REVIEW OF THE 29 APRIL 1999 “FORESTS AND FISH REPORT” 
AND OF ASSOCIATED “DRAFT EMERGENCY FOREST PRACTICE RULES”

Review prepared at the request of 
the American Fisheries Society and the Society for Ecological Restoration 
31 January 2000

Introduction

Background

The “Forests and Fish Report” (USFWS et al. 1999, here referred to as the “Report”) that is here reviewed was written to provide recommendations upon which revised forest practice laws could be established for private lands in Washington State. Stated goals of the Report are to keep the timber industry economically viable, recover salmonid fisheries, and achieve compliance with water quality standards and Endangered Species Act requirements (USFWS et al. 1999).

The Report was accepted by the Washington state legislature in May 1999. Draft Emergency Forest Practice Rules were then prepared for review by the Forest Practices Board with the intention of codifying the recommendations of the Report; these rules are also considered in this review. The emergency rule package was adopted by the Washington Forest Practices Board on 20 January 2000. In Schedule M-1 of the Report, the Washington Department of Ecology and the Environmental Protection Agency (EPA) have formally assured landowners that adherence to the recommendations of the Report will be considered sufficient to demonstrate compliance with requirements of the Clean Water Act and the state’s water quality standards.

It seems likely that the Report’s recommendations will be used in the future as a basis for adoption of a “4(d) rule” under the Endangered Species Act, thus providing assurance that adherence to the rules would be sufficient to demonstrate compliance with the Endangered Species Act. The Report is also likely to be a basis for preparation of a Habitat Conservation Plan (HCP) for private timber lands in Washington State, which would result in granting of an “incidental take permit” to allow inadvertent “taking” of particular threatened and endangered species.

The Report consists of a series of recommended prescriptions for forest management practices in Washington. The authors of the Report state that compliance with the Report’s prescriptions will lead to attainment of performance targets outlined in Schedule L-1 of the Report. Attainment of specific “performance targets” is asserted to be sufficient to meet requirements of state and federal legislation concerning water quality and endangered species.

Nature of the review

Because the authors of the Report provide no rationale and cite no evidence to support the assertions and prescriptions included in the Report, the American Fisheries Society and the Society for Ecological Restoration jointly convened a technical review committee to evaluate the extent to which the scientific literature supports the recommendations of the Report. The review committee consisted of four members with expertise in salmonid biology, silviculture, hydrology, aquatic ecology, cumulative impacts, riparian ecology, forest engineering, and geomorphology. The technical review presented here represents a consensus of all committee members.

The review addresses the overall question of whether the prescriptions provided by the Report are sufficient to meet the stated objectives of the Report. To answer this question, it is necessary to
determine whether the performance targets specified by the Report satisfy regulatory requirements,"nwhether the recommended prescriptions are sufficient to attain the performance targets, and whether
the prescriptions can reasonably be implemented and enforced.

The Report was challenging to review because it does not adhere to the norms expected of a
technically-based document and because its provisions are extremely complex. The Draft Emergency
Rules provided an even more difficult challenge because the rules were being modified as the review
progressed. Review comments were thus focused on the Report so that references to specific
passages would remain stable even as the Draft Rules changed, but review comments are intended to
apply also to those rules based on the portions of the Report discussed here.

The review begins with general comments concerning the Report, then considers the
adequacy of the Report’s provisions with respect to its intended goals. An attached appendix
provides specific comments from members of the review committee. References to particular
passages in the Report are noted by item number, as presented in the Report (e.g., “IIB.1(d)” refers to
item II 1(d) of Appendix B).

**General comments concerning the nature of the Report**

In general, the Report fails to relate its goals and prescriptions to the ecological requirements
of the fish that are a primary object of the protection. The authors of the Report describe their
conclusions as “biologically sound” (Item B of “Background”). However, such an attribute is not one
that can be acquired simply through assertion. Instead, a document intended to be based on sound
science would provide documentation from the scientific literature to support each of the document’s
conclusions. Not only does the Report contain no supporting citations, but it does not describe
rationales used to develop the recommended prescriptions. Science-based information is presented
only in the definitions accompanying the Report, and a surprising portion of the information
presented is inaccurate. Phyllite, for example, is described as a “metallic” rock rather than a
“metamorphic” rock, and high-gradient slopes are said to be susceptible to “undertowing” rather than
to “undercutting of their toes.” Although these particular examples are trivial—these definitions do
not affect implementation of rules—the implications of such errors are not trivial. Because the Report
cites no scientific literature, the credibility of the Report rests solely on the credibility and expertise
of the Report’s authors. That the authors appear to be ill-informed concerning disciplines on which
the Report is founded undermines the credibility of the Report itself. Because the Draft Emergency
Rules rest primarily on the recommendations of the Report, the credibility of which is now in
question, the content of the Emergency Rules is also in question.

The Report’s prescriptions are excessively complex. This complexity penalizes land owners,
because the likelihood of inadvertently violating prescriptions increases with the complexity of the
prescription; it penalizes regulatory agencies, because inordinate effort is required to oversee
implementation of a complicated rule; and it penalizes the tax-payer and consumer, because citizens
ultimately pay the cost of implementation and oversight.

The Report also suffers from a lack of precision in the language used, with respect to both the
definitions provided and the standards against which compliance would be judged. The document
contains too little information to determine what prescriptions are applicable to a given site.
“Moderately confined” channels, for example, require a particular prescription for the width of the
channel migration zone, yet no definition is provided for “moderately confined.” Standards are
provided that require that the level of particular changes not be “highly significant” (IIB.1(e)(ii)(3)),
or that “virtually no” sediment be added (Schedule L-1), or that measures be taken “to the extent
reasonably practical” (IIB.4(d)(ii)). These requirements are operationally meaningless unless accompanied by precise definitions.

Definitions presented in the Report are interwoven with descriptions of diagnostic features. This non-standard practice introduces ambiguity in interpretation of prescriptions because many of the Report’s prescriptions are keyed to particular site types. Many sites of a given type do not exhibit all of the diagnostics included with the definitions, and it is not clear whether such sites therefore would be excluded from the categories in which experts would ordinarily place them.

In addition, many of the Report’s prescriptions are phrased as what “should” be done, rather than as what “shall” be done. This wording produces “suggestions” rather than “rules.” In a 1998 decision, U.S. Magistrate J.M. Stewart determined that voluntary guidelines are inadequate for protection of species.

In the remainder of the review, we evaluate whether the Report’s provisions will accomplish the goals it outlines. Because the Report’s stated goals are, in part, to meet regulatory requirements, we first examine the regulatory context for the Report and then evaluate the effectiveness of the Report’s provisions in meeting those requirements.

**Regulatory context for forest practice prescriptions**

Federal legislation pertinent to the regulatory framework includes the Endangered Species Act (ESA), the Administrative Procedures Act, and the Clean Water Act. If the Report will also be used in a Habitat Conservation Plan (HCP), provisions of the National Environmental Policy Act (NEPA) will also need to be considered. At the state level, the State Environmental Policy Act (SEPA), the “Water Quality Standards for Surface Waters of the State of Washington,” and the Washington Forest Practices Act provide the relevant regulatory context.

The federal Endangered Species Act of 1973 requires that land use be carried out such that the survival of evolutionarily significant units of species is not jeopardized and that actions toward their recovery are not foreclosed. In Washington, salmonid species or stocks listed as threatened or endangered include the Upper Columbia steelhead, Snake River sockeye and chinook, Snake River and Lower Columbia steelhead, Columbia River bull trout, Puget Sound chinook, Lake Ozette sockeye, and Hood Canal summer chum. Additional stocks are being considered for future listing.

Federal agencies must ensure that any action authorized by the agency “…is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined…to be critical” and “In fulfilling the requirements of this paragraph each agency shall use the best scientific and commercial data available” (ESA section 7(a)(2)). Although regulatory agencies have the power to issue permits to allow incidental “take” of a threatened or endangered species, such permits can be issued only if the anticipated taking “will not appreciably reduce the likelihood of the survival and recovery of the species in the wild” (ESA section 10 (a)(2)(B)(iv)). “Take” means to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct” (ESA section 3(5)(A)).

A recent rule has clarified the meaning of “harm,” emphasizing that this “may include significant habitat modification or degradation that significantly impairs essential behavioral patterns of fish or wildlife” (Rosenberg 1999). The rule specifically notes that “conducting timber harvest, grazing, mining, earth-moving or other operations which result in substantially increased sediment input into streams” and “conducting land-use activities in riparian areas and areas susceptible to mass wasting and surface erosion, which may disturb soil and increase sediment delivered to streams” are considered to harm the species if there is a causal link between habitat
damage and the injury or death of listed species (Rosenberg 1999). Significant adverse modification of habitat critical to the species would thus considered a form of harm. Critical habitat includes areas occupied by the species “on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection” as well as some unoccupied areas, “upon a determination by the Secretary that such areas are essential for the conservation of the species” (ESA section 3(5)(A)).

The federal Administrative Procedures Act provides a measure of accountability for the actions of federal agencies and for the design of federally authorized plans and agreements. Under the provisions of this act, federal agencies cannot make decisions that are “arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law” (APA section 706 (2)(A)). Similar legislation has been passed by states with respect to state procedures.

The federal Clean Water Act provides for establishment of water quality standards by states, and Washington has adopted water quality standards that (1) specify upper limits for pollutant levels in various categories of state waters, and (2) require that existing water quality not be degraded. The Clean Water Act further provides for identification of waters that do not meet standards and for development of management plans to attain those standards. Development of these plans requires identification of “Total Maximum Daily Load” (TMDL) allotments.

At the state level, the State Environmental Policy Act (SEPA) ensures that environmental impacts are considered before certain kinds of land-use activities are carried out. SEPA specifies that “If information on significant adverse impacts essential to a reasoned choice among alternatives is not known, and costs of obtaining it are not exorbitant, agencies shall obtain and include the information in their environmental documents” (WAC 197-11-080). The Act specifically requires that direct, indirect, and cumulative environmental impacts be evaluated, but includes no definition of “cumulative impact.” Such a definition has been provided by the federal Council on Environmental Quality in guidelines developed for implementation of the National Environmental Policy Act: “‘Cumulative impact’ is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions” (CEQ Guidelines, 40 CFR 1508.7). The Washington State Forest Practice Rules also provide a definition of cumulative effects as they relate to forest practices: “‘Cumulative effects’ means the changes to the environment caused by the interaction of natural ecosystem processes with the effects of two or more forest practices” (WAC 222-16-010).

SEPA excludes ordinary forest practice activities from provisions of the Act. However, “those forest practices determined by rule of the forest practices board to have a potential for a substantial impact on the environment, and thus to be Class IV practices, require an evaluation by the Department of Natural Resources as to whether or not a detailed statement must be prepared...” (RCW 43.21C.037). Class IV applications require completion of a SEPA checklist to disclose potential environmental impacts. If that evaluation shows that impacts could be significant, an Environmental Impact Statement may also be required. Among other provisions, Class IV status may be triggered if forest practices are to be carried out on lands designated as critical habitat for a threatened or endangered species. Proposed timber harvest or road construction on unstable lands in watersheds not having undergone a watershed analysis also triggers Class IV status if “there is potential for a substantial debris flow or mass failure to cause significant impact to public resources” (WAC 222-16-050).

The Washington Forest Practices Board is authorized by the state Forest Practices Act to develop forest practice regulations for private forestry in Washington. The Forest Practices Act
requires that “Promulgation of all forest practices regulations shall be accomplished so that compliance with such forest practices regulations will achieve compliance with the water quality laws” (WAC 222-12-010).

It should be noted that the authors of this review are not experts in law. Some of the legal provisions described above may have been modified or reinterpreted through development of regulations, guidelines, and case law. Where the discussion below refers to legal considerations, these references generally are to the legislation as written and may not reflect subsequent official interpretations.

**Measures needed to comply with the Endangered Species Act**

Considerable work has already been done to identify conditions under which populations of threatened and endangered salmonids can be sustained. This work was summarized in a document prepared at the request of the EPA, US Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS) to provide guidance for preparation of HCPs for salmonids on private lands in the Pacific Northwest (Spence et al. 1996). This document, known widely as the “Mantech Report,” outlines the measures considered necessary to assure that activities on privately owned lands will not appreciably reduce the likelihood of survival and recovery of threatened or endangered salmonids, and documents the evidence on which the guidelines are based. An earlier report prepared by the Forest Ecosystem Management Assessment Team (FEMAT 1993) also describes recommended guidelines and the scientific basis for those guidelines and, in addition, provides estimates of population viability for salmonids under different management options. Although neither of these documents is cited by the Report, it can be assumed that the Report’s authors are familiar with them because several of the authoring agencies were co-authors of the FEMAT report and contractors of the Mantech report. It would be expected that agency personnel would not authorize actions that provide a lesser level of protection than that described as necessary in agency documents. Because more species have been listed as “threatened” since the FEMAT and Mantech recommendations were prepared, an even higher level of protection might be expected.

A higher level might also be expected because the Report’s prescriptions are intended to provide not merely a sustained population of salmonids, but to recover a harvestable population (Background, item B(2)). It would thus be expected that FEMAT or Mantech recommendations would provide the minimum level of protection necessary for the present application.

We do not intend to imply that measures appropriate for federal lands are necessarily appropriate for private lands. However, the biological requirements of an organism are independent of who owns the organism’s habitat. Spence et al. (1996, p.203) note that protection of salmonids on federal lands is not sufficient to ensure survival and recovery of the species because 1) the wide range of habitat needs cannot be accommodated on federal lands alone; 2) preservation of the species requires preservation of genetic diversity across the landscape; 3) anadromous salmonids often must pass through private lands to reach federal lands; and 4) recovery of the species to fishable levels will require restoration of the most productive salmon habitats, which are largely in private ownership.

Most efforts at salmonid conservation acknowledge that the best estimate of conditions compatible with sustained populations are those under which the species evolved. Salmonid population levels were demonstrably sustainable and resilient to moderate levels of fishing under the conditions that pertained before Euro-American settlement. The extent of deviation from these original conditions provides a measure of the extent of deviation from conditions known to have sustained salmonid populations. This observation forms a basis for habitat assessments that have been carried out using Washington’s watershed analysis method: “...old-growth conditions most
closely represent the conditions to which multiple species have adapted over the past several thousand years” (WFPB 1997). A report prepared for the DNR and the TFW/CMER Committee explains that it is appropriate to use “conditions indicative of the streams draining unmanaged forests as the standard by which to set target conditions. This approach...assumes naturally functioning and ecologically intact channels will provide long term sustainability for diverse fish assemblages” (Peterson et al. 1992, p.2).

The FEMAT report also references undisturbed conditions as the measure against which habitat conditions are assessed, and the aquatic conservation strategy objectives in use on federally managed timber lands in the Pacific Northwest call for restoration of the sediment regimes under which the species evolved (USDA and USDI 1994a). The NMFS has developed a description of in-stream habitat conditions found in natural settings and therefore considered by NMFS staff to be capable of sustaining salmonid populations (NMFS 1996). The PACFISH effort (USDA and USDI 1994b) also developed in-stream habitat guidelines based on natural conditions.

In short, most science-based approaches to habitat conservation for salmonids employ the assumption that conditions present before Euro-American settlement represent the optimal conditions for sustaining the suite of species that had been present then. This assumption is reasonable because those are the conditions under which the fish evolved for millions of years, to which they therefore have closely adapted, and on which they therefore depend. The best scientific information available, represented by the consensus of these diverse efforts, is that habitat changes that shift conditions away from those characteristic of the original systems are adverse. If substantial adverse habitat modifications have already occurred and present and future activities prolong the duration of the modification, thereby delaying or preventing recovery, those activities contribute to a substantial cumulative impact to habitat.

Neither the FEMAT (1993) nor the Mantech (Spence et al. 1996) guidelines require complete return to original conditions: each recognizes that land-use activities on hillslopes will inevitably cause some changes in aquatic environments. Each, however, is designed to ensure that the level of change does not significantly impair the aquatic system’s ability to sustain salmonids. These plans attempt to ensure that the level of function of the habitat system is actually sufficient to sustain the species.

In contrast, conservation plans that merely provide for “proper functioning” of a subset of habitat processes are insufficient to ensure survival of a threatened species. An individual riparian stand might, by some definitions, be considered to function “properly” if it provides woody debris. However, a plan based on such a definition would not be capable of sustaining salmonids if the resulting stands are producing the wrong size, species, volume, or frequency of wood, or if important portions of the upstream watershed are not producing appropriate woody debris, or if some functions of riparian stands were overlooked. For example, a habitat system cannot function properly if the role of headwater riparian stands as buffers against excessive sediment inputs is not preserved. Proper function cannot be evaluated at the site scale because conditions in a channel reach depend on conditions throughout the upstream watershed.

Each of the conservation efforts described above focuses on particular aspects of environmental change that harm salmonids. Most of these plans identify extreme water temperatures, increased sediment load, decreased size of channel substrate, degraded water quality, altered riparian vegetation, altered channel morphology, increased peak flows, altered hydrologic regimes, and altered woody debris loadings as particularly important impacts on salmonids (NMFS 1996, FEMAT 1993, USDA and USDI 1994, WFPB 1997).
Because the Mantech guidelines (Spence et al. 1996) were developed for private lands, these recommendations are likely to be the most relevant to the present application. Among other provisions, Spence et al. (1996) describe the importance of including strategies for:

- Preventing cumulative hydrologic effects within watersheds (including minimizing the areal extent of hydrologically immature vegetation and of roads and other impermeable surfaces)
- Minimizing cumulative sediment delivery (including minimizing or avoiding land-use activities in areas susceptible to mass wasting or surface erosion, minimizing road density, and developing a road maintenance and rehabilitation schedule)
- Protecting riparian areas along all streams (including establishment of no-cut buffers with widths equivalent to 75% of a site-potential-tree’s height along all perennial and ephemeral streams)
- Maintaining water quality (including no application of chemical treatments in riparian zones of either perennial or ephemeral channels)

Spence et al. (1996) also note the importance of assessing current conditions in each watershed to allow evaluation of existing impact levels. Such information is needed if cumulative impacts are to be managed, and Spence et al. (1996) observe that “strategies that rely on site-specific analyses without regard for other activities that have occurred or are occurring within a watershed or region will generally fail to protect salmonid populations against cumulative impacts” (Spence et al. 1996, p.27). Specific guidelines presented by the Mantech report are discussed where relevant in following sections of this review.

Marine mortality is often cited as an uncontrollable influence on anadromous salmonid populations, and ocean conditions are currently unfavorable. However, ocean conditions have always fluctuated, but salmonid species until recently have been resilient enough that such fluctuations have not threatened their survival. Human activities now persistently hold fish populations at such low levels that their resilience to adverse marine conditions is disrupted. In addition, condition of out-migrating smolt (Holtby et al. 1990) and timing of out-migration (Holtby 1988) strongly influence marine survival. Decreased smolt size or poor smolt condition due to altered freshwater habitats will result in decreased marine survival, and this anthropogenic marine mortality is likely to be most severe when marine conditions are least favorable. Similarly, altered migration timing caused by increased stream temperature is reported to have led to decreased marine survival (Holtby 1988).

**Measures needed to comply with water quality standards**

More than 630 waterways in Washington are listed as impaired under Section 303(D) of the Clean Water Act. All of those that are impaired by effluents from nonpoint sources are cumulatively impacted, as are many that are impaired by point-source effluents. Altered temperature regimes are a common cause of impairment, and high sediment loads are also an issue at some locations. Impairment is identified through documented non-compliance with water quality standards.

Water quality standards for most rivers and tributaries in the state of Washington require that “turbidity shall not exceed 5 NTU [nephelometric turbidity units] over background turbidity when turbidity is 50 NTU or less or have more than a 10% increase in turbidity when the background turbidity is more than 50 NTU” (WAC 173-201A). The only exceptions to this provision are Crab Creek, the lower 11 mi. of the Duwamish River, the lower 9.3 mi. of the Hoquiam River, the lower 6.4 mi. of Mill Creek, the lower 89.5 mi. of the Palouse River, the lower mile of the Puyallup River, Sulphur Creek, the lower 27.2 mi. of the Walla Walla River, and the lower 6 miles of the Wishkah River; in these streams, no more than a 20% increase is allowed. “Background” is defined as the
condition “outside the area of influence of the discharge under consideration” (WAC 173-201A-020). In the case of nonpoint source pollution (e.g., sediment or temperature), “background” thus refers to conditions outside the area of influence of the anthropogenic nonpoint sources. The law also notes that “When assessing background conditions in the headwaters of a disturbed watershed it may be necessary to use the background conditions of a neighboring or similar watershed as the reference condition.” Background levels of turbidity in timberland watersheds are those that would be present under natural conditions.

Water quality standards are also presented for temperature in Washington streams. Except in waters listed in the previous paragraph ("Class B" waters), human activities are not allowed to increase stream temperatures to more than 16°C (for “Class AA” waters) or 18°C ("Class A" waters), and total temperature increases from nonpoint source activities cannot exceed 2.8°C. As the law is written, these standards apply to all tributaries, irrespective of whether or not they contain fish: “All unclassified surface waters that are tributaries to Class AA waters are classified Class AA. All other unclassified surface waters within the state are hereby classified Class A” (WAC 173-201A-120).

Washington’s antidegradation policy states that “Existing beneficial uses shall be maintained and protected and no further degradation which would interfere with or become injurious to existing beneficial uses shall be allowed” (WAC 173-201A-070). In some cases, “overriding considerations of the public interest” may justify degradation of water quality when “waters are of a higher quality than the criteria assigned for said waters,” but “when lowering the water quality in high quality waters is authorized, the lower water quality shall still be of high enough quality to fully support all existing beneficial uses” (WAC 173-201A-070). Beneficial uses for most Washington streams are described as “characteristic uses” under WAC 173-201A-030, and include use for water supply, stock watering, fish and shellfish, wildlife habitat, recreation, commerce and navigation. Short-term modifications (“i.e., hours or days rather than weeks or months”) to water quality may be allowable under certain circumstances, but “In no case will degradation of water quality be allowed if this degradation significantly interferes with or becomes injurious to characteristic water uses or causes long-term harm to the environment” (WAC 173-201A-110).

Compliance with water quality standards for turbidity would require that sediment inputs be restricted to levels that will produce less than a 10% increase in turbidity in Class A and AA waters. Except in areas with high tannin inputs or other sources of coloring, turbidity is usually a near-linear function of suspended sediment concentration, and a sediment concentration near zero produces a turbidity near zero (Figure 1). Maintenance of turbidities at no more than 10% over background therefore would require that inputs of suspendable sediment be restricted to no more than 10% over background. In areas where sediment input is predominantly from surface erosion or other fine-grained sources, a 10% increase in total sediment input is likely to produce nearly a 10% increase in turbidity. More generally, bedload usually accounts for less than 20% of the total sediment load in streams (Vanoni 1975), so total sediment input would need to be maintained at less than 20% over background. Assurance that a forest practice plan will comply with water quality regulations thus is possible only if the plan is capable of preventing total sediment inputs of greater than 10% to 20% over naturally occurring levels.
Among other factors, stream temperature is strongly influenced by air temperature, shading, and ground-water temperature. Logging and road building affect each of these controlling factors. If assurances are to be made that a forest practice plan will result in compliance with temperature standards, the plan must be capable of ensuring that the cumulative effect of changes to these controlling factors cannot result in violation of the temperature standards.

**Adequacy of performance targets and prescriptions**

The Report’s provisions are intended to provide assurance that regulatory requirements will be met with respect to water quality and endangered species. The Report asserts that the prescriptions it outlines will lead to attainment of the Resource Objectives listed in Schedule L-1 of the Report.

The “overall performance goals” of the Report are that "Forest practices, either singly or cumulatively, will not significantly impair the capacity of aquatic habitat to: a) Support harvestable levels of salmonids; b) Support the long-term viability of other covered species; or c) Meet or exceed water quality standards (protection of designated uses, narrative and numeric criteria, and antidegradation)" (Schedule L-1). “Resource objectives” are outlined that describe intended outcomes and the mechanisms by which the outcomes are to be attained. Taken together, “These resource objectives are intended to meet the overall performance goals” (Schedule L-1).

Performance targets are then described (Table 1), which are “the measurable criteria defining specific, attainable target forest conditions and processes. These targets are intended to meet the resource objectives” (Schedule L-1).

In this section of the review, we examine each resource objective to determine whether attainment of the objective is likely to achieve the Report’s overall performance goals. Specific performance targets and relevant prescriptions are then examined to assess whether those provisions are likely to meet the resource objectives.

**Stream temperature**

**Resource objective**

The resource objective for water temperature, to “provide cool water by maintaining shade, groundwater temperature, flow, and other watershed processes controlling stream temperature,” is appropriate only if it is assumed that the extent of the cool water to be provided is intended to be sufficient to support harvestable levels of salmonids and to support the long-term viability of other covered species. Otherwise, provision of a small amount of cool water at a few sites could be construed to be sufficient to meet the resource objective. Because of this ambiguity, it is necessary to
### Table 1. Performance targets (from Schedule L-1)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Performance targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream temperature</td>
<td>Water quality standards--current and anticipated in next triennial review</td>
</tr>
<tr>
<td>Shade</td>
<td>Westside, Type F &amp; S streams: that produced by shade model or, if model not used, virtually all available shade</td>
</tr>
<tr>
<td></td>
<td>Westside, Type N streams: shade available within 50’ for at least 50% of stream length</td>
</tr>
<tr>
<td></td>
<td>Eastside: virtually all available shade within 75’ of designated bull trout habitat per predictive model; elsewhere, shade produced by leave tree requirements per habitat series and selection criteria</td>
</tr>
<tr>
<td>Riparian condition</td>
<td>Westside: Desired Future Condition targets; current stands on pathways to meeting DFCs</td>
</tr>
<tr>
<td></td>
<td>Eastside: Desired Future Condition; current stands on pathways to achieve Eastside DFCs for each habitat series</td>
</tr>
<tr>
<td>In-stream LWD</td>
<td>Westside: 85% of recruitment potential for a stand on the trajectory toward DFC conditions; additional recruitment from trees in the outer zone</td>
</tr>
<tr>
<td></td>
<td>Eastside: to be developed based on eastside disturbance regimes</td>
</tr>
<tr>
<td>Litter fall</td>
<td>Westside Type N: At least 50% of recruitment available from within 50’</td>
</tr>
<tr>
<td></td>
<td>Eastside Type N: At least 70% of recruitment available from within 50’</td>
</tr>
<tr>
<td>Mass wasting sediment delivered to streams</td>
<td>Virtually none triggered by new roads; Virtually none triggered by new harvesting on high risk sites verified per Report criteria; Favorable trend on old roads</td>
</tr>
<tr>
<td>Road sediment delivered to streams</td>
<td>New roads--virtually none; Old roads--no more than 50% above background levels or favorable trend, whichever is more protective</td>
</tr>
<tr>
<td>Streambank disturbance (caused by forest practices)</td>
<td>Type S&amp;F: none outside road crossings; Type N: &lt;10%</td>
</tr>
<tr>
<td>Road run-off</td>
<td>Significant reduction in delivery of water from roads to streams</td>
</tr>
<tr>
<td>Peak flows</td>
<td>West side: Increases in 2-year peak flows related to forest management (roads and harvest) are &lt;20%</td>
</tr>
<tr>
<td>Wetlands</td>
<td>No net loss in the hydrologic functions of wetlands</td>
</tr>
<tr>
<td>Entry of chemicals to water</td>
<td>None for large droplets; minimized for small droplets (drift)</td>
</tr>
<tr>
<td>Entry of chemicals in RMZs</td>
<td>Core zone--none except conversions, toxic weeds; Inner zone--levels cause no significant harm to native vegetation</td>
</tr>
</tbody>
</table>

examine the two performance targets provided by the Report to infer how much cool water is intended.

**Performance target: temperature**

The Report specifies as a performance target that water quality standards are to be attained. However, there is some concern that existing water quality standards for temperature may no longer adequately protect species now classified as threatened or endangered. Reeves et al. (1987), for example, found that steelhead trout production declined 54% with the introduction of redside shiners in warm (19-22°C) environments, while production was not affected under cool (12-15°C) conditions. Standards that allow a 2.8°C increase in water temperatures to reach 18°C might thus be expected to significantly increase the competitive advantage for non-salmonid species, thereby indirectly inducing mortality among threatened salmonids. Interspecific competition can also be important among salmonids (De Staso and Rahel 1994), and a shift in environmental conditions could alter the competitive advantage further toward the non-threatened species because those
species often are more tolerant of sub-optimal conditions. Because most studies of temperature tolerance are carried out with single species, results do not reflect the indirect impacts on a species’ population due to altered competition. A species found to tolerate 20°C temperatures in isolation may disappear from a 20°C stream if coexisting species tolerate that temperature more effectively.

Other sub-lethal effects of altered temperature regimes also increase indirect salmonid mortality. For example, mortality from particular diseases has been found to increase with increasing water temperature (e.g., Holt et al. 1975), and Spence et al. (1996) summarize such studies by stating “With most pathogens, the susceptibility of salmonids to infection tends to increase with increasing water temperatures” (Spence et al. 1996, p.76). Altered temperature can also alter the timing of out-migration, leading to increased marine mortality (Holtby 1988).

Altered near-stream cover and microclimate caused by nearby logging increase both the maximum daily temperature and the daily temperature range more than mean daily temperature (e.g., Chen et al. 1995) because nighttime lows decrease and daytime highs increase. Juvenile coho salmon have been found to experience physiological stress when diurnal temperature fluctuations increase (Thomas et al. 1986). Increased stress levels result in decreased growth and impaired health, rendering the fish, by virtue of inferior size, strength, and speed, less competitive for food, space, and mates, and less capable of avoiding predators or surviving infection. Temperature standards cannot be assured to provide sufficient protection for threatened salmonids if the standards are expressed in terms of mean daily temperature because the daily mean is not sensitive to changes in diurnal range.

Recommendations for preventing harm to salmonids have included the suggestion to adopt a maximum 7-day average daily maximum of 15.6°C in Oregon (ODEQ 1995) and a call for no increase of temperature in streams where summer maximum temperatures exceed 15.6°C in critical habitat on Federal land (Rhodes et al. 1994). NMFS (1996) specifies that to be “properly functioning,” stream temperatures generally must be in the range of 10° to 14°C. The Mantech guidelines for private lands in the Pacific Northwest recommend that “for all waters containing threatened or endangered stocks, no new activities be initiated that would result in measurable increases in stream temperature” (Spence et al. 1996, p.232).

**Performance target: shade**

The only mechanism for management of stream temperatures for which the Report provides a performance target is regulation of stream shading. This limited specification falls short of the resource objective to provide cool water by “maintaining shade, groundwater temperature, flow, and other watershed processes” (Schedule L-1). Maintenance of shading alone will not assure attainment of Washington State water quality standards for stream temperature; maintenance of appropriate air temperature and groundwater temperature is also necessary.

Temperature models show that stream temperatures are more sensitive to air temperature than to shading (Sullivan et al. 1990). The US Fish and Wildlife Service SSTEMP model (Theurer et al. 1984), for example, predicts a 4°C increase in stream temperature for a 4°C air temperature increase (from 19°C to 23°C), while a change in canopy cover from 75% to 0% would cause a 5°C increase (Sullivan et al. 1990). Field measurements by Sullivan et al. (1990) also suggest that air temperature has a stronger proportional influence on stream temperature than does shade.

Effects of a cut margin on air temperatures in the adjacent stand are well described. Chen et al. (1995), for example, found at sites in western Washington and Oregon that maximum air temperatures at stand margins are elevated 2°C to 16°C relative to interior temperatures, and that the temperature effect generally extends 60 to 120 meters (equivalent to 1 to 2 tree heights) into the old-growth stand. A figure accompanying the paper (Chen et al. 1995, Fig.3) indicates that air
temperatures 50 feet from the stand margin have recovered by only about 20%, and that recovery at
100 feet is on the order of 50%. Measurements by Sullivan et al. (1990) also indicate that
temperatures at the margins of clearcuts are a minimum of 15% higher (relative to 0°C) than at
locations more characteristic of the interior of a stand (Sullivan et al. 1990; the widths of the buffer
strips are not noted). These results demonstrate the importance of managing riparian stands to
maintain appropriate air temperature regimes if appropriate stream temperature regimes are to be
maintained.

Attainment of the Report’s performance targets for shading is insufficient to allow
compliance with water quality standards for stream temperature. In the case of perennial non-fish-
bearing channels, for example, 50% of the channel length can be left without a buffer strip.
Maximum daily air temperatures along these reaches, were they located in the areas studied by Chen
et al. (1995), would be 2°C to 16°C higher than in undisturbed forest. Air temperatures along the
other 50% of these channels (with 50-ft buffers) would be 1°C to 13°C higher than background
because of the proximity of the stand edge. Maximum stream temperatures thus would be elevated
proportionally throughout the perennial non-fish-bearing streams. Stream temperatures would
decrease slightly in the shaded reaches, but the artificially elevated air temperatures would prevent
recovery by more than 20%. Anthropogenically warmed water would then feed directly to fish-
bearing channels.

The study upon which the Report’s shade prescriptions appear to be based (Caldwell et al.
1991) unfortunately was not designed to be capable of addressing air-temperature effects, so the
dominant impact on stream temperatures was not taken into account when the prescriptions were
designed. Caldwell et al. (1991) tracked water temperatures downstream of unshaded reaches as
waters entered reaches with already-modified riparian zones; in only one case was the downstream
comparison to a mature forest that contained some conifers. Measurements of reequilibration were
thus with respect to artificially high stream and air temperatures in the “control” reaches. The study
therefore provides no information on the flow distance or travel time needed for water temperature to
equilibrte with the temperature regime expected in undisturbed forests. The greater temperature drop
needed would require a significantly greater flow distance for equilibration.

Furthermore, Caldwell et al. (1991) conclude that water temperatures equilibrate to the
artificially high downstream temperatures over a distance equivalent to one to two hours’ travel time
for the flow, or “150 meters or less.” For a 150-m reach to represent one hour’s travel time, water
velocity would be only 8 feet per minute. The Type 4 channels they studied had an average discharge
of 0.02 cfs, only 6% of the upper limit of summer flow for Type 4 channels (0.3 cfs). Water velocity
in a channel with a discharge of 0.3 cfs is expected to be about 8 times greater. If one hour’s travel
time is required to equilibrate temperature, then the distance over which equilibration takes place
would be about 1100 m.

The shade-based performance target also is inadequate because it cannot prevent significant
cumulative impacts. Because of past land-use practices, many Washington streams are already
temperature impaired and many others are very close to the 16°C or 18°C limit. In these streams, any
anthropogenic increase in water temperature would result in non-compliance with water quality
standards. We have already demonstrated that adherence to shading prescriptions will result in
increased maximum water temperatures throughout a perennial non-fish-bearing stream. Entry of this
over-heated water to an already marginal or temperature-impaired downstream reach would thus
result in non-compliance. A shade prescription intended to be applied uniformly through an area
cannot prevent violations of water quality standards. Only if the current level of temperature impact
to a stream is evaluated and prescriptions are designed to reflect the existing conditions can violation of water quality standards for temperature be avoided.

The conclusion of Caldwell et al. (1991) that logging of Type 4 channels cannot cause cumulative impacts on water temperature is based on assumptions that 1) the results of a study of 0.02 cfs streams can be applied to streams with 15 times as much flow, and 2) temperature regimes in partially logged buffer strips and alder thickets are equivalent to those in old-growth conifer forests. Such assumptions are demonstrably unfounded, so the general conclusions of Caldwell et al. (1991) concerning potential cumulative impacts are clearly unsupported by the study.

It should also be noted that water quality standards are written to apply to all surface waters within the state, without regard for presence or absence of fish. A proposal to allow complete removal of shade along half of the length of perennial non-fish-bearing streams thus will clearly not lead to compliance with state water quality standards.

**Temperature-related prescriptions**

The prescriptions provided by the Report for controlling temperature-related impacts are those dealing with riparian buffer-strip retention. As described above, these prescriptions alone cannot ensure that the performance target for temperature is met. Compliance with water quality standards can be achieved only if provisions are made to maintain appropriate air temperature regimes along enough of the non-fish-bearing stream length to prevent excessive increases in maximum stream temperatures. Because such provisions are currently lacking, and because no provision is made to adjust prescriptions to reflect existing thermal impacts in a watershed, prescriptions will allow further degradation of already impaired watersheds through continued modification of air temperature regimes in riparian areas. Such impacts would violate the state’s water quality standards and thus would also conflict with the Report’s objectives and performance targets and with the requirements of the Forest Practices Act.

The problem is particularly acute because narrower buffer strips are to be provided for small fish-bearing streams than for large fish-bearing streams. Temperatures in small streams are more strongly influenced by local conditions and experience greater diurnal fluctuations. A plan that provides lesser levels of protection for the most sensitive fish-bearing streams is not appropriate.

The problem of cumulative temperature impacts is also aggravated because the Report specifies that information from watershed analysis cannot be used to modify riparian prescriptions (IIG.1(a)). For example, if watershed analysis discloses that temperatures in a watershed are marginal and that most of the riparian zone has already been cut, this information could not be used to design prescriptions for the watershed that would provide additional protection along non-fish-bearing streams to prevent further cumulative impacts to downstream critical habitat. In addition, the Report states that “The new regulations for riparian management zones supersede existing watershed analysis prescriptions” (Appendix G item IIG.2(a)). If there are any cases where watershed analysis in the past found that higher levels of protection were needed to avert cumulative temperature impacts, those prescriptions would be abandoned.

It is also of concern that observations of the presence of fish cannot be used to correct erroneous classifications of stream segments (IIB.1(d)). Instead, results of an as-yet-undeveloped GIS-based state-wide model will provide the only allowable basis for defining “fish-bearing” and “non-fish-bearing” waters. The Report specifies that the as-yet-undeveloped model will be capable of defining the margin between the two channel types to ±5%. This specification is meaningless unless the quantity that ±5% refers to is defined. If it is intended that the accuracy is to be ±5% of the total channel length in a watershed, the result will not be useful. In a typical watershed, ±5% of the total
channel length represents ±25% of the length of fish-bearing waters. An uncertainty of this magnitude concerning the location of federally declared critical habitat would clearly be inappropriate. Furthermore, because the Report’s rules are developed in part to assure survival of threatened species, a specification that permits a 50% chance of overlooking critical habitat (“the line demarcating fish and non-fish habitat waters will be drawn so as to be equally likely to be over and under inclusive”) seems unreasonable. A more supportable standard would be one that provided 95% confidence that 95% of the potential habitat in a 4th-order watershed is identified.

Because observations of the presence of fish cannot be used to define fish-bearing streams and because the fish distribution model appears to be expected to have an accuracy of only ±25% of the length of fish-bearing streams in a watershed, it is likely that riparian trees will be cut along some channels in which threatened or endangered fish are known to be present.

Large woody debris and organic inputs

Resource objective

The objective to “Provide complex in- and near-stream habitat by recruiting large woody debris and litter fall to streams” (Schedule L-1) would appear to be satisfied by any level of wood and litter recruitment. By specifying management only of woody debris and litter fall, the objective seems to preclude management of other triggers for altered complexity. In this case, too, the objective does not provide sufficient guidance to be useful in evaluating the adequacy of prescriptions. The Report specifies performance targets for riparian condition, in-stream large woody debris, and litter fall.

Performance target: riparian conditions

For westside riparian forest conditions, performance targets specify “current stands on pathways to meeting DFCs,” where “DFC” refers to “desired future condition” targets. Desired future conditions are defined by the Report to be “the stand conditions of a mature riparian forest, agreed to be 140 years of age...and the attainment of resource objectives” (Appendix B, item 1(a)). The desired future condition targets are further defined by basal area requirements for core- and inner-zone stands on different site classes (draft WAC 222-30-021 and Schedule B-2).

The performance target thus appears to require simply that trees be growing in the buffer strips and that conditions be improving. It is not clear how this performance target provides “the measurable criteria defining specific, attainable target forest conditions and processes,” as Schedule L-1 indicates is the intended function of performance targets. It can be argued, however, that a performance target that effectively requires that “current stands be on pathways that lead toward attainment of resource objectives” is compatible with the statement in Schedule L-1 that “These targets are intended to meet the resource objectives.” (Schedule L-1).

Performance target: in-stream large woody debris

The performance target for recruitment of large woody debris specifies that “85% of the recruitment potential for a stand on the trajectory toward DFC conditions” is required. This performance target is not defined with reference to the needs of the public resources to be protected, but in terms of the trees expected to be present at a given time while a stand is developing. In other words, it doesn’t matter if there is wood in the stream or not, as long as the basal area of the stand is more than 85% of that required by the performance target for riparian conditions. As currently worded, this performance target could be met by cutting a riparian stand and replanting at 85% of the required stocking rate. A performance target for instream wood that does not consider instream wood...
is clearly not useful for meeting the overall performance goals. Furthermore, a performance target defeats the purpose of a regulation if the performance target declares that it is acceptable to achieve only 85% compliance with that regulation.

Because the performance target is defined for conditions at a site, it is not capable of preventing an increase in the severity of already significant adverse modifications to critical habitat. As much as 50% of the large woody debris in a fish-bearing stream can be derived from upstream and upslope sources. Debris loading at a site in the stream channel thus depends on the cumulative woody debris input upstream of the site. Even if there is an overall impoverishment of large wood in a reach or watershed, the performance target would allow continued harvest of a proportion of the trees that would have been capable of falling into the stream. It will thus be possible to further increase the severity of cumulative impacts to woody debris loadings in watersheds already impaired by a deficit of large wood. If the system is already impaired and the potential for recovery is further reduced, the severity of the impact increases.

The performance target would be more useful if it were instead phrased to indicate that riparian stands throughout a watershed are intended to be capable of providing 85% of the potential natural input rate of woody debris from undisturbed stands, and that the characteristics of the input (tree species and size distribution of the component pieces) are to be equivalent to those under natural conditions. In this case it is likely that the performance target would not be fully met for many years, but in the interim it would provide a basis for designing woody debris placement strategies and it would better prevent further adverse modification to already impacted critical habitat.

**Performance target: litter fall**

Performance targets for litter fall specify that 50% (westside) and 70% (eastside) of potential litter fall will be available from within 50’ of non-fish-bearing channels. The wording of the target is ambiguous: it is not clear whether “potential” is to be defined on the basis of original stand conditions or with respect to “a stand on the trajectory toward DFC conditions.” There is also no indication of whether the character of the litter fall is intended to be similar to that present under natural conditions.

Non-fish-bearing channels are expected to account for 50% to 70% of the entire length of the channel system (e.g., Table 2), so if the appropriate potential sources are removed along 50% of these channels, the result will be removal of those sources along 25% to 35% of the system. Under these conditions, there will be a considerable change in the amount and type of inputs of allochthonous materials to downstream, fish-bearing reaches. Vannote et al. (1980) stress the importance of channel continuity: upstream inputs provide extremely important energy sources for downstream aquatic communities. Changes in channel-side vegetation will strongly influence the amount, timing, and type of allochthonous inputs. Naiman and Sedell (1979) note that infall is particularly important to aquatic ecosystems’ energy budgets in small streams.

**Debris- and litter-related prescriptions**

For large woody debris and litter, relevant prescriptions provided by the Report include requirements for buffer-strip retention, movement of debris cleared from culverts to downstream reaches, and design of “placement strategies” for woody debris.

The Report’s riparian prescriptions are based on a definition of site potential tree that is inconsistent with the goals of the Report, with other provisions within the Report, and with other riparian policies. The Report defines the site potential tree height as the height of a 100-year-old tree. However, “mature” forest is specified by the Report to be older than 140 years. Adoption of a site
potential tree height that is based on the size of trees acknowledged to be immature is unreasonable when the intent is to provide appropriate woody debris to stream channels. FEMAT (1993), for example, defines a “site potential tree” as “A tree that has attained the average maximum height possible given site conditions where it occurs” (FEMAT 1993, p. IX-32).

Use of immature trees as the basis for buffer-strip design instead of 140-yr trees results in a 10% shortfall of buffer strip widths compared to those that would be consistent with the Report’s definition of “mature riparian forest” (Appendix B item I(a)). Buffer strip widths will be 15% narrower than strips designed on the basis of 200-year-old trees.

Surprisingly, examination of stand tables provided by McArdle et al. (1949) indicates that the Report’s internal inconsistency extends to an even more fundamental level. The Report’s definition of “desired future conditions” as “the stand conditions of a mature riparian forest, agreed to be 140 years in age” would lead one to assume that the stand requirements provided by the Report for a 140-year forest (Schedule B-2) would reflect stand conditions expected in a 140-year forest. In actuality, the required basal areas are representative of 80- to 90-year forests (Figure 2). Basal areas would need to be increased by 25% to become consistent with the Report’s stated intention. In addition, although the stand conditions described by McArdle et al. (1949) for mapped site classes are likely to be appropriate for the inner and outer zones of the buffer strip and for core zones on small fish-bearing streams, which would ordinarily all be located on upland soils, they may not be appropriate for the deeper soils and more mesic environments nearer the medium-sized channels. Although site classes are often higher near channels, these differences often are not depicted on site class maps because the scale of variation is finer than the map resolution. Core zones might regularly
be of higher site class than adjacent inner zones, yet design would be based on the inappropriate site class mapped for areas outside the core zone.

Definition of stand requirements to be those of 85-year forests rather than 140-year forests will prevent attainment of the performance target for riparian forest conditions. The performance target requires that “current stands [be] on pathways to meeting DFCs,” and desired future conditions are defined to be “the stand conditions of a mature riparian forest, agreed to be 140 years of age” (Appendix B, item 1(a)). Allowance for 20% of the core riparian zone to be cut for logging corridors is also incompatible with meeting the performance target, as is the provision that riparian zones along half the perennial non-fish-bearing channel length can be cut.

Use of stand requirements characteristic of 85-year stands also will result in consistently narrower inner-zone buffers than a cursory examination of the Report would lead one to expect. The 50-foot core zone will not be logged, but the inner zone can be logged as soon as the average basal area in the combined core and inner zones exceeds that expected for an 85-year stand. If a core zone has a basal area higher than that expected for an 85-year stand, the inner zone can be partially cut even if it does not by itself meet the stand requirements. As core zones actually approach stand conditions expected for 140-year trees, the width of the inner zone buffer is likely to progressively decrease toward the minimum value of 30 feet as the stand requirements for average basal area can increasingly be met on the weight of the core-zone stand. For example, if the core zone is 160 years old, a 43-foot-wide band of 160-year trees in the inner zone would allow clearcutting of the remainder of the inner zone.

In any case, use of basal area as the only basis for stand characterization is fundamentally inappropriate. High basal areas may be attained by overcrowding of small trees as well as by maturing of large trees, so simply specifying a desired basal area provides no assurance that stand characteristics will allow a stand to function appropriately in the riparian ecosystem.

Given the descriptions of desired basal areas presented in the draft WAC 222-30-021, it is possible to estimate the level of potential woody debris input, relative to background conditions, that would be provided by the Report’s prescriptions. Unpublished measurements of drainage density for a western Washington watershed provide channel data necessary for the calculation (Table 2). The watershed is assumed to be Site Class II, with a 160-yr tree height of 192 ft and a basal area of 353 ft² (McArdle et al. 1949). Infall proportions are estimated as a function of distance from the channel using a mean curve (Figure 3) derived from information presented by Murphy and Koski (1989—and Spence et al. 1996, p.218, indicate that tree height is 40 m for the area), McDade et al. (1990), and VanSickle and Gregory (1990). The 80% of the core zone not allowed to be occupied by yarding corridors is assumed to have a stand characteristic of 160-year forests, and the managed 70-foot inner zone is assumed to have a uniform stand of 12” diameter trees with a basal area of 220 ft²/ac. Average basal area for combined core and inner zones is thus the required 275 ft²/ac. The 50-foot outer zone is assumed to contain 20 12-inch-diameter trees per acre; these are too short to reach the channel when they fall, so this zone does not contribute to infall. Infall proportions from the inner zone were calculated from the mean curve shown on Figure 3, but with the assumption that the tree height is that expected for Site Class II Douglas-fir of 12” diameter (119 ft).

Results indicate that 3rd through 6th order channels would be expected to receive approximately 62% of the characteristic rates of debris input, while perennial non-fish-bearing channels would receive only 26% of the expected infall and seasonal channels would not receive infall. The average potential infall over the entire channel system would be about 19% of original levels in unmanaged forests.
Table 2. Estimate of potential direct woody debris infall produced by Report prescriptions (relative to background conditions) at a site in western Washington. A core zone of 50’ is left on 2nd order and larger channels, an inner zone of 70’ and an outer zone of 50’ are left on 3rd order and larger channels. “Class” refers to channel classes described in the Report, with “Ne” indicating ephemeral non-fish-bearing channels and “Np” referring to perennial fish-bearing channels.

<table>
<thead>
<tr>
<th>Channel Proportion of stand Proportion of infall Potential infall Percent potential</th>
<th>Load¹</th>
<th>Load²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orde Class mi/mi²</td>
<td>Proportion of stand</td>
<td>Proportion of infall</td>
</tr>
<tr>
<td>Ne</td>
<td>8.2</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>3.3</td>
<td>0.4</td>
</tr>
<tr>
<td>F</td>
<td>1.6</td>
<td>0.8</td>
</tr>
<tr>
<td>F</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>S</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>S</td>
<td>0.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>14.5</td>
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</tr>
</tbody>
</table>

¹ Calculations assume 50% of debris load originates upstream
² Calculations assume 50% of debris load originates upslope

Only about half of the instream debris load in fish-bearing channels appears to be derived from direct infall (McGarry 1994, cited by Pollack 1999); the remainder is transported to these reaches by slope processes and upstream sources (Spence et al. 1996, p.217). Hillslope sources of allochthonous woody debris are not to be routinely preserved, and upstream sources are reduced by 74%, so in-stream loadings are expected to be substantially diminished. If all allochthonous inputs are assumed to be produced from upstream rather than upslope, downstream loading rates can be estimated on the basis of infall along upstream reaches (Table 2, column 14). Results suggest that fish-bearing channels will have an average of 49% of background debris loadings in areas where upslope inputs are negligible and 31% where upslope inputs dominate.

A similar calculation was carried out by Pollack (1999) for conditions at two sites elsewhere in western Washington. Pollack considered wood inputs just to fish-bearing channels, and found results similar to those described here: prescriptions were found to be capable of producing only 40% of characteristic wood inputs.

The Report’s prescriptions will provide considerably lower rates of woody debris input than are generally considered necessary for sustaining viable populations of anadromous salmonids. Based on an extensive review of the scientific literature, the conservation guidelines prepared for NMFS, EPA, and USFWS (Spence et al. 1996) recommend adoption of a riparian buffer zone with a width equivalent to 75% of the height of a site-potential tree. Such a design would provide 95% of the expected infall for unmanaged forests. The guidelines specify that such buffers are needed on all streams: “Because these influences of land management propagate downstream, protection of riparian zones along nonfish-bearing streams and ephemeral channels is also needed to maintain salmonid habitats” (Spence et al. 1996, p.216).

Spence et al. (1996) also cite a review by Cederholm (1994) that found that “most authors recommended buffers of 30-60 m for maintaining this function [production of large woody debris].”
Figure 3. Published curves for woody debris source distances, plotted as a function of tree height. The heavy line indicates the mean relationship.

(Spence et al. 1996, p.216). For Site Class II Douglas-fir, a 60-m buffer would provide nearly all of the direct woody debris expected under unmanaged conditions.

Concerning management of the buffers, the guidelines prepared for NMFS, EPA, and USFWS recommend that “no forestry activities be allowed within these buffers in old-growth or late-successional forests. In second-growth forests, limited harvest, thinning, planting, or other manipulations may be appropriate in order to facilitate recovery and protection of key functions that have been identified through watershed analysis” (Spence et al. 1996 p.246).

Both FEMAT (1993) and Spence et al. (1996) stress the importance of providing woody debris sources for small channels. Woody debris in non-fish-bearing channels is critical to the maintenance of adequate habitat in downstream fish-bearing channels. Woody debris in seasonal channels is essential for reducing the extent of channel scour during the wet season, for reducing the mobility and impact of landslides, and for trapping sediment entering that portion of the channel system, which accounts for as much as 50% of the channel system during sediment-generating storms. It is not sufficient to simply protect sources immediately adjacent to fish-bearing reaches if substantial adverse habitat modification to those reaches is to be avoided.

Blowdown rates increase in stands abutting logged areas (Grizzel and Wolff 1998, Chen et al. 1992), and Spence et al. (1996) note that in areas where blowdown is common, it may be necessary to expand buffer widths to sustain appropriate infall rates near the channel. It is not clear that a 30- to 70-ft-wide, partially cut inner buffer is sufficient to maintain stability in the core buffer zone. Accelerated blowdown in the years immediately following logging may deplete riparian forests of sources of future wood. By the time the short-term windfall has decomposed or has been transported downstream, insufficient sources may remain to replenish the wood. Rather than distributing the
infall through time in a manner typical of undisturbed conditions, woody debris regimes may take on a “boom or bust” character, with periods of inappropriate overloading followed by periods of inappropriate deficiency.

The Report calls for placement of woody debris in streams as mitigation to allow increased cutting in buffer strips (IIB.4(a)(v)). Such a strategy violates the generally accepted need to “mitigate in kind” because addition of wood addresses current wood deficits while the presence of intact buffer strips addresses future wood deficits. Under current conditions, debris loading at many sites is likely to decrease in the future because relic logs are decomposing and previous logging has depleted riparian zones of future sources. Further depletion of woody debris sources would thus aggravate the habitat degradation already expected due to present riparian conditions. In addition, debris placement is intended as mitigation for logging that will decrease the stability of core buffer zones, thus further depleting sources of future woody debris. The long-term cumulative impact of depleted riparian buffers is not mitigated by short-term additions of woody debris to creeks unless the placement strategy requires that wood of appropriate sizes and character be replaced in perpetuity to balance a perpetual short-fall from reduced buffer strips.

Destabilization of the buffer strip by adjacent logging will cause extensive blowdown at some sites (Grizzel and Wolff 1998), and the risk of inappropriate near-stream blowdown is expected to increase if the outer portions of the potential buffer are logged (Chen et al. 1992). Although the Report proscribes salvage logging in core buffer zones of fish-bearing streams, it allows removal of trees that have fallen into the core zone from upslope. However, a major reason for buffer strips is to provide a near-stream environment capable of sustaining ecosystem functions in the aquatic environment. Fallen wood is an important component of soil formation processes and nutrient cycling in forests (see review by Maser et al. 1988), and attainment of appropriate riparian stand conditions requires that appropriate soil conditions be maintained. It would be more reasonable to allow salvage logging of the portion of trees that fall out of core zones than to allow salvage of trees that fall into core zones of buffer strips.

The Report also allows salvage within all buffers zones on non-fish-bearing streams. However, some of the wood falling along non-fish-bearing channels is transported downstream to fish-bearing channels. Wood is not effective as a structural element in streams until it has fallen, so a provision that allows removal of the wood as soon as it falls is incompatible with the Report’s stated intent to provide for recruitment of large woody debris. Even that wood falling onto floodplains is susceptible to downstream transport during large storms.

Prescriptions relevant to litter fall will not allow the performance targets to be met. For westside channels, the Report requires that 50% of the potential litter fall to be available from within 50’ of non-fish-bearing channels. However, prescriptions require that riparian buffer strips be left along only about 10% of the length of non-fish-bearing channels. Ephemeral non-fish-bearing channels, which comprise as much as 50% of the channel length, will be provided with no riparian buffers, and only 40% of the perennial non-fish-bearing channels (50% of the length of those channels, with 20% of that occupied by yarding corridors) are to be accorded riparian buffer strips. In addition, ephemeral channels will be subject to direct herbicide application, further modifying their function as a source of organic materials to downstream reaches.

Sediment

Resource objective

The resource objective for sediment is to “Prevent the delivery of excessive sediment to streams by protecting stream bank integrity, providing vegetative filtering, protecting unstable...”
slopes, and preventing the routing of sediment to streams” (Schedule L-1). The strategy thus places more emphasis on catching eroded sediment before it reaches a channel than on reducing erosion rates. Presumably, “excessive sediment” is to be defined in the context of the overall goal to “Meet or exceed water quality standards (protection of designated uses, narrative and numeric criteria, and antidegradation)” (Schedule L-1). Unlike the case of water temperature, however, attainment of water quality standards for sediment or turbidity is not specified as a performance target.

Performance target: mass wasting sediment delivered to streams

For landsliding, new roads and new harvesting are required to produce “virtually” no landslides, but no definition is provided for “virtually.” This definition is important, as protocols used for watershed analysis in Washington consider increased sediment loads of up to 100% to be of no operational consequence (WFPB 1997). In actuality, if water quality standards for turbidity are to be attained, it will be necessary to maintain anthropogenic landsliding rates at no more than 20% over background levels, as discussed above. Thus, an anthropogenic increase in probability of landsliding by more than 20% would be expected, on average, to result in non-compliance with water quality standards.

A 20% threshold for increased landsliding associated with new activities would need to be reduced further to balance larger inputs allowed by the Report for other sources. The criterion for existing roads is simply that there be a “favorable trend” in landslide frequency. Because rates of landsliding often decrease with age of road (Reid and Dunne 1996, p.58), this performance target could be attained in many areas simply by leaving the existing road network in its present condition. Given that the existing road network is generally considered to be the major source of sediment in timberland watersheds (see reviews in Sidle et al. 1985, Ice 1985, Furniss et al. 1991, Spence et al. 1996), it is clear that this performance target is insufficient to attain the Report’s stated overall goal of attaining water quality standards. Even where a “favorable trend” is evident, if improvement is occurring slowly and the starting point is far from compliance, it may take an excessive length of time to achieve compliance. When species are already threatened or endangered, compliance must be achieved over a time-frame that does not significantly prolong harm to the species if the likelihood of the survival and recovery of the species is not to be appreciably reduced.

In addition, even the release of “virtually no” sediment would increase the severity of an already existing cumulative impact in sediment-impaired watersheds if “virtually no” sediment is an amount greater than zero.

Performance target: road sediment delivered to streams

The inconsistency between performance targets and water quality regulations is even more evident in the case of targets for delivery of road sediment to streams, if “road sediment” is assumed to refer to sediment from sources other than road-related landsliding. In this case, the Report requires existing road networks to produce sediment at rates no greater than 50% over background levels or to show a favorable trend in sediment production. Road sediment generally is of suspendible size, so in order to maintain levels of turbidity at no more than 10% over background, as required by state law in most timberland streams, road sediment inputs must be reduced to no more than 10% over background. The Report’s performance target thus is not consistent with the stated goals of the Report or with existing Forest Practice legislation, which requires that forest practice regulations achieve compliance with water quality laws (WAC 222-12-010).
Furthermore, road sediment is additive to landslide sediment and streambank sediment, so the sum of sediment production rates from these sources would need to be less than 10% to 20% over background if compliance with water quality standards is to be assured.

**Performance target: streambank disturbance**

Performance targets call for less than 10% of the streambanks of non-fish-bearing channels to be left in a disturbed state after logging. As discussed previously, however, these channels account for 50% to 70% of the channel network, and 86% of their length can be left without buffers. Performance targets thus would allow 4% to 6% of the entire length of wet-weather streambanks in a watershed to be mechanically disrupted. Sediment eroded from disturbed banks is readily available for channel transport during storms even in ephemeral channels, so sediment inputs are expected to be large from this source. When this sediment input is combined with that allowed from the existing road network, it is extremely unlikely that water quality standards for turbidity will be attained. Allowing more than 4% of the stream banks in a watershed to be left in a disrupted state also is highly inconsistent with the resource objective to “Prevent the delivery of excessive sediment to streams by protecting stream bank integrity.” Because direct disturbance of streambanks and ephemeral streambeds introduces sediment directly into channels, the provision also directly conflicts with the resource objective to “Prevent the delivery of excessive sediment to streams by...preventing the routing of sediment to streams” (Schedule L-1).

The distinction between ephemeral and perennial non-fish-bearing channels is not relevant with respect to concerns about hydrological and sediment-related impacts. Both ephemeral and perennial channels carry water during periods when these impacts are important. To be capable of addressing sediment-related impacts, provisions must be applicable to the channel network as it exists during sediment-transporting events. Because low-order tributaries are more closely associated with sediment sources, some have argued that low-order channels need higher levels of protection than downstream channels if delivery of excessive sediment is to be prevented, as required by the Report’s resource objective for sediment. Kondolf et al. (1996), for example, call for buffer strip widths to increase with increasing side-slope gradient, and low-order channels generally have the steepest side slopes.

**Sediment-related prescriptions**

The Report’s prescriptions to address sediment range from requirements for road maintenance to specifications for how unstable slopes will be managed. The Report’s requirements for road maintenance and improved road standards represent significant improvements over previous rules.

In contrast, measures for managing unstable slopes appear to weaken previous requirements. Requirements to assess slope stability patterns at a watershed scale have been replaced with a requirement to use state-wide hazard maps and to evaluate slope stability at specific sites of concern. Site-based stability analyses are not effective for identifying many sites that are stable under current conditions but unstable after land-use activities have taken place. Valid assessment of altered likelihoods of failure requires a watershed-scale analysis of the response of similar site types to past forest practices, yet use of the results of such an analysis is now specifically prohibited for modifying prescriptions (IIG.1(a)).

Furthermore, the Draft Emergency Rules indicate that although inner gorges are recognized to be formed “by a combination of the downcutting action of a stream and mass movement on the slope walls” (Draft WAC 222-16-010), and are thus strongly associated with landsliding, only a subset of inner gorges (those with slopes steeper than 70%) are to be considered “potentially unstable” (WAC
222-16-959 (1)(d)(i)(A)). The Draft Rules also remove SEPA consideration for public resources in cases where timber operations are planned on unstable slopes. In the past, proposed timber harvest or road construction on unstable lands in watersheds not having undergone a watershed analysis would trigger Class IV application status if “there is potential for a substantial debris flow or mass failure to cause significant impact to public resources” (WAC 222-16-050). Now however, such status would be required only if there is a potential for resulting landsliding, debris flows, or snow avalanche to “threaten public safety” (Draft WAC 222-16-050), a standard that provides considerably less protection.

Sediment from road-surface erosion is intended to be controlled simply by diverting road-surface runoff onto hillslopes rather than directly into stream channels. This measure is not sufficient to adequately reduce sediment input from this source because it has never been demonstrated to be possible to fully decouple road-surface runoff from the stream system. According to a report prepared for the TFW/CMER Sediment, Hydrology and Mass Wasting Steering Committee and the Department of Natural Resources, “Roads nearly always increase sediment yields in small watersheds, even with state of the art construction and erosion control practices” (MacDonald and Ritland 1989, p.37).

Diversion of surface water is usually attempted by outsloping roads and by shunting runoff onto unchannelled hillslopes. Experience indicates that outsloping is difficult to maintain on trafficked roads with slopes of greater than about 5%, and discharge of water onto hillslopes carries the threat of increased landsliding at the discharge sites. In addition, unchannelled hillslopes swales are often saturated during winter storms or snow-melt periods, providing efficient overland transport of water and sediment even where surface channeling is not present. Where road runoff cannot be fully infiltrated into soils before entering a channel or unchannelled swale, it would be necessary to pave surfaces or manage traffic levels if rates of sediment input from road-surface erosion are to be maintained at levels low enough to assure that water quality standards in the receiving waters can be met.

The Draft Rules call for outsloping of roads “where practical” (Draft WAC 222-24-020 (14)) and provision of inside ditches where outsloping is not practical. Relief culverts for inside ditches near typed waters and wetlands “must be located as close to the stream crossing or wetland as possible so it drains off before reaching the stream” (Draft WAC 222-24-020 (13)). The Washington watershed analysis manual (WFPB 1997, p. B-38) indicates that at least 10% sediment delivery is expected when culvert outflow occurs within 200 feet of a stream, so hydrologic decoupling of the road network through culvert diversion would only be possible for those portions of the road located more than 200 feet of a stream or seasonally saturated swale.

Taken together, the Report’s recommended prescriptions will allow sediment inputs at levels considerably higher than are currently allowed by state water quality standards. Sediment inputs of 50% over background are to be permitted from the existing road system; effective methods for developing prescriptions to manage slope stability hazards are no longer to be allowed; 4% to 6% of the streambanks in a watershed can be left in a disrupted state; and peak-flow increases are allowed to increase by as much as 20%, thus increasing sediment loads by more than 20% (see following discussion of hydrology) and contributing to increased erosion on the disrupted streambanks. Whether water is present in the summer is irrelevant to a channel’s significance as a source or transport route for sediment, yet summer-dry channels are accorded no effective protection. Prescriptions that preclude protection for the majority of the wet-season channel network, and at the same time allow herbicide application directly a portion to those channels and permit direct physical disruption of up to 10% of their banks, clearly cannot be assured to result in compliance with water
quality standards. No performance target is provided that requires compliance with state water quality standards for turbidity, even though the Report cites compliance with water quality standards as a general objective and the Forest Practices Act requires that forest practice rules achieve compliance with water quality laws (WAC 222-12-010).

We expect increases in sediment loads from implementation of the Report’s prescriptions to be on the order of 100% or more beyond naturally occurring background levels. Some effects of such an input rate can be estimated. Data from an undisturbed watershed in the Oregon Cascades (Rothacher et al. 1967) allow characterization of naturally occurring suspended sediment loads for 4 years of record (Figure 4a). Loads are then doubled to estimate the likely influence of combined logging and road management (Figure 4b). Doubling of the sediment load significantly increases the duration of exceedence of a given concentration of suspended sediment. A concentration of 20 mg/l, for example, would be experienced for about 3 times longer than under background conditions.

Adherence to water quality standards for turbidity is important for ensuring survival and recovery of threatened anadromous salmonid species. Consistent increases in chronic turbidity levels are likely to produce indirect mortality in anadromous salmonids due to reduced growth and impaired condition (Sigler et al. 1984, Redding et al. 1987, Lloyd 1987, Newcombe and MacDonald 1991, Newcombe and Jensen 1996, Barrett et al. 1992). Because marine survival rates tend to be correlated with smolt size (Holtby et al. 1990), reduced smolt condition and smolt size would be expected to lead to decreased rates of marine survival. Furthermore, increased temperatures can interact with increased turbidities to worsen the impact (Servizi and Martens 1991, Newcombe and Jensen 1996).

Newcombe and Jensen (1996) analyzed a wide range of studies that document the impacts of suspended sediment exposure on salmonids (Figure 5). During the studies, fish were exposed to different sediment concentrations for different lengths of time. Effects of fluctuating levels were not evaluated, so rates of recovery between exposures is not known. Results indicate that moderate levels
of physiological stress occur after 3 days’ exposure to 20 mg/l. This level would not have been attained even as a cumulative exposure under undisturbed conditions shown in Figure 4.

Altered sediment loads are also of concern with respect to resources other than fish. Definitions of stream types provided by the Report suggest that prescriptions will not adequately protect domestic water supplies. The channel classification system provides greater protection for fish-bearing streams (“Type F”) than for non-fish-bearing streams because the Report assumes that resource values are in more need of protection in fish-bearing streams. However, the definition of “Type F” is also based on domestic water use: “Waters which are diverted for domestic use by more than 10 residential or camping units or by a public accommodation facility licensed to serve more than 10 persons, where such diversion is determined by DNR to be a valid appropriation of water and the only practical water source for such users; such waters shall be considered to be Type F waters upstream from the point of such diversion for 1,500 feet or until the drainage area is reduced by 50 percent, whichever is less” (IIB.1(e)(ii)(1)).

That such a provision is included implies that there is an expectation that the level of threat to downstream water users from upstream forest practices is significant, and thus that downstream water users need added protective measures to ensure that the water supply is not degraded. Such measures would be required to meet the anti-degradation provisions of the state’s water quality standards, which requires that "Existing beneficial uses shall be maintained and protected and no further degradation which would interfere with or become injurious to existing beneficial uses shall be allowed" (WAC 173-201A-070). The legislation makes no distinction between the rights of 10 water users and the rights of 9 water users, so it does not seem reasonable that the level of protection
needed for a source supplying 10 users is considerably higher than that for one supplying 9 users. Furthermore, the requirement that the water source for 10 or more users be “the only practical water source” for those users is not reasonable if the plan is to achieve compliance with water quality standards. Washington state law prohibits degradation that interferes with any existing beneficial use (WAC 173-201A-070).

Although salvage is not allowed in core zones of fish-bearing streams, there is no such restriction on salvage of stream-adjacent buffers on non-fish-bearing streams. Because the functioning of riparian environments as a buffer against sediment inputs is essentially the same in both locations, there is no technically justifiable basis for treating these buffer zones differently. The extent of buffers on non-fish-bearing streams is already insufficient; allowing salvage logging of these insufficient buffers will compound the problem. In any case, allowing herbiciding of the “vegetative filter” in and adjacent to as much as 50% of the storm-flow channel network is highly inconsistent with the Report’s resource objective to “Prevent the delivery of excessive sediment to streams by...providing vegetative filtering” (Schedule L-1).

In general, the prescriptions related to sediment input fail to provide assurance that water quality standards will be attained because there is no mechanism in the Report’s strategy by which cumulative impacts from sediment can be managed. For example, the Report specifies that activities at sites with a high risk for landsliding may need to be evaluated under SEPA rules “if the proposed forest practices...(ii) are likely to cause significant adverse impacts” (IIC.1(g)(iii)). This wording suggests that there will be no cause for concern if the impact of those practices considered in isolation are not significant, even if the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions is significant. Unless wording is altered throughout the Report to make explicit the need for SEPA review or increased levels of environmental protection in areas where cumulative impacts have already occurred or are likely to occur, the Report’s strategy will not be capable of meeting its stated objectives.

Hydrology

Resource objective

The resource objective for hydrology is to “Maintain surface and groundwater hydrologic regimes (magnitude, frequency, timing, and routing of stream flows) by disconnecting road drainage from the stream network, preventing increases in peak flows causing scour, and maintaining the hydrologic continuity of wetlands” (Schedule L-1).

Hydrologic change is addressed by performance targets for road run-off, peak flows, and wetlands.

Performance target: road run-off

The performance target for road run-off is simply that there be a “Significant reduction in delivery of water from roads to streams.” However, there is no definition provided for what constitutes a “significant reduction,” so the selected target cannot be evaluated for compliance.

Performance target: peak flows

Two-year peak flows are not to be increased by more than 20%, but results of studies suggest that a 20% increase in a 2-year peak flow is likely to be very harmful to threatened salmonids. A 20% increase in a 2-year peak flow can increase the frequency of what had been a 2-year peak flow to approximately once every 1.3 years (Dunne and Leopold 1978). Because a 2-year recurrence interval flow is almost always capable of mobilizing the stream bed, some proportion of in-gravel salmon
eggs and alevins are killed during 2-year flows. Increasing the frequency to occur on average every 1.3 years will be likely to increase mortality of salmonids due to flood scour by about 54% over background levels in the affected reaches.

The importance of this effect is demonstrated by Thorne and Ames (1987), who found that survival of sockeye from the Cedar River, Washington, decreases markedly with increasing maximum peak flow during the incubation period. Given the results they report, a 20% increase in peak flows would result in an average decrease of 11% in fry production. Holtby and Healey (1986) found a similar relationship in Carnation Creek: egg-to-fry mortality increases significantly with peak winter discharge. In that case, calculations indicate that a 20% increase in peak flows would have decreased fry production by approximately 13% each year over the 12 years of record. Such a decrease in survival rate for an already threatened species would clearly reduce the likelihood of survival for that species.

Scour equations developed by Carling (1987) and by Leopold et al. (1966) suggest that a 20% increase in peak flow will induce a 5 to 10% increase in scour depth. Such an increase will also increase the rate of channel erosion in non-fish-bearing channels. This effect will be aggravated because 10% of the unbuffered length of these channels can be left in a mechanically disrupted state. The cumulative impact of the increased transport capacity and increased availability of sediment is likely to result in a considerable increase in sediment transport from these channels.

A 20% increase in a 2-year peak flow will significantly increase the sediment transport capacity of the flow. Turbidity levels are generally correlated with discharge by a power function, so turbidity levels increase exponentially with increasing discharge. A 20% increase in peak flow will thus produce more than a 20% increase in turbidity, thereby violating laws that require compliance with state water quality standards. Water quality standards for most of the relevant streams require that turbidity levels be increased by no more than 10% over background levels.

It is also not clear why the performance target was restricted to consideration of the 2-year peak flow. Large rain-on-snow floods are of great concern in western Washington, where such flooding causes severe economic impacts to downstream agriculture, dairy farms, and communities. During the largest events, rain-on-snow occurs at considerably lower elevations than those comprising the characteristic “transitional snow zone.” Because analysis in the past has considered only the average monthly snow accumulation and because analyses consider only individual watersheds (WFPB 1997), no evaluations are made of the potential impacts of forest practices on the floods most likely to damage downstream properties. Average conditions don’t cause floods, so methods based on evaluation of average snow conditions are not particularly relevant. The Report would need to provide performance targets for influences on property-damaging floods if aggravation of flood damage is to be avoided. A determination would then need to be made of what level of downstream private property damage attributable to state-sanctioned forest practices is considered acceptable by regulatory agencies. If a 20% increase in peak flows is also considered acceptable for peak flows capable of damaging downstream properties, then regulatory agencies may need to consider the implications for legal liability.

No targets are provided for management of peak flow increases on the east side of the state, although it would be expected that increased scour, increased gully erosion, and increased flooding would also be of concern there.
**Hydrology-related prescriptions**

The only provisions for regulation of peak-flow change provided by the Report are directives to decrease the amount of road runoff entering streams. However, simply diverting road-surface flow onto hillslopes will not reliably prevent road-surface flow from entering streams during storms.

In addition, timber harvest can increase peak flows through mechanisms other than road runoff. Patric (1966), for example, demonstrated that foliage interception and reevaporation of rain can divert a significant proportion of the storm rainfall in coastal areas even during large storms. Patric (1966) also noted that his results are in accordance with those of earlier studies in the Pacific Northwest. In areas that can receive snowfall, warm rains falling onto snow can generate rapid melt and increased hillslope runoff where forest canopy has been removed (Coffin and Harr 1992). As discussed above, during the major flood-producing storms such conditions often occur at elevations much lower than those now designated by WFPB (1997) as the “transitional snow zone.”

**Chemicals**

**Resource objective**

The resource objective for chemicals is “Use of forest chemicals in a manner that meets or exceeds water quality standards and label requirements by buffering surface water and otherwise using best management practices.” Performance targets for chemical contamination consider only the effects of herbicides and pesticides; other sources of chemical contamination are not addressed.

**Performance target: entry of chemicals to water**

Performance targets address only potential inputs of chemicals to streams through direct application to the water surface. No restrictions are placed on direct application to the channel of seasonal non-fish-bearing streams if no water is present at the time of application. These channels are expected to comprise about 50% of the channel system, and most carry flow during moderate autumn storms and during much of the winter and spring (unless snow is present). Occasional summer storms can also generate flow. Furthermore, logging decreases rates of evapotranspiration, thus increasing summer baseflows. Previously ephemeral channels can become perennial under these conditions, and dry periods are in any case reduced in duration. Any pesticide or herbicide that is applied directly to a temporarily dry channel and that has a half-life of greater than one to two months will inevitably enter the stream system. Even chemicals with shorter half-lives can be present for appreciable periods. For example, an herbicide with a 2-week half life will be present at 1/16 the original concentration two months later.

Norris et al. (1991) note that surface residues of picloram, which can remain in biologically significant quantities for as long as 12 months after application (Norris et al. 1976, cited in Norris et al. 1991) and has a half-life of about a month, can be mobilized if the herbicide is applied to ephemeral channels. Atrazine has a shorter half-life, but 10% may remain in the soil for more than a year (Birk and Roadhouse 1964). Triclopyr has been found in runoff from an ephemeral stream during the first runoff event, 6 months after application (Norris et al. 1987, cited in Norris et al. 1991). Glyphosate also has a half-life of a month or more in soils (Norris et al. 1991). Even after an herbicide breaks down chemically, daughter products may themselves be highly toxic. Welch et al. (1998) note that many herbicides are readily adsorbed by sediment particles and in this form are resistant to chemical breakdown. Concentrations in sediments can thus accumulate to toxic levels (Welch et al. 1998).
Given the near certainty that herbicides applied directly to temporarily dry stream channels will enter the stream system during the first rains, it seems odd that domestic water sources supplying up to 9 people are not accorded the same level of protection from toxic contamination as salmonids.

**Performance target: entry of chemicals in RMZs**

Recommendations of the Report allow herbicides to be applied directly onto temporarily dry streambeds, and also allow up to 10% of those streambeds to be left in a disrupted state. Under these conditions, accelerated surface erosion and bank erosion along these streams is expected to provide efficient transport of toxics to downstream fish-bearing channels. The combined effects of increased flow from altered evapotranspiration, increased erosion from increased flow and disrupted channels, and direct application of toxic chemicals to channels and to disturbed banks would increase the likelihood of downstream water quality impacts. Guidelines prepared for NMFS by Spence et al. (1996) specify that “chemical treatments should be applied only outside riparian zones (including those of headwater streams), and aerial spraying should be conducted to prevent drift into the riparian zone.”

Application of herbicides to first and second order streams would also impact downstream salmonid habitat by altering the nature of litter-fall into the stream network. Furthermore, many aquatic invertebrates and amphibians remain alive in the damp substrate of ephemeral streams during dry periods.

**Cumulative watershed impacts**

The Report gives no consideration to preventing cumulative watershed impacts or avoiding the aggravation of existing cumulative impacts other than noting that “the purpose of watershed analysis is to provide a tool to address cumulative effects…” (Appendix G, item I). Unfortunately, provisions of the Report then remove the ability of watershed analysis to address cumulative impacts effectively. Because of the overriding importance of cumulative watershed impacts in causing destruction of or adverse modifications to critical habitat for salmonids, we find it necessary to evaluate the implications of the Report for cumulative impacts.

Many of the state’s waterways are already known to be cumulatively impacted by nonpoint source pollutants and are listed as impaired under section 303(d) of the Clean Water Act. Many are also known to be deficient in woody debris loadings or to have chronic sediment inputs higher than 20% over naturally occurring background levels. In watersheds where cumulative impacts are already significant, activities that incrementally contribute to those impacts are preventing or delaying recovery from significant adverse modifications to critical habitat. These activities harm threatened or endangered species. It is clear from the Report’s performance targets that the Report’s provisions are not intended to prevent all impacts; any level of logging and road management entails some level of impact. Because the Report’s provisions are not contingent on assessment of the current level of impact in watersheds—and, in fact, remove the ability to modify prescriptions for riparian buffers and slope stability on the basis of watershed-specific information—the Report’s prescriptions will contribute to causing or will prolong the effect of existing cumulative impacts to water quality and critical habitat. Unless the level of care in already-impacted watersheds is higher than that in unimpaired watersheds, habitat conditions will continue to deteriorate in many of those watersheds, thus increasing the level of harm to already threatened species.

When recovery from an existing impact is delayed, the result is a cumulative impact on the affected resources. Species have evolved behavioral strategies for accommodating short-term environmental fluctuations. Those strategies—such as seeking clean water during high turbidity
events or cleaning gravels before laying eggs—are no longer effective when temporary changes become chronic. No amount of cleaning of gravels before spawning will be sufficient if every freshet brings new sediment to embed the gravels. An occasional period of high turbidity can be out-waited, but it is not possible to out-wait an entire winter. High mortality during an occasional scouring flood used to be accommodated by an “overabundance” of recruitment during years with ordinary flows: even if vast numbers of fish were lost during a catastrophic event, enough survived to restock the system during the following good years. If there are no good years, however, the population will spiral toward extinction. To prevent extinction, habitat recovery must occur while salmon still remain.

Cumulative watershed impacts accrue through a variety of interactions. Sediment is a “nonpoint source” pollutant: high sediment loads result from multiple inputs in a watershed. The Report attempts to manage sediment loads primarily by attempting to divert anthropogenic sediment before it reaches a stream; it does not provide for managing the rate or extent of activities that contribute to erosion. Accelerated erosion and sediment delivery will continue to occur on the 10% of a watershed’s wet-weather stream banks that are allowed to be disrupted during logging; additional sediment will come from increased scour of low-order tributaries that experience increased flows after logging; some sediment will continue to reach the stream system from surface erosion on portions of roads that cannot be effectively disconnected from the stream network. These sources contribute sediment in proportion to the level of forest management activities in a watershed. If the rates of logging and road use increase, the cumulative rate of sediment input to streams increases. Controlling the rate of sediment input from these sources would require management of activity rates in a watershed.

Similarly, management of hydrologic change requires management of rates of cutting. Provisions for such a strategy are already present in the state’s watershed analysis approach: the extent of hydrologically immature forest cover is assessed as it relates to potential changes in rain-on-snow peakflows. The guidelines prepared for EPA, NMFS, and USFWS for logging on private lands in the Pacific Northwest also take such an approach, recommending that no more than 15 to 20% of a watershed be in hydrologically immature condition at any time. The time required to achieve hydrological maturity is described as 15 to 30 years, thereby implying that the rate of cut in a watershed should be no higher than 1.3% per year (Spence et al. 1996, p.211). Spence et al. also note that “more conservative measures would be appropriate where channel condition has already been degraded by hydrologic changes” or “if significant portions of the watershed lie in the transient snow zone, or if past harvest has occurred in hydrologic source areas.”

Cumulative impacts can also be generated when two kinds of activities or influences contribute to the same response. The Report includes provisions that aggravate these kinds of cumulative impacts. For example, erosion rates in seasonal channels will increase because 1) 10% of their banks can be disrupted, 2) runoff will increase due to decreased canopy cover and decreased evapotranspiration, 3) future sources of channel-stabilizing woody debris will be removed, and 4) herbicides can be applied to streambank vegetation at these sites.

Cumulative impacts can also occur when changes interact to intensify the response. For example, increased stream temperature increases the sensitivity of salmonids to increased suspended sediment concentrations (Newcombe and Jensen 1996). As discussed earlier, provisions of the Report will contribute to both increased temperature and increased suspended sediment.

In the case of threatened and endangered salmonids, the potential for severe cumulative impacts on survival of the species is particularly high. Under natural conditions, salmon were very abundant, and that abundance provided part of the context for sustenance of the species. Sufficient
“extra” fish were present to provide resiliency in times of natural environmental stress, as occurred regularly with large storms, El Niño ocean events, droughts, and wildfires. Abundant carcasses of spawned-out adults and exhumed eggs provided important food sources for young fish (Bilby et al. 1996, Bisson and Bilby 1998), and the fish cleaned silts from vast areas of spawning gravels (Montgomery et al. 1996). The salmon themselves were an important component of the habitat that sustained the salmon. With severely declining populations, this component is disappearing, and the habitat is becoming less suitable for salmon because salmon are not abundant enough to maintain the habitat. Fish carcasses are no longer a dominant food source, and only a small portion of the gravels are cleaned each year. Premature death of an individual thus decreases the likelihood of survival of the progeny of the remaining fish. Anthropogenic mortality, in combination with anthropogenic sediment inputs, creates a cumulative impact to the remaining fish.

The Report focuses on the significance of individual impacts and avoids consideration of the cumulative impact of individual actions. In the slope stability section, for example, the Report notes that further analysis is necessary if an individual action may have a significant impact through altered slope stability (IIC.1(g)(iii)). No allowance is made, however, for the possibility that there may already be a significant impact in the watershed, so that the incremental impact of the proposed action would aggravate an already existing significant impact. The Report’s prescriptions make it clear that the existing level of impact cannot be considered in such an evaluation: “for the purpose of DNR’s threshold determination (in implementing SEPA) on a watershed analysis, DNR shall not make a determination of significance unless the prescriptions themselves, compared to rules or prescriptions in place prior to the analysis, will cause probable significant adverse impacts on the elements of the environment other than those addressed in the watershed analysis” (IIG.2(c)). In other words, the “significance” of an impact is now to be defined by comparison to the impact that might have occurred under previous regulations rather than with respect to the level of harm experienced by the impacted party.

Such a provision is fundamentally unjustifiable. There is no conceivable technical basis for redefining the words “significant impact” to mean anything other than the significance of the impact with respect to the impacted party. If “significance” is evaluated relative to a pre-existing regulatory framework, it is impossible to develop regulations that will comply with water quality and endangered species legislation. Both water quality and endangered species legislation incorporate standards of compliance that are based on severity of impact. If past regulations were inadequate for compliance, and new regulations are still inadequate, compliance remains impossible even if the new regulations are marginally better than the previous ones. Clearly, it would be unthinkable that a plan known to be inadequate could be accepted as having “no significant impact” simply because it is slightly better than a pre-existing inadequate plan.

Overall, the proposed regulations decrease the level of protection from cumulative impacts relative to existing regulations because the new approach removes the ability to design prescriptions to address such impacts. Whether the current regulations are actually resulting in appropriate prescriptions is a separate question that cannot be addressed here. If they are not, then it would seem reasonable to increase the level of oversight and guidance for existing procedures. In any case, it is not reasonable that an existing procedure that has the potential for avoiding cumulative impacts is being replaced by prescriptions that is incapable of doing so. More appropriate would be a strategy that sets a minimum level of protection that would assure compliance with water quality and endangered species regulations even in already impacted watersheds, and then allow deviations from this level at those sites where watershed analysis shows that lesser levels of protection will be sufficient.
Implementation of prescriptions

The prescriptions described in the Report are of unprecedented complexity. It is not possible to determine whether a site is in compliance with regulations without expending considerable effort in measurement of stand condition and site characteristics. Compliance thus cannot be evaluated by simple inspection. Further, it is not possible for a timberland owner to determine what prescription is appropriate for a site because of the imprecision in definition of key terms. If it is difficult for a conscientious operator to follow the prescriptions, and it is also difficult for a conscientious inspector to determine whether prescriptions have been followed, it is unlikely that adequate implementation of the prescriptions will be possible.

The Report depends on an Adaptive Management program to adjust prescriptions to become more appropriate in the future. The preponderance of available studies indicate that the level of protection currently afforded by the Report’s provisions will not be sufficient to accomplish the Report’s goals, and inconsistencies between overall goals, performance targets, and prescriptions (as described in previous sections of the review) provide prima facie evidence that the Report’s goals cannot be attained using the Report’s prescriptions. If it is already known that the prescriptions are insufficient, it is not appropriate to defer modification until after a research program further explores the deficiencies.

Adaptive management is useful and necessary when designing prescriptions in the face of incomplete knowledge. In such a situation, initial prescriptions would be designed to be conservative enough to ensure that irreversible outcomes will not occur: they would ensure adequate protection for an endangered or threatened species. As knowledge grows and alternative practices are developed, prescriptions would be modified to reflect the new level of understanding. If the original prescriptions were adequately conservative in the face of uncertainty, the modified prescriptions would be less conservative. The Report takes the opposite approach. Demonstrably inadequate prescriptions are mandated, but the possibility is left open that they might be upgraded to appropriate levels at some time in the future through adaptive management. This approach is not appropriate if the goals of the Report’s provisions are indeed intended to comply with regulatory requirements.

Adaptive management has been a component of the Timber/Fish/Wildlife agreement since the program was developed, and research intended to support adaptive management has been produced over much of that period. This research, however, has not yet addressed the basic issues that present the most obvious areas of uncertainty for the Report. The track record already established thus does not build confidence in the future ability of this effort to produce information needed to address these issues quickly enough to prevent irrevocable harm to threatened and endangered species. In the case of listed amphibians this inability is particularly overt: the Report indicates that additional protections “may be added after 10 years” (IIB.4(d)(iv)). Furthermore, research results from the Timber/Fish/Wildlife effort are rarely published in peer-reviewed journals. Unless a research program produces studies that can stand up to public scrutiny by independent technical experts, little confidence can be placed on the studies’ conclusions.

The Timber/Fish/Wildlife program also called for development of an extensive monitoring program. This monitoring effort has not been effectively implemented, contributing to concerns that the Report’s strong dependence on future research and monitoring is unrealistic.

Conclusions

Provisions of the Forests and Fish Report represent a significant decrease in the maximum levels of environmental protection possible relative to previous forest practice rules in Washington.
Watershed analysis will no longer be capable of developing prescriptions capable of addressing cumulative impacts. Instead, a blanket set of prescriptions will be applied, irrespective of the existing level of impact in a watershed.

The minimum levels of protection afforded by the Report, although in many cases higher than those of the previous standard forest practice rules, do not approach the levels of protection considered necessary by science-based guidelines already prepared for use on private forest lands in the Pacific Northwest (Spence et al. 1996).

Particular aspects of the Report’s prescriptions that would need improvement if the Report’s provisions are to be capable of meeting the Report’s objectives include:

- Provision of riparian buffer strips along all non-fish-bearing channels
- Requirements to modify prescriptions to account for existing levels of impact
- Reinstatement of watershed analysis as a means to provide information necessary to modify prescriptions for slope stability and riparian protection
- Definition of desired stand conditions on the basis of characteristics other than simply basal area
- Regulation of wet-weather operations to reduce chronic sediment inputs
- Guidance concerning appropriate maximum rates of cut and road densities in a watershed

A variety of other changes would also be necessary; these are discussed in the body of this review. Guidance for appropriate modifications is available from many sources, including Spence et al. (1996).

Several provisions of the Report represent significant weakening of previous forest practice rules:

- Observations of the presence of fish cannot be used to correct inaccurate stream typing
- Watershed analysis results cannot be used to design buffer strips to address existing cumulative impacts
- Watershed analysis results cannot be used to address cumulative impacts resulting from mass wasting
- Blanket approval is provided for riparian logging corridors
- Prior assurance is provided that water quality standards will be assumed to be met
- SEPA review is triggered if mass wasting threatens public safety rather than if it has a potential to significantly impact public resources

Aspects of the Report that represent significant improvements over previous forest practice rules include:

- Provision of 50-foot no-cut buffers along fish-bearing channels
- Requirements for road maintenance plans
- Provision of some controls on salvage in riparian areas of fish-bearing streams
- Provisions that road crossings be passable by fish
- Establishment of an independent scientific review committee

These improvements, however, are insufficient to accomplish the Report’s stated goals.

As currently written, attainment of the Report’s performance targets will not assure attainment of the overall goals described by the Report: levels of turbidity will be permitted to be maintained at values considerably higher than those allowed by state water quality standards, provisions are insufficient to assure attainment of water quality standards for temperature, and
allowed levels of impact will decrease the likelihood of survival of threatened salmonid species by adversely modifying critical habitat.

Several years before the Report was prepared, consideration of the best available science by staff of EPA, NMFS, and USFWS resulted in design of prescriptions for federal lands in the Pacific Northwest that were considered necessary to avoid jeopardizing the continued existence of threatened or endangered salmonids and to avoid destruction or adverse modification of critical habitat (FEMAT 1993). Likewise, consideration of the best available science by contractors to EPA, NMFS, and USFWS resulted in guidelines for activities on private lands in the Pacific Northwest (Spence et al. 1996) that were considered necessary to avoid reducing the likelihood of the survival and recovery of the salmonids in the wild. The EPA, NMFS, and USFWS, in authorizing the recommendations arising from the Fisheries and Forest Report, have arbitrarily abandoned prescriptions and guidelines based on the preponderance of the best available scientific evidence in favor of recommendations for which no scientific support whatsoever is provided.

The scientific documentation outlined in reports prepared by or for participant agencies provides substantial evidence to indicate that the proposed regulations will result in adverse modification of critical habitat for threatened and endangered species of salmonids and are likely to appreciably reduce the likelihood of the survival and recovery of the species.

There are many issues that must be considered when developing regulations and land-management protocols, and many of these do not involve scientific concerns. Sociological, economic and political factors often determine whether a plan is appropriate or not, and technical validity may not be an overriding consideration in some cases. However, in cases where expediency requires that technical considerations be set aside, the resulting plan cannot be represented as being scientifically based. In the present case, it is clear from examination of published scientific literature that the Report’s recommendations conflict with the preponderance of results of scientific studies and with the preponderance of recommendations based on those studies. If political, economic, and social expediency has made it necessary to abandon the weight of scientific evidence in order to produce an acceptable plan, then societal needs may justify such a decision. However, in that case, the Report should not be represented as being “biologically sound.”
Appendix: Comments on the April 29, 1999 “Forests and Fish Report”

Preliminary comments from individual reviewers are here compiled and grouped under the relevant topics. Similar comments from multiple reviewers are combined. General comments on a section are presented first in a numbered list, while comments referring to specific items are noted by item number. In some cases, comments are available concerning specific provisions in the Draft Emergency Rules associated with the report; these comments are tabulated at the end of each section, where available. Comments on the “schedules” accompanying each appendix are included with comments concerning the relevant appendix.

These preliminary comments and suggestions from individual reviewers were not reviewed for consensus by the committee as a whole, but many of the ideas expressed in these comments subsequently provided the basis for consensus reached later in the review process.

General comments on Report

1. The rules are overly complex and unenforceable.

2. The document (USFWS et al. 1999) provides little rationale or scientific support—often none at all—for the rules set forth. Therefore, the rules seem arbitrary. For example, on p. 10, the “core zone” for Type S and F waters is specified as 30 feet wide for the Eastside and 50 feet wide for the Westside. Why? What is the justification? What is the evidence that these core zones and other aspects of the proposed riparian buffers protect fish habitat enough to let endangered salmon populations regenerate? The document contains neither words nor literature references from which a person can estimate the extent the proposed rules would aid in protection and recovery of salmon and other “covered resources.” Little or no connection is drawn between the material in the document and the habitat needs of the fishes that are supposed to be benefited. Therefore, it is most prudent to regard the stated rules as not having reasonable assurance of effectiveness.

3. By way of explaining why each rule is important, its ecological relevance to particular kinds of fishes (species, life stages) and other wildlife, including ecosystem ramifications, should be described. For example, cycling of nutrients from salmon carcasses is a consideration that connects the stream with biota beyond it, particularly in the riparian zone.

4. The rules should also be designed to benefit wildlife other than fish.

5. Floodplain considerations and flood regimes should be incorporated in the rules and in the explanations of their importance.

6. Provisions for wind buffers should be made.

7. The plan includes an adaptive management program but seems to largely ignore the adaptation that has already been done, particularly in the Pacific Northwest, i.e., recent development of knowledge and techniques for adjusting timber harvest to reduce its fish habitat destructiveness enough to allow fish populations to regenerate. Basing the rules on the best scientific knowledge that now exists will reduce the amount of management error for which adaptive management eventually must adjust and will speed the recovery of fish populations.

8. Analyses by outside entities (Pollack and Kennard 1998; Pollack 1999; Puyallup Tribe 1999; Yakima Tribe 1999), embody many pertinent scientific and technical articles that the FFR could have referenced. These analyses indicate that the presently stated FFR rules will benefit fish
habitat only minimally, hence have high risk of failing to do its fair share toward restoring salmonids. The thoroughly documented paper by Pollack (1999) concludes that the FFR plan has low probability of success in meeting its goals of preventing salmon extinction and restoring habitat to sustain harvestable levels of fish population.

9. Pollack (1999) further determined that under the FFR recommendations
   a) riparian buffers will be present on only about 25% of the streams in Western Washington forested watersheds;
   b) the riparian buffers on fish habitat streams would typically be 80 to 100 feet wide;
   c) the riparian buffers could eventually provide only 29% to 54% of the rates of input of large woody debris to fish habitat streams that occur in undisturbed forests (it’s 16% to 30% under present rules);
   d) even this low FFR proportion of natural input would take two to three hundred years to develop; and
   e) the riparian protection afforded would be less than under any other of the recently proposed or enacted state or federal salmonid protection plans in the region—and considerably less than under Option 8 of the Federal Ecosystem management Team (FEMA), which itself has been judged to have only a 28% chance of preserving salmon throughout federal lands of the Pacific Northwest.

5. Thus, as now proposed, the FFR’s plan is weak and should be upgraded to be at least as protective of salmon habitat as FEMA Option 8. Rules matching the FEMA Option 8 would promote stream conditions much more closely approaching the natural conditions to which salmon and other native stream organisms are adapted. Salmon cannot be expected to thrive, that is, maintain harvestable populations under conditions that deviate from natural.

6. Under the proposed FFR plan, the “adaptive management” procedure for improving rules, a gradual process, would start from a basis of inadequate rules and would undoubtedly modify them too slowly to rescue various salmon stocks which are declining rapidly. From the standpoint of the fishes that need help, it would be safer and more conservative to start instead from a basis of maximal protection of riparian forest from human-generated disturbance, then let the adaptive management program gradually and carefully determine where the rules might be eased with minimal risk to “covered resources.”

7. The FFR’s allowance for yarding “breaks” across streams could alone reduce shade and LWD production by 20%.

8. The FFR is difficult to evaluate—and, more importantly, will be misunderstood and misinterpreted in application—because (a) parts of it are incomplete, (b) parts seem unnecessarily complex, (c) many terms are obscure or ambiguous and should be defined, (d) illustrative diagrams are inadequately drawn and explained, and (e) much of the text is awkwardly, hence unclearly written. The document is incomplete because it leaves various matters to be decided upon after it is adopted (e.g., “subject to future discussions, the landowner may be allowed to” [p. 21, ¶ 1, item (E)], and words to the effect that the authoring agencies will merely seek funding for programs of enforcement and adaptive management, not guarantee it). It is also incomplete because it fails to deal with or even recognize the existence of some pertinent issues. Examples of missing considerations may include beaver habitat zones, the roles of beaver, and flow
(recruitment) of water, gravel, and woody debris from (undefined?) runoff channels lying upstream from the types of channels to which the proposed rules apply. The document is also editorially deficient in that the footnotes corresponding to footnote numbers shown in the text are missing, supportive literature is seldom referenced, and no reference list is provided. The fact that the page numbers in the Table of Contents do not match with the text indicates a carelessness that seems to pervade the document. In contrast, various other writings on the subject (NMFS 1999; Pollack 1999; Pollack and Kennard 1998; Puyallup Tribe 1999; WEC 1998; Yakima Tribe 1999) much more clearly and fully elucidate forest practices needed for protection and recovery of salmon and other riparian-associated biota.

9. One of the more clearly written of the document’s sections is that on adaptive management (Appendix L). It contains words implying that communications should be made in clear and widely understandable form. For example, it states that “reports should be addressed to a non-scientific audience” (p. 57), and that one of the program administrator’s duties is “communicating the activities of the program and the project results in an effective manner” (p. 59). The FFR document itself should adhere to such principles.

10. Some of the lack of clarity derives from use of slang and undefined technical jargon.

11. The audience for the document is not stated, and should be. Whoever the main audience might be, it still should be written so that the general public could understand it.

12. The document should be revised by people trained in logic and effective writing.

13. Is there provision for expanding the “covered resources” to further species if and when they become ESA-listed or of other pertinent concern?

14. The term, habitat, seems to be misapplied (or at least used too loosely and vaguely) at various points in the document. Habitat is a place having suitable physical and chemical characteristics (other than food, which however, will often depend also on closely associated environmental characteristics) for a population of a given species of organism to sustain itself (usually over many generations)—or for that population to carry on a specified stage of its life cycle. Therefore, the word, habitat, has no useful meaning unless the species (or group of related species, e.g., salmonids) to which it applies—often also the life stage in question—is specified. People often loosely use the word, habitat, where ecosystem or biome is meant. The FFR document should be revised to sharpen the use of such terms.

15. I am not sure that the FFR gives adequate (or any) consideration to the effects of forest practices on contribution of water to Type-F and -S waters by Type-N waters or by storm and snowmelt runoff in ephemeral rills that might not be classified even as Type-N waters. How is this dealt with in the FFR, or how should it be?

16. It is my understanding that under the proposed rules, all water typing must be done by a full ID (interdisciplinary) team under TFW. This will greatly hamper the work because arrangements for assembling all members of a full ID team are cumbersome, in contrast to having well-trained, contracted teams do the typing more efficiently. Under the full-ID-team stipulation, progress in typing the state’s streams will be so slow as to not provide effective protection—unless the rules also stipulate that no forest practices (particularly pesticide application or timber harvest) will be applied on any parcel of land until all waters within the drainage basin containing that parcel or any portion of it have been typed.
Background Section

Item D. A document cannot be considered to represent a consensus if one or more of the relevant parties did not agree to the document. Describing the document as representing, in effect, “a consensus among only those who agreed with it” is not useful.

Item E. Economic impacts. Line 5: insert the words, of land, after the word, acquisition.

Appendix A: Definitions

1. The existing definitions often go into great detail (sometimes unneeded detail) about their terms. On the other hand, the majority of specialized terms that exist in the document have not been defined and should be.

2. All of the document’s definitions should be in this appendix, not, as at present, some definitions in Appendix A and others strewn throughout the document (the appendix now refers to some of the scattered definitions but not to others).

3. Confusion between definition and description: Many of the present definitions are less clear than they could be because they mix true definition with (often lengthy) descriptive or explanatory material that goes far beyond defining the term in question. It verges on textbook rambling. Some of the descriptive material is helpful, but it would be much clearer to first state a concise definition, labeling it “Definition,” then have a second label, “Description” or “Explanation,” and present the auxiliary material following it. For example, from page 6, the definition of bedrock hollow could be changed to: “Bedrock hollow” (also known as hollow, colluvium-filled bedrock hollow, zero-order basin, or bedrock depression)—Definition: a commonly spoon-shaped area of convergent topography (upward or contour concavity) on a hill slope within an unchanneled valley. Explanation: Hollows are formed on slopes of varying steepness and tend to . . . [and so forth, as on p.6]. Confusion of definitions and diagnostics presents a major problem when there is an intention to regulate on the basis of the definitions.

4. Where “slope” is mentioned in the definitions—and in the rest of the document—the kind of slope should be specified: streambed slope, water surface slope, hillside slope, etc.

5. In some of the definitions (e.g., p. 8, item vi, line 4) and perhaps elsewhere in the document, “vegetation” is written where only arboreal vegetation or tree community composition or simply trees is apparently meant.

“Bankfull depth”: The phrase “having a return period of approximately 1.5 years” should not really be part of the definition. It is more or less true and possibly helpful (though, especially in such a document, it may be merely a distraction), but such material belongs in “further explanation” if included at all. The essential definition should be something like the following: In any given cross-section of the stream, the vertical distance from the water surface to the thalweg (the stream bed’s deepest point) when the stream is flowing such that water surface in that cross-section is at the same elevation as the immediate flood plain. By the way, does the term, bankfull depth, actually occur elsewhere in the document (if it is, I didn’t notice it)—and if it is used, does it really need to be used? If not, eliminate it from the definitions. Note also that it is not the “top” of the floodplain that is of interest here, but the low point. At bank-full discharge, the flow begins to inundate the floodplain.
“Bankfull width”: The definition should be changed to: *In any given cross section of a stream, the horizontal distance, perpendicular to the channel centerline, between the shorelines when the stream is flowing such that water surface in that cross-section is at the same elevation as the immediate flood plain.* The wording of the document’s present definition implies that bankfull width applies to some average width for the whole stream. This would include the point where stream width becomes zero, as well as at the stream’s mouth—a meaningless average for most purposes. Bankfull width, per se, is what exists at a certain stage of streamflow discharge in a specified cross-section. If an average of bankfull widths for a certain section of a stream is meant in the text of the rules, then that can be specified there.

“Bedrock hollow”: A bedrock hollow is not defined on the basis of topography, but on the basis of the shape of the bedrock surface. If it were defined according to topographic expression, you couldn’t have a filled one ("Hollows that are completely filled with colluvium may show no surface continuity"). Also, because what is being described sounds very much like a “small valley,” it will be necessary to explain how it will be possible that “Hollows should not be confused with other hillslope concavities such as small valleys...”

“Channel migration zone”: There is no definition provided for “moderately confined stream,” although this is an extraordinarily important distinction to the regulations. The definition appears to contradict the intent of the distinction. If the regulation is to achieve its apparently intended objectives, a channel migration zone must be defined as “the area where the active channel is prone to move and where such movement would result in a potential near-term loss of riparian forest adjacent to the stream. Constraining the definition by channel type does not make sense: In forested areas, much of the channel migration is due to bank erosion associated with downed logs, not with meanders, avulsions, or braids. Evidently, moderately confined channels of 5th order and greater will not be protected. This may or may not be an important oversight because no definition is provided for “moderately confined,” and we thus have no basis for determining whether such channels are common. Graphics provided in Schedules A-2 through A-4 to illustrate the definition are deficient in detail and quality. The meanings of some of the items in the drawing in Schedule A-4 are unclear. It would help if an explanatory caption were added. It might help if hypothetical contours of the land surface were added. This figure looks like only a rough, preliminary, conceptual sketch.

“(vii) CMZ for moderately confined streams”: The term “high frequency of disturbance” is used. The actual frequency and degree of disturbance could probably be specified more closely. For example, how much lateral channel migration per year in terms of fractions of bankfull width? Or how many lateral channel migration events $\geq 0.01$ bankfull width per decade? The definition also states that a “diverse set of vegetation can grow within these zones including cedar, spruce, hardwoods, ...” It would be helpful to include mention also of non-arboreal vegetation that characterizes the zone. Much of that vegetation is also important to fish. Finally, the last sentence is too imprecise. How small are the “small streams” mentioned?

“(viii) CMZ for unconfined meandering streams”: Option 1 (width of meander wavelength) doesn’t make geomorphological sense because the meander belt migrates. Option 2 (migration rate multiplied by years to grow functional woody debris) doesn’t make geomorphological sense because the river as a whole doesn’t migrate linearly. Furthermore, the definition for “unconfined meandering stream” seems amiss. All streams (and indeed all flowing fluids) meander or “strive” to do so. It is erroneous to imply, as in the present definition, that the only streams that meander
are those larger than 5th order or having bankfull width greater than 50 feet. Meanders can be found in half-inch-wide rills of a newly plowed field after the first hard rain.

“(ix) CMZ for unconfined braided streams”: It is not true that the zone of channel migration coincides with the bank-full width because the entire braid train may itself migrate in the same way that a meandering stream migrates beyond its bank-full width.

“(x) CMZ for unconfined avulsing streams”: “Avulsing streams” has not actually been defined here. Furthermore, meandering streams can avulse.

“(xi) Levees”: the words, and still meets those requirements, should be added after the word, “requirements.”

“Core zone”: Should be from water edge or edge of channel migration zone

“Deep-seated landslides”: “fault gauges” should be “fault gouges,” and “undertowing” should be “undercutting of toes of slopes.” Furthermore, phyllite is not “metallic”—could it be that “metamorphic” is meant here, rather than “metallic”? In addition, the definition provided for “deep-seated landslides” is not valid or useful because any slide that mobilizes bedrock has a failure surface deeper than the rooting depth of forest trees—roots don’t tend to penetrate bedrock. Is the rooting zone to be determined by where roots could be, rather than by where roots are? If so, how will that be determined? If the intention is to develop regulations based on landslide type, it will be necessary to employ a standard definition of landslide types. Finally, the groundwater recharge areas of “glacial deep-seated slides” are described. Why would these be different for other kinds of deep-seated slides?

“Edge”: Because floodplains are used by fish during floods, and because considerable volumes of material are exchanged between floodplains and stream channels during floods, and because flood conditions have been found to be important influences on salmonid survival, a biologically meaningful definition would consider the “edge” of the waterway to be the inland edge of the floodplain, not the stream-side edge.

“Inner gorges”: If “slope gradients as gentle as 28 degrees can be unstable in gorges cut into incompetent bedrock,” why is “The upper boundary of an inner gorge assumed to be...the line above which slope gradients are typically gentler than 30 degrees”? 

“Inner zone”: Why would the inner zone be narrower if the distal edge is to be logged than if the whole zone is to be selectively cut? Also, in item A, line 1, the phrase, “three-fourths of a site potential tree height feet” seems erroneous; likewise as similar phrase in item B. The material concerning the inner zone should be summarized in a diagram or set of diagrams. The tables might be kept but are not adequate.

“Outer zone”: While the inner zone is well described by an accompanying table, the outer zone is not usefully described.

“Placement strategy”: This would be more understandable in the text if the term were changed to large woody debris placement plan. The word “plan” also carries a more definite connotation than “strategy.” The latter might be seen by many as merely a vague idea, whereas a plan is more likely to be taken as a written course of action. It is not clear what is meant by “The strategies will provide an incentive ratio of one unit deposited to streams for every two units otherwise required to be left.” Is the idea that if you have to put it in, you only need half as much as you
would if it were there in the first place? If this is the idea, it is essential that some justification be provided.

“Preferred species”: The standpoint from which “preferred” is meant needs to be designated. Economic value? Aesthetic value? Benefit to fish? Benefit for a range of riparian functions? Which ones? The Draft Emergency Rules list “all hardwoods” as the most preferred species, while the decay resistant, slow growing redcedar is at or near the bottom of the list. This ranking is not appropriate. There are also apparent inconsistencies between the east- and west-side preferences. This is an issue in riparian prescriptions (IIB-4 e (i) A), where leave tree are selected based on, among other criteria, the preferred species.

“Qualified expert”: The FFR’s use of the term seems overly restrictive. Many kinds of experts exist, and at least several kinds are pertinent to the FFR subject. The definition applies only to qualified geomorphic experts. Therefore, the defined term should be changed to “qualified geomorphic expert.” The rules should also specify other appropriate kinds of experts, e.g., qualified riparian plant ecologists, qualified aquatic ecologists, etc., and definitions for these should be added.

“Public safety” does not mean “reducing the risk to the public at large from…” The definition seems illogical and convoluted. To say that public safety “means reducing” is awkward. The authors probably meant to say that public safety means low risk relative to (some stated standard). Also, the clauses, “identified in consultation with the department of transportation [sic] or a local government” and “caused or triggered by forest practices,” are cumbersome and confusing as inserted in the definition’s single sentence. Split the sentence into several, each containing a single thought—or eliminate one or both of the above clauses.

“Site potential tree height”: If the intent is to maintain appropriate loadings of woody debris in channels, then the site potential tree height should be determined on the basis of the tree heights that would likely have been present under old-growth conditions, not under 100-year-old second growth conditions. Even by the definitions provided in the document under review, a 100-year-old tree is not yet “mature.” In the tables accompanying the definition, units (feet?) should be added to headings for columns that contain quantitative data—although “site index” might be dimensionless. Is the site potential tree height for Douglas fir to be used in all forest types?

“Yarding corridors”: The definition contains the redundant term, “linear path.” Do the authors mean a straight path?

Many terms and acronyms that exist in the document (pages in parentheses) or concepts that are implied in it are not defined and should be. A list of some of these follows. Reviewing them might reveal opportunities to eliminate some as needless—or to express some in more appropriate terms so that they would not need special definition.

1. Confined channel (implied whenever “unconfined” channels are referred to)
2. APA
3. Adaptive management
4. Active channel
5. Active flood plain
6. Geomorphic flood plain
7. Basal area component
8. Basal area target
9. Excess basal area
10. Baseline rule
11. Stream (or channel) order
12. The “classes” of practices (Class III and Class IV practices, maybe others)
13. Colluvium
14. CWA
15. ESA
16. HCP
17. Habitat (This is a term that people often use too loosely and misapply. In this document, it should be carefully defined, then used only in strict conformity with that definition.)
18. Habitat productivity
19. Habitat series
20. Headwall
21. Headwall seep
22. team
23. Woody debris (including Large woody debris (LWD) and Small woody debris (SWD))
24. Orphan road
25. Productivity—low, medium, and high. Several kinds of “productivity” may have to be defined, e.g., fish productivity, forest productivity, soil productivity. Or maybe the term could be omitted wherever it occurs in the text, and the thought simply expressed in plain English instead.
26. Riparian
27. Riparian function, by which is perhaps meant ecological function of riparian vegetational zones. If that is so, then that phrase could be used in the text, and the definition skipped.
28. Riparian zone. It would be useful to have the full ecological definition, in addition to “riparian management zone” (already defined), which is different.
29. Shade rule
30. Side-slope seep
31. Services
32. Site index
33. Stand requirements
34. TFW
35. Thalweg
36. WAU
37. Yield (p. 16, item I (a))
38. Resource objectives
39. Off-channel habitat
40. Defined channel
41. Rehabilitation
42. Alluvial fan
43. Assessment phase
44. GF-S and GF-F

Appendix B: Riparian Strategies

1. The riparian rules are exceedingly complicated, and are based on insufficient data from reference stands because few reference stands exist in riparian environments. Revision of these
prescriptions as regional information becomes available will be cumbersome and time consuming.

2. A major deficiency of the prescriptions from a silvicultural and forest ecology standpoint are that they are all based on basal area of the stands. The target basal area can be achieved with many small trees or with fewer large ones. These options have very different ecosystem values: stands of large trees are considerably more desirable. Similarly, leave tree requirements simply specify a minimum diameter of 12”. There is no requirement to leave the trees that will provide the greatest benefit. When a minimum size is specified, it becomes a target. Mitigation requirements for stream-adjacent roads also are presented only in terms of basal area, likely leading to inadequate mitigation. Mitigation should require replacement trees or stands similar or older than those removed. There is a clause in IIB.4(b)(ii)(A) that recognizes the need to avoid overly dense stands that are in jeopardy of stagnating. This is an example of where the stand definition is made clear by the use of both basal area and stand density (e.g. the last sentence says no more than 100 - 6-inch-or-less trees will be left). It is also not appropriate to allow hardwoods to be used in place of conifers to achieve mitigation or meet leave tree requirements.

3. It is not appropriate that roads and yarding are exempt from riparian protection standards. Prescriptions repeatedly state that “Restrictions on forest practices conducted in RMZs set forth above will not preclude or limit (A) the construction and maintenance of road crossings in accordance with applicable rules: or (B) the creation or use of yarding corridors in accordance with paragraph B-2 above.” Guidelines are needed to discourage road construction and creation of yarding corridors in these sensitive sites.

4. There are a number of elements that have been passed into law before they were developed (e.g. thinning guidelines, LWD placement guidelines, Stand Requirements of trees per acre). It is not possible for the authors of the Report or the responsible agencies to have determined that the plan was appropriate without this information. Likewise, it would not have been possible for agencies to provide assurances that water quality standards would be complied with in the absence of this information.

Title: what kinds of strategies are meant? If strategies for riparian forest practices, say so.

I(a). If a “mature” forest is assumed to be 140 years, why is a site-potential tree height considered to be that of a 100-year-old tree? And why is “the midpoint between 80 and 200 years” selected as the definition of “mature”? If the intent is to provide conditions characteristic of those under which the “covered resources” were known to be sustainable, then the desired future conditions should not be arbitrarily selected as the midpoint between 80 and 200. There is no solid reference for the use of 140-year-old Douglas-fir as the target DFC. At age 140 there is still a fair amount of stand development to be done.

I(a). Furthermore, if the “desired future conditions” are “a reference point on the pathway to restoration of riparian functions, not an endpoint of riparian stand development,” they are meaningless. Anything better than present can be “a reference point on the pathway to restoration.”

I(a). What are the “resource objectives”? Goals concerning avoidance of jeopardy to species and attainment of water quality standards are mandated by law; they are not optional. If the plan cannot accomplish these goals, the plan is not adequate.
I(a): the term “riparian function” is ambiguous. See item 23 of the previous section of these comments. Also, “growth and yield” of what? And in the last sentence, the clause, “These desired future conditions are a reference point [sic]” is confusing, as is the whole sentence. It should be corrected and expanded to be more specific.

I(b): replace “aquatic system conditions” with *aquatic ecosystems*.

II.B.1(a): replace “delineating” with *classifying*. Also, “habitat driven” appears in quotation marks, implying that it is a phrase considered by its authors as inadequate for describing what is meant. Therefore, better words should be used, or the phrase should be defined.

II.B.1(d): The issue here is defining the extent of fish habitat waters. There is no indication of what the +/-5% accuracy would be evaluated against: 5% of what? I question stipulation (B) that “the line demarcating fish and non-fish habitat waters will be drawn so as to be equally likely to be over and under inclusive.” Because an FFR objective is recovery of fish habitat and populations, and many, perhaps most, of the forest-practices-affected fish populations are in crisis, the rule should err on the side of being over-inclusive of fish habitat.

II.B.1(d): Why should electrofishing “no longer affect stream type determination”?—and what does “from an operational standpoint” mean? If this could be taken to mean that finding fish by electrofishing will not be considered proof of fish presence in a part of a stream, then this part of the rule should be deleted. Item (C) appears to imply that observations of the presence of fish will not be admissible evidence for modifying prescriptions based on the predictions of the range model. This is inappropriate. If fish are present, the stream demonstrably provides fish habitat. If fish are not present, then it is not known whether the stream provides fish habitat.

II.B.1(e): the idea of a map dividing anything is awkward. Why not just say “mapped”?

II.B.1(e)(ii): Note that areas beyond the “bankfull widths of defined channels” can be extremely important for fish survival during floods.

II.B.1(e)(ii)(1): Why would a water supply in use by 9 residential units not be accorded the same protection that a fish would have? Why would a landowner’s “right” to pollute downstream waters be considered sufficient grounds to force traditional downstream water users to find another “practical” water source, even when more than 10 users are affected? Who will bear the cost of development of the other practical source of water?

II.B.1(e)(ii)(B): what is the justification for specifying 0.5 acre as the lake, pond, or impoundment size? Ponds much smaller than this can provide essential fish habitat.

II.B.1(e)(ii)(3): This item states that “DNR may allow additional [timber?] harvest beyond the limitations set forth below [where below?] with respect to Type F waters . . .” Does this apply just to the waters covered in this paragraph (3), or to all Type-F waters? If the latter, then this stipulation should be reconsidered. Does the definition of “fish habitat” (which should be moved to Appendix A) mean that fish habitat cannot also be established by other methods, particularly methods that are more direct, such as by seeing fish in a stream section or by catching them? If so, this should be changed.

II.B.1(e)(ii)(3): What does “significant” mean? How does this differ from “highly significant”? It will be necessary to consider cumulative impacts in this case; even if a particular activity were not to be in itself “highly significant,” if equivalent activities are occurring or will occur throughout the upstream watershed, the impact could be “highly significant.”
IIB.1(e)(iii): Such a distinction between perennial and non-perennial ignores the function of channels as sediment transport corridors. In summer-dry climates, more than 50% of the winter channel network may be dry in summer, yet this 50% contributes the majority of sediment to the stream system. Whether water is present in the summer is irrelevant to the channel’s significance as a sediment source.

IIB.2: add and the riparian zone after the word, water. Also, what does “across the landscape” mean, and is it needed? In the 5th and 12th lines, change “should” to “must”, and in the 10th line, omit the word “Generally,” and adjust the rest of the sentence’s grammar accordingly. In the next-to-last line, “sufficient” for what?

IIB.2: Yarding in RMZs. This provision allows logging of 20% of the core zones with no mitigation. This is not appropriate. Mitigation would require an area to be left as an increase in core-zone width that would provide for the shortfall in infall. Because infall rates are lower further from the stream, making up for the 20% shortfall along the affected reaches would require that the core zone in the remaining 80% be increased to 75 feet in site class I lands. Also, it is not clear what is meant by “all calculations of basal areas...will be determined as if the yarding corridors were constructed prior to any other harvest activities.”

IIB.2: Yarding through riparian zones was previously allowed on a case by case basis when it could be demonstrated to provide a clear benefit to resource objectives (e.g. minimizing road construction, hillslope protection). In contrast, the FFR, with guidance from the emergency rules, allows 20% of the length of the riparian corridor to be perforated by 30-ft-wide yarding corridors, spaced no closer than 150 feet apart. The only limit is that corridors “should be no wider or numerous than necessary.” This change represents a decreased level of environmental protection relative to previous regulations. Presence of yarding corridors will not require mitigation of any kind, although wood in the inner and core zones may not be removed.

IIB.3: The provisions explicitly limiting salvage logging of streams, CMZ, and buffers are an improvement over past regulations.

IIB.3(c): Wood attached to that within the bank-full width would also need to be left, because this attached wood provides stability to that portion within the bank-full channel.

IIB.3(d): It would be necessary to base the prescription on stand conditions if cumulative impacts are to be managed for.

IIB.4: One of the biggest problems with the proposed riparian strategies is the reliance on basal area measurements to determine sufficiency of stocking. The target structure is not keyed to the size of LWD needed for the size of stream (after Bilby and Ward, 1990). The Stand Requirement is based on a target basal area but is not balanced by the density of stems that occupy that basal area. There are a number of solutions to meet the basal area target that will not retain large-dimension trees. Basal area alone does not describe stand structure adequately (Husch et al. 1972, Curtis 1982). Also, riparian forest stand dynamics are complicated. The model to be used for determining the thinning guidelines is the ORGANON growth and yield model, which is inadequate for modeling tree mortality (the source of LWD), interspecies dynamics (it does not include several Washington State riparian species), and older forests (140 years). While ORGANON might be a useful element in describing riparian areas, it does not provide a complete picture.
IIB.4(a)(ii): In the last sentence: the words, “may” and “certain,” render the sentence too vague. Make it definite.

IIB.4(a)(iv): The last sentence contains the sort of language that discourages understanding and will interfere with compliance.

IIB.4(a)(v): In the 2nd line, insert large woody debris (LWD) before the phrase, “placement strategy.” A “placement strategy” deals with current conditions in the creek; leave trees deals with future conditions. A placement strategy is thus not an adequate mitigation for removing riparian trees. Note that 10 trees per acre is equivalent to one tree per 87 feet of channel bank on site class II, compared to an expected density of about one tree per 4 to 8 feet of channel bank before logging. Furthermore, I thought that sensitive features such as seeps and springs, wetlands, shallow rotational unstable and potentially unstable slopes were to be protected anyway. Unstable areas “not detected by other site evaluations” would presumably have been detected or they would not be recognized to allow clumping. It is not reasonable that a known unstable area would not be protected.

IIB.4(b)(ii)(A,B,C): The eastside riparian forest stand requirements appear to have been determined arbitrarily; they are without reference.

IIB.4(b)(ii)(A): In the 7th line, after the phrase, “largest trees,” add that were present within the area before timber harvest commenced.

IIB.4(b)(ii)(C): In the 2nd line, the prescription is qualified by “Except as noted below.” Where is this referring to? In what paragraph? The final sentence of this paragraph is vague. Make it specific.

IIB.4(b)(ii)(D): Why the stipulations of 15-ft stream width and 75-ft road set-back? Also, in the 9th line of the second bullet point, insert LWD before the word, “placement.” To what do the words, “size” and “rehabilitation,” refer? Take care of these matters also wherever else in the document it is appropriate. In the following bullet, what are the justifications for the dimensions of 15, 50, and 75 feet? Justify dimensions wherever else they are mentioned in the document.

IIB.4(b)(ii)(E): Air temperature also affects stream temperature; shade is not the only function that needs protection. Also, to avoid confusion, insert the word “ever” after “which.”

IIB.4(c,d,e): Provision of some protection to low-order streams and “sensitive sites” is an improvement.

IIB.4(c): Leaving 9% of the area adjacent to Type N waters with disturbed soils is going to lead to potentially severe cumulative impacts. If 9% of an ELZ can be left disturbed by ground-based equipment and skid trails, then what exactly is the equipment limitation? If more than 10% of the surface is disturbed, mitigation is required. However, emplacement of water bars is considered an acceptable mitigation. Elsewhere in the region (e.g. California) water bars are standard BMPs on skid trails, and in British Columbia, site degradation is limited as well.

IIB.4(d)(i)(A): Type N waters provide invertebrates, organic material, and primary production that supplies downstream fish-bearing reaches. Modifying the function of up to half these stream lengths is not compatible with sustaining the populations of downstream fish.

IIB.4(d)(i)(C): Visible when? Obvious inflow in the winter, when sediment is most likely to be introduced, may not be evident during the dry season.
IIB.4(d)(i)(D): The feature described here is a type N stream: it is connected to the downstream network by “perennial channelized flow.”

IIB.4(d)(i)(F): If the feature began forming in the Pleistocene and is continuing to grow, does it fit the definition of an alluvial fan that requires protection?

IIB.4(d)(ii): How is “the extent reasonably practical” to be decided? This item needs to be examined to determine whether it will lead consistently to implementation of riparian-destroying forest practices despite the rest of the rules. In the 6th line, add disturbance and before the word, compaction,” and examine whether “sedimentation” should be replaced with the word, erosion. Also, “Management initiated efforts” is of obscure meaning. Add explanatory words, including examples of such efforts.

IIB.4(d)(iii): Item (4) within this paragraph specifies “areas further downstream from other areas,” which seems not to make much sense because all areas except those at a topographic ridge lie downstream from some other area. So what is really meant by this item?

IIB.4(e)(i): Does “identify one of two different management strategies” mean commit to one of two timber harvest strategies? If so, say so. If not, explain why not—and insert words that give the reader a clearer understanding.

IIB.4(e)(i)(A): Priority areas for the partial cutting strategy are located based on physical and biological factors, yet preferred trees for leaving include hardwoods. Conifers would fulfill the physical and biological needs more effectively, they are longer-lived, more decay resistant, and generally larger. It does not seem reasonable that hardwoods would be “preferred” when they are less effective at meeting the objectives of leaving trees.

IIB.4(e)(i)(B): What if part of the “harvest unit” has already been cut? The allowable harvest must be based on existing conditions relative to original conditions or cumulative impacts cannot be managed. In addition, the selection of riparian areas in the clear-cutting strategy results in a conservation easement for 50 years, but there is no requirement that the buffer on perennial non-fish-bearing channels remain in the same place during subsequent logging cycles. This constitutes a de facto rotation age of 50 years for low-order riparian reserve areas. Either partial cutting or clearcutting in these buffers will certainly reduce their effectiveness in fulfilling their intended function of sustaining watershed and geomorphic processes.

IIB.4(e)(ii): The 4th sentence, which begins: “Other relevant factors . . .” is not really a sentence (the role of the phrase, “is clear,” is not clear). In the same sentence: “deliver” what? The next sentence has the term, “needed function.” Needed for what? Does the last sentence mean: No trees will be harvested between the road and the stream when the distance between the two is less than 30 feet? If so, say so. If not, make the sentence clearer. No direction to landowners on the re-location or abandonment is provided. Guidelines for redesign of road networks would be useful to address in the Roads section.

IIB.4(f): Does this item deal adequately with cumulative thermal effects? If shade requirements “will not preclude or limit the construction and maintenance of road crossings or the creation or use of yarding corridors,” what good are they, and why are they called “requirements”? This clause would allow further impairment of waters already known to be thermally impacted.

IIB.4(g): Provisions for management of CMZs include several clauses that reduce their effectiveness in meeting the Report’s goals. The first paragraph states that no harvest will occur except for the “construction and maintenance of road crossings or the creation or use of yarding corridors.”
Hardwoods are allowed to replace conifers at a ratio of 3:1. There is still the same basal area replacement that could lead to a decline in the riparian forest structure over time if smaller trees in greater numbers are used to replace fewer but larger and more functional trees.

IIB.4(g)(ii): The state buys the CMZ and the landowner gets to cut the outer zone? Seems like double-dipping.

IIB.4(g)(iii)(C,D): It does not seem reasonable that inappropriate management of riparian zones that resulted in inappropriate hardwood dominance should allow increased cutting in the outer zone. In areas where conifers are expected in the riparian zone and are underrepresented, conifers are needed in the outer zone to make up for the deficit.

IIB.4(h): What does “including on a regional basis” mean? What region? This paragraph suggests that regional adjustments are made only through the as-yet-to-be-determined adaptive management process. Watershed-scale information relevant to particular activities now can no longer be used to adjust practices to the needs of a site; watershed analysis results can only be used to inform some future adaptive management process. This is not appropriate.

III: What do “safe,” “unsafe,” and “snags” mean? If the latter means standing dead timber, say so. Specify what is to be done with the safe and unsafe objects. Standing and downed dead timber are important as habitat for wildlife—and if they or parts of them enter a stream, they are important as fish habitat. This should be said.

Schedule B-2: Basal area units are missing in the table describing DFC basal area targets.

**Draft Emergency Rules—Riparian management zones**

1. “Preferred species”: For both westside and eastside, hardwoods are considered a preferred species to leave, contrary to what literature has said about LWD (citation on the longevity of conifer vs. hardwood**). Redcedar, which is one of the most decay resistant woods in Washington, is listed near or at the bottom of both lists. This prioritization is inconsistent with the state goal of the riparian rules: “The goal of riparian rules is to protect covered resources and related habitat” (Draft 222-30-010). Furthermore, drift of herbicides into the inner zone of the riparian buffer is likely to impair growth of broad-leaf trees in those locations.

2. Selection of a desired future condition of 140-year-old riparian stands is a positive move, but the basis for this age as a structural target (e.g., for basal area considerations) is not founded in the literature. If the native forest conditions are indeed the target, a number of authors (Naiman et al. 1998, Fetherston) indicate that riparian forests will not optimize the functions of LWD delivery, Shade, hyporheic amelioration, or sediment filtering until they attain old-growth characteristics. Old-growth characteristics are not attained by 140 years in Douglas-fir forests, which occur in later seres (e.g. old growth).

3. An additional improvement is that legal definitions recognize a number of “sensitive sites” associated with the higher elevation riparian system: Headwall seep, Side-slope seep, side-slope spring, perennial initiation points, and alluvial fan. These sites are afforded protection under the FFR (B-4 c, d, e).

4. There may be some confusion with regard to “site index” definitions. The “site index” is evaluated on a 50-year basis, from soil surveys. “Site potential tree height” (SPTH), which is
used to determine riparian buffer widths, is on a 100-year basis. While any errors in the layout should be caught in the permitting process, the incongruency is unnecessary.

5. The timber harvesting policy now includes recognition of the need to convert some understocked, overstocked or uncharacteristically hardwood-dominated riparian stands to maintain some landscape-level functions (Draft 222-30-010). This improvement should make some riparian forest restoration goals easier to achieve.

6. Section 222-30-021 describes the structure of the new riparian buffers and defines the basal area targets, but the basal area chart does not describe required tree densities. This allows the landowner to decide the size and number of trees to be left.

7. Section 222-30-023 exempts 20-acre parcels within ownerships of less that 80 acres from riparian prescriptions. These parcels must follow a lower standard of protection intended to offset the diseconomies of scale with small land holdings. The effect is to leave a great number of stream miles in the forested reaches with low protections.

8. Section 222-30-022 describes Eastern Washington riparian zone prescriptions. These are complicated by the attempt to make them site specific by habitat type (e.g. Ponderosa pine, mixed conifer, and high elevation). Tree density, tree size, leave tree pattern, and down wood requirements are now complex and difficult to interpret.

9. Section 222-30-045 restricts salvage logging from riparian areas. This is a significant improvement.

Appendix C: Unstable Slopes

1. Introduction: This should be rephrased to read “The goal of management on unstable slopes is to prevent forest practices that increase the rate of landslide occurrence.”

II.C.1(b,c): Note that potentially unstable areas must be disclosed.

II.C.1(b): Insert *geomorphologic* between qualified and expert in line 2.

II.C.1(c): After the word, “if,” the sentence should read *the applicant can reasonably be expected to have known that these areas exist.*

II.C.1(d): In the 3rd line, “deliver” what? And same comment on line 5.

II.C.1(g): This provision cannot be evaluated until we know what the SEPA guidance is. Also, insert *geomorphologic* between qualified and expert in the first and last paragraphs.

II.C.1(g)(iii): “are likely to cause significant adverse impacts”: this ignores cumulative impacts. It doesn’t matter if the individual plan causes insignificant impacts; what matters is if the plan, in combination with past and foreseeable plans, will cause a significant impact. Significance thus cannot be judged out of context.

Appendix D: Roads

1. The Report’s recommended improvements to roads all are better designs, and the requirements for preparation of road maintenance and abandonment plans is a major improvement. The timescale for upgrading—15 years on all ownerships—is reasonable if the riskiest sites are treated
first. Upgrades include the removal and re-design of all culverts that are currently blocking the passage of spawning salmonids, and this is a very important improvement.

2. The Draft Emergency Rules include several provisions that are improvements towards the conservation goals. Road location and design (WAC 222-24-020) calls for full bench roads on slopes greater than 60% slope if typed waters are nearby (WAC 222-24-020 5). Drain structures are required now (WAC 222-24-020 (17)) before draining surface flow from roads into streams or wetlands. Native species are preferred for erosion control measures (WAC 222-24-030 (4)). There are new provisions for temporary log landings to facilitate abandonment (WAC 222-24-035 (3))

3. Deferral of treatment of orphan roads is a concern. Where high-risk sites are already known, it would be reasonable to address these early, and repair of existing problems would also be reasonable. This may not be possible after abandonment of more recent roads if that abandonment makes access to orphan-road sites difficult.

4. Most of the significant improvements in Schedule D are with the drainage system. While this may not be the document to address the impact that roads have on intercepting and re-directing overland and groundwater flow, there still needs to be conveyed some acknowledgment that hydrologic function can be severely affected by road design.

5. Management of traffic levels during wet weather can significantly decrease fine sediment inputs to streams.

I(a): This should read: The policy for managing roads will be to maintain at natural (pre-roading and pre-logging) levels (i) the opportunity for passage of all fish species in all their life stages which would naturally occur in that part of the stream system, (ii) the opportunity for passage of woody debris, (iii) sediment input to the stream system, (iv) water quality, and (v) streambank stability, as well as to divert most road run-off water to the forest floor, such that it will have the longest possible route to a stream system.

P. 89: The material written on this page does not seem consistent with the previously stated objective of allowing LWD passage. The 2nd paragraph on the page should be revised with that in mind. In item (a) (i), a culvert 24 inches in diameter will not pass much LWD. And what is the evidence that this is sufficient size for “anadromous fish”? Also, presence of the words, “or the equivalent,” could be misleading. Two smaller culverts having the same flow-carrying capacity as the larger one may not be sufficient for the same fish. In addition, it should be specified that all culvert installations intended for fish passage shall be so constructed as to have gravel bed throughout the length of the culvert.

Schedule D-1, Section 222-24-040 (2): Specifications for culvert size do not seem consistent with the previously stated objective of allowing LWD passage. The 2nd paragraph on the page would need to be revised with that in mind. In item (a) (i), a culvert 24 inches in diameter will not pass much LWD. And what is the evidence that this is sufficient size for “anadromous fish”? Also, presence of the words, “or the equivalent,” could be misleading. Two smaller culverts having the same flow-carrying capacity as the larger one may not be sufficient for the same fish. In addition, it should be specified that all culvert installations intended for fish passage shall be so constructed as to have gravel bed throughout the length of the culvert.
Appendix E: Pesticides

1. In general, it would seem more reasonable to tie the level of protection to the level of toxicity (e.g. LD 50) and strength (e.g. pounds per acre). If a one-size-fits-all prescription is used, then streams are either being over-protected from benign chemicals or under-protected from dangerous ones.

IIE.1 (a): I question the second sentence: “Dry stream segments (i.e., with no surface water) do not require a buffer.” Important aquatic organisms, including juvenile salmon, commonly live in subsurface flows beneath stream beds that have no surface flow. Moreover, pesticides applied to temporarily “dry” stream segments are likely to be washed downstream when the next rain storm or snowmelt flow sends water through them. In addition, herbiciding riparian zones along dry stream segments will alter riparian vegetation and thus impact downstream aquatic communities.

IIE.2: Riparian vegetation requires buffering even if water is not present because stream-side vegetation becomes an important moderator of sediment inputs during the wet season, when water is present.

Appendix G: Watershed Analysis

I: In the 6th line, “assurances” of what? And in the last sentence, “continue” after what?

IIG.1(a): This eliminates hazard mapping in the mass wasting module and precludes the use of the results of the riparian and road modules for developing watershed-specific prescriptions. This makes it impossible for watershed analysis to “provide a tool to address cumulative effects,” which the Report represents as a primary reason for conducting watershed analysis (Appendix G, item I). Road prescriptions would still be needed because this document does not consider all aspects of road-related impacts, and watershed-specific prescriptions for riparian zones and mass-wasting are needed to avoid contributing to already significant cumulative impacts.

IIG.1(a): There’s no evidence of “significant upgrade” of mass wasting management through this report. A statewide map of mass-wasting hazard does not take the place of watershed-scale analysis.

IIG.2(c): It is not reasonable to define the significance of a potential impact on the basis of the nature of past regulations; significance must be defined with respect to impact.

Appendix H: Alternative Plans

H.2 (a): In the 3rd line, insert the same before the phrase, “public resources,” and I question the advisability of the last sentence of the same paragraph, which states: “Alternate plans may address different resources . . .”

H.2 (g): And if the audit reveals non-compliance, then what?

Appendix I: Small landowners

II.1.2(c). State has to buy the same trees every 50 years, at higher and higher values because they were left and are growing?
Appendix L: Adaptive management

1. The primary concern with the approach here is that levels of protection have been instated that will not be sufficient for meeting the stated objectives, but revision of the prescriptions will require a considerable amount of work. Ordinarily, when managing uncertainty, the preliminary decision is designed to make sure that future options are not constrained, such as by the extinction of the species. Adaptive management is then used to redesign activities so that increased levels of activity remain compatible with the plan’s goals. This plan, however, has taken the opposite approach. Priority research listed in Schedule L-1 focuses on finding out if the prescriptions were effective, thus indicating that the Report’s authors are fully cognizant of the fact that the prescriptions cannot be assured to be sufficient to meet the plan’s objectives.

2. It will be very important that prioritization of research topics be done by an independent body. When absence of appropriate knowledge works in the favor of a vested interest, that vested interest should not be in a position to decide whether to attempt to obtain the knowledge.

3. It is extremely important that it be stated explicitly that the adaptive management program will incorporate (and continually update) not just what is developed from within the program but also the advances in pertinent scientific and technical fields that develop from outside Washington and the Pacific Northwest. This outside information and its application should include especially geomorphology, hydrology, aquatic ecology, and forest ecology.

4. The adaptive management program should strongly encourage publication of the results of its studies in peer-reviewed professional journals. Results may be suspect if never exposed to critical outside review.

I(a), line 6: “habitat” for what?

I(e)(i): Insert in management after the word, “change.”

I(e)(ii): Does this rule out innovation and better approaches when they are discovered?

Figure 1: Other applicable laws should also inform establishment of resource objectives. The meanings of the arrows and of the lines that don’t have arrowheads are not evident. Explain these symbols (and the circle symbol) in the Figure 1 caption. Also, three of the diagram’s four corner boxes are entities (TFW, FP Board, Sci Review Committee), but the fourth (cooperative monitoring, etc.) is a process. Is this congruous? In that caption, the term, “peer review,” is used, but it is not present in the diagram itself.

IIL1 a (ii): This defines hypothesis testing as the only valid scientific protocol. Silvicultural and ecological studies of stand development can take decades. Those studies that do not are often descriptive science that can still produce valid conclusions regarding the nature of forest function.

IIL.1(a)(vii): What does “forward” mean in this context?

IIL.1(c) (ii): Implications of a study should be based on the study’s results, whatever the design was. What did the authors mean by saying: “Implications of the study should be based on the study design”?

IIL2 b (ii): This states that “CMER will not make recommendations on the use of its results unless asked…” This contradicts the notion that the science is done to solve or describe a problem that needs fixing. The language of FFR puts the science in a political arena.
IIL3 a: This establishes a data bank for to support adaptive management. While the Northwest Indian Fish Commission (NWIFC) has banked ambient monitoring data in the past, there is no such operation established for the FFR. Funding may become an issue with all of the other costs associated with FFR.

IIL.4(b), line 3: After “bull trout,” insert *and other species that are listed or soon-to-be-listed.*
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