Grays River Watershed and Biological Assessment

Annual Report

January 2005 – December 2005

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Summary of Accomplishments

- Completion of all deliverables as defined by project specifications
- Field data collection completed, including: substrate, hyporheic temperature and flow, spawner counts
- Development, calibration, and validation completed for the hydrology model (Distributed Hydrology Soil Vegetation Model, or DHSVM) and the hydrodynamic model (MASS2) and completed processing of required outputs for fish task (Work Elements D, E)
- Geomorphic assessment and receipt of Herrera Environmental Consultants, Inc., final report
- Preliminary analyses of spawning habitat variables completed, including substrate, depth, velocity, and hyporheic temperature
- Attendance at Grays River stakeholder meetings and coordination with other local interests and agencies
- Preparation of 2006 Statement of Work and Pisces reporting

Project Goal and Objectives

The goal of this project is to enhance and restore the ecological integrity and ecosystem function of the Grays River watershed. The recommended restoration and enhancement efforts developed in this project should incorporate local community stakeholder interests and needs.

The objectives of this project are 1) to perform a comprehensive watershed and biological analysis, including hydrologic, geomorphic, and ecological assessment; 2) to develop a prioritized list of actions that protect and restore critical chum and Chinook salmon spawning habitat in the Grays River based on comprehensive geomorphic, hydrologic, and stream channel assessments; and 3) to gain a better understanding of chum and Chinook salmon habitat requirements and survival within the lower Columbia River and the Grays River sub-basin.

Study Area

The Grays River Watershed and Biological Assessment Project study area is a 2.5 km section of the Grays River immediately upstream of the Highway 4 Bridge, and associated tributaries to this reach, in Wahkiakum County, Washington (Figure 1).

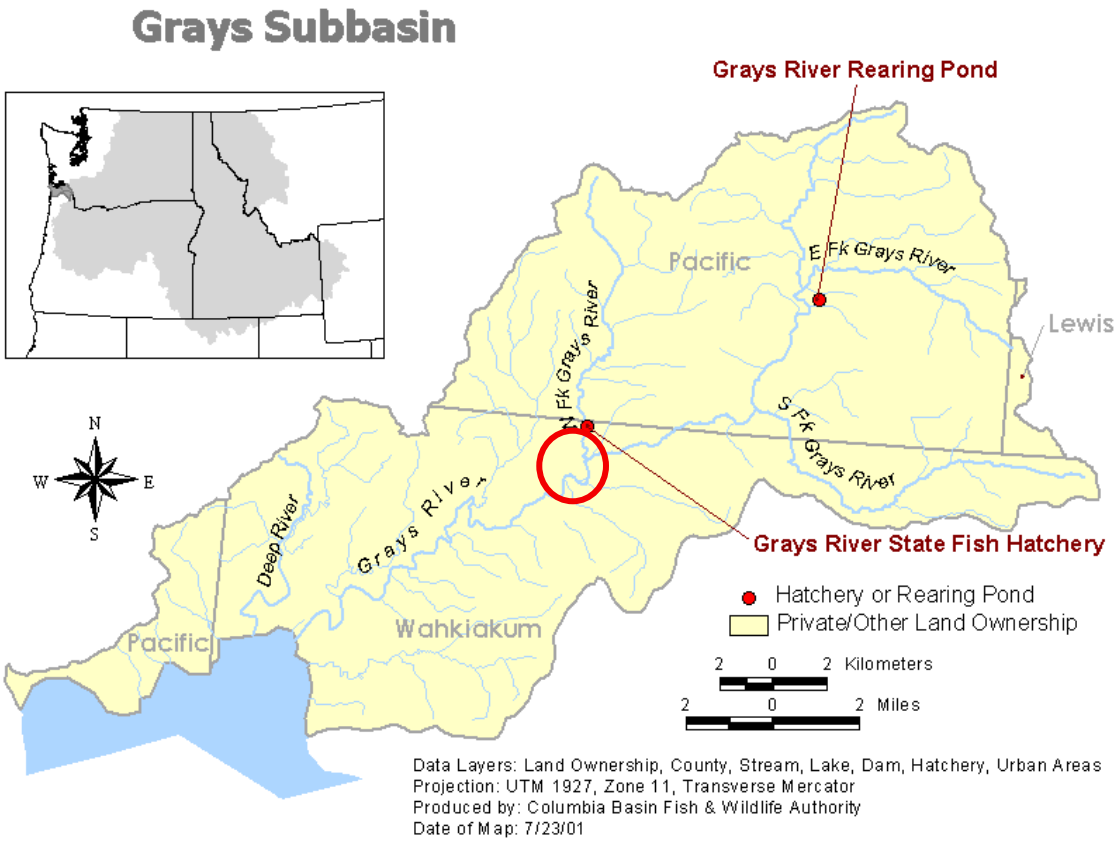

Figure 1. Grays River watershed. Study area is indicated by the red circle.

2005 Progress by Work Element

A: Develop and calibrate the Distributed Hydrology Soil Vegetation Model (DHSVM).

Deliverable: Hydrologic model, including the digital evaluation model (DEM) and all geographic information system (GIS) data layers used in developing the model

Accomplishments During 2005: River stage data were processed and incorporated into developing the DHSVM. The completed hydrologic model was prepared using the 40-year precipitation data record for the Grays River watershed. Model scenarios for watershed assessment and restoration prioritization were defined for the hypothetical undisturbed condition (100% forested) and for percent and distribution of forest cover for 1942, 1953, 1964, 1976, 1983, 1990, and 1996 using available land use/land cover (LULC) data for these years. Thus, the DHSVM will be run with the 40-year precipitation record eight times, differing by vegetative cover input. Differences in percent of watershed area that has been harvested, road construction, and other factors associated with effects of timber harvest on watershed hydrologic characteristics will be reflected in model outputs. Locations within the Grays River watershed that are critical for accomplishing other work elements were identified to generate hydrology model outputs that will be used to specify boundary conditions for the hydrodynamic model

(Work Element B). The frequency distribution of mean flows during the chum salmon spawning period (November 1 through December 31) was constructed based on DHSVM-simulated discharges. This frequency distribution is being used to select discharges corresponding to specific exceedance probabilities to specify boundary conditions for the hydrodynamic model (MASS2; see Work Element B below). Additional outputs will include various hydrologic metrics describing effects of land use change on the watershed hydrograph. Routing sediment through the model is redundant with analyses completed under Work Element C and will not be conducted in this work element. Calibration of the hydrologic model was completed, and model runs began in July. Watershed model runs were completed for 1996 (current condition) and the historic condition, and model discharge outputs were delivered as inputs to the MASS2 model. Remaining DHSVM land use model runs for the watershed assessment portion of the project were initiated and will be finalized in early 2006.

Deliverable Status: All model parameters, calibration and validation data, and GIS coverages, including the DEM associated with model development, execution, and output, are available, and appropriate outputs and results will be incorporated into the final technical project report. Additional model outputs for assessment will be produced in early 2006.

B: Develop and calibrate the Modular Aquatic Simulation System Two-Dimensional (MASS2) hydrodynamic model.

Deliverable: Hydrodynamic model, including GIS data layers used in developing the model

Accomplishments During 2005: River stage gauge data were processed and supplied to the hydrodynamics model team. The study area bathymetry was constructed and used as input to the computational grid generation software, Gridgen (Pointwise, Inc., Fort Worth, Texas). A computational grid for the MASS2 hydrodynamic model was completed that defines model flow parameters and data output locations. PNNL staff conducted a study site visit in February to evaluate channel changes during high-water events in winter 2004-2005. Significant changes occurred at the upstream end of the Gorley Reach, such that some flow is now diverted into the old channel even at lower flows. The Grays River is also actively meandering through much of the Gorley Reach. Bathymetry changes such as these have significant implications for the effectiveness of the MASS2 model to estimate spawning habitat characteristics in this area. Calibration, configuration, and testing of the MASS2 model were completed, and model runs began in July 2005. The model was validated by comparing simulated water surface elevation and velocity data to field-measured values using inflow estimates obtained from the DHSVM (hydrologic model). MASS2 was used to generate a mean water surface elevation map for the period November 1 - December 31 (chum salmon spawning season) to guide summer 2005 data collection efforts for Work Element D. All model runs for the spawning habitat evaluation (Work Elements D, F) were completed, using mean annual 10%, 50%, and 90% exceedance discharge inputs for the chum salmon spawning season provided by the DHSVM. Output parameters, such as bedform and flow characteristics for the geomorphic analysis (Work Element E) and water velocity and depth for spawning site characterization (Work Element F), were delivered to appropriate personnel. Additional restoration scenario model runs may be conducted in early 2006.

Challenges to Progress: Field collection to obtain bathymetry elevation data for the MASS2 model proved to be more difficult and time-consuming than expected, due primarily to dense canopy cover over the West Fork Grays River and associated difficulties using a global positioning system (GPS) to collect survey data. This challenge necessitated more field and data processing time than expected, delaying completion of some MASS2 model runs and therefore output acquisition until early 2006. We expect to complete required work within the project schedule but may need to adjust scope to accommodate budget constraints imposed on us in FY 2006.

Deliverable Status: All model parameters, calibration and validation data, model mesh, and GIS coverages associated with model development, execution, and output are completed, and appropriate outputs and results will be incorporated into the final technical project report.

C: Integrate results from the geomorphic and stream channel evaluation into a hydrologic modeling into a comprehensive watershed analysis.

Deliverable: Progress report on integration document to include data through December 1, 2005, including trends and the locations of sediment inputs, storage, and transport, and synthesis of data from the geomorphic sediment source and loading model for the watershed, including sediment source maps. The final integration report will be finalized by the end of CY 2006 and will be part of the next contracting period (January 1, 2006, through December 31, 2006).

Accomplishments During 2005: A post-doctoral staff member was hired to assist staff with the Grays River project, including integration of project components. Literature reviews were conducted to identify stream classification schemes for stratifying chum salmon spawning habitat in the Grays River, stream geomorphology variables associated with hyporheic upwelling zones, specific effects of forest harvest and agriculture on hydrology, sediment delivery, stream morphology, and salmonid habitat, and analysis of pebble count (stream substrate) data to identify differences between spawning and non-spawning areas and effectiveness of various substrate metrics at differentiating between spawning and non-spawning areas. Data assembled or collected during 2004-2005 by the various project teams were consolidated into a GIS database. Staff met onsite with landowners and agency representatives in February 2005 and attended Grays River stakeholder groups to advise them on restoration options throughout 2005. Historical watershed data (general land office surveys and timber cruise records) were obtained for the Grays River, and field visits were conducted to collect oral history interviews with Grays River residents. Additional activities included a site visit with the Gorley family and agency personnel to discuss restoration opportunities and a meeting with the Washington Department of Natural Resources to discuss forest practices and road maintenance.

Early in the year, PNNL coordinated with Herrera Environmental Consultants, Inc., on its geomorphic assessment and details of its large woody debris assessment and final report, to obtain preliminary results and confirm report format and delivery details. The final draft report prepared by Herrera was received in August 2005:

Herrera. 2005. *Grays River Watershed Geomorphic Analysis*. Prepared for PNNL. August 3, 2005. Herrera Environmental Consultants, Inc., Seattle, Washington. 110 pp.

PNNL reviewed the Herrera report for technical accuracy and consistency with requirements for deliverables specified in the subcontract to Herrera. PNNL reviewed the report specifically to 1) ensure adequacy of methods used for sediment transport estimations, 2) identify scenario time frames and significant time and date values for application to restoration modeling, and 3) evaluate conclusions and recommendations.

Deliverable Status: The Herrera report is available at BPA's website. It contains data and summary information described in the deliverable for this work element. Additional integration efforts will be conducted during 2006 as final redd count data become available and analyses are finalized.

D: Conduct limits analysis for depth, substrate, and velocity at representative habitat types/locations.

Deliverable: The deliverable will include preferred spawning habitat maps of depth, velocity, and substrate, and predictions of river reaches that have suitable spawning habitat based on depth, velocity, and substrate over a range of river discharges.

Accomplishments During 2005: Spawning data for 2004 were received from the Washington Department of Fish and Wildlife (WDFW), and data were prepared for analysis. We evaluated stream classification schemes, selected classification criteria for the fish task, and defined a broad scale approach to field sampling for the fish task in the summer/fall 2005. Because WDFW sampling methods changed between 2003 and 2004, our preparation included establishing study segments consistent with 2004 WDFW methods that could also be applied to the earlier methods. GIS layers using chum salmon redd location data were prepared for use in field sampling. In July, two PNNL field crews collected fine-scale pebble count (substrate) data for all study stream sections and installed pressure/temperature sensors in a deep-water well in the Grays River. Pebble count data were aligned with the WDFW and other data (water depth, velocity from MASS2 modeling) and prepared for analysis, and pebble count analyses are under way.

Challenges to Progress: Spawner use data were collected by the Pacific States Marine Fisheries Commission (PSMFC) during 2002, 2003, and 2004 using somewhat different methods each year. Although PNNL has developed data preparation and analytical methods that accommodate these differences in data, they may ultimately limit the clarity and resolution of ultimate findings for this work element.

Deliverable Status: Draft map deliverables have been completed; final maps will be incorporated into the final technical project report.

E: Select/describe appropriate geomorphic features/hyporheic zone characteristics in spawning areas.

Deliverable: Geomorphic features may include, but not be limited to, longitudinal slope, channel width/depth, bed form morphology and/or typology, and hyporheic zone characteristics.

Characteristics of the hyporheic zone that will be measured may include water surface elevation, electrical conductivity, dissolved oxygen, temperature, and substrate permeability. Included in the deliverable will be a two-dimensional map of hyporheic upwelling (based on temperature differences between river and bed) within key study areas.

Accomplishments During 2005: PNNL initiated work on identification of geomorphological variables affecting the hyporheic exchange for the fish task. In April 2005, one PNNL crew visited the Grays River field site to retrieve data loggers from piezometers, survey active channels to document channel changes from winter 2004 floods, collect stage discharge data, and obtain access to a public utility district well within the project area. A draft sampling plan for hyporheic characteristics was prepared, and GIS layers using chum salmon redd location data were prepared to assist in fieldwork planning. In November, three PNNL crews collected hyporheic (river bed) and river temperature and hyporheic flow data throughout the Grays River, abandoned Grays River channel (Gorley Reach), Crazy Johnson Creek, and the West Fork Grays River within the study area, successfully completing field work for this project. Initial data processing was completed. Bathymetry data produced by the MASS2 model were used to begin bedform analyses. Flowpath algorithms were developed for the Grays, West Fork, and Crazy Johnson, longitudinal bed slope was estimated, and bedform shape and slope change were estimated throughout these reaches. Bedform analyses will be conducted in 2006 to evaluate relationships among spawning habitat, bedform, and hyporheic flow characteristics. Hyporheic temperature data are currently being analyzed.

Deliverable Status: Temperature and flow data were collected in late November 2005. These data have been prepared and are currently being analyzed. Hyporheic upwelling maps will be prepared early in 2006 and will be incorporated into the final technical project report.

F: Integrate results by comparing spawning habitat predictions to actual spawning.

Deliverable: Quantitative predictions of available habitat will be based on hydrodynamic model runs and in-channel geomorphic analysis. Input from watershed analysis and hydrologic model runs will be used to establish a relationship between watershed activities and site-specific habitat conditions.

Accomplishments During 2005: Data required for these analyses have been field collected (substrate, hyporheic characteristics, spawner counts) or estimated from models (water depth, velocity, bedform) associated with work elements described above. Spawner count data collected by the PSMFC are expected to be received early in 2006. Chum salmon spawning analyses will be finalized soon after those data have been received.

Deliverable Status: All habitat variable data are prepared and await receipt of 2005 chum spawner data from the WDFW. All analyses and deliverables will be completed during early 2006.

G: Prepare input to Pisces metrics.

Deliverable: Maintain records of Pisces metrics accomplished in FY 2005 for subsequent reporting. Metrics will include such information as measurable quantities of accomplishments (e.g., miles and acres of riparian buffer protected), exact locations of the actions (latitude/longitude, preferably from a global positioning system), and classification information (e.g., agricultural incentive program or not; lease, easement, or fee title acquisition). Metrics will be required for many non-habitat activities as well. Metrics, if any, for this project's Work Elements need not be reported during this contract period but will be required by December 31, 2005.

Accomplishments During 2005: Metrics were input into Pisces for FY 2005 and FY 2006 work elements.

Deliverable Status: Completed.

H: Produce statement of work and budget for 2006.

Deliverable: 2006 statement of work and budget

Accomplishments During 2005: In May 2005, PNNL submitted a response to the Council's budget request for FY 2006. Considerable time was spent responding to the Council's preliminary budget recommendation for this project in FY 2006, including preparation of several documents for submission to BPA and the Council. Interaction with the Council and BPA in developing the justification to continue this work in FY 2006 continued through summer 2005.

Challenges to Progress: In 2004, participation in stakeholder meetings through the completion of the project was added to Work Element C without an increase in project budget to cover the additional expenses. In addition, funding provided for 2006 is less than that budgeted. Therefore, PNNL has concerns regarding the sufficiency of available funding to complete all deliverables as originally proposed. We will accomplish the goals and objectives of the project, but there may be additional uncertainty with our findings and conclusions that will ultimately be resolved only with additional study.

Deliverable Status: The FY 2006 Statement of Work was submitted to Pisces in September 2005.

Schedule and Deliverables for 2006

January-March

- Receive 2005 PSMFC spawning data.
- Complete DHSVM and MASS2 model runs and obtain outputs.
- Complete geomorphic and hyporheic analyses.
- Analyze spawning characteristics and spawning habitat availability.
- Draft outline of final technical report.
- Prepare quarterly Pisces report.
- Continue attendance at monthly stakeholder meetings.

April-June

- Finalize final technical report outline.
- Complete watershed assessment and integration of geomorphic, hydrologic, biological data.
- Prepare figures, tables.
- Prepare introduction, background, methods sections.
- Prepare results, conclusions, discussion sections.
- Submit June 2006 accrual report to BPA.
- Prepare quarterly Pisces report.
- Continue attendance at monthly stakeholder meetings.

July-September

- Complete any remaining text/redrafts of final technical report.
- Compile complete draft of final technical report.
- Submit draft for external peer review.
- Submit September 2006 accrual report to BPA.
- Prepare quarterly Pisces report.
- Continue attendance at monthly stakeholder meetings.

October-December

- Finalize final technical report.
- Present report to BPA, stakeholders.
- Produce 2006 annual report.
- Prepare quarterly Pisces report.
- Continue attendance at monthly stakeholder meetings.