Cooperative Monitoring, Evaluation, and Research Committee (CMER) Review of Science

FINAL REPORT

Prepared for
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List of Acronyms and Abbreviations

AMP – Adaptive Management Program
BACI – before-after control-impact
BAPA – basal area per acre
BLM – Bureau of Land Management
BURP– Beneficial Use Reconnaissance Program
BTO – Bull Trout Overlay
BTSAG – Bull Trout Scientific Advisory Group
CMER – Cooperative Monitoring, Evaluation, and Research
CWA – Clean Water Act
DEQ – Department of Environmental Quality
DFC – desired future conditions
DNR – Washington Department of Natural Resources
FFR – Forest and Fish Report
FPA – forest practice application
FPB – Forest Practices Board
HCP – Habitat Conservations Plan
ISP – Independent Science Panel
ISPR – Independent Science Panel Review
KACP – key aquatic conditions and processes
LCBAPA – live conifer basal area per acre
LHZ – Landslide Hazard Zonation project
LWD – large woody debris
MDT – Monitoring Design Team
RMZ – riparian management zone
RLIP – Regional Landform Identification Project
RSAG – Riparian Scientific Advisory Group
SAA – stream-associated amphibians
SAG – Scientific Advisory Group
SAGE – Scientific Advisory Group - Eastside
TFW – Timber, Fish, and Wildlife
USFS – United States Forest Service
WDFW – Washington Department of Fish and Wildlife
WDOE – Washington Department of Ecology

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1 INTRODUCTION

In 2001 the Washington State Forest Practices Board (State Forest Practices Board; FPB) approved a revision to the full suite of forest practice rules (excluding non-aquatic wildlife issues) that govern land management activities on private and state forest lands (State Forest Practices Rules Chapter 222-12 WAC). This new set of forest practices rules was primarily based on the Forest and Fish Report (FFR), the product of negotiations between federal, state, and local governments, private landowners, and some tribes to protect public resources while maintaining a viable forest products industry in Washington State. A major component of the legislation is an adaptive management program (State Forest Practices Rules WAC 222-12-045) designed to provide science-based information and recommendations to the FPB for rule implementation questions, rule effectiveness questions, and status-and-trends questions. The adaptive management program also prioritizes funding for scientific studies with a direct nexus to aquatic resources. These rules are now also part of a federal and state Habitat Conservation Plan (HCP) Agreement that provides an incidental take permit for listed species under the Endangered Species Act.

The Forest Practices Adaptive Management Program (AMP) is intended to provide a mechanism to acknowledge uncertainties about the effectiveness of forest practices rules in protecting public resources, and to plan and implement scientific studies that can inform those uncertainties and provide a basis to judge if changes are needed to improve overall performance of these rules. The Cooperative Monitoring, Evaluation, and Research Committee (CMER) was created to define and implement research and monitoring strategies in order to provide science-based recommendations and technical information to the FPB regarding adaptive management decisions.

It has been nearly 10 years since the Forest and Fish Report was completed and nearly eight years since the revised Forest Practices Rules ("rules") based on the FFR were adopted. Substantial investments have been made in defining and implementing a science-based program to provide relevant and timely information to inform the adaptive management system as contemplated by the FFR and required by the rules. These collective efforts—organized and implemented by CMER—have attempted to address the full spectrum of information needs and priorities set forth by the AMP, which consists of the Forest Practices Board (FPB), Policy, CMER, the Independent Science Panel (ISP), and the Program Administrator. This document represents the first independent review of the collective contribution and progress from the various CMER research and monitoring studies.

The approach taken for this review included several successive steps and alternative perspectives. First, a review of relevant background materials was conducted to provide a comprehensive understanding of the history and context of the science program. A summary of our understanding of the CMER program is in **Section 2**, composed of an overview of the Forest and Fish Report, the CMER monitoring strategy (as articulated by the Monitoring Design Team [MDT] report), and the priority research and monitoring programs as described in the FY 2009 CMER Work Plan (CMER Committee 2008). This overview is provided as a basis from which the program strategy and objectives may be understood, and is particularly valuable in defining the intent and overarching questions derived from the FFR.

Second, a review of selected individual study reports (for both completed and active projects) was completed to understand the nature of each study and its respective contribution to addressing key questions and associated resource objectives as defined in Schedule L-1. Completed projects

have associated reports; active projects have study plans or progress reports or both; and planned projects are outlined in the Work Plan and flow charts provided by the Department of Natural Resources. The results and summaries from reviewing the completed, active, and planned projects are represented in **Section 3**. While not a complete critique of each individual study and also not a major focus of this report, we have provided remarks about many of the studies in terms of their successful implementation and alignment with the goals and priorities of the AMP.

Interviews with a subset of CMER and/or Science Advisory Group (SAG) members were also conducted to help provide a more complete understanding of the goals, the progress of individual study themes (or more typically "rule groups"), significant study gaps, and expected future study investments (see Appendix A for the list of members interviewed and their affiliations). We have not provided a direct summary of these interviews, but insights and information acquired as a result of these interviews have been incorporated, where appropriate, into our review.

Section 4 presents an overarching assessment of the cumulative progress of the research and monitoring program. Specifically, we investigate whether the Work Plan is clearly and effectively focused to answer adaptive management key questions defined in Schedule L-1 (see Section 2.2). In this section we identify critical gaps and areas of potentially unnecessary focus in the Work Plan, we estimate the extent of progress toward answering the adaptive management key questions, and we offer recommendations on ways to focus the Work Plan.

Finally, **Section 5** offers specific recommendations on ways to effectively and efficiently focus the Work Plan to answer the adaptive management key questions.

2 PROGRAMMATIC OVERVIEW

The Forest and Fish Report represents the conclusions from negotiations between private landowners; federal, state, and local governments; and interested tribal parties that commenced in November 1997 and concluded in April 1999. The Washington State Legislature adopted these conclusions and directed the FPB to adopt rules consistent with the goals and objectives described in the report. These rules became the Forest Practices Rules that currently serve as the foundation for the private and state forest lands aquatic habitat component of the Statewide Strategy to Recover Salmon, which includes an adaptive management program. This adaptive management program is intended to support the overall **performance goal** that:

"Forest practices, either singly or cumulatively, will not significantly impair the capacity of aquatic habitat to:

a) Support harvestable levels of salmonids;
b) Support the long-term viability of other covered species; or
c) Meet or exceed water quality standards (protection of designated uses, narrative and numeric criteria, and anti-degradation)" (USFWS et al.1999).

To support this performance goal, the Forest Practices Rules identified key questions, initial functional resource objectives, and performance targets (although incomplete) to be assessed and refined as part of the mission of the Forest Practices AMP.

2.1 CMER Research and Monitoring Strategy

The CMER research and monitoring strategy is outlined in the CMER Work Plan, which is revised annually. 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" (CMER Committee 2008). Three **key questions** to be answered using various monitoring approaches are:

1) Are forest practices being conducted in compliance with the prescriptions contemplated in the FPB's rules?
2) Will the rules produce forest conditions and processes that achieve resource objectives as measured by the performance targets, while taking into account the natural spatial and temporal variability inherent in forest ecosystems?
3) Are the resource objectives the right ones to achieve the overall performance goals?

Only the last two questions fall under the direct responsibility of CMER and this program review, as the first question is a compliance monitoring issue that is administered outside of the AMP.

Judging the effectiveness of forest practices over time in terms of meeting the Schedule L-1 overall performance goal (that of non-impairment of aquatic habitat) is a function of tracking of specific resource objectives (e.g., heat input/water temperature). Success is judged by comparing actual performance to specific quantitative **performance targets** (where they have been defined).

The monitoring design and implementation strategy is based on the framework provided by the Monitoring Design Team (MDT 2002) and formally transmitted to CMER in October 2006. This framework calls for the development of a three-tiered monitoring program that looks at the

outcomes of forest practices at several nested spatial and temporal scales, including a site-specific effectiveness scale, a watershed-scale analysis of cumulative outcomes of multiple practices over decades, and a broad landscape-level scale to better understand how key environmental indicators might naturally vary across the landscape. Such an organizational framework should facilitate the integration of research and monitoring efforts across multiple spatial scales and research themes. It would also provide a reasonably comprehensive view of how the suite of forest practices, individually and cumulatively, perform in terms of protection of public resources.

The integrated monitoring approach provided by the MDT report was largely adopted as the operational framework by the AMP. The language below is paraphrased from the Work Plan (FY 2009) and describes how each research and monitoring study identified and funded by CMER falls into one of the following categories.

1) Effectiveness Monitoring Programs – designed to evaluate the performance of forest practices prescriptions in achieving resource goals and objectives at the site scale of resolution. Effectiveness monitoring differs from the other approaches in that it is directed at the performance of individual forest practice rules, primarily at the scale of an individual treatment (or "site"). These programs also may include related projects to develop research methodologies or to validate relationships between forest practices activities, input processes and resource response.

2) Extensive Status and Trend Monitoring Programs – evaluate the current status and trends in key watershed characteristics (including water quality, riparian and instream habitat conditions) across lands governed by Forest Practices Rules, and document trends in these indicators over time as the rule prescriptions are applied across the landscape. Extensive monitoring provides a statewide, landscape-scale assessment of the effectiveness of rules to attain specific performance targets across the diversity of landscape conditions. Extensive monitoring is designed to provide report-card-type measures of rule effectiveness (i.e., are 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. This CMER monitoring category is similar to the "broad landscape-level scale" monitoring of the MDT report but it omitted the objective of characterizing the natural variability of key indicators.

3) Intensive Monitoring Programs – designed to evaluate the cumulative effects of multiple forest practices at the watershed scale, equivalent to the MDT's recommendation for analysis of cumulative, decadal-scale outcomes of multiple practices. Analysis of these effects improves our understanding of causal relationships and of the ultimate effects of 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 on physical processes requires an understanding of the effects of individual actions on a site and the cumulative interaction of those responses through the system. Evaluating biological responses is similarly complicated, requiring an understanding of how various management actions interact to affect habitat conditions and how aquatic resources respond to these habitat changes. This sophisticated level of understanding physical and biologic systems can only be achieved with an intensive, integrated, monitoring effort.

4) Rule Implementation Tool Development Programs – designed to develop, refine or affirm tools that enhance the implementation of forest practices rules.

a. *Methodology Tool Development Projects* develop, test or refine protocols, models, and guides that allow the identification and location of FFR-specified management features, such as the Water Typing Model (later referred to as the "Last Fish Model"), landslide screens, the Np/Ns break, perennial flow initiation points (PIP), and Sensitive Sites Identification, or the achievement of specific stand conditions such as the DFC Basal Area Target.
b. *Target Verification Projects* consist of studies designed to verify the appropriateness of performance targets developed during FFR negotiations that the authors identified as having a weak scientific foundation, such as the DFC basal area targets for Type F streams.

There are some subtle but important differences in how the basic components of the monitoring strategy are described in the CMER Work Plan (FY 2009) versus the MDT report. The MDT report refers to "Prescription Monitoring," which consists of tracking the performance of individual or groups of prescriptions by measuring input processes and/or habitat indicators. Prescription Monitoring is equivalent to the Work Plan definition for Effectiveness Monitoring, with the caveat that it allows for multiple prescriptions to be evaluated at the same time or location. In the MDT report, Extensive Monitoring "estimates the distribution of conditions across the landscape regardless of management history as FFR rules are applied and represents the ultimate test of whether FFR rules are effective in meeting the conditions needed to protect salmon and other protected species." In the Work Plan, however, extensive monitoring documents trends over time only as Forest Practices Rules prescriptions are applied across the landscape, and so it cannot provide any comparison with unmanaged conditions nor characterize the range of natural variability in the selected indicators.

"Intensive Monitoring," as described in the MDT report, evaluates two important aspects of the effectiveness of forest practices that cannot be addressed with other approaches; cumulative effects of multiple practices and biological responses. Intensive Monitoring evaluation requires an understanding of how individual actions influence a site and how those responses propagate through the system, and also allows for understanding of the cumulative effectiveness of management practices applied at multiple locations over time.

As described in the CMER Work Plan there is some inconsistency in the interpretation of the MDT definitions and how the various components interact to create a more integrated whole. For example, the MDT report states that prescription and extensive monitoring are forms of effectiveness monitoring conducted at different scales, while validating relationships between forest practices and biotic resource response is part of intensive monitoring. These inconsistencies are not fatal, but they should be acknowledged to ensure that all parties share a consistent and coherent agreement on what they are attempting to achieve. This is especially important if there is lingering uncertainty in terms of the merits of future investments in intensive monitoring, for reasons described in more detail in Sections 4 and 5 of this report.

2.2 CMER Priority Research and Monitoring Programs

There are currently 70 individual projects outlined in the 2009 CMER Work Plan. In order to determine which projects would be implemented given limited resources for a designated fiscal year, a two-tiered prioritization process was adopted.

Research and monitoring programs were prioritized to rank the relative potential of programs to meet adaptive management goals and objectives. A notable component of program-level prioritization is that the effectiveness monitoring and extensive status-and-trend monitoring programs were ranked by considering both the uncertainty of the underlying science and/or assumptions, as well as how much risk to aquatic resources exists if the underlying science and/or assumptions are incorrect. Project-level prioritization occurred based on how essential projects were considered for informing adaptive management decisions, the relative importance of projects to improve implementation of forest practices rules, the status of projects in relation to pending policy decisions, and the imperative to complete projects already in progress. The priority-setting process is driven in part by the level of interest and capacity shared by various stakeholders and in recognition that overall staffing and funding capacity is finite. While beyond the scope of this synopsis, it is worth understanding who is involved in making these prioritizations and what provision there is for reconsideration as new information is made available.

3 OVERVIEW AND ASSESSMENT OF COMPLETED, ACTIVE AND PLANNED PROJECTS IN THE CMER WORK PLAN

This section provides a summary and brief assessment of each of the active or completed projects in the CMER Work Plan. The projects are grouped and presented here by the 12 "rule groups" as listed in the Work Plan, and for some rule groups they are further categorized into "Effectiveness Monitoring," "Extensive Status and Trend Monitoring," and "Rule Implementation Tool Programs." Although the category of "Intensive Monitoring" was also articulated in the MDT report, no projects have yet been initiated or completed, and only one program is planned (Project Number 126, Cooperative Statewide Intensive Monitoring). For a few rule groups, one or more additional studies not formally part of the Work Plan were reviewed as well.

Note that the "Project Number" used in this report a unique index value assigned for review purposes only and does not correspond to CMER assignments. For planned projects or others without a clearly identified category in our review structure, we assigned ordinals preceded by a "U".

For each project reviewed we employed our own assessment of the information provided in the report. For the very limited number of projects where external peer-review comments were available to us, we considered their judgment as well. This project-by-project review was conducted to give us direct exposure of the work that has been accomplished since the inception of CMER, but providing individual project critiques was *not* the focus of our overall review. We anticipate that some of our comments, documented in brief in the subsections that follow, reflect an incomplete understanding of the context and the outcomes of certain reports. For purposes of developing a synoptic understanding of the overall program, however, we found this to be an essential, albeit imperfect, exercise.

We also conducted interviews with various CMER and SAG members and project managers as part of our programmatic assessment. Information obtained during interviews served to clarify questions, to highlight possible issues of concern, and to provide a more complete perspective about the realities of implementing the AMP. While the content of the interviews varied depending on the experience, background, and role(s) of the interviewee, our questions and discussions focused on the Work Plan, and only secondarily on specific projects. We also heard concerns about the process of implementing the AMP, but since that topic was not the focus of this assessment those comments are not reflected here.

Overall, the experience and feedback provided by project managers and CMER members were insightful and thought-provoking. Rather than explicitly documenting individual remarks, however, we have used the information provided during the interviews as background to guide our subsequent discussion and summary. Any remaining factual errors and interpretive judgments are the responsibility of this report's authors alone.

3.1 Stream Typing Rule Group

Table 3-1 lists the completed CMER projects listed in the Work Plan for the Stream Typing Rule Group. There were no active or planned projects reviewed within the Stream Typing Rule Group for this report.

Table 3-1. CMER projects in the Stream Typing Rule Group.

Project #	CMER Project Name	Status
5a	Last Fish/Habitat Prediction Model Development	Completed
5b	The Development and Assessment of the Preliminary Model for Identifying Fish Habitat in Western Washington	Completed
6	Last Fish/Habitat Prediction Model Field Performance Pilot	Completed
7	Annual/Seasonal Variability	Completed

Project 5a. Last Fish/Habitat Prediction Model Development

Cole, M.B., M.P. Killian, and A.P.Harris. 2003. 2003 last fish surveys for eastern Washington water typing model development. Final Report.

Terrapin Environmental. 2002. Data collection for development of eastern Washington water typing model.

This study collected data and developed a multi-parameter field-verified GIS logistic regression model to predict the location of Type F and Type N boundaries across eastern Washington. It also evaluated the effectiveness of hand-held computers with respect to spatially-explicit field data. The study appears to be well designed and documented, with the inclusion of field verification, discussion of problems encountered and recommendations for addressing study discrepancies and limitations. In March 2006, new water type maps were created based on this study; however, the Forest Practice rule (WAC 222-16-031) remains unchanged and so the study results have not influenced a specific management response or change in the rules, to date.

Project 5b. Last Fish/Habitat Prediction Model Development for Western Washington

This document was not identified until late in the process of report preparation and was not reviewed.

Project 6. Last Fish/Habitat Prediction Model Field Performance Pilot

Terrapin Environmental. 2005. Water typing model field performance assessment pilot study.

Cupp, C.E. 2004. Water typing model field performance assessment approach and procedures.

The objective of this project was to assess the performance of the model predictions in western Washington. A study design was developed and accepted by CMER and a pilot field effort of the study design was performed. 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 FFR Policy Sub-Committee on Water Typing. The study methods, analysis and interpretation are thorough. The authors included a detailed discussion of model performance, precision and the balance of prediction at different scales, and sources of error in the model performance. However, despite the careful documentation, the authors express caution with respect to model interpretation. The study design and protocol were developed prior to implementing the pilot study but were not included in the study report, and hence they were not reviewed for our report.

Project 7. Annual/Seasonal Variability

Cole M.B. and J.L. Lemke. 2003. Eastern Washington Last Fish Variability Characterization Resurvey: Final Report.

Work began in 2000–2001 to identify annual and seasonal variability of last fish points and also to assess sampling error. Prior to 2002, no repeated "last fish" survey data existed for Eastside streams, but it was still deemed necessary to characterize variability associated with last fish points. Resurveys were conducted on terminal boundary points (i.e., where the "last fish" occurs in a fish-bearing stream) and lateral boundary points (where a non fish-bearing stream intersects a fish-bearing stream); preliminary data suggest that one is more variable than the other.

Given the initial lack of knowledge, the study design and implementation were largely successful. The suggested efforts, however, might have been better spent selecting sites where drainage size and reach-scale characteristics would not be certain to preclude fish use.

Three years of field survey data were collected (2002, 2003 and 2005) and the study report was provided in spring 2006. According to the Work Plan, the Policy Group decided that additional information was not necessary at that time, although Policy is planning on re-engaging stream typing issues later this spring.

3.1.1 Projects Not Included in the Work Plan

Project 29. Type N Stream Demarcation Pilot

Palmquist, R. 2005. Washington state Cooperative Monitoring, Evaluation, and Research Committee (CMER) Final Report. Type N stream demarcation study phase I: pilot results.

A pilot study to be expanded statewide, the Type N Demarcation Study gathered data to refine the demarcation of perennial and seasonal Type N streams. As the study highlights, this is a task identified in Schedule L-1 of the FFR (USFWS et al. 1999). The pilot study had three objectives:

1. To test the adequacy and repeatability of the pilot field protocol for identifying the perennial and seasonal stream breaks;
2. Estimate the size and variability of the basin areas and other parameters; and
3. Evaluate the potential for using basin and channel attributes to determine the perennial and seasonal stream breaks in the field.

Key findings were as follows: 1) observed basin areas are smaller than the Forest Practices Rules default basin areas; 2) considerable variability among basin areas exist that may be attributable to survey bias; and 3) no sampled channel characteristics were found to be reliable field indicators of the perennial/seasonal break, although channel head or distance downstream from channel head may be suitable alternatives. Distance down-slope from the basin divide may also provide a suitable map-based indicator.

The pilot protocol was determined to be adequate for collecting observed field conditions associated with perennial flow; however, recommendations for Phase 2 efforts included the collection of additional channel characteristics (channel head, debris-flow characteristics, and valley width), randomization of study areas and survey routes, a reduction of sampling and measurement error, and improvements to the statistical rigor of the study (i.e., random sampling, adequate sample size, modifications to the stratification methods). CMER and the Policy Group decided not to pursue Phase 2 and instead used results obtained in Phase 1 to recommend the elimination of default basin areas for Type N streams. Alternative implementation options to meet functional objectives are still being generated.

3.2 Type N Riparian Prescriptions Rule Group

This group of studies concentrated on the non-fish-bearing streams and includes both the perennial and ephemeral (i.e., seasonal) streams. Studies on the characterization of riparian forests and the evaluation of the effectiveness of riparian prescriptions were initiated, including a study to examine the outcome of alternative buffer configurations. A significant amount of effort was placed on the relationship of stream-associated amphibians (SAA) to riparian conditions.

Table 3-2 lists the completed, active, and planned CMER projects listed in the Work Plan for the Type N Riparian Prescriptions Rule Group. Projects for this rule group have been further categorized into Effectiveness Monitoring, Extensive Status and Trend Monitoring, and Rule Implementation Tool Programs for context.

Table 3-2. CMER projects in the Type N Riparian Prescriptions Rule Group.

Program	Project #	CMER Project Name	Status
Effectiveness Monitoring	10	Type N Riparian Effectiveness	Planned
	13	Type N Experimental Buffer Treatment in Basalt Lithologies	Active
	14	Type N Experimental Study in Incompetent Lithologies	Planned
	U01	Windthrow Frequency, Distribution, and Effects	Planned
	12	DNR Type 5 Experimental Buffer Treatment	Active
	16	Eastside Type N Characterization	Planned
	11	Eastside Type N Classification	Planned
	U02	Type N Performance Target Validation	Planned
	21	SAA - Detection/Relative Abundance Methodology	Completed
	22	Tailed Frog Literature Review & Meta-analysis	Active
	24	Tailed Frogs & Parent Geology	Planned
	23	Dunn's & Van Dyke's Salamander	Completed
	25	Buffer Integrity-Shade Effectiveness	Active
	26	Amphibian Recovery	Completed
	27	Amphibians in Intermittent Streams	Planned
Extensive Status and Trend Monitoring	n/a	*No projects are listed in the Work Plan for this Rule Group. The Study Plan for Project 43/44, Eastside Type F/S Riparian Extensive Monitoring, also includes monitoring strategies for Type N streams*	n/a
Rule Implementation Tool	32	SAA Sensitive Sites Identification Methods	Completed
		SAA Sensitive Sites Characterization	

3.2.1 Effectiveness Monitoring

3.2.1.1 Type N Riparian Effectiveness Program

Project 10. Type N Riparian Effectiveness

Schuett-Hames et al. 2003. Type N/F riparian prescription monitoring to evaluate the effectiveness of FFR riparian prescriptions.

This study proposal provides an overview of the Type N and Type F riparian prescriptions (both Eastside and Westside streams) and a thorough discussion of assumptions, uncertainties and effectiveness monitoring questions versus validation questions. For Type N streams, the highly variable riparian harvest/leave-tree prescriptions that are dependent upon site conditions complicate the process of systematic evaluation since there are numerous treatments that could occur. It presents an integrated approach that defines specific studies to address areas of uncertainty and to link these together into a complete program.

This is a well-conceived study that links three complementary study components, one of which documents the site locations where riparian adjacent harvest activities occur, and the others that test hypotheses about the effectiveness of RMZ prescriptions in terms of minimizing changes in riparian stand conditions, tree mortality, riparian functions and stream temperatures. The proposal provides an implementation timeline for each of its components, specific details about the study design, corresponding hypotheses, and an analytical approach. While specific hypotheses are defined, the proposal does not identify a hypothetical magnitude of the change that would be "significant," nor is a timeline suggested that will generate data sufficient enough to measure the changes. Determining the change should come as a result of the statistical analysis, but uncertainties as to variability in the metrics and the variations in treatment types may prove challenging to the interpretation of study results. An alternate and/or complementary approach may need to be generated.

Schuett-Hames, D, A. Roorbach, and G. Stewart. 2006. Implementation Plan: Summer 2006 sampling event Westside Type N riparian buffer characteristics, integrity and function study.

This is a companion report for implementation of sampling in 2006 for only Westside Type N buffers. The metrics seem reasonable to the extent they can be reliably measured. Methods rely on TFW sampling methods (which, while broadly used, have not been fully peer-reviewed). The coefficient of variation inherent in some of these methods is not yet fully understood. There are no instream measures taken in association with this study, other than in-channel wood loading. One could argue that since these streams include only non-fish-bearing streams that efforts to characterize instream habitats might best be left to corollary studies done on Type F streams.

One issue with the design is the indeterminate timeline within which meaningful and detectable changes in riparian integrity and ecological functions can be measured. Some attributes like temperature can be detected in a reasonably short time frame post-harvest, but other functions will take a much longer period, as suggested by their repeat sampling interval of 5 years into the indefinite future. Being able to detect tree mortality from blow-down and disease in such a short period seems likely but other stand dynamics and trajectory trends would likely require decades to measure and may confound interpretation of results.

Project 12. Type N Experimental Buffer Treatment in Basalt Lithologies

Hayes, M. P., et al. 2005. Washington State Cooperative Monitoring, Evaluation, and Research Committee (CMER) study plan for the Type N experimental buffer treatment study: addressing buffer effectiveness on stream-associated amphibians, riparian inputs and water quality, and exports to and fish in downstream (Type F) waters in basaltic lithologies of the coastal areas and the South Cascades of Washington state.

The three overarching goals of the Forest Practices AMP are addressed by this Type N Experimental Buffer Treatment Study, which attempts to evaluate the effectiveness of Type N

(non-fish-bearing) stream buffers to (1) maintain viable populations of stream-associated amphibians (SAAs), (2) meet water quality standards (criteria for temperature and anti-degradation requirements), and (3) provide harvestable levels of fish (i.e., provide for sufficient quality habitat to support fish populations). Specifically, this study is aimed at understanding how timber harvest activities using different buffer configurations in relatively small Type N basins affect a suite of input processes (heat, litter, sediment, and wood) and how changes in those processes affect downstream fish-bearing waters. The study will also link changes in stream conditions and input processes to changes in abundance (or other responses, such as growth rate) of amphibians and fish.

The objective of this study is to assess the degree to which forestry practices may impose changes to conditions important for protection of public resources, and it includes "treatments" that incorporate a common version of current RMZ rules and two alternatives approaches. It will do so by direct comparison of characteristics at treated (harvested) sites to their respective pre-treatment (reference) conditions (4 experimental treatments with 5 replicates per treatment for a total of 20 sites). As stated in the study plan, "the 4 treatments include: 1) no buffer (i.e., clearcut harvest throughout basin), 2) the standard buffer prescription (50% of the stream has a 50-ft-wide buffer, the rest is clearcut), 3) a 50-ft buffer along 100% of the stream, and 4) an unharvested reference site. All 20 sites will be surveyed 2 years pre-harvest and 2 years post-harvest." It seems likely that other opportunities for long-term monitoring not specifically covered in this proposal could easily be developed from the foundation of this work. Comparison of individual treatments to reference treatments (basin with stand age between 30 and 80 years, but will not be harvested for this study) will help distinguish whether observed changes are attributable to environmental variation or forestry practices.

This study is among the most ambitious and comprehensive studies attempted to date in the CMER program. It is the only study that addresses downstream effects of harvest on Type N streams, in terms of meaningful inputs that drive food-web dynamics and direct effects on fish and amphibians. The study design is thoughtful and quite reasonable, but the timeline in which to detect a change (2 years post-treatment) seems overly optimistic. Overall, the study design employs hypotheses-testing in a fashion that other studies would do well to emulate.

Project 16. Eastside Type N Characterization Project: Forest Hydrology

The study design includes an evaluation of relationships between stream hydrology and other processes derived from landscape and climatic features as well as timberland management. The design addresses development of reliable criteria for characterizing and mapping comparable streams across the diverse landscapes of Eastern Washington forestlands. Once implemented, this project will provide a broad-scale description of the spatial and temporal characteristics of stream flows in Type N (non fish-bearing) streams within forested Eastside basins on state and private lands. The scope of the project currently underway is only for the development of a study design and implementation plan, and not to conduct the study itself.

The study design is almost complete; it will characterize flow regimes of streams and their distribution across the landscape, as well as provide a GIS database, data, and a protocol and software for obtaining stratified, equal-probability random sample of Type N channels for field surveys, and specify the measurements and types of analyses required for study implementation. The completed study design is planned for submission to the Independent Science Panel Review (ISPR) for their review in March 2009.

Project 11. Type N Buffer Characteristics, Integrity, and Function (Eastside)
This proposed project would measure the effectiveness of Forest Practices HCP buffers for promoting the desired future stand structure, wood recruitment, and shade, and for preventing bank erosion. While a pilot level effort was initiated in 2004, this project is currently on-hold because this prescription is seldom implemented and a sufficient number of stands to provide enough replicates to make a meaningful study have so far not been available. No study material was reviewed for this report. Commentators noted that the Department of Ecology has requested that a Type N buffer-effectiveness project in Eastern Washington be made a high priority for Clean Water Act assurances. The required conceptual design of such a project would need to focus on temperature and sediment issues, and will require a different approach then was envisioned for this particular study.

3.2.1.2 Type N Amphibian Response Program

Given the Forest Practices RMZ prescriptions for Type N streams, there has been a need to increase our understanding of the relationship between riparian prescriptions and conservation of stream-associated amphibian (SAA) communities. To date, a variety of studies have been done that add to the knowledge base for further evaluation of these relationships.

Project 21. SAA Detection/Relative Abundance Methodology
Hayes, M.P., et al.. 2006. Dispersion of coastal tailed frog (*Ascaphus truei*): a hypothesis relating occurrence of frogs in non-fish-bearing headwater basins to their seasonal movements.

This study examined the relationship between the distribution of coastal tailed frog (*Ascaphus truei*) by life stage within and among non-fish-bearing headwater basins on an intrusive basalt lithology in southwest Washington State. The coastal tailed frog (*Ascaphus truei*) is of particular management and conservation interest across its geographic range, largely because of its potential sensitivity to forestry practices. This species is one of the best-studied stream-associated amphibians in the Pacific Northwest and is an appropriate subject for this detection survey.

Study results indicated that the probability of tailed frog occupancy increases with increasing non-fish-bearing basin size and complexity. This result is likely because breeding habitat quality increases as a function of basin size. Further, the distribution of different frog life-history stages suggests that adult frogs breed in stream reaches that exhibit perennial flow but move upstream and forage higher in the basin at or near stream origin during the non-breeding active season. This has implications for how the current regulatory harvest scheme along these ephemeral (i.e., seasonal Type N) streams intersects with maintaining viable populations of tailed frogs using these habitats. This study was more about generally understanding species behavior and ecology rather than directly testing the efficacy of a given forest practice rule group.

This project was an off-shoot of another project, the contents of which are reported in:
Quinn, T., M.P. Hayes, D.J. Dugger, T.L. Hicks, and A. Hoffman. 2007. Comparison of two techniques for surveying headwater stream amphibians. Journal of Wildlife Management 71:282-288.
This paper was not included in this review.

Project 22. Tailed Frog Literature Review and Meta-Analysis
The goal of the literature review portion of this project is to assemble a comprehensive literature review of the tailed frog to inform development of the dimensions of a meta-analysis for this

species behavior in managed forested landscapes. Although a draft literature review was completed by a consultant, they were unable to finalize the document. WDFW is currently re-drafting the report and intends to complete it during fiscal year 2009.

The meta-analysis potion of this project assembles data from a variety of research projects that have examined tailed frog habitat use in commercial forest from California to British Columbia. The goals of this portion of the project are 1) to determine if the trends in tailed frog abundance as estimated by the above literature review persist if the various data sets are combined and subjected to consistent analyses, and 2) to use the results to guide further LWAG projects. WDFW is in the final stages of this project and expect to produce a draft report during fiscal year 2009.

Project 24. Tailed Frog and Parent Geology

This proposed project will test the parent geology hypothesis about amphibian occupancy and distribution, which could support an evaluation of where to implement Type N buffer rules, required to protect both water quality and amphibian populations.

Project 23. Dunn's and Van Dyke's Salamanders

Hayes, M.P., et al. 2008. Terrestrial salamander wood utilization in managed landscapes: implications for forestry practices. Draft Report, Washington Department of Fish and Wildlife.

This project was designed to provide additional information on the role of LWD in riparian areas that provide habitats for four species of salamanders. The importance of woody debris to these species in riparian forests is not fully understood, so the implications of riparian harvest and alteration of wood debris for species viability is unknown. Inferences made from study results were intended to be broadly applicable and establish general habitat-species relationships between wood and terrestrial amphibians in managed landscapes. The data suggest that wood debris plays an important role in mitigating moisture and temperature extremes in upland habitats during dry years. The report includes some recommendations for further studies. The study sites apparently did not include fish-bearing Type F streams but did span 19 streams located in 1st to 4th order streams with surrounding forests >15 years of age (95% of sites in managed stands).

Project 25. Buffer Integrity/ Shade Effectiveness

The two primary short-term effects of timber harvest of concern on stream breeding amphibians are: 1) the coincident reduction of shade, and 2) increased sediment inputs through ground disturbance. This study compliments CMER's effectiveness monitoring approach and links to the Type N Experimental Buffer Project by examining similar response variables but at the patch-buffer scale. This project is evaluating the effects of four shade levels on amphibian abundance, body condition, spatial organization, and other aspects of stream food webs, such as particulate organic matter drift, and water temperature.

This study uses a multiple-treatment, before-after control-impact design (BACI). Selected study sites are stream reaches that will be randomly assigned to four levels of shade retention) as treatments. Twenty-eight streams distributed within 8 sample blocks will be evaluated two years prior to and two years following treatment. Response variables include abundance and condition assessments of amphibians, including both free-ranging and individuals held in enclosures. In addition, water temperature and stream productivity will be measured to better understand those influences on amphibians. The results should provide valuable information to two of CMER's

programs: Type N Buffer Characteristics and Integrity and Type N Amphibian Response. The project is anticipated to continue through 2010.

Project 26. Amphibian Recovery

Jackson, C.R., et al. 2003. Final report: Integrated headwater stream riparian management study. Final report: Recovery of amphibian and invertebrate communities in recently-logged coastal range headwater streams.

This project was conducted in response to the need for information on stream-associated amphibian and macroinvertebrate communities in non-fish bearing headwater channels. The consequence of timberland management (i.e., timber harvest, road building, etc.) on these resources is poorly understood. In this study, these relationships were investigated by an inter-disciplinary team including physical and biological scientists, using 15 streams in the Coast Range of Washington.

Significant results included a discussion about what criteria are appropriate for determining what constitutes a "headwater" stream—a key determinant of the presence of amphibians is the associated lithology and topography of the stream corridor. The role of LWD in these headwater streams in terms of structuring suitable amphibian habitats is very different than the literature would suggest; as the narrow channel width limits the function of large wood (defined, somewhat idiosyncratically in this report, as >40-cm diameter), smaller wood plays a disproportionally large role in structuring habitats. It should be noted that there was some difficulty with finding suitable treatment and control study sites, which limited the statistical rigor and extrapolation of results to other forested streams.

Project 27. Amphibians in Intermittent Streams

This project proposes to inform the Type N rule about amphibian occupancy of perennial stream reaches that have spatially discontinuous surface flow during base flow periods, which could support an evaluation of where to implement Type N buffer rules. This project is currently on-hold.

3.2.2 Extensive Status and Trend Monitoring

No projects are listed in the Work Plan for the Type N Riparian Prescriptions Rule Group. The Study Plan for Project 43, Eastside Type F/S Riparian Extensive Monitoring, also includes monitoring strategies for Type N streams (see Table 3-3 and Section 3.3.2 of this report).

3.2.3 Rule Implementation Tool

Project 32. SAA Sensitive Sites Identification Methods and SAA Sensitive Sites Characterization

O'Donnell, et al. 2007. Comparison of three methods for surveying amphibians in forested seep habitats in Washington.

This study was designed to compare the relative efficiencies of three different survey methods for detecting amphibians in wetland seeps occurring within forests. Seeps are defined as wetlands where the water table intercepts the surface, and are relatively rare and only occupy a small proportion of most landscapes. This study fills a gap in understanding what sampling tools might be most appropriate for these wetland features. The project tested three methods: trapping using pit-fall traps, light-touch observations and destructive sampling. Light-touch detected more

species compared to trapping alone, while destructive sampling detected more species than trapping but showed similar results to light-touch in terms of species detected. Where a repeatable survey method is required, light-touch seems preferable to trapping because it yields a higher percentage of species and individuals, has fewer potential survey biases, and can provide data on within-seep amphibian use. In contrast, destructive sampling significantly modifies habitats with unknown effects on amphibians.

3.3 Type F Riparian Prescriptions Rule Group

The Forest Practices Rules that apply to riparian zones along fish-bearing streams are rather complex, vary between the Eastside and Westside forests, and present a suite of challenges in terms of systematically evaluating their contributions to achieving the goals of the Forest Practices HCP. The specific rules will not be described in this report, but the reader is referred to a description of the stratification of riparian zones and the restrictions and criteria for exercising thinning harvest options in the Forest Practices HCP.

During the first eight years of the implementation of the revised Forest Practices Rules, a number of studies have focused on fish-bearing streams (Type F), particularly the forest practices that affect the characteristics of the riparian zone. In this section we briefly review those studies and describe the reported objectives, key aquatic conditions and processes addressed, and the spatial scale considered. The spatial scale is relevant to the extent that a particular study addresses information needs defined by the hierarchical framework defined in the MDT report. Specifically, does the study address effectiveness of forest practices at the site scale, or provide information on the status and trends to help define the expected range of variability essential for interpretation of the site scale data (extensive scale monitoring), or contribute to a cumulative effects analyses (i.e., intensive level monitoring at the watershed scale)?

The initial approach taken to investigate the relationship between forest practices in riparian zones along Type F streams focused on (1) filling in significant knowledge gaps in understanding how riparian zones are structured and respond to disturbance, and (2) refining tools (referred to as "rule tools") to enhance the application of the rules themselves rather than testing any direct relationship to the key questions (i.e., cause-and-effect relationship between the rules and the resource objective).

The disparity between what is known about riparian stand dynamics and ecological functions between Eastside forests and Westside forests perceived by policy-makers during FFR negotiations resulted in a need for CMER efforts on the Eastside to focus on establishing a common knowledge base both for riparian stand characteristics and the role of geology, geomorphology, hydrology, and the influence of human as well as natural disturbance factors in shaping present conditions and future potential riparian characteristics. At least initially, the focus on the Westside has been on "rule tools," and only in the last few years have studies been initiated that may directly inform the key questions defined in Schedule L-1.

Table 3-3 lists the completed, active, and planned CMER projects listed in the Work Plan for the Type F Riparian Prescriptions Rule Group. Projects are further categorized into Effectiveness Monitoring, Extensive Status and Trend Monitoring, and Rule Implementation Tool Programs, based on the structure presented in the Work Plan.

Table 3-3. CMER projects in the Type F Riparian Prescriptions Rule Group.

Program	Project #	CMER Project Name	Status
Effectiveness Monitoring	35	Type F Riparian Prescription Monitoring (Westside)	On Hold
	36	Type F Riparian Prescription Monitoring (BTO Add-on)	Active
	U03	Type F Experimental Buffer Treatment	On Hold
	U04	Type F Performance Target Validation	On Hold
	40	Hardwood Conversion	Active
	41	WDFW Temperature Data Collection	Completed
	42	WDOE Temperature Modeling Project	Completed
Extensive Status and Trend Monitoring	43 & 44	Eastside Type F/S Riparian Extensive Monitoring – Temperature and Vegetation Components	Active
Rule Implementation Tool	46	DFC Target Validation	Completed
	49	DFC Plot Width Standardization Scoping	On Hold
	47	FPA Desktop Analysis Project	Completed
	48	DFC Site Class Map Validation Scoping	On Hold
	U05	DFC Trajectory Model Validation	On Hold
	U06	DFC-Aquatic Habitat	On Hold
	U07	Pathways of Riparian Stand Development to Maturity	On Hold
	50	Red Alder G&Y Data Collection	Completed
	55	Eastside Disturbance Regime Literature Review	Completed
	54	Eastside LWD Literature Review	Completed
	59	Eastside Temperature Nomograph	Completed
	57	Eastside Riparian Current Condition Assessment	Active
	U08	Eastside Type F Instream Characterization	Planned

3.3.1 Effectiveness Monitoring Program

3.3.1.1 Statewide Prescription Monitoring Program

Project 35. Type F Riparian Prescription Monitoring (Westside) (this project is also listed as Project 10, Type N Riparian Effectiveness—see Table 3-2 and Section 3.2.1.1 of this report)

Dating back to January 2003, CMER approved the N/F Riparian Prescription Monitoring study. Designed to evaluate the effectiveness of the Type F riparian prescriptions, the study would evaluate post-harvest survival of buffer leave trees, changes in stand structure and composition, and changes in riparian functions including shade, LWD recruitment, and soil disturbance. Six years later, project implementation has not yet begun and changes to the study design have been proposed to address new issues of temperature monitoring and vegetation sampling. The Riparian Scientific Advisory Group (RSAG) has discussed the possibility of waiting to revise the study design until the Forest Practices Board decides on the DFC rule-making for Type F waters. The extent of the current rule changes could affect the Type F Riparian Prescription Monitoring study. Currently, a self-assigned subgroup in RSAG is working to redesign this project. They are behind schedule on bringing this back to RSAG; but because the Type F rules still hang in limbo, RSAG remains uncertain how to proceed. As a result, little progress is currently being made on this project.

Project 36. Type F Riparian Prescription Monitoring (Eastside)

Schuett-Hames, D., S. McConnell, and R. Conrad. 2006. Eastside Type F riparian prescription effectiveness: riparian stand mortality and LWD recruitment.

In early 2006, RSAG, in conjunction with the Bull Trout Science Advisory Group (BTSAG) and the Scientific Advisory Group- Eastside (SAGE), drafted a proposal to evaluate the effectiveness of Eastside Type F riparian prescriptions at the paired treatment–control sites used for the Bull Trout Overlay temperature study. The Eastside Riparian Shade/Temperature Effectiveness Project (commonly referred to as the Bull Trout Overlay temperature study) is designed to quantify and compare differences in shade and stream temperature response between the standard Eastside Type F riparian management prescriptions and special prescriptions that apply within designated bull trout management areas (the Bull Trout Overlay or BTO). This project involves collecting additional information on buffer tree integrity, survival, changes in stand conditions and LWD recruitment to augment the BTO project data on temperature and canopy closure. As an alternative to the 2003 F Riparian Prescription Monitoring study, the pairing of treatment–control sites proposed by RSAG will support two studies, thereby saving time and resources. Post-harvest sampling will continue over a several year period due to the staggered harvest schedule of the sites. As of late 2008, data collection has been conducted 16 sites. That data was submitted and checked for accuracy. Three sites remain to be harvested with a data collection timeframe scheduled for summer 2009.

Project 40. Hardwood Conversion

Riparian Scientific Advisory Group. Riparian hardwood conversion study plan. Revision 11. Washington Department of Natural Resources, Olympia, Washington.

Duck Creek Associates. 2008. Draft case study reports - hardwood conversion study. Prepared for Washington Department of Natural Resources, Olympia, Washington.

As stated in the introduction to this project report, its purpose was to examine the conversion of alder-dominated riparian zones to conifer production lands and the implications that conversion will have on maintaining stream temperatures in compliance with water quality criteria. The temperature component of this project was the responsibility of Washington Department of Ecology and the Department of Fish and Wildlife (see next entry). The objective of this project was to provide information on techniques, tools, and treatments for harvesting hardwood trees in riparian areas and re-establishing dominant conifer species.

The draft report presents an economic case study for riparian hardwood harvest and conversion at sites adjacent to upland harvest units, and summarizes the silvicultural prescriptions used. While the objective of the project is to quantify and describe stream temperature responses to hardwood conversion, no stream temperature data were presented.

Project 41. WDFW Temperature Data Collection

Increases in stream temperature following hardwood conversion are a major issue to some parties. Preliminary results show significant, but small, water temperature responses to the hardwood harvest treatment for four of five case study sites. It was also documented that downstream recovery occurred at four of the five sites and that responses varied in relation to site-specific conditions and concurred with DOE Temperature Model findings.

Project 42. WDOE Temperature Modeling Project

Cristea, N. and J. Janisch. 2007. Modeling the effects of riparian buffer width on effective shade and stream temperature.

This study was requested by a working group trying to develop a simple template for small forest landowners to use when planning a hardwood conversion harvest. The purpose of this study was to provide an understanding of the relative risk of extending the length of stream that could be harvested under a hardwood conversion template alternate plan. Secondary purpose included providing a sensitivity analysis to better describe the factors most influential on water temperature. This report evaluated the application of two temperature models (a shade model and a water-quality model) that predict the effects that converting hardwood-dominated riparian stands to conifer-dominated stands have on stream temperatures. The report also explored the potential for stream temperature increases under three hypothetical buffer-width scenarios. A useful review of the assumptions and the physics of heat transfer are presented for context, and the results of model outputs for various combinations of stream widths, buffer widths, and lineal lengths of stream subjected to the "treatment" of hardwood dominated harvest to promote conversion to conifer species are presented. The overall results for the scenarios analyzed indicated that riparian vegetation characteristics (i.e., height and width) and harvest unit length exerted the greatest influence on stream temperatures during periods of low flows.

Models to predict temperature effects of changes to riparian zones are abundant and reasonably well understood. It is not directly evident how the information and results of this project will be useful for answering broader questions about the effectiveness of general riparian prescriptions in mitigating stream temperature increases. The study frames a narrow set of circumstances and falls short of the more applicable objective to model the adequacy of the various riparian retention/harvest prescriptions for Type F and Type N streams. Clearly it could be used to predict specific outcomes from a given site and the results compared with actual empirical measurements to help calibrate the model output and utility. It is not evident if this report has gone through ISPR review.

3.3.2 Extensive Riparian Status and Trend Monitoring Programs

Project 43. Eastside Type F/S Riparian Extensive Monitoring

Ehinger, W., et al. 2007. Draft study plan extensive riparian status and trend monitoring program including: Westside Type F/S riparian extensive monitoring project; Eastside Type F/S riparian extensive monitoring project; Westside Type Np riparian extensive monitoring project; Eastside Type Np riparian extensive monitoring project.

This project addresses the Type F Riparian Prescriptions Rule Group at the extensive scale and proposes an organization scheme to systematically sample stream temperatures in both Eastside and Westside forests, and in both Type F and Type N streams. This is a significant contribution to the extensive riparian status and trend monitoring project and could provide essential stream temperature and related data. Such data is needed to demonstrate the landscape-scale effects of implementing forest practices riparian prescriptions. This information is also required by the regulatory agencies to justify their assumption that that current forest practices rules meet Clean Water Act requirements, or if they do not that such information will be used to make needed adjustments through the adaptive management process.

The authors of this study assert that "this will obtain an unbiased estimate of the distribution of stream temperatures across forestlands subject to the Forest Practices Act, as well as identify trends over time as necessary to better understand natural variability and the influence of

landscape features. This program will provide statistically valid estimates of two riparian resource indicators, water temperature and riparian stand conditions, for streams across lands covered by the Forest Practices Rules and identify trends in these indicators over time." As designed, this seems to be a reasonable ambition that requires time to fully evaluate.

As of late 2008, there is an ongoing and related effort to obtain an unbiased estimate of the distribution of riparian vegetation types across forestlands subject to the State forest practices rules, as well as to identify trends over time. It was pointed out to us during our review that the vegetation and stream-temperature components were separated early in this study plan development. The stream-temperature assessment referred to here is actually the stream-temperature component of the Extensive Riparian Status and Trends project described above.

Temperature data from eastern Washington Type F streams have been compiled and a draft report has been received, but was viewed as being incomplete by RSAG. The report authors are currently working on a revised report.

3.3.3 Rule Implementation Tool

Shortly after the adoption of the revised Forest Practices Rules, the Policy Group directed CMER to initiate three studies that focus on the rules themselves. These "rule tools" included studies to address (1) the validation of DFC basal area targets; (2) the validation of basin area defaults for identification of PIPs; and (3) water typing, which included development of a predictive model to determine where the likely location in the stream network the last fish could be found. The studies associated with DFC target validation are described in the following section (Section 3.3.3.1). The two other "rule tool" studies referred to above (PIP and water typing) were initiated by the Policy Group to provide information judged to be critical in resolving major uncertainties about fish versus non-fish-bearing streams and the location of the upstream extent of perennial streams subject to Type N riparian prescriptions. The two latter studies are reviewed in Section 3.1 (Projects 5a, 6, and 7; and Project 29).

3.3.3.1 Type F DFC Validation Program

Project 46. DFC Target Validation

Schuett-Hames, D., R. Conrad, and A. Roorbach, 2005. Validation of the western Washington riparian desired future condition performance targets in the Washington state forest practice rules with data from mature, unmanaged, conifer-dominated riparian stands.

The purpose of this study was to validate the current riparian DFC basal area targets for riparian stands adjacent to fish-bearing streams in western Washington. Specifically, the purpose was to validate assumptions about measures of basal area and other stand conditions from unmanaged riparian areas in forests averaging 140 years old, which constitute a specific resource performance target for riparian zones along Type F streams on Westside commercial forest lands.

The objectives of the study were to (1) document stand characteristics of mature, unmanaged conifer and mixed-composition riparian forest from sites in western Washington; (2) provide estimates of mean and standard deviations for basal area measurements on a per-acre basis and stratified by stand productivity site class for comparison with the current DFC performance target values; and (3) provide measured values for other stand attributes and evaluate the merits of their inclusion as DFC performance target metrics. To accomplish this, a random sample of riparian stands west of the Cascade Mountain divide (N=113) was selected for study. Site class categories

were sampled separately so the specific performance target for each site class could be compared with other data. Summary statistics were estimated for stand attributes including trees per acre, mean over story tree height, quadratic mean diameter of trees, basal area (ft^2) per acre, volume, and Curtis' relative density.

Key findings from the DFC Target Validation Report (reflecting measured values from mature, unmanaged, conifer-dominated riparian forest stands) included: (1) mean live conifer basal area per acre (LCBAPA) is significantly higher than the BAPA used in the current-rule targets, and (2) There was no statistically significant difference, and little actual measured difference, in LCBAPA by site class. However, it was noted that less productive sites yielded smaller trees, while fewer but larger trees dominated more productive sites.

Results of the validation study suggest that the basal area targets currently being used in the forest practice rules are likely not accurately reflecting reference conditions. The differences between current Rule DFC Targets by Site Class and mean LCBAPA obtained from measurements made in mature, conifer-dominated riparian stands are statistically significant. For all site classes, the measured values exceed the current rule target value, in some cases substantially. A peer review was done but was not available for our inspection.

Project 49. DFC Plot Width Standardization Scoping

This follow-up study to the DFC Target Validation study developed due to the use of both map-derived and field-derived site class during the completion of Project 46. The ISPR noted that while comparisons using the map-derived site class using the original design were appropriate, any comparisons of the data from field-derived site class was incorrect because the plots were different widths for the different site classes. This follow-up study to the DFC Target Validation study was proposed to standardize the width of the study sample plots. This would remove bias when comparing basal areas among the field-derived site class data. No documentation was reviewed for this report. The Policy Group decided to not pursue a plot width standardization project.

Project 47. FPA Desktop Analysis Project

McConnell, S. 2007. An overview of the DFC model and an analysis of Westside Type F riparian prescriptions and projected stand basal area per acre.

The forest practice rules that govern timber harvest along Westside Type F streams are complex because RMZ widths vary by site class and stream width, and landowners have two prescription options to choose from on Site Class 1 and 2 lands and Site Class 3 where the harvest unit is associated with a small stream. The DFC Model, using landowner-collected data, is used to determine harvest prescriptions, but the DFC Model functions more-or-less as a black box. For this reason, constraints to timber harvest that went beyond constraints attributable to basal area target requirements were not readily recognized. The analysis done for this study determined that, in most cases, the required number of leave trees per acre for the thin-from-below prescription (Option 1) was the more consequential constraint to the amount of timber harvest allowed 96 percent of the time, and the extra stream width required for the leave-trees-closest-to-the-stream prescription (Option 2) was the more consequential constraint 67 percent of the time. The forest practices RMZ prescriptions are intended to place riparian forests along fish-bearing streams on growth trajectories that over time will allow the stands to take on the characteristics of mature, unmanaged riparian forests approximately 140 years old. They do so by setting minimum residual BAPA targets that stands must exhibit by age 140 years, hence the DFC.

The FPA Desktop Analysis results are derived from *model-projected* values taken from 150 Forest Practice Applications (FPAs). Associated studies in this group examined the relative influence of input variables used in the model in terms of constraining the harvest options in stands meeting the minimum BAPA. Other studies provided confirmation of site class assignment and other data relevant to the model. The DFC Model was derived from ORGANON, a model used for 30- to 80-year-old homogeneous upslope forested stands that may not accurately reflect growth in riparian stands. There are no currently available riparian specific growth and yield model. The extent to which the DFC Model conforms to either ORGANON or the FVS Model is unknown as it was tested against only 11 stands, all of them hemlock-dominated. A proposal was made by RSAG, approved by CMER to compare DFC Model outputs against these other well-established models but this was rejected by Policy, so uncertainty remains as to the validity of DFC Model results as compared to other models.

Given the complexity of this effort, the reader is referred to the original set of study reports to clarify any unintended inconsistencies or inaccuracies in this brief summary.

Project 48. DFC Site Class Map Validation Scoping
Preliminary results of the DFC Validation Study provided several optional approaches (conceptual study designs) for validating the accuracy of the DNR site class maps in riparian areas. Evidently, inaccuracies in site class maps were discovered in that study, and a follow-up study was proposed to resolve these. The Policy Group decided not to pursue a site class validation project. No documentation was reviewed for this report.

Project 50. Red Alder Growth and Yield Data Collection
CMER contributed funding for cleaning and compiling data for the initial stages of a study to collect data on red alder stand characteristics in riparian zones and to enhance understanding and refinement of alder growth and yield models. No final report was produced.

3.3.3.2 Eastside Riparian Type F Program

CMER efforts on the Eastside have focused on establishing a common knowledge base for riparian stand characteristics and dynamics, and the role of geology, geomorphology, hydrology, and the influence of human as well as natural disturbance factors in shaping present conditions and future potential riparian characteristics. To date, five such studies have been completed, with an equal number either in progress or planned.

Project 55. Eastside Disturbance Regime Literature Review
Concurrent Technologies Corporation. 2002. A review and synthesis of available information on riparian disturbance regimes in Eastern Washington. Document Package - Report prepared for Washington Department of Natural Resources, Olympia, WA.

The lack of understanding and documentation of the influence of past and current "disturbance" factors on shaping the present and future characteristics of Eastside riparian zones were considered significant. This literature review was commissioned to provide a common knowledge base and to help frame the design of studies to examine the overall effectiveness of riparian prescriptions in protecting ecological conditions along riparian zones. Elevation "bands" are currently used to group anticipated responses to riparian zones in eastern Washington after timber harvest. Within each elevation band, Type F rules delineate riparian forests into specific lateral zones (the core, inner zone and outer zone). Similar to Westside Type F streams, timber harvest in the inner and outer zones is permitted if stand requirements (measured as BAPA) are

met, yet little is know about growth and disturbance effects on stand dynamics of Eastside riparian areas. These effects serve as precursors for establishing specific targets and measures of performance for evaluating RMZ rule effectiveness.

This project was intended to provide a better scientific understanding of the role of natural and human disturbance in shaping riparian-zone stand characteristics and potential effects of these disturbances. To help frame the review, the SAGE posed 17 questions to the review team that covered a variety of topics relevant to disturbance. Understanding historic versus current forest conditions and disturbance regimes was a consistent them in these questions. A one-page executive summary was provided for this several hundred page review and annotated bibliography. A clear statement of how the 17 questions related to the forest practice harvest rules seems to be missing, but it would be a useful adjunct to provide context.

It is not clear how project findings have been used to inform "next steps" in terms of effectiveness monitoring of RMZ rules at either the site or watershed scales of interest, or if they have been applied at all. No doubt a rationale does exist and we recommend that the authors or SAGE members be asked to help clarify these relationships to an outside reader.

Project 54. Eastside LWD Literature Review

Herrera Environmental Consultants, Inc. 2004. Technical memorandum, Review of the available literature related to wood loading dynamics in and around streams in Eastern Washington forests.

This project was a comprehensive literature review of large woody debris (LWD) loading in Eastside forested streams. The authors presented their reviews by responding to 41 questions, grouped into nine themes initially posed by the SAGE.

The literature review successfully documented what is known and not known about LWD loading in Eastside streams, but it was unable to specifically answer the questions in many cases due to the identified lack of specific and/or relevant data. Inferences from data sources other than those derived for Eastside forests did provide some useful insights. It should also be noted that the questions generated by the SAGE were numerous, and that not all may be equally critical for the evaluation of prescription effectiveness. Overall, the review offers a significant and organized contribution that should provide some specific guidance to the SAGE as they continue to define initial performance targets and to judge the outcomes of Eastside RMZ prescriptions. It would seem that from these data a reasonable range of LWD conditions could be defined that would serve as an interim target from which to judge the outcomes associated with RMZ applications in Eastside forests.

Project 58. Eastside Temperature Nomograph

This study was designed to provide detailed analysis of landscape- and watershed-scale factors that contribute to stream temperatures, and to provide statistical relationships about the influence of both canopy closure and elevation on stream temperatures. These analyses were deemed important in terms of understanding the consequence of canopy removal during riparian adjacent timber harvest along Type F streams in Eastside forests. Flaws in the study implementation and analysis, however, resulted in this study being rejected by SAGE and CMER. Specifically, there were very little data available that had both canopy coverage and stream temperature for a given site. The scattering of data that had one or the other of these could were not supported by the specifications of this project, and despite a massive attempt at reconciling this problem through statistical means by the contractor, no meaningful results could be obtained. A draft report was

written but it was not finalized due to inconsistencies in data and analyses. No documentation was reviewed for this report.

Project 57. Type F Riparian Prescription Monitoring (Eastside)

Mason, Bruce, and Girard, Inc. 2006. Eastside Type F riparian assessment project phase 1 study plan.

This study plan emphasizes the need for relevant data for Eastside Type F riparian prescriptions that currently lack specific resource objectives or numeric targets.

As taken directly from the study report:

> "This project will be a baseline assessment of current riparian forest stand conditions and will help develop targets to accomplish prescription scale evaluation. The Scientific Advisory Group for the Eastside (SAGE) is responsible for validating Type S/F riparian prescriptions on lands managed in eastern Washington under the FFR. This study plan will be the basis for implementing Phase I of SAGE's preferred strategy for conducting the Eastside Type F Riparian Assessment Project. In advance of Phase II (full study implementation), Phase I is specifically designed to test field methods, estimate variability in the sample population, refine statistical and analytical approaches, and to assess the ability of the study to meet SAGE's defined objectives, including:
>
> Objective 1: Determine range and distribution of current riparian stand conditions;
> Objective 2: Determine the relationship between site characteristics and riparian stand attributions;
> Objective 3: Determine the effect of proximity to the stream on the characteristics of Eastside riparian stands;
> Objective 4: Determine the frequency and distribution of mortality and insect and disease effects in eastern Washington riparian stands; and
> Objective 5: Document management practices and other disturbance factors that affect eastern Washington riparian stands."

The focus of this study underscores the issue that riparian characteristics of Eastside forests are poorly understood, and that before any systematic evaluation of prescriptions (in their various forms) can occur, a basis to understand the range of conditions and characteristics must be established. The variety of riparian-adjacent harvest options currently on the table for Eastside operations further complicates the testing of a standard suite of prescriptions. The quarterly progress report (December 2008) suggests that Phase I has been completed. Phase II analysis will include modeling riparian data to determine stand susceptibility to insects, pathogens and crown fire. Additional statistical analyses of Phase I data will also be done by SAGE members with the goal of better understanding the characteristics of the data and reasonable and useful statistical analyses that can be done with these data.

3.4 Bull Trout Rule Group

Table 3-4 lists the completed and active CMER projects listed in the Work Plan for the Bull Trout Rule Group.

Table 3-4. CMER projects in the Bull Trout Rule Group.

Project #	CMER Project Name	Status
61	BTO Temperature (Eastside Riparian Shade/Temperature)	Active
62	Solar Radiation/Effective Shade	Active
U09	Groundwater Conceptual Model	On Hold
n/a	Groundwater Research Studies	Planned
67A and 67B	Bull Trout Presence/Absence	Completed
68	Bull Trout Habitat Prediction Models	Completed
U10	Yakima River Radiotelemetry	Completed

Project 61. BTO Temperature (Eastside Riparian Shade/Temperature)

Light, J. Conrad, B., and Ehinger, B. Undated. Comparison of standard F&F Eastside riparian prescriptions with no shade removal within 75-ft prescription (bull trout overlay), study plan.

As stated in this study report, the goal of this project is to determine if the riparian prescriptions for the bull trout overlay (all available shade) and the standard forest practices shade rule are comparable in their protection of stream temperature, and whether the prescriptions maintain riparian conditions that will meet water quality standards for temperature and bull trout thermal preferences.

The specific objectives include:

- Quantify and compare differences in canopy cover following timber harvest and its relationship to stream temperature using standard Forests and Fish riparian prescriptions and those requiring retention of all available shade within 75 ft of Type F (fish habitat) streams;
- Quantify the relationship of each treatment in terms of achieving water quality temperature criteria appropriate for bull trout thermal preferences; and
- Use study findings to develop recommendations to CMER regarding the relative performance of each prescription for meeting temperature criteria specific for bull trout preferences.

An associated study noted below supplements this study with measurements of solar radiation actually reaching the stream. Recent contract amendments for both studies have extended until June 30, 2011. No final report was available to review for this current synopsis.

Project 62. Solar Radiation/Effective Shade

CMER Committee. 2002. Study plan to evaluate the effectiveness of the current TFW shade methodology for measuring attenuation of solar radiation to the stream.

This project is a secondary component of the Bull Trout Temperature Overlay project, and will determine if the "all available shade" riparian rule, which relies on densiometer measurements of canopy cover, is effective at preventing the harvest of trees that block solar energy from reaching the stream and preventing changes in stream temperatures. Recent contract amendments have extended the study until June 30, 2011.

The primary research objective is supported by the following list of research questions:

1. Does removing trees that do not qualify as "all available shade" affect solar energy and/or stream temperature?
2. Is canopy cover, as defined by the "all available shade" rule, an adequate surrogate for the attenuation of solar energy to the stream to prevent stream temperature increases?
3. If canopy cover remains the same pre- and post-harvest, as defined in the rule for all available shade, does the amount of solar energy input to the stream also remain the same?
4. If solar energy input to the stream increases after harvest though all canopy cover is retained, do stream temperatures also increase after harvest?
5. Do multiple layers of canopy attenuate more solar energy to the stream than a single layer of canopy (as measured with the densiometer)?
6. Under what circumstances does solar radiation (direct and indirect) significantly influence stream temperature?

No final report was available to review for this review.

Project 67A. Bull Trout Presence/Absence

Peterson, J.T., N.P. Banish, and R.F. Thurow. 2003. Analysis of movement patterns of stream-dwelling salmonids in response to three survey methods.

In support of the Bull Trout Presence/Absence Protocols, the focus of this study was to evaluate and estimate the movement of stream-dwelling salmonids in response to sampling activities. It is one of two such protocol studies and had three primary objectives:

- Measure the distance and direction bull trout and other salmonids move during surveys using day snorkeling, night snorkeling, and electrofishing.
- Describe the influence of physical channel features (stream size, water temperature, channel complexity, and cover density) on salmonid response
- Compare probabilities of detection for different salmonid species and size classes with and without the use of blocknets.

The findings of the study can be used to evaluate potential biases in the absence of blocknet surveys and develop methods for adjusting sample data, if necessary. This is part one of a two-part study. Assessment remarks for both studies are presented under Project 67B (below).

Project 67B. Bull Trout Presence/Absence

Thurow, R.F., et al. 2004. Development of bull trout sampling efficiency models.

In response to the known challenges of bull trout sampling, this study was conducted to support the development of protocols for establishing bull trout presence/absence specific to Washington State. The specific study objectives were as follows:

- Compare the probability of capturing bull trout and other non-anadromous salmonids using day snorkeling, night snorkeling, and successive capture or mark-recapture electrofishing with an unbiased estimate of the true population;
- Describe the influence of various physical channel features (stream size, water temperature, conductivity, channel complexity, and abundance of cover) on capture probabilities; and
- Compare capture probabilities for different size classes of bull trout and other salmonids.

While considerable attention was paid to study design and statistical rigor, unanticipated problems with equipment failures and restricted site access during high-flow events led to

uncertainties in the validity of results. Furthermore, the study documentation noted an insufficient number of sample sites from undercut banks due to the fact that sample sites fitting this habitat strata had inadequate bull trout densities to conduct mark/recapture surveys. To address these study limitations, it would be valuable to discuss potential ramifications and the severity of such occurrences. In the absence of such scientific assessment, it is likely that the conclusions of the study may be spurious.

The collective results of the two bull trout presence/absence protocol studies shed light on the probability of detection issues and effort necessary to survey bull trout under various habitat conditions; however, the Work Plan explicitly states that additional work is needed to achieve the programmatic goal of a bull trout field protocol. As such, we would expect to see additional studies required to address this data gap.

Project 68. Bull Trout Habitat Prediction Models

Dunham, J.B. and G.L Chandler. 2001. Models to predict suitable habitat for juvenile bull trout in Washington State. Final Report.

This report describes some research relevant to prediction models to help identify juvenile bull trout presence or absence in Washington State under current conditions of habitat distribution. The description was not explicitly specific to eastern Washington streams, but a number of study sites were located in Eastside stream systems. The primary conclusion of the study is that summer maximum stream temperatures are the main predictor of suitable bull trout habitat. Summer maximum temperatures were highly predictable with a simple model incorporating site elevation and geomorphic conditions. The probability of occurrence of juvenile bull trout is very low as temperatures exceed 20ºC. The study also examined some other variables, such as LWD loading and channel geometry, but none were very significant.

3.5 Channel Migration Zone Rule Group

Table 3-5 lists the CMER projects listed in the Work Plan for the Channel Migration Rule Group. No projects were defined and therefore none were reviewed for the Channel Migration Rule Group.

Table 3-5. CMER projects in the Channel Migration Zone Rule Group.

Project #	CMER Project Name	Status
U12	CMZ Screen and Aerial Photograph Catalog Project and CMZ Boundary Identification Criteria	Dropped
U13	Consistency and Accuracy of CMZ Boundary Delineations	On Hold

3.6 Unstable Slopes Rule Group

Table 3-6 lists the completed, active, and planned CMER projects listed in the Work Plan for the Unstable Slopes Rule Group.

Table 3-6. CMER projects in the Unstable Slopes Rule Group.

Project #	CMER Project Name	Status
75	Testing the Accuracy of Unstable Landform Identification	Planned
79	Mass Wasting Landscape-Scale Effectiveness Monitoring (MWLSE)	Planned
77	Mass Wasting Prescription-Scale Monitoring Protocol Development	Active
U14	Mass Wasting Buffer Integrity and Windthrow Assessment	Planned
B	Shallow Rapid Landslide Screen for GIS Projects	Completed
U15	Technical Guidelines for Geotechnical Reports	On-Hold
83	Regional Unstable Landforms Identification	Completed
84	Landform Hazard Classification System and Mapping Protocols	Completed
85	Landslide Hazard Zonation	Active
87	Model Evapo-transpiration in Deep-Seated Landslide Recharge Areas	Completed
U16	Evapo-transpiration Model Refinement	Planned
U17	Landslide Classification	Planned
U18	Groundwater Recharge Modeling	Planned
U19	Board Manual Revision	Planned

Project 79. Mass Wasting Landscape-Scale Effectiveness Monitoring
This proposed project would evaluate trends in the number and volume of landslides over time at the watershed scale on FFR and on unmanaged lands.

Project 77. Mass Wasting Prescription-Scale Monitoring Protocol Development
Dieu, J., et al. 2008. Mass wasting prescription-scale effectiveness monitoring project (post-mortem).

The purpose of this study is to evaluate effectiveness at the "prescription scale" or site scale, which might consist of a single clearcut, unstable landform, or culvert. It was initiated immediately following a "significant" storm event, which was judged to occur in December 2007. The goal of the project is to evaluate the effectiveness of unstable slope rules, particularly the identification and associated mitigation of unstable landforms and landslides (the Regional Landform Identification Project [RLIP] and the Landslide Hazard Zonation Project [LHZ]), and to test the effectiveness of mass wasting prescriptions at avoiding landslides. Specific links to future management actions, however, were not developed.

According to the September 2008 progress report, a preliminary estimate for fieldwork completion was October 2008, the completion of a draft report for UPSAG review in winter 2009, and a revised report for CMER review in spring 2009.

Project B. Shallow Rapid Landslide Screen for GIS Projects
Shaw, S. and L.M Vaugeois. 1999. Project 10. Final report. Comparison of GIS-based models of shallow landsliding for application to watershed management.

This study tested the predictive ability of three GIS-based models to identify shallow landslides. The assessment was strictly empirical, supplemented by discussion of the principals of slope instability. The primary question addressed is simply whether or not the models reproduce observed landslides. This assessment may be useful for considering Westside prescriptions, but perhaps not nearly so much for the Eastside since a comparison was not made with an appropriate dataset. There was no assessment of whether the necessary parameters for the more complex models are readily available at a state scale. If these parameters are not available, their associated values are essentially equivalent to constants, and any model that uses these parameters should not be thought of as having more flexibility than is operationally true.

There is no forest practice rule explicitly promulgated by this study, but it is intended to inform those rules related to FP activities on "unstable slopes." This study provides reasonable evidence that the recommended guidance (use of a particular slope-stability model, SMORPH) will work well for Westside watersheds. It provides only the barest hope, however, that the same will be true for Eastside watersheds, where the determining processes assumed in the model (slope and topographic convergence) may or may not be controlling for slope stability. Given the long-standing association of logging practices with landsliding, and the documented damage caused by unnaturally high rates of landslides on aquatic resources, this is certainly a useful approach and it has been widely applied. Any such model results, however, are subject to the implicit (or at least hidden-from-the-user) process by which the boundaries between "stability" and "instability" are defined, but such discrimination is critical to management outcomes and may merit future additional scrutiny.

Project 83. Regional Unstable Landforms ID (Deep-Seated Screen)
This project was a tool development project that provided regional information to identify unstable landforms that do not meet the present statewide landform descriptions. Additionally, it included identifying lithologies that promote deep-seated landslides. Results have been entered into the hazard zones spatial database used by DNR for classifying forest practices applications. No documentation was reviewed for this report.

Project 84. Landform Hazard Classification System and Mapping Protocols
This project was a tool development project that provided a statewide standard for assigning hazard to unstable slopes. This standard is being used in the DNR Landslide Hazard Zonation Project. No documentation was reviewed for this report.

Project 85. Landslide Hazard Zonation
Results from this ongoing project include GIS mapping of landslides and landforms, and landslide hazard classification. No documentation was reviewed for this report, although there is information on the LHZ website about the status of this project..

Project 87. Model Evapotranspiration in Deep-Seated Landslide Recharge Areas
Sias, J. 2003. Estimation of multi-season evapotranspiration in relation to vegetation cover for regions with rainy-winter/ dry-summer climate.

Because there is a rule covering timber harvest on groundwater recharge areas to deep-seated landslides, there has been an effort at CMER to provide some understanding of the processes involved. The science to support this rule is not well-developed, but regulatory foresters need tools with which to evaluate these proposed harvests. The purpose of this study was to evaluate a mechanism hypothesized to link timber harvest with an increased occurrence of deep-seated landslides, namely the change in evapotranspiration, which in turn might lead to higher

groundwater levels, greater pore pressures, and thus a lower factor-of-safety for slope stability. Because of the potential for deep-seated landslides to deliver sediment to rivers and streams, understanding the mechanism(s) by which landslides are related to timber harvest could directly address resource issues.

The literature is replete with studies on the effects of harvest, particularly the loss of root strength over time, on shallow landslides. The literature citations suggest that a study such as this one, specifically focusing on slope instabilities below the level of rooting depth, had not heretofore been conducted. The scope of this study was limited to changes in evapotranspiration, based on a model developed by the author. The conclusions of this study are suitably limited—winter evapotranspiration is "potentially…non-negligible", and uncertainties are large. Its primary recommendation was to evaluate the study's "conclusions" empirically.

The peer reviews of the report raised concerns that the model required a non-calibrated, non-physical parameter to match simulated and observed data, and a variety of questions were raised about this and other modeling assumptions. The summary of the reviews concluded that, were this a journal submission, the decision would be "reject with encouragement for resubmission," and concluded that "the results are not presently usable in a management context." The author replied that "direct validation" would adequately test whether the reviewers' concerns are correct, and that she "continues to have a strong opinion that there is much value in directly testing whether this idea is viable." This is all-but-explicit acknowledgment that the results, even if they had direct management applicability, would not be ready for such use.

Another concern is whether the phenomenon being considered, namely the change in wintertime ET (when deep-seated landslides are presumed to be most likely) is in fact the mechanism most likely to link harvest with slope instability. For example, the role of how road networks redirect drainage has the potential to locally surcharge runoff and increase pore water pressure (see, for example, Sidle et al. 2006).

3.7 Roads Rule Group

Table 3-7 lists the completed, active, and planned CMER projects listed in the Work Plan for the Roads Rule Group.

Table 3-7. CMER projects in the Roads Rule Group.

Project #	CMER Project Name	Status
91	Road Surface Erosion Model Update	Complete
93	Road Sub-basin-Scale Effectiveness Monitoring	Active
U20	Road Surface Erosion Model Validation/Refinement	Planned
U21	Effectiveness of RMAP Fixes	Planned
96	Road Site-Scale Effectiveness Monitoring	Planned

Project 91. Road Surface Erosion Model Update

Dube, K., W. Megahan, and M. McCalmon. 2004. Washington Road Surface Erosion Model (WARSEM).

The Washington Road Surface Erosion Model (WARSEM) is a tool that allows users to calculate average annual road surface erosion and sediment delivery to channels in a standardized manner.

This report is primarily a user's manual, rather than a "monitoring report"; the "science" in this document is located in Appendix A and the field testing in Appendix D. These are the most relevant sections for purposes of this review.

The science of generalized road-sediment production and delivery is well founded but data-sparse. Only a modest number of studies are available to actually calibrate the various factors that are assumed to be relevant, and thus only a scant fraction of the wide range of actual conditions are well-described by existing data. Of particular potential significance is the assumption of maximum transport distance from culvert to stream, the role of lithology, and owner-reported road usage levels. None of these parameter values appear to be particularly well-supported, but all have significant influence on the model results. Most of the source documents are gray-literature, non-peer-reviewed studies, and although there is no reason to doubt their general veracity, they are limited in geographic scope and difficult to retrieve to check on their direct applicability.

Most revealing, however, is the preliminary results of three field tests of observer variability. The results of a given road vary by no less than 2-fold, and as much as 10-fold, between observers. The observers could generally discriminate between the relative production from the three roads in the test sample, but not every observer ranked them in the same order. In short, the technique is clearly suitable in its present condition to make only the broadest assessments. Because there was no actual data on sediment yield collected from any of the sites, there is also no knowledge of whether the method as a whole actually returns realistic values.

Additional replicate surveys have apparently been executed, but the results are not yet available.

Project 93. Road Sub-basin-Scale Effectiveness Monitoring

Raines, M., Conrad, R., Clark, J., Coe, D., Palmquist, R., and C. Veldhuisen. 2005. Road sub-basin scale effectiveness monitoring design. Study plan developed for the Department of Natural Resources, Olympia, WA.

This project is designed to determine the degree to which road attributes or conditions that affect water and sediment production and delivery to downstream watercourses are improving over time. To accomplish this, the status and trend in characteristics of the basic road attributes known to be important to road sediment delivery will be assessed, with sites revisited on a 5-year cycle to allow time for trends to express themselves. A statistical power analysis suggested that fairly substantial change (>25%) will be needed to be detectable, without allowing for budgetary limitations on the recommended number of samples (60) or irresolvable observer variability. Thus any results from this study relevant to determining trends, although well conceived and potentially quite useful, may remain ambiguous for some years.

3.8 Fish Passage Rule Group

Table 3-8 lists the CMER project listed in the Work Plan for the Fish Passage Rule Group.

Table 3-8. CMER projects in the Fish Passage Rule Group.

Project #	CMER Project Name	Status
102	Extensive Fish Passage Trend Monitoring	On Hold
101	Fish Movement and Culvert Gradient Flume Study	On Hold
100	Fish Ecology & Movement in Headwater Streams – Literature Review	Completed
99	Effectiveness of Stream Simulation Culverts	On Hold

Projects Not Included in the 2009 Work Plan

Project 100. Fish Ecology & Movement in Headwater Streams – Literature Review
Hoffman, R., and Dunham, J., 2007, Fish Movement Ecology in High Gradient Headwater Streams: Its Relevance to Fish Passage Restoration Through Stream Culvert Barriers: U.S. Geological Survey, OFR 2007-1140, p. 43.

The avowed purpose of this report was to 'think outside the pipe' by reviewing the broad-scale issues associated with fish passage. It is self-described as a review of animal movement, focused on (but not limited to) salmonids, with a summary of high-priority information needs. It is explicitly not a how-to guide for designing fish-passage improvements, and it also does not offer concrete guidance on how to prioritize multiple prospective improvements. It notes the paucity of information on the consequences of barriers with respect to migratory life histories, population persistence, and genetics. These uncertainties are not answered by this report; its purpose is to highlight them.

The study's focus was less on "limiting factors," such as an insufficient area of spawning gravel or rearing habit, that could be improved by barrier removal; and more on the threats of extirpation or genetic homogeneity that are imposed by barriers. There is little assessment of whether these larger issues are "more important" than the more narrow, site-specific issues that usually are the topic of barrier-removal efforts, but the implicit judgment of the authors is clear.

A series of questions (from WDFW) and answers (by the authors) presented as Appendix II suggests the likely expectations for this report. Based on the answers, the authors do not think that these questions were particularly well-directed. Here as elsewhere, the dichotomy appears to be place- and barrier-based concerns (WDFW's perspective) versus population- and context-based issues (the authors' perspective).

3.9 Pesticides Rule Group

There are no projects completed, active, or planned for the Pesticides Rule Group.

3.10 Wetland Protection Rule Group

As a final area of emphasis for non-fish-bearing streams and wetlands, two literature reviews were done to focus on forested wetlands and how they are affected by forest practices. Table 3-9 lists the CMER projects listed in the Work Plan for the Wetland Protection Rule Group.

Table 3-9. CMER project in the Wetland Protection Rule Group.

Project #	CMER Project Name	Status
109	Forested Wetlands Literature Review and Workshop	Completed
110	Statewide Forested Wetland Regeneration Pilot	Completed
U22	Wetland/Stream Water Temperature Interactions	Planned
U23	Wetland Hydrologic Connectivity	Planned
114	Wetland Mitigation Effectiveness	Active
U24	Wetland Management Zone Effectiveness Monitoring	Planned
U25	Extensive Wetlands Trend Monitoring	Planned
120	DNR GIS Wetlands Data Layer	Planned
U26	Hydro-geomorph Wetland Classification System	Planned
U27	Overlay	Planned

Project 109. Forested Wetlands Literature Review and Workshop
Spear, S., et al. 2005. Pacific Northwest forested wetland literature survey synthesis paper.

The objectives of this literature review and synthesis were to provide a synopsis of relevant forested wetland research, with an emphasis on interactions of timber harvesting and related management activities and forested wetland functions, emphasizing topics listed in the Forest and Fish Report (USFWS et al. 1999). The final products of this study include an annotated bibliography, a forested wetland workshop with supporting materials, and a synthesis of relevant forested wetland-related research relevant to forest practices in the Pacific Northwest. Topics examined in this review include general characteristics, forested wetlands in the context of timberland management, functions of forested wetlands, effects of forest practices on wetlands (both on vegetation and wildlife), gaps in current knowledge, and recommendations for further research.

The main conclusion from this effort is that there is a paucity of information on forested wetland functions, their characterization, and their relationship to effects from timber harvest. Little is either known or documented about certain fundamental aspects of how forested wetlands function in the context of PNW forest ecology. They note (p. 92-93) that although the Forest Practices Board Manual provides guidelines for wetland replacement by substitution or enhancement that are required of lost wetland functions during timber harvest, the quantification of wetland functions lost is not required, nor have any studies examining the effectiveness of these guidelines been done. 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 and recovery from disturbance. The secondary question of how timber management in the PNW affects wetland functions is virtually untouched as a research topic, which is a noteworthy omission given the contemporary emphasis on ecosystem management.

Project 110. Statewide Forested Wetland Regeneration Pilot
Washington Department of Ecology. 2004. Forested wetland regeneration pilot study summary report.

This pilot study was done to understand if once-harvested forested wetlands exhibit regeneration of forest characteristics and maintain ecological functions. This pilot study was to characterize regeneration of forested wetlands that have already been subjected to timber harvest. As such, it

is limited in scope to develop and test methods for collecting, summarizing and analyzing data on the effectiveness of forest wetland regeneration. It was also intended to gather information on the factors contributing to regeneration success or failure. First, they had to identify suitable sites to use in their sample frame. Secondly, they had to develop measures to judge regeneration "success" and other factors to guide the study design of the full scale study.

The current rules assume that harvesting trees in forested wetlands will result in relatively short-term impacts to wetland functions, and that by the mid-point of the harvest rotation (although the period of rotation not specified) the wetland will have recovered sufficiently to provide wetland functions similar to pre-harvest conditions. While such wetlands may regenerate trees of similar size and species, it's not known if these wetlands provide a similar type and degree of hydrologic and biologic function. There is little published literature on the subject, especially in the PNW.

Those involved with study implementation recognized a number of challenges that limited their success, notably identifying suitable forested wetland sites to include in their sample. First, there is no reliable database of forested wetlands sites exists, and sites were located only after consultation with landowners familiar with where they occur on their ownership. Also, the field characterization methods had some issues. Pre-harvest forested stand conditions at some sites had to be envisioned by reconstruction from field data on relic post-harvest tree stumps. This limited the ability to understand other relevant site conditions that may play a role in determining relative hydrologic and ecological functions. While the pilot study does indicate that seedlings and samplings are able to establish in forested wetlands after harvest, the data do not answer the long-term question about whether a functional forested wetland is recovered at mid-point of a rotation (as stated in WAC 222). The pilot study also did not address the role of hydrology in forested wetlands, which appears to be a fundamental limitation. It does not appear that the full study has yet been defined nor implemented.

3.11 Wildlife Rule Group

Numerous critical questions and programs have been prioritized for the Wildlife Rule Group, but given the overriding importance of aquatic issues within the Forest Practices AMP, funding for the Wildlife Rule Group is predominantly limited to stream-associated amphibians (see earlier reports). The RMZ Resample is the only wildlife project funded at this time. Table 3-10 lists the CMER projects listed in the Work Plan for the Wildlife Rule Group.

Table 3-10. CMER projects in the Wildlife Rule Group.

Project #	CMER Project Name	Status
U28	RMZ Study Resample	Active
U29	Ponderosa Pine Habitat	Planned
U30	Other Wildlife Programs/Projects	Planned

Project U28. RMZ Study Resample
Although this report was not available at the time of our review, we found the following project description in the 2009 Work Plan: "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 2 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. Since the smart

buffer was similar to the FFR buffer for Type F streams and more than five years had elapsed since last sampling 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. The final report was completed in 2006 and, once CMER review is complete, will be reviewed by the Independent Science Panel (ISP) in 2009. A final report incorporating comments is expected in late 2009. This project is administered by LWAG.

3.12 Intensive Watershed-Scale Monitoring to Assess Cumulative Effects

The MDT report identified Intensive Watershed-Scale Monitoring as an essential component of an integrated monitoring program. According to the 2009 Work Plan, CMER is in the process of scoping its intensive monitoring needs, including possible collaboration with similar programs such as the State's Intensively Monitoring Watersheds Program. CMER drafted a scoping paper that identifies program objectives and critical questions. From that they identified additional scoping needs for the cumulative effects of forest practices from changes in fine sediment input and LWD. As of the 2009 Work Plan, a draft scoping document for fine sediment is under review by CMER; however, no scoping documents, study plans, or reports were available for our review.

Project #	CMER Project Name	Status
126	Cooperative Statewide Intensive Monitoring	Planned

4 ASSESSMENT OF PROGRESS – FOREST PRACTICES ADAPTIVE MANAGEMENT

Schedule L-1 documents key questions, overall performance goals, resource objectives, and performance targets for the Forest Practices AMP. Two key questions from Schedule L-1 serve as the primary focus for the present assessment:

> *Will the rules produce forest conditions and processes that achieve resource objectives as measured by the performance targets, while taking into account the natural spatial and temporal variability inherent in forest ecosystems?*
>
> *Are the resource objectives the right ones to achieve the overall performance goals?*

In order to answer the questions, we reviewed two primary documents; the Monitoring Design Team Report (MDT 2002; discussed in Section 2.2) and the FY 2009 Work Plan (CMER Committee 2008). The MDT report describes an integrated monitoring strategy, while the Work Plan uses this monitoring strategy as an organizing framework to identify the programmatic and science project priorities. The Work Plan identifies how each study fits into the framework defined in the MDT Report, or rather how each study contributes to: (1) effectiveness monitoring to evaluate the effectiveness of specific forest practice prescriptions at the site or landscape scale, (2) extensive status and trends monitoring to evaluate temporal and spatial characteristics of key resource condition indicators across private forest lands, and (3) intensive monitoring to identify causal relationships and document cumulative effects at the watershed scale. Additional projects have been done to develop, refine and validate scientific tools necessary for implementing the Forest Practices Rules and for establishing performance measures. In our judgment, having complementary studies in each of these monitoring categories (both proposed and implemented) is essential for addressing the two key questions defined in Schedule L-1.

In an effort to assess progress to date, this section identifies the objectives, the focus and the gaps in the 2009 Work Plan. It also includes an estimate of progress towards answering the adaptive management key questions and highlights issues of concern.

4.1 CMER 2009 Work Plan

The CMER Work Plan is a living document, revised annually in response to changes in research findings by CMER or by those of the scientific community, changes in technology, changes in policy objectives, and changes in funding. The Work Plan is designed to inform CMER participants, policy constituents, and the interested public about CMER's activities. The Work Plan presents this information using the "rule group" as the central organizing framework under which the purpose, the strategy to achieve that purpose, and the rationale for each study are discussed. There are more than 70 projects distributed throughout 28 identified programs. The Work Plan also makes a clear distinction between studies done to enhance the understanding and application of the respective regulatory "tool" and studies conducted to examine the effectiveness of the Forest Practices Rules in protecting public resources. This distinction is important when one looks at the relative allocation of time and effort to "rule tool" implementation projects, as opposed to research and monitoring "tools" that are required as part of the overall design and implementation of a specific effectiveness monitoring program.

4.1.1 Objectives and Focus

In its current form, the Work Plan attempts to organize its strategy for conducting research and monitoring around the integrated framework recommended by the MDT Report. Because in its early years the science program was initiated prior to the availability of MDT recommendations, not all projects align perfectly with this integrated framework. Also, because early projects were focused on refining "rule tools" to aid the application of prescriptions, many do not fit into the three tiers of spatial focus or the three types of monitoring as recommended by the integrated framework. In addition, little effort to date has been expended on the "intensive" scale of monitoring as called for in the Work Plan.

The FY 2009 Work Plan (CMER Committee 2008) lists and prioritizes the CMER projects as follows (Table 4-1).

Table 4-1. Rankings for effectiveness monitoring and extensive status/trend 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	3.8	2
Road 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 Site-scale Effectiveness Monitoring	9	2.6	14	3.1	6
Hardwood Conversion	10	3.0	8	2.6	12
Wetland 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 Mon.	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/Trend 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

Source: FY 2009 Work Plan (CMER Committee 2008)

The ranking process used criteria that included estimates of relative uncertainty and risk. "Uncertainty" is a measure of confidence in the science underlying a rule. "Risk" is a measure of the potential for detrimental impacts to aquatic resources including fish, stream-associated amphibians, and water quality. By assigning a numeric rating to both uncertainty and risk, the tabular ranking prioritizes programmatic level efforts for effectiveness/validation and extensive status and trend monitoring. This is intended to guide CMER towards pursuing the most pressing research and monitoring issues in an orderly manner over time, given the limited number of projects that CMER can pursue under current budget and personnel constraints.

Following the program-level ranking, a second stage of prioritization occurred at the project level. This was done to enable CMER to provide recommendations to the Forest Practices AMP policy committee. Projects were prioritized by four metrics: (1) their level of contribution to essential adaptive management objectives, (2) their potential improvement of DNR forest practice rule implementation, (3) the status of projects relative to policy decisions on adaptive management, and (4) the need to follow through and complete work already underway. Overall, the close correspondence between the "uncertainty" and "risk" ratings implies that those conditions that pose the greatest resource threat are also those that are apparently the least well understood. Thus, things with either high uncertainty or risk should have been given the highest priority for research and monitoring since the initiation of the Forest Practices AMP. Addressing these directly would be expected at some in determinant point, to have alleviated much, if not all, of the uncertainty associated with them.

For a more complete description of the prioritization process, we encourage reviewers to directly consult the FY 2009 Work Plan. Given the magnitude and duration of the Forest Practices AMP, the transparent prioritization of programs and projects and the adherence to such rankings are valuable for both scientists and policy makers. These rankings reflect the collective judgments of the participants at the time and should be judged as informed, albeit subjective. These rankings have not been routinely reconsidered by CMER, nor has there been a documented effort to track debriefing discussions and cumulative lessons learned in order to refine the prioritization process.

The relative rankings assigned to various programs reflects the interests and perspectives of the participants at the time, and one can assume that on balance they are a reasonable initial set on which to build the adaptive management science program. Yet these initial rankings do not necessarily align with the subsequent investments made to examine the inherent relationships between forest practices and the resource of concern. For example, wetland mitigation (i.e., to offset losses associated with timber harvest operations) ranked 11 out of 16, and the effectiveness of wetland protection prescriptions ranked near the bottom at 14. In contrast, the success of revegetation of wetlands was ranked 8 out of 16, despite little or no evidence that this was a reliable surrogate for restoring hydrologic and other ecological functions of wetlands subjected to timber harvest. As one reviewer pointed out, forested wetlands have not been identified by any participant as an overarching concern, which in part explains why little study investments have been made to date regarding this issue. While maybe true, it might be prudent to preempt future criticism by reconsidering this issue in light of wetland protection under existing Clean Water Act Section 404 provisions.

Other prioritization examples display some mismatches between rankings and investment. Little emphasis was given to the idea of addressing cumulative effects of forest practices (the "intensive monitoring" category). Even though supporting native populations of fish is one of the overall performance goals, a relatively modest rank of "5" was given to the relationship between forest

practice effectiveness and fish-bearing streams. This suggests that it may now be useful to go through the issue prioritization exercise once again, but with a renewed perspective on the relationship between the critical questions defined for each of the rule groups and the overall needs of the AMP.

4.1.1.1 Resource Objectives and Critical Questions

We examined Schedule L-1 for insights into the relationship between the Key Questions and the Resource Objectives, striving to clarify the role that specific *key aquatic conditions and processes* (KACPs) play in helping to focus the science and address the overarching questions about the outcomes of forest practices on public resources. To that end, we focused on the list of functional objectives and their associated *measures* and *performance targets*. The way in which these three elements are initially described in Schedule L-1 was likely intended to be preliminary, but it is not clear to what extent they have been refined or reconsidered as progress has been made in the AMP. These KACPs play a large part in the critical questions identified for each research and monitoring program, but many of them still do not have identified numeric performance targets.

Setting aside the issue of the rule group organization structure to the discussion in the Work Plan for the moment, it is worth examining the list of critical questions that accompany each of the rule group study programs. Stating critical questions and assumptions is a valuable way to define priorities and testable hypotheses around which a sampling program and a schedule can be defined. Just getting to a list of critical questions by committee is a substantial achievement in terms of relating the resource objectives to the effectiveness of the Forest Practices Rules. What would be helpful, however, is to see the relationship more fully described. Although the studies are nominally linked to the resource conditions and critical questions in the flow charts, the exact contribution of a given question to addressing the effectiveness of forest practices is not always evident or explicit. Each question could be linked to subsequent questions to show how each in turn incrementally contributes to answering the ultimate question.

A timeline would also help in mapping out these relationships and forecasting how long will be needed to reasonably provide answers to the critical questions. For example, in the Work Plan, Table 9 (p. 27) lists three critical questions for the Type N Extensive Riparian Status and Trend Monitoring Program. In regards to the first of these critical questions listed in Table 9, how long will it take to develop sufficient data to establish a reliable characterization of stream temperatures on lands subject to Washington State Forest Practices Rules? If this will take 20 years because budget limitations restrict the number of sampling locations, is there a sampling design that will allow much more rapid progress? Can existing stream temperature data from lands not subject to Washington State Forest Practices Rules be used to supplement our understanding of the nature of stream temperatures throughout forested environments of the Pacific Northwest? If not, why not?

4.1.1.2 Progress to Date

In an effort to evaluate the Work Plan coverage and identify possible gaps in each rule group, we developed a summary table of all completed, active and planned projects (Table 4-2). The table is structured by rule group (as outlined in the Work Plan) and attempts to link associated studies with corresponding KACPs (derived from Schedule L-1). Our intent is to showcase the correspondence between the study themes and the specific ecological attributes that should contribute to answering the key questions defined in Schedule L-l. The reader should be aware

that this exercise is meant to provide a first-level view and is not in any way meant to be definitive. It also should be noted that we did not rigorously follow the L-1 KACP and in some cases expanded on the list to be more comprehensive. Indeed, some projects were difficult to associate with a KACP without losing important distinctions, and this fact may make the table less useful. For example, one KACP category in Schedule L-1 included riparian condition, litter fall, pool frequency, in-stream LWD and residual pool depth. While these are associated conditions, in many cases they have been studied only in isolation. For the purpose of this table, we needed to distinguish an LWD study from a riparian condition study, and so we expanded the original set of KACPs to include them both.

We then populated the table with project numbers based upon the information we were provided. Projects we assumed were associated with the Forest Practices AMP were identified numerically and can be referenced in Appendix A. We distinguished completed projects from those active and planned in order to reflect the degree of progress. This distinction will be further discussed in Section 4.3 of this report. Table 4-2 thus illustrates the extent of coverage by rule group, recognizing that not every rule group should address every KACP.

Although this approach is not a comprehensive assessment of all topics covered by a given study, it does provide a quick overview of the thematic focus of studies conducted to date. Associating critical questions with specific projects can be tracked using rule group "flow charts," which are discussed in Section 4.3 of this report. While not developed by nor fully endorsed by CMER, we have found these rule group charts useful for mapping out the relationships between key questions and subsequent studies to address their information needs.

4.1.1.3 Additional Projects not reflected in the Summary Table

As we reviewed the CMER projects, several could not be fully categorized by KACP. These projects were predominantly life-history studies on amphibians, broad literature reviews, and fish surveys. These projects include the following:

Project 21. Detection methods for amphibians (completed)

Project 22. Literature review on general ecology of tailed frogs including a meta analysis (active)

Project 23. General ecology of Dunns and Van Dykes salamanders (active)

Project 32. Rule tools about detection methods in seeps (completed)

Project 67. BT presence/absence project and is only a Rule Tool project

Project 68. Bull trout habitat prediction models that included salmonid distribution surveys (completed)

Project 96. Road Site-Scale Effectiveness Monitoring proposes to examine road water control and road stream passage/crossing, but not sediment or hydrology (planned)

Project 109. Literature review on general characteristics of forested wetlands and how they respond to timber harvest (completed)

Project 110. A pilot study on wetland regeneration after timber harvest (completed)

Project 14. Type N experimental study in incompetent lithologies (scoping doc/study plan)

Project 27. Amphibians in intermittent streams (scoping document nearly approved)

Table 4-2. CMER Adaptive Management completed, active, and planned projects.

Key: **bold font** indicates completed projects; standard font indicates active projects; *italic font* indicates planned projects

Rule Groups			Key Aquatic Conditions and Processes (KACP) *from Schedule L-1*									
			Stream Temp	**Shade**	**Riparian Condition**	**Litter Fall**	**Pool Charac-teristics**	**Instream LWD**	**Sediment**	**Basin Hydrology**	**Chemical Inputs**	**Fish Passage**
Stream Typing							**5, 6, 7**	**5, 6, 7**		**29**		
Type N Riparian Prescriptions	**Effectiveness Monitoring**	Riparian	10,12, 13 *14*	10,12, 13	10,12, 13	10,12, 13		10,12, 13	10, 13 *14*			
		Amphibian	**21,26** 25, 13	**21,26** 25, 13	**21,23,26** 10,12,25,13	**21,23,26** 25, 13	13	**21,23,26** 13	13	13		
	Extensive Riparian Status and Trend Monitoring		43	43	43					16		
	Rule Implementation Tool											
Type F Riparian Prescriptions	**Effectiveness Monitoring**	Statewide Prescription Monitoring	**42** 36 *35*	**42** 10, 36 *35*	**42** 10			10, 36 *35*	*35*	**42**		
		Hardwood Conversion	**41** 40	**41** 40								
	Extensive Riparian Status and Trend Monitoring		43, 44	43	43, 44	43		43, 44				
	Rule Implementation Tool	DFC Validation Program			**46,47** 57 *48, 49*							
		Eastside Riparian Type F Program	**59,55**	**55** 36	**55,54** 36,57 *58*	**55** *58*	**55,54**	**55,54**	**55**	**55**		

Rule Groups	Key Aquatic Conditions and Processes (KACP) *from Schedule L-1*									
	Stream Temp	**Shade**	**Riparian Condition**	**Litter Fall**	**Pool Charac-teristics**	**Instream LWD**	**Sediment**	**Basin Hydrology**	**Chemical Inputs**	**Fish Passage**
Bull Trout Rule Group	**68** 36, 61, 62	**67, 68** 36,61,62								
Unstable Slopes Rule Group							**83,84,87,B** *77* *75, 79*			
Roads Rule Group							**91** 93			
Fish Passage Rule Group										**100** *99, 101*
Pesticides										
Wetlands Rule Group		**109**	**110**					**109,110** 114	**109**	
Wildlife			U28							
Intensive Monitoring	*126*		*126*			*126*	*126*			

4.1.2 Work Plan Gaps

We recognize that Table 4-2 only indicates if a particular study "fits" into a general KACP, but such assignments do not speak to the extent to which a study addresses the underlying ecological conditions or processes. We thus used the table simply to give a broad view of which KACP's are covered and to highlight possible gaps in terms of the current research efforts. While there are scattered blank cells, four rule groups stand out as being disproportionately underrepresented and are listed below. There may be good rationale for each omission, but an explicit explanation about what themes are not receiving attention, and why, would be helpful so that others may fully understand the underlying rationale.

1. DFC Validation Program, a Rule Implementation Tool within Type F Riparian Prescriptions, is lacking project coverage for most of the KACPs, and currently only applies to Westside forest riparian zones.

2. Wildlife Rule Group has one project (unavailable for review), but two KACPs with no applicable projects. Presumably this reflects the current emphasis on aquatic-dependent wildlife and not upland wildlife.

3. Intensive Monitoring currently has only one project addressing two of the necessary seven KACPs (we elaborate on this topic below).

4. Few studies are directly evaluating the relationship between forest practices on fish populations or instream habitat.

Aside from displaying absences in project coverage, the table can also be used to assess the distribution of completed, active and planned projects. Ultimately we suggest that the "gaps" and project status summarized in this table should be coupled with a review of the Work Plan prioritization. In doing so, future project planning will reflect the extent and breadth of coverage, as well as programmatic prioritization.

From the perspective of key aquatic conditions and processes, three in particular—fish, litterfall, and basin hydrology—are underrepresented in the Work Plan. The Type N buffer experiment does address the latter two topics, but other studies as of yet do not. Identifying and addressing potential changes to hydrology, in particular, are not well-served by the current rule group structure because hydrologic alteration is a watershed-scale condition that may be affected by aspects of timber harvest that are not directly tied to either riparian zones or any of the other rule groups. While litterfall (as fuel for food web dynamics) and basin hydrology may be important, we suggest that the AMP should take advantage of others who are working on these topics at university or federal forest research labs. In the larger picture these topics might be deferred until some of the more fundamental relationships are more firmly established, such as the effects of forest harvest on aquatic habitats and fish populations in Type F waters and downstream from Type N streams. Apparently little direct research or monitoring effort has yet to be focused on this important topic, although it is one of the primary goals of the Forest Practices AMP.

4.1.3 Areas of Unnecessary Focus

In the process of evaluating the Work Plan focus and gaps, we also identified areas of potentially unnecessary focus.

1. Studies in the Work Plan do not reflect the suggested spatial and temporal framework suggested in the MDT report. Without a reaffirmation of the monitoring strategy and a clear roadmap for implementation, it is highly likely that forthcoming efforts will continue to be imbalanced, poorly integrated and in some cases, inappropriate or irrelevant.

   At the most fundamental level, any lingering doubts must be resolved that an evaluation of cumulative effects (both positive and negative) of forest practices on public resources is warranted in this AMP. Because an understanding of the whole almost always requires more than just a summing its parts, we suggest that if such an effort is not made then it voids the chance to understand the full extent of the protection afforded by the Forest Practices Rules. Worse, this shortcoming exposes all parties to future criticisms from those who may demand some proof of such protection. The current lack of effort could begin to be resolved by taking a fresh look at the opportunities to co-locate sampling sites useful at more than one scale of interest. For example, clustering a variety of baseline status and trend monitoring sites for KACPs within a few basins would begin to develop the requisite data to define an intensive monitoring watershed, thus satisfying the need to begin building the network of these cumulative effects sites

2. Studies in the Rule Tool Implementation project category limit the collective focus on forest practice evaluations. The initial heavy investments in Rule Tool Implementation projects, while likely needed, deflected the attention away from the primary mission and muddied subsequent decisions on how best to prioritize work that could have focused on testing assumptions about the effectiveness of forest practices. This deflection of attention caused significant delays in mounting relatively straightforward studies on the most basic questions, such as the effectiveness of riparian management zone prescriptions in terms of protecting stream temperatures and thus showing relevance to the Clean Water Act (CWA) assurances agreement.

3. Sampling site selection is problematic for those studies that require experimental treatments or manipulations. This is a consequence of studies not being able to direct where and when a particular prescription is applied or a treatment occurs that needs evaluation. This is especially true when testing current or alternative riparian-adjacent harvest configurations that rely on private landowners or DNR to apply a specific treatment, such as Type N experimental buffer treatments, buffer treatments for streams associated with the bull trout overlay, or forested wetlands. In some (but not all) cases, this continuing problem directly undercuts the timing, rigor and credibility of the application of the scientific method to get answers needed by the Forest Practices AMP. One possible solution is to set aside a portion of state lands to serve as experimental forests in which specific studies needing more direct control of site conditions and treatments can be applied in a more deliberate way. It also might be appropriate to reconsider the fundamental study designs that are being used to advance the AMP, especially in light of the uneven emphasis given to effectiveness versus status and trends versus rule tool development to date. Matching riparian harvest studies on Type N streams with downstream effects on Type F stream fish populations and habitat characteristics would seem a useful investment and it is already part of at least one ongoing study (Project 10).

4. Both Type N and Type F effectiveness studies suffer from a lack of focus and no clear plan or timeline to overcome persistent impediments to moving forward. This is particularly true for Eastside forests where riparian harvest routinely occurs on both stream types. Establishing working estimations of DFC-type resource conditions and interim

performance targets for the Eastside streams and riparian prescriptions have progressed very little. Several reviewers noted that one reason for this is that few landowners are electing to harvest in the Type N riparian zone using the current rules, so effectiveness evaluations are limited by available sites. If this is true, it would seem to shift the burden of providing sampling sites from the private landowner to DNR and applying the treatments under a controlled experiment that tests the rules. This seems to arise from the notion that conditions in Eastside watersheds are highly variable and have been (and continue to be) profoundly affected by past and concurrent "disturbances," and thus one cannot simply define a numeric value for resource objectives and performance targets.

As a consequence of this belief, large amounts of time and effort have been spent investigating dozens of different questions, some of which have only an oblique relationship to the relatively simple task of characterizing riparian conditions before and after riparian rules are implemented in the course of a timber harvest along a Type N and Type F stream. For example, while it is important to acknowledge the role of natural and anthropogenic disturbances on current riparian stand conditions on the Eastside (indeed, across the entire state), this uncertainty should not preclude defining interim expectations of baseline conditions from which to measure changes associated with the imposition of current harvest prescriptions. Surely there are additional research plots in comparable Eastside forest stands that could be used to help frame the range of possibilities and that provide sufficient detail to define a working hypothesis. Similarly, it is not essential to develop detailed knowledge of Eastside forest hydrology and streamflow conditions, as called for in recent discussions, before defining some working assumptions and hypotheses. There are likely very legitimate reasons why the SAGE group has had neither the circumstances nor the resources to advance as much as the members would have liked. If their efforts are to be successful, they need adequate resources. This appears to be a significant limitation to resolve for the overall success of the AMP.

4.2 Issues of Concern

4.2.1 Integration of results across studies is weak

While the current Work Plan attempts to fully describe how completed and currently active projects each contribute to their respective programmatic theme by virtue of association with a particular rule group, it lacks a succinct description of how these overall efforts address the adaptive management key questions. This leaves the impression that while each study might contribute to a specific topic of uncertainty, it offers less (or no) contribution to the overarching goal of resource protection within commercial timberlands. We make some specific recommendations on how this might be remedied in the last section of this report.

4.2.2 Efforts on the Eastside forests have languished from lack of support and capacity

It appears that despite well-intentioned efforts, progress to identify and implement field studies for Eastside forests have languished—both the site-scale effectiveness of forest practices and the extensive scale to establish status and trends in key conditions. This seems to derive from the belief that less is known about dry-side forests when compared with the west side of the Cascade Divide. Furthermore, there is a perception that natural and management induced disturbance regimes over the last 100 years have created significant diversity in riparian stand conditions, thereby confounding direct measures of RMZ effectiveness. This has resulted in delay of progress to define initial operational performance targets for the effectiveness of RMZ rules.

This situation seems to be slowly resolving, but in the interim it seems entirely consistent to establish provisional performance targets that can serve as a basis to initiate a site-scale effectiveness study for Eastside Type N and Type F riparian areas. Even if dry-side forests are more complicated than Westside forests, a broader review of the collective research done on dry-side forests throughout the Western U.S. would probably lead to some initial expectations for ranges of conditions to establish working hypotheses and functional performance targets. These could be used as interim performance targets to evaluate the relative outcomes of forest practices and to learn as we go. This is an essential feature of the adaptive management paradigm being articulated, and scientists should embrace the opportunity to acknowledge uncertainty but nonetheless define working assumptions and initial hypotheses about how they expect ecological resources will respond to forest practice prescriptions. The promise of extensive survey level studies (Project 43) and the characterization work of Project 57, 16 and 58 will definitely help, but only the former study actually includes some effectiveness component.

One positive recent development is that the first round of extensive temperature monitoring sites for Eastside Type F streams is now complete, and a comparable set of sites for Eastside Type N streams is planned for FY 2011. This progress could be accelerated with additional resources and a prioritization of the critical questions for Eastside forests. In the interim, one should be able to document the locations and spatial extent of the accumulating list of sites where timber harvesting is occurring coincident with riparian zones on Type N and Type F streams.

4.2.3 Timelines are needed to track progress

None of these study themes (i.e., programs) display a timeline in which one could reasonably expect that study investments will pay off and deliver relevant and sufficient information to address the stated critical questions. For example, for judging the effectiveness of RMZ prescriptions in Type F and Type N streams (both Eastside and Westside), how many years of data at how many sample sites are expected to be needed before one can make a reasonable conclusion about the relationship? We emphasize that every study that either is testing a specific hypothesis about the outcome of forest practices or is gathering status-and-trend data should clearly state a reasonable timeline for implementation and a statistically-based estimate of the number of years and sampling effort that will be required to demonstrate a defensible outcome.

What significant milestones might be defined to help gauge concrete progress? True, there are significant issues with choosing comparable sample sites over the variable population of sites available, but one can pose a reasonable estimate as part of the overall study design. For example, will it take 10 years of data (control versus treatment) at 200 sites from each Type N and Type F to make some reasonable judgments? Can one identify any specific milestones by which one could judge incremental progress, such as “by year three, all treatment and control sites will be established and temperature recording devices deployed”?

One encouraging example of a well-conceived, multi-metric study is the Type N/F Riparian Buffer Prescription Monitoring to Evaluate the Effectiveness of Forest Practices Riparian Prescriptions (Project 10). This study has components that strive to test hypotheses about the effectiveness of RMZ prescriptions in terms of minimizing changes in riparian stand conditions, tree mortality and riparian functions. This study would seem to be a useful basis to expand the scope by including some direct measures of instream habitats and fish responses in the Type F component of the study. Once the sites have been established, this would seem to be a logical and relatively cost-effective addition. This study does provide an implementation timeline for

each of its three components, specific details about the study design, corresponding hypotheses and analytical approach. Even here, however, the time span needed to generate data that are sufficient to reject or accept the hypothesis is uncertain. A reasonable estimate for these studies needs to be defined in order to inform policy makers.

4.2.4 Selection of study sites is subordinate to timber harvest

In many of the study reports completed and planned, the study design is constrained by the significant lack of control over the selection of sampling sites and the timing of the application of the treatment (i.e., timber harvest associated management action) imposed on the location interest. This constraint has and will continue to hamper the implementation of timely and effective study plans. It also restricts one's ability to learn from the examples and have statistical confidence in extrapolating the results to a broader scale of interest. In terms of tracking the temporal trajectory of a "treatment" site over time, there are few comparable substitutes for a study design that employs a before-after-control-treatment approach. Yet many suitable study sites are apparently not available for pre-harvest data collection (i.e., before versus after) and researchers are left having to find comparable reference sites to serve as a basis to make comparisons and to base judgments about changes over time. It might be useful to take a second look at using comparable data from managed landscapes outside of the immediate realm of lands governed by Forest Practices Rules, at least to establish the requisite reference data to understand landscape and site variability in setting performance metrics. This might be an especially appropriate approach to use for instream habitat metrics such as residual pool depth, distance between pools, and LWD loading.

4.2.5 Lack of demonstrated progress on studies that examine the direct effects of RMZ's on fish

With one exception that has started only in the last few years, there are no studies on a direct measure of the relationship of fish productivity in stream systems with the ongoing land management activities on private forest lands. Under the terms of the legislation, forest land owners are responsible for complying with the new rules which maintain (or promote recovery of) a "suitable" level of key aquatic conditions and processes, which in turn are assumed to support "harvestable levels of salmonids." Yet efforts to document this essential relationship have not been forthcoming. Only in the last few years has much progress been made on setting up the necessarily long-term study sites at which this assumption can be tested (e.g., Project 12 Type N Experimental Buffer Treatment Study, and this is not a "CMER study"). These studies might best be addressed through an intensive-scale monitoring program that can look at the cumulative watershed outcomes on fish populations at multiple watershed locations, which could inform both inter-annual variability at the individual watershed and how this performance compares to other watersheds having similar conditions.

4.2.6 Using "Rule Groups" vs. "Aquatic Conditions" as the approach to organize and report study results

Taking a "rule group" approach as a central, organizing theme to define appropriate study efforts is problematic in that it treats the rule group as an end unto itself, rather than a means to an end. The "ends" in these circumstances are reliable indicators reflecting specific ecological conditions and how those conditions have been affected by nearby forest practices and best management practices. By not directly associating these studies with the functional objectives and key aquatic

conditions and processes, it muddies the ability to clearly represent how any individual study will address a specific element germane to the resource condition(s) of interest.

4.2.7 Narrative resource or functional objectives and numeric performance targets have not been defined for all key aquatic conditions and processes

Nearly 10 years after resource objectives and performance targets were initially defined there remain critical gaps in establishing numeric targets for habitat elements that are critical to produce fish—one of three main performance goals. For example, population characteristics for stream-associated amphibians lack any numeric targets, no doubt due to the current state of knowledge. Additionally, some listed functional (resource) objectives (pesticides and channel migration zones) have not yet been assigned numeric targets. If reasons exist, they ought to be made clear, identifying them as issues not needing resolution at this time. This is also the case for Eastside forest riparian zones, where concern about past and contemporary disturbance, fire suppression, and site variability have stymied the development of even provisional performance targets. Similarly, it is not resolved whether some listed functional (resource) objectives defined for the Westside forests could serve as proxy values for those Eastside forests that currently do not have corresponding values. We note that the AMP openly acknowledged uncertainty but allows for the use of best judgment in making initial determinations.

These initial determinations can and should be modified as new information comes to light. Without having some numeric performance measures, however, there is little hope of establishing a durable and credible system to inform the policy makers about the relative effectiveness of the current rules package.

4.2.8 Critical questions for each “Rule Group” need re-examination

For each of the twelve rule groups described in the FY 2009 Work Plan, there is a corresponding table of "resource objectives" and subsequent “critical questions” that defines the information needs and, by extension, the scope of the studies. These questions are presumably intended to address fundamental gaps in understanding that relate to the resource objectives (e.g., Eastside forest hydrology and Type N streams; fundamental relationships of amphibians to their habitats) while providing the basis for testing hypothesis about the effectiveness of Forest Practices Rules on resources of concern. Our review of these critical questions suggests that while many are well conceived, others may be redundant or, conversely, irrelevant to the mission at hand. Since these questions are the foundation on which the individual projects are based, it would be worthwhile to revisit the questions and evaluate if they remain critical given what has been learned in the last few years. Some specific examples include:

- The questions about Eastside forest hydrology pose basic questions about the nature of stream and groundwater flow in Eastside forests. The questions are broad in scope and their relationship to forest practices is not well described, and any specific metrics that might be used are not described. How will flow statistics be used in evaluating RMZ prescriptions in Type N streams? How will the change associated with a given RMZ prescription at the site scale be distinguished from background variability in terms of surface and groundwater flow? This line of inquiry seems impractical at best.
- The Unstable Slopes Rule Group poses a critical question about the background rate of landsliding, but there are no "Priority Research" needs identified that require the answer to such a question (nor any project to address it).

- The Channel Migration Zone Rule Group has neither resource objectives, performance targets, nor priority research identified, although two critical questions are posed. No projects have yet been initiated.
- The Type F Rule Group Eastside Riparian Program has both a narrow focus on LWD recruitment and a very broadly articulated need to "assess the historical ranges of conditions and disturbance regimes." The former is represented in a critical question ("What is the desired range of conditions for eastside riparian stands and what are the appropriate LWD performance targets?"). The latter, however, is unrepresented in the critical questions; it is also probably so all-encompassing as to provide little discrete guidance for future research.
- The Type F Rule Group Extensive Riparian Status and Trend Monitoring Program identifies priority research focused solely on temperature, although the resource objectives are (rightly) cast more broadly in terms of not only temperature but also hydrology, water quality, and LWD recruitment.

4.2.9 Definition and prioritizing of studies are not uniformly well-justified

Some studies (such as hardwood conversions and perennial initiation point of ephemeral streams), particularly amongst those executed in the early years of CMER, do not appear to have addressed high-priority needs nor to have resolved significant scientific uncertainties. The likelihood of this pattern continuing appears to be lessened with the approach being taken in the 2009 Work Plan. However, “opportunistic” projects can be completed with little to show in the way of improved scientific understanding or management guidance, and thus they can undermine the credibility of the program. Although ISP evaluations of individual project designs and results should provide a safeguard, in some cases their most substantive input comes only after-the-fact (as a review of an already-funded and completed project), their judgment on the primary and secondary objectives for any given study is commonly not readily available, and (in at least one case early in the CMER program [Project 87] where both the review and the reply were accessible to us) their unfavorable recommendations were all-but-summarily rejected in subsequent comments. To the extent that the peer-review process can (or has already) become more central to decisions about which projects to fund and what results to embrace, overall program effectiveness should advance. This could be accomplished by ensuring that the ISP understands the larger purpose of the suite of studies, and especially if the panel understands the incremental contributions that are expected to be provided by the individual study plan they are being asked to comment on. This would set them up to have two perspectives from which to make their review, one focused on the merits of the science for the individual study and one that focuses on the contribution this study makes to answering the key questions identified in the AMP.

4.2.10 Intensive monitoring has not yet been initiated in any meaningful way

Although intensive monitoring was one of the three major elements recommended in the MDT report, there has been little progress to date in developing this element or in applying any study efforts. We do understand that budgetary and staffing limits constrain the overall program, but this important issue should not be left unaddressed. Although the identification of integrative, watershed-scale benefits from the application of new forest practices can only be expected once those practices have been put into effect over a broad enough area to be detected, the absence of even a credible baseline measurement program seems to guarantee that any recognition of “benefits” is many years or decades into the future. This omission makes any assessment of whether the right aquatic conditions and processes are being protected, or whether that protection

is working, almost impossible, and it will limit the program's ability to defend against criticism that points to forestry-related cumulative effects as the root cause of current or future declines in water quality or fisheries resources.

Other land-management agencies find themselves in similar situations regarding their capacity to develop a cumulative effects monitoring program (e.g., USFS, BLM, DNR). There may be opportunities to work with non-Forest Practices HCP participants in different forest practice contexts to understand how best to approach designing and putting in place an intensive monitoring program, albeit with a different legacy of timber harvest and a different current land management regime. Nonetheless, this might be one way of extending the range and capacity of CMER's effort.

Many have noted the seemingly overwhelming expense that an intensive monitoring program would entail. We observe, however, that genuine resource protection will *never* occur if only individual pieces of the ecosystem drivers are measured (e.g., Karr and Chu 2000). The whole is always greater than the sum of the parts, and yet the existing program appears to focus largely on the smallest elements. With such a narrow focus, answering the two key questions that drive the entire CMER program will forever lie beyond reach.

4.3 Estimates of Progress

In our efforts to understand and assimilate the large number of studies and data that have been generated during the tenure of the Forest Practices AMP, we have tabulated the studies done by rule group with their associated key aquatic conditions and processes (Table 4-2). Our estimate of progress of these accumulated studies is inherently subjective, and based on our review of the available study reports and plans. We also made use of fifteen flow charts that display the relationship between the L-1 resource objectives, performance targets, priority research topics and the critical questions. From these derive the specific programs and their associated research and monitoring projects. Examples of these flow charts are attached as Appendix C.

Starting with Table 4-2, we provide our estimate of progress towards answering the key questions by first evaluating the columns in the table that correspond to the key aquatic conditions and processes as derived from Schedule L-1.

4.3.1 Stream Temperature and Shade

Currently, there are three studies that focus on direct measures of stream temperature and its surrogate of riparian "shade." Only recently have any of these projects initiated field studies to establish status and trends in stream temperatures or evaluated before-after consequences of RMZ prescription applications. On Westside streams, the Type N Experimental Buffer Treatment project and the extensive temperature project are the only on-the-ground projects measuring temperature directly. For streams on the Eastside, work has begun on measuring temperature on streams that support bull trout habitat. The Eastern Washington Riparian Prescription Effectiveness Studies for Shade/Solar and Stream Temperature are significant, and they should address stream temperature issues at the prescription scale. The studies launched in the last few years in terms of defining and implementing both extensive-scale and site-scale effectiveness studies do seem to be on the right track and should provide timely and relevant information within the next decade or more. However, it is worth considering examining the results after the first few years of implementation to see to what extent study sites have been successfully identified. It also would be useful to ensure that these studies are taking advantage of the

substantial temperature data collected by the USFS on reference streams in wilderness areas of Eastern Washington.

4.3.2 Riparian Condition and Litterfall

The topic of riparian condition is treated through various rule groups and at different scales. It is also associated with the shade component closely linked to RMZ prescriptions for Type F and Type N streams on both sides of the state, and includes the DFC targets that define desired stand characteristics ultimately to be achieved in Westside Type F stream corridors. There is not an equivalent DFC-type study project for Eastside Type F streams, nor an equivalent Type N experimental buffer study for Eastside streams. Progress has been made in terms of investigating the relevance to stream-associated amphibians, but more work needs to be done with respect to RMZ effectiveness in Type N waters. The only study currently being done that includes a provision to measure litterfall contributions to downstream Type F food webs is the Type N Experimental Buffer Treatment in Basaltic Lithologies study (Project 12). It would seem to be a good adjunct to include in the Type N/F Prescription Effectiveness study (Project 10) that has just begun.

Recent progress in the characterization of riparian conditions through specific extensive-scale studies is significant, given that this information is critical to understanding the range of expression (i.e., variability) in key metrics that in turn help evaluate the role of landscape features and disturbance in shaping current conditions. This information should help inform the future evaluation of the performance measures and help identify other less obvious factors (such as limitations on food webs) that in turn may limit biotic outcomes such as fish productivity. Extensive-scale studies should also help resolve remaining uncertainties in appropriate measures of ecological integrity needed for Eastside forested lands. Our assessment is that after long delay, these studies are now reasonably well defined and moving forward.

4.3.3 In-stream LWD and Pool Characteristics

In the lexicon of terms used in Schedule L-1, "LWD" is the catch-all category that includes other characteristics of instream habitats important for fish and other aquatic organisms important to driving aquatic food webs. In terms of communicating to the broader scientific community, it would be clearer if there were a specific category for instream habitat because of its importance to maintaining viable fish communities. Work has just started to establish on-the-ground studies to characterize riparian conditions. Progress on Eastside forests lags behind the Westside by several years, especially in terms of RMZ effectiveness evaluations and establishing initial metrics for performance targets. It appears that comparable LWD and instream habitat data available from USFS and other sources have not yet been fully integrated into consideration of how a provisional set of performance targets might be defined. Data sets exist from Eastside forest stream surveys from the TFW along with decades of stream-survey data from USFS managed and unmanaged reference basins that could address variability for instream LWD and pool characteristics. Perhaps there are compelling reasons why this approach has been judged impractical, but if so it would be useful to document what those reasons are and what alternatives seem more suitable.

4.3.4 Sediment

Sediment is the one fundamental process category that addresses input sources of sediment from hillslope processes and from fine sediments generated from unpaved forest road surfaces.

Sediment is also a component of the experimental buffer treatment evaluation study for Type N streams

Sediment as an element of instream habitat conditions is not widely incorporated in ongoing or completed studies, which is potentially problematic given its importance in terms of habitat quality and fish and primary productivity, as well as its role in documenting CWA compliance. "Sediment" has been invoked as the motivation for virtually all of the unstable slope studies, but in our judgment only the most recent ("Post-Mortem study") is likely to provide useful, albeit still ambiguous, guidance for reducing the risk of landslides from forest practices on unstable slopes. Substantial investment has also been made in road treatments to reduce sediment loads, but to date there are no results to evaluate whether recommended or required practices are actually resulting in reduced sediment loading to channels, or whether the combination of natural and observer variability will permit the demonstration of statistically significant trends over even a 5–10 year period. If this is not a useful (minimum) time frame for management actions, then either the measurement precision needs improvement or the effort should be abandoned. Recent advances on measuring the role of sediment fines in streams that receive surface-water runoff from forest roads may provide useful guidance on how to approach monitoring this important metric (see Klein et al. 2008).

4.3.5 Basin Hydrology—surface water and groundwater

This too is a fundamental process category with multiple dimensions, but one that is only nominally addressed in the current CMER Work Plan. Concern is for changes to basin hydrology from alteration of drainage density, forest cover and other aspects of the hydrologic cycle. There is also a component of concern in terms of the relationship of RMZ harvest and prescriptions on surface flow, groundwater inflow and other run-off characteristics. This is especially true on the Eastside forests where sections of both Type F and Type N streams apparently exhibit periods of intermittent seasonal flow that confuse the appropriate stream type assignment. The issue of determining the break between an ephemeral stream (Type Ns) and a perennial Type N stream (Type Np) still seems to be in question and there are no further studies to address this. The hydrologic functions of wetlands still seem to be poorly addressed by past and current studies, although this topic has been identified as a key component of interest. We also note that there is no acknowledgment in the 2009 Work Plan of any potential influence of climate change over the next 50–100 years, although potential impacts to basin hydrology are widely recognized in the broader scientific (and popular) literature, and the potential relevance to the effects of timber harvest are easy to appreciate. It is noteworthy that the Eastside Riparian Disturbance Regime Literature Review (Project 55, prepared by Concurrent Technologies Corp.) is one report where the implications of climate change on key resource characteristics were discussed.

4.3.6 Chemical Inputs

Reflecting prior decisions about relative levels of priority and potential risk, there are no specific studies to address any concerns about forest chemical applications and their drift into riparian zones, wetlands and streams. The omission may be warranted if, as some have indicated, there currently are no aerial applications of forest chemicals on private forest lands.

4.3.7 Stream Typing

This is an issue of distinguishing between Type N and Type F streams, and it is primarily about distinguishing Type Np (perennial) from Ns (seasonal or ephemeral) streams, as mentioned

above. The primary stream-typing studies focused on the "Last Fish" prediction model. It was well designed and included three components: model development, performance, and variability. No additional model development is planned, despite author recommendations for next steps. Qualitatively the program has made moderate progress in support of Stream Typing within CMER. The issue does remain important on Eastside forested streams, has been the topic of much discussion by the SAGE group, and a study to develop a detection method is nearly complete.

4.3.8 Fish Passage

Minimal work has been done to address fish passage to date and it does not appear that there is yet a coherent plan of action nor a core set of critical questions fully developed. As one reviewer noted, the issue concerns resident fish in headwater streams and the risks to populations that might result if movements were restricted via fish-passage barriers. Some believe that fish residing in steeper gradients may move very little or not at all and thus might not be affected by fish-passage barriers. Others believe that they do move and maintaining connectivity is important to maintaining population viability and preventing extirpation over time.

The one completed study does not appear to have had any direct influence on subsequent priority research or critical questions, although presumably this was the original intent of the study. Two projects are planned, but the use of the results in terms of identifying and fixing road-related culvert blockages is not clear. One useful action that could be taken would be the development and maintenance of a GIS database of known blockages on private forest lands and the extent the blockages are remedied. Some private timber companies have worked diligently over the last decades to identify and fix such blockages; documenting their progress would be a useful thing to showcase and relevant to other issues

4.4 Answering the Key Questions

Given the work to date and the studies either in progress or planned, it is possible that the overall CMER program will eventually answer the Forest Practices AMP "Key Questions" posed in the Schedule L-1:

> *Will the rules produce forest conditions and processes that achieve resource objectives as measured by the performance targets, while taking into account the natural spatial and temporal variability inherent in forest ecosystems?*
>
> *Are the resource objectives the right ones to achieve the overall performance goals?*

However, the path to achieving success is predicated on a number of things, including affirmation that the *resource objectives* and associated *performance targets* are correct and sufficiently well defined to be addressed systematically through the science program. Given some of the missing pieces, it's unclear how much time will pass before we have sufficient information to answer even a few of the key questions. One important task is to fully document the knowledge that has come out of the studies completed to date, and to integrate these results with similar information from the broader body of available scientific literature. That task was beyond the scope of this current study, but it remains an important task to do soon. Completion of this task would identify major and relevant findings as well as point out key information gaps that can help refine the critical questions and thus help prioritize future investments in study efforts. This also might help

the larger CMER community feel more fully informed, keeping the primary objectives more clearly in focus and reaffirming the importance of the program.

Some of the *resource objectives* (which equate to KACPs) are reasonably well-defined in narrative form, while others are not yet defined (according to either Schedule L-1 or L-2). Other resource objectives that are surely important are missing. These include metrics for anadromous and resident fish population performance, which are not explicitly called out except in terms of presence or absence in a given stream reach, and implicitly through rectifying blockages to upstream and downstream migration at forest road crossings. One notable exception is bull trout, which are specifically identified for focused consideration on both the Eastside and Westside Type F streams.

Amphibians are treated inconsistently. The resource objective for stream-associated amphibians is the long-term viability of populations in the subbasins where they currently occur. The enumeration of this measure is still the subject of ongoing research. Those associated with streams are directly addressed; those associated with forested wetlands are not, while those associated with seeps are. We recognize that amphibian species that occur in forested wetlands are not the seven species identified in the Forest Practices HCP, but it would seem that state and private landowners are vulnerable to future challenges about the inconsistency and adequacy of this level of protection.

Similarly, water quality is addressed only as a limited function of stream temperature and specific pathways of fine-sediment introduction (namely roads, mass wasting and, to a limited extent, bank disturbance on Type N streams). This shortfall seems critical given the numerous CWA compliance actions taken over forest-road related sediment issues in Northern California and Idaho (e.g., under the TMDL process; see Klein et al. 2008 for examples). While water temperature is important, it does not appear to have been included in studies addressing water in forested wetlands that may have been subjected to allowable timber harvest.

Not all of the requisite *performance targets*—that is, numeric values for specific indicators that are both responsive to forest practices and provide reliable measures—have been defined, especially for Eastside riparian forests and instream habitats. It is especially notable that no performance targets have yet been defined for resident or anadromous fish from which to gauge overall level of protection afforded by the current rules. These indicators (also called metrics) and their associated values are critical to answering the key questions posed in Schedule L-1. Uncertainty for what specific values to assign a given performance target should not continue to delay the assignment of interim values. Doing so would provide tangible feedback on forest practice performance under a variety of circumstances. Even the simple act of documenting before-and-after conditions in a riparian zone will begin to build capacity for understanding the range of conditions affected by treatments and help distinguish the most important factors.

5 RECOMMENDATIONS

In reviewing our list of "Issues of Concern" (Section 4.2), an overarching theme is that motivating questions, and progress towards finding their answers, is uneven from one rule group to the next, and that relative progress does not appear entirely driven by importance or priority needs. In short, the framework approach articulated by the MDT report and the CMER Work Plan is well-founded but its implementation has not been uniformly well-executed. In particular:

- Performance targets are not always defined—criteria for "success" are commonly ill-defined;
- Methodological and "technique" studies have taken precedence over evaluations of whether the guidance they provide have achieved resource protection; and
- Cross-study integration is minimal, and so overall integration of results across rule groups is virtually absent.

We offer no judgment about whether these issues simply reflect the necessary evolution of an evaluation program that began at the same time as the promulgation of new forest practice rules. Clearly, implementation tools need to be developed and used before on-the-ground effects can be measured. We only assert that at the present time, eight years into the Forest Practices AMP, that the recommendations listed below might represent the most prominent and timely areas for attention.

1. Take a fresh look at the "Critical Questions" by rule group in the CMER Work Plan. These form the link between the list of "Priority Research" needs and the recommended projects, and so their selection is critical. However, they do not always appear to support identified research needs, and so the derivative projects may not provide the greatest management utility. Because the Work Plan does not systematically (re)articulate either the resource objectives or any previously identified research needs, the Critical Questions may not always reflect either current knowledge (whether generated by CMER or by scientific study outside the program altogether) or the most current and pressing management needs. For example, five priority research topics were identified for the Unstable Slopes Rule Group (accuracy of unstable landform identification, best model for predicting shallow landslides, screening tool for deep-seated landslides, effectiveness of mass-wasting prescriptions, and validating mass-wasting targets); but as noted previously, not every critical question in the current work program corresponds with any identified priority research need (e.g., "Does harvesting of the recharge area of a glacial deep-seated landslide promote its instability?"). This suggests that the logic flow of the Work Plan should be revisited—are previously articulated research needs obsolete? Or, have the critical questions, and the projects that are justified by them, lost their connection with identified research needs? This is particularly problematic for those rule groups (channel migration zones and pesticides) that have no priority research identified at all.

2. Take another step down the chain of implementation by systematically evaluating whether the critical questions are being properly addressed by the specific projects being proposed or executed. Some of these issues have been noted previously in this report. For example, the Roads Rule Group defines five critical questions that appear to be well-aligned with the associated priority research needs, but the listed projects that are scheduled for implementation focus on erosion-model development and use, not on direct measurement of whether road prescriptions actually reduce sediment input into streams. Such a model-

based emphasis in the list of projects does not actually "answer" the critical question of whether we are meeting performance targets for sediment and water discharges from roads.

3. Integrate the studies by emphasizing the complementary relationships between the studies being done. This could be accomplished by creating a parallel organizational framework that puts the key questions and KACP's at the top of the organization structure, and then shows the critical questions that address the key aquatic conditions and processes (which will include studies from a variety of rule groups) and thus contribute to addressing the more fundamental questions. It might help to create a master integration flow chart that shows the obvious and implied relatedness of both the studies and the issues needing resolution.

4. Look more broadly for useful information to include in the overall scoping, analysis and interpretation of the studies. For example, field studies done by the USFS and BLM as well as from other states (e.g., Idaho DEQ and their Beneficial Use Reconnaissance Project [BURP] data, EMAP sampling for aquatic conditions, Interior Columbia Basin Ecosystem Management Project) have created significant databases of relevant information about hillslope and riparian conditions, characteristics of instream habitats and LWD associations and the effects of various management "treatments" for forested areas throughout the interior West. These data could be useful to inform decisions about choosing interim performance targets, pending completion of various baseline studies. Much of these data are now consolidated through the Pacific Northwest Aquatic Monitoring Program, which has worked to assemble such data and standardize both the field methods and the analytical approach used for interpretation. Also, there are new comprehensive efforts throughout the Northwest to systematically evaluate the outcomes of restoration efforts at the site scale, the watershed scale, and the landscape scale, particularly in the Columbia River Basin. As is part of any normal scientific investigation, each study proposed should be required to present a thorough review of the science on the topic of study and explain how the proposed study can make use of this available information. It would also seem prudent to address the potential influence of climate change over the next 50–100 years, as it will undoubtedly influence the characteristics and dynamics of public natural resources and complicate the interpretation of the overall effectiveness of the AMP. The Eastside Riparian Disturbance Regime Literature Review (Project 55, prepared by Concurrent Technologies Corp.) is one report where the implications of climate change on key resource characteristics were discussed.

5. Create a master timeline for each of the key questions to showcase year-to-year milestones of accomplishment (by virtue of the studies initiated or completed) and to offer a reasonable prediction of the year in which CMER expects to provide concrete results relevant to the evaluation of forest practices. For example, one such timeline might highlight the studies being done to address the issue of water quality, in which all the studies having to do with stream temperature and sediment inputs to streams are shown according to their start date and anticipated completion date. It would include a specific statement of what data will result from these studies and what uncertainty will be addressed in support of policy action.

6. Deemphasize further model-development studies in favor of those that emphasize actual field data collection of key processes and conditions. The landslide "post-mortem" study (in progress), for example, should provide tangible guidance on the success of prescriptions for avoiding unstable slopes. Further work on slope-stability modeling, in

contrast, could offer no such information. Similarly, the $1.7M spent on Stream Typing models may have resulted in a scientifically defensible approach, but wide acceptance of its application in the present context still remains a point of contention.

7. Put additional effort into those areas that have been overlooked to date, or else clearly articulate why they merit no attention beyond what they have already received. From our tabulation of active, planned, and completed projects (Table 4-2), any outside observer would conclude that several rule groups have been largely ignored but would be unable to understand why; Type N and F Rule Implementation Tools, especially Eastside DFC validation and provisional performance targets; wildlife; channel migration zones; and pesticides and their relationship to water quality. From subsequent discussions with members of the CMER community, we understand there is reasonable rationale for these omissions, but the coherence of the entire structure is weakened by the lack of a clearly articulated rational.

(a) Expand extensive monitoring, and embrace the need for *natural* as well as *managed* sites. Recall the Key Question:

> *"Will the rules produce forest conditions and processes that achieve resource objectives as measured by the performance targets, <u>while taking into account the natural spatial and temporal variability inherent in forest ecosystems</u>?"*

Understanding natural variability will become very important when attempting to interpret accumulated data and differentiating those changes attributable to forest practices versus those attributable to natural variability in the system under examination. Stream temperature is an example of where this knowledge could be vital when beginning to interpret variance in measurements on managed landscapes. Without background data from undisturbed forested stream sites, one will not know how much of the site-to-site and year-to-year variation is occurring naturally and how much is associated with forest practices and the effects of those practices on stream temperatures.

(b) The current absence of intensive monitoring is a critical shortcoming of the Forest Practices AMP to date, and has crippled any attempt to determine whether the interplay of various forest practices are actually achieving resources objectives and performance goals. This *must* be corrected if progress toward achieving program goals is to occur (and be recognized).

Both the Policy Group and CMER need to appreciate that no compilation of site-specific studies and modeling exercises, regardless of the total number of projects executed or the number of dollars spent, can provide credible and scientifically defensible evaluation of the program's effectiveness. Although concern has been expressed that CMER's organizational structure (work done by contractors with oversight from DNR project managers and SAGs) is not well-suited to such an effort, we submit that this probably is the *only* structure that is likely to achieve this goal. A well-designed, statistically robust program of intensive monitoring, whose design and execution is probably outside the time availability and specific expertise of the SAGs or of DNR, could begin to generate useful information at a cost that is no greater than the scale of many CMER projects that have already been funded, and it could begin to respond to the questions that continue to badger the forest-practices industry in Washington about whether resource protection is actually

being achieved.

We also note that this interest in integrative resource protection is shared by land managers and resource agencies around the state and throughout the region; there would be no better way to find opportunities for collaborative efforts than through a clearly articulated, actively engaged program in such a program as originally envisioned by the MDT. This is the heart of an adaptive management program; the question that CMER should ponder is not "how can we afford this?" but rather "how can we not?"

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Appendices

Appendix A

CMER/SAG Members Interviewed by Stillwater Sciences

CMER/SAG Members Interviewed by Stillwater Sciences

Name	Affiliation
Terry Jackson	Washington Department of Fish and Wildlife, CMER Co-Chair
Chris Mendoza	Forest and Fish Conservation Caucus, CMER Co-Chair
Joe Murray	Merrill & Ring, RSAG Co-Chair
Lyle Almond	Makah Tribe, RSAG Co-Chair
Jim MacCracken	Longview Timber, LWAG Co-Chair
Todd Baldwin	Kalispel Tribe, SAGE Chair
Candace Cahill	Rayonier Timberlands
Nancy Sturhan	Northwest Indian Fisheries Commission
Doug Martin	Washington Forest Protection Association
Mark Mobbs	Quinault Nation
Dick Miller	Washington Farm Forestry Association
Mark Hicks	Washington Department of Ecology
Jenelle Black	Northwest Indian Fisheries Commission
Ash Roorbach	Northwest Indian Fisheries Commission
Teresa Moon	Washington State Department of Natural Resources
Amy Kurtenbach	Washington State Department of Natural Resources

Appendix B

Table of CMER Project Numbers and Names

Project No.	CMER Project Name	Status	Rule Group
5a	Last Fish/Habitat Prediction Model Development – Eastern Washington	Completed	Stream Typing
5b	Last Fish/Habitat Prediction Model Development – Western Washington	Completed	Stream Typing
6	Last Fish/Habitat Prediction Model Field Performance Pilot	Completed	Stream Typing
7	Annual/Seasonal Variability	Completed	Stream Typing
10	Type N Riparian Effectiveness	Active	Type N Riparian Prescriptions
11	Eastside Type N Classification	Planned	Type N Riparian Prescriptions
12	DNR Type 5 Experimental Buffer Treatment	Active	Type N Riparian Prescriptions
13	Type N Experimental Buffer Treatment in Basalt Lithologies	Active	Type N Riparian Prescriptions
14	Type N Experimental Study in Incompetent Lithologies	Planned	Type N Riparian Prescriptions
16	Eastside Type N Characterization	Active	Type N Riparian Prescriptions
21	SAA - Detection/Relative Abundance Methodology	Completed	Type N Riparian Prescriptions
22	Tailed Frog Literature Review & Meta-analysis	Active	Type N Riparian Prescriptions
23	Dunn's & Van Dyke's Salamander	Completed	Type N Riparian Prescriptions
24	Tailed Frogs & Parent Geology	Planned	Type N Riparian Prescriptions
25	Buffer Integrity-Shade Effectiveness	Active	Type N Riparian Prescriptions
26	Amphibian Recovery	Completed	Type N Riparian Prescriptions
27	Amphibians in Intermittent Streams	Planned	Type N Riparian Prescriptions
29	Type N Stream Demarcation Pilot	Completed	Stream Typing
32	SAA Sensitive Sites Identification Methods SAA Sensitive Sites Characterization	Completed	Type N Riparian Prescriptions
35	Type F Riparian Prescription Monitoring (Westside)	Planned (on hold)	Type F Riparian Prescriptions
36	Type F Riparian Prescription Monitoring (BTO Add-on)	Active	Type F Riparian Prescriptions
40	Hardwood Conversion	Active	Type F Riparian Prescriptions
41	WDFW Temperature Data Collection	Completed	Type F Riparian Prescriptions
42	WDOE Temperature Modeling Project	Completed	Type F Riparian Prescriptions

Project No.	CMER Project Name	Status	Rule Group
43	Eastside Type F/S Riparian Extensive Monitoring – Temperature Component	Active	Type F Riparian Prescriptions
44	Eastside Type F/S Riparian Extensive Monitoring – Vegetation Component	Active	Type F Riparian Prescriptions
46	DFC Target Validation	Completed	Type F Riparian Prescriptions
47	DFC FPA Analysis Project	Completed	Type F Riparian Prescriptions
48	DFC Site Class Map Validation Scoping	Planned (on hold)	Type F Riparian Prescriptions
49	DFC Plot Width Standardization Scoping	Planned (on hold)	Type F Riparian Prescriptions
50	Red Alder G&Y Data Collection	Completed	Type F Riparian Prescriptions
54	Eastside LWD Literature Review	Completed	Type F Riparian Prescriptions
55	Eastside Disturbance Regime Literature Review	Completed	Type F Riparian Prescriptions
57	Eastside Riparian Current Condition Assessment	Active	Type F Riparian Prescriptions
58	Eastside Channel Wood Characterization	Planned	Type F Riparian Prescriptions
59	Eastside Temperature Nomograph	Completed	Type F Riparian Prescriptions
61	BTO Temperature (Eastside Riparian Shade/Temperature)	Active	Bull Trout
62	Solar Radiation/Effective Shade	Active	Bull Trout
67	Bull Trout Presence/Absence	Completed	Bull Trout
68	Bull Trout Habitat Prediction Models	Completed	Bull Trout
75	Testing the Accuracy of Unstable Landform Identification	Planned	Unstable Slopes
77	Mass Wasting Prescription-Scale Monitoring Protocol Development	Active	Unstable Slopes
79	Mass Wasting Landscape-Scale Effectiveness Monitoring	Planned	Unstable Slopes
83	Regional Unstable Landforms Identification	Completed	Unstable Slopes
84	Landform Hazard Classification System and Mapping Protocols	Completed	Unstable Slopes
85	Landslide Hazard Zonation	Active	Unstable Slopes
87	Model Evapo-transpiration in Deep-Seated Landslide Recharge Areas	Completed	Unstable Slopes
88	Method to Assess Vulnerability of D-S Landslides	Active	Unstable Slopes

Project No.	CMER Project Name	Status	Rule Group
91	Road Surface Erosion Model Update	Completed	Roads
93	Road Sub-basin-Scale Effectiveness Monitoring	Active	Roads
96	Road Site-Scale Effectiveness Monitoring	Planned	Roads
99	Effectiveness of Stream Simulation Culverts	Planned	Fish Passage
100	Fish Ecology & Movement in Headwater Streams-Lit Rev	Completed	Fish Passage
101	Fish Movement and Culvert Gradient Flume Study	Planned	Fish Passage
102	Extensive Fish Passage Trend Monitoring	Planned (on hold)	Fish Passage
109	Forested Wetlands Literature Review and Workshop	Completed	Wetland Protection
110	Statewide Forested Wetland Regeneration Pilot	Completed	Wetland Protection
114	Wetland Mitigation Effectiveness	Planned	Wetland Protection
120	DNR GIS Wetlands Data Layer	Completed	Wetland Protection
126	Cooperative Statewide Intensive Monitoring	Planned	Cumulative Effects / Intensive
B	Shallow Rapid Landslide Screen for GIS Projects	Completed	Unstable Slopes
U01	Windthrow Frequency, Distribution, and Effects	Planned	Type N Riparian Prescriptions
U02	Type N Performance Target Validation	Planned	Type N Riparian Prescriptions
U03	Type F Experimental Buffer Treatment	Planned	Type F Riparian Prescriptions
U04	Type F Performance Target Validation	Planned	Type F Riparian Prescriptions
U05	DFC Trajectory Model Validation	Planned	Type F Riparian Prescriptions
U06	DFC-Aquatic Habitat	Planned	Type F Riparian Prescriptions
U07	Pathways of Riparian Stand Development to Maturity	Planned	Type F Riparian Prescriptions
U08	Eastside Type F Instream Characterization	Planned	Type F Riparian Prescriptions
U09	Groundwater Conceptual Model	Active	Bull Trout
U10	Groundwater Research Studies	Planned	Bull Trout
U11	Yakima River Radiotelemetry	Completed	Bull Trout

Project No.	CMER Project Name	Status	Rule Group
U12	CMZ Screen and Aerial Photograph Catalog Project and CMZ Boundary Identification Criteria	On Hold	Channel Migration Zone
U13	Consistency and Accuracy of CMZ Boundary Delineations	Planned	Channel Migration Zone
U14	Mass Wasting Buffer Integrity and Windthrow Assessment	Planned	Unstable Slopes
U15	Technical Guidelines for Geotechnical Reports	On Hold	Unstable Slopes
U16	Evapo-transpiration Model Refinement	Planned	Unstable Slopes
U17	Landslide Classification	Planned	Unstable Slopes
U18	Groundwater Recharge Modeling	Planned	Unstable Slopes
U19	Board Manual Revision	Planned	Unstable Slopes
U20	Road Surface Erosion Model Validation/Refinement	Planned	Roads
U21	Effectiveness of RMAP Fixes	Planned	Roads
U22	Wetland/Stream Water Temperature Interactions	Planned	Wetland Protection
U23	Wetland Hydrologic Connectivity	Planned	Wetland Protection
U24	Wetland Management Zone Effectiveness Monitoring	Planned	Wetland Protection
U25	Extensive Wetlands Trend Monitoring	Planned	Wetland Protection
U26	Hydro-geomorph Wetland Classification System	Planned	Wetland Protection
U27	Overlay	Planned	Wetland Protection
U28	RMZ Study Resample	Active	Wildlife
U29	Ponderosa Pine Habitat	Planned	Wildlife
U30	Other Wildlife Programs/Projects	Planned	Wildlife

Project numbers 5 through 126 correspond to CMER budget lines
Project B precedes the establishment of CMER
Projects U01 through U30 do not have a budget line; the majority of them are in the scoping/planning phase

Appendix C

Example Rule Group Flow Charts

1. Type F Statewide Riparian Prescription Monitoring Program
2. Type N Statewide Riparian Prescription Monitoring Program
3. Type N Rule Group Amphibian Response Program

Type F Statewide Riparian Prescription Monitoring Program

1.
L-1 Functional Resource Objective

Provide cool water by maintaining shade, GW temperature, and other watershed processes controlling stream temperature

Provide complex in- and near-stream habitat by recruiting LWD and litter fall

Prevent the delivery of excessive sediment to streams by protecting stream bank integrity, providing vegetative filtering, protecting unstable slopes and preventing the routing of sediment to streams

Maintain hydrologic regimes by disconnecting road drainage from streams, preventing increases in peak flows causing scour and maintaining hydrologic continuity of wetlands

2.
L-1 Performance Targets

Temperature: WQS

Shade: (Westside) retain shade produced by shade model or, if model not used, 85-90% of effective shade; (Eastside) all available shade within 75' of designated bull trout habitat per predictive model; outside BTO retain shade produced by shade model or, if model not used, 85-90% of all effective shade

Riparian stand: (Westside) DFC (Eastside): high elevation habitats on pathway to meet DFC targets; current stands on pathways to achieve Eastside condition ranges (DFCs) for each habitat series

LWD: (Westside) 85% of recruitment potential for a stand on trajectory (see L-1 for LWD piece criteria and pool frequency/depth); (Eastside) to be developed based on disturbance regimes

Sediment: virtually none from new roads; old roads not to exceed .08 - .12 miles of road length delivering/mile of total stream length and 1 - 3 tons of sediment delivered per year/mile of total stream length; no stream bank disturbance outside road crossings

3.
L-1 Priority Research

Determine rates of natural regeneration and tree mortality in RMZs and their effects on the ability of management prescriptions to provide riparian function

Evaluate the effects of riparian prescription Options I and II on LWD recruitment relative to riparian reference stand conditions.

4.
Type F Riparian Prescription Rule Group Critical Questions from CMER Workplan

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

Do stands in Type F RMZs remain on trajectory to DFC (west side) or within desired ranges (east side)?

Do riparian functions meet FFR resource objectives and performance targets for shade, stream temperature, LWD recruitment, and litter fall following application of the riparian Type F prescriptions?

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

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

5.
Prescription Scale Effectiveness Program

6.
Prescription Scale Effectiveness Projects

1. Type F Riparian Prescription Monitoring Project - Westside
2. Type F Riparian Prescription Monitoring Project - Eastside
3. Type F Experimental Buffer Treatment Project

7.
Prescription Scale Project Costs / Timeline

Status	FY09	Total	End Date
1. Study Design	$60,000	$532,000	2014
2. Implement	$135,000	$672,000	2012
3. Pre-Scope	$0	?	?

5.
Intensive/Validation Program

6.
Intensive/Validation Projects

1. Type F Performance Target Validation Project

7.
Intensive/Validation Project Status / Costs / Timeline

Status	FY09	Total	End Date
1. Pre-scope	$0	?	?

Key
Brown = Rule Tools
Green = Extensive projects
Red = Effectiveness projects
Purple = Intensive/validation projects

Type N Statewide Riparian Prescription Monitoring Program

1.
L-1 Functional Resource Objective

Provide cool water by maintaining shade, GW temperature, and other watershed processes controlling stream temperature

Provide complex in- and near-stream habitat by recruiting LWD and litter fall

Prevent the delivery of excessive sediment to streams by protecting stream bank integrity, providing vegetative filtering, protecting unstable slopes and preventing the routing of sediment to streams

Provide conditions that sustain SAA population viability

2.
L-1 Performance Targets

Temperature: WQS

Westside streams: shade available within 50' for at least 50% of stream length

LWD/Organic Inputs (Westside): at least 50% recruitment available within 50'; (Eastside): at least 70% recruitment available within 50'

Sediment: ≤ 10% stream bank disturbance

3.
L-1 Priority Research

Test the cumulative effect (at basin scale) of the Westside Type N RMZs in meeting temp. targets

Test the effectiveness of prescriptions on Type N streams in meeting LWD targets

Determine LWD targets for Type N streams

Determine targets for nutrient cycling on Type N streams and test the effectiveness of prescriptions in meeting them

Test the effectiveness of the ELZ on Type N streams at meeting targets for stream bank disturbance

Refine the demarcation between perennial and seasonal Type N streams

4.
Type N Riparian Prescription Rule Group Critical Questions from CMER Work Plan

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

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

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 FFR resource objectives and performance targets for shade, stream temperature, LWD recruitment, litter fall and amphibians?

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

How do the Type N riparian prescriptions affect downstream water quality and fish populations?

What is the frequency and distribution of windthrow in FFR buffers on Type N and F streams? What site and habitat conditions are associated with sites with significant blowdown?

Is Stream Associated Amphibian (SAAs) population viability maintained by the Type N prescriptions*?

What is the current status of riparian stand conditions and stream temperature in Type N streams on a statewide scale, and how are conditions changing over time?

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

5. Rule Implementation Tools

5. Prescription Scale Effectiveness Program

5. Extensive Program

5. Intensive/Validation Program

6.
Rule Tool Projects
1. Perennial Stream Survey Pilot Project
2. Sensitive Site ID Methods/Characterization Project

7.
Rule Tool Project Status / Costs / Timeline

Status	FY 09	Total	End Date
1. Complete	$0	$70,666	2004
2. Complete	$0	$313,800	2007

6.
Prescription Scale Effectiveness Projects
1. Type N Buffer Characteristic, Integrity and Function Project (Westside)
2. Type N Buffer Characteristic, Integrity and Function Project (Eastside)
3. Type N Experimental Buffer Treatment Project (basalt lithologies)
4. Type N Experimental Buffer Treatment Project (incompetent lithologies)
5. Windthrow Frequency, Distribution and Effects Study
6. Eastside Type N Characterization Study
7. Eastside Type N Classification Study
8. Eastside Type N Function Study
9. Eastside Type N Water Quality/Downstream Effects Study

7.
Prescription Scale Project Status / Cost / Timeline

Status	FY 09	Total	End Date
1. Study Design	$90,000	$390,524	2010
2. Study Design	$0	?	?
3. Data Collection	$856,000	$4.5M	2012
4. Scoping	$50,000	$2M (est.)	?
5. Pre-Scope	$0	?	?
6. Study Design	$50,000	$310,000 (est.)	2012
7. Pre-Scope	$0	?	?
8. Pre-Scope	$0	?	?
9. Pre-Scope	$0	?	?

6.
Extensive Projects
1. Extensive Temperature Monitoring Project
2. Extensive Riparian Monitoring Project

7.
Landscape Scale Project Status / Cost / Timeline

Status	FY 09	Total	End Date
1. Data Collection	$411,000	$1.1M	2011
2. Study Design	$75,000	$275,000	2011

6.
Intensive/Validation Projects
1. Type N Performance Target Validation Project

7.
Intensive/Validation Project Status / Cost / Timeline

Status	FY 09	Total	End Date
1. Pre-Scope	$0	?	?

Key
Brown = Rule Tools
Green = Extensive projects
Red = Prescription effectiveness projects
Purple = Intensive/validation projects

Type N Rule Group
Amphibian Response Program

1.
L-1 Functional Resource Objective

Provide cool water by maintaining shade, GW temperature, and other watershed processes controlling stream temperature

Provide complex in- and near-stream habitat by recruiting LWD and litter fall

Prevent the delivery of excessive sediment to streams by protecting stream bank integrity, providing vegetative filtering, protecting unstable slopes and preventing the routing of sediment to streams

Provide conditions that sustain SAA population viability

2.
L-1 Performance Targets

Temperature: WQS

Westside streams: shade available within 50' for at least 50% of stream length

LWD/Organic Inputs (Westside): at least 50% recruitment available within 50'; (Eastside): at least 70% recruitment available within 50'

Sediment: ≤ 10% stream bank disturbance

3.
L-1 Priority Research

Determine targets for LWD for Dunn and Van Dykes salamanders, and determine effectiveness of Type N prescriptions in meeting them

Test the effectiveness of the prescriptions for Westside Type N streams in maintaining long-term viability of amphibians

Determine if amphibians or other designated uses require different temp targets

Determine LWD targets for Type N streams (e.g. for sediment retention and amphibians)

4.
Type N Amphibian Response Program Critical Questions from CMER Work Plan

Is Stream Associated Amphibian (SAAs) population viability maintained by the Type N prescriptions (includes several sub-questions)?

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 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?

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

What are the effects of various levels of shade retention on the streambreeding SAAs?

Is there an optimum level of shade retention?

Does territoriality in high quality habitat confound interpretation of SAA relative abundance estimates?

What are the effects of three buffer treatments on SAAs, 2 years postharvest?

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

5.
Prescription Scale Effectiveness Program

6.
Prescription Scale Effectiveness Projects

1. SAA Detection/Relative Abundance Methodology Project
2. Type N Experimental Buffer Treatment Project (Basalt lithologies)
3. Tailed Frog Lit review and Meta-analysis Project
4. Tailed Frog and Parent Geology Project
5. Dunn's and Van Dykes Salamander Project
6. Buffer Integrity/Shade Effectiveness Project
7. Amphibian Recovery Project
8. Amphibians in Intermittent Streams Project

7.
Prescription Scale Project Status / Cost / Timeline

Status	FY 09	Total	End Date
1. Complete	$0	$336,600	2007
2. Data Collection	$856,000	$4.5M	2012
3. Final Report	$0	$64,123	2009
4. Pre-Scope	$0	?	?
5. Final Report	$0	$62,583	2009
7. Data Collection	$156,000	$763,425	2011
8. Complete	$0	$27,000	2003
9. Study Design	$0	$350,000	2011

Key
Brown = Rule Tools
Green = Extensive projects
Red = Prescription effectiveness projects
Purple = Intensive/validation projects