Action Effectiveness Monitoring of Tributary Habitat Improvement: a Programmatic Approach for the Columbia Basin Fish and Wildlife Program

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Executive Summary

In their recent review of research, monitoring, and evaluation projects, both the Northwest Power and Conservation Council (Council) and the Independent Scientific Review Panel (ISRP) recommended that the Bonneville Power Administration (BPA) and its partners develop a consistent, rigorous, and cost-effective approach for evaluation of habitat actions implemented under the Council's Fish and Wildlife Program. In response, the following document outlines a coordinated, programmatic action effectiveness monitoring (AEM) program proposed by BPA to meet this need.

This program is built on past habitat monitoring experience in the region. It is designed to be compatible and integrated with other ongoing monitoring efforts (e.g., SRFB AEM, CHaMP, and ISEMP) and a remains a key component of BPA's Research, Monitoring and Evaluation Framework. Overall, consistent with the Council and ISRP recommendations, the proposed AEM approach should provide more useful, standardized information capable of synthesis without requiring a full monitoring and evaluation effort for each individual habitat project,

The proposed program includes three major components:
(1) Improving and streamlining *on-going* currently funded project level AEM,
(2) developing a programmatic third-party approach for AEM of *new* actions, and
(3) programmatic approach for AEM of *past (completed)* actions.

The first component includes standardized project annual reporting, monitoring designs, protocols and metrics, and data standardization and management for *on-going* AEM that is part of existing BPA funded projects. Component 2 includes a AEM of a subset of each of the most common action categories and sub-categories (barriers, fencing, off-channel/floodplain) using a multiple before-after-impact-control (MBACI) design compatible with that used by the Washington Salmon Recovery Funding Board. Specific case studies may still be needed for a few less common action categories (e.g. beaver enhancement, gravel addition) or actions whose response is best evaluated at a watershed scale (e.g., instream flow, road removal). To learn from the thousands of completed riparian planting, barrier removal, and instream habitat actions completed prior to 2012, an extensive post-treatment design (EPT) – a design that samples paired treatment and controls well after the habitat improvement has been occurred – will be used to evaluate a subset of past actions (component 3). The EPT design has been widely used to evaluate historic restoration actions for other programs and provide quick results on action effectiveness. Sample size estimates, years of monitoring, and monitoring metrics are described for each habitat action category and sub-category for components 2 and 3.

A suggested timeline with steps for finalizing the proposed AEM approach and implementing these three components over the next three to five years is also proposed. This includes initial steps for 2013 such as improvements in reporting for on-going projects and the implementation of third-party AEM of new actions. We also describe how project sponsors will use this document to incorporate this new programmatic approach into their project proposals.

Introduction and Background

The Bonneville Power Administration (BPA) is currently investing more than $80 million annually in a variety of tributary habitat improvement actions (Table 1). This includes funding of dozens of projects that implement hundreds of on the ground habitat improvement and protection actions every year. Evaluating the effectiveness of these actions is critical for determining success of these investments and for guiding future investments in tributary habitat improvement and watershed restoration. The current approach to AEM is piecemeal and variable. Because of the recent increase in the magnitude of the habitat program, a new action effectiveness monitoring approach that provides clear and consistent coverage is essential.

BPA and the Bureau of Reclamation (Bureau) currently fund two types of tributary habitat action effectiveness monitoring (AEM). The first, **"Project level"** AEM, involves monitoring of individual habitat actions such as removal of passage barriers, habitat restoration, and increasing of instream flows. The second, "**Watershed level"** AEM includes larger suites of combined habitat actions. Project-level AEM measures <u>local</u> or reach-scale response of habitat and fish to a habitat improvement action. This includes monitoring reach-scale changes in habitat and fish metrics such as pool area, large woody debris (LWD), fine sediment, water temperature, fish abundance, biomass, and growth. Because project-level AEM assesses the effects of specific habitat actions on local or reach-scale habitat and fish, it is less likely to be confounded by the broad-scale factors found in watershed-scale effectiveness monitoring (e.g., multiple treatments, other management activities) and, therefore, it easier to detect a response due to the restoration treatment (Roni et al. 2005) Project-level AEM typically does not assess the effects of habitat actions on fish survival, because fish survival is best measured at a larger spatial scale. Other forms of habitat research, monitoring, and evaluation (RM&E) look at larger spatial scales through watershed-level AEM (e.g., Intensively Monitored Watersheds) or status and trend monitoring.

In this document, we focus on "project level"[1] AEM though some action categories are recommended to be evaluated at a "watershed level" using an intensively monitored watershed (IMW) approach. It should be noted that tributary habitat AEM is one component of BPA's and the Northwest Power and Conservation Council's (Council) broader, more comprehensive approach to RM&E. Other types of research and monitoring (e.g. compliance, status and trend) are described in the BPA's broader RM&E framework document (BPA 2013a).

Although the BPA currently funds AEM as part of its habitat projects, the Council and others have noted the need for improvements. For example, the Independent Scientific

[1] Because the word "project" is used by the BPA Fish and Wildlife Program to cover a contract with a sponsor that may cover many different restoration "actions", we use the term "action" rather than project to minimize confusion and clarify that we are talking about individual restoration actions. Actions are equivalent to BPA "Work Elements" or a suite of work elements implemented at a restoration site.

Table 1. Summary of the estimated number of individual habitat actions funded by BPA and completed by project sponsors in interior Columbia Basin since 2005. Actions are divided by category and common sub-categories. The limiting factors addressed by each action type are described in Appendix 1.

Action	Sub-category	Number of Actions Completed
Fish Passage	Barriers – Complete	
	Barriers – Partial	299
	Diversion screening	588
Instream Structures	LWD/Boulders/Pool & Complexity	
	Bank stabilization	
	Engineered Logjams/structures	613
	Beaver enhancement	
	Nutrients	
Off-Channel/Floodplain	Levee set-back removal	57
	Floodplain reconnection or creation	
	Wetland restoration	174
	Remeandering	
Riparian Improvement	Fencing	435
	Planting	485
	Invasive plant removal	508
Sediment Reduction/Addition	Roads	273
	Agricultural practices	75
	Spawning gravel addition	?
Acquisition & Protection	Land acquisition, lease, or easement	408
Flow Augmentation	Waters lease or purchase	226
	Irrigation improvement	459

Review Panel's (ISRP) RM&E Categorical Review[2] concluded that "There is comparatively little evidence that habitat effectiveness monitoring is being coordinated in such a way that monitoring programs can take advantage of multiple restoration actions occurring in the same area, at least at the sub-basin scale. Perhaps the emergence of the new regional "umbrella"-type projects can facilitate better coordination and more cost-effective monitoring actions" (NWPCC 2011). Based on that review, the Council recommended that" Bonneville and its partners should develop for ISRP review a proposal to transform that effort away from monitoring work elements on individual projects into a cost-effective, independent third-party, standardized, and statistically valid method for evaluating project-level effectiveness." In addition, the Council, the ISRP, an assessment of existing BPA funded project-level tributary habitat effectiveness studies (Tetra Tech 2011), and recent synthesis of reports prepared in 2012 (In prep) have found a number of key issues that should be addressed to improve investments in habitat improvement and their monitoring and evaluation. These include:

1) The lack of a standardized reporting format for providing habitat RM&E results

2) The lack of standardized monitoring metrics prevents comparing or combining results.

3) The lack of consideration by some sponsors of standard statistical designs that use treatment, controls and or references.

4) A disproportionate level AE monitoring for different categories of restoration actions

5) The need to move away from monitoring individual projects and actions to programmatic approach to evaluating action effectiveness[3].

These points highlight the need for improvements in both current AEM including: more consistent monitoring and reporting, standardization of action categories, monitoring designs, and metrics. It also highlights the need for a programmatic third-party approach to evaluating a subset of not only new actions (those proposed for 2013 and beyond) but also previously completed actions (those implemented prior to 2012).

To address these needs, BPA is proposing a number of programmatic changes to improve the quality, utility, and efficiency of tributary habitat project effectiveness monitoring. This document describes BPA's three key components of the proposed changes and provides the framework for their implementation. This includes *(1) improvements needed in on-going RM&E, (2) a programmatic approach for both AEM of new actions and (3) a programmatic approach for completed actions.* We close with a summary of proposed changes, timeline for comment and implementing proposed changes, and key contacts for additional information for project sponsors.

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[2] http://www.nwcouncil.org/fw/budget/2010/rmeap/2011_06decision.pdf
[3] See page 19 of June 2011 Council Decision letter (http://www.nwcouncil.org/fw/budget/2010/rmeap/2011_06decision.pdf

Improving Current Action Effectiveness Monitoring (AEM)

Prior to embarking on a new programmatic approach for AEM, it is important to evaluate current practice. Most project-level habitat AEM monitoring funded by BPA is developed independently by project sponsors with limited consideration for consistency with other AEM efforts, other designs, and metrics or methods (Tetra Tech 2011). This has lead to monitoring on a case by case basis rather than according to a consistent program that allows for roll up or down of data to look at individual actions or actions across a number of projects. To address this and issues 1 through 4 described above, BPA is proposing improvements to the current AEM including:

- Standardized reporting
- Standardized project AEM metrics
- Redesign, reduce and increase efficiency of habitat project monitoring for specific action categories
- Data standardization and management

BPA has already begun to implement a standardized habitat-reporting format for 2012. This requires all project sponsors currently funded by BPA to conduct AEM, to develop an AEM progress report and to present their data and results using a common format[4]. Additional development of protocols will further develop standard output graphs and tables for annual reports to facilitate summarization across the program. Consistent with the Council's draft Monitoring, Evaluation, Research and Reporting (MERR) framework annual reports will include as a minimum, a clear statement of objectives and hypothesis: linkage to Program priorities; a description of treatments; a discussion of scientific methods including designs and protocols; statistical analyses, results, and conclusions; a summary of accomplishments; and implications for fish, wildlife and their habitat.

This common reporting format is critical to

a. Evaluate results and the quality of current RM&E data
b. Provide a basis for standardizing metrics
c. Provide data to further evaluate current AEM and provide recommendations for efficiency
d. Assist with the roll up and analysis of AEM on a system-wide basis
e. Aid the development of standardized metrics and database for storing AEM data

For both ongoing and new AEM it is essential that standardized AEM metrics and methods/protocols are developed and coordinated with proper training and QA/QC processes. All new habitat action effectiveness contracts will include "standard" action effectiveness reporting metrics. These metrics are based on the "*Washington State Salmon Recovery Funding Board (SRFB) Reach-Scale Effectiveness Monitoring Program*" design and assessment (Tetra Tech 2009). In some instances, they have been slightly modified (e.g. added an instream flow category and metrics that SRFB doesn't evaluate).

[4] See Appendix 3 that includes BPA Fish and Wildlife Program email dated 30 October 2012 to all project sponsors on new reporting format and guidelines.

The monitoring measurements and metrics and AEM questions are discussed in more detail in the subsequent section.

Along with improvements to reporting, standardization, and implementation of a programmatic AEM approach for new and completed (past) actions (described in detail in following section), BPA proposes to streamline and reduce the total number of individual tributary habitat projects conducting AEM for individual actions. On a staged basis, efficiencies gained through the programmatic approach for AEM will allow a reduction of the total number of actions that require monitoring. Although this proposal contemplates reductions in current AEM, compliance monitoring will continue to be performed to ensure that all actions are implemented as specified in contracts (See BPA 2013b).

Moreover, data management and access is necessary to facilitate synthesis of existing AEM data and meta-analysis of similar action categories. Currently data from AEM are stored and managed by project sponsors and most data are neither readily available nor compatible. Data management practices and standards, the methods used in collecting and analyzing the data, and the metadata should be documented to ensure appropriate data management, longevity of the data, and to facilitate data sharing (see NWPCC Undated for Council's draft data management and reporting framework). Data should also be entered into a centralized database for each project and action so that data are standardized and available for analysis across different projects and action categories. For more information and guideline related to proper data management see BPA's data management guidance documents "*A Framework for the Fish and Wildlife Program Data Management: Issues and Policy Direction for Development of 2013 Data Management Strategies and Action Plan*" (BPA 2013b).

Programmatic Approach for New and Completed Actions

Commensurate with the need for improved reporting is the need for a consistent programmatic approach for AEM for habitat actions that are currently being planned or proposed. A programmatic approach, similar to that used by the SRFB, would provide evaluation of new actions (planned or proposed actions) and provide consistent results for the habitat improvement by BPA under the Council's Fish and Wildlife Program along with greater efficiencies. The data collection would either be by the sponsor or a third party and the data analysis completed by a third party.

A programmatic approach focusing on new actions alone would take five to 10 years or more to provide information on effectiveness for many action categories and not provide information on past (completed) actions More than 25,000 individual habitat improvement actions have been implemented by various organizations in the Columbia basin in the last three decades (Figure 1). The BPA alone has funded implementation of actions at more than 4,600 unique treatment sites since 2005 (Table 1; Based on work elements in BPAs PISCES database). Considerable information can be obtained by using post-treatment or retrospective study designs to evaluate these actions. By using this monitoring design, data can be collected on actions completed prior to 2012 and provide information on effectiveness of actions within the next two to five years. Therefore, to provide both information on AE in the near-term (2 to 5 years), BPA is proposes to implement a consistent and cost-effective basin-wide programmatic approach to AEM to evaluate a subset of both new (proposed) and past (completed) actions. These two components would be consistent with SRFB and other standard AEM monitoring, use the new standard metrics, and be overseen by a third-party, although as noted above, project-sponsors could contribute to data collection.

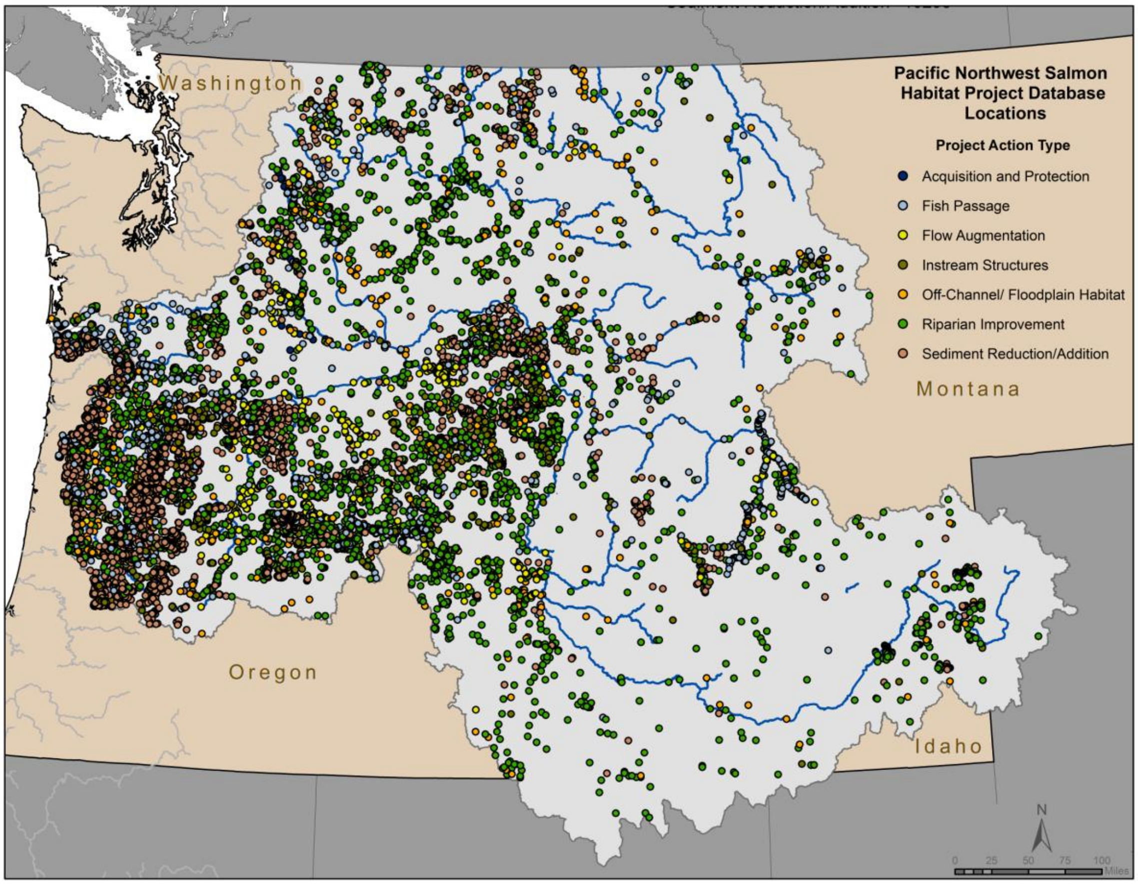

Figure 1. Map showing completed habitat improvement actions by all entities in Columbia Basin by action category since ~ 1980 (Source NOAA PNSHR database). Since 2005 BPA has funded implementation of actions at more than 4,600 sites.

AEM Goals and Questions

The ultimate goal of the proposed AEM approach is to a) quantify improvements in localized habitat and fish abundance as a function of restoration actions implemented in the Basin and b) help guide future restoration and improvement efforts to ensure BPAs is investing in effective restoration techniques.

Specifically, AEM is designed to answer the following questions:

1. What is the effectiveness of different action categories on fish habitat at the reach (action) scale?

2. What is the effect of different action categories on fish and other biota at a reach (action) scale?

3. Within an action category, why are some actions more successful than others? (What is the relationship between physical habitat improvement and fish for a given action category?)

4. Are there geographic differences in physical and biological success of different action categories?

Evaluating new or completed actions requires very different study designs and not all action categories are best monitored by one design or another (Roni et al. 2005). The most cost-effective and scientifically rigorous approach for programmatic AEM depends upon a number of factors. This includes the restoration action-category or sub-category (see Table 1), the number of actions that have been or will be implemented, the questions or hypotheses being tested by the monitoring program, the geographic extent of the desired monitoring program, and whether pre-treatment data can be collected or is needed. Based on this, we outline a programmatic approach that is tailored to the different action categories funded under the BPA for the Council's Fish and Wildlife Program. In the following subsections we first describe different study designs, levels of stratification, and initial estimates of sample size for major action categories (Table 1).

Monitoring Designs

There are two basic monitoring designs with several minor variations that are used for AEM. These include before-after designs and post-treatment (sometimes called retrospective) designs. Before-after (BA) designs include collection of data before and after restoration in a treatment (restored) area.

The most common BA design is a before-after impact-control design (BACI), which includes the addition of one or more control reaches. In contrast, post-treatment designs do not include pre-treatment monitoring but simply collect data at multiple treatment and control reaches. Designs can be further divided by the level of replication with those that focus on one or a few actions being intensive and those that focus on many actions being extensive. Each design varies in its strengths and weaknesses and time and resources needed to implement them and achieve results (Table 2). No one design is ideal for all situations or action categories.

Table 2. Different monitoring designs used for action effectiveness monitoring and their strengths and weaknesses (Modified from Roni et al. 2005). BA = before after, BACI = before-after control-impact, MBACI – multiple before-after control impact, IPT = intensive post-treatment, and EPT = extensive post-treatment.

Attribute (pros and cons)	Study Designs				
	Before and After Designs			Post-treatment	
	Intensive (BA)	Intensive (BACI)	Extensive (MBACI)	Intensive (IPT)	Extensive (EPT)
Includes collection of pre-treatment data	yes	yes	yes	no	no
Ability to assess inter-annual variation	yes	yes	yes	yes	no
Ability to detect short-term response	yes	yes	yes	no	yes
Ability to detect long-term response	yes	yes	yes	yes	yes
Appropriate scale (WA = watershed, R=Reach)	R/WA	R/WA	R/WA	R	R/WA
Ability to assess interaction of physical setting and treatment effects	low	low	high	low	high
Applicability of results	limited	limited	broad	limited	broad
Potential bias due to small number of sites	yes	yes	No	yes	no
Assume treatment and controls are similar before treatment	NA	no	no	yes	yes
Results influenced by climate, etc.	yes	yes	no	yes	no
Years of monitoring needed to detect a fish response	10+	10+	5+	5+	1-3

An extensive or multiple BACI (MBACI) design – such as has been done by the SRFB – involves sampling a large number of actions before and after restoration (treatment). This design is in fact proposed for programmatic monitoring of many action categories (e.g., floodplain restoration; riparian fencing), particular those that require pre-treatment and are relatively common (several actions are implemented every year). However, the MBACI design requires extensive pre-pre-project planning, a minimum of 2 to 3 years of pre-treatment data collection, and considerable time to produce results and is not ideal for all action types. For actions that are new, experimental or rare, an extensive MBACI design is not possible because there are not enough potential actions. For these action types, an intensive case study using either a BACI or BA design is proposed. Whether these focused case studies should be at the "reach" scale or watershed-scale (such as an IMW) depends in part on the action category and whether the treatment effects are localized or widespread. For example, an individual road removal or improvement action often covers several miles of road, has broad-scale effects on stream reaches downstream from the restoration site, and is therefore best monitored at a watershed scale. In contrast, spawning gravel addition typically occurs in one stream reach and has localized physical and biological response and is best monitored at reach scale.

MBACI, BACI and BA designs require considerable planning and do not allow one to evaluate or learn from previously completed habitat improvement actions. To evaluate past actions (those completed before ~2012), particularly those that are very common and a large population of past actions available, a post-treatment design is considered ideal. In fact, some of the most thorough evaluations of habitat improvement in both the United States and Europe have used extensive post-treatment (EPT) designs, which sample many treatment and control pairs on completed actions (e.g., Roni and Quinn 2001; Morley et al. 2005; Pretty et al. 2003; Louhi et al. 2011). Because actions of various ages (time since treatment) are often sampled it is sometimes called a space for time substitution. While this design does not allow for evaluation of the success of an individual action, it does provide a robust way to evaluate the "average" response of a category of actions (Grant et al. 1986). Thus, it is particularly well suited for evaluating actions already implemented under a large restoration program such as the Council's Fish and Wildlife Program (Roni et al. 2005; Roni et al. 2012).

Based on this information, we identify the different study designs in Table 3 (i.e., MBACI, EPT) for evaluating new or proposed actions, completed (past) actions, and, for those actions that are rare or relatively new and experimental. In addition, the intensity of the monitoring, the number of actions that need to be monitored, and the uncertainty and frequency of the action were considered in determining the study design for each action category.[5] We explain the rational for selecting designs for each major action category below. Further development of the will clarify how to integrate on-going or completed BPA and other program studies to this approach and if additional studies are needed to meet sample size requirements.

Barrier and Fish Passage

This action category includes two major subcategories: barrier removal (e.g., culvert replacement, dam removal), and diversions screens. Because the monitoring of diversions screens is largely compliance monitoring, we do not propose to include this as part of the AEM program. Moreover, a subsample of diversion screening actions was monitored by Tetra Tech under the SRFB/Oregon Watershed Enhancement Board (OWEB) program to determine if they were installed successfully and in compliance with standard NOAA Fisheries guidance. Their results indicated this action category successfully met criteria and recommended discontinuing AEM of this action category but continuing with compliance monitoring of screening actions (Tetra Tech 2010). Therefore, we do not include this as part of our AEM program, but compliance monitoring should continue on all screening actions.

More than a thousand barrier removals have been completed in the Columbia Basin in the last few decades – the vast majority of these were culvert replacement or removal. Barrier removals can be further subdivided into those that address complete barriers, such as

[5] This is similar to the "risk uncertainty matrix" to guide monitoring intensity recommended in the Council's draft MERR framework. For example, actions that are uncommon or experimental are riskier and recommended for intensive case studies rather than a broader less intensive MBACI or EPT design.

perched culverts that are impassible to adults or juvenile salmonids, and those that are partial barriers, such as culverts that may be a barrier to some species or life stages at

Table 3. Monitoring designs proposed for programmatic evaluation of new and completed habitat improvement actions based on action category. MBACI = Multiple before-after control impact design, EPT = extensive post-treatment, NA = Not applicable (not recommended for monitoring). Case study = should be evaluated as part of focused study specific to that action or as part of an Intensively Monitored Watershed (IMW). Colors indicate which of the action sub-categories will be monitored with a programmatic approach (green) and those that require an intensive case study (red).

Action	Sub-category	Programmatic	Design	Notes on Design
Fish Passage	Barriers - Complete	Yes	EPT	No before monitoring needed for complete barriers
	Barriers - Partial	Yes	MBACI	Requires pre-treatment data
	Diversion screening	NA	NA	Compliance monitoring
Instream Structures	LWD/Boulders/Pool & Complexity	Yes	EPT	One of most common actions
	Bank stabilization	Yes	MBACI	Lots of variability in techniques, limits possibility of EPT
	Engineered Logjams/structures	Yes	EPT	Common technique easily evaluated with EPT
	Beaver enhancement	No	Case study	Relatively uncommon technique, best as IMW or case study
	Nutrients	No	Case study	Relatively uncommon technique, best as IMW or case study
Off-Channel/Floodplain	Levee set-back removal	Yes	MBACI	Lots of variability in techniques, limits possibility of EPT
	Floodplain reconnection or creation	Yes	MBACI	Lots of variability in techniques, limits possibility of EPT
	Wetland restoration	No	Case study	Best as IMW or case study
	Remeandering	Yes	MBACI	Increasingly common approach but not enough for EPT design
Riparian Improvement	Fencing	Yes	MBACI	Best as MBACI based on previous studies
	Planting	Yes	EPT	One of most common actions, doesn't require pre-treatment data
	Invasive plant removal	Yes	EPT	One of most common actions, doesn't require pre-treatment data

Sediment Reduction/Addition	Roads	No	Case study	Broad-scale response, best as IMW
	Agricultural practices	No	Case study	Includes many sub-categories of actions
	Spawning gravel addition	No	Case study	Relatively rare action category
Acquisition & Protection	Land acquisition, lease, or easement	Yes	MBACI or EPT	Pre-treatment data typically not necessary
Flow Augmentation	Water lease or purchase	No	Case study	Broad-scale response, best as IMW or case study
	Irrigation improvement	No	NA	Compliance monitoring

certain seasons or flows. This is an important distinction because it affects the monitoring design that may be necessary. Evaluating the biological response to removal of a complete barrier is fairly straightforward as pre-treatment data are not critical to determining action success. In contrast, because low numbers of anadromous fish may be present above the partial barrier, pre-treatment data are needed to confirm that fish numbers have increased upstream following barrier removal. Because of the large number of actions, we propose to evaluate a subsample of actions that involved removal of total barriers to fish migration using the EPT design. In contrast, a sample of new partial barrier removals will be evaluated using MBACI design. While not all barrier removal actions will include AEM, compliance monitoring is still needed for all barrier removals.

Instream Structures

The placement of instream structures is one of the oldest and most widespread habitat improvement techniques (Roni et al. 2008)(Table 1; Figure 1). Despite being one of the most thoroughly evaluated techniques, relatively little info exists on its effectiveness for Chinook salmon or streams in the Columbia Basin. Moreover, there are dozens of techniques and efforts to evaluate the success of this action category have been complicated by grouping together actions of different categories or in streams of different sizes. Thus our proposed approach varies by different subcategories which include: LWD and Boulder Placement, bank stabilization, engineered logjams and structures, beaver reintroduction and nutrient addition. Within each of these subcategories, actions should be further stratified by stream size (> or < 20 m bankfull width) and geographic region or evolutionarily significant unit (ESU). LWD and boulder placement, ELJs are common enough that a subset of completed actions should be evaluated with an EPT design. While banks stabilization actions are also common, they vary widely in methods used and best evaluated using an MBACI design (Cooperman et al. 2007). Beaver reintroduction or enhancement is a relatively new technique that is not common, can have broad effects and is best evaluated using as a specific case study or as part of the IMW such as is occurring in the John Day Basin (Pollock et al. 2012). Nutrient enrichment, while increasingly popular, has broad-scale effects and is best evaluated as part of an IMW.

Land Acquisition and Protection
Land leases, conservation easements, and other land acquisition are key components of any restoration strategy. They have rarely received effectiveness monitoring because they often do not include specific restoration treatment. Thus often the monitoring focuses on status and trends to document that high quality conditions are maintained or, if a management activity (e.g. farming, grazing, timber harvest) is removed, that the conditions are improving. Depending upon the situation either a post-treatment or a BACI design could be appropriate. Thus they should be stratified based on whether their goal is to protect high quality habitat or to allow recovery of habitat by removing land management activities. The SRFB is one of the few monitoring programs that have developed a programmatic approach for monitoring this action category and we will largely adapt their methods with minor modification (Crawford and Arnett 2011).

Off-channel and Floodplain Habitat
Habitat improvement efforts for Chinook salmon often focus on restoration of floodplain and off channel habitats. This includes a variety of subcategories of actions such as levee setback or lowering, side channel or pond construction, remeandering straightened channels, and creation or improvement of wetlands. Because actions vary widely, any programmatic approach needs to stratify these by region, treatment method and, in some instances, the type of habitat created (e.g., pond, channel, wetland). While this will greatly reduce the number of potential actions in any one category, it will help reduce variability and improve chances of detecting a response. The monitoring design used to evaluate these will depend upon whether the treatment is intended to improve existing habitat or construct new habitat. A MBACI design is proposed new for actions that improve existing habitat. For actions that create a new floodplain habitat monitoring before construction is not necessary (or possible) so modified MBACI or EPT design can be used (essentially a EPT replicated in time or a MBACI minus the before monitoring) An EPT design of past actions may be possible, but initial data on total number of action implemented in the last few decades (Table 1) suggest that a large enough sample does not exist for all action subcategories.

Riparian Improvement
Riparian treatments, which include planting, removal of weeds or invasive plants, and fencing or livestock exclusion are the most common improvement action in the basin, with more than 2000 actions being implanted in the last few decades (Table 1). Planting and removal actions can be monitored using an EPT design, while fencing (livestock exclusion) is best evaluated using an MBACI design. Large differences in climate and plant communities among ecoregions require that these actions should be stratified by geographic region.

Flow Augmentation
Instream flows are a major limiting factor in many basins in the interior Columbia. Increasing instream flows is a treatment that has broad-scale effects on habitat and stream biota downstream of flow augmentation and is not easily measured at a reach or action scale. Moreover, the magnitude and duration of agreed upon increase in instream flows

varies greatly from one action to another. Because flow augmentation is stream or project specific, intensive stream specific case studies evaluating different flow treatments are needed to determine the effects of these techniques on habitat, fish and biota. Status and trend monitoring in watersheds where flow augmentation is being implemented may also help quantify fish production due improved instream flows.

Sample Size and Stratification

For any monitoring program it is important to determine the minimum sample size – the number of years (temporal replication) and sites (temporal replication) necessary to detect a significant improvement. This is particularly important for a large programmatic AEM monitoring program being implemented and proposed by BPA. This is typically done with a relatively straightforward statistical power or sample size analysis. Sample size estimates can vary widely depending upon the variability of the parameter or metric chosen. Fortunately, some of this variability can be reduced by stratifying actions by ESU or geographic region or action category. For example, instream habitat improvement actions include several action sub-categories that differ greatly in treatment methods and occur in a variety of stream types and across many geographic ecoregions with different climate, stream flow and fish species. Stratifying these by treatment, region and stream size will decrease variability of the metric of interest, while grouping them will increase variability, increase the required sample size and decrease the probability of detecting a significant response.

For the MBACI design and the EPT some preliminary sample size estimates have been calculated. For example, Tetra Tech conducted sample size estimates for the MBACI design based on variance estimates from actions they have implementing for the SRFB (Tetra Tech 2011). Given that the SRFB data are from many ecoregions and in some cases group many action categories, these estimates are likely the maximum sample size needed. Stratification of actions by ESU or ecoregion, stream size, and action sub-categories should help reduce variability and sample sizes. Similarly, NOAA Fisheries has estimated sample sizes for various parameters using an EPT design (Roni and Quinn 2001; Roni et al. 2012). While more refined sample size estimates are necessary for certain action categories, we used these sources to provide approximate estimates of spatial and temporal replication for evaluating new actions (MBACI design) and past actions (EPT design). The estimates are provided in Table 4 and typically require a sample size of 10 to 15 sites per region for each action category and seven additional years of monitoring (2 to 3 before and more than 5 after restoration) for MBACI designs.

Table 4. Initial estimates of sample sizes need by action category. The total years of monitoring and frequency of that monitoring are provided for the MBACI design. For EPT design, all sites are sampled at once and it includes actions completed various ages and replication is purely spatial. Potential stratification includes by evolutionary significant unit or ecoregion (ESU), by channel size (BFW) and by “treatment” which may vary within an action sub-category.

Action Sub-category	Sample size (# of actions)	Years and Frequency (MBACI only)	Potential stratification
Barriers - Complete	30		
Barriers - Partial	10+	-2,-1,0, 1, 2, and 5	
Diversion screening	NA		
LWD/Boulders/Pool & Complexity	30		ESU, BFW
Bank stabilization	10+	-2,-1, 0, 1, 2, and 5	ESU, BFW
Engineered Logjams/structures	15+	-2,-1, 0, 1, 2, and 5	ESU, BFW
Beaver enhancement	NA		
Nutrients	NA		
Levee set-back removal	30	-2,-1,0, 1, 2, and 5	ESU, Treatment
Floodplain reconnection or creation	30	-2,-1,0, 1, 2, and 5 reconnection; 1, 2, and 5 for creation	ESU, Treatment
Wetland restoration	NA		
Remeandering	30	-2,-1,0, 1, 2, and 5	ESU, BFW
Fencing	10+	-2,-1,0, 1, 2, and 5	ESU
Planting	30	0, 1, 2, 5, 10, 15+	ESU
Invasive plant removal	30	0, 1, 2, 5, 10, 15+	ESU
Roads, Agricultural practices, Spawning gravel addition	NA		
Land acquisition, lease, or easement	10+	0, 1, 2, 5, and 7+	ESU
Water lease or purchase, irrigation improvement	NA		

Monitoring Measurements, Metrics and Protocols

There are hundreds of measurements that could be monitored and different metrics that could be calculated to determine action effectiveness (reference). Fortunately, these can be narrowed down to a number of key metrics that are best suited to measure the response due to specific habitat action types. The proposed list of biological and physical metrics for each action category is displayed in Table 5. This proposed list is based in part on measurements and metrics used for the SRFB programmatic approach and is consistent with that suggested by the ISRP (2008). In addition, in 2012 BPA had a focused group of experts from U.S. Geological Service, Tetra Tech, NOAA and BPA to examine and revise the original list of metrics.

The detailed protocols for most of these metrics will be based in part on the SRFB approach for evaluating actions (Tetra Tech 2008; Crawford and Arnett 2011; also see www.monitoringmethods.org) with some minor additions. For example, for barrier removal and remeandering studies, measurements and metrics associated with pools have been added to evaluate potential variations in localized effects of juvenile densities. Similarly, for evaluating completed actions using an EPT, the SRFB protocols will be modified to allow less intensive sampling of a large number of actions in a short period of time than currently done by SRFB. For these measures and metrics, modified protocols will be posted on the monitoringmethods.org website as “proposed”.

Table 5. Key measurements to be monitored for action categories. * indicates that for some action sub-categories measurement not necessary.

Measurements	Common Metrics Calculated	Barriers	Instream	Off-channel/ Floodplain	Riparian - Planting & removal	Riparian - Fencing	Acquisition & protection
Biological							
Juvenile salmon and fish abundance and size	Juvenile salmon density by spp. (fish/m^2) for summer and winter, fish density, fish length, weight, growth	X	X	X			
Redds or Spawner #	Spawner or redd density	X	X				
Macro-invertebrate composition	Drift or benthic biomass, composition, IBI,		X	X			X
Vegetation species composition/structure	species diversity/composition, growth, survival, area of woody cover			X*	X	X	X
Plant survival	Survival by species, elevation, soil type, etc.				X		
Shade (percent)	% shade				X	X	X
Physical							
Reach Length & Width	Total area, mean width	X	X	X	X	X	X
Reach Depth	Mean depth	X	X	X		X	
Bankfull Width & Depth	Width/Depth Ratio, mean BFW		X	X		X	
Thalweg profile, depth & sinuosity	Mean thalweg depth, sinuosity		X	X		X	
Flood prone width	Mean floodprone width			X		X	X
Pool and riffle area (m2) and frequency	% pool, % riffle, channel widths/pool,	X	X	X		X	X
Pool depth (cm)	Mean pool depth	X	X	X		X	X
Residual pool depth, volume and area	Mean residual pool depth, volume & area	X	X	X		X	X
LWD number and size	#/100m, volume/100m,		X				
Bank erosion	% or length of eroding bank			X	X	X	X
Substrate composition	% fines, % of different types, D50, D84,			X		X	X
Percent fines (sediment)	% fines, pool tail fines			X	X	X	X
Temperature	Mean, max, range, # days greater than threshold		X			X	

Relation to Other Existing Monitoring Programs

This new approach is designed to integrate with and compliment the SRFB and OWEB AEM programs; the BOR monitoring program; and NOAA Northwest Fisheries Science Center AEM efforts (e.g., Watershed Program restoration evaluation, ISEMP). This should lead to efficiencies in cost and effort and increase the confidence in the design and findings of all five programs.

A major benefit of integrating with the SRFB AEM is the larger sample size for many action categories, which will not only allow for cost savings, but stratification of actions by region, stream size, and action sub-category. This increased sample size and stratification will improve ability to detect significant changes in habitat and fish due to restoration. In addition, because BPA will be evaluating new actions, they can make improvements in AEM based on 10 years of SRFB AEM experience. Most notably, sample size calculations indicate that collecting additional years of pre-treatment data and better stratification of monitoring by action categories and geographic region, can greatly reduce the number of actions that will need to be sampled. Furthermore, habitat action categories not covered by the SRFB AEM program could be covered under the BPA program.

Other programmatic AEM approaches were also considered by BPA as potential models, but they did not provide as good of a fit as Washington's SRFB program. These other programs, such as the Pacific Fisheries Resource Conservation Council's program in Canada, did not provide the same opportunities to meld existing data sources together in the same manner. The WA SRFB AE program already collects many of the same habitat and fish data as BPA's program and covers similar geographic areas as BPA. The data collected and metrics calculated and evaluated under both BPA and SRFB programs will also have the ability to be combined with other existing BPA funded actions such as the Okanogan Basin Monitoring and Evaluation Program (OBMEP), and Bureau led RM&E efforts in the Methow River basin.

As noted previously, AEM is one component of the BPA's "Framework for Implementing Tributary Habitat Research, Monitoring & Evaluation for the Columbia Basin Fish and Wildlife Program" document developed by BPA (2013a). The framework includes: Implementation & Compliance Monitoring (did we do what we said we were going to do?); Status and Trend Monitoring (how are the fish and habitat conditions doing currently and how are they performing relative to the previous condition?); and Action Effectiveness (did the habitat actions accomplish their ecological objectives?);. A separate, but integrated programmatic approach to estuarine habitat restoration will be discussed in the Columbia Estuary Ecosystem Restoration Program (CEERP) action plan developed by BPA and the Corps.

The approach and BACI and EPT designs discussed here are consistent with the NOAA RM&E Guidance for ESA listed Salmon (Crawford and Rumsey 2011), the Council's MERR Framework, and previous recommendations by the Council, BPA and past reviews of current RM&E (i.e., Tetra Tech 2011), which have recommended development and implementation of a consistent programmatic approach for evaluating habitat action effectiveness.

BPA will continue outreach to work with the SRFB, OWEB, NOAA and other regional funding entities to identify existing or potential actions that may be integrated into this programmatic approach. In addition, where possible, actions for programmatic monitoring will be selected in basins where intensive juvenile and adult spawner abundance and CHaMP habitat status and trend monitoring is occurring to leverage population level evaluation of restoration actions.

How Project Sponsors Can Use this Document

Based on the 1996 Amendment to the NW Power Act, the ISRP reviews habitat project proposals to determine whether the project meets specific criteria including provisions for monitoring and evaluation and thus action effectiveness. There are several ways that the provision for monitoring and evaluation could be addressed. For example this provision could be addressed by using AEM data from other projects or from a larger programmatic (regional) approach as long as the project proposal clearly demonstrates integration with this program. In the absence of a programmatic approach, the ISRP has generally been recommending AEM be included in every project. The programmatic approach outlined in this framework is designed in part to meet the requirements for AEM. Individual project sponsors will be able to rely on this AEM framework, and will describe their participation in the programmatic approach in their proposals where appropriate, including which actions in their proposal will be part of the programmatic approach.

First, project sponsors will use this framework to determine if some or all of the actions are addressed by the programmatic approach (Figure 2). This can be done quickly by screening Table 3. Next, for those action categories or sub-categories that are part of a programmatic approach, the project sponsor needs to indicate that their restoration actions are part of the programmatic AEM program and that they intend to do compliance monitoring but not AEM for those actions. For those action categories that are not part of the programmatic approach, the project sponsor should first discuss with BPA Fish and Wildlife Program staff to determine if the action category is being addressed by an existing case study or IMW. Finally, if it is not currently part of existing case study or IMW, BPA will ask the project sponsor to develop an AEM to evaluate the action.

For actions categories that fall within the programmatic approach for new and completed actions, the project sponsors can choose to assist with data collection. Whether they decide to assist or not, they should indicate appropriate work elements and monitoring protocols (www.monitoring methods.org). It should be noted that if the project sponsor chooses to assist with data collection, a third-party may be asked to conduct data analysis and work with sponsor to assure data is collected consistently.

Time Line for Implementation and Study Plan Completion

Implementing the changes outlined in this framework will be completed and refined in 2013 to 2015 and include a series of steps (Table 6). First, improvements and refinements of existing AEM will be implemented in 2012 and 2013 and be completed by 2014. Based on these results, existing AEM efforts will be refined and refocused to integrate existing and new monitoring by 2014. A pilot programmatic AEM will also be implemented in 2014 focusing on new grazing actions or another action category consistent with SRFB monitoring AEM schedule. Based on the results of this pilot, a schedule for AEM for the remaining action categories will be developed by 2015. The intent is to implement AEM using a rotating panel basis for all project categories by 2018. Evaluation of completed habitat actions using an EPT design, will begin with barrier removals in 2013 or 2014 and move to other action categories in future years with the hope to complete EPT evaluations of a subset of all actions categories by 2018 if not sooner. These categories of study will be a focal point for BPA as this program is launched.

Figure 2. AEM Decision support tree for project sponsors to determine what to include in Taurus proposals.

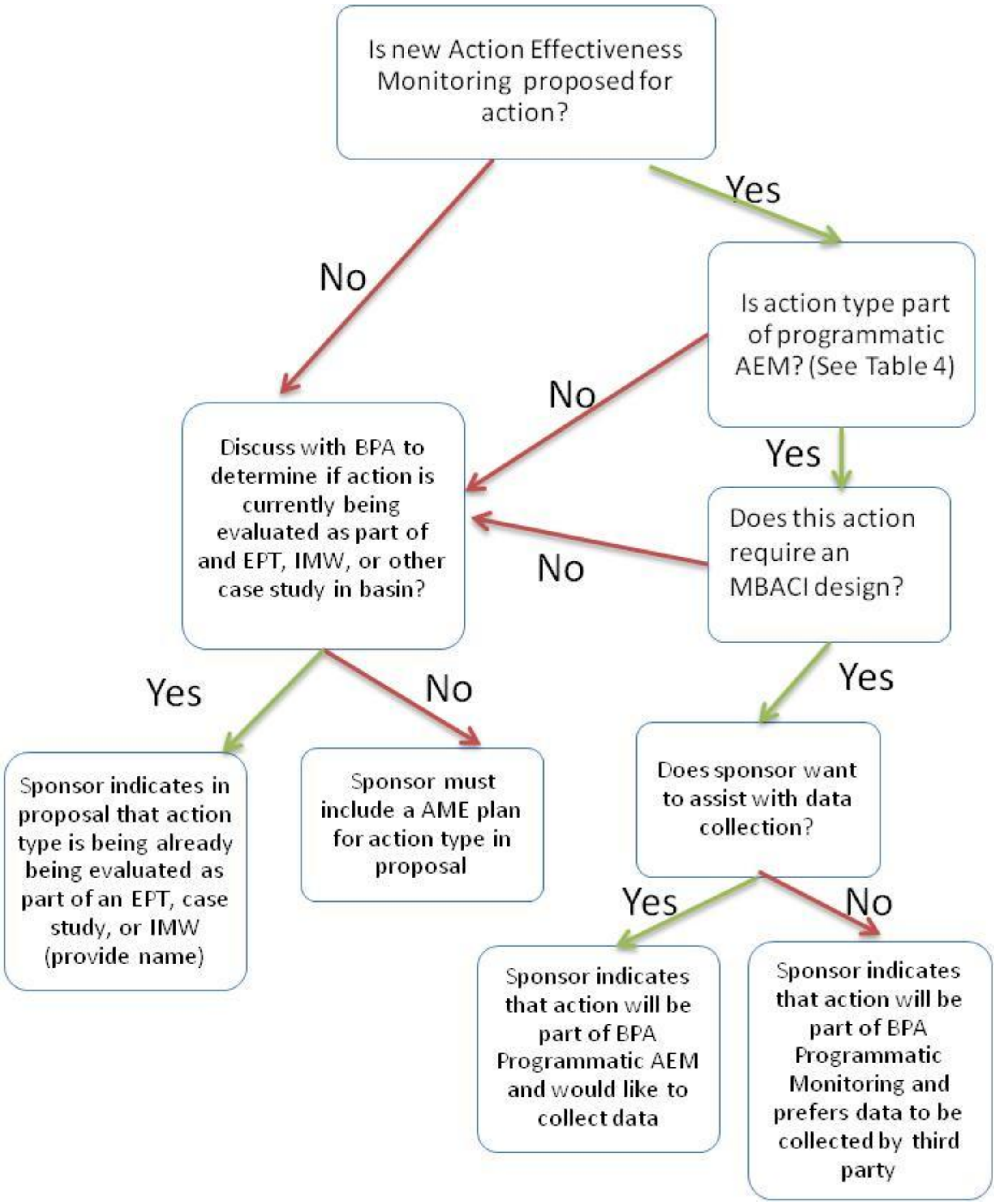

Table 6. Proposed timeline for implementing AEM framework components.

Component/Task	2012	2013	2014	2015	2016	2017	2018
Refine Current AEM							
Standardize the reporting format	X	X					
Standardize AE metrics		X	X				
Redesign, reduce and increase efficiency	X X						
Develop and Implement Rotating Panel of AEM for New or Proposed Actions (MBACI)							
Finalize Metrics, Protocols & sample size	X	X					
Implement specific action categories		Grazing	Grazing Barriers	TBD	TBD	TBD	TBD
Develop and Implement AE for Completed Actions (EPT)							
Finalize Metrics, Protocols & sample size		X	X				
Implement specific action categories			Barriers	Instream	TBD	TBD	TBD

While this document lays out the initial monitoring design and sample size aspects for each action category, a critical next step will be for BPA to development a monitoring plan for each action type and subtype. This will include: key monitoring questions, design, refined sample size estimates (number of sites and years to monitor), confirming measurements, metrics and protocols, as well as analysis and reporting. This plan will be shared for discussion with the Council, ISRP, and others such as PNAMP. Fortunately, much of the information on protocols and designs can already be found on the PNAMP website and will streamline the process (see also Appendix 2 for protocols).

Review and Comment

As these proposed improvements in BPA's AEM program will be a change from current practice, BPA will provide opportunities for project sponsors to comment on this new process and discuss continuing long-term monitoring of ongoing AEM programs Also, BPA will meet with Council staff and other interested parties (e.g. Accord parties) to get additional comments and assure process is consistent other RM&E efforts. BPA will also seek input from the region through collaboration with PNAMP's project-level action effectiveness workgroup. This design will be submitted to the Council and reviewed by the ISRP by April for implementation in 2013.

Summary and Conclusions

This document lays out the framework and key pieces of AEM program for BPA. This includes three major components:

1) Improving and streamlining currently funded project level AEM,

2) Developing a programmatic approach for AEM of new actions, and

3) Developing a programmatic approach for AEM of completed actions.

The first piece of the framework lays out the strategy for improving the consistency in reporting, metrics, and designs for projects with existing AEM. BPA has already begun to implement some of these changes by requiring project sponsors to provide annual reports of findings in a consistent format. This will serve as the basis for a process to evaluate on-going (existing) efforts to determine which should be continued, completed or even expanded. Additional pieces that are underway, but need to be completed include finalizing key measurements and metrics and making design improvements were necessary in existing AEM that is expected to continue.

The second component is designed to implement a programmatic AEM approach for new actions that is based partly the SRFB AEM with some minor improvements such as additional pre-treatment monitoring, larger sample sizes and stratification of actions by region, stream size and other factors. While we describe the basic monitoring design for different action categories in this document, additional steps are needed to finalize metrics, protocols and minimum sample sizes. In addition, intensive "case studies" will need to be designed for those few action categories that are new or uncommon do not lend themselves to a programmatic MBACI design approach (e.g., gravel addition, instream flow augmentation, road removal).

The third final component includes monitoring a subset of completed actions using an EPT design to learn lessons from historic and recently completed actions. This approach will provide short-term results and guidance on past actions, while longer term AEM for new actions (component 2) is being implemented. One benefit is that this post-treatment monitoring would not required repeated sampling every year for the actions selected. It would likely take two to three years to complete evaluations for each action category. This would allow post-treatment AEM to be completed for one action category every few years rather than trying to complete all of the monitoring in a short period. Similar to AEM for new actions, the details of the sample size, metrics and protocols need to be finalized.

Finally, this approach is proposed to reshape and refocus Fish and Wildlife Program AEM efforts to increase efficiency, provide a more balanced coverage across the range of different habitat action categories, and provide higher quality study results necessary for more extensive and robust habitat action effectiveness assessments. By adopting this new programmatic approach, BPA will be better able to leverage the data collected by individual habitat restoration actions in a cost effective way without increasing the burden on project sponsors. The end result of this effort will be data that provides meaningful outputs for managers who are making future implementation decisions.

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Appendices

Appendix 1.Limiting factors addressed by habitat restoration action category

Action Category	Sub Categories	General Characteristic	Limiting Factor/Habitat Impairments
Fish Passage	Barriers	Habitat Access	Passage or Migration Barriers (Diversions)
			Passage or Migration Barriers (Road Crossings)
	Entrainment	Habitat Access	Entrainment
In-stream Structures	Complexity	Habitat Elements	Habitat Diversity/Complexity
			Habitat Quality
			Habitat Quantity
			Large Woody Debris
			Pool Quality
			Pool Quantity
			Side-Channel Connectivity
	Stabilization	Habitat Elements	Habitat Quality
	Large Engineered Structures	Habitat Elements	Large Woody Debris
	Beaver Introductions	Habitat Elements	Fine Sediment
			Large Woody Debris
			Pool Quality
			Pool Quantity
Off Channel Habitat	Confinement	Channel Condition	Channel Alteration and Confinement
			Channel Complexity
			Channel Morphology
			Streambank Condition/Erosion
			Streambed Instability
	Side Channel	Riparian/Floodplain Condition	Floodplain Connectivity
	Floodplain	Riparian/Floodplain Condition	Riparian Condition and Function
			Floodplain Connectivity
			Wetland Structure and Function

	Wetland Restoration	Riparian/Floodplain Condition	Wetland Structure and Function
Riparian	Fencing	Channel Condition	Streambank Condition/Erosion
		Riparian/Floodplain Condition	Riparian Condition and Function
	Planting	Channel Condition	Streambank Condition/Erosion
		Riparian/Floodplain Condition	Riparian Condition and Function
	Removal	Channel Condition	Streambank Condition/Erosion
		Riparian/Floodplain Condition	Riparian Condition and Function
Sediment	Roads	Water Quality	Water Quality (Chemical Pollution)
			Water Quality (Dissolved Oxygen)
			Water Quality (Heavy Metal Contamination)
			Water Quality (High Turbidity)
			Water Quality (pH)
			Water Temperature
		Habitat Elements	Fine Sediment
	Agricultural	Water Quality	Water Quality (Chemical Pollution)
			Water Quality (Excess Nutrients)
			Water Quality (Low Nutrients)
			Water Quality (pH)
			Water Temperature
		Habitat Elements	Fine Sediment
	Spawning Gravel	Water Quality	Water Quality (High Turbidity)
		Habitat Elements	Fine Sediment
			Habitat Diversity/Complexity
			Habitat Quality
			Habitat Quantity
Acquisition/Protection	Acquisition/Protection	Habitat Elements	Fine Sediment
			Habitat Diversity/Complexity
			Habitat Quality

			Habitat Quantity
			Large Woody Debris
			Pool Quality
			Pool Quantity
			Side-Channel Connectivity
		Riparian/Floodplain Condition	Riparian Condition and Function
			Floodplain Connectivity
			Wetland Structure and Function
		Ecological Factors	Competition
			Disease/Pathogens
			Food
			Poaching/Harassment
			Predation
Flow	Water Quality	Water Quality	Water Quality (Chemical Pollution)
			Water Quality (Dissolved Oxygen)
			Water Quality (Excess Nutrients)
			Water Quality (Heavy Metal Contamination)
			Water Quality (High Turbidity)
			Water Quality (Low Nutrients)
			Water Quality (pH)
			Water Temperature
		Flow/Hydrology	Instream Flows/Water Quantity
	Barriers	Habitat Access	Passage or Migration Barriers (Diversions)

Appendix 2. MBACI and EPT Protocols under development by category

Action	Sub-category	Design	Protocol
Fish Passage	Barriers - Complete	EPT	BPA - EPT Monitoring Effectiveness of Complete Fish Passage Barriers Projects (ID: 1869)
	Barriers - Partial	MBACI	BPA - MBACI Monitoring Effectiveness of Partial Fish Passage Barriers Projects (ID: 1870)
Instream Structures	Bank Stabilization	MBACI	BPA - MBACI Monitoring Effectiveness of Instream Habitat Projects (Bank Stabilization) (ID: 1875)
	LWD/Boulders/Pool & Complexity	EPT	BPA - EPT Monitoring Effectiveness of Instream Habitat Projects (Engineered Logjams/LWD/Boulders/Pool & Complexity) (ID: 1871)
	Engineered Logjams/structures		
Off-Channel/Floodplain	Levee set-back removal	MBACI	BPA - MBACI Monitoring Effectiveness of Off-Channel/Floodplain (ID: 1880)
	Floodplain reconnection or creation		
	Remeandering		
Riparian Improvement	Fencing	MBACI	BPA - MBACI Monitoring Effectiveness of Riparian Improvements (Fencing) Projects (ID: 1877)
	Planting	EPT	BPA - EPT Monitoring Effectiveness of Riparian Invasive Planting and Plant Removal Projects (ID: 1876)
	Invasive plant removal		
Acquisition & Protection	Land acquisition, lease, or easement	MBACI	BPA - MBACI Monitoring Effectiveness of Habitat Protection Projects (ID: 1868)

Example Draft Protocol:

Protocol: BPA - MBACI Monitoring Effectiveness of Partial Fish Passage Barriers Projects

ID: 1870

State: Draft

Version: 1.0

Purpose: Project Scale Effectiveness Monitoring

Owner: Russell Scranton (rwscranton@bpa.gov)

Sponsoring Org: Bonneville Power Administration, Northwest Power and Conservation Council

Referenced: 0 times

# of Methods: 15

Est. Cost / Site: > $10,000

Created: 1/3/2013 1:39 PM

Created by: Russell Scranton (rwscranton@bpa.gov)

Updated: 1/9/2013 12:32 AM

Updated by: Russell Scranton (rwscranton@bpa.gov)

Basics & Objectives

Background / Rationale

This document details the monitoring design, procedures and quality assurance steps necessary to document and report the effectiveness of: Complete Fish Passage Barriers Projects at the Project site scale.

This supports the Bonneville Power Administration's Programmatic approach to project level Action Effectiveness Monitoring (AEM), as documented in "Action Effectiveness Monitoring of Tributary Habitat Improvement: a programmatic approach for the BPA Fish and Wildlife Program". This is based on the WA SRFB protocol SRFB - Monitoring Effectiveness of Fish Passage Projects (ID: 34) (https://www.monitoringmethods.org/Protocol/Details/34) however variations in the design and metrics collected required slight modification of the protocol.

Monitoring Program

Bonneville Power Administration Fish & Wildlife Program

Objectives for this Protocol

1. Determine salmon abundance both in the downstream control reach and impact reach upstream of the fish blockage for each project. (Years 1, 2, and 5)
2. Determine whether fish passage design criteria are being met at each project monitored. (Years 1, 2, and 5)
3. Determine salmon abundance both in the downstream control reach and impact reach upstream of the fish blockage for the sampled projects. (Year 0)
4. Project managers determine the proper design criteria for meeting the fish passage objectives for the project. (Year 0)

Key Assumptions

Access will be provided to impact and suitable control reaches.

Study Design

Spatial Design Description

IMPACT REACH Fish passage projects are often larger than other types of restoration projects and may not be measured in its entirety. One stream reach immediately upstream of the project in suitable spawning and rearing habitat will be identified and sampled according to identified methods for each of the projects. The assumption is that fish colonizing new habitat will colonize the area nearest the barrier first. CONTROL REACH A paired control reach immediately downstream of each project site should be selected in the same manner as the impact reach for each of the projects.

Avg Site Size

150-500

Temporal Design Category

Complete Revisit - we monitor / resample the same sites

Does your intended study have a fixed duration?

Yes - 5 Year(s)

Total # of Planned Sites

10+

Temporal Design Description

Sampling will be done in years-2,-1, 0, 1, 2, and 5.

Response - Methods

Methods

Data Collection

- Characterizing Stream Morphology and In-Stream Habitat - Thalweg Profile (ID: 45) (Revising)

  1 Comment, 0 Replies
- Determining effectiveness of passage project structures (ID: 169) (Published)

  1 Comment, 0 Replies
- Electrofishing Methods (ID: 190) (Published)

  1 Comment, 0 Replies
- Estimating Adult Spawner Abundance (ID: 195) (Published)

  1 Comment, 0 Replies
- Estimating Instream Juvenile Salmonid Abundance Using Electrofishing (ID: 196) (Published)
- Estimating Instream Juvenile Salmonid Abundance Using Snorkeling (ID: 197) (Published)
- Laying Out Control and Impact Stream Reaches for Wadeable Streams (For Fish Passage Projects) (ID: 913) (Published)
- Measuring channel constraints (ID: 239) (Published)

  1 Comment, 1 Reply
- Measuring Pool Attributes (ID: 906) (Published)
- Measuring Wetted Width (Abridged Version From Characterizing Stream Morphology For Determining Area) (ID: 243) (Published)

  1 Comment, 0 Replies
- Redd Count Survey (ID: 131) (Published)
- Redds (ID: 30) (Published)

  1 Comment, 0 Replies

Data Analysis/Interpretation

- CHaMP - Bankfull Width Calculation (ID: 856) (Draft)

  2 Comments, 0 Replies
- Fish Condition Factor (ID: 952) (Proposed)
- Summary Statistics for Fish Passage Projects (ID: 914) (Published)

Comments on the Methods section:

Add a comment

Response - Metrics & Indicators

Metrics

Title	Category	Subcategory	Subcategory Focus 1
"Fish Passage Design"	Disturbance/Restoration	Restoration Action (ID: 407)	NA
"Growth"	Fish	Condition Factor (ID: 282)	NA
"Juvenile Fish Density"		Density of Fish Species (ID: 59)	Fish Life Stage: Juvenile Fish
"Spawner Density"			Fish Life Stage: Adult - Spawner
"Redd Density"		Spawning/Nesting (ID: 507)	Fish Origin: Unknown
"Riffle area (m2) "	Landscape Form & Geomorphology	Aquatic or Floodplain Geomorphology: Area (ID: 369)	Habitat Type: Channel: Riffles
"Pool Area (m2)"			Habitat Type: Channel: Pools
"Pool frequency"		Density of Habitat Type (ID: 21)	Habitat Type: Channel: Pools
"Riffle frequency"			Habitat Type: Channel: Pools
"Reach Depth"		Depth/Height: Bankfull (ID: 188)	NA
"Pool depth"		Depth: Pool (ID: 37)	NA
"Residual pool depth, volume and area"			NA
"Reach Length"		Length/Width/Area (ID: 36)	Habitat Type: Rivers & Streams
"GPS Coordinates"	Other	Location (ID: 218)	NA
"Sample Date"	Time	Date (ID: 116)	NA

Indicators

Title	Category	Subcategory	Subcategory Focus 1	Subcategory Focus 2
"Spawner Density"	Fish	Abundance of Fish (ID: 46)	Fish Life Stage: Adult - Spawner	Fish Origin: Both

"Juvenile salmon density by spp. (fish/m2) "		Density of Fish Species (ID: 59)	Fish Life Stage: Juvenile Fish	NA
"Total Area"	Landscape Form & Geomorphology	Aquatic or Floodplain Geomorphology: Area (ID: 369)	Habitat Type: Rivers & Streams	NA
"Percent Pools"		Density of Habitat Type (ID: 21)	Habitat Type: Channel: Pools	NA
"Percent Riffles"			Habitat Type: Channel: Riffles	NA
"Mean Depth"		Depth/Height: Bankfull (ID: 188)	NA	NA
"Mean Pool Depth"		Depth: Pool (ID: 37)	NA	NA
"Mean Width"		Length/Width/Area (ID: 36)	Habitat Type: Rivers & Streams	NA

Metric Method Mappings

HTML5 Canvas isn't supported. Upgrade your browser to see the Metric Method Mappings.

Quality Control & Reporting

Data Handling Considerations

Data will be collected in the field using various hand-held data entry devices. Raw data will be kept on file by the project monitoring entity. A copy of all raw data will be provided to the SRFB at the end of the project. Summarized data from the project will be entered into the PRISM database after each sampling season.

Quality Control Considerations

All data collected in the field is uploaded into a replication of the database on a laptop computer and run through a series of QA/QC checks prior to leaving the site. In addition to the automated QA/QC process, this allows field staff to visually review the data for errors. Should errors or omissions be found, field staff can correct items that may be recorded improperly or collect additional data that may be missing from the data forms while still onsite.

Reporting Considerations

A progress report will be prepared in writing after each sampling season which will include preliminary results. A final report will be prepared in writing by the monitoring entity after the sampling season for Year 5. It shall include: • Raw data in the required data format. • Estimates of precision and a power analysis of the data. • Confidence limits for data. • Summarized data required for PRISM database. • Determination whether project met decision criteria for effectiveness. • Analysis of completeness of data, sources of bias. Results will be entered in the PRISM database and will be reported and available over the Interagency Committee for Outdoor Recreation web site and the Natural Resources Data Portal.

Equipment Cleaning and Calibration

Field equipment (i.e., waders, wading socks, boots, dry suits, snorkel equipment or any other field gear) should be maintained to prevent the spread of disease or invasive species. This can be accomplished by thoroughly cleaning equipment prior to leaving a site or at the office prior to using that equipment at another location. Electronic equipment should be maintained in good working condition to ensure that measurements are collected and recorded accurately. This includes ensuring that equipment is fully charged or has sufficient battery power to operate correctly, as well as any calibration that may be required or recommended by manufacturers.

Personnel & Training

Roles and Responsibilities

Field Manager (FM): The Field Manager is responsible for and has the authority to direct all operations related to the field work necessary to complete this project. The Field Manager oversees all field crews and is directly responsible for insuring that all safety procedures are followed. The Field Manager shall be directly responsible for the safety of all field crews when in the field and for strictly following a daily field plan. He/She shall implement an established emergency plan at the field level should an emergency situation arise. The Field Manager will know the location of crews and their itineraries at all times and shall keep the field team leaders advised of significant project developments on a daily basis by providing and following a daily field plan or itinerary. Field Team Leader (FTL): Each Field Team Leader shall be directly responsible for the safety of his or her field crew when in the field and for strictly following the daily field plan. Each FTL shall implement the emergency plan at the field level during emergency situations. Each FTL in the field shall know the location of his or her field crew and their itineraries at all times and shall keep the other FTLs advised of significant project developments on a daily basis by providing and following a daily field plan or itinerary. Field Investigators: Each field investigator shall be responsible for following the Health and Safety Plan. He or she shall maintain scheduled communications with the FTL and shall assure that during emergency situations appropriate procedures are followed. In the event the FTL is incapacitated or unavailable, the most senior field investigator shall assume the duties of the FTL.

Qualifications

Field Manager: The FM must have experience with the type of work that is being conducted and must be familiar with all field operations related to the field work. The FM must also be familiar with safety and emergency procedures and be capable of overseeing and/or carrying out any necessary tasks associated with those procedures. Field Team Leader: The most experienced member of every field team will be designated as the FTL. The FTL must also be familiar with safety and emergency procedures and be capable of carrying out any necessary tasks associated with those procedures. Field Investigator: The field investigators must be trained in the type of work that is being conducted or have sufficient experience/education to be capable of conducting the necessary tasks.

Training Requirements

An interdisciplinary training session and site-specific orientation shall be given to all field personnel by the Field Manager prior to beginning site work. The training shall cover material presented in this Health and Safety Plan and technical training. This training shall also be provided to any new employees arriving after the start of the field season before they begin field work. The Field Manager will conduct weekly safety meetings and prior to the start of any new activities. These meetings will provide the chance for field personnel to present questions or address any safety issues that may have arisen during the conduct of field work. Tailgate meetings will be held on a regular basis.

Safety Considerations

At least two team members of each field team will be current with their first aid/CPR training. First aid/CPR training is recommended for any subcontractors. A copy of the Health and Safety Plan shall accompany each field team into the field. Field staff must always work in teams of 2 or more and may never work alone. At the end of each work day, the FTL will check in with the Field Manager to confirm that all team members are accounted for and have left the site safely. Check in can be done by leaving a phone message for the Field Manager.

Schedule & Budget

Field Schedule Notes

Surveys are scheduled to coincide with summer low flow conditions whenever possible. Monitoring of the impact and control reaches should be conducted consecutively to capture similar flow and environmental conditions at each reach. Monitoring of a site should be conducted during each monitoring year on a schedule similar to that of the previous years so that seasonal fluctuations in stream conditions and fish use are not an issue.

Redd Surveys are scheduled to coincide with Peak run time of the species.

Budget Considerations

For each project, a team of 2-4 field staff surveying for two 10-hour days (1 day control, 1 day impact) is budgeted. The number of field staff required is dependent on the size of the site and the level of effort that will be required to collect all data at both reaches within the two-day period.

References

Who's Using this Protocol?

<none>

Literature Cited

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Appendix 3. Email from William Maslin outlining new BPA reporting requirements for project sponsors.

From: Maslen,Bill (BPA) - KEW-4
Sent: Tuesday, October 30, 2012 7:48 AM
Subject: Letter to Project Sponsors from Bill Maslen

Dear project sponsors with contracts to conduct RM&E activities:

BPA is implementing a new policy and procedure for all Annual Reports with RM&E that informs the Fish and Wildlife Program strategies and ESA Biological Opinions. We are asking for your help in adopting a new annual reporting system to replace the past report requirement for your Research, Monitoring & Evaluation results that should be simpler and more efficient for both of us. It includes a standard report template that makes better use of information already in our system, reducing demands on you. It will also help us more effectively compile results and better describe just how much we are learning from your work.

This is important for BPA, sponsors and for the region. By demonstrating together that RM&E activities produce valuable results that inform and help tailor salmon recovery, we can help justify the continued investments required to keep the work going and the results coming.

We encourage your participation during this pilot year and request that you use this approach for FCRPS BiOp projects and major research studies. You may work with your COTR to determine whether this approach is appropriate for other projects in fiscal 2013.

We know that writing reports is time consuming and rarely fun. Part of the challenge is that sponsors have had to develop report formats on their own. We have consequently received reports that varied widely in terms of depth and the parameters used. This has made it difficult if not impossible to build on the strengths of each individual report by combining and comparing results in ways that could provide valuable scientific results and lessons we can all learn from. The Northwest Power and Conservation Council's 2011 Categorical Review of RM&E underscored this shortcoming and we set out to change it.

The new approach will provide you with a ready-made online report design that will link to information you have already provided, eliminating duplication of effort. Depending on the report you're compiling, you may be able to simply cut and paste text into the document. The template will explain what information is needed where and will even create a table of contents for you.

Producing your annual reports will still take time, but, we hope, less of it, and will result in reports that more clearly communicate the results of your hard work in a way that we all find easier to understand and benefit from. We are asking for a second, simpler report for sponsors with projects that support Reasonable and Prudent Alternatives in the Biological Opinion for the Federal Columbia River Power System, which will help us

track and report our progress toward BiOp goals. This is especially important because the BiOp calls for Comprehensive Evaluations of this progress in both 2013 and 2016. Due to regulatory reporting requirements BPA is asking all sponsors to have draft reports submitted in January and final reports completed in March to align with BiOp reporting timelines. This change will be required in new contracts, however in existing FY 12 contracts we are asking for sponsors to accommodate the time change without pursuing contract amendments in the pilot year of the tool.
To help sponsors use the new reporting tools BPA will be offering trainings online and in person. These trainings will also provide a review and discussion session of how to document protocols in the www.monitoringmethods.org tools to meet Pisces contracting and Taurus proposal form requirements. These trainings will be offered:

November 6th in Portland (Online) 9-4 PM
November 8th in Boise 8-3 PM
November 9th in Spokane 8-3 PM
November 13th in Pendleton 10-5 PM
December 3rd in Portland (Online) 8-3 PM

Final details of training agendas, locations, times and training registration will be sent shortly. If sponsors do not register for the trainings, the trainings in Boise, Spokane and Pendleton may be canceled.

We want your feedback on this approach because it needs to work for you. This year will be a pilot phase for the new reporting program and we will offer web-based training over the next few months to help guide you and answer any questions. The templates will be available on www.cbfish.org, with step-by-step instructions and frequently asked questions attached below. Comments may be submitted through the "Request Support" link by July 2013. For more information please review the attached material, contact your COTR or submit comments to rmesupport@bpa.gov

Thanks for your assistance in making the most of these important improvements.

Reporting_FAQ.docx Sponsor_Reporting_Procedural_G...

William C. Maslen
Director, Fish and Wildlife
Bonneville Power Administration