

Proposal Outline

Habitat and Water Quality Status and Trends Statewide Monitoring Framework

This is a request to develop a sampling point network across the state that can be used to generate information for making management decisions about our important aquatic resources. We will:

1. Develop a sampling network such that anyone anywhere can contribute to the monitoring.
2. Assemble the correct list of indicators.
3. Assemble the best set of protocols for measuring the indicators.
4. Meet with local governments and organizations to determine their monitoring needs and desires.
5. Examine the use of citizens in sampling programs and identify organizational costs associated with using volunteers.

Purpose

We propose to develop a Quality Assurance Monitoring Plan (MP) for implementing a statewide probability based sampling effort to inform us about the condition of our streams, rivers, and nearshore estuaries. The MP will include details on:

- Goals and objectives
- Sampling design
- Targeting aquatic resources to be monitored
- Monitoring and reporting metrics or indicators
- Process for using existing information
- Sampling protocols
- Analytical and laboratory procedures
- Quality assurance and quality control procedures
- Data management process
- Data analysis and evaluation procedures
- Partnerships (e.g., agency, local government, and volunteer collaboration)
- Organization and schedule
- Budget

This proposal is designed to provide a brief discussion and examples about the major components of the MP listed above, including a cost estimate for developing the MP. Most of the discussion is based on knowledge about wadeable stream site selection and

sampling procedures using EMAP protocols. Workgroups are proposed (and meeting dates) to discuss and better define individual topics.

Introduction and Background

A randomized site selection approach has been developed and used by the United States Environmental Protection Agency (USEPA) to report on the state of the waters in the United States. USEPA has partnered with state agencies in order to pass the technology on to state and local governments for more extensive use. Extensive work with protocol development, data management, and development of indicators has been accomplished. This site selection and sampling approach had been examined and endorsed by the Comprehensive Monitoring Strategy efforts with further review and encouragement by the Governor's Forum on Monitoring for Salmon Recovery and Watershed Health.

A site selection method that is based on a randomized sampling approach eliminates bias by randomly selecting the target population. For example, a target population could be the number and area of lakes that are acidic in potentially sensitive areas of the northeastern United States. Lakes randomly selected from this target population will provide unbiased information that can be extrapolated to the population with known certainty.

Problem Statement and Key Questions

We have identified 5 domains (nearshore, estuary, nonwadeable, wadeable, and uplands) as strata that could help inform on Status and Trends of many important watershed process and habitat indicators. Nearshore and estuarine are being scoped and developed by a number of groups (PSNERP). We believe that the forum wants us to concentrate on developing the implementation plan for wadeable and nonwadeable streams and coordinating our efforts with PSNERP (or others) working on the nearshore and estuary domains. The goal will be to make sure that our stream and river program is consistent with the needs of the nearshore and estuarine evaluations.

A major gap in monitoring watershed health and salmon recovery is measuring the status and trends of streams, rivers, and nearshore estuaries, including landscape forming processes at scales that are useful. Within Salmon Recovery Regions (SRR), and Water Resource Inventory Areas (WRIA), one of the greatest needs is the ability to describe with some degree of certainty what changes have occurred in the status and trends of habitat conditions affecting watershed health and salmon recovery statewide.

The purpose of this type of monitoring is to estimate the status of fish populations and watershed conditions, and to track over time indicators of habitat, water quality, and other factors that impact watershed health.

What are the beneficial uses we want to evaluate and why?

The major beneficial uses we want to evaluate are salmon, steelhead, and trout population characteristics and the habitat on which they depend. The reason we want to evaluate these beneficial uses is because it is a goal of Washington State to protect and restore salmon populations and watershed health. Monitoring the status and trend in the condition of these beneficial uses provides the policy and management information that is needed to determine if this goal is being met, and if not how can we best allocate resources to make progress to achieve this goal.

What is status and trends monitoring?

The “status” of aquatic resources such as a stream is described by the current condition of its physical, chemical, and biological characteristics. The measurements made at each stream location represent only a single characterization of many that could be described over time. These general descriptions of stream setting characteristics made at different time intervals into the future can be used for trend analysis. This information is useful for determining the management strategies in improving habitat or cleaning up pollution for the benefit of aquatic life.

What are the important spatial scales to apply status and trends monitoring?

The condition of stream characteristics will be estimated at several spatial scales: 1) statewide, 2) SRR, 3) WRIA, and 4) smaller units. The estimate at each generates unique expressions for describing stream and river conditions. The statewide monitoring scale spreads a limited number of sites across a broad area. This results in sparse distribution of sites and generates estimates of stream conditions with poor precision.

Focus on the SRR scale results in an increased density of sites given the smaller spatial scale. This scale for monitoring would evaluate stream conditions within the natural range of individual salmon populations. Restoration efforts that are intended to improve recruitment and escapement for individual populations are appropriately evaluated by this scale of monitoring. Individual restoration efforts are limited in their extent of effectiveness, but these projects produce a cumulative effect in the region. Estimates of the condition and evaluations of trend at the SRR scale will inform the adaptive management processes of these restoration efforts.

Monitoring site locations by WRIA is the finest level of proposed monitoring framework. Management for water quality improvements usually occurs at a WRIA scale which makes it a desirable scale for monitoring. At the WRIA scale, estimates of stream condition are more closely related to the cause of aquatic resource impairments. Trend analysis using the WRIA data set will be more likely to detect change in the estimate of stream condition over the shortest time period with repeat monitoring. In addition, the focus on watersheds is understood and readily used by local governments such that they

are likely to participate in data collection efforts and become users of data generated by the monitoring program.

Why do we want to do status and trends monitoring?

Status and trends monitoring is necessary to inform the adaptive management process of salmon recovery projects and other state and local actions. Efforts to improve conditions can be measured through implementation of a status and trend monitoring network.

Goals and Objectives

The goal of status and trends monitoring is to provide quantitative, statistically valid estimates of habitat and water quality that are important for policy and management decisions.

The objectives of the status and trends monitoring plan are as follows:

- Provide a probability based sampling framework that can be used at the state, SRR, and WRIA scales by all levels of government to assess the conditions of the state's aquatic resources.
- Determine a sampling site selection process that provides a minimum of 80% confidence in the estimated status of wadeable and non wadeable streams and nearshore estuaries.
- Identify specific metrics or indicators that will be monitored and the protocols used to measure them.
- Incorporate existing information and monitoring data, where possible, into the status and trends assessment.
- Develop partnerships with other agencies, local governments, and volunteer groups to implement the monitoring plan or share data.

Identify populations to be monitored and site selection

Wadeable Streams

Surveying wadeable streams is desirable for several reasons: 1) water levels are lower and the stream reach easily traversed, 2) scientists can safely wade and make measurements, and 3) small streams represent the largest proportion of river miles in a drainage area. These streams are areas where critical life stages for salmon are completed like spawning and rearing. The highest density of randomly selected sites is located in the wadeable stream portion of a drainage network.

Non-Wadeable Streams

Surveying non-wadeable streams presents logistical challenges in comparison to the wadeable streams. Many of the conventional assessment techniques become difficult if not impossible to complete. Fewer non-wadeable stream sites are selected for evaluation based on the lower density of this stream setting in the drainage network.

The non-wadeable streams are conduits for migration/out migration of salmonids to and from estuaries and can present severe challenges with respect to pollution barriers or physical barriers. The survey protocols for large, non-wadeable streams can primarily be image or map-based as the important characteristics describing sources for pollution are geo-referenced in agency databases. Large rivers outside of urban/suburban areas are more difficult to monitor given the difficulties in traversing rapids and physical barriers with boats in order to verify map-based determinations.

Currently, research has been proposed to develop standardized large-river habitat and biological assessment protocols. This research is being conducted by scientists from Oregon State University (along with state partners) and was funded by the U.S. EPA this year and will be underway summer 2005. Large rivers are composed of micro-habitats that are used by various species and life stages critical for their survival. Pollutants often gather in specific micro-habitat environments and will affect species that seek out these places. Adoption of the eventual protocols will be used in the statewide monitoring program for evaluating large rivers and the corridors.

Other Domains

A similar effort to this proposal is being developed by the Nearshore Subcommittee. Further linkages can be developed between these two complementary efforts through future workshops. In addition, Uplands monitoring will be coordinated with the Forest Service. Although Riverine-tidal areas are considered part of the non-wadeable domain these systems will likely need to be addressed separately.

Statistical Design and Site Selection by EMAP protocol

Statistical Tests

Sampling enough sites is critical for enabling precise statements to be made by using statistical expressions. Statistical evaluations are important in order to measure how confident we are in deriving conclusions. Ideally, a balance between the numbers of monitoring sites necessary to make adequate statistical evaluations and the cost of sampling is determined by the precision desired for the estimate of condition. Knowledge of the variability expected determines the ability to detect trend in condition. However, the total number of sites is more likely constrained by the budget and logistical considerations.

An estimate of the stream condition is of limited value without some suggestion of how confident one should be in it. The appropriate level of confidence in an estimate derived

from a sample survey is directly related to the management decision that the monitoring informs. This description of statistical confidence is used frequently in reporting the results of opinion polls using statements such as "this poll has a margin of error of $\pm 4\%$." Provided random sampling is used, similar statements can be made about estimates from probabilistic monitoring. If an 80% confidence in the stream condition estimate is adequate to inform management decisions being made from the data, then the number of sites needed in each WRIA or SRR can be derived statistically.

Scale

The difference between SRR's and WRIA's represent a large difference in landscape area. Collecting data from a fixed number of randomly selected sites will produce an estimate of stream conditions that is influenced by the size of the landscape area being assessed. More precise estimates of condition are made when site density within the landscape area being assessed is high.

Reasons for using each of these landscape areas is based on the objectives for monitoring and the ability to detect change in specific components of the ecosystem (e.g., fish communities, water quality, physical habitat). As well, the information generated from this monitoring program is expected to supplement or be enhanced by local monitoring efforts. Estimating conditions at both the SRR and WRIA scales will provide two landscape areas from which environmental characterizations can be made.

Based on the need for a monitoring strategy that could use information at two landscape scales, a method for "nesting" sites from the smaller WRIA level needs to occur within the larger SRR level. In effect, an over sampling of each WRIA takes place and a sub-set of the sites that includes the WRIA's in Salmon Recovery Region (SRR) are monitored each year for a period of five years. Over five years, the number of sites visited in each WRIA accumulates until such a time that site descriptions can be made. One five-year period can be compared with the following five-year period for monitoring in a specific WRIA. Data can be partitioned based on the large scale SRR or the smaller area (WRIA) for general description of stream conditions.

A proposal for stream locations and timing for site visits has been generated by U.S. EPA for use in WRIA and SRR scale estimates of stream condition. The strategy for monitoring includes a six-panel design. Using a panel design approach, a select number of sites are visited annually with a subset of sites that are visited on a 5-year frequency. The cumulative site descriptions over a five-year period are combined to form a precise overall estimate at the SRR and statewide scales. Visiting a large number of sites for each WRIA or SRR on an annual basis is not possible, so these subsets of sites are used to improve the estimate of stream condition. Again, the total number of sites visited will more likely be constrained by the resources available and logistical considerations for sampling, and the number of "partner" groups that choose to participate in the sampling program (i.e., local efforts to visit WRIA sites).

Design Characteristics

The overall design will be based on EMAP site selection strategy and may include a rotating panel design. Design characteristics will take into account the desire for WRIA scale estimates at an 80% confidence level and potential for stratification of samples into other categories (e.g., land-use). An example of a possible sampling design for wadaeable and non-wadaeable streams is as follows:

Samples are stratified into equal number of sites by Strahler order (i.e., 1st, 2nd+)

State-Wide scale

1054 unique sites allocated to 6 panels

Panels 1 to 5 visit once every 5 years

Panel 6 visit annually

Condition estimate is made from 1,554 site-visits over 5 years

SRR scale

50 total sites minimum each SRR

Condition estimate is made 17 sites from each WRIA 5 year design and annual sites

WRIA scale

Condition estimate is made 17 sites each WRIA for total 1,054 sites

(see map in appendix showing the example sample sites for the design discussed above.)

NOTE: Although we have discussed the overall scale and design characteristics in reference to an example generated by U.S. EPA, it is only one of many possible designs. We will finalize a design as part of the MP development.

Framework

Site selection is first based on the WRIA or SRR. Next, streams are identified as wadeable or non-wadeable and can be designated by using “stream order” descriptions. The association between stream order and the wadeability category can vary among WRIA’s or SRR’s. Site selection is also made considering “uniformity” within the WRIA or SRR. “Bunching” of sites is not allowed to occur within the WRIA or SRR so that stream characterizations are not skewed toward specific locations with the larger region.

Selection of sites is highly influenced by map scale and the subsequent designation of stream condition (e.g., perennial, intermittent, presence/absence). The more detailed maps include a larger number of river miles and have greater accuracy representing stream condition (perennial/intermittent status). However, a larger number of geographic

coverages are limited at the 1:100,000 scale and user groups have become accustomed to stream identifications at this scale.

We need to evaluate the need for accuracy and detail in each map scale and whether we can generate useable information that will assist in adequately determining status for biological, chemical, and physical attributes of streams. Neglecting use of the finer scale will eliminate the possibility for measuring condition in a sub-population of streams throughout an SRR or WRIA. However, if the resources at risk (e.g., listed species) are not normally found in this sub-population then the coarser map scale is adequate.

The selection of sites needs to address description of stream condition at both the SRR and WRIA levels. This being the case, an over-sampling of sites in each regionalization strategy is needed in order to satisfy the minimum requirements of the larger landscape area (SRR) and compiling more site information over time for use in the smaller landscape area (WRIA).

Prioritization of Locations

Prioritizing the SRR's or WRIA's for initial monitoring effort can be approached in one of two ways. First, uniform sampling of streams can be accomplished statewide for the period of five years before general characterizations are made for stream conditions in each landscape area. The alternative is that select WRIA's and SRR's are sampled intensively each year in a systematic routine so that stream condition descriptions can be made immediately following the processing of data and shortly after the sampling year.

Rotational Timeframe and Reporting Schedule

The rotational timeframe for monitoring enables a timely and cost-effective means for accomplishing a large monitoring task. The proposed panel design by U.S. EPA scientists satisfies the need to reduce the number of monitoring sites visited per year, but maintain a constant and comparable monitoring effort that can be combined a few years later. Also, the rotational panel design can also be used as a framework in which to organize multiple monitoring efforts from federal, state, local, and tribal governments. The sequence of rotating panels will determine which partners can contribute to the monitoring effort and will relieve cost to any one agency.

Monitoring and Reporting Metrics (Indicators)

Chemical, Biological, Physical, and Landscape Indicators Need to Measure Status and Trends for Each Habitat Sampled

Several evaluations have been conducted by U.S. EPA scientists (e.g., Phil Kaufmann) to determine the physical, chemical, and biological variables and their “signal” properties. These evaluations determine the magnitude of change that occurs in a single variable when some sort of human-induced influence is present. Variables can change over the short-term or the long-term depending on how much artificial change is necessary to measure a response.

Two categories can be established that describe the utility of variables; those useful in indicating change over the broad spatial scale (e.g., WRIA or SRR) and those that change at the “stream-reach” level. Some variables integrate the characteristics of streams over the broad spatial scale while others are sensitive to small changes from place-to-place in a stream. Each can make effective evaluations that answer objectives for monitoring that includes status of habitat for salmon species (which typically have a broad geographic range and respond to cumulative pollution effects) and examine variables that respond to site specific changes (which identify and diagnose reasons for change in reach-level indicators).

We will use existing methods for analyzing and identifying variables useful in landscape characterizations of streams and in determining potential causes for impairment. We can begin by conducting serial autocorrelation on existing habitat data collected over time at the same place in order to calculate the minimum frequency that the indicator should be measured. This could result in saving money by not over-sampling in order to be successful at trend detection. Also, evaluating properties of each indicator variable like the “signal/noise” variance assists with determining the length of time sampling is needed in order to detect a trend. This is an informative approach that would guide decisions for length of time a monitoring effort would need to be sustained in order to produce results.

Selection process based on comparability and sensitivity

A final list of indicators will be selected based on their ability to detect change (i.e., based on their “response” to physical and chemical changes). Variables can be chosen that present the best opportunity to report on change at the larger SRR or WRIA scale and those that determine the cause for change. The list should be sufficiently short by representing stressor groups (e.g., conventional water quality pollution, toxic pollutants, physical degradation, etc.) so that evaluation of regional stream condition is able to describe status and detect trends. The indicator list should also address objectives for the multiple user groups like “State of the Salmon Report” or the “Puget Sound Update.”

Develop performance measures that can be used to evaluate progress

Performance Measures developed and adopted by agencies involved in monitoring and evaluating data through this statewide program may differ depending on their mandates. We need to know the type of reporting desired by each agency and to determine what the focus is in the aquatic ecosystem. The focus for some agencies will be on the biological response variables (e.g., fish indicators) while others will be interested in reducing physical changes to water quality or habitat (e.g., temperature, turbidity, sedimentation). These serve as the basis for tracking the progress of agency remediation efforts.

Process to Evaluate/Incorporate Existing and Monitoring Efforts

Limiting Factor Analysis (LFA) Results

Currently, the Conservation Commission is using the Limiting Factors Analysis (LFA) as a major portion of their evaluation program in river and stream remediation efforts. Components of this program need to be preserved in the “core” monitoring protocols so that future characterizations in the statewide monitoring program can be used to compare with past data evaluations using LFA. We need to evaluate how comparable any of the components of LFA are with suites of characterizations in other programs. Also, LFA is currently used to characterize stream conditions in agricultural lands with a focus on habitat-land use interactions.

Intensively Monitored Watersheds (IMW)

IMW as a component of the Forest and Fish Agreement is an important project to consider when identifying indicators that can be used for ascribing causes to degraded stream condition. Status and trend monitoring can be thought of as gathering information mostly about the *effects* (or indicators) of change rather than the causes of those changes. In contrast, IMW is concerned with relating effects to specific causes (i.e., cause and effect). By understanding how habitat change affects watershed health and fish response, we can use IMW's to help identify the most important indicators to monitor, i.e, those that tell us most about how watersheds are doing.

EMAP/REMAP/ISEMP

We have been conducting EMAP-style monitoring since 1993. We have characterized stream conditions in watersheds, ecoregions, ecologically significant units (ESU's), and in basins. However, each of the projects has had minor modifications in sampling protocols and inclusion for habitat, biological, and water quality characterizations. The challenge will be to determine the usability of some of this data in a standardized statewide monitoring effort. Determination for this inclusion will be evaluated on how convergent data response is from the various data sets using a standardized expression like an index.

Ecology Ambient Stations

The Washington State Department of Ecology (Ecology) has been monitoring for water quality at select stations in each WRIA throughout the state. The lower mainstem stations represent the cumulative characteristics of water quality at the base of each major WRIA (62 total) and have been used as reference points for developing water quality permits in the past. Currently, the water quality information from these sites is used to measure for trends and also are embedded in the TMDL (Total Maximum Daily Load) monitoring design.

AREMP/PIBO

The Aquatic Riparian Effectiveness Monitoring Program (AREMP) evaluates the past and current efforts to Implement the President's Forest Plan (1994) on all U.S. Forest Service Lands in the Pacific Northwest. This effort has sought partnerships among state, federal, and tribal agencies in order to monitor and evaluate effectiveness of forest practices including best management practices (BMP's) in large tracts of land throughout the northwest. AREMP used the U.S. EPA's EMAP protocols for site selection, evaluating physical habitat, and characterizing biological communities. AREMP focuses on U.S. Forest Service, Bureau of Land Management, and National Park Service lands resulting in exclusion of large portions of the landscape in SRR's and WRIA's. The site selection process for AREMP represents a sub-population of the streams needed for characterization at the WRIA and SRR level. Site selection is based on a two-stage process; first selection by HUC (Hydrologic Unit Code) and then selection of a stream reach within each HUC. Researchers from U.S. EPA Laboratory in Corvallis, Oregon, have investigated how to combine environmental information from comparable EMAP programs without violating key statistical principles.

ODEQ/ODFW

The Oregon Department of Environmental Quality (ODEQ) and the Oregon Department of Fish and Wildlife (ODFW) have been involved in implementing the EMAP sampling strategy throughout the range of the listed threatened and endangered coastal Coho (Onchorhynchus kisutch) salmon. The monitoring effort was part of the "Governor's Salmon Plan." They provide a model for how local watershed groups and multiple state

agencies can form a combined work effort to generate data needed to adequately characterize conditions.

The partnership enhances the ability to generate condition summaries in a shorter length of time and is advantageous so long as the changes occurring in aquatic ecosystems are sufficiently rapid to measure over these short time frames. ODEQ and ODFW have evaluated physical, chemical, and biological characteristics for use as indicators and provide a good starting point, but address specific political and management issues with this list. The indicators that will be identified for Washington will be different from those identified in the Oregon Plan.

John Day Side-By-Side Study

This recent project funded by NOAA-Fisheries (National Oceanic and Atmospheric Administration) evaluates the various habitat characterization protocols established by state and federal agencies and their comparability. The results from this comparability study provides the type of guidance we need in selecting indicators and for refining field protocols most useful to answer our monitoring questions. The Washington State Department of Ecology has sent a field crew to Oregon to participate by using U.S. EPA's EMAP protocols in this comparison. Some of the answers that will be provided include: sensitivity of specific habitat characterizations, applicability of habitat measures at the reach and landscape scales, and length of time needed to detect change in habitat features.

Linking Watershed S/T monitoring to Monitoring for Biodiversity

Monitoring the status and trends in Biodiversity is required as part of the State Wildlife Grants Program. This federal program that will begin by the end of 2007 will provide state funding to conserve native biodiversity. As part of that program, each state is mandated to develop a monitoring program that can track success. Development of the monitoring program within WDFW (Washington Department of Fish and Wildlife) is in the early stages, but already have similarities with that described in this proposal. We will work with the WDFW to create efficient sampling programs that can serve both the goals of the SOS (State of the Salmon Report) and the State Wildlife Grants Program.

Field Methods and Sampling Procedures

Chemical, biological, and habitat assessment protocols for wadeable streams are well-documented and have been recorded by the U.S. EPA in several documents. These are descriptions for Standard Operating Procedures (SOP's) for measuring habitat characteristics, characterizing biological communities, and evaluating water quality conditions. The focus for past and recent work has been on wadeable streams, but work is underway at the Oregon State University (Robert Hughes) to develop effective large river monitoring protocols. Many of the wadeable stream protocols are used in large rivers, but logistical constraints arise when water depth increases and river width is broad.

Surface water turbulence on large rivers makes measuring habitat and biological features difficult. The following documents provide a starting place for reviewing Standard Operating Procedures:

Kaufmann, P. 1999. Quantifying Physical Habitat in Wadeable Streams. United States Environmental Protection Agency, Western Ecology Division, Corvallis, Oregon. 102 p.

Peck, D. et al. 2001. Environmental Monitoring and Assessment Program – Surface Waters: Western Pilot Study Field Operations Manual for Wadeable Streams. United States Environmental Protection Agency, Western Ecology Division, Corvallis, Oregon.

Wadeable Streams

- Chemistry (discussed in the references listed above)
- Biology (discussed in the references listed above)
- Habitat (discussed in the references listed above)
- Remote sensing

Remote sensing technology has improved in recent years and has become available for characterizing landscape features. Some landscape features can be measured by examination of spectral characteristics generated in images. Elements of the spectral image are compared with actual measurements from locations within the image. These comparisons are important for determining how well the spectral image can predict actual characteristics in stream or estuary settings. The following descriptions for types of remote sensing directly address the means by which we can characterize upland areas in watersheds. Quantification of upland characteristics are key in evaluating watershed processes and components in need of restoration.

The Comprehensive Monitoring Strategy (CMS) listed remote sensing as a means for characterizing landscape characteristics like: 1) number of road miles in a watershed, 2) impervious surfaces to rain and snow, and 3) quantifying landslide attributes within regions. Since this recommendation was made, further advances in the technology with novel application have expanded the variety of elements that can be evaluated in aquatic and riparian ecosystems. The resolution of remotely sensed images has become greater and the quality of reach-level characterizations has become possible. However, on-the-ground verification of physical characterizations has to be completed at a proportionate number of sites in order to quantify mis-characterizations that will occur. Continual testing of remote sensing technologies will enhance efficiency of evaluations by making a portion of data gathering a desk-top exercise.

Other imaging techniques include LIDAR (Light Detection and Ranging) that provide spectral images with higher resolution and will penetrate water surfaces. This is especially advantageous in characterizing stream reaches and not just larger landscape areas. Images generated from LIDAR are related to on-the-ground measurements so that other areas within a drainage or water body can be categorized and used to estimate overall condition for aquatic ecosystems. Work like this has been completed for the

Queets River, Washington by Rick Hauer and his associates. They found convergent physical features important for various life stages of chinook salmon and were able to relate these features to spectral characteristics generated from the LIDAR images. An overall estimate of location and extent of desirable habitat was made for this important species.

Aerial photographic sampling has several advantages: 1) several sites can be visited in one day, 2) site access is more certain, 3) reduction of time spent accessing sites by field crews, and 4) photographs provide a permanent record of a site and monuments condition at a specific point in time. These were described in a recent proposal submitted by the Washington Department of Fish and Wildlife. Relationships between reach-level or landscape characteristics and elements of the aerial photograph need to be developed and can then be used as a surrogate for field sampling. However, field sampling at a proportion of sites is always needed in order to verify and validate accuracy of assessments.

We propose examining the results from this work and determine how we can use this research to estimate locations and extent of important habitat for salmon species in WRIA's and SRR's where LIDAR images are available. It's also possible to seek assistance from our partners in generating more LIDAR images where currently unavailable.

Non-Wadeable Streams and Rivers

- Chemistry
- Biology
- Habitat
- Remote sensing (same discussion as for Wadeable Streams)

Draft sampling protocols have been developed for non-wadeable streams and rivers. However, they will need to be evaluated as part of the development of the MP.

Analytical and Laboratory Procedures

Procedures for analyzing water samples and biological samples are recorded in the Quality Assurance Project Plans prepared by Holdsworth (2004) and Paulsen (1997). All of the EMAP projects completed by Ecology since 1993 have followed some or all of the procedures recorded in these two documents. Also, individual Quality Assurance Project Plans had been prepared for each of Ecology's projects funded by U.S. EPA. These plans provide important documentation to determine comparability of individual projects before combining data sets. Citations for the specific procedures and protocols are found below and all of the QAPP's for Ecology's five EMAP projects are available in electronic form. All of the SOP's, final reports, and data can be found at Ecology's web site for stream biological monitoring: http://www.ecy.wa.gov/programs/eap/fw_benth/emap-remap.html

Quality Assurance and Quality Control Procedures

Several documents have been prepared that describe the quality assurance elements for the proposed status and trend monitoring program. The U.S. EPA had prepared documents for their Western EMAP Rivers and Streams Program and the National Wadeable Streams Program. Each of these documents provides the necessary detail for preparation of a Quality Assurance Monitoring Plan that would be developed in later phases of the Status and Trends Monitoring Program planning process. Training of field crews is also an important element for implementing a large-scale program. U.S. EPA has historically taken on this role and will be consulted in order to develop our own training program. The following are documents that can be used as guidance for preparing a Status and Trends Quality Assurance Monitoring Plan:

Holdsworth, S. 2004. Wadeable Streams Assessment: Quality Assurance Project Plan. United States Environmental Protection Agency, Office of Water, Office of Environmental Information. Washington, D.C. EPA 841-B-04-005. 71 p.

Paulsen, S. 1997. Environmental Monitoring and Assessment Program: Integrated Quality Assurance Project Plan for Surface Waters Research Activities. United States Environmental Protection Agency, Office of Research and Development. Corvallis, Oregon. 129 p.

Data Management Process

Who is Managing Agency

Ecology has been managing EMAP data from its projects since 1993. Currently we use both an independent database with the capacity for combining a variety of project types into a single database. We also upload this information into Ecology's Environmental Information Management system (EIM). The largest multi-state EMAP project uses the SWIM database (Surface Waters Information Management managed by U.S. EPA) which is located in Corvallis, Oregon and makes data available in a user-friendly format to project participants. We need to develop an interface or adopt structure from the U.S. EPA SWIM database in Ecology's EIM database that enables easy uploading and access to data in a statewide monitoring program. Currently, the Natural Resource Data Portal allows a user to find available data and connect with its source. This requires that a user visit several web sites that provide little uniformity in presentation of results and data. We will explore the development of uniformity in off-site database systems and a single, more inclusive database that has the capacity for storing a large variety of environmental information.

Maintenance and Updates

There is an on-going cost for managing a database for large projects. There are periodic changes to protocols or enhancements to indicator lists that have to be incorporated into existing data systems. Taxonomic changes in species lists occur on a routine basis and have to be reviewed and incorporated into individual tables of a database. The need for a portion of a database administrator is critical for successful maintenance and changes needed in order to access high quality data for other purposes.

Providing GIS Coverage

GIS coverages should be part of the overall data management system and linked.

Project Status Tracking

- Who
- What
- Where
- When

Compiling/disseminating reports and results

Data collection is completed by the end of September in each calendar year. Analysis of water samples and biological samples will extend the period of time summary reports can be written by three months. The reporting can be completed by providing information on a web site and provide brief summary interpretations for each monitoring year. A larger and more complete report should be published in the sixth year of a five-year sampling rotation plan. Results need to directly address the questions and statements outlined in the objectives regarding the status of important biological resources, physical habitat condition, and water quality. Included with the summary of status are likely causes for impairment. Information generated from the Status and Trends program can use results from the “Data Pyramid” (conclusions drawn from other monitoring programs that assist in explaining the status of our aquatic resources and causes or risks for negative change).

Data Analysis and Evaluation of Results

There are standard analyses that have been developed for EMAP program data. The U.S. EPA has provided on-line tools as well as routines that run on freeware (free software) that analyze and present summary information for habitat and chemical data. Biological information has a few more steps included in its analysis, but provides index-based expressions as well as predictive model-based evaluations of biological condition.

Some Ecology staff have been trained in the use of on-line data analysis tools and have the assistance of the analysts at U.S. EPA who originally developed them. We have had a strong partnership with the U.S. EPA in developing and describing results from several projects in Washington where EMAP monitoring has been completed. Recent developments for analyzing data have included determination of habitat and water quality characteristics that are causes for degradation in biological communities (e.g., fish,

aquatic invertebrates, amphibians, algae). These results can be used as “high level indicators” in the State of Salmon Report and sources for pollution identified to explain watershed health and salmon condition evaluations.

Partnerships

Local Government and Volunteer Groups

Several county and city government agencies have developed the capacity to conduct sophisticated monitoring programs and complete data analysis. We have worked with numerous grantees representing these levels of government on collaborative projects and already share many of the same skills. We share monitoring technology and training in data collection procedures with Skagit County Department of Public Works and the City of Bellevue. Training in field and analytical procedures is provided by monitoring groups regardless of organizational identity (i.e., state, federal, city, county, tribe, private). We would encourage any state funding opportunities provided local governments (and others) to enhance a Status and Trends program within their jurisdiction.

Volunteer groups have become a greater force in revealing important environmental issues and in conducting survey and monitoring work. Some volunteer groups are well-organized and produce high-quality information that can be very informative to natural resource agencies. However, the training and maintenance of quality data collection by volunteers has a continuing cost for trained professional staff that provide quality assurance checks throughout all of the volunteer monitoring activities.

Successful volunteer monitoring programs have been implemented in British Columbia where the focus has been on fish and fish habitat. The use of volunteers providing assistance to regionally-based staff in natural resource agencies, local governments, contractors, or tribes will increase efficiency by shortening survey times. This may lead to evaluating more sites per unit time or by expanding the variety of characterizations possible within the same time frame. Volunteers will also be useful in data management procedures including data entry and generation of automated summary reports. Logistics for operating a volunteer-based program should use the British Columbia example as a guide.

Examination of current organized volunteer monitoring programs is needed in order to determine the variables measured, methods used to characterize environmental variables, and how results are reported. These data will be considered in the “roll up” of existing data and will be evaluated against standards described in the Quality Assurance Monitoring Plan.

Agency Collaboration

Operating a Status and Trends Monitoring Program requires that partnerships among several agencies, contractors and existing programs be coordinated. Currently, there are monitoring programs being conducted by Ecology in partnership with the U.S. Forest Service and KWA Ecological Sciences. KWA Ecological Sciences is also organizing the same type of monitoring strategy for the Okanogan Basin and is operating as contractor to the Colville Tribe. All of these government, tribal and private groups belong to the Upper Columbia Regional Technical Team (UCRTT) that provides guidance for environmental research efforts. Funding has been provided by the Bonneville Power Administration and NOAA-Fisheries for past projects. These projects were intended to develop how partnerships could work and protocols that could be used consistently among the field crews.

State-federal partnerships have been strong and provided a new look at how federal/non-federal land evaluations could be addressed. The federal agencies have provided useful opportunities for evaluating performance and utility of indicator variables. A review of the entire monitoring partnership structure currently in existence is needed to develop a “core” EMAP program that can be used for evaluation of natural resources.

Organization and Schedule

Roles and Responsibilities

Each of the consulting scientists has a key contribution to create a successful Status and Trends Monitoring Program. These contributions include: planning, technical, and coordination of partnerships. The following are necessary contributions from each:

- Consulting scientists:
 - Phil Larsen
 - Generation of site locations in each WRIA and SRR
 - Integration of data from multiple on-going and past projects
 - Steve Leider
 - Coordination of existing and future monitoring efforts in Washington State
 - Coordination and acquisition of funding to maintain EMAP monitoring in Washington State
 - Steve Lanigan
 - Maintenance of state-federal monitoring partnerships involving federal lands
 - Research and evaluation of indicator performance
 - Tim Quinn
 - Coordination and summary of fisheries status and trends in WRIA’s and SRR’s
 - Research and evaluation of cause-and-effect between land-habitat and habitat-fish relationships

- Chris Jordan
- Coordination with federal efforts in salmon recovery monitoring
- Link between types of monitoring (e.g., status & trends, effectiveness, cause and effect)

Workgroup Dates to Discuss Individual Topics

Workgroup participation will be by invitation and will rely on “key” participants and their attendance. The workgroups will include the consulting scientists above in one or more of the sessions. Key participants will be provided travel assistance if they reside outside of the meeting area. If the meeting were to be held in Olympia, the total travel and reimbursement cost for lodging and per diem would be:

\$120.00/day x 25 participants x 4 Workgroups = \$12,000.00

July 28, 2005

Site Selection Process and Sub-Populations (WRIA, SRR, AREMP, UCRTT)

- Methods for determining use of existing data
 - Comparability among data sets
 - Combining data sets

September 1, 2005

Indicators Performance Evaluation and Selection

- Field Protocols
- Remote Sensing
- Analytical Procedures
- Results from performance evaluations

October 13, 2005

Existing Data Sets and their Contribution to a Monitoring Program

- Ecology EMAP Projects
- AREMP
- PIBO
- UCRTT (Wenatchee and Okanogan)
 - National Parks

November 24, 2005

Data Management and Analysis

- Management needs/comparison to existing systems
- Structure and content of summary reports
- Transfer of information to existing status/trend reports

Draft and Final Quality Assurance Monitoring Plan due dates

Draft QAPP due March 30, 2006

Final QAPP due May 31, 2006

Cost and Staff Levels to Develop Plan for Status and Trends Monitoring Framework

Agencies that will be involved in developing the Status and Trends Monitoring Plan will require some level of funding to help develop the MP. The Washington Conservation Commission, Washington State Department of Ecology and the Washington Department of Fish and Wildlife have been identified as the lead agencies in this effort. Each agency has expended some past level of effort in establishing a viable monitoring program that would provide an evaluation of status and trends. Staffing for preparation of this Quality Assurance Monitoring Plan includes senior scientists that have experience with EMAP or expertise in environmental research. The following are proposed cost for the lead agencies (includes salary, benefits, indirect costs, goods and services, travel):

| Agency | Salary/mo | Benefits/mo | Indirect/mo | G&S/yr | Travel/yr |
|--------|-----------|-------------|-------------|--------|-----------|
|--------|-----------|-------------|-------------|--------|-----------|

Washington Conservation Commission (0.17 FTE)

| | | | | | |
|-------|-------|-------|-------|-------|-------|
| WMS-1 | \$877 | \$237 | \$442 | \$687 | \$641 |
|-------|-------|-------|-------|-------|-------|

Total \$20,000/year

Washington Department of Fish and Wildlife (.25 FTE)

| | | | | | |
|-------|-------|-------|-------|-------|-------|
| NRS-1 | \$871 | \$236 | \$439 | \$687 | \$761 |
|-------|-------|-------|-------|-------|-------|

Total \$20,000/year

Washington State Department of Ecology (1.0 FTE)

| | | | | | |
|------|--------|--------|--------|--------|--------|
| ES-4 | \$4570 | \$1234 | \$2300 | \$3454 | \$1438 |
|------|--------|--------|--------|--------|--------|

Total \$102,000/year

Cost to Develop Quality Assurance Monitoring Plan

The total cost to develop an MP is estimated to be a maximum of \$154,000.

Appendix

State Map showing example sample draw by WRIA

