Report of the Scientific Review Panel on California Forest Practice Rules and Salmonid Habitat

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Scientific Review Panel

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Executive Summary

The Scientific Review Panel (SRP) was created under the auspices of the Watershed Protection and Restoration Council, as required by the March 1998 Memorandum of Agreement (MOA) between the National Marine Fisheries Service (NMFS) and The Resources Agency of California. Under this agreement the state agreed to organize an independent panel of scientists to undertake a comprehensive review of the California Forest Practice Rules (FPRs), with regard to their adequacy for the protection of salmonid species.

NMFS and The Resources Agency jointly developed a letter that posed a series of questions regarding a review of the FPRs, the THP review and approval process, and the rule-making process. They also requested that the public be involved and provide comments and information to the SRP. Beyond this input, no state or federal agency provided any direction to, or had any control over, the SRP. The state and federal MOA specifically addressed steelhead in the Northern California and Klamath Mountains Province ESUs within California. Considerations and recommendations presented in this report apply to this geographic area and are not necessarily applicable to other areas.

Approach

To implement the project, the SRP (first convening in November 1998) agreed to operate by consensus, with one member serving as coordinator. The SRP also developed a plan to involve the public, state and federal agencies, landowners, and other interested parties. A total of 29 constituency groups (comprising 128 interviewees) interested in salmonid issues was invited to meet with the SRP. Interviewees included state and federal agency representatives, environmental representatives, large and small landowners, foresters, geologists, watershed specialists, fisheries representatives, fish/habitat restorationists, South of San Francisco ("856 counties") representatives, and fish biologists. Following the interviews, the SRP visited THP sites in Humboldt and Mendocino counties.

Overall Conclusions

The SRP concluded that the FPRs, including their implementation (the "THP process") do not ensure protection of anadromous salmonid populations. The primary deficiency of the FPRs is the lack of a watershed analysis approach capable of assessing cumulative effects attributable to timber harvesting and other non-forestry activities on a watershed scale. As currently applied, Technical Rule Addendum No. 2 does not provide the necessary cumulative effects assessment at the appropriate temporal and spatial scales. Therefore, with regard to the SRP's mandate, the state will need to sponsor and conduct watershed analyses in all watersheds within both steelhead ESUs. Also, specific rules governing onsite operations and road maintenance need stronger enforcement and/or modification to further minimize sediment production, improve stream habitat, and guarantee unrestricted passage by migrating juvenile and adult salmonids. The SRP focused on the following rule sections: watercourse protection measures, road construction and maintenance, and winter operations limitations. Finally, the SRP reviewed Timber Harvesting Plan (THP) implementation issues, especially RPF involvement throughout the THP process as well as THP review and approval procedures, and developed recommendations for improving this process.

Watershed Analysis

The SRP recommends watershed analysis as the best available tool to evaluate past, ongoing, and potential future cumulative watershed effects (CWEs) resulting from forest management and

other watershed activities, and to identify strategies to avoid, minimize, and/or mitigate adverse CWEs on salmonid populations and their habitat. All THPs within a specific watershed would rely upon the same watershed-specific analysis to identify key concerns and potential factors limiting salmonid populations. Because widespread availability of watershed analyses will be required, the state must develop and manage an interagency watershed analysis program. This should be done in consultation with NMFS, EPA, the forest industry, and academic and other non-agency scientists. All watershed analyses should be peer reviewed and then certified by a panel of scientists. The SRP has developed general guidelines for a watershed analysis that can result in specific harvest prescriptions, quantifiable performance targets, and prioritized mitigation opportunities.

Success of the watershed analysis process relies on the following two key items: (1) the credibility of the science and methodologies used, and (2) the professionalism of the scientists and specialists involved in the process. To succeed, data collected for the watershed analysis must be done in a consistent manner agreed to by all parties involved, with protocols established well before a watershed analysis program is implemented. Quality Assurance/Quality Control (QA/QC) must be an integral part of the process.

Although a watershed analysis program may require several years to develop and implement, certain actions can begin immediately. The SRP recommends the following preliminary actions until watershed analyses are completed: (1) identify legacy sediment problems that should be immediately mitigated in high priority watersheds, (2) assess anadromous fish migration corridors (both within and outside watersheds), and prioritize barriers for potential removal or replacement, and (3) modify specific forest practice rules (see below).

Pending completion of watershed analyses, the SRP recommends the Board of Forestry consider whether a harvest limitation based on percent of watershed area is warranted. This percentage would function as a red flag rather than as a moratorium. Predictably, the environmental community advocated a maximum harvest of 10% to 15% of watershed area per decade, whereas timber industry constituencies offered a maximum of 70% to 85% per decade. The SRP believes a more likely value would range from 30% to 50% per decade, but will depend on numerous factors including geology, harvest prescriptions, past disturbance, etc. The SRP recommends that a blue-ribbon science panel be commissioned in 1999 to consider the need for harvest limitations.

Specific Rule Recommendations

Recommendations by the SRP for changes to specific rule sections and issues include:

Watercourse and Lake Protection Zones and LWD Recruitment (WLPZ):

- Increase Class I WLPZs to 150 ft and encourage thinning and selection harvesting to grow bigger trees faster; increase shade requirements to 85% for the first 75 ft and 65% for the remainder; permanently retain the 10 largest conifers trees for every 100 meters of stream channel; restrict salvage logging of downed trees within 75 ft of the watercourse; provide special harvesting zone on steep slopes and adjacent to evenage management.
- Class IIs: increase WLPZ to 100 ft and require 85% overstory canopy within 30 ft and 65% overstory canopy for the remainder; restrict salvage logging within first 30 ft; require retention of a minimum of 25% post-harvest overstory of conifers; assign a special operating zone adjacent to evenage management units.
- Class III: 30-50 ft ELZ; limit burning within zones; minimize and pre-designate all tractor crossings.

- General recommendations; all slopes >55% within inner gorge harvested under evenage prescriptions must be reviewed by a geologist; all slopes >65% must be reviewed by a geologist; combine all exemptions into one rule section.
- Develop program to introduce LWD into streams.
- Redefine the watercourse transition line to include the flood plain.

Geologic Concerns:

- Geologist to conduct broad review of properties to identify any potential problems; geologist to review all proposed activities on unstable features; develop more geologic training for RPFs; all evenaged harvesting on slopes >65% must be reviewed by a geologist; develop better geology maps for resource specialists.

Road Construction and Maintenance:

- Designate roads as either permanent, temporary, or abandoned; remove watercourse and cross drain culverts from abandoned roads; eliminate road construction during winter period; develop rocking standards and consider other road stabilization measures for winter hauling; require geologist review for construction on slopes >65%; no blading of roads during wet conditions; use outsloped roads with rolling dips (where appropriate); treat and stabilize fill slopes at watercourse crossings to prevent erosion; remove legacy roads within WLPZs.

Watercourse Crossings:

- Require 100-year flood capacity for culverts with a design standard HW/D $\leq$1; permanently maintain or remove drainage structures following road use; all Class I watercourse crossings must have a natural bottom or naturally formed bottom (culvert, pipe arch, or bridge); show all watercourse crossings on THP map; restrict ditch drainage into a watercourse to no more than 100 ft; design and reconstruct crossings to avoid diversion potential and use a "fail-soft" design; minimum cross drain culvert should be 18 inches in diameter.

Site Preparation:

- Limit tractor site preparation to period before soils become saturated (see Winter Operations); reduce use of broadcast burning; restrict burning of Class III watercourses to retain LWD in channels; require a "Site Preparation Completion Report" showing the area treated.

Winter Operations:

- Use "Antecedent Prescription Index" (API) to define winter period; RPF required to oversee winter operations; allow limited use of ground-based skidding equipment under specified conditions; require a full winter operating plan that addresses sediment issues; no road or landing construction during winter period.

THP Preparation, Review and Implementation:

- THP length to be reduced following watershed assessment – THP to address concerns identified in the watershed assessment and to serve as a disclosure and operational document; RPFs should pre-consult with agencies during plan preparation.
- RPFs should consult with other resource specialists during plan preparation; THP should be signed by the landowner and timber owner; require RPF involvement in THP implementation similar to the requirements of Santa Cruz County; LTO should sign the THP and major amendments, and attend the PHI (if a LTO is identified on THP); extend agency review to minimum of 10 days between PHI and second review; extend public review to a minimum of 10 days after second review; increase agency budgets to support involvement in more PHIs,

operational, and post-harvest inspections, and provide pre-consultation with RPFs; reduce THP paperwork and focus emphasis on field review; post THPs and related information on the Internet; limit case level of CDF inspectors to 40-50 active plans; develop civil penalties for FPR violations; meeting with LTO and RPF to convey plan contents should be on site; increase training for RPFs and other resource specialists; RPF should maintain role as the lead coordinator and author of the THP; make the FPR more efficient and friendly; centralize all rules pertaining to a topic, even though this may cause some rules to be repeated.

Social and Economic Impacts:

- Nearly all the constituency groups interviewed supported incentives to landowners to improve and maintain salmonid habitat. This included the use of tax deductions, conservation easements, and restructuring of the federal tax codes to allow expensing rather than amortizing capital road expenditures such as culvert replacements. A program of incentives must be developed to allow the value of the permanently designated standing and downed trees to be deducted from the timber owner's yield or other state taxes. The valuation of these trees could be based on the yield tax value schedules, and would be claimed when harvesting is completed for the associated harvest unit adjacent to the WLPZ. This may also help encourage landowners to include watercourse protection zones in conservation easements. The benefit of providing landowners tax credits against the retained recruitment trees will encourage the retention of important habitat features and is likely to prevent legal proceedings for property taking. If the state and federal governments are going to pay millions for salmonid rehabilitation, then tax credits for the retention of key habitat features may be a reasonable step.

Some of our recommendations can be independently evaluated, while others must be considered as complete packages that cannot be separated. For example, recommended widths for the WLPZ depend on our definition of the channel zone. If the SRP's channel zone definition is modified, then the width of the WLPZ must be re-evaluated. Winter hauling is another example. A recommendation for continued winter hauling depends on formulating and enforcing adequate rocking and road surface stabilization standards. Finally, all our recommendations depend on implementing an adequate watershed analysis program.

Critical research needs were too numerous to adequately address in this report. The SRP listed a few research needs including quantification of salmonid-habitat relationships, LWD recruitment dynamics, and sediment studies on Class III watercourses.

ACKNOWLEDGEMENTS

The SRP would like to acknowledge and thank the numerous interviewees who took time from their busy schedules to meet with our panel and express their views and concerns regarding salmonids. We would also like to express our gratitude to the staff members at Natural Resources Management Corporation and Stillwater Sciences, particularly Juanita Petersen, Angela Percival, Bill Sears, and Sabrina Simpson. Without their support and assistance the development and completion of this report in a timely manner would not have happened. We would also like to thank the local, state, and federal agencies that provided our panel with meeting facilities during our interviews.

Cover illustration by Angela Percival.

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I INTRODUCTION

The Scientific Review Panel (SRP) was created under the auspices of the Watershed Protection and Restoration Council, as required by Memorandum of Agreement (MOA) between the National Marine Fisheries Service (NMFS) and The California Resources Agency. This MOA was signed in March of 1998, and was instrumental in deferring the listing of the steelhead (*Oncorhynchus mykiss*) along the north coast of California. As part of the MOA, The Resources Agency agreed to organize an independent panel of scientists, the Scientific Review Panel (SRP) to undertake a comprehensive review of the California Forest Practice Rules (FPRs), with regard to their adequacy for the protection of salmonid species. A copy of the MOA is included as Appendix A.

The SRP met initially in November of 1998. This meeting was attended by representatives of NMFS, The Resources Agency, the California Department of Forestry and Fire Protection (CDF), and the California Department of Fish and Game (DF&G). This meeting included a general discussion of the goals and objectives of the scientific review and the timing necessary to meet the objectives of the federal and state agencies. NMFS stated that it was their goal to have the SRP report completed and presented to the agencies so that any potential rule changes could be considered in time for implementation by January 1, 2000. In order to provide sufficient time for the Board of Forestry or other rule making bodies to review the report and hold public hearings on any proposed rule changes, it was necessary to complete the report by June 1999. The completed report was to be submitted to The Resources Agency and NMFS.

NMFS and The Resources Agency jointly developed a letter that posed a series of questions, regarding a review of the FPRs, the THP review and approval process, and the rule making process. A copy of this letter is included as Appendix B. The agencies also requested that the public be involved and be able to provide comments and information to the SRP. Beyond this input, no state or federal agency provided any direction to, or had any control over the SRP.

THE SRP'S MANDATE

The MOA required (MOA, Sec 9(f)) that the SRP conduct a review of "California's forest practices regulations, their implementation and enforcement in order to determine their adequacy". This same section of the MOA directed the SRP to develop the following products: "(1) define properly functioning habitat conditions which adequately conserve anadromous salmonids; and (2) jointly review the adequacy of the California Forest Practice Rules, including implementation and enforcement, to achieve properly functioning habitat conditions." Given this direction, the SRP assumed that the scope of the review and analysis was to include all anadromous salmonids, and was not limited to steelhead.

In order to address requirements of the MOA and the four questions posed to the SRP by The Resources Agency in the October 19, 1998 letter from Undersecretary Jim Branham (see Appendix B), the SRP members agreed that a comprehensive review of the rules and process was necessary, including a review of the rule making process, the rules, rule implementation through the Timber Harvesting Plan (THP) review and approval process, administration during harvesting, and post-harvest follow up.

The SRP recognizes that there are many factors that may impact salmonids other than forest management. The SRP was aware of these factors, but our analysis and resulting report focuses on interactions between forestry and salmonids.

Because the charge of the SRP was to review the rules for adequacy specific to protecting salmonids, we did not consider other non-related resources. Therefore, recommendations presented in our report may or may not affect (either in a positive or negative manner) other resources. The SRP also recognizes that there may be financial impacts to landowners and state programs resulting from the implementation of recommendations contained herein to achieve properly functioning salmonid habitat. The SRP provides additional recommendations to address this issue.

GEOGRAPHIC RANGE OF APPLICATION

The state and federal MOA specifically addressed steelhead in the Northern California and Klamath Mountains Province ESUs. The California portion of these ESUs ranges from the Oregon border south to the northern boundary of the Russian River basin, and inland to the crest of the Coast Range (see Figure 1). The SRP interviews included representatives from the Oregon border south to Santa Cruz, and east to the crest of the Coast Range. This is consistent with the region included in the Northern California and Klamath Mountains Province steelhead ESUs, and includes portions of the Coast Forest District and the Northern Forest District. Considerations and recommendations presented in this report apply specifically to this geographic area and are not necessarily applicable to other areas.

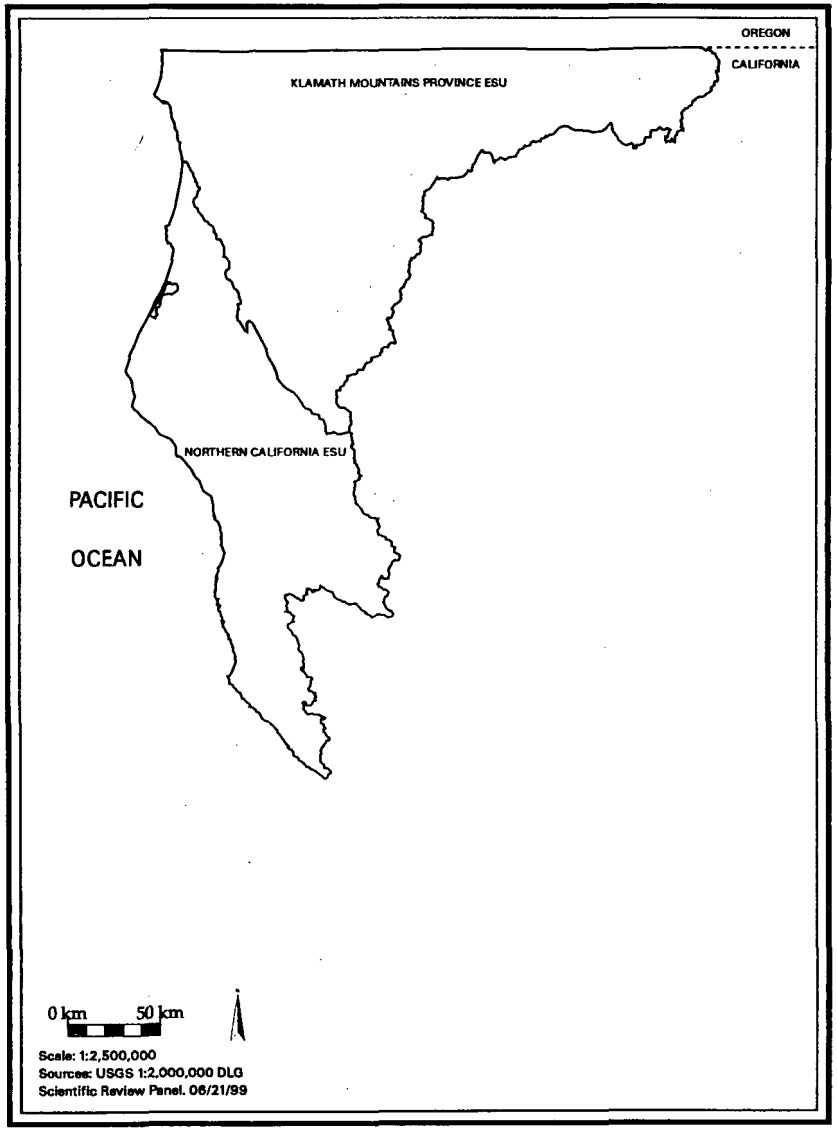


Figure 1. Northern California and Klamath Mountains Province steelhead ESUs within California

II APPROACH AND METHODOLOGY

To implement the project, the SRP met independently in November of 1998. The SRP decided to operate as a consensus group, with one panel member serving as coordinator. The SRP also developed a plan to involve public, state and federal agencies, landowners, and other interested parties. Various constituency groups interested in salmon issues were invited to meet with the SRP. The SRP identified 28 different constituency groups. The participants were selected by recommendation and agreement of the SRP members, and were invited by letter (Appendix C) to partake in panel interviews and discussions. The letter of invitation included, or was followed by, a series of prepared questions. Different questions were prepared for each constituency group (Appendix D). The interviewees were asked to respond to these questions candidly and were promised that they would not be quoted as individuals, but might be quoted as a constituency group. These discussions were not recorded or video taped. SRP members took notes and often engaged interviewees in discussion.

The interviews were conducted between January and May of 1999. Interviewees included state and federal agency representatives, environmental group representatives, large and small landowners, foresters, geologists, watershed specialists, fisheries and fish restoration representatives, South of San Francisco ("856 counties") representatives, and fisheries biologists. Interviews were conducted in Sacramento, Berkeley, Santa Rosa, Ukiah, and Eureka. A total of 128 people were interviewed by the SRP, mostly in discussion groups involving three or more interviewees. The industrial landowner representatives were interviewed separately due to potential antitrust issues.

To evaluate their adequacy for protecting salmonids, the SRP was charged with a review of the FPRs. This required a review of the rules, the Board of Forestry rule making process, and how the rules are actually applied once THPs are approved. Several interviewees noted that the rules were the minimums required by law, and it would be unlikely that a THP would ever be approved in the north coast region of California, if submitted under these standards. One agency representative stated that he felt that the rules themselves were inadequate, but that the THP approval process was adequate. This is because the rules contain intent language that allows the agencies to require higher protection standards than the minimums provided in the rules. A representative of the environmental community noted that this broad intent language and the "explain and justify" sections of many rules provided an "equal and opposite" exception to every rule.

In order to better understand the rules and the THP approval process, the SRP reviewed the 1999 version of the rules, THPs that had recently been approved, and supporting documents utilized by CDF during THP review and approval. This included the "Coho Salmon Considerations" document prepared by CDF (1997), and a subsequent document that reviewed the FPRs prepared by NMFS (1998). The Resources Agency (1998) also prepared a review of the NMFS report titled "Resources Agency's response to NMFS California Forest Practice Rules". The SRP also reviewed the report produced by NMFS and USFWS (1997) titled "Aquatic Properly Functioning Condition Matrix" (Matrix). The NMFS matrix puts forward a condition for the landscape that NMFS believes to be properly functioning with regard to the needs of anadromous salmonids and other aquatic organisms in northern California.

To obtain a better understanding of how the THP review and approval system works, the SRP interviewed representatives of the full complement of agencies involved in the THP review and approval process, as well as RPFs preparing THPs and members of the public reviewing THPs.

The SRP also reviewed the 2090 Agreement (CDFG 1996) that was developed to address for-

estry activities and potential impacts to the coho salmon in the area located south of San Francisco. Coho salmon in this area were listed under the state ESA (CESA) before the federal listing.

The state provided SRP members with copies of the current FPRs (CDF 1999). This version was compiled by the CDF for use by licensed timber operators (LTOs) and registered professional foresters (RPFs) "to provide field personnel with working rules for their use." The authoritative FPRs are printed by Barclays Official California Code of Regulations. The Barclays version is printed in a larger format, and contains the history of each rule section.

The "Coho Salmon Considerations" document was prepared by CDF and sent to all RPFs on April 29, 1997. The complete title of this document is "Coho Salmon (*Oncorhynchus kisutch*) Considerations for Timber Harvesting Under The California Forest Practice Rules." The stated purpose of the document was "to provide some biological background regarding coho salmon and its habitat, provide guidance to RPFs, landowners and CDF in their assessments of possible adverse impacts to salmon habitat and to describe potential conservation measures for timber operations within the Central California Coast and Transboundary ESUs." The introduction to the document states it is for guidance only, and encourages RPFs to seek input during plan development from NMFS, DF&G, and/or non-agency fisheries biologists.

THPs submitted after the release of the "Coho Salmon Considerations" were required to incorporate considerations for impacts to coho salmon in the THP. While the benefits of these measures may not be agreed to by all of the agencies, CDF Forest Practice Inspectors indicated that after the document was released they had seen the canopy retention levels on Class I watercourses increase to 70-80% as compared to the minimum of 50%.

NMFS released a document identifying their concerns with the FPRs on May 22, 1998 entitled "Effectiveness of the California Forest Practice Rules to Conserve Anadromous Salmonids." Under "General Concerns" the document states:

"Two areas of concern that the National Marine Fisheries Service has with the implementation of the California Forest Practice Rules relate to the large number of rules under which adequate conservation for anadromous salmonids depends heavily on the Registered Professional Forester (RPF) having a high level of biological, ecological, and/or geological expertise. It is unrealistic to expect all RPFs have such knowledge. Often, the conservation of ecological resources, including anadromous salmonids, depends upon protective measures that are inserted into Timber Harvest Plans (THPs) during the review process. Two state agencies, the California Department of Fish and Game (DF&G) and the Regional Water Quality Control Board (RWQCB) have been given statutory responsibility to review THPs for compliance with the California Fish and Game Code and Clean Water Act, respectively. The Division of Mines and Geology also reviews THPs. No integrated guidelines or policies are available to provide a framework for treatment of THPs through the review process (Little Hoover Commission 1994). In addition, the agencies can review only a small fraction of the THPs, and thus are forced to rely on RPFs, not agency personnel, to determine problems and design mitigation measures. Furthermore, even when these agencies participate in a review, there is no requirement that the agencies recommendations must be incorporated into THPs."

The NMFS report reviews specific rule sections of the FPRs and provides opinions on whether the rule is adequate or inadequate, if the rule requires a high level of expertise to implement, or if implementation relies on agency review that is not consistent. The report displays the analysis of the rules in a matrix format, and provides additional narrative comments on selected rules. Of the rule sections reviewed, NMFS listed nine as adequate and 20 as inadequate.

The Resources Agency responded to the NMFS report in an 81-page report dated July 2, 1998. In the preface the report states:

"Taken in isolation, the individual sections of the rules may not appear to provide adequate protection for watercourses of the habitat and species that rely on watercourses. California relies on an adaptive management approach to in regulating timber harvesting. This approach relies heavily on mitigating any significant impact on environmental resources. It is a process that allows the reviewing agencies to ask the question 'How is coho being protected?' and ends up with a plan that fully protects the species and its habitat."

The Resources Agency report included the original NMFS comments and the response to each issue raised by NMFS.

Another document that specifically addresses salmon is the 2090 Agreement (CDFG 1996). This is a Biological Opinion (BO) under the CESA issued on April 17, 1999 by the DF&G to CDF for the "Review And Approval Of Timber Harvest Plans And Timber Operations Plans In The Range Of The Coho Salmon South Of San Francisco." The BO found that DF&G and CDF concur with these Conservation Measures prescribed in the BO:

- Provide foresters specific information and guidelines for coho salmon protection;
- Allow CDF to approve a majority of plans with minimum delays;
- Ensure the Board of Forestry's Forest Practice Rules are applied appropriately to protect coho salmon without the need for new regulations;
- Give Registered Professional Foresters (RPFs) flexibility with respect to their projects by allowing them to develop alternatives to the mitigation and avoidance measures prescribed in this Biological Opinion where such alternatives provide equal or greater protection for coho salmon;
- Obviate the need for consultation with DF&G in most situations;
- Provide DF&G the option, as necessary and in concert with CDF, to create a citizen advisory group for exchanging concerns and suggestions; and
- Provide monitoring information that will help determine the level of success achieved by the Conservation Measures.
- The conservation measures in the agreement include: (1) requirements for a more intensive cumulative effects analysis (but not a full-scale watershed analysis); (2) conclusions regarding potential impacts to coho salmon; (3) baseline conservation measures for watercourse protection; (4) director's approval standards for THPs; and, (5) requirements for a monitoring program.

Under the 2090 Agreement, the baseline conservation standards for Class I streams require 85% shade canopy within 25 feet of the watercourse and 75% for the remaining Watercourse and Lake Protection Zone (WLPZ) if there are concerns regarding water temperature for protection of salmonids. DF&G must approve all new road or landing construction within the WLPZ except at crossings. All roads within the WLPZ must be rocked or otherwise stabilized before the start of the winter operating period, and all skid trails within the WLPZ must be covered with tractor-packed slash before the start of the winter period. Any area of disturbed soil greater than 100 square feet within the WLPZ must be treated prior to the winter period. The trees in the WLPZ must be marked prior to the pre-harvest inspection (PHI) and, if large woody debris (LWD) is lacking, the RPF must propose measures for its recruitment, including placing LWD in the channel (in cooperation with DF&G). The minimum road maintenance period is three years.

Standards for Class II and III watercourses are more restrictive than the current rules. This includes 75% canopy cover on Class II streams where there are temperature concerns. Class III's must have suitable Equipment Limitation Zones

(ELZs) to prevent the generation of erosion into watercourses, and all tractor crossings must be flagged prior to PHI. All operations must avoid dislodging LWD currently in the channels of Class III streams and site preparation cannot occur if it will generate sediment into Class IIIs.

Of all the constituency groups interviewed by the SRP, there was broad agreement among the participants of the 2090 group even though they included landowners, RPFs, and agency representatives from CDF, RWQCB, and DF&G. This group had worked together extensively and it was clear they had developed mutual trust. All members of the 2090 group felt the 2090 Agreement was sufficient to protect coho salmon and was not overly burdensome to landowners.

III BIOLOGICAL CONSIDERATIONS

LIFE STAGE REQUIREMENTS OF SALMONIDS

Timber harvesting can adversely affect aquatic systems and therefore negatively impact salmonids. Timber harvesting operations involving log skidding, road and landing construction, road maintenance, and harvest of trees in riparian areas can increase input of fine sediments into stream channels, increase water temperatures, affect aquatic food resources, and reduce long-term recruitment of LWD (Chamberlin et al. 1991, Furniss et al. 1991, Beschta et al. 1987).

Understanding the biological and physical factors that are necessary to sustain salmonid populations is critical to developing forest management strategies to protect and, if possible, improve habitat and populations. Salmonid production is affected by environmental conditions at each life stage. Salmonids have different habitat requirements for the successful completion of each of their life stage; i.e., egg development and hatching, fry and juvenile growth and survival, parr-smolt transformation, and life in the ocean. Thus, it is essential to understand what a watershed has to offer each of these species of fish, before one can determine: (1) potential impacts of a timber harvesting; and, (2) whether or not mitigation measures would offset impacts to the point of no net impact.

Life history events for salmonids must be discussed in concert with key life stage requirements. Life stage requirements are those features of an organism's environment that are essential to its continued survival and reproductive success. Critical life stage requirement variables for salmonids include:

- Appropriate water temperatures
- Appropriate water quality;
- Abundant food;
- Accessibility to spawning and rearing areas; and,
- Appropriate physical habitat.

Each of the life stage requirements may vary, depending upon the season and the life stage and condition of the fish. If any life stage of any species is deprived of a life stage requirement, the population as a whole can be negatively affected. When life stage requirements are not met, or are limited in some way, the fish's survival and reproductive success can be jeopardized.

Factors limiting to populations are called "limiting factors." Fry (1971) used the term to describe environmental factors (e.g., food, dissolved oxygen, other respiratory gases) that limited the metabolic rate of fishes. Limiting factors operate by restricting the supply or removal of materials involved in metabolism. Thus, a reduction in the supply of dissolved oxygen (DO) below a certain level can reduce metabolic rate, and below that level it can be said that the oxygen supply is limiting. The effect of a limiting factor is to reduce the maximum metabolic rate that would be permitted by the existing levels of controlling factors, such as temperature. During the past decade, agency and forest industry biologists working on THPs and watershed analyses have expanded the limiting factors concept to apply to ecological systems. Thus, the terms "lethal", "controlling", "limiting", "masking", and "directive", that were originally used to describe physiological processes, are now being used to describe both environmental and physiological processes that affect fish production (Reeves et al. 1989). Potential limiting factors from an ecological context include: water temperature, sediment, water quality, and the quantity and quality of habitat suitable for spawning and rearing. Some potentially limiting factors can be influenced by human intervention; others, such as the lack of water, often cannot be altered.

Before one can assess whether or not a proposed THP could have an impact on salmonids, one must identify the following:

- the requirements of the species; and,
- any potential factors that may be limiting to populations of the species.

As each life stage of a salmonid has specific habitat requirements, it is imperative to understand the factors that influence habitat quantity and quality for each life stage and the thresholds required for successful survival to the next life stage. For example, the prediction that a temperature increase would limit growth rate by a specified amount without knowledge of other potentially limiting factors (e.g., food availability) can lead to significant errors in predicting potential population responses, such as decreases in smolt production in a watershed. In order to understand how environmental factors influence salmonid productivity, it is necessary to first identify the components that strongly influence fish survival. Each of these components is influenced by physical and ecological processes that may be affected by forest management activities in a watershed.

Ideally, by integrating knowledge of salmonid habitat requirements with that of historical and existing conditions, one can determine how habitat conditions for salmonids have been affected by past and ongoing watershed activities and how a proposed timber harvest may further affect these habitat conditions. In addition, by determining what salmonids need, it may be possible to mitigate negative impacts, and, thus, restore the health of salmonid populations within the watershed. The use of this general approach, together with a monitoring and adaptive management plan may improve fish habitat and populations.

The best method for identifying salmonid life stage requirements, determining whether or not these requirements are being met, and determining what is needed to maintain or restore salmonid populations is to use site-specific data. However, site-specific information is often incomplete for one or more of the life stages of the salmonids. Thus, when site-specific data are not available, it is customary to extrapolate using information from other areas. Then, ideally, as more site-specific information becomes available, requirements for each life stage of a salmonid would be re-evaluated in a particular area and/or watershed on an ongoing basis. If necessary, the standards for one or more of these requirements could be modified, if there were a scientific basis for such a change.

In the absence of appropriate site-specific studies, it is common to analyze information from other areas or laboratories and to identify a "threshold value" or "threshold effect". "Threshold values" and "threshold effects" are two commonly used terms that are rarely defined during the THP process, but are often determined using laboratory data. Biologically speaking, a "threshold" is a level or value that must be reached before an event occurs; a "threshold effect" is the harmful effect of a small change in the environment that exceeds the limit of tolerance of an organism or population, and (Lawrence 1995). There are several problems with using thresholds based on data from laboratories or areas other than the site of interest. First, in the laboratory environment, one is forced to control or eliminate many of the factors (e.g., effect of ration size on thermal requirements, effect of energy expenditure as a result of escaping predators or seeking prey, effect of previous stressors) that affect fish in the wild. Thus, laboratory data are not analogous to those collected in a stream. Therefore, wherever possible, site-specific information should be used to determine life stage requirements and impacts of proposed THPs and incorporated into the watershed analysis for areas where timber harvest is going to occur.

In the following paragraphs, critical life stage requirement variables for salmonids are discussed. No specific threshold values or quantitative estimates are provided because such information should be based on site-specific data.

Appropriate Water Temperatures

Of all of the life stage requirements for fish, water temperature may be the most important, and yet least understood by those involved with the THP process. A major problem hindering precise understanding of temperature effects is that many environmental factors (e.g., food availability, previous exposure to stress, genetic adaptation, age and size) simultaneously influence a fish's response to temperature. Water temperature can be considered in two ways: (1) as a factor affecting the rate of development, metabolism, and growth; or (2) as a stressful or lethal factor. The two, of course, are inseparable. Fishes are poikilotherms, or cold-blooded animals, which means that their internal body temperature varies, according to the external environment. This means that a fish has little physiological control (i.e., thermoregulation) over its body temperature; if the water is hot, the fish is hot and if the water is cold, the fish is cold, etc. Thus, fish have no physiological way to quickly acclimate to changes in water temperature. And a fish's metabolism, which controls all aspects of its body, is directly proportional to water temperature, within certain limits. Thus, as water temperatures increase, so does the metabolic rate and the need for food. If there is enough food available and dissolved oxygen conditions are sufficient, then the fish will grow, within certain thermal ranges. However, if the amount of food is limited and/or other stressors exist (e.g., low dissolved oxygen, pollution), the fish will not grow. Beyond certain physiological limits, however, even an increase in food availability will not assist the fish; beyond this point, water temperature can be stressful and even lethal.

Despite a fish's inability to change quickly, physiologically, they often use behavior to thermoregulate. This is of great importance when their habitat provides more than one thermal option. For example, in studies on the Navarro River (Rich 1991), juvenile coho salmon were collected in water temperatures that would be considered stressful according to results in the scientific literature. Yet, the fish had good growth rates and appeared to be healthy. It was surmised that both the abundant food resources and cool thermal "refugia" accounted for this apparent anomaly (Rich 1991). Thus, within the thermocline in the pool, the cooler areas provided a refuge for the salmonids during the hot part of the day. The fish could then digest their food at physiologically acceptable water temperatures, even though a large percentage of the pools were characterized by high water temperatures.

In establishing criteria for setting safe limits of water temperatures for each life stage of a selected fish species, chronic sublethal stressful water temperatures are usually of more importance to fishes than acute lethal temperatures. Sublethal stressful water temperatures are more common and the results less easily studied and understood than a "fish kill", resulting from lethal water temperatures. However, sublethal water temperatures can effectively block migration, reduce growth rate, create disease problems, and inhibit smoltification (Elliott 1981). All of these stress indicators have been directly and indirectly linked with survival in natural populations of salmonids. In addition, the stressful impacts of water temperatures on salmonids are cumulative and positively correlated to the duration and severity of the exposure. Thus, the longer the salmonid is exposed to thermal stress, the less chance it has for long-term survival. In fact, sublethal thermal stress is as decisive as lethal temperatures to continued survival (Brett 1956). It is of paramount importance that the impacts of sublethal stressful water temperatures be understood and, when possible, mitigation measures be implemented to reduce potential impacts on salmonid production.

Water temperature criteria used for salmonids are often subject to debate. One primary reason for this problem stems from the fact that it is common to base water temperature standards on selected laboratory data, rather than on site-specific field data for a given species. For example, water temperature requirements for salmonids are

often developed from laboratory data reported in the scientific literature without any understanding of the physiological and/or behavioral response of the fish to changes in water temperature in the area proposed for timber harvesting. Therefore, water temperature standards established under a laboratory setting often do not agree with field data for a given fish species and impacts of water temperature on salmonids in the field can differ, depending upon ambient conditions.

The interaction of water temperature and the physiology of fishes in the wild is far more complex than in a controlled laboratory setting. Consequently, extrapolation of results from such tests to the natural environmental can often lead to incorrect evaluations and inaccurate predictions of thermal impacts on salmonids. For example, a summer temperature might enhance coho salmon production in a northern stream, but depress it in a southern one. Thus, to identify appropriate water temperature requirements and determine whether or not a particular timber harvest will result in impacts on salmonids, the best method is to use a site-specific thermal physiology approach that integrates information on water temperature, food use, and fish growth. The approach needs to: (1) permit the detection of stress-related variables that are biologically and ecologically relevant; and, (2) maximize predictive capabilities (Adams 1990).

The variety of methodologies used to assess thermal impacts can result in a variety of interpretations of the data. The lack of standardized methodologies among fish physiologists has resulted in many definitions for the same term. Similar to all specific areas of scientific inquiry, fish thermal physiology has its own nomenclature that can be confusing when there are different meanings for "optimal", "lethal", "preferred", "tolerance", "threshold", and "stressful" temperatures. Such a lack of standardization is problematical when one compares the results of one "optimal temperature" study with those of another, and the results of the former are based on "thermal tolerance" while those of the latter are based on growth rate. Similarly, the term "lethal" can be used literally, as a percentage of the eggs or fish that die. But, the term "lethal" is often also used by physiologists to identify the temperature at which 50% of the eggs or fish die within 28 days, or 7 days, or even 14 hours within a laboratory setting, hardly something one can directly apply to a field situation (Fry et al. 1942, Brett 1944).

Another problem with determining the water temperature requirements of salmonids is one of misinterpretation, primarily from biologists with no background in fish physiology. Following are some examples of such misinterpretations/misapplications (Rich 1997).

- Transferring of numbers (e.g., percent mortality, thermal optimum) directly from a laboratory study to a field situation in another geographical area. The impacts of water temperature are not only species and life stage specific, they are site specific, as well, because the wild fish's responses to water temperature is far more complicated than those of a laboratory fish in a controlled environment.
- When conducting a review of information, disregarding some of the thermal studies reported in the scientific literature. This is an unfortunate problem because, by selectively excluding studies, one does not have an accurate representation of the range of thermal impacts that have been reported, and thus, one cannot accurately establish unstressful thermal ranges for salmonids.
- "Inputting" field data from a salmonid study directly into an unvalidated growth-temperature model, such as the model designed by Brett et al. (1982). The problem with this is at least two-fold: (1) most of the bioenergetics models reported in the scientific literature have not been validated; and, (2) unless site-specific studies are undertaken, one has no idea what percent of maximal ration the fish consume in the field, as they rarely, if ever consumer the maximal rations usually reported in the laboratory studies.

By incorrectly applying the results of the studies, incorrect conclusions are made, with regard to optimal, stressful, and lethal water temperatures. Thus, to determine potential impacts of a THP, it is important to understand and correctly apply the results of thermal studies, using site-specific data.

A method commonly used by fish physiologists for determining both thermal requirements and impacts on fishes is bioenergetics (Brett and Groves 1979). Very simply stated, bioenergetics is the study of where food goes, once an organism ingests it. Once food is eaten, the energy must first go to maintaining the fish's basic metabolism. Then, if there is energy left over, the energy is used for swimming or reproduction or growth. However, if water temperatures are high, more energy is needed for basic metabolism and for swimming and hence, more food is needed. If the food available satisfies the basic requirements for the fish, then energy will be used for swimming and, eventually for other functions such as growth and reproduction. As water temperature, food availability and fish growth are integral components to bioenergetics, it is possible to determine optimal water temperatures for a given life stage of a fish, if one knows how fast the fish grows and what and how much the fish eats over a given time period.

A functional (from the standpoint of a meaningful site-specific field studies) method for determining optimal water temperatures and impacts is the use of the *Computerized Fish Bioenergetics* models originally developed in the late 1980s at the University of Wisconsin (University of Wisconsin 1997; Hewett and Johnson 1992, 1989). These computerized models were developed from sythesizing the results of many fish bioenergetics studies and, provided one collects the appropriate site-specific data, can be adapted to any life stage of salmonids. Thus, instead of using an upper optimal threshold of about 15°C for juvenile coho salmon for any stream inhabited by this species, one would determine the appropriate range of water temperatures for a specific stream, based on food availability and existing water temperatures. Using bioenergetics modeling, in conjunction with thermal modeling, it is also possible to predict both short-term (i.e., months) and long-term (i.e., years) impacts on the total productivity of salmonids emigrating out of a system.

In summary, knowledge of temperature tolerance and sublethal stress responses of salmonids is far from adequate to define safe thermal limits and determine potential thermal impacts for each THP. Key factors that affect thermal requirements and stress include food availability, dissolved oxygen, previous exposures to stressful situations, and innate metabolic rate (i.e., fish with more hatchery genes have lower metabolic rates that their wild counterparts). Until a more site-specific physiological approach is used in conjunction with a watershed analysis, determining site-specific thermal requirements and impacts on salmonids as a result of timber harvesting will remain in the realm of conjecture.

Suitable Water Quality Conditions

Dissolved Oxygen

Of the various fish species, salmonids are particularly sensitive to low dissolved oxygen (DO) concentrations. Except for rare occasions, dissolved oxygen is not likely to be limiting to salmonid populations in the geographic range covered by this assessment. To establish DO concentration requirements, a limited amount of site-specific data should be collected as part of the watershed analysis, which can integrate water temperatures, food eaten, and ambient DO concentrations.

Contaminants

Forest fertilization and the use of chemicals such as fire retardants, herbicides, pesticides may affect water quality and nutrient cycling processes in

watersheds occupied by salmonids. Detailed discussion of potential effects of such forest management practices was considered beyond the purview of the SRP.

Sedimentation and Turbidity

Salmonids require and seek out clean (silt-free) gravel. They will spawn and rear in embedded substrate if nothing else is available; however, there is usually a subsequent reduction in survival to emergence. Successful spawning, incubation, and fry emergence depends upon the following factors: (1) size class composition of the substrate; (2) existing degree of embeddedness; (3) substrate permeability down to below the point of egg deposition in the fish's redd; and, (4) percolation rate of water through the substrate.

It is well known that fine sediments can influence the survival of salmonids, particularly at the egg and alevin life stages. Considerable research has shown that varying amounts of fine sediments (defined in most studies as particles with a diameter of less than 3 mm or 0.85 mm) may reduce intergravel flow and the delivery of dissolved oxygen to incubating eggs and developing alevins in the redd (McNeil and Ahnell 1964; Cooper 1965). Fines may also form a seal or cap in the upper layers of the redd gravel (Einstein 1968), impeding or obstructing the emergence of alevins in a process known as "entombment" (Koski 1966, Cloern 1976, Phillips et al. 1975). Filling of pools with fine sediments can reduce carrying capacity of rearing habitats for juvenile salmonids (Bjornn et al. 1977). Sedimentation also may fill interstitial spaces in the substrate used as velocity refuges by juvenile salmonids during high flow events or low temperatures (Hillman et al. 1987). Such filling of interstitial spaces also reduces habitat for aquatic macroinvertebrates and may therefore reduce juvenile salmonid production (Crouse et al. 1981). Increased input of fine sediment may most seriously impact salmonid habitat when the source continues to deliver sediment over a long period of time (Chamberlin 1982). It is generally accepted that increased input of fine sediment can be harmful to salmonids; however, determining the exact threshold amount that may limit production of salmonid populations within a watershed is more problematic. Many stream systems in California have naturally high sediment loads, including an abundance of fine materials less than 1 mm diameter, yet, historically these streams supported healthy populations of salmonids (Sedell and Swanson 1984). Nevertheless, in many streams within the region covered by this review, delivery of fine sediment may have increased over background rates and legacy effects of poorly constructed roads or poorly conducted logging on unstable hillslopes may be a continuing source of fine sediment to streams.

Chronic turbidity that is caused by fine sediment suspended in the water column may interfere with feeding by juvenile salmonids and thereby reduce growth. Other potential effects of suspended sediment on salmonids include irritation of gill tissues, avoidance behavior, and mortality at very high concentrations (Noggle 1978).

Abundant Food Resources

Salmonids are opportunistic predators that eat a wide variety of aquatic invertebrates, as well as terrestrial invertebrates that fall into the stream (Mundie 1969, Elliott 1973, Tippets and Moyle 1978). Abundant food is particularly important to salmonids during warm summer months, when water temperatures and metabolisms are high. In order to survive and grow, young salmonids require a large and constantly replenished supply of food. The relationship between food availability and water temperature is an extremely important phenomenon that is too often ignored when fisheries biologists attempt to determine the optimal temperatures for salmonids. Consequently, evaluation of food availability should be included with assessment of water temperature in the watershed analysis.

Access to Spawning and Rearing Areas

Physical barriers (e.g., culverts, waterfalls, debris jams) may sometimes delay, or block upstream and downstream movements by salmonids. Such barriers may reduce the amount of spawning habitat available for salmonids. Information on barriers that prohibit access to areas historically accessible to salmonids must be included in a watershed analysis.

Appropriate Physical Habitat

The amount of streamflow, substrate quality and quantity, appropriate water depths, and adequate shelter or cover affect all life stages of salmonids. Sedimentation of substrate is discussed under "Suitable Water Quality Conditions" above.

Large Woody Debris

Reduction of in-channel LWD through splash-damming, stream cleaning, and harvesting of trees in riparian areas may lead to the loss of habitat features important to juvenile salmonids. Reductions in LWD may cause decreased frequency, depth, and complexity of pool habitat used by rearing juvenile and holding adult salmonids. In particular, the carrying capacity of streams for older age classes of juvenile salmonids may be reduced as these life stages typically prefer deeper pool habitats (Bisson et al. 1988). Reduced LWD may also limit formation of backwater pools and the complex stream margin habitat used by emergent fry (McCain 1992). Stream channels tend to become simpler and less stable after the removal of LWD, and the structural complexity that provides substrate diversity, low-velocity refugia during high flows, and cover from predation is also lost (McMahon and Reeves 1989). Other impacts of reduced in-channel LWD may include reduced retention and sorting of spawning gravels and fine sediment, and reduced retention of fine and coarse organic materials important for maintaining macroinvertebrate communities used as food by juvenile salmonids, as well as reduced retention of salmonid carcasses that contribute important nutrients to the stream and food for juvenile salmonids.

Instream Flows

Of the factors known to influence anadromous salmonids' ascent of streams, flow connected with storm events is one of the most important. Once the fish immigrate into a stream, there has to be enough water for them to pass over barriers in order for the fish to reach their spawning areas. Streamflow regulates the amount of spawning area available; as flows increase (up to a point), more gravel is covered and becomes suitable for spawning. During egg incubation and fry emergence, adequate streamflows are necessary to cover the eggs, provide oxygen, and wash away metabolic waste. During rearing, the amount of food and physical habitat available is related to streamflow. Streamflow is also an important factor during the parr-smolt transformation and emigration of anadromous fishes.

Water depth is important to salmonids, particularly during the immigration and spawning season. Preferred depths have been determined by measuring the water depth over active redds (Shapovolov and Taft 1954, Thompson 1972, Hooper 1973, Smith 1973). Cover is an important factor in a fish's life. Cover provides protection from predators (e.g., birds, mammals, other fishes), as well as, sometimes, reduced water temperatures during hot days. Cover can be provided by overhanging vegetation, undercut banks, submerged rocks and vegetation, submerged objects such as logs, floating debris, and even turbulence and depth, sometimes. Young salmonids prefer habitats characterized by abundant cover. The nearness of cover to a spawning area may be a factor in the actual selection of spawning sites; some salmonids select areas adjacent to undercut banks and overhanging vegetation (Moyle 1976, Reiser and Bjornn 1979). Although, it is generally accepted that salmonids require cover, there is a large body of evidence

demonstrating that abundant shade may result in the reduction in density of both salmonids and invertebrates, the food sources of salmonids. Many investigators have found that heavily-shaded streams were less productive than open-canopied streams (Murphy and Hall 1981, Bisson and Sedell 1984); however, greater productivity does not guarantee healthier salmonid populations. In summary, site-specific studies should be conducted on physical habitat requirements, as part of the watershed analysis.

Biological Interactions

In determining the impacts of a proposed THP, there are a myriad of complex ecological interactions within the freshwater aquatic environment that can affect salmonids and that we have not discussed. For example, the introduction of non-native fish species such as bass and brown trout have certainly had a negative impact on salmonid populations in some areas. Predation by birds, mammals, and piscivorous fishes also can affect salmonid populations. In addition, disease, including pathogens introduced by hatchery stocks, may be an important factor in some streams. As these ecological interactions are important in determining the impacts of timber harvesting, they should be addressed as part of the watershed analysis approach.

Ocean Impacts

Ocean conditions affect survival and productivity of anadromous salmonid stocks during their life cycle. Similar to the freshwater environment, unfavorable ocean and estuarine conditions act as limiting factors to the successful completion of the anadromous salmonid's life cycle. Recent studies indicated that fluctuations in climate (e.g., El Niño and other global weather phenomena) were the ultimate source of widespread, regionally coherent changes in marine survival rates for many anadromous salmonids (Lawson 1993, Beamish and Bouillon 1993, Hare et al. 1999). From 1977 to the early 1990's, ocean conditions generally disfavored West Coast stocks and favored Alaska stocks (Hare et al. 1999). It was postulated that unfavorable ocean conditions were confounding recent management efforts focused on increasing West coast Pacific salmon production. Due to the 10-year climatic cycle apparently affecting productivity in the Pacific Ocean, recovery of at-risk (i.e., threatened and endangered) salmonid stocks may have to await the next reversal of the productivity cycle (Hare et al. 1999). Detailed discussion of the factors that affect salmonids in the ocean was beyond the SRP's assigned purview. However, it is important to be aware of and consider these impacts in the context of the life history of these salmonids when conducting a watershed analysis that will later be used as the foundation for biological considerations for a THP.

Genetic Impacts

Intentional or incidental releases of hatchery-reared fishes into areas inhabited by naturally-reproducing populations potentially threaten the wild populations. The negative impacts of hatchery-bred salmonid stocks on their wild counterparts are well-known. Studies have demonstrated that hatchery stocks exhibited: (1) less of the "fight or flight" reaction associated with more hardy wild strains; (2) inferior swimming performance; (3) low survival rates; (4) low incidence of re-spawning by steelhead; and, (5) low reproductive success. These negative attributes, as well as others, are often passed on genetically to subsequent generations when interbreeding occurs with wild populations. Any, or all, of these characteristics ultimately result in genetic loss at the population level (Miller 1953; Vincent 1960; Reisenbichler and McIntyre 1977; Rich 1979; Chilcote et al. 1986; Leider et al. 1986; Johnsson et al. 1993, 1994). Detailed discussion of the influence of genetics (i.e., hatchery introductions) on productivity of salmonids in timber harvest areas was beyond the SRP's assigned purview. However,

it is important to identify hatchery influences and consider their impacts in the context of the life history and productivity of salmonids in a particular watershed. Therefore, the influence of genetics on salmonids may need to be considered in the watershed analysis.

Review of Agency Biological Approaches

The SRP concluded that the FPRs, as currently written, do not ensure sufficient protection of salmonid habitat nor offer scientifically-based determinations of the potential impacts of THPs on salmonids. The "Coho Salmon Considerations" document (CDF 1997), while providing useful biological information, does not establish a process to evaluate potential impacts on salmonids. In order to protect and, if possible, enhance salmonid habitat and populations in forested areas, the following biologically-related steps may need to be undertaken, with regard to salmonids:

- Determine each life stage requirement needed, on a site-specific basis, to sustain each of the salmonids that inhabit the area to be harvested;
- Determine the conditions that could affect each of the species within the proposed harvested area;
- Identify protective measures that could be used to limit harvesting impacts;
- Either undertake the timber harvesting, using the protective measures or, if the proposed THP would result in one or more significant impacts that could not be mitigated, deny the THP; and,
- Monitor both short- and long-term impacts of the timber harvesting on the salmonids.

Until a scientifically meaningful methodology is designed and implemented, such as the watershed analysis approach, which can address "cause-and-effect" type interactions, it may not be possible to identify completely all impacts of THPs on anadromous salmonids. Following is an analysis of the existing biological approaches used by the agencies during the THP process.

NMFS Aquatic Properly Functioning Condition Matrix

The Aquatic Properly Functioning Condition Matrix (NMFS and USFWS 1997) was meant to be a work in progress that would be able to respond to information not previously considered.

An underlying concern with the Matrix is that one cannot determine what is "properly functioning" without conducting a watershed analysis of the area in which the timber harvesting is to occur. In addition, there needs to be an emphasis on collecting and analyzing site-specific data, rather than emphasizing the use of information from the scientific literature. Currently, there are enormous gaps in the type of scientific information needed to determine the "properly functioning condition" of a system, with regard to salmonids. For example, site-specific studies are needed to determine if and how much in-channel LWD is needed. Similarly, there has been a wide variation in the amount of sediment or silt that causes damage to salmonids and other aquatic organisms. The Matrix was intended as a work in progress and does recommend site-specific studies for many of the parameters. However, in practice, such site-specific studies rarely occur. Data meant to be used for guidance may, due to the lack of suitable alternatives, be used as minimum standards. Furthermore, the water temperature issue is not being addressed in a manner that is physiologically meaningful in the field. The Maximum Weekly Average Temperature (MWAT) method (Appendix A of the Matrix) needs to be replaced with a site-specific bioenergetics approach that includes an evaluation of food availability.

In an attempt to advance beyond the search for a "magic number" in establishing theoretical temperature tolerance limits, Brungs and Jones (1977) developed the concept of the MWAT. The MWAT is defined as follows:

$$\text{MWAT for growth} = \frac{\text{Optimum temperature}}{3} + \frac{\text{Ultimate Upper Incipient Lethal Temperature} + \text{Optimum Temperature}}{3}$$

The objective of the MWAT used in the Matrix was to provide thermal thresholds that were safe, as well as productive, for each life stage of the salmonid species. MWAT, however, as it is being used in the THP process, does not achieve that objective for the following reasons:

- Recent studies suggest that the MWAT method is not a validated hypothesis;
- The MWAT method used in the THP process does not incorporate the appropriate site-specific physiological approach that is needed to determine optimal thermal ranges and impacts; and,
- The "optimum" temperatures used for salmonids in the THP process do not appear to be based on <u>all</u> thermal studies reported in the scientific literature, but appear to be derived *from a few selected studies.*

The MWAT method, or hypothesis, has never been rigorously validated in the field. In fact, in recent years there have been an increasing number of field studies that invalidate the results of the MWAT. Two examples illustrate the importance of: (1) using site-specific data, rather than relying on a few laboratory studies; (2) using all information reported in the scientific literature, rather then selecting one or two studies upon which to base one's conclusions regarding thermal optimal ranges; and, (3) collecting the appropriate type of information.

The first example concerns the optimal temperature range for coho salmon. Brungs and Jones (1977) used 5-17°C as an optimal thermal range, depending on the season, with 15°C being optimal in laboratory fish fed maximal rations. The upper lethal temperatures they used ranged from 23-25°C. If one uses these optimal and lethal thermal ranges in the MWAT equation, the MWAT ranges between 11.0-19.7°C for coho salmon. The NMFS (1997) Matrix uses an "optimum" temperature of 13.2°C and a range of upper lethal temperatures of between 24-25.8°C for late summer rearing coho salmon. If one uses these optimal and lethal ranges in the MWAT equation, the MWAT ranges between 16.8-17.4°C. However, after the 1980 Mt. St. Helens eruption, juvenile coho salmon were collected in streams where water temperatures exceeded 20°C during much of the summer months. Despite the apparently unfavorable environment, both growth and survival rates were higher during these months than during those times when water temperatures were considered to be unstressful (i.e., below 15.6°C. And, the long-term (i.e., 3-6 years posteruption) consequences of the elevated water temperatures demonstrated a high productivity (Bisson et al. 1985). This example illustrates the importance of site-specific long-term growth-temperature (i.e., bionenergetics) studies. It also illustrates the fact that every system is unique, with regard to it food availability and salmonids' physiological response to water temperature.

A second example concerns the optimal temperature range for rearing rainbow trout and steelhead. Brungs and Jones (1977) used 17-19°C as an optimal thermal range and an upper lethal temperature of 27°C. If one uses these optimal and lethal thermal ranges in the MWAT equation, the MWAT ranges between 20.3-21.6°C. However, in Pescadero Lagoon south of San Francisco, juvenile steelhead grew quickly in water temperatures well above 21°C. The reason that the steelhead were

able to grow well at temperatures that would be considered stressful from the results of laboratory studies was because of an abundant food source, primarily *Neomysis* shrimp (Smith 1990). Thus, if one were to use the MWAT equation in the Matrix for the Pescadero fish with the intent of minimizing thermal stress on salmonids, one would conclude that the temperature in that lagoon should never exceed 21.6°C, yet site-specific studies prove otherwise.

Although, in the examples above, the emphasis was on the upper optimal thermal thresholds, the same type of field validation is warranted for the lower optimal thermal thresholds, as well; low water temperatures can impede the growth process. The point is that using "optimal" and "lethal" temperatures based on laboratory studies and inserting them into the MWAT equation often will not provide a realistic outcome, in terms of both thermal requirements and thermal impacts, as a result of a land use such as timber harvesting. In fact, some streams during the summer will always exceed the MWAT calculations for salmonids, yet one or more species may be present in abundance. In other instances, higher water temperatures probably either preclude the existence of, or result in stress to, salmonids. Thus, to determine the optimal range for salmonids, one must include factors not currently being assessed in the THP process. These other factors include the availability of food and food eaten, whether or not there are cool water refugia for the fish to reside in and digest their food, and site-specific thermal studies conducted during each life stage. Only then can one determine whether or not there will be thermal impacts as a result of timber harvesting and, if so, develop measures to mitigate for those impacts.

Coho Salmon Considerations Document

To assist foresters on how to address the take of coho salmon, CDF issued the document "Coho Salmon (*Oncorhynchus kisutch*) Considerations for Timber Harvests Under the California Forest Practice Rules" (CDF 1997). In the cover letter, dated April 29, 1997, to "All Registered Professional Foresters" from Craig Anthony, Deputy Director, the following statement was made:

"The enclosed document is intended to provide some biological background regarding coho salmon and its habitat, provide guidance to RPFs, landowners and CDF in their assessment of possible adverse impacts to salmon habitat and to describe potential conservation measures for timber operations within the Central California Coast and Trans-boundary ESUs. The two ESUs encompass all coastal watersheds that contain coho salmon from the San Lorenzo River to the Oregon border. Timber operations south of San Francisco Bay are still under the provisions of the 2090 Agreement between DFG and CDF."

The FPRs require that impacts to species sensitive to the effects of timber operations must be mitigated to a level of insignificance.

Although the "Coho Salmon Considerations" document provides general background information on the various factors (e.g., water temperature, dissolved oxygen, turbidity, LWD) that affect salmonids, it does not provide specific measures that would result in the avoidance of take of coho salmon from direct, indirect, and cumulative effects. With regard to water temperatures, although the document correctly identifies some factors (e.g., thermal refugia) that can affect coho salmon, it does not summarize all relevant thermal studies. In addition, it identifies preferred water temperatures as between 12-14 °C, which may or may not be valid, depending upon the system. The section on ranges of MWAT values may be misleading, as the MWAT, as it is currently being used in the THP process, is not an appropriate tool for determining either thermal requirements or impacts on coho salmon. With regard to DO, turbidity, food sources, space, LWD, and out-migration, this document summarizes some results of studies that have been conducted in these areas.

In the "Coho Salmon Considerations" document, it states that, CDF expects the RPF to assess how their plan could affect coho salmon and their habitat and include in the plan appropriate measures to reduce any identified impacts to less than significant. It is the consensus of the SRP that the RPF would not be able to do this, without the data and synthesis provided by a watershed analysis.

Limiting Factors Analysis

To date, there is no standardized "limiting factors analysis" method used by either the agencies or industrial biologists during the THP process. Although, some of the environmental factors used in a limiting factors analysis (e.g., water temperature thresholds, physical habitat characteristics) are used in the Aquatic Properly Functioning Condition Matrix (NMFS and USFWS 1997), they are not used in the context of a limiting factors analysis. Thus, one needs a limiting factors analysis before one can assess whether or not a proposed THP could have impacts on salmonids.

IV FINDINGS AND PROPOSED STRATEGY

INTRODUCTION

The SRP has concluded that if salmon and steelhead populations are to be maintained and restored in a manner that does not place undue burdens on forest landowners and local communities, substantial modifications to the timber harvest planning process are necessary. While the approach we are advocating may depart from the current system in some respects, it has the potential to be well received by resources agencies, forest landowners and the environmental community, as it is based on ideas that are currently being discussed and promoted in many different forums and are rapidly gaining wide acceptance.

The SRP believes that healthy salmonid populations can be completely compatible with a robust timber industry. The SRP has found, however, that the current THP process is not conducive to finding the appropriate balance between salmonid habitat protection measures and economic concerns. Some THPs may thus contain costly but scientifically unwarranted measures for protecting salmonids while other THPs may be woefully inadequate to protect salmonids. In this section, the SRP discusses what it perceives to be the major problems with the current forest practice rules and the THP planning and implementation process and our proposed approach to addressing them.

RESPONSES TO THE MANDATES GIVEN TO THE SCIENTIFIC REVIEW PANEL

Mandate A: Define properly functioning habitat conditions which adequately conserve anadromous salmonids.

It is the SRP's understanding that the concept of "properly functioning conditions" is meant to represent conditions in a managed system as opposed to pristine conditions which are referred to as "fully functioning." The properly functioning conditions concept acknowledges that a managed system will not likely have the same habitat quality and salmonid population characteristics (e.g., size, stability) as a pristine stream, but that a managed system can provide "sufficiently" good habitat to maintain a "sufficiently" large "healthy" population (i.e., a "properly functioning population"). A key obstacle to applying this concept is the lack of guidance or agreement on what constitutes a properly functioning population. For example, is a properly functioning population, on average, 99% or 50% as large as a population that existed under pristine conditions? (Admittedly, focusing on average population size alone oversimplifies the issue.)

The SRP believes that the concept of properly functioning conditions is useful and appropriate. But to differentiate properly functioning from pristine conditions would assume some consensus as to the characteristics of a "properly functioning" population. Even with such guidance, the SRP believes properly functioning conditions would sometimes vary significantly between watersheds and between stream reaches within a watershed. One of the primary goals of a watershed analysis would be to define properly functioning conditions for various watersheds and types of channels and use them to evaluate trends in current channel conditions. We have not, therefore, attempted to define properly functioning conditions, but rather lay out a watershed analysis framework for determining them.

Mandate B: Jointly review the adequacy of the California Forest Practice Rules, including implementation and enforcement, to achieve properly functioning habitat conditions.

The SRP believes that the current FPRs, particularly in their treatment of assessing cumulative effects, are not adequate to ensure achievement of properly functioning habitat conditions for salmonids (although in some cases the rules may be currently achieving properly functioning conditions). The majority of the report addresses this mandate and the specific questions addressed to the SRP (Appendix B).

Major Concerns

Concerns with Inadequate Cumulative Effects Assessment

The words "cumulative effects" may be interpreted in many ways and are not necessarily restricted to the CEQA definition[1]. The SRP has interpreted cumulative effects to mean the effect of all past and ongoing watershed activities that are affecting or have affected the quantity and quality of salmonid habitat in a manner that may influence salmonid population size, stability, and resiliency to disturbance (see Watershed Analysis and Cumulative Effects section for a more complete discussion). To be effective in protecting salmonid populations, a cumulative effects assessment should determine what factors are limiting to the populations of concern in a watershed. Once it is established which factors are limiting, appropriate timber harvest prescriptions can be developed to prevent additional cumulative effects and mitigate cumulative effects of previous watershed activities adversely affecting salmonid habitat. The SRP found that the cumulative effects assessment as currently required under the FPRs does not provide insightful information about which watershed activities may be preventing the recovery of salmonid populations, nor does it provide a decision-making process for addressing such activities on a watershed scale. The SRP believes that this is the primary obstacle to protecting anadromous salmonids under the current system regulating forest practices. Without such an assessment methodology, the only recourse to ensure the protection of salmonids is to have very conservative non-site-specific prescriptions that may entail severe economic consequences relative to current rules. The section "Recommendations Regarding Institution of a Watershed Analysis Approach to Address Cumulative Effects and Guide Forest Management" gives further details on SRP concerns and recommendations on this subject.

1. "'Cumulative impacts' are defined as 'two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts' [CEQA Guidelines Sec. 15355]. '[I]ndividual effects may be changes resulting from a single project or a number of separate projects' [CEQA Guidelines Sec. 15355, subd. (a)]. 'The cumulative impacts from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time' [CEQA Guidelines Sec. 15355, subd. (b)]" (Remy et al. 1996).

Concerns with Specific Rules

The SRP believes that without a watershed-analysis-based cumulative effects assessment it may be difficult, if not impossible, to judge the adequacy of particular forest practice rules for protecting salmonid populations for any given THP. The same rule may in some cases be completely inadequate, while in others overly restrictive. The SRP found some rules generally inadequate; primary examples include rules requiring retention of only two 16-in DBH trees per acre be left along Class I and II streams. Recommended changes to these rules are discussed under "Recommendations Regarding Specific Forest Practice Rules" in the following sections:

1. Watercourse and Lake Protection Zones (WLPZs)
2. Large Woody Debris (LWD) Recruitment
3. Geological Concerns
4. Road Construction and Maintenance
5. Watercourse Crossing Structures
6. Site Preparation
7. Winter Operations
8. Harvest Limitations

Concerns with THP process

Potential Breakdown Between Planning and Implementation

A well-developed THP based on a clear understanding of what is needed to protect salmonids may be of limited value without proper implementation. The SRP has concluded that the current system is conducive to a breakdown between the plan, public review, and its implementation. Improving actual implementation of THPs should therefore be a critical step in restoring salmonid populations.

Not Enough Early Involvement By Specialists In THP Preparation

Currently, THPs are usually prepared by an RPF and submitted to CDF without prior substantive input from the scientific staff of state and federal resources agencies (e.g., DF&G, RWQCBs, DMG, CDF). This is often a consequence of state agency budget limitations. The preharvest inspection is often the first time that agency scientists visit the area covered by the THP. The SRP believes that discussions between agency scientists and the RPF at the beginning of the THP planning process would result in substantially better THPs and reduce the number of revisions needed.

Uneven Allocation of Effort Committed to THP Paperwork vs. Field Review and Inspections

The SRP believes that excessive time and money are devoted to RPFs writing and agencies reviewing and revising long THPs that often do little more than restate forest practice rules or attempt to protect the THP from procedural challenges. This ultimately limits the resources devoted to mitigation and supervision of THP implementation.

Recommendations concerning the THP process are included under "Recommendations Regarding the Timber Harvesting Plan Process" in the following sections:

9. Timber Harvesting Plan (THP) Preparation
10. Timber Harvesting Plan (THP) Review and Approval
11. Involvement of Other Resource Professionals in THP Review and Implementation
12. Involvement of RPF in THP Implementation

Other Concerns

Additional recommendations included under "Other Panel Recommendations" in the following sections:

13. Rule Organization
14. Additional Research Needs
15. Social and Economic Impacts

Proposed Strategy

The SRP believes there are two main approaches that could be used to modify FPRs for ensuring protection of salmonid habitat: (1) develop highly restrictive rules to be applied universally regardless of conditions, or (2) use watershed analysis to develop tailored, cost-effective prescriptions based on a clear understanding of what is needed in a particular watershed. The SRP believes that the second alternative is far preferable both from the perspective of salmonid restoration and for minimizing economic impacts. The SRP therefore did not try to develop more restrictive rules that would be needed in the absence of instituting a watershed analysis program.

Institute a Watershed Analysis Approach

To address the major concerns outlined in the previous section, the SRP believes that there should be a major restructuring of how the state approaches timber harvest regulation, and in particular, how it addresses past and ongoing cumulative effects to salmonid habitat. With regard to the SRP's mandate concerning steelhead, we believe that the state should sponsor and conduct watershed analysis in all watersheds that are located in the Northern California and Klamath Mountain Province steelhead ESUs. Watershed analysis may likely be necessary throughout California to protect sensitive aquatic and riparian species from habitat degradation incurred during timber harvesting; however, the SRP did not specifically evaluate the need for watershed analysis outside the MOA-mandated area.

Goals of the SRP's proposed watershed analysis are to: (1) identify for individual watersheds the extent to which habitat alteration by past or ongoing watershed activities has adversely affected the health of salmon and steelhead populations (the term "health" refers to a population's size, stability, and resilience to disturbance), and (2) determine what steps are necessary to maintain adequate salmonid habitat or restore degraded habitat (i.e., achieve properly functioning conditions). One goal of such a watershed analysis is to provide a document that summarizes cumulative effects (past and ongoing) within the watershed in terms of their effects on salmonid population health. Individual THPs to be implemented within the watershed will then incorporate the findings of the watershed analysis as the basis for addressing the potential additional cumulative effects of the proposed THP. The watershed analysis also must recommend specific timber harvest prescriptions, performance targets, and mitigation opportunities for the entire watershed. The THP can then do one of the following: (1) incorporate the prescriptions included in the watershed analysis, (2) demonstrate how it will meet performance targets included in the watershed analysis, (3) describe which mitigation alternative identified in the watershed analysis it will pursue, or (4) adopt some combination of the first three options.

Revise Certain Forest Practice Rules

In the "Recommendations Regarding Specific Forest Practice Rules" section, the SRP specifically recommends changing the FPRs. The SRP believes that these changes would be adequate to protect salmonid habitat in the near-term before watershed analysis is conducted, with one significant exception discussed below. However, the SRP considers these rules minimum standards that need to be combined with watershed-specific prescriptions and mitigation measures in order to achieve properly functioning conditions for salmonid habitat. In the absence of the watershed analysis program, these rules may not, and in some cases will not, be expected to adequately protect salmonid habitat. If a watershed analysis program is not instituted, therefore, the rules would need to be revisited. In the near-term, the agencies and the Board of Forestry must address the issue of potential watershed impacts that may result from intensive harvesting within a watershed. The SRP has not resolved this issue, and believes watershed

impacts should be reviewed by a panel of specialists (see "Harvesting Limitations").

Modify THP Preparation Process

The RPF will consult with resources agency staffs (CDF, DMG, DF&G, RWQCB) during preparation of the THP, including whenever possible a field reconnaissance of the area in which the proposed action will take place. The RPF and the agency staff will discuss the cumulative impacts assessment contained in the watershed analysis and the most appropriate ways of addressing its conclusions during plan preparation. The THP will be much shorter than is currently the norm and will consist primarily of a map showing where various activities will take place, a description of how performance targets will be reached, or what mitigation will be undertaken. The RPF will sign the THP accepting oversight responsibility to work with the LTO ensuring that all forest practice rules will be followed, including the prescriptions or performance standards of the watershed analysis cumulative effects report. The SRP believes that a shorter THP could result in significant cost savings in THP preparation that could be applied toward better implementation and mitigation.

Increase RPF's Responsibility for THP Implementation

To reduce the effort allocated to producing individual THPs, changes must be made in the planning process to ensure that THPs are properly implemented. The RPF will be responsible for THP preparation and submittal as is currently the case, but an RPF will also be responsible for working with the LTO and landowner to ensure proper implementation of the THP. This so-called cradle-to-the-grave responsibility is necessary to ensure that THPs are not misunderstood by licensed timber operators (LTOs). The FPRs and the timber harvest planning process in general are built on the foundation of the RPF's professional responsibility to manage and protect natural resources (e.g., timber, fish, wildlife, water quality and supply). Extending the RPF's responsibility to include THP implementation oversight would be the most effective way to ensure that the RPF's vision will be fully realized. The SRP believes that a necessary condition for establishing the short THP described above is including oversight of plan implementation as one of the RPF's responsibilities. This would be verified in the completion report prepared by the RPF. As is now the case, the RPFs that do not follow the rules would be subject to disciplinary action. While there are many excellent LTOs, RPF oversight (as is currently done in Santa Cruz County) is the best way to achieve proper THP implementation. This is especially true with the added complexity of the rules to protect salmonids.

Begin a Directed Science Program (Monitoring and Adaptive Management)

The SRP believes that the state should coordinate a directed science program that uses focused monitoring to evaluate the effectiveness of specific prescriptions and validate the overall approach to protecting salmonids based on watershed analysis and the revised FPRs described in this report. This program of effectiveness and validation monitoring needs to be focused on testing key hypotheses, particularly those with both a high degree of scientific uncertainty and a high risk of adverse impacts (including both environmental impacts to salmonids or other aquatic resources and economic impacts on landowners) if they are incorrect. Directed research will also be needed to help resolve critical uncertainties in our understanding of how forest practices may affect salmonids and their habitat. Some examples of such research needs are provided under Recommendation 14 in Section V. This program of monitoring and directed research should be conducted within an adaptive management framework, which should include a clear decision-making process to ensure

that the results of such research and monitoring provide timely feedback to land managers and resources agencies.

V RECOMMENDATIONS

RECOMMENDATIONS REGARDING INSTITUTION OF A WATERSHED ANALYSIS APPROACH TO ADDRESS CUMULATIVE EFFECTS AND GUIDE FOREST MANAGEMENT

Watershed Analysis and Cumulative Effects

The SRP believes watershed analysis is the best tool for (1) evaluating existing and potential cumulative watershed effects (CWEs), and (2) identifying means of avoiding, minimizing, or mitigating adverse CWEs on salmonid populations and their habitats. This section provides background on cumulative effects, and existing watershed analysis approaches. It then outlines a specific watershed analysis approach that the SRP believes is needed for effective protection and restoration of anadromous salmonids in the geographic area covered by the MOA.

It is important to define what one means by watershed analysis and to state its primary objectives. The SRP intends watershed analysis to mean something quite specific—*a watershed analysis should establish the linkages between past and ongoing land management activities, geomorphic processes, aquatic and terrestrial habitat, and salmonid population responses* (Figure 2). The emphasis, at least initially, should be on assessing the linkages between changes in stream and estuarine habitat and salmonid population responses. The watershed analysis should result in some understanding of how to improve timber management practices in ways that will actually benefit salmonid populations.

Background on Cumulative Effects

The potential importance of cumulative silvicultural effects in forested watersheds has been recognized for some time (Coats and Miller 1981). Our understanding of cumulative effects has increased in recent years, but there is still debate about the best methods to identify and predict signficant cumulative adverse impacts, the use of regulation to reverse adverse cumulative effects, and approaches for avoiding adverse cumulative effects (Reid 1998).

Cumulative effects result from the combined effect of multiple activities at different locations, sequential activities over time at the same site, or a combination of the two (Reid 1993, 1998; MacDonald *in press*). The idea of cumulative watershed effects is based on a simple concept. A single action of limited size, such as a 20-acre clearcut in the middle of a mature forest in a large watershed, is unlikely to have a measurable effect on, say, downstream peak flow or water quality. However, as the proportion of the watershed subjected to clearcutting during a given time period increases, the likelihood of detectable changes increases. At some point, the amount of change will be sufficient to be both detectable and to have substantial adverse impacts on resources of concern in the watershed.

The concept of cumulative effects implies a persistence of impacts through time, often coupled with a transmittal mechanism through space (MacDonald *in press*). Figure 3 illustrates the possible combinations of activities over space or time that can lead to a cumulative effect; Figure 4 illustrates the conceptual process for predicting downstream cumulative watershed effects that forms the foundation for the watershed analysis approach (described below).

Although basic in concept, assessment of cumulative effects is often problematic in practice because of the following factors: (1) the large number of potentially affected resources; (2) the numerous mechanisms (or pathways) by which resources can be affected; (3) the potential for the combination of different land use activities to produce effects that would not have necessarily

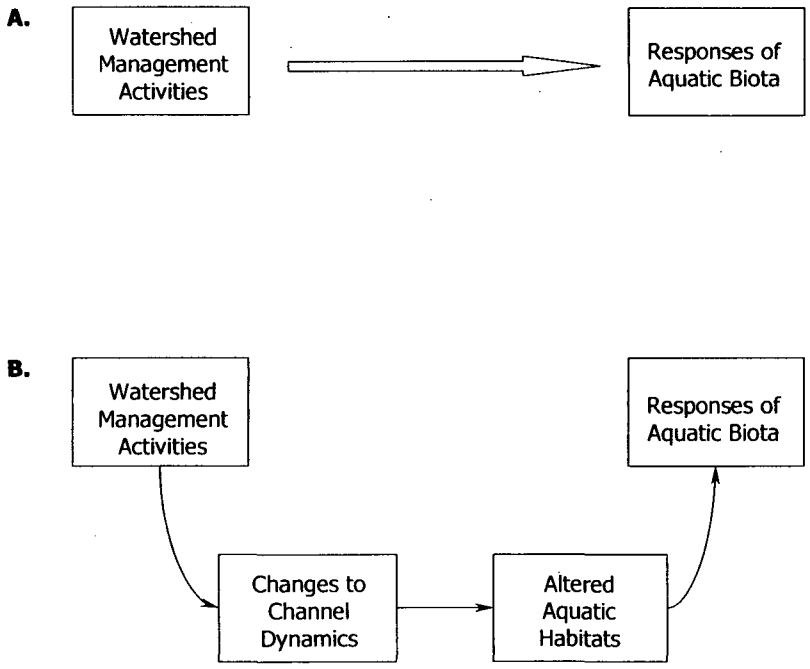


Figure 2 Conceptual framework for a watershed analysis reference model. (A) The primary objective of the reference model is to predict the effects of watershed management activities on aquatic biota of interest (e.g., salmonids). (B) This is achieved by linking the effects of management activities to changes in channel dynamics, which cause alterations in aquatic habitat conditions, resulting in some response by aquatic organisms (for example, a decrease or increase in salmonid production).

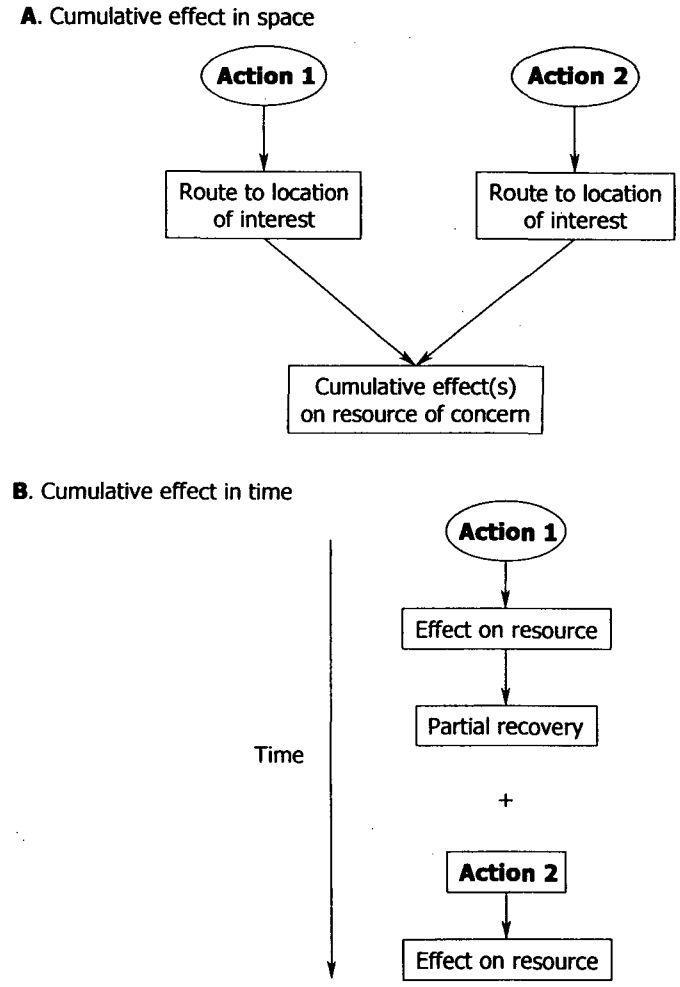


Figure 3 Possible combinations of management actions over space (A) and time (B) that will lead to a cumulative effect (from MacDonald *in press*).

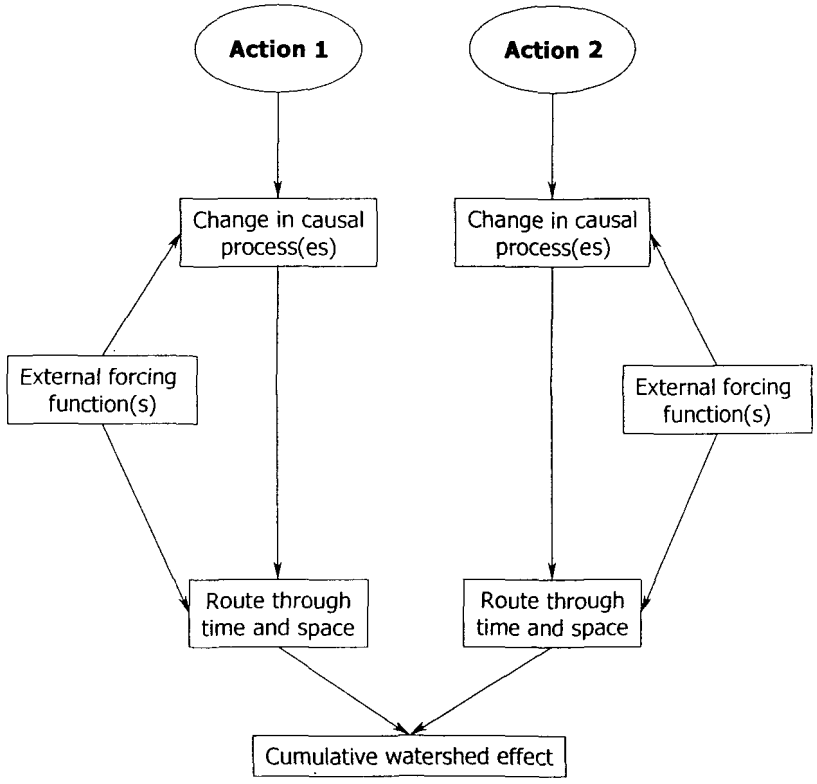


Figure 4 Conceptual framework for predicting an off-site (downstream) cumulative watershed effect (from MacDonald *in press*).

resulted from each individual action; (4) the difficulty of defining recovery rates; (5) uncertainty over the appropriate spatial and temporal scales for the assessment; and (6) the uncertainty of future events (both management and natural events) (Berg et al. 1996, MacDonald *in press*).

A number of recent reviews provide detailed descriptions of cumulative effects, inherent difficulties in assessing and avoiding cumulative effects, and various approaches that have been proposed to assess them (NCASI 1992; Reid 1993, 1998; Beschta et al. 1995; Berg et al. 1996; Bunte and MacDonald 1998; MacDonald *in press*). The three most recent studies (Berg et al. 1996, Reid 1998, MacDonald *in press*) reviewed existing approaches to addressing cumulative watershed effects and came to the following similar conclusions:

- cumulative effects can be important and must be considered in environmental assessment and management planning;
- cumulative effects analysis should focus on issues and resources of greatest concern (e.g., resources at risk);
- cumulative effects analysis should identify key cause-and-effect processes;
- a tiered approach is likely the most efficient and cost-effective means of addressing cumulative effects; such an approach starts with a coarse screening of potential issues at broad spatial and temporal scales and then focuses more detailed analysis on issues of greatest concern (i.e., management effects that are most likely to occur and that would result in significant adverse impacts on resources of concern);
- because of time lags in effects and uncertainty in our ability to predict cumulative effects, the most effective means for avoiding cumulative effects is probably a proactive approach characterized by minimizing on-site effects through use of site-specific prescriptions (which, in some cases, might be coupled with the use of an index of activity or disturbance to set upper thresholds on the amount of activity allowed for a given area and time period), coupled with a well-defined process for adaptive learning through the use of focused monitoring to test the effectiveness of prescriptions and validate the key assumptions underlying the cumulative effects assessment procedures.

A National Research Council (NRC 1995) study was commissioned to assess the condition of anadromous salmonid stocks in the Pacific Northwest. The NRC's scientific panel evaluated the causes of decline, analyzed options for management, and concluded that: "There is an increasing need to understand cumulative effects not only on a site-specific basis, but also across entire watersheds. Only through a broad geographic perspective can the unique qualities of each watershed and their spatial and temporal effects on aquatic habitats be effectively understood." Clearly, the recent scientific literature indicates a consensus view that cumulative effects on salmonids and other aquatic resources are often best addressed in a watershed context. Berg et al. (1996) concluded that watershed analysis, although not perfect in its current form, was likely the best available tool for addressing cumulative effects on aquatic resources. Reid (1998) also concluded that future methods for assessing cumulative effects would likely be based on watershed analysis strategies.

Why the Current Cumulative Effects Process is Inadequate

The current guidance in the FPRs (Technical Rule Addendum No. 2) does not lead to cumulative effects assessments in THPs that provide useful information on how to alter watershed activities that may be impeding or preventing the recovery of salmonid populations. Most THP cumulative effects assessments address site-specific conditions in the THP area. However, the assessment of the larger CWE assessment area is usually just a paper exercise based only on existing information

(Technical Rule Addendum No. 2 states: "The RPF preparing a THP shall conduct an assessment based on information that is reasonably available before the submission of the THP") and avoids collection of new field data (Technical Rule Addendum No. 2 states: "No actual measurements are intended"). These analyses focus mainly on the plan area with very limited reference to the larger assessment area (which is often a single planning watershed with no reference to the larger river basin). These analyses qualitatively describe previously known problems, and conclude that there are no significant cumulative effects associated with the proposed THP. The Little Hoover Report (1994) concluded that the existing THP process had "proven less than effective in protecting the environment" and that this was, in part, because the "process looks at potential damage on a site-by-site basis rather than across entire ecosystems, making it difficult to assess cumulative impacts over time and throughout watersheds."

Some of the practical problems with the current process that were identified during the SRP review of the THP process and constituency group interviews are described below:

- Full disclosure of watershed conditions (e.g., riparian conditions, in-channel LWD levels and recruitment potential, channel habitat conditions, road systems, mass movement) are rare. In particular, quantitative information, such as road density, landslide density, or sediment yield, is rarely presented.
- Water temperature assessments often lack data or meaningful analysis of potential on-site impacts, let alone downstream cumulative impacts.
- Analysis of past activities is often limited to a simple list of the THPs that have occurred in the assessment area in the past 10 years, with little or no reference to potential continuing legacy effects (i.e., past significant effects that may be continuing to impact salmonids and their habitat).
- Analysis of other current and reasonably foreseeable activities in the watershed assessment area, especially non-forestry activities, is typically cursory.

In summary, the "checklist approach" and accompanying narrative to cumulative effects assessment specified in the FPRs have been found adequate to meet the procedural requirements of CEQA (see the 1993 decision: *East Bay Municipal Utility District v. California Department of Forestry and Fire Protection*). However, the existing approach has failed in some circumstances to adequately protect salmonids and other aquatic resources in watersheds in the Northern California and Klamath Mountains Province steelhead ESUs. One particular problem is that ownership patterns in many watersheds make it difficult for any single landowner to have access to all of the relevant data. This is especially true for smaller landowners. The SRP, therefore, feels that it should be the role of the state to examine CWEs at the basin level. The CWE analysis for an individual THP would then "tier" off of this basin-level assessment.

Background on Watershed Analysis

The concept of watershed analysis arose from the need to improve our ability to predict and then prevent or minimize cumulative impacts on aquatic resources, including salmonids (see Montgomery et al. 1995, Berg et al. 1996, and Reid 1998). Efforts initiated in the 1980s by a consortium of various organizations involved in the Washington State Timber/Fish/Wildlife Agreement led to the development of the Washington Watershed Analysis (WWA) approach (see Berg et al. 1996 and Montgomery et al. 1995). It was first published in 1992 and continues to evolve through feedback from participants (WFPB 1992, 1997). The WWA approach describes detailed methods for evaluating processes such as landsliding and road surface erosion. The method defines areas of sensitivity or hazard (such as mass wasting hazard areas or riparian areas) within each watershed and then evaluates the vulnerability of resources of concern (specifically, fish habitat, water quality,

and public works) to adverse impacts associated with timber harvesting and other forest management activities. The approach includes a specific and detailed policy framework that lays out the steps, operating rules, key links, and decision requirements for the assessment teams, which are composed of scientists and managers. The approach does not, however, require evaluation of the potential effects of future activities in the watershed and does not specifically evaluate the cumulative effects that might result from implementation of the prescribed practices. One of its key assumptions is that cumulative effects will not be produced if the prescribed practices are followed (WFPB 1994, 1997; Reid 1998). This assumption needs to be validated through monitoring. A more comprehensive review of the WWA approach and some of its successes and failures to date is provided in Collins and Pess (1997a, 1997b).

The other common approach currently in use is the Federal Interagency Watershed Analysis (FWA) methodology (REC 1995). It was developed in response to recommendations made by the Forest Ecosystem Management Team (FEMAT 1993) on implementation of an ecosystem management approach to managing federal lands within the range of the northern spotted owl. The FWA is a more flexible information gathering process than the WWA. It is designed to interpret the structure, composition, and function of ecosystems within a given watershed. It differs from the WWA in that it explicitly is not a decision process; formal management decisions (which must follow the NEPA process) are made at the smaller site-specific scale (e.g., timber harvest unit) or the larger landscape-scale (e.g., the forest plan). One of the problems with implementation of the FWA approach is that analyses to date have tended to be prepared as a series of mono-disciplinary chapters, rather than as a true interdisciplinary effort as originally envisioned (Reid 1998).

Both the WWA and FWA approaches emphasize that interdisciplinary analysis is required and that process (i.e., "cause-and-effect") interactions must be evaluated over large areas in order to understand their significance. Neither approach currently provides the quantitative linkages among management actions, changes in watershed processes and channel dynamics, alterations in aquatic habitat conditions, and responses of the aquatic biota (e.g., salmonid populations). Reid (1998) and Berg et al. (1996) both concluded that watershed analysis approaches appeared to be the best available tool for addressing cumulative effects. They also concluded, however, that both approaches were still in need of improvement before they could fulfill the goal of understanding watershed systems well enough to have confidence that land-use activities can be planned to prevent future impacts. Reid (1998) states that evaluation of the results of watershed analyses completed to date should enable us to learn enough to design an improved watershed analysis approach that effectively addresses cumulative effects. The SRP believes that it is possible to develop an improved watershed analysis process, founded on the existing methods of the WWA and FWA approaches, that will allow effective evaluation of cumulative effects and promote protection and recovery of anadromous salmonids.

State-sponsored and Conducted Watershed Analysis Program

The SRP recommends that a watershed analysis program be developed and managed by the state. It is important that it be a multi-disciplinary and multi-agency program involving staff from CDF, DF&G, RWQCB, and Division of Mines and Geology (DMG). The SRP believes that the state should develop a standardized watershed analysis methodology in consultation with NMFS, EPA, timber industry scientists, and academic scientists. The SRP decided not to recommend specific techniques to include in the program (although these could be provided if desired), but rather to specify the type and quality of the products that are needed to ensure that salmonids are protected. Inadequacies inherent in some approaches and the

scientific challenges to implementing a useful watershed analysis program are discussed below.

Having the watershed analyses conducted by the state will help foster consistency and confidence in the resulting work products. In addition, for watersheds containing multiple landowners it would not be practical for individual landowners to conduct watershed-scale analyses when they own only a portion of the watershed. Because a standardized methodology will be developed and published, however, landowners may participate in the analysis or, where landowners own all or most of a watershed, conduct the analysis themselves. All watershed analyses should be peer-reviewed and certified by a panel of state, federal, and timber industry scientists whether or not the state staff or scientists working for the landowners conduct the watershed analysis. This scientific panel would determine if the analysis was properly conducted and whether the conclusions and recommendations are consistent with the guidelines presented in the state watershed analysis manual.

Watershed Analysis Goals and Products

The goal of watershed analysis as the SRP envisions it is not to describe the watershed or to catalog various geomorphic or ecological features. Rather, it should focus specifically on maintaining or restoring healthy salmonid populations while minimizing economic impacts to landowners. The watershed analysis would include the following: (1) a comparison between historical and current freshwater and estuarine salmonid habitat conditions and how watershed activities have resulted in changes to reference conditions, (2) an analysis of the extent to which watershed changes may have affected salmonid populations in the watershed, and (3) specific recommendations for management actions necessary to maintain or restore properly functioning salmonid populations. The key point is that prescriptions for a given watershed coming out of a watershed analysis will be driven by the needs of salmonids in that watershed, i.e., what specifically is needed to maintain properly functioning conditions.

While the SRP is not recommending a particular watershed analysis methodology, it believes that there are certain elements of watershed analysis that are critically important to include in any such assessment. Most watershed analyses that focus on salmonids have modules addressing fish distribution and life history, roads, mass wasting, temperature, etc. However, the following components are sometimes lacking or ill-defined.

1. Historical Disturbances

The watershed analysis should, for each watershed, document the historical and—to the extent possible—the present-day consequences of major natural and anthropogenic disturbances. For example, the historical analysis should account for such factors as occurrence of large floods and splash damming, effects of these disturbances on watershed processes and salmonid habitat conditions, and ongoing effects of these disturbances. Without this information, interpreting the effects of present-day activities and predicting the effects of proposed activities may be difficult or impossible. In some watersheds, addressing the legacy of past disturbances (through active restoration) may be more important for the benefit of salmonids than mitigating the effects of current or proposed activities.

2. Integrated Analysis of Management Activities, Channel Processes, and Salmonid Habitat

The watershed analysis should establish how watershed activities have affected the input of water, sediment, wood, light, and nutrients to a stream. More importantly, it must address how changes in these inputs have altered physical processes and, in turn, how these processes have altered salmonid habitat. An integrated analysis based on changes in channel processes and conditions that documents trends in habitat quality and quantity should be included in a watershed analysis.

3. Limiting Factors Assessment

A biological response model that links changes in habitat conditions in streams and estuaries (and the ocean if data are available) to responses of salmonid populations is critical. This model would assess how changes in habitat over time (i.e., from reference conditions to current conditions) have likely contributed to the decline of salmonids. In addition, the model would identify where habitat improvements would most likely result in benefits to salmonids. This type of analysis makes it possible to determine properly functioning habitat conditions that are necessary for maintaining properly functioning populations (keeping in mind, however, that other factors such as ocean conditions and harvest may also affect such populations).

4. Consideration of All Watershed Activities

The watershed analysis should evaluate all watershed activities, not just forestry. Without knowing the relative impact of different watershed activities (e.g., gravel mining, housing construction or urbanization, agriculture) on salmonid habitat, it would be difficult to develop prescriptions for forestry that would be effective and fair.

5. Multiple Scales

The watershed analysis should be conducted at biologically relevant scales. Prescriptions from the watershed analysis may address local conditions or issues at a much larger scale. For example, in a larger watershed of several hundred square miles, a dearth of LWD in a particular subwatershed (of, say, ten square miles) may limit salmonid production and may need to be addressed through altered management or mitigation. But chronic turbidity downstream in the main channel and the estuary may also be an important limiting factor and may require prescriptions addressing fine sediment inputs, even though fine sediment is not limiting salmonid production in any of the subwatersheds located upstream.

The current cumulative effects analysis requirements do not lead to effective protection for salmonids, thus, it is important that cumulative effects be addressed in the short term in a meaningful manner, even if only to a limited degree. A full watershed analysis might not be completed on all watersheds for several years. The SRP therefore recommends that watershed analysis be developed and implemented in the following two phases: (1) Phase I—analysis of existing information, and (2) Phase II—implementation and scientific research. Phase I would begin in the year 2000, and Phase II would begin later. The approach and products for the proposed Phase I and Phase II are described below.

Phase I

- Identify high priority watersheds for Phase II analysis. The screening procedure for identifying high priority watersheds might include factors such as current status of salmonid populations in a watershed, 303(d) listing, status and timeframe for TMDL development, and use of a Watershed Relative Risk Index (WRRI) approach. The WRRI approach uses a GIS and digital terrain modeling (DTM) process to generate comparisons among watersheds of the estimated potential for adverse cumulative watershed effects related to sediment delivery to stream ecosystems. It combines measures of the potential for hillslope sediment production with the value and vulnerability of downstream beneficial uses (e.g., salmonids and their habitat). CDF is currently exploring various GIS models (such as SHALSTAB) and (in cooperation with USGS) is developing 10-m DEM coverages for the north coast area of California that would greatly facilitate such an effort. This process may also identify legacy sediment problems that could be addressed without the watershed analysis assessment.
- Assign priority rankings to culvert problems based on degree of problem and potential quality and quantity of habitat upstream of the

culvert. This could be performed using a GIS DTM analysis in conjunction with field surveys to create a stream network model to estimate the quality and quantity of habitat upstream of culverts. Replacement of high priority culverts could serve as mitigation for THPs prior to completion of watershed analysis. Coordination with counties, CalTrans, and landowners would be required.

- In the short term (3–5 years), prior to a watershed analysis being conducted, the changes in the rules that are recommended would help reduce the potential for cumulative effects. In some cases, the watershed analysis may conclude that one or more of the rules as adjusted by Section V are inadequate to reverse cumulative effects in a watershed and the recommended prescriptions would be more restrictive.

Phase II

Directed Science Program

Ideally the watershed analysis would establish quantitative relationships for the linkages shown in Figures 2 and 5. These linkages would enable the development of prescriptions or mitigation are necessary to benefit salmonid populations. However, despite continuing advances in the field of watershed science and salmonid ecology, the SRP believes that the current state of knowledge limits the ability to confidently establish these linkages. This is not to say that a watershed analysis methodology would not provide immediately useful information. Rather, the SRP recommends a focused scientific effort to address key scientific uncertainties. Such an effort should greatly increase the confidence in the results of the watershed analysis. The SRP believes that if the linkages shown in Figures 2 and 5 are not established to some degree, then watershed analysis cannot protect salmonids from habitat degradation resulting from timber harvesting. In addition, a focused monitoring and adaptive management program should be coordinated by the state to speed up our learning process and reduce key uncertainties in our understanding of the effects of forest management activities on salmonids.

Relationship Between the Watershed Analysis and the THP

To achieve properly functioning conditions, the results of the watershed analysis will include the following three types of management actions: (1) specific prescriptions, (2) performance targets, and (3) prioritized mitigation opportunities. The results of these management actions would provide the means for individual THPs to address cumulative effects.

Specific Prescriptions

The results of the watershed analysis may offer the opportunity to (1) identify significant cumulative effects in the watershed, and (2) recommend temporally and spatially explicit timber harvesting prescriptions over and above what is required by the FPRs to address these cumulative effects. Alternatively, the watershed analysis may conclude that although significant cumulative impacts from past activities have occurred, the current rules are sufficient to prevent further impacts. In these cases the watershed analysis may suggest mitigation for addressing cumulative effects, such as repairing legacy roads that contribute sediment to stream channels. When a THP falls within the area of a watershed where rule changes have been specified, the RPF may elect to follow the more restrictive rules. The watershed analysis prescriptions would simply be referenced in the THP and it would be the responsibility of the RPF to ensure the rules are properly followed. There would be no penalty for the RPF or landowner if the desired effects (i.e., properly functioning conditions) are not achieved.

Performance Targets

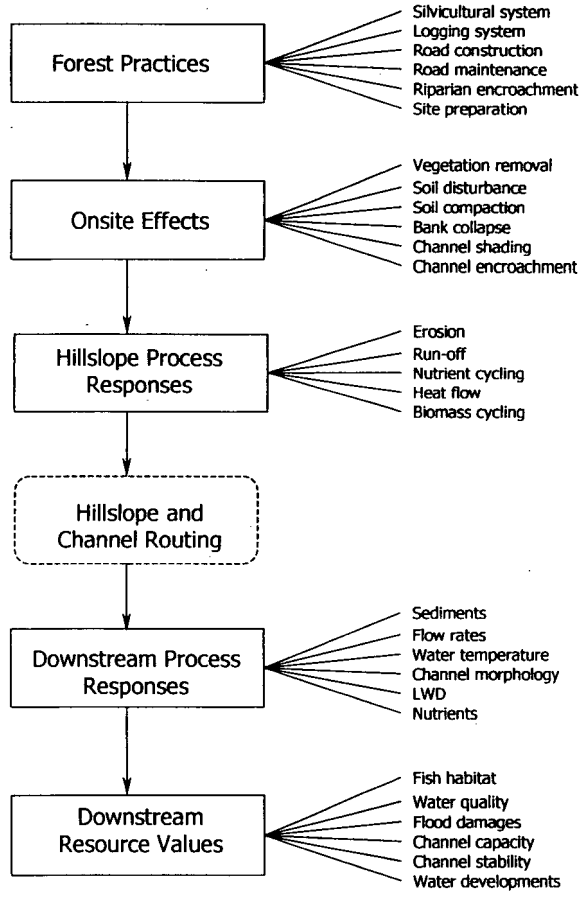


Figure 5 Components linking forest management to water resource values (from NCASI 1992).

Whenever possible, the watershed analysis would present performance targets to achieve properly functioning conditions as an alternative to more restrictive rules. The RPF may propose an alternative strategy to meet the performance standards in the THP. This would allow the RPF the flexibility to adjust timber harvest prescriptions if local conditions allowed for a more efficient means of achieving the same goal. In this situation, the RPF would discuss the alternative with state agency scientists and describe in the THP the alternative measures that were developed. Under this option, the RPF and the landowner would be responsible not only for successful implementation of the measure, but also for achieving the performance targets. This would require that a monitoring component be included in the THP. If the performance targets were not met, the landowner would be required to undertake mitigation actions (in addition to whatever mitigation was originally required under the THP).

Mitigation

The watershed analysis would also include identification of mitigation measures expected to reduce cumulative effects and benefit salmonid populations in the watershed. Mitigation measures would address cumulative effects that were not associated with the current THP (e.g., legacy roads, offsite habitat restoration). The watershed analysis would rank these mitigation measures in terms of their potential benefit to salmonid populations in the watershed. Depending on the severity of existing cumulative effects, the watershed analysis may specify how much mitigation is required in addition to following the prescriptions or meeting the performance targets.

Recommendations Regarding Specific Forest Practice Rules

1. Watercourse and Lake Protection Zones

Background

The stated intent of the WLPZ rules is to ensure the protection of beneficial uses derived from the physical form, water quality and biological characteristics of watercourses and lakes. This rule further states "It is the intent of the Board to restore, enhance, and maintain the productivity of timberlands while providing equal consideration for the beneficial uses of water." (CCR916.) Under 916.2, the measures to protect the beneficial uses of water for each watercourse and lake shall be determined by the following:

> *The quality and beneficial uses of water as specified by the applicable water quality control plan.*
>
> *The restorable uses of water for fisheries as identified by the Department of Fish and Game.*
>
> *The biological needs of the fish and wildlife species provided by the riparian habitat.*
>
> *Sensitive near stream conditions as specified in 14CCR 916.4(a).*

The regulations then separate the state's waters into four classes (I-IV) with Class I being a fish-bearing stream, or a stream that is being used for domestic water supplies. The regulations also have a provision at 916.2(c) that state "When the protective measures contained in 14 CCR 916.5 are not adequate to provide protection to beneficial uses, feasible protective measures shall be developed by the RPF or proposed by the director under the provisions of 14 CCR 916.6. Alternative Watercourse and Lake Protection, and incorporated in the THP when approved by the Director."

The rules require that "During timber operations, the timber operator shall not place, discharge, or dispose of or deposit in such a manner as to permit to pass into the water of this state, any substances or materials, including, but not limited to, soil, silt, bark, slash, sawdust, or petroleum, in quantities deleterious to fish, wildlife, or the quality and beneficial uses of water. All provisions of this article shall be applied in a manner which complies with this standard."

Item (5) of this same section allows either party to request an increase or decrease in the width of a WLPZ, and such a decrease shall not exceed 25% of the standard width. Such changes in zone widths shall be based upon considerations of soil, slope, climatic factors, biological, hydrologic, and geologic values as identified in CCR 916.4(b), and silvicultural methods, yarding systems, road location and site preparation activities. In addition to the overstory canopy requirements, within the WLPZ at least 75% surface cover and undisturbed area shall be retained to act as a filter strip for raindrop energy dissipation, and for wildlife habitat. (CCR 916.4(b)(6).) Also there are no specific provisions for a WLPZ on a Class III watercourse. The rules require a 25-ft wide equipment limitation zone (ELZ) where sideslopes are less than 30%, and a 50-ft wide ELZ where sideslopes are greater than 30%. A Class III watercourse within a logging area where the erosion hazard rating (EHR) is low and the slopes are less than 30%, will not require an ELZ unless proposed by the RPF or required by the Director. Where necessary to protect the beneficial use of water, the RPF shall designate and the Director may require a WLPZ for Class III and IV watercourses or an ELZ for Class IV waters. (CCR 916.4(c)(1).) The width of the WLPZs for Class I and II watercourses is determined by slope classes (less than 30%, 30 to 50%, and greater than 50%) and are presented in Table 1 at CCR 916.5 (see Table 1).

WLPZ widths for Class I watercourses vary from 75 to 150 ft (depending upon slope). However, 50 ft may be subtracted where cable-yarding operations are conducted, resulting in a 100-ft wide WLPZ along Class I watercourses with sideslopes greater than 50%. Class II WLPZs range in width from 50 to 100 ft; however, the 100 ft zone may be reduced to 75 ft where cable yarding operations occur on slopes greater than 50%. For Class I waters, at least 50% of the overstory and 50% of the understory canopy covering the adjacent ground shall be left in a well-distributed, multi-story stand with a species composition similar to that found prior to the start of operations. The residual (post-harvest) canopy shall be composed of at least 25% of the existing overstory conifers. For Class II watercourses, at least 50% of the total canopy covering the ground shall be left in a well-distributed multi-story stand with a species composition similar to that found prior to the start of operations. At least 25% of the residual overstory canopy shall be composed of existing overstory conifers.

Discussion

The width and canopy requirements of the WLPZs have received more discussion than any other section of the FPRs relative to salmonid protection considerations. Following the listing of the coho salmon in 1996, many environmental advocates called for the designation of critical habitat compatible with that of the Northwest Forest Plan (USDA Forest Service and USDI Bureau of Land Management 1994). On federally owned lands, these standards require an approximately 300-ft wide (two site-tree heights) buffer along Class I (fish-bearing) watercourses. Management was not precluded from these 300-ft zones, but requires an intensive assessment of resource implications before occurring within this zone. In the designation of critical habitat, NMFS recognized that the 300-ft buffers identified in the FEMAT report were intended to maintain functions other than riparian functions, including protection of terrestrial wildlife habitat (NMFS 1999). In their review of the literature and documentation presented at hearings for consideration of the designation of critical coho habitat, NMFS cited several

TABLE 1. 916.5, 936.5, 956.5 Procedures for Determining Minimum Watercourse and Lake Protection Zone Widths and Protective Measures [All Districts]

Procedures for Determining Watercourse and Lake Protection Zone Widths and Protective Measures[1]								
Water Class Characteristics or Key Indicator Beneficial Use	1) Domestic supplies, including springs, on site and/or within 100 feet downstream of the operations area and/or 2) Fish always or seasonally present onsite, includes habitat to sustain fish migration and spawning.		1) Fish always or seasonally present offsite within 1000 feet downstream and/or 2) Aquatic habitat for nonfish aquatic species. 3) Excludes Class III waters that are tributary to Class I waters.		No aquatic life present, watercourse showing evidence of being capable of sediment transport to Class I and II waters under normal high water flow conditions after completion of timber operations.		Man-made watercourses, usually downstream, established domestic, agricultural, hydroelectric supply or other beneficial use.	
Water Class	Class I		Class II		Class III		Class IV	
Slope Class (%)	Width Feet	Protection Measure	Width Feet	Protection Measure	Width Feet	Protection Measure	Width Feet	Protection Measure
					[see 916.4(c)] [see 936.4(c)] [see 956.4(c)]		[see 916.4(c)] [see 936.4(c)] [see 956.4(c)]	
<30	75	BDG	50	BEI	See CFH		See CFI	
30-50	100	BDG	75	BEI	See CFH		See CFI	
>50	150[2]	ADG	100[3]	BEI	See CFH		See CFI	

1 - See Section 916.5(e) for letter designations application to this table.
2 - Subtract 50 feet width for cable yarding operations.
3 - Subtract 25 feet width for cable yarding operations.

references regarding riparian protection zones. Two of these citations (Johnson and Ryba 1992, Castelle et al. 1994) identified a riparian zone width of 30 m (98 ft) as the minimum necessary to provide riparian function (NMFS 1999). Also cited was "An Ecosystem Approach to Salmonid Conservation" (Spence et al. 1996) that stated that a protected buffer of approximately one site-tree height (30-45 m) would provide 90 to 100% of a fully functioning riparian corridor in terms of years or decades. A fully protected 30-45 m-wide riparian buffer may therefore provide "fully functioning habitat," as compared to "properly functioning habitat."

The two direct functions of the WLPZ are to provide shade for temperature control and long-term input of LWD. Other benefits include screening input of fine sediments, maintenance of microclimates for temperature and humidity, and the input of energy in the form of organic debris that supports other biota, including invertebrates and other vertebrates. Many of the agency representatives, environmental representatives, and other resource specialists commented on the inadequacy of the current WLPZ rules for the recruitment of LWD. They cited the current standard of two trees 16 inches or larger per acre within the WLPZ as being inadequate for both short- and long-term LWD recruitment needs. Several suggestions were offered, including near-stream no-cut riparian buffers and permanently designated trees within the WLPZ.

The Monitoring Study Group (MSG) team reviewed WLPZs for compliance with rules and effectiveness as a sediment buffer (MSG 1999). They found:

"Watercourse and lake protection zones (WLPZs) have been found to generally meet Forest Practice Rule requirements for width, canopy, and ground cover. Additionally, very few erosion features associated with current THPs were recorded in WLPZs."

"Approximately three-quarters of the WLPZs evaluated to date have been on Class II watercourses, which are much more common than the generally larger Class I waters. The data collected in WLPZs indicates that minimum canopy requirements following harvesting on Class I and II watercourses are being exceeded, since an average of greater than 70% canopy cover following harvesting has been measured using the spherical densiometer. Similarly, mean ground cover requirements in WLPZs following logging was estimated to exceed 85%. Required WLPZ widths generally met Rule requirements, with major departures from Rule requirements noted only about 1% of the time. Erosion events originating from current THPs and encountered on mid-zone or streambank WLPZ transects were found to be rare. The implementation data suggests that RPFs should do a better job of taking existing roads and erodible, unstable stream banks into account when designing WLPZs and specifying protection measures."

Unfortunately, there is currently a lack of science on the necessary amount of LWD for either properly functioning or fully functioning conditions for various stream orders and conditions. Two of the constituency groups interviewed recommended no-cut buffers along Class I watercourses. One of these groups recognized the difficulties and issues that would result from no-cut buffers, but felt that they needed to support this standard because they did not trust the system to properly prescribe and maintain adequate WLPZs. Many of the landowners and RPFs interviewed felt the current WLPZ standards, as required under the "Coho Salmon Considerations Document", were adequate. Recent studies conducted by the Monitoring Study Group of the Board of Forestry found that, although the requirement for Class I watercourses was to retain 50% overstory canopy, the average canopy closure for Class I watercourses exceeded 70% (see above). The MSG rarely found problems in WLPZs on industrial ownerships, and commonly found trees left in the WLPZ that were designated for harvest with paint, but were not cut.

Of the landowners interviewed, many have increased their WLPZ standards over those required in the FPR. One industrial landowner uses a tiered WLPZ on Class I watercourses that

includes 80% overstory canopy retention within the 25ft of the WLPZ closest to the watercourse and 65% for the remainder of the WLPZ. In addition to these standards, this company also retains at least 10 trees per 1,000 ft of watercourse (considering both sides of the stream) that represent the larger trees in the stand including leaning trees and wildlife trees. On Class II watercourses, this landowner retains 75% canopy in the zone 0 to 25 ft from the watercourse and 65% overstory canopy in the remainder of the WLPZ. On Class III watercourses, the company maintains a 20-50-ft wide ELZ.

Another landowner has also adopted 70% overstory canopy for Class I and II watercourses. They use standard WLPZ widths and exclude all salvage logging from these zones, retain six trees per acre 32 inches in diameter or larger, as well as 1-2 snags per acre. No harvesting may occur in the WLPZs unless there is at least 70% overstory canopy. Within Class III watercourses, they follow the standard rules regarding the equipment limitation zones (ELZs) and retain all hardwoods. A third industrial landowner also maintains 70% canopy closure on all Class I and II watercourses and provides more protection to larger Class II watercourses that support coldwater species such as salamanders. On Class III watercourses, this same landowner retains LWD on adjacent hillslopes for slope stability. Field observations by the SRP indicated that this landowner had also instituted no-cut buffers on a site-specific basis for geologic hazards and other site-specific concerns.

Based on the interviews and review of THPs both on paper and in the field, it appears that most landowners are exceeding the current minimum WLPZ standards. When asked why landowners would not support retention of a 70% canopy closure (the amount that is currently being achieved by almost all landowners on Class I watercourses), landowners and RPFs expressed concern that such a modification would cause a "ratcheting-up" of the required regulations. Under the current requirements, RPFs are retaining 70% canopy along Class I watercourses where the regulations only require 50%. Landowners and RPFs fear that if the new standard is 70%, then to err on the side of the conservative, the de facto standard will approach 75-80% canopy retention requirements. RPFs in particular were very concerned of meeting both the intent and the letter of the law when designating and marking WLPZs. Because of the variability within a WLPZ and the difficulty in accurately measuring canopy closure, RPFs said they tend to leave more trees than is stated in the THP requirements. The CDF has recently adopted a standardized methodology for calculating compliance with WLPZ canopy closure requirements. The so-called "sighting tube" used in this method requires a substantial number of sample points to determine canopy closure, and does not appear to be a repeatable sampling methodology.

Several constituency groups expressed concerns regarding the classification system used for watercourses. The definition of Class I and III watercourses were generally considered acceptable, but it was suggested that the definition of a Class II watercourse be reviewed. Class II watercourses represent a wide range of steam conditions and flows. They can include streams of stream order 1, 2, 3 or higher, and may have substantial water flow. The larger streams have the capacity to transport LWD and substantial amounts of sediment directly into Class I streams. The larger Class IIs may have all of the characteristics of Class I streams, but are defined as Class IIs only due to the absence of fish.

For salmonid protection, the SRP is not recommending permanent designation of recruitment trees along Class II watercourses, except for retention of 1-3 snags per acre. The SRP believes that the high canopy retention requirements (85%), and restrictions on salvage logging of downed trees within Zone A of Class II WLPZs (see recommendations below), will produce adequate amounts of suitably sized LWD in the majority of Class II watercourses. The larger Class IIs that enter Class I watercourses, however, may be an

important source of LWD to these channels through the mechanism of downstream transport. This process needs to be addressed through the watershed analysis process, and may result in the need to provide for additional LWD recruitment opportunities for these types of Class II watercourses.

The constituency group made up of agency fish biologists reported the need to protect critical "metapopulations" of salmonids. The locations of these metapopulations are known to the biologists, and they recommend a program to identify which areas may be critical for maintenance of these metapopulations and provide extra protection to these areas. This may include increased WLPZ widths, harvest limitations, and sediment control. It is important that the landowners are informed of these metapopulations to coordinate protection.

The watershed specialist constituency group, as well as other groups, emphasized the importance of Class III watercourses for sediment metering and storage. These channels typically have stepped profiles formed by LWD largely consisting of smaller pieces from limbs or broken tree tops. These channels tend to be stable until there is disturbance creating a catch point that migrates headwords. It is therefore important to minimize disturbance to these channels, and to stabilize crossings where they occur.

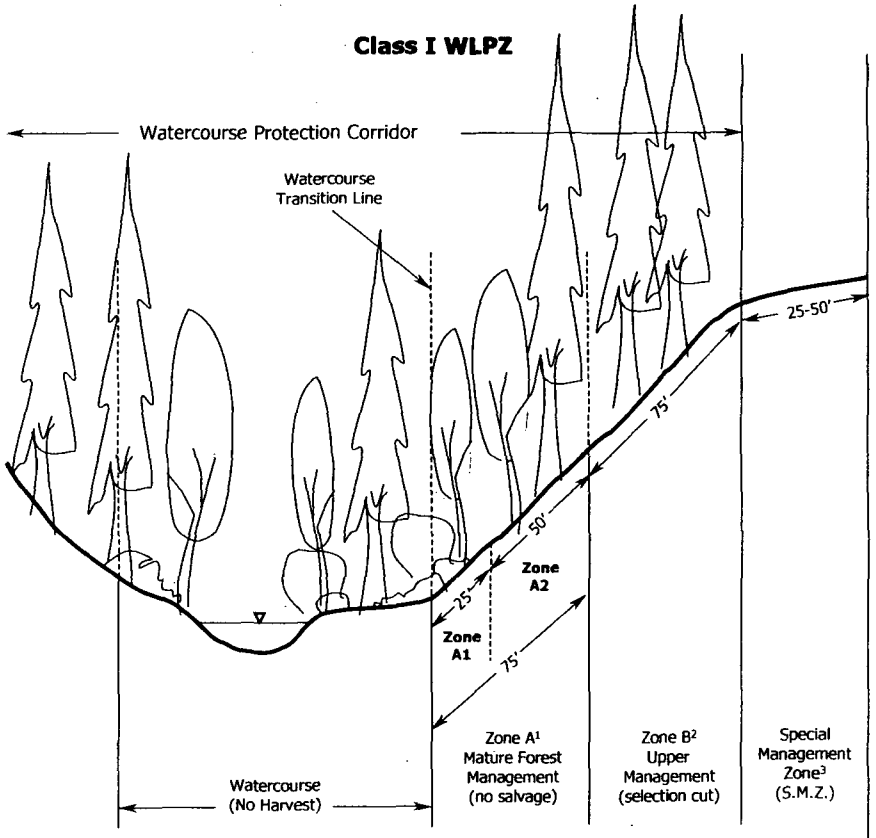
The SRP realizes (and has been told by many constituency groups) that the regulatory expectation that "one-size-fits-all" is unrealistic and undesirable to all. The FPRs must include flexibility. However, changes to the standard WLPZ prescription may result in significant adverse on-site and cumulative impacts to salmonid habitat. As written, most proposed changes do not explicitly require this level of evaluation; rather, the RPF need simply explain and justify proposed changes. While we respect the RPFs' abilities to address many potential on-site adverse impacts, adverse cumulative impacts are considerably more difficult to evaluate.

Recommendations

1. The SRP recommends the following watercourse protection standards:

Class I Watercourses

- Re-write CCR 916.5(e) and "G" to include the following: Minimum riparian buffer widths on Class I streams of 150 ft (slope distance) tiered with the following canopy requirements: Zone A = 0-75 ft wide with 85% overstory canopy closure; Zone B = 75-150 ft wide with 65% overstory canopy closure (see Figure 6). For evenaged treatments adjacent to WLPZs (and rehabilitation with the same effect as a clearcut), an additional 25-50 ft wide (25-ft wide on slopes 0-50%; 50-ft wide on slopes greater than 50%) special operating zone shall retain understory and mid-canopy trees at a density sufficient to reduce the impacts of edge effects. Within this special operating zone, understory and mid-canopy conifers and hardwoods shall be retained and protected during falling, yarding, and site preparation. Zone A shall be divided into two zones: Zones A-1 and A-2. Zone A-1 shall extend from 0-25 ft above the watercourse transition line (WTL) and shall be managed for salmonid habitat purposes using salmonid-directed silviculture (see Definitions). Zone A-2 shall extend from 25-75 ft above the watercourse transition line. It is the goal of Zone A-2 to create a multi-aged stand with late-successional forest characteristics including: (1) maintaining a mix of small, medium, and large diameter trees managed on a selection harvest basis to create large diameter LWD recruitment trees and allow shade-intolerant trees to reproduce; (2) maintaining snags at a density of 1-3 per acre; and (3) retaining downed wood, while maintaining height growth function. This stand should be representative of the tree species composition that would have naturally



[1] A1 special zone managed specifically for salmon habitat through limited selection harvests or thinning: 85% canopy; no salvage.
A2 zone managed for large diameter trees through thinning and selection harvest: 85% canopy; no salvage

[2] B upper management zone; selection harvest; salvage of downed trees O.K.

[3] Special Management Zone: for even-aged management only; retain understory and hardwood trees

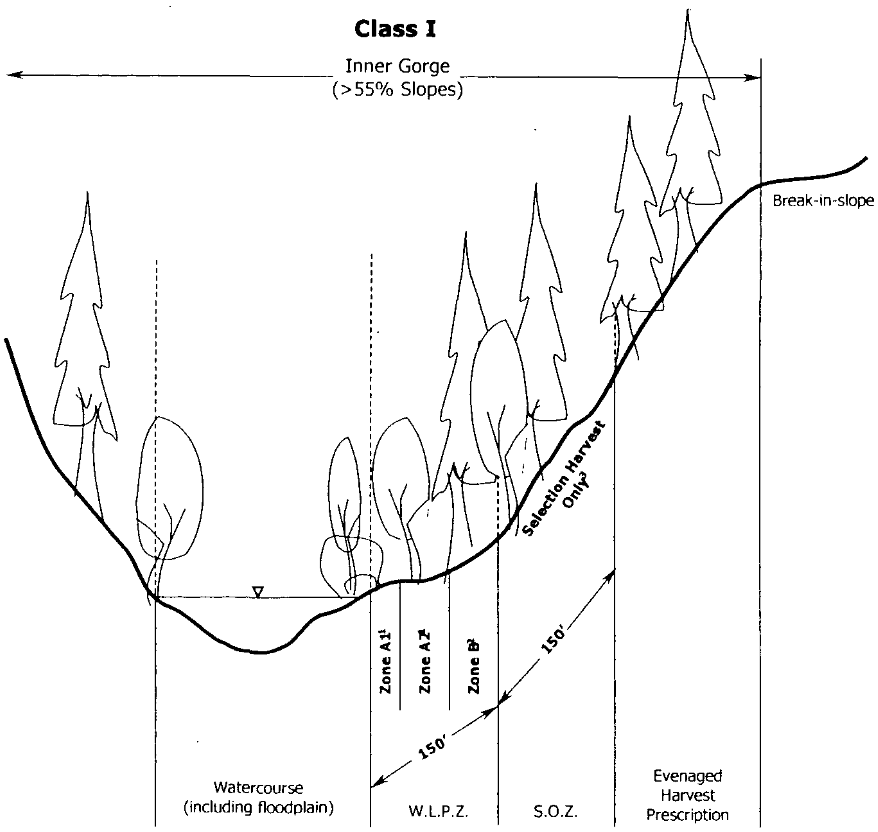
Figure 6 Proposed Class I Watercourse Protection Standards

occurred on the site under reference conditions, including hardwoods. To create larger diameter trees at a younger age, the thinning of younger stands within this zone is encouraged. In order to provide and maintain LWD recruitment trees, the ten largest trees per 100 m (328 ft) of stream channel (considering both sides of the stream) within 50 ft of the watercourse transition line (WTL) shall be marked for permanent retention. The RPF may trade the next smaller diameter tree more conducive to LWD recruitment, or shading, or bank stability, if DF&G concurs. Criteria for the selection of alternative recruitment trees shall favor leaning trees, large-diameter decadent trees, and the next largest diameter trees lowest on the slope within the zone. Trees shall be permanently designated (see Definitions) prior to the PHI (unless alternative trees are proposed), and shall be marked with paint, tags, or other suitable means both above and below stump height. Recruitment trees shall be remarked upon each reentry, and additional recruitment trees shall be designated to replace those trees that have fallen. No salvage of dying, dead, or downed trees may occur within Zone A, except for safety reasons. Trees that have fallen uphill into Zone B must have at least 30% of their lower bole retained regardless of location. Trees that occur within the channel zone (defined as the area between opposing watercourse transition lines) may not be harvested. These trees may not be counted as recruitment trees.

- Drop all exemptions for cable logging; require full WLPZ width for all operations.
- Standards for Class I watercourses shall apply only to fish-bearing streams and not to watercourses designated for use as domestic water sources; Class II protection measures shall apply to these watercourses.
- Zones A and B shall be managed through thinning or selection harvest, including small group openings each less than or equal to ¼ acre.
- Where an inner gorge is present above the WLPZ and slopes are greater than 55%, a special management zone shall be established that requires the use of selection harvesting (see Figure 7). This zone shall extend upslope to the first major break-in-slope, or 300 ft as measured from the watercourse transition line (WTL), whichever is less. Even-aged management above the 300 ft zone within the inner gorge on slopes of 55-65% shall be reviewed by a geologist prior to approval. All slopes exceeding 65% (both inside and outside the WLPZ) within the inner gorge shall be reviewed by a Certified Engineering Geologist (CEG) prior to plan approval.
- No harvesting may occur on any unstable feature within the WLPZ without review by a CEG. Trees retained on these features within Zone A may be counted as LWD recruitment trees if size criteria are met (or DF&G concurs with a smaller diameter tree).
- Where water temperature is not limiting, and Zone A-2 is occupied with even-aged conifers, the canopy requirements within this zone may be reduced to 70% as part of a "low thinning" prescription (see Definitions).
- Equipment is excluded from the WLPZ except on existing active haul roads.

Class II Watercourses

- Rewrite CCR 916.5 (e) and "1" to read: 100 ft minimum (slope distance) WLPZs tiered with the following overstory canopy retention requirements: Zone A = 30 ft wide with 85% canopy; Zone B = 30-100 ft wide with 65% canopy. This must be composed of at least 25% overstory conifer canopy post-harvest.
- Drop exemptions for cable logging – maintain minimum WLPZ widths.



[1] A1 special zone managed specifically for salmon habitat through limited selection harvests or thinning: 85% canopy; no salvage.

A2 zone managed for large diameter trees through thinning and selection harvest: 85% canopy; no salvage

[2] B upper management zone; selection harvest; salvage of downed trees O.K.

[3] Special Operating Zone: Required for slopes >55% within inner gorge when evenaged harvesting is proposed above; selection harvesting required within S.O.Z.

General Requirement: All harvesting on slopes >65% anywhere in the inner gorge must be reviewed by a geologist.

Figure 7. Recommended Class I Inner Gorge Protection Standards

Report of the Scientific Review Panel

- To increase LWD, salvage logging shall be prohibited in Zone A of the WLPZ. Trees that fall into Zone A may be removed with the following stipulations: (1) the portion of the tree that extends outside of Zone A may be removed if such removal does not destabilize the remaining portion of the tree; and (2) no portion of the tree may be removed if the tree has become incorporated into the duff layer and is metering or storing sediment.
- To reduce the edge effects of the WLPZ adjacent to evenaged harvest areas, a special operating zone extending 25 ft upslope of the WLPZ shall be established. Within this zone, understory and mid-canopy conifers and hardwoods shall be retained and protected during falling, yarding, and site preparation.
- Where temperature is not limiting, and Zone A is occupied with evenaged conifers, canopy requirements may be reduced to 70% to facilitate a "low thinning" (see Definitions).
- Natural seeps and springs shall be protected as on Class II watercourses.
- No equipment shall enter the WLPZ except at currently active permanent roads or designated crossings (i.e., abandoned roads shall not be reopened).
- To ensure larger, lower gradient (less than 10%) Class II streams that do not have fish present during some portion of the year (i.e., to ensure that they are not actually Class I streams), more rigorous fish investigations by qualified fisheries biologists should be conducted.
- Retain 1-3 snags per acre.

Class III Watercourses

- No WLPZ shall be required. Rewrite CCR 916.4(c) to read: "Maintain a 30-50 ft wide EEZ (depending on slope) and retain all hardwoods within the EEZ. No equipment may enter this zone except at pre-designated tractor crossings. Such crossings are to be kept to a minimum, shown on the THP map, and shall be removed and stabilized prior to October 15."
- Minimize burning within the EEZ; retain all downed woody material that is currently acting to store sediment within Class III watercourse channels and on adjacent banks and slopes. The protection of Class III watercourses during broadcast burning must be addressed in the Site Preparation Plan. Where broadcast burning is used and burning through Class IIIs cannot be prevented, only cool spring burning shall be used. Fall burning may be used only where LWD in Class III watercourses is protected. No ignitions may occur within 50 ft of the channel as measured from the center of the channel.

General WLPZ Recommendations

- Slopes greater than 65% within the WLPZ shall be reviewed by a geologist prior to THP approval.
- From a salmon protection perspective, salvage of downed trees in Zone B is not considered detrimental, if properly conducted.
- Site-specific watercourse protection standards that may exceed the minimums in CCR916.5 (as modified) based upon needs identified through if a watershed analysis indicates that this is necessary for the protection of salmonid habitat.
- The issue of converting hardwood-dominated WLPZs shall be addressed through the watershed analysis. This may allow more intensive harvesting within Class I and II WLPZs that are currently hardwood dominated.
- Consider differential WLPZ standards for properties managed through selection harvest versus evenaged harvest. This would include considering reduced buffer widths where there

is no marked change between the WLPZ and the silvicultural hillslope harvesting applications. This should be addressed in the watershed analysis.

2. The WLPZ rules include too many exemptions that are scattered throughout the FPRs. Regulatory exemptions within the WLPZ rules include: CCR 916.1 In Lieu Practices, CCR 916.6 Alternative Watercourse and Lake Protection, CCR 916.4(b)(5) width adjustments for WLPZs, CCR 916.4(b)(6) surface cover adjustments, and CCR 916.4(d) heavy equipment use in the WLPZ. Assign all WLPZ exemption language to one section, essentially CCR 916.6, to: (1) clearly define the standard prescription, and (2) require specific evaluation for proposed changes in the cumulative effects assessment. For example, use of existing roads within the WLPZ should be evaluated in CCR 916.6, and not CCR 916.3(c); heavy equipment use exemptions within WLPZs should be evaluated similarly. At present (refer to Cumulative Effects Assessment section), Technical Rule Addendum No. 2 is not designed to adequately address proposed exemptions. With an adequate cumulative effects analysis in place, future THP approval could allow more intensive harvesting for hardwood conversion within Class I and II WLPZs by stating, then justifying, a future desired stand structure. Thinning of younger stands within the WLPZ could be encouraged to promote diameter growth and more rapid development of large trees for future LWD recruitment. Until an adequate cumulative effects analysis is implemented, the SRP recommends formal interagency review of all proposed exemptions. This should require two of the three review agencies (CDF, DF&G and RWQCB) to formally approve the changes (and their justification), rather than requiring two or more agencies to deny proposed exemptions (as required in CCR 916.6(b)).

2. Large Woody Debris Recruitment

Background

In several locations under Article 6, "Watercourse and Lake Protection" (CCR 916), the rules both directly and indirectly discuss LWD recruitment and function within stream channels and riparian areas. The specific recruitment requirements developed for LWD are described under 916.3(g): "Recruitment of large woody debris for instream habitat shall be provided by retaining at least two living conifers per acre at least 16 inches diameter breast height and 50 feet tall within 50 feet of all Class I and II watercourses." LWD is indirectly addressed at 916.2(a)(3) as "The biological needs of the fish and wildlife species provided by the riparian habitat." LWD is identified by name and referred to under 916.4(b) "Vegetative Structure Diversity" where determination of the WLPZ width is described: "A combination of the rules, the THP, and mitigation measures shall provide protection for the following: ...stream bed and flow modification by LWD...and vegetation structural diversity for fish and wildlife..."

Discussion

Current FPR standards for maintaining LWD recruitment to stream channels were criticized by numerous constituency groups as being grossly inadequate. Landowners, RPFs, and some agency representatives noted, however, that the number of trees remaining after harvest greatly exceeded these standards. However, there is nothing in the regulations that requires the permanent retention of any individual trees that could be recruited as LWD. This was considered a high priority by several constituency groups, including some representatives of the state and federal agencies, as well as of the environmental community, fisheries biologists, and habitat restorationists.

As described under "Watercourse and Lake Protection Zones," there is a lack of data identifying those characteristics of LWD that promote the

creation and maintenance of habitat for anadromous salmonids. A watershed analysis could provide information on current abundance and distribution of LWD in various watersheds throughout the north coast region of California; however, further analysis of these data would be needed to identify reasonable ranges for adequate abundance and distribution of appropriately sized LWD by stream size.

Several interviewees considered LWD to be a critical factor influencing the quality of salmonid habitat, especially for coho salmon. Others felt that the role of LWD might be overemphasized and other factors, such as suspended sediment and stream temperature, might have equal or greater importance. There was also much discussion regarding the natural background levels of LWD in north coastal California streams. There were some mentioned instances where reference streams with little to no LWD were observed to have high salmonid densities. Other streams, such as Prairie Creek, contain large amounts of LWD and are known to be important coho salmon streams. Without further analysis, the question of "how much LWD is enough" can not be readily answered. Further studies and analysis should be undertaken, regarding the role of LWD in north coastal California streams and its effect on salmonid habitat and populations.

Comments received from various constituency group members, including state and federal representatives and several other groups, indicated that rates of LWD recruitment to streams has been dramatically reduced from historical rates through timber harvesting and other activities. LWD that enters the system in the upper reaches is often removed by private landowners and firewood cutters in the lower reaches of the drainage. To many small landowners, LWD represents diversion potential that can damage their property, public and private roads, culverts, and bridges. The economic opportunity presented by a large redwood log on a river bar also results in the rapid removal of LWD by firewood cutters and fence post/shingle-bold makers.

Several of the constituency groups engaged the SRP in discussions regarding both short- and long-term LWD recruitment needs. Rules created today for increasing recruitment of LWD by retaining more trees in the WLPZ may not result in measurable increases to in-channel LWD for several decades. Within this time frame, it is possible that runs of salmonids could become extirpated within certain watersheds while waiting for trees to grow and recruit LWD to the stream channel. There may be a need to increase in-channel LWD in the short term in some stream systems by direct placement of LWD. Several of the large landowners who were interviewed supported this concept and said that they would be willing to work with the state and federal agencies in the placement of LWD, where it was identified as a critical limiting factor. The landowners and RPFs noted that when logging equipment, such as cable yarders and helicopters is on site, these machines could be used to place LWD into watercourses at pre-designated locations. This LWD could originate from trees felled during road construction or hillside logging activities. Where there is a lack of LWD in the streams, but a relative abundance of larger diameter trees along the watercourses, logging equipment could be used to pull trees over into stream channels. This may provide very stable and geomorphically functional pieces of LWD, as they would consist of both an intact bole and a root wad. The SRP received several comments that preferred LWD would come from a larger diameter tree and would contain an intact root wad.

The SRP also heard many discussions of what may be the best methods to ensure long-term recruitment of LWD. One suggestion was for a near-stream, no-cut zone that would allow for the development of large trees that could then fall into the stream over time. This would not of course preclude increasing recruitment of LWD from upslope of this zone through additional protection

measures. Another discussion considered the permanent designation of trees for LWD recruitment. These trees would be selected from within the WLPZ and would include conifers that had the highest likelihood of entering the stream in the near term, and would therefore most likely include larger diameter, more decadent, and leaning trees. These characteristics are often those associated with the "wildlife tree" designation. One landowner has already undertaken this program and has permanently designated such trees with plastic "wildlife tree" signs. An issue raised by some state representatives was the state's ability to require the protection and maintenance of these trees over time. There was a question regarding the state's jurisdiction once the THP had been completed and stocking requirements had been met. Because the harvest and removal of any trees from private property requires a permit from the state, this may provide sufficient safeguard.

Most interviewees, including foresters, landowners and state agencies, stated that the current FPRs do not ensure adequate recruitment of LWD. Landowners indicated that they could put more LWD into streams by using stumps and logs remaining after road building and logging. Some foresters stated that the current rules tended to convert the WLPZ into hardwood stands. Such conversion would reduce recruitment of conifers, which tend to enter the channel at larger sizes and decay more slowly.

The conversion of most of the old-growth redwood forests with their abundance of large decadent trees into relatively vigorous, young-growth stands has greatly reduced the recruitment of large trees into streams and replaced it with recruitment of smaller pieces of woody debris. These smaller pieces tend to be less stable in the channel and have less influence on stream channel morphology and salmonid habitat (Bragg and Kershner 1999). Recent forest management has altered natural disturbance regimes affecting LWD recruitment. Natural forest fires and Native American burning resulted in episodic delivery of riparian trees to stream channels in a variable recruitment pattern. During the conversion of the old-growth forest to young-growth, a considerable number of riparian areas and streams were cleared of large wood and many coastal streams were used for dragging, hauling, or floating logs downstream. Until recent years, the LWD that was left in north coastal California streams was removed under the mistaken belief that it often hindered or blocked fish migration. In hindsight, this was a poor decision. Many studies have since indicated that LWD performs critical geomorphological and ecological functions in fish-bearing streams. Science has not yet defined what types of management will ensure adequate recruitment of LWD into streams and the actual amounts required for protection of salmonid habitat. To determine the amount of LWD currently present in the many different streams of the region, adaptive management and monitoring will be needed.

The simplest way to increase LWD in streams in the short term and ensure that variable recruitment of LWD in these streams continues is to establish wide no-cut riparian buffer strips. Since a considerable amount of riparian zones are currently occupied with smaller diameter young-growth, hardwoods and shrubs, however, most riparian areas need some type of active management to promote regrowth of large conifers that historically occurred in these areas. A 100-foot no-cut riparian buffer zone would be simpler to implement in the field and politically more acceptable to some. However, we have always tended to simplify our management of nature by making uniform prescriptions. Such simplified approaches, however, may not result in LWD recruitment patterns similar to those that existed under pristine conditions. Prior to intensive management of the redwood forests, recruitment of LWD into streams was very chaotic with a large inherent variation in the amount of LWD present in any one stream at any given time. This inherent variation probably resulted in ecosystem stability in terms of providing salmonid habitat on a landscape scale with at least some streams having suitable levels of LWD abundance at any one point in time. On the landscape scale, at any one point in time, some watersheds or streams would likely have had high densities of LWD while others would be relatively lacking in LWD due to natural disturbance events including catastrophic windthrow, disease and insect epidemics, fire, flooding, and mass wasting. Some portion of the landscape would therefore likely have contained high quality habitat for salmonids while other portions were in a state where habitat for salmonids was limited (Reeves et al. 1995).

A riparian buffer zone with a patchy distribution of different management treatments would result in a variety of different stand structures and successional stages that would more closely mimic natural forest patterns. These management treatments could include small patch cuts, selective cuts, and thinning to foster regrowth of larger-diameter conifers in the riparian zone, as well as maintenance of some lightly managed and unmanaged patches. The buffer zone width would vary depending on channel type and stream dynamics. The size, shape, and spatial configuration of these differently managed patches should therefore depend on the riparian zone's expected response to such treatments and whether or not the desired results may occur. Several of the interviewees expressed concern that much of the vegetation within riparian zones had been converted to hardwoods, and therefore needed to be actively managed to promote re-growth of conifers.

The Aquatic Properly Functioning Conditions Matrix (Matrix) was produced by NMFS in order to address habitat needs for salmonids on the lands of the Pacific Lumber Company. Attachment E to the Matrix identifies numeric targets for trees per acre by diameter (DBH) groups for both redwood and Douglas-fir. For redwood stands NMFS recommends leaving 23.8 trees per acre greater than 32-in DBH and 17.4 trees per acre greater than 40-in DBH. For Douglas-fir stands the recommendations are for leaving 18.5 (16.3) trees per acre greater than 30-in DBH and 11.0 (9.0) trees per acre greater than 40-in DBH (numbers in parentheses are for different site classes). These tree-per-acre requirements are not additive; the requirement for trees per acre greater than 40 DBH is a subset of the trees per acre for the greater than 32-in DBH group. These recommendations were developed from data included in a master's thesis at Humboldt State University (Combs 1984) and from the Old-Growth Program at the USDA Forest Service Pacific Southwest Forest and Range Experiment Station (Bingham 1991) (B. Condon, 1999, pers. comm.). The redwood recommendations were based on inventory data from 48 ¼-acre plots in undisturbed redwood stands greater than 200 years of age in Redwood National Park (Humboldt County) and the Northern Coast Range Preserve in Mendocino county. The source of the Douglas-fir data is not clearly identified. These data were originally compiled for use in development of the "Old Growth Protection" rule package considered by the Board of Forestry in 1992. The riparian data in the Matrix represents undisturbed old-growth conditions that are "fully functioning."

The following is an example of a timber management strategy that could be used to maintain high levels of properly functioning (i.e., approaching fully functioning) riparian conditions for protecting salmonid habitat. The stand used in this example was located along a small Class I stream in the redwood region (D. Thornburgh, unpublished stand inventory data for Mendocino County, California). Prior to the first timber harvest, the natural disturbance in this stand consisted of light to moderate fire occurring at 40-year intervals, and single- and multiple-tree blowdown. Partial "high grade" harvest occurred 100 years ago, followed by natural stand regeneration. This stand represents ideal conditions for a mature (100-year-old) Site I streamside stand that contains residual old-growth. This stand does not represent an average mature young-growth stand, and exceeds the basal area found in average late-successional (i.e., old-growth) stands. Stand characteristics included:

- a riparian zone of variable width
- a streamside stand composition of multiaged redwoods and mixed conifers
- riparian-associated hardwood trees growing along stream (e.g., alders, cottonwoods)
- basal area of 700 sq. ft. per acre
- 5–7 trees per acre greater than 40-in DBH
- 50–60% of basal area made up of trees from 15- to 40-in DBH
- remaining basal area made up of trees 0- to 15-in DBH
- 5–8 snags per acre greater than 15-in DBH
- 10 –20 dry tons per acre of downed wood
- growth rate of 2,440 BF per acre per year (periodic annual increment)

For management purposes, the structure and distribution of tree sizes in the stand can be averaged over an area of five acres allowing for wide variability in stand structure. The following management measures could be used in this stand to maintain riparian stand functions important for protecting salmonid habitat:

- harvest 85% of the annual growth in 10-year increments equal to 20,740 BF every 10 years
- cut timber in small patches to form single- to multiple-tree-size gaps large enough to allow Douglas-fir to become established (1/4-acre or larger)
- maintain vertical canopy structural diversity of 5-7 trees greater than 40-in DBH and 50-60% of remaining basal area in 15- to 40-in DBH trees
- if a stream reach is believed to be lacking in LWD, retain larger trees (greater than 40-in DBH) in a strip along that reach to allow for future LWD recruitment
- avoid disturbing or compacting the soil
- allow light to moderate burning of slash following timber harvest

The above management scheme may mimic natural disturbances that result in the input of some coarse and fine sediments to the stream. Rather than require a specific number of trees to leave or the specific width of a no-cut zone, the desired condition should be described as a management objective.

Average conditions for old-growth stands can be determined by reviewing historical timber inventories. Based on an intensive inventory of approximately 3,000 acres of undisturbed redwood stands in Humboldt County, the average basal area per acre was 531 ft^2 and the average number of trees (conifers, greater than 8-in DBH) was 51 trees per acre (NRM 1984). Of this total, 18 trees per acre were greater than 40-in DBH. This represents historical (reference) conditions that were considered to be "fully functioning", and that are very similar to the requirements contained in the NMFS Matrix (17.4 trees per acre). Recreating these conditions would likely require several hundred years.

The expected yield of a 90-year-old stand of Douglas-fir is predicted to be 118 trees per acre (site index = 180, trees greater than 7-in DBH) (McArdle et al. 1961). The "Empirical Yield Tables for Young-Growth Redwood" (Lindquist and Palley 1963) predicted yields for a site Class II (site index = 180) stand of redwood to have an estimated basal area of 576 ft^2 per acre and 158 trees per acre (greater than 10.5-in DBH) at 90 years of age. These predicted yields for young-growth redwood have a higher basal area and a higher number of trees per acre compared to empirical measurements of old-growth stands. By comparison, empirical measurements of a naturally regenerated, unmanaged stand of 90-year-old redwood and Douglas-fir (site index = 180) in Humboldt County indicated a basal area of 402 ft^2 per acre and 132 trees per acre (greater than or equal to 10-

in DBH) (NRM 1991). This stand had the following tree diameter (DBH) composition:

DBH Group	Trees per Acre
10–28 inches	98
28–38 inches	31
40 inches +	3

The differences between the young-growth versus old-growth stands are reflected in the number of trees per acre and the distribution of tree diameters. Although the young-growth redwood yield tables for a 90-year-old stand indicate basal areas similar to an old-growth stand (576 ft^2 per acre verses 531 ft^2 per acre), the number of trees per acre is significantly different. The old-growth stand has 51 trees per acre (greater than 8-in DBH, conifers only) while the 90-year-old young-growth stand is predicted to have 158 trees per acre (including hardwoods). The actual 90-year-old stand has a similar number of trees per acre at 132, including hardwoods. When hardwoods are excluded, this stand has 105 conifer trees per acre. The old-growth stand has 18 trees per acre greater than 40-in DBH, while the 90-year-old stand has 3 trees per acre greater than 40-in DBH.

Basal Area

Basal area by itself is not a good measure of the number of trees per acre, size of trees in a stand, percent of full occupancy, or amount of canopy cover. Normal basal area is a function of age and site. For example, depending on the site, the basal area of 300 square feet can be:

Site	Stand Age	Trees per Acre
V	80 years	194
IV	58 years	180
III	45 years	190
I	20 years	377

The above represents evenaged stands and these data are not applicable to unevenaged management. Although some HCPs and the Washington State Watershed Assessment Program use basal area to define standards for riparian stands, the SRP believes that this is not a good measure to use to achieve desired goals. Instead, we support the use of canopy closure requirements and describing the desired stand characteristics for functional riparian habitat. Stand tables need to be developed that illustrate the desired stand characteristics essential for properly functioning salmonid habitat. The stand tables need to illustrate multi-aged, multi-story stands that provide optimum canopy coverage, recruitment of LWD, and regeneration of conifers that will eventually replace the larger trees. The stand table needs to cover all the different sites and tree species in the geographic area covered by the two ESUs in California.

To create and maintain stands within the WLPZ that contain elements common to late-successional stands, it will be necessary to grow and maintain larger diameter conifer trees. To accomplish this, it may be necessary to manage these zones through thinnings and selection harvests to promote the growth of the larger trees present that have the best opportunity to maximize diameter and height growth.

Oliver et al. (1994) found that young-growth redwood responded well to thinning. The authors concluded that up to 50% of the stand density (as measured by basal area) could be removed without significant loss in volume production. This would result in transferring stand growth to the remaining trees and significant acceleration of basal area growth. Over the 15-year study period, stands that were thinned at 50% of initial stand density increased annual basal area growth by 34% compared to the untreated stands. Stands thinned at 25% of initial stand density (75% retained) increased annual basal area growth by 25% compared to the untreated stand. There are many other considerations for management of the riparian zone, but it appears that thinning, if properly applied (while giving equal consideration to the other functions of the riparian zone), can increase tree growth in a manner that is compatible with

the objectives of achieving properly functioning habitat conditions. However, this must be combined with the near-term retention of larger diameter trees and treatment of the WLPZ to increase recolonization and regrowth by conifers. These combined efforts will provide the best opportunity to ensure long-term recruitment of LWD.

To enhance riparian protection and LWD recruitment, many of the constituency groups interviewed supported incentive programs. Incentives proposed by interviewees included tax credits for retaining trees in riparian areas and financial rewards for re-establishing and maintaining healthy riparian buffers, creating conservation easements, and for being good land stewards.

The FEMAT report (1993) identifies two management goals: (1) provide appropriate solar shading, streambank protection, and sufficient inputs of LWD to maintain/restore necessary instream physical habitat; and (2) maintain/restore the riparian community. Both are inter-related and both depend, site-specifically, on adjacent hillslopes. A watercourse protection corridor should have four zones spanning a range of acceptable management goals and prescriptions. These are: (1) the watercourse channel; (2) a riparian buffer; (3) the transition zone; and (4) the upper hillslope (for steeper slopes and inner gorges). Each requires as unambiguous a demarcation as possible, as well as clear scientific justification.

A "watercourse transition line", as defined in CCR 969.7 is *"that line closest to the watercourse where riparian vegetation is permanently established"*. This transition line will generally occur at an elevation lower than frequent flood stage heights, including the bankfull discharge. The bankfull discharge or greater, often considered the normal high flow, has an average annual recurrence of approximately once annually (Leopold et al. 1964). Many woody riparian species (e.g., white alder) in the north coast region of California typically establish at or below the bankfull stage height. A "watercourse bank" as defined at CCR 895.1 (definitions) is *"that portion of the channel cross-section that confines the normal high water flow"*. In a meandering alluvial channel, the bank on the outside bend will typically have an elevation as great or greater than the bankfull stage, whereas the inside bend will be flooded by the bankfull discharge. This inside bend is often occupied by red or white alders, bigleaf maples (on the backside), and willow species. The watercourse transition line, as defined, would therefore occur below bankfull stage on the inside bend where permanent woody riparian vegetation is established. The watercourse transition line (as currently defined) thus generally separates the active stream channel from its floodplain.

Floodplains are variably defined. Leopold (1994) defines a floodplain simply as "a level area near a river channel, constructed by the river in the present climate and overflowed during moderate flow events." Maddock (1976) notes that "There are two definitions of a floodplain, each of which is equally important. The geologist defines a floodplain as that area of a river valley covered with material deposited by floods. The hydrologist says that a floodplain is that area of a river valley that is periodically overflowed by water in excess of the stream channel's capacity. Any definition more precise than these two is arbitrary to some degree." Both authors agree, however, that the river channel and its floodplain inseparably comprise a stream.

A watercourse is composed of an active channel and a floodplain, although the floodplain may be subtle. For example, dense rows of white alders lining the streambanks are rooted well below bankfull stage. The floodplain may extend only 10 horizontal feet landward, behind the alders, along confined channels with 1.5-3.0% channel gradients. On less steep and less confined channels, the floodplain often extends between valley walls with unequivocal evidence of recently abandoned sidechannels among dense stands of white and red alders.

Why is the floodplain important to anadromous salmonids? First, the floodplain is extremely important as habitat to other riparian-dependent species (e.g., FEMAT 1993). Their protection is sanctioned in CCR 916.2(a)(3): *"The measures used to protect the beneficial uses of water for each watercourse and lake shall be determined by the following: ...(3) The biological needs of the fish and wildlife species by the riparian habitat."* Second, floodplains provide winter refuge habitat for juvenile anadromous salmonids during high flows. Backwaters, old scour channels, and the vegetated floodplain surface greatly reduce water velocities during even the highest floods. Third, floodplains supply and store LWD. In Prairie Creek, Humboldt County, the channel can migrate over individual LWD pieces, and back again, given the low decomposition rate of submerged redwood. Finally, the floodplain provides hydraulic roughness that buffers potentially radical changes in channel morphology.

A watercourse transition line should demarcate the Class I and II watercourse from the hillside by identifying the outer (landward) edge of the floodplain. There is no single distinguishing feature for demarcation, but rather a preponderance of evidence can be used for identification of this line. This uncertainty should not detract from applying the definition in the field. Several excellent indicators include: (1) evidence of recent flood debris; (2) upper depositional limits of sands and silts; (3) remnant channel features, especially oxbow wetlands and relict scour channels; and (4) immature soils. A brief workshop would benefit RPFs, fisheries biologists, CDF inspectors, and others in field identification of the watercourse transition line.

The next zone, the riparian buffer, should begin at the watercourse transition line (i.e., the floodplain boundary) and extend upslope. Primary and secondary functions of the riparian buffer will define its width and acceptable management prescriptions. If possible, site-specific characteristics and objectives should influence these prescriptions.

Many reviews of riparian buffer function are available. These reviews generally conclude that a buffer width equivalent to 100 ft wide or to one site-potential tree (SPT) height delivers most LWD into the stream channel (momentarily disregarding hillslope processes such as mass wasting). For example, the ManTech report (Spence et al. 1993, p. 218) concludes: "In summary, most recent studies suggest buffers approaching one site-potential tree height are needed to maintain natural levels of recruitment of LWD." With respect to a short segment of watercourse, most LWD will be supplied either by the floodplain or from the adjacent hillslope. The actual proportion of LWD delivered to the stream channel will be site-specific.

Analysis of downed timber on 17-70% hillslopes in the Oregon Cascades (R. L. Beschta, unpublished data) indicated that the probability of a tree falling downslope was greater than 75% (Robison and Beschta 1990, p. 791). Another source (Cummins et al. n. d.) stated that it was essential that rootwads remain on wood that recruits to a stream. McDade et al. (1990) found, for mature conifer stands in western Oregon and Washington, that 85% of the LWD was recruited from within 23 m (75.5 ft) of the stream channel.

In the north coastal area of California, one site-potential tree height is not a good indicator to use as a criteria for determining buffer widths that would maintain natural levels of recruitment of LWD and canopy coverages that would protect against changes in stream temperatures. Site curves of average total height for average DBH redwood and Douglas-fir are curvilinear with rapid initial increases up to age 20-40 years, less rapid increase with age from age 60-100 years, and only a slight increase in height after 100 years of age. The main problem with using site-potential tree height is the difference between Site I and Site V. In the upper reaches of some north coast California streams that are located outside of the fog belt on hot dry sites, one site-potential tree may be 80 ft tall at 100 years of age. At lower elevations

within the redwood region, one site-potential tree could be 240 ft tall. Consequently, if one site-potential tree height is used to determine buffer width in the hot dry zones, the buffer would be 80-ft wide, while in the lower zone it would be 240-ft wide. This would result in more shade and LWD in the cooler stream zone and considerably less shade and LWD in the warmer stream zone. This is probably the reverse of what is actually needed for protection of salmonid habitat.

A state program that could have an impact on LWD is the DF&G program for issuing "stream alteration" permits under Section 1600 of the Fish and Game Code. The SRP believes that this program should be reviewed to ensure that its goals are consistent with regard to maintaining LWD recruitment for protection of salmonid habitat. These permits are issued by the DF&G and are usually reviewed and approved in the field by the wardens. This program needs to be reviewed for its possible impacts on LWD.

Recommendations (see WLPZ section for additional LWD recruitment recommendations)

1. The state and federal government should work closely with landowners to develop programs for the placement of LWD into streams where the watershed analysis indicates that the lack of in-channel LWD may be limiting to salmonid populations. Incentive programs should be developed to encourage landowners to participate in this program through tax benefits and other incentives.

3. Geological Concerns

Background

Impacts to unstable features are addressed at CCR 923.(c), pertaining to road construction where the rules state "logging roads and landings shall be planned and located, where feasible, to avoid unstable areas." The rules also allow the Director to approve exceptions to this rule where crossing the unstable feature is unavoidable when mitigation measures are provided in the THP. At CCR 914.2 (d), the rules require tractor operations to avoid unstable features, and allow the same exception to operate on such features where the RPF explains and justifies the THP and incorporates mitigation. This same rule section at (f) excludes tractors from operating on slopes greater that 50% where the erosion hazard rating is high or extreme.

All unstable features must be shown on the THP map, as required by rule section CCR 1034(x)(10). There are no specific requirements for the RPF to consult with a private geologist. However, they must identify the locations of all the existing slides on the ground and show them in the THP, and provide migration if they proposed to operate on these features.

Discussion

Both foresters and geologists are required to be licensed by the state, and RPFs are required to consult outside specialists when they exceed their area of expertise (CCR 1602(b)). Professional organizations, such as CLFA, have co-sponsored workshops for foresters, and the staff of the respective licensing boards for the two professions are working on a geological training program for RPFs. The geologist constituency group was supportive of training for foresters, and supported the development of better, up-to-date geologic maps from the state Division of Mines and Geology (DMG). State representatives confirmed that they are updating maps.

During the THP review process CDF utilizes the services of the DMG. The purpose of this review is to identify impacts that may result to unstable features from timber operations. This review is based on the information provided in the THP, inspection of available geologic maps, and, if necessary, a field inspection. However, this review depends heavily upon the recognition and identification of unstable features described and mapped in the THP.

The geologists constituency group, as well as several other interviewees, recommended that geologists provide a review of THPs at the following two levels: (1) provide a broad overview of geological conditions on the CWE assessment area; and, (2) recommendations for harvesting or road construction on unstable slopes. They suggested that a registered geologist could provide the overview on a property-wide basis, similar to the way that archeology is reviewed. This review would be photo and map-based, and would identify any areas of potential geological concern that would need field review. This review would not replace a thorough field inspection of any THP area. It is, therefore, important for RPFs, who are the primary resource professional performing field reconnaissance, to have a basic understanding of geology. To assess impacts of harvesting operations or road construction on an unstable feature, and recommend mitigation, a certified engineering geologist would be required.

Several constituency groups, including the environmental community, the geologists, and the watershed specialists, expressed concern that there needed to be more consideration of geological concerns, with respect to silviculture on unstable slopes. In the last few years there have been several high-profile slides on timbered properties that occurred on or near where logging had occurred. Regardless of the cause of these slides, the public has a concern for safety issues and adverse impacts to fishery resources.

The issue of landslides on soft, poorly consolidated sedimentary rock has been the subject of recent studies that found slides on steep inner-gorge slopes, not roads, were the primary source for erosion on this geologic type (PWA 1998). This has raised concern regarding the use of evenaged, or in some cases, any harvesting, on these types of geology. Geologists have been assisting foresters with harvest prescriptions on these geologic types. An issue raised by several interviewees was whether or not RPFs were qualified to locate slides and unstable slopes (especially potential slides and unstable areas), and propose mitigation.

Another area of concern identified by several studies was the steep, headwater areas with concave slopes that might occur at the top of Class III watercourses. These types of slope conditions were identified in the Critical Sites Erosion Study (Durgin et al. 1989) and are, in part, the basis to identify potentially unstable slopes in the SHALSTAB Model. Failures initiated in these headwall areas may result in debris torrents in the Class III watercourse downstream of the failures. Additional geological issues are addressed in the watercourse and lake protection section.

Recommendations

1. To identify any known or likely unstable areas, RPFs (or landowners) should have a geologist conduct a broad geologic review of the property. This review would be conducted using maps and aerial photographs and would identify areas of geological concern that would then require field investigations by a geologist.

2. A review by a CEG or Registered Geologist should be conducted where road construction or harvesting is proposed on an unstable feature.

3. Programs need to be developed that provide RPFs with geologic training through field-based workshops. These programs need to provide RPFs with a basic understanding of geologic processes and recognition of unstable features. This training is not intended to supplant the role of geologists. This RPF geologic training should be required for RPFs preparing plans in the north coast region of California.

4. Due to the increased risk of impacts of harvesting on steep slopes, the SRP recommends that no evenaged harvesting be allowed on slopes greater than 65% unless the plan is reviewed by a geologist and suitable mitigation is available for avoiding adverse significant sediment impacts.

5. Steep headwall areas at the top of Class III watercourses should be carefully evaluated for geologic issues before harvest, and alternative silviculture utilized where needed to protect slopes.

6. CDF and DMG should work together to provide RPFs and geologists up-to-date geology and slope hazard maps.

4. Road Construction and Maintenance

Background

The Forest Practice Rules require (CCR 923) that all logging roads and landings shall be planned, located, constructed, reconstructed, used and maintained in a manner that "is consistent with long-term enhancement and maintenance of the forest resource; best accommodates appropriate yarding systems, and economic feasibility; minimizes damage to soil resources and fish and wildlife habitat; and prevents degradation of the quality and beneficial uses of water." Factors that the RPF shall consider when selecting feasible alternatives for road locations shall include, but not be limited to, the use of existing roads wherever feasible; the use of systematic road layout patterns to minimize total mileage; roads are to be planned to fit topography to minimize disturbance to the natural features of the site; and avoidance of routes near the bottoms of steep and narrow canyons, through marshes and wet meadows, on unstable areas, and near watercourses or near existing nesting sites of threatened or endangered bird species. Roads are also to be located in such a way as to minimize the number of watercourse crossings. Roads should be located on natural benches, flatter slopes and areas of stable soils to minimize the effects on watercourses. Logging systems are to be selected that will reduce excavation or placement of fill on unstable areas (CCR 923 (a-g)).

The FPRs also require that all roads be designated as permanent, seasonal, or temporary (CCR 923.1) Landings associated with roads and yarding activities that will require substantial excavation or exceed 1/4 acre in size are to be located and shown on the THP map (CCR 923.1(a)). The rules also require that roads and landings are to be planned so that an adequate number of draining facilities structures are installed to minimize the erosion on roadbeds, landing surfaces, sidecast, and fills. Unless otherwise explained and justified, the regulations require logging roads to be a single-lane width with turnouts at reasonable intervals. Roads are also planned to achieve as close a balance to the cut and fill volume as feasible (CCR923.1(f & g)). Roads also shall be planned to stay out of watercourse and lake protection zones; however, the RPF may propose an alternative for better protection of water quality or other forest resources (CCR923.1(h)).

The regulations require that drainage structures and facilities shall be a sufficient size and number and location to carry runoff of roadbeds, landings and fill slopes. The drainage structure and facilities shall be constructed as to minimize erosion, to ensure proper functioning, and to maintain or restore the natural drainage pattern (CCR923.2 (h)).

The rules also require that no road construction shall occur under saturated soil conditions, except that construction may occur on isolated wet spots (CCR923.2(r)), and road construction that takes place between October 15 and May 1 shall be adequately drained concurrent with construction operations (CCR923.2(s)). Roads that are to be used for log hauling during the winter period shall be, where necessary, surfaced with rock in depth and quantity sufficient to maintain a stable road surface through the period of use, and no road activities may occur within the WLPZ except for stream crossings or a specified in the THP (CCR923.2(t & v)).

The current FPRs require that all logging roads, landings, and associated drainage structures used in a timber operation shall be maintained in a manner that minimizes concentration of runoff, soil erosion, and slope instability which prevents degradation of the water quality and beneficial uses of water during timber operations and throughout the prescribed maintenance period. In addition, those roads which are used in connection with stocking activities shall be maintained throughout their use even if this is beyond the prescribed maintenance period (CCR 923.4). The prescribed maintenance period is defined as at least one year for roads and associated landings and drainage structures that have not been abandoned in accordance with CCR 923.8. The Director may prescribe a maintenance period extending for up to three years in accordance with CCR 1050 that states (923.4(a)):

"Upon approving a work completion report, the Director may prescribe a maintenance period which extends for as much as three years after filing the work completion report based on physical evidence that erosion controls need to be maintained for the extended maintenance period in order to minimize soil erosion or slope instability or to prevent degradation of the quality and beneficial uses of water."

The road maintenance section (CCR 923.4) requires temporary roads to be blocked or otherwise closed to normal vehicular traffic before the winter period. Subsection (h) requires all road running surfaces in the logging area shall be treated as necessary to prevent excessive road surface loss of materials by rocking, watering, chemically treating, asphalting, or oiling. Subsection (i) also requires soil stabilization treatments on road or landing cuts, fills or sidecast, and shall be installed or renewed when such treatment could minimize surface erosion that threatens the beneficial uses of water. Required soil stabilization is reinforced by subsection (k) that states: action shall be taken to prevent failure of cut, fill or sideslopes from discharging materials into watercourses or lakes in quantities deleterious to the quality of beneficial uses of water."

Discussion

Forest roads have typically been blamed as the culprit for the majority of sediment associated with harvesting and forest management operations. This is still accurate not withstanding more recent reports that for certain geologic types in the Coast Range mountains, mass wasting in the inner gorge area may be the primary source of sediment (PWA 1998). The Critical Sites Erosion Study (CSES), Volume I (Durgin et al. 1989) found that although roads accounted for only 4% of the area, they accounted for 76% of the erosion measured. However, Rice noted (citing McCashion and Rice 1983) that approximately one-third the sediment production was from surface erosion. This same study also supports the findings of more contemporary works that found landslides were concentrated in "soft sedimentary bedrock" that were "geologically young, poorly consolidated and therefore little strength, yet may be on steep slopes" (Durgin et al. 1989). The geologist of the CSES team, also commented that "one of the surprises of the study is that there weren't more failures than we found. Many of the slopes we were on were extremely steep and we had to watch out for our own safety. We had thought cutting trees on these slopes would have resulted in failures but that was rarely the case. There generally had to be some other contributing factors for failures to occur."

The CSES study (Durgin et al. 1989) recommended increased road maintenance until at least following restocking, and recommended that a culvert should be maintained "as long as it remains in the ground." In Volume II of the CSES (Lewis and Rice 1989), Rice wrote that "the lack of follow up has been one of the greatest weaknesses in the erosion control rules." He went on to say that the three year maintenance period may not be enough and a "more hydrologically meaningful rule would be for monitoring to continue for at least 8 years or until the THP had withstood a 4-year or larger storm."

An interview with the Monitoring Study Group of the Board of Forestry and Fire Protection (MSG) and its contractor conducting THP audits provided some interesting preliminary findings to the SRP. The MSG had found little evidence of sedimentation from the road surface or skid trails entering watercourses. However, they did report that the most common source of sedimentation into watercourses was from the fillslope immediately adjacent to the watercourse crossing. They also noted that WLPZs provided sediment filtration for mobilized fines associated with surface disturbance immediately above the WLPZ. However, these buffer zones did not prevent sedimentation from entering the watercourse in Class III waters or in gullies or rills that were created by concentrated runoff from poorly maintained or poorly designed road drainage systems.

Representatives of the MSG group felt that one weak link in the system was the implementation of the THP and the follow-up following harvest, including the implementation and maintenance of road maintenance facilities. The MSG noted few erosion problems from landings and skid roads. Older roads on steep slopes that were reopened generated some problems and they noted some sidecast in the stream from these types of roads. The MSG also noted outsloped roads worked very well, and the best roads they observed were outsloped roads that had been rocked. They also felt that proper maintenance efforts would have prevented some observed crossing failures.

In the final report, the MSG (MSG 1999) found:

"Roads and their associated crossings were found to have the greatest potential for sediment delivery to watercourses...Results to date indicate that greater attention should be focused on improvement of crossing design, construction, and maintenance due to the high levels of departures from Rule requirements and the close proximity of crossings to channels. For roads, better implementation of Rules related to drainage structure design, construction, and maintenance is needed. Mass failures associated with current timber operations were mostly related to roads and produced the highest sediment delivery to watercourse channels when compared to other erosion processes. The majority of the road related mass failures were associated with fill slope problems —indicating that proper road construction techniques are critical for protecting water quality." (p. iii)

A summary of key findings from the MSG report can be found in Appendix E.

Many interviewees noted that past road construction practices, and so-called "legacy" roads, have been and are continuing to be, the source of many sedimentation problems. Many of these roads are in a state of disrepair and several interviewees felt these are critical or key sources of sediment. Both landowner representatives and RPFs noted that newer, more modern road construction efforts have greatly reduced the sediment discharges, including better maintenance efforts and better designed drainage structures. Several landowners have adopted the use of outsloped roads with rocked or unrocked surfaces. Except at watercourse crossings, these outsloped roads had few (if any) cross drain culverts, and field inspections indicated minor surface runoff associated with this type of road drainage design. However, at least two other landowner representatives felt outsloped roads worked well where winter road usage was not planned, and believed that crowned roads with adequate cross-drain culverts and rock surfaces were far better to minimize sedimentation during winter hauling operations. The interviewees stated that the crowned roads provided more direct and rapid road surface drainage, thereby minimizing the distance water traveled on the road surface before entering the ditch line. A representative from the geologist constituency group recommended that if rocked roads were to be used during the winter, then an increase in the number of cross-drain culverts would help reduce sedimentation.

Numerous interviewees, including agency representatives, environmental representatives, and other resource specialists felt very strongly that road maintenance should be extended well beyond

the current three years. There were three common themes from these commentators: (1) roads should be maintained throughout their useful life; (2) roads should be designed in such a way as to be nearly maintenance free, except at watercourse crossings (outslope roads where feasible); and (3) roads that are not necessary for long-term use should be appropriately abandoned by heavily outsloping the roads, and pulling all watercourse crossings back to the natural gradient. These same interviewees felt that the lack of road maintenance of old "legacy" roads, as well as more contemporary roads that are not being adequately maintained, were critical sources of sediment.

There was also discussion regarding the requirement for long-term maintenance under the FPRs. Currently, the rules require the Licensed Timber Operator (LTO) to maintain the road until a completion report is filed and accepted by the CDF (CCR1050(c)). The one-year minimum maintenance requirement then becomes effective, and may be extended for up to three years by the Director under the provisions of CCR 1050. This is very rarely done, according to several agency interviewees. There is also a provision in the rules that may extend the maintenance period even longer for consideration of road maintenance during restocking activities. At CCR 923.4, the rules state "In addition, those roads which are used in connection with stocking activities shall be maintained throughout their use even if this is beyond the prescribed maintenance period." This appears to provide some authorization for CDF to inspect and require maintenance beyond the three year prescribed maintenance period, as restocking may occur for several years following completion of harvest activities.

Although road rocking is typically associated with winter road usage, some landowners have elected to apply rock to maintain a stable road surface and prevent the loss of fines. The rocking of these roads also provides better winter management access for planting and road inspections. Several interviewees expressed concerns about the quality of rock used for winter hauling. Some of the rock used was soft, or had too high of content of fines. The result was the pumping and mobilization of fines during hauling.

Recommendations

1. Roads are either permanent, temporary, or abandoned. Permanent roads can be all weather or seasonal. Temporary roads that may last several years should be considered seasonal (i.e., permanent during its lifetime). There are other variations of road types. Tractor roads can be any one of the three types, though most often temporary, then abandoned. Roads that receive light winter use (e.g, for maintenance, fire breaks) should still be considered permanent (seasonal). The FPR needs to have all requirements for the three road types centralized.

2. An abandoned road must not require cross drains or watercourse crossing structures to direct flow from the road surface or pass watercourse runoff. Both are permanent structures requiring long-term maintenance.

3. No road construction shall occur during the winter period. Road construction must be completed by Oct 15 (refer to Section 923.2(s)) or the start of the winter period, whichever is earlier (see Winter Operations).

4. Develop quantitative rocking standards for anticipated hauling on permanent, all weather roads.

5. The upper slope limit for road construction should be no greater than 65% (refer to CCR 923.1(d)) unless reviewed, and both the location and road design and construction methodology are approved by a CEG.

6. CCR 923.1(d) only vaguely addresses the effects of steep roads (i.e., what to do with "concentrated" surface runoff and soil mobilization), rather than prevention. This rule uses a 100 ft distance from a WLPZ to trigger additional measures

that do not account for the long, steep continuous slopes over which road and landing failures often travel. Nor does this rule consider Class III watercourses. These "additional measures" are not specified, even generally. For example, endhaul requirements should be triggered by any road construction on slopes greater than 50% above any watercourse or hillslope depression. Another consideration should be no sidecasting on slopes over 55%.

7. In reference to Section CCR 923.1(e): new or reconstructed roads with a 20% grade for 500 ft or more should be completely rocked; surfaces of these steep roads are easily compromised by winter and wet weather use.

8. Winter road maintenance must not allow blading. The road must be allowed to dry prior to use. If blading is considered needed, the road is improperly designed and/or maintained. If a permanent road is to be used for winter hauling, it should be upgraded to all-weather status before October 15 or the start of the winter period, whichever is earliest. Limited use of season roads may occur early in the winter period under specific conditions (see "Winter Operations" section).

9. Outsloped roads should be the standard for temporary, seasonal (permanent), and abandoned roads. For permanent all weather roads, crowned, insloped, or outsloped roads may be appropriate and acceptable if long-term maintenance is planned. In Santa Cruz County, vegetation as a surface armor on permanent roads has been considered for light (non-hauling) winter use; this should be explored further.

10. The FPR inadequately addresses (CCR 923) the future trend of re-opening abandoned roads and/or rebuilding/improving existing roads, as opposed to decreasing emphasis on new road construction. Road density, not explicitly considered in the FPR, must be factored into this future trend. While a watershed analysis is the convenient, though not yet defined solution, road density can be considered in CR 923. At a minimum, a general threshold density can flag local areas where additional roads (new and reopened) would have a high likelihood of producing unacceptable sediment runoff and flow concentration.

11. Because the road maintenance period is inadequate (refer to other recommendations), road abandonment, as part of the THP, is critical. The commitment, including personnel and financial, for long-term maintenance must be demonstrated; otherwise abandonment should be required. If the road is to receive occasional use, including the winter period, the road must be considered permanent (seasonal).

12. Where roads within WLPZs receive extended and frequent winter log hauling, additional stabilization measures must be considered. Due to the high cost of road rocking, especially where rock sources are limited, alternatives, such as asphalting or the treatment with heavy road surface treatments, may be a feasible alternative. This is consistent with the requirement of CCR 923.4(h) that states "During timber operations, road running surfaces in the logging area shall be treated as necessary to prevent excessive loss of road surface materials by, but not limited to, rocking, watering, chemically treating, asphalting or oiling."

13. Watercourse crossings and fill slopes should be stabilized using rocking or other suitable means to prevent the erosion of fill slopes and the direct deposition of sediment into watercourses. This is already required under CCR 923.4(i). It appears that a more strict application of this rule requirement at watercourse crossings would greatly reduce direct sedimentation associated with road watercourse crossings.

14. All permanent forest roads (essentially all rural and wildland roads) must be maintained throughout their useful life. When roads are no longer needed in the near-term, these roads must be temporarily or permanently abandoned by outsloping, and the removal of watercourse crossings back to the natural stream gradient. The rules at CCR 923.8 specifically address road abandonment procedures. Any rule modifications should consider the partial abandonment of roads that would allow, where feasible, the passage of four-wheel drive vehicles to provide fire suppression access as well as on-going management or ranching.

15. All roads, permanent, temporary, abandoned and legacy roads that are generating, or have the potential to generate, sediment and are in the WLPZ (except at watercourse crossings) should be removed and stabilized. Some state incentive or cost-sharing program should be developed to implement this recommendation.

5. Watercourse Crossing Structures

Background

Watercourse crossings are addressed in the rules at four primary locations. They are specifically addressed in CCR 923.3 Watercourse Crossings, requiring that all "Watercourse crossing drainage structures on logging roads shall be planned, constructed, and maintained or removed, according to the following standards. Exceptions may be provided through application of Fish and Game Code Sections 1601 and 1603 and shall be included in the THP." To locate and describe watercourse crossing structures in the THP document, CCR 923.3(a) states: "The location of all new and permanent watercourse crossing drainage structures and temporary crossings located within the WLPZ shall be shown on the THP map. If the structure is a culvert intended for permanent use, the minimum diameter of the culvert shall be specified in the plan. Extra culverts beyond those shown in the THP map may be installed as necessary." The number of crossings shall be kept to a minimum (CCR 923.3(b)) and structures on watercourses that support fish shall allow unrestricted passage of fish (CCR 923.3(c)). Watercourse crossing structure removal (CCR 923.3(d)) requires that: "(1) fills shall be excavated to form a channel which is as close as feasible to the natural watercourse grade and orientation and is wider than the natural channel, (2) the excavated material and any resulting cut bank shall be sloped back from the channel and stabilized to prevent slumping and to minimize soil erosion. Where needed, this material shall be stabilized by seeding, mulching, rock armoring, or other suitable treatment." The final provision in CCR 923.3 states (e): "Permanent watercourse crossing and associated fills and approaches shall be constructed or maintained to prevent diversion of stream overflow down the road and to minimize fill erosion should the drainage structure become obstructed. The RPF may propose an exception where explained in the THP and shown on the THP map and justified how the protection provided by the proposed practice is at least equal to the protection provided by the standard rule."

Maintenance of watercourse crossing structures (CCR 923.4 Road Maintenance) is intended to "prevent degradation of the quality and beneficial uses of water during timber operations and throughout the prescribed maintenance period. In addition those roads which are used in connection with stocking activities shall be maintained throughout their use even if this is beyond the prescribed maintenance period." The prescribed maintenance period for watercourse crossing structures can extend up to three years (CCR 923.8(a)). No maintenance period is required for abandoned watercourse crossing structures. Provision (d) requires unrestricted passage of water (when feasible) and use of trash racks. Culverts not capable of passing the 50-yr floods are to be removed (though exceptions are allowed) and structures that are "properly functioning" prior to timber operations need not be removed (923.4(f)). Provisions (m) and (n) recognize a wide range of practices to keep structures functioning: "Inlet and outlet structures, additional drainage structures (including ditch drains), and other features to provide adequate capacity and to minimize erosion of road and landing fill and sidecast to minimize soil erosion and to minimize slope instability shall be repaired, replaced, or installed wherever such maintenance is needed to protect the quality and

beneficial uses of water." Finally, (p) allows exceptions to CCR 923.4 (b through o) if at least equal to the standard practice.

Another rules section addresses watercourse crossing abandonment (CCR 923.8) which provides "permanent maintenance-free drainage, ... and protects the quality and beneficial uses of water." Provision (e) states: "Removal of watercourse crossings, other drainage structures, and associated fills in accordance with 14 CCR 923.3(d). Where it is not feasible to remove drainage structures and associated fills, the fill shall be excavated to provide an overflow channel which will minimize erosion of fill and prevent diversion of overflow along the road should the drainage structure become plugged." Exceptions are provided for (e), if at least equal to the standard rule.

Watercourse crossings on tractor roads are addressed in CCR 914.8. Provisions (a) through (e) and (e) are similar to requirements on other road types (listed above). Provision (d) states: "Watercourse crossing facilities not constructed to permanent crossing standards on tractor roads shall be removed before the beginning of the winter period. If a watercourse crossing is to be removed, it shall be removed in accordance with 14 CR 923.3(d)."

Discussion

Watercourse crossings were also considered a key issue affecting salmonids. Several interviewees, including agency representatives, watershed specialists, and fisheries biologists, expressed a need for fish passage at all watercourse crossings for all life stages of fish (as required in the FPR). This includes passage of juvenile salmonids both upstream and downstream. Many landowner representatives supported this requirement. However, several expressed concern that the wholesale removal and replacement of culverts on existing road systems would be very costly. Several interviewees felt that wherever forest roads crossed Class I watercourses, bridges or natural bottom pipe arches should be used in lieu of culverts.

One hydrologist interviewed noted that, "The risk of culvert failure depends on its size compared to flood events. Data from FEMAT suggest that the probability of failure for a culvert sized for a 100-yr storm is less than 20% after 20 years, which is the average useful life for a CMP. This compares to probabilities of more than 50% and less than 40% for culverts sized for 25- and 50-yr storms, respectively. Increasing culvert diameters also allows for passage of sediment and debris, and adds a factor of safety. Fish passage, however, may be negatively affected by increased culvert diameters." Several interviewees stated that peak discharge estimates and culvert sizing methods should be clearly documented in all timber harvest plans wherever a watercourse crossing structure is to be installed.

The FPRs require all watercourse crossing structures to pass a 50-year flood, but the rules provide no guidelines for how to size watercourse crossings for the 50-yr flood. CDF (1983) has provided RPFs with a technical memorandum that includes the Rational Method and other culvert sizing methods. Documentation of culvert sizes (CCR 923.3(a)) is of limited usefulness (but important for compliance) without knowledge of the upslope drainage area and/or channel width. For small drainages, sizing for debris (woody and mineral) blockage, rather than hydraulic capacity (e.g., the 100-yr flood), may be the appropriate sizing methodology. However, a sizing methodology similar to sizing floods has not been developed, and can be very site-specific. Flanagan et al. (1998, p. 21) noted that: "In low-order channels of northwest California, 99 percent of transported wood greater than 300 mm long was less than the channel width (Flanagan, in review). These findings suggest that culverts sized equal to the channel width will pass a significant portion of potentially pluggable wood. However, the remaining one percent of the pieces remain a hazard. Thus, wood plugging hazard can be reduced but not eliminated. The woody debris capacity of a crossing can be assessed by taking the ratio of the culvert diameter to the channel width (w*). Crossings with low values of

w* are more prone to debris plugging. Using the Northwest California coast region as an example, sizing culverts equal to the channel width will, in most cases, satisfy a 100-yr design peak flow (Figure 7). However, on wider channels (e.g., > 2 m), the cost of employing this strategy can be prohibitive." For culverts in small drainages, sizing by channel width is preferred over hydraulic/hydrologic sizing (requires drainage area to estimate the 50-yr flood). Hydraulic/hydrologic methods (such as the Rational Method) targeting the FPR for sizing a 50-yr flood are available (e.g., Weaver and Hagans 1994). Other methods are available, (e.g., regional equations), but are often more appropriate for larger drainage areas (Waananen and Crippen 1977). Depending on the method employed, either channel width and/or drainage area should be provided in the THP.

Flood stage for a 50-yr flood (the headwall depth, HW) can exceed the culvert diameter (D) and not endanger a culvert's structural integrity. However, floods that exceed HW/D = 1.0 for the design storm (presently the 50-yr flood) risk plugging by woody debris (Flanagan et al. 1998): debris rafts at the inlet during the rising flood stage, then collapses into the culvert inlet during the falling flood stage. The design flood should have a HW/D no greater than 1. A 100-year design flood will reduce plugging failure, minimize channel constriction, and allow a significant portion of the culvert invert to be set below the channelbed elevation thereby creating a natural bottomed bed surface.

Many watercourse crossing structure requirements, including maintenance, depend on road type. For permanent (all weather and seasonal), tractor, temporary, and abandoned roads (as defined in CCR 895.1), there should be only two types of watercourse crossing structures: permanent and temporary. We feel strongly that a permanent watercourse crossing structure cannot be left "in a condition which provides for long-term functioning of erosion controls with little to no continuing maintenance" as defined for the term "abandonment" (CCR 895.1). As noted by Flanagan et al. (1998): "In the absence of maintenance and replacement, all these structures [road stream crossings] will eventually fail as they plug or the culvert invert deteriorates." A fully functional, permanent watercourse crossing structure (including cross drains) must be accompanied by a long-term commitment to its continual maintenance.

A seasonal watercourse crossing structure is only fully functional unless accompanied by a commitment to remove it prior to the winter period. Thus, the maximum lifetime of a seasonal structure spans a single season: from the end of one winter period to the start of the next winter period. Therefore, on temporary roads, used only during timber operations, the provision "that drainage structures be adequate to carry the anticipated flow of water during the period of use" (CCR 895.1, p.15) is insufficient. No one can anticipate next winter's flows. If timber operations extend into the next winter period, watercourse crossing structures must be designed, constructed, and maintained as permanent. Seasonal roads should have permanent watercourse crossings.

Section CCR 923.3(c) of the FPRs states: "Drainage structures on watercourses that support fish shall allow unrestricted passage of fish. "Although this rule is stated clearly, many culverts remain partial or complete barriers to both adult and juvenile salmonids migrating upstream. Recent attention on upstream migration of juvenile salmonids has revised our interpretation of what constitutes a fish barrier. Many culverts that allow unrestricted adult passage are typically partial, if not complete, barriers to juvenile salmonids because of the considerably poorer jumping and swimming abilities of young salmonids.

Culverts that completely block adult migration are often easy to identify. Many of these occur along older county roads. These artery roads frequently follow the larger tributaries (crossing them several times) or cross many tributaries flowing into the mainstem (as the road parallels the valley bottom).

In contrast, culverts that partially block migration are particularly common along established artery logging roads and county roads. These crossings can be extremely difficult to assess: a user-friendly assessment protocol is available (http://www.stream.fs.fed.us/fishxing) for adult salmonids, but not yet fully functional for juvenile salmonids. With the present-day emphasis of new road construction along or near the ridge tops, most new culvert installations cross upper Class II or Class III streams. Therefore, the issue of fish passage will be focused more on existing watercourse crossings than new installations.

There are no watercourse crossing design standards (including retrofitting standards) or practical guidelines for fish passage in the FPRs. All new and replaced watercourse crossings on Class I watercourses must allow unrestricted passage to adult and juvenile salmonids by having a natural bottom to the culvert or the use of a bridge. Existing watercourse crossings on Class I watercourses that do not have a natural bottom, or could not be replaced with a natural bottom, must be evaluated for fish passage. Existing culverts must be retrofitted to allow adult passage. Some will never achieve the even more restrictive juvenile passage no matter what the retrofitting. Juvenile passage may be critical, and thus must be evaluated on a site-by-site basis.

To assist culvert siting and replacement with respect to fish passage, the SRP favors an approach developed by Bates et al. (1999). This protocol is readily available at: www.wa.gov/wdfw/habitat.htm. There are two options. The first is a no-design option that allows a culvert diameter 1.2 times the channel width placed on a flat gradient with (Bates et al. 1999, Appendix B WAC 220-110-070 Water Crossing Structures) "the bottom of the culvert placed below the level of the streambed a minimum of twenty percent of the culvert diameter for round culverts, or twenty percent of the vertical rise for elliptical culverts (this depth consideration does not apply within bottomless culverts). The twenty percent placement below the streambed shall be measured at the culvert outlet." The second option specifies a quantitative fish passage analysis. The fish passage design criteria for adult salmonid passage (Table 1 in Bates et al. 1999) are appropriate to Northern California. Bates et al. (1999) specifies the following low flow passage window: the two-year seven-day low flow or 90% exceedence flow for migration months of the fish species of concern. A high flow passage window is "the flow that is not exceeded more than ten percent of the time during the months of adult fish migration" or "the two-year peak flood flow may be used where stream flow data are unavailable." For northern California salmonids, the 10% rule for high flow passage is too low. We strongly recommend using the two-year peak flow as the upper passage flow.

Analysis of existing culverts for fish passage can be implemented using the USDA Forest Service protocol (http://www.stream.fs.fed.us/fishxing). This protocol requires some training in hydrology and hydraulics. A brief workshop would allow RPFs, THP inspectors, DF&G and NMFS staff, and others to use the protocol as a diagnostic tool. For borderline and/or unusual culvert settings, an engineer (or similarly trained professional) may be required, for example, retrofitting would typically involve backwater analysis. We do not recommend baffles.

The FPRs at section CCR 923.3(a) states: "The location of all new and permanent watercourse crossing drainage structures and temporary crossings located within the WLPZ shall be shown on the THP map. If the structure is a culvert intended for permanent use, the minimum diameter of the culvert shall be specified in the plan. Extra culverts beyond those shown in the THP map may be installed as necessary." Insufficient documentation of watercourse crossing locations and sizing make evaluation from the THP documents impossible. Given the last sentence in CCR 923.3(a) above, the final number and sizes of culverts in a particular THP remain uncertain. The unforeseen need for additional watercourse crossings should be limited

to cross drains, when constructing and/or upgrading roads, and small Class III watercourses. Presumably, additional crossings on Class I and II watercourses require DF&G Fish and Game Code Sections 1601 and 1603 permits. The SRP did not discuss with DF&G recent changes, as well as implications of these changes, to the 1600 process. However, these additional, larger crossings should be located and documented (e.g., sizing) in the THP or by amendment.

The FPRs (CCR 923.3(h)) require maintaining or restoring the natural drainage pattern, functionally disconnecting road surface drainage from watercourse drainages. Disconnecting the road drainage from the watercourse drainage prevents overburdening the watercourse with road surface water and helps minimize sediment input from road ditches or from road surface drainage into watercourses. This is also consistent with the requirements of CCR 923.2(h) that requires drainage structures and facilities "to maintain and restore the natural drainage pattern." Insufficient guidelines are provided in the FPR for accomplishing this hydrologic disconnect.

The FPRs at CCR 923.4 state: "(a) The prescribed maintenance period for erosion controls on permanent and seasonal roads and associated landings and drainage structures which are not abandoned in accordance with 14 CCR 923.8 [943.8, 963.8] shall be at least one year." The Director may prescribe a maintenance period extending up to three years in accordance with 14 CCR 1050. This section (CCR 923.4) should become obsolete for watercourse crossings with designating them as either permanent or temporary (as discussed above): there is either continual long-term maintenance or a single season's. The problem is guaranteeing long-term maintenance beyond the time horizon of the THP. The maintenance period could be extended longer than three years, but the collective administrative oversight by all concerned agencies for such a provision is unlikely. One strategy could be demonstration by the landowner that a particular road is needed, and if so, that the landowner has the resources for its maintenance. Another strategy could utilize Rice's (p.49, in CDF and USFS [1989] Critical Sites Erosion Study, Vol. I) suggestion that monitoring continue until the structure has successfully performed in a prescribed flood event (Rice uses a 4-yr event). For culverts, this event probably should be a higher magnitude, less frequent event, (e.g., a 10-yr flood). We support this process-based approach, but have no mechanism to recommend past responsibilities connected to the individual THP.

The FPRs do not provide a definitive directive for minimizing stream crossing failure for "fail-soft" considerations. Crossings must be built so that they cannot divert a stream if (when) the culvert fails, and must not rely on a structure or maintenance for this guarantee. Critical dips at watercourse crossings prevent the diversion of water resulting from a plugged culvert. CCR 923.2(h) states that these are to be constructed where feasible. Weaver and Hagans (1994) provide numerous guidelines for a "fail-soft" design. As they stress (p.67): "Stream crossings on all newly built or reconstructed roads should not be constructed in a manner that gives any opportunity for future stream diversion." Abandoned roads should be held strictly to a high standard of "fail-soft." An excellent description of the "fail-soft" concept, with examples, can be found in Furniss et al. (1997) (see Figure 8).

The FPRs at 923.4 (f) require drainage structures, if not adequate to carry water from the fifty-year flood level, shall be removed in accordance with 14 CCR 923.3(d) by the first day of the winter period, before the flow of water exceeds their capacity if operations are conducted during the winter period, or by the end of timber operations whichever occurs first. Properly functioning drainage structures on roads that existed before timber operations need not be removed. An RPF may utilize an alternative practice, such as breaching of fill, if the practice is approved by the Director as providing greater or equal protection to water

Figure 8.

quality as removal of the drainage structure. The SRP does not consider culvert breaching to provide equal or better protection than culvert removal.

The rules do not specify a minimum cross drain culvert size for roads. Most constituency groups interviewed considered 18 inches the minimum acceptable diameter for cross drains. Weaver and Hagans (1994) emphasize that: "In areas of high erosion and/or storm runoff, minimum ditch relief culvert sizes should be 18 inches, but ditch relief culverts should never be less than 12 inches diameter."

Recommendations

1. A design flood for sizing watercourse crossings must have a HW/D no greater than 1 for a 100-year flood. Specifying the methodology employed for sizing and providing pertinent information (channel width and/or drainage area) must be provided in the THP.

2. A drainage structure left in an abandoned road should be considered permanent and, therefore, the landowner's long-term responsibility. Otherwise, the drainage structure must be removed. For planned abandonment of roads (CCR 923.8), provision (e) should be eliminated: "Where it is not feasible to remove drainage structures and associated fills, the fill shall be excavated to provide an overflow channel which will minimize erosion of fill and prevent diversion of overflow along the road should the drainage structure become plugged." This rule is particularly inappropriate for cross drains. An abandoned road with cross drains (on an insloped or crowned road) cannot meet the intent of CCR 923.8.

3. To allow adult and juvenile salmonid passage, all new and replaced Class I watercourse crossings must have a natural bottom.

4. All permanent and temporary crossings (new and existing) on Class I and II streams must be shown on the THP map or, for existing crossings only, referenced to a specific map and database in the watershed analysis. Watercourse crossings over Class I and II watercourses, not included in the THP, must be included as amendments.

5. Section 923.1(g)(3): should state that no more than 100 ft of an inside ditch should drain into a stream crossing. Section CCR 923.2 should be modified to state: "Permanent watercourse crossings... shall be constructed to prevent diversion of stream overflow down the road."

6. A permanent culvert requires permanent maintenance; provisions for 1-yr or 3-yr periods are inadequate. A hydrologically-based maintenance period has potential and should be investigated.

7. Require fail-soft road stream crossings that do not rely on structures (e.g., overflow ditches) or maintenance.

8. Breaching is not an alternative to restoring a watercourse crossing's proper function.

9. The minimum cross drain diameter should be 18 inches.

6. Site Preparation

Background

Regulations specifically pertaining to site preparation are found at CCR 915. The regulations require "Site preparation shall be planned and conducted in a manner that encourages maximum timber productivity, minimizes fire hazards, prevents substantial adverse effects to soil resources and to fish and wildlife habitat, and prevents degradation of the quality and beneficial uses of water." Site preparation activities involving tractors are required to follow all of the provisions applicable to "tractor operations" found at CCR 914.2. This section limits the use of tractors on steep slopes and requires tractors not to be operated when soils are saturated. Site preparation cannot be conducted during winter operations unless a winter operating plan is incorporated into the THP and followed, or unless the requirements of the in lieu winter operating plan are met. (CCR 914.7(a))

The slash burning requirements are identified under CCR 915.2. Under provision (b) of this section it states "Broadcast burning shall not fully consume the larger organic debris which retains soil on slopes and stabilizes watercourse banks." Further, during site preparation all activities shall comply with the watercourse and lake protection zone requirements under Article 6, and the wildlife and habitat protection provisions under Article 9 of the Forest Practice Rules. Item CCR 915.3(c) requires site preparation to be performed "in a manner that does not deleteriously affect species that are threatened, endangered, or designated by the Board as species of special concern." Where site preparation will occur in the logging area, all THPs must incorporate a site preparation addendum (CCR 915.4) which describes the general methods of site preparation being used, the types of equipment, the methods for protecting desired residual trees, and explanations and justifications for acceptance alternatives to the standard rules. The current rules allow the treatment of slash by burning except in the WLPZ for Class I and II streams. The restriction of "such burning shall be done only after the first heavy fall rains" may still result in a fairly hot burn because most of the larger diameter LWD will still be dry.

Discussion

Several landowners are reducing sedimentation from slash burning following clearcutting by reducing the amount of broadcast burning. Instead, whole-tree yarding to ridgetop roads was used or slash was lopped and piled and burned. In some operations the slash was chipped or burned at the landing as opposed to on the hillslope. This reduction of slash burning in clearcuts on the steep areas above Class III streams may reduce sediment into these Class III streams. A study should be done to review sediment generated from site preparation and burning.

Most fires, wildfire, prescribed fires and slash burning, increases sediment transport into streams caused by the fire consumption of the slash, litter and other decomposed organic matter on the soil surface and a reduction in infiltration with consequent increase in overland flow (DeBano et al. 1998). An increase in water repellency of soil following broadcast burning of slash has been reported for several locations in Southwest Oregon and Northwest California (McNabb et al. 1989). In the coast range of California the soils with *Ceanothus* and *Arctostaphylos* spp. as early successional species acquire hydrophobic properties that are resistant to wetting (Smith et al. 1997). Fires on these soils may increase sediment transport 30 times above the ambient level with about 70 percent of total sediment resulting from fires (Swanson 1981). Following slash burning in clearcuts, increased solar heating of blackened soils and woody debris can lead to increased soil water temperatures and stream water temperatures

(McMahon and deCalesta 1990). Slash burning has reduced LWD in riparian zones and streams (McMahon and deCalesta 1990).

Several interviewees from agencies and from the environmental community expressed concern regarding site preparation activities. Several comments concerned the use of broadcast burning and potential impacts to Class III watercourses. Others expressed concern that site preparation completed during the prior winter could produce excessive amounts of sediment. On two ownerships visited by the SRP, clearcut-harvesting operations were observed that did not utilize broadcast burning following harvest. On one ownership, the trees had been felled and left tree length, and were then limbed and bucked into log lengths at the landing. On another operation, tops and concentrations of slash were yarded to the landing and decked where they were scheduled to be burned at a later time. The reasons for not utilizing broadcast burning described by landowner representatives included protection of soil resources, and concerns that burning might enhance conditions for undesirable brush species through scarification of seeds. Landowners who utilized broadcast burning stressed concern that the loss of this tool, especially in young-growth redwood, would greatly increase the reforestation costs and would result in poorly stocked future stands due to the limitations on planting. One interviewee suggested that the impact of burning through Class III watercourses once a rotation (every 50-80 years) may be similar to natural fires that occurred at 30-40 year intervals before wide-scale fire suppression efforts became so effective.

One interviewee noted that redwood stands tended to have much heavier and more concentrated slash than those found in Douglas-fir stands following harvest. Several interviewees from state and federal agencies supported the use of spring burning over fall burning because it tended to produce cooler fire temperatures that did not consume the medium to large sized coarse woody debris stored in and near Class III channels. Some large landowner representatives expressed concerns that if they were limited to only spring burning, it would greatly hinder their burning program due to the severe limitations placed upon broadcast burning as a result of air quality standards.

The 2090 Agreement in the southern counties specifically addresses site preparation issues. This agreement requires that all operations must avoid dislodging LWD currently in the channels of Class III's and site preparation cannot occur if it will generate sediment into Class IIIs.

Recommendations

1. Limit mechanical site preparation to the initial portion of the winter operating period before soils have become saturated (see Winter Operations for definition of winter period).

2. Limit broadcast burning where feasible.

3. To prevent soil damage and retain LWD in and near Class III watercourses, develop practices to limit burning to cool burns. Rewrite CCR 915.2(b) where it states "Broadcast burning shall not fully consume the larger organic debris which retains soil on slopes and stabilizes watercourse banks," to better define what "fully consume" means. Minimize burning within the ELZ and avoid ignition in the ELZ. The protection of Class III watercourses during broadcast burning must be addressed in the Site Preparation Plan. Where broadcast burning is used and burning through Class IIIs cannot be prevented, use only spring burning. Fall burning may only be used where the LWD in the Class III is protected.

4. Require a "Site Preparation Completion Report" to be filed with CDF when site preparations are final and an inspection could occur. This report should include a map of the actual area treated, and be separate from the Work Completion Report so the LTO does not have extended responsibility for road maintenance following the completion of harvesting operations.

7. Winter Operations

Background

The specific regulations pertaining to winter operating rules are contained in CCR 914.7. Other provisions throughout the regulations, including those in tractor operations and road maintenance, also pertain to winter operations.

Subsection 914.7(a) of the Winter Period Timber Operations Requirements states that in a winter operating plan: "mechanical site preparation and timber harvesting, shall not be conducted unless a winter period operating plan is incorporated in the timber harvesting plan and is followed, or unless the requirements of subsection (c) are met. Cable, helicopter and balloon yarding methods are exempted." Subsection (b) identifies the requirements of a winter operating plan that must be incorporated into the THP. This winter operating plan must address: 1) erosion hazard rating; 2) mechanical site preparation methods; 3) yarding system (constructed skid trails); 4) operating period; 5) erosion control facilities timing; 6) consideration of form of precipitation – rain or snow; 7) ground conditions (soil moisture condition, frozen); 8) silvicultural system – ground cover; 9) operations within the WLPZ; 10) equipment use limitations; and 11) no unstable areas.

Subsection (c) provides the following exemption to the winter operating plan: "In lieu of the winter operating plan, the RPF can specify the following measures in the THP: 1) Tractor yarding or the use of tractors for constructing layouts, firebreaks or other tractor roads shall be done only during dry, rainless periods where soils are not saturated; 2) Erosion control structures shall be installed on all constructed skid trails and tractor roads prior to the end of the day if the U.S. Weather Service forecast is a "chance" (30% or more) of rain before the next day, and prior to weekend or other shutdown periods; 3) Site-specific mitigation measures needed to comply with 14 CCR 914 for operations within the WLPZ and unstable areas during the winter period." Provisions of subsection (c) do not apply to the mechanical site preparations; a full winter operating plan must be prepared.

The road construction rules at CCR 923.2(n) require that all permanent drainage structures be installed no later than October 15, before the start of the winter operating period. For construction and reconstruction of roads after October 15, drainage structures shall be installed concurrently with the activity. Subsection (r) states: "No road construction shall occur under saturated soil conditions, except that construction may occur on isolated wet spots arising from localized ground water such as springs, provided measures are taken to prevent material from significantly damaging water quality". The rules also require at subsection (s) that: "Completed road construction shall be drained by outsloping, waterbreaks and/or cross-draining before October 15. If road construction takes place from October 15 to May 1, roads shall be adequately drained concurrent with construction operations." Subsection (t) requires: "Roads to be used for log hauling during the winter period shall be, where necessary, surfaced with rock in depth and quantity sufficient to maintain a stable road surface throughout the period of use." Under the "Road Maintenance" section of the regulations at 923.4(h) requires that "During timber operations, road running surfaces in the logging area shall be treated as necessary to prevent excessive loss of road surface materials by, but not limited to rocking, watering, chemically treating, asphalting or oiling." Subsection (o) states: "Except for emergencies and maintenance needed to protect water quality, use of heavy equipment for maintenance is prohibited during wet weather where roads or landings are within a WLPZ." Provisions similar to requirements of winter road construction are also contained in CCR923.5 "Landing Construction."

Discussion

Several members of the state and federal agency groups, as well as representatives from the envi-

ronmental community and other resource specialists expressed concern regarding winter operations. Many concerns were focused on winter hauling operations where fines generated from roads entered watercourses. Some also expressed concern regarding the use of heavy equipment during the winter operating period and during wet weather outside the winter period.

Several interviewees wanted better and clearer standards for road rocking. The rules require road rock to be placed in sufficient quantities to provide a stable road surface, without specifying bulk density or percent fines requirements. Several agency personnel commented that low quality rock was sometimes used that required constant replacement and generated excessive fine sediment[1].

The logger constituency group, as well as the RPF and landowner groups, stated the need to maintain the opportunity for winter operations. This was, in part, due to additional restrictions placed on the operating season as a result of wildlife survey requirements. An example was given where timber falling and yarding operations often could not commence until after June 1 due to limitations on the northern spotted owl survey requirements. Loggers and landowners noted that this had greatly reduced the tractor operating season; to maintain sufficient log flow to supply their mills, several landowners must now generate more logs during the winter operating period. At least one major landowner voluntarily limits winter hauling operations, and has ceased all hauling during periods of rainfall. Another landowner had reached an agreement with CDF and the RWQCB to not haul logs until at least five days had passed since the most recent measurable rainfall. Another major landowner allows no road construction during the winter period. THPs have contained site-specific agreements that allow tractor yarding and hauling on season roads until a designated amount of rainfall occurs.

"Winter Period" is defined as "the period between November 15 and April 1, except for purposes of installing drainage facilities and structures, waterbreaks and rolling dips, in which case the period shall be October 15 to May 1." A USDA Forest Service research scientist has developed a method that may assist with the identification of winter period from a soil moisture standpoint.

The antecedent precipitation index (API) could be used as an erosion forecast tool (R. Ziemer, 1999, pers. comm.). Cumulative rainfall is countered by a daily recession coefficient to track soil moisture (Saxton and Lenz 1967; Keppeler and Ziemer 1990). Use of such an index has the advantage of objectively determining the start and end of the winter period. Presently, the official beginning and end of the winter period are static dates. County changes to the November 15 and April 1 dates include Marin County (October 1 through April 15 (CCR 927.1)), Santa Clara County (October 1 through April 15 (CCR 925.1)), and Santa Cruz County (October 15 through April 15 (CCR 926.18)). In many years, saturated soil conditions can occur either many days earlier or later than the defined date. The API would allow specific adjustment to these dates annually. Regional daily recession coefficients can be developed and the daily API calculated, then posted on the internet, or easily computed by the RPF. Bob Ziemer (pers. comm.) estimated that recession coefficients could be developed within a year, i.e., the API could be available by the beginning of the winter period in 2000.

The rules provide a wide range of winter period and wet weather activities for mechanical site preparation and timber harvesting that may impact water quality. Once initially mobilized, fines will either be stored on the hillslope, in the WLPZ, or will enter a watercourse. This may occur in successive steps associated with storm events. Rules requiring on-site judgement that ongoing activities

1. A member of the watershed specialists constituency group noted that even "good quality" rock could produce significant fines.

are producing fines reaching the watercourse should be taken out of the FPR. For example, section CCR 923.6 Conduct of Operations on Roads and Landings (p. 91) states: "Operations and maintenance shall not occur when sediment discharged from landings or roads will reach watercourses or lakes in amounts deleterious to the quality and beneficial uses of water." The sediment produced by the activity could be entering watercourses throughout the remainder of the winter period, not just during a single event. This provision may therefore not protect beneficial uses of water.

Prevention of initial sediment mobilization should be the focus of allowable activities in the winter period and during wet weather. Erosion control structures constructed one day (or less) before a rainfall event (if accurately forecasted) cannot adequately mitigate soil loss. Surface runoff over a freshly disturbed ground surface risks significant fine sediment production. There should be no tractor road construction in the winter period; erosion control measures on tractor roads must be completed before the winter period.

Winter hauling and tractor yarding must be limited to specifically defined dry periods in the winter. Tractor yarding should require more stringent dry period conditions than cable yarding. The definition of "dry period" is difficult--perhaps too difficult to effectively implement, monitor, and enforce. Enforcement can best be accomplished by requiring that the RPF supervise the winter operating plan. Supervision would not require continual onsite presence, but the level of supervision should be specified in the plan. It should be the RPF's responsibility for sufficient site visitation and communications with RPF LTD to maintain the objectives of the THP. The API index may be a tool for defining a "dry window" within the winter period. A pre-determined percentage of saturation could define this period; for example, a two week dry period in early December could cause a 25% reduction in the index, signaling a 'dry" period. This percentage would allow limited prediction, as well. If a two-inch rainfall occurred the next day, would significant surface runoff result? The API's potential should be explored, experimentally, for objectively defining "dry weather conditions" as well as objectively defining the winter period.

There are newer ground yarding technologies that incorporate lower levels of ground disturbance. The newer ground yarding techniques include "track loader yarding" and "feller/buncher forwarder" operations. These machines typically work on lower gradient slopes (<35%) and have wide low-ground pressure tracks on rubber tires. They also typically work across the ground, on top of the slash and may not utilize a prepared skid road. When done properly, this reduces disturbance to the duff layer, and minimizes exposure of mineral soil, and, due to machine limitations, restricts operations to lower gradient slopes.

The FPRs at CCR 914.7 provides the RPF in lieu alternatives to a winter operating plan (except for mechanical site preparation). These include: (1) "Tractor yarding or the use of tractors for constructing layouts, firebreaks or other tractor roads shall be done only during dry, rainless periods where soils are not saturated", (2) "Erosion control structures shall be installed on all constructed skid trails and tractor roads prior to the end of the day if the U.S. Weather Service forecast is a "chance" (30% or more) of rain before the next day, and prior to weekend or other shutdown periods", and (3) "Site-specific mitigation measures needed to comply with 14 CCR 914|934,954| for operations within the WLPZ and unstable areas during the winter period." Also CCR 914.7(a) excludes cable, balloon, and helicopter yarding operations from a winter operations plan.

The SRP believes that the risk of initiating long-lasting erosion problems from preventable activities during the winter is very high. The measures for preventing erosion therefore need to be clearly defined in a winter operating plan.

Recommendations

1. Use the antecedent API index to define the winter period.

2. The RPF must supervise winter operations. Tractor yarding must only be allowed under "dry" conditions more stringent than cable yarding that are clearly defined in the winter operations plan. The API should be investigated for defining "dry" conditions in the winter period and "wet" weather conditions outside the winter period, particularly for objectively assigning "dry" conditions status for tractor logging. Without an objective determination, traditional tractor logging in the winter period should be prohibited or restricted to the early portion of the winter period during extended dry periods (as measured by cumulative rainfall or the API).

3. The use of ground yarding systems, such as "track loader yarding" and "feller/buncher-forwarder" operations, may be allowed during extended dry periods during the winter period under the following conditions: slopes < 35%; no new skid trail construction during winter period; all skid trails used must be out sloped with rolling dips installed before the commencement of the winter period.

4. In lieu alternatives should be eliminated; acceptable winter practices must be addressed in a winter operating plan for all yarding systems (e.g., tractor yarding). Cable, balloon, and helicopter yarding operations should require a winter operations plan. The winter operation plan must specifically address sediment production measures for all aspects of the operation.

5. No road or landing construction during the winter period (as measured by API). This shall not limit road rocking or road maintenance during the winter period.

8. Harvest Limitations

Background

The harvest limitation section is a subset of the cumulative effects analysis consideration, and is intended to specifically address the amount and timeframe over which harvesting could occur before significant cumulative effects occurred.

The current standards for harvest limitations are found within the silvicultural section of the rules. At 913.1, the regulations identify the "Regeneration Methods used in Evenaged Management." These regulations identify the requirements of clearcutting and other "regeneration step harvests." To ensure that trees are harvested under "maximum sustained production of high quality timber products" (PCR 4513), the Board of Forestry established rotation ages for evenage regeneration harvests (clearcuts) that are applied by various site classes (CCR 913.1(a)(1)). For Site Class I, the stand age must be at least 50 years, for Site Classes II and II, stand age must be at least 60 years of age, and on site IV and V lands, stand age must at least 80 years. This same rule section under (2) further limits the size of evenage harvest units to 20 acres per tractor yarding, and 30 acres for aerial (helicopter or balloon) or cable yarding. Tractor yarding may be increased to 30 acres where the erosion hazard rating (EHR) is low and slopes are less than 30%. The RPF may propose increasing these acreage limits to a maximum of 40 acres where there is substantial evidence that the increase in acreage meets at least 1 of 5 tests, including: reducing the overall detrimental effects of erosion thereby providing better protection of soil, water, fish and/or wildlife resources. The RPF may also provide feasible off-site mitigation measures that can be incorporated into the plan to justify the increased harvest acreage.

Section (3) of this rule section requires that logical yarding units be placed between each evenaged regeneration unit that are at least as large as the area being harvested, or 20 acres, whichever is less,

and are separated by at least 300 feet in all directions. Following harvesting of the evenaged regeneration unit, harvesting of the adjacent logical yarding unit cannot occur until the following conditions are met: a report of stocking has been submitted and approved and the dominant and codominant trees of the evenaged regeneration unit are at least five years of age, or at least five feet tall and three years of age from the time of establishment on the site by either planting or natural regeneration. If these standards are to be met with trees that were present at the time of the harvest, there shall be an interval of not less than five years following the completion of operations before adjacent evenage management may occur.

Rule section (CCR 913.1(a)(4)(A)) of the regulations is commonly referred to as the "Adjacency Requirement." This requirement applies within ownerships, but does not transcend ownership boundaries. There are further restrictions placed upon evenaged management operations that are adjacent to public roads and non-timber production zone lands. The rules require that "Special consideration for aesthetic enjoyment shall be given to selection of silvicultural treatments and timber operations within 200 feet of the edge of the traveled surface of any permanent road maintained by the county or the state (6)." And, section (7) of this rule states: "Special consideration for aesthetic enjoyment and protection of adjacent stand vigor shall be given to the selection of silvicultural methods and timber operations within 200 feet of adjacent non-federal lands not zoned TPZ."

The above provisions apply to all "evenage regeneration methods" that include clearcutting, seed tree, seed tree seed step, seed tree removal step, shelterwood seed step and the shelterwood removal step. There are no specific tree age or area limitations contained within the regulations pertaining to unevenaged (selection) regeneration methods. Rather than addressing area control (as is done in the evenage regeneration methods), the selection silvicultural regulations utilize tree retention standards to ensure tree canopy is retained and a diversity of tree sizes are maintained across the landscape following selection harvesting. The selection system also includes "group selection" where trees are removed individually or in small groups that are sized from 0.25 acres to 2.5 acres.

For standard selection applications, a basal area retention standard is based on site classification (CCR 913.2(a)(2). On Site I lands, at least 125 square feet of basal area per acre must be retained; on Site II and III lands at least 75 square feet per acre of basal area must be retained; and on site IV lands at least 50 square feet per acre of basal area must be retained. For group selection harvesting, no more than 20% of the THP area may be harvested using group selection areas no larger than 2.5 acres in size. Of the 80% of the remaining area not covered by group selection cuts, at least 80% of that area must meet the basal area standards for standard selection harvesting, and on 20% of that area the stocking may be met by point count of trees that are at least 10 years old (CCR 913.2(a)(2)(B)).

The result of the selection and the group selection retention standards is to retain a moderate degree of canopy cover represented by trees of more than two age classes across the THP area. Re-entry periods for selection areas may vary greatly, with some re-entries being as short as five years and others exceeding 15 years. There are no specific re-entry time frame limitations in the rules for section harvesting. For group selections, the requirement that 80% of the area not covered by group selection harvests must meet the basal area stocking requirements of selection (and 20% may be met with small trees at least 10 years old) means that a moderate canopy density of all sized trees must occur across the THP area. This, therefore, limits the return interval and the intensity of group selection harvesting. It is unlikely given these basal area and stocking requirement constraints that group selection could be used in a frequency of less than a 10- or 15-year return interval. Therefore, if group selection were utilized across the

landscape on a 10-year return interval approximately 20% of the watershed (on an area basis) would be harvested per decade.

Other types of silvicultural system that have tree retention requirements are "intermediate treatments." (CCR 913.3.) This includes the practice of commercial thinning. Commercial thinning is the removal of trees in a young-growth stand to maintain or increase average stand diameter of the residual crop trees, promote timber growth, and/or improve forest health. "Residual stands shall consist primarily of healthy and vigorous dominant and co-dominant trees from the preharvest stand." Section (a) of this rule defines the minimum basal area standards for thinning, and are higher than those for selection harvest. The retention requirements are applied by site classification as follows: on site I lands, there must be at least 125 square feet of basal area per acre following harvest; on site II and III lands there must be at least 100 square feet per acre; on site IV lands there must be at least 75 square feet per acre; and on site V lands at least 50 square feet per acre post harvest.

Sanitation salvage is also included in the intermediate treatment regulations at CCR 913.3(b). "Sanitation salvage is removal of insect attacked or diseased trees in order to maintain or improve the health of the stand. Salvage is the removal of only those trees that are dead, dying, or deteriorating, because of damage from fire, wind insects, disease, flood, or other injurious agent. Salvage provides for the economic recovery of trees prior to a total loss of their wood product value." Stocking standards consistent with 912.7(b) must be met following operations, unless explained and justified in the THP. This requires the retention of at least 50 square feet per acre, or a point count of 300 trees per acre following harvest. Trees to be harvested or retained under this method must be marked by, or under the supervision of, an RPF. This method of silviculture is frequently utilized under the sanitation salvage exemption (CCR1038(b)) and the emergency notice (CCR1052). An RPF is required to prepare the emergency notice and, the emergency must be substantiated by an RPF. Both of these types of notices are "ministerial" in nature, and therefore the agencies do not have discretionary authority over approval. Under the 1038(b) exemption an RPF is not required, and less than 10% of the dead and dying trees may be removed utilizing this exemption. The size and nature of an emergency notice is dependent upon the type of emergency for which the notice is filed. These may be small operations that have resulted from minor fires or wind damage, or may be broad scale operations that resulted from catastrophic fires or widespread insect infestation. Although no formal THP is prepared for either the 1038(b) exemption or the emergency notice, all operations must comply with all operational provisions of the Forest Practice Act and the District Forest Practice Rules applicable to "timber harvest plan" (THP), and "plan." This review does not include a formalized cumulative effects analysis prepared either by the submitter or the state.

Discussion

The issue of harvest limitations was the focus of several lengthy discussions between SRP members and various constituency groups. It was commonly agreed that it would be difficult to set specific limitations of percent harvest goal per decade due to the effect of confounding and, in some cases, mitigating factors. Many involved with these discussions felt that any limitation on harvesting over time should be based upon a thorough analysis of the conditions that would include the geology, the road network, the affected hydrology, and numerous other factors. Others interviewed felt that the current system provided sufficient safeguards to prevent cumulative impacts due to the rate or level of harvesting. Although reluctant to do so, some interviewees provided their opinion that the maximum harvest limitation should not exceed 10% per decade at any particular watershed, and admitted this was based on their opinion and not on any scientific study. Other interviewees stated 75–85% could be harvested, but also stated harvesting

could not be done this quickly under the current rules. An industrial landowner indicated that under the current rules the most rapidly that any watershed could be clear-cut was 20-25 years. This was based on actual experience in two isolated ownership blocks of less than 5,000 acres each.

Based on the interviews conducted with various resource specialists, and a review of available research, the SRP has not found any widely accepted methodology or program that quantifies the level of timber harvesting with either cumulative effects or flooding. There were several discussions pertaining to measuring cumulative effects throughout a basin versus the current methodology of analyzing cumulative effects on a 3-5,000 acre planning watershed. Several resource specialists commented that while there might not be significant adverse impacts on the smaller assessment area, minor impacts may accumulate and be additive in nature, resulting in cumulative impacts when measured downstream at a basin level. There clearly needs to be more science and a better understanding of the incremental and additive impacts of land management activities at a basin scale. Several interviewees supported the concept of watershed analyses conducted at a basin level to identify cumulative effects and help develop management practices that would mitigate those adverse impacts.

A study recently completed by CDF and other cooperators in the Caspar Creek watershed on Jackson Demonstration State Forest indicated that there might be some correlation between harvest levels and peak flows. The study was conducted in the North Fork of Caspar Creek, a roadless area with uncut mature second-growth timber before treatment. The study showed that where 100% of a subdrainage watershed had been clearcut, a two-year rainfall event resulted in a 35% increase in peak flow. In areas where clearcutting had occurred on 30-50% of the watershed, there was a 16% increase in peak flows for drainages with flows greater than 4 liters/second/hectar (Ziemer 1998). Studies in Caspar Creek also found that when 50% of the drainage was clearcut in a short period of time, there was a 98% increase in suspended sediment levels, caused primarily by a single landslide (Lewis et al., in review). Studies in Caspar Creek also demonstrated that, to date, there was no difference in the number of landslides that occurred in areas that had been clearcut compared with uncut areas (Cafferata and Spittler 1998).

Several groups expressed concerns over the lack of rules regulating reentry periods. Their concern was specific to the reentry of stands that had been harvested using thinning or selection and were then reentered within a few years and clearcut. These individuals felt that there should be some type of reentry limitations that prevented this from occurring. The use of clearcutting on stands that were recently thinned or selection harvested was considered to be counter to the intent for these silvicultural methods and the FPA. There was also concern expressed for increased impacts that could occur under rapid reentry on the same area.

Recommendations

Based on concerns raised by some constituency groups, the SRP believes that the Board should consider whether or not a harvest limitation based on percent of watershed area is warranted pending completion of a watershed analysis. This percentage would initially function as a red flag, rather than as a moratorium, signaling a more scrutinized interagency review and public disclosure before approving additional THPs. A considerable range in percentage was recommended among interviewees. Predictably, the environmental community advocated 10% to 15% per decade, whereas several timber industry constituencies offered 70% to 85% per decade. This wide range perhaps best defines the prevailing perceptions of cumulative effects. The SRP believes that a more likely value ranges from 30% to 50%. This range depends on site-specificity, type of harvest prescription, and past history of watershed disturbance, etc., but

putting these (and other) qualifiers aside, this range basically reflects the individual group members' perceptions of cumulative effects. The SRP did entirely agree that any proposed percentage, or range in percentage, could not withstand the intense public and scientific scrutiny if based predominantly on professional opinion. Therefore, the SRP recommends that a blue-ribbon scientific panel (composed of industry, agency, and academic specialists in cumulative effects assessment) be commissioned in 1999 to accomplish this interim mission. Having one panel recommend another was done with great reluctance. But we have the responsibility of offering more than opinion: our investigation was not provided with the necessary time to evaluate our proposed (watershed-analysis-based) cumulative effects assessment protocol.

Recommendations Regarding the Timber Harvesting Plan Process

9. Timber Harvesting Plan Preparation

Background

The Forest Practices Act requires that a THP be prepared by an RPF. The RPF is required to prepare a complete and accurate plan based on field conditions, and submit the plan to CDF for review and consideration of approval (CCR1035.1). The regulations also require RPFs to prepare and submit non-industrial timber management plans (NTMPs) (CCR Article 6, Sec. 1090), PTHPs (CCR Article 6.8, Sec 1092), minor conversion permits (CCR1104), and emergency notices (CCR1058). The minor conversion permit and the emergency notice are both ministerial permits, while all others listed are discretionary permits subject to the approval of CDF as the lead agency under a functional equivalent program to the California Environmental Quality Act (CEQA) process.

The purpose of the THP is to: "1) provide information the director needs to determine whether the proposed timber operations conform to the rules of the Board; and, 2) provide information and direction to timber operators so that they comply with the rules of the Board" (CCR1034).

Discussion

Many of the interviewees, including state agency representatives, private landowners, and some members of the environmental community, stated that the THP process had become overly burdensome and cumbersome. Several private landowners and RPFs noted that the creation of a THP had become very expensive (ranging from $8,000 to $25,000+) and often constituted a financial hardship to small landowners managing low timber volumes. One frequently expressed comment from both RPFs and state agency representatives was that the final THP document was more designed to withstand the rigors of judicial review than to serve as an operational document for the LTO and disclosure document to the public. Members of the public complained that THPs were often inaccurate and incomplete upon submission, and go through significant changes during the review process. Due to the time-frames involved in the THP review process, some members of the public felt that they were precluded from commenting on the complete and final document prior to its approval (see "Timber Harvesting Plan Review" section). Many interviewees, including agency staff, landowners, and RPFs, felt that the THP preparation process should be greatly simplified and should include more emphasis on ground review and active field inspections during operations to insure compliance with the intent of the plan and the forest practice rules.

There was general agreement among the constituency groups that the THP process should include less paperwork and more field time for all of those involved in the process. Due to agency understaffing and the large amount of paperwork required under the current FPR's, few THPs (15-20% for WQ and 2% for DF&G in north coastal California) are reviewed, and field inspections are rarely attended by staff of those agencies whose input may be most needed to protect salmonid habitat. Decisions and conclusions that could affect salmonids are therefore typically made by those who may not have the proper expertise. There was a general consensus that the presence of agency personnel (particularly from DF&G) was lacking, not only at the PHI, but also at subsequent field inspections throughout the THP process. To provide the professional and scientific input necessary for protecting salmonids, there would need to be an increase in staff time, personnel, and budgets for the agencies involved in the THP process.

One suggestion was to create a THP that would primarily be a disclosure document identifying the location of the proposed operations and the site-specific protection measures that would be incorporated in the THP. This document could then be used by both the public and the licensed timber operator (LTO). The abbreviated plan would consist of a minimum number of text pages where the plan submitter identified the location of the plan and the intent to meet the requirements of the regulations, and several maps that would provide the general location of the operation and appurtenant road system, and the specific location of the operation and the locations of watercourses and special protection areas. The emphasis of agency plan review would then be placed upon field inspections during an extended PHI and the preparation of subsequent reports prior to plan approval. This approach could only occur where a watershed analysis had taken place.

The abbreviated THP would reference the watershed analysis document and would incorporate the findings of this analysis in the THP. This is similar to the process that was intended by both the sustained yield plan (CCR913.10) and Program EIR (PTEIR) and PTHP (CCR Article 6.8, 1092). However, the watershed analysis process would be more rigorous and would specifically address watershed conditions and potential factors limiting to salmonid populations that would then be mitigated through the THP process (see Findings and Proposed Strategy).

Another recommendation from members of several groups was the need for accurate, easy to read maps. Several interviewees supported requiring the submittal of larger scale maps and the use of color-coding. All WLPZs and special protection areas would be easily identified on these large-scale maps and could be greatly enhanced by use of color-coding. The quality of the maps currently used by the LTOs was an issue that was raised repeatedly. The rules currently require map scales of "not less than 2" (1 inch = 2640 feet) to the mile" (CCR1034x). This same rule section states that "color coding shall not be used". The RPFs said that the current practice of using small-scale, black-and-white maps made their jobs more difficult, due to the fact that they had difficulty depicting the information that is required on the map for each THP. The RPFs and LTOs recommended the use of maps that were computerized (if available), with standardized legend symbols, color-coded, and in a larger scale than is currently used. Even though it would be more expensive, the LTOs stated that the additional cost would be well worth it, due to the gain in readability and usefulness.

From the standpoint of compiling existing information on salmonids and their habitats (e.g., distribution of habitat, locations of water temperature monitors, results of population surveys), it would be extremely beneficial to be able to use a GIS to integrate the results of relevant surveys from a watershed-based database, with the information required in the THP. For example, if the maps were improved considerably with regard to size, quality, and with the addition of colors, relevant biological information (e.g., where and when salmonid spawning occurs, where thermal "hot spots" have been recorded) could be transferred electronically directly to the THP map from these watershed-based databases. This would allow for better integration of the scientific information into

the THP and would help in developing a comprehensive database.

Several of the LTOs interviewed also suggested standardization of flagging and paint colors. They felt that this would help to alleviate some confusion among the equipment operators and timber fallers. They also supported the use of printed flagging that incorporated both color-codes and words such as "stream protection zone" printed on the plastic flagging. The LTOs encouraged liberal use of flagging and paint, and suggested that the WLPZ boundary be both flagged and painted because after timber felling had occurred, it was often difficult to locate the flagging. The use of standardized paint colors for leave trees and cut trees might also help to avoid confusion during felling operations. The USDA Forest Service has recently proposed standardized paint colors for use in the National Forest system.

Several agency representatives, as well as members of the geologist constituency group, recommended that the RPF consult with other resource specialists prior to and during the preparation of the plan. To provide insight regarding potential areas of geologic instability, a broad overview of the plan area and the cumulative effects assessment area should be done by a geologist. This would be similar to the current review that is undertaken for archaeology. Several CDF and RWQCB representatives recommended that the RPFs consult with agency resource specialists during plan preparation to discuss areas of concern prior to plan submission. They felt that this would greatly expedite the plan review process, and might provide greater disclosure to the public regarding the areas of concern. This consultation could involve only a phone call prior to submission of the THP, to gain input from agencies such as DF&G prior to submission of the THP, and alert the RPF to any fishery resources issues at the onset of the THP process. This is also consistent with the current FPRs at CCR1034.2 under "Professional Judgment" where it states:

"Where the rules or these regulations, provide for the exercise of professional judgment by the forester (RPF) or the Director, the parties, at the request of either party shall confer on the plan area during the initial pre-harvest inspection provided for by law to reach agreement if possible on the conditions and standards to be included in the plan."

It may also be necessary for RPFs to consult with resource specialists other than geologists prior to preparation of the THP. Assuming a watershed analysis has not been completed, the RPF may need to pre-consult with fisheries biologists, watershed specialists, or others to address specific issues related to the THP and its potential impacts to other resources. This would result in site-specific recommendations and mitigations to address items such as key habitat or refugia for salmonids.

Under the current FPRs, there is fragmented responsibility with regard to conducting the THP process. This may make it difficult to hold any one person accountable for their actions. The THP is filed "by a person who owns, leases, or otherwise controls or operates on all or any portion of any timberland" (PRC 458). The landowner, who is not also the timber owner, may or may not know that a THP was submitted on their land until after it has been submitted. The RPF must notify the landowner of the THP submission in writing, but the landowner does not have to sign the THP. Under the current FPRs, although the RPF must prepare the THPs and is usually involved throughout the THP review and approval process, the RPF may not be responsible for, or involved with, the actual implementation (harvesting). Thus, if there is a problem during logging operations, the RPF who prepared the THP is not always available to provide guidance to the LTO. If, however, the landowner and an RPF are held responsible for the THP throughout the THP process, there would be more accountability, the process would be expedited, and the salmonids would be better protected.

Recommendations

1. Revise the THP to focus on operational considerations and serve as a disclosure document for compliance with the applicable regulations. This type of THP could only be used after a comprehensive watershed analysis had been conducted that identified site-specific conditions within the watershed. The THP document would then refer to sections of the watershed analysis to address potential limiting factors, such as sedimentation, temperature, dissolved oxygen, or LWD. Emphasis would be placed upon agency review of the THP, including an in-depth pre-harvest field inspection. The public could then rely on the accuracy of the finding of the watershed analysis, the disclosure of the RPF in the abbreviated THP identifying the resources that may be affected, and a thorough and comprehensive review and reporting by the state agencies. In order for this process to be successful, there would likely need to be an increase in the time available for review by the agencies and the public.

2. To review and discuss areas of concern during the preparation of the plan, the RPF should pre-consult with agency representatives (e.g., CDF, DF&G, RWQCB, NMFS). This may consist of merely a phone conversation, or it may be more elaborate and involve a field visit. The result would be a more concise and accurate plan that already reflects some input from the state agencies upon submission. The three primary reviewing agencies (CDF, DF&G, and RWQCB) would need to recognize that additional time may be required for this pre-consultation, and should budget personnel accordingly.

3. RPF should pre-consult as necessary with other resource specialists, including geologists, fisheries biologists, etc. during plan preparation. Consultation with these specialists will provide insight into site-specific considerations regarding these other resources that the RPF may not otherwise have identified, and will provide the reviewing agencies with a more complete assessment of the THP area. This is also consistent with the requirements of the "Registration of Professional Foresters" at CCR1602 where it states:

"Thus, for an RPF to accomplish a site-specific forestry project where the RPF's prudent level of expertise is surpassed, that RPF may need to utilize the services of other qualified experts including but not limited to geologists, landscape architects, engineers and land surveyors, archaeologists, botanists, ecologists, fisheries biologists, stream restorationists, wildlife biologists, hydrologists, range scientists, soil scientists, and certified specialists established pursuant to PRC772."

4. All THPs should be signed by the landowner when the landowner and timber owner are different parties.

5. The RPF should be involved with THP implementation in a manner similar to that listed in CCR 913.8(b)(5), as applied in Santa Cruz County, California.

10. THP Review and Approval

Background

Upon completion, THPs are submitted to CDF for review and approval. Upon receipt of the THP, CDF is required to place a copy of the plan in a file available for public inspection in the county in which timber operations are proposed. For the purpose of interdisciplinary review, CDF is required to transmit a copy to the DF&G, the RWQCB, and to the county planning agency. CDF shall invite, consider, and respond in writing to comments received from public agencies that have reviewed the plan and shall consult with those agencies at their request. (PRC 4582.6.(a).) Within the public comment period, any responsible agency (as defined in PRC 21069) shall provide CDF with specific comments or recommendations regarding any significant environmental issues or proposed mitigation measures raised by the THP. If any of these agencies fail to respond by the end of the public comment period, the department may assume that the responsible

agency has no comments or recommendations concerning the THP. However, failure of the responsible agency to make comments or recommendations shall not be used as the basis for determining or presuming that the THP has no significant effect on the environment. The director may grant a responsible agency an extension of up to 14 days to comment on the THP. (PRC 4582.6.(b).) The director of CDF has 15 days from the date the initial inspection (pre-harvest inspection) is completed to accept public comments. If the director determines that the field inspection is not necessary, the director has 15 days from the date of filing, or a longer period mutually agreed upon by the director and the plan submitter, to review the plan and receive public comments. After the initial review and public comment period has ended, the director has up to 10 working days, or a longer period mutually agreed upon by the director and the plan submitter, to review the public input, consider the recommendations and mitigation measures proposed by other agencies, respond in writing to the issues raised, and to determine if the plan is in conformance with the rules and the regulations of the Board. (PRC 4582.7.(a).)

THPs are often rejected by CDF and returned to the RPF who prepared the plan. The decision to accept the plan for filing is made at the first review that is held in Santa Rosa for all THPs submitted in the Coast Forest District. Plans in the Northern Forest District undergo first review at the Redding CDF office. If the plan is rejected for filing, it is returned to the RPF accompanied by a letter identifying the reasons for rejection. An RPF may be subject to disciplinary action by Foresters Licensing if they have repeatedly submitted inaccurate or incomplete THPs. The Forest Practices Act requires that the Board of Forestry undertake disciplinary actions against any RPF who has made any material misstatement in the filing of a THP (PCR 4583.5). Under CCR 1035.1, the rules state "The RPF who prepares and signs a plan is responsible for the accuracy and completeness of its contents."

Discussion

The THP review and approval process was the subject of extensive conversations with several of the interviewed groups. Several interviewees expressed concern that the current THP review and approval process did not provide sufficient time and opportunity for the public to review and comment on the THP. Their specific concern was the changes that occur during the plan review. Several interviewees noted that a THP might be substantially different in its final version compared to when it was originally submitted. They noted that substantial changes might occur during or following the second review of the THP, and that the public did not often have the opportunity to review these changes prior to the end of the public comment period. It was suggested that the public review period be extended to 10 to 15 days following the second review. Under the current standards, the director has 15 days following the preharvest inspection (PHI) to review the plan and receive public comment. Members of the CDF Forest Practice Inspectors group suggested that the public comment period should be tied to the date of the second review and not to the date of the PHI. They suggested that the public comment period be extended to 10 days after the second review, rather than 15 days after the PHI. The CDF Forest Practice inspectors group also suggested more time be allowed between the PHI and the second review. This would allow them more time to prepare field reports, as well as to receive the PHI reports from the other agencies involved.

The CDF Forest Practice inspectors also expressed concern that the three agencies assigned to the review teams (CDF, RWQCB, and the DF&G) did not have sufficient budget resources or staff available to adequately review THPs. They noted that the RWQCB attended only 15-20 percent of THP pre-harvest inspections, and that the DF&G only attended approximately 2 percent of the THP pre-harvest inspections in the Humboldt/Del Norte Ranger unit. The CDF inspectors noted that they typically had a caseload of 50

to 100 or more active THPs, and this greatly limited their ability to do on-site operational inspections when timber harvesting was occurring. They recommended that a caseload of no more than 40-50 active plans be assigned to each inspector. There are also no RWQCB THP representatives stationed in Eureka. Inspectors must travel from Santa Rosa to review plans in the north coast area of California.

Another concern raised by CDF and private RPFs was the timing of THP submissions. Due to seasonal constraints on obtaining northern spotted owl data, most THPs (and NTMPs and major amendments) are submitted in the second and third quarters of the year. Based on information from CDF in Santa Rosa, there were 265 submissions in the first and fourth quarters of 1998, versus 347 for the second and third quarters. This represents a 31% increase in submissions and creates a substantial burden on the reviewing agencies. The THP submission program should consider measures that help maintain an even flow of THP submittals throughout the year.

To assist in review of THPs, and to reduce the extreme variability in responses from RPFs, the CDF inspectors suggested that Question 2 of the cumulative effects section of the THP be rewritten. They also suggested that RPFs need to provide a better description of impacts from the past THPs that were listed in the cumulative effects analysis. They also supported the use of other specialists during THP preparation and encouraged consultation with agency representatives during plan preparation.

Several members of constituency groups, including LTOs, suggested that the LTO should attend the PHI. Several RPFs and landowner representatives noted that the name of the LTO was not always known at the date of submission, and suggested that this might cause some difficulties.

Nearly all groups interviewed agreed that the timber harvesting process has become too cumbersome, creates too much paperwork, and should place more emphasis on site visits. Most agency representatives, as well as many other groups, supported the idea of less requirements for paperwork by the reviewing agencies, more field review during the plan review and approval stage, and more operational and post-harvest inspections. Many were concerned that the paperwork required by the current THP process was designed to address issues that might be raised during a judicial proceeding rather than to create an effective operational document. Several interviewees supported reducing paperwork by conducting more intensive pre-harvest inspections prior to THP approval.

Several large landowner representatives, the environmental community, and at least two agencies supported a more rigorous review of THPs and of active operations. Landowners felt that they conducted good operations that would stand the scrutiny of inspections, and encouraged more severe penalties for landowners who did not follow the regulations, including the institution of civil penalties.

The Board of Forestry rule-making process was not considered by most interviewees to represent true adaptive management. The rule-making relies primarily on political process where rule changes are proposed by CDF, other agencies, or the public, and are usually the result of public pressure. A true adaptive process relies on monitoring as the feedback loop, not politics. The periodic review and modification of the rule does not indicate the adaptive nature of the process. Some may question if the process as sensitive to modification as provided by an adaptive management system driven by monitoring.

To disseminate information more effectively to interested parties, many recommended that CDF post the THPs on an Internet website. Recommended items to post included: (1) a map of the area, including the watershed analysis area; (2) the names of the landowner and RPF in charge of the THP with phone numbers, email, and addresses; (3) the status of the THP (e.g., THP filed or not,

pre-harvest inspection completed, and any reports filed by agency review); (4) the CDF inspector in charge of the review; and (5) the THP. The use of the Internet would provide a central "clearing-house" of information for each THP, thus providing a status report for each THP during the THP process.

Recommendations

1. When known, have the LTO attend the PHI.

2. Extend the agency review period to a minimum of 10 days between the PHI and second review.

3. Increase the time for public comment following the second review to a minimum of 10 days.

4. Increase staff budgets for CDF, DF&G, DMG, and RWQCB to support more frequent attendance at PHIs and provide for periodic operational and post-harvest field inspections.

5. Encourage agencies to conduct more frequent inspections of active operations and conduct post-harvest inspections.

6. Support a THP review system that reduces unnecessary paperwork by reviewing agencies and provides more time for field inspection and reviews.

7. Provide sufficient agency staff time to support pre-consultation with RPFs during the plan preparation.

8. Put key THP information on the Internet that identifies the plan submitter, the RPF, the CDF inspector who is in charge of the plan review, and a copy of the THP.

9. Limit the case load for CDF inspectors to 40-50 active THPs.

10. The CDF should be allowed to impose civil penalties on the RPF, LTO, or landowner, similar to those imposed by the RWQCB.

11. Involvement of RPF in Implementation of THP

Background

Under the current FPRs for the Coast Forest District, the RPF is not required to be involved in the actual implementation of the THP except in some of the Southern Subdistrict counties. These counties have special rules that require the forester to be involved after the plan preparation and with the actual implementation of the plan.

There are typically three parties involved with THP planning, preparation and implementation. These are the plan submitter, who is usually the landowner or the timber owner; the RPF who prepares the plan on behalf of the plan submitter; and the LTO, who actually implements the plan on the ground and conducts the logging operations. For most large landowners, the LTO is either a direct employee of the landowner (or timber owner), or is a contractor hired by the landowner. In either case, a landowner's representative typically administers the THP through a contract to conduct the logging operation. This person may or may not be a RPF. Where "company loggers" are used by large landowners, these administrators often have direct control over the employees that give them the right to hire and fire, and to directly instruct logging personnel on how to conduct operations. In the case of a logging contractor, the person administering the logging contract and the THP for the landowner typically does not have the right to hire or fire the contractor's personnel. They would put themselves in jeopardy of liability laws if they attempted to directly instruct any of the contractor's employees on how to conduct the operations. These administrators typically review the conduct of operations to insure that they are in compliance with the contract and the provisions of the THP and required rules. They may have the right to tell a contractor's employee to stop what they are doing if it is in violation of the contract or the THP; however, these types of actions are generally taken through the chain of command by

reporting any concerns directly to the contractor or his or her foreman.

The regulations specifically require interactions between the plan submitter, the RPF, and the LTO. At CCR 1035, "Plan Submitter Responsibility," the plan submitter is required to insure that the RPF conducts any activities that require an RPF, and the plan submitter is required to provide the RPF preparing the plan with complete and correct information pertaining to legal rights, interest in and responsibilities for land, timber, and access at these affect the planning and conduct of timber operations. (CCR 1035, (a) and (b)) The plan submitter is also required to provide a copy of portions of the approved THP and approved operational amendments to the LTO that contain the general information, plan of operations, THP map, yarding system map, erosion hazard rating map, and other information deemed by the RPF to be necessary for timber operations (c). The submitter is required to disclose to the LTO through an on the ground meeting prior to start of any operations the location and protection measures for any archaeological or historic sites (g). It is the responsibility of the RPF who prepared the plan for the accuracy and completeness of its contents. (CCR 1035.1) The RPF must also, in writing, "inform the plan submitter(s) of their responsibility pursuant to Section 1035 of this Article, and the timberland owner(s) of their responsibility for compliance with the requirements of the Act and where applicable, Board rules regarding site preparation, stocking, and maintenance of roads, landings, and erosion control facilities." (CCR 1035.1(b).)

The rules at Section CCR 1035.2 also specifically identify the interaction that must occur between the RPF and the LTO. This regulation requires that after the start of the plan preparation process, but before the commencement of operation, the responsible RPF or supervised designee familiar with on-site conditions must meet the LTO or their supervised designee, who will be on the ground and directly responsible for the harvesting operation. If requested by either the RPF or the LTO, this meeting is required to be on-site. The intent of an on-site meeting is to assure that the LTO is: (1) advised of any sensitive on-site conditions requiring special care during operations; and, (2) advised regarding the intent and applicable provisions of the approved plan including amendments.

At section 1035.3, "Licensed Timber Operator Responsibilities" are identified. The LTO is responsible for the work of his or her employees and to familiarize all employees with the intent and details of the operational and protection measures of the plan and amendments that apply to their work (b). The LTO is required to keep a copy of the applicable approved plan and amendments available for reference at the site of the active timber operations (c). The operator also must comply with the provisions of the Act, the Board rules and regulations, the applicable approved plan, and any approved amendments to the plan (d).

In addition to the regulations identified above, the Southern Subdistrict of the coast has special provisions for the involvement of the RPF during operations. Under CCR 913.8(b)(5) the rule states:

"The timber operator is responsible for carrying out timber operations as described in the plan. The plan submitter is responsible for retaining an RPF to provide professional advice to the timber operator and timberland owner on a continuing basis throughout the timber operations. The RPF or the designee of the RPF works closely with the timber operator to help assure compliance with the approved alternative prescription and the terms and specifications of the approved plan. The RPF or designee of the RPF is present on the harvest area sufficient hours each week to know the operations' progress and advise the timber operator. The RPF informs the timber operator of potential environmental impacts and the mitigation measures to be taken to minimize such impacts. The timber operator shall sign the plan and major amendments thereto, or shall sign and file with the Director a facsimile thereof prior to commencement or continuation of operation thereunder agreeing to abide by the terms and specifications of the plan. An RPF

may be responsible for the conduct of timber operations under contractual arrangements with the timber owner."

Under the requirements of this rule section, all operations conducted in Santa Cruz County require the advice and monitoring of the THP by an RPF. In the remainder of the Coast Subdistrict, an RPF must be directly involved with the implementation of the THP only when an "alternative regeneration method" is used as described under CCR913.8(b). The RPF involvement identified above under CCR913.8(b)(5) also applies in Marin County.

Discussion

Several interviewees stated that, in their opinion, a critical issue for effective application of the rules was active administration during THP operations. Several agency representatives, as well as representatives of the Monitoring Study Group, noted that problems on THPs were more common when RPFs were not actively involved with the administration of the plan as compared to operations where an RPF or other qualified administrator was directly involved. On larger industrial ownerships RPFs (or other qualified administrators) typically administered the plan and interacted on a frequent basis with the LTO. The LTOs, and most major landowners, supported the involvement of the RPF being involved during the operational phase of the THP. The LTO constituency group noted that when RPFs were involved in the administration of the THP, they typically monitored the plan once a week or more frequently, depending upon the conditions and the status of the operations. Typically, RPFs are more involved during the "start-up" phase of the plan. This is a critical time to identify the issues involved in the plan and to educate the timber fallers and equipment operators about these issues and other operational considerations.

Licensed Timber Operators (LTOs) are required to complete a training course before they can be issued a license to conduct timber harvesting and road construction activities. The Associated Loggers of California (ALC), a loggers trade association, assisted the state with the development of this training program and has initiated a training program of their own. Individual landowners have also initiated training programs. At least one company conducts training for their equipment operators using experienced erosion control specialists. Another company has initiated the "Pro-Logger" program for their logging contractors. This program, developed by the American Forest and Paper Association, is intended to improve the skills of the members' logging personnel.

The South of San Francisco constituency group indicated that there did not seem to be a high degree of resistance to the involvement of the RPF working with the LTO during operations. Both the agency representatives and the RPFs interviewed indicated that landowners felt this was a necessary cost to insure adequate and effective administration of the THP. These state agencies also indicated that this provided very effective application of the THP and rule requirements and that it increased their level of confidence that the provisions of the plan would be achieved. Small landowners interviewed by the SRP expressed concern that the THP plan process was already extremely costly, and the required involvement of an RPF during operations would just add to an already expensive process. Several small landowners also noted that they typically had the RPF administer the THP during the operational phase. Several of the state and federal agency representative's interviews supported a "cradle to the grave" concept, where the RPF would prepare the plan and then be actively involved in the administration of the plan during harvesting operations. This administration would be general oversight to provide advice to the LTO and to review the operations on behalf of the landowner or plan submitter to insure that the provisions of the plan and the regulations are being met. The logger's constituency group pointed out potential issues that might arise if the RPF was put in a direct supervisory role over any of the LTO's employees and

expressed concerns regarding liability and insurance issues.

Recommendations

1. The RPF (or an RPF) should be involved with the operational implementation of the THP. The RPF should visit the plan area frequently enough during plan implementation to insure the provisions of the plan and the rules are being adequately achieved.

2. The meeting between the RPF and the LTO, as required under CCR1035.2, should always be on site rather than just a paper review. This would insure better transfer of plan contents, and allow the RPF and the LTO to visit any critical or sensitive sites that might be present on the plan area. It would also allow the LTO and the RPF to review the flagging and painting designations so there is a clear understanding as to the requirements for protection measures.

3. When identified in the THP, the LTO should attend the preharvest inspection. LTOs should also be required to sign the final approved copy of the THP and all major amendments.

12. Involvement of Other Resource Professionals in THP Review and Implementation

The current rules and the THP review and approval process has several opportunities for the involvement of professionals other than the Registered Professional Forest (RPF) who is charged with the preparation and submission of the THP. Under the current standards, the RPF (or his or her designee) is required to review the plan area for archaeological concerns. This must be done by an RPF or a qualified person who has been certified under an archaeological training course. This does not make the RPF an archaeologist, but allows the RPF to identify archaeological features and search for archaeologist and historic artifacts or other evidence. If the RPF discovers a significant site, a qualified archaeologist is then called in to assess, map and record the site. The RPFs may also map and record minor archaeological sites. There is no similar formal process for the involvement of outside geologists, watershed specialists, fisheries biologists, wildlife biologists, or botanists. (Although private consulting biologists are often used by RPFs for northern spotted owl consultation.) These professionals are usually called in on a site-specific basis depending upon the specific concerns relative to the THP area and its surroundings. The foresters licensing law requires foresters to utilize the services of other resource specialists when the area of concern is outside the RPF's specialty. (PRC 752(b)) Under the current THP preparation, review and approval process, other specialists are often involved.

THPs are reviewed by a multi-disciplinary review team composed of CDF, DF&G, and RWQCB personnel. Representatives from the Parks & Recreation Department, and representatives from the county in which the THP was submitted, may also be involved in the review team upon request. The Division of Mines and Geology (DMG) serves as a consultant to CDF, is often involved in the review team, and reviews all THPs that are identified as having geologic concerns by the CDF following initial screening (First Review). Currently, there is uneven involvement of DF&G and RWQCB in the THP review process. DFG has stated they review less than 5% of the THPs submitted, and RWQCB reviews approximately 10-15% of the THPs submitted in north coastal California. CDF reviews all of the plans submitted, and requires field inspection for over 95% of all THPs submitted in the north coast area.

Resource specialists from the various state agencies are usually not actively involved in the preparation of the THP. Based on input from the agency representatives during the review, THPs are often modified (sometime significantly) to address issues that are raised during the plan review process. Currently there is no formalized process to involve agency representatives in a pre-

submission consultation. However, CCR 1033 requires that all THPs be complete and accurate to be accepted for filing. If a THP has significant geologic issues that are not identified by the RPF, the THP will be most likely be rejected for filing and CDF will require a geologic review by a consulting geologist before the THP may be resubmitted. Similar concerns may be raised for biological or botanical issues.

Discussion

Several constituency groups interviewed, including the environmental group, commented that RPFs needed to involve more outside resource professionals more frequently in plan preparation. Some interviewees were very critical of RPFs working under the assumption that they had sufficient knowledge to address all of the THP issues, when the plans reviewed by a multidisciplinary panel identified several significant issues that were not addressed in the submitted THP. Several interviewees also expressed concern that the state was often put in a position of being the RPF's and plan submitter's expert in the fields of fisheries, biology, geology, and botany. They felt these issues should have been addressed by the RPF prior to plan submission, and the lack of this information frequently resulted in extensive first review questions or plan rejection. While some interviewees felt that the state should not be wasting taxpayer's money by rewriting adequate THPs, some CDF representatives suggested that THPs would be better prepared if RPFs consulted with the state agencies (including CDF) about significant issues during plan preparation and prior to submission. This had mixed support from other interviewees, but seemed to have general (but not unanimous) support from the RPFs interviewed. Several RPFs noted that they already pre-consult with different state agencies prior to submission. This includes pre-consultation for northern spotted owls and other wildlife issues.

The constituency groups of other resource specialists encouraged RPFs to utilize other specialists prior to and during plan preparation. This included a recommendation from the geologist constituency group to have a geologist provide a broad, extensive overview of the area that will be included in the THP to identify any geologic hazards of instability. They felt that this would prevent the RPF from completing extensive fieldwork before a geologist was involved who might identify areas of geologic concerns after the THP was completed. Fisheries biologists also suggested that their involvement early in the THP preparation process could help identify any fisheries concerns on either a watershed level or on a site-specific basis. Watershed specialists expressed the need for a broad overview that would identify basin-wide concerns. This group was critical of the current cumulative effects analysis in that it only provided assessment for small (3-5,000 acres) areas, and did not consider the basin-wide issues. They felt a comprehensive watershed analysis was necessary in order to identify potential basin-wide issues such as sedimentation, LWD, temperature, etc.

Representatives from the state and federal agencies indicated that the RPF's should have continuing education so they have a basic understanding of other resources, and know when to contact other resource specialists. Independent and industrial RPFs stated that they often used other resource professionals, and that workshops were helpful, but should not be mandatory. Some interviewees felt that RPFs did not understand the complexity of riparian – stream ecosystems and some felt that RPFs did not seem to care how their THP affected ecosystems. The small landowners indicated that the more professionals are involved, the higher the cost of harvesting timber.

All of the constituency groups involving other resource specialists supported the concept of providing more continuing education and workshops to foresters regarding other resources. While it is not intended that foresters who take geology short courses will become geologists, RPFs will become more cognizant of the geologic processes. They then have a better understanding of when it may

be appropriate to call in a geologist to assist with THP preparation. An existing program to educate RPFs and other resource professionals on the watershed processes is the "Watershed Academy." This has been a joint effort of CDF and DF&G. There was support from interviewees to develop similar programs for geology and fisheries issues. Emphasis was placed on minimizing classroom-type lectures and emphasizing field oriented workshops.

Recommendations

1. Formalized programs should be developed between CDF, DMG, and professional organizations such as California Licensed Foresters Association (CLFA) and Society of American Foresters (SAF) to help develop more intensive training programs for geologic issues, fisheries issues, and watershed considerations. The Board of Forestry or Foresters Licensing could act as a coordinator for this program.

2. RPFs need to become more aware when other resource specialists are required in the THP process. This is currently required by the licensing regulations at CCR 1602 (b), but there may be a need to place more emphasis on this requirement. To insure an adequate review of resource issues, agency specialists should monitor the involvement of other resource specialists.

3. Although there may be numerous resource specialists involved in the preparation of a THP, the RPF should maintain the role of the coordinator and principal author of the THP document. It is the RPF who is typically hired by the landowner, or employed by the company to be the principal resource manager of a forested property. The RPF usually has a long-term relationship with the property. Thus, he or she is in the best position to coordinate and implement plans and practices on the ground in coordination with the other resource professionals, as well as with the LTO and the landowner.

4. Develop some type of incentives for RPFs to attend different types of workshops; free tuition, certificate of attendance, published list of attendees, etc. Do not make them these programs mandatory. Improve the quality of the workshops, so that all RPFs would enjoy benefit from going to them.

OTHER PANEL RECOMMENDATIONS

13. Rule Organization

Background

The current Forest Practices Act was passed in 1973 as the "Z'berg-Nejedley Forest Practices Act of 1993." Rules were then promulgated in 1974. Since their creation, the Forest Practices Act and the FPRs have undergone continuous change. Various sections of the rules have been changed annually, based on input to the Board of Forestry, and at times, to legislative and judicial requirements. The rules have also witnessed substantial changes in response to significant events such as the release of the 208 Forest Practice Review report in 1987. Another set of significant rule changes occurred in the early 1990s following the adoption of the sustained yield requirements. As a result, these rule modifications have resulted in a set of regulations that are often very difficult to understand, and are disorganized.

Discussion

Numerous constituency groups commented on the difficulties using the FPRs and said that the rules needed to be reorganized to make them more user-friendly. One recommendation was to incorporate all the rules that pertained to a particular title or heading even though the rule might exist elsewhere in the regulations. While this may create some redundancy, it would make the rules easier to use and better identify all pertinent rule

sections without searching through seemingly unrelated rules.

An example of needed rule reorganization is the requirement in the county rules for the Southern Subdistrict of the Coastal Forest District that requires RPF interaction with the LTO during operations. Instead of being listed under the section for county regulations (or under RPF responsibility at 1035.1), this is listed at 913.8 within the Silvicultural Rules. Another example is the requirement for designing culverts to withstand a 50-year return interval storm. This requirement is not included under the section entitled "Watercourse Crossings" at CCR923.3, but instead is included at CCR 923.4 under "Road Maintenance." While there may be good reason to include this requirement under the "Road Maintenance" section, it should also be listed under the "Watercourse Crossings" section.

Recommendations

1. Make the current Forest Practice Rule organization more efficient and user-friendly. For example, reorganize and condense the exemptions, e.g., centralize all road construction and maintenance requirements by each road type (permanent, temporary, and abandoned). The "standard practice" must be made clear, again separating out and centralizing the exemption language.

14. Additional Research Needs

The investigations of the SRP demonstrated the need for more in-depth research. This includes the following issues:

- Sediment study of Class III watercourses: this should include an analysis of post-harvest condition of Class IIIs that are included in units that have been clearcut and burned, and clearcut units that were not burned.
- LWD recruitment mechanisms in young-growth stands: most studies to date are based on old-growth standards. No analysis of recruitment or the functionality of mature young-growth as LWD has been done.
- Review of temperature and humidity regimes pre- and post-harvest: to monitor the effectiveness of the rule standards, monitoring should be established to monitor the effectiveness of the WLPZs for temperature and humidity.
- Water Temperature Studies: physiologically-based site-specific water temperature studies are needed for each watershed area. Knowledge of temperature tolerance and sublethal stress responses of salmonids is far from adequate to define safe thermal limits and determine potential thermal impacts for each THP. Key factors that affect thermal requirements and stress include food availability, DO, previous exposures to stressful situations, innate metabolic rate (i.e., hatchery fish have lower metabolic rates that their wild counterparts). Until a more site-specific physiological approach is used in conjunction with a watershed analysis, determining site-specific thermal requirements and impacts on salmonids as a result of timber harvesting will remain in the realm of conjecture.
- Sediment and Salmonid Habitat: We currently lack a solid quantitative understanding of the relationships between anthropogenic increases in sediment delivery to streams and changes in biologically significant channel characteristics. Such relationships must be understood before an accurate assessment can be made about the effects on salmonid populations of increased sediment delivery to stream channels. We propose a research program that combines hillslope and fluvial geomorphology with salmonid population biology and modeling to link sediment loading, salmonid habitat, and salmonid population response. This regional research program, which would be conducted in a variety of watersheds in the MOA area (see Figure 1), is needed to determine the following: (1) for each type of channel used by salmonids, those indicators or metrics of salmonid habitat (e.g., V*, pool frequency, permeability) that are both sensitive to sediment supply and clearly related to salmonid survival at one or more life stages; (2) what degree of change in habitat indicators from a reference or pristine state will result in an unhealthy population (in terms of population size, stability, and resilience to disturbance); and (3) what level of anthropogenic (relative to natural) sediment delivery will produce changes in channel conditions that would be expected to result in an unhealthy salmonid population.

15. Social and Economic Impacts

The results of successful salmonid rehabilitation are obvious. Healthy salmon runs mean a return of commercial and sport fishing and the secondary support jobs that support a diverse economy. Many consider salmon to be the symbol of the coastal west and an indicator of the health of the overall ecosystem.

When species are listed under the ESA, economic issues cannot be considered. However, under both CEQA and the FPRs the economic and social implications of a project must be considered. In the FPRs under PRC 4513 (c) it states:

"The legislature declares that it is the policy of this state to encourage prudent and responsible forest resource management calculated to serve the public's need for timber and other forest products, while giving consideration to the publics need for watershed protection, fisheries and wildlife, and recreational opportunities alike in this and future generation."

This section also states at (d):

"It is not the intent of the Legislator by enactment of this chapter to take private property for public use without payment for just compensation in violation of the California and United States Constitutions."

Landowners expressed concern over the cost of implementing the FPRs and the potential loss of the trees and land to over-regulation. Members of the fishing community, as well as the environmental groups, stated that they felt as though the impacts to salmon had essentially caused a taking of the fishermen's livelihood and had nearly extirpated salmon from their native habitat. They believe impacts from logging are at least partially to blame.

Regardless of blame, there is currently a reduction in the number of salmon and steelhead on the north coast and the state and federal governments are spending millions to restore the runs. The SB 271-grant fund program is to spend up to $8 million per year for six years for salmon restoration, and the federal government is considering spending $25 million/year for one to several years for salmon restoration.

The impacts to landowners resulting from the proposed rules contained herein will be variable, depending upon how many stream zones they have on their property. There will be additional costs associated with upgrading roads that will most likely be realized during harvesting operations. If our proposed WLPZ rules are enacted, there will be additional cost from deferred harvest of timber, especially in Zone A of the WLPZ for Class I watercourses. The largest impact to landowners will be from the retention of ten large recruitment trees per acre and the retention of all the downed trees in Zone A of both Class I and II watercourses. Assuming retention of ten 32-in DBH trees per 100 m of stream channel, a 1,000-ft section of a Class I watercourse would have approximately 36.4 MBF of LWD recruitment trees. Using $500 as the average stumpage value, the timber retained on this 1,000 ft of stream would have a value of $18,200.

There will also be other costs the landowners will experience over time. The water quality attainment strategy for the Redwood Creek TMDL by the North Coast RWQCB for the 107,000 acres of

private lands in the Redwood Creek basin requires treatments to roads, increased road maintenance, and reduced timber harvesting in the Class I and II watercourses. They estimated the assessment cost for road construction and road maintenance for the Redwood Creek Basin at $18.6 million, and the lost revenue for timber harvesting at $16.4 million. These are the net present values of costs, discounted over a 25-year period for road maintenance and lost timber revenue, and a 12-year discount period for road construction (NCRWQCB 1998). This represents a cost of $327 per acre.

Several of the landowners interviewed urged the development of incentive-based regulations that would reward the good land stewards and establish penalties to penalize the bad with civil or administrative fines. The small landowners noted that there was no incentive in the regulations to encourage the development or maintenance of habitat for threatened species. All the rules currently in place penalize a forest landowner for maintaining habitat and attracting species to their property. There should be some incentive (such as more regulatory certainty) for these land owners that maintain good habitat condition.

It is also important to consider the impacts to the diversity of ownerships. Small, non-industrial landowners represent approximately 40% of the private land in the north coast region, and often have different land management objectives than the larger industrial owners. The smaller owners do not have to supply a mill with logs, so they may be under no pressure to harvest; however, to some small owners their property is their sole source of annual income. The variability in management approaches between the large and small landowners manifests in a diversity of forest structures across the landscape.

One thing that is consistent among landowners is the desire to protect their investment. Large landowners expressed the need to support continued timberland investment in California. One small landowner was more blunt. He had purchased his property about ten years ago and had an NTMP completed a few years ago. He said he wanted to be a good land steward but he had to protect his investment, and would do whatever was necessary. This might include subdivision or sale to a large industrial owner. Several other small owners expressed similar concerns.

Recommendation

Nearly all the constituency groups interviewed supported incentives to landowners to improve and maintain salmonid habitat. This included the use of tax deductions, conservation easements, and restructuring of the federal tax codes to allow expensing rather than amortizing capital road expenditures such as culvert replacements. A program of incentives must be developed to allow the value of the permanently designated standing and downed trees to be deducted from the timber owner's yield or other state taxes. The valuation of these trees could be based on the yield tax value schedules, and would be claimed when harvesting is completed for the associated harvest unit adjacent to the WLPZ. This may also help encourage landowners to include watercourse protection zones in conservation easements. The benefit of providing landowners tax credits against the retained recruitment trees will encourage the retention of important habitat features and is likely to prevent legal proceedings for property taking. If the state and federal governments are going to pay millions for salmonid rehabilitation, then tax credits for the retention of key habitat features may be a reasonable step.

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Report of the Scientific Review Panel

MEMORANDUM OF AGREEMENT

between the

STATE OF CALIFORNIA

and the

NATIONAL MARINE FISHERIES SERVICE

regarding

NORTH COAST STEELHEAD TROUT

Section 1. Purpose and Context

a. Purpose

1. Establish terms and conditions for a collaboration between the State of California (California) and the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (NMFS) for the improved conservation and management of North Coast steelhead.

2. Express the parties' commitment to make needed modifications and adaptive changes to harvest measures, hatchery policies, and habitat and monitoring programs, and to conduct further research on population abundance and viability.

3. Assure continuing collaboration between NMFS and California so that the development and implementation of the California Watersheds Protection Program and the provisions of SB 271 (Statutes 1997, chapter 293) achieve the restoration and maintenance of properly functioning habitat conditions, and contribute to the conservation of steelhead.

b. Context

1. California and NMFS recognize that local conservation efforts are crucial to the success of any conservation strategy for California's anadromous fish. Existing efforts will continue to be supported by NMFS and California, and new local efforts will be encouraged.

2. California and NMFS recognize that existing efforts by the private sector to gather and analyze data and information are beneficial to any conservation strategy for anadromous fish. California will work with the private sector to incorporate such efforts, when feasible.

3. California has made significant commitments of resources and personnel to restore the health of North Coast steelhead through management and monitoring activities that will contribute to long-term steelhead conservation efforts. Adequate funding of these commitments is critical to the successful implementation of these efforts.

4. Recent harvest rate reductions and regulation amendments affecting North Coast steelhead will contribute to increased spawning escapement and population stability. The reduction in harvest rates is expected to accelerate the recovery of North Coast steelhead, while habitat conditions necessary for long-term sustainability are achieved.

5. Compliance with existing Federal Endangered Species Act (ESA) requirements for listed salmon species in the same habitat will be an important component of conservation efforts for North Coast steelhead and will provide important benefits for all species.

Section 2. Powers and Authorities

a. Nothing in this MOA is intended to grant to either party powers and authorities that they do not otherwise possess under the constitutions, statutes, laws, and rules of the State of California or of the United States, including but not limited to the Federal ESA of 1973 (16 U.S.C. § 1531 *et seq.*).

b. Nothing in this MOA shall be construed as limiting or affecting in any way the statutory authorities or obligations of the parties to this MOA.

c. Notwithstanding any other provision of this MOA, California recognizes that NMFS may at any time exercise its authority to provide additional protection to North Coast steelhead. When NMFS is considering implementing a change in pertinent Federal regulation or policy with the exception of emergency rule making, it shall give notice to California. California can provide comment and take additional actions if it determines such changes in regulation are unnecessary.

d. The authority for NMFS to enter into this MOA is the Anadromous Fish Conservation Act of 1973 (16 U.S.C. § 757 (a) *et seq).* and the Endangered Species Act of 1973, (16 U.S.C. § 1531 *et seq).* NMFS undertakes this collaborative activity pursuant to 15 U.S.C. § 1525. The authority for California to enter into this MOA is the Salmon, Steelhead Trout, and Anadromous Fisheries Program Act (Fish and Game Code § 6900 *et seq).*

Section 3. Definitions

a. "Conserve," "conserving," and "conservation" as used herein have the same meaning as those terms have under the Federal ESA including to use and the use of all methods and procedures which are necessary to bring an endangered or threatened species to the point at which the measures provided under the ESA are no longer necessary.

b. "Department" means the Department of Fish and Game within the Resources Agency, State of California.

c. "ESU" means "evolutionarily significant unit" as that term is defined in NMFS' policy dated November 20, 1991, and published in the Federal Register at 56 Fed. Reg. 58612-58618.

d. "Fish and Game Commission" means the California Fish and Game Commission created by Article IV, section 20 of the California Constitution.

e. "North Coast steelhead" means naturally spawned steelhead (Oncorhynchus mykiss) found in river basins north of the Russian River, Sonoma County, to the California/Oregon border, including the "half-pounder" life history form found in this geographic area. Included in this area are the Klamath Mountains Province Steelhead ESU and the Northern California ESU as described by NMFS.

f. "Coho salmon" means naturally spawned coho (Oncorhynchus kisutch) found in coastal river basins from Cape Blanco Oregon south to the San Lorenzo River, California. Included in this area are the Southern Oregon/Northern California Coho ESU and the Central California Coho ESU.

Section 4. Compliance with Existing State Regulations

The Department shall enforce State regulations and implement its management measures described in its Strategic Plans for Management of Steelhead Trout dated February 1998. Regulations recommended in those plans, and adopted by the Fish and Game Commission pursuant to Fish and Game Code § 240, do the following:

a. Prohibit the retention by anglers of naturally spawned adult steelhead in rivers and streams north of the Russian River, while permitting retention of winter run steelhead in the Smith River, Del Norte County.

b. Prohibit fishing for naturally produced juvenile steelhead in tributary streams north of San Francisco, and minimize fishing impacts on juvenile steelhead in mainstem rearing areas through a combination of gear restrictions and delayed summer fishing season openings.

c. Prohibit retention of summer steelhead during their upstream migration and prohibit fishing in their summer holding areas.

d. Provide for the retention of hatchery-produced steelhead north of the Russian River.

e. The Department, with concurrence from NMFS, will only recommend to the Fish and Game Commission changes to lessen or repeal the regulations promulgated to achieve subsections 4 (a), (b), and (c) upon a showing by the Department or NMFS of evidence of a change in population health of North Coast steelhead population that justifies such a regulatory action.

Section 5. Compliance with Existing Federal Law

The listing of Southern Oregon/Northern California coho salmon as a threatened species under the ESA also provides a substantial amount of protection for North Coast steelhead and its habitat. The Department commits to recommending fishing regulations to the Fish and Game Commission consistent with applicable Federal coho protective regulations. NMFS will work with the Department toward developing a 4(d) regulation that approves a Department fishery management plan that is adequate for the conservation of coho.

Section 6. Harvest and Hatchery Management

The Department will implement its strategic plans for steelhead which identify the following actions:

a. Harvest Management.

1. The Department will recommend that the Fish and Game Commission adopt permanent regulations to provide for retention of hatchery origin steelhead trout, and will disseminate public information on how to identify hatchery steelhead.

2. By May 1, 1998, the Department shall implement a process for setting recovery and strategic goals for naturally spawned North Coast steelhead.

b. Hatchery Practices.

1. The Department shall mark all hatchery-reared steelhead released north of the Russian River commencing with brood year 1997.

2. The Department shall continue its long-standing hatchery management practices that minimize adverse interactions between hatchery and naturally produced native fishes. These include, but are not limited to, prohibition on stocking of resident fishes in anadromous waters; only releasing anadromous salmonids at times, sizes, and places that minimize interactions with naturally produced native fishes; and only releasing hatchery fish that are determined by Department pathologists to be healthy and to pose no threat to naturally produced native fishes of the area.

3. By May 1, 1998, the Department shall initiate a monitoring program to measure hatchery fish stray rates on North Coast steelhead spawning grounds.

4. NMFS is encouraged to provide comments about hatchery programs affecting steelhead to the Department; with any concerns to be resolved between NMFS and the Department. The Department and NMFS shall undertake a review of the Mad River Hatchery program, including stocking history, genetic analysis of current broodstock, and its consistency and compatibility with the Department's strategic plan for North Coast steelhead.

5. The Department and NMFS shall work together in ensuring the harvest and hatchery objectives of this section are met.

Section 7. Monitoring Evaluation and Adaptive Management.

a. The parties agree that the following activities are critical to conserve North Coast steelhead:

1. Extensive resource monitoring is required to evaluate and conserve North Coast steelhead;

2. Scientific oversight is required to evaluate population data, and report the results;

3. Establish a joint scientific and technical team made up of representatives from, at a minimum, California; Oregon, as appropriate; and NMFS to develop a comprehensive monitoring program for North Coast steelhead no later than June 1, 1998. This team shall ensure that the monitoring program meets its objective to assess the health of North Coast steelhead runs and that it provides an informational basis for reviewing and modifying, as appropriate, the harvest regulations and hatchery operations described in this MOA.

b. If the Department's or NMFS' evaluation of monitoring results or other information shows that North Coast steelhead runs continue to decline, or harvest and hatchery programs are not achieving agreed upon biological goals, the Department and NMFS shall confer and seek appropriate changes in agency regulations, policies, and programs.

c. If the Department's or NMFS' evaluation of monitoring results or other information shows populations are above agreed upon thresholds, NMFS will work with the Department in determining appropriate allowance, or increase, of harvest for such populations.

d. California commits to seek adequate funding to implement the agreed to North Coast steelhead monitoring program beginning in State FY 1998-1999.

e. NMFS commits to seek Federal funding to participate in California's monitoring efforts. NMFS further commits to provide technical assistance to the maximum extent feasible, and to aid in the design and implementation of such monitoring efforts.

g. The counties of Del Norte, Humboldt, Mendicino, Siskiyou, and Trinity have approved a jointly developed work plan with California. They are working cooperatively in developing anadromous fish conservation efforts. With technical and funding support from California, these counties are undertaking a comprehensive review and coordination of county level land use regulations and practices as they relate to anadromous salmonid habitat within the North Coast steelhead region. NMFS commends this approach and expresses its intent to provide technical and financial support to this effort.

h. California has recently increased, and proposes to further increase, its funding commitment to support the California Watershed Protection Program. In recent years, the Department has expended approximately $16 million annually in base funding for relevant anadromous salmonid conservation activities. In 1997, the Legislature passed and the Governor signed SB 271 (Thompson), which provides an additional $43 million over six years to specifically improve salmon and steelhead restoration efforts, including the conduct of watershed assessments, developing watershed action plans, implementing restoration projects and the conduct of appropriate monitoring. The Governor's 1998/99 budget proposal includes over $100 million in additional bond funds to support relevant State-wide watershed protection and restoration efforts.

i. NMFS will participate as an ex-officio member of the Advisory Committee for recommending approval of SB 271 grant funds.

j. The Department's fishery management program includes, but is not limited to: resource and habitat monitoring; enforcing laws and regulations; applying habitat protection and restoration measures; operating fish hatcheries, ladders, and screens; recommending fish and wildlife laws and regulations, and providing public information. In this regard, the Department will review its management program as it applies to North Coast steelhead with the Independent Scientific Review Panel, established under the Watershed Protection Program, and the NMFS to facilitate understanding, share resource information, and to exchange views on current and future management direction.

k. The Department commits to directing personnel and fiscal resources contained in its 1998-99 SB271 BCP, as appropriate and consistent with the provisions of SB271, to watershed-related efforts in the North Coast area.

l. California commits in 1998-99 and in subsequent years to seek funding for those activities identified in the Eel River Action Plan having the most immediate and direct benefits to salmon and steelhead.

m. A substantial factor for decline of steelhead in this area centers around habitat loss, degradation and alteration. The Department and NMFS will work collaboratively to complete the development of state regulations on lake and stream bed alteration and suction dredging with a goal of adopting regulations in 1999.

Section 10. Availability of Data

California shall provide NMFS with access to all data and records compiled regarding the conservation status of North Coast steelhead and pertinent to implementation of habitat, harvest, and hatchery measures.

Section 11. Amendments and Termination

This MOA may be amended by either party upon consent, in writing, of both parties to this MOA. This MOA shall remain in force and effect for ten years or until termination by NMFS or California. Such termination shall be effective upon 30 days notice in writing from either party. This MOA may be extended beyond its original term by mutual agreement. Financial arrangements in furtherance of this MOA will be contingent upon appropriation of necessary funds by the Congress of the United States, with respect to NOAA/NMFS and the California State Legislature, with respect to California, and subject to budgetary limitations which may arise.

In the event of a dispute involving the execution of this MOA, the matter shall be resolved by the Secretary of the Resources Agency and the NOAA Assistant Administrator for Fisheries, whose decision shall be final.

This MOA is not intended to construe benefits upon, or be subject to, enforcement by third parties.

If any part of this MOA is determined to be invalid of in violation of law, all other parts not so determined shall remain in full force and effect.

This MOA may be executed in counterparts.

This MOA has been executed by and on behalf of the parties hereto as of the date last signed below:

Douglas P. Wheeler
Secretary, Resources Agency
State of California and
Chair of the California
Watershed Protection and
Restoration Council

3-11-98
Date

Jacqueline E. Schafer
Director
Department of Fish and Game

March 11, 1998
Date

William T. Hogarth Ph.D.
Regional Administrator
Southwest Region, NMFS

3-11-98
Date

Section 8. Joint Enforcement Strategy

The parties agree on the importance of adequate funding and personnel for enforcement of environmental laws and regulations. They will work to facilitate the existing cooperative working partnership between appropriate California and Federal enforcement agencies in order to enhance law enforcement, public awareness and voluntary compliance related to harvest, habitat and other issues.

Section 9. California Watersheds Protection Program

In July 1997, the Governor issued executive order W-159-97 to establish the Watershed Protection Program. The Program is described as follows.

a. California, in cooperation with local governmental entities and interested parties, and in consultation with NMFS will develop a State conservation program to be known as the California Watersheds Protection Program, with an Anadromous Salmonid Conservation Element (ASCE). Collectively, California and local entities, and other interested parties will, in cooperation with NMFS, carry out the activities identified in the ASCE for the benefit of anadromous fish species in the State of California. NMFS supports this effort and commits to substantively participate in its development. California will facilitate NMFS' participation by including NMFS in meetings of the WPRC.

b. The California Watershed Protection Program is intended, among other purposes, to provide conservation efforts necessary to conserve anadromous salmonids and lead to the promulgation of a 4(d) rule by NMFS under the Federal ESA. If the program, including its forestry components, adequately provides for the conservation of listed species as required in section 4(d) of the ESA, NMFS will include the program as the basis for such protective regulations as provided for in Section 4(d).

c. The California Watersheds Protection Program and its ASCE are to be implemented based on California's statutory authority in the California Fish and Game Code, California Environmental Quality Act, the Forest Practices Act, the Porter-Cologne Water Quality Act, and the Federal Clean Water Act and, if appropriate, the statutory authority granted NMFS in the ESA. The program will use authorities of California and local agencies to restore and maintain properly functioning habitat conditions and other needed protections. Among its goals are development of specific watershed protection plans. The watershed protection plans, to the extent consistent with achieving properly functioning habitat conditions, will recognize and incorporate existing regulatory regimes and voluntary efforts such as habitat conservation plans, sustained yield plans, best management practices, and similar endeavors (including Coordinated Resource Management Plans, water quality control plans, rangeland water quality management plans, and surface mining reclamation plans).

d. California has appointed a multi-disciplinary Scientific Review Panel to advise in the development of the California Watershed Protection Program. California will review with NMFS no later than April 15, 1998 the composition and role of this panel, and they will jointly determine if modifications would be beneficial, including involvement of NMFS scientists on the panel.

e. The California Watersheds Protection Program, including the ASCE, in conjunction with other State and federal efforts, is intended to provide habitat protection sufficient to conserve currently listed species and to create conditions that adequately protect unlisted species in North Coast watersheds. Prior to making additional listings, NMFS will consider the scope of this program and the value of its conservation efforts.

f. California and NMFS are reviewing the contributing factors affecting properly functioning habitat conditions. As part of this review, initial focus will be on California's forest practices regulations, their implementation, and enforcement in order to determine their adequacy. NMFS will participate in this effort by, among other things, providing information describing properly functioning habitat conditions for salmonids and reviewing California's Forest Practice rules and their implementation as they affect properly functioning habitat conditions. The Scientific Review Panel will be utilized to ensure scientifically supportable conclusions.

The parties have agreed to the following schedule for conducting the review and implementing any needed changes:

BY July 1, 1998: PHASE IA

Complete preliminary review by State and NMFS, including active participation by the stakeholders groups. The Scientific Review Panel will be utilized to ensure scientifically supportable conclusions are achieved. Products to be developed.

1) Define properly functioning habitat conditions which adequately conserve anadromous salmonids.

2) Jointly review the adequacy of existing California Forest Practice Rules, including implementation and enforcement, to achieve properly functioning habitat conditions.

3) Identification of changes, if any, in implementation and enforcement of existing rules jointly agreed upon by the State and NMFS.

BY October 1, 1998: PHASE IB

1) Identification of changes, if any in addition to those identified in phase IA3, in implementation and enforcement of rules which NMFS believes are necessary.

2) Identification of changes, if any, in rules which NMFS believes are necessary to adequately conserve anadromous salmonids as defined in the ESA.

PHASE II

BY December 15, 1998: Review of proposed changes will include assistance from the Scientific Review Panel and stakeholders groups. These State actions will be undertaken consistent with actions taken by NMFS pursuant to Section 9 b of this agreement.

1) California to make changes in implementation and/or enforcement of rules mutually agreed upon by State and NMFS as necessary to conserve anadromous salmonids.

2) California, in consultation with NMFS, recommends to the California Board of Forestry changes, if any, to the Forest Practice Rules necessary to conserve anadromous salmonids.

BY July 1, 1999: PHASE III

California Board of Forestry to complete its action on recommended changes, if any, to the Forest Practice Rules.

* For purposes of this process rules refer to the Forest Practice Rules and appropriate elements of the California Environmental Quality Act.

The Resources Agency

Pete Wilson
Governor

Douglas P. Wheeler
Secretary

of California

California Conservation Corps • Department of Boating and Waterways • Department of Conservation
Department of Fish and Game • Department of Forestry & Fire Protection • Department of Parks & Recreation • Department of Water Resources

October 19, 1998

OCT 2 : 1998

Dear WPRC Science Panel Members:

Thank you for agreeing to serve on the Forest Practices Subcommittee of the Watershed Protection and Restoration Councils' (WPRC) science panel. The council was established by an executive order of Governor Wilson and Resources Secretary Doug Wheeler serves as its Chair.

On March 11, 1998, a Memorandum of Agreement was entered into between the State of California (Resources Agency) and the National Marine Fisheries Service regarding North Coast Steelhead Trout. Among provisions concerning Harvest and Hatchery Management; Monitoring Evaluation and Adaptive Management and Compliance with Existing State Regulations is a provision dealing with a California Watersheds Protection Program. Phase 1-A of this program calls for a Scientific Review Panel to:

- Define properly functioning habitat conditions which adequately conserve anadromous salmonids, and
- Jointly review the adequacy of existing California Forest Practice Rules, including implementation and enforcement, to achieve properly functioning habitat conditions.

The National Marine Fisheries Service has recently completed an "evaluation" of California's Forest Practice Rules. The Resources Agency has issued a lengthy and detailed response to this evaluation by NMFS. Additionally, NMFS also did an evaluation of CDF's "Coho Considerations". You should have already received copies of both of these documents. In addition I have enclosed a list of four questions to be addressed by the science panel subcommittee.

The Resources Agency • 1116 Ninth Street, Suite 1311 • Sacramento, CA 95814 • (916) 653-5656 • FAX (916) 653-8102
http://ceres.ca.gov/ceres/

The WPRC has scheduled a meeting for the scientific review panel on Thursday, November 5th at 10:30 am at the USFS Redwood Science Laboratory in Arcada. Also in attendance will be representatives of the Resources Agency, CDF, DFG, the State Water Board and NMFS. The purpose of the meeting will be to develop a strategy, timeline and work plan for the science panel subcommittees' evaluation of the forest practice rules. For further details please contact Mark Hite at (916) 227-2664.

And finally, there are funds budgeted for the subcommittees' activities. Both for direct compensation as well as for travel and expenses.

I look forward to hearing from you at your earliest possible convenience.

Sincerely,

Jim Branham

Jim Branham
Undersecretary for Resources

Attachment

Appendix C: CONSTITUENCY GROUP MEMBERS

Constituency Group	Interview Format	Location	Date
Environmental Community - Ukiah Area Kathy Baily[1] Helen Libeau Alan Lavine Jay Halcomb Craig Bell	Panel	Ukiah	3/2/99
Environmental Community - Eureka Area Chad Robert Bob Martel Cynthia Elkins Ali Freedland	Panel	Eureka	4/27/99
LARGE LANDOWNERS			
Simpson Timber Neal Ewald	Individual	Eureka	3/15/99
Pacific Lumber Company Tom Herman Dan Opalach		Eureka	3/15/99
Gualala Redwoods Henry Alden		Santa Rosa	2/26/99
Mendocino Redwood Company Tom Schultz Jim Lemieux Nancy Budge		Ukiah	2/26/99
Barnum Timber Company Bob Barnum Ed Mendes Steve Horner		Eureka	3/15/99
California Forestry Association Dave Bischel Mark Rentz		Berkeley	4/16/99
Sierra Pacific Industries Ed Murphy Steve Self Tom Nelson		Eureka	4/27/99
The Timber Company Tom Ray Ron Monk Jon Ambrose		Eureka	3/15/99

Constituency Group	Interview Format	Location	Date
Small Landowners Pete Bussman Andy Westfall Mark Moore Art Harwood Steve Hackett Bill Kleiner	Panel	Eureka	3/16/99
AGENCIES			
Water Quality Frank Reichmuth Christine Wright-Shacklet Dave Parsons Mark Neeley Andy Baker	Panel	Santa Rosa	2/26/99
Environmental Protection Agency Chris Heppe Doug Deberhardt Janet Parish		Eureka	3/17/99
National Marine Fisheries Services Bill Condon Sharon Kramer		Eureka	3/11/99
Department of Fish & Game - Sacrmento Jim Steele		Sacramento	1/6/99
Board of Forestry Tharon O'Dell Bob Heardd		Sacramento	1/6/99
Division of Mines and Geology Trinda Bedrossian John Schlosser		Sacramento	1/6/99
THP Reviewers Armand Gonzales, DFG Mark Moore, DFG Holly Lungborg, WQ	Panel	Eureka	3/12/99
CDF Forest Practice Inspectors Joe Fassler Charlie Martin Ron Pape Jim Purcell Jack Marshall Dave McNamara	Panel S	anta Rosa	2/26/99

Constituency Group	Interview Format	Location	Date
Board of Forestry Tharon O'Dell Bob Heald	Panel	Sacramento	1/7/99
California Department of Forestry - Sacmento Dean Cromwell Dean Luckie Jerry Ahlstrom Ross Johnson		Sacramento	1/6/99
Loggers Dick Schirmann Otto Van Emmerk Mike Anderson Ed Ehlers John Lima	Panel	Eureka	2/11/99
Consulting Foresters - Ukiah Nick Kent Fred Euphrat Greg Blenco Steve Vanderhorst John Williams	Panel	Ukiah	3/2/99
Consulting Foresters - Eureka Ron Hunt George "YG" Gentry Bill Solinsky Rick Holub Mark Collins Charles Ciancio Mark Andre		Eureka	3/12/99
Geologists Tom Koler Greg Bundros Matt O'Conner Bill Weaver	Panel	Eureka	3/17/99
Fish Biologists (Academic) Terry Roelofs	Panel	Eureka	3/16/99
Fish Biologists (Agency) Scott Downie Larry Preston	Panel	Eureka	4/27/99
Fish Biologists (Private) Steve Self Chris Howard Dennis Halligan	Panel	Eureka	3/16/99

Constituency Group	Interview Format	Location	Date
Fish Restoration/Habitat Improvement Richard Grenger Jesse Noell Traci Thiele Tom Weseloh Mitch Farro Sun Nome Madrone	Panel	Eureka	3/17/99
Watershed Specialists/CE Randy Klein Mike Furniss Leslie Reid Tom Lisle Sari Sommarstrom[1]	Panel	Eureka	3/17/99
Road/Road Maintenance Nick d'Usseau Ray Miller Doug Davis	Panel	Eureka	2/11/99
UC/RCD/NRCS Greg Giusti Kim Rodriques[1] Bernie Bush Chris Fisher Tim Viel	Panel	Ukiah	3/2/99
2090/South of San Francisco Jennifer Nelson (DF&G) Nancy Drinkard (CDF) Howard Colb(WQ) Dave Hope (County of Santa Cruz) [1] Mike Jani (Big Creek) Steve Butler (RPF/Consultant)	Panel	San Francisco Area	3/23/99
Industrial Foresters Tom Walls Bill Blackwell Scott Gray Bill Houston[1]	Panel	Eureka	3/12/99
UC Freshwater Team	Panel	Berkeley	3/23/99
Forest Science Project Tim Lewis	Individual	Eureka	5/19/99

1/ Did not attend panel meeting, but provided written comments.

APPENDIX D:
QUESTIONS FOR CONSTITUENCY GROUP MEMBERS

QUESTIONS FOR 2090/SOUTH OF SAN FRANCISCO PANEL

1) Please describe how the Forest Practice Rules for the 856 counties in the Southern Sub-District are different that the FPRs in the remainder of the Coast District. Please consider issues such as watercourse protection measures, silviculture and the RPF's involvement in the implementation of the THP.

2) How is the 2090 agreement implemented? Do you feel it provides adequate protection for salmonids? If you could change sections of the agreement, what would those changes be?

3) What is your definition for "significant cumulative impact?" Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout?

4) What do you use for "baseline" conditions for water temperature, stream flow, sediment, and large woody debris? Do you use averages for water temperature, stream flow, and/or sediment?

5) Many rules in the FPR are ultimately subject to RPF discretion. Where can/should the sideboards to an RPF's discretion be changed (narrowed or widened) within the FPR? Please give precise locations of desired rule changes within the FPRs. Has the added responsibility for THP implementation by the RPF provided greater resource protection?

6) What is your definition for "adaptive management?" Do you feel the FPR's and the rule making process, when combined with the 2090 Agreement, represent adaptive management? Are you directing/participating in adaptive management with regards to forest management?

7) What is your position on upstream passage by juvenile salmonids at road stream crossings? Mandatory passage? How will legacy culverts be treated? Are channel fords being considered satisfactory alternatives to culverts?

8) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do you envision this program somehow being formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?

9) Do the Forest Practice Rules contain all the elements that are essential to maintain long-term salmonid habitat or must they rely on the additional mitigation based on the understanding of essential salmonid habitat by the RPF?

10) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?

12) Do the agencies review all of the THPs submitted? What is the frequency of the various agencies attending pre-harvest inspection field tours? Does your agency undertake post-harvest monitoring of THPs for: 1) compliance with rules and THP, and 2) adequacy for the needs of salmonids? If post harvest monitoring has occurred, has a report of the results been prepared?

13) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document" and the 2090 Agreement) are adequate: Stream protection rules (WLPZ widths and operations near streams) Winter operating rules Cumulative effects analysis Yarding and roads rules Retention/recruitment of LWD Road maintenance If you feel the current standards are inadequate, what changes would you propose?

14) If you have a riparian no cut zone of 200 feet slope distance for class 1 streams and a nocut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Southern Sub-District, would this protect salmon habitat?

15) From your standpoint, do you feel the level of expertise in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids? If not, what changes would you propose?
16) Do you feel the certification of forestlands by independent organizations, such as "Scientific Certification Systems" or "Smart Wood" improves the sustainability of the salmonid habitat?
17) Have the special rules in the 856 counties helped address public concerns regarding forestry issues?
18) Would an increased road and BMP maintenance period significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the FPR?
19) Timber harvesting operations are often executed under emergency notices and exemptions, without undergoing the full THP review. Do you feel water quality and salmon are adequately protected under this process?
20) From your perspective, what is the ideal outcome of the MOA/Science panel process? What can we do to maximize the chances for success of this process?

QUESTIONS FOR ACADEMIC FISHERIES BIOLOGISTS

1) Can we develop rules that ensure a THP (or other land management activity) would not result in a "take" or a finding of jeopardy of coho salmon and/or steelhead trout? What analysis should we rely upon to make these determinations?
2) What monitoring efforts do you believe the agencies and landowners should be undertaking?
3) How do you determine whether or not the effects of timber operations would be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?
4) What information is available for "baseline" conditions for water temperature, stream flow, sediment, and large woody debris when assessing habitat conditions? Do you believe we use averages for water temperature, stream flow, and/or sediment? What are the sources of the protocols used to determine these parameters?
5) What is your definition of "adaptive management?" Do you feel the FPR's represent adaptive management? How can we develop an adaptive management approach for salmonid protection measures in regard to forest management?
6) "Limiting factors analyses" for anadromous salmonids are often cited in cumulative effect assessments. Can you provide examples of limiting factors analysis that you consider satisfactory or exemplary?
7) What is your position on upstream passage by juvenile salmonids at private logging road stream crossings? Should there be mandatory passage? Do you believe there is sufficient assessment of fish passage on existing culverts? Do we have adequate models to properly design fish passage through culverts for all life stages of salmonids? How should legacy culverts be treated? Are channel fords being considered satisfactory alternatives to culverts?
8) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do you believe this program somehow be formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?
9) Do the Forest Practice Rules contain all the elements that are essential to maintain long-term salmonid habitat or must they rely on the additional mitigation based on the understanding of essential salmonid habitat by the RPF?
10) Given your experience, from a fisheries standpoint if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
11) How could the THP process be changed to encourage more fish/stream rehabilitation work?
12) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: Stream protection rules (WLPZ widths and operations near streams) Winter operating rules Cumulative effects analysis Yarding and roads rules Retention/recruitment of LWD Road Maintenance If you feel the current standards are inadequate, what changes would you propose?
13) Based on your observations, do the THPs as prepared and approved exceed the minimums of the rules? Do you think the majority of the approved plans contain adequate protection for salmonids?
14) Do different types (large industrial verses small non-industrial) of landowners provide better protection of salmonid habitat?

15) If you have a riparian no cut zone of 200 feet slope distance for class 1 streams and a no cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat on the North Coast?
16) From your standpoint, do you feel the level of expertise utilized in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids?
17) Would an increased road and CMP maintenance period significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the FPR?
18) From your perspective, what would be the ideal regulatory and scientific process to incorporate fisheries principles into forest management?

QUESTIONS FOR THE AGENCY FISHERIES BIOLOGISTS

1) How can you ensure that a THP or other land use activity would not result in a "take" or a finding of jeopardy of coho salmon and/or steelhead trout? 2) What do you use for "baseline" conditions for water temperature, stream flow, sediment, and large woody debris? Do you use averages for water temperature, stream flow, and/or sediment? What is the source of the protocols used to determine these parameters?
3) What is your definition of "adaptive management?" Do you feel the FPR's represent adaptive management?
4) "Limiting factors analyses" for anadromous salmonids are often cited in cumulative effect assessments. Can you provide examples of limiting factors analysis that you consider satisfactory or exemplary?
5) What is your opinion on upstream passage by juvenile salmonids at private logging road stream crossings? Should there be mandatory passage? Do you believe there is sufficient assessment of fish passage on existing culverts? How should legacy culverts be treated? Are channel fords considered satisfactory alternatives to culverts?
6) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do you believe this program should somehow be formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?
7) Given your experience, from a fisheries standpoint if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
8) How could the THP process be changed to encourage more fish/stream rehabilitation work? Do you have other suggestions to encourage more fish habitat restoration/retention by landowners? Are there regulatory changes that could be done to make restoration easier and more attractive for landowners?
9) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho considerations document") contain the necessary elements for salmon: Stream protection rules (WLPZ widths and operations near streams) Cumulative Effects Analysis Retention/recruitment of LWD Road Maintenance What changes, if any, would you propose to these rules sections to make them more fish friendly?
10) Do different types (large industrial verses small non-industrial) of landowners provide better protection of salmonid habitat?
11) If you have a riparian no cut zone of 200 feet slope distance for class 1 streams and a no cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat on the North Coast?
12) From your standpoint, do you feel the level of expertise utilized in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids? Do foresters have a good understanding of fish habitat requirements?
13) Would an increased road and CMP maintenance period significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the FPR?
14) From your perspective, what would be the ideal regulatory and scientific process to minimize the effects of mass wasting and surface erosion on stream ecosystems?
15) In your opinion, what is the greatest opportunity to for fish restoration?

QUESTIONS FOR THE CALIFORNIA DEPARTMENT OF FISH AND GAME

(1) The Forest Practices Rules require that the Director disapprove plans that would result in a "take", or a finding of jeopardy, of a listed species by a federal agency of the Department of Fish and Game Specifically, 1) How do you ensure that the THP would not result in a "take" or a finding of jeopardy of coho salmon and/or steelhead trout?

(2) What is the agency's definition for "significant cumulative impact?" 1)Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout?

(3) How do you determine whether or not the effects of timber operations would be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?

(4) What do you use for "baseline" conditions for water temperature, stream flow, sediment, large woody debris? Do you use averages for water temperature, stream flow, and/or sediment?

(5) Many rules in the FPR are ultimately subject to RPF discretion. Where can/should the sideboards to an RPF's discretion be changed (narrowed or widened) within the FPR? Please give precise locations of desired rules changes within the FPR. Are the agency's desired changes supported by quantitative evidence?

(6) What is the agency's definition for "adaptive management?" Do you feel the FPR's represent adaptive management? Is the agency directing/participating in adaptive management with regards to the FPR?

(7) "Limiting factors analyses" for anadromous salmonids are often cited in cumulative effect assessments. Can the agency provide a copy of a limiting factors analysis that the agency considers satisfactory or exemplary?

(8) What will be the agency's position on upstream passage by juvenile salmonids at road stream crossings? Mandatory passage? How will legacy culverts be treated? Are channel fords being considered satisfactory alternatives to culverts?

(9) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Does CDFG envision this program somehow being formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?

(10) What changes in managing the riparian zone are necessary to protect anadromous salmonid habitat? Please reference specific locations within the FPR.

(11) Do the Forest Practice Rules contain all the elements that are essential to maintain long-term salmonid habitat or must they rely on the additional mitigation based on the understanding of essential salmonid habitat by the RPF?

(12) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?

(13) Please describe your role in the review and approval of Timber Harvesting Plans in the north coast. Do you see your role changing in the future?

(14) How does your agency review all of the THPs submitted? What is the frequency of your agency attending pre-harvest inspection field tours? In the last two years, how often has your agency filed a non-concurrence or a head of agency appeal on a THP with coho issues?) Does your agency undertake post-harvest monitoring of THPs for; 1) compliance with rules and THP, and 2) adequacy for the needs of salmonids? If post harvest monitoring has occurred, has a report of the results been prepared?

(15) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: - Stream protection rules (WLPZ widths and operations near streams) - Winter operating rules - Cumulative effects analysis - yarding and roads rules - retention/recruitment of LWD If you feel the current standards are inadequate, what changes would you propose?

(16) If you have a riparian nocut zone of 200 feet slope distance for class 1 streams and a nocut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat in the North Coast?

(17) From your agencies stand point, do you feel the level of expertise in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids?

(18) Do you feel the certification of the SYP's for large forest land owners by independent organizations, such as "Scientific Certification Systems" or "Smart Wood" improve the sustainability of the salmonid habitat?

Report of the Scienctific Review Panel

June 1999

DEPARTMENT OF MINES AND GEOLOGY

(1) What is the source of your statutory authority to protect water quality and fisheries resources? How is that authority implemented? How does this authority interact with that of other agencies?
(2) Would an increased road and BMP maintenance period significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the FPR?
(3) Are the rules adequate from DMG's perspective?
(4) Does DMG see a greater or altered role for geologists in the THP process in the future?
(5) From DMG's perspective, what would be the ideal regulatory and scientific process to minimize the effects of mass wasting and surface erosion on stream ecosystems?

QUESTIONS FOR THE BOARD OF FORESTRY

(1) What is the source of your statutory authority to protect water quality and fisheries resources? How is that authority implemented? How does this authority interact with that of other Boards or agencies?
(2) The Forest Practices Rules require that the Director disapprove plans that would result in a "take" or a finding of jeopardy of a listed species by a federal agency of the Department of Fish and GameDo you feel the current rules provide the Director sufficient guidance to disapprove or approve a plan?
(3) Can we develop a specific set of rules that would establish certain nocut riparian zone distances, for Class 1, 2 & 3 streams that would protect salmon habitat and not unduly restrict forest owners? Should these be the same nocut width for all areas in the Redwood Region?
(4) Other "Certified Sustainable Forests" have different size of nocut zones. The Arcata City Forest, Class 1, 200 ft; Class 2, 100 ft.; Class 3,50 ft. Could you rely on each landowner or "Certified Forest" to set the appropriate nocut zone or other protection measures that would protect salmon habitat?
(5) Would the certification of the SYP's for large forest land owners by independent organizations, such as "Scientific Certification Systems" or "Smart Wood" improve the sustainability of the salmonid habitat?
(6) Do you consider the Forest Practice Rules and the Board of Forestry rule making process to be "*adaptive management*"?
(7) Do you believe the Forest Practice Rules related to salmonid protection measures are based on sound science?
(8) Is the Board comfortable that the rules they develop are properly implemented? Is there a monitoring program set up to measure the effectiveness of the implementation of the rules? Is there a formal feedback to have the rules revisited based on monitoring results?

CDF

(1) What is the source of your statutory authority to protect water quality and fisheries resources? How is that authority implemented? How does this authority interact with that of other agencies?
(2) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
(3) Please describe your role in the review and approval of Timber Harvesting Plans in the north coast. How does your agency review all of the THPs submitted? What is the frequency of your agency attending pre-harvest inspection field tours? Has does your agency undertake post-harvest monitoring of THPs for; 1) compliance with rules and THP, and 2) adequacy for the needs of salmonids? If post harvest monitoring has occurred, has report of the results been prepared?
(4) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: - Stream protection rules (WLPZ widths and operations near streams) - Winter operating rules - Cumulative effects analysis - yarding and roads rules - retention/recruitment of LWD - If you feel the current standards are inadequate, what changes would you propose?
(5) From your agencies stand point, do you feel the level of expertise in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids? If not, what changes would you propose?
(6) Do you consider the Forest Practice Rules and the rule making process to be "adaptive management"?
(7) Do the Forest Practice Rules contain all the essential elements that are essential to maintain long-term salmonid habitat or must they rely on the additional mitigation based on the understanding of essential salmonid habitat by the RPF?
(8) Would the certification of the SYP's for large forest land owners by independent organizations, such as "Scientific Certification Systems" or "Smart Wood" improve the sustainability of the salmonid habitat?
(9) Timber harvesting operations are often executed under emergency notices and exemptions, without undergoing the full THP review. Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout or a taking under these types of operations? Is your methodology of analysis any different than it would be for standard THPs?
(10) From CDF's perspective, what is the ideal outcome of the MOA/Science panel process? What can we do to maximize the chances for success of this process?

CDF-THP REVIEWER QUESTIONS

(1) Please describe your role in the review and approval of Timber Harvesting Plans in the north coast. How does your agency review all of the THPs submitted? What is the frequency of CDF agency holding pre-harvest inspection field tours? Has does your agency undertake post-harvest monitoring of THPs for; 1) compliance with rules and THP, and 2) adequacy for the needs of salmonids? If post harvest monitoring has occurred, has report of the results been prepared?
(2) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
(3) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: * Stream protection rules (WLPZ widths and operations near streams) * Winter operating rules * Cumulative effects analysis * Yarding and roads rules * Retention/recruitment of LWD * Road maintenance If you feel the current standards are inadequate, what changes would you propose?
(4) From your stand point, do you feel the level of expertise in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids? If not, what changes would you propose?
(5) Do you consider the Forest Practice Rules and the rule making process to be "adaptive management"?
(6) Do the Forest Practice Rules contain all the essential elements that are essential to maintain long-term salmonid habitat or must they rely on the additional mitigation based on the understanding of essential salmonid habitat by the RPF?
(7) Would the certification of the SYP's for large forest land owners by independent organizations, such as "Scientific Certification Systems" or "Smart Wood" improve the sustainability of the salmonid habitat?
(8) Timber harvesting operations are often executed under emergency notices and exemptions, without undergoing the full THP review. Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout or a taking under these types of operations? Is your methodology of analysis any different than it would be for standard THPs?
(9) How do you determine whether or not the effects of timber operations would be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?
(10) What do you use for "baseline" conditions for water temperature, stream flow, sediment, large woody debris? Do you use averages for water temperature, stream flow, and/or sediment?
(11) Many rules in the FPRs are ultimately subject to RPF discretion. Where can/should the sideboards to an RPF's discretion be changed (narrowed or widened) within the FPRs? Please give precise locations of desired rules changes within the FPRs.
(12) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do you believe this program somehow formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?
(13) If you have a riparian nocut zone of 200 feet slope distance for class 1 streams and a nocut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat in the North Coast?

(14) Do you feel the public is adequately represented in the review process? Do they have sufficient opportunity to review and comment on THPs?
(15) What is your relationship with the other review agencies? Do they provide CDF with the needed input for plan review relative to salmon and water quality? Do they respond timely to requested inputs and deadlines?
(16) Based on your review of north coast THPs, do plans with fish present on or downstream of the plan area exceed the minimum standards of the rules?
(17) Give the provisions of the Forest Practice Rules, do you believe the rules as implemented provide adequate protection for salmonids?
(18) In regards to salmonid protection, please identify areas of concern for the following stages of the THP process: * THP preparation * Agency review and field inspection * Public input during review * Approval * Post approval operational inspections * Post-completion issues
(19) From your perspective, what is the ideal outcome of the MOA/Science panel process? What can we do to maximize the chances for success of this process?

QUESTIONS FOR CONSULTING GEOLOGISTS

(1) How wide is the gap between the THP and on-the-ground implementation? What are the primary causes for this gap? How can these be remedied?
(2) Is the rationale method adequate for sizing culverts? Is any additional protection gained in sizing culverts for the 100-yr storm rather than the 50-yr storm? How can culvert failure, or the effects of culvert failure, be better reduced?
(3) Would tighter controls on winter logging significantly reduce road related failures and/or suspended sediment production? What changes in the FPR, or other changes, would you recommend?
(4) Are many RPFs overestimating their abilities for recognizing potential geologic hazards and prescribing mitigative actions? Should there be some administrative "trigger" in preparing a THP that would require a licensed geologist? What would that be?
(5) Given an ounce of prevention is worth a pound of cure, is sufficient attention provided in planning and locating new roads? Does the FPR adequately address/require this? Please mention specific rules within the FPR.
(6) How effective has CDMG been at heading-off potential problems? Has CDF effectively utilized CDMG in reviewing THPs?
(7) How often do you return to assess your recommendations? Have you monitored conditions over time?
(8) Do rely upon the Geology maps prepared by DM&G? Are these a useful? Are you aware of the hazard maps DM&G has prepared for selected watersheds? Would these be useful to you?
(9) Do you feel your recommendations are adequately addressed in the approved THP?
(10) Do feel geologists should be more frequently involved in the THP preparation process?
(11) Would an increased road and BMP maintenance period significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the FPR?
(12) Do you see a greater or altered role for geologists in the THP process in the future?
(13) From your perspective, what would be the ideal regulatory and scientific process to minimize the effects of mass wasting and surface erosion on stream ecosystems?
(14) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
(15) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: - Stream protection rules (WLPZ widths and operations near streams) - Winter operating rules - Cumulative effects analysis - Yarding and roads rules - Retention/recruitment of LWD - Road Maintenance - If you feel the current standards are inadequate, what changes would you propose? -
(16) Timber harvesting operations are often executed under emergency notices and exemptions, without undergoing the full THP review. Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout or a taking under these types of operations? Is your methodology of analysis any different than it would be for standard THPs?
(17) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Does CDFG envision this program somehow being formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?

QUESTIONS FOR THE ENVIRONMENTAL COMMUNITY

(1) What is your definition of "cumulative significant impact"? Can cumulative adverse impacts really be measured? If so, who should be measuring them and what authority should this entity have for changing forest practices? If not, why does the environmental community rely on cumulative effects so heavily for demanding changes in forest practices? Is there a better strategy?
(2) Could the FPR be replaced by something more simple? Or is the FPR mostly satisfactory, but its implementation seriously flawed?
(3) Do you believe the FPRs related to salmonid protection measures are based on sound science?
(4) Are the following sections of the current FPR adequate for protecting salmonid habitat: WLPZ widths and operations, winter operating rules, cumulative effects analyses, yarding and roads rules, retention/recruitment of large woody debris from the stream corridor, and road maintenance? If these standards are inadequate, what changes do you propose?
(5) Does the FPR contain all essential elements for maintaining long-term salmonid habitat, or must the rules be mitigated by an RPF?
(6) While preparing THP's, do RPF's have the expertise to recognize potential risks to salmonid habitat?
(7) Does certification of the SYP's for large forestland owners by independent organizations, such as "Scientific Certification Systems" or "Smart Wood" improve salmonid habitat sustainability?
(8) Should we develop specific rules that establish no-cut riparian zones? What should these widths be?
(9) Is the present stream classification system adequate? What changes would you propose?
(10) Has "adaptive management" been instrumental in refining the FPR? What is you definition for "adaptive management"?
(11) In regard to salmonid protection, identify areas of personal concern over the following stages of the THP process: THP preparation, agency review and field inspection, public input during the review, approval, post-approval operational inspections, and post-completion issues.
(12) What maximum percentage of a watershed can harvested per decade? What are basing an answer on?
(13) There are the rules, and then there is the intent of the rules. Can more specific rules be fashioned to guarantee compliance with the intent of the rules? Is there a way to keep the flexibility but guarantee compliance with the intent?
(14) From your perspective, what are the ideal and realistic outcomes of the MOA/Science panel process? What can we do to maximize this opportunity to effect real change?
(15) Were the donuts OK?

QUESTIONS FOR ENVIRONMENTAL PROTECTION AGENCY PANEL

1) What is the source of your statutory authority to protect water quality and fisheries resources? How is that authority implemented? How does this authority interact with that of other Boards or agencies?
2) What is the future role of TMDL's in respect to the Forest Practice Rules? How has the Garcia River River TMDL been implemented? What have been the strengths and weaknesses?
3) Are the TMDLs going to be developed separately for each watershed?
4) Does EPA have any suspended sediment or temperature thresholds above which is considered an impairment? If so what are they. If not, how will they be developed?
5) What will EPA do to offset the loss of gauging stations as an important element of monitoring?
6) Do you think nutrient introduction in regards forest management needs to be modified by changes in the Forest Practice Rules?
7) What is the agency's definition for "significant cumulative impact?" 1)Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout?
8) How do you determine whether or not the effects of timber operations would be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?
9) What do you use for "baseline" conditions for water temperature, stream flow, sediment, large woody debris? Do you use averages for water temperature, stream flow, and/or sediment?
10) What is the agency's definition for "adaptive management?" Do you feel the Forest Practice Rules represent adaptive management? Is the agency directing/participating in adaptive management with regards to the FPR?
11) "Limiting factors analyses" for anadromous salmonids are often cited in cumulative effect assessments. Can the agency provide a copy of a limiting factors analysis that the agency considers satisfactory or exemplary?
12) What will be the agency's position on upstream passage by juvenile salmonids at road stream crossings? Mandatory passage? How will legacy culverts be treated? Are channel fords being considered satisfactory alternatives to culverts?
13) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Does WQ believe this program should be formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?
14) Do the Forest Practice Rules contain all the elements that are essential to maintain long-term salmonid habitat or must they rely on the additional mitigation based on the understanding of essential salmonid habitat by the RPF?
15) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
16) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: - Stream protection rules (WLPZ widths and operations near streams) - Winter operating rules - Cumulative effects analysis - Yarding and roads rules - Retention/recruitment of LWD - Road maintenance If you feel the current standards are inadequate, what changes would you propose?

17) If you have a riparian no-cut zone of 200 feet slope distance for class 1 streams and a no-cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat in the North Coast?
18) From your agencies stand point, do you feel the level of expertise in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids?
19) Would an increased road and CMP maintenance period significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the Forest Practice Rules?
20) From your perspective, what would be the ideal regulatory and scientific process to minimize the effects of mass wasting and surface erosion on stream ecosystems?
21) What is the ideal outcome of the MOA/Science panel process? What can we do to maximize the chances for success of this process?

Questions for Forestry Consultants

1) How do you determine whether or not the effects of timber operations would be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?
2) What is your definition for "adaptive management?" Do you feel the FPR's represent adaptive management?
3) How do you address upstream passage by juvenile salmonids at road stream crossings? How are legacy culverts and roads assessed and treated? Are channel fords being considered satisfactory alternatives to culverts?
4) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do believe this program should be formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?
5) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
6) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: Stream protection rules (WLPZ widths and operations near streams) Winter operating rules Cumulative effects analysis Yarding and roads rules Retention/recruitment of LWD Road Maintenance If you feel the current standards are inadequate, what changes would you propose?
7) If you have a riparian no cut zone of 200 feet slope distance for class 1 streams and a no cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat in the North Coast? Can we develop a specific set of rules that would establish certain no cut riparian zone distances, for Class 1, 2 & 3 streams that would protect salmon habitat and not unduly restrict forest owners? Should landowners be compensated for no cut buffers?
8) From your stand point, do you feel you have a sufficient level of expertise in the preparation of THPs recognize potential risk factors relative to salmonids? If not, how do you develop this information?
9) Do you feel certification of forest landowners by independent organizations, such as "Scientific Certification Systems" or "Smart Wood" improve the sustainability of the salmonid habitat?
10) How often do you consult with the following specialists (other than state THP reviewers) during the preparation of THPs/NTMPs: Engineering Geologist; Fisheries Biologist; Hydrologist/ Watershed Specialist?
11) Do you believe the Forest Practice Rules related to salmonid protection measures are based on sound science?
12) Timber harvesting operations are often executed under emergency notices and exemptions, without undergoing the full THP review. Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout or a taking under these types of operations? Is your methodology of analysis any different than it would be for standard THPs?
13) From your experience, do the minimum practice standards utilized by your clients exceed those of the FPR's in regards to salmonids.
14) How would you streamline the THP approval process.
15) Do you feel the process should be changed to provide more on the ground review and compliance monitoring?

16) What role do you believe science should have in the process?
17) Are there incentives that could be provided to landowners to exceed the present standards in regards to salmonids (tax incentives, etc)?
18) Should heavily impacted watersheds be treated differently?
19) How do you feel small landowners are different are from large industrial owners. Who do you think has the best forest practices in regards to salmonid protection?
20) Because it is difficult for small landowners to do large Watershed Analysis, what is your opinion of a fee based cooperative effort where landowners are charged on a per acre basis for assessments?

QUESTIONS FOR FISH HABITAT RESTORATION PANEL

(1) How wide is the gap between the THP and on-the-ground implementation? What are the primary causes for this gap? How can these be remedied?
(2) Is the FPR adequate for protecting functions of WLPZs? If not, please cite specific rules in the FPR? Are more large trees generally left in the WLPZ than required in the FPR? Can you generally distinguish large from small landowners based on the quality of WLPZs?
(3) Roughly what percent of the road stream crossings you've observed pose migrational barriers (total and/or partial) to adult salmonids? To juvenile salmonids?
(4) What is the greatest source of suspended sediment you have observed during storms? Could this be remedied? If so, how?
(5) What future role do your envision for instream restoration projects in timberland watersheds? Now that several high flow years have occurred recently, have stream structures placed in the late-1980s and through the 1990s been evaluated? If so, what was the outcome? If not, why not?
(6) What role can you have in THPs for preventing problems to fish habitat, rather than being called-in to fix (or band-aid) problems?
(7) What are typical annual costs for operating an adult salmonid migration counting weir on a 5 to 10 sq. mile watershed?
(8) Do RPFs have sufficient understanding of salmonid habitat requirements? How much do they really need to implement the FPR? How would you change the FPR to limit/expand RPF discretion, if you consider necessary? Please cite specific rules within the FPR?
(9) Are you satisfied with CDFG's performance with respect to the THP process? If so, give highlights. If not, provide specific problem areas?
(10) Is the stream classification system in the FPR adequate for protecting salmonid habitat? If not, can you suggest a different approach?
(11) How do you determine cause and effect for your restoration project; i.e. how do you determine whether or not your project was successful?
(12) Do you believe landowners would respond positively to incentive-based regulations? Can you provide examples of landowner incentives that would benefit fish restoration efforts?
(13) Should monitoring be part of the Forest Practice Rules? If yes, what should be monitored?
(14) Would no-cut buffers of specified widths provide adequate salmon protection?
(15) Are the current road maintenance requirements adequate?
(16) From your perspective, what is the ideal outcome of the MOA/Science panel process? What can we do to maximize the changes for success of this process?

QUESTIONS FOR LANDOWNER ASSISTANCE ORGANIZATIONS

1) What changes in managing the riparian zone are necessary to protect anadromous salmonid habitat? Please reference specific locations within the FPR.
2) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
3) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: Stream protection rules (WLPZ widths and operations near streams) Winter operating rules Cumulative effects analysis Yarding and roads rules Retention/recruitment of LWD Road maintenance If you feel the current standards are inadequate, what changes would you propose?
4) In your opinion, do you feel the level of expertise in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids?
5) Do the Forest Practice Rules contain all the essential elements that are essential to maintain long-term salmonid habitat or must they rely on the additional mitigation based on the understanding of essential salmonid habitat by the RPF?
6) Would "not cut" riparian buffers protect salmon habitat? Can we develop a specific set of rules that would establish certain no-cut riparian zones distances and not unduly restrict forest owners? Should these be the same no-cut width for all areas in the Redwood Region?
7) If stronger rules are implemented that result in loss of income, should landowners be compensated by a tax break or some other mechanism?
8) Do you consider the Forest Practice Rules and the rule making process to be "adaptive management"? Should the rules be based on "adaptive management" approaches? If yes, what role should the environmental community have in adaptive management?
9) Do you believe landowners recognize the need to address salmonid protection issues? Are they cognizant of the physical processes they affect and the potential impacts to salmon? If not, what is the best method for educating these landowners?
10) Are landowners willing to undertake "fish friendly" practices on their property even though such practices may to not be required by regulation? What type of incentives can be developed to encourage these practices?
11) Can "voluntary" programs to protect or recover fish be successful? How can government ensure that these programs are implemented?
12) From your perspective, what is the ideal outcome of the MOA/Science panel process? What can we do to maximize the chances for success of this process?

QUESTIONS FOR LOGGERS

1) From your point of view, how difficult are timber harvesting plans to understand? Are they well organized, and do they provide you with sufficient information to understand the on-the-ground requirements of the THP? Is your crew able to understand the requirements of the THP?
2) Do you feel the on-the-ground flagging and tree marking is adequately done to provide clear guidance to you and your logging crew? If not, what would you do to make flagging and tree marking more obvious?
3) Do you or one of your representatives typically attend the pre-harvest inspection? Does you or your foreman personally inspect every THP before operations with the RPF who prepared the plan? If it not the RPF who prepared the plan, what other party may provide you a review of the plan? Is this review always done in the field, or is it done as a paper exercise?
4) What difficulties do you have logging within watercourse and lake protection zones? Are there more problems associated with tractor or cable logging within these zones? If you could design how these zones were logged, what methodologies would you employ?
5) Do you feel the trees marked within the WLPZ for harvest are properly selected by the RPF from both an operational and stream protection standpoint? If you could designate which trees would be removed and which trees would be retained in the WLPZ, how would you do it? How much flexibility should be provided to the faller when selecting or trading trees within the WLPZ (if any)?
6) If you could change the Forest Practice Rules to make them more operationally friendly, how would you do it?
7) In your opinion, do you believe the Forest Practice rules provide adequate protection measures for salmon?
8) As currently written and implemented, do you feel the rules pertaining to road maintenance are adequate to prevent the erosion of roads and skid trails?
9) On a percentage basis, how often are the THPs you are operating administered by an RPF? For those plans that are administered by foresters, what is the frequency of field visitations by the forester during the administration? During your logging operations, how often are you checked by a forester or other landowner representative?
10) Have you worked for both large and small landowner representatives? If yes, what are the differences in the logging administration between these two types of landowners?
11) During operations, how often are you inspected by CDF representatives? Do you or you crew have direct contact with them or do you just receive written notice of inspection?
12) Do you feel the CDF violation process is fairly administered and achieves compliance with the Forest Practice Rules? If you could change this system, how would you?
13) Do you feel you can harvest trees from within the WLPZ and not expose mineral soil or cause surface erosion?
14) What difficulties would no cut buffers create for harvesting, if any?

QUESTIONS FOR INDUSTRIAL FORESTERS

1) How do you determine whether or not the effects of timber operations will be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?
2) What is your definition for "adaptive management?" Do you feel the FPR's represent adaptive management?
3) How do you address upstream passage by juvenile salmonids at road stream crossings? How are legacy culverts and roads assessed and treated? Are channel fords being considered satisfactory alternatives to culverts?
4) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do believe this program should be formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?
5) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
6) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: Stream protection rules (WLPZ widths and operations near streams) Winter operating rules Cumulative effects analysis Yarding and roads rules Retention/recruitment of LWD Road Maintenance If you feel the current standards are inadequate, what changes would you propose?
7) If you have a riparian no cut zone of 200 feet slope distance for class 1 streams and a no cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat in the North Coast? Can we develop a specific set of rules that would establish certain no cut riparian zone distances, for Class 1, 2 & 3 streams that would protect salmon habitat and not unduly restrict forest owners? Should landowners be compensated for no cut buffers?
8) From your standpoint, do you feel you have a sufficient level of expertise in the preparation of THPs to recognize potential risk factors relative to salmonids? If not, how do you develop this information?
9) How often do you inspect your inactive roads?
10) When developing a THP, how often do you consult with the following specialists (other than state THP reviewers) during the preparation of THPs/NTMPs: Engineering Geologists; Fisheries Biologists; Hydrologist/Watershed Specialist?
11) Do you believe the Forest Practice Rules related to salmonid protection measures are based on sound science?
12) Timber harvesting operations are often executed under emergency notices and exemptions, without undergoing the full THP review. Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout under these types of operations? Is your methodology of analysis any different than it would be for standard THPs?
13) From your experience, do the minimum practice standards utilized by your company exceed those of the FPR's in regards to salmonids?
14) How would you streamline the THP approval process?
15) Do you feel the process should be changed to provide more on the ground review and compliance monitoring?
16) What role do you believe science should have in the process?

17) Are there incentives that could be provided to landowners to exceed the present standards in regards to salmonids (tax incentives, etc)? Can you provide examples?
18) Should heavily impacted watersheds be treated differently?
19) Who do you think has the best forest practices in regards to salmonid protection, small landowners or large industrial owners?
20) If you were asked to develop a program for the input of LWD into watercourses, how would you do it?

QUESTIONS FOR LARGE LANDOWNERS

1) How do you determine whether or not the effects of timber operations would be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?
2) What is your definition for "adaptive management?" Do you feel the Board of Forestry rule making process and the FPR's represent adaptive management?
3) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do you support this program somehow being formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?
4) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
5) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: Stream protection rules (WLPZ widths and operations near streams) Winter operating rules Cumulative effects analysis Yarding and roads rules Retention/recruitment of LWD Road maintenance If you feel the current standards are inadequate, what changes would you propose?
6) If you have a riparian no-cut zone of 200 feet slope distance for class 1 streams and a no-cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat in the North Coast?
7) Do you feel the certification of the SYP's for large forestland owners by independent organizations, such as "Scientific Certification Systems" or "Smart Wood" improve the sustainability of the salmonid habitat?
8) Can we develop a specific set of rules that would establish certain no-cut riparian zone distances, for Class 1, 2 & 3 streams that would protect salmon habitat and not unduly restrict forest owners? Should these be the same no-cut width for all areas in the Redwood Region?
9) Do you believe the Forest Practice Rules related to salmonid protection measures are based on sound science?
10) Do you feel the level of expertise in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids? If not, what changes would you propose?
11) Timber harvesting operations are often executed under emergency notices and exemptions, without undergoing the full THP review. Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout or a taking under these types of operations? Is your methodology of analysis any different than it would be for standard THPs?
12) How would you streamline the THP approval process.
13) Do you feel the process should be changed to provide more on the ground review and compliance monitoring?
14) What role do you believe science should have in the process?
15) Are there incentives that could be provided to landowners to exceed the present protection standards in regards to salmonids (tax incentives, etc)?
16) Should heavily impacted watersheds be treated differently?
17) How should legacy roads and skid trails that are current or potential sources of sediment be addressed.

18) What is your position on upstream passage by juvenile salmonids at road stream crossings? Mandatory passage? How should legacy culverts be treated? Are channel fords being considered satisfactory alternatives to culverts?
19) On your forestlands do you adequately protect salmonid habitat? How are you dealing with the issue of coho recovery.
20) Do your practice standards exceed those of the FPR's in regards to salmonids?
21) Should the LTO sign the THP? Should they attend the PHI?
22) Should RPF's be required to review THPs during operations to insure compliance?
23) Who does a better job of resource protection, large or small landowners?
24) From your perspective, what is the ideal outcome of the MOA/Science panel process? What can we do to maximize the changes for success of this process?

QUESTIONS FOR PRIVATE FISHERIES BIOLOGISTS

1) The Forest Practices Rules require that the Director disapprove plans that would result in a "take", or a finding of jeopardy, of a listed species by a federal agency of the Department of Fish and Game Specifically; How do you ensure that the THP would not result in a "take" or a finding of jeopardy of coho salmon and/or steelhead trout? What analysis do you rely upon to make these determinations?

2) What is your definition for "significant cumulative impact?" Specifically, how do you determine whether or not there significant cumulative impacts on coho salmon and/or steelhead trout have occurred?

3) How do you determine whether or not the effects of timber operations would be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?

4) What do you use for "baseline" conditions for water temperature, stream flow, sediment, large woody debris when assessing habitat conditions? Do you use averages for water temperature, stream flow, and/or sediment? What is the source of the protocols used to determine these parameters?

5) What is your definition of "adaptive management?" Do you feel the FPR's represent adaptive management? Are landowners you work with participating in adaptive management in regards to salmonids?

6) "Limiting factors analyses" for anadromous salmonids are often cited in cumulative effect assessments. Can you provide examples of limiting factors analysis that you consider satisfactory or exemplary?

7) What is your position on upstream passage by juvenile salmonids at private logging road stream crossings? Should there be mandatory passage? Do you believe there is sufficient assessment of fish passage on existing culverts? Do we have adequate models to properly design fish passage through culverts for all life stages of salmonids? How should legacy culverts be treated? Are channel fords being considered satisfactory alternatives to culverts?

8) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do you believe this program somehow be formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?

9) Do the Forest Practice Rules contain all the elements that are essential to maintain long-term salmonid habitat or must they rely on the additional mitigation based on the understanding of essential salmonid habitat by the RPF?

10) Given your experience, from a fisheries standpoint if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?

11) Please describe your role in the preparation or review of Timber Harvesting Plans on the North Coast. Do you see your role changing in the future?

12) How could the THP process be changed to encourage more fish/stream rehabilitation work?

13) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: Stream protection rules (WLPZ widths and operations near streams) Winter operating rules Cumulative effects analysis Yarding and roads rules Retention/recruitment of LWD Road Maintenance If you feel the current standards are inadequate, what changes would you propose?

14) Based on your observations, do the THPs as prepared and approved exceed the minimums of the rules? Do you think the majority of the approved plans contain adequate protection for salmonids?

15) Do different types (large industrial verses small non-industrial) of landowners provide better protection of salmonid habitat?

16) If you have a riparian no cut zone of 200 feet slope distance for class 1 streams and a no cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat on the North Coast?

17) From your standpoint, do you feel the level of expertise utilized in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids?

18) Would an increased road and CMP maintenance period significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the FPR?

19) From your perspective, what would be the ideal regulatory and scientific process to minimize the effects of mass wasting and surface erosion on stream ecosystems?

20) How would you rank environmental factors most limiting salmonid populations in their freshwater environment (e.g., absence of LWD, suspended sediment, water temperature, gravel quality)?

21) How do you assess cumulative effects on salmonid populations from a given THP, or can it be done?

22) Are RPF's adequately distinguishing Class I, II, and III streams? Is this classification scheme adequate for protecting salmonid habitat? If not, do you have another in mind?

23) Is there a quantitative way to evaluate effects of Class III streams on salmonid habitat?

24) Is the concept/practice of adopting thresholds a viable approach for assessing potential harm to salmonids and for assessing cumulative effects? For example, can a threshold for percent fines in spawning gravel be established in specific basins? What percent mortality would dictate a "fines" threshold? If thresholds won't work, what will?

25) Does the FPR provide adequate protection to salmonids from timber harvest operations? If not, please cite specific rules in the FPR. Is adequate protection sufficient, or should recovery be the objective? Are RPFs sufficiently competent to assess salmonid habitat needs and status?

26) Can salmonid habitat be objectively quantified?

27) How important is upstream migration of juvenile salmonids?

28) Are amphibians adequately considered in THPs? Is more attention/guidelines needed? Is so, what?

29) What size steelhead and coho smolts have reasonable chances of returning as adults?

QUESTIONS FOR THE NATIONAL MARINE FISHERIES SERVICE

1) The Forest Practices Rules require that the Director disapprove plans that would result in a "take", or a finding of jeopardy, of a listed species by a federal agency of the Department of Fish and Game. How does your agency evaluate a THP to determine if it would result in a "take" or a finding of jeopardy of coho salmon and/or steelhead trout?

2) How difficult is defining take?" Specifically, how do you determine whether or not a taking of a listed salmonid has occurred?

3) How do you determine (if you can) acceptable levels of risk when associated with timber harvesting in regards to salmonid protection?

4) What do you use for "baseline" conditions for water temperature, stream flow, sediment, and large woody debris? Do you use averages for water temperature, stream flow, and/or sediment? What are the sources of the protocols determining these parameters?

5) What is your definition of "adaptive management?" Do you feel the FPR's accommodate adaptive management? Is your agency encouraging adaptive management with regards to the FPRs? If so, how would this be implemented administratively and guaranteed?

6) "Limiting factors analyses" for anadromous salmonids are often cited in cumulative effect assessments. Can you provide examples of limiting factors analyses that you consider satisfactory or exemplary?

7) What is your position on upstream passage by juvenile salmonids at private logging road stream crossings? Should there be mandatory passage? Do you believe there is sufficient assessment of fish passage on existing culverts? How should legacy culverts be treated? Are channel fords being considered satisfactory alternatives to culverts?

8) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do you believe this program should somehow be formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?

10) As the agency charged with enforcement of the ESA, what assurances do you need to approve a process-based THP review and approval system in regards to protection of salmonids?

11) Given your experience from a fisheries standpoint, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?

12) What has been your agency's role to date in reviewing and approving Timber Harvesting Plans in the North Coast? Will (should) your role change in the future, and if so how?

13) How could or should the THP process be changed to encourage more fish/stream rehabilitation work? Could this be used as mitigation banking?

14) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate:Stream protection rules (WLPZ widths and operations near streams) Winter operating rules Cumulative effects analysis Yarding and roads rules Retention/recruitment of LWD Road MaintenanceIf you feel the current standards are inadequate, what changes would you propose?

15) Based on your observations, do the THPs as prepared and approved exceed the minimums of the rules? Do most approved plans contain adequate protection for salmonids?

16) Do different types (large industrial versus small non-industrial) of landowners provide better protection of salmonid habitat?

17) If you have a riparian no cut zone of 200 feet slope distance for class 1 streams and a no cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this adequately protect salmon habitat on the North Coast?

18) From your standpoint, do you feel the level of expertise utilized in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids?

19) Do you believe an increased road and CMP maintenance period would significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the FPR?

20) From your perspective, what would be the ideal regulatory and scientific process to minimize the effects of mass wasting and surface erosion on stream ecosystems?

QUESTIONS FOR ROAD CONSTRUCTION AND ROAD MAINTENANCE SPECIALISTS

) From your point of view, how difficult are timber harvesting plans to understand? Are they well organized, and do they provide you with sufficient information to understand the on-the-ground requirements of the THP? Is your crew able to understand the requirements of the THP?

2) Do you feel the on-the-ground flagging of new roads and location and size of new culverts is adequately done to provide clear guidance to you and your crew? If not, what would you do to make flagging and watercourse crossing information more obvious?

3) How are the road construction and maintenance requirements contained in the THP transferred to you and your crew? Do you or one of your representatives typically attend the pre-harvest inspection? Do you or your foreman personally inspect the proposed roads in every THP before operations with the RPF who prepared the plan? If it is not the RPF who prepared the plan, what other party may provide you a review of the plan? Is this review done in the field, or is it done in the office?

4) For you operations, who designs and locates the proposed roads in the field? Do you feel the roads are well located and the watercourse crossings well designed? Does the road design and location recognize problem areas (such as unstable features) and adequately address how these areas are to be treated during the road construction process?

5) If you could change the Forest Practice Rules to make them more operationally friendly, how would you do it?

6) In your opinion, do you believe the Forest Practice Rules provide adequate protection measures for salmon?

7) As currently written and implemented, do you feel the rules pertaining to road maintenance are adequate to prevent the erosion from roads?

8) During road construction activities, how often does a forester or other resource specialist inspect the operation.

9) Have you worked for both large and small landowners? If yes, what are the differences, if any, in the quality of road construction and maintenance between these two types of landowners?

10) During operations, how often are you inspected by CDF representatives? Do you or you crew have direct contact with them or do you just receive written notice of inspection?

11) Do you feel the CDF violation process is fairly administered and achieves compliance with the Forest Practice Rules? If you could change this system, how would you?

12) Can road maintenance be conducted in such a manner that eliminates soil erosion?

13) What specific difficulties are there in maintaining roads during the winter period?

14) How frequently are roads inspected?

15) Do you have a winter storm watch program for roads and watercourse crossings?

16) From a road maintenance standpoint, how should secondary or spur roads that are not likely to be used for several years be treated? What can be done to these roads to keep them useable, but minimize maintenance requirements?

17) When you construct major watercourse crossings do you include rolling dips (or other measures) to minimize diversion potential?

18) In your opinion, would rocking the fill slopes of watercourse crossings significantly reduce erosion?

QUESTIONS FOR SMALL LANDOWNERS

1) How do you determine whether or not the effects of timber operations would be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?

2) What is the your definition for "adaptive management?" Do you feel the FPR's represent adaptive management? Are you as a landowner participating in adaptive management with regards to your management?

3) What will be the agency's position on upstream passage by juvenile salmonids at road stream crossings? Mandatory passage? How will legacy culverts be treated? Are channel fords being considered satisfactory alternatives to culverts?

4) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do you envision this program somehow being formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?

5) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?

6) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: Stream protection rules (WLPZ widths and operations near streams) Winter operating rules Cumulative effects analysis Yarding and roads rules Retention/recruitment of LWD Road Maintenance If you feel the current standards are inadequate, what changes would you propose?

7) If you have a riparian no-cut zone of 200 feet slope distance for class 1 streams and a no-cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat in the North Coast? If there were no cut buffers, should landowners be compensated?

8) From your standpoint, do you feel the level of expertise in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids?

9) Do you feel the certification of the SYP's for forestland owners by independent organizations, such as "Scientific Certification Systems" or "Smart Wood" improve the sustainability of the salmonid habitat?

10) Can we develop a specific set of rules that would establish certain no-cut riparian zone distances, for Class 1, 2 & 3 streams that would protect salmon habitat and not unduly restrict forest owners? Should these be the same no-cut width for all areas in the Redwood Region?

11) Timber harvesting operations are often executed under emergency notices and exemptions, without undergoing the full THP review. Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout or a taking under these types of operations? Is your methodology of analysis any different than it would be for standard THPs?

12) Do your minimum practice standards exceed those of the FPR's in regards to salmonids.

13) How would you streamline the THP/NTMP approval process.

14) Do you feel the process should be changed to provide more on the ground review and compliance monitoring?

15) What role do you believe science should have in the process?

16) Are there incentives that could be provided to landowners to exceed the present standards in regards to salmonids (tax incentives, etc)?

17) Should heavily impacted watersheds be treated differently?
18) How should legacy roads and skid trails that are current or potential sources of sediment be addressed.
19) How do you feel you different are from large industrial owners.
20) Because it is difficult for small landowners to do large Watershed Analysis, would you participate a fee based cooperative effort where landowners are charged on a per acre basis for assessments?
21) On your forestlands, do you adequately protect salmonid habitat when you harvest timber?
22) In order to protect salmonid habitat would you prefer more restrictive rules or have the RPF mitigate the protection of salmonid habitat during timber harvest?
23) From your perspective, what is the ideal outcome of the MOA/Science panel process? What can we do to maximize the chances for success of this process?

THP REVIEWERS PANEL

1) What is the future role of TMDL's in respect to the FPR's? How has the Garcia River River TMDL been implemented? What have been the strengths and weaknesses?
2) Doe you have any suspended sediment or temperature thresholds above which is considered an impairment? If so what are they. If not, how will they be developed?
3) Do you think nutrient introduction in regards forest management needs to be modified by changes in the FPR's?4
) What is the agency's definition for "significant cumulative impact?" 1)Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout?
5) How do you determine whether or not the effects of timber operations would be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?
6) What do you use for "baseline" conditions for water temperature, stream flow, sediment, large woody debris? Do you use averages for water temperature, stream flow, and/or sediment?
7) Many rules in the FPR are ultimately subject to RPF discretion. Where can/should the sideboards to an RPF's discretion be changed (narrowed or widened) within the FPR? Please give precise locations of desired rules changes within the FPR. Are the agency's desired changes supported by quantitative evidence?
8) What is the agency's definition for "adaptive management?" Do you feel the FPR's represent adaptive management? Is your agency directing/participating in adaptive management with regards to the FPR?
9) "Limiting factors analyses" for anadromous salmonids are often cited in cumulative effect assessments. Can you provide a copy of a limiting factors analysis that the agency considers satisfactory or exemplary?
10) What is your agency's position on upstream passage by juvenile salmonids at road stream crossings? Mandatory passage? How will legacy culverts be treated? Are channel fords being considered satisfactory alternatives to culverts?
11) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Do you believe this program should be formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?
12) Do the Forest Practice Rules contain all the elements that are essential to maintain long-term salmonid habitat or must they rely on the additional mitigation based on the understanding of essential salmonid habitat by the RPF?
13) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?
14) How does your agency review all of the THPs submitted? What is the frequency of your agency attending pre-harvest inspection field tours? Does your agency undertake post-harvest monitoring of THPs for; 1) compliance with rules and THP, and 2) adequacy for the needs of salmonids? If post harvest monitoring has occurred, has a report of the results been prepared?
15) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: - Stream protection rules (WLPZ widths and operations near streams) - Winter operating

Proposed by the CA Resources Agency
And the National Marine Fisheries Service

In an effort to ascertain whether or not the California Forest Practice Rules (FPR) *are adequate to contribute to the long-term survival of salmonids* and salmonid habitat, the following four questions are posed to the scientific review panel:

Question 1: Do the Forest Practice Rules contain all the relevant scientific principles of watershed analysis, hydrologic function, and biological science applicable to conserving anadromous salmonids on California's forestlands; specifically as they relate to:

- the design of the proposed project;
- the cumulative impacts assessment and related mitigation;
- measures to protect the hillslope;
- watercourse protection measures, including riparian areas; and
- provision of monitoring and feedback on the implementation and effectiveness of mitigation.

If not, are they incomplete, missing, misstated or not being implemented?

Question 2: Do the Forest Practice Rules provide an adequate adaptive management framework to integrate new science, new technology, or new understanding in watershed assessment and watercourse and fisheries protection? If not, what improvements can be made.

Question 3: For the following question, it is requested that the Science Panel consider the application of the rules as contained in THPs approved subsequent to the Coho listing and the issuance of the Coho considerations by CDF.

Do the approved THPs consider all relevant scientific principles of watershed analysis, hydrologic function, and biological science? As appropriate, are these principles reflected in:

- the design of the proposed project;
- the cumulative impacts assessment and related mitigation;
- the choice of measures to protect the hillslope;
- the choice of watercourse protection measures, including riparian areas; and
- provision of monitoring and feedback on the implementation and effectiveness of mitigation.

If not, what improvements can be made?

Question 4: Do the THPs approved under the 2090 Agreement consider all relevant scientific principles of watershed analysis, hydrologic function, and biological science? As appropriate, are these principles reflected in:

- the design of the proposed project;
- the cumulative impacts assessment and related mitigation;
- the choice of measures to protect the hillslope;
- the choice of watercourse protection measures, including riparian areas; and
- provision of monitoring and feedback on the implementation and effectiveness of mitigation.

If not, what improvements can be made?

rules - Cumulative effects analysis - Yarding and roads rules - Retention/recruitment of LWD - Road maintenance If you feel the current standards are inadequate, what changes would you propose?

16) If you have a riparian no-cut zone of 200 feet slope distance for class 1 streams and a no-cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat in the North Coast?

17) From your standpoint, do you feel the level of expertise in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids?

18) In regard to salmonid protection, identify areas of personal concern over the following stages of the THP process: THP preparation, agency review and field inspection, public input during the review, approval, post-approval operational inspections, and post-completion issues.

19) Would an increased road and CMP maintenance period significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the FPRs?

20) From your perspective, what would be the ideal regulatory and scientific process to minimize the effects of mass wasting and surface erosion on stream ecosystems?

21) What is the ideal outcome of the MOA/Science panel process? What can we do to maximize the chances for success of this process?

WATER QUALITY

1) What is the source of your statutory authority to protect water quality and fisheries resources? How is that authority implemented? How does this authority interact with that of other Boards or agencies?

2) What is the future role of TMDL's in respect to the FPR's? How has the Garcia River River TMDL been implemented? What have been the strengths and weaknesses?

3) Are the TMDLs going to be developed separately for each watershed?

4) Does WQ have any suspended sediment or temperature thresholds above which is considered an impairment? If so what are they. If not, how will they be developed?

5) What will WQ do to offset the loss of gauging stations as an important element of monitoring?

6) Do you think nutrient introduction in regards forest management needs to be modified by changes in the FPR's?

7) What is the agency's definition for "significant cumulative impact?" 1)Specifically, how do you determine whether or not there would be significant cumulative impacts on coho salmon and/or steelhead trout?

8) How do you determine whether or not the effects of timber operations would be mitigated to a level of insignificance, with regard to cumulative impacts on coho salmon and/or steelhead trout?

9) What do you use for "baseline" conditions for water temperature, stream flow, sediment, large woody debris? Do you use averages for water temperature, stream flow, and/or sediment?

10) Many rules in the FPR are ultimately subject to RPF discretion. Where can/should the sideboards to an RPF's discretion be changed (narrowed or widened) within the FPR? Please give precise locations of desired rules changes within the FPR. Are the agency's desired changes supported by quantitative evidence?

11) What is the agency's definition for "adaptive management?" Do you feel the FPR's represent adaptive management? Is the agency directing/participating in adaptive management with regards to the FPR?

12) "Limiting factors analyses" for anadromous salmonids are often cited in cumulative effect assessments. Can the agency provide a copy of a limiting factors analysis that the agency considers satisfactory or exemplary?

13) What will be the agency's position on upstream passage by juvenile salmonids at road stream crossings? Mandatory passage? How will legacy culverts be treated? Are channel fords being considered satisfactory alternatives to culverts?

14) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Does WQ believe this program should be formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?

15) Do the Forest Practice Rules contain all the elements that are essential to maintain long-term salmonid habitat or must they rely on the additional mitigation based on the understanding of essential salmonid habitat by the RPF?

16) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?

17) How does your agency review all of the THPs submitted? What is the frequency of your agency attending pre-harvest inspection field tours? In the last two years, how often has your agency

filed a non-concurrence or a head of agency appeal on a THP with coho issues? Does your agency undertake post-harvest monitoring of THPs for; 1) compliance with rules and THP, and 2) adequacy for the needs of salmonids? If post harvest monitoring has occurred, has a report of the results been prepared?

18) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: - Stream protection rules (WLPZ widths and operations near streams) - Winter operating rules - Cumulative effects analysis - Yarding and roads rules - Retention/recruitment of LWD - Road maintenance If you feel the current standards are inadequate, what changes would you propose?

19) If you have a riparian no-cut zone of 200 feet slope distance for class 1 streams and a no-cut zone of 100 feet slope distance for Class 2 and 3 for all forests in the Redwood Region, would this protect salmon habitat in the North Coast?

20) From your agencies stand point, do you feel the level of expertise in the preparation of THPs is adequate to recognize potential risk factors relative to salmonids?

21) Would an increased road and CMP maintenance period significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the FPRs?

22) From your perspective, what would be the ideal regulatory and scientific process to minimize the effects of mass wasting and surface erosion on stream ecosystems?

23) What is the ideal outcome of the MOA/Science panel process? What can we do to maximize the chances for success of this process?

QUESTIONS FOR WATERSHED SPECIALIST PANEL

(1) Is the current cumulative effects analysis utilized in the THP approval process adequate? If not, how should it be changed?

(2) Are basin-wide watershed assessments a reasonable approach to identify problems in watershed? How should these assessments be funded? Who should establish baselines or limiting factors?

(3) Would tighter controls on winter logging significantly reduce road related failures and/or suspended sediment production? What changes in the FPRs, or other changes, would you recommend?

(4) Are many RPFs overestimating their abilities for recognizing potential geologic hazards and prescribing mitigative actions? Should there be some administrative "trigger" in preparing a THP that would require a licensed geologist? What would that be?

(5) Given an ounce of prevention is worth a pound of cure, is sufficient attention provided in planning and locating new roads? Does the FPR adequately address/require this? Please mention specific rules within the FPR.

(6) Are the FPRs adequate for protecting functions of WLPZs? If not, please cite specific rules in the FPR? Are more large trees generally left in the WLPZ than required in the FPR? Can you generally distinguish large from small landowners based on the quality of WLPZs?

(7) What is the greatest source of suspended sediment you have observed during storms? Could this be remedied? If so, how?

(8) What future role do your envision for instream restoration projects in timberland watersheds? Now that several high flow years have occurred recently, have stream structures placed in the late-1980s and through the 1990s been evaluated? If so, what was the outcome? If not, why not?

(9) Do RPFs have sufficient understanding of salmonid habitat requirements? How much do they really need to know to implement the FPRs? How would you change the FPRs to limit/expand RPF discretion, if you consider necessary? Please cite specific rules within the FPRs?

(10) Is the stream classification system in the FPR adequate for protecting salmonid habitat? If not, can you suggest a different approach?

(11) Do you believe landowners would respond positively to incentive-based regulations? Can you provide examples of landowner incentives that would benefit fish/watershed restoration efforts?

(12) Should monitoring be part of the Forest Practice Rules? If yes, what should be monitored?

(13) Would no-cut buffers of specified widths provide adequate salmon protection?

(14) Would an increased road and BMP maintenance period significantly reduce road related hillslope failures and suspended sediment production? If so, how much longer than required/practiced in the FPR?

(15) Do you see a greater or altered role for geologists in the THP process in the future?

(16) From your perspective, what would be the ideal regulatory and scientific process to minimize the effects of mass wasting and surface erosion on stream ecosystems?

(17) Given your experience, if you could throw out the existing California Forest Practice Rules, could you write a simpler, less confusing, easily enforceable set of rules that more effectively protect aquatic ecosystems?

(18) From the perspective of adequacy for protection of salmonid species, please describe if you feel the following sections of the current rules (including the "coho consideration document") are adequate: - Stream protection rules (WLPZ widths and operations near streams) - Winter operating rules - Cumulative effects analysis - yarding and roads rules - retention/recruitment of LWD - If you feel the current standards are inadequate, what changes would you propose?

(19) Recent watershed workshops sponsored, at least in part, by CDFG have been aimed at educating the RPF's discretion with regard to anadromous salmonid needs and potential cumulative watershed effects. Does CDFG envision this program somehow being formally incorporated into the FPR, RPF registry, and/or Board of Forestry oversight?

(20) *From your perspective, what is the ideal outcome of the MOA/Science panel process? What can we do to maximize the changes for success of this process?*

APPENDIX E
Definitions (CCR 895.1)

Channel Zone: A watercourse's channel zone includes its bankfull channel and floodplain, encompassing the area between the watercourse transition lines.

Critical dip: A critical dip is a drainage facility constructed on a haul road immediately above a culvert. This dip is constructed on the down-slope side of the road and is intended to direct water over the center of the fill slope above the culvert in case the culvert becomes plugged and overflows the road fill.

Inner-gorge: *An inner-gorge is a physiographic feature that can occur along valley side-slopes* adjacent to stream channels, and is characterized by steep slopes at the base of the valley that flatten at a distinct break-in-slope with a gain in elevation. It can be considered "a valley within a valley" (after Kelsey 1988). The lower slopes of these features are generally defined by slopes exceeding 50% although in more competent bedrock, inner gorge slope gradients typically exceed 65%. In northern California, inner gorges are best developed in mid-order stream reaches (Kelsey 1988). Chronic mass wasting, such as shallow landsliding or deep-seated transrotational features, is the main erosional hillslope process associated with inner gorges.

Low thinning: A low thinning is to be used in conjunction with silvicultural treatments in Zone A of Class I WLPZs. This thinning involves the removal of the understory, mid-canopy, and very limited numbers of co-dominant trees. Co-dominant trees may be removed only to improve spacing and enhance growth. Dominant trees may not be removed, and average stand diameter must increase following harvest.

Overstory trees (for WLPZ only): Trees that occur in the mid to upper canopy and are at least 50' tall.

% Overstory Canopy: Canopy closure provided by the overstory trees as measured against 100%.

Permanently designated: Trees are to be marked in such a manner that the designation will be retained for sufficient time to identify upon the next entry following the initial marking. This may include a combination of paint, tree tags, blazes, metal fence posts, etc. Marks will be applied both above and below the stump line.

Recruitment trees: Recruitment trees are permanently designated trees within Zone A of Class I WLPZs. *These trees shall be the ten largest trees per 100 meters within 50 feet (slope distance)* upslope of the watercourse transition line. The RPF may propose, with concurrence from DF&G, trading for smaller diameter trees that are more conductive to recruitment as LWD. Recruitment

trees shall be remarked for identification upon each subsequent entry, and additional trees shall be designated to replace those trees that have fallen.

Riparian zone: The riparian zone is the area extending from the watercourse transition line upslope to the top of Zone B in the WLPZ.

Salmonid-directed silviculture: This is defined as silvicultural treatments specifically designed to improve forest stand conditions that have indirect or direct effects on salmonids. This silviculture shall support the growth and development of large diameter conifers and hardwood tree species with stand composition that will ultimately benefit salmonid habitat. This shall be accomplished using selection, thinning, and small group openings (less than ¼ acre), while meeting the shade canopy requirements. Any harvesting within this zone may only be conducted to improve stand conditions for the benefit of salmonid habitat. Examples of these types of harvests include thinning to increase growth of residual trees, selection harvest to benefit the ratio of conifers to hardwoods and selection harvests to promote conifer regeneration.

WLPZ, Class I; Zone A: Zone A extends from the watercourse transition line upslope for a distance of 75 feet (slope distance). This zone is divided into two zones; Zone A-1 and Zone A-2. Zone A-1 occupies the first 25 feet, and Zone "B" the remaining 50 feet. Zone A-1 shall be managed for "salmonid-directed silviculture" (as defined. Zone B extends from the top of Zone A, upslope for a distance of 75 feet (slope distance).

WLPZ, Class II; Zone A: Zone A extends from the watercourse transition line upslope for distance of 30 feet (slope distance). Zone B extends from the top of Zone A, upslope 75 feet (slope distance).

Watercourse Transition Line: The watercourse transition line is the outer boundary of a watercourse's floodplain as defined by the following: (1) the upper limit of sand deposition; and, (2) evidence of recent channel migration and/or flood debris. The first line of permanent woody vegetation must not be used to determine this transition line.

APPENDIX F
KEY FINDINGS OF THE MONITORING STUDY GROUP REPORT

From the Executive Summary:

"Roads and their associated crossings were found to have the greatest potential for sediment delivery to watercourses...Results to date indicate that greater attention should be focused on improvement of crossing design, construction, and maintenance due to the high levels of departures from Rule requirements and the close proximity of crossings to channels. For roads, better implementation of Rules related to drainage structure design, construction, and maintenance is needed. Mass failures associated with current timber operations were mostly related to roads and produced the highest sediment delivery to watercourse channels when compared to other erosion processes. The majority of the road related mass failures were associated with fill slope problems —indicating that proper road construction techniques are critical for protecting water quality." (p. iii)

Conclusions:

1. ***"Erosion problem points noted for roads, skid trails, landings, crossings, and WLPZs were almost always associated with improperly implemented Forest Practice Rules."***

"The data collected to date suggests that the vast majority of erosion problem points were caused by minor or major departures from specific Forest Practice Rule requirements. Nearly all the problem points were judged to result from non-compliance. For example on the road transects, only about three percent of the implementation ratings assigned at erosion features were for situations where the Rule requirements were judged to have been met or exceeded."

"The Forest Practice Rules and individual THP requirements (i.e., site-specific mitigation measures developed through recommendations of interagency Review Teams) were generally found to be sufficient to prevent hillslope erosion features when properly implemented on the ground by Licensed Timber Operators (LTOs).[1] To improve implementation, new training programs for LTOs and their employees should be encouraged, and these programs should include a field component."

2. ***"Roads and their associated crossings were found to have the greatest potential for delivery of sediment to watercourses. Implementation of Forest Practice Rules that specify drainage structure design, construction and maintenance need improvement."***

"More than 80% of the road transects evaluated from 1996 through 1998 were seasonal roads, and less than 30% of the sampled road mileage was surfaced with rock. Overall, 36 Rule requirements for roads and crossings were found to have more than 5% minor and major departures, considerably more than that found for landings, skid trails and WLPZs. The Forest Practice Rules with the highest departures from stated road requirements were related to waterbreak spacing, maintenance, and construction standards; adequate number, size, and location of drainage structures; prevention of discharge onto erodible fill; and

[1] Rice and Datzman (1981) previously reported that operator performance may equal site characteristics as a source of variation in logging related erosion.

sidecast limitations on steep slopes. Erosion problem points were noted, on average, approximately every 400 feet. Rilling was common, but had low sediment delivery to channels; mass failures were noted much less frequently but had high sediment delivery. Rilling and gullying were primarily caused by drainage feature problems, while mass failures were most commonly associated with unstable fill material."

"In most types of terranes, earlier studies have reported that roads produce 75-95% of the erosion related to timber operations (Rice 1989). Based on the data collected to date as part of this program, these estimates still seem reasonable in the late 1990's.[2] The data suggests that there is considerable room for improvement in road design and construction—particularly regarding fill slopes, cutslopes, and crossings (see No. 4 below). As documented by Lewis and Rice (1989) as part of the Critical Sites Erosion Study, site factors overwhelm management impacts in most terranes. Therefore, *where* roads are built will remain critical for reducing the likelihood of producing significant sediment input to channels."

3. ***"Mass failures related to current timber operations are most closely associated with roads and produce the highest sediment delivery to watercourse channels when compared to other erosional processes."***

"Data from 100 THPs shows that about one-quarter of the plans had large erosion features. More than 80% of the large erosion events that were documented as part of the statewide survey were associated with roads and crossings. Estimates from the randomly located road transects revealed that about 50% of the mass failures delivered material to stream channels—much higher than the average sediment delivery associated with sloughing, rilling, and gullying. The majority of the mass failures were associated with fill slopes, with cutbank and culvert problems also commonly noted. The data from both the large erosion event record and the randomly located road transects suggests that RPFs must locate and design, and LTOs must construct, drain, and maintain roads in a manner that will reduce the frequency of mass failure events."

4. ***"Numerous problems were noted at watercourse crossings. Implementation of Forest Practice Rules that specify design, construction, and maintenance of crossings require considerable improvement."***

"Conclusions about watercourse crossings are based on a sample with 95% of the crossings in Class II or III watercourses. Very few Class I crossings were reviewed, because the random selection of crossings was tied to road transects and roads that were commonly located high on hillslopes. Only 15% of the crossings evaluated had been removed or abandoned, so the sample sizes for these types of crossings is still relatively small. The data collected to date shows that problem points at watercourse crossings are a major source of sediment delivered to watercourses. Because crossings are adjacent to and within channels, eroded material has direct access to the watercourses. Approximately 40% of the crossings had one or more problems, while more than 60% had none, indicating that they were functioning properly. Common problems included fill slope gullies, plugging, scour at the outlet, and high diversion potential. Although not readily derived from the database, the field crew members observed that where a well designed and constructed crossing was encountered in a THP being reviewed, the other crossings in the plan were

[2] Exceptions include landscapes that are highly unstable and have significant components of erosion resulting from inner gorge landsliding, such as have been found in portions of southern Humboldt County (PWA 1998).

usually also well constructed. These data indicate that more attention is needed with the design, construction, and review of crossings. Recent research has provided RPFs and Licensed Timber Operators new information on how to build better crossings (Flanagan et al. 1998)."

5. ***Watercourse and lake protection zones (WLPZs) have been found to generally meet Forest Practice Rule requirements for width, canopy, and ground cover. Additionally, very few erosion features associated with current THPs were recorded in WLPZs.***

"Approximately three-quarters of the WLPZs evaluated to date have been on Class II watercourses, which are much more common than the generally larger Class I waters. The data collected in WLPZs indicates that minimum canopy requirements following harvesting on Class I and II watercourses are being exceeded, since an average of greater than 70% canopy cover following harvesting has been measured using the spherical densiometer. Similarly, mean ground cover requirements in WLPZs following logging was estimated to exceed 85%. Required WLPZ widths generally met Rule requirements, with major departures from Rule requirements noted only about 1% of the time. Erosion events originating from current THPs and encountered on mid-zone or streambank WLPZ transects were found to be rare. The implementation data suggests that RPFs should do a better job of taking existing roads and erodible, unstable stream banks into account when designing WLPZs and specifying protection measures."

6. ***"Landings did not have substantial numbers of erosion events associated with current operations and erosion events on landings generally did not transport sediment to watercourses."***

"More than half of the randomly selected landings were greater than 300 feet from the nearest watercourse (I, II, III, or IV), almost 90% were built on slopes less than 45%, and more than 80% were built on a ridge or above the break in slope. These factors indicate why landings generally did not create significant water quality problems and why very few erosion events transported sediment from landings, with the exception of landings located very near watercourses (generally old landings built for previous entries). Drainage structures associated with landings were cited as needing improvement about 10% of the time, but most of the Rule requirement implementation ratings were for minor departures, indicating that direct adverse impacts to water quality were infrequent."

7. ***"Skid trail segments had a lower frequency of erosion features related to current operations when compared to road segments. Overall, skid trails are having much less impact to water quality than roads."***

"The frequency of erosion problems noted on skid trail transects was fairly low when compared to problems documented on roads. For example, problem points assigned to waterbreaks that did not conform to the Rule requirements on skid trails occurred at about half the rate as on road transects (i.e., 4% vs. 9%). The overall average was one erosion problem point assigned for every 1,175 feet of skid trail evaluated, verses [sic] one problem every 380 feet for roads. Rills were noted fairly frequently on skid trails but had very low delivery to watercourse channels. Gullies were noted with about one-third the frequency of rills, but had a higher percentage of sediment delivery to watercourse channels. Spacing of waterbreaks was the most commonly cited drainage feature problem associated with skid trail rilling and gullying."

8. "Recent timber operations cannot be linked to current instream channel conditions based on results from the Hillslope Monitoring Program."

"This program has evaluated Forest Practice Rule effectiveness on hillslopes—not in the stream channels. This type of monitoring can provide a rapid feedback loop to managers for improving hillslope practices. It does not, however, address current instream channel conditions which are often the result of land use impacts that took place decades ago. Instream measurements can be difficult to relate to individual forest practices (Murphy 1995). In addition, results presented in this interim report do not allow us to draw conclusions about whether the existing Rules are providing properly functioning habitat for aquatic species because evaluating the biological significance of the current Rules is not part of this project. For example, hillslope monitoring in WLPZs does not allow us to draw conclusions regarding whether canopy levels resulted in acceptable water temperatures for anadromous fish, or whether the observed timber operations retained an adequate number of mature trees for large woody debris recruitment that is needed to create complex habitats for anadromous fish species. Also, the adequacy of the Rules in addressing cumulative watershed effects are not covered by this program."

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APPENDIX G

RECOMMENDATIONS REGARDING SPECIFIC FOREST PRACTICE RULES

1.Watercourse and Lake Protection Zones (WLPZs)

Recommendations

1. The SRP recommends the following watercourse protection standards:

Class I Watercourses

- Re-write CCR 916.5(c) and "G" to include the following: Minimum riparian buffer widths on Class I streams of 150 ft (slope distance) tiered with the following canopy requirements: Zone A = 0-75 ft wide with 85% overstory canopy closure; Zone B = 75-150 ft wide with 65% overstory canopy closure (see Figure 6). For evenaged treatments adjacent to WLPZs (and rehabilitation with the same effect as a clearcut), an additional 25-50 ft wide (25-ft wide on slopes 0-50%; 50-ft wide on slopes greater than 50%) special operating zone shall retain understory and mid-canopy trees at a density sufficient to reduce the impacts of edge effects. Within this special operating zone, understory and mid-canopy conifers and hardwoods shall be retained and protected during falling, yarding, and site preparation. Zone A shall be divided into two zones: Zones A-1 and A-2. Zone A-1 shall extend from 0-25 ft above the watercourse transition line (WTL) and shall be managed for salmonid habitat purposes using salmonid-directed silviculture (see Definitions). Zone A-2 shall extend from 25-75 ft above the watercourse transition line. It is the goal of Zone A-2 to create a multi-aged stand with late-successional forest characteristics including: (1) maintaining a mix of small, medium, and large diameter trees managed on a selection harvest basis to create large diameter LWD recruitment trees and allow shade-intolerant trees to reproduce; (2) maintaining snags at a density of 1-3 per acre; and (3) retaining downed wood, while maintaining height growth function. This stand should be representative of the tree species composition that would have naturally occurred on the site under reference conditions, including hardwoods. To create larger diameter trees at a younger age, the thinning of younger stands within this zone is encouraged. In order to provide and maintain LWD recruitment trees, the ten largest trees per 100 m (328 ft) of stream channel (considering both sides of the stream) within 50 ft of the watercourse transition line (WTL) shall be marked for permanent retention. The RPF may trade the next smaller diameter tree more conducive to LWD recruitment, or shading, or bank stability, if DF&G concurs. Criteria for the selection of alternative recruitment trees shall favor leaning trees, large-diameter decadent trees, and the next largest diameter trees lowest on the slope within the zone. Trees shall be permanently designated (see Definitions) prior to the PTH (unless alternative trees are proposed), and shall be marked with paint, tags, or other suitable means both above and below stump height. Recruitment trees shall be remarked upon each reentry, and additional recruitment trees shall be designated to replace those trees that have fallen. No salvage of dying, dead, or downed trees may occur within Zone A, except for safety reasons. Trees that have fallen uphill into Zone B must have at least 30% of their lower bole retained regardless of location. Trees that occur within the channel zone (defined as the area between opposing watercourse transition lines) may not be harvested. These trees may not be counted as recruitment trees.
- Drop all exemptions for cable logging; require full WLPZ width for all operations.

- Standards for Class I watercourses shall apply only to fish-bearing streams and not to watercourses designated for use as domestic water sources; Class II protection measures shall apply to these watercourses.
- Zones A and B shall be managed through thinning or selection harvest, including small group openings each less than or equal to ¼ acre.
- Where an inner gorge is present above the WLPZ and slopes are greater than 55%, a special management zone shall be established that requires the use of selection harvesting (see Figure 7). This zone shall extend upslope to the first major break-in-slope, or 300 ft as measured from the watercourse transition line (WTL), whichever is less. Evenaged management above the 300 ft zone within the inner gorge on slopes of 55-65% shall be reviewed by a geologist prior to approval. All slopes exceeding 65% (both inside and outside the WLPZ) within the inner gorge shall be reviewed by a Certified Engineering Geologist (CEG) prior to plan approval.
- No harvesting may occur on any unstable feature within the WLPZ without review by a CEG. Trees retained on these features within Zone A may be counted as LWD recruitment trees if size criteria are met (or DF&G concurs with a smaller diameter tree).
- Where water temperature is not limiting, and Zone A-2 is occupied with evenaged conifers, the canopy requirements within this zone may be reduced to 70% as part of a "low thinning" prescription (see Definitions).
- Equipment is excluded from the WLPZ except on existing active haul roads.
- Class II Watercourses
- Rewrite CCR 916.5 (c) and "I" to read: 100 ft minimum (slope distance) WLPZs tiered with the following overstory canopy retention requirements: Zone A = 30 ft wide with 85% canopy; Zone B = 30-100 ft wide with 65% canopy. This must be composed of at least 25% overstory conifer canopy post-harvest.
- Drop exemptions for cable logging – maintain minimum WLPZ widths.
- To increase LWD, salvage logging shall be prohibited in Zone A of the WLPZ. Trees that fall into Zone A may be removed with the following stipulations: (1) the portion of the tree that extends outside of Zone A may be removed if such removal does not destabilize the remaining portion of the tree; and (2) no portion of the tree may be removed if the tree has become incorporated into the duff layer and is metering or storing sediment.
- To reduce the edge effects of the WLPZ adjacent to evenaged harvest areas, a special operating zone extending 25 ft upslope of the WLPZ shall be established. Within this zone, understory and mid-canopy conifers and hardwoods shall be retained and protected during falling, yarding, and site preparation.
- Where temperature is not limiting, and Zone A is occupied with evenaged conifers, canopy requirements may be reduced to 70% to facilitate a "low thinning" (see Definitions).
- Natural seeps and springs shall be protected as on Class II watercourses.
- No equipment shall enter the WLPZ except at currently active permanent roads or designated crossings (i.e., abandoned roads shall not be reopened).
- To ensure larger, lower gradient (less than 10%) Class II streams that do not have fish present during some portion of the year (i.e., to ensure that they are not actually Class I streams), more rigorous fish investigations by qualified fisheries biologists should be conducted.

- Retain 1-3 snags per acre.
- Class III Watercourses
- No WLPZ shall be required. Rewrite CCR 916.4(c) to read: "Maintain a 30-50 ft wide EEZ (depending on slope) and retain all hardwoods within the ELZ. No equipment may enter this zone except at pre-designated tractor crossings. Such crossings are to be kept to a minimum, shown on the THP map, and shall be removed and stabilized prior to October 15."
- Minimize burning within the EEZ; retain all downed woody material that is currently acting to store sediment within Class III watercourse channels and on adjacent banks and slopes. The protection of Class III watercourses during broadcast burning must be addressed in the Site Preparation Plan. Where broadcast burning is used and burning through Class IIIs cannot be prevented, only cool spring burning shall be used. Fall burning may be used only where LWD in Class III watercourses is protected. No ignitions may occur within 50 ft of the channel as measured from the center of the channel.
- General WLPZ Recommendations
- Slopes greater than 65% within the WLPZ shall be reviewed by a geologist prior to THP approval.
- From a salmon protection perspective, salvage of downed trees in Zone B is not considered detrimental, if properly conducted.
- Site-specific watercourse protection standards that may exceed the minimums in CCR916.5 (as modified) based upon needs identified through if a watershed analysis indicates that this is necessary for the protection of salmonid habitat.
- The issue of converting hardwood-dominated WLPZs shall be addressed through the watershed analysis. This may allow more intensive harvesting within Class I and II WLPZs that are currently hardwood dominated.
- Consider differential WLPZ standards for properties managed through selection harvest versus evenaged harvest. This would include considering reduced buffer widths where there is no marked change between the WLPZ and the silvicultural hillslope harvesting applications. This should be addressed in the watershed analysis.
- 2. Regulatory exemptions within the WLPZ rules include: CCR 916.1 In Lieu Practices, CCR 916.6 Alternative Watercourse and Lake Protection, CCR 916.4(b)(5) width adjustments for WLPZs, CCR 916.4(b)(6) surface cover adjustments, and CCR 916.4(d) heavy equipment use in the WLPZ.
- 3. Assign all WLPZ exemption language to one section, essentially CCR 916.6, to: (1) clearly define the standard prescription, and (2) require specific evaluation for proposed changes in the cumulative effects assessment. For example, use of existing roads within the WLPZ should be evaluated in CCR 916.6, and not CCR 916.3(c); heavy equipment use exemptions within WLPZs should be evaluated similarly. At present (refer to Cumulative Effects Assessment section), Technical Rule Addendum No. 2 is not designed to adequately address proposed exemptions. With an adequate cumulative effects analysis in place, future THP approval could allow more intensive harvesting for hardwood conversion within Class I and II WLPZs by stating, then justifying, a future desired stand structure. Thinning of younger stands within the WLPZ could be encouraged to promote diameter growth and more rapid development of large trees for future LWD recruitment. Until an adequate cumulative effects analysis is implemented, the SRP recommends formal interagency review of all proposed exemptions. This should require two of the three review agencies (CDF, DF&G and RWQCB) to formally approve the changes (and their justification), rather than requiring two or more agencies to deny proposed exemptions (as required in CCR 916.6(b)).

2. Large Woody Debris Recruitment

Recommendations (see WLPZ section for additional LWD recruitment recommendations)

1. The state and federal government should work closely with landowners to develop programs for the placement of LWD into streams where the watershed analysis indicates that the lack of in-channel LWD may be limiting to salmonid populations. Incentive programs should be developed to encourage landowners to participate in this program through tax benefits and other incentives.

3. Geological Concerns

Recommendations

1. To identify any known or likely unstable areas, RPFs (or landowners) should have a geologist conduct a broad geologic review of the property. This review would be conducted using maps and aerial photographs and would identify areas of geological concern that would then require field investigations by a geologist.

2. A review by a CEG or Registered Geologist should be conducted where road construction or harvesting is proposed on an unstable feature.

3. Programs need to be developed that provide RPFs with geologic training through field-based workshops. These programs need to provide RPFs with a basic understanding of geologic processes and recognition of unstable features. This training is not intended to supplant the role of geologists. This RPF geologic training should be required for RPFs preparing plans in the north coast region of California.

4. Due to the increased risk of impacts of harvesting on steep slopes, the SRP recommends that no evenaged harvesting be allowed on slopes greater than 65% unless the plan is reviewed by a geologist and suitable mitigation is available for avoiding adverse significant sediment impacts.

5. Steep headwall areas at the top of Class III watercourses should be carefully evaluated for geologic issues before harvest, and alternative silviculture utilized where needed to protect slopes.

6. CDF and DMG should work together to provide RPFs and geologists up-to-date geology and slope hazard maps.

4. Road Construction and Maintenance

Recommendations

1. Roads are either permanent, temporary, or abandoned. Permanent roads can be all weather or seasonal. Temporary roads that may last several years should be considered seasonal (i.e., permanent during its lifetime). There are other variations of road types. Tractor roads can be any one of the three types, though most often temporary, then abandoned. Roads that receive light winter use (e.g., for maintenance, fire breaks) should still be considered permanent (seasonal). The FPR needs to have all requirements for the three road types centralized.

2. An abandoned road must not require cross drains or watercourse crossing structures to direct flow from the road surface or pass watercourse runoff. Both are permanent structures requiring long-term maintenance.

3. No road construction shall occur during the winter period. Road construction must be completed by Oct 15 (refer to Section 923.2(s)) or the

start of the winter period, whichever is earlier (see Winter Operations).

4. Develop quantitative rocking standards for anticipated hauling on permanent, all weather roads.

5. The upper slope limit for road construction should be no greater than 65% (refer to CCR 923.1(d)) unless reviewed, and both the location and road design and construction methodology are approved by a CEG.

6. CCR 923.1(d) only vaguely addresses the effects of steep roads (i.e., what to do with "concentrated" surface runoff and soil mobilization), rather than prevention. This rule uses a 100 ft distance from a WLPZ to trigger additional measures that do not account for the long, steep continuous slopes over which road and landing failures often travel. Nor does this rule consider Class III watercourses. These "additional measures" are not specified, even generally. For example, endhaul requirements should be triggered by any road construction on slopes greater than 50% above any watercourse or hillslope depression. Another consideration should be no sidecasting on slopes over 55%.

7. In reference to Section CCR 923.1(e): new or reconstructed roads with a 20% grade for 500 ft or more should be completely rocked; surfaces of these steep roads are easily compromised by winter and wet weather use.

8. Winter road maintenance must not allow blading. The road must be allowed to dry prior to use. If blading is considered needed, the road is improperly designed and/or maintained. If a permanent road is to be used for winter hauling, it should be upgraded to all-weather status before October 15 or the start of the winter period, whichever is earliest. Limited use of season roads may occur early in the winter period under specific conditions (see "Winter Operations" section).

9. Outsloped roads should be the standard for temporary, seasonal (permanent), and abandoned roads. For permanent all weather roads, crowned, insloped, or outsloped roads may be appropriate and acceptable if long-term maintenance is planned. In Santa Cruz County, vegetation as a surface armor on permanent roads has been considered for light (non-hauling) winter use; this should be explored further.

10. The FPR inadequately addresses (CCR 923) the future trend of re-opening abandoned roads and/or rebuilding/improving existing roads, as opposed to decreasing emphasis on new road construction. Road density, not explicitly considered in the FPR, must be factored into this future trend. While a watershed analysis is the convenient, though not yet defined solution, road density can be considered in CR 923. At a minimum, a general threshold density can flag local areas where additional roads (new and reopened) would have a high likelihood of producing unacceptable sediment runoff and flow concentration.

11. Because the road maintenance period is inadequate (refer to other recommendations), road abandonment, as part of the THP, is critical. The commitment, including personnel and financial, for long-term maintenance must be demonstrated; otherwise abandonment should be required. If the road is to receive occasional use, including the winter period, the road must be considered permanent (seasonal).

12. Where roads within WLPZs receive extended and frequent winter log hauling, additional stabilization measures must be considered. Due to the high cost of road rocking, especially where rock sources are limited, alternatives, such as asphalting or the treatment with heavy road surface treatments, may be a feasible alternative. This is consistent with the requirement of CCR 923.4(h) that states "During timber operations, road running surfaces in the logging area shall be treated as necessary to prevent excessive loss of road surface

materials by, but not limited to, rocking, watering, chemically treating, asphalting or oiling."

13. Watercourse crossings and fill slopes should be stabilized using rocking or other suitable means to prevent the erosion of fill slopes and the direct deposition of sediment into watercourses. This is already required under CCR 923.4(i). It appears that a more strict application of this rule requirement at watercourse crossings would greatly reduce direct sedimentation associated with road watercourse crossings.

14. All permanent forest roads (essentially all rural and wildland roads) must be maintained throughout their useful life. When roads are no longer needed in the near-term, these roads must be temporarily or permanently abandoned by outsloping, and the removal of watercourse crossings back to the natural stream gradient. The rules at CCR 923.8 specifically address road abandonment procedures. Any rule modifications should consider the partial abandonment of roads that would allow, where feasible, the passage of four-wheel drive vehicles to provide fire suppression access as well as on-going management or ranching.

15. All roads, permanent, temporary, abandoned and legacy roads that are generating, or have the potential to generate, sediment and are in the WLPZ (except at watercourse crossings) should be removed and stabilized. Some state incentive or cost-sharing program should be developed to implement this recommendation.

5. Watercourse Crossing Structures

Recommendations

1. A design flood for sizing watercourse crossings must have a HW/D no greater than 1 for a 100-year flood. Specifying the methodology employed for sizing and providing pertinent information (channel width and/or drainage area) must be provided in the THP.

2. A drainage structure left in an abandoned road should be considered permanent and, therefore, the landowner's long-term responsibility. Otherwise, the drainage structure must be removed. For planned abandonment of roads (CCR 923.8), provision (e) should be eliminated: "Where it is not feasible to remove drainage structures and associated fills, the fill shall be excavated to provide an overflow channel which will minimize erosion of fill and prevent diversion of overflow along the road should the drainage structure become plugged." This rule is particularly inappropriate for cross drains. An abandoned road with cross drains (on an insloped or crowned road) cannot meet the intent of CCR 923.8.

3. To allow adult and juvenile salmonid passage, all new and replaced Class I watercourse crossings must have a natural bottom.

4. All permanent and temporary crossings (new and existing) on Class I and II streams must be shown on the THP map or, for existing crossings only, referenced to a specific map and database in the watershed analysis. Watercourse crossings over Class I and II watercourses, not included in the THP, must be included as amendments.

5. Section 923.1(g)(3): should state that no more than 100 ft of an inside ditch should drain into a stream crossing. Section CCR 923.2 should be modified to state: "Permanent watercourse crossings... shall be constructed to prevent diversion of stream overflow down the road."

6. A permanent culvert requires permanent maintenance; provisions for 1-yr or 3-yr periods are inadequate. A hydrologically-based maintenance period has potential and should be investigated.

7. Require fail-soft road stream crossings that do not rely on structures (e.g., overflow ditches) or maintenance.

8. Breaching is not an alternative to restoring a watercourse crossing's proper function.

9. The minimum cross drain diameter should be 18 inches.

6. Site Preparation

Recommendations

1. Limit mechanical site preparation to the initial portion of the winter operating period before soils have become saturated (see Winter Operations for definition of winter period).

2. Limit broadcast burning where feasible.

3. To prevent soil damage and retain LWD in and near Class III watercourses, develop practices to limit burning to cool burns. Rewrite CCR 915.2(b) where it states "Broadcast burning shall not fully consume the larger organic debris which retains soil on slopes and stabilizes watercourse banks," to better define what "fully consume" means. Minimize burning within the ELZ and avoid ignition in the ELZ. The protection of Class III watercourses during broadcast burning must be addressed in the Site Preparation Plan. Where broadcast burning is used and burning through Class IIIs cannot be prevented, use only spring burning. Fall burning may only be used where the LWD in the Class III is protected.

4. Require a "Site Preparation Completion Report" to be filed with CDF when site preparations are final and an inspection could occur. This report should include a map of the actual area treated, and be separate from the Work Completion Report so the LTO does not have extended responsibility for road maintenance following the completion of harvesting operations.

7. Winter Operations

Recommendations

1. Use the antecedent API index to define the winter period.

2. The RPF must supervise winter operations. Tractor yarding must only be allowed under "dry" conditions more stringent than cable yarding that are clearly defined in the winter operations plan. The API should be investigated for defining "dry" conditions in the winter period and "wet" weather conditions outside the winter period, particularly for objectively assigning "dry" conditions status for tractor logging. Without an objective determination, traditional tractor logging in the winter period should be prohibited or restricted to the early portion of the winter period during extended dry periods (as measured by cumulative rainfall or the API).

3. The use of ground yarding systems, such as "track loader yarding" and "feller/buncher-forwarder" operations, may be allowed during extended dry periods during the winter period under the following conditions: slopes < 35%; no new skid trail construction during winter period; all skid trails used must be out sloped with rolling dips installed before the commencement of the winter period.

4. In lieu alternatives should be eliminated; acceptable winter practices must be addressed in a winter operating plan for all yarding systems (e.g., tractor yarding). Cable, balloon, and helicopter yarding operations should require a winter operations plan. The winter operation plan must specifically address sediment production measures for all aspects of the operation.

5. No road or landing construction during the winter period (as measured by API). This shall not limit road rocking or road maintenance during the winter period.

8. Harvest Limitations

Recommendations

Based on concerns raised by some constituency groups, the SRP believes that the Board should consider whether or not a harvest limitation based on percent of watershed area is warranted pending completion of a watershed analysis. This percentage would initially function as a red flag, rather than as a moratorium, signaling a more scrutinized interagency review and public disclosure before approving additional THPs. A considerable range in percentage was recommended among interviewees. Predictably, the environmental community advocated 10% to 15% per decade, whereas several timber industry constituencies offered 70% to 85% per decade. This wide range perhaps best defines the prevailing perceptions of cumulative effects. The SRP believes that a more likely value ranges from 30% to 50%. This range depends on site-specificity, type of harvest prescription, and past history of watershed disturbance, etc., but putting these (and other) qualifiers aside, this range basically reflects the individual panel members' perceptions of cumulative effects: some accepted the higher end, while others advocated the lower. The SRP did entirely agree that any proposed percentage, or range in percentage, could not withstand the intense public and scientific scrutiny if based predominantly on professional opinion. Therefore, the Panel recommends that a blue-ribbon scientific panel (composed of industry, agency, and academic specialists in cumulative effects assessment) be commissioned in 1999 to accomplish this interim mission. Having one panel recommend another was done with great reluctance. But we have the responsibility of offering more than opinion: our investigation was not provided with the necessary time to evaluate the proposed cumulative effects assessment protocol.

Recommendations Regarding the Timber Harvesting Plan Process

9. Timber Harvesting Plan Preparation

Recommendations

1. Revise the THP to focus on operational considerations and serve as a disclosure document for compliance with the applicable regulations. This type of THP could only be used after a comprehensive watershed analysis had been conducted that identified site-specific conditions within the watershed. The THP document would then refer to sections of the watershed analysis to address potential limiting factors, such as sedimentation, temperature, dissolved oxygen, or LWD. Emphasis would be placed upon agency review of the THP, including an in-depth pre-harvest field inspection. The public could then rely on the accuracy of the finding of the watershed analysis, the disclosure of the RPF in the abbreviated THP identifying the resources that may be affected, and a thorough and comprehensive review and reporting by the state agencies. In order for this process to be successful, there would likely need to be an increase in the time available for review by the agencies and the public.

2. To review and discuss areas of concern during the preparation of the plan, the RPF should preconsult with agency representatives (e.g., CDF, DF&G, RWQCB, NMFS). This may consist of merely a phone conversation, or it may be more elaborate and involve a field visit. The result would be a more concise and accurate plan that already reflects some input from the state agencies upon submission. The three primary reviewing agencies (CDF, DF&G, and RWQCB) would need to recognize that additional time may be required for this pre-consultation, and should budget personnel accordingly.

3. RPF should pre-consult as necessary with other resource specialists, including geologists, fisheries

biologists, etc. during plan preparation. Consultation with these specialists will provide insight into site-specific considerations regarding these other resources that the RPF may not otherwise have identified, and will provide the reviewing agencies with a more complete assessment of the THP area. This is also consistent with the requirements of the "Registration of Professional Foresters" at CCR1602 where it states:

"Thus, for an RPF to accomplish a site-specific forestry project where the RPF's prudent level of expertise is surpassed, that RPF may need to utilize the services of other qualified experts including but not limited to geologists, landscape architects, engineers and land surveyors, archaeologists, botanists, ecologists, fisheries biologists, stream restorationists, wildlife biologists, hydrologists, range scientists, soil scientists, and certified specialists established pursuant to PRC772."

4. All THPs should be signed by the landowner when the landowner and timber owner are different parties.

5. The RPF should be involved with THP implementation in a manner similar to that listed in CCR 913.8(b)(5), as applied in Santa Cruz County, California.

10. THP Review and Approval

Recommendations

1. When known, have the LTO attend the PHI.

2. Extend the agency review period to a minimum of 10 days between the PHI and second review.

3. Increase the time for public comment following the second review to a minimum of 10 days.

4. Increase staff budgets for CDF, DF&G, DMG, and RWQCB to support more frequent attendance at PHIs and provide for periodic operational and post-harvest field inspections.

5. Encourage agencies to conduct more frequent inspections of active operations and conduct post-harvest inspections.

6. Support a THP review system that reduces unnecessary paperwork by reviewing agencies and provides more time for field inspection and reviews.

7. Provide sufficient agency staff time to support pre-consultation with RPFs during the plan preparation.

8. Put key THP information on the Internet that identifies the plan submitter, the RPF, the CDF inspector who is in charge of the plan review, and a copy of the THP.

9. Limit the case load for CDF inspectors to 40-50 active THPs.

10. The CDF should be allowed to impose civil penalties on the RPF, LTO, or landowner, similar to those imposed by the RWQCB.

11. Involvement of RPF in Implementation of THP

Recommendations

1. The RPF (or an RPF) should be involved with the operational implementation of the THP. The RPF should visit the plan area frequently enough during plan implementation to insure the provisions of the plan and the rules are being adequately achieved.

2. The meeting between the RPF and the LTO, as required under CCR1035.2, should always be on site rather than just a paper review. This would insure better transfer of plan contents, and allow the RPF and the LTO to visit any critical or sensitive sites that might be present on the plan area. It would also allow the LTO and the RPF to review the flagging and painting designations so there is a clear understanding as to the requirements for protection measures.

3. When identified in the THP, the LTO should attend the preharvest inspection. LTOs should also be required to sign the final approved copy of the THP and all major amendments.

12. Involvement of Other Resource Professionals in THP Review and Implementation

Recommendations

1. Formalized programs should be developed between CDF, DMG, and professional organizations such as California Licensed Foresters Association (CLFA) and Society of American Foresters (SAF) to help develop more intensive training programs for geologic issues, fisheries issues, and watershed considerations. The Board of Forestry or Foresters Licensing could act as a coordinator for this program.

2. RPFs need to become more aware when other resource specialists are required in the THP process. This is currently required by the licensing regulations at CCR 1602 (b), but there may be a need to place more emphasis on this requirement. To insure an adequate review of resource issues, agency specialists should monitor the involvement of other resource specialists.

3. Although there may be numerous resource specialists involved in the preparation of a THP, the RPF should maintain the role of the coordinator and principal author of the THP document. It is the RPF who is typically hired by the landowner, or employed by the company to be the principal resource manager of a forested property. The RPF usually has a long-term relationship with the property. Thus, he or she is in the best position to coordinate and implement plans and practices on the ground in coordination with the other resource professionals, as well as with the LTO and the landowner.

4. Develop some type of incentives for RPFs to attend different types of workshops; free tuition, certificate of attendance, published list of attendees, etc. Do not make them these programs mandatory. Improve the quality of the workshops, so that all RPFs would enjoy benefit from going to them.

Other Panel Recommendations

13. Rule Organization

Recommendations

1. Make the current Forest Practice Rule organization more efficient and user-friendly. For example, reorganize and condense the exemptions, e.g., centralize all road construction and maintenance requirements by each road type (permanent, temporary, and abandoned). The "standard practice" must be made clear, again separating out and centralizing the exemption language.

14. Additional Research Needs

The investigations of the SRP demonstrated the need for more in-depth research. This includes the following issues:

- Sediment study of Class III watercourses: this should include an analysis of post-harvest condition of Class IIIs that are included in units that have been clearcut and burned, and clearcut units that were not burned.
- LWD recruitment mechanisms in young-growth stands: most studies to date are based on old-growth standards. No analysis of recruitment or the functionality of mature young-growth as LWD has been done.

- Review of temperature and humidity regimes pre- and post-harvest: to monitor the effectiveness of the rule standards, monitoring should be established to monitor the effectiveness of the functionally of the WLPZs for temperature and humidity.

- Water Temperature Studies: physiologically-based site-specific water temperature studies are needed for each watershed area. Knowledge of temperature tolerance and sublethal stress responses of salmonids is far from adequate to define safe thermal limits and determine potential thermal impacts for each THP. Key factors that affect thermal requirements and stress include food availability, DO, previous exposures to stressful situations, innate metabolic rate (i.e., hatchery fish have lower metabolic rates that their wild counterparts). Until a more site-specific physiological approach is used in conjunction with a watershed analysis, determining site-specific thermal requirements and impacts on salmonids as a result of timber harvesting will remain in the realm of conjecture.

- Sediment and Salmonid Habitat: We currently lack a solid quantitative understanding of the relationships between anthropogenic increases in sediment delivery to streams and changes in biologically significant channel characteristics. Such relationships must be understood before an accurate assessment can be made about the effects on salmonid populations of increased sediment delivery to stream channels. We propose a research program that combines hillslope and fluvial geomorphology with salmonid population biology and modeling to link sediment loading, salmonid habitat, and salmonid population response. This regional research program, which would be conducted in a variety of watersheds in the MOA area (see Figure 1), is needed to determine the following: (1) for each type of channel used by salmonids, those indicators or metrics of salmonid habitat (e.g., V^*, pool frequency, permeability) that are both sensitive to sediment supply and clearly related to salmonid survival at one or more life stages; (2) what degree of change in habitat indicators from a reference or pristine state will result in an unhealthy population (in terms of population size, stability, and resilience to disturbance); and (3) what level of anthropogenic (relative to natural) sediment delivery will produce changes in channel conditions that would be expected to result in an unhealthy salmonid population.

15. Social and Economic Impacts

Recommendation

Nearly all the constituency groups interviewed supported incentives to landowners to improve and maintain salmonid habitat. This included the use of tax deductions, conservation easements, and restructuring of the federal tax codes to allow expensing rather than amortizing capital road expenditures such as culvert replacements. A program of incentives must be developed to allow the value of the permanently designated standing and downed trees to be deducted from the timber owner's yield or other state taxes. The valuation of these trees could be based on the yield tax value schedules, and would be claimed when harvesting is completed for the associated harvest unit adjacent to the WLPZ. This may also help encourage landowners to include watercourse protection zones in conservation easements. The benefit of providing landowners tax credits against the retained recruitment trees will encourage the retention of important habitat features and is likely to prevent legal proceedings for property taking. If we are going to pay millions for salmonid rehabilitation, then tax credits for the retention of key habitat features may be a reasonable step.