FISCAL YEAR 2015 CMER WORK PLAN

Prepared by:
COOPERATIVE MONITORING, EVALUATION AND RESEARCH COMMITTEE
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Comments or questions, contact:

Mark Hicks, CMER Co-Chair
(mhic461@ecy.wa.gov)

Todd Baldwin, CMER Co-Chair
(tbaldwin@kalispeltribe.com)

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1.0 EXECUTIVE SUMMARY

The fiscal year 2015 (FY15) Cooperative Monitoring, Evaluation and Research Committee (CMER) Work Plan and associated budget have been approved by the Forest Practices Board (Board) based on recommendations from the TFW Policy Committee (Policy) and CMER. The CMER Work Plan presents an integrated strategy for conducting research and monitoring to provide scientific information to support the Forest Practices Adaptive Management Program (AMP). The primary purpose of the work plan is to inform CMER participants, Policy constituents, the Board and interested members of the public about CMER research and monitoring activities. Continued annual revisions are anticipated in response to research findings of CMER and the broader scientific community, as well as changes in policy priorities and funding.

Ninety-four (94) projects (including multiple phases of a project) are listed in the work plan. See Appendix A: CMER Projects, Objectives, and Targets for a listing of projects. The projects cover a range of topics related to the forest practices rules and are at various stages of development or completion. Approximately 36 projects are complete and 24 projects are ongoing or to be initiated (i.e., undergoing study design development or currently being implemented or reviewed). Projects originated as priority research topics in Schedule L-1 of the Forests and Fish Report (April 1999), which was later revised and adopted by the Board in February 2001 and incorporated into the Washington Forest Practices Habitat Conservation Plan (FP HCP). The work plan is organized in a hierarchical format consisting of rule groups, programs, and projects. Section 3.0 describes the CMER research and monitoring strategy and approaches used to address critical questions relevant to the AMP. Section 4.0 describes CMER and Policy procedures for prioritization at the program and project level, and Section 5.0 presents the Board approved FY15 projects and budget allocations. Proposed budget allocations for FY15 projects and activities can be found in Table 4. Section 6.0 provides an overview of the CMER research and monitoring program, with program and project descriptions organized by rule group. Appendix A contains a table titled “CMER Projects, Objectives, and Targets,” which links specific resource objectives and key riparian functions (e.g., in-stream temperature, large woody debris, litter, sediment, etc.) to CMER projects, organized by programs within rule groups.

For FY15, there are twelve projects in the Type N Riparian Prescriptions Rule Group, five in the Type F Prescriptions Rule Group, two in the Unstable Slopes Rule Group, one in the Roads Rule Group, three in the Wetlands Protection Rule Group, and one in the Wildlife Rule Group. Of the twenty-four projects listed in the table below, twenty are ongoing and four have yet to be initiated. Three ongoing Type N Riparian Prescriptions Rule Group projects include extension of monitoring for a limited set of functions (e.g., water temperature, sediment, windfall, and amphibian demographics) for time periods beyond those contained in the original study designs. Specific project descriptions can be found on the pages listed below; however, reading the complete rule group subsection is recommended in order to better understand the different programs and projects within each rule group, as well as to understand how they are integrated to answer critical research and monitoring questions.

FY15 CMER Projects

Project	Status	Page
Westside Type N Buffer Characteristics, Integrity, & Function (BCIF)	Analysis & report writing	35
Type N Experimental Buffer Treatment in Hard Rock Lithologies	Analysis & report writing	36
Type N Experimental Buffer Treatment in Hard Rock Lithologies – Amphibian Demographics/Channel Metrics	Field implementation (Extended monitoring)	36
Type N Experimental Buffer Treatment in Hard Rock Lithologies – Temperature, Sediment, Vegetation, Litter Fall	Field implementation (Extended monitoring)	36
Type N Experimental Buffer Treatment in Soft Rock Lithologies	Field implementation	37
Eastside Type N Forest Hydrology	Analysis & report writing	46
Eastside Type N Riparian Effectiveness Perennial streams Dry spatially intermittent streams	Study design Scoping	46
Tailed Frog Literature Review	Post-ISPR review	55
Buffer Integrity - Shade Effectiveness (Amphibians)	Post-ISPR review	56
Van Dyke's Salamander	To be initiated	58
Extensive Riparian Status and Trends Monitoring – Temperature, Type Np-Westside	In CMER review	67
Eastern Washington Riparian Assessment (EWRAP)	Analysis & report writing	87
Westside Type F Riparian Prescription Effectiveness	TWIG scoping	97
Eastside Type F Riparian Effectiveness Monitoring (BTO add-on)	Field implementation	102
Riparian Hardwood Conversion	Analysis & report writing	108
Extensive Riparian Status and Trends Monitoring – Temperature, Type F, Westside	In CMER review	113
Glacial deep-seated landslide program (scoping)	To be initiated	128
Unstable Slopes Criteria Evaluation and Development	To be initiated	132
Road Prescription-Scale Effectiveness Monitoring	TWIG formed	145
Forested Wetlands Effectiveness Project	To be initiated	168
Forested Wetlands Systematic Literature Review	In ISPR review	169
Wetlands Program Research/Monitoring Strategy Development	In WetSAG discussion	170
RMZ Re-Sample (birds)	In ISPR review	183

2.0 INTRODUCTION

The Washington State Forest Practices Board (Board) adopted an adaptive management program (Washington State Forest Practices Rules, WAC 222-12-045) in concurrence with the 1999 Forests and Fish Report (FFR) legislation (RCW 76.09.370). This legislation, guided primarily by the Washington Forests and Fish Report, formed the basis for the federally approved Washington Forest Practices Habitat Conservation Plan (FP HCP) in 2006. The purpose of the Forest Practices Adaptive Management Program is to:

> "provide science-based recommendations and technical information to assist the board in determining if and when it is necessary or advisable to adjust rules and guidance for aquatic resources to achieve resource goals and objectives."

To provide the science needed to support adaptive management, the Board established the Cooperative Monitoring, Evaluation and Research Committee (CMER). The Board appoints core CMER members and empowers CMER to implement research per guidelines established by the FFR and implemented under the FP HCP.

Currently, CMER is supported by four active scientific advisory groups (SAGs). One former SAG (BTSAG) has been merged with another SAG (RSAG), and two SAGs (ISAG and UPSAG) are inactive. The SAGs consist of both core voting CMER members and additional scientific participants representing the various stakeholders of the forest practices rules. The purpose of the SAGs is to design and implement the research and monitoring prioritized by CMER. Each SAG focuses on specific aspects of the forest practices rules, according to their areas of scientific expertise. Table 1 provides a brief description of the SAGs.

Table 1. CMER Scientific Advisory Group Structure

Active Scientific Advisory Group	**Acronym**	**Develops and Oversees Projects Related To:**
Landscape-Wildlife Advisory Group	LWAG	Wildlife, including stream-associated amphibians
Riparian Scientific Advisory Group	RSAG	FP HCP riparian strategy
Scientific Advisory Group - Eastside	SAGE	Issues specific to eastside of the Cascade Mountains
Wetlands Scientific Advisory Group	WETSAG	Wetland issues, including identification and protection
Inactive Scientific Advisory Group	**Acronym**	**Develops and Oversees Projects Related To:**
Upland Processes Scientific Advisory Group	UPSAG	Roads, mass wasting, and channel processes
~~Bull Trout Scientific Advisory Group~~	~~BTSAG~~	~~Bull trout biology and the forest practices rules designed to maintain bull trout habitat. In 2008, this SAG was merged with RSAG.~~
~~In-Stream Scientific Advisory Group~~	~~ISAG~~	~~In-stream issues, including stream typing and fish passage. This SAG is inactive pending further assignments from Policy.~~

In 2012 the Forest Practices Board directed that CMER conduct a pilot test of a LEAN process recommendation designed with the intention of making CMER more efficient in developing research studies. This pilot process replaces the role of the SAGs in study design with smaller Initial Writing Teams (IWTs) and Technical Writing and Implementation Groups (TWIGs). It is being examined whether smaller groups of scientists and fewer review steps will be more efficient in developing research study designs.

The goal of the CMER Work Plan is to present an integrated strategy for conducting research and monitoring to provide credible scientific information to support the Forest Practices Adaptive Management Program. The purpose of the work plan is to inform CMER participants, TFW Policy Committee (Policy) constituents, the Board, and interested public about CMER activities. The plan is revised annually in response to research findings of CMER or the scientific community, changing technology, changes in policy objectives, and funding. This version supersedes the FY14 CMER Work Plan.

The remainder of the document describes the CMER research and monitoring program and CMER recommendations for the work plan. Section 3.0 describes the organization of the CMER research and monitoring strategy and the approaches used to address research and monitoring questions relevant to Forest Practices Adaptive Management. Section 4.0 describes CMER procedures for prioritization at the program (topic areas) level and at the project level. Section 5.0 presents the Board approved CMER Work Plan, including project prioritization, scheduling, and budget allocations. Section 6.0 provides an overview of the CMER research and monitoring program, with program and project descriptions organized by rule group. Appendix A contains the table titled “CMER Projects, Objectives, and Targets” which links specific resource objectives and key riparian functions (e.g., in-stream temperature, large woody debris, litter, sediment, etc.) to CMER projects, organized by programs within rule groups.

3.0 CMER RESEARCH AND MONITORING STRATEGY

The CMER Work Plan consists of 94 projects (including multiple phases of a given project) covering a range of topics related to the forest practices rules. See Appendix A: CMER Projects, Objectives, and Targets for a listing of projects. These projects are at various stages of development or completion. Approximately 36 projects are complete and 24 projects are ongoing or to be initiated (i.e., undergoing study design development or currently being implemented or reviewed). The work plan is organized in a hierarchical format consisting of rule groups, programs, and projects.

3.1 FOREST PRACTICES RULE GROUPS

At the highest level, the CMER Work Plan is organized by forest practices "rule groups." A rule group is a set of forest practices rules relating either to a particular resource, such as wetlands or fish-bearing streams, or to a particular type of forest practice, such as road construction and maintenance. The ten rule groups are shown in Table 2. Although the rule group divisions are somewhat arbitrary, they provide a useful framework for developing a research and monitoring strategy.

Table 2. Description of the Rule Groups Used as a Framework for the CMER Work Plan

Rule Group	Description	Rule Context
Stream Typing	Prescriptions for identification of fish-bearing and non-fish-bearing streams	WAC 222-16
Type N Riparian Prescriptions	Prescriptions for identification of non-fish-bearing streams and management of adjacent riparian areas	WAC 222-30
Type F Riparian Prescriptions	Prescriptions for management of fish-bearing streams and adjacent riparian areas	WAC 222-30
Channel Migration Zone	Prescriptions for delineation of channel migration zones	WAC 222-30
Unstable Slopes	Prescriptions for identification and management of areas potentially susceptible to mass wasting/erosion processes	WAC 222-24,30
Roads	Prescriptions for identification and management of erosion and runoff from forest roads	WAC 222-24
Fish Passage	Prescriptions for identification and prevention of fish passage barriers	WAC 222-24
Pesticides	Prescriptions for application of forest chemicals	WAC 222-38
Wetlands Protection	Prescriptions for the identification and management of wetlands	WAC 222-30
Wildlife	Prescriptions for protection of wildlife	WAC 222-10,30

3.2 RESEARCH AND MONITORING PROGRAMS

Critical research and monitoring questions are identified at the rule group level to address information gaps related to scientific uncertainty and resource risk associated with the rules. Once research and monitoring questions are identified, programs are developed to address them. Programs consist of one or more related projects designed to strategically address a set of related scientific questions. Thirty-two programs containing multiple projects at various stages of development are identified in the CMER Work Plan.

CMER research and monitoring programs utilize a variety of approaches that address critical questions at different spatial and temporal scales. The work plan incorporates an integrated

research and monitoring approach as recommended by the Monitoring Design Team (MDT) Report (MDT, 2002). This includes effectiveness monitoring to evaluate prescription effectiveness at the site or landscape scale; extensive status and trend monitoring to evaluate status and trends of resource condition indicators across FP HCP lands; and intensive/validation monitoring to identify causal relationships and document cumulative effects at the watershed scale. CMER also conducts rule implementation tool projects to develop, refine, or validate science-based management tools necessary for implementing the rule(s) (e.g., predictive models, protocols, etc.) or for establishing performance standards. These approaches are summarized below:

Effectiveness Monitoring: Effectiveness monitoring programs are designed to evaluate the performance of the prescriptions in achieving resource goals and objectives. Effectiveness monitoring differs from the other approaches in that it is directed at prescription effectiveness, primarily at the site scale.

Extensive Status and Trends Monitoring: Extensive monitoring programs evaluate the current status of key watershed input processes and habitat condition indicators across FP HCP lands and document trends in these indicators over time as the forest practices prescriptions are applied across the landscape. Extensive monitoring provides a statewide, landscape-scale assessment of the effectiveness of forest practices rules to attain specific performance targets on FP HCP lands. Extensive monitoring is designed to provide report-card-type measures of rule effectiveness (i.e., to what extent are FP HCP performance targets and resource condition objectives being achieved on a landscape scale over time) that can be used to determine the degree to which progress is consistent with expectations.

Intensive Monitoring (Cumulative Effects) and Validation Monitoring: Intensive monitoring is designed to evaluate cumulative effects of multiple forest practices at the watershed scale. Analysis of these effects improves our understanding of the causal relationships and effects of forest practices rules on aquatic resources. Intensive monitoring integrates the effects of multiple management actions over space and through time within the watershed. Evaluation of monitoring data requires an understanding of the effects of individual actions on a site and the interaction of those responses through the system. Evaluating biological responses is similarly complicated, requiring an understanding of (1) how various management actions and site conditions interact to affect habitat conditions and (2) how aquatic resources respond to these habitat changes. Taken together, these evaluations will address the adaptive management program's objectives for validation monitoring. This sophisticated level of understanding of physical and biological systems can be achieved with an intensive, integrated monitoring effort.

Rule Implementation Tool Development: Rule implementation tool projects are designed to develop, refine or validate tools used to implement the forest practices rules.

1. Methodology Tool Development Projects develop, test, or refine protocols, models, and guidance that are designed for the identification and location of forest practices rule–specified management features, such as the Last Fish/Habitat Model, landslide screens, Np/Ns breaks and sensitive sites, or the achievement of specified stand conditions, such as the desired future condition (DFC) basal area target.

2. Target Verification Projects consist of studies designed to verify assumptions and targets developed during FFR negotiations that authors identified as having a weak scientific foundation (such as the DFC basal area targets for Type F streams), or that have been established in the Methodology Tool Development Projects.

Rule implementation tools differ from tools needed to implement a specific monitoring program or project. For example, the Road Surface Erosion Model is a tool necessary to implement several projects in the Roads Rule Group Effectiveness Monitoring Program. Monitoring implementation tools are typically included with the effectiveness monitoring programs.

4.0 PRIORITIZATION OF CMER PROJECTS

4.1 CMER PRIORITIZATION PROCESS

CMER's long-term goal is to address the full range of critical questions identified in the CMER Work Plan, while recognizing that availability of funding, time, and human resources limit the number of projects that can be developed and implemented each year. In order to focus effort and resources on the most critical issues for Forest Practices Adaptive Management, CMER prioritizes proposals for research and monitoring at both the program and project levels. Establishing priorities allows CMER to pursue the most pressing research and monitoring issues in an orderly manner over time.

The first step in CMER's initial prioritization process was to rank the relative importance of proposed programs in meeting FP HCP goals and objectives. CMER projects have since gone through several rankings in response to budget priorities and changes in workload allocation. The program prioritization strategy was to:

1. Rank effectiveness/validation monitoring and extensive status and trend monitoring programs on the basis of scientific uncertainty and risk to aquatic resources.
2. Evaluate the importance of rule implementation tool programs by consulting with DNR and then establish priorities on a project basis.
3. Defer integration of the intensive monitoring program into the CMER Work Plan until further scoping and coordination with other efforts occurs.

Effectiveness monitoring and extensive status and trend monitoring programs were ranked initially by CMER members in attendance at the December 19, 2002, CMER meeting, where each program was evaluated by asking two questions:

1. How certain are we of the science and/or assumptions underlying the rule?
2. How much risk is there to aquatic resources if the science or assumptions underlying the rule are incorrect?

These questions were selected as the criteria to rank programs, because the need for scientific information to inform adaptive management is most critical when there is a high level of scientific uncertainty concerning the interaction between forest practices, watershed processes, and aquatic resources; and where the sensitivity of the processes and aquatic resources to potential disturbance creates the greatest risk of resource impacts.

Uncertainty is a measure of confidence in the science underlying a rule, including the causal relationships providing the conceptual foundation for the prescriptions and assumptions about prescription effectiveness and resource response when the prescription is applied on the ground. High uncertainty (low certainty) indicates that little is known about the underlying science and the rule is likely based on assumptions that have not been validated. It may also indicate that the prescription is untested and performance under field conditions is unknown. Low uncertainty (high certainty) indicates that the science underlying the rule is well known and accepted or that the prescription (or similar treatment) has been evaluated under similar conditions. Risk is a measure of the potential for detrimental impacts to aquatic resources, including fish, stream-associated amphibians, and water quality. High risk indicates the activity covered by the

prescription has a greater potential to affect aquatic resources due to its magnitude, frequency, or direct linkage to the resource. Low risk indicates the rule has less potential to affect resources.

Individual scores were averaged to obtain mean risk and uncertainty scores for each program. These were multiplied to get a combined score that was used to rank the programs (Table 3). Policy accepted the rankings and instructed CMER to use them as the basis for prioritizing effectiveness/validation and extensive status and trend monitoring projects.

Table 3. Rankings for Effectiveness Monitoring and Extensive Status and Trends Monitoring Programs

Program Title	Overall Ranking	Uncertainty		Risk	
		Mean	Rank	Mean	Rank
Effectiveness/Validation Programs					
Type N Buffer Characteristics, Integrity Function	1	4.4	1	3.9	1
Eastside Type F Desired Future Range and Target	2	4.2	2	3.8	2
Type N Amphibian Response	3	4.2	2	3.7	3
Road Sub-Basin-Scale Effectiveness Monitoring	4	3.4	5	3.4	4
Type F Statewide Prescription Monitoring	5	3.2	7	3.1	6
Mass Wasting Effectiveness Monitoring	6	3.2	6	2.9	8
Eastside (BTO) Temperature	7	3.0	9	3.2	5
Wetlands Revegetation Effectiveness	8	3.5	4	2.7	11
Road Prescription-Scale Effectiveness Monitoring	9	2.6	14	3.1	6
Hardwood Conversion	10	3.0	8	2.6	12
Wetlands Mitigation	11	2.8	11	2.7	10
Fish Passage Effectiveness Monitoring	12	2.6	14	2.9	9
Wildlife Program	13	2.9	10	2.4	14
Wetland Management Zone Effectiveness Monitoring	14	2.8	12	2.5	13
CMZ Effectiveness Monitoring	15	2.7	13	2.1	15
Forest Chemicals	16	2.0	16	2.1	16
Extensive Status and Trends Monitoring Programs					
Extensive Riparian Monitoring	1	3.5	2	3.5	1
Extensive Mass Wasting Monitoring	2	3.7	1	2.9	3
Extensive Fish Passage Monitoring	3	3.1	3	3.1	2

Program rankings for effectiveness/validation programs and extensive status and trend monitoring programs shown in Table 3, as well as information on the relative importance of rule implementation tool programs gleaned from consultation from DNR, were used to provide guidance to the SAGs on where to focus time and energy in program and project scoping and development. Since 2002, when Table 3 was developed, some program titles within the work plan have changed to improve upon the clarity of research strategies within the rule group and program structure. However, the basic prioritization has not changed.

The second stage of prioritization occurs at the project level in order for CMER to make recommendations to Policy concerning scheduling and allocation of funding among the projects developed by the SAGs. Projects are prioritized based on (1) the extent to which projects are deemed essential to inform the Forest Practices Adaptive Management Program, (2) input from DNR on their importance in improving implementation of forest practices rules, (3) status of projects relative to Policy decisions on adaptive management, and (4) the need to follow through and complete work already underway. CMER and the Adaptive Management Program Administrator (AMPA) develop each fiscal year's proposed projects based on those criteria.

4.2 POLICY PRIORITIZATION

Policy is responsible for reviewing and approving each CMER Work Plan before submitting it to the Board for approval. Policy is also responsible for providing guidance to CMER on project prioritization, consistent with directions outlined in WAC 222-12-045 and in Section 22, "Guidelines for Adaptive Management Program," in the Forest Practices Board Manual.

Policy's project prioritization process may not always be consistent with CMER's process regarding scientific uncertainty and potential risk to aquatic resources. While Policy has in past years approved CMER's work plan priorities, Policy must also consider annual/biennial state budget fluctuations and other factors associated with meeting milestones in accordance with the FP HCP and/or Clean Water Act (CWA) assurances.

Due to delays in meeting deadlines for determining if forest practices rules were adequate in meeting CWA assurances, Policy made a decision in 2009 to prioritize CMER projects according to whether or not they were answering critical questions associated with meeting the CWA assurances. Due to anticipated substantial budget shortfalls in 2010 and beyond, Policy directed CMER to implement only ongoing projects in FY10. New projects would need to be delayed until adequate funding was available. Active projects in the current CMER Work Plan reflect these priorities, based on Policy's input concerning CMER's annual budget and the CWA.

The Washington Department of Ecology (WDOE) is charged with overseeing the CWA assurances milestones and has developed a document outlining specific CMER projects targeted at answering critical questions associated with the CWA. WDOE's document also lists timelines and anticipated completion dates for those CMER projects. Policy has determined that the WDOE CWA assurances milestones document will guide CMER's project prioritization process until a more stable source of long-term funding can be secured.

In 2012, in responding to a threat of a lawsuit, a settlement was reached that further affected the project priorities of CMER. This settlement agreement included a project work schedule (CMER master project schedule) that can only be changed with consensus agreement by the full Policy committee and the Board. The settlement work schedule generally maintained CMER's prior priorities.

5.0 FY15 CMER WORK PLAN PROJECTS AND BUDGETS

Table presents information on ongoing and new CMER projects for FY15, organized by rule group. Project budgets are categorized as either Tier 1 or Tier 2 projects. Tier 1 projects are those projects CMER is certain to implement in FY15. Tier 2 projects are those projects that CMER may initiate in FY15, but that have not yet been approved by CMER and/or Policy and may still require additional work on study design development, review, and/or accurate cost requirements.

Table 4. FY15 CMER Projects and Budget (*projects to be initiated or added scope to project)

	Tier 1	Tier 2
Type N Rule Group		
*Westside Type N Buffer Characteristics, Integrity, & Function (BCIF)	0	
Type N Experimental Buffer Treatment Project in Hard Rock Lithologies	304,000	
*Type N Experimental Buffer Treatment Project in Hard Rock Lithologies – Amphibian Demographics/Channel Metrics	0	
*Type N Experimental Buffer Treatment Project in Hard Rock Lithologies (Temperature, Sediment, Vegetation, Litter Fall)	134,000	
Type N Experimental Buffer Treatment Project in Soft Rock Lithologies	344,000	
Eastside Type N Characterization - Forest Hydrology	425,000	
Eastside Type N Riparian Effectiveness Perennial stream Dry intermittent	 5,000 80,000	
Tailed frog literature review	0	
Buffer Integrity - Shade Effectiveness (Amphibians)	30,000	
*Van Dykes Salamander	56,000	
Extensive Riparian Status and Trends Monitoring – Westside -Temperature, Type N (budget combined for Type N and Type F)	10,000	
Type F Rule Group		
Eastern Washington Riparian Assessment Project (EWRAP)	0	
Westside Type F Riparian Prescription Effectiveness	10,000	
Eastside Type F Riparian Effectiveness Monitoring (BTO add-on)	0	
Riparian Hardwood Conversion Project	10,000	
Extensive Riparian Status and Trends Monitoring – Temperature – Westside - Type F (budget combined for Type N and Type F – shown under Type N)	0	
Unstable Slopes Rule Group		
*Unstable Slope Criteria Project	5,000	
*Glacial Deep-seated Landslides Program (Scoping)	50,000	
Roads Rule Group		
*Road Prescription-Scale Effectiveness Monitoring	25,000	
Wetlands Rule Group		
Forested Wetlands Systematic Literature Review	60,000	
*Forested Wetlands Effectiveness Study	25,000	
Wetlands Program Research/Monitoring Strategy Development	33,000	
Wildlife Rule Group		
RMZ Resample (Birds)	2,000	
Subtotal Projects (by Tier 1 and Tier 2)	**$2,608,000**	**$0**
Total Project (both Tier 1 and Tier 2)	**$2,608,000**	

Project Staffing		
CMER Principal Investigator Staff at NWIFC (4)	601,000	
Total Project and Staffing Costs (by Tier 1 and Tier 2)	**$2,209,000**	**$0**
Project Support		
Contingency Fund for Active Projects	100,000	
Policy Information/Analysis Support or Grant Writer or Facilitation/Mediation	100,000	
CMER Project Managers (2)	187,000	
Fish LiDAR Model	100,000	
Program Administration		
AMP Administrator	105,000	
Contract Specialist / CMER Coordinator	66,000	
CMER Information Management System	20,000	
Independent Science Review Panel	60,000	
Cooperative Fish and Wildlife Research Unit Dues (U of W)	16,000	
Subtotal Support and Administration	**$754,000**	
Total FY15 Expenditures for Projects/Activities (by Tier 1 and Tier 2)	**$2,963,000**	**$0**

6.0 RULE GROUP DESCRIPTIONS AND MONITORING STRATEGIES

This portion of the work plan includes research and monitoring strategies for each forest practices rule group. Information on each rule group is presented separately, in a similar format. The "Rule Overview and Intent" briefly describes a summary of the rule and its intent; the "Rule Group Resource Objectives and Performance Targets" lists the resource objectives and performance targets from Schedule L-1, adopted by the Board in 2001; and the "Rule Group Strategy" describes the programs within a given rule group and how they work together to answer the rule group critical questions. The programs for each rule group are organized by approach, i.e. rule implementation tools, effectiveness monitoring, extensive monitoring, and intensive monitoring. The "Program Strategy" describes how the specific program research and monitoring projects work together to answer the rule group critical questions, specific to that program. For some programs, there are additional program research questions, which are sub-questions to the specific rule group critical questions. These program research questions are identified in tables under the specific program strategies. The description, goals and status of each project are also described under each program.

Under each program is a section titled "Link to Adaptive Management." This section was added to the FY11 CMER Work Plan primarily to help Policy and the Board understand how each rule group critical question is being addressed by the CMER projects. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. For "knowledge gained," results are only described for projects that have gone through the required peer-review process and have been approved by CMER and Policy. For projects that aren't complete, "knowledge anticipated" is described. The "Link to Adaptive Management" section will be updated with better information as projects are completed within CMER. The intent is to eventually have this section completed for every program within the CMER Work Plan beginning with the active and completed projects.

Because of the complexity of the riparian strategy, it is divided into four rule groups: Stream Typing Rule Group (Type F/N delineation), Type N Rule Group (non-fish-bearing streams), Type F Rule Group (fish-bearing streams and associated wetlands), and Channel Migration Zone Rule Group. Sections on the remaining rule groups appear in the following order: Unstable Slopes, Roads, Fish Passage, Pesticides, Wetlands Protection, and Wildlife rule groups. Last is a section on the intensive monitoring program, which addresses cumulative effects and validation of performance targets/resource objectives.

6.1 STREAM TYPING RULE GROUP

Rule Overview and Intent

The Forest Practices Board adopted rules delineating waters of the state into three categories, Type S waters (shorelines of the state), Type F waters (fish-bearing), and Type N waters (non-fish-bearing). Distinguishing the upstream limits of Type F (or S) waters is particularly important, because presence or absence of fish and fish habitat in streams creates differences in the aquatic resources of concern, the forest management strategies, and the prescriptions applied.

Prior to the rules associated with the Forests and Fish Report (1999), stream typing was based on a set of physical and beneficial-use criteria. Due to questions about the accuracy of this system, the forest practices rules require development of a statewide stream map using a multiparameter, field-verified, GIS logistic regression model to identify the upper extent of Type F streams.

The intent of the Stream Typing Rule Group is to develop a statewide stream typing map, described as follows in the forest practices rules:

> "The department will prepare water type maps showing the location of Type S, F, and N (Np and Ns) Waters within the forested areas of the state. The maps will be based on a multiparameter, field-verified geographic information system (GIS) logistic regression model. The multiparameter model will be designed to identify fish habitat by using geomorphic parameters such as basin size, gradient, elevation and other indicators. The modeling process shall be designed to achieve a level of statistical accuracy of 95% in separating fish habitat streams and nonfish habitat streams. Furthermore, the demarcation of fish and nonfish habitat waters shall be equally likely to over and under estimate the presence of fish habitat. These maps shall be referred to as 'fish habitat water typing maps' and shall, when completed, be available for public inspection at region offices of the department. Fish habitat water type maps will be updated every five years where necessary to better reflect observed, in-field conditions."

Until the fish habitat water type maps described above are adopted by the Board, WAC 222-16-031 — the Interim Water Typing System — will continue to be used.

Rule Group Resource Objectives and Performance Targets

Resource Objectives:

- Streams and their associated wetlands should be typed to include fish habitat. Fish habitat is defined in the forest practices rules to mean "habitat, which is used by fish at any life stage at any time of the year, including potential habitat likely to be used by fish, which could be recovered by restoration or management, and including off-channel habitat."
- The rules also direct that the department (DNR) will prepare water typing maps, which will be based on a multiparameter, field-verified, peer-reviewed, geographic information system (GIS) logistic regression model. The multiparameter model will be designed to identify fish habitat by using geomorphic parameters such as basin size, gradient, elevation, and other indicators.

Performance Target:

- The predictive fish habitat model should have a statistical accuracy of +/- 5% with the line of demarcation between fish and non-fish-habitat waters equally likely to be over- and under inclusive.

Rule Group Strategy

The Forests and Fish Report (FFR) provided rationale and guidance for a strategy related to the stream typing system. The FFR indicated that the current approach to stream typing was not adequately precise, defined a modeling approach for developing a new map, and set specifications for the accuracy of the model. It also called for development of a field protocol for inclusion in the Forest Practices Board Manual.

The In-Stream Scientific Advisory Group (ISAG) was tasked with developing and validating a GIS-based model to predict the upstream extent of fish habitat (Table 4). This task falls under one program, the Stream Typing Program, which is categorized as a rule tool.

Table 4. Stream Typing Rule Group Critical Questions and Programs

Rule Group Critical Questions	Program Name	Task Type	SAG
How can the demarcation between fish- and non-fish-habitat waters be accurately identified?	Stream Typing Program	Rule Tool	ISAG

6.1.1 Stream Typing Program (Rule Tool)

Program Strategy

Table 5. Stream Typing Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
How can the demarcation between fish- and non-fish-habitat waters be accurately identified?	Last Fish/Habitat Prediction Model Development Project
	Annual/Seasonal Variability Project
	Last Fish/Habitat Prediction Model Field Performance Project

Last Fish/Habitat Prediction Model Development Project

Description:
A GIS-based logistic regression model was developed, associating geomorphic parameters (i.e., basin size, gradient, elevation, and other indicators) with last fish points in order to determine and map the upstream boundary of Type F (fish-habitat) streams. The forest practices rules specified that once the model was developed, with an accuracy of 95%, the resulting map would be used as rule.

Status:
The model was completed in 2006. Based on the results of the Last Fish/Habitat Prediction Model Field Performance Project, the model did not achieve the target accuracy of 95%. In response, DNR developed new water type maps based on the model in March 2006, but the maps are only to be used as a starting point for delineating fish habitat, not as rule. The DNR maps are currently used as part of the forest practices application process in combination with the Interim Water Typing System (WAC 222-16-031). This water typing rule specifies physical criteria for identifying fish-bearing streams (channel width, channel gradient, and contributing basin area), unless overridden by a protocol survey for determining fish use.

Based on the results of the Last Fish/Habitat Prediction Model Field Performance Project, and the CMER recommendation that further efforts to improve the model would likely not increase its level of accuracy, Policy decided that additional CMER work on the model was not necessary at this time. Policy has identified stream typing as a task to be resolved on their Policy work list.

Annual/Seasonal Variability Project

Description:
The Annual/Seasonal Variability Project was conducted to help validate the Last Fish/Habitat Model. The project goal was to assess whether or not the upstream extent of fish distribution in eastern Washington varies on an annual basis and/or from season to season. The study sampled for changes in fish movement at both “terminal” (midstream) and “lateral” (tributary junctions) fish distribution points. Key questions related to this project include:

- Does the upstream extent of fish distribution vary with seasons?

- What is the magnitude of the variation in the upstream extent of fish distribution between seasons?
- Are there trends in fish movement upstream or downstream related to season or year?
- What is the magnitude of observed variability?
- Is there a drought impact?

Annual variability estimates were obtained from two years of summer data, collected during the low-flow period (2001–2002). Project results indicated a range of observed annual variability from 943 m downstream to 400 m upstream of terminal last fish points (n=172). Last fish points did not change from 2001 to 2002 at 51 of 172 locations; and, when movement occurred (in either direction), the last fish point shifted by 25 m or less at 61 of the 172 terminal points. Last fish shifted by more than 100 m in either direction at 17 of 172 locations, and moved more than 200 m at only 8 locations. Last fish shifted by more than 500 m at only 3 locations; all of these were downstream movements. For all last fish points in 2002 (terminal and lateral combined), 94% of last fish points shifted by 50 m or less. Of 309 terminal and lateral sites resurveyed in 2002, last fish points did not change at 150 sites.

Seasonal/annual variability estimates were obtained in the summer and fall of 2005 and later were compared, to the extent possible, with the annual variability estimates from 2001–2002. Project results showed similar differences in the seasonal variability of fish movement between years, with the majority occurring within 100 m of the original survey. Seasonal variability results compared fish movement between years and seasons and included the average upstream/downstream movements, as well as trends in upstream/downstream movement.

The project also included an assessment of sampling error to help determine the degree to which the field survey protocol (using a single pass electroshocking survey) was likely to detect the "last fish" at the maximum upstream extent of fish distribution.

Status:
Work began in 2000–2001 to identify annual and seasonal variability of last fish points and also to assess sampling error. Additional field survey data were collected in 2002 and 2003. In 2005, a seasonal variability study was completed and a final report was provided in the spring of 2006. This study was conducted as a subproject to inform the Last Fish/Habitat Prediction Model Field Performance Project. However, since the model did not meet the required target accuracy (95%), Policy decided that additional CMER work on annual and seasonal variability was not necessary at this time.

Last Fish/Habitat Prediction Model Field Performance Project

Description:
The objective of the Last Fish/Habitat Prediction Model Field Performance Project was to assess the performance of the model predictions in western Washington. A study design was developed by ISAG and approved by CMER, and a pilot field test of the study design was performed. The pilot field test primarily included resurveying a randomized sample of last fish points and comparing those points to the predicted model point. If the field-identified last fish point occurred upstream of the model-predicted point, the prediction was considered to be an underestimation of fish habitat; if the field-identified last fish point occurred downstream of the

model-predicted point, the prediction was considered to be an overestimation of fish habitat. ISAG compiled existing information related to water typing and presented this, along with the model performance assessment study design and pilot field effort results, to the Policy Subgroup on Water Typing.

Status:
Because the model did not achieve the level of accuracy specified in the forest practices rules (95%), and further work was unlikely to improve upon that level of accuracy, Policy decided that no additional CMER work was necessary at this time.

Link to Adaptive Management

This section should be completed in the next year.

Knowledge Gained or Anticipated:

Identified Gaps:

Recommendations for Addressing Gaps:

6.2 TYPE N RIPARIAN PRESCRIPTIONS RULE GROUP

Rule Overview and Intent

Type N streams either do not provide suitable habitat to support fish or do not contain fish because of a natural barrier to fish migration. Type N streams are protected under forest practices rules for several reasons. First, they provide habitat for stream-associated amphibians (SAA) covered by the agreement. Second, water quality standards pertaining to these streams need to be met. Finally, Type N streams contribute water, nutrients, woody debris, and sediment that affect downstream fish habitat and water quality.

Two buffering strategies are prescribed for Type Np streams, the clear-cut and the partial-cut strategies. The clear-cut strategy is prescribed for the westside, whereas landowners on the eastside have the flexibility to use either clear-cut or partial-cut strategies. The clear-cut strategy on the westside involves a patch buffering system where portions of the riparian stand can be clear-cut to the stream, but the remaining areas are protected with a 50-ft-wide no-cut patch buffer. The patch buffer includes fixed and flexible components. Fixed components include 50-ft buffers around the sensitive sites (e.g., connected springs and seeps, Np initiation points, and stream junctions) and on both sides of the stream 300–500 ft upstream from the Type F/Type Np junction. The flexible component allows the landowner to choose where to place the remaining buffer to bring the total buffer length to 50% of the Type Np length. Eastside landowners have the second option of using the partial-cut strategy, a continuous 50-ft buffer along the length of the Type Np stream. The partial-cut buffer can be thinned, provided that the appropriate basal area and leave tree requirements are met. A 30-ft-wide equipment limitation zone (ELZ) is established on all Type N streams (Np and Ns) statewide to minimize sediment input from bank and soil disturbance. Operations within the ELZ are designed to avoid soil disturbance, and sediment delivery must be mitigated.

The Type N rules are based on the assumption that riparian buffering strategies will result in aquatic conditions that meet resource objectives and consequently achieve the three Forests and Fish Report performance goals. However, a high level of uncertainty exists in the science underlying these assumptions because the functional relationships between riparian management practices, riparian functions, and aquatic resource response are not well studied or understood. Several major areas of uncertainty include: (1) how to identify the upper boundary of perennial flow in Type N streams; (2) how riparian stands and the inputs and functions they provide respond to management practices and the level of protection provided by the prescriptions; (3) the habitat utilization patterns of SAAs and their response to riparian management practices; and (4) the effects of Type N riparian management practices on sediment, large woody debris (LWD), temperature, and nutrient regimes in downstream fish-bearing streams.

Rule Group Resource Objectives and Performance Targets

Resource Objectives:

The Type N riparian prescriptions are designed to accomplish the following FP HCP resource objectives:

- Provide cool water by maintaining shade, groundwater temperature, flow, and other watershed processes controlling stream temperature.

- Provide complex in- and near-stream habitat by recruiting LWD and litter.
- Prevent delivery of excessive sediment to streams by protecting stream-bank integrity, providing vegetative filtering, protecting unstable slopes, and preventing routing of sediment to streams.
- Provide conditions that sustain SAA population viability within occupied sub-basins.

Performance Targets:

- Stream Temperature: To be developed
- Water quality standards: To be developed
- Sediment: Target related to harvest and activities in the ELZ has yet to be developed.
- Groundwater Temperature: To be developed.

Rule Group Strategy

As mentioned in the rule overview section above, there were scientific uncertainties concerning the assumptions on which the forest practices Type N riparian prescriptions were based. The Type N riparian strategy is designed to address those areas of scientific uncertainties by focusing on critical questions related to delineation of Np/Ns streams, characterization of Np streams, identification and characterization of sensitive sites, and the effectiveness of the rules in achieving FP HCP goals and resource objectives. The critical questions, programs, task types, and responsible scientific advisory groups (SAGs) are listed in Table 6. The first step in the strategy involves rule tool programs that address how to delineate and characterize Type N streams and sensitive sites. The Type N Delineation Program addresses how to characterize and delineate the uppermost boundaries of Type N streams, including perennial and seasonal streams. The purpose of the Sensitive Site Program is to refine the descriptions of SAA sensitive sites in the forest practices rules and to estimate their importance to SAAs.

After rule tools have been developed to characterize and/or delineate Type N streams, the next step in the strategy is to assess the effectiveness of the riparian prescriptions in meeting resource goals and performance targets. The Type N Riparian Effectiveness Program assesses how the forest practices riparian prescriptions, as well as alternative buffer prescriptions, address the FP HCP resource objectives (i.e., riparian processes and functions) within Type N streams, as well as their contribution to downstream Type F streams. The Type N Amphibian Response Program addresses how SAA population viability is maintained by the Type N prescriptions on the westside. The Extensive Riparian Status and Trends Monitoring Program is then designed to provide a snapshot of temperature and riparian vegetation conditions in Type N streams across the FP HCP landscape and to document how those conditions change over time.

Table 6. Type N Riparian Prescriptions Rule Group Critical Questions and Programs

Rule Group Critical Questions	Program Names	Task Type	SAG
How should the initiation point of Type Np streams be identified for management purposes?	Type N Delineation Program	Rule Tool	UPSAG
Can the methods used to identify and characterize sensitive sites be improved?	Sensitive Site Program	Rule Tool	LWAG
Are rule-identified sites valuable for amphibians?	Sensitive Site Program	Rule Tool	LWAG
Are sites important to amphibians correctly identified by rule?	Sensitive Site Program	Rule Tool	LWAG
How do survival and growth rates of riparian leave trees change following Type Np buffer treatments? Are riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, litter fall, and amphibians? How do other buffers compare with the forest practices Type N prescriptions in meeting resource objectives? How do the Type N riparian prescriptions affect water quality delivered to downstream Type F/S waters? Are the Type N performance targets valid and meaningful measures of success in meeting resource objectives? What is the frequency and distribution of windthrow in forest practices buffers on Type N and F streams? What site and habitat conditions are associated with sites with significant blowdown? What is the effect of buffering or not buffering spatially intermittent stream reaches in Type Np streams?	Type N Riparian Effectiveness Program	Effective-ness	RSAG SAGE
Is stream-associated amphibian (SAA) population viability maintained by the Type N prescriptions?	Type N Amphibian Response Program	Effective-ness	LWAG
What is the current status of riparian conditions and functions in Type N streams on a statewide scale, and how are conditions changing over time?	Extensive Riparian Status and Trends Monitoring Program	Extensive	RSAG
Are forest practices riparian prescriptions effective at protecting groundwater flow and temperature?	Groundwater Conceptual Model Project Type N Riparian Effectiveness Program	Effectiveness	UPSAG RSAG SAGE WetSAG

6.2.1 Type N Delineation Program (Rule Tool)

Program Strategy

Because the Type N protections differ between perennial and seasonal stream reaches, it is important that perennial and seasonal reaches can be identified before management activities occur. This is difficult because flow regime determination requires walking extensive stream lengths during the summer dry season. The need for a simpler year-round determination method led to the basin area default method contained in the FFR. The Type N Delineation Program was designed to determine whether regulatory delineation methods were sufficiently accurate and whether there were preferable alternatives.

The Type N Delineation Program evaluated existing and alternative delineation methods using observational field studies. In 2001, a pilot study (administered by UPSAG) was conducted to validate existing methods for defining perennial and seasonal streams for both western and eastern Washington, as described below. Based on the results of the study (see "Link to Adaptive Management," below), in November 2006 the Forest Practices Board adopted the rule that eliminated the option to use a default basin size. Though the Board Manual was to be relied upon to provide guidance for determining the uppermost point of perennial flow, the proposed Board Manual language for providing this guidance was not approved at that time. Currently, no further action is being taken by CMER on this issue.

Table 7. Type N Delineation Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names	SAG
How should the initiation point of Type Np streams be identified for management purposes?	Perennial Initiation Point Survey: Pilot Study	UPSAG

Perennial Initiation Point Survey: Pilot Study

Description:

The PIP pilot study was initiated in 2001 to evaluate field methods and inform sampling needs for a subsequent statewide field study. The field portion of the study was done by Forests and Fish cooperators (tribes, timber companies, and the Washington Department of Fish and Wildlife [WDFW]) on a voluntary basis. Data analysis and reporting was done by CMER staff under the direction of the Np technical subgroup and UPSAG.

Completion of the pilot study in 2004 was followed by independent scientific peer review (ISPR) and revisions and the preliminary scoping of a coordinated statewide study.

Status:

The pilot study was completed in 2004. A coordinated statewide study has not been scoped or initiated based on direction from Policy.

Link to Adaptive Management

The following section addresses the critical question for the Type N Delineation Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed. The rule group critical question is listed in bolded italics. "Knowledge gained" is only shown for projects with final reports that have been through final review and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is described. For this program, only one CMER project is listed (see Table 7) for addressing the critical question.

How should the initiation point of Type Np streams be identified for management purposes?

Knowledge Gained or Anticipated:

Key results were that the field methods were adequate with some modifications and that 30 to 300 sites (depending on the metric) would be needed for a statistically robust study. The pilot failed to identify any reliable field indicators (e.g., channel width, indicator plant species, etc.) but found the proximity of perennial flow initiation to the channel head or upslope ridge to be promising alternative methods. Basin areas were substantially smaller than the default values for all regions of the state where data were collected. Although variability was high between sites, differences were better correlated with average annual precipitation than existing rule regions (i.e. west Cascade, east Cascade, and coastal spruce zones).

Identified Gaps:

Data sites were clustered, rather than randomly selected, reducing confidence in spatial representativeness. Minimal sampling occurred within the coastal spruce zone. There is limited understanding of seasonal and year-to-year variability in flows.

Recommendations for Addressing Gaps:

Design and carry out statewide follow-up study to improve default basin areas or to refine other field indicators.

6.2.2 Sensitive Site Program (Rule Tool)

Program Strategy

The Sensitive Site Program, which began in 1999, consists of two rule tool implementation projects. The purpose of this program is to refine the descriptions of stream-associated amphibian (SAA) sensitive sites in the forest practices rules and to estimate their importance to SAAs. The strategy is to first develop a field methodology to assist forest managers in identifying sensitive sites and then characterize sensitive sites that are the most important to the FP HCP SAAs. Critical questions and associated research projects are presented in Table 8.

Table 8. Sensitive Site Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
Are sites important to amphibians correctly identified by rule?	SAA Sensitive Sites Characterization Project
Are rule-identified sites valuable for amphibians?	SAA Sensitive Sites Characterization Project
Can the methods used to identify and characterize sensitive sites be improved?	SAA Sensitive Sites Identification Methods Project
	SAA Sensitive Sites Characterization Project

SAA Sensitive Sites Identification Methods Project

Description:

The purpose of this project is to develop a practical methodology for identifying SAA sensitive sites, such as headwall seeps, side-slope seeps, and headwater springs.

This project is intended to inform the Type N riparian rule by providing a standard methodology (field guide) for field managers to identify SAA sensitive sites when designing harvest units.

Status:

This project was completed in 2007. One manuscript has been submitted to a peer-reviewed journal and two additional manuscripts are in preparation. This project is administered by LWAG.

SAA Sensitive Sites Characterization Project

Description:

The purpose of this project is to document the distribution and characteristics of sensitive sites as described by the forest practices rules and to verify their utilization and habitat value for SAAs. It will generate information on the characteristics of sensitive sites, validate the extent to which they are utilized by amphibians, and determine if other sensitive sites exist. Information from this project could result in changes to the sensitive site criteria in the rules to better focus buffer protection on areas important to SAAs.

Status:
This project was completed in 2006. One manuscript has been approved by CMER and published, and another manuscript is in preparation. This project is administered by LWAG.

Link to Adaptive Management

The following section addresses critical questions for the Sensitive Site Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed. Rule group critical questions are listed in bolded italics. "Knowledge gained" is addressed exclusively for project final reports that have been through final review and approved by CMER and Policy. For projects which are incomplete, "knowledge anticipated" is described. For this program, two CMER projects are listed (see Table 8) for addressing the critical questions. The two projects with this program, the SAA Sensitive Sites Identification Project and SAA Sensitive Sites Characterization Project, were completed in 2007 and 2006, respectively. Though no new projects have been developed for this program, those projects do not provide all the information needed to answer the critical questions. As new projects and associated final reports are developed and completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations to address those gaps.

Are sites important to amphibians correctly identified by rule?

Knowledge Gained or Anticipated:
Language describing substrate in the rule defining headwall and side-slope seeps is ambiguous, which creates uncertainty in the ability to identify them. If rule definitions of seeps are intended to exclude seeps having fine substrates, definitions currently exclude all seeps identified in the SAA Sensitive Sites Identification Methods and SAA Sensitive Sites Characterization projects. No rule definition exists for unambiguously distinguishing headwater from side-slope seeps. The SAA Sensitive Sites Identification Method Project developed an easily applied rule that identified headwall seeps as any seep with 50% or more of its hydrologic footprint located upstream of a line perpendicular to the stream axis at a perennial initiation point; side-slope seeps included all other seeps not so defined. This arbitrary definition was needed to allow for the handling of the two apparent seep types in a meaningful way.

Identified Gaps:
Ambiguity in seep rule definitions needs to be addressed. To date, research on rule-defined sensitive sites has been limited to the two seep categories and headwater springs; it has not been determined whether rule correctly identifies the other two categories of sensitive sites (tributary junctions and alluvial fans), which may provide important habitat for amphibians. To date, data on the value of sensitive sites to amphibians have been restricted to the two categories of seeps and to hard rock lithologies; however, sampling methods which preceded incorporating detectability (the method not yet developed for sensitive sites) and involved temporally short-interval single-pass sampling, constrain what may be inferred from these data. Existing data suggest that torrent salamanders, which are strongly associated with low-flow habitats, are the dominant amphibians in seeps. Hence, besides issues of detection, sampling was biased against species with short-term use of seep habitats. Moreover, no systematic data are available on the importance of headwater springs, tributary junctions, and alluvial fans to amphibians; and on the sensitive site information relative to amphibians in soft rock lithologies. Further, it is not known

whether the two arbitrarily defined seep categories differ in physically meaningful ways that may influence amphibian occupancy and abundance.

Recommendations for Addressing Gaps:
If the original intent of the forest practices rules was to capture seeps important to amphibians, rule language for seep definitions needs reconsideration. The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies (see Type N Riparian Effectiveness Program) will provide some information on the relative importance of these sensitive sites relative to non–sensitive site habitats. The Hard Rock Project will also be able to provide some information on seeps, but rule language reconsideration should precede such an assessment in order to understand what seeps rule actually captures. Moreover, since treatment basins in this study were not selected for either seep presence or a minimum number of seeps, one should not expect data from the Hard Rock Project to provide an answer to this question that is either systematic or comprehensive. Though the importance of alluvial fans to amphibians represents an information gap, it may not be a tractable question since the Type N landscape typically has few alluvial fans. Evaluation of whether sensitive sites important to amphibians are correctly identified on non–hard rock lithologies is generally regarded as a lesser priority because, based on site screening for the Hard Rock Project, occupancy and abundance of rule-identified SAAs on such lithologies appears more limited. However, this view must be mitigated by the fact that occupancy and abundance of amphibians on non-hard rock lithologies was conducted with single-pass screening for which one cannot estimate detectability; and what is currently regarded as non-hard rock lithologies, includes lithologies that are structurally akin in their behavior to lithologies currently placed in the hard rock category.

Are rule-identified sites valuable for amphibians?

Knowledge Gained or Anticipated:
Headwall and side-slope seep sensitive sites appear important to amphibians. Torrent salamanders are encountered more frequently in seep versus non-seep habitats (but see the previous critical questions for issues with seep definitions in rule). However, variation in apparent torrent salamander abundance among seeps is large and the methods that identified this variation, as previously noted, did not incorporate detectability (see “Identified Gaps,” below). Few non–torrent salamander amphibians were detected in seeps, but this pattern may be affected by residency in seeps. Torrent salamanders can be identified in seeps year-round, whereas other amphibian species appear to use seeps intermittently. Understanding of the pattern and importance of the intermittent use of seeps by other amphibians is lacking.

Identified Gaps:
Assuming rule language for seeps definitions is addressed (see previous critical question), the greater relative abundance of torrent salamanders in seeps relative to non-seep habitats is ambiguous because the studies that made this determination were carried on without the intensive mark-recapture studies needed to address detectability and prior to the development of less costly sampling advances allowing detectability determination. In particular, if detectabilities differ between seep and non-seep habitats, then current results could be misleading, as they do not account for these potential differences in detectability. Furthermore, habitat conditions responsible for the large variation in apparent abundance of torrent

salamanders among seeps is unknown; and whether the habitat conditions contributing to apparently larger abundances in some seeps could be used to consistently identify seeps that might be judged as more valuable based on greater abundances is unclear. Limited numbers of non–torrent salamander amphibians observed in seeps may reflect the short sampling interval (one or a few days) of the approach, especially for species that use seeps for brief intervals as part of their seasonal rounds. To date, data on the value of sensitive sites to amphibians have been restricted to the two categories of seeps and to hard rock lithologies: no systematic data are available on the importance of headwater springs, tributary junctions, and alluvial fans to amphibians; and on the sensitive site information relative to amphibians in soft rock lithologies.

Recommendations for Addressing Gaps:
The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies (see Type N Riparian Effectiveness Program) will be able to address some of these gaps — namely, information on the importance of headwater springs and tributary junctions to amphibians and the relative importance of these sensitive site categories relative to non–sensitive site habitat and for which the estimates are corrected for detectability. The Hard Rock Project will also be able to provide some information on seeps. Since treatment basins were not selected for presence or number of sensitive sites , these data are not systematic. Some kind of higher resolution sampling approach will be required to understand the non–torrent salamander amphibian use of seeps. The importance of alluvial fans to amphibians may not be a tractable question unless a landscape is found in which these are a common feature; in the landscapes with hard rock lithologies surveyed to date, alluvial fans appear to be an infrequent feature. Assuming that biases relative to screening (detectability) and lithological categorization are of insufficient magnitude to create a problem, evaluation of sensitive sites important to amphibians on non–hard rock lithologies is a lesser priority because occupancy and abundance of rule-identified SAAs on such lithologies appears more limited.

Can the methods used to identify and characterize sensitive sites be improved?

Knowledge Gained or Anticipated:
Opportunity exists to improve identification and characterization of seeps, but a combination of methods will be needed due largely to their generally small sizes. Canopy gaps and selected deciduous trees frequently characterize the location of seeps, so aerial photographs can be used to screen for these features or for the frequent lateral expansion of deciduous trees that characterize them in association with stream channels. Once potential seeps are identified from aerial photographs, verification of their presence on the ground can be assisted through determining whether a series of hydric-soil-requiring plant species, a hydric footprint, or both exist on the ground. Disadvantage of the approach is that one must have knowledge of a relatively large suite of hydric-soil-requiring species, since no one plant species, or consistent small combination of plant species, is widespread enough across all seeps to serve as indicators. Furthermore, we do not currently know how many seeps may not be identified using this method, as some seeps may not be identifiable using aerial photography. Methods to identify headwater springs (a perennial initiation point analog) have been developed elsewhere.

Identified Gaps:
The method to identify seeps and its levels of error have not been verified either on a regional scale or in soft rock lithologies. Methods to identify alluvial fans have not been addressed.

Recommendations for Addressing Gaps:
The approach to seep identification and its levels of error need verification on a larger scale in hard rock lithologies and need to be tested in soft rock lithologies. The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies (see Type N Riparian Effectiveness Program) could be used to address some of these information gaps. Since on-the-ground reconnaissance at all sites identified all areas of non-channelized overland flow and categorized each as either meeting or not meeting rule definitions of seeps, we could use seep data to evaluate whether existing seeps are associated with canopy gaps identifiable from aerial photographs. Examination of soft rock lithologies is a lesser priority, at least from the amphibian viewpoint, because amphibian occupancy and abundance on such lithologies appears more limited.

6.2.3 Type N Riparian Effectiveness Program

The effectiveness of the Type N riparian management prescription package is uncertain because there are many gaps in the scientific understanding of headwater streams, their aquatic resources, and the response of riparian stands, amphibians, water quality, and downstream fish populations to different riparian management strategies. Consequently, prescriptions are based on assumptions that have been neither thoroughly studied nor validated. This program is ranked first among the 16 CMER programs. This program has been divided into two sections, one for the westside and one for the eastside, due to differences in the prescriptions and critical questions, which lead to unique program strategies.

Program Strategy (Westside)

The purpose of this program is to evaluate the westside Type N riparian management prescriptions, including response of riparian vegetation, growth and mortality of buffer trees, level of riparian functions provided, biotic and water quality responses to prescriptions (both within the Type N system and in downstream fish-bearing waters), and the prescriptions' effectiveness in achieving performance targets and meeting water quality standards. Critical questions for this program, along with the projects designed to answer them, are shown in Table 9.

Three CMER projects are currently underway to evaluate the effectiveness of the westside Type N riparian prescriptions. These projects utilize different but complementary approaches to inform adaptive management. The Westside Type N Buffer Characteristics, Integrity, and Function (BCIF) Project examines a random sample of westside Type N forest practices applications (FPAs) after harvest to evaluate the performance of Type N prescriptions as they are applied operationally over the range of conditions occurring in the FP HCP landscape. The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies and Type N Experimental Buffer Treatment Study in Soft Rock Lithologies focus on aquatic resource response to Type N prescriptions in streams with competent (i.e., less erodible, or hard rock) lithologies and relatively incompetent lithologies, respectively, in western Washington. Both studies utilize a manipulative experimental design that compares the effectiveness of the riparian buffers left in harvested watersheds to unharvested control sites. The Type N Experimental Buffer Treatment Study in Soft Rock Lithologies serves as a companion study to the Hard Rock study. The Soft Rock study provides important confirmation of the effect of forest practices prescriptions on the more erodible substrates that were not included in the Hard Rock study.

Table 9. Type N Riparian Effectiveness Program - Westside: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
How do survival and growth rates of riparian leave trees change following Type Np buffer treatments?	Westside Type N Buffer Characteristics, Integrity, and Function (BCIF) Project Type N Experimental Buffer Treatment Projects (hard and soft rock lithologies)
Are riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, litter fall, and amphibians?	Westside Type N Buffer Characteristics, Integrity, and Function (BCIF) Project Type N Experimental Buffer Treatment Projects (hard and soft rock lithologies). *The soft rock project does not include amphibians or litterfall*
How do other buffers compare with the forest practices Type N prescriptions in meeting resource objectives?	Type N Experimental Buffer Treatment Projects (hard rock lithologies). *The soft rock project tests only the forest practices rule buffer, no alternative buffers.*
How do the Type N riparian prescriptions affect water quality delivered to downstream Type F/S waters?	Type N Experimental Buffer Treatment Projects (hard and soft rock lithologies). *The soft rock project does not include fish.*
What is the frequency and distribution of windthrow in forest practices buffers? What site and habitat conditions are associated with sites with significant blowdown?	Westside Type N Buffer Characteristics, Integrity, and Function (BCIF) Project Type N Experimental Buffer Treatment Projects (hard and soft rock lithologies) Windthrow Frequency, Distribution, and Effects Project
Are forest practices riparian prescriptions effective at protecting groundwater flow and temperature?	No project identified
Are the Type N performance targets valid and meaningful measures of success in meeting resource objectives	No project identified
What is the effect of buffering or not buffering spatially intermittent stream reaches in Type Np streams?	No project identified

Westside Type N Buffer Characteristics, Integrity, and Function (BCIF) Project

Description:

The Westside Type N Buffer Characteristics, Integrity, and Function Project is designed to evaluate the effectiveness of the westside Type N riparian prescriptions, including survival of buffer leave trees, stand condition and trajectory over time, and changes in riparian functions, including shade, LWD recruitment, and soil disturbance/stream-bank protection. A random sample of 15 Type Np treatment sites were selected from forest practices applications (FPAs) and paired with unharvested reference sites to provide an unbiased estimate of the magnitude of change following application of the clear-cut and 50-ft buffer prescriptions. Data were also collected on the PIP buffer prescription.

Status:
Initial post-harvest sampling at 15 treatment/reference pairs in the western Washington western hemlock zone strata was initiated in the fall of 2003. Post-harvest low altitude photography and field measurements of canopy conditions were collected in 2004. After a pilot project to evaluate feasibility of aerial photography, RSAG determined that field data were needed to accomplish the project objectives. Field data on riparian stand conditions, fallen trees, LWD recruitment, shade, channel wood loading, and soil disturbance from windthrown trees was collected. Field data were collected three and five years after timber harvest in the summer/fall of 2006 and 2008. A draft report was submitted for ISPR in October 2010. The report was revised to address ISPR comments and the final report was approved by RSAG and CMER in December 2011. The ten year post harvest data collection effort was completed in the summer of 2013.

Type N Experimental Buffer Treatment Project in Hard Rock Lithologies

Description:
This study is a field experiment that assesses the effects of three riparian buffer strategies (compared to unharvested reference basins) on amphibians, water quality, and exports of nutrients, detritus, macroinvertebrates and suspended sediment, and downstream fish populations. The BACI (before-after/ control-impact) study design includes randomized blocks, with sites assigned to one of four treatments. reference. Pre- and post-harvest data on variables such as amphibian populations, riparian stand characteristics, tree mortality and LWD recruitment, shade and stream temperature, litterfall, light, stream flow, water chemistry, particulate and invertebrate export, primary productivity, and stream-bank erosion have been collected. Data on downstream effects on water quality and fish populations have been collected, where possible, and will also be assessed. Study sites are limited to basins with basalt or other hard rock lithologies where the target amphibian species are more likely to be found.

Status:
The study plan for this project has gone through ISPR and has been approved by CMER. Site selection site setup, and hree years of pre-harvest sampling have been completed, including one year of sampling in 2008 which was added due to a large windthrow event that impacted several sites. Harvest treatments began in April 2008 and most were completed by September 2009. However, due to the economic recession beginning in 2008, harvest in two sites were not applied. As a result the 100% treatment site in the South Cascade Block was eliminated from the study, and the FP treatment site in Willapa 2 Block was maintained as a second reference within that block. Two years of post-harvest sampling occurred in 2009 and 2010, except for the 0% treatment site in the Olympic Block where harvest treatment wasn't completed until late August 2009. Therefore, summer 2010 and 2011 are the first and second years, respectively, of post-harvest sampling for stream temperature in this site. Water quality data through October 2011 have gone through QA/QC and are stored in databases. Based on preliminary analyses of the data collected through August 2011, stream temperature, riparian cover, stream flow, and turbidity will continue to be measured through 2014.

Drafts of Chapters 1 through 6, 8, and 9 have been submitted to CMER for review. Chapter 13 is currently under PI review. All chapters, except Chapter 17-Conclusions, are expected to be submitted by June 2014 to CMER for review.

Additional post-harvest sampling was completed in spring and summer 2013, five years after harvest treatments were implemented. During this time riparian stand characteristics were evaluated in all vegetation plots, and stream metrics and woody debris were sampled in all stream plots. These data will be shared in an addendum to the original report that is currently under development. A later period of post-harvest sampling, including the above-mentioned response variables as well as water quality and amphibian demographics and genetics, is recommended between FY 2015 and 2019, with exact timing dependent on harvest plans for reference sites. Amphibian genetics sampling during this proposed period is necessary for post-harvest amphibian genetics sampling, the timing of which requires generational turnover of the focal amphibian species. The intent for including the remaining variables would be to complete another period of sampling across the entire group of original response variables prior to the loss of reference sites to harvest. Data from this latter sampling period would also be shared in an addendum to the original report.

Type N Experimental Buffer Treatment Project in Soft Rock Lithologies

Description:
This study is a field experiment analogous to the Hard Rock Project but implemented on more erodible (soft rock, largely marine sedimentary) lithologies. This project differs from the Hard Rock Project in that it:

- employs a Multiple Before-After/Control-Impact (but multiple control sites),
- tests only the forest practices rule buffer treatment; no alternative buffers are tested,
- does not include any amphibian, fish, litterfall, or drift measurements,
- includes benthic macroinvertebrate sampling rather than macroinvertebrate drift..

Status:
A grant from the Environmental Protection Agency (EPA) was awarded to the Department of Ecology in October 2010 that will partially fund the design and implementation of the soft rock lithologies project. The Quality Assurance Project Plan is complete and was published in September 2011 (http://www.ecy.wa.gov/biblio/1103109.html).

Site selection was completed in August 2012 and temperature monitors installed. Woody debris, channel dimensions, stream cover, and substrate size class measurements have been completed. Montana flumes were installed in four basins by Oct 9, 2012 to measure stream flow. Stage height and turbidity measurements began in January 2013.

Stream temperature data were downloaded as scheduled in spring and fall 2013. Channel measurements and riparian vegetation data were completed in summer 2013. Harvest is scheduled to begin in 2014.

Windthrow Frequency, Distribution, and Effects Project

Description:
Preliminary results of the Westside Type N BCIF Project indicate that windthrow mortality in westside Type N buffers is widespread. Many land managers have observed this as well. In response to this concern, RSAG plans to scope the inclusion of a windthrow assessment into existing Type N riparian projects.

Status:
To be scoped within existing Type N riparian projects.

Link to Adaptive Management

The following section looks at each rule group critical question for the Type N Riparian Effectiveness Program for western Washington. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. "Knowledge gained" is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is described. For this program, there are four CMER projects listed (see Table 9) for answering specific critical questions. The Westside Type N Buffer Characteristics, Integrity, and Function (BCIF) Project has been completed and has an approved final report. The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies is in the data-analysis and report-writing phase and should be complete in 2015. Though most of the initial post-harvest sampling for this study was completed in 2012, the amphibian genetic portion of post-harvest sampling cannot be initiated until 2016. The Type N Experimental Buffer Treatment Project in Soft Rock Lithologies is in the site selection phase. And finally, the Windthrow Frequency, Distribution, and Effects Project has been put on hold by Policy, with direction that windthrow studies should be scoped within existing Type N riparian projects. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained or anticipated, identified gaps, and recommendations for addressing those gaps.

How do survival and growth rates of riparian leave trees change following Type Np buffer treatments?

Knowledge Gained or Anticipated:
The Westside Type N Buffer Characteristics, Integrity, and Function (BCIF) Project is completed. It compared riparian areas harvested under the westside Type Np prescriptions with unharvested reference sites. Three treatments were evaluated for five years after harvest, including 50-ft buffers, perennial initiation point buffers, and clear-cuts. Tree mortality was greater than in-growth for all treatments and reference stands. During the first three years after harvest, the mean percentage of live trees that died per year in the 50-ft buffers was 3.5 times that of the reference patches, a statistically significant difference. Wind was the dominant mortality agent in the 50-ft buffers, while suppression mortality exceeded wind mortality in the references reaches. During years 4-5 after harvest, the difference between mortality rates for the 50-ft buffers and reference patches was not significant due to increased mortality in the reference reaches in response to a high intensity wind storm. The cumulative percentage of live trees that died over the entire five-year period was 27% in the 50-ft buffers compared to 14% in the reference reaches, but the difference was not statistically significant. Tree mortality rates for the 50-ft buffers were variable and the distribution was bimodal. Ten of 15 50-ft buffer patches had mortality rates of <33% (mean = 15%), while the remaining three had mortality in excess of 50% (mean = 68%). This resulted in a substantial difference in stand density after 5 years (140 vs. 63 trees/acre). The clear-cut patches had few trees remaining after harvest (mean = 12.5 trees/acre),

and a mortality rate of 50% for the remaining trees over the five-year period. The three PIP buffers had a higher mean mortality (53%) than the 50-ft buffers.

The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies is in the data-analysis and report writing phase. The comparable project in soft rock lithologies could be implemented as early as the summer of 2012. Once completed, these studies will provide information on post-harvest changes in riparian stand conditions and tree mortality for harvested Type Np basins treated with three experimental treatments in comparison to unharvested basins. Data on riparian vegetation (i.e., density, diameter, species, wood recruitment, etc.) will be collected to determine the effects of treatments on stand composition, tree growth, and mortality.

Identified Gaps:
Determination of riparian leave tree growth rates and tree mortality rates following Type Np buffer treatments requires long-term monitoring beyond the five year post-harvest time frame of the Westside Type N BCIF Project and the two-year time frame of the Type N Experimental Buffer Treatment Projects in Hard and Soft Rock Lithologies.

In the Westside Type N BCIF Project, sample size for perennial initiation point (PIP) buffers was low (3), so data from a larger sample would be useful to confirm and expand the findings of the Westside Type N BCIF Project (this gap will be addressed in part by the Type N Experimental Buffer Treatment Projects in Hard and Soft Rock Lithologies).

Recommendations for Addressing Gaps:
Continue to monitor riparian stand conditions and tree mortality over a longer time frame at the Westside Type N BCIF and Type N Experimental Buffer Treatment in Hard Rock Lithologies study sites. Conduct additional literature review. Consider the potential use of models if appropriate.

Analyze data on PIP buffers from the Hard Rock Project. Collect data on buffer tree mortality associated with PIP buffers (and other buffer types) in the proposed Soft Rock Project. Consider collecting additional data on stand conditions and tree mortality on a wider range of PIP buffers if necessary.

Are riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, litter fall, and amphibians?

Knowledge Gained or Anticipated:

Shade

The Westside Type N BCIF Project evaluated two types of cover that provide shade and thermal buffering for stream channels: overhead shade (e.g., trees and tall shrubs) and shade from live understory plants. One year after harvest, mean overhead shade was lower in the 50-ft buffer streams (76%) than in the reference patches (89%). Five years after harvest, overhead shade increased in the 50-ft buffers (mean = 80.6%) and was about 10% less than in the reference patches. The differences between the 50-ft buffers and the reference patches were statistically

significant for all sample events. The ten 50-ft buffers with <33% mortality had 86.9% overhead shade, while 50-ft buffers with mortality >50% had mean overhead shade of 59.3%. Mean overhead shade in the PIP buffers was about 20% less than in the 50-ft buffers throughout the study period. Mean overhead shade in the clear-cut streams was 12% one year after harvest, but increased to 37% five years after harvest in response to growth of shrubs and saplings. The differences between the clear-cut and reference patches were statistically significant for all sample events.

The mean percentage of understory cover after harvest in the 50-ft buffers was consistently about double that of the reference patches for all sampling events. The differences were statistically significant, but may have existed prior to harvest. Mean understory cover in the clear-cut patches increased from 18% in year one post-harvest to 41% in year five, due to growth of streamside shrubs and plants following clear-cut harvest. The value in year five was over 2.5 times the reference value, a statistically significant difference.

The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will compare differences in shade between the treatment buffers and corresponding reference sites. A draft report is due to the SAG by June 2013. Similar data are being collected in the Soft Rock Project.

Stream Temperature

The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies has monitored stream temperature at 30-minute intervals at fixed stations within each Type N site through two years pre-harvest, and five years post-harvest at all sites but one (due to delayed harvest, this site has four years post-harvest data). An analysis of data through summer 2011 shows statistically significant increases in daily maximum stream temperature at many locations in multiple sites. The effect persists into the second year post-harvest. This draft report is due in 2013. The Soft Rock Project has collected similar data since summer 2012, but will test only the forest practices rule buffer, no alternate prescriptions.

LWD Recruitment

The Westside Type N BCIF Project evaluated the volume of large woody debris recruited to the stream channel and the percentage of the channel covered by woody debris of all sizes. The difference between the mean volume of large woody debris recruited in the 50-ft buffers and the reference patches was statistically significant for years 1-3 after harvest (8 times the reference rates) and for the entire first five years after harvest (3 times the reference rate. The rate for buffers with >50% mortality was over 6 times the rate for buffers with 33% mortality (mean = 437 vs. 64 ft^3/acre/yr). The LWD recruitment rate for the PIP buffers (mean = 68 ft^3/acre/yr) was over twice the rate for the 50-ft buffers. LWD recruitment for the clear-cut patches was very low for all sampling periods, because few trees were available to fall and recruit wood to the stream. However, the clear-cut stream channels received a large input of broken stems and branches during harvest, as reflected in the high values for total woody debris cover in post-harvest sampling. Total debris cover in the clear-cut reaches five years after harvest (mean = 51%) was nearly double the reference patch value, a statistically significant difference. In contrast, the percentage of total debris cover in the 50-ft buffers was not significantly different than for the reference patches.

The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will compare LWD recruitment rates and processes from riparian stands following the various prescription treatments with rates and functions in the unharvested reference sites. Characteristics of fallen trees (i.e., species, diameter, distance from stream, etc.) and functions of LWD are being assessed. The Hard Rock Project also documented changes in LWD loading and will relate LWD loading to net changes in sediment storage in the channel. The Soft Rock Project is collecting similar data.

Litter Fall

Litter fall deposition is being measured year-round at eight of the study sites within the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies, in conjunction with sampling downstream export of detritus and macroinvertebrates. Changes in the quantity and quality of litter fall may affect the number and type of macroinvertebrates and detritus exported downstream.

Amphibians

Within the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies, amphibians were sampled to identify potential treatment-specific changes in density and species richness over the short term and will be sampled to identify potential changes in genetic diversity and persistence over the longer term.

Identified Gaps:

The length of the initial post-harvest monitoring for riparian tree survival and large wood recruitment for the Westside Type N BCIF Project (five years) is too short to determine long-term changes in riparian stands and functions in response to the treatments or to determine the duration of impacts. The scope of the Westside Type N BCIF Project was limited to documenting the magnitude of change in riparian stand condition and riparian processes at a reach or harvest-unit scale. The channel, water quality, and aquatic resources response to the westside Type N prescriptions will be studied in the Type N Experimental Buffer Treatment Project. Neither the Westside Type N BCIF Project nor the Type N Experimental Buffer Treatment Project were designed to assess the relative frequency and spatial distribution of the Type Np buffer and clear-cut treatments across FP HCP lands (this information would be collected by the proposed Extensive Riparian Status and Trends Monitoring - Vegetation, Type Np Westside and Eastside Projects). Neither study was designed to assess how the nature and magnitude of disturbance and recovery processes triggered by the prescriptions are influenced by physiographic, vegetation, and climatic factors.

Recommendations for Addressing Gaps:

Based on the results of the first two years post-harvest, an effort should be made to continue monitoring critical variables over the long term. For example:

- Continue to monitor stream temperature in the Type N Experimental Buffer Treatment Project until temperatures return to pre-harvest levels or until reference basins are no longer available for study.
- Continue to monitor windthrow, shade, and LWD recruitment.

The greatest potential limitation to long-term monitoring is that cooperators only guaranteed the unharvested reference sites through eight years post-harvest (equivalent to one generation for stream-associated amphibians, to allow post-harvest amphibian genetic sampling). Of six references, we know of three that will likely be harvested between CY 2016 and 2019; therefore, if harvested treatments are tracked later into the rotation, a new set of reference units may be required. Maintenance of the remaining references basins in their unharvested condition is more likely, as two of these basins are located on Federal lands and one is a state-owned site located within favorable Marbled Murrelet habitat.

How do other buffers compare with the forest practices Type N prescriptions in meeting resource objectives?

Knowledge Gained or Anticipated:
Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will compare forest practices Type N prescriptions (50% of stream buffered) to treatments with 100% buffered and 0% buffered, and unharvested references. Results are pending a June 2013 draft report.

Identified Gaps:
The final report is currently in development.. Gaps have not yet been identified.

Recommendations for Addressing Gaps:
The final report is currently in development. No gaps have yet been identified.

How do the Type N riparian prescriptions affect water quality delivered to downstream Type F/S waters?

Knowledge Gained or Anticipated:

Fish
Within the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies, six sub-basins in the southern Olympics and Willapa Hills are being assessed for fish response to riparian harvest along the upstream Type N stream channels. These sites are also being sampled for flow, material export, litter fall, periphyton, and temperature. These sites will offer an opportunity to conduct case studies that provide insight into fish response under different treatment conditions. Because of the low number of available sites, the fish portion of the study was removed from the repeated measures analysis of variance design used for other segments of the study.

Downstream Water Quality
Within the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies, export data (i.e., flow, water chemistry, drift, litter fall) are being collected on two complete blocks (one in the Olympics and one in the Willapa Hills). Water temperature is being monitored at all sites, including the type N/F confluence.

Within the Type N Experimental Buffer Treatment Project in Soft Rock Lithologies, export data (i.e., flow, suspended sediment, nutrients) will be collected at four sites. Water temperature will be monitored at all sites from the Type N/F junction upstream to the PIP.

Identified Gaps:
Results are pending. No gaps have yet been identified.

Recommendations for Addressing Gaps:
Results are pending. No gaps have yet been identified.

What is the frequency and distribution of windthrow in forest practices buffers? What site and habitat conditions are associated with sites with significant blowdown?

Knowledge Gained or Anticipated:
The Westside Type N BCIF Project documented windthrow rates for riparian areas where the Westside Type Np prescriptions were applied. Mortality associated with wind accounted for 29% of the mortality in reference patches, 50% of mortality in the 50-ft buffer patches, and 87% of the mortality in PIP buffer patches. In the first three years following harvest, there were four windstorms of moderate intensity (40-60 mph peak windspeed). During this period, mortality rates in the 50-ft buffers (mean = 7%/yr) were three times those in the reference patches, indicating the vulnerability of newly established buffers to wind damage. However, in years 4-5 after harvest, there were three windstorms with windspeeds ≥ 60 mph, including one of the strongest windstorms on record. During this period, mortality rates increased in the reference patches and were not significantly different from those in the 50-ft buffers.

The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will provide data on windthrow rates for three Type N treatments and compare them with windthrow rates for unharvested reference basins. It will also provide additional data on windthrow in PIP buffers to augment the limited sample in the Westside Type N BCIF study.

Identified Gaps:
Neither the Westside Type N BCIF Project nor the Type N Experimental Buffer Treatment Project were designed to assess the frequency or distribution patterns of windthrow in forest practices buffers across the landscape. The Westside Type N BCIF Project determined that windthrow rates in PIP buffers and some 50-ft buffers were elevated above the reference rates; but the sample size was small for the PIP buffers, and the duration of the studies was not long enough to determine whether the remaining trees will remain standing over time.

Neither project addresses the question: *What site and habitat conditions are associated with sites with significant blowdown?*

Recommendations for Addressing Gaps:
The Type N Experimental Buffer Treatment Project will add to the sample from the Westside Type N BCIF Project, increasing the amount of data on windthrow in PIP buffers and 50-ft buffers. Longer-term monitoring at the existing study sites will inform how windthrow rates change over time. The proposed Windthrow Frequency, Distribution, and Effects Project would

address the frequency and distribution of windthrow in buffers; however, at the direction of Policy, scoping was put on hold until windthrow data from existing Type N riparian projects could be evaluated. A number of publications and windthrow hazard models also exist from which we can draw information.

Are the Type N performance targets valid and meaningful measures of success in meeting resource objectives?

Knowledge Gained or Anticipated:
No projects are yet identified to address this question.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

What is the effect of buffering or not buffering spatially intermittent stream reaches in Type Np streams?

Knowledge Gained or Anticipated:
No projects are yet identified to address this question.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

Are forest practices riparian prescriptions effective at protecting groundwater flow and temperature?

Knowledge Gained or Anticipated:
No projects are yet identified to address this question.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

Program Strategy (Eastside)

The purpose of the eastside program is to evaluate Type N riparian management prescriptions, including response of riparian vegetation, growth and mortality of buffer trees, level of riparian functions provided, biotic and water quality responses to prescriptions (both within the Type N system and in downstream fish-bearing waters), and the prescriptions' effectiveness in achieving performance targets and meeting water quality standards. Critical questions for this program, along with the projects designed to answer them, are shown in Table 10.

RSAG was overseeing a project called Eastside Type N Buffer Characteristics, Integrity and Function (BCIF) Project. As part of the project, RSAG intended to examine a random sample of eastside Type N riparian forest practices applications (FPAs) to evaluate the performance of Type N prescriptions as they were applied operationally over the range of eastside Type N streams. However, this study has been placed on hold due to a lack of suitable study sites.

The Eastside Type N Forest Hydrology Project developed by SAGE contains a series of studies that will examine eastern Washington headwater streams with the final intent of effectiveness monitoring. Given the importance of flow as a transport mechanism between non-fish-bearing and fish-bearing streams and the unique functions these streams exhibit, SAGE decided that determining the hydrology of Type N streams would be the first step in laying the groundwork for additional studies. By understanding forest hydrology we will better understand spatially intermittent reaches and where they are likely to occur across eastern Washington, thus providing additional information to help correctly delineate the Type Np/Ns break.

A Technical Writing and Implementation Group (TWIG) was formed in 2013 to develop options for addressing questions related to the effectiveness of riparian prescriptions for non-fish bearing (Type N) streams in eastern Washington. This study (ENREP) is needed to determine if, and to what extent, the prescriptions found in the Type N Riparian Prescriptions Rule Group are effective in achieving performance targets and water quality standards, particularly as they apply to sediment and stream temperature in eastern Washington.

Table 10. Type N Riparian Effectiveness Program - Eastside: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions		Project Names	SAG
How do survival and growth rates of riparian leave trees change following Type Np buffer treatments?		Eastside Type N Buffer Characteristics, Integrity and Function (BCIF) Project	RSAG
Are riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, litter fall, and amphibians?		Eastside Type N Riparian Effectiveness Project	SAGE
Program Research Questions	*What are the characteristics of eastern Washington Type N stream channels and riparian areas and how do they vary across eastern Washington?*	Eastside Type N Forest Hydrology Project	SAGE
	Do different types of Type N channels explain the variability in the response of Type N channels to forest practices?	Eastside Type N Riparian Effectiveness Project	
What is the effect of buffering or not buffering spatially intermittent stream reaches in Type Np streams?		Eastside Type N Riparian Effectiveness Project	SAGE TWIG

How do the Type N riparian prescriptions affect water quality delivered to downstream Type F/S waters?	No projects yet scoped	SAGE
Are forest practices riparian prescriptions effective at protecting groundwater flow and temperature?	No projects yet scoped. (See Groundwater Conceptual Model Project)	UPSAG RSAG SAGE WetSAG

Eastside Type N Buffer Characteristics, Integrity, and Function (BCIF) Project

Description:
The Eastside Type N Buffer Characteristics, Integrity, and Function (BCIF) Project, managed by RSAG, is designed to evaluate the effectiveness of the eastside Type N riparian prescriptions, including survival of buffer leave trees, stand condition and trajectory over time, and changes in riparian functions, including shade, LWD recruitment, and stream-bank protection. RSAG proposes to examine a random sample of eastside Type N riparian FPAs to evaluate the performance of Type N prescriptions as they are applied operationally over the range of eastside Type N streams.

Status:
RSAG attempted to implement this project in 2004 and again in 2006, but was unable to find an adequate number of study sites because there were very few FPAs where landowners proposed to apply the eastside Type N prescriptions. Most landowners opted to simply stay out of the 50-ft Type N management zone rather than implement the thinning or patch-cut prescription. RSAG documented these findings in a series of memos. Due to the lack of suitable study sites, this study has been placed on hold.

Eastside Type N Forest Hydrology Project (FHS)

Description:
The Eastside Type N Forest Hydrology Project was designed to determine the spatial characteristics of late summer surface-water discharge across eastern Washington FP HCP lands whether there were a set of readily identified external characteristics that could be used to group and/or remotely identify stream reaches that exhibit similar hydrologic characteristics..
*Status:*The Eastside Type N Forest Hydrology Project study design was approved by CMER in December 2009. Field work was completed in 2012. Data analysis and report writing is expected to be completed in early 2014.

Eastside Type N Riparian Effectiveness Project

Description:
The study will determine if, and to what extent, the prescriptions found in the Type N Riparian Prescriptions Rule Group are effective in achieving performance targets and water quality standards, particularly as they apply to sediment and stream temperature in eastern Washington. A TWIG (Technical Writing and Implementation Group) was formed to identify critical questions, review the best available science, and recommend an approach to the study design.

The objectives of the ENREP study are to: 1) quantify the magnitude of change in stream flow, canopy closure, water temperature, suspended sediment transport and wood loading within eastern Washington riparian management zones (RMZ) following harvesting within current rule constraints, and 2) evaluate the effects of these changes on downstream waters where possible.

Status:
The Forest Policy Committee recently approved the following Technical Writing and Implementation Group's recommendations:

1. Develop a BACI study design on Eastern Washington spatially continuous Type Np streams. TWIG should consider in the development of the study design:
   - Alternative harvest strategies within current rule constraints
   - Effects on downstream Type F waters, including downstream temperature response
   - Longer time period
2. Collect further information on Eastern Washington Type Np basins with spatially discontinuous surface flow that will assist the TWIG in developing a study design that could test the effect of buffering or not buffering spatially intermittent stream reaches on Type Np streams. Policy requests the TWIG to report back after the collection of further information prior to developing study design (briefing, not decision item).

Link to Adaptive Management

The following section looks at each rule group critical question for the Type N Riparian Effectiveness Program - Eastside. Knowledge gained, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The critical questions are listed in bolded italics. "Knowledge gained" is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is addressed. For this program, there are four rule group critical questions (Table 10). The program research questions shown in the table were developed to supplement the first two rule group critical questions. Three projects, which are not yet complete, are identified to address the first two rule group critical questions and the Program Research questions. No projects are yet identified or scoped for addressing the last two critical questions. As projects and associated final reports are completed within this program, this section will be updated to better address the knowledge gained, identified gaps, and recommendations for addressing those gaps.

How do survival and growth rates of riparian leave trees change following Type Np buffer treatments?

Knowledge Gained or Anticipated:
One project was identified to address this critical question, the Eastside Type N Buffer Characteristics, Integrity and Function (BCIF) Project; however, the project is currently on hold

due to the infrequent application of the eastside Type N harvest prescription. This study was designed to evaluate the survival of buffer leave trees and trajectory of stand conditions over time.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

Are riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, litter fall, and amphibians?

Knowledge Gained or Anticipated:
Two projects are identified that would address this critical question (the Eastside Type N BCIF Project and the Eastside Type N Riparian Effectiveness Project). As mentioned above, the Eastside Type N BCIF Project is currently on hold but, if implemented, would help to address changes in riparian functions, including shade, LWD recruitment, and stream-bank protection. The Eastside Type N Riparian Effectiveness Project (currently being scoped) will help to address how the current rules are protecting water quality and riparian function.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

What are the characteristics of eastern Washington Type N stream channels and riparian areas and how do they vary across eastern Washington?

Knowledge Gained or Anticipated:
The Eastside Type N Forest Hydrology Project will help determine what the spatial and temporal characteristics of base flow surface-water discharge are across eastern Washington FP HCP lands. It will also help determine what landforms and/or independent physical attributes are related to the different flow characteristics. Perennial initiation point (PIP) locations will also be collected, which may provide additional data to the results of the 2002 PIP surveys.

Identified Gaps:
The forest hydrology study will not address stream functions or how various flow characteristics are supposed to behave in a properly functioning condition. The initial survey will not show temporal variability of stream flow. Other gaps have not been identified at this time.

Recommendations for Addressing Gaps:
A second phase of the forest hydrology study will look at spatial and temporal distributions of in-stream flow attributes.

Do different types of Type N channels explain the variability in the response of Type N channels to forest practices?

Knowledge Gained or Anticipated:
The variability in response of Type N channels to forest practices may be addressed through ENREP.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

How do the Type N riparian prescriptions affect water quality delivered downstream to Type F/S waters?

Knowledge Gained or Anticipated:
ENREP is expected to quantify the effect of Forest Practices on sediment and temperature delivery to downstream waters.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

What is the effect of buffering or not buffering spatially intermittent stream reaches in Type Np streams?

Knowledge Gained or Anticipated:
No projects are yet identified to address this question.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

Are forest practices riparian prescriptions effective at protecting groundwater flow and temperature?

Knowledge Gained or Anticipated:
No projects are yet identified to address this question.

Identified Gaps:

Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

6.2.4 Type N Amphibian Response Program (Effectiveness)

Program Strategy

The restricted distribution of stream-associated amphibians (SAAs) and the lack of information about them required development of an amphibian response strategy that differs from that of many other rule groups or programs. The Type N Amphibian Response Program began with development of tools needed to implement the Type N buffer rule for sensitive sites (i.e., SAA sensitive sites identification methods and characterization) and procedures to detect and determine the relative abundance of SAAs for monitoring purposes. During this time, other projects designed to determine critical monitoring questions for some species (i.e., tailed frog literature review and meta-analysis) or to answer species-specific L-1 questions were undertaken (i.e., Dunn's and Van Dyke's salamanders). This program is administered by LWAG. This program is ranked third among the 16 CMER programs.

The restricted distribution of SAAs and uneven abundance limited the amphibian response program. LWAG determined that an extensive monitoring project for SAAs would not provide useful information for the Forest Practices Adaptive Management Program, and cooperation with other monitoring projects was not possible. LWAG concluded that any monitoring program must focus on those physical factors (e.g., geology) that appear to affect SAA distribution, abundance, and response to timber harvest (i.e., the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies).

The purpose of this program is to addresses critical questions about the response of SAAs to forest practices, particularly the Type N riparian prescriptions. Many uncertainties exist about the distribution of SAAs; their life history, habitat-utilization patterns, and population dynamics; and the effects of forest practices on SAA habitats and the response of SAA populations to these changes. Consequently, the Type N riparian rule is based on the assumption that buffering of perennial Type N streams around "sensitive" sites (sites thought to provide high-quality SAA habitat) will maintain the viability of SAA populations. These assumptions and uncertainties have been examined and used to develop a series of subquestions under the main critical question (Table 11).

Table 11. Type N Amphibian Response Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions		Project Names
Is stream-associated amphibian (SAA) population viability maintained by the Type N prescriptions?		
Program Research Questions	*Do SAAs continue to occupy and reproduce in the patch buffers?* *Do SAAs continue to occupy and reproduce in the equipment limitation zone (ELZ)–only reaches?* *If SAAs do not continue to occupy the ELZ-only reaches, do they re-occupy those reaches before the next harvest?* *How does SAA habitat respond to the sensitive site buffers?* *How does SAA habitat respond to variation in inputs, e.g., sediment, litter fall, wood?* *How do SAA populations respond to the Type N prescriptions over time?*	SAA Detection/Relative Abundance Methodology Project Type N Experimental Buffer Treatment Project in Hard Rock Lithologies
	What are the common findings and inconsistencies in published studies on the effects of timber harvest on tailed frogs? *What can be learned from a meta-analysis of published data and unpublished data on tailed frogs in managed forests?* *Are published generalizations on the relationship between parent geology and tailed frog abundance correct and consistent?*	Tailed Frog Literature Review Project Tailed Frog Meta-Analysis Project Tailed Frog and Parent Geology Project
	What are the common findings and inconsistencies in published studies on the habitat associations of Dunn's and Van Dyke's salamanders? *Does territoriality confound interpretation of SAA relative abundance in relation to specified habitats?*	Dunn's Salamander Project Van Dyke's Salamander Project
	What are the effects of various levels of shade retention on the stream-breeding SAAs? *Is there an optimum level of shade retention?*	Buffer Integrity - Shade Effectiveness Project
	What are the effects of three buffer treatments on SAAs two years post-harvest?	Amphibian Recovery Project Type N Experimental Buffer Treatment Project in Hard Rock Lithologies
	How do SAAs utilize intermittent stream reaches at or near the origins of headwater streams?	Amphibians in Intermittent Streams Project
	Does sufficient SAA-occupied area exist in Eastside managed lands that is under FFR jurisdiction to justify study attention?	Eastside Amphibian Evaluation Project

In response to a review of the Type N research program, the TFW Policy Committee developed and approved a Type N Research Strategy that included some additional Critical Questions for the Amphibian Response Program. These questions were developed in consultation with LWAG representation, and approved by CMER as part of the Type N Strategy. CMER has not yet built these questions into this section of the workplan, and will attempt to do so before the plan is next revised:

1. What is the range of conditions (temperatures, time periods, etc.) at which amphibian surveys should occur?
2. How should changes in detection across soil and air temperature ranges affect use of previously completed studies?
3. Does the distribution of SAA on Forests and Fish lands across Eastern Washington warrant inclusion in CMER effectiveness research?
4. How does large wood and decay class affect the distribution and abundance of Van Dyke's?
5. How do site specific factors (e.g., streams dominated by ground water) affect abundance and condition of amphibian populations?
6. What is the effect of road generated sediment on in-stream amphibians?
7. What is the effect of fertilizer and herbicides applied as a silvicultural treatment on the health of amphibians?

SAA Detection/Relative Abundance Methodology Project

Description:
The SAA Detection/Relative Abundance Methodology Project is designed to evaluate and develop a standard methodology for sampling SAAs in headwater forest streams. It addresses the need for a research/monitoring methodology to detect amphibians and determine their relative abundance. The most widely used methods produce high-variance estimates, and detection probabilities are unknown.

Status:
This project was completed in 2006. A journal publication gives details of the findings of this project.

Type N Experimental Buffer Treatment Project in Hard Rock Lithologies

Description:
This study is a field experiment that assesses the effects of three riparian buffer strategies (compared to unharvested reference basins) on amphibians, water quality, and exports of nutrients, detritus, macroinvertebrates and suspended sediment, and downstream fish populations. The study design includes randomized blocks that include sites assigned to one of four treatments, including references. Pre- and post-harvest data on variables such as amphibian populations, riparian stand characteristics, tree mortality and LWD recruitment, shade, stream temperature, litterfall, stream flow, water chemistry, detritus and invertebrate export, primary productivity, and stream-bank erosion have been collected. Data on downstream effects fish populations have been collected and will also be assessed where possible. Study sites are limited to basins with basalt or other hard rock lithologies where the target amphibian species are more likely to be found.

Status:
The study plan for this project has gone through ISPR and has been approved by CMER. Site selection, site setup, three years of pre-harvest sampling and two years of post-harvest sampling have been completed, including one year of sampling in 2008 which was added due to a large windthrow event that impacted several sites.

Harvest treatments began in April 2008 and most were completed by September 2009. However, due to the economic recession beginning in 2008, harvest treatments in two sites were not applied: the 100% treatment site in the South Cascade Block was eliminated from the study and the FP treatment site in Willapa 2 Block was maintained as a second reference within that block. Post-harvest sampling occurred in 2009 and 2010, except for the 0% treatment site in the Olympic Block for which harvest treatment application was not completed until late August 2009. Therefore, summer 2010 and 2011 are the first and second years, respectively, of post-harvest sampling. Based on analysis of the data collected through August 2010 showing a statistically significant increase in the daily maximum summer temperature in most harvested basins, stream temperature will be measured through April 2014.

Drafts of Chapters 1 through 6, 8 and 9 have been submitted to CMER for review. Chapter 13 is currently under PI review. All chapters, except Chapter 17 Conclusions, are expected to be submitted to CMER for review by June 2014.

Additional post-harvest sampling was completed in spring and summer 2013, five years after harvest treatments were implemented. During this time riparian stand characteristics were evaluated in all vegetation plots, and stream metrics and woody debris loading (including overall loading and counts and quantification of pieces) were sampled in all stream plots. These data will be shared in an addendum to the original report that is currently under development.

A later period of post-harvest sampling, including the above-mentioned response variables as well as water quality and amphibian demographics and genetics, is recommended between FY 2015 and 2019, with exact timing dependent on harvest plans for reference sites. Amphibian genetics sampling during this proposed period is necessary for post-harvest amphibian genetics sampling, the timing of which requires generational turnover of the focal amphibian species. The intent for including the remaining variables would be to complete another period of sampling across the entire group of original response variables prior to the loss of reference sites to harvest. Data from this latter sampling period would also be shared in an addendum to the original report.

Tailed Frog Literature Review Project

Description:
Of the seven FP HCP SAAs, the two tailed frog species may be the most extensively studied due to their wide distribution in the coastal Pacific Northwest. There are enough published studies on this species that a synthesis of those results will be useful in helping LWAG develop a research and monitoring program. A draft literature review was completed in 2011. The recent reclassification of the tailed frog into two species required the review to be restructured in midstream to reflect that taxonomic revision.

Status:
The draft review was completed in 2011. It was submitted to LWAG for review in December 2011 and it went to CMER in March 2012. It was approved to go to ISPR in October 2012. It was returned from ISPR review in June 2013. The final report is projected for finalization in January 2014.

Tailed Frog Meta-Analysis Project

Description:
Published data, as well as some that is not published, is being subjected to a meta-analysis that will relate tailed frog abundance with habitat conditions created by timber harvest. This analysis may or may not support the conclusions of the tailed frog literature review described above and will likely identify other factors related to tailed frog distribution and response to timber harvest that will be useful in developing the Type N Amphibian Response Program. The recent reclassification of the tailed frog into two species required the meta-analysis to be restructured in midstream to reflect that taxonomic revision.

Status:
The six data sets have been formatted, quality control has been completed, and the analysis is underway.

Tailed Frog and Parent Geology Project

Description:
Recent studies in managed forests have emphasized the relationship between parent geology, stream substrate composition, and tailed frog abundance. A general hypothesis has emerged that tailed frogs are most abundant in streams on lithologies that produce hard or competent rock (e.g., volcanic basalt) versus those that do not (e.g., marine sandstones). However, a study in Olympic National Park found that tailed frogs were abundant on both marine and volcanic parent material, and a recent broader regional study (2008) did not find a clear pattern with regard to lithologies. These studies were largely observational and the distinction between geologies was an extrapolated finding of the results. This proposed project would test the parent geology hypothesis throughout Washington.

Status:
This project has not been scoped and scoping efforts are currently on hold.

Dunn's Salamander Project

Description:
The FP HCP indicates that LWD may be important for Dunn's and Van Dyke's salamanders. However, general habitat descriptions for both these species emphasize the importance of streamside rocky substrates. A literature review to determine the basis for the LWD connection to these species was completed external to CMER in 2000. The initial field phase of this project, completed in cooperation with the Forest Service in 2001, was designed to provide additional information on the role of LWD in these species habitats. The initial field phase collected data across too few sites to complete an effective analysis, so a second phase of field data were collected in 2003.

Status:
Analysis of data from both phases has been completed and a peer-reviewed submittal ready final report approved by CMER in 2011. That manuscript is currently under revision.

Buffer Integrity - Shade Effectiveness (Amphibians) Project

Description:
Timber harvests result in two important immediate physical changes: reduction in shade levels and increased sedimentation. Since during harvests these changes are coupled, it is typically not possible to partition their respective contributions. Understanding their individual effects is important because sediment is suspected of having largely negative effects, whereas the effects of shade reduction have the potential to be positive. The Buffer Integrity - Shade Effectiveness Project provided the opportunity to examine the effects of reducing shade on a scale that minimizes sedimentation effects. This project examined the effects of three levels of shade reduction on SAA density, body condition, and spatial distribution, as well as water temperature, primary productivity, litter fall and macroinvertebrates. This is a cooperative project between Longview Timberlands LLC and CMER. Longview Timberlands LLC completed a pilot study in 2003 and initiated a broader study in 2004. The latitudinal breadth of this study was increased with CMER approval to include WDFW-monitored sites on the Olympic Peninsula. Though the original study was intended to address all major groups of SAAs (i.e., tailed frogs, torrent

salamanders, and giant salamanders), the region available for selection of the SAA-occupied sites on the eastern Olympia Peninsula lacked the giant salamander species — Cope's giant salamander — present on much of the peninsula. Hence, the Olympic portion of the study addressed only tailed frogs and torrent salamanders.

Status:
The first two years of pre-treatment sampling occurred in 2006 and 2007. Treatments were implemented during the winter of 2007–2008, and two years of post-treatment sampling were completed in 2008 and 2009. A draft report was completed in 2012, underwent CMER review, and went to ISPR in mid-2013, was revised and is pending final approval.

Amphibian Recovery Project

Description:
In 1998, the National Council for Air and Stream Improvement (NCASI) funded a study by Dr. Rhett Jackson on the effects of three buffer treatments on headwater streams in the Willapa Hills and Olympic Peninsula. Many of the FP HCP SAAs occurred on these sites. The NCASI funding covered a year of pre-treatment data and immediate post-harvest sampling. CMER funding allowed for the collection of an additional two years of post-harvest data.

Status:
This project was completed in 2003, and four journal articles have been published. One of the publications addresses amphibian response and contains information pertinent to the Type N Amphibian Response Program.

Amphibians in Intermittent Streams Project

Description:
This project seeks to provide an understanding of amphibian use of the stream segments exhibiting spatially discontinuous perennial flow that often occur at or near the origins of headwater streams. This project will provide information that will directly inform the efficacy of buffering these stream segments in terms of SAA occupancy and ecology. The study plan includes three phases: (1) an assessment of data collected under previous CMER-funded projects for data applicability to the project's goals and objectives; (2) an analysis of the data, if applicable, identified in Phase 1; and (3) based on the results of Phases 1 or 2, additional data will be collected if needed.

Status:
Phase 1 identified only 10 streams from previous LWAG-sponsored western Washington work with data appropriate to the project; thus LWAG determined there were not enough data to warrant undertaking Phase 2 and that Phase 3 should be implemented. Phase 3 scoping and study design has been completed. However, LWAG's re-evaluation of the need for this project has shifted it to a low priority status, given other LWAG projects deemed to be much higher in importance. For this reason, the project is currently being withheld from review by CMER until higher priority projects have been addressed. Data from the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies may inform the importance of revisiting this project.

Van Dyke's Salamander Project

Description:
The Van Dyke's salamander is the only one of seven Forests and Fish amphibian species that is not adequately addressed by any previous or current study. The Van Dyke's salamander is a former Survey and Manage Species under the Northwest Forest Plan; survey protocols under the Survey and Manage Program emphasize that Van Dyke's salamander is a stenothermic cool-adapted species and that conditions for sampling must fall under narrow moisture, relative humidity, and temperature ranges. Conflicting information exists regarding the occurrence of Van Dyke's salamander on managed landscapes (ranging from total absence to fairly broad distribution). At least part of the disparity observed in Van Dyke's salamander distribution across managed and unmanaged landscapes may be due to differential seasonal detectability that arises from the species' thermal requirements. A study is being considered to address Van Dyke's salamander distribution in three phases: (1) assemble available information to characterize current (and sometimes conflicting) information and define focal question(s); (2) develop a sampling tool, including seasonal (or thermal) sampling restrictions, that incorporates detectability estimation approaches; and (3) use that tool to identify the current distribution of Van Dyke's salamander across the landscape.

Status:
This project is being scoped for a potential initiation target sometime after 2015.

Eastside Amphibian Evaluation Project

Description:
The Type N Hard Rock Project focused entirely on managed landscapes in western Washington. This was due to the fact that most FFR-designated amphibians have westside distributions, and that those with eastside distributions are believed to have limited overlap with eastside managed landscapes. However, this latter assumption is based on limited coarse-level distributional data available from Washington GAP Analysis modeling. Determining whether distributions of eastside FFR-designated amphibians actually do have limited overlap with managed landscapes requires a focused inventory. A study is being considered to address eastside FFR-designated amphibian distributions. The purpose would be to provide information on eastside amphibian distributions to evaluate whether eastside managed landscapes occupied by FFR-designated amphibians deserves larger study attention. The study would be a relatively simple occupancy study that incorporates the probability of detection to ensure accurate occupancy descriptions across the eastside FFR landscape. Note: This project is listed under Type N Amphibian Response Program, but its assessment may encompass at least some of the Type F landscape.

Status:
This project is under consideration and has not yet been scoped.

Link to Adaptive Management

The following section addresses critical questions for the Type N Amphibian Response Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed. Rule group critical questions are listed in bolded italics. "Knowledge gained" is addressed only for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is

described. For this program, nine CMER projects are listed (see Table 11) for addressing the critical questions. Three projects in this program have been completed (Amphibian Recovery Project, Dunn's Salamander Project, SAA Detection/Relative Abundance Methodology Project), four others are in various stages of nearing completion (Buffer Integrity - Shade Effectiveness Project, Tailed Frog Literature Review, Tailed Frog Meta-Analysis, Type N Experimental Buffer Treatment Project in Hard Rock Lithologies), one has been scoped but not initiated (Amphibians in Intermittent Streams), and two remain unscoped (Tailed Frog and Parent Geology, Van Dyke's Salamander Project). As the latter three projects within this program are developed, this section will be updated to more accurately reflect the knowledge gained, identified gaps, and recommendations to address those gaps.

Do SAAs continue to occupy and reproduce in the patch buffers?

Knowledge Gained or Anticipated:
The Amphibian Recovery Project provided a tentative "yes" answer to this question (see "Identified Gaps" for the basis of the tentative answer).

Identified Gaps:
The conclusion obtained from the Amphibian Recovery Project was tentative for several reasons. Selection of sites for this project was not based on pre-knowledge of amphibian occupancy (some sites were unoccupied by the species of interest), which limited the power of the experiment and, thus, the strength of the conclusions. The experiment was designed across hard rock and soft rock lithologies, complicating any comparison. Amphibian occupancy and abundance information did not take detectability under different conditions into account. Additionally, the Amphibian Recovery Project only addressed this question over the short-term (two post-harvest years).

Recommendations for Addressing Gaps:
The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies addresses the limitations of the Amphibian Recovery Project, described above, which will enable a strong inference that can effectively answer this question. The Type N Experiment Buffer Treatment Project in Hard Rock Lithologies will also have some ability to address this question over a longer timeline. However, though cooperators knew there was a desire to maintain unharvested references for 12 years (through post-harvest genetics and 10-year post-harvest sampling), some cooperators have expressed a need to harvest reference basins as early as 2016. Hence, if data collection over a longer timeline is desired, we will need to address the impact of the potential loss of some reference basins. Currently, one reference basin is scheduled for harvest in 2016. Luckily, this is the basin that was originally a harvest basin to which the treatment was never applied. Without this basin we will still have five reference basins. Harvest of two additional reference basins is tentatively scheduled in CY2019. Therefore, if data collection over a longer timeline is desired, we recommend coordination of another sample period of post-treatment data collection in conjunction with post-harvest amphibian genetics sampling to enable completion of both objectives within the timeframe established by landowners.

Do SAAs continue to occupy and reproduce in the ELZ-only reaches?

Knowledge Gained or Anticipated:
The Amphibian Recovery Project also provided a tentative "yes" answer to this question (see identified gaps for the basis of the tentative answer).

Identified Gaps:
The identified gaps are identical to the previous critical question, see that question for details.

Recommendations for Addressing Gaps:
The recommendations for addressing gaps are identical to the previous critical question, see that question for details.

If SAAs do not continue to occupy the ELZ-only reaches, do they reoccupy those reaches before the next harvest?

Knowledge Gained or Anticipated:
No completed project can answer this question.

Identified Gaps:
Answering this question requires some kind of tracking through the harvest rotation.

Recommendations for Addressing Gaps:
The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will be capable of partly answering this question. However, cooperators in the study were not able to commit to maintaining reference units in the unharvested condition for an entire harvest rotation. Of six references, we know of three that will likely be harvested between 2016 and 2019. Therefore, if harvested treatments are tracked later into the rotation, a new set of reference units may be required. Since selected logistic issues exist with this kind of replacement, an entirely separate study may be needed to effectively answer this critical question. Maintenance of the remaining references basins in their unharvested condition is more likely, as two of these basins are located on Federal lands and one is a state-owned site located within favorable Marbled Murrelet habitat. Discussions should be held with statisticians to explore our options.

How does SAA habitat respond to the sensitive site buffers?

Knowledge Gained or Anticipated:
There are currently no completed projects that can answer this question. It is anticipated that the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will provide results that will inform this question.

Identified Gaps:
Answering this question requires amphibian sampling of sensitive site buffers through harvest treatments.

Recommendations for Addressing Gaps:
The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will be capable of partly answering this question, but not for all categories of sensitive sites.

How does SAA habitat respond to variation in inputs, e.g., sediment, litter fall, wood?

Knowledge Gained or Anticipated:
There are currently no completed projects that can answer this question. It is anticipated that the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will provide results that will inform this question.

Identified Gaps:
Answering this question requires monitoring of inputs during implementation of a variety of harvest prescriptions for which amphibians are also monitored.

Recommendations for Addressing Gaps:
The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will be capable of partly answering this question — confidently for some inputs (litter fall and wood), but less so for others (e.g., sediment).

How do SAA populations respond to the Type N prescriptions over time?

Knowledge Gained or Anticipated:
There are currently no completed projects that can answer this question. It is anticipated that the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will provide results that will inform this question.

Identified Gaps:
Answering this question requires amphibian monitoring through the harvest treatment period for different prescriptions and for an extended period after harvest.

Recommendations for Addressing Gaps:
The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will be capable of answering this question over the first part of the rotation once completed. However, cooperators in the study were not able to commit to maintaining reference units in the unharvested condition for an entire harvest rotation. Of six references, we know of three that will likely be harvested between 2016 and 2019. ; Therefore, if harvested treatments are tracked later into the rotation, a new set of reference units may be required. Since selected logistic issues exist with this kind of replacement, an entirely separate study may be needed to effectively answer this question. Maintenance of the remaining references basins in their unharvested condition is more likely, as two of these basins are located on Federal lands and one is a state-owned site located within favorable Marbled Murrelet habitat. Discussions should be held with statisticians to explore our options.

What are the common findings and inconsistencies in published studies on the effects of timber harvest on tailed frogs?

Knowledge Gained or Anticipated:
There are currently no completed projects that can answer this question. It is anticipated that the Tailed Frog Literature Review Project will answer this question.

Identified Gaps:
Gaps will be identified in the Tailed Frog Literature Review Project, which is currently in review.

Recommendations for Addressing Gaps:
Recommendations for addressing gaps will be identified in the Tailed Frog Literature Review Project, which is currently in review.

What can be learned from a meta-analysis of published data and unpublished data on tailed frogs in managed forests?

Knowledge Gained or Anticipated:
There are currently no completed projects can answer this question. It is anticipated that the Tailed Frog Meta-Analysis Project will answer this question.

Identified Gaps:
No results or gaps have yet been identified.

Recommendations for Addressing Gaps:
If gaps exist, it anticipated that the Tailed Frog Meta-Analysis Project will be capable of providing recommendations to address those gaps.

Are published generalizations on the relationship between parent geology and tailed frog abundance correct and consistent?

Knowledge Gained or Anticipated:
There are currently no completed projects that can address this question. It is anticipated that Tailed Frog and Parent Geology Project will be developed to examine the relationship between tailed frog abundance and lithology.

Identified Gaps:
No results or gaps have yet been identified.

Recommendations for Addressing Gaps:
If gaps exist, it anticipated that the Tailed Frog and Parent Geology Project will be capable of providing recommendations to address those gaps.

What are the common findings and inconsistencies in published studies on the habitat associations of Dunn's and Van Dyke's salamanders?

Knowledge Gained or Anticipated:
The Dunn's Salamander Project confirmed that Dunn's salamander is stream-associated in a similar manner as its geographic range to the south; i.e., it appears infrequent in upland habitat outside riparian areas. Two important findings about Van Dyke's salamander were made; Van Dyke's salamander was found at a large proportion of sampled sites and the species appears

disproportionately associated with large-diameter woody debris. Further, the occurrence of Van Dyke's salamander was detected differentially under low temperature conditions.

It is anticipated that the Van Dyke's Salamander Project will define the inconsistencies in published studies and explore not only the potential causes of these perceived inconsistencies, but the true distribution of Van Dyke's salamander across the landscape.

Identified Gaps:
Current gaps in the understanding of Van Dyke's salamander distribution across the landscape, and potential thermal and seasonal limits to sampling, would be addressed in the Van Dyke's Salamander Project.

Recommendations for Addressing Gaps:
It is recommended that the Van Dyke's Salamander Project be fully scoped and initiated in order to develop a protocol for adequately detecting Van Dyke's salamander presence, particularly on a seasonal basis, and for determining the actual distribution of Van Dyke's salamander on managed lands. This represents a high-priority gap, since it is the only Forests and Fish target amphibian species that has not been directly addressed in any study.

Does territoriality confound interpretation of SAA relative abundance in relation to specified habitats?

Knowledge Gained or Anticipated:
There are currently no completed projects that can address this question. It is anticipated that a study will be developed that can address the relationship between territoriality and relative abundance. Prior to designing such a study, data are needed to establish whether territorial effects exist among SAAs in managed landscapes. Territoriality among the life stages of SAAs that live in-stream is unstudied, but it is known to occur among lungless salamanders like Dunn's and Van Dyke's salamanders. Data collected during the Dunn's Salamander Project may have some promise for evaluating territoriality and perhaps providing at least a preliminary assessment of whether territoriality influences estimates of relative abundance for these two SAA species.

Identified Gaps:
No results or gaps have yet been identified.

Recommendations for Addressing Gaps:
No results or gaps have yet been identified.

What are the effects of various levels of shade retention on the stream-breeding SAAs? Is there an optimum level of shade retention?

Knowledge Gained or Anticipated:
There are currently no completed projects that can address both of these questions. It is anticipated that the Buffer Integrity - Shade Effectiveness project will inform these questions.

Identified Gaps:

No results or gaps have yet been identified.

Recommendations for Addressing Gaps:
If gaps exist, recommendations for addressing gaps will be available when the Buffer Integrity - Shade Effectiveness Project is completed.

What are the effects of three buffer treatments on SAAs two years post-harvest?

Knowledge Gained or Anticipated:
The Amphibian Recovery Project, which attempted to answer this question, provided the ambiguous answer that the difference among the three buffers in the context of amphibian response was uncertain. It is anticipated that the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will inform this question.

Identified Gaps:
The conclusion obtained from the Amphibian Recovery Project was ambiguous for several reasons. Selection of sites for this project was not based on pre-knowledge of amphibian occupancy (some sites were unoccupied by the species of interest), which limited the power of the experiment and, thus, the strength of the conclusions. The experiment was designed across hard rock and soft rock lithologies, complicating any comparison. Finally, amphibian occupancy and abundance information did not take detectability under different conditions into account.

Recommendations for Addressing Gaps:
The Type N Experimental Buffer Treatment Project in Hard Rock Lithologies addresses the limitations of the Amphibian Recovery Project, described above, which will enable a strong inference that can effectively answer this question.

How do SAAs utilize intermittent stream reaches at or near the origins of headwater streams?

Knowledge Gained or Anticipated:
There are currently no completed projects that can address this question. It is anticipated that the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies will be able to address some of this question. The scoped, but not yet implemented, Amphibians and Intermittent Streams Project will address amphibian occupancy and abundance in intermittent streams relative to perennial reaches downstream.

Identified Gaps:
No results or gaps have yet been identified.

Recommendations for Addressing Gaps:
If gaps are found when the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies and Amphibian and Intermittent Streams Project are completed, those projects will provide recommendations for addressing them.

Does sufficient SAA-occupied area exist in Eastside managed lands under FFR jurisdiction to justify study attention?

Knowledge Gained or Anticipated:
No currently completed or in progress projects can address this question. The potential Eastside Amphibian Evaluation Project would address this question.

Identified Gaps:
No results or gaps have yet been identified.

Recommendations for Addressing Gaps:
If gaps exist, recommendations for addressing gaps will be available when the study addressing this question is completed.

6.2.5 Extensive Riparian Status and Trends Monitoring Program

Program Strategy

The purpose of the Extensive Riparian Status and Trends Monitoring Program is to provide data needed to evaluate landscape-scale effects of implementing forest practices riparian prescriptions and to provide data needed by state and federal regulatory agencies to provide assurances that forest practices rules meet Clean Water Act requirements and achieve riparian resource objectives. Critical questions for the Extensive Riparian Status and Trends Monitoring Program are shown in Table 12. The projects of this program will obtain an unbiased estimate of the distribution of stream temperature and shade and of riparian stand characteristics on Type N streams across FP HCP lands; and with resampling, the projects will identify trends in these indicators over time.

The Extensive Riparian Status and Trends Monitoring Program is stratified by region (eastside/westside) and by stream type (fish-bearing and perennial non-fish-bearing). Stratification at this coarse scale is necessary because riparian buffer requirements differ both for Type F/S (fish-bearing) and Type Np (perennial non-fish-bearing) streams and for eastern versus western Washington forestlands. Organizing the sampling effort into separate strata creates projects of a manageable size and allows project-specific adjustments in the sampling strategy and effort to leverage sample site permitting and related data collection among other concurrent riparian studies. This program was ranked first by CMER among the three extensive monitoring programs.

A study design for the entire Extensive Riparian Trend Monitoring Program was developed by RSAG. RSAG is currently implementing the stream temperature monitoring component while developing the vegetation monitoring component methodology.

Table 12. Extensive Riparian Status and Trends Monitoring Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions		Project Names
What is the current status of riparian conditions and functions in Type N streams on a statewide scale, and how are conditions changing over time?		
Program Research Questions	*What is the distribution of maximum summer stream temperature and 7-day mean maximum daily water temperature on FP HCP lands, and how is the distribution changing over time as the forest practices prescriptions are implemented?*	Extensive Riparian Status and Trends Monitoring - Temperature, Type Np Westside Extensive Riparian Status and Trends Monitoring - Temperature, Type Np Eastside
	What proportion of stream length on FP HCP lands meets specific benchmarks for water temperature, and is this proportion changing over time as the forest practices prescriptions are implemented?	Extensive Riparian Status and Trends Monitoring - Temperature, Type Np Westside Extensive Riparian Status and Trends Monitoring - Temperature, Type Np Eastside
Program Research Questions	*What are current riparian stand attributes on FP HCP lands, and how are stand conditions changing over time as the forest practices prescriptions are implemented?*	Extensive Riparian Status and Trends Monitoring - Vegetation, Type Np Westside Extensive Riparian Status and Trends Monitoring - Vegetation, Type Np Eastside

Extensive Riparian Status and Trends Monitoring - Temperature, Type Np Westside

Description:
This project is intended to develop unbiased estimates of the frequency distribution of Type Np stream temperatures across FP HCP lands in western Washington. Stream temperatures are monitored using recording thermographs at upstream and downstream locations; air temperature is monitored using a recording thermograph at the stream reach. Along with stream temperature measurements, shade, riparian vegetation type, LWD, and several channel measurements are collected.

Status:
Sampling has been completed the Type Np Westside streams. The report was initially reviewed by RSAG and CMER then revised again based on the ISPR review of the Eastside Type F report. This copy was reviewed by RSAG and is awaiting revision based on comments received. We expect these to be completed in spring 2014.

Extensive Riparian Status and Trends Monitoring - Temperature, Type Np Eastside

Description:
This project is intended to develop unbiased estimates of the distribution of Type Np stream temperatures across eastern Washington. Stream temperatures will be monitored using recording thermographs at upstream and downstream locations; air temperature will be monitored using a recording thermograph at the stream reach. Along with stream temperature measurements, shade, riparian vegetation type, LWD, and several channel measurements will be collected.

Status:
Initial site screening occurred in the summer of 2008. Only 10% of the sites inspected had flow during the summer (peak temperature) monitoring season (site requirement). Therefore, this project is planning to leverage results from the Eastside Type N Forest Hydrology Project in order to better target appropriate study sites. Site screening may follow the hydrology study report.

Extensive Riparian Status and Trends Monitoring - Vegetation, Type Np Westside and Eastside Projects

Description:
The Type Np and Type F/S eastside and westside projects will be designed to assess riparian conditions in randomly selected Type Np, F, and S stream reaches across FP HCP lands in the state in order to estimate conditions statewide. The feasibility of using the same sites used in the Extensive Riparian Status and Trends Monitoring temperature study will be investigated.

Status:
During the scoping process, a contractor was hired to investigate the feasibility of utilizing existing available aerial photography for this project to assess riparian stand conditions. The contractor concluded that this approach would not achieve the project objectives. The contractor submitted a report on the results of these investigations and a design for a revised pilot study. RSAG accepted the conclusion that the specified photography is unsuitable and requested that work on the protocol development be suspended. RSAG is currently investigating collecting

riparian stand data in the field in conjunction with the Extensive Riparian Status and Trends Monitoring temperature data collection.

Link to Adaptive Management

The following section looks at each rule group critical question for the Extensive Riparian Status and Trends Monitoring Program for western Washington. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. "Knowledge gained" is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is described. Of the three projects in this program, the Westside Type Np Status and Trends Temperature Project is being implemented. The Eastside Type Np Status and Trends Temperature Project is waiting on the results of the Eastside Type N Forest Hydrology Project to more effectively screen sites. The vegetation monitoring project study design has yet to be completed. As more projects and associated final reports are completed, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

What is the distribution of maximum summer stream temperature and 7-day mean maximum daily water temperature on FP HCP lands, and how is the distribution changing over time as the forest practices prescriptions are implemented?

Knowledge Gained or Anticipated:
The Westside Type Np Status and Trends Temperature Project for western Washington will provide an unbiased estimate of the frequency distribution of stream temperature in westside Type N streams. This project also will provide an estimate of the current conditions of riparian shade.

Identified Gaps:
Phase 1 of the Westside Type Np Status and Trends Temperature Project for western Washington does not address the trends in water temperature over time nor can it evaluate the antidegradation standard. Phase 2 (repeated sampling over time) of this study could inform the trend question. Small forest landowners were underrepresented in the sample, and that may affect the applicability of the results.

The eastside Type Np stream stratum was not sampled because of the difficulty in finding suitable sites.

Recommendations for Addressing Gaps:
Phase 2 of this project will include repeated sampling over time to estimate the trends in stream temperatures. The implications of underrepresentation of small forest landowners must be addressed. A concerted effort at outreach and communication with small forest landowners will be required or this land base may need to be excluded from the sampling frame.

The Eastside Type N Forest Hydrology Project, if implemented, may provide the means to efficiently find suitable sites for the Eastside Type Np Status and Trends Temperature Project.

At the request of Forest Policy, RSAG is investigating possible alternative means of conducting extensive monitoring that would meet the objectives but not require physical entry to the stream site. These will include the use of aerial or satellite photography and the selection of surrogate variables for stream temperature.

What proportion of stream length on FP HCP lands meets specific benchmarks for water temperature, and is this proportion changing over time as the forest practices prescriptions are implemented?

Knowledge Gained or Anticipated:
The frequency distribution described above will provide a means of estimating the proportion of stream length meeting a specific temperature criterion.

Identified Gaps:
Phase 1 of the Westside Type Np Status and Trends Temperature Project for western Washington does not address the trends in water temperature over time nor can it evaluate the antidegradation standard. Phase 2 (repeated sampling over time) of this study will inform the trend question. Small forest landowners were underrepresented in the sample.

The eastside Type Np stream stratum was not sampled because of the difficulty in finding suitable sites.

Recommendations for Addressing Gaps:
Phase 2 of this project will include repeated sampling over time to estimate the trends in stream temperatures. A concerted effort at outreach and communication with small forest landowners will be required or this land base may need to be excluded from the sampling frame.

The Eastside Type N Forest Hydrology Project may provide the means to effectively find suitable sites for the Eastside Type Np Status and Trends Temperature Project.

What are current riparian stand attributes on FP HCP lands, and how are stand conditions changing over time as the forest practices prescriptions are implemented?

Knowledge Gained or Anticipated:
The Westside/Eastside Type Np Status and Trends Vegetation Projects do not yet have an approved study design. However, these projects will be designed to assess riparian conditions in randomly selected Type Np, F, and S stream reaches across FP HCP lands in the state in order to estimate conditions statewide.

Identified Gaps:
Gaps have not yet been identified.
Recommendations for Addressing Gaps:
Gaps have not yet been identified.

6.3 TYPE F RIPARIAN PRESCRIPTIONS RULE GROUP

Rule Overview and Intent

The FP HCP recognizes differences in riparian systems and processes between eastern (eastside) and western (westside) Washington. However, though the Type F riparian rules prescribe different protection strategies for eastern and western Washington riparian management zones (RMZs), they also share common basic characteristics. The common characteristics are RMZs equal in width to a site-potential tree height and divided into three zones: core, inner, and outer. All zones are intended to provide key riparian functions, including bank stability, shade, wood recruitment, litter fall, and preventing sediment delivery to streams, caused by surface erosion. The core zone is adjacent to the stream and is a no-harvest zone. The core zone is intended to provide the majority of most key riparian functions. The inner zone extends outward from the core zone and is primarily intended to provide additional shade and large woody debris (LWD) recruitment. The outer zone extends the RMZ out to one site-potential tree height.

During development of the Forests and Fish Rules, the protection of bull trout was determined to be an area of special concern because the species was listed under the Endangered Species Act (ESA) as threatened throughout its geographical distribution in Washington. A main factor contributing to bull trout's threatened status is the degradation of habitat, especially increasing stream temperatures. Bull trout require cooler stream temperatures than other salmonids. The water quality standards in place at the time of forest practices rule development were assumed to be too warm for bull trout. The proposed rule protection strategies for shade and stream temperature were assumed to be more at risk in eastern Washington than in western Washington because of the potential for more shade removal from within eastside RMZs, combined with warmer eastside air temperatures. Therefore, an additional shade rule to be applied within the bull trout habitat overlay (BTO) was prescribed for eastern Washington riparian rules in order to provide adequate stream temperature protection for bull trout (see section below on eastside Type F rules for further details). The additional shade rule does not apply to western Washington.

The specific rule protection strategies for western and eastern Washington are described separately in the sections below.

Westside Type F Rules:

The FFR described the goal of the riparian strategies for westside Type F (fish-bearing) streams as follows:

> "Riparian silvicultural treatments and conservation measures that are designed to result in riparian conditions on growth and yield trajectories towards what are called 'desired future conditions.' As used in this report, desired future conditions are the stand conditions of a mature riparian forest, agreed to be 140 years of age (the midpoint between 80 and 200 years) and the attainment of resource objectives. … These desired future conditions are a reference point on the pathway to restoration of riparian functions, not an endpoint of riparian stand development."

The western Washington Type F riparian rules are based upon the following assumptions:

- The desired future condition (DFC) basal area targets adequately describe mature riparian forest conditions (140 years old).
- Stands meeting the DFC targets will provide the aquatic habitat conditions needed to achieve functions and to meet the overall performance goals and resource objectives.
- The growth model used for DFC adequately projects riparian growth and mortality.
- Some hardwood-dominated riparian stands need to be converted to conifer in order to achieve DFC.

Western Washington RMZs consist of three zones, including:

1. A 50-ft no-harvest core zone.
2. An inner zone extending from 10 to 100 ft beyond the core zone (depending on the site class and stream size) where the timber harvest management objective is to place the combined core and inner zone on a trajectory to grow into the DFC.
3. An outer zone extending beyond the inner zone to the edge of the RMZ where timber harvest is managed to protect special sites and wildlife habitat, and to provide for one site-potential tree height, required by the Federal Services under the FP HCP.

Eastside Type F Rules:

The goals for the eastern Washington Type F riparian rules are to provide for stand conditions that (1) vary over time within the range of historical disturbance regimes; (2) provide riparian functions needed to meet resource goals for fish, amphibians, and water quality; and (3) maintain forest health by minimizing risk of catastrophic damage from insect, disease, or fire.

The eastern Washington Type F riparian rules are based upon the following assumptions:

- The management strategies in the Type F rules will put stands in the RMZ on a trajectory that is within the range of natural variability.
- The defined elevation bands are reasonably accurate reflections of the spatial distribution of historical disturbance regimes and species compositions.
- The management strategies will minimize risk of catastrophic events within the RMZs.
- The management strategies will put stands on a trajectory that will provide the riparian functions needed to support harvestable populations of fish.
- The shade/temperature overlays are necessary to provide stream temperatures that meet the state water quality standards and the needs of bull trout.

Eastern Washington Type F rules consist of three riparian zones, including:

1. A 30-ft no-harvest core zone.
2. An inner zone that is 45 to 70 ft wide (depending on site class and stream size).
3. An outer zone between 0 and 55 ft wide.

The sum of the core, inner, and outer zones approximates the height of a site-potential tree, which varies with site class. Allowable harvest within the inner and outer zones is different for each of three elevation bands, referred to as timber habitat types in the rules. These elevation bands were intended to emulate variations in natural disturbance regimes, variations in species distributions, and other riparian characteristics. Guidance for selecting RMZ leave trees based on

size and species are intended to move riparian stand conditions toward larger trees of fire- and disease-resistant species.

Two shade rules exist for the eastside Type F riparian rule package. The first is the Standard Shade Rule, which defines the amount of shade needed to meet state water quality standards (in place at the time of rule development) using the nomograph in Section 1 of the Forest Practices Board Manual. The second is the all available shade rule, which applies to areas within the BTO. The BTO is an area defined on a map that depicts the distribution of known and potentially suitable bull trout habitat in eastern Washington. When a timber harvest unit is located within the BTO, all available shade (as determined by a densiometer) must be retained within 75 ft of the bankfull channel width or channel migration zone, whichever is greater. When outside of the BTO, prescriptions fall under the Standard Shade Rule, which can allow for harvest of a portion of shade trees within the 75 ft, depending on elevation and the amount of canopy cover prior to harvest.

The FP HCP assumes that riparian forests managed in accordance with western and eastern Washington riparian rule strategies will provide adequate levels of key riparian functions (providing LWD, bank stability, shade, and nutrients and preventing sediment input to streams) necessary to meet the resource objectives and performance targets outlined in the FP HCP.

Rule Group Resource Objectives and Performance Targets

Resource Objectives:

- Heat/Water Temperature: Provide cool water by maintaining shade, groundwater temperature, flow, and other watershed processes controlling stream temperature.
- LWD/Organic Inputs: Develop riparian conditions that provide complex habitats for recruiting LWD and litter.
- Sediment: Provide clean water and substrate and maintain channel-forming processes by minimizing to the maximum extent practicable the delivery of management-induced coarse and fine sediment to streams (including timing and quantity) by protecting stream-bank integrity, providing vegetative filtering, protecting unstable slopes, and preventing the routing of sediment to streams.
- Hydrology: Maintain surface and groundwater hydrologic regimes (magnitude, frequency, timing, and routing of stream flows) by disconnecting road drainage from the stream network, preventing increases in peak flows causing scour, and maintaining the hydrologic continuity of wetlands.

Performance Targets:

- Stream Temperature: Water quality standards.
- Shade: Type F and S streams, except eastside bull trout habitat — That produced by shade model or, if model not used, 85–90% of all effective shade. Eastside — All available shade within 75 ft of designated bull trout habitat per predictive model.
- Riparian Condition: Westside and high-elevation eastside habitats — Riparian stands are on pathways to meet DFC targets (species, basal area, trees per acre, growth, and mortality). Eastside, except high elevation — DFC; current stands on pathways to achieve eastside condition ranges for each habitat series.
- Pool Frequency: < 2 channel widths per pool.

- Sediment: Mass wasting — Virtually none triggered by new roads, favorable trend on old roads. Timber harvesting–related — No increase over natural background rates from harvest on a landscape scale on high-risk sites. Old roads (ratio of road length delivering to streams/total stream length in miles) — Not to exceed 0.15–0.25 in the coast (spruce) zone and west of the crest; 0.08–0.12, east of the crest. Old roads (ratio of road sediment production delivered to streams/total stream length in tons/year/mile) — Not to exceed 6–10 T/yr in coast (spruce) zone; 2–6 T/yr west of the crest; and 1–3 T/yr east of the crest. No stream-bank disturbance outside road crossings on S/F streams. Less than or equal to 10% of the equipment limitation zone (ELZ). Less than 12% embedded fines (< 0.85 mm).
- In-stream LWD: Westside — 85% of recruitment potential for stands on the trajectory toward DFC; additional recruitment from trees in the outer zone. See Schedule L-1[1] for details on numbers of pieces. Eastside — To be developed, based on eastside disturbance regimes.
- Residual Pool Depth: See Schedule L-1[2] for details.
- Stream/ELZ disturbance: No stream-bank disturbance outside road crossings.
- Peak Flows: Westside — Do not cause a significant increase in peak flow recurrence intervals resulting in scour that disturbs stream-channel substrates that provide actual or potential habitat for salmonids, attributable to forest management activities.[3] Increases in two-year peak flows related to forest management (roads and harvest) are $\leq$ 20%.[4]
- Groundwater Temperature: *To be developed.*

Rule Group Strategy

Uncertainties about the validity of the above-mentioned assumptions and effectiveness of the rules to achieve resource objectives and performance targets lead to a series of critical questions and programs to address them (Table 13). The programs include:

1. The DFC Validation Program, a rule tool program that addresses uncertainties regarding the validity of the westside DFC performance targets and the accuracy of the DFC model that is used to project stand trajectory to age 140. The purpose of this program is to validate the DFC approach for management of western Washington, conifer-dominated riparian stands on fish-bearing streams.
2. The Eastside Riparian Type F Rule Tool Program, which assesses current riparian stand and stream conditions on Type F streams across the eastside to provide a baseline for effectiveness monitoring and for establishing eastern Washington targets.
3. The Eastside Type F Riparian Effectiveness Program, which addresses the effectiveness of eastside Type F prescriptions in meeting riparian functions and resources conditions.

[1] Details for the number of in-stream LWD pieces are found in the Schedule L-1 version adopted by the Forest Practices Board on 02-14-01.
[2] Details for residual pool depths are found in the Schedule L-1 version adopted by the Forest Practices Board on 02-14-01.
[3] From Schedule L-1, Appendix H to Forests and Fish Report.
[4] From Schedule L-1, version adopted by Forest Practices Board on 01-14-01.

4. The Westside Type F Riparian Effectiveness Program, which addresses effectiveness of the Type F riparian rules in meeting performance targets and achieving resource objectives.
5. The Bull Trout Habitat Identification Program, which is a rule tool program. The primary goal of this program was to develop protocols and/or predictive models for determining sampling efficiency, presence/absence of bull trout, and for identifying habitat suitable to support bull trout. Site-specific data on bull trout presence/absence above barriers or habitat suitability would help to identify areas that might be added or removed from the bull trout habitat overlay, as defined in the rule. The work for this program has been completed and no further work is planned at this time.
6. The Hardwood Conversion Program, which addresses uncertainty regarding strategies and prescriptions for managing hardwood-dominated stands.
7. The Extensive Riparian Status and Trends Monitoring Program, which documents status and trends of riparian conditions on Type F streams on a regional scale.
8. The Intensive Monitoring/Cumulative Effects Program, which is designed to evaluate the cumulative effects of multiple forest practices on a watershed-scale, and to provide information that will improve our understanding of causal relationships and the biological effects of forest practices rules on aquatic resources.

Table 13. Type F Riparian Prescriptions Rule Group Critical Questions and Programs

Rule Group Critical Questions	Program Name	Task Type	SAG
Does the DFC model adequately project stand basal area growth to age 140? Do the basal area targets adequately describe mature riparian forest conditions?	DFC Validation Program	Rule Tool	RSAG
What is the current range of conditions for eastside riparian stands and streams? What are appropriate LWD performance targets? Can the shade/temperature relationships in the eastside temperature nomograph be refined? Will application of the prescriptions result in stands that achieve eastside FP HCP objectives (forest health, riparian function, and historical disturbance regimes)?	Eastside Type F Riparian Rule Tool Program	Rule Tool	SAGE
How can habitat suitable for bull trout be identified?	Bull Trout Habitat Identification Program	Rule Tool	Former BTSAG
Are the Type F riparian rules effective in meeting the performance targets, resource objectives, and overall performance goals of the FP HCP?	Westside Type F Riparian Effectiveness Program	Effective-ness	RSAG

Rule Group Critical Questions	Program Name	Task Type	SAG
Are the Type F riparian rules effective in meeting the performance targets, resource objectives, and overall performance goals of the FP HCP? Will application of the prescriptions result in stands that achieve eastside FP HCP objectives (forest health, riparian function, and historical disturbance regimes)? Are both the standard eastside prescriptions and the all available shade rule effective in protecting shade and stream temperature and in meeting water quality standards? Are there differences between the standard eastside rule and the BTO all available shade rule in the amount of shade provided and their effect on stream temperature? Is all available shade actually achieved with the densiometer methodology under the BTO shade rule? Are forest practices riparian prescriptions effective at protecting groundwater flow and temperature?	Eastside Type F Riparian Effectiveness Program	Effective-ness	SAGE RSAG
Where and how should hardwood conversion projects be conducted, and what are the ecological outcomes?	Hardwood Conversion Program	Effective-ness	RSAG
What is the current status of riparian conditions and functions in Type F and S streams on a regional scale, and how are conditions changing over time?	Extensive Riparian Status and Trends Monitoring Program	Extensive	RSAG
How do aquatic organisms respond to changes in habitat and water quality associated with changes in riparian inputs and functions?	Intensive Monitoring/Cumu-lative Effects Program	Intensive	RSAG

6.3.1 DFC Validation Program (Rule Tool)

Program Strategy

The DFC Validation Program is administered by RSAG and is designed to address uncertainties about the DFC approach, including uncertainties about (1) how well the current targets reflect mature unmanaged riparian conditions for conifer and mixed stands; (2) how prescription options and constraints affect leave tree requirements and future basal area; (3) the accuracy of site class maps; (4) how accurately the DFC model predicts growth of riparian stands to age 140; (5) what sort of habitat conditions will be provided by mature riparian stands; and (6) how young stands of different composition and density develop as they mature.

The program consists of several projects designed to answer a series of critical questions (Table 14). The DFC Target Validation Project was identified as a high priority by CMER and the Monitoring Design Team. To manage conifer and mixed riparian stands to achieve functions associated with mature stands, the DFC approach requires stand targets that reflect mature stand conditions and a model that can accurately predict the trajectory of young stands to maturity.

Work on the DFC Target Validation Project began in 2000, and the project results were transmitted to Policy in March 2005. In response to the DFC report, Policy requested that CMER undertake three additional tasks: (1) conduct scoping for a project to standardize the width of the plots used in the DFC study to address concerns raised in the ISPR (DFC Plot Width Standardization Project); (2) undertake preparation of a scoping document to identify and evaluate potential approaches for validating the accuracy of the DNR site class maps in riparian areas (DFC Site Class Map Validation Project); and (3) complete a study, originated by the Northwest Indian Fisheries Commission (NWIFC) staff, to determine how the westside Type F riparian prescriptions are being applied by landowners and to evaluate how the different prescription options and constraints influence the amount of timber available for harvest and projected future basal area (the FPA Desktop Analysis Project).

Validation of the DFC model is another important issue to be addressed by this program. Development of a study to quantify the growth and dynamics of riparian buffers created by implementation of the DFC rule was put on hold while RSAG waited to assess the feasibility of the regional riparian stand growth-mortality cooperative effort to address this issue in a cost-effective manner. The DFC Aquatic Habitat Project was ranked as a lower priority project. Consequently, scoping on this project has not begun; although, RSAG proposed conducting this study as part of the DFC Plot Width Standardization Project. That RSAG recommendation was rejected by Policy. The Pathways of Riparian Stand Development to Maturity Project is an outgrowth of the DFC Target Validation Project, based on the realization that many young, low-density stands of mixed composition may not achieve DFC on a timeline consistent with policy objectives without some form of intervention. Finally, a better understanding of the development of such stands is needed to identify appropriate management approaches.

Table 14. DFC Validation Program: Rule Group Critical Questions and Associated Research Projects

Rule Group Critical Questions		Project Names
Does the DFC model adequately project stand basal area growth to age 140? Do the basal area targets adequately describe mature riparian forest conditions?		
Program Research Questions	*Do the DFC targets accurately reflect stand conditions for mature, unmanaged conifer-dominated west-side riparian stands?*	DFC Target Validation Project DFC Plot Width Standardization Project
	How are the westside Type F riparian prescriptions being applied by landowners? What is the effect of various prescription options and constraints on current harvest and projected future basal area?	FPA Desktop Analysis Project
	What is the accuracy of the DNR site class maps in riparian areas, and what factors influence map accuracy?	DFC Site Class Map Validation Project
	Does the DFC growth and mortality model accurately predict the trajectory of westside conifer-dominated riparian stands to age 140?	DFC Trajectory Model Validation Project
	What aquatic habitat conditions are associated with mature westside riparian stands?	DFC Aquatic Habitat Project DFC Plot Width Standardization Project
	How do mature stand structures develop from younger stands in a variety of stand compositions and densities?	Pathways of Riparian Stand Development to Maturity Project
	What growth trajectories and successional pathways are characteristic of hardwood-dominated riparian stands?	Red Alder Growth and Yield Model Project

DFC Target Validation Project

Description:
The purpose of this project was to collect data on stand characteristics from a random sample of mature (140 years) unmanaged conifer-dominated riparian stands in western Washington; to compare basal area per acre from the field sample with the current DFC targets in rule; and to evaluate alternative parameters for characterizing DFC.

Status:
This project has been completed. The results are available in a CMER document titled "Validation of the Western Washington Desired Future Conditions (DFC) Performance Targets in the Washington State Forest Practices Rules with Data from Unmanaged, Conifer-Dominated Riparian Stands." The results were transmitted to Policy for consideration in the summer of

2005. In 2009, the Board adopted rule changes based on the results of the DFC Target Validation Project.

DFC Plot Width Standardization Project

Description:
In response to the DFC Target Validation Project described above, Policy requested that CMER undertake several additional tasks, including scoping a follow-up sampling effort to standardize the width of the plots used in the DFC study to address concerns raised in the ISPR regarding grouping plots by field-measured site class.

Status:
RSAG completed scoping of this document in the spring of 2006. A scoping paper with options for follow-up sampling and simultaneously conducting aquatic habitat validation research was approved by CMER and presented to Policy in the summer of 2006. Policy has not approved moving forward with this project.

FPA Desktop Analysis Project

Description:
This project was intended to determine how westside Type F prescriptions are being applied by landowners and to evaluate the effect of various riparian prescription options and constraints on timber available for current harvest and on projected future basal area. Although originated by NWIFC staff outside of the adaptive management program, Policy requested that CMER complete an office (desktop) analysis of a random set of forest practices applications (FPAs) that had active management of the inner zone, and to conduct a field- verification project on a subsample of those FPAs. From FPAs approved for harvest in 2003 and 2004, 75 were randomly selected in each year, and the associated stand inventory data were entered in the concurrent DFC model. As part of the quality assurance process, data from 15 randomly selected FPAs were compared to field data collected by CMER staff (i.e., FPA Field Check Report).

Status:
A draft report on the desktop analysis was presented to RSAG in December 2005. Data collection for the field-verification project occurred in the winter of 2006, and a draft report was submitted to RSAG in the spring of 2006. Later in 2006, CMER approved a contract to finalize the desktop analysis, field check, and model and manual reports, along with a document that synthesized findings from each of the reports. This work was completed in 2007 and the desktop analysis and field check reports underwent ISPR in 2009. A final report was submitted to Policy and the Forest Practices Board in 2010.

DFC Site Class Map Validation Project

Description:
The third request from Policy was to prepare a scoping document that identifies and evaluates approaches for validating the accuracy of the DNR site class maps in riparian areas.

Status:
CMER staff prepared a scoping document that was approved by CMER and presented to Policy in the summer of 2006. Policy has not approved moving forward with this project.

DFC Trajectory Model Validation Project

Description:
This project will assess the accuracy of the DFC model in predicting riparian stand growth and trajectory from harvest age to the DFC target (age 140). This project will be designed to validate the DFC model as a tool to predict trajectory to the DFC target for both conifer-dominated and mixed stands.

Status:
This study has neither been scoped nor designed. RSAG does not plan to begin scoping on this project at this time.

DFC Aquatic Habitat Project

Description:
The purpose of this project is to determine the range of aquatic habitat associated with mature (DFC) riparian forest conditions.

Status:
This study has been neither scoped nor designed, except for the work proposed in the DFC Plot Width Standardization Project. RSAG does not plan to begin scoping on this project or implementing the DFC Plot Width Standardization Project unless directed by Policy.

Pathways of Riparian Stand Development to Maturity Project

Description:
The purpose of this project is to determine the development sequence of younger stands of various species compositions and densities to mature stands. The study is intended to inform management of uneven-aged stands and those of low density or mixed composition.

Status:
RSAG does not plan to begin scoping on this project at this time.

Red Alder Growth and Yield Model Project

Description:
The purpose of this project is to develop a growth and yield model for red alder. Existing models either do not include red alder among the species simulated or use equations that are based on too few field data. In this project, cooperators from across the Pacific Northwest have contributed existing data that were compiled and edited at the Oregon State University Hardwood Silviculture Cooperative. A growth and yield model for red alder will be developed from these data in a second phase of the project. Red alder is a dominant component of many riparian forests, and although the model is not specific to riparian areas, it will provide better information on the growth dynamics of these riparian stands than is currently available.

Status:
CMER contributed project development funds to this cooperative effort in the past, and in the fall of 2006 received a request from the Washington Hardwood Commission to fund additional

sampling at some existing sites. This request was approved and the work occurred in the winter of 2007. The model was completed by the Hardwood Commission (or OSU) in 2010.

Link to Adaptive Management

The following section addresses critical questions for the DFC Validation Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed. Rule group critical questions are listed in bolded italics. "Knowledge gained" is addressed only for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is described. For this program, eight projects are listed (see Table 14) for addressing the critical questions.

Do the DFC targets accurately reflect stand conditions for mature, unmanaged conifer-dominated westside riparian stands?

Knowledge Gained or Anticipated:

The DFC Target Validation Project — This final report has undergone ISPR and has been approved by CMER and Policy. The following is taken directly from the Abstract of the DFC Target Validation Study:

> "Mean live conifer basal area per acre (LCBAPA) was estimated by map site class (SC) for site classes II, III, and V and compared with the DFC performance targets. Mean LCBAPA values (ft^2/acre) were 333.8 (SC II), 307.7 (SC III), 353.1 (SC IV), and 341.0 (SC V). These values were significantly greater than the DFC targets ($P<0.001$). The differences ranged from 49.7 ft^2/acre for SC III to 151.0 ft^2/acre for SC V. The percentage of sites with LCBAPA values greater than the DFC targets ranged from 66.7% for SC II to 100% for SC IV and V. These results indicate that the current DFC targets are low for these site classes. No conclusions were reached concerning map Site Class I because only one site was available. Similar results were obtained when the data were sorted by field site class and compared with the DFC targets, supporting the conclusions of the analysis by map site class.
>
> Differences in mean LCBAPA between the five site class groups were not statistically significant (either by map or field site class).[5] The data indicate that stem diameter tends to increase as site productivity increases while density (trees per acre) decreases. These factors offset one another, resulting in similar basal area values for high density, small diameter stands on poor quality sites and large diameter, low density sites with higher productivity. Most site attributes explained little of the variability in LCBAPA. Of the 16 variables tested, only dominant tree species and precipitation had significant relationships with LCBAPA. The difference in mean LCBAPA between stands dominated by Douglas-fir and those dominated by western hemlock were statistically significant.

[5] This result (differences between site classes) is potentially confounded by differences in plot widths. Plot widths in the study were designed to be consistent with those required in rule (i.e., riparian management zone widths by specific site class).

> A discrepancy was observed between the site class indicated on the maps and the site class estimates from field measurements. The map and field site class calls were in agreement less than half the time, and the majority of the cases where they disagreed, the field estimates indicated higher productivity than the map site classes. Although this study was not designed to evaluate the accuracy of the site class maps, it provides an indication of possible inaccuracies that may affect their utility as a framework for riparian management.
>
> A suite of alternative metrics were evaluated on the basis of their ability to characterize stand structure, variability, biological/ecological significance and cost/feasibility. None were clearly superior to basal area per acre as a DFC target metric but several better distinguished differences in stand structure associated with site productivity. Volume appears to provide the most information about the stand because it incorporates tree density, diameter and height and directly relates to potential LWD recruitment."

DFC Plot Width Standardization Project — This study is anticipated to provide additional tree and plot data based on standardized plot widths in the DFC Target Validation Project.

Identified Gaps:
Discrepancies were identified in site class (five classes total) determinations from the DNR GIS data and those made from data collected in the field. The methods available for determining site class from mature forest stands, however, are not well tested. The discrepancies were substantial, with 59% of the field site class estimates indicating higher quality (site class) than the map estimates and 15% yielding lower map estimates.

Data were collected from the regulatory width, based on map site class and stream size characteristics of each stand. Thus plots were not equal in size. Comparing data from stands of different plot sizes has the potential to introduce bias. This can only be resolved by collecting data within a standard width for all plots.

Recommendations for Addressing Gaps:
CMER submitted a proposal to Policy to further investigate the discrepancies between mapped versus field site classes. Policy had no consensus regarding funding the DFC Site Class Maps Validation Project.

CMER submitted a proposal to Policy to further investigate the plot width sizes in question when comparing and pooling mapped site class versus field site class DFC sites. Policy had no consensus regarding funding the DFC Plot Width Standardization Project.

How are the westside Type F riparian prescriptions being applied by landowners? What is the effect of various prescription options and constraints on current harvest and projected future basal area?

Knowledge Gained or Anticipated:
FPA Desktop Analysis Project — This project was intended to determine how westside Type F prescriptions are being applied by landowners and to evaluate the effect of various riparian prescription options and constraints on timber available for current harvest and on projected future basal area. The final report has undergone ISPR and has been approved by CMER and Policy. The following is taken directly from the abstract of the FPA Desktop Analysis Report:

> "DFC Model outputs were analyzed using data from 150 randomly selected, approved Forest Practices Applications (FPAs) in which inner zone timber harvest was proposed along west-side Type F streams. These analyses showed that for Option 1, bapa was the primary constraint to timber harvest on only 7 FPAs (4.6%) while the required 57 inner zone leave tpa was the primary constraint to timber harvest on 142 FPAs (94.6%). One FPA (0.7%) was constrained equally by bapa and the required number of leave trees. One-hundred and eight (108) of the 150 stands were eligible for Option 2. Of these, the bapa target constrained timber harvest on 40 FPAs (37%), while the required minimum no-cut floor widths constrained timber harvest on 68 FPAs (63%).
>
> Stand-age-140-bapa (average and the 95th percentile confidence interval around the mean) for each prescription, for all FPAs, across all Site Classes, stream sizes and other possible covariates was: no-cut, 364.1 ±7.1, Option 1, 335.5 ± 7.4, and Option 2, 301.1 ± 5.4 with the trees in the outer part of the inner zone excluded and 333.0 ± 6.0 with the trees in the outer part of the inner zone included.
>
> Tree inventory data submitted with the 15 randomly selected FPAs proved similar to that collected by CMER staff. Some uncertainties about and discrepancies in the Manual instructions for field procedures and data collection were detected and documented in the final report."

Identified Gaps:
The FPA Desktop Analysis was conducted using the initial DFC growth and yield model that was adopted with the Forests and Fish Report in 1999. Neither the existing nor the 1999 DFC model have been validated or compared against other forest stand growth and yield models, since they were adopted by DNR under Forests and Fish in 1999 (see critical question below: "Does the DFC growth and mortality model accurately predict the trajectory of westside conifer-dominated riparian stands to age 140?").

Recommendations for Addressing Gaps:
In the absence of validating the DFC model with field data, CMER may consider comparing the DFC model against other growth and yield models that have been updated in the past 10 years.

What is the accuracy of the DNR site class maps in riparian areas, and what factors influence map accuracy?

Knowledge Gained or Anticipated:
DFC Site Class Map Validation Project — This project proposal was designed to investigate the discrepancies found between field site class and mapped site class in the DFC Target Validation Project.

Identified Gaps:
Discrepancies were identified in site class determinations from the DNR GIS data and those made from data collected in the field during the DFC Target Validation Project. The methods available for determining site class from mature forest stands, however, are not well tested. The discrepancies were substantial, with 59% of the field site class estimates shown to be higher quality (site class) than the map estimates and 15% yielding lower estimates.

Recommendations for Addressing Gaps:
CMER presented a proposal to Policy to further investigate the field site class/mapped site class discrepancies; however, Policy had no consensus regarding funding this proposal.

Does the DFC growth and mortality model accurately predict the trajectory of westside conifer-dominated riparian stands to age 140?

Knowledge Gained or Anticipated:
DFC Trajectory Model Validation Project — This project is anticipated to assess the accuracy of the DFC model in predicting riparian stand growth and trajectory from harvest age to the DFC target (age 140). This project will be designed to validate the DFC model as a tool to predict trajectory to the DFC target for both conifer-dominated and mixed stands.

Identified Gaps:
The existing DFC model has not been validated or calibrated against other forest stand growth and yield models, since it was adopted by DNR under Forests and Fish in 1999.

Recommendations for Addressing Gaps:
In the absence of validating the DFC model with field data, CMER may consider calibrating the DFC model against other growth and yield models that have been updated in the past 10 years.

What aquatic habitat conditions are associated with mature westside riparian stands?

Knowledge Gained or Anticipated:
DFC Aquatic Habitat Project/DFC Plot Width Standardization Project — The purpose of the DFC Aquatic Habitat project is anticipated to determine the range of aquatic habitat associated with mature (DFC) riparian forest conditions. This study has been neither scoped nor designed, except for the work proposed in the DFC Plot Width Standardization Project.

Identified Gaps:
Aquatic habitat conditions associated with mature westside riparian forests are currently unknown. Existing in-channel performance targets in Schedule L-1 have not been validated.

Recommendations for Addressing Gaps:
The first step to address this gap is to scope approaches for addressing the critical question. The DFC Plot Width Standardization Project proposal has a component that could be a pilot project that investigates aquatic habitat conditions for westside riparian forests using channel segments adjacent to the DFC Target Validation Project study plots. The proposal was submitted to Policy, who had no consensus regarding funding the proposal.

How do mature stand structures develop from younger stands in a variety of stand compositions and densities?

Knowledge Gained or Anticipated:
The Pathways of Riparian Stand Development to Maturity Project is anticipated to determine the development sequence of younger stands of various compositions and densities to mature stands. The study is intended to inform management of uneven-aged stands and those of low density or mixed composition.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

What growth trajectories and successional pathways are characteristic of hardwood-dominated riparian stands?

Knowledge Gained or Anticipated:
The Red Alder Growth and Yield Model Project is intended to develop a growth and yield model for red alder. Existing models either do not include red alder among the species simulated or use equations that are based on too few field data. In this project, cooperators from across the Pacific Northwest have contributed existing data that were compiled and edited by the Oregon State University Hardwood Silviculture Cooperative. A growth and yield model for red alder will be developed from these data in a second phase of the project.

Identified Gaps:
Data from the Oregon State University Hardwood Silviculture Cooperative have been limited thus far to young (< 20 years) hardwood stands. Older hardwood stands are needed to better inform model development.

Recommendations for Addressing Gaps:
Continue to monitor the progress of the Oregon State University Hardwood Silviculture Cooperative on hardwood growth and yield for older hardwood stands.

6.3.2 Eastside Type F Riparian Rule Tool Program

Program Strategy

The Eastern Washington Riparian Assessment Project consists of the following studies: Phase 1 and Phase 2 of the riparian assessment study, and the Eastside Type F Channel Wood Characterization Study. Both the Phase 1 and the channel wood characterization study are designed to sample the current condition of riparian and in-stream conditions (baseline conditions) on FP HCP lands. Phase 2 of the riparian survey is designed to complete the analysis of the information collected in Phase 1 to answer the critical questions of the study. Phase 2 also contains a modeling approach in which the Phase 1 data will be analyzed to help address the rule group critical question, "Will the application of the prescriptions result in stands that achieve eastside FP HCP objectives (forest health, riparian function, and historical disturbance regimes)?" By modeling the riparian data collected in Phase 1, SAGE can begin to explore what conditions are sustainable when the current forest practices rules are applied to various stand conditions in eastern Washington.

Based on the final results of Phase 2, SAGE will then decide what additional data are needed before desired future conditions can be developed for riparian forest stands. Still in the study plan stage, the In-Stream Channel Wood Characterization Project and its results will be evaluated similarly in order to determine the next steps necessary for developing desired future conditions for LWD. Once these desired future conditions have been established, effectiveness monitoring can begin.

Uncertainties about the validity of assumptions and effectiveness of the rule led to the critical questions listed in Table 15.

Table 15. Eastside Type F Riparian Rule Tool Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
What is the current range of conditions for eastside riparian stands and streams?	Eastern Washington Riparian Assessment Project - Phase 1 Eastside Type F Channel Wood Characterization Study Eastern Washington Riparian Assessment Project - Phase 2
What are appropriate LWD performance targets?	Eastside LWD Literature Review Project Eastside Type F Channel Wood Characterization Study
Can the shade/temperature relationships in the eastside temperature nomograph be refined?	Eastside Temperature Nomograph Project
Will application of the prescriptions result in stands that achieve eastside FP HCP objectives (forest health, riparian function, and historical disturbance regimes)?	Eastside Disturbance Regime Literature Review Project Eastern Washington Riparian Assessment Project - Phase 2

Eastside Disturbance Regime Literature Review Project

Description:
A literature review titled "A Review and Synthesis of Available Information on Riparian Disturbance Regimes in Eastern Washington" was produced to gain an understanding of what disturbance regimes existed in the past and how they affected riparian forests. The information from this review will help determine whether we can apply these past conditions to present riparian stands and meet the desired future conditions for riparian function.

The literature review indicates that, despite a very large information base on historical and current disturbance regimes within eastern Washington forests, differences in riparian and upslope forest disturbance regimes and post-disturbance responses are not well known. Much of the scientific literature describing eastern Washington disturbance regimes and forest responses is at the forest series or plant association group level and does not distinguish between riparian and upslope communities. The differences between current and historical disturbance regimes for fire are better defined than for insects, pathogens, and other disturbance types. No clear consensus exists on whether there is a difference between disturbance regimes and forest responses of riparian and upslope areas. In fact, available information on riparian ecosystem disturbance regimes and responses was often contradictory. Additional research aimed at regional-scale forest stand disturbance processes is recommended, to supplement existing data and better define the role of disturbance in riparian and upslope forest habitats. The likelihood of duplicating historical disturbance regimes, to reestablish historical forest conditions, is low given current forest stand conditions and global climate change.

Status:
This document was approved by CMER in June 2002.

Eastside LWD Literature Review Project

Description:
A literature review titled "A Review of the Available Literature Related to Wood Loading Dynamics in and around Streams in Eastern Washington Forests" was undertaken to help gain an understanding of the dynamics of functional stream wood and, to a lesser degree, the linkage between the level of LWD recruitment and the health of aquatic habitat. Addressing the uncertainty will require additional information on the relationship of LWD recruitment and habitat function. There is uncertainty about the response of aquatic habitat to different types or levels of LWD input and loading and about how much LWD riparian buffers need to produce.

SAGE's literature review consisted of 41 questions concerning channel wood issues in eastern Washington. Ten of the 41 questions were answered at least in part by studies in eastern Washington, but these were usually limited to a few specific regions of eastern Washington. The other questions could not be answered by literature currently available for eastern Washington.

Status:
This document was approved by CMER in 2004.

Eastside Temperature Nomograph Project

Description:
The Eastside Temperature Nomograph Project developed an eastern Washington–specific nomograph using existing data and identified gaps for future study. The study identified site characteristics necessary to produce a better predictive model of stream temperatures in eastern Washington.

Status:
The report was reviewed by SAGE and CMER and was not accepted as an approved project because technical shortcomings were identified. The document was retired to the file with comments noted. The data used in the analysis have been obtained and archived for potential future use and analysis. Further work on the eastside temperature nomograph project has been put on hold pending the results of an evaluation by WDOE of the approach for achieving water quality criteria, which will determine if the nomograph will be needed.

Eastern Washington Riparian Assessment Project (EWRAP)

Description:
Eastern Washington has a wide range of climatic conditions, elevations, forest types, riparian zones, and management history. The focus of the Eastern Washington Riparian Assessment Project is to document the current range of conditions of riparian stands on eastside forestlands. Information gathered through this project provided CMER and Policy with a common understanding of status and characteristics of riparian stands in lands managed under the eastside Type F prescriptions. The data were analyzed to identify patterns in the distribution of riparian stand types across eastern Washington, and relationships between riparian stand conditions and factors such as precipitation, elevation, and geology.

Due to the perceived variability of forest stand attributes being high in eastside Type F streams, Phase 1 of this study was designed to test proposed methodologies; determine appropriate sample size with current riparian data; provide a data set that could be used for future studies, such as extensive monitoring and an in-stream characterization study; and to provide a baseline for future monitoring.

As a result of variability being lower between sites than expected, Phase 2 of this study is entirely a desktop project, which analyzes existing data from 103 sites using statistics and modeling. This work will provide information on the accuracy of Forest Practices rules, habitat types, and forest health and sustainability, and analysis of how much harvest can occur on each site given stand densities and tree size. Upon completion of both phases, both reports will complete the EWRAP work.

Status:
The report for the Phase 1 was approved by CMER in 2007. Phase 2 of this study is currently being implemented and is scheduled to be completed in 2014.

Eastside Type F Channel Wood Characterization Study (ESICCS)

Description:
Characterizing eastern Washington's Type F streams is important, because information is scarce or simply does not exist that describes the current status of channel wood conditions and that condition's influence on in-stream habitat conditions. SAGE has identified three primary problems due to this lack of information. First, the scarcity of data limits the ability to make informed management decisions required of land managers and regulators. Second, a lack of information hinders the ability to address forest health risks (insects, disease, and fire) in upland and riparian forests. Finally, land managers and regulators have little guidance or context to evaluate alternate plans to meet necessary stream and riparian functions.

SAGE believes that better information is needed to determine the appropriate frequency and distribution of channel wood for meeting properly functioning aquatic habitat conditions. In addition, desired channel wood conditions need to consider and approximate the historical disturbance regimes.

Status:
ISPR responses are currently under review by SAGE. After SAGE approval, the response matrix will be sent to CMER for final review and approval.

Link to Adaptive Management

The following section looks at each rule group critical question for the Eastside Type F Riparian Rule Tool Program. Knowledge gained, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The critical questions are listed in bolded italics. "Knowledge gained" is only shown for projects with final reports that have been through the final peer-review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is described. For this program, there are four critical questions (Table 15). There are five projects identified to address these critical questions. Three projects are complete: the Eastern Washington Riparian Assessment Project (EWRAP) - Phase 1, the Eastside LWD Literature Review Project, and the Eastside Disturbance Regime Literature Review Project. The second phase of the EWRAP is currently being implemented. The Eastside Type F Channel Wood Characterization Study (ESICCS) is within the design phase, and the Eastside Temperature Nomograph Project was put on hold. As projects and associated final reports are completed within this program, this section will be updated to better address the knowledge gained, identified gaps, and recommendations for addressing those gaps.

What is the current range of conditions for eastside riparian stands and streams?

Knowledge Gained or Anticipated:
In EWRAP Phase 1, 103 study sites were surveyed and data were collected on Type F riparian and upland stand characteristics. Data were collected to inform three general areas:

- The current characteristics of riparian stands in eastern Washington;
- The extent to which current riparian stands meet the size and basal area thresholds for timber harvest across the regulatory habitat types (elevation bands); and
- Insect and disease effects and distribution in eastside riparian zones.

The Phase 1 data showed that variability in RMZ forest stand attributes on Type F streams was much lower than previously thought. Forest stand data also showed how often the RMZ could be entered for management and how often insect and disease impacted the trees within the RMZ in comparison to the upland areas.

ESICCS, when complete, is anticipated to provide information on the current status of channel wood conditions and its influence on in-stream habitat conditions.

Identified Gaps:
EWRAP Phase 1 was designed to reveal where data deficits existed and is being followed by Phase 2 of the study. Due to the low variability in forest stands across the eastside, no additional field research was required, and the following information gaps will be addressed in Phase 2, which is currently under contract:

- How will stand characteristics change over time with no timber harvest and with timber harvest applied to the limits that rules allow?
- Are there differences in stand characteristics associated with distance to the stream?
- How susceptible to insect, disease, and crown fire are the stands sampled in EWRAP, Phase 1, and how does susceptibility change over time?
- What are the projected rates and characteristics of stand mortality in riparian stands with and without management intervention?

Recommendations for Addressing Gaps:
Data gaps not addressed in EWRAP Phase 1 are currently being addressed in Phase 2.

What are appropriate LWD performance targets?

Knowledge Gained or Anticipated:
To date, targets have not been developed for the eastside. A literature search was done in 2004 that attempted to address numerous questions regarding wood loading in managed and unmanaged streams; but, alone, this information was not complete enough to develop targets. In response to the results in the literature, SAGE proposed to implement the ESICCS project following EWRAP Phase 1. When implemented, ESICCS is anticipated to provide information on the current status of channel wood conditions and its influence on in-stream habitat conditions.

Identified Gaps:
Data gaps between the correlation of in-stream wood and the adjacent riparian stands currently exist. Only three studies referred to in the Eastside LWD Literature Review Project have been completed in eastern Washington that have the data available to link riparian with in-stream attributes, but these studies only look at unharvested stands; data for managed streams is still needed.

Recommendations for Addressing Gaps:
SAGE recommends a re-survey of the EWRAP Phase1 sites.

Can the shade/temperature relationships in the eastside temperature nomograph be refined?

Knowledge Gained or Anticipated:
The Eastside Temperature Nomograph Project was intended to refine the nomograph, but the contract was never completed.

Identified Gaps:
Possible gaps exist, but these have never been completely identified. Current water quality data have not been used to refine the eastside nomograph.

Recommendations for Addressing Gaps:
SAGE believes that improvements to the eastside nomograph can be made by incorporating existing temperature data; however, there are still unanswered questions based on the new state water quality standards that are more complex.

Will application of the prescriptions result in stands that achieve eastside FP HCP objectives (forest health, riparian function, and historical disturbance regimes)?

Knowledge Gained or Anticipated:
The Eastside Disturbance Regime Literature Review was SAGE's first attempt to summarize historical disturbance regimes. The results showed that little is known about past disturbance regimes, and what is known is not detailed enough to address SAGE's questions. EWRAP Phase 2 is the first study to look at existing conditions in RMZs and to evaluate forest health; this project is currently under contract and no results are yet available.

Identified Gaps:
The Eastside Disturbance Regime Literature Review showed that little was known about past disturbance regimes.

Recommendations for Addressing Gaps:
A study to try and reconstruct historical disturbance regimes would be very expensive and is not planned or budgeted within the program. Instead, EWRAP Phase 2 is looking at existing riparian stand conditions and estimating how these stands will respond under the current forest practices rules specific to forest health. Further survey of the riparian stands could be done to address function in more detail, but this is not currently planned.

6.3.3 Bull Trout Habitat Identification Program (Rule Tool)

Program Strategy

The Bull Trout Habitat Identification Program is a Rule Tool Program. This program was developed to address possible modifications of the bull trout habitat overlay, as defined in the rule. Because knowledge of the current and potential distribution of the species is imprecise, large areas of forestland in eastern Washington may be included in the BTO. These areas may result in excessive restrictions and in riparian conditions that do not meet the intent of the eastside riparian strategy. Site-specific data on bull trout presence/absence or habitat conditions were thought to be able to help in identifying areas that might be added or removed from the BTO. There were two primary tasks identified for this program: (1) development of sampling efficiency models and protocols for detection of bull trout; and (2) development of habitat prediction models for helping to make determinations of habitats unsuitable to support bull trout.

This program was originally administered by the former BTSAG. The work for this program has been completed. Because of the difficulty in stakeholder agreement in removing areas from the BTO, efforts have moved to comparing and assessing the effectiveness of the two shade rules in protecting and maintaining shade and stream temperature. Results from this effort could lead to modifications of the BTO, in part or as a whole. No further work is planned for this program at this time.

Table 16. Bull Trout Habitat Identification Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
How can habitat suitable for bull trout be identified?	Bull Trout Presence/Absence Protocols
	Bull Trout Habitat Prediction Models
	Yakima River Radiotelemetry

Bull Trout Presence/Absence Protocols

Description:

Because sampling efficiency and probability of detection for bull trout were believed to be less than that known for other salmonids, work was focused first on developing sampling efficiency models for bull trout specifically. These sampling efficiency models were intended to prescribe the effort necessary to be able to detect bull trout, using three different survey methods (i.e., electroshocking, day snorkeling, and night snorkeling). The models also included the influence of physical channel features on the response of bull trout to sampling activities and compared probabilities of detection with and without the use of blocknets.

Status:

Sampling efficiency models for detecting bull trout have been developed that are part of the development of presence/absence protocols. Two papers were finalized and approved by CMER, relating to sampling efficiency models: (1) “Development of Bull Trout Sampling Efficiency Models,” by Thurow et al., March 2004; and (2) “Analysis of Movement Patterns of Stream-Dwelling Salmonids in Response to Three Survey Methods,” by Peterson et al., July 2003. The

results of these papers provide valuable information toward understanding the probability of detection and associated effort needed to survey for bull trout presence under various habitat conditions, some of which could be included in a bull trout field protocol, but additional work would be needed to achieve the program goal of a bull trout field protocol. The two CMER reports have been forwarded to Policy, who accepted the reports and decided that no further action was needed at this time.

Bull Trout Habitat Prediction Models

Description:
This project was designed to develop bull trout habitat suitability models, which would help in identifying those areas on the bull trout habitat overlay that might actually be "unsuitable" for supporting bull trout. According to the forest practices rules, if areas were found to be unsuitable for potentially supporting bull trout, those areas could be exempt from the requirements of the all available shade rule. The project was focused on bull trout juveniles; it did not include adult bull trout. The primary habitat predictor was the stream temperature at which juvenile bull trout could be supported.

Status:
To date, preliminary draft models have been developed but found to be too coarse for forest practices purposes. One report from this project was finalized and approved by CMER: "Models to Predict Suitable Habitat for Juvenile Bull Trout in Washington State," by Dunham and Chandler, July 2001. This report provided valuable information pertaining to habitat suitability for juvenile bull trout. However, the study only resulted in setting up a preliminary model, which was too coarse of a screen for determining what would represent unsuitable bull trout habitat within forested lands. Predictive models tend to be more appropriate for determining "suitable" habitat rather than "unsuitable" habitat. Additional work would be needed to incorporate additional variables, resulting in a finer screen for determining what might be suitable or unsuitable habitat. It is likely, however, that a model would not be adequate by itself to determine habitat suitability; additional field surveys would probably be needed on a site-by-site basis. The CMER report has been forwarded to Policy, who accepted the report and decided that no further action was needed at the time.

Yakima River Radiotelemetry

Description:
This project is designed to evaluate the migratory patterns of adult bull trout and to identify their distribution and habitat preferences in the Yakima River watershed. The information gained from this project will inform bull trout presence/absence protocols and habitat prediction models.

Status:
This project was contracted through the USFWS and was only partially funded with CMER funds. The draft final report from this project is currently being finalized by the authors and is expected to be delivered to CMER for review when complete.

Link to Adaptive Management

The following section looks at each rule group critical question for the Bull Trout Habitat Identification Program. Knowledge gained, identified gaps, and recommendations for addressing

gaps are discussed for each critical question. The critical questions are listed in bolded italics. "Knowledge gained" is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is described. As identified in Table 16, there is only one critical question for this program. Three projects were designed to address this critical question. The descriptions of those projects are listed in the section above. Knowledge was gained pertaining to the critical question, but the intended tool was not successfully completed for determining areas that could be removed from the bull trout habitat overlay. As mentioned above, efforts have been transferred to comparing and determining the effectiveness of the two shade rules for protection of stream temperature. Policy provided direction to CMER that no further work on this critical question was needed at this time.

How can habitat suitable for bull trout be identified?

Knowledge Gained or Anticipated:
Bull trout sampling efficiency models were developed to address the ability to detect bull trout presence in various habitats and with the use of various sampling methodologies (i.e., snorkeling and electrofishing). These models provided guidance on the sample size needed to obtain the desired probability of detection with and without blocknets. Thurow et al. (2004) results showed that undercut banks and rubble substrate negatively influenced bull trout day snorkeling efficiencies, whereas larger mean wetted cross-sectional areas and undercut banks negatively influenced bull trout electrofishing efficiency. Temperature was positively related to electrofishing efficiency, which helps to explain why detection of bull trout, which live in colder waters, tends to be lower than for other species. Larger individuals are more vulnerable to electrofishing and easier to see during snorkeling. Peterson et al. (2003) results indicated that, on average, more than 17% of bull trout and rainbow trout leave unblocked units during sampling, showing the importance of blocknets during sampling. Biologists should attempt to characterize stream habitats prior to sampling in order to determine the most efficient sampling method and effort needed for adequately detecting bull trout.

Dunham and Chandler (2001) found that model selection analysis using logistic regression indicated that summer maximum temperature was the most likely factor to explain patterns of occurrence for juvenile bull trout. As water temperatures exceed a single daily maximum of 20°C, it becomes increasingly unlikely that juvenile bull trout will be found using a given habitat. Other habitat variables did not appear to be strongly related to occurrence in this study, though specific habitat variables, such as undercut banks, stream width, etc., have been correlated with occurrence in other studies.

The Yakima River Radiotelemetry Project, when complete, will help to inform the migratory patterns and habitat preferences of adult bull trout. The other two projects described above only address juvenile bull trout.

Identified Gaps:
Success was made in development of sampling efficiency models for bull trout, as well as tables containing information on sampling effort needed to obtain a desired probability of detection for

a given habitat type. However, a user-friendly presence/absence protocol was not developed. Furthermore, a great amount of sampling effort is needed to provide a high level of detection.

The model developed for predicting potential habitat only applies to juvenile bull trout. The model has also been found to be too coarse for application to forested lands (within the bull trout habitat overlay). The model also does not take into consideration habitats that are already degraded, which could be suitable if restored.

Recommendations for Addressing Gaps:
More work could be applied to developing user-friendly presence/absence protocols for bull trout; however for Forests and Fish applications, there may be limited need for application. Within Forests and Fish, focus is more on potentially suitable habitats rather than presence at a given time.

More work could also be applied to developing more fine-scaled habitat predictive models, which take into account other factors, such as habitat size and additional habitat factors. More scientific literature may be available on the subject since CMER work in 2001. However, Policy would need to determine the current need for such a model within Forests and Fish.

6.3.4 Westside Type F Riparian Effectiveness Program

Program Strategy

The purpose of this program is to undertake research and monitoring to evaluate the effectiveness of westside Type F riparian prescriptions, to compare and evaluate alternative westside Type F buffer treatments, and to validate westside Type F performance targets. The program is designed to address scientific uncertainty about FFR/HCP prescriptions for westside Type F streams, including:

1. Survival of buffer trees and rates of buffer tree mortality from competition, windthrow, disease, insects, and other factors.
2. Post-harvest changes in conifer-dominated westside RMZs, and whether westside stands will remain on trajectory to achieve DFC performance targets.
3. Uncertainty about the level of riparian functions provided by riparian stands produced by Type F prescriptions, and whether or not FP HCP resource objectives and performance targets will be achieved.
4. Efficacy of alternative buffer designs in providing riparian functions and meeting resource objectives and performance targets.
5. Validity of performance targets for Type F streams.

Table 17 lists the critical questions for the Westside Type F riparian effectiveness program, and identifies specific projects to address them.

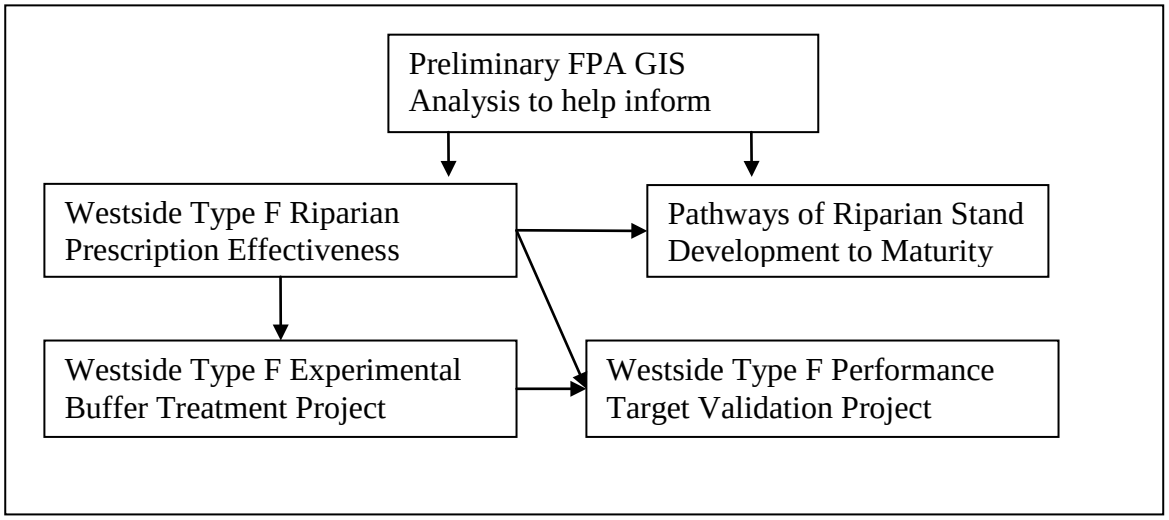
Table 17. Westside Type F Riparian Effectiveness Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions		Project Names
Are the Type F riparian rules effective in meeting the performance targets, resource objectives, and overall performance goals of the FP HCP?		
Program Research Questions	*How do stand conditions change over time (i.e., forest growth, mortality, regeneration) following application of the Westside Type F RMZ inner zone harvest prescription? And do stands remain on trajectory to achieve DFC targets?*	Westside Type F Riparian Prescription Effectiveness Project Pathways of Riparian Development to Maturity Project (DFC Validation)
	What level of riparian functions are provided by stands following application of the Westside Type F riparian prescriptions allowing inner zone management? Do riparian functions meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, and litter fall?	
	How do stand conditions change over time in (i.e., forest growth, mortality, regeneration) where no RMZ inner zone management is allowed (does not meet DFC basal area/acre targets) under the Westside Type F riparian prescriptions?	

	What level of riparian functions are provided where no RMZ inner zone management is allowed under the Westside Type F riparian prescriptions?	
	Would alternative approaches to the westside Type F prescriptions be more effective in meeting FP HCP resource objectives and performance targets, while reducing costs or increasing flexibility for landowners?	Westside Type F Experimental Buffer Treatment Project
	Are Westside Type F performance targets valid and meaningful measures of success in meeting resource objectives?	Westside Type F Performance Target Validation Project
	Are forest practices riparian prescriptions effective at protecting groundwater flow and temperature?	Groundwater Conceptual Model Project

We propose implementing these projects so that each project will help to inform the design and implementation of subsequent projects (Figure 1). The Westside Type F Riparian Prescription Effectiveness Project is the first project in the sequence. This project will begin by analyzing information from forest practice applications and GIS data to determine how frequently westside Type F FPAs occur in different management categories (RMZ inner zone harvest, no RMZ inner zone harvest, site class, stream width) and physical settings. This information will help inform the scoping, study design and site selection. The GIS data should also be useful in the study design for the Pathways of Riparian Stand Development to Maturity Project in the DFC Validation Program, and the Westside Type F Performance Target Validation Project. The first project, Westside Type F Riparian Prescription Effectiveness, will provide information on the effectiveness of the current FPHCP prescriptions in achieving resource objectives and performance targets. Once completed, the results will help RSAG decide if there is a need to design and implement the Westside Type F Experimental Buffer Treatment Project, which would test the effectiveness of alternative treatments which are currently not included in the FFR/HCP prescriptions.

Figure 1. Relationship of projects in the Westside Type F Riparian Effectiveness Program.



Westside Type F Riparian Prescription Monitoring Project

Description:
The purpose of this project is to determine how stand conditions respond over time to the Westside Type F riparian prescriptions and to evaluate the effectiveness of the prescriptions in meeting FP HCP resource objectives and performance targets. We anticipate that the project would evaluate both stands where active management of the inner zone will occur (based on meeting DFC basal area/acre targets), as well as stands where no management of the inner zone will occur when the adjacent stand is harvested. The project is anticipated to focus on the response of riparian stands and riparian inputs such as heat energy and large wood to answer the critical questions.

Status:
RSAG formed an initial writing team in 2013 to develop a charter and initiate work on forming a TWIG (Technical Writing and Implementation Group) to undertake the scoping and design of this study.

Westside Type F Experimental Buffer Treatment Project

Description:
The purpose of this project is to test the effectiveness of alternative treatments which are not part of the current FFR/HCP prescription package. RSAG will recommend whether to pursue this project after reviewing the results of the Westside Type F Riparian Prescription Effectiveness Project.

Status:
This project has been neither scoped nor designed.

Type F Performance Target Validation Project

Description:
This project will evaluate the validity of the Type F performance targets and the measures of success in meeting resource objectives.

Status:
This project has been neither scoped nor designed.

Link to Adaptive Management

The following section looks at each rule group critical question for the Type F Riparian Effectiveness Program for western Washington. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. “Knowledge gained” is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, “knowledge anticipated” is described. For this program, there are three CMER projects listed (see Table 17) for answering specific critical questions. The Westside Type F Riparian Prescription Effectiveness Project had a study design

approved by CMER in January 2003. This study design included components for monitoring the effectiveness of the westside and eastside Type F and Type N riparian prescriptions. The westside Type F component of this study has not been implemented because other components had higher priorities. RSAG has been reviewing the study plan to determine if the approach should be revised to reflect what has been learned from implementing the other components. Both the Type F Performance Target Validation Project and the Type F Experimental Buffer Treatment Project have not been scoped or designed. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

How do stand conditions change over time (i.e., forest growth, mortality, regeneration) following application of the Westside Type F RMZ inner zone harvest prescription? And, do stands remain on trajectory to achieve DFC targets?

Knowledge Gained or Anticipated:
It is anticipated that the Westside Type F Riparian Prescription Effectiveness Project will track how riparian stand conditions change in response to inner zone harvest, according to the Westside Type F prescriptions, and the affect it has on the ability of stands to remain on trajectory to meet DFC performance targets over time.

Identified Gaps:
The study plan for this project is in the process of being revised and the study has not been implemented. No results or gaps have yet been identified.

Recommendations for Addressing Gaps:
No results or gaps have yet been identified.

What level of riparian functions are provided by stands following application of the Westside Type F riparian prescriptions allowing inner zone management? Do riparian functions meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, and litter fall?

Knowledge Gained or Anticipated:
It is anticipated that the Westside Type F Riparian Prescription Effectiveness Project will look at the ability of treatment sites to meet performance targets and resource objectives by comparing post-harvest values against numeric performance targets for woody debris recruitment, soil disturbance, shade, and stream temperature that have been adopted by Policy. It is anticipated that this project will compare the magnitude and duration of change between treatments and untreated control sites.

Identified Gaps:
The study plan for this project is in the process of being revised and the study has not been implemented. No results or gaps have yet been identified.

Recommendations for Addressing Gaps:

No results or gaps have yet been identified.

How do stand conditions change over time (i.e., forest growth, mortality, regeneration) where no RMZ inner zone management is allowed (does not meet DFC basal area/acre targets) under the Westside Type F riparian prescriptions?

Knowledge Gained or Anticipated:
It is anticipated that the Westside Type F Riparian Prescription Effectiveness Project will track how riparian stand conditions change in response to no inner zone harvest treatments under the Westside Type F prescriptions.

Identified Gaps:
The study plan for this project is in the process of being revised and the study has not been implemented. No results or gaps have yet been identified.

Recommendations for Addressing Gaps:
No results or gaps have yet been identified.

What level of riparian functions are provided where no RMZ inner zone management is allowed under the Westside Type F riparian prescriptions?

Knowledge Gained or Anticipated:
It is anticipated that the Westside Type F Riparian Prescription Effectiveness Project will look at the ability of treatment sites (those without inner zone management) to meet performance targets and resource objectives by comparing post-harvest values against numeric performance targets for woody debris recruitment, soil disturbance, shade, and stream temperature that have been adopted by Policy. It is anticipated that this project will compare the magnitude and duration of change resulting from the application of the treatments to untreated control sites (no adjacent upland harvest).

Identified Gaps:
The study plan for this project is in the process of being revised and the study has not been implemented. No results or gaps have yet been identified.

Recommendations for Addressing Gaps:
No results or gaps have yet been identified.

Would alternative approaches to the westside Type F prescriptions be more effective in meeting FP HCP resource objectives and performance targets, while reducing costs or increasing flexibility for landowners?

Knowledge Gained or Anticipated:
It is anticipated that the Type F Experimental Buffer Treatment Project
will test the effectiveness of alternative treatments that are not part of the current forest practices HCP prescriptions. RSAG will recommend whether to pursue this project after reviewing the results of the Westside Type F Riparian Prescription Effectiveness Project.

Identified Gaps:
Gaps have not yet been determined, and this study has not been scoped.

Recommendations for Addressing Gaps:
Gaps have not yet been determined, and this study has not been scoped.

Are westside Type F performance targets valid and meaningful measures of success in meeting resource objectives?

Knowledge Gained or Anticipated:
It is anticipated that the Type F Performance Target Validation Project will develop specific objectives and critical questions that will evaluate the validity of the Type F performance targets and the measures of success in meeting resource objectives.

Identified Gaps:
Gaps have not yet been determined, and this study has not been scoped.

Recommendations for Addressing Gaps:
Gaps have not yet been determined, and this study has not been scoped.

Are forest practices riparian prescriptions effective at protecting groundwater flow and temperature?

Knowledge Gained or Anticipated:
This project has been neither scoped nor designed. Questions was requested by Policy in 2013.

Identified Gaps:
Gaps have not yet been determined, and this study has not been scoped.

Recommendations for Addressing Gaps:
Gaps have not yet been determined, and this study has not been scoped.

6.3.5 Eastside Type F Riparian Effectiveness Program

Program Strategy

The purpose of the Eastside Type F Riparian Effectiveness Program is to conduct research and monitoring to evaluate the effectiveness of the eastside Type F riparian rules in meeting resource objectives and riparian functions. The goals of the eastern Washington Type F riparian rules are to provide for stand conditions that (1) vary over time within the range of historical disturbance regimes; (2) provide riparian functions needed to meet resource goals for fish, amphibians, and water quality; and (3) maintain forest health by minimizing risk of catastrophic damage from insects, disease, or fire. Six rule group critical questions are covered under the Eastside Type F Riparian Effectiveness Program (see Table 18). Four projects are identified to address those critical questions. The BTO Temperature (Eastside Riparian Shade/Temperature) Project is evaluating the effectiveness of the two shade rules (the standard shade rule using the nomograph, and the all available shade rule within the bull trout habitat overlay) for protection of stream temperature. A companion study (the Solar Radiation/Effective Shade Project) focuses on effectiveness of the densiometer methodology for actually achieving all available shade within the bull trout habitat overlay. The Eastside Type F Riparian Effectiveness Monitoring Project (BTO add-on) uses the same sites as the Eastside Riparian Shade/Temperature Project and the Solar Radiation/Effective Shade Project to assess changes in stand conditions, buffer integrity, and LWD recruitment. In order to understand the effectiveness of the forest practices rules in protection of groundwater temperature and flow, a conceptual model needs to first be developed to understand where the areas of sensitivity might be. This conceptual model would provide guidance on where effectiveness monitoring should be focused. Table 18 lists the rule group critical questions and the Projects identified to address each of those critical questions.

Table 18. Eastside Type F Riparian Effectiveness Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
Are the Type F riparian rules effective in meeting the performance targets, resource objectives, and overall performance goals of the FP HCP?	BTO Temperature (Eastside Riparian Shade/Temperature) Project Solar Radiation/Effective Shade Project Eastside Type F Riparian Effectiveness Monitoring Project (BTO add-on)
Will application of the prescriptions result in stands that achieve eastside FP HCP objectives (forest health, riparian function, and historical disturbance regimes)?	BTO Temperature (Eastside Riparian Shade/Temperature) Project Solar Radiation/Effective Shade Project Eastside Type F Riparian Effectiveness Monitoring Project (BTO add-on)

(Table 19 cont. next page)

(Table 19 cont.)

Rule Group Critical Questions	Project Names
Are both the standard eastside prescriptions and the all available shade rule effective in protecting shade and stream temperature and in meeting water quality standards? Are there differences between the standard eastside rule and the BTO all available shade rule in the amount of shade provided and their effect on stream temperature? Is all available shade actually achieved with the densiometer methodology under the BTO shade rule?	BTO Temperature (Eastside Riparian Shade/Temperature) Project Solar Radiation/Effective Shade Project
Are forest practices riparian prescriptions effective at protecting groundwater flow and temperature?	Groundwater Conceptual Model Project

Bull Trout Overlay Temperature (Eastside Riparian Shade/Temperature) Project

Description:
The Eastside Riparian Shade/Temperature Project is designed to evaluate the effectiveness of both the all available shade rule and the standard eastside riparian prescriptions in meeting FP HCP resource objectives, and to determine if a difference exists between shade and stream temperature provided by the BTO all available shade prescriptions and the standard shade requirements. This field study was originally administered by BTSAG but is currently administered by RSAG. The study design specified a two-year pre-harvest data-collection period, a year for harvesting, and a two-year post-harvest data-collection period; however, due to delays in landowner harvest schedules, post-harvest data collection has also been delayed for many sites, extending the project time line for several years. This study is combined with the Solar Radiation/Effective Shade Project.

Status:
Post-harvest data collection was completed during the 2010 field season. The draft report has been through CMER and ISPR review. RSAG has approved sending the post ISPR draft to CMER for final approval in March 2014.

Solar Radiation/Effective Shade Project

Description:
The Solar Radiation/Effective Shade Project is designed to evaluate whether all available shade is actually achieved under the BTO shade rule. This study is being conducted in conjunction with the BTO Temperature (Eastside Riparian Shade/Temperature) Project.

Status:
Complete. Field data collection was completed in the summer of 2009. The final report went through SAG and CMER and ISPR review. Results from the solar component will be incorporated into the Eastside Riparian Shade/Temperature final report, which will go through a final ISPR before becoming a CMER final report.

Eastside Type F Riparian Effectiveness Monitoring Project (BTO add-on)

Description:

The original RSAG study design for eastside Type F riparian prescription effectiveness monitoring called for random sampling of Type F forest practices applications (FPAs) paired with untreated control sites to determine the effectiveness of the prescriptions as applied operationally across the range of conditions on FP HCP lands. The eastside was to be sampled as a separate stratum. However, the Eastside Riparian Shade/Temperature Project demonstrated the great expense and difficulty in finding suitable treatment and control sites in eastern Washington. Consequently, the decision was made to utilize the BTO temperature study sites for the eastside riparian prescription monitoring component, despite the fact that they were not randomly selected, in order to save money, expedite implementation of the project, and provide an integrated package of results for the adaptive management process. This will be accomplished by collecting additional data on changes in vegetation, buffer integrity, and LWD recruitment at the BTO temperature study sites. (Consequently, the Eastside Type F Riparian Effectiveness Monitoring Project is sometimes referred to as the BTO add-on project.)

Status:
Initial post-harvest sampling is completed for all 18 sites included in the BTO add-on project, and the data have been error checked and input into a database set up to analyze the data. Five-year post-harvest data was collected at seven sites in the summer of 2010 and one site in 2011. Data collection at two sites were completed in 2013, the data error checked prior, and submitted to CMER staff at the NWIFC. One site (Cole Creek) remains to be surveyed in 2014 and following its completion the 5-year Post Harvest Survey work will be complete. Data analysis and report writing by NWIFC CMER staff will begin in the second half of 2014. Post-harvest sampling has been staggered over several years due to landowner harvest schedules; therefore, fifth-year post-harvest sampling has also been staggered over several years.

Groundwater Conceptual Model Project

Description:
The Groundwater Conceptual Model Project was designed to investigate the potential impacts of timber harvest on groundwater temperatures, which subsequently could have the potential to discharge to streams and thereby affect the temperature regime of fish habitat. A draft literature review has been completed. However, the draft conceptual model developed from the original contract did not meet the expectations or objectives described by the former BTSAG to identify areas that might be highly susceptible to groundwater heating after timber harvest. The staff from CMER and the U.S. Fish and Wildlife Service (USFWS) was able to make additional progress on development of the intended conceptual models; however, due to limited staffing availability and higher priorities, that progress has not yet reached completion.

Status:
This project has currently been put on hold, and it is unknown whether or not further CMER work will occur.

Link to Adaptive Management

The following section looks at each rule group critical question for the Eastside Type F Riparian Effectiveness Program. Knowledge gained, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The critical questions are listed in bolded italics. “Knowledge gained” is only shown for projects with final reports that have been through the

final review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is described. For this program, there are six critical questions (Table 18). Four CMER projects are identified in the table to address the critical questions. Currently no project is yet complete; therefore, no results are currently available to report on knowledge gained. However, the projects are designed to address certain components of the critical questions as shown below under each critical question. Gaps are also identified, where known, to show where critical questions, or components of them, may not be addressed. As projects and associated final reports are completed within this program, this section will be updated to better address the knowledge gained, identified gaps, and recommendations for addressing those gaps.

Are the Type F riparian rules effective in meeting the performance targets, resource objectives, and overall performance goals of the FP HCP?

Knowledge Gained or Anticipated:
As pertains to shade and stream temperature, the BTO Temperature and Solar Radiation/Effective Shade projects (two components of one study) are intended to compare the two shade prescriptions in eastern Washington (the standard FFR shade rule using the nomographs and the all available shade BTO rule) and to determine each rule's effectiveness in protection of shade and stream temperature. The solar component of the study will also help to determine if we are actually achieving all available shade with the densiometer methodology.

The BTO add-on project, when completed, will provide information on LWD recruitment rates (and function) for sites harvested according to the two shade rules in comparison to unharvested reference sites. Data on soil disturbance from uprooted buffer trees will also be collected.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

Will application of the prescriptions result in stands that achieve eastside FP HCP objectives (forest health, riparian function, and historical disturbance regimes)?

Knowledge Gained or Anticipated:
As pertains to riparian function for shade and stream temperature, the BTO Temperature and Solar Radiation/Effective Shade projects (two components of one study) are intended to compare the two shade prescriptions in eastern Washington (the standard FFR shade rule using the nomographs and the all available shade BTO rule) and determine each rule's effectiveness in protection of shade and stream temperature. The solar component of the study will also help to determine if we are actually achieving all available shade with the densiometer methodology.

The BTO add-on project, when completed, will provide information on LWD recruitment rates (and function) for sites harvested under the BTO all available shade rule and the standard eastside riparian shade rule in comparison to unharvested reference sites. Data on soil disturbance from uprooted buffer trees will also be collected. The BTO add-on project will also

provide information on post-harvest changes in riparian stand condition and tree mortality for sites harvested under the eastside Type F riparian prescriptions according to two different scenarios (the standard rule and the BTO shade rule) in comparison to unharvested reference sites. Tree mortality rates and stand conditions will be compared to determine if forest health issues arise and to determine if the stands remain within the basal area ranges for their forest habitat type (disturbance regimes).

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

Are both the standard eastside prescriptions and the all available shade rule effective in protecting shade and stream temperature and in meeting water quality standards?

Knowledge Gained or Anticipated:
The BTO Temperature and Solar Radiation/Effective Shade projects (two components of one study) are intended to determine if the two shade prescriptions in eastern Washington are effective in protection of shade and stream temperature.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

Are there differences between the standard eastside rule and the BTO all available shade rule in the amount of shade provided and their effect on stream temperature?

Knowledge Gained or Anticipated:
The BTO Temperature and Solar Radiation/Effective Shade projects (two components of one study) are intended to compare the two shade prescriptions in eastern Washington to determine if there are differences in their effectiveness in protection of shade and stream temperature.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

Is all available shade actually achieved with the densiometer methodology under the BTO shade rule?

Knowledge Gained or Anticipated:

The solar component of the Eastside Riparian Shade/Temperature and Solar Radiation/Effective Shade projects (two components of one study) will determine if all available shade is actually being achieved with the current densiometer methodology.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps not yet identified.

Are forest practices riparian prescriptions effective at protecting groundwater flow and temperature?

Knowledge Gained or Anticipated:
A conceptual model for potential impacts to groundwater temperature from forest practices was partially developed but never completed.

Identified Gaps:
There are no CMER projects currently designed to address the effectiveness of Forests and Fish riparian prescriptions in regard to protection of groundwater flow and temperature.

Recommendations for Addressing Gaps:
Further work could be focused on finishing the groundwater conceptual model in order to see where the areas of most sensitivity might be. CMER projects could then be designed to address the priority areas of sensitivity. Further literature reviews could also be conducted to determine those areas of sensitivity and/or impacts of forest practices on groundwater temperature and flow.

6.3.6 Hardwood Conversion Program (Effectiveness)

Program Strategy

The purpose of the Hardwood Conversion Program is to inform the FP HCP strategy for converting riparian stands from hardwood to conifer-dominated. These riparian stands may include a variety of hardwood species, although red alder (*Alnus rubra*) is typically the most common in western Washington. Presence of alder-dominated riparian stands on the landscape is often the result of past forest management practices, which historically did not always include replanting conifers after harvest or liberating conifers from nearby, more rapidly growing alder.

Table 19 presents the critical questions and projects of the Hardwood Conversion Program. The program began by implementing the Riparian Hardwood Conversion Project to provide information for Policy about the effectiveness of hardwood conversion treatments to regenerate conifers successfully and about the economic costs and benefits of hardwood conversion. In response to guidance from Policy, a component to examine stream temperature response was added to the project after the silvicultural study design had been adopted.

In spring of 2005, another project was initiated in response to a request from the Small Forest Landowners Advisory Committee that was developing a small forest landowner hardwood conversion template. This group requested information on the effect of hardwood conversion on stream temperature as a function of buffer width and stream length treated. In response to this request, WDOE submitted a proposal to CMER for the Hardwood Conversion Water Temperature Modeling Project. The project was carried out and is described below under WDOE Water Temperature Modeling Project.

Table 19. Hardwood Conversion Program: Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions		**Project Names**
Where and how should hardwood conversion projects be conducted, and what are the ecological outcomes?		
Program Research Questions	*How effective are different hardwood conversion treatments in reestablishing conifers in hardwood-dominated riparian stands?*	Riparian Hardwood Conversion Project
	Is hardwood conversion in riparian stands operationally feasible, and what are the economic costs and benefits of the hardwood conversion treatments?	
	What effects do hardwood conversion treatments in riparian stands have on shade, stream temperature, and LWD recruitment?	Riparian Hardwood Conversion Project - Temperature Component Annotated Bibliography: Riparian Hardwood Conversion[1]
	What is the effect of hardwood conversion practices on stream temperature as a function of buffer width and length of stream treated?	WDOE Water Temperature Modeling Project

[1]In 2011, RSAG decided to terminate the Annotated Bibliography: Riparian Hardwood Conversion. See status update below for explanation.

Riparian Hardwood Conversion Project

Description:
The Riparian Hardwood Conversion Project is a series of case studies at eight sites. Each site consists of landowner-designed and -implemented site-specific harvests of hardwood trees in riparian buffers. In each case, harvest is followed by replanting of conifers. Data about tree regeneration and residual stand condition are collected at each site. Data collection also includes annually asking participating landowners to document their silvicultural strategies and the costs and benefits associated with each conversion.

Status:
Harvest has occurred at all sites, and 4 years after harvest, monitoring of regeneration is complete. A draft interim report describing the pre-harvest and harvest silviculture, and costs and benefits of the harvests at six of the eight sites, was reviewed by CMER. This report is titled "The Draft Case Study Reports: Hardwood Conversion Study," and the principal investigators are with Duck Creek Associates. Final drafts of the eight case study reports were received in Spring of 2012 and were reviewed by CMER. An outline for a summary report that will synthesize the results and findings from the eight case studies has been approved by RSAG. After RSAG review, the synthesis summary report will be reviewed by CMER concurrently with the case study reports. This summary report is expected to be completed in 2014.

Pending funding by Policy, RSAG intends to revisit all eight sites in 2016 for a final 10-year assessment of regeneration status (survival rates by species, heights, brush competition). These revisits are in response to concerns that four-year post-harvest stocking data are not adequate to reliably determine the likely future stocking levels at these sites. Results and analysis of data from these 2016 visits will be incorporated as addenda to the final case studies and summary report.

Riparian Hardwood Conversion Project - Temperature Component

Description:
Stream temperatures were measured upstream and downstream and at 25-m intervals along stream reaches at the same eight study sites used in the Riparian Hardwood Conversion Project. These temperature measurements occurred before and after harvests. Pre-harvest data collection began in 2003, with the final post-harvest data collected in 2006. The minimum buffer width was 25 ft, but ranged from 25 ft to more than 100 ft. This project was contracted with WDFW.

Status:
The final report has been reviewed and approved by CMER. This report did not undergo ISPR since it provided the data and site descriptions only and did not include a statistical evaluation of harvest effects on stream temperature. High inter- and intra-site variability in both the treatment and control sites before and after harvest prevented CMER from using the data in a statistical analysis of treatment effects. CMER therefore agreed to finalize the study as a data collection report and archive all of the supporting documentation for potential future use.

Annotated Bibliography: Riparian Hardwood Conversion

Description:
The proposed bibliography was meant to assemble literature citations, including comments about the value and findings of each citation. This bibliography would describe silviculture and effects of hardwood conversion on riparian functions, including shade, stream temperature, and nutrient inputs.

Status:
Initial drafts of the annotated bibliography were considered inadequate; and after several revisions and discussions by RSAG on the scope, intent and overall usefulness of the bibliography in the adaptive management program, RSAG decided to terminate this project in 2011. In lieu of an annotated bibliography, RSAG decided to focus on literature related to regenerating conifers in riparian areas cited in the Hardwood Conversion Case Study Synthesis Summary Report to inform the Adaptive Management Program on principles of effective conifer regeneration methods in riparian areas.

WDOE Water Temperature Modeling Project

Description:
This study used an existing stream temperature and shade model to explore the relative effect on stream temperature of different hardwood conversion strategies. The management strategies that were evaluated include a one-sided harvest with continuous 30-ft and 50-ft wide buffers with treated stream lengths ranging from 500 to 1500 ft. A sensitivity analysis was performed on a range of modeled stream conditions (width, flow, gradient, groundwater, and hyporheic flow).

Status:
A draft report was completed in 2006 and was reviewed and approved by CMER. The report was completed in 2007 and submitted to the Small Forest Landowners Advisory Committee, who forwarded the report on to Policy with a recommendation of no further action warranted at this time.

Link to Adaptive Management

The following section looks at the rule group critical question for the Hardwood Conversion Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for the critical question. “Knowledge gained” is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, “knowledge anticipated” is described. As identified in Table 19, there is only one rule group critical question for the Hardwood Conversion Program. Four program research questions were developed to more specifically answer the primary rule group critical question, and four projects were designed to address these questions. The descriptions and status of those projects are listed in the section above. Of particular interest to the adaptive management program is the role of riparian stands at moderating stream temperatures and what the long- and short-term effects are to stream functions when harvesting hardwoods along streams. No conclusive results are currently available. CMER is currently investigating the costs and benefits of different silvicultural strategies that landowners participating in the Hardwood Conversion study use when converting hardwood riparian stands to conifer. As projects and associated final reports are completed within the program, this section

will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

Where and how should hardwood conversion projects be conducted, and what are the ecological outcomes?

Knowledge Gained or Anticipated:
Two studies have been completed in the Hardwood Conversion Program — the WDOE Water Temperature Modeling Project and the Hardwood Conversion Temperature Project. The final report from the WDOE Water Temperature Modeling Project states the following:

> "Riparian buffer width, canopy cover, and harvest-unit length were the most important controls on stream heating. When a 500-ft harvest unit length and a 50-ft buffer were then applied to our model channel, the downstream temperature of the 10-ft-wide stream increased 0.13°C relative to the upstream state. Temperature continued to rise as harvest unit length increased, with the 1500-ft-long unit showing the most change (+0.36°C, or approximately +0.12°C per 500 ft of harvest length). Wider buffers (75 ft), in contrast, continued to dampen temperature increases for the 10-ft stream, even at a harvest unit length of 1500 ft. Results for the 20-ft-wide stream showed a similar pattern, but temperature increases in response to harvest unit length were higher: 0.15°C (500 ft) — 0.60°C (1500 ft), or about 0.18°C per 500 ft of harvest length. Temperature of the 10-ft-wide stream was more sensitive to buffer width than the 20-ft-wide stream. In contrast, all buffer scenarios cooled the 20-ft-wide stream less effectively, with predicted downstream temperatures converging somewhat when harvest unit length reached 1000 ft. Inferences vary depending on the shade curve used. Overall, results indicated that for the stream scenarios analyzed, riparian vegetation and harvest unit length exerted greatest control on stream temperature at lower flow rates. Conditions favoring high daily maximum stream temperatures include: shallow and wide streams, north-south channel orientation, low groundwater influx or hyporheic exchange with the channel, and low gradient."

The report also states that:

> "Interpretation of these results should consider uncertainties associated with the shade and stream temperature models. Model assumptions and simplifications, estimation of internal model parameters, and input data influence the relative effects. Some important thermal phenomena acting over relatively short distances also were not modeled (for example, pool and riffle sequences, and complex surface and subsurface flow paths)."

The Hardwood Conversion Temperature Project improved our understanding of longitudinal variability of temperature in small streams. It also provided insights to the design of future stream temperature studies.

Identified Gaps:
The Rule Group Critical Question, "What effects do hardwood conversion treatments in riparian stands have on shade, stream temperature, and LWD recruitment?", was not resolved by the

Hardwood Temperature study or annotated bibliography. As such, questions about the response of stream temperatures to hardwood tree removal from riparian areas may still need to be addressed. Other data gaps that may need additional research include a better understanding of how riparian stand conditions and attributes affect the capacity of riparian areas to support FFR goals.

Recommendations for Addressing Gaps:
Based on the results of the Riparian Hardwood Conversion Project, RSAG will identify gaps and develop strategies for addressing them. This may include scoping a follow-up Hardwood Conversion Temperature Effectiveness Study.

6.3.7 Extensive Riparian Status and Trends Monitoring Program

Program Strategy

The purpose of the Extensive Riparian Status and Trends Monitoring Program is to provide data needed to evaluate landscape-scale effects of implementing forest practices riparian prescriptions and to provide data needed by regulatory agencies to provide assurances that forest practices rules meet Clean Water Act requirements and achieve riparian resource objectives. Critical questions for the Extensive Riparian Status and Trends Monitoring Program are shown in Table 20. The projects in this program will obtain an unbiased estimate of the distribution of stream temperature and shade and of riparian stand characteristics on Type F streams across FP HCP lands and, with resampling, will identify trends in these indicators over time.

The Extensive Riparian Status and Trends Monitoring Program is stratified by region (eastside/westside) and by stream type (fish-bearing and perennial non-fish-bearing). Stratification at this coarse scale is necessary because riparian buffering strategy differs both for Type F/S (fish-bearing) and Type Np (perennial non-fish-bearing) streams and for eastern versus western Washington forestlands. Organizing the sampling effort into separate strata creates projects of a manageable size and allows project-specific adjustments in the sampling strategy and effort to leverage permitting of sample sites and related data collection among other concurrent riparian studies. This program ranked first among the three CMER extensive monitoring programs.

A study design for the entire Extensive Riparian Status and Trends Monitoring Program was developed by RSAG. RSAG is working further on developing the methodology for the vegetation monitoring component.

Table 20. Extensive Riparian Status and Trends Monitoring Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions		Project Names
What is the current status of riparian conditions and functions in Type F and S streams on a regional scale, and how are conditions changing over time?		
Program Research Questions	*What is the distribution of maximum summer stream temperature and 7-day mean maximum daily water temperature on FP HCP lands, and how is the distribution changing over time as the forest practices prescriptions are implemented?*	Extensive Riparian Status and Trends Monitoring - Temperature, Type F/S Westside Extensive Riparian Status and Trends Monitoring - Temperature, Type F/S Eastside
	What proportion of stream length on FP HCP lands meets specific benchmarks for water temperature, and how is the proportion changing over time as the forest practices prescriptions are implemented?	
	What are current riparian stand attributes on FP HCP lands, and how are stand conditions changing over time as the forest practices prescriptions are implemented?	Extensive Riparian Status and Trends Monitoring - Vegetation, Type F/S Westside Extensive Riparian Status and Trends Monitoring - Vegetation, Type F/S Eastside
	What proportion of westside Type F/S stream length on FP HCP lands meet DFC basal area performance targets, and how is the proportion changing over time as the forest practices prescriptions are implemented?	
	What proportion of eastside Type F/S stream length on FP HCP lands are within the eastside basal area ranges, and how is the proportion changing over time as the forest practices prescriptions are implemented?	

Extensive Riparian Status and Trends Monitoring - Temperature, Type F/S Westside

Description:

This project is intended to develop unbiased estimates of the frequency distribution of Type F and S stream temperatures across FP HCP lands in western Washington. Stream temperatures are monitored using recording thermographs at upstream and downstream locations; air temperature is monitored using a recording thermograph at the stream reach. Along with stream temperature measurements, shade, riparian vegetation type, LWD, and several channel measurements are collected.

Status:

This project was implemented simultaneously with the westside Type Np project. Approximately 60 sites were sampled over the 2008–2009 summer seasons. A draft report covering both years of sampling has been reviewed by RSAG and CMER. This was revised based on the ISPR review of the eastside report. It was then reviewed by RSAG and is awaiting revision based on those comments. This is expected by spring 2014.

Extensive Riparian Status and Trends Monitoring - Temperature, Type F/S Eastside

Description:
This project is intended to develop unbiased estimates of the frequency distribution of Type F and S stream temperatures across FP HCP lands in eastern Washington. Stream temperatures are monitored using recording thermographs at upstream and downstream locations; air temperature is monitored using a recording thermograph at the stream reach. Along with stream temperature measurements, shade, riparian vegetation type, LWD, and several channel measurements are collected.

Status:
Approximately 50 sites were sampled over the 2007–2008 summer seasons. A draft report covering both years of sampling was reviewed by RSAG and CMER, revised accordingly, and reviewed by ISPR. The revised report was completed in June 2013.

Extensive Riparian Status and Trends Monitoring - Vegetation, Type F/S Westside and Eastside Projects

Description:
The Type N and Type F/S eastside and westside studies will be performed concurrently. These projects will assess riparian conditions in randomly selected Type N, F, and S stream reaches across FP HCP lands in the state in order to estimate conditions statewide. The vegetation assessment component will use aerial photography evaluation methods and is not dependent on fieldwork to implement. All vegetation assessment is expected to occur once the methodology has been finalized. Existing data from other riparian projects will be used to help calibrate that effort and also to validate results of the remote-sensing characterization. The plan is to assess conditions at the same sites used in the temperature study and to use the ground data collected in that study (as well as any other riparian studies) as verification for aerial photo interpretations.

Status:
A study design has not been completed.

Link to Adaptive Management

The following section looks at each rule group critical question for the Extensive Riparian Status and Trends Monitoring Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. “Knowledge gained” is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, “knowledge anticipated” is described. Of the four projects in this program, only the Westside Type F/S Status and Trends Temperature and Eastside Type F/S Status and Trends Temperature projects are being implemented. The vegetation monitoring project study design has yet to be fully developed. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

What is the distribution of maximum summer stream temperature and 7-day mean maximum daily water temperature on FP HCP lands, and how is the distribution changing over time as the forest practices prescriptions are implemented?

Knowledge Gained or Anticipated:
The final report for the Eastside Type F/S Status and Trends Temperature Project provides an estimate of the frequency distribution of stream temperature across eastside Type F/S streams on FFR lands and, because the project spanned two summers, an estimate of interannual variability. This project also provides an estimate of the current conditions of riparian shade and water temperature. The draft report for the Westside Type F/S Status and Trends Temperature Project provides an estimate of the frequency distribution of stream temperature across westside Type F/S streams on FFR lands and, because the project spanned two summers, an estimate of interannual variability.

Identified Gaps:
Phase 1 of the Type F/S Status and Trends Temperature projects (both Westside and Eastside) does not address the trends in water temperature over time nor can it evaluate the antidegradation standard. Phase 2 (repeated sampling over time) of this study could inform the trend question. Small forest landowners were underrepresented in the sample. The eastside study was hampered because we could not get permission to access to many sites.

Recommendations for Addressing Gaps:
Phase 2 of this project will include repeated sampling over time to estimate the trends in stream temperatures. A concerted effort at outreach and communication with small forest landowners will be required if we are to include these lands in the project.

What proportion of stream length on FP HCP lands meets specific benchmarks for water temperature, and how is this proportion changing over time as the forest practices prescriptions are implemented?

Knowledge Gained or Anticipated:
The frequency distributions of stream temperature for eastside and westside FFR lands can be used to estimate the proportion of stream length meeting a specific temperature criterion at this time.

Identified Gaps:
The Type F/S Status and Trends Temperature projects do not address the trends in water temperature over time nor can they evaluate the antidegradation standard. Phase 2 (repeated sampling over time) of these projects could inform the trend question. It is also limited in addressing water temperatures on small forest landowners' property, because small forest landowners were underrepresented in the sample.

Recommendations for Addressing Gaps:
Phase 2 of this project will include repeated sampling over time to estimate the trends in stream temperatures. At the request of TFW Policy, RSAG is investigating possible alternative means of conducting extensive monitoring that would meet the objectives but not require physical entry to the stream site. These will include the use of aerial or satellite photography and the selection of surrogate variables for stream temperature.

What are current riparian stand attributes on FP HCP lands, and how are stand conditions changing over time as the forest practices prescriptions are implemented?

Knowledge Gained or Anticipated:
The vegetation monitoring project does not yet have an approved sampling design. However, this project will be designed to assess riparian conditions in randomly selected Type F and S stream reaches across FP HCP lands in the state in order to estimate conditions statewide.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

What proportion of westside Type F/S stream length on FP HCP lands meet DFC basal area performance targets, and how is the proportion changing over time as the forest practices prescriptions are implemented?

Knowledge Gained or Anticipated:
The vegetation monitoring project does not yet have an approved sampling design. However, this project will be designed to assess riparian conditions in randomly selected Type F and S stream reaches across FP HCP lands in the state and how those conditions change over time.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

What proportion of eastside Type F/S stream length on FP HCP lands are within the eastside basal area ranges, and how is the proportion changing over time as the forest practices prescriptions are implemented?

Knowledge Gained or Anticipated:
The vegetation monitoring project does not yet have an approved sampling design. However, this project will be designed to assess riparian conditions in randomly selected Type F and S stream reaches across FP HCP lands in the state and how those conditions change over time.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

6.3.8 Intensive Monitoring/Cumulative Effects Program

Program Strategy

Intensive monitoring is watershed-scale research designed to evaluate the cumulative effects of multiple forest practices and to provide information that will improve our understanding of causal relationships and the biological effects of forest practices rules on aquatic resources (validation monitoring). The evaluation of cumulative effects of multiple management actions on a system requires an understanding of how individual actions influence a site and how those responses propagate through the system. This sophisticated level of understanding can only be achieved with an intensive, integrated monitoring effort. Evaluating biological responses is similarly complicated, requiring an understanding of how various management actions interact to affect habitat conditions and how aquatic organisms respond to these habitat changes. This program was identified in the Monitoring Design Team (MDT) Report (MDT, 2002) as an essential component of an integrated monitoring program. CMER is in the process of scoping its intensive monitoring needs but currently has not finalized a strategy for the Intensive Monitoring/Cumulative Effects Program. Contacts with outside programs with similar interests in intensive monitoring (such as the state's Intensively Monitored Watersheds Program) are being pursued to identify opportunities for collaboration.

6.4 CHANNEL MIGRATION ZONE RULE GROUP

Rule Overview and Intent

The channel migration zone (CMZ) is an area within a river or stream valley where the active channel is prone to move laterally. The intent of the CMZ rule is to maintain riparian forest functions (e.g., woody debris recruitment, bank reinforcement, shade, and litter) along migrating channels, in their present or future location. No timber harvest, salvage, or road construction (except for road crossings) is allowed within CMZs without an alternate plan that specifies the conditions that will provide equal and overall effective protection of public resources as described in the forest practices rules and the Forest Practices Act.

Rule Group Resource Objectives and Performance Targets

Resource Objectives:

- Same as for Type F riparian prescriptions (see Section 6.3).

Performance Targets:

- Same as for Type F riparian prescriptions (see Section 6.3).

Rule Group Strategy

The strategy for the CMZ Rule Group is intended to answer a set of critical questions that address uncertainties concerning CMZ delineation and effectiveness (Table 21). The first question arises from the need to identify and delineate the CMZ so that the prescriptions can be implemented as intended. The rule assumes that the CMZ can be identified and that the extent of the CMZ can be and will be consistently delineated by landowners. This assumption has high uncertainty because, although many CMZs are relatively easy to recognize, their boundaries are difficult to define in the field. Incorrect delineation of the CMZ edge results in incorrect placement of the adjacent riparian management zone (RMZ), making it potentially vulnerable to channel disturbance.

The second question addresses the future patterns of channel migration. The CMZ rule is based on the assumption that the area subject to channel migration during the last 100 years is the same area that will be subject to channel migration during the next 100 years. A high level of uncertainty exists for this assumption because changes in land use and other factors (i.e., in channel wood, sediment, and flow) during the next 100 years could change the frequency of channel avulsion (the most common form of channel migration in forested conditions).

Table 21. CMZ Rule Group Critical Questions and Programs

Rule Group Critical Questions	Program Names	Task Type	SAG
What field/map criteria allow consistent, repeatable delineation of the CMZ lateral boundaries (“edge”)?	CMZ Delineation Program	Rule Tool	UPSAG
Will the physical processes that drive channel migration change appreciably due to the application of forest practices rules?	CMZ Validation Program	Intensive	UPSAG

6.4.1 CMZ Delineation Program

Program Strategy

The purpose of the CMZ Delineation Program is to assess the available methods and criteria for accurately identifying and delineating CMZs. The program will develop materials and procedures to aid field managers in the consistent and accurate delineation of CMZs. It consists of two projects. The first would provide a screening tool to locate areas with potential CMZs, and the second would provide a methodology to accurately delineate their boundaries once located. The program is not being actively developed because of its low ranking in the CMER priority list.

Table 22. CMZ Delineation Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
What field/map criteria allow consistent, repeatable delineation of the CMZ lateral boundaries ("edge")?	CMZ Screen and Aerial Photograph Catalog Project and CMZ Boundary Identification Criteria Project Consistency and Accuracy of CMZ Boundary Delineations

CMZ Screen and Aerial Photograph Catalog Project and CMZ Boundary Identification Criteria Project

Description:

The need for the CMZ delineation project, which was outlined in the 2005 work plan, may have been resolved with the recent revision of the Forest Practices Board Manual for CMZs (i.e., Section 2), which provides more detailed guidance.

Status:

Aside from the preliminary scoping, no CMER work on these topics has been proposed.

Consistency and Accuracy of CMZ Boundary Delineations

Description:

The recent development of revised CMZ delineation guidelines (i.e., Board Manual, Section 2) leaves open questions as to whether new methods result in accurate and consistent CMZ delineations. Although this project has not yet been scoped, it would likely involve field evaluation of a sample of CMZ delineations.

Status:

Not yet scoped. This issue may be included in the DNR Forest Practices Compliance Monitoring Program.

Link to Adaptive Management

This section will be completed when this program is further developed.

Knowledge Gained or Anticipated:

Identified Gaps:

Recommendations for Addressing Gaps:

6.4.2 CMZ Validation Program (Intensive)

Program Strategy

There is general interest in learning how the protection and recovery of mature forests in CMZs will influence channel migration rates, aquatic habitat formation, and other functions. These questions could presumably be addressed by field and/or remote-based (photos, LIDAR) studies. Such issues have never been elevated among CMER priorities and thus no studies have been scoped to date.

Table 23. CMZ Validation Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
Will the physical processes that drive channel migration change appreciably due to the application of forest practices rules?	No projects scoped at this time

Link to Adaptive Management

This section will be completed when this program is further developed.

Knowledge Gained or Anticipated:

Identified Gaps:

Recommendations for Addressing Gaps:

6.5 UNSTABLE SLOPES RULE GROUP

Rule Overview and Intent

The FP HCP goal for the management of potentially unstable slopes is to prevent forest practices from increasing or accelerating mass wasting (landslides) beyond the naturally occurring rates. The intent of the goal and its related rules is to protect water quality and aquatic habitat by minimizing sediment delivery from management-related increases in mass wasting.

The rules assume that (1) the administrative process of identifying, reviewing, and regulating forest practices on potentially unstable slopes will maintain a naturally occurring rate of mass wasting following forest practices; (2) implementation of the unstable slopes prescriptions will achieve the Schedule L-1 resource objectives of clean water and substrate and will maintain channel-forming processes; and (3) implementation of the unstable slopes prescriptions will meet FP HCP landscape-scale performance targets (there are no site-scale targets).

The forest practices rules' default protective measure for potentially unstable slopes is avoidance. The rule protection strategy begins with definition of unstable landforms and the identification of unstable slopes. The strategy then is either to avoid the area or conduct a risk evaluation through the State Environmental Protection Act (SEPA) process. The rule protection strategy relies on the ability of forest managers and regulators to recognize and mitigate for unstable slopes within the forest practices application (FPA) and approval process. If forest practices are planned on potentially unstable slopes, the FPA process includes a SEPA review.

The correct identification and assessment of unstable slopes is achieved by the rules defining unstable landforms at a statewide level and DNR regions defining regional unstable landforms using local knowledge. As further protection, a specific forest practices rule relates to timber harvest on the groundwater recharge areas of deep-seated landslides in glacial sediments.

Rule Group Resource Objectives and Performance Targets

Resource Objectives:

- Sediment: Provide clean water and substrate and maintain channel-forming processes by minimizing to the maximum extent practicable the delivery of management-induced coarse and fine sediment to streams (including timing and quantity) by protecting stream bank integrity, providing vegetative filtering, protecting unstable slopes, and preventing the routing of sediment to the streams.

Performance Targets:

- Road-related: Virtually none triggered by new roads; favorable trend on old roads.
- Timber harvesting–related: No increase over natural background rates from harvest on a landscape-scale on high-risk sites.

Rule Group Strategy

Table 24 contains critical questions for the Unstable Slopes Rule Group and identifies a series of programs to address them. The strategy is to immediately implement an unstable-landform identification program to address the first two critical questions, and then to design and

implement mass wasting effectiveness monitoring and validation programs to assess the effectiveness of landform recognition and mitigation at various scales. All effectiveness, extensive, and intensive tasks are administered by UPSAG; rule tools are administered by DNR in collaboration with UPSAG.

Table 24. Unstable Slopes Rule Group Critical Questions and Programs

Rule Group Critical Questions	Program Names	Task Type	SAG
What screening tools can be developed to assist in the identification of potentially unstable landforms that minimize the omission of potentially unstable landforms?	Unstable Landform Identification Program	Rule Tool	UPSAG
Does harvesting of the recharge area of a glacial deep-seated landslide promote its instability?	Glacial Deep-Seated Landslides Program	Rule Tool	UPSAG
Are unstable landforms being correctly and uniformly identified and evaluated for potential hazard? How does the rate of landsliding on managed lands compare to an estimate of the natural (background) rate? Are the forest practices unstable-landform rules effective at reducing the rate of management-induced landsliding at the landscape scale? Are the mass wasting prescriptions and mitigation measures effective in preventing landslides from roads and harvest units? Does windthrow on mass wasting buffers (leave areas) increase mass wasting?	Mass Wasting Effectiveness Monitoring Program	Effective-ness	UPSAG
What levels of cumulative sediment inputs are harmful to aquatic resources at the basin scale?	Mass Wasting Validation Program	Intensive	UPSAG

6.5.1 Unstable Landform Identification Program (Rule Tool)

Program Strategy

The purpose of the Unstable Landform Identification Program is to provide a set of screening tools to identify forested areas containing potentially unstable slopes and to focus field verification activities on potential problem areas, thereby improving our ability to avoid them.

The management strategy for regulating forest practices on unstable slopes consists primarily of an administrative process for identifying and reviewing forest practices on potentially unstable slopes. The main elements include defining and screening unstable slopes and improvements to the SEPA process. The success of the management strategy for unstable slopes is dependent on early recognition of potentially unstable slopes by forest managers in order to avoid or mitigate the hazards posed by them. The projects in this program are specifically referenced in the FP HCP as necessary for implementing forest practices that meet resource objectives.

This program consists of five projects that provide statewide information on the distribution of unstable landforms. Two projects are completed, one was underway but is now on hold due to budget constraints, one is partially completed and has been on hold, and one has not yet been started. Because the projects consist of the development of screening tools that are used for information only and not as regulatory tools, we do not anticipate that program results will require Policy action.

Table 25. Unstable Landform Identification Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
What screening tools can be developed to assist in the identification of potentially unstable landforms that minimize the omission of potentially unstable landforms?	Shallow Rapid Landslide Screen for GIS Project
	Technical Guidelines for Geotechnical Reports Project
	Regional Unstable Landforms Identification Project (RLIP)
	Landform Hazard Classification System and Mapping Protocols Project
	Landslide Hazard Zonation Project

Shallow Rapid Landslide Screen for GIS Project

Description:

This project has three phases. The first phase of this project compared different slope stability models. Based on the results of that study, Policy directed DNR to develop a GIS-based screen of modeled slope stability based on DEM topography for the westside. This first phase was completed in 2001 and was released as TFW Report 118 titled, “Comparison of GIS-Based Models of Shallow Landsliding for Application to Watershed Management.” The second phase produced a modeled slope stability screen, which is available on the DNR forest practices website. A third phase has been proposed to identify topographic model(s) appropriate for similar mapping on the eastside. This phase is on hold while the Landslide Hazard Zonation (LHZ) Project is being conducted.

The funding for the LHZ Project was suspended in 2009.

Status:
Phase 1 — Complete.
Phase 2 — Complete.
Phase 3 — Suspended due to funding since July 2009.

Technical Guidelines for Geotechnical Reports Project

Description:
This project develops technical guidelines for geotechnical reports used in the SEPA review process. The guidelines include identification of appropriate analytical tools and techniques appropriate for different projects and at different scales.

Status:
Complete.

Regional Unstable Landforms Identification Project (RLIP)

Description:
This completed project provided a coordinator to work with Timber, Fish and Wildlife (TFW) cooperators within each DNR region in order to identify unstable landforms that do not meet the statewide landform descriptions. Its results also serve as an interim screen for deep-seated landslides by identifying lithologies that promote deep-seated landslides; however, the project did not actually map individual deep-seated landslides but rather the areas where they occur in abundance. The information created by the RLIP was recommended by UPSAG and CMER to be incorporated into the LHZ Project. In 2005, data from this project were placed into the hazard zones spatial database, which is used by DNR for classifying applications and by the LHZ team as preexisting work that they incorporate into their studies.

Status:
Complete.

Landform Hazard Classification System and Mapping Protocols Project

Description:
This project developed a detailed protocol to be used to map landslides and potentially unstable landforms in a consistent manner, leading to the assignment of hazard to unstable slopes in the forested environment. This project was completed in 2004; the protocol has subsequently been used for the implementation of the LHZ Project (described below) and by state lands geologists for large blocks of land under state ownership.

Status:
This project was completed in 2004 and has been utilized in the LHZ Project.

Landslide Hazard Zonation (LHZ) Project

Description:
This is a multiphase project. During Phase 1, all mass wasting modules from completed watershed analyses and other information on unstable landforms, landslides, and unstable slopes were collected and compiled in a GIS database. This database has been made available for free download to the public and is utilized as a screening tool in the Forest Practices Application process. During Phase 2, mass wasting modules from incomplete watershed analyses were either finished, reviewed, and added to the database or were rejected. During Phase 3, the protocol was being implemented at the watershed scale following a list of priority watersheds based on presence of steep slopes and FP HCP lands. The Landslide Hazard Zonation (LHZ) Project has been suspended due to budgetary constraints. There were 22 watershed administrative units (WAUs) identified as priorities for the LHZ Project; these represent incomplete watershed analyses. Of these 22 watershed analyses, nine were never completed within the LHZ Project. If and when funding is available, priorities will be reassessed, as 33 of the original priority WAUs for watershed analyses have not been completed.

Status:
Phase 1 — Complete.
Phase 2 — Complete.
Phase 3 — Suspended ,waiting for additional funding.

Link to Adaptive Management

The following section looks at each rule group critical question for the Unstable Landform Identification Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. “Knowledge gained” is only answered for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, “knowledge anticipated” is described. For this program, there are five CMER projects (see Table 25) that address one critical question. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

What screening tools can be developed to assist in the identification of potentially unstable landforms that minimize the omission of potentially unstable landforms?

Knowledge Gained or Anticipated:
This program has satisfied the requirements of the critical question in that four of the projects have been completed and are in daily use and are appreciated by not only the DNR Forest Practices Division but by the TFW community at large. These projects are being used as follows:

1. The **Shallow Rapid Landslide Screen** is used by all DNR regions in screening FPAs for classification. Geologists and forest engineers use this screen as a first cut to determine if further investigation is needed. It has been considered for use in other CMER projects, such as the Post-Mortem Project, as the basis of particular statistical analyses.
2. The **Technical Guidelines for Geotechnical Reports** are being used in all submitted Class IV special reports. Having a standard for reports is vital to the consistency of the review process.

3. The **Landform Hazard Classification System and Mapping Protocols Project** is the written and accepted protocol for the Landslide Hazard Zonation (LHZ) Project. These LHZ protocols are designed to ensure that all the final documents are consistent and comparable.
4. The results of the **Regional Unstable Landforms Identification Project** have been rolled into the LHZ hazard areas. Copies of reports on all identified regional landforms are used in each DNR region, and the Forest Practices Division maintains the originals.
5. The **Landform Hazard Zonation (LHZ) Project** has been completed. The protocol was used to complete 59 WAUs within the LHZ Project. Due to a suspension of legislative funding in July 2009, completion of LHZ WAUs have been postponed.

Identified Gaps:
New LIDAR digital elevation models are supplanting the use of the Shallow Rapid Landslide Screen, commonly known as SLPSTB, which will become obsolete if not updated.

The other identified gap is the completion of the remaining WAUs for the LHZ Project. Depending on prioritization of protocols, there may be another 30–33 WAUs that could be assessed by the LHZ process. The prioritization criteria will need to be designed and approved by the larger TFW community when funding is reestablished in the future. If there are at least three people funded for this project, it is predicted that nine WAUs could be completed per year if the protocol is strictly adhered to. Funding would have to be provided for three to four years.

Recommendations for Addressing Gaps:
As LIDAR becomes available across the state, an updated shallow rapid screening tool should be developed.

Completing the unfinished LHZ WAUs is the only gap that exists, and this issue will be addressed when adequate funding is reestablished by the legislature.

6.5.2 Glacial Deep-Seated Landslides Program (Rule Tool)

Program Strategy

The purpose of the Glacial Deep-Seated Landsides Program is to develop science, tools, and/or guidance for assessing the resource impact potential of deep-seated landslides in glacial sediments resulting from changes in groundwater hydrology during and after timber harvest in the landslide recharge area. Each of the five listed projects develops tools or science that help us address the critical question, "Does harvesting of the recharge area of a glacial deep-seated landslide promote its instability?"

Recent Developments:

At the budget retreat in 2006, Policy requested that UPSAG investigate pathways to resolve difficulties in the application of rules governing timber harvest on groundwater recharge areas of deep-seated landslides. In 2007, UPSAG hired a contractor to provide assistance in scoping several alternative studies. UPSAG evaluated the scoped projects and presented their findings to CMER in the fall of 2007. When there is time available, UPSAG plans to develop recommendations about these three scoped projects and about a fourth project and will present them to CMER and Policy. These four potential projects and one completed project are described below.

Table 26. Glacial Deep-Seated Landslides Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
Does harvesting of the recharge area of a glacial deep-seated landslide promote its instability?	Model Evapo-Transpiration in Deep-Seated Landslide Recharge Areas Project
	Evapo-Transpiration Model Refinement Project
	Landslide Classification Project
	Groundwater Recharge Modeling Project
	Board Manual Revision Project

Model Evapo-Transpiration in Deep-Seated Landslide Recharge Areas Project

Description:

This completed project developed an analytical model for assessing the evapo-transpiration changes resulting from timber harvest. The model was intended to be applied to timber harvest within the recharge area of deep-seated landslides in glacial sediments. The model has been developed but was not directly validated and refined because of insufficient field data to verify model parameters. As such, UPSAG and CMER did not recommend a policy change, even though the results of the model suggest that there is likely a significant, detectible change in water availability when converting an entire groundwater recharge area from mature forest to a clear-cut. A follow-up validation/refinement study could be pursued as a second phase, as described below.

Status:

Complete, but there has been no use of the model due to a general lack of available data required to run the model in the forested environment.

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Evapo-Transpiration Model Refinement Project

Description:
This potential project would use fine-scale meteorological data to validate or refine the evapo-transpiration model developed previously and would develop materials to facilitate application of the model. UPSAG presently recommends that this project not be pursued due to the low likelihood that fundamental scientific uncertainties will be resolved.

Status:
Scoped and on hold.

Landslide Classification Project

Description:
This potential project would categorize the common stratigraphic and geomorphic situations present among deep-seated landslides in glacial sediments to hypothetically evaluate which situations are most sensitive to changes in groundwater produced by upslope timber harvest. UPSAG recommends that this project, in its present form, not be pursued. However, this project may be more attractive if expanded to include an empirical component that evaluates movement of active landslides where harvest occurred in the groundwater recharge area. With CMER and Policy support, UPSAG could further scope a revised version of this study as time and resources allow.

Status:
Scoped and on hold.

Groundwater Recharge Modeling Project

Description:
This potential project would use groundwater modeling to determine whether there are ways of evaluating which parts of the groundwater recharge zone are most influential on landslide movement. This project might be useful if modeling efforts were focused on the common and probably sensitive types of stratigraphic and geomorphic situations as might be identified by the Landslide Classification Project.

Status:
Scoped and on hold.

Board Manual Revision Project

Description:
This potential project would involve revising the Forest Practices Board Manual (Section 16) to more clearly describe which deep-seated landslides are at risk and what intensity of study is required by the activity level of the landslide described by the groundwater recharge rule. This project would not require additional science but would use the expertise of geologists that have extensive experience with deep-seated landslides. It would not require contractors but would

require input from Policy and regulatory personnel. UPSAG will recommend that this project be conducted at the time the recommendations about the three scoped projects are presented.

Status:
On hold.

Link to Adaptive Management

The following section looks at each rule group critical question for the Glacial Deep-Seated Landslides Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. "Knowledge gained" is only answered for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is described. For this program, there are five CMER projects (see Table 26) that address one critical question. The only project in this program that has been completed and approved by CMER is the Model Evapo-Transpiration in Deep-Seated Landslide Recharge Areas Project. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

Does harvesting of the recharge area of a glacial deep-seated landslide promote its instability?

Knowledge Gained or Anticipated:
The knowledge gained for the one completed and approved CMER project (Model Evapo-Transpiration in Deep-Seated Landslide Recharge Areas Project) is a tool to assist in decision making about the harvest of groundwater recharge areas of glacial deep-seated landslides. What was learned during the development of the model was that winter evapo-transpiration is a *potentially* significant component of the annual water balance of an evergreen needle-leaf forest and may be significant also for nonforest vegetation.

Identified Gaps:
Further development of the model as a screening tool is not recommended until after the hypothetical linkage between forest practices and wet-season groundwater storage is empirically substantiated. The proposed research should determine the harvest-groundwater storage effect in several basins where glacial sediments and climate are the most conducive to such effect. If no effect appears in these basins, then the conclusion can be drawn that no effect is likely to be found in *any* basin dominated by glacial sediments. The model may be useful for finding suitable sites for such experiments.

Recommendations for Addressing Gaps:
Near-term research efforts should focus on making *empirical* determinations of the degree to which (1) cumulative winter evapo-transpiration within the forest is significant, (2) vegetation conversion results in a significant decrease in cumulative winter evapo-transpiration, and (3) groundwater storage levels are changed. In addition, typical values of the aquifer parameter for different types of glacial lacustrine deposits must be determined for use in the hydrogeologic portion of the model.

6.5.3 Mass Wasting Effectiveness Monitoring Program

Program Strategy

The purpose of the Mass Wasting Effectiveness Monitoring Program is to assess the degree to which implementation of the forest practices rules is preventing or avoiding an increase in landsliding beyond natural background levels. Natural background rates are difficult to determine. The Mass Wasting Effectiveness Monitoring Program will address the critical question that defines the program: "Are the mass wasting prescriptions effective in meeting the performance targets?" The strategy is to (1) evaluate the effectiveness of identifying unstable slopes for applying prescriptions (avoidance or mitigation); and (2) evaluate effectiveness at two scales, the landscape scale (extensive monitoring) and the site scale (effectiveness monitoring).

Four projects are proposed. The first, Unstable Slope Criteria Project (which replaced the Testing the Accuracy of Unstable Landform Identification Project), is being re-scoped as a pilot project under the LEAN process in response to FP Board direction and Policy feedback. The second, The Mass Wasting Effectiveness Monitoring Project: An examination of the landslide response to the December 2007 storm in Southwestern Washington has been submitted as a non-consensus report to Policy.. The third, Mass Wasting Landscape-Scale Effectiveness Monitoring Project, has been preliminarily scoped. The fourth, Mass Wasting Buffer Integrity and Windthrow Assessment Project, is on hold. Table 27 lists critical questions identified for the Mass Wasting Effectiveness Monitoring Program and the associated projects.

Table 27. Mass Wasting Effectiveness Monitoring Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
Are unstable landforms being correctly and uniformly identified and evaluated for potential hazard?	Unstable Slope Criteria Project (which replaced the Testing the Accuracy of Unstable Landform Identification Project)
Are the forest practices unstable slopes rules reducing the rate of management-induced landsliding at the landscape scale? Are the mass wasting prescriptions and mitigation measures effective in preventing landslides from roads and harvest units?	Mass Wasting Effectiveness Monitoring Project
How does the rate of landsliding on managed lands compare to an estimate of the natural (background) rate? Are the forest practices unstable-landform rules effective at reducing the rate of management-induced landsliding at the landscape scale? Are the mass wasting prescriptions and mitigation measures effective in preventing landslides from roads and harvest units?	Mass Wasting Landscape-Scale Effectiveness Monitoring Project
Does windthrow on mass wasting buffers (leave areas) increase mass wasting?	Mass Wasting Buffer Integrity and Windthrow Assessment Project

Unstable Slope Criteria Project: An Evaluation of Hillslopes Regulated under Washington Forest Practices Rules

Description:
This project will evaluate the degree to which the landforms described in the unstable slopes rules identify potentially unstable areas with a high probability of impacting public resources.

The project will be designed to evaluate the original Forests & Fish Report Schedule L-1 research topic: "*Test the accuracy and lack of bias of the criteria for identifying unstable landforms in predicting areas with a high risk of instability"* (FFR p. 127). The project replaces the Testing the Accuracy of Unstable Landform Identification Project, based on feedback from Policy at the November 2010 meeting. At that meeting, UPSAG presented two interpretations of the original Forests & Fish Report Schedule L-1 topic and asked for direction as to how to proceed and prioritize efforts. UPSAG understands Policy's direction is to evaluate the landslide susceptibility of different slopes/landforms in the interest of evaluating current rule-identified landforms and identifying/characterizing additional potentially unstable landforms.

Status:
The project is on the list for re-scoping using the TWIG approach as a pilot project under the LEAN process.

Mass Wasting Effectiveness Monitoring Project (aka Post-Mortem)

Description:
This project is designed to statistically compare landslide rates among five harvest treatments and five road treatments. The treatments are sets of prescriptions associated with the period in which different forest practices rules were in effect. Given a storm event that produces a significant population of landslides, landslide data will be collected within 4-square-mile blocks, and all area encompassed by the block will be classified into one of the five harvest and five road treatments. Harvest and road landslides will be analyzed separately, and all analyses will be made relative to the block response. Tests will be conducted to determine whether there are differences in the density or volume of landslides associated with each of the harvest and road strata. The statistical design will answer two critical questions in Table 27: "Are the forest practices unstable slopes rules reducing the rate of management-induced landsliding at the landscape scale?" and "Are the mass wasting prescriptions and mitigation measures effective in preventing landslides from roads and harvest units?" The detailed data collection at individual landslides will be used to help evaluate the effectiveness of specific best management practices.

ISPR of the study design was completed over the summer of 2007. UPSAG was revising the study design and asking for final CMER review when the landslide-producing December 2–3, 2007, storm occurred. Final approval of the study design was given by CMER in January 2008. Policy and the Forest Practices Board approved moving forward with implementation in February 2008. UPSAG implemented this project in the spring of 2008. Additional data were incorporated into the study in the fall of 2009.

Status:

The report has been submitted as a non-consensus report which includes minority reports to Policy.

Mass Wasting Landscape-Scale Effectiveness Monitoring Project

Description:
This project will be designed to evaluate trends in the number and volume (or area) of landslides over time at the watershed scale using landslide inventory methods similar to those of watershed analysis. In broad terms, the trend monitoring will include sites that sample statewide variability in the factors that control landslide occurrence. These sites will consist of tracts containing both FP HCP–regulated lands and other forestlands under no or less extensive management (representative of natural or background conditions). Landslide rates and volume fluxes from both will be compared. Data to infer status and trends may consist of an inventory of landslides using data collected through the Landslide Hazard Zonation Project, complemented with aerial photography, terrain, topographic, forest cover, and road network maps. When prioritized, UPSAG will work to better understand how a study might be designed to isolate the mass wasting trends associated with the forest practices rules from the dynamic noise of the natural system.

Status:
Preliminarily scoped and on hold.

Mass Wasting Buffer Integrity and Windthrow Assessment Project

Description:
This project will be designed to test the effect of windthrow in mass wasting leave areas on overall landslide rates. There is a school of thought that suggests that mass wasting leave areas are especially prone to windthrow. If that is true, then mass wasting leave areas may be counterproductive for reducing sediment load to streams. However, downed timber from windthrow has been documented as being effective at slowing the rate of sediment movement on the hillslope. How these two divergent effects affect actual sediment yield to streams is not known.

Status:
There has been no action on this project. In 2012, Policy requested that CMER further investigate the potential for windthrow on FP HCP lands for projects listed in the Work Plan.

Link to Adaptive Management

The following section looks at each rule group critical question for the Mass Wasting Effectiveness Monitoring Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. None of the projects in this program have been completed and approved by CMER. The “Knowledge Gained or Anticipated” section represents anticipated knowledge only. For this program, there are four CMER projects (see Table 27) that address five different critical questions. The Unstable Slope Criteria Project should be completed in 2012. The Mass Wasting Landscape-Scale Effectiveness Monitoring Project has been scoped, but the study will not be designed until the Mass Wasting Effectiveness Monitoring Project (aka Post-Mortem) has been completed. The Mass Wasting Effectiveness Monitoring Project (aka

Post-Mortem) has gone through ISPR. The report was not a consensus approved report by CMER. It went through dispute resolution and was finalized in 2013 with the inclusion of minority reports. And finally, the Mass Wasting Buffer Integrity and Windthrow Assessment Project has been put on hold, and the study is most likely to be scoped within one of the existing Type N riparian projects. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

Are unstable landforms being correctly and uniformly identified and evaluated for potential hazard? *(This question is likely to be redrafted during the Unstable Slope Criteria Project scoping)*

Knowledge Gained or Anticipated:
This intended project will evaluate the degree to which the rule-identified landforms described in the forest practices rules identify potentially unstable areas with a high probability of impacting public resources. The LEAN TWIG will be proposing anticipated knowledge in 2013. Knowledge anticipated is an evaluation of the landslide susceptibility of the current rule-identified landforms and potentially additional landforms of at least regional importance.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Recommendations have not yet been developed.

How does the rate of landsliding on managed lands compare to an estimate of the natural (background) rate?

Knowledge Gained or Anticipated:
The Mass Wasting Landscape-Scale Effectiveness Monitoring Project may be designed to compare landslide rates in managed and unmanaged forests and to evaluate long-term trends in landslide rates in managed forests.

Identified Gaps:
The study has not been designed, so gaps have not yet been identified.

Recommendations for Addressing Gaps:
Recommendations have not yet been developed.

Are the forest practices unstable slopes rules effective at reducing the rate of management-induced landsliding at the landscape scale?

Knowledge Gained or Anticipated:
The Landscape-Scale Effectiveness Monitoring Project, which has not been scoped, will be necessary to address this question. The Mass Wasting Effectiveness Monitoring Project (aka Post-Mortem), may inform elements of this question at the regional scale.

Identified Gaps:
The Post-Mortem Project is limited to landslides from a single storm in a portion of southwest Washington, which does not allow for inference to be made at the landscape level. Additional gaps have not yet been identified.

Recommendations for Addressing Gaps:
Recommendations have not yet been identified.

Are the mass wasting prescriptions and mitigation measures effective in preventing landslides from roads and harvest units?

Knowledge Gained or Anticipated:
The report was ….

Identified Gaps:
Gaps are not identified at this time.

Recommendations for Addressing Gaps:
Additional data analysis and limited additional data collection may be necessary to address gaps, and may be undertaken in conjunction with Policy guidance.

Does windthrow on mass wasting buffers (leave areas) increase mass wasting?

Knowledge Gained or Anticipated:
Although no study has been scoped on this question, the Mass Wasting Effectiveness Monitoring Project (aka Post-Mortem) included data collection about windthrow to potentially address this. However, because the Post-Mortem study area didn't experience significant windthrow, a separate study will be needed.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Recommendations have not yet been developed.

6.5.4 Mass Wasting Validation Program (Intensive)

Program Strategy

No program strategy has been developed, but it is presumed that when UPSAG has time to work on this program that the efforts of the Monitoring Design Team will be a useful starting point.

Table 28. Mass Wasting Validation Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
What levels of cumulative sediment inputs are harmful to aquatic resources at the basin scale?	No projects have been developed

Link to Adaptive Management

This program links to adaptive management by answering the biological "so what" question about the effectiveness of the unstable slopes rules and about the mass wasting performance targets. While there is broad recognition that individual landslides have short- and perhaps medium-term biological impacts in the channels through which they travel, the FFR also acknowledges that landslides are a natural process on the landscape. The key objective of projects developed in this program will be to understand, at a watershed scale, the cumulative effects of different sediment loads in the context of rates of management-induced versus natural landslides. This section will be completed as the program is further developed.

Knowledge Gained or Anticipated:

The knowledge anticipated is the identification of biological thresholds from cumulative sediment levels in the context of rates of management-induced versus natural landslides and with respect to FFR performance targets.

Identified Gaps:

Gaps have not yet been identified.

Recommendations for Addressing Gaps:

Recommendations have not yet been developed.

6.6 ROADS RULE GROUP

Rule Overview and Intent

The intent of the rules for roads is to protect water quality and riparian/aquatic habitat by minimizing sediment delivery to Type S, F, and N waters from road erosion and mass wasting, as well as minimizing changes in hillslope and stream hydrology due to roads. Fish passage at road crossing structures is treated as a separate rule group. The road rules protect water quality and riparian/aquatic habitats through prescriptions and road best management practices (BMPs).

Implementation of these prescriptions through road maintenance and abandonment plans (RMAPs) is intended to minimize road surface sediment production and the hydrologic connection between the road system and the stream network, and the risk of road-related landslides caused by inadequately built and maintained roads. The road rules specify prescriptions for road construction, maintenance and abandonment, landings, and stream crossing structures. In addition, the Forest Practices Board Manual identifies BMPs for roads and landings. The rules required RMAPs for all forest roads to be developed by 2006 for large forest landowners and timed with timber harvest activity for small forest landowners. Mass wasting harvest rules also minimize management activities, including road construction, in landslide-prone locations. Monitoring conducted under the Unstable Slopes Rule Group programs includes mass wasting associated with roads. The Roads Rule Group programs are primarily directed toward monitoring surface erosion and hydrologic disconnection.

The basic assumptions of the road rules are the following:

1. Implementation of road prescriptions will result in achieving FP HCP performance goals and resource objectives, including:
    a. Meeting water quality standards.
    b. Providing clean water and substrate, and maintaining channel-forming processes by minimizing the delivery of management-induced coarse and fine sediment to streams by protecting stream-bank integrity, providing vegetative filtering, protecting unstable slopes, and preventing the routing of sediment to streams and associated wetlands.
    c. Minimizing the effects of roads on surface and groundwater hydrologic regimes (magnitude, frequency, timing, and routing of stream flow). This will be accomplished by disconnecting road drainage from the stream network, preventing increases in peak flows causing scour, and maintaining the hydrologic continuity of wetlands.
2. Assessment and planning using RMAPs is the best method to assure effective implementation of BMPs and this will achieve the above objectives.
3. Roads differ in their degree and importance of impact to the resources of concern, and landowners and other Forests and Fish cooperators can identify and prioritize roadwork based on these differences.
4. Appropriately identified BMPs are effective at achieving functional objectives.

Rule Group Resource Objectives and Performance Targets

Resource Objectives:

- Sediment: Provide clean water and substrate and maintain channel-forming processes by minimizing to the maximum extent practicable the delivery of management-induced coarse and fine sediment to streams (including timing and quantity) by protecting stream-bank integrity, providing vegetative filtering, protecting unstable slopes, and preventing the routing of sediment to the streams.
- Hydrology: Maintain surface and groundwater hydrologic regimes (magnitude, frequency, timing, and routing of stream flows) by disconnecting road drainage from the stream network, preventing increases in peak flows causing scour, and maintaining the hydrologic continuity of wetlands.

Performance Targets:

- Road sediment delivered to streams: New roads — Virtually none.
  Ratio of road length delivering to streams/total stream length (miles/mile): Old roads not to exceed — Coast (spruce), 0.15–0.25; west of crest, 0.15–0.25; east of crest, 0.08–0.12
- Ratio of road sediment production delivered to streams/total stream length (tons/year/mile): Old roads not to exceed — Coast (spruce), 6–10 T/yr; west of crest, 2–6 T/yr; east of crest, 1–3 T/yr.
- Fines in gravel: Less than 12% embedded fines (< 0.85 mm).
- Road runoff: Same targets as road-related sediment; significant reduction in delivery of water from roads to streams.

Rule Group Strategy

The effectiveness monitoring program for roads is planned for two scales: (1) monitoring at the sub-basin scale; and (2) monitoring at the site scale (or prescription scale). The FP HCP contains performance targets at the sub-basin scale. At the sub-basin scale, road monitoring assesses the effectiveness of the rules at meeting the FP HCP performance targets for surface erosion sediment delivery and hydrologic connectivity across ownerships and regions of the state. Site-scale effectiveness monitoring assesses the effectiveness of individual prescriptions.

Site-scale effectiveness monitoring provides more insight into the effectiveness of individual road prescriptions than does sub-basin-scale monitoring. The timetable for forest landowners to implement forest practices prescriptions is tied to RMAPs. The site-scale monitoring program requires the development of site-specific road performance measures (based on prescription objectives), the testing of site-level effectiveness using RMAP-implemented areas as a sampling stratum, and the development of field protocols for site-scale performance measures. The road site-scale effectiveness monitoring program will inform the rules at several levels by determining the degree to which strategies are achieving resource objectives at the site scale, assessing the need to modify individual RMAPs to achieve resource objectives, and assessing the need to modify guidelines and rules for road maintenance and abandonment planning.

Assessment of the rules leads to five critical questions to be addressed by three monitoring and validation programs (Table 29). The monitoring strategy is based on CMER's experience with road sediment problems and BMPs and with implementation realities, as well as on the data from numerous watershed analyses used to develop the forest practices road performance targets for

sediments. The effectiveness monitoring strategy includes both a site-scale program and a basin-scale program. Validation of the road performance targets, which is more complex and time-consuming, will come later. This approach will first inform the uncertainties about BMP effectiveness and BMPs' ability to meet performance targets. If BMPs are ineffective, validation monitoring is unwarranted. If BMPs are proving to be effective, then validating the performance targets should begin (i.e., do we have the right target?).

Table 29. Roads Rule Group Critical Questions and Programs

Rule Group Critical Questions	Program Names	Task Type	SAG
Are road prescriptions effective at meeting sub-basin-scale performance targets for sediment and water? (Exclusive of mass wasting prescriptions, which are covered under the Unstable Slopes Rule Group)	Road Sub-Basin-Scale Effective-ness Monitoring Program	Effectiveness	UPSAG
Does the RMAP process correctly identify and prioritize road problems for repair? Are road prescriptions effective at meeting site-scale performance targets for sediment and water? (Exclusive of mass wasting prescriptions, which are covered in the Unstable Slopes Rule Group section)	Road Prescription-Scale Effective-ness Monitoring Program		
Have the correct performance targets for sediment delivery and connectivity been identified? What levels of cumulative sediment inputs are harmful to the resource at the basin scale?	Roads Validation Program and Cumulative Sediment Effects	Intensive	UPSAG

6.6.1 Road Sub-Basin-Scale Effectiveness Monitoring Program

Program Strategy

The purpose of the Road Sub-Basin-Scale Effectiveness Monitoring Program is to determine the degree to which the road rule package is effective at meeting performance targets for surface erosion sediment and water established at the sub-basin scale as a whole across the state. This program is ranked fourth among the 16 CMER programs.

The Road Sub-Basin-Scale Effectiveness Monitoring Program currently consists of three projects that are related to critical questions in Table 30. Two projects revise and validate the analytical model to estimate road surface erosion (the Washington State Road Surface Erosion Model, or WARSEM) that is used in the monitoring program to estimate sediment contributions and connectivity from selected road segments and road systems. The third project measures changes in the road conditions known to generate sediment and hydrologic connectivity between those road segments and the stream-channel network. Because the rules provide a 15-year window for implementation of RMAP upgrades, this program is long-term and results will provide a periodic evaluation of the trend and the trajectory toward meeting the performance targets by 2016.

Table 30. Road Sub-Basin-Scale Effectiveness Monitoring Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions		Project Names
Are road prescriptions effective at meeting sub-basin-scale performance targets for sediment and water?		Road Sub-Basin-Scale Effectiveness Monitoring Project
Program Research Questions	*Are field or analytical methods needed to support the monitoring program?*	Road Surface Erosion Model Update Project
	How accurate is the road surface erosion model in predicting average road sediment from runoff at the site scale?	Road Surface Erosion Model Validation/Refinement Project

Road Sub-Basin-Scale Effectiveness Monitoring Project

Description:

The main purpose of this project is to provide data that can be used to assess the degree to which sub-basin-scale performance targets, and therefore resource objectives, are being met throughout the state. This project also characterizes the extent of road conditions that reduce surface erosion (e.g., improved surfacing, reduced runoff to streams). Data collected at the sub-basin scale will determine the status and assess trends of key indicators of road connectivity using WARSEM sediment delivery through time. This project does not address performance targets for road performance relative to mass wasting erosion processes, which are more readily evaluated through other monitoring projects. Forest road systems in randomly selected sample areas that are proportionately distributed statewide in areas under forest practices rules, independent of ownership, are being monitored. Small forest landowner properties are included in the study whenever they fall within the sampling blocks. Data are collected to determine the degree to which roads meet established performance targets and the strength of the relationship between those reported measures and the percentage of sample area under implemented RMAPs. Because

road monitoring at the sub-basin scale extends through the15-year road rule implementation period, this piece was put in place before model validation and performance target validation.

Status:
Results from Phase 1 underwent ISPR and were approved by CMER in early 2010. Re-measurement of Phases 2 and 3 are scheduled to occur, respectively, later within the RMAP implementation period and following completion currently scheduled for 2021 (this deadline was extended for up to 5 years from 2016).

Road Surface Erosion Model Update Project

Description:
The road surface erosion model within the Surface Erosion Module of the Washington Forest Practices Board Manual on Standard Methodology for Conducting Watershed Analysis (version 4.0, November 1997) is an empirically derived model widely used for estimating surface erosion and sediment delivery to streams from forest roads. The primary purpose of this project was to refine and adapt the model for use in forest road monitoring and as an assessment method. Revisions include standardizing input variables and developing repeatable application protocols. This project also included development, testing, and refinement of standardized protocols for field application of the revised road surface erosion model for use at the site and road-segment scale.

Status:
This project was completed in 2003 and produced the Washington State Road Surface Erosion Model (WARSEM).

Road Surface Erosion Model Validation/Refinement Project

Description:
WARSEM is based on a range of empirically derived data available in 2003. This project would measure sediment from selected Washington road sites to evaluate the accuracy of modeled sediment delivery rates. This study could be designed to also evaluate the effectiveness of individual sediment control strategies, such as sediment traps, silt fences, or enhanced cutslope vegetation.

Status:
Timing of scoping and study design is planned to follow completion of the Roads Prescription-Scale Effectiveness Monitoring project. The need for this project will depend largely on the expansion of available relevant road erosion data sets and/or modeling tools due to research occurring outside of CMER.

Link to Adaptive Management

The following section looks at each rule group critical question for the Road Sub-Basin-Scale Effectiveness Monitoring Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. “Knowledge gained” is only answered for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, “knowledge anticipated” is described. For this program,

there is one CMER project listed (see Table 30) for answering the one critical question. The Phase 1 report for the Road Sub-Basin-Scale Effectiveness Monitoring Project has undergone the ISPR process and was approved by CMER. CMER subsequently approved and forwarded the answers to the Six Questions (Adaptive Management Board Manual, Section 22), which are a synthesis of the knowledge gained, with the CMER-approved report to Policy in December 2011.

Are road prescriptions effective at meeting sub-basin-scale performance targets for sediment and water?

Knowledge Gained or Anticipated:
Phase 1 is the first sampling of 60 four-square-mile blocks randomly selected across Washington State. It is intended that sampling occur once or twice more during the years of RMAP implementation (through 2021) to understand the long-term trend of road erosion and to determine if the performance targets are achieved at the end of RMAP implementation.

Road managers reported that over half of the sample units had at least 85% of road length meeting post-RMAP standards. Across all samples, an average of 11% of the road length was hydrologically connected to streams or wetlands, though much variability exists between regions and blocks. Sixty-two percent of the road samples met the regional performance target for hydrologic connectivity, and 88% of the samples met the sediment target. These are all favorable results, given that they were observed less than halfway through the RMAP implementation period. Sediment delivery performance by sample block was statistically correlated with progress toward RMAP standards. However, hydrologic connectivity was not statistically related to progress toward rule standards, reflecting that connectivity targets are difficult to achieve for roads located in areas of high stream density. The results of future monitoring events (planned interval of five years) will identify what changes in road performance result from additional road improvements.

Advisory language was placed in DNR's Board Manual Section 3 – Guidelines for Forest Roads – recommending that landowners identify those road segments which they believe are in good repair, but which the study indicates remain highly connected to the channel network.

Identified Gaps:
Due to the sample selection protocol, approximately 95% of the roads sampled were within large industrial and state or local government ownership. Although the project was intended to incorporate roads owned by small forest landowners, the fragmented ownership pattern among such landowners seldom fits into the sub-basin-sized (i.e., 4 mi^2) sample blocks.

The scope of work for this project did not include direct measurement of actual eroded sediment quantities delivered to surface water or the water quality of biotic impacts. Because a sub-basin-scale sampling approach was chosen, this project was not designed to evaluate the effectiveness of road conditions at preventing sediment delivery from causing landslides, or the effectiveness of individual road practices. Furthermore, the project did not evaluate the implementation of RMAPs or the implementation or effectiveness of fish passage at forest roads.

Recommendations for Addressing Gaps:
To address the unrepresentative sample of small forest landowner roads, the development of a companion study would be required. This project should be designed specifically to access and evaluate roads within small forest landowner ownership. This project is one of several in the CMER Work Plan conceived to evaluate the effects of forest roads on watershed functions. Other gaps listed as outside of this project's scope of work should be prioritized by Policy in the CMER Work Plan and considered in future projects.

Performance targets for this project were developed using field data from watershed analyses and similar road studies. This project revealed some uncertainty in existing targets and indicated a wider range in road conditions than anticipated. Targets could be improved with results of intensive watershed monitoring and/or outside research. This project significantly improved knowledge of statewide forest road conditions, especially within industrial ownership.

6.6.2 Road Prescription-Scale Effectiveness Monitoring Program

Program Strategy

The dual purposes of the Road Prescription-Scale Effectiveness Monitoring Program are to (1) determine the degree to which maintenance activities within RMAPs have been appropriately identified; and (2) assess the effectiveness of specific BMPs in meeting their intended objective(s).

As described in Table 31, an important issue related to road effectiveness monitoring is the degree to which maintenance activities targeted in the RMAP assessments are appropriately identified and prioritized based on rule language to fix the "worst first." Monitoring this aspect of the prescription strategy for roads is important because individual or collective prescriptions that are effective in meeting resource protection goals, if not applied to the right locations, may not achieve resource objectives and yet might still incur cost to the landowner. Equally important is the assessment of the degree to which BMPs are effective in meeting their stated objective of either reducing sediment delivery or disconnecting roads from DNR typed waters. This program is ranked ninth among the 16 CMER programs.

We anticipate that the results of these studies will inform the forest practices adaptive management process about the effectiveness of RMAP rules in achieving the FP HCP goals. Should RMAPs prove to be ineffective, Policy may have to revisit the rule to refine its requirements and application.

Table 31. Road Prescription-Scale Effectiveness Monitoring Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
Does the RMAP process correctly identify and prioritize road problems for repair?	Effectiveness of RMAP Fixes Project
Are road prescriptions effective at meeting site-scale performance targets for sediment and water?	Road Prescription-Scale Effectiveness Monitoring Project

Effectiveness of RMAP Fixes Project

Description:

The primary purpose of this project is to evaluate the degree to which RMAP road repairs have been appropriately identified and implemented. The project is envisioned to follow the completion of the Road Sub-Basin-Scale Effectiveness Monitoring (for surface erosion and connectivity issues) and Mass Wasting Effectiveness Monitoring projects (for road instability issues), so that results of these studies can be used to refine the list of treatments to be investigated and inform a sampling design for the RMAP project described here.

This project would determine the extent to which identified road problems were located in areas where RMAP repairs had been implemented and would attempt to determine why site-scale benefits were not achieved.

Status:
This project has not been scoped.

Road Prescription-Scale Effectiveness Monitoring Project

Description:
The objectives of monitoring forest roads at the prescription scale are to (1) evaluate the effectiveness of road maintenance categories in meeting road performance targets; and (2) identify sensitive situations where prescriptions are not effective. This project would address surface erosion sediment reductions from site-specific measures. An extensive body of research already exists and was used to develop WARSEM; and data collected during the Road Sub-Basin-Scale Effectiveness Monitoring Project can be evaluated to determine which measures are proving most effective at reducing sediment production, sediment delivery, and hydrologic connectivity.

Status:
This project has been targeted to be used as a pilot for the LEAN revisions to the CMER process for developing study designs. CMER is currently in the process of forming a technical writing and implementation group (TWIG) to begin scoping this project.

Link to Adaptive Management

The following section looks at each rule group critical question for the Road Prescription-Scale Effectiveness Monitoring Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. "Knowledge gained" is only answered for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is described. For this program, there are two CMER projects listed (see Table 31) for answering the two critical questions. UPSAG has not scoped these projects; results from the Mass Wasting Effectiveness Monitoring Project and from the Road Sub-Basin-Scale Effectiveness Monitoring Project are expected to guide the development of these projects. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

Does the RMAP process correctly identify and prioritize road problems for repair?

Knowledge Gained or Anticipated:
The project to address this critical question has not yet been scoped.

Identified Gaps:
The Road Sub-Basin-Scale Effectiveness Monitoring Project found a subset of roads that landowners have identified as up to standard but that still have a connection to the channel network.

Recommendations for Addressing Gaps:
Use the Road Sub-Basin-Scale Effectiveness Monitoring Project to focus this critical question and its associated project on key situations that the RMAP process is not adequately addressing.

Are road prescriptions effective at meeting site-scale performance targets for sediment and water?

Knowledge Gained or Anticipated:
The Road Prescription-Scale Effectiveness Monitoring project may partially answer this critical question.

Identified Gaps:
This critical question will need further clarification from the Policy Committee, as there currently are not "site-specific performance targets" listed in the FP HCP. For example, this could be interpreted as simply meeting water quality standards for sediment and/or encompass the effectiveness of road prescriptions.

This type of detailed research will need to be focused on individual prescriptions, and we do not currently know which ones those are and which of those would be most appropriately used as the subject of this research. The Road Sub-Basin-Scale Effectiveness Monitoring project data will be used as one source of information to help inform this project during scoping.

Recommendations for Addressing Gaps:
Interaction with Policy will be needed to clarify the meaning of "site-scale performance targets."

Previous work, including WARSEM documentation, details which prescriptions are reasonably well quantified and which are not. The Road Sub-Basin-Scale Effectiveness Monitoring Project will tell us which prescriptions are commonly used. An update to our already extensive literature knowledge will tell us what others are doing. All of this will help us focus on which individual prescriptions will be most useful to better quantify.

6.6.3 Roads Validation Program and Cumulative Sediment Effects

Program Strategy

Validation of road effects and performance targets is envisioned to occur with CMER research in coordination with external cumulative effects research. This is because of the need to coordinate research on sediment generation with parallel study of potentially affected biota, including fish and amphibians.

Table 32. Roads Validation Program and Cumulative Sediment Effects: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
Have the correct performance targets for sediment delivery and connectivity been identified? What levels of cumulative sediment inputs are harmful to the resource at the basin scale?	Intensive Watershed-Scale Monitoring to Assess Cumulative Effects

Intensive Watershed-Scale Monitoring to Assess Cumulative Effects

Description:

For preliminary study description, see this work plan's Section 6.11, "Intensive Watershed-Scale Monitoring to Assess Cumulative Effects."

Status:

Initial scoping began in 2008. Additional effort depends on prioritization.

Link to Adaptive Management

The following section looks at each rule group critical question for the Roads Validation Program and Cumulative Sediment Effects. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. "Knowledge gained" is only answered for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, knowledge anticipated is described. For this program, there is one CMER project listed (see Table 32) for answering the two critical questions – Intensive Watershed-Scale Monitoring to Assess Cumulative Effects. UPSAG has not scoped this project, and there are no plans to do so in the near future.

Have the correct performance targets for sediment delivery and connectivity been identified?

Knowledge Gained or Anticipated:

No project has yet been scoped to address this question.

Identified Gaps:

The current performance targets were crudely derived from watershed analysis results — we believe that these performance targets achieve water quality standards (at least in the lower channel network where fish live), but we have no idea what the biological response is to these

sediment levels (i.e., we do not know if the performance targets for sediment levels are in the right order of magnitude).

Recommendations for Addressing Gaps:
A wide range of sediment levels will have to be evaluated to answer both this question and the next one — the study design must account for this.

What levels of cumulative sediment inputs are harmful to the resource at the basin scale?

Knowledge Gained or Anticipated:
No project has yet been scoped to address this question.

Identified Gaps:
Validation modeling to answer the biological "so what" question is very difficult to design and requires that specific species and life history stages be targeted. What are "the resources" we are specifically targeting?

This type of basin-scale research has not been done for road sediment, so there is not a solid foundation of previous work to guide a study design.

Recommendations for Addressing Gaps:
Interaction with Policy will be needed, probably between the scoping of alternatives and study design steps, to help confirm the study has the specific species and life history stages (e.g., the resource) useful to policy-makers.

A literature review of related work will probably need to be done before this project is scoped.

6.7 FISH PASSAGE RULE GROUP

Rule Overview and Intent

Fish passage blockages at road crossing structures are to be addressed as part of the road maintenance and abandonment plan (RMAP) process. Road crossing structures will be inventoried and evaluated, and those functioning as fish barriers are to be prioritized based on the quantity and quality of a potential fish-bearing stream being affected upstream of the barrier. Those structures that do not provide fish passage must be repaired or replaced within 15 years, typically on a "worst first" basis. WDFW's hydraulic code rules, the associated barrier-assessment manual, and DNR's forest practices rules apply to crossing structures on forest roads.

The fish passage rule is based on the following assumptions:

- Achieving the objective of no fish barriers is critical for recovery of depressed stocks and the health of fish at all life history stages.
- Implementation of the forest practices rules will result in achieving the objective to maintain or provide passage for fish in all life history stages and to provide for the passage of some woody debris likely to be encountered.
- Assessment, prioritization, and implementation of RMAPs will achieve the objectives in a timely manner.
- Current stream crossing replacement standards are adequate to address fish passage at all life history stages.
- Hydraulic rules are effective at achieving resource objectives.
- Performance targets can be developed for fish at all life history stages.
- Stream-simulation methods provide passage for fish (definition WAC 222-16-010) at all life history stages.

Rule Group Resource Objectives and Performance Targets

Resource Objectives:

- Maintain or restore passage for fish in all life stages and provide for the passage of some woody debris by building and maintaining roads with adequate stream crossings.

Performance Targets:

- Eliminate road-related access barriers over the time frame for road management plans.
- Test the effectiveness of fish passage prescriptions at restoring and maintaining passage.

Rule Group Strategy

Based on an analysis of the forest practices rules, assumptions and uncertainties underlying the rules were identified. To address these uncertainties, in 2003 ISAG developed critical questions. Two programs were set up to address these critical questions (Table 33). The goal of the Fish Passage Effectiveness/Validation Monitoring Program is to validate the assumptions and test the effectiveness of the forest practices rules in providing passage at road crossings for fish (as defined by WAC 222-16-010) at all life history stages. The Monitoring Design Team defines extensive monitoring as a population-scale assessment of the effectiveness of the forest practices rules in attaining forest practices–related performance targets across FP HCP lands (MDT, 2002). The implied FP HCP performance target for fish passage, based upon the requirements for

RMAPs, is to eliminate fish blockages on FP HCP–regulated lands. The purpose of this program is to evaluate status and trends in fish passage conditions at forest road crossings. The strategies for each of the two programs are described in the sections below.

Table 33. Fish Passage Rule Group Critical Questions and Programs

Rule Group Critical Questions	Program Names	Task Type	SAG
Are the corrective measures effective in restoring fish passage for fish at all life history stages?	Fish Passage Effectiveness/ Validation Monitoring Program	Effective -ness	ISAG
What is the current status of fish passage on a regional scale, and how are conditions changing over time?	Extensive Fish Passage Monitoring Program	Extensive	ISAG

ISAG presented the proposed CMER research strategy for fish passage to Policy. Due to differing stakeholder perspectives on what the CMER research strategy should focus on, Policy designated a subgroup to determine which important issues and/or critical questions should be prioritized for the Fish Passage Rule Group. The Policy subgroup decided that if and when important policy and/or management issues are determined Policy will then define an appropriate research and monitoring strategy for CMER.

The following sections describe ISAG efforts to date on the fish passage research and monitoring strategy. Currently, ISAG is inactive.

6.7.1 Fish Passage Effectiveness/Validation Monitoring Program

Program Strategy

There are key questions concerning the adequacy of current fish passage design methods, existing fish passage criteria, and the definition of a fish passage barrier. This is particularly true for passing "all species and life stages" as required in the forest practices rules. Some of these questions are applicable to high-gradient headwater streams where only resident fish species are present. This was a particular area of interest for ISAG because information on these headwater streams is lacking.

The primary purpose of the Fish Passage Effectiveness/Validation Monitoring Program is to address scientific uncertainties surrounding fish passage in headwater streams. The Fish Passage Effectiveness/Validation Monitoring Program was originally (2005) composed of three principal elements: (1) fish movement capability; (2) fish life history and movement ecology; and (3) road crossing structure designs that provide fish passage (barrier solutions). As part of this strategy, ISAG worked on study designs for two primary projects: (1) the Fish Passage Capability - Culvert Test Bed Project; and (2) the Effectiveness of Design Criteria for Stream Simulation Culverts. ISAG also developed questions to be answered by a literature review to address headwater fish ecology and movement.

ISAG completed the study designs for the two proposed studies in 2007. CMER delivered the study designs to Policy. Policy was uncertain about the direction and focus of the proposed fish passage research strategy, as well as the proposed studies presented to them. A Policy subgroup was formed to further assess the fish passage research and monitoring strategy. During the interim, Policy directed CMER to send both study designs through the ISPR process. After CMER reviewed the results of the ISPR in May 2008, Policy decided to not proceed with either study (i.e., the Culvert Test Bed Project or Stream Simulation Project).

In June 2009, Policy agreed that (1) no fish passage research should be planned for FY10; (2) further discussion should occur on extensive fish passage monitoring; and (3) Policy should consider waiting for more information to come out of efforts currently underway within WDFW relative to fish passage under the hydraulic permit application (HPA) habitat conservation plan (HCP) development and fish passage effectiveness research. When the information from WDFW becomes available, Policy should consider the information's importance and relevance to the existing CMER fish passage research strategy.

Since 2007, the two studies and the literature review have been funded through sources outside of the Forest Practices Adaptive Management Program. A pilot for the Culvert Test Bed Project, funded through the National Council for Air and Stream Improvement (NCASI), was implemented in the summer of 2009. The Stream Simulation Project, funded through DNR and carried out by WDFW, was implemented on DNR state lands. The literature review for headwater fish ecology and movement was funded by WDFW and contracted with the Forest Service. Although the study designs for these studies were primarily developed through CMER, these studies are no longer considered CMER studies. The scientific results, however, may still be considered in future efforts in the Forest Practices Adaptive Management Program.

Table 34. Fish Passage Effectiveness/Validation Monitoring Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions		Project Names
Are the corrective measures effective in restoring fish passage for all life history stages?		
Program Research Questions	*What is fish passage capability (e.g., probability of passage) through culverts under different flow and slope conditions for native headwater species and life stages?*	Former proposed CMER study: Fish Passage Capability - Culvert Test Bed Project
	How well does laboratory-derived passage-capability criteria apply to fish passage through culverts in the field?	No project defined yet
	Are the solutions (existing tools) we are implementing working to provide fish passage as needed?	Former proposed CMER study: Effectiveness of Design Criteria for Stream Simulation Culverts
	Are our assumptions about fish movement and fish passage in headwater streams correct?	Formerly proposed by CMER: Literature review of headwater fish ecology and movement

Link to Adaptive Management

This section should be developed within the next year.

Knowledge Gained or Anticipated:

Identified Gaps:

Recommendations for Addressing Gaps:

6.7.2 Extensive Fish Passage Monitoring Program

Program Strategy

ISAG completed an extensive fish passage monitoring study design in 2005. CMER delivered the study design to Policy. Policy decided not to fund the project due to budget considerations and also limitations in scope due to the absence of "small" forest landowners in the sampling design. Implementation of the study design has been delayed indefinitely.

Table 35. Extensive Fish Passage Monitoring Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
What is the current status of fish passage on a regional scale, and how are conditions changing over time?	Extensive Fish Passage Trend Monitoring Project

Extensive Fish Passage Trend Monitoring Project

Description:

A study design for fish passage trend monitoring was developed using guidelines consistent with the Forests and Fish Report and supplied by ISAG. The contractor (WDFW) reviewed possible monitoring approaches and presented a recommended study design and methodology that was reviewed and approved by ISAG and CMER.

In addition to the WDFW study proposal, ISAG explored the potential of collecting stream crossing condition data in conjunction with the UPSAG Road Sub-Basin-Scale Effectiveness Monitoring Project. ISAG recognized that this approach would not provide all of the information needed to address the critical question but considered it a cost-effective opportunity to get supplemental information about culvert conditions from a statewide random sample. ISAG developed a set of questions for assessing culvert suitability and these questions were added to the UPSAG road survey.

Status:

Due to budgetary considerations and potential limitations in scope, implementation of the WDFW design has been delayed indefinitely by Policy. The UPSAG road survey was completed in 2008, and culvert conditions data were collected from approximately 1300 stream crossings. These data have not been analyzed and further investigation is pending Policy direction.

Link to Adaptive Management

This section should be developed within the next year.

Knowledge Gained or Anticipated:

Identified Gaps:

Recommendations for Addressing Gaps:

6.8 PESTICIDES RULE GROUP

Rule Overview and Intent

The objectives of the Pesticides Rule Group are to manage pesticide use to achieve water quality standards, meet label requirements, and avoid harm to riparian vegetation. In the context of the forest practices rules, pesticide means "any insecticide, herbicide, fungicide or rodenticide, but does not include nontoxic repellents or other forest chemicals."

The pesticide rules include a series of regulations that cover (1) aerial application of pesticides; (2) ground application of pesticides with power equipment; and (3) hand application of pesticides. The rules for aerial application of pesticides prescribe a setback (offset) to prevent application of pesticides within the core and inner zones of Type F and S streams, or the wetland management zone (WMZ) of Type A or B wetlands. In these cases, the offset is from the outer edge of the inner zone or the WMZ. Offsets are also prescribed for flowing Type N streams and Type B wetlands < 5 acres; however, in these cases the offsets are measured from the edge of the bankfull channel or wetland. The offset distances vary depending on water type, the type of nozzle used, and wind conditions at the time of application. Separate guidelines govern ground application of pesticides with power equipment and hand equipment within RMZs and WMZs.

The main assumption is that the pesticide rules will be effective in achieving the objectives of meeting water quality standards, label requirements, and preventing damage to vegetation in RMZs and WMZs. A level of uncertainty exists for the aerial application of pesticides because of the potential difficulties caused by terrain and wind conditions.

Rule Group Resource Objectives and Performance Targets

Resource Objectives:

- Provide for clean water and native vegetation (in the core and inner zones) by using forest chemicals in a manner that meets or exceeds water quality standards and label requirements by buffering surface water and otherwise using best management practices.

Performance Targets:

- Entry to water: No entry to water for medium and large droplets; minimized for small droplets (drift).
- Entry to RMZs: Core and inner zone — Levels cause no significant harm to native vegetation.

Rule Group Strategy

A single critical question has been developed, with a corresponding effectiveness program (Table 36).

Table 36. Pesticides Rule Group Critical Questions and Programs

Rule Group Critical Questions	Program Name	Task Type	SAG
Do the pesticide rules protect water quality and vegetation within the core and inner zones of Type S and F RMZs, the WMZs of Type A or B wetlands, and Type N streams and buffers?	Forest Chemicals Program	Effective-ness	RSAG

6.8.1 Forest Chemicals Program (Effectiveness)

Program Strategy

The purpose of the Forest Chemicals Program is to address uncertainty concerning the effectiveness of the chemical application rules in protecting water quality and vegetation in riparian and wetland buffers. Alternative strategies with lower costs will also be considered.

This program is ranked last among the 16 CMER programs. Scoping has not occurred and no projects have been identified.

Link to Adaptive Management

This section will be completed as the program is further developed.

Knowledge Gained or Anticipated:

Identified Gaps:

Recommendations for Addressing Gaps:

6.9 WETLANDS PROTECTION RULE GROUP

Rule Overview and Intent

The intent of the WAC 222 wetland rules is to achieve no net loss of wetland function (water quality, water quantity, fish and wildlife habitat, and timber production) by avoiding, minimizing, or preventing sediment delivery and hydrologic disruption from roads, timber harvest, and timber yarding; and by providing wetland buffers (wetland management zones, or WMZs). The application of WAC 222 rules is assumed to achieve and protect aquatic conditions and processes that meet resource objectives and consequently achieve the three Forests and Fish Report (FFR) performance goals. WETSAG understands that there is uncertainty regarding this assumption because the functional relationships between forest practices, wetland functions, and aquatic resource response are not well studied or understood.

Areas of uncertainty include the following: (1) how to quantify the functions and connectivity of wetlands to streams and for fish and amphibian habitat; (2) how wetlands contribute to base flow, or provide flood storage and downstream peak flow attenuation; (3) how wetlands contribute to water quality; (4) the effects of road management practices on sediment delivery to wetlands; and (5) the contribution of large woody debris (LWD) and nutrient regimes from wetlands to downstream fish-bearing streams.

The rules contain additional assumptions that include:

- Implementation of the wetland prescriptions for timber harvest (WAC 222-30-020) will result in no net loss of wetland functions over a timber rotation, assuming that some wetland functions may be reduced until the midpoint of a timber rotation cycle.
- Application of the mitigation sequence in WAC 222-24-015 for road construction will result in no net loss of wetland function.
- Appropriately identified, best management practices (BMPs) are effective at achieving resource objectives.
- Forested wetlands will successfully regenerate following timber harvest.

Several uncertainties exist about the validity of these assumptions based on a lack of applied research and accurate wetland mapping and typing. These uncertainties include the following: (1) the response of wetlands and wetland functions to management practices and the level of protection provided by prescriptions is not known; (2) the wetland typing system (A, B, Forested) does not reflect the complexity of different wetland functions across the landscape, potentially reducing the ability to target rule protection to aquatic resources, including water quality, hydrology, and rule-covered species in different types of wetlands; (3) forested wetlands are not consistently treated as “typed” waters and thus may not receive water quality protection measures and BMPs during road construction or harvest; and (4) it is not known to what degree current rules for wetland mitigation related to road construction will achieve the “no net loss of wetland functions.”

Quantifying “no net loss” is difficult because no objective performance measures are available for determining the following:

- The range of wetland functions affected by road construction or harvest.

- Net loss or gain of these functions over time.
- Net loss of one or more functions with a concurrent net gain of another function.
- The cumulative impact across the FP HCP landscape of filling or draining individual wetlands that are less than 0.10 acre.
- The cumulative effect of creating or expanding wetlands through forest practices activities.

The forest practices rules (WAC 222-16-035) classify wetlands into three general categories: Type A, B, and Forested, depending on soils, vegetation, canopy closure, wetland size, and acreage of open water.

Mapping and delineation requirements in WAC 222-16-036 must be performed as outlined in the Forest Practices Board Manual, Section 8, for the following: wetlands greater than 0.1 acre that will be impacted by filling and where mitigation for such filling is required; forested wetlands greater than 3 acres; and all forested wetlands in a riparian management zone, unless entry within the riparian management zone is not proposed as part of the harvest application.

Wetland management zones (WMZs) and harvest methods in WAC 222-30-020 are as follows: WMZs are prescribed for all Type A and Type B wetlands greater than 0.5 acre, or 0.25 acre for bogs. WMZ widths vary based on the wetland type and area; harvest is allowed within the maximum-width WMZ. The specific leave tree requirements within WMZs differ for eastern and western Washington. The use of ground-based harvesting equipment is restricted within WMZs. Harvest methods are limited to low-impact harvest or cable systems within forested wetlands, and landowners are encouraged to leave a portion of the wildlife reserve tree requirement within the wetland.

Road construction in wetlands (WAC 222-24-015) is as follows: A mitigation sequence applies to road construction to address no net loss of wetland function. The preferred option is to prevent impacts by locating roads outside of wetlands (avoidance); however, where this is not possible, the mitigation sequence and Board Manual guidelines seek to minimize and mitigate impacts.

Rule Group Resource Objectives and Performance Targets

Resource Objectives:

The wetland WMZ and road prescriptions are intended to accomplish the following stated FP HCP functional objectives under the Hydrology Resource Objective as stated in Schedule L-1:

- Maintain surface and groundwater hydrologic regimes (magnitude, frequency, timing, and routing of stream flows) by disconnecting road drainage from the stream network, preventing increases in peak flows causing scour, and maintaining hydrologic continuity of wetlands.
- Prevent increases in peak flows causing scour, and maintain hydrologic continuity of wetlands.

Performance Targets:
There are two performance targets under the Hydrology Resource Objective that include wetlands:

- Westside: Do not cause a significant increase in peak flow recurrence intervals resulting in scour that disturbs stream channel substrates providing actual or potential habitat for salmonids, attributable to forest management activities.
- No net loss in the hydrologic functions of wetlands.

A number of other FP HCP resource objectives specific to streams also apply to wetlands but are not explicitly stated in either Schedule L-1 of the FFR or in the FP HCP. Schedule L-2 refers to the following functional objectives, performance targets, and projects regarding wetlands:

1. Heat Temperature Functional Objective: Provide cool water by maintaining shade, groundwater temperature, flow, and other watershed processes controlling stream temperature.
    a. Performance targets: Stream temperature, groundwater, and shade.
        i. Project TH8: Test whether the wetland prescriptions are effective in preventing downstream temperature increases beyond targets.
2. Large Woody Debris/Organic Inputs Functional Objective: Provide complex and productive in- and near-stream habitat by recruiting large woody debris and litter.
    a. Performance targets: Riparian conditions, litter fall, in-stream LWD targets, residual pool depth.
        i. Project LWD14: Test the regeneration capacity of forested wetlands in riparian zones.
        ii. Project LWD 15: Evaluate the effectiveness of current WMZs in meeting in-stream LWD targets.
3. Hydrology Functional Objective: Maintain surface and groundwater hydrologic regimes (magnitude, frequency, timing, and routing of stream flows) by disconnecting road drainage from the stream network, preventing increases in peak flows causing scour, and maintaining the hydrologic continuity of wetlands.
    a. Performance targets: Peak flows and wetlands.
        i. Project H3: Develop a process to accurately identify wetlands in the dry season, especially on the eastside.
        ii. Project H8: Determine wetland size and function requiring mitigation sequencing to achieve targets.
        iii. Project H9: Assess the hydrologic functions of forested wetlands, the effects of harvesting on stream flows, and the effectiveness of prescriptions in meeting wetland targets. If needed, revise the classification system based on wetland function.

These objectives are discussed in more detail in the Wetlands Rule Group critical questions and the “Link to Adaptive Management” sections for each program strategy outlined below.

Rule Group Strategy

The Research Strategy for projects is a revised Clean Water Act (CWA) milestone that is guiding the prioritization of projects. Rather than to establish a new set of detailed milestones (date priorities for each project) Ecology inserted a new milestone that would allow the order to

essentially be established as part of a CMER led wetland strategy project. The work plan integrates the projects below.

The former wetland mitigation study was redirected to a forested wetlands effectiveness study. WETSAG is in process to complete the Wetlands Literature Synthesis, and use the information as a foundation to develop both a research strategy and as a foundation to scope the forested wetlands effectiveness study.

Current FP-HCP Adaptive Management Program Priority Projects

Forest Practices and Wetlands Systematic Literature Review
Forested Wetlands Effectiveness Study
Wetlands Program Research Strategy
Wetland/Stream Water Temp Interactions
Wetland Hydrologic Connectivity
Wetlands Management Zone Effectiveness Monitoring
Wetlands Overlay Project
Wetlands Intensive Monitoring
Wetlands Mitigation Effectiveness (de-prioritized by CMER/ Policy)

The assumptions and uncertainties listed above guided the development of critical questions and research and monitoring programs to address them (Table 37).

The Washington Department of Ecology (WDOE) is charged with overseeing the Clean Water Act (CWA) assurances milestones. In July 2009, WDOE developed the document *2009 Clean Water Act Assurances Review of Washington's Forest Practices Program*, which outlines specific CMER projects targeted at answering critical questions associated with the CWA. Based on this review, research projects were reprioritized to improve the adaptive management program in meeting the intent of the CWA. WDOE's document also lists timelines and anticipated completion dates for those CMER projects. Policy has determined that the WDOE CWA assurances milestones document will guide CMER's project prioritization process until a more stable source of long-term funding can be secured; therefore, this has affected the Wetlands Rule Group strategy.

The Wetlands Rule Group strategy began in 2005 by conducting a comprehensive literature review (i.e., the Forested Wetlands Literature Review and Workshop Project) to establish the current scientific basis for evaluating forested wetland functional relationships for salmonids, covered species, and water quality and quantity. WETSAG then conducted a pilot study, the Statewide Forested Wetlands Regeneration Pilot Project, to evaluate regeneration of forested wetlands after harvest.

In combination, these efforts concluded that many research gaps exist relative to forested wetlands and that, in order to locate wetlands in a systematic and unbiased manner and to study the effect of forest practices activities on these wetlands, the mapping data available needed improvement. A recommendation that emerged from the Statewide Forested Wetlands Regeneration Pilot Project led to creation of the DNR GIS Wetlands Data Layer Project, which

added 165,000 polygons to the Forest Practices Application Review System (FPARS). Work on a process for continued improvement of the wetland data layer is ongoing in Policy, though a lack of funding and staff resources currently limits or prevents much progress on this task at DNR. Linking the mapping to the studies in order to characterize, describe, and assess impacts to wetland functions — a hydrogeomorphic (HGM) classification system that defines wetlands based on landscape position and the source and connectivity of water to other water bodies — will be evaluated in the future under the Hydrogeomorphic Wetlands Classification System Project.

The 2010 strategy of completing the study design for the pilot project and Phases 1 and 2 of the Wetlands Mitigation Effectiveness Project was reprioritized in 2011 based on CMER review of the study design, FPA review, and discussions during field visits in follow-up meetings that led to returning the focus to the Forested Wetlands Effectiveness Program. Two main issues led to the recommendation of delaying the Wetlands Mitigation Effectiveness Program and reprioritizing how WETSAG proceeds in the wetland research program. The two issues are the following:

1. It is difficult, if not impossible, to know landowner intent when assessing the mitigation sequence.
2. The effects of harvesting forested wetlands are uncertain and the risks to wetland functions may be greater than the effects of road construction/maintenance under current rules.

The current project, the Forest Practices and Wetlands Systematic Literature Review, looks at how forest practices affect the capacity of wetlands to sustain fish, amphibians, and water quality in a watershed context. The Literature Review intends to evaluate risk and uncertainty to wetland functions associated with harvesting and road construction in and around wetlands. The current Literature Review will address data gaps identified in the 2005 literature review; and will attempt to develop testable hypotheses for other WETSAG projects to inform the scoping and design of future field studies. Projects identified in the CWA assurances milestones, that must be addressed include the Forested Wetlands Effectiveness Study, the Wetland/Stream Water Temperature Interactions Project and the Wetland Hydrologic Connectivity Project
To the extent possible, the current Literature Review will address data gaps identified in the 2005 literature review; and will attempt to develop testable hypotheses for other WETSAG projects and inform the scoping and designing of future field studies.

Table 37. Wetlands Rule Group Critical Questions and Programs

Rule Group Critical Questions	Program Names	Task Type	SAG
How should wetlands be classified and mapped for management purposes?	Wetlands Mapping Tools Program	Rule Tool	WETSAG
Are forested wetlands regenerating sufficiently to maintain wetland functions? Does timber harvest in forested wetlands affect water temperature sufficiently to negatively affect temperatures in connected streams? Does timber harvest in forested wetlands alter hydrology sufficiently to affect wetland functions?	Forested Wetlands Effectiveness Program	Effective-ness	WETSAG
Are road construction activities, harvest, and harvest methods adequately mitigated to achieve no net loss of wetland functions?	Wetlands Mitigation Program	Effective-ness	WETSAG
Are current WMZs effective in providing adequate levels of LWD, shade, and water quality and in maintaining microclimates in and downstream of wetlands?	WMZ Effectiveness Monitoring Program	Effective-ness	WETSAG
Are current rule-defined wetland functions sufficiently specific to maintain water quality standards, support the long-term viability of covered species, and support the goal of harvestable levels of salmonids?	Wetlands Intensive Monitoring Program	Intensive Monitoring	WETSAG

6.9.1 Wetlands Mapping Tools Program (Rule Tool)

Program Strategy

The purpose of the Wetlands Mapping Tools Program is to develop mapping tools that will be used to describe and locate wetlands throughout the state, to assist in wetland identification and improvement of rules and BMPs, and to facilitate CMER's ability to answer critical questions involving wetlands.

This program consists of three projects. The first project was proposed in phases to develop a GIS-layer mapping tool administered by DNR. The first phase of this was initiated by DNR's incorporation of an existing wetland layer (FPWET) into the Forest Practices Application Review (FPARS) GIS layer, which added 165,000 wetland polygons. The second phase of this project was to develop a methodology for updating the GIS data layer from forest practices application (FPA) maps. This phase of the project will be conducted by DNR and WDOE and is not active due to technology, policy, budget, and staff constraints.

The second project, the Hydrogeomorphic Wetlands Classification System Project, involves the analysis and development of a simple hydrogeomorphic (HGM) classification system for wetlands on FP HCP lands. This HGM classification would inform the determination of which functions should be examined to assure adequate protection (i.e., use by fish, amphibians, or for water quality BMP application), if the current regulatory classification system is determined to inadequately protect wetland functions. As each separate study that uses HGM to define wetland function progresses, the information and experience gathered will inform this project. The third project would focus on the integration of an overlay tool to incorporate WETSAG's research needs with other proposed CMER research in order to increase the efficiency of locating wetlands for study.

Table 38. Wetlands Mapping Tool Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
How should wetlands be classified and mapped for management purposes?	DNR GIS Wetlands Data Layer Project
	Hydrogeomorphic Wetlands Classification System Project
	Overlay Project

DNR GIS Wetlands Data Layer Project

Description:

The first phase of the mapping layer project focused on combining existing wetlands information into one database layer in order to create an adjustable platform that will allow the database to be modified. A subject matter expert (SME) coordinated with DNR's cartography department to create a statewide map of all mapped wetlands under a single classification system (National Wetland Inventory) relevant to forest practices. The second phase will recommend how the database will be updated with new information submitted through FPAs. Recommendations

could include a mechanism to incorporate data submitted by landowners using the same process that currently exists for updates to the stream typing layer.

Status:
Phase 1 was scoped and presented to CMER in 2007 but was not approved as a WETSAG research project. Instead, it was directed to DNR for incorporation of the FPWET data layer into FPARS, which was accomplished in December 2007, resulting in the addition of 165,000 wetland polygons originating from a separate DNR data layer. The second phase, updating the layer with new information generated on FPAs, has been delegated to a Policy subgroup, including DNR and WDOE. No additional action was taken in 2012, or is planned in 2013.

Hydrogeomorphic Wetlands Classification System Project

Description:
WAC 222-16-035 classifies wetlands under the state forest practices rules as either Type A, B, Forested, or bogs (also Type A). Wetlands under this system are characterized according to soils, vegetation, canopy closure, acreage of open water, and size. Each of these wetland classifications is likely to include several HGM categories, which are based on landscape position, water source, and hydrologic connectivity, indicating how each wetland functions relative to fish, amphibians, and water quality parameters. An HGM classification system, based on function, is necessary in order to answer questions regarding “no net loss of wetland functions” or other critical questions, such as whether wetland management zones are functioning.

Status:
The Forest Practices and Systematic Literature Review will develop a crosswalk between the HGM, Cowardin, and WADNR classification systems for the wetlands covered in the research. This may provide pertinent information to move this project forward in future years.

Overlay Project

Description:
This project will develop a system that will facilitate cooperation between WETSAG and other SAGs when wetlands are encountered. By using information provided by other SAG research, particularly in terms of locating wetlands for studies, CMER’s overall approach to information gathering can be streamlined. Potential areas where research efforts and funding can be combined among SAGs include where wetlands overlap with other landscape features, such as roads, riparian zones, amphibian habitat (i.e., seeps and springs), or unstable slopes. The other purpose of this project is to develop technical guidelines to add to the Board Manual for identifying HGM classification of wetlands for foresters and other SAGs. This project may also involve a workshop for DNR, CMER, foresters, and landowners to detail the products developed.

Status:
WetSAG is working with CMER partners to connect this project with the Road Sub-basin Effectiveness Monitoring and Road Compliance programs in future years.

Link to Adaptive Management

The following section looks at the rule group critical question for the Wetlands Mapping Tools Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for the critical question relative to the three CMER projects (see Table 38). The rule group critical question is listed in bolded italics. "Knowledge gained" is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that have not been through this final process, "knowledge anticipated" is discussed.

The DNR GIS Wetlands Data Layer Project was not approved as a CMER project and was directed to DNR. The lack of accurate wetland mapping has implications for other projects, described below. The Hydrogeomorphic Wetlands Classification System Project has not yet been scoped but has been identified as a primary need for future studies; initial data informing the use of an HGM classification system on FP HCP lands may be forthcoming in the Forest Practices and Wetlands Systematic Literature Review. The Overlay Project is not currently targeted for scoping. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

How should wetlands be classified and mapped for management purposes?

Knowledge Gained or Anticipated:
The initial phase of the DNR GIS Wetlands Data Layer Project scoped by WETSAG and implemented by DNR in 2007 added 165,000 additional wetland polygons from an existing DNR database to the FPARS wetland mapping layer. From scoping and developing the project, WETSAG, DNR, and WDOE gained more knowledge about the degree of inaccuracy of the existing wetland layer and the sources of inaccuracy, and about identified measures that would make updating the wetlands data layer more efficient. The data layer was determined to be substantially inaccurate for small wetlands and in terms of identifying fish use of associated wetlands. A number of impediments to updating the data layer were also identified, including incomplete FPA reporting, reduced staff, budgetary constraints, and the need to update GIS technology.

The Hydrogeomorphic Wetlands Classification System Project's anticipated contribution to wetland classification and mapping is to provide the identification of the different functions of wetlands related to hydrology, fish, amphibians, and water quality — i.e., filtration of sediment or transport of pollution, such as sediment or thermal alterations. HGM classification defines wetlands by water source, flow direction, connectivity to other water, and landscape position, all information necessary to the evaluation of whether forest practices BMPs are effective at meeting the three FFR performance goals — fish, water quality, and threatened and endangered species. HGM classification will be required for WETSAG studies, including Wetland Mitigation Effectiveness, Wetland Management Zone Effectiveness Monitoring, Wetland/Stream Water Temperature Interactions, and Wetland Hydrologic Connectivity.

The Overlay Project has not been scoped, but the anticipated contribution to WETSAG, CMER, and the FP HCP would be a more comprehensive inclusion of wetlands encountered in other CMER studies.

Identified Gaps:
The following gaps have been identified: (1) GIS layers need to be updated with new information provided in FPAs; (2) a water-type modification process to incorporate mapped wetlands into the hydrology or wetland data layer is recommended; (3) mapping accuracy and efficiency needs to be improved; (4) use of stream-associated wetlands by fish is poorly understood or reported; and (5) the simplified wetland typing system — A, B, and Forested — does not characterize specific wetland functions, unlike the more specific stream typing where a subset of functions — fish use and hydrologic regime — are documented (Type S, F, NP, and NS).

Finally, WETSAG has encountered significant challenges in identifying wetlands for studies in a systematic and unbiased manner. Due to inaccurate mapping and lack of training, other CMER projects conducted in and around wetlands do not separate wetlands from other landscape features such as riparian forests or seeps and springs covered in Type N and amphibian studies.

Recommendations for Addressing Gaps:
Wetland mapping needs to be improved. One recommendation is to obtain funding to implement data layer updates to the wetland (hydrography) GIS layers at DNR. Remote sensing technologies, including LIDAR and all available wetland information, should be used to scope a pilot project that focuses on a subset of ecoregions. Work to improve mapping of wetlands should be conducted in partnership with WDOE. Other recommendations include the following: Design and implement a coordinated process similar to the stream typing program to address the gaps identified in wetland mapping and classification. Develop a protocol to identify fish and amphibian use of forested or associated wetlands. Develop a cross-training program using HGM classification to ensure that wetlands encountered in other CMER studies are characterized in the studies and reported to WETSAG for study efficiencies. Work to increase stakeholder support for addressing these data gaps.

6.9.2 Forested Wetlands Effectiveness Program

Program Strategy

This program addresses uncertainty concerning the net loss of hydrologic function, water quality, fish and amphibian use, and recovery capacity of forested wetlands following timber harvest.

This program consists of seven projects. Schedule L-1 of the FFR states that a key performance target for wetlands is "no net loss in the hydrologic functions of wetlands."

The Rule Group Critical Questions include the evaluation of the regeneration and recovery capacity of forested wetlands. A literature review and synthesis of forested wetlands research was performed between 2003 and 2005 to identify current understanding of forested wetland functions and regeneration capabilities in the Pacific Northwest. The review concluded that little research has been performed in forested wetlands, and did not provide definitive research related to the regeneration question. It concluded that, in general, functions can be extrapolated from other studies and from research in floodplain wetlands, and identified a number of significant informational gaps.

The follow-up Forest Practices and Wetlands Systematic Literature Review, which is currently underway, will evaluate risk to and uncertainty about wetland functions associated with harvesting wetlands and constructing roads in and adjacent to wetlands. The primary focus is how these forest practices activities affect the capacity of wetlands to contribute to watershed processes that sustain fish, amphibians, and water quality. The literature review will also fill data gaps identified in the previous wetland literature review; and it will support development of testable hypothesis for WETSAG projects, which will inform the scoping and designing of future field studies. Priority will be placed on scoping projects identified in the CWA assurances milestones, specifically the Forested Wetlands Effectiveness Project, the Wetland/Stream Water Temperature Interactions Project and the Wetland Hydrologic Connectivity Project.

The Statewide Forested Wetlands Regeneration Pilot Project, which was designed to evaluate methods for determining whether regeneration in forested wetlands was meeting the goal of replacing function at the midpoint of a timber rotation cycle, was completed in 2004. This project showed the difficulty in finding forested wetlands in an unbiased manner. Though recommended by WETSAG upon completion of the pilot project, a full-scale study is not planned at this time. Future studies of wetland prescription effectiveness, wetland and stream temperature interactions and hydrologic connectivity will further explore wetland functions and impacts associated with timber harvest.

Table 39. Forested Wetlands Effectiveness Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions		Project Names
Are forested wetlands regenerating sufficiently to maintain wetland functions?		
Program Research Questions	*What is currently known about regeneration in forested wetlands in the Pacific Northwest?* *What are the information gaps?* *What is currently known about the effects of timber harvest on forested wetland functions?*	Forested Wetlands Literature Review and Workshop Project Forest Practices and Wetlands Systematic Literature Review
	What are the current methods of evaluating regeneration in forested wetlands? *How successfully are they being implemented?* *What results are landowners experiencing?* *What kind of guidance can be given to landowners to best ensure regeneration of forested wetlands?* *How does the post-harvest stand composition compare to pre-harvest condition?* *How are forested wetland functions affected by timber harvest?*	Statewide Forested Wetlands Regeneration Pilot Project Forest Practices and Wetlands Systematic Literature Review Forested Wetlands Effectiveness Project
Does timber harvest in forested wetlands affect water temperature sufficiently to negatively affect stream temperatures in connected streams?		Wetland/Stream Water Temperature Interactions Project Forest Practices and Wetlands Systematic Literature Review
Does timber harvest in forested wetlands alter hydrology sufficiently to affect wetland functions?		Wetlands Hydrology Connectivity Project Forest Practices and Wetlands Systematic Literature Review

Forested Wetlands Effectiveness Project

Description: The need for this project was recommended by CMER and Policy as a priority following a WetSAG field trip with Ecology that raised concerns about the potential effects of timber harvest on forested wetlands and their functions. Currently, the rules give limited protection to these systems, and little is known about the effects of harvest. This project will look at the effectiveness of current prescriptions and forest practices on these systems.

Status: WetSAG anticipates scoping this project in 2014. This project may be combined with one or more additional projects pending completion of the Wetland Strategy.

Forested Wetlands Literature Review and Workshop Project

Description:
This project included three elements: (1) performing a literature review and creating an annotated bibliography; (2) holding a one-day workshop for involved forest and wetland professionals as part of the collection and dissemination of experiential information; and (3) developing a synthesis paper that includes the literature and workshop information. The results from the literature search indicate that there are substantial information gaps regarding the characterization of forested wetlands, including but not limited to studies of water quality, hydrology, and fish and wildlife use.

Status:
This project has been completed and has undergone CMER review and ISPR. The paper and workshop proceedings are available online and through CMER. Workshops occurred in November 2002 and the "Pacific Northwest Forested Wetland Literature Survey Synthesis Paper" was completed in April 2005. The Forest Practices and Wetlands Systematic Literature Review will add to our knowledge gained from this project by reviewing literature since 2003 (where this literature synthesis left off) and evaluate risk to and uncertainty about wetland functions resulting from forest practices activities that occur in or adjacent to forested wetlands. If a paucity of information is found within Pacific Northwest (PNW) forested landscapes, the proposed literature review will need to draw on literature conducted outside the PNW and in non-forested settings. Studies outside the PNW will then need to be evaluated as to their relevance to forested PNW landscapes.

Forest Practices and Wetlands Systematic Literature Review

Description:
The Forest Practices and Wetlands Systematic Literature Review is intended to address the uncertainty about how harvesting wetlands and constructing roads in and adjacent to wetlands affects the capacity of wetlands to contribute to watershed processes that support fish, amphibians, and water quality. This project will review and synthesize scientific literature to identify and evaluate effects on wetland functions, with a primary focus on harvesting trees from forested wetlands and on road construction and maintenance activities. This project will allow WETSAG to develop testable hypotheses for future WETSAG projects; to evaluate risk to and uncertainty about protecting wetland function to inform prioritizing, scoping, and designing of future field studies; and to fill data gaps identified in the previous wetland literature review. Following the literature review, priority will be placed on scoping projects identified in the CWA assurances milestones, specifically the Wetland/Stream Water Temperature Interactions Project and the Wetland Hydrologic Connectivity Project.

Status:
This project is currently underway and is anticipated to be completed in 2014.

Wetlands Program Research Strategy

Description:
The Wetlands Program Research Strategy was added to the Work Plan for the 2014FY. The strategy will address the need to reconsider how the projects could be integrated. Rather than to establish a new set of detailed milestones (date priorities for each project) Ecology inserted a new milestone that would allow the order to essentially be established as part of a CMER led wetland strategy project. WetSAG will finish the Forest Practices and Wetlands Systematic Literature Review, and use the information as a foundation to develop both a research strategy and as a foundation to scope the forested wetlands effectiveness study.

Status:
This project began in FY 2014 and will continue for FY15.

Statewide Forested Wetlands Regeneration Pilot Project

Description:
The pilot project was conducted in Olympic Region and finalized in 2004. The report has been reviewed by CMER and is available online. This pilot study was initiated to characterize regeneration in forested wetlands, develop research methodologies, examine current methodologies of forested wetland regeneration, and determine the success of their implementation. The pilot study had two primary objectives: (1) To develop a process for identifying suitable sites to sample. This included working with landowners who manage forested wetlands to identify forested wetlands that have been harvested. (2) To develop and test methods for site selection, develop and test sampling protocol, develop measures of regeneration success, develop methods for data analysis, and collect some preliminary information about regeneration in forested wetlands to guide study design for a full-scale study.

The pilot study indicates that seedlings and saplings are able to establish in forested wetlands that have been harvested. All but one site met the Board Manual guidelines for acceptable stocking level. However, the data did not answer the longer-term question of whether a functional forest is recovered at the midpoint of a timber rotation cycle as stated in WAC 222-30-010 timber harvest policy. The pilot study did not address the role of hydrology in forested wetlands or what potentially affects the hydrology, nor did it attempt to evaluate alterations to surface water quality and chemistry, groundwater, or fish or amphibian use resulting from harvest. The study objective to determine methodologies to assess the regeneration of forested wetlands was not sufficiently answered by the pilot. Improved mapping and tracking of forest practices operations would better support a full study to be conducted in the future.

Status:
This pilot project was completed in July 2004. CMER approved the “Forested Wetland Regeneration Pilot Summary Report.”

Wetland/Stream Water Temperature Interactions Project

Description:
This project would assess the change in water temperature in wetlands and associated streams as a result of timber harvest in forested wetlands. This project is a priority of the CWA assurances

milestones; it is anticipated that scoping will begin once the Forest Practices and Wetlands Systematic Literature Review is completed, which will inform hypothesis and study design development.

Status:
This project has not been scoped, but scoping is anticipated to begin once the Forest Practices and Wetlands Systematic Literature Review is completed.

Wetlands Hydrology Connectivity Project

Description:
This project would assess the impact of forest practices, and road construction and maintenance in and adjacent to wetlands on basin hydrology and determine if that impact results in "no net loss of hydrologic function." Hydrologic connectivity links wetlands to streams. This project is a priority of the CWA assurances milestones; it is anticipated that scoping will begin once the Forest Practices and Wetlands Systematic Literature Review is completed, which will inform hypothesis and study design development.

Status:
This project has not been scoped, but scoping is anticipated to begin once the Forest Practices and Wetlands Systematic Literature Review is completed.

Link to Adaptive Management

The following section looks at each rule group critical question for the Forested Wetlands Effectiveness Program. Knowledge gained or anticipated, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. "Knowledge gained" is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, knowledge anticipated is described. For this program, there are five CMER projects listed (see Table 39) for answering specific critical questions. The Forested Wetlands Literature Review and Workshop Project, and the Statewide Forested Wetlands Regeneration Pilot Project have both been completed. The Forest Practices and Wetlands Systematic Literature Review is currently underway. The Forested Wetlands Effectiveness Project, the Wetland/Stream Water Temperature Interactions Project and the Wetlands Hydrology Connectivity Project have not been scoped. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

Are forested wetlands regenerating sufficiently to maintain wetland functions?

Knowledge Gained or Anticipated:
From the Forested Wetlands Literature Review and Workshop Project, we learned that few studies and literature related to forested wetlands have been conducted outside of riparian forests in the Pacific Northwest and elsewhere.

The Regeneration Pilot Project was not able to answer the longer-term question about restoring function at the midpoint of a timber rotation cycle, but it did establish that seedlings and saplings were shown to be present in the surveyed study sites.

Identified Gaps:
The Forested Wetlands Literature Review and Workshop Project concluded that substantial information gaps exist regarding the characterization of forested wetlands, especially in the Pacific Northwest, including but not limited to studies of water quality, hydrology, and fish and wildlife use. The final section of the document is a compilation of the apparent knowledge gaps, including recommendations for additional research. Applied research in reference forested wetlands and harvested forested wetlands to characterize function and management response, especially for fish and wildlife use, is needed.

Gaps identified in the Regeneration Pilot Project were mostly related to the difficulty of identifying harvested wetlands and types of harvest from forest practices applications (FPAs). The pilot study did not address the role of hydrology in forested wetlands or what potentially affects the hydrology. Because the sample sites were all recently harvested, the data collected did not answer the longer-term question of whether a functional forest is recovered at the midpoint of a timber rotation cycle as stated in WAC 222-30-010 timber harvest policy.

Recommendations for Addressing Gaps:
Work with agency, tribal, academic, and industry partners to develop applied research to study the function of forested wetlands for fish and wildlife; and refine water quality performance goals in the FP HCP.

Improved mapping and tracking of forest practices operations, including reporting of the use of the mitigation sequence, would better support all WETSAG studies.

Long-term study sites of different HGM categories are required to fully evaluate functional changes — including pre-harvest, initial post-harvest, and decades past harvest.

Future studies may include investigations as to how moisture gradients and microclimate correlate with or affect the biodiversity of a site.

Does timber harvest in forested wetlands affect water temperature sufficiently to negatively affect stream temperature in connected streams?

Knowledge Gained or Anticipated:
The Wetland/Stream Temperature Interactions Project has not been scoped, but the study is anticipated to develop methodologies and to provide both an analysis of whether surface and groundwater temperature is altered by timber harvest in forested wetlands and an analysis of whether temperature alterations can be detected downslope or downstream in receiving waters.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

Does timber harvest in and adjacent to wetlands alter hydrology sufficiently to affect wetland functions?

Knowledge Gained or Anticipated:
The Wetlands Hydrology Connectivity Project has not been scoped, but the study is intended to evaluate net loss or gain of function and, specifically, the impacts of harvest and roads on the quantity and movement of water within wetlands and to receiving waters. This project will inform implementation of road BMPs, stream and wetland typing related to fish use, and research on water quality parameters such as temperature, turbidity, and dissolved oxygen.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

How does the post-harvest stand composition compare to pre-harvest condition?

The Forested Wetlands Effectiveness Project has not been scoped and is pending completion of the Forested Wetlands Literature Review Project. The study is intended to evaluate the impact of timber harvest prescriptions on wetland functions, including comparing pre-harvest to post-harvest (treatment) stand conditions.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

How are forested wetland functions affected by timber harvest?

The Forested Wetlands Effectiveness Project has not been scoped and is pending completion of the Forested Wetlands Literature Review Project. The study is intended to evaluate the impact of timber harvest prescriptions on wetland functions, and if possible identify causal mechanisms for potential changes in wetland functions if detected.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified

6.9.3 Wetlands Mitigation Program

Program Strategy

In order to achieve "no net loss of wetland function" when filling or draining more than 0.10 acre of wetland during road construction, forest practices rules require implementation of a mitigation sequence, including avoidance and minimization (WAC 222-24); and replacement or restoration for filling of more than 0.5 acre of wetland. Information on the effectiveness of these mitigation requirements is not currently available.

To address the performance target of "no net loss of hydrologic functions of wetlands" (Schedule L-1), this program will evaluate several critical questions, including whether mitigation activities are successful in achieving stated goals and objectives by replacing lost wetland functions caused by wetland filling or draining (see Table 40). This information can then be used to recommend any changes to the current process of wetland mitigation.

Table 40. Wetlands Mitigation Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions		Project Names
Are road construction activities, harvest and harvest methods adequately mitigated to achieve no net loss of wetland functions?		
Program Research Questions	*What sizes and types of wetlands are being impacted by road and landing construction and maintenance activities on the FP HCP landscape?* *Is implementation of the wetland mitigation sequence ensuring no net loss of wetland functions?* *What are the cumulative effects to wetland functions of impacts to multiple small wetland areas?* *What wetland functions are assumed critical to achieve the goal of no net loss?* *What functions are not being mitigated or replaced?*	Wetlands Mitigation Effectiveness Project

Wetlands Mitigation Effectiveness Project

Description:

The Wetlands Mitigation Effectiveness Project will answer the question of whether the current forest practices road construction rules are effective at preventing net losses to wetland functions. Documentation of how often and what types of wetlands are being impacted by road construction is not readily available, and currently there is no information available on how road construction under the current rules is affecting wetland functions or area across the FP HCP landscape.

The overall goal of the Wetlands Mitigation Effectiveness Project is to determine whether the current Washington State forest practices goal of "no net loss to wetland function" is being achieved.

This project was initially scoped as a single study with multiple phases. After CMER review, it has evolved into four projects that make up the Wetlands Mitigation Program. The first project would develop and test site selection, data collection, and data analysis methods. The second project would be a pilot study to refine and finalize the field methods developed in the first project, test the usefulness of using FPA maps to identify wetlands in site selection, and test the feasibility of using remote sensing tools (LIDAR, aerial photography, etc.) to identify and classify wetlands. The third project would apply the tested and finalized methods in a statewide survey to describe and quantify forest road and wetland interactions and assess and rank risks to wetland functions from specific road construction/maintenance activities. The fourth project would build on the results of the statewide study and would directly test whether following the "wetland mitigation sequence" when constructing or maintaining roads in or near wetlands prevents a net loss of wetland functions.

Status:
The scoping document was approved by CMER in June 2008. The study design for the pilot project was developed and CMER review was initiated in the spring of 2010. The review generated a lot of discussion on several of the project's design elements as well as some of the basic questions being addressed by the project. As a result, WETSAG has set aside implementing the Wetlands Mitigation Effectiveness Project at this time and instead is currently conducting a Forest Practices and Wetlands Systematic Literature Review. In the future, WETSAG intends to explore opportunities to connect this project with the Road Sub-Basin-Scale Effectiveness Monitoring Program and to work with the Compliance Monitoring Program pertaining to roads.

Link to Adaptive Management

The following section looks at each rule group critical question for the Wetlands Mitigation Program. Knowledge gained, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical questions are listed in bolded italics. "Knowledge gained" is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy. For projects that are incomplete, "knowledge anticipated" is described. For this program, there is one CMER project listed (see Table 40) for answering specific critical questions.

The Wetlands Mitigation Effectiveness Project pilot study design was developed and CMER review was initiated. Due to discussions that occurred during the review, this project has been set aside. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

Are road construction activities, harvest, and harvest methods adequately mitigated to achieve no net loss of wetland functions?

Knowledge Gained or Anticipated:
It is anticipated that the Wetland Mitigation Effectiveness Project will provide a preliminary analysis of wetland functions and of physical and structural conditions affected by road construction, as well as which functions are being impacted in what types of wetlands and

whether the mitigation sequence is effective at preventing loss of wetland functions. The project will design, test, and refine site selection, data collection, and data analysis methods. It will also evaluate which HGM classes and FP HCP types and sizes of wetlands are at highest risk of impact from road construction and maintenance. Incidental data will include verification of FPARS mapping accuracy. This project will also inform future projects, such as the Wetland Management Zone Effectiveness, HGM Classification, and Hydrology Connectivity projects.

Identified Gaps:
Gaps identified in the process of scoping and developing the study design for this project include the lack of reported information on FPAs; mapping inaccuracies that lead to misidentification of wetlands, both for and against; and issues with variability in interpretation of field parameters. The DNR Road Maintenance and Abandonment Plan (RMAP) program and the Road Sub-Basin-Scale Effectiveness Monitoring Program do not include road impacts to unmapped wetlands or to forested wetlands that are not clearly identifiable. Finally, the Forested Wetlands Literature Review and Workshop Project revealed a significant lack of data on forested wetlands as well as on forest road impacts on wetlands; we do not have research on functions of wetlands in the forested landscape specific to the Pacific Northwest upon which to base our study. It is difficult to establish impacts to function if there is no pre-harvest and post-harvest monitoring across a range of different functional types of wetlands. Additional gaps will be determined as the project progresses.

Recommendations for Addressing Gaps:
In order to develop the best study design possible, addressing all the uncertainties described above, WETSAG will be coordinating closely with WDOE and DNR regarding wetland rating, functions, and HGM classification, and with statisticians to develop the most robust analysis possible. To decrease variability in best professional judgment determinations (if this method is used), training sessions will be required for data gathering. Improved mapping and tracking of forest practices operations, including reporting of the use of the mitigation sequence, would better support all WETSAG studies.

6.9.4 Wetland Management Zone Effectiveness Monitoring Program

Program Strategy

The Wetland Management Zone Effectiveness Monitoring Program will be designed to assess the effectiveness of wetland management zones (WMZs) in meeting FP HCP resource objectives and performance targets. The WMZ rules are based on a number of assumptions, including the following:

- Meeting the wetland performance targets will achieve functional objectives.
- We can determine the effectiveness of BMPs, to a generalized degree, and standardize how we measure and document this effectiveness.
- Reaching BMP objectives at the site scale (i.e., applying WMZs and disconnecting road drainage to Type A and B wetlands) will lead to meeting sub-basin and watershed-scale functional objectives. (Note: Forested wetlands do not receive WMZs but may influence functional objectives at the sub-basin and watershed scale.)

These uncertainties form the basis for the critical questions (Table 41) that the program will be designed to address.

Table 41. Wetland Management Zone Effectiveness Monitoring Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
Are current WMZs effective in providing adequate levels of LWD, shade, and water quality and in maintaining microclimates?	Wetland Management Zone Effectiveness Monitoring Project

Wetland Management Zone Effectiveness Monitoring Project

Description:

This project will evaluate indicators of wetland functions to determine if the target of no net loss of hydrologic function and hydrologic connectivity are being achieved. This would include informing two of the Schedule L-2 research questions listed below:

- TH8: Test whether the wetland prescriptions are effective in preventing downstream temperature increases beyond targets; and
- LWD15: Evaluate the effectiveness of current WMZs in meeting in-stream LWD targets.

Status:

To be scoped in the future. This project will be informed by the HGM Classification, Forest Practices and Wetlands Systematic Literature Review, and Hydrology Connectivity projects.

Link to Adaptive Management

The following section looks at each rule group critical question for the Wetland Management Zone Effectiveness Monitoring Program. Knowledge gained, identified gaps, and recommendations for addressing gaps are discussed for each critical question. The rule group critical question is listed in bolded italics. “Knowledge gained” is only shown for projects with final reports that have been through the final review process and approved by CMER and Policy.

For projects that are incomplete, knowledge anticipated is described. For this program, there is one CMER projects listed (see Table 41) for answering the specific critical question. The Wetland Management Zone Effectiveness Monitoring Project has not been scoped. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

Are current WMZs effective in providing adequate levels of LWD, shade, and water quality and in maintaining microclimates?

Knowledge Gained or Anticipated:
There is little research specific to forest practices and wetlands in the Pacific Northwest, and there is no TFW or CMER research relative to the effectiveness of forest practices WMZs for LWD, shade, meeting receiving stream water quality targets, or other functions. Thus, this study will build upon previous studies (Wetlands Mitigation Effectiveness, HGM Classification, and Hydrology Connectivity) to further test whether the functional objectives for fish, wildlife, and water quality are met through the application of WMZs and BMPs for WMZ management.

Identified Gaps:
Beyond the lack of applied research to determine the effectiveness of WMZs, there are no identified gaps as of yet.

Recommendations for Addressing Gaps:
No recommendations have been developed at this time.

6.9.5 Wetlands Intensive Monitoring Program

Program Strategy

The Wetlands Intensive Monitoring Program will assess the status of forested wetlands harvested under forest practices rules. WETSAG will utilize the updated mapping and data-layer tools and a hydrogeomorphic (HGM) wetland classification system, if these are available, to assess functional integrity. The project will be informed by the Wetlands Mitigation Effectiveness Project data-collection methodologies and the baseline data metrics produced.

Table 42. Wetlands Intensive Monitoring Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
Are current rule-defined wetland functions sufficiently specific to maintain water quality standards, support the long-term viability of covered species, and support the goal of harvestable levels of salmonids?	Wetlands Intensive Monitoring Project

Wetlands Intensive Monitoring Project

Description:

Wetland functions are broadly defined in WAC 222-24 and -30 as water quality, water quantity, fish and wildlife habitat, and timber production, without specific species-related, wetland-type habitat criteria, narrative, or quantitative standards. Little to no research has been conducted within wetlands specific to forestlands or forest management in the Pacific Northwest relative to the species, resources, and critical processes (i.e., movement of surface and subsurface water) occurring within different types of wetlands and covered by the FP HCP. Without baseline information about expected species use, development and maintenance of structural habitat components, and connectivity of water through surface or subsurface flowpaths, and without numeric or narrative standards, it is not possible to evaluate whether the three performance goals of the FP HCP are being met through the application of forest practices regulations.

This project will evaluate the full suite of wetland functions in different ecoregions on both the eastside and the westside, stratified by HGM classification, forest practices type, WDOE wetland rating, and size. The primary question will be whether expanding the list of functions enables more effective protection of those functions.

Status:

To be scoped in the future and to be informed by the Wetland Management Zone Effectiveness, HGM Classification, Forest Practices and Wetlands Systematic Literature Review, and Hydrology Connectivity projects.

Link to Adaptive Management

The following section looks at each rule group critical question for the Wetlands Intensive Monitoring Program. Knowledge gained, identified gaps, and recommendations for addressing gaps are discussed for the critical question. The rule group critical question is listed in bolded italics. Because no projects have yet been scoped, the “Knowledge Gained or Anticipated”

section is not relevant at this time. For this program, there is one CMER project listed (see Table 42) for answering specific critical question. The Wetlands Intensive Monitoring Project has not been scheduled for scoping. As projects and associated final reports are completed within this program, this section will be updated to better address knowledge gained, identified gaps, and recommendations for addressing those gaps.

Are current rule-defined wetland functions sufficiently specific to maintain water quality standards, support the long-term viability of covered species, and support the goal of harvestable levels of salmonids?

Knowledge Gained or Anticipated:
The anticipated outcomes have not been established.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

6.10 WILDLIFE RULE GROUP

Historically, Timber, Fish and Wildlife (TFW) has funded a number of wildlife research projects since the late 1980s. These projects have addressed general multispecies and statewide issues, as well as species-specific concerns about the effects of forest practices. Although the FP HCP is focused on water quality, fish, and stream-associated amphibians (SAAs), both Policy and CMER acknowledge that wildlife issues are important and need attention. Consequently, CMER has recently funded additional sampling and analyses of a study that examines wildlife use of two streamside buffer designs. However, because CMER's focus is currently on FP HCP priorities, the only funding available for additional wildlife projects is from the State General Fund.

Rule Overview and Intent

Forest practices rules directed at wildlife conservation take two approaches: (1) general statewide requirements; and (2) species-specific strategies. In addition, forest practices rules may benefit wildlife through the retention or enhancement of habitat, such as riparian buffers, upland management areas, mass wasting sites, channel migration zones, etc. The only general statewide rule specifically directed at wildlife conservation is the provisions for wildlife reserve tree management (WAC 222-30-020[11]). Specifications for the retention of wildlife reserve trees, green recruitment trees, and down logs are provided for both eastern and western Washington. Species-specific forest practices rules are closely tied to state and federal endangered and threatened species programs. Habitat of listed species is defined as critical habitat (state), and any proposed forest practices activity in critical habitat becomes a Class IV special forest practices under SEPA (WAC 222-10-040), requiring consultation, evaluation, an environmental impact statement (where appropriate), and mitigation. There are currently 10 species for which these rules apply (e.g., the bald eagle [*Haliaeetus leucocephalus*], grizzly bear [*Ursus arctos*], northern spotted owl [*Strix occidentalis*], and marbled murrelet [*Brachyramphus marmoratus*]).

In some cases, a species-specific approach that avoids rule making has been endorsed by the Forest Practices Board. This approach usually involves the development and adoption of management plans or the specification of "voluntary" guidelines. The federal listing of the lynx (*Lynx canadensis*) prompted the state and a few large private landowners in northeastern Washington to develop and adopt lynx management plans. Similarly, the state listing of the Taylor's checkerspot butterfly (*Euphydryas editha taylori*) resulted in landowner commitments to develop management plans to protect, and possibly help restore, the few individual occupied sites. The state listing of the western gray squirrel (*Sciurus griseus*) resulted in landowners agreeing to apply forest practices guidelines developed by the Washington Department of Fish and Wildlife in areas known to contain the species. These rules and associated guidelines are very complex. Each species generates specific definitions of habitats, specific monitoring methods, and specific provisions for protection of sites that vary with the species needs. In addition, the Forest Practices Board often adopts rule options that allow landowners to develop species-specific management plans.

Rule Group Resource Objectives and Performance Targets

No resource objectives or performance targets exist for wildlife rules.

Rule Group Strategy

Wildlife research pertaining to fish and amphibians (aquatic and riparian-dependent) are covered under the Type N Riparian Prescriptions Rule Group, specifically within the Sensitive Site Program and the Type N Amphibian Response Program. Within the Wildlife Rule Group, the Wildlife Program is the only program currently active and primarily focuses on wildlife species within upland management areas (UMAs) or riparian management zones (RMZs). The rule group critical question for the Wildlife Program is listed in Table 43.

Table 43. Wildlife Rule Group Critical Questions and Programs

Rule Group Critical Questions	Program	Task Type	SAG
What roles do RMZs, UMAs, and other forest patches play in maintaining species and providing structural and vegetative characteristics thought to be important to wildlife?	Wildlife Program	Effectiveness Validation	LWAG

6.10.1 Wildlife Program

The purpose of the Wildlife Program is to (1) determine the species of wildlife that use managed forests; (2) estimate habitat conditions associated with wildlife use of managed forests; (3) assess the efficacy of regulations designed to provide habitat for wildlife in managed forests; and (4) identify emerging forestry-wildlife issues and develop research projects that address those issues.

Program Strategy

With the current emphasis of CMER on the Forest Practices Adaptive Management Program, there is little opportunity to fund projects for wildlife other than those species that are covered under the FP HCP (i.e., aquatic species and riparian-dependent amphibians). LWAG has identified and prioritized several wildlife issues (upland and/or riparian) that need attention. These issues are described in the rule group critical question in Table 44 and are primarily addressed with the RMZ Resample Project.

Table 44. Wildlife Program: Applicable Rule Group Critical Questions with Associated Research Projects

Rule Group Critical Questions	Project Names
What roles do RMZs, UMAs, and other forest patches play in maintaining species and providing structural and vegetative characteristics thought to be important to wildlife?	RMZ Resample Project

RMZ Resample Project

Description:

In 1990, CMER funded an experimental study to examine the effects of two buffer configurations (state regulations and “smart buffers”) on birds, small mammals, and amphibians. The study produced two years of pre- and post-harvest data and a final report that was completed in 2000. The results were species specific and equivocal and raised numerous questions about the long-term response of wildlife to the treatments. Because the smart buffer was similar to the forest practices buffer for Type F streams, and more than five years had elapsed since last sampling in the RMZ, another two years of sampling was initiated in 2003 to document changes over time. The study will provide additional data on riparian conditions and some SAAs.

Status:

The final report was completed in 2008 and was reviewed by LWAG, CMER, and ISPR. The contract with the consultant that collected the data and prepared the final report was not renewed; therefore, the final report has not been revised based on ISPR comments. LWAG developed a memorandum that summarized the complex issues surrounding the inability to finalize the RMZ Resample report and its tentative conclusions, and LWAG provided suggestions for addressing any useful information that might be extracted from the RMZ Resample. That memorandum and the ISPR comments were attached as an addendum to the final report and submitted to CMER for final approval. Since that time, LWAG has examined the report and available data and has determined that only the bird and amphibian data have some potential for further analysis and development of useful additional products. Because of the nature of how it was collected, the bird data have a higher priority. A report on the bird data was developed in 2013, has gone through LWAG review and is projected for CMER review in early 2014.

Link to Adaptive Management

The following section looks at the rule group critical question for the Wildlife Program. Knowledge gained, identified gaps, and recommendations for addressing gaps are discussed for this critical question. The rule group critical question is listed in bolded italics. "Knowledge gained" is shown for the one project (the RMZ Resample Project) that has been through the final review process and approved by CMER and Policy. The RMZ Resample Project is currently being examined for useful data that can be extracted (see "Status," above).

What roles do RMZs, UMAs, and other forest patches play in maintaining species and providing structural and vegetative characteristics thought to be important to wildlife?

Knowledge Gained or Anticipated:
The bird portion of the RMZ Resample Project will provide some information that can answer this question when the project is completed.

Identified Gaps:
Gaps have not yet been identified.

Recommendations for Addressing Gaps:
Gaps have not yet been identified.

6.10.2 Other Wildlife Programs/Projects

Wildlife research priorities were developed as part of the original Timber, Fish and Wildlife stakeholder process. These research priorities were in place prior to adoption of the current adaptive management program developed in concurrence with the Forests and Fish Report. Under the current Forest Practices Adaptive Management Program and to fulfill requirements of the FP HCP, research is prioritized and funded to primarily address aquatic resources. However, TFW stakeholders continue to see the importance of addressing effectiveness and monitoring of nonaquatic wildlife, and they hope to incorporate priority wildlife research in the future. Table 45 lists the critical wildlife research questions developed in the past by TFW stakeholders.

Table 45. Wildlife Rule Group Critical Questions and Associated Programs (Developed as Part of TFW)

Rule Group Critical Questions	Program	Task Type
What are the values of snags retained in upland management units and riparian management zones (RMZs)? Is there a threshold response by wildlife to snag density? What are the fates of wildlife reserve trees (WRT) and green recruitment trees (GRT) in managed forests? What are the most effective ways of retaining and replacing snags?	Effectiveness of snags for wildlife	Effectiveness Validation
What are the effects of variation in stand establishment practices, herbicides, thinning, fertilization, and rotation lengths on vegetation and wildlife? Does the concept of the steady-state shifting mosaic apply, and how does that process affect wildlife?	Conifer management effects on wildlife	Effectiveness Validation
What roles do RMZs, upland management areas (UMAs), and other forest patches play in maintaining species and providing structural and vegetative characteristics thought to be important to wildlife? What are the functions of large legacy trees (snags, down wood, high stumps) as compared to the smaller complements produced in intensively managed forests? What are the roles and fates of special sites (e.g., rock outcrops, cliffs, talus slopes, isolated small wetlands, etc.) in managed forests?	Legacy features and their effect on wildlife	Effectiveness Validation

(Table 45 cont. next page)

(Table 45 cont.)

Rule Group Critical Questions	Program	Task Type
What are the movement patterns, processes, and distances of amphibians in managed forests? Do amphibians persist in refugia following timber harvest, or is subsequent occupancy related to movements from other areas? How quickly do amphibians recolonize areas, particularly habitat outside the stream network? What are the roles of ponds created by beaver, slumps, rotational failures, road ditches, sediment traps, and off-channel habitats in the distribution and abundance of still-water-breeding amphibians?	Amphibian movement and distribution effective-ness monitoring	Effectiveness
What are the status and trends of bats in managed forests?	Forest Bats	Extensive
What are the roles of WRTs and GRTs in bat ecology? What are the relationships between forest management and bat foraging and roosting?	Forest Bats	Effectiveness
What is the relationship between the abundance and productivity of wildlife and gradients in the composition and structure of ponderosa pine stands?	Ponderosa Pine Habitat	Effectiveness
What are the effects of forest practices on the western gray squirrel and oviposition sites of egg-laying reptiles? What are the roles of isolated oak trees and small patches of oaks? What are the appropriate management approaches to maintaining and restoring oak woodlands at stand and landscape levels?	Oak Woodland Habitat	Effectiveness

6.11 INTENSIVE WATERSHED-SCALE MONITORING TO ASSESS CUMULATIVE EFFECTS

Intensive monitoring is watershed-scale research designed to evaluate the cumulative effects of multiple forest practices and to provide information that will improve our understanding of causal relationships and the biological effects of forest practices rules on aquatic resources. The evaluation of cumulative effects of multiple management actions on a system requires an understanding of how individual actions influence a site and how those responses propagate through the system. This understanding will enable the evaluation of the effectiveness of management practices applied at multiple locations over time. This sophisticated level of understanding can only be achieved with an intensive, integrated monitoring effort. Evaluating biological responses is similarly complicated, requiring an understanding of how various management actions interact to affect habitat conditions and how system biology responds to these habitat changes. This program was identified in the Monitoring Design Team (MDT) Report (MDT, 2002) as an essential component of an integrated monitoring program. CMER and Policy will be scoping intensive monitoring needs for the adaptive management program.

Resource Objectives and Performance Targets have not yet been identified.

APPENDIX A: CMER PROJECTS, OBJECTIVES, AND TARGETS

				Direct Measure of FFR Goals			Direct or Indirect Measurement[1] of Objectives & Targets (D = direct; I = indirect; L = literature; ? = probable if implemented in future)												Other Important Issues		
Rule Group/ Program	CMER Projects	Status	Task Type	Fish	Amphib	WQ	In-Str Temp	Rip/ Wet Shade	Rip/ Wet Stand[2]	In-Str/ Wet LWD	Rip/ Wet Litter	In-Str/ Wet Hab[3]	Strm Bnk ELZ[4]	Mass Wast-ing	Rd Sed Runoff	Peak Flow	Wet-land	Fish Passage	Wind-throw	Ground-water	Intermit Flow[5]
Stream Typing Rule Group																					
Stream Typing Program (Rule Tool)																					
	Last Fish/Habitat Prediction Model Development	complete	RIT	yes	---	---	---	---	---	---	---	D	---	---	---	---	---	---	---	---	---
	Annual/Seasonal Variability	complete	R&D	yes	---	---	---	---	---	---	---	D	---	---	---	---	---	---	---	---	---
	Last Fish/Habitat Prediction Model Field Performance	complete	RIT	yes	---	---	---	---	---	---	---	D	---	---	---	---	---	---	---	---	---
Type N Riparian Prescriptions Rule Group																					
Type N Delineation Program (Rule Tool)																					
	Perennial Initiation Point Survey: Pilot Study	complete	RIT	---	---	---	---	---	---	---	---	D	---	---	---	---	---	---	---	---	D
Sensitive Site Program (Rule Tool)																					
	SAA Sensitive Sites Identification Methods	complete	RIT	---	yes	---	---	---	---	---	---	D	---	---	---	---	---	---	---	---	---
	SAA Sensitive Sites Characterization	complete	RIT	---	yes	---	---	---	---	---	---	D	---	---	---	---	---	---	---	---	D
Type N Riparian Effectiveness Program																					
	Westside Type N Buffer Characteristics, Integrity, and Function (BCIF)	complete	EFF	---	---	---	I	D	D	D	---	I	D	---	---	---	---	---	D	---	---
	Type N Exp Buffer Treatment Feasibility Study	complete	R&D	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Type N Exp Buffer Treatment in Hard Rock Lithologies	in prog	EFF	yes	yes	yes	D	D	D	D	D	D	D	---	D	D	---	---	D	---	D
	Type N Exp Buffer Study in Soft Rock Lithologies	in prog	EFF	---	---	yes	D?	D?	D?	?	?	?	D?	---	D?	D?	---	---	D?	I	I?
	Windthrow Frequency, Distribution, and Effects	delayed	EFF	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	D?	---	---
	Eastside Type N Buffer Characteristics, Integrity, and Function (BCIF)	delayed	EFF	---	---	yes	D?	D?	D?	D?	---	---	D?	---	---	---	---	---	D?	---	---
	Eastside Type N Forest Hydrology	in prog	RIT	---	yes	yes	I	---	I	---	---	---	---	---	---	---	---	---	---	I	D
	Eastside Type N Riparian Effectiveness	scoping	EFF	---	yes	yes	D	D	D	D?	D	D	D	---	D?	D?	---	---	D	---	D
Type N Amphibian Response Program (Effectiveness)																					
	SAA Detection/Relative Abundance Methodology	complete	R&D	---	yes	---	---	---	---	---	---	D	---	---	---	---	---	---	---	---	D
	Type N Exp Buffer Treatment in Hard Rock Lithologies[6]	in prog	EFF	yes	yes	yes	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Amphibian Genetics (pre-harvest)	complete			yes																
	Tailed Frog Literature Review	in prog	R&D	---	yes	---	L	L	L	L	L	L	L	L	L	L	---	---	L	---	L
	Tailed Frog Meta-Analysis	in prog	R&D	---	yes	---	---	---	---	---	---	I	---	---	---	---	---	---	---	---	I
	Tailed Frogs and Parent Geology	scoping	R&D	---	yes	---	---	---	---	---	---	D?	?	?	?	---	---	---	?	---	?
	Dunn's Salamander	complete	R&D	---	yes	---	---	D	D	---	D	---	---	---	---	---	---	---	---	---	---
	Buffer Integrity - Shade Effectiveness (Amphibian)	in prog	EFF	---	yes	yes	D	D	---	---	---	D	---	---	---	---	---	---	I	---	---
	Amphibian Recovery	complete	EFF	---	yes	yes	D	D	D	D	---	D	I	---	---	---	---	---	D	---	I
	Amphibians in Intermittent Streams	delayed	R&D	---	yes	---	?	?	---	?	---	D?	---	---	---	?	---	---	---	---	D?
	Van Dykes Salamander Project	delayed	R&D	---	yes	---	---	D	D	---	D	---	I	---	---	---	---	---	---	---	---
	Eastside Amphibian Evaluation Project	delayed	R&D	---	yes	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Extensive Riparian Status and Trends Monitoring Program																					
	Extensive Riparian Status and Trends Monitoring - Temperature, Type Np Westside	in prog	EXT	---	---	yes	D	D	I	D	---	D	D	---	---	---	---	---	---	---	---
	Extensive Riparian Status and Trends Monitoring - Temperature, Type Np Eastside	in prog	EXT	---	---	yes	D	D	I	D	---	D	D	---	---	---	---	---	---	---	---
	Extensive Riparian Status and Trends Monitoring - Vegetation, Type Np Westside and Eastside	scoping	EXT	---	---	---	?	?	?	---	?	---	---	---	---	---	---	---	?	---	---

				Direct Measure of FFR Goals			Direct or Indirect Measurement[1] of Objectives & Targets (D = direct; I = indirect; L = literature; ? = probable if implemented in future)												Other Important Issues		
Rule Group/ Program	CMER Projects	Status	Task Type	Fish	Amphib	WQ	In-Str Temp	Rip/ Wet Shade	Rip/ Wet Stand[2]	In-Str/ Wet LWD	Rip/ Wet Litter	In-Str/ Wet Hab[3]	Strm Bnk ELZ[4]	Mass Wast-ing	Rd Sed Runoff	Peak Flow	Wet-land	Fish Passage	Wind-throw	Ground-water	Intermit Flow[5]
Type F Riparian Prescriptions Rule Group																					
DFC Validation Program (Rule Tool)																					
	DFC Target Validation	complete	RIT	---	---	---	---	---	D	---	---	---	---	---	---	---	---	---	---	---	---
	DFC Plot Width Standardization (scoping)	delayed	R&D	---	---	---	---	---	?	?	---	?	---	---	---	---	---	---	---	---	---
	FPA Desktop Analysis (includes field analysis)	complete	RIT	---	---	---	---	---	D	---	---	---	---	---	---	---	---	---	---	---	---
	DFC Site Class Map Validation (scoping)	delayed	RIT	---	---	---	---	---	?	---	---	---	---	---	---	---	---	---	---	---	---
	DFC Trajectory Model Validation	delayed	R&D	---	---	---	---	---	?	?	---	---	---	---	---	---	---	---	---	---	---
	DFC Aquatic Habitat	delayed	R&D	---	---	---	---	---	?	?	---	?	---	---	---	---	---	---	---	---	---
	Pathways of Riparian Stand Development to Maturity	delayed	R&D	---	---	---	---	---	?	---	---	---	---	---	---	---	---	---	---	---	---
	Red Alder Growth and Yield Model (coop. contribution)	in prog	R&D	---	---	---	---	---	D	---	---	---	---	---	---	---	---	---	---	---	---
Eastside Type F Riparian Rule Tool Program																					
	Eastside Disturbance Regime Literature Review	complete	R&D	---	---	---	---	L	L	L	L	---	---	L	---	---	---	---	L	---	---
	Eastside LWD Literature Review	complete	R&D	---	---	---	---	L	L	L	L	L	---	---	---	---	---	---	L	---	---
	Eastside Temperature Nomograph	incomplete	RIT	---	---	yes	D	D	---	---	---	---	---	---	---	---	---	---	---	---	---
	Eastern WA Riparian Assessment (Phase 1)	complete	R&D	---	---	---	---	D	D	D	D	D	---	---	---	---	---	---	D	---	---
	Eastside Type F Channel Wood Characterization	delayed	R&D	---	---	---	---	D	I	D	I	D	---	---	---	---	---	---	D	---	---
Bull Trout Habitat Identification Program (Rule Tool)																					
	Bull Trout Presence/Absence Protocols	complete	RIT	yes	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Bull Trout Habitat Prediction Models	complete	RIT	yes	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Yakima River Radiotelemetry	in prog	R&D	yes	---	---	---	---	---	---	---	D	---	---	---	---	---	---	---	---	---
Westside Type F Riparian Effectiveness Program																					
	Westside Type F Riparian Prescription Monitoring	delayed	EFF	---	---	---	?	?	?	?	---	?	?	---	---	---	---	---	?	---	---
	Type F Experimental Buffer Treatment	delayed	EFF	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Type F Performance Target Validation	delayed	EFF	---	---	---	---	---	?	?	---	?	?	---	---	---	---	---	---	---	---
Eastside Type F Riparian Effectiveness Program																					
	Eastern Washington Riparian Assessment (Phase 2)	in prog	EFF	---	---	---	---	I	D	I	---	---	---	---	---	---	---	---	I	---	---
	BTO Temperature (Eastside Riparian Shade/Temperature)	in prog	EFF	---	---	yes	D	D	D	---	---	---	---	---	---	---	---	---	---	---	D
	Solar Radiation/Effective Shade	complete	EFF	---	---	---	I	D	---	---	---	---	---	---	---	---	---	---	---	---	---
	Eastside Type F Riparian Effectiveness Monitoring (BTO add-c	in prog	EFF	---	---	---	---	---	D	D	---	I	D	---	---	---	---	---	D	---	---
	Groundwater Conceptual Model	incomplete	R&D	---	---	---	I	---	---	---	---	---	---	---	---	---	---	---	---	I	---
Hardwood Conversion Program (Effectiveness)																					
	Riparian Hardwood Conversion	in prog	EFF	---	---	---	---	---	D	---	---	---	---	---	---	---	---	---	?	---	---
	Riparian Hardwood Conversion - Temperature Component	complete	EFF	---	---	yes	D	D	---	---	---	I	---	---	---	---	---	---	---	---	---
	Annotated Bibliography: Riparian Hardwood Conversion	incomplete	R&D	---	---	---	?	---	L	---	---	---	---	---	---	---	---	---	---	---	---
	WDOE Water Temperature Modeling	complete	R&D	---	---	---	I	I	I	---	---	---	---	---	---	---	---	---	---	---	---
Extensive Riparian Status and Trends Monitoring Program																					
	Extensive Riparian Status and Trends Monitoring - Temperature, Type F/S Westside	in prog	EXT	---	---	yes	D	D	I	D	---	D	D	---	---	---	---	---	---	---	---
	Extensive Riparian Status and Trends Monitoring - Temperature, Type F/S Eastside	complete	EXT	---	---	yes	D	D	I	D	---	D	D	---	---	---	---	---	---	---	---
	Extensive Riparian Status and Trends Monitoring - Vegetation, Type F/S Westside and Eastside	scoping	EXT	---	---	---	?	?	?	---	?	---	---	---	---	---	---	---	?	---	---
Intensive Monitoring/Cumulative Effects Program: No projects yet identified.																					

				Direct Measure of FFR Goals			Direct or Indirect Measurement[1] of Objectives & Targets (D = direct; I = indirect; L = literature; ? = probable if implemented in future)												Other Important Issues		
Rule Group/ Program	CMER Projects	Status	Task Type	Fish	Amphib	WQ	In-Str Temp	Rip/ Wet Shade	Rip/ Wet Stand[2]	In-Str/ Wet LWD	Rip/ Wet Litter	In-Str/ Wet Hab[3]	Strm Bnk ELZ[4]	Mass Wast-ing	Rd Sed Runoff	Peak Flow	Wet-land	Fish Passage	Wind-throw	Ground-water	Intermit Flow[5]
Channel Migration Zone Rule Group																					
CMZ Delineation Program																					
	CMZ Screen and Aerial Photo Catalog and CMZ Boundary Identification Criteria	delayed	RIT	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Consistency and Accuracy of CMZ Boundary Delineations	delayed	RIT	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
CMZ Validation Program: No projects yet identified.																					
Unstable Slopes Rule Group																					
Unstable Landform Identification Program (Rule Tool)																					
	Shallow Rapid Landslide Screen for GIS (Westside)	complete	RIT	---	---	---	---	---	---	---	---	---	---	I	---	---	---	---	---	---	---
	Shallow Rapid Landslide Screen for GIS (Eastside)	delayed	RIT	---	---	---	---	---	---	---	---	---	---	?	---	---	---	---	---	---	---
	Technical Guidelines for Geotechnical Reports	complete	RIT	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Regional Unstable Landforms Identification (Deep-Seated Screen)	complete	RIT	---	---	---	---	---	---	---	---	---	---	I	---	---	---	---	---	---	---
	Landform Hazard Classification System and Mapping Protocols	complete	R&D	---	---	---	---	---	---	---	---	---	---	I	---	---	---	---	---	---	---
	Landslide Hazard Zonation (priority 1 and 2 watersheds)	complete	RIT	---	---	---	---	---	---	---	---	---	---	D	---	---	---	---	---	---	---
	Landslide Hazard Zonation (priority 3 watersheds)	incomplete	RIT	---	---	---	---	---	---	---	---	---	---	D	---	---	---	---	---	---	---
Glacial Deep-Seated Landslides Program (Rule Tool)																					
	Model Evapo-Transpiration in Deep-Seated Landslide Recharge Areas	complete	RIT	---	---	---	---	---	---	---	---	---	I	I	---	---	---	---	---	I	---
	Evapo-Transpiration Model Refinement	delayed	R&D	---	---	---	---	---	---	---	---	---	---	I?	---	---	---	---	---	---	---
	Landslide Classification	delayed	RIT	---	---	---	---	---	---	---	---	---	---	I?	---	---	---	---	---	I	---
	Groundwater Recharge Modeling	delayed	R&D	---	---	---	---	---	---	---	---	---	---	I?	---	---	---	---	---	D	---
	Board Manual Revision	delayed	RIT	---	---	---	---	---	---	---	---	---	---	I?	---	---	---	---	---	I	---
Mass Wasting Effectiveness Monitoring Program																					
	Testing the Accuracy of Unstable Landform Identification (aka Accuracy and Bias)	scoping	EFF	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Mass Wasting Effectiveness Monitoring (aka Post-Mortem)	complete	EFF	---	---	---	---	---	---	D	---	I	I	D	D	I	---	---	---	---	---
	Mass Wasting Landscape-Scale Effectiveness Monitoring	delayed	EFF	---	---	---	---	---	---	---	---	---	---	D?	---	---	---	---	---	---	---
	Mass Wasting Buffer Integrity and Windthrow Assessment	delayed	EFF	---	---	---	---	---	---	---	---	---	---	?	---	---	---	---	?	---	---
Mass Wasting Validation Program (Intensive)																					
	Method to Assess Harmful Cumulative Sediment Inputs	delayed	RIT	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Roads Rule Group																					
Road Sub-Basin-Scale Effectiveness Monitoring Program																					
	Road Sub-Basin-Scale Effectiveness Monitoring (Phase 1)	complete	EFF	---	---	I	---	---	---	---	---	---	---	---	D	I	---	I	---	---	---
	Road Surface Erosion Model Update	complete	RIT	---	---	---	---	---	---	---	---	---	---	---	D	---	---	---	---	---	---
	Road Surface Erosion Model Validation/Refinement	delayed	R&D	---	---	---	---	---	---	---	---	---	---	---	?	---	---	---	---	---	---
Road Prescription-Scale Effectiveness Monitoring Program																					
	Effectiveness of RMAP Fixes	delayed	EFF	---	---	---	---	---	---	---	---	---	---	---	D?	---	---	---	---	---	---
	Road Prescription-Scale Effectiveness Monitoring	delayed	EFF	---	---	---	---	---	---	---	---	---	---	---	D?	I	---	I	---	---	---
Roads Validation Program and Cumulative Sediment Effects																					
	Intensive Watershed-Scale Monitoring to Assess Cumulative Effects	delayed	INT	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

				Direct Measure of FFR Goals			Direct or Indirect Measurement[1] of Objectives & Targets (D = direct; I = indirect; L = literature; ? = probable if implemented in future)												Other Important Issues		
Rule Group/ Program	CMER Projects	Status	Task Type	Fish	Amphib	WQ	In-Str Temp	Rip/ Wet Shade	Rip/ Wet Stand[2]	In-Str/ Wet LWD	Rip/ Wet Litter	In-Str/ Wet Hab[3]	Strm Bnk ELZ[4]	Mass Wast-ing	Rd Sed Runoff	Peak Flow	Wet-land	Fish Passage	Wind-throw	Ground-water	Intermit Flow[5]
Fish Passage Rule Group																					
Fish Passage Effectiveness/Validation Monitoring Program																					
	No projects listed under this program.																				
Extensive Fish Passage Monitoring Program																					
	Extensive Fish Passage Trends Monitoring (Design)	complete	EXT	---	---	---	---	---	---	---	---	---	---	---	---	---	---	I	---	---	---
Pesticides Rule Group																					
Forest Chemicals Program (Effectiveness): No projects yet identified.		delayed																			
Wetlands Protection Rule Group																					
Wetland Mapping Tools Program (Rule Tool)																					
	DNR GIS Wetlands Data Layer	delayed	RIT	---	---	---	---	---	---	---	---	---	---	---	---	---	I	---	---	---	---
	Hydrogeomorphic Wetland Classification System	delayed	RIT	---	---	---	---	---	---	---	---	---	---	---	---	---	I	---	---	---	---
	Overlay Project	delayed	R&D	---	---	---	D?	D?	D?	D?	D?	D?	---	D?	D?	D?	D?	D?	D?	I?	D?
Forested Wetlands Effectiveness Program																					
	Forested Wetlands Literature Review and Workshop	complete	R&D	---	---	---	L	L	L	L	L	L	---	L	L	L	L	L	L	L	L
	Forest Practices and Wetlands Systematic Literature Review	in progress	R&D	yes	yes	yes	L	L	L	L	L	L	---	L	L	L	L	L	L	L	L
	Statewide Forested Wetlands Regeneration Pilot	complete	EFF	---	---	---	---	---	D	---	---	---	---	---	---	---	D	---	---	---	---
	Wetland/Stream Water Temp Interactions	delayed	EFF	---	---	yes	D?	D?	D?	---	---	---	---	---	---	---	D	---	---	D?	---
	Wetlands Hydrologic Connectivity	delayed	EFF	yes	yes	yes	D?	D?	D?	---	---	D?	---	---	D?	D?	D?	D?	---	D?	D?
Wetlands Mitigation Program																					
	Wetlands Mitigation Effectiveness (Pilot Study)	delayed	EFF	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Wetlands Mitigation Effectiveness (Phase 1)	delayed	EFF	---	---	yes	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Wetlands Mitigation Effectiveness (Phase 2)	delayed	EFF	yes	yes	yes	D?	D?	D?	?	?	I?	---	D?	D?	I?	D?	I?	D?	I?	D?
Wetland Management Zone Effectiveness Monitoring Program																					
	Wetland Management Zone Effectiveness Monitoring	delayed	EFF	yes	yes	yes	D	D	D	D	D	D	D	D	D	I?	D	D	D	I?	D?
Wetland Intensive Monitoring Program																					
	Wetlands Intensive Monitoring	delayed	INT	yes	yes	yes	D?	D?	D?	D?	?	D?	?	D?	D?	D?	D?	D?	D?	D?	?
Wildlife Rule Group																					
Wildlife Program																					
	RMZ Resample	complete	EFF	---	yes	---	---	---	D	---	---	---	---	---	---	---	---	---	---	---	---
Intensive Watershed-Scale Monitoring to Assess Cumulative Effects																					
	No programs or projects yet identified.	delayed																			

NOTES

Status:

In Progress: Site selection, data collection, analysis, or report writing (in prog)

Complete: Final CMER report (consensus & non-consensus reports) (complete)

Scoping: Currently being scoped (scoping)

Delayed: Planned, but not yet scoped; or delayed due to funding, prioritization, etc. (delayed)

Task Type:

Monitoring Type: Effectiveness (EFF); Intensive/Cumulative Effects (INT); Extensive Status and Trends (EXT)

Rule and Project Tools: Rule Implementation Tools (RIT) needed to correctly implement the rules; includes accurately delineating prescription boundaries

Research & Development (R&D) includes literature reviews and development of research protocols

[1] Direct or Indirect Measurement: Direct = actual field measurement; Indirect = modeling/correlations, etc.

[2] Riparian/Wetland Stand Objectives/Targets include windthrow, potential LWD recruitment, DFC basal area targets, and other stand conditions, etc.

[3] In-Stream/Wetland Habitat Objectives/Targets include fish and amphibian habitat ID, substrate, flow, etc.

[4] Stream Bank/Equipment Limitation Zone (ELZ) includes bank erosion, delivery of sediment from the ELZ

[5] "Intermit Flow" refers to spatially intermittent flow below the uppermost point of perennial flow in Type Np streams.

[6] Type N Exp Buffer Treatment in Hard Rock Lithologies: This project is repeated in three programs (Type N Effectiveness, Amphibian Response, and Wildlife); however, the designation of functions is shown only once in order to not overdesignate projects that address those functions. The functions are designated under the Type N Effectiveness Program.