DEPARTMENT OF ECOLOGY

Environmental Assessment Program

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SUBJECT: **ADDENDUM**
PEND OREILLE RIVER TEMPERATURE TMDL
QUALITY ASSURANCE PROJECT PLAN
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Background

The Pend Oreille River Temperature Total Maximum Daily Load (TMDL) Study was initiated with a Quality Assurance Project Plan in 2004 (Pickett, 2004). This Addendum describes a revised scope of work and Quality Assurance details for this project.

The overall description in the original project plan remains unchanged. The modifications described below provide additional details on how modeling will be conducted. Also, the additional modeling is expected to allow remaining temperature listings for tributaries to the Pend Oreille River to be addressed in the final TMDL.

Currently, the Idaho Department of Environmental Quality (IDEQ), Kalispel Tribe, and Washington Department of Ecology (Ecology) are coordinating their work under the guidance of the United State Environmental Protection Agency with the goal of issuing a single temperature TMDL for the Pend Oreille River from the outlet of Lake Pend Oreille to the Canadian border (EPA, 2005; Ecology *et al.*, 2005). Three reaches of the river will each have a CE-QUAL-W2 model: (1) Lake Pend Oreille to Albeni Falls Dam, (2) Albeni Falls Dam to Box Canyon Dam, and (3) Box Canyon Dam to the Canadian Border. Portland State is recalibrating a model of the Box Canyon Dam reservoir under a contract with Ecology, while Seattle City Light, owner of Boundary Dam, has contracted with Batelle Pacific Northwest Laboratories to model the Boundary Dam reservoir and tailrace.

Water Quality Standards and Beneficial Uses

Temperature standards for Pend Oreille River tributaries were adopted in 2003, but a recent EPA decision is requiring Ecology to reissue these standards. The primary outstanding issue is the classification of streams as Bull Trout streams. The new standards should be in place prior to the completion of this study, so the analysis of tributaries will follow the proposed revised standards.

TMDL Approach

Ecology and IDEQ have been coordinating their approach to the TMDL and are currently following a conceptual approach which will include several TMDL model scenarios (8 are currently planned, but the actual number may change). The scenarios will vary the following factors:

- Current conditions with dams present and conditions with dams absent.
- Current tributary conditions and tributaries with natural system-potential shading and channel morphology.
- Current mainstem conditions and mainstem with natural system-potential shading.
- Current conditions with permitted point sources present and conditions with point sources absent.

The calibrated model will be run as current conditions for several years (calendar years 2004 and 2005 are currently planned): one scenario will have all human development factors absent and the other scenarios will include variations of factors present and absent.

Modeling of dams and point sources absent or present was anticipated in the original project plan. The modeling of system-potential in the tributaries and shade on the mainstem was not discussed in detail. The current approach to evaluating current shade and channel conditions and natural system-potential conditions is expected to follow the process used in the Colville National Forest TMDL (Whiley *et al.*, 2005) and will include the following steps:

- Current shade conditions will be assessed using digital orthophotos with ArcMap and the tTools extension.
- The Shade program will be used to process tTools output data for model input data.
- Current shade will be directly input into the CE-QUAL-W2 model.
- Current conditions for 2004-05 in tributaries will be modeled with the spreadsheet model rTemp to reproduce observed temperatures for CE-QUAL-W2 model inputs using meteorological data, shade input data, channel conditions, and groundwater inflow estimates.
- Direct measurements of shade collected in the field will be used to assess the accuracy of the remote sensing shade methods.
- Natural system-potential shade will be estimated by using soils and forestry information.
- Changes in tributary channel morphology will be estimated using statistical methods that compare disturbed and undisturbed watersheds.
- Natural system-potential shade will be directly input into the CE-QUAL-W2 model and used with rTemp to predict temperatures under natural system-potential conditions.

Project Objectives

An additional project objective will be to address 303(d) temperature listings for Pend Oreille River tributaries into the final TMDL analysis using simple modeling analyses with existing data and additional shade measurements.

Study Design – Monitoring Methods

Effective shade inputs to models require an estimate of the areal density of vegetation shading the stream. Shade data has been historically collected by the Kalispel Tribe as selected tributary locations using a spherical densiometer. Ecology is proposing to collect additional shade

information using a spherical densitometer, and also with a hemispherical lens and digital camera, which will be used to take 360° pictures of the sky and shading vegetation at the center of the stream. The digital images will be processed and analyzed using the Hemiview© software program.

Ecology stream temperature survey methods will be followed for the collection of data during shade surveys (e.g. Bilhimer, *et al.*, 2006). The surveys will be conducted in August 2006 at mainstem and tributary sites established by Ecology. The location of each site will be established with Global Positioning System equipment.

Tributary sites will be selected for the major tributaries identified in the original project plan that have not already been included in the Colville National Forest TMDL (Whiley *et al.*, 2005). At each tributary shade site, depending on stream access, hemispheric digital photos will be taken midstream at several transects upstream of existing temperature monitoring stations. Spherical densitometer readings will be taken at one or more sites on each tributary. If the tributary is not currently listed as impaired, at least one shade site will be monitored and, if the tributary is listed as impaired, then at least two shade sites will be monitored. At shade measurements sites stream channel information will be collected that include: bank full width and depth, wetted width and depth, channel incision (stream depth profile), width of the near stream disturbance zone (defined here as the distance from the bank full edge to the edge of the zone of unique riparian vegetation and/or channel disturbance), and descriptions of tree heights and riparian vegetation composition.

Mainstem sites will be selected from locations with significant stands of shade vegetation that are representative of reaches of river shoreline with similar soils, river valley topography, and solar aspect. At each mainstem site, spherical densitometer and hemispheric digital photos will be taken and the site location and vegetation conditions documented.

Study Design – Modeling Methods

For the mainstem Pend Oreille River, the CE-QUAL-W2 model was described in the original project plan. The additional enhancements to that model will be the inclusion of natural system-potential shade along the banks of the river for selected model scenarios, and the inclusion of major tributaries.

For temperature modeling of tributaries, the spreadsheet model rTemp will be used. Ecology's website for TMDL models (www.ecy.wa.gov/programs/eap/models.html) describes rTemp as *a simple model to predict a time-series of water temperatures in response to heat fluxes determined by meteorological data, groundwater inflow, hyporheic exchange, and conduction between the water and sediment*. Meterological data is available from the CE-QUAL-W2 model development, current shade conditions will be developed, and the tributaries being modeled have temperature and flow data. Groundwater flow, hyporheic exchange, and sediment-water conduction will be adjusted to calibrate the tributary model to the observed temperatures.

The model will be used to evaluate the system-potential temperature in the tributaries by estimating system-potential shade and inputting those into the calibrated tributary models. Sensitivity analysis will be run to assess the variability of the model results.

The shade estimates will be developed using specialized software tools:

- Ecology's Ttools extension for Arcview will be used to sample and process GIS data for input to the shade and temperature models.
- Ecology's shade calculator (available at: www.ecy.wa.gov/programs/eap/models.html) will be used to estimate effective shade along the tributaries and mainstem. Effective shade will be calculated at 250-meter intervals along the mainstem, at 50 to 100-meter intervals along the tributaries for about 1,000 meters above the temperature monitoring stations, and then averaged over the 1,000-meter intervals for input to the temperature model.

The performance of shade estimation methods will be evaluated by comparison between shade monitoring and shade estimation results. Tributary temperature model resolution and performance will be measured using the root-mean-square-error (RMSE), a commonly used measure of model variability (Reckhow, 1986). The RMSE is defined as the square root of the mean of the squared difference between the observed and simulated values.

Schedule

Report schedules will be consistent with the most recent Study Scope Change form for this project. No additional data appropriate for EIM entry is anticipated.

References

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