UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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WATER
DIVISION

Total Maximum Daily Loads (TMDLs) for the Deschutes River and its Tributaries

Sediment, Bacteria, Dissolved Oxygen, pH, and Temperature

July 31, 2020 TMDLs for Public Comment

In compliance with the provisions of the Clean Water Act, 33 U.S.C. 1251 et seq., as amended by the Water Quality Act of 1987, P.L. 1004, the Environmental Protection Agency is today establishing a TMDL to address sediment, bacteria, dissolved oxygen, pH, and temperature loading in the mainstem of the Deschutes River as well as its tributaries.

The Regional Administrator is concurrently seeking public comment on these TMDLs. Consistent with EPA's regulations in 40 C.F.R. 130.7(d)(2), EPA will issue a public notice seeking comment on these TMDLs established by EPA. EPA will begin a 60-day public process on August 7, 2020. Comments should be provided to magdangal.miranda@epa.gov by 5:00 pm Pacific time on October 7, 2020.

After considering public comment and making any revisions deemed appropriate, the Regional Administrator intends to transmit these TMDLs to the State of Washington for incorporation into their current water quality management plan.

/s/ 7/31/2020

Daniel Opalski, Director

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
°C	Degrees Celsius
7-DADMax	7-Day Average Daily Maximum
7Q10	Seven-day Average Low Flow with a Ten-year Recurrence Interval
BMP	Best Management Practices
CFR or C.F.R.	Code of Federal Regulations
cfs	Cubic Feet per Second
cfu/100mL	Colony Forming Units per 100 Milliliters
cfu/day	Colony Forming Units per Day
CSWGP	Construction Stormwater General Permit
CWA	Clean Water Act
DES	Washington Department of Enterprise Services
DO	Dissolved Oxygen
E. coli	Escherichia coli
Ecology	Washington Department of Ecology
EIM	Environmental Information Management System
EIS	Environmental Impact Statement
EMC	Event Mean Concentration
EPA	United States Environmental Protection Agency
GIS	Geographic Information System
GP	General Permit
ISGP	Industrial Stormwater General Permit
kg/day	Kilograms per Day
kg-TN/day	Kilograms Total Nitrogen per Day
kg-TP/day	Kilograms Total Phosphorus per Day
kWh/day	Kilowatt-hours per Day
LA	Load Allocation
LDC	Load Duration Curve
LiDAR	Light Detection and Ranging
mg/L	Milligrams per Liter
mg-N/L	Milligrams Nitrogen per Liter
mg-P/L	Milligrams Phosphorus per Liter
min	Minimum

mL	Milliliter
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
n	Sample Size
N/A	Not Applicable
NHD	National Hydrography Dataset
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
PARIS	Permitting and Reporting Information System
RUSLE	U.S. EPA Revised Universal Soil Loss Equation Model
SGGP	Sand and Gravel General Permit
s.u.	Standard Units (for pH)
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
tons/yr	Tons per Year
TP	Total Phosphorus
TSS	Total Suspended Solids
USGS	United States Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WLA	Wasteload Allocation
WRIA	Water Resource Inventory Area
WSDOT	Washington Department of Transportation

1 INTRODUCTION

This document establishes total maximum daily loads (TMDLs) addressing waterbodies impaired for fine sediment, bacteria, dissolved oxygen (DO), pH, and temperature within the Deschutes River watershed in Washington. The Environmental Protection Agency is establishing these TMDLs because on June, 29, 2018, it partially disapproved the *Deschutes River, Percival Creek, and Budd Inlet Tributaries TMDLs* ("*2015 Deschutes TMDLs*"), which were submitted by Washington Department of Ecology ("Ecology") on December 17, 2015. In that action, EPA approved 26 temperature TMDLs and disapproved TMDLs for 37 pollutant-waterbody combinations for a variety of reasons including lack of required TMDL components, lack of public review, and targets that did not adequately protect downstream uses or demonstrate TMDLs would meet water quality standards, as explained in EPA's action letter.[1] Section 303(d)(2) of the Clean Water Act (CWA) requires EPA to establish replacement TMDLs for those that were disapproved.

1.1 TMDLS AND THE CLEAN WATER ACT

Section 303(c) of the CWA requires states to establish water quality standards that identify each waterbody's designated uses and the criteria needed to support those uses. CWA section 303(d) requires states to develop lists of impaired waters that fail to meet the applicable water quality standards set by jurisdictions even after implementing technology-based and other pollution controls. The CWA requires TMDLs to be developed for waters on the 303(d) list.

A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet applicable water quality standards. Title 40 of the Code of Federal Regulations (CFR) Section 130.2(i)) allows for TMDLs to be "expressed in terms of mass per time, toxicity or other appropriate measure," meaning a TMDL for a "pollutant," e.g., "heat" or "sediment," may be expressed in terms of a surrogate measure like "effective shade" or "turbidity," as long as the TMDL and its allocations are set at a level necessary to result in attainment of water quality standards for the pollutant causing the impairment.

A mathematical definition of a TMDL is written as the sum of the individual wasteload allocations (WLAs) for point sources, the load allocations (LAs) for nonpoint sources and natural background, and a margin of safety (MOS) [CWA § 303(d)(1)(C); 40 CFR 130.2(i)]:

$$TMDL = \Sigma WLA + \Sigma LA + MOS$$

where

WLA = wasteload allocation, or the portion of the TMDL allocated to existing and/or future point sources.

LA = load allocation, or the portion of the TMDL attributed to existing and/or future nonpoint sources and natural background.

MOS = margin of safety, or the portion of the TMDL that accounts for any lack of knowledge concerning the relationship between effluent limitations and water quality,

[1] https://www.epa.gov/sites/production/files/2019-12/documents/deschutes-tmdl-final-action-06-29-2018.pdf

such as uncertainty about the relationship between pollutant loads and receiving water quality, which can be provided implicitly by applying conservative analytical assumptions or explicitly by setting aside a portion of the TMDL.

Additionally, a portion of the TMDL may be set aside as reserve capacity for future growth of unquantified sources, future growth in the watershed, or potential new permitted point sources. The reserve may be allocated to a specific point source in the form of a reserve WLA, or it may be set aside as a more general reserve for unspecified sources. A reserve capacity which is explicitly included in the development of a TMDL can be allocated to sources as needed in the future.

1.2 SCOPE OF TMDLS IN THIS DOCUMENT

The 29 TMDLs established within this document replace all TMDLs disapproved by EPA's action on the *2015 Deschutes TMDLs*. The impaired waterbodies and their associated listing IDs are organized by parameter in

Table 1 and shown in Figure 1.

The *2015 Deschutes TMDLs* were based on the 2010 303(d) List, but the listing IDs in this document reflect the most recently approved 303(d) list, herein referred to as the “2012 303(d) List.” The 2012 303(d) List was submitted to EPA on June 3, 2016, and approved by EPA on July 22, 2016. Because Ecology updated its segmentation of assessment units to better align with National Hydrography Dataset (NHD) streams for the 2012 303(d) List, the count of disapproved listing IDs associated with the *2015 Deschutes TMDLs* has changed from 37 to 29 because certain listing IDs from the 2010 303(d) List were combined with, or rolled into, existing listing IDs. Appendix A includes a crosswalk of the listing changes.

Table 1. Parameter-waterbody list for TMDLs included in this report.

Parameter	Waterbody	Assessment Unit ID	2012 Listing ID
Fine Sediment	Deschutes River	17110016000014	6232
Bacteria	Reichel Creek	17110016000057	3763
	Spurgeon Creek	17110016000044	46061
	Upper Indian Creek	17110019020859	3758
	Lower Indian Creek	17110019000800	74218
	Upper Moxlie Creek	17110019007890	3761
	Lower Moxlie Creek	17110019007948	3759
	Schneider Creek	17110019007705	45559
	Mission Creek	17110019020856	45212
	Ellis Creek	17110019007661	45480
	East Adams Creek	17110019007395	45462
	West Adams Creek	17110019007396	45695
Temperature	Huckleberry Creek	17110016000085	3757
	Reichel Creek	17110016000057	48666
	Tempo Lake Outlet	17110016000233	48696
	Unnamed Spring to Deschutes River	N/A	48923[1]
	Ayer (Elwanger) Creek	17110016000187	73229
DO	Deschutes River	17110016000007	10894
		17110016000008	47753
		17110016000009	47754
		17110016000014	47756
	Lake Lawrence Creek	17110016000056	47696
	Reichel Creek	17110016000057	47714
	Ayer (Elwanger) Creek	17110016000187	5851
	Black Lake Ditch	17110016007722	47761
	Percival Creek	17110016007720	48085
pH	Ayer (Elwanger) Creek	17110016000187	5850
	Black Lake Ditch	17110016007722	50989
	East Adams Creek	17110019007395	50965

[1]The Unnamed Spring to Deschutes River is not included in the high resolution NHD coverage. The NHD code specified in Table 1 of Ecology's 2015 TMDL for the Unnamed Spring is for the nearby Deschutes River segment. The Unnamed Spring was incorrectly aggregated with Listing ID 48713 for the 2012 listing cycle, which designates a segment of the Deschutes River near the spring as impaired for water temperature. The correct listing ID from the 2010 listing cycle is provided in this table, Listing ID 48923.

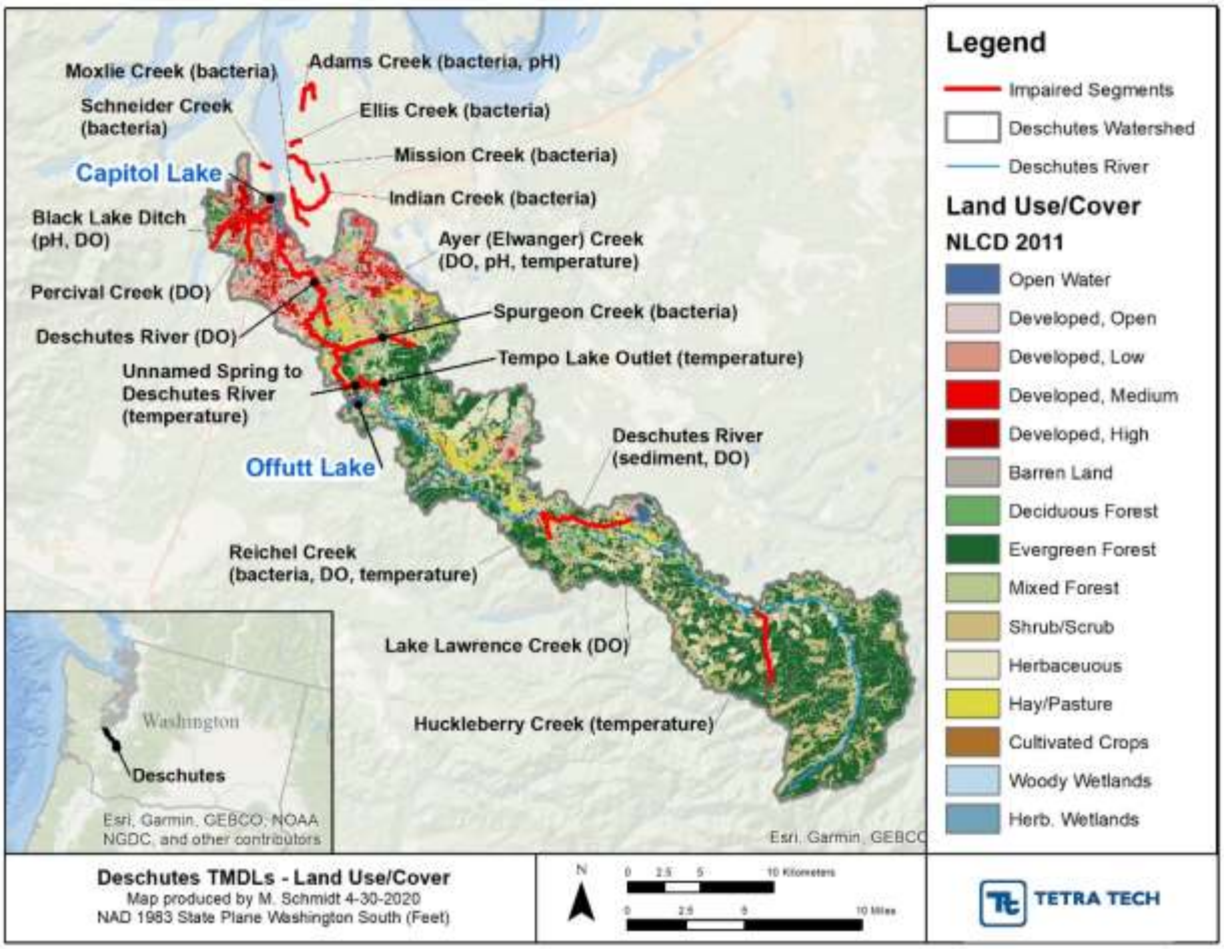

Figure 1. Impaired waterbodies and associated parameters addressed by TMDLs in this document.

2 WATERSHED DESCRIPTION

2.1 OVERVIEW

The TMDLs in this document address impaired waterbodies within the Deschutes River watershed in western Washington (inset in Figure 1). Although the number of waterbody-parameter combinations covered in this document is different than *2015 Deschutes TMDLs* (described in Section 1.2), the details about the physical, biological, and cultural characteristics of the watershed contained in the *2015 Deschutes TMDLs* are applicable.

The universe of the point sources discharging to impaired waterbodies in the watershed has changed since the *2015 Deschutes TMDLs.* Figure 2 provides the locations of all of the point sources addressed in this document. Most point sources are concentrated in the lower watershed within the urbanized areas. The three municipalities of Lacey, Olympia, and Tumwater, as well as Thurston County, are permitted to discharge stormwater under the Western Washington Phase II Municipal Stormwater Permit. The Washington Department of Transportation (WSDOT), which is covered under a Phase I Municipal Stormwater General Permit (GP), is responsible for stormwater discharges from state roads such as Interstate 5, which runs through the watershed. Ecology has issued several other GPs covering permittees in the watershed: Industrial Stormwater General Permit (ISGP), Sand and Gravel General Permit (SGGP), and Construction Stormwater General Permit (CSWGP). There are currently no point sources authorized to discharge under an individual National Pollutant Discharge Elimination System (NPDES) permit. However, Washington Department of Fish and Wildlife (WDFW) has applied for permit coverage for a fish hatchery near Pioneer Park, which is in the planning phases for construction and not yet in operation. EPA evaluated expected future loading from the Pioneer Park hatchery in these TMDLs. Also, EPA evaluated loading from the Tumwater Falls hatchery, a WDFW facility that operates seasonally and does not currently meet the production threshold for necessitating permit coverage. EPA included Tumwater Falls in the TMDLs in case production increases in the future above the production threshold, or Ecology determines it requires permit coverage. Sections 5.3.2, 6.3.2, and 7.3.2.2 include lists of permittees relevant to each parameter and waterbody. Because of the transient nature of coverage under the CSWGP, the existing construction stormwater permittees as of April 2020 are listed separately in Appendices D, E, and F.

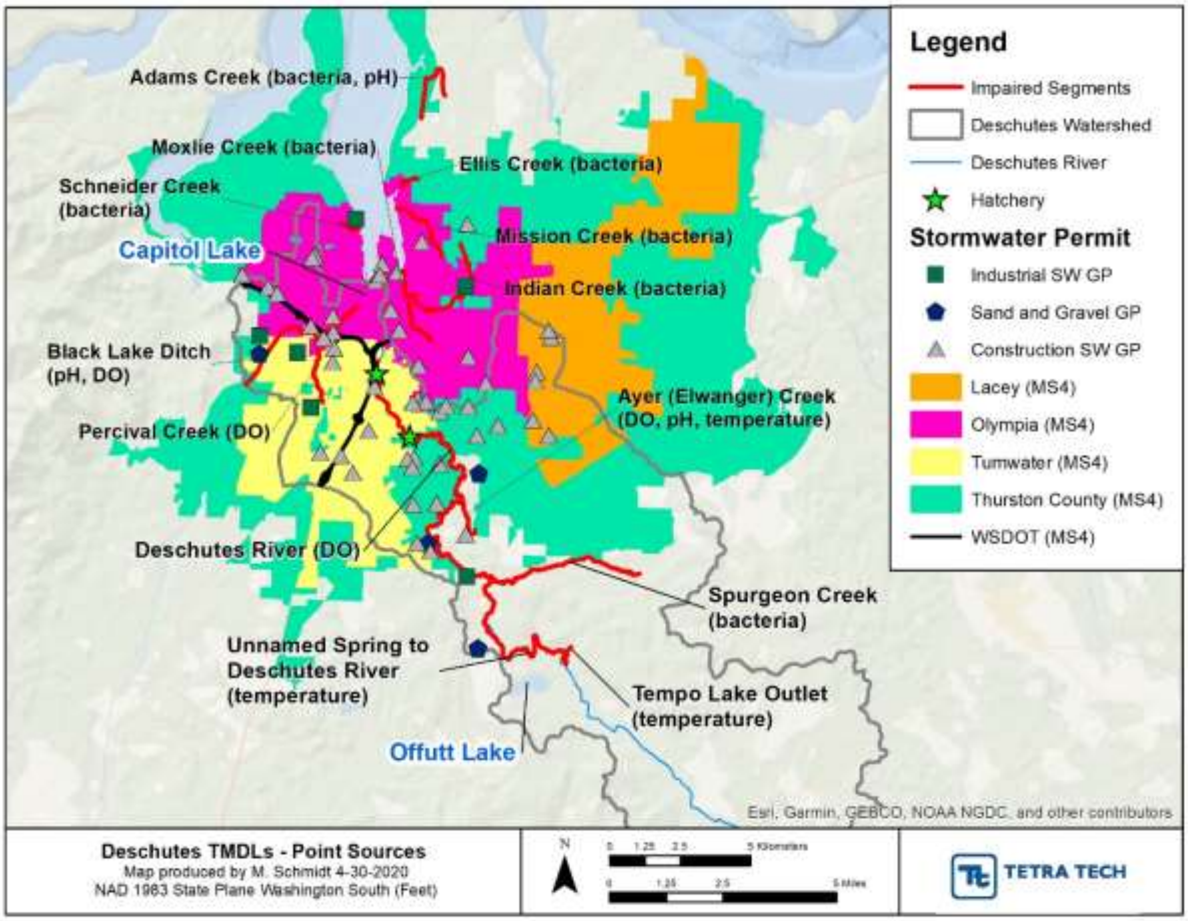

Figure 2. Point sources in the Deschutes watershed.

3 WATER QUALITY STANDARDS

3.1 DESIGNATED USES

Surface water quality is protected and regulated for fresh and marine waters under standards adopted by the state of Washington and approved by EPA. Waters of the State are assigned designated uses and associated criteria to protect those uses. Fresh water uses in Washington are aquatic life (e.g., core summer salmonid habitat); recreation (i.e., primary contact); water supply (i.e., domestic, industrial, agricultural, and stock water); and other miscellaneous uses (e.g. wildlife habitat, fish harvesting, navigation, boating, and aesthetics). Marine waters, such as Budd Inlet, have similar use categories as fresh waters, but they also have a shellfish harvesting use and do not have a water supply use.

Definitions of the designated uses for freshwaters are found in Washington Administrative Code [WAC] 173-201A-200. All waters in the Deschutes watershed, which largely makes up Washington's Water Resource Inventory Area (WRIA) 13, have the following designated uses: aquatic life, primary contact recreation, water supply, and miscellaneous (i.e., wildlife habitat, fish harvesting, commerce and navigation, boating, and aesthetics). The aquatic life use is the only designation that varies by waterbody as there are aquatic life use subcategories that reflect the most sensitive species and developmental activity, such as the period for spawning and rearing of juvenile fish (

Table 2).

As discussed in Section 3.2.1, the applicable water quality standards for downstream waters must be considered for each impaired waterbody, so

Table 2 also includes designated uses for downstream waterbodies – Capitol Lake, Inner Budd Inlet, and Budd Inlet/South Puget Sound. Inner Budd Inlet is the portion of the inlet from the Capitol Lake dam to Priest Point Park. Budd Inlet/South Puget starts at Priest Point Park until it meets South Puget Sound. Because Ecology did not identify the applicable downstream water quality standards in the *2015 Deschutes TMDLs,* EPA included that as part of TMDL development. It is a fairly straightforward process for most tributaries, but for the Deschutes River and the tributaries flowing into Capitol Lake, EPA's downstream standards evaluation is more detailed. EPA needed to factor in Capitol Lake's residence time and its status as an artificial lake. The factors evaluated to determine the applicable aquatic life designated use for Capitol Lake are explained in Appendix B.

Table 2. Designated uses for TMDL waterbodies and additional downstream waterbodies. Tributaries are listed upstream to downstream.

Waterbody	Aquatic Life Use Category				Recreation Use Category		Other Use Category
	Freshwater		*Marine*				
	Core Summer Salmonid Habitat	Salmonid Spawning, Rearing, and Migration	Good	Excellent	Freshwater Primary Contact	Marine Primary Contact	Marine Shellfish Harvesting
TMDL Waterbodies							
Deschutes River (upstream Offutt Lake)	X				X		
Deschutes River (downstream Offutt Lake)		X			X		
Huckleberry	X				X		
Lake Lawrence	X				X		
Reichel Creek	X				X		
Tempo Lake		X			X		
Unnamed Spring		X			X		
Spurgeon Creek		X			X		
Ayer (Elwanger) Creek		X			X		
Percival Creek		X			X		
Black Lake Ditch		X			X		
Indian Creek		X			X		
Moxlie Creek		X			X		
Schneider Creek		X			X		
Mission Creek		X			X		
Ellis Creek		X			X		
Adams Creek		X			X		
Additional Downstream Waterbodies							
Capitol Lake		X			X		
Inner Budd Inlet			X			X	
Budd Inlet/South Puget Sound				X		X	X

3.2 APPLICABLE WATER QUALITY STANDARDS

Washington's water quality standards contain provisions for downstream water quality standards, as well as both narrative and numeric criteria that apply to the impaired waterbodies addressed in this document.

3.2.1 Protection of Downstream Water Quality Standards

Washington's water quality standards require that "upstream actions must be conducted in manners that meet downstream water body criteria," as discussed in WAC 173-201A-260(3)(b)-(d):

> *(b) Upstream actions must be conducted in manners that meet downstream water body criteria. Except where and to the extent described otherwise in this chapter, the criteria associated with the most upstream uses designated for a water body are to be applied to headwaters to protect nonfish aquatic species and the designated downstream uses.*
>
> *(c) Where multiple criteria for the same water quality parameter are assigned to a water body to protect different uses, the most stringent criterion for each parameter is to be applied.*
>
> *(d) At the boundary between water bodies protected for different uses, the more stringent criteria apply.*

Therefore, EPA's review of applicable water quality standards for each impaired waterbody segment, and the water quality standard used as the basis for TMDLs, includes a review of downstream waterbodies where the designated use or protection level of the designated use differs, and identification of the most stringent applicable standard.

EPA evaluated the Deschutes River in two distinct sections, upstream of Offutt Lake (Listing ID 47756) and downstream of Offutt lake (Listing IDs 10894, 47753, and 47754), because each of those two sections of the river has a different aquatic life designated use. In evaluating downstream impacts, EPA compared the applicable criteria for the Deschutes River upstream of Offutt Lake to the criteria for the section of the river downstream of Offutt Lake. The Deschutes River downstream of Offutt Lake flows into Capitol Lake, so EPA compared the applicable criteria of that section to Capitol Lake. For the remaining tributaries, EPA compared the criteria for each tributary to the criteria of the waterbody directly downstream. An exception to this was made for Percival Creek and Indian Creek. Percival Creek flows into Black Lake Ditch which then flows into Capitol Lake, so EPA applied Capitol Lake as the downstream waterbody for both Percival Creek and Black Lake Ditch. Indian Creek flows into Moxlie Creek which then flows into Budd Inlet, so EPA applied Budd Inlet as the downstream waterbody for both Indian and Moxlie creeks. This was done due to the close physical proximity of the tributaries to either Capitol Lake or Budd Inlet. Section 3.2 outlines which criteria apply to each impaired waterbody based on these methods.

3.2.2 General Narrative Criteria

Natural conditions criteria apply to waterbodies under the following circumstances, as described in WAC 173-201A-260 (1)(a) and (b):

> *(a) It is recognized that portions of many water bodies cannot meet the assigned criteria due to the natural conditions of the water body. When a water body does not meet its*

assigned criteria due to natural climatic or landscape attributes, the natural conditions constitute the water quality criteria.

(b) When a water body does not meet its assigned criteria due to human structural changes that cannot be effectively remedied (as determined consistent with the federal regulations at 40 C.F.R. 131.10), then alternative estimates of the attainable water

quality conditions, plus any further allowances for human effects specified in this chapter for when natural conditions exceed the criteria, may be used to establish an alternative criteria for the water body (see WAC 173-201A-430 and 173-201A-440).

Washington's water quality standards also include pollutant-specific natural conditions provisions for temperature and DO, which are described in Sections 3.2.5 and 3.2.6.

The following general criteria, which are described in WAC 173-201A-260 (2)(a) and (b), apply to all existing and designated uses for fresh and marine water:

(a) Toxic, radioactive, or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health (see WAC 173-201A-240, toxic substances, and 173-201A-250, radioactive substances).

(b) Aesthetic values must not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste (see WAC 173-201A-230 for guidance on establishing lake nutrient standards to protect aesthetics).

3.2.3 Sediment

Washington does not have numeric criteria for fine sediment. However, harm from excess fine sediment is addressed by the toxics narrative criteria contained at WAC 173-201A-260(2)(a) and described in Section 3.2.2.

Although fine sediment is a natural component of aquatic ecosystems, it can become deleterious and harm the survival and reproductive success of salmonids and other aquatic life when present in excess amounts (Suttle et al., 2004; Kemp et al., 2011).

In many of Washington's stormwater general permits regulated under Ecology's NPDES program, including those in the Deschutes watershed, turbidity is used as a surrogate measure for fine sediments. In addition to a WLA of no visible accumulation of fine sediment in the Deschutes River or its tributaries within the *2015 Deschutes TMDLs*, Ecology explicitly stated that turbidity is a surrogate for fine sediment in its WLAs. For example, the turbidity WLA for MS4 was based on the allowable turbidity increase over background as stated in Washington's water quality standards (see below), and the non-MS4 WLAs were assigned turbidity WLAs based on existing permit requirements (e.g., 25 NTU). Given these factors and because turbidity is a measure of suspended particulate matter, including fine sediment, EPA determined turbidity is a reasonable surrogate for fine sediment in the water column. The turbidity-TSS relationship and further rationale for choosing turbidity as a surrogate is explained in Appendix C. Therefore, in addition to applying the toxics narrative criteria, EPA also evaluated achievement of the applicable turbidity criteria during development of the fine sediment TMDL for the Deschutes River.

For the core summer salmonid habitat designated use applicable to the segment of the Deschutes River impaired for sediment, which is upstream of Offutt Lake, Washington has the following numeric criteria for turbidity at WAC 173-201A-200 Table 200(1)(e):

> *Turbidity shall not exceed: 5 nephelometric turbidity units (NTUs) over background when the background is 50 NTU or less; or a 10% increase in turbidity when the background turbidity is more than 50 NTU.*

These criteria are protective of downstream water quality standards because the designated use that applies to the portion of the Deschutes River downstream of Offutt Lake is salmonid spawning, rearing, and migration, which has less stringent criteria for turbidity (i.e., 10 NTU over background when background is 50 NTU or less).

3.2.4 Bacteria

Washington has numeric water quality standards for bacteria to protect the primary contact recreation designated use in both freshwater and marine water and to protect the shellfish harvesting designated use in marine water. The criteria for each designated use consist of two values that vary by indicator bacteria: a geometric mean and statistical threshold value . The criteria are contained at WAC 173-201A-200(2)(b) for freshwater and WAC 173-201A-210(2)(b) and (3)(b) for marine water (text and values that vary shown in square brackets with placeholders):

> ***[Indicator bacteria]*** *organism levels must not exceed a geometric mean value of* ***[X]*** *colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding* ***[Y]*** *colonies/100 mL.*

The applicable values for [X], geometric mean, and [Y], single sample, are shown in Table 3. The freshwater criteria apply to all bacteria-impaired waterbodies addressed in this document (

Table 1). Mission, Ellis, and Adams creeks flow directly into marine waters protected for shellfish harvesting. EPA found the shellfish harvesting criteria to require lower bacteria values than for freshwater primary contact (explained further in Section 5.2 and Appendix D), so EPA applied the shellfish use to those waters (Table 3) to ensure downstream criteria are met. The applicable downstream designated use for Indian, Schneider, and Moxlie creeks is marine primary contact recreation; because Washington's freshwater and marine primary contact recreation criteria are based on the same risk level (i.e., illness rate), the freshwater criteria for these waterbodies are protective of downstream waterbodies (EPA, 2012; L. Wilcut, personal communication, 7/8/2020).

Escherichia coli (*E. coli*) is the indicator for the freshwater primary contact recreation criteria and fecal coliform is the indicator for the marine shellfish harvesting criteria (Table 3)[2]. These indicators measure different species and cannot be directly compared to ensure each bacteria TMDL complies with Washington's water quality standards requirement for protection of downstream uses.Therefore, EPA used a regression analysis to relate them so that the *E. coli* criteria could be translated into fecal coliform values (Francy et al., 1983; EPA, 2012). For this analysis, EPA used paired *E. coli*-fecal data within the Green-Duwamish and Central Puget Sound Watershed (WRIA 9), as explained in Appendix D. As described in Section 5.2 (and additionally in Appendix D), EPA used the translated E. coli criteria to identify the applicable designated use and associated criteria required for TMDL development (Table 3).

Table 3. Applicable Designated Uses and Criteria for Bacteria TMDL Development.

TMDL Waterbody	Downstream Waterbody	Designated Use for TMDL	Indicator Bacteria	Applicable Criteria (colonies/100mL)
Reichel Creek	Deschutes River (upstream Offutt Lake)	Freshwater Primary Contact	*E. coli*	**Geometric mean**: 100 **Single sample**: 320
Spurgeon Creek				
Indian Creek	Inner Budd Inlet			
Moxlie Creek				
Schneider Creek				
Mission Creek	Budd Inlet/South Puget Sound	Shellfish Harvesting	Fecal coliform	**Geometric mean**: 14 **Single sample**: 43
Ellis Creek				
Adams Creek				

3.2.5 Temperature

Washington has numeric temperature criteria to protect the aquatic life use for freshwaters, promulgated at WAC 173-201A-200(1)(c). Numeric water temperature criteria are based on the highest allowable 7-day average of daily maximum temperature (7-DADMax) and vary based on the designated use category, with 17.5 ºC applying to waters designated for Salmonid

[2] The *E. coli* criteria reflect Washington's water quality standards, approved by EPA April 30, 2019, which included revisions to replace fecal coliform with *E. coli* as the indicator organism for freshwater primary contact recreation.

Spawning, Rearing, and Migration, and 16.0 ºC applying to waters designated for Core Summer Salmonid Habitat. The numeric criteria apply year-round, and water temperatures are not to exceed the 7-DADMax standard at a probability frequency of more than once every 10 years on average.

In addition to the general narrative natural conditions provision described in Section 3.2.2, Washington also has a natural conditions provision specific to its temperature water quality standard, found at WAC 173-201A-200(1)(c)(i):

> *When a waterbody's temperature is warmer than the applicable criterion (or is within 0.3 ºC) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that waterbody to increase more than 0.3 ºC.*

Table 4 lists each waterbody, the downstream waterbody, the most stringent designated use, and the applicable numeric criterion. The criterion associated with the most stringent designated use, whether it applies to the TMDL waterbody or the downstream waterbody, was applied in TMDL development.

Table 4. Applicable Designated Uses and Criteria for Temperature TMDL Development.

<table>
<tr><th>TMDL Waterbody</th><th>Downstream Waterbody</th><th>Most Stringent Designated Use</th><th>Applicable Criterion (7-DADMax)</th></tr>
<tr><td>Huckleberry Creek</td><td rowspan="2">Deschutes River (upstream Offutt Lake)</td><td rowspan="2">Core Summer Salmonid Habitat</td><td rowspan="2">16.0 ºC</td></tr>
<tr><td>Reichel Creek</td></tr>
<tr><td>Tempo Lake Outlet</td><td rowspan="3">Deschutes River (downstream Offutt Lake)</td><td rowspan="3">Salmonid Spawning, Rearing, and Migration</td><td rowspan="3">17.5 ºC</td></tr>
<tr><td>Unnamed Spring to Deschutes River</td></tr>
<tr><td>Ayer (Elwanger) Creek</td></tr>
</table>

3.2.6 Dissolved Oxygen

Washington has numeric criteria for DO to protect the aquatic life use for freshwaters, which are promulgated at WAC 173-201A-200(1)(d). Washington's DO criteria are based on the aquatic life designated use category and are expressed as the lowest 1-day minimum DO concentration.

The standard specifies that DO concentrations are not to fall below the allowable minimum concentration at a probability frequency of more than once every ten years on average.

In addition to the general narrative natural conditions provision described in Section 3.2.2, Washington also has a natural conditions provision specific to its DO water quality standard, found at WAC 173-201A-200(1)(d)(i):

> *When a waterbody's DO is lower than the criteria (or within 0.2 mg/L of the criteria) and that condition is due to natural conditions, then human activities considered cumulatively may not reduce DO concentration in the waterbody by more than 0.2 mg/L.*

Based on the DO concentration attainable under natural conditions, EPA applied the natural conditions provision for the portion of the Deschutes River upstream of Offutt Lake, as described further in Section 6.2.

Table 5 lists each waterbody, the downstream waterbody, and the most stringent designated use, whether it was for the TMDL waterbody, or the downstream waterbody. The numeric criterion associated with the most stringent designated use is also listed. This value was applied in TMDL development for all waterbodies except the Deschutes River upstream of Offutt Lake, where modeling demonstrated that the waterbody would not attain 9.5 mg/L, even under fully natural conditions. There, the natural conditions value is the applicable water quality criterion and is protective of the downstream waterbody (Deschutes River downstream of Offutt Lake).

Table 5. Applicable Designated Uses and Criteria for Dissolved Oxygen TMDL Development.

TMDL Waterbody	Downstream Waterbody	Most Stringent Designated Use	Applicable Criterion (1-day min)
Deschutes River (upstream Offutt Lake)[1]	Deschutes River (downstream Offutt Lake)	Core Summer Salmonid Habitat	9.5 mg/L*
Deschutes River (downstream Offutt Lake)	Capitol Lake	Salmonid Spawning, Rearing, and Migration	8.0 mg/L
Lake Lawrence Creek	Deschutes River (upstream Offutt Lake)	Core Summer Salmonid Habitat	9.5 mg/L
Reichel Creek			
Ayer (Elwanger) Creek	Deschutes River (downstream Offutt Lake)	Salmonid Spawning, Rearing, and Migration	8.0 mg/L
Percival Creek	Capitol Lake		
Black Lake Ditch			

[1]The natural conditions apply to the Deschutes River upstream of Offutt Lake.

3.2.7 pH

Washington has numeric criteria for pH to protect the aquatic life use for freshwaters, promulgated at WAC 173-201A-200(1)(g). Aquatic life pH criteria are expressed as the negative logarithm of the hydrogen ion concentration. The freshwater criteria apply to all pH impaired waterbodies addressed in this document (

Table 1), but the marine criteria, promulgated at WAC 173-201A-210(1)(f), are also included here because they are the applicable downstream water quality standard for Adams Creek.

The standard limits human-caused variation to less than 0.2 standard units (s.u.) for core summer salmonid habitat segments, and less than 0.5 s.u. for both excellent quality aquatic life segments and salmonid spawning, rearing, and migration segments.

Table 6 lists each waterbody, the downstream waterbody, and the most stringent designated use. The criterion associated with the most stringent designated use, whether it applies to the TMDL waterbody or the downstream waterbody, was applied in TMDL development.

Table 6. Applicable Designated Uses and Criteria for pH TMDL Development.

TMDL Waterbody	Downstream Waterbody	Most Stringent Designated Use	Applicable Criterion (s.u.)
Ayer (Elwanger) Creek	Deschutes River (downstream Offutt Lake)	Salmonid Spawning, Rearing, and Migration	6.5 to 8.5
Black Lake Ditch	Capitol Lake		
Adams Creek	Budd Inlet/South Puget Sound	Excellent Quality Aquatic Life	7.0 to 8.5

4 TMDLS FOR SEDIMENT

4.1 TECHNICAL APPROACH

EPA developed a TMDL to address a waterbody impaired for fine sediment within a segment of the upper Deschutes River extending from Lake Lawrence Creek to Reichel Creek (Listing ID 6232) (

Table 1 and Figure 1). The fine sediment TMDL in the *2015 Deschutes TMDLs* relied on controlling excess fine sediment from streambank erosion, landslides, and unpaved roads to meet a substrate embeddedness fine sediment target within the river, but EPA determined that the linkage between the source assessment and water quality target was inadequate. Approximately 28 percent of Ecology's source assessment was not attributed to any source category, and addressing the identified human sources resulted in a percent reduction in loading that was approximately half of the 42 percent required to meet the embeddedness target.

To better demonstrate the linkage between the source assessment and in-stream target, EPA addressed the unattributed portion of the existing load by conducting an assessment of fine sediment loads associated with existing and natural rates of upland erosion to evaluate if the unattributed portion includes controllable sources that, if addressed, will result in loading reductions that will meet the embeddedness target. Additionally, as explained in Section 3.3.2, EPA applied turbidity as a surrogate for fine sediment in the water column. The application of turbidity as a surrogate in addition to the in-stream embeddedness target provides multiple lines of evidence that the fine sediment load will result in attainment of Washington's water quality standards. The details of EPA's technical approach for the Deschutes River fine sediment TMDL are contained in Appendix C.

4.2 NUMERIC TARGETS

As described in Section 3.2.3, Washington has narrative criteria that apply to fine sediment. Although EPA disapproved the Deschutes River fine sediment TMDL in the *2015 Deschutes TMDLs*, EPA concluded that the State's translation of the narrative criteria to a fine sediment target of less than 12 percent embeddedness, which was based on the *Timber, Fish, and Wildlife Watershed Analysis Manual* (Washington Forest Practices Board, 1997), was reasonable and protective of designated uses. Therefore, EPA is using a substrate embeddedness target of less than 12 percent for fine sediment, consistent with Washington's approach. While a substrate embeddedness target cannot be used to calculate a load, because of its direct linkage to aquatic life support (which is explained on p.180-182 of Ecology's *2015 Deschutes TMDLs* Technical Report (Roberts et al., 2012)), it is intended to be used to evaluate existing conditions and progress towards meeting the TMDL.

EPA also established turbidity as a water quality target for the sediment TMDL. As discussed in Section 3.2.3, the applicable standard for the impaired segment Deschutes River is 5 NTU over background when background turbidity is 50 NTU or less, and less than a 10 percent increase when the background turbidity is more than 50 NTU. Based on a background turbidity of 6.1 NTU, which was determined using data from WRIA 13 (which is largely comprised of the Deschutes basin) and the analysis presented in Section 3.1 of Appendix C, the turbidity target is 11.1 NTU.

4.3 CURRENT CONDITIONS

4.3.1 Available Data

The *2015 Deschutes TMDLs* cited data collected by the Squaxin Island Tribe (Konovsky and Puhn, 2005) as representative of the existing level of embeddedness. As shown in Table 7, the average percent fines in Segments 22 and 28, which bound the upstream and downstream end of the impaired segment, both exceed the water quality target (Konovsky and Puhn, 2005).

Table 7. Percent Embedded Fine Sediment for the Deschutes River Listing ID 6232.

Segment	River Mile Range	Average Percent Fines in 2004 (n=14)	Target Percent Fines
Lake Lawrence (Segment 22)	28.8 - 30.4	17.1%	12%
State Route 507 (Segment 28)	20.8 - 24.4	20.5%	12%

As part of the analysis to identify the background turbidity level and examine the relationship between turbidity and total suspended solids (TSS), EPA reviewed data from Washington's Environmental Information Management System (EIM) database for paired turbidity and TSS data collected in streams within WRIA 13. After screening the data, the search yielded 1,062 paired samples between 1979 and 2019. As presented in Section 4.0 of Appendix C, there is a strong correlation between TSS and turbidity in the sample data, and most samples had a TSS concentration less than 50 mg/L and a turbidity value less than 40 NTU.

4.3.2 Sources of Sediment

Based on an April 2020 query of Ecology's Water Quality Permitting and Reporting Information System (PARIS), there are no permitted point sources within the portion of the watershed draining to the sediment-impaired segment (Figure 1 and Figure 2). The *2015 Deschutes TMDLs* identified bank erosion, unpaved roads, and landslides as the nonpoint sources of fine sediment to the Deschutes River but indicated additional human sources such as upland erosion were likely part of the unattributed load. As described in the Technical Approach (Section 4.1) and detailed in Appendix C, EPA relied on Ecology's assessment of fine sediment sources but supplemented it by using the Natural Resource Conservation Service's Revised Universal Soil Loss Equation (RUSLE) model to assess loading from upland sheet and rill erosion, which is commonly recognized as a source of fine sediment loading to aquatic ecosystems (Castro and Reckendorf, 1995).

4.3.3 Existing Loading

The average annual load of fine sediment contributed to the impaired segment of the Deschutes River and the basis of EPA source assessment is summarized in

Table 8 by source category. The largest contributors are unpaved roads and landslides.

Table 8. Summary of source assessment basis for each source category.

Sediment Source	Technical Assessment Source	Fine Sediment Load (tons/yr)
Upland sheet and rill erosion	RUSLE model	1,494
Bank erosion	*2015 Deschutes TMDLs* based on Raines (2007)	1,080
Unpaved roads		3,780
Landslides		4,050
Total		10,404

4.4 TMDL ANALYSIS

As detailed in Appendix C, the annual TMDL for sediment is calculated based on meeting both the fine sediment and turbidity targets.

4.4.1 Seasonal Variation and Critical Conditions

The TMDL must ensure protection of designated uses under seasonal variations and critical conditions. Accumulation of embedded fine sediment in the riverbed is a long-term process, so critical conditions for sediment happen throughout the year during events that elevate sediment in the water column and cause the accumulation of fine sediment in spawning habitat. Environmental conditions may fluctuate naturally (e.g., due to weather patterns) or based on human activities (e.g., due to changing forestry or agricultural practices). In general, higher loads are anticipated to correspond with periods of higher flow, although some sediment sources (e.g., landslides) may elevate sediment levels sporadically at times that may or may not correspond with higher runoff and streamflow. Based on measurements from the USGS gage on the Deschutes River near Rainier (12079000) from 1950 through 2018, streamflow in the Deschutes River tends to be highest at from late fall to early spring, with January being the month exhibiting the highest average daily streamflow (about 561 cfs) and August being the month exhibiting the lowest average daily streamflow (about 39 cfs).

Much like the analysis conducted for fine sediment in the *2015 Deschutes TMDLs*, the source assessment incorporates the use of long-term estimates of sediment generation and delivery, which inherently captures variability in sediment loading. Also, because of the long-term nature of sediment accumulation, the TMDL is expressed as an allowable annual sediment load from all sources. However, a daily maximum load is also provided that corresponds with achieving the annual load. The expression of both an annual load and the total maximum daily load addresses seasonal variation and critical conditions.

4.4.2 Margin of Safety

The MOS for the Deschutes River fine sediment TMDL is implicit because conservative assumptions were applied throughout the TMDL development process. The turbidity target, which is driving the loads, was based on a conservative statistical analysis (see Sections 4.0 and 5.1.1 of Appendix C). Also, the use of dual water quality targets that are protective of fine sediment in both the river bottom (percent embedded fines) and water column (turbidity) provides multiple lines of evidence for identifying the load of fine sediment that will meet water quality standards. Lastly, as described in Appendix C, the upland source assessment uses conservative literature values that result in a load estimate more reflective of a highly erosive year.

4.4.3 TMDL

The average annual TMDL for sediment is 5,202 tons/yr. Using the 95th percentile flow value of 906 cfs from Deschutes River gage (as described in Section 5.2 of Appendix C) and the TSS value corresponding to the turbidity target (20.8 mg/L), the TMDL for sediment is 50.8 tons/day.

4.4.4 Reserve Allocation

There are no wasteload allocations for sediment because there are no permitted point sources in the watershed of the impaired segment. Although EPA is not aware of any pending permits and determined the likelihood of future permits is low based on the land uses in the upper watershed and distance from urban areas, EPA is setting aside 2 percent of the TMDL as a reserve capacity to account for possible future development. The most likely future source is discharges covered under Ecology's CSWGP, which is considered a short-term source because it is associated with construction projects. A review of turbidity and TSS requirements for the CSWGP, as well as other GPs issued by Ecology for facilities located in the lower watershed (see Section 2.1), indicates TMDL revisions would not be necessary to address potential loading if future discharges are authorized under these permits. The current effluent limits and other requirements are consistent with the assumptions of these TMDLs and are expected to minimize sediment loading. The reserve capacity is set to 2 percent of the TMDL, which equates to 104 tons/yr. The remaining TMDL is allocated to nonpoint sources as discussed in the following section.

4.4.5 Load Allocations

The load allocations shown in Figure 3 are based on the source assessment, with reductions required for human sources of loading. EPA used the same approach applied by Ecology in the *2015 Deschutes TMDLs*, and assumed the following sources to be natural: all bank erosion and the portion of loading from landslides not caused by the presence of unpaved roads. Additionally, part of the load from upland sheet and rill erosion is considered natural. No loading reductions are required from the natural portion of the existing load within each source category. Collectively, these natural background loads amount to 2,517 tons/yr, or 48 percent of the TMDL. With two percent being set aside as reserve for future growth, EPA allocated the remaining 2,580 tons/yr equally among the source categories with human sources of loading: unpaved roads, upland sheet and rill erosion, and the portion from landslides caused by the presence of unpaved roads (i.e., 860 tons/year plus any natural background load for each source category). The resulting allocations require varying levels of reduction in annual loading, with the most being required from unpaved roads. Allocations are provided as both an annual average and maximum daily load in Table 9 to account for temporal variability throughout the year.

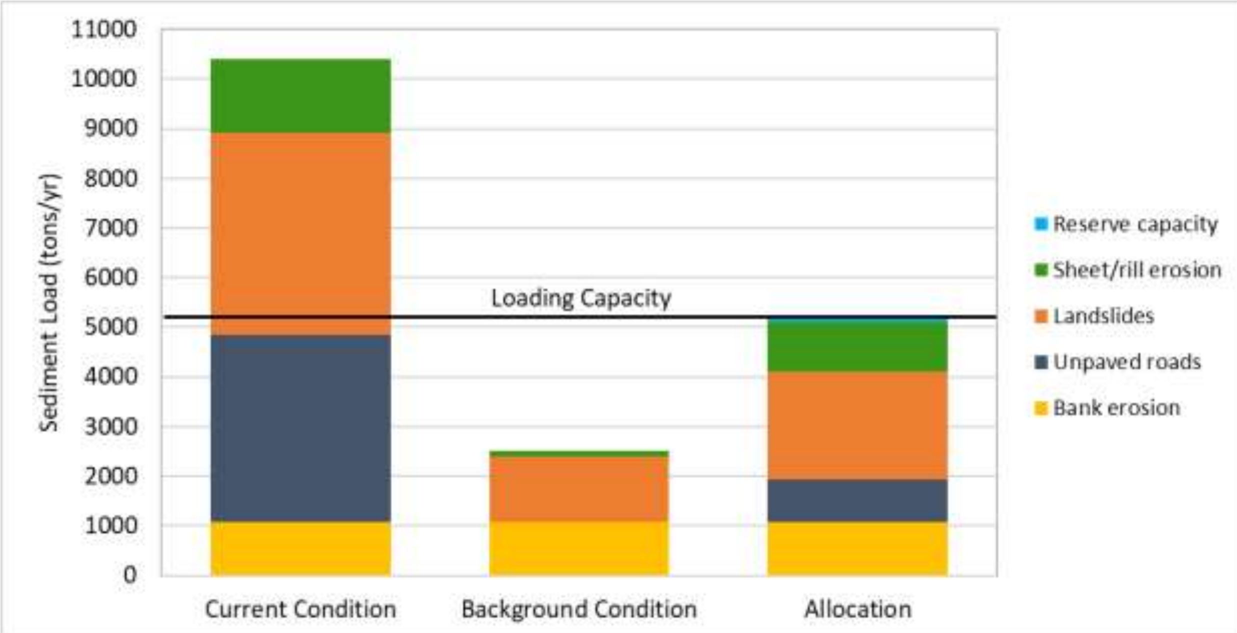

Figure 3. Allocations Relative to the Current Load and the Natural Background Load.

Table 9. Annual and Daily Load Allocations for Fine Sediment.

Allocation Category	Annual LA (tons/yr)	Maximum Daily LA (tons/day)
Reserve capacity	104	1.0
Upland sheet and rill erosion	993	8.9
Bank erosion	1,080	11.8
Unpaved roads	860	7.5
Landslides	2,165	21.6
TMDL	**5,202**	**50.8**

5 TMDLS FOR BACTERIA

5.1 TECHNICAL APPROACH

EPA developed TMDLs to address waterbodies impaired for bacteria within tributaries to the Deschutes River and Budd Inlet (

Table 1 and Figure 1). The *2015 Deschutes TMDLs* failed to meet public participation requirements for newly developed bacteria loads submitted separately in 2017, and to protect downstream waterbodies for some of the segments. Additionally, as explained in Section 3.2.4, EPA approved Washington's new water quality standards for primary contact recreation in 2019. In order to comply with 40 CFR 130.7(c)(1), which requires TMDLs to "attain and maintain the applicable narrative and numerical water quality standards…," these TMDLs establish loadings consistent with the recently approved water quality standards appropriate for the designated use. The TMDLs also identify the appropriate water quality target based on a comparison between water quality standards for the impaired segment and the downstream segment.

The Load Duration Curve (LDC) method was used to determine existing loads and TMDLs for each impaired segment. This method relies on paired flow volumes and bacteria concentrations to derive the load curve. The remainder of this section outlines EPA's TMDL analysis for bacteria. Further details describing all of the analysis steps are contained in Appendix D.

5.2 NUMERIC TARGETS

To determine numeric targets, EPA evaluated multiple factors. First, EPA compared designated uses and criteria for each impaired segment with the downstream designated uses and criteria. As presented in Section 3.2.4, the freshwater E. coli criteria are protective of downstream uses for Reichel, Spurgeon, Indian, Moxlie, and Schneider creeks, and the shellfish fecal coliform criteria are protective of downstream uses for Adams, Ellis, and Mission creeks.

Next, the applicable criteria were examined to identify which criterion to apply as the target for each TMDL. The bacteria criteria are written in two parts – a geometric mean and a statistical threshold value (which is not to be exceeded at a frequency of more than 10 percent). Consistent with EPA guidance (USEPA 2007), EPA translated the geometric mean criterion to a single sample threshold value. This allowed EPA to compare it to the statistical threshold value in the water quality standards. Depending on the distribution of data for a particular waterbody, it is possible for the geometric mean, as translated to a single sample threshold, to be more stringent than the statistical threshold value in the water quality standards. Table 10 displays the numeric targets for either *E. coli* or fecal coliform. Tributaries that had more than one listing ID segment were evaluated as a whole. A more detailed explanation of this analysis is provided in Appendix D.

Table 10. Applicable Numeric Target for TMDL Development

Waterbody	Indicator	Numeric Target (cfu/100mL)
Reichel	*E. coli*	320
Spurgeon	*E. coli*	320
Indian	*E. coli*	320
Moxlie	*E. coli*	320
Schneider	*E. coli*	320
Mission	Fecal coliform	40.3
Ellis	Fecal coliform	41.2
Adams (East and West)	Fecal coliform	43

5.3 CURRENT CONDITIONS

5.3.1 Available Data

Flow data were obtained from the U.S. Geological Survey (USGS) Deschutes River at Tumwater gage (USGS 12080010). Since continuous flow data were not available for the impaired tributaries, the flow from the Tumwater gage was scaled based on the relative drainage area for each tributary.

EPA obtained instream bacteria monitoring data from Washington's EIM database and Thurston County. All tributaries had some instream bacteria dating from 1998 – 2018. Most data were collected in the early 2000s and were used in the *2015 Deschutes TMDLs*. Thurston County data were more recent and included 2017 and 2018. The least amount of data was collected for Adams Creek (Listing ID 45462), with 39 samples. The most data were available for Indian Creek (Listing ID 74218), with 229 samples. As explained in Section 5.2, most of the available data was for fecal coliform. This is because Ecology's past sampling efforts for contact recreation focused on fecal coliform prior to the water quality standards update to *E. coli* for freshwater.

5.3.2 Sources of Bacteria

Fecal bacteria originate from the fecal waste of warm-blooded animals. These bacteria are generally not harmful, but the presence of fecal bacteria indicates that other disease-causing organisms associated with fecal waste may be in the water. Fecal bacteria concentrations are therefore often used as an indicator of human health risk. Different groups or species of fecal bacteria, called indicator bacteria, may be monitored to assess human health risks from contact with surface waters or consumption of harvested shellfish. Indicator bacteria in these TMDLs include *E. coli* and total fecal coliform bacteria. Ecology's Technical Report for the *2015 Deschutes TMDLs* (Roberts et al. 2012) includes a detailed description of sources of fecal bacteria in the Deschutes River watershed, which EPA relies on for these TMDLs.

The sources of bacteria for the impaired tributaries include non-point sources of bacteria (from runoff not included in the MS4s), MS4s, and permittees covered under the Industrial Stormwater GP.

Table 11 lists the permitted sources. While the City of Lacey MS4 is within the TMDL study area, it is not included because it does not intersect with any bacteria-impaired waterbodies.

Runoff from non-MS4 areas may include bacteria from domestic and wild animals, livestock, as well as waterfowl. Within urban MS4s, there is the potential for wastes from domestic and wild animals to become entrained and transported in stormwater. There is also the potential for illicit sewage discharges. Industrial facilities are included because of the potential for wild animals to congregate on or near buildings and retention/detention basins.

Permittees covered under the Construction Stormwater GP are also present in the bacteria-impaired tributary catchments. However, the level of noise and activity at construction sites is likely to deter wildlife that would contribute to bacteria loading. Given that discharge authorizations for these permittees are also short-term in nature, EPA does not expect Construction Stormwater permittees to be sources of stormwater associated bacteria loading.

Table 11. Permitted Sources for Bacteria-impaired tributaries

Permittee	Permit Type	Permit Number	Receiving Water (and Listing ID)
City of Olympia	Western Washington Phase II Municipal Stormwater Permit	WAR045015	Indian (3758, 74218); Moxlie (3761, 3759); Ellis (45480); Mission (45212); Schneider (45559)
City of Tumwater		WAR045020	Moxlie (3761, 3759)
Thurston County		WAR045025	Indian (3758, 74218); Moxlie (3761, 3759); Adams (45462, 45695); Ellis (45480); Mission (45212); Schneider (45559); and Spurgeon (46061)
Washington Department of Transportation	WSDOT Phase I Municipal Stormwater Permit	WAR043000A	Indian (3758, 74218); Moxlie (3761, 3759)
Pacific NW Bulkhead Yard	Industrial Stormwater	WAR304545	Schneider (45559)
Olympia Service Center		WAR304313	Indian (3758, 74218); Moxlie (3759)[1]

[1]Olympia Service Center is located within the catchments of both segments of Indian Creek. Since Indian Creek flows directly into the downstream segment of Moxlie Creek, it was also included as a receiving water for this discharge.

5.3.3 Existing Loading

Load duration curves (LDCs), as discussed in Section 5.4 and presented in Appendix D, display observed fecal coliform data, grouped into flow intervals – high flows, moist conditions, mid-range flows, dry conditions, and low flows. Observed data points above the TMDL curve represent exceedances of the numeric water quality target. Observed data points below the TMDL curve comply with the numeric water quality target. In addition, each table in Section 5.4.5 includes summary statistics of the current fecal coliform conditions for each impaired tributary.

In addition to the overall existing conditions for each impaired tributary, existing loads from MS4s, non-MS4 areas, and industrial facilities were characterized (further details in Appendix D). Existing loads for the MS4s and non-MS4s were approximated using an area-based approach and monitoring data. Once the proportion of the individual MS4s and the remaining non-MS4 area within each catchment was determined, the overall existing load for each tributary was scaled down accordingly based on those area proportions to determine the existing load for each MS4.

Table 12 shows the area attributed to each MS4 and the remaining non-MS4 area for each catchment. Tables with the existing load for each tributary can be found in Appendix D, underneath each corresponding LDC.

Table 12. Percentage of MS4 and Non-MS4 area within the catchment for each tributary.

Source	Reichel Creek	Spurgeon Creek	Upper Indian Creek	Lower Indian Creek[1]	Upper Moxlie Creek	Lower Moxlie Creek[1]	Schneider Creek	Mission Creek	Ellis Creek	E Adams Creek	W Adams Creek
Non-MS4	100	92.63	--	--	--	0.44	0.06	0.05	7.63	91.48	50.48
Tumwater	--	--	--	--	4.32	--	--	--	--	--	--
Thurston Co	--	7.37	46.59	--	10.76	--	1.21	5.53	77.11	8.52	49.52
Olympia	--	--	51.25	98.08	83.31	99.56	98.73	94.42	15.26	--	--
WSDOT	--	--	2.17	1.92	1.61	--	--	--	--	--	--

[1]The areas for the lower segments of Indian and Moxlie creeks exclude the area associated with the upper segment.

Existing loads for the two industrial facilities were estimated using event mean concentrations (EMCs) from industrial stormwater data collected by NPDES Phase I Stormwater permittees in western Washington (Hobbs et al., 2015) and estimated annual runoff for each site. Table 13 lists the resulting approximated existing loads.

Table 13. Approximated existing stormwater bacteria loads for industrial facilities.

Permittee	Fecal Coliform Load (billion cfu/day)
Pacific NW Bulkhead Yard	0.07
Olympia Service Center	1.4

5.4 TMDL ANALYSIS

5.4.1 Seasonal Variation and Critical Conditions

For each impaired tributary, EPA developed a LDC (provided in Appendix D, along with plots of the flow-ranked fecal coliform concentrations). The LDC explicitly incorporates seasonal variation into the analysis, since it uses long-term flow gage data to derive the TMDL. Thus, the bacteria TMDLs are protective of seasonal changes and the range of flow conditions in the Deschutes watershed.

The LDC plots a flow-ranked TMDL based on the numeric target. Because the LDC derives a TMDL for the entire range of flow conditions, the TMDLs for bacteria are protective of all conditions. However, each LDC provides insight into which flow conditions are driving water quality criteria excursions (by observing where bacteria loads are the highest), and which flow interval may be the most critical condition where excursions are more likely to occur. In order to better quantify this, EPA ranked the 90th percentile observed concentrations for each tributary based on flow interval (Table 14). Most of the impaired tributaries have the highest bacteria concentrations during the dry flow interval. Dry flows are typically observed in the warm season (about May to October). The upstream Indian Creek segment has the highest bacteria concentrations during mid-range flows, and Schneider Creek exhibits the highest concentrations during high flows.

Table 14. Rank of critical conditions based on computed 90th percentile existing concentrations

Waterbody	Flow Condition[1]				
	High	Moist	Mid-range	Dry	Low
Reichel Creek	4	5	3	1	2
Spurgeon Creek	4	5	3	1	2
Upper Indian Creek	5	2	1	4	3
Lower Indian Creek	5	3	4	1	2
Upper Moxlie Creek	5	3	4	2	1
Lower Moxlie Creek	5	4	3	1	2
Schneider Creek	1	2	5	3	4
Mission Creek	5	3	2	1	4
Ellis Creek	2	4	5	3	1
E Adams Creek	2	1	5	4	3
W Adams Creek	5	4	3	1	2

[1]Flow intervals are ranked based on 90th percentile concentrations computed from available monitoring data. The flow interval with the highest concentration is ranked 1 and the flow interval with the lowest concentration is ranked 5.

5.4.2 Margin of Safety

An explicit 10 percent MOS was established for each impaired segment. The MOS was calculated as 10 percent of the TMDL value for each flow interval. An explicit margin of safety was chosen to account for uncertainties in the TMDL analysis, including:

- Potential biases in different test methods for deriving bacteria concentrations (i.e. challenges in determining bacteria colony counts);
- Uncertainty related to the translation between bacteria indicators.

An implicit MOS also exists due to assumptions made in the TMDL analysis for bacteria die-off, which typically occurs through exposure to ultraviolet radiation and salinity. Die-off would theoretically increase the TMDL of the river, but in order to be conservative the TMDL calculations assumed it to be negligible.

5.4.3 TMDLs

The LDCs for Reichel, Spurgeon, Indian, Moxlie, and Schneider Creekswere developed for *E. Coli*. The LDCs for Mission, Ellis, and Adams Creeks were developed for fecal coliform. All of the LDC graphs and further explanation can be found in Appendix D. TMDLs are presented in the LDC analysis results tables in Section 5.4.5 (

Table 16 through Table 26) based on the applicable target.

To calculate the load for a particular flow, the following equation can be used:

$$Bacteria\ TMDL = flow\ (cfs) \times Concentration\ target \times 2.45e7\ (conversion\ factor)$$

5.4.4 Reserve Capacity

The bacteria TMDLs do not have a reserve capacity, and the TMDL is fully allocated to WLAs, LAs, and the MOS.

5.4.5 Wasteload and Load Allocations

All point sources potentially discharging to the impaired waterbodies were assigned a WLA (

Table 11). For the bacteria-impaired waterbodies, there are two categories of permittees which are assigned a WLA: (1) MS4s, both Phase I and Phase II; and (2) industrial stormwater permittees. During non-stormwater periods (dry and low flow intervals), MS4s and industrial facilities are not expected to be sources of bacteria loading because their NPDES permits only authorize stormwater discharges (with limited exceptions). In

Table 16 through Table 26, this is represented by showing WLAs of zero for the low and dry flow intervals because stormflow is assumed to be negligible during those flow conditions. In practice, regardless of flow interval, the WLAs apply during any conditions generating stormwater discharges.

The industrial stormwater WLAs were determined by calculating the percent contribution of each permittee's existing load (Table 13) to the existing overall load for each applicable segment, and then that same percentage was calculated relative to the TMDL and established as the WLA for each flow tier (Table 15).

Table 15. Percent contribution of existing loading for each industrial stormwater permittee

Permittee	Waterbody	Relative Percent Contribution
Pacific NW Bulkhead Yard	Schneider Creek	6.7%
Olympia Service Center	Upper Indian Creek	0.7%
	Lower Indian Creek	2.5%
	Moxlie Creek	0.47%

Similar to the approximation of existing loads for MS4s, WLAs were assigned to each MS4 source using an area-based approach. The relative contributions of each individual MS4 and non-MS4 area to an impaired catchment (

Table 12) were used to apportion the remaining load among the MS4s and non-MS4s (assigned to the LA), after the MOS and industrial stormwater WLA (for applicable segments) were subtracted from the TMDL.

Table 16 through Table 26 summarize the entire LDC analysis, including the current conditions, the TMDL, and the allocations (MOS, LA, and WLA).

Table 16. LDC Analysis Results and TMDL for Reichel Creek, Listing ID 3763

	Flow Condition				
	High	Moist	Mid-range	Dry	Low
Sample Count	15	52	36	49	14
Estimated Average Flow (cfs)	58.41	22.84	11.46	5.67	3.50
Current Condition Fecal Coliform Measures					
Observed Geometric Mean Concentration (cfu/100 mL)	23.01	17.08	36.15	81.75	73.43
Observed 90th Percentile Concentration (cfu/100 mL)	88.94	81.07	113.74	428.14	208.27
Observed 90th Percentile Load (billion cfu/day)	127.11	45.30	31.90	59.35	17.81
Current Condition E. coli Measures					
Translated Observed 90th Percentile Concentration (cfu/100 mL)	91.10	83.10	116.60	438.70	213.40
Translated Observed 90th Percentile Load (billion cfu/day)	130.20	46.43	32.70	60.81	18.25
TMDL expressed as E. coli					
Concentration Target (cfu/100 mL)	320				
TMDL (billion cfu/day)	457.33	178.81	89.75	44.36	27.37
Allocations (billion cfu/day)					
Margin of Safety (billion cfu/day)	45.73	17.88	8.97	4.44	2.74
Load Allocation	411.6	160.9	80.77	39.92	24.63

Table 17. LDC Analysis Results and TMDL for Spurgeon Creek, Listing ID 46061

		Flow Condition				
		High	Moist	Mid-range	Dry	Low
Sample Count		28	65	47	57	28
Estimated Average Flow (cfs)		74.22	29.02	14.57	7.20	4.44
Current Condition Fecal Coliform Measures						
Observed Geometric Mean Concentration (cfu/100 mL)		33.16	17.38	21.08	49.13	61.18
Observed 90th Percentile Concentration (cfu/100 mL)		93.44	56.38	98.31	268.68	217.08
Observed 90th Percentile Load (billion cfu/day)		169.68	40.03	35.03	47.32	23.59
Current Condition E. coli Measures						
Translated Observed 90th Percentile Concentration (cfu/100 mL)		95.80	57.80	100.70	275.30	222.50
Translated Observed 90th Percentile Load (billion cfu/day)		173.97	41.04	35.89	48.49	24.18
TMDL expressed as E. coli[1]						
Concentration Target (cfu/100 mL)		320				
TMDL (billion cfu/day)		581.11	227.20	114.04	56.36	34.78
Allocations (billion cfu/day)						
Margin of Safety		58.11	22.72	11.40	5.64	3.48
Load Allocation		484.46	189.41	95.07	50.73	31.30
Wasteload Allocations	Thurston County (MS4)	38.53	15.07	7.56	0.00	0.00

[1]The TMDL is currently being met based on the 90th percentile observed load and respective 90th percentile load for each flow interval. Note there are individual samples observed in the low, dry, and mid-range flow intervals that exceed the target; these are allowable because the single sample bacteria criteria permit a 10 percent exceedance frequency.

Table 18. LDC Analysis Results and TMDL for Upper Indian Creek, Listing ID 3758

		Flow Condition				
		High	**Moist**	**Mid-range**	**Dry**	**Low**
Sample Count		10	19	5	8	5
Estimated Average Flow (cfs)		14.88	5.82	2.92	1.44	0.89
Current Condition Fecal Coliform Measures						
Observed Geometric Mean Concentration (cfu/100 mL)		109.46	603.98	246.81	247.52	529.51
Observed 90th Percentile Concentration (cfu/100 mL)		371.40	3,196.12	3,608.25	481.51	2,707.70
Observed 90th Percentile Load (billion cfu/day)		135.25	455.05	257.85	17.01	59.01
Current Condition E. coli Measures						
Translated Observed 90th Percentile Concentration (cfu/100 mL)		380.60	3,275.30	3,697.60	493.40	2,774.70
Translated Observed 90th Percentile Load (billion cfu/day)		138.60	466.33	264.24	17.43	60.47
TMDL expressed as E. coli						
Concentration Target (cfu/100 mL)		320				
TMDL (billion cfu/day)		116.53	45.56	22.87	11.30	6.97
Allocations (billion cfu/day)						
Margin of Safety		11.65	4.56	2.29	1.13	0.70
Load Allocation		0.00	0.00	0.00	10.17	6.28
Wasteload Allocations	Thurston County (MS4)	48.60	19.00	9.54	0.00	0.00
	Olympia (MS4)	53.46	20.90	10.49	0.00	0.00
	WSDOT (MS4)	2.26	0.88	0.44	0.00	0.00
	Industrial Stormwater	0.56	0.22	0.11	0.00	0.00

Table 19. LDC Analysis Results and TMDL for Lower Indian Creek, Listing ID 74218

		Flow Condition				
		High	Moist	Mid-range	Dry	Low
Sample Count		24	68	38	73	26
Estimated Average Flow (cfs)		20.09	7.85	3.94	1.95	1.20
Current Condition Fecal Coliform Measures						
Observed Geometric Mean Concentration (cfu/100 mL)		101.75	130.08	147.10	292.26	363.50
Observed 90th Percentile Concentration (cfu/100 mL)		468.85	734.76	673.58	998.59	871.53
Observed 90th Percentile Load (billion cfu/day)		230.45	141.20	64.97	47.61	25.64
Current Condition E. coli Measures						
Translated Observed 90th Percentile Concentration (cfu/100 mL)		480.50	752.90	690.30	1,023.30	893.10
Translated Observed 90th Percentile Load (billion cfu/day)		236.18	144.69	66.58	48.78	26.27
TMDL expressed as E. coli						
Concentration Target (cfu/100 mL)		320				
TMDL (billion cfu/day)		157.29	61.50	30.87	15.26	9.41
Allocations (billion cfu/day)						
Indian Creek (upstream), Listing ID 3758[1]		116.53	45.56	22.87	11.30	6.97
Margin of Safety		4.08	1.59	0.80	0.40	0.24
Load Allocation		0.00	0.00	0.00	3.56	2.20
Wasteload Allocations	Olympia (MS4)	35.98	14.07	7.06	0.00	0.00
	WSDOT (MS4)	0.70	0.28	0.14	0.00	0.00

[1]Includes the load allocations, wasteload allocations, and margin of safety assigned to the upstream Indian Creek drainage area (Listing ID 3758).

Table 20. LDC Analysis Results and TMDL for Upper Moxlie Creek, Listing ID 3761

		Flow Condition				
		High	Moist	Mid-range	Dry	Low
Sample Count		12	28	17	22	12
Estimated Average Flow (cfs)		21.92	8.57	4.30	2.13	1.31
Current Condition Fecal Coliform Measures						
Observed Geometric Mean Concentration (cfu/100 mL)		72.62	71.03	85.13	121.64	98.99
Observed 90th Percentile Concentration (cfu/100 mL)		408.76	567.07	510.88	567.50	631.32
Observed 90th Percentile Load (billion cfu/day)		219.23	118.91	53.77	29.52	20.26
Current Condition E. coli Measures						
Translated Observed 90th Percentile Concentration (cfu/100 mL)		418.90	581.10	523.50	581.60	646.90
Translated Observed 90th Percentile Load (billion cfu/day)		224.67	121.85	55.10	30.25	20.77
TMDL expressed as E. coli						
Concentration Target (cfu/100 mL)		320				
TMDL (billion cfu/day)		171.63	67.10	33.68	16.65	10.27
Allocations (billion cfu/day)						
Margin of Safety		17.16	6.71	3.37	1.66	1.03
Load Allocation		0.00	0.00	0.00	14.98	9.24
Wasteload Allocations	Tumwater (MS4)	6.68	2.61	1.31	0.00	0.00
	Thurston County (MS4)	16.62	6.50	3.26	0.00	0.00
	Olympia (MS4)	128.68	50.31	25.25	0.00	0.00
	WSDOT (MS4)	2.49	0.98	0.49	0.00	0.00

Table 21. LDC Analysis Results and TMDL for Lower Moxlie Creek, Listing ID 3759

		Flow Condition				
		High	Moist	Mid-range	Dry	Low
Sample Count		20	69	41	71	24
Estimated Average Flow (cfs)		49.13	19.21	9.64	4.77	2.94
Current Condition Fecal Coliform Measures						
Observed Geometric Mean Concentration (cfu/100 mL)		248.62	168.63	294.10	448.73	472.01
Observed 90th Percentile Concentration (cfu/100 mL)		509.64	1,110.80	1,496.86	2,062.63	1,679.50
Observed 90th Percentile Load (billion cfu/day)		612.57	522.02	353.07	240.47	120.82
Current Condition E. coli Measures						
Translated Observed 90th Percentile Concentration (cfu/100 mL)		522.30	1,138.30	1,533.90	2,113.70	1,721.10
Translated Observed 90th Percentile Load (billion cfu/day)		627.79	534.94	361.81	246.42	123.81
TMDL expressed as E. coli						
Concentration Target (cfu/100 mL)		320				
TMDL (billion cfu/day)		384.63	150.38	75.48	37.31	23.02
Allocations (billion cfu/day)						
Indian Creek (downstream), Listing ID 74218[1]		40.76	15.93	8.00	3.95	2.44
Moxlie Creek (upstream), Listing ID 3761[2]		171.63	67.10	33.68	16.65	10.27
Margin of Safety		5.57	2.18	1.09	0.54	0.33
Load Allocation		0.22	0.09	0.04	4.86	3.00
Wasteload Allocations	Olympia (MS4)	49.93	19.52	9.80	0.00	0.00

[1]Includes the load allocations, wasteload allocations, and margin of safety assigned to the upstream and downstream Indian Creek drainage areas (Listing ID 3758 and 74218).

[2]Includes the load allocations, wasteload allocations, and margin of safety assigned to the upstream Moxlie Creek drainage area (Listing ID 3761).

Table 22. LDC Analysis Results and TMDL for Schneider Creek, Listing ID 45559

		Flow Condition				
		High	Moist	Mid-range	Dry	Low
Sample Count		12	38	25	34	16
Estimated Average Flow (cfs)		5.15	2.02	1.01	0.50	0.31
Current Condition Fecal Coliform Measures						
Observed Geometric Mean Concentration (cfu/100 mL)		35.44	23.33	11.30	23.38	32.06
Observed 90th Percentile Concentration (cfu/100 mL)		349.78	320.70	35.83	185.09	104.27
Observed 90th Percentile Load (billion cfu/day)		44.11	15.81	0.89	2.26	0.79
Current Condition E. coli Measures						
Translated Observed 90th Percentile Concentration (cfu/100 mL)		358.40	328.60	36.70	189.70	106.90
Translated Observed 90th Percentile Load (billion cfu/day)		45.19	16.20	0.91	2.32	0.81
TMDL expressed as E. coli						
Concentration Target (cfu/100 mL)		320				
TMDL (billion cfu/day)		40.35	15.78	7.92	3.91	2.42
Allocations (billion cfu/day)						
Margin of Safety		4.04	1.58	0.79	0.39	0.24
Load Allocation		0.02	0.01	0.00	3.52	2.17
Wasteload Allocations	Thurston County (MS4)	0.39	0.15	0.08	0.00	0.00
	Olympia (MS4)	31.9	12.5	6.26	0.00	0.00
	Industrial Stormwater	4.00	1.56	0.78	0.00	0.00

Table 23. LDC Analysis Results and TMDL for Mission Creek, Listing ID 45212

		Flow Condition				
		High	Moist	Mid-range	Dry	Low
Sample Count		6	14	9	12	11
Estimated Average Flow (cfs)		6.08	2.38	1.19	0.59	0.36
Current Condition Fecal Coliform Measures						
Observed Geometric Mean Concentration (cfu/100 mL)		122.65	47.34	115.64	232.40	181.74
Observed 90th Percentile Concentration (cfu/100 mL)		223.83	500.02	823.03	2,206.90	445.66
Observed 90th Percentile Load (billion cfu/day)		33.32	29.10	24.04	31.86	3.97
TMDL expressed as Fecal coliform						
Concentration Target (cfu/100 mL)		40.3				
TMDL (billion cfu/day)		6.00	2.35	1.18	0.58	0.36
Allocations (billion cfu/day)						
Margin of Safety		0.60	0.23	0.12	0.06	0.04
Load Allocation		0.00	0.00	0.00	0.52	0.32
Wasteload Allocations	Thurston County (MS4)	0.30	0.12	0.06	0.00	0.00
	Olympia (MS4)	5.10	1.99	1.00	0.00	0.00

Table 24. LDC Analysis Results and TMDL for Ellis Creek, Listing ID 45480

		Flow Condition				
		High	Moist	Mid-range	Dry	Low
Sample Count		21	41	28	41	18
Estimated Average Flow (cfs)		9.39	3.67	1.84	0.91	0.56
Current Condition Fecal Coliform Measures						
Observed Geometric Mean Concentration (cfu/100 mL)		136.53	45.70	33.72	70.34	58.17
Observed 90th Percentile Concentration (cfu/100 mL)		522.52	205.91	187.06	267.57	556.59
Observed 90th Percentile Load (billion cfu/day)		120.09	18.50	8.44	5.96	7.66
TMDL expressed as Fecal coliform						
Concentration Target (cfu/100 mL)		41.2				
TMDL (billion cfu/day)		9.47	3.70	1.86	0.92	0.57
Allocations (billion cfu/day)						
Margin of Safety		0.95	0.37	0.19	0.09	0.06
Load Allocation		0.65	0.25	0.13	0.83	0.51
Wasteload Allocations	Thurston County (MS4)	6.57	2.57	1.29	0.00	0.00
	Olympia (MS4)	1.30	0.51	0.26	0.00	0.00

Table 25. LDC Analysis Results and TMDL for East Adams Creek, Listing ID 45462

		Flow Condition				
		High	Moist	Mid-range	Dry	Low
Sample Count		2	10	7	12	8
Estimated Average Flow (cfs)		6.70	2.62	1.31	0.65	0.40
Current Condition Fecal Coliform Measures						
Observed Geometric Mean Concentration (cfu/100 mL)		103.49	114.01	21.31	21.43	42.88
Observed 90th Percentile Concentration (cfu/100 mL)		2,072.14	2,430.05	153.78	155.17	485.97
Observed 90th Percentile Load (billion cfu/day)		339.51	155.67	4.94	2.47	4.77
TMDL expressed as Fecal coliform						
Concentration Target (cfu/100 mL)		43.0				
TMDL (billion cfu/day)		7.05	2.75	1.38	0.68	0.42
Allocations (billion cfu/day)						
Margin of Safety		0.70	0.28	0.14	0.07	0.04
Load Allocation		5.80	2.27	1.14	0.62	0.38
Wasteload Allocations	Thurston County (MS4)	0.54	0.21	0.11	0.00	0.00

Table 26. LDC Analysis Results and TMDL for West Adams Creek, Listing ID 45695

		Flow Condition				
		High	Moist	Mid-range	Dry	Low
Sample Count		6	9	11	12	4
Estimated Average Flow (cfs)		4.73	1.85	0.93	0.46	0.28
Current Condition Fecal Coliform Measures						
Observed Geometric Mean Concentration (cfu/100 mL)		205.57	357.12	76.83	1,868.69	1,290.49
Observed 90th Percentile Concentration (cfu/100 mL)		562.72	1,381.16	2,011.58	62,061.57	36,080.92
Observed 90th Percentile Load (billion cfu/day)		65.18	62.55	45.72	697.21	250.12
TMDL expressed as Fecal coliform						
Concentration Target (cfu/100 mL)		43.0				
TMDL (billion cfu/day)		4.98	1.95	0.98	0.48	0.30
Allocations (billion cfu/day)						
Margin of Safety		0.50	0.19	0.10	0.05	0.03
Load Allocation		2.26	0.88	0.44	0.43	0.27
Wasteload Allocations	Thurston County (MS4)	2.22	0.87	0.44	0.00	0.00

6 TMDLS FOR MAINSTEM DESCHUTES RIVER – DISSOLVED OXYGEN

6.1 TECHNICAL APPROACH

EPA developed TMDLs for the mainstem of the Deschutes River, which is impaired for DO (

Table 1 and Figure 1). These TMDLs establish loadings for both total nitrogen (TN) and total phosphorus (TP), set at levels which will attain the applicable criteria for DO, in conjunction with targets for riparian shade, as explained below. The *2015 Deschutes TMDLs* included allocations for riparian shade but not nutrients for the DO impaired segments of the Deschutes River. However, EPA developed nutrient TMDLs because nutrients facilitate the production of algae and contribute to sediment oxygen demand, which can lead to violations of the DO standard even if shade conditions are restored. Although it did not establish nutrient loads in the *2015 Deschutes TMDLs*, Ecology identified nutrient reductions as a necessary component for attaining the DO water quality standards in the Technical Report for the *2015 Deschutes TMDLs* (Roberts et al. 2012). EPA used Ecology's existing QUAL2Kw model for the Deschutes River, which was developed to support the *2015 Deschutes TMDLs*, to determine the appropriate TMDL for the river.

As described in Section 3.2.6, there is a natural conditions provision for DO that applies when the numeric criterion cannot be met even when conditions in the waterbody are modeled at fully natural levels. During the QUAL2kw modeling exercise, EPA found that the numeric criterion in the portion of the river upstream of Offutt Lake would not be met, even when all input values were set to natural levels (second scenario described in Section 6.2). Thus, EPA applied the natural conditions provision in Washington's water quality standards to the impaired segment in that portion of the river, where the allowable water quality DO level is the naturally attainable DO concentration minus 0.2 mg/L of allowed human impacts.

EPA uses Ecology's temperature TMDLs and associated riparian shade targets for the Deschutes River (found in EPA-approved *2015 Deschutes TMDLs*) as the baseline for these DO TMDLs. Improving riparian shade will result in cooler stream temperatures that will directly improve DO levels by allowing the water to hold more oxygen, as well as indirectly improve DO levels by decreasing primary productivity (these relationships are further described in Appendices E and F). For the *2015 Deschutes TMDLs*, Ecology used the Shade.xls model (based on the restoration of riparian shade) to identify shade targets and establish the thermal heat loads for the mainstem of the Deschutes River. Because of the direct linkage between temperature and DO levels, achieving the heat loads in the *2015 Deschutes TMDLs* is a necessary component to meeting the DO water quality standards in these TMDLs.

The remainder of this section outlines EPA's TMDL analysis for DO. Further details describing all of the analysis steps are provided in Appendix E.

6.2 NUMERIC TARGETS

In order to establish numeric targets, EPA ran three scenarios in QUAL2Kw to determine which key variables and inputs needed to be modified in order to attain instream DO concentrations which were consistent with the applicable criteria (further details in Appendix E). Because the Deschutes River upstream of Offutt Lake has a different designated use and criteria than the river downstream of Offutt Lake, EPA established different targets for each location. The first location covers one impaired segment in the portion of the river upstream of Offutt Lake, and the TMDL targets were established to be protective at the downstream point of that segment. The second location covers three consecutive impaired segments. The most downstream point of those three segments is near the mouth of the Deschutes River before it enters Capitol Lake. The TMDL targets were established to be protective at that downstream point. This ensures the TMDL is comprehensively protective of all three segments, because it accounts for loading from all sources upstream of that point. Further discussion of the applicable water quality standards and criteria can be found in Section 3.2.6.

The first two scenarios relied on the QUAL2Kw model to estimate two natural conditions scenarios – one for temperature and one for DO (model input values are listed in Appendix E). To determine an appropriate natural conditions scenario, EPA used Ecology's definition of natural conditions from Washington's water quality standards, found at WAC 173-201A-020:

> *"Natural conditions" or "natural background levels" means surface water quality that was present before any human-caused pollution. When estimating natural conditions in the headwaters of a disturbed watershed it may be necessary to use the less disturbed conditions of a neighboring or similar watershed as a reference condition."*

The first scenario was a natural conditions temperature scenario that included the following criteria, which are the same criteria Ecology applied in the *2015 Deschutes TMDLs*:

- The riparian corridor was simulated with the Shade.xls model to achieve maximum system potential vegetation. System potential vegetation assumes a full, dense, old-growth forest along the riparian corridor. The resulting combined topographic and vegetative shade was used as an input to QUAL2Kw to evaluate improvements in water temperature conditions.
- When system potential vegetation is achieved along a riparian corridor, localized air temperatures are cooler. This microclimate impact was incorporated into the model as a decrease in air temperature of 2 ºC every hour of the day.
- Changes in riparian vegetation are expected to stabilize the streambanks, decreasing both channel width and near stream disturbance zone width. To simulate these improvements, both channel hydraulic parameters were reduced by 10 percent.
- Ecology assumed that water temperature standards will be met (or better) with the restoration of shade along the tributary corridors and headwaters. Therefore, the maximum water temperature allowed by criteria were applied as the inputs for the river headwaters and all tributaries in the QUAL2Kw scenario.

The second scenario built off of the natural conditions for temperature scenario to create a natural conditions scenario for DO. It addressed other oxygen-depleting stressors and incorporated the following additional assumptions:

- Natural nutrient conditions for headwaters, tributaries, springs and groundwater (nitrogen and phosphorus species and carbonaceous biochemical oxygen demand).
- Natural DO concentrations for headwaters and tributaries.
- Natural conductivity, pH, alkalinity, and DO concentrations in groundwater and springs.

Based on the results of the above two scenarios, EPA found that under natural conditions for temperature, the applicable numeric DO criterion for the portion of the Deschutes River downstream of Offutt Lake (8.0 mg/L) could be achieved. Thus, the temperature TMDLs (as heat loads) approved in the *2015 Deschutes TMDLs* are sufficient to meet the DO water quality standards in that part of the river, without further nutrient reductions. Existing TN and TP concentrations are shown in Table 27.

However, for the portion of the Deschutes River upstream of Offutt Lake, EPA found that under natural conditions for temperature and DO, the applicable numeric DO criterion (9.5 mg/L) could not be achieved. As shown in Appendix E, the minimum DO levels do not exceed 9.2 mg/L under natural conditions.

The third scenario served to determine the level of nutrient reductions needed to meet the natural conditions for DO, along with the allowable 0.2 mg/L anthropogenic decrease (see Appendix E for a summary of these values by model segment). This scenario is also referred to in Appendix E as the "TMDL Scenario." Based on the results of this model scenario, EPA determined the nutrient targets for the portion of the Deschutes River upstream of Offutt Lake that would result in DO water quality standards being attained. Table 27 displays the final numeric nutrient targets for both sections of the river. Downstream of Offutt Lake, the nutrient targets are set to existing levels. The shade targets are from the *2015 Deschutes TMDLs*, and they are provided for reference. The effective shade values in the *2015 Deschutes TMDLs* were provided for every river kilometer. Table 27 displays the average for each portion of the river (upstream and downstream of Offutt Lake). The switch from upstream to downstream of Offutt Lake occurs around river mile 15 (river kilometer 24), which was estimated based on the latitude and longitude where the standard changes, the streamline from NHD, and cross-checking using the river miles listed for USGS sites along the river.

Table 27. Applicable Targets for the DO TMDLs

Impaired Waterbody	Effective Shade[1]	Targets	
		TN (mg/L)	TP (mg/L)
Deschutes River (upstream of Offutt Lake)	85%	0.175	0.006
Deschutes River (downstream of Offutt Lake)[2]	79%	0.763	0.019

[1]Shading targets are not assigned in these TMDLs – they are implicitly incorporated via the EPA-approved temperature TMDLs from the *2015 Deschutes TMDLs*.

[2]TN and TP downstream of Offutt Lake are based on existing levels.

6.3 CURRENT CONDITIONS

6.3.1 Available Data

Water chemistry and flow monitoring data were available at several locations along the Deschutes River. Most data were collected in 2003 and 2004 to support the model development, and are still the most recent data available in the watershed. Ecology used the following data to develop, calibrate, and verify the Deschutes River QUAL2Kw model:

- Continuous flow monitoring from the United States Geological Survey (USGS gages 12080010, Deschutes River at E. Street Bridge at Tumwater, WA and 12079000, Deschutes River near Rainier, WA);
- Periodic flow measurements and grab sample water quality data from Thurston County;
- Grab and continuous water quality data from the Washington EIM online database.

6.3.2 Sources of Dissolved Oxygen Impairment

Ecology's Technical Report for the *2015 Deschutes TMDLs* (Roberts et al. 2012) includes a detailed description of sources of oxygen depletion in the Deschutes River watershed, which EPA relies on for these TMDLs.

The sources of oxygen depletion for the Deschutes River, which are assigned LAs and WLAs, include non-point sources (from runoff not included in the MS4s), MS4s, aquaculture facilities, and permittees covered under the GPs for Industrial Stormwater, Sand and Gravel, and Construction Stormwater.

Table 28 lists the permitted sources, except Construction Stormwater which can be found in Appendix E. All permitted sources discharge to the Deschutes River downstream of Offutt Lake.

Wastewater released by fish hatcheries to the Deschutes River accumulates oxygen-demanding substances from uneaten feed and fish waste. Many facilities use flow-through or offline settling basins to avoid discharging all untreated effluent directly into waterways. Stormwater flows from MS4s and the general stormwater permittees can act as DO stressors because substances in stormwater runoff delivered to the river accumulate in the water column and sediment over time. Natural processes and anthropogenic activities, such as detrital matter from vegetation on the landscape and fertilizer applied to lawns or cropland, elevate stormwater nutrient loads. Nutrients facilitate the production of algae and contribute to sediment oxygen demand, which can lead to violations of the DO standard during dry weather conditions. These same nutrient loads may also come from non-MS4 areas, and are included in the LA.

Table 28. Permitted Sources for DO-impaired segments of the Deschutes River.

Permittee	Permit Type	Permit Number	Receiving Water Listing ID
City of Olympia	Western Washington Phase II Municipal Stormwater Permit	WAR045015	10894
City of Tumwater		WAR045020	10894 and 47753
Thurston County		WAR045025	10894 and 47753
City of Lacey		WAR045011	10894
Washington Department of Transportation	WSDOT Phase I Municipal Stormwater Permit	WAR043000A	10894
Tumwater Falls Hatchery[1]	N/A	N/A	10894
Pioneer Park Hatchery[1]	N/A	N/A	10894
Lakeside Industries (Olympia Airport)	Sand and Gravel	WAG501042	47753
Alpine Sand and Gravel (Rixie Rd)		WAG501037	10894
Lakeside Industries (Waldrick Rd)		WAG501231	47754
ONeill and Sons Trucking Inc	Industrial Stormwater	WAR001404	47753

[1]The two hatcheries do not currently have NPDES permits.

6.3.3 Existing Water Quality and Loading

The QUAL2Kw model, as discussed in Section 6.4 and presented in Appendix E, was used to analyze existing DO levels under critical conditions. Critical conditions were represented by choosing both a low flow and high air temperature condition, which were modeled simultaneously. The low flow condition was defined as the 7-day average low flow with a 10-year recurrence interval (7Q10). The high air temperature condition was defined as the 90th percentile of long-term observed air temperatures from the Olympia Airport. The model outputs in Figure 4 show that under existing critical conditions (represented by the critical DO saturation, and critical mean, min, and max DO lines in the figure), the minimum DO does not achieve the numeric criteria (in terms of the lowest allowable 1-day minimum DO concentration) for most of the mainstem. The critical oxygen saturation level shown in Figure 4 is the maximum level of dissolved oxygen expected based on the temperature and salinity of the water. It is generally accepted that the best achievable DO concentration is limited to the oxygen saturation level. Summary statistics of observed instream and groundwater DO data, as well as instream nutrient data can be found in Appendix E.

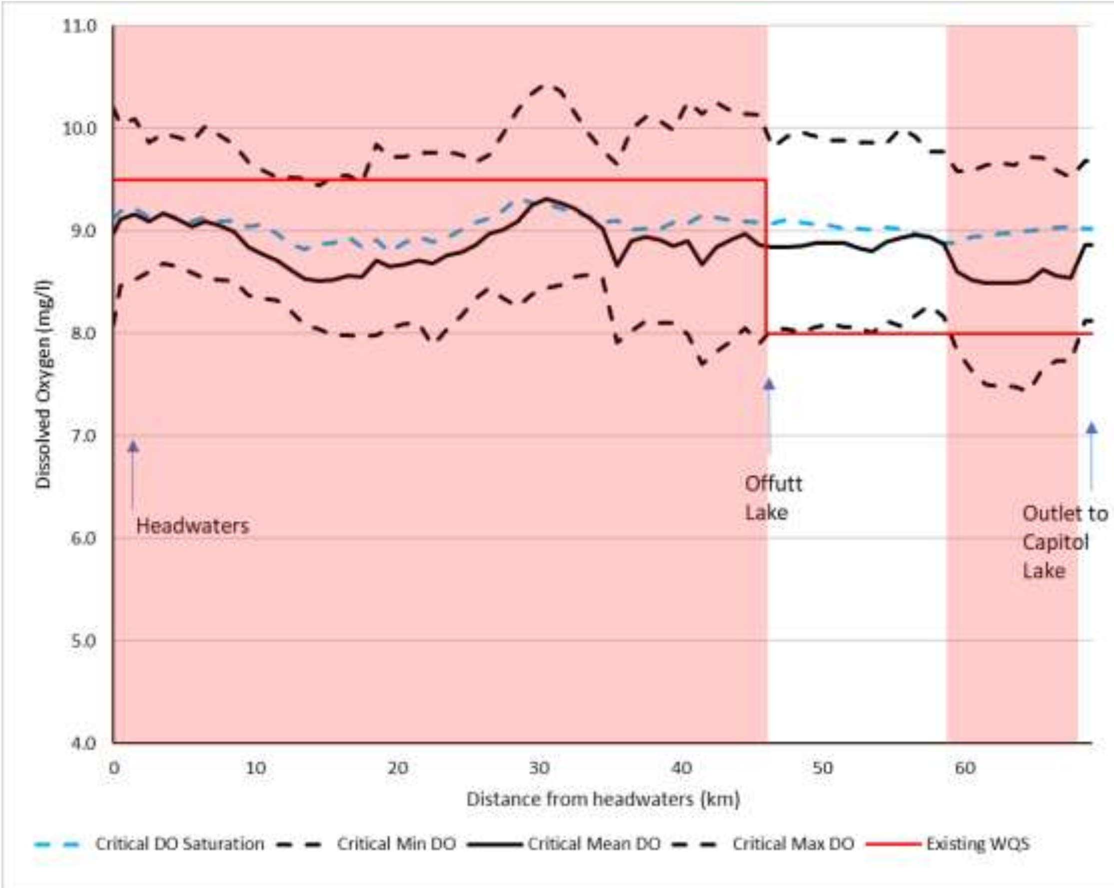

Figure 4. Existing critical condition model results: DO (red shading indicates where critical minimum DO is lower than the applicable numeric criteria).

In addition to summarizing instream DO conditions in the Deschutes River, EPA estimated existing nutrient loading associated with stormwater from the MS4s and other permitted point sources, as well as non-MS4 areas (Appendix E). Existing loads for MS4s and non-MS4 areas were derived from land use-based export coefficients and then scaled based on existing instream loads for the Deschutes River (see Appendix E for further detail). Existing loads for industrial, sand and gravel, and construction stormwater sites were estimated based on EMCs from stormwater monitoring data collected by Phase I MS4s in western Washington (Hobbs et al., 2015) and estimated runoff volumes, as described in Appendix E. Existing stormwater daily load estimates for TP and TN are presented for each source type in Table 29 and Table 30. There are no point sources upstream of Offutt Lake, so the entire existing load is attributed to non-MS4 areas, which represent the non-point sources.

Table 29. Average daily existing TP and TN loads (kg/day) from non-point sources upstream of Offutt Lake.

Source	TP (kg/day)	TN (kg/day)
Non-MS4 areas	8	255

Table 30. Average daily existing TP and TN loads (kg/day) from non-point and point sources downstream of Offutt Lake.

Source	TP (kg/day)	TN (kg/day)
Lacey MS4	0.5	15
Olympia MS4	0.2	6.4
Tumwater MS4	0.6	19
Thurston MS4	1.9	62
WSDOT MS4	<0.1	0.1
Tumwater Falls Hatchery[1]	0.13	1.94
Pioneer Park Hatchery[1]	0.67	6.20
Sand and Gravel GP[2]	0.43	2.75
Industrial SWGP	0.06	0.37
Construction SWGP[2]	0.71	4.52
Non-MS4 areas	14	643

[1]The average annual WLAs are presented in this table for the hatcheries, which were computed by weighting the monthly loads provided by the facilities by the number of days in each month. Average daily loads by month are presented in Appendix E. The Pioneer Park Hatchery Loads in this table are for the long-term proposed operations.

[2]The sum of all permittees covered under the Sand and Gravel and Construction Stormwater GPs is shown here. The specific loads attributed to each permittee for Sand and Gravel can be found in Appendix E.

6.4 TMDL ANALYSIS

6.4.1 Seasonal Variation and Critical Conditions

As discussed in Section 6.3.3, critical conditions were defined for the model runs which were used to develop the TMDL. DO excursions are more common during warm periods due to algae activity and lower DO solubility. For example, minimum DO concentrations recorded during 2004 at the mainstem monitoring site, 13-DES-05.5, were lowest for the month of August (7.5 mg/L) and highest for the month of April (11.3 mg/L). Moreover, average DO concentrations at this site were greater than 10 mg/L for months between October and May and less than 10 mg/L for months between June and September. The warmest air temperatures are typically observed in July and August in the Deschutes River watershed.

Nutrient loading may be relatively low during the critical period (i.e., due to negligible contributions from runoff). Additionally, because stream sediment may act as a sink for nutrients, and nutrients that are incorporated into macrophyte and algal tissue are released as plants and algae breakdown, effects of excess nutrient loading may occur during multiple times of the year. Therefore, critical conditions and seasonal variation in loading is addressed by establishing flow-variable nutrient TMDLs. This method inherently accounts for seasonal variation and critical conditions because the maximum allowable TN and TP loads are evaluated across the full flow spectrum, including times of the year when runoff occurs.

Hatcheries weren't incorporated into the QUAL2Kw model because the Tumwater Falls Hatchery doesn't discharge during the critical conditions for the model, and the Pioneer Park Hatchery is not yet operating (see Appendix E for further explanation). However, they have been incorporated into the TMDL analysis and have also received nutrient allocations (described further in Section 6.4.5). Hatchery discharges are not dependent on streamflow. Instead, hatcheries are provided seasonally-dependent WLAs because they discharge at a consistent flow and predictable effluent loads based on the fish-rearing schedule. The seasonal WLAs are defined for the hatcheries according to anticipated operation patterns (e.g., production numbers and feed requirements).

6.4.2 TMDLs

As explained in Section 6.2, the QUAL2Kw model was used to determine the TMDL for two sections of the river (listing ID 10894 for the Deschutes River upstream of Offutt Lake; listing IDs 47753, 47754, and 47756 for the Deschutes River downstream of Offutt Lake). Based on the model, nutrient reductions are necessary upstream of Offutt Lake and no additional nutrient loading may occur downstream of Offut Lake. In addition to the nutrient loads provided in these TMDLs, the baseline restored riparian shade and effective heat loads established in the *2015 Deschutes TMDLs* will be essential for meeting the DO water quality standards. Using the nutrient concentration targets defined in Table 27, EPA defined the TMDL. Flow-based TMDLs are provided in Table 31 based on recorded flow levels from long-term flow gaging records.

Table 31. TN and TP TMDLs for the Deschutes River.

Percent of Time Flow is Equaled or Exceeded	Deschutes River Upstream of Offutt Lake (Listing ID 10894)			Deschutes River Downstream of Offutt Lake (Listing IDs 47753, 47754, and 47756)		
	Flow (cfs)[1]	TN TMDL (kg/day)	TP TMDL (kg/day)	Flow (cfs)[1]	TN TMDL (kg/day)	TP TMDL (kg/day)
95%	25	11	0.37	78	145	3.6
90%	29	12	0.42	89	166	4.1
50%	129	55	1.9	250	467	12
10%	533	229	7.8	842	1,573	39
5%	792	340	12	1,210	2,262	56

[1]USGS 12079000 (Deschutes River near Rainer) used to determine flows for the river upstream of Offutt Lake. USGS 12080010 (Deschutes River at East Street Bridge at Tumwater) used to determine flows for the river downstream of Offutt Lake.

While the nutrient TMDLs are provided for specific flows in Table 31, they can be expressed as flow-varied loads based on the TN and TP concentration targets using the equations below. The equations can also be applied to define the allocations.

$$TN\ TMDL = \ flow\ (cfs) \times TN\ target \times 2.45\ (conversion\ factor)$$

where TN target = 0.175 mg/L upstream of Offutt Lake, 0.763 mg/L downstream of Offutt lake.

$$TP\ TMDL = flow\ (cfs) \times TP\ target \times 2.45\ (conversion\ factor)$$

where TP target = 0.006 mg/L upstream of Offutt Lake, 0.019 mg/L downstream of Offutt Lake.

Figure 5 and Figure 6 show how the TMDL scales with flow for both sections of the Deschutes River. This means that at any given flow, the TMDL is met if the water quality target is met.

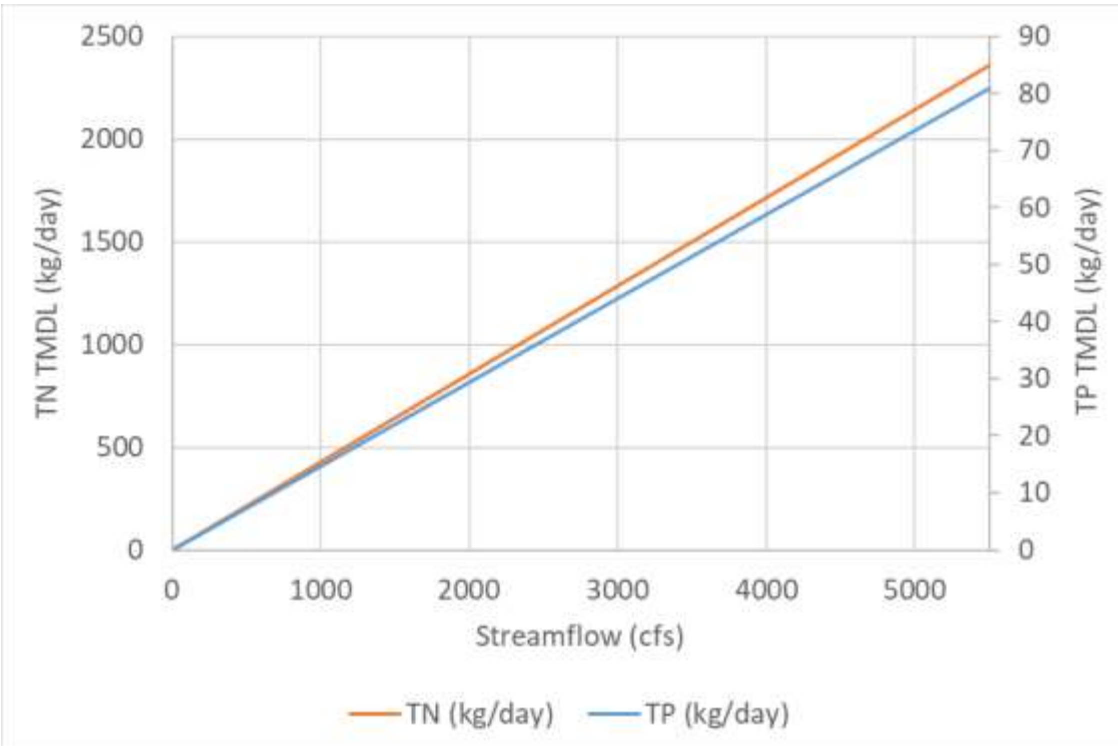

Figure 5. Plot of TN and TP TMDLs for the Deschutes River upstream of Offutt Lake.

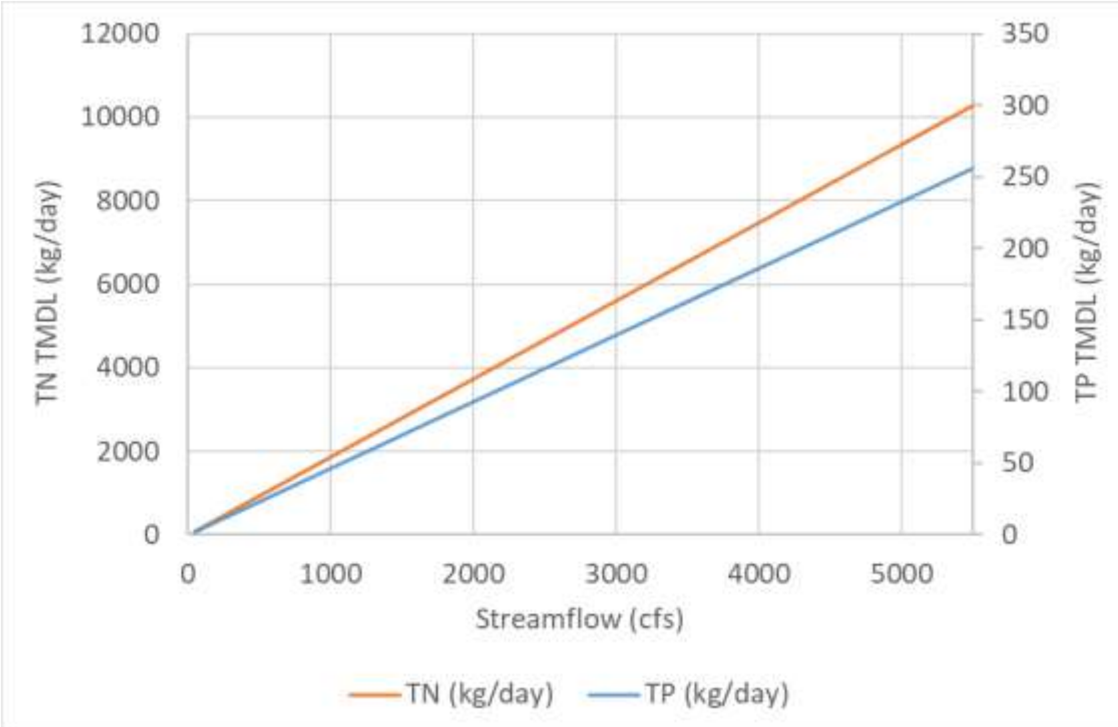

Figure 6. Plot of TN and TP TMDLs for the Deschutes River downstream of Offutt Lake.

6.4.3 Reserve Capacity

The Tumwater Falls hatchery has been given a reserve-based WLA (discussed further in Section 6.4.5). However, there is no overall reserve capacity for the DO TMDLs, and the TMDL is fully allocated to WLAs (including the reserve WLA for Tumwater Falls) and LAs.

6.4.4 Margin of Safety

For both portions of the river, upstream and downstream of Offutt Lake, an implicit MOS is applied. The implicit MOS is comprised of conservative assumptions built into the calculations and the QUAL2Kw model. The shade and heat loads (from the *2015 Deschutes TMDLs*), which apply to both portions of the river, were developed using targets based on reference conditions to ensure attainment of the applicable water quality standards. This serves as an implicit MOS, because the most conservative targets were chosen. Conservatism is also incorporated into the source assessments for point sources. For instance, most construction occurs within the MS4s, but the Construction Stormwater GP was given its own WLA. Also, the entire site area was assumed to be impervious for estimates from facilities permitted under the Sand and Gravel and Industrial Stormwater GPs. This errs towards providing an over-estimate of contributions from those facilities. Conservative assumptions built into the QUAL2Kw model included the following:

- The likelihood of both 7Q10 flows and 90th percentile air temperatures coinciding (as represented by the critical conditions scenario) is lower than either condition occurring individually; and
- The numeric temperature and DO criteria were applied statically throughout the day (instead of varying on an hourly basis) to conservatively approximate the worst-case state (highest heat load and lowest oxygen load).

6.4.5 Wasteload and Load Allocations

WLAs and LAs are defined for point and non-point sources for the DO TMDLs. All WLAs except those given to the fish hatcheries vary by stream flow, as explained in Section 6.4.1. Example WLAs and LAs are provided in Table 32 (upstream of Offut Lake) and Table 33 (downstream of Offutt Lake) for average daily flow. The seasonal-based hatchery WLAs are provided in Table 34.

Upstream of Offutt Lake, there are no WLAs for permitted point sources. Since the MOS is implicit, the LAs are equivalent to the TMDLs for TN and TP. Downstream of Offutt Lake, there are WLAs allocated to fish hatcheries and permitted stormwater sources (based on existing loads) and an implicit MOS. Therefore, the LAs downstream of Offutt Lake are equal to the TMDL minus all WLAs.

Discharges from MS4s and other permitted stormwater entities are negligible during dry periods, and the NPDES permits only authorize stormwater discharges (with limited exceptions). For the purpose of these TMDLs, a dry period is defined as a time when there is either no precipitation or there is not adequate precipitation to generate stormwater runoff in the catchments of the stormwater entities. Nutrient WLAs for all point sources associated with stormwater are zero during dry periods.

The Tumwater Falls Hatchery is receiving a reserve WLA and the Pioneer Park Hatchery is receiving a WLA. The Tumwater Falls Hatchery is receiving a reserve WLA since, as described in Section 2.1, it does not currently meet the production threshold for necessitating permit coverage, but Ecology may determine it requires permit coverage in the future. The Pioneer Park Hatchery is not yet in operation, but it has submitted an application for permit coverage, so it is covered by a WLA in these TMDLs to account for its anticipated discharge. As the TMDL requires no loading reductions from the hatcheries, the reserve WLA for Tumwater Falls and WLA for Pioneer Park equal existing or projected loads that were estimated by the facilities according to their operational procedures. These are grouped into time periods of similar loading magnitudes.

Table 32. Nitrogen and phosphorus load allocations for estimated average daily streamflow (cfs)[1] for the Deschutes River upstream of Offutt Lake.

LA	Load (kg/day)	
	TN	TP
General LA	102	3
Total TMDL	**102**	**3**

[1]Estimated average daily streamflow based on historic gaging records at Deschutes River near Rainier (235 cfs – USGS 12079000).

Table 33. Nitrogen and phosphorus wasteload and load allocations for estimated average daily streamflow (cfs)[1] for the Deschutes River downstream of Offutt Lake.

WLA or LA	Load (kg/day)	
	TN	TP
Tumwater Falls Hatchery Reserve WLA[2]	2	0.1
Pioneer Park Hatchery WLA[2]	6	0.7
City of Lacey (MS4) WLA	15	0.5
City of Olympia (MS4) WLA	6.4	0.2
City of Tumwater (MS4) WLA	19	0.6
Thurston County (MS4) WLA	62	1.9
WSDOT (MS4) WLA	0.1	<0.1
Industrial Stormwater WLA	0.4	0.1
Sand and Gravel Stormwater WLA	2.7	0.4
Construction Stormwater WLA	4.5	0.7
General LA	643	13.7
Total TMDL	**761**	**18.9**

[1]Estimated average daily streamflow based on historic gaging records at Deschutes River at East Street Bridge (407 cfs – USGS 12080010) from 2000 to 2019.

[2]WLAs for the hatcheries are summarized in this table on an average annual basis for comparison to other permittees; however, WLAs are assigned on a seasonal basis in Table 34.

Table 34. Wasteload allocations for hatcheries (downstream of Offutt Lake).

Months	Tumwater Falls Hatchery Reserve Wasteload Allocations		Months	Pioneer Park Hatchery Wasteload Allocations	
	TN (kg/day)	TP (kg/day)		TN (kg/day)	TP (kg/day)
January	0[1]		January	2.81	0.29
February - June	5.43	0.31	February - May	13.23	1.16
July - August	0[1]		June	0.97	0.05
September - December	0.07	0.05	July - December	6.35	0.78

[1]This reflects periods when the hatchery does not discharge.

7 TMDLS FOR TRIBUTARIES – TEMPERATURE, DISSOLVED OXYGEN, AND PH

7.1 TECHNICAL APPROACH

In the *2015 Deschutes TMDLs*, nine tributaries impaired by a combination of temperature, DO, and/or pH (

Table 1 and Figure 1) were either lacking any explicit loads or were assigned loads that did not ensure attainment of water quality standards. EPA developed TMDL allocations (primarily using surrogate parameters) for these tributaries as summarized below and discussed further in the following sections.

7.1.1 Temperature

Ecology identified riparian shade loss as the primary cause of temperature impairment in Deschutes River tributaries and used the Shade.xls model (based on the restoration of riparian shade) to identify shade targets and establish the thermal TMDLs for Black Lake Ditch and Percival Creek in the *2015 Deschutes TMDLs*. EPA used the same approach and model to develop temperature TMDLs for the five tributaries listed in

Table 1 (i.e., Huckleberry, Reichel, and Ayer creeks; Unnamed Spring; and Tempo Lake Outlet) because EPA determined that restoration of riparian shade is necessary to meet the temperature TMDLs and using shade as a surrogate is a commonly-used approach to address temperature impairment in Washington.

7.1.2 Dissolved Oxygen and pH

As discussed in Appendix F, improving riparian shade will result in cooler stream temperatures that will directly improve DO levels by allowing the water to hold more oxygen, indirectly improving DO and pH levels by decreasing primary productivity. This approach is also consistent with Ecology's approved 2015 temperature TMDL for the Deschutes River. EPA therefore set shade targets and established thermal TMDLs for DO-impaired tributaries (

Table 1). As noted above, Black Lake Ditch and Percival Creek, which are also impaired for pH and/or DO (

Table 1), have approved temperature TMDLs from the *2015 Deschutes TMDLs*. EPA found that Ecology's shade targets and thermal TMDLs are also needed to address the pH and DO impairments in Black Lake Ditch and Percival Creek.

Although the *2015 Deschutes TMDLs* did not set adequate loads for the DO and pH impaired tributaries, it identified nutrients as a cause of the DO and pH impairments because of their role (along with temperature) in driving primary productivity, and incorporated nutrient reductions from the tributaries into the QUAL2Kw model for the mainstem. EPA determined that this was an appropriate approach and established nutrient TMDLs, in conjunction with temperature TMDLs, in order to address the DO and pH impaired tributaries. EPA developed ecoregionally derived targets for total nitrogen and phosphorus for all tributary waterbodies impaired for DO and pH. This strategy is consistent with other DO and pH TMDLs that have implemented nutrient targets as surrogate measures for water quality restoration in Washington (Moore and Ross, 2010; Snouwaert and Stuart, 2015). The details of EPA's technical approach to the tributary TMDLs are contained in Appendix F.

7.2 NUMERIC TARGETS

As discussed in Section 7.1, EPA established temperature-related targets for all tributaries impaired for temperature, DO, and/or pH. While the numeric temperature criteria presented in Table 4 can be used to assess progress towards meeting the TMDL, the target for each tributary is a surrogate measure, based on effective shade. As described in Appendix F, effective shade, which is the fraction of the potential shortwave solar radiation blocked by riparian vegetation and topography before it reaches the stream surface, is an appropriate surrogate for temperature because it is the primary factor influencing stream temperature in the tributaries. The effective shade target varies by and along each tributary because it is a function of stream-specific variables such as channel geometry and the system potential riparian vegetation (as described in Appendix F), but the average effective shade target for each tributary is provided in

Table 35. The system potential riparian vegetation for all tributaries was based on that used for EPA-approved temperature TMDLs for the Deschutes River, Percival Creek, and Black Lake Ditch, but the species is generally expected to be Douglas Fir.

As discussed in Section 7.1.2, EPA established nutrient targets for all tributaries impaired for DO, and/or pH. While the applicable numeric criteria presented in

Table 5 and Table 6 can be used to assess progress towards meeting the TMDLs, attainment of those criteria will be achieved by meeting the surrogate targets for shade and nutrients. As detailed in Appendix F, the targets correspond to EPA recommendations for the Puget Lowlands Level III ecoregion based on reference conditions (EPA, 2000). The lower portion of Reichel Creek and the entirety of other DO and pH impaired tributaries is within the Puget Lowlands Level III ecoregion. The recommended values shown in

Table 35 are established as nutrient targets for the waterbodies impaired for DO and/or pH to achieve the water quality criteria.

Table 35. Tributary water quality targets for temperature, DO, and pH.

Impaired Waterbody	Parameter	Target
Huckleberry Creek	Temperature	Effective Shade: 97%
Reichel Creek	Temperature	Effective Shade: 94%
	DO	Effective Shade: 94% TN: 0.34 mg/L TP: 0.0195 mg/L
Tempo Lake Outlet	Temperature	Effective Shade: 93%
Ayer (Elwanger) Creek	Temperature	Effective Shade: 79%
	pH and DO	Effective Shade: 79% TN: 0.34 mg/L TP: 0.0195 mg/L
Unnamed Spring to Deschutes River	Temperature	Effective Shade: 99%
Black Lake Ditch[1]	pH and DO	Effective Shade: 84% TN: 0.34 mg/L TP: 0.0195 mg/L
Percival Creek[1]	DO	Effective Shade: 98% TN: 0.34 mg/L TP: 0.0195 mg/L
Lake Lawrence Creek	DO	Effective Shade: 94% TN: 0.34 mg/L TP: 0.0195 mg/L
East Adams Creek	pH	Effective Shade: 98% TN: 0.34 mg/L TP: 0.0195 mg/L

[1]Shade targets for Percival Creek and Black Lake Ditch are calculated from *2015 Deschutes TMDLs* Appendix E.

7.3 CURRENT CONDITIONS

7.3.1 Available Data

EPA reviewed water quality data in Ecology's EIM database on instream water temperature, DO, and pH for each impaired tributary addressed in this document, and TN and TP for tributaries impaired for DO and/or pH. Some newer data are available for Percival Creek, Reichel Creek, and Black Lake Ditch that were collected by Thurston County, but most data were collected between 2003 and 2005 in support of the *2015 Deschutes TMDLs*. All tributaries have data associated with each relevant parameter, and most have more than 20 samples. Data summaries are provided by pollutant in Appendix F.

7.3.2 Pollutant Sources

7.3.2.1 Loss of Riparian Vegetation

As documented in Appendix F and the *2015 Deschutes TMDLs*, lack of riparian vegetation is the primary source of elevated water temperatures in the Deschutes watershed. Ecology used a QUAL2Kw model for the mainstem to evaluate other factors that influence stream temperatures such as channel morphology, microclimate, and baseflow. The model identified channel morphology and microclimate as the most important secondary factors but indicated they are inherently linked to the condition of the riparian vegetation. Therefore, achieving target shade conditions will also improve the secondary factors.

A lack of riparian vegetation is also an influencing factor for DO and pH levels because riparian vegetation blocks sunlight and filters nutrients from overland flow and groundwater. This limits excess primary productivity in streams, thereby modulating DO and pH levels. The various land uses in the watershed have the potential to alter riparian vegetation and reduce effective shade, but the source assessment focuses more holistically on the shade deficit rather than specific land uses.

Adams Creek and Ayer Creek are the only two tributaries with temperature TMDLs in this document that have point sources in their watersheds; they are both partially within the boundary of the Thurston County MS4. There is also one site permitted under the CSWGP within the Ayer Creek watershed, but potential discharges under that permit are not anticipated to be a source of thermal loading due to the transient nature of construction activities and permit requirement to “retain natural vegetation in an undisturbed state to the maximum extent practicable” (Ecology, 2017).

7.3.2.2 Nutrients

Many sources that reduce riparian shade also may contribute excess nutrients to the impaired tributaries. The *2015 Deschutes TMDLs* discussed residential and urban development, agriculture, and permitted point sources as potential sources but did not include a comprehensive source assessment.

The tributary watersheds contain a mix of all of the types of NPDES GPs in the Deschutes watershed, with most of them being concentrated in the Black Lake Ditch and Percival Creek watersheds (Figure 2 and

Table 36). The watersheds for Lake Lawrence Creek and Reichel Creek do not contain any portions of the MS4s, or other permitted point sources.

The tributary watersheds currently have 13 active permittees under Ecology's CSWGP, which are listed in Appendix F. Except for the Sand and Gravel GP, all permittees in

Table 36 are only authorized to discharge stormwater. Facilities permitted under the SGGP may potentially discharge process wastewater, dewatering, and stormwater, but permit number WAG501118 (i.e., K and M Quarry) is not authorized to discharge process wastewater and the dewatering discharge is not considered a source of nutrient loading (A. Caroll-Perkins, personal communication, 4/10/2020). Therefore, the source assessment for permitted point sources focuses on potential loading associated with stormwater.

Table 36. Permitted point sources in the watersheds of DO and pH impaired tributaries.

Permittee	Permit Number	Permit Type	Waterbodies
K and M Quarry (Black Lake Quarry)	WAG501118	Sand and Gravel	Black Lake Ditch
Pepsi Northwest Beverages LLC	WAR009988	Industrial Stormwater	Black Lake Ditch
Pepsi Northwest Beverages LLC	WAR004082		Black Lake Ditch
Truss Components of Washington	WAR000758		Percival Creek
Construction Stormwater (Multiple)	Multiple	Construction Stormwater	Ayer Creek, Black Lake Ditch, Percival Creek
Thurston County	WAR045025	MS4	East Adams Creek, Ayer Creek, Black Lake Ditch, Percival Creek
City of Tumwater	WAR045020		Black Lake Ditch, Percival Creek
City of Olympia	WAR045015		
WSDOT	WAR043000A		

7.3.3 Existing Water Quality and Loading

7.3.3.1 Temperature and Effective Shade

As shown in Appendix F, all temperature-impaired tributaries have maximum temperature values exceeding the applicable 7-DADMax criterion. Huckleberry Creek is the closest to attainment, with a maximum recorded temperature of 16.3 ºC (target of 16.0 ºC), and Tempo Lake Outlet is the warmest with a maximum temperature of 25.1 ºC (target of 17.5 ºC).

EPA used the Shade.xls model to estimate the existing effective shade and associated thermal load, as detailed in Appendix F. The inputs for the Shade.xls model relied on aerial imagery, as well as inputs using GIS and LiDAR data regarding channel geometry, land cover and vegetation characteristics, and solar position to generate effective shade values at 10-meter intervals along the stream corridor in mid-summer. The average existing percent effective shade for all temperature-impaired tributaries, as estimated by the shade models, is provided in

Table 37. The existing and effective shade percentages for Lake Lawrence and Adams creeks, which are not impaired for temperature, are also presented in

Table 37 since they were completed as part of the assessment of existing thermal loading for those tributaries to address DO and pH impairments. Appendix F contains aerial imagery with a streamline showing the average effective shade deficit along each stream segment.

Table 37. Existing effective shade relative to the target for each impaired tributary. Temperature impaired tributaries are bolded.

Waterbody	Existing Effective Shade (%)	Effective Shade Target (%)
Huckleberry Creek	**96%**	**97%**
Reichel Creek	**71%**	**94%**
Tempo Lake Outlet	**79%**	**93%**
Unnamed Spring to Deschutes River	**99%**	**99%**
Ayer Creek	**34%**	**79%**
Lake Lawrence Creek	46%	94%
Adams Creek	90%	98%

EPA conducted a source assessment of thermal loading associated with loss of riparian shade within the Thurston County MS4. The existing thermal load associated with the loss of riparian shade within the Thurston County MS4 was estimated by summing the loading values from the Shade.xls model for portions of Ayer Creek and Adams Creek that flow through MS4. The MS4 overlaps with Adams Creek near its mouth and with Ayer Creek near its headwaters. The existing heat load and effective shade values for the portions of Adams and Ayer creeks that flow within the Thurston County MS4 boundary are provided in Table 38.

Table 38. Existing heat load and effective shade relative to the Thurston County MS4.

Waterbody	Existing Daily Heat Load (kWh/day)	Existing Effective Shade (%)	Effective Shade Target (%)
Adams Creek	9,280	97%	97%
Ayer Creek	77,546	32%	90%

7.3.3.2 Dissolved Oxygen, pH, and Nutrients

As shown in Appendix F, all tributaries impaired for DO have values below the applicable criterion for 1-day minimum and all tributaries impaired for pH exceed Washington's water quality standards (see Section 3.2 for applicable standards). Additionally, the mean observed TN and TP concentrations for all the DO and pH impaired waterbodies addressed in this report exceed the nutrient water quality targets. Adams Creek has the highest mean TN and TP concentrations and Black Lake Ditch is currently the closest to meeting both nutrient targets.

Nutrient sampling on the tributaries did not include storm events, and because there are no point sources permitted to discharge anything other than stormwater, the monitoring data is considered representative of nonpoint source contributions. There is insufficient paired flow and concentration data to calculate representative loads, but the distribution of the monitoring data (Figure 7 - Figure 8) indicates current conditions relative to the water quality target. The mean value indicated for Lake Lawrence Creek is based on a single sampling event. The monitoring data indicate that nonpoint sources contribute excess loads of TN and TP to all tributaries.

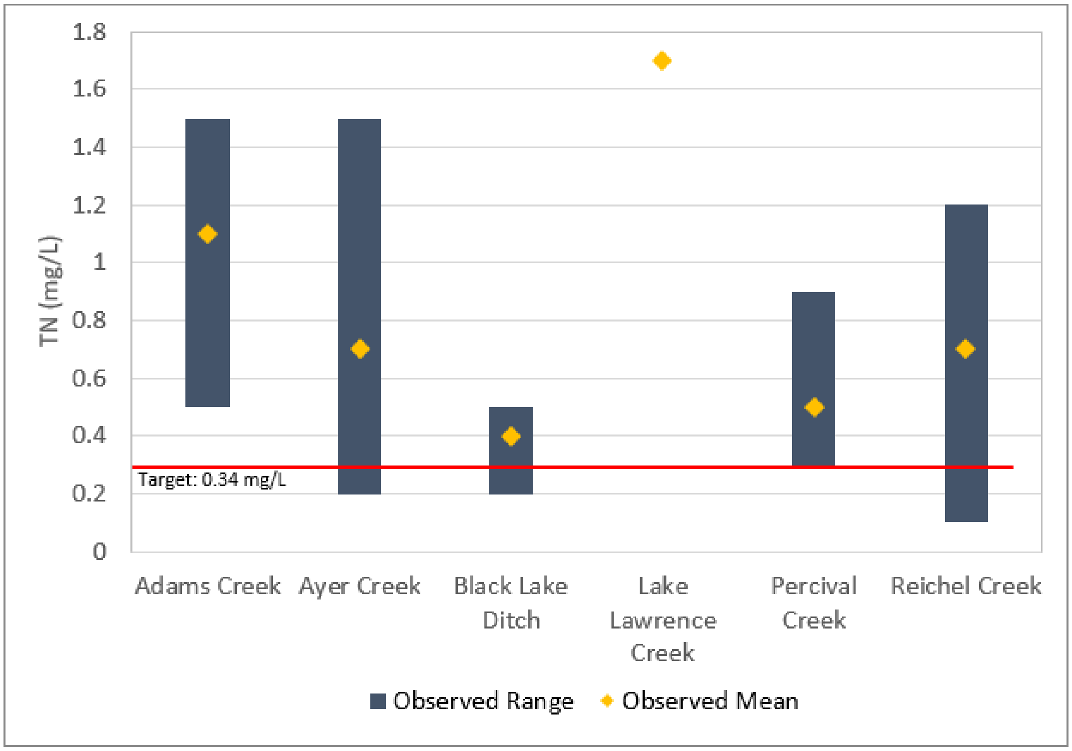

Figure 7. Range and average of TN samples in the DO and pH impaired tributaries.

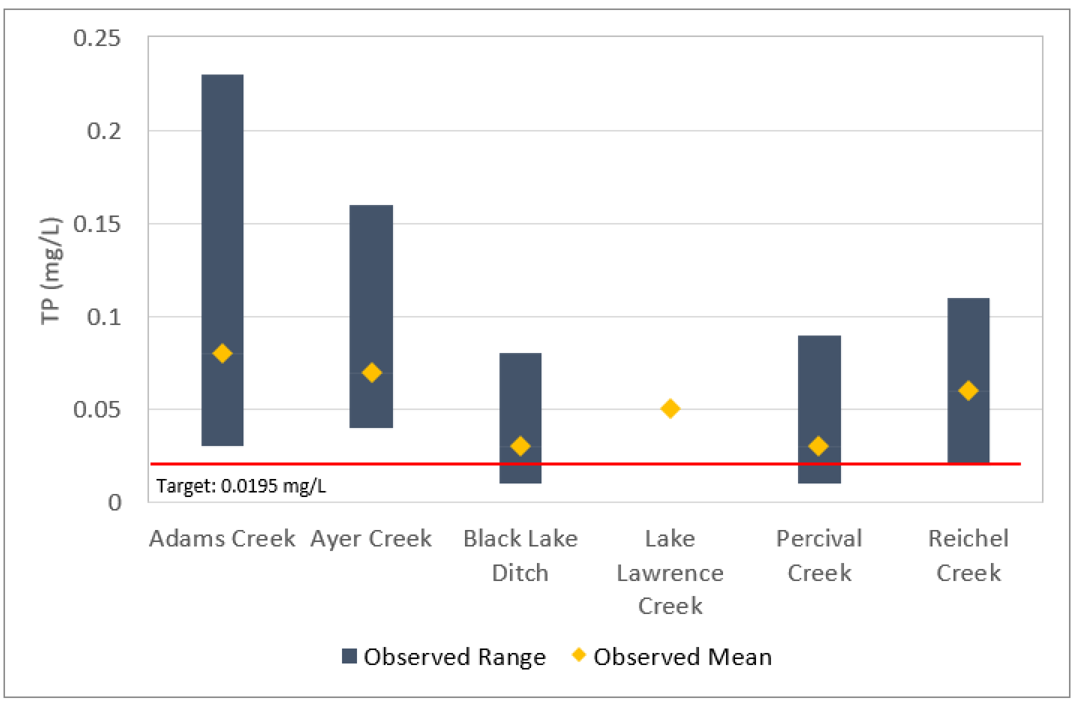

Figure 8. Range and average of TP samples in the DO and pH impaired tributaries.

EPA conducted a source assessment of nutrient loading in stormwater from the MS4s and other permitted point sources within the watershed for each tributary. Portions of the watersheds for Adams Creek, Ayer Creek, Black Lake Ditch, and Percival Creek all fall within MS4 boundaries. The existing daily nutrient loads in stormwater runoff from the MS4s and all other point sources were estimated using the Simple Method (Schueler, 1987), which incorporated local precipitation data, land cover and percent imperviousness, and EMC data from stormwater monitoring data collected by Phase I MS4s in western Washington (Hobbs et al., 2015), as described in Appendix F. Existing stormwater daily load estimates for TP and TN are presented by tributary for each MS4 and for each non-MS4 permit type in Table 39 and Table 40.

Table 39. Existing stormwater TP loads (kg/d) from point sources.

Permit Type	Adams Creek	Ayer Creek	Black Lake Ditch	Percival Creek
Olympia MS4	--	--	0.890	1.09
Tumwater MS4	--	--	0.311	1.49
Thurston MS4	0.008	0.030	0.056	0.123
WSDOT MS4	--	--	0.045	0.105
Sand and Gravel GP	--	--	0.210	--
Industrial SWGP	--	--	0.058	0.004
Construction SWGP	--	0.089	0.059	0.053

Table 40. Existing stormwater TN loads (kg/d) from point sources.

Permit Type	Adams Creek	Ayer Creek	Black Lake Ditch	Percival Creek
Olympia MS4	--	--	9.05	11.1
Tumwater MS4	--	--	3.20	15.2
Thurston MS4	0.08	0.32	0.62	1.31
WSDOT MS4	--	--	0.45	1.06
Sand and Gravel GP	--	--	1.347	--
Industrial SWGP	--	--	0.373	0.026
Construction SWGP	--	0.568	0.376	0.336

7.4 TMDL ANALYSIS

7.4.1 Seasonal Variation and Critical Conditions

Cooler air temperatures and lower solar heat levels occur in the winter when water temperature criteria are unlikely to be exceeded. The critical period for water temperature is when aquatic life is most likely to be stressed during the summer due to hotter air temperatures and higher solar heat loads. The warmest air temperatures are typically observed in July and August in the Deschutes River watershed. EPA used the date of July 24, 2004 for the shade models. This is the same date used by Ecology for approved temperature TMDLs in the *2015 Deschutes TMDLs*, and it ensures the temperature TMDLs incorporate the critical period. This date was also applied to represent the critical period in the shade models developed for the approved temperature TMDLs for Black Lake Ditch and Percival Creek. Meeting shade targets that are protective during the critical period but associated with the system potential is also protective of seasonal variations in thermal loading.

Critical conditions for DO and pH primarily occur during warm periods due to algae activity and lower DO solubility. However, except for localized hotspots (such as from improperly functioning or sited septic systems), nutrient loading tends to be greatest during runoff. Additionally, because stream sediment may act as a sink for nutrients, and nutrients that are incorporated into macrophyte and algal tissue are released as plants and algae breakdown, effects of excess nutrient loading may occur during multiple times of the year. Therefore, critical conditions and seasonal variation in loading is addressed by establishing flow-variable nutrient TMDLs. This method inherently accounts for seasonal variation and critical conditions because the maximum allowable TN and TP loads are evaluated across the full flow spectrum.

7.4.2 Margin of Safety

Conservative assumptions were applied in the development of the temperature, DO, and pH TMDLs that comprehensively serve as implicit MOS. For temperature TMDLs, solar heat loads were evaluated for zero cloud cover under critical summer conditions when solar aspect and incoming radiation are respectively high. Thermal TMDLs were defined at a fine resolution (10-meter intervals) to characterize variability along the stream corridor and to identify the most critical areas for restoration activities.

For the DO and pH TMDLs, a conservative assumption was made to use shade and nutrient targets both based on reference conditions. Conservatism is incorporated into the source assessments for point sources because values erring on the higher side were selected to represent concentrations in runoff, most construction occurs within the MS4 but the Construction Stormwater GP was given its own WLA, and the entire site area was assumed to be impervious for estimates from facilities permitted under the Sand and Gravel and Industrial Stormwater GPs. For nonpoint sources, conservatism is factored into the required reductions as maximum measured values were used to estimate existing loading.

7.4.3 Reserve Capacity

Reserve capacities are not defined for the tributary TMDLs and the TMDLs are fully allocated to WLAs and LAs as discussed in the following sections.

7.4.4 TMDLs

7.4.4.1 Temperature

The TMDL for temperature was identified by using the Shade.xls model to calculate the thermal load that will reach the stream when the shade target is attained. Daily TMDLs are provided in kilowatt-hours per day (kWh/day) for each temperature-impaired tributary, as shown in Table 41. Temperature TMDLs are expressed here as a load to ensure compliance with regulatory requirements (40 CFR 130.2(i)) but the practical measure for meeting the TMDL is attainment of the percentage of effective shade necessary to meet the heat load. The values presented in

Table 41 represent the TMDL for each stream. Appendix F contains tables and figures presenting the shade deficit at 10 meter intervals for each stream, which indicates which areas along each stream require the most improvement in effective shade. Note, because thermal load is a function of factors such as latitude, channel width, vegetation, and topography, the relationship between the increase in effective shade required (shade deficit,

Table 37) and the reduction needed in thermal load (excess heat load, Table 41) is not linear. The temperature TMDLs for tributaries impaired for pH and/or DO are described in the following section.

Table 41. Existing head load, temperature TMDL, and effective shade target for temperature impaired tributaries.

Waterbody	Existing Daily Heat Load (kWh/day)	Temperature TMDL (kWh/day)	Effective Shade Target
Huckleberry Creek	118,403	53,861	97%
Reichel Creek	301,709	55,602	94%
Tempo Lake Outlet	30,326	10,908	93%
Unnamed Spring to Deschutes River	414	413	99%
Ayer Creek	547,275	175,841	79%

7.4.4.2 Dissolved Oxygen and pH

Like the nutrient TMDL for the mainstem Deschutes River, the nutrient TMDLs for the tributaries are expressed as flow-varied daily loads based on the following equation using TN and TP concentration targets (i.e., 0.34 mg-N/L and 0.0195 mg-P/L):

$$TN\ TMDL = \ flow\ (cfs) \times 0.34\ \frac{mg}{L} \times 2.45\ (conversion\ factor)$$

$$TP\ TMDL = \ flow\ (cfs) \times 0.0195\ \frac{mg}{L} \times 2.45\ (conversion\ factor)$$

Using these equations, the TMDL scales with flow, as shown in the Figure 9, which is based on flows from Black Lake Ditch but applies to all of the tributaries. This means that at any given flow, the TMDL is met if the water quality target is met.

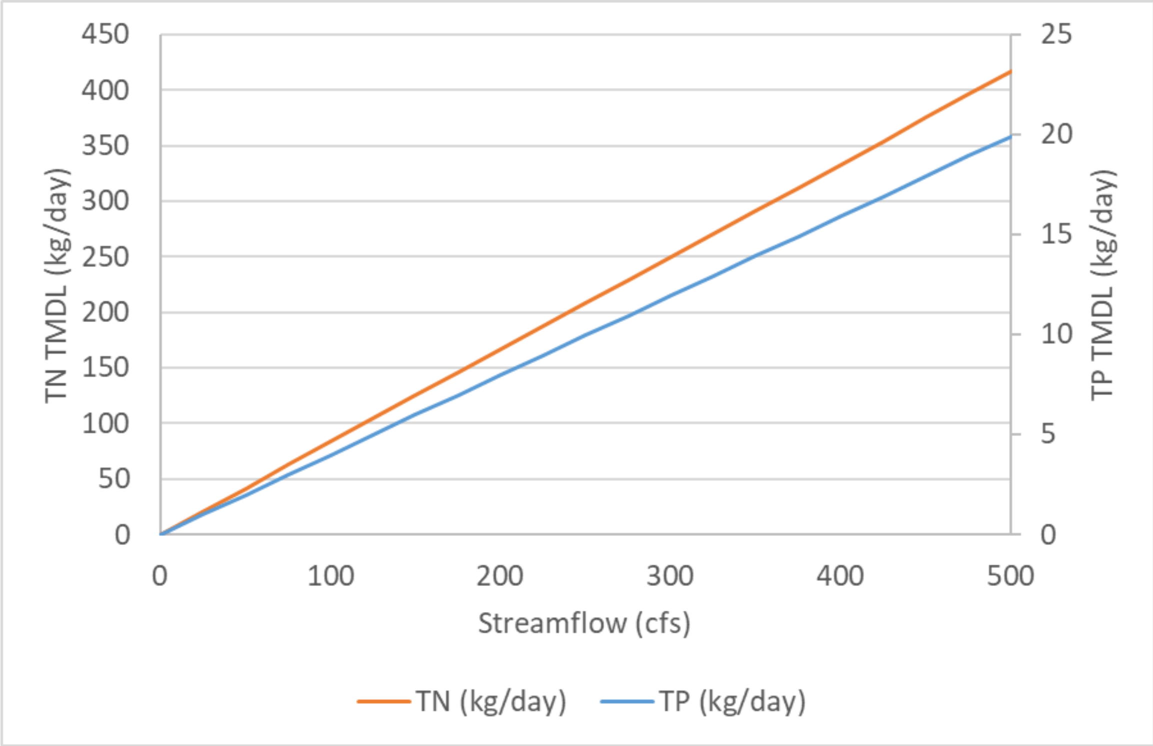

Figure 9. Plot of nutrient TMDLs for DO and pH impaired tributaries at various flows.

Daily TN and TP TMDLs for all pH and/or DO impaired tributaries are provided in Table 42 using average historic flows. Where long-term flow gaging records were not available, flows are based on daily flows observed at the Deschutes River at Tumwater USGS gage scaled based on relative drainage area. The flow value used for each tributary is provided in Appendix F. Daily temperature TMDLs based on meeting the effective shade target are also shown in Table 42 because the nutrient and thermal TMDLs must collectively be met to ensure attainment of the DO and pH water quality standards.

Table 42. Nutrient and thermal TMDLs for DO and pH impaired tributaries.

Waterbody	TN TMDL (kg/day)	TP TMDL (kg/day)	Temperature TMDL (kWh/day)	Effective Shade Target
East Adams Creek	1.8	0.10	24,848	98%
Ayer Creek	2.8	0.16	175,841	79%
Black Lake Ditch[1]	51	2.9	--	84%
Lake Lawrence Creek	6.1	0.35	43,354	94%
Percival Creek[1]	62	3.6	--	98%
Reichel Creek	16	0.89	55,602	94%

[1]Thermal capacity is contained Appndix E of the *2015 Deschutes TMDLs* and not summarized here because it is expressed in different units.

7.4.5 Load Allocations and Wasteload Allocations

All tributary TMDLs for temperature, DO, and pH have an implicit MOS and no reserve capacity, so the TMDL equals the sum of the LAs to nonpoint sources and WLAs to point sources. Therefore, if there are no point sources, the LAs equal the TMDL. For TMDLs with WLAs, the LA(s) is calculated by subtracting the WLA(s) from the TMDL. Additional explanation of allocations is provided below regarding each type of TMDL.

7.4.5.1 Temperature

For the temperature TMDLs in Table 41, all tributaries except Ayer Creek have no point sources. Therefore, the entire TMDL is allocated to nonpoint sources of riparian shade loss for all tributaries except Ayer Creek, which involves one WLA for Thurston County MS4. Thurston County MS4 land comprises about 23 percent of the Ayer Creek watershed, but its WLA is based on the effective shade target and associated thermal load for the portion of Ayer Creek that flows through the MS4. EPA assumes the reductions in thermal loading contributed by the MS4 will be met by improving riparian shade, which has been recognized in the MS4 GP's fact sheet as providing stormwater benefits by improving temperatures (Ecology, 2018). The WLA is expressed as both a thermal load and effective shade target to provide flexibility to Ecology as the permitting authority in how the WLA is incorporated into the permit conditions. The LA and WLA for the Ayer Creek temperature TMDL is provided in Table 43.

Table 43. Temperature load allocation and wasteload allocation for Ayer Creek.

Allocation Type	Temperature Load Allocation (kWh/day)	Effective Shade Target
LA	164,485	79%
WLA: Thurston Co MS4	11,356	90%
TMDL	175,841	79%

7.4.5.2 Dissolved Oxygen and pH

Since Lake Lawrence Creek and Reichel Creek have no point sources in their watersheds, the load allocations equal the TMDL provided in Table 42. The LAs and WLAs for temperature and nutrients in the remaining tributaries are presented and the approach used to develop them are described within this section.

As mentioned in the source assessment (Section 7.3.2.1), Adams Creek, which is pH-impaired, is the only other tributary with a temperature TMDL that contains a point source in its watershed that may be a source of thermal loading. The WLA for Thurston County MS4 for the Adams Creek TMDL was developed using the same approach as that for Ayer Creek (described above), which focuses on the restoration of riparian shade. There are MS4s within the Black Lake Ditch and Percival Creek watersheds, and they were assigned temperature WLAs in the *2015 Deschutes TMDLs* that were expressed based on the 0.3°C change allowed by human actions as part of Washington's water quality standards (Section 3.2.5). Attainment of the DO standard in Percival Creek and Black Lake Ditch, and the pH standard for Black Lake Ditch, relies on the LAs and WLAs within those temperature TMDLs, incorporated into EPA's TMDL here by reference.

For each nutrient TMDL, a single LA is established for all nonpoint sources, including natural background. Both the LAs and WLAs are based on the product of the flow and nutrient target, which is the same equation used to calculate the TMDL (see equations in Section 7.4.4.2). Because of this approach, the WLAs and LAs scale like the TMDLs shown in Figure 9 and increase during periods of greater streamflow/stormwater runoff. Permitted point sources that require a WLA in the tributary TMDLs for DO and pH include MS4s and facilities covered under the GPs for Industrial Stormwater, Sand and Gravel, and Construction Stormwater (

Table 36).

As all point sources are associated with stormwater, nutrient WLAs are zero during dry periods when there is either no precipitation or insufficient precipitation to produce runoff because the NPDES permits only authorize stormwater discharges (with limited exceptions). In these conditions, the LA is equivalent to the TMDL. This is conceptually shown in

Table 44 and Table 45 for average flows in each tributary where point sources are expected to discharge zero TN and TP during non-storm conditions. LAs and WLAs for nutrient and temperature TMDLs are also provided in

Table 44 and Table 45 for the 95th percentile flow for each tributary, to show what the WLAs would look like during stream flows most likely associated with storm conditions generating runoff. Regardless of in-stream flow, the WLAs apply during any conditions generating stormwater discharges. The flow values used to calculate the nutrient WLAs in

Table 44 and Table 45 are based on the runoff estimates from the source assessment, which is detailed in Appendix G. EPA assumes the MS4 WLAs will guide prioritization and best management practice (BMP) implementation and evaluation, and that there is flexibility as to how Ecology incorporates them into permits.

EPA reviewed the current facilities permitted under the SGGP and ISGP, as well as the existing permit requirements. In particular, EPA focused on the sector-specific numeric benchmarks and effluent limits for facilities with a greater potential to cause or contribute to DO and pH impairment. Based on this review, EPA determined the existing permit conditions for the SGGP and ISGP are sufficient to meet the WLAs. The CSWGP focuses on BMPs that minimize erosion and site runoff, and it requires permittees to prevent the exposure of stormwater to pollutants causing impairment; EPA assumes that collectively these requirements will meet the WLAs.

Table 44. LAs and WLAs for Black Lake Ditch and Percival Creek. Nutrient units are in kg/day.

Allocation Type	Black Lake Ditch					Percival Creek				
	Temperature	Non-Storm TN[1]	Non-Storm TP[1]	Storm TN[2]	Storm TP[2]	Temperature	Non-Storm TN[1]	Non-Storm TP[1]	Storm TN[2]	Storm TP[2]
City of Olympia (MS4) WLA	See 2015 *Deschutes TMDLs*	0	0	2.79	0.160	See 2015 *Deschutes TMDLs*	0	0	3.41	0.196
City of Tumwater (MS4) WLA		0	0	0.99	0.057		0	0	4.70	0.269
Thurston County (MS4) WLA		0	0	0.20	0.012		0	0	0.42	0.024
WSDOT (MS4) WLA		0	0	0.14	0.008		0	0	0.33	0.019
Industrial Stormwater WLA		0	0	0.12	0.007		0	0	0.12	0.007
Sand and Gravel GP WLA		0	0	0.418	0.024		0	0	0.418	0.024
Construction SWGP WLA		0	0	0.12	0.007		0	0	0.22	0.013
LA		51.0	2.9	163.22	9.325		62.0	3.6	193.38	11.448
TMDL		51.0	2.9	168	9.6		62.0	3.6	203	12

[1]Average flow = 61 cfs for Black Lake Ditch, 75 cfs for Percival Creek.
[2]95th% flow = 202 cfs for Black Lake Ditch, 244 cfs for Percival Cr.

Table 45. LAs and WLAs for Adams Creek and Ayer Creek. Nutrient units are in kg/day and thermal units for the temperature TMDLs are in kWh/day.

Allocation Type	East Adams Creek					Ayer Creek				
	Temperature	Non-Storm TN[1]	Non-Storm TP[1]	Storm TN[2]	Storm TP[2]	Temperature	Non-Storm TN[1]	Non-Storm TP[1]	Storm TN[2]	Storm TP[2]
Thurston County (MS4) WLA	6,211	0	0	0.02	0.001	11,356	0	0	0.10	0.006
Construction SWGP WLA	-	-	-	-	-	-	0	0	0.17	0.010
LA	18,637	1.8	0.1	5.38	0.309	164,485	2.8	0.16	8.13	0.464
TMDL	24,848	1.8	0.1	5.40	0.310	175,841	2.8	0.16	8.40	0.480

[1]Average flow = 2.1 cfs for Adams Creek, 3.3 cfs for Ayer Creek.
[2]95th% flow = 6.4 cfs for Adams Creek, 10 cfs for Ayer Creek.

8 REASONABLE ASSURANCE

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

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

By contrast, these TMDLs are being established by EPA, which lacks authority to implement nonpoint source controls or otherwise assure reductions in nonpoint source pollution. Nonpoint sources typically implement their load allocations through a wide variety of programs (which may be regulatory, non-regulatory, or incentive-based, depending on the state or tribal program) and voluntary actions. An Implementation Plan was a component of the *2015 Deschutes TMDLs* document, and it was developed jointly between Ecology and interested stakeholders. Ecology's Implementation Plan identifies the conservation of existing riparian buffers and establishment of additional forested buffers as the most critical action needed because of the significant progress it will help make on problems related to "temperature, fecal coliform bacteria, DO, pH, and fine sediment," the same pollutants addressed by the TMDLs established in this document.

Furthermore, as the TMDLs in this document address the same impaired water bodies as the *2015 Deschutes TMDLs*, and rely on riparian vegetation being at its fullest potential, this priority is equally applicable to the TMDLs in this document. The Implementation Plan also discusses the roles and responsibilities of stakeholders ranging from various agencies, the Squaxin Island Tribe, businesses, and residents. These stakeholders are important participants in helping to implement the TMDL and improve water quality. Expected actions to reduce loadings for point sources and nonpoint sources (organized by land use category) are also included in Ecology's Implementation Plan. As part of the expectations for implementation, Ecology identified priority areas for nonpoint source categories and included a schedule for actions. Entities and organizations with specific action items in Ecology's Implementation Plan include the cities, state agencies, Squaxin Island Tribe, Thurston Conservation District, NPDES permittees, LOTT Clean Water Alliance, and Puget Sound Partnership. Additionally, Ecology's Implementation Plan includes performance measures and a timeline for achievement for all of the pollutant causes of impairment addressed in these TMDLs. While the *2015 Deschutes TMDLs* did not include nutrient TMDLs, Ecology's Implementation Plan does include actions to address excess nutrients such as converting on-site septic systems in high priority/density areas to a sewer system, cultivating cropland so it minimizes soil and nutrient loss, and setting off-stream water facilities for livestock at least 100 feet from surface waters. Ecology has indicated that their 2015 Implementation Plan will be used as a starting point for implementing the TMDLs established in this document. Ecology plans to re-engage the Deschutes stakeholder group who assisted with the development of the 2015 Implementation Plan in conjunction with the implementation of the Budd Inlet TMDL (under development) (L. Weiss, personal communication, 7/16/2020).

EPA has reviewed Ecology's approach for addressing reasonable assurance in the Implementation Plan within the *2015 Deschutes TMDLs* and finds that the action items identified correspond well with the TMDLs established in this document, and the level of stakeholder engagement indicates there is a high level of commitment in implementing the action items. The *2015 Deschutes TMDLs* state, "Ecology will consider affected stakeholders in compliance if all appropriate BMPs have been implemented and are being operated and maintained correctly by 2030." The plan details how Ecology will conduct effectiveness monitoring and evaluate progress towards milestones at 5 year intervals, and that adaptive management will be applied to adjust the actions required and try new strategies if necessary. While the allocations in this document differ from those in the *2015 Deschutes TMDLs*, the sources of loading and type of actions necessary to achieve these TMDLs is the same. Ecology outlined a schedule to evaluate TMDL implementation and has communicated to EPA its commitment to adjusting it as necessary if significant improvement in water quality is not shown.

Based on foregoing discussion, EPA concludes there is reasonable assurance that implementation of the LAs and WLAs will occur and water quality standards will be achieved. Therefore, EPA relies on Ecology's Implementation Plan to provide reasonable assurance for these TMDLs. Implementation of these TMDLs is ultimately the responsibility of the State.

9 TRIBAL CONSULTATION AND PUBLIC PARTICIPATION

Government-wide and EPA-specific policies call for regular and meaningful consultation with Indian tribal governments when developing policies and regulatory decisions on matters affecting their communities and resources. EPA has offered an opportunity for tribal consultation to the Squaxin Island Tribe and will conduct consultation and coordination as requested.

Consistent with 40 CFR 130.7(d)(2), EPA will promptly issue a public notice seeking comment on these TMDLs after they are established. EPA will revise the TMDLs, if necessary, after the public comment period has ended.

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