Fraser Timber Supply Area Analysis Report

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Preface

This report contains a timber supply analysis and a socio-economic analysis and is part of the provincial Timber Supply Review (TSR) carried out by the British Columbia Forest Service. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) and tree farm licences (TFLs) throughout British Columbia.

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

This report focuses on a single forest management scenario that reflects current management practices. Current management practices are defined by the specifications in management plans for the timber supply area including guidelines for the protection of forest resources, the *Forest Practices Code (FPC) of B.C. Act* and official land-use decisions made by Cabinet.

Focussing the assessment on the implications of current practices rather than looking at a number of different management regimes expedites the analysis process. In addition, it reflects that the chief forester does not have the legal authority to establish land use and management direction as part of allowable annual cut (AAC) determination.

An important part of these analyses is an assessment of how results might be affected by uncertainties — a process called sensitivity analysis. Together, the sensitivity analyses and the assessment of timber supply and related forest characteristics under current forest management provide a basis for discussions among stakeholders about alternative timber harvesting levels.

In addition to having an up-to-date assessment of timber supply when setting the AAC the chief forester considers short- and long-term implications of alternative harvest levels, capabilities and requirements of existing and proposed processing facilities, and the social and economic objectives of the Crown. The socio-economic analysis provides the chief forester with some of the information necessary for these considerations.

This report is second of four documents that will be released for each TSA as part of the timber supply review. (The first document is the data package). A third document called the public discussion paper summarizes the technical information and provides a focus for public discussions of possible timber harvest levels. The fourth outlines the chief forester's harvest level 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 Fraser Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over the short- (next 20 years), medium- (21 years to 100 years from the present) and long- (beyond 100 years from the present) terms. It also examines the potential changes in timber supply stemming from uncertainties about forest growth and management actions. **It is important to note that the various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. The forecasts are intended for discussion purposes only; they are not allowable cut (AAC) recommendations.**

The Fraser Timber Supply Area (TSA) is located in the Coast Forest Region in the southwest mainland area of British Columbia. While the TSA occupies a total of approximately 1.4 million hectares, the forest available for timber production and harvesting under current management practices is only about 260 910 hectares or 18% of the total. In the area available for timber harvesting, most of the forests are dominated by western hemlock, balsam and Douglas-fir. Smaller areas are dominated by western redcedar, spruce, pine, larch and alder. Hemlock, Douglas-fir and western redcedar are the tree species most commonly used by the forest industry in the area. About 59% of the timber harvesting land base is subject to biodiversity and cutblock adjacency considerations. The remaining 41% of the harvestable land has additional considerations such as visuals, community watershed or wildlife habitat of some type.

The current allowable annual cut (AAC) for the Fraser TSA is 1.27 million cubic metres per year. Given current management assumptions, the analysis shows that the current harvest can be maintained until increasing about 140 years from now to a long-term sustainable harvest level of 1.52 million cubic metres per year. The higher harvest level in the long-term coincides with harvesting predominantly second-growth managed stands.

The most important factors contributing to the projected stability in the timber supply are:

- The new photo-interpreted Vegetation Resources Inventory (VRI), adjusted through ground sampling, has resulted in higher estimates of volume per hectare than the previous adjusted inventory file. The new inventory indicates that overall there is about 13% more volume on the timber harvesting land base than in the last analysis and includes volume adjustments in young stands that were not sampled to calibrate the previous inventory file.
- New information on post-harvest site productivity for the Fraser TSA. The final report *Site Index Adjustment of the Coastal Western Hemlock Zone in the Fraser TSA* by J.S. Thrower and Associates was completed in March, 2003 and provides the post-harvest site index for Douglas-fir and western hemlock. When the adjustments are applied after the first harvest in the timber supply model, the average site index for the TSA is expected to increase by 3.2 metres, from 20.4 to 23.6 metres. The site index for adjusted stands, which make up about half of the timber harvesting land base, increases from 22 metres to about 28.

If neither of these two sources of information were applied, the resulting timber supply projection would be similar to that shown in the previous (1998) timber supply review analysis for the Fraser TSA.

The current management timber supply projection, or base case, uses the best available information and is based on current land use and management decisions. The management context in the Fraser TSA is complex, and any future developments could change the timber supply outlook. For example, the Spotted Owl Recovery Team is currently developing a draft recovery plan and associated action plan. When they are completed, government will assess those plans and make relevant management decisions. Also, a process is underway to assess and establish ungulate winter ranges. Potential spotted owl and ungulate areas have been logged around, pending final management decisions. In addition, First Nations' land claims, concerns about forest industry operations near to forest-urban interfaces in the Fraser TSA, and other issues create uncertainty about the future. All of these issues could affect future timber supply; however, in the absence of final decisions on withdrawal of areas from the TSA, or on management restrictions, the most current official decision is reflected in timber supply review analysis. When final decisions are made, or additional information becomes available with respect to these issues, it will be reflected in future analyses.

Due to the amount and complexity of information regarding forest dynamics and management, there is always some uncertainty in the data and assumptions used, which may affect the results. The analysis examined several such issues. The Chilliwack Forest District has begun to implement harvesting practices based on the principles of the variable retention harvesting system. Initial indications are that the practice of leaving dispersed trees within clearcuts reduces the medium- and long-term timber supply relative to the base case.

In addition, disturbances in areas outside the timber harvesting land base at the rates suggested in the *Biodiversity Guidebook* reduce timber supply in the medium and long term.

The analysis also indicates that harvesting in second-growth stands or in Douglas-fir-leading stands above the level of their contribution to the harvestable forest could have significant implications for timber supply. There could be a significant reduction in long-term harvest since harvesting second-growth before existing older stands would delay the time until all stands on the timber harvesting land base are brought under management to promote timber productivity. In addition, concentration of harvesting in Douglas-fir stands would lead to the need to harvest a high proportion of hemlock and balsam stands in the medium term, which could have economic implications in the TSA.

In the socio-economic context, the economy of British Columbia and the Chilliwack Forest District is continuing to shift towards service industries. From 1998 to 2002, service-producing industries in British Columbia, such as transportation, education, wholesale and retail trade, and accommodation, have increased by close to 8%. Goods-producing industries in British Columbia, such as forestry, mining, agriculture and manufacturing, have declined by over 2%.

In the Mainland-Southwest Development Region, which includes the Chilliwack Forest District, there are no sectoral data to compare at this time, however employment has increased overall. From 1998 to 2002, the total labour force in the Mainland-Southwest Development Region increased by close to 10%. The population of the development region increased by about 6%, indicating a net increase in total employment.

For the smaller communities in the eastern portion of the Chilliwack Forest District, especially from Hope through the Fraser Canyon, the trends are not as favourable.

In terms of forestry activity in the forest district, the timber supply forecast indicates that the timber supply can be maintained at its current level for the short and perhaps medium terms, which should contribute to economic stability.

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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 pattern. Decisions about whether a stand is available for harvest often depend on how its harvest could affect other forest values, such as wildlife or recreation.

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 which define current forest management — as well as the uncertainties affecting these conditions — must first be understood.

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

Timber supply projections made for TSAs look far into the future — 250 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. This allows close monitoring of the timber supply and of the implications for the AAC stemming from changes in management practices and objectives.

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

Timber supply
The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)
An integrated resource management unit established in accordance with Section 7 of the Forest Act.

Allowable annual cut (AAC)
The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

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 Fraser TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Section 3 outlines the timber supply analysis methodology. Timber supply analysis results are presented in Section 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used, and is followed by a summary and conclusions in Section 6. Section 7 shows results of a socio-economic analysis for the Fraser TSA. Appendix A contains further details about the data and assumptions used in the analysis.

As part of the timber supply review (TSR), information is gathered on the short- and long-term implications of alternative harvest levels, and the capabilities and requirements of existing and proposed processing facilities. The socio-economic analysis (Section 7) provides information for the chief forester and the local community to better understand the potential magnitude of impacts associated with any proposed harvest level changes.

The socio-economic analysis considers the current and projected levels of forestry activity associated with the Fraser TSA within the context of regional timber supplies and production capacity. It does this by examining the profile of the region and the local forest industry; and assessing employment and income implications of the timber harvesting levels projected in the base case.

The analysis includes estimates of the employment and income impacts associated with timber supply analysis projections by three main sectors: harvesting and woodlands-related activities, processing, and silviculture. Employment is measured in terms of person-years*. Employment income is calculated using average industry income estimates.

Forest inventory
An 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 other forest values such as recreation and visual quality.

Model
An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.

Person-year(s)
One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.

1 Description of the Fraser Timber Supply Area

The Fraser Timber Supply Area (TSA) is located in the southern mainland portion of the Coast Forest Region (Figure 1). Administered from the Chilliwack Forest District office, it covers approximately 1.4 million hectares. It is the most densely populated TSA in the province, encompassing the major population centres of the Lower Mainland and the Fraser Valley.

Within the Fraser TSA, 34 First Nations Indian Bands and five tribal organizations have asserted traditional territories. Eight groups are in treaty negotiations.

Although much of the timber processed in the TSA is harvested elsewhere, timber harvesting is an important part of the local economy, especially in the smaller communities. Primary sectors such as agriculture, forestry, fishing and mining are more important east of metropolitan Vancouver, especially in the upper Fraser Valley and Fraser Canyon. For example, these sectors account for one per cent of the total experienced labour force in the Greater Vancouver Regional District and 9% in the Fraser Valley Regional District.

Tourism, recreation, biodiversity* and conservation values are also very important in the Fraser TSA. The area provides easily accessible forest recreation opportunities for people living in the Lower Mainland, and scenic values along several major highway corridors that transect the TSA. The Fraser TSA, along with the adjacent Soo and Lillooet TSAs, provides critical areas of habitat for the endangered northern spotted owl.

B.C.'s Spotted Owl Management Plan, approved in May 1997, was based on the belief that the spotted owl population would stabilize and increase as the amount of habitat stabilizes and then increases. In 1999, resource management plans were developed and approved for spotted owl special resource management zones (SRMZ), and harvesting in the Fraser TSA has been guided by these plans. As a result, harvesting within the approximately 135 500 hectares of SRMZs have been limited to activities that will create, maintain or enhance spotted owl habitat.

Forests in the Fraser TSA are dominated by stands of western hemlock and Douglas-fir. There is a long history of timber harvesting in the Fraser TSA and a large proportion of the current forest comprises second-growth stands established after previous harvesting.

The current allowable annual cut (AAC) in the Fraser TSA is 1.27 million cubic metres, set in 1999. The current allowable annual cut includes a harvest of up to 32 500 cubic metres of deciduous*-leading forest types*.

> ***Biodiversity (biological diversity)***
> *The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.*
> ***Deciduous***
> *Deciduous trees shed their leaves annually and commonly have broad-leaves.*
> ***Forest type***
> *The classification or label given to a forest stand, usually based on its tree species composition. Pure spruce stands and spruce-balsam mixed stands are two examples.*

1.1 The environment

The Fraser timber supply area closely corresponds to the watershed* of the Lower Fraser River Basin.

Three physiographic units shape the area:

- the Coast Mountains border it on the north and east, and various tributaries and lakes drain into the Fraser River;
- the Fraser lowland, a broad plain of riverine and glacial deposits, extends east from Vancouver to the community of Hope; and
- the Fraser estuary covers the delta and tidal waters surrounding the outlet of the Fraser River.

With five biogeoclimatic zones* and 13 commercial tree species, the Fraser TSA is one of the most biologically diverse regions in the province. Table 1 summarizes the zones and their locations, the major tree species present, and other considerations such as wildlife values. The coastal western hemlock zone is the most abundant zone in this TSA.

> ***Watershed***
> *An area drained by a stream or river. A large watershed may contain several smaller watersheds.*
> ***Biogeoclimatic zones***
> *A large geographic area with broadly homogeneous climate and similar dominant tree species.*

1 Description of the Fraser Timber Supply Area

Table 1. Biogeoclimatic zones of the Fraser TSA

Zone	Location	Tree species	Other
Coastal western hemlock	Fraser lowland and estuary, sea level to 900 metres.	Dominant: western hemlock, amabilis fir. Minor: Douglas-fir, western redcedar.	Wettest zone in B.C. Highest diversity of vertebrates in this timber supply area. Highest diversity of birds, amphibians and reptiles in B.C.
Mountain hemlock	Between 900 and 2,250 metres elevation.	Dominant: mountain hemlock, yellow-cedar, amabilis fir. Minor: western hemlock, western redcedar, Douglas-fir, western white pine.	Harsh conditions limit wildlife (short cool summers; long snowy winters). There are no reptiles and only a few species of amphibians.
Alpine tundra	Above 2,250 metres.	Treeless except stunted individuals at lower elevations.	Wildlife diversity and density are low, some summer range.
Interior Douglas-fir	West of Manning Park, on east (lee) side of Coast Mountains below coastal western hemlock zone.	Dominant: Douglas-fir.	
Engelmann spruce-subalpine fir	In eastern portion of timber supply area, just below alpine tundra.	Dominant: Engelmann spruce, subalpine fir.	

The Fraser TSA contains one of the richest and most diverse arrays of wildlife in Canada. More than 300 species of migratory and resident birds, 45 species of mammals, 11 species of amphibians and five species of reptiles range throughout the area.

Population estimates do not exist for many of the non-game species or for the species of reptiles and amphibians inhabiting the timber supply area. However, species considered at risk in the Chilliwack Forest District (which includes the Fraser TSA) are summarized in Table 2.

Table 2. Vulnerable, endangered and threatened species

Endangered or threatened (red-listed)		**Vulnerable (blue-listed)**	
Spotted owl	southern red-backed vole	Black-tipped darner	Wolverine
green sturgeon	peregrine falcon	mountain beaver *(rainieri* subspecies)	brassy minnow
white sturgeon	sandill crane (Georgia Depression)	great blue heron	western river cruiser
western grebe	western red bat	Nez Perce dancer	great Arctic
mountain beaver (*rufa* subspecies)	snowshoe hare	coastal tailed frog	cutthroat trout
marbled murrelet	Johnson's hairstreak	short-eared owl	western screech–owl
salish sucker	Lewis's woodpecker (Georgia Depression)	American bittern	blue dasher
western pond turtle	long-tailed weasel	green heron	red-legged frog
yellow-billed cuckoo	Keen's long-eared myotis	mountain sucker	bull trout
Cultus Lake sculpin	gopher snake	common woodnymph	dolly varden
coastal giant salamander	purple martin	Hoofman's checkerspot	Trowbridge's shrew
horned lark	Oregon spotted frog	painted turtle	Williamson's sapsucker
grappletail	American avocet	western sulphur	Caspian tern
Indra swallowtail	Nooksack dace	band-tailed pigeon	yellow-legged meadowhawk
double-crested cormorant	Pacific water shrew	Townsend's big-eared bat	black petaltail
Townsend's mole	pygmy longfin smelt	beaverpond baskettail	eulachon
western bluebird	western meadowlark	propertius duskywing	barn owl
	killer whale (resident/ transient populations)	western pondhawk	grizzly bear
		dun skipper	killer whale (offshore population)
		sandhill crane	

Source: B.C. Conservation Data Centre, Ministry of Sustainable Resource Management, Nov. 3, 2003.

The northern spotted owl has the highest profile of the species of management concern, and is recognized as nationally endangered. The analysis reflects B.C.'s management plan for the northern spotted owl, which was approved in 1997. A multi-disciplinary spotted owl recovery team is currently working on a draft recovery strategy.

At least 87 species of resident, semi-resident and migratory finfish and shellfish inhabit the rivers, streams and lakes of the Lower Fraser Valley basin. These include commercially valuable salmonid species of chum, pink and sockeye as well as at least 17 species with significant value in the recreational fishery.

Under the Forest Practices Code*, a process exists for identifying species at risk and designating wildlife habitat areas (WHA) with associated specific management practices. The wildlife species that have been identified within the Fraser TSA under the Identified Wildlife Management Strategy are listed in Table 3.

Forest Practices Code
Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.

Table 3. Chilliwack Forest District identified fish, birds and mammals

Common name of identified wildlife
Fish
Bull trout
Birds
Western grebe
American bittern
Marbled murrelet
Sandhill crane
Turkey vulture
Mammals
Grizzly bear
Mountain beaver (both subspecies)
Keen’s long-eared myotis
Pacific water shrew
Amphibians
Coastal tailed frog
Snakes
Rubber boa

Source: Managing Identified Wildlife, Volume 1, February 1999.

Note: An update of the standards, procedures and list of species is currently under development. This update is not yet available but is scheduled to be published by the end of 2003.

The timber supply analysis reflects the current forest management practices that follow the standards and legislation set out by the *Forest Practices Code* and guidebooks. Government is currently preparing legislative amendments to allow for a transition between the existing *Forest Practices Code* and the new *Forest and Range Practices Act*, which is expected to be fully implemented in December 2005.

1 Description of the Fraser Timber Supply Area

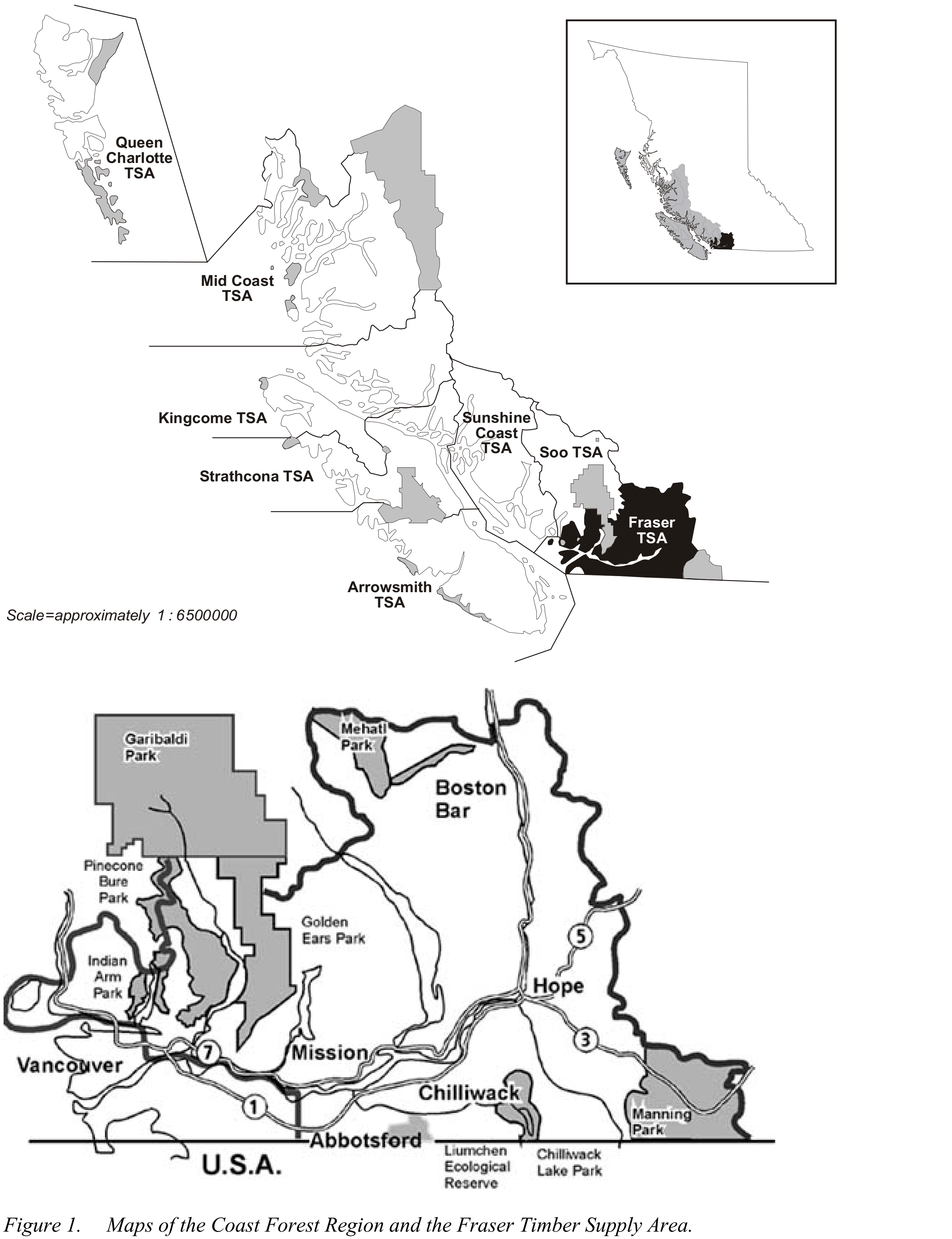


Figure 1. Maps of the Coast Forest Region and the Fraser Timber Supply Area.

2 Information Preparation for the Timber Supply Analysis

Timber supply analysis requires three general categories of information: land base inventory; timber growth and yield; and management practices. These three categories are discussed below.

2.1 Land base inventory

Land base information used in this analysis came in a number of formats. The forest cover information was compiled in 2001 by the Resource Information Branch, Ministry of Sustainable Resource Management. Additional information such as harvest depletion, stand age in very young plantations and resource emphasis mapping (e.g. spotted owl areas, mule deer winter range areas, etc.) was supplied or obtained by the Chilliwack Forest District, Ministry of Forests. These files were combined by Forest Analysis Branch staff. The resultant file contains a considerable amount of information on the forest land in the Fraser TSA including general geographic location, area, nature of forest cover (such as presence or absence of trees, species, number of trees, age, and timber volume), nature of land forms and other notable characteristics such as environmental sensitivity and physical accessibility (operability*). Stand characteristics such as tree height, stocking* and age have been projected to January 2001. The inventory file has been updated to account for timber harvesting up to December 31, 1998 for the majority of the Fraser TSA, however some harvesting activities between 1999 through 2001 are also recorded.

The inventory file represents the land base for the entire TSA. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur. Examples are land set aside for parks, areas needed to protect wildlife habitat, and areas in power lines, highways, or town sites. A description of these areas specific to the Fraser TSA is provided below. These types of areas do not contribute to the timber supply of the Fraser TSA. Before assessing timber supply these non-contributing areas are identified and separated from the land base which represents the timber harvesting land base*. When classifying areas in the data file, care is taken to consider areas sequentially. Where an area possesses more than one characteristic that would make it unavailable for harvesting (for example, where a park area is also suitable for wildlife habitat), the area was excluded according to the first characteristic evaluated.

Identifying areas as not contributing to timber supply does not mean the area is also removed from the Fraser TSA. The B.C. Forest Service still manages the entire area of the TSA (except for designated areas under the jurisdiction of other agencies) as a land unit that contributes a mix of timber and non-timber values. For instance, forest that does not contribute to timber harvesting may still provide values for biodiversity, wildlife and visual quality.

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

Operability
Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Stocking
The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.

Timber harvesting land base
Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.

2 Information Preparation for the Timber Supply Analysis

For the Fraser TSA, the following types of areas were not part of the timber harvesting land base:

- non-Crown area — areas not managed directly by the B.C. Forest Service (e.g., private land, parks).
- non-forest areas — areas not occupied by forest cover (e.g., rock, swamp, treeless alpine areas and water bodies).
- non-productive forest — areas with sparse tree cover, extremely low site productivity or characterized as containing more than 50% of a non-forest land cover (e.g., trees on rock talus slopes, islands of trees on rock outcrops or gravel pits).
- inoperable areas* — areas classified as unavailable for harvest for terrain-related or economic reasons. Characteristics used to define operability include slope, topography (e.g., presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality.
- currently unharvested forest types — areas covered by timber stands that are not currently harvested due to a lack of demand linked to limited merchantability. These are predominantly maple, cottonwood, aspen and birch stands.
- low timber productivity areas — areas exhibiting low growth potential based on site index (SI)*.
- environmentally sensitive areas (ESAs)* — areas with soil types that would be highly susceptible to damage by timber harvesting activities, areas with a high potential for difficulty in re-establishing forests following harvesting, and areas with a high avalanche hazard.
- long-term spotted owl habitat — Spotted Owl Management Plans have defined areas where habitat requirements will significantly restrict conventional timber harvesting with the goal to retain permanent forest cover.
- recreation areas — areas of recreational significance, such as campgrounds, trails and lookout sites.
- stands with low volume — areas that possess adequate growth potential but are not expected to achieve minimum merchantable requirements.
- old-growth management areas (OGMA) — areas that have been identified to provide for the conservation of old forest. Currently, draft OGMAs have been identified in nine landscape units (LU)*. Forest cover requirements providing for old forest representation were used in the remaining landscape units.
- streamside buffers — areas unavailable for timber harvesting to account for protection of riparian and stream ecosystems.
- archaeological sites — sites that are protected by the *Heritage Conservation Act*. For the analysis, one hectare of forest has been reserved for each site.

Inoperable areas
Areas defined as unavailable for harvest for terrain-related or economic reasons. Operability can change over time as a function of changing harvesting technology and economics.
Site index
A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.

Environmentally sensitive areas
Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.
Landscape unit
A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.

- hydrolines —areas that are currently classified as forested in the vegetation resources inventory (VRI), but will not be managed for timber production.
- existing roads, trails and landings (RTLs) — areas of forest land that have been removed from timber production due to access development.
- wildlife tree* patches (WTP) — areas of forest that are to be left during timber harvesting to provide stand structure in newly harvested areas.
- future roads, trails, and landings — future losses of productive forest land to access development. These areas are initially included in the timber harvesting land base, and are subsequently removed as part of the first harvest.

A more detailed description of these categories, including specific criteria for removal is located in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Table 4 summarizes the areas in each category, and shows the area of the timber harvesting land base. The column "Productive forest area by classification" provides the total forested area within the given category. For example, while a total of 63 828 hectares of Crown productive forest is in long-term spotted owl habitat, only 33 616 hectares were removed specifically due to long-term habitat. The difference arises because one area can be in more than one classification (e.g., inoperable and low productivity). The order listed in Table 4 is the sequence used when excluding areas from the timber harvesting land base. If the order were changed, the areas in the various categories would also change but the timber harvesting land base would remain the same.

Wildlife tree
A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

2 Information Preparation for the Timber Supply Analysis

Table 4. Determination of the timber harvesting land base for the Fraser TSA

Classification	Productive forest area by classification	Area (hectares)	Per cent of total TSA area	Per cent of Crown forest land
Total TSA area		**1 420 432**		
Land not managed by the B.C. Forest Service	189 968[a]	530 795		
Non-forest		186 878		
Non-productive forest[b]		66 084		
Total productive forest managed by the B.C. Forest Service (Crown forest)		**636 675**	44.8	100.0
Reductions to the Crown forest available for timber supply				
Stands considered inoperable	253 155	246 751	17.4	38.8
Stands currently not considered for harvesting	12 074	10 329	0.7	1.6
Stands exhibiting low productivity	99 278	16 168	1.1	2.5
Environmentally sensitive areas	100 953	21 562	1.5	3.4
Long-term spotted owl habitat	63 828	33 616	2.4	5.3
Provincially important recreation features	102	39	0.0	0.0
Stands with low volume	134 297	6 745	0.5	1.1
Areas considered for old-growth management[c]	30 344	4 183	0.3	0.7
Riparian reserves and management zones	22 911	13 026	0.9	2.0
Existing unclassified roads	11 512	9 746	0.7	1.5
Archaeological sites	252	125	0.0	0.0
Hydrolines	3 059	1 259	0.1	0.2
WTP requirements		12 208	0.9	1.9
Total reductions		375 757	26.5	59.0
Current timber harvesting land base[d]		**260 918**	18.4	41.0
Future reductions				
Future roads trails and landings		1 389	0.1	0.2
Future timber harvesting land base		**259 529**	18.3	40.8

(a) Forest found in parks that contributed to forest cover requirements in the timber supply analysis.

(b) Stands listed as vegetated treed which were very sparsely treed, possessed significant amounts of non-productive area within the polygon or had low site index and were located in the Atp Biogeoclimatic zone.

(c) These are draft old-growth management areas in 9 landscape units. Forest cover requirements to maintain old forest are used in the other landscape units in the timber supply analysis.

(d) Timber harvesting land base includes 21 180 hectares of vegetated non-treed land with logging history, 11 124 hectares of NSR derived from the FIP file and 9657 hectares of Timber Licenses which have reverted or will revert to the Crown over the next 10 years.

Figure 2 shows the current species composition on the timber harvesting land base. Hemlock, balsam and Douglas-fir stands dominate the timber harvesting land base with small amounts of cedar, spruce, pine and alder. About 40% of the timber harvesting land base area has stands currently above minimum harvest criteria.

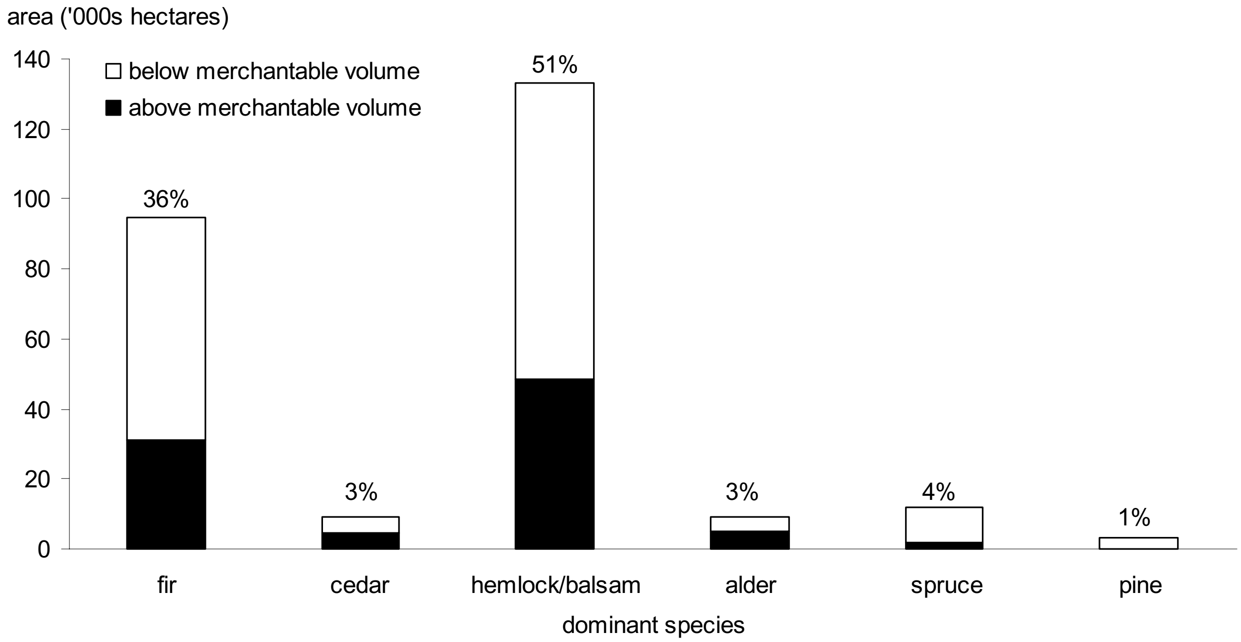


Figure 2. Area by dominant tree species on the timber harvesting land base — Fraser TSA, 2003.

Figure 3 shows areas by broad age groups on the timber harvesting land base, and their condition relative to minimum merchantable age. The figure illustrates the opportunity for second-growth harvesting in the TSA as there are many second-growth stands that have reached the minimum requirements for harvest. The transition in harvest from older stands to second-growth stands is one of the key drivers of the timber supply dynamics in the Fraser TSA. Note that some stands above 105 years of age are still below minimum criteria at this time.

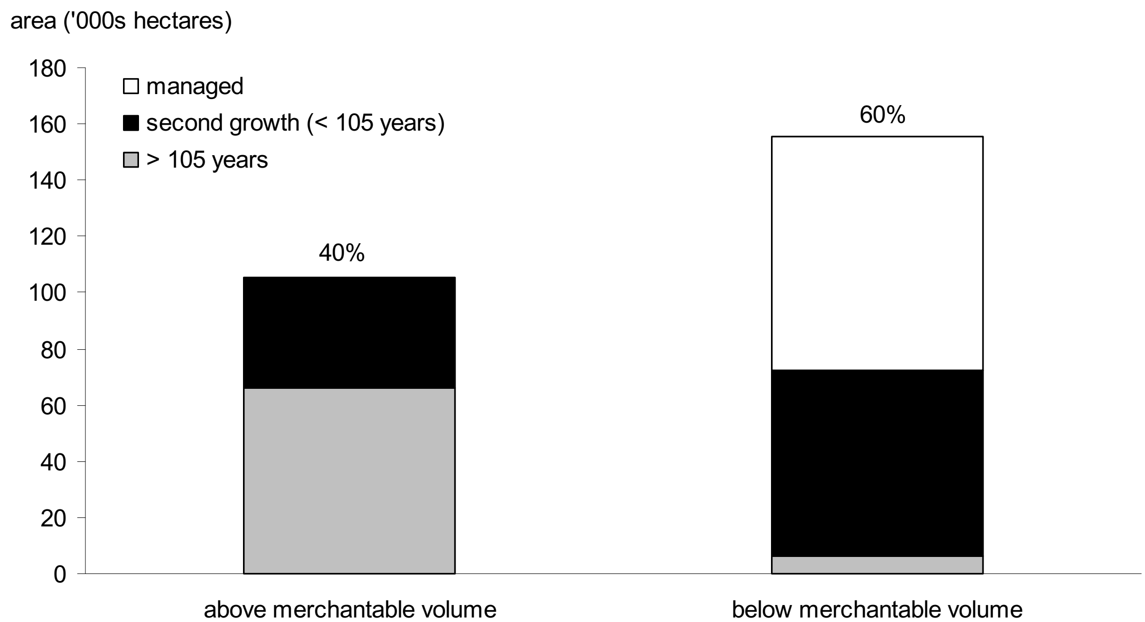


Figure 3. Area by broad age range within the timber harvesting land base — Fraser TSA, 2003.

The age class composition represented in Figure 4 shows stands currently expected to be available for harvesting (the timber harvesting land base) and those that are not available to be harvested. Stands above 250 years of age make up about 11% of the timber harvesting land base and about 14% of the productive forest. About 60% of the timber harvesting land base is below 60 years of age. A much smaller proportion of the area outside of the timber harvesting land base is less than 20 years old than in the older age classes, reflecting the lack of stand replacing natural disturbance that has occurred in the last 20 years.

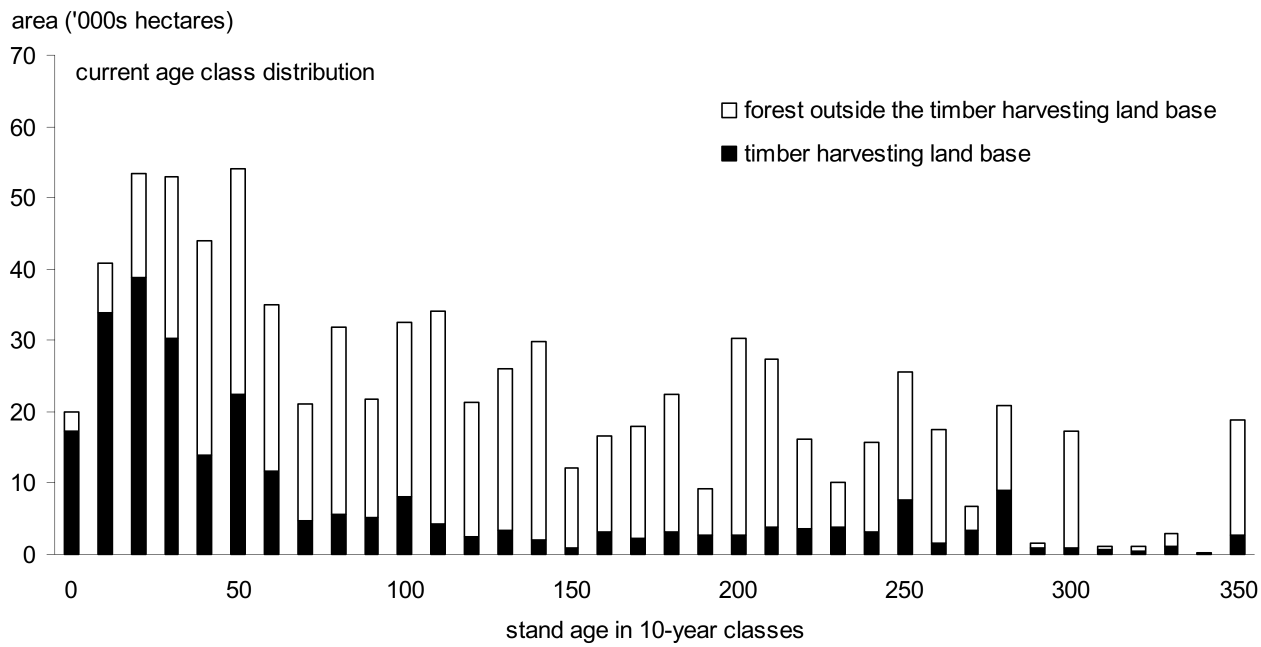


Figure 4. Current age class composition of the timber harvesting land base — Fraser TSA, 2003.

2 Information Preparation for the Timber Supply Analysis

Table 5 shows the distribution of biogeoclimatic (BEC) variants* in the Crown forest area and timber harvesting land base. The table shows the prevalence of each variant in the timber harvesting land base (third numerical column), and an indication of the role of the timber harvesting land base in achieving biodiversity requirements for the variant (rightmost column). For example, the CWHdm makes up 14% of the timber harvesting land base, while 49% of the total forest area of the CWHdm is within the timber harvesting land base. The greater the percentage in the last column, the higher the likelihood that at least a part of the old-seral retention requirements will need to be met from within the timber harvesting land base.

Table 5. Biogeoclimatic variants of the Fraser timber supply area

Biogeoclimatic variant	Timber harvesting land base (‘000s hectares)	Forest outside the timber harvesting land base (‘000s hectares)	Per cent of timber harvesting land base in the BEC variant (%)	Per cent of variant available for harvest (%)
CWHdm	36.2	37.3	14%	49%
CWHds1	27.2	37.7	10%	42%
CWHms1	79.2	119.9	30%	40%
CWHvm1	25.4	31.6	10%	45%
CWHvm2	37.5	50.2	14%	43%
ESSFmw	12.8	82.6	5%	13%
IDFww	12.4	26.5	5%	32%
MHmm1	11.1	40.5	4%	22%
MHmm2	18.1	89.0	7%	17%
ATunp	0.62	30.7	0%	2%
CWHxm1	0.25	0.6	0%	28%
ESSFdc2	0.01	5.9	0%	0%
ESSFmwp	0	0.5	0%	0%
IDFdk2	0	2.5	0%	0%
MSdm2	0	5.4	0%	0%

Biogeoclimatic (BEC) variant
A subdivision of a biogeoclimatic subzone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.

2.2 Timber growth and yield

Timber growth and yield refers to the prediction of the growth and development of forest stands over time. Forest stands have many characteristics that change with age (for example, number of trees per hectare, tree diameter, tree height, species composition). Since this analysis concentrates on timber volumes available for harvest over time, the most relevant measure for this analysis is volume per unit of area (in British Columbia, cubic metres per hectare). An estimate of timber volume in a stand assumes a specific utilization level, or set of dimensions, that establish the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters both near the base and the top of a tree.

Two growth and yield models were used to estimate timber volumes for the Fraser TSA timber supply analysis. The variable density yield prediction (VDYP)* model supported by the Resource Information Branch of the Ministry of Sustainable Resource Management, was used for estimating timber volumes for all existing natural stands. The table interpolation program for stand yields (TIPSY)*, which was developed by the B.C. Forest Service, Research Branch was used to estimate timber volumes for both existing and future managed stands. Table A-17., "Immature plantation history" shows the age below which each of the species harvested in the TSA is assumed to be managed (that is, stocking density has been controlled), based on harvest history in the TSA.

One of the components currently used to complete the inventory process is gathering field information to calibrate some photo-interpreted stand attributes, namely height, age and volume. This was performed by Resource Information Branch of the Ministry of Sustainable Resource Management. Emphasis was placed on producing adjustments that reflected species differences, age differences and geographic differences. The full documentation is found in *Chilliwack Forest District— Documentation of Analysis for Vegetation Resources Inventory Statistical Adjustment — Addendum* and is available on-line at http://srmwww.gov.bc.ca/tib/vri/vri/reports&pub/adjustment/tsa/chilliwack_documentation_analysis_addendum.pdf.

In addition, the licensee group within the Fraser TSA hired growth and yield specialists, J.S. Thrower and Associates to investigate the potential site productivity in the CWH portion of the TSA, focusing mainly on Douglas-fir and hemlock-leading stands. The report *Site Index Adjustment of the Coastal Western Hemlock Zone in the Fraser TSA* was reviewed by Ministry of Forests staff and accepted as the best available information on site productivity for the TSA. The report was used in the analysis to assign site index to stands after first harvest in the simulation model. The study suggested that the average site index for the TSA will to increase by 3.2 metres, from 20.4 to 23.6 metres. The site index for adjusted stands, which make up about half of the timber harvesting land base, increases from 22 metres to about 28. Table A-25. provides the specific site index assignment for eligible stands by analysis unit*.

Variable Density Yield Prediction model
An empirical yield prediction system supported by the Ministry of Sustainable Resource Management, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed species composition.
Table Interpolation Program for Stand Yields
A B.C. Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.

Analysis unit
A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location — done to simplify analysis and generation of timber yield tables.

Based on timber volume estimates*, the current timber inventory or growing stock* on the timber harvesting land base is approximately 67.9 million cubic metres. Most of this volume (about 51.8 million cubic metres) is currently merchantable; that is, above the minimum harvestable criteria which is generally 350 cubic metres per hectare. The total growing stock on the timber harvesting land base is estimated to be about 13% larger than in the previous (1998) TSR analysis for the Fraser TSA.

2.3 Management practices

Timber supply depends directly on how the forest is managed for both timber and non-timber values. Therefore, levels of management activity must be defined for the timber supply analysis process. The *Forest Practices Code of British Columbia Act* and established management plans guide forest management practices in the Fraser TSA. Staff in the Chilliwack Forest District provided descriptions for the following management practices:

- Silviculture practices — reforestation activities required to establish free-growing* stands of acceptable tree species.
- Forest health and unsalvaged losses* — average annual unsalvaged losses to natural forces such as insects, fire, wind and disease on the timber harvesting land base are estimated to be 18 425 cubic metres per year for the entire 250 year analysis horizon. These losses have been subtracted from all harvest forecasts* shown in this report.
- Utilization levels — minimum sizes of trees and logs to be removed during harvesting.
- Harvesting priorities — second-growth harvesting currently provides at least 20% of the TSA harvest.
- Minimum harvest criteria — the minimum requirement for stands to be considered eligible for harvest. Minimum harvest criteria for this analysis were based on the minimum volume that is generally required for licensees to harvest a stand. See Table A–16., "Minimum merchantability and growth potential by analysis unit".

Volume estimates (yield projections)
Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.
Growing stock
The volume estimate for all standing timber at a particular time.
Free-growing
An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.

Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.
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 practices. 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.

- Tree improvement — improved planting stock of cedar, fir and to a lesser extent spruce is expected to increase timber growth. The associated genetic gains depend on the availability of seed and the respective seed planning unit.
- Fertilization —a small amount of area (about 7000 hectares) has been fertilized.
- Forest cover requirements — many of the forest management activities in the Fraser TSA are guided by forest cover requirements that apply to specified areas, and indicate the maximum percentage of the area that may be in stands under a certain height, or the minimum retention of area above a certain age. Often, several management objectives apply to the same area (for example, a visual quality area may coincide with a spotted owl objective).

Since showing all of the existing overlaps is not feasible in a simple graph, Figure 5 provides a non-overlapping listing of the various considerations in the TSA in the order shown in the graph (that is, the percentages add to 100). In addition to these objectives, landscape-level biodiversity* requirements apply to the entire productive forest outside of the landscape units with draft old-growth management areas. More detailed descriptions of the forest cover requirements can be found in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Roughly 59% of the timber harvesting land base is subject only to cutblock adjacency* as well as old forest retention for biodiversity, while the other 41% has at least one additional resource emphasis that needs to be considered in planning timber harvesting activities.

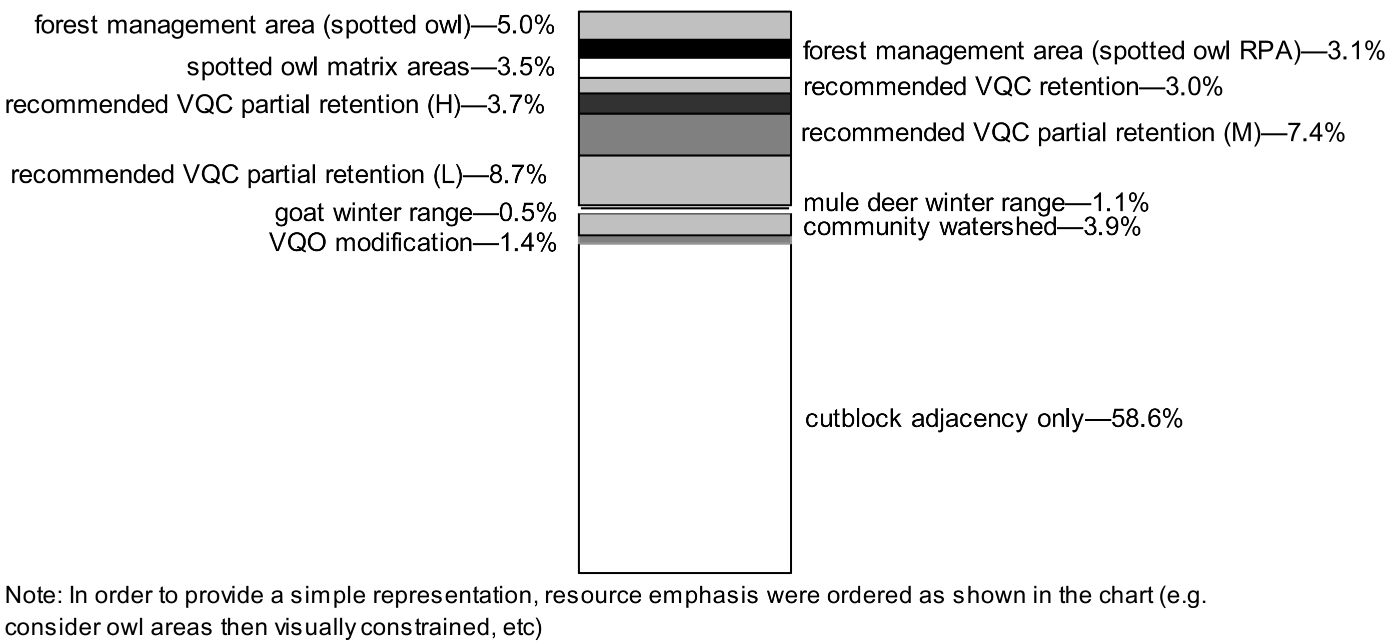


Figure 5. Timber harvesting land base by resource emphasis (non-overlapping) — Fraser TSA, 2003.

> ***Landscape-level biodiversity***
> *The* Landscape Unit Planning Guide *provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.*

> ***Cutblock adjacency***
> *The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.*

3 Timber Supply Analysis Methods

The purpose of this analysis was to examine both the short- and long-term timber harvesting opportunities in the Fraser TSA under current forest management practices. A timber supply model, as distinct from a growth and yield model, assists the timber supply analyst in determining how an entire forest (collection of stands) could be managed to obtain a harvest forecast (supply of timber over time). The simulation model uses information about the timber harvesting land base, timber volumes, and the management practices to represent how forests grow and are harvested over hundreds of years.

A spatial timber supply computer simulation model developed using the Spatially Explicit Landscape Event Simulator (SELES) was used for this analysis. SELES was developed by Fall and Fall (1996). SELES is a high-level language that was created for the purpose of facilitating spatial and temporal modelling. A spatial timber supply model patterned after the Forest Service Simulator (FSSim) was created using SELES by Dr. Andrew Fall in collaboration with the Forest Analysis Branch of the B.C. Forest Service. The basic model has been benchmarked against FSSim.

SELES allows for modelling of the spatial relationships among areas (e.g., adjacency), as well as control of the size and shape of spatial units such as harvest units and reserve areas. SELES is a raster, or grid-based modelling language, and the spatial input files for the timber supply analysis were created at a one hectare pixel size with linear features such as roads and riparian areas* being captured as the per cent of the pixel. Hence, the approximate spatial location of road and riparian networks could be tracked.

Generally, only the results for the first 250 years are shown graphically in this report because the projected harvest remains constant after that time.

Similar to other models, the spatial timber supply model assumes that trees grow according to specified yield projections and are harvested according to either a volume target or a specified objective set by the analyst. The model also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of cutblock adjacency and green-up* prescriptions. For example, guidelines might specify that no more than some maximum percentage of the forest can be younger than a specified green-up age or height, or that some minimum percentage of the forest must be in older age classes to provide wildlife habitat. The simulation model facilitates examination of the effects of such guidelines on timber supply.

This type of analysis is used to determine the timber supply implications of a particular 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 assist local B.C. Forest Service staff to administer their programs according to relevant guidelines and principles. However, the results of the analysis are not meant to be taken as recommendations of any particular AAC or any particular spatial pattern of harvest on the landscape.

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

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

Green-up
The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.

4 Results

This section provides the results of timber supply analysis for the Fraser TSA. The base case harvest forecast* uses the most recent assessments of forest management, the land available for timber harvesting and timber yields as described in Section 2, "Information Preparation for the Timber Supply Analysis," Appendix A of this report and the *Fraser Timber Supply Area Data Package* (BC MoF, 2003). The timber supply impacts of uncertainty in the inputs, and of important issues and new information will be discussed in Section 5, "Timber Supply Sensitivity Analyses." It is important to keep in mind that the base case provides only part of the timber supply picture for the Fraser TSA, and should not be viewed in isolation of the sensitivity analyses.

4.1 Base case harvest forecast

The base case harvest forecast found in Figure 6 shows that the current AAC of 1.27 million cubic metres per year can be maintained for the next 140 years followed by a 20% increase in the long-term timber supply to 1.52 million cubic metres per year after that time. The base case harvest forecast represents a significant increase in timber supply over previous analyses for this unit. The most important factors contributing to this increase have been identified in Section 2.2, "Timber growth and yield", namely new post-harvest site index information and a new photo-interpreted and ground-sampled inventory. These two factors are further examined in the sensitivity analysis described in Section 5.3.

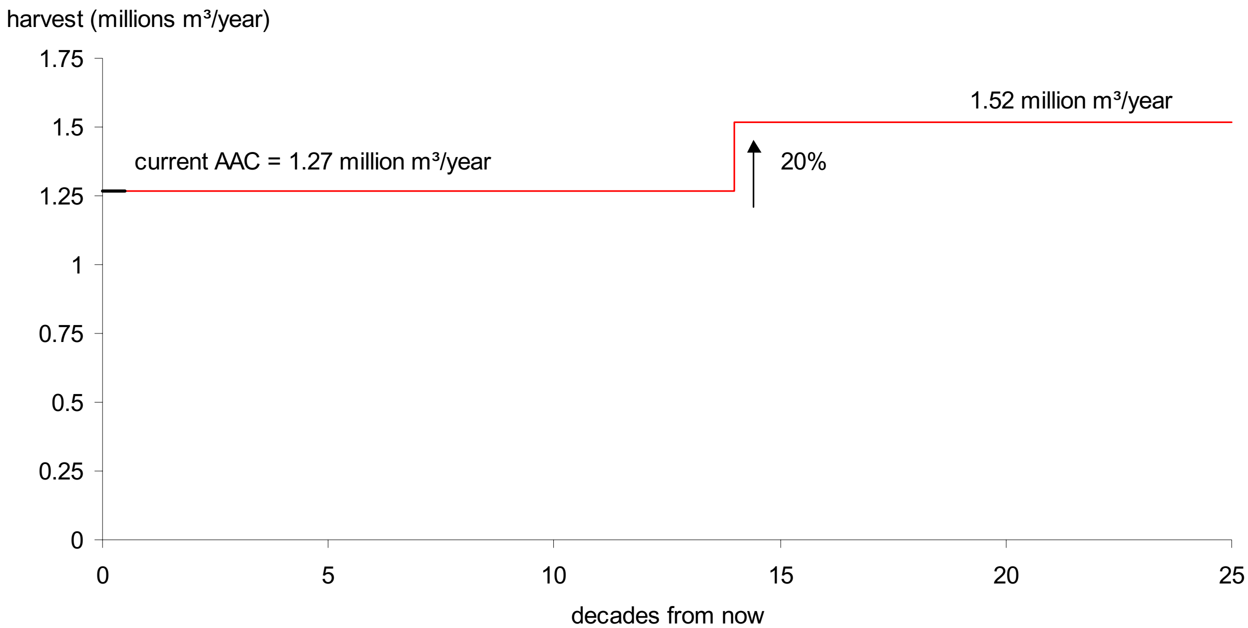


Figure 6. Base case harvest forecast for the Fraser TSA, 2003.

Base case harvest forecast *The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.*

4.2 Base case harvest characteristics

Figure 7 shows the two transitions that are instrumental in defining the timber supply in the Fraser TSA. Current old forest harvesting is expected to continue at a significant level for the next 30 years with an increasing amount of harvest in second-growth stands that are defined as stands currently below 105 years of age. Once old forest harvesting is essentially completed, it is expected that managed stands will become steadily more important. Even after the rise to the long-term harvest level*, harvest from existing natural stands, both old growth and natural second growth, is expected due to various forest cover requirements that affect the rate of harvest in these stands.

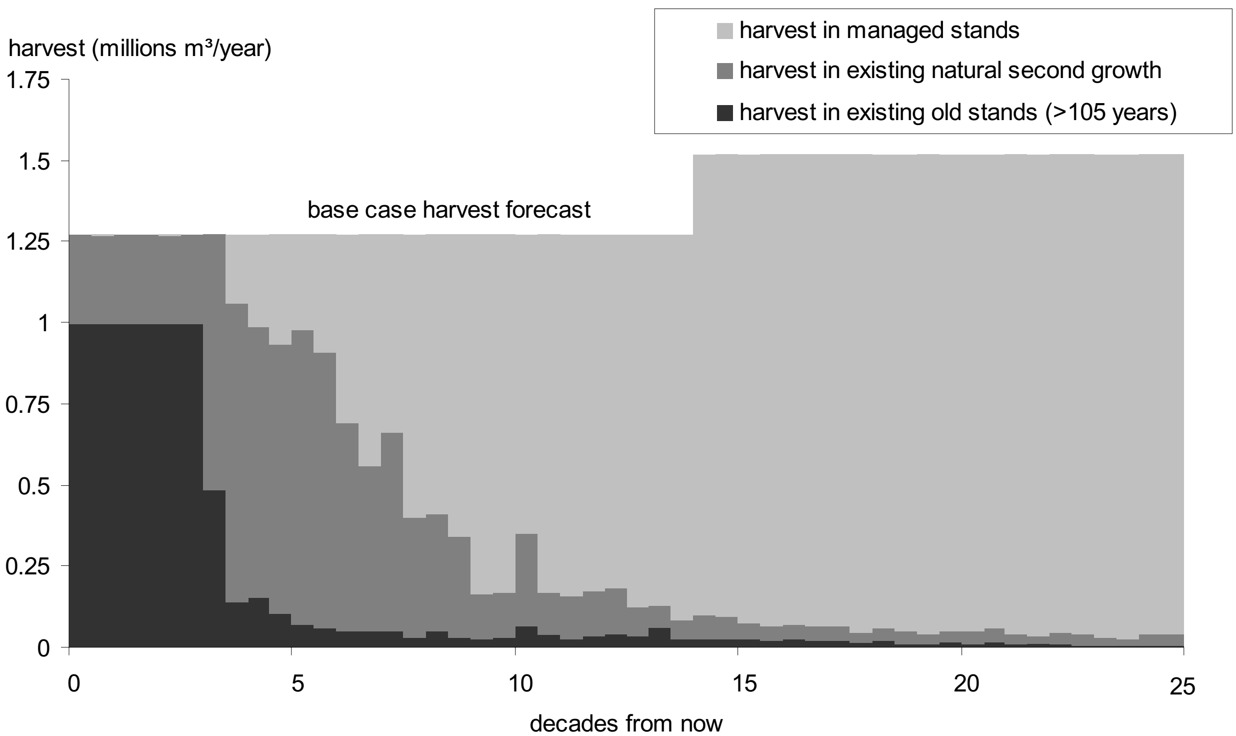


Figure 7. Harvest contribution from existing, second-growth and managed stands — Fraser TSA base case, 2003.

Long-term harvest level
A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

4 Results

Projected area harvest in the analysis is shown in Figure 8, along with the average area-weighted volume per hectare projected for harvest. The area harvested is generally about 2300 hectares per year over the short and medium terms and about 2400 hectares per year over the long term. Projected volume harvested in the short and medium term averages about 565 cubic metres per hectare and 640 cubic metres in the long term. Over the long term, while stands are expected to possess higher volumes at younger ages because of the post-harvest site index adjustment, the area harvested is also higher since the overall long-term harvest level is higher.

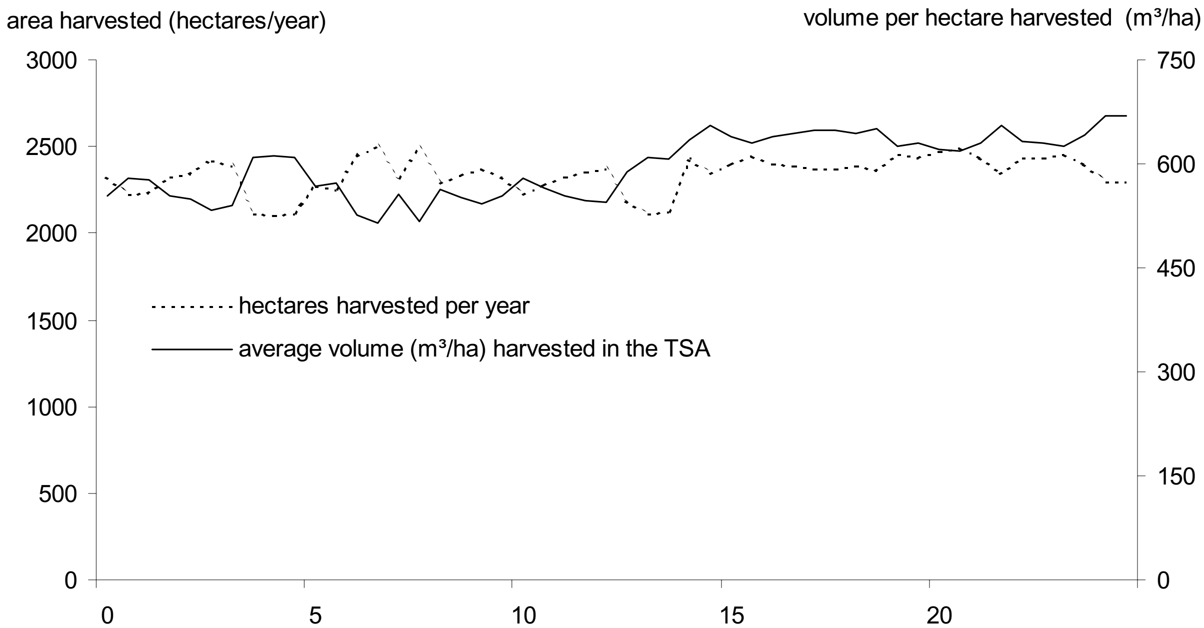
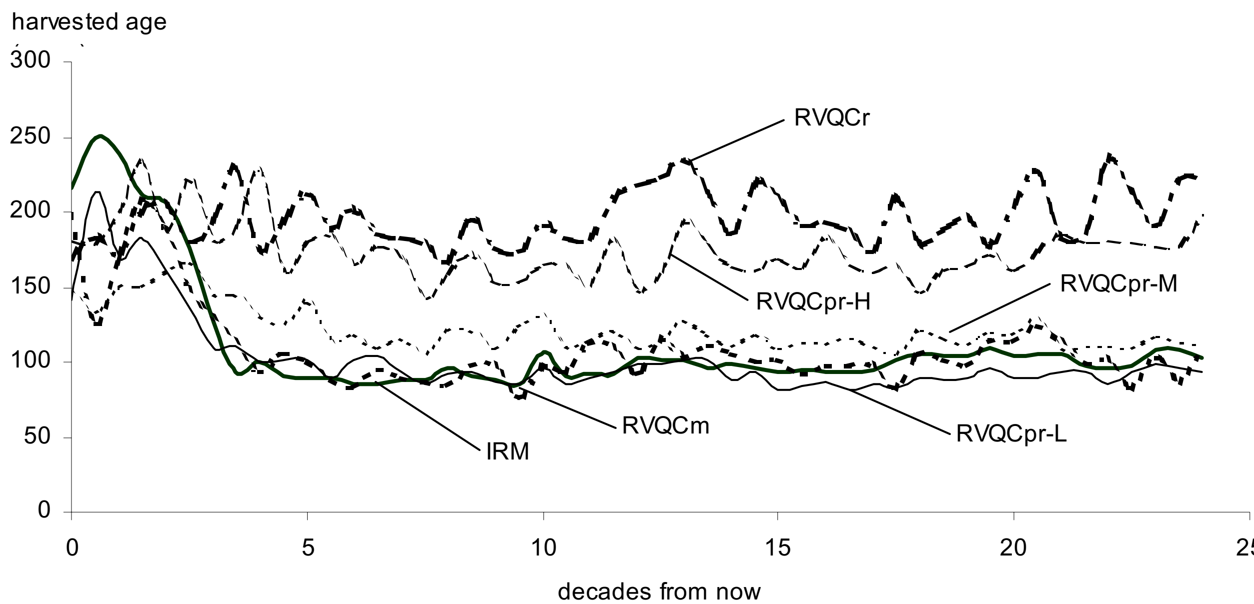


Figure 8. Average annual area harvested and volume yield stock over time — Fraser TSA base case, 2003.

4 Results

Minimum harvest criteria are based on the volume necessary to make a stand operationally and economically feasible to harvest. In many cases, forest cover requirements can extend the time between when a stand is considered to be merchantable for harvest and when it is available for harvest. Figure 9 shows the area-weighted harvest age by the recommended visual quality classes (RVQC) and general IRM (cutblock adjacency only). These classes are further described in Tables A-2. and A-19. in Appendix A. It can be seen that the visual quality classes RVQCm and RVQCprL do not produce harvest ages much different than the IRM areas. In the short term, harvested ages in these visual management areas are actually somewhat lower than in the IRM zone, which is a function of the concurrence of visual areas and second-growth forest. The forest cover requirements for RVQCprM, RVQCprH and RVQCr result in higher average harvest ages, as each requirement reduces the rate at which stands can be harvested. Visual quality classes also influence the rise to the long-term harvest level to a small degree since the harvest of managed stands in more constraining visual areas will occur later than in stands whose availability is limited only by how quickly the stands will grow to harvestable age.



Notes: RVQOr – recommended VQO of retention; RVQOpr – recommended VQO of partial retention with low (L), moderate (M) or high (H) visual sensitivity; RVQOm – recommended VQO of modification.

Figure 9. Average area-weighted harvest age by certain resource emphasis over time — Fraser TSA base case, 2003.

4 Results

4.3 Base case forest characteristics

As noted earlier in Section 2.2, "Timber growth and yield", the current standing inventory on the timber harvesting land base is about 67.9 million cubic metres. The stock is projected to decline slightly to a medium-term average of about 61 million cubic metres until rising between 100 and 150 years from now to stabilize at about 77 million cubic metres (Figure 10). The short- and medium-term stability of the inventory results because growth in the second-growth forest (thick dark line) is counter-balancing the loss of growing stock through harvesting. The increase in inventory over the long term is a function of the change in site index in fir and cedar stands in the CWH zone. Without the site index change, total long-term growing stock would be about 10% lower, at 69 million cubic metres. Volume in existing second-growth stands is projected to increase significantly for the next thirty years at which time second-growth stands are projected to support about 65% of the harvest.

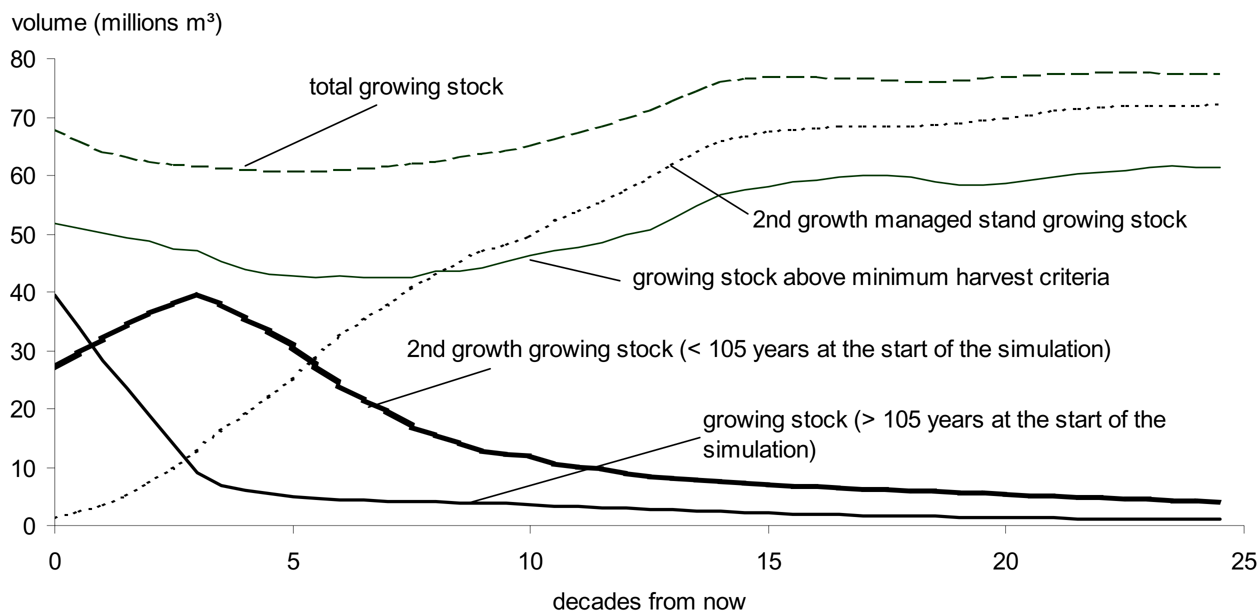


Figure 10. Changes in timber growing stock over time — Fraser TSA base case, 2003.

4 Results

The series of charts in Figure 11 show how the age composition of the Crown forest within the Fraser TSA is projected to change over the next 250 years under the base case harvest forecast. The dark bars represent the timber harvesting land base while the unshaded bars represent the stands outside of the timber harvesting land base. The Fraser TSA inventory will experience significant volume increment as the stands currently under 60 years of age begin to reach sizes where merchantable volume is calculated.

An important assumption in the base case is that stands will continue to age indefinitely, as can be seen by the increase in the area of stands above 350 years of age as time progresses. While stands are likely to be disturbed by natural processes such as fire, windthrow or biotic agents such as insect and disease, the current age class distribution shows that there has been remarkably little area outside of the timber harvesting land base that has experienced stand replacing events in the last 20 years. This subject is examined further in Section 5.12, "Implications of natural disturbance-based succession using the *Biodiversity Guidebook* return intervals."

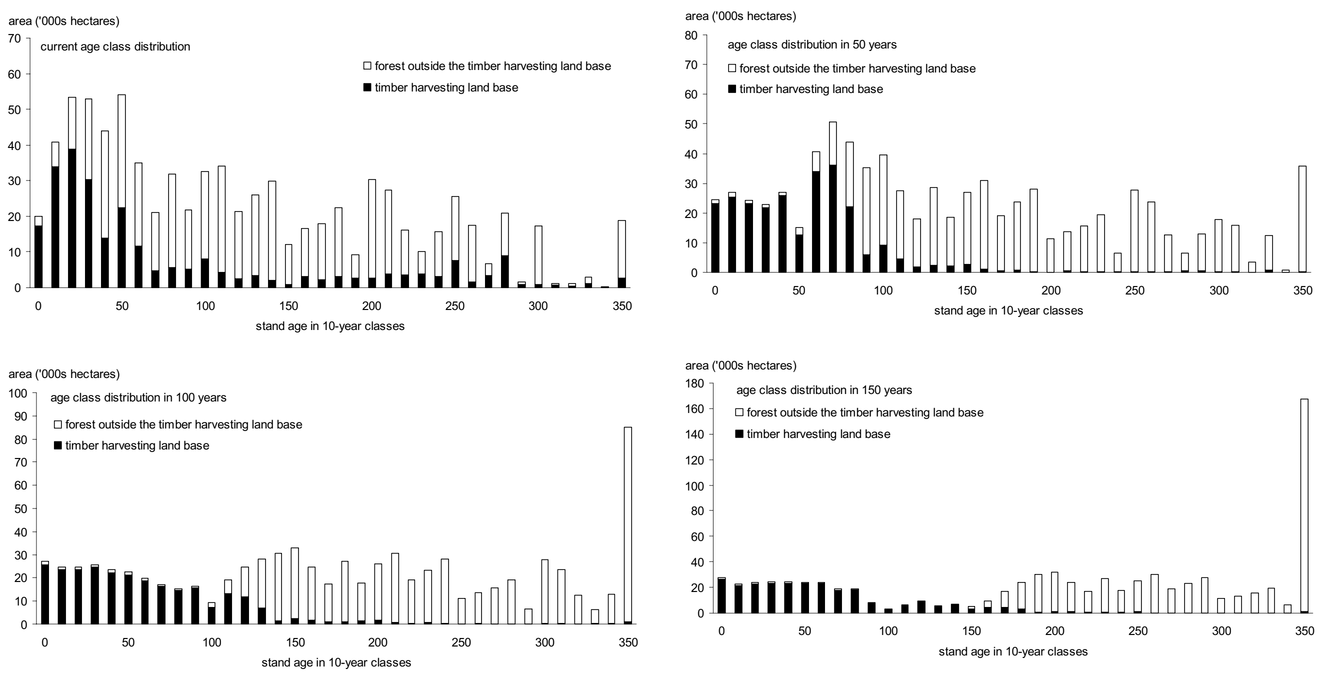


Figure 11. Changes in age composition on the Crown forest land base over time — Fraser TSA base case, 2003.

5 Timber Supply Sensitivity Analyses

The best available information on forest inventories and management practices is used to analyse the timber supply implications of continuing with current management. However, forest management is complicated since it must account for diverse and changing human values, the dynamics of complex ecosystems, and fluctuating and uncertain economic factors. As well, forests grow quite slowly in terms of human life spans. It is therefore often useful to understand the long-term effects of changes or uncertainties in the information used for short-term decisions.

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

Another important way of dealing with uncertainty is to assess how values of interest (for example, timber supply) could change if the information used in the analysis is not accurate. Sensitivity analysis* is one way of evaluating how uncertainty could affect analysis results, and ultimately decision-making. Sensitivity analysis can highlight that fairly small uncertainties about some variables could have large effects on timber supply projections, or conversely that fairly large inaccuracies in others could have negligible effects. Also, sensitivity analysis could show that some variables affect timber supply more in the short term than in the long term, while others have the opposite effect. Sensitivity analysis can highlight priorities for collecting information for future analysis, and show which variables, and associated uncertainties, have the most significance for decisions. It can clarify whether current best estimates provide safe bases for decisions, or whether high uncertainty about important variables means more conservative decisions may be wiser.

A further way in which sensitivity analysis is employed in the timber supply review is to examine how changes in information since the previous analysis — such as new inventories, recent research, and land use and management decisions — have affected the timber supply projection.

In this section, results of a number of sensitivity analyses are discussed. Sensitivity analyses are intended primarily to test the relative change (i.e., high *versus* low sensitivity) in the harvest forecast resulting from changes in forest management assumptions* and data used in the base case. Short-term refers to the first 20 years of the harvest forecast, medium-term is 21 to 100 years from now, and long-term is after 100 years from now.

Sensitivity analysis
A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.

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

5 Timber Supply Sensitivity Analyses

5.1 Estimating the maximum long-term harvest level

In determining the maximum long-term harvest level, it is useful as a benchmark to set the minimum harvestable age (MHA)* at the an based on the time when the maximum average stand growth occurs. Harvesting close to the age of maximum average stand growth ensures the highest long-term volume production (although this criterion is not always consistent with economic or product objectives, such as log size). Figure 12 shows the implications of setting minimum harvestable age to the age at which 95% of the maximum average growth rate is achieved (see Table A–16.), and disregarding the volume per hectare requirements necessary for stands to be operationally harvested. In addition, the second-growth target used in the base case (target of 20% harvest from second growth in the short term to reflect current practices) was not applied. If the minimum harvestable age criteria were changed, the bulk of the old-growth forest would be harvested over about 20 years, given the base case harvest levels. This harvest sequence results in stands currently classified as poor productivity being transferred to the higher post-harvest site index values earlier than in the base case. This changes both the magnitude and timing of the rise to the long-term harvest level relative to the base case. Within 100 years, growing stock is projected to be about 11 million cubic metres higher than in the base case.

This long-term level cannot be achieved under the base case management assumptions because the minimum volume criteria employed in the base case result in harvestable ages either younger or older than the long-term volume maximizing ages used in this sensitivity analysis. On average the ages used in this sensitivity analysis are older than in the base case. This difference is the source of the medium-term drop in timber supply: setting the minimum harvest criteria at ages needed to maximize long-term supply requires waiting longer, on average, for stands to become harvestable than in the base case.

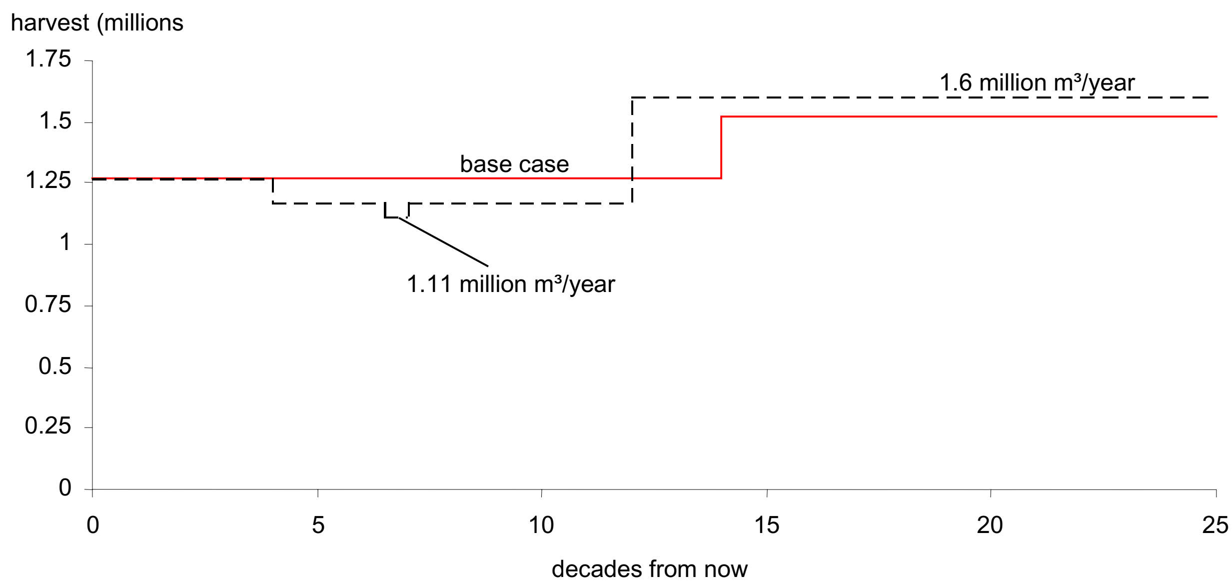


Figure 12. Estimating the maximum long-term harvest level — Fraser TSA base case, 2003.

> ***Minimum harvestable age***
> *The age at which a stand of trees is expected to achieve a merchantable condition. The minimum harvestable age could be defined based on maximize average productivity (culmination of mean annual increment), minimum stand volume, or product objectives (usually related to average tree diameter).*

5.2 Alternative harvest flow

Figure 13 shows an alternative harvest forecast based on base case inputs, including minimum harvestable ages, that mirrors the harvest flow pattern shown in Section 5.1, “Estimating the maximum long-term harvest level”. This alternative forecast shows that the long-term level can be achieved earlier than in the base case, but not without a reduction in medium-term timber supply. Also, the long-term harvest level is still below the maximum harvest level achievable if all stands were harvested near their maximum productivity. This reduction in the long-term level from the maximum achievable occurs because the minimum volume criteria employed in the base case result in harvestable ages that are on average older than the harvestable ages that maximize long-term volume production, as noted in Section 5.1.

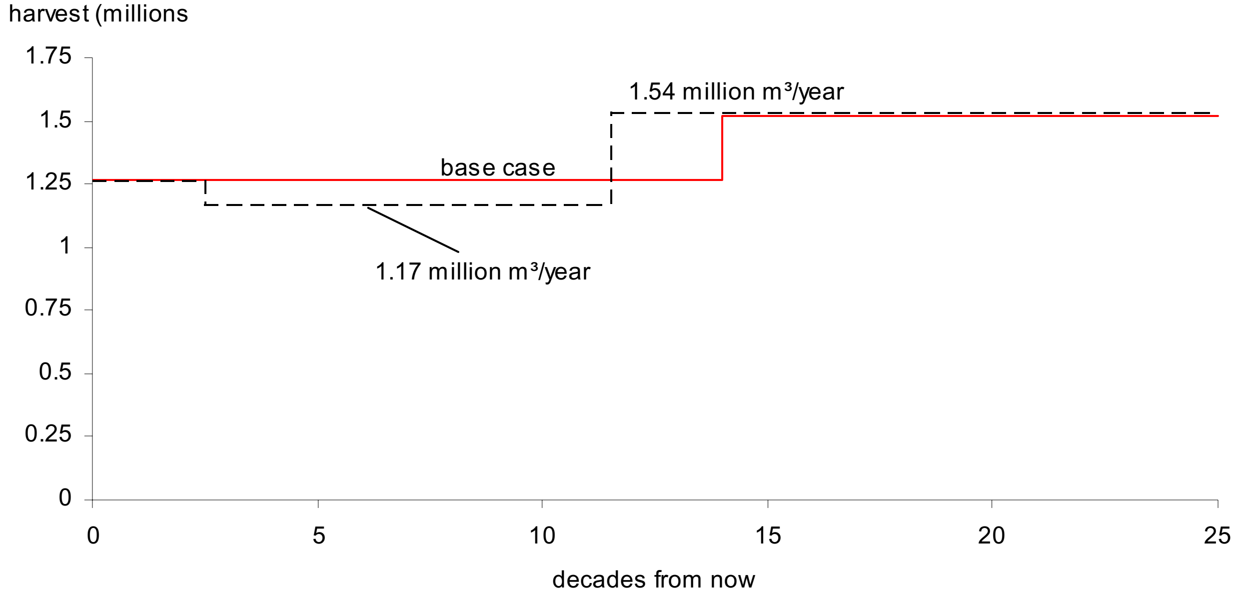


Figure 13. Alternative harvest forecast — Fraser TSA base case, 2003.

5.3 Implications of using the vegetation resource inventory and site index assignment

Section 4.1 alludes to the new inventory and the site index assignment as key elements in the stability of the base harvest forecast. To examine the implications of these new information sources, existing natural stand yields were reduced by 10% (to approximate impacts of the new inventory) and the inventory file site indexes were used after stands were harvested for the first time in the model (to show the impact of the new site index adjustments).

Figure 14 displays the outcome of applying these two changes. Timber supply declines after the first and second decades by about 11 and 18%, respectively. This harvest forecast resembles forecasts from the previous timber supply review (TSR) analysis for the Fraser TSA (June 1998). The small disruptions in 20 and 60 years from now indicate that medium-term timber supply is highly sensitive to projections of stand growth and yield.

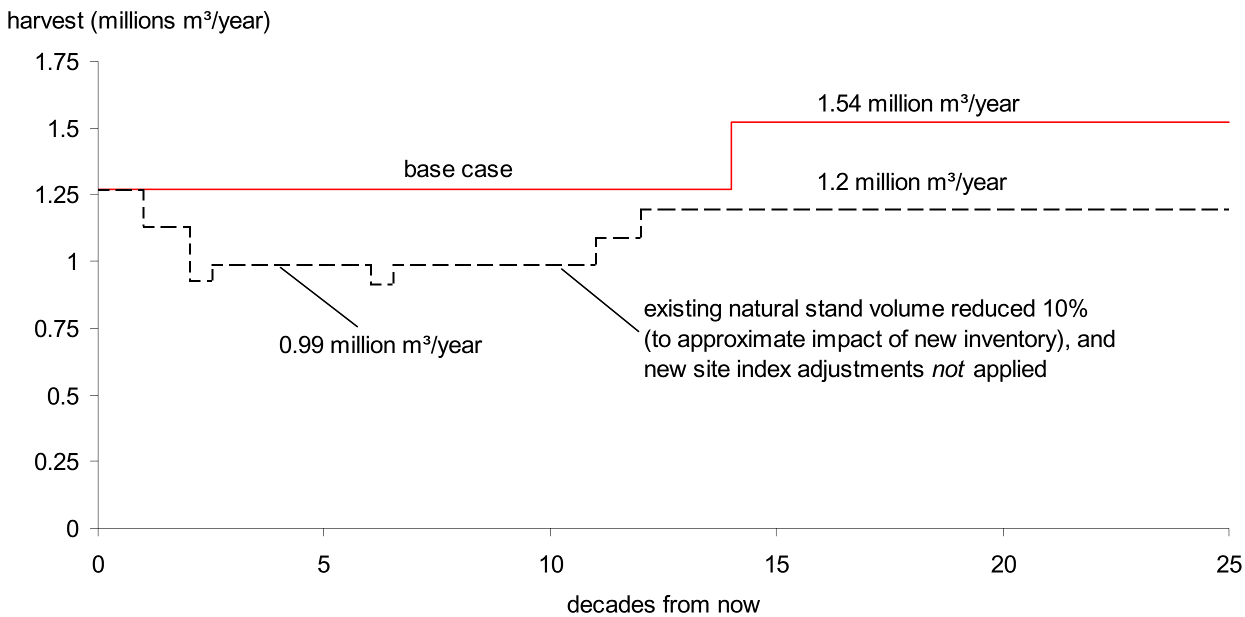


Figure 14. Harvest forecast approximating the impacts of the new inventory and site index adjustments — Fraser TSA, 2003.

5.4 Implications of ranking stands based on volume per hectare

Second-growth forest is beginning to contribute substantially to harvest in the Fraser TSA, and interest appears to be increasing. A number of factors have led to the increase in second–growth harvest, such as an increase in the available harvest planning area for licensees, reduced activity in the remaining older forests to achieve other forest objectives, and an increase in the opportunities to use existing infrastructure for harvesting (i.e., existing road networks). However, the ramifications of a significant shift of harvesting to second growth have not been thoroughly examined.

Figure 15 displays the results of a sensitivity analysis in which the target on second-growth stands applied in the base case was removed. For the sensitivity analysis, stands were ranked solely on the basis of volume per hectare. From a volume per hectare standpoint, some second-growth stands possess much higher volumes than some old forest and would be harvested first if stand volume were the sole driver. However, as the lower long-term level shown in Figure 15 demonstrates, a timber supply impact is expected if high productivity second-growth stands are targeted first before poorer productivity old forest. The lower long-term level results because the site indexes of the old growth are not adjusted until they are harvested. Hence targeting second-growth delays the increase in timber productivity.

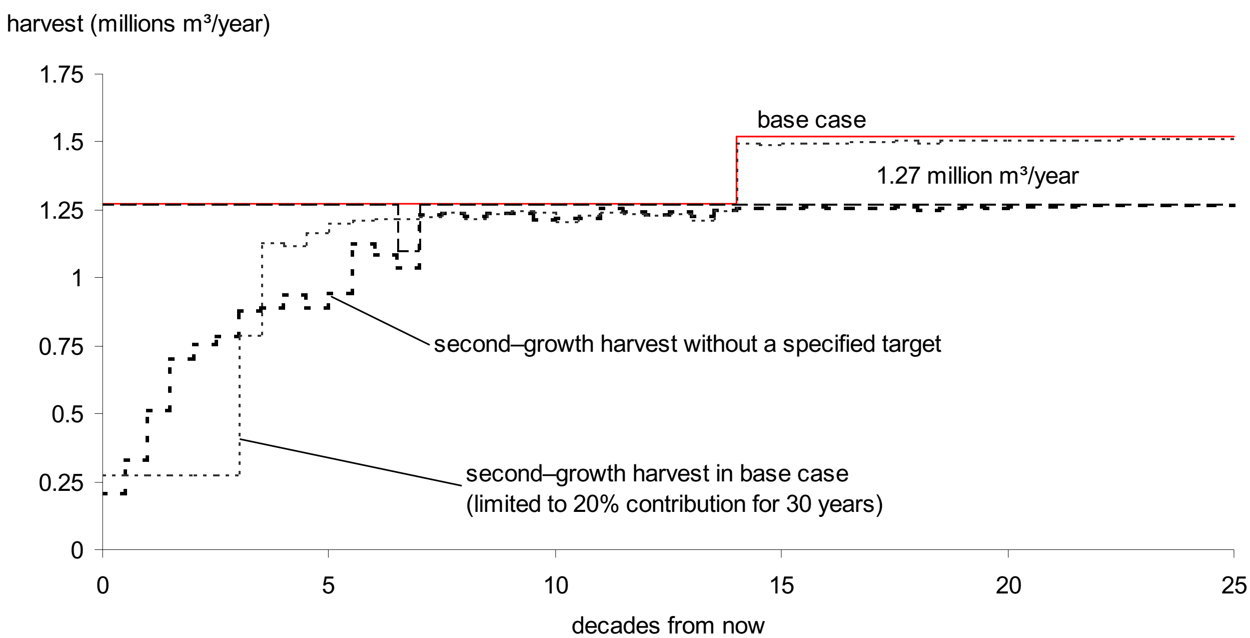


Figure 15. Harvest forecast if stands are scheduled for harvest based on volume per hectare — Fraser TSA, 2003.

5.5 Implications of harvesting fir stands before other species

A potential concern during periods of time when markets for some tree species are poor is the preferential harvesting of a more valuable species. To explore this issue, a sensitivity analysis was performed in which highest priority for harvesting was placed on Douglas-fir. Figure 16 shows that this strategy would yield significantly more fir volume (about one million cubic metres per year) than in the base case for about 15 years until declining quite rapidly to levels around 350 000 cubic metres per year. A cycle is then set up to harvest about 750 000 cubic metres for about 20 years followed by a harvest of about 500 000 cubic metres per year for the subsequent 30 to 40 years. This sequence means that fir stands in many cases are harvested well below the age of maximum average growth, which reduces long-term timber supply. This forecast provides an indication that if there were a focus on fir, hemlock and balsam would need to contribute a large proportion to the timber supply in the future, which could have economic and milling implications for the TSA.

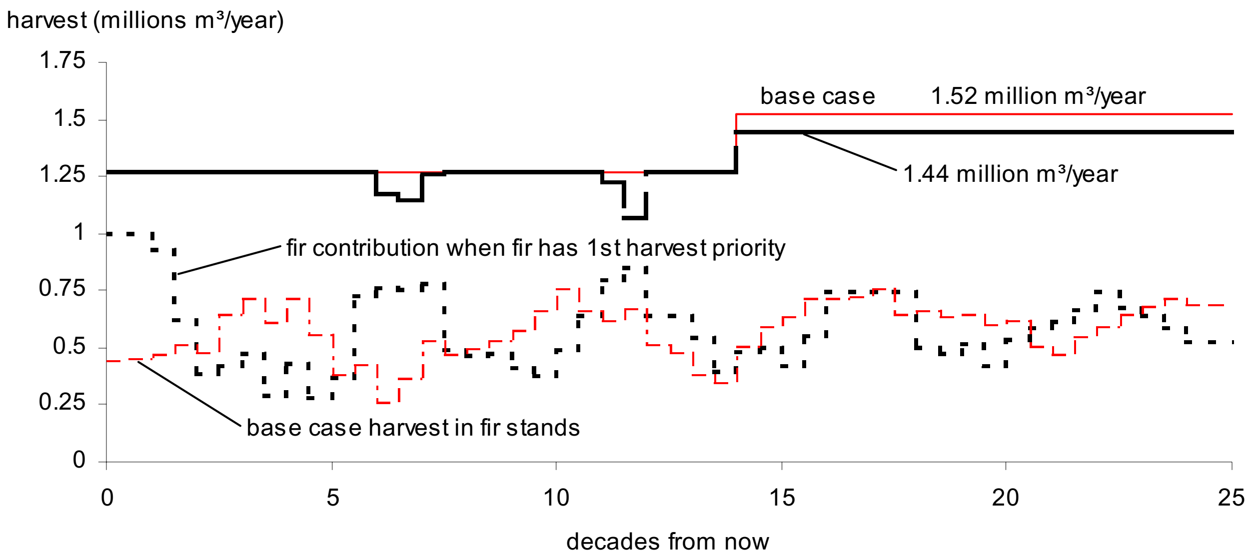


Figure 16. Harvest forecast if fir stands are harvested before other species — Fraser TSA, 2003.

5.6 Uncertainty with the minimum volume required for harvest

Figure 17 portrays the timber supply implications of raising the minimum volume requirements by 100 cubic metres per hectare. The minimum for most stands in the base case was 350 cubic metres per hectare (see Table A–16., in Appendix A). The forecast shows that the base case is not highly sensitive to a significant increase (about 33%) in stand volume required for a stand to be considered harvestable. The forecast shows a decline of 50 000 cubic metres per year in the medium term and long term. The medium-term level is about 4% lower than the base case, while the long-term level is about 3% lower. About 10 000 hectares of timber harvesting land base that is harvested in the base case is not harvested by the end of the planning horizon as a result of the change in merchantability. This is largely responsible for the decrease in the long-term harvest level.

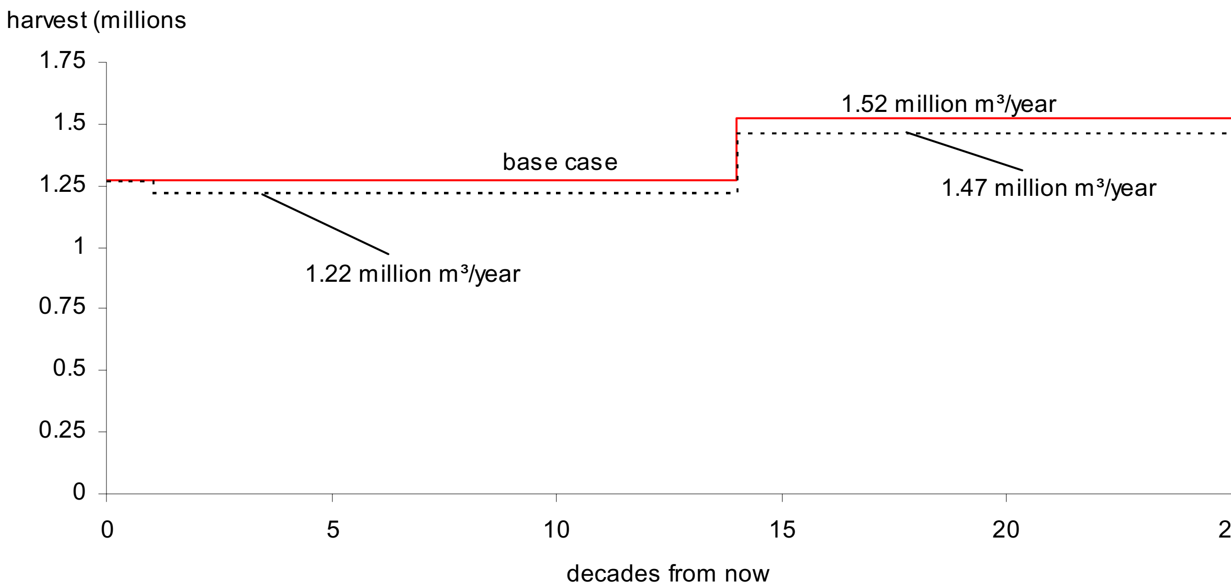


Figure 17. Harvest forecast if the minimum volume requirement is increased by 100 cubic metres per hectare — Fraser TSA, 2003.

5.7 Uncertainty in the implications of the variable retention system

For the past several years, the Chilliwack Forest District has been committed to implementing the principles of variable retention. The retention system is defined under the *Forest Practices Code Act of B.C.* as a silviculture system designed to retain individual trees or groups of trees to maintain structural diversity over the area of the cutblock* for at least one rotation, and to leave more than half the total area of the cutblock within one tree height from the base of a standing tree or group of trees, whether or not the tree or group of trees is inside the cutblock. Both of these methods (single tree and group retention) can be seen in the photograph on the left side of Figure 18. In order to examine the impacts of this practice, a number of assumptions and data methods were employed in this analysis. For group retention, groups were assumed to be one hectare and larger and to be completely accounted for by the land base exclusion for WTPs. Dispersed trees were assumed to be left at the rate of 15 per hectare except in some spotted owl areas where 40 trees per hectare were retained. The implication for existing stand volumes was determined by dividing the retained number of trees by the average initial (or pre-harvest) area-weighted stems per hectare by age class. This implies that higher existing stand volume losses will be experienced in older stands than younger stands.

Research Branch of the Ministry of Forests provided a number of models to estimate the impact of residual trees on the growth of regenerating trees. The simplest form of the yield model uses the variables: tree species (fir or hemlock), per cent retention (surrogate being the number of trees retained divided by the initial total trees per hectare) and the amount of edge the trees occupy. More complex formulations include stand attributes such as site index, and tree height. Crown closure was assumed to be 100%. An example of a virtual variable retention block is seen on the right side of Figure 18.

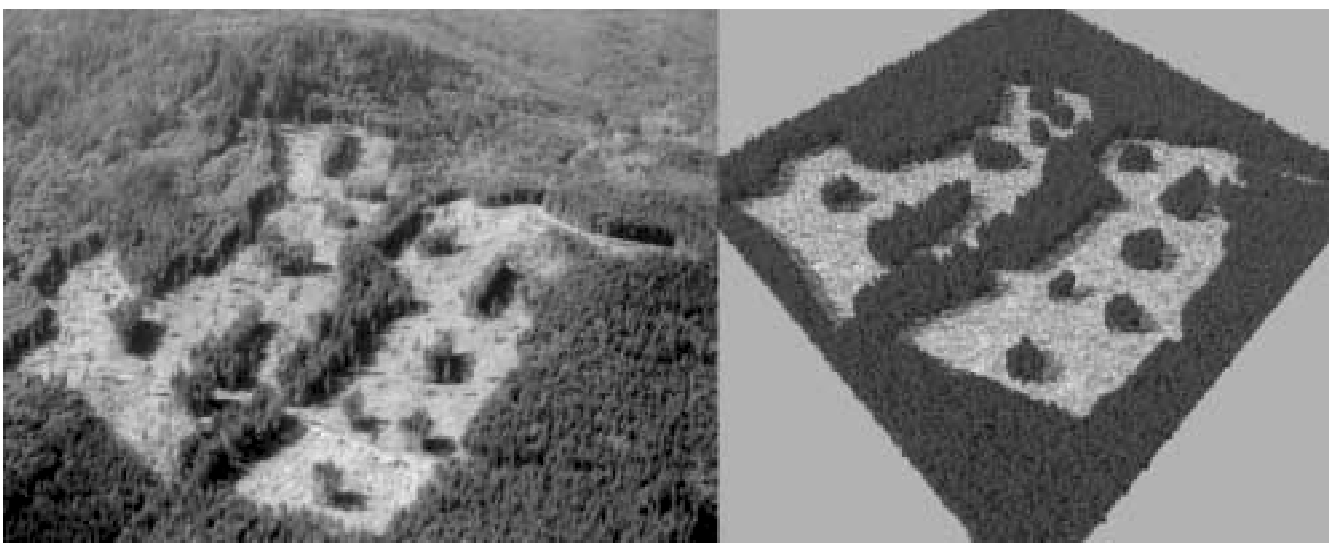


Figure 18. Example of variable retention practiced in the Chilliwack Forest District and the virtual representation — Fraser TSA, 2003

Cutblock
A specific area, with defined boundaries, authorized for harvest.

The timber supply impact associated with variable retention based on the simplest form of the yield model was a reduction of about 3% in the medium term, which accounts for the volume of retained trees left within blocks. The long-term impact is about 8%, which consists of 3% in veteran trees left during the first harvest (short and medium terms), and 5% due to the impact on the regenerated managed forest.

The Chilliwack Forest District funded an office and field review of variable retention practices in the district. The completed report, *Evaluation of the Timber Supply Impacts of Using the Retention System in the Chilliwack Forest District*, found that the estimated volume of planned retention within the blocks reviewed was 6.4% of the estimated harvest volume. In the opinion of the report's author, the expected volume impact from the use of the variable retention system is likely less than 6% as actual retention tended to be lower than what was planned. Another important observation in the report is the increasing irregularity of cutblock boundaries used to provide the forest influence required to achieve the variable retention designation. When stands adjacent to existing cutblocks are harvested, the cutblock edges will need to be retained as part of the variable retention system, which could have an additional, currently unquantified, timber supply impact.

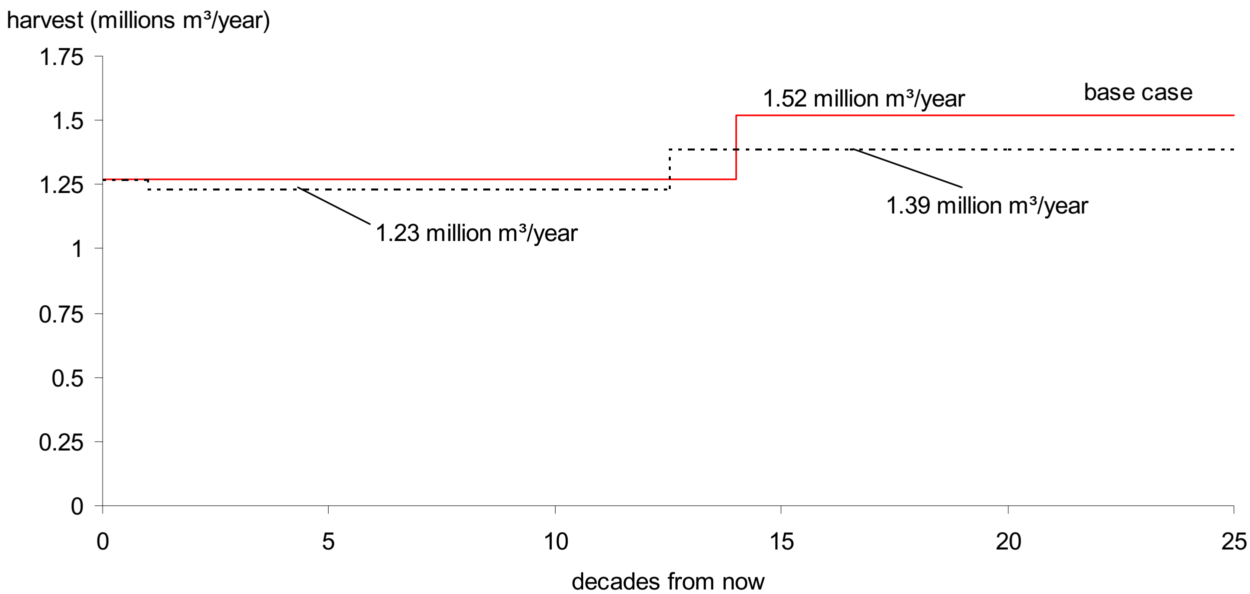


Figure 19. Approximation of the impact of variable retention harvesting on timber supply — Fraser TSA, 2003.

5.8 Uncertainty with IRM forest cover requirements

In the base case, the maximum allowable area below green-up requirements in the integrated resource management (IRM)* area within each landscape unit was 25%. This means that for every one hectare of recent harvest in areas where the only constraint on harvesting is cutblock adjacency, three hectares of timber harvesting land base must be at or above green-up height. The 25% limit on disturbance did not constrain timber supply. No timber supply implications occurred until the allowable disturbance level was reduced to 18% (Figure 20). These results assume that it is possible to harvest in all landscape units at any time, so that when the disturbance limit is reached in one area, harvesting can shift to another.

The allowable disturbance level of 18% is a threshold after which further constraints would produce further reductions in medium- and long-term timber supply. Figure 20 show that if the maximum disturbance were reduced to 15%, the forecast harvest in the second decade would drop to about one million cubic metres per year.

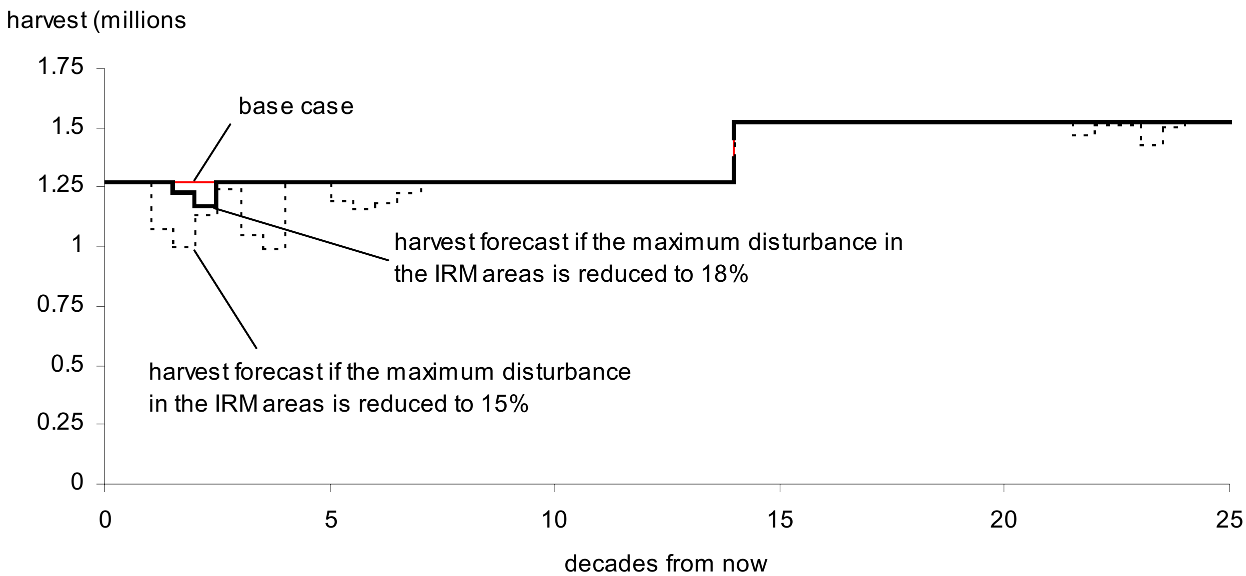


Figure 20. Uncertainty in expressing cutblock adjacency objectives — Fraser TSA, 2003.

Integrated resource management (IRM)
The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

5.9 Uncertainty with the effects of spatial adjacency

The timber supply model used in this analysis allows for a spatial representation of cutblocks subject to adjacency requirements. This approach was not used in the base case, but the implications were evaluated in a sensitivity analysis. For the sensitivity analysis, cutblocks were generated in the model and allowed to range in size from 2 to 40 hectares (the target size of a particular cutblock was chosen from a uniform probability distribution). A 200-metre buffer was drawn around each cutblock. If a cutblock was harvested, the buffer surrounding it could not be cut until the post-harvest regeneration in the cutblock grew to 3 metres in height. In addition, the second-growth target applied in the base case was removed for this sensitivity analysis.

Figure 21 shows that if this adjacency regime were applied, the base case short- and medium-term timber supply could be maintained. The long-term timber supply would be about 11 percent lower than in the base case. When the explicit adjacency requirements were applied, available harvestable area at the beginning of the analysis horizon declined from the base case level of 46 million cubic metres on about 91 000 hectares to 41 million cubic metres on 81 000 hectares.

Even without the specific second-growth harvest target, the base case level of second-growth harvest still occurred. The explicit adjacency restriction reduced the amount of old–growth available for harvest in the model, so second-growth was the only source of timber remaining to achieve the overall harvest target. The result suggests that additional spatial harvest restrictions could lead to more isolation and fragmentation of old-growth, thereby reducing its availability for harvest.

The reduction in long-term timber supply resulted partially because the harvest scheduling rules used in the base case were not applied during cutblock building. In building the cutblocks, a seed point was chosen and stands around it were added, as long as they had achieved merchantable condition, until a cutblock size as close as possible to the target size was reached. The result was that the sequencing of harvests related largely to cutblock size criteria, which led to harvests further from the age of maximum average productivity than did the queuing priorities used in the base case. The observed effect on long-term supply was similar to that seen in other sensitivity analyses in which stands were harvested earlier than the age of maximum average productivity (see Sections 5.1 "Estimating the maximum long-term level, and 5.4 "Implications of ranking stands based on volume per hectare").

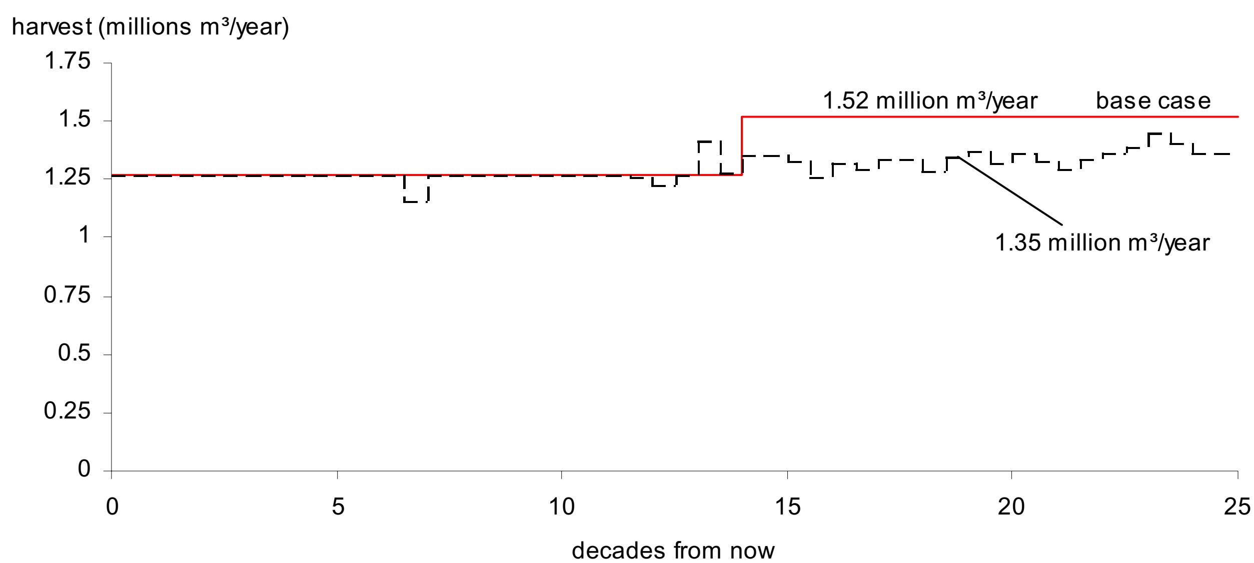


Figure 21. Influence of spatial blocking on timber supply — Fraser TSA, 2003.

5.10 Implications of tree improvement (genetic worth)

A *Forest Practices Code* regulation currently requires that the best available genetic quality source of seed or planting stock be used in reforestation. The base case management assumptions use the genetic gain information available up until 2001, the date all stands were projected to in the inventory file used in the analysis. Currently only fir, cedar and some spruce stands are planted with improved stock*. Once the base case simulation started, the 2001 information based on seed use and genetic gain was assumed to remain static and affect only stand volume. To examine the implications of the tree improvement program currently in use in the Fraser TSA, genetic gain was removed in the derivation of standing volume and the dotted line in Figure 22 shows the long-term timber supply implication. The current genetic gain is about 2% and is applicable only in fir and cedar areas.

Conversely, if the current 10-year projection of seed availability and seedlot gains were employed in generating yield tables for the analysis, the long-term timber supply would increase by 5% over the base case, as shown by the dashed line in Figure 22. This sensitivity analysis involved using genetic gain assignments based on appropriate seed zones and the seed use and the seedlot genetic gain available in a particular year. The timber supply increase due to genetic gain is associated with fir and cedar stands. If silviculture operations were shifted from natural regeneration of hemlock to planting improved hemlock seedlings, the long-term level would be further increased. Currently, improved stock is being used on only about 40% of the timber harvesting land base under the current seed use guidelines and planting regimes.

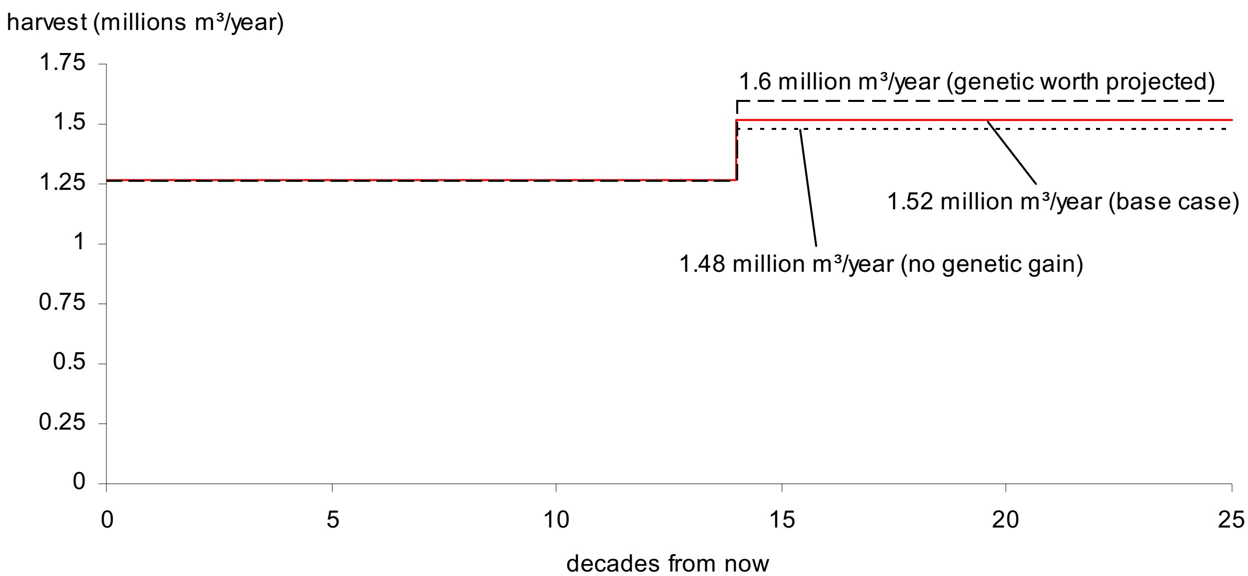


Figure 22. Sensitivity of the harvest forecast to genetic worth considerations — Fraser TSA, 2003.

Improved stock
Trees selected from the natural population with better than average characteristics such as growth rates.

5.11 Old-forest retention: implications of recruitment and minimum size requirements

Currently, nine landscape units in the Fraser TSA have had significant work completed in the delineation of old-growth management areas. This information was used in the base case. The implication of applying a forest cover requirement to allow continual recruitment of old forest rather than reserving specific old-growth management areas in the model was examined in a sensitivity analysis. The stands in old-growth management areas excluded from the timber harvesting land base in the base case that would otherwise be eligible for the timber harvesting land base (about 3800 hectares) were considered available for harvest. Forest cover requirements for biodiversity were applied in all landscape units. The resulting forecast, shown by the dashed line in Figure 23, is higher than the base case by about 2% in the medium term and 3% in the long term.

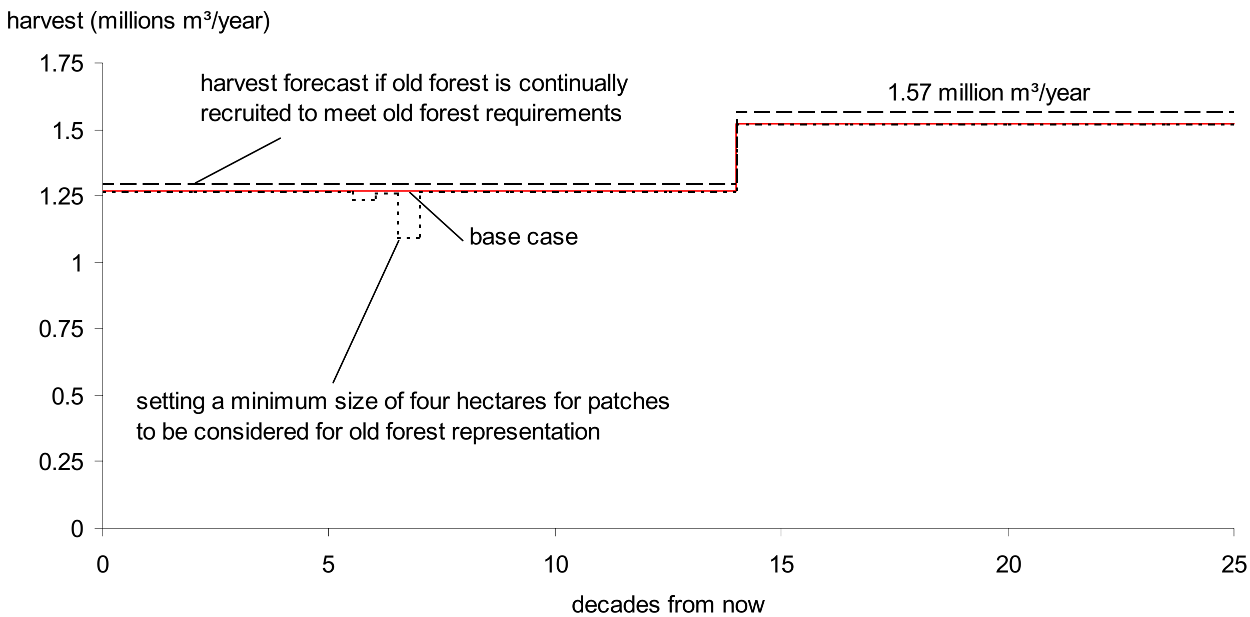


Figure 23. Sensitivity of the harvest forecast to recruiting old forest and setting minimum size criteria — Fraser TSA, 2003.

Other important ingredients in designing effective old-growth management areas are the size and shape of the area. A sensitivity analysis was performed to examine the implications of requiring that stands must be at least four hectares in size to be eligible as old forest in the landscape units where draft old-growth management areas have not been assigned. The dotted line in Figure 23 shows a disruption relative to the base case in the medium term. This disruption is small in the context of the entire medium term, and could be eliminated by slightly reducing the medium-term level. However, the impact indicates that if contiguous areas of old forest over four hectares are used to create future OGMAs, some timber harvesting land base will likely be reserved, which would reduce timber supply in the landscape units currently without old-growth management areas.

5.12 Implications of natural disturbance-based succession using the *Biodiversity Guidebook* return intervals

In the base case, it was assumed that natural disturbance would not affect areas outside of the timber harvesting land base, so that stands would age indefinitely. A sensitivity analysis was done to evaluate the potential timber supply effects of natural disturbances in those areas. The rate of natural disturbance for the sensitivity analysis was based on return intervals of stand replacing events listed in the *Biodiversity Guidebook*. The return intervals were used to estimate an expected rate of stand replacing events for each BEC variant. Because most of the Fraser TSA is in NDT 1 and 2 where stand types are long-lived, stands within 100 years of the old-forest age or older were assumed to be eligible to experience a stand replacing event. The forecast displayed in Figure 24 shows that the medium-term timber supply would decline by 4%, and the long-term harvest by 3%, relative to the base case. This impact occurred because, given the estimated disturbance rate outside the timber harvesting land base, more forest within the timber harvesting land base was reserved from harvest to achieve old-forest requirements and visual quality objectives (VQO)*.

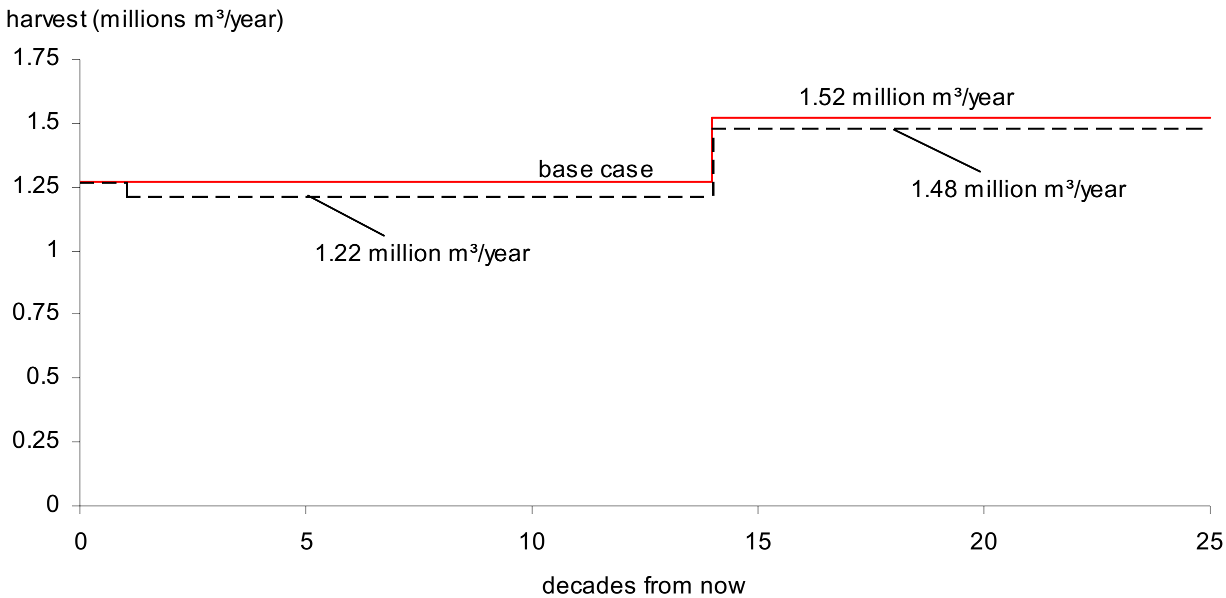


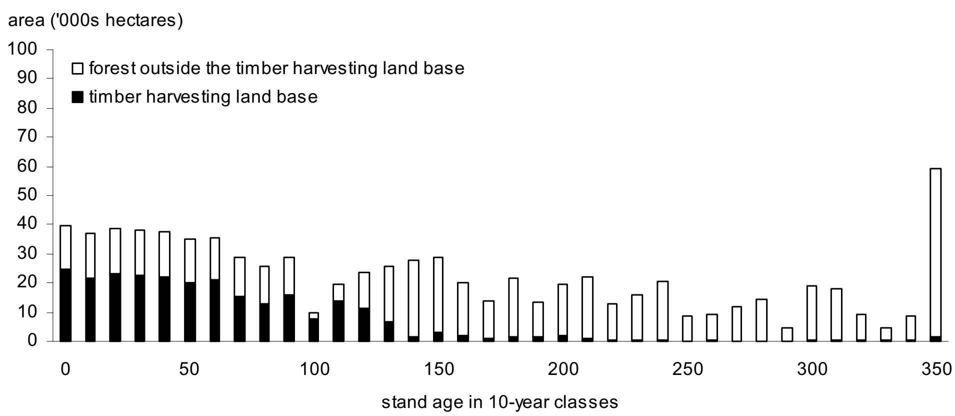
Figure 24. Impact of applying natural disturbance based on Biodiversity Guidebook return intervals — Fraser TSA, 2003.

Visual quality objective (VQO)
Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.

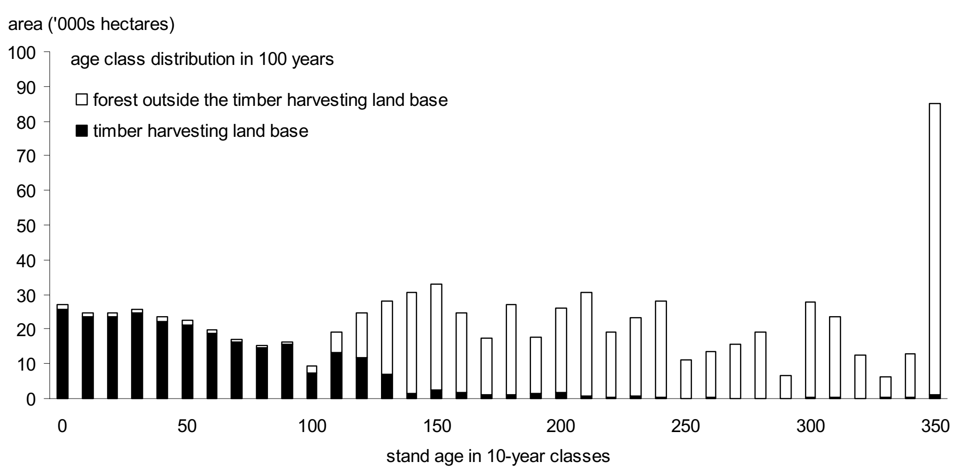
Figure 25 compares the age class distributions 100 years from now, for this sensitivity analysis and the base case. The modelled natural disturbance resulted in a uniform distribution of area in younger ages outside of the timber harvesting land base (Figure 25a). Using the *Guidebook* return intervals, about 1300 hectares could be expected to be affected annually by natural disturbance outside of the timber harvesting land base. Conversely, there was very little area in these age classes in the base case.

The current age class distribution (Figure 4), shows only a small area in younger classes in the non-timber harvesting land base, meaning that the approach used in the sensitivity analysis resulted in disturbance of more area than has been experienced in the last twenty years. Some of this difference may be due to underestimation of recently disturbed land in the inventory, for example, because incomplete regeneration after stand replacing events may have led to land being considered as non-vegetated, rather than as disturbed forest, or because stands that have experienced incomplete destruction may be labelled in the inventory with the age of the residual trees.

While the amount of natural disturbance outside of the timber harvesting land base is uncertain, the disturbance rate can affect timber supply and other management objectives. For example, if stands cannot be expected to remain on the landscape indefinitely, definition of old-growth management areas and assignment of visual management regimes could be affected.



(a) Age class composition at 100 years assuming natural disturbance outside the timber harvesting land base



(b) Base case age class composition at 100 years, assuming no natural disturbance

Figure 25. Age class composition at 100 years with different assumptions regarding natural disturbance — Fraser TSA, 2003.

6 Summary and Conclusions of the Timber Supply Analysis

The results of the timber supply analysis suggest that under current management assumptions and the use of new forest cover inventory information and new post-harvest site index information, the timber supply can be maintained at the current AAC for 140 years and then increase by 20% to 1.52 million cubic metres per year 140 years from now. If neither of the two new sources of information were applied, the resulting timber supply projection would be similar to that shown in the previous timber supply review analysis for the Fraser TSA, in which timber supply continued to decline for 20 to 30 years into the future.

The analysis also highlights the significant transition points that can be expected when harvesting shifts from predominately old forest to second growth and when future managed stands begin to contribute most of the timber supply.

To facilitate a summary of the sensitivity analyses, Table 6 was prepared to describe medium- and long-term harvest levels. The first 10 years of harvest was held constant at 1.27 million cubic metres per year in all sensitivity analysis. For sensitivity analyses in which there was an abrupt timber supply disruption or no particular harvest flow was requested, the medium- or long-term level shown in the table is the average harvest over the time period.

The table highlights that the issues and uncertainties most important to defining short- and medium-term timber supply are: the impacts of the new VRI and site productivity information; and choice of the time of harvesting in future stands, which is linked to merchantability criteria. For long-term timber supply, issues with significant impact are: the new site productivity estimates; harvest priority by volume, stand age and/or species; variable retention harvesting regimes; spatial adjacency constraints; and future genetic gains.

Table 6. Summary information from the timber supply sensitivity analyses — Fraser TSA, 2003

		Harvest level (millions cubic metres per year)	
Report section	**Harvest forecast description**	**Medium term 21-100 years**	**Long term > 100 years**
5.1	Estimating the maximum long-term harvest level	1.11	1.60
5.2	Alternative harvest flow	1.11	1.54
5.3	Implications of using the VRI and site index assignment	0.99	1.2
5.4	Implications of ranking stands based on volume per hectare	1.27	1.27
5.5	Implications of harvesting fir stands before other species	1.27	1.44
5.6	Uncertainty with the minimum volume required for harvest	1.22	1.47
5.7	Uncertainty in the implications of the variable retention system	1.23	1.39
5.8	Harvest forecast at maximum 18% allowable disturbance in the IRM zone	1.17	1.27
	Harvest forecast at maximum 15% allowable disturbance in the IRM zone	< 1.0	1.27
5.9	Uncertainty with the effects of spatial adjacency	1.27	1.35
5.10	Removing genetic gain from timber supply	1.27	1.48
	Projecting future gains and seed use	1.27	1.6
5.11	Implications of recruiting old forest	1.3	1.57
	Implications of requiring a minimum old-forest size	< 1.27	1.52
5.12	Implications of natural disturbance based succession using the *Biodiversity Guidebook* return intervals	1.22	1.48

7 Socio-Economic Analysis

7.1 Socio-economic setting

7.1.1 Current population and demographic trends

The Fraser timber supply area (TSA) is part of the Chilliwack Forest District and includes the communities of the Lower Mainland, Fraser Valley, and smaller communities and rural areas of the Fraser Canyon. For purposes of describing the socio-economic setting, the reference to the Fraser TSA and Chilliwack Forest District are used interchangeably.

In 2001, the district's population was over 2.2 million people, reflecting a 8.3% increase since 1996.[1] Table 7 provides population statistics for selected communities, Chilliwack Forest District, and the Greater Vancouver and Fraser Valley Regional Districts. From 2001 to 2006, the population of the Chilliwack Forest District is expected to increase by 8.1%.[2] This growth is projected to be spread fairly evenly between the Greater Vancouver Regional District (8.3%) and the Fraser Valley Regional District (7.9%).

Table 7. Chilliwack Forest District population statistics, 1996 – 2006

Community	1996	2001	2006 (est.)[a]	% change 1996-01	% change 2001-2006
Vancouver	514,008	545,671	N/A	6.2	–
City of Abbotsford	105,403	115,463	N/A	9.5	–
Chilliwack	60,186	62,927	N/A	4.6	–
Mission	30,519	31,272	N/A	2.5	–
Hope	6,247	6,184	N/A	-1.0	–
Fraser Canyon[b]	733	596	N/A	-18.7	–
Fraser Valley Regional District	222,397	237,550	256,300	6.8	7.9
Greater Vancouver Regional District	1,831,665	1,986,965	2,152,000	8.5	8.3
Chilliwack Forest District	2,052,672	2,223,000	2,403,000	8.3	8.1
British Columbia	3,724,500	3,907,738	4,130,500	4.9	5.7

Source: Census, 1996, 2001, BC Stats Population Projections. http://www.bcstats.gov.bc.ca/data/pop/pop/popproj.htm

a. 2006 Regional District estimates based on BC Stats population projections. Chilliwack Forest District population for 2006 estimated using Regional District estimates.

b. Fraser Canyon includes Boston Bar and communities north to Boothroyd, as well as other rural areas.

(1) BC Stats. Population Section. Government of B.C.

(2) BC Stats. Population Section. Government of B.C.

7 Socio-Economic Analysis

7.1.2 Economic profile

Current Economic Structure

The Chilliwack Forest District has fairly distinct economic regions, becoming more service oriented closer to the City of Vancouver. Table 8 shows the most recent labour force statistics by industry sector for the Fraser Valley and Greater Vancouver Regional Districts — the two approximately cover the Fraser TSA.

Typical of larger urban centres, the Fraser TSA economy, especially Greater Vancouver, has large business, consumer service, and public sectors. While no single sector dominates, the business and consumer services sectors, including finance, insurance and real estate (FIRE), transportation, communications and utilities (TCU), wholesale and retail trade, accommodation, and government services, combine to account for about 70% of the region's employment.

As Table 8 indicates, the primary sectors, such as forestry, do not dominate the forest district's economy. However, these sectors become more important east of metropolitan Vancouver and especially the upper Fraser Valley and Fraser Canyon. This shift can be seen in the statistics in Table 8 where agriculture, forestry, fishing and mining account for 1% of the total experienced labour force in the Greater Vancouver Regional District (GVRD) *versus* the 9% in the Fraser Valley Regional District (FVRD). The table also indicates the dominance of service sectors and public service related services such as health, education and government services. Wholesale and retail trade also contribute substantially to the employment of the area.

Table 8. Chilliwack Forest District labour force by industry sector, 2001[3]

	Fraser Valley Regional District	Greater Vancouver Regional District	FVRD %	GVRD %
Total labour force	115,650	1,049,910	100%	100%
Agriculture, forestry, fishing and hunting	10,190	13,270	9%	1%
Mining and oil and gas extraction	370	2,250	0%	0%
Utilities	475	6,205	0%	1%
Construction	8,615	53,800	7%	5%
Manufacturing	13,190	99,055	11%	9%
Wholesale and retail trade	18,110	172,540	16%	16%
Transportation and warehousing	6,645	65,700	6%	6%
Information and cultural industries	1,800	44,350	2%	4%
Finance, insurance and real estate	4,930	78,845	4%	8%
Management, admin. and other services	10,620	98,105	9%	9%
Professional, scientific and technical services	4,755	91,715	4%	9%
Educational services	7,340	74,480	6%	7%
Health care and social assistance	11,280	99,355	10%	9%
Arts, entertainment and recreation	1,905	24,050	2%	2%
Accommodation and food services	8,595	81,560	7%	8%
Public administration	6,830	44,630	6%	4%

(3) Census of Canada, 2001, Labour force by industry. BC Stats.

Employment income is another indicator of a sector's contribution to the economy. While income dependency data is not yet available for the 2001 Census, income dependency statistics based on the 1996 Census provide an insight into the sub-district differences. For example, in the Hope-Fraser Canyon area, forestry alone accounted for 17% of the total income flowing into the forest district. However, in the more urban area of Chilliwack, forestry only accounted for 5% of the total. In all areas of the district, the public sector, including health, education and government services accounted for the largest share of income.

Sectors with high-income levels will also tend to support more supply and service activity than those with lower income levels. For example, using basic income and employment* as indicators of a sector's activity, Table 9 indicates that the forest sector supports less basic employment than tourism, but has a higher basic income level, thus each job in the forest sector will have a greater impact on the local economy.

A regional impact, or multiplier analysis, gives yet another perspective. Each 100 direct forestry jobs in the Fraser TSA are estimated to support a further 74 to 110 indirect and induced jobs*, depending on the type of forestry activity (wood manufacturing, logging, or pulp and paper) and the associated level of wages and salaries. In contrast, each 100 public sector jobs are estimated to support another 40 positions while each 100 tourism jobs support 20 further jobs. Only mining (rock quarries for example) and construction fall into the range of forestry, at 78 and 70 associated positions, respectively per 100 jobs.

Table 9. Comparison of basic sector indicators, Fraser TSA, 1996*

Basic sector	% basic employment[a]	% basic income[a]	Employment multiplier*
Forestry	5.0	4.0	1.37 – 1.80
Mining and mineral processing	1.0	1.0	1.66
Fishing and trapping	1.0	1.0	N/A
Agriculture and food	5.0	3.0	1.28
Tourism	12.0	5.0	1.03
Public sector	32.0	25.0	1.20
Construction	13.0	9.0	1.44

(a) Does not add to 100 as table excludes "other" category and transfer and investment related income.

Source: The 1996 Forest District Tables, Ministry of Finance and Corporate Relations.

Basic income and employment
Indicators used to describe the size of a basic sector.
Indirect and induced jobs
Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.

Basic sector
Sectors of the economy, such as forestry, tourism and mining, that create flows of income into the region and are assumed to be drivers of the local economy. Non-basic sectors, such as retail outlets, are supported by basic sectors.
Employment multiplier
An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

7 Socio-Economic Analysis

Since release of the previous socio-economic report for the timber supply review, the economy of British Columbia and the Chilliwack Forest District has continued to shift towards service industries. From 1998 to 2002, service-producing industries in British Columbia, such as transportation, education, wholesale and retail trade, and accommodation, have increased by close to 8%.[4] Goods-producing industries in British Columbia, such as forestry, mining, agriculture and manufacturing, have declined by over 2%.

In the Mainland-Southwest Development Region, which includes the Chilliwack Forest District, there are no sectoral data to compare at this time, however employment has increased overall. From 1998 to 2002, the total labour force in the Mainland-Southwest Development Region increased by close to 10%. The population of the development region increased by about 6%, indicating a net increase in total employment.

For the smaller communities in the eastern portion of the Chilliwack Forest District, especially from Hope through the Fraser Canyon, the trends are not as favourable.

In terms of forestry activity in the forest district, the timber supply forecast indicates that the timber supply can be maintained at its current level for the short and perhaps medium terms, which should contribute to economic stability.

(4) Statistics Canada, Labour Force Survey. Provided by BC Stats.

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9 Glossary

Allowable annual cut (AAC)	The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.
Analysis unit	A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location — done to simplify analysis and generation of timber yield tables.
Base case harvest forecast	The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.
Basic income and employment	Indicators used to describe the size of a basic sector.
Basic sector	Sectors of the economy, such as forestry, tourism and mining, that create flows of income into the region and are assumed to be drivers of the local economy. Non-basic sectors, such as retail outlets, are supported by basic sectors.
Biodiversity (biological diversity)	The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.
Biogeoclimatic (BEC) variant	A subdivision of a biogeoclimatic subzone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.
Biogeoclimatic zones	A large geographic area with broadly homogeneous climate and similar dominant tree species.
Cutblock	A specific area, with defined boundaries, authorized for harvest.
Cutblock adjacency	The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.
Deciduous	Deciduous trees shed their leaves annually and commonly have broad-leaves.

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Employment multiplier	An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.
Environmentally sensitive areas	Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.
Forest inventory	An 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 other forest values such as recreation and visual quality.
Forest Practices Code	Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Forest type	The classification or label given to a forest stand, usually based on its tree species composition. Pure spruce stands and spruce-balsam mixed stands are two examples.
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 after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Growing stock	The volume estimate for all standing timber at a particular time.
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 practices. 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.
Improved stock	Trees selected from the natural population with better than average characteristics such as growth rates.
Indirect and induced jobs	Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.

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Inoperable areas	Areas defined as unavailable for harvest for terrain-related or economic reasons. Operability can change over time as a function of changing harvesting technology and economics.
Integrated resource management (IRM)	The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.
Landscape-level biodiversity	The *Landscape Unit Planning Guide* provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.
Landscape unit	A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.
Long-term harvest level	A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.
Management assumptions	Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.
Minimum harvestable age	The age at which a stand of trees is expected to achieve a merchantable condition. The minimum harvestable age could be defined based on maximize average productivity (culmination of mean annual increment), minimum stand volume, or product objectives (usually related to average tree diameter).
Model	An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.

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Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.
Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Sensitivity analysis	A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.
Site index	A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.
Stocking	The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
Table Interpolation Program for Stand Yields	A B.C. Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.
Timber harvesting land base	Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.
Timber supply	The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)	An integrated resource management unit established in accordance with *Section 7* of the *Forest Act*.
Unsalvaged losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.

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Variable Density Yield Prediction model	An empirical yield prediction system supported by the Ministry of Sustainable Resource Management, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed species composition.
Visual quality objective (VQO)	Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Volume estimates (yield projections)	Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.
Watershed	An area drained by a stream or river. A large watershed may contain several smaller watersheds.
Wildlife tree	A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

Appendix A

Description of Data Inputs and Assumptions for the Timber Supply Analysis

Introduction

This appendix outlines the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Fraser TSA timber supply analysis. This information represents current forest management in the area.

Current management is defined as the set of land-use decisions and forest and stand management practices currently implemented and enforced. Future forest management objectives that may be intended, but are not currently implemented and enforced, are not included in this appendix.

The purpose of the timber supply review is to provide information on the effects of current management on both short- and long-term timber supply in each timber supply area in the province. Any changes in forest management objectives and practices, and any improvements to the data will be included in subsequent timber supply analyses.

A.1 Inventory Information

The following data sources were consulted during this timber supply review.

Table A-1. Inventory information

Data	Source	Vintage	Update	Scale
Forest cover – FC1	Ministry of Forests (MoF)	1970-74	2001	1:20000
Forest cover – VRI	Ministry of Sustainable Resource Management (MSRM)	1996	2001	1:20000
Updated recommended visual quality classes	MoF	1996	2001	1:20000
Draft landscape unit boundaries	MSRM	1996	1996	1:20000
Draft old-growth management areas	MSRM	2002	2002	1:20000
Operability mapping	MoF	1996	1996	1:20000
Archaeological data – known sites only	MoF	1997-2001	2001	1:50000
Consolidated Forest Development Plan (FDP)	MoF	2001	2001	1:50000
Community watershed	Ministry of Water, Land and Air Protection (WLAP)	1997	N/A	1:20000
Spotted owl SRMZ and matrix areas	MSRM	1999	1999	1:20000
Seed planning units version 2	MoF	2003		1:250000
Mule deer winter ranges (MDWR)	WLAP	2001		1:20000
Goat winter ranges	WLAP	2003		1:20000

Data source and comments:

A new vegetation resource inventory (VRI) has been completed for the Fraser TSA based predominantly on 1996 aerial photography. For this analysis, the new VRI file has been updated with logging information to 2000 (including NSR — not satisfactorily stocked and all areas with opening history under 45 years of age). Information from the previous forest cover maps (i.e., FC1) were used for this process. Note that the new Fraser TSA VRI does not include all of the historical information that has been traditionally recorded on the FC1 coverage. Phase 2 of the VRI involved the establishment of ground sample plots to determine the accuracy of the photo-interpreted labels established during phase 1. The specific age, height and volume adjustment factors applied to each species group and the associated statistical data can be obtained from Ministry of Sustainable Resource Management in Victoria.

Currently, only nine landscape units (LUs) have had OGMAs advertised for public review (Ainslie, Anderson, Coquihalla, Manning, Mehatl, Nehatlatch, Silverhope, Spuzzum and Yale).

A.1 Inventory Information

The operability mapping has been adjusted to include all logged areas or areas in the Forest Development Plan that were previously considered inoperable.

As the VRI maps contain only vegetation data, local information needed for analysis such as operability mapping, environmentally sensitive areas (ESA), updated recommended visual quality classes (RVQC) codes, spotted owl special resource management zones (SRMZs) and matrix areas, draft landscape unit boundaries, old-growth management areas (OGMAs), draft biodiversity emphasis options (BEO), community watershed designations, goat winter range etc, were merged with the VRI file to produce a set of resultant data files for use in the timber supply analysis. This local information is available in digital format from the Ministry of Forests, Chilliwack Forest District or the source custodian upon request.

A.2 Zone and Analysis Unit Definitions

A.2.1 Management zones (groups)

Management zones are used to differentiate areas with different management objectives. For example, a zone may be defined as an area which has a common silviculture system, wildlife habitat requirement, or visual quality objective. The computer simulation model enables the tracking of multiple objectives on the forested land base. In addition, the non-contributing forest (land considered unavailable for timber harvesting) may be included for consideration in attaining forest cover objectives. Grouping enables forest management constraints to be apply to different combinations of variables or zones. Groups may be thought of as layers of different objectives, which must be tracked over time. Further information on the forest cover requirements to be applied to these areas can be found in Section A.4.8.

Table A-2. Objectives to be tracked

Objective/Issue	Inventory definition
Cutblock adjacency only	No recommended visual quality class (RVQC) or non-visual areas (NVA).
Recommended visual quality classes (RVQC)	The new RVQC codes are: R, PR_L, PR_M and PR_H, and M. The partial retention classification is divided into low(L), moderate(M) and high(H) sensitivity for visual impact.
Deer and goat winter range	WLAP defined classic mule deer winter range and goat winter range.
Second-growth harvesting	Above the minimum harvest age and younger than 105 years old. (Current stands < 105 years will be called second growth).
Harvesting in fir	All fir-leading analysis units.
Spotted owl SRMZs and matrix areas	SRMZ numbers indicated on spotted owl SRMZ mapping. Within SRMZs there are: long-term owl habitat (LTOH), forest management areas (FMA) and replacement areas (RPA). Outside of the SRMZ areas are matrix areas where harvest sequencing will be managed.
Community watersheds	Community watershed numbers indicated on mapping.
Urban interface areas	Crown forests that are outside provincial forest.
Draft landscape units, biodiversity emphasis options and biogeoclimatic variants	Draft BEO and BEC indicated on mapping. Limited OGMA mapping is available (9 landscape units).
Helicopter logging	Operability code ‘H’.

A.2 Zone and Analysis Unit Definitions

A.2.2 Analysis unit characteristics

An analysis unit is a grouping of stands that are dominated by a specific tree species and have similar timber growing capability. Each analysis unit is assigned its own timber volume projection (yield table) for *future* stands. For *existing* stands, a yield table was defined using the variable density yield prediction (VDYP) model for each unique combination of relevant forest attributes, rather than for pre-defined analysis units; no aggregation of different stand types was done.

Yield tables for recent plantations and future stands were derived using the table interpolation program for stand yields (TIPSY).

Table A-3. General definition of analysis units

General analysis unit description	Inventory type groups	Description
Fir (Fd) – SI less than 17.4	1 – 8	< 17.4
Fir (Fd) – SI 18 to 34	1 – 8	1 metre increments (e.g., SI 17.5 – 18.4 is in SI 18 AU)
Fir (Fd) – SI 35+	1 – 8	> 34.5
Cedar (Ce) – < 101 years	9 –11	All sites
Cedar (Ce100) – 100+ years	9 –11	All sites
Hemlock/balsam (HB) – SI less than 10.4	12 – 20	< 10.4
Hemlock/balsam (HB) – SI 11 to 29	12 – 20	1 metre increments (e.g., SI 10.5 – 11.4 is in SI 11 AU)
Hemlock/balsam (HB) – SI 30+	12 – 20	> 29.5.
Pine/larch (Pl)	27 – 31	All sites
Spruce (S_)	21 – 26	All sites
Alder (D_)	37 – 38	All sites

A.3 Definition of the Timber Harvesting Land Base

This section outlines the steps used to identify the timber harvesting land base (i.e., the productive forest expected to support timber harvesting) within the Fraser timber supply area. Land may be unavailable for timber harvesting for three principle reasons:

- it is not administered by the Forest Service for timber supply purposes (e.g., private land, parks, etc.);
- it is not suitable for timber production purposes (e.g. non-forested areas); or
- it is unavailable for timber harvesting (e.g. recreation areas, wildlife areas).

Conversely, land may be added to the timber harvesting land base:

- by management activities which improve productivity or operability (e.g., the stocking of land currently classified as non-commercial brush); or
- by the acquisition of productive forest land (e.g., timber license reversions).

A.3.1 Land not administered by the British Columbia Forest Service for timber supply

Ownership codes were used to identify whether the land was considered to contribute to timber supply. Generally only ownership codes 62C and 69C contribute to the timber supply although timber licence areas (70N) will eventually contribute after the areas are harvested and regenerated.

A.3 Definition of the Timber Harvesting Land Base

Table A-4. Land base summary by ownership code

Code	Ownership classification description	Area within Fraser TSA (hectares)	Timber harvesting land base (hectares)
40N	Private	137 699	
50N	Federal reserve	276	
52N	Indian reserve	12 630	
53N	Military reserve	711	
60N	Ecological reserve	3 337	
61C	Use recreation & enjoyment of the public (UREP)	1 858	
61N	UREP	1 766	
62C	Forest management unit	0	235 654
63N	Provincial park, class A	283 960	
66N	Provincial park, class C	32	
67N	Provincial park/reserve	8 795	
69C	Miscellaneous reserves	0	16 297
69N	Miscellaneous reserves	2 681	
70N	Timber licence in a TSA	0	9 050
72A	Private land in a TFL	2 627	
72B	Provincial land in a TFL	10 799	
74N	Private and provincial in a watershed	58 406	
76N	Unreported in a TFL	1 072	
77N	Provincial land in a woodlot licence	4 004	
99-N	Miscellaneous leases	143	
	Total	530 795	261 001

A.3 Definition of the Timber Harvesting Land Base

A.3.2 Land classified as non-vegetated, non-treed or exhibiting very poor productivity

The vegetation resource inventory uses the B.C. land cover classification coding system to identify components of the land base. Areas are classified by the presence or absence of vegetation, land cover type (treed or non-treed), land position (alpine, wetland or upland), vegetation type and vegetation density.

In general, land was excluded from the timber harvesting land base if it was classified as: non-vegetated; vegetated non-treed; or vegetated-treed with sporadic tree cover or very low productivity, or in wetland or alpine areas.

Land that has a logging history in the old forest cover inventory (FIP) or was proposed as a harvest block in the 2001 Forest Development Plan was considered part of the working forest regardless of its current B.C. land cover classification code. This was necessary as the B.C. land cover classification provides the current state of many areas but does include projections (e.g., newly harvested areas classed as vegetated non-treed areas would be replanted, or current plantations that currently have a large shrub component that will be over-topped by trees in the next 10 to 20 years). About 10% of the timber harvesting land base falls into the category of vegetated non-treed land.

Certain vegetated-treed stands were considered unavailable for timber supply, specifically those in alpine or wetland areas and with either very poor productivity or sporadic tree cover. Alpine and wetland complexes are actual inventory designations. Sparse stands or stands with questionable productivity were identified as those with a very isolated tree cover pattern (below 5), with more than 50% in a non-productive land cover component (e.g., rock), within the Alpine Tundra biogeoclimatic zone, or with site index below 10 metres.

A.3 Definition of the Timber Harvesting Land Base

Table A-5. Land base summary of excluded non-forest non-productive forest types

Broad B.C. land cover classification	Description	Area removed (hectares)
Water	Lake	37 469
	River or stream	14363
	Salt water	13 525
	Reservoir	10
Non-vegetated land	Rock	9 175
	Snow and ice	5 697
	Exposed soil	633
Vegetated land — non-treed	Shrubs	58 989
	Herbs	28 237
	Bryoid	14 598
Vegetated land — treed	Alpine or wetland Sparsely treed, low productivity	3 491 66084
Unreported	None available	691
Total		252 962

A.3.3 Inoperable areas

Operability codes are generally based on the presence or absence of physical barriers or limitations to harvesting, the appropriate logging methods (e.g., cable, helicopter) and the merchantability of the stands. Stands with an operability code of I or N were excluded from the timber harvesting land base. Stands that have been harvested or were in the forest development plan in 2001 were considered operable regardless of the operability code. Table A-6. summarizes the tree species composition of inoperable areas.

A.3 Definition of the Timber Harvesting Land Base

Table A-6. Description of inoperable area by leading species

Leading species	Area-weighted site productivity	Area removed (hectares)
Aspen	26	232
Balsam	12	127 086
Western redcedar	15	2 564
Alder	13	3 179
Birch	21	1 100
Fir	19	51 223
Hemlock	12	51 058
Maple	21	413
Pine	16	4 699
Spruce	14	3 980
Yellow-cedar	12	1 217
Total		246 751

A.3.4 Currently unmerchantable stand types

Unmerchantable forest types are stands which are physically operable and exceed low site criteria yet are not currently utilized. In the Fraser TSA, aspen, birch and maple are not normally used commercially, and were excluded from the timber harvesting land base.

Table A-7. Description of unmerchantable stand types

Leading species	Area-weighted productivity	Area removed (hectares)
Aspen	27	1 322
Birch	22	4 343
Maple	22	4 665
Total		10 329

A.3.5 Stands with low site productivity

Sites may have low productivity either because of inherent site factors (e.g., poor nutrient availability, exposure, excessive moisture, etc.), or because they are not fully occupied by commercial tree species. Such sites, as identified by the criteria listed in Table A-8., are not expected to contribute to timber supply, and were removed from the timber harvesting land base.

Table A-8. Description of sites with low timber growing potential

Leading species	Characteristics	Reduced area (hectares)
Fir	Existing volume less than 350 m^3/hectare and SIBHA50 less than 16 metres (projected not to produce 350 m^3/hectare by age 150 years). In heli-log areas existing volume less than 400 m^3/ha and SIBHA50 less than 18 metres.	3 209
Cedar	Existing volume less than 350 m^3/hectare and SIBHA50 less than 13 metres (projected not to produce 350 m^3/hectare by age 150 years). In heli-log areas existing volume less than 400 m^3/ha and SIBHA50 less than 15 metres.	798
Hemlock/balsam	Existing volume less than 350 m^3/hectare and SIBHA50 less than 11 metres (projected not to produce 350 m^3/hectare by age 150 years). In heli-log areas existing volume less than 400 m^3/ha and SIBHA50 less than 13 metres.	8 116
White spruce (FIZ D)	Existing volume less than 300 m^3/hectare and SIBHA50 less than 11 metres (projected not to produce 300 m^3/hectare by age 150 years). All heli-log areas (operability = "H").	539
Sitka spruce (FIZ A,B.C)	Existing volume less than 350 m^3/hectare and SIBHA50 less than 11 metres (projected not to produce 350 m^3/hectare by age 150 years). In heli-log areas existing volume less than 400 m^3/ha and SIBHA50 less than 13 metres.	68
Pine	Existing volume less than 300 m^3/hectare and SIBHA50 less than 13 metres(projected not to produce 300 m^3/hectare by age 150 years). All heli-log areas (operability = "H").	992
Alder	Existing volume less than 150 m^3/hectare.	2 446
Total		16 168

A.3.6 Environmentally sensitive areas

An environmentally sensitive area (ESA) is an area that is susceptible to disturbance (e.g., unstable terrain, or areas that are difficult to reforest) or is significantly valuable for fisheries, wildlife, water or recreation. ESA values are used to exclude areas from the timber harvesting land base where more specific and detailed information is not available about a particular forest resource. Areas can be identified as either very sensitive (E1) or moderately sensitive (E2) to disturbance, and are entirely or partially removed from the timber harvesting land base.

A.3 Definition of the Timber Harvesting Land Base

Table A-9. Land base exclusions for environmentally sensitive areas

ESA category	ESA description	Reduction (%)	Reduced area (hectares)
S1	Highly sensitive soils	100	17 734
H1	Special management for water quality	100	1 270
A1	Avalanche hazard	100	43
P1	Severe regeneration problems	100	2 515
Total			21 562

A.3.7 Spotted owl habitat

In keeping with the Spotted Owl Resource Management Plans released in May 1999, area assigned to long-term owl habitat (LTOH), representing approximately 67% of all spotted owl special resource management zones, is assumed to be unavailable for harvest. The plan allows 1/3 of the volume on 1/3 of the area to be harvested in order to improve spotted owl habitat. No timing or specific plans have been specified for this harvest. Given the lack of specific plans and the relatively small volume involved, no harvesting in the excluded LTOH areas was incorporated into the analysis. The volume resulting from this activity, however, was considered to be too small to require incorporation in the timber supply analysis. Table A-10. outlines the LTOH, replacement areas and remaining forest management areas for the TSA along with matrix areas which are released for harvest over a fifty year period. Of the 135 494 hectares indicated on the inventory file in the SRMZs listed, only about 22% is expected to be available for harvest.

Table A-10. Spotted owl management land base considerations by SRMZ code

SRMZ code	Forested area (hectares)	Long-term owl habitat (hectares)	Reduced area for long-term owl habitat (hectares)	Replacement areas (hectares)	Unencumbered forest management area (hectares)	Matrix areas outside of owl habitat (hectares)
0	22 844		0			9 114
1	9 508	7 940	305	63	551	
2	16 368	11 570	5 145	851	1 782	
3	7 099	5 960	1 822	381	373	
4	9 918	6 395	2 635	934	1 030	
5	9 309	6 208	3 354	838	956	
6	11 528	7 757	5 694	1 231	1 477	
11	23 188	15 683	7 559	1 648	3 120	
12	12 400	8 241	3 369	1 093	2 049	
13	9 904	6 761	2 939	609	1 430	
14	3 429	2 299	793	306	401	
Total	135 494	78 816	33 616	7 954	13 169	9 114

A.3.8 Stands with low volume

Table A-8. shows stands that exhibit productivity estimates below the productivity required to produce a merchantable stand by 150 years of age. Table A-11. shows stands that do possess an adequate productivity estimate but due to other forest cover attributes (for example stocking class, species composition, crown closure, etc.) are not projected to reach the minimum volume by 150 years of age. These areas were excluded from the timber harvesting land base.

A.3 Definition of the Timber Harvesting Land Base

Table A-11. Stands not expected to reach the minimum volume per hectare required for harvesting

Species	Total forest area (hectares)	Reduced area (hectares)
Balsam	67 590	2 221
Cedar	1 724	253
Alder	7 427	42
Fir	23 133	1 875
Hemlock	25 078	907
Pine	5 041	1 213
Spruce	4 304	234
Total	134 297	6 745

A.3.9 Areas considered for old-growth management

Currently, only nine landscape units have had OGMAs advertised for public review (Ainslie, Anderson, Coquihalla, Manning, Mehatl, Nehatlatch, Silverhope, Spuzzum and Yale). The mapping for these was provided by Ministry of Sustainable Resource Management. Table A-12. provides the species distribution by area of the old-growth management areas.

Table A-12. Stand types identified in current draft old-growth management areas, by leading species

Species	Total forest area (hectares)	Reduced area (hectares)
Aspen	7	0
Balsam	10 617	1 108
Cedar	208	84
Alder	8	2
Birch	24	0
Fir	11 314	1 537
Hemlock	6 591	1 105
Maple	10	0
Pine	375	32
Spruce	1 189	315
Total	30 344	4 183

A.3.10 Riparian reserves and management zones

Detailed discussion of the riparian classification methodology was provided in the data package. A summary of the productive forest and reduced area by biogeoclimatic variant is shown below to provide an understanding of where the riparian areas are. Fully a third of the forested area found in riparian types is in the CWH ms1.

Table A-13. Riparian considerations by biogeoclimatic variant

BECLABEL	Forest area (hectares)	Reduced area (hectares)
AT unp	320	6
CWH dm	2 139	1 335
CWH ds 1	3 059	1 648
CWH ms 1	7 133	4 732
CWH vm 1	3 040	2 380
CWH vm 2	1 866	1 318
CWH xm 1	60	21
ESSFdc 2	0	0
ESSFmw	2 035	638
ESSFmwp	5	0
IDF dk 2	1	0
IDF ww	900	369
MH mm 1	547	172
MH mm 2	1 807	408
Total	22 911	13 026

A.3.11 Archaeological sites

Archaeological sites have been catalogued during archaeological impact assessments (AIA). These sites have been recorded under the *Heritage Conservation Act*. In the analysis, one hectare was removed from the timber harvesting land base around each site.

A.3.12 Hydrolines

It was expected that hydrolines would be visible and show a set of forest cover attributes in the VRI that would disqualify them as productive forest. However, this proved false so in the interest of locating these areas spatially, information from the FIP was transferred to the model file, and the appropriate area was removed from the timber harvesting land base.

A.3.13 Wildlife tree patches (WTP) requirements

Wildlife tree retention values for each LU/BEC variant have been developed and were shown in Table 22 of the data package. The numbers were derived from Table 20b of the *Biodiversity Guidebook* which assumes a higher requirement of wildlife tree retention (WTR) where OGMAs have not been assigned. Table 20a is to be used when OGMAs are in place. The timber supply analysis used the newly assigned OGMAs in nine landscape units and dynamically created OGMAs in other areas during the simulation so it was appropriate for the analysis to reduce the numbers found in the data package by 3%. This reduction reflects the difference between Table 20b and Table 20a of the *Biodiversity Guidebook*. This procedure does not affect the current operational requirements for licensees to leave a higher WTR until OGMAs are officially designated.

A spatial exercise was used to reduce the area of the timber harvesting land base where WTR must occur. This exercise delineated a 200-meter buffer around forested stands that are not considered part of the timber harvesting land base. It is assumed that conditions in this buffer meet all of the requirements for WTR and therefore additional contributions are not needed in those areas. According to this exercise, about 115 000 hectares of timber harvesting land base will require the full WTR requirement while it is assumed that the other 145 000 hectares of timber harvesting land base is sufficiently close to existing stand structure (i.e., in the 200–metre buffers).

Figure A-1. shows the spatial location of randomly assigned WTPs in dark grey for one landscape unit. No size requirement was used in the assignment, however the nature of the exercise resulted in various sized reserves in areas that had no stands outside of the timber harvesting land base to provide the stand structure requirements of WTR. The entire 12 208 hectares shown in Table 4, "Determination of the timber harvesting land base for the Fraser TSA" is located in the type of area represented in light grey.

In the analysis, WTPs contributed to old–forest requirements if their age was sufficient. For the base case, no restriction was placed on the area of the WTPs that can contribute old forest. Since WTPs under two hectares in size should not contribute to biodiversity, there was some risk that contribution of WTPs may have been overstated slightly. However, the assignment of the WTPs in analysis was largely random within the areas requiring retention, and consequently reflected the age class distribution of the timber harvesting land base in general. Since the forest age conditions in the timber harvesting land base in the Fraser TSA do not often meet old-forest requirements, the contribution of WTPs to old–forest requirements was limited at any rate. Sensitivity analysis verified that placing an minimum area requirement (2 hectares) did not significantly change timber supply.

A.3 Definition of the Timber Harvesting Land Base

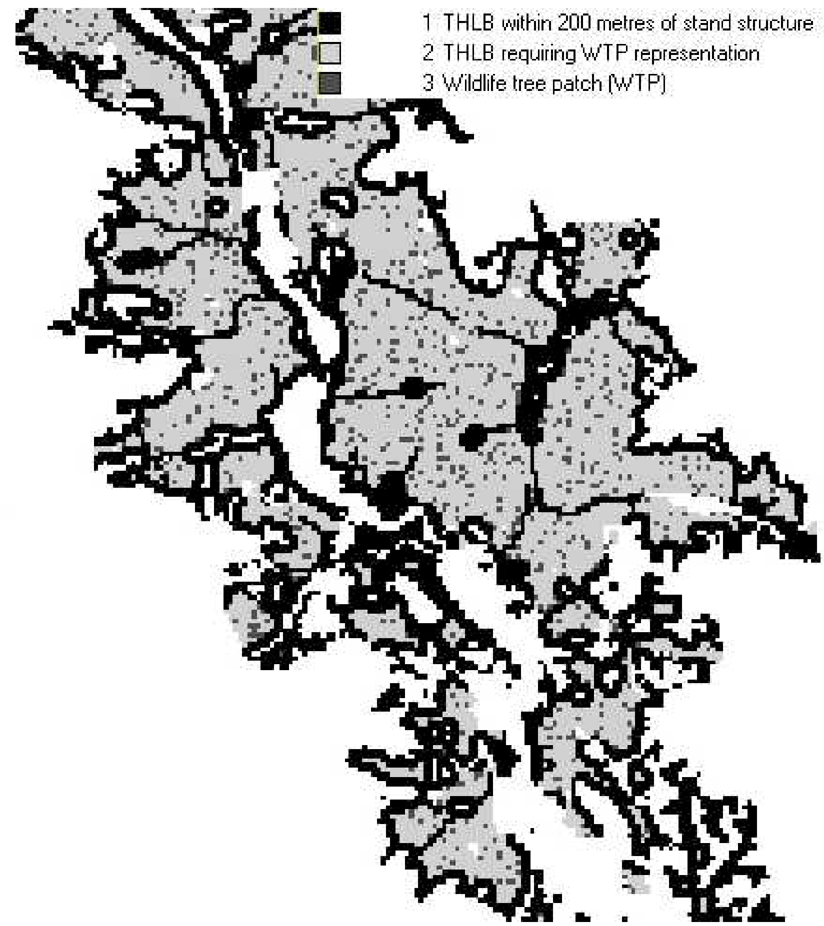

Figure A-1. Spatial representation of the timber harvesting land base and wildlife tree patch retention in a portion of the Pitt Landscape Unit — Fraser TSA, 2003.

A.4 Forest Management Assumptions

A.4.1 Utilization levels

Utilization levels define the maximum stump height, minimum top diameter (inside bark) (dib) and minimum diameter at breast height (dbh) that will be used to calculate merchantable volume.

Table A-14. Utilization levels

Leading species	Minimum dbh (cm)	Maximum stump height (cm)	Minimum top dib (cm)
Pine/larch	12.5	30	10
White spruce	12.5	30	10
All others – < 121 years	12.5	30	10
All others > 121 years	17.5	30	15

Data source and comments:

The volume compilation used in the inventory adjustment process reflected the utilization standards detailed in Table A-14. VDYP, however, will only provide data based upon 17.5 cm minimum dbh. It is assumed that the adjustment factors derived with the appropriate utilization level accounted for the volume differences between these two standards.

A.4.2 Harvest scheduling and targets priorities

The general harvest scheduling rule used in the base case is based on the relative age of a stand. Stands have been scheduled based on the difference between their current age and the age when 95% of the maximum growth has been reached. All stands younger then the latter age are given equal priority for harvest.

The Chilliwack Forest District has implemented a management strategy of shifting the timber harvest towards second growth. This provides for an increase in the available harvest planning area for licensees, a reduced activity in the remaining older forests and an increase in the opportunities to use existing infrastructure for harvesting (i.e., existing road networks). Second growth also tends to be at lower elevations where the gentler terrain characteristics reduce harvesting costs.

Concentric circles represent areas outside the special resource management zones but within spotted owl matrix areas. These are circular buffers around a particular area of interest.

Table A-15. Priorities for scheduling the harvest

Description	Analysis unit	Period (10 year increments)	Priority 1 – 100 or Minimum Harvest Level
2nd growth	Stands under 105 years of age	First 20 years	Minimum 20% of the total forecast
Concentric circles	Stands in the spotted owl matrix areas		Harvest stands further away from the centre of the matrix area before stands in the centre of the matrix

A.4 Forest Management Assumptions

A.4.3 Minimum merchantability by analysis unit

In the analysis, the minimum harvestable age was defined implicitly in the model for each stand based on the stand–level yield table and the minimum required volume criteria shown in Table A-16. The analysis used too many yield tables to list all minimum harvest ages, however the basic TIPSY analysis unit tables provide some guidance based on the site index derived growth rates. Table A-16. shows the age to reach minimum volume requirements, the age of maximum average growth, and the age when 95% of maximum average growth for each of the analysis units. At lower site index values, stands must be held beyond the age where maximum average growth occurs while in more productive analysis units, stands achieve the minimum volume at much younger ages. Harvesting at the minimum volume could significantly reduce long-term timber supply. Minimum volume required was increased by 100 cubic metres per hectare in areas identified for heli-logging.

A.4 Forest Management Assumptions

Table A-16. Minimum merchantability and growth potential by analysis unit

Analysis unit	Minimum volume required (m³/ hectare)	Minimum harvest age (years)	Age of maximum average growth (years)	Age at 95% of maximum average growth (years)	95% of maximum MAI (m³/ha/yr)	Average growth at minimum harvestable age (m³/ha/yr)
Ce	350	60	120	80	6.9	6.0
Ce100	350	110	140	90	3.2	3.3
D_	150	50	90	70	4.5	3.8
Fd17	350	260	110	80	1.8	1.4
Fd18	350	140	90	70	2.6	2.6
Fd19	350	120	100	70	3.0	3.1
Fd20	350	100	100	75	3.4	3.5
Fd21	350	90	90	75	3.7	3.9
Fd22	350	90	100	75	4.2	4.4
Fd23	350	80	90	70	4.6	4.8
Fd24	350	70	80	70	5.1	5.1
Fd25	350	70	80	65	5.5	5.6
Fd26	350	70	80	65	5.9	6.2
Fd27	350	60	80	60	6.4	6.4
Fd28	350	60	80	60	6.9	6.9
Fd29	350	60	80	60	7.4	7.6
Fd30	350	50	80	60	7.9	7.4
Fd31	350	50	80	60	8.4	7.9
Fd32	350	50	70	55	8.9	8.5
Fd33	350	50	70	55	9.4	9.1
Fd34	350	50	70	55	10.1	9.8
Fd35	350	40	60	50	11.8	10.4
HB10	350	350	240	190	1.1	1.0
HB11	350	210	220	170	1.7	1.8
HB12	350	170	190	160	2.0	2.1
HB13	350	150	180	150	2.4	2.4
HB14	350	140	160	140	2.7	2.8
HB15	350	120	170	130	3.1	3.0
HB16	350	110	160	120	3.5	3.4
HB17	350	100	150	110	3.9	3.7
HB18	350	90	140	110	4.4	3.9
HB19	350	90	140	110	4.8	4.6
HB20	350	80	140	110	5.3	4.7
HB21	350	80	130	100	5.8	5.3
HB22	350	70	120	100	6.3	5.5
HB23	350	70	120	100	6.7	5.9
HB24	350	70	110	90	7.3	6.7
HB25	350	60	110	90	7.8	6.5
HB26	350	60	100	80	8.4	7.3
HB27	350	60	100	80	8.9	7.9
HB28	350	50	100	75	9.5	7.3
HB29	350	50	110	75	10.0	8.0
HB30	350	50	100	70	12.2	10.4
Pl	300	90	70	60	3.4	3.5
S_	300	80	130	100	5.1	4.5

A.4 Forest Management Assumptions

A.4.4 Immature plantation history

This section identifies areas of existing immature forest where the density (i.e., stems per hectare) has or will be controlled, and therefore warrant assignment to a managed stand yield table (MSYT). All NSR and stands harvested in the future will be managed under MSYTs. The stand attributes assumed for each analysis unit are described in Table A-25. of Section A.6. Also described in this table is the post-harvest regenerated site index used for fir and hemlock stands in the CWH based on the site productivity study (Thrower et al, 2003). Some of the existing managed stands, about 7600 hectares, are eligible for consideration of a 2% genetic gain based on the Class A seed use in Table A-18.

Table A-17. Immature plantation history

Analysis unit	Stand age at which MSYT will be applied
All Douglas-fir	<= 35 years
All Hemlock/balsam	<= 25 years
All Cedar	<= 15 years
All Pine/larch	<= 15 years
All Spruce	<= 15 years

A.4.5 Not satisfactorily restocked (NSR) areas

Land classified in the TSA FIP file as type identity 4 or 9 is included in the current timber harvesting land base. These type identities indicate old cutblocks that have not yet reached free-growing status. The type identity from the FIP file was used to identify recent logging not contained in the VRI but also to provide stand ages for areas in the VRI which were photo-interpreted as bare ground (recently harvested) or vegetated but having few trees. Stand age from the FIP has been overlaid with the VRI to provide a harvest depletion update. NSR from the FIP was given an age based on standard regeneration delay and logging year. For example:

Estimated current age = Current Year (2001) – Logged Year (1996) – Regeneration Delay (2 years)
= 3 years

A.4.6 Fertilized areas

Fertilization information from the FIP (2002) file was extracted as a spatial coverage to indicate which stands should receive an increase in stand volume due to this treatment. This increase was applied to these stands in the timber supply model as opposed to the yield tables at a rate of 30 cubic metres per hectare (i.e., the volume increment is not included in the volumes shown below in Table A–22).

A.4.7 Genetic gain through tree improvement

Data from the Tree Improvement Branch of the Ministry of Forests indicate that Class A seed has been employed for cedar, fir and spruce stands. On average, this seed produces a genetic gain of 2%. This level of gain was included in the base case timber supply projection. Seed with higher genetic worth is becoming available but future seed use cannot be predicted with certainty, so increases in genetic worth were not used in the base case. The relative per cent of Class A seed use by species in all planting activity is listed below (Table A–18).

A.4 Forest Management Assumptions

Table A-18. Per cent class A seed use by year

Species	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CW	0	0	2	12	11	18	21	25	22	26	15
FD	1	12	8	58	63	89	70	92	84	83	73
SX	0	0	9	0	14	0	12	44	63	54	74

A.4.8 Forest cover requirements

As noted in Section 4.1, forest cover requirements may be examined at a number of different levels. These may be considered as layers in GIS terminology. One possible layer may be landscape units, another may be wildlife areas, while another may be associated with a different resource emphasis. With the requirement to retain different forest characteristics across the landscape, it is important to identify how non-contributing forest (productive forest which does not contribute to the timber harvesting land base) may be considered in the forest cover requirements (i.e., maximum allowable disturbance or minimum area retention). Table A-19. details the groups that were tracked in the timber supply analysis.

A.4 Forest Management Assumptions

Table A-19. Forest cover requirements

Group	Maximum allowable disturbance (%)	Green-up height or age	Minimum retained area (%)	Minimum age or height for retention	Area of application
IRM	25	3 m			Timber harvesting land base within a landscape unit outside of visual areas
RVQC= R	2.5	5.1 m			Forested area in a visual polygon
RVQC=PR_L	16.4	5.4 m			Forested area in a visual polygon
RVQC=PR_M	9.8	5.2 m			Forested area in a visual polygon
RVQC=PR_H	5	5 m			Forested area in a visual polygon
RVQC=M	28.4	5.3 m			Forested area in a visual polygon
Classic deer WR			50	100 years	Classic deer winter range timber harvesting land base in a landscape unit
Community watershed	5	5 years			Productive forest by watershed
Spotted owl habitat			LTOH (RPA+LTOH)	100 years	Long-term owl habitat + replacement area in each activity centre

A.4 Forest Management Assumptions

Data source and comments:

The integrated resource management (IRM) objective is a surrogate for cutblock adjacency. Recommended visual quality class (RVQC) have been assigned by Chilliwack Forest District manager. Community watershed guidelines are taken from the *Forest Practices Code Community Watershed Guidebook*. Spotted owl management guidelines have been extrapolated from the Spotted Owl Resource Management Plan that identifies the current owl habitat with the goal towards eventually allowing harvest in the replacement areas (RPA), which are currently serving as owl habitat and are reserved from harvest, when stands in the LTOH reach 100 years of age.

All stand heights shown in Table A-19. refer to top heights (inventory definition), not average stand heights.

Stand heights and maximum disturbance rates in the visual areas have been localized for the Fraser TSA based on new plan-to-perspective information by slope class developed by Ministry of Forests, Forest Practices Branch. The numbers were area-weighted to create a single number for each visual category. The area-weighted heights were derived using *Procedures for Factoring Visual Resources into Timber Supply Analyses* (Table 6, "Tree height required to meet VEG by per cent slope for well stocked stands").

Classic deer winter range has been defined by the staff of the Ministry of Water, Land and Air Protection. This inventory will eventually supercede the environmentally sensitive area classification of deer habitat. While both inventories are reasonably similar in terms of total area, in some cases the new and the old classification cover different areas. The classic winter range has a smaller impact on the timber harvesting land base (about 8700 hectares compared to over 12 000 hectares in the ESA inventory) and also is smaller in terms of operable area. At the time of this analysis, it was understood that only about 50% of the classic winter range in the timber harvesting land base would be retained indefinitely to meet current ungulate winter range (UWR) requirements. This resulted in the forest cover requirement requiring that at least 50% of the winter range area in the timber harvesting land base in each landscape unit must provide significant habitat attributes assumed to occur by 100 years of age.

Goat winter range represents about 0.5% of the timber harvesting land base, but no official management requirements currently exist for these areas. Hence, no forest cover requirements were applied in the analysis. Staff of the Ministry of Water, Land and Air Protection are requesting that these areas be reserved from timber harvesting, but no final decisions have been made on the management regimes for these areas.

For nine landscape units in the Fraser TSA, the old-growth management areas have been specifically identified and advertised. For all other landscape units, the biodiversity guidelines with the draft biodiversity emphasis option were modelled based on the old-seral requirements found in the *Forest Practices Code Biodiversity Guidebook*. For low biodiversity emphasis option areas, a recruitment strategy was modelled, to ensure that the old-seral objectives are achieved by the end of the third rotation. Forest cover requirements were determined for each BEC variant within each landscape unit.

A.4 Forest Management Assumptions

Table A-20. Landscape unit old-seral forest cover requirements

Natural disturbance type	BEO	Old-growth requirement (%)	Starting in year		
			1	70	140
NDT 1	L	13	4.3	8.6	13
	I	13	13	13	13
	H	19	19	19	19
NDT 2	L	9	3	6	9
	I	9	9	9	9
	H	13	13	13	13
NDT 3	L	14	5	10	14
	I	14	14	14	14
	H	21	21	21	21
NDT 4	L	13	4.3	8.6	13
	I	13	13	13	13
	H	19	19	19	19

Data source and comments:

In natural disturbance types (NDTs) 1, 2 and 4, old-seral forest is defined as stands older than 250 years. In NDT 3, old-seral forest is defined as stands older than 140 years.

A.4.9 Unsalvaged losses

Table A-21. shows the estimated average annual unsalvaged volume loss due to catastrophic events such as insect epidemics, fires, wind damage or other agents. The unsalvaged loss column reflects only those areas in which the volume will not be recovered.

Table A-21. Unsalvaged losses

Cause of loss	Total loss (m^3/year)	Annual unsalvaged loss (m^3/year)
Fire	17 000	15 925
Wind damage	31 500	2 500
Total	48 500	18 425

A.5 Volume Estimates for Existing Stands

The variable density yield projection (VDYP) model, version 6.6 developed and supported by the B.C. Ministry of Sustainable Resource Management, Resource Information Branch, was used to estimate timber volumes for existing natural stands. While it has been common practice to aggregate yield tables to simplify the dataset, no simplifications were made in this analysis other than to direct stands with identical stand attributes (stand age, crown closure, site productivity, volume adjustment factor, forest inventory zone, etc.) to the same yield table. This procedure results in thousands of yield table, too many to be included in this appendix. Table A-22. shows the area-weighted volume estimates by analysis unit for existing natural stands in various age ranges. Managed stands and current NSR were projected using managed stand yield tables.

A.5 Volume Estimates for Existing Stands

Table A-22. Current area-weighted volume by age range for existing natural stands (m³/ha)

Analysis Unit	Current NSR	Managed stands	Stands under 60 years of age	Stands under 100 years of age	Stands under 140 years of age	Stands over 140 years of age
Ce	0	0	148	299		
Ce100	0	0	0	278	387	546
D_	0	.	208	300	182	
Fd17	0	0	36	190	317	387
Fd18	0	0	94	218	365	428
Fd19	0	4	104	270	379	474
Fd20	0	1	129	289	411	529
Fd21	0	3	127	317	433	547
Fd22	0	11	183	337	477	602
Fd23	0	16	213	368	525	684
Fd24	0	35	202	402	528	688
Fd25	0	10	244	416	586	760
Fd26	0	80	265	428	604	769
Fd27	0	30	308	446	657	815
Fd28	0	119	309	475	716	861
Fd29	0	121	341	545	714	825
Fd30	0	26	349	558	809	833
Fd31	0	188	373	601	810	
Fd32	0	141	363	652	855	.
Fd33	0	34	432	651	853	1096
Fd34	0	284	414	623	910	
Fd35	0	314	483	741	1048	1300
HB10	0	0	0	54	169	388
HB11	0	0	1	97	198	451
HB12	0	0	3	161	286	485
HB13	0	0	15	208	314	537
HB14	0	0	5	223	338	577
HB15	0	0	9	268	385	617
HB16	0	0	35	290	429	686
HB17	0	0	75	299	449	731
HB18	0	0	70	349	460	780
HB19	0	0	97	349	549	811
HB20	0	0	111	368	539	862
HB21	0	0	133	354	561	745
HB22	0	0	131	395	631	823
HB23	0	0	118	406	603	
HB24	0	1	230	423	661	
HB25	0	7	244	451	678	916
HB26	0	9	318	454	705	507
HB27	0	10	314	505		
HB28	0	10	369	546		
HB29	0	13	407	552		
HB30	0	62	441	599	907	
Pl	0	0	52	165	283	364
S_	0	.	1	264	323	507

A.6 Volume Estimates for Regenerated Stands

WinTIPSY (Windows™ version of the Table Interpolation Program for Stand Yields) version 3.2, supported by the B.C. Ministry of Forests', Research Branch, was used to estimate growth and yield for existing and future managed stands. The area-weighted site index for each analysis unit was used, along with regeneration assumptions, as input to TIPSY. Table A-17. indicates which stands are assumed to be managed in the analysis.

Table A-25. displays the inputs for creating base volume tables for managed stands. The base volumes were then by augmented by genetic gain factors developed by Forest Analysis Branch or altered by variable retention factors developed by Research Branch. About 7000 hectares in the VRI do not have an analysis unit (species label) and the FIP analysis unit was used. Table A-25. includes secondary species in the hemlock/balsam analysis unit as balsam stands are expected to remain balsam-leading after harvest. Incorporating the balsam stands in this manner captures the difference in stand yield between balsam and hemlock. The right hand column of Table A-25. shows the post-harvest site index for the fir and hemlock stands in the CWH biogeoclimatic zone that were developed by J.S. Thrower and Associates.

Stand yields were altered to reflect the planting of genetically improved stock. Table A-24. shows the projected improved stock use and Table A-23. shows the projected genetic gain associated with each seed planning zone. For the base case, only the information up to the start of the simulation (2001) was used. A sensitivity analysis was performed to examine the implications if the projections for the next ten years of seed use and genetic gain actually occur.

Table A-23. Genetic gain projections by seed planning unit (%)

Seed planning unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CWMlo	0.02	0.03	0.03	0.03	0.05	0.05	0.08	0.09	0.09	0.09	0.13	0.13
FdMhi	0.02	0.02	0.02	0.02	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
FdMlo	0.08	0.08	0.10	0.11	0.11	0.12	0.12	0.14	0.14	0.14	0.14	0.14
FdSM	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.08	0.08	0.08
SXSM	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

Table A-24. Seed use projections by seed planning unit as a percentage of total seed request

Seed planning unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CWMlo	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
FdMhi	0.73	0.73	0.50	0.50	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
FdMlo	0.73	0.96	0.63	0.67	0.74	0.79	0.87	0.91	0.98	1.00	1.00	1.00
FdSM	0.73	0.64	0.42	0.46	0.49	0.58	0.72	0.85	0.59	0.73	0.91	1.00
SXSM	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74

A.6 Volume Estimates for Regenerated Stands

Table A-25. Regeneration assumptions by analysis unit

Analysis unit	Timber harvesting land base	Adjusted inventory site index	Regen method	Species composition	Stems per hectare	OAF1	OAF2	Utilization	Post harvest site index for hemlock and fir stands in the CWH
Ce	3515	22.2	Planted	Cw100	1200	15	5	12.5	
Ce100	5290	15.4	Planted	Cw100	1200	15	5	12.5	
D_ [a]	9052	22.7	Planted	Fd100	1200	15	5	12.5	
Fd17	7098	15.3	Planted	Fd100	1200	15	5	12.5	29
Fd18	5982	18	Planted	Fd100	1200	15	5	12.5	30
Fd19	6098	19	Planted	Fd100	1200	15	5	12.5	30
Fd20	9672	20	Planted	Fd100	1200	15	5	12.5	30
Fd21	6842	20.9	Planted	Fd100	1200	15	5	12.5	31
Fd22	7192	22	Planted	Fd100	1200	15	5	12.5	31
Fd23	6097	22.9	Planted	Fd100	1200	15	5	12.5	31
Fd24	5747	24	Planted	Fd100	1200	15	5	12.5	31
Fd25	5016	24.9	Planted	Fd100	1200	15	5	12.5	31
Fd26	4597	26	Planted	Fd100	1200	15	5	12.5	31
Fd27	8567	27	Planted	Fd100	1200	15	5	12.5	31
Fd28	4330	27.9	Planted	Fd100	1200	15	5	12.5	31
Fd29	3513	29	Planted	Fd100	1200	15	5	12.5	31
Fd30	2927	30	Planted	Fd100	1200	15	5	12.5	32
Fd31	2111	30.9	Planted	Fd100	1200	15	5	12.5	32
Fd32	2106	31.8	Planted	Fd100	1200	15	5	12.5	33
Fd33	1252	32.8	Planted	Fd100	1200	15	5	12.5	33
Fd34	979	33.9	Planted	Fd100	1200	15	5	12.5	33
Fd35	3155	37.1	Planted	Fd100	1200	15	5	12.5	33
HB10	4608	9.1	Natural	Hw46Ba54	1700	15	5	12.5	23
HB11	6106	11	Natural	Hw56Ba44	1700	15	5	12.5	23
HB12	8429	12	Natural	Hw52Ba48	1700	15	5	12.5	23
HB13	9917	12.9	Natural	Hw48Ba52	1700	15	5	12.5	23
HB14	12468	13.9	Natural	Hw55Ba45	1700	15	5	12.5	24
HB15	11463	15	Natural	Hw47Ba53	1700	15	5	12.5	24
HB16	6484	15.9	Natural	Hw57Ba43	1700	15	5	12.5	24
HB17	3935	16.9	Natural	Hw62Ba38	1700	15	5	12.5	24
HB18	4985	18	Natural	Hw42Ba58	1700	15	5	12.5	25
HB19	3058	19	Natural	Hw58Ba42	1700	15	5	12.5	26
HB20	6545	20	Natural	Hw47Ba53	1700	15	5	12.5	26
HB21	3240	20.9	Natural	Hw61Ba39	1700	15	5	12.5	25
HB22	10824	22	Natural	Hw72Ba28	1700	15	5	12.5	26
HB23	14388	23	Natural	Hw26Ba74	1700	15	5	12.5	26
HB24	3791	24	Natural	Hw63Ba37	1700	15	5	12.5	27
HB25	3278	24.9	Natural	Hw61Ba39	1700	15	5	12.5	27
HB26	3174	25.9	Natural	Hw78Ba22	1700	15	5	12.5	28
HB27	2729	26.9	Natural	Hw65Ba35	1700	15	5	12.5	26
HB28	2709	28	Natural	Hw58Ba42	1700	15	5	12.5	28
HB29	1611	28.9	Natural	Hw51Ba49	1700	15	5	12.5	27
HB30	5578	31.9	Natural	Hw82Ba18	1700	15	5	12.5	28
Pl	3074	17.8	Natural	Pl100	1200	15	5	12.5	
S_	10364	15.8	Natural	S100	1200	15	5	12.5	

Note: Alder was regenerated as 100% Fd due to the small size of this analysis unit.