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Snake River Temperature Total Maximum Daily Load

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Executive summary

The Snake River Temperature Total Maximum Daily Load establishes the thermal pollutant loading limits needed to attain applicable temperature water quality standards throughout the entirety of the Snake River, Brownlee Reservoir, Oxbow Reservoir, and Hells Canyon Reservoir. The area is located within Oregon from approximately river mile 176 at the tri-state border of Oregon, Washington, and Idaho upstream to approximately river mile 409 at the Oregon and Idaho border.

This TMDL replaces the temperature-related requirements of the 2003/2004 Snake River Hells - Canyon TMDL while leaving the TMDLs addressing other pollutants unchanged. DEQ is replacing the 2003/2004 TMDL following the outcome from two court cases and related EPA actions. In response to a court decision, EPA disapproved Oregon's Natural Conditions Criterion for temperature in 2013, which had been used in most temperature TMDLs from 2003 through 2012. A 2019 court ruling then required DEQ and EPA to replace 15 temperature TMDLs using the remaining approved parts of Oregon's temperature water quality standard.

The TMDL addresses 12 Snake River and reservoir assessment units that are listed as impaired for temperature in Oregon’s 2024 Integrated Report 303(d) list. Assessment units are partitioned segments of rivers, lakes, or other waters bodies. Water quality data collected on the same assessment unit are used for assessing if the waters of that unit attain water quality standards. The Integrated Report and 303(d) list report and track assessment conclusions for each assessment unit. Similarly, there is one TMDL loading capacity and set of pollutant allocation limits developed for each pollutant on each assessment unit.

Elevated temperatures are a concern because they adversely affect salmon, steelhead, redband trout, and other native aquatic species. Temperature is the water quality parameter of concern. Excess heat and specifically excess thermal loading, is the pollutant addressed by this TMDL. Federal regulations require TMDLs to be set at levels that will attain all applicable temperature water quality standards, including standards in downstream and cross stream waters in the States of Idaho and Washington. As was the case in the 2003/2004 TMDL, Oregon’s temperature criteria are the most stringent. The TMDL analysis shows that attainment of Oregon’s temperature criteria is expected to result in attainment of Idaho and Washington’s criteria as well. Therefore, Oregon’s criteria were used as the basis for the TMDL pollutant limits.

Development of the TMDL relied upon numerous temperature, hydrologic, and meteorologic monitoring data and water temperature models to characterize temperature conditions and complete a thermal pollutant source assessment. These analyses evaluated the relative thermal contributions of point source discharges, tributary inflows, dam and reservoir operations, riparian vegetation conditions, and background sources to temperature exceedances throughout the TMDL project area. Data analysis and the model framework provided the means to evaluate potential sources of stream warming and, to the extent existing data allow, the amount of pollutant loading from these sources. The results from this analysis are then used to determine

the maximum amount of thermal load the Snake River can receive from each source category and still attain temperature criteria.

The analysis shows that elevated temperatures result primarily from nonpoint sources, with thermal loading from background and human related sources flowing into the Snake River from upstream and the Hells Canyon Complex dam and reservoir operations being the primary sources. The Hells Canyon Complex influence water temperature by altering the natural seasonal thermal profile, producing cooler water in the spring and early summer and warmer water in the late summer and fall. Removal of riparian vegetation along the Snake River has a small contribution. Point source discharges are also a source, but their contributions are very small relative to nonpoint sources. Consequently, achieving water quality temperature standards will primarily rely upon nonpoint source thermal load reductions in upstream waters along with management of the thermal effects from the Hells Canyon Complex dam and reservoirs

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Acronyms

7DADM	7-Day Average Daily Maximum
7Q10	7-Day, 10-Year Low Flow
ADWDF	Average Dry Weather Design Flow
AU	Assessment Unit
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
DEQ	Oregon Department of Environmental Quality
DMA	Designated Management Agency
DMR	Discharge Monitoring Report
EPA	United States Environmental Protection Agency
EQC	Oregon Environmental Quality Commission
EWEB	Eugene Water and Electric Board
GNIS	USGS Geographic Names Information System
HUA	Human Use Allowance
HUC	Hydrologic Unit Code
IDAPA	Idaho Administrative Procedures Act administrative rules
IMD	Internal Management Directive
LA	Load Allocation
LC	Loading Capacity
MGD	Millions of Gallons per Day
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
OAR	Oregon Administrative Rules
ODC	Oregon Department of Corrections
ODFW	Oregon Department of Fish & Wildlife
ORS	Oregon Revised Statutes
POMI	Point of Maximum Impact
SIC	Standard Industrial Classification
STP	Sewage Treatment Plant
TMDL	Total Maximum Daily Load
TSD	Technical Support Document

USGS	United States Geological Survey
WLA	Wasteload Allocation
WQMP	Water Quality Management Plan
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

1 Introduction

This Total Maximum Daily Load (TMDL) project addresses temperature impairments on the Snake River, Brownlee Reservoir, Oxbow Reservoir, and Hells Canyon Reservoir within Oregon.

OAR 340-42-0040(3) requires the Oregon Department of Environmental Quality (DEQ) or the Oregon Environmental Quality Commission (EQC) to prioritize and schedule TMDLs for completion considering various factors outlined in the rule. The Snake River Temperature TMDL was identified as a medium priority on Oregon's TMDL priority ranking included with the 2024 Integrated Report. DEQ developed this TMDL as a response to a court order requiring Oregon and the Environmental Protection Agency (EPA) to replace 15 Oregon temperature TMDLs that were based on the natural conditions criteria, a component of Oregon's water quality standards that was subject to litigation and eventually disapproved by EPA. The 2003/2004 Snake River – Hells Canyon TMDLs (Table 1-1) is one of the 15 temperatures TMDLs required to be replaced.

1.1 Previous TMDLs

In 2003 and again in 2004 Oregon DEQ and Idaho DEQ issued joint TMDL actions addressing a number of Snake River impairments, including temperature (Table 1-1). EPA approved these TMDL actions in March of 2003 and September 2004 respectively. Once approved by EPA, the updated Snake River Temperature TMDL will replace Oregon's temperature TMDLs listed in Table 1-1. TMDLs for other water quality impaired parameters are still effective.

Table 1-1: Summary of previous TMDLs developed for the Snake River and Hells Canyon Complex.

TMDL Action ID	TMDL Name	EPA Approval Date	Water Quality Impairments Addressed
10007	Snake River - Hells Canyon TMDL	3/1/2003	DDD 4,4', DDE 4,4', DDT 4,4', Dieldrin, Temperature, Total Dissolved Gas
10791	Snake River - Hells Canyon TMDL Revised	9/9/2004	Chlorophyll-a, Dissolved Oxygen, Algae, Sedimentation

2 TMDL name and location

Per OAR 340-042-0040(4)(a), this element describes the geographic area for which the TMDL was developed.

The Snake River Temperature TMDL apples to the entirety of the Snake River, Brownlee Reservoir, Oxbow Reservoir, and Hells Canyon Reservoir within Oregon (Figure 2-1) from

approximately river mile 176 at the tri-state border of Oregon, Washington, and Idaho upstream to approximately river mile 409 at the Oregon and Idaho border. This extent sums to a total of 12 assessment units (AUs), all of which are Category 5 listed as impaired for temperature on Oregon's 2024 Section 303(d) list (Table 2-2).

Table 2-1: Assessment units included within the scope of the Snake River Temperature TMDL.

Assessment Unit Name	Assessment Unit Description	River Mile	Assessment Unit ID
Snake River	Idaho to Boise River	409 - 392	OR_SR_1705010311_02_102702
Snake River	Boise River to Malheur River	392 - 368	OR_SR_1705011501_02_103231
Snake River	Malheur River to Weiser River	368 - 352	OR_SR_1705011502_02_103230
Snake River	Weiser River to Hog Creek/Brownlee Reservoir	352 - 342	OR_SR_1705020101_02_103229
Brownlee Reservoir	Brownlee Reservoir (Snake River)	342 - 284	OR_LK_1705020103_05_100578
Brownlee Reservoir	Brownlee Reservoir Powder River Arm	9 - 0	OR_LK_1705020311_05_100605
Oxbow Reservoir	Oxbow Reservoir	284 - 272	OR_LK_1705020107_05_100583
Hells Canyon Reservoir	Hells Canyon Reservoir	272 - 247	OR_LK_1705020107_05_100582
Snake River	Hells Canyon Reservoir to Sheep Creek	247 - 229	OR_SR_1706010101_02_103274
Snake River	Sheep Creek to Getta Creek	229 - 206	OR_SR_1706010102_02_103280
Snake River	Getta Creek to Salmon River	206 - 188	OR_SR_1706010103_02_103282
Snake River	Salmon River to Stateline	188 - 176	OR_SR_1706010301_02_103306

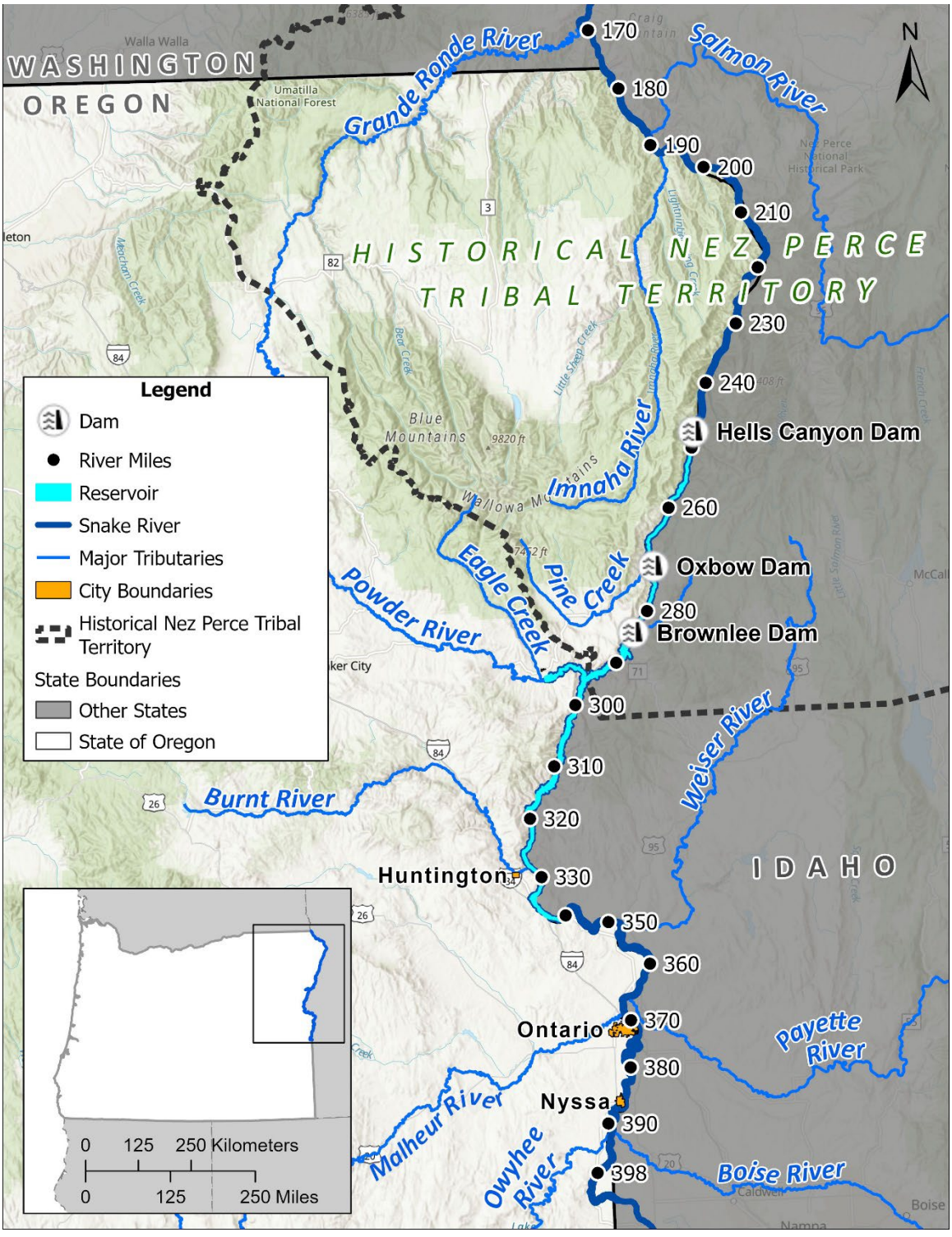


Figure 2-1: Snake River Temperature TMDL project area overview.

2.1 Impaired waters on 303(d) list

Table 2-2 presents AUs that were listed as impaired for temperature on DEQ's 2024 Clean Water Act Section 303(d) List (as part of Oregon's Integrated Report), which was approved by

the EPA on May 11, 2026. AUs listed in Category 5 (i.e., designated use is not supported, or a water quality standard is not attained) require development of a TMDL. Locations of these listed segments are depicted in Figure 2-2.

Some of the assessment units downstream of Hells Canyon Dam have both year-round and spawning use designations impaired. If both use designations are impaired, it is counted as two Category 5 303(d) listings. Therefore, the TMDL addresses a total of 15 category 5 temperature listings identified in the 2024 Integrated Report 303(d) list.

Table 2-2: Snake River and Hells Canyon Complex category 5 temperature impairments on the 2024 Integrated Report.

AU ID	AU Name	AU Description	Use Period
OR_SR_1705010311_02_102702	Snake River	Idaho to Boise River	Year round
OR_SR_1705011501_02_103231	Snake River	Boise River to Malheur River	Year round
OR_SR_1705011502_02_103230	Snake River	Malheur River to Mann Creek	Year round
OR_SR_1705020101_02_103229	Snake River	Mann Creek to Hog Creek	Year round
OR_LK_1705020103_05_100578	Brownlee Reservoir	Lake/Reservoir Unit	Year round
OR_LK_1705020311_05_100605	Brownlee Reservoir	Lake/Reservoir Unit - Powder River Arm	Year round
OR_LK_1705020107_05_100583	Oxbow Reservoir	Lake/Reservoir Unit	Year round
OR_LK_1705020107_05_100582	Hells Canyon Reservoir	Lake/Reservoir Unit	Year round
OR_SR_1706010101_02_103274	Snake River	Hells Canyon Reservoir to Sheep Creek	Spawning
OR_SR_1706010101_02_103274	Snake River	Hells Canyon Reservoir to Sheep Creek	Year round
OR_SR_1706010102_02_103280	Snake River	Sheep Creek to Getta Creek	Spawning
OR_SR_1706010102_02_103280	Snake River	Sheep Creek to Getta Creek	Year round
OR_SR_1706010103_02_103282	Snake River	Getta Creek to Salmon River	Spawning
OR_SR_1706010103_02_103282	Snake River	Getta Creek to Salmon River	Year round
OR_SR_1706010301_02_103306	Snake River	Salmon River to Stateline	Year round

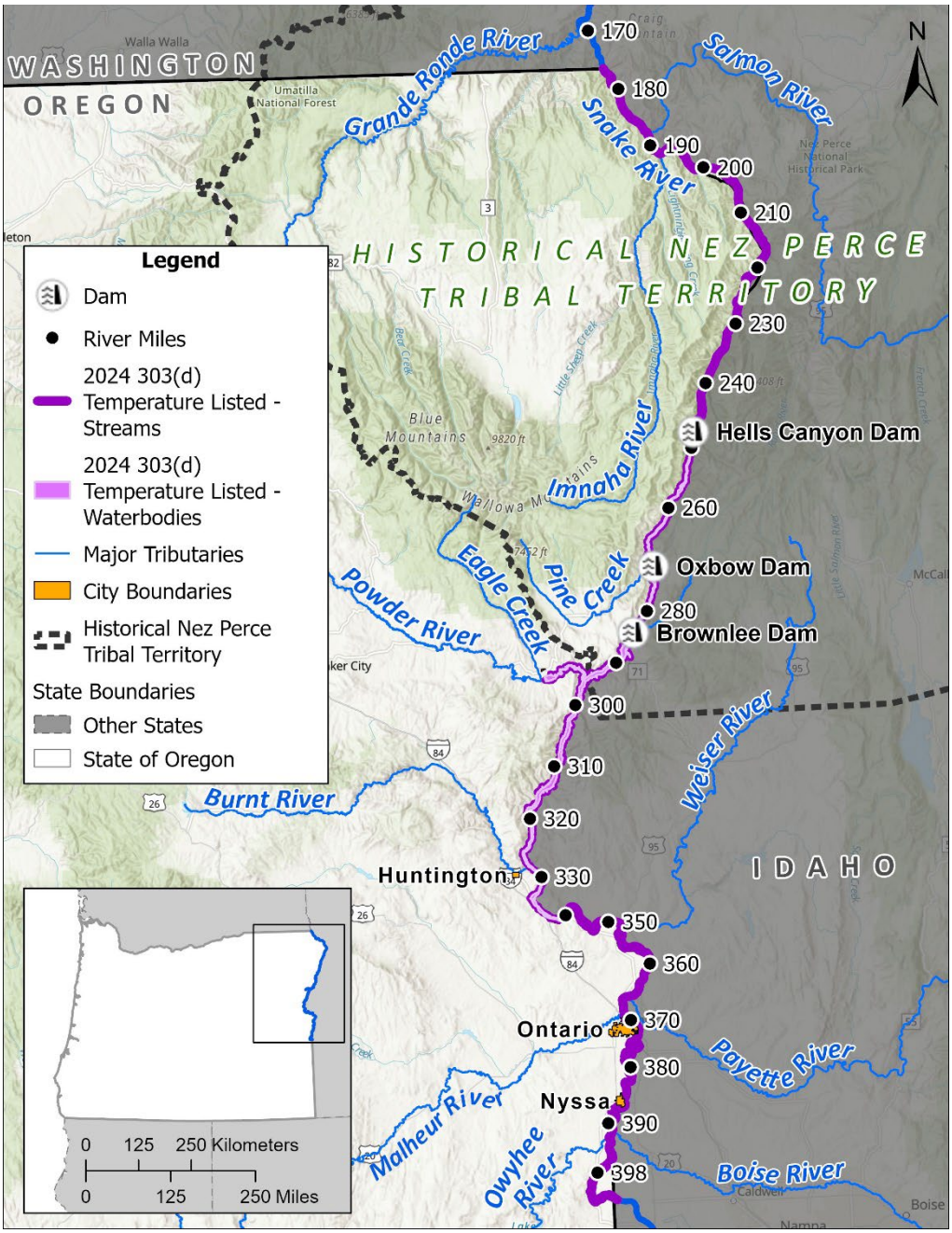


Figure 2-2: Snake River and Hells Canyon Complex Category 5 temperature impairments on the 2024 Integrated Report.

2.2 Impaired waters not on 303(d) list

Snake River assessment unit OR_SR_1706010301_02_103306 (Salmon River to Stateline) has an unassessed temperature status during the spawning use period on the 2024 Integrated Report. Temperature data assessed during the TMDL process at USGS 13317660 located in Idaho just downstream of the Stateline recorded temperatures that exceed the spawning criterion (Table 8-2). While this monitoring location is physically located in Idaho and was not

included in Oregon's Integrated Report assessment, it is an accurate characterization of temperatures flowing into Idaho and Washington from Oregon. Similarly, the model calibration 7DADM temperatures located within the AU in Oregon, show exceedances to the spawning criteria at a frequency that would likely result in a 303(d) listing. Therefore, this TMDL sets allocations at a level that will address any future 303(d) listing for the spawning use period on OR_SR_1706010301_02_103306. As noted in TSD section 7.2.2, the Salmon River provides cold inflowing water to the Snake River that is frequently at or below the 13°C spawning use criterion. The TMDL model predicts the spawning criterion in the Snake River below the confluence of the Salmon River will be attained once TMDL allocations assigned to upstream anthropogenic point and nonpoint sources are achieved.

3 Pollutant identification

OAR 340-042-0040(4)(b) requires identification of the pollutants causing impairment of water quality that are addressed by these TMDLs. The associated water quality standards and beneficial uses are identified in Section 4.

Temperature is the water quality parameter of concern, but heat or thermal loading is the pollutant of concern causing impairment. Heat caused by human activities are of particular concern.

EPA regulations (40 CFR 130.2(i)) and OAR 340-042-0040(O)(5)(b) allow for TMDLs to utilize other appropriate measures (or surrogate measures). Surrogate measures are defined in OAR 340-042-0030(14) as "substitute methods or parameters used in a TMDL to represent pollutants." In accordance with OAR 340-042-0040(5)(b), DEQ used a temperature target for thermal loading caused by dam and reservoir operations. Monitoring stream temperature, rather than a thermal load, is easier and a more meaningful approach for reservoir management. Temperature is mathematically related to excess thermal loading and used directly to evaluate attainment of temperature water quality standards. For these reasons, DEQ is using a surrogate measure to implement the load allocation for dam and reservoir operations.

4 Temperature water quality standards and beneficial uses

OAR 340-042-0040(4)(c), requires TMDLs identify the beneficial uses in the basin, specifying the most sensitive beneficial use, and the relevant water quality standards established in OAR 340-041-0202 through 340-041-0975.

Table 4-1 specifies the beneficial uses designated in the Snake River. Fish and aquatic life use is the most temperature sensitive beneficial use. Oregon's water quality standards for temperature are designed to protect fish and aquatic life uses.

Table 4-1: Designated beneficial uses in the Snake River as identified in OAR 340-041-021 Table 121A. An "X" indicates the use is applicable.

Beneficial Uses	Snake River RM 176 to 409	Most Sensitive to Temperature
Public Domestic Water Supply	X	
Private Domestic Water Supply	X	
Industrial Water Supply	X	
Irrigation	X	
Livestock Watering	X	
Fish & Aquatic Life	X	X
Wildlife & Hunting	X	
Fishing	X	
Boating	X	
Water Contact Recreation	X	
Aesthetic Quality	X	
Hydro Power	X	
Commercial Navigation & Transportation	X	

The Snake River and Hells Canyon Complex of reservoirs serve as the shared border between Oregon and Idaho from river miles 176 to 409.The Snake River flows into the states of Washington and Idaho downstream of Oregon at river mile 176. Table 4-5, Figure 4-1, Figure 4-2, and the sections that follow summarize each state's applicable temperature criteria on the Snake River and reservoirs along the shared border with Oregon. The most stringent temperature criteria, which formed the basis for the TMDL allocations, are Oregon's criteria. When Oregon's criteria are attained, it is expected to result in attainment of Idaho and Washington's criteria. See Section 4.1 of the TSD for the evaluation of each state's criteria and the determination of the most stringent criterion. The final instream numeric temperature targets are summarized in Section 4.4.

Table 4-2: Summary of Oregon, Idaho, and Washington numeric temperature criteria on the Snake River and Hells Canyon Complex reservoirs.

Location	Oregon Criteria	Idaho Criteria	Washington Criteria
Snake River Oregon-Idaho Stateline to Hells Canyon Dam,	Redband or Lahontan Cutthroat Trout Use 20.0°C 7DADM	Cold water aquatic life 22.0°C Daily Maximum 19.0°C Daily Average	NA
Brownlee Reservoir (Powder River Arm)	Redband or Lahontan Cutthroat Trout Use 20.0°C 7DADM	NA	NA
Snake River Hells Canyon Dam to Salmon River	Salmon and steelhead migration corridor Apr 16 – Oct 22 20.0°C 7DADM Salmon and steelhead spawning Oct 23 – Apr 15 13.0°C 7DADM	Cold water aquatic life 22.0°C Daily Maximum 19.0°C Daily Average Salmonid spawning Oct 23 – Nov 6 14.5°C 7DADM Nov 7 – Apr 15 13.0°C 7DADM	NA
Snake River Salmon River to the Tri-State border	Salmon and steelhead migration corridor Apr 16 – Oct 22 20.0°C 7DADM Coldwater refugia narrative Natural seasonal thermal pattern narrative Salmon and steelhead spawning Oct 23 – Apr 15 13.0°C 7DADM	Cold water aquatic life 22.0°C Daily Maximum 19.0°C Daily Average	NA
Snake River Tri-State border to Clearwater River	NA	Cold water aquatic life 22.0°C Daily Maximum 19.0°C Daily Average	20.0°C Daily Maximum

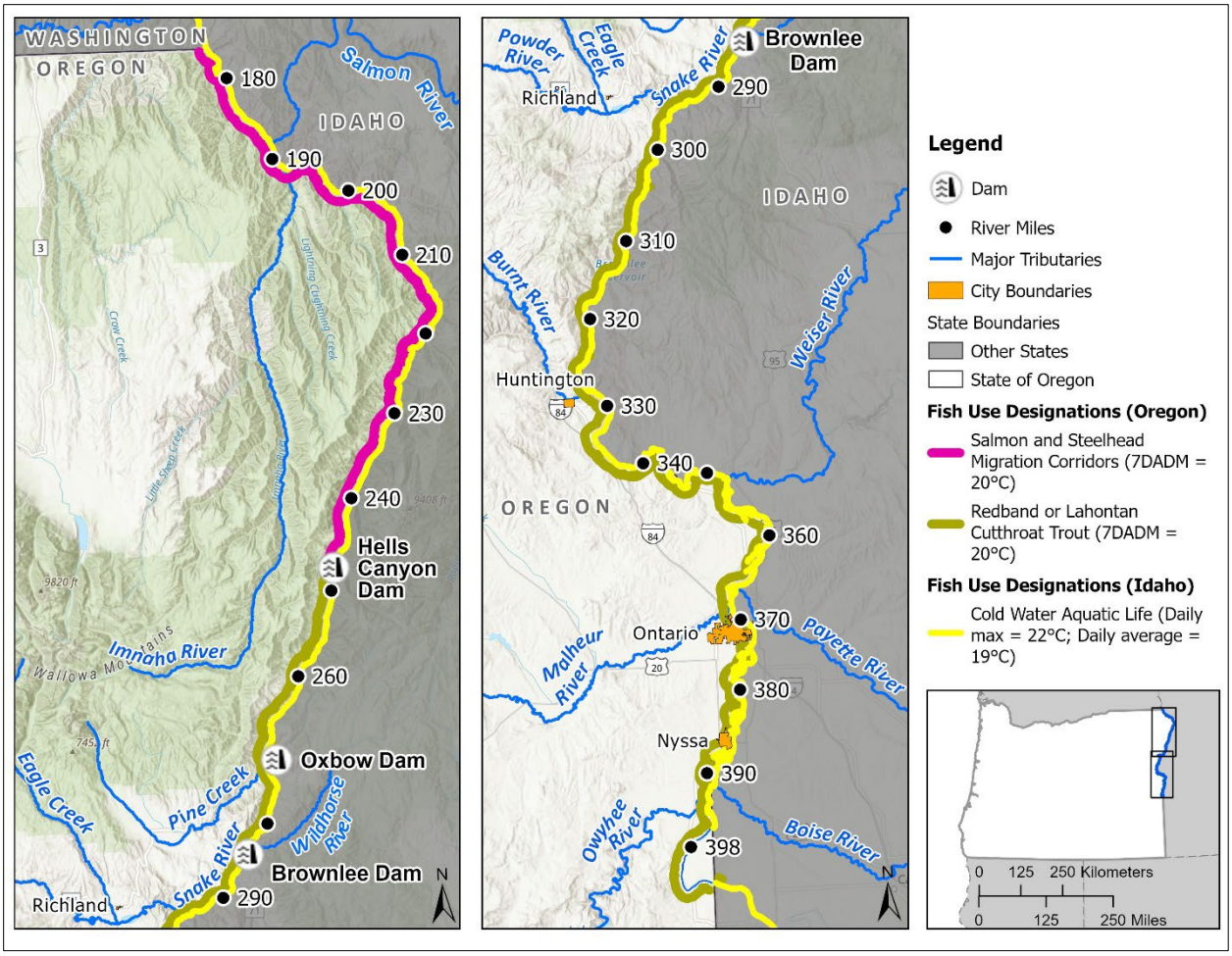


Figure 4-1: Oregon and Idaho aquatic life fish use designations in the Snake River.

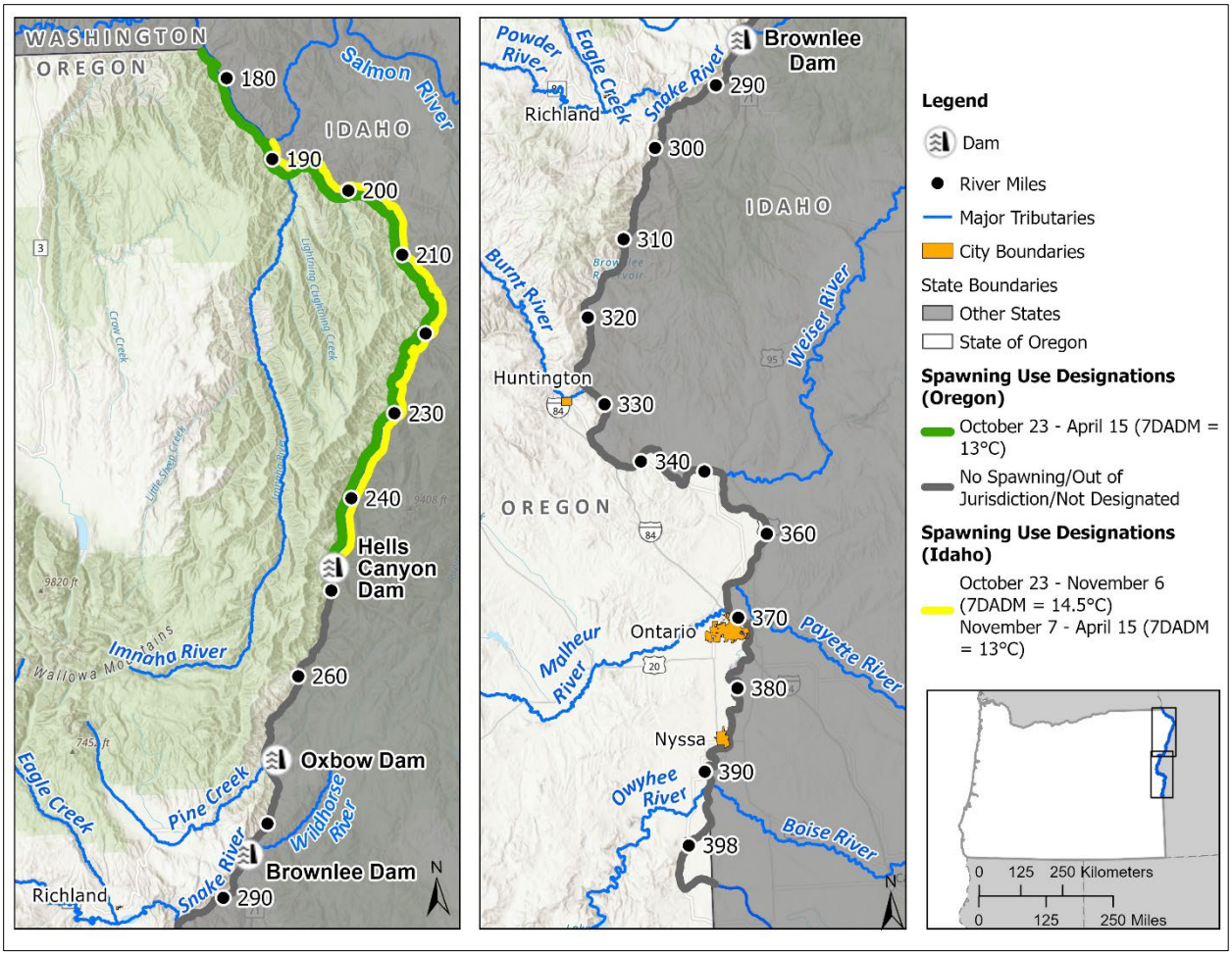


Figure 4-2: Oregon and Idaho salmon and steelhead spawning related use designations in the Snake River.

4.1 Oregon temperature criteria

4.1.1 Salmon and steelhead migration corridor use

The Snake River from the tri-state border to Hells Canyon Dam (approximately river mile 176 to 247.5) is designated for salmon and steelhead migration corridor use and cool water refugia.OAR 340-041-0028(4)(d). Waters that have been designated as having a migration corridor use are identified in OAR 340-041-0121 Table 121B and shown in Figure 4-1. These waters may not exceed 20.0°C (68.0°F) expressed as a 7DADM. Waters designated for salmon and steelhead migration corridor use also have two narrative temperature criteria provisions that apply. The provisions include protection of cold water refugia (Section 4.1.1.1) and the natural seasonal thermal pattern (Section 4.1.1.2).

4.1.1.1 Cold water refugia narrative

Waters designated as a salmon and steelhead migration corridor (see section 4.1.1) must have cold water refugia that are sufficiently distributed so as to allow salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the water body. The narrative provision supplements the numeric criterion of 20°C to protect migrating populations of salmon and steelhead.

Cold water refugia is defined in OAR 340-041-0002(10) to mean those portions of a water body where or times during the diel temperature cycle when the water temperature is at least 2°C colder than the daily maximum temperature of the adjacent well-mixed flow of the water body.

The narrative criteria directs that sufficient cold-water refugia be available within the warmer waters of migration corridors. As the temperature of the corridor approach 20°C, the role of cold water refugia is to enable fish to avoid stressful temperatures elsewhere in the waterbody by moving into this cooler water. These refugia enable migrating salmon and steelhead to conserve their energy during these warm periods so they can migrate to upstream and downstream destinations beyond the Snake River without impairment.

The cold water refugia narrative is applicable to the Snake River from approximately river mile 176 at the tri-state border of Oregon, Washington, and Idaho upstream to approximately river mile 247.5 at Hells Canyon Dam.

The critical period for migration is June 15 through October 22, when Snake River temperatures typically exceed 18°C and salmon and steelhead are actively migrating and may seek cold water refugia.

There are several types of cold water refuges. The different types are discussed in the TMDL Technical Support Document section 4.2. DEQ evaluated the potential for tributaries of the Snake River to serve as cool water refugia as well as diurnal cool water refugia, which is when cooler waters are available at night in the mainstem Snake River due to the daily diel temperature patterns. Table 4-3 identifies the cold water refugia narrative translation and assessment framework for the Snake River.

Table 4-3: Cold water refugia narrative criteria translation and assessment framework.

Element	Description
A. Critical period	June 15 through October 22 is the critical temperature period when mainstem temperatures exceed 18°C and salmon and steelhead are actively migrating and may seek cold water refugia.
B. Temperature difference	1. Tributary/groudwater plumes. Difference in daily maximums (mainstem – tributary) >= 2°C when the mainstem exceeds 18°C based on continuous temperature data; difference in NorWeST v2 7DADM (mainstem – tributary) >= 2°C; or documented fish use with supporting temperature measurements or 2. Mainstem diurnal cold water refugia. Mainstem daily diel range (mainstem daily max – mainstem daily minimum) >= 2°C when the mainstem exceeds 18°C
C. High-quality cold water refugia	Tributary 7-day average daily maximum temperatures are consistently 18°C or less during the critical temperature period of migration.
D. Discharge	Adults: Tributaries that are known to be large enough for adults to occupy a tributary plume or the tributary confluence area during the critical temperature period for migration. Juveniles: Tributary flow rate >= 1 cfs during the critical temperature period for migration.
E. Spatial distribution	The distance between cold water refugia along the migration corridor is less than or equal to the mean distance migrating fish travel in one day, approximately 13.2 miles for juveniles and 15.4 miles for adults.

A tributary is determined to be a cold water refuge if it is at least 2°C cooler than the Snake River using the temperature difference framework summarized in Table 4-3, and stream discharge was at least > 1 cfs during the critical migration period. High quality cold water refugia have temperatures that maintain 18°C as a 7DADM during the critical period. 18°C is used because it is the applicable temperature criteria for salmon and trout rearing and migration use and is fully protective.

Mean fish swim speed, used to assess the spatial distribution of cold water refugia, was estimated using detections of PIT-tagged juveniles and adults at the four lower Snake River dams: Ice Harbor, Lower Monumental, Little Goose, and Lower Granite, and at observation points upstream on the Snake River near Clarkston/Asotin, Grande Ronde River, Salmon River, and Imnaha River. Additional information on travel rates were compiled from published reports and peer-reviewed journal articles. The data sources and reach summaries for each species are

included in TSD section 4.2.4. The swim speeds in Table 4-3 (13.2 miles/day for juveniles and 15.4 miles/day for adults) represent the slowest overall mean swim speed by species and run for all reaches and published studies after normalizing by sample size. Adult summer steelhead and juvenile Chinook salmon had the slowest overall mean swim speeds. The slowest mean speed was used in order to ensure slower swimming species could reach cold water refugia within one day. DEQ considers these swim speeds best available estimates. They may be revised with new or updated information as appropriate. DEQ is not aware of PIT-tagged data for fish that have been tracked at locations on the Snake migration corridor upstream of the Imnaha River. These data would be beneficial to collect and evaluate.

Applying the translation framework approach to tributaries or groundwater with available temperature data, 21 Snake River tributaries, listed in Table 4-4 and mapped in Figure 4-3 provide cold water refugia at their mouths. High-quality cold water refugia appear readily available at Sheep Creek and tributaries upstream of river mile 229. There are no known high-quality cold water refugia tributaries downstream of river mile 229.

The distances between all 21 tributary cold-water refugia locations with flow estimated to be greater than one cfs in August are all located less than the mean distance that juvenile salmon and steelhead swim in one day. For the six tributaries known to be large enough for adults, the distance between the Imnaha River and Sheep Creek cold water refugia is about 38 miles, a little over twice the mean swim distance that adult summer steelhead swim in one day. The distances between the other five cold water refugia tributaries are within one day's mean swim speed for adult salmon and steelhead.

Cold water refugia use is generally not a concern for out-migrating juvenile Sockeye, steelhead, and Chinook based on fish passage data available at Lower Granite Dam. For example, yearling Spring Chinook salmon smolts have generally outmigrated past Lower Granite Dam by June, prior to exposure to temperatures > 18^{o}C. However, for adults, approximately 50% of adult Chinook, 80% of adult sockeye and 32% of the adult steelhead fish runs are exposed to temperatures exceeding 18^{o}C when cold water refuge seeking behavior may be occurring.

Table 4-4: Tributary or groundwater cold water refugia in the Snake River migration corridor.

Cold Water Refugia Tributary	River Mile	State	High Quality Cold Water Refugia	Tributary Plume Large Enough for Adults
Deep Creek	247	ID	Yes	Yes
Hells Canyon Creek	246.9	OR	Yes	
Stud Creek	245.7	OR	Yes	
Battle Creek	242	OR	Yes	
Wild Sheep Creek	241.5	OR	Yes	
Bull Creek	241.4	OR	Yes	
Granite Creek	239	ID	Yes	Yes
Three Creek	238	ID	Yes	
Unnamed stream[a] and associated groundwater springs	237.1	ID	Yes	
Saddle Creek	236	OR		
Bernard Creek	235	ID	Yes	Yes
Sluice Creek	231.7	OR	Yes	
Sheep Creek	229	ID	Yes	Yes
Temperance Creek	223	OR		
Kirkwood Creek	220.6	ID		
Somers Creek	210.3	OR		
Getta Creek	205	ID		
Wolf Creek	203	ID		
Divide Creek	193	ID		
Imnaha River	191	OR		Yes
Salmon River	188	ID		Yes

Based on the available data, cold water refugia are available and sufficiently distributed for juvenile salmon and steelhead. For adult salmon and steelhead, cold water refugia are available and sufficiently distributed throughout most of the migration corridor with the exception of the 38 mile reach between the Imnaha River and Sheep Creek. In this reach, the available data show there are many tributaries with cold water, however, it is unknown if these tributaries generate cold water plumes of sufficient size that could be used by adults. Additional temperature, flow, and fish monitoring is recommended.

The approach used to evaluate Snake River diurnal cool water refugia is similar to the tributary analysis. The Snake River daily maximum and daily minimums were compared for each day when the Snake River daily maximum temperature is 18°C or warmer. The model calibration temperatures were used for this analysis as it provides a complete temporal and spatial

[a] Unnamed in the federal Geographic Names Information System (GNIS) database, but the drainage is shown as Dry Gulch and named Blind Creek on the 1995 USGS 7.5 minute topographic map (Old Timer Mountain Quadrangle, ID-OR, NIMA 2674 1 NE – Series V893).

characterization of temperatures in the Snake River downstream of Hells Canyon Dam. The differences between Snake River daily maximums and daily minimums is less than 2°C except for a few rare outlier days in the reaches between river miles 220 and 230 with differences at 2.1°C. Based on these results nighttime temperatures in the Snake River do not provide diurnal cold water refuge.

Additional information on the evaluation of cold water refuges is discussed in Section 4.2 of the Technical Support Document.

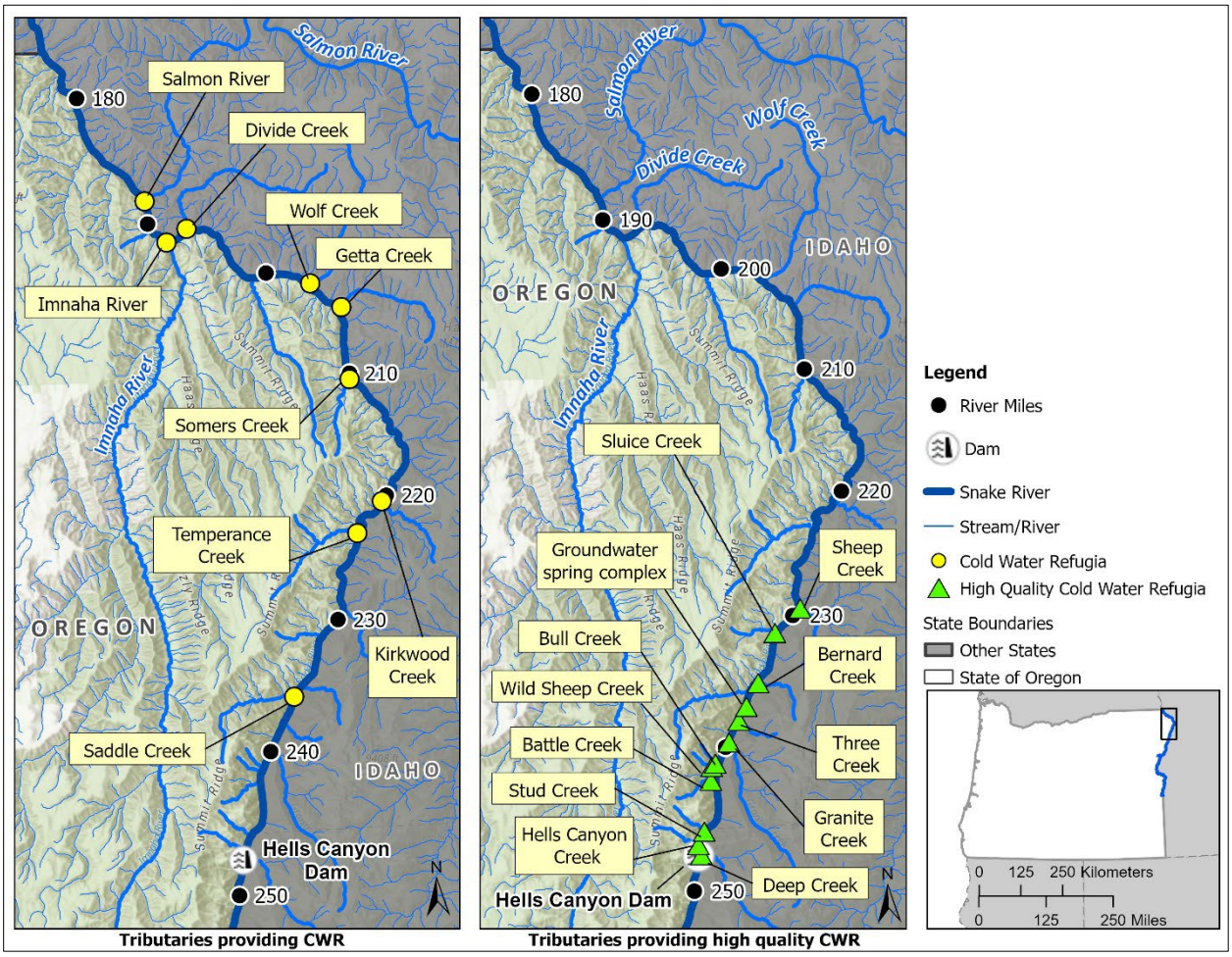


Figure 4-3: Locations of tributary or groundwater cold water refugia in the Snake River migration corridor.

4.1.1.2 Natural seasonal thermal pattern narrative

The seasonal thermal pattern in waters designated as a salmon and steelhead migration corridor (see section 4.1.1) must reflect the natural seasonal thermal pattern. This narrative is applicable to the Snake River from approximately river mile 176 at the tri-state border of Oregon, Washington, and Idaho upstream to approximately river mile 247.5 at Hells Canyon Dam. The focus of this narrative is on the seasonal shift of the temperature profile rather than the magnitude of temperatures. It is attained when the seasonal temperature profile is similar to the natural profile. Key traits are that the summer maximum occurs at the same time it would naturally without modification. The timing and slope of the onset of spring warming and fall cooling are also similar to the natural timing and slope.

A significant seasonal temperature shift may impact the fish uses even if the 20°C summer maximum criterion is not exceeded. Oregon Department of Fish and Wildlife advises that in the fall, a modification to a thermal pattern causes warmer water temperatures to remain longer in the fall, which can adversely affect the survival of fish until spawning and the viability of eggs after spawning. Fall cooling is important to protect the migration of adult salmon upstream and spawning. Many northwest rivers cool quite rapidly in the fall. In the spring, impoundments delay warm water from passing downstream in a manner that slows the growth of newly emerged fry, which can adversely affect survival during rearing and outmigration.

Currently, the natural seasonal thermal pattern criteria is not attained. The temperature data and TMDL model results show upstream of Brownlee Reservoir the peak maximum temperatures occur in early July. Downstream of the dams the peak maximum temperatures shift to late-August. The 7DADM temperatures downstream of the reservoirs are therefore cooler in the spring and early summer, and warmer later in the summer and fall relative to 7DADM temperatures upstream of the reservoirs. The seasonal pattern shift, illustrated in Figure 4-4 for the year 2018. Additional plots and discussion of these pattern shifts are included in TSD Section 5 and TSD section 7.2.1.

The seasonal pattern shift is caused by the dam and reservoir operations and the effect each impoundment has on residence time and the thermocline. DEQ evaluated the shift by comparing the seasonal thermal profile of the calibrated model to the profile of the Snake River without the influence of the Hells Canyon Complex dam and reservoirs. The no dam scenario has a similar seasonal thermal profile as the background model scenario, which also excludes the dams as well as other anthropogenic sources. The background scenario reflects a more natural seasonal thermal profile. See TSD Appendix C for additional details on the no dam and background model scenarios.

The dam and reservoir surrogate measure temperature target described in Section 9.4 is the numeric temperature target implementing the natural seasonal thermal pattern narrative. Attainment of the surrogate measure temperature target ensures attainment of the natural seasonal thermal pattern downstream of Hells Canyon Dam. The surrogate measure temperature target is designed to implement the load allocation assigned to the Hells Canyon Complex and will lead to no increase in temperatures at Hells Canyon Dam relative to inflowing

temperatures above Brownlee (replicating a free flowing no dam temperature pattern). The resulting seasonal thermal profile will also reflect the natural seasonal thermal profile and therefore attain the natural seasonal thermal pattern temperature criteria.

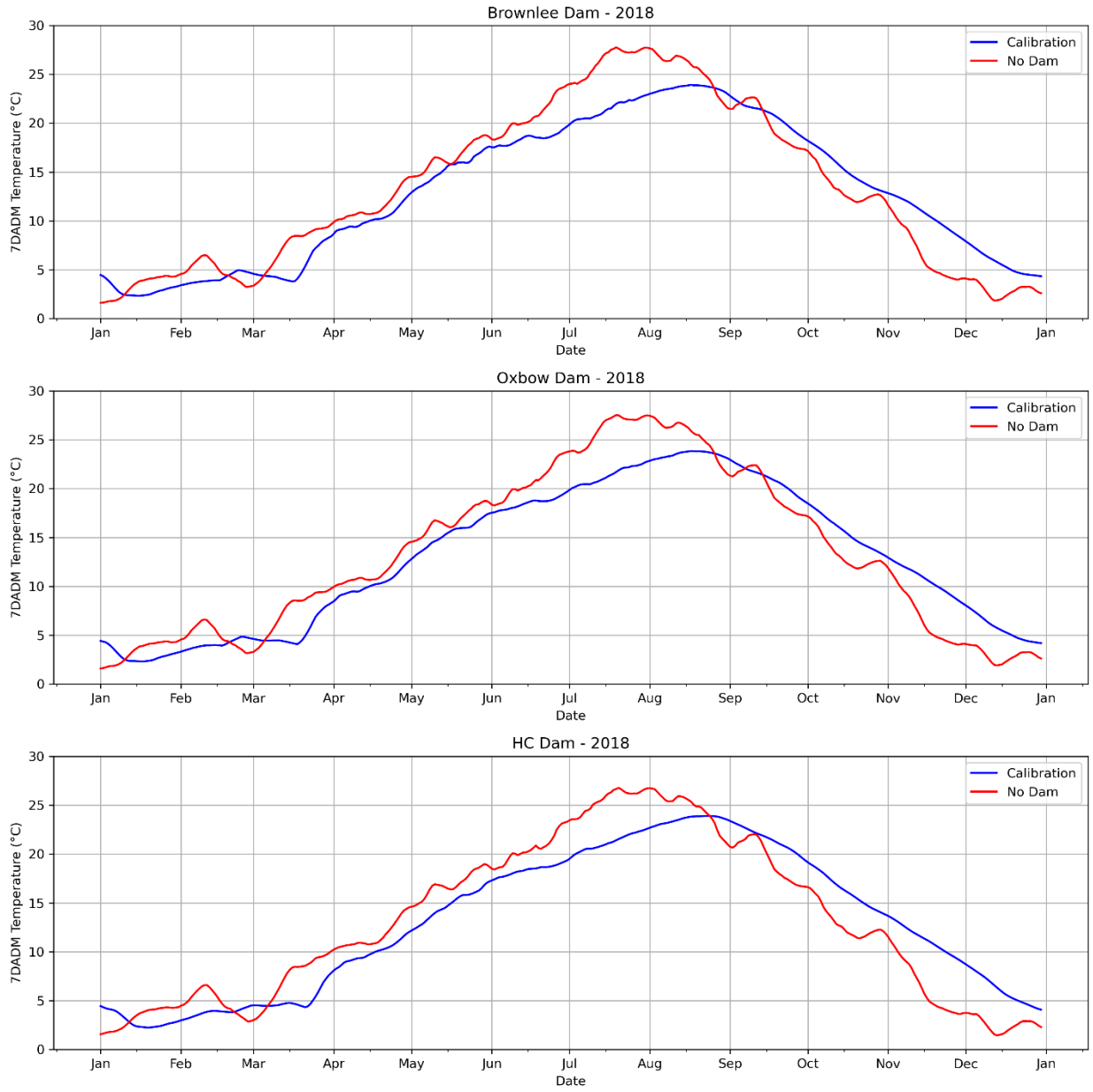


Figure 4-4: Modeled 7DADM temperature in 2018 for the Snake River segment at Brownlee Dam, Oxbow Dam, and Hells Canyon Dam, comparing calibration and no dams scenarios and the seasonal thermal pattern shift.

4.1.2 Redband or Lahontan Cutthroat Trout

The Snake River from Hells Canyon Dam to the Oregon/Idaho Stateline (approximately river mile 247.5 to 409) is designated for Lahontan cutthroat trout or redband trout use. Waters that

have been designated as having Lahontan cutthroat trout or redband trout use are identified in rule at OAR 340-041-0121 Table 121B and shown in Figure 4-1.

OAR 340-041-0028(4)(e) The seven-day-average maximum temperature of a stream identified as having Lahontan cutthroat trout or redband trout use may not exceed 20.0 degrees Celsius (68.0 degrees Fahrenheit).

4.1.3 Salmon and steelhead spawning use

The Snake River from the Oregon/Washington/Idaho border to Hells Canyon Dam (River Mile 176 to 247.5) is designated for salmon and steelhead spawning use from October 23 – April 15.

OAR 340-041-0028(4)(a). Waters that have been designated as having salmon and steelhead spawning use are identified in rule at OAR 340-041-0121 Table 121B and shown in Figure 4-1. During the spawning period, these waters may not exceed 13.0°C (55.4°F) expressed as a 7DADM.

4.1.4 Human use allowance

Oregon water quality standards have provisions for human use (OAR 340-041-0028(12)(b)). The human use allowance (HUA) is an insignificant addition of heat (0.3°C) authorized in waters that exceed the applicable temperature criteria. Following a temperature TMDL, or other cumulative effects analysis, wasteload and load allocations will restrict all NPDES point sources and nonpoint sources to a cumulative increase of no greater than 0.3°C (0.5°F) above the applicable biological criterion after complete mixing in the waterbody, and at the point of maximum impact (POMI). The rationale behind selection of 0.3°C for the HUA and how DEQ implements this portion of the standard can be found in DEQ (2003) and the Temperature IMD (DEQ, 2008a).

4.1.5 Protecting cold water

The “protecting cold water” criterion in OAR 340-041-0028(11) applies to waters of the state that have summer ambient 7DADM temperatures that are colder than the biologically based criteria. With some exceptions (summarized in Figure 4-5), these waters may not be warmed cumulatively by anthropogenic point and nonpoint sources by more than 0.3°C (0.5°F) above the colder water ambient temperature. This applies to all anthropogenic sources taken together at the point of maximum impact where salmon, steelhead or bull trout are present. A summary of how DEQ implements this portion of the standard can be found in the PCW IMD (DEQ, 2011) and the Temperature IMD (DEQ, 2008a). DEQ found that the protecting colder water criteria does not apply to the Snake River and Hells Canyon Complex reservoirs as the 7DADM temperatures regular exceed the applicable biologically based criteria. However, when temperatures consistently attain the year round and spawning criteria in the future, the protecting cold water criteria will apply.

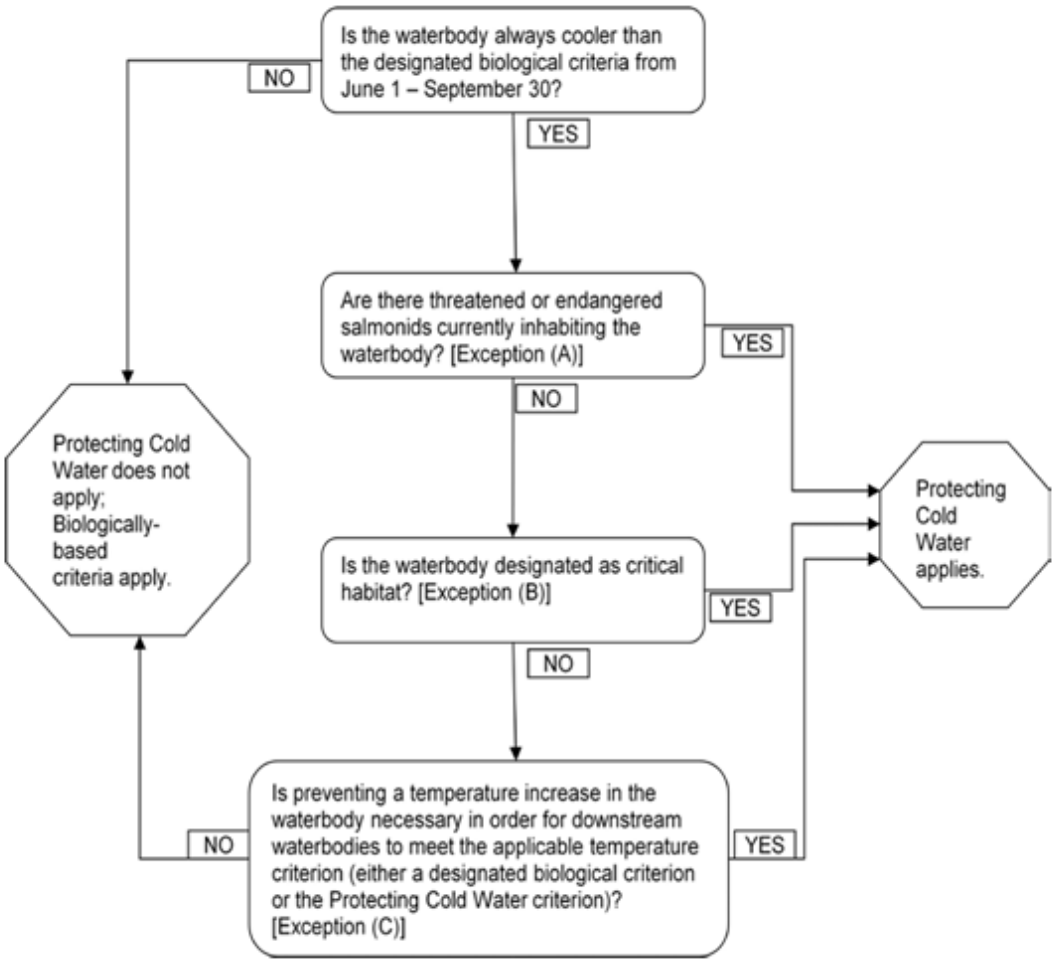


Figure 4-5: Flowchart to determine applicability of the PCW criterion. Extracted from DEQ, 2011.

4.1.6 Minimum duties

The minimum duties provision at OAR 340-041-0028(12)(a) states there is no duty for anthropogenic sources to reduce heating of the waters of the State below their natural condition. Similarly, each anthropogenic point and nonpoint source is responsible only for controlling the thermal effects of their own discharge or activity in accordance with its overall heat contribution. In no case may a source cause more warming than that allowed by the human use allowance.

The TMDL allocations implement this provision by assigning allocations for anthropogenic sources separate from background sources, which includes the warming contributed from natural background conditions. Anthropogenic sources assigned a wasteload allocation or nonpoint source load allocation are only responsible for attaining their respective allocations and controlling for the warming they contribute.

For dam and reservoir operations, DEQ developed a surrogate measure temperature target (Section 9.4) that implements the TMDL load allocation and the minimum duties provision. On

days when incoming temperatures upstream of the reservoirs cause exceedances to applicable criteria plus the assigned human use allowance in the reservoirs or downstream, the dam and reservoir operations must not contribute any additional heat to the waterbody above those incoming temperatures. This ensures dam operators are only responsible for temperature increases caused by the dam and reservoir operations.

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

For facilities that operate as a flow through facility, the minimum duties provision applies when the intake temperatures are warmer than the maximum effluent discharge temperatures allowed by the assigned wasteload allocation. On days when this occurs, the facility cannot add any additional thermal loading above what is contributed by the intake temperatures (i.e. no increase in temperature, HUA = 0.0^{o}C above the intake temperature) The purpose is to ensure the facility controls for thermal effects resulting from passing the water through and not from upstream sources. DEQ found the minimum duties provision does not apply to any of the existing NPDES permitted facilities discharging to the Snake River or Hells Canyon Complex reservoirs.

4.1.7 Statewide narrative criteria

The Oregon statewide narrative criteria at OAR 340-041-0007(1) apply to all waters of the state. The highest and best practicable treatment and/or control of wastes, activities, and flows must in every case be provided so as to maintain dissolved oxygen and overall water quality at the highest possible levels and water temperatures, coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor and other deleterious factors at the lowest possible levels.

4.1.8 Antidegradation policy

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

water quality as it is designed to achieve compliance with existing temperature criteria in order to ensure that beneficial uses of the Snake River are fully supported.

4.2 Idaho temperature criteria

4.2.1 Cold water aquatic life

IDAPA 58.01.02.250.02.b. Idaho has designated the entire extent of the Snake River and Hells Canyon Complex (river mile 176 to 409) for cold water aquatic life use (Figure 4-1). Waters designated for cold water aquatic life are not to vary from the following due to human activities:

Water temperatures of 22°C or less with a maximum daily average of no greater than 19°C.

4.2.2 Salmonid spawning site specific criteria

IDAPA 58.01.02.286. Weekly maximum temperatures (WMT) are regulated to protect fall chinook spawning and incubation in the Snake River from Hell's Canyon Dam to the confluence with the Salmon River from October 23 through April 15 (Figure 4-2). Because the WMT is a lagged seven (7) day average, the first WMT is not applicable until the seventh day of this time period, or October 29. A WMT is calculated for each day after October 29 based upon the daily maximum temperature for that day and the prior six (6) days. From October 29 through November 6, the WMT must not exceed 14.5°C. From November 7 through April 15, the WMT must not exceed 13°C.

IDAPA 58.01.02.0.10.59 defines the WMT as the mean of daily maximum temperatures measured over a consecutive seven (7) day period ending on the day of calculation. When used seasonally, e.g., spawning periods, the first applicable WM temperature occurs on the seventh day into the time period. Idaho's WMT is the same summary statistic as Oregon's 7DADM.

4.2.3 Protection of downstream water quality

IDAPA 58.01.02.070.08. All waters shall maintain a level of water quality at their pour point into downstream waters that provides for the attainment and maintenance of the water quality standards of those downstream waters, including waters of another state or tribe.

4.2.4 Natural background conditions

IDAPA 58.01.02.200.09. When natural background conditions exceed any applicable water quality criteria set forth in [IDAPA 58.01.02] Sections 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, there shall be no lowering of water quality from natural background conditions. Provided, however, that temperature may be increased above natural background conditions when allowed under Section 401.

4.2.5 Point source wastewater treatment requirements

IDAPA 58.01.02.401.01.c. If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then wastewater must not raise the receiving water temperatures by more than 0.3°C.

4.3 Washington temperature criteria

WAC 173-201A-602 Table 602: WRIA 35, Note 2b. Temperature on the Snake River above Clearwater River shall not exceed a one day maximum of 20.0°C due to human activities.

4.4 Numeric water quality targets

TMDLs must contain numeric water quality targets. The targets summarized in Table 4-5 represent the instream endpoint that ensures all applicable temperature water quality standards are attained and beneficial uses are protected, including relevant temperature criteria for the States of Idaho and Washington. The most stringent temperature criteria, which formed the basis for the targets and TMDL allocations, is Oregon's temperature criteria. The evaluation of each state's criteria is discussed in Section 4.1 of the Technical Support Document.

Temperature targets summarized in Table 4-5 include Oregon's temperature criteria and application of the water quality standard implementation provisions, relevant narrative provisions, and the antidegradation policy.

The Clean Water Act and EPA's implementing regulations have provisions for development of TMDLs under 33 U.S.C. §1313(d)(1)(D), to address waters impaired by thermal discharges under 33 U.S.C. §1313(d)(1)(B), 40 C.F.R. § 130.7(b). These provisions allow temperature TMDLs to be written to assure the "protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife," rather than the applicable temperature water quality standards. TMDLs for temperature can also be written to the applicable temperature standards, given that the temperature criteria protects beneficial uses. Oregon's water quality standards for temperature are consistent with 40 C.F.R. § 130.7(c)(1) because they were developed and approved by EPA to "assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife." This TMDL targets the temperature water quality standards as it will assure propagation of indigenous salmon, steelhead, redband trout, and other aquatic life.

Table 4-5: Summary of applicable numeric temperature targets in the Snake River and Hells Canyon Complex.

Applicable Criteria	Applicable Waters	Temperature Target (°C)	Period When Criteria Applies
Salmon and steelhead spawning	Snake River RM 247.5 to169 Hells Canyon Dam to OR/WA/ID border	13.0 + 0.3 HUA 7DADM	Oct 23 – Apr 15
Salmon and steelhead migration corridor	Snake River RM 247.5 to169 Hells Canyon Dam to OR/WA/ID border	20.0 + 0.3 HUA 7DADM	Year Round
Redband or Lahontan Cutthroat Trout	Snake River RM 409 to 247.5 OR/ID border to Hells Canyon Dam	20.0 + 0.3 HUA 7DADM	Year Round
Coldwater refugia narrative OAR 340-041-0028(4)(d)	Snake River RM 247.5 to169 Hells Canyon Dam to OR/WA/ID border	2 degrees Celsius colder than the daily maximum temperature of the adjacent well-mixed water body	When salmon and steelhead are actively migrating
Natural seasonal thermal pattern narrative	Snake River RM 247.5 to169 Hells Canyon Dam to OR/WA/ID border	HCC Surrogate Measure Temperature Target	Year Round

5 Seasonal variation and critical period for temperature

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

Stream temperatures have an annual pattern with the warmest 7DADM stream temperatures occurring in July or August and the coldest occurring in late December and January. July and August are months when stream flows typically are low, solar radiation fluxes are high, and ambient air temperature conditions are warmest. Conversely, the coldest seasonal temperatures occur in late December and January.

The critical period is based on the frequency and period when 7DADM stream temperatures exceed the applicable temperature criteria. In setting this period, DEQ relied upon monitoring sites with the longest period of exceedance and frequency of exceedance.

The Snake River critical periods are presented in Table 5-1. Allocations presented in the TMDL apply during these critical periods. If temperature monitoring data consistently show the period of temperature criteria exceedances in the reservoirs and downstream of Hells Canyon Dam

(approximately RM 340 – 176) have shifted from the periods presented in Table 5-1, DEQ may adjust the period when TMDL allocations apply consistent with the criteria exceedances. This situation may occur once the natural seasonal thermal pattern is restored. The surrogate measure temperature target will continue to apply April 1 – November 15 to ensure the natural seasonal thermal pattern narrative criterion is attained.

Section 5 of the TSD summarizes the critical period approach and presents plots of 7DADM temperature data used to determine seasonal variation and the critical periods, including how the restoration of the natural seasonal thermal pattern may influence the critical period.

Table 5-1: Critical periods for the Snake River and Hells Canyon Complex.

Location	AU IDs	Critical Period
Snake River from ID/OR Stateline to Brownlee Reservoir (approximately RM 409 - 340)	OR_SR_1705010311_02_102702 OR_SR_1705011501_02_103231 OR_SR_1705011502_02_103230 OR_SR_1705020101_02_103229	May 1 - October 31
Brownlee Reservoir, Oxbow Reservoir, Hells Canyon Reservoir and Snake River from Hells Canyon Dam to the tri-state border (approximately RM 340 - 176)	OR_LK_1705020103_05_100578 OR_LK_1705020311_05_100605 OR_LK_1705020107_05_100583 OR_LK_1705020107_05_100582 OR_SR_1706010101_02_103274 OR_SR_1706010102_02_103280 OR_SR_1706010103_02_103282 OR_SR_1706010301_02_103306	May 15 – November 15

6 Temperature water quality data evaluation overview

The TMDL development process requires use of numerous temperature, hydrologic, meteorologic, and landscape data sets to characterize temperature conditions and complete a thermal pollutant source assessment. The purpose of the source assessment is to identify the sources of stream temperature warming and quantify the impact and contributions each source contributes to the temperature criteria exceedances. Data analysis and models provide the means to evaluate potential sources of stream warming and, to the extent existing data allow, the amount of pollutant loading from these sources. The results from this analysis are then used to evaluate the maximum amount of thermal load the waterbody can receive from each source category and still meet temperature criteria. This latter step informs the assignment of allocations to each pollutant source category.

Figure 6-1 summarizes the different data types used to support the TMDL analysis and TMDL model. Data from approximately 77 temperature monitoring sites, 29 discharge or water level monitoring sites, and 7 meteorological monitoring stations in and around the Snake River were

used to support the TMDL analysis. DEQ reviewed multiple years of point source discharge monitoring reports and other relevant information from the NPDES permits to characterize point source discharges. The specific monitoring sites and how these data were used for TMDL development is summarized in the Technical Support Document and in greater detail in the supporting appendices.

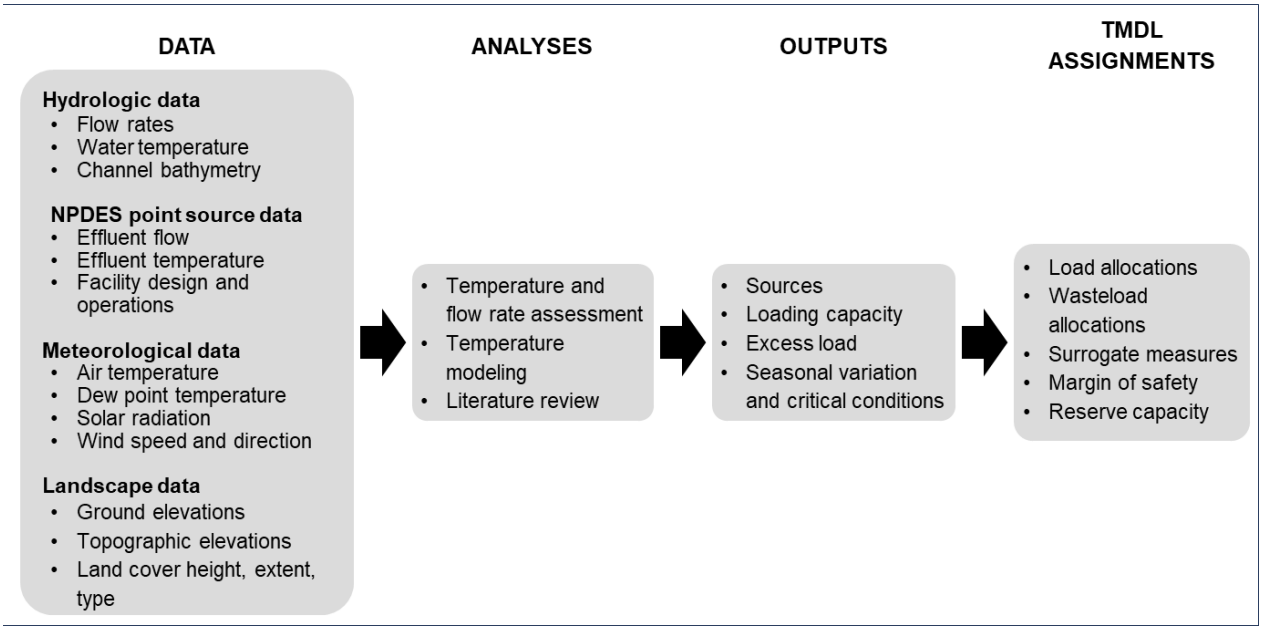


Figure 6-1: Diagram summarizing types of data used for the Snake River temperature TMDL analysis, analysis outputs, and resulting TMDL assignments.

6.1 Model overview

An important step in the TMDL process is to perform a source assessment which quantifies the background and anthropogenic contributions to stream heating. Models provide a way to evaluate potential sources of stream warming and complete a cumulative effects analysis to ensure the TMDL pollutant allocations assigned to each source will result in attainment of the applicable temperature criteria.

CE-QUAL-W2 version 4.5 was the model used to support the Snake River TMDL analyses. CE-QUAL-W2 is a laterally averaged, two-dimensional hydrodynamic and water quality model developed by the U.S. Army Corps of Engineers and Portland State University (Wells, 2021). It can be used to model multiple water quality parameters, including temperature.

The calibrated model for Brownlee, Oxbow, and Hells Canyon Reservoirs was developed by Portland State University and Idaho Power (Technical Support Document Appendix A). EPA and their contractor Tetra Tech, and Oregon DEQ led the development of Snake River calibrated model which includes the riverine sections upstream and downstream of the reservoirs (Technical Support Document Appendix B). Several model scenarios were developed to evaluate different management options and assess TMDL allocations (Technical Support Document Appendix C).

The models cover a five-year period from the beginning of 2014 to the end of 2018.

There are six linked models stretching from mile 398 river near the town of Adrian, Oregon, through the reservoirs, downstream to the Clearwater River at Lewiston, Idaho. The extent of the six linked models is as follows:

- Adrian to Brownlee (RM 398 – 345)
- Brownlee Reservoir (RM 345 – 285)
- Oxbow Reservoir (RM 258 – 272)
- Hells Canyon Reservoir (RM 272 – 247)
- Hells Canyon Dam to OR-ID-WA border (RM 247 – 176)
- OR-ID-WA border to Clearwater River, ID (RM 176 - 139)

These models were used to understand how current conditions and source activity contribute to pollutant loading and temperature dynamics.

7 Pollutant sources or source categories

This element identifies the pollutant sources and estimates, to the extent existing data allow, the amount of actual pollutant loading from these sources (OAR 340-042-0040(4)(f)). The rule requires that a TMDL will establish wasteload allocations and load allocations for these sources.

OAR 340-042-0030(12) defines a pollutant source as is any process, practice, activity or resulting condition that causes or may cause pollution or the introduction of pollutants to a waterbody. This section identifies the pollutant sources and estimates, to the extent existing data allow, the amount of pollutant loading from existing sources.

Both point and nonpoint sources are sources of thermal pollution to the Snake River and Hells Canyon complex of reservoirs. Within the nonpoint source category, both background and anthropogenic nonpoint sources contribute to thermal pollution. Each source's thermal loading varies in frequency and magnitude based on the flow rate and temperature of discharge, prevalence of the activities, size of the land area on which the activities occur, locations of activities in relation to surface water, and transport mechanisms.

7.1 Point sources

OAR 340-045-0010(17) and ORS 468B.005(4) defines a point source as "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged."

Individual NPDES permittees in Table 7-1 were identified as sources of thermal loading. These sources discharge or have potential to discharge thermal loads that increase 7DADM stream temperatures and impact aquatic life beneficial uses. Only Oregon permittees were assigned thermal waste load allocations in this TMDL. Individual NPDES permittees located in Idaho were assigned a wasteload allocation in the 2004 TMDL (ODEQ and IDEQ, 2004). When assessing

attainment of allocations of Idaho permittees, DEQ used the thermal waste load allocations from the 2004 TMDL, or as implemented in the NPDES permit. The thermal loading from the individual facilities evaluated have a relatively small temperature increase. Current discharges evaluated with the model have a 95th percentile 7DADM cumulative temperature increases above the applicable criteria of 0.08ºC. The maximum estimated temperature increase at the point of discharge for each Oregon facility is summarized in TSD Section 9.2.

Table 7-1: Individual NPDES permittees discharging to the Snake River.

NPDES Permittee WQ File Number: EPA Number	Oregon WQ File Number	EPA Number	Applicable Oregon Temperature Criteria (°C)	Receiving Stream (Oregon AU ID)
Idaho Power – Hells Canyon Power Plant	41297	OR0027278	20.0 13.0	Snake River RM 247 (OR_SR_1706010101_02_103274)
Idaho Power - Oxbow Power Plant	41299	OR0027286	20.0	Hells Canyon Reservoir RM 272.5 (OR_LK_1705020107_05_100582)
Idaho Power - Brownlee Power Plant	-	ID0020907	20.0	Oxbow Reservoir RM 284 (OR_LK_1705020107_05_100583)
Ontario STP	63631	OR0020621	20.0	Snake River RM 369 (OR_SR_1705011501_02_103231)
Simplot - Ontario	63810	OR0002402	20.0	Snake River RM 370 (OR_SR_1705011501_02_103231)
Weiser WWTP	-	ID0020290	20.0	Snake River RM 351 (OR_SR_1705011502_02_103230)

NPDES permitted point source discharges covered by ODOT's Phase I individual MS4 stormwater permit and registrants under the general stormwater permits (MS4 phase II, 1200-A, 1200-C, and 1200-Z) and other Oregon general NPDES permits with discharges to the Snake River (200-J, CAFO NPDES) are not consequential sources of thermal loading and do not impact aquatic life beneficial uses based on DEQ evaluation of the permit requirements, available dilution, or frequency and magnitude of discharges.

7.2 Nonpoint sources

OAR 340-041-0002(42) defines nonpoint sources as “diffuse or unconfined sources of pollution where wastes can either enter, or be conveyed by the movement of water, into waters of the state.” ORS 468B.005(3) defines a nonpoint sources as any source of pollution other than a point source.

Nonpoint source categories or activities identified as sources of thermal loading and increase 7DADM stream temperatures above the applicable criteria include:

- Dam and reservoir operation;
- Elevated temperatures from inflowing tributaries to the Snake River.
- Increases in solar radiation loading from the disturbance or removal of near-stream vegetation.
- Background sources, including natural sources and anthropogenic sources defined as backgrounds sources (See Section 7.3)

Table 7-2: Summary of nonpoint source 95th percentile cumulative 7DADM temperatures increases when temperature exceed the applicable criteria.

Nonpoint Source Category	95th percentile 7DADM cumulative warming (°C)	Spawning Use Period RM 176 - 247 95th percentile 7DADM cumulative warming (°C)
Dam and reservoir operations	4.6	6.36
Oregon tributaries	0.49	0.06
Disturbance or removal of near-stream vegetation	0.15	0.04

7.3 Background sources

OAR 340-042-0030(1) states background sources include all sources of pollution or pollutants not originating from human activities. Background sources may also include anthropogenic sources of a pollutant that DEQ or another Oregon state agency does not have the authority to regulate, such as pollutants emanating from another state, tribal lands, or sources otherwise beyond the jurisdiction of the state.

Natural background thermal loading is influenced by a number of landscape and meteorological characteristics, such as substrate and channel morphology conditions; streambank and channel elevations; near-stream vegetation; groundwater; hyporheic flow; tributary inflows; precipitation; cloudiness; air temperature; relative humidity; and others natural factors. Some of these factors, may be influenced by anthropogenic impacts. As such, it was not possible to develop a model in which all human influences were controlled or accounted for. The difference between natural

background sources and anthropogenic background sources were quantified using the best available information.

Table 7-3: Summary of background nonpoint source 95th percentile cumulative 7DADM temperatures increases above the applicable criteria.

Background Nonpoint Source Category	95th percentile 7DADM cumulative warming (°C)	Spawning Use Period RM 176 - 247 95th percentile 7DADM cumulative warming (°C)
Idaho and Oregon tributaries and the Snake River at upstream boundary	6.95	0.28
All background sources (natural and anthropogenic)	7.77	1.61

8 Loading capacity and excess loads

OAR 340-042-0040(4)(d) defines the loading capacity as the amount of a pollutant or pollutants that a waterbody can receive and still meet water quality standards. The excess load is the difference between the actual pollutant load in a waterbody and the loading capacity of that waterbody. In accordance with OAR 340-042-0040(4)(e), Oregon TMDLs must include the excess load to the extent existing data allow.

The loading capacity represents the thermal load equivalent to the applicable river temperature criteria plus the 0.30°C human use allowance. The excess load represents the thermal load equivalent of the difference between the maximum 7DADM ambient river temperature and the applicable temperature criteria plus 0.3°C human use allowance.

For temperature, thermal loading capacity (LC) was calculated using **Equation 8-1**. The excess load was calculated using **Equation 8-2**.

Table 8-1 and Table 8-2 present the loading capacity and excess load on each AU with available data during the 20 °C year round use period and 13 °C spawning use period, respectively. The loads in these tables represent the loading capacity and excess loads on the same day that the maximum 7DADM river temperature was recorded. The estimated river flow (Q_R) is also from the same day the maximum 7DADM river temperature was recorded. The loading capacity was also calculated using 7Q10 low flows (see Section 9.7) for consistency with the source category allocations, which were also calculated using 7Q10 flows.

Because loading capacity is dynamic and scales with flow, **Equation 8-1** may be used to calculate the loading capacity when river flow is greater than 7Q10. **Equation 8-1** may also be used to calculate the loading capacity if in the future the applicable temperature criteria are updated and approved by EPA.

Wasteload allocations to point sources and load allocations to nonpoint sources are based on loads equivalent to the allowed 0.30°C human use allowance increase above the applicable

temperature criterion. For some NPDES permitted point sources and nonpoint sources, the maximum cumulative temperature impact in an AU is less than the sum of the individual HUA assignments at their respective points of discharge or locations of activity due to heat dissipation within the AU. For this reason, the temperature criterion and the maximum allowed cumulative temperature increase for each source category is used in **Equation 8-1**, rather than the sum of the HUAs for each unique individual source. The river flow (Q_R) used in **Equation 8-1** is assumed to include the combined sum of effluent flow from all upstream point sources; inflows from upstream tributaries, groundwater, and nonpoint sources; and any outflows.

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

where,

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

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

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

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

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

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

$$EL = (T_R \cdot Q_R \cdot C_F) - LC$$ **Equation 8-2**

where,

$EL =$ The excess load (kilocalories/day)

$LC =$ The loading capacity (kilocalories/day) calculated using **Equation 8-1**.

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

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

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

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

The percent reduction, calculated using **Equation 8-3,** is the percent reduction needed attain criteria and is applicable to both temperature and thermal loading. This is because the river flow rate used to calculate a thermal load is the same number in the numerator and denominator is cancelled out when calculating the percent reduction.

$$\mathrm{PR} = \frac{(T_R - T_C - \mathrm{HUA})}{T_R} \cdot 100 \qquad \textbf{Equation 8-3}$$

where,

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

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

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

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

Table 8-1: Maximum observed 7DADM water temperature on AUs during the 20 °C year round use period with the corresponding river flow rate, loading capacity, excess load, excess temperature, and percent load reduction on that day.

Assessment Unit	Maximum 7DADM Temperature (°C)	Excess 7DADM Temperature (°C)	Date of Maximum 7DADM Temperature	Flow (cfs)	Loading Capacity (kcal/day)	Excess Load (kcal/day)	Percent Load Reduction
Snake River Stateline to Boise River OR_SR_1705010311_02_102702	26.2	5.9	2010-08-05	5420	2.692E+11	7.881E+10	22.6
Snake River Boise River to Malheur River OR_SR_1705011501_02_103231	28.5	8.2	2015-07-05	5910	2.935E+11	1.189E+11	28.8
Snake River Malheur River to Weiser River OR_SR_1705011502_02_103230	28.3	8.0	2013-07-05	6616	3.286E+11	1.290E+11	28.2
Snake River Weiser River to Hog Creek/Brownlee Reservoir OR_SR_1705020101_02_103229	29.5	9.2	2006-07-28	10900	5.414E+11	2.461E+11	31.3
Oxbow Reservoir OR_LK_1705020107_05_100583	24.3	4.0	2018-08-12	11760	5.841E+11	1.145E+11	16.4
Hells Canyon Reservoir OR_LK_1705020107_05_100582	23.6	3.3	2018-08-18	9166	4.552E+11	7.490E+10	14.1
Snake River Hells Canyon Reservoir to Sheep Creek OR_SR_1706010101_02_103274	24.0	3.7	2018-08-20	10800	5.364E+11	9.830E+10	15.5
Snake River Sheep Creek to Getta Creek OR_SR_1706010102_02_103280	24.0	3.7	2018-08-20	10800	5.364E+11	9.671E+10	15.3
Snake River Getta Creek to Salmon River	24.0	3.7	2018-08-21	11710	5.816E+11	1.063E+11	15.5
Snake River Salmon River to Stateline	24.0	3.7	2006-07-29	20500	1.018E+12	1.870E+11	15.5

Table 8-2: Maximum observed 7DADM water temperature on AUs during the 13 °C spawning use period with the corresponding river flow rate, loading capacity, excess load, excess temperature, and percent load reduction on that day.

Assessment Unit	Maximum 7DADM Temperature (°C)	Excess 7DADM Temperature (°C)	Date of Maximum 7DADM Temperature	Flow (cfs)	Loading Capacity (kcal/day)	Excess Load (kcal/day)	Percent Load Reduction
Snake River Hells Canyon Reservoir to Sheep Creek OR_SR_1706010101_02_103274	18.7	5.4	2015-10-23	8750	2.847E+11	1.145E+11	28.7
Snake River Sheep Creek to Getta Creek OR_SR_1706010102_02_103280	18.6	5.3	2015-10-23	8750	2.847E+11	1.124E+11	28.3
Snake River Getta Creek to Salmon River OR_SR_1706010103_02_103282	18.4	5.1	2015-10-23	9038	2.941E+11	1.137E+11	27.9
Snake River Salmon River to Stateline OR_SR_1706010301_02_103306	16.7	3.4	2015-10-23	13100	4.263E+11	1.090E+11	20.4

9 Allocations, reserve capacity, and margin of safety

9.1 Human use allowance assignments

The HUA rule included in OAR 340-041-0028(12)(b)(B) identifies the allowed temperature increase reserved for human uses. The rule requires that wasteload and load allocations restrict all NPDES point sources and nonpoint sources to a cumulative increase of no greater than 0.3°C (0.5°F) above the applicable criteria after complete mixing in the waterbody, and at the POMI.

Table 9-1 present the portions of the HUA assigned to anthropogenic source categories for each AUs in the TMDL project area. See TSD Section 9 for approach to HUA assignments.

The assigned HUA for NPDES point sources is the maximum cumulative warming allowed anywhere in the AU from all NPDES individual permittees. The HUA assigned to any single NPDES point source is summarized in Table 9-2. Similarly, the assigned portion of the HUA for nonpoint sources represents the maximum cumulative warming allowed anywhere in the AU and at the POMI from all nonpoint source activities within each source category. DEQ expects the amount of warming for each unique point or nonpoint source activity to be less than the cumulative warming values shown in Table 9-1. DEQ will implement the TMDL in a manner consistent with the HUA rule by requiring all nonpoint sources to implement management strategies and reduce their warming impact such that the assigned HUA is attained. Point sources will be required to implement their wasteload allocations through their NPDES permits such that the assigned HUA is attained.

The dam and reservoir operations source category accounts for nonpoint source temperature impacts associated with dam impoundment and release of the impounded water back into the natural channel. Dam and reservoir discharges associated with an NPDES permit are included in the NPDES assigned HUAs. The HUA for nonpoint source dam and reservoir operations are achieved through the implementation of the load allocations described in Section 9.3 and the temperature target surrogate measure described in Section 9.4.

Anthropogenic warming from tributaries accounts for temperature increases in the Snake River caused by point or nonpoint source anthropogenic warming in tributaries to the Snake River. Inflow from canals or drains are also included in this category. The HUA assignments in Table 9-1 are based on all tributaries in Oregon and the Payette River in Idaho having no more than a 0.3°C. increase at the tributary mouth. Other Idaho tributaries are assumed to have no more than a 0.14°C increase at the mouth consistent with Idaho's Snake River Temperature TMDL (IDEQ, 2004). Snake River anthropogenic warming entering Oregon at river mile 409 is considered a background source under OAR 340-042-0030(1) and was not assigned any HUA. Warming from background sources is addressed under the background load allocation.

Other potential nonpoint source sectors include temperature warming associated with climate change sources in Oregon, solar loading from lack of streamside vegetation, and the withdrawal of water from the Snake River that is intended for consumptive uses.

Table 9-1: HUA assignments (deg-C) for source or source categories on Snake River or Hells Canyon Complex Reservoir assessment units.

Assessment Unit	Assessment Unit ID	NPDES point sources	Dam and reservoir operations	Anthropogenic warming from tributaries	Other nonpoint sectors	Reserve capacity	Total HUA
Snake River Idaho to Boise River	OR_SR_1705010311_02_102702	0.01	0.00	0.05	0.00	0.24	0.30
Snake River Boise River to Malheur River	OR_SR_1705011501_02_103231	0.01	0.00	0.05	0.00	0.24	0.30
Snake River Malheur River to Weiser River	OR_SR_1705011502_02_103230	0.01	0.00	0.15	0.00	0.14	0.30
Snake River Weiser River to Hog Creek/Brownlee Reservoir	OR_SR_1705020101_02_103229	0.01	0.00	0.15	0.00	0.14	0.30
Brownlee Reservoir	OR_LK_1705020103_05_100578	0.01	0.00	0.12	0.00	0.17	0.30
Brownlee Reservoir Powder River Arm	OR_LK_1705020311_05_100605	0.01	0.00	0.10	0.00	0.19	0.30
Oxbow Reservoir	OR_LK_1705020107_05_100583	0.02	0.00	0.10	0.00	0.18	0.30
Hells Canyon Reservoir	OR_LK_1705020107_05_100582	0.04	0.00	0.10	0.00	0.16	0.30
Snake River Hells Canyon Reservoir to Sheep Creek	OR_SR_1706010101_02_103274	0.11	0.00	0.11	0.00	0.08	0.30
Snake River Sheep Creek to Getta Creek	OR_SR_1706010102_02_103280	0.09	0.00	0.11	0.00	0.10	0.30
Snake River Getta Creek to Salmon River	OR_SR_1706010103_02_103282	0.09	0.00	0.12	0.00	0.09	0.30
Snake River Salmon River to Stateline	OR_SR_1706010301_02_103306	0.09	0.00	0.12	0.00	0.09	0.30

9.2 Wasteload allocations for point sources

Wasteload allocations (WLAs) are assigned to the NPDES permitted point sources listed in Table 9-2. NPDES permitted point source discharges covered by ODOT's Phase I individual MS4 stormwater permit and registrants under the general stormwater permits (MS4 phase II, 1200-A, 1200-C, and 1200-Z) and other general NPDES permits with discharges to the Snake River (200-J, CAFO NPDES) do not contribute to exceedances of applicable temperature criteria and impact beneficial uses based on DEQ evaluation of the permit requirements, available dilution, or frequency and magnitude of discharge. Therefore, no additional TMDL requirements are needed for these permitted points sources to control temperature, other than those included in their respective NPDES permits.

Table 9-2: Thermal wasteload allocations (WLA) assigned to point sources.

NPDES Permittee WQ File Number: EPA Number	WLA period	Applicable Temperature Criteria (°C)	Assigned HUA ΔT (°C)	Annual 7Q10 River flow (cfs)	Effluent discharge (MGD/cfs)	7Q10 WLA (kcals/day)
Idaho Power – Hells Canyon Power Plant 41297 : OR0027278	5/15 – 11/15	20.0 13.0	0.019[b] 0.035[c]	6884	10.5/16.25	320.769E+6 590.891E+6
Idaho Power - Oxbow Power Plant 41299 : OR0027286	5/1 – 10/31	20.0	0.021	6854	12.15/18.8	353.124E+6
Ontario STP 63631 : OR0020621	5/1 – 10/31	20.0	0.001	4755	3.06/4.7	11.645E+6
Simplot - Ontario 63810 : OR0002402	5/1 – 10/31	20.0	0.017	4755	4.3/6.7	198.055E+6

Wasteload allocations were calculated using Equation 9-1.

The effluent discharge used to calculate the wasteload allocations presented in Table 9-2 are based on the average dry weather facility design, a maximum discharge authorized by an NPDES permit, or an effluent discharge characterized from discharge data. More information on the specific source of the effluent discharge flow, effluent temperature, and the rationale behind the assigned HUA is described in the TSD Section 9.2.

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

[b] Applicable during the 20 °C salmon and steelhead migration corridor use period.

[c] Applicable during the 13 °C salmon and steelhead spawning use period.

(1) Incorporate the 7Q10 wasteload allocation in Table 9-2 as a static numeric limit. Permit writers may recalculate the static limit using different values for 7Q10 (Q_R) and effluent discharge (Q_E) using seasonal values or annual values, as appropriate, if more recent data or better estimates are available. The assigned portion of the HUA (ΔT) is static and based on the value in Table 9-2.

(2) Incorporate **Equation 9-1** directly into the permit with effluent flow (Q_E), river flow (Q_R), and the wasteload allocation (WLA) being dynamic and calculated on a daily basis. The assigned portion of the HUA (ΔT) is static and based on the value in Table 9-2. Permit writers may recalculate the 7Q10 using seasonal or annual values, as appropriate, if more recent data or better estimates are available.

If temperature monitoring data consistently show the period of temperature criteria exceedances in the reservoirs and downstream of Hells Canyon Dam (approximately RM 340 – 176) have shifted from the allocation periods presented in Table 9-2, DEQ may adjust the period when TMDL allocations apply consistent with the criteria exceedances. This situation may occur once the natural seasonal thermal pattern is restored. The surrogate measure temperature target will continue to apply April 1 – November 15 to ensure the natural seasonal thermal pattern narrative criterion is attained. See TSD section 5 for additional context.

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

$$WLA = \Delta T \cdot Q_E \cdot D_F \cdot C_F$$ Equation 9-1b

where,

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

$\Delta T =$ The assigned portion of the HUA at the point of discharge from Table 9-2. It is the maximum temperature increase (°C) above the applicable river temperature criterion using 100% of river flow not to be exceeded by each individual source from all outfalls combined.

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

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

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

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

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

$D_F =$ Dilution factor. $(Q_E + Q_R)/Q_E$ For lakes, the dilution factor is 1 unless determined using another method.

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

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

9.3 Load allocations for nonpoint sources

OAR 340-042-0040(4)(h) defines load allocations as the portions of the receiving water's loading capacity that are allocated to existing nonpoint sources, including runoff, deposition, soil contamination and groundwater discharges, or to background sources. Load allocations are best estimates of loading, and may range from reasonably accurate estimates to gross allotments depending on the availability of data and appropriate techniques for predicting loading. Whenever reasonably feasible, natural background, long-range transport and anthropogenic nonpoint source loads will be distinguished from each other.

Load allocations assigned to background sources on each AU are calculated using **Equation 9-2**.

$$LA_{BG} = (T_C) \cdot (Q_R) \cdot C_F \qquad \textbf{Equation 9-2}$$

where,

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

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

$Q_R =$ The daily average river flow rate (cfs). For a lake, a dilution factor of 1 may be used for Q_R unless determined using another method.

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

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

Load allocations assigned to anthropogenic nonpoint sources on each AU are calculated using **Equation 9-3.**

$$LA_{NPS} = (\Delta T) \cdot (Q_R) \cdot C_F$$ **Equation 9-3**

where,

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

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

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

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

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

The load allocations apply during the TMDL critical period as defined in Table 5-1. If temperature monitoring data consistently show the period of temperature criteria exceedances in the reservoirs and downstream of Hells Canyon Dam (approximately RM 340 – 176) have shifted from the critical periods presented in Table 5-1, DEQ may adjust the period when TMDL allocations apply consistent with the criteria exceedances. This situation may occur once the natural seasonal thermal pattern is restored. The surrogate measure temperature target will continue to apply April 1 – November 15 to ensure the natural seasonal thermal pattern narrative criterion is attained. See TSD section 5 for additional context.

Some nonpoint source categories were assigned a 0.0°C human use allowance or no increase in temperature and corresponding zero load allocation. A zero human use allowance and load allocation should not be interpreted as zero total thermal loading or zero discharge. Thermal loads from source categories assigned a zero may still conduct activities or have a discharge but cannot contribute to temperature increases above the applicable criteria when 7DADM temperature exceed the criteria.

Table 9-3: Thermal load allocations (LA) assigned to background sources.

AU Name	AU ID	Year Round Use Temperature Criteria	Spawning Use Temperature Criteria	7Q10 Background LA Year Round Use Period (kcals/day)	7Q10 Background LA Spawning Use Period (kcals/day)
Snake River Idaho to Boise River	OR_SR_1705010311_02_102702	20	NA	2.083E+11	NA
Snake River Boise River to Malheur River	OR_SR_1705011501_02_103231	20	NA	2.327E+11	NA
Snake River Malheur River to Weiser River	OR_SR_1705011502_02_103230	20	NA	2.853E+11	NA
Snake River Weiser River to Hog Creek/Brownlee Reservoir	OR_SR_1705020101_02_103229	20	NA	2.981E+11	NA
Brownlee Reservoir	OR_LK_1705020103_05_100578	20	NA	3.548E+11	NA
Brownlee Reservoir Powder River Arm	OR_LK_1705020311_05_100605	20	NA	3.915E+08	NA
Oxbow Reservoir	OR_LK_1705020107_05_100583	20	NA	3.354E+11	NA
Hells Canyon Reservoir	OR_LK_1705020107_05_100582	20	NA	3.369E+11	NA
Snake River Hells Canyon Reservoir to Sheep Creek	OR_SR_1706010101_02_103274	20	13	3.369E+11	2.190E+11
Snake River Sheep Creek to Getta Creek	OR_SR_1706010102_02_103280	20	13	3.745E+11	2.434E+11
Snake River Getta Creek to Salmon River	OR_SR_1706010103_02_103282	20	13	3.745E+11	2.434E+11
Snake River Salmon River to Stateline	OR_SR_1706010301_02_103306	20	13	5.563E+11	3.616E+11

Table 9-4: Thermal load allocations (LA) assigned to anthropogenic nonpoint sources.

AU Name	AU ID	7Q10 LA Dam and reservoir operations (kcals/day)	7Q10 LA Anthropogenic warming from tributaries (kcals/day)	7Q10 LA Other nonpoint sectors (kcals/day)
Snake River Idaho to Boise River	OR_SR_1705010311_02_102702	0	5.207E+08	0
Snake River Boise River to Malheur River	OR_SR_1705011501_02_103231	0	5.817E+08	0
Snake River Malheur River to Weiser River	OR_SR_1705011502_02_103230	0	2.140E+09	0
Snake River Weiser River to Hog Creek/Brownlee Reservoir	OR_SR_1705020101_02_103229	0	2.236E+09	0
Brownlee Reservoir	OR_LK_1705020103_05_100578	0	2.129E+09	0
Brownlee Reservoir Powder River Arm	OR_LK_1705020311_05_100605	0	1.957E+06	0
Oxbow Reservoir	OR_LK_1705020107_05_100583	0	1.677E+09	0
Hells Canyon Reservoir	OR_LK_1705020107_05_100582	0	1.684E+09	0
Snake River Hells Canyon Reservoir to Sheep Creek	OR_SR_1706010101_02_103274	0	1.853E+09	0
Snake River Sheep Creek to Getta Creek	OR_SR_1706010102_02_103280	0	2.060E+09	0
Snake River Getta Creek to Salmon River	OR_SR_1706010103_02_103282	0	2.247E+09	0
Snake River Salmon River to Stateline	OR_SR_1706010301_02_103306	0	3.338E+09	0

9.4 Surrogate measures

EPA regulations (40 CFR 130.2(i)) and OAR 340-042-0040(O)(5)(b) allow for TMDLs to utilize other appropriate measures (or surrogate measures). This section presents the surrogate measure that implements the dam and reservoir load allocations, the natural seasonal thermal pattern narrative criteria, and the minimum duties provision.

The HCC project thermal load allocations (Table 9-4) and assigned HUA (Table 9-1) are zero. This means that the dam and reservoirs cannot cause or contribute to increases of the 7DADM temperatures that result in warming above the applicable criteria plus assigned human use allowance in the reservoirs or in downstream waters. When temperatures entering the reservoirs are already warm enough to cause an exceedance to the criteria in the reservoirs or downstream, the reservoir operations must not increase the 7DADM temperatures above those warmer temperatures as it would cause an exceedance to the assigned load allocation and HUA. The dam and reservoir operations may warm temperatures that are below the criteria, however it was determined that temperature increases above inflowing 7DADM temperatures that exceed 19.0 °C and 12 °C result in temperature increases above the applicable 20°C and 13°C spawning criteria (respectively) and assigned human use allowances in downstream waters. Therefore, to not cause an exceedance to criteria in downstream waters, temperature increases from the dam and reservoir operations shall only occur when temperatures are cooler than 19.0 °C and 12°C as a 7DADM. This requirement is incorporated into the surrogate measure described below.

Monitoring stream temperature, rather than a thermal load, is easier and a more meaningful approach for reservoir management and effectiveness monitoring. Temperature is mathematically related to excess thermal loading and directly linked to the temperature water quality standard. For these reasons, DEQ is using a surrogate measure to implement the load allocation for dam and reservoir operations. The surrogate measure is as follows:

The 7DADM temperatures released from Hells Canyon Dam shall be less than or equal to:

a) The flow weighted 7DADM no dam temperature[d] + 0.14 °C, or
b) The applicable seasonal 7DADM temperatures in I or II:
    I. 12.0 °C from Apr 1 to Apr 15 and Oct 21 to Nov 15 when the value from a) is less than 12.0 °C;
    II. 19.0 °C from Apr 16 – Oct 20 when the value from a) is less than 19.0 °C;

The surrogate measure temperature target implements the minimum duties provision (Section 4.1.6). On days when incoming temperatures upstream of the reservoirs cause exceedances to applicable criteria plus the assigned human use allowance in the reservoirs or downstream, the dam and reservoir operations must not contribute any additional heat to the waterbody above

[d] No dam temperatures are the temperature at Hells Canyon Dam absent the dam and reservoir operations.

those incoming temperatures. This ensures dam operators are only responsible for temperature increases caused by the dam and reservoir operations.

No dam temperatures may be estimated on a daily basis from temperatures flowing into the reservoirs accounting for any warming or cooling that would occur through the reservoir reaches absent the dam and reservoir operations. The regression shown in Equation 9-4 provides a simple method to calculate no dam temperatures on a daily basis, accounting for natural warming or cooling through the reservoir reaches, using daily Snake River temperature and stream discharge data monitored upstream of Brownlee Reservoir. Details on the development of the regression equation are in TSD Appendix D.

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

$$tmax_{RM247} = -5.2987 + (0.5964 * tmean_{RM345}) + (0.4703 * tmax_{RM345}) + (0.4215 * log_qmean_{RM345})$$

Equation 9-4

where,

$tmax_{RM247} =$ The estimated no dam daily maximum temperature (°C) at Hells Canyon Dam, Snake River mile 247.

$tmean_{RM345}$= The daily mean temperature (°C) at Snake River mile 345. e.g. IPC monitoring station *Snake_River_345.2_LB.*

$tmax_{RM345}$= The daily maximum temperature (°C) at Snake River mile 345. e.g. IPC monitoring station *Snake_River_345.2_LB.*

$log_qmean_{RM345} =$ The natural log of the daily mean flow rate (cfs) at USGS gage 13269000, Snake River at Weiser ID.

9.5 Reserve capacity

The portion of the 0.30 HUA not explicitly assigned to each source or source category has been set aside as reserve capacity. The portion of the HUA associated with reserve capacity is identified Table 9-5 and Table 9-1 for each AU.

Reserve may be used to assign allocations to either point or nonpoint source(s) for new or increased thermal loads, or to assign additional allocation to any existing source(s) that were assigned an erroneous allocation or may not have been identified during the development of this TMDL.

DEQ will consider requests for allocation of reserve capacity submitted in writing on a case-by-case basis. Except when DEQ is correcting an error or omission, DEQ may require requesters

to demonstrate that there are no reasonable alternatives to an increased load and to prepare modeling or similar analysis to ensure that loading capacity is available at the discharge location(s) and in downstream waters. The HUA assigned to reserve capacity in Table 9-5 may not be available for allocation due to cumulative warming and points of maximum impact from reserve allocations assigned in upstream or downstream AUs. The cumulative warming of any approved reserve allocations must not exceed the cumulative HUA assigned to existing sources and reserve capacity in downstream AUs. DEQ will use its discretion in making determinations on requests, based on the information available and priorities appropriate at the time of the request. DEQ will track allocation of reserve capacity over time and will not approve requests once reserve capacity is depleted. Allocations of reserve capacity must be approved by DEQ's Director or designee.

Modeling analyses were performed to evaluate the cumulative temperature impacts from a hypothetical reserve capacity allocation of 0.10°C and 0.15°C located at the upstream model boundary condition near Adrian, Oregon (RM 398). The model results show there is sufficient capacity for a reserve capacity allocation of up to 0.15°C in that reach as the cumulative warming above the criteria did not exceed the 0.3°C HUA.

Table 9-5:Thermal load set aside as reserve capacity (RC).

AU Name	AU ID	RC HUA ∆T (°C)	7Q10 RC (kcals/day)
Snake River Idaho to Boise River	OR_SR_1705010311_02_102702	0.24	2.499E+09
Snake River Boise River to Malheur River	OR_SR_1705011501_02_103231	0.24	2.792E+09
Snake River Malheur River to Weiser River	OR_SR_1705011502_02_103230	0.14	1.997E+09
Snake River Weiser River to Hog Creek/Brownlee Reservoir	OR_SR_1705020101_02_103229	0.14	2.087E+09
Brownlee Reservoir	OR_LK_1705020103_05_100578	0.17	3.016E+09
Brownlee Reservoir Powder River Arm	OR_LK_1705020311_05_100605	0.19	3.719E+06
Oxbow Reservoir	OR_LK_1705020107_05_100583	0.18	3.018E+09
Hells Canyon Reservoir	OR_LK_1705020107_05_100582	0.16	2.695E+09
Snake River Hells Canyon Reservoir to Sheep Creek	OR_SR_1706010101_02_103274	0.08	1.347E+09
Snake River Sheep Creek to Getta Creek	OR_SR_1706010102_02_103280	0.10	1.873E+09
Snake River Getta Creek to Salmon River	OR_SR_1706010103_02_103282	0.09	1.685E+09
Snake River Salmon River to Stateline	OR_SR_1706010301_02_103306	0.09	2.503E+09

9.6 Margin of safety

CFR 130.7(c)(1) and OAR 340-042-0040(4)(i) require a TMDL to include a margin of safety. The margin of safety accounts for lack of knowledge or uncertainty. This may result from limited data; an incomplete understanding of the exact magnitude or quantity of thermal loading from various sources; or the actual effect controls will have on loading reductions and receiving water. The margin of safety is intended to account for such uncertainties in a manner that is conservative and will result in environmental protection. A margin of safety can be achieved through two approaches: (1) implicitly using conservative analytical assumptions to develop allocations, or (2) explicitly specifying a portion of the TMDL loading capacity as a margin of safety.

The Snake River temperature TMDL used an implicit margin of safety in derivation of the allocations. The primary conservative assumptions include:

- Calculating wasteload allocations based on the paired average dry weather design flow (ADWDF) or a maximum flow allowed by the NPDES permit, maximum effluent temperature, and the critical 7Q10 low river flow. It is rare that actual discharges from point sources will reach design flows at the same time that maximum effluent temperature and low 7Q10 river flows occur.
- Setting point source effluent temperatures as high as 32°C for the model scenario assessing the wasteload allocations. On days when the current thermal load was less than the wasteload allocation, the maximum effluent temperatures were increased above the actual temperatures up to either 32°C or the effluent temperature that would fully utilize the wasteload allocation. Actual maximum effluent temperatures are unlikely to get this warm or be sustained over multiple days or weeks.
- The modeling shows the maximum temperature increases from various source categories is seasonal in nature with the maximum increase limited to a short period of time. In addition, the maximum warming for each source category assessed does not always occur at the same time. However, the HUA and subsequent allocations are assigned based on the assumption that the maximum warming occurs all at the same time. This means that a portion of the loading capacity reserved for human use will go unutilized most of the time.

9.7 Allocation summary

Table 9-7 through Table 9-18 present TMDL allocations for source or source categories on each AU in the project area. The allocations to background sources were calculated using Equation 9-2 and were based on the applicable year-round use criterion and the spawning use criterion in the respective AU. The allocations to NPDES point sources were calculated using Equation 9-1. The allocations to nonpoint sources were calculated using Equation 9-3. All allocations presented in Table 9-7 through Table 9-18 were calculated using the annual 7Q10 river flow rate (Table 9-6). These calculations assume the 7Q10 flows at these gages include effluent flow from all upstream point sources; plus inflows from upstream tributaries, groundwater, or nonpoint sources; and any outflows. As summarized in the TMDL, allocations may be dynamic and calculated using the relevant equations when river flow rates are greater than 7Q10.

The HUA assignments to all anthropogenic sources or source categories are equal to 0.30°C. Wasteload allocations to point sources and load allocations to nonpoint sources are based on loads equivalent to the allowed 0.30°C increase. For some NPDES permitted point sources and nonpoint sources, the maximum cumulative impact at the POMI in an AU is less than the sum of the individual HUA assignments at their respective points of discharge or activity due to heat dissipation within the AU. Point source and nonpoint source thermal loading that maintains temperatures below the applicable temperature criteria are included as part of the background allocation.

Table 9-6: Summary of 7Q10 flow and temperature targets used to calculate allocations for each assessment unit.

AU Description	AU ID	Annual 7Q10 (cfs)	Year Round Use Period Temperature Target (°C)	Spawning Use Period Temperature Target (°C)
Snake River Idaho to Boise River	OR_SR_1705010311_02_102702	4256	20 7DADM + 0.3 HUA	NA
Snake River Boise River to Malheur River	OR_SR_1705011501_02_103231	4755	20 7DADM + 0.3 HUA	NA
Snake River Malheur River to Weiser River	OR_SR_1705011502_02_103230	5831	20 7DADM + 0.3 HUA	NA
Snake River Weiser River to Hog Creek/Brownlee Reservoir	OR_SR_1705020101_02_103229	6092	20 7DADM + 0.3 HUA	NA
Brownlee Reservoir	OR_LK_1705020103_05_100578	7251	20 7DADM + 0.3 HUA	NA
Brownlee Reservoir Powder River Arm	OR_LK_1705020311_05_100605	8	20 7DADM + 0.3 HUA	NA
Oxbow Reservoir	OR_LK_1705020107_05_100583	6854	20 7DADM + 0.3 HUA	NA
Hells Canyon Reservoir	OR_LK_1705020107_05_100582	6884	20 7DADM + 0.3 HUA	NA
Snake River - Hells Canyon Reservoir to Sheep Creek	OR_SR_1706010101_02_103274	6884	20 7DADM + 0.3 HUA	13 7DADM + 0.3 HUA
Snake River Sheep Creek to Getta Creek	OR_SR_1706010102_02_103280	7654	20 7DADM + 0.3 HUA	13 7DADM + 0.3 HUA
Snake River Getta Creek to Salmon River	OR_SR_1706010103_02_103282	7654	20 7DADM + 0.3 HUA	13 7DADM + 0.3 HUA
Snake River Salmon River to Stateline	OR_SR_1706010301_02_103306	11369	20 7DADM + 0.3 HUA	13 7DADM + 0.3 HUA

Table 9-7: Allocation summary for the Snake River from Idaho to the Boise River (OR_SR_1705010311_02_102702).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)
Background	0.00	2.083E+11
NPDES point sources	0.01	1.041E+08
Dam and reservoir operations	0.00	0.000E+00
Anthropogenic warming from tributaries	0.05	5.207E+08
Other nonpoint sectors	0.00	0.000E+00
Reserve capacity	0.24	2.499E+09
-	Total Allocated Load	2.114E+11
-	Loading Capacity	2.114E+11

Table 9-8: Allocation summary for the Snake River from Boise River to Malheur River (OR_SR_1705011501_02_103231).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)
Background	0.00	2.327E+11
NPDES point sources	0.01	1.163E+08
Dam and reservoir operations	0.00	0.000E+00
Anthropogenic warming from tributaries	0.05	5.817E+08
Other nonpoint sectors	0.00	0.000E+00
Reserve capacity	0.24	2.792E+09
-	Total Allocated Load	2.362E+11
-	Loading Capacity	2.362E+11

Table 9-9: Allocation summary for the Snake River from Malheur River to Weiser River (OR_SR_1705011502_02_103230).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)
Background	0.00	2.853E+11
NPDES point sources	0.01	1.427E+08
Dam and reservoir operations	0.00	0.000E+00
Anthropogenic warming from tributaries	0.15	2.140E+09
Other nonpoint sectors	0.00	0.000E+00
Reserve capacity	0.14	1.997E+09
-	Total Allocated Load	2.896E+11
-	Loading Capacity	2.896E+11

Table 9-10: Allocation summary for the Snake River from Weiser River to Hog Creek/Brownlee Reservoir (OR_SR_1705020101_02_103229).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)
Background	0.00	2.981E+11
NPDES point sources	0.01	1.491E+08
Dam and reservoir operations	0.00	0.000E+00
Anthropogenic warming from tributaries	0.15	2.236E+09
Other nonpoint sectors	0.00	0.000E+00
Reserve capacity	0.14	2.087E+09
-	Total Allocated Load	3.026E+11
-	Loading Capacity	3.026E+11

Table 9-11: Allocation summary for Brownlee Reservoir (OR_LK_1705020103_05_100578).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)
Background	0.00	3.548E+11
NPDES point sources	0.01	1.774E+08
Dam and reservoir operations	0.00	0.000E+00
Anthropogenic warming from tributaries	0.12	2.129E+09
Other nonpoint sectors	0.00	0.000E+00
Reserve capacity	0.17	3.016E+09
-	Total Allocated Load	3.601E+11
-	Loading Capacity	3.601E+11

Table 9-12: Allocation summary for Brownlee Reservoir, Powder River Arm (OR_LK_1705020311_05_100605).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)
Background	0.00	3.915E+08
NPDES point sources	0.01	1.957E+05
Dam and reservoir operations	0.00	0.000E+00
Anthropogenic warming from tributaries	0.10	1.957E+06
Other nonpoint sectors	0.00	0.000E+00
Reserve capacity	0.19	3.719E+06
-	Total Allocated Load	3.973E+08
-	Loading Capacity	3.973E+08

Table 9-13: Allocation summary for Oxbow Reservoir (OR_LK_1705020107_05_100583).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)
Background	0.00	3.354E+11
NPDES point sources	0.02	3.354E+08
Dam and reservoir operations	0.00	0.000E+00
Anthropogenic warming from tributaries	0.10	1.677E+09
Other nonpoint sectors	0.00	0.000E+00
Reserve capacity	0.18	3.018E+09
-	Total Allocated Load	3.404E+11
-	Loading Capacity	3.404E+11

Table 9-14: Allocation summary for Hells Canyon (OR_LK_1705020107_05_100582).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)
Background	0.00	3.369E+11
NPDES point sources	0.04	6.737E+08
Dam and reservoir operations	0.00	0.000E+00
Anthropogenic warming from tributaries	0.10	1.684E+09
Other nonpoint sectors	0.00	0.000E+00
Reserve capacity	0.16	2.695E+09
-	Total Allocated Load	3.419E+11
-	Loading Capacity	3.419E+11

Table 9-15: Allocation summary for the Snake River from Hells Canyon Reservoir to Sheep Creek (OR_SR_1706010101_02_103274).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)	7Q10 Year Spawning Use Allocations (kcal/day)
Background	0.00	3.369E+11	2.190E+11
NPDES point sources	0.11	1.853E+09	1.853E+09
Dam and reservoir operations	0.00	0.000E+00	0.000E+00
Anthropogenic warming from tributaries	0.11	1.853E+09	1.853E+09
Other nonpoint sectors	0.00	0.000E+00	0.000E+00
Reserve capacity	0.08	1.347E+09	1.347E+09
-	Total Allocated Load	3.419E+11	2.240E+11
-	Loading Capacity	3.419E+11	5.053E+09

Table 9-16: Allocation summary for Snake River from Sheep Creek to Getta Creek (OR_SR_1706010102_02_103280).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)	7Q10 Year Spawning Use Allocations (kcal/day)
Background	0.00	3.745E+11	2.434E+11
NPDES point sources	0.09	1.685E+09	1.685E+09
Dam and reservoir operations	0.00	0.000E+00	0.000E+00
Anthropogenic warming from tributaries	0.11	2.060E+09	2.060E+09
Other nonpoint sectors	0.00	0.000E+00	0.000E+00
Reserve capacity	0.10	1.873E+09	1.873E+09
-	Total Allocated Load	3.802E+11	2.491E+11
-	Loading Capacity	3.802E+11	5.618E+09

Table 9-17: Allocation summary for Snake River from Sheep Creek to Getta Creek (OR_SR_1706010103_02_103282).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)	7Q10 Year Spawning Use Allocations (kcal/day)
Background	0.00	3.745E+11	2.434E+11
NPDES point sources	0.09	1.685E+09	1.685E+09
Dam and reservoir operations	0.00	0.000E+00	0.000E+00
Anthropogenic warming from tributaries	0.12	2.247E+09	2.247E+09
Other nonpoint sectors	0.00	0.000E+00	0.000E+00
Reserve capacity	0.09	1.685E+09	1.685E+09
-	Total Allocated Load	3.802E+11	2.491E+11
-	Loading Capacity	3.802E+11	5.618E+09

Table 9-18: Allocation summary for Snake River from Salmon River to Stateline (OR_SR_1706010301_02_103306).

Source or Source Category	Assigned HUA (°C)	7Q10 Year Round Use Allocations (kcal/day)	7Q10 Year Spawning Use Allocations (kcal/day)
Background	0.00	5.563E+11	3.616E+11
NPDES point sources	0.09	2.503E+09	2.503E+09
Dam and reservoir operations	0.00	0.000E+00	0.000E+00
Anthropogenic warming from tributaries	0.12	3.338E+09	3.338E+09
Other nonpoint sectors	0.00	0.000E+00	0.000E+00
Reserve capacity	0.09	2.503E+09	2.503E+09
-	Total Allocated Load	5.647E+11	3.700E+11
-	Loading Capacity	5.647E+11	8.345E+09

10 Water quality management plan

As described in OAR 340-042-0040(4)(I)(A)-(O), an associated WQMP is a required element of a TMDL and must include the following components: (A) Condition assessment and problem description; (B) Goals and objectives; (C) Proposed management strategies design to meet the TMDL allocations; (D) Timeline for implementing management strategies; (E) Explanation of how TMDL implementation will attain water quality standards; (F) Timeline for attaining water quality standards; (G) Identification of persons, including DMAs, responsible for TMDL implementation; (H) Identification of existing implementation plans; (I) Schedule for submittal of implementation plans and revision triggers; (J) Description of reasonable assurance of TMDL implementation; (K) Plan to monitor and evaluate progress toward achieving TMDL allocations and water quality standards; (L) Plan for public involvement in TMDL implementation; (M) Description of planned efforts to maintain management strategies over time; (N) General discussion of costs and funding for TMDL implementation; and (O) citation of legal authorities relating to TMDL implementation.

DEQ sought and considered input from various persons, including DMAs, responsible for TMDL implementation and other interested public and prepared the Snake River WQMP as a stand-alone rule document.

11 Reasonable assurance

OAR 340-042-0030(9) defines Reasonable Assurance as “a demonstration that a TMDL will be implemented by federal, state or local governments or individuals through regulatory or voluntary actions including management strategies or other controls.” OAR 340-042-0040(6)(g) states that “to establish reasonable assurance that the TMDL’s load allocations will be achieved requires determination that practices capable of reducing the specified pollutant load: (1) exist; (2) are technically feasible at a level required to meet allocations; and (3) have a high likelihood of implementation.” Likewise federal regulations (40 CFR § 130.2(i)) and EPA’s TMDL guidance describes that when a TMDL is developed for waters impaired by both point and nonpoint sources and WLAs are based on an assumption that NPS load reductions will occur, the TMDL must provide “reasonable assurances” that NPS control measures will achieve expected load reductions (EPA, 1991).

The Snake River TMDLs were developed to address both point and nonpoint sources with TMDL load reductions set at a level estimated to attain the applicable temperature criteria with consideration of opportunities for effective measures to reduce those contributions. Reasonable assurance that Oregon’s three-point test is met, needed load reductions will be achieved for nonpoint sources, and that antidegradation requirements and narrative water quality criteria will be attained is based primarily on an accountability framework incorporated into the WQMP. The accountability framework includes identification of pollutant reduction strategies by source and

activity, identification of persons and agencies responsible to implement the strategies, timelines and measurable objectives, tracking implementation progress and water quality conditions, and DEQ action when responsible persons or agencies fail to implement. Section 7 of the WQMP (Reasonable Assurance of Implementation) discuss this framework directly.

The WQMP also includes a general discussion of implementation costs and available funding programs, identification of state legal authorities that aid in implementation of management strategies, and DEQ's adaptive management approach to DMA implementation if sufficient progress towards TMDL attainment is not being made. The entirety of the WQMP and its execution along with the implementation plans of persons and agencies responsible for TMDL implementation represents reasonable assurance that nonpoint source load reductions will be achieved.

12 References

DEQ (Oregon Department of Environmental Quality). 2003. Staff report to the Environmental Quality Commission from Stephanie Hallock, Director. "Agenda Item D, Rule Adoption: Water Quality Standards, Including Temperature Criteria, OAR Chapter 340, Division 41, December 4, 2003, EQC Meeting."

DEQ (Oregon Department of Environmental Quality). 2008a. Temperature Water Quality Standard Implementation – A DEQ Internal Management Directive.