November 30, 2010

MEMORANDUM FOR: Karin Baldwin, WA Dept of Ecology

SUBJECT: Draft Pend Oreille River Temperature TMDL, Seattle District COE review comments

The Seattle District Corps of Engineers (Seattle District) reviewed the *Draft Pend Oreille River Temperature Total Maximum Daily Load Water Quality Improvement Report, October 2010, Publication No. 10-10-065,*, prepared by Washington Department of Ecology. Comments as submitted below were provided by Kent Easthouse, Seattle District Corps of Engineers and Mike Schneider, U.S. Army Corps of Engineers Engineering Research and Development Center.

General Comments:

1. **Seattle District COE Comment:** The Seattle District agrees with the use of the cumulative frequency method to assess temperature differences between model scenarios. This methodology is beneficial for summarizing the thermal response of two river systems with small differences in travel time and provides a more meaningful statistical summary of water temperatures.

Executive Summary:

Page xi, Overview of results, Second Paragraph: *This is due to withdrawal of colder subsurface water within Albeni Falls forebay ….*

2. **Seattle District COE Comment:** Albeni Falls forebay does not stratify and subsurface withdrawal is not the source of colder water. The cooling effect in Pend Oreille River temperatures is due to Albeni Falls maintaining a higher Lake Pend Oreille elevation during the summer which allows for the exchange of deeper cooler waters from Lake Pend Oreille into the Pend Oreille River for Existing Conditions. For Natural Conditions the lake elevation was lower and a sill at the outlet of the lake prevented the exchange of cooler deep water from the lake to the river resulting in warmer surface waters entering the Pend Oreille River under natural conditions.

Page xii, Table ES-2, Skookum Reach:

3. **Seattle District COE Comment:** Why does the model show the Pend Oreille River to be in compliance upstream and downstream of the Skookum reach, but not in the Skookum reach? Please explain how this reach could be out of compliance when reaches upstream and downstream are in compliance.

Analysis Framework:

Page 16, CE-QUAL-W2 temperature model:

4. **Seattle District COE Comment:** Need to explain the Idaho section of the model. The output of the Idaho CE-QUAL-W2 model is the input to the Box Canyon model and thus is a very important boundary condition.

Page 19, Model Calibration, First Paragraph: States *Ecology used results from a CE-QUAL-W2 model of the Pend Oreille River in Idaho (Idaho model) to provide .....*

5. **Seattle District COE Comment:** The Idaho CE-QUAL-W2 model developed by PSU in 2006 and 2007 was updated by the Seattle District in November 2009 (update was presented to WAG in November 2008 and submitted to IDEQ in November 2009). Was the updated version of the Idaho model used for boundary conditions or did Ecology use the original 2006/2007 PSU version of the Idaho model for the boundary conditions? The Seattle District recommends that the updated version of the Idaho CE-QUAL-W2 model for the existing and natural conditions should be used to represent boundary conditions for the Box Canyon Model.

TMDL Analysis:

Page 25, Temperature criteria bullet 2:

6. **Seattle District COE Comment:** A reference is made to the equation t=34/ (T+9) on page 7 and the definition of capital "T" in this relationship as the natural temperature condition. This interpretation contradicts the definition given in Appendix F were "T" is defined as the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge (a similar definition of "T" as representing the background temperature is also given in 2006 WAC 173-201A-200-1-c-ii-A as well as in previous versions of the Water Quality Standards). From this definition of "T" as background temperature or ambient water temperature in the vicinity of the discharge, it seems clear that is criterion should not be interpreted as an allowable change from „natural water temperatures' and is application to thermal point sources to the river.

Methods:

Page 26, Peak temperature analysis methods:

7. **Seattle District COE Comment:** The Seattle District agrees with the use of the cumulative frequency method used by Ecology. Frequency analysis is a substantially more meaningful approach to characterizing the thermal impacts to a river system where time of travel differences exists between model scenarios.

Page 26, Daily maximum temperatures, First Paragraph:

8. **Seattle District COE Comment:** Please state the method used to determine the daily maximum temperature. Did Ecology use the maximum temperature in any single cell in a reach, the maximum surface cell temperature or the maximum volume weighted temperature?

9. **Seattle District COE Comment:** The Seattle District Corps of Engineers recommends using daily maximum volume weighted temperatures at a model segment or reach for compliance determinations. Volume weighted temperatures represent the entire water column of the river and are more representative of the water quality in the river and of the dominant aquatic habitat compared to surface cells or single cells.

   Washington DOE Water Quality Standards for Surface Waters of the State of Washington Chapter 173-201A WAC states *"Temperature measurements should be taken to represent the dominant aquatic habitat of the monitoring site. This typically means samples should:*

   (A) Be taken from well mixed portions of rivers and streams; and

   (B) Not be taken from shallow stagnant backwater areas, within isolated thermal refuges, at the surface, or at the water's edge."

   The Seattle District believes that the WDOE recommendations for sampling water temperatures in a river as cited above should also apply to characterizing the thermal conditions in a river as simulated in a numerical model. Use of a surface cell or a single cell to represent daily maximum temperatures from a model segment does not accurately *represent the dominant aquatic habitat of the monitoring site.* Use of volume weighted daily maximum temperatures would provide a more accurate and reliable representation of the dominant aquatic habitat compared to surface cells. The interpretation of multi-dimensional modeling results in determining compliance with water quality standards are much more reliable when integrated over larger regions (many cells versus single cell) and time periods (daily average versus daily maximum). The volume of surface cells in CE-QUAL-W2 simulations of impounded and unimpounded river conditions can be significantly different contributing to thermal differences that may be numerically and not physically based.

Page 28, Peak temperature analysis methods-Kalispel tribal criteria, First Paragraph:

10. **Seattle District COE Comment:** Why was a different methodology of summarizing the cumulative frequency of water temperatures used for the Kalispel Tribe river reach? Why not use the entire Kalispel Reach, which encompasses all tribal lands, instead of a single upstream segment of the Skookum Reach and a single downstream segment of the Middle Reach?

Page 30, Data filtered, First Paragraph:

11. **Seattle District COE Comment:** Why use only data from segments 115 and 172 for the cumulative frequency analysis? Segments 115 and 172 bookend the Kalispel Reach, so why not use the Kalispel Reach instead of changing the methodology. The reason for the change in methodology needs to be explained in the document.

Results:

Page 41, Table 6:

12. **Seattle District COE Comment:** An explanation of why Skookum Reach is out of compliance but the adjacent downstream river reach was in compliance is needed. How can two reaches upstream and three reaches downstream be in compliance but the Skookum Reach be out of compliance. Could this be due to model uncertainty, error or calibration issues in the Skookum reach or possibly due to using surface cells?

Page 42, Heating patterns and temperature shifts, General:

13. **Seattle District COE Comment:** The explanation of thermal patterns needs to consider the use of a grid cell based definition for daily maximum temperature where the reach specific maximum temperature will be based on the simulation of surface heating over a calendar day.

Page 42, Heating patterns and temperature shifts, Fourth Paragraph:

14. **Seattle District COE Comment:** States *Similar to Albeni Falls, the Box Canyon facility withdraws water for power generation from a deeper and colder region of the water column in its forebay.* Disagree with statement. Albeni Falls forebay does not stratify with deeper cooler water being drawn for power generation. Also, based on Box Canyon Model (PSU 2007) and Washington Ecology field data (Ecology 2004), the forebay at Box Canyon does not stratify and there is no source of deeper cooler water being withdrawn for power generation. The emphasis on instantaneous surface temperatures to define daily maximum temperature in this investigation maybe mischaracterizing the prominent thermal patterns in the Pend Oreille River.

Page 44, Figures 12, 13 and 14:

15. **Seattle District COE Comment:** An explanation of the change in the natural river temperatures seen over the Skookum Reach is needed. The existing river modeled temperatures are similar from Newport Reach through Kalispel Reach. However, the natural river modeled temperatures change which results in the Skookum Reach being out of compliance. The natural river temperatures are similar at Newport, Dalkena, and Kalispel Reaches but substantially cooler at Skookum Reach. Why does the natural river cool down through the Skookum Reach and then warm up through the Kalispel reach? Because the 4 mile long Skookum Reach represents the only location in the 40 miles

between the Newport Reach and Tiger Reach where the temperature criteria is not met, a thorough analysis of the possible source(s) of non compliance is needed.

Page 51, Kalispel tribal criteria:

16. **Seattle District COE Comment:** Explain the large difference in the natural river temperature between segment 115 and 172. The existing river shows little change in temperature between segments 115 and 172 while the natural river warms up between segments 115 and 172.

Page 62, Hydroelectric facilities, Third Paragraph:

17. **Seattle District COE Comment:** The explanation of backwater effect and side channel impacts on water temperatures in the Skookum Reach does not seem plausible for a laterally averaged 2-D model such as CE-QUAL-W2. Recommend WDOE more fully analyze and explain the physical source for the odd occurrence of cooler/warmer waters in the Skookum Reach.

Loading Capacity:

General:

18. **Seattle District COE Comment:** There should be a discussion of the uncertainty in model estimates and prediction error relative to decisions regarding compliance using a 0.3 C delta temperature threshold.

Page 71, Equation 1:

19. **Seattle District COE Comment:** The use of a grid cell based definition for daily maximum temperatures is not consistent with the loading formulation presented in Equation 1. The application of a volume weighted daily maximum temperature is consistent with this equation and would also more appropriately reflect the dominant aquatic habitat in the Pend Oreille River.

Page 73, Load and Wasteload Allocations, Idaho-Washington Stateline:

20. **Seattle District COE Comment:** Please explain how the temperature allocation for water temperatures at the Idaho-Washington state line based on observed conditions in 2004 will be applied. There will be years where water temperatures will be much warmer than presented in Figure 32 at the Idaho-Washington state line. We recommend dropping the reference to a specific year and referencing the maintenance of existing water temperature conditions in the Pend Oreille River at the state line.

Page 78, Hydroelectric facilities, Second Paragraph:

21. **Seattle District COE Comment:** Document states *The discharge of cooler subsurface water from Box Canyon's forebay….* Are there field/model/calibration data that corroborate that the forebay of Box Canyon stratifies and has cooler subsurface water?

Based on Box Canyon Model (PSU 2007) and Washington Ecology field data (Ecology 2004), the forebay at Box Canyon does not stratify and there is no source of deeper cooler water being withdrawn for power generation.

Kent Easthouse
Hydraulics and Hydrology Branch
Water Management Section
Seattle District, US Army Corps of Engineers