

Cassiar TSA Timber Supply Analysis

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Victoria, B.C.
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August 1994

Canadian Cataloguing in Publication Data:

Main entry under title:

Cassiar TSA timber supply analysis

Includes bibliographical references: p.

ISBN 0-7726-2151-9

1. Timber - British Columbia, Northern. 2. Forests and forestry - British Columbia, Northern - Mensuration. 3. Forest management - British Columbia, Northern. 4. Prince Rupert Forest Region (B.C.) I. British Columbia. Ministry of Forests.

SD438.B7C37 1994 333.75'11'0971185 C94-960198-5

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Preface

This analysis is part of the provincial Timber Supply Review being carried out by the British Columbia Forest Service. The review is examining the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) throughout British Columbia. In many areas of the province, timber supply analyses performed in the early 1980s have not been updated to reflect new inventory information or changes in management practices.

To determine allowable timber harvesting levels accurately and rationally, the Chief Forester must have an up-to-date assessment of timber supply based on the best available information and reflecting current management direction. **The report that follows provides this assessment but should not be construed as a recommendation on permissible harvest levels.**

Unlike past analyses, which normally assessed the implications of several forest management scenarios, this report focuses on a single scenario — current management practices. Current management practices are defined by the specifications in management plans for the timber supply area, and include guidelines for the protection of forest resources, and official land-use decisions made by

Cabinet. The current nature and capabilities of the local forest industry are also considered.

Assessing the implications of current practices only rather than looking at a number of different management schemes will expedite the analysis process, allowing analysis of all TSAs in the province to be completed by the end of 1994. An important part of these analyses, however, is an assessment of how results might be affected by uncertainties — a process called *sensitivity analysis*. Together, the sensitivity analyses and the assessment of the effects of current forest management on timber supply will form a solid basis for discussions among stakeholders about alternative timber harvesting levels.

This report is one of four documents that will be released for each TSA in the province as part of the Timber Supply Review. Two of these documents provide detailed technical information on the results of timber supply and socio-economic analyses. Another paper summarizes this information to provide a focus for public discussions of possible timber harvest levels. The fourth outlines the Chief Forester's decision and the reasoning behind that decision.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Cassiar Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over the next 400 years. It also examines the potential changes in timber supply stemming from uncertainties about forest growth and management actions. It is important to note that the various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. **As such, the forecasts should be used for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Cassiar TSA covers a total area of 13.4 million hectares, of which 394 000 hectares are considered available for timber harvesting under current management practices. The current timber harvesting land base is more than three times larger than that which was reported in the last timber supply analysis in 1984. This increase is the result of more land being accessible and hemlock, balsam and poor site pine stands being included.

The current AAC for the Cassiar TSA is 140 000 cubic metres per year. Although harvest levels have been well below the AAC in the past, they have been rising in recent years.

Given current management assumptions, the analysis results indicate that the initial harvest level can be increased substantially above the current AAC to 842 400 cubic metres per year. This rate of harvest can be maintained for 7 decades before increasing to a long-term harvest level of 867 400 cubic metres per year.

Many of the data and assumptions used in the analysis are subject to varying degrees of uncertainty. Cassiar Forest District staff feel that the extent of the land base assumed to be available for timber harvesting is particularly uncertain. Sensitivity analyses show that timber supply is highly sensitive, both in the short and long term, to changes in the timber harvesting land base.

Given the limited harvesting and silvicultural history of the Cassiar TSA, there is uncertainty about the reliability of the forest inventory and the existing

and managed stand timber yield estimates. The harvest forecast is highly sensitive, in the short term, to decreases in existing stand yield estimates. In the long term, the harvest forecast is moderately sensitive to uncertainty in existing yield estimates. Conversely, timber supply has little sensitivity in the short term to uncertainty in regenerated stand yields, but high sensitivity in the long term.

The harvest forecast is highly sensitive to a combination of increasing the timber harvesting land base by 30% and increasing both the existing and managed stand yield estimates by 10%. However, the harvest forecast was only moderately sensitive to the combined impact of a 30% decrease in the land base and 10% decreases in yield estimates.

Two other uncertainties which may affect future harvest levels are estimates of cutblock adjacency requirements and minimum harvestable ages. The harvest forecast is highly sensitive in the short term to increased cutblock adjacency requirements and moderately sensitive to large (20 year) increases in minimum harvestable ages. The harvest forecast is only slightly affected when cutblock adjacency requirements are removed and minimum harvestable ages are decreased.

Uncertainty in green-up ages has a moderate effect on potential harvest levels in the short term, and only a slight effect in the long term.

The main conclusion drawn from the sensitivity analyses is that inventory and mapping work is needed to assist in defining the timber harvesting land base. Timber supply is also sensitive to uncertainties in other variables, such as timber volume estimates. However, more experience in harvesting timber will be needed to indicate the nature and magnitude of these uncertainties in the Cassiar TSA.

In conclusion, this analysis indicates that timber supply in the Cassiar TSA is sufficient to support some increase in harvests above the current AAC. However, the high uncertainties about variables important in determining timber supply should be considered during discussions about future allowable harvest levels.

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Introduction

Timber supply is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time.

Assessing the timber supply involves considering physical, biological, social and economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

All of these factors are linked: the financial profitability of harvest operations depends upon the terrain, as well as the physical characteristics of the trees to be harvested. Determining the physical characteristics of trees in the future requires knowledge of their growth. Decisions whether a stand is available for harvest often depends on how its harvest could affect the growth and development of another part of the forest resource, such as wildlife or a recreation area.

These factors are also subject to both uncertainty and different points of view. Financial profitability may change as world timber markets change. Unforeseen losses due to fire or pest infestations will alter the amount and value of timber. The appropriate balance of timber and non-timber values in a forest is an ongoing subject of debate, and is complicated by changes in social objectives over time.

Thus, before an estimate of timber supply is interpreted, the set of physical, biological and socio-economic conditions on which it is based — and the uncertainties affecting these conditions — must first be understood.

Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit (a geographic area). For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by the Chief Forester of British Columbia in determining an allowable annual cut (AAC)* — the permissible harvest level for the area.

Timber supply projections made for TSAs look far into the future — 200 years or more. However, because of the uncertainty surrounding the information and because forest management objectives change through time, these projections should not be viewed as static prescriptions that remain in place for that length of time. They remain relevant only as long as the information upon which they are based remains relevant. Thus, it is important that re-analysis occur regularly, using new information and knowledge to update the timber supply picture. Indeed, the *Forest Act* now requires that the timber supply for management units through British Columbia be reviewed at least every 5 years. This allows close monitoring of the timber supply and of the implications for the AAC stemming from changes in management practices and objectives.

**Throughout this document, an asterisk after a word or phrase indicates that it is defined in a box at the foot of the page, as well as in the glossary.*

Timber Supply Area (TSA)

An integrated resource management unit established in accordance with Section 6 of the Forest Act.

Allowable annual cut (AAC)

The allowable rate of timber harvest from a specified area of land. The Chief Forester sets AACs for Timber Supply Areas (TSAs) and Tree Farm Licences (TFLs) in accordance with Section 7 of the Forest Act.

Introduction

Timber supply analysis involves three main steps. The first is collecting and preparing information and data. The B.C. Forest Service forest inventory* plays a major role in this. The second step is using this data along with a timber supply computer model or models to make projections or estimates of possible harvest levels over time. These projections are made using different sets of assumed values or conditions for the factors discussed above. The third step is interpreting and reporting results.

The following sections outline the timber supply analysis for the Cassiar TSA. Following a brief description of the TSA in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Analysis methodology and results are presented in Sections 3 and 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used. The report ends with a summary and conclusions.

The appendixes contain further details about the data and assumptions used in this analysis.

Forest inventory

Assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of additional forest values such as recreation and visual quality.

1 Description of the Cassiar Timber Supply Area

The Cassiar TSA is located in the northern portion of the Prince Rupert Forest Region (Figure 1), and is administered by the Cassiar Forest District office in Dease Lake. The Cassiar TSA covers approximately 13.4 million hectares. Although the Cassiar TSA is the largest in the province, a relatively small proportion of its area is productive forest land because of its mountainous topography, thin soils and harsh climate.

The economy of the sparsely populated area is dependent on government services and several industries including forestry, mining, and recreation and tourism. The timber industry is relatively undeveloped, and as a result the current AAC has never been fully used. Most of the demand for timber comes from processing facilities outside the TSA. Recently, however, more

industrial interest in timber supplies has prompted an increase in harvesting levels.

Forests available for timber harvesting are dominated by stands of balsam fir, hemlock, lodgepole pine and spruce. In the northern portions of the Cassiar TSA, pine is the most dominant species; in the southern portion, hemlock dominates. Currently, 47% of the stands that make up the timber harvesting land base* are below harvestable size due to a long history of fires.

Several important recreation, tourism, and wilderness areas exist within the Cassiar TSA. Examples of these areas are Atlin Park and Recreation Area, Mount Edziza Park and Recreation Area, Spatsizi Plateau Wilderness Park, Stikine River Recreation Area, and Tatshenshini-Alsek Wilderness Park.

Timber harvesting land base

The portion of the total land area of a management unit considered to contribute to, and be available for, long-term timber supply. The harvesting land base is defined by deducting non-contributing areas from the total land base according to specified management assumptions.

1 Description of the Cassiar Timber Supply Area

Figure 1. Map of the Prince Rupert Forest Region.

2 Information Preparation

Many pieces of information are required to conduct a timber supply analysis. Each piece falls into one of three categories: land base inventory, timber growth and yield, and management practices.

2.1 Land base inventory

Land base inventory information used in this analysis comes in the form of a computer file prepared in 1993 by the B.C. Forest Service Inventory Branch. This file contains a considerable amount of data about the thousands of pieces of forest land that make up a TSA, including the geographic location, the area, and the nature of the forest cover (such as presence or absence of trees, number of trees, species, age, and timber volume).

Initially, this file is a representation of the land base for the entire TSA. It includes data for areas on which timber harvesting operations are not expected to take place, and therefore do not contribute to the timber supply of the area. Examples include land that has been set aside for a park, or areas occupied by power lines, highways, or town sites (such non-contributing areas specific to the Cassiar TSA are described below). Before this land base file is used to make timber supply projections, data for these non-contributing areas must be removed to ensure that the file represents the timber harvesting land base.

The reduced data file is derived through a computer process that identifies information for non-contributing areas and removes it from the file. When these reductions are made, care is taken to ensure that only a single reduction is made where categories overlap (for example, where a park area also has unstable soils).

It is important to remember that removal of data for areas not contributing to the timber supply does not imply withdrawal of these areas from the TSA.

The B.C. Forest Service still manages the entire area of the TSA (except for certain designated lands) as a forest unit that contributes a mix of timber and non-timber values. It is within that integrated resource context that the timber supply is managed. The timber supply analysis in this report is consistent with this philosophy.

This section describes the types of areas not contributing to the timber harvesting land base. Use of the term *timber harvesting land base* in this report does not mean that an area is open to unrestricted harvesting activities. Rather, it implies that forests in the area contain timber of sufficient economic value — and sites with adequate environmental resilience — to accommodate timber harvesting with due care for other resources.

Areas on which timber harvesting is not expected to occur, under current forest management in the Cassiar TSA, are:

- areas not managed by the B.C. Forest Service — these include non-Crown land, areas managed by other agencies, and forest land not administered as part of the TSA. Examples of these areas are ecological reserves, parks and recreational areas.
- non-forest areas — areas not occupied by productive forest cover (for example, alpine areas, rock and swamp).
- inoperable areas — areas defined as unavailable for harvest for access reasons.
- riparian areas* — river-, stream- and lake-side buffers for the protection of fish and wildlife habitat and water quality.
- environmentally sensitive areas*(ESAs) — portions of areas classified as sensitive are considered unavailable for timber harvesting.

Riparian areas

Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.

Environmentally sensitive areas

Areas with significant non-timber values or fragile or unstable soils, or where there are impediments to establishing a new tree crop, or timber harvesting may cause avalanches.

2 Information Preparation

- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- non-merchantable forest types* — areas occupied by timber stands of low volume or non-merchantable species, or with low timber-growing potential.
- Highway 37 corridor — visual quality corridor where no harvesting will occur within 500 metres on either side of the centre line of the highway.
- forest roads, skid trails and landings — the area of existing forest roads, trails and landings is excluded from the timber harvesting land base. Future losses of productive forest land to roads,

trails and landings are projected and modeled as deductions over time as future harvesting occurs.

- not satisfactorily restocked* (NSR) areas — NSR areas are initially deducted from the timber harvesting land base. The portion of the total NSR area considered available for timber harvesting is then added back in.

A more detailed description of these categories, including specific criteria for removal is located in Appendix A, "Description of Data Inputs and Assumptions."

Table 1 summarizes the areas in each category, and shows the area of the timber harvesting land base.

Non-merchantable forest types

Stands that are accessible and otherwise available for harvesting but are assumed to be non-merchantable due to stand characteristics such as small piece size, incidence of decay, species composition and low stocking.

Not satisfactorily restocked

An area not covered by a sufficient number of tree stems of desirable species. Stocking standards are set by the Forest Service, Silviculture Branch. If the expected regeneration delay (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) has not elapsed, the land is defined as current NSR. If the expected delay has elapsed, the land is classified as backlog NSR.

2 Information Preparation

Table 1. Timber harvesting land base for the Cassiar TSA

Classification	Area (hectares)	Per cent of total area	Per cent of productive area
Total area on inventory file ^a	13 413 249	100.0	
Not managed by the B.C. Forest Service	311 000	2.3	
Non-forest	9 434 815	70.4	
Total productive forest managed by the B.C. Forest Service (Crown forest)	3 667 434	27.3	100.0
Reductions to Crown forest^b:			
Inoperable areas ^c	1 838 723	13.7	50.1
Riparian areas	86 711	0.6	2.4
Environmentally sensitive areas (ESAs)	550 095	4.1	15.0
Non-commercial	89 580	0.7	2.4
Non-merchantable	681 310	5.1	18.6
Highway 37 corridor	27 030	0.2	0.7
Existing roads, trails, landings	230	0.0	0.0
Not satisfactorily restocked (NSR)	27 268	0.2	0.7
Total reduction	3 300 947	24.6	90.0
Initial timber harvesting land base (less NSR)	366 487	2.7	10.0
Additions:			
Not satisfactorily restocked	27 268	0.2	0.7
Current timber harvesting land base	393 755	2.9	10.7
Future reductions:			
Future roads, trails, landings	27 114	0.2	0.7
Future timber harvesting land base	366 641	2.7	10.0

(a) The actual land base of the Cassiar TSA is larger than the area stated. Many ecological reserves, provincial parks, and recreational areas are not included in the forest inventory file; for example, Spatsizi Plateau Wilderness Provincial Park.

(b) Reductions were performed in the following order: 1) not managed by the B.C. Forest Service; 2) non-forest land; 3) inoperable; 4) riparian class 3 and 4 streams; 5) environmentally sensitive areas; 6) riparian class 1 and 2 streams and lakes > 400 hectares; 7) Highway 37 corridor; 8) non-merchantable stands; and 9) existing roads and NSR.

(c) Areas included in this estimate are all of the Alsek and Kechika timber supply blocks*, and other areas known to be inaccessible (roading is not viable, merchantable timber is lacking and ground-based harvest systems cannot be used). Also, at the time of data preparation mapping was not available for the Tatshenshini-Alsek Wilderness Park. Therefore, the area of the park has been included in the inoperable estimate.

Timber supply blocks
A division of a timber supply area.

2 Information Preparation

The current timber harvesting land base is approximately 394 000 hectares, almost 275 000 hectares larger than the area reported in the 1984 Cassiar TSA analysis. The difference is due to an increase in the accessible land base and the inclusion of balsam and hemlock, and poor site pine forest types.

Figure 2 shows the classification of the total land base for Cassiar TSA on the left and the productive forest land base on the right. Of the productive Crown forest land base, 50.1% of the area is inoperable. The current timber harvesting land base accounts for about 2.7% of the total, and 10.0% of the productive forest land base.

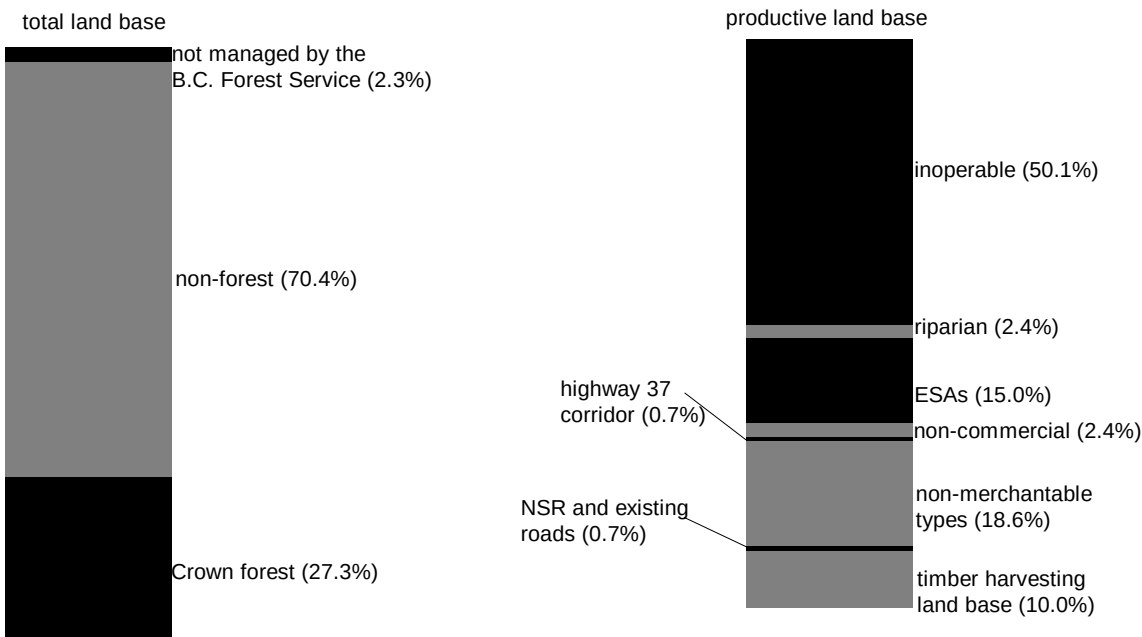


Figure 2. Classification of the total and productive forest land base, Cassiar TSA.

2 Information Preparation

Figure 3 shows a breakdown of the timber harvesting land base by major tree species and maturity. Overall, there is an almost even split between areas below (46.7%) and above (53.3%) the

minimum harvestable age*. Much of the forest dominated by pine is currently young because of past fires.

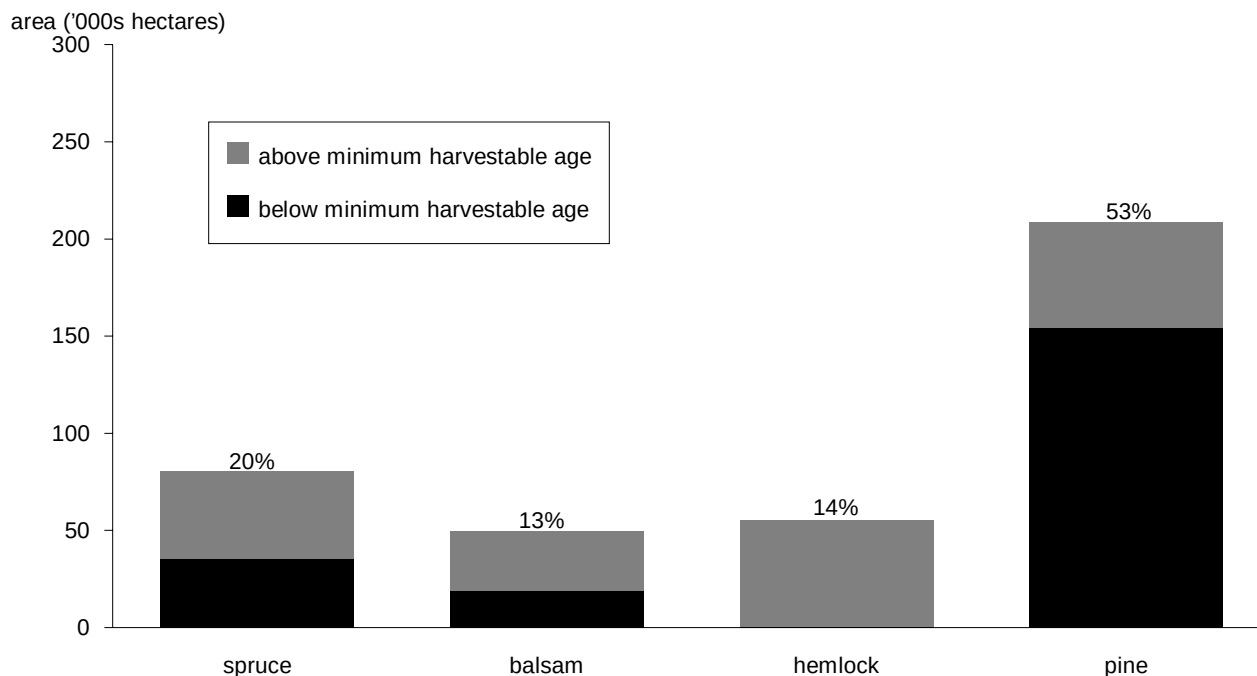


Figure 3. Timber harvesting land base by major species type and maturity, Cassiar TSA.

Minimum harvestable age

The age below which stands will not be approved for harvest. For the Cassiar TSA, these ages are defined by minimum volume and average diameter criteria and they vary by tree species and site productivity. Actual harvest ages depends on many factors, including the ages of other stands, limits on the overall harvest level, and forest cover guidelines.

2 Information Preparation

Figure 4 shows a breakdown of the growing stock* on the timber harvesting land base by major tree species and maturity. Almost 90% of the volume is above the minimum harvestable age. Figures 3 and 4 show that although most of the area is occupied by

pine stands, most of the volume is hemlock. In part this is because pine stands occupy areas recently burned by wildfire.

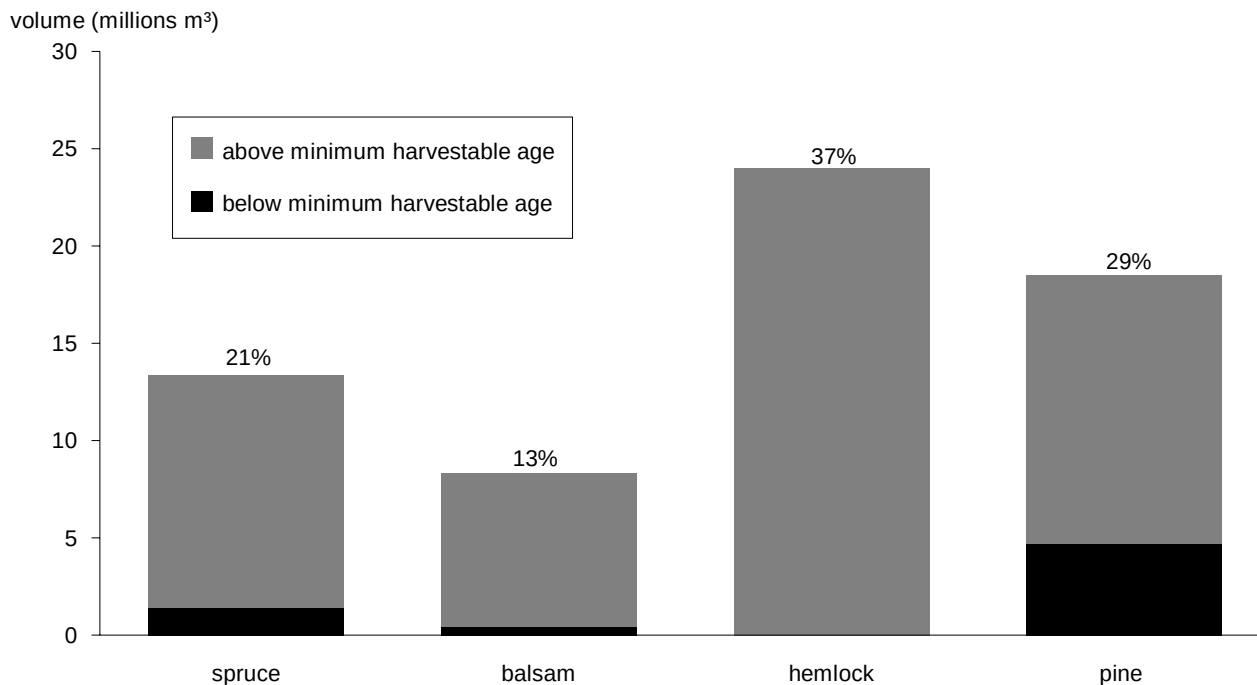


Figure 4. Growing stock distribution by major tree species and maturity, Cassiar TSA.

Growing stock

The volume estimate for all standing timber, of all ages, at a particular time.

2 Information Preparation

Figure 5 shows the current stand age class distribution for the Cassiar TSA timber harvesting land base. Note that while the TSA has had only a brief history of timber harvesting, frequent large fires

have resulted in a large amount of the TSA being in younger age classes.

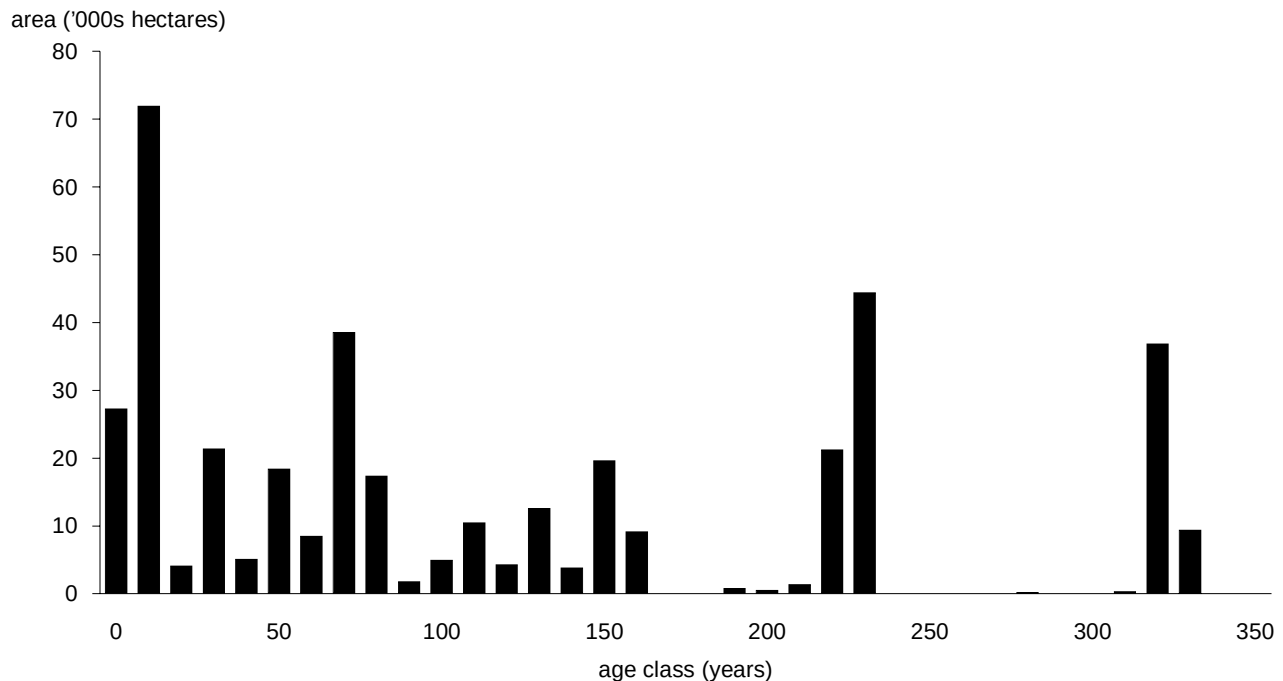


Figure 5. Age class distribution for the timber harvesting land base, Cassiar TSA.

2.2 Timber growth and yield

Timber growth and yield refers to the prediction of the growth and development of individual forest stands over time. The most common measure of the amount of standing timber is volume per area (in British Columbia, cubic metres per hectare). This measure assumes a utilization level or set of dimensions that establishes a minimum size limit for trees and logs that must be harvested and removed from a site. Utilization levels specify a maximum stump height and minimum diameters at the tree base and top.

Timber volumes applied to existing stands in this analysis are based on the Variable Density Yield Prediction (VDYP) model developed by the B.C. Forest Service, Inventory Branch. This model provides estimates of stand volume according to age. Timber volumes estimated for future regenerated stands are based on the Table Interpolation Program for Stand Yields (TIPSY) model developed by the B.C. Forest Service, Research Branch. Sensitivity analysis addresses the possibility that stand volumes may be different from those predicted.

2 Information Preparation

2.3 Management practices

Timber supply is directly connected to forest management activity. The *Interim Regional Timber Harvesting Guidelines for the Interior Portion of the Prince Rupert Forest Region*, and the *British Columbia Coastal Fisheries/Forestry Guidelines* guide forest management practices in the Cassiar TSA. The focus of the Timber Supply Review is to describe the timber supply based on current management practices, as implemented in plans for the area. Staff in the Cassiar Forest District and in the Prince Rupert Forest Region defined these practices according to the following management assumptions*:

- Basic silviculture — levels of reforestation activities required to establish free-growing stands* of acceptable species and the basic silvicultural systems used in the TSA. In the Cassiar TSA, most areas are managed using a conventional ground-based clearcut harvesting* system and are restocked by planting or natural regeneration.
- Forest health and unsalvaged losses — expected timber losses due to fire, pest (insect, disease

and animals), and wind damage. Losses due to pest and wind damage are considered to be negligible. Unsalvaged losses due to fire are estimated to be 7600 cubic metres per year. The harvest volumes shown throughout this report have been reduced by this amount.

- Cutblock adjacency* and green-up* — previously harvested stands must reach a desired condition, or green-up, before adjacent stands may be harvested. The northern portions of the TSA are managed under a 3-pass harvest system which means that no more than 33% of the area can be occupied by stands that have not reached green-up. The southern portions are managed under a 4-pass harvest system where no more than 25% of the area can be occupied by stands that have not reached green-up condition. The green-up period is defined, on a management zone basis, as the average time that stands need to attain a height of 3 metres.
- Utilization levels — size limits of the trees and logs to be removed from harvested sites.

Management assumptions

Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

Free-growing stands

Stands composed of sufficient seedlings of an acceptable commercial species that are free from growth-inhibiting brush, weed and excessive tree competition.

Clearcut harvesting

A harvesting method whereby all trees that meet utilization standards are harvested. The harvested site is then regenerated to acceptable standard by appropriate means including planting and natural seeding.

Cutblock adjacency

The desired spatial relationship among cutblocks as specified in integrated management guidelines. They can be approximated by specifying the maximum allowable proportion of a forested landscape that does not meet green-up requirements.

Green-up

The time needed after harvesting for a stand of trees to reach a desired condition (e.g., height) to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics.

2 Information Preparation

- Minimum harvestable ages — the time it takes for stands to grow to a merchantable size. For the Cassiar TSA, these ages are defined by minimum volume and average diameter criteria and vary by tree species and site productivity. Actual harvest age may be greater but not less than the minimum, and will depend on many factors, including the ages of other stands, limits on the overall harvest level, and forest cover guidelines.
- Restocking of current and backlog NSR — the schedule of restocking these stands.

A more detailed description of the management assumptions is provided in Appendix A, "Description of Data Inputs and Assumptions."

2.4 Management zones

Many forest values are considered when planning and practicing timber harvesting in the Cassiar TSA. Non-timber values are accounted for either by following integrated resource management guidelines, or by removing land from consideration for harvesting. Special management zones or additional timber harvesting constraints were not required for the management of biodiversity, old-growth forest, or habitat management values. Sensitive sites and critical wildlife areas were removed from the timber harvesting land base. The forest ecosystem specialist from the Ministry of Environment, Lands and Parks recommended that 12% of the land base, by major forest species type, be reserved from harvesting to ensure ecosystem representation. Analysis of the area reductions (Table 1) showed that at least 12% of the major forest species types had been removed. No additional reductions were required.

Figure 6 shows that the Cassiar TSA is divided into 6 timber supply blocks. Under present management assumptions, only portions of the Atlin, Boundary, Dease-Liard and Iskut timber supply blocks are included in the operable land

base. The definition of the operable land base is based on the use of conventional ground-based harvest systems, accessibility from existing roads, presence of merchantable timber, presence of topographic features such as mountain ranges, and current road construction costs and technologies. Forests that could be available for timber harvesting within the Alsek and Kechika timber supply blocks are not considered economically accessible at this time.

The species growth rates and management assumptions (for example, regeneration delay period, see Appendix A, "Description of Data Inputs and Assumptions") vary between the northern and southern timber supply blocks. This variation is attributed to biogeoclimatic differences such as topography, moisture, and soil types. As a result, the dominant stand type to the south is hemlock and to the north is pine (Figure 7). Based on these differences, as well as the different visual quality objectives, the Cassiar TSA timber harvesting land base has been divided into two management zones:

- Zone 1 (Cassiar TSA south) — the timber harvesting land base of the Boundary and Iskut timber supply blocks is managed as an integrated resource management zone in which no more than 25% of the forest is to be less than 3 metres in height (4-pass harvest system). The objective of using the 4-pass harvesting system is to protect visual quality for the adjacent parks, wilderness and recreation areas, and to enhance wildlife management.
- Zone 2 (Cassiar TSA north) — the timber harvesting land base of the Atlin and Dease-Liard timber supply blocks is managed as an integrated resource management zone in which no more than 33% of the forest is to be less than 3 metres in height (3-pass harvesting system).

2 Information Preparation

Figure 6. Map of the timber supply blocks, Cassiar TSA.

2 Information Preparation

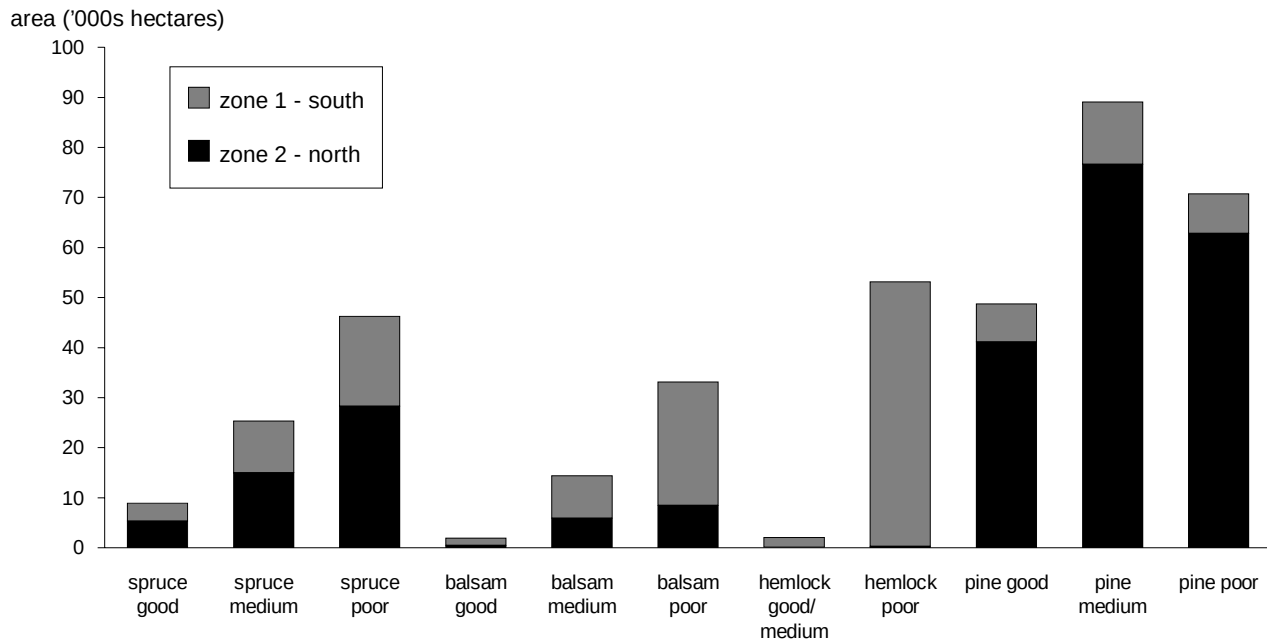


Figure 7. Area by zone, major species, and site class, timber harvesting land base, Cassiar TSA.

3 Analysis Methods

The purpose of this analysis was to examine both the short-and long-term timber harvesting opportunities in the Cassiar TSA, in light of current forest management practices. A timber supply computer simulation model developed by the B.C. Forest Service was used to aid in the assessment. A timber supply model, as distinguished from a growth and yield model, assists the timber supply analyst in determining how a whole forest (collection of stands) could be managed to obtain a harvest forecast (supply of timber over time). The simulation model uses information about the timber harvesting land base, timber volumes and the management regime to represent how trees grow and are harvested over a period of up to 400 years. For most of the figures to follow only the results for the first 250 years are shown in this report, because the harvest flow remains relatively constant from 250 to 400 years from now.

Similar to other models, the B.C. Forest Service model assumes that trees grow according to provided yield projections and are harvested according to either a volume target or a specified objective set by the analyst, such as harvest volume maximization. However, the Forest Service model differs from most other models in that it allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of

cutblock adjacency and green-up prescriptions. For example, guidelines might specify that no more than some maximum percentage of the forest can be younger than a specified green-up age, or that some minimum percentage of the forest must be in older age classes to provide wildlife habitat. The B.C. Forest Service simulation model examines the effects of such guidelines on timber supply.

This type of analysis is used to determine the timber supply implications of a particular timber harvesting regime. The results of the analysis are especially important in determining allowable cuts that will not restrict options of future resource managers, and that will allow local B.C. Forest Service staff to administer their programs according to relevant guidelines and principles. However, **the results of the analysis are not meant to be taken as recommendations of any particular AAC.**

The main results of the analysis are forecasts of potential timber harvests and timber inventory changes (ages and volumes) over time. Although information gives field staff only very limited guidance in the design of operational activities such as harvesting block location and silviculture planning, it does help ensure that the timber harvest level supports rather than hinders sustainable forest management in the field.

4 Results

This section presents the results of the timber supply analysis for the Cassiar TSA. The analysis uses the most recent assessments of current forest management, the land available for timber harvesting, and timber yields as described in Section 2, "Information Preparation." These results will be referred to as the base case because they form the basis for comparison when assessing the effects of data and management uncertainty on timber supply. Because forest management is inherently a very long-term venture, uncertainty surrounds much of the information important in determining timber supply. These factors will be discussed in Section 5, "Timber Supply Sensitivity Analyses." The base case provides only a part of the timber supply picture in the Cassiar TSA, and should not be viewed in isolation of the sensitivity analysis.

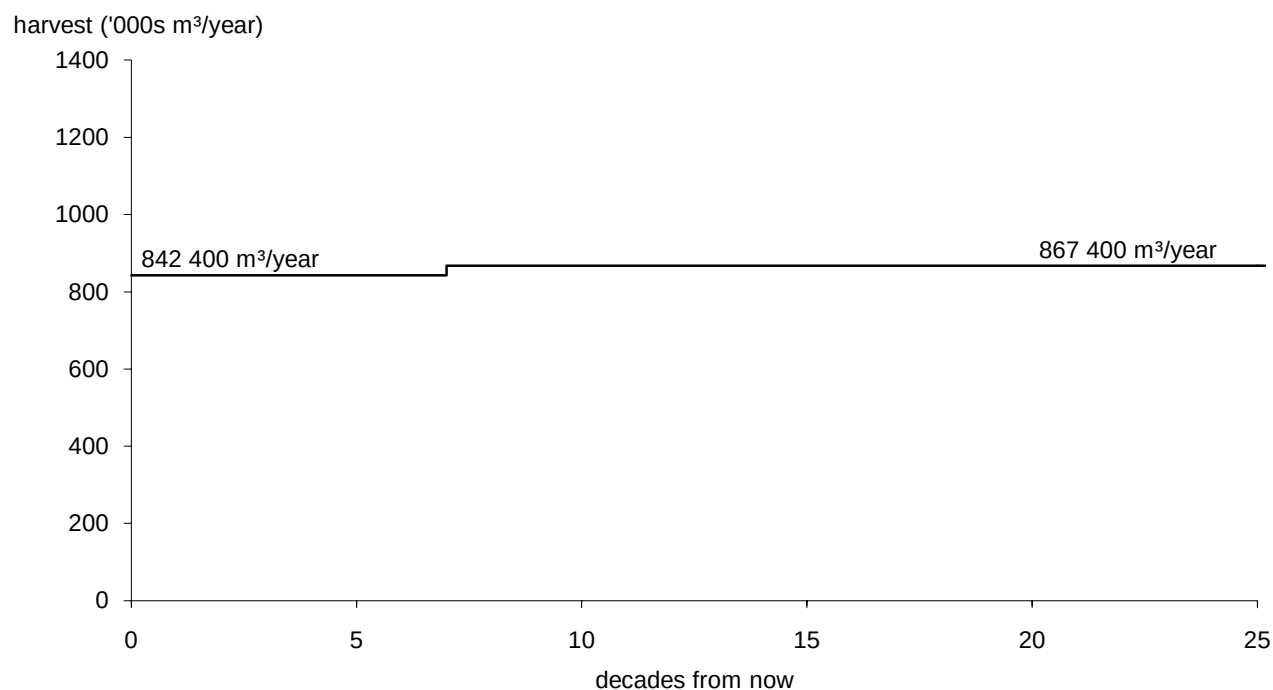


Figure 8. Base case harvest forecast, Cassiar TSA.

The long-term harvest level was set to maintain growing stock at a constant level once most of the initial forest is replaced by a second-growth forest. A constant growing stock serves as an indicator that a particular harvest level can be maintained over the long term. Figure 9 shows both the total and harvestable growing stock projected over time. Although in the long term the total level of growing stock oscillates, the trend is constant, suggesting that the long-term harvest level can be maintained.

4.1 Base case harvest forecast

The base case harvest forecast shows an initial harvest rate of 842 400 cubic metres per year, well above the current AAC of 140 000 cubic metres (Figure 8). After 7 decades, the rate of harvest is increased to the long-term harvest level of 867 400 cubic metres per year.

The base case harvest forecast is only one of many possible harvest flows given current forest management assumptions. It was based on an attempt to achieve an initial harvest as high as possible without causing future shortfalls. However, many other harvest flows are possible and some alternatives are discussed in Section 5.1, "Changes in harvest flow over time."

The current total and harvestable growing stock levels are, respectively, about 64.2 and 57.6 million cubic metres, indicating the large proportion of older stands that are currently available for harvest. As harvesting occurs, the older stands are replaced with managed stands that grow faster but are harvested at younger ages. This reduction in average harvest age is illustrated in Figure 10. After 14 decades all existing stands have been replaced with managed stands.

4 Results

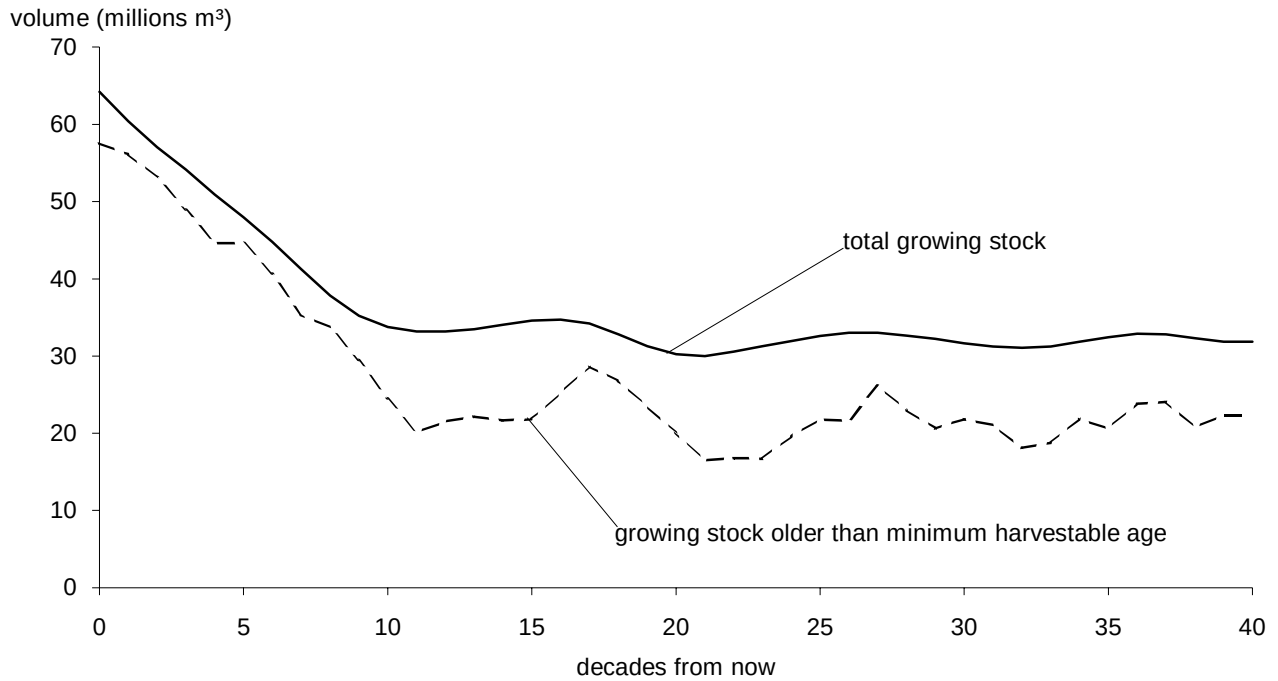


Figure 9. Total growing stock for the base case, Cassiar TSA.

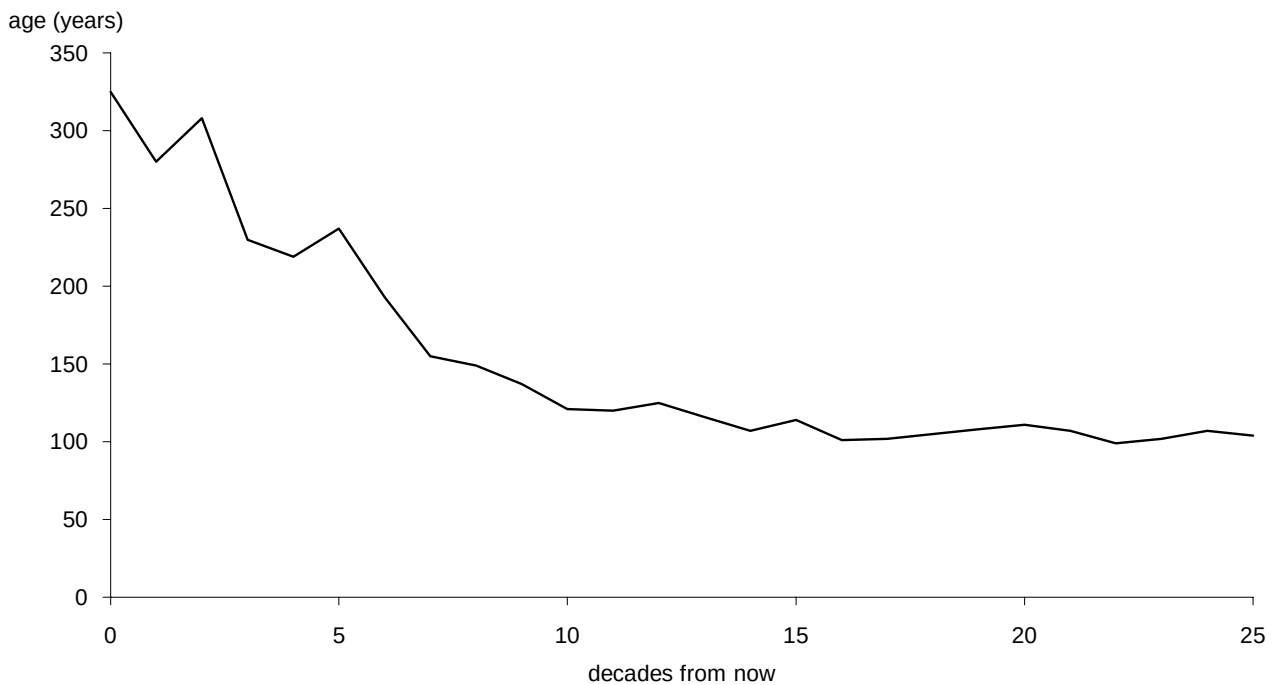


Figure 10. Average harvest age over time for the base case, Cassiar TSA.

4 Results

Figure 11 shows the average volume per hectare harvested over time. The initial average volume harvested is 430 cubic metres per hectare; the

projected average volume harvested from decade 25 to 40 (not shown) is 250 cubic metres per hectare.

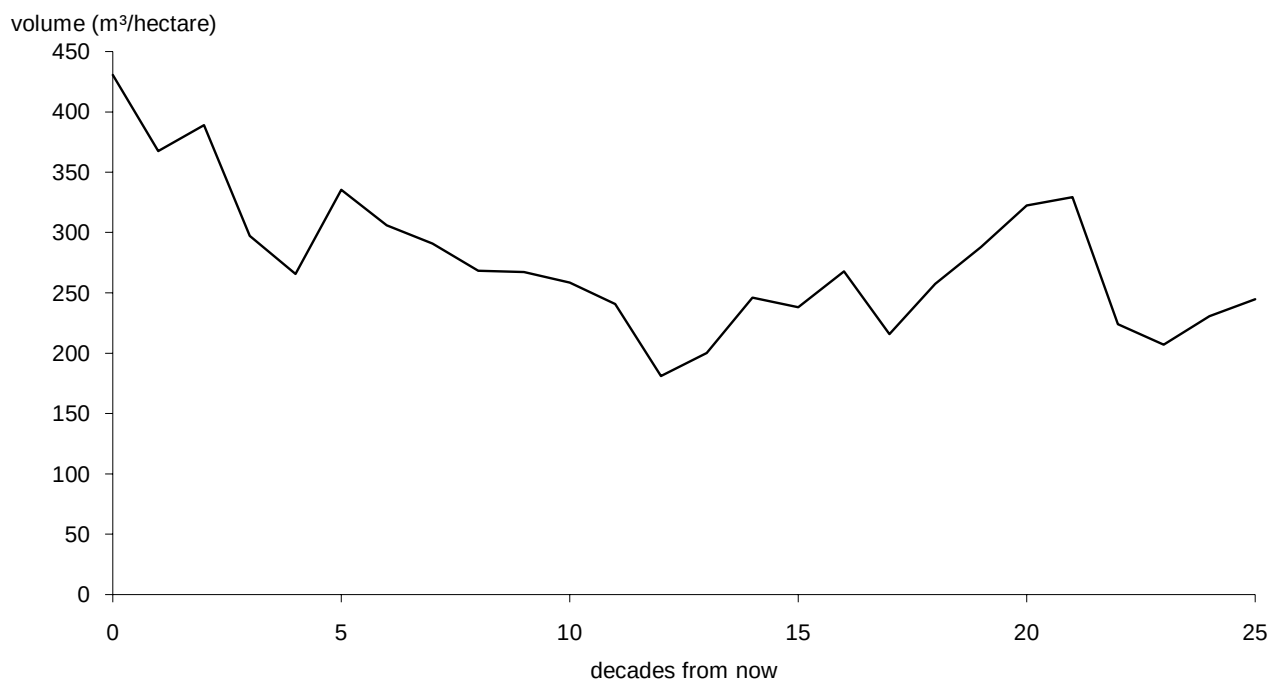


Figure 11. Average volume per hectare harvested, for the base case, Cassiar TSA.

Figure 12 shows the changes projected to occur in the age distribution over 250 years. Initially the forest has a dispersed age class ranging from young to older aged stands. After 100 years, all stands older than 200 years have been harvested and replaced with younger managed stands. After 250 years, all forest stands in the timber harvesting land base are under managed conditions and the forest age classes become fairly evenly distributed. After 400 years (not shown) the age class distribution is much more evenly distributed than at 250 years from now.

One of the main factors affecting potential harvests over time in the Cassiar TSA is the current age class composition (Figure 5). Almost half of the timber harvesting land base is occupied by forest younger than harvestable age. The rate at which the existing stock of mature timber can be harvested depends on when the large area of immature forest will become available for harvest. As the base case

harvest forecast shows, a harvest slightly below the long-term level could be maintained for several decades. The harvest could be increased slightly when currently young forest — particularly the recently burned areas — become old enough to contribute to harvests. The other main factor affecting timber supply is illustrated by the cyclic pattern of average volume per hectare harvested shown in Figure 11. At the times around 120 and 230, harvesting is projected to occur mostly on poorer quality, low volume forest sites. Therefore, to achieve a given harvest target, more area would need to be harvested, resulting in more area younger than green-up age than when volume per hectare harvested is higher. Therefore forest cover requirements may limit harvests at times when volume per hectare harvested is low. This is particularly important around 230-240 years from now.

4 Results

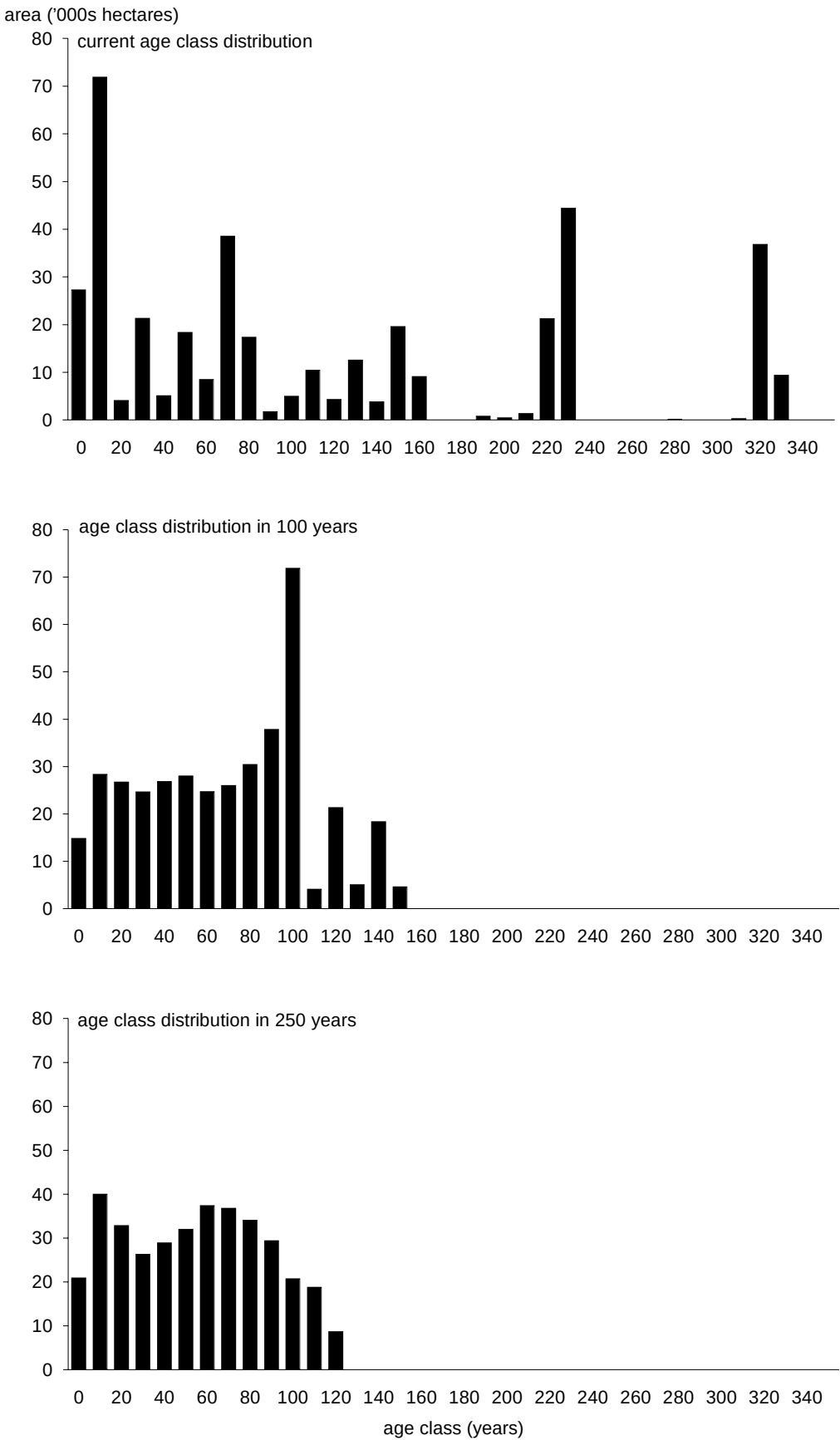


Figure 12. Age class distribution over time for the base case, Cassiar TSA.

5 Timber Supply Sensitivity Analyses

The best available information on forest inventories and management practices is used to analyse the timber supply implications of continuing with current management. However, forest management is a complicated and ever-changing endeavor that must account for diverse and changing human values, the dynamics of complex ecosystems, and fluctuating and uncertain economic factors. As well, forests grow quite slowly in terms of human time spans, which means that decisions we make today have not only short-term but also long-term effects. In such a context, we cannot be certain that all data accurately reflect the current state of all values in the forest, how the forest will change, or how our management activities will affect the forest.

One important way to deal with this uncertainty is to revise plans and analyses frequently to ensure they incorporate up-to-date information and knowledge. Frequent planning and decision-making can help minimize any negative effects that may occur if decisions are based on inaccurate information. Frequent revision can also ensure that opportunities that become apparent from new information are not missed.

Another important way of dealing with uncertainty is to assess its potential effects on values of interest, for example, timber supply. Every decision either implicitly or explicitly incorporates an attitude towards uncertainty. If we believe that existing information accurately reflects reality, we are being neutral to uncertainty, believing essentially that any inaccuracies probably balance out. Ignoring uncertainty is implicitly neutral. If maximizing timber supply were the goal, someone with an optimistic position towards uncertainty would believe that current information probably underestimates timber supply, and that problems can be resolved through human ingenuity and changes to practices. A conservative position would be that current information probably overestimates timber supply, and that decisions should minimize the potential for future timber supply shortages, or negative effects on other values.

This report does not advocate any of these positions. One of its goals is to supply information to assist people with different attitudes towards forest management and uncertainty to provide input.

Sensitivity analysis is one way of evaluating how uncertainty could affect analysis results, and ultimately, decision-making. One purpose of sensitivity analysis is to highlight which variables most affect results. For example, it is possible that small inaccuracies in estimating some variables could have large effects on timber supply, or that fairly large inaccuracies in other variables could have negligible effects. Sensitivity analysis can therefore highlight priorities for collecting information for future analysis. It can also clarify whether current best estimates provide safe bases for decisions, or whether high uncertainty about important variables means more conservative decisions may be wiser.

In this section, results of several sensitivity analyses are discussed. The results that are based on current forest management assumptions (shown in Figures 8 - 12) are referred to as the base case.

5.1 Changes in harvest flow over time

The base case harvest forecast in this analysis starts with a harvest level of 842 400 cubic metres per year for 7 decades, and then increases to the long-term harvest level of 867 400 cubic metres. However, many other harvest flows are possible. This section examines four harvest flow alternatives, which are illustrated in Figures 13 and 14.

The first harvest forecast examines the effect of establishing and maintaining the rate of harvest at the long-term level. Figure 13 shows that this harvest level cannot be maintained during decade 24. The shortfall occurs due to cutblock adjacency requirements; at harvest levels greater than 792 000 cubic metres per year, the area occupied by stands that have reached green-up conditions would be insufficient to achieve adjacency and green-up guidelines.

5 Timber Supply Sensitivity Analyses

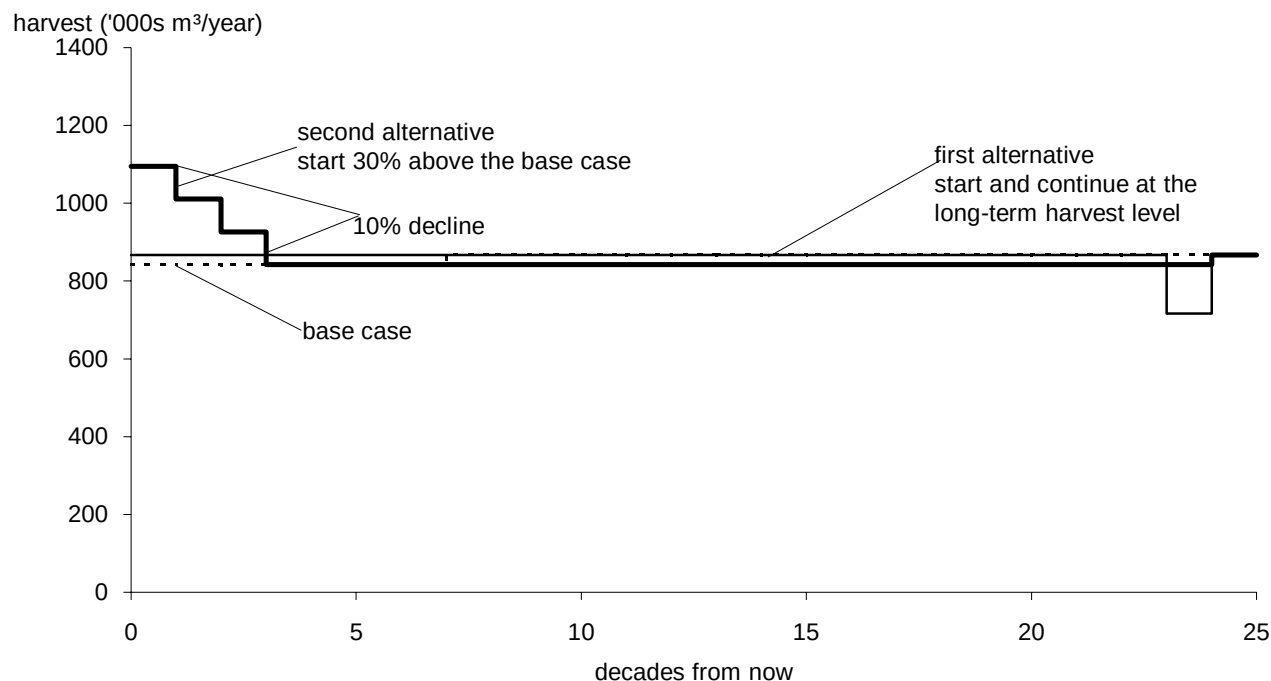


Figure 13. Alternative harvest flows above base case, Cassiar TSA.

The second harvest flow examines the implications of raising the initial harvest level as high as possible and then declining in steps of 10% per decade to the base case harvest level. Figure 13 shows this harvest flow pattern begins with an initial harvest level 30% higher than the base case, declining by 10% over 3 decades to the short-term base case harvest level (842 400 cubic metres per year). Instead of rising to the long-term harvest level after 7 decades as in the base case, the harvest level remains at this lower level for 24 decades before rising to the long-term level. This harvest flow alternative shows that any significant increase over the base case initial harvest level requires that harvests decline to a level below the base case for an extended period of time further into the future. Figures 15 and 16 illustrate the effect of this harvest

forecast on growing stock levels and average stand harvest age.

Figure 14 shows potential harvest forecasts that begin at the current AAC of 140 000 cubic metres per year. This figure shows it would be possible to maintain a harvest of 140 000 cubic metres per year throughout the analysis horizon. The effect of this flow pattern is accumulation of older stands within the Cassiar TSA. Figures 15 and 16 illustrate this effect as growing stock and average stand age at harvest continue to increase over time. The accumulation of older stands may enhance values such as biodiversity that are characteristic of older stands. However, maintenance of older timber and higher levels of growing stock over longer periods of time may increase risks to forest health and raise protection concerns.

5 Timber Supply Sensitivity Analyses

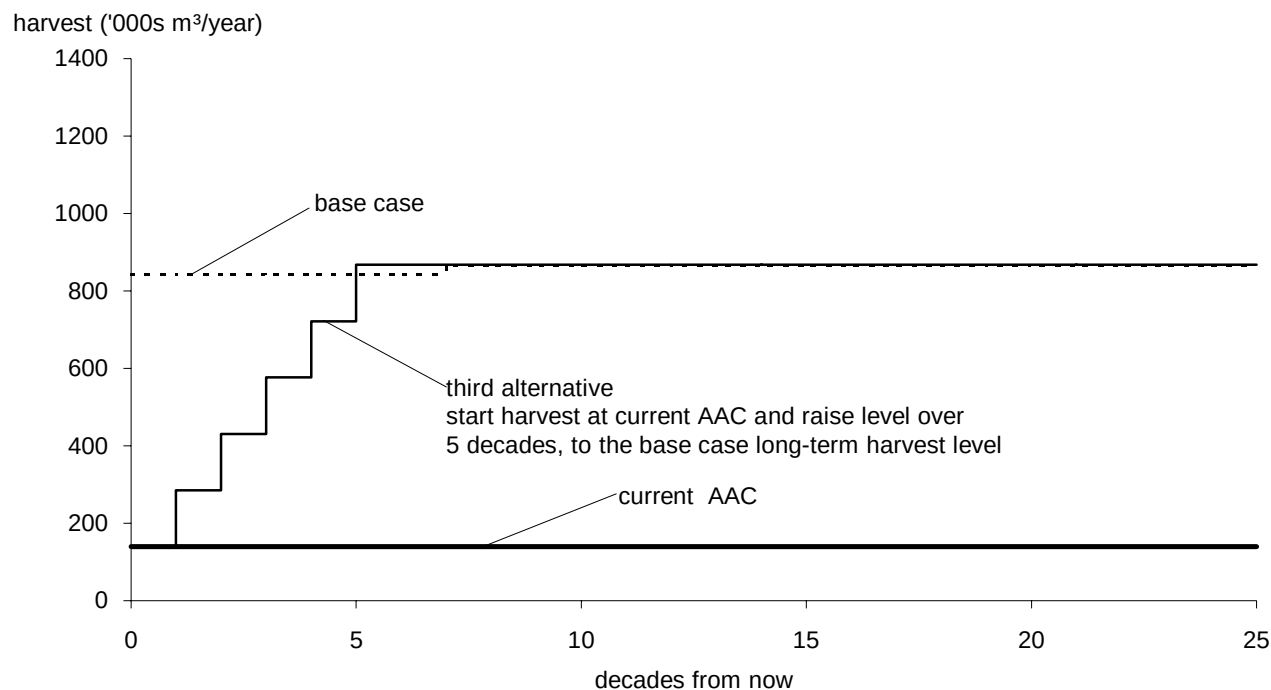


Figure 14. Alternative harvest flows below base case, Cassiar TSA.

The final harvest flow pattern examined, shown in Figure 14, involves an initial harvest rate at the current AAC, followed by constant volume (145 500 cubic metres) increases each decade for 5 decades. After 50 years, the harvest level is set at the long-term harvest level of 867 400 cubic metres

per year. Figures 15 and 16 show the effect of this harvest forecast on levels of growing stock, and on average harvested ages. Harvested ages and volumes in the Cassiar TSA would increase for 50 years and then decrease to levels similar to those of the base case.

5 Timber Supply Sensitivity Analyses

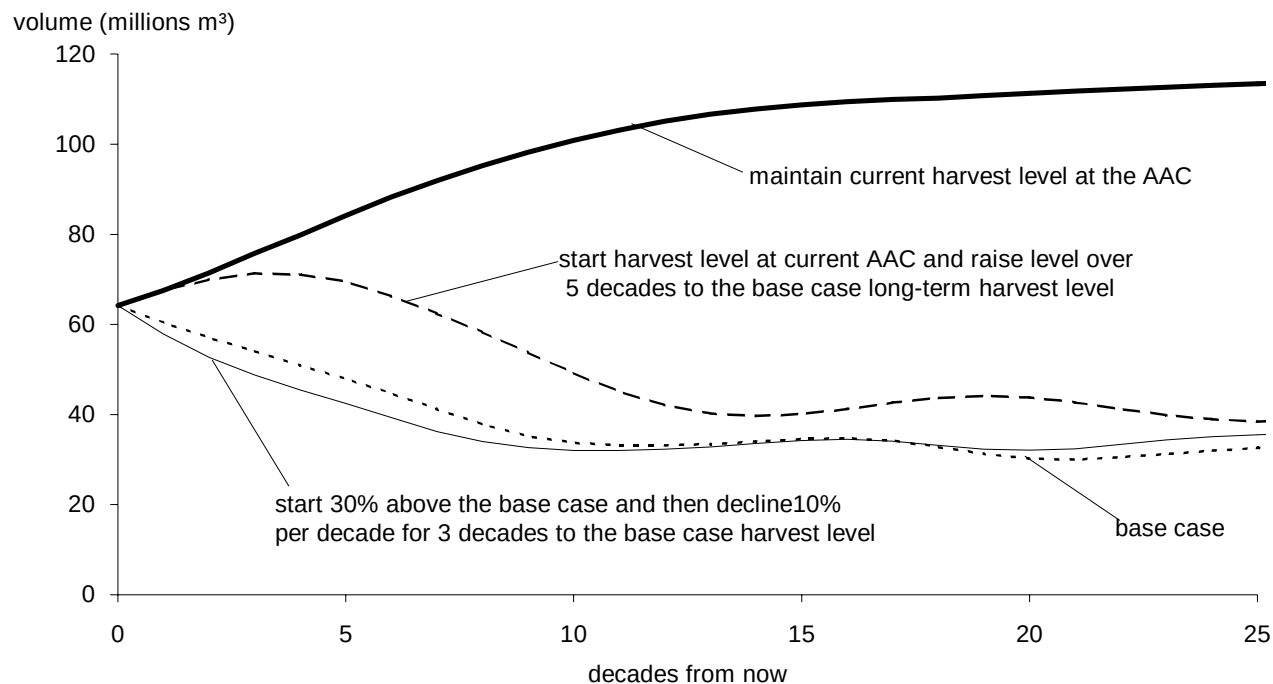


Figure 15. Growing stock over time for the alternative harvest flows, Cassiar TSA.

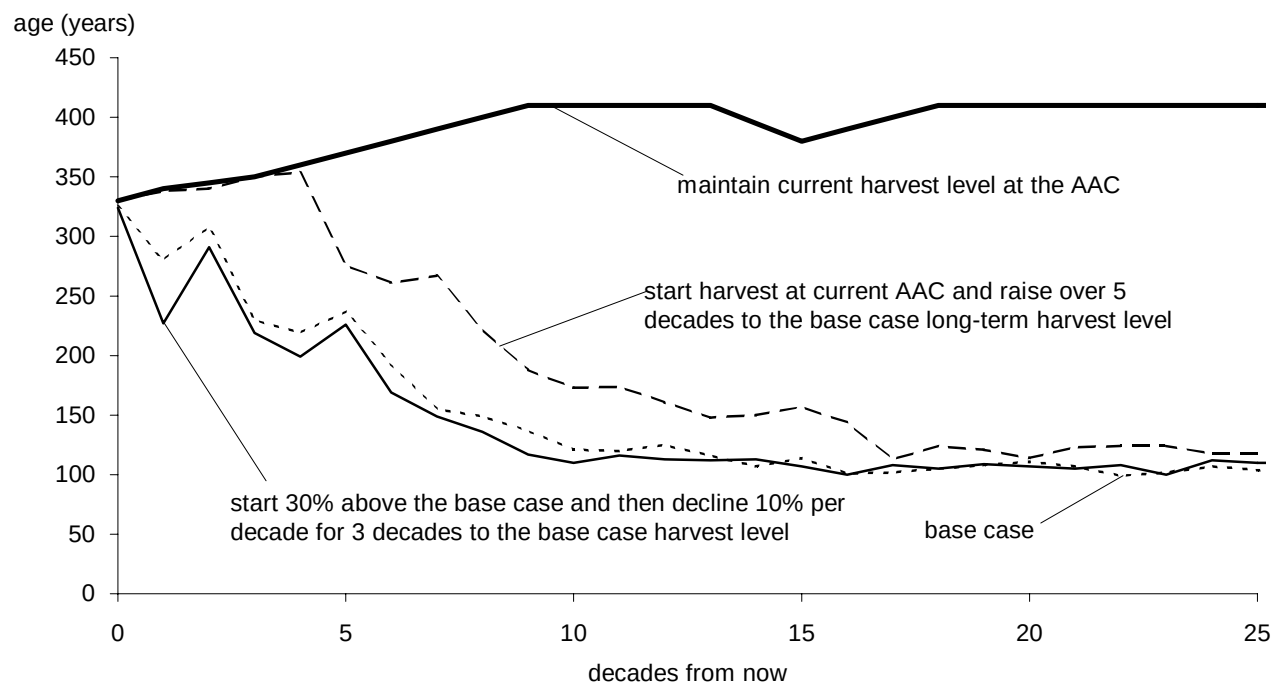


Figure 16. Average stand harvest age over time for the alternative harvest flows, Cassiar TSA.

5 Timber Supply Sensitivity Analyses

5.2 Uncertainty about the timber harvesting land base

The largest source of uncertainty in this timber supply analysis stems from the assumptions used to define the timber harvesting land base. Lack of data for the following factors is particularly important:

- There is uncertainty with the criteria used to define the operable land base. For example, steep slopes which prohibit the use of conventional ground-based harvesting systems were not identified in the operable land base. Also, the economic accessibility of isolated and poor quality stands, could not be considered.
- Riparian areas were estimated without the aid of a formal inventory. Furthermore, riparian areas for small streams (class III and IV according to the *British Columbia Coastal Fisheries/Forestry Guidelines*) were estimated from 33 randomly sampled mapsheets (10%) and then extrapolated to obtain an estimate for the entire timber harvesting land base.
- Environmentally sensitive areas (ESAs) were estimated from 39 closely grouped mapsheets

and then extrapolated to obtain an estimate for the entire timber harvesting land base.

Given the current lack of data, Cassiar Forest District staff are unable to assess how the uncertainties listed above may combine to affect future definition of the timber harvesting land base.

Improved definition of the timber harvesting land base must await complete ESA, riparian and operability mapping. In the meantime, the sensitivity of the land base assumptions to uncertainty can be tested by increasing and decreasing the timber harvesting land base by 30% and 50%. These rather large percentages reflect the high uncertainty surrounding definition of the harvesting land base. Figure 17 shows that the impact of increasing and decreasing the timber harvesting land base on the harvest forecast is proportional to the amount of change to the land base.

These results highlight the importance of performing inventory work to assist in future definition of the timber harvesting land base.

5 Timber Supply Sensitivity Analyses

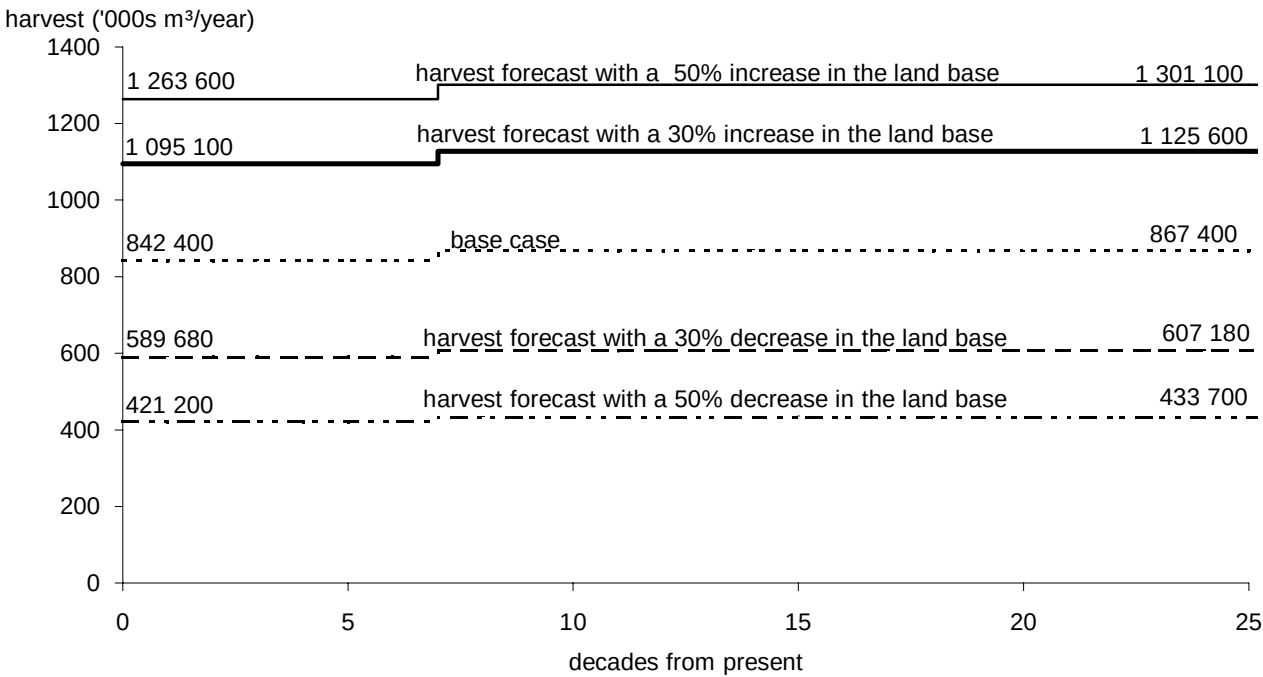


Figure 17. Harvest forecasts if the timber harvesting land base were different than in the base case, Cassiar TSA.

5.3 Uncertainty about existing stand volume estimates

Volume estimates from the Variable Density Yield Prediction (VDYP) system were used in the base case for existing stands. These estimates have a degree of uncertainty stemming from such factors as the statistical process used to develop the VDYP system, the inventory classification procedures, and the potential for changes in utilization standards. In addition, the Cassiar TSA has had only a brief history of harvesting activities. As a result, the

Cassiar Forest District staff have little information for assessing the uncertainty about existing stand volume estimates used in the analysis. However, the Cassiar Forest District staff, based on field observations, feel that the short-term projected volumes at harvest (430 cubic metres per hectare) for the base case may overstate the volume that can actually be harvested. To examine the volume-based uncertainty, existing stand volumes were increased and decreased by 10% and 25%. The results are shown in Figure 18.

5 Timber Supply Sensitivity Analyses

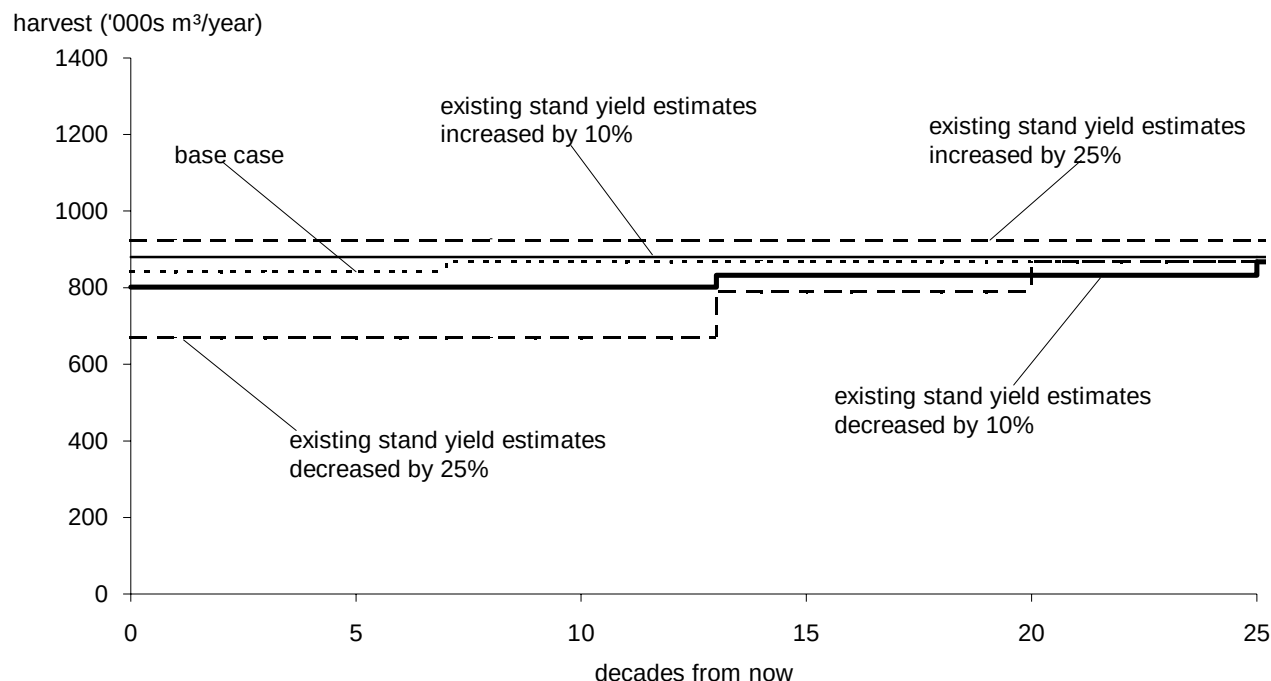


Figure 18. Harvest forecasts if existing stand yield estimates different than in the base case, Cassiar TSA.

If existing stand yields are actually 10% greater than those used for the base case, then the rate of harvesting over the analysis horizon could be 880 400 cubic metres per year, 1.5% higher than the base case long-term harvest level. With this increase in existing yields, it is possible to achieve a constant harvest level, as opposed to the base case which starts below the long-term harvest level. If existing stand yields were actually 25% greater than in the base case, then the rate of harvesting can be maintained at 924 400 cubic metres per year over the analysis horizon. Compared to the base case, this is a 7% increase in the short-term harvest level and a 10% increase in the long-term harvest level. The short- and long-term increases are due to more existing growing stock being available for harvest from existing stands. This allows the managed stands to become older, thereby developing more volume before they are harvested. Overall, more harvestable volume is available in the existing and managed stands, which allows harvest levels to increase. However, a longer planning horizon

would show that once the impact of the higher levels of initial growing stock has diminished, the level of harvesting would need to decline to the base case long-term level.

If existing stand yields were 10% lower than in the base case the rate of harvesting would need to decrease approximately 5% from base case level to 801 400 cubic metres for the first 12 decades and 832 400 cubic metres for the next 12 decades. After decade 24, the harvest increases to the base case long-term harvest level. A 25% decrease in existing stand yields would require an initial reduction in the harvest level of 21% to 668 400 cubic metres for the first 12 decades. During decades 13 through 24 the harvest could increase to 790 400 cubic metres. Thereafter, the harvesting rate could be constant at the base case long-term harvest level. Lower existing stand volumes mean that less volume is available for harvest for the first 24 decades. Such reductions have no effect on long-term timber supplies.

5 Timber Supply Sensitivity Analyses

The results indicate that initial harvest levels are moderately sensitive to a 10% decrease and to 10% and 25% increases in existing stand volumes. A 25% decrease in existing stand volume has a highly significant impact on potential harvest levels in the short term. Long-term harvest levels would be unchanged by decreases in existing stand yields. Note that the intent in generating all forecasts shown was to achieve as high an initial harvest as possible subject to no subsequent declines. Evaluating other harvest flow patterns could result in different impacts.

5.4 Uncertainty about regenerated stand volume estimates

As with harvesting, the Cassiar TSA has had only a brief history of regeneration activities. As a result, there is some uncertainty associated with the regenerated stand volume estimates. The following sensitivity analyses examine the effect that uncertainty in the estimated yields for regenerated stands has on the harvest forecast. To examine these effects, regenerated stand volume estimates were increased and decreased by 10% and 25%. The results are shown in Figure 19.

If regenerated stand yields were actually 10% or 25% greater than assumed for the base case, potential harvests over the short term would not be affected. However, the long-term harvest level would be higher in direct proportion to the increase in stand yields: 10% higher regenerated stand yields would allow a 10% higher long-term harvest level, 25% higher yields would allow a 25% increase in the long-term level.

Small increases in harvests over the first few decades would be possible if the increase to the maximum long-term level was deferred. For example, if regenerated stand yields were 25%

greater than in the base case, it would be possible to harvest 893 400 cubic metres per year over the first 130 years, or 6% more than the base case initial level, if this was followed by a harvest of 1 038 400 cubic metres per year from year 130 to 250, and then an increase to a maximum long-term level 25% above that in the base case. Similarly, a small increase in short-term harvests could be achieved if regenerated stand yields were 10% greater than in the base case, but only by deferring the rise to the maximum long-term level. However, for the range of regenerated stand yields examined the potential short-term increases are small.

If regenerated stand yields were actually 10% lower than assumed in the base case, the non-declining harvest forecast would be 782 400 cubic metres per year. This is 7% lower than the base case initial harvest level, and 10% lower than the long-term level. If regenerated stand yields were 25% lower than in the base case, the maximum non-declining harvest forecast would be 682 400 cubic metres per year, or 19% lower than the base case initial harvest level, and 21% lower than the long-term level. If the harvest forecast was not required to be non-declining, it would be possible to achieve the base case initial harvest level for several decades, and then decline to a long-term level either 10% or 25% below the base case level.

These results show that short-term timber supply would be affected only slightly if regenerated stand yields were either higher or lower than base case estimates. However, if harvests were required to follow a non-declining pattern over time, the harvest forecast would be highly sensitive to reductions in regenerated stand volume estimates. Long-term harvests are highly sensitive to both reductions and increases in regenerated stand yield estimates.

5 Timber Supply Sensitivity Analyses

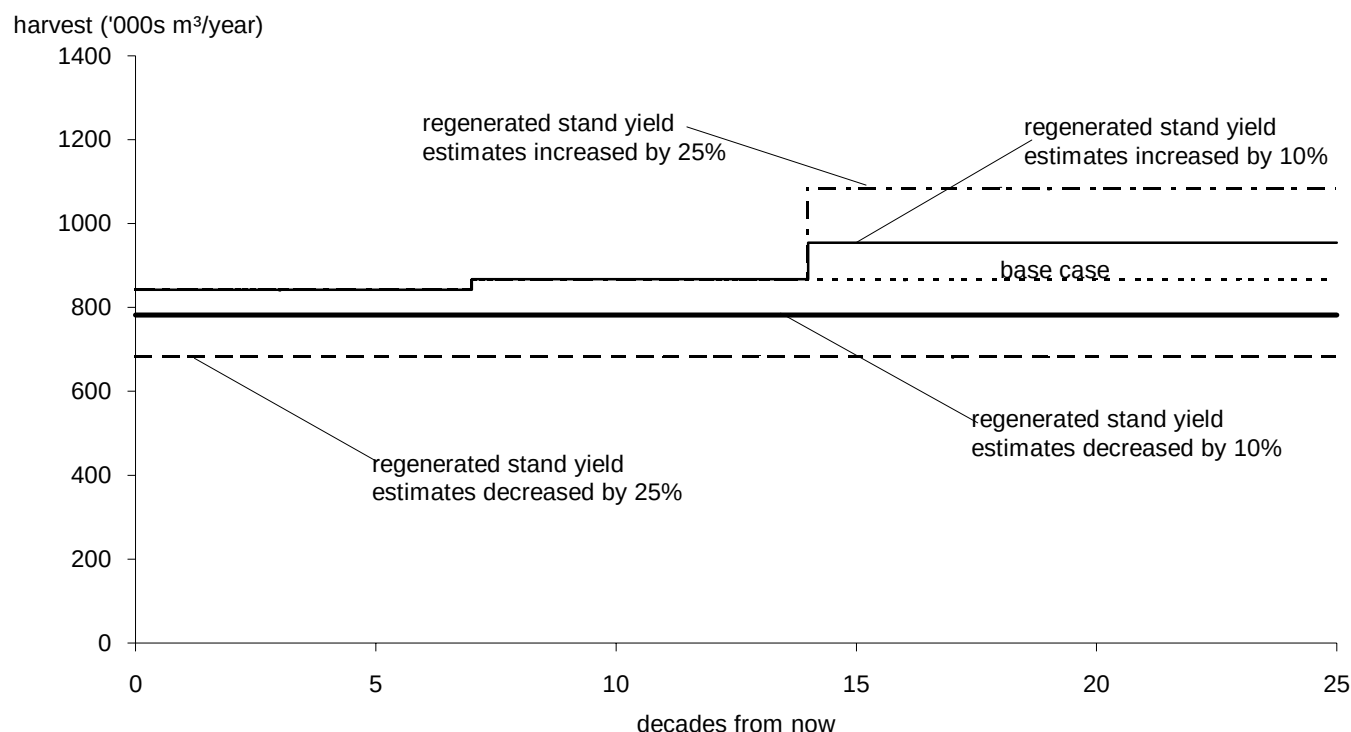


Figure 19. Harvest forecasts if regenerated stand yields are different than the base case, Cassiar TSA.

5.5 Uncertainty about the timber harvesting land base and yield estimates

The two most important sources of uncertainty in this analysis are the extent of the land base assumed available for timber harvesting, and the existing and regenerated stand yield estimates. Therefore, it is particularly important to evaluate the combined impact of these three sources of uncertainty on the harvest forecast. In Section 5.2, "Uncertainty about the timber harvesting land base", it was shown that the impact on the harvest forecast of increasing or decreasing the timber

harvesting land base is proportional to the amount of change to the land base. In Sections 5.3, "Uncertainty about existing stand volume estimates", and 5.4, "Uncertainty about regenerated stand volume estimates", it was shown that the harvest forecast shows moderate to high sensitivity to changes of 25% in both types of yield estimates. In addition, the harvest forecast is moderately sensitive to 10% changes in both yield estimates. The following sensitivity analysis examines the effect on the harvest forecast of increasing and decreasing the timber harvesting land base by 30% and both types of yield estimates by 10%.

5 Timber Supply Sensitivity Analyses

If the timber harvesting land base is increased by 30%, and the existing and managed stand yield estimates are increased by 10%, then the rate of harvest for the first 14 decades could increase to 1.23 million cubic metres per year, or 46% greater than the base case. After 14 decades the harvest rate could increase to a long-term level of 1.24 million cubic metres, or 43% greater than the base case. While the individual effects of changing land base and both yield estimates cannot be separated out of the analysis results, about two-thirds of the change in the harvest level can be attributed to change in the land base. Overall, the harvest forecast is highly sensitive to the combined increases in land base and yield estimates.

If the timber harvesting land base is decreased by 30%, and the existing and managed stand yield

estimates are decreased by 10%, then a harvest of 538 400 cubic metres per year (or 35% lower than the base case) could be maintained for the first 13 decades. After 13 decades the harvest rate could increase to a long-term harvest level of 542 400 cubic metres or 37% lower than the base case. Again, the individual effects of changing the land base and both yield estimates cannot be separated out of the analysis results, but it can be approximated that more than three-quarters of the change in the harvest level can be attributed to change in the land base. Overall, the harvest forecast is sensitive to the combined decreases in land base and yield estimates.

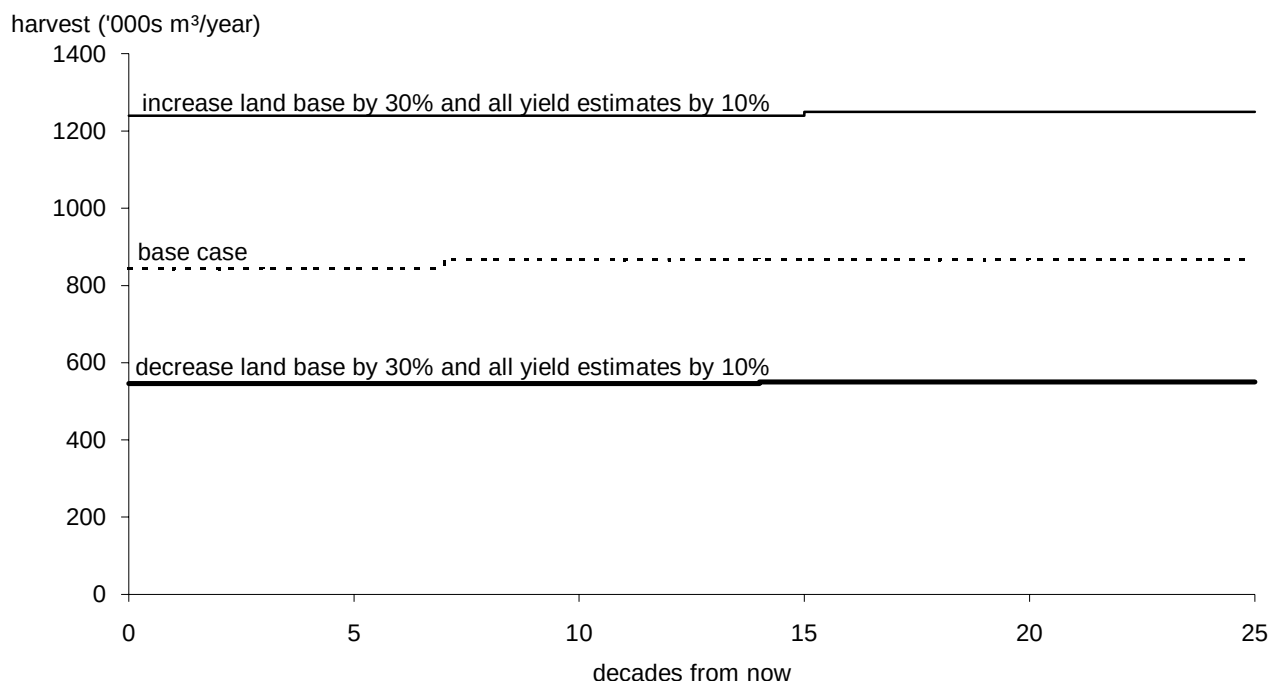


Figure 20. Harvest forecasts if both timber harvesting land base and yield estimates are different than the base case, Cassiar TSA.

5.6 Uncertainty about cutblock adjacency constraints

The forest cover guidelines applied to the Cassiar TSA were derived from adjacency considerations. Current management assumptions require a 4-pass harvest system for the south zone and a 3-pass harvest system for the north zone. This means that no more than 25% and 33%, respectively, of the area of the south and north

zones can consist of stands that do not meet green-up requirements. The purpose of this analysis is to examine the impact on timber supply of forest cover requirements for adjacency. Changes in potential harvests resulting from shifting to a less restrictive harvest system (1-pass) and a more restrictive system (5-pass) were examined. The results are shown in Figure 21.

5 Timber Supply Sensitivity Analyses

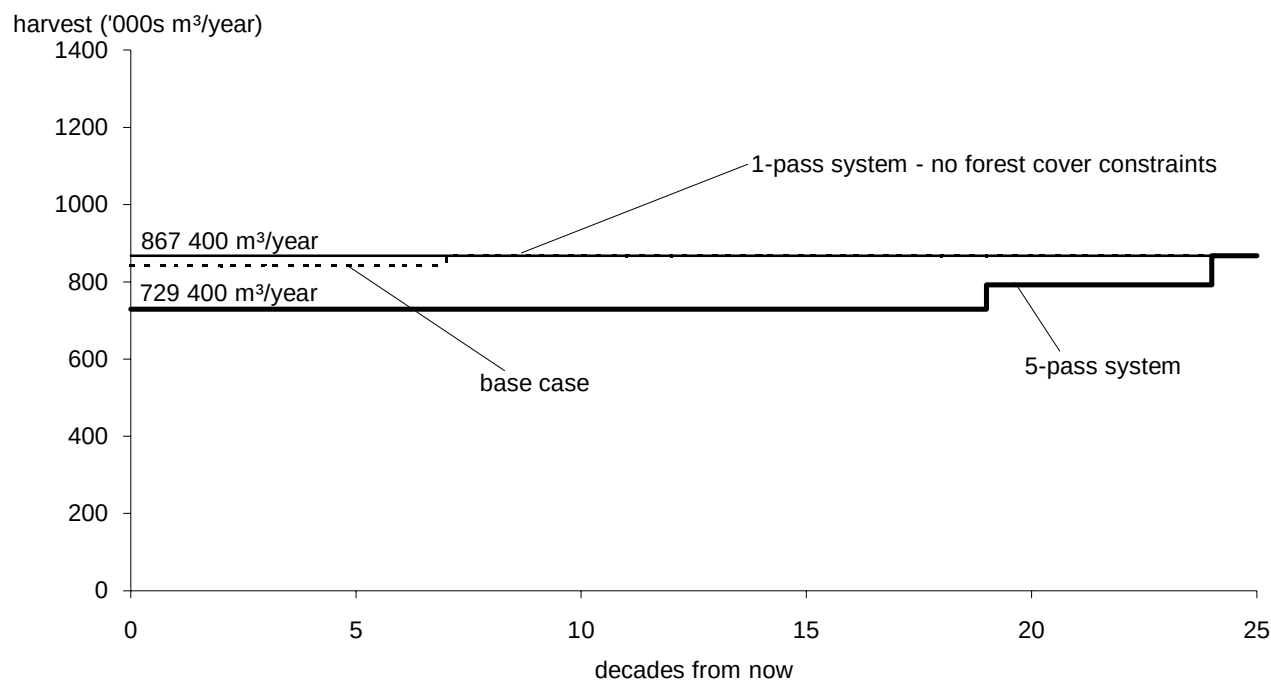


Figure 21. Harvest forecasts if forest cover requirement for adjacency is different from the base case, Cassiar TSA.

When there are no adjacency requirements (1-pass harvest system), a harvest of 867 400 cubic metres, the same as the base case long-term harvest level, could be maintained over the entire analysis horizon. This is a slight increase in the short-term over the base case harvest level. Under a 5-pass system, whereby less than 20% of the area in the zones may consist of stands that are not greened-up, the rate of harvesting for the first 18 decades would need to drop to 729 400 cubic metres per year. Compared to the base case, this is a 13% decline in initial harvest rates. Between decades 19 and 23, the harvest could increase to 792 400 metres per year, or 9% less than the base

case harvest level. After decade 23, harvest rates could rise to the base case long-term harvest level. The decline in initial harvest levels would be required because approximately 26% of the timber harvesting land base is currently in a non-greened-up state. This current state would limit the rate of harvest under a 5-pass system.

In summary, timber supply in the short term is slightly sensitive to a change in harvesting guidelines to a 1-pass system, and highly sensitive to a change to a 5-pass harvest system. Long-term levels are unaffected by changes to cutblock adjacency requirements.

5 Timber Supply Sensitivity Analyses

5.7 Uncertainty about green-up period

Green-up period refers to the estimated number of years required before the trees on a previously harvested site reach 3 metres in height. Green-up periods for the south and north zones are estimated to be 22 and 19 years, respectively. These estimates have a degree of uncertainty because the stand height that provides the necessary cover for the various

resource values, such as visual quality or wildlife habitat, is difficult to determine exactly. In addition, the actual time it takes for a stand to reach these heights may be more or less than the current estimates. To examine the effects of this uncertainty, all green-up periods were increased and decreased by 5 years while leaving all other factors the same as the base case. The results are shown in Figure 22.

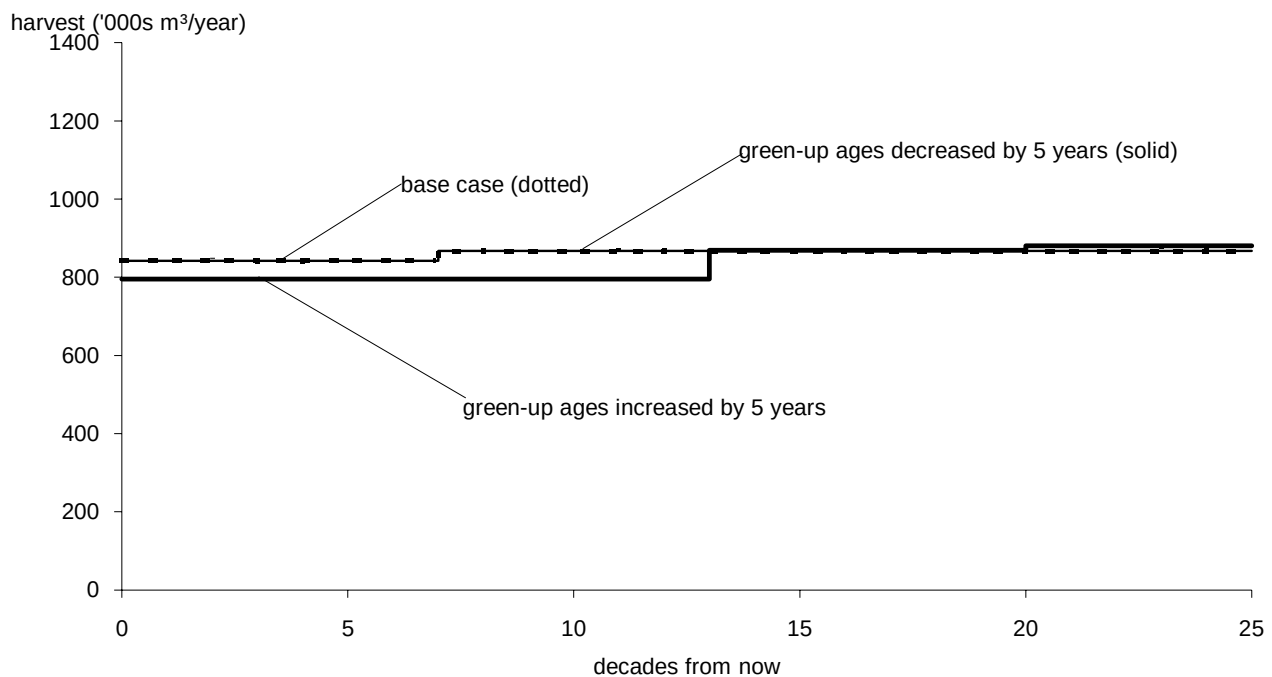


Figure 22. Harvest forecasts if period is longer or shorter than in the base case, Cassiar TSA.

5 Timber Supply Sensitivity Analyses

If green-up periods were 5 years shorter than in the base case, timber supply would be unaffected. If green-up periods were 5 years longer, an initial rate of harvest of 795 400 cubic metres per year, or 6% less than the base case could be achieved. After 13 decades the rate could increase to just above the base case harvest level. After decade 19 the rate of harvest could be maintained at 880 400 cubic metres per year, or 1.5% higher than the base case long-term harvest level. The initial drop in the harvest level occurs because the green-up period is more limiting than in the base case. Longer green-up periods increase the amount of area below the green-up period, therefore, the rate of harvest must be reduced. The slight increase in the long-term harvest level occurs because the longer green-up periods result in stands being harvested closer to their age of maximum average growth while not being long enough to cause forest cover restrictions that would limit harvests.

In summary, timber supply would not be affected by a 5 year decrease in green-up periods. However, a 5 year increase in green-up periods would have a moderate impact on the short-term timber supply and a slight impact in long-term timber supply.

5.8 Uncertainty about minimum harvestable ages

Estimates of minimum harvestable ages can be defined by several criteria. In the Cassiar TSA, to be harvestable, stands must have a minimum of 140 cubic metres per hectare of timber and a minimum average diameter of 17.5 centimetres, except for pine which must have a minimum average diameter of 12.5 centimetres. Stand yield information is needed to determine the ages at which these criteria are met. As discussed in Section 5.3, "Uncertainty about existing stand volume estimates" and Section 5.4, "Uncertainty about regenerated stand yield estimates", Cassiar Forest District staff are unsure about the accuracy of stand yield estimates. To test the impact of uncertainty about minimum harvestable age assumptions on the timber supply, these ages are decreased and increased by 5 and 20 years.

Figure 23 shows the results of the analysis for the 20 year increase and decrease in minimum harvestable ages. The results for the 5 year increase

and decrease are not shown because the amount of impact is too small to show graphically.

When minimum harvestable ages are decreased by 5 and 20 years, the harvest rates over the entire planning horizon are respectively, 853 400 and 845 400 cubic metres. These rates are very slightly above the short-term and somewhat below the long-term base case harvest levels. When ages are reduced by 5 years, the initial harvest level is increased due to the increased availability of timber older than the minimum harvestable age. As a result of the increased harvest level in the short term, green-up requirements further limit harvests during periods in which base case harvest levels are already restricted. Therefore, to support the initial harvest increase, the long-term harvest level must decrease. The 20-year decrease in minimum harvestable ages requires a slight reduction relative to the base case long-term harvest level. The primary reason that younger minimum harvestable ages reduce the long-term harvest level is that stands are harvested before they attain their maximum average growth rate. A further contributing factor is that harvesting at younger ages (and therefore lower per hectare volumes) means that more area would need to be harvested to meet a given harvest level; therefore green-up requirements would restrict harvests.

If minimum harvestable ages are 5 years longer, a harvest of 867 400 cubic metres per year (equal to the base case long-term harvest level) could be supported for the entire analysis horizon. If minimum harvestable ages were 20 years longer, a harvest level of 825 400 cubic metres per year could be achieved for the first 15 decades (2% below the short-term harvest level in the base case). Between decades 16 and 20, the harvest rate could increase to the base case harvest level and after that, increase further to 874 400 cubic metres per year, or 1% above the base case.

Longer minimum harvestable ages mean that stands could grow longer, and thus develop more volume before they are eligible for harvest. As a result, more volume per hectare may be harvested over the long term. With a 5 year increase in harvestable ages, initial harvest levels could increase because more area is greened-up and is therefore available for harvest during the 14th decade which restricts the initial rate of harvest in the base case. The longer minimum

5 Timber Supply Sensitivity Analyses

harvestable ages do not change the long-term harvest level. If minimum harvestable ages were 20 years longer, the initial harvest would be limited to 825 400 cubic metres per year because green-up requirements restrict harvests during several decades over the first 150 years. The long-term harvest level would increase because stands could be harvested at

higher volumes, and green-up requirements would no longer be limiting.

Note that the intent of all forecasts is to maintain the initial harvest levels as high as possible subject to no subsequent declines. Evaluating other flow patterns could result in different impacts.

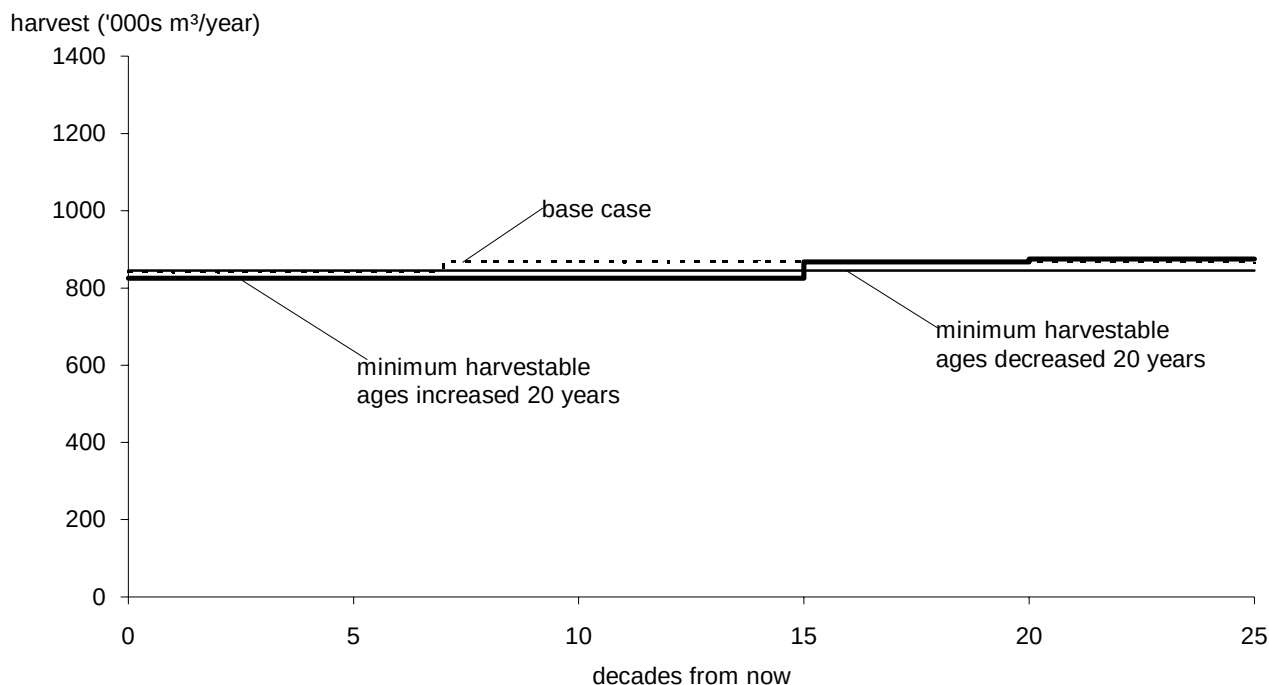


Figure 23. Harvest forecasts if minimum harvestable age is longer or shorter than in the base case, Cassiar TSA.

6 Summary and Conclusions

Since the last timber supply analysis in 1984, the timber harvesting land base for the Cassiar TSA has increased considerably. The major factors contributing to the increase are better accessibility, and the inclusion of balsam, hemlock and lodgepole pine poor site stands.

The analysis for the Cassiar TSA indicates that, under current management assumptions an initial harvest of 842 400 cubic metres per year can be maintained for 7 decades. Thereafter, harvests can increase to the long-term harvest level of 867 400 cubic metres per year. These forecasted harvest levels are substantially higher than the current AAC of 140 000 cubic metres.

The analysis employs the best current estimates for all variables used to describe forest management in the Cassiar TSA. However, varying degrees of uncertainty surround most of the estimates. The most important factor affecting timber supply is the uncertainty about the size of the timber harvesting land base. Sensitivity analysis show that increases or decreases in the timber harvesting land base cause proportionate increases or decreases to the timber supply.

Another important factor affecting estimates of timber supply is the limited harvesting and silvicultural history of the Cassiar TSA. Cassiar Forest District staff did not have sufficient stand volume data with which to set benchmarks for testing the reliability of the forest inventory, or existing and managed stand yield estimates. Sensitivity analyses show that the short-term harvest forecast is particularly sensitive to decreases in existing stand yield estimates. Long-term harvest, on the other hand are highly sensitive to uncertainties in managed stand yield estimates.

The harvest forecast is highly sensitive to the combined impact of increasing the timber harvesting land base by 30% and increasing both the existing and managed stand yield estimates by 10%.

However, the harvest forecast is only moderately sensitive for a 30% decrease in the land base and 10% decreases in both types of yield estimates.

Other analyses show that the short-term harvest forecast is particularly sensitive to more constraining forest cover adjacency requirements (a 5-pass harvest system), and only slightly sensitive to a 20-year increase in minimum harvestable ages. The harvest forecast is minimally affected or unaffected when forest cover requirements for adjacency are removed. Changes to green-up periods and lower minimum harvestable ages have little effect on harvest levels relative to the base case.

The main conclusion drawn from the sensitivity analyses is that inventory and mapping work is needed to assist in defining the timber harvesting land base. Timber supply is also sensitive to uncertainties in other variables, such as timber volume estimates. However, more experience in harvesting timber will be needed to indicate the nature and magnitude of these uncertainties in the Cassiar TSA.

In conclusion, this analysis indicates that timber supply in the Cassiar TSA is sufficient to support some increase in harvests above the current AAC. However, the high uncertainties about variables important in determining timber supply should be considered during discussions about future allowable harvest levels.

7 References

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8 Glossary

Allowable annual cut (AAC)	The allowable rate of timber harvest from a specified area of land. The Chief Forester sets AACs for Timber Supply Areas (TSAs) and Tree Farm Licences (TFLs) in accordance with <i>Section 7</i> of the <i>Forest Act</i> .
Clearcut harvesting	A harvesting method whereby all trees that meet utilization standards are harvested. The harvested site is then regenerated to acceptable standard by appropriate means including planting and natural seeding.
Cutblock adjacency	The desired spatial relationship among cutblocks as specified in integrated management guidelines. They can be approximated by specifying the maximum allowable proportion of a forested landscape that does not meet green-up requirements.
Environmentally sensitive areas	Areas with significant non-timber values or fragile or unstable soils, or where there are impediments to establishing a new tree crop, or timber harvesting may cause avalanches.
Forest inventory	Assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of additional forest values such as recreation and visual quality.
Free-growing stands	Stands composed of sufficient seedlings of an acceptable commercial species that are free from growth-inhibiting brush, weed and excessive tree competition.
Green-up	The time needed after harvesting for a stand of trees to reach a desired condition (e.g., height) to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics.
Growing stock	The volume estimate for all standing timber, of all ages, at a particular time.
Management assumptions	Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.
Minimum harvestable age	The age below which stands will not be approved for harvest. For the Cassiar TSA, these ages are defined by minimum volume and average diameter criteria and they vary by tree species and site productivity. Actual harvest ages depends on many factors, including the ages of other stands, limits on the overall harvest level, and forest cover guidelines.
Non-merchantable forest types	Stands that are accessible and otherwise available for harvesting but are assumed to be non-merchantable due to stand characteristics such as small piece size, incidence of decay, species composition and low stocking.

8 Glossary

Not satisfactorily restocked	An area not covered by a sufficient number of tree stems of desirable species. Stocking standards are set by the Forest Service, Silviculture Branch. If the expected regeneration delay (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) has not elapsed, the land is defined as current NSR. If the expected delay has elapsed, the land is classified as backlog NSR.
Riparian areas	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Timber supply blocks	A division of a timber supply area.
Timber harvesting land base	The portion of the total land area of a management unit considered to contribute to, and be available for, long-term timber supply. The harvesting land base is defined by deducting non-contributing areas from the total land base according to specified management assumptions.
Timber Supply Area (TSA)	An integrated resource management unit established in accordance with <i>Section 6</i> of the <i>Forest Act</i> .
Timber supply blocks	A division of a timber supply area.

Appendix A

Description of Data and Assumptions

Introduction

The following tables and commentary outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Cassiar Timber Supply Review analysis. This information represents current forest management in the area. Current management is defined as the set of land base decisions and forest and stand management practices currently implemented and enforced. Future forest management objectives that may be intended, but are not currently implemented and enforced are not included in this appendix. The purpose of the Timber Supply Review is to provide information on the effects of current management on both short- and long-term timber supply in each timber supply area in the province. Any changes in forest management objectives and practices will be included in subsequent timber supply analyses after the Timber Supply Review project has been completed.

A.1 Zone and Analysis Unit Definition

A.1.1 Definition of management zones

The timber harvesting land base is divided into management zones based on differences in forest management practices. Management practices vary between zones because of different cutblock adjacency requirements, different growth rates, and the use of different harvesting and silvicultural practices. Zone boundaries were defined using forest inventory timber supply block (TSB) codes. Two zones were defined for the analysis:

- zone 1 (south) — This is an integrated resource management zone managed under a 4-pass harvesting system. The zone includes all operable areas within the Iskut and Boundary timber supply blocks.
- zone 2 (north) — This is an integrated resource management zone managed under a 3-pass harvesting system. The zone includes all operable areas within the Atlin and Dease-Liard timber supply blocks.

In the Cassiar TSA, special management zones or other timber harvesting constraints were not required for the management of biodiversity, old-growth forest or habitat management values. Reductions were made to the timber harvesting land base for sensitive sites or critical wildlife areas.

Detailed ecosystem mapping was not available for the Cassiar TSA. To ensure adequate ecosystem representation, the forest ecosystem specialist from the Ministry of Environment, Lands and Parks recommended that 12% of the timber harvesting land base, by major forest species type, be reserved from harvest. Detailed analysis of the Table 1 land base reductions showed that at least 12% of each major forest species type would not be available for harvest. No additional area reductions were recommended by the forest ecosystem specialist.

A.1.2 Definition of analysis units

To simplify timber supply modelling given the high number of unique forested stands in the Cassiar TSA, as well as to reflect the precision of inventory sampling, individual stands are grouped into analysis units. Analysis units are defined by forest cover (inventory type group), timber growing capability or site quality (NSITE), and silvicultural prescription. Separate yield tables (existing and regenerated) were produced for each analysis unit.

Table A-1. shows the analysis units' characteristics for existing stands. Type groups are B.C. Forest Service Inventory Branch categories that denote the dominant tree species as well as other species present.

A.1 Zone and Analysis Unit Definition

Table A-1. Analysis unit characteristics

Zone	Analysis unit	Type groups	Site class	Age ^a	Area (hectares)
1	1 Spruce	21, 23 - 26	Good	0+	3 345.6
1	2 Spruce	21, 23 - 26	Medium	0-140	6 149.6
1	3 Spruce	21, 23 - 26	Medium	141+	3 507.3
1	4 Spruce	21, 23 - 26	Poor	0-140	3 934.2
1	5 Spruce	21, 23 - 26	Poor	141+	12 806.1
1	6 Balsam	18 - 20	Good	0+	1 340.6
1	7 Balsam	18 - 20	Medium	0-140	4 155.8
1	8 Balsam	18 - 20	Medium	141+	3 763.6
1	9 Balsam	18 - 20	Poor	0-140	4 667.9
1	10 Balsam	18 - 20	Poor	141+	18 326.4
1	11 Hemlock	12, 14 - 17	Good & Medium	0+	1 854.8
1	12 Hemlock	12, 14 - 17	Poor	0+ FIZ A	35 336.9
1	13 Hemlock	12, 14 - 17	Poor	0+ FIZ K	13 906.7
1	14 Pine	28, 30, 31	Good	0+	7 045.1
1	15 Pine	28, 30, 31	Medium	0-120	8 943.6
1	16 Pine	28, 30, 31	Medium	121+	2 619.3
1	17 Pine	28, 30, 31	Poor	0+	7 397.2
2	1 Spruce	21, 23 - 26	Good	0+	4 952.4
2	2 Spruce	21, 23 - 26	Medium	0-140	11 664.4
2	3 Spruce	21, 23 - 26	Medium	141+	2 290.7
2	4 Spruce	21, 23 - 26	Poor	0-140	12 749.4
2	5 Spruce	21, 23 - 26	Poor	141+	13 559.0
2	6 Balsam	18 - 20	Good	0+	437.6
2	7 Balsam	18 - 20	Medium	0-140	4 222.8
2	8 Balsam	18 - 20	Medium	141+	1 261.7
2	9 Balsam	18 - 20	Poor	0-140	4 321.3
2	10 Balsam	18 - 20	Poor	141+	3 529.9
2	11 Hemlock	12, 14 - 17	Good & Medium	0+	88.3
2	12 Hemlock	12, 14 - 17	Poor	0+ FIZ A	204.3
2	13 Hemlock	12, 14 - 17	Poor	0+ FIZ K	68.6
2	14 Pine	28, 30, 31	Good	0+	38 331.7
2	15 Pine	28, 30, 31	Medium	0-120	51 231.5
2	16 Pine	28, 30, 31	Medium	121+	20 127.6
2	17 Pine	28, 30, 31	Poor	0+	58 498.0
					366 639.6

(a) Hemlock site class poor was divided into forest inventory zone (FIZ) analysis units to account for different growth rates.

A.2 Definition of the Timber Harvesting Land Base

The final timber harvesting land base is determined by first deducting from the total TSA area all areas considered to be unavailable for timber production. All NSR area on the inventory file is also removed at this stage as a first step in updating the NSR figure. The NSR area is then added back to establish the current timber harvesting land base. Harvesting operations will subsequently result in the removal of some of the initial area because of long-term productivity losses. All these categories are summarized in Table 1 of the main report. An estimate of overlap area between the following reductions was provided by the district staff so that overlap areas were only removed once.

A.2.1 Land not managed by the B.C. Forest Service

Non-Crown land is all land that is not administered or managed by the B.C. Forest Service and includes such categories as provincial parks, Indian Reserves and areas under federal jurisdiction. This area, which is identified on the inventory file as Ownership Code not equal to 62C was excluded from the land base.

A.2.2 Non-forest land

Non-forest land includes lakes, swamps, mountains and alpine forest, and is classified on the inventory file as type identification code 5 and 6. These areas were completely removed from the land base.

A.2.3 Non-commercial cover

Areas with non-commercial tree species were excluded. These are identified as all deciduous and larch inventory type groups (ITG) 33 to 42.

A.2.4 Inoperable areas

Cassiar TSA is the largest TSA in the province and is sparsely populated. Under current management assumptions only limited areas within the Atlin, Boundary, Dease-Liard and Iskut timber supply blocks were considered operable. The major assumptions used to define the operable land base within the TSA were:

- use of conventional ground-based harvesting systems;
- accessibility considering current road infrastructure (including non-forest service roads);
- the presence of marketable timber;
- topographic features such as mountain ranges; and
- current road construction costs and technologies.

A.2 Definition of the Timber Harvesting Land Base

Within the defined operable land base deductions could not be made to account for slope or terrain features which prohibit the use of conventional ground-based harvesting systems.

The procedure used to derive the operable land base was to remove all the area that was not defined by the region and compartment numbers listed in Table A-2. The amount of area removed was 1 838 723 hectares and is identified as "Inoperable" in Table 1.

Table A-2. Definition of the operable land base by region and compartment number

Region	Compartment
76	4-9, 11, 12, 14-17, 26-30, 34-37, 39, 43, 68-70, 75, 81, 85, 86, 88, 89, 91, 94-96, 97-100, 103-106, 112-116, 128, 155, 156, 159, 160, 161, 162-173, 175-180
80	1, 4, 19-21, 23, 24
82	1-4, 6-10, 12, 13, 17-32, 33-39, 45, 49, 52
83	14-16, 19-23, 57, 58, 70-72, 74
84	1-6, 12, 13, 14, 15-20, 33-35, 40-49, 53-55
85	1-27, 31-33, 35, 36, 44, 45, 47, 49-53, 54-67, 79-82, 89-93, 97-105, 107, 111-115, 118
86	100-104, 127

A.2.5 Environmentally sensitive areas (ESAs)

Environmentally sensitive areas include areas that have moderate to high non-timber values (such as recreation and wildlife) and areas that because of geological or topographical conditions are prone to excessive degradation if harvested. Table A-3. shows the percentage reduction by ESA category.

Table A-3. Percentage reduction by ESA category

ESA code	ESA description	Per cent area reduction
Es 1	Soils	100
Es 2	Soils	25
Ep 1	Regeneration	80
Ep 2	Regeneration	25
Ea 1	Avalanche	100
Ew 1	Wildlife	100
Ew 2	Wildlife	20

A.2 Definition of the Timber Harvesting Land Base

An ESA inventory was available for 39 mapsheets in the Iskut timber supply block (zone 1 - south). There was no ESA inventory for the remaining portions of the Cassiar TSA. On the assumption that the 39 mapsheets are representative of the uninventoried portions, the percentage of ESA area for the inventoried area was calculated and then applied to the uninventoried areas.

Many recreation, wildlife and hydrological values are managed through cutblock adjacency requirements, riparian management guidelines by classifying on the inventory file as Use, Recreation and Enjoyment of Public (UREP) areas. Stands with specific values that have not been identified will be evaluated and managed through Pre-Harvest Silvicultural Prescriptions (PHSPs).

A.2.6 Riparian values

At the time of data assembly, there was no detailed classification of streams and lakes for the Cassiar TSA. Using information provided by the Department of Fisheries and Oceans as well as local knowledge, all major streams¹ were classified using the *British Columbia Coastal Fisheries/Forestry Guidelines* as class I or class II streams. Upon recommendation by the forest ecosystem specialist (Ministry of Environment, Lands and Parks), 150 metre riparian buffers were applied to each side of these streams, of which up to a maximum of 30% may be harvested using special harvesting techniques. Stream lengths were measured and then the riparian area was calculated.

All streams that did not meet the class I and II criteria were considered class III and IV. In lieu of an inventory of streams, 33 maps were randomly sampled (approximately 10% of the timber harvesting land base) to derive an estimate of the amount of class III and IV streams and riparian area within the timber harvesting land base. The recommended buffer (forest ecosystem specialist) was 20 metres on each side of the stream of which up to a maximum of 20% may be harvested using special harvesting techniques.

Within the timber harvesting land base, 22 large lakes were identified. The perimeter of each of these lakes was measured, and the riparian areas was calculated using a 30 metre buffer. The calculation allowed for a maximum of 20% of the buffer being harvested using special harvesting techniques.

All measurements included the consideration of other values or reductions so that there was no "double counting" of area. Table A-4. shows the specific reductions by riparian value.

¹ Major streams were defined as double-lined water courses on Ministry of Forests' forest cover maps.

A.2 Definition of the Timber Harvesting Land Base

Table A-4. *Riparian values and reductions*

Riparian value	Amount of reduction
Class 1 & 2 streams	28 725 hectares
Class 3 & 4 streams	3% of the timber harvesting land base
Major lakes (> 400 hectares)	3125 hectares

A.2.7 Non-merchantable stands

Some stands are not currently used because they either cannot be harvested economically or they contain mostly non-commercial tree species. Examples include older stands that contain low net timber volumes or poor quality trees and stands dominated by deciduous species. The following stands were removed from the timber harvesting land base:

- all low site class (NSITE classification) stands; and
- all stands that are age class 5 through 9 and are height class 2 or less.

A.2.8 Highway 37 buffer

A preservation zone was created along Highway 37 to protect visual quality values. The zone is a 500 metre wide buffer on both sides of the highway and excludes all timber harvesting activities. In all, 27 030 hectares were excluded from the timber harvesting land base.

A.2.9 Existing unclassified roads, trails and landings

Productive land has been lost due to past timber harvesting operations and road building and is not accounted for on the inventory file. Road and landing measurements were taken from 10 roaded cutblocks to provide an estimate of this loss. When prorated to the amount of land base currently accessed, the loss of land was 6.9% or 230 hectares. This area was deducted from the forest inventory file NSR area.

A.2.10 Not satisfactory restocked (NSR) areas

Areas assigned on the forest inventory as NSR (projected type identity 4, 7 and 9) were initially removed from the timber harvesting land base. This was done as the areas were not assigned an analysis unit or the analysis unit assignment did not reflect district silvicultural records. This area amounted to 27 498 hectares and was given the following land base assignments for this analysis:

- The Cassiar Forest District estimated that 3 278 hectares of the NSR area was attributed to harvesting activities. Of this area, 230 hectares (7%) were removed from the timber harvesting land base as existing roads, landings and trails. After this reduction, 27 268 hectares were considered the gross NSR area for the timber harvesting land base.
- Table A-5. shows a summary of the district silvicultural records and schedules for restocking the NSR areas. These record assignments and schedules were applied to 24 422 hectares of the NSR land base.
- The remaining 2846 hectares was prorated and distributed across analysis units with age characteristics 0+, 0-120, and 0-140 years old.

A.3 Forest Management Assumptions

A.3.1 Utilization levels

The utilization level defines the maximum allowable stump height and minimum merchantable diameter by species and is used to calculate merchantable volumes. Timber in the Cassiar TSA is currently utilized to a 12.5-centimetre (pine) and 17.5-centimetre (all other coniferous species) minimum diameter at breast height, a 10-centimetre diameter top, and a 30-centimetre stump.

A.3.2 Future roads

Losses in productive area will occur as future harvesting continues. Based on current losses (see Section A.2.10) all existing stands are expected to be subject to a 6.9% loss of area as harvesting occurs. Future roads are modelled by removing the specified percentage (6.9%) from all areas not subject to the existing roads reduction. The future roads reduction applies to all areas without a history of harvesting.

A.3.3 Not satisfactorily restocked (NSR) adjustments

There has been only a small amount of timber harvesting in the Cassiar TSA. However, there is a history of large fires and it accounts for most of the area's NSR land. Table A-5. summarizes the Cassiar Forest District data for NSR land.

A.3 Forest Management Assumptions

Table A-5. Not satisfactorily restocked (NSR) areas

Zone	Analysis unit	Backlog NSR		Current NSR area (hectares)	Total area (hectares)
		Area (hectares)	Rate of restocking (hectares/decade)		
1	2 Spruce, M	860	430	1 712	2 572
1	4 Spruce, P	2 409	803	0	2 409
1	6 Balsam, G	0	0	364	364
1	7 Balsam, M	1 019	680	1 448	2 467
1	10 Balsam, P	1 922	961	323	2 245
1	13 Hemlock, P	205	137	18	223
1	15 Pine, M	0	0	556	556
1	17 Pine, P	744	744	0	744
2	2 Spruce, M	0	0	315	315
2	4 Spruce, P	1 644	658	308	1 952
2	9 Balsam, P	2 043	1 022	703	2 746
2	15 Pine, M	5 290	5 290	9	5 299
2	17 Pine, P	1 669	668	861	2 530
Total					24 422

Notes:

- Most of the NSR is due to large wildfires. Also, most of this area is not presently accessible for silvicultural programs and as such is left to regenerate naturally. The time frame for regeneration is 10 to 30 years.
- While bear habitat management is not the primary management objective for wildfire NSR area, the district is letting the areas regenerate naturally for habitat management reasons. Not enough is known at this time to create a specific bear management zone.
- The difference between the forest inventory file and district database for NSR is an additional 2 846 hectares. This area was prorated across the analysis units with age characteristics 0+, 0-120 and 0-140.

A.3.4 Immature plantation history

Due to the relatively short history of the silvicultural program in the Cassiar TSA, it was assumed, for this analysis only, that all stands would start on existing stand volume tables.

A.3.5 Unsalvaged losses

Unsalvaged losses are timber volumes destroyed or damaged by natural causes such as fire and pests. Estimated annual losses are deducted from the gross timber supply to determine the projected net volumes that will be harvested over time.

Very little information exists about the occurrence of insects, disease, animal damage and windthrow volume losses for the Cassiar TSA. It was assumed that any losses are from endemic populations and are accounted for in existing and managed stand volume estimates.

During the 1983 to 1992 period, 17 wildfires greater than 4 hectares occurred within the timber harvesting land base. The average annual unsalvaged loss was 7600 cubic metres.

The estimated average annual unsalvaged loss for the Cassiar TSA is 7600 cubic metres.

A.3 Forest Management Assumptions

A.3.6 Forest cover requirements

This analysis did not involve an explicit spatial evaluation of timber supply. However, the computer model used for this analysis (FSSIM Version 4.2) can incorporate forest cover requirements that specify either the maximum proportion of an area allowed to be in a disturbed condition (usually defined by the height of young trees), or the minimum required area of old-age forest. Stand level adjacency concerns can be addressed using forest cover requirements; that is, experience may show that a certain number of harvest entries (passes) may be necessary to meet adjacency guidelines. Therefore, forest cover guidelines can approximate the effect of adjacency guidelines as well as broader forest level goals. For this analysis, the forest cover requirements were specified through adjacency requirements for the two zones. Table A-6. shows the specifications.

Table A-6. Forest cover requirements - adjacency requirements

Zone	Definition of green-up	Green-up period (years)	Maximum area less than green-up
1 - south	3 metres	22	25% - 4 pass system
2 - north	3 metres	19	33% - 3 pass system

A.3.7 Minimum harvestable and green-up ages

Minimum harvestable ages define the earliest age at which an area may be harvested, not the age at which harvesting must occur. Minimum harvestable ages were defined as the age when a stand has at least 140 cubic metres per hectare and the average minimum diameter is 17.5-centimetres (dbh) for spruce, balsam and hemlock, and 12.5-centimetres for lodgepole pine.

The criterion for green-up was a height of 3 metres for both management zones.

Based on the above criteria, minimum harvestable and green-up ages were derived from the Variable Density Yield Prediction (VDYP) model for existing stands and from the Table Interpolation Program for Stand Yields (TIPSY) model for managed stands. Table A-7. specifies the minimum harvestable and green-up ages by zone and analysis unit.

A.3 Forest Management Assumptions

Table A-7. Minimum harvestable and green-up age by zone and analysis unit

Zone	Analysis unit	Analysis unit description	Estimated minimum harvestable age (years)		Green-up age (years)
			existing	managed	
1	1	Spruce, G	60	44	15
1	2	Spruce, M, I	100	67	19
1	3	Spruce, M, M	90	77	20
1	4	Spruce, P, I	85	66	18
1	5	Spruce, P, M	65	107	25
1	6	Balsam, G ^a	70	55	15
1	7	Balsam, M, I	75	65	18
1	8	Balsam, M, M	100	90	22
1	9	Balsam, P, I	100	88	21
1	10	Balsam, P, M	140	123	26
1	11	Hemlock, G/M	60	66	17
1	12	Hemlock, P, A	90	107	25
1	13	Hemlock, P, K	100	107	25
1	14	Pine, G	50	45	14
1	15	Pine, M, I	80	66	17
1	16	Pine, M, M	90	69	18
1	17	Pine, P	95	88	21
2	1	Spruce, G	65	52	16
2	2	Spruce, M, I	90	42	13
2	3	Spruce, M, M	100	79	21
2	4	Spruce, P, I	105	88	22
2	5	Spruce, P, M	130	114	26
2	6	Balsam, G	70	50	15
2	7	Balsam, M, I	70	65	17
2	8	Balsam, M, M	110	90	21
2	9	Balsam, P, I	100	88	21
2	10	Balsam, P, M	160	123	26
2	11	Hemlock, G/M	60	66	17
2	12	Hemlock, P, A	90	107	25
2	13	Hemlock, P, K	100	107	25
2	14	Pine, G	60	49	15
2	15	Pine, M, I	80	66	17
2	16	Pine, M, M	90	69	18
2	17	Pine, P	120	100	23
Area weighted average			93.3	82.5	zone 1: 22.11 zone 2: 18.95

Note that forest cover constraints (cutblock adjacency) are applied at the zonal level.

(a) Site class abbreviations: G - Good; M - Medium; P - Poor.

Maturity abbreviations: I - Immature; M - Mature.

Forest inventory zones: A - FIZ A; K - FIZ K.

A.3 Forest Management Assumptions

A.3.8 Regeneration assumptions

Basic silviculture is assumed to be continued indefinitely into the future. Table A-8. shows the existing analysis unit description by leading species and the site class, as well as the expected species composition, initial stocking level and regeneration delay for the stands regenerated after harvest.

Table A-8. *Regeneration assumptions*

Zone	Analysis unit	Leading species	Site class ^a	Species regenerated	Initial stocking (stems/hectare)	Regeneration delay (years)
1	1	Spruce	Good	S(70) P(30)	1600	4
1	2	Spruce	Medium - I	S(65) P(35)	1600	4
1	3	Spruce	Medium - M	S(65) P(35)	1600	4
1	4	Spruce	Poor - I	S(60) P(40)	1600	4
1	5	Spruce	Poor - M	S(60) P(40)	1600	4
1	6	Balsam	Good	S(50) B(30) P(20)	1600	4
1	7	Balsam	Medium - I	S(50) P(50)	1600	4
1	8	Balsam	Medium - M	S(50) P(50)	1600	4
1	8	Balsam	Poor - I	S(50) P(50)	1600	4
1	10	Balsam	Poor - M	S(50) P(50)	1600	4
1	11	Hemlock	Good/Medium	S(60) H(40)	1600	4
1	12	Hemlock	Poor - FIZ A	S(60) H(40)	1600	4
1	13	Hemlock	Poor - FIZ K	S(60) H(40)	1600	4
1	14	Pine	Good	P(50) S(50)	1600	4
1	15	Pine	Medium	P(60) S(40)	1600	4
1	16	Pine	Medium	P(50) S(50)	1600	4
1	17	Pine	Poor - M	P(50) S(50)	1600	4
2	1	Spruce	Good	S(70) P(30)	1600	5
2	2	Spruce	Medium - I	S(70) P(30)	1600	5
2	3	Spruce	Medium - M	S(70) P(30)	1600	5
2	4	Spruce	Poor - I	S(60) P(40)	1600	5
2	5	Spruce	Poor - M	S(60) P(40)	1600	5
2	6	Balsam	Good	S(50) P(50)	1600	5
2	7	Balsam	Medium - I	S(50) P(50)	1600	5
2	8	Balsam	Medium - M	S(50) P(50)	1600	5
2	9	Balsam	Poor - I	S(50) P(50)	1600	5
2	10	Balsam	Poor - M	S(50) P(50)	1600	5
2	11	Hemlock	Good/Medium	S(60) H(40)	1600	5
2	12	Hemlock	Poor - FIZ A	S(60) H(40)	1600	5
2	13	Hemlock	Poor - FIZ K	S(60) H(40)	1600	5
2	13	Pine	Good	P(60) S(40)	1600	5
2	14	Pine	Medium	P(60) S(40)	1600	5
2	15	Pine	Poor - I	P(50) S(50)	1600	5
2	16	Pine	Poor - M	P(50) S(50)	1600	5

(a) I - immature M - mature S - Spruce P - Pine B - Balsam H - Hemlock.

Some proportion of the regenerated analysis units are expected to regenerate naturally. The 4- and 5- year regeneration delay accounts for a 2-year delay for plantations, re-plants and naturally regenerated stands.

A.3 Forest Management Assumptions

A.3.9 Yield assumptions

A batch version of the Variable Density Yield Prediction (VDYP) model, developed by the Inventory Branch of the B.C. Forest Service, was used to predict volume yields for existing stands. All yield tables assume the utilization levels identified in Section A.3.1. The data requirements for the VDYP model are met from existing stand information on the 1993 inventory file provided by Inventory Branch. The exception is the NSITE variable which was derived before model computations. The system used produces yield curves based on close utilization less decay, and reduced for waste and breakage. Yields have also been reduced by the proportion of deciduous volumes in each analysis unit. Where there was sufficient area, sample size and variation, yield tables were calculated for each zone and analysis unit. Table A-9. shows the zone and analysis units and the associated yield table number. Table A-10. shows the yield estimates for the existing stands.

Yield tables for managed stands are based on the Table Interpolation Program for Stand Yields (TIPSY) model developed by the Research Branch of the B.C. Forest Service. To construct the tables for the analysis, the average site index for each analysis unit was calculated for existing analysis units. This site index was used for modelling the predicted stand tables. The tables were constructed to the specifications given in Section A.3.8. To account for operational conditions, a 15% reduction was applied to all regeneration yield values. Yields were further reduced in older ages by 5% to account for decay, waste and breakage. Table A-9. shows the zone and analysis units and the associated yield table number. Table A-11. shows the yield estimates for the managed stands.

A.3 Forest Management Assumptions

Table A-9. Zones, analysis units and associated yield table number

Zone	Analysis unit	Existing volume table number	Regenerated volume table number
1	1 Spruce, G ^a	1	51
1	2 Spruce, M, I	2	52
1	3 Spruce, M, M	3	53
1	4 Spruce, P, I	4	54
1	5 Spruce, P, M	5	55
1	6 Balsam, G	6	56
1	7 Balsam, M, I	7	57
1	8 Balsam, M, M	8	58
1	9 Balsam, P, I	9	59
1	10 Balsam, P, M	10	60
1	11 Hemlock, G/M	11	61
1	12 Hemlock, P, A	12	62
1	13 Hemlock, P, K	13	63
1	14 Pine, G	14	64
1	15 Pine, M, I	15	65
1	16 Pine, M, M	16	66
1	17 Pine, P	17	67
2	1 Spruce, G	21	71
2	2 Spruce, M, I	22	72
2	3 Spruce, M, M	23	73
2	4 Spruce, P, I	24	74
2	5 Spruce, P, M	25	75
2	6 Balsam, G	6	56
2	7 Balsam, M, I	27	77
2	8 Balsam, M, M	28	78
2	9 Balsam, P, I	9	59
2	10 Balsam, P, M	30	80
2	11 Hemlock, G/M	11	61
2	12 Hemlock, P, A	12	62
2	13 Hemlock, P, K	13	63
2	14 Pine, G	34	84
2	15 Pine, M, I	15	65
2	16 Pine, M, M	16	66
2	17 Pine, P	37	87

(a) Site class abbreviations: G - Good; M - Medium; P - Poor.
Maturity abbreviations: I - Immature; M - Mature.
Forest inventory zone: A - FIZ A; K - FIZ K.

A.3 Forest Management Assumptions

Table A-10. Volume in cubic metres for existing stands

	Zone 1 spruce good site	Zone 1 spruce medium site immature	Zone 1 spruce medium site mature	Zone 1 spruce poor immature	Zone 1 spruce poor mature	Zone 1 & 2 balsam good	Zone 1 balsam medium immature
Table:	1	2	3	4	5	6	7
Age	volume	volume	volume	volume	volume	volume	volume
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.20	0.00	0.00	0.09	0.00	0.00	0.00
30	1.07	0.00	0.02	0.46	0.00	12.52	0.51
40	38.98	0.43	2.10	1.63	0.01	45.82	27.70
50	107.60	6.80	17.90	29.68	0.43	85.42	61.78
60	169.28	40.11	47.57	63.53	3.15	124.23	95.52
70	222.50	72.47	82.03	101.37	14.47	162.38	130.05
80	268.20	101.79	113.12	137.21	39.03	195.36	159.21
90	305.66	127.88	140.31	168.68	66.93	224.35	184.43
100	337.07	151.08	164.39	196.33	93.23	250.72	207.16
110	363.67	171.69	186.40	220.66	117.43	274.87	227.85
120	386.18	189.71	206.13	242.03	139.58	296.80	246.64
130	407.99	206.27	227.22	261.83	160.78	320.10	267.80
140	426.09	220.20	245.89	278.43	180.08	341.37	287.93
150	441.36	232.20	262.66	292.99	197.69	361.21	306.83
160	454.45	242.59	277.84	305.68	213.74	379.63	324.69
170	465.57	251.50	291.67	316.70	228.33	396.53	341.58
180	474.85	259.12	304.27	326.27	241.55	412.08	357.63
190	482.44	265.48	315.82	334.45	253.52	426.54	372.87
200	490.08	271.55	326.78	342.16	264.73	440.85	387.61
210	497.04	277.04	337.05	349.09	275.11	454.59	401.17
220	503.44	281.94	346.72	355.34	284.72	467.69	414.26
230	509.31	286.33	355.81	360.98	293.63	480.35	426.85
240	514.69	290.24	364.37	366.10	301.90	492.48	439.01
250	519.62	293.72	372.46	370.74	309.55	504.17	450.80
260	523.64	296.56	379.47	374.38	315.62	506.83	452.00
270	527.30	299.10	386.11	377.67	321.25	509.37	453.17
280	530.52	301.32	392.41	380.61	326.46	511.73	454.25
290	533.42	303.31	398.38	383.20	331.29	514.01	455.27
300	536.07	305.06	404.00	385.54	335.76	516.19	456.24
310	538.46	306.58	409.34	387.58	339.87	518.24	457.16
320	540.64	307.90	414.41	389.35	343.68	520.17	458.00
330	542.66	309.04	419.24	390.89	347.18	522.03	458.82
340	544.50	310.05	423.84	392.25	350.37	523.78	459.62
350	546.17	310.89	428.24	393.43	353.25	525.49	460.39

continued

A.3 Forest Management Assumptions

Table A-10. Volume in cubic metres for existing stands

	Zone 1 balsam medium mature	Zone 1 & 2 balsam poor immature	Zone 1 balsam poor mature	Zone 1 & 2 hemlock good/medium	Zone 1 & 2 hemlock poor FIZ A	Zone 1 & 2 hemlock poor FIZ K	Zone 1 pine good
Table:	8	9	10	11	12	13	14
Age	volume	volume	volume	volume	volume	volume	volume
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.49	0.24	0.00	0.73
30	0.00	0.00	0.02	2.94	1.12	0.01	38.74
40	2.64	6.05	0.17	32.30	3.24	0.75	98.27
50	18.52	23.65	3.15	98.36	15.57	4.67	149.49
60	41.07	46.92	17.58	156.30	40.97	28.04	193.53
70	73.92	76.98	38.01	207.67	79.51	61.51	231.57
80	100.19	101.25	56.58	253.49	115.66	94.70	264.78
90	123.22	122.66	73.42	290.12	146.80	122.81	294.45
100	144.04	142.11	88.87	320.87	174.03	147.17	321.06
110	162.96	159.93	103.02	346.96	197.90	168.37	345.22
120	180.19	176.20	115.96	368.93	218.87	186.86	367.35
130	198.87	193.76	129.90	395.42	240.49	207.50	388.33
140	216.57	210.30	143.36	419.28	260.78	226.19	402.36
150	233.29	225.84	156.27	441.03	279.53	243.43	413.26
160	249.09	240.50	168.65	460.73	296.94	259.25	421.14
170	263.96	254.35	180.54	478.48	313.09	273.65	426.03
180	278.01	267.43	191.97	494.39	328.12	286.74	427.94
190	291.25	279.76	202.95	508.57	342.13	298.47	426.87
200	304.22	291.84	213.61	522.86	355.26	310.48	429.43
210	316.70	303.38	223.92	536.03	367.52	322.01	432.29
220	328.76	314.50	233.91	547.60	379.03	333.13	435.18
230	340.32	325.16	243.59	558.16	389.84	343.82	438.05
240	351.46	335.44	252.96	568.03	399.98	354.09	440.84
250	362.21	345.34	262.05	577.20	409.54	364.04	443.48
260	364.94	347.41	263.40	585.32	418.54	372.47	445.80
270	367.51	349.39	264.68	592.92	427.03	380.57	447.93
280	369.96	351.28	265.89	599.98	435.04	388.43	449.94
290	372.29	353.08	267.03	606.57	442.62	396.02	451.83
300	374.46	354.72	268.13	612.75	449.79	403.31	453.54
310	376.49	356.27	269.16	618.52	456.58	410.23	455.12
320	378.39	357.72	270.15	623.92	462.98	416.87	456.57
330	380.21	359.09	271.10	629.02	469.08	423.25	457.89
340	381.93	360.39	272.00	633.77	474.86	429.34	459.04
350	383.53	361.65	272.84	638.26	480.33	434.87	460.07

continued

A.3 Forest Management Assumptions

Table A-10. Volume in cubic metres for existing stands

	Zone 1&2 pine medium immature	Zone 1&2 pine medium mature	Zone 1 pine poor	Zone 2 spruce good site	Zone 2 spruce medium site immature	Zone 2 spruce medium site mature	Zone 2 spruce poor immature
Table:	15	16	17	21	22	23	24
Age	volume	volume	volume	volume	volume	volume	volume
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.03	0.04	0.04	0.12	0.06	0.00	0.00
30	2.00	0.33	0.78	0.77	0.18	0.02	0.00
40	25.76	19.01	8.51	12.65	0.43	0.45	0.07
50	61.28	51.81	29.67	76.69	4.84	3.35	9.37
60	93.41	81.40	59.02	135.57	37.03	20.86	26.21
70	122.36	108.05	85.65	186.11	76.51	55.94	47.50
80	148.60	132.14	109.96	229.47	112.94	88.45	74.78
90	172.74	154.21	132.34	266.80	146.21	118.19	102.04
100	195.03	174.49	153.02	299.14	176.46	145.22	128.30
110	215.74	193.25	172.22	327.38	203.91	169.68	152.32
120	235.14	210.71	190.15	351.98	228.42	191.89	174.21
130	253.47	227.19	207.46	373.46	250.14	212.38	194.60
140	265.95	238.60	219.90	390.83	268.15	230.15	212.57
150	275.81	247.67	229.99	405.70	283.74	245.81	228.59
160	283.04	254.44	237.76	418.38	297.15	259.48	242.90
170	287.66	258.93	243.23	429.09	308.61	271.46	255.66
180	289.69	261.16	246.42	437.96	318.25	281.98	266.97
190	289.15	261.12	247.37	445.17	326.20	291.14	276.98
200	291.54	263.53	250.53	452.31	334.07	299.83	286.49
210	294.16	266.06	253.77	458.77	341.16	307.81	295.20
220	296.78	268.59	256.93	464.66	347.53	315.08	303.24
230	299.37	271.01	259.94	469.97	353.21	321.71	310.62
240	301.82	273.32	262.79	474.68	358.21	327.77	317.41
250	304.15	275.47	265.44	478.93	362.66	333.27	323.67
260	306.30	277.46	267.49	482.36	366.60	338.25	328.91
270	308.30	279.27	269.34	485.44	370.13	342.71	333.72
280	310.15	280.93	271.05	488.21	373.30	346.72	338.04
290	311.81	282.45	272.57	490.73	376.13	350.38	342.01
300	313.34	283.81	273.94	492.94	378.65	353.66	345.62
310	314.70	285.01	275.15	494.85	380.89	356.66	348.93
320	315.91	286.09	276.19	496.52	382.89	359.38	351.91
330	316.97	287.03	277.11	497.99	384.61	361.85	354.64
340	317.89	287.83	277.87	499.31	386.13	364.13	357.11
350	318.66	288.51	278.48	500.42	387.45	366.17	359.32

continued

A.3 Forest Management Assumptions

Table A-10. Volume in cubic metres for existing stands (concluded)

	Zone 2 spruce poor mature	Zone 2 balsam medium immature	Zone 2 balsam medium mature	Zone 2 balsam poor mature	Zone 2 pine good	Zone 2 pine poor
Table:	25	27	28	30	34	37
Age	volume	volume	volume	volume	volume	volume
10	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.01	0.01
30	0.00	5.60	0.00	0.00	21.86	0.05
40	0.00	36.93	2.03	0.02	70.87	1.42
50	0.05	74.84	15.45	1.21	114.55	10.38
60	0.61	111.76	36.95	10.45	153.16	32.55
70	5.42	148.91	65.05	24.99	187.40	53.60
80	24.45	180.71	86.91	41.65	218.06	73.36
90	50.78	208.19	107.09	57.28	246.06	92.00
100	76.18	233.07	125.86	71.97	271.73	109.58
110	100.06	255.76	143.44	85.89	295.54	126.23
120	122.44	276.38	159.85	99.10	317.73	142.04
130	143.60	299.32	175.69	111.96	338.69	157.12
140	162.31	320.62	190.51	124.05	352.18	167.85
150	179.22	340.70	204.53	135.46	362.53	176.47
160	194.47	359.64	217.81	146.25	369.72	182.97
170	208.17	377.45	230.32	156.51	373.81	187.40
180	220.43	394.15	242.27	166.21	374.71	189.77
190	231.36	409.55	253.56	175.40	372.55	190.04
200	241.74	424.43	264.43	184.40	374.39	192.38
210	251.36	438.69	274.83	193.05	376.66	194.81
220	260.26	452.40	284.80	201.45	379.10	197.22
230	268.47	465.61	294.38	209.56	381.59	199.51
240	276.05	478.32	303.54	217.40	384.02	201.68
250	283.07	490.56	312.38	224.97	386.35	203.67
260	289.35	492.06	314.55	226.80	388.60	205.49
270	295.14	493.45	316.59	228.50	390.71	207.13
280	300.44	494.79	318.52	230.09	392.67	208.63
290	305.32	496.06	320.29	231.59	394.54	209.97
300	309.79	497.30	321.97	233.03	396.24	211.16
310	313.87	498.47	323.50	234.38	397.79	212.17
320	317.62	499.56	324.92	235.64	399.21	213.05
330	320.98	500.57	326.29	236.83	400.50	213.79
340	324.05	501.57	327.53	237.96	401.63	214.35
350	326.84	502.52	328.72	239.01	402.63	214.81

A.3 Forest Management Assumptions

Table A-11. Volume in cubic metres for regenerated stands

	Zone 1 spruce good site	Zone 1 spruce medium site immature	Zone 1 spruce medium site mature	Zone 1 spruce poor immature	Zone 1 spruce poor mature	Zone 1 & 2 balsam good	Zone 1 balsam medium immature
Table:	51	52	53	54	55	56	57
Age	volume	volume	volume	volume	volume	volume	volume
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	2.70	0.00	0.00	5.60	0.00	0.60	0.00
30	33.50	3.15	1.40	23.20	0.00	13.80	5.00
40	115.70	18.85	10.85	46.60	1.20	48.60	27.00
50	221.30	50.70	28.35	80.60	6.40	114.20	64.50
60	312.00	103.05	67.50	133.00	15.40	189.10	114.00
70	387.50	159.80	114.40	192.60	31.40	251.90	166.50
80	430.70	211.40	163.85	241.00	58.60	312.40	215.00
90	460.60	258.05	206.10	286.00	92.20	357.10	258.50
100	482.70	305.45	246.10	327.60	124.80	389.60	300.50
110	493.90	340.75	287.30	359.60	155.40	414.00	332.00
120	496.70	366.50	319.90	381.40	182.60	434.30	355.50
130	497.40	386.70	345.95	397.80	207.20	451.20	374.00
140	496.00	401.30	364.15	411.00	231.40	464.00	388.00
150	494.60	413.55	379.35	421.40	257.20	474.70	399.00
160	494.60	422.85	390.65	429.80	280.00	481.40	408.00
170	493.90	431.15	400.60	437.00	298.20	486.60	416.00
180	493.20	437.15	408.90	442.20	313.20	491.10	422.00
190	493.20	442.15	415.20	446.80	325.20	492.90	426.50
200	493.20	445.80	420.85	449.20	335.40	494.50	430.50
210	493.20	448.15	424.85	449.40	343.20	495.70	433.00
220	493.20	448.55	428.50	449.60	350.00	496.50	434.00
230	493.20	435.60	430.85	449.80	355.20	497.10	434.00
240	493.20	448.65	433.50	449.00	360.40	497.50	434.50
250	493.20	447.70	432.90	448.20	364.60	498.20	434.00
260	493.20	446.75	432.95	447.40	368.20	498.40	433.50
270	493.20	445.80	432.00	445.60	371.20	498.40	433.00
280	493.20	444.20	431.05	444.40	373.80	498.20	431.50
290	493.20	442.90	430.75	442.60	375.80	499.00	431.00
300	493.20	440.95	429.45	441.40	377.20	499.60	429.50
310	493.20	440.95	429.45	441.40	377.20	499.60	429.50
320	493.20	440.95	429.45	441.40	377.20	499.60	429.50
330	493.20	440.95	429.45	441.40	377.20	499.60	429.50
340	493.20	440.95	429.45	441.40	377.20	499.60	429.50
350	493.20	440.95	429.45	441.40	377.20	499.60	429.50

continued

A.3 Forest Management Assumptions

Table A-11. Volume in cubic metres for regenerated stands

	Zone 1 balsam medium mature	Zone 1 & 2 balsam poor immature	Zone 1 balsam poor mature	Zone 1 & 2 hemlock good/medium	Zone 1 & 2 hemlock poor FIZ A	Zone 1 & 2 hemlock poor FIZ K	Zone 1 pine good
Table:	58	59	60	61	62	63	64
Age	volume	volume	volume	volume	volume	volume	volume
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	2.00
30	0.00	0.50	0.00	0.00	0.00	0.00	32.00
40	5.50	7.50	0.50	3.40	0.00	0.00	95.50
50	19.50	22.50	3.00	48.40	0.00	0.00	179.50
60	39.50	46.50	12.50	117.80	2.60	2.60	256.50
70	73.50	83.00	24.00	188.80	15.00	15.40	324.50
80	110.50	122.00	41.00	250.00	47.20	47.20	377.00
90	146.50	159.00	68.00	310.80	83.80	83.80	410.00
100	179.00	191.00	98.00	366.00	123.00	123.00	434.00
110	207.00	221.00	125.50	412.60	159.60	159.60	452.50
120	237.00	253.00	150.50	448.80	191.40	192.00	466.50
130	266.50	282.00	172.00	477.80	222.20	222.20	477.00
140	290.50	304.00	193.00	502.80	252.40	252.80	483.00
150	310.00	321.50	212.50	526.80	282.20	282.20	483.00
160	324.00	335.50	233.00	548.40	306.40	307.00	482.50
170	336.00	346.50	251.50	566.60	328.40	328.80	481.50
180	346.00	355.50	267.50	583.40	345.80	346.20	480.50
190	354.00	363.50	282.00	597.80	360.60	361.00	479.50
200	361.00	370.00	293.00	608.60	373.80	374.20	479.00
210	366.50	375.50	302.50	618.00	384.20	385.20	478.50
220	372.00	380.50	311.00	625.00	395.40	395.80	477.50
230	376.50	384.50	317.50	631.20	405.60	406.00	477.00
240	380.00	388.00	323.00	636.00	413.80	414.20	477.00
250	382.50	390.00	328.00	639.80	421.40	422.40	477.00
260	384.50	392.00	332.00	643.40	428.60	428.60	477.00
270	386.50	393.50	335.50	647.20	435.00	435.40	477.00
280	388.00	394.50	338.00	651.20	440.20	440.60	477.00
290	389.00	394.50	341.50	654.60	445.00	445.40	477.00
300	388.50	394.00	343.50	657.80	448.80	449.20	477.00
310	388.50	394.00	343.50	657.80	448.80	449.20	477.00
320	388.50	394.00	343.50	657.80	448.80	449.20	477.00
330	388.50	394.00	343.50	657.80	448.80	449.20	477.00
340	388.50	394.00	343.50	657.80	448.80	449.20	477.00
350	388.50	394.00	343.50	657.80	448.80	449.20	477.00

continued

A.3 Forest Management Assumptions

Table A-11. Volume in cubic metres for regenerated stands

	Zone 1 & 2 pine medium immature	Zone 1 & 2 pine medium mature	Zone 1 pine poor	Zone 2 spruce good site	Zone 2 spruce medium site immature	Zone 2 spruce medium site mature	Zone 2 spruce poor immature
Table:	65	66	67	71	72	73	74
Age	volume	volume	volume	volume	volume	volume	volume
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.60	6.30	0.00	0.00
30	6.00	3.00	0.50	14.70	49.90	0.90	0.00
40	32.20	26.20	7.50	54.70	160.00	7.80	4.80
50	73.80	63.60	29.50	130.20	269.10	19.80	16.60
60	121.20	112.80	70.00	211.40	367.90	53.40	35.80
70	170.20	160.60	121.00	279.80	429.20	98.70	71.80
80	216.40	202.00	163.50	345.50	466.80	147.10	111.20
90	258.20	244.40	200.00	389.60	485.70	190.40	150.80
100	296.60	284.00	237.50	419.30	497.60	229.40	185.40
110	325.40	312.80	271.00	440.50	499.00	269.50	216.80
120	347.60	335.00	299.50	456.30	499.00	306.70	248.80
130	365.20	353.20	320.00	469.40	497.60	334.70	281.20
140	378.40	366.40	336.50	478.40	497.60	356.10	306.40
150	389.40	378.60	349.00	484.30	497.60	372.70	326.40
160	398.20	387.40	360.00	486.10	497.60	385.20	341.20
170	406.00	395.20	368.50	487.20	497.60	396.30	354.40
180	412.00	401.20	376.50	486.50	497.60	404.70	363.80
190	416.40	406.20	382.50	484.40	497.60	412.10	372.00
200	420.40	410.80	387.50	483.00	497.60	417.80	378.80
210	422.60	413.00	392.00	481.60	497.60	423.20	385.00
220	424.00	414.40	395.00	480.20	497.60	427.20	390.00
230	424.40	414.80	396.50	479.50	497.60	430.20	394.20
240	425.20	415.60	397.50	478.10	497.60	432.20	397.60
250	425.00	416.00	398.00	476.70	497.60	434.20	400.60
260	424.80	415.80	398.50	475.30	497.60	434.10	402.60
270	424.60	415.60	398.00	473.90	497.60	434.00	404.60
280	423.40	414.40	398.00	473.90	497.60	432.90	405.60
290	422.60	414.20	397.00	473.90	497.60	431.80	406.40
300	422.00	413.00	396.50	473.90	497.60	430.40	405.60
310	422.00	413.00	396.50	473.90	497.60	430.40	405.60
320	422.00	413.00	396.50	473.90	497.60	430.40	405.60
330	422.00	413.00	396.50	473.90	497.60	430.40	405.60
340	422.00	413.00	396.50	473.90	497.60	430.40	405.60
350	422.00	413.00	396.50	473.90	497.60	430.40	405.60

continued

A.3 Forest Management Assumptions

Table A-11. Volume in cubic metres for regenerated stands (concluded)

	Zone 2 spruce poor mature	Zone 2 balsam medium immature	Zone 2 balsam medium mature	Zone 2 balsam poor mature	Zone 2 pine good	Zone 2 pine poor
Table:	75	77	78	80	84	87
Age	volume	volume	volume	volume	volume	volume
10	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	1.20	0.00
30	0.00	10.00	0.00	0.00	31.80	0.00
40	0.80	35.50	6.00	0.50	90.00	2.50
50	4.80	85.00	21.00	3.00	160.20	14.00
60	13.40	141.50	42.50	12.50	235.80	29.00
70	27.20	198.00	78.00	24.00	295.20	55.50
80	50.80	249.50	115.50	41.50	347.80	90.00
90	81.40	296.50	151.50	68.50	383.20	123.50
100	114.20	334.50	184.00	98.00	408.80	156.00
110	145.40	362.00	213.00	125.50	427.60	183.50
120	171.20	384.00	244.00	150.50	442.80	209.50
130	196.20	398.50	273.50	172.50	454.20	235.50
140	219.20	411.00	296.50	193.00	463.60	262.50
150	243.60	421.50	315.00	212.50	468.80	284.00
160	267.80	429.50	329.00	233.50	472.40	302.50
170	286.20	436.00	340.50	252.00	472.00	315.50
180	302.80	441.00	350.00	268.00	471.20	326.50
190	315.40	444.00	358.00	282.00	470.40	335.50
200	326.00	445.50	365.00	293.00	469.60	343.00
210	335.40	446.50	370.50	302.50	468.80	349.50
220	342.20	447.00	375.50	311.00	468.00	355.50
230	348.00	447.00	379.50	318.00	467.60	360.00
240	353.20	446.50	383.00	323.00	466.80	364.50
250	357.80	446.50	385.50	328.00	466.00	368.00
260	362.00	445.00	388.00	332.00	465.20	371.00
270	364.60	444.50	390.00	335.50	465.20	373.00
280	368.20	443.00	391.00	339.00	465.20	374.50
290	370.20	442.00	391.50	341.50	465.20	376.50
300	372.20	441.00	391.00	343.50	465.20	377.50
310	372.20	441.00	391.00	343.50	465.20	377.50
320	372.20	441.00	391.00	343.50	465.20	377.50
330	372.20	441.00	391.00	343.50	465.20	377.50
340	372.20	441.00	391.00	343.50	465.20	377.50
350	372.20	441.00	391.00	343.50	465.20	377.50

Appendix B

Inventory Changes

Introduction

The inventory was compiled in 1983, at which time the total land base was 14 930 508 hectares. Since then the inventory has been revised several times. The total land base for the 1984 analysis was 14 471 500 hectares. The present total land base is 13 583 290 hectares (FIP file release dated August 1, 1993). The area difference between the 1983 and 1993 inventories is 1 347 218 hectares. The major reason for the reduction in the total land base is that many parks and recreation areas have been established; for example, the Stikine River Recreation Area. These areas are not managed by the B.C. Forest Service and their area has been removed from the inventory file. Also, a minor change in land base occurred due to changes in forest region and forest district boundaries.

The calculation of the timber harvesting land base for this analysis was considerably different from that of the 1983 timber supply analysis. To provide a comparison, regroupings of data were required and the results are presented in Table B-1. The major differences and regroupings are:

Non-forest and economically inaccessible

In 1983 the non-forest and economically inaccessible reductions were calculated using the following procedures:

- areas not considered economically operable based on technological, ecological and accessibility criteria (10 272 200 hectares) were removed first from the land base;
- after that, non-forest (1 380 300 hectares) and non-commercial brush (26 070 hectares) areas were removed from within the land base considered economically accessible.

In the 1994 analysis, all non-forest areas which included non-commercial brush (9 434 815 hectares) was removed first from the land base. After that, areas considered economically inaccessible (1 838 711 hectares) were removed from the land base.

Riparian and ESA areas

In the 1983 analysis no information was available to calculate the amount of riparian and ESA area within the operable land base. A 5% reduction was assumed.

In the 1994 analysis, reductions were made based on partial or complete inventories (see Sections A.2.5, "Environmentally sensitive areas (ESAs)", and A.2.6, "Riparian values.")

Non-commercial stands

In the 1983 timber supply analysis, all hemlock and balsam stands, and most poor site pine stands were considered non-commercial and removed from the timber harvesting land base. In the 1994 analysis these stands were considered commercial and left in the timber harvesting land base.

Not satisfactorily restocked (NSR) areas

In the 1983 analysis there were large areas that had been burnt by wildfires. No assessments for regeneration or site productivity (i.e. the amount of non-commercial brush area) were available. Therefore, all areas were categorized as NSR and removed from the timber harvesting land base. By 1993, areas had been assessed and assigned a forest inventory file type identity (e.g. forest versus non-commercial brush).

Table B-1

Table B-1. Timber harvesting land base for the Cassiar TSA

Classification	Area (hectares) 1983 analysis	Area (hectares) 1994 analysis	Land base change between 1983 and 1994 ^a
Total area on inventory file ^b	14 471 500	13 413 249	- 1 058 251
Not managed by the B.C. Forest Service	1 413 800	311 000	- 1 102 800
Non-forest and economically inaccessible ^c	11 678 570	11 273 538	- 405 032
Total productive forest managed by the B.C. Forest Service (Crown forest)	1 379 130	1 828 711	+ 449 581
Reductions to Crown forest:			
Riparian (lake and streamside) buffers ^d		86 711	+ 86 711
Environmentally sensitive areas (ESAs) ^d	5 955	550 095	+ 544 140
Non-commercial stands	94 041	89 580	- 4 461
Non-merchantable stands	872 642	681 310	- 191 332
Highway 37 buffer	0	27 030	- 27 030
Existing roads, trails, landings	0	230	- 230
Not satisfactorily restocked (NSR)	287 404	27 268	- 260 136
	1 260 042	1 462 224	+ 202 182
Total reduction			
Initial timber harvesting land base (less NSR)	119 088	366 487	+ 247 399
Additions:			
Not satisfactorily restocked	0	27 268	+ 27 268
Current timber harvesting land base	119 088	393 755	+ 274 667
Future reductions:			
Future roads, trails, landings	0	27 114	+ 27 114
Future timber harvesting land base	119 088	366 641	+ 247 553

(a) The land base change in this column represents the area difference between the 1983 and 1994 timber supply analyses. A positive value indicates a gain in area and a negative value indicates a loss in area.

(b) The actual land base of the Cassiar TSA is larger than the area stated. Many ecological reserves, provincial parks, and recreational areas have been removed from the forest inventory file. These types of removals account for most area lost in between the 1983 and 1994 timber supply analysis.

(c) This category includes of all non-commercial brush, non-forest and all areas considered economically inaccessible.

(d) In 1984 riparian and ESA areas were assessed as a single reduction to the land base.

