Strathcona TSA
Timber Supply Analysis

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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. They include guidelines for the protection of forest resources. Current management practices also include official land-use decisions made by Cabinet. The current nature and capabilities of the local forest industry are also considered.

Assessing the implications of only current practices 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. This also allows for an important part of these analyses — a process called *sensitivity analysis*. Sensitivity analysis is the assessment of how results might be affected by uncertainties. The sensitivity analyses can be used to examine the timber supply implications of uncertainty in or changes to the definition of current management practices. 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 timber supply analysis for the Strathcona TSA began in September, 1993. The information it contains is independent of the February 1994 *Vancouver Island Land Use Plan* by the Commission on Resources and Environment (C.O.R.E.). Any land-use decisions by Cabinet, or changes to management practices arising from the C.O.R.E. report will be included in the current management practices defined for the next Strathcona TSA timber supply analysis, scheduled to be completed within 5 years.

This timber supply analysis 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 one 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 it.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Strathcona Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over the next 250 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 harvest forecasts in this 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 area of the Strathcona TSA that is considered available for timber harvesting under current management practices is about 236 000 hectares. The total volume of standing timber in the area is about 73 million cubic metres, of which 60 million cubic metres is of merchantable age. The area is dominated by stands of Douglas-fir, western hemlock, western redcedar and Sitka spruce.

The current AAC for the Strathcona TSA is 1 693 745 cubic metres per year before temporary reductions to account for harvesting deferrals in three areas that are currently under study as protected areas. These deferrals, and the temporary reduction of 188 000 cubic metres per year, are not modelled in this analysis. Portions of Quadra Island and Boughey Bay which have been recently added to the TSA and together contribute 28 000 cubic metres per year to the allowable annual cut, are not included in this analysis. Therefore, the current AAC is assumed to be 1 665 745 cubic metres per year from the areas included in this analysis.

Using current forest management assumptions, the analysis results indicate that the current harvest level must be reduced immediately by about 12% or 210 000 cubic metres per year to 1.45 million cubic metres per year in order to avoid major future disruptions in timber supply. To continue to avoid major harvest level disruptions, the harvest forecast declines from this reduced initial harvest level by about 12% per decade over the next 4 decades to a low of about 940 000 cubic metres per year, which is 13% below the steady long-term harvest level. This decline to below the long-term level is unavoidable. In about 110 years, when timber harvesting occurs in predominantly second growth stands, the harvest level increases to the steady long-term harvest level of about 1.1 million cubic metres per year.

The harvest level cannot be maintained at or above the steady long-term harvest level at all times, even if it is immediately reduced to the steady long-term level.

Several important factors effect the timber supply forecast. The most important factor is that the original abundance of mature forest which historically allowed harvest rates well above the long-term level no longer exists. In this situation harvest rates must decline towards the long-term level to avoid serious timber supply short falls in the future.

Also contributing to the decline in timber supply are forest cover requirements for non-timber resources such as wildlife and scenic values. However, it is important to note that even if these forest cover requirements were removed, the harvest forecast will show a decline in the near future because most of the original mature forest has been harvested.

Uncertainty in the data and assumptions used in the analysis may affect results. The harvest forecast is moderately increased by relaxing forest cover requirements for visual quality or by increasing the size of the timber harvesting land base. Increasing forest cover requirements greatly reduces the short-term timber supply. For the same amount of change (e.g., plus or minus 10%) to an uncertain assumption or piece of data, decreases in the harvest forecast were generally larger than positive effects.

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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 the Chief Forester of British Columbia uses to determine an allowable annual cut (AAC)*. 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 occurs 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.

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 Strathcona TSA. Following a brief description of the TSA in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Analysis methods 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 appendix contains further details about the data and assumptions used in this analysis.

**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.*

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 Strathcona TSA

The Strathcona TSA covers central Vancouver Island from the south end of Strathcona Park to the Brooks Peninsula in the north, and also encompasses several of the islands in the Strait of Georgia and portions of the mainland to the east (see Figure 1). The TSA covers approximately 480 000 hectares and is administered from the Campbell River Forest District office in Campbell River.

As figure 1 shows the TSA is divided into three timber supply blocks. The Sayward supply block covers all of the TSA on the east coast of Vancouver Island, the Loughborough supply block encompasses portions of the TSA on the mainland and in Georgia Strait, and the Kyuquot supply block covers the west coast portion of the TSA. The Kyuquot supply block is separated geographically from the other two supply blocks by other forest tenures such as tree farm licences, and by other land uses such as Strathcona Park and privately owned land.

The communities in the Strathcona TSA are predominantly resource based, and are especially dependent on the local timber industry. Mining and commercial fishing are also very important to several of the local economies. The Strathcona TSA also offers excellent recreational opportunities. The sport fishing industry in the TSA is world renowned, and the wilderness tourism and recreation industries are also expanding.

Figure 1. Map of the Strathcona TSA.

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 Strathcona 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.

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

2 Information Preparation

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 timber 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.

It is important to note that the timber harvesting land base recommendations of the Commission on Resources and the Environment (CORE) have <u>not</u> been included in this analysis. All study areas identified under the Protected Areas Strategy are assumed to be available for timber harvesting.

Areas on which timber harvesting is not expected to occur, given current forest management in the Strathcona TSA, are as follows:

- non-Crown areas — areas not managed directly by the B.C. Forest Service.
- non-forest areas — areas not occupied by productive forest cover (for example rock, swamp and alpine areas).
- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- inoperable areas* — areas defined as unavailable for harvest for terrain-related and economic reasons.
- not satisfactorily restocked* (NSR) areas — these areas are initially removed, but are considered available for timber production and are added back into the timber harvesting land base once they have been restocked with trees.
- areas with highly sensitive soils, susceptible to damage by timber harvesting activities.
- non-merchantable forest types — areas occupied by timber stands of low volume or non-merchantable species (deciduous and coniferous), or with low timber-growing potential.
- critical wildlife habitat
- areas with high recreation value
- forested buffers along fish-bearing streams
- roads, skid trails and landings — the area of existing forest roads is excluded from the timber harvesting land base. Future losses of productive forest land due to roads, trails and landings are projected and modelled as deductions over time as future harvesting occurs.
- growth and yield plots — 2133 hectares of productive forest land is within research plots used to estimate forest growth and yield and is unavailable for harvesting.
- the timber harvesting land base is expected to increase by approximately 900 hectares as alder leading stands are rehabilitated and converted to Douglas-fir and cottonwood stands.

Inoperable areas
Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.

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 summarizes the areas represented by each of the above criteria, leaving the land base upon which timber harvesting is expected to occur — the timber harvesting land base. The area assumed to be available and suitable for timber harvesting is less than has been estimated in the past. This is due primarily to improved mapping of the area that is currently suitable for timber harvesting (operability mapping) and improved mapping of areas that have sensitive soils. A more detailed description of the removals and additions used to define the timber harvesting land base is provided in Appendix A, "Description of Data Inputs and Assumptions."

Table 1. Timber harvesting land base, Strathcona TSA.

Classification	Area (hectares)	Per cent of total area	Per cent of Crown forest land
Total area on inventory file	659 089	100.0	
Non-Crown land and/or marine water bodies	230 193		
Non-forest land	51 892		
Crown forest land	377 004	57.2	100
Reductions to Crown forest:			
Non-commercial cover	202	-	-
Inoperable areas	85 899	13.0	22.8
Not satisfactorily restocked	13 329	2.0	3.5
Highly sensitive soils	11 902	1.8	3.1
Non-merchantable forest types	17 738	2.7	4.7
High wildlife value	7 450	1.1	2.0
High recreation value	6 505	1.0	1.7
Stream side buffers	3 092	0.5	0.8
Existing roads	6 665	1.0	1.8
Growth and yield plots	2 133	0.3	0.6
Total reductions	154 916	23.5	41.1
Initial timber harvesting land base (less additions for restocking)	222 088	33.7	59.0
Additions:			
Not satisfactorily restocked	13 329	2.0	3.5
Alder rehabilitation	900	0.1	0.2
Total additions	14 229	2.1	3.8
Current timber harvesting land base	236 317	35.9	62.7
Future reductions:			
Future roads, trails, landings	6 397	1.0	1.7
Future timber harvesting land base	229 920	34.9	61.0

2 Information Preparation

Figure 2 shows a breakdown of the timber harvesting land base by tree species, quality of growing site and maturity. The timber harvesting land base in the Strathcona TSA is comprised mainly of hemlock/balsam (59%), Douglas-fir (21%) and western redcedar (19%) with smaller components of Sitka spruce and yellow cedar (included with western redcedar in Figure 3). Note that the majority of the existing forest older than 100 years old, which is expected to be the primary source of timber for harvesting over the short term, is primarily on the poorer growing sites.

A breakdown of the productive Crown forest is shown in Figure 3.

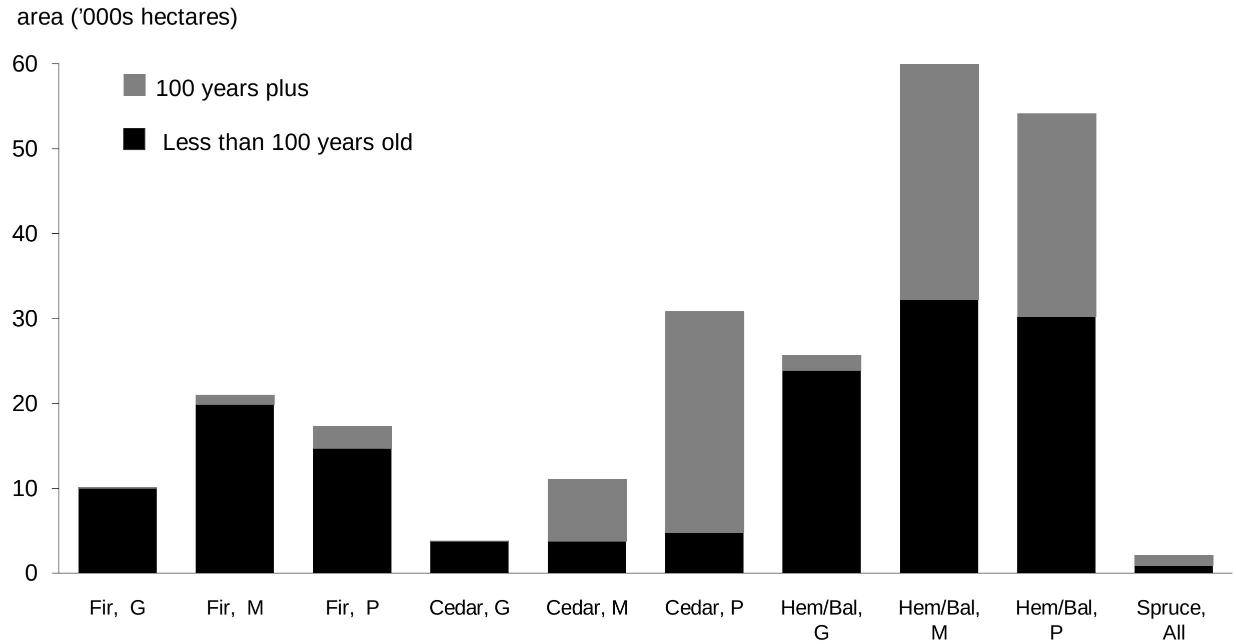


Figure 2. Area by dominant tree species, quality of growing site and maturity - timber harvesting land base.

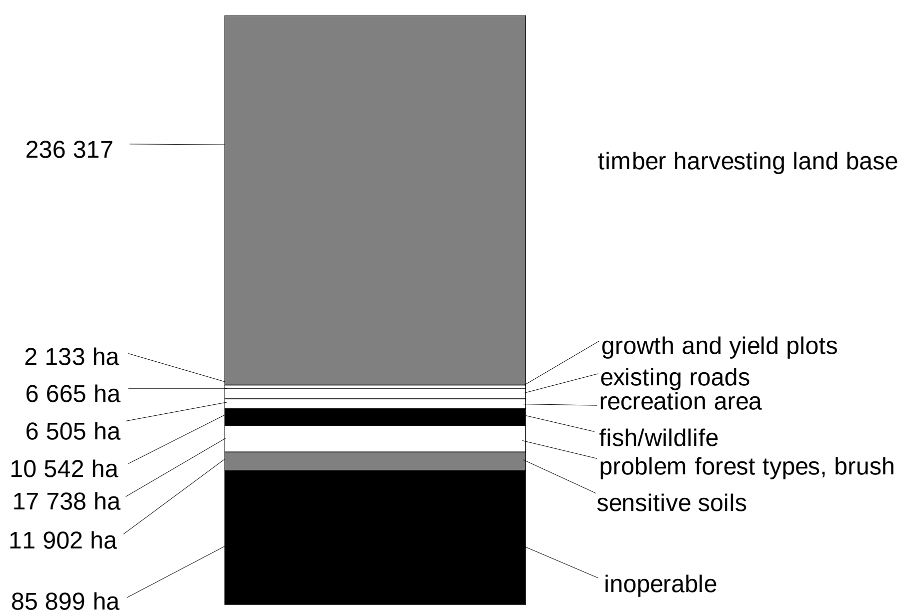


Figure 3. Breakdown of the productive crown forest.

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 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 model developed by the B.C. Forest Service, Research Branch. Sensitivity analyses address the possibility that stand volumes may be different from those predicted. Appendix A contains more information on the methods and models used to predict timber volumes.

2.3 Management practices

Timber supply is directly connected to forest management activity. 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.

The following harvesting and silvicultural assumptions reflect current forest management in the Strathcona TSA, and are used in the timber supply analysis.

2.3.1 Forest cover requirements

Harvest forecast
The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized, over time, for a specified land base and set of management assumptions. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.

- Cutblock adjacency — timber harvesting is generally not carried out on an area until any adjacent previously harvested areas have reached a particular set of desired conditions (covered with trees that are approximately 3 metres tall). This is usually specified by green-up period.* This guideline generally ensures that no more than 25% of an area being developed for timber harvesting is covered with stands of trees less than 3 metres tall. The sensitivity of the harvest forecast* to both the amount of area that may be covered by stands less than 3 metres tall and the estimated time required for regenerated stands to reach a 3-metre height is examined in Section 5.3.
- Visual quality of the landscape — in visually sensitive areas, the green-up requirement is achieved when the trees on a previously harvested area reach approximately 5 metres in height. The proportion of each visually sensitive area that may be covered by recently harvested stands less than 5 metres in height depends on the visual quality objectives for the area. Visual quality objectives modelled in this analysis include retention (most restrictive), partial retention (less restrictive) and modification (least restrictive), and are an important factor affecting the timber supply in the Strathcona TSA. About 37% of the timber harvesting land base is affected by management for visual quality.
- Wildlife winter range — areas that provide critical wildlife winter range have been excluded from the timber harvesting land base. Management of less critical wildlife winter range is achieved by maintaining a minimum of 50% of these areas under cover of stands greater than 5 metres in height to provide hiding cover.

Green-up period
The time needed for a stand of trees on a previously harvested site, to reach a desired condition (e.g., height) to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics.

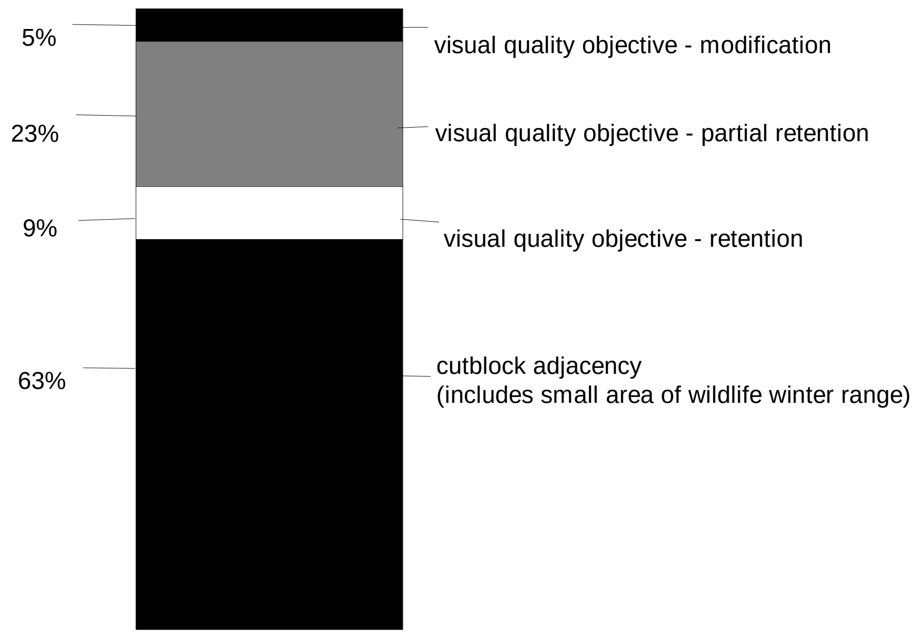


Figure 4. Proportion of the timber harvesting land base subject to each forest management consideration.

The proportion of the timber harvesting land base that is subject to each of the above forest management guidelines is shown in Figure 4.

2.3.2 Other management practices

- Basic silviculture levels — reforestation activities required to establish free-growing stands* of acceptable species. In the Strathcona TSA, most areas are harvested using a clear cut harvesting* system and restocked by planting or natural regeneration.
- Forest health and unsalvaged losses — losses of merchantable timber in the Strathcona TSA due to fire and wind damage are estimated to be 31 750 cubic metres per year. Losses of merchantable timber to forest insects and disease are assumed to be negligible.

> ***Free-growing stands***
> *Established seedlings of an acceptable commercial species that are free from growth-inhibiting brush, weed and excessive tree competition.*

> ***Clear cut 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.*

- Minimum harvest ages — the time required for trees to grow to a harvestable size. The minimum harvest ages used in this analysis vary by tree species and site productivity, but were all set at or near the age at which the trees achieve their maximum average annual volume growth (often referred to as maximum MAI*). Harvesting at this age maximizes the amount of timber that is produced over the long term. It is important to remember that these ages represent a minimum requirement. Management for non-timber forest values (such as visual quality, fish habitat and water quality) may necessitate harvesting stands at ages well above the minimum, with associated losses in long-term timber yield. The minimum harvest ages for each tree species and quality of growing site are listed in Appendix A. The effect that uncertainty in the minimum harvest ages has on the timber supply forecast is examined in sensitivity analysis in Section 5.2.

- Current AAC — the current AAC for the Strathcona TSA is 1 693 745 cubic metres per year, but has been temporarily reduced by 188 000 cubic metres per year to allow the deferral of harvesting from three areas under study by the provincial Protected Areas Strategy. As these study areas are not yet formally designated as protected areas, this analysis assumes that they are still contributing to the AAC. Portions of Quadra Island and Boughey Bay, which were recently added to the TSA, and together contribute 28 000 cubic metres per year to the AAC and are not included in this analysis. Therefore, the AAC assumed in this analysis is the AAC before the temporary reduction, less the contribution of Quadra Island and Boughey Bay or 1 665 745 cubic metres per year.

Mean annual increment (MAI)
Stand volume divided by stand age. The stand age at which the MAI assumes its maximum value is called the culmination age. Harvesting all stands at this age results in a maximum average harvest over the long term.

3 Analysis Methods

The purpose of this analysis was to examine both the short- and long-term timber harvesting opportunities in the Strathcona 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 in determining how a whole forest (collection of stands) be managed in order 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 0 to 400 years. (Only the results for the first 250 years are shown graphically in this report because the harvest flow remains constant from 200 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 period, or that some minimum percentage of the forest must be older than a certain age 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 forest management 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 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 this 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 sound sustainable forest management in the field.

Cutblock adjacency
Integrated management guidelines that specify the desired spatial relationship among cutblocks. They can be approximated by specifying the maximum allowable proportion of a forested landscape that does not meet green-up requirements.

4 Results

4.1 Base harvest forecast

The harvest forecast based on current forest management assumptions for the Strathcona TSA is shown in Figure 5. This forecast will be referred to as the base harvest forecast and will be used as the basis for comparison for all other harvest forecasts in this report.

The base harvest forecast shows an initial rate of harvest of 1.45 million cubic metres per year, which is about 12% lower than the current AAC (before the temporary reduction for the Protected Areas Strategy study areas). From this reduced initial rate of harvest, the harvest forecast declines by about 12% per decade for the next three decades to about 940 000 cubic metres per year; about 13% below the steady long-term harvest level. The projected rate of harvest remains below the steady long-term level for 7 decades before rising to the steady long-term harvest level of 1.1 million cubic metres per year.

The base harvest forecast shown is only one of many possible harvest flows given current forest management assumptions. The harvest forecast shown in Figure 5 was chosen as the base case for this analysis as a balance between short- and long-term timber supply interests. Starting the harvest forecast at a higher initial level, delaying the decline, or reducing the rate of decline results in a more severe timber supply short fall in the future, as will be discussed further in Section 5.1.

Several important factors effect the timber supply forecast. The most important factor is that the original abundance of mature forest which historically allowed harvest rates well above the long-term level no longer exists. In this situation harvest rates must decline towards the long-term level to avoid serious timber supply short falls in the future.

Also contributing to the decline in timber supply are forest cover requirements for non-timber resources such as wildlife and scenic values. However, it is important to note that even if these forest cover requirements were removed, the harvest forecast will show a decline in the near future because most of the original mature forest has been harvested. As discussed in Section 2.1 and shown in Figure 3, the remaining older forests, in which most harvesting is expected to occur over the short term, are on poorer than average growing sites and will therefore yield lower than average volumes of timber. As well, the rate at which a large proportion of these remaining older forests may be harvested is limited by the forest cover requirements.

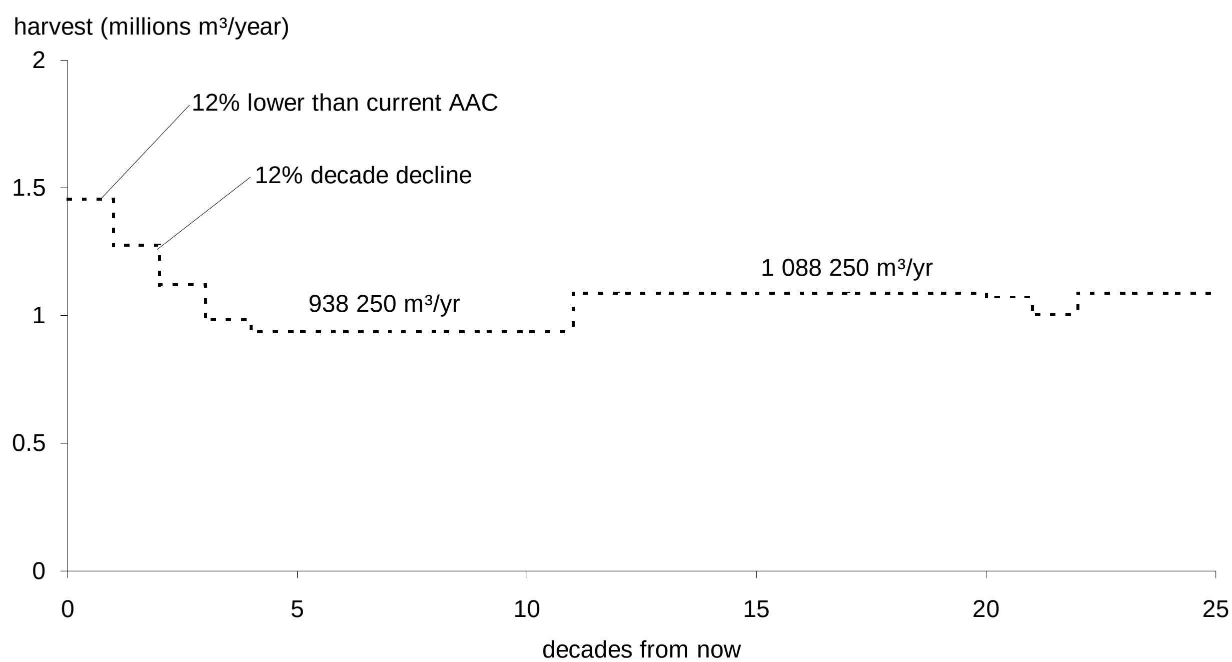


Figure 5. Base harvest forecast for the Strathcona TSA.

4 Results

The concentration of harvesting activities in the Sayward and Loughborough supply blocks in the past is another factor that adds to the effect that forest cover requirements are having on the harvest forecast. As shown in Figure 6, a large proportion of the timber harvesting land base, especially in the Sayward and Loughborough supply blocks, is areas of regenerated stands less than 100 years old. The majority of the older stands, in which most harvesting is expected to occur in the short term, are concentrated in the Kyuquot supply block. However, the degree to which harvesting operations may be concentrated in the Kyuquot supply block is limited by forest cover requirements for non-timber resources. As a result, the remaining older forest cannot maintain the current rate of harvest, meet objectives for non-timber resources, and still have a gradual decline in the rate of harvest to a steady long-term-level.

Figure 7 shows both the total and harvestable growing stock projected over time. There is currently a total of about 73 million cubic metres of timber in the timber harvesting land base, as indicated by the thick line in Figure 7. Of the total, about 60 million cubic metres of timber is currently old enough to be considered harvestable, as shown by the thin line in Figure 7. Similar to the trend seen for the harvest levels in the base harvest forecast, both the total and harvestable timber growing stock are projected to decline over the next 50 years then rise to a steady long-term level in about 100 years. The current total growing stock is approximately equal to the total growing stock expected to be maintained over the long term, when the rate of harvest has reached a steady long-term level.

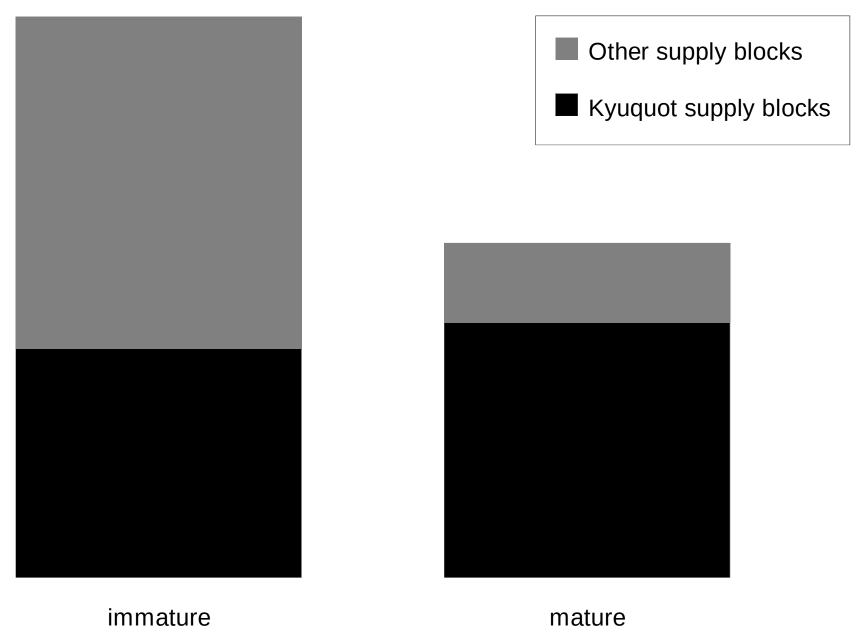


Figure 6. Area of immature and mature forest grouped by supply block.

4 Results

Figure 8 shows that the average volume of timber obtained from each hectare of forest harvested is expected to decline only slightly over time, from about 650 cubic metres per hectare in the short term to an average of about 600 cubic metres per hectare over the long term. This change in the expected volume of timber per hectare harvested is relatively small for the following reasons:

- the remaining older stands expected to be harvested over the short term are on sites with poorer than average timber productivity, and
- in general, the managed regenerated stands that will be harvested over the long term are assumed to be more productive in terms of timber than the stands that they replace.

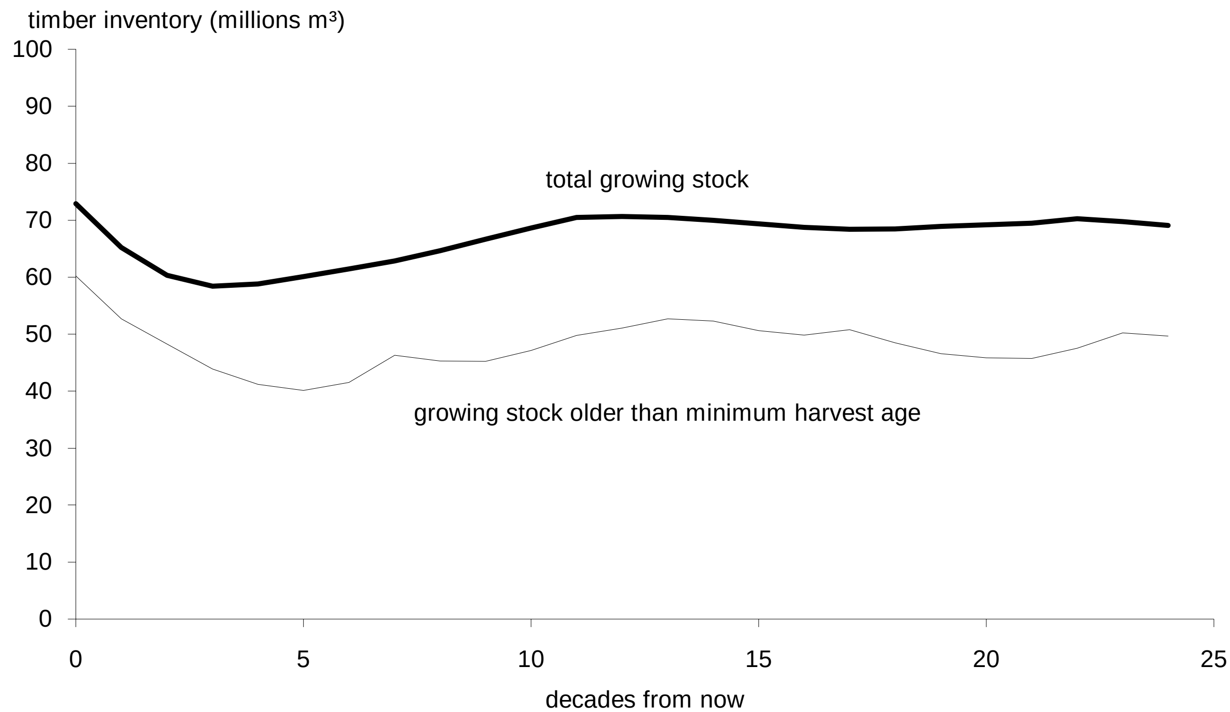


Figure 7. *Total and harvestable growing stock over time – Strathcona TSA.*

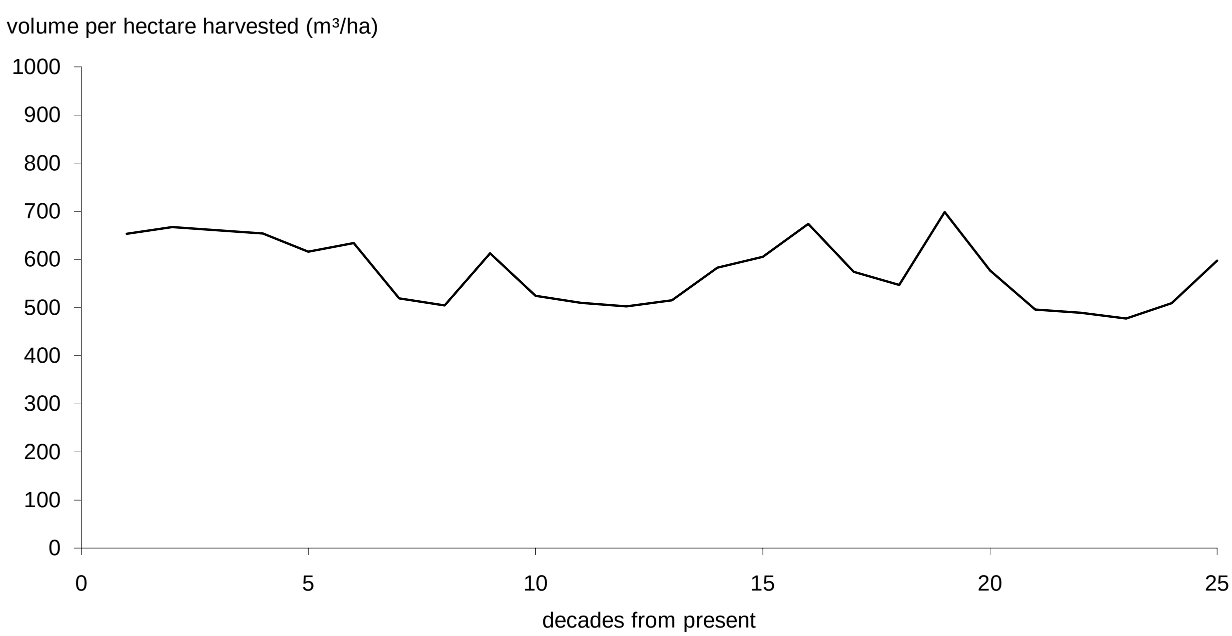
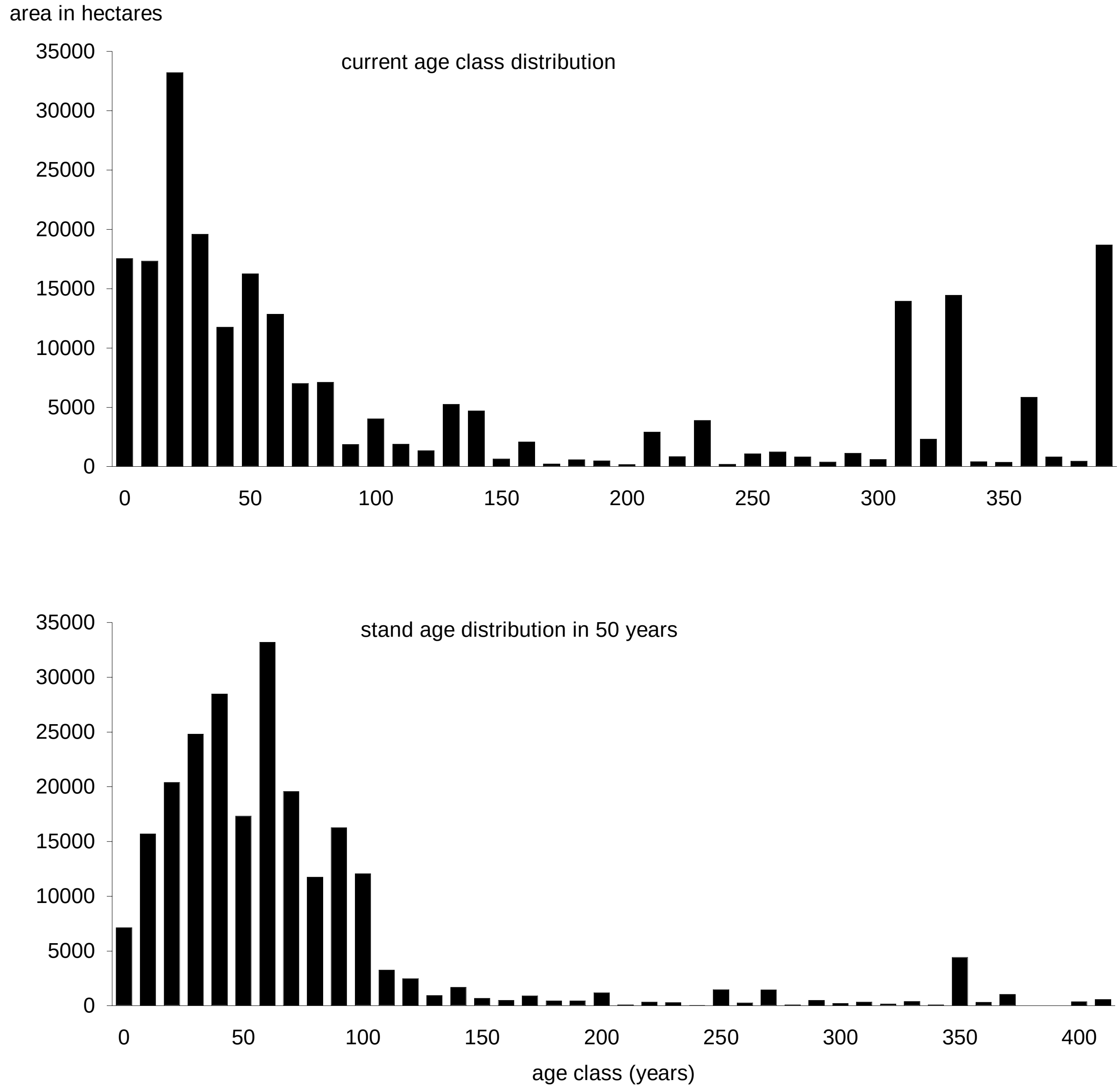


Figure 8. *Average volume of timber obtained from each hectare harvested over time - Strathcona TSA.*

4 Results

Figure 9 shows the changes projected to occur in the age distribution of forest stands in the Strathcona TSA. Over the 250 year period modelled, the remaining older stands are harvested and the amount of area at each age becomes more balanced. By 50 years, almost all of the remaining older stands have been harvested and replaced with regenerated stands. The older stands that exist throughout the 250 year period modelled are the result of forest cover requirements for visual quality.



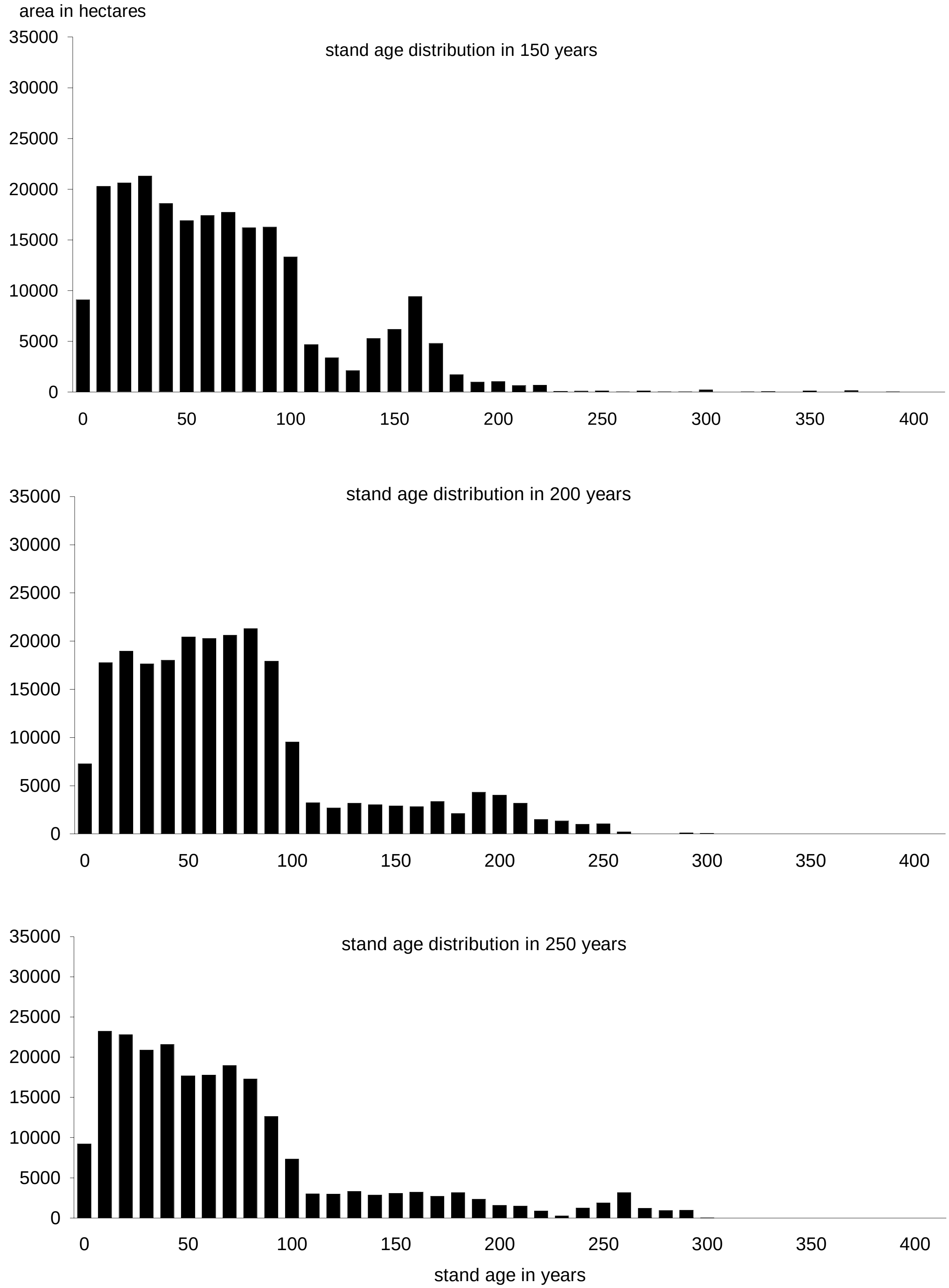


Figure 9. Stand age distribution over time - Strathcona TSA.

4 Results

A timber supply issue affecting the Strathcona TSA is the alternating concentration of harvesting activities between the east coast and west coast of the TSA over time. Historically, most harvesting has occurred in the Sayward and Loughborough supply blocks on the east coast of Vancouver Island and the mainland. As a result, the majority of stands in these supply blocks are relatively young (see Figure 6).

More recently, harvesting operations have been concentrated on the west coast of Vancouver Island in the Kyuquot supply block, which contains the majority of the remaining mature timber. Figure 10 shows the modelled harvest level from each supply block in the base harvest forecast. Of note are the first two decades modelled. In the base harvest forecast, the harvest level requested for the entire TSA in decade 2 is a maximum. Therefore, the harvest from the Kyuquot supply block in the second decade, 700 000 cubic metres per year, is the maximum that can be harvested given that 800 000 cubic metres per year are harvested in the first decade. In recent years, harvesting operations have been concentrated in the Kyuquot supply block and the current rate of harvest from the Kyuquot supply block is approximately 1 100 000 cubic metres per year. This higher real rate of harvest from the Kyuquot supply block in the first decade implies that even less timber from the Kyuquot supply block will be available for harvest in the second decade. Harvesting operations may have to rely more heavily on the regenerated stands in the Sayward and Loughborough supply blocks in the second decade than is indicated by the model results.

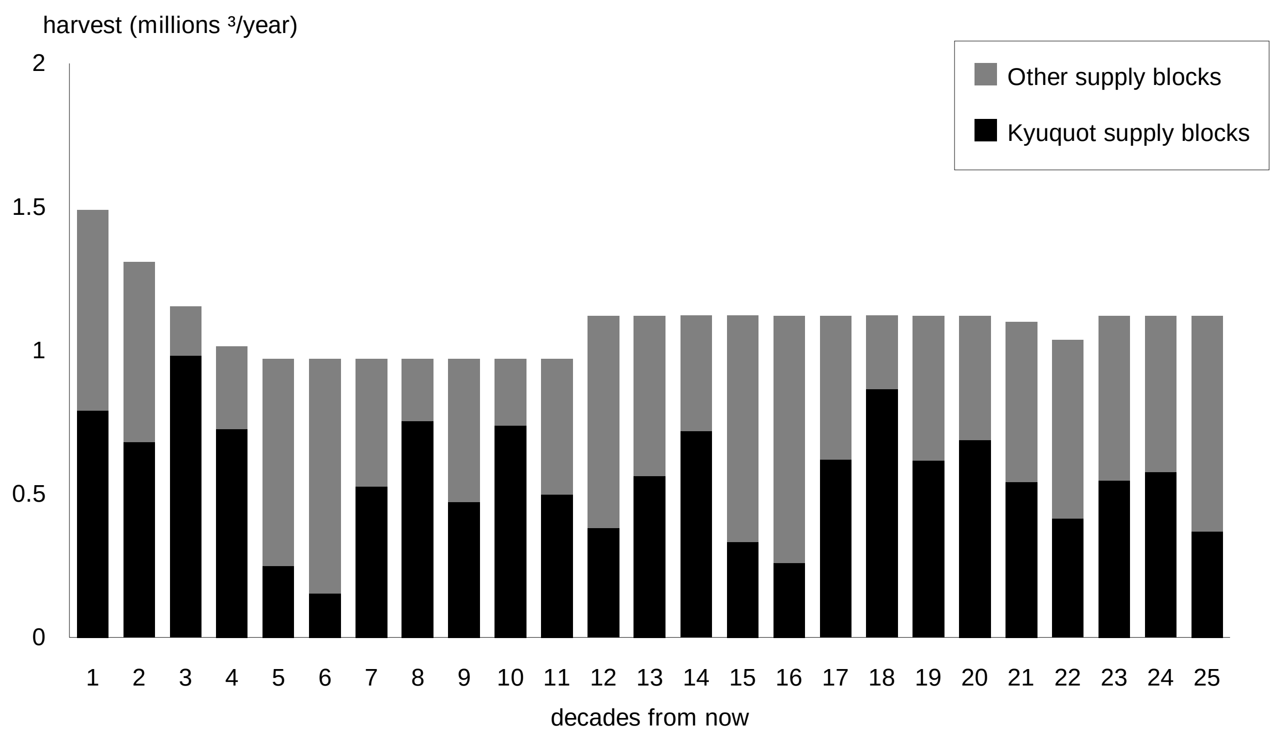


Figure 10. Supply block harvests — Base harvest forecast for the Strathcona TSA.

5 Timber Supply Sensitivity Analyses

Sensitivity analysis is the exercise of examining how uncertainty in data and assumptions affect the outcome of analysis. The main purpose of timber supply sensitivity analysis is to highlight which variables most affect results. Sensitivity analysis is an important aid to decision-making, since uncertainty surrounds estimates of many variables used in timber supply analysis.

The best available information on forest inventories and management practices is used to analyse the implications for timber supply of current management. It is possible, nevertheless, that small inaccuracies in estimating some variables could have large effects on results, or that fairly large inaccuracies for other variables could have negligible effects. Sensitivity analysis can highlight priorities for collecting information for future analyses. As well, it can clarify for decision-makers whether current estimates are safe bases for decisions, or whether high uncertainty around important variables necessitates more conservative decisions.

In this section, results of several sensitivity analyses are outlined. The results that are based on current forest management assumptions are referred to as the base case (shown in Figure 5).

5.1 Alternative harvest flows given the base forest management assumptions

For a given set of forest management assumptions, many different harvest flows are often possible. This section examines alternative harvest flows to that shown as the base harvest forecast, given the same set of forest management assumptions.

The base harvest forecast, shown in Figure 5, and discussed in Section 4 started from an initial rate of harvest that is about 12% below the current AAC. The solid line in Figure 11 shows the harvest forecast if the starting harvest level is set at only 8% below the current AAC, while still trying to limit the future rate of decline in the harvest level to 12% per decade. As shown by the solid line, a starting harvest level of 1.52 million cubic metres per year (8% below the current AAC) is achievable for the first 10 years modelled. However, with this increase in the amount of timber harvested in the first decade, a timber supply short fall occurs in the second decade. The harvest level in the second decade is 19% below the initial level, well in excess of the 12% decline that was attempted. The increased initial harvest level also causes a timber short fall to occur in approximately 200 years as the increased amount of poor productivity sites harvested in the short term become available for a third harvest in the model (recall from Section 2.1 that the majority of older existing stands are on poor growing sites). This timber short fall was evident in the base harvest forecast as well (shown by the dashed line in Figure 11), but was not as dramatic.

5 Timber Supply Sensitivity Analyses

The harvest level in the base harvest forecast dropped to below the steady long-term level, and remained below the steady long-term level for 7 decades. The solid line in Figure 12 shows the harvest forecast if the harvest level is increased to the steady long-term level after only 5 decades. This earlier rise to the steady long-term harvest level is possible, but results in a temporary timber short fall later in the harvest forecast due to a persistent imbalance in the area of forest at each age and the fact that large proportion of stands available for harvest at that time are on poor growing sites.

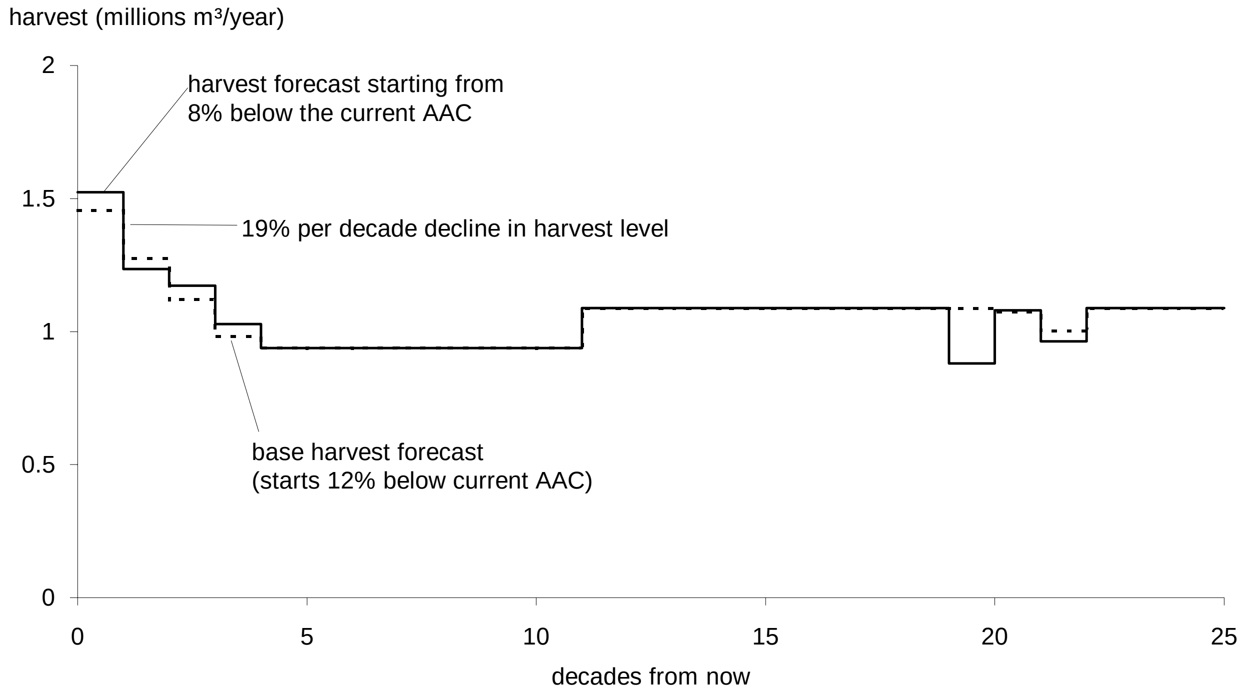


Figure 11. Harvest forecast with a starting harvest level set at 8% below the current AAC.

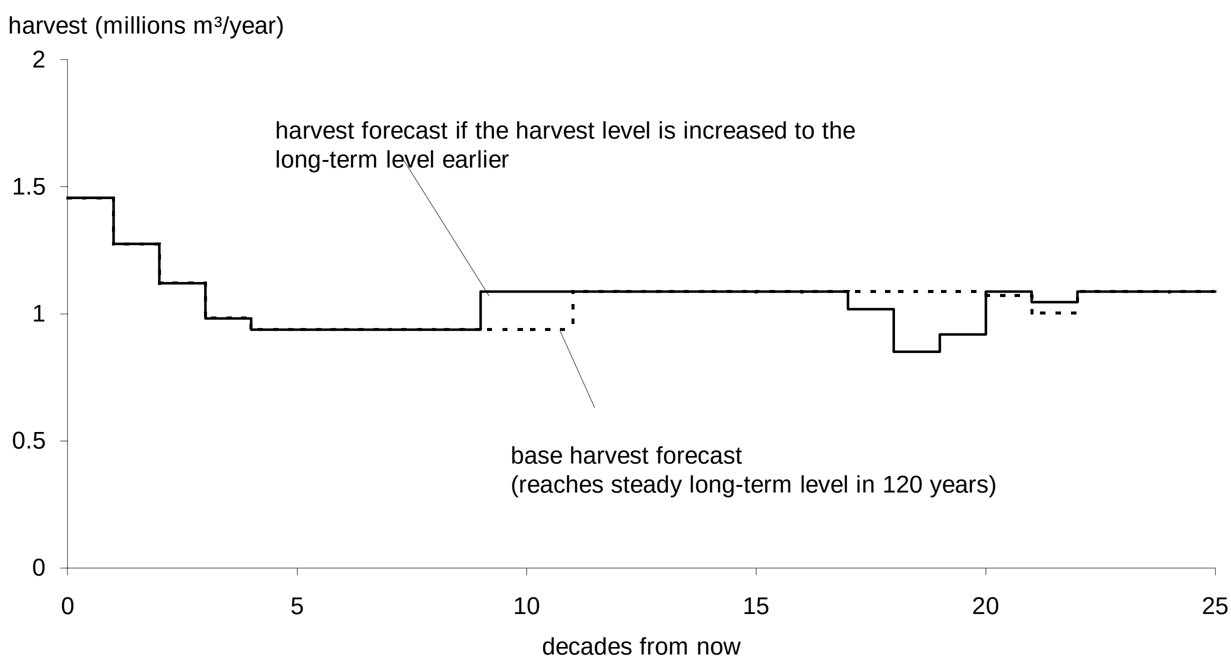


Figure 12. Harvest forecast if the harvest level is increased to the long-term level 2 decades earlier.

5 Timber Supply Sensitivity Analyses

The solid line in Figure 13 shows the harvest forecast if the initial rate of harvest is set as high as possible given current forest management assumptions. The maximum initial rate of harvest that can be achieved for the first 10 year period modelled is 1 625 800 cubic metres per year, 2% below the current AAC. However, harvesting at this higher rate over the first decade reduces the amount of timber that is available for harvest in the second decade. As a result, a timber supply short fall occurs in the second decade and the harvest level falls to 28% below the initial harvest level.

The harvest forecast if the initial rate of harvest is set at the steady long-term harvest level is shown by the solid line in Figure 14. The steady long-term harvest level cannot be maintained for the entire 250 year period modelled. The solid line in Figure 15 shows that in order to achieve a non-declining harvest forecast, the initial rate of harvest must be reduced to just over 1 million cubic metres per year, about 40% below the current AAC and about 6% below the steady long-term harvest level.

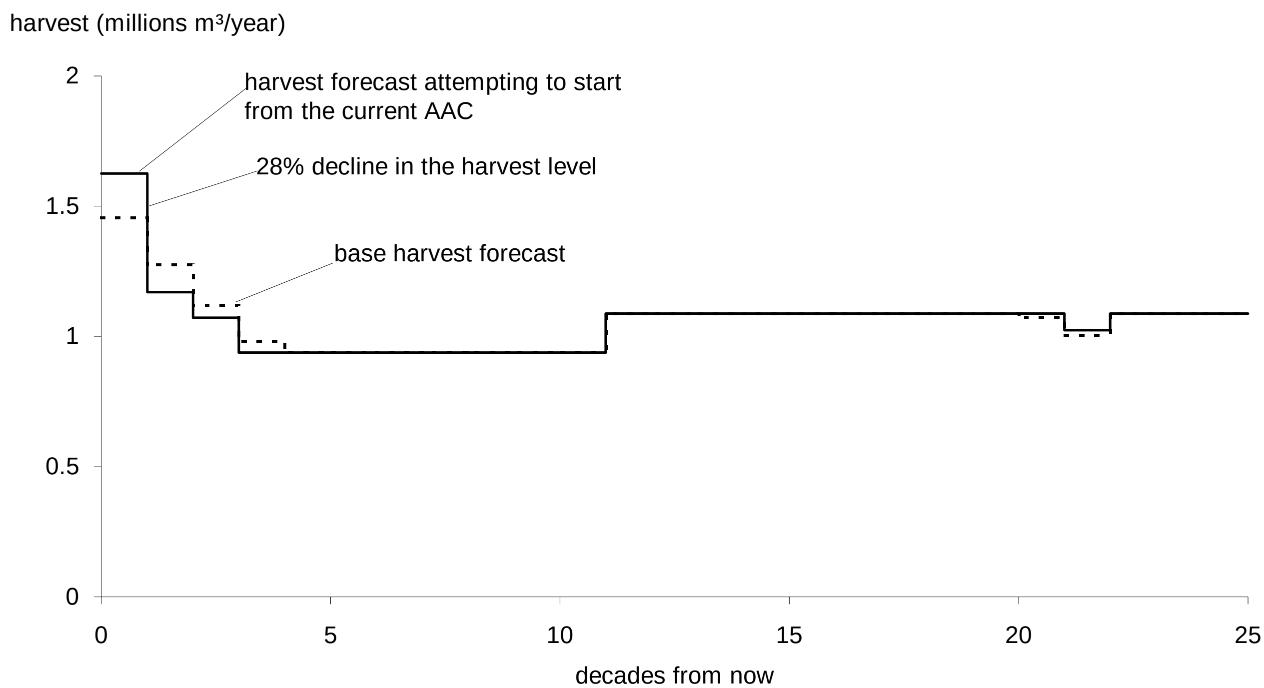


Figure 13. Harvest forecast if the initial harvest level is set as high as possible.

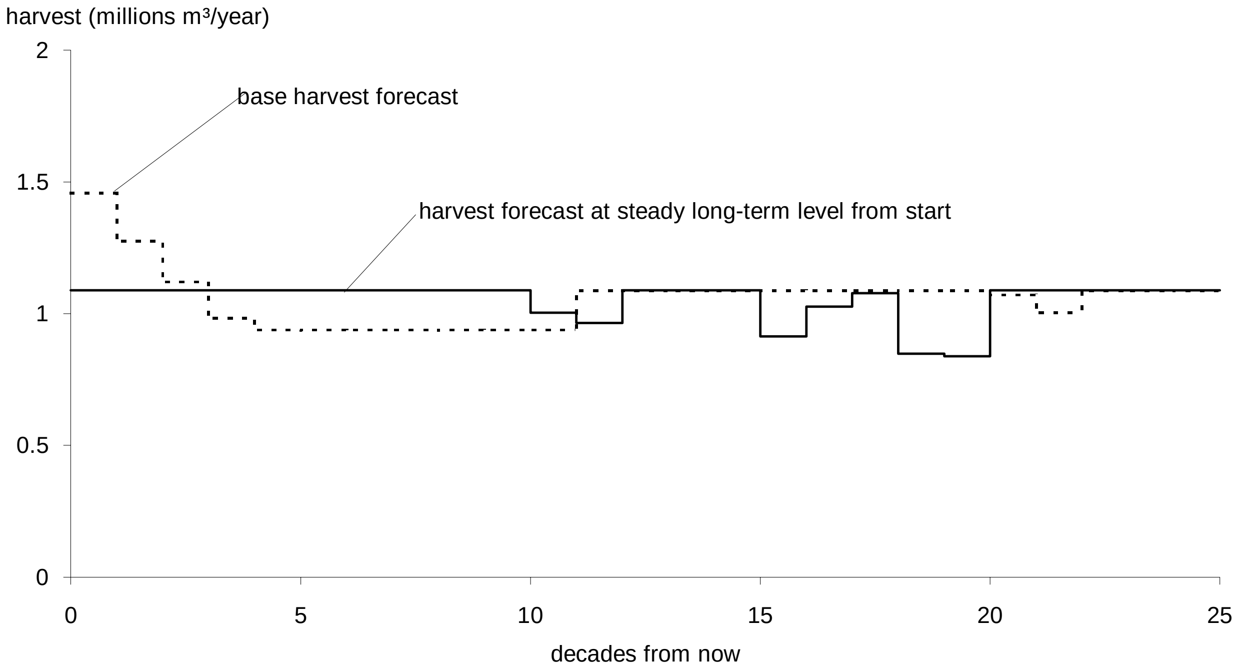


Figure 14. Harvest forecast if the initial rate of harvest is set at the steady long-term harvest level.

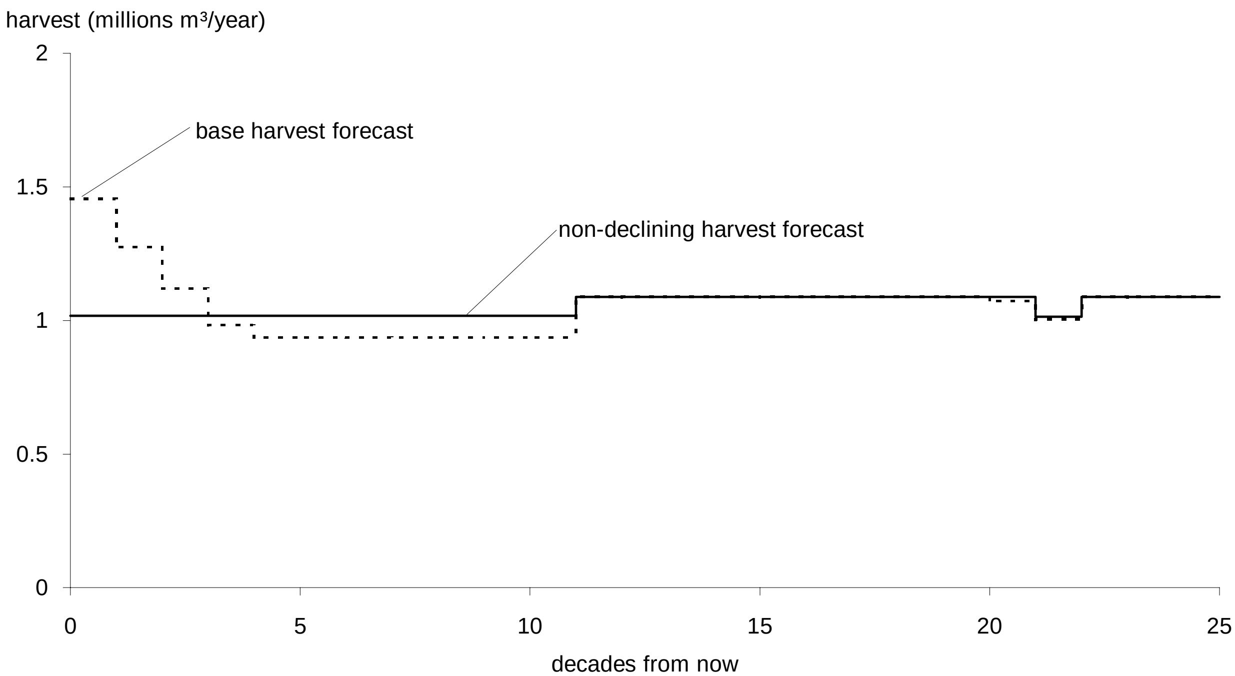


Figure 15. Non-declining harvest forecast.

5.2 Sensitivity to uncertainty in minimum harvest ages

In the base harvest forecast, minimum harvest ages were set with the objective of maximizing the volume of timber produced over time. The minimum harvest ages for each forest type ranged from a minimum of 50 years up to 110 years. This section examines the sensitivity of the harvest forecast to changing the minimum harvest ages for each forest type by 10 years.

The effect on the harvest forecast of increasing all minimum harvest ages by 10 years for all forest types is minimal, as shown by the solid line in Figure 16. With an increase in minimum harvest ages, less timber is available from regenerated stands early in the 250 year period modelled. The decrease in the amount of timber available from regenerated stands in the short term causes a slightly larger total decline in the rate of harvest than is seen in the base harvest forecast (shown by the dashed line in Figure 16). The steady long-term harvest level is only 2% lower than in the base harvest forecast.

Decreasing all minimum harvest ages by 10 years also has a minimal effect on the harvest forecast, as shown by the thick solid line in Figure 16. The total decline to below the steady long-term level is reduced slightly due to an increase in the amount of regenerated stands that are available for harvest in the short term. Because the minimum harvest ages used in the base harvest forecast are already at or below the age that maximizes the production of timber over time, the steady long-term level is unchanged from the base harvest forecast.

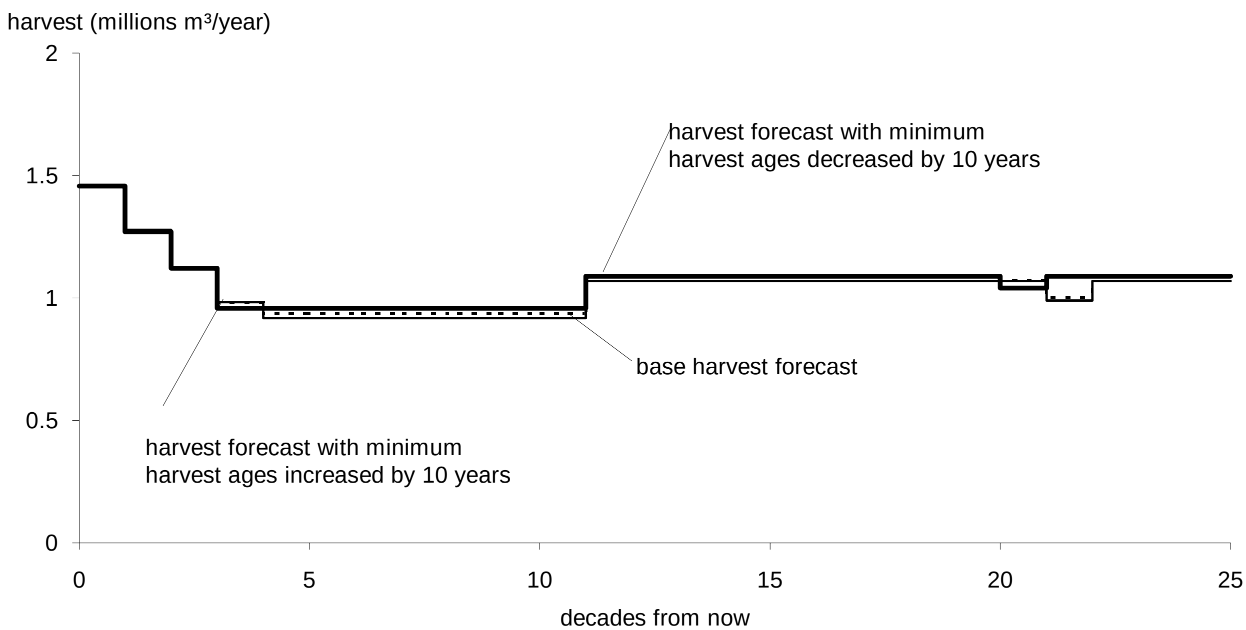


Figure 16. Harvest forecast with minimum harvest ages changed by 10 years.

5.3 Sensitivity to uncertainty in green-up periods

As discussed in Section 2.3, "Management Practices," the required green-up periods used in the base forecast are the estimated number of growing years before the trees on a previously harvested area reach a required height. Uncertainty in the required green-up period stems from both the uncertainty in stand height growth rates as well as the subjectivity of the height requirement before a stand is considered "greened-up". The following sensitivity analysis examines the effect that uncertainty in the required green-up period has on the harvest forecast.

The thick solid line in Figure 17 shows the harvest forecast if all green-up periods are reduced by 5 years. The decrease in the required green-up period increases the availability of areas for timber harvesting over time. The initial harvest level increases to just over 1.5 million cubic metres per year; 4% higher than the base harvest forecast (shown as the dashed line in Figure 17) but still 9% below the current AAC. The projected harvest level still declines by 12% per decade after the first decade, just as in the base harvest forecast, but the extent of the decline to below the steady long-term level is reduced. The steady long-term harvest level is not significantly changed from the base harvest forecast.

Increasing all required green-up periods by 5 years has a dramatic effect on the harvest forecast, as the thin solid line in Figure 17 shows. Cutblock adjacency requirements, discussed in Section 2.3, "Management Practices" are relatively unconstraining on the rate of harvest in the base harvest forecast. Increasing the required green-up period makes the forest cover requirements for cutblock adjacency, as well as the requirements for visual quality much more constraining on the rate of harvest in the short term. The initial rate of harvest must be reduced to about 970 000 cubic metres per year, 33% lower than in the base harvest forecast and 42% below the current AAC. In the long term, the forest cover requirements for cutblock adjacency are not limiting. The steady long-term harvest level is only about 3% below the long-term level in the base harvest forecast.

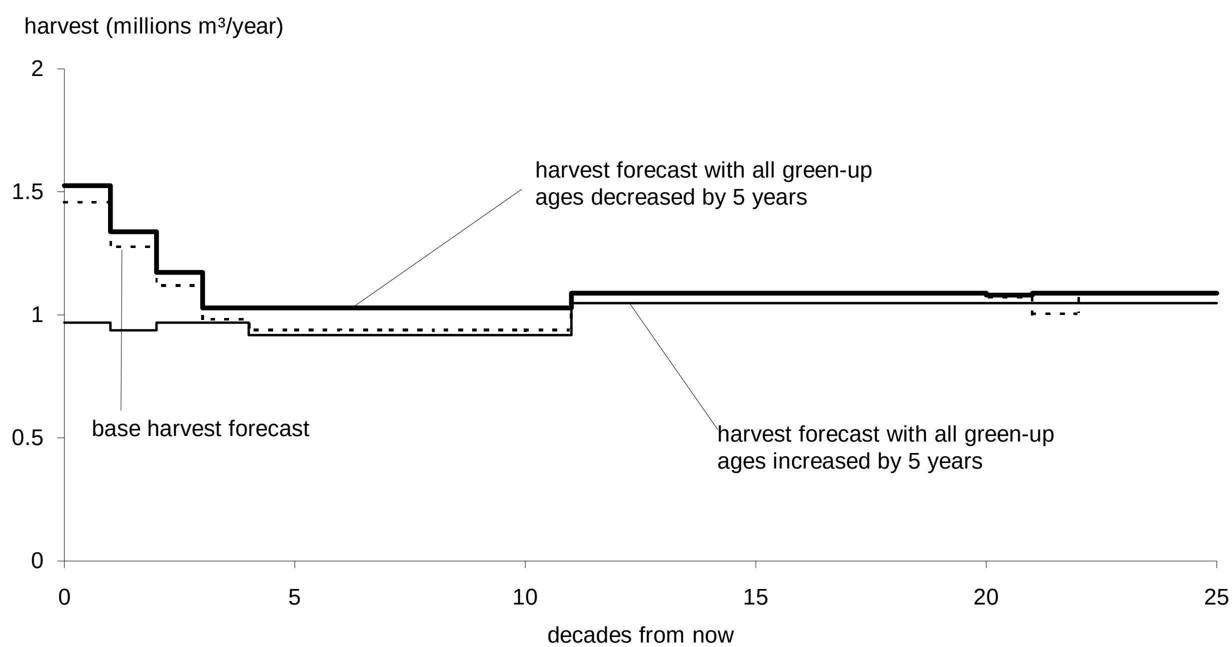


Figure 17. Harvest forecast with all green-up periods changed by 5 years.

5.4 Sensitivity to cutblock adjacency requirements

In the base case, forest cover requirements used to model cutblock adjacency and green-up were based on the assumption that a maximum of 25% of the timber harvesting land base may be forested with stands less than 3 metres tall at any time (see Section 2.3, "Management Practices.") However, this forest cover requirement should be viewed only as an **average** forest cover requirement that applies to areas with no overriding management concerns such as visual quality or wildlife habitat. Site specific forest cover requirements will vary from this average requirement. Uncertainty in the average forest cover requirement used to model cutblock adjacency and green-up in this analysis stems from these site specific variations from the average.

Because this forest cover requirement was not a limiting factor in the base case, the harvest forecast was not changed by relaxing the forest cover requirement to allow more area to be covered with stands less than 3 metres tall. However, the solid line in Figure 18 shows the effect of making the forest cover requirement for cutblock adjacency more stringent so that only 20% of the area may be forested with stands less than 3 metres tall. This change makes the forest cover requirement for cutblock adjacency a limiting factor and affects the short-term harvest forecast dramatically. The highest possible harvest level in the first decade is about 1.1 million cubic metres per year, about 25% lower than in the base case, and about 34% below the current AAC. The reduced harvest in the short term causes a larger inventory to be maintained until later decades, and allows the harvest level to be increased to the steady long-term level 2 decades earlier.

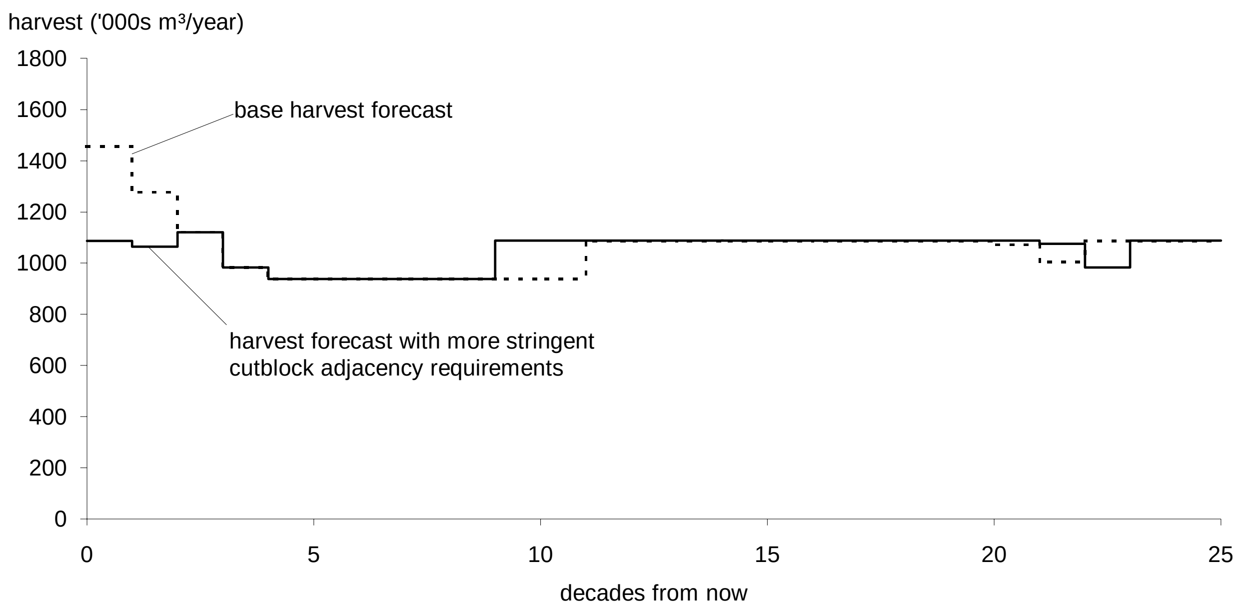


Figure 18. Harvest forecast with more stringent cutblock adjacency requirements.

5.5 Sensitivity to visual quality requirements

In the base case, forest cover requirements for visually sensitive areas defined the maximum percentage of a visually sensitive forest area that is permitted to be not greened-up (recently harvested, covered with trees less than 5 metres tall) at any time. As noted in Section 2.1, "Land Base Inventory" approximately 37% of the timber harvesting land base is subject to forest cover requirements for visual quality.

The thin solid line in Figure 19 shows the harvest forecast if the forest cover requirements are relaxed so that an additional 5% of each visually sensitive area may be younger than green-up age at any time. The initial rate of harvest of about 1.5 million is only about 3% higher than in the base case (shown by the thin solid line in Figure 19).

However, the increased availability of areas for timber harvesting over time eliminates the need to decline below the steady long-term harvest level. This large increase in the harvest forecast amounts to over 14 million cubic metres more timber being harvested over the first 10 decades. The steady long-term level is also increased from the base case by about 3% to 1.12 million cubic metres per year.

The thick solid line in Figure 19 shows the harvest forecast if forest cover requirements for visual quality are made more stringent so that 5% less of each visually sensitive area may be younger than green-up age at any time. The initial rate of harvest with this change is about 1.37 million cubic metres per year, 6% lower than in the base harvest forecast. As in the base case, the harvest level declines in decades 2 through 5 to below the steady long-term harvest level. The steady long-term level of about 940 000 cubic metres per year is 14% lower than in the base case.

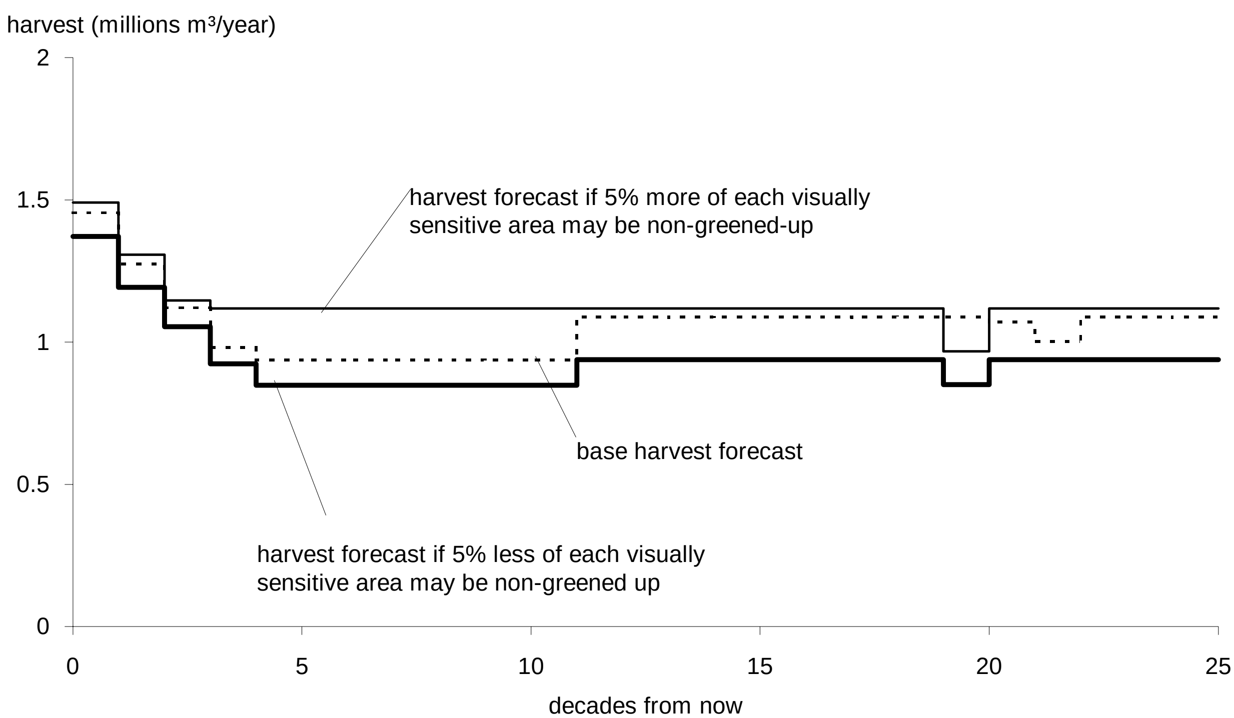


Figure 19. Harvest forecasts with increased and decreased forest cover requirements for visual quality.

5.6 Sensitivity to uncertainty in existing stand yield estimates

Timber yield estimates have a degree of uncertainty due to such factors as the statistical process used to develop growth and yield models, uncertainty in the forest inventory, and changing timber utilization standards. The following sensitivity analyses examine the effect on the harvest forecast of uncertainty in the volume of timber that currently exists on the timber harvesting land base.

The thick solid line in Figure 20 shows the effect on the harvest forecast of increasing the estimated timber yield from existing stands by 10%. This change does not necessarily allow an increase in the short-term (first 20 - 30 years) harvest forecast as might be expected. The additional volume of timber, as shown in Figure 20, alleviates the projected short fall below the steady long-term level. If a decline to below the long-term level is accepted, as in the base case, the increase in existing available timber would show up in an increased short-term harvest level.

The thin solid line in Figure 20 shows the harvest forecast if the estimated timber yield from existing stands is decreased by 10%. This change has a direct effect on the short-term harvest forecast simply because of the direct reduction in the existing mature inventory of timber that is ready for harvest. In addition, reducing the volume of timber per hectare harvested requires more forest area to be harvested in order to achieve a given harvest level than would be required using the base case yield estimates. The forest cover requirements for visual quality do not allow this required increase in the total area harvested to occur. Thus, reducing the estimated volume of existing mature timber makes the forest cover requirements for visual quality more limiting on the short-term harvest forecast. If the initial rate of harvest is set only 7% lower than in the base harvest forecast (19% lower than the current AAC), the harvest rate must decline by 18% in the second decade and 12% per decade thereafter to about 870 000 cubic metres per year, well below the steady long-term harvest level. The steady long-term harvest level is unchanged from the base case.

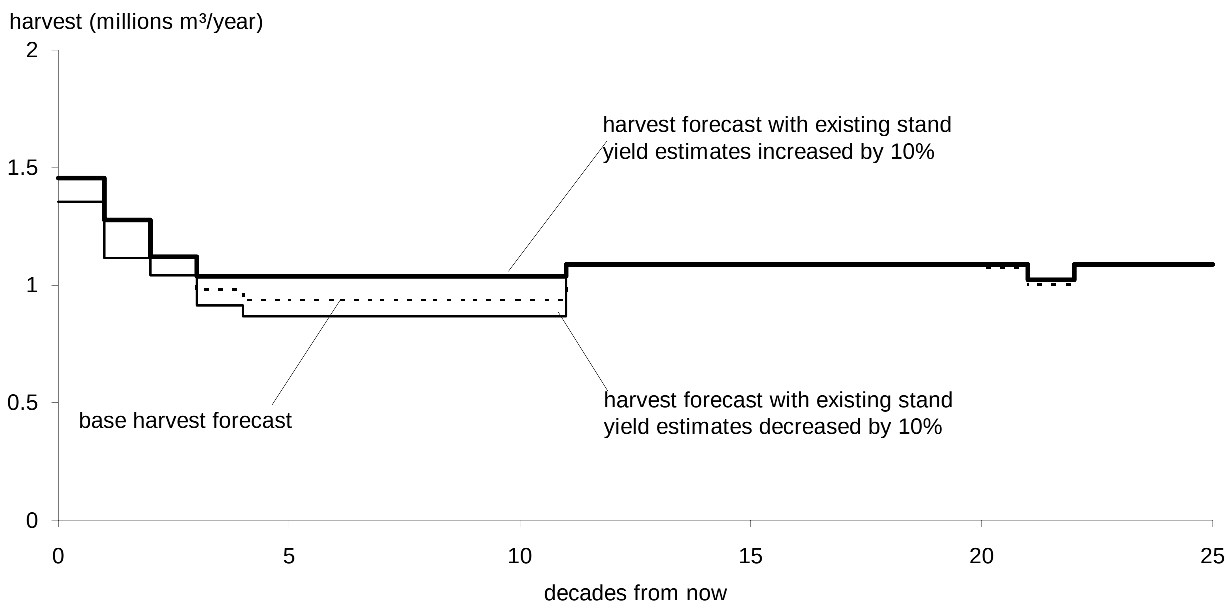


Figure 20. Harvest forecasts with existing stand timber yield estimates changed by 10%.

5.7 Sensitivity to uncertainty in regenerated stand yield estimates

Uncertainty in regenerated stand yield estimates is due to numerous factors such as using inventory data from existing mature forests to predict the growth and yield of future regenerated stands, uncertainty about the effect of replacing existing forests with different tree species after logging, and the effects of soil degradation, pests and forest disease on future forest productivity.

The following sensitivity analyses examine the effect that uncertainty in the estimated yields from regenerated stands have on the harvest forecast.

The thin solid line in Figure 21 shows the effect on the harvest forecast of increasing the estimated timber yields from all regenerated stands by 20%.

Although a large proportion of the Strathcona TSA is in regenerated stands, many of which are almost old enough to harvest for a second time, increasing the estimated timber yield from regenerated stands by 20% does not improve the short-term harvest forecast. The additional volume of timber created by this change does reduce the absolute amount of the decline in the harvest forecast below the steady long-term level. In the long term, when almost all harvesting occurs in regenerated stands, the harvest level is increased from the base case by slightly more than 21% to 1.31 million cubic metres per year.

The thick solid line in Figure 21 shows the effect on the harvest forecast of decreasing all regenerated stand timber yield estimates by 20%. This change affects only the steady long-term harvest level, which is reduced by about 22% from the base harvest forecast.

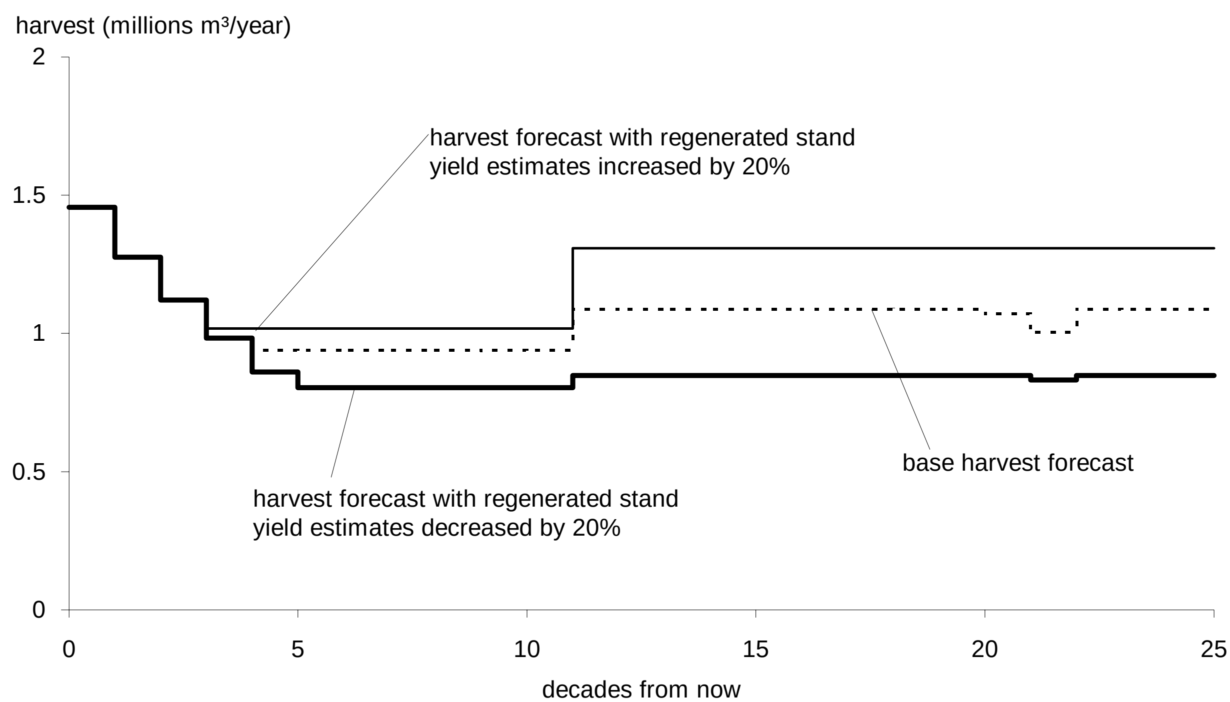


Figure 21. Harvest forecasts with regenerated stand yield estimates changed by 20%.

5.8 Sensitivity to changes in the area of the timber harvesting land base

The area that is assumed to be suitable and available for timber harvesting is one of the primary inputs into a timber supply analysis. In the Strathcona TSA, the timber harvesting land base could be larger or smaller than expected if any of the areas listed in Table 1. are different. There are a number of reasons that these areas could be different from what is expected. The timber harvesting land base could be increased by improved timber harvesting techniques and equipment, or as a result of increases in the value of currently unmerchantable forest types.

Conversely, the timber harvesting land base could be smaller than expected if for example:

- harvesting costs increased, reducing the economic feasibility of harvest operations, or
- guidelines to protect sensitive soils are inadequate in meeting their objectives, and additional protection is necessary, or
- decisions to protect additional areas, such as those considered through the provincial Protected Areas Strategy are made. (It should be noted that the base case harvest forecast in this report assumes these areas are available for timber harvesting.)

The following sensitivity analysis examines the effects on the harvest forecast of the uncertainty associated with the size of the timber harvesting land base.

The majority of areas not already included in the timber harvesting land base are poorer than average in terms of timber production. With this in mind, the increase in the timber harvesting land base was made by increasing the area of poor growing sites in the timber harvesting land base by 20%, or about 19 000 hectares. The harvest forecast with this increase in the timber harvesting land base is shown by the solid line in Figure 22. The initial rate of harvest is 3% higher than in the base case, but is still 11% below the current AAC. The rate of decline in the harvest forecast is still 12% per decade, as in the base case, but the total extent of the decline below the steady long-term level is reduced. The steady long-term harvest level is increased by 4% to about 1.14 million cubic metres per year.

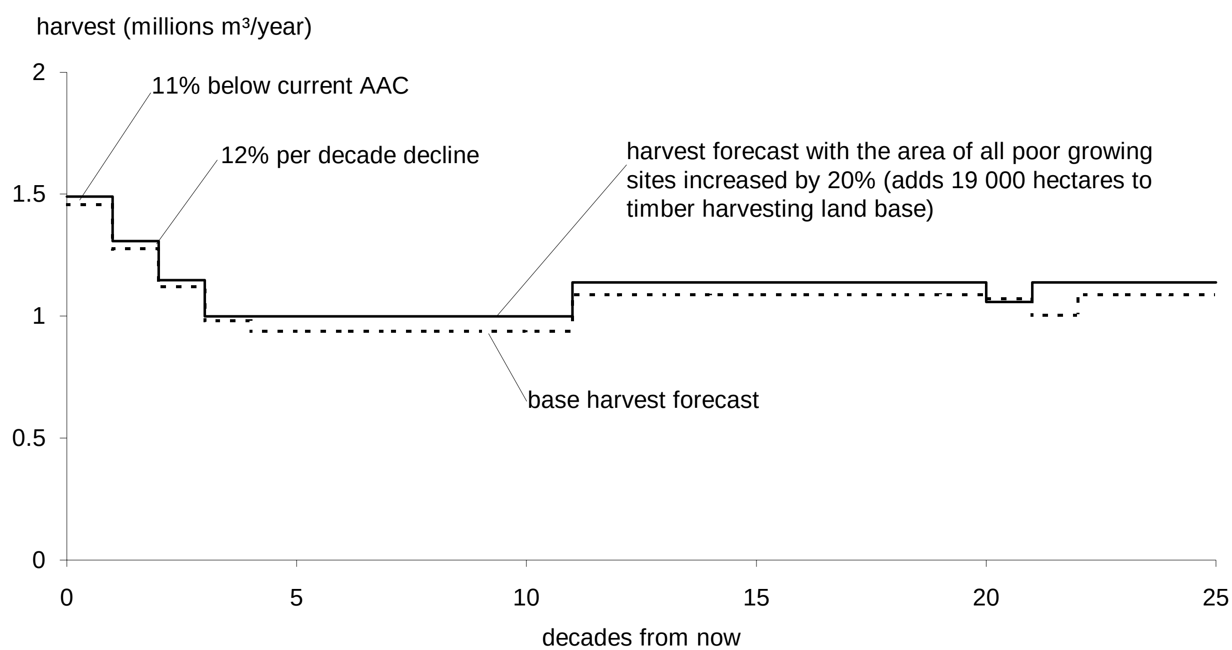


Figure 22. Harvest forecast with the area of the timber harvesting land base increased.

The harvest forecast with a reduced timber harvesting land base is shown by the solid line in Figure 23. To keep this sensitivity analysis consistent with the sensitivity analysis examining an increase in the timber harvesting land base, the area of all poor growing sites in the timber harvesting land base by was reduced by 20%, or about 19 000 hectares. The actual sites removed from the timber harvesting land base due to land-use decisions may not be skewed to the poorer timber growing sites, as this assumption suggests. Figure 23 shows an initial rate of harvest is that is 2% lower than in the base case and 14% lower than the current AAC. In the second decade, the maximum possible harvest level given the smaller land base (and therefore a smaller timber inventory) is 20% below the initial harvest level. After this relatively large short fall in the second period, the harvest forecast declines further to below the steady long-term level, just as in the base case. The steady long-term level is decreased by 5% from the base case.

5.9 Sensitivity to removing all forest cover requirements

The following sensitivity analysis examines the effect that removing all forest cover requirements for cutblock adjacency and green-up and management of visually sensitive areas has on the harvest forecast. The solid line in Figure 24 shows the harvest forecast with all forest cover requirements removed. The initial rate of harvest is the current AAC of 1.66 million cubic metres per year. After the first decade, the rate of harvest declines by about 10% per decade to a steady long-term level of about 1.17 million, which is about 8% higher than in the base case. The harvest forecast does not drop below the steady long-term level as in the base case. This change in the harvest forecast is due largely to the removal of the forest cover requirements for visual quality.

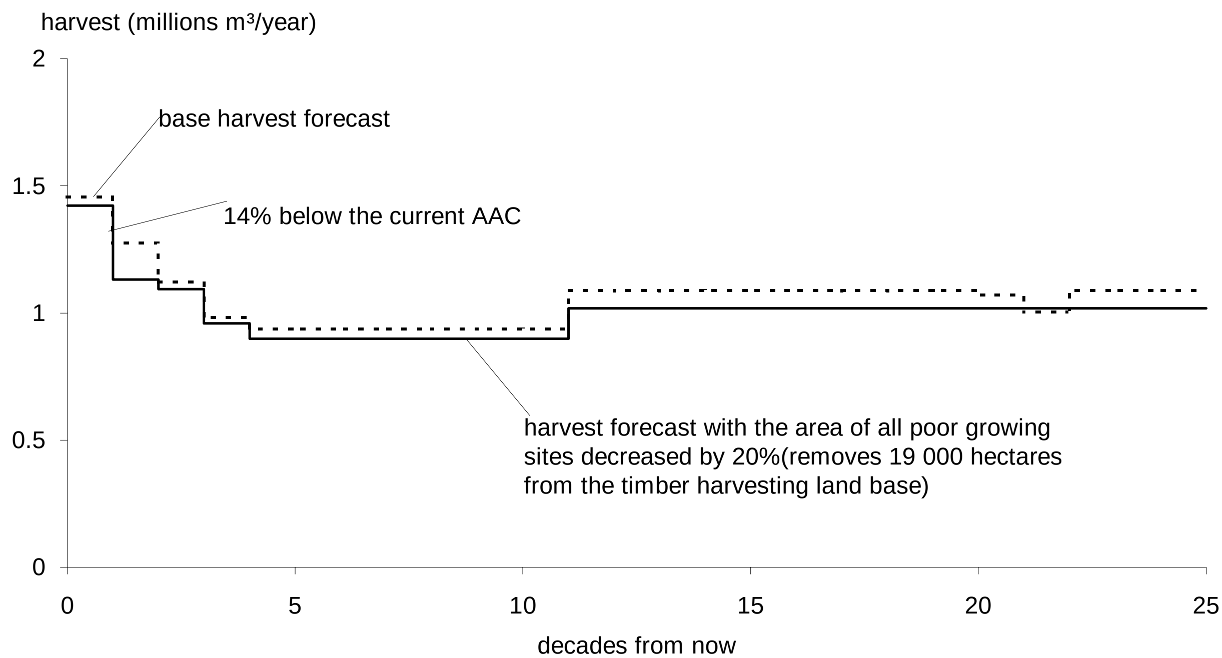


Figure 23. Harvest forecast with the area of the timber harvesting land base decreased.

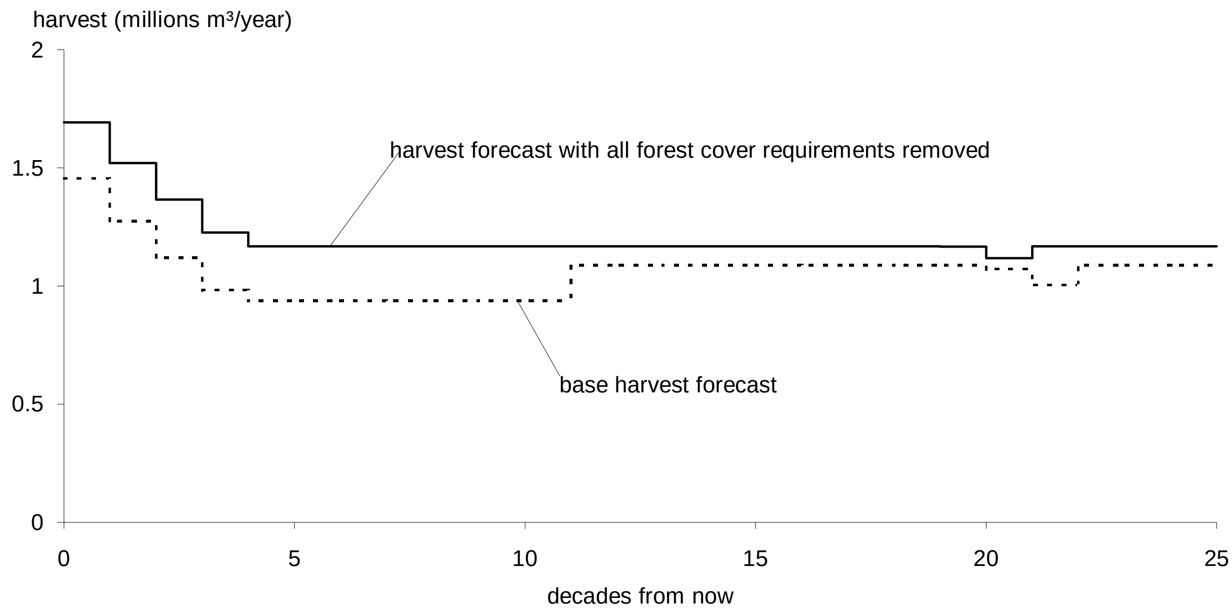


Figure 24. Harvest forecast with all forest cover requirements removed.

5.10 Sensitivity to changing several assumptions concurrently

The sensitivity analyses completed in Sections 5.2 to 5.9 examine the effect on the harvest forecast of altering one forest management assumption at a time. The following sensitivity analyses examine the effect of changing a number of assumptions concurrently. The thin solid line in Figure 25 shows the harvest forecast using concurrently all of the following changes to increase the harvest forecast:

- all green-up periods reduced by 5 years,
- 5% more area allowed to be younger than green-up age in visually sensitive areas,
- existing stand yield estimates increased by 10%,
- regenerated stand yield estimates increased by 20%, and
- all minimum harvest ages reduced by 10 years.

The effect on the harvest forecast of using all of the above assumptions concurrently is enormous. The initial rate of harvest is increased to the current AAC, and can be maintained for the first 2 decades. After the first 2 decades the harvest forecast declines by only 10% per decade to a steady long-term harvest level that is 30% higher than in the base case (shown by the dashed line in Figure 25).

The thick solid line in Figure 25 shows the harvest forecast using the following changes which tend to decrease the available timber supply and the harvest forecast.

- all green-up periods increased by 5 years,
- 5% less area allowed to be younger than green-up age in visually sensitive areas,
- existing stand yield estimates decreased by 10%,
- regenerated stand yield estimates decreased by 20%, and
- all minimum harvest ages increased by 10 years.

The harvest forecast is decreased dramatically by the above changes. The initial rate of harvest is about 850 000 cubic metres per year, less than half the current AAC and about 42% lower than the initial harvest level in the base case. The entire harvest forecast is reduced from the base case by about 40%.

Of note, is that given the same absolute amount of change in the assumptions, the harvest forecast is more sensitive to changes that decrease the harvest forecast than to changes that increase the harvest forecast. The dotted line in Figure 25 (all assumptions that decrease the harvest forecast) is farther from the base case (dashed line) than is the solid line (all assumptions that increase the harvest forecast).

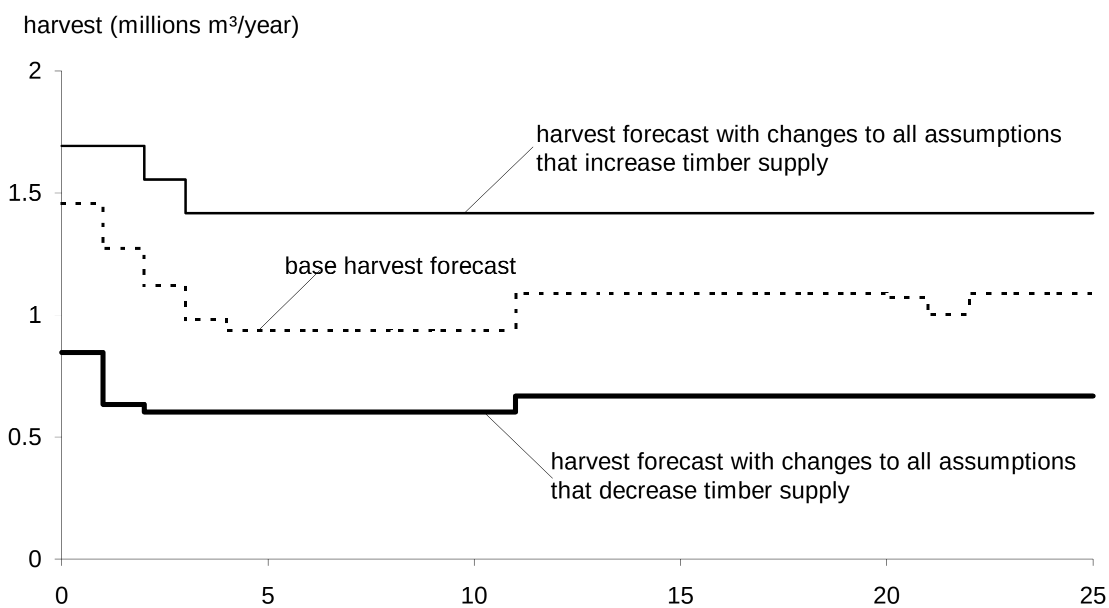


Figure 25. Harvest forecast with changes to several forest growth and management assumptions concurrently.

6 Summary and Conclusions

The base results of this analysis indicate that the current AAC in the Strathcona TSA cannot be maintained for even one more decade without causing a more severe short fall in the timber supply in the future.

Several important factors effect the timber supply forecast. The most important factor is that the original abundance of mature forest which historically allowed harvest rates well above the long-term level no longer exists. In this situation harvest rates must decline towards the long-term level to avoid serious timber supply short falls in the future.

Also contributing to the decline in timber supply are forest cover requirements for non-timber resources such as wildlife and scenic values. However, it is important to note that even if these forest cover requirements were removed, the harvest forecast will show a decline in the near future because most of the original mature forest has been harvested.

The results of sensitivity analyses indicated that the short-term harvest forecast could be increased from the base case by relaxing forest cover requirements for visual quality or increasing the area of the timber harvesting land base. However, the improvements were generally small and the initial harvest levels were still well below the current AAC. Sensitivity analyses also show that in the absence of any forest cover requirements, the current AAC could only be maintained for one more decade before declining if more severe timber short falls are to be avoided in the future.

The substantially reduced timber supply shown in the base harvest forecast was also predicted in the 1989 timber supply analysis completed for the Strathcona TSA. Although that analysis indicated that continuing at the current rate of harvest would be possible for 10 years, it also showed that a decline in the rate of harvest was imminent, and that the harvest level would have to be reduced to below the steady long-term harvest level to avoid a more severe timber short fall later in time.

The results of sensitivity analyses indicate that uncertainty in the assumptions and data used in this analysis may be significant to the harvest level in both the long term and short term. If gains in timber production however, are used to minimize the projected drop in the harvest level to below the steady long-term level, very little opportunity is left to improve the short-term (first 30 years) harvest forecast.

The harvest forecast is especially sensitive to changes in the forest cover requirements for cutblock adjacency and green-up. In the base case, this forest cover requirement was not a limiting factor. However, sensitivity analyses completed in Section 5.3 and 5.4 indicate that if either the maximum per cent area that is allowed to be non-greened-up is decreased by 5% or the number of years required for a stand to reach green-up conditions is increased by 5 years, the short-term harvest forecast is reduced dramatically.

The projected distribution of the total harvest between supply blocks and between different harvesting systems over time must be noted. The results of the base case suggest that if 800 000 cubic metres per year is harvested from the Kyuquot supply block in the first decade, the maximum harvest level that will be possible in the second decade given forest cover requirements is about 700 000 cubic metres. At present, about 1.1 million cubic metres per year is being harvested from the Kyuquot supply block. If a more even-flow of timber is to be maintained from the Kyuquot supply block over time, the level of harvesting occurring in younger, regenerated forests in the Sayward and Loughborough supply blocks will have to increase to offset reduced harvesting in the Kyuquot supply block.

7 References

B.C. Ministry of Forests, Inventory Branch. 1989. Strathcona TSA/Canadian Pacific Forest Products Ltd. TFL Extension Proposal Timber Supply Impact Analysis Report. Victoria, B.C.

B.C. Ministry of Forests, Inventory Branch. 1988. Strathcona TSA, Canadian Forest Products Ltd. (CFP) TFL 37 Extension and CIP TFL 19 Extension Proposal Timber Supply Impact Analysis Information Report. Victoria, B.C.

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 *Section 7* of the *Forest Act.*
Clear cut 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	Integrated management guidelines that specify the desired spatial relationship among cutblocks. They can be approximated by specifying the maximum allowable proportion of a forested landscape that does not meet green-up requirements.
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	An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Green-up	The time needed 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.
Harvest forecast	The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized, over time, for a specified land base and set of management assumptions. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.
Inoperable areas	Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.
Mean annual increment (MAI)	Stand volume divided by stand age. The stand age at which the MAI assumes its maximum value is called the culmination age. Harvesting all stands at this age results in a maximum average harvest over the long term.

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.
Timber harvesting land base	The portion of the total area of a management unit considered to contribute to, and be available for, long-term timber supply. The harvesting land base is defined by reducing the total land base according to specified management assumptions.
Timber Supply Area (TSA)	An integrated resource management unit established in accordance with *Section 6* of the *Forest Act*.

Appendix A
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 data set for the timber supply analysis of the Strathcona TSA. The information represents current forest management in the area. Current forest management can be defined as the set of land-use decisions and forest and stand management practices that are currently implemented and enforced. Forest management practices and land-use decisions that may be intended for the future but are not currently implemented and enforced have not been included.

A.1 Zone and Analysis Unit Definition

A.1.1 Zone characteristics

For the purpose of the timber supply analysis, the timber harvesting land base is broken down into units with similar forest management concerns. These units are referred to throughout this appendix as zones. The purpose of dividing the timber harvesting land base into zones is to facilitate modelling of the forest management concerns specific to each zone (ie. concerns about visual quality of the landscape).
The zones used in the timber supply analysis for the Strathcona TSA are listed in Table A-1.

Table A-1. Definition of forest management zones

Zone	Timber supply block	Harvesting systems	Special resource concerns
1	Kyuquot	Conventional	None
2	Kyuquot	Conventional	Retention VQO
3	Kyuquot	Conventional	Partial retention VQO
4	Kyuquot	Conventional	Modification VQO
11	Kyuquot	Non-conventional	None
12	Kyuquot	Non-conventional	Retention VQO
13	Kyuquot	Non-conventional	Partial retention VQO
14	Kyuquot	Non-conventional	Modification VQO
21	Sayward/Loughborough	Conventional	None
22	Sayward/Loughborough	Conventional	Retention VQO
23	Sayward/Loughborough	Conventional	Partial retention VQO
24	Sayward/Loughborough	Conventional	Modification VQO
25	Sayward/Loughborough	Conventional	Deer habitat
31	Sayward/Loughborough	Non-conventional	None
32	Sayward/Loughborough	Non-conventional	Retention VQO
33	Sayward/Loughborough	Non-conventional	Partial retention VQO
34	Sayward/Loughborough	Non-conventional	Modification VQO

Timber supply blocks are defined in the inventory file as Sayward = A, Kyuquot = B, Loughborough = C.

Harvesting systems are defined in the inventory file using the "operable" variable. Areas where conventional harvesting systems may be used are designated as "A", areas where non-conventional harvesting systems (long line systems, helicopter logging) will be used are designated as "M".

Special resource concerns are defined using the visual quality objectives encoded in the "recreate" field in the inventory file, as listed below:

07 = Retention VQO
08 = Partial retention VQO
09 = Modification VQO

A.1 Zone and Analysis Unit Definition

A.1.1 Zone characteristics (continued)

Although visual quality objective mapping has been completed for the entire Strathcona TSA, only the visual quality objectives mapped for the Sayward and Kyuquot supply blocks appear on the inventory file. Visual quality objectives for the Loughborough supply block were modelled by assuming the same proportion of the Loughborough supply block is affected by visual quality objectives as is affected in the Kyuquot supply block. This assumption is based on comparisons made by District recreation staff of the visual quality mapping completed for each of the two supply blocks and was used to determine the proportion of the Loughborough supply block that was in each forest management zone shown in Table A-1. The specific percentage of the Loughborough supply block assumed to be in each forest management zone is shown in Table A-2. The percentage in areas of conventional harvesting has been kept separate from areas of non-conventional harvesting in Table A-2.

Table A-2. Proportion of the Loughborough supply block in each forest management zone

Forest management zone	Per cent of conventional harvesting areas in zone	Per cent of non-conventional harvesting areas in zone
21	65	
22	8	
23	21	
24	6	
31		73
32		6
33		15
34		6

Specific areas of only the Sayward supply block, defined by mapsheet and forest polygon number, are modelled as deer habitat areas using forest cover requirements rather than area exclusions (Zone 25 in Table A-1.) These areas were compiled by Ministry of Environment, Lands and Parks staff in cooperation with Campbell River Forest District staff and are a subset of the Ew2 areas on the ESA field of the inventory file. The specific mapsheet and polygon numbers identified are listed in Table A-3.

A.1 Zone and Analysis Unit Definition

Table A-3. Deer habitat areas to be modelled using forest cover requirements, identified by mapsheet and polygon

Mapsheet number	Forest cover polygon numbers
092K001	0015, 0034, 0371, 0102, 0045, 0058, 0069, 0060, 0205, 0390, 0630, 0652, 0624, 0645, 0539, 0532, 0530, 0520, 0519, 0517, 0557, 0537,
092K002	0105, 0053, 0553, 0551, 2856, 0700, 0554, 0555, 0556, 1238, 0902, 1209, 0907, 0574, 0573, 0575, 0576, 0511, 0587, 0592, 0593, 0648, 0594, 0904, 0912, 0914, 0976, 0913, 0977, 0981, 0989, 0994, 0990, 1203, 0995, 0991, 0997, 1001, 1002, 1003, 0993, 1234, 1118, 1119, 1127, 1128, 1129, 1132, 1138, 1139, 1140, 1141, 1142, 1143, 1194, 0622, 0624, 0669, 0623, 0625, 0665, 0627, 0630, 0626, 0629, 0417, 0419, 0422, 0420, 0423, 0424, 0487, 0483, 0481, 0477, 0480, 0486, 0707, 0400, 0717, 0406, 0410, 0368, 0365, 0366, 0362, 0363, 0383, 0356
092K003	0625, 0877, 0626, 0634, 0633, 0878, 0879, 0622, 0721, 0722, 0723, 0724, 0727, 0627, 0827, 0298, 0200, 0387, 0374, 0302, 0186, 0373, 0192, 0213, 0187, 0371, 2860, 0370, 0109, 0365, 0367, 0366, 0434, 0355, 0356, 0354, 0362, 0361, 0359, 0358, 0849, 0850, 0323, 0326, 0327, 0391, 0317, 0452, 0252, 0383, 0253, 0218, 0254, 0478, 0223, 0237, 0382, 0379, 0211, 2857, 0219, 0381, 0132, 0135, 0750, 0916, 0745, 0775, 0777, 0669, 0670, 0921, 0774, 0780, 0781, 0807, 0810, 0808, 0818, 0820, 0821, 1246, 0863, 1348, 1490, 1467, 1468, 1306, 1304, 1316, 1469, 1491, 1471, 1027, 1209, 1411, 1412, 1403, 1264, 1263, 1262, 1414, 1445, 1447
092K012	0341, 0342, 0344, 0345, 0357, 0361, 0362, 0349, 0351, 0379, 0392, 0394, 0396, 0397, 0400, 0401, 0306, 0307, 0282, 0310, 0311, 0313, 0314, 0316, 0318, 0321, 0423, 0424, 0431, 0422, 0428, 0450, 0475
092K013	0149, 0339, 0340, 0284, 0355, 1841, 0506, 0507, 0508, 0514, 0518, 0512, 0522, 0519, 0606, 0607, 0612, 0614, 0946, 0561, 0565, 0572, 0573
092K023	2008

The deer habitat in the Sayward is the only zone used in the analysis that is not mutually exclusive. When an area of the TSA met the criteria for any visual quality objective, the area would be assigned to the forest management zone dealing with the visual quality objective. Assigning an area to the deer habitat forest management zone takes priority over only those zones with no special resource concerns (Zones 1, 11, 21, and 31).

A.1 Zone and Analysis Unit Definition

A.1.2 Analysis unit characteristics

Within each forest management zone, the area was divided into analysis units, based on leading tree species and site class, as shown in Table A-4. Separate yield curves (existing and regenerated) were produced for each analysis unit, and are shown in Table A-13.

Table A-4. Analysis unit characteristics

Analysis unit	Inventory type group	Site class
1 Douglas-fir	1 - 8	Good
2 Douglas-fir	1 - 8	Medium
3 Douglas-fir	1 - 8	Poor
4 Cedar	9 - 11	Good
5 Cedar	9 - 11	Medium
6 Cedar	9 - 11	Poor
7 Hemlock/balsam	12 - 20	Good
8 Hemlock/balsam	12 - 20	Medium
9 Hemlock/balsam	12 - 20	Poor
10 Sitka spruce	21 - 26	All sites

A.2 Utilization Levels

The utilization level defines the maximum allowable stump height and minimum merchantable diameter by species and is used to calculate merchantable volume.

Timber in the Strathcona TSA is currently utilized to a 17.5 cm minimum diameter at breast height, a 10 cm diameter top and a 30 cm stump height for all species.

A.3 Definition of the Timber Harvesting Land Base

The following area exclusions were used to define the timber harvesting land base.

A.3.1 Inventory file status

Forest cover polygon information in the Strathcona TSA inventory file is projected to January 1992.

A.3.2 Non-contributing ownership codes

All areas that are not designated as being ownership code 62C (Crown forest management unit available for long-term integrated resource management), 69C (miscellaneous reserves available for long-term integrated resource management), or 70-N (timber licences) are excluded from the timber harvesting land base.

A.3.3 Non-forested and non-commercial/brush areas

Forest cover type identities 5 (NC/brush) or 6 (non-forest) are excluded from the timber harvesting land base.

A.3.4 Inoperable areas

Areas defined on the inventory file as inoperable for timber harvesting (operable = I) are excluded from the timber harvesting land base.

A.3.5 Not satisfactorily restocked areas (NSR)

Areas designated as forest cover type identity 4 and 9 (NSR), and 7 (disturbed, stocking doubtful) are excluded from the timber harvesting land base. NSR areas are assumed to be restocked over time, according to the schedule shown in Section A.4.3.

A.3.6 Highly sensitive soils

Areas with highly sensitive soils, susceptible to damage by timber harvesting, are excluded from the timber harvesting land base. This exclusion is based on soils mapping completed in 1992. Sensitive soils are designated as "S001" on the planning cell layer of the inventory file.

A.3.7 Uneconomic forest types

Areas designated as inventory type groups 27 through 42 (pines, all deciduous) are excluded from the timber harvesting land base. Stands of all species that are greater than age class 7 and are height class 1 or 2 are also excluded. Stands that are greater than age class 7 and are height class 3 are excluded unless they are cedar or cypress (yellow cedar) leading, or have a secondary component of at least 20% cypress.

A.3.8 Wildlife values

All areas designated as Ew1 in the ESA codes on the inventory file are excluded from the timber harvesting land base. As noted in Section A.1.1 and identified in Table A-3., some wildlife habitat areas designated Ew2 on the inventory file are modelled using forest cover requirements. The Ew2 areas identified by mapsheet and forest cover polygon number in Table A-5. are completely excluded from the timber harvesting land base. Fifty per cent of Ew2 areas not identified in either Table A-3. or Table A-5. are also excluded from the timber harvesting land base.

Table A-5. Ew2 areas completely excluded from the timber harvesting land base

Mapsheet number	Forest cover polygon number
092K001	0694, 0696, 0699, 0700, 0701, 0697, 0695, 0716, 0606, 0745, 0746, 0747, 0748, 0749, 0737, 0738, 0739,. 0755, 0742, 0741, 0754, 0750, 0744, 0743, 0756, 0751, 0753, 0752, 0757, 0557
092K002	0134, 0135, 0136, 0133, 0130, 2855, 0934
092K003	1670, 1674, 1675, 1676, 1793, 1805, 1806, 0574, 0913, 0025
092K013	03434, 0342, 1821, 1822, 1823, 1826, 1845
092K023	0180, 0181, 0190, 0300, 0302, 0303, 0187, 0318, 0320, 0322
092K033	0095, 0101, 0102

A.3.9 Recreation values

Areas designated as recreation management class A0, B0, or C0 in the recreate field on the inventory field, or that have preservation as a visual quality objective (defined as 06 in the recreate field) are excluded from the timber harvesting land base. Areas that are recreation management class A1 or B1 are 50% excluded, as long as they have not already been 50% excluded due to wildlife concerns. Areas designated as having karst features present are 6% excluded from the timber harvesting land base.

A.3.10 Stream and lakeshore buffers

To account for the area of forested stream and lakeshore buffers which are not available for timber harvesting, the length of all Class A and B streams and lake perimeter on a sample of 40 mapsheets was measured. The area unavailable to timber harvesting was then calculated by multiplying the stream lengths by a 20 metre buffer width, and the length of lakeshore by a 30 meter width. These areas were then converted to a per cent of the operable land base in each supply block. These per cent areas were then excluded from the operable area of each supply block. The final per cent area excluded from each supply block for stream and lakeshore buffers is shown in Table A-6.

Table A-6. Per cent of the operable land base excluded from each supply block for stream and lakeshore buffers

Supply block	Per cent of operable area excluded
Sayward	1.8
Loughborough	1.2
Kyuquot	1.1

A.3.11 Existing roads, trails and landings

The total length of existing forest roads and trails was summed from the inventory design files for 35 mapsheets that fall entirely within the Strathcona TSA. The road lengths were then multiplied by an assumed width of 6 metres in order to arrive at a total area in forest roads and trails per mapsheet. The area of forest roads and trails was then divided by the area of each mapsheet that has been developed by timber harvesting (assumed to be all stands less than age class 5). The percentage obtained by this calculation, which rounded to 5%, was assumed to be representative of the TSA as a whole. Therefore, 5% of all areas less than age class 5 are assumed to be occupied by existing roads, trails and landings and are excluded from the timber harvesting land base.

Future roads are modelled by excluding a percentage of all stands older than age class 4 after the first harvest (to simulate the harvest of right-of-way timber). The percentage reduction is 7% in areas of conventional harvesting and 1% in areas of non-conventional harvesting. These numbers are based on the following assumptions:

1. Areas of conventional harvesting in the future will in general be on rougher terrain requiring more roads.
2. Non-conventional areas will have little or no additional roading.

A.3.12 Growth and yield plots in the Sayward supply block

Permanent growth and yield plots totaling to 2133 hectares of medium site Douglas-fir in the Sayward supply block are excluded from the timber harvesting land base.

A.4 Forest Management Assumptions

A.4.1 Forest cover requirements

Table A-7. specifies the forest cover requirements used to model current forest management objectives defined for each forest management zone. Each forest management zone was defined in Section A.1, Table A-1.

Table A-7. Forest cover requirements for each forest management zone

Forest management zone	Age 1	Max. per cent area younger than age 1	Age 2	Min. per cent area older than age 2
1 Kyuquot, Conv	14	25	-	-
2 Kyuquout, Conv, VQO - R	20	5	-	-
3 Kyuquot, Conv, VQO - PR	20	11	-	-
4 Kyuquot, Conv, VQO - M	21	27	-	-
11 Kyuquot, Non-conv	15	25	-	-
12 Kyuquot, Non-conv, VQO - R	21	42	-	-
13 Kyuquot, Non-conv, VQO - PR	19	42	-	-
14 Kyuquot, Non-conv, VQO - M	-	-	-	-
21 Sayward/Loughborough, Conv	13	25	-	-
22 Sayward/Loughborough, Conv, VQO - R	18	5	-	-
23 Sayward/Loughborough, Conv, VQO - PR	18	11	-	-
24 Sayward/Loughborough, Conv, VQO - M	18	27	-	-
25 Sayward/Loughborough, Conv, Deer	12	25	18	50
31 Sayward/Loughborough, Non-conv	14	25	-	-
32 Sayward/Loughborough, Non-conv, VQO - R	18	14	-	-
33 Sayward/Loughborough, Non-conv, VQO - PR	20	33	-	-
34 Sayward/Loughborough, Non-conv, VQO - M	20	69	-	-

Conv = areas of conventional harvesting
Non-conv = areas of non-conventional harvesting
VQO - R = retention visual quality objective
VQO - PR = partial retention visual quality objective
VQO - M = modification visual quality objective

In forest management zones 1, 11, 21, 25, and 31, forest cover requirements are determined by forest management prescriptions that roughly 25% of an area in which harvesting is occurring will be harvested with each subsequent harvest. After harvesting has occurred in an area no further harvesting is allowed to occur in adjacent forested areas until the regenerated stands on the previously harvested area have reached a height of 3 metres. The time required to reach this height is shown as Age 1 in Table A-7., and ranges from 12 to 14 years.

A.4 Forest Management Assumptions

In all zones that have visual quality objectives, the forest cover requirements are based on provincial guidelines for managing forest cover in visually sensitive areas. These guidelines define the maximum per cent of the landscape that may be non-greened-up, as well as the stand height required in order to be visually greened-up. The stand height required for visual green-up is 5 metres. For all zones with a visual quality objective, the time required for stands to achieve a 5 meter height is shown as Age 1 in Table 7. The maximum per cent of the timber harvesting land base that may be less than Age 1 in each zone is based on the following assumptions:

Retention VQO - 5% of the gross forested area may be less than 5 metres tall
Partial retention VQO - 10% of the gross forested area may be less than 5 metres tall
Modification VQO - 20% of the gross forested area may be less than 5 metres tall

The above per cents are then adjusted using the methods outlined in Recreation Branch Technical Report 1993:1, *Procedures for Factoring Recreation Resources into Timber Supply Analyses.* The gross green/operable ratio used in the calculation was determined separately for each zone, and default values for dispersion, identified in the technical report were used.

The forest cover requirement for deer habitat (Zone 25) was based on a prescription by Ministry of Environment staff that at least half of the areas managed for deer using forest cover requirements be at least 5 metres tall at all times.

A.4.2 Timber licence reversions

All timber licence areas (ownership 70-N) less than age class 6 are assumed to have already been harvested a first time. All future harvests attributable to these areas are considered to contribute to the AAC. All timber licence areas age class 6 and older are assumed to have never been harvested. These areas are reverted in three equal proportions (within 5 years, 5-10 years from now, 10-15 years from now) in the timber supply model. The first harvest from these areas does not count towards the AAC.

A.4.3 Not satisfactorily restocked areas

Table A-8. summarizes the area that has been harvested but is currently not satisfactorily restocked with trees (NSR). All NSR is assumed to be restocked in the first period in the model. The amount of area restocked to each analysis unit in each zone reflects the assumption that one half of the NSR is on good growing sites and the rest is equal proportions of medium and poor growing site.

Table A-8. Not satisfactorily restocked areas

Zone	Analysis unit	NSR area restocked
1	1 Fir, G	170
	2 Fir, M	85
	3 Fir, P	85
	4 Cw, G	677
	5 Cw, M	338
	6 Cw, P	338
	7 Hw, G	1841
	8 Hw, M	920
	9 Hw, P	920
2	1 Fir, G	22
	2 Fir, M	11
	3 Fir, P	11
	4 Cw, G	64
	5 Cw, M	32
	6 Cw, P	32
	7 Hw, G	147
	8 Hw, M	73
	9 Hw, P	73
3	1 Fir, G	53
	2 Fir, M	27
	3 Fir, P	27
	4 Cw, G	202
	5 Cw, M	101
	6 Cw, P	101
	7 Hw, G	565
	8 Hw, M	283
	9 Hw, P	283

Continued

Table A-8. Not satisfactorily restocked areas

Zone	Analysis unit	NSR area restocked
4	1 Fir, G	11
	2 Fir, M	5
	3 Fir, P	5
	4 Cw, G	108
	5 Cw, M	54
	6 Cw, P	54
	7 Hw, G	185
	8 Hw, M	92
	9 Hw, P	92
11	7 Hw, G	11
	8 Hw, M	6
	9 Hw, P	6
13	7 Hw, G	6
	8 Hw, M	3
	9 Hw, P	3
21	1 Fir, G	644
	2 Fir, M	322
	3 Fir, P	322
	4 Cw, G	202
	5 Cw, M	101
	6 Cw, P	101
	7 Hw, G	818
	8 Hw, M	409
	9 Hw, P	409
22	1 Fir, G	66
	2 Fir, M	33
	3 Fir, P	33
	4 Cw, G	27
	5 Cw, M	13
	6 Cw, P	13
	7 Hw, G	166
	8 Hw, M	83
	9 Hw, P	83

Continued

Table A-8. Not satisfactorily restocked areas (concluded)

Zone	Analysis unit	NSR area restocked
23	1 Fir, G	206
	2 Fir, M	103
	3 Fir, P	103
	4 Cw, G	53
	5 Cw, M	27
	6 Cw, P	27
	7 Hw, G	265
	8 Hw, M	133
	9 Hw, P	133
24	1 Fir, G	32
	2 Fir, M	16
	3 Fir, P	16
	4 Cw, G	15
	5 Cw, M	7
	6 Cw, P	7
	7 Hw, G	52
	8 Hw, M	26
	9 Hw, P	26
25	7 Hw, G	2
	8 Hw, M	1
	9 Hw, P	1
31	1 Fir, G	13
	2 Fir, M	6
	3 Fir, P	6
	4 Cw, G	7
	5 Cw, M	3
	6 Cw, P	3
	7 Hw, G	22
	8 Hw, M	11
	9 Hw, P	11
32	7 Hw, G	3
	8 Hw, M	3
	9 Hw, P	2
33	7 Hw, G	7
	8 Hw, M	4
	9 Hw, P	4
34	7 Hw, G	3
	8 Hw, M	1
	9 Hw, P	1

A.4 Forest Management Assumptions

A.4.4 Stand Rehabilitation

A total of 900 hectares of alder leading stands are planned for rehabilitation to merchantable species as shown in Table A-9.

Table A-9. Alder rehabilitation

Decade	Hectares rehabilitated to managed medium site Douglas-fir	Hectares rehabilitated to managed cottonwood
1	400	100
2	80	20
3	80	20
4	80	20
5	80	20

A.4.5 Unsalvaged losses

Unsalvaged losses are timber volumes destroyed by natural causes. Estimated annual losses are deducted from the gross harvested volume in the model to determine the net volume of timber that will be harvested over time. Table A-10. shows the estimated average annual unsalvaged losses in the Strathcona TSA.

Table A-10. Unsalvaged losses

Cause of loss	Gross losses (m^3/yr)	Unsalvaged loss (m^3/yr)
Fire	2 500	1 750
Windthrow	60 000	30 000
Total		31 750

A.4.6 Minimum harvest age for each analysis unit

Table A-11. lists the minimum harvest age for each analysis unit. Minimum harvest ages are based on the age at which the mean annual increment for each species and growing site reached within 5% of the culmination value.

Table A-11. Minimum harvest age by species and site type

Species and growing site	Minimum harvest age in years for existing stands	Minimum harvest age in years for regenerated stands
Fir, G	70	60
Fir, M	80	70
Fir, P	90	80
Cw, G	80	80
Cw, M	90	90
Cw, P	110	110
Hw, G	70	70
Hw, M	80	90
Hw, P	110	90
Ss, all	70	70
Cottonwood *	-	50

* regenerated stand only - see Section A.4.4

A.4 Forest Management Assumptions

A.4.7 Basic silviculture and regeneration assumptions

Basic silviculture is assumed to be continued indefinitely into the future. Table A-12. shows the expected average regeneration delay (time before an area is restocked with trees after harvesting) for each species and growing site type.

Table A-12. Expected average regeneration delay by species and growing site

Species and growing site type	Regeneration delay (years)
Douglas-fir, G	2
Douglas-fir, M	2
Douglas-fir, P	2
Cedar, G	5
Cedar, M	5
Cedar, P	5
Hem/Bal, G	5
Hem/Bal, M	5
Hem/Bal, P	5
Sitka spruce, all sites	5
Cottonwood	2

A.4.8 Yield assumptions

Yield tables for all existing stands were developed using a batch processing of the Variable Density Yield Projection (VDYP) model provided by Inventory Branch, Ministry of Forests. All yield tables assume the utilization levels identified in Section A-2. The data requirements for the VDYP model are from existing stand information on the 1993 inventory file provided by Inventory Branch. For all existing stands, aggregated waste and breakage (W2B) factors are developed from the Inventory Metric Diameter Class Decay, Waste and Breakage Factors Manual (B.C. Ministry of Forests 1976). A single W2B factor is developed for each of two age ranges for each Public Sustained Yield Unit (PSYU), species, and utilization level.

Yield tables for all regenerated stands except cottonwood were produced using the Table Interpolation Program for Stand Yields (TIPSY) growth and yield model developed by Research Branch, Ministry of Forests. Yield tables for cottonwood stands were produced using interactive VDYP, Version 4.2b. Regenerated stand yield tables and are based on the following assumptions:

1. All Douglas-fir, hemlock/balsam, and cottonwood stands are regenerated back to the same species and site class.
2. All cedar and spruce stands are regenerated to hemlock of the same site class.
3. A pure species composition is assumed after regeneration.
4. All Douglas-fir stands are assumed to be planted to 900 stems per hectare.
5. Half of all hemlock stands are assumed to be planted at 900 stems per hectare and half are assumed to regenerate naturally to 1800 stems per hectare. The two yield tables produced by these differing regeneration assumptions are averaged to produce one yield table that is applied to all regenerated stands.

6. Mean area weighted site indices of the existing stands are assumed to apply to the regenerated stands as well.
7. For all regenerated stands except cottonwood, waste and breakage factors are assumed to be included in operational adjustment factor 2 used in the TIPSY model inputs. The specific operational adjustment factors used are:

    Operational adjustment factor 1 - 15%

    Operational adjustment factor 2 - 5%
8. Aggregated waste and breakage factors for PSYU 196 are applied to the yield tables produced for cottonwood stands using interactive VDYP, Version 4.2b.

A.4.9 Existing immature plantations

To reflect the expected productivity of managed Douglas-fir stands resulting from past harvesting, all existing stands of Douglas-fir that are less than or equal to 60 years of age, and all existing hemlock leading stands that are less than or equal to 30 years old are assigned immediately to regenerated stand yield tables in the model.

A.5 Yield Tables for Existing and Regenerated Stands

Table A-13. shows the existing and regenerated stand yield tables for all species and site types in the analysis. The appropriate regeneration delays, as discussed in Section A-7., are applied within the timber supply model and are not accounted for in these yield tables.

Table A-13. Yield tables for all species/site types

Age	Fir, good exist	Regen.	Fir, med. exist	Regen.	Fir, poor exist	Regen.
10	0	0	0	0	0	0
20	3	4	0	0	0	0
30	147	141	64	43	6	1
40	300	299	191	164	50	19
50	431	464	297	263	114	63
60	543	605	388	367	169	116
70	641	731	466	458	217	157
80	728	833	534	532	258	192
90	802	919	593	602	295	222
100	868	987	645	663	327	250
110	927	1043	691	715	355	279
120	979	1090	733	759	381	304
130	1021	1135	766	797	402	327
140	1056	1174	793	830	419	349
150	1084	1208	814	859	433	368
160	1105	1237	829	885	443	385
170	1118	1254	837	906	449	400
180	1125	1268	841	925	452	414
190	1140	1268	851	941	458	425
200	1155	1268	860	956	464	435
210	1169	1268	870	967	471	444
220	1184	1268	879	977	476	452
230	1197	1268	888	986	482	460
240	1211	1268	896	994	487	466
250	1223	1268	904	1001	492	473
260	1224	1268	905	1001	493	473
270	1225	1268	906	1001	494	473
280	1225	1268	907	1001	495	473
290	1225	1268	907	1001	496	473
300	1226	1268	908	1001	497	473
310	1226	1268	908	1001	498	473
320	1226	1268	909	1001	499	473
330	1226	1268	909	1001	499	473
340	1226	1268	909	1001	500	473
350	1226	1268	909	1001	501	473

continued

A.5 Yield Tables for Existing and Regenerated Stands

Table A-13. Yield tables for all species/site types

Age	Cedar, good exist	Regen.	Cedar, med. exist	Regen.	Cedar, poor exist	Regen.
10	0	0	0	0	0	0
20	1	1	0	0	0	0
30	103	103	17	17	0	0
40	219	219	89	89	10	10
50	326	326	166	166	42	42
60	427	427	238	238	81	81
70	518	518	303	303	120	120
80	602	602	363	363	157	157
90	667	667	413	413	188	188
100	723	723	457	457	216	216
110	770	770	496	496	241	241
120	805	805	526	526	259	259
130	853	853	562	562	281	281
140	899	899	594	594	301	301
150	938	938	623	623	319	319
160	972	972	648	648	334	334
170	1000	1000	669	669	346	346
180	1030	1030	691	691	359	359
190	1059	1059	712	712	372	372
200	1087	1087	732	732	384	384
210	1115	1115	751	751	396	396
220	1147	1147	775	775	409	409
230	1179	1179	797	797	423	423
240	1210	1210	819	819	436	436
250	1240	1240	840	840	449	449
260	1244	1244	844	844	451	451
270	1247	1247	847	847	453	453
280	1249	1249	850	850	455	455
290	1252	1252	852	852	457	457
300	1254	1254	855	855	459	459
310	1256	1256	857	857	461	461
320	1257	1257	859	859	462	462
330	1259	1259	861	861	463	463
340	1260	1260	862	862	465	465
350	1261	1261	864	864	466	466

continued

A.5 Yield Tables for Existing and Regenerated Stands

Table A-13. Yield tables for all species/site types

Age	Hem/Bal, good exist	Regen.	Hem/Bal, med. exist	Regen.	Hem/Bal, poor exist	Regen.
10	0	0	0	0	0	0
20	9	2	0	0	0	0
30	155	108	35	5	0	0
40	296	282	134	75	10	0
50	416	461	228	181	53	5
60	520	623	309	284	101	31
70	608	781	381	385	145	66
80	685	915	444	481	185	111
90	749	1034	498	562	220	152
100	804	1147	545	647	251	194
110	852	1250	587	725	279	231
120	892	1329	622	796	304	266
130	933	1402	658	857	329	298
140	970	1476	691	910	353	329
150	1002	1540	720	959	374	361
160	1030	1591	746	1007	394	391
170	1055	1636	769	1051	412	418
180	1077	1684	790	1093	428	442
190	1098	1727	810	1132	444	463
200	1118	1766	829	1168	459	484
210	1136	1802	846	1199	473	501
220	1152	1834	862	1223	487	518
230	1168	1863	877	1245	499	536
240	1182	1889	891	1264	511	553
250	1195	1913	904	1282	522	569
260	1202	1913	912	1282	529	569
270	1208	1913	918	1282	536	569
280	1213	1913	924	1282	542	569
290	1217	1913	930	1282	547	569
300	1221	1913	934	1282	553	569
310	1224	1913	939	1282	558	569
320	1226	1913	942	1282	562	569
330	1228	1913	946	1282	567	569
340	1230	1913	949	1282	571	569
350	1231	1913	951	1282	574	569

continued

A.5 Yield Tables for Existing and Regenerated Stands

Table A-13. Yield tables for all species/site types (concluded)

Age	Spruce, all exist	Regen.	Cottonwood, all Regen.
10	1	1	0
20	35	35	0
30	111	111	43
40	194	194	92
50	271	271	129
60	340	340	157
70	401	401	179
80	454	454	196
90	499	499	209
100	540	540	221
110	575	575	230
120	606	606	238
130	638	638	245
140	668	668	251
150	695	695	256
160	719	719	256
170	741	741	256
180	762	762	256
190	782	782	256
200	801	801	256
210	819	819	256
220	835	835	256
230	851	851	256
240	867	867	256
250	881	881	256
260	893	893	256
270	904	904	256
280	915	915	256
290	926	926	256
300	936	936	256
310	945	945	256
320	955	955	256
330	964	964	256
340	972	972	256
350	980	980	256