

To: WRIA 35 Planning Committee	
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**PROPOSAL  
LEVEL 2 TUCANNON RIVER TEMPERATURE ASSESSMENT  
MIDDLE SNAKE WATERSHED (WRIA 35)**

**INTRODUCTION**

This proposal describes the proposed Tucannon River temperature assessment. The proposal describes project tasks, field data collection procedures, methods of analysis and modeling approach for the project. A cost estimate has been included. The proposal has been further developed from our preliminary scoping memo, dated March 21, 2005, and refined based on comments received from the Planning Unit. The scope of the proposal has also been developed to include input from the Department of Ecology Environmental Assessment Program.<sup>1</sup>

**PROJECT OBJECTIVES**

Several reaches of the Tucannon River are included on Ecology's 303(d) list for impaired water quality. Temperature is listed as the water quality parameter of concern for the 303(d) listing. The WRIA 35 Planning Unit members have expressed an interest in conducting a study to evaluate the factors that are contributing to elevated temperature in the river. The project has the following objectives:

- Evaluate the sources of heat to the river. Assess the current river temperature for the existing river morphology and riparian shading.
- Determine the temperatures of the Tucannon River assuming natural riparian shading for the current river morphology.
- Evaluate temperature differences between current and natural conditions for the low-flow "critical" high temperature conditions.
- Assess temperature benefits/impacts of potential management options (e.g., riparian planting and streamflow augmentation).

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<sup>1</sup> A consultation meeting was conducted at Ecology's office in Olympia on April 6, 2005 to discuss the proposed project approach, field work, and data requirements.

## **SCOPE OF WORK**

This scope of work includes the following tasks:

- Compile and Review Existing Data/Studies
- Field Studies/GIS analysis
- Model Development
  - Develop QUAL2K Temperature Model
  - Model Scenario 1 – Evaluate Low Flow Conditions
  - Model Scenario 2 – Evaluate “Natural Riparian Conditions” Temperatures
  - Model Scenario 3 – Evaluate Management Options – Optional
- Report Preparation

### **COMPILE AND REVIEW EXISTING DATA/STUDIES**

Existing information will be compiled and reviewed to develop an understanding of the major influences of temperature conditions in the Tucannon River and to improve the design of the field work required to support the development of the QUAL2K temperature model. The existing information that will be reviewed within the available budget includes:

- Previous temperature modeling conducted on Tucannon River
- Temperature and flow data for the Tucannon River and its tributaries
- Methods and results from other nearby temperature studies
- Past and existing Tucannon River monitoring programs
- Previous studies of the physical characteristics of the river (for example, channel morphology) and its watershed.
- Groundwater withdrawal and inflow information
- Previous surveys of riparian vegetation

### **FIELD STUDIES/GIS ANALYSIS**

Field studies will be conducted in the late spring and summer 2005 to support the development of the Tucannon River QUAL2K temperature model. The fieldwork will consist of the following elements:

- Temperature monitoring
- Flow monitoring
- Seepage measurements
- Riparian survey and GIS riparian assessment

## **Temperature Monitoring**

Temperature monitoring will include continuous water temperature monitoring along the mainstem Tucannon River and the mouths of the major tributaries, continuous air temperature and relative humidity monitoring, and spot temperature measurements collected during a seepage study.

### Continuous water temperature monitoring

Approximately 20 water temperature loggers will be installed by WDFW along the mainstem Tucannon River. Several of these sites have collected hourly temperature data for many years. In addition, continuous water temperature loggers will be installed at the mouths of Pataha Creek and six other tributaries (Cummings Creek, Hixon Canyon (creek), Little Tucannon River, Panjab Creek, Cold Creek, and Sheep Creek). Continuous water temperature monitoring will occur from June through September.

### Continuous air and relative humidity temperature monitoring

Air and relative humidity temperature are currently monitored near the middle section of the Tucannon River by Ecology (Tucannon River near Marengo, RK 42.5). We will install continuous air and relative humidity loggers near the lower and upper sections of the river if these parameters are not being monitored.

### Spot water temperature measurements

As part of the seepage study, spot water temperatures will be collected at various mainstem Tucannon River stations and at the mouths of the major tributaries to the river.

### Groundwater temperatures

Groundwater temperatures in the QUAL2K model will be based on existing well data or previous temperature modeling. If no existing groundwater data exists, the groundwater temperatures used in the previous Tucannon River temperature modeling will be used (groundwater temperature was assumed to be equal to the mean annual air temperature). No groundwater monitoring is proposed.

## **Flow Monitoring**

Flow monitoring will include continuous flow monitoring on the mainstem Tucannon River, instantaneous mainstem flow measurements, and a seepage run.

### Continuous flow monitoring stations

We will obtain flow data collected at the USGS gage station - Tucannon River near Starbuck (river kilometer 13) and the Ecology station (35B150) - Tucannon River near Marengo (river kilometer 42).

### Instantaneous flow measurements

A stage recorder will be installed at up to two locations to supplement flow data. River flow measurements will be collected up to three times at the stage recorders to develop a gage to flow record. Pressure transducers will be used to record hourly water levels that will be converted to flows based on the rating curve developed from the instantaneous flow measurements. The likely

locations will be between the two existing continuous flow gages listed above. The purpose of the river gaging will be to evaluate low-flow conditions. The flow ratings developed will not be sufficient for higher flows.

### Seepage Measurements

The purpose of the seepage measurements is to quantify flow and temperature (thermal) inputs to and losses from the river, including groundwater gaining and losing reaches, tributary inflows and withdrawal amounts.

One seepage measurement data collection effort (also called a seepage run) will be conducted on the Tucannon River during a period from June to August. We will attempt to conduct the seepage measurements during a low-flow period. The seepage run will consist of flow and temperature spot measurements at locations in the mainstem Tucannon River and where tributaries flow into the river. Temperature and flow measurements will be taken upstream and downstream of the major tributaries and known withdrawal/diversion locations. The known withdrawal locations will be based on field observations, water rights data presented in the Level I watershed assessment report, personal communication, and other existing information.

It is expected that the seepage run will last for two days and require two teams of two people. Each team will likely be able to measure 6 to 8 flow measurements per day. Flow measurements will be made using portable flow meters.

### **Riparian Survey and GIS Riparian Assessment**

Estimates of existing effective shade will be developed for input into the QUAL2K model. Effective shade is defined as the portion of potential solar radiation that is blocked from reaching the surface of the stream by either vegetation or topographic features.

Existing riparian characteristics will be developed by assessing orthophotos and through field verification. Orthophotos and information from recent field surveys will be used to identify riparian areas with similar shade characteristics. Vegetation characteristics will be evaluated in the field to determine specific parameters that influence riparian shade such as, vegetation density, height, overhang, and distance from the stream. Vegetation characteristics will be estimated between the river and up to 200 feet of the river's centerline. A rangefinder will be used to estimate vegetation height and distance, and a densiometer or solar pathfinder will be used to verify canopy cover.

GIS analysis will be used to estimate other influences on the stream shading including shade from nearby topography and vegetation width near the stream.

## **MODEL DEVELOPMENT**

### **Develop QUAL2K Temperature Model**

We will use the data and information collected during the summer of 2005 to develop a QUAL2K temperature model for the Tucannon River. We anticipate developing the model to the warmest 7-day period. In addition to the data collected through field studies and GIS analysis, it is anticipated

that we will develop the QUAL2K temperature model using the following information required by the model:

Meteorological data: Weather data from the Dayton, Pomeroy, and/or Walla stations will be used for most meteorological data required by the model.

Groundwater flows: Groundwater flows and temperatures will be based on existing data/studies, personal communication, and results from the seepage study.

Headwater temperature boundary conditions: Headwater temperature boundary conditions will be based on daily minimum and maximum temperatures recorded by the U.S. Forest Service.

Reach hydraulic geometry: Geometry of the river will be based on data collected during the instantaneous flow measurements and the seepage study.

Stream elevation, aspect, and topographic shade angles – Analysis of digital elevation models in GIS will be used to estimate the river's elevation, aspect, and topographic shade angles.

The uncertainty of the predicted temperatures from the QUAL2K model will be assessed by calculating the root mean squared error (RMSE) of the predicted versus observed maximum and minimum temperatures. The target RMSE will be 1.0 °C.

### **MODEL SCENARIO 1 – EVALUATE LOW FLOW CONDITIONS**

The QUAL2K model will be used to characterize Tucannon River temperatures during critical low flow (7Q10) and high temperature conditions commonly used to develop TMDL load allocations. The 7Q10 flows will be based on data from the USGS Tucannon River station near Starbuck.

### **MODEL SCENARIO 2 – EVALUATE “NATURAL RIPARIAN CONDITIONS” TEMPERATURES**

We will use the model to simulate temperatures in the Tucannon River with potential riparian conditions (without human disturbances) under the same flow conditions as Model Scenario 2. Site potential vegetation will be based on review of physical site characteristics, historical information, other regional temperature studies, and consultation with the WRIA 35 Planning Unit members.

### **MODEL SCENARIO 3 – EVALUATE MANAGEMENT OPTIONS – OPTIONAL**

We will use the QUAL2K model to assess the benefits or impacts of other restoration scenarios (for example, riparian planting or streamflow augmentation). This would be completed based on the scenarios under consideration and depending on available budget for this effort. This task is optional and is currently not budgeted.

## **REPORT PREPARATION**

Information gathered in the previous tasks will be compiled into a draft report that will summarize methods, assumptions, and results. The report will be distributed to members of the WRIA 35 Planning Unit. Copies of the draft report will be distributed to the Planning Unit in PDF format.