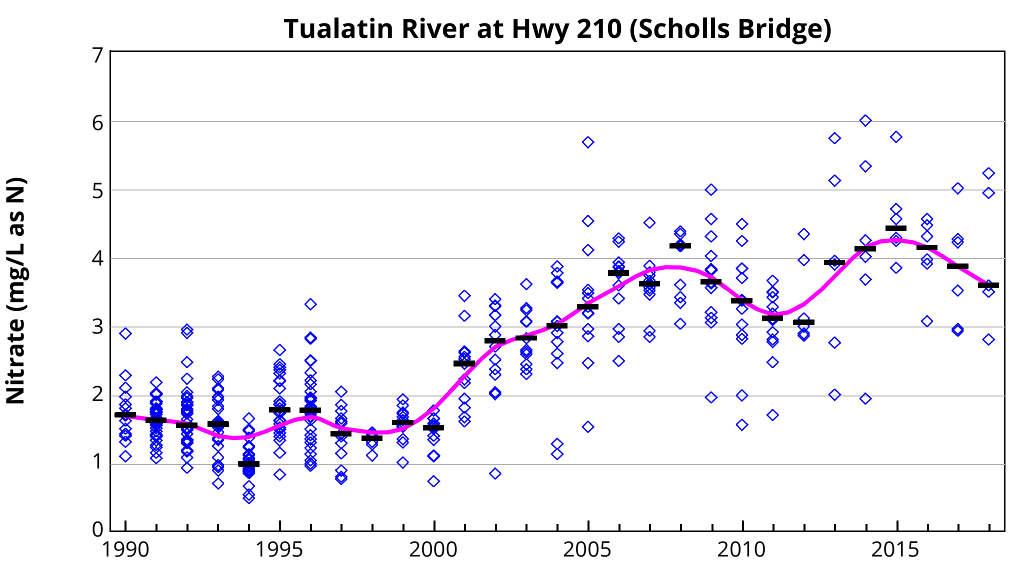
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — 14206690

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	34	2.04	2.01	0.88	0.89	1.03	0.83	1.68	1.49	2.12	1.63	1.52	1.99
1991	80	1.49	1.88	1.88	1.47	1.25	1.70	1.57	1.63	1.58	1.56	2.66	2.58
1992	114	2.43	2.17	1.76	1.30	1.47	1.43	1.40	1.42	1.84	1.82	1.50	3.24
1993	68	2.45	1.75	1.38	1.46	1.04	1.20	1.51	1.91	1.35	1.45	1.39	2.65
1994	64	2.23	2.13	1.54	1.31	1.43	1.73	0.97	0.90	1.00	0.98	2.44	1.96
1995	65	1.76	1.33	1.24	1.19	1.08	1.06	1.69	1.58	1.97	1.82	2.05	1.48
1996	70	1.44	1.20	1.26	1.26	1.09	1.23	1.82	1.74	1.76	1.57	1.32	1.57
1997	38	1.04	1.00	1.08	0.97	0.88	0.97	1.71	1.62	0.88	1.02	1.42	1.58
1998	24	1.23	1.13	1.14	1.19	0.92	1.10	1.25	1.28	1.44	1.06	1.52	1.62
1999	38	1.50	1.05	0.91	0.99	0.75	1.08	1.53	1.66	1.56	1.72	1.51	1.65
2000	41	1.45	1.43	1.27	1.34	0.73	1.04	1.64	1.41	1.25	1.03	1.60	1.46
2001	40	1.72	1.51	1.12	1.15	0.92	1.50	2.44	1.73	2.87	2.56	2.54	2.13
2002	39	1.82	1.35	1.30	1.04	1.25	1.82	2.02	2.78	3.28	3.38	2.81	2.90
2003	38	1.92	1.46	1.38	1.20	1.30	2.37	3.14	2.73	2.43	2.89	3.15	2.13
2004	39	2.68	1.36	1.35	1.39	2.01	2.43	3.06	2.59	3.70	3.05	2.11	2.80
2005	40	1.72	1.38	1.44	1.66	1.63	1.44	2.65	3.27	4.31	3.03	2.55	2.26
2006	39	1.47	1.20	1.36	1.21	1.66	1.81	3.58	3.36	3.86	4.03	1.65	1.57
2007	40	1.31	1.55	1.20	1.26	2.29	2.74	3.55	3.63	3.87	3.67	3.94	1.75
2008	35	1.33	1.38	0.96	1.06	1.40	2.55	3.22	4.18	4.16	4.01	1.25	1.88
2009	38	1.61	1.38	1.38	1.09	1.37	3.00	3.50	3.82	3.34	3.87	2.01	2.03
2010	38	1.80	1.69	1.53	1.10	1.29	1.07	2.91	3.37	4.03	3.46	1.90	1.69
2011	40	1.20	1.30	1.17	0.94	1.18	1.91	2.78	3.10	3.34	4.07	3.30	1.66
2012	24	1.36	1.28	1.18	1.10	1.45	2.08	2.98	3.66	3.42	2.66	1.54	1.40
2013	23	1.16	1.45	1.01	0.84	2.04	2.46	3.92	3.93	3.86	3.42	1.92	1.05
2014	24	1.75	1.69	1.32	1.51	1.68	2.66	2.80	4.12	5.66	1.95	2.27	2.20
2015	25	1.78	1.72	1.93	1.82	2.03	4.08	4.04	4.49	5.15	7.07	1.95	1.93
2016	42	1.62	1.34	1.14	1.32	2.27	3.19	3.77	4.26	4.03	1.96	1.77	1.77
2017	44	1.30	1.08	1.05	1.00	1.24	2.00	3.09	4.11	3.61	3.76	1.51	1.82
2018	22	1.53	1.37	1.38	0.90	1.53	3.21	3.54	2.79	5.08	3.76	3.46	2.11
POR Median		1.61	1.38	1.27	1.19	1.30	1.81	2.78	2.78	3.34	2.66	1.92	1.88

Key
nitrate in mg/L as N
N ≤ 1.2
1.2 < N ≤ 1.5
1.5 < N ≤ 2.1
2.1 < N ≤ 3.5
N > 3.5

July-September trend (low-flow high-sunlight period)



Graph Key

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

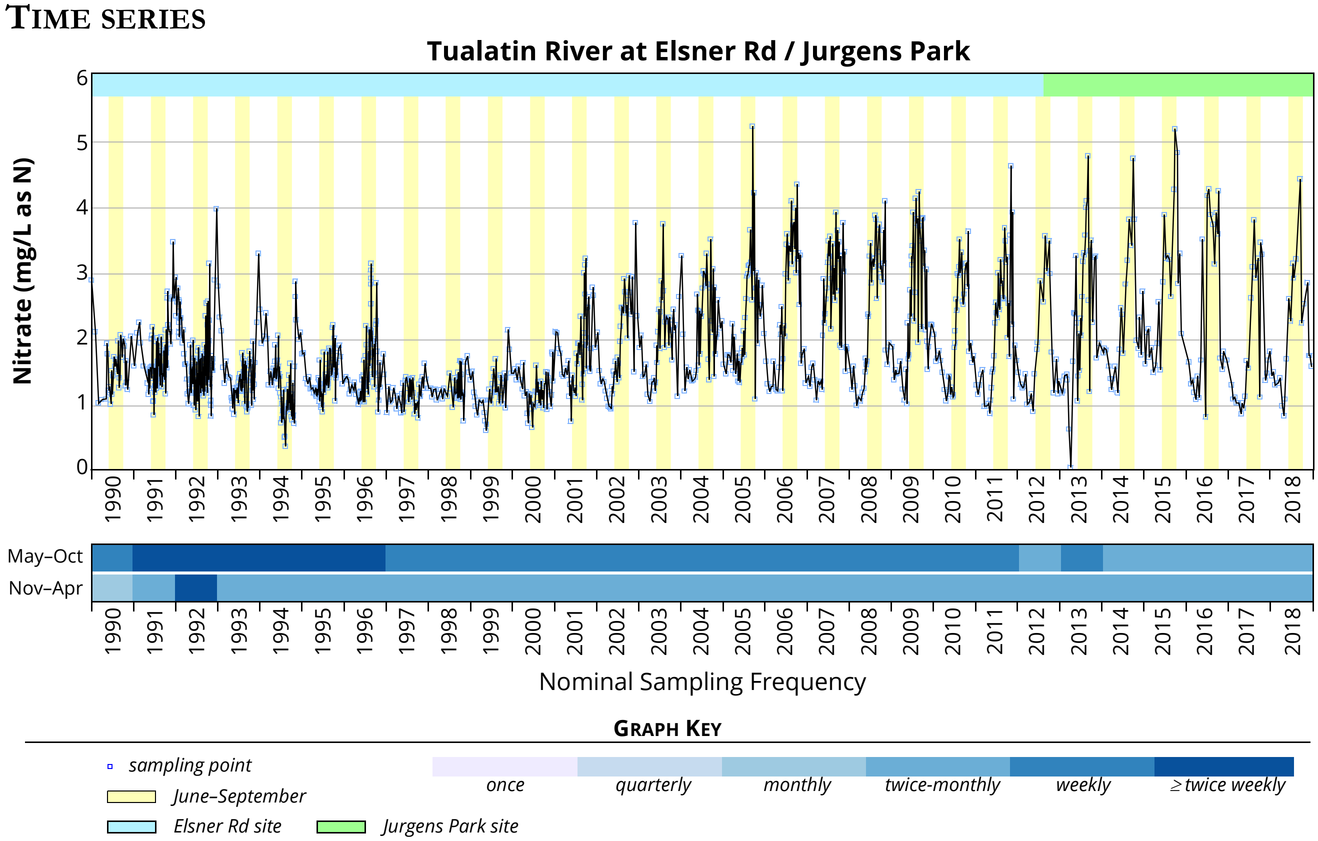
Sampling frequency & location

- The period of record is January 1990 through present. Sampling frequency was variable during May–October, ranging from twice a week to twice a month. November–April sampling was usually twice a month.
- In 2012, the site location moved from Elsner Road (RM 16.2) to Jurgens Park (RM 10.8). Two tributaries (Chicken and South Rock Creeks) enter the Tualatin River between the two sites. The Tualatin River National Wildlife Refuge is between the sites, as is US Hwy 99W. The extent to which the tributaries, the wetlands at the refuge, or the highway affect nutrient concentrations in the river is unknown.

Concentrations & trends

- Nitrate (NO3) concentrations in the Tualatin River at Elsner/Jurgens are strongly influenced by effluent from the Rock Creek WWTF (RC-WWTF). NO3 has a seasonal pattern that has changed over time.
- Before 1997, the RC-WWTF had not yet been expanded. NO3 concentrations followed a seasonal pattern somewhat similar to that of the upstream sites, but far noisier.
  - —Minimum NO3 concentrations in late spring rather than October: NO3 from effluent was large enough to mask the natural concentration decrease in summer
  - —Maximum concentrations in early winter: rainstorms were still important
  - —Sample-to-sample variability often as much as seasonal variation: WWTF operations affected NO3
- From 1997–2001, the RC-WWTF was being expanded and the data have no obvious seasonal pattern.
- By 2001, discharges from the RC-WWTF had doubled and effluent accounted for about 20% of river flow. The new seasonal pattern is dominated by NO3 releases from the RC-WWTF that swamp other sources.
  - —Lowest NO3 concentrations in winter: minimal nitrification at WWTF and dilution by high river flow
  - —Highest NO3 concentrations in summer: nitrification at RC-WWTF and less dilution during low river flow
- The July–September NO3 concentration shows a marked increasing trend over the period of record that can be explained by RC-WWTF expansion. Low NO3 concentrations in 2010–2012 were because wet spring weather caused higher summer streamflow which increased the dilution of RC-WWTF effluent.

Time series



TREL / TRJU – Tualatin River at Elsner Rd / Jurgens Park

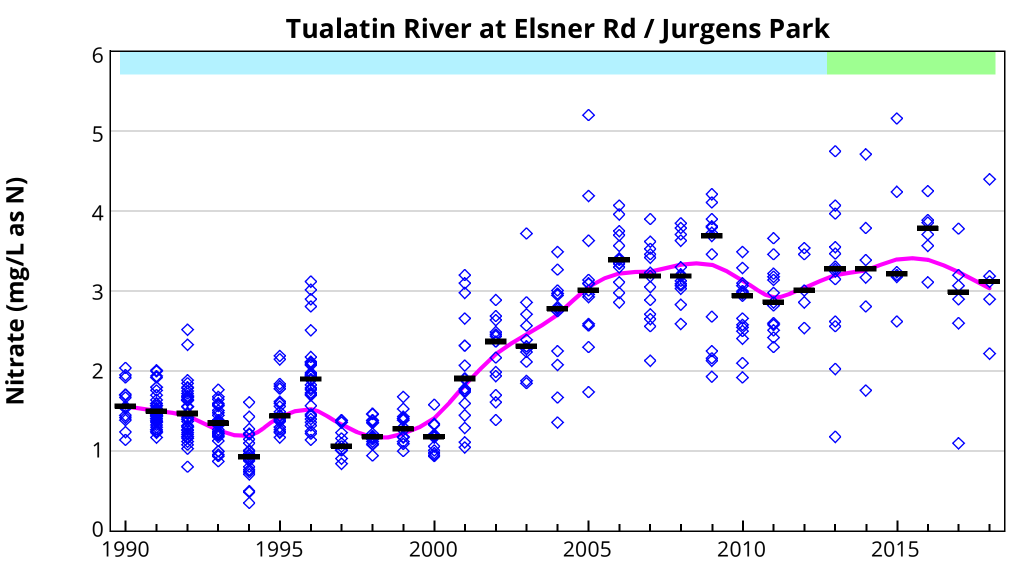
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — TREL / TRJU

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	33	2.87	2.09	1.01	1.06	1.48	1.21	1.56	1.50	1.81	1.87	1.27	2.02
1991	79	1.57	2.15	1.92	1.57	1.48	1.53	1.52	1.60	1.44	1.82	2.09	2.61
1992	115	2.54	2.29	1.84	1.18	1.34	1.52	1.39	1.48	1.55	1.90	1.51	3.41
1993	68	2.55	1.83	1.48	1.40	1.07	1.19	1.32	1.48	1.13	1.52	1.36	2.75
1994	64	2.17	2.20	1.63	1.39	1.49	1.43	0.85	0.88	1.15	0.82	2.62	2.03
1995	65	1.76	1.34	1.31	1.20	1.22	1.10	1.34	1.38	1.59	1.55	1.78	1.51
1996	70	1.40	1.22	1.24	1.23	1.08	1.31	1.73	2.08	1.77	1.61	1.44	1.60
1997	38	1.06	1.04	1.12	1.12	1.07	1.19	1.17	1.26	1.01	1.12	1.34	1.49
1998	41	1.23	1.16	1.14	1.18	1.15	1.14	1.34	1.16	1.17	1.17	1.18	1.60
1999	40	1.43	1.10	0.94	1.03	0.71	1.05	1.36	1.22	1.24	1.26	1.39	1.64
2000	41	1.50	1.46	1.29	1.37	0.99	0.95	1.18	1.11	1.13	1.30	1.18	1.55
2001	47	2.08	1.80	1.43	1.54	1.20	1.22	1.76	1.74	2.49	2.00	1.83	2.25
2002	39	1.79	1.34	1.26	0.96	1.21	1.44	1.70	2.45	2.49	2.54	2.20	3.04
2003	38	1.94	1.43	1.37	1.18	1.33	1.88	2.72	2.28	2.28	2.15	2.15	1.87
2004	39	2.65	1.37	1.44	1.35	1.96	2.32	2.96	2.78	2.50	2.26	2.05	2.20
2005	41	1.52	1.74	1.62	1.73	1.62	1.78	2.45	3.10	3.60	2.75	2.49	2.43
2006	39	1.47	1.22	1.45	1.20	2.05	2.10	3.39	3.50	3.55	3.25	1.68	1.57
2007	41	1.34	1.58	1.21	1.34	2.13	2.67	3.23	2.85	3.41	3.23	3.15	1.85
2008	38	1.36	1.42	1.04	1.11	1.54	2.35	3.10	3.50	3.30	3.02	1.81	1.92
2009	42	1.61	1.48	1.55	1.14	1.60	2.91	2.68	3.73	3.46	3.06	1.86	2.20
2010	40	1.85	1.75	1.56	1.13	1.29	1.21	2.41	3.09	2.61	3.13	1.79	1.72
2011	40	1.21	1.36	1.23	0.98	1.24	2.30	2.47	2.82	3.34	2.52	2.20	1.77
2012	23	1.38	1.25	1.22	1.09	1.17	1.88	2.86	3.04	3.24	2.38	1.42	1.25
2013	35	1.18	1.43	0.99	0.84	2.36	1.78	3.15	4.02	2.94	2.72	2.46	1.91
2014	24	1.81	1.69	1.30	1.47	1.49	2.40	2.29	3.48	4.05	2.88	2.07	2.22
2015	22	1.84	1.92	1.66	1.75	2.03	3.35	3.22	2.90	4.70	3.81	2.67	
2016	22	1.63	1.33	1.12	1.26	2.58	2.47	4.06	3.41	3.73	2.96	1.66	1.66
2017	23	1.28	1.09	1.01	0.93	1.02	1.60	2.84	3.34	2.15	3.35	1.41	1.73
2018	21	1.45	1.28	1.35	0.89	1.38	2.42	3.01	3.19	3.31	2.51	2.28	1.65
POR Median		1.57	1.43	1.30	1.18	1.34	1.60	2.41	2.78	2.49	2.38	1.81	1.86

Key
nitrate in mg/L as N
N ≤ 1.2
1.2 < N ≤ 1.5
1.5 < N ≤ 2
2 < N ≤ 3
N > 3

July-September trend (low-flow high-sunlight period)



Graph Key

- Elsner Rd site
- Jurgens Park site
- ◇ value
- — Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

SAMPLING FREQUENCY

- The period of record is January 1990 through present. Sampling frequency was variable during May–October, ranging from twice a week to twice a month. November–April sampling was usually twice a month.

CONCENTRATIONS & TRENDS

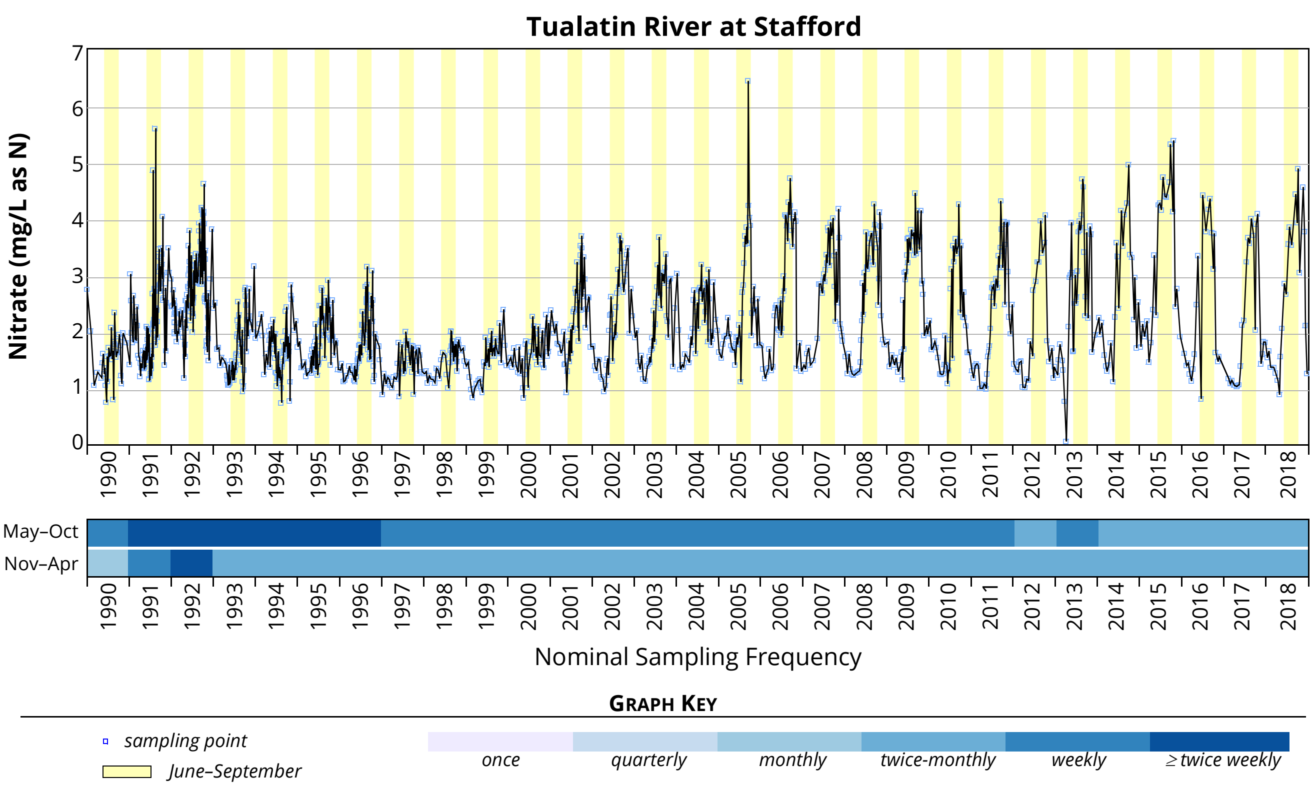
- Nitrate (NO3) concentrations at the Stafford Rd site are strongly influenced by effluent from the Durham WWTF (D-WWTF) and to a lesser extent by the Rock Creek WWTF (RC-WWTF). NO3 follows a seasonal pattern that has become more pronounced over time.

- From 1991–2005, the seasonal pattern, while present, was noisy, with many concentration spikes.
  —Low NO3 concentrations throughout winter were related to minimal nitrification at D-WWTF and dilution by high river flow. The lowest concentrations occurred in late spring.
  —NO3 concentrations increased steadily through summer reaching their highest values in late fall. Because of nitrification at the D-WWTF, more NO3 entered the river. Dilution of effluent by river flow decreased until the rainy season started sometime in fall.
  —Sample-to-sample variability, with many small concentrations, was often as much as seasonal variation. Some of the variability may have been due to WWTF operations.

- By 2001, the seasonal pattern at Stafford was clearer. By 2005, the pattern had wider amplitude, was less noisy, and the seasonal minimum concentrations had increased. The wider amplitude and increase in minimum concentrations were probably due to NO3 from the recently-expanded RC-WWTF. The decreased noise may be related to less frequent sampling that did not capture short-lived NO3 spikes.

- The July–September NO3 concentrations show a marked increase over the period of record that can be explained by an increasing volume of treated effluent, mostly from the RC-WWTF. NO3 concentrations in 2010–2012 were low because wet spring weather caused higher river flows and more effluent dilution.

TIME SERIES



TRST – Tualatin River at Stafford Rd – 14207050

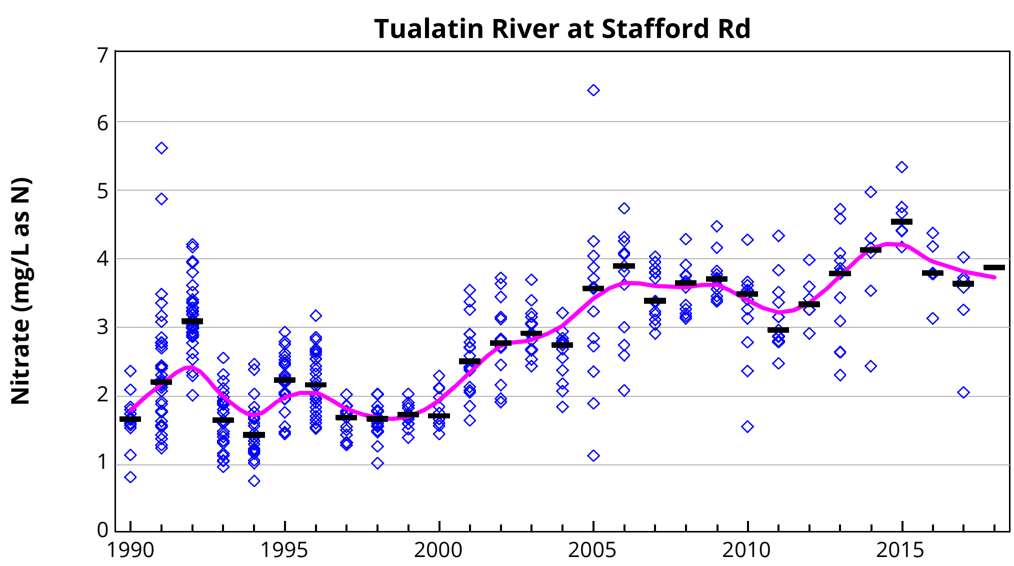
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — 14207050

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	34	2.75	2.01	1.05	1.28	1.35	1.21	1.58	1.66	1.64	1.75	1.94	1.80
1991	92	2.27	2.17	1.98	1.44	1.44	1.65	1.55	2.19	2.79	3.03	2.09	3.04
1992	115	2.46	2.16	2.12	2.21	2.45	2.93	2.81	3.09	3.49	3.43	1.88	3.37
1993	68	2.46	1.71	1.47	1.45	1.15	1.32	1.46	1.87	1.32	2.34	2.21	2.58
1994	64	1.93	2.23	1.59	1.52	1.85	1.74	1.24	1.20	1.74	1.65	2.64	2.11
1995	65	1.78	1.38	1.34	1.29	1.57	1.59	2.19	2.11	2.47	2.16	1.88	1.57
1996	65	1.38	1.14	1.31	1.28	1.29	1.52	1.98	2.55	1.94	2.30	1.92	1.62
1997	38	1.07	1.14	1.05	1.20	1.33	1.44	1.39	1.78	1.66	1.58	1.48	1.44
1998	41	1.28	1.16	1.16	1.22	1.24	1.57	1.41	1.67	1.65	1.71	1.72	1.60
1999	39	1.43	1.09	0.91	1.11	1.02	1.46	1.60	1.71	1.70	1.73	1.90	1.58
2000	41	1.51	1.54	1.35	1.50	1.24	1.43	1.73	1.80	1.66	1.58	1.96	1.69
2001	47	2.26	2.06	1.78	1.71	1.36	1.70	2.11	2.68	2.79	3.00	2.40	2.17
2002	39	1.57	1.41	1.35	1.05	1.47	2.30	1.94	2.95	3.13	3.12	2.73	2.52
2003	38	1.96	1.40	1.37	1.26	1.51	1.89	2.72	2.85	3.02	2.23	2.93	1.90
2004	39	2.53	1.37	1.49	1.49	1.99	2.35	2.74	2.66	2.59	2.29	1.98	2.12
2005	41	1.59	1.85	1.93	1.86	1.68	1.91	2.10	3.54	4.13	2.55	2.37	2.18
2006	38	1.55	1.23	1.53	1.35	2.42	2.21	2.72	3.96	4.15	3.95	1.35	1.55
2007	36	1.38	1.67	1.41	1.49	2.36	2.79	3.09	3.81	3.73	2.59	2.90	1.88
2008	38	1.41	1.48	1.24	1.28	1.66	2.86	3.22	3.69	3.74	3.21	2.28	1.77
2009	40	1.60	1.54	1.48	1.35	1.67	3.14	3.60	3.70	3.64	3.56	2.66	2.04
2010	38	1.94	1.78	1.63	1.25	1.42	1.32	2.94	3.46	3.55	2.70	2.10	1.64
2011	40	1.25	1.42	1.19	1.04	1.25	2.34	2.77	2.94	3.65	3.54	3.06	2.22
2012	24	1.38	1.38	1.25	1.09	1.49	2.15	3.06	3.60	3.48	2.95	1.59	1.28
2013	35	1.37	1.64	1.04	1.07	3.00	2.50	3.76	4.31	3.02	3.05	2.68	1.94
2014	24	2.10	1.88	1.35	1.61	1.69	3.45	3.28	3.79	4.61	3.34	2.59	2.12
2015	23	1.93	1.94	1.83	2.10	2.82	4.26	4.44	4.39	4.98	4.75	2.60	1.91
2016	20	1.62	1.43	1.19	1.47	2.91	2.61	3.77	4.26	3.43	2.68	1.52	
2017	22		1.13	1.10	1.04	1.23	2.16	3.45	3.78	2.87	3.99	1.52	1.82
2018	22	1.60	1.37	1.32	1.01	1.81	2.76	3.70	3.53	4.18	3.96	4.16	1.69
POR MEDIAN		1.60	1.48	1.35	1.29	1.51	2.15	2.72	2.95	3.02	2.70	2.10	1.89

KEY
nitrate in mg/L as N
N ≤ 1.4
1.4 < N ≤ 1.8
1.8 < N ≤ 2.7
2.7 < N ≤ 3.5
N > 3.5

July-September trend (low-flow high-sunlight period)



GRAPH KEY

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

GCNH – Gales Creek at New Hwy 47

Data source: Clean Water Services

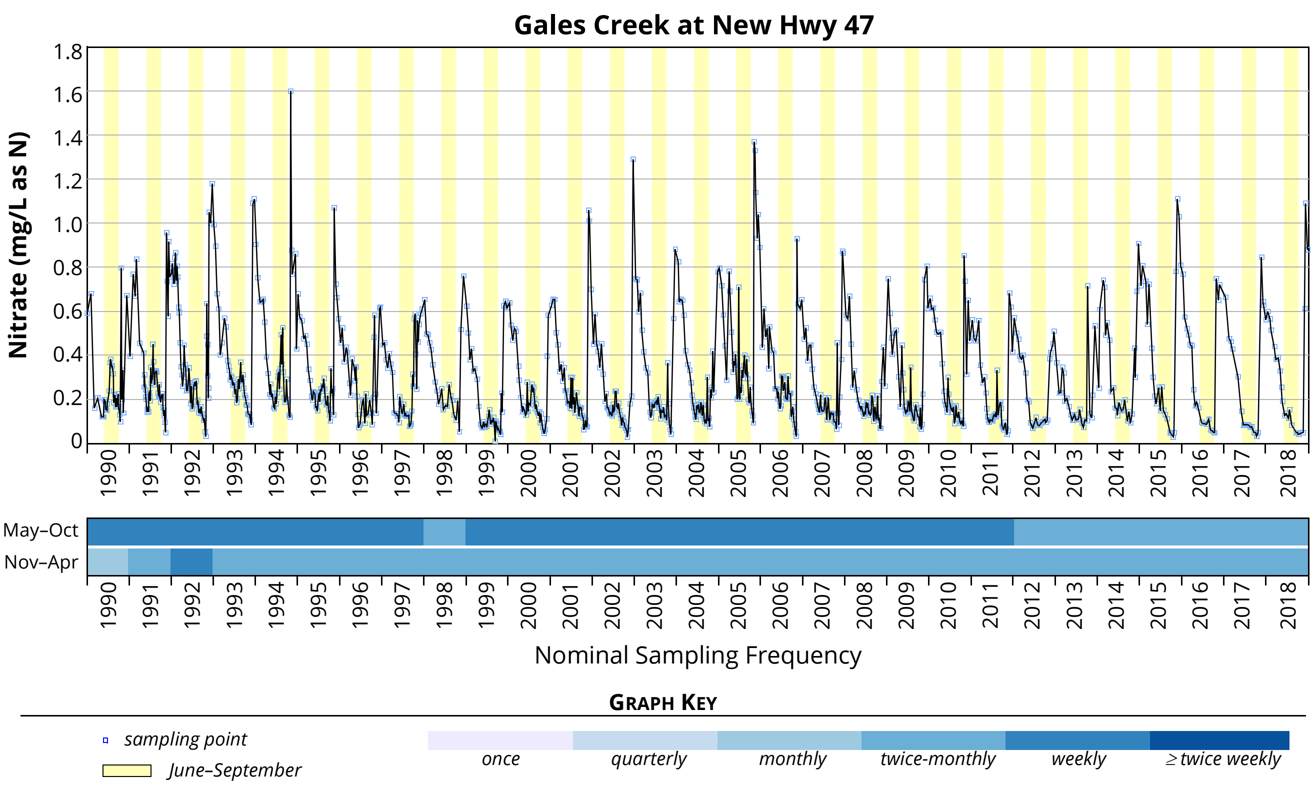
Sampling frequency

- The period of record is January 1990 through present.
- The sampling frequency was mostly weekly for May–October and every two weeks for November–April. Since 2012, the May–October sampling frequency decreased to every two weeks.
- Except for a brief time in 1992, sampling frequency likely was not adequate to fully characterize the conditions associated with high flows, especially in winter.

Concentrations & trends

- Nitrate (NO3) concentrations in Gales Creek followed a seasonal pattern that reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.
  —Seasonal minimum (about 0.1 mg/L), usually October, duration of no more than a few weeks
  —Sharp increase to seasonal maximum, usually November–December
  —Quick decline through winter (with many small spikes) to spring concentrations < 0.3 mg/L
  —Slow decline through the summer to seasonal minimum
- The seasonal maximum concentration was generally pronounced and occurred at the beginning of the rainy season which indicates the importance of the first major rainstorm of the season. Because peak concentrations were shorter-lived than the usual sampling frequency, the graph below likely under-represents their magnitude. Targeted sampling of the first major rainstorm could determine if that is the case.
- July–September NO3 concentrations show a statistically significant decreasing trend. The reason is unknown.

Time series



GCNH – Gales Creek at New Hwy 47

Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — GCNH

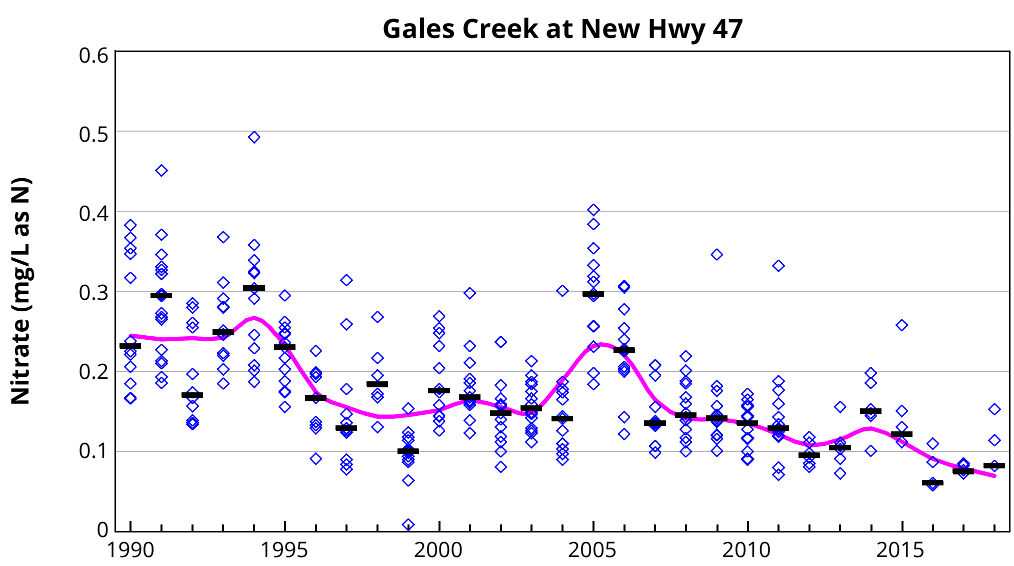
	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	32	0.59	0.68	0.16	0.21	0.12	0.17	0.37	0.32	0.19	0.17	0.24	0.67
1991	50	0.40	0.72	0.84	0.46	0.25	0.16	0.30	0.32	0.21	0.21	0.42	0.76
1992	58	0.78	0.78	0.53	0.31	0.26	0.26	0.26	0.17	0.14	0.08	0.45	1.09
1993	39	0.94	0.65	0.43	0.55	0.34	0.28	0.21	0.29	0.27	0.17	0.12	1.10
1994	38	0.83	0.64	0.60	0.36	0.22	0.17	0.28	0.36	0.20	0.16	0.88	0.64
1995	40	0.63	0.52	0.47	0.31	0.22	0.17	0.23	0.26	0.17	0.23	0.72	0.61
1996	35	0.49	0.41	0.34	0.30	0.31	0.09	0.18	0.13	0.17	0.21	0.18	0.62
1997	38	0.45	0.36	0.38	0.23	0.13	0.17	0.13	0.13	0.15	0.49	0.54	0.60
1998	23	0.58	0.48	0.39	0.26	0.19	0.20	0.17	0.22	0.13	0.15	0.29	0.76
1999	37	0.56	0.41	0.33	0.23	0.08	0.09	0.12	0.10	0.08	0.06	0.23	0.63
2000	39	0.59	0.50	0.43	0.25	0.15	0.16	0.25	0.20	0.14	0.09	0.06	0.49
2001	40	0.64	0.58	0.39	0.32	0.24	0.18	0.18	0.19	0.16	0.11	0.08	0.85
2002	39	0.52	0.44	0.40	0.23	0.16	0.14	0.17	0.15	0.11	0.07	0.12	0.75
2003	38	0.75	0.64	0.47	0.33	0.14	0.18	0.19	0.15	0.13	0.14	0.05	0.72
2004	38	0.73	0.65	0.50	0.35	0.21	0.15	0.16	0.13	0.11	0.16	0.25	0.78
2005	39	0.76	0.51	0.53	0.60	0.36	0.21	0.28	0.35	0.23	0.14	1.24	0.97
2006	39	0.52	0.50	0.43	0.42	0.25	0.18	0.27	0.21	0.18	0.10	0.63	0.63
2007	39	0.50	0.41	0.39	0.24	0.17	0.15	0.18	0.14	0.13	0.10	0.21	0.87
2008	38	0.57	0.56	0.29	0.22	0.16	0.14	0.16	0.17	0.12	0.11	0.28	0.26
2009	38	0.67	0.44	0.51	0.23	0.28	0.15	0.16	0.13	0.14	0.08	0.48	0.71
2010	37	0.64	0.59	0.50	0.43	0.18	0.19	0.16	0.12	0.10	0.10	0.53	0.56
2011	39	0.52	0.48	0.46	0.29	0.14	0.10	0.13	0.14	0.12	0.07	0.06	0.52
2012	24	0.54	0.43	0.39	0.26	0.14	0.07	0.10	0.09	0.10	0.10	0.40	0.48
2013	23	0.30	0.29	0.26	0.19	0.12	0.12	0.13	0.08	0.11	0.43	0.17	0.54
2014	24	0.43	0.73	0.52	0.35	0.21	0.14	0.17	0.18	0.12	0.11	0.37	0.80
2015	23	0.76	0.74	0.63	0.37	0.20	0.20	0.20	0.12	0.05	0.04	0.95	0.92
2016	21	0.67	0.51	0.45	0.21	0.18	0.09	0.09	0.11	0.06	0.40	0.69	
2017	20	0.66	0.47	0.43	0.30	0.15	0.08	0.08	0.07	0.05	0.04	0.74	0.59
2018	21	0.58	0.52	0.41	0.36	0.22	0.13	0.13	0.08	0.05	0.04	0.33	0.99
POR MEDIAN		0.59	0.51	0.43	0.30	0.19	0.16	0.17	0.15	0.13	0.11	0.33	0.69

KEY

nitrate in mg/L as N

- N ≤ 0.13
- 0.13 < N ≤ 0.2
- 0.2 < N ≤ 0.5
- 0.5 < N ≤ 0.7
- N > 0.7

July-September trend (low-flow high-sunlight period)



GRAPH KEY

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

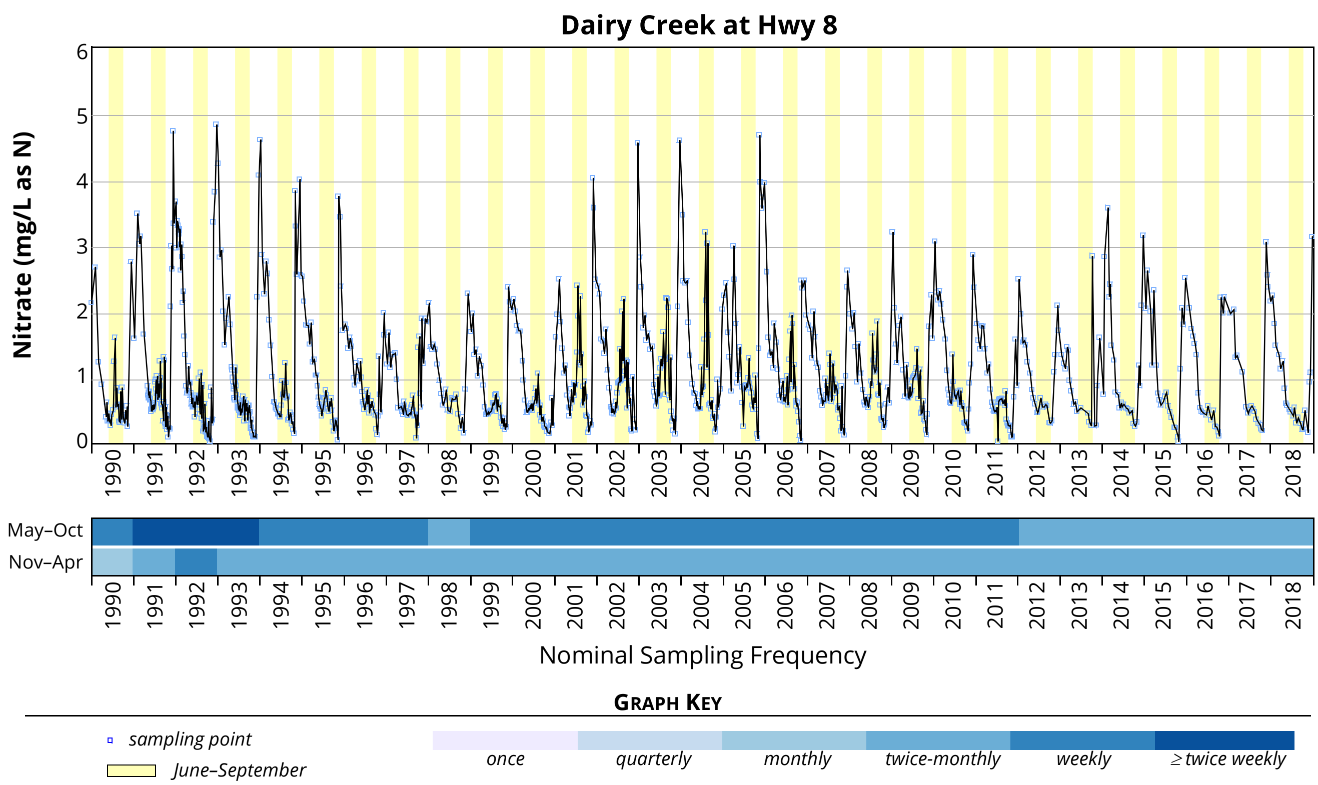
SAMPLING FREQUENCY

- The period of record is January 1990 through present.
- The sampling frequency was mostly weekly for May–October and every two weeks for November–April. Since 2012, the May–October sampling frequency decreased to every two weeks.

CONCENTRATIONS & TRENDS

- Nitrate (NO3) concentrations in Dairy Creek followed a seasonal pattern that reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.
  —Seasonal minimum (0.1–0.2 mg/L), usually October, duration of no more than a few weeks
  —Sharp increase to seasonal maximum, usually November–December
  —Quick decline through winter (with many small spikes) to spring concentrations < 1 mg/L
  —Slow decline through the summer to seasonal minimum
- The seasonal maximum concentration was generally pronounced and occurred at the beginning of the rainy season which indicates the importance of the first major rainstorm of the season. Because peak concentrations were shorter-lived than the usual sampling frequency, the graph below likely under-represents their magnitude. Targeted sampling of the first major rainstorm could determine if that is the case.
- The seasonal maximum concentrations at Dairy Creek were the highest among the tributary sites.
- Many small concentration spikes occurred throughout the year, although fewer occurred in summer. Because these spikes are shorter-lived than the usual sampling frequency for this site, the graph below likely under-represents their frequency, especially since sampling frequency decreased to twice-a-month.
- July–September NO3 concentrations were higher from 2001–2009 compared to the years before or since. The difference is statistically significant. The reason is unknown.

TIME SERIES



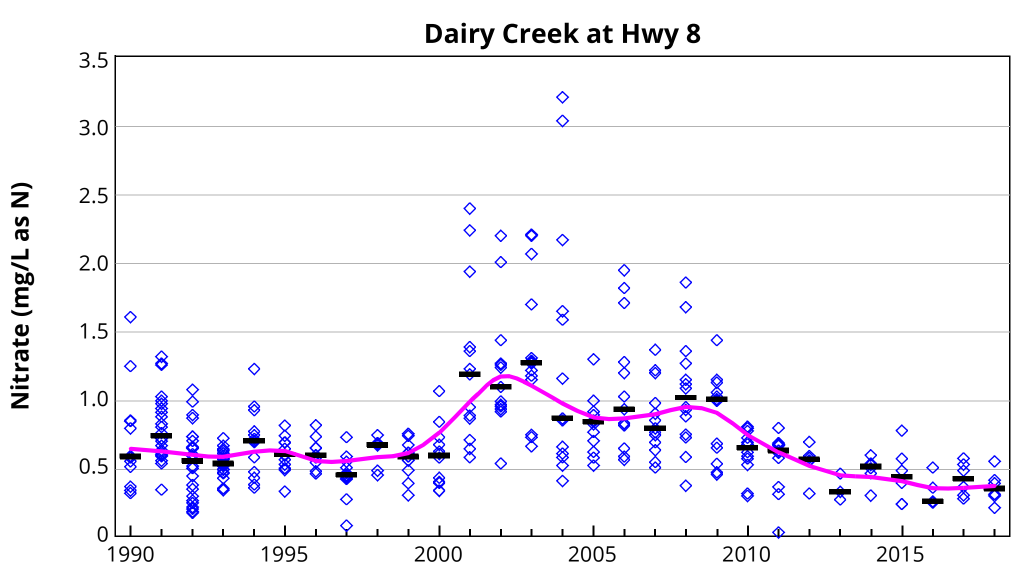
DAIRY – DAIRY CREEK AT HWY 8 – 14206200

Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — 14206200

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	32	2.13	2.67	1.23	0.89	0.43	0.35	0.89	0.58	0.58	0.36	0.41	2.75
1991	60	1.59	3.25	3.14	1.65	0.71	0.52	0.79	0.80	0.59	0.30	1.15	3.33
1992	83	3.25	3.17	1.88	0.87	0.71	0.57	0.65	0.65	0.24	0.09	0.36	4.32
1993	68	3.53	2.47	1.69	2.01	0.90	0.73	0.49	0.59	0.54	0.25	0.10	3.14
1994	38	3.73	2.51	2.22	1.25	0.58	0.42	0.72	0.77	0.40	0.25	3.29	3.28
1995	40	2.34	1.79	1.67	1.25	0.87	0.51	0.68	0.60	0.53	0.24	3.43	2.05
1996	36	1.77	1.55	1.23	1.05	1.04	0.61	0.69	0.57	0.52	0.42	0.61	1.81
1997	38	1.44	1.25	1.36	0.75	0.51	0.54	0.45	0.56	0.42	1.10	1.31	1.87
1998	23	1.80	1.46	1.31	0.85	0.62	0.66	0.58	0.67	0.45	0.32	0.49	2.27
1999	37	1.83	1.38	1.17	1.02	0.46	0.48	0.61	0.67	0.47	0.32	0.30	2.08
2000	37	2.10	1.74	1.48	0.80	0.50	0.55	0.67	0.62	0.36	0.24	0.23	0.48
2001	40	1.78	2.17	1.25	0.96	0.55	0.81	1.38	1.27	0.78	0.28	0.34	3.03
2002	39	2.32	1.57	1.55	0.84	0.48	0.58	0.95	1.63	1.16	0.60	0.68	2.38
2003	38	2.60	1.85	1.62	1.45	0.74	0.72	1.21	1.27	1.30	0.36	0.26	3.33
2004	39	2.96	2.45	1.58	0.83	0.61	0.57	1.22	1.64	0.56	0.30	0.54	1.43
2005	39	2.34	1.50	1.89	2.15	1.21	0.73	0.84	0.91	0.59	0.32	3.76	3.84
2006	39	2.10	1.36	1.48	1.33	0.80	0.67	0.91	1.70	0.73	0.40	2.35	2.21
2007	40	1.76	1.65	1.41	0.97	0.65	0.80	0.96	0.90	0.67	0.37	0.19	2.50
2008	38	1.85	1.72	1.22	0.94	0.64	0.63	1.14	1.23	0.72	0.31	0.60	0.61
2009	38	2.63	1.36	1.85	0.91	0.83	0.80	1.04	0.99	0.53	0.27	1.11	1.92
2010	37	2.68	2.24	1.99	1.34	0.68	0.73	0.74	0.61	0.31	0.28	1.06	2.61
2011	38	1.69	1.61	1.60	1.13	0.62	0.50	0.64	0.67	0.47	0.27	0.10	1.23
2012	24	2.23	1.55	1.36	0.94	0.64	0.47	0.62	0.57	0.44	0.33	1.21	1.90
2013	19	1.28	1.30	1.18	0.69	0.56	0.54		0.46	0.30	1.55	0.57	1.60
2014	24	1.79	2.90	1.95	1.02	0.63	0.59	0.56	0.49	0.40	0.29	1.03	2.62
2015	23	2.33	2.00	1.75	0.97	0.62	0.68	0.67	0.43	0.24	0.06	1.59	2.16
2016	20	2.05	1.68	1.43	0.65	0.48	0.50	0.36	0.50	0.25	1.16	2.10	
2017	20	1.97	1.67	1.33	1.08	0.55	0.48	0.55	0.42	0.29	0.20	2.80	2.26
2018	23	2.03	1.48	1.24	1.04	0.59	0.49	0.48	0.35	0.25	0.36	0.55	2.10
POR MEDIAN		2.10	1.68	1.48	0.97	0.62	0.57	0.69	0.65	0.47	0.31	0.61	2.23

KEY
nitrate in mg/L as N
N ≤ 0.4
0.4 < N ≤ 0.6
0.6 < N ≤ 1.2
1.2 < N ≤ 2.2
N > 2.2



GRAPH KEY

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

Sampling frequency & location

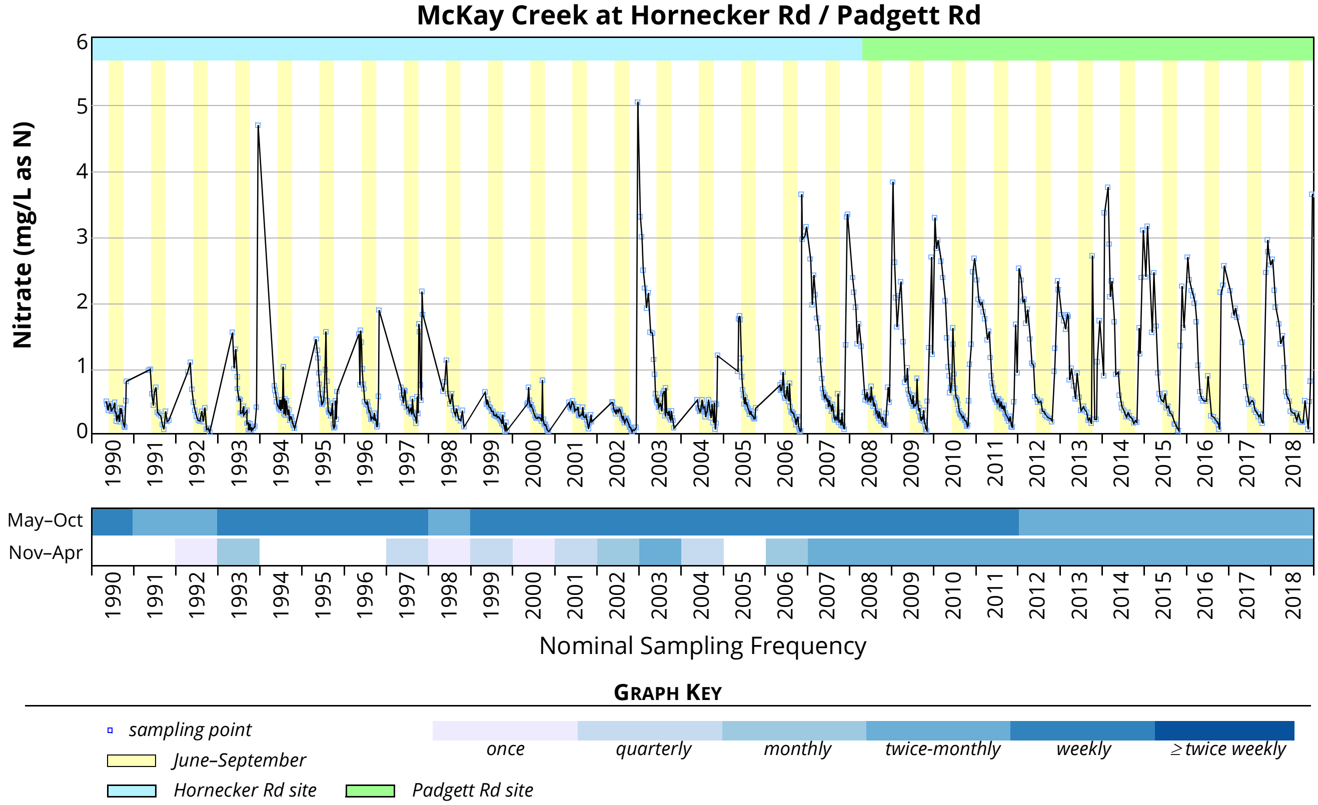
- The period of record is May 1990 through present.
- Sampling frequency varied, ranging from weekly to twice monthly for May–October. Sampling for November–April was intermittent and occurred rarely before 2006.
- The site location changed during 2008. The distance between the sites is about one mile. The data show no obvious difference between sites with regard to NO3.

Concentrations & trends

- Nitrate (NO3) concentrations in McKay Creek followed a seasonal pattern that reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.
  —Seasonal minimum (0.05–0.2 mg/L), usually October, duration of no more than a few weeks
  —Sharp increase to seasonal maximum (2.5–4 mg/L), usually November–December
  —Quick decline through winter (with small spikes) to spring concentrations <1 mg/L
  —Slow decline through the summer to seasonal minimum
- The seasonal maximum concentration was generally pronounced and occurred at the beginning of the rainy season which indicates the importance of the first major rainstorm of the season. Because peak concentrations were shorter-lived than the usual sampling frequency, the graph below likely under-represents their magnitude. Targeted sampling of the first major rainstorm could determine if that is the case.
- No trends are evident for the July–September period.

Time series

McKay Creek at Hornecker Rd / Padgett Rd



MK-H / MK-P – McKay Creek at Hornecker Rd / Padgett Rd

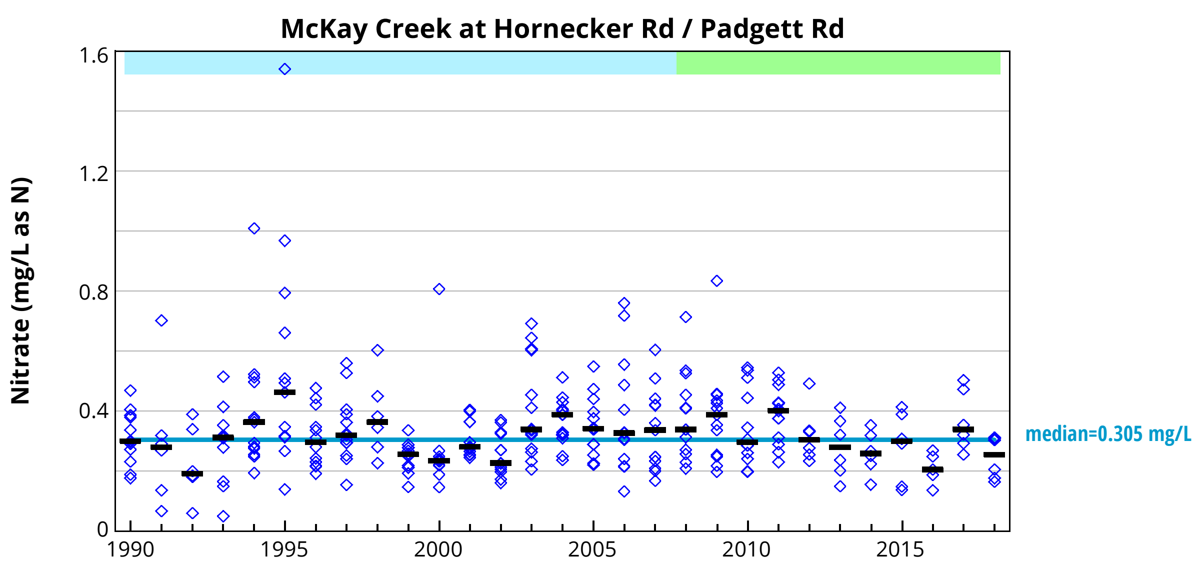
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — MK-H / MK-P

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	25					0.43	0.41	0.41	0.27	0.34	0.18		
1991	14					0.97	0.60	0.51	0.28	0.10	0.20		
1992	14				0.93	0.88	0.35	0.19	0.26	0.23	0.05		
1993	25					1.26	0.68	0.32	0.32	0.16	0.07	0.10	2.54
1994	25					0.62	0.39	0.44	0.38	0.25	0.14		
1995	27					1.14	0.49	0.81	0.35	0.29	0.22		
1996	25					1.45	0.71	0.43	0.26	0.22	0.23		
1997	27					0.56	0.55	0.38	0.31	0.25	1.14	1.98	
1998	13					0.71	0.86	0.53	0.35	0.23	0.27	0.10	
1999	26					0.52	0.39	0.28	0.26	0.20	0.12	0.11	
2000	27					0.47	0.38	0.24	0.24	0.20	0.09	0.03	
2001	29					0.44	0.40	0.37	0.29	0.25	0.16	0.23	
2002	30					0.43	0.35	0.33	0.21	0.21	0.09	0.05	2.56
2003	34	3.13	2.34	2.02	1.53	0.75	0.44	0.45	0.49	0.28	0.22		
2004	26					0.45	0.38	0.39	0.39	0.32	0.16	0.81	
2005	22					1.73	0.66	0.46	0.34	0.23	0.39		
2006	31					0.70	0.61	0.64	0.33	0.22	0.09	2.94	3.06
2007	39	2.64	2.18	1.93	1.36	0.61	0.52	0.42	0.25	0.22	0.20	0.11	3.30
2008	36	2.36	2.03	1.51	1.32	0.59	0.51	0.53	0.33	0.24	0.19	0.31	0.47
2009	38	3.20	1.84	2.20	1.08	0.75	0.53	0.43	0.42	0.25	0.10	0.90	1.94
2010	36	3.04	2.93	2.49	1.73	0.79	0.90	0.52	0.29	0.20	0.15	1.20	2.55
2011	39	2.18	1.97	1.79	1.49	0.82	0.53	0.47	0.41	0.28	0.21	0.10	1.28
2012	24	2.41	2.02	1.78	1.25	0.80	0.49	0.41	0.30	0.24	0.20	1.12	2.25
2013	23	1.76	1.69	1.29	0.86	0.72	0.45	0.39	0.26	0.19	1.45	0.65	1.71
2014	24	2.11	3.30	2.19	1.29	0.76	0.42	0.30	0.29	0.19	0.18	1.41	2.72
2015	21	2.76		1.99	1.27	0.56	0.54	0.40	0.30	0.14	0.04	1.78	1.60
2016	21	2.50	2.12	1.83	0.83	0.51	0.68	0.27	0.25	0.19	1.10	2.40	
2017	20	2.16	1.85	1.76	1.38	0.71	0.48	0.49	0.34	0.27	0.18	2.69	2.65
2018	23	2.41	1.91	1.51	1.24	0.59	0.41	0.31	0.25	0.17	0.34	0.28	2.21
POR Median		2.41	2.02	1.83	1.28	0.71	0.49	0.41	0.30	0.23	0.18	0.65	2.39

Key
nitrate in mg/L as N
N ≤ 0.2
0.2 < N ≤ 0.4
0.4 < N ≤ 0.7
0.7 < N ≤ 1.8
N > 1.8

July-September trend (low-flow high-sunlight period)



Graph Key

- Hornecker Rd site
- Padgett Rd site
- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

RCTV / RCBR – Rock Creek at Hwy 8 / Brookwood

Data source: Clean Water Services

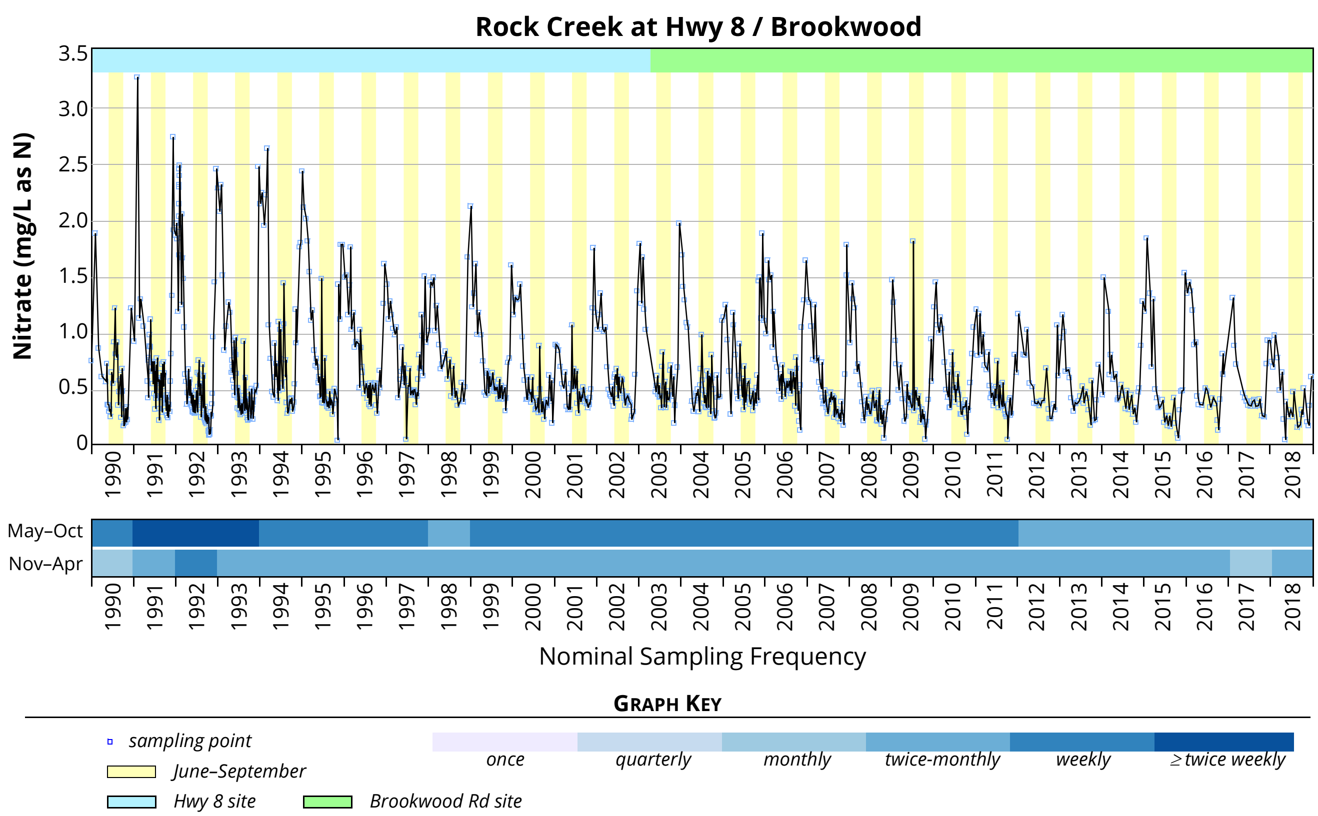
Sampling frequency & location

- The period of record is January 1990 through present.
- The sampling frequency was mostly weekly for May–October and every two weeks for November–April. Since 2012, the May–October sampling frequency decreased to every two weeks.
- The site location changed during 2003. The distance between the sites is about 1.2 miles. The data show no obvious difference between sites with regard to NO3.

Concentrations & trends

- Nitrate (NO3) concentrations in Rock Creek followed a seasonal pattern that reflects the balance between the influx of NO3 by leaching from soil and the consumption of NO3 by phytoplankton and aquatic plants.
  —Seasonal minimum (0.2–0.3 mg/L), usually October, duration of no more than a few weeks
  —Sharp increase to seasonal maximum (1–2.5 mg/L), usually November–December
  —Quick decline through winter (with many small spikes) to spring concentrations <0.6 mg/L
  —Slow decline through the summer to seasonal minimum
- The seasonal maximum concentration was generally pronounced and occurred at the beginning of the rainy season which indicates the importance of the first major rainstorm of the season. The graph below suggests that annual maximum NO3 may have decreased in recent years. That conclusion is probably incorrect. Because peak NO3 concentrations are short-lived and occur in the November–April coarser sampling period, the chances of sampling exactly on the peak day are remote. If so, the graph below underestimates the magnitude of the high concentrations in general and may have missed the peak concentrations altogether in recent years. Targeted sampling of the first major rainstorm could determine if that is the case.
- July–September NO3 concentrations show a small, but statistically significant decreasing trend. The timing of site change and concentration decrease do not coincide.

Time series



RCTV / RCBR – Rock Creek at Hwy 8 / Brookwood

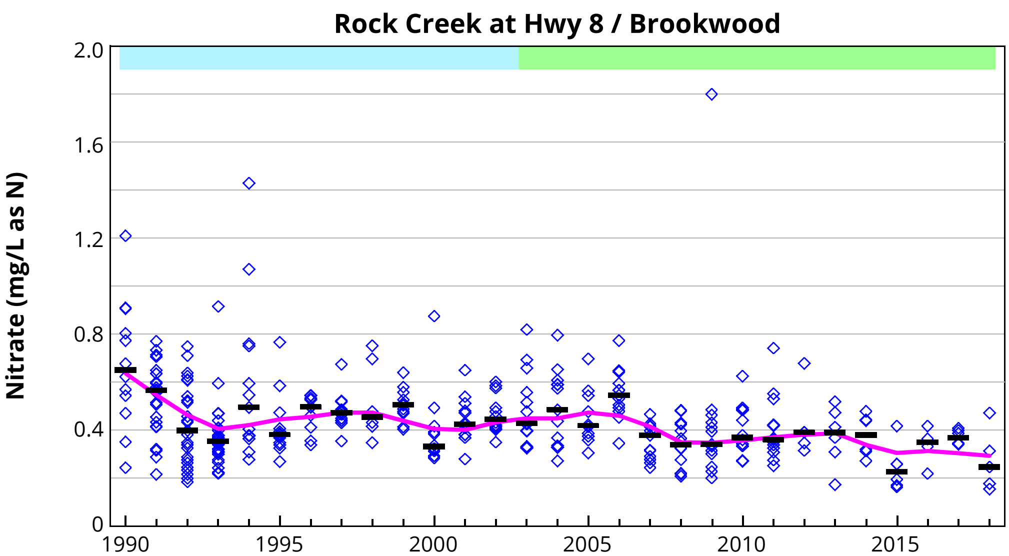
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — RCTV / RCBR

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	32	0.74	1.87	0.85	0.60	0.46	0.31	0.86	0.62	0.60	0.20	0.28	1.21
1991	60	0.92	2.19	1.29	1.05	0.82	0.67	0.53	0.56	0.60	0.37	0.46	1.90
1992	83	1.85	2.28	1.26	0.46	0.39	0.36	0.49	0.44	0.25	0.14	0.33	1.94
1993	68	2.17	1.90	0.94	1.22	0.65	0.63	0.35	0.38	0.35	0.33	0.39	1.49
1994	38	2.18	2.08	1.84	0.62	0.66	0.75	0.65	0.60	0.37	0.35	0.90	1.77
1995	40	2.26	1.90	1.32	1.01	0.69	0.43	0.50	0.38	0.36	0.43	1.11	1.77
1996	36	1.49	1.41	1.10	0.89	0.88	0.59	0.51	0.43	0.50	0.46	0.58	1.43
1997	38	1.27	1.21	1.00	0.73	0.66	0.56	0.52	0.48	0.45	0.68	0.96	1.20
1998	23	1.23	1.45	1.12	0.78	0.74	0.71	0.59	0.48	0.35	0.47	0.45	1.66
1999	37	1.67	1.47	1.07	0.86	0.46	0.53	0.56	0.49	0.52	0.47	0.41	1.18
2000	39	1.23	1.29	1.19	0.63	0.45	0.44	0.32	0.42	0.31	0.35	0.40	0.38
2001	40	0.88	0.77	0.52	0.49	0.45	0.52	0.47	0.42	0.44	0.36	0.49	1.46
2002	38	1.09	1.18	1.02	0.49	0.41	0.61	0.48	0.53	0.41	0.37	0.28	0.99
2003	32	1.52	1.43	1.02		0.47	0.52	0.43	0.43	0.43	0.54	0.27	1.32
2004	38	1.54	1.18	1.04	0.34	0.45	0.53	0.46	0.34	0.59	0.27	0.42	0.76
2005	36	1.19	0.79	0.72	0.93	0.54	0.46	0.48	0.41	0.39	0.48	1.29	1.49
2006	39	1.31	1.48	1.02	0.72	0.59	0.52	0.55	0.55	0.54	0.39	0.53	1.46
2007	40	1.27	0.90	0.99	0.66	0.42	0.35	0.40	0.42	0.28	0.28	0.26	1.64
2008	37	1.17	1.25	0.68	0.45	0.31	0.32	0.35	0.35	0.32	0.22	0.30	0.38
2009	38	1.36	0.82	0.60	0.31	0.42	0.36	0.47	0.40	0.25	0.19	0.30	0.75
2010	37	1.33	1.03	1.08	0.61	0.38	0.53	0.48	0.36	0.33	0.29	0.43	0.92
2011	38	1.00	0.98	0.84	0.74	0.46	0.41	0.48	0.37	0.29	0.33	0.27	0.72
2012	20	1.16	0.80	0.91	0.55	0.44	0.37	0.37	0.39	0.50	0.23	0.34	0.84
2013	23	1.05	0.82	0.63	0.36	0.37	0.41	0.44	0.44	0.24	0.39	0.31	0.71
2014	23	0.96	1.18	0.71	0.60	0.41	0.51	0.38	0.40	0.36	0.26	0.48	1.08
2015	23	1.51	1.34	0.99	0.45	0.33	0.30	0.22	0.21	0.31	0.08	0.39	1.00
2016	19	1.39	1.28	0.90	0.39	0.35	0.49	0.33	0.42	0.29	0.27	0.72	
2017	19		1.09	0.71		0.44	0.37	0.37	0.37	0.38	0.30	0.48	0.92
2018	22	0.71	0.97	0.63	0.44	0.21	0.28	0.36	0.16	0.25	0.38	0.19	0.48
POR Median		1.27	1.25	0.99	0.61	0.45	0.49	0.47	0.42	0.36	0.35	0.41	1.19

Key
nitrate in mg/L as N
N ≤ 0.3
0.3 < N ≤ 0.4
0.4 < N ≤ 0.8
0.8 < N ≤ 1.3
N > 1.3

July-September trend (low-flow high-sunlight period)



Graph Key

- Hwy 8 site
- Brookwood site
- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

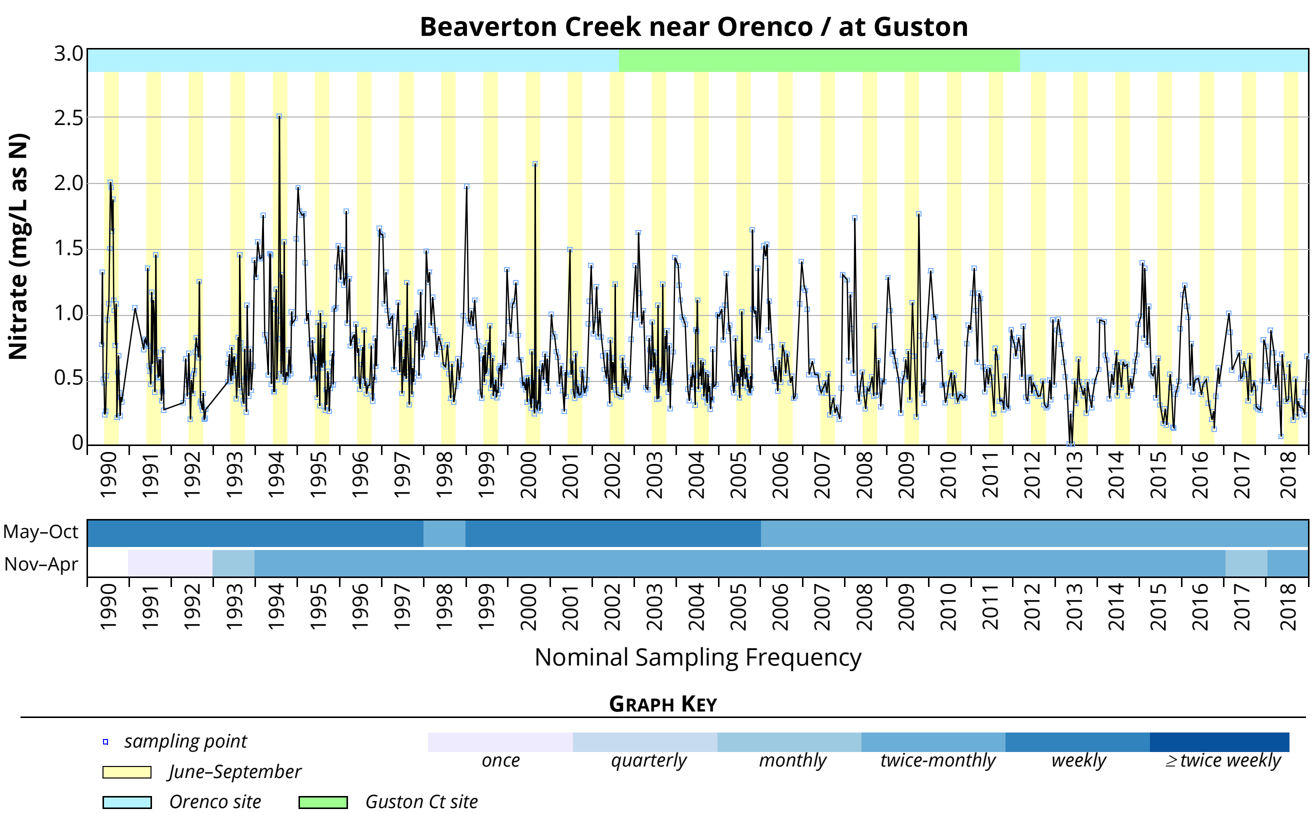
Sampling frequency & location

- The period of record is May 1990 through present.
- The sampling frequency was mostly weekly for May–October through 2005 and every two weeks since. Sampling frequency for November–April was very sparse through 1993 and about every two weeks since.
- The site location changed twice. The distance between the sites is very small.

Concentrations and trends

- Nitrate (NO3) in Beaverton Creek is characterized by numerous, short-lived concentration spikes. Although the data have a seasonal pattern, with higher concentrations in winter and lower concentrations in summer, the pattern was weaker and far more noisy than the pattern common at other tributaries.
- Maximum concentrations in Beaverton Creek were short lived spikes that occurred throughout the year, including spring and summer. The two spikes with the highest concentrations shown in the graph below occurred in July and August. This behavior is consistent with the flashy nature of this urban stream. Because the spikes are shorter-lived than the usual sampling frequency for this site, the graph below likely under-represents their frequency. Data from weekly sampling captured numerous spikes; data from twice-a-month sampling captured far fewer.
- July–September NO3 concentrations show a decreasing trend. Interpretation is complicated because both the sampling frequency and site location changed over time. Most of the lower concentrations occurred since 2006 when sampling was less frequent. The medians since 2006 may be lower because short-lived spikes in summer NO3 concentrations were not captured when sampling dropped to every two weeks. It is also possible that fewer spikes actually occurred at the new site. The data do not provide a way to disentangle the effects of sampling frequency changes from any effects of site location changes.

Time series

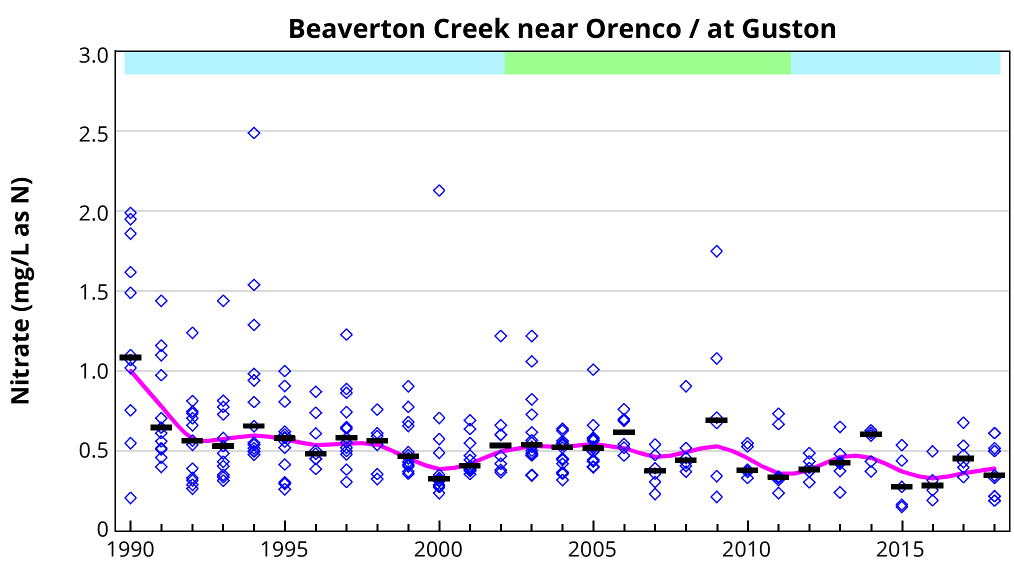


MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — BVTS

	Samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	25					0.63	0.39	1.72	1.36	0.65	0.36		
1991	26		1.04			0.78	0.75	0.61	0.84	0.58	0.37		
1992	26				0.32	0.49	0.45	0.55	0.75	0.30	0.24		
1993	32					0.58	0.65	0.53	0.78	0.37	0.55	0.51	1.00
1994	38	1.41	1.42	1.29	0.66	1.27	0.72	0.90	0.66	0.53	0.56	0.92	1.26
1995	40	1.86	1.75	1.16	0.88	0.66	0.51	0.59	0.62	0.47	0.45	1.03	1.43
1996	35	1.37	1.28	1.09	0.78	0.81	0.59	0.68	0.45	0.45	0.49	0.70	1.62
1997	36	1.33	1.17	0.93	0.78	0.97	0.66	0.59	0.65	0.58	0.82	0.93	0.91
1998	23	1.12	1.27	1.01	0.78	0.81	0.67	0.68	0.54	0.33	0.55	0.55	0.98
1999	37	1.45	0.97	1.00	0.77	0.40	0.56	0.78	0.46	0.41	0.57	0.59	0.97
2000	38	0.89	1.08	1.03	0.65	0.46	0.49	0.33	0.35	0.32	0.51	0.58	0.53
2001	35	0.92	0.77	0.57	0.51	0.37	1.01	0.48	0.46	0.38	0.43	0.50	1.23
2002	34	0.90	1.01	0.92	0.57	0.52	0.65	0.47		0.60	0.47	0.46	0.89
2003	38	1.16	1.38	0.97	0.43	0.66	0.70	0.48	0.53	0.73	0.61	0.38	1.06
2004	39	1.29	1.04	0.93	0.38	0.52	0.86	0.54	0.45	0.45	0.38	0.45	0.72
2005	38	1.00	0.93	1.08	0.76	0.45	0.49	0.55	0.57	0.42	0.78	0.99	1.07
2006	22	1.51	1.48	0.98	0.66	0.48	0.56	0.73	0.62	0.50	0.36		1.23
2007	22	1.18	0.78	0.64	0.53	0.48	0.41	0.43	0.39	0.33	0.27	0.32	1.29
2008	23	0.95	1.01	1.13	0.38	0.51	0.33	0.42	0.49	0.64	0.51	0.39	0.48
2009	23	1.15	0.70	0.62	0.37	0.51	0.57	0.53	0.88	0.98	0.61	0.40	0.76
2010	23	1.32	0.97	0.72	0.58	0.39	0.42	0.46	0.45	0.36	0.37	0.56	0.89
2011	24	1.25	0.82	1.13	0.50	0.52	0.55	0.49	0.50	0.33	0.40	0.29	0.84
2012	24	0.72	0.78	0.71	0.35	0.51	0.43	0.42	0.37	0.40	0.29	0.42	0.70
2013	23	0.91	0.81	0.58	0.19	0.12	0.40	0.57	0.40	0.34	0.42	0.32	0.49
2014	23	0.76	0.93	0.66	0.45	0.53	0.54	0.53	0.61	0.49	0.47	0.60	0.80
2015	23	1.18	1.08	0.90	0.53	0.48	0.48	0.17	0.21	0.49	0.13	0.41	0.68
2016	19	1.18	1.01	0.61	0.45	0.51	0.42	0.50	0.32	0.22	0.25	0.53	
2017	19		0.93	0.57		0.60	0.58	0.44	0.54	0.45	0.28	0.38	0.77
2018	22	0.54	0.87	0.57	0.47	0.38	0.43	0.48	0.19	0.36	0.31	0.25	0.54
POR Median		1.17	1.01	0.93	0.53	0.51	0.55	0.53	0.51	0.45	0.43	0.50	0.89

Key
nitrate in mg/L as N
N ≤ 0.4
0.4 < N ≤ 0.5
0.5 < N ≤ 0.8
0.8 < N ≤ 1.2
N > 1.2

July-September trend (low-flow high-sunlight period)



Graph Key

- Orenco site
- Guston site
- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

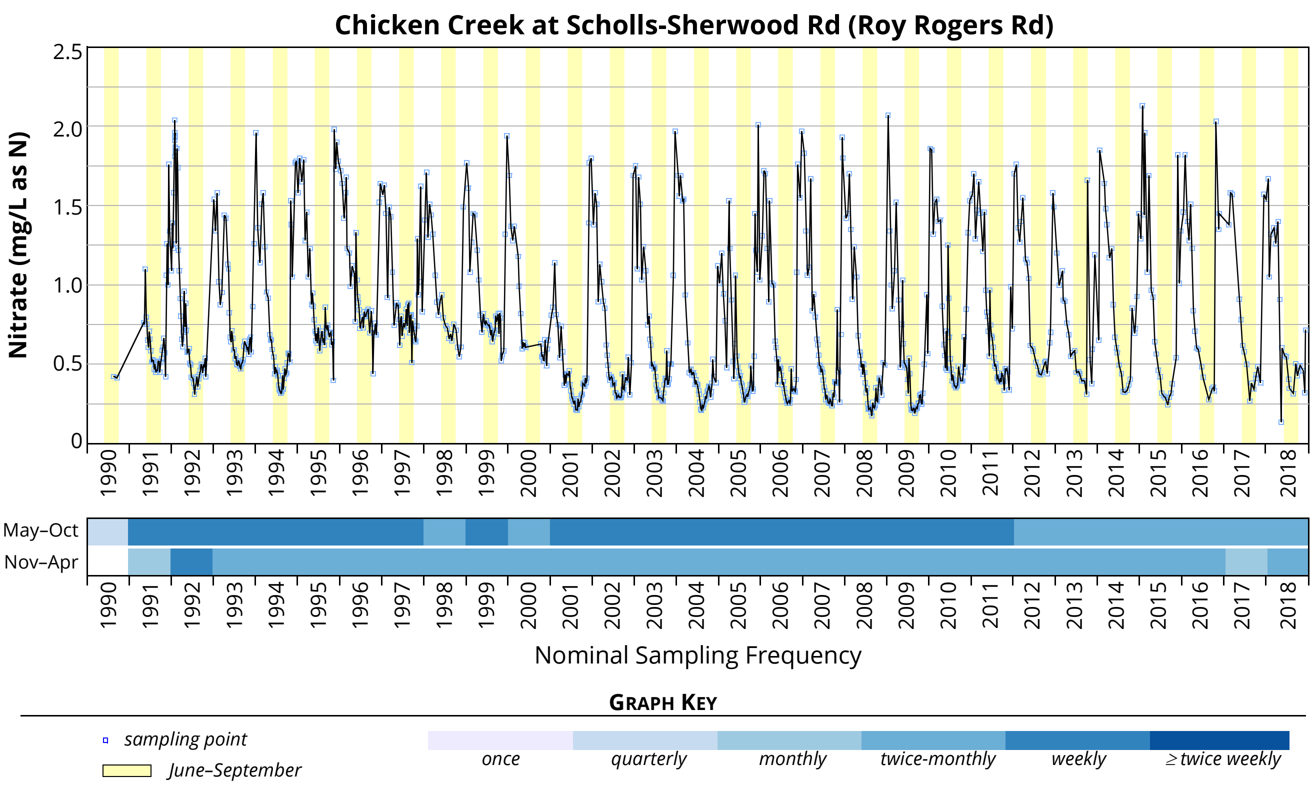
Sampling frequency

- The period of record is effectively May 1991 through present. Only two samples were collected in 1990.
- The sampling frequency was mostly weekly for May–October and every two weeks for November–April. Since 2012, the May–October sampling frequency decreased to every two weeks.

Concentration and trends

- Nitrate (NO3) concentrations in Chicken Creek followed a seasonal pattern similar to the one at many other tributary sites, but different in late-summer through fall. At other sites, NO3 decreased until the first significant fall rainstorm. At Chicken Creek, NO3 slowly increased August–October. The timing of this increase, when streamflow is lowest, suggests that groundwater might be a more important NO3 source at this site compared to others.
  - —Seasonal minimum (0.2–0.3 mg/L), usually August
  - —Small, steady increase (0.1–0.2 mg/L) through October
  - —Sharp increase to seasonal maximum (1.5–2 mg/L), usually November–December
  - —Quick decline through winter to spring concentrations <0.5 mg/L
  - —Slow decline through the summer to seasonal minimum
- July–September NO3 concentrations were unusual in that they differed among distinct time periods. The difference among time periods cannot be simply explained.
  - —Site location did not change.
  - —If analytical methods changed, all other sites were unaffected.
  - —Although sampling frequency changed, summer NO3 spikes at this site were uncommon, so varying sampling frequency would not account for the difference.
  - —The differences among summer NO3 concentrations at Chicken Creek are a mystery.

Time series



CCSR – Chicken Creek at Scholls-Sherwood Rd (Roy Rogers Rd) – 14206750

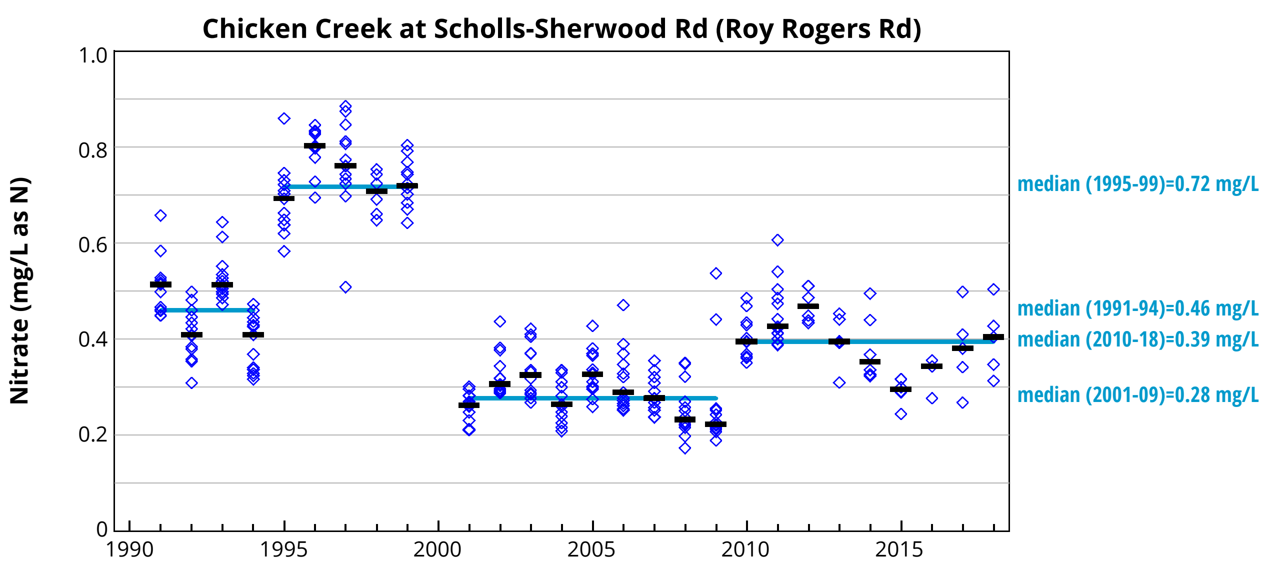
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — 14206750

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	2								0.42	0.41			
1991	33					0.78	0.68	0.53	0.46	0.49	0.59	0.82	1.34
1992	49	1.58	1.87	1.00	0.70	0.65	0.50	0.37	0.40	0.46	0.49		
1993	40	1.44	1.30	0.91	1.43	0.96	0.64	0.52	0.51	0.57	0.61	0.62	1.06
1994	38	1.66	1.33	1.41	0.94	0.65	0.47	0.40	0.33	0.44	0.54	1.38	1.78
1995	40	1.69	1.72	1.37	1.14	0.87	0.67	0.64	0.66	0.73	0.67	1.73	1.84
1996	36	1.68	1.58	1.22	1.06	1.05	0.87	0.79	0.82	0.77	0.70	0.72	1.58
1997	38	1.60	1.18	1.46	0.91	0.87	0.73	0.76	0.81	0.77	0.68	1.02	1.22
1998	23	1.56	1.41	1.38	0.98	0.85	0.86	0.73	0.66	0.75	0.66	0.58	1.49
1999	37	1.69	1.18	1.45	1.13	0.78	0.76	0.74	0.68	0.78	0.80	0.56	1.63
2000	21	1.53	1.33	1.18	0.91	0.61					0.55	0.52	0.62
2001	40	0.83	0.98	0.64	0.66	0.43	0.40	0.27	0.21	0.26	0.37	0.41	1.79
2002	39	1.48	1.20	1.08	0.85	0.46	0.41	0.32	0.29	0.33	0.40	0.43	1.10
2003	38	1.43	1.60	1.14	0.92	0.64	0.48	0.34	0.29	0.37	0.39	0.50	1.52
2004	39	1.63	1.61	1.24	0.54	0.45	0.37	0.29	0.24	0.32	0.34	0.42	0.75
2005	39	1.11	0.86	1.00	1.07	0.57	0.47	0.37	0.30	0.33	0.36	1.15	1.52
2006	39	1.52	1.47	1.21	1.00	0.53	0.47	0.36	0.27	0.30	0.34	1.08	1.76
2007	40	1.59	1.09	1.25	0.87	0.56	0.45	0.32	0.27	0.26	0.39	0.45	1.87
2008	38	1.44	1.53	1.07	0.87	0.53	0.44	0.25	0.21	0.24	0.38	0.34	0.49
2009	38	1.71	0.93	1.31	0.69	0.69	0.48	0.34	0.21	0.23	0.28	0.41	0.75
2010	37	1.86	1.42	1.47	1.14	0.59	0.67	0.42	0.36	0.43	0.42	0.66	1.43
2011	39	1.64	1.38	1.55	1.34	0.81	0.68	0.52	0.41	0.42	0.43	0.45	0.86
2012	24	1.73	1.32	1.48	1.15	0.83	0.59	0.50	0.44	0.48	0.48	0.67	1.54
2013	23	1.10	1.07	0.90	0.72	0.56	0.52	0.45	0.40	0.35	1.09	0.49	1.19
2014	23	1.25	1.64	1.43	1.20	0.77	0.59	0.47	0.33	0.35	0.63	0.71	1.19
2015	23	1.71	1.70	1.39	0.94	0.60	0.44	0.31	0.27	0.30	0.38	1.18	1.18
2016	19	1.64	1.34	1.37	0.77	0.60	0.45		0.28	0.35	1.18	1.40	
2017	17		1.48	1.57		0.85	0.60	0.50	0.32	0.38	0.46	0.38	1.56
2018	21	1.36	1.32	1.31	1.15	0.37	0.55	0.38	0.31	0.47	0.47	0.39	0.72
POR MEDIAN		1.58	1.34	1.31	0.94	0.64	0.52	0.41	0.33	0.40	0.48	0.58	1.39

KEY	
nitrate in mg/L as N	
N ≤ 0.4	
0.4 < N ≤ 0.5	
0.5 < N ≤ 1.0	
1.0 < N ≤ 1.5	
N > 1.5	

July-September trend (low-flow high-sunlight period)



GRAPH KEY

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

FANO – FANNO CREEK AT DURHAM – 14206950

Data source: Clean Water Services

SAMPLING FREQUENCY

- The period of record is January 1990 through present.
- The sampling frequency was mostly weekly for May–October and every two weeks for November–April. Since 2012, the May–October sampling frequency decreased to every two weeks.
- Except for a brief time in May–October 1991–1993, sampling frequency likely was not adequate to fully characterize short-lived concentration spikes.

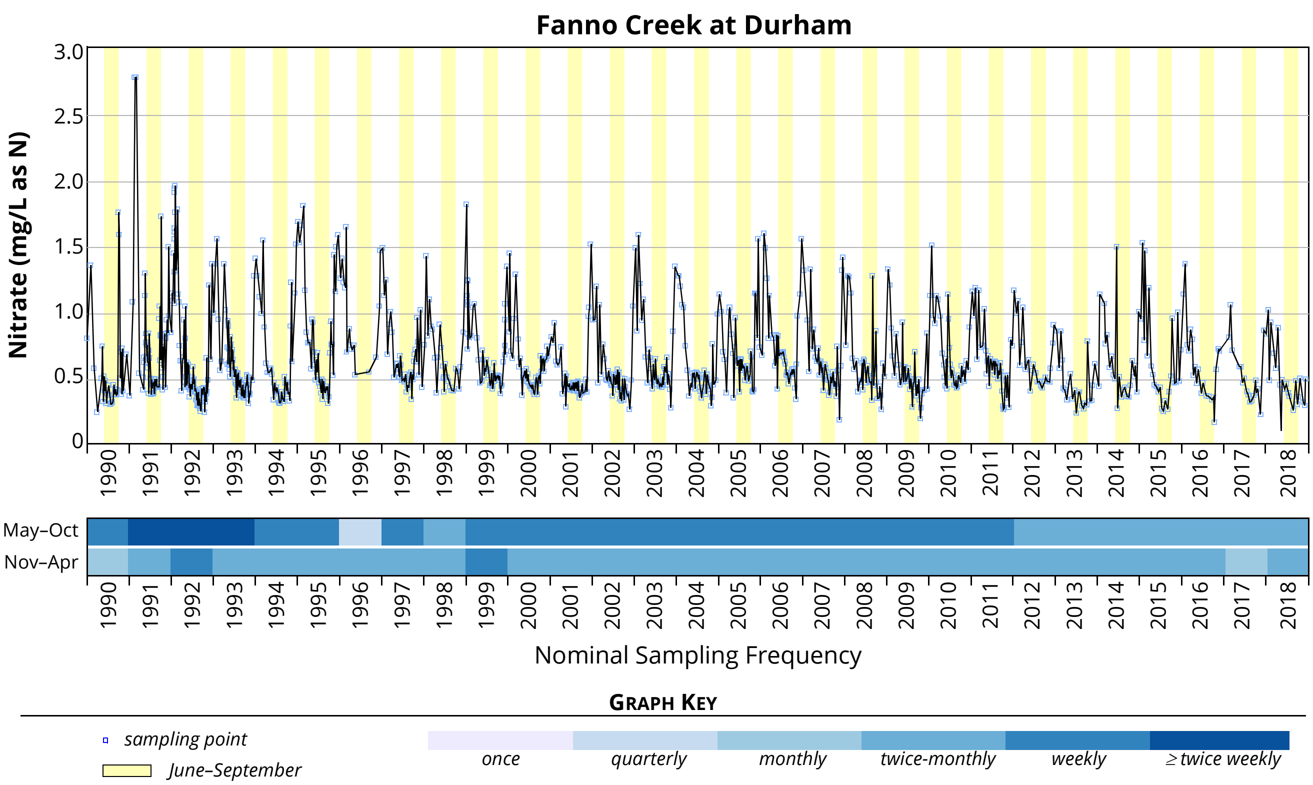
CONCENTRATIONS & TRENDS

- Nitrate (NO3) concentrations in Fanno Creek followed a seasonal pattern that was generally similar to other tributary sites, but with much more noise.

  —Seasonal minimum (0.2–0.5 mg/L), usually October, duration of no more than a few weeks
  —Overall increasing concentrations in fall and early winter, with many sharp increases and decreases
  —Seasonal pattern maximum (1–2 mg/L), usually January
  —Quick decline through winter (with many concentrations spikes) to spring concentrations <0.6 mg/L
  —Slow decline through the summer (with many concentration spikes) to seasonal minimum

- Short-lived NO3 spikes were prevalent at Fanno Creek. They occurred throughout the year, although they were smaller in the summer. This behavior is consistent with the flashy nature of this urban stream. Because the spikes are shorter-lived than the usual sampling frequency for this site, the graph below likely under-represents their frequency. Since 2012, when the sampling frequency decreased to twice-a-month, many spikes were probably missed completely.
- July–September NO3 concentrations appear to be lower in the past few years, but the trend is not statistically significant. The apparent decrease may be related to the 2012 decrease in sampling frequency. Summer medians since 2012 may be lower because less frequent sampling missed short-lived NO3 spikes.

TIME SERIES



FANO – Fanno Creek at Durham – 14206950

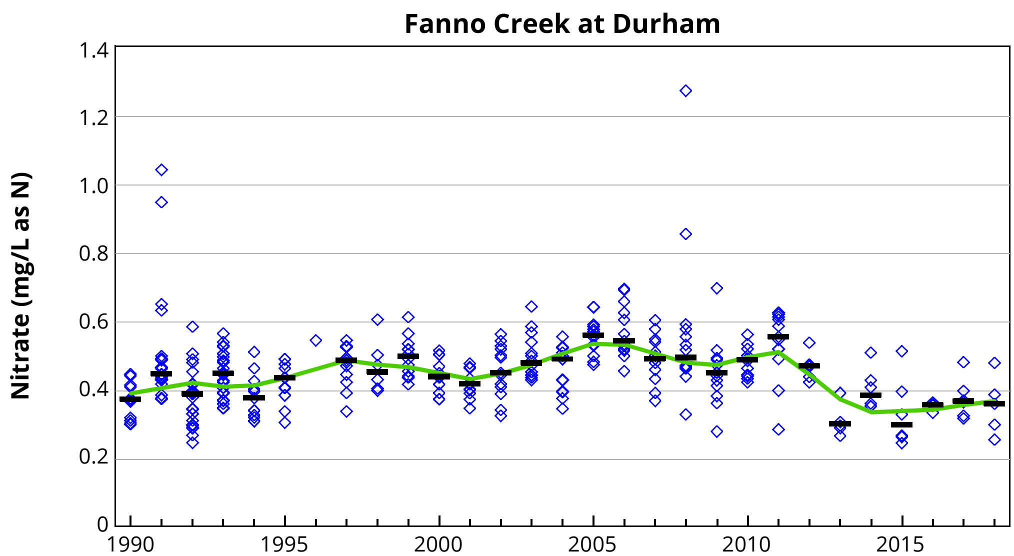
Data source: Clean Water Services

MEDIAN MONTHLY NITRATE CONCENTRATION (mg/L as N) — 14206950

	SAMPLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	32	0.80	1.35	0.57	0.24	0.50	0.39	0.33	0.34	0.39	0.69	0.56	0.68
1991	60	0.36	1.92	2.77	0.53	0.71	0.64	0.45	0.44	0.43	0.71	0.82	0.97
1992	83	1.14	1.75	0.91	0.63	0.54	0.42	0.46	0.34	0.31	0.39	0.48	1.00
1993	68	1.17	1.25	0.59	1.19	0.66	0.66	0.50	0.48	0.39	0.44	0.37	0.88
1994	38	1.34	1.05	1.21	0.57	0.55	0.40	0.38	0.34	0.43	0.38	0.89	1.33
1995	40	1.60	1.73	1.00	0.76	0.70	0.59	0.45	0.41	0.42	0.75	1.15	1.54
1996	15	1.33	1.22	0.78	0.73	0.63				0.54		0.65	1.25
1997	38	1.30	0.96	0.95	0.67	0.59	0.55	0.49	0.43	0.52	0.65	0.77	0.72
1998	26	1.08	0.95	0.88	0.52	0.78	0.51	0.55	0.43	0.40	0.56	0.50	0.85
1999	46	1.10	0.81	1.05	0.72	0.47	0.57	0.52	0.45	0.50	0.50	0.44	0.94
2000	40	0.85	0.79	1.04	0.61	0.50	0.50	0.43	0.41	0.48	0.64	0.63	0.70
2001	40	0.79	0.77	0.61	0.55	0.45	0.42	0.43	0.44	0.38	0.39	0.49	1.27
2002	39	0.94	0.83	0.79	0.64	0.50	0.45	0.50	0.47	0.40	0.38	0.32	0.76
2003	38	1.17	1.40	1.01	0.56	0.61	0.50	0.48	0.44	0.54	0.51	0.34	1.09
2004	39	1.27	1.12	0.88	0.46	0.48	0.53	0.46	0.43	0.50	0.42	0.45	0.73
2005	39	1.07	0.66	0.69	0.93	0.71	0.60	0.60	0.57	0.51	0.53	0.97	1.14
2006	39	1.13	1.37	0.96	0.81	0.62	0.68	0.67	0.52	0.53	0.54	0.60	1.34
2007	39	1.31	0.74	1.02	0.76	0.62	0.56	0.56	0.48	0.48	0.48	0.42	1.36
2008	37	1.01	1.20	0.60	0.51	0.48	0.59	0.51	0.47	0.53	0.34	0.37	0.51
2009	38	1.26	0.77	0.67	0.52	0.54	0.51	0.46	0.46	0.43	0.30	0.40	0.62
2010	37	1.31	0.94	1.11	0.82	0.55	0.72	0.51	0.44	0.49	0.55	0.55	0.72
2011	39	1.06	0.91	0.94	0.88	0.64	0.57	0.62	0.55	0.47	0.37	0.34	0.76
2012	24	1.07	0.84	0.90	0.58	0.52	0.58	0.50	0.45	0.45	0.49	0.52	0.83
2013	23	0.71	0.74	0.41	0.40	0.43	0.32	0.39	0.27	0.30	0.55	0.38	0.61
2014	23	0.78	1.06	0.79	0.62	0.50	0.88	0.43	0.42	0.35	0.53	0.55	0.69
2015	24	1.23	1.12	0.92	0.55	0.44	0.41	0.25	0.29	0.45	0.70	0.73	0.59
2016	20	1.25	0.72	0.83	0.55	0.51	0.42	0.36	0.36	0.34	0.36	0.71	
2017	18		0.93	0.70		0.58	0.48	0.38	0.32	0.42	0.40	0.22	0.84
2018	21	0.74	0.92	0.63	0.66	0.29	0.43	0.37	0.25	0.39	0.43	0.30	0.49
POR MEDIAN		1.11	0.95	0.88	0.62	0.54	0.52	0.46	0.43	0.43	0.49	0.50	0.84

KEY
nitrate in mg/L as N
N ≤ 0.4
0.4 < N ≤ 0.5
0.5 < N ≤ 0.8
0.8 < N ≤ 1.1
N > 1.1

July-September trend (low-flow high-sunlight period)



GRAPH KEY

- value
- Jul-Sep median
- POR Jul-Sep median
- POR Jul-Sep smooth line (LOWESS)
- POR Jul-Sep trend line (LOWESS) - statistically significant

APPENDIX J
WATER QUALITY: METALS

SCOPE

This appendix shows data for copper and zinc concentrations (total recoverable and dissolved for both) at selected sites in the Tualatin River and its tributaries. The data were collected by Clean Water Services. Copper and zinc data collected by other agencies may exist, but are not shown here. An explanation of the tables and figures is on page J-3.

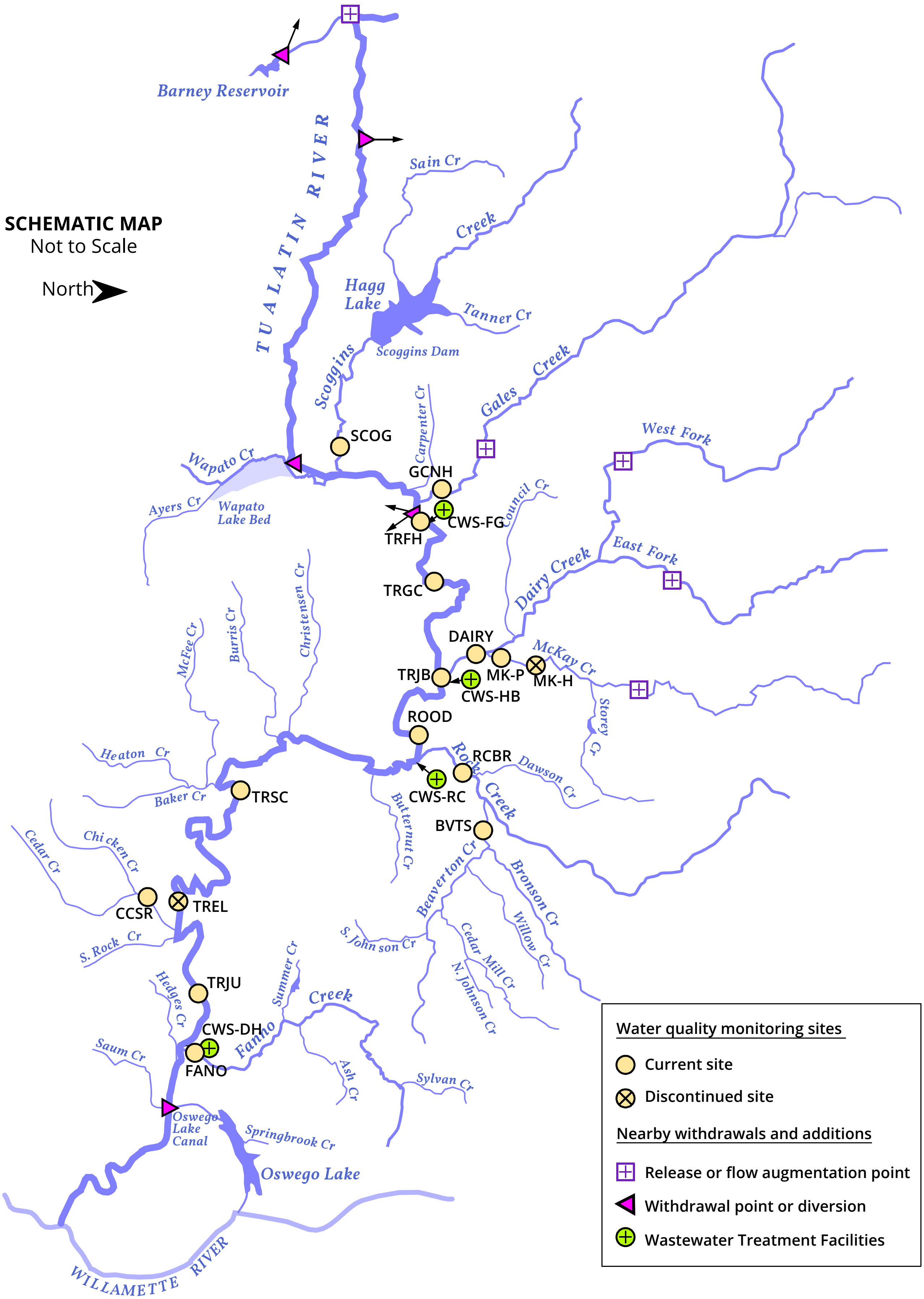
PATTERNS AND PROCESSES

- *Highest concentrations*— Fanno Creek and Beaverton Creek had the highest concentrations overall for both copper and zinc. These two sites are in highly urban areas where sources of copper and zinc would be common.
- *Lowest concentrations*—Scoggins Creek had the lowest concentrations of copper and zinc.
- *Seasonal pattern*— Concentrations at many sites show possible seasonal patterns. Interestingly, the seasonal pattern in dissolved zinc concentration in the Tualatin River appears to change with downstream location. Determining patterns among these data is complicated by inadequate sampling frequency and high variability in concentrations. The table below summarizes the observed patterns:

	SITES WITH SEASONAL PATTERN	PERIOD	NOTES
Copper			
Total recoverable	Tualatin River sites at Fern Hill, Golf Course Rd, Hwy 219 & Rood Bridge Rd Dairy Creek and Gales Creek (weak pattern)	2008–2011	concentrations possibly lower in summer & higher in winter; pattern difficult to distinguish from noise
Dissolved	Tualatin River sites at Rood Bridge Rd, Hwy 210 and Jurgens Park	2016–2017	concentrations increase spring through late summer/early fall two year record is too short to confirm pattern sampling too infrequent to show pattern before 2016 or to determine persistence into 2018
Zinc			
Total recoverable	no patterns distinguishable from noise		
Dissolved	Tualatin River sites at Hwy 219 and Rood Bridge Rd Dairy, Rock, Beaverton, & Fanno Creeks	2008–2011	lowest concentrations usually in summer; highest concentrations usually in winter; after 2011, sampling too infrequent to show pattern
Dissolved	Tualatin River sites at Hwy 210 and Jurgens Park	2008–2011	concentrations lowest in winter & highest at end of summer after 2011, sampling too infrequent to show pattern

- *Trends*—No clear trends were observed for either copper or zinc whether they were total recoverable or dissolved. At all sites except Scoggins Creek, high concentrations of total recoverable copper and total recoverable zinc occurred more times before 2012 than after. Had the sampling frequency been constant, this difference would indicate a decreasing trend, but the sampling frequency decreased by a factor of three. Based on the earlier more frequent sampling, high concentrations are less common than low concentrations. This means that the lower frequency of high values after 2012 could easily have occurred by chance and no conclusions about trends can be made.
- *Uncertainty*—In some instances, dissolved concentrations exceeded total recoverable concentrations, indicating that the reported values may have significant uncertainty.

Copper & zinc sampling sites



COPPER AND ZINC SAMPLING SITES — ALPHABETICAL LISTING BY SITE CODE			
SITE CODE	**SITE NAME**	**RIVER MILE**	**PAGE**
BVTS	Beaverton Creek near Orenco / at Guston Ct	1.2 / 1.2	J–15
CCSR	Chicken Creek at Scholls-Sherwood Rd (Roy Rogers Rd)	2.3	J–16
DAIRY	Dairy Creek at Hwy 8	2.06	J–12
FANO	Fanno Creek at Durham Rd	1.2	J–17
GCNH	Gales Creek at New Hwy 47	2.36	J–11
MK-H & MK-P	McKay Creek at Hornecker Rd / Padgett Rd	2.2 / 1.3	J–13
RCBR	Rock Creek at Brookwood	2.4	J–14
ROOD	Tualatin River at Rood Bridge Rd	38.4	J–8
SCOG	Scoggins Creek near Gaston	1.71	J–4
TREL & TRJU	Tualatin River at Elsner Rd / Jurgens Park	16.2 / 10.8	J–10
TRFH	Tualatin River at Spring Hill Pump Plant / Fern Hill Rd	55.3	J–5
TRGC	Tualatin River at Golf Course Rd	51.5	J–6
TRJB	Tualatin River at Hwy 219	44.4	J–7
TRSC	Tualatin River at Hwy 210 (Scholls Bridge)	26.9	J–9

Explanation of Figures and Tables in this Appendix

One page of tables and graphs is included for every site.

Sampling frequency: Period of record, sampling frequency during that time and any changes in site location are included.

Concentrations: Median concentrations of copper and zinc (both total recoverable and dissolved) over the period of record are given in a table.

Time series: Two time series graphs are on the lower half of the page. The upper graph is for copper and the lower graph is for zinc. Individual data points and medians are shown. Both total recoverable and dissolved forms are included on each graph (in black and green, respectively).

SCOG – Scoggins Creek near Gaston – 14203000

Data source: Clean Water Services

Sampling frequency & data

• The period of record is March 2013 through present, except for dissolved copper which began February 2011.

NOMINAL SAMPLING FREQUENCY

2013	2014–present
twice a year	quarterly

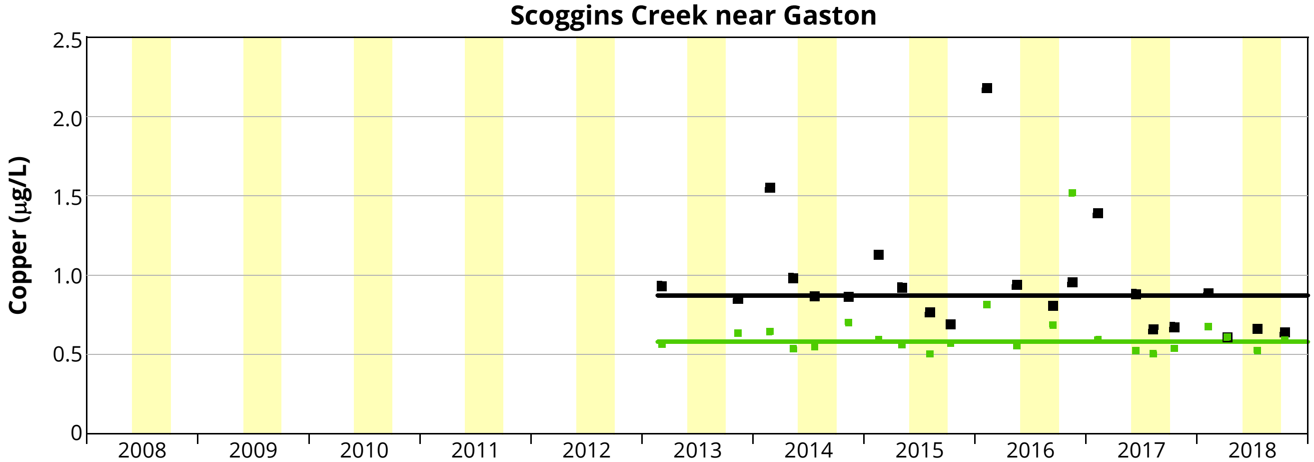
Concentrations

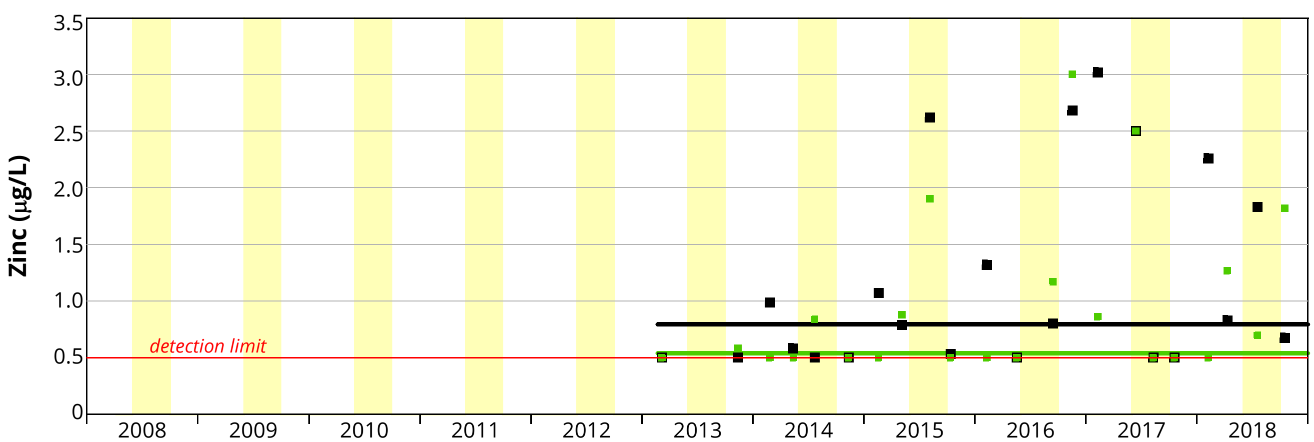
MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (μg/L)	Total Recoverable (μg/L)
Copper	0.58	0.87
Zinc	0.54	0.79

Time series

Scoggins Creek near Gaston





Graph Key

June–September

Dissolved: *sampling point* *POR median*

Total Recoverable: *sampling point* *POR median*

TRFH – Tualatin River at Spring Hill Pump Plant/Fern Hill Road

Data source: Clean Water Services

Sampling frequency & data

• The period of record is January 2008 through present, except for dissolved copper which began February 2011.

NOMINAL SAMPLING FREQUENCY

2008–2011	2012–2015	2016-present
monthly sparse for dissolved copper	approximately quarterly	approximately monthly

• The sampling location switched between two sites, sometimes as often as every other sample. These two sites are close to each other, so the site changes may not be important.

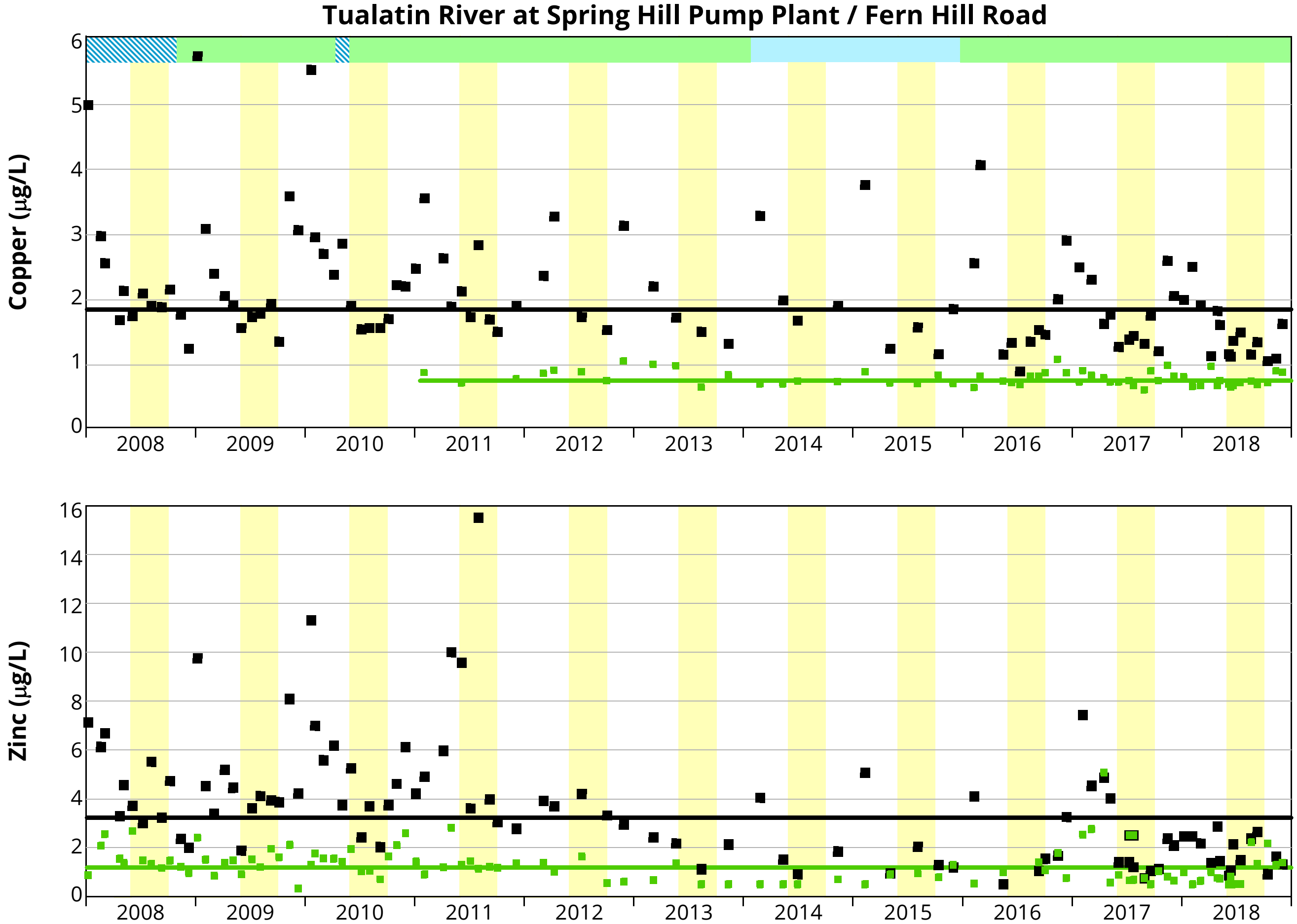
Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (μg/L)	Total Recoverable (μg/L)
Copper	0.72	1.82
Zinc	1.20	3.23

Time series

Tualatin River at Spring Hill Pump Plant / Fern Hill Road



Graph Key

	Dissolved	Total Recoverable
June–September		
SHPP site *Fern Hill site* *mixed sites*	*sampling point* *POR median*	*sampling point* *POR median*

TRGC – Tualatin River at Golf Course Road – 14204800

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began February 2011.

NOMINAL SAMPLING FREQUENCY

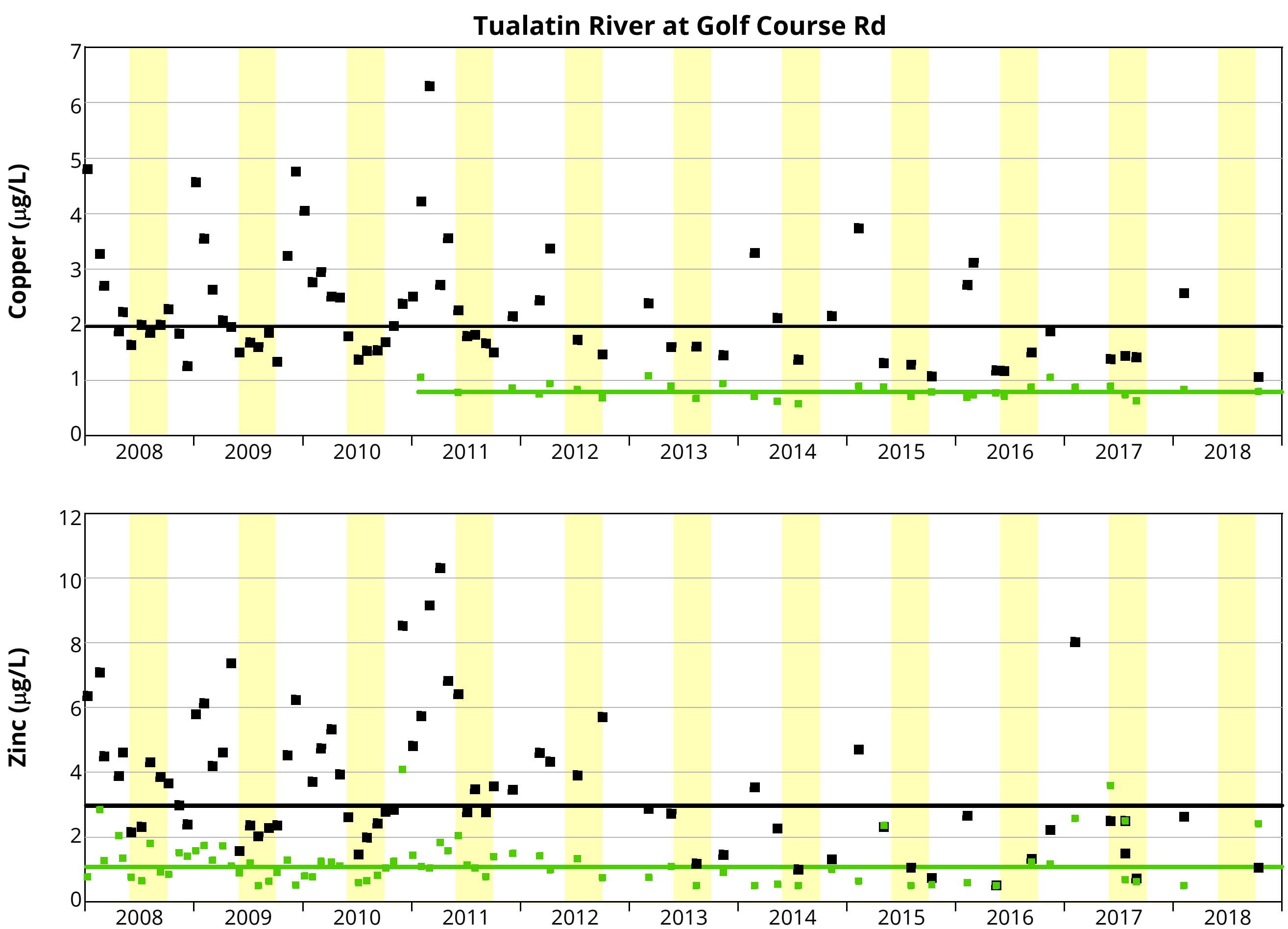
2008–2011	2012–2017	2018
monthly sparse for dissolved copper	approximately quarterly	twice a year

Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (μg/L)	Total Recoverable (μg/L)
Copper	0.80	1.97
Zinc	1.09	2.98

Time series



Graph Key

June–September

Dissolved		Total Recoverable	
sampling point	*POR median*	*sampling point*	*POR median*

TRJB – Tualatin River at Hwy 219 – 14206241

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began in February 2011.

NOMINAL SAMPLING FREQUENCY

2008–2011	2012–2015	2016–May-2018	Jun-2018 -present
monthly sparse for dissolved copper	approximately quarterly	approximately monthly	quarterly

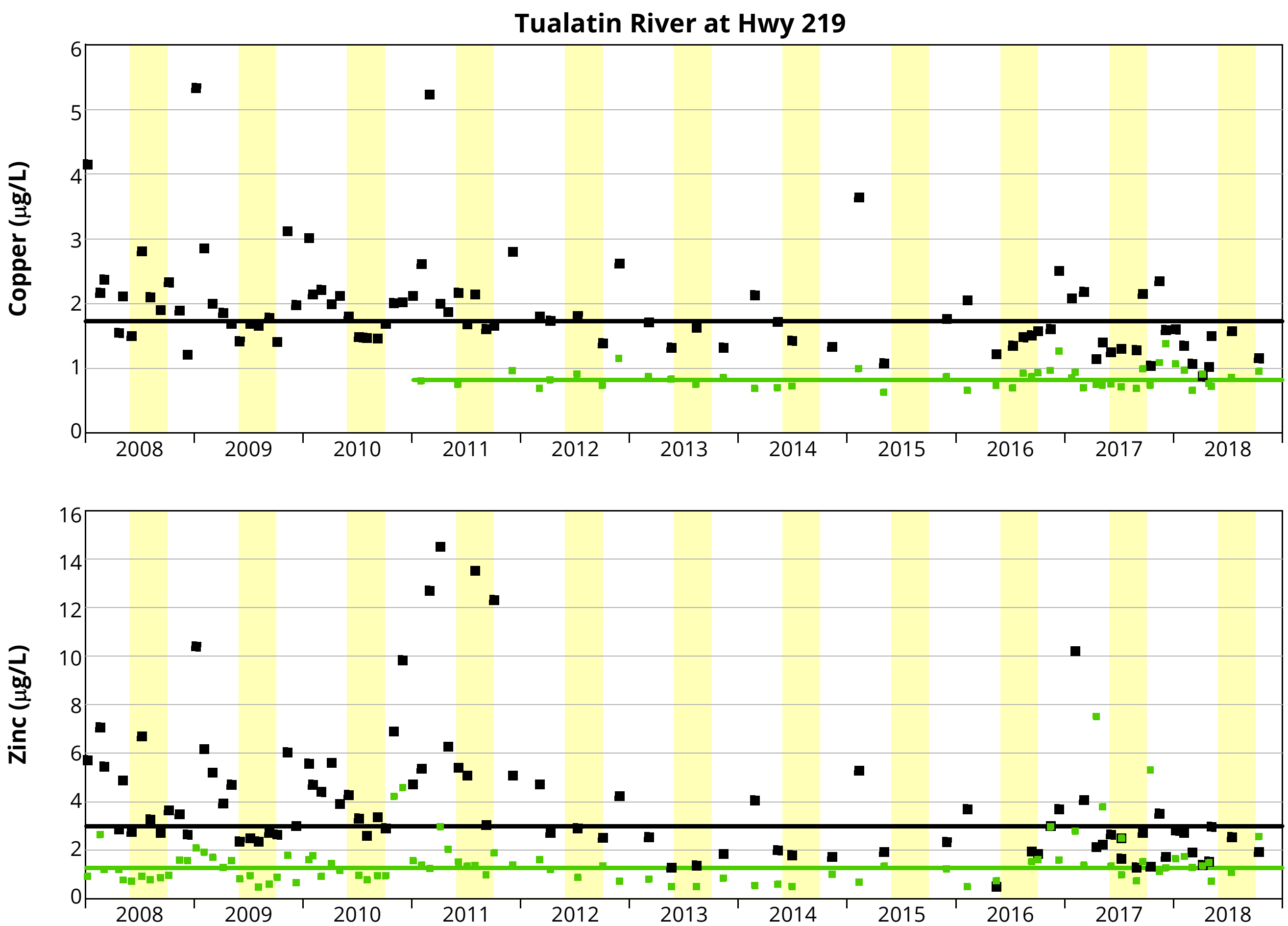
Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (µg/L)	Total Recoverable (µg/L)
Copper	0.83	1.73
Zinc	1.29	3.00

- Fewer data are available for dissolved copper than total recoverable copper.

Time series



Graph Key

June–September

Dissolved: *sampling point* — *POR median*

Total Recoverable: *sampling point* — *POR median*

ROOD – Tualatin River at Rood Bridge Rd – 14206295

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began June 2009.

NOMINAL SAMPLING FREQUENCY

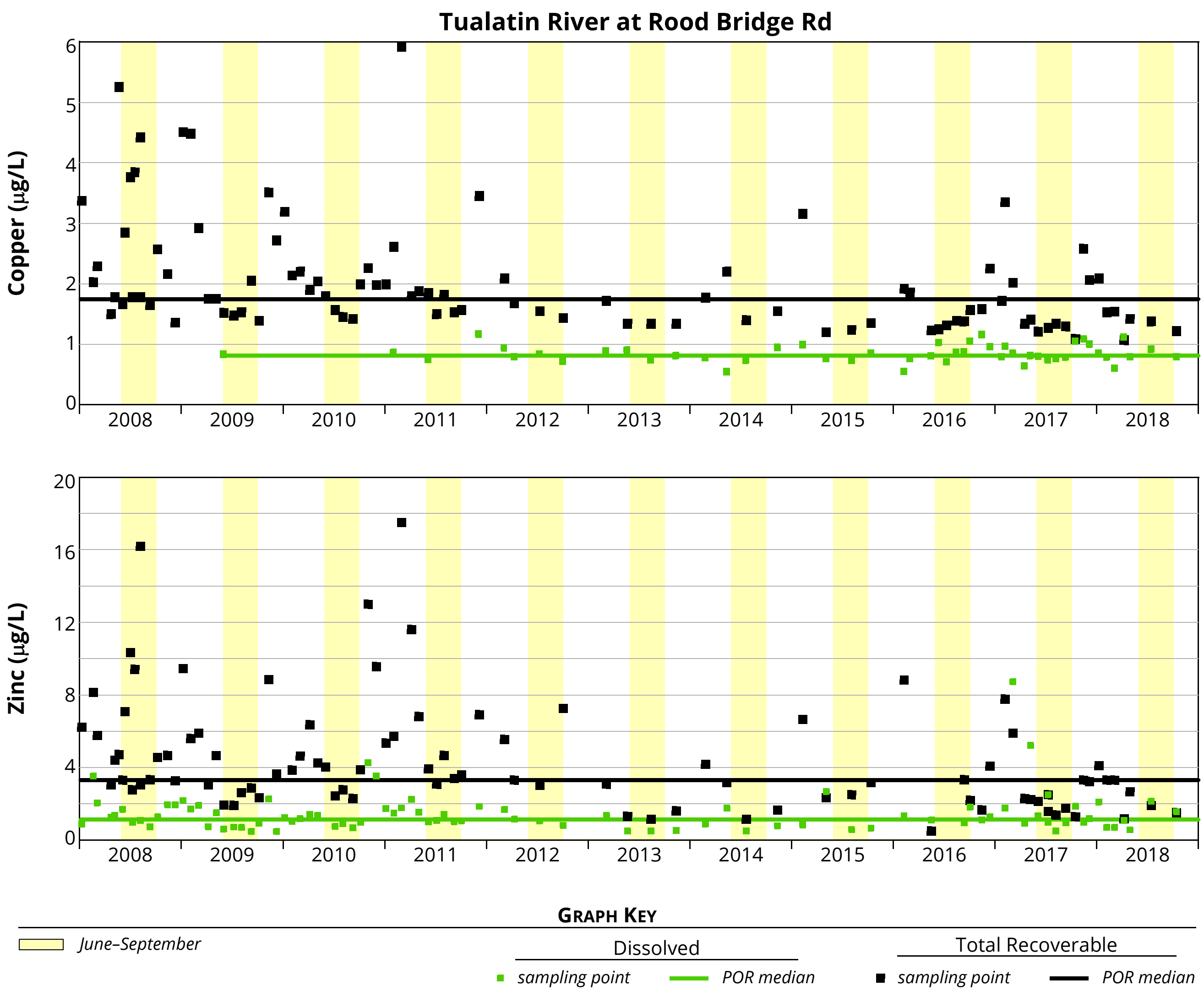
2008–2011	2012–2015	2016–May-2018	Jun-2018 -present
monthly sparse for dissolved copper	approximately quarterly	approximately monthly	quarterly

Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (μg/L)	Total Recoverable (μg/L)
Copper	0.82	1.75
Zinc	1.14	3.32

Time series



TRSC – Tualatin River at Hwy 210 (Scholls Bridge) – 14206690

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began February 2011.

NOMINAL SAMPLING FREQUENCY

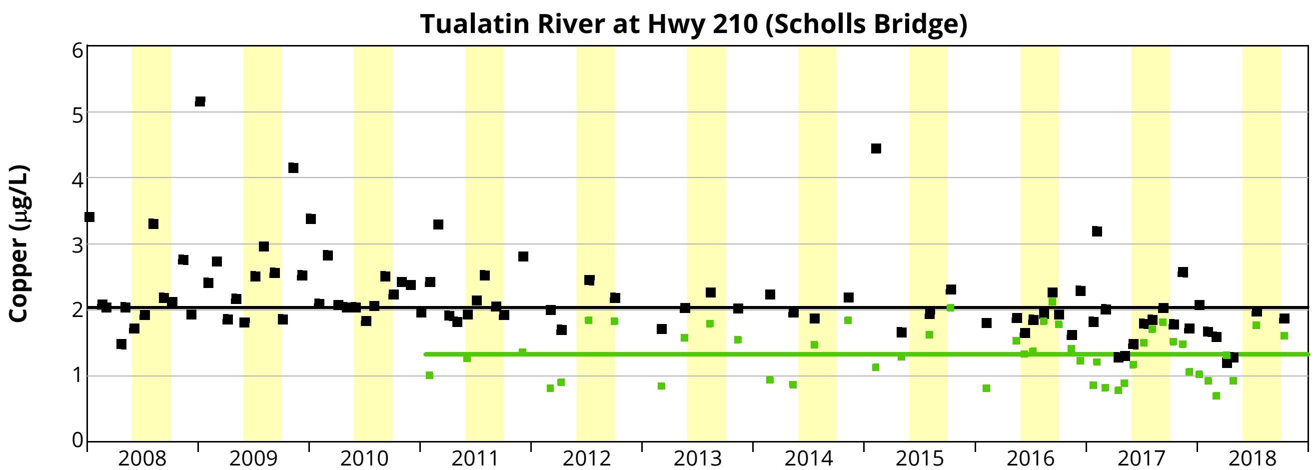
2008–2011	2012–2015	2016–May-2018	Jun-2018 -present
monthly sparse for dissolved copper	approximately quarterly	approximately monthly	quarterly

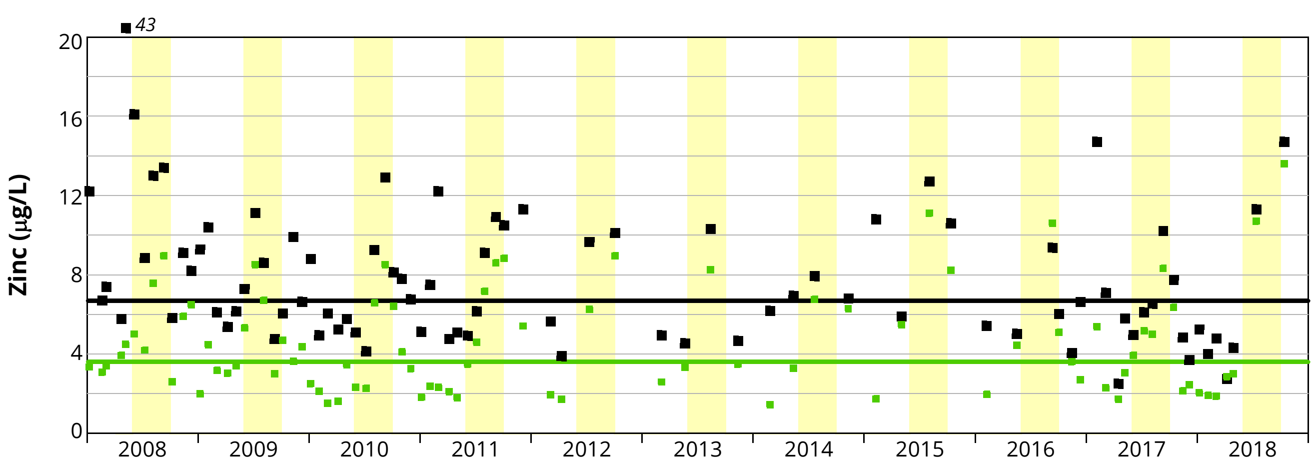
Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (μg/L)	Total Recoverable (μg/L)
Copper	1.33	2.04
Zinc	3.62	6.69

Time series





Graph Key

June–September

Dissolved: *sampling point* · *POR median*

Total Recoverable: *sampling point* · *POR median*

TREL / TRJU – Tualatin River at Elsner Rd / Jurgens Park

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began June 2010.

NOMINAL SAMPLING FREQUENCY

2008–2011	2012–2015	2016–May-2018	Jun-2018 -present
monthly sparse for dissolved copper	approximately quarterly	approximately monthly	approximately every 2 months

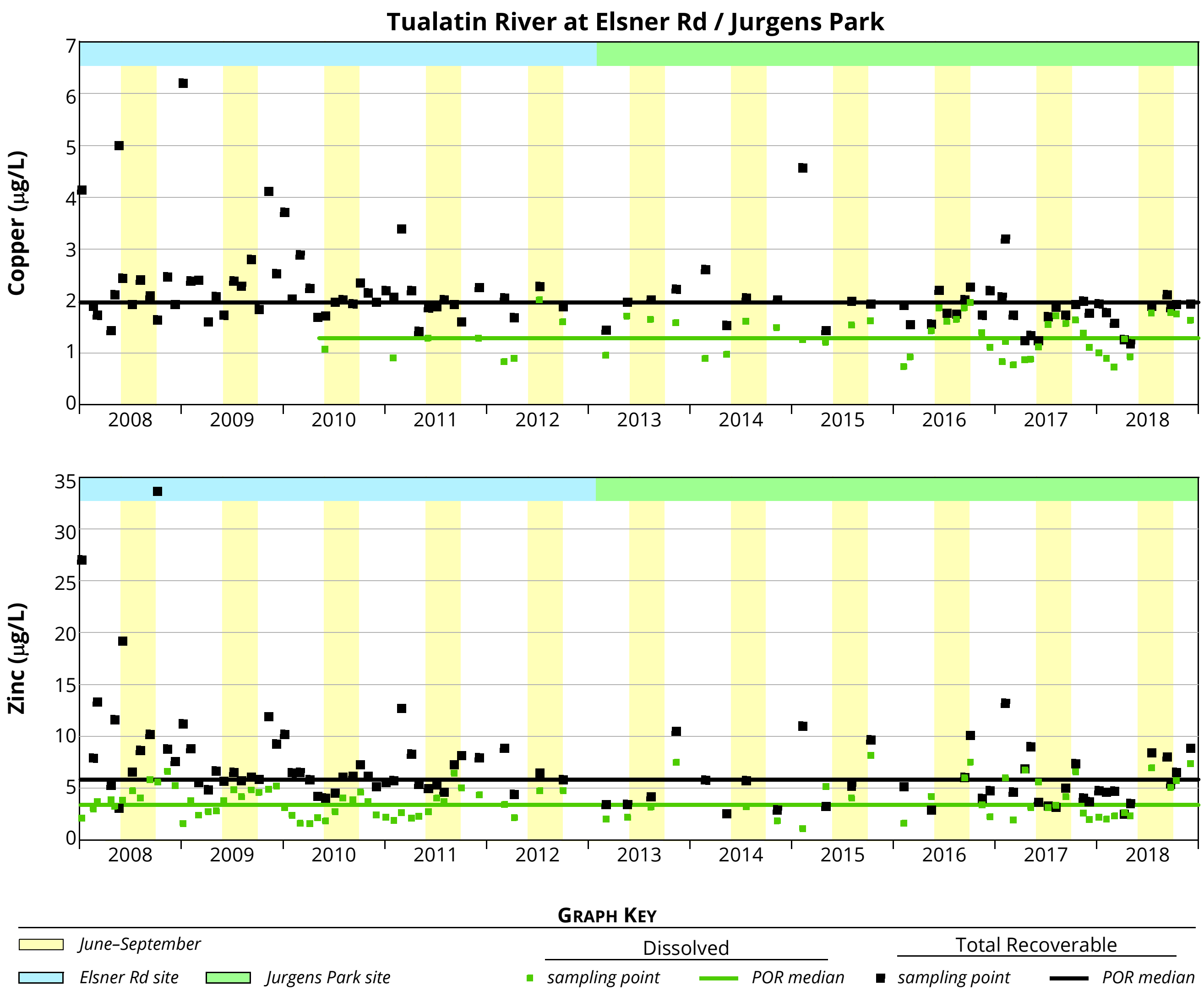
- In 2012, the site location moved from Elsner Road (RM 16.2) to Jurgens Park (RM 10.8). Two tributaries (Chicken and South Rock Creeks) enter the Tualatin River between the two sites. The Tualatin River National Wildlife Refuge is between the sites, as is US Hwy 99W. The extent to which the tributaries, the wetlands at the refuge, or the highway affect copper or zinc concentrations in the river is unknown.

Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (µg/L)	Total Recoverable (µg/L)
Copper	1.29	1.98
Zinc	3.41	5.86

Time series



GCNH – Gales Creek at New Hwy 47

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began December 2008.

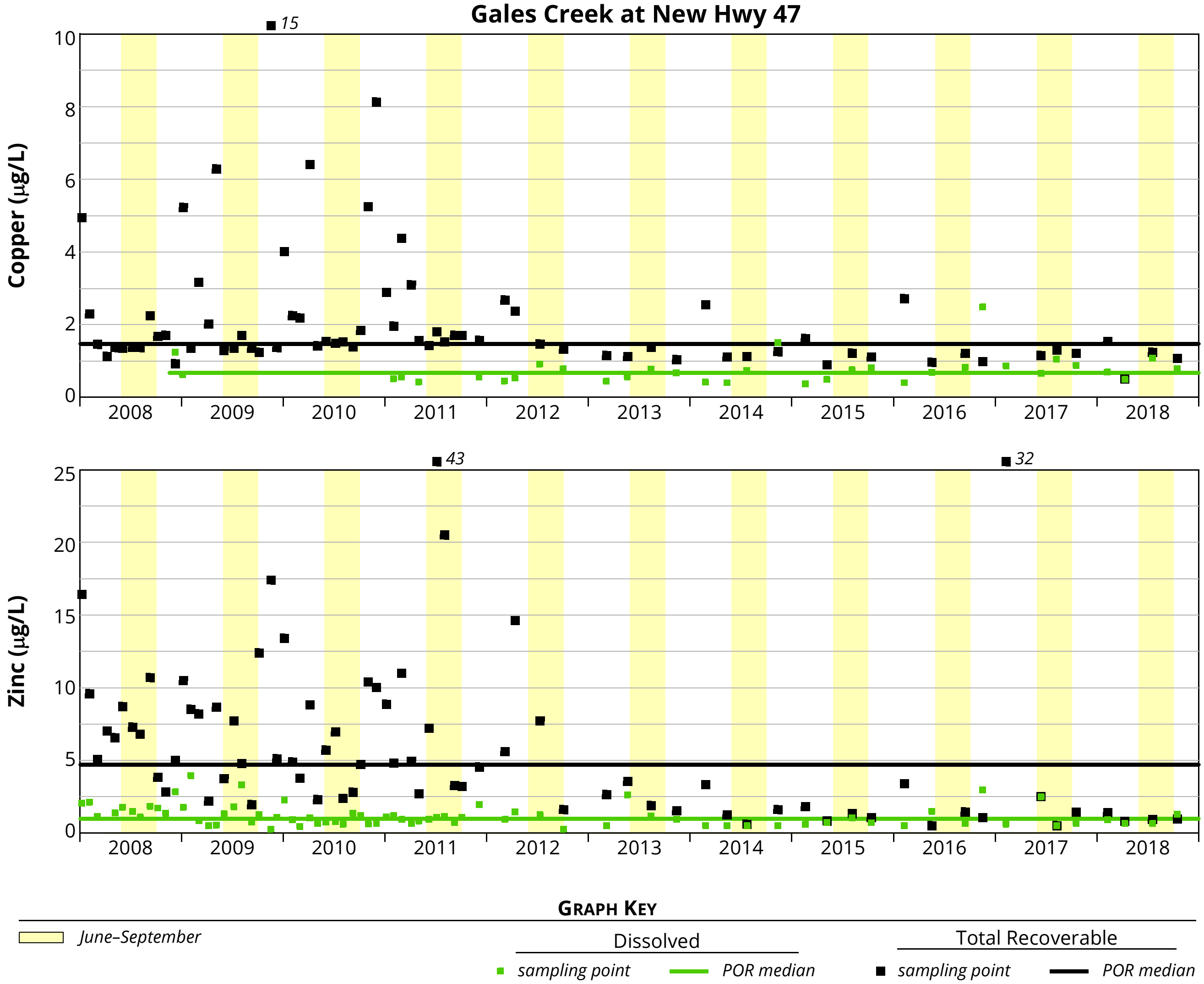
NOMINAL SAMPLING FREQUENCY	
2008–2011	**2012–PRESENT**
monthly sparse for dissolved copper	approximately quarterly

Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD		
	Dissolved (µg/L)	Total Recoverable (µg/L)
Copper	0.68	1.48
Zinc	0.99	4.72

- Some values are off-scale and shown above the graphs with their concentrations noted.

Time series



DAIRY – Dairy Creek at Hwy 8 – 14206200

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began December 2008.

NOMINAL SAMPLING FREQUENCY	
2008–2011	**2012–present**
monthly sparse for dissolved copper	approximately quarterly

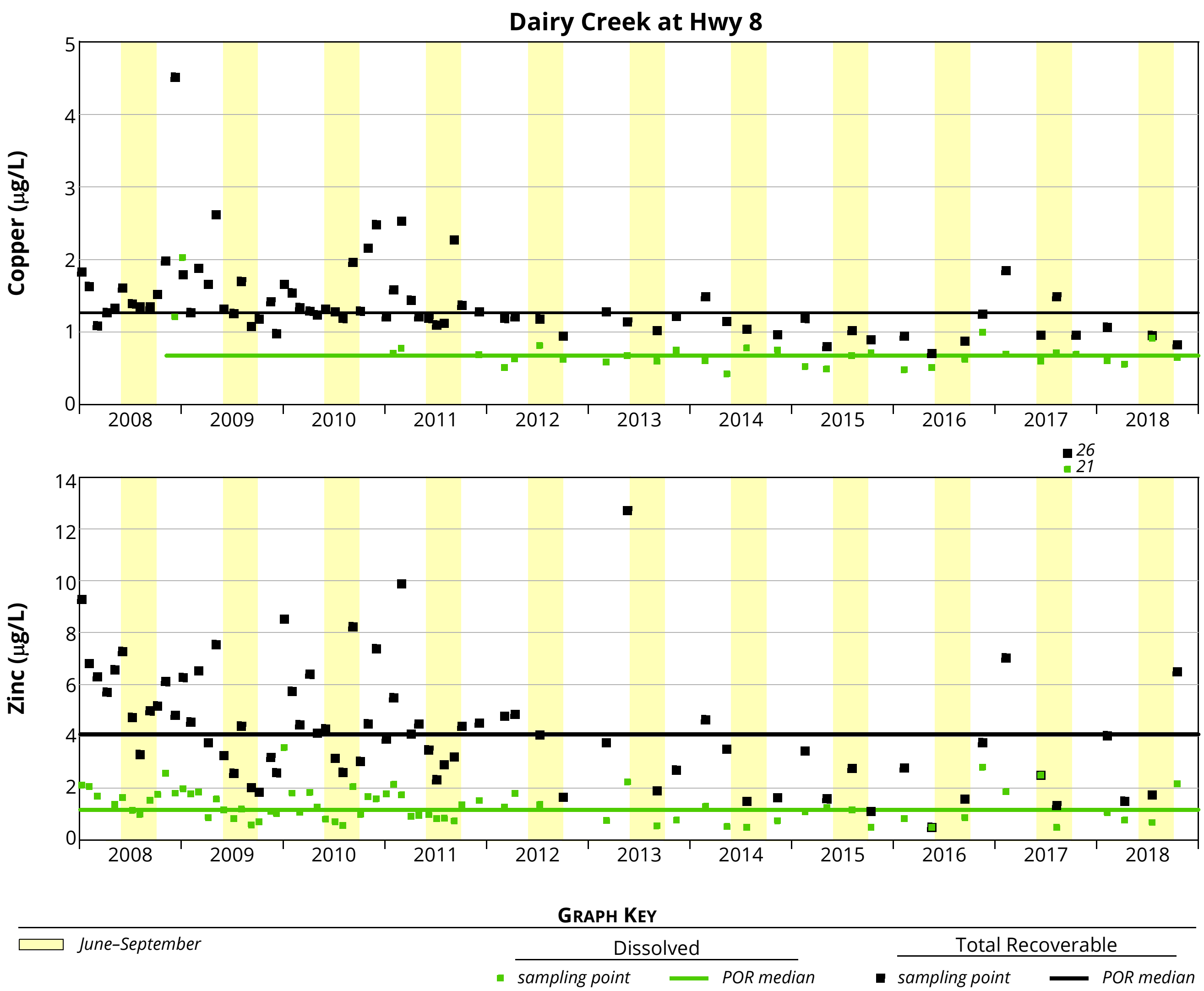
Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (μg/L)	Total Recoverable (μg/L)
Copper	0.68	1.27
Zinc	1.19	4.09

- Some values are off-scale and shown above the graphs with their concentrations noted.

Time series



MK-H / MK-P – McKay Creek at Hornecker Rd / Padgett Rd

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began January 2009.

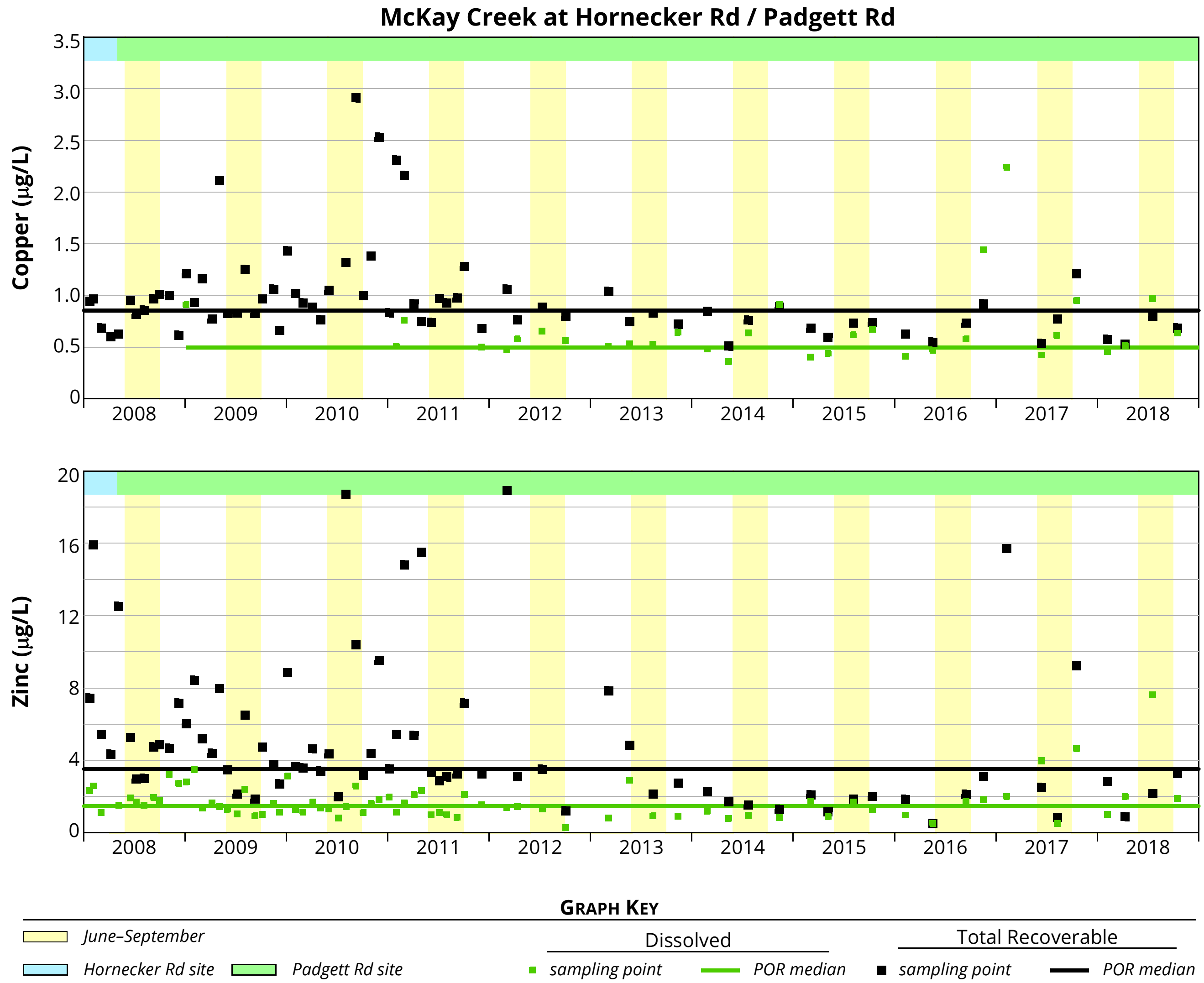
NOMINAL SAMPLING FREQUENCY	
2008–2011	**2012–present**
monthly sparse for dissolved copper	approximately quarterly

- The site location changed during 2008. The distance between the sites is about one mile.

Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD		
	Dissolved (µg/L)	Total Recoverable (µg/L)
Copper	0.57	0.86
Zinc	1.48	3.53

Time series



RCBR – Rock Creek at Brookwood

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began January 2009.

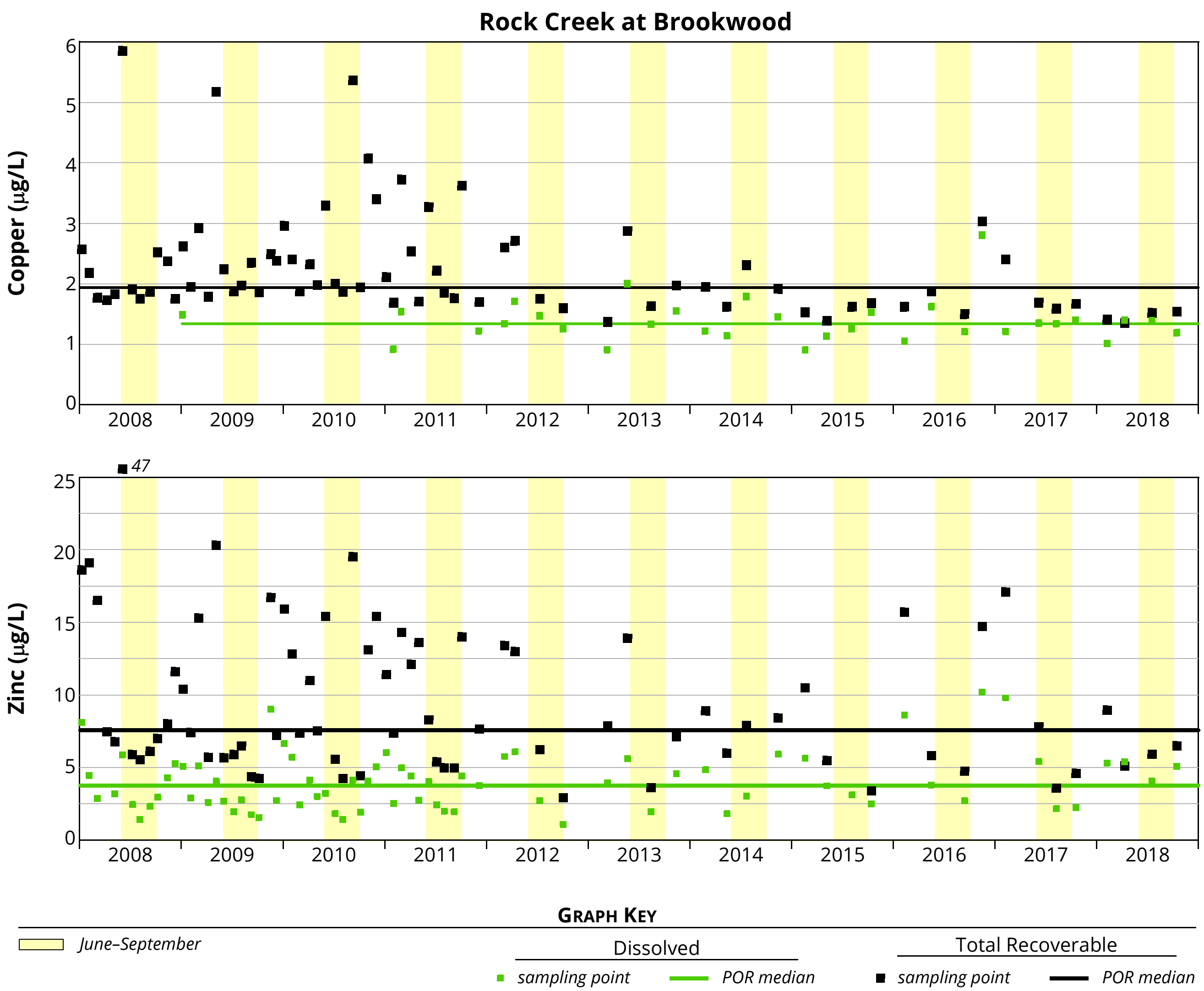
NOMINAL SAMPLING FREQUENCY	
2008–2011	**2012–present**
monthly sparse for dissolved copper	approximately quarterly

Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD		
	Dissolved (µg/L)	**Total Recoverable (µg/L)**
Copper	1.34	1.94
Zinc	3.78	7.58

- One value is off-scale and shown above the graphs with its concentration noted.

Time series



BVTS – Beaverton Creek near Orenco / at Guston Ct

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began February 2011.

NOMINAL SAMPLING FREQUENCY

2008–2011	2012–PRESENT
monthly sparse for dissolved copper	approximately quarterly

- The site location changed from Orenco to Guston Ct (2002) and back to Orenco (2012). The distance between the sites is very small.

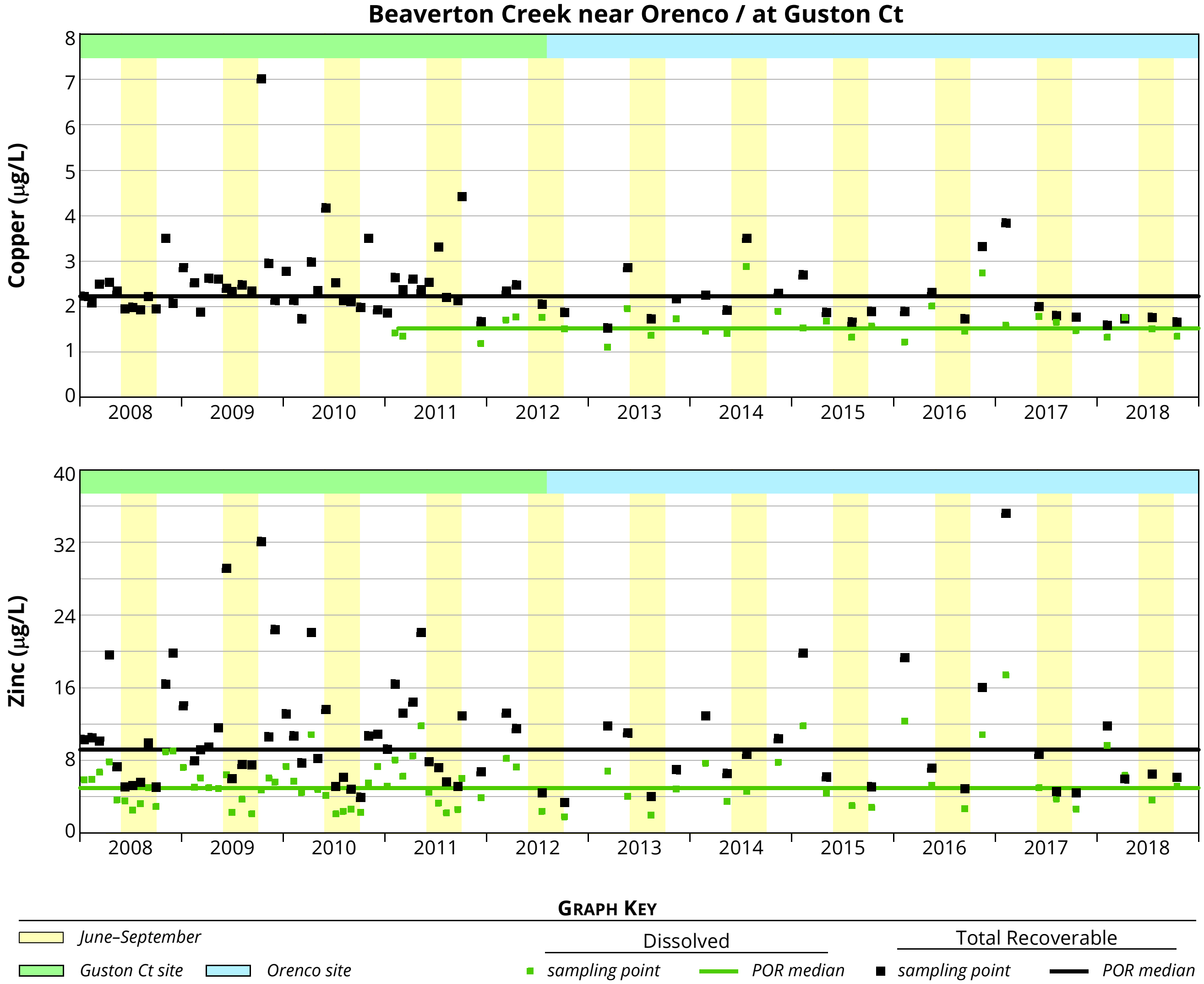
Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (µg/L)	Total Recoverable (µg/L)
Copper	1.53	2.23
Zinc	4.99	9.20

Time series

Beaverton Creek near Orenco / at Guston Ct



CCSR – Chicken Creek at Scholls-Sherwood Rd (Roy Rogers Rd) – 14206750

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began January 2009.

NOMINAL SAMPLING FREQUENCY

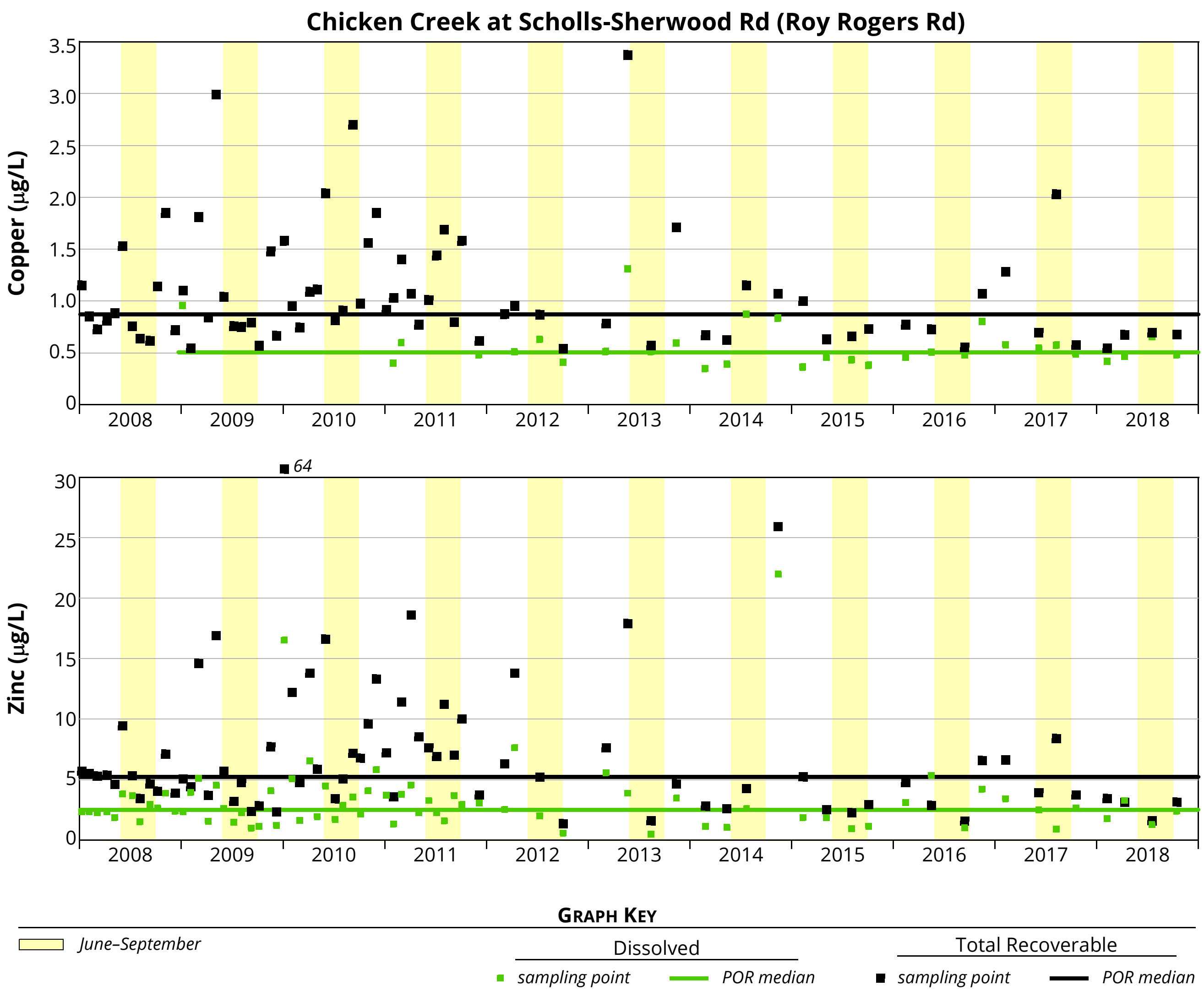
2008–2011	2012–present
monthly sparse for dissolved copper	approximately quarterly

Concentrations

MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (μg/L)	Total Recoverable (μg/L)
Copper	0.51	0.87
Zinc	2.53	5.24

Time series



FANO – Fanno Creek at Durham – 14206950

Data source: Clean Water Services

Sampling frequency & data

- The period of record is January 2008 through present, except for dissolved copper which began August 2008.

NOMINAL SAMPLING FREQUENCY

2008–2011	2012–present
monthly sparse for dissolved copper	approximately quarterly

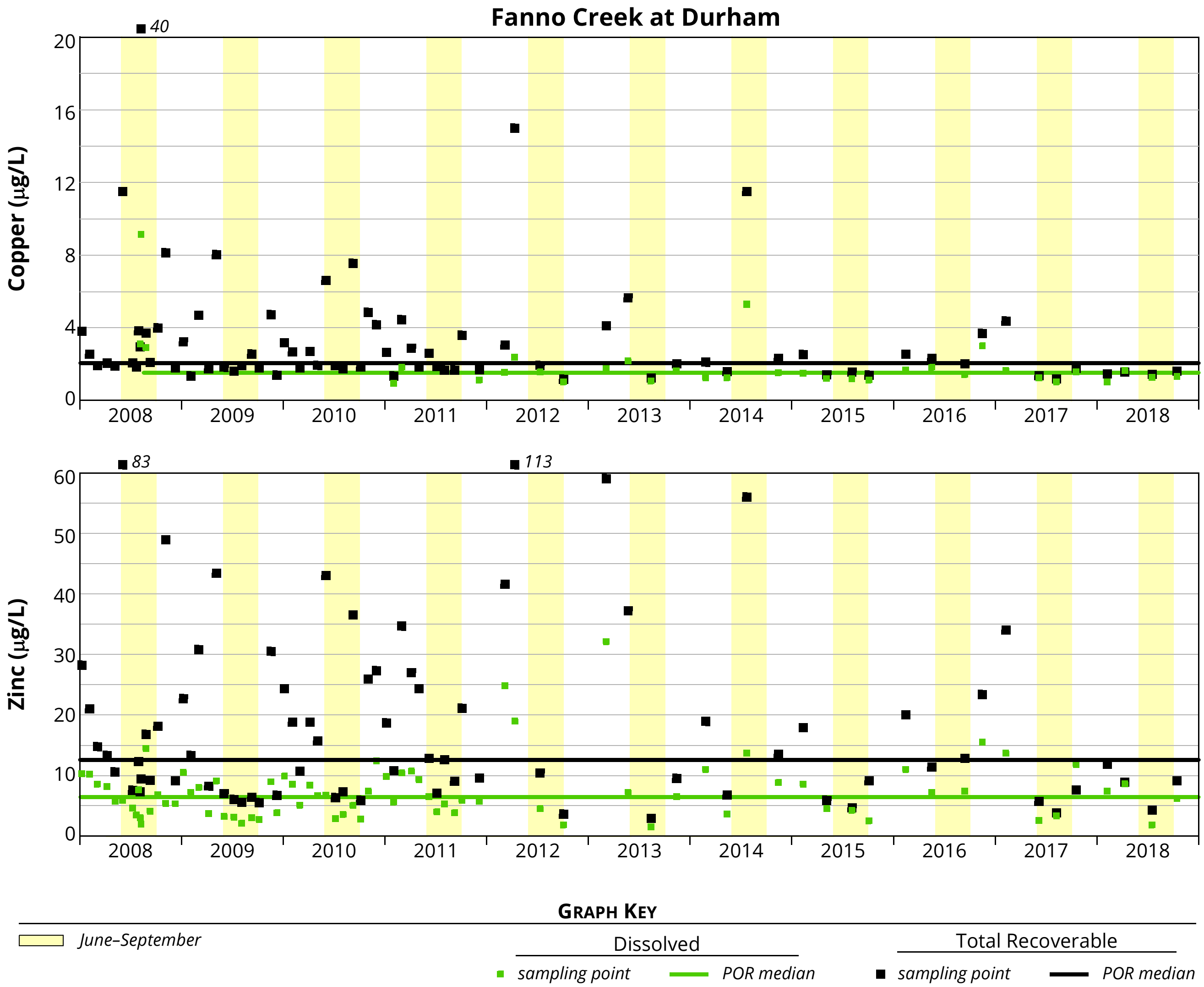
Concentrations

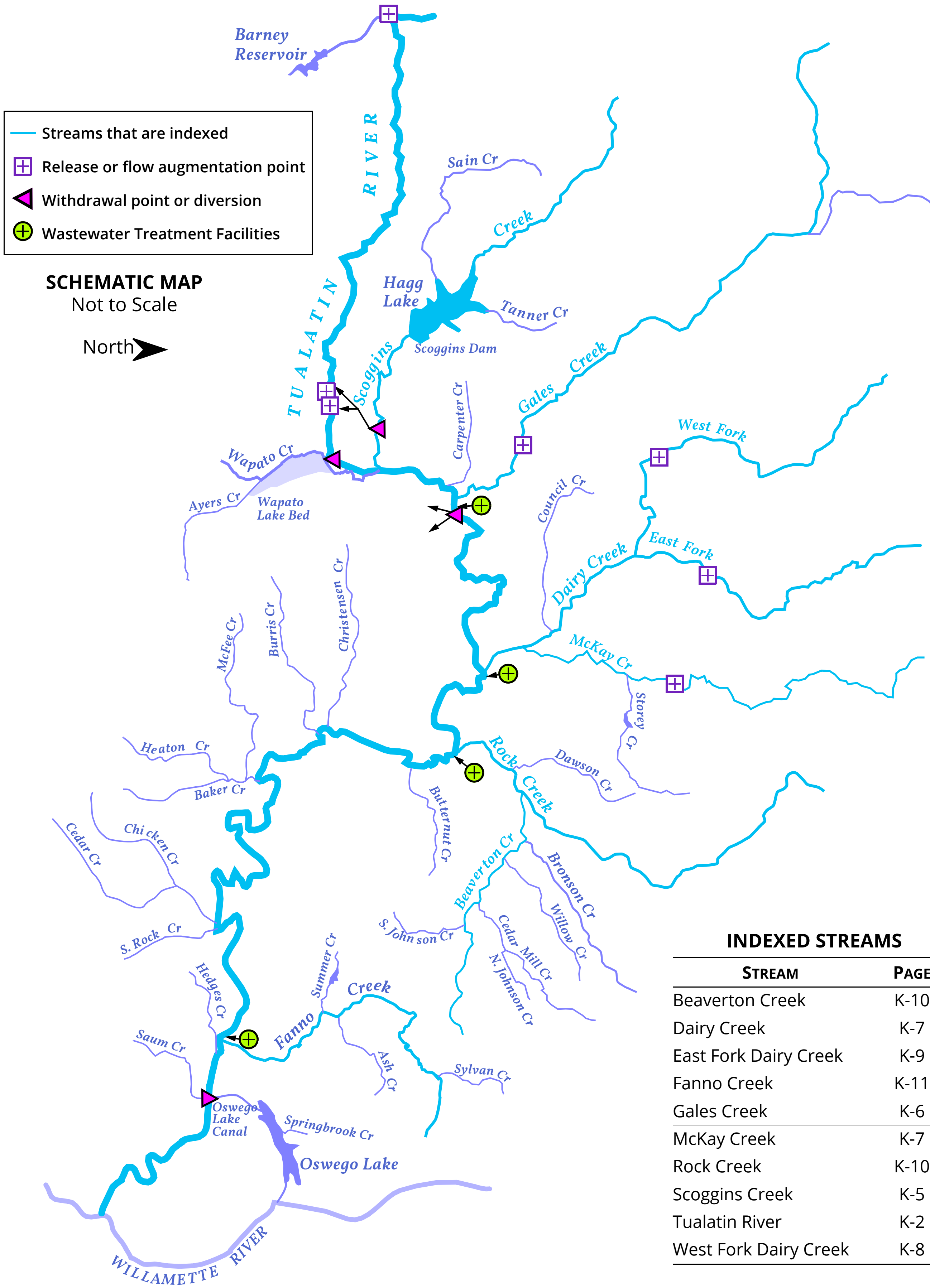
MEDIAN CONCENTRATION FOR PERIOD OF RECORD

	Dissolved (μg/L)	Total Recoverable (μg/L)
Copper	1.54	2.07
Zinc	6.48	12.60

- Some values are off-scale and shown above the graphs with their concentrations noted.

Time series





INDEXED STREAMS

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TUALATIN RIVER – RIVER MILE INDEX

[Abbreviations: RB= right bank, LB= left bank]

RIVER MILE	BANK	DESCRIPTION	DRAINAGE AREA (square miles)	ELEVATION (feet)
0.00		Mouth of Tualatin River at Willamette River (LB of Willamette River @ River Mile 28.5)	712	
0.20		Weiss Bridge – Petes Mtn Rd.		
1.60	RB	Fields Creek		
1.69		State Hwy 212 Bridge (Fields Bridge)		
1.75	LB	USGS Gage #14207500: Tualatin River at West Linn	706	85.61
2.40	LB	Tate Creek		
3.45		Lake Oswego Corp. Diversion Dam		
4.25		Interstate 205 Bridge		
4.56	LB	Wilson Creek		
5.34	LB	Boat Launch		
5.36	LB	Shipley Creek		
5.38		Shipley Bridge– Stafford Rd NWS Wire Weight Gage		
5.62	LB	Pecan Creek		
6.02	RB	Athey Creek		
6.70	RB	Saum Creek		
6.70	LB	Oswego Canal Diversion River Elevation Recording Gage #14206990 Headgate and Canal Recording Gage #14207000		
7.36	LB	Boat Launch – Dogwood Drive		
7.67	RB	Browns Ferry Park Canoe Launch		
7.83		Clackamas County – Washington County Boundary (Underground Cable Crossing Sign)		
8.18		Interstate 5 Bridge		
8.60		Boones Ferry Road Bridge		
8.64	RB	Hedges Creek		
8.90	RB	Tualatin Park Boat Launch		
8.91	RB	Southern Pacific RR Bridge Tualatin River at Tualatin Elevation Recording Station #14206956 (formerly #14206960)		
9.32	LB	Fanno Creek *[Index on page I-13]*	26.8	
9.33	LB	Durham Wastewater Treatment Plant Outfall (9.2 on NPDES permit)		
9.34		Oregon Electric RR Bridge		
9.80	LB	Cook Park Boat Launch		
11.50	LB	US Hwy. 99W Bridge (Pacific Highway) Canoe Launch(access from southeast of bridge)		
12.68		Overhead BPA Transmission Line; Vancouver–Eugene		
12.80	LB	Rivermeade Boat Launch (Private)		
15.20	RB	Rock Creek–South	13.7	
15.50	RB	Chicken Creek		
16.09	RB	Chicken Creek Drainage Ditch		
16.22	RB	Shamberg Bridge (Elsner Road) Rated Staff Gage for Stream Flow		

Tualatin River – River mile index

[Abbreviations: RB= right bank, LB= left bank]

River Mile	Bank	Description	Drainage Area (square miles)	Elevation (feet)
21.12		Overhead BPA Transmission Line; Big Eddy–Keeler		
26.90		State Hwy. 210 bridge (Scholls)		
28.20	RB	McFee Creek		
30.76	LB	Unnamed Stream (Jacktown)		
31.62	RB	Burris Creek		
31.92	RB	Christensen Creek		
33.30	 LB	Harris Bridge (State Highway 208) Farmington Recording Stream Gage #14206500	568	100.42
35.68	LB	Butternut Creek		
37.38	LB	Gordon Creek		
38.08	LB	Rock Creek Wastewater Treatment Plant Outfall (37.7 on NPDES permit)		
38.09	LB	Rock Creek Beaverton Creek	74.6 36	
38.44	LB LB	Rood Bridge Small Watercraft Launch Rood Bridge Road Bridge Recording Stream Gage #14206295		 105.16
40.44	RB	Davis Creek		
41.64		Minter Bridge Road Bridge		
43.88	LB LB	Jackson Slough Jackson Bottom Wetlands Hillsboro Wastewater Treatment Plant Effluent Outfall (42.9 and 43.3 on NPDES permit)		
44.40	RB	State Highway 219 Bridge Recording Stream Gage #14206241		
44.73	LB	Dairy Creek *[Index on page I-9]* McKay Creek (LB) *[Index on page I-10]* East Fork Dairy Creek *[Index on page I-11]* West Fork Dairy Creek *[Index on page I-12]*	226 63.4	
51.54	 RB	Golf Course Road Bridge Golf Course Recording Stream Gage #14204800		
53.74		LaFollett Road (Bridge removed)		
55.24	LB	Forest Grove Wastewater Treatment Plant Outfall (53.8 on NPDES permit) Fern Hill Wetlands and CWS Natural Treatment System		
55.32		Fernhill Road Bridge		
56.10		Springhill Pump Plant Intake		
56.80	LB	Gales Creek *[Index on page I-8]*	78.6	
57.38	LB	Carpenter Creek		
57.84	LB	Dilley Creek		
58.04	LB	Johnson Creek		
58.82	 LB	Springhill Road Bridge USGS Gage #14203500: Tualatin River at Dilley	125	147.57
59.02	LB	O'Neil Creek		
60.00	LB	Scoggins Creek *[Index on page I-7]*		
60.80	RB	Wapato Creek Wapato Creek Improvement District Return Flow		

Tualatin River – River mile index

[Abbreviations: RB= right bank, LB= left bank]

River Mile	Bank	Description	Drainage Area (square miles)	Elevation (feet)
62.00	RB	Wapato Improvement District Headgate)		
62.24		Southern Pacific RR Bridge		
62.25		State Highway 47 Bridge (Gaston) New Tualatin River at Gaston Recording Stream Gage #14202510		
62.30		Bates Road Bridge		
62.80	LB	Black Jack Creek		
62.90		Overhead BPA Transmission Line; Forest Grove–McMinnville		
63.13		TVID Patten Valley Pump Station Outfall #1		
63.87	RB	Discontinued Tualatin River at Gaston Recording Stream Gage	48.5	
64.26		TVID Patten Valley Pump Station Outfall #2		
65.34	RB	Williams Canyon		
65.90		Mt. Richmond Road Bridge		
67.30	LB	Hering Creek		
67.83		South Road Bridge (Cherry Grove)		
68.44	RB	Roaring Creek		
69.42		Little Lee Falls		
70.70	LB	Raines Bridge– Tualatin River below Lee Falls Rated Staff Gage for Stream Flow		
71.07		Lee Falls		
73.28		Haines Falls		
73.30	LB	City of Hillsboro Haines Falls Intake		
74.00	LB	Lee Creek		
74.05	RB	Patten Creek		
75.70	LB	Sunday Creek		
76.60	LB	Maple Creek		
76.95		Ki–A–Cut Falls		
78.00	RB	Barney Reservoir Aqueduct Outfall		
79.3+		Headwaters of Tualatin River		

SCOGGINS CREEK — STREAM MILE INDEX

[Abbreviations: RB= right bank, LB= left bank]

RIVER MILE	BANK	DESCRIPTION
0.00		Confluence with Tualatin River @ River Mile 60.00
0.94		RR Bridge
1.00		State Highway 47 Bridge
1.70		Old State Highway 47 Bridge
1.71		USGS Gage #14203000: Scoggins Creek near Gaston, OR (10/1940 – 9/1974) Drainage Area = 43.3 square miles
4.80		USGS Gage #14202980: Scoggins Creek below Henry Hagg Lake, near Gaston, OR (1/1975 –present) Drainage Area = 38.8 square miles
5.10		Scoggins Dam
7.00	RB	Sain Creek
7.62	LB	Tanner Creek
8.40	LB	Wall Creek
9.70		Lake Loop Road Bridge
9.30		Scoggins Creek above Henry Hagg, near Gaston, OR – Gage #14202850 (10/1972 – present) Drainage Area = 15.9 square miles
10.52	LB	Parson Creek
15.50	LB	Fisher Creek
15.5+		Headwaters

Gales Creek — Stream mile index

[Abbreviations: RB= right bank, LB= left bank, ISWR= Instream Water Right]

River Mile	Bank	Description
0.00	RB	Confluence with Tualatin River@ River Mile 56.80 ***ISWR:*** C–59523 5/25/66
1.63		Southern Pacific RR Bridge
1.75		Forest Grove Bypass Bridge – State Highway 47 to State Highway 8
2.36		State Highway 47 Bridge Gales Creek Recording Stream Gage #14204530
3.66		Ritchey Road Bridge (County Road 461)
6.53	RB	Prickett Creek
6.98		Stringtown Road Bridge (County Road A–176)
7.70	RB	Roderick Creek
8.56		Roderick Road Bridge (County Road 395) USGS Gage #14204500: Gales Creek near Forest Grove Oregon (10/1940–9/1956, 10/1970–9/1981)
8.94	RB	Godfrey Creek
9.22	LB	Kelly Creek
10.68	RB	Clear Creek
11.44	RB	Iler Creek
11.46		NW Gales Creek Road (County Road 1312) Community of Gales Creek
11.47	RB	Fir Creek
12.00		***ISWR:*** C–59509 5/25/66 above this point
12.36		Clapshaw Hill Road Bridge (County Road 2037) Rated Staff Gage for Stream Flow
12.40	LB	Little Beaver Creek ***ISWR:*** C–59512 5/25/66
12.92		Parson Road Bridge
14.44	RB	White Creek
14.68		NW Wilson River Highway Bridge (State Highway 6)
15.74	RB	Lyda Creek
16.26	RB	Bateman Creek
17.50		USGS Gage #1420400: Gales Creek near Gales Creek, OR – (10/1935–9/1945 & 10/1963–9/1970)
18.00	LB	Beaver CreekCommunity of Glenwood ***ISWR:*** C–59524 5/25/66
18.45		NW Timber Road Bridge (County Road 374)
18.65		Wilson River Highway Bridge (State Highway 6)
19.70		Wilson River Highway Bridge (State Highway 6)
19.88	LB	Coffee Creek
20.07	LB	Finger Creek
20.70	RB	South Fork Gales Creek ***ISWR:*** C–59514 5/25/66
21.60	LB	North Fork Gales Creek ***ISWR:*** C–59513 5/25/66
22.76	RB	Low Divide Creek
		Gales Creek Forest Park
23.20		USGS Gage #14203750: Gales Creek near Glenwood, OR (7/94 – present)
23.2+		Headwaters

Dairy Creek — Stream mile index

[Abbreviations: RB= right bank, LB= left bank]

River Mile	Bank	Description
0.00		Confluence with Tualatin River @ River Mile 44.73
1.65		Southern Pacific RR Bridge
2.06		State Highway 8 Bridge USGS Gage #14206200: Dairy Creek at TV Hwy
2.20		Oregon Electric RR Bridge
2.26	LB	McKay Creek
3.53	RB	Council Creek
6.02		Susbauer Road Bridge (County Road 196)
7.39		BPA Power Line Crossing
8.51		Cornelius–Schefflin Road Bridge (County Road 2161) Rated Staff Gage for Stream Flow
10.55		Confluence of East Fork Dairy Ck & West Fork Dairy Ck

McKay Creek — Stream mile index

[Abbreviations: RB= right bank, LB= left bank]

River Mile	Bank	Description
0.00		Confluence with Dairy Creek @ River Mile 2.26
1.31		Padgett Road Bridge (County Road 2245)
2.25		Hornecker Road Bridge (County Road 2393) Rated Staff Gage for Stream Flow
2.30		Southern Pacific RR Crossing
4.32		Glencoe Road Bridge (County Road A–146½) Rated Staff Gage for Stream Flow
4.46		BPA Transmission Line Crossing
5.34	LB	Waible Creek
6.30		NW Old Scotch Church Road Bridge (County Road A–66)
8.00		US Hwy 26 Bridge – Sunset Highway
9.36		NW West Union Road Bridge (County Road 2496) City of North Plains to West
9.38		Southern Pacific RR Crossing
10.94	LB	Jackson Creek
12.80		NW Shadybrook Road Bridge (County Road A–110)
15.56		NW Collins Road Bridge (County Road 1889) Rated Staff Gage for Stream Flow
16.56	RB	Brunswick Canyon
16.66	LB	East Fork McKay Creek
24.0+		Headwaters

West Fork Dairy Creek — Stream mile index

[Abbreviations: RB= right bank, LB= left bank]

River Mile	Bank	Description
0.00		Confluence with East Fork Dairy Creek @ River Mile 10.56 of Dairy Creek
1.96		Evers Road Bridge (County Road A–187) Rated Staff Gage for Stream Flow
2.09	RB	Lousignant Canal
2.82		State Highway 47 Bridge
5.28		Greenville Road Bridge (County Road A–159)
6.20		State Highway 6 Bridge
6.22	RB	Cedar Canyon Creek
7.53		Cedar Canyon Road Bridge (County Road 1938) City of Banks to SE
7.70		State Hwy 47 Bridge – Rated Staff Gage for Stream Flow USGS Gage #14205000: West Fork Dairy Creek at Banks, OR (10/1940 – 9/1943) Drainage Area = 47.5 square miles
7.72		Port of Tillamook Bay RR Bridge
9.30		US Highway 26 Bridge
10.60		NW Green Mountain Road Bridge (County Road 127)
11.02	LB	Garrigus Creek
12.19		NW Turk Road Bridge (County Road 233)
12.36	RB	Kuder Creek
12.90		NW Pihl Road Bridge (County Road 1045) Community of Manning
13.33		Port of Tillamook Bay RR Bridge
13.48		Port of Tillamook Bay RR Bridge
13.58	LB	Witcher Creek
14.37		Port of Tillamook Bay RR Bridge
14.50		US Highway 26 Bridge
15.00		NW Fisher Road Bridge (County Road 394)
15.11	LB	Mendenhall Creek
15.58	RB	Burgholzer Creek
15.60		US Highway 26 Bridge
16.00		Community of Buxton – ½ mile east
17.02	LB	Williams Creek
17.98	RB	Cummings Creek
18.10		State Highway 47 Bridge
18.85		Port of Tillamook Bay RR Bridge
22.0+		Headwaters

East Fork Dairy Creek — Stream mile index

[Abbreviations: RB= right bank, LB= left bank, ISWR= Instream Water Right]

River Mile	Bank	Description
0.00		Confluence with West Fork Dairy Creek @ River Mile 10.56 of Dairy Creek
1.24		Roy Road Bridge (County Road A–159) Rated Staff Gage for Stream Flow
2.34		Port of Tillamook Bay RR Bridge
3.04	RB	Bledsoe Creek
3.20		Harrington Road Bridge (County Road 1989)
4.80		SP&S RR Bridge
5.56		US Highway 26 Bridges
6.91		Mountaindale Road Bridge (County Road 12)
6.97	LB	Baker Creek
8.44		Dairy Creek Road Bridge (County Road 2067) Rated Staff Gage for Stream Flow
8.55		USGS Gage #14205500: East Fork Dairy Creek at Mountaindale, OR – (10/1940–9/1951) Drainage Area = 43.0 square miles
9.62		NW Uebel Road Bridge (County Road 304)
12.50		Murphy Lane Bridge (Private) Rated Staff Gage for Stream Flow
12.82	RB	Big Canyon
13.00		***ISWR:*** C–59525 5/25/66
13.95	RB	Murtaugh Creek
14.04	LB	Meadow Brook Creek
14.17		Meacham Road Bridge (County Road 742)
15.55	LB	Plentywater Creek ***ISWR:*** C–59527 5/25/66
16.52	RB	Denny Creek ***ISWR:*** C–59526 5/25/66
16.56		Bacona Road Bridge (County Road 422) Snooseville Corner
17.21		Greener Road Bridge (County Road 1990)
17.34	LB	Rock Creek
17.50		Little Bend Park
17.60		Fern Flat Road Crossing (County Road 241)
18.15	LB	Panther Creek
18.31		Fern Flat Road Crossing (County Road 241)
18.84	RB	Roundy Creek
19.10	RB	Campbell Creek
21.30		Washington County – Columbia County Boundary
21.48		BPA Power Line Crossing
22.0+		Headwaters

ROCK CREEK — STREAM MILE INDEX

[Abbreviations: RB= right bank, LB= left bank

RIVER MILE	BANK	DESCRIPTION
0.8		River Road Bridge
1.2		Southern Pacific RR Bridge
1.2+		State Highway 8 Bridge – Rated Staff Gage for Stream Flow
2.4		SW Brookwood Avenue Bridge
3.1	RB	Dawson Creek
4.4	LB	Beaverton Creek
4.5		Baseline Road Bridge
4.9		NW Quatama Road Bridge – Rated Staff Gage for Stream Flow
5.5		Oregon Electric RR Bridge
5.7		NW 216th Avenue Bridge
6.7		NW Cornell Road Bridge
7.8		US Highway 26 Bridge
9.0		West Union Road Bridge – Rated Staff Gage for Stream Flow
9.3	RB	Holcomb Creek
10.0		NW 185th Avenue Bridge
10.9	LB	Abbey Creek
11.0		Germantown Road Bridge
11.9		Cornelius Pass Road Bridge
13.0		Old Cornelius Pass Road Bridge
14.1		Burlington Northern RR Bridge
15.1		Rated Staff Gage for Stream Flow
16.4		Rock Creek Road Bridge
16.5		Van Raden Reservoir
19.1		Headwaters

BEAVERTON CREEK — STREAM MILE INDEX

[Abbreviations: RB= right bank, LB= left bank

RIVER MILE	BANK	DESCRIPTION
0.00		Confluence with Rock Creek @ River Mile 4.3
0.40		Southwest Baseline Road
1.16		Southwest 216th Avenue Road Bridge– Rated Staff Gage for Stream Flow
2.20	RB	Bronson Creek
3.32	RB	Willow Creek
4.90		Southwest 170th Avenue Road Bridge– Rated Staff Gage for Stream Flow
5.47	LB	Unnamed Stream
6.06	LB	Johnson Creek
6.30	LB	Unnamed Stream
6.66		Oregon Electric Railroad
7.45		Cedar Hills Boulevard
7.90	RB	Reasoners Creek
8.75+		Headwaters

FANNO CREEK – RIVER MILE INDEX

[Abbreviations: RB= right bank, LB= left bank]

RIVER MILE	BANK	DESCRIPTION
0.00		Confluence with the Tualatin River at River Mile 9.32
0.86		Oregon Electric RR Bridge
1.19		Durham Road Bridge USGS Gage #14206950: Fanno Creek at Durham
2.00	LB	Ball Creek
2.12		Bonita Street Bridge – Rated Staff Gage
3.28		SW Hall Blvd Bridge
3.95		SW Ash Avenue Bridge
4.28		SW Main St Bridge
4.30		State Hwy 99W Bridge
4.49		SW Grant Ave Bridge
5.07		SW Tiederman Ave. Bridge
5.08	RB	Summer Creek Rated Staff Gage at Fowler School
5.32		SW Tigard Ave Bridge
5.53		SW North Dakota St Bridge
5.54	LB	Ash Creek Rated Staff Gage at Greenburg Road
6.38		Scholls Ferry Road Bridge
7.30		Tuckerwood – Rated Staff Gage
7.66		SW Hall Blvd Bridge
8.40		SW Denny Rd Bridge
8.60		Oregon Electric RR Bridge
8.70		State Hwy 217 Bridge
9.42		Scholls Ferry Road Bridge Rated Staff Gage
9.66		SW 92nd Ave Bridge
9.90		SW Bohmann Parkway Bridge
10.16		SW 86th Ave Bridge
10.78		SW Nicol Road Bridge
11.76		Olson Road Bridge
11.96	RB	Sylvan Creek
11.98		SW Beaverton–Hillsdale Hwy (State Hwy 10)
12.10		Washington County – Multnomah County Line
12.58		SW 56th Ave Bridge USGS Gage #14206900: Fanno Creek at 56th
12.81		SW Shattuck Road Bridge
13.22		SW 45th Ave Bridge
13.23	RB	Ivey Creek
13.32		SW 43rd Ave Bridge
13.38		SW 42nd Ave Bridge
13.48		SW 39th Ave Bridge
13.98		SW Beaverton–Hillsdale Hwy (State Hwy 10)
14.10		SW 30th Ave Bridge
14.1+		Headwaters