TIMBER SUPPLY BRANCH

TIMBER SUPPLY REVIEW

Soo Timber Supply Area
Analysis Report

August 1999

BRITISH COLUMBIA

Ministry of Forests

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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 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. A review of each TSA and TFL is completed at least once every five years.

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

This report focuses on a single forest management scenario — 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.

Assessing the implications of only current practices rather than looking at a number of different management schemes will expedite the analysis process, allowing analysis of all TSAs in the province every five years. 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 the effects of current forest management on the timber supply form a solid 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 allowable annual cut (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.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Soo Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over both the short- (next 20 years) and long- (next 250 years) term. It also examines the potential changes in timber supply stemming from uncertainties about forest growth and management actions. **It is important to note that the various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. As such, the forecasts should be used for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Soo TSA covers about 826 000 hectares of area north of Vancouver in the southwest mainland area of British Columbia. Within this area, 299 000 hectares are productive forest and 123 400 hectares are considered available for timber production and harvesting under current management practices. In the area available for timber harvesting, the greater part of the forest is dominated by Douglas-fir, western hemlock, balsam and western redcedar. Smaller areas are dominated by spruce, cottonwood and pine. Douglas-fir, hemlock, balsam and redcedar are the tree species most commonly used by the forest industry in the area.

The current allowable annual cut (AAC) for the Soo TSA is 506 000 cubic metres per year. Given the current management assumptions, the analysis shows that the current AAC can be maintained, at an even-flow, in the short- and long-term.

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

- Significant changes in forest management have occurred since the last analysis. These changes include the implementation of *Forest Practices Code (FPC) of B.C. Act* and *Regulations*, creation of several new parks, Cabinet release of the *Northern Spotted Owl Management Plan*, implementation of the *Operational Planning Regulation* (OPR 107/98) for ungulate winter range management, new definition of minimum harvestable ages and an increase in the helicopter logging component of the timber harvesting land base.
- The abundance of existing merchantable stands permits the transition of harvest to managed stands to start in about seven decades and to finish, for the most part, 15 decades from now.
- The base case harvest forecast is relatively insensitive in the short term to uncertainties in data and management. There is a long transition period during which harvesting is projected to shift from existing to managed stands. This long transition allows for potential increases in timber supply over all time frames if management practices or information result in increased managed stand yields.

Important data and management uncertainties that could affect the results of the analysis are:

- In the base case, it was assumed that clearcut harvesting systems would be employed across the Soo TSA. However, alternative systems such as selection harvest, partial harvest and variable retention have been employed for years. These practices could not be fully included in the analysis given uncertainties about the location and extent of future operations. Impact on base case short-, medium- and long-term timber supply is therefore unknown.

- The management regimes and habitat areas outlined in the district draft management plan for deer habitat management are used in the base case. Following the completion of the analysis, revisions to the *Operational Planning Regulation* (OPR 107/98) were implemented, which resulted in less area being "grandparented" as deer winter range than was accounted for in the base case. After adjusting the timber harvesting land base for this change the base case even-flow harvest forecast increases by 6000 cubic metres per year (1.6%) to 512 000 cubic metres per year. While the grandparented areas are assumed to reflect deer winter range in the Soo TSA, Ministry of Forests and the Ministry of Environment, Lands and Parks staff will be reviewing and updating ungulate winter range areas by October 15, 2003, as required by the *Operational Planning Regulation* of the *Forest Practices Code*.
- Adjustments required to represent forest area left in riparian management zones is uncertain because classification of streams to *FPC* standards for the Soo TSA has not been completed (the area in riparian reserves was estimated and modelled in the base case, however). Evaluation of current practices in other management units suggests that riparian management zones may cover up to 4.2% of the timber harvesting land base. Sensitivity analysis shows that if the maximum area is removed (4.2%), the base case harvest forecast can be maintained for at least six decades and the long-term harvest will decrease proportionately to the amount of area reduction.
- There is uncertainty about the size of the helicopter logging component of the timber harvesting land base. Sensitivity analysis shows that if the entire helicopter logging land base is excluded, the base case harvest level can be achieved in the first decade, while the long-term level would be about 20% lower. If the helicopter logging land base is reduced by 50%, the base case harvest level can be maintained for eight decades.
- In May 1997, cabinet released the management plan for the northern spotted owl. The base case modelled the impact of maintaining 67% of each special resource management zone (SRMZ) in stands older than 100 years of age, and increased wildlife tree retention within the SRMZs as outlined in the government approved *Northern Spotted Owl Management Plan*. However, development of specific resource management plans for activity centers and special resource management zones is ongoing. Completion of these plans is required before the ultimate impact of the owl management plan can bed fully analyzed.

Evidence from the provincial *Old-Growth Site Index (OGSI)* project suggests that the estimated future productivity of sites currently occupied by old-growth stands has been underestimated. However, there is no evidence to suggest that the productivity of existing second-growth stands that make up the majority of the forest stands in the Soo TSA, has been underestimated. An alternative to OGSI adjustments is to use the results of the *Site Index — Biogeoclimatic Ecosystem Classification (SIBEC)* project which presents a first approximation of estimates of average site index for coniferous crop tree species according to site units of the BEC system of British Columbia. Results of sensitivity analyses assessing the potential impacts of OGSI and SIBEC site index adjustments showed increases in short- and long-term timber supply. These results need to be viewed as only a general indication of trends, since OGSI adjustments were not calibrated for the Soo TSA, and the BEC information was derived from small scale maps at the variant level, rather than at the more detailed site series level.

Executive Summary

This analysis indicates that, based on current inventory and growth and yield information and current management practices, the current rate of harvest in the Soo TSA can be maintained in the short- and medium-term. Several sources of uncertainty, including the implications of forest cover retention in riparian management zones, use of alternative silvicultural systems and the outcome of further planning for the spotted owl, suggest the long-term harvest level indicated in the base case could be slightly overestimated. However, any changes to practices or data that increase managed stand yield estimates, or verify the applicability of site index adjustments to the Soo TSA, may increase both short- and long-term timber supply.

The socio-economic analysis for the Soo TSA indicates that the current AAC of 506 000 cubic metres can support a provincial total of approximately 683 person-years of direct employment. Residents of the Soo TSA account for approximately 39% of this direct employment. Total provincial direct employment associated with the Soo TSA forestry sector supports a further 840 person-years of indirect and induced employment across the province.

The base case harvest forecast indicates a stable timber supply. If harvests remain at the current level, they will provide stability for employment within the Soo TSA and help to maintain processing activity in the south-western portion of the province.

Provincial government revenues associated with the current AAC average approximately $20.8 million per year, and could remain at this level with the continuation of current stumpage and tax rates.

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Introduction

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

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

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

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

Thus, before an estimate of timber supply is interpreted, the set of physical, biological and socio-economic conditions on which it is based, and 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. Indeed, the Forest Act requires that the timber supply for management units through British Columbia be reviewed at least every 5 years. This allows close monitoring of the timber supply and of the implications for the AAC stemming from changes in management practices and objectives.

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

Timber supply
The amount of timber that is forecast to be available 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 Soo TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Timber supply analysis methodology and results are presented in Sections 3 and 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used. This is followed by a summary and conclusions for the timber supply analysis. Section 7 shows results of a socio-economic analysis for the Soo TSA. Appendices A and B contain further details about the data and assumptions used in the analysis.

As part of the timber supply review, 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 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 Soo 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 by assessing employment and income implications of timber harvesting level projected in the base case.

The socio-economic analysis includes an estimate of the employment and income impacts associated with timber supply analysis projections by three main sectors: harvesting and other woodlands related, processing, and silviculture. Employment is measured in terms of person-years*. A person-year is defined as a full-time job and part-time positions are converted to person-years. Employment income is calculated using average industry income estimates.

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

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

Introduction

Data on direct employment*, harvest levels, and fibre flows was obtained by surveying licensees and mill operators. The information was used to estimate harvesting, processing and silviculture direct employment averages associated with the harvest and the proportion of workers living in the area. The estimates of local and provincial harvesting, processing, and silviculture direct employment were then used to determine ratios of employment per 1000 cubic metres of timber harvested.

Indirect and induced employment* figures were calculated using the Soo TSA and provincial employment multipliers* developed by the Ministry of Finance and Corporate Relations. Indirect impacts result from direct businesses purchasing goods and services; induced impacts result from direct employees purchasing goods and services. Employment coefficients per 1000 cubic metres were also determined for the indirect and induced impacts.

To estimate the level of employment that could be supported by alternative harvest rates, projected timber supply levels were multiplied by the calculated employment coefficients. It should be noted that employment coefficients are based on current productivity, harvest practices and management assumptions* and will not likely reflect industry conditions decades into the future. As such, the employment estimates can only be viewed as general indicators.

Direct employment
Jobs directly associated with a particular sector. For example, direct employment in forestry consists of work in harvesting, silviculture, log transportation and timber processing.
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.

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.
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.

1 Description of the Soo Timber Supply Area

The Soo TSA is located on the southern coast of British Columbia, just north of Vancouver. The Soo TSA is part of the Vancouver Forest Region, and is administered from the Squamish Forest District office in Squamish, which is also responsible for administering TFL 38 to the west of the timber supply area. Of a total 826 000 hectares in the Soo TSA, approximately 299 000 hectares (36%) is considered productive forest land. The area considered available for timber harvesting is 123 000 hectares; this is 41% of the productive forest land or about 15% of the total area of the Soo TSA.

The Soo TSA closely corresponds to the drainages* of the lower Squamish and Cheakamus Rivers, which flow into Howe Sound, and the Lillooet River, which flows into Harrison Lake. The Soo TSA is bounded on the west by TFL 38 and the Sunshine Coast TSA; on the north and northeast by the Lillooet TSA; and on the south by the Fraser TSA and Garibaldi Provincial Park. The communities of Squamish, Whistler, Lions Bay and Pemberton, as well as several First Nations communities, are located in this TSA.

The current allowable annual cut (AAC) for the Soo TSA, which came into effect January 1996, is 506 000 cubic metres, including 2500 cubic metres specified for cottonwood-leading forest types*. The determination represented a reduction of about 13% from the previous level of 580 000 cubic metres.

Significant changes in forest management that have occurred since the last timber supply review was completed include:

- implementation of the *Forest Practices Code**;
- an update to management of scenic values;
- inclusion of helicopter-accessible areas in the timber harvesting land base;
- updates to guidelines for ungulate winter range;
- new parks have been removed from contributing to the timber supply.

Overall, the timber harvesting land base has increased by 13.4%, and current practices have changed considerably since the last timber supply analysis.

The Soo TSA includes many parks, including the northern portion of Garibaldi Park, Porteau Cove, Shannon Falls, Murrin, Brandywine, Blackcomb Glacier, Nairn Falls, Birkenhead Lake, Joffre Lake, Stawamus Chief, Alice Lake, Pine Cone Burke, Indian Arm and a portion of Golden Ears Provincial Park. In addition, several new provincial parks were created as a result of the Lower Mainland Protected Areas Strategy. These include Upper Lillooet River, Callaghan Lake, Sockeye and Tantalus provincial parks. The establishment of Brackendale Eagle Provincial Park is anticipated.

Drainage
The surface and sub-surface water derived within a clearly defined catchment area, usually bounded by ridges or other similar topographic features, encompassing part, most, or all of a watershed. The term is sometimes used to describe an operating area or location.

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.

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

Biogeoclimatic zones
A large geographic area with broadly homogeneous climate and similar dominant tree species.

1 Description of the Soo Timber Supply Area

1.1 The environment

The Soo TSA is characterized by the rugged terrain of the Coast Mountains and by valley bottom floodplains such as the Pemberton Valley and the Squamish River estuary. Due to the range in climate (from coastal to interior) and elevation (from sea level to 2700 metres), this TSA is ecologically diverse and includes five biogeoclimatic zones*. Table 1 summarizes the zones and their locations, the major tree species present, and other considerations such as climate and wildlife values.

Table 1. Biogeoclimatic zones of the Soo timber supply area

Zone	Location	Tree species	Other
Coastal western hemlock	Almost all valley floors and lower mountain sides. From sea level to 900 metres.	**Dominant:** Western hemlock Amabilis fir **Minor:** Western redcedar Douglas-fir	Wettest zone in B.C. Characterized by cool summers and mild winters. High diversity of vertebrates.
Mountain hemlock	Between 900 and 1650 metres.	**Dominant:** Mountain hemlock Yellow cedar Amabilis fir **Minor:** Western hemlock Western redcedar Douglas-fir Western white pine	Short, cool summers. Long, cool, wet winters with heavy snow cover for several months. Harsh conditions limit wildlife diversity. No reptiles, few amphibians.
Engelmann spruce-subalpine fir	Occupies an area in the eastern portion of the Soo TSA, between 1200 and 2000 metres.	**Dominant:** Engelmann spruce Subalpine fir **Minor:** Mountain hemlock Douglas-fir Lodgepole pine Western redcedar	Wet cool summers, long snowy winters, and steep topography. Important habitat for ungulates and furbearers.
Interior Douglas-fir	Occupies a small area in eastern portion of the Soo TSA, between 325 and 1375 metres.	**Dominant:** Douglas-fir Lodgepole pine **Minor:** Western hemlock Ponderosa pine Western redcedar	Warm, dry summers with fairly long growing season; cool winters. Important wildlife habitat due to variety of landscapes and vegetation.
Alpine tundra	Above 1650-1800 metres.	Trees generally absent except in stunted form at lower elevations of this zone.	Climate is cold, windy and snowy. Short growing season. Wildlife diversity and density are low.

1 Description of the Soo Timber Supply Area

The mature forests of this TSA support about 130 wildlife species that depend on the characteristics of older forests. These include four species of amphibians, five species of reptiles, 93 species of birds and 28 species of mammals (excluding big game species). Big game species found in the Soo TSA include grizzly and black bears, moose, mule and black-tailed deer, mountain goat, cougar and gray wolf.

Forested areas are home to bird species such as the northern spotted owl, northern flicker, hairy woodpecker and various songbirds. The spotted owl is designated as an endangered species in Canada and some of the estimated 100 pairs in southern B.C. occur in the Soo TSA. Clearcut areas provide habitat for blue grouse, hairy woodpecker, cedar waxwings, and songbirds. The nutrient-rich, protected waters of the Squamish estuary provide shelter for various ducks, swans, geese and gulls. In addition, the many fish-bearing waters support a range of predators including the common merganser, Barrow's goldeye and bald eagle. Portions of the Soo TSA are within the range of the marbled murrelet but its presence has not been officially recorded.

Four major river systems support salmon species (sockeye, coho, chum, pink and chinook), other salmonids (such as steelhead, cutthroat trout, kokanee, rainbow trout, bull trout, mountain whitefish and Dolly Varden char) and non-salmonids (such as sculpin and stickleback). Valuable fish streams are present in the Soo TSA; however, in some instances, fisheries potential is limited by rapid stream flow, extreme flow variation, and low temperatures and nutrients that are a function of the climate and rugged terrain in the area.

Species considered at risk in the Squamish Forest District (which includes the Soo TSA) are summarized in Table 2.

Table 2. Vulnerable, endangered and threatened species

Endangered or threatened (red-listed)	Vulnerable (blue-listed)	
Marbled murrelet	Great blue heron	Grizzly bear
American peregrine falcon	Green heron	Wolverine *luscus*
Northern spotted owl	Short-eared owl	Fisher
Keen's long-eared myotis	American bittern	Townsend's big-eared bat
	Surf scoter	Tailed frog
	Bull trout	Orca (3 ecotypes)

Source: B.C. Conservation Data Centre, November 1998.

1 Description of the Soo Timber Supply Area

Current forest management practices follow the standards and legislation set out by *Forest Practices Code (the Code)*. Consequently the protection of wildlife and the environment will primarily be managed through the Code. Some inventory work and development of management guidelines is still outstanding in order to fully mitigate impacts to fish and wildlife as anticipated by the Code. The *Northern Spotted Owl Management Plan*, released by the provincial government in May 1997, contains management guidelines intended to protect this endangered species. In addition, the development of management plans for activity centres and special resource areas is ongoing. The *1998 Operational Planning Regulation*, B.C. Regulation 107/98, provides procedures for identifying and managing existing ungulate winter range.

As timber harvesting proceeds in the Soo TSA, which will involve conversion of some of the mature forest to younger managed forest, care will be required to protect habitat for species that depend on the characteristics of older forests. This includes species of significant management concern, such as the spotted owl.

1.2 First Nations

Seven First Nations have reserve lands and traditional territory within the Soo TSA. The Mt. Currie Band (Stl'atl'imx) and Anderson Lake Band (N'Quatqua) have well-established communities within the TSA. The Douglas, Samahquam and Skookumchuck reside in the Lillooet River valley in several small communities, and the Squamish Nation (Skxwumish7ulh) has a community near Squamish. The Burrard Band (Tsleil-Waututh) has reserve land and traditional territory in the Soo TSA. The Mt. Currie Band is currently the only band within the Soo TSA that is not involved in the treaty process.

Some First Nations are employed in forestry activities, such as timber harvesting, processing and, more recently, silviculture. Most First Nations in the area have expressed concerns about the management of cultural heritage resources and have indicated an interest in increased involvement in the forest sector.

For more information on the Soo TSA communities and First Nations, see Section 7.1.1, "Population and demographic trends."

1 Description of the Soo Timber Supply Area

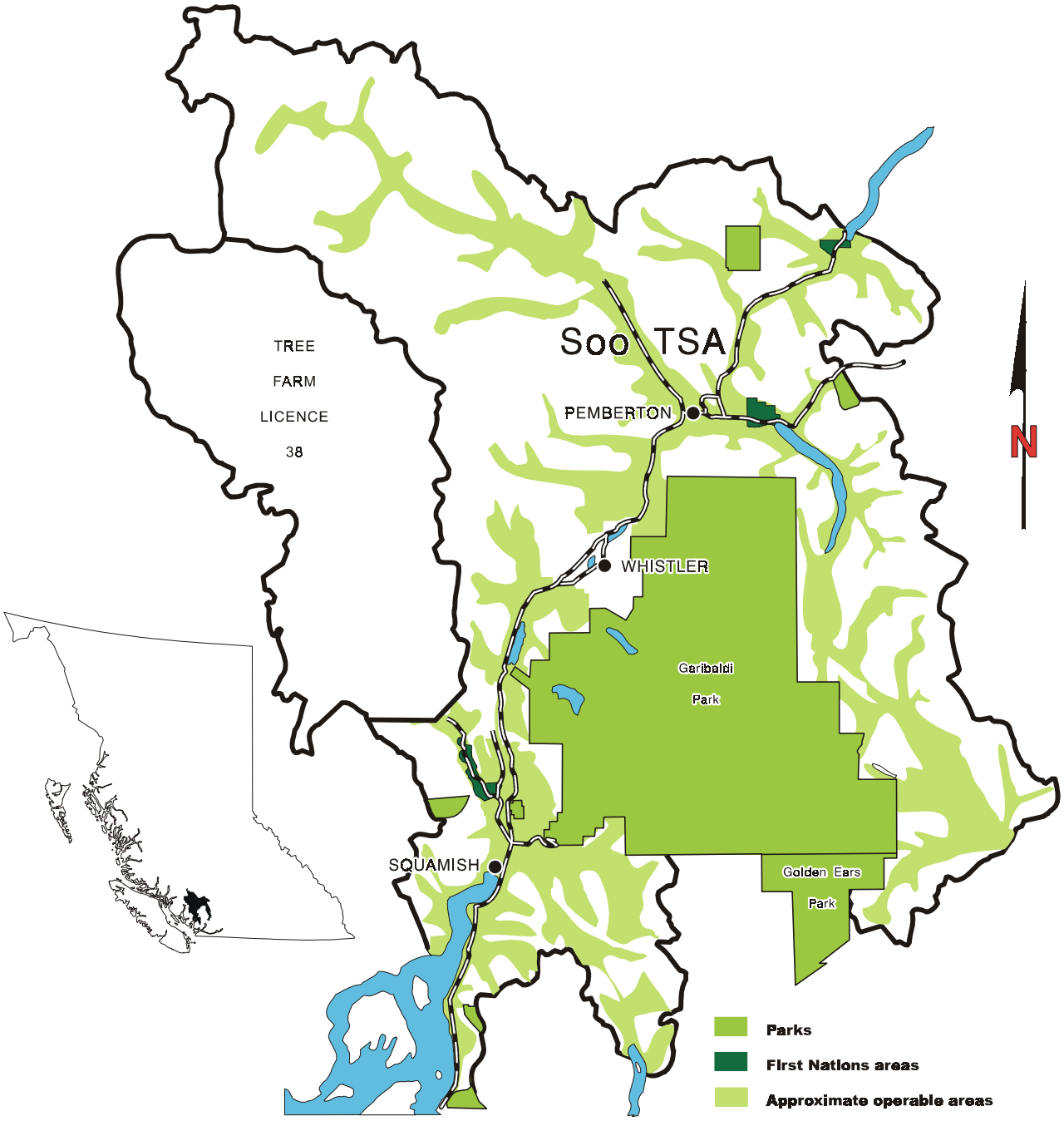

Figure 1. Map of the Soo Timber Supply Area in the Vancouver Forest Region.

2 Information Preparation for the Timber Supply Analysis

Much information is required for timber supply analysis. This information falls into three general categories: land base inventory; timber growth and yield; and management practices. In preparation for the analysis, a number of changes since the 1994 Soo TSA timber supply analysis were noted.

2.1 Land base inventory

Land base information used in this analysis came in the form of a computer file compiled in 1997 by the B.C. Forest Service. This file contains a considerable amount of information on the forest land in the Soo 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), and other characteristics such as environmental sensitivity and physical accessibility (operability). Stand attributes such as tree height, stocking* and age have been projected to 1997. Except for a few mapsheets shared with adjacent forest districts, the inventory file has been updated to account for timber harvesting up to 1997 for the majority of the Soo TSA.

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, areas in utility and transportation corridors, and residential and industrial development. A description of these areas specific to the Soo TSA is provided below. These types of areas do not contribute to the timber harvesting land base of the Soo TSA. Before assessing timber supply, these non-contributing areas are identified and separated from the timber harvesting land base*. When deriving this data file, care is taken to make only a single reduction for areas which overlap (for example, where an inoperable area is also wildlife habitat).

Identifying areas as not contributing to timber supply does not mean the area is removed from the Soo 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. The timber supply is managed within this integrated resource context, and the analysis described herein is consistent with this philosophy.

This section describes the types of areas not contributing to the timber harvesting land base. Use of the term timber harvesting land base in this report does not mean 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.

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 that is currently considered feasible and economical for timber harvesting.

2 Information Preparation for the Timber Supply Analysis

For the Soo TSA, the following types of areas were excluded from the timber harvesting land base.

- not managed by the B.C. Forest Service.— these are non-Crown area and parks removed from the productive forest. Parks and reserves (e.g., ecological) contribute towards biodiversity* values. Some inventory information on Garibaldi Park that was not part of the Soo TSA inventory file was added and contributes towards meeting biodiversity objectives.
- newly created parks — the location of newly created parks was mapped and overlaid on the inventory file. This permitted the exclusion of the areas from the timber harvesting land base.
- non-forest areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies).
- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- 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.
- Timber Licences —Timber Licences provide the holder rights to harvest mature timber from the licence area. These areas revert to the TSA when they have been harvested and satisfactorily restocked, (i.e., free-to-grow) by the licensee.
- deciduous-leading stands — deciduous species are generally not used, except cottonwood which is included in the timber harvest land base.
- problem forest types — stands which are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability.
- sites with low timber productivity — areas occupied by forest with low timber-growing potential.
- existing roads, trails and landings — areas of forest land that have been removed from timber production due to access development and harvesting to date.
- environmentally sensitive areas* — portions of the areas considered sensitive.
- riparian reserve zone area — area otherwise available for timber production, a portion of which is assumed to be unavailable for harvesting to provide protection for riparian* and stream ecosystems.
- wildlife tree* patch areas — areas reserved within and along the edges of cutblocks for the maintenance of stand-level biodiversity (stand structure), primarily for conservation or enhancement of wildlife.

Biodiversity (biological diversity)
The diversity of plants, animals and other living organisms in all their forms and levels of organization, and includes the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them
Inoperable areas
Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.

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.
Environmentally sensitive areas
Areas with significant non-timber values, fragile or unstable soils, or impediments to establishing a new tree crop, or areas where timber harvesting may cause avalanches.
Wildlife tree
A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

- geographically defined areas — specific areas where harvesting is not currently proposed due to safety or other considerations.

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 3 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 productive forest area managed by the B.C. Forest Service within the given category. For example, while there is a total of 86 935 hectares of land classified as environmentally sensitive area (ESA), only 17 117 hectares were removed specifically due to environmental sensitivity. The difference arises because one area can be in more than one classification (e.g., inoperable and ESA), and the actual area deducted depends on the point at which the reduction occurs in the sequence. Further, partial reductions are sometimes employed to represent situations where parts of areas are retained to protect a particular value.

The current timber harvesting land base in the Soo TSA represents about 14.9% of the total TSA area and about 41.3% of the productive forest. The three categories which most reduce the availability of the productive forest for timber supply are: inoperable areas (33.1%), sites with low productivity (7.5%) and environmentally sensitive areas (5.7%). The remaining deducted categories, such as riparian areas, represent 12.4% of the productive forest. The percentages provided depend on the order in which each class is considered. For instance, riparian areas would constitute a larger proportion of the reduction if they were considered prior to inoperable areas.

2 Information Preparation for the Timber Supply Analysis

Table 3. Determination of the timber harvesting land base for the Soo TSA

Classification	Productive forest area by classification	Area (hectares)	Per cent of total TSA area	Per cent of Crown forest land
Total TSA area[a]		826 160	100.0	
Non-forest		483 392	58.5	
Not managed by the B.C. Forest Service[b]		43 856	5.3	
Total productive forest managed by the Forest Service (Crown forest)		**298 912**	**36.2**	**100.0**
Reductions to Crown forest:				
Non-commercial cover (brush)	685	685	0.1	0.2
Current roads, trails and landings	7 200	7 200	0.9	2.4
Newly created parks[c]	11 517	11 221	1.4	3.8
Inoperable areas	106 114	99 075	12.0	33.1
Environmentally sensitive areas (ESAs)	86 935	17 117	2.1	5.7
Retention deer management zone[d]	5 084	4 071	0.5	1.4
Sites with low productivity	28 767	22 530	2.7	7.5
Problem forest types	3 970	3 166	0.4	1.1
Geographically defined areas[e]	4 700	2 057	0.2	0.7
Riparian areas		6 326	0.8	2.1
Wildlife tree patch (WTP) area		2 072	0.3	0.7
Total current reductions		**175 520**	**21.2**	**58.7**
Current timber harvesting land base (includes 2444 hectares of Timber Licences[f] and 3803 hectares not satisfactorily restocked (NSR)* land)		**123 392**	**14.9**	**41.3**
Future reductions				
Future roads		2 827	0.3	0.9
Long-term timber harvesting land base		**120 565**	**14.6**	**40.4**

(a) Includes 22 124 hectares of forest inventory (Garibaldi Provincial Park) not in the Soo TSA inventory file.

(b) A portion of the area not directly managed by the B.C. Forest Service – 24 986 hectares – contributes to some non-timber objectives, bringing the total forest area that contributes to forest management objectives to 323 898 hectares.

(c) These newly created parks have not been removed from the Crown Forest.

(d) Two of five special deer management zones do not permit timber harvesting activities.

(e) No harvesting is permitted in an area of East Howe Sound where helicopter-logging operations would endanger public safety. The remaining area is within the old Resort Municipality of Whistler boundary where logging is not a designated use.

(f) Timber licences were initially excluded from the timber harvesting land base, but were added after the areas are projected to be harvested and restocked by the licensee.

2 Information Preparation for the Timber Supply Analysis

Figure 2 represents both the total Soo TSA area, and the productive forest land base. The total area chart shows that about 64% of the total land base is classified as not managed by B.C. Forest Service, non-forest or non-productive forest (i.e., having very few trees). The productive forest chart details the categories of forest land and shows that about 59% of the forest land in the Soo TSA is considered to be unavailable for harvesting. The predominant reasons for forest unavailability are physical or economic inoperability, environmental sensitivity and low site productivity. Approximately 41% of the productive forest is considered available for timber harvesting (including NSR* and timber licences).

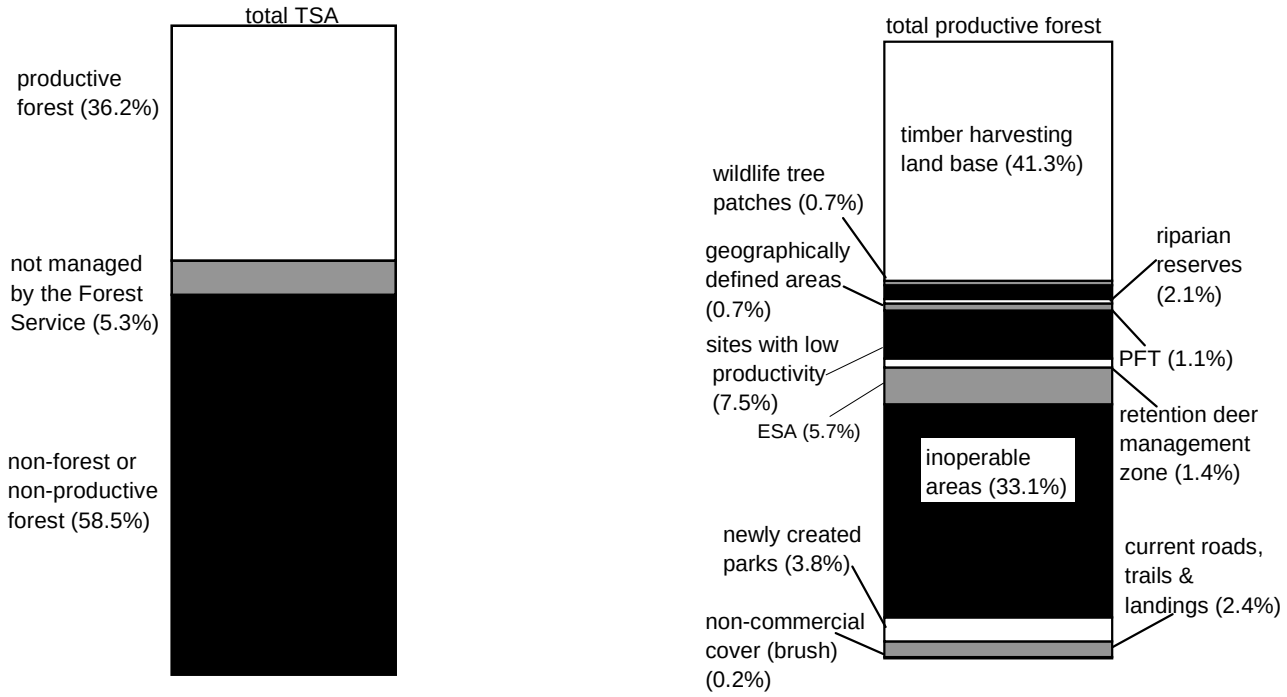

Figure 2. Composition of the total and productive forest land bases — Soo TSA, 1999.

Not satisfactorily restocked (NSR)
An area not covered by a sufficient number of well spaced tree stems of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since 1987 are classified as current NSR.

2 Information Preparation for the Timber Supply Analysis

Figure 3 shows the current composition of the timber harvesting land base by dominant tree species. Douglas-fir species dominate about 52% of stands within the timber harvesting land base, with balsam dominating 20%, hemlock 19%, cedar 6%, spruce 1.4%, cottonwood 0.6% and pine 0.2%. After harvest, most stands are expected to be regenerated to the same species, except the better hemlock and balsam sites, which will be mostly regenerated to fir, cedar and spruce.

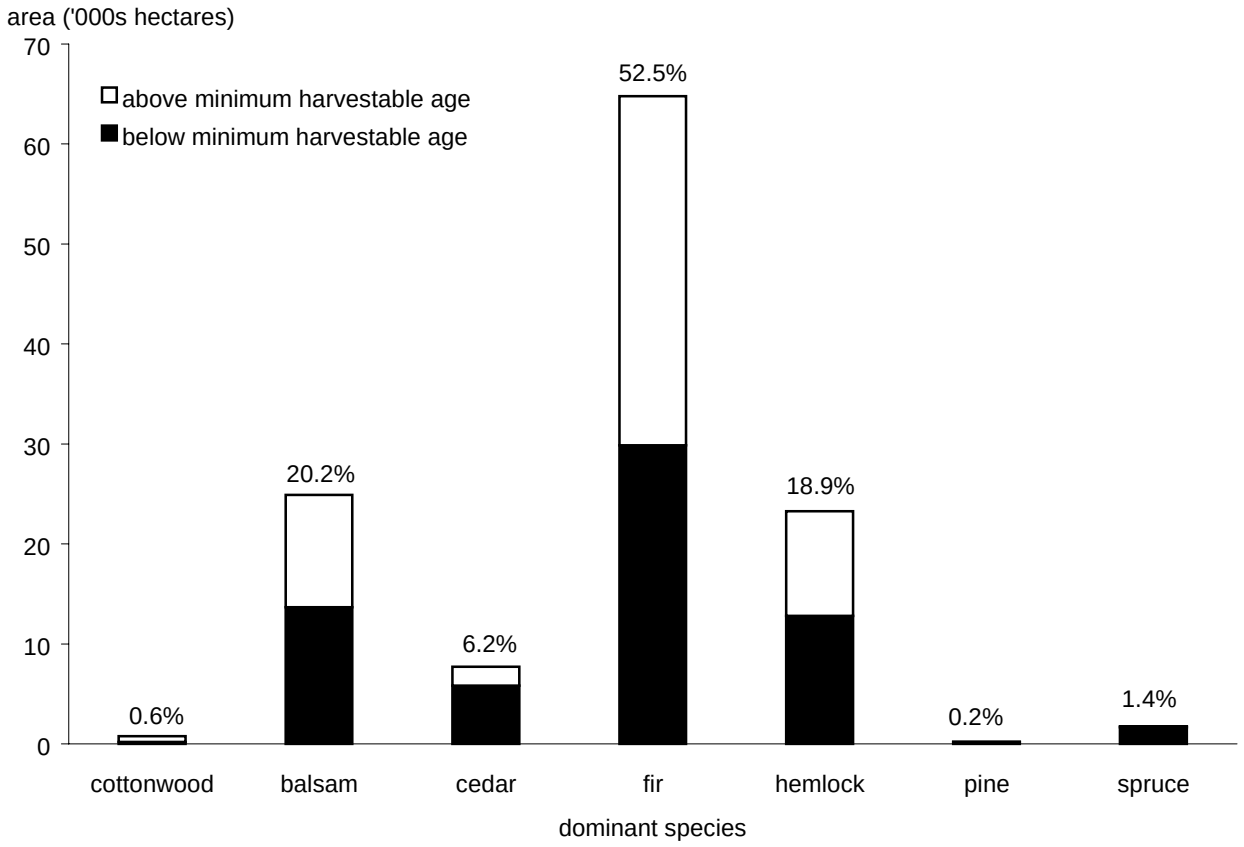

Figure 3. Area by dominant species — Soo TSA timber harvesting land base, 1999.

Figure 3 also shows the proportion of area of each species that is either younger or older than the minimum harvestable age (see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" for details on the minimum harvestable age for each species). In total, about 48% of stands in the timber harvesting land base are at or above the minimum harvestable age. There is variation around this proportion for each of the species groupings: 76% of cottonwood stands, 45% of balsam stands, 25% of cedar stands, 54% of fir stands, 45% of hemlock stands, 45% of the pine stands and 5% of spruce stands are currently older than the minimum harvestable age.

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Given the different proportions of area below minimum harvestable age for each species group, it would appear that harvesting in the Soo TSA has concentrated mostly on fir, followed by balsam and hemlock. As noted previously, better site hemlock and balsam stands have been converted to fir stands, which adds immature area to the fir category, and expands the indicated harvesting in fir stands.

Figure 4 provides an overview of the distribution of site productivity of the dominant stand types within the timber harvesting land base. Forty-one per cent of the stands are classified as having a site index* (height at age fifty years) between 17.5 and 22.4 metres. Stands with a site index less than 17.5 metres occupy 27% of the area, and those with a site index between 22.5 and 27.4 metres, 22.5%. Stands with a site index site equal to or greater than 27.5 metres occupy the least (5%) amount of area. Sites of very low productivity are excluded from the timber harvesting land base.

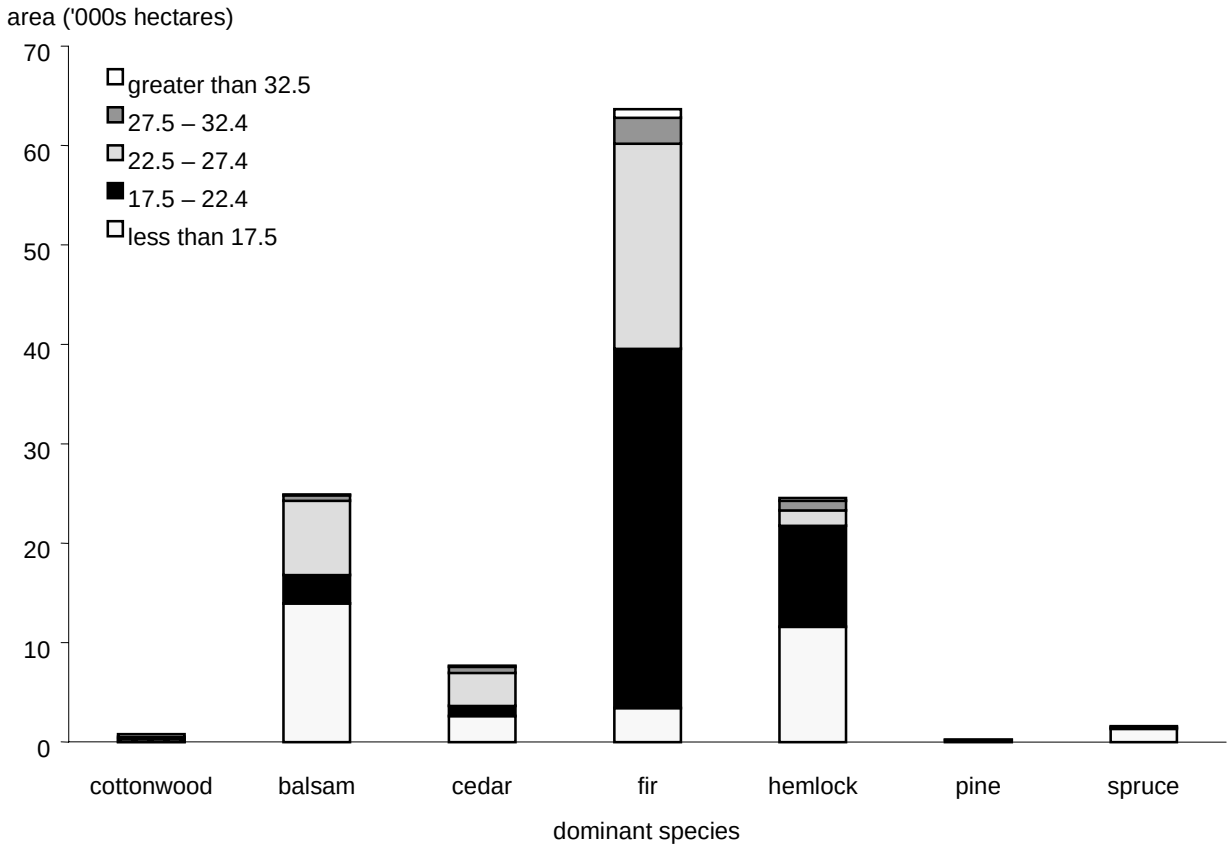

Figure 4. Area by predominant species and 5 metre site index class — Soo TSA timber harvesting land base, 1999.

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.

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Figure 5 shows the current age composition of forested stands in the Soo TSA. Within the timber harvesting land base, 20% of the stands are older than 250 years. About 25% of stands are 20 years or younger, 31% are between 21 and 100 years old, and 24% are between 101 and 250 years of age. Almost 48% of the stands in the timber harvesting land base are at or above the minimum harvestable age applicable to the stand.

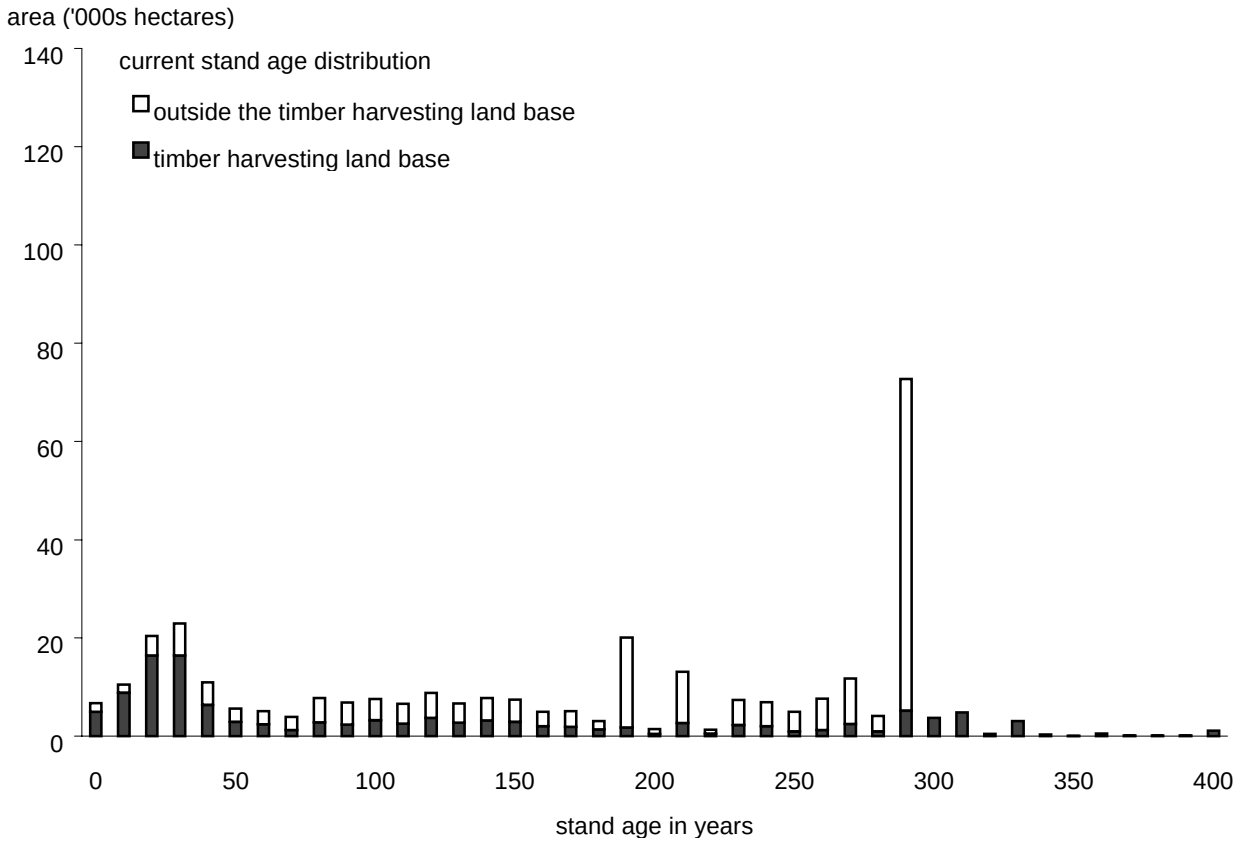

Figure 5. Current age class composition — Soo TSA productive forest land base, 1997.

The age class distribution of forested stands excluded from the timber harvesting land base also affects timber supply. In the case of the Soo TSA, 62% of the total forest land base of 323 898 hectares (which includes some land not managed by the B.C. Forest Service) is covered by these stands which, although they do not contribute directly to the timber supply, can affect how much harvesting can be conducted and the pattern of the harvesting within the TSA by providing old-forest and biodiversity attributes. About 34% of these "non-timber harvesting land base" stands are older than 250 years. Only 12% of the stands are 20 years or younger, 22% are between 21 and 100 years old, and 32% are between 101 and 250 years of age.

In the long term, the non-timber harvesting land base will be able to provide all but 25 hectares of the area needed to meet old-forest biodiversity requirements. However, some old-forest timber harvesting land base will have to be reserved from harvesting into the medium-term while forests in the non-timber harvesting land base age sufficiently to achieve old-forest conditions.

2 Information Preparation for the Timber Supply Analysis

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 over time that could be the subject of growth and yield (for example, number of trees per area, tree diameter, tree height, species composition). Since timber supply analysis concentrates on timber volumes available over time, the most relevant measure for this analysis is volume per 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 Soo TSA analysis. The variable density yield prediction (VDYP) model developed by the B.C. Forest Service, Resources Inventory Branch, was used for estimating volumes in unmanaged coniferous and deciduous stands. Managed deciduous stand volumes were also assigned using VDYP volume estimates*. The table interpolation program for stand yields (TIPSY), developed by the B.C. Forest Service, Research Branch was used to estimate yields for coniferous managed stands. Managed stands were defined as Douglas-fir stands less than 31 years of age; hemlock and balsam stands less than 21 years of age; cedar and spruce stands less than 11 years of age; and those stands that will be established in the future.

Volume estimation and prediction is subject to uncertainty due to uncertainties in inventories which form the basis for estimating site productivity, limited experience with second-growth in British Columbia, and the long time frame over which trees grow. Sensitivity analyses described in Section 5, "Timber Supply Sensitivity Analyses," address the possibility that actual timber volumes may be different from estimates used in this analysis.

Based on timber volume estimates, the current timber inventory on the timber harvesting land base is approximately 36.6 million cubic metres. About 33.1 million cubic metres, or 90%, of the total, are currently merchantable; that is, older than minimum harvestable age. The conventional, helicopter and cottonwood land bases comprise, respectively, 66.7%, 32.9% and 0.4% of the area available for timber harvesting activities. On these areas, 93.9%, 89.3% and 97.4%, respectively, of the standing timber volume is estimated to be merchantable.

Volume estimate (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.

2 Information Preparation for the Timber Supply Analysis

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 associated regulations guide forest management practices in the Soo TSA. The focus of the Timber Supply Review is to assess timber supply based on current management practices as implemented in plans for the area. Staff in the Squamish Forest District provided descriptions for the following management practices:

- Silviculture practices — reforestation activities required to establish free-growing* stands of acceptable tree species. Most areas in the Soo TSA are harvested using a clearcut harvesting* system and restocked by planting or natural regeneration.
- Incremental silviculture — juvenile spacing*, fertilization, and planting of genetically improved stock are practiced in the Soo TSA. Most stands are juvenile spaced, which ensures young trees are well distributed to maximize growth. A portion of Douglas-fir sites with high growing potential are fertilized, and many of the seedlings used for planting originate from seeds which are of genetically superior stock. Some commercial thinning* is being done within the Soo TSA. However, the area involved is too small to be accounted for in the analysis.
- Forest health and unsalvaged losses* — timber losses to fire and pest (insect) damage are expected to average 34 000 cubic metres per year over the 250 year analysis horizon.
- Utilization levels — minimum sizes of trees, and logs to be removed during harvesting.

Free-growing
An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Clearcut harvesting
A harvesting method whereby all trees that meet utilization standards are harvested. The harvested site is then regenerated to acceptable standards by appropriate means including planting and natural seeding.
Juvenile spacing
A silvicultural treatment to reduce the number of trees in young stands, often carried out before the stems removed are large enough to be used or sold as a forest product. Prevents stagnation and improves growing conditions for the remaining crop trees so that at final harvest the end-product quality and value is increased (see Commercial thinning).

Commercial thinning
A silviculture treatment that 'thins' out an overstocked stand by removing trees that are large enough to be sold as products such as poles or fence posts (see also, Juvenile spacing). It is carried out to improve the health and growth rate of the remaining crop trees.
Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.

2 Information Preparation for the Timber Supply Analysis

- Cutblock adjacency* and green-up* — in the Soo TSA, approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up (three metres in height for integrated forest management area and five metres in height for visual quality management areas), before adjacent stands may be harvested. The purpose of the cutblock adjacency guidelines is to prevent timber harvesting from becoming overly concentrated in an area at any time. These guidelines were modeled by limiting the area of the integrated resource management* (IRM) zones that do not meet green-up conditions to a maximum of 33%.
- Mushroom habitat — in the small area managed for mushroom habitat the green-up requirement is achieved when trees on a previously harvested area are approximately five metres tall. No more than 20% of the area is allowed to be under cover of stands that have not reached green-up conditions. At least 50% of the area must be covered with trees older than 80 years. The mushroom habitat area covers 0.4% of the timber harvesting land base.
- The management direction provided in the draft deer management plan was incorporated in the base case*. The objective of the plan is to provide for the maintenance of deer winter range within one of five deer management zones. Timber harvesting is either excluded or modified within these. Harvesting activities are modified through forest cover requirements* by ensuring that within individual deer planning cells at least 50% of the forested area is older than 50 years, or 80% of the forested are is greater than 20 years old, depending on the specific area.
- Maintenance of northern spotted owl habitat with special resource management zones (SRMZ) — as a minimum management practice, 67% of the forested area within each special resource management zone is always maintained in forest stands that are more than 100 years old.

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

Base case 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.
Forest cover requirements
Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see Cutblock adjacency guidelines and Green–up).

2 Information Preparation for the Timber Supply Analysis

- Protection of environmentally sensitive areas — areas where soils, avalanche tracks, recreation activities, forest regeneration problems and habitat for mountain goat, moose and various birds have been identified. To maintain ecological or other valuable resource values, land has been partially or wholly removed from the timber harvesting land base. Of the total of 86 935 hectares identified as ESA, only 3.2% remain in the timber harvesting land base after all the area reductions.
- Community watersheds* — within designated watersheds a maximum of 5% of the forest area may be harvested within a 5-year period, as suggested by the *Forest Practices Code Community Watershed Guidebook*. Community watersheds cover 3.2% of the timber harvesting land base.
- Maintenance of scenic values — maintaining important scenic values requires that visible evidence of harvesting must be kept within limits in some areas of the Soo TSA. The maximum proportion of each scenic area* that may be covered by young stands that do not meet green-up requirements varies depending on the forest characteristics and the visual quality objectives (VQO)* for each area, but generally ranges between 5% and 20%.

Watershed
An area drained by a stream or river. A large watershed may contain several smaller watersheds.
Scenic area
Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager. In the Mid Coast Forest District, the district manager has designated scenic areas as either highly sensitive or moderately sensitive as per the map of the scenic areas for the Mid Coast Forest District, dated September 2, 1998.

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.

- Minimum harvestable ages (MHA) — the time it takes for stands to grow to a merchantable condition. The criterion used to define minimum harvestable ages for the conventional land base was 90% of the age at which stands attain the maximum growth, that is, 90% of culmination age*. Stands to be helicopter logged also had to have a minimum volume of 400 cubic metres per hectare. Actual harvest age may be greater but not less than the minimum, and will depend on ages of other available stands, forest cover objectives* and overall timber harvest targets.
- Landscape-level biodiversity* — to maintain biological diversity throughout a landscape unit*, the Forest Practices Code contains targets for the proportion of the area in each biogeoclimatic variant that should be covered by stands with old-forest characteristics. Within the Soo TSA, old-forest is characterized by stands greater than 250 years old. Since biodiversity emphasis options have not been established for each landscape unit, a weighted average old-seral requirement was applied (see Section A.4.4 "Forest cover requirements" in Appendix A)
- Harvest systems — the timber harvesting land base supports conifer and hardwood harvesting. Within these types harvesting is conducted either by conventional or helicopter harvesting systems. Helicopter operations have the added benefits of permitting greater access to stands (i.e., groups of small stands and/or stands up to 1.5 kilometres from roads) and stands at higher elevations.

The data package for the Soo Timber Supply Area (TSA) was released in August 1997. As a result of public input, changes were required to the data package (e.g., increased helicopter land base). The revised data package, which includes detailed descriptions of the management practices and the assumptions used to incorporate them into the analysis, is presented in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" of this document.

Culmination age
The age at which a timber stand reaches its highest average growth rate, or mean annual increment (MAI). MAI is calculated as stand volume divided by stand age. Culmination age is the optimal biological rotation age to maximize volume production from a growing site.

Forest cover objectives
Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see Cutblock adjacency guidelines and Green–up).

Landscape level biodiversity
The Forest Practices Code Biodiversity Guidebook 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.

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Figure 6 displays the proportions of the timber harvesting land base subject to spotted owl and deer management emphasis. The two charts in Figure 7 show the proportions of the timber harvesting land base subject to management for scenic values, and the different types of harvesting systems. The entire area of the timber harvesting land base is represented in each bar chart. Often several management objectives are applied to the same area; for example, all or part of a visual quality area may also be managed for spotted owl habitat. The bar charts show the total area in each management emphasis area.

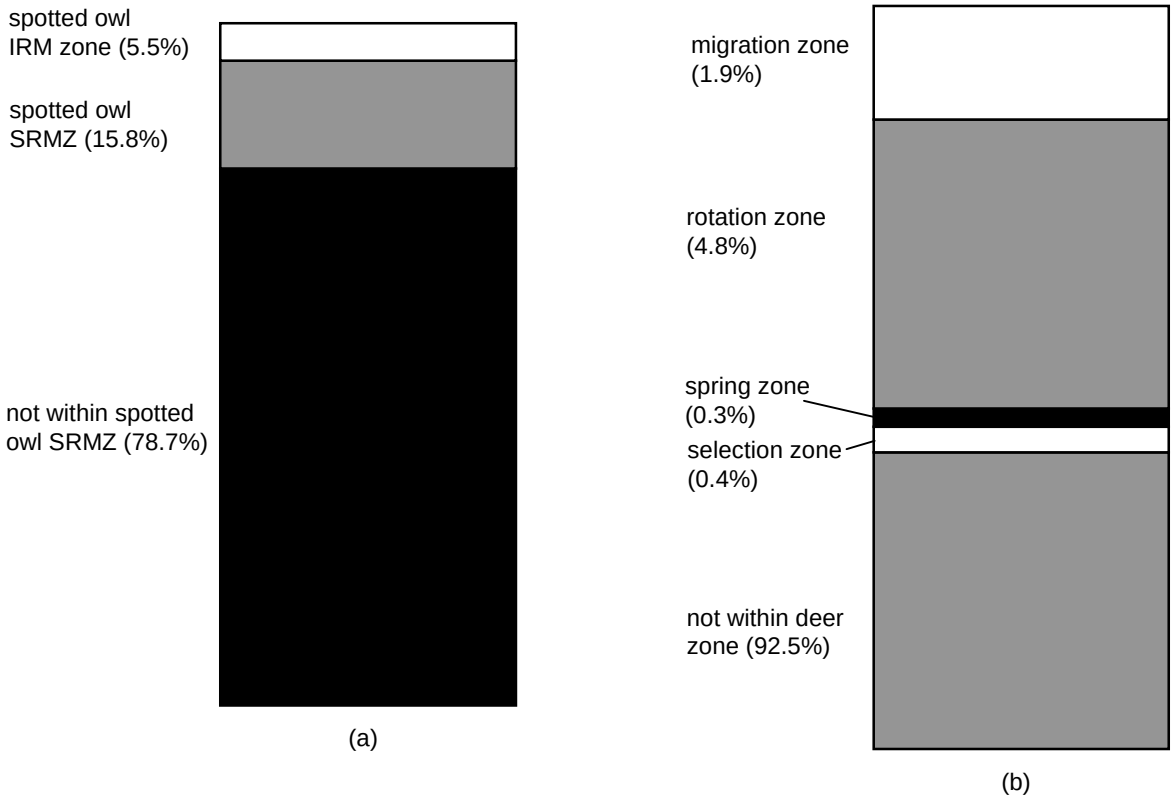


Figure 6. Forest area by spotted owl (a) and deer management (b) category — Soo TSA timber harvesting land base, 1999.

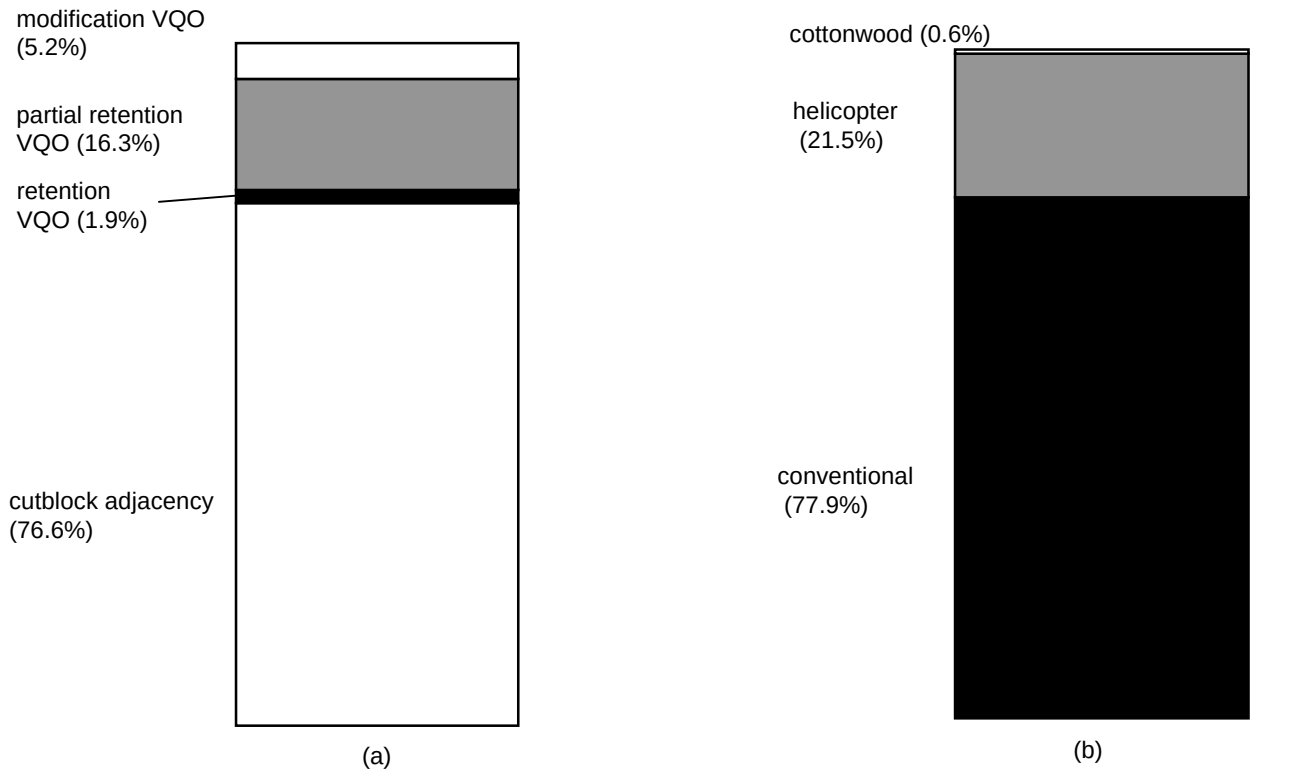
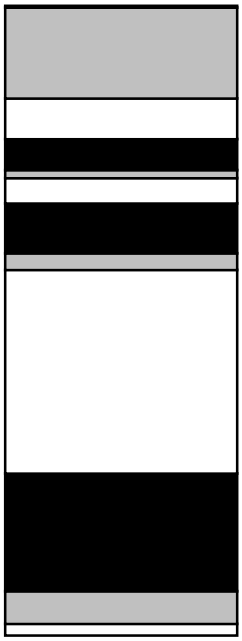


Figure 7. Forest area by scenic management class (a) and harvest system (b) — Soo TSA timber harvesting land base, 1999.

2 Information Preparation for the Timber Supply Analysis

The conventional timber harvesting land base is approximately 11 200 hectares (10.9%) smaller than in the last timber supply review. However with the inclusion of 26 450 hectares of area operable for helicopter logging, the overall change in the timber harvesting land base is an increase of 14 600 hectares (13.4%).

Figure 8 shows an overview of the proportion of each biogeoclimatic (BEC) variant in the productive forest. Also shown is the proportion of the total forest area in each BEC variant that is in the timber harvesting land base. For example, the MHmm2 variant makes up 14.4% of the total forest area, while 10.2% of the total area of MHmm2 is within the timber harvesting land base. In general, greater proportions of the lower elevation BEC variants (IDF, CWH) are within the timber harvesting land base, than the higher elevation units (ESSF, MH).



BEC variant	% of productive forest	% BEC variant in THLB
MH mm 2e	0.3%	0.0%
MH mm 2	14.4%	10.2%
MH mm 1	6.5%	24.8%
IDF ww	4.9%	53.8%
ESSFmw h	1.3%	26.3%
ESSFmw	4.0%	7.1%
CWH vm 2	7.9%	49.8%
CWH vm 1	2.6%	67.3%
CWH ms 1	32.4%	41.3%
CWH ds 1	18.7%	55.6%
CWH dm	5.2%	41.3%
AT p	1.8%	6.1%
	100%	

Figure 8. Area by biogeoclimatic classification — Soo TSA, 1999.

In a few of the 107 landscape unit/biogeoclimatic variant combinations, retention of forest from the timber harvesting land base is required in the short- and medium-term to achieve old-seral targets until forest outside the timber harvesting land base ages sufficiently to meet old-seral characteristics. Initially, 1053 hectares of the timber harvesting land base are required to meet landscape biodiversity objectives. In the long term, only 25 hectares of the timber harvesting land base need to be reserved for landscape-level biodiversity.

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2.4 Changes since the 1994 Soo TSA analysis

The size and availability of the timber harvesting land base has changed since the last analysis for the Soo TSA. The objective of this section is to present the major changes to the land base and forest management assumption since the last analysis.

- In the last analysis the forested area managed by the B.C. Forest Service was 300 716 hectares. It is now 298 912 hectares, mostly due to ownership changes to account for the removal of parks. In addition, 11 517 hectares of newly created parks, for which ownership codes have not been changed, have been removed from contributing to timber supply for this analysis.
- The timber harvesting land base has changed significantly since the last analysis. The timber harvesting land base operable for conventional harvesting systems is approximately 11 800 hectares smaller. However, after the inclusion of new helicopter logging area, the overall increase in area is approximately 14 600 hectares. Table 4 shows the change in the area of timber harvesting land base within the two harvesting systems categories.

Table 4. Change in timber harvesting land base

Type of land base	Current timber harvesting land base (hectares)	Previous timber harvesting land base (hectares)[a]	Change in area (hectares)
Conventional	96 942	107 297	– 11 823
Helicopter	26 450	1 468	+ 26 450
Total	123 392	108 765	+ 14 627

(a) 1468 hectares of inoperable land base was evaluated as helicopter logging area. Except for seven hectares, this area was subsequently updated in the inventory file as conventional operable land base.

- Implementation of the FPC has increased land base reductions for riparian reserves and wildlife tree patches (WTPs). Additional constraints limiting the availability of the timber harvesting land base are the requirements to maintain (or recruit) suitable areas of old forest for landscape-level biodiversity.
- The area under partial retention visual quality objective (VQO) has increased significantly (approximately 5000 hectares). However, the application of forest cover requirements to the entire forested area within a visual management area, rather than to just the timber harvesting land base as in the last analysis, resulted in VQOs being less restrictive to timber supply in this analysis.

- In this analysis, a draft deer management plan was modelled, rather than removal of deer ESAs from the timber harvesting land base. The management plan involves more area being removed from the timber harvesting land base, and more area being under forest cover requirements than the area that was considered in the last AAC determination. Current practice for deer habitat management changed with the implementation of revisions to the *Operational Planning Regulation* (OPR 107/98). Information about grandparented areas was only available after the completion of most of the analysis. Impact to the base case timber supply due to the implementation of OPR 107/98 is assessed in a sensitivity analysis*.

The *Northern Spotted Owl Management Plan* has been approved by government. This plan has resulted in the application of a forest cover requirement and additional WTP requirements in special resource management zones.

Additional management measures are anticipated, but not included in the base case, as the development of management plans for owl activity centres and special resource management zones is ongoing.

- Changes in the criteria used to define both minimum harvestable ages and sites with low productivity have changed the estimated timing of the availability of stands for harvest, as well as which stands are excluded from the timber harvesting land base. Some higher productivity pine stands are included in this analysis.
- In the last analysis, 1000 hectares of these stands were forecast for conversion to coniferous-leading stands. These plans have been discontinued.

In summary, the timber harvesting land base has increased by 13.4% and the definition of current practices have changed considerably since the last analysis. Given the extent of the change of the timber harvesting land base and the definitions of current management, direct comparisons between this and the previous analysis cannot be made. Each analysis needs to be evaluated in the context of the management regime and related data inputs and assumptions that applied at the time (See Appendix A of the respective reports). As noted in the introductory section, there is uncertainty surrounding information used in analyses and forest management objectives change over time, which is why the *Forest Act* requires the Chief Forester to periodically review the timber supply and AAC for each TSA.

Any changes to the land base or management assumptions that may occur or become effective after the completion of this timber supply analysis will be presented to the Chief Forester for consideration during the AAC determination if possible.

Sensitivity analysis
Examines how uncertainty in data and management assumptions affect timber supply.

3 Timber Supply Analysis Methods

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

Similar to other models, the B.C. Forest Service model assumes that trees grow according to provided yield projections and are harvested according to either a volume target or a specified objective set by the analyst, such as harvest volume maximization. The Forest Service 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 that some minimum percentage of the forest must be in older age classes to provide wildlife habitat. The B.C. Forest Service 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 forest management regime. The results of the analysis are especially important in determining allowable cuts that will not restrict options of future resource managers, and that will 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.

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

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.

4 Results

This section presents results of the timber supply analysis for the Soo TSA. The base case harvest forecast uses the most recent assessments of current forest management, the land available for timber harvesting, and timber yields as described in Section 2, "Information Preparation for the Timber Supply Analysis." Because forest management is inherently a long-term venture, uncertainty surrounds much of the information important in determining timber supply. This uncertainty will be discussed in Section 5, "Timber Supply Sensitivity Analyses." The base case provides only a part of the timber supply picture for the Soo TSA, and should not be viewed in isolation of the sensitivity analysis.

4.1 Base case and alternative flow harvest forecasts

Figure 9 shows the base case harvest forecast for the Soo TSA. The initial, medium-term and long-term harvest level* is 506 000 cubic metres per year.

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.

Unsalvaged losses due to natural forces such as insects and fire are estimated to be 34 000 cubic metres per year for the entire 250-year horizon and have been subtracted from all harvest forecasts shown in this report.

Section 2.4, "Changes since the 1994 Soo TSA analysis," provides an overview of the major changes to the land base and management assumptions since the last analysis. The summary concludes that any comparison between this and the last analysis should be made with recognition of the extent and nature of those changes. Each analysis should be evaluated in the context of the management regime and related data inputs and assumptions that applied at the time. Finally, one of the major reasons the Chief Forester is required under the *Forest Act* to periodically review the timber supply and AAC is to account for changes in management, as well as new information that may resolve some uncertainties.

4 Results

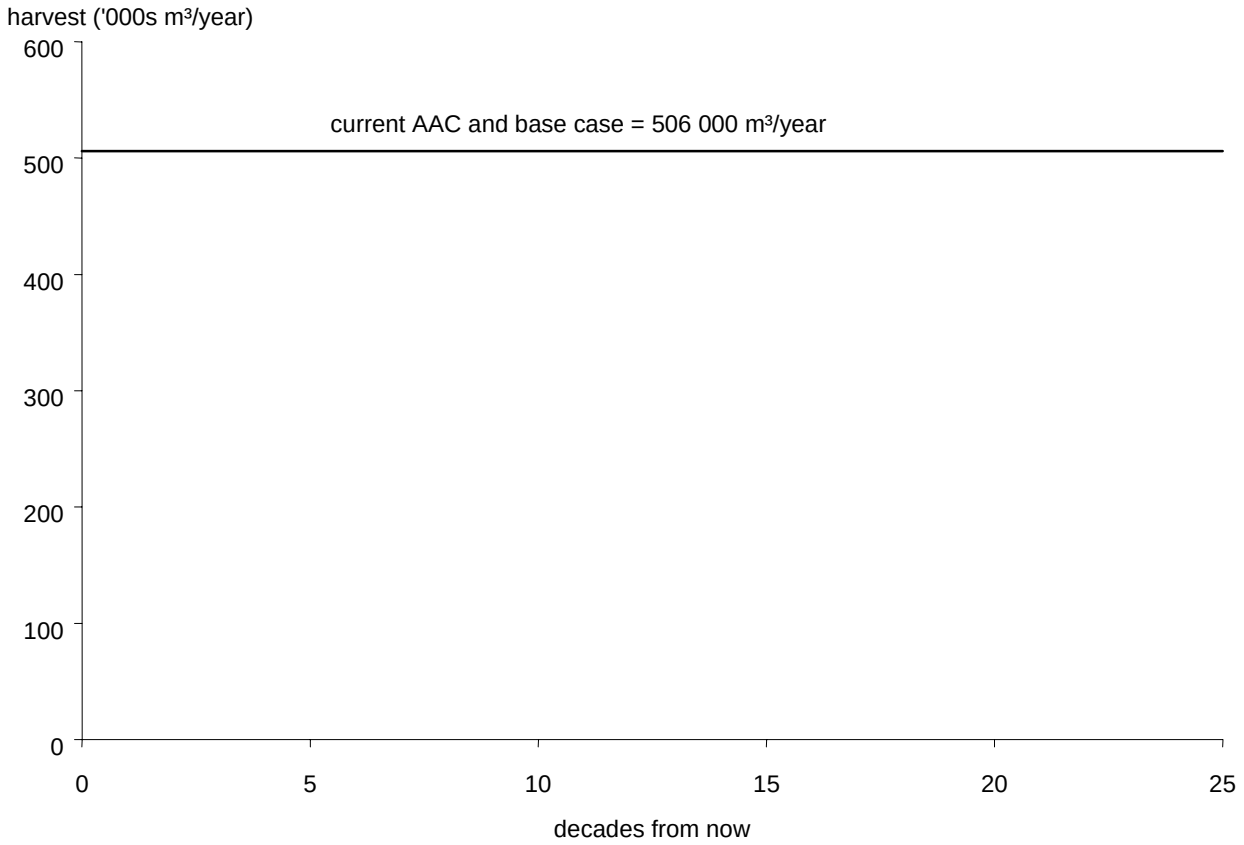

Figure 9. Base case harvest forecast for the Soo TSA, 1999.

Several harvest forecasts are possible for the Soo TSA within the current management regime as described in previous sections. Objectives and considerations in choosing among the possible alternative harvest flows are:

- Attempt to establish an initial harvest that meets the current AAC (506 000 cubic metres per year), while avoiding medium-term harvest levels that drop below the long-term level.
- Since there is a partition for cottonwood harvesting, timber supply attributable to cottonwood was modelled separately. The maximum even-flow harvest forecast was 2000 cubic metres per year.
- The area classed as operable for helicopter harvesting has recently expanded to 26 500 hectares in the Soo TSA. The greater part of the additional area (74%) was based on stand characteristics (e.g., species and site index) and the lesser part based on aerial or ground assessments. Given uncertainty that all the stands will actually be harvested, and concerns of the Squamish Forest District staff that harvesting not be overly concentrated in the helicopter land base, the rate of harvest for the first 20 years in this area was limited to the current level of activity - 135 hectares per year.

4 Results

- The harvest level that can be sustained over the very long-term could not be defined until the forest within the timber harvesting land base initially required to achieve landscape-level biodiversity requirements is forecast to be replaced by forest outside the timber harvesting land base. This transition is not forecast to occur until well into the future, and therefore a forecast period 600 years was used in the analysis.

Prior to selecting the base case, a number of forecasts were developed to analyze the potential timber supply for the Soo TSA. Figure 10 presents some of these forecasts, and the following paragraphs describe how the alternative forecasts were evaluated, and how the final selection of the base case harvest forecast was made.

The first evaluation of the analysis tested the feasibility of having an even-flow harvest at the current AAC or 506 000 cubic metres per year. Additionally, the forecast had to be comprised of coniferous and deciduous even-flow harvests. Results showed that an even-flow of 506 000 cubic metres per year is feasible and the coniferous and deciduous harvests are, respectively 504 000 cubic metres per year and 2000 cubic metres per year. In all subsequent alternative harvest flows, the deciduous component of the harvest is maintained as an even-flow harvest of 2000 cubic metres per year.

The second evaluation tested the feasibility of establishing a higher even-flow forecast. Results show the maximum even-flow harvest to be 514 000 cubic metres per year. Since Squamish Forest District staff wish to avoid over-concentration of the harvest in either the helicopter or conventional timber harvesting land base, the volumes forecast for harvest from the land bases were examined separately. Results show the contribution of the helicopter area varied widely between 41 000 cubic metres per year and 219 000 cubic metres per year.

Additional analysis was performed to determine the impact on the maximum even-flow harvest of constraining the harvest forecast to prevent both over-concentration of harvests in the helicopter land base. The helicopter harvest was limited to 135 hectares per year for the first 20 years (current performance). Another criterion was that after 20 years, the area harvested should produce a fairly regular flow of volume over time (i.e., a stable flow allowing some, but not wide fluctuation in volume). It was found that when the helicopter contribution was constrained to 160 and 200 hectares per year after year 20, the variation of harvest was reduced, as the size of the permissible harvest area was reduced. Figure 10 shows the magnitude and variation of helicopter harvest when the maximum annual harvest area is 160 hectares. The timber supply trade-off of constraining area harvest to reduce the harvest volume variation between conventional and helicopter land bases is 8000 cubic metres per year (the maximum is reduced by 1.6% to 506 000 cubic metres per year).

The third evaluation tested whether it was possible to increase the initial level above the current AAC. Results show an initial harvest of 607 200 cubic metres per year, 20% above the AAC, is feasible if timber supply is reduced after one decade (dashed line in Figure 10). The harvest level at the start of the third decade would be 506 000 cubic metres per year.

4 Results

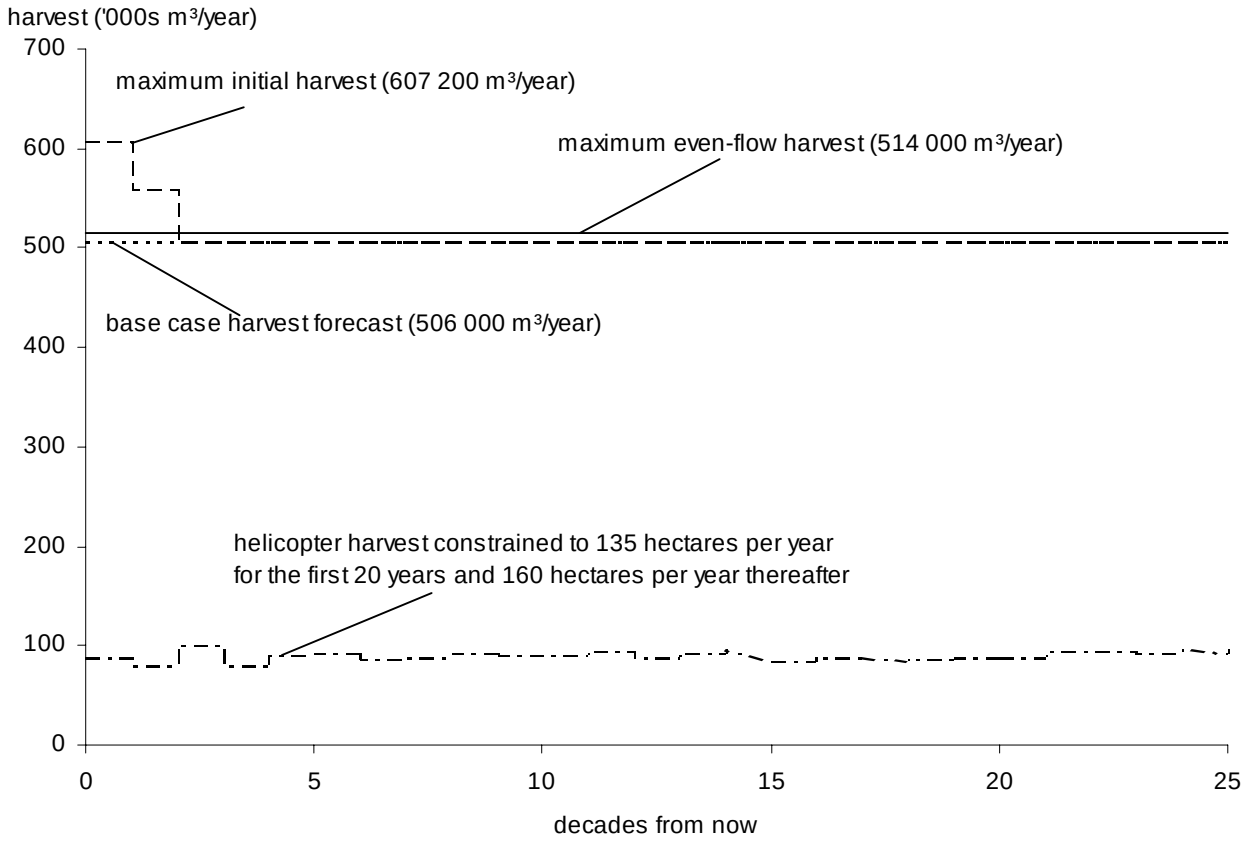

Figure 10. Alternative harvest flows: part 1 — Soo TSA, 1999.

The final evaluation was to perform independent assessments of the timber supply from the conventional and helicopter land bases. The objective was to determine the time frame for which the current AAC (506 000 cubic metres per year) can be supported on the conventional land base. Results shown in Figure 11 suggest that the current AAC can be supported for one decade, and then timber supply declines by 10% in the second decade and 9% in the third decade. At the beginning of decade 3 the long-term harvest level of 416 000 cubic metres per year is achieved and maintained for the duration of the forecast. The objective of the helicopter land base assessment was to determine the long-term harvest level from that area, and if the initial harvest level could be higher than the long-term harvest level. Figure 11 shows the long-term harvest level to be 103 200 cubic metres per year and that an initial harvest of 200 000 cubic metres can be maintained for 20 years. The subsequent four declines in timber supply are in steps of 25 000 cubic metres per year.

4 Results

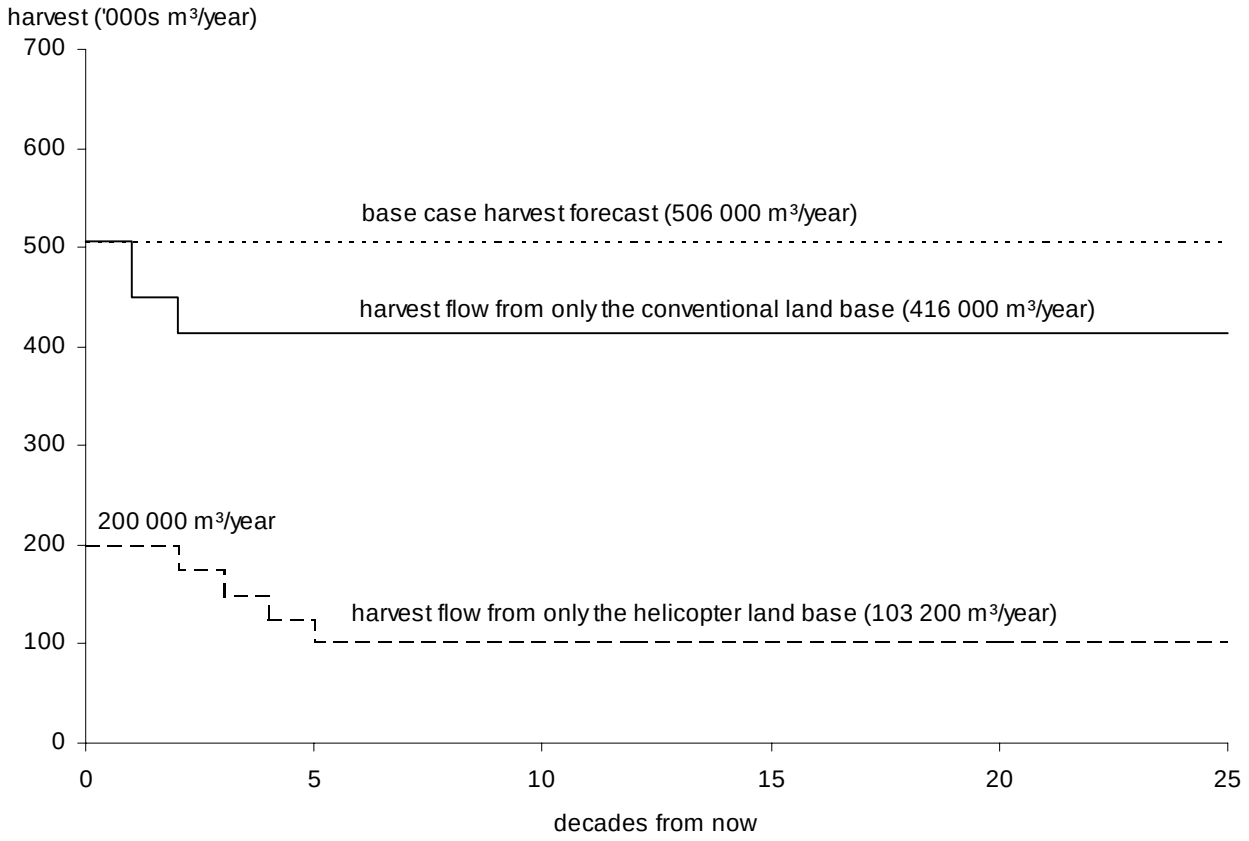

Figure 11. Alternative harvest flows: part 2 — Soo TSA, 1999.

The four evaluations of timber supply led to the selection of an even-flow harvest of 506 000 cubic metres per year as a base case, with the following attributes:

- 504 000 cubic metres per year from coniferous stands and 2000 cubic metres per year from deciduous stands;
- Helicopter logging is limited to 135 hectares per year for the first 20 years and 160 hectares per year thereafter. There are no restrictions on the area harvested from the conventional land base.

Major reasons for the selection of the base case harvest forecast are:

- The maximum even-flow harvest forecast has a higher level of harvest but was not selected since there is also a high inter-decadal variation in conventional and helicopter land base harvest levels. The trade-off for more uniform flows is 8000 cubic metres per year.
- An initial harvest level of 20% greater than the base case is feasible. Squamish Forest District staff indicate there is uncertainty about the size the helicopter land base (see Section 5.2.2, "Uncertainty in the estimated area of the helicopter component of the timber harvesting land base") and a higher short-term forecast would introduce greater short-term risk to timber supply should the helicopter-operable area actually be smaller than estimated. In addition, selection of a more stable short-term forecast could also increase flexibility in locating harvesting units, while a higher level might reduce the ability to respond to uncertainties and reduce operational flexibility.
- Results of the independent assessment of conventional and helicopter timber supply suggest that the short-term base case timber supply can be achieved even if the actual magnitude of the helicopter land base is overestimated. Secondly, in the short- and medium-term, the timber harvesting land base can accommodate a greater variation in harvest contribution from the helicopter land base without requiring deviations from the base case harvest forecast.

4.1.1 Base case timber supply dynamics

Currently, 41% of the timber harvesting land base is comprised of stands with ages greater than 141 years. Figure 12 shows the transition of harvest from existing to managed stands for the base case. The transition on the conventional land base from existing to managed stands, which is not shown, starts at the beginning of decade 8 and during the same decade the contribution from both types of stands is almost an equal. By decade 13, managed stands contribute about 90% of the harvest. For the helicopter land base these events occur at decades 11, 12 and 14.

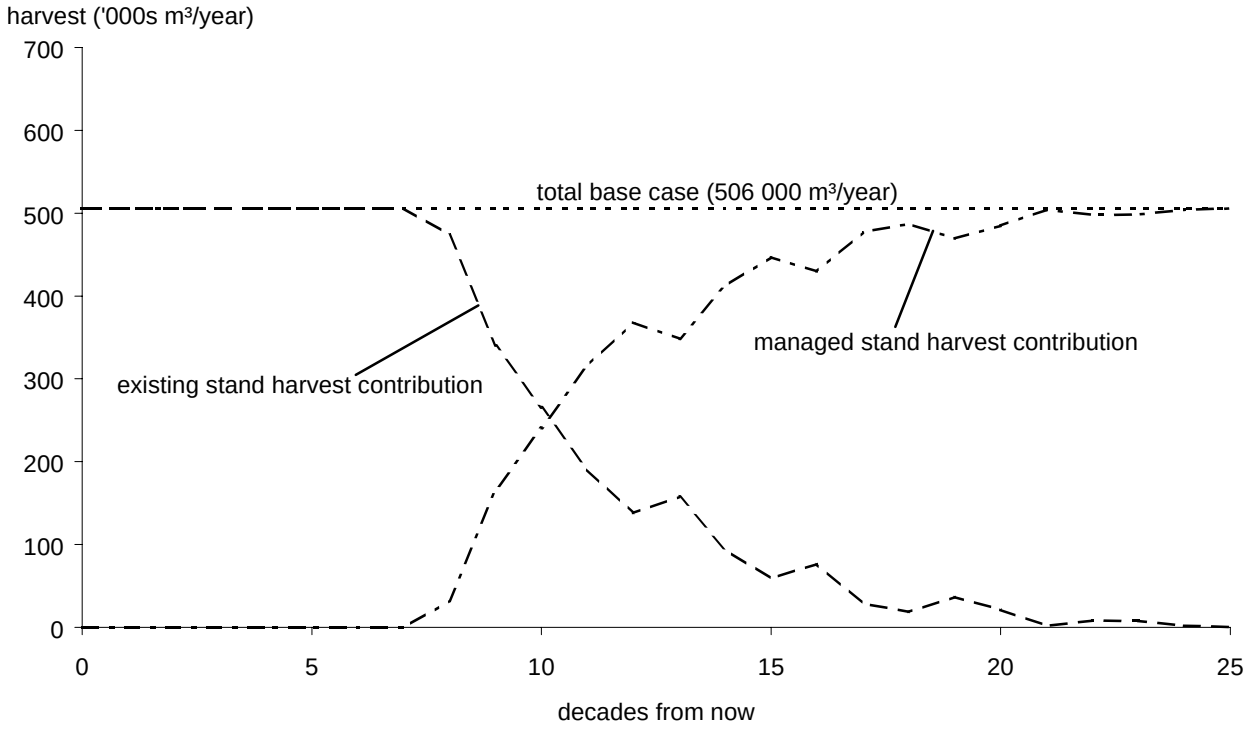

Figure 12. Harvest contribution from the existing and managed stands — Soo TSA, 1999.

Figure 13 shows the transition from existing to managed stand growing stock*. The transition of growing stock on the conventional and helicopter land bases, which is not shown, occurs in a similar manner to the harvest contribution transition, except that stands become merchantable earlier (i.e., the respective growing stocks cross during decades 7 and 13).

The long period during which harvesting shifts from existing to managed stands results in the following dynamics for the Soo TSA timber supply:

- Existing growing stock can absorb potential reduction in timber supply due to increasing constraints on managed stands (e.g., adjacency restrictions increased, or minimum harvestable ages increased) so that the base case short term and generally, medium-term timber supply can be achieved. For example, if managed stand yields were lower than expected, the short-term base case timber supply volumes would not be affected, because the lower managed-stand volumes would not be harvested until well into the future. However, long-term supply would decrease at some point in the medium or long term (see Section 5.2.5, "Uncertainty in timber volume for managed stand yields").

Growing stock
The volume estimate for all standing timber, at a particular time.

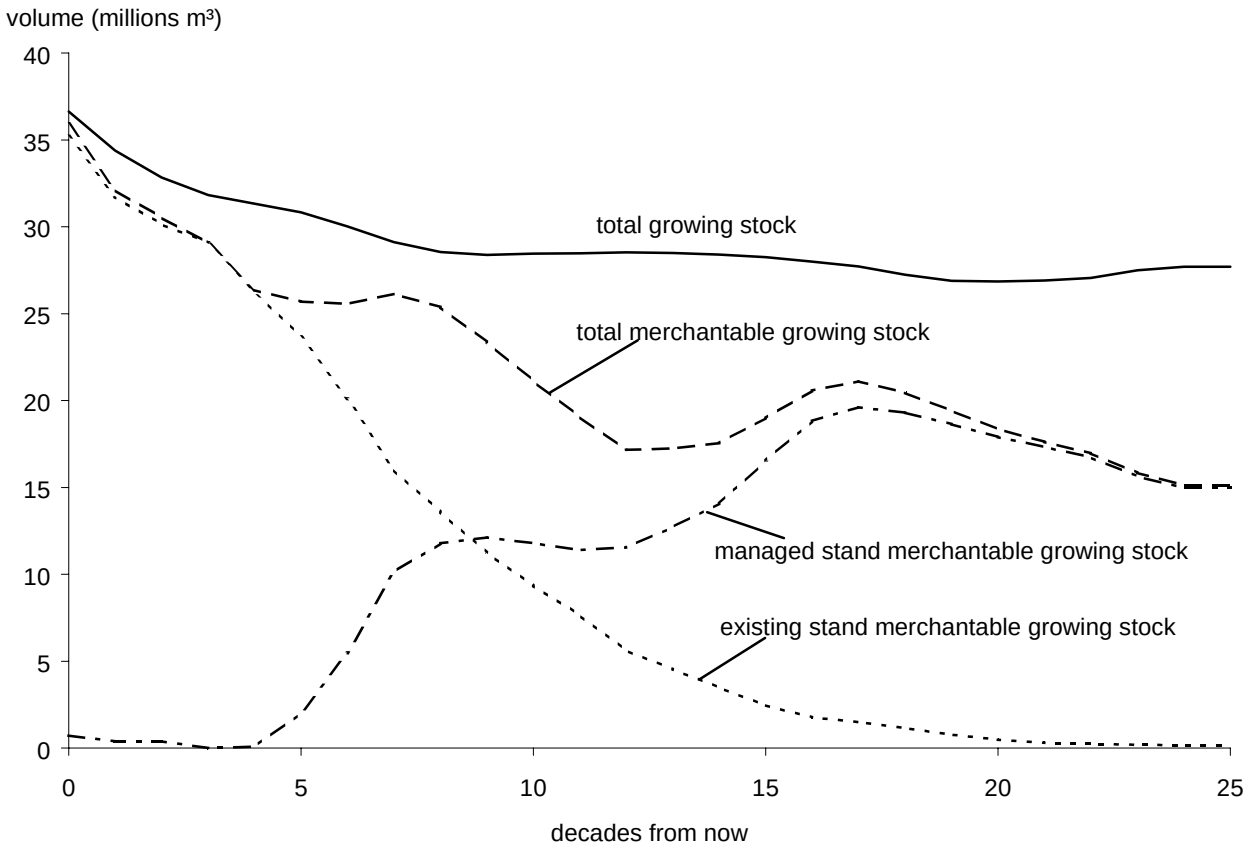

Figure 13. Total and merchantable growing stocks — Soo TSA, 1999.

- If managed stand characteristics or assumptions are less constraining (e.g., retention VQO requirement reduced from 5% to partial retention requirement 15%, or minimum harvestable ages decreased) then more merchantable managed stand growing stock becomes available earlier. For the Soo TSA, earlier availability of managed stand stock may allow increased short-term timber supply. Additionally, the long-term harvest level is usually increased in such cases.

Sensitivity analyses described in Section 5 "Timber Supply Sensitivity Analyses" illustrate these dynamics.

4.2 Area, average volume and average age harvested

Figure 14 tracks the change in the area-weighted harvest age resulting from the base case forecast. Currently, 41% of the stands in the timber harvesting land base are older than 140 years of age. These stands predominate the timber supply for the first 5 decades of the forecast. From decade 6 onward, managed stands comprise more of the forecast harvest, and the average age of the stands harvested — approximately 100 years — trends slightly above the area-weighted average minimum harvestable age of 94 years.

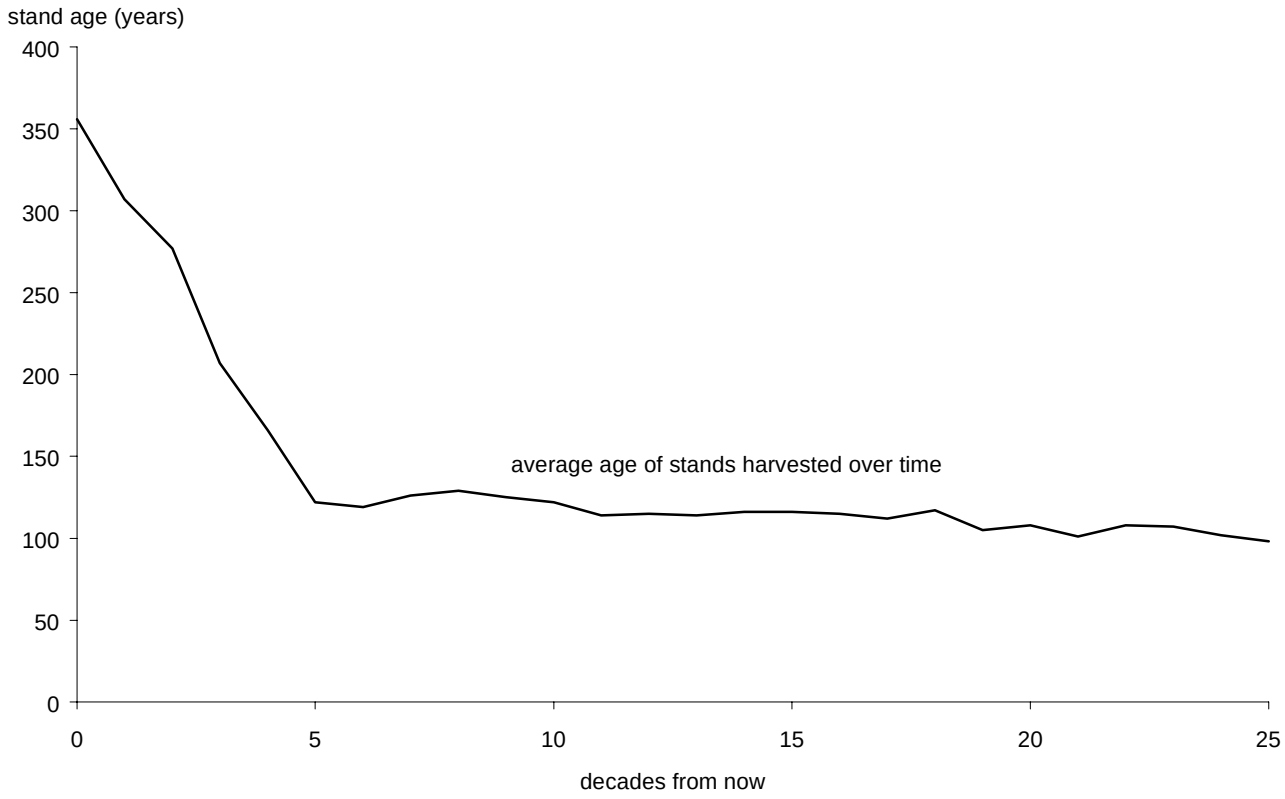

Figure 14. Average age of stands harvested over time — Soo TSA base case, 1999.

Within the timber harvesting land base the long-term average area-weighted harvest ages for the conventional, helicopter and cottonwood land base are respectively 90, 140, and 66 years. The criteria for minimum harvestable ages are more restrictive (older) for stands in the helicopter logging areas than for the conventionally operable stands.

4 Results

Figure 15 shows the average area and volume harvested per year over next 250 years under the base case harvest forecast. For the first 5 decades the timber supply is forecast to come from progressively less productive, lower volume old-growth stands; hence the area harvested is forecast to increase. Decreases in expected volume at harvest may in part result from moving harvests from valley bottom to higher elevation stands. After decade 5, when the harvest is composed mostly of younger, lower volume second-growth stands, more area is required to maintain the base case harvest level. Fluctuations in the amount of area harvested per period after decade 10 result because stands become merchantable at different ages when stand volumes are different (lower productivity stands have lower volumes, and more area would be required to harvest the same volume than from higher volume stands). Timing of availability of areas subject to different forest cover requirements can also lead to fluctuations in area and volume harvested.

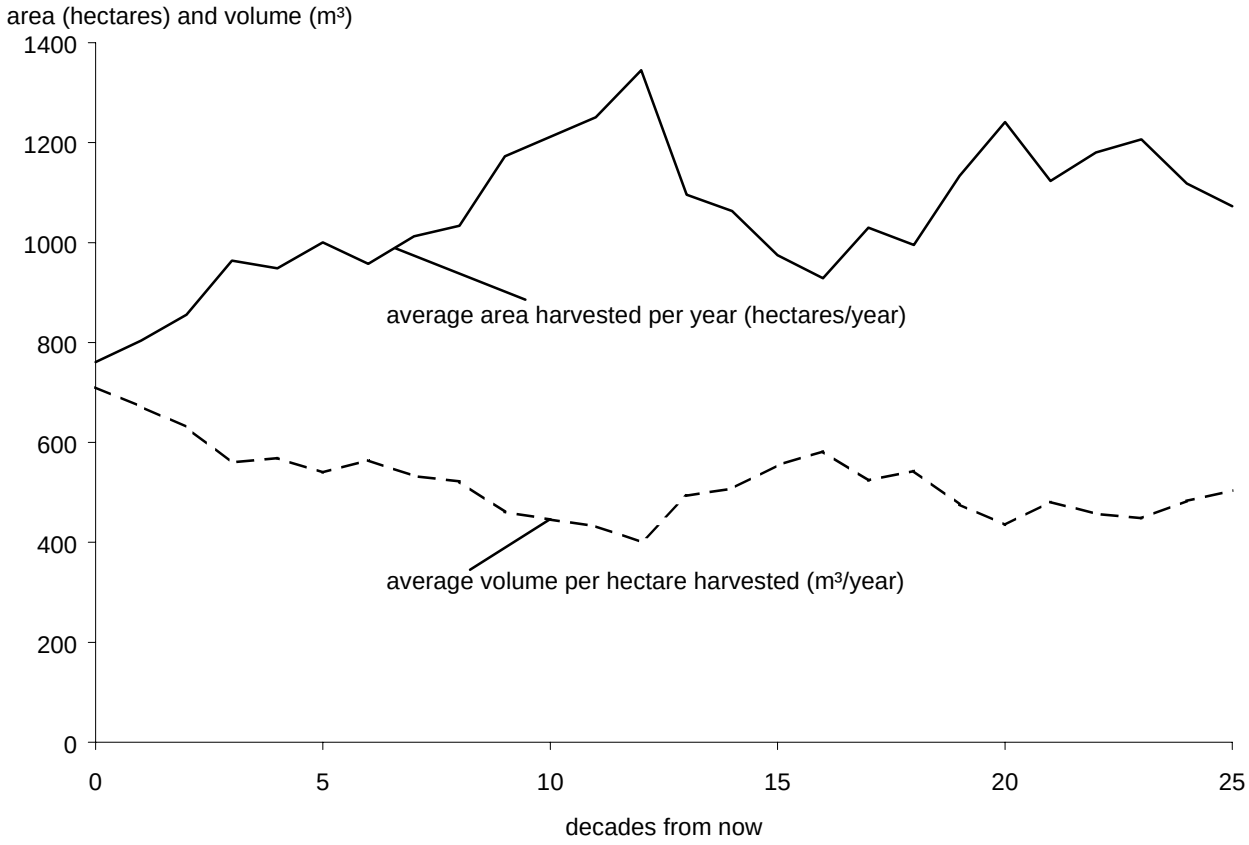

Figure 15. Average area harvested and average volume per hectare harvested over time — Soo TSA base case, 1999.

4.3 Age-class profile over time

The charts in Figure 16 show how the age composition of the productive forest within the Soo TSA land base changes under the base case harvest forecast.

The current age class distribution shows a relatively high proportion of young stands within the timber harvesting land base. However, 41% of the land base is still in stands over 140 years old.

Outside of the timber harvesting land base, 71% of the stands area are over 140 years old. Stands under 140 years old comprise the remaining 29% of the area. These younger stands exist because of fires, and occasionally past harvesting practices that occurred under different economic conditions or prior to the Code. For example, in the past, some harvesting occurred in riparian areas that are now deducted from the harvesting land base.

One consequence of the large proportion of stands under 250 years old (57%) in the area outside the timber harvesting land base is that some of the timber harvesting land base needs to be reserved from harvest to meet old seral stage landscape-biodiversity objectives until stands outside the timber harvesting land base age. Mitigating factors for timber supply are the phase-in of old seral stage requirements and a good distribution of older stands within landscape units. Nonetheless, suspension of harvest eligibility for some stands is as long as 260 years and this is shown in charts which follow the progression of the harvest forecast and resultant age class distribution in 50 year intervals. Reserving of stands for a long time extends the period over which existing stands are harvested, and results in fluctuations around average volume and area harvested into the long term. Secondly, the final long-term harvest level is not established until well beyond the forecast period presented in this report (600 years). In the long term only 25 hectares of the timber harvesting land base are permanently ineligible for harvest.

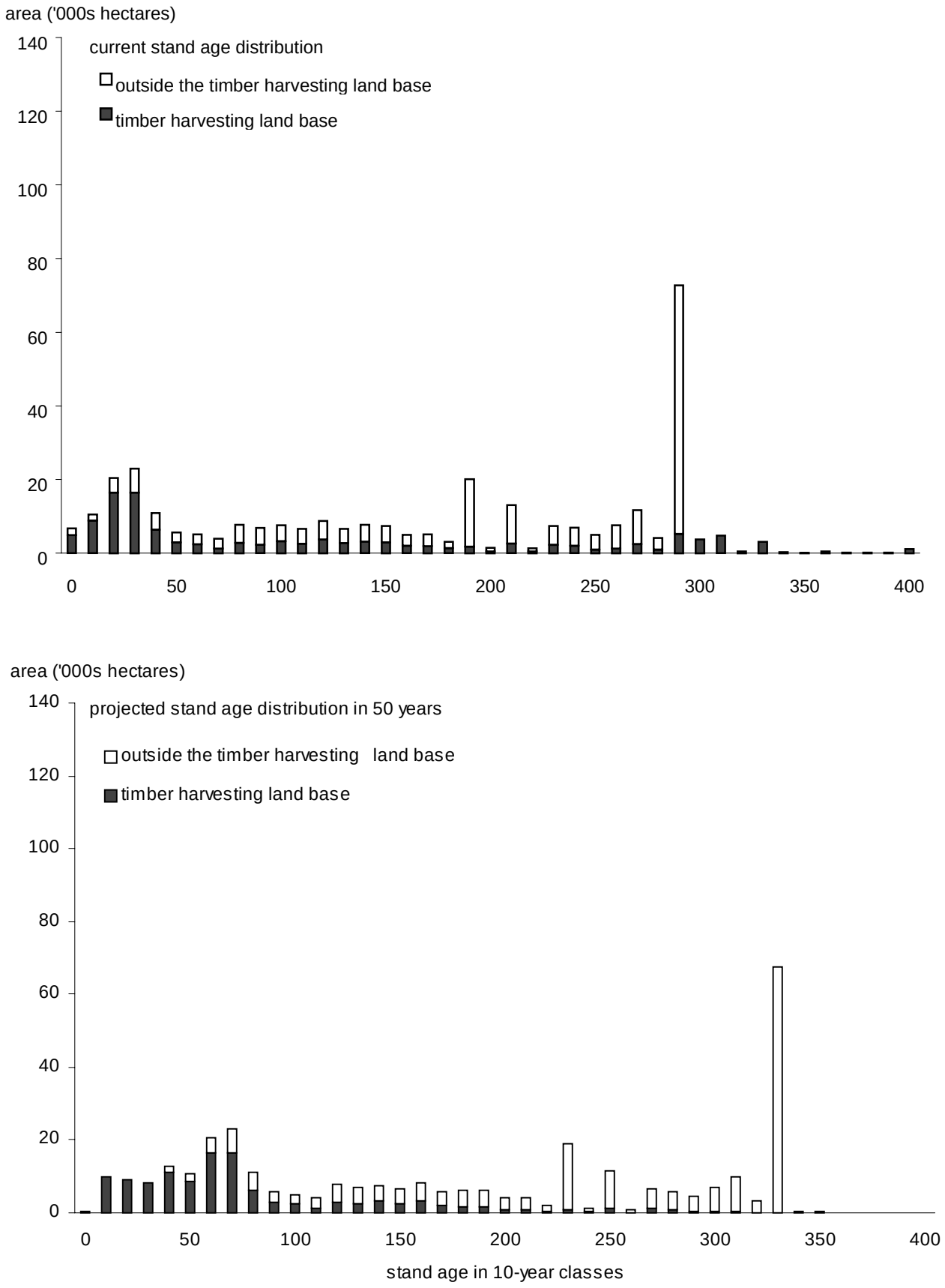

Figure 16. Changes in age composition on the productive land base over time — Soo TSA base case, 1999.

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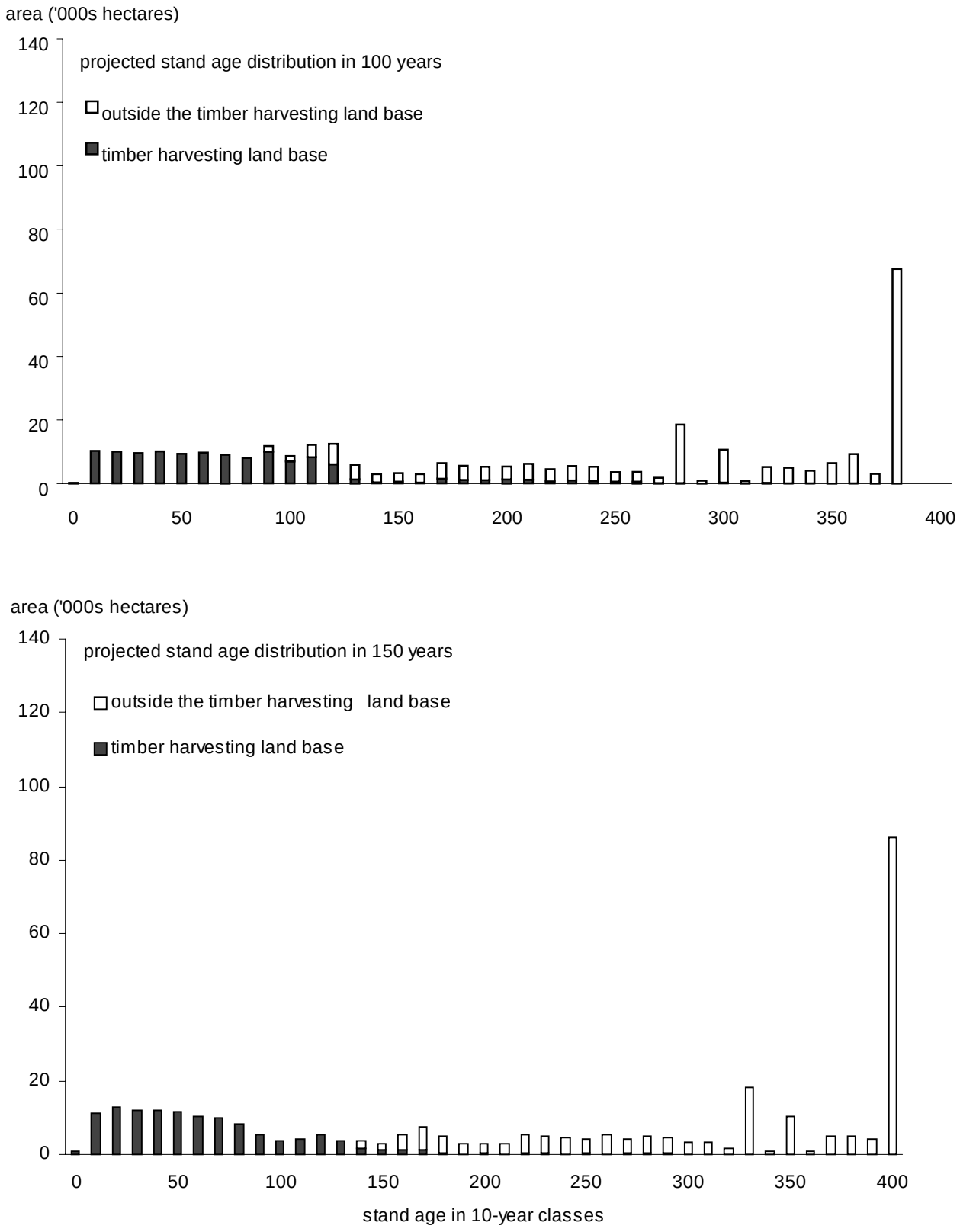

Figure 16. Changes in age composition on the productive land base over time — Soo TSA base case, 1999.
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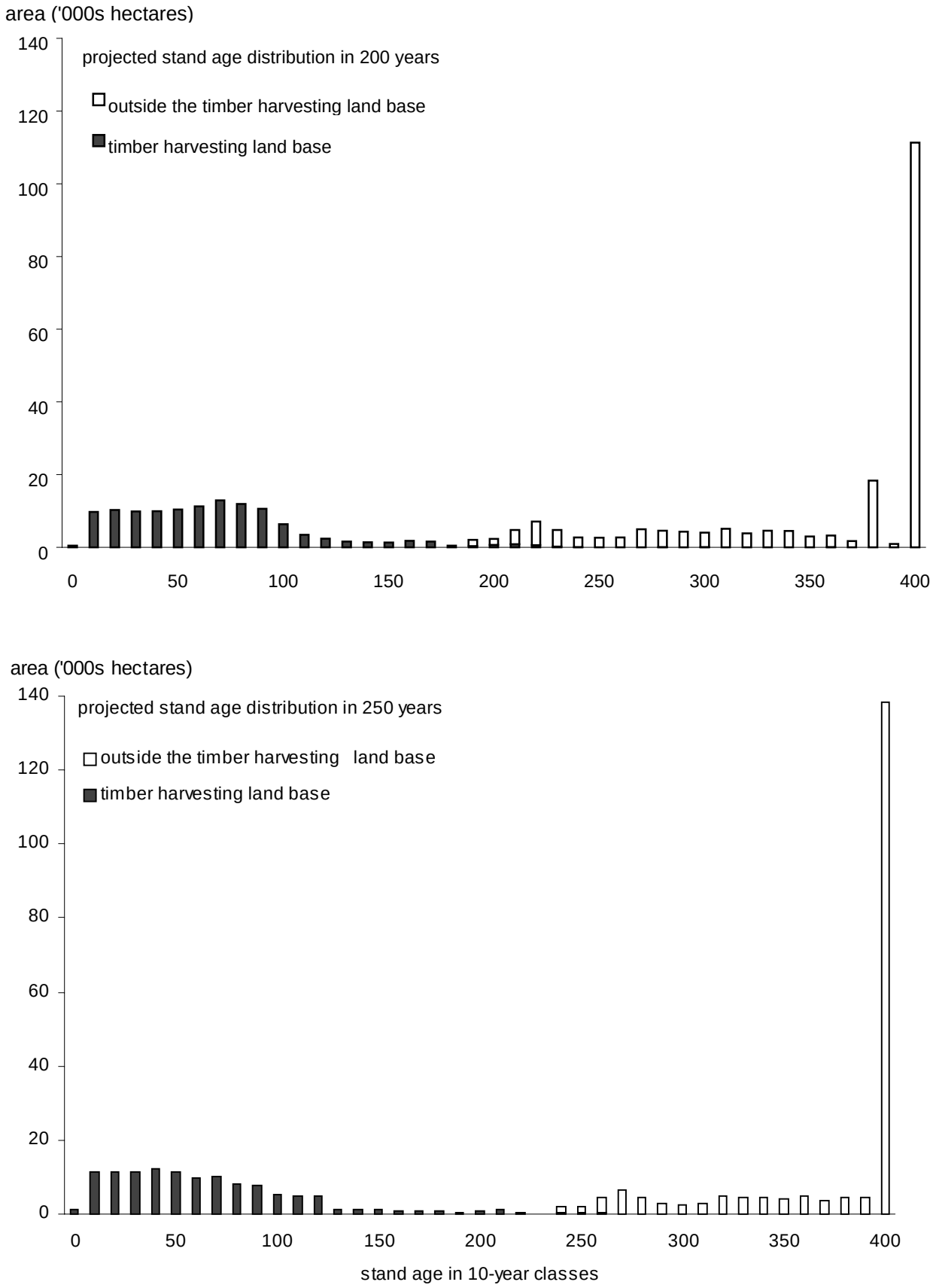


Figure 16. Changes in age composition on the productive land base over time — Soo TSA base case, 1999.
(concluded)

5 Timber Supply Sensitivity Analyses

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

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

Another important way of dealing with uncertainty is to assess 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 analyses, 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.

In this section, results of several sensitivity analyses are discussed. Sensitivity analyses are intended primarily to test the relative change (i.e., high versus low sensitivity) in the harvest forecast from changes in forest management assumptions and data. Note that the base case was established on the basis of even-flow harvests. Even-flow or non-declining harvest flow strategies were considered equally acceptable for all sensitivity analyses.

5 Timber Supply Sensitivity Analyses

5.1 Sources of uncertainty to which base case shows moderate or high sensitivity

Analysis showed that most sources of uncertainty had little or no effect on the base case harvest forecast. Results of these analyses are summarized in Section 5.2. However, the base case showed moderate or high sensitivity to some sources of uncertainty, which are discussed below.

5.1.1 Uncertainty in the estimated area of the timber harvesting land base

Uncertainty in the estimated size of the timber harvesting land base is due to factors such as fluctuations in timber prices, changes in harvesting and milling technology and land-use decisions.

Another factor is the uncertainty around the use of regional or provincial averages in defining the land base when localized data are not available. For example, local stream and fish habitat inventories were not available for the Soo TSA, so average coastal figures were used to estimate land base reductions for riparian reserves.

Currently it is not possible to assess whether the timber harvesting land base has been over- or under-estimated, so two sensitivity analyses were performed. The first evaluates the outcome of shifting 10% of the non-timber harvesting land base to the timber harvesting land base. The second evaluates outcome of shifting 10% of the timber harvesting land base to the non-timber harvesting land base. Table 5 shows the base case and shifted land bases for the sensitivity analyses. Figure 17 shows the resulting harvest forecasts.

Table 5. Area of the base case and land base sensitivity analysis

Forecast	Timber harvesting land base (hectares)	Outside timber harvesting land base (hectares)	Total[a] (hectares)
Base case	123 392	200 499	323 898
Shift 10% non-timber harvesting land base to timber harvesting land base.	143 442 (+12% from base case)	180 456	323 898
Shift 10% timber harvesting land base to non-timber harvesting land base.	111 060 (-10% from base case)	212 838	323 898

Note: (a) This area includes 24 986 hectares from the "not managed by the B.C. Forest Service" category in Table 3, which contributes to forest cover requirements for some non-timber values.

5 Timber Supply Sensitivity Analyses

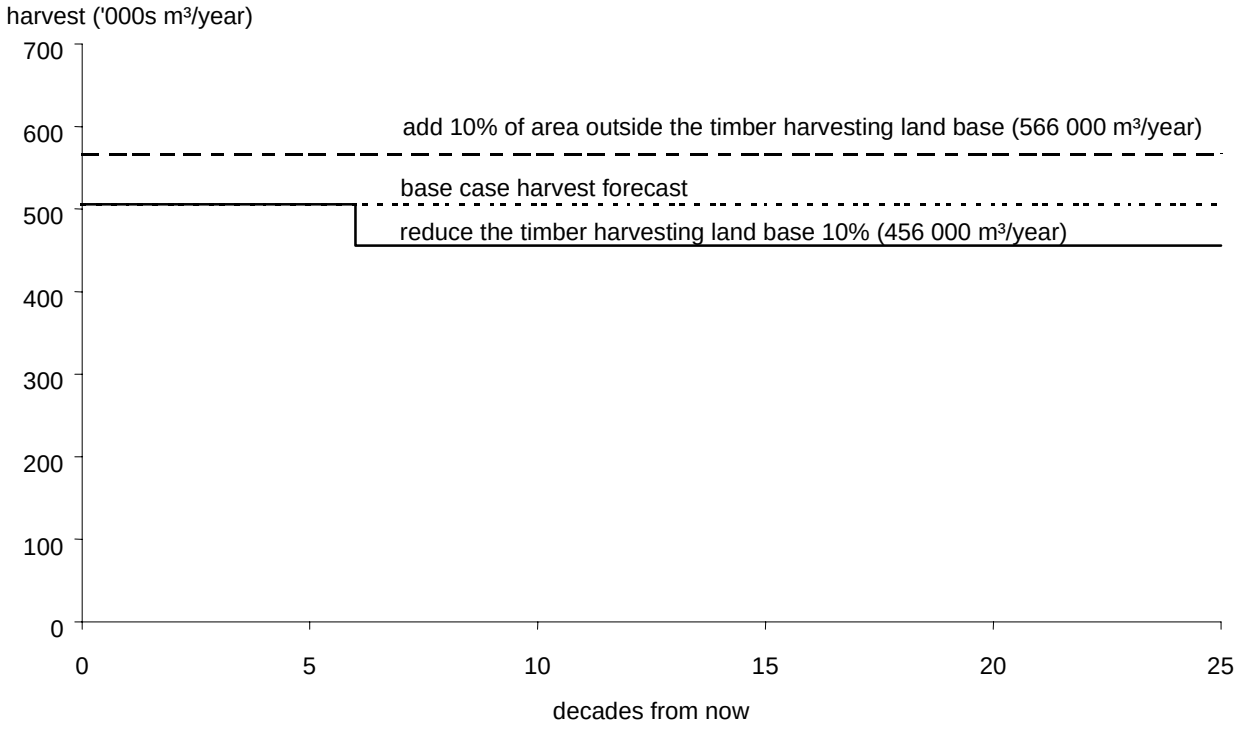


Figure 17. Land base sensitivity analysis — Soo TSA, 1999.

The sensitivity analysis shows that if the timber harvesting land base is over-estimated in the base case, there is still sufficient area in older existing stands to support the harvest for six decades. After six decades the harvest then decreases by approximately 10%, to the new long-term harvest level of 456 000 cubic metres per year. If the timber harvesting land base is larger than in the base case, the transition to harvesting predominately second-growth managed stands is delayed. This delay results in older, higher volume stands being harvested during the transition period. The combination of higher volume second-growth stands and addition of more existing stands permits the initial harvest to start at the new long-term harvest level of 566 000 cubic metres per year.

5.1.2 Uncertainty in the estimated area of the helicopter component of the timber harvesting land base

Helicopter-operable areas comprise 21.5% or 26 500 hectares of the timber harvesting land base. Most of the increased helicopter area (74%) was defined using inventory information on stand characteristics, not aerial or ground surveys. Squamish Forest District staff have indicated that until the entire area is assessed in more detail there is uncertainty about the extent of area eligible for helicopter logging.

A sensitivity analysis was performed to understand the impact on the base case projection if the helicopter land base is reduced by 50%. Furthermore, from decade three onwards the harvest limit on the helicopter area was reduced from 160 to 100 hectares per year. Figure 18 shows that even if the helicopter land base is over-estimated by 50%, the base case harvest forecast can be achieved for the first eight decades. Analysis results not shown in Figure 18 indicate the base case harvest forecast can be maintained for the next 10 years even if all of the helicopter area is removed from the timber harvesting land base. The results suggest that uncertainty about the contribution of helicopter logging to the timber harvesting land base does not present a high degree of risk in the short term. Reducing uncertainties about longer term timber supply, however, will require that Forest Service staff verify the area.

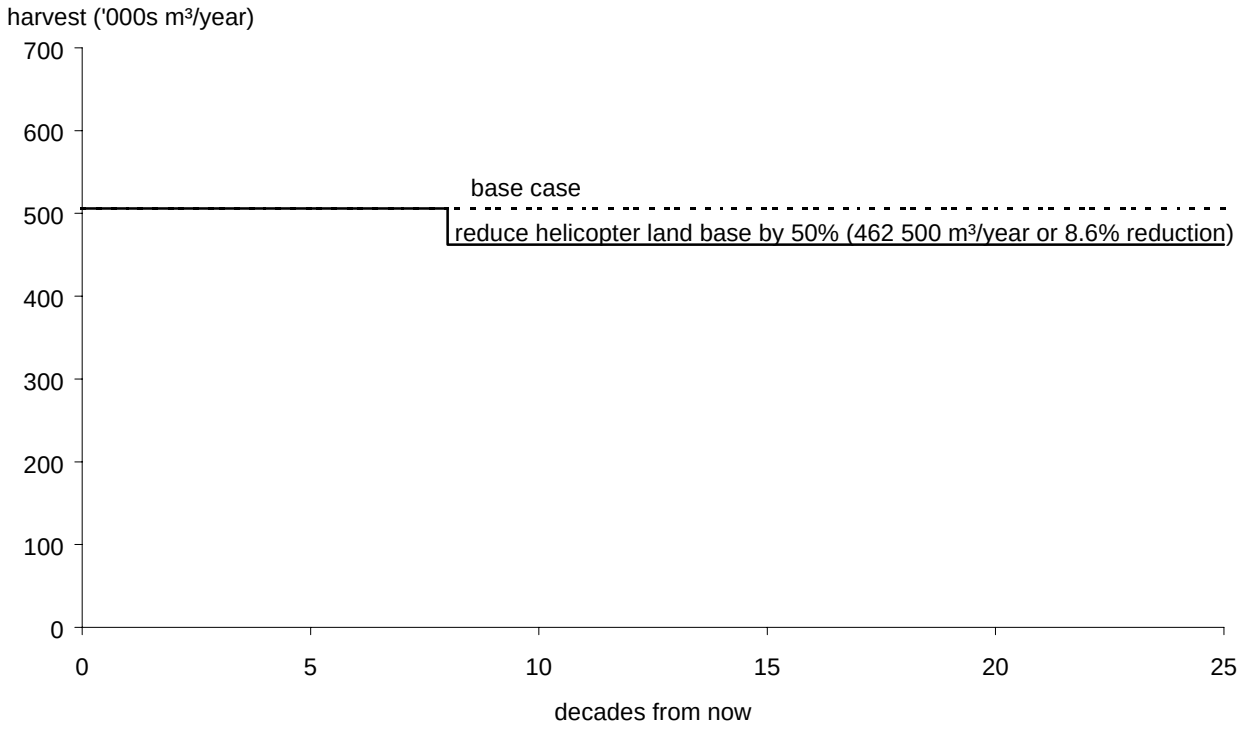


Figure 18. Helicopter logging land base sensitivity analysis — Soo TSA, 1999.

The results also show that changes in the helicopter area affect timber supply disproportionately relative to changes in the overall land base. When the entire timber harvesting land base is reduced by 10% (12 332 hectares) the base case timber supply can be maintained for six decades and the long-term harvest level decreases by 9.9% . However, when the helicopter land base is reduced by 50% (13 250 hectares) the base case can be maintained for eight decades and then the harvest only decreases 8.6%. The reason for this disproportionate timber supply effect is that the average productivity of the helicopter land base is less than that of the conventional land base. Therefore, when the helicopter land base is reduced 50%, the average site index of the remaining timber harvesting land base is increased and results in less impact to the base case forecast.

5.1.3 Uncertainty in the estimated area of ungulate (deer) winter range

Both during and after the preparation of the data package, Squamish Forest District Staff were using a draft deer winter range management plan as a guide for the management of ungulate winter range (UWR) in the forest district. This plan was modelled in the base case.

Subsequently, effective April 2, 1998 the *Operational Planning Regulation*, (OPR 107/98) provided procedures for identifying and approving existing ungulate winter ranges. UWRs that met the specified criteria were "grandparented" and approved by the Squamish Forest District manager. The result of considering the "grandparented" UWRs rather than the draft deer management plan was a net increase in the timber harvesting land base of 1670 hectares, This additional land base increased timber supply by 6000 cubic metres per year relative to the base case (see Figure 19).

5 Timber Supply Sensitivity Analyses

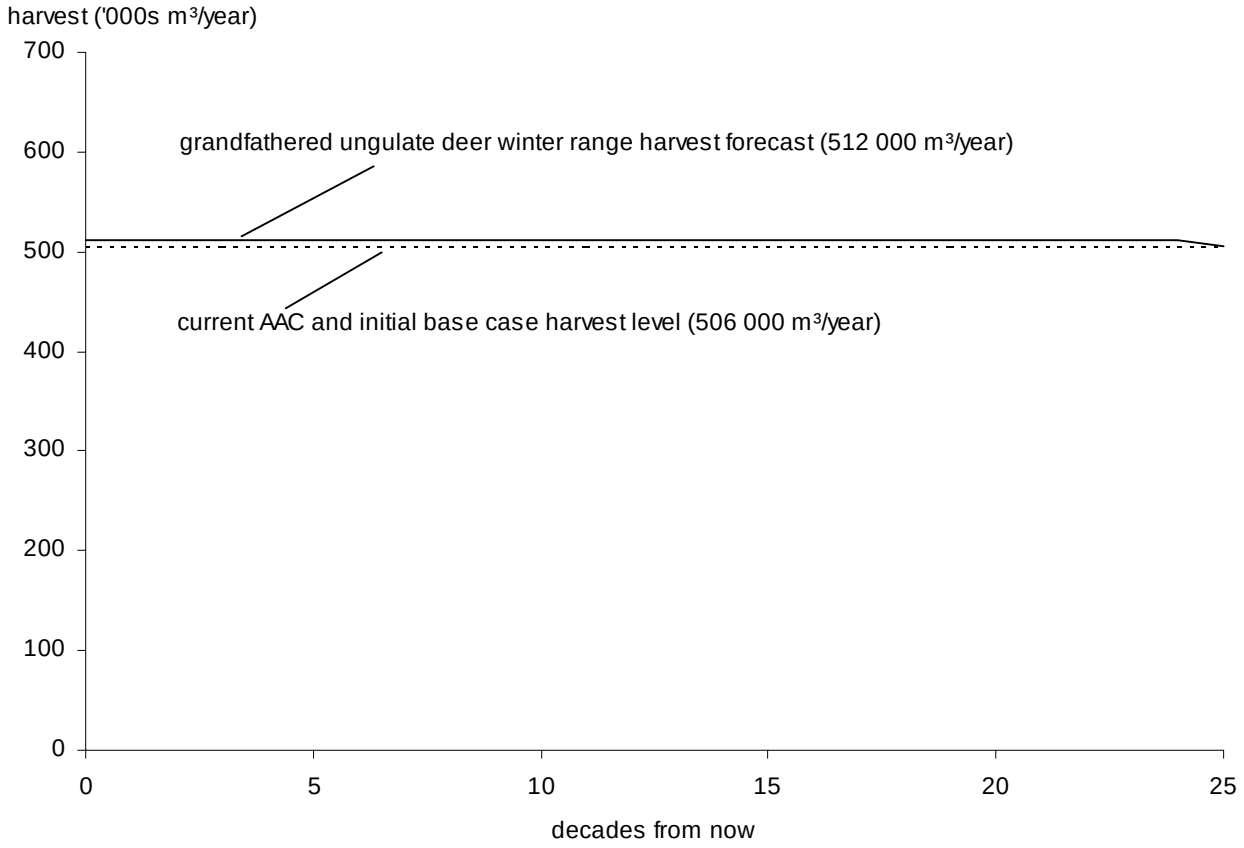


Figure 19. Change to base case harvest forecast under grandfathered ungulate deer winter range management — Soo TSA, 1999

Ministry of Forests and the Ministry of Environment, Lands and Parks staff will be reviewing and updating ungulate winter range areas by October 15, 2003, as required by the *Operational Planning Regulation* of the *Forest Practices Code*. These reviews may alter the amount and location of UWRs from the grandparented areas. Any new information will be presented to the Chief Forester at the time of the AAC determination, or incorporated into future timber supply analyses.

5.1.4 Uncertainty in the estimated existing stand yields

Timber volume estimates for existing unmanaged stands are subject to uncertainties in the forest inventory used to estimate timber volumes (i.e., estimated tree heights and stand ages), and the statistical process used to develop the equations for predicting forest growth and yield. Although no specific issues were identified for the Soo TSA a standard sensitivity analysis was performed. The results of decreasing and increasing existing unmanaged stand yield by 10% are presented in Figure 20.

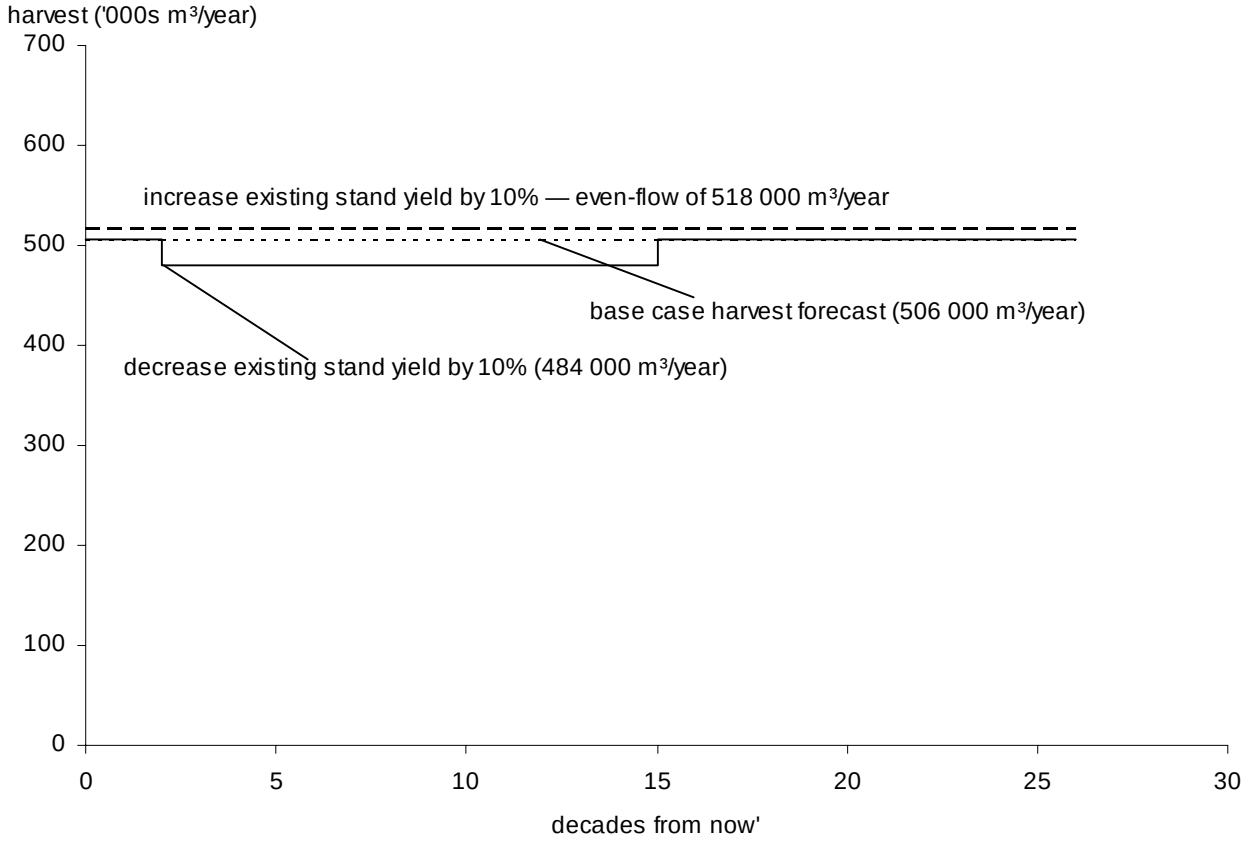


Figure 20. The effect on the harvest forecast of increasing and decreasing volume estimates for existing unmanaged stands by 10% — Soo TSA, 1999.

Figure 20 shows that if existing unmanaged stand volumes are decreased by 10%, initial harvest levels of either 484 000 cubic metres per year or 506 000 cubic metres per year are possible. Under a non-declining harvest flow, the harvest would be 484 000 cubic metres per year, 4.3% or 22 000 cubic metres less than the base case. If a non-declining harvest flow rule is not imposed, the base case is harvest level is feasible for the first two decades. Timber supply then declines to 480 000 cubic metres per year where it is maintained until decade 15 when it increases to the base case harvest level.

When existing unmanaged stand volumes are increased by 10%, the transition to managed stand yields is delayed by three decades. This results in more merchantable volume from managed stands being available during decades 8 to 12. The outcome of the increased available of merchantable volume is an overall 2.4% or 12 000 cubic metres per year increase in timber supply relative to the base case.

5.1.5 Uncertainty in the estimated managed stand yields

Uncertainty in volume estimates for managed stands exists for the same reasons listed for estimated existing stand yields (inaccuracies in the forest inventory and the growth and yield models), but also because of the limited experience and data that is available for regenerated managed stands in B.C. There is also uncertainty around the site productivity assigned to older unmanaged stands relative to the site productivity expressed by the stands after they regenerate. This issue is examined in Section 5.2.7, "Uncertainty in the productivity of current old-growth sites after harvest."

As with existing unmanaged stand yield estimates, there are no specific issues directly related to managed stand yield estimation, other than site productivity estimates. However, the Squamish Forest District staff have identified that the silvicultural prescriptions for some managed stands may change. Specifically, reduced levels of fertilization and juvenile spacing are anticipated. A comparison of yield tables with and without the treatments indicated that expected stand volumes both with and without fertilization and juvenile spacing are not substantially different at and beyond minimum harvestable ages. This is due to the level of fertilization treatment and the level of expected response. Given that there are only small differences in expected volumes at harvest (i.e., minimum harvestable ages), there appears to be little risk to the base case forecast at least in the context of these uncertainties in silviculture. However, the change in the silvicultural prescriptions will likely affect the number of expected stems, piece size and quality of the harvested timber.

Factors other than the silvicultural regime could affect future yields, so a standard sensitivity analysis, in which managed stands yields were increased and decreased by 10%, was performed. The results are presented in Figure 21. When yields are decreased by 10% and a non-declining harvest flow is imposed, an even-flow of 462 000 cubic metres per year results (not shown). Without the non-declining harvest flow rule, there is sufficient existing stand growing stock to maintain the base case harvest forecast for seven decades. When yields are increased by 10% a harvest level of 534 000 cubic metres per year can be maintained for the first 13 decades at which time the harvest increases to the new long-term harvest level of 562 000 cubic metres per year. The increase in the initial harvest level (5.5%) results from more merchantable managed volume being ready earlier, which allows for a higher harvest level from the existing stand growing stock.

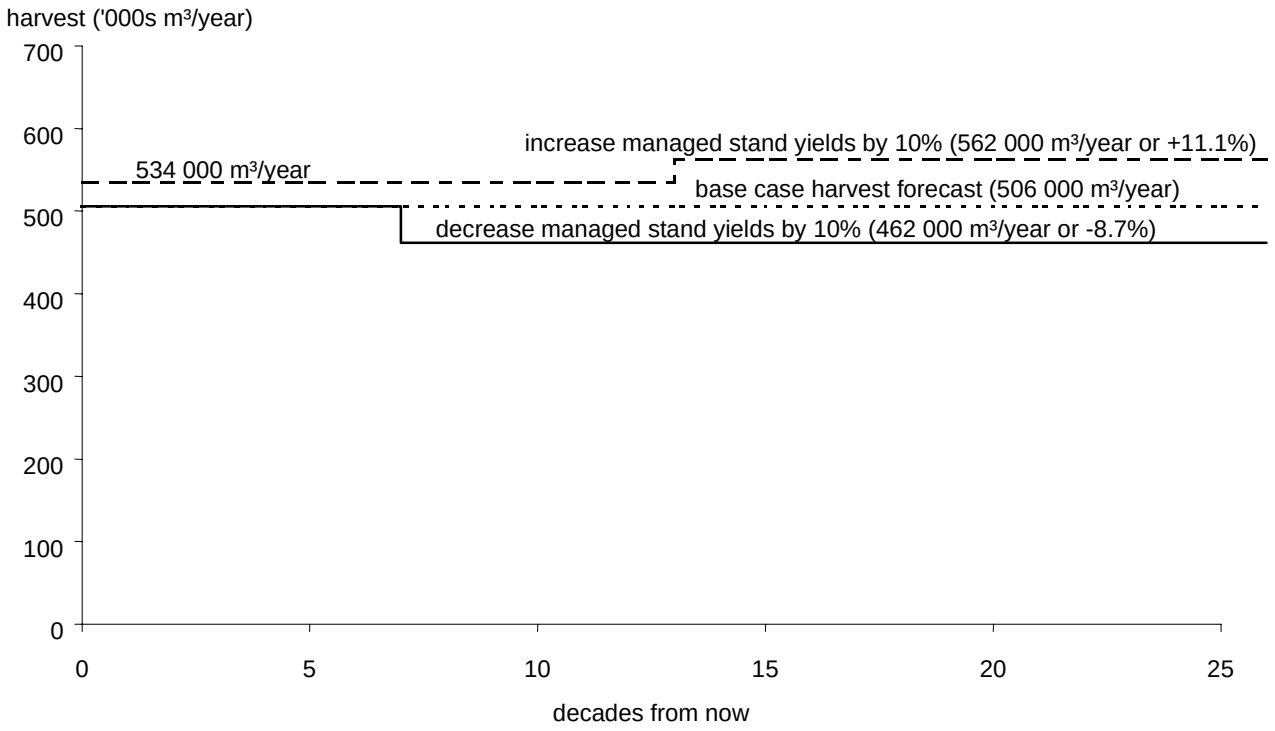


Figure 21. The effect on the harvest forecast of increasing and decreasing volume estimates for managed stands by 10% — Soo TSA, 1999.

5.1.6 Uncertainty in area or volume reductions needed to account for riparian management zone practices

Area was deducted from the base case timber harvesting land base to account for riparian reserves (see Table 3). However, local estimates of the area or volume in riparian management zones (RMZs) were not available for this analysis, and no adjustments were made in the base case. The *Forest Practices Code Riparian Management Area Guidebook* suggests the use of an average coastal stream density estimate of a 4.2% volume reduction to all yield tables (i.e., harvested volumes are reduced by 4.2%) to account for RMZs.

Squamish Forest District staff reviewed the 4.2% volume reduction factor and suggest this factor overestimates the current performance within the Soo TSA. Reasons for the overestimation are:

- Volume reductions are generally used to represent retention of part of a stand, for example, when selection or partial harvest systems are used in the management zones. In the Soo TSA clearcut harvests are used in the majority of the areas. Therefore, reductions should be applied as area rather than volume factors.
- Timber supply analysis in other coastal TSAs and TFLs indicates that equivalent area-reduction factors can be as little as half the volume factor in the guidebook.
- Squamish Forest District staff estimate that the density and distribution of riparian classes is less than the coastal average used to calculate the volume reduction factor.

Section 5.2, "Uncertainty in the estimated area of the timber harvesting land base" summarizes a sensitivity analysis evaluating the impact of a 10% reduction to the timber harvesting land base. The results showed that the base case level could be maintained for six decades, and the long-term harvest was decreased proportionately to the land base reduction. If it is assumed that the area reduction for riparian management zones is no more than 4.2%, it is reasonable to assume the base case can be maintained for at least six decades and the long-term harvest level will not decline by more than 4.2%. This evaluation shows that the base case timber supply is not sensitive in the short- or medium-term to area reduction factors of 4.2% or less. Localized data will assist in decreasing uncertainty about long-term timber supply related to practices in riparian management zones.

5.1.7 Uncertainty in the productivity of current old-growth sites after harvest

Estimating the future productivity of sites currently occupied by existing old-growth forest is difficult in that it is not possible to know with certainty how the productivity of a regenerated stand will compare to the productivity of the existing stand it replaces. The productivity of a site largely determines how quickly trees will grow. It therefore affects the timber volumes in regenerated stands, the time to reach green-up and the age at which those stands will reach merchantable size. The most accurate estimates of site productivity come from stands between 30 and 150 years old. At ages less than about 30 years a temporary increase or decrease in growth due to factors such as a post-harvest flush of nutrients or an unusual drought year can affect the overall productivity estimated for the stand. At older ages, site productivity estimates may be incorrect because tree heights do not represent actual production—for example due to top breakage—and it is very difficult to determine ages of old trees accurately. The results of recent province-wide research suggests that the estimated productivity of sites currently occupied by old-growth stands may be significantly underestimated. Two Old Growth Site Index (OGSI) studies applicable to timber supply forecasting are:

- *Site index adjustments for old-growth stands based on paired plots* (Nussbaum 1998). Data were obtained from paired plots installed in old-growth stands and adjacent logged and regenerated stands of the same productivity. Site index was estimated for both and comparisons were made. Results are available for Douglas-fir, lodgepole pine, and interior spruce.
- *Site index adjustments for old-growth stands based on veteran trees* (Nigh 1998). The objective of the study was to develop site index adjustments for species not covered by the paired-plot project. The data for this study came from temporary and permanent plots with a veteran and main stand component. The site indices for the two components were estimated and an adjustment equation for each species was derived using linear regression analysis. The results of the study are considered less reliable than those from the paired-plot study.

5 Timber Supply Sensitivity Analyses

An alternative approach to estimating post-harvest site index of the mature and old forest is use of the Site Index - Biogeoclimatic Ecosystem Classification (SIBEC) study (Forest Renewal B.C. and Ministry of Forests, B.C., 1997). Results present a first approximation of estimates of average site index for coniferous crop tree species according to site units of the Biogeoclimatic Ecosystem Classification (BEC) system of B.C. The estimates are presented in site index - site unit (SISU) tables and the correlation between site index and site units varies from weak to moderately strong across species and sites.

Use of the results of the aforementioned studies is of particular interest to the Soo TSA, as stands older than 140 and 250 years comprise, respectively 41% and 20% of the timber harvesting land base. To test the sensitivity of the base case harvest forecast to uncertainty about site index estimates, three sensitivity analyses were performed. First, site indices of stands greater than 140 years were adjusted using the paired plot information, where applicable. Second, site indices of these older stands were adjusted using either the paired plot or veteran-tree results, whichever was applicable. Third, all stands in the timber harvesting land base had their site index assigned using the SIBEC report. Timber supply analysis inputs affected by changes in estimated future productivity (managed stand volume estimates, green-up ages and minimum harvestable age) were recalculated for each test based on average site productivity. Figure 22 compares the average forest inventory-based site index for each tree species group to those defined using each of the adjustments.

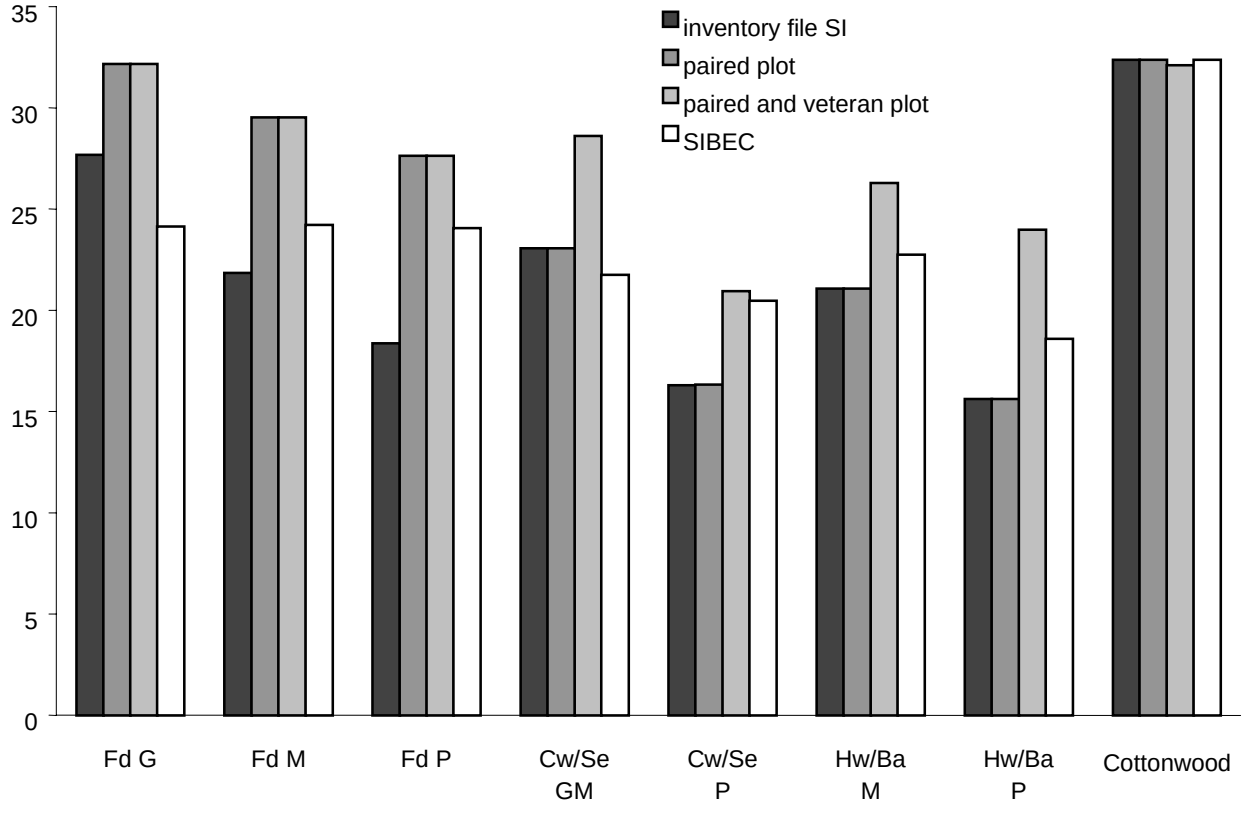


Figure 22. Average analysis unit site index based on forest inventory, paired plot, and paired plot and veteran plot, and SIBEC information — Soo TSA, 1999.

5 Timber Supply Sensitivity Analyses

Results of the OGSI and SIBEC sensitivity analysis are presented in Figure 23. The graph shows that initial and medium-term harvest level for the paired plot and SIBEC sensitivity analyses - 542 000 cubic metres per year- is approximately 7.1% higher than the base case. The paired and veteran plot forecast starts 13.8% higher (576 000 cubic metres per year). The long-term harvest levels are, respectively 11.7% and 28.1% above the base case.

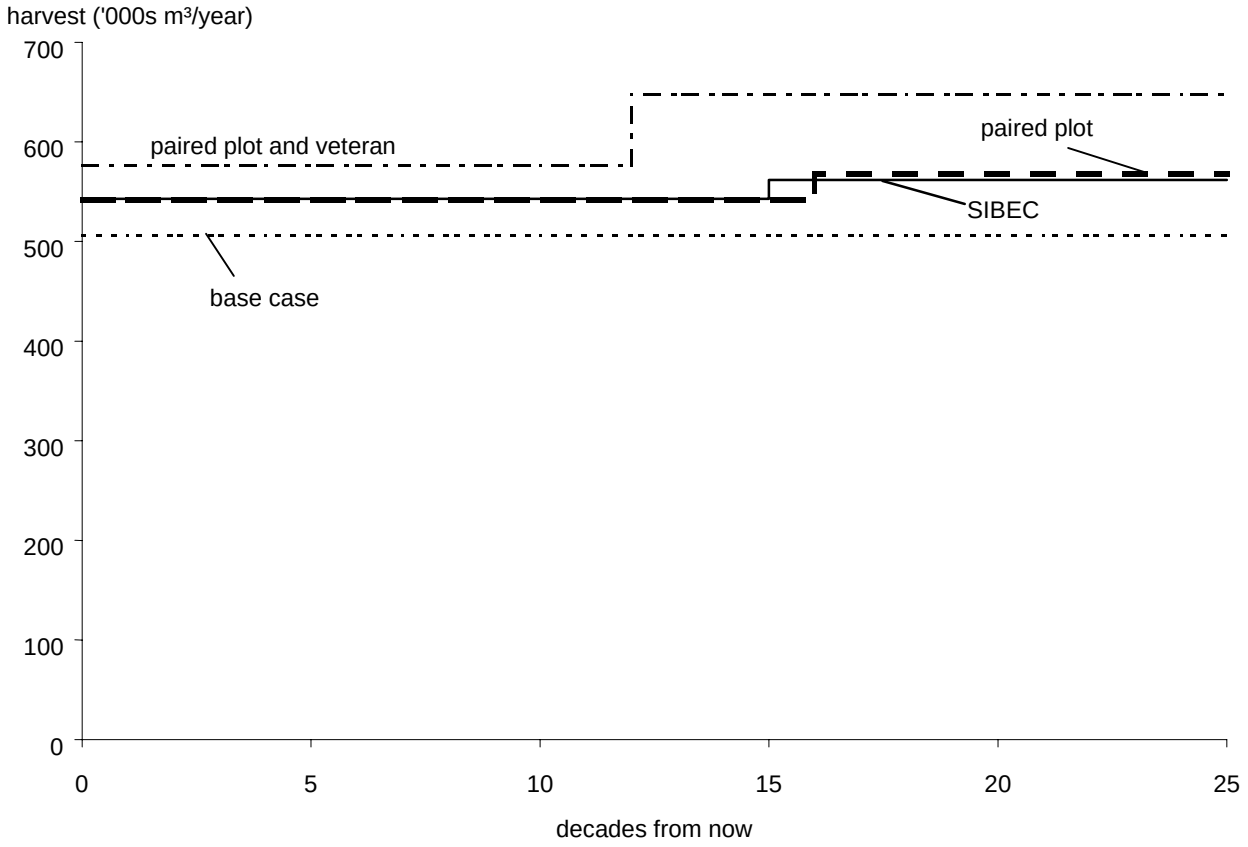


Figure 23. Harvest forecasts based on OGSI (paired plot and veteran studies) and SIBEC site index adjustments — Soo TSA, 1999

Site index adjustments are not included in the base case as there are no local data to support the site index adjustments. The results of the sensitivity analysis included in this sections need to be viewed with the following cautions:

- The difference in site productivity between the thrifty (intermediate aged) and older components of the tree species groups is on average less than one metre. Frequently, larger site index differences are observed between the younger and older stands. The small difference in the Soo TSA might indicate that the site index of the old component may not be underestimated to the extent generally suggested in the OGSI studies. However, no local information is available to validate this observation.
- The results of the OGSI and SIBEC studies are province-wide. No specific studies were performed to calibrate the results for the Soo TSA. Therefore, the results of the sensitivity analyses only provide insight into the possible trends associated with site productivity information.
- The OGSI studies provide site index adjustments that represent the maximum potential level for the tree species. There has been no accounting for site and management factors such as stocking and local climate.
- The Biogeoclimatic Ecosystem Classification inventory for the Soo TSA is based on small-scale mapping (1:250 000) at the BEC variant level. The SIBEC study results are applicable at the site-series level, not the courser variant level, Also, the SI assignments are based in province-wide data, and provide average site index for each species by BEC site series.

5.2 Sources of uncertainty where the base case showed little or no sensitivity

The base case harvest forecast showed little or no sensitivity to many sources of uncertainty. These sources, and results of the sensitivity analyses are summarized in Table 6 (next page).

5 Timber Supply Sensitivity Analyses

Table 6. Summary of sensitivity analyses where there was no or little effect on the base case harvest forecast

Source of uncertainty	Sensitivity analysis	Effect on base case
Green-up	Change criteria from 3 metres (15 yrs) to 2 metres (12 yrs) in IRM zones.	No change.
Green-up	Change criteria from 5 metres (19 yrs) to 4 metres (17 yrs) in VQO zones.	No change.
Green-up	Change criteria from 5 metres (15 yrs) to 6 metres (21 yrs) in VQO zones.	No change.
Green-up	Decrease green-up age by 5 years in VQO zones.	Even-flow increased to 511 000 cubic metres per year (1% increase).
Green-up	Increase green-up age by 5 years in VQO zones.	No change.
Adjacency	Allowable disturbance in each landscape unit decreased to 25%.	No change.
Adjacency	Allowable disturbance in each landscape unit decreased to 20%.	No change.
Landscape-level biodiversity	Increase old seral age requirement by 20 years.	No change.
Landscape-level biodiversity	Decrease old seral age requirement by 20 years.	No change.
Landscape-level biodiversity	Apply both mature and old seral stage requirements.	No change.
Landscape-level biodiversity	Use draft emphasis options for old seral stage.	No change.
Maximum allowable disturbance by VQO class	Mid-point of maximum allowable disturbance range (upper end used in base case).	In decade 26 long-term harvest level reduced to 498 000 cubic metres per year (1.6% decrease).
Maximum allowable disturbance by VQO class	Inventory values (Visual absorption capability) used to define maximum allowable disturbance.	In decade 26 long-term harvest level reduced to 502 000 cubic metres per year (0.8% decrease).
Minimum harvestable ages	Decrease minimum harvestable ages by 10 years.	Even-flow increased to 511 000 cubic metres per year (1% increase).
Minimum harvestable ages	Increase minimum harvestable ages by 10 years.	Initial harvest 499 000 cubic metres per year (1.4% decrease) and after 18 decades increased to 511 000 cubic metres per year. Under different harvest flow strategies the base case harvest can be maintained for the first two decades.
Expected volume from managed stands	Shift all yield curves up 10 years; i.e., volume @ 100 years becomes volume at 110 years.	Harvest level in very long-term decreased to 462 000 cubic metres per year in decade 26 (8.7%).
Expected volume from managed stands	Shift all yield curves down 10 years; i.e., volume @ 100 becomes volume at 90 years.	Harvest level in very long-term increased to 589 000 cubic metres per year in decade 26 (16.4%).
Hemlock and balsam volumes in the Pemberton timber supply block	Reduce inventory type groups 9 and 15 volumes by 30% (total initial growing stock 4% lower).	No change.

6 Summary and Conclusions of the Timber Supply Analysis

Since the last timber supply analysis for the Soo TSA, several land use and forest management initiatives have been implemented. These include: implementation of the *Forest Practices Code;* creation of several new parks; cabinet release of the *Northern Spotted Owl Management Plan;* use of a draft deer management plan to guide practices and the subsequent revisions to the *Operational Planning Regulation* for ungulate winter range; re-definition of minimum harvestable ages and sites with low productivity sites; and an increase in the helicopter logging component of the timber harvesting land base. Overall, the timber harvesting land base is 14 600 hectares larger than in the previous analysis.

Based on current inventory information and forest management assumptions in the Soo TSA, the results of this analysis indicate that the current AAC of 506 000 cubic metres per year can be maintained over the short and long terms.

The timber supply forecast for the Soo TSA is driven by several factors. Currently 48% of the timber harvesting land base is at or above minimum harvestable age. This abundance of growing stock in combination with a non-declining harvest flow provides stability in short-term timber supply against sources of uncertainty such as changes to green-up age or reductions to the helicopter land base. One limitation placed on the base case was that projected harvests could not be overly concentrated in either the conventional or helicopter land base. Allowing for free fluctuation of harvesting in these areas would increase supply by 8000 cubic metres per year or 1.6% of the base case harvest level. The transition of harvests to managed stands is forecast to start in about seven decades, and is mostly complete by 15 decades from now. This long transition allows for potential increases in overall harvest if management assumptions or practices result in increased managed stand yields.

For the base case it was assumed that clearcut harvesting systems would be employed across the Soo TSA. However, alternative systems such as selection harvest, partial harvest and variable retention have been employed for years but the location and extent of future operations are not known and could not be included in the analysis. Impact on timber supply is therefore unknown and will required assessment in future timber supply reviews.

In the base case it was also assumed that the draft deer winter range management plan would provide the direction for ungulate management. Recent changes to the *Operational Planning Regulation* of the *Forest Practices Code (OPR* 107/98*)* meant that areas can be designated as ungulate winter range only if they are necessary for the survival of ungulate species. These changes resulted in a reduction in area required for deer winter range management (relative to the base case). The resulting 1670 hectare increase in timber harvesting land base provides a 6000 cubic metres per year increase in the base case harvest forecast. While the grandparented areas are assumed to reflect current and future deer winter range in the Soo TSA, Ministry of Forests and the Ministry of Environment, Lands and Parks staff will be reviewing and updating ungulate winter range areas by October 15, 2003, as required by the *Operational Planning Regulation*.

6 Summary and Conclusions of the Timber Supply Analysis

The impacts of management practices in riparian management zones (RMZs) are uncertain at this time. Evaluation of current practices in other management units suggests that RMZs may reduce timber availability by up to 4.2%. Sensitivity analysis shows that if the timber harvesting land base were reduced by 10%, the base case harvest forecast could be maintained for six decades, with a decrease in the long-term level proportionate to the area reduction. Base case timber supply levels could be maintained for even longer given a 4.2% land base reduction to account for RMZs.

Currently about 74% of the helicopter logging land base was identified based on stand attributes such as species, volume per hectare and site index obtained from the forest inventory file. The Squamish Forest District staff believe there is some uncertainty about the estimate of this area. Future field assessments are planned, to clarify the area involved. Nonetheless, sensitivity analysis shows that the base case harvest forecast can be maintained for the next 10 years even if all of the helicopter area is removed from the timber harvesting land base.

One factor that has an unknown impact on the base case timber supply is the uncertainty in productivity of sites currently occupied by old-growth stands. Results of sensitivity analysis show that the old-growth site index (OGSI) adjustments increase the base case harvest forecast through increased managed yields, and reduced minimum harvestable and green-up ages. The magnitude of the increase is unknown since the site index adjustments were developed in a province-wide study and are not specific to the Soo TSA. An alternative method of estimating site index is through the site index biogeoclimatic ecosystem classification (SIBEC) adjustment. As with the OGSI adjustments, the actual magnitude of increase applicable to the Soo TSA is unknown given the level of inventory mapping and lack of local calibration of average site indices. The small differences between site indices determined for old-growth and thrifty (intermediate-aged) stands, relative to those commonly observed in other parts of the province, also bring to question the degree to which site indices of old-growth stands in the Soo TSA are underestimated.

In May 1997, cabinet released the *Northern Spotted Owl Management Plan*. The forest management objectives prescribed in this document were modelled in the base case. Development of specific management plans for activity centres and special resource areas is ongoing. Completion of these more specific plans is required before analysis of their impact on timber supply can be performed.

A number of standard sensitivity analyses were performed to evaluate the potential timber supply impacts of other sources of uncertainty (e.g., adjacency, green-up age, landscape-level biodiversity, and minimum harvestable age). These analyses showed no or little sensitivity to short-term timber supply, with some factors having effects in the very long-term (see Table 7 for a summary of the results).

In conclusion, this analysis indicates that, based on current inventory, growth and yield information, and current forest management practices, the current rate of harvest in the Soo TSA can be maintained over the short and medium terms. Some sources of uncertainty about data used in the analysis — primarily those related to practices in riparian management zones, use of alternative silviculture systems, and ongoing planning under the spotted owl plan — suggest the long-term harvest level may be slightly overestimated. Conversely, any information or management changes that enhance managed stand yields, or verify the applicability of site index adjustments to the Soo TSA would improve both short- and long-term timber supply.

7 Socio-Economic Analysis

The impact of timber supply adjustments on local communities and the provincial economy is an important consideration in the timber supply review. The socio-economic analysis compares the level of forestry activity currently supported by timber harvested from the Soo TSA with the level of activity that the TSA could support as the timber supply moves towards its long-term harvest level.

The socio-economic analysis examines harvest levels as projected in the base case harvest forecast and is not intended to examine alternative management scenarios.

The socio-economic analysis consists of the following:

1) a profile of the current socio-economic setting;
2) a description of the Soo TSA forest industry; and
3) an analysis of the socio-economic implications of the base case harvest forecast.

7.1 Current socio-economic setting

7.1.1 Population and demographic trends

The socio-economic analysis focuses on the Soo TSA; however, the Soo TSA is part of the larger Squamish Forest District. Also located within the Squamish Forest District are Garibaldi Park and International Forest Products' Tree Farm Licence* (TFL) 38. The larger communities located in the Squamish Forest District include Squamish, Pemberton, Whistler, and Lions Bay. According to the 1996 Census, the population of the forest district was 26,117, reflecting a 28.3% increase since 1991 (see Table 7). The region experienced the highest population growth rate in the province, and Pemberton and Whistler were the province's fastest growing communities with population increases of 70.3% and 60.8%, respectively.

Table 7. Squamish Forest District and selected community population statistics, 1991-2001

	1991	1996	2001	% change 1991-1996	% change 1996-2001
Squamish	11,709	13,994	N/A	19.5	—
Pemberton	502	855	N/A	70.3	—
Whistler	4,459	7,172	N/A	60.8	—
Lions Bay	1,328	1,347	N/A	1.4	—
Squamish Forest District	20,353	26,117	31,210	28.3	19.5
British Columbia	3,282,910	3,724,500	4,249,075	13.5	14.1

Source: Census of Canada 1991, 1996. Population growth estimates from BC STATS Population Section.

Tree farm licence (TFL)
Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.

From 1996 to 2001, the population of the Squamish Forest District is forecast to grow by approximately 20%, to over 31,000 people.[1] The largest population increases will likely be in Whistler and Pemberton and will be associated with the expansion of the tourism industry, rather than any increase in primary forestry activity. These increases depend on the capacity of the communities to absorb higher population levels.

7.1.2 Economic profile

From 1991 to 1996, the total experienced labour force in the Squamish Forest District increased by 41% to 16,185 from 11,460.[2] In comparison, the provincial experienced labour force increased by 14% over the same period. The unemployment rate in the forest district was 6.9% in 1996 compared with 11.4% in 1991. However, the average unemployment rate for the Squamish Forest District does not necessarily reflect every community, some of which may have substantially higher numbers of workers unemployed, and these numbers do not reflect any post-1996 changes such as additional growth in the tourism sector or the closure of International Forest Products Ltd. lumber mill in Squamish.

Figure 24 shows employment dependency by sector for the Squamish Forest District for 1996. The percentages include direct, indirect and induced employment, thus reflecting the supply and service employment supported by each sector.

As Figure 24 indicates, in 1996, the tourism industry was the largest employer in the Squamish Forest District supporting approximately 6,000 people, or 37% of the total labour force.[3] Tourism in this illustration includes business travel. In 1991, the tourism sector accounted for 26% of the total labour force. The increases in tourism-related employment are the result of growth in the resort community of Whistler. From 1990-1991 to 1996-1997, the number of visitors to Whistler steadily increased, as indicated by annual resort room nights in Whistler which increased by over 47%. The increase in the number of visitors to Whistler is expected to continue at an average annual rate of 5%.[4] While the tourism industry employs numerous individuals, much of the work is seasonal with below-average wages. This characteristic is illustrated by examining sector income: tourism employs 37% of the total labour force, but accounts for 25% of the Squamish Forest District's total employment income.[5]

1 BC STATS, Population Section. Ministry of Finance and Corporate Relations.

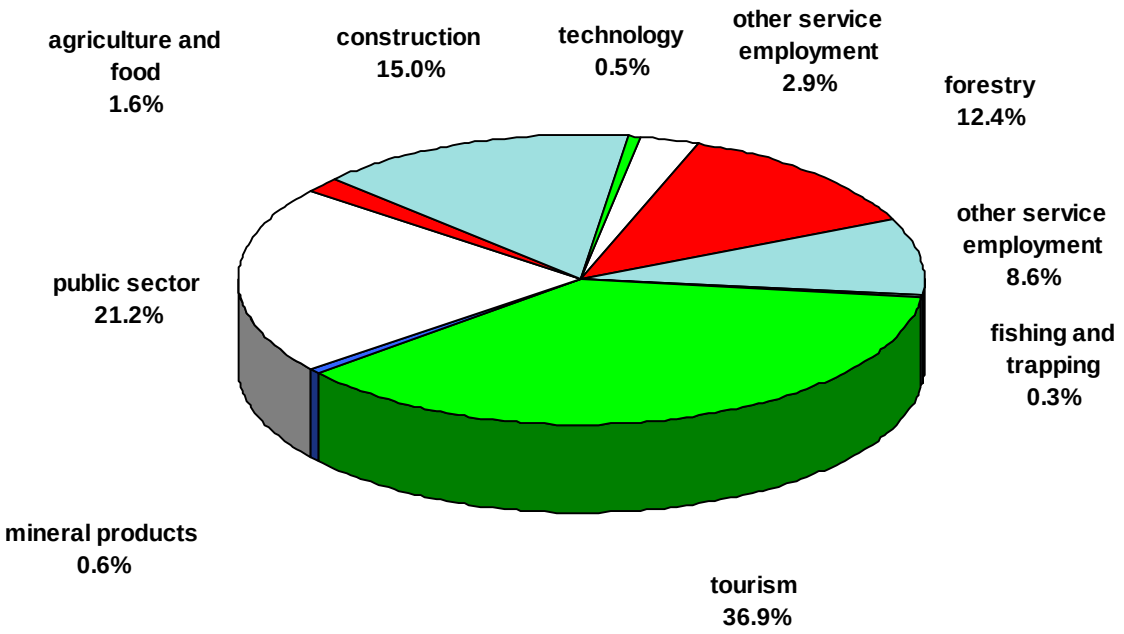
2 Census of Canada 1991, 1996

3 Horne, 1999a.

4 Whistler Resort Assn.

5 Horne, 1999a. For a more in-depth discussion of the methodology used to calculate these figures see Horne, 1999b.

7 Socio-Economic Analysis



Note: "Other service employment" consists of induced employment supported by pension and other transfer income such as employment insurance. "Other" consists of other basic industries such as manufacturing and transportation that is not elsewhere classified.

Source: Horne, 1999a.

Figure 24. Squamish Forest District employment dependency by sector, 1996.

The public sector is the second largest employer and in 1996 supported approximately 3,400 direct, indirect and induced workers, or 21% of the total labour force, and provided 21% of the Squamish Forest District's total income. The public sector consists of municipal, federal, and provincial government employees, health care workers, teachers and other support staff. From 1991 to 1996, employment in the public sector grew by approximately 30%. However, these employment and income percentages are derived from Census information, which in turn is based on a respondent's place of residence. As such, some of these public sector workers may have homes in the Squamish area, but work in Vancouver. This characteristic of the labour force may also be true for several of the sectors shown in Figure 24.

Forestry continues to have a leading role in the Squamish Forest District and in 1996 supported approximately 2,000 direct, indirect, and induced workers, or 12% of the total labour force, and provided over 13% of the forest district's total employment income. This employment is supported by the Soo TSA, TFL 38, and other areas outside the Squamish Forest District, where residents may travel for harvesting-related work. In 1998, one large pulp mill operated near Squamish. Four other smaller facilities located at Brackendale, Cheekeye, Pemberton, and Whistler also operate in the Soo TSA. Also in 1998, International Forest Products Ltd. closed its Squamish sawmill which will likely remain closed permanently, at least in its previous form. Prior to closing, the sawmill employed approximately 180 people.

In 1996, the construction sector supported approximately 2,400 direct, indirect, and induced workers, or 15% of the total labour force, and provided 14% of the Squamish Forest District's total employment income. The strength of the construction sector is closely tied to the tourism sector, with building focusing on the development of residential and resort accommodation, and commercial facilities. The value of residential, commercial, and industrial building permits in Whistler municipality more than doubled through the 1990s, increasing from $47.7 million in 1991 to a high of $180 million in 1996, before coming down to $98 million in 1997. In contrast, the value for the province remained fairly constant, and in Squamish varied around an average of approximately $25 million, but did not show any increasing or decreasing trend.

7.2 Soo TSA forest industry

7.2.1 Current allowable annual cut

The current allowable annual cut (AAC) for the Soo TSA was set in October 1995 at 506 000 cubic metres. Previously, in 1992 the AAC was reduced to 580 000 cubic metres from 705 000 cubic metres. The current AAC is separated into a number of tenure types. Table 8 shows the various types of tenure by volume.

Table 8. Soo TSA allowable annual cut, by licence type

	AAC (cubic metres)	Per cent (%) of total AAC
Forest licences — replaceable	376 526	74.4
Timber sale licence (TSL) < 10 000 cubic metres	19 190	3.8
Small business forest enterprise program (SBFEP)	96 599	19.1
Forest Service reserve	6 585	1.3
Woodlot licences	4 741	0.9
Cottonwood leading	2 359	0.5
Total	506 000	100.0

Source: Ministry of Forests.

7.2.2 Soo TSA harvest history

Table 9 summarizes the volume of timber harvested in the Soo TSA from 1994 to 1998. The actual volume of timber harvested is an important indicator of forestry activity in the TSA. While the AAC is the maximum allowable annual harvest level, the actual volume of timber harvested in a particular year determines the level of economic activity. Differences in annual harvest levels are due to provisions for cut control,[6] which allow licensees to vary their harvests based on operating and market conditions. If actual annual harvest levels are consistently less than the AAC, then forestry activity is below its full potential.[7]

In 1998, approximately 433 000 cubic metres of timber were harvested from the Soo TSA. From 1994 to 1998, the annual average harvest was approximately 482 836 cubic metres. The low average harvest reflects a combination of the AAC reduction in 1995, the fact that the years listed in Table 9 cover portions of two cut control periods, the implementation of protected areas and spotted owl management strategies, and general market conditions. Future harvests are expected to average near the current AAC of 506 000 cubic metres.

Table 9. Soo TSA volumes billed, by licence type, 1994-1998

	(Cubic metres)					
Tenure	**1994**	**1995**	**1996**	**1997**	**1998**	**Average 1994-1998**
Forest licences	393 904	419 640	344 826	300 014	317 472	355 171
Small business forest enterprise program (SBFEP)	84 630	115 486	106 555	88 586	102 914	99 904
Timber sale licence (TSL)	4 488	12 132	22 403	5 064	8 779	10 304
Woodlot	6 923	4 574	3 424	6 521	3 228	4 934
Other[a]	20 708	26 956	3 082	10 987	883	12 523
Total	510 653	578 788	480 290	411 172	433 276	482 836
Allowable annual cut (AAC)	580 000	580 000[b]	506 000	506 000	506 000	

(a) "Other" consists of cutting permits such as rights of way, road permits, and other small temporary permits.

(b) The AAC was reduced to 506 000 cubic metres in October 1995.

Source: Ministry of Forests.

6 Cut control allows licensees to vary the volume harvested from the AAC by +/- 50 % per year, and by +/- 10 % over a 5-year cut-control period.

7 Full potential referred to here is based on the allocated volumes of the AAC, and is not necessarily the same as full economic potential which is based on the international market for wood products.

7.2.3 Soo TSA major licensees and processing facilities

International Forest Products Ltd.

International Forest Products Ltd. (Interfor) has a replaceable forest licence in the Soo TSA to harvest 121 227 cubic metres per year. Interfor has numerous other tenures throughout the province with harvesting rights totalling 3.5 million cubic metres. Table 10 outlines Interfor's recent harvest activity, and 1995 to 1997 average employment levels in person-years of employment associated with its Soo TSA operations.

Table 10. Interfor volumes billed and average employment statistics

AAC	121 227 cubic metres
1998 harvest	93 619 cubic metres
1995-1997 average harvest	126 757 cubic metres
Employment[a] (average 1995-1997 person-years)	
Logging, log transport, and forestry services	52
Silviculture	4
Processing	70
Total	126

(a) The employment figures relate to data collected for 1995-1997 and the average 1995-1997 volume billed of 126 757 cubic metres from the Soo TSA.

Interfor operates seven lumber mills in the province and a remanufacturing facility in Fort Langley. However, at this time the Squamish mill and the Flavelle cedar mill in the Chilliwack Forest District are not operating. In 1998, Interfor lumber mills processed approximately 2.7 million cubic metres of logs. Approximately 45% to 50% of Interfor's production is shipped to the Pacific Rim, 25% to 30% is shipped to the United States, approximately 18% remains in Canada, and the remainder is shipped to Europe.[8]

Prior to its closure in 1998, the Squamish lumber mill had an annual capacity to process over 400 000 cubic metres of timber. In 1997, this mill processed close to 230 000 cubic metres of logs (down from 430 000 cubic metres in 1996), and in 1998 processed approximately 111 000 cubic metres of timber, prior to its closure after 98 days of operation. The mill employed approximately 180 people. The Soo TSA was one source of fibre for this mill and in 1997 accounted for about 60% of the mill's total timber requirement. This timber is now destined for Interfor's Vancouver area mills.

8 Interfor, Annual Report, 1997.

Canadian Forest Products Ltd.

Canadian Forest Products Ltd. (Canfor) has a replaceable forest licence in the Soo TSA to harvest 40 623 cubic metres per year. Canfor has numerous other tenures throughout the province with harvesting rights totalling 4.8 million cubic metres. Table 11 outlines Canfor's recent harvest activity and 1995 to 1997 average employment levels associated with its Soo TSA operations.

Table 11. Canfor volumes billed and average employment statistics

AAC	40 623 cubic metres
1998 harvest	17 405 cubic metres
1995-1997 average harvest	34 344 cubic metres
Employment[a] (average 1995-1997 person-years)	
Logging, log transport, and forestry services	11
Silviculture	1
Processing	19
Total	31

(a) The employment figures relate to data collected for 1995-1997 and the average 1995-1997 volume billed of 34 344 cubic metres from the Soo TSA.

In British Columbia, Canfor currently operates eight sawmills (excluding the Eburne lumber mill in Vancouver and Netherlands lumber mill in Prince George, both of which closed in 1998), three pulp and two paper mills, four remanufacturing plants, a panel and fibre operation, and a chip mill. None of these operations are within the Soo TSA. In 1998, Canfor lumber mills processed approximately 5.5 million cubic metres of logs and its pulp operations processed close to 2 million bone dry units of wood chips. The majority of its products are sold in the United States (46% in 1997), Canada (22%), and Asia (19%).[9] All of the timber harvested in the Soo TSA is shipped to mills located in the Fraser TSA.

Squamish Mills Ltd.

Squamish Mills Ltd. (Squamish Mills) has a replaceable forest licence in the Soo TSA to harvest 39 600 cubic metres per year. Squamish Mills' Soo TSA forest licence is held in affiliation with MacMillan Bloedel Ltd. and International Forest Products Ltd. Table 12 outlines Squamish Mills' recent harvest activity and 1995 to 1997 average employment levels associated with its Soo TSA operations.

9 Canfor Corporation, Annual Report, 1997.

Table 12. Squamish Mills volumes billed and average employment statistics

AAC	39 600 cubic metres
1998 harvest	21 745 cubic metres
1995-1997 average harvest	43 589 cubic metres
Employment[a] (average 1995-1997 person-years)	
Logging, log transport, and forestry services	28
Silviculture	2
Processing	23
Total	53

(a) The employment figures relate to data collected for 1995-1997 and the average 1995-1997 volume billed of 43 589 cubic metres from the Soo TSA. Squamish Mills does not operate a processing facility; the processing employment refers to person-years supported by the volume of timber harvested by Squamish Mills.

Approximately two-thirds of the timber harvested under this licence goes into the production of lumber in the Vancouver lower mainland, with a minor volume going to the Lillooet area. Close to 23% is used to produce pulp. The remainder goes into the production of veneer and plywood.

Terminal Forest Products Ltd.

Terminal Forest Products Ltd. (Terminal Forest Products) has a replaceable forest licence in the Soo TSA to harvest 59 780 cubic metres per year. Terminal Forest Products has two forest licences in the province which provide annual harvesting rights to a total of 226 471 cubic metres. Table 13 outlines Terminal Forest Products' recent harvest activity and 1995 to 1997 average employment levels associated with its Soo TSA operations.

Table 13. Terminal Forest Products volumes billed and average employment statistics

AAC	59 780 cubic metres
1998 harvest	34 805 cubic metres
1995-1997 average harvest	55 316 cubic metres
Employment[a] (average 1995-1997 person-years)	
Logging, log transport, and forestry services	26
Silviculture	2
Processing	30
Total	58

(a) The employment figures reflect district averages for 1995-1997 and the average 1995-1997 volume billed of 55 316 cubic metres from the Soo TSA.

Terminal operates two sawmills in the province, both of which are located in the Vancouver lower mainland. The two mills have a combined log requirement of approximately 600 000 cubic metres per year and employ 130 people.

Doman-Western Lumber Ltd.

Doman-Western Lumber Ltd. (Doman-Western) has a replaceable forest licence in the Soo TSA to harvest 58 466 cubic metres per year. The combined operations of Doman-Western and Doman Industries have several tenures in the province with AACs totalling approximately 4.5 million cubic metres. Table 14 outlines Doman-Western's recent harvest activity (mainly based on Pacific Forest Products previous ownership) and 1995 to 1997 average employment levels associated with its Soo TSA operations.

Table 14. Doman-Western volumes billed and average employment statistics

AAC	58 466 cubic metres
1998 harvest	87 599 cubic metres
1995-1997 average harvest	43 807 cubic metres
Employment[a] (average 1995-1997 person-years)	
Logging, log transport, and forestry services	21
Silviculture	2
Processing	24
Total	47

(a) The employment figures reflect district averages for 1995-1997 and the average 1995-1997 volume billed of 19 246 cubic metres harvested from the Soo TSA.

Halray Logging Co. Ltd.

Halray Logging Co. Ltd. (Halray) in partnership with Macmillan Bloedel Ltd. has a replaceable forest licence in the Soo TSA for 18 952 cubic metres per year. Halray also has a replaceable timber sale licence for 8048 cubic metres per year. Table 15 outlines Halray's recent harvest activity and 1995 to 1997 average employment levels associated with its two Soo TSA licences. Halray did not harvest under its licences in 1997.

Table 15. Halray volumes billed and average employment statistics

AAC	27 000 cubic metres
1998 harvest	14 600 cubic metres
1995-97 average harvest [a]	20 507 cubic metres
Employment [b] (average 1995-97 person-years)	
Logging, log transport, and forestry services	8
Silviculture	N/A
Processing	9
Total	17

(a) no volumes were harvested in 1997.

(b) the employment figures reflect district averages for 1995-97 and the average 1995-97 volumes billed of 20 507 cubic metres from the Soo TSA.

CRB Logging Ltd.

CRB Logging Ltd. (CRB Logging) has a replaceable forest licence in the Soo TSA for 19 626 cubic metres per year. Table 16 outlines CRB Logging's recent harvest activity and 1995 to 1997 average employment levels associated with its Soo TSA operations.

Table 16. CRB Logging volumes billed and average employment statistics

AAC	19 626 cubic metres
1998 harvest	22 218 cubic metres
1995-97 average harvest	19 246 cubic metres
Employment [a] (average 1995-97 person-years)	
Logging, log transport, and forestry services10	10
Silviculture	N/A
Processing	10
Total	20

(a) the employment figures reflect district averages for 1995-97 and the average 1995-97 volumes billed of 19 246 cubic metres harvested from the Soo TSA.

Richmond Plywood Corp. Ltd.

Richmond Plywood Corp. Ltd. (Richmond Plywood) has a replaceable forest licence in the Soo TSA for 18 252 cubic metres per year. Table 17 outlines Richmond Plywood's recent harvest activity and 1995 to 1997 average employment levels associated with its Soo TSA operations.

Table 17. Richmond Plywood volumes billed and average employment statistics

AAC	18 252 cubic metres
1998 harvest	25 244 cubic metres
1995-1997 average harvest	15 636 cubic metres
Employment[a] (average 1995-1997 person-years)	
Logging, log transport, and forestry services	7
Silviculture	N/A
Processing	8
Total	15

(a) The employment figures reflect district averages for 1995-1997 and the average 1995-1997 average volume billed of 15 636 cubic metres from the Soo TSA.

Other licensees

In addition to the timber sale licence (TSL) held by Halray Logging, discussed previously, there are five other TSLs in the Soo TSA to harvest 11 142 cubic metres per year. In 1998, a total of 8779 cubic metres were harvested under TSLs (3968 cubic metres excluding the Halray TSL which was discussed previously).

The Small Business Forest Enterprise Program (SBFEP) is apportioned 96 599 cubic metres per year. In 1998, 102 914 cubic metres were harvested under the SBFEP. Table 18 outlines the recent harvest activity and average 1995 to 1997 employment levels for these timber volumes.

Table 18. Volumes billed and average employment statistics, TSL and SBFEP

AAC	107 741 cubic metres
1998 harvest	106 882 cubic metres
1995-1997 average harvest	112 367 cubic metres
Employment[a] (average 1995-1997 person-years)	
Logging, log transport, and forestry services	50
Silviculture	N/A
Processing	85
Total	135

(a) Employment estimates reflect the 1995-1997 average annual volume of 112 367 cubic metres harvested from the Soo TSA land base. TSL estimates for Halray Logging Ltd. are included in Table 18 above.

Other processing facilities

The Western Pulp Ltd. Partnership operates a pulp mill at Woodfibre near Squamish and is the largest forest products manufacturer employing 350 employees. In 1998, the pulp mill consumed approximately 600 000 bone dry units of chips and produced 220 000 metric tonnes of pulp.

Two other smaller sawmills operate in the Soo TSA: A J Forest Products in Brackendale which employs 16 individuals, and Howe Sound Forest Products which is closed due to market conditions, but in 1996 employed 17 individuals. Continental Pole, also located in the Soo TSA, has a capacity to use 10 000 to 12 000 cubic metres of timber and employs approximately 17 people.

In total, in 1998, processing facilities within the Soo TSA processed approximately 216 000 cubic metres of logs and 600 000 bone dry units of chips. Due to the Interfor lumber mill shutdown, the volumes being processed within the Soo TSA in the second-half of 1998 and throughout 1999 will be less than in the past. The remaining mills have the capacity to process approximately 40 000 to 50 000 cubic metres per year, versus a total of 450 000 to 500 000 cubic metres per year when the Squamish lumber mill was in operation.

7.2.4 Forest sector employment and employment coefficients

The preceding harvesting and employment information is used to develop employment coefficients*, which are used to project future employment levels in the forestry sector. For this purpose, the forestry sector has been divided into three sub-sectors:

- harvesting and other woodlands-related employment including falling, log transport, log salvage, log scaling, harvest planning and administration;
- silviculture employment such as planting, surveying, and other basic and intensive silviculture activities, such as spacing, fertilizing and pruning*; and
- primary timber processing employment at lumber mills, veneer and plywood mills, shake and shingle mills, chip mills, log home mills, and pulp and paper mills.

Harvesting and silviculture employment

The harvesting component of the forest industry is the most closely tied to the AAC and includes both company and contract loggers. Clearcut is the predominant silvicultural system used in the TSA, and involves mostly cable and some helicopter harvesting methods. The residence of the Soo TSA harvesting workforce varies by company, with some operations using TSA residents for over 90% of their workforce and others using non-TSA residents exclusively. On average, approximately 80% of the harvesting workforce resides within the TSA, mainly around the communities of Squamish and Pemberton.

Silviculture is perhaps the least tied to the current level of harvest, given that silviculture activities continue for up to 10 to 15 years following harvesting. Basic silviculture consists of surveys, site preparation, planting, brushing, cone collecting and some spacing. Enhanced, or intensive silviculture includes spacing, fertilizing, and pruning. In the TSA, licensees are responsible for basic silviculture on areas harvested under major licences; the provincial government is responsible for the remaining basic and all enhanced silviculture on Crown land and uses contractors to complete this work.

The 1994 *Soo TSA Socio-Economic Analysis* prepared for the previous timber supply review identified approximately 350 person-years of direct harvesting and silviculture employment, associated with an average harvest of about 675 000 cubic metres per year. The survey completed for this timber supply review indicates that from 1995 to 1997, harvesting and silviculture operations associated with an average harvest of approximately 490 000 cubic metres supported approximately 290 person-years of direct harvesting and silviculture employment across the province.

Employment coefficient
The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

Pruning
The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.

Processing employment

The timber harvested from the Soo TSA is processed into a variety of products such as lumber, veneer, log homes, pole and posts, shakes and shingles, and pulp and paper. Soo TSA timber supplies mills not only in the Soo TSA, but also in the Vancouver and Vancouver Island regions. In 1997, the Soo TSA supplied approximately 50% of the TSA's primary milling requirement. However, this percentage will have changed with the closure of Interfor's Squamish mill.

The 1994 *Soo TSA Socio-Economic Analysis* estimated that Soo TSA timber harvest of 675 000 cubic metres supported approximately 425 person-years of direct processing employment. From 1995 to 1997, the Soo TSA average harvest of 490 000 cubic metres per year supported an average of approximately 370 person-years of direct processing employment across the province. Note that although processing employment supported within the TSA will have declined after the Squamish mill closed, the timber will now be supporting employment in other mills.

Forest Service employment

The Soo TSA is administered by the Squamish Forest District office located in Squamish.
Forty-four people currently work in the forest district office. Forest Service staff are involved in the administration and enforcement of government policy for the TSA and TFL 38, and SBFEP planning for the Squamish Forest District.

Soo TSA forestry employment coefficients

Table 19 summarizes the employment supported by the 1995 to 1997 average harvest in the Soo TSA and the corresponding employment coefficients. These coefficients have been calculated at a TSA and provincial level to highlight the importance of the forestry sector within the Soo TSA and to identify the contribution that the Soo TSA's forestry sector makes to the provincial economy. The two employment levels are defined as follows:

1) TSA employment and employment coefficients, which comprise residents of the Soo TSA who are employed in the forestry sector within the Soo TSA and whose jobs depend on the Soo TSA timber supply; and

2) provincial employment and employment coefficients, which comprise all forestry sector employment in the province that relies on the Soo TSA timber supply, including both residents of the Soo TSA and those who live elsewhere.

Employment is divided into direct, indirect and induced components; the sum of the components is the total impact. The coefficients are expressed as the number of full-time jobs, or person-years, per 1000 cubic metres of timber harvested. Indirect and induced employment figures were derived using employment multipliers developed by the Ministry of Finance and Corporate Relations.

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For more detailed information regarding employment coefficients see Appendix B, "Socio-Economic Analysis Background Information."

Table 19. Soo TSA forestry employment and employment coefficients[10], average 1995-1997

Forest industry activity	TSA employment (person-years)	TSA coefficients (person-years/'000s m³)	Provincial employment (person-years)	Provincial coefficients (person-years/'000s m³)
Harvesting	186	0.38	221	0.45
Silviculture	20	0.04	69	0.14
Processing	50	0.10	372	0.76
Total direct	256	0.52	662	1.35
Indirect + induced	154	0.31	814	1.66
Total employment	410	0.83	1,476	3.01

Note: Employment estimates are reported in person-years based on average 1995-1997 employment levels and the average annual 1995-1997 Soo TSA harvest of 490 083 cubic metres. TSA processing employment was adjusted to reflect the 1998 closure of Interfor's Squamish lumber mill.

7.2.5 Soo TSA employment income

In 1997, the average income for forest sector employees in the Soo TSA was approximately $50,800 per year, based on average provincial income levels for logging and forestry services, solid wood manufacturing, and pulp and paper manufacturing (see Appendix B, "Socio-Economic Analysis Background Information"). Average income for indirect and induced sector employees was $34,070 per year. The total direct income associated with the forest sector in the Soo TSA averaged $33.6 million per year and total income for indirect and induced employment averaged $27.7 million per year (incomes are reported in 1997 dollar value). Combined, total employment income in the Soo TSA averaged $61.3 million per year. Table 20 shows average annual wages and salaries, total income levels, and total income per thousand cubic metres harvested.

10 Other employment coefficients may be found in other documents for the same or similar areas. A difference in ratios can occur for several reasons, such as using different sources of employment data and rounding of estimates, dividing employment by a different harvest level, using a different definition of a full time position, and changing the definition of forestry sub-sectors. However, the relative impacts associated with a timber supply change should be similar.

Table 20. Average annual direct and indirect/induced incomes, 1995-1997

	Average annual wage (1997 dollar value)	Total annual income ($ millions)	Total annual income ($ per '000s m^3)
Direct	50,800	33.6	68,620
Indirect / induced	34,070	27.7	56,588
Total income		61.3	125,208

7.2.6 Provincial government revenues

The provincial government receives various taxes and other revenues from the forest industry. The forest industry pays stumpage, royalties and rents to the provincial government for the rights to timber and its use, and other industry operating taxes such as corporate income, property, and sales taxes. The provincial and federal governments also receive revenues from forest industry employees through income taxes.

From 1996 to 1998, forest industry activity in the Soo TSA led to an average of approximately $10.3 million in annual stumpage and rent payments to the provincial government (see Table 21). Other government revenues accounted for $4.4 million per year. From 1995 to 1997, total employment supported by the Soo TSA harvest contributed total provincial and federal income taxes worth $15.3 million per year; approximately one-third, or $5.1 million, of the income tax goes to the provincial government.

Table 21. Average annual provincial government revenues, 1996-1998

	Average annual revenue 1996-1998 (millions 1997 $)	Average annual revenue ($ per '000s m^3)
Stumpage, rents and royalties	10.3	21,192
Industry taxes	4.4	9,050
Provincial income tax (1995-1997)	5.1	10,775
Total government revenues	19.8	41,017

7.3 Socio-economic implications of the base case harvest forecast

The socio-economic analysis focuses on harvest level changes in the short- to medium-term of 10 to 30 years from now and considers:

- the implications of alternative harvest levels for both the Soo TSA and the province;
- possible impacts on the communities within the TSA;
- timber requirements of processing facilities within the Soo TSA; and
- regional timber supply implications.

The socio-economic analysis considers average levels of forest industry-related activity that the base case harvest forecast could support. Impacts associated with future harvest levels are calculated using employment, income and revenue coefficients (per 1000 cubic metres harvested). This method assumes that the current role of the forest industry in the provincial economy continues and that labour productivity will not change. This means that, for example, employment levels in the future can be predicted based on today's relationship between employment and the volume of timber harvested and processed. The analysis also assumes that the proportions of harvesting, silviculture and timber processing employment will remain constant and that the types and proportions of wood products manufactured will remain the same.

While this method is reasonably accurate for short-term forecasts (within the next five years), employment coefficients 20 years from now may be very different due to changes in market conditions, timber processing technologies, etc. The analysis indicates the magnitude of impacts to employment, employment income and provincial government revenues, within a constantly changing socio-economic environment.

The base case harvest forecast from the timber supply analysis indicates that the current timber supply of 506 000 cubic metres per year can be maintained.

7.3.1 Short- and long-term implications of alternative harvest levels

Soo TSA employment and income impacts

Soo TSA level employment and income impacts focus on those employees who are supported by the TSA harvest and who reside within the TSA. Table 22 indicates the employment and income that the current AAC can support when fully harvested and processed, and the levels that would be supported at the base case timber supply levels in the short-to medium-term (in this case the current AAC and base case levels are the same).

The current AAC of 506 000 cubic metres can support approximately 263 person-years of direct employment and a further 157 person-years of indirect and induced employment within the Soo TSA. Total employment income associated with this level of employment is $18.7 million.

The stable timber supply of the base case forecast indicates that TSA employment levels could be maintained, assuming that the characteristics of the forest industry, as described in the previous section, remain the same. These employment levels reflect the closure of Interfor's Squamish lumber mill.

Provincial employment and income impacts

Provincial level employment and income impacts include all the activity supported by the Soo TSA harvest, regardless of milling location and place of residence. Employment is supported by the Soo TSA harvest within the Soo TSA, in the Vancouver lower mainland, and on Vancouver Island. The current AAC can support approximately 683 person-years of direct employment and up to 840 person-years of indirect and induced employment. Total employment income associated with this level of employment is $63.3 million.

Government revenue impacts

Provincial government revenues from the forest industry include stumpage, royalties and rent payments, other taxes such as logging, corporate income, sales, property and electricity taxes, and income taxes from direct, indirect and induced employees. Under the existing tax and stumpage regimes, the current AAC of 506 000 cubic metres provides on average approximately $20.8 million annually to the provincial government (1997 dollar value).

Given the stable timber supply as suggested in the base case forecast, any changes to government revenues will not be due to changes to the timber supply.

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Table 22. Soo TSA socio-economic impacts of the base case harvest forecast

		Base case harvest forecast	
	At current[a] AAC	**Decade 1**	**Decade 2**
Timber supply ('000s m³)	506 000	506 000	506 000
Harvest level (1995-1997 average)	490 083	N/A	N/A
Difference from current AAC	15 917	0	0
Soo timber supply area			
Employment		(person-years)	
Direct	263	263	263
Indirect/Induced	157	157	157
Total	420	420	420
Range of employment gain (loss)			
Employment income		($1997 million)	
Direct	13.4	13.4	13.4
Indirect/Induced	5.3	5.3	5.3
Total	18.7	18.7	18.7
Range of income gain (loss)			
Province[b]			
Employment		(person-years)	
Direct	683	683	683
Indirect/Induced	840	840	840
Total	1,523	1,523	1,523
Range of employment gain (loss)			
Employment income		($1997 million)	
Direct	34.7	34.7	34.7
Indirect/Induced	28.6	28.6	28.6
Total	63.3	63.3	63.3
Range of income gain (loss)			
Provincial government revenues		($1997 million)	
Stumpage and related payments	10.7	10.7	10.7
Forest industry taxes	4.6	4.6	4.6
Employee income taxes	5.5	5.5	5.5
Total	20.8	20.8	20.8
Gain (reduction) in revenues			

(a) Estimates for current employment in Table 22 differ from those in Table 19. Employment figures in Table 22 are based on the current AAC of 506 000 cubic metres, while the figures in Table 19 are based on the 1995-1997 annual average harvest volume of 490 083 cubic metres.

(b) TSA employment and income estimates are included as part of the provincial employment and income estimates.

7.3.2 Community level impacts

The impacts of short- and long-term changes in the timber supply include any resulting changes to the socio-economic environment of a community. A reduction in employment and income may affect various socio-economic conditions in communities (for example, population growth rates; the size of the labour force; economic development opportunities; and federally, provincially, and locally funded services). These changes have more immediate implications for an economy dependent on a single industry than on one which is more diversified. Individuals affected by lay-offs also may suffer from various physical and/or emotional effects.

While the tourism industry has led the demographic growth and economic diversification of the Soo TSA, forestry has been affected by a declining timber supply and reduced manufacturing activity. The tourism growth centres are not necessarily the same as the communities experiencing declines in forestry activity. Consequently, how communities affected by forest industry changes can take advantage of the growth in tourism will depend on the ability of the communities to become part of the area's broader tourism focus and cater to the clientele attracted to the area. The forest industry will, however, remain an important contributor to the local economy and the area's economic diversity.

While the base case timber supply analysis indicates a stable timber supply, the TSA is not isolated from changes in other timber regions, as discussed in more detail in Section 7.3.4, "Regional timber supply implications."

7.3.3 Nature, production capabilities, and timber requirements of processing facilities

In 1997, the Soo TSA supplied approximately 50% of the TSA's primary milling requirements, not including the pulp mill which acquires its supply from outside the Soo TSA. With the current closure of the Interfor's Squamish sawmill, however, this supply scenario will have changed. When Interfor's Squamish mill was operating, local solid wood mills had the capacity to process over 450 000 cubic metres of timber; excluding the Squamish mill the remaining processors have the capacity to process approximately 40 000 to 50 000 cubic metres per year. The timber supply in the forest district, which includes TFL 38 held by Interfor, is sufficient to provide enough timber for local mills currently operating; however, given declining timber supplies in other areas of the province, the high demand for Soo TSA timber by producers from outside the Squamish Forest District will continue.

7.3.4 Regional timber supply implications

The future timber supply of other management units around the Soo TSA and the entire Vancouver Forest Region is also an important issue for primary milling operations throughout the region. The Vancouver Forest Region is highly inter-related with timber flowing across district boundaries and the Strait of Georgia between Vancouver Island and the mainland.

In the Vancouver Forest Region, the previous timber supply review led to a reduction in the coniferous AAC of 9.3%, or a reduction in the annual harvest of about two million cubic metres. Based on harvest forecasts from the previous timber supply review, in just over two decades from now, the annual timber supply from Vancouver Forest Region TSAs and TFLs could decline by a further 18%, or an additional 3.5 million cubic metres, assuming management practices and land use priorities remain unchanged, and new information does not lead to changes in estimates of important forest inventory and management variables.

The existing primary milling capacity in the region could not be supported after reductions of this magnitude. For example, a timber supply of 3.5 million cubic metres from the Vancouver Forest Region is comprised of roughly 75% sawlogs. A sawlog supply of 2.6 million cubic metres (75% of 3.5 million) could support between four to seven large lumber mills, based on a mill processing 350 000 to 600 000 cubic metres per year. It is impossible to predict, however, which mills, product types, and communities may be most affected, or if new "value added" operations will offset some of these changes. Also, note that changes of this magnitude are over two decades away and would likely occur gradually as industry adjusts to anticipated harvest levels. The future industry situation will likely be substantially different from the current one, however.

7.4 Summary

The Soo TSA has had one of the strongest rates of population growth in the province. Tourism is the leading sector in terms of employment in the Squamish Forest District accounting for approximately 37% of the total labour force, including the indirect and induced employment supported by the sector. The Squamish Forest District forestry sector, supported by the Soo TSA and TFL 38, employs approximately 12% of the total labour force in the forest district. However, the area has been affected by AAC reductions and mill closures over the last several years.

The current AAC of 506 000 cubic metres for the Soo TSA is capable of supporting approximately 683 person-years of direct employment across the province in harvesting, silviculture and primary processing activities. Residents of the Soo TSA account for approximately 39% of the direct employment. This direct activity can support a further 840 indirect and induced person-years across the province.

Fully harvested, the AAC for the Soo TSA also generates approximately $20.8 million per year in stumpage related payments, corporate taxes, and provincial income taxes.

The base case harvest forecast for the Soo TSA suggests that the current AAC of 506 000 cubic metres can be maintained, and consequently that no employment and other industry related changes appear to be expected due to timber supply changes in the Soo TSA. Given the declining harvests in other areas of southwestern British Columbia, a stable timber supply should help to maintain the existing forest industry, both within the Soo TSA and province. It must be noted that the timber supply analysis is not a recommendation or decision. The chief forester will make the AAC determination based in part on the results of the timber supply and socio-economic analyses.

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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 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.

Biodiversity (biological diversity) The diversity of plants, animals and other living organisms in all their forms and levels of organization, and includes the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.

Biogeoclimatic zones A large geographic area with broadly homogeneous climate and similar dominant tree species.

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

Commercial thinning A silviculture treatment that 'thins' out an overstocked stand by removing trees that are large enough to be sold as products such as poles or fence posts (see also, Juvenile spacing). It is carried out to improve the health and growth rate of the remaining crop trees.

Culmination age The age at which a timber stand reaches its highest average growth rate, or mean annual increment (MAI). MAI is calculated as stand volume divided by stand age. Culmination age is the optimal biological rotation age to maximize volume production from a growing site.

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.

Direct employment Jobs directly associated with a particular sector. For example, direct employment in forestry consists of work in harvesting, silviculture, log transportation and timber processing.

Drainage

The surface and sub-surface water derived within a clearly defined catchment area, usually bounded by ridges or other similar topographic features, encompassing part, most, or all of a watershed. The term is sometimes used to describe an operating area or location.

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Employment coefficient — The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

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

Forest cover objectives — Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see Cutblock adjacency guidelines and Green–up).

Forest cover requirements — Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see Cutblock adjacency guidelines and Green–up).

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

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.

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

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

Juvenile spacing — A silvicultural treatment to reduce the number of trees in young stands, often carried out before the stems removed are large enough to be used or sold as a forest product. Prevents stagnation and improves growing conditions for the remaining crop trees so that at final harvest the end-product quality and value is increased (see Commercial thinning).

Landscape-level biodiversity — The *Forest Practices Code Biodiversity Guidebook* 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.

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.

Not satisfactorily restocked (NSR) — An area not covered by a sufficient number of well spaced tree stems of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since 1987 are classified as current NSR.

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.

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Partial retention VQO — Alterations may be visible but not conspicuous. Up to 15% of the area can be visibly altered by harvesting activity (see Visual quality objective).

Person-year(s) — One person working the equivalent of one full year, defined as at least 180 days of work. If someone works full-time for 90 days, he or she accounts for 0.5 person years.

Protected area — A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).

Pruning — The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.

Retention VQO — Alterations are not easy to see. Up to 5% of the visible landscape can be altered by harvesting activity (see Visual quality objective).

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

Scenic area — Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager. In the Mid Coast Forest District, the district manager has designated scenic areas as either highly sensitive or moderately sensitive as per the map of the scenic areas for the Mid Coast Forest District, dated September 2, 1998.

Sensitivity analysis — Examines how uncertainty in data and management assumptions affect timber supply.

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.

Timber harvesting land base — Crown forest land within the timber supply area that is currently considered feasible and economical for timber harvesting.

Timber supply area (TSA) — An integrated resource management unit established in accordance with Section 7 of the Forest Act.

Timber supply — The amount of timber that is forecast to be available over a specified time period, under a particular management regime.

Tree farm licence (TFL) — Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.

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

In August of 1997 a data package for the Soo Timber Supply Area timber supply review was released for public review. As a result of public input a number of data and management assumptions have been revised (e.g., expansion of the area eligible for helicopter logging). This appendix presents the revised data package used to produce the timber supply analysis.

The following tables and commentary outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Soo 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 inventory information used in this analysis combines the Ministry of Forests forest cover inventory for the Soo TSA (updated to 1996) with non-standard overlays added to provide information on forest conditions as well as the management considerations listed in Table A-1.

Table A-1. Major forest management considerations

Consideration/issue	Description
Visual quality objectives (VQO)	VQO inventory updated (source: standard and non-standard field variables from the forest inventory planning (FIP) file).
Community watersheds	Designated community watersheds mapped by the Ministry of Environment, Lands and Parks (MELP), Water Management Branch (source: non-standard overlay).
Botanical forest products	Modelling of forest management prescriptions to maintain mushroom habitat (source: forest inventory planning file polygon listing from TSR 1).
Stand and landscape-level biodiversity	Forest practices code (FPC) requirements (source: draft landscape unit non-standard overlay and FIP file field for biogeoclimatic classification).
Riparian requirements	Forest practices code (FPC) requirements (source: FIP file polygon reduction).
Deer management plan	Modelling of draft deer management plan prescriptions (source: non-standard. Planning cell information was added from a FIP file polygon list[a]). Note: Change due to OPR 107/98 and area grandparented occurred after the completion of the analysis. Impact is shown in the analysis report as a sensitivity analysis.
Spotted owl	Modelling of owl management prescriptions (non-standard overlay). Special resource management zone (SRMZ) and owl activity centre information modified to approximate March 1998 special resource management zones). Development of management plans for activity centres and special resource management zones is ongoing. Any new information will be brought to the Chief Forester at the time of the AAC determination.
Operability	Operability updated (source: standard from FIP file modified[a] and updated[a] [1997] to reflect expanded helicopter land base).
Protected areas (P.A.)	Several new parks announced as part of the Lower Mainland protected areas strategy (non-standard overlay).

(a) Data and polygon list on file at Timber Supply Branch, Ministry of Forests.

A.2 Zone and Analysis Unit Definition

In 1996 an inventory audit was performed for the Soo TSA. The final report presented the findings for the mature component (stand age ≥ 60 years) of the timber harvesting land base for the 1994 timber supply analysis. Audit results (29 samples) showed a difference of 15 cubic metres per hectare (+3.1%) between the mean audit volume of 486 cubic metres per hectare and mean inventory volume of 501 cubic metres per hectare. The difference of 15 cubic metres per hectare (+3.1%) between these two estimates is not statistically significant, 19 times out of 20. The 95% confidence interval for the mean paired difference is -90 to +61 cubic metres per hectare. Since the difference was not statistically significant, the ground attribute volume was not calculated. These results indicate that the volume estimates used in TSR 1 were adequate and not a notable source of uncertainty.

The timber harvesting land base for the Soo TSA changed significantly since the last timber supply review. As such, the 1996 inventory audit results cannot be applied to the current timber harvesting land base.

A.2.1 Management zones (groupings) and objectives

For the purpose of modelling current forest management, several resource emphasis groupings were defined for this analysis based on the following forest management objectives:

1. Landscape unit/biogeoclimatic variants;
2. Community watersheds;
3. Spotted owl special resource management zones;
4. Deer winter range by deer planning cell;
5. Visual quality objectives (VQO) by landscape unit;
6. Adjacency (non-VQO) by landscape unit;
7. Botanical forest products.

Land considered unavailable for timber harvesting was included in the timber supply model and contributed to the attainment of objectives for visual quality, deer management, spotted owl and landscape unit biodiversity.

A.2 Zone and Analysis Unit Definition

Table A-2. shows the inventory variables used to define the various model groupings used in this analysis.

Table A-2. Objectives to be tracked

Objectives	Inventory definition
Level 1 groupings — VQOs and cutblock adjacency	
Cutblock adjacency only (Non-VQO)	No VQO assigned, modelled independently by landscape unit.
VQO = Retention	VQO code = R or P (only nine hectares of preservation so grouped with retention area), modelled independently by landscape unit.
VQO = Partial retention	VQO code = PR, modelled independently by landscape unit.
VQO = Modification	VQO code = M, modelled independently by landscape unit.
ESA = Recreation 2	if VQO code = M or no VQO assigned then modelled as VQO = PR, if VQO code = PR then modelled as VQO = R.
Level 2 groupings	
Draft deer management plan zones	Draft deer management plan zones by planning cell. Planning cell information from FIP file polygon listings.
Spotted owl SRMZs	Special resource management zone (SRMZ) and owl activity centre information modified to approximate March 1998 special resource management zones. Some additional spotted owl area from Garibaldi Provincial Park added to file[a].
Botanical forest products	Listing of forest stand polygon numbers.
Community watersheds	Community watershed numbers as indicated on mapping.
Level 3 groupings	
Draft landscape units	Draft landscape unit number as indicated on mapping.
Draft landscape unit/biogeoclimatic variant	Each landscape unit (LU)/variant combination is assigned a unique group number to facilitate modelling of landscape level biodiversity guidelines. Some additional area from Garibaldi Provincial Park added to file[a].

(a) Area from Garibaldi Provincial Park that was not in FIP file was added. Garibaldi Provincial Park FIP file information obtained from the Ministry of Environment, Lands and Parks. Spotted owl SRMZ and FIP file information on file at Timber Supply Branch. Ministry of Forests.

A.2 Zone and Analysis Unit Definition

A.2.2 Analysis unit characteristics

To facilitate modelling of stand growth and silvicultural treatments, individual forest stands were grouped according to dominant tree species (inventory type group) and timber growing capability (site index).

Table A-3. shows the variables used to define each analysis unit. A separate timber volume was generated for each analysis unit (see Table A-24. for existing natural stands and Table A-25. for future managed stands). The analysis units are not management zone specific; that is an analysis unit can be in one or more of the management zones described in Section A.2.1, "Management zone (groupings) and objectives." Once stands have been harvested, some analysis units are subdivided by treatment by management zone (general forest management and deer management Douglas-fir medium differ in that the latter site receives fertilization treatments). Also, some analysis units have helicopter-logging land base which used the same volume table as the conventional areas but have different minimum harvestable ages.

Table A-3. Definition of analysis units

	Analysis unit (leading species)	Criteria		
		Inventory type groups	Site index range (metres)	Average area-weighted site index (metres)[a]
1.	Douglas-fir (Fd), good	1-8	≥ 26	29.3
2.	Douglas-fir (Fd), medium	1-8	20-25.9	22.1
3.	Douglas-fir (Fd), poor	1-8	< 20	18.3
4.	Cedar/spruce (Cw/Sx), good/medium	9-11, 21-26	≥ 20	24.5
5.	Cedar/spruce (Cw/Sx), poor	9-11, 21-26	< 20	15.7
6.	Hemlock/balsam (Hw/Ba), good	12-20	≥ 25	28.6
7.	Hemlock/balsam (Hw/Ba), medium	12-20	20-24.9	22.3
8.	Hemlock/balsam (Hw/Ba), poor	12-20	< 25	15.7
9.	Pine, all	27-32	≥ 20	21.2
10.	Cottonwood (At), all	35 and 36	> 20	29.3

(a) Site index reference age is 50 years.

A.2 Zone and Analysis Unit Definition

The site index ranges used to separate each leading tree species into good, medium and poor site analysis units were determined by natural breaks in the distribution of area by site index for each species summarized from the forest inventory file.

Within each analysis unit the site index for the thrifty stands (< 141 years) and old stands (> 140 years) was calculated. The difference in site index was less 0.5 metre for all but two analysis units. The difference in height was just over one metre for these two analysis units. Therefore, separate analysis units were not developed in the base case to differentiate between the thrifty and old stands.

A.3 Definition of the Timber Harvesting Land Base

Timber is harvested from only a portion of the total Soo TSA area. One of the first steps in this timber supply analysis was to define the timber harvesting land base. This land base was derived by identifying certain types of land and forest where timber harvesting is not likely to occur under current management. The characteristics of each of these types are discussed below in the order in which they were excluded from the timber harvesting base. Also, shown are the types of forest where timber harvesting will not occur but the land base contributes to meeting the other objectives such as landscape-level biodiversity.

A.3.1 Total analysis area

Only area within the Soo TSA boundaries, and some adjacent areas that contribute to non-timber management objectives are included in the timber supply analysis.

All area on the FIP file that is not coded as TSA = 31 and within the 300 series of draft landscape units is not included in the timber supply analysis.

Productive forest land within Garibaldi Provincial Park not in the FIP file was retrieved from the archive and added to the total Soo TSA area for the analysis. While this area does not contribute to the timber harvesting land base it does contribute to meeting other value objectives. A total of 22 124 hectares was added to aid in meeting landscape-level biodiversity objectives and 1636 hectares of area not in the Soo TSA FIP file was added to aid in meeting spotted owl management objectives.

A.3.2 Non-forest

Non-forest (TYPID_PR = 6) and non-type (TYPID_PR = 8) areas do not contribute to the timber supply analysis land base. These categories include areas such as sparse alpine forest, ice, swamps, rocks and water.

A.3.3 Land not managed by the B.C. Forest Service

Productive forest in ownership codes 62 C (forest management unit), 69 C (forest reserves) and 70 N (timber licences) contribute to the timber harvesting land base of the TSA.

Provincial parks, ecological reserves and recreation areas (ownership codes 60 to 70) contribute to meeting biodiversity objectives. While harvesting is not permitted, these areas (26 446 hectares) remain in the total land base used for timber supply modelling

During the review of the Soo TSA land base there was a strong indication that ownership code 61 C (UREP) area has reverted to area where timber harvesting activities are permitted. A comprehensive review of areas coded as ownership code 61 C will be needed prior to the next timber supply review.

A.3 Definition of the Timber Harvesting Land Base

A.3.4 Non-commercial cover

Non-commercial brush types (TYPID_PR = 5), are excluded from the timber harvesting land base.

A.3.5 Current roads, trails and landings

Separate estimates are made to reflect the loss in productive forest land due to existing and future roads, trails and landings (RTL). Existing RTL estimates are applied as reductions to the current productive forest considered available for harvesting and future RTL reductions are applied after stands are harvested for the first time in the simulation model.

Geographic information system (GIS)-based computer software (ODOMETER) was used to measure the lengths of existing roads. In the Soo TSA there were 4800 kilometres, and an average right-of-way width of 15-metres was assumed, for a total estimated road area of 7200 hectares. The 15 metre width also accounts for landing area that will not be rehabilitated. The current RTL reduction is performed after non-commercial bush as the procedure did not take into account other timber harvesting land base reductions (e.g., measurements also include roads within newly created parks). The current roads reduction was applied to stands with projected age class less than five.

Future roads, trails and landings reductions are based on a survey of integrated silviculture information system (ISIS) and major license silviculture information system (MLSIS) reports for areas logged since 1987. Squamish Forest District staff estimated the losses to be 5.4% of the available timber harvest land base. All existing stands currently with projected age class five or greater were subject to a 5.4% land base reduction after the first harvest.

Table A-4. Estimates for existing and future roads, trails and landings

Location	Age class	Road length (km)	Road width (metres)	Reduction area (hectares) or per cent (%)
Existing RTLs				
Roads	0 to 4	4 800	15	7 200 hectares
Future RTLs				
Roads, trails and landings	5 to 9			5.4%

A.3 Definition of the Timber Harvesting Land Base

A.3.6 Newly created parks

The location of newly created parks was mapped and overlaid on the FIP file. This permitted the exclusion of the areas from the timber harvesting land base.

Table A-5. Newly created parks

Identifying inventory variables (location descriptors)	Excluded area
Stawamus P.A. (on new PAS mapping)	All
Indian Arm P.A. (on new PAS mapping)	All
Upper Lillooet P.A. (on new PAS mapping)	All
Sockeye P.A. (on new PAS mapping)	All
Callaghan P.A. (on new PAS mapping)	All
Tantalus P.A. (on new PAS mapping)	All
Brackendale P.A. (on new PAS mapping)	All

A.3.7 Inoperable areas

Operability and inoperability codes are generally used to describe the presence or absence of physical barriers or limitations to harvesting, logging methods (e.g., cable), and the merchantability of stands. The current operability and inoperability inventories were updated to the standard used in TSR 1 (OP codes = I [inoperable], A [conventional] and H [helicopter]).

Public review of the August 1997, *Soo TSA Data Package* noted that the operability did not reflect current conditions and performance for helicopter logging. In the fall of 1997 Squamish Forest District staff reviewed helicopter operability for the Soo TSA. The results of the review produced revised helicopter logging criteria (operable) and a revision of the associated land base. The procedures used for the timber supply analysis (no revisions have been made to the FIP file) to modify the areas eligible for helicopter logging are:

- The operability line between the conventional, helicopter and inoperable was reviewed from aerial surveys, ground inspections and aerial photography. The review produced mapsheet and stand polygon lists which changed the operability, or listed the stands as eligible for helicopter logging.

  The criteria used in a hierarchical order to evaluate eligibility for helicopter logging, as well as the remaining area were:

- If a stand had a helicopter logging history, it automatically became a helicopter logging stand.
- Only leading species Douglas-fir, hemlock, balsam, cedar and spruce stands were eligible for helicopter logging.

- All stands classified as environmentally sensitive area (ESA) soils (high) or regeneration were ineligible for helicopter logging and remained as inoperable.

For all remaining stands the following rules were applied:

- Except hemlock and balsam stands, stands had to be able to achieve a minimum volume of 350 cubic metres per hectare by age 140. The minimum site indices associated with this criterion are: Fd (16), balsam (15), cedar (15) and spruce (15). While site index 13 was sufficient for hemlock and balsam stands to meet the volume criterion, other factors related to merchantability (eg., stem size) required the site index to be raised to 15. Stands that meet the minimum site index also had to meet the following criteria:
  - Stands younger than age 141 (age class projected < 7). All Douglas-fir stands qualified unless the stands were greater than 60 years (age class projected > 3) and did not have a height greater than 19.5 metres (height class projected > 2).
  - Stands greater than age 140 (age class projected > 6). Stands with height less than 28.5 metres (height class projected < 4) or crown closure less than 4 or did not have a standing volume of 400 cubic metres per hectare were excluded from helicopter logging.
  - All stands meeting the above criteria were included as eligible for helicopter logging in the timber harvesting land base.

  All lists of polygons by mapsheet number are on file at Timber Supply Branch, Ministry of Forests.

A.3.8 Environmentally sensitive areas

Some forest lands are environmentally sensitive and/or significantly valuable for other resources. These areas are identified and delineated during a forest inventory and are called environmentally sensitive areas (ESAs). Table A-6., shows the criteria used to account for environmentally sensitive areas in which harvesting is not expected to occur.

Table A-6. Description of environmentally sensitive areas

ESA category	ESA description	Reduction per cent (%)
S1	Soils — high	90[a]
S2	Soils — moderate	60[a]
R1[b]	Recreation — high	90
W1g, W1m, W1o	Wildlife (mountain goat, moose and birds) — high	90
P1	Regeneration — high	90[a]
A1	Avalanche — high	60
W2g	Wildlife (mountain goat) — moderate	90

(a) No reduction if the area has a harvesting history.

(b) Includes ESA and recreation from Recreation Features Inventory. Stands from the Recreation Features Inventory were those labeled as Feature significance A, B and C with management class 0.

W1d (deer) and W2d are mapped and the data is on the FIP file. Deer ESA's were not used in favour of the draft deer management plan requirements. Further, the changes due OPR 107/98 were not incorporated into the base case and the information was only available after the completion of the analysis. The impact due to the change is shown in the analysis report as a sensitivity analysis. See Section A.4.4, "Forest cover requirements" — Ungulate (deer) winter range habitat management (draft deer management plan) — for more detail.

A.3 Definition of the Timber Harvesting Land Base

A.3.9 Retention deer management zone

A draft deer management plan provided the direction for forest management in the Soo TSA at the time of the analysis. One of the five deer resource management zones excludes all timber harvesting activities. For the timber supply analysis, this zone is coded as retention deer winter range and completely removed from the timber harvesting land base.

Note: The changes due OPR 107/98 were only available after the completion of the timber supply analysis. These changes are not incorporated into the base case. The impact due to the change is shown in a sensitivity analysis in the analysis report. See Section A.4.4, "Forest cover requirements" for more detail.

A.3.10 Sites with low timber growing potential

Stands that do not currently have sufficient timber volumes to make harvesting feasible and area not likely to achieve a harvestable volume over time (based on estimated site productivity) are excluded from the timber harvesting land base. All stands with a harvesting history are included in the timber harvesting land base.

Table A-7. shows the minimum volume and site productivity criteria used to define stands with low timber growing potential.

Table A-7. Description of sites with low timber growing potential

Species	Characteristics	SI limit	Per cent (%) excluded
Fir	Existing stands with volumes less than 350 m³/hectare and sites projected not capable of producing 350 m³/hectare by age 140.	16	100
Cedar	Existing stands with volumes less than 350 m³/hectare and sites projected not capable of producing 350 m³/hectare by age 140.	13	100
Hemlock/balsam[a]	Existing stands with volumes less than 350 m³/hectare and sites projected not capable of producing 350 m³/hectare by age 140.	13 conventional 15 helicopter	100
Spruce	Existing stands with volumes less than 300 m³/hectare and sites projected not capable of producing 300 m³/hectare by age 140.	13	100
Pine[b]	Existing stands with volumes less than 300 m³/hectare and sites projected not capable of producing 300 m³/hectare by age 140.	20	100
Cottonwood[b]	Existing volume less than 150 m³/hectare.	20	100

(a) Minimum site index for the helicopter land base was increased from 13 to 15 metres after an additional criterion of merchantability was considered.

(b) Site indices for pine and cottonwood stands exceeded the stated characteristics, e.g. ,pine meets the characteristics at site index 13. Additional considerations of merchantability and pest damage (pine) necessitated increases in site index.

Currently there are no cottonwood harvest licences. Cottonwood has been left in the timber harvesting land base to show potential levels of harvest.

Pest damage limits the availability of pine stands. In lieu of pest damage information, more restrictive merchantability limits were set.

A.3 Definition of the Timber Harvesting Land Base

A.3.11 Problem forest types

Problem forest types are stands which are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability. These types are wholly or partially excluded from the timber harvesting land base.

Table A-8. Problem forest types criteria

Species	Inventory type groups	Reduction per cent (%)
Larch and all deciduous except cottonwood	32-34, 37-42	100

Currently there are no cottonwood harvest licences. Cottonwood has been left in the timber harvesting land base to show potential levels of harvest. All other deciduous and larch stand are not currently utilized in the Soo TSA.

A.3.12 Exclusion of specific, geographically defined areas

Two areas where current management excludes timber management activities and the operability is not accounted for in the inventory file are:

- East Howe Sound (region 9, compartment 86) has limited harvesting chances and most would required helicopter logging. This type of harvesting would require timber to be flown over highways and railroads. For public safety reasons, this area has been excluded from the timber harvesting land base.
- *Whistler Local Resource Use Plan* (LRUP) excludes timber harvesting activities within the Whistler old municipal boundary.

Polygon lists by mapsheet and area have been compiled for these exclusions and are on file at Timber Supply Branch, Ministry of Forests.

Archaeological overview and cultural heritage value inventories for the entire Soo TSA are yet to be completed or are not comprehensive. The impacts of measures required to protect known sites remain unquantified at this time.

A.3 Definition of the Timber Harvesting Land Base

A.3.13 Riparian reserve zones

In order to account for riparian reserve zones the timber harvesting land base was reduced by 4.8%. This figure is based on coastal average figures for stream length by stream class, estimated in a 1994 study completed by Wild Stone Resources and the riparian reserve width specifications for each stream class found in the *Riparian Management Area Guidebook*. The per cent area excluded from the timber harvesting land base is calculated by multiplying the specified reserve width for each stream class by the lengths of stream of each class found on the cutblocks sampled (92 coastal cutblocks), then dividing by the total area of cutblocks sampled. The information used in the analysis to capture the effect on timber supply from the riparian management zone is dealt with in Section A.4.5, "Riparian management zones."

A.3.14 Wildlife trees (WT) and wildlife tree patches (WTP)

Using principles from the *Forest Practices Code Biodiversity Guidebook*, Forest District staff reviewed the amount, location and type of wildlife tree patches in current and past harvest areas, dispersed in the productive forest and estimated that the requirement for WTPs is 5.8%. Based on the assumption that three-quarters of the requirement can be meet within the non-timber harvesting land base, the timber harvesting land base was reduced by 1.45% for WTPs.

The entire land base of the Soo TSA was evaluated for spotted owl management. Special resource management zones are identified and management prescriptions have been assigned that modify timber harvesting activities through forest cover requirements. In addition to the special resource management zones, the Squamish Forest District staff have also augmented the amount of area in WTPs in areas that are considered to have potential future value for owls and in areas within owl ecosystem networks. Within these areas, a 5% area reduction was applied to account for WTPs.

No area reductions were applied to areas within the Soo TSA that are under retention or partial retention VQO and community watershed management strategies. Under these strategies sufficient timber is left standing so that additional amounts for WTPs are not required.

Table A-9. Reductions to reflect volume retention in cutblocks for wildlife tree patches

Management zone	Analysis unit	Persistence	Per cent (%) recommended in applicable guidebook	Residual area estimate on the timber harvesting land base (%)
All	All	Long term	12	1.45
Spotted owl IRM	All	Long term	12	5.0%

An area reduction is used to model wildlife tree patch requirements rather than a volume reduction because it more accurately reflects the area upon which harvesting will occur. These wildlife trees, in conjunction with other riparian reserves and area removals, are generally larger than two hectares in size and are left to maintain stand structure within the landscape over time, and will contribute to meeting old-seral stage forest requirements at the landscape level. It is assumed that these wildlife tree patches will not be economical to harvest at a later date, nor will they be available to harvest in subsequent harvests of the stand.

A.3.15 Timber licence reversions

Timber licences (TLs) are old tenure arrangements managed by the B.C. Forest Service that give a licensee exclusive rights to harvest Crown merchantable timber within the licence area and do not contribute to the TSA allowable cut. Once these areas have been harvested, regenerated and attain free-growing status, the timber licence area reverts to the Soo TSA. Accordingly, these areas are included in the timber harvesting land base after the first harvest and contribute to the TSA harvests in medium- to long-term timber supply.

The forest inventory file shows a total of 15 806 hectares of timber licences in the Soo TSA. After accounting for land base that has reverted to the TSA (stands age class projected ≤ 4) and area removals such as ESAs and protected areas, approximately 2444 hectares remain in the area considered available for harvesting in the Soo TSA. Of the 2444 hectares, 700 hectares are expected to be harvested within the next three years. It is assumed that the remainder of the area will be harvested proportionately over remainder of the next 30 years. Table A-10. shows the timber licence reversion schedule in tabular format.

Table A-10. Timber harvest reversion schedule

Area of timber licence (TL) harvested (hectares) (decade of harvest) (hectares per year)			
1st decade		2nd decade	3rd decade
Year 1-3	Year 4-10	Year 1-10	Year 1-10
233.3 Total = 700	64.59 Total = 452.2	64.59 Total = 645.9	64.59 Total = 645.9

Timber licence areas are initially assigned to groups and analysis units in the same way as the rest of the land base. When a licence area reverts it will remain in the same groups and analysis units (regenerated) that it is initially assigned to.

A.3.16 Not satisfactorily restocked (NSR) areas

Land classified in the Soo TSA inventory file as type identity 4 or 9 and age class projected 0 is included in the timber harvesting land base. These areas identify not satisfactorily restocked land base. The areas are first removed from the land base, re-assigned leading species if necessary and then added back into the timber harvesting land base at the estimated rate of which the NSR area will be restocked.

The total area of NSR in the Soo TSA is 5875 hectares and 3803 hectares are within the timber harvesting land base. The FIP file area for NSR within the timber harvesting land base approximates the area in the Squamish Forest District and major license silviculture information system (MLSIS) and integrated silviculture information system (ISIS) (silvicultural) records (3754 hectares). However, the amount of area by species differs between the inventory and silvicultural records.

Reasons for this are the use of default species codes (inventory type group [ITG] = 12, ITG source code = D) for 2077 of the 3803 hectares of FIP file NSR.

A.3 Definition of the Timber Harvesting Land Base

The following procedures (the specific procedures and data are on file in the Timber Supply Branch, MoF.) were used to adjust the amount of area by species from the FIP file to approximate the forest district silvicultural records.

- Squamish Forest District staff reported that the silvicultural records show the breakdown of the NSR area by analysis unit species to be similar to those presented in the *1994 Soo TSA Timber Supply Analysis Report* (Table A-6, TSR 1). The per cent breakdown by analysis unit is: fir 48.4%, hemlock/balsam 35.2% and cedar/spruce 16.4%.
- The per cent breakdown of the FIP file NSR area by analysis unit is: fir 19.8%, hemlock/balsam 78.2%, and cedar/spruce 2.0%.
- Changes to current NSR data was made at the Forest Service Simulator (FSSIM) data entry stage of the analysis (i.e., only model input was modified).
- For the timber supply analysis, the amount of area by analysis unit area was adjusted to reflect the proportion used in TSR 1. Adjustment was only made to area with default codes. Within each analysis unit, area was transferred to the same relative level, site productivity group. For example, hemlock/balsam good was transferred to either fir good or cedar/spruce good analysis units.
- The data package identified 597 of 3754 hectares as backlog NSR. As noted previously the actual total area was 3803 hectares of which 3516 hectares are within the conventional land base. It was assumed that all backlog is within the conventional land base so the equivalent backlog area is 572 hectares. The amount of area by analysis unit in the backlog NSR is proportionate to the analysis units' representation in the conventional land base. The backlog area was brought back into the timber harvesting land base over a ten year period. For modelling purposes half of the initial backlog NSR area in an analysis unit was assigned age minus 3, and the remaining half was assigned an age of minus 8.

A.4 Forest Management Assumptions

A.4.1 Utilization levels

The utilization level defines the maximum stump height, minimum top diameter inside bark and minimum diameter at breast height (1.3 metres) by species and is used in the analysis to calculate merchantable volume.

Table A.11 reflects current regional standards, licence requirements and current performance.

Table A-11. Utilization levels

Analysis unit	Utilization		
	Minimum dbh (cm)	Maximum stump height (cm)	Minimum top dib (cm)
Pine	12.5	30	10
Cottonwood	12.5	30	10
All others	17.5	30	10

A.4.2 Volume exclusions for mixed species stands

One or more species in mixed species stands may be unmerchantable. For example, the deciduous species in a predominantly coniferous stand may not be harvested, or may only be partially harvested. The unharvested portion should not contribute to the estimated stand volume. The species that do not contribute and that were excluded from the estimation of stand volume are shown in the table below.

Table A-12 reflects current regional utilization standards, licence requirements and current performance.

Table A-12. Volume exclusions for mixed species types

Species	Volume exclusion (%)
Larch and all deciduous except cottonwood	100

A.4.3 Minimum harvestable age derivation

Minimum harvestable ages are, as the term implies, the minimum age at which harvesting is expected to be feasible. While harvesting may occur in stands at the minimum requirements in order to meet forest level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large interdecadal changes in harvest levels), most stands will not be harvested until well past the minimum timber production ages because other resource values take precedence (e.g., requirements for the retention of older forest).

The criteria used to define minimum harvestable ages for this analysis is 90% of culmination age (e.g., for a species with a culmination age of 100 years, the minimum harvestable age will be 90 years). Additional criterion was given for areas to be helicopter logged. Older stands also had to have a minimum volume of 400 cubic metres per hectares.

A.4 Forest Management Assumptions

Table A-13. Minimum harvestable ages

Analysis unit	Minimum harvestable age Existing yield tables		Minimum harvestable age Managed yield tables	
	Conventional land base	Helicopter land base	Conventional land base	Helicopter land base
1.a. Fir, good[a]	72	72	72	72
1.b. Fir, good, deer area	72	72	82	82
2.a. Fir, medium	82	82	63	72
2.b. Fir, medium, deer area	82	82	80	80
2.c. Fir, medium, botanical area	82	82	90	90
3.a. Fir, poor	90	140	90	200
3.b. Fir, poor, deer area	90	90	90	90
3.c. Fir, poor, botanical area	90	90	100	100
4. Cedar/spruce, good/medium	72	72	72	80
5. Cedar/spruce, poor	100	120	117	122
6. Hemlock/balsam, good	63	63	54	54
7. Hemlock/balsam, medium	72	80	90	90
8. Hemlock/balsam, poor	100	170	100	120
9. Pine, all	90	N/A	63	N/A
10. Cottonwood, all	50	N/A	50	N/A

(a) Additional Douglas-fir analysis units were developed for managed stands to accommodate different silvicultural regimes.

A.4 Forest Management Assumptions

A.4.4 Forest cover requirements

Current forest management practices in the Soo TSA that were modelled using forest cover requirements and the rationale/source for the forest cover requirements are reported in the following sub-sections. Many forest cover requirements are modelled at the landscape unit level. The draft landscape unit names and codes are presented within the first sub-section "Landscape-level biodiversity guidelines."

Many forest cover requirements are described as the maximum amount of area permitted below a specified green-up height. In the timber supply analysis green-up ages are used to model the average time for a stand to reach the specified height. The procedures used to estimate the average green-up ages are:

- The average area-weighted site index for each analysis unit was calculated.
- The per cent by major species in the inventory type group in an analysis unit was calculated and are presented in the Table A-14.

Table A-14. Per cent major species (inventory type group) within each analysis unit

Analysis unit — leading species	Fd %	Hm %	Ba %	Cw %	Sx %	Px %	At %
1. Douglas-fir (Fd)	100						
2. Douglas-fir (Fd)	100						
3. Douglas-fir (Fd)	100						
4. Cedar/spruce (Cw/Sx)				90	10		
5. Cedar/spruce (Cw/Sx)				70	30		
6. Hemlock/balsam (Hw/Ba)		70	30				
7. Hemlock/balsam (Hw/Ba)		50	50				
8. Hemlock/balsam (Hw/Ba)		50	50				
9. Pine						100	
10. Cottonwood (Ac)							100

A.4 Forest Management Assumptions

The site index and major species and inventory type group were used as input to the Ministry of Forests, Research Branch *Site Tools* program to calculate age to green-up height.

The average area-weighted, age by major species and inventory type group at which green-up heights are achieved was calculated for each analysis unit.

For each type of forest cover requirement (e.g., VQO retention) the average area-weighted age for the required green-up heights was calculated from the age-height data for each analysis unit.

Landscape-level biodiversity guidelines

Only the old-seral guidelines were modelled, consistent with the assumptions used in the February, 1996 *Forest Practices Code Timber Supply Analysis*. As biodiversity-emphases have not yet been approved for landscape units in the Soo TSA, an average old-seral prescription was applied to all landscape units. This average prescription was calculated assuming a distribution of area between biodiversity-emphases of 45% low-biodiversity, 45% intermediate-biodiversity and 10% high-biodiversity. The per cent area of old-seral forest to be maintained over time under each biodiversity-emphasis is based on values from the *Forest Practices Code Biodiversity Guidebook* for each of the biogeoclimatic variants in the Soo TSA. The final old-seral requirements calculated using this method for each landscape unit/variant combination are shown in Table A-15.

In Table A-15. the reference to base is the calculated average prescription assuming a distribution of area between biodiversity-emphases of 45% low-biodiversity, 45% intermediate-biodiversity and 10% high-biodiversity. The base per cent figure does not account for phase-in within low emphasis areas. The starting year reference accounts for phase-in of the old-seral requirements in low emphasis areas over three rotations (1st rotation = year 1, 2nd rotation = year 70, and 3rd = year 140). The figures underneath the header show the per cent required as part of the phase-in, and the first year the amount is applied.

A.4 Forest Management Assumptions

Table A-15. Seral stage requirements (per cent old seral) by natural disturbance type (NDT) over time

Biogeoclimatic unit	NDT	Base and age		Starting year for requirement for %		
		(%)	(years)	1	70	140
AT p[a]	5	13.6	250	9.7	11.6	13.6
CWH dm	2	10.0	250	7.3	8.6	10.0
CWH ds 1	2	10.0	250	7.3	8.6	10.0
CWH ms 1	2	10.0	250	7.3	8.6	10.0
CWH vm 1	1	13.6	250	9.7	11.6	13.6
CWH vm 2	1	13.6	250	9.7	11.6	13.6
ESSF mw	2	10.0	250	7.3	8.6	10.0
ESSF mw h	2	10.0	250	7.3	8.6	10.0
IDF ww	4	13.6	250	9.7	11.6	13.6
MH mm 1	1	19.9	250	14.2	17.0	19.9
MH mm 2	1	19.9	250	14.2	17.0	19.9
MH mm 2e	1	19.9	250	14.2	17.0	19.9

(a) Areas without biogeoclimatic unit coding on the inventory were assigned to AT p. Review of the inventory suggested that these areas are within the CWH zone, consequently, the seral stage requirements for CWH were used for AT p.

Sensitivity analysis was performed to test the mature plus old requirements. Base percentage seral requirements were calculated similarly to those for old-seral forest. The sensitivity analysis evaluating the impact of using draft biogeoclimatic unit emphasis used the assignments presented in Table A-16.

A.4 Forest Management Assumptions

Table A-16. Draft biogeoclimatic unit emphasis by landscape unit

Landscape unit number	Landscape unit name	Biogeoclimatic unit draft emphasis
301	Rogers	Intermediate
302	Meager	Intermediate
303	U. Elaho(TFL)	Intermediate
304	L. Elaho(TFL)	Intermediate
305	U. Squamish(TFL)	Low
306	Ryan	Low
307	L. Squamish	Intermediate
308	Billygoat	Intermediate
309	Mamquam	Low
310	Tuwasus	Intermediate
311	E. Howe Sound	Low
312	Indian	Low
313	Soo	Low
314	Whistler	Low
315	Callaghan	Intermediate
316	Sloquet	Intermediate
317	U. Lillooet	Intermediate
318	Railroad	Intermediate
319	Birkenhead	High
320	Gates	High
321	Lizzie	Intermediate

After the analysis was completed LU 318 (Railroad) was changed to high emphasis and LU 320 (Gates) was changed to intermediate emphasis.

A.4 Forest Management Assumptions

Visual quality objectives (VQO) and integrated resource management (IRM)

The visual quality objective for each area of the Soo TSA was determined by VQO mapping as shown in the FIP file and by additional new inventory prepared as a non-standard inventory for this analysis. Guidelines provided in *Procedures for Factoring Visual Resources into Timber Supply Analyses* were used to derive forest cover requirements for areas under each VQO within each landscape unit. Areas without an assigned VQO, within each landscape unit, were grouped into integrated resource management (IRM) areas and were subject to adjacency forest cover requirements. Table A-17. shows the per cent of the total forested area or timber harvesting land base that is allowed to be not greened-up at any time. Some unharvestable areas, for example, riparian reserves and inoperable areas, contribute towards visual quality objectives.

The visual absorption capability (VAC) ratings from the inventory were not employed in developing forest cover requirements for VQO areas. The VACs are not applicable to current practices in the TSA. Current practice in VQO areas is generally to design harvests such that the upper end of the recommended disturbance range is employed. The base case in the analysis reflected this practice.

Table A-17. Visual quality objective[a] and adjacency forest cover requirements

	Green-up height (metres)	Green-up maximum allowable disturbance (% area)
1 IRM (base)	3	33 (timber harvesting land base)
2 VQO = R (base)	5	5 (of total forested area)
3 VQO = PR (base)	5	15 (of total forested area)
4 VQO = M (base)	5	25 (of total forested area)

(a) Includes recreation ESA (2) — recreation from Recreation Features Inventory (see Section A.2.1, Table A-2).

Spotted owl special resource management zones

The August 1997 *Soo TSA Data Package* outlined the strategies to model spotted owl habitat management. The habitat prescriptions were retention (no harvesting) for owl activity centres and use of forest cover requirements for special resource management zones (SRMZ). The Ministry of Environment, Lands and Parks staff provided maps showing the location of the activity centres and SRMZs.

Prior to starting the timber supply analysis, the spotted owl habitat management strategy was updated. This resulted in owl activity centres being rezoned to SRMZs. Where applicable and possible, SRMZ boundaries used in the analysis were redefined to approximate current information.

Areas with habitat potential for owls are identified as candidate SRMZs. Agreement between the Ministry of Forests and the Ministry of Environment, Lands and Parks led to the inclusion of candidate areas in the analysis (referred to as spotted owl IRM zone in the analysis report). Adjacency in forest cover requirements, to prevent over-concentration of harvests, and 5% wildlife tree patch requirements were applied.

A.4 Forest Management Assumptions

The following forest cover requirements were applied to SRMZs ("Level 2" groupings from Table A-2) to model spotted owl habitat management.

Table A-18. Spotted owl SRMZ forest cover requirements

	Green-up height (metres)	Green-up maximum allowable disturbance (% area)	Minimum older age (years)	Minimum area retained as older age (%)
Spotted owl areas (SRMZ)	N/A	N/A	100	67
Candidate (IRM) spotted owl areas	3	33	N/A	N/A

Maps showing the location of the spotted owl SRMZs and candidate area are on file at the Ministry of Forests, Timber Supply Branch.

Development of management plans for activity centres and special resource management zones is ongoing. If new data or information becomes available the chief forester will be advised at the time of the determination of the AAC.

Ungulate (deer) winter range habitat management (draft deer management plan)

The August 1997 *Soo TSA Data Package* outlined the strategies from the Squamish Forest District draft deer management plan to model ungulate winter range habitat management. While the areas and strategies presented in the data package remain the same for the analysis, the deer management regime names were modified to reflect the information in the inventories. Also in the analysis, forest cover requirements were applied at the deer planning cell level rather than at the draft landscape unit-level, as was described in the data package.

The forest cover requirements and area removals listed in Table A-19 were applied to the forested area within each deer planning cell. These requirements are based on the migration, selection, spring, retention and rotation habitat management strategies identified in the Squamish Forest District draft deer management plan.

A.4 Forest Management Assumptions

Table A-19. Draft deer management plan — winter range strategy forest cover requirements

Deer management regime	% area removal	Forest cover requirements for total forest	
		Minimum age or height	Minimum % retained
Retention	100	N/A	N/A
Migration[a]	0	≥ 3 metres	80
Selection	0	50 years	50
Spring	0	50 years	50
Rotation	0	50 years	50

(a) Only applies to the Upper Lillooet planning cell.

The inventory mapping of the deer planning cells was added after receipt of the inventory file by Timber Supply Branch. The lists and procedures used to add the planning cell information to the inventory are on file at Timber Supply Branch, Ministry of Forests.

In April 1999, the *Operational Planning Regulation (OPR), B.C. Regulation 107/98* came into effect which provided procedures for identifying and approving existing ungulate winter ranges. Only winter ranges identified as being necessary for the survival of the ungulate species, at a base population level throughout the range of the species, were to be approved by October 15, 1999.

As part of the OPR process, Squamish Forest District staff approved (grandparented) areas that are identified as both winter range in the draft deer management plan, and ESA wildlife (deer). Winter ranges identified as both ESA1 (high value) and retention zone in the draft plan were excluded from the timber harvesting land base. The remaining grandparented areas are managed using forest cover requirements associated with the various zone designations under the deer management plan (Table A-19). Table A-20 shows the habitat areas classified in the deer management plan, the ESA inventory and as grandparented areas, together with the general management approach used.

Table A-20. Amount of deer winter range area in the productive forest by source and general management prescription

Management strategy	Deer management plan (hectares)	Deer ESA (hectares)	Grandfathered area (hectares)
Retention or area reduction	5 779.5	2 380.0	3 109.6
Forest cover constraints[a]	15 240.0	15 659.1	1 964.8
Total	21 019.5	18 039.1	5 074.4

(a) Forest cover constraints developed for the management of selection, migration, spring and rotation winter ranges.

A.4 Forest Management Assumptions

The Squamish Forest District staff note that grandparented area represents the expected area necessary for the survival of the baseline population. Nothwithstanding, staff acknowledge that location and size of ranges may change due to additional assessments and resultant changes in future development plans.

The timber supply analysis was completed before receipt of the information and data of *OPR 107/98*. The impact of the change in the management of deer winter range areas in the Soo TSA is shown in Section 5.23, "Uncertainty in the estimated area of ungulate deer winter range of the timber supply analysis."

In the analysis the grandparented areas are assumed to reflect deer winter range in the Soo TSA. While the Squamish Forest District staff cannot speculate on the final outcome, changes to the locations and extent of winter ranges may occur as a result of field assessments. The Ministry of Forests and the Ministry of Environment, Lands and Parks staff will be reviewing and updating ungulate winter range areas by October 15, 2003, as required by the OPR 107/98. Any new information will be presented to the Chief Forester at the time of the AAC determination or incorporated into subsequent timber supply analyses.

Community watersheds

Twenty-three community watersheds have been identified within the Soo TSA where additional forest cover requirements are the current management practice. The practice is to limit harvesting, within a five year period, to a maximum of 5% of the total forested area within a community watershed. This forest cover requirement reflects the guideline provided on page 59 of the *Forest Practices Code Community Watershed Guidebook.*

In the timber supply analysis, the community watershed forest cover requirement was modified to a maximum of 10% of the forested area being eligible for harvest within a 10 year period. This modification was necessary as the timber supply forecast was based on ten year period lengths between harvesting, forest aging and regeneration activities.

Botanical forest products (mushrooms)

Within the Soo TSA mushroom and timber harvesting areas are managed concurrently. Within the mushroom areas only selection harvesting is permitted and in the timber supply analysis this has been simulated through the following forest cover requirements:

- No more than 25% of the forested area can be less than 5 metres in height.
- A minimum of 50% of the forested area needs to be greater than 80 years of age.

A.4.5 Riparian management zones

Riparian management zones (RMZs) were not modelled in the base case. Volume reductions are typically used to account for the timber volume that will be left unharvested in RMZs. The estimated reduction factor based on average stream density figures for the coast using partial or selection harvesting systems in the riparian management zone is 4.2% (source: *Forest Practices Code Riparian Management Area Guidebook*).

In the Soo TSA current practice within the RMZs is characterized as per cent area retention rather than per cent volume retention.

In the analysis, the base case did not include area or volume reductions for RMZs as there is uncertainty surrounding the amount of reduction. Ministry of Forests district staff estimate that the area reduction could be up to 4.2% of the timber harvesting land base. The impact on the base case of practices in RMZs was assessed through sensitivity analysis.

A.4.6 Unsalvaged losses

Table A-21. shows the estimated average annual unsalvaged volume loss to catastrophic events such as insect epidemics, fires, wind damage or other agents on the timber harvesting land base. The unsalvaged loss column only reflects those areas in which the volume will not be recovered or salvaged. The unsalvaged losses are deducted from all harvest forecasts shown in the timber supply analysis.

A.4 Forest Management Assumptions

Table A-21. Unsalvaged losses

Cause of loss	Annual unsalvaged loss (m^3/year)
Insects	4 000
Fire	30 000
	34 000

Data source and comments:

Insects

Current and projected volume losses can be expected in Douglas-fir stands due to western spruce budworm and Douglas-fir bark beetle. The volume loss estimate was derived by applying a loss factor to the volume of stands currently under attack. Estimates of losses in pine stands attributable to the mountain pine beetle are unknown, but pine comprises only a very small portion of the Soo TSA.

Fire

The unsalvaged loss estimate due to fire is based on 10 years of district fire reports. The total losses were reduced so that only volume loss that occurred in the timber harvesting land base is included in the estimate.

A.4.7 Basic silviculture and regeneration assumptions

The silviculture program reflects the mix of treatments expected to be carried out according to the Soo TSA Plan. This level of activity assumes basic silviculture on all sites plus incremental silviculture on some sites. Table A-22. shows the proportion of each analysis unit to be treated under each silviculture regime and the expected average regeneration delay.

Recent plantations and future stands will be grown on managed stand yield tables (MSYTs) produced using the B.C. Forest Service table interpolation program for stand yields (TIPSY) growth and yield model. Stands where fertilization treatments are to be applied will have MSYTs produced using the B.C. Forest Service tree and stand simulator (TASS) growth and yield model.

A.4 Forest Management Assumptions

Table A-22. Regeneration assumptions by analysis unit

Analysis unit	Zone	Site index (m@50yrs)	Regen delay (yrs)	OAFs		Method		Density	
				1	2	Type	%	Initial (sph)	Space (sph)
121. Fir – G	Deer	29.3	3	15	5	planted	100	2500	500
122. Fir – M	Deer	22.1	3	15	5	planted[c]	100	2500	500
123. Fir – P	Deer	18.3	3	15	5	planted	75	1500	500
						planted[c]	25	1500	500
132. Fir – M	Botanical	22.1	3	15	5	planted[b]	100	2500	600
133. Fir – P	Botanical	18.3	3	15	5	planted	40	1500	none
						planted	60	1500	500
101. Fir – G	Remaining	29.3	3	15	5	planted[a]	100	2500	600
102. Fir – M	Remaining	22.1	3	15	5	planted[c]	25	2500	600
						planted[a,c]	75	2500	600
103. Fir – P	Remaining	18.3	3	15	5	planted	40	1500	none
						planted[c]	35	1500	500
						planted	25	1500	500
104. C/S – G/M[d]	Remaining	24.5	3	15	5	planted	100	3000	700
105. C/S[d] – P	Remaining	15.77	3	15	5	planted	100	2000	none
106. H/B – G	Remaining	28.6	3	15	5	planted	100	4000	700
107. H/B – M	Remaining	22.3	3	15	5	planted	70	4000	600
						natural	30	2000	none
108. H/B – P	Remaining	15.7	3	15	5	natural	100	1800	none
109. Pine all	Remaining	21.2	3	15	5	planted	100	2000	700
110 Ac all[e]	Remaining	29.3	3	N/A	N/A	natural	100	VDYP	VDYP

(a) Planted means that genetically improved stock is used and at least a 3% volume increase (first generation stock from Dewdney Seed Orchard) is applied in the yield curves developed for these regimes.

(b) Planted means that 25% of the stock planted is genetically improved. Same gain as above.

(c) Planted means fertilization is applied at ages 20, 30 and 40 years at 200 kg/hectare. TASS growth and yield model will be used to generate yield tables.

(d) C/S medium and poor assumed a hybrid of Sitka and Engelmann which is represented by White Spruce yield curve. No planting of Sitka on good sites because of Sitka spruce weevil.

(e) Cottonwood regenerates along VDYP curves as there are no MSYTs for cottonwood.

A.4 Forest Management Assumptions

Planted stock was assumed to be two years old. Effectively this reduced the regeneration delay to zero (i.e., spring tree planting at the beginning of year 3).

In the case of an analysis unit having mixed species, the species composition for the regenerating analysis unit is assumed to be similar, to the nearest 10%, as the original analysis unit. Table A-14. presents the per cent species for the existing natural stand analysis units.

For H/B-G and H/B-M the regeneration strategy is not to regenerate the area back to the original species portions but to plant 30% Douglas-fir, 30% spruce, 20% balsam and 20% cedar. When an area was planted to species not in the original analysis unit, the area was transferred to the most appropriate analysis unit. For example, the 30% of the H/B-G analysis unit planted to Douglas-fir was transferred to the Fir-G analysis unit. If applicable, site indices were adjusted for species conversion. If the new Fir-G area did not have the same site index as the original group then the overall site index was adjusted (i.e., new average area-weighted site index).

In the analysis data sets helicopter area analysis unit numbers were identified by adding 50 to identification number shown in the above table.

All values in the above table are based on current performance as estimated by the Squamish Forest District staff.

A.4.8 Immature plantation history

This section identifies areas of existing immature forest where the density (stems per hectare) was controlled and therefore should be assigned to a managed stand yield table curve (MSYT). All NSR and future harvested stands will be projected using MSYTs.

Table A-23. Immature plantation history

	Area managed (%)		
Analysis unit	**Age 1-10**	**Age 11-20**	**Age 21-30**
All Douglas-fir	100	100	100
All hemlock/balsam	100	100	
All cedar/spruce	100		

Data source and comments:
The proportion of immature stands that are considered "managed" is based on professional estimates by forest district silviculture staff. Douglas-fir stands less than 30 years old and hemlock/balsam-leading stands less than 20 years old are considered managed stands due to the longer history of control of density at establishment and through stand tending in these stands. Density control and tending has only occurred over the last 10 years in all other stands in the Soo TSA.

A.4 Forest Management Assumptions

A.4.9 Harvest scheduling priorities

The *1994 Soo TSA Management Plan Strategy* specifies that 25% of the AAC must come from "difficult or decadent stands" (a stand qualifies if there is 30% or greater decay). Implementation of this strategy has reduced the amount of affected stands to the extent that special harvesting priorities are no longer needed.

The management plan also specifies that at least 10% of the annual harvest come from non-clearcut or partial harvests systems. As second-growth or managed-stands start to mature it is expected that an additional 10% of the annual harvest will come from commercial thinnings.

During timber supply modelling the relative oldest harvesting rule will be used. Additionally, cottonwood was given the first harvest priority to ensure the harvest target would be achieved.

A.4.10 Logging methods and silvicultural systems

Review of past development plans showed the logging methods employed in the Soo TSA over the last five years were conventional ground based (85%), cable (10%) and helicopter-logging (5%). Current development plans now show the trend to be the same excepting that helicopter logging will increase and the average amount of area to be harvested per year is 135 hectares.

The majority of the Soo TSA is being harvested utilizing clearcut harvesting methods. Squamish Forest District staff anticipate increased usage of partial or selection harvest systems, especially in the spotted owl management zone. However, there is limited current performance and factoring partial or selection harvest silvicultural systems into the TSA timber supply is not an issue at this time.

A.5 Volume Estimates for Existing Stands

The variable density yield projection (VDYP) model, version 6.4a developed and supported by the B.C. Ministry of Forests, Resources Inventory Branch, was used to estimate timber volumes for existing natural stands. Table A-24. shows the volume estimates by analysis unit for existing natural stands.

Specific volume curves were not developed for the conventional and helicopter logging land bases. However, minimum harvestable ages may vary as helicopter stands have additional criteria for harvest eligibility. During modelling, the same volume curves were entered for conventional and helicopter analysis units. In the analysis data sets, helicopter tables were identified by adding 50 to the table number.

Table A-24. Timber volume tables for existing natural stands (cubic metres)

Table	1	2	3	4	5	6	7
Age	**Fir-G**	**Fir-M**	**Fir-P**	**Ce/Spruce G-M**	**Ce/Spruce P**	**Hem/Bal G**	**Hem/Bal M**
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.33	0.00	0.00	0.11	0.00	5.77	0.00
30	79.13	5.50	0.23	38.97	0.08	136.63	32.61
40	202.66	83.11	26.14	125.52	16.71	270.53	139.80
50	307.79	162.22	90.26	207.82	57.66	385.51	236.35
60	397.96	230.23	146.15	284.12	108.64	485.02	322.27
70	475.65	289.37	194.51	352.04	155.87	570.04	396.27
80	544.03	341.55	237.11	414.88	199.37	644.50	461.87
90	601.44	386.43	273.88	465.30	235.94	704.64	516.28
100	651.61	426.19	306.46	508.71	267.99	755.69	563.28
110	695.98	461.82	335.67	546.63	296.21	799.41	604.19
120	734.53	493.42	361.60	575.59	318.47	835.16	638.49
130	767.45	518.85	382.59	611.16	343.07	874.83	675.52
140	794.92	539.54	399.66	643.56	365.18	910.86	709.46
150	816.33	555.30	412.75	671.54	384.29	942.42	739.71
160	831.69	566.14	421.87	695.15	400.44	969.89	766.51
170	841.26	572.15	427.08	714.60	413.77	993.56	790.09
180	846.22	573.99	428.93	734.22	427.17	1 015.42	812.07
190	856.70	580.46	434.10	754.03	440.39	1 036.60	833.19
200	867.38	587.29	439.53	772.88	452.93	1 056.41	852.96
210	877.93	594.07	444.86	791.15	464.78	1 074.88	871.41
220	888.21	600.66	449.98	813.36	478.63	1 092.09	888.69
230	898.13	606.97	454.85	834.92	492.14	1 108.13	904.84
240	907.67	612.97	459.45	855.77	505.14	1 123.06	919.99
250	916.81	618.66	463.76	875.96	517.66	1 136.97	934.18
260	917.53	619.48	464.80	878.28	520.34	1 143.09	941.82
270	918.17	620.25	465.77	880.36	522.79	1 148.50	948.79
280	918.71	620.95	466.67	882.24	525.03	1 153.27	955.15
290	919.17	621.61	467.51	883.90	527.09	1 157.46	960.91
300	919.59	622.21	468.28	885.40	528.96	1 161.10	966.16
310	919.91	622.78	469.01	886.69	530.68	1 164.24	970.92
320	920.20	623.29	469.68	887.85	532.27	1 166.91	975.21
330	920.42	623.77	470.31	888.84	533.72	1 169.14	979.08
340	920.59	624.21	470.87	889.71	535.06	1 170.99	982.57
350	920.72	624.61	471.40	890.44	536.29	1 172.44	985.69

(continued)

A.5 Volume Estimates for Existing Stands

Table A-24. Timber volume tables for existing natural stands (cubic metres) (concluded)

Table	8	9	10
Age	Hem/Bal P	Pine All	Cottonwood All
10	0.00	0.00	0.00
20	0.00	0.00	12.86
30	0.38	11.28	63.72
40	20.82	66.81	105.84
50	80.00	119.31	139.15
60	145.68	166.63	164.52
70	207.69	208.94	183.12
80	260.23	247.47	197.56
90	306.15	282.47	208.19
100	347.01	314.78	216.41
110	383.55	344.92	222.85
120	415.67	373.03	227.62
130	448.04	398.24	232.26
140	477.93	413.33	236.04
150	505.15	423.81	238.98
160	529.88	430.64	239.56
170	552.33	433.92	239.86
180	573.26	434.03	240.17
190	593.20	432.41	240.67
200	611.98	434.27	241.18
210	629.63	436.51	241.70
220	646.23	438.87	242.21
230	661.86	441.24	242.68
240	676.57	443.56	243.18
250	690.44	445.81	243.64
260	700.34	447.68	243.67
270	709.59	449.47	243.71
280	718.26	451.11	243.73
290	726.38	452.68	243.77
300	733.98	454.09	243.80
310	741.10	455.34	243.81
320	747.79	456.46	243.84
330	754.05	457.50	243.86
340	759.92	458.36	243.87
350	765.42	459.02	243.89

A.6 Volume Estimates for Regenerated Stands

WinTIPSY (Windows™ version of the Table Interpolation Program for Stand Yields) version 1.4, 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 and regeneration assumptions for each analysis unit were used as inputs to TIPSY. Section A.4.8 “Immature plantation history” and Table A-23. document which stands are assumed to be managed in the analysis. TASS growth and yield model was used to develop yield curves with fertilization treatments.

Operational adjustment factors (OAFs) used in managed stand yield table generation were:

OAF1 of 15% (a constant percentage reduction at all ages to represent incomplete site occupancy, for example, small holes in a stand), and OAF2 of 5% (an increasing reduction, to represent losses such as decay that increase with stand age).

Table A-25. displays the volume tables for managed stands. Volumes are assumed to remain constant after 300 years of age. For some tables there was insufficient growth and yield information to model to 300 years of age — data to maximum ages are presented and the maximum volume is carried forward to 300 years of age.

Specific volume curves were not developed for the conventional and helicopter logging land bases. However, minimum harvestable ages may vary as helicopter stands have additional criteria for harvest eligibility. During modelling, the same volume curves were entered for conventional and helicopter analysis units. In the analysis data sets, helicopter tables were identified by adding 50 to the table number.

A.6 Volume Estimates for Regenerated Stands

Table A-25. Timber volume tables for managed stands (cubic metres)

Table	101	121	102	122	132	103	123
Age	**Fir-G**	**Fir-G (deer)**	**Fir-M**	**Fir-M (deer)**	**Fir-M (botanical)**	**Fir-P**	**Fir-P (deer)**
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	5.42	6.42	0.00	0.00	0.00	0.00	0.00
30	104.28	95.86	19.07	18.51	21.91	0.04	0.03
40	220.89	202.58	156.36	136.25	93.04	7.75	8.68
50	346.65	322.23	251.40	223.39	159.40	47.83	45.83
60	469.80	440.69	336.59	304.15	219.11	81.80	77.00
70	571.41	540.99	394.36	361.22	278.53	116.63	105.88
80	665.66	632.35	445.78	412.69	335.89	143.28	128.63
90	747.39	713.18	492.17	458.99	388.57	166.52	149.23
100	816.33	781.12	532.60	500.41	435.54	186.34	167.10
110	876.17	840.37	569.34	537.19	473.70	204.23	183.88
120	928.90	892.42	601.36	570.63	507.67	220.10	199.50
130	973.90	937.63	630.60	600.07	538.44	233.97	212.55
140	1 014.69	980.31	655.01	626.04	567.93	247.02	225.30
150	1 050.27	1 017.79	678.24	650.39	594.22	260.62	239.30
160	1 080.96	1 050.27	698.61	671.04	617.51	272.97	251.55
170	1 106.06	1 076.37	716.46	689.66	637.80	283.96	262.83
180	1 127.37	1 098.69	732.37	707.54	656.99	294.01	273.15
190	1 147.58	1 118.90	746.92	722.33	673.19	303.14	282.53
200	1 163.90	1 136.11	760.52	735.44	688.38	311.19	290.28
210	1 176.58	1 149.69	771.72	747.48	702.48	319.24	298.60
220	1 188.17	1 161.27	782.11	758.40	713.67	326.62	306.73
230	1 198.85	1 171.85	791.02	767.94	724.77	333.24	314.03
240	1 207.54	1 181.43	797.83	776.10	734.86	339.40	320.43
250	1 207.54	1 181.43	804.15	783.20	743.06	344.80	326.00
260	1 207.54	1 181.43	810.69	788.92	751.16	349.70	331.50
270	1 207.54	1 181.43	813.42	793.81	758.16	354.18	336.13
280	1 207.54	1 181.43	817.92	798.41	764.25	358.58	340.70
290	1 207.54	1 181.43	821.79	801.35	770.25	362.45	345.18
300	1 207.54	1 181.43	824.24	804.31	770.25	362.45	345.18

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-25. Timber volume tables for managed stands (cubic metres) (concluded)

Table	133	104	105	106	107	108	109	110
Age	Fir-P (botanical)	Ce/Spruce G-M	Ce/Spruce P	Hem/Bal G	Hem/Bal M	Hem/Bal P	Pine All	Cottonwood All
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.32	0.00	2.00	0.00	0.00	12.00	12.86
30	0.00	38.96	0.00	106.00	5.10	0.00	69.00	63.72
40	5.40	156.94	2.50	243.00	45.60	1.50	130.00	105.84
50	31.20	283.94	41.50	379.00	138.50	18.50	198.00	139.15
60	62.20	397.59	104.00	468.00	241.10	62.50	253.00	164.52
70	94.40	503.68	172.50	537.00	334.40	124.00	299.00	183.12
80	121.40	594.83	235.00	578.00	402.30	188.50	337.00	197.56
90	145.20	671.36	292.50	594.00	452.80	246.50	370.00	208.19
100	165.20	748.16	339.00	601.00	491.80	301.50	399.00	216.41
110	183.40	812.99	377.00	601.00	521.30	353.00	426.00	222.85
120	199.80	868.78	411.00	601.00	541.20	397.50	449.00	227.62
130	213.60	918.61	440.50	601.00	550.60	435.00	468.00	232.26
140	227.00	962.09	465.50	601.00	556.80	465.00	468.00	236.04
150	242.00	998.87	488.00	601.00	558.90	493.00	468.00	238.98
160	255.40	1 031.17	507.50	601.00	560.10	520.00	468.00	239.56
170	267.40	1 060.40	524.50	601.00	560.30	544.00	468.00	239.86
180	278.40	1 088.46	539.00	601.00	559.90	565.00	468.00	240.17
190	288.40	1 113.46	550.50	601.00	559.50	583.50	468.00	240.67
200	296.80	1 135.43	560.00	601.00	559.50	601.00	468.00	241.18
210	305.80	1 156.14	566.50	601.00	559.50	616.00	468.00	241.70
220	314.40	1 179.59	574.50	601.00	559.50	628.00	468.00	242.21
230	322.00	1 201.87	582.00	601.00	559.50	639.50	468.00	242.68
240	329.00	1 222.47	588.50	601.00	559.50	648.50	468.00	243.18
250	335.00	1 242.23	598.00	601.00	559.50	658.00	468.00	243.64
260	340.60	1 260.74	607.00	601.00	559.50	665.00	468.00	243.67
270	345.60	1 277.45	615.50	601.00	559.50	671.50	468.00	243.71
280	350.60	1 292.82	623.50	601.00	559.50	677.00	468.00	243.73
290	355.20	1 306.70	630.50	601.00	559.50	682.50	468.00	243.77
300	355.20	1 306.70	630.50	601.00	559.50	687.50	468.00	243.80

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The report identifies employment and income impacts, changes in government revenues, and community impacts at various harvest levels and times in the future. This type of analysis involves several assumptions, some of which are outlined below:

- **Employment multipliers —** the multipliers used in the analysis of indirect and induced impacts are based on analytical assumptions and estimates using data collected at a certain time, thus they reflect industry and employment conditions at that time. Consequently, they may not accurately reflect future industry conditions. While generally reliable indicators when based on fairly recent information, older multipliers can be dated and potentially not reflect the industry under examination. In any impact analysis, the information should be considered an order of magnitude indicator.
- **Employment coefficients —** employment impacts associated with future harvest levels are calculated using employment coefficients (person-years per 1000 cubic metres harvested). This approach assumes that the industry structure will remain the same. While reasonably accurate in the short term, employment coefficients may change, as a result of changing market conditions or production technologies, for example.
- **Timing of impacts —** employment impacts are shown to occur simultaneously with a change in the harvest level. While fairly accurate for the harvesting sub-sector, this close relationship may not be the case for the processing and silviculture sub-sectors of the forest industry. Additionally, indirect and induced impacts will likely occur over a longer period, as business and consumer spending levels adjust.
- **Processing thresholds —** processing job impacts are unlikely to occur in direct proportion to harvest changes (i.e., a 10% harvest reduction may not lead to a 10% processing employment reduction). Impacts are more likely to occur in a step-wise manner related to processing thresholds. A processing threshold is the level of a mill's timber supply where, when reached, will cause a mill to either reduce the number of shifts or shut down the mill, temporarily or permanently. Accurately predicting a mill's threshold level is not a function of impact analysis. As a result, the analysis may overestimate processing impacts if mills continue to operate the same number of shifts, but perhaps at lower production levels, or alternatively could underestimate impacts if a mill were to eliminate a shift. Over the medium- to long-term, the impact figures should be reasonably accurate, however.
- **Government expenditures —** provincial government expenditures are more related to population levels than to industry activity. As such, expenditures on education, health care and other government services are assumed to remain unchanged despite harvest changes and any subsequent change in government revenues. However, if community population levels change sufficiently, public expenditures would likely change, and would amplify the community impacts of forestry job losses or gains.
- **Proportional harvest reductions —** harvest reductions are assumed to be spread evenly among all licensees and all forms of tenure.

B.2 Economic Impact Analysis Methodology

Data sources

Data for the socio-economic analysis were obtained from several sources. Harvest volume and stumpage data are from the Ministry of Forests. Timber flow and employment data are from responses to questionnaires that were sent to licensees, operators and processing facilities in the TSA. Other general economic data are from the Ministry of Finance and Corporate Relations, Statistics Canada and local communities.

Person-year of employment

The unit of measurement for employment is a person-year. A person-year of employment is defined here as a full-time job, which lasts at least 180 days per year. Part-time jobs were converted to equivalent full-time person-years of employment.

To estimate employment and income impacts associated with changes in TSA timber harvest levels, the forestry sector was divided into three sub-sectors:

1) harvesting;
2) silviculture; and
3) timber processing.

Estimating employment and income impacts involves several steps. The first step was to assess current activity in each of the three sub-sectors. Then indirect and induced employment and employment income impacts were estimated using data from Ministry of Finance and Corporate Relations and Statistics Canada. Next, employment coefficients were calculated and applied to the base case harvest forecast. Other indicators of the forestry sector's contribution to the provincial economy, such as government revenues, were also calculated using Ministry of Forests stumpage estimates and other data sources.

Employment — harvesting

Direct employment in harvesting consists of all woodlands-related jobs including falling, log transport, log salvage, planning and administration functions. While road building and maintenance work are important activities in the forest industry, the employment multipliers used in this analysis define these activities as indirect rather than direct. Therefore, road building and maintenance employment are not included in the direct impact estimates, but are captured in the estimates of indirect impacts. Including this employment as direct would be double-counting and result in overestimating employment impacts.

B.2 Economic Impact Analysis Methodology

Data on employment, place of residence and timber flows were obtained through a survey of licensees and operators in the TSA. The information was then used to estimate employment averages associated with harvest changes and the proportion of residents versus non-residents who work in the TSA.

Two estimates of direct employment in harvesting were calculated:

1) TSA direct employment in harvesting — consists of employees who are engaged in harvesting and related activities within the TSA and who reside in communities within the TSA; and,

2) Provincial direct employment in harvesting — consists of all employees who come to the TSA to work in harvesting and harvesting related activities, regardless of their place of residence.

The estimates of TSA and provincial direct employment in harvesting were used to calculate employment coefficients per 1000 cubic metres. These employment coefficients were then used to estimate harvesting employment associated with the different harvest levels in the base case forecast.

Employment — silviculture

Silviculture employment consists of all basic and intensive reforestation activities, including surveys, site preparation, planting, fertilizing, pruning and spacing. Silviculture employment data were collected from the Ministry of Forests and licensees whose tenures require post-harvest silviculture work. Most silviculture work is seasonal, and because of this silviculture jobs were converted into equivalent full-time person-years of employment. Respondents were also asked to provide estimates of the percentage of their silviculture employees who resided within the TSA and outside the TSA.

As with the harvesting sub-sector, two estimates of direct employment in silviculture were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for silviculture employment in the same manner as the employment coefficients for harvesting employment.

Employment — timber processing

Information about employment, production and sources of timber was gathered from TSA mills. Information was also gathered as to whether timber harvested from the TSA was processed within the TSA or outside the TSA. This information indicates the degree of dependence the mills have on timber harvested within the TSA. To estimate the share of processing employment supported by TSA timber, mill employment was prorated by the relative contribution of timber from the TSA to a mill's total timber requirement. For example, if 80% of a plant's timber requirement was supplied by the harvest from the TSA, then 80% of the employment in the plant would be attributable to the TSA harvest.

Employment figures were also adjusted to reflect the residences of workers (i.e., those who lived within the TSA and those who lived outside the TSA). Employment in timber processing that is supported by chip by-products from milling operations was similarly estimated.

As with the harvesting sub-sector, two estimates of direct employment in timber processing were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for timber processing employment in the same manner as the employment coefficients for harvesting employment.

Indirect and induced employment estimates

Indirect employees associated with the forestry sector are those who work to provide goods and services to firms directly engaged in the basic forestry sector; for example, those who provide road maintenance services. Induced employees are those who work to provide the goods and services purchased by employees who are directly and indirectly engaged in the industry; for example, those who work in retail outlets. Indirect and induced employment figures were calculated using TSA and provincial employment multipliers developed by the Ministry of Finance and Corporate Relations.

Two sets of employment multipliers were used for this report: migration multipliers and no-migration multipliers. The migration multipliers assume that a displaced worker will leave the region, reducing total income in the region by his/her full wage. The no-migration multipliers assume that a displaced worker remains in the area, at least in the short term, and employment insurance and other social transfer payments temporarily offset some of the income loss. Using the no-migration multipliers reduces the induced impacts associated with a change in direct employment.

B.2 Economic Impact Analysis Methodology

The TSA and provincial employment multipliers used in the Soo TSA analysis are shown in Table B-1.

Table B-1. Total employment multipliers

Forest sub-sector	TSA migration multiplier	TSA no-migration multiplier	Provincial coastal migration multiplier	Provincial coastal no-migration multiplier
Harvesting	1.60	1.41	2.02	1.72
Solid wood processing	1.49	1.33	2.31	1.94
Pulp	1.98	1.74	2.54	2.13

Source: Horne *et al*. 1996; Horne, 1999a.

Employment estimates of alternative timber supply levels

To estimate employment generated by alternative timber supplies, the forecast harvest level is multiplied by the calculated employment coefficients. Note that employment coefficients are based on current industry productivity, harvest practices and forest management assumptions and will not likely reflect industry operating conditions far into the future. Therefore, the employment estimates should be viewed as indicators of the general magnitude of change rather than as precise estimates of changes in employment levels.

Employment income estimates

Employment income was calculated using average income estimates for workers in the forest industry. Income data are from Statistics Canada Survey of Employment Payroll and Hours. In 1997, the average pre-tax annual income (less benefits) for sub-sectors of the forestry sector associated with the Soo TSA was approximately $47,850 for logging and forestry services, $46,250 for solid wood manufacturing, and $54,990 for the pulp and paper sector. The weighted average annual income for direct forestry workers in the Soo TSA was $50,800. The average annual income for indirect and induced employees averaged approximately $34,070. This figure is based on a selection of business and personal service sectors, accommodation, food and beverage sector, and the construction sector average annual wages. Income taxes were calculated based on marginal tax rates of 23% to 28% with one-third of the total income tax accruing to the province.

B.2 Economic Impact Analysis Methodology

Provincial government revenues

Except for stumpage, royalty and rents, which are specific to the TSA, provincial government revenue impacts were estimated by using industry averages. Revenues per 1000 cubic metres of harvest, expressed as dollars per 1000 cubic metres, were calculated and applied to the harvest levels in the base case forecast in a manner similar to how employment impacts were estimated (see Table B-2). Rates from 1996 to 1998 were used (rather than 1995 to 1997 as with the employment and income estimates) to partially capture the stumpage reduction in 1998.

Table B-2. Soo TSA provincial government revenue estimates

	Average revenue 1996-1998 ($1998 millions)	Revenue ($/'000s m^3)
Stumpage, rents and royalties	10.3	21,192
Industry taxes	4.4	9,050
Provincial income tax (1995-1997)	5.1	10,775
Total government revenues	19.8	41,017

Source: Ministry of Forests. Price Waterhouse, 1997.