

**BRITISH COLUMBIA
MINISTRY OF FORESTS**

Arrow Timber Supply Area

**Rationale for
Allowable annual cut (AAC) determination**

effective October 1, 1995

**Larry Pedersen
Chief Forester**

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Objective of this document

This document is intended to provide an accounting of the factors considered and the rationale employed in making my determination, under section 7 of the *Forest Act*, of the allowable annual cut for the Arrow Timber Supply Area. The document will also identify where new or better information is required for incorporation into future determinations.

Introduction

The Arrow Timber Supply Area (TSA) lies in the West Kootenay area in the southeastern part of the province. It is located in the Nelson Forest Region, and is administered from the Arrow Forest District Office in Castlegar. The TSA covers 754 079 hectares (ha) and extends along the Arrow Lakes-Columbia River system from the U.S. border in the south to Nakusp and beyond in the north. To the west it is bounded by the Monashee Mountains, and to the east it is bounded by the Selkirk Mountains. The TSA also includes a small area in the northwest, abutting the Revelstoke TSA. The Arrow TSA covers just over half the Arrow Forest District. The remainder of the District is covered by Tree Farm Licences 23 and 3, Valhalla Provincial Park and Monashee Park. The main communities in the TSA are Trail, Castlegar, Nakusp, and Rossland.

The Arrow TSA is characterized by steep, mountainous terrain in the north, with gentler terrain and wider valleys and trenches in the south. Approximately half of the TSA is productive forest land. A significant portion of the productive forest land area is unavailable for timber harvesting for various reasons, including operability, environmental sensitivity, unstable soils and steep slopes, and non-merchantable forest types.

The TSA is situated in the Interior Wet Belt, and its forests are among the most productive in the B.C. interior. Its major biogeoclimatic zones are the Interior Cedar Hemlock, Engelmann Spruce-Subalpine Fir, and Alpine Tundra zones; a few small areas in the Lower Arrow Lakes are classified as Interior Douglas-fir zone. The dominant tree species are Douglas-fir and western larch (occupying over 46 percent of the land base available for timber harvesting); lodgepole pine (17 percent); and balsam (just over 10 percent). Western white pine, ponderosa pine, Engelmann spruce, western redcedar, and western hemlock are also found in the Arrow TSA. As a result of fires at the turn of the century, only 16 percent of all stands are over 140 years. The majority of the stands in the TSA are between 60 and 120 years of age.

The economy of the Arrow TSA is heavily dependent on the forest industry, particularly in the Castlegar/Arrow Lakes portion of the TSA, where income derived from the forest sector accounts for 45 percent of the total income generated in this part of the TSA. Approximately 85 percent of the wood harvested from the Arrow TSA is processed inside the TSA, providing about 600 person-years of direct employment and a further 432 person-years of indirect and induced employment (employment created by service industries and by the re-spending of income earned by employees of businesses involved with the forest industry). Timber harvesting within the TSA also has a substantial impact on induced and indirect employment outside the TSA.

There are four major sawmills in the Arrow Forest District, three of which have major licences in the TSA. These three licensees rely on the TSA for 55 to 60 percent of the wood supply for their mills. The fourth sawmill relies primarily on timber from its tree farm licence. There are also cedar shake and shingle mills, and one large pulp mill in the District.

Mineral processing is the other principal industry in the TSA. Other industries such as tourism and outdoor recreation have been increasing in importance, although they are still relatively small compared to forestry and mineral processing. Agriculture and construction are also relatively small sectors, but still have an important role in the economy of the TSA.

There are no First Nations reserves in the Arrow Forest District. However, the eastern portion of the TSA, up to and including the western shores of the Arrow Lakes, is subject to comprehensive claim negotiation through the B.C. Treaty Commission by the Ktunaxa/Kinbasket Tribal Council. I understand that another portion of the TSA may be subject to negotiation.

History of Present AAC

The allowable annual cut (AAC) for the TSA has been stable for the last decade. In 1983, the AAC was reduced from 640 000 cubic metres to the current AAC of 619 000 cubic metres due to a reduction in the land base available for timber harvesting as a result the creation of Valhalla Provincial Park. Actual harvest levels since 1983 have generally been lower than the AAC, with annual harvests ranging from 500 000 cubic metres to 560 000 cubic metres for the period of 1990 to 1993. The current AAC of 619 000 cubic metres does not include harvest volumes from Timber Licences or private lands. The AAC is currently apportioned by the Minister of Forests as follows:

	Cubic Metres	% of AAC
Major Licences (Forest Licences): 5	489 758	79.1
Small Business Forest Enterprise Program	113 336	18.3
Woodlot Licences	9 700	1.6
Subtotal (allocated)	612 794	99.0
Unallocated (Forest Service Reserve)	6 206	1.0
Total = current AAC	619 000	100

There are five major licensees in the Arrow TSA. As noted above, three have processing facilities located within the TSA; the other two have processing facilities located outside the TSA. Almost 70 percent of the timber harvested under the Small Business Forest Enterprise Program (SBFEP) is used to supply the processing facilities for these five licensees. Private land, timber licences, TFLs 3 and 23, and other sources outside the TSA provide the rest of the timber supply required by the processing facilities owned by the major licensees, as well as the timber supply required by the pulp mill and the other mills in the TSA.

New AAC determination

Effective October 1, 1995, the new AAC for the Arrow TSA will be 619 000 cubic metres, unchanged from the current AAC. This will remain in effect until a new AAC is determined, which must take place within five years of this determination.

Information sources used in the AAC determination

Information considered in determining the AAC for the Arrow TSA includes the following:

- Forest inventory planning file updated to December 1989 (includes spatial information for Visual Quality Objectives), British Columbia Forest Service (BCFS);
- Terrain Resource Information Management (TRIM) data files, 1992;
- Survey Intensity Level (SIL) 3 terrain surveys for parts of the Arrow TSA, 1985-1992;
- Riparian digital file, West Kootenay CORE Table, Mirkwood Consultants, 1993;
- Winter range digital data, Ministry of Environment, Lands and Parks (MELP), 1994;
- Arrow Forest District Development Plan Evaluation Criteria, 1994;
- *Procedures for Factoring Recreation Resources into Timber Supply Analyses*, Recreation Branch, BCFS, December 1993;
- *Arrow TSA Timber Supply Analysis*, BCFS (the "BCFS analysis"), September 1994;
- *Arrow TSA Socio-Economic Analysis*, Resource Systems Management International, New Westminster, September 1994;
- *Arrow Timber Supply Area: Timber Supply Review Discussion Paper*, BCFS, October 1994;
- *Arrow TSA Summary of Public Input*, BCFS;
- *Arrow TSA Timber Supply Analysis*, Arrow Forest Association, Timberline Forest Inventory Consultants ("AFA analysis"), October 1994;
- Integrated Silviculture Information System (ISIS) and Major Licensee Silviculture Information System (MLSIS) records, 1993;
- Five-year timber harvesting development plans, forest licensees and SBFEP, Arrow Forest District, 1993;
- *Watershed Harvesting Guidelines*, Nelson Forest Region, March 1991;
- *Logging Guidelines for Wildlife Habitat Classes*, Fish & Wildlife Branch, Kootenay Region, 1989;
- Soil disturbance surveys, Arrow Forest District/Nelson Forest Region Research Section, 1993;
- Timber Harvesting Database — Billed Volumes, BCFS Timber Harvesting Branch, 1984-1993;
- Licensee cut control letters, 1984-1993;
- Pedro Creek project, BCFS/MELP, Arrow Forest District, 1994;
- Deer Creek project, BCFS/MELP, Arrow Forest District, 1994;
- Licensee mill capacity data, Arrow Forest District survey of mills, 1995;
- Letter from the Minister of Forests to the Chief Forester, dated July 28, 1994, stating the Crown's economic and social objectives;
- Technical review and evaluation of current operating conditions through comprehensive discussions with Forest Service staff, including a meeting in the Arrow Forest District on March 2 and 3, 1995, with a helicopter tour of part of the TSA;
- *West Kootenay-Boundary Land Use Plan*, Commission on Resources and Environment, October 1994.

Role and limitations of the technical information used

The *Forest Act* requires me to consider biophysical as well as social and economic information in AAC determinations. A timber supply analysis and the inventory and growth and yield data used as inputs to the analysis formed the major body of technical information used in my AAC determination for the Arrow TSA. The timber supply analysis is concerned primarily with biophysical factors—such as the rate of timber growth and definition of the land base considered available for timber harvesting—and with management practices. The analysis also indirectly incorporates some economic information such as an operability classification that defines the types of terrain and timber that can be physically and economically accessed given current technology and markets.

However, the analytical techniques used to assess timber supply are simplifications of the real world. There is uncertainty about many of the factors used as inputs to timber supply analysis due to both site variation and ongoing, science-based improvements in the understanding of ecological dynamics.

Furthermore, technical analytical methods such as computer models cannot incorporate all of the social, cultural and economic factors that are relevant when making forest management decisions. Therefore, technical information and analysis do not necessarily provide the complete answer or solution to forest management problems such as AAC determination. The information does, however, provide valuable insight into potential impacts of different resource-use assumptions and actions, and thus forms an important component of the information I must consider in AAC determinations.

In making the AAC determination for the Arrow TSA, I have considered known limitations of the technical information provided. I am satisfied that this information provides a sound basis for my determination.

Statutory framework

Section 7 of the *Forest Act* requires the Chief Forester to consider various factors in determining AACs for TSAs. Section 7 is reproduced in full as Appendix 1.

Guiding principles for AAC determinations

Rapid changes in social values and in our understanding and management of complex forest ecosystems mean that there is always some uncertainty in the information used in AAC determinations. Two important ways of dealing with uncertainty are (i) avoiding unnecessary risk, and (ii) redetermining AACs frequently to ensure they incorporate up-to-date information and knowledge. The latter represents a principle that has been recognized in the legislated requirement to redetermine AACs every five years. The adoption of this principle is central to many of the guiding principles that follow.

In considering the various factors that section 7 of the *Forest Act* requires me to take into account in determining AACs, I attempt to reflect as closely as possible operability and forest management factors that are a reasonable extrapolation from current practices. It is not appropriate to base my decision on unsupported speculation with respect either to factors that could work to increase the timber supply—such as optimistic assumptions about harvesting in unconventional areas, or using unconventional technology, that are not substantiated by demonstrated performance—or to factors that could work to reduce the timber supply—such as integrated resource management (IRM) objectives beyond those articulated in current planning guidelines or the Forest Practices Code.

The impact of the Forest Practices Code on timber supply is a matter of considerable public concern. In determinations made before the Code was brought into force, no final standards or regulations were available at the time the BCFS timber supply analyses were conducted. Accordingly, the analyses were unable to assess the impacts of any new constraints on timber production which might be imposed under the Code. In those determinations I did not consider any more stringent restrictions or additional impacts upon timber supply beyond those anticipated to occur due to the application of guidelines current at the time of determination. However, I assumed that the Code would at least entrench the standards exemplified by those guidelines as statutory requirements.

The Forest Practices Code Regulations were approved by the Lieutenant Governor in Council on April 12, 1995, and released to the public at that time. The Forest Practices Code of British Columbia Act was brought into force on June 15, 1995. Preliminary studies in selected TSAs indicate that under the Code there will be some impacts on timber supply additional to those expected under previous guidelines. In AAC determinations made since the coming into force of the Code, I have viewed with some caution the timber supply projections in the BCFS timber supply analyses for TSAs such as the Arrow, which pre-date the Code. At the same time, I am mindful that the full force of the Code may not be felt during the transition phase of its implementation, and the impacts of specific factors on timber supply may not yet have been assessed on a local basis.

The impact on the timber supply of land use decisions resulting from planning processes such as the Commission on Resources and Environment (C.O.R.E.) process or the Land and Resource Management Planning (LRMP) process is a matter often raised in discussions of AAC determinations. In determining AACs it would be inappropriate for me to attempt to speculate on the impacts on timber supply that will result from land-use decisions that have not yet been taken by government. Thus I do not consider the possible impacts of existing or anticipated recommendations made by such planning processes, nor do I attempt to anticipate any action the government could take in response to such recommendations.

Moreover, even where government has made land-use decisions, it may not always be possible to analyze their timber supply impact in an AAC determination. In most cases, government's land-use decision must be followed by detailed implementation decisions. For example, a land-use decision may require the establishment of resource management zones and resource management objectives and strategies for these zones. Until such implementation decisions are made, it is impossible to properly assess the impact of the land-use decision. However, the legislated requirement for five-year AAC reviews will ensure such decisions are addressed.

The Forest Renewal Plan will fund a number of intensive silviculture activities that have the potential to affect timber supply, particularly in the long term. In general, it is too early for me to assess the consequences of these activities, but wherever feasible I will take their effects into account. The next timber supply review will be better positioned to determine how the Plan may affect timber supply.

Some have suggested that, given the large uncertainties present with respect to much of the data in AAC determinations, any adjustments in AAC should wait until better data are available. I agree that some data are not complete, but this will always be true where information is constantly evolving and management issues are changing. Moreover, in the past, waiting for improved data has created the extensive delays that have resulted in the current urgency to redetermine many outdated AACs. In any case, the data and models available today are superior to those available in the past, and will undoubtedly provide for more reliable determinations.

Others have suggested that, in view of data uncertainties, I should immediately reduce some AACs in the interests of caution. However, any AAC determination I make must be the result of applying my judgement to the available information, taking any uncertainties into account. Given the large impacts that AAC determinations can have on communities, no responsible AAC determination can be made solely on the basis of a response to uncertainty. Nevertheless, in making my determination, I may need to make allowances for risks that arise because of uncertainty.

With respect to First Nations issues, I am aware of the Crown's legal obligations resulting from the June 1993 Delgamuukw decision of the B.C. Court of Appeal regarding "unextinguished non-exclusive aboriginal rights". The AAC I determine for a TSA should not in any way be construed as limiting the Crown's obligation under the Delgamuukw decision, and in this respect it should be noted that my determination does not prescribe a particular plan of harvesting activity within the TSA and it is independent of any decision by the Minister of Forests with respect to subsequent allocation of the wood supply. Aboriginal rights will be taken into account

as far as possible under section 7(3)(a)(v) of the *Forest Act*, and it is expected that these will be respected in the administration of the AAC determined.

Regarding future treaty decisions, as with other land-use decisions it would be inappropriate for me to attempt to speculate on the impacts on timber supply that will result from decisions that have not yet been taken by government.

Overall, in making AAC determinations, I am mindful of my obligation as steward of the forest land of British Columbia, and of the mandate of the Ministry of Forests as set out in section 4 of the *Ministry of Forests Act*.

Consideration of factors as required by section 7 of the *Forest Act*

The role of the "base case":

In considering the factors required under section 7 to be addressed in AAC determinations, I am assisted by timber supply forecasts provided to me through the work of the timber supply review project. For each TSA determination a timber supply analysis is carried out, using a data package of information from three categories: land base inventory, timber growth and yield, and management practices. Using this set of data and a computer simulation model (FSSIM), a series of timber supply forecasts is produced. Each forecast is based on the same set of data, and reflects different decline rates, starting harvest levels, and trade-offs between short- and long-term harvest levels.

From this range of forecasts, one is chosen which attempts to avoid excessive changes from decade to decade and significant timber shortages in the future, while ensuring the long-term productivity of forest lands. This is known as the "base case" forecast, which forms the basis for comparison when assessing the effects of uncertainty on timber supply.

Because it represents only one in a number of theoretical forecasts, and because it incorporates information about which there may be some uncertainty, the base case forecast is not an AAC recommendation. Rather, it is one possible forecast of timber supply, whose validity—as with all the other forecasts provided—depends on the validity of the assumptions incorporated into the computer simulation used to generate it.

Therefore, much of what follows in the considerations outlined below is an examination of the degree to which all the assumptions made in generating the base case forecast are realistic and current, and the degree to which its theoretical estimates of timber supply must be adjusted, if necessary, to more properly reflect the current situation.

These adjustments are made on the basis of informed judgement, using current information available about forest management, which—particularly during the period leading up to, and now during the implementation of, the Forest Practices Code—may well have changed since the original data package was produced.

Thus it is important to remember, in reviewing the considerations which lead to the AAC determination, that while the timber supply analysis with which I am provided is integral to those

considerations, the AAC determination itself is not a calculation but a synthesis of judgement and analysis in which numerous risks and uncertainties are weighed. Depending upon the outcome of these considerations, the AAC determined may or may not coincide with the base case forecast. But once an AAC has been determined that reflects appropriate assessment of all the factors required to be considered, no additional precision or validation may be gained by attempting a computer analysis of the combined considerations to confirm the exact AAC determined—it would be impossible for any such analysis to fully incorporate the subtleties of the judgement involved.

For the Arrow TSA, the base case projection indicated the initial harvest level could be maintained at the current AAC of 619 000 cubic metres for another seven decades, declining thereafter by approximately 10 percent per decade before reaching the long-term harvest level of 422 000 cubic metres in decade 11.

The Forest Act, section 7 (3)

In determining an allowable annual cut under this section the chief forester, despite anything to the contrary in an agreement listed in section 10, shall consider

(a) the rate of timber production that may be sustained on the area, taking into account

(i) the composition of the forest and its expected rate of growth on the area

Inventory information

-general comments

The last inventory in the Arrow TSA was conducted in 1977 and covered most of the TSA. The inventory information was updated in 1990, using growth projections to December 1989, to account for changes to the forest, including those due to harvesting and fire. This update does not account for harvesting and other changes to the forest occurring in the last six years. The information was also updated for the purposes of the BCFS analysis to incorporate inventory information on visually sensitive areas.

- age class structure

Almost 55 percent of the forests covering the land base available for timber harvesting (also known as the "timber harvesting land base") in the Arrow TSA are between the ages of 60 and 120 years due to a history of extensive fires. Only about 16 percent of the timber harvesting land base is occupied by old-growth forests (older than 140 years). As the available old growth stands are harvested, harvesting must shift to the younger, fire-origin stands, which will tend to have lower average volumes per hectare because they will be harvested at a younger age. This means that a relatively greater area will need to be harvested to produce the same harvested volume currently produced by the existing

old growth stands. This has implications with respect to forest cover requirements, which have been taken into account in the BCFS analysis.

- *site index estimates*

Inventory data includes estimates of site productivity, which is usually expressed in terms of "site indexes". Site index is based on tree height as a function of the age of a particular forest stand. The productivity of a site largely determines how quickly trees will grow, and therefore affects expectations of the time seedlings will take to reach green-up conditions, the volumes of timber that will grow in regenerated stands, and the age at which those stands will reach merchantable size or minimum harvestable age.

The AFA analysis disagreed with the site indexes used in the BCFS analysis for existing old growth stands. The AFA submits that these site indexes do not reflect the productivity those sites will show when regenerated.

Determining the site index for old growth stands is often difficult. If the stocking density of these stands has not been controlled, the trees measured for the purpose of determining the site index may have grown under intense competition or may have been damaged, and therefore may not reflect the productive potential of the site. While there is no direct evidence showing that site indexes in the Arrow TSA have been underestimated, there is some evidence indicating that site indexes in other areas of the province have been underestimated. A provincial paired-plot survey, which is examining this issue, is expected to be completed by the spring of 1997 and will provide the statistically sound information required to assess site indexes in particular areas, including the Arrow TSA.

In the AFA analysis, when an old growth stand is harvested and regenerated, the site index for the regenerated stand is adjusted based on site indexes derived from 'thrifty stands'—defined as existing stands between the ages of 35 and 150 years (or 35 to 125 years in the case of pine). Thus the site indexes for regenerated stands in the AFA analysis are significantly higher than those used in the BCFS analysis. This contributes to the higher overall estimate of regenerated stand volumes projected in the AFA analysis (see below, *volume estimates for regenerated stands*).

This site index adjustment also has implications for the AFA analysis' estimate of green-up and minimum harvestable ages. If site indexes are higher, the estimated time required for stands to reach green-up is decreased, which could increase the estimated short-term timber availability by allowing adjacent stands to be harvested sooner. Furthermore, because the estimated rate of growth would be faster with higher site indexes, minimum harvestable ages for regenerated stands could be decreased, i.e. trees would be assumed to be large enough to harvest at an earlier age (see below, *minimum harvestable ages*). This could also increase the estimated short-term availability of timber.

I am not satisfied that the AFA analysis is correct in assuming that the site indexes used in the BCFS analysis for existing old growth stands underestimate site productivity. As noted above, there is no direct evidence at this time of any such underestimation in the

Arrow TSA. When the paired plot information is available, I will be in a position to determine what site index adjustments, if any, would be suitable to apply in this TSA.

However, even assuming the AFA analysis is correct, adjustments to site indexes for existing old growth stands would only affect the volume estimates for regenerated stands; there would be no effect on the volume estimates for existing stands. In addition, old-growth stands represent a relatively small component of the timber harvesting land base (approximately 16 percent). I conclude therefore that even if site indexes have been underestimated, the short-term impact on timber supply would be relatively small. Accordingly, while I have considered the possibility that site indexes for existing old growth stands are underestimated in the BCFS analysis, I do not believe this possibility represents a serious cause for concern in this determination.

- *aggregation procedures*

Every TSA land base is divided into polygons for inventory purposes, and each polygon is classified according to tree species composition, heights and ages, and the sites on which they grow. Polygons with similar characteristics are aggregated for timber supply analysis purposes.

Different approaches to aggregation may prove equally valid, provided important differences between similar polygons are recognized. In the case of the Arrow TSA, the BCFS analysis and the AFA analysis use different approaches to aggregation. However, neither BCFS staff nor the AFA have detected any problems with either approach.

- *volume estimates for existing mature stands*

The BCFS analysis used the Variable Density Yield Projection (VDYP) growth and yield model to estimate volumes for existing mature stands. VDYP is generally accepted as the appropriate model for these types of stands. However, the accuracy of the resulting estimates has been questioned by the Arrow District staff. This was raised as a critical factor in the *Timber Supply Review Discussion Paper* for this TSA.

As discussed below (see *decay, waste and breakage* under section 7(3)(a)(iv)), District staff submits that actual volumes for older hemlock, cedar and balsam stands may be 15 percent lower than the volume estimates in the BCFS analysis. This submission is based on the scale returns for a relatively small sample of these timber types.

If the District is correct, this would likely have some impact on the timber supply. A sensitivity analysis included in the BCFS analysis indicates that the harvest forecast is sensitive to decreases in mature volumes for existing stands. The analysis shows that if there is a 10 percent overestimation of volumes for all existing mature stands (not just older hemlock, cedar and balsam stands), the initial harvest level could not be maintained for seven decades, as in the base case; the level would have to decline after four decades in order to avoid a severe drop in harvest levels in the future.

I am not satisfied that scale returns can be used to assess the validity of the volumes for existing mature stands. There may be any number of reasons why estimated volumes and scaled volumes would not coincide. An inventory audit is underway for the province, using volume ratio-sampling to compare actual volumes with estimated volumes. When the audit information is available, I will be in a position to determine whether an adjustment to the volume estimates for existing mature stands is required. At present, I believe the BCFS analysis provides a reliable estimate for the purposes of this determination.

Growth and yield predictions

- volume estimates for regenerated stands

The BCFS analysis also used the VDYP model to estimate volumes for regenerated stands. This model is designed primarily for use in predicting volumes in existing, rather than in managed regenerated stands. Since the BCFS analysis was conducted, a model has been developed specifically for managed stands — the Table Interpolation Program for Stand Yields (TIPSY). Based on my experience of the implications of using VDYP rather than TIPSY for regenerated stands, I would predict that the projected long-term timber supply level could be 20 to 30 percent higher if TIPSY were used. This is confirmed to some extent by the AFA analysis results, although it is difficult to isolate the impact of TIPSY from the impact of other differences in the assumptions used in that analysis. In particular, it is difficult to assess the interaction of TIPSY and the AFA assumptions regarding site indexes for existing old growth stands (see above, *site index estimates*). In addition, other assumptions in the AFA analysis, such as the assumptions used to determine the timber harvesting land base, further affect the projected long-term harvest level in the AFA analysis.

A sensitivity analysis in the BCFS analysis indicates that even if the estimated volumes for regenerated stands were increased by 25 percent, there would be no impact on short-term harvest levels. Accordingly, while I have considered the implications of underestimating volumes for regenerated stands, I do not believe this underestimation represents a serious cause for concern in this determination. Of course, I would expect future analyses to use a managed stand model to estimate volumes for regenerated stands.

I am also mindful that an increase in the estimated volumes for regenerated stands might not fully materialize in all regenerated stands in the Arrow TSA due to the impact of endemic root rot (see *Armillaria root disease* under section 7(3)(e)). This brings me to a discussion of the operational adjustment factors used in the AFA analysis.

- operational adjustment factors (AFA analysis)

TIPSY is based on stands reflecting better than average conditions. Operational adjustment factors (OAFs) are therefore applied to TIPSY yield predictions for regenerated stands in order to account for conditions one would normally expect to see in the field which would result in loss of timber volume due to such factors as openings in

stands, pests and diseases. In the AFA analysis, the analyst first applied OAFs developed by the BCFS Research Branch. The resulting TIPSy yield curves were then further adjusted by increasing the volumes by 10 - 15 percent for stands over 200 years old. I am not convinced that this further adjustment provides a justifiable view of future growth, partly because no rationale was provided to explain the basis for the adjustment. In particular, there is no indication that this further adjustment reflects actual site conditions such as the effects of root rot, which affects stand establishment and growth in many areas of the TSA (see *Armillaria root disease* under section 7(3)(e)). I recognize that it is extremely difficult to assess the impact of root rot on regenerated stands. However, if the impact of root rot could have been assessed and incorporated into the AFA analysis, I believe the estimated regenerated stand volumes would have been lower, but probably not as low as the estimated regenerated stand volumes in the BCFS analysis.

This conclusion reinforces my belief that any underestimation of volumes for regenerated stands in the BCFS analysis does not represent a serious cause for concern in this determination. The difference between the BCFS analysis and the AFA analysis may be partially offset by the impact of root rot on regenerated stands. Also, as noted above, the impact of underestimating volumes for regenerated stands does not affect the short-term timber supply. Nonetheless, I do expect this matter to be more fully investigated and clarified prior to the next AAC determination.

Minimum harvestable ages

Minimum harvestable age is the average time required for trees to reach the minimum harvestable size. In the BCFS analysis, the minimum harvestable ages used in the 1981 Arrow Timber Supply Analysis were adjusted based on the District staff's knowledge of the TSA, which reflects their extensive operational experience, and knowledge of preliminary VDYP stand volume and diameter tables, which were used to approximate the age at which a minimum harvestable piece size would be attained. These ages ranged from 70 to 140 years.

In the AFA analysis, minimum harvestable age was assumed to be the culmination age—the age at which the annual rate of growth of a forest stand is at a maximum. Culmination ages in the AFA analysis were estimated to range from 60 to 178 years. Culmination ages are commonly used in timber supply analysis and I believe their use to be an acceptable alternative to the approach used in the BCFS analysis. However, the culmination ages in the AFA analysis were based on yield curves influenced by site index adjustments which I do not accept (see above, *site index estimates*). Therefore, while there may be some uncertainty regarding the appropriate minimum harvestable ages, on balance, I consider the ages used in the BCFS analysis to be more reliable.

Land base contributing to timber harvest

The total area of the Arrow TSA is 754 079 hectares. The land base that is considered available for timber harvesting (the "timber harvesting land base") is limited by inoperability, environmental sensitivity, non-merchantable forest types, steep slopes and unstable soils, non-commercial forest cover types, and use of the area for purposes other than timber production. Reasonable assumptions, and if necessary, projections, must be made about these factors and appropriate areas must be deducted from the productive forest area to determine the timber harvesting land base. The timber harvesting land base determined for the purposes of the BCFS analysis was 216 760 hectares.

There may be more than one reason to deduct an area from the timber harvesting land base. It is important to ensure an area that has already been deducted for one reason is not deducted again for another reason. BCFS staff have confirmed that no such "double counting" has occurred with respect to the deductions in the BCFS analysis.

It is also important to ensure the timber harvesting land base reflects reasonable assumptions regarding operability. Operability was defined in the BCFS analysis according to slope, topography, access, soil stability, elevation and terrain characteristics. It is possible that there may be an opportunity to increase the size of the operable land base in the future if changes in technology and markets enable harvesting to occur in areas that are currently inoperable; however, nothing would suggest there is any reasonable basis for projecting such an increase at this time.

It is equally important to ensure all areas unavailable for timber harvesting are in fact deducted from the timber harvesting land base. In this regard, BCFS staff have identified a concern regarding the deductions for sensitive soils and terrain.

To account for sensitive soils and terrain, the BCFS analysis deducted 90 percent of all areas with highly sensitive soils. An additional deduction was applied to account for those portions of Class 1 and 2 watersheds which will be not be available for timber harvesting (these sensitive domestic use watersheds are discussed below, see *watershed guidelines* under section 7(3)(a)(v)). These deductions were made to account for areas of high and extreme mass wasting hazard that had not already been deducted from the timber harvesting land base as sensitive soils or inoperable sites. Further reductions in the BCFS analysis were made based on existing TRIM (Terrain Resource Information Management) data to account for steep slopes within the operable land base.

Not all Class 1 and 2 watersheds have been covered by TRIM mapping. District staff submitted that an additional deduction should be made to reflect those areas not covered by TRIM mapping. They suggested a deduction of two to three percent. However, while there appears to be a risk of underestimating the expected level of constraints on the land base, in the absence of TRIM mapping, I have no way to assess the appropriateness of the suggested deduction. I expect this matter to be resolved prior to the next AAC determination for the Arrow TSA.

The land-use impacts which might result from the West Kootenay-Boundary Land-Use Plan are another cause for concern. At this time, the only decisions that have been made by government are the creation of the Goat Range (White Grizzly) and Syringa Creek protected areas. Together these two areas represent about 4 900 ha, or 2.3 percent of the timber harvesting land base, and about 2 percent of the merchantable volume for the Arrow TSA.

I am also aware that the timber supply impact of the two protected areas may be offset by other aspects of the land-use decision. As noted under *Guiding principles for AAC determinations*, government's land-use decision generally must be followed by detailed implementation decisions. This is the case with the West Kootenay-Boundary Land-Use Plan. Until the necessary implementation decisions are made, it is impossible to properly assess the overall timber supply impact of this land-use decision.

Given the ability of the timber supply in the Arrow TSA to support the current harvest level for several decades, and the relatively small size of the land base reductions resulting from government's land-use decisions, I am satisfied that this factor does not introduce unacceptable risks and I have made no adjustment for the two protected areas in this determination. Moreover, as I also note, due to the complexity and time requirements of the timber supply analysis process, it may not always be possible in the current round of analyses to address some land-use decisions that have already been made. Of course, analysis should be carried out before the next determination to quantify the timber supply implications of these land-use decisions. The legislated requirement to revisit AAC determinations will ensure such decisions will be addressed within five years.

The AFA analysis raises somewhat different considerations. The AFA analysis included two sets of options, one using on the land base assumptions from the BCFS analysis, and one using a different set of assumptions. The latter set of assumptions resulted in a timber harvesting land base of 241 762 hectares, which is 10 percent larger than the timber harvesting land base in the BCFS analysis. Based on this larger timber harvesting land base, the AFA analysis indicates that an initial harvest level of 780 000 cubic metres per year could be maintained for 10 years, using the same forest management assumptions used in the BCFS analysis, but only if harvest levels were allowed to fall slightly below the long-term level for 30 years.

The AFA analysts did not deduct areas designated as environmentally sensitive due to soil concerns and recreation values, contending that these areas are adequately accounted for through deductions for operability, steep slopes, and mass wasting, and through the application of forest cover requirements. I disagree. The analytical process followed by BCFS staff is premised on the need to avoid such overlap or "double counting". Deductions are not made for environmentally sensitive areas if these areas have already been accounted for under deductions for other reasons (e.g. operability, steep slopes, etc.). I am satisfied that the BCFS analysis for the Arrow TSA properly followed this process.

Another reason for the larger timber harvesting land base in the AFA analysis is that a smaller deduction was made for existing roads, trails and landings on the assumption that the inventory description of crown closure (i.e. the description of spaces in the stand canopy) would account for any roads that have not been specifically accounted for on the inventory file. BCFS staff acknowledge that the possibility that crown closure does account for at least some roads warrants further investigation. However, pending the results of such an investigation, I am satisfied that the reductions for roads, trails and landings in the BCFS analysis are acceptable.

For these reasons, I do not accept the larger timber harvesting land base used in the AFA analysis. I am satisfied the timber harvesting land base used in the BCFS analysis more closely reflects areas actually available for harvest.

Timber licence reversions

Timber licences are old tenure arrangements that give a licensee exclusive rights to harvest merchantable timber within the licence area. Once these areas have been harvested, all future harvesting rights revert to the Crown. Where a timber licence is surrounded by or contiguous to a TSA, future harvests from the area will then contribute to the AAC for the TSA. Accordingly, in the BCFS analysis, timber licences in the Arrow TSA are assumed to be included in the operable land base when reversion takes place.

In this TSA, there are three active timber licences which cover a total of 1 835 hectares. These licences are scheduled to revert over the next 35 years to Crown land, after being harvested and restocked. The reversion schedule has been accounted for in the BCFS analysis, and I am satisfied the contribution to the timber supply from these areas has been properly reflected for the purposes of my AAC determination.

Harvest profile

In the BCFS analysis, it is assumed that harvesting will be distributed throughout the timber harvesting land base, and over the range (or profile) of sites and forest conditions that exist.

BCFS staff advise me that harvesting in the TSA has not been well distributed geographically across the timber harvesting land base, because harvesting has been avoided in certain areas due to public pressure and historical uses incompatible with timber harvesting. As a result, harvesting has been concentrated in the less contentious areas of the TSA. Much of the remaining mature volume in these areas cannot be harvested until adjacent areas meet green-up requirements. If current harvest levels are to be maintained, more harvesting must take place in those areas which were contentious prior to the land-use decision by government. I will return to this issue below: see *planning deferrals* under section 7(3)(a)(vi).

In the BCFS analysis, it is also assumed that older stands will be harvested before younger stands, subject to the following constraint. Harvesting in hemlock and cedar and balsam timber types for the first two decades is limited to the standing forest profile to more closely represent the harvesting pattern that could reasonably be expected in the TSA. In this regard, the BCFS analysis for the Arrow TSA takes a somewhat different approach to that taken in many other TSAs.

I believe the approach taken in the BCFS analysis is appropriate for the Arrow TSA. In any case, limiting the timber types harvested in this manner does not affect short-term harvest levels; rather, it simply affects the age and species profile of the harvest.

(ii) the expected time that it will take the forest to become re-established on the area following denudation;

Not-satisfactorily-restocked areas

There is currently a total of 7481 hectares of not-satisfactorily-restocked (NSR) areas in the Arrow TSA. Both current and backlog NSR areas are scheduled to be restocked within the next five years. This was taken into account in the BCFS analysis, and I am satisfied the impact on the timber supply has been properly reflected for the purposes of my AAC determination.

Regeneration delay

Regeneration delay is the period of time between harvesting and the date by which an area is occupied by a specified minimum number of acceptable well-spaced trees. Silviculture records dating from 1982 to the present show that the regeneration delays in the Arrow TSA range from three to nine years, depending on site quality and tree species. The longer regeneration delays in some areas are at least partly attributable to the effects of brush on stand establishment.

The three- to nine-year range in regeneration delay is reflected in the BCFS analysis, but not in the AFA analysis. In the latter analysis, regeneration delays were assumed to be three years for all species and site qualities. I am not prepared to accept this assumption, since current silvicultural records for the TSA indicate otherwise. It may be possible to reduce regeneration delays in the future; however, without evidence that this is being achieved on the ground, I am unwilling to speculate on the potential timber supply implications of decreased regeneration delays. Furthermore, a sensitivity analysis in the BCFS analysis shows that, under the modelling constraints in the BCFS analysis, the harvest forecast is not sensitive to shorter regeneration delays.

(iii) silvicultural treatments to be applied to the area;

Silvicultural systems

In the Arrow TSA, partial cutting harvesting systems such as shelterwood, seed tree, group selection and species selection systems currently account for approximately 10 percent of the total harvested volume.

Partial cutting may provide an opportunity to increase access to areas in the TSA in which little harvesting has taken place due to land use contention prior to the government decision. However, a more extensive partial cutting program in the TSA is limited by terrain, species suitability and root rot, and BCFS staff advise me that in order to expand the use of partial cutting (particularly on steep slopes), suitable equipment, training and expertise must be made available. Accordingly, while the opportunities presented by partial cutting may assist in maintaining harvest levels, they must be viewed with caution.

The BCFS analysis accounted for some of the partial cutting taking place in the visual quality management zones, but did not take into account partial cutting occurring in other management zones. Thus, the analysis may have underestimated timber availability in some zones of the TSA. However, most partial cutting takes place in visual quality

management zones and any such underestimation would be small. For this present determination I have no information to suggest that current levels of use of partial cutting practices will affect the short-term harvest level. Accordingly, I have made no adjustment on this account in my determination.

Incremental silviculture

Silviculture programs such as juvenile spacing are currently limited by the presence of endemic root rot in many stands in the TSA.

There is some opportunity for commercial thinning in stands in the 40- to 80-year range (most of which are pine), but this opportunity is similarly limited by root rot, and to date there has been no commercial thinning in the TSA. In general, partial cutting and commercial thinning may be used to alter the timing and availability in the short and long term. Consideration should be given to the application of these systems in the TSA, taking into account the possible short-term benefits and long-term implications.

(iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area;

Utilization standards

In the BCFS analysis, the utilization standards assumed were 17.5 cm diameter at breast height (dbh) for all species other than pine (which must be harvested down to a 12.5 cm dbh), a 30 cm stump height, and a 10 cm top diameter. However, the SBFEP is currently requiring that all species be utilized to 12.5 cm dbh ('high utilization'), and District staff advise that some major licensees are also attaining this level of utilization in some areas of the TSA.

There is even a potential for 'super utilization'—i.e. harvesting trees to 5 cm tops and utilizing trees with higher proportions of rot. Some super utilization is being done in the East Kootenays, although it is not currently being done in the Arrow TSA. District staff suggest if super-utilization becomes current practice in the Arrow TSA, it might increase timber supply by five percent. However, I am not satisfied at this time that super utilization will become standard practice in the TSA.

I conclude that both high utilization and super utilization could be used to offset some of the constraints on timber supply in the TSA. High utilization is currently achieved on a portion of the TSA, and I consider this factor to have an unquantified upward influence on short-term timber supply, subject to my comments below on biodiversity requirements. However, until super utilization becomes the new standard in the TSA, the timber supply implications of super utilization remain speculative.

I note that high utilization and super utilization may conflict with coarse woody debris requirements for biodiversity by removing *too much* wood from a harvested site. These objectives must be reconciled before high utilization, and particularly super utilization, are applied throughout the TSA.

Decay, waste and breakage

District staff suggest that an underestimation of decay, waste and breakage may account in part for the reported discrepancy between expected volumes for existing mature stands based on VDYP and what is actually achieved. However, this has not been confirmed.

The accuracy of decay, waste and breakage factors is currently being reviewed. When the results of this review are available, they will be incorporated into future timber supply analyses. In the meantime, I am satisfied that the existing decay, waste and breakage factors represent the best information available for use in this determination.

(v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production;

Integrated Resource Management (IRM) objectives

As provided in the *Ministry of Forests Act*, the purpose and function of the Ministry of Forests is to manage, protect and conserve the forest and range resources of the Crown and to plan the use of these resources to ensure production and harvesting of timber and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated. Accordingly, the extent to which integrated resource management (IRM) objectives constrain the timber supply must be considered in AAC determinations.

- length of green-up period

Blocks adjacent to harvested cutblocks are not available for harvest until the harvested cutblocks have been regenerated, and the regenerated stands have attained an acceptable 'green-up' height. The estimated age at the time the green-up height is attained is referred to as the green-up age. In the BCFS analysis, it was assumed that the green-up age was 17 years. Given a regeneration delay of three to nine years, this means the total green-up period ranges from 20 to 26 years.

The length of green-up periods was identified as a critical factor in the *Timber Supply Review Discussion Paper*. The *Discussion Paper* indicated there was a difference between the actual green-up period in the field and the green-up period assumed in the BCFS analysis. Concerns were expressed during the public input process regarding this apparent difference. I have examined this issue in detail, and I am satisfied that appropriate allowances were made for regeneration delay and that the green-up period as assumed in the BCFS analysis is appropriate.

However, there is one outstanding consideration with respect to length of green-up periods. District staff advise me that the effects of *Armillaria* root rot could increase the amount of time required for some stands to meet green-up requirements due to low stocking or reduced tree vigour. However, current information on the impact of root rot on the length of green-up periods is not adequate to assess the timber supply implications. BCFS staff are currently engaged in studies to quantify the impact of *Armillaria* root rot

on the length of green-up periods, and I anticipate this information will be available for the next analysis for this TSA.

The impact of longer green-up periods could be offset if site indexes have been underestimated, as suggested by the AFA analysis (see above, *site index estimates* under section 7(3)(a)(i)). Indeed, if the AFA analysis is correct, the green-up periods may actually be less than indicated in the BCFS analysis. However, as noted above, it is not conclusive at this time that site indexes have been underestimated in the Arrow TSA. In any case, a sensitivity analysis in the BCFS analysis indicates that decreasing green-up periods by five years has no impact on the base case.

- *cutblock adjacency*

In order to protect non-timber resources such as wildlife, water quality and aesthetics, current harvesting practices limit the size and shape of cutblocks, and prescribe minimum green-up times for adjacent cutblocks. This provides for a distribution of harvested areas and retained forest cover across the landscape, and as such, it takes into account the impact of several forest management issues. Cutblock adjacency guidelines are commonly expressed in terms of the number of harvesting entries, or 'passes', required to remove the mature timber from the timber harvesting land base.

The *Timber Supply Review Discussion Paper* for the Arrow TSA identified the number of passes modelled in the BCFS analysis as a critical factor, and concern about this issue was expressed during the public input process.

A three-pass harvesting system was assumed in the timber supply analyses for many TSAs in the province. Based on past harvest patterns, cutblock locations, cutblock sizes and topography in the Arrow TSA, District staff indicated initially that a more restrictive 'four-pass' harvesting system would most accurately represent cutblock adjacency constraints. Accordingly, the BCFS analysis modelled a 'four-pass' system, which assumes a maximum of 25 percent of the timber harvesting land base is permitted to be less than three metres tall.

It is the view of District staff that it has now become apparent that past harvest patterns, cutblock locations, cutblock sizes and the topography of the area may require a five-pass system to represent cutblock adjacency constraints in the integrated management (timber emphasis) zone, which represents approximately 58 percent of the timber harvesting land base. Furthermore, the District states that in the wildlife, watershed and VQO management zones (covering the remaining 42 percent of the timber harvesting land base), a minimum of five passes and possibly six passes may be required to represent cutblock adjacency constraints and other resource management and public concerns.

A sensitivity analysis in the BCFS analysis shows that if harvesting throughout the TSA were actually conducted under a five-pass system, the projected initial harvest level could only be maintained for one decade before declining to the long-term harvest level (instead

of seven decades with four passes). If a six-pass harvesting system were required, the projected initial harvest level would decline by 19 percent to 501 400 m³/year.

However, the District has not demonstrated to my satisfaction that a minimum of five harvesting passes is needed in the integrated management zone, or even in the wildlife, watershed and VQO management zones. After examining a number of similar TSAs in the province, I note that there is a range from 1 to 4 harvesting passes; on average three passes are assumed in the BCFS analyses. I acknowledge that the number of passes is often difficult to determine based on operational requirements. However, the four-pass harvesting system assumed in the BCFS analysis for this TSA is already more restrictive on timber supply than the average assumed in the current timber supply review, and I have no reason to believe that more than a four-pass system would be required to reflect the overall forest cover requirements in the Arrow TSA.

Further study of the pass system that would most accurately represent cutblock adjacency constraints in the Arrow TSA is required prior to my next AAC determination for this TSA. I do not think the assumption of a six-pass system accurately reflects harvesting practices. However, even if five passes are required, the current harvest level could still be maintained for one decade. Therefore, for the present determination, I accept the assumption of a four-pass system as appropriate.

- visual quality objectives

Recreation resources are one of the forest resources to be managed in the Arrow TSA. 'Recreation resource' is defined in the *Forest Practices Code of British Columbia Act* to include a 'scenic or wilderness feature or setting that has recreational significance or value'. In order to manage such scenic features, visual landscape foresters in B.C., in collaboration with specialists in other parts of the world, have developed procedures for identifying and managing 'visually sensitive areas'. These procedures incorporate both biophysical and social factors—including visual sensitivity ratings based on topography, slope and other biophysical factors, and social factors such as numbers of viewers and their perceptions—and provide recommended visual quality objectives (VQOs) for these visually sensitive areas. These objectives limit the amount of visible disturbance that is acceptable in these areas.

To meet these objectives, constraints are placed on timber harvesting, road building and other forest practices in the sensitive areas. The constraints are expressed in terms of 'forest cover requirements' which relate to the maximum allowable percentage of a landscape unit that can be harvested at any one time, and to "visually effective green-up" i.e. the stage at which regeneration is perceived by the public as newly established forest, based on the results of focus tests with a cross section of the general public in 12 communities throughout B.C.

It was assumed for the purposes of the BCFS analysis for the Arrow TSA that 40 percent of the timber harvesting land base would be subject to forest cover requirements for visual sensitivity. However, some visually sensitive areas are also managed for

watershed values and wildlife winter range, so there is significant overlap between VQO management zones and other management zones in the timber harvesting land base. As a result, in the BCFS analysis, approximately 19 percent of the timber harvesting land base was modelled as part of the visual quality management zones. The remaining 21 percent subject to forest cover requirements for visual sensitivity was included in other management zones. The BCFS analysis accounted for areas of overlap by using the most constraining forest cover requirements where overlaps occurred.

The forest cover requirements for visual sensitivity used in the BCFS analysis reflect current management practices in the TSA, allowing for the contribution of inoperable forested areas and partial cutting toward achieving visual quality objectives. Although the methodology for estimating forest cover requirements for VQOs has changed since completion of the BCFS analysis, District staff advise that the results are similar to those obtained using the newer methodology. The AFA analysis used more restrictive forest cover requirements, based on a local resource planning exercise in the Slocan Valley. I do not believe the Slocan Valley is representative of the entire TSA, and I am satisfied that the less restrictive forest cover requirements for visual sensitivity used in the BCFS analysis are more appropriate.

Since the completion of the BCFS analysis, licensees have been following more restrictive VQO guidelines in the Sandon area of the Arrow TSA. As a result of these changes, this area is subject to more restrictive forest cover requirements. However, because the area affected is very small, I do not expect this factor to have a significant impact on the short-term timber supply of the TSA.

Finally, it was assumed in the BCFS analysis that all areas subject to forest cover requirements for VQOs would be harvested up to the maximum limits for disturbance. In reality, however, harvesting has been avoided in many of the areas subject to VQOs due to public pressures and historical use patterns. If this trend continues, timber supply options and the achievement of integrated management objectives elsewhere in the TSA will be adversely affected. This issue is discussed further below (see *planning deferrals* under section 7(3)(a)(vi)).

- watershed guidelines

For the purposes of BCFS analysis, the entire land base was classified into six watershed classes based on the draft Nelson Region "Watershed Harvesting Guidelines" (March, 1991). Class 1 and 2 watersheds (small, sensitive domestic watersheds, springs and seeps) make up approximately 29 percent of the timber harvesting land base. Parts of these areas overlap with and are therefore included in the VQO management zones. After adjusting for this overlap, these Class 1 and 2 watersheds were used to define the watershed management zone in the BCFS analysis (representing approximately 14 percent of the timber harvesting land base). In the BCFS analysis, the watershed management zone was modelled according to the 1992 watershed guidelines, which specify a maximum of 25 percent equivalent clearcut area (ECA) and a seven-metre green-up height requirement. After adjustment for the contribution made by inoperable

areas toward meeting watershed objectives, the final ECA requirement in the BCFS analysis specified that no more than 30 percent of the timber harvesting land base within the watershed management zone could be in a non-greened-up state.

In the BCFS analysis, it is assumed that Class 1 and 2 watersheds will be harvested up to the limits specified in the 1992 watershed guidelines. However, *Timber Supply Review Discussion Paper* notes that due to public pressures, harvesting has not reached permitted levels in many of these watersheds. As noted above in the discussion of Harvest profile under section 7(3)(a)(i), BCFS staff have indicated that harvesting in the TSA has not been well distributed geographically across the timber harvesting land base due to the avoidance of harvesting in areas where land use has been contentious. As I have already noted, it is evident to me that more harvesting must take place in these areas if current harvest levels are to be maintained. The implications of this issue are discussed below in section 7(3)(a)(vi), *planning deferrals*.

The *Timber Supply Review Discussion Paper* also refers to "recent changes to guidelines for managing community watersheds", e.g. "increasing in the green-up height from seven to nine metres". Concern has been expressed through the public input process that the requirements modelled in the BCFS analysis, based on the 1992 watershed guidelines, do not reflect the requirements of the draft guidelines, or the requirements that may be imposed under the Forest Practices Code.

I have discussed this matter with BCFS Branch staff responsible for watershed guidelines and procedures. The draft Interior Watershed Assessment Procedures indicate a range of 3-9 metres as the green-up height required for hydrological recovery. Based on the advice of BCFS staff responsible for preparing these assessment procedures, I believe that in some specific areas a higher green-up height may be required, but overall a 7-metre green-up height represents a reasonable average for the Arrow TSA. Accordingly, for the purposes of this determination, I am satisfied that the assumptions modelled for Class 1 and 2 watersheds in the BCFS analysis are adequate.

Class 3 to 6 watersheds, which occupy much of the remainder of the land base in the Arrow TSA, were not included in the watershed management zone, but rather in one of the four other management zones. These watersheds were modelled according to the management zone in which they occurred.

The 2 VQO management zones, representing approximately 19 percent of the timber harvesting land base, have requirements which are more constraining on timber supply than the watershed management zone. The wildlife management zone and the integrated management (timber emphasis) zone, representing approximately 67 percent of the timber harvesting land base, have requirements which are less constraining.

While there are admittedly fewer water management concerns associated with Class 3 to 6 watersheds, compared to Class 1 and 2 watersheds, it is possible that on balance the BCFS analysis may underestimate the constraints on timber supply in these watersheds. However, the information before me at this time is inconclusive, and I am not satisfied

that this possibility warrants a reduction to the initial harvest level. In this regard, I note that in the AFA analysis, it was possible to maintain an initial harvest level of 619 000 cubic metres, even using more restrictive forest cover requirements for all management zones, although this may be attributable in part to the assumptions used in the AFA analysis which resulted in a larger timber harvesting land base.

- *forest ecosystem networks and old growth*

The Arrow TSA *Timber Supply Review Discussion Paper* identified the protection of biodiversity and wildlife habitat through the use of forest ecosystem networks (FENs) and old growth as a critical factor affecting timber supply. FENs consist of important wildlife habitats connected by linking corridors. The location of FENs is dependent on the distribution of old growth across the land base. Forest development plans prepared in 1994 in respect of licences within the TSA incorporate FENs and old growth management strategies which were not modelled in the base case in the BCFS analysis.

MELP staff have examined the impact FENs and old-growth management strategies have on the timber harvesting base. They advise that these management strategies would require at least 10 percent of the timber harvesting land base to be maintained as old-growth forests (i.e. stands older than 140 years). A sensitivity analysis in the BCFS analysis shows that if at least 10 percent of the land base is maintained as stands older than 140 years, an initial harvest level of 619 000 cubic metres can be maintained, but only for four decades (three decades less than in the base case). In other words, these strategies appear to have an impact on the medium and long term timber supply, but not on the short term timber supply.

I would add that the sensitivity analysis may overestimate the impact of FENs and old growth management strategies, because of an overlap with other IRM constraints which have been considered in this determination, e.g. wildlife winter range and stand level biodiversity (see below, *wildlife habitats* and *stand level biodiversity*, respectively).

FENs also overlap with riparian habitats. It is difficult to determine at this time how these factors interact and what overall effect they will have on the timber supply. However, I can determine at this time that these two factors will not have a strictly cumulative effect. The implementation of the Forest Practices Code will provide guidance on the management strategies for both FENs and old growth and will assist in addressing overlapping objectives. Further study should be carried out, before the next AAC determination, on the interaction of FEN requirements with other provisions for integrated resource management.

Accordingly, while the base case may indeed underestimate the medium- and long-term impact of FENs and old growth management strategies, I am satisfied that these management strategies have no impact on the short-term supply.

- *wildlife habitats*

The BCFS analysis took wildlife habitats into account by using the 1989 *Logging Guidelines for Wildlife Habitat Classes*, prepared by the Fish & Wildlife Branch of MELP for the Kootenay Region, as a basis for the forest cover requirements in the wildlife winter range management zone, which represents approximately 9 percent of the timber harvesting land base. However, MELP staff advises that critical caribou habitats, such as the Caribou and Slewiskin drainages which cover approximately 16 500 hectares (approximately 80 percent of the wildlife winter range management zone), are currently managed to retain at least 50 percent of the timber harvesting land base in stands older than 121 years. Constraints of this magnitude are not reflected in the 1989 guidelines and consequently were not modelled in the BCFS analysis.

I recognize the importance of managing critical caribou habitats, as well as elk and deer habitats. Further studies are clearly required to properly assess the impact of current management practices on the timber supply, and I urge both BCFS and MELP staff to pursue these studies. I am also aware there is uncertainty regarding the overlap between wildlife winter habitat, riparian habitat, VQOs, FENs, and stand-level biodiversity requirements. These factors are interrelated, and it is unlikely that their impacts on the timber supply are entirely cumulative.

Nonetheless, while the impact of current wildlife habitat management cannot be quantified at this time, I conclude this factor will limit timber availability to some extent in the short term. At the same time, I note that there is flexibility in the base case to address this impact. I will return to this point below in Reasons for decision.

- riparian habitats

To protect riparian habitat, buffer or reserve zones are located along watercourses, and limit timber harvesting practices adjacent to these watercourses. At the time of the BCFS analysis, there was insufficient information on the area occupied by these buffer zones to incorporate their impact into the analysis.

Since the completion of the BCFS analysis, BCFS staff have conducted studies on portions of the TSA, and conclude that approximately 1.7 percent of the timber harvesting land base is occupied by these riparian zones. This study utilized buffer zone widths which were based on riparian guidelines that were in effect before the Forest Practices Code was brought into force.

FENs will overlap with riparian zones to a certain extent. Furthermore, some riparian zones will have been accounted for in the BCFS analysis—at least in part—under requirements for wildlife habitat and stand-level biodiversity. As I have indicated above, I am mindful that the timber supply impacts of these factors will not necessarily be cumulative. The implementation of the Forest Practices Code will provide direction on riparian management. Further assessment of riparian zones should be carried out before the next AAC determination, on the area required for riparian habitats, taking into account any overlaps.

The sensitivity analysis in the BCFS analysis did not examine the timber supply implications of a reduction of less than two percent in the timber harvesting land base; it only shows the impact of reducing the timber harvesting land base by 20 percent. This sensitivity analysis indicates that a 20 percent reduction in the timber harvesting land base results in only a five percent decrease in the initial harvest level shown in the base case. I conclude that a 2 percent reduction would have little or no impact on the initial harvest level shown in the base case, although the length of time this initial harvest level can be maintained may well be affected.

- stand-level biodiversity

In the Arrow TSA, at the time of the BCFS analysis, stand-level biodiversity was managed (by retaining individual wildlife trees ('green trees')) to provide structural diversity for wildlife habitat. In the BCFS analysis, it was assumed, based on 1993 BCFS research, that on average 20 green trees per hectare would be retained on harvested areas. The analysis therefore deducted 5000 cubic metres per year from the total volumes harvested each year from the timber harvesting land base to account for the retention of these trees.

However, currently in the TSA, wildlife tree patches, rather than individual 'green trees' are retained in each harvested area. MELP staff submit that this change in practice may result in a much greater volume being left on harvested areas. They maintain that, *over the entire TSA land base*, this volume could be as high as 50 000 cubic metres per year if deciduous volume and volume currently considered unavailable for timber harvesting due to inoperability are included. MELP was unable to adjust this estimate to reflect the impact on the total volumes harvested each year from the timber harvesting land base. In particular, it is necessary to account for the magnitude of the contribution from deciduous forest types and timber on inoperable areas.

Further studies incorporating the requirements of the Forest Practices Code are clearly needed to properly assess the impact of stand-level biodiversity, and I urge both BCFS and MELP staff to pursue these studies. As noted above, I am also aware there is uncertainty regarding the overlap between wildlife winter habitat, riparian habitat, VQOs, FENs, and stand-level biodiversity requirements. These factors are interrelated, and it is unlikely that their impacts on the timber supply are entirely cumulative.

As with the impact of current wildlife habitat management, while the impact of stand level biodiversity cannot be quantified at this time, I conclude this factor will limit timber availability to some extent in the short term. At the same time, as previously noted, there is flexibility in the base case to address this impact. I will return to this point below in Reasons for decision.

- forest cover requirements

As with cutblock adjacency discussed above, the forest cover requirements used in the BCFS analysis are based on a four-pass harvesting system. As discussed above, although District staff questioned the four-pass-system, I am satisfied with its use in the BCFS analysis.

However, the pass-system alone will not account for the full impact of forest cover requirements. Forest cover requirements are also applied in the form of minimum amounts of forest cover to be retained for various purposes such as visual quality, water quality, old-growth forest or wildlife cover. These forest cover requirements incorporate both age and height requirements.

District staff submitted that the forest cover requirements modelled in the BCFS analysis are not restrictive enough to represent 1994 operational reality. They provided me with a harvest forecast based on what they believed to be a reasonable approximation of current operational realities. In this harvest forecast, an old growth requirement and more restrictive forest cover requirements—particularly for visual quality and watershed values—were modelled. Based on these management assumptions, the District forecast projected an initial harvest level of 600 000 cubic metres per year—three percent less than in the BCFS analysis base case.

The AFA analysis also produced a harvest forecast incorporating more stringent old growth and adjacency requirements. These requirements were derived from a planning exercise for the Slocan Valley. This harvest forecast projected an initial harvest level of 557 100 cubic metres per year. However, when these same forest cover requirements were applied to the model used in the BCFS analysis, the resulting harvest forecast indicated that an initial harvest level of 619 000 cubic metres per year could be maintained for three decades. BCFS staff advise me that this discrepancy arises from the different approaches used by the analysts to model required reductions in the harvest level. The BCFS analyst sought to maintain the initial harvest level for as long as possible before initiating the decline to the long-term harvest level. The AFA analyst chose to initiate the harvest level decline earlier, but with a more gradual rate of decline than used in the BCFS analysis.

I am reluctant to accept the results of either the District harvest forecast or this AFA forecast without further documentation. I note that neither forecast adjusted the forest cover requirements to reflect the contribution of inoperable areas.

A sensitivity analysis in the BCFS analysis shows that if all forest cover requirements are tightened by 10 percent across all five management zones, there is no impact on the initial harvest level, although this harvest level can only be maintained for two decades, rather than seven decades as shown in the base case. However, tightening the forest cover requirements by more than 10 percent significantly affects the harvest forecast.

I recognize that it is possible that the forest cover requirements used in the BCFS analysis base case may not adequately represent operational reality; however, I am not satisfied the operational reality would require tightening these requirement by more than 10 percent. Hence, while these additional forecasts highlight a potential risk, I do not believe this risk warrants a reduction to the projected initial harvest level at this time.

(vi) any other information that, in his opinion, relates to the capability of the area to produce timber;

Planning deferrals

In recent years in the Arrow TSA harvesting has been avoided in contentious areas. These 'log-around' strategies or planning deferrals have created two problems. First, licensees are having difficulty finding sufficient suitable and available timber in non-contentious areas to meet their timber harvesting commitments, and the available timber in these non-contentious areas is at lower average volume per hectare than estimated in the base case. Second, the avoidance of harvesting in contentious areas means that, for harvesting to continue at the level indicated by the AAC, the remaining areas must be harvested at higher rates. Continuing these planning deferrals will at some point risk compromising integrated resource management objectives in some of the non-contentious areas, which is incompatible with good forest management.

Unless government makes land-use decisions prohibiting or restricting harvesting in contentious areas, my interpretation of Section 7 of the *Forest Act*, read in conjunction with Section 53 and Part 15 of the *Act*, is that these areas must be considered as part of the timber harvesting land base in an AAC determination under Section 7 of the *Forest Act*. To do otherwise would be to assume a *change in the overall land base* of the TSA where no such change has actually been made. Such a change in the land base is usually effected under the *Forest Act* by the Minister of Forests under Sections 6 and 53, or by Cabinet under Part 15. Accordingly, to determine an AAC based on a reduced land base before any decision has been made to reduce the land base would pre-empt a decision which properly belongs to the Minister or to Cabinet. Moreover, it would not even guarantee the interim protection of the areas in question, since a reduction of the AAC would not of itself define or limit the specific areas within the TSA in which licensees retain legal rights to harvest.

However, I trust the recent completion of the West Kootenay- Boundary Land-Use Plan has resolved many of the issues surrounding these contentious areas. Nonetheless, if the District Manager feels that harvesting should be avoided in the previously identified contentious areas, I would recommend that steps be taken towards the specification of these areas as designated areas in order to effect a temporary AAC reduction under Part 15 of the *Forest Act*.

- (b) **the short and long term implications to the Province of alternative rates of timber harvesting from the area;**

Harvest flow

A notable feature of the harvest projections displayed in the BCFS timber supply analysis for the Arrow TSA is that timber supply is projected to decline or fall-down toward a sustainable long-term level. In the short term, the presence of large volumes of mature timber permits harvest levels above the long-term level without compromising future timber supplies. In keeping with the objectives of good forest stewardship, AACs in British Columbia for areas in which a fall-down in timber supply is expected have been and continue to be determined so as to ensure that current and mid-term harvest rates will be compatible with a smooth and orderly transition toward the lower long-term harvest level. That is, timber supplies should remain sufficiently stable that there will be no inordinately adverse impacts on current or future generations. To achieve this, the rate set must not be so high as to cause later disruptive shortfalls in supply, nor so low as to cause undue immediate social and economic impacts.

The BCFS analysis indicates that due to the availability of high-volume older stands, harvest levels in the short- and mid-terms in the Arrow TSA can remain above, but must decline toward, a long-term harvest level. Based on the assumptions used in the BCFS analysis, this long-term level is projected to be reached 110 years from now, and to remain relatively steady thereafter.

The base case in the BCFS analysis indicates that the current AAC of 619 000 cubic metres per year could be maintained for 70 years without causing an abrupt decline in future harvest levels. This level could be maintained for 70 years, after which it would decline by 10 percent per decade for 40 years to reach the long-term harvest level of 422 000 cubic metres per year in 110 years.

The BCFS analysis examined a number of alternative harvest schedules. The analysis shows that the initial harvest level could be increased by 15 percent to 711 850 cubic metres per year without causing an abrupt decline in future harvest levels. However, the harvest level would have to begin to decline to the long-term level after 40 years (30 years earlier than in the base case).

The analysis also shows that if the initial harvest level were decreased by 15 percent to 526 150 cubic metres per year, then this harvest level could be maintained for 160 years before declining to the long-term harvest level. Alternatively, the initial harvest level could be decreased immediately to the long-term harvest level of 422 000 cubic metres per year and remain at this harvest level in perpetuity.

A socio-economic analysis (SEA) report for the Arrow TSA was prepared by Resource Systems Management International Inc. for the BCFS. This report details the importance of the forest industry to local economies, and describes the community impact associated with three different timber supply scenarios, including the base case described above, a scenario in which the initial harvest level is 15 percent less than in the base case, and a

scenario in which the initial harvest level is 15 percent higher than that of the base case. The report indicates that the economy of the Arrow TSA is heavily dependent on the forest industry, particularly in the Castlegar/Arrow Lakes portion of the TSA, where income derived from the forest sector accounts for 45 percent of the total income generated in this part of the TSA. The timber harvested from the TSA provides about 600 person-years of direct employment and a further 432 person-years of indirect and induced employment within the TSA. Timber harvesting within the TSA also has a substantial impact on jobs outside the TSA, creating an additional 553 person-years of employment (direct, indirect and induced) provincially.

The Interior Lumber Manufacturers' Association (ILMA) and the Slocan Valley Watershed Alliance (SVWA) each provided a critique of the SEA. The ILMA submitted that the SEA underestimated community dependency and overstated the impact of forestry on the environment, while the SVWA submitted that the SEA overstates community dependency and understates the economic opportunities associated with non-timber resources. The SVWA also submitted that harvesting has an adverse impact on these opportunities.

I have reviewed the economic development impacts described in the SEA report, together with the critiques provided by the ILMA and SVWA, as well as other comments received through the public input process. I am satisfied that the SEA provides a useful and reliable indication of the socio-economic implications of alternative rates of harvest in the Arrow TSA, and I believe there is a significant level of dependence on timber harvesting. I will return to this point under the discussion of the social and economic objectives of the Crown.

(c) the nature, production capabilities and timber requirements of established and proposed timber processing facilities;

Mill requirements

Approximately 85 percent of the wood harvested from the Arrow TSA is processed inside the TSA,. There are four major sawmills in the Arrow Forest District, three of which have major licences in the TSA. These three licensees rely on the TSA for 55 to 60 percent of the wood supply for their mills. The fourth sawmill relies primarily on timber from its tree farm licence. There are also cedar shake and shingle mills, and one large pulp mill in the District.

There are five major licensees in the Arrow TSA. As noted above, three have processing facilities located within the TSA; the other two have processing facilities located outside the TSA. Almost 70 percent of the timber harvested under the Small Business Forest Enterprise Program (SBFEP) is used to supply the processing facilities for these five licensees. Private land, timber licences, TFLs 3 and 23, and other sources outside the TSA provide the rest of the timber supply required by the processing facilities owned by the major licensees, as well as the timber supply required by the pulp mill and the other mills in the TSA.

As described above (see Planning deferrals), because of the contentious nature of harvesting in some parts of the TSA, it may be very difficult for some licensees to meet their timber harvesting commitments. Furthermore, many licensees rely heavily on private timber sources to meet their mill capacity. As private wood becomes more expensive and scarce, this important source of timber will not be as accessible to licensees. In addition, it is possible that harvest levels may decline in other TSAs, which supply some of the timber for processing facilities in the Arrow TSA.

From the above, it is evident that wood availability is decreasing and the demand for timber in this area exceeds the available supply. I am mindful that a significant AAC reduction could have implications for the viability of local processing facilities.

(d) the economic and social objectives of the Crown, as expressed by the minister, for the area, for the general region and for the Province; and

Minister's letter

The Minister has expressed the social and economic objectives of the Crown for the province (letter to former Chief Forester John Cuthbert, dated July 28, 1994, attached as an appendix), and I understand these to apply to the Arrow TSA. They are consistent with the objectives stated in the Forest Renewal Plan and include good forest stewardship, a stable timber supply, and allowance of time for communities to adjust to harvest level changes in a managed transition from old growth to second-growth forests, so as to provide for continuity of employment.

The Minister also stated in his letter that "any decreases in allowable cut at this time should be no larger than are necessary to avoid compromising long-run sustainability." He placed particular emphasis on the importance of long-term community stability and the continued availability of good forest jobs. To this end he asked that the Chief Forester consider the potential impacts on timber supply of commercial thinning and harvesting in previously uneconomical areas. The latter would likely require the use of alternative harvesting systems, and to encourage this the Minister suggested consideration of partitioned AAC.

The employment and community impact issues are discussed in detail in the *Arrow Timber Supply Area Socio-Economic Analysis*, (SEA) and I am familiar with the varying impacts of different harvest levels (see discussion under section 7(3)(b) above). The use of commercial thinning has been discussed earlier in section 7(3)(a)(iii) *incremental silviculture*, where I concluded that while commercial thinning may be used to alter the schedule of timber availability, opportunities for commercial thinning are limited in this TSA, and there is no proven performance or strategy in place for commercial thinning. Therefore, I am not considering the effects on timber supply from commercial thinning in this determination.

The operability issue was discussed in section 7(3)(a)(i) *land base contributing to timber harvest* above. There I concluded that there may be an opportunity in the future to harvest in areas that are currently inoperable. However, my review of the operability

leads me to believe that at present it is an accurate reflection of the timber harvesting land base. I do not consider it appropriate to establish a partitioned AAC for the purpose of harvesting in currently inoperable areas. Any future consideration of the inclusion of currently inoperable areas in the timber harvesting land base will require careful consideration of environmental factors.

Local objectives

The Minister's letter suggests that I should consider important local social and economic objectives that may be derived from the public input in the timber supply review. I am mindful of the many views which were brought forward in the public input received. I have considered this input thoroughly in my determination, and where possible I have attempted in this rationale to respond briefly to many of the views expressed.

The Ktunaxa/Kinbasket Tribal Council had three objectives: an increase in First Nation employment and contracting opportunities in the area, no further development within their traditional territory until archaeological assessments and traditional use studies have been completed, and allocation of a portion of the AAC to satisfy treaty obligations. The first objective is a reflection of the dependence of local communities on timber harvesting and, as such, has been considered in this determination. As for the second objective, I would stress that an AAC determination does not dictate management practices, nor may it be construed as limiting the Crown's obligations respecting aboriginal rights. Where information is available, archaeological sites and traditional uses are considered in my determination. As for third objective, decisions on apportionment are not within my jurisdiction; these decisions rest with the Minister of Forests.

(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

Armillaria root disease

One of the concerns raised during the public input portion of the timber supply review for this TSA was the timber supply impacts of *Armillaria ostoyae*, which results in mortality and reduced tree growth. BCFS staff advise me that the effects of root rot in existing mature stands are incorporated into the volume estimates generated by VDYP. As a result, I am satisfied that the BCFS analysis adequately incorporates the effects of *Armillaria* in estimates of existing stand volumes.

As discussed above (under *volume estimates for regenerated stands and operational adjustment factors*), managed stand volumes that might otherwise have been anticipated by the use of TIPSy are not likely to be achieved in practice, due to the prevalence of *Armillaria*. In addition, green-up of younger stands could be delayed, which would limit the availability of adjacent stands for harvesting. Therefore, the supply of timber could be further constrained beyond current projections in the short term. Until more information is available on the short-term implications, however, I am reluctant to speculate on the impacts of *Armillaria* on stand establishment and the length of the green-up period.

Root rot has possible short-term and serious long-term effects on the timber supply for the Arrow TSA that remain as yet unquantified. I expect studies on the effects of *Armillaria* to be completed, and these effects to be quantified, prior to the next AAC determination.

Normal unsalvaged losses

The BCFS analysis assumed a deduction of 34 259 cubic metres per year to account for unsalvaged losses due to insects, disease, fire, wind damage, and wildlife trees left unharvested (see above 7(3)(a)(v) *stand level biodiversity*). Although the estimate used in the analysis is somewhat lower than losses experienced in other areas of the Nelson Forest Region, from my review of the data supporting the deduction I am satisfied that it is a reasonable estimate of what is currently experienced in the TSA (notwithstanding the foregoing discussion of the impacts of *Armillaria*) and is suitable for use in this determination.

Reasons for decision

In reaching my decision on an AAC for the Arrow TSA, I have considered all of the factors presented above and have reasoned as follows.

The base case forecast indicates that a harvest level of 619 000 cubic metres can be maintained for seven decades before declining to the long-term harvest level. However, my considerations have identified several reasons why an earlier decline may be required.

Recent changes to the way in which forests are managed in the TSA affect the availability of timber in both the short and the long term. However, many of the integrated resource management factors examined in this determination which constrain timber supply overlap to some extent. For example, management objectives for values such as visual quality often meet requirements for other values, such as wildlife habitat. In considering the timber supply implications of these changes in management, I must therefore be mindful that overlaps exist and that the individual timber supply impacts are not cumulative. At the same time, as noted above in Guiding principles, further and as yet unquantified impacts on timber supply may be expected due to the implementation of the Forest Practices Code.

Factors identified as limiting the timber supply relative to the base case forecast include the following:

- Although the BCFS analysis used a comparatively restrictive four-pass system, District staff submit that a five-pass system more accurately reflects current practice. However, it is my assessment that no more than a four-pass system would be required to reflect the overall forest cover requirements in the Arrow TSA. In any case, a sensitivity analysis in the BCFS analysis indicates that with a five-pass system, the initial rate of harvest in the base case could still be maintained for one decade.

- Since the completion of the BCFS analysis, more stringent visual quality objectives are being implemented in a small area of the TSA. At present, there is no information available to assess the impact of this factor on short-term timber supply. However, the area affected is very small, so I do not consider this factor to have a significant impact on the short-term timber supply. Again, it is also important to note that the additional constraints resulting from forest cover requirements for VQOs overlap with constraints resulting from wildlife habitat and watershed management.
- The BCFS analysis may underestimate the constraints on timber supply in Class 3 to 6 watersheds. However, the information before me at this time is inconclusive, and while this factor may reduce the period for which the base case initial harvest level could be maintained, I am not satisfied that it warrants a reduction to the AAC.
- Not all Class 1 and 2 watersheds have been covered by TRIM mapping, and District staff submitted that an additional deduction of two to three percent should be made from the timber harvesting land base to reflect those areas not covered by TRIM mapping. However, while there appears to be a risk of underestimating the expected level of constraints on the land base I have no way to assess the appropriateness of the suggested deduction. I expect this matter to be resolved prior to the next AAC determination.
- Riparian areas were not modelled in the BCFS analysis. District staff submit that riparian habitat management represents a reduction to the timber harvesting land base of approximately two percent. The sensitivity analysis in the BCFS analysis did not examine the timber supply implications of a reduction of less than two percent in the timber harvesting land base; it only shows the impact of reducing the timber harvesting land base by 20 percent. This sensitivity analysis indicates that a 20-percent reduction in the timber harvesting land base, using a harvest flow consistent with the base case, results in only a five-percent decrease in the initial harvest level shown in the base case. I conclude that a two-percent reduction would have little or no impact on the initial harvest level shown in the base case, although the length of time this initial harvest level can be maintained may well be affected. Again, I am mindful that the impact of riparian zones will overlap with other integrated resource management constraints.
- The BCFS analysis did not take into account all areas being managed for wildlife habitat. The Caribou and Slewiskin drainages are currently managed to retain stands older than 121 years over at least 50 percent of the timber harvesting land base in those drainages. I conclude this factor will limit timber availability to some extent in the short term. At the same time, I note that there is flexibility in the base case to address this impact. Also, as noted above, integrated resource management constraints are interrelated and it is unlikely that their impacts on the timber supply are entirely cumulative.
- Stand-level biodiversity is another integrated resource management issue that affects short-term timber supply in the Arrow TSA. The BCFS analysis accounted for a volume retention of 5000 cubic metres per year for individual wildlife tree retention in harvested cutblocks. However, current practice in the TSA is to retain wildlife tree patches in cutblocks. MELP staff submit that this change in practice may result in a much greater volume being left on

harvested areas, although the actual impact may be reduced due to the contribution of inoperable areas and deciduous stands to meeting biodiversity objectives. Furthermore, riparian corridors, FENs and wildlife habitat will be used, where possible, to accommodate biodiversity needs. Further studies are needed to assess the impact of stand level biodiversity on timber supply, but it is clear that this factor will limit the short-term timber supply to some extent.

- It is possible that the forest cover requirements used in the BCFS analysis base case may not adequately represent operational reality. A sensitivity analysis in the BCFS analysis shows that if all forest cover requirements are tightened by 10 percent across all five management zones, there is no impact on the initial harvest level, although this harvest level can only be maintained for two decades, rather than seven decades as shown in the base case. I am not satisfied that current practice would require tightening these requirements by more than 10 percent; hence, while this factor may contribute to an earlier decline in harvest level, I do not believe this risk warrants a reduction to the AAC at this time.

Two factors suggest some optimism for timber supply in the TSA, as follows:

- High utilization is currently required in the SBFEP for the TSA, and some major licensees are also attaining this level of utilization. If a higher level of utilization becomes current practice, an increase in timber supply will result. An estimate of the impact of high utilization as it is currently practiced in Arrow TSA is not available to me at this time, so I am unable to quantify the short-term timber supply impact of high utilization. However, considered alone, this will serve to extend the duration of the initial harvest level projected in the BCFS base case.

- Higher regenerated stand volumes than projected in the base case will also serve to augment the timber supply in the TSA. However, gains that might otherwise be anticipated to occur from managed stands may not materialize fully due to the impact of *Armillaria* root rot on some stands in the TSA. Although the impact of root rot on stand establishment is not quantified at this time, it is almost certain that expected managed stand volumes will not be achieved in many regenerating stands. Furthermore, even if regenerated stand volumes were 25 percent higher than indicated in the BCFS analysis, there would be no impact on short-term harvest levels. However, this factor does suggest some optimism for future timber supplies.

Examining both the restrictive and augmenting influences on the timber supply for the Arrow TSA, I find that it is not reasonable to expect the effects of high utilization in the TSA to completely offset the combined impact of the restrictive influences of all the factors discussed above. I conclude that the initial harvest level projected in the BCFS analysis base can be maintained at least for the period of this determination, but that it is unlikely to be maintained for the seven decades projected in the forecast.

Sensitivity analyses illustrate that the changes to cutblock adjacency and FENs (two of the factors which can be reasonably quantified) could reduce the amount of time that the projected initial harvest level can be maintained to as little as one decade, or possibly even less. The fact that the inventory has been updated only to 1989 indicates that the timber supply is actually 6 years into the harvest forecast. Therefore, the decline to the long-term harvest level could occur as early as the next determination. In fact, I have considered the possibility of initiating this decline in the present determination.

However, I am mindful of the fact that the four-pass harvesting system assumed in the BCFS analysis for this TSA is already more restrictive on timber supply than the three-pass system assumed in the analyses for many other TSAs in the current timber supply review. Moreover, the impact on the harvest forecast of the individual restrictive factors identified above has been quantified in only a very few cases, and there is currently little understanding of the relationships between the factors or the timber supply implications of potential overlaps. There is considerable uncertainty in any estimation of the combined restrictive impacts.

In view of this uncertainty, and of the adverse social and economic implications of an immediate harvest level reduction, I am satisfied that there is enough flexibility in the timber supply over the short term to support a harvest level of 619 000 m³ per year, until the next AAC determination or until new information is available, without jeopardising long-term harvest stability or compromising objectives for integrated resource management.

However, I must emphasize that achieving an AAC of 619 000 cubic metres is only possible if harvesting is distributed throughout the timber harvesting land base. Both partial cutting and commercial thinning programs should be examined as strategies to achieve harvesting distribution throughout the TSA. If harvesting does not take place in contentious areas that have been avoided, and if the District Manager feels that continued avoidance of harvesting in certain areas would require harvesting in other areas at rates that may compromise IRM objectives, I

would recommend that steps be taken toward the specification of the affected areas as designated areas in order to effect a temporary AAC reduction under Part 15 of the *Forest Act*.

It is therefore my determination that a timber harvesting level that accommodates objectives for all forest resources during the next five years, that ensures longer-term IRM objectives can be met, that reflects forest management practices, that avoids severe curtailment of locally established patterns of socio-economic activity based on timber harvesting, and that avoids disruptive shortfalls in future wood supply, can best be achieved in this TSA at this time by determining an AAC of 619 000 cubic metres.

Determination

Effective October 1, 1995, the new AAC for the Arrow TSA will be 619 000 cubic metres, unchanged from the current AAC. This will remain in effect until a new AAC is determined, which must take place within five years of this determination.

Implementation of determination

As indicated above, there is some specific work that must be done to resolve uncertainties with respect to the timber supply in the Arrow TSA. In particular, I am directing BCFS staff to address the following priorities:

- Quantify the impact of *Armillaria* root rot on stand volumes and green-up periods prior to the next AAC determination;
- Complete an inventory audit to estimate the accuracy of the existing timber inventory for the TSA, and evaluate the validity of decay, waste and breakage estimates for age class 8 and 9 (141 years of age and older) cedar and hemlock before the next determination;
- Quantify the volume of timber that is made unavailable for harvesting in order to account for stand-level biodiversity;
- Analyse the timber supply impacts of protected areas designated in the TSA;
- Estimate site productivity for regenerated stands, by completion of the Resources Inventory Branch paired plot study;
- Research should be accelerated into the forest cover requirements needed to maintain critical caribou habitat in the Arrow TSA;
- While I do not consider it appropriate at this time to establish a partitioned cut, an AAC of 619 000 cubic metres may not be achieved under current guidelines for integrated resource management unless harvesting occurs in all zones throughout the timber harvesting land base. District staff should therefore identify appropriate harvest targets for areas in which harvesting has previously been avoided.

As mentioned earlier, this determination is being made before the effects of the government's March 1995 decision based on the West-Kootenay Boundary Land-Use Plan can be fully assessed. Except for broad consideration of the impact of the designation of the Goat Range (White Grizzly) and Syringa Creek protected areas, this determination does not reflect the timber supply implications of the West Kootenay-Boundary Land Use Plan. However, if at any time during the implementation of the land use plan it becomes apparent that the new AAC is no longer consistent with the Plan, I am prepared to reassess the timber supply and redetermine the AAC before the five-year period required under the *Forest Act*.

A handwritten signature in black ink, appearing to read 'J. Pedersen', with a long horizontal flourish extending to the right.

Larry Pedersen
Chief Forester
September 6, 1995

Appendix 1: Section 7 of the Forest Act

The B.C *Forest Act* section 7 reads as follows:

Allowable annual cut

7. (1) The chief forester must determine an allowable annual cut before December 31, 1996, and after that determination at least once every 5 years after the date of the last determination, for

- (a) the Crown land in each timber supply area, excluding tree farm licence areas and woodlot licence areas, and
- (b) each tree farm licence area.

(1.1) If, after the coming into force of this subsection, the minister

- (a) makes an order under section 6 (b) respecting a timber supply area, or
- (b) amends or enters into a tree farm licence to accomplish the result set out under section 33.1 (1) (a) to (d),

then, with respect to that timber supply area or tree farm licence area, as the case may be, the chief forester is not required to make the determination under subsection (1) of this section before December 31, 1995, or within 5 years after the last determination, but is required to make the determination

- (c) within 5 years after the order under paragraph (a) or the amendment or entering into under paragraph (b), and
- (d) after the determination under paragraph (c), at least once every 5 years after the date of the last determination.

(1.12) If the allowable annual cut for the tree farm licence area is reduced under section 7.1 (3), the chief forester is not required to make the determination under subsection (1) or (1.1) of this section at the times set out in subsection (1) or (1.1) (c) or (d), but must make that determination within one year after the chief forester determines that the holder is in compliance with section 7.1 (2).

(1.2) When the chief forester determines an allowable annual cut for a tree farm licence area, any management plan that specifies an allowable annual cut for that area is conclusively deemed to be amended so that the allowable annual cut specified in the management plan is the same as the most recent one determined by the chief forester.

(1.3) In determining an allowable annual cut under this section the chief forester may specify portions of the allowable annual cut attributable to

- (a) different types of timber and terrain in different parts of Crown land within a timber supply area or tree farm licence area,
- (b) different types of timber and terrain in different parts of private land within a tree farm licence area, and
- (c) gains in timber production on Crown land that are attributable to silviculture treatments funded by the Province, the federal government, or both.

(2) The regional manager or district manager shall determine a volume of timber to be harvested under a woodlot licence during each year or other period of its term, according to the licence.

(3) In determining an allowable annual cut under this section the chief forester, despite anything to the contrary in an agreement listed in section 10, shall consider

- (a) the rate of timber production that may be sustained on the area, taking into account
 - (i) the composition of the forest and its expected rate of growth on the area;
 - (ii) the expected time that it will take the forest to become re-established on the area following denudation;
 - (iii) silvicultural treatments to be applied to the area;

- (iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area;
 - (v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production; and
 - (vi) any other information that, in his opinion, relates to the capability of the area to produce timber;
- (b) the short and long term implications to the Province of alternative rates of timber harvesting from the area;
 - (c) the nature, production capabilities and timber requirements of established and proposed timber processing facilities;
 - (d) the economic and social objectives of the Crown, as expressed by the minister, for the area, for the general region and for the Province; and
 - (e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

Appendix 2: Section 4 of the *Ministry of Forests Act*

Section 4 of the *Ministry of Forests Act* (1978) reads as follows:

Purposes and functions of ministry

4. The purposes and functions of the ministry are, under the direction of the minister, to
- (a) encourage maximum productivity of the forest and range resources in the Province;
 - (b) manage, protect and conserve the forest and range resources of the Crown, having regard to the immediate and long term economic and social benefits they may confer on the Province;
 - (c) plan the use of the forest and range resources of the Crown, so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated, in consultation and cooperation with other ministries and agencies of the Crown and with the private sector;
 - (d) encourage a vigorous, efficient and world competitive timber processing industry in the Province; and
 - (e) assert the financial interest of the Crown in its forest and range resources in a systematic and equitable manner.

Documents attached:

Appendix 3: Minister of Forests' letter expressing provincial socio-economic objectives to Chief Forester

Appendix 4: Summary of Public Input
