Draft Tualatin Subbasin TMDL

Appendix 2B-1
Point Source Allocations for Dischargers to Tributaries in the Tualatin Basin Temperature TMDL

State of Oregon
Department of Environmental Quality

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This Appendix describes the calculations for the waste load allocations for NPDES permittees that discharge to the tributaries of the Tualatin Basin. The approach used and the calculations for discharges to the mainstem Tualatin River are described in Appendix B-2 and B-3.

Oregon's water quality standard allows for minimal heating, and does so by requiring that all sources combined may not heat the water by more than 0.3°C at the point of largest impact in a waterbody. All sources of thermal pollution must be addressed by this plan, thus the TMDL will include allocations for both permitted point sources of pollution, as well as dispersed sources of thermal pollution, also called non-point sources. An example of a non-point source of heat is lack of shade along a stream, allowing too much solar radiation to reach the stream and heat it. DEQ also may reserve some of the allowed thermal load for future growth in the watershed. Similar to other TMDLs that have been completed after adoption of the new temperature standard, DEQ will allocate the human use allowance for this TMDL in the following manner:

0.05°C for non-point sources (load allocation, described in Section 3.12 of TMDL)
0.05°C for reserve capacity
0.20°C for all point sources combined (waste load allocations).

The thermal sources from point source discharges to the tributaries of the Tualatin River are all from industrial sources and consist of general permits for non-contact cooling water, and individual permits for stormwater or groundwater clean-up. The NPDES 100-J permit for non-contact cooling water dictates the same requirements for all sources that receive the permit. This permit requires monthly reporting for effluent flow and temperature. There are 5 individual industrial permits; 3 are industrial stormwater permits for lumber yards, and two were issued for ground water cleanup. Monitoring and reporting requirements for these are unique to each permit holder.

The first step for tributary allocations was to calculate the largest excess thermal load that each source might have discharged. This calculation assumed that minimal dilution flow was available in the river (the 7Q10 flow, or lowest seven-day average flow expected to recur in a ten year period, based on a log-Pearson distribution of flow data), and that the source discharged at its' highest recorded flow at its' highest recorded temperature. The ∆Ts of the receiving water at low flow calculated using these assumptions are shown in Table 1 below. The following equations were used to compute these numbers, the equation numbers are the same as those presented in Chapter 2 of the TMDL:

$$\Delta T_{River}=(Q_E/Q_{R7Q10}+Q_E)(T_E-T_R) \qquad \text{(Equation 2-2)}$$

Where: ΔT_{River} = Change in river temperature resulting from discharge, expressed as ∆T °C
Q_E= Effluent Flow in cubic feet per second (highest recorded in source's monitoring record)
Q_R= River Flow (7Q10 flow condition) in cubic feet per second
T_E=Temperature of the effluent, °C (highest recorded in the source's monitoring record)
T_C= Applicable Biological Criterion (18º C for these Tualatin tributaries; Natural Thermal Potential temperatures are not available because tributaries were not modeled)

<u>Proposed Allocations</u>:
The ∆Ts shown in Table 1 identify the maximum possible heat load to its' receiving water, and because it is conservatively calculated, it may not reflect what a source actually contributes. These estimates are used as a starting point in the development of individual waste load allocations. The following guidelines were used to develop the proposed waste load allocations:

- Provide a implicit allocation for very small heat sources (∆T< 0.01) that allows these sources to continue current operations under the same conditions as their existing practice
- Allocate a waste load that is equivalent to the source's ∆T ºC if that value is less than 0.2°C (∆T), and the source is the only one on a stream
- For single sources with ∆T ºC that exceed a ∆T of 0.2° C, allocate a ∆T of 0.2° C.
- Where multiple sources occur in proximity, the total ∆T of 0.2° C for all sources is allocated proportional to each sources ∆T ºC.

Permits with no or limited discharge:
Stimson Lumber has a discharge permit that allows seasonal discharge from a treatment pond at their lumber yard, located on Scoggins Creek. Discharge from this pond only occurs between November and April, or by special request under unseasonably wet weather conditions when stream heating is not a concern due to high river flows.

Permapost owns a lumber treatment facility located near the mouth of Rock Creek. This facility uses discharge water for irrigation and no longer discharges during TMDL- critical summer months.

Henningsen Cold Storage is the only permitted discharge to Council Creek. It has an irrigation program, and no longer discharges to Council Creek between May and October.

These three sources will receive an implicit allocation, allowing the sources to continue current operations of no discharge between May 1 and October 31, and to discharge according to permit conditions between November 1 and April 30.

Electro Scientific discharges to Willow Creek. As seen in Table 1, the discharge volume is so small that impact to Willow Creek is quite low, estimated at a change of 0.0003º C in the temperature of Willow Creek. This TMDL provides an implicit allocation for this minor source of heat, allowing Electro Scientific to continue discharging at its current rate and temperature.

Single Source to Tributary: Pacific Foods is the only discharger to Hedges Creek, approximately one river mile upstream from its' confluence with the Tualatin River. Clean Water Services has collected flow data near the mouth of Hedges Creek since the summer of 2002. This data provides an estimate of 0.7 cfs for summer low flow (7Q10) in Hedges Creek. At this stream flow, and using the conservative assumptions of the highest recorded daily discharge and temperature, Pacific Foods exceeds the 0.2° ΔT allowed thermal load to the creek (Table 1). Thus Pacific Foods will receive an allocation allowing an increase of 0.2°C in Hedges Creek. This point source is located close to the mouth of Hedges Creek in the Tualatin River, so the contribution of Pacific Foods heat to the Tualatin River was calculated using a simple dilution equation. This calculation estimated a maximum thermal load to the Tualatin River as a ΔT of 0.002°C in the Tualatin River, small enough to be considered a deminimus contribution to the Tualatin River. When Pacific Foods is in compliance with the waste load allocation provided here, the actual heat load to the Tualatin River is even smaller than a change in temperature of 0.002º C.

Oregon Canadian Products is the only permitted discharge source to McKay Creek, and has an estimated impact to McKay Creek of 0.01 ºC. Thus the waste load allocation for this source is a ΔT ºC = 0.01 ºC.

Multiple Sources to Tributary: The remaining tributary sources are located within the Rock Creek sub-basin. Willow Creek is a tributary to Beaverton Creek, which flows into Rock Creek. Thus the cumulative impact of all 7 sources in the Rock Creek Watershed must be considered. HeatSource was used to model the thermal contribution of Rock Creek to the Tualatin River. However, the model did not include Willow Creek, and did not encompass enough of the watershed to include the location of Epson's discharge at river mile 7 on Rock Creek, or the three sources located at river miles 6.7 and 7 on upper Beaverton Creek. Because the water quality model could not be used, a simple mass-balance model was used to examine the potential cumulative impacts for all 7 sources in the Rock Creek-Beaverton Creek Subbasin.

The relative locations of the Beaverton-Rock Creek sources are portrayed in Figure 1. Table 2 shows the actual thermal load estimates at the mouths of Rock Creek and Beaverton Creek. Here, with all sources contributing the ΔT reported in Table 1, we demonstrate that the total point source thermal load at the mouth of Rock Creek is conservatively estimated as a ΔT of 0.0.11°C, and as a ΔT of 0.19.°C at the mouth of Beaverton Creek. Thus the maximum a ΔT's for all sources combined should meet the human use allocation of 0.2°C for all of the point sources at the mouths of both Beaverton Creek, and Rock Creek.

However, there are three sources in close proximity at river miles 6.7 and 7 on Beaverton Creek. One of the Tektronix discharges and the Maxim Wafer discharge are permitted under the General 100-J permit for non-Contact cooling water. The second Tektronix discharge is permitted under an Individual Industrial Permit. Dilution in the creek shows that these impacts, combined with downstream sources would meet the proposed allocation of 0.2°C at the mouth of Beaverton Creek, however the a ΔT ºC at the point of discharge in upper Beaverton Creek is calculated at 0.69°C. This thermal increase exceeds both the DEQ-proposed point source load of 0.2°C as well as the human use allowance of 0.3°C for all sources. Thus more restrictive allocations are required for Maxim Wafer and the two Tektronix permitted discharges.

DEQ apportioned the 0.2°C total point source waste allocation among the three sources using the following approach. A ratio of each sources' ΔT (column 8, ΔT °C) to the total ΔT º was multiplied by 0.2 to determine each source's Waste Load Allocation. The results are shown in column 10 (Waste Load Allocation, ΔT °C) of Table 1.

Waste Load Allocations can also be expressed in units of kilocalories per day, and are also shown in Table 1. The following equation is used to calculate these (Equation numbers correspond to those in Chapter 2, The Temperature TMDL):

$$WLA_{7Q10}=(\Delta T)(Q_{R7Q10}+Q_E)(C_F) \quad \text{(Equation 2-8)}$$

Where: WLA_{7Q10}= Waste Load Allocation in kilocalories per day

ΔT= the Waste Load Allocation of this TMDL as a change in river temperature, ° C (Table 1)

Q_{R7Q10}= Summer low flow of river upstream of discharge, known as 7Q10 low flow, in cubic feet per second (cfs)

Q_E=Discharge flow, cubic feet per second (design flow if known, or maximum recorded discharge flow)

C_F=2,446,665 (kcal·second)/°C·ft^3·day (a conversion factor to transform the units to Kilocalories/day)

<u>Flow-Based Waste Load Allocations:</u>

The ΔT_{River} and the WLA_{7Q10} presented above are based on changes in stream temperature due to specific permitted sources of thermal pollution into receiving water at the low flow 7Q10 level. This approach was used because WLA_{7Q10} set to protect water temperature at this flow level will also protect the waterbody at higher flows. When limited information is available, the WLA_{7Q10} is simple to implement. However, with higher flow in the receiving river, more dilution and a larger heat capacity are available. This TMDL provides a flow-based waste load allocation, expressed as kilocalories per day that is equivalent to the waste load allocations expressed as a change in temperature. The following equations allow calculation of the Waste Load Allocation at a flow that is higher than the 7Q10 Flow. This load value may be used to calculate a maximum discharge flow or temperature, providing point sources some flexibility to meet this TMDL.

The equation for the flow-adjusted Waste Load Allocation is:

$$WLA_{FLOWAD}=\Delta T_{WLA}(Q_R+Q_E)C_F \quad \text{(Equation 2-4)}$$

Where: WLA_{FLOWAD} =Flow-adjusted waste load allocation, expressed as Kilocalories/day

ΔT_{WLA}= the Waste Load Allocation of this TMDL, °C (Table 1)

Q_R=the river flow, in cubic feet per second

Q_E= the effluent flow, in cubic feet per second

C_F=2,446,665 (kcal·second)/°C·ft^3·day (a conversion factor to transform the units to Kilocalories/day)

To determine whether the source is meeting its' WLA_{FLOWAD} under flow and temperature conditions that differ from those used develop the WLA_{7Q10}, the source's Actual Thermal Load can be calculated and compared to the WLA_{FLOWAD} in Equation 2-4:

$$ATL=(Q_E)(T_E-T_c)C_F \quad \text{(Equation 2-5)}$$

Where: ATL= Actual Thermal Load, expressed as Kilocalories/day

Q_E= Effluent Flow in cubic feet per second
T_E=Temperature of the effluent, °C , expressed as a 7 day average of the daily maximum temperature
T_c= Applicable Biological Criterion (18º C for these Tualatin tributaries; Natural Thermal Potential temperatures are not available because tributaries were not modeled)
C_F=2,446,665 ((kcal·second)/°C·ft^3·day)

The WLA_{7Q10} (calculated using Equation 2-8 for summer low flows), or WLA_{FLOWAD} (Equation 2-4, for higher river flows), can be used to calculate an acceptable discharge temperature. Discharge temperature calculated for 7Q10 river flows are protective at all river flows. Discharge temperatures calculated for higher river flows are no longer protective when river flow drops below the values used to calculate the WLA_{FLOWAD} in Equation 2-4.

$$T_E = (WLA_{FLOWAD} /(Q_E \cdot C_F))+T_C \qquad \text{(Equation 2-6)}$$

Where: T_E=Seven-day average of the daily maximum effluent temperature, °C. This is the maximum allowable discharge temperature for the specified discharge and river Flow used to calculate the WLA.
WLA_{FLOWAD} = Flow-adjusted Waste Load Allocation in Kilocalories per day as calculated in Equation 2-4
Q_E= Discharge flow in cubic feet per second
C_F= 2,446,665 (kcal·second)/°C·ft^3·day
T_c= Applicable Biological Criterion (18º C for these Tualatin tributaries; Natural Thermal Potential temperatures are not available because tributaries were not modeled)

The WLA (calculated using Equation 2-2 or 2-4) can also be used to calculate a maximum discharge flow at for a given discharge temperature, applicable at the river flow used in the Equation 2-8 (7Q10 low flow) or 2-4 (river flow). The following equation shows how to calculate this discharge rate:

$$Q_E = WLA_{FLOWAD} /((T_E-T_R) \cdot C_F) \qquad \text{(Equation 2-7)}$$

Where: Q_E= the effluent flow, in cubic feet per second
WLA_{FLOWAD} = Flow-adjusted Waste Load Allocation in Kilocalories per day as calculated in Equation 2-4
T_E=Discharge temperature, as a 7-day average of the daily maximum, °C
T_c= Applicable Biological Criterion (18º C for these Tualatin tributaries; Natural Thermal Potential temperatures are not available because tributaries were not modeled)
C_F=2,446,665 (kcal·second)/°C·ft^3·day

Table 1. Excess or Actual Thermal Loads and Waste Load Allocations expressed as both a change in river temperature, and kilocalories per day for the NPDES permitted sources to the Tualatin River Tributaries.

Source:	Permit Type	Receiving Stream	River mile	7Q10 River Flow	Effluent Flow[1] Q_E, cfs	Effluent Temperature[2] °C	ΔT_{River} °C	Actual Thermal Load[4], Kilocalories/ day	Waste Load Allocation[5] ΔT_{WLA} °C	Waste Load Allocation[6] Kilocalories/ day
General Industrial										
Electro Scientific	Gen 100-J	Willow Creek		0.5[7]	0.000023	24	0.0003	341	Implicit	Implicit
Pacific Foods	Gen 100-J	Hedges Creek	1.2	0.7[8]	0.06	31	1.1	2,035,625	0.2	373,850
Epson	Gen 100-J	Rock Creek	7	0.35[8]	0.006	27	0.15	132,120	0.15	132,120
Maxim Wafer	Gen 100-J	Beaverton Creek	7	0.84[8]	0.01547	25	0.13	264,949	0.04	83,722
Tektronix	Gen 100-J	Beaverton Creek	6.7	0.84[8]	0.0247	28	0.29	604,326	0.08	169,250
Individual Industrial										
Tektronix	NPDES-IW-B15	Beaverton Creek	6.7	.84[8]	0.06	22	0.27	590,136	0.08	176,219
Intel	NPDES-IW-B15	Unnamed Trib	NA	NA[9]	0.01161	30	NA[3]	NA[3]	0.2	382,991
Oregon Canadian Products	NPDES-IW-B16	McKay Creek	8.5	0.27[8]	0.000263	29	0.01	7078	0.01	7078
No Discharge										
Permapost	NPDES-IW-B21	Rock Creek	1	3[8]				No measurable	Implicit	Implicit
Stimson Lumber	NPDES-IW-B20	Scoggins Creek		10[10]				No measurable	Implicit	Implicit
Henningsen Cold Storage	Gen 100-J	Council Creek	10	0.2[11]	0	24	No measurable	No measurable	Implicit	Implicit

[1]Effluent flow reported here is the highest flow reported on Discharge Monitoring Reports (DMR) over the past few years of record

[2]Effluent T is the highest effluent temperature reported on DMRs over the past few years of record
[3]Actual Thermal Load is the predicted change in temperature attributed to the source using the following equation: $Q_e(T_e-T_R)$ where Q_e= effluent discharge in cubic feet per second, T_e=Temperature of the discharge in °C, T_R=Temperature of the river in °C.
[4]Actual Thermal Load is the amount of heat added by the source using the following equation: $Q_e(T_e-T_R)C_F$ where Q_e= effluent discharge in cubic feet per second, T_e=Temperature of the discharge in °C, T_R=Temperature of the river in °C, and C_F is a conversion factor that calculates the load in Millions of Kilocalorie·seconds/day·°C·cubic foot
[5]Waste Load Allocation is the amount of heat that a source is allowed to contribute to the stream as assigned by the TMDL allocation expressed as a change in temperature in °C
[6]Waste Load Allocation in Millions of Kilocalorie·seconds/day·°C·cubic foot is the amount of heat that a source is allowed to contribute to the stream as assigned by the TMDL allocation
[7]7Q10 flow from extrapolation by watershed area and Clean Water Services Stream gage on Beaverton Creek
[8]7Q10 flow from Clean Water Services stream gages, 2003-2007
[9]Intel discharges to an un-named tributary of Beaverton Creek. No flow estimates of the creek are available, so Excess Thermal Loads could not be quantified
[10]7Q10 flow from Historical USGS stream gage 14202980, 1975-2008
[11]7Q10 flow from 2001 TMDL

Table 2. A simple mass balance approach was used to estimate the combined impact of all permitted thermal sources at mouths of Rock Creek and Beaverton Creek in the Tualatin Basin Streams.

Rock Creek:						
Source	**Tributary and River Mile**	**7Q10 Flow near Source, cfs**	**7Q10 Flow at Mouth, cfs**	**ΔT_{River} °C at discharge site**	**Dilution Ratio**	**ΔT_{River} °C at Mouth**
Electro Sci	Willow Creek	0.5	7.73	0.003	0.5/7.73	0.0002
Maxim Wafer	Beaverton Creek	0.84	7.73	0.13	0.84/7.73	0.0141
Tektronix 100-J	Beaverton Creek	0.84	7.73	0.29	0.84/7.73	0.0315
Tektronix NPDES	Beaverton Creek	0.84	7.73	0.27	0.84/7.73	0.0293
Intel	Beaverton Creek	3.9	7.73	0.04	3.9/7.73	0.0202
Epson	Rock Creek	0.35	7.73	0.15	0.35/7.73	0.007
Permapost	Rock Creek	7.73	7.73	0	7.73/7.73	0
Total Thermal Load at Mouth of Rock Creek						**0.11**
Beaverton Creek						
Electro Scientific	Willow Creek	0.5	3.9	0.01	0.5/3.9	0.0004
Maxim Wafer	Beaverton Creek	0.84	3.9	0.13	0.84/3.9	0.0280
Tektronix 100-J	Beaverton Creek	0.84	3.9	0.29	0.84/3.9	0.0625
Tektronix NPDES	Beaverton Creek	0.84	3.9	0.27	0.84/3.9	0.0581
Intel	Beaverton Creek	3.9	3.9	0.04	3.9/3.9	0.04
Total Thermal Load at Mouth of Beaverton Creek						**0.189**

Figure 1. A diagram showing the relative locations and impacts of the permitted thermal sources in the Beaverton-Rock Creek sub-basin.