Productivity of Nonindustrial Private Forests in Western Washington: Alternative Futures

Ralph J. Alig, *USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331 and* **Darius M. Adams**, *University of Montana, School of Forestry, Missoula, MT 59812.*

ABSTRACT. *Nonindustrial private timberlands in western Washington have high productive potential and contribute harvest amounts somewhat more than proportional to their area. Of all private ownerships they are influenced the most by land use shifts and are affected in important ways by forest practice regulations. About 1 million acres of nonindustrial private timberland contain opportunities for timber management intensification that would increase net growth, in many cases offering attractive financial returns. Significant increases in timber growing investments could double softwood harvest levels in the long term. A combination of forest practice regulations to lengthen rotations by 10 yr and a 15% setaside of other timberland with older timber could reduce short-term softwood harvest levels by one-third. West. J. Appl. For. 10(1): 29–35.*

Nonindustrial private forest (NIPF) owners—all private owners other than those that own timber processing facilities—hold over 2 million acres of timberland in western Washington, about a quarter of the total timberland base (MacLean et al. 1992). Although these timberlands are among the world's most productive, their future production possibilities are being re-examined today in the face of significant changes in the use of public land and the prospect of further restrictions in the regulation of private practices. Substantial increases in long-term timber growth per acre, perhaps up to a doubling, may be possible with higher levels of management on these lands, even if relying only on technology available in the 1980s (Boyd 1982). However, forest practice regulations and other institutional factors may in some cases limit realization of this potential.

This paper offers an analysis of future timber productivity alternatives on NIPF ownerships in western Washington. These lands are the second largest source of timber harvests in western Washington, after forest industry, and will become more important given recent reductions in public harvests. NIPF owners are subject to a wide range of market and policy influences, including forest practice regulations, and are the target of government incentive programs for forest management. In addition, changes in the use of private lands (e.g., shifts from forest to suburban housing) have had their greatest impact on this ownership group. We examine the relative importance of factors influencing projected timber supply levels on NIPF land, including the amount and timing of investments in forestry practices. To illustrate future prospects, we develop simulations of NIPF timber growth and harvest under different scenarios of timberland management and land use.

Trends in Land Use and Timberland Management

Trends in timberland area, forest practice rules, and intensity of timber management all play key roles in shaping future supplies of forest resources. These variables, in turn, are influenced by a range of institutional factors, including land use and forest policies.

Timberland Area

Over 140,000 ac of NIPF timberland in western Washington were converted to nonforest uses between 1978–1979 and 1988–1989 (MacLean et al. 1992). The total area of nonforest uses converted to NIPF timberland totaled around 10,000 ac, resulting in a net loss of timberland area to other land uses of 130,000 ac. Converted timberland primarily went to urban and developed uses, such as residences in the Puget Sound area, and rights-of-way. When timberland is converted to other land uses, timber is often harvested, adding to near-term timber supplies but reducing the timber supply potential of the overall timberland base over the longer term.

Population growth is the primary driver in expansion of urban and suburban development and infrastructure, and hence in the decline in NIPF timberland area (Alig and Healy 1987, Parks and Murray 1991). Urban population growth has greatly outstripped rural population growth, particularly in the Puget Sound area that contains the bulk of the NIPF timberland in western Washington. Moreover, personal in-

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come levels have risen markedly since the 1950s, adding to development pressure.

Forest Practice Regulations

Washington has some of the most progressive forest practice regulations in the United States, designed to ensure continuous productivity of forestlands and to protect water, wildlife, fisheries, soil productivity, recreation, aesthetics, and other ecosystem functions and services. Most forest management activities are regulated: timber harvest, road construction, chemical and fertilizer use, slash management, site preparation, and precommercial thinning, among others. Most NIPF timberland receives relatively low levels of timber management; the most common regime is natural regeneration with no intermediate treatments before final harvest (Adams et al. 1992). Less than one-tenth of the NIPF timberland area is estimated to receive timber stand improvement (TSI) practices. Kurtz et al. (1993) likewise found that once established, relatively few NIPF plantations receive any other treatment before harvest. Thus, regulations pertaining to final harvest and reforestation requirements are particularly important for this ownership.

Investment In Timber Practices

Adams et al. (1992) estimated that net growth could be increased on about 1 million acres of NIPF timberland in western Washington. In the 1980s, the area of such treatment opportunities—where timber management could be intensified to increase net growth—increased on NIPF lands by over 200,000 ac, or 22% (FIC 1980). In contrast, the area of treatment opportunities on forest industry lands declined by 280,000 ac or 14% over the same period. During the 1980s, over one-third of industry timberland area was treated before harvest, markedly higher than the one-tenth of NIPF timberland so treated. Differences between industrial and nonindustrial timber management are most pronounced for treatments such as site preparation and planting. The higher rate of treatment for forest industry lands (e.g., higher proportion of area fertilized, thinned, and treated in other ways) is partly responsible for net timber growth per acre that is about 20% higher than on NIPF timberlands (MacLean et al. 1992). Given this industrial experience, to what extent could growth be increased on NIPF timberlands through timber management intensification?

Projections of Timber Supplies

Projections of NIPF softwood harvests in western Washington have differed widely in previous studies; however, most studies project declining harvest levels in the longer term. A comparison of projected softwood harvest levels from five studies—Gedney et al. (1975); Larsen and Wadsworth (1982); Forest Policy Project (1981); Resource Information Systems Inc. (1987); and Adams et al. (1992)—is shown in Figure 1. These are the "baseline" projections in each case, all made under the assumption of constant (then current) forest practice regulations, but with some considerable differences in other assumptions and methods. With regard to method of projection, the Gedney et al., Larsen and Wadsworth, and Adams et al. studies used various forms of even-flow calculations; the Forest Policy Project assumes private owners are wealth (present value) maximizers; and the Resource Information Systems Inc. study links harvest to both sustainability and market (price) factors. The market responsiveness of the Forest Policy Project and Resource Information Systems Inc. approaches explains part of the rising behavior of these two projections in the period to 2000. Intensity of timber management was taken as "constant at recent levels" in the Gedney et al. study and "following recent historical trends" in the Forest Policy Project, Larsen and Wadsworth, and Adams et al. projections; in the Resource Information Systems Inc. projection, NIPF management moves upward to the levels comparable to industrial lands as the projection progresses. This latter difference provides a further basis for expanding harvest in the Resource Information Systems Inc. projection. Finally, land base assumptions also differ substantially. The Resource Information Systems Inc. projection assumes no area change in the western Washington NIPF timberland base, but Gedney et al. assume a 436,000 ac loss between 1980 and 2020, Forest Policy Project a 706,000 ac reduction and Larsen and Wadsworth a 360,000 ac loss over the same period, and Adams et al. a loss of about 200,000 ac between 1990 and 2020.

To provide a common and controlled basis for comparison of the independent effects of variation in land base, management intensity, and forest practice rules alone, we employ the models and methods developed by Adams et al. (1992). The projection method is "fixed look-ahead even-flow" not sensitive to price, thus restricting the focus to the physical growth and inventory impacts of changes in assumptions. In the baseline case shown in Figure 1, the timberland base declines as described above and forest practice regulations are assumed fixed at their late 1992 form. A large majority of existing (1990) NIPF conifer timberland acres are in an extensive timber management class—natural regeneration with no intermediate treatments before final harvest. After harvest, NIPF timberland acres are assumed to return mainly to this same management class.

Changes in Timberland Area

Land use changes can alter both short-term and long-term production potentials of timberlands, especially NIPFs in western Washington. In the baseline case, the rate of timberland conversion to other uses was assumed to decrease across the projection period; nonetheless, more than 500,000 ac of NIPF timberland are projected to be converted during the next 100 yr. In contrast to 98% of industrial private timberland in primary forest zones, over half of NIPF timberland is in low-density suburban-farm and urban zones (Oswald 1984). Thus, increasing urbanization, primarily in the Puget Sound Basin, is the primary cause for the projected loss. Some of the reduction in NIPF timberland area is also due to ownership shifts through acquisition by forest industry, but this only comprises a small part of the overall projected decrease.

To examine the sensitivity of projected NIPF harvest levels to land loss, we developed three scenarios involving

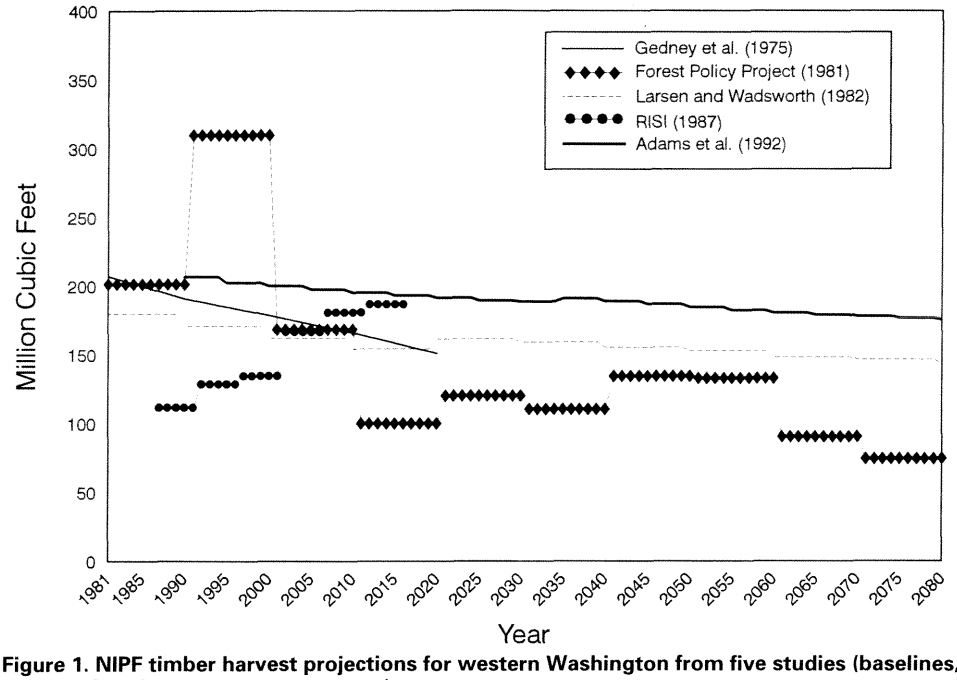

Figure 1. NIPF timber harvest projections for western Washington from five studies (baselines, softwoods only, current management).

the future area of NIPF timberland: (1) no net loss; (2) double the projected loss in the baseline case; and (3) a 15% immediate reduction—equal to about 360,000 ac—by reclassification for critical habitat for wildlife species, wetlands, wildlife reserve trees, and other nontimber purposes (Adams et al. 1992). The third case involved the set aside primarily of older timber, in contrast to a proportional set aside by age class in the first two cases: over 60% of the NIPF timberland acres set aside in the third case had timber that was 70 yr or older.

Figures 2 and 3 show the softwood harvest impacts of these changes. The immediate 15% reduction due to reclassification for nontimber uses results in a relatively sharp drop in NIPF softwood harvest levels, equal to a 11% reduction in short-term harvest relative to the baseline (see Figure 3). In contrast the "double area loss" scenario leads to a slower rate of harvest reduction, in part because some short-term timber volume is harvested during conversion of the timberland (see Figure 2). However, over the long term, less timber volume is harvested, 15% less compared to the baseline case. Under the constant area scenario, projected increases in NIPF harvest above the baseline case are almost equal in absolute value to the decreases under the double area loss. If the NIPF timberland area was held constant over the next 100 yr, NIPF harvests in western Washington could increase 15% by 2090.

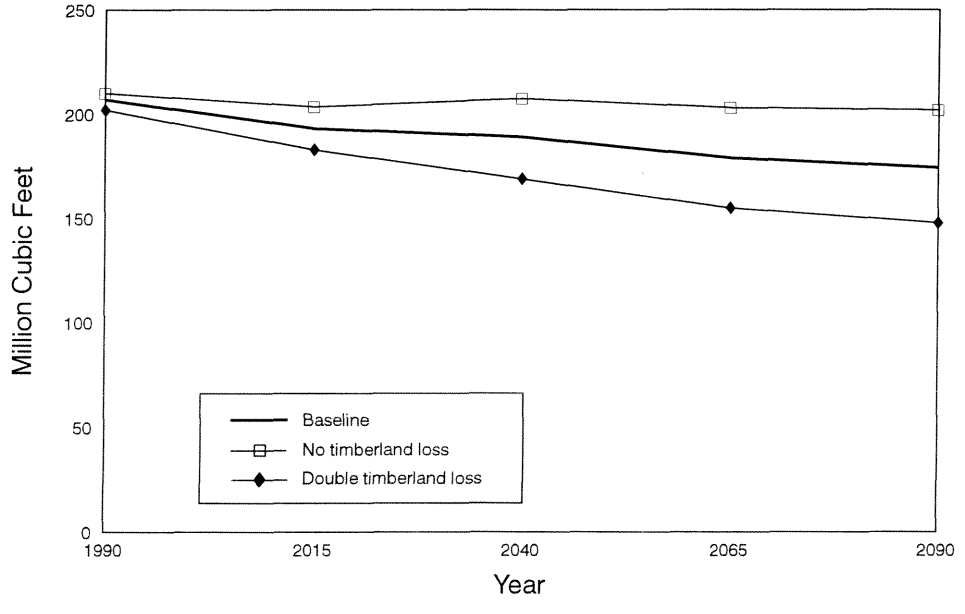

Figure 2. NIPF timber harvest projections for area scenarios for western Washington (softwoods only).

Forest Practice Regulations and Timber Management

Short-term NIPF harvest projections are most sensitive to policies impacting the stock of currently harvestable timber, because these stocks are quite limited. For example, if rotation ages on NIPF lands were to be increased across the board by 10 yr due to some regulation, softwood harvest projected for 1990 to 2005 would be reduced by 11% (Figure 3). If a rotation lengthening on retained timberland is combined with a 15% set aside or reclassification of other timberland for nontimber uses, impacts on short-term harvests are more than a simple summation of separate impacts, rising to a 35% reduction. In the longer term, rotation lengthening regulations raise the level of sustainable harvests as stands are harvested at higher average volumes per acre (see Figure 3) (Curtis 1992). The long-run increment is not as large as the short-term reduction because of the partially offsetting effects of a declining timberland base (as assumed in the baseline case).

Other changes in forest practice regulations, such as required retention of green or dead trees after harvest (including wildlife leave trees) and restrictions on use of herbicides or other silvicultural tools, would reduce harvest yields per acre. Though yields will likely be impacted in more complicated ways in practice, for this sensitivity analysis we used a simple 15% immediate reduction in harvestable per acre volume for both existing and regenerated stands. As shown in Figure 3, the harvest impacts are distributed more broadly across the projection period than the 15% area set aside examined above. A 15% increase in yield (not shown in Figure 3) has a roughly symmetric effect of increasing timber harvests.

Opportunities to Intensify Timber Management

In the baseline case, we assume only modest timber management intensification by NIPF owners, consistent with past trends and conditions. Although we assume a future trend of more timber management intensification relative to past management, the potential for added forest investment is quite sizable. Economic analysis suggests that most of the roughly 1 million acres of NIPF timberland containing opportunities for timber management intensification offer attractive financial returns (Adams et al. 1992). To examine the harvest impacts of accessing such opportunities, we used the forest survey estimates (MacLean et al. 1992) of treatment opportunities in conjunction with expert opinion as guides in constructing two alternative sets of management intensification assumptions: (1) a moderate level, where about half of the acres receiving custodial management in the baseline case, are now assumed to be planted and receive intermediate treatments; and (2) a more optimistic level of investments, where the rate of management intensification is similar to that anticipated for forest industry. In both cases, we assumed that fewer softwood acres would shift to hardwood cover types through natural processes after harvest compared to the baseline projection. We adjusted estimates of opportunities to reflect topography and accessibility considerations (Adams et al. 1992). Over 40% of current timberland has slopes of 30% or greater where ground-based operations are limited (Bettinger et al. 1993), and a similar percentage of the treatment opportunities are on timberland in that slope class.

Figure 4 shows the softwood harvest effects of the two higher levels of timber management investment. The optimistic investment scenario leads to the largest short- and long-term increases. Projected harvests take a large jump upward around 2035–2040. This is the period when softwood stands harvested in the 1990s and regenerated to more intensified classes (as well as converted hardwood stands) would be eligible for the next harvest.

The optimistic scenario for level of timber management intensification results in 10% higher levels of near-term

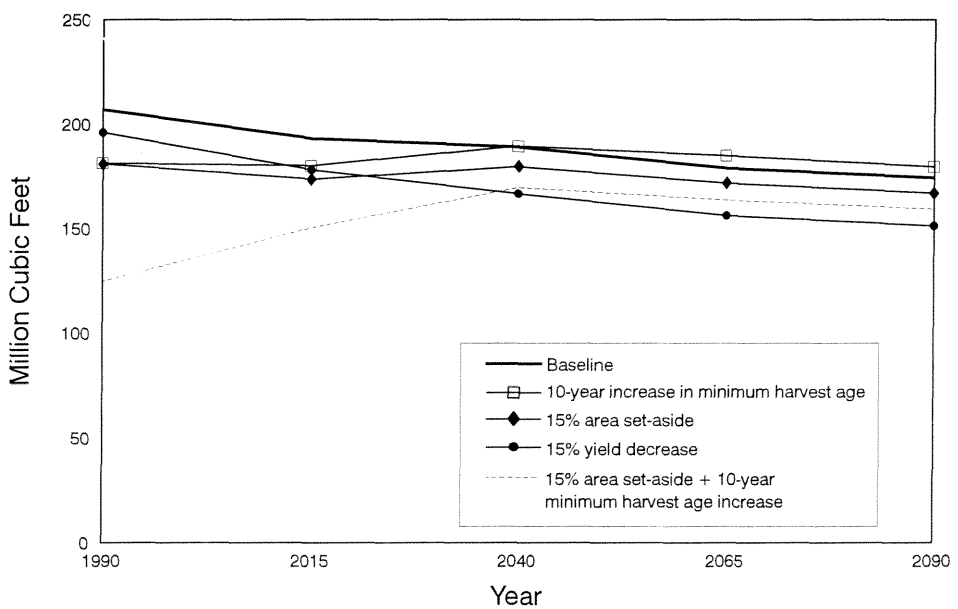

Figure 3. NIPF timber harvest projections for timber management scenarios for western Washington (softwoods only).

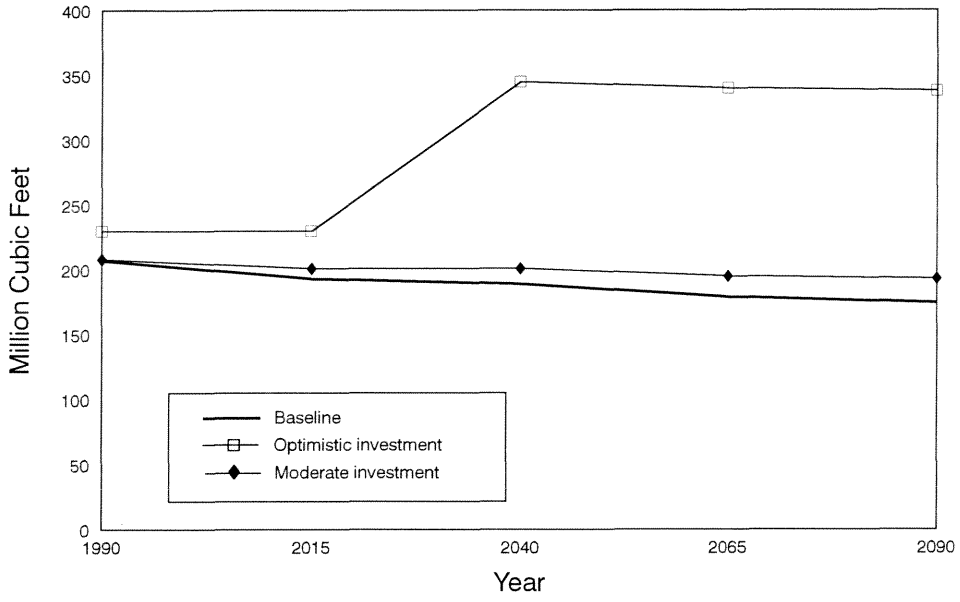

Figure 4. NIPF timber harvest projections for treatment opportunity scenarios for western Washington (softwoods only).

harvest, in large part due to harvest of timber volumes on converted hardwood stands, which remained in hardwoods in the baseline case. The long-term increase is over 90%, almost a doubling over the baseline case. The amount of potential increase is consistent with cumulative net growth increments for the treatment opportunities reported in the most recent forest survey (MacLean et al. 1992) and an earlier study (FIC 1980). The doubling of harvest also is consistent with potential effects of timber management intensification on NIPF lands in western Oregon reported by Sessions et al. (1990).

The moderate intensification scenario results in near-term harvest levels that are 1% higher than the baseline case, and 10% higher in the long term. In contrast to the optimistic scenario, significantly more acres are assumed to be naturally regenerated. This means introducing less genetically improved stock and significantly more acres shift to hardwoods and mixed types through natural processes.

Discussion

The alternative projections of forest resource supplies based on physical growth and inventory span a broad range for both the level as well as the timing of future timber harvests. For example, timber supply increments from implementation of many investment opportunities would be realized mainly in the longer term, 30 yr or more from now. In contrast, imposition of certain forest practice regulations, such as set-asides, would immediately affect relatively large volumes of available timber stocks.

In the short term (the next decade), increases to timber supply must come from existing timber stands. Prime opportunities are either through harvest of stands to be rehabilitated or converted, fertilization of stands in advance of harvest, and commercial thinning of younger stands. These are generally *one-time* increments, in contrast to the increases in longer term productivity possible with regeneration of sites with faster growing species. The cumulative volume of these one-time harvest increments over the next 15 yr is equal to about one and a half years of the average NIPF softwood harvest in recent years from western Washington.

Looking longer term, over the next 100 yr, the cumulative amount of projected increments in NIPF harvest levels due to other timber management intensification (e.g., regeneration using genetically improved stock) is about 10 billion cubic feet. That is roughly equal to 10 yr of total west-side Washington harvest at the average level of recent years, based on the cumulative differences in harvest amounts between the optimistic investment scenario and the baseline case.

In trying to assess the likelihood of the modest or optimistic investment scenarios, we can gain insights into NIPF owner responses by examining historical behavioral tendencies. Historical trends indicate that many NIPF owners are not likely to invest in timber management intensification without some sort of government assistance (Alig et al. 1990). For example, many NIPF owners rely on natural regeneration rather than actively reforesting their harvested tracts. Plantations that are established in many cases on such ownerships are subsidized with government cost-sharing or technical assistance (e.g., use of a public forester) and followup intermediate treatments (e.g., stocking control) are often not implemented (Kurtz et al. 1993). Past surveys suggest that both timber and nontimber objectives are of interest to the majority of NIPF owners (Blatner et al. 1991). Although capital and cash flow limitations faced by certain owners influence behavior, nontimber income as a share of total income has increased in importance for NIPF owners (Adams et al. 1992). Studies indicate that owners are willing to harvest timber once it is mature (Alig et al. 1990), and NIPF harvest levels have increased significantly since the mid-1980s. Toward further understanding of NIPF behavioral responses, an ongoing study is investigating harvest and timber investment responses of NIPF owners across western Washington to the possible expanded regulation of forest practices and other future policy changes (Moore et al. 1994).

Recent stumpage price increases and reduced supply of timber from public timberlands may provide opportunities for accelerating intensification of NIPF timber management. However, timber management costs may increase, including any due to additional regulations. Some studies suggest that NIPF owners tend to respond more strongly to changes in current costs than to future stumpage prices (Alig et al. 1990), consistent with their receptivity to government cost-sharing programs.

Timber treatment opportunities also offer avenues for enhancing nontimber outputs from the forest. For example, thinnings can improve wildlife habitat in many cases. NIPFs possess most of the hardwood lands in western Washington, which are important for wildlife habitat and also are in increasing demand for timber products. Mixed species management also is increasing as some owners prefer to retain at least a partial hardwood component. Levels of softwood timber inventory on NIPF timberlands, under the baseline case, were projected to drop by 27% by 2090, while hardwood inventory drops by 50%. Projected inventory levels drop under all scenarios. Results of the optimistic investment scenario point to one of the key implications for nontimber resource managers, in that hardwood inventory levels are projected to drop much more than in the baseline case. Post-harvest conversion of more hardwood acres to softwood types through additional investment in softwood timber management would contribute to more than an 80% reduction in hardwood inventory by 2090.

Conclusions

NIPF timberlands in western Washington have contributed harvest amounts somewhat more than proportional to their area. Survey data also indicate that overall net growth exceeds harvest and that the volume of growing stock inventory has been increasing. Nonetheless, without significant timber management intensification, even-flow simulations developed here and those of earlier studies (Gedney et al. 1975, Forest Policy Project 1981, Larsen and Wadsworth 1982) project a declining trend in NIPF softwood harvest over the next several decades. NIPF timberlands are the most heavily influenced among forest owner groups by land use shifts, and continued land loss or expanded forest practice regulation could yield even lower harvests.

The area of NIPF timberland is continually subject to changing market forces and regulatory policies that could lead to a cumulative loss of over half a million acres over the next 100 yr. Changes in forest practice regulations could have more immediate and sizable impacts on timber production, by reducing the harvestable portion of the existing stock of timber. Combinations of policies can lead to harvest impacts that are more than a sum of the individual policies acting alone. Intensification of timber management could offset these developments. About a million acres of intensification opportunities across NIPF timberland in western Washington have the potential to double long-term growth. Site rehabilitation and thinning opportunities provide a possible means of expanding harvest even in the relatively tight supply situation projected for the next 10 to 15 yr.

Simulations conducted as part of this study indicate that:

1. doubling the conversion of NIPF timberland to other land uses could reduce long-term NIPF supply of softwood timber supply by 15%;
2. regulations to lengthen timber rotations by 10 yr could reduce short-term timber supply by 10–20%, but could increase longer term timber supply by a smaller percentage;
3. a combination of rotation lengthening as in (2) and a 15% timberland setaside by reclassifying other timberland with older trees for nontimber purposes could reduce short-term harvest by 35%; and
4. significant increases in timber growing investments could increase projected short-term harvest by 10% and by over 90% in the long term.

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