Intensively Monitored Watershed Project Implementation in Asotin Watershed:

PROPOSAL

Submitted to:

Gary Boone, RFP Coordinator
Walla Walla Community College
500 Tausick Way
Walla Walla, WA 99362
Tel. 509-527-4280
Fax. 509-527-4533
Gary.boone@wwcc.edu

Submitted by:

Nick Bouwes and Stephen Bennett
Eco Logical Research, Inc.
456 South 100 West
Providence, Utah 84332
Tel. 435-760-0771
nbouwes@gmail.com

Submitted: September 15th, 2012

Table of Contents

Intensively Monitored Watershed Project Implementation in Asotin Watershed: PROPOSAL

Submitted By

Eco Logical Research, Inc.

SUMMARY

The Walla Walla Community College has received funds to implement the restoration and monitoring phase of the Intensively Monitored Watershed (IMW) Project in the Asotin Creek watershed in the Snake River Salmon Recovery Region of southeast Washington. Eco Logical Research Inc. (ELR) has worked at developing IMW projects for the Snake River Salmon Recovery Board (SRSRB),the Integrated Status and Effectiveness Monitoring Project (ISEMP), Oregon Watershed Enhancement Board (OWEB), and the Collaborative System-wide Monitoring and Evaluation Program (CSMEP), as well as developing other components of Research, Monitoring, and Evaluation programs (RME) throughout the Pacific Northwest. Of significant relevance to this proposal request, ELR has developed and implemented an IMW design for the Asotin Creek in southeast Washington and Bridge Creek in the John Day Basin in central Oregon and thus has both the local knowledge and extensive background in the development and implementation of this and similar IMWs to undertake the effort described in the request for proposal (RFP).

Eco Logical Research Inc. proposes to use the following outline to implement the experimental and monitoring design for an IMW study in Asotin Creek:

1. Project Management and Coordination
    - Technical and Stakeholder Coordination
    - Landowner and Community Outreach
    - Budget and Equipment Management
2. Implementation Asotin IMW Design
    - Experimental Design
    - Monitoring Design
    - Restoration Design
3. Data Management, Reporting and Deliverables
    - Data Management
    - Mapping and Spatial Analysis

- Data Analysis and Synthesis

To provide these services on an annual basis from November 2012 to October 2019 we estimate the costs to be approximately ***$300,000*** per year with annual services to be provided by the Washington Department of Fish and Wildlife of approximately $50,000 in a separate contract. However, we will work with the contract monitor to manage the project with the funding available. Implementation of the stream restoration will be covered by other funding sources.

INTRODUCTION

Nearly 100 million dollars per year are spent on stream restoration projects in the Pacific Northwest in an effort to reverse declines in many salmonid stocks (Bernhardt et al. 2005, Roni et al. 2010). Recent reviews of many restoration projects have highlighted concerns over the lack of measureable effects of restoration activities, especially regarding increases in salmon and steelhead population levels and improvements to critical habitat (Beechie and Bolton 1999, PNAMP 2005, Roni et al. 2008). In response to this situation, both Washington state and several large regional initiatives are currently developing and implementing a network of Intensively Monitored Watershed (IMW) projects to respond to the need for more scientifically defensible monitoring and restoration programs (Bilby et al. 2004). The fundamental approach of IMW projects is to treat restoration as an experiment and concentrate a large restoration effort in order to increase the likelihood of detecting a population increase (Fullerton et al. 2010, Roni et al. 2010). The goal of these IMW projects is to link salmon and steelhead population responses to specific mechanisms related to habitat restoration. These initiatives will increase our understanding of what restoration activities are the most effective, demonstrate how changes in habitat influence survival of various life stages of salmon and steelhead, determine what magnitude of restoration is required to cause a significant population response, and ultimately provide information to better evaluate the efficacy of habitat restoration as a means of salmon and steelhead conservation and enhancement (Bayley 2002, PNAMP 2005).

In 2007, ELR was contracted by the State of Washington Recreation and Conservation Office to help develop an IMW in southeast Washington. The contract required ELR to coordinate the selection of a location for the IMW, develop an experimental and monitoring design, and implement pre-treatment sampling of fish and habitat. Eco Logical Research Inc. helped Snake River Salmon Recovery Board (SRSRB) coordinate input to the IMW process by federal, state, and local government, and local landowners via meetings with the Regional Technical Committee (RTT). The result of this contract was the development of a report titled: *Southeast Washington Intensively Monitored Watershed Project: Selection Process and Proposed Experimental and Monitoring Design for Asotin Creek* (hereafter referred to as the 'IMW design'; Bennett and Bouwes 2009). ELR was contracted in 2009 and 2010 to implement the IMW design including the installation and testing of PIT tag antenna arrays, fish and habitat monitoring, detailed geomorphic surveys (e.g., ground based LiDAR, aerial photography, and bathymetry), data analysis and management, and reporting. For both the IMW development phase (2007-2008) and the implementation of pre-restoration monitoring (2009-2012), ELR coordinated with and had assistance from the Washington Department of fish and Wildlife (WDFW) in the collection of fish and habitat data. The current RFP is for the implementation phase of the IMW which includes implementing the restoration design and post-restoration monitoring. The implementation phase is expected to cover the period from ***November 1, 2011 to October 30, 2019*** with annual renewals of contracts. Eco Logical Research Inc. is submitting this proposal for the *Intensively Monitored Watershed Project Implementation for the period of* ***Oct 1, 2012 to September 30, 2013***. We have arranged our proposal as per the original RFP for the implementation phase with three separate sections: A) Technical Proposal, B) Management Proposal, and C) Cost Proposal.

TECHNICAL PROPOSAL

A. Project Approach/Methodology

Eco Logical Research Inc. is submitting this proposal with the understanding that an IMW design has already been completed, and that the design has received approval by the RTT. As part of the IMW design process, Asotin Creek was selected as the most suitable site for the implementation of an IMW project. Asotin Creek is a tributary of the Snake River and supports a regionally significant run of mostly wild summer run steelhead (*Oncorhynchus mykiss;* ACCD 2004, Mayer et al. 2009, Crawford et al. 2011). Asotin Creek and its tributaries are desirable as an IMW location in the Snake River Salmon Recovery Region, in part, because there is strong agency and land owner support, extensive planning processes have already been undertaken, there is substantial amounts of historic habitat and steelhead population data available, and there are extensive ongoing monitoring efforts that can be utilized as part of an IMW (e.g., adult weir, smolt trap, and spawning monitoring; Bennett and Bouwes 2009, Crawford et al. 2011).

Three tributaries to Asotin Creek are the focus of the IMW and hereafter are referred to as the “study streams”: Charley Creek, North Fork Asotin Creek, and South Fork Asotin Creek. Each one of these streams has been divided into three 4 km long sections starting at the mouth, and within these sections permanent sites have been established to monitor fish and habitat each year. The lower 8 km of Charley Creek is located primarily on private property (two landowners) whereas the North Fork and South Fork of Asotin Creek are owned and managed by the WDFW and USFS. The original IMW design proposed implementation of riparian restoration in three sections of Charley Creek (i.e., 12 km total restoration); however, we recently revised the experimental design based on extensive statistical modeling of alternative designs (Wheaton et al. 2012). The current design now proposes that a 4 km section be restored in each study stream (Figure 1). This proposal is based on the revised experimental design.

Riparian function was recognized as a limiting factor in Asotin Creek by several previous assessments (ACCD 1995, ACCD 2004, SRSRB 2006) and will be addressed with fencing and planting of native vegetation (Bennett and Bouwes 2009). However, it was recognized in the IMW design that riparian fencing and planting would take several decades to restore full riparian function, and that in the short-term the addition of large woody debris (LWD) could increase pool abundance and instream habitat complexity. Therefore, LWD restoration methods will be the main focus of the IMW experiment. We propose to implement the revised IMW design with the steps outlined below.

1) Project Management and Coordination

Technical and Stakeholder Coordination

One of the main tasks of the successful candidate will be to act as the Project Coordinator for all aspects of the Asotin IMW. The duties of the Project Coordinator will be to communicate with all participating stakeholders, coordinate all IMW related activities (i.e., meetings, restoration actions, monitoring, communication, and dissemination of data), and manage the project to best meet the goals and objectives as described by the IMW design. Effective project coordination will best be accomplished by working with the RTT and the SRSRB office, local landowners, the Asotin County Conservation District, the Washington Department of Fish and Wildlife (WDFW), NOAA Fisheries, the U.S. Forest Service, and other local and regional agencies to make sure that the goals and objectives of the IMW can be met. We have already developed strong working relationships with the above mentioned agencies and groups having worked with them during the study area selection, IMW development, and the pre-restoration phases of the IMW. We believe the working relationships we developed during this period will allow us to more efficiently implement the IMW design.

Examples of the types of coordination and management that will be required include:

- Coordination with the WDFW, Asotin County Conservation District (ACCD), and NOAA Fisheries to secure permits for fish capture and tagging and restoration implementation. We have already secured fish capture and tagging permits from NOAA fisheries through to 2013 for the Asotin Creek IMW. Permits have also been received for past installation of PIT tag arrays and the first year of restoration in South Fork Asotin Creek in accordance with the WDFW Joint Aquatic Resource Permit Application (JARPA) requirements, the Department of Highways, and County Shorelines Permits.

- Coordination with SRSRB and the RTT to ensure that IMW related information is shared. We regularly attend monthly RTT meetings to provide updates on the IMW's progress, review technical data, request budget reallocations, and approval for changes to design elements of the IMW as necessary.

- Coordination with the ongoing WDFW Asotin monitoring programs to ensure that the data can be shared between projects and that duplication of effort is avoided (e.g., adult weir, smolt trap, redd counts; Crawford et al. 2011). We coordinate with the Clarkston office of WDFW regularly as they provide 2-3 staff to assist in habitat and fish data collection from June through October each year. We also coordinate with the Dayton office in regard to redd counts.

Landowner and Public Outreach

It is important to provide information to the local community about the IMW an its goals. We propose to do this with consultation and regular meetings with private landowners to ensure that access by IMW monitoring crews will be allowed and to maintain landowner support for the project. We also propose to contact all local landowners regularly to get approval for any entrance on to their land to conduct IMW related activities. We currently have a landowner agreement with J. Thornton to access land along

Charley Creek and recently the Koch family sold land along Charley Creek to WDFW so we now have access agreement to all three study streams. Work on WDFW land is coordinated with regular meetings with the RTT.

We are also using outreach and education with local groups to increase understanding of the IMW and its goals. We have hosted Washington State University students each year and provide education on fish capture techniques, habitat surveys, and the goals and objectives of the IMW program. We have also presented IMW results at professional society meetings (AFS), and board meetings to draw attention to the IMW project and increase awareness of the data being collected. We have also provided news stories and a poster to the ACCD to increase local awareness of the IMW and KLEW television recently ran a story on the restoration work being implemented as part of the IMW: http://www.klewtv.com/news/local/Fish-habitat-restoration--167904895.html.

Budget and Equipment Management, Purchase, and Maintenance

Management of the IMW Implementation budget and tasks is critical for efficient use of IMW resources. As the Project Coordinator our responsibility will also be to manage the IMW implementation budget, and submit monthly progress reports to the RTT, SRSRB, and Walla Walla Community College. To date we have successfully managed three IMW contracts collecting pre-treatment data and overseeing the installation of a cost effective monitoring infrastructure. All equipment will be carefully inventoried and maintained to extend the life of the equipment. Below we describe the major equipment management that will be required for the duration of the IMW project.

Pit Tag Antennas and Readers

Since the summer of 2009 ELR has been downloading PIT tag detections at each antenna array site, testing the read range of each antenna, and conducting detection efficiency tests. Read ranges for all antennas are between 25-45 cm and efficiency tests indicate detection rates are high (typically > 90%). In cooperation with Quantitative Consultants Inc. (QCI) we have linked all the arrays to the QCI server via a telephone modem. QCI manages numerous arrays for WDFW, IDFG and ISMEP. The performance of the arrays are now monitored continually, and the project coordinator will receive an alert via email if the performance of any array falls below set criteria (e.g., low power or high site noise/interference). ELR has arranged to have Quantitative Consultants Inc. (QCI) automatically upload all the Asotin IMW array data to PTAGIS for a monthly service fee. QCI currently manages ISEMP and WDFW arrays throughout the Columbia Basin. We will continue to test the efficiency of the antenna arrays, maintain the tag readers, and ensure that the data is downloaded and stored on a regular basis throughout the life of the contract.

Temperature Loggers

To assess water temperatures in the study streams, 25 temperature loggers were deployed in the summer of 2008 and 2009. We will continue to maintain, monitor, and replace temperature loggers through 2019 by downloading and analyzing the temperature data, replacing batteries as needed, and re-deploying the devices to continually monitor water temperature throughout the study area.

Stream Gauges

There are currently four active stream gauges in Asotin Creek managed by the Department of Ecology and the U.S. Geological Survey. We will continue to access these data online and use them for assessing stream conditions and as covariates in analyses of fish capture rates and other biological assessments. The original IMW design called for the addition of two manual gauge height stream flow sites (Charley Creek and South Fork). We installed two TruTrak water level gauges in 2009 - one at the pit tag antenna array at Charley Creek and one at the antenna array on South Fork. Since the water level gauges were installed, we have collected manual discharge estimates and developed a discharge relationship at each site. We will continue to maintain and monitor these water level gauges and use the data to estimate discharge within Charley and South Fork Creeks. Additionally we have installed a water level gauge linked via telephone modem at each PIT tag array. These gauges will provide discharge information at the arrays which is necessary to fully assess detection rates and array performance. The array water level gauges will also provide backup discharge information throughout the watershed. These data will be used as covariates in analyses of fish abundance and also used to help design restoration structures.

2) Implementation of Asotin IMW Design

Our general approach to completing the *Intensively Monitored Watershed Project Implementation* contract will be to implement the original IMW design (Bennett and Bouwes 2009) and recent refinements to the design (Bennett et al. 2010, Bennett et al. 2011a). We have not reproduced all the details of the IMW design in this RFP because the design is a stand-alone document. However, the following sections detail our proposed approach and methodology for implementing the IMW design, and we have highlighted situations where the existing design may require amendments due to funding constraints, information gathered in the pre-treatment phase, and/or improvements in monitoring technology. We acknowledge that the original design has been revised and may continue to need revisions as new data analyses are performed and based on funding availability.

Experimental Design

During the summer of 2010 we completed a detailed model simulation of the original IMW experimental design (restoring one stream and using two streams as controls) and an alternative design (restoring one section in each study stream and using all remaining sections as controls) with the assistance of Dr. Tom Logan of Simon Fraser University. Dr. Loughin is one of the few people to publish papers related to the staircase design we originally proposed (Loughin et al. 2007). We determined that the alternative design was potentially more powerful at detecting changes in fish abundance and as such, recommended that the alternative design be adopted. The main assumptions of the current experimental design are that a 4 km long restoration treatment in each stream will be large enough to detect a population response of steelhead, that the variance between sections within streams is less than the variance between sections in different streams, and that the responses of sections and streams are relatively independent. We will be able to further test these assumptions as we implement restoration in each stream and the design is flexible enough that if these assumptions are violated we can alter the distribution of the restoration accordingly.

Monitoring Design

We have collected almost four years of pre-restoration fish and habitat data for the Asotin IMW. The majority of the data has been collected at 12 permanent monitoring sites within the study streams (Figure 2). Currently six sites are monitored in Charley Creek and three sites are monitored in both the North Fork and South Fork. We may need to establish some new permanent sites in the North Fork and South Fork because the experimental design has been revised. Originally the North Fork and South Fork were going to be used as control streams but in the new experimental design sections of all three streams will be restored. We propose to explore the benefits and costs of reallocating sampling effort based on the new design during the restoration phase of the IMW. Restoration will be implemented over three or more years in a staircase design to minimize the potential of restoration x year affects from biasing the results (Walters 1988, Loughin et al. 2007). We propose to continue monitoring fish and habitat in sections that are restored (e.g., treatments) and sections that are not restored (e.g., controls) for the duration of the project which is expected to extend to at least 2019. The following sections briefly describe our proposed monitoring methods and rationale.

Fish Capture and Tagging

The IMW design calls for sampling of adult spawning (weir and redd counts), juvenile abundance estimates, and PIT tagging of juveniles. The WDFW operates an adult weir and smolt trap on the mainstem Asotin and conduct redd counts throughout the study streams (Crawford et al. 2010). These data will be used as part of the IMW monitoring design. The design also calls for adult fish to be PIT tagged at the weir so that we can estimate the number of adults entering the study streams using the IMW PIT tag array network. This information will be critical in helping calibrate the abundance of juveniles in relation to the number of adult spawners each year.

Juvenile sampling is scheduled for two periods per year - summer and fall. We propose to conduct the first juvenile sample after high flows in early July. The second sample will be conducted during low flow conditions in early fall starting in late September or early October. During each period we conduct a mark-recapture survey over two days at each site. All steelhead >= 70 mm are tagged with PIT tags and abundance is calculated using the modified Lincoln-Peterson mark-recapture method (Krebs 1999). The summer and fall capture periods also allow us to calculate growth and survival parameters for juvenile fish for the summer and winter/spring seasons. We propose to tag approximately 1500-2500 steelhead per period (i.e., 5000 per year). Bull trout and Chinook will also be tagged but make up < 1% of all fish captured.

Redetection of PIT Tagged Fish

We installed three PIT tag antenna arrays in 2009 at Charley Creek, Cloverland Bridge, and Asotin Forks and one array at the mouth of Asotin Creek in 2011 in conjunction with the WDFW. All the arrays are capable of detecting the direction of fish movement except the Cloverland array. All arrays were upgraded in 2011 to allow for remote data acquisition via telephone modem. These arrays form a critical part of the IMW monitoring framework allowing detection of adult and juvenile movement into and out of Asotin Creek and the three study streams. The detection of PIT tagged fish also allows us to determine when fish migrate from Asotin Creek and improve our survival estimates of juvenile steelhead by increasing the number of detections. We propose to continue to monitor and manage the array infrastructure to provide this valuable data.

We also propose to use a mobile pit tag detection antenna system to survey the fish sites in between the two tagging periods. This work takes advantage of the number of tagged fish that are in Asotin Creek to improve estimates of fish movement and survival. A mobile antenna will be used to detect tagged fish and a GPS system will be used to record the location of all tagged fish. These data will be used to calculate distances moved, habitat use, and site fidelity of juvenile fish. An additional resight of tagged fish will also improve the precision of survival estimates. We have conducted summer, fall, winter and spring mobile surveys at each study site since 2009 and propose to continue these surveys. We also began to survey the entire 12 km of each study stream in 2011 to better understand movement of PIT tagged fish outside of the study sites and propose to continue these surveys.

Auxiliary Fish Data

In 2011 we initiated a tag retention and fish community study. At the end of the second day of the mark-recapture surveys we held fish over-night in live wells to determine if there was any tag loss within a 24 hour period. We also fin clipped all PIT tagged fish during the summer survey. We then recorded the number of fish with a PIT tag, fin clip, or both during the fall survey to determine tag loss between the summer and fall survey periods. We also began fin-clipping sculpin and dace in an effort to better understand the abundance of these fishes in relation to steelhead abundance. We believe that these are important data to collect and will increase our ability to explain the affect of restoration and help improve monitoring methods.

Riparian and Stream Habitat

The IMW design calls for stream habitat to be assessed once each year and riparian vegetation, and flood plain conditions to be assessed every three years. The restoration actions are designed to increase instream large wood and riparian conditions in Charley Creek to near historic conditions. It is hypothesized that additions of large wood will increase the number and quality of pools, increase channel complexity, and improve sediment sorting and bar development. Riparian and stream habitat characteristics were measured using the PACFISH/INFISH Biological Opinion (PIBO) Effectiveness Monitoring Program riparian and stream habitat protocols from 2008 to 2009 (Heitke et al. 2010; Leary and Ebertowski 2010). However, since 2010 we have transitioned to using the Columbia Habitat Monitoring Program (CHaMP; Bouwes et al. 2011). The protocols use many similar methods to assess riparian and stream habitat conditions and CHaMP will likely be able to reproduce PIBO channel assessments. But we feel that the CHaMP protocol in combination with remote sensing (see below) will provide data that will be move directly related to fish habitat requirements. The CHaMP protocol provides standard measures of key stream characteristics such as pool frequency, large wood abundance, width to depth ratio, and substrate size, as well as site level attributes such as food abundance (drift samples), topographic mapping of the channel and banks (digital elevation models), and solar radiation input (degree days of solar energy). The CHaMP approach also identifies and maps habitat units that will allow a more detailed assessment of habitat available for fish and allow us to better understand the influence of stream restoration on specific habitat attributes. The CHaMP program is also working in conjunction with ESSA Technologies to refine the River Bathymetry Tool Kit to allow automated data analysis of the CHaMP topographic surveys (McKean et al. 2009). This will further expand the ability to analyze and interpret the influence of the proposed restoration on stream habitat, channel form, and sediment transport. We propose to continue using the CHaMP protocol.

Spatially Explicit Rapid Habitat Surveys

To assist in the development of a restoration plan and assess how representative our permanent sample sites were of the study streams we began conducting spatially explicit rapid habitat surveys of the entire lower 12 km of each study stream in 2010. During these rapid surveys we determined the geomorphic reach type based on Montgomery and Buffington (1997). Determining the reach type will be important in determining the potential response of the channel to restoration. We also georeferenced attributes that we expect to use as response variables to detect changes due to restoration which include: abundance of LWD, pools, inset bars, and sediment sources. For each pool we determined the main forcing mechanisms (i.e., how was the pool created) to better understand how to design restoration structures that could mimic these mechanisms. We propose to repeat these surveys after restoration actions have been completed to help understand the spatial influence of restoration actions: for example, are LWD moving downstream from restoration sections to non-restoration sections.

Aerial Photography and LIDAR

Changes in riparian habitat and channel form will be assessed using a combination of high resolution aerial photography, and ground based and aerial LiDAR (Jones et al. 2007). Most of the Charley Creek study sites were surveyed using ground based LiDAR in 2009, which provides information on riparian vegetation size and density, valley and channel topography. The ground based LiDAR surveys from 2009 will be augmented with aerial LIDAR surveys in 2011 (data has not been analyzed yet). The aerial surveys will cover the Asotin mainstem from the mouth to the confluence of North Fork and South Fork and the lower 15 km of each of the study streams. Georeferenced aerial photography (from a blimp) has been completed for most of Charley Creek. Further aerial photography surveys with a remote control plane will be completed over the extent of the aerial LIDAR surveys. The aerial photography can also be used to assess LWD, pool habitat, and water depth when used in conjunction with georeferenced water depth measurements (Marcus and Fonstad 2008). The LiDAR and aerial photographic surveys will provide context for the IMW study and allow us to determine changes in the stream channel form and riparian extent. We propose to synthesize the LiDAR and photographic data and make it all publically available. We propose to repeat these surveys after restoration has been completed and based on funding availability.

Restoration Design

During the summer of 2010 we conducted a literature review of the potential restoration options for IMW study streams (Charley Creek, North Fork and South Fork). We also invited several restoration practitioners from a variety of government and academic organizations (e.g., USU, WDFW, USFS, NOAA) to visit Asotin Creek and help us assess the restoration options that were proposed in the original IMW design (Bennett and Bouwes 2009). Based on these field visits and input from the participants, ELR determined that the original proposal of adding large woody debris (LWD) to the study streams was an appropriate restoration action to implement and test the effectiveness of as per the goals of the IMW program. A detailed restoration design has now been completed for the Asotin IMW and has been submitted to the RTT for review prior (Wheaton et al. 2012).

The restoration plan was developed by ELR in consultation with Dr. Joe Wheaton, a fluvial geomorphologist at Utah State University. Dr. Wheaton has also been consulted by ISMEP to aid in restoration design and monitoring of the Bridge Creek IMW. The primary restoration design proposed for the Asotin IMW is to drive wooden posts into the stream bottom to act as a flow width constriction and as a debris catchers (Figure 3). Large woody debris will also be added to some structures to increase the habitat complexity of the stream and promote pool formation and sediment sorting.

As part of the 2010 Asotin IMW contract, ELR conducted a trial of the proposed restoration approach at the request of the RTT. Fifteen structures (five per study stream) were built in the lower reach of each stream to assess the techniques feasibility. The trial restoration demonstrated that the post structures are logistically feasible to build, inexpensive, and can be constructed with minimal disturbance to the existing riparian habitat. We conducted a habitat assessment and topographic survey as per the CHaMP protocol (Bouwes et al. 2011) at each trial restoration site prior to installation of the post and LWD structures. Pretreatment habitat attributes and topographic conditions will be compared to post-treatment conditions to determine the affects of the structures. We are currently developing a manuscript for publication based on the results of the trial structures.

We implemented the restoration plan in July 2012 based on approval of the restoration plan by the RTT and based on the results of the trial restoration. We are actively coordinating with the SRSRB, USFS, landowners, and other groups to acquire materials for restoration activities (i.e., large wood, etc.). The USFS has already donated LWD that is being stock piled on WDFW and private property. To date we have built 170 of the proposed 200 structures.

Restoration Funding

We currently have a proposal under review by the SRFB to fund the last two years of the restoration in Charley Creek and North Fork Creek. We expect restoration to begin in July 2013. Restoration will end in 2014 and be followed by 3-5 years of post-restoration monitoring.

3) Data Management, Analysis, Synthesis, and Reporting

Data Management

ELR is continually working with ISEMP database managers to develop databases for current monitoring efforts throughout the Columbia River Basin. ISEMP also provides data management tools and guidance to encourage best data management practices within local agencies. These data management tools are MS Access based databases providing users with database structures that ensure that newly collected data and historic data are structured in formats consistent with regional databases. These databases also ensure metadata is directly linked to raw data, and that a minimum level of data quality is assured at the time of data entry. The databases have an easy to understand structure, including tables for tracking projects, sites, data collection events, and observations. Templates have data entry forms and perform standard metric calculations and also allow users to create new tables, create data entry forms, or develop new metric calculations. ISEMP is currently providing training agencies during the testing phase of these tools. To date, agencies have expressed an overwhelming interest in ISEMP tools and guidance because these tools assist agencies in meeting both their analysis and reporting objectives. In addition, these databases will be loaded into a web-based data application. We propose to use the ISEMP data management and QA/QC procedures with all the Asotin IMW data collected. Nick Bouwes, President of ELR, will also review all analyses and reports produced from the IMW design to ensure data quality and consistency with professional standards.

Data Analysis and Synthesis

To fully understand how the restoration treatment influences steelhead populations we propose to monitor a wide variety of response variables. The fish response variables we will assess will be components of overall population production: abundance, growth, and survival. These metrics will be used in combination with abiotic metrics such as stream discharge and temperature to explain changes in overall steelhead production (Sogard et al. 2009, Horton et al. 2009, Davidson et al. 2010). We will use the program MARK to estimate seasonal survival estimates from PIT tag detection data (Cooch and White 2010). Examples of steelhead response variables we will monitor include:

- Smolts/Spawner;
- Spatial distribution as measured by changes in relative density;
- population abundance;
- seasonal survival;
- parr-to-smolt survival;
- recruiting adults (R/S – provided by ongoing WDFW Asotin Assessment Project, Crawford et al. 2010);
- smolts per redd or per spawner;
- migratory timing, size, and growth rates.

Mapping and Spatial Analysis

A goal of our approach is to bring most of the data collected for this IMW into a GIS database in order to allow spatial analysis of fish populations and stream habitat. To this end we have completed geomorphic surveys of the first 12 km of each of the study streams and have mapped these data in GIS.

Other aspects of the project we propose to bring into GIS and analyze include:

- Fish movement within and between study streams will be plotted using GIS and detections of tagged fish at fixed antennas, the smolt trap, and with mobile antenna surveys,
- Adult spawning locations (with the assistance of WDFW all redds identified during spawning surveys will be located with hand held GPS during spring redd surveys),

- Existing restoration structures within Charley Creek, North Fork, and South Fork (i.e., use hand held GPS to locate large wood and boulders placed during previous restoration efforts and assess each structure as to its current function). Photographs will also be taken at each site.

- Aerial photographs of the study streams will be georeferenced and used for assessing channel change,

- All fish sample sites, habitat sample sites, restoration treatments, and supporting infrastructure (PIT tag arrays, temperature probes, water gauges, etc.), and

- CHaMP topographic surveys of the valley and stream channel will be converted to digital elevation models (DEMs) and further analyzed using an ArcGIS toolkit developed for ISEMP. Output information includes cross sections, pool frequency, pool volume, sinuosity, gradient, entrenchment, width, width:depth ratios and others metrics.

Reporting

All data collected will be summarized and presented in a year-end report (e.g., see Bouwes and Bennett 2009, Bennett et al. 2010). The report will incorporate the data collected since the beginning of the Asotin IMW and historic data where appropriate and include the following sections: Introduction, Methods, Results, Discussion, Conclusion and Recommendations. The report will also include a Work Plan for the next year and recommendations for refinements to the experimental and monitoring designs. Monthly progress reports will also be submitted to the contract monitor.

B. Work Plan

We provide a work plan for the period of October 1, 2012 through September 30, 2013 for the implementation of the IMW design (Appendix 1). The work plan also outlines what tasks the WDFW will be conducting as part of a cooperative agreement to collect and share data. We have proposed a ***one year*** work plan assuming that there will be a set amount of coordination, management, monitoring, and reporting required each year that will be repeated over the course of the IMW project (i.e., 2012-2019). Where appropriate we have outlined other tasks that are likely to occur less frequently (e.g., LiDAR flights). The exact timing of the non-annual tasks will be dependent on budget and implementation of restoration activities.

C. Project Schedule

The exact timing of monitoring will depend on stream conditions, weather, and availability of the WDFW crews. We anticipate conducting a late spring and a late summer/fall fish survey and conducting the habitat sampling during summer low flow conditions. The schedule we present reflects the approximate time range that tasks will be completed within (Table 1). We will coordinate, and seek approval from the contract monitor for any changes or refinements to this schedule.

Table 1. Proposed annual schedule for major project elements of the Asotin IMW project: 2011 - 2019. See Work Plan in Appendix 1 for a more detailed timeline of annual elements.

Year	Period	Activity	Description
2011	Nov - Dec	Management&Coordination	Begin contract & meet with RTT to assess future direction
	Nov - Dec	Implementation&Monitoring	Conduct mobile PIT tag surveys & maintain IMW equipment
	Nov - Dec	Data Analysis&Synthesis	Continue to data analysis & synthesis
2012	Jan- Dec	Management&Coordination	Manage activities & coordinate with landowners & stakeholders
	Jan - Dec	Implementation&Monitoring	Conduct fish & habitat surveys, maintain equipment, & revise design
	Aug - Sept	**Implement Restoration***	Restore 4 km long section of South Fork (separate contract)
	Oct	Reporting&Deliverables	Data analysis & synthesis, submit annual report
2013	Jan- Dec	Management&Coordination	Manage activities & coordinate with landowners & stakeholders
	Jan - Dec	Implementation&Monitoring	Conduct fish & habitat surveys, maintain equipment, & revise design
	Aug - Sept	**Implement Restoration***	Restore 4 km long section of Charley Creek (separate contract)
	Oct	Reporting&Deliverables	Data analysis & synthesis, submit annual report
2014	Jan- Dec	Management&Coordination	Manage activities & coordinate with landowners & stakeholders
	Jan - Dec	Implementation&Monitoring	Conduct fish & habitat surveys, maintain equipment, & revise design
	Aug - Sept	**Implement Restoration***	Restore 4 km long section of North Fork (separate contract)
	Oct	Reporting&Deliverables	Data analysis & synthesis, submit annual report
2015	Jan- Dec	Management&Coordination	Manage activities & coordinate with landowners & stakeholders
	Jan - Dec	Implementation&Monitoring	Conduct annual fish (tagging & mobile) habitat surveys
	Oct	Reporting&Deliverables	Data analysis & synthesis, submit annual report
2016	Jan- Dec	Management&Coordination	Manage activities & coordinate with landowners & stakeholders
	Jan - Dec	Implementation&Monitoring	Conduct fish & habitat surveys, maintain equipment, & revise design
	Oct	Reporting&Deliverables	Data analysis & synthesis, submit annual report
2017	Jan- Dec	Management&Coordination	Manage activities & coordinate with landowners & stakeholders
	Jan - Dec	Implementation&Monitoring	Conduct annual fish (tagging & mobile) habitat surveys
	Oct	Reporting&Deliverables	Data analysis & synthesis, submit annual report
2018	Jan- Dec	Management&Coordination	Manage activities & coordinate with landowners & stakeholders
	Jan - Dec	Implementation&Monitoring	Conduct fish & habitat surveys, maintain equipment, & revise design
	Oct	Reporting&Deliverables	Data analysis & synthesis, submit annual report
2019	Jan- Dec	Management&Coordination	Manage activities & coordinate with landowners & stakeholders
	Jan - Dec	Implementation&Monitoring	Conduct annual fish (tagging & mobile) habitat surveys
	Oct	Reporting&Deliverables	Data analysis & synthesis, submit annual report

C1. References

Work References - N. Bouwes

Dr. Chris Jordan NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Blvd. E Seattle, WA 98112. Telephone: 541-754-4629. Integrated Status and Effectiveness Monitoring Program.

Dr. Michael Pollock- NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Blvd. E Seattle, WA 98112. ISEMP-Intensively Monitored Watershed Restoration Project-Bridge Creek. Telephone: 206-860-3451.

Dr. James Ruzycki- Oregon Department of Fish and Wildlife, 203 Badgley Hall, EOU, One University Blvd, La Grande, OR 97850. The Middle Fork Intensively Monitored Watershed Study and the John Day Steelhead and Salmon Monitoring Program. Telephone: 541-962-3067.

Dr. David Marmorek- ESSA Technologies Ltd. Suite 300, 1765 W, 8th Ave. Vancouver BC Canada V6J 5C6. Collaborative Systemwide Monitoring and Evaluation Program. Telephone: 604-733-2996

References - S. Bennett
Dr. Jeffery Kershner, Center Director, USGS Northern Rocky Mountain Science Center
Bozeman, MT. Telephone: 406-994-5304

Dr. Brett Roper, National Aquatic Ecologist, USDA Forest Service, Fish and Aquatic Ecology Unit, Logan, UT 84322. The PACFISH/INFISH Biological Opinion (PIBO) Effectiveness Monitoring Program. Telephone: 435-755-3566.

Peter Corbett, Manager, Mirkwood Ecological Consultants Ltd., Box 138, Winlaw, B.C. V0G 2J0. Telephone: 250-226-7249.

D. Deliverables

The minimum deliverables that will be submitted as part of this contract are an annual report which will contain a summary of the previous years results and a synthesis of the fisheries and habitat data in relation to the restoration activities. Data and reports and supporting information (e.g., photos, digital elevation models, georeferenced fish and habitat data, LiDAR data, and aerial photography will be posted on a website and made publically available as the project progresses). Examples of the reporting elements that will be provided include the following:

- Summary of fish and habitat assessments within treatment and control sections of the study streams.
- Summary aerial and ground based geomorphic assessments (e.g., ground and aerial LiDAR, aerial photography, bathymetry, and topography) within treatment and control sections of the study streams.
- Maintenance and data downloading of all of PIT tag antenna arrays, stream flow gauges, and temperature probes. We will also include a list of all equipment purchased, a maintenance schedule, and replacement requirements.
- PIT tag approximately 3000-4500 juvenile steelhead per year, and all adults captured at the WDFW adult weir (coordinated with WDFW).
- Enter all PIT tag data into the PTAGIS system

- Enter and maintain all data collected (fish, habitat, water quality, geomorphic) into MS Access and GIS databases. Time and budget permitting, historic data will also be imported in databases.
- Monthly progress reports.
- A annual report including a revised experimental and monitoring plan, and a draft work plan for the following year of the IMW project form 2011 through 2019.
- A final report summarizing the Asotin IMW project, the affect of stream restoration on steelhead production, and implications for other restoration efforts in similar watersheds.

E. Outcomes and Performance Measurement

The above described Technical Proposal will provide the management, coordination, and implementation of the Asotin IMW through to the end of 2019. During this period all the proposed restoration will be implemented and the results of the experiment will be reported. We expect to further refine the existing experimental and monitoring design, and continue to coordinate all monitoring activities within the Asotin watershed to best attain the goals and objectives of the IMW design. We will have regular meeting with the RTT, private landowners, and interested agencies to coordinate our activities and engage these groups in the goals of the IMW. Monthly progress reports and budget updates will be provided to the contract monitor no later than five days after the end of each month. The progress reports will report any external contracts, deadline status, problems encountered, and our accomplishments. The progress report will be organized according to the tasks outlined in our Technical Proposal (see above). The SRSRB will provide oversight for the project and the projects progress will be communicated to the contract monitor (Walla Walla Community College), SRSRB, RTT, public and other interested parties via a final report and presentation.

Management Proposal

A. Project Management

1. Project Team Structure/Internal Controls

Dr. Stephen Bennett will be the team leader for this project. Dr. Bennett was the team leader in the development of the original IMW design and the implementation of the first four years of monitoring in Asotin Creek (2008-2012). Stephen has developed a solid working relationship with the groups and agencies that will be instrumental in implementing the Asotin IMW. Dr. Nicolaas Bouwes, as President of ELR, will provide oversight of the project and review all products and work plans to ensure they meet the regional standards that are currently being developed for IMWs (e.g., PNAMP 2005). Field technicians will be hired to assist in the equipment maintenance and monitoring portions of the contract and support staff will also be provided by WDFW through a cooperative agreement to coordinate monitoring in the Asotin Watershed. The cooperative agreement provides an opportunity for training and coordination of survey protocols and an ability to increase the efficiency of the monitoring program. Eco Logical Research Inc. has also conducted an annual training session for all employees working on

IMW projects in order to increase consistency among projects, coordinate data collection, and reduce measurement and observer errors. These training sessions are also used to review goals and objectives of the IMW projects to ensure crew members are all working towards a common goal with a high degree of competency.

2. Staff Qualifications/Experience

Below we provide brief resumes of the two principle investigators that will be working on this project. More detailed resumes can be provided upon request.

Dr. Nicolaas Bouwes

Dr. Bouwes has a strong foundation in biometric and data analyses, modeling, experimental and monitoring design, fisheries research and aquatic ecology and has detailed knowledge of the salmon, steelhead, and bull trout issues in the Columbia River Basin. Nick is the owner of Eco Logical Research, Inc. Nick is also an adjunct professor at the Watershed Sciences Department, Utah State University, Logan UT. Projects he is currently working on include: Asotin Creek Intensively Monitored Watershed Project in southeast Washington and the Integrated Status and Effectiveness Monitoring Program to developed standardized status, trend, and effectiveness monitoring programs for salmon and steelhead in the Columbia River Basin. Other relevant projects he has worked on includes Collaborative Systemwide Monitoring and Evaluation Program to review information needs and development of monitoring and analyses for salmon and steelhead populations of the Columbia River Basin; technical review and validation of EDT and the KlamRAS models used in the FERC relicensing process of the Klamath River hydrosystem, and the Comparative Survival Study to compare steelhead and salmon smolt and adult survival rates across different regions and hydrosystem experiences. Nick was previously employed first as a fish population analyst and then as a biometrician/modeler for ODFW on regional issues related to the salmon and steelhead management in the Columbia River Basin. His project involvement included PATH, which was a multi-agency evaluation of the impacts of alternative management actions on survival and recovery of listed salmon and steelhead stocks in the Columbia River Basin. He also worked on the NMFS Technical Recovery Team to determine recovery goals and assessing risk to endangered salmonids of Lower Columbia/Willamette. Nick and employees from ELR recently completed a draft stream habitat monitoring protocol review and methods development for NOAA and Bonneville Power that will be used as the foundation of stream habitat monitoring in the throughout the Columbia River basin as part of the BiOP salmon and steelhead recovery process (Bouwes et al. 2011). Nick received a BS in zoology from the University of WI, Madison, and a MS and PhD in aquatic ecology from Utah State University, Logan UT.

Dr. Stephen N. Bennett

Dr. Bennett has been working for Eco Logical Research, Inc. since 2007 as the project coordinator of the Asotin Creek Intensively Monitored Watershed Project in southeast Washington. Stephen has also worked to aid in the development and assessment of regional salmonid monitoring programs and has been working as a Post Doctoral researcher with Dr. Brett Roper of the USDA Forest Service, Fish and Aquatic Ecology Unit. Stephen's Post Doctoral research has focused on writing a National Forest Fish

Inventory and Monitoring Manual for the Forest Service involving a comprehensive review of the statistical design and analyses of fish abundance data. Stephen also co-authored a paper with Dr. Roper comparing the effectiveness of common stream habitat monitoring protocols (e.g. AREMP, PIBO, EMAP, ODFW, etc.) using a variety of measures of precision and estimating minimum sample size requirements to detect change (Roper et al. 2010). Stephen recently completed a PhD in Fisheries Biology in 2007 at the Watershed Sciences Department at Utah State University, Logan, Utah. Stephen's dissertation focused on invasion ecology and issues related to hybridization between native cutthroat trout and introduced rainbow trout. Prior to starting his PhD Stephen was a biological consultant for 12 years working on a variety of fisheries issues including fish inventory, fish passage assessment, watershed analysis, habitat monitoring, impact assessments, and salmonid enhancement projects. Stephen also has a Masters in Resource and Environmental Management (M.R.M.) from Simon Fraser University, Canada, and a Wildlife Biology (B.Sc. Honors), University of Montana.

Dr. Joseph Wheaton

Dr. Wheaton is an Assistant Professor at Utah State University and a fluvial geomorphologist with over a decade of experience in river restoration, including working with beaver in restoration. Joe runs the Ecogeomorphology & Topographic Analysis Lab at Utah State University and is a leader in the monitoring and modeling of riverine habitats and watersheds. He has worked to develop monitoring protocols for the USFS, NOAA, USGS and National Park Service and he and his lab have produced software for monitoring applications and simulation modeling. He is the co-director of the Intermountain Center for River Rehabilitation & Restoration. He worked four years in consulting engineering before completing his B.S. in Hydrology (2003, UC Davis), M.S. and Ph.D. in Hydrologic Sciences (2003, UC Davis; 2008, U. of Southampton, UK). He has worked as a lecturer (U. of Wales 2006-08), Research Assistant Professor (Idaho State U. 2008-09) and is an Assistant Professor at Utah State U. (2009-present) where he teaches courses on GIS, Fluvial Hydraulics and Ecohydraulics as well as workshops on 'Restoration Monitoring: Geomorphic Change Detection', 'Partnering with Beaver in Restoration Design', and 'Geomorphology and Sediment Transport in Channel Design'. Projects he is currently working on include: Asotin Creek Intensively Monitored Watershed Project in southeast Washington, Intercomparing Monitoring Methods in the Lemhi Watershed of Idaho for the Integrated Status and Effectiveness Monitoring Program, Bridge Creek Intensively Monitored Watershed restoration project in Central Oregon, developing a Big River Monitoring Protocol for the National Park Service, working on sediment budgeting in the Grand Canyon with the USGS Grand Canyon Monitoring & Research Center.

Dr. Mary Conner

Dr. Conner is a population ecologist with an emphasis in biostatistics and the analysis of large and often messy data sets. Mary has extensive experience in inference methods for mark-reencounter (i.e., mark-recapture, mark-resight) data, and a strong background in the use of stochastic population projection modeling, meta-analyses of demographic data, simulation experiments to design or assess population monitoring programs, and application of information theoretic methods to management experiments with a focus on multi-model inference. In addition, Mary's Post Doctoral research included analysis of spatial and temporal epidemiology of chronic wasting disease. Mary has worked for academic and government agencies on a variety of projects; recent projects include developing a stochastic population model to assess the relative contribution of competition and disease to low population growth rates in a native cutthroat trout population, designing a meta-analyses to assess forest management strategies on California spotted owl demographics, developing a stochastic population model to assess impacts of disease and management interventions on endangered Sierra Nevada bighorn sheep, conducting a simulation experiment to compare precision and bias of Cormac-Jolly-Seber and Barker mark-resight models when data is collected by passive instream antennae, and conducting a simulation experiment to compare estimates of population growth rate from Pradel and occupancy models for a territorial species. The overarching goal of her work is to enable managers to evaluate effects of management actions or inaction in the face of temporal and/or spatial environmental variation. Mary is an adjunct professor in the Watershed Sciences and Wildland Resource Sciences Departments at Utah State University. She received her BS in Agricultural Engineering from California Polytechnic State University, a MS in Wildland Resource Science from University of California, Berkeley, and a PhD in Wildlife Biology from Colorado State University.

Nadine Trahan

Nadine Trahan recently joined Eco Logical Research as GIS / Remote Sensing Analyst. She is implementing a process driven approach to the geomorphic classification of Columbia River Basin streams upon which to base geo-spatial data organization, analysis and results to support ELR's monitoring and assessment of salmonid habitat. Nadine has over 10 years experience in applying GIS and remote sensing technologies to interdisciplinary river research. Her research has focused on placing water quality assessment, macro-invertebrate indices and salmonid distributions into biophysical contexts via implementation of a geomorphic classification system, i.e., the River Styles Framework developed by Dr. Gary Brierley, (www.riverstyles.com). She has significant experience in GIS based watershed modeling associated with water quality, sediment and biological monitoring to support TMDL and BMP implementation. She has also spent several years researching remote sensing applications in extracting various parameters describing river systems, including the distribution of submerged aquatic vegetation (hyper-spectral imagery) in the St. Johns River, FL, topographic classification (Lidar) and wetland loss (multi-temporal Landsat) in the Mississippi River Delta, LA. Nadine received a Master's of Science degree in Environmental Science from the University of Auckland, New Zealand, where she spent two years working as research assistant in fluvial geomorphology to Dr. Gary Brierley. She co-authored a paper with Dr. Brierley focused on using geomorphic principles to frame eco-hydrological assessments of river condition (Brierley et al. 2010). Nadine also has a BA in Geography from Massey University, New Zealand.

B. Experience of the Consultant

1. Within Asotin Creek Watershed and Monitoring Protocols

Eco Logical Research, Inc. (ELR) is uniquely qualified to implement the Asotin IMW design as outlined in the RFP for several reasons. First and foremost, ELR helped coordinate the selection of Asotin Creek as a location for an IMW in southeast Washington and then developed the experimental and monitoring design (Bennett and Bouwes 2009) and implemented five years of pre-treatment monitoring which included the design and installation of PIT tag antenna arrays in key locations within the study area (Bennett et al. 2010). Second, Eco Logical Research, Inc. also has experience and training in stock assessment, biometric and data analyses, modeling, experimental and monitoring design and implementation, fisheries research and aquatic ecology and has detailed knowledge of the salmon, steelhead, and bull trout issues in the Columbia River and Klamath River basins. In addition, ELR has particular specialized experience with the on-going development of the Northwest Fisheries Science Center's (NWFSC) Integrated Status and Effectiveness Monitoring Program (ISEMP) in the Wenatchee, Salmon, and John Day River basins. ELR is heavily involved in ISEMP and in the development of the IMWs portion of that program. Currently, ELR is involved in designing experimental and sampling programs for the John Day Basin, the Bridge Creek IMW (in the John Day), the Middle Fork John Day IMW, the Entiat IMW and the Lemhi IMW. Eco Logical Research, Inc. has also functioned as the ISEMP John Day Pilot Project coordinator. As coordinator ELR summarized and synthesized current research and monitoring, collaborated with researchers and managers, and participated in the building and deployment of instream PIT tagged detectors, snorkel, seining, shocking, redd surveys, and habitat surveys.

2. Other Relevant Experience

Other related projects of ELR has participated in include: the Collaborative Systemwide Monitoring and Evaluation Project (CSMEP), administered through the Columbia Basin Fish and Wildlife Authority, that is working collaboratively with state, federal, and tribal fisheries agencies to review and develop status and effectiveness monitoring programs (including the development of an effectiveness monitoring program for the Lemhi IMW) addressing NOAA and USFWS Biological Opinions and Recovery Plans and the Northwest Power Planning Councils' Fish and Wildlife Program throughout the Columbia River Basin; providing analytical support to the US Forest Service Pacfish/Infish Biological Opinion (PIBO) Effectiveness Monitoring Project to determine the quality of their monitoring protocols, whether monitoring data can distinguish impacts to streams due to different management actions in the Columbia River Basin, and provide review and recommendations of associated fish monitoring protocols; the Comparative Survival Study, a collaborative project of state, federal, and tribal fisheries agencies, administered by the Fish Passage Center, that has monitored survival over different life-stages of spring/summer Chinook with different migrational experiences through the Columbia River hydropower system through the use of PIT-tags; review of the Ecosystem Diagnosis and Treatment (EDT) model and KlamRAS model in assessing anadromous species population responses to current habitat conditions and different management alternatives evaluated in the FERC relicensing of Pacific Corps hydroelectric projects in the Klamath River; and development of paired watershed experiment (an IMW approach) in Boulder Creek, UT, to look at the impacts of incremental impacts of water augmentation and non-native fish removal on the performance of the Colorado Cutthroat trout, considered a sensitive and conservation species, and are currently manage under a Conservation Agreement among resource agencies.

Given the level of involvement ELR has with other IMWs, ELR's development of the proposed IMW would help insure consistency with other IMWs in the region, would build off the experience in designing these other IMWs, would allow for access to infrastructure produced by ISEMP (e.g. databases, analytical tools, etc.), and would build on the network of collaborators in the region in a consistent manner. See Appendix 2 for selected report and publications.

C. Related Information

1. Eco Logical Research Inc. has worked on two contracts for the state of Washington in the past 24 months. Both contracts were part of the Asotin IMW. Both contracts were with the Walla Walla Community College and the Snake River Salmon Recovery Board:

Contract Number and Title:	09-003; Intensively Monitored Watershed Project Implementation
Contract Description:	Implement the Asotin IMW Experimental and Monitoring Design in Charley, North Fork, and South Fork Creeks in the Upper Asotin Watershed.
Contract Monitor:	Gary Boone
Contract Agency and contact information:	Walla Walla Community College, 500 Tausick Way, Walla Walla, WA 99362 Phone: 509-527-4280, Fax: 509 527-4533

Contract Number and Title:	10-004; Intensively Monitored Watershed Project Implementation
Contract Description:	Implement the Asotin IMW Experimental and Monitoring Design in Charley, North Fork, and South Fork Creeks in the Upper Asotin Watershed.
Contract Monitor:	Gary Boone
Contract Agency and contact information:	Walla Walla Community College, 500 Tausick Way, Walla Walla, WA 99362 Phone: 509-527-4280, Fax: 509 527-4533

2. Reid Camp may be hired as a field technician if we are the successful applicants for the IMW implementation. Reid worked for the Washington State Fish and Wildlife Office in Clarkston, WA as a field technician in the spring of 2010 and at the same time helped ELR monitor PIT tag antennas in Asotin Creek.

3. No ELR contracts have been terminated in the last five years.

4. No termination of a contract for default has been experienced by Eco Logical Research Inc. within the last five years of the submission of this proposal.

D. OMWBE

Eco Logical Research Inc. is not certified minority owned.

COST PROPOSAL

We understand that the budget for the Asotin IMW will vary annually depending on available State and Federal funds. We have developed numerous budgets for the IMW implementation based on funding availability and in this cost proposal we provide our charge out rates for each staff member and all equipment costs/rentals based on the previous years contracts (Appendix 3a and 3b). We propose that these estimates should be reviewed each year and that future budgets should be based on the funds available, schedule of the IMW design, and current status of the monitoring infrastructure (e.g., arrays, temperature loggers, etc.). We will work with the contract monitor and RTT to tailor each years work based on the available funds and the priorities of the IMW. We have also outlined value added work we can provide.

A. Hourly Rates, Field Costs, and Annual Budget

Please refer to Appendix 3a for a break-down of our charge out rates for personnel and crew field rates and 3b for one time and annual equipment costs from October 1, 2012 to September 30, 2013 for implementing the IMW design and reporting the results of data collection activities. All costs and expenses will be based on cost recovery and therefore, any cost savings on equipment or wages will be used for other aspects of the project after approval of the contract monitor and the RTT.

B. Value Added Work

In addition to the proposed Technical Proposal we have outlined, ELR will provide following value added work as part of our proposal:

Foraging model development: we currently have a graduate student working on the net energy intake of steelhead to evaluate response of proposed Asotin restoration actions. The addition of large wood in the study streams is expected to change the stream from high gradient plane-bed, to a step-pool system that should provide refugia to high velocity currents and reduce energy cost of steelhead. We are testing a foraging model that assess energy intake and losses, which we believe will help identify causal mechanisms of fish response to the proposed IMW treatments. The student will be using underwater video recorders and snorkel surveys to record fish behavior in different habitat types pre- and post-treatment.

Statistical Modeling: ELR is currently working with a statistician to run complex simulations of the IMW design to determine statistical power and better understand the potential to detect treatment effects. The statistician is one of the few people to have published literature on the effectiveness of staircase designs (employed in the Asotin IMW) and we hope to publish peer reviewed journal articles on the effectiveness of the IMW design and provide guidance for future IMW projects.

Aerial Photography: ELR is also developing expertise in aerial image acquisition and analysis and can provide these services at low cost for the Asotin Watershed because of our familiarity with the watershed and established control network. These data can be used to augment the change detection surveys we are currently implementing.

LITERATURE CITED

ACCD. 1995. Asotin Creek model watershed plan. Prepared by the Landowner Steering Committee. Prepared for the Asotin County Conservation District.

ACCD. 2004. Asotin subbasin plan. Prepared by the Asotin County Conservation District. Prepared for the Northwest Power and Conservation Council. Appendix B: Asotin subbasin plan aquatic assessment.

Bayley, P.B. 2002. A review of studies on response of salmon and trout to habitat change, with potential for application in the Pacific Northwest, Dept. Fisheries and Wildlife, Oregon State University. Repot to Washington State Independent Science Panel.

Beechie, T. and S. Bolton. 1999. An approach to restoring salmonid habitat-forming processes in the Pacific Northwest watersheds. Fisheries 24(4):6-15.

Bennett, S. et al. 2011a. Summary of monitoring results of the Asotin Intensively Monitored Watershed: 2008-2011. *In preparation*

Bennett, S., N. Bouwes, and E. Wall. 2010. Southeast Washington Intensively Monitored Watershed Project in Asotin Creek: Year Two Pretreatment Monitoring Annual Report. Submitted to State of Washington, Recreation and Conservation Office, Olympia, Washington.

Bennett, S. and N. Bouwes. 2009. Asotin Creek Intensively Monitored Watershed: Final Design and Work Plan. Submitted to State of Washington Recreation and Conservation Office, Olympia, Washington.

Bernhardt, E. S., M. A. Palmer, J. D. Allan, G. Alexander, K. Barnas, S. Brooks, J. Carr, S. Clayton, C. Dahm, J. Follstad-Shah, D. Galat, S. Gloss, P. Goodwin, D. Hart, B. Hassett, R. Jenkinson, S. Katz, G. M. Kondolf, P. S. Lake, R. Lave, J. L. Meyer, T. K. O'Donnell, L. Pagano, B. Powell, and E. Sudduth. 2005. Synthesizing U.S. river restoration efforts. Science 308(5722): 636-637.

Bilby, R. E., W. J. Ehinger, C. Jordan, K. Krueger, M. McHenry, T. Quinn, G. Pess, D. Poon, D. Seiler, and G. Volkhardt. 2004. Evaluating watershed response to land management and restoration actions: intensively monitored watersheds (IMW) progress report. Prepared by the IMW Scientific Oversight Committee. Submitted to the Washington Salmon Recovery Funding Board.

Bouwes, N., J. Moberg, N. Weber, B. Bouwes, C. Beasley, S. Bennett, A.C. Hill, C.E. Jordan, R. Miller, P. Nelle, M. Polino, S. Rentmeester, B. Semmens, C. Volk, M.B. Ward, G. Wathen, and J. White. 2011. Scientific protocol for salmonid habitat surveys within the Columbia Habitat Monitoring Program. Prepared by the Integrated Status and Effectiveness Monitoring Program and published by Terraqua, Inc., Wauconda, WA.

Cooch, E. and D. White. 2010. Program MARK: A gentle introduction, Fifth Edition. College of Natural Resources, Colorado State University, Fort Collins, CO.

Crawford, E., Schuck, M., and M. Herr. 2011. Assess salmonids in the Asotin Creek watershed: 2010 Annual Report. Prepared for US Department of Energy, Bonneville Power Administration, Environment, Fish and Wildlife, Portland, OR. Prepared by Washington Department of Fish and Wildlife Fish Program, Science Division, Hatchery/Wild Interactions Unit, Clarkston, WA.

Fullerton, A. H., E. A. Steel, I. Lange, and Y. Caras. 2010. Effects of Spatial Pattern and Economic Uncertainties on Freshwater Habitat Restoration Planning: A Simulation Exercise. Restoration Ecology 18:354-369.

Heitke, J. D., E. K. Archer, and B. B. Roper. 2010. Effectiveness monitoring for streams and riparian areas: sampling protocol for stream channel attributes. Unpublished paper on file at: http://www.fs.fed.us/biology/fishecology/emp.

Horton, G. E., B. H. Letcher, M. M. Bailey, and M. T. Kinnison. 2009. Atlantic salmon (Salmo salar) smolt production: the relative importance of survival and body growth. Canadian Journal of Fisheries and Aquatic Sciences 66:471-483.

Krebs, C. J. 1999. Ecological methodology: second edition. Benjamin /Cummings, Menlo Park, CA.

Loughin, T. M., M. P. Roediger, G. A. Milliken, and J. P. Schmidt. 2007. On the analysis of long-term experiments. Journal of the Royal Statistical Society: Series A (Statistics in Society) 170:29–42.

Jones, A. F., P. A. Brewer, E. Johnstone, and M. G. Macklin. 2007. High-resolution interpretative geomorphological mapping of river valley environments using airborne LiDAR data. Earth Surface Processes and Landforms 32(10):1574–1592.

Leary, R. J., and P. Ebertowski. 2010. Effectiveness monitoring for streams and riparian areas: sampling protocol for vegetation parameters. Unpublished paper on file at: http://www.fs.fed.us/biology/fishecology/emp.

Marcus, W. A. and M. A. Fonstad. 2008. Optical remote mapping of rivers at sub-meter resolutions and watershed extents. Earth Surface Processes and Landforms 33:4–24.

Mayer, K., M. Schuck, and P. Iversen. 2009. Assess salmonids in the Asotin Creek Watershed: 2009 Annual Report. Prepared for US Department of Energy, Bonneville Power Administration, Environment, Fish and Wildlife, Portland, OR. Prepared by Washington Department of Fish and Wildlife Fish Program, Science Division, Hatchery/Wild Interactions Unit, Clarkston, WA.

Montgomery, D. R. and J. M. Buffington. 1997. Channel-reach morphology in mountain drainage basins. Geological Society of America Bulletin 109:596-611.

PNAMP. 2005. Establishing a Network of intensively monitored watersheds in the Pacific Northwest. Available: July 2006 http://www.pnamp.org//web/workgroups/WM/documents/General/2005_0405IMWPlan.doc

Roni, P., G. Pess, T. Beechie, and S. Morley. 2010. Estimating Changes in Coho Salmon and Steelhead Abundance from Watershed Restoration: How Much Restoration Is Needed to Measurably Increase Smolt Production? North American Journal of Fisheries Management 30:1469-1484.

Roni, P., K. Hanson, and T. Beechie. 2008. Global review of physical and biological effectiveness of stream habitat rehabilitation techniques. North American Journal of Fisheries Management 28:856-890.

Sogard, S. M., T. H. Williams, and H. Fish. 2009. Seasonal Patterns of Abundance, Growth, and Site Fidelity of Juvenile Steelhead in a Small Coastal California Stream. Transactions of the American Fisheries Society 138:549-563.

Snake River Salmon Recovery Board (SRSRB). 2006. Snake River salmon recovery plan for SE Washington. Prepared by Snake River Salmon Recovery Board for the Washington Governor's Salmon Recovery Office.

Walters, C. J., J. S. Collie, and T. Webb. 1988. Experimental designs for estimating transient responses to management disturbances. Canadian Journal of Fisheries and Aquatic Sciences 45:530-538.

Wheaton, J., S. Bennett, B. Bouwes, and R. Camp. 2012. Asotin Creek Intensively Monitored Watershed: Restoration plan for Charley Creek, North Fork Asotin, and South Fork Asotin Creeks. DRAFT: April 7, 2012. Prepared for the State of Washington Recreation and Conservation Office, Olympia, WA. Prepared by Eco Logical Research Ltd. .

Appendix 1. Proposed Annual Work Plan and Budget for the Asotin Creek Intensively Monitored Watershed Implementation Project (November 1, 2011 to October 30, 2019). See Appendices 3 and 4 for the schedule, charge-out rates, and budget respectively.

Work Plan, Schedule and Estimated Costs by Task for the Asotin IMW - October 1, 2012 to Sept 30, 2013*

Start Date	End Date	Task	Description and Rational	Cost Estimates
		Eco Logical Research Inc.		
10/1/2012	9/30/2013	Project Management	Management of overall project goals including project coordination with landowners, local community, and government agencies, and budget and work plan development and tracking	
10/1/2012	9/30/2013	Fish and Habitat Monitoring	Monitor permanent sites for fish abundance and habitat condition, maintain PIT tag arrays, temperature probes, water level gauges; conduct mobile fish surveys and rapid habitat surveys	
10/1/2012	9/30/2013	Expenses	Purchase or rent equipment to conduct surveys (PIT tags and supplies, electrpshockers, seine nets, waders, total stations, mapgrade GPS, etc), travel and vehicle expenses, utilities (power, internet and phone lines for PIT tag arrays and field house), accomodation and meals	
10/1/2012	9/30/2013	Data Management and Reporting	Manage PIT tag, fish capture data, PTAGIS and array resight data; coordinate with CHaMP to upload and analyse habitat data; manage LiDAR and aerial photography; provide monthly progress and annual reports; manage temperature and discharge data; synthesis and interpret data and test hypotheses using statistical models.	
subtotal ELR				***136,792.45***
		WashingtonDepartment of Fish and Wildlife		
10/1/2012	9/30/2013	WDFW cooperation and support of IMW Project	WDFW provides 2-3 people to support fish and habitat survey and restoration activities; specifically sample 12 fish sites 4 times (2 summer and 2 fall) and aid in habitat monitoring, maintenance of monitoring infrastructure, and/or restoration activities	
subtotal WDFW				***50,000.00***
sub-total ELR and WDFW				***186,792.45***
10/1/2012	9/30/2013	Walla Walla Community College Contract Monitoring Fee	WWCC provides contract monitoring for the IMW project (6% of 1.06 x 198,000)	11,207.55
TOTAL				**198,000.00**

** because the available funds are less than the project costs we will work with SRSRB to prioritize activities and maintain long-term data streams based on available*

Appendix 2. Selected publications and reports by ELR personnel.

Bennett, S. and Corbett. 1996. Level 1 Fish Habitat Assessment of Caribou and McMurdo Creek: A Watershed Restoration Project. Prepared for Forest Renewal BC.

Bennett, S.N. and Roper, B.B. 2007. DRAFT: Fish inventory and monitoring technical guide for wadeable streams on National Forests. Gen. Tech. Rep. U.S. Department of Agriculture, Forest Service

Budy, P., G. P. Thiede, N. Bouwes, C. Petrosky, H. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. North American Journal of Fish Management. 22:35-51

Bouwes, N., Weber, N., S. Bennett, J. Moberg, B. Bouwes, and C. Jordan. 2010. Tributary Habitat Monitoring at the Watershed or Population Scale: Preliminary Recommendations for Standardized Fish Habitat Monitoring in the Columbia River Basin. Prepared for NOAA-Fisheries and Bonneville Power Authority. Prepared by the Integrated Status and Effectiveness Monitoring Program1.

Bouwes, N. ed. 2006. Integrated status and effectiveness monitoring John Day pilot program, 2005 annual report. Compiled and edited by Eco Logical Research, Inc. Providence, UT for NOAA Fisheries Service and the Bonneville Power Administration. 115 pp. http://www.nwfsc.noaa.gov/research/divisions/cbd/mathbio/index.cfm

Bouwes, N.. 2004. Analytical Framework and Study Plan Outline for the John Day Basin. Report compiled by Eco Logical Research, Providence, UT for the United States Bureau of Reclamation, Portland, OR. 92 pp.

Kershner, J.L, B.B. Roper, N. Bouwes, R. Henderson, and E. Archer. 2004. An analysis of stream habitat conditions in reference and managed watersheds on some federal lands within the Columbia basin. North American Journal of Fisheries Management 24:1363-1375.

Knight, C. and N. Bouwes. 2005. Shasta River Ecosystem Diagnosis and Treatment Model: Validation Analysis. Report compiled by California Trout, Shasta, CA and Eco Logical Research, Inc., Providence, UT for PacificCorps. 29 pp.

Marmorek, D.R., M. Porter and D. Pickard (eds). 2006. Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) – Year 3, Project No. 2003-036-00, Annual Report for FY 2006. Prepared by ESSA Technologies Ltd., Vancouver, B.C. on behalf of the Columbia Basin Fish and Wildlife Authority, Portland, OR. 126 pp. + appendices.

Nelle, P., M. B. Ward, C. Beasley, N. Bouwes, C. E. Jordan, S. Rentmeester, C. Volk eds. 2006. A Review of the Integrated Status and Effectiveness Monitoring Program: 2003 – 2006. Prepared for the

Bonneville Power Administration’s Integrated Status and Effectiveness Monitoring Program. 238 pp.

Pacific Northwest Aquatic Monitoring Partnership (PNAMP) & The Collaborative Systemwide Monitoring and Evaluation Project (CSMEP). 2006. Second Annual Research, Monitoring and Evaluation (RME) Workshop for Decision Makers, Program Managers, Scientists and Field Practitioners.

Roper, B. B., J. M. Buffington, S. Bennett, S. H. Lanigan, E. Archer, S. T. Downie, J. Faustini, T. W. Hillman, S. Hubler, K. Jones, C. Jordan, P. R. Kaufmann, G. Merritt, C. Moyer, and A. Pleus. 2010. A Comparison of the Performance and Compatibility of Protocols Used by Seven Monitoring Groups to Measure Stream Habitat in the Pacific Northwest. North American Journal of Fisheries Management 30:565-587.

Roper, B.B., J.L. Kershner, E. Archer, R. Henderson, and N. Bouwes. 2002. An evaluation of physical stream habitat attributes used to monitor streams. Journal of the American Water Resources Association 38(6): 1637-1646.

Schaller, H., P. Wilson, S. Haeseker, C. Petrosky, E. Tinus, T. Dalton, R. Woodin, E. Weber, T. Berggren, J. McCann, S. Rassk, H. Franzoni, P. McHugh, N. Bouwes. 2007. Comparative Survival Study (CSS) of PIT-Tagged Spring/Summer Chinook and Steelhead of the Columbia River Basin: Ten-year Retrospective Analyses Report. Prepared for the Bonneville Power Administration.

Appendix 3a. Charge-out rates for all Eco Logical Research Inc. personnel. Rates include a 20% overhead and 24-29% fringe rate for most employees.

Name	Title	Fringe	Indirect	Hourly	Fringe	Hourly+Fringe	Indirect	Total Hourly
Bouwes	Project Manager	0.24	0.2	73.02	17.52	90.54	18.11	108.65
Bennett	Project Coordinator	0.24	0.2	60.00	14.40	74.40	14.88	89.28
Bouwes/Bennett	Field Work	0.24	0.2	50.00	12.00	62.00	12.40	74.40
Bouwes/Bennett	Travel	0.24	0.2	30.00	7.20	37.20	7.44	44.64
Dr Wheaton	Geofluvial Morphologist	0.25	0.2	41.69	10.42	52.11	10.42	62.54
Dr Conner	Analyst	0.25	0.2	41.69	10.42	52.11	10.42	62.54
Trahan	GIS Specialist	0.29	0.2	25.86	7.50	33.36	6.67	40.03
Camp	Field Biologist	0.29	0.2	20.69	6.00	26.69	5.34	32.03
To be named	Field Technician 1	0.1	0.2	14.37	1.44	15.81	3.16	18.97
To be named	Field Technician 2	0.1	0.2	12.00	1.20	13.20	2.64	15.84
Wall	Research Specialist	0.1	0.2	10.56	1.06	11.62	2.32	13.94
Johnson	Local Coordinator	0	0.2	64.80	-	64.80	12.96	77.76

Appendix 3b. Eco Logical Research Inc. equipment cost and rental rates for the Asotin IMW project.

Equipment/Utilities	Item	Unit Cost	Quantity	Total Cost to Buy or Rent	Equipment Life (Yrs)
Arrays	MUX	9,015	4	36,060	life of project
Arrays	antenna	1,000	20	20,000	life of project
Arrays	Support Equipment	1,000	20	20,000	life of project
Arrays	water level & temp transducer	1,000	4	4,000	life of project
Arrays	data loggers	1,500	20	30,000	life of project
Arrays	modems	350	4	1,400	life of project
Arrays	software	500	1	500	life of project
Arrays	electrical contract	20,000	1	20,000	life of project
Arrays	**Total Annual**			-	
Arrays	**Total One-Time**			131,960	
Computing/Office	Laptop	1,000	1	1,000	life of project
Computing/Office	Data logger	2,700	1	2,700	life of project
Computing/Office	laser printer	350	1	350	life of project
Computing/Office	Misc. USB Adapters/Splitters	150	1	150	life of project
Computing/Office	power cords, surge protectors	100	1	100	life of project
Computing/Office	Rite-in-rain notebooks	10	5	50	1
Computing/Office	Box Rite-in-rain printer paper	50	4	200	1
Computing/Office	Photocopying, printing, postage	250	1	250	1
Computing/Office	Field desks and chairs	200	1	200	life of project
Computing/Office	Thumb and external hard drives	125	1	125	life of project
Computing/Office	shoulder bag for laptop	30	1	30	life of project
Computing/Office	Memory Cards (SD)	50	4	200	life of project
Computing/Office	Office Supplies	60	1	60	1
Computing/Office	**Total Annual**			560	

Computing/Office	**Total One-Time**			4,855	
Field camp (3-4 person crew)	chairs	10	3	30	life of project
Field camp	table	70	1	70	life of project
Field camp	propane stove	72	1	72	life of project
Field camp	propane tank	40	2	80	life of project
Field camp	coolers	25	2	50	life of project
Field camp	cots	80	3	240	life of project
Field camp	frame packs	150	3	450	life of project
Field camp	cook wear	100	1	100	life of project
Field camp	tents	150	3	450	1
Field camp	tool set	100	1	100	life of project
Field camp	68 quart storage totes	40	1	40	life of project
Field camp	Hand tools	150	1	150	life of project
Field camp	Tow Strap	20	1	20	life of project
Field camp	6 gallon reliance water jugs	40	1	40	life of project
Field camp	Bungee Chords	10	5	50	1
Field camp	Batteries, AA, AAA, C, D, 9v, Lithium	150	1	150	1
Field camp	First Aid Kits	150	2	300	life of project
Field camp	Tape, duct	5	3	15	1
Field camp	WD40	10	1	10	1
Field camp	zip ties	5	1	5	1
Field camp	2 gallon gas can	15	1	15	life of project
Field camp	Rags, shop	20	1	20	1
Field camp	**Total Annual**			700	
Field camp	**Total One-Time**			1,757	
Habitat	Small Depth Rods	30	3	90	1
Habitat	Large Depth Rods	30	2	60	1
Habitat	Compass	10	1	10	life of project
Habitat	Measuring Tape	28	3	83	life of project

Habitat	Hip chain	120	1	120	life of project
Habitat	Conductivity Meter	58	1	58	life of project
Habitat	Conductivity Solutions	50	1	50	1
Habitat	Alkalinity Test Kit	30	1	30	1
Habitat	Pool Tail Fines Grid	50	1	50	life of project
Habitat	Pool Tail Fines Viewer	5	1	5	life of project
Habitat	Clinometer	130	2	260	life of project
Habitat	Shovel	15	1	15	life of project
Habitat	Sieve	200	1	200	1
Habitat	Pebble Ruler	70	1	70	life of project
Habitat	Handheld GPS	240	2	480	life of project
Habitat	Solar Pathfinder	260	1	260	life of project
Habitat	Solar Pathfinder software	190	1	190	life of project
Habitat	Digital Camera	325	1	325	life of project
Habitat	Water temperature Loggers	55	35	1,925	life of project
Habitat	Water temperature usb dock	150	1	150	life of project
Habitat	Air temperature loggers	38	15	570	life of project
Habitat	Air temperature usb dock	60	1	60	life of project
Habitat	Clip Boards	15	3	45	life of project
Habitat	Flags - stream	20	4	80	1
Habitat	SPOT	150	1	150	life of project
Habitat	Maps	10	1	10	1
Habitat	Action Packers	20	3	60	life of project
Habitat	**Total Annual**			520	
Habitat	**Total One-Time**			4,885	
Invertebrates	Drift Nets	160	2	320	life of project
Invertebrates	Benthic Net	300	1	300	life of project
Invertebrates	Sample Jars	140	1	140	1
Invertebrates	500 um Sieve	1	30	30	life of project
Invertebrates	Spray Bottle	1	10	10	life of project
Invertebrates	Ethanol	1	40	40	1

Invertebrates	Flow Velocity Meter	1	800	800	life of project
Invertebrates	tweezers	10	2	20	life of project
Invertebrates	**Total Annual**			180	
Invertebrates	**Total One-Time**			1,480	
Invertebrates	**Processing per sample**			150	annual
Mobile Surveys	Back pack	60	3	180	life of project
Mobile Surveys	Button GPS	39	3	117	life of project
Mobile Surveys	Mobile wand	430	3	1,290	life of project
Mobile Surveys	Pole assembly	75	4	300	life of project
Mobile Surveys	FS2001 Tag Reader tuner	160	3	480	life of project
Mobile Surveys	f2001 Pittag Readers	3,000	3	9,000	life of project
Mobile Surveys	**Total Annual**			-	
Mobile Surveys	**Total One-Time**			11,367	
Seining PIT Tagging	Electrofishing Dipnets	60	6	360	life of project
Seining PIT Tagging	Power sonic sealed lead acid batteries	75	3	225	1
Seining PIT Tagging	Electrofishing electrode poles	225	4	900	life of project
Seining PIT Tagging	Electrode pole Rings (5)	40	3	120	life of project
Seining PIT Tagging	Multi Meter (AC/DC)	15	1	15	life of project
Seining PIT Tagging	Samus Electrofishers	1,000	2	2,000	life of project
Seining PIT Tagging	Pocket thermometers	13	4	50	1
Seining PIT Tagging	DNA sample vials	0	100	28	1
Seining PIT Tagging	Variable dispenser bottles	150	1	150	life of project
Seining PIT Tagging	Case of DNA storage boxes	100	1	100	1
Seining PIT Tagging	Neoprene Socks	30	4	120	1
Seining PIT Tagging	Neoprene Gloves	55	4	220	1
Seining PIT Tagging	Wader repair supplies	50	1	50	1
Seining PIT Tagging	Daypacks	75	2	150	life of project
Seining PIT Tagging	External pack frames	150	1	150	life of project

Seining PIT Tagging	Carbineers	10	6	60	life of project
Seining PIT Tagging	Conductivity meter	100	1	100	life of project
Seining PIT Tagging	3 gallon collapsible bucket	30	1	30	life of project
Seining PIT Tagging	Clipboards	25	2	50	life of project
Seining PIT Tagging	Maps (Forest/Topo)	120	1	120	life of project
Seining PIT Tagging	Field utility boxes	35	1	35	life of project
Seining PIT Tagging	DC 400 inverter	60	1	60	life of project
Seining PIT Tagging	rock bar	40	1	40	life of project
Seining PIT Tagging	Seines/Blocknets	250	4	1,000	life of project
Seining PIT Tagging	repair kits for nets	25	1	25	1
Seining PIT Tagging	Nylon Rope	50	1	50	1
Seining PIT Tagging	Cable wire	5	1	5	1
Seining PIT Tagging	Utility straps	10	10	100	life of project
Seining PIT Tagging	Rebar	2	10	20	life of project
Seining PIT Tagging	Lockable, waterproof Streamside Boxes (Ammo Cans)	70	1	70	life of project
Seining PIT Tagging	scale card containers Tupperware	5	2	10	life of project
Seining PIT Tagging	aluminum site marking tags	100	1	100	1
Seining PIT Tagging	50 meter fiberglass measuring tape	50	1	50	1
Seining PIT Tagging	100 meter fiberglass measuring tape	75	1	75	1
Seining PIT Tagging	Flagging Tape	5	1	5	1
Seining PIT Tagging	Digital Camera	200	1	200	life of project
Seining PIT Tagging	Tagging Needles	2	500	1,000	1
Seining PIT Tagging	PIT tags	2	5000	11,600	life of project
Seining PIT Tagging	Anesthetic	25	2	50	1
Seining PIT Tagging	Airstones for bubblers	15	6	90	life of project
Seining PIT Tagging	Aquarium Nets	2	5	10	1
Seining PIT Tagging	Misc. Nalgene Bottles	100	1	100	life of project
Seining PIT Tagging	Scales w/usb adapters	250	2	500	life of project
Seining PIT Tagging	Injector supplies	150	1	150	life of project
Seining PIT Tagging	100 Round shotgun shell cases (Injector Rack)	40	1	40	life of project
Seining PIT Tagging	Aerators	40	4	160	life of project

Seining PIT Tagging	table top antenna	280	1	280	life of project
Seining PIT Tagging	tagging table/case	50	1	50	life of project
Seining PIT Tagging	Measuring Boards	30	2	60	life of project
Seining PIT Tagging	f2001 Pittag Readers	3,000	3	9,000	life of project
Seining PIT Tagging	Distilled H20	15	1	15	1
Seining PIT Tagging	Buckets 5-gallon	5	15	75	life of project
Seining PIT Tagging	**Total Annual**			2,178	
Seining PIT Tagging	**Total One-Time**			27,845	
Topographic Surveying and Video	Total Station setup	200	20	4,000	1
Topographic Surveying and Video	Map Grade GPS	75	20	1,500	1
Topographic Surveying and Video	Under Water Video Camera	50	20	1,000	1
Topographic Surveying and Video	**Total Annual**			6,500	
Topographic Surveying and Video	**Total One-Time**			-	
Utilities	Phone lines x 4	125	12	1,500	1
Utilities	Internet x 1	60	12	720	1
Utilities	Power x 4	60	12	720	1
Utilities	**Total Annual**			2,940	
Vehicles	4x4 truck	1,041	10	10,410	1
Vehicles	ATV	600	4	2,400	1
Vehicles	**Total Annual**			12,810	
Waders	waders	120	3	360	1
Waders	wading boots	95	3	285	1
Waders	**Total Annual**			645	

Figures.

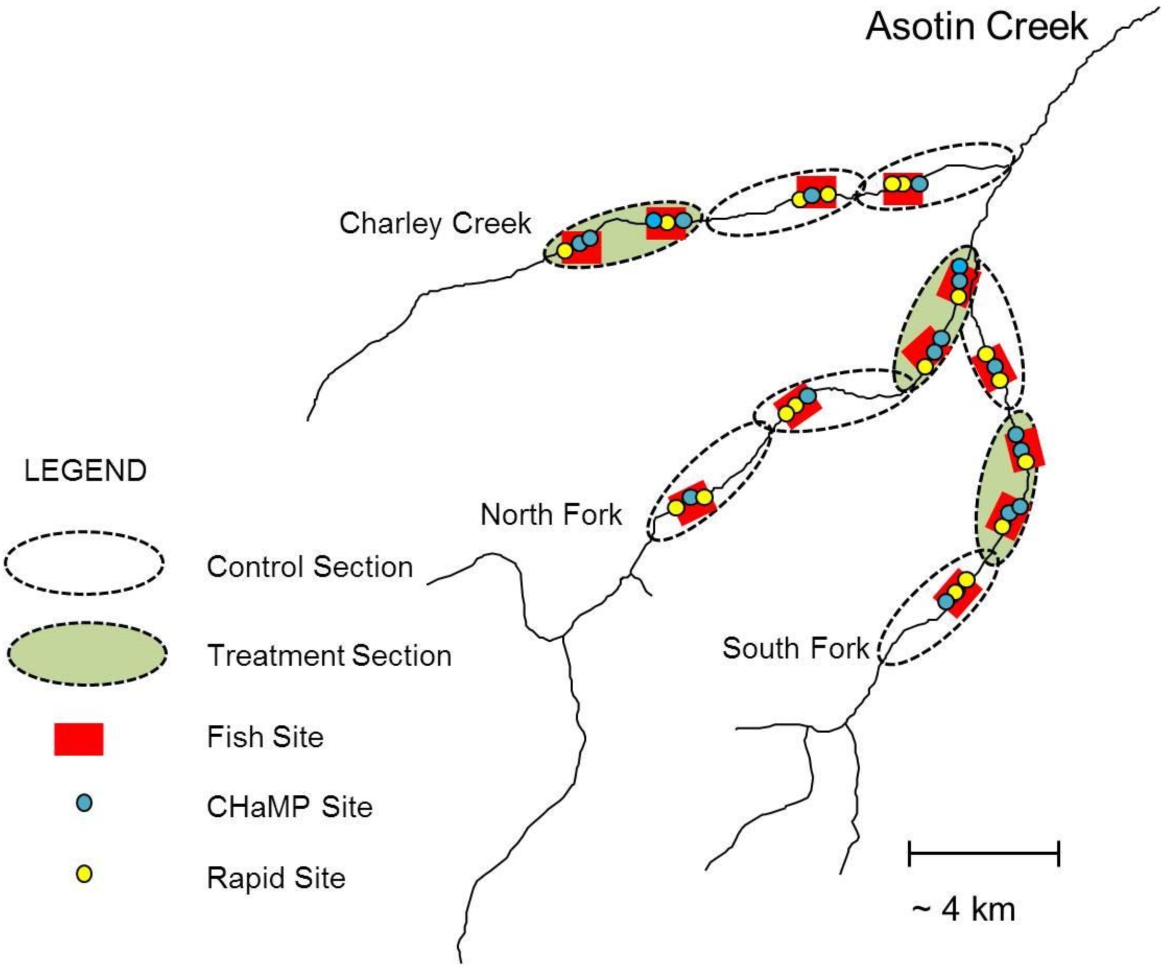

Figure 1. The revised experimental deign of the Asotin Creek Intensively Monitored Watershed project.

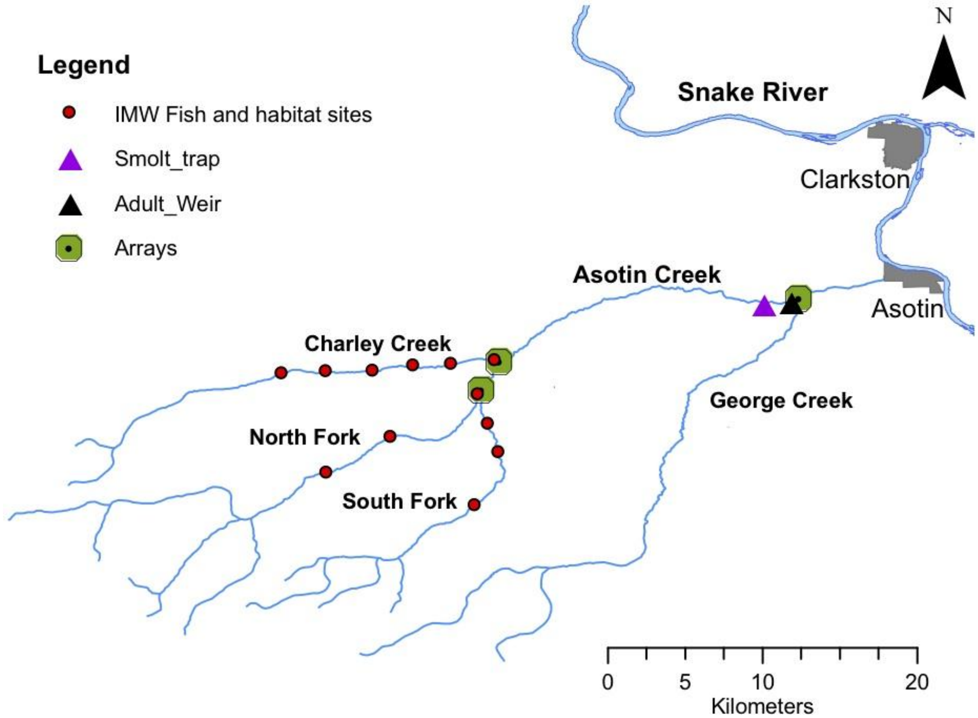

Figure 2. Monitoring design of the Asotin Creek Intensively Monitored Watershed project.

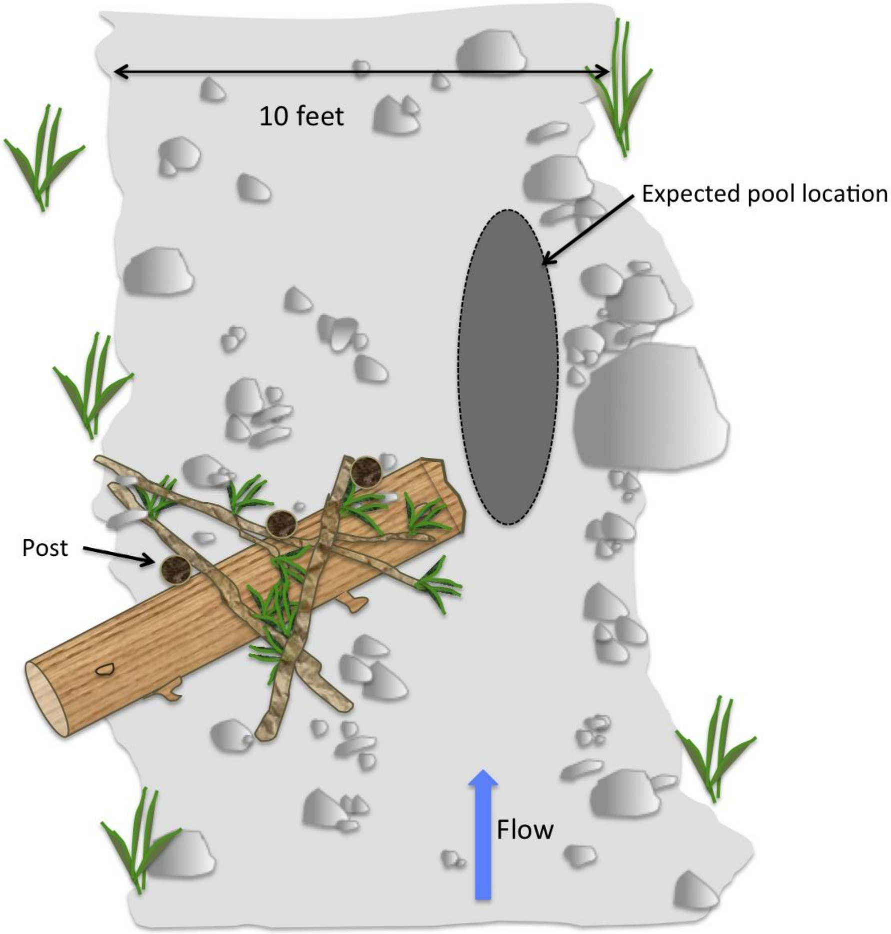

Figure 3. Proposed restoration design for the Asotin IMW. Wooden posts will be driven into the stream and large woody debris added to force a width constriction and scour a pool.