4e. Direct and Indirect Effects of Activities Covered by the Plan

4e-1 Introduction

A mandatory element of habitat conservation plans is a description of the "…impacts likely to result from the proposed taking of the species for which the [incidental take] permit coverage is requested" (USFWS and National Marine Fisheries Service 1996). Part of impact identification involves quantifying anticipated take levels, either in terms of the number of animals of a covered species occupying the project area or in terms of the amount of habitat affected.

Oftentimes, expressing take in terms of the number of animals is complicated by insufficient data. At a minimum, reliable information regarding 1) population numbers, and 2) the cause-and-effect relationship that exists between the proposed activities and the population(s) is necessary to estimate take. For some species, such as anadromous fish, the wide range of factors that affect population numbers further complicates estimating take in terms of animals. For these reasons, take estimation under the FPHCP is expressed in terms of the number of habitat acres potentially affected by the plan. The following sections describe the approach and the likely effects of plan implementation on key habitat-forming processes and covered species.

4e-2 Approach

Estimating take for purposes of the FPHCP focuses on the number of habitat acres affected by the plan. The approach involves developing a hypothetical management strategy that it is assumed would have little if any measurable effects on species covered by the plan. This "minimal effects" strategy serves as a baseline for evaluating and comparing management under the FPHCP. Differences between the minimal effects and FPHCP strategies are compared both quantitatively, in terms of the number of habitat acres affected, and qualitatively, in terms of the expected effects of implementing certain site- and watershed-scale protection measures.

The approach assumes that protection of two parts of the landscape—riparian zones and unstable slopes—is particularly important to the long-term conservation of covered species. Riparian zones and unstable slopes are therefore collectively referred to as "critical areas" throughout this discussion. While covered species may be affected by forest practices activities conducted outside critical areas, the assessment assumes the likelihood is low relative to activities that occur within critical areas. It assumes that timber harvesting (including tree felling and log yarding) and road construction, use, maintenance and abandonment in critical areas have the greatest potential for effects. As a result, the discussion of likely effects included later in this section is limited to these forest practices activities.

The minimal effects strategy defines and protects critical areas as follows:

1) Fish-bearing (Type S and Type F) waters receive protection from channel migration zones and 250-year site index riparian management zones. CMZs are defined in accordance with forest practices rules. RMZs are established along the entire length of the fish-bearing stream network. No management activity is allowed within CMZs and RMZs under the minimal effects strategy.

2) Non-fish-bearing perennial (Type Np) waters receive protection from 100-year site index riparian management zones. RMZs are established along the entire length of the non-fish-bearing perennial network. No management activity is allowed within RMZs under the minimal effects strategy.

3) Unstable slopes include all areas identified as "high hazard" using the SMORPH (Shaw and Vaugeois 1999) model. SMORPH hazard designations are based on slope gradient (i.e., steepness) and slope shape (e.g., concave, planar, convex). No management activity is allowed on unstable slopes under the minimal effects strategy.

Riparian zones adjacent to Type Ns waters were not considered critical areas under the minimal effects strategy. Critical areas did, however, include all Type Ns-associated unstable slopes. The assessment assumes that forest practices conducted in Type Ns riparian zones that affect riparian function (i.e., reductions in LWD recruitment and shade supply due to harvest) would be unlikely to result in adverse affects, and that adverse affects would more likely result from activities that could accelerate mass wasting on Type Ns-associated unstable slopes (i.e., harvest or road-related landsliding) which, in turn, might directly or indirectly affect covered species and their habitats in downslope and/or downstream areas.

The following rationale is provided in support of this assumption:

1) The movement of LWD from small, seasonal headwater channels (e.g., Type Ns waters) to downstream reaches largely occurs via colluvial (i.e., mass wasting) processes as opposed to fluvial transport (Benda et al. 2002). The protection of unstable slopes (including landslide initiation sites and steep, channel-adjacent slopes) adjacent to Type Ns waters will protect the source of most mass wasting-derived LWD delivered to downstream reaches during debris flows and debris torrents.

2) Type Ns waters are, by definition, seasonal waters where surface flow is absent for at least some portion of a year of normal rainfall. In many Type Ns waters, flow cessation occurs prior to or during late summer. Late summer also represents the period of peak stream water temperatures (Beschta et al. 1987). Therefore, Type Ns waters should not be susceptible to increased water temperatures that could result from riparian timber harvest. Also, temperatures in downstream Type Np waters should not appreciably be affected by timber harvest adjacent to Type Ns waters.

3) Since adoption of the emergency forest practices rules in July 2000, implementation of the interim water typing system by DNR field staff suggests the extent of the Type Ns network is more limited than is reported on DNR water

> type base maps. Field staff have found that the point of perennial flow that defines the downstream end of Type Ns waters is often substantially higher in the stream network than is shown on DNR water type base maps. Since the length of Type Ns waters is shorter than depicted on the water type maps, the extent of impacts from forest practices conducted in close proximity to Type Ns waters will be more limited than what map-based data suggest. CMER recently completed a high priority study to help refine the demarcation of perennial and seasonal Type N streams. As a result of the study, the Forests and Fish Policy Committee (FF Policy) informed the Forest Practices Board (the Board) that the existing default basin areas for determining stream perennial initiation points (PIPs) in WAC 222-16-031(3) and (4) are incorrect. FF Policy recommended to the Board on August 16, 2005, that the default basin area language be deleted from the WACs and replaced with language that refers readers to the forest practices Board Manual Section 23 to help them locate PIPs in the field. For additional information about the study, see Chapter 4a-4.2, Research and Monitoring, or go to www.dnr.wa.gov/forestpractices/adaptivemanagement/pipstudy/.

The minimal effects strategy was developed independent of the alternatives included in the Final Environmental Impact Statement (FEIS) (USFWS and NOAA Fisheries 2006). While in most cases, the minimal effects strategy provides greater protection than the FEIS alternatives, FEIS Alternative 4 ("Increased Forest Ecosystem Protections"; FEIS Chapter 2) is more protective in some respects. For example, FEIS Alternative 4 provides 70-foot, no-harvest RMZs along channels greater than 30 percent gradient. This represents increased protection relative to the minimal effects strategy in cases where the >30 percent channel category includes Type Ns waters. In addition, FEIS Alternative 4 includes the retention of no-harvest buffers within "channel disturbance zones" and "beaver habitat zones," which are not recognized as critical areas under the minimal effects strategy.

Differences between the minimal effects strategy and FEIS Alternative 4 largely reflect different objectives behind their development. The minimal effects strategy was developed in an attempt to identify the level of habitat protection necessary to avoid adverse effects to covered species in light of existing scientific uncertainties about the effects of forest practices on aquatic and riparian habitats. As indicated earlier, this was necessary to satisfy ESA requirements related to HCP development. On the other hand, FEIS Alternative 4 was developed to satisfy National Environmental Policy Act (NEPA) requirements that call for the development of a range of reasonable alternatives. FEIS Alternative 4 represents one end of the range and was largely based on comments received from the public as part of the NEPA scoping process.

The spatial extent of critical areas was calculated for both the minimal effects and FPHCP strategies. Appendix K includes a detailed description of all critical areas calculations. The extent of critical areas under the FPHCP strategy was largely based on the results of riparian and unstable slopes modeling contained in Appendices C and E of the Forest Practices Rules EIS (2001) and Appendix B of the FPHCP NEPA EIS (2006).

Key assumptions underlying the modeling have been summarized from FEIS Appendices C and E and are as follows:

1) The interim water typing system currently in use is a reasonable surrogate for the permanent water typing system still under development.

2) Average CMZ width for Type S and Type F waters in western Washington are 30 feet and 10 feet, respectively. Average CMZ widths for Type S and Type F waters in eastern Washington are 5 feet and 2 feet, respectively.

3) The average site class adjacent to Type S and Type F waters is the average of site class II and site class III.

4) The average site class adjacent to Type Np waters in both western and eastern Washington is site class III (applies to the minimal effects strategy only; not included in FEIS modeling).

5) Forty percent of harvest units adjacent to Type Np waters in eastern Washington are clearcut, while 60 percent are partial-cut (applies to the FPHCP strategy only).

6) The SMORPH model (Shaw and Vaugeois 1999) reasonably predicts the extent of high hazard unstable slopes defined by the forest practices rules. While the SMORPH model has not been calibrated for eastern Washington, the most conservative (i.e., encompassing) calibration criteria from western Washington were used when applying the model in eastern Washington.

Bankfull widths were included in the calculations of critical area extent. While including bankfull width as part of the critical area increases the critical area acres, it does not affect the comparison of strategies since both strategies included bankfull width in the calculations. Also, unlike the riparian modeling performed as part of the DEIS, the modeling here made no attempt to account for the overlap of RMZs that occurs at channel junctions and did not include the channel areas of Type Ns waters and unbuffered Type Np waters in the calculation of critical area extent. Again, while these factors may affect the total critical area acres, they do not affect the comparison of strategies since neither strategy included overlap reduction factors nor Type Ns and unbuffered Type Np channel areas. For these reasons, the riparian critical area acres calculated for the FPHCP strategy do not correspond with the riparian management zone acres reported in the FEIS (See section 4.3 Land Ownership and Use).

4e-3 Results

Under the minimal effects strategy, the total critical area extent encompasses 2,613,151 acres statewide (Table 4.17). Of this total, about 2.1 million acres, or 81 percent, consists of riparian zones while the remainder is unstable slopes. Over 82 percent of the total minimal effects critical area is located in western Washington and 83 percent of western Washington critical area acres are riparian zones (Table 4.17). The 2.6 million acres that represent the minimal effects critical area encompass 28 percent of the approximately 9.3 million acres of forestlands covered under the FPHCP.

Under the FPHCP strategy, total critical area extent encompasses 2,065,451 acres (Table 4.17). This represents 79 percent of the minimal effects critical area acres and 23 percent of the forestland area covered by the FPHCP. Like the minimal effects strategy, over 82 percent of the total FPHCP critical area is located in western Washington and 79 percent of those critical area acres lie within riparian zones (Table 4.17). The disproportionate number of critical area acres in western Washington reflects the higher density of typed waters and unstable slopes found there.

Critical area extent under each strategy can be used as an indicator of the number of habitat acres affected. Since the FPHCP provides protection for 79 percent of the minimal effects critical area acres, the remaining 21 percent—or approximately 548,000 acres—can be viewed as the "affected area." This amounts to approximately six percent of the forestland area covered under the FPHCP. Again, due to higher densities of typed waters and unstable slopes in western Washington, most of the affected area is located in that part of the state (approximately 452,000 acres or 83 percent of the total area affected).

The assessment assumes that all high-hazard unstable slopes designated under the minimal effects strategy will be protected under the FPHCP, either through avoidance or the implementation of road- or harvest-related mitigation measures. As a result, the affected area includes no unstable slopes and is comprised solely of riparian zones. Moreover, 40 percent of the total affected area—or 216,577 acres—is associated with Type Np riparian zones in western Washington.

Table 4.17 Spatial extent of riparian zones and unstable slopes (collectively referred to as "critical areas") protected under a hypothetical minimal effects strategy and the FPHCP.

	Riparian Zones[1] (acres)		Unstable Slopes[2] (acres)		Total Critical Area (acres)	
	Western WA[3]	Eastern WA[4]	Western WA	Eastern WA	Western WA	Eastern WA
Minimal Effects Strategy	1,788,166	338,527	358,251	128,207	2,146,417	466,734
FPHCP Strategy	1,335,771	243,222	358,251	128,207	1,694,022	371,429

1 – includes bankfull channel, CMZ (where present) and riparian buffer associated with Type S and Type F waters and bankfull channel and riparian buffer associated with Type Np waters

2 – includes high hazard slopes identified using the SMORPH model (Shaw and Vaugeois 1999); does not include unstable slopes in riparian zones

3 – includes 1,522,684 Type S and Type F acres and 265,482 Type Np acres under the minimal effects strategy and 1,286,866 Type S and Type F acres and 48,905 Type Np acres under the FPHCP strategy

4 – includes 275,919 Type S and Type F acres and 62,608 Type Np acres under the minimal effects strategy and 214,084 Type S and Type F acres and 29,138 Type Np acres under the FPHCP strategy

While 79 percent of the minimal effects critical area acres is protected under the FPHCP, some management activities are allowed on a portion of those acres. Parts of critical areas that are more sensitive to forest practices effects (e.g., CMZs, RMZ core zones) receive higher levels of protection under the FPHCP as compared to areas that are less sensitive (e.g., RMZ outer zones, some Type Np waters). Forest practices rules mandate some protection measures (i.e., no harvest in RMZ core zones) while others are performance or outcome-based (i.e., avoid accelerating the rate or magnitude of mass wasting). The likely effects of management under the FPHCP on key watershed processes and covered species and their habitats are discussed in the following section.

4e-3.1 Implications

The assessment described above indicates the FPHCP protects approximately 2.1 million critical area acres or 79 percent of the critical area acres identified in the minimal effects strategy. The remaining 548,000 critical area acres, referred to as the "affected area" throughout this discussion, is comprised entirely of riparian zones.

This section discusses the likely effects of FPHCP implementation. The discussion considers the effects of implementing the FPHCP protection measures within critical areas as well as the effects of providing less protection within the affected area. The discussion focuses on habitat effects, but includes an overview of the expected effects on fish and amphibians. Effects are described in terms of expected changes in three key watershed processes: LWD recruitment, water temperature and erosion. The discussion assumes that changes in these three processes have the greatest potential to adversely affect the habitats of covered species. Both near-term (<10 years) and long-term (>40 years) effects are discussed.

LARGE WOODY DEBRIS RECRUITMENT

Type S and Type F Waters

In the near-term (i.e., <10 years), FPHCP implementation is expected to have little effect on wood recruitment to Type S and F waters relative to the minimal effects strategy. This is because most riparian zones are currently in early- to mid-seral conditions (See FEIS Chapter 3) and tree heights are typically less than the RMZ width. Thus, the core and inner zones will provide virtually all near-term wood recruitment. Debris recruited from the outer zone in the near term will likely be small in size (i.e., tops and limbs), will be easily mobilized and will provide limited in-stream function.

In larger channels, even debris recruited from the core and inner zones in the near-term may be of insufficient size to resist mobilization and provide function. The FEIS estimates that early-seral stands are still at least 100 years from full recovery with respect to woody debris recruitment (See FEIS Chapter 4). In a northwest Washington study, Grizzel et al. (2000) concluded that riparian stands must be 85 to 100 years of age to provide functional in-stream woody debris to small streams. Thus, stands that are currently 40 to 60 years of age may not provide debris of functional size for 25 to 45 years. Accelerating growth rates by thinning within riparian zones may shorten the recovery period in some cases, but full recovery is still likely to take decades.

Over the long term (i.e., >40 years), FPHCP implementation is expected to result in slightly lower levels of wood recruitment to Type S and F waters relative to the minimal effects strategy. As riparian stands develop over time, proportionately more in-stream woody debris will originate farther from the channel. As tree height increases, so does the probability that outer zone trees will be recruited (Robinson and Beschta 1990a; and Bragg et al 2000). While harvest of outer zone trees will not appreciably reduce wood recruitment in the near term, it is likely to decrease recruitment over the long term. However, reductions in outer zone recruitment due to harvest are not expected to substantially affect overall recruitment, as this zone represents only about ten percent of potential woody debris inputs (See Section 4d-1.1). In addition, the protection of CMZs as no-harvest areas mitigates the effects of reduced wood recruitment from the outer zone along those channels where CMZs are present.

Once riparian tree heights surpass RMZ width (presumably at or beyond age 100), the probability of recruitment increases for trees located outside the RMZ. The effect of the FPHCP on potential wood recruitment from beyond the RMZs depends in large part on the maximum age (and therefore height) that trees will attain during the 50-year life of the plan. In order for trees beyond the RMZ to be potentially recruitable, their height must exceed the 100-year site index on which RMZ widths are based.

Adams et al. (1992) reported the age class distribution for privately owned forestlands in western Washington. These data indicate 80 percent of privately owned forests in western Washington are less than 50 years old. These stands, even if left uncut throughout the duration of the FPHCP, would not reach 100 years of age prior to the projected end of the plan in 2055. Therefore, 20 percent of privately owned forests in western Washington would meet or exceed 100 years of age at or before the FPHCP expires. These stands could potentially provide wood recruitment from beyond the 100-year site index RMZ during the next 50 years. However, as is the case with near-term recruitment from the outer zone, debris recruited from beyond the RMZ during the life of the FPHCP would likely be small in size (i.e., tops and limbs), would be easily mobilized and would provide limited in-stream function. While data for eastern Washington were not available, it is likely that age class distributions would shift to the right (i.e., higher mean stand age) relative to western Washington. Thus, a larger proportion of eastern Washington stands, if left uncut, would provide wood recruitment from beyond the RMZs.

In addition to woody debris that is recruited to Type S and Type F waters from streamside RMZs, debris is also supplied from unstable slopes located outside riparian zones. This is particularly true for many areas in western Washington where high landslide frequencies make mass wasting an important debris-delivery mechanism. Wood delivery to typed waters from unstable slopes can result from shallow-rapid debris avalanches, debris flows and debris torrents as well as from deep-seated landslide processes. Because implementation of the FPHCP is expected to result in high levels of tree retention on unstable slopes, wood recruitment from these areas is expected to remain at or near background levels. A complete discussion of unstable slopes protection measures follows in a later section.

In summary, the effects of the FPHCP on LWD recruitment to Type S and Type F waters are expected to be negligible in the near term. This is primarily because most riparian stands are in early- to mid-seral stages, tree heights are less than the 100-year site index RMZ widths and areas beyond the RMZ are unlikely to provide substantial recruitment during the next ten years. Thus, providing less protection for that portion of the affected area adjacent to Type S and Type F waters poses little risk to covered species in the near term. As tree heights increase over time, there is increasing probability that trees farther from the stream will be recruited. As a result, over the long term the FPHCP is expected to lead to slightly reduced wood inputs as compared to the minimal effects strategy to Type S and Type F waters due to harvest of potentially recruitable trees in the outer zone and from beyond the RMZ into the affected area. CMZs will partially mitigate the reduction in wood recruitment associated with outer zone harvest in channels where they are present. The FPHCP is likely to maintain mass wasting-derived wood inputs to Type S and Type F waters at or near background levels both in the near term and long term due to high tree retention levels expected on unstable slopes. Wood recruitment from Type S and Type F RMZs and CMZs will result in improved in-stream and riparian habitats for all covered species. Increased wood loads will increase the quantity and quality of habitats used by fish for spawning, rearing and migration.

Type Np Waters

The near-term effects of the FPHCP on LWD recruitment within any given Type Np network are expected to vary directly with the proportion of Type Np critical area acres protected. In basins where a large proportion of the Type Np network is bordered by unstable slopes, only small to moderate reductions in wood recruitment are expected relative to the minimal effects strategy. This is because recruitment from Type Np RMZs and sensitive site buffers will be supplemented by recruitment from unstable slopes buffers. Reductions in wood recruitment relative to the minimal effects strategy are expected to be small in areas where unstable slopes protection extends out to or beyond a distance equal to the 100-year site index, while moderate reductions are likely where the lateral extent of unstable slopes is limited. In areas where a small proportion of the Type Np length is bordered by unstable slopes, reductions in wood recruitment relative to the minimal effects strategy are expected to be greater. This is because wood recruitment will originate mainly from Type Np RMZs and sensitive site buffers with little supplemental recruitment from unstable slopes buffers. Moderate reductions in recruitment are expected where the lateral extent of unstable slopes is limited or where their distribution is patchy; larger reductions are likely where no unstable slopes are present and wood recruitment originates solely from RMZs.

In areas where most or all of the Type Np critical area protection comes from RMZs and sensitive site buffers, the effects of the FPHCP on wood recruitment relative to the minimal effects strategy are expected to become more pronounced with time. As tree height increases, a larger proportion of the potential woody debris load originates from beyond the 50-foot Type Np RMZ. The results of McDade et al. (1990) suggest tree growth over the 50-year life of the FPHCP may increase the proportion of potential wood recruitment that originates from beyond 50 feet by as much as 20 percent. Therefore, while the near-term reductions in wood recruitment to some Type Np waters may be small, long-term reductions are likely to be greater.

Woody debris in many small, non-fish-bearing waters increases channel complexity by storing sediment and creating pools (Curran and Wohl 2003; Faustini and Jones 2003; Potts and Anderson 1990; Commandeur and Guy 1996). Wood also increases the retention of smaller organic debris and leaf litter, which often leads to increased primary production in headwater channels (Bilby and Likens 1980). Reductions in wood recruitment to Type Np waters may affect these processes; however, the resulting effects on covered species are not clear.

Because the importance of woody debris in non-fish-bearing waters to the recovery and survival of covered species in downstream waters is not well understood, the CMER Committee has identified this issue as a priority research and monitoring topic under adaptive management. Two research programs are currently under development that will help address the role of wood in non-fish-bearing waters and its influence on downstream habitats: the Type N Buffer Characteristics, Integrity and Function program and the Type F Statewide Effectiveness Monitoring program (See 2006 CMER Work Plan, Appendix H). Both programs are intended to evaluate the effectiveness of riparian protection measures in meeting established resource objectives and performance targets at the site scale. In addition to the Type N and Type F research programs, a watershed-scale intensive monitoring program is being developed to evaluate the cumulative effects of forest practices on certain covered species and their habitats. Intensive monitoring will complement effectiveness monitoring by providing data that will help evaluate the effects of forest practices on woody debris recruitment and habitat formation at the watershed scale.

In summary, the effects of the FPHCP on wood recruitment to Type Np waters vary considerably and are largely dictated by the frequency of sensitive sites and unstable slopes. Protection of sensitive sites and unstable slopes supplements standard RMZ protections, resulting in increased wood recruitment in Type Np networks where these features are present. The impacts on wood recruitment are greatest in areas where RMZs and sensitive site buffers provide the only protection; these effects will likely become more pronounced with time. This is because as tree height increases, a larger proportion of potential wood recruitment originates from beyond 50 feet, a distance equal to the width of Type Np RMZs and sensitive site buffers.

WATER TEMPERATURE

Forest practices can affect water temperature by changing the amount of streamside shade, by altering channel morphology through accelerated sedimentation and by modifying the hydrologic regime of watersheds. Of these factors, reductions in streamside shading are most likely to adversely affect water temperature and the habitats of covered species. The discussion of FPHCP effects on water temperature therefore focuses on the retention of shade adjacent to typed waters.

Type S and Type F Waters

The effects of the FPHCP on water temperatures within Type S and Type F waters are expected to be negligible. Two reasons are provided in support of this conclusion. First, research into the relationship between buffer width and angular canopy density (an index of shade or canopy cover) from western Oregon shows that no-harvest buffer widths between 70 and 120 feet provide shade levels similar to those found in old-growth stands (Brazier and Brown 1973; Steinblums et al. 1984). Under the FPHCP, RMZ widths range from 90 to 200 feet in western Washington and from 75 to 130 feet in eastern Washington. Most trees within the combined core and inner zones of the RMZ (about 2/3 to 3/4 of the RMZ width) must be left uncut. Within the Bull Trout Overlay in eastern Washington, all available shade must be retained within 75 feet of the stream and additional retention requirements apply to that portion of the RMZ beyond 75 feet. These requirements are likely to result in the retention of nearly all shade adjacent to Type S and Type F waters.

Second, forest practices rules (on which the FPHCP is based) are designed to meet state water temperature standards established by Ecology. The standards are intended to protect beneficial uses including fish and their habitats by minimizing allowable increases in water temperatures. In an assessment of the forest practices rules that preceded the current rules, Rashin and Graber (1992) found that riparian requirements were effective in meeting temperature standards at only 5 of 11 sites where RMZs had been retained. The authors concluded that the minimum RMZ width required at the time (25 feet) for western Washington was inadequate to protect temperatures in low- to moderate-elevation streams. The results of the study helped Forests and Fish Report authors develop riparian protection measures more likely to meet water temperature standards. As current protection measures for Type S and Type F waters are likely to retain shade levels necessary to meet water quality standards and protect covered species, the risks associated with providing less protection in the affected area are negligible.

Further water temperature research and monitoring is planned through the CMER Committee. CMER is currently developing a comprehensive study to evaluate the effectiveness of Type F RMZs in meeting a wide range of resource objectives, including temperature standards (See Type F Statewide Effectiveness Monitoring program in the 2006 CMER Work Plan, Appendix H). The results of this work will help refine forest practices rule requirements through adaptive management, if necessary, to meet water temperature standards.

Type Np Waters

Relative to Type S and F waters, the effects of Type Np protection measures on water temperatures are difficult to assess. The level of shade retained along any given Type Np network is highly variable and is dependent upon a wide range of factors including: location (i.e., western vs. eastern Washington), adjacent harvest strategy (applies only to eastern Washington), frequency of sensitive sites and frequency and extent of stream-adjacent unstable slopes. Minimally, a 50-foot RMZ must be retained along 50 percent of the Type Np network length in western Washington; up to 100 percent of the Type Np length may be protected in eastern Washington where adjacent units are partial-cut and in western Washington where there are high frequencies of sensitive sites and/or unstable slopes. For purposes of this analysis, establishing the precise level of shade that will be retained along any given Type Np network is difficult given the numerous management and environmental factors that affect Type Np protection.

Recent research into the effects of riparian timber harvest on temperature dynamics in small streams offers some insight into expected effects of Type Np protection measures. Three studies in Oregon documented water temperature increases in small streams flowing through clearcut units (Andrus 1993; Dent and Walsh 1997; Robison et al. 1999a). Robison et al. (1999a) concluded that clearcutting adjacent to small, non-fish-bearing coastal streams generally did not produce water temperatures that exceeded state standards. Two of the studies (Andrus 1993; Robison et al. 1999a) found significant cooling of water temperatures below most clearcut units as streams entered forested reaches. Andrus (1993) found that at sites where cooling occurred, the cooling rate was greatest in the first 600 feet downstream from the clearcut boundary. The third study (Dent and Walsh 1997) also documented cooling within 500 to 1,000 feet downstream of clearcut units at 10 of 15 study sites. However, the degree of cooling was not statistically significant.

Caldwell et al. (1991) monitored 11 sites in western Washington for downstream temperature effects associated with clearcut harvesting adjacent to non-fish-bearing waters. The authors found that 8 of the 11 harvested Type 4 (non-fish-bearing) waters met state water temperature standards. The main conclusions of the study included:

1) Type 4 (non-fish-bearing) waters that were tributary to Type 3 (fish-bearing) waters had minimal influence on downstream water temperature. This was primarily because of differences in flow volumes between the two water types. Type 3 waters farther than 4.5 miles from the watershed divide will show virtually no effect from the temperatures of incoming Type 4 tributaries, because the flow of the Type 3 water is too large relative to the size of the Type 4 water to have an influence.

2) For single streams where the water type changes from a Type 4 to a Type 3, water temperatures respond quickly to increased shade levels as flow progressed downstream into a shaded Type 3 reach. Water temperatures quickly reached equilibrium with downstream conditions, with the influence of the upstream Type 4 water temperature extending 500 feet or less beyond the water type change.

The results of these studies suggest that the combination of RMZs and sensitive site buffers should be effective in minimizing and mitigating temperature effects in Type Np waters. The results also indicate that increases in water temperatures in downstream Type S and Type F waters should be negligible. However, each of the studies cited above included a small number of study sites and, in some cases, the geographic distribution of sites was limited. None of the studies included management or environmental conditions representative of eastern Washington. Therefore, the degree of uncertainty surrounding the expected effects of Type Np protection measures on water temperature is high relative to other FPHCP requirements—particularly for eastern Washington.

The uncertainty surrounding the effectiveness of Type Np protection measures in meeting water temperature standards has made this issue a priority research and monitoring topic under adaptive management. The CMER Committee is currently developing a comprehensive study to assess the effectiveness of non-fish-bearing riparian protection measures in achieving established performance targets and resource objectives (See Type N Buffer Characteristics, Integrity and Function program in the 2006 CMER Work Plan, Appendix H). Water temperature is a primary focus of the study. CMER is also developing an extensive monitoring program that will establish the status of water temperatures at a statewide scale and document trends over time. The results of these efforts will help refine Type Np protection measures, where necessary, through the adaptive management process.

EROSION

Forest practices can accelerate erosion rates and the delivery of coarse and fine sediment to surface waters. The FPHCP includes multiple protection measures to reduce sediment inputs from existing sources and limit inputs from future sources. Two sets of these measures relate to the management of forest roads and the protection of unstable slopes. The expected effects of these protection measures on erosion processes and sediment supplies are discussed below.

Forest Roads

Implementation of the FPHCP will substantially reduce road-related erosion and sediment delivery both in the near term (<10 years) and over the long term (>40 years) relative to current levels. Near-term reductions from existing sources are expected to result largely from implementation of RMAPs on large forest landowner lands. All roads owned or managed by large forest landowners must be improved to meet forest practices standards by the end of 2015. The standards require that roads be disconnected from the stream network through the installation of drainage structures, that road fills susceptible to mass wasting be removed or stabilized and that stream-adjacent parallel roads be repaired or maintained.

Sediment reductions from small forest landowner lands will occur after these landowners submit—and DNR approves—forest practices applications for timber harvest. Application approval by DNR will include a requirement for improving roads to forest practices standards as part of the operation. Therefore, sediment reductions from small landowner lands will likely be distributed over the life of the FPHCP. In cases where roads are causing damage—or have the potential to cause damage—to public resources, DNR can, at any time, require the landowner to take corrective action(s) to minimize and mitigate the impacts.

The FPHCP will also limit road-related sediment delivery from future sources by regulating the construction of new roads. Forest practices rules include standards for locating, designing and constructing roads in ways that minimize sediment inputs to surface waters and wetlands.

While the FPHCP will reduce sediment inputs from existing roads and limit inputs from future roads and harvest activities, sediment inputs will remain above “natural” or “background” levels. While implementation of best management practices can minimize management-related erosion and sedimentation, complete elimination of management-related inputs is not possible. Therefore, chronic inputs of fine sediment from road and harvest surface erosion are expected to continue, as are episodic inputs of fine and coarse sediment associated with harvest and road-related mass wasting. Even as these inputs continue, implementation of RMAPs for both large and small landowners, together with all other sediment-related measures, is expected to result in a substantial reduction in sediment inputs to surface waters and wetlands on covered lands relative to pre-FPHCP levels.

Unstable Slopes

While many road-related protection measures are designed to reduce existing sediment sources, unstable-slopes measures are primarily intended to limit future sediment inputs by preventing management-related mass wasting. Forest practices rules are designed to achieve this goal by regulating timber harvesting and road and landing construction on all high-hazard unstable slopes. Unstable slopes protection measures include: 1) the use of more specific unstable landform definitions and descriptions for regulating forest practices activities, 2) the use of technology-based tools to screen forest practices applications for unstable slopes presence, 3) training DNR field staff and staff from cooperating agencies and organizations in unstable slopes identification, and 4) review of forest practices applications involving operations on unstable slopes under the SEPA. Collectively, these measures will improve the detection and protection of unstable slopes and reduce the incidence of management-related mass wasting and sediment delivery.

Reduced erosion and sediment delivery from roads and unstable slopes will have significant positive effects on the habitats of covered species. In the near term, road maintenance and abandonment work will reduce fine sediment delivery, resulting in improvements in spawning and rearing habitat in many areas. Prevention of management-related mass wasting will reduce coarse sediment inputs. Decreased coarse sediment supplies, combined with higher in-stream woody debris loads, will increase the quantity and quality of pool habitat. Reduced sediment inputs will also allow for the recovery of channels that have been impacted by excess sediment supplies resulting from past forest practices. Over the long term, reduced erosion and sedimentation will increase the complexity of in-stream and riparian habitats that will benefit all covered species.

CMER has identified several projects to evaluate the effectiveness of roads and unstable slopes protection measures in achieving resource objectives and performance targets. Two road-related effectiveness monitoring projects are currently in the design phase: one that addresses road prescriptions effectiveness at the site scale and one that addresses effectiveness at the sub-basin scale. Unstable slopes-related projects include an evaluation of investigator bias in recognizing and identifying unstable landforms and an assessment of mass wasting protection measure effectiveness at site and landscape scales. These projects are currently in the scoping and/or design phase. More information about these projects can be found in the 2006 CMER Work Plan (Appendix H).

FISH AND THEIR HABITATS

Large Woody Debris

The greatest near-term improvements in LWD conditions under the FPHCP will be in small streams where small- to moderate-sized wood will function. Increased wood in smaller streams will result in greater stream complexity and sediment storage and, therefore, improved spawning and rearing habitat for bull trout and other resident trout. Adequate wood in small, steep streams can also provide additional habitat for resident fish by moderating channel gradients and providing access farther upstream. In larger streams, wood-related habitat features require longer time periods to recover due to the larger sized wood requirements and the early-seral nature of many riparian zones. Thus, spawning and rearing habitat improvements for mainstem spawners such as chinook and chum will take longer to develop. LWD placement will be encouraged in these larger streams to accelerate habitat recovery. Existing stream-adjacent roads reduce LWD recruitment because they displace trees that would naturally recruit to stream channels. Under the FPHCP, locating new roads away from surface waters and wetlands and abandonment of existing roads will improve future wood recruitment to streams.

Temperature

Temperatures in smaller streams are expected to respond most quickly to improved riparian conditions, due to greater potential shading and lower flow volumes. Headwater species such as bull trout and other resident trout will benefit most from reduced water temperatures. Temperatures in larger channels are expected to respond more slowly to improved riparian conditions due to lower potential shading, higher flow volumes and, in some channels, altered morphologies associated with past sediment impacts. Thus, temperature-related benefits to mainstem species such as chinook, chum and pink salmon will be slower to develop. Stream-adjacent roads have the potential to increase stream temperatures due to displacement of trees that would normally provide shade. Additional delivery of fine sediment from roads can also contribute toward increased stream temperatures through altered channel morphology. Locating new roads away from streams and abandonment of existing roads should improve shade conditions in many areas. Furthermore, improved road construction and maintenance practices should minimize delivery of sediment to streams.

Sediment

Roads are the largest source of sediment on managed forestlands. From a habitat standpoint, fine sediment can impact spawning gravels and egg survival, and fill pools needed for rearing. Coarse and fine sediments entering small headwater channels are routed to downstream depositional reaches where they can affect lower mainstem fish species such as chinook, chum, steelhead and coho. Reductions in sediment inputs are expected as a result of improved construction and maintenance practices and higher levels of road abandonment. Improved habitat conditions will develop sooner in headwater streams, which are most closely linked with the road network. Bull trout and other resident trout will benefit most in terms of improved spawning and rearing conditions in headwater streams. Habitat recovery will be slower to develop in lower mainstem channels.

Habitat Availability

Some fish habitat on covered lands is currently inaccessible due to human-caused blockages associated with forest roads. One goal of the FPHCP is to remove all fish blockages on covered lands before the end of 2016 according to a “worst first” principle. Effects will be to restore access to habitat that has been unavailable for periods ranging from a few years to decades. Species most likely to benefit in the short-term will be those inhabiting reaches lower in the system, as those barriers are likely to be corrected first. It is likely that fish passage blockages are most abundant in headwater streams where the forested road network is concentrated. Technology for fixing barriers in smaller, steeper streams in a more economical way is improving over time; these barriers will most likely be addressed over the longer term. According to forest practices rules, installation of new stream crossing structures must provide for fish passage at all life stages; therefore, future road construction is not expected to reduce available habitat.

AMPHIBIANS AND THEIR HABITATS

Large Woody Debris

Variable levels of near-term improvement are expected in small streams where small- to moderate-sized wood may form small steps (Jackson et al. 2003). These steps can provide stable in-stream structures used as refuges and breeding sites for several in-stream amphibian taxa. As headwater streams are largely colluvial-dominated, a greater level of improvement can be anticipated over the longer term. Larger wood will be contributed from older trees in buffers that become available to form variable-sized sediment wedges and larger-scale, more complex in-stream habitat for amphibians. It is likely that these latter effects will require several decades to develop. In either case (of smaller or larger streams), additions of progressively larger wood are expected to improve sediment retention in ways that both improve amphibian habitat locally and better protect amphibian and fish habitat downstream.

Temperature

Temperature variability in small headwater streams tends to be high due to low flow volumes. This variability often decreases with increasing distance downstream. Historically, high headwater stream temperatures associated with past riparian timber harvest are expected to respond more rapidly to improved riparian conditions. These conditions can be expected to improve habitat for in-stream amphibians, virtually all of which have lower temperature requirements. Amphibian habitat in larger streams will benefit through improved water quality conditions in upstream reaches.

Sediment

Significant near-term improvement of in-stream amphibian habitat can be expected due to a combination of better road maintenance and abandonment practices and improved riparian conditions along headwater streams. In particular, greater protection of headwater streams will reduce both direct sediment inputs and those associated with bank disturbance from near-stream harvest activity (Jackson et al. 2003). This is expected to improve the interstitial substrate structure used as refuges during some life stages of all in-stream amphibians. Amphibian habitat in larger streams will benefit through improved water quality conditions (reduced sediment loading) in upstream reaches.

Habitat Availability

Riparian function improvement will increase near-stream terrestrial habitat available for terrestrial stream-associated amphibians (i.e., Dunn’s and Van Dyke’s salamanders) and the post-metamorphic stages of all in-stream amphibians. It will also indirectly increase in-stream habitat structure and complexity, which represents habitat for the early stages (eggs and larvae) of in-stream amphibians. This increase in habitat availability is expected to improve downstream habitat conditions.

4e-4 Summary

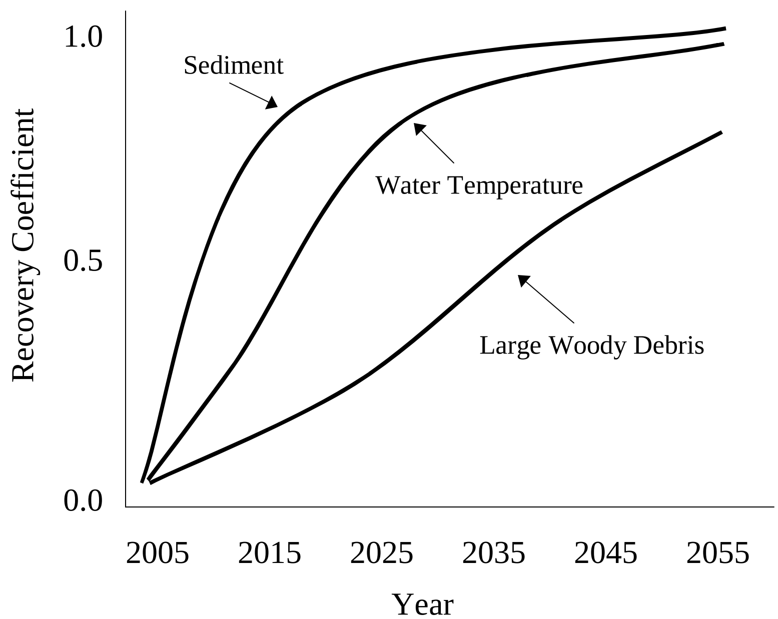
This assessment suggests that of the 9.3 million acres covered by the FPHCP, protection of approximately 2.6 million acres is required to avoid adverse affects to covered species. These 2.6 million acres are collectively referred to as the “critical area” under the minimal effects strategy and include riparian zones adjacent to Type S, Type F and Type Np waters and high-hazard unstable slopes. Under the minimal effects strategy, no silvicultural activities would occur in the critical area. The FPHCP protects approximately 2.1 million acres—or 79 percent—of the minimal effects critical area. Thus, the difference between the two strategies is approximately 548,000 acres, or six percent of the land area covered by the plan.

Implementation of the FPHCP will produce improved habitat conditions for covered species across forestlands managed under the plan. Riparian protection measures will likely provide adequate levels of wood recruitment and shade, while roads and unstable-slopes measures will substantially reduce existing sediment sources and limit future inputs. These protection measures will be implemented at a time when many riparian and aquatic systems are still recovering from impacts stemming from a legacy of unregulated forest practices conducted prior to the 1974 Forest Practices Act. Implementation of FPHCP protection measures will not only conserve existing habitats, but will also foster habitat recovery, improving prospects for the continued survival of species across covered lands.

Recovery trends for large woody debris, water temperature and sediment expected as a result of FPHCP implementation are illustrated in Figure 4.14. Implementation of erosion-related measures, particularly road maintenance and abandonment plans, should greatly accelerate the recovery of habitat conditions affected by sediment. However, full recovery is not expected for decades, primarily due to slower system responses to past coarse sediment impacts. Water temperatures should respond fairly quickly to improved riparian protection measures, though full recovery is dependent upon riparian canopy development (i.e., increased shade) and channel responses to reduced sediment inputs (i.e., narrowing). The slowest recovery will be for in-channel large woody debris, which is a function of riparian forest growth. Although most small channels are likely to recover within a few decades, full recovery of larger channels that require larger wood is expected to take more than 100 years. Unlike sediment and water temperature, woody debris loads are not expected to experience full recovery prior to the 50-year life of the FPHCP.

Under the ESA, issuance of an Incidental Take Permit must meet the issuance criteria identified in Section 10(2)(2)(B) of the ESA, which includes a determination that the activity would not "…appreciably reduce the likelihood of the survival and recovery of the species in the wild…." This is identical to the "jeopardy" definition under the Section 7 regulations (50 CFR Part 402.02) (USFWS and National Marine Fisheries Service 1996). The above assessment suggests the FPHCP provides protection for 79 percent of minimal effects critical area acres. Protection measures in these areas are designed to sustain watershed processes important to the creation, maintenance and recovery of habitat for covered species. In many cases, the extent to which the FPHCP will achieve established resource objectives and performance targets is uncertain. The plan includes a robust adaptive management process to address these uncertainties through research and monitoring. Adaptive management is the mechanism for refining protection measures to ensure that program goals (one of which is to achieve compliance with the ESA) are met. Thus, the high level of protection provided under the FPHCP combined with a commitment to adaptive management research and monitoring will ensure the continued survival and recovery of species covered by the plan.

Figure 4.14 Hypothetical time-to-recovery curves for sediment, water temperature and large woody debris under Washington's Forest Practices Habitat Conservation Plan. A recovery coefficient of 1.0 assumes the parameter has attained the maximum recovery possible under the plan.



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