Fraser Timber Supply Area

Incremental Silviculture
Interim Strategy Analysis

-- Version 1.1 --

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STRATEGY ANALYSIS AT A GLANCE

General Strategy

The main focus of incremental silviculture in the Fraser TSA is to 1) minimize reductions in short term timber supply and employment, 2) increase the supply of merchantable volume in the form of quality sawlogs during the mid and long term periods, 3) move timber supply forward from the long term into the mid term, and 4) increase the future supply of premium quality logs while maintaining the quality of aesthetic values, critical wildlife habitat and First Nations traditional uses.

The following report focuses on timber supply issues relating to incremental silviculture.

Timber Targets

The Fraser TSA has limited ability to overcome forecast reductions in mid term timber supply but long term levels have potential to be near current levels.

Quantity: Manage mid-term timber supplies to yield a harvest of approximately 1.16 million m3/yr and long term supplies to yield 1.44 million m3/yr.

Quality: Manage regenerated stands to yield at least 8% premium logs by volume, with the majority of the remainder being of sawlog quality.

Product Objectives

The following are simplified product objectives used for the purpose of this analysis. Comprehensive site specific product regimes can be found in the Chilliwack Forest District Enhanced Forest Resource Management Plan - Interim Approach.

Quality Class	Species	Characteristics
Premium Log:	Douglas-fir, clear, pruned	45+ cm min DBH, pruned, min 5 m log.
	Douglas-fir, large timber	45+ cm min DBH, unpruned.
	Hem/Bal/Spruce, large timber	45+ cm min DBH, unpruned.
	Cedar, large timber	45+ cm min DBH, unpruned.
Sawlog:	Minimum average stand DBH of 30 cm and min. stand vol. of 350 m3/ha. A large timber log is presently 55 - 60 cm, however, is expected to decrease to 45+ cm in the future.	

Major Silvicultural Strategies

Quantity

1. Fertilize 250 ha/yr of Douglas-fir stands scheduled for harvest in the 2nd decade.
2. Repeat fertilize approximately 45 000 ha of Douglas-fir stands on an annual program of 3 000 ha/yr to raise mid term harvest volumes.
3. Space 1 400 ha/yr of Douglas-fir, hemlock and other stands to either set up for commercial thinning or to bring forward harvest the harvest of stand from the long term into the mid term. (Commercial thinning may commence approximately 50 years from now.)
4. Plant 300 ha of backlog NSR and maintain 225 ha of backlog plantations.
5. Increase regenerated stand yields by fertilizing suitable regenerated stands.

The greatest timber supply benefits can be achieved by the following activities which are

not within the traditional scope of incremental silviculture but are included here for consideration.)

1. Achieve green-up 2 years earlier in VQ zones by planting large, genetically improved stock, brushing for growth enhancement and fertilizing regenerated stands.
2. Implement partial harvesting / commercial thinning regimes in VQ zones, fertilizing 150 ha/yr post CT.
3. Increase regenerated stand yields 20% by:
   - using (2nd generation) A class seed or better (requires tree improvement);
   - using large planting stock; and
   - managing stocking to reduce voids 5%.

Quality

1. Prune 250 ha/yr to 5.5 m in two lifts (requires and annual program of 500 ha) to produce 2% clear wood in long term harvests.
2. Space stands (1400 ha) to increase average piece sizes and prepare stands for fertilization and pruning. (The spacing program under strategy #5 above will contribute to this strategy. The dual objectives of increased piece size and earlier harvest may be conflicting. Modelling is required to determine the best balance.)

Habitat

1. Upon completion of the Northern Spotted Owl Resource Management Plans there may be the opportunity to space 250 ha of age class 1 and 2 stands and fertilize 100 ha of age class 1 to 4 stands, as part of a regime to create spotted owl habitat. However, until the plans are finalized these are will not be the focus of investment related incremental forest management activities because of the uncertainty of future harvest potential.

Incremental Silviculture Program

(ha)

Program Table - Ha, Fraser TSA, August 1998

Year	Surveys*	Backlog Planting	Backlog Brushing	Backlog Conversion	Space Df leading	Space Hw leading	Prune 1st lift	Prune 2nd lift	Fertilize	Owl Habitat Space	Owl Habitat Fertilize
1	12,500	100	250	50	420	400	250	300	800	-	-
2	16,500	100	200	100	740	520	250	250	2,000	?	?
3	12,500	100	200	100	740	520	250	250	3,400	?	?
4	9,500	-	100	200	740	520	250	250	3,400	?	?
5	9,500	-	100	200	740	520	250	250	3,400	?	?
Subtot Yr 1 - 5	60,500	300	850	650	3,380	2,480	1,250	1,300	13,000	?	?
6 - 10	60,500	-	500	1,000	3,380	2,480	1,250	1,300	13,000	?	?
Total Yr 1 - 10	121,000	300	1,350	1,650	6,760	4,960	2,500	2,600	26,000	-	-
Unit cost ($/ha)	100	1,500	500	2,500	600	1,000	1,000	1500	200	600	200

* Includes prescription and layout

Note* Overall, Licensees indicated they would like to apportion time spent on activities as follows: Backlog - 30%, Fertilization - 15%, Spacing - 30%, Pruning - 15% and Stand Conversion - 10%.

Introduction

About the Interim Strategy

The terms of a service agreement between Forest Renewal BC (FRBC) and the BC Ministry of Forests (MoF) require the MoF to develop, and FRBC to fund, what is essentially an incremental silviculture strategy. This document is in fulfillment of this contractual requirement.

Incremental silviculture is part of a suite of strategies which together may influence the future quality and quantity of habitat and timber supply. This strategy document broadly analyzes the full range of potential silviculture activities in order to create a context for an incremental silviculture strategy.

An incremental silviculture strategy should not be confused with the allowable annual cut (AAC) determination process. AAC's are based on actual practice and current information at the time of the determination. This strategy, on the other hand, is about creating a future state of our forests. The degree to which the strategy proves appropriate and is achieved may influence future, but not necessarily present, AAC determinations.

This strategy is founded on readily available information and the knowledge of forestry professionals. It is intended as an interim strategy until a more in-depth analysis-based review is completed.

Methodology

This strategy was prepared through the following process:

1. Prior to the district working session, L. P. Atherton & Associates prepared a preliminary draft of this document, summarizing all available information relevant to a strategy and identifying opportunities to improve the future quantity and quality of timber supply.
2. A district working session was held July 22 & 23, 1998 in Rosedale, attended by representatives of the MoF and forest licensees of the Kingcome TSA. Larry Atherton of L. P. Atherton & Associates and Doug Williams of Cortex Consultants Inc. led the session. Participants reviewed the potential opportunities identified in the draft document along with others that arose. The outcome of the session was a regime table, complete with priorities.
3. The consultants incorporated the results of the working session into the draft document and added forecasts of future harvest quantity and quality and of job outcomes.
4. After ministry review, the consultants submitted a completed strategy document to the MoF in electronic format as version 1.0. (The ministry will assign higher version numbers (e.g., 1.1, 1.2, etc.) as the strategy evolves and changes are made.)

Acknowledgments

The participation of representatives of the following organizations at the district working session is gratefully acknowledged. *[check all, particularly Boston Bar Band]*

Ministry of Forests:

- Chilliwack Forest District
- Vancouver Forest Region

Forest licensees of the Fraser TSA:

- Pretty's Timber
- Tamihi Logging
- Western Forest Products
- Cattermole
- Interfor
- Canfor

Other Participants:

- Nlaka'pomux Nation
- Boston Bar Band
- Ministry of Environment, Lands and Parks

The project was managed by Mr. Larry Sigurdson of the Ministry of Forests, Vancouver Forest Region. Funding was provided by Forest Renewal BC.

Basic Data

Land Area

Description	Area (ha)	Area %
Total Area of TSA	1 107 100	100
Total Productive Crown Forest	507 000	46
Net Timber Harv. Land Base	281 500	25

Source: TSR2 analysis report - rounded to nearest 100 ha.

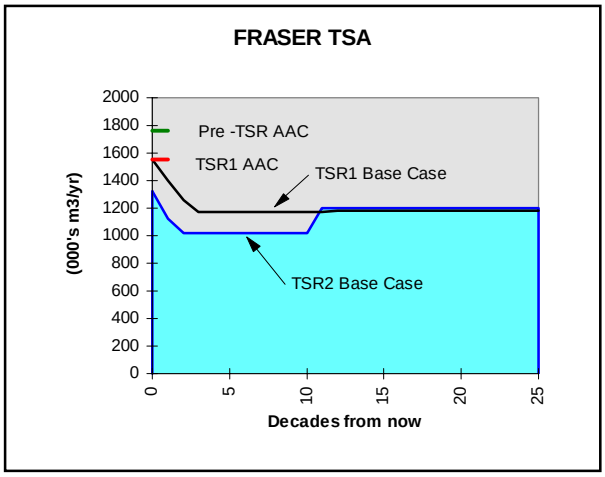
AAC

AAC Type	Pre-TSR	TSR1*	Change (%)
Conventional	1 700 000	1 493 000	-12.2
Deciduous	65 000	57 000	-12.3
Insect/Disease	-	-	
Marginal	-	-	
Total	1 765 000	1 550 000	-12.2

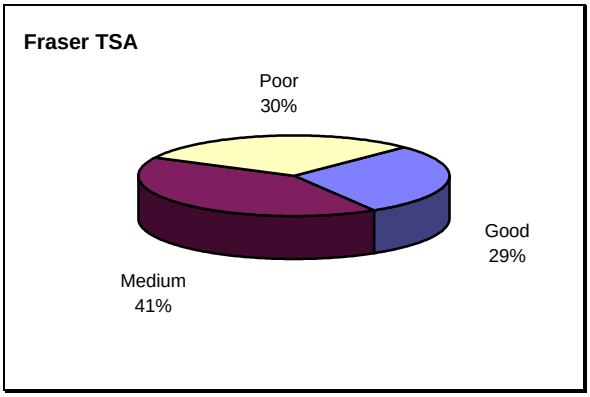
Woodlot AAC	Part of conventional AAC	10 000

*effective Apr 1/95

Harvest Forecast

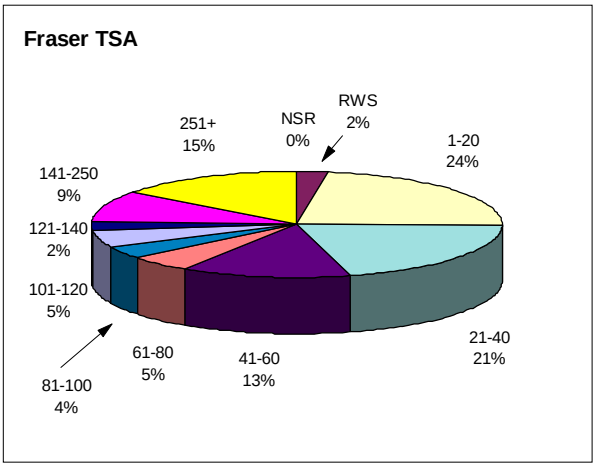


Site Class



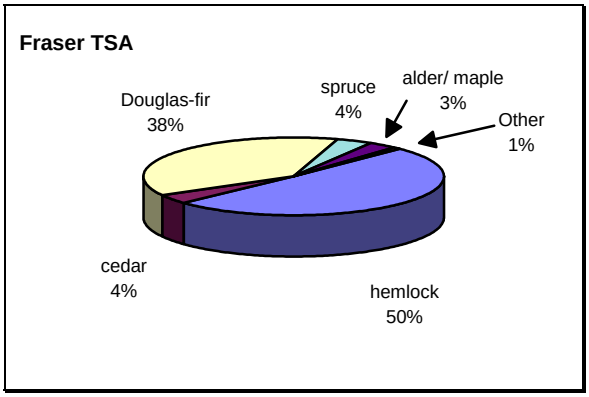
Data interpreted from TSR2 chart.

Age Class



THLB only, scaled from chart in TSR2 analysis report.
RWS - Regenerating Within Standards

Tree Species



Source: TSR2 analysis report

Issues

Individual Issue Analysis

The following information is primarily from the second timber supply analysis report, or TSR2. Because a TSR2 AAC determination had not been made at the time this document was prepared, the TSR1 AAC rationale statement is also referenced. Full references are given on page 30. Only information which is relevant to an incremental silviculture strategy is recorded. Key statements are bolded.

Note: Sensitivity analyses in the TSR2 analysis report are compared to an "initial" harvest forecast, not the base case. The base case and the initial harvest forecast differ in only the first 3 decades, with the base case starting harvest level being 80 000 m3/yr below that of the initial harvest forecast. The reported percent change in harvest levels is more or less the same for a sensitivity test that uses either the base case or the initial harvest forecast as a reference point. (analysis2, 31)

Abbreviations: AAC - allowable annual cut; THLB - timber harvesting land base; IHL - initial harvest level; LTHL - long term harvest level; CF - chief forester; TSR - timber supply review.

Species abbreviations: Fd - Douglas-fir; Fdc - coastal Douglas-fir; Hw - western hemlock; Cw - western redcedar; B or Ba - balsam fir.

Site class abbreviations: G - good; M - medium; P - poor.

♦ Harvest Forecast	The starting harvest level is 1.32 million m3/yr, about 15% below the TSR1 AAC of 1.55 million m3/yr. **Significant harvest level reduction of 34%** from the TSR1 AAC of to a mid term shortfall level of 1.02 million m3/yr during the period 20 to 100 years from now, rising to a long term harvest level of 1.20 million m3/yr after 110 years (23% below TSR1 AAC). A variation in the standard harvest flow policy allows declines of 15%; a slower rate of decline would have resulted in a larger reduction in the starting harvest level (analysis2, 23). The mid term period is mostly dependent upon harvesting existing unmanaged stands of younger ages (analysis2, 36), but the proportion of harvesting in second growth stands is increasing steadily (analysis2, 37). Harvesting changes from mostly unmanaged stands to almost exclusively managed stands 105 yrs from the present (analysis2, 22). Under a non-declining harvest flow alternative, the short and mid term harvest levels are the same, starting 30% below the starting harvest level of the "initial forecast." This level is about 10% above the base case mid term level, but about 15% below the LTHL. (analysis2, 32). Avg harvested ages decline rapidly, from just under 300 yrs old at the beginning of the forecast to a long term avg of about 120 years starting only 40 years from now (analysis2, 26). Total growing stock also declines over the first 40 years, rising steadily thereafter (analysis2,24). Avg vol/ha harvested is almost constant at 500 m3/ha. This is because the remaining older timber is on poorer site and of relatively lower volume compared to earlier harvests. Younger stands of higher productivity are replacing these, hence the almost constant avg volume (analysis2, 25).
♦ Age Class	Over 60% of the THLB is in stands less than 60 years of age (analysis2, 13). Nevertheless, the age class distribution is not well balanced, with large areas of second-growth timber concentrated in single (10 -yr) age groups (analysis2, 27).

Over 80% of existing volume is over min harvest ages (analysis2, 14). Poor site stands are harvested in the model in the periods 10-20 yrs and 80 - 100 yrs from now. **Avoiding shortfalls in these periods requires the initial rate of harvest to be reduced in order to save a portion of the existing mature for later harvest.** (analysis2, 23) Most mature timber upon which harvesting will depend in the short term is located on **poor growing sites**, having implications for meeting forest cover constraints.

♦ Forest Cover

General Zone: (all areas not having more restrictive cover requirements) XX% of THLB. Base case requirement of at most 30% of THLB permitted to be < 3 m tall.

Sensitivity test of increasing the constraint by allowing 10% less area to be not greened up. (analysis2, 41)

Relaxation: N/A.

Increase: (-10%, to 20%) Very sensitive. Starting harvest level reduced 17% to a level that can be held for the first 20 years, followed by a drop to the mid term harvest level, one decade earlier than in the initial forecast.

Visual Quality Zones: About the same area is classed as VQO as in the last analysis (25% of THLB now, 28% last time). However, the area under retention VQO has dropped dramatically from 16% to about 4% of the THLB. This change represents current management and is the result of a review of all existing VQO areas. No adjacency sensitivity tests reported. (analysis2, 18) See "Green-up" below, for related sensitivity tests on green-up ages in the VQO zones.

Deer Winter Range: About 13 000 ha or 5% of THLB. Base case requirement of same area of forest older than 100 years of the same forest type as currently exists within each landscape unit being maintained over time. Sensitivity test of ± 50% of area requirement. (analysis2, 44-45)

Decrease: (-50%) Insensitive. Short term harvest level is not dependent upon harvesting the max. area allowed within the deer winter range.

Increase: (+50%) Slight sensitivity over the first 3 decades only (about 2% lower), due to the decreased availability of the existing older stands for harvesting early in the harvest forecast.

Community Watersheds: 4% of THLB. Base case requirement of at most 5% of area could be harvested in a 5 year period. Sensitivity test of ± 2%. (analysis2, 45-46)

Decrease: (-2% to 3%) Starting harvest level reduced about 2%, with levels in decades 2 and 3 about 4% and 6% lower respectively. Mid and long terms 1% lower, due to extending the average age stands become available for harvest to about 167 years (presumably extending them beyond culmination).

Increase: (+2% to 7%) Insensitive. Less than half of the area in community watersheds is old enough for harvesting in the short term, resulting in low dependence in the model upon these forests. Also, **making more forest area available is of little benefit because of the need to reserve some of the existing mature timber to avoid projected future shortfalls.**

Green-up: (analysis2, 40)

General zone - 3m (avg 12 yrs). Insensitive to varying requirements between 2 m (9yrs) and 4.5 m (15 yrs).

VQO zones - 5m (avg 16 yrs) (25% of THLB - analysis2, 18, 40). Slightly sensitive in short term to varying requirements between 4 m (14 yrs) and 6 m (18 yrs). 4 m requirement raises starting harvest level 1% and reduces rate of decline over next 20 years by 1%.

♦ Backlog NSR

Not separately identified. Assume all NSR identified in analysis2 report (p 104) will be regenerated within the next decade and thereby does not warrant modelling.

♦ Quality (deciduous)	• About 10 000 ha of harvestable deciduous types included in the THLB (presumably alder), ¾'s assumed converted to Fdc following harvest. Problems with poor stem form and potential location of these stands in riparian management or reserve zones places some uncertainty over the amount of harvesting that will actually occur in deciduous stands. There has been little, if any, harvesting in deciduous stands under the partitioned AAC.[1] If no harvesting occurs, the starting harvest level must be reduced 2%, with 4% and 6% declines in decades 2 and 3 respectively. Mid and long term levels 4% lower because the conversion from deciduous to higher volume Douglas-fir would not occur. (analysis2, 28) • About 5 600 ha of non-utilized deciduous stands deducted (analysis2, 9) - presumably cottonwood, aspen and birch (analysis2, 90).
♦ Quality (other)	• 943 ha of brush deducted from THLB (analysis2, 9). • 34 256 ha of low productivity sites deducted from THLB (analysis2, 9). (61 444 ha deducted in TSR1). [Opportunity to expand the THLB?]
♦ Biodiversity	• The proportion of the THLB under each draft-biodiversity emphasis falls fairly close to the target of 45% low, 45% medium and 10% high biodiversity. (analysis2, 42) • Old seral (old-growth) guidelines were included in the initial harvest forecast. Adding early seral guidelines (30% younger than 40 years), which have been agreed with MELP to be of lesser importance than old, significantly affects short term harvests, causing an almost 40% (unconstrained) drop starting at year 5 and ending at year 20. Adding mature plus old seral requirements (36% older than 80 years) causes a drop of lesser magnitude and which only lasts for a 5 year period. If all seral stage requirements were applied, timber supply plunges 50% starting in year 6, returning to the "initial harvest forecast" level after two decades. These analyses were included in the report for demonstration purposes only. It has been agreed with MoELP that they will not be applied. The mid to long term is not affected by application of the guidelines. (analysis2, 49-51) • A 3% volume reduction is applied to all yields to account for the timber volume left unharvested in wildlife tree patches, based on the assumption that ¼ of the 12% requirement must be provided by the THLB. (analysis2, 100)
♦ Older Forests	At all times, there is sufficient old growth to meet FPCode biodiversity guidelines (analysis2, 27). See also biodiversity. *Deer Winter Range*: Base case 18 000 ha always older than 100 yrs. Sensitivity test of ± 100% of area. Relaxation: (0 ha) Moderately sensitive short term with 5% increase in 1st 3 decades over base case. Insensitive in mid/long term. Increase: (36 000 ha) Moderately sensitive short term with a decrease of 7% over 1st 3 decades below base case. Slightly sensitive mid/long term.
♦ Min. Harvest Ages	Based on age stands achieve 350 m3/ha and an avg. DBH of 30 cm. Ages range from 50 (good site Dfc) to 170 (poor site H/B). Avg modeled harvest age is older than the minimum due to forest cover objectives and managing for a stable flow over time (analysis2, 38). Sensitivity analyses of ± 10% of ages. (analysis2, 38-39) Decrease: (- 10%) Slightly sensitive. Starting harvest level increased 1%. Same rate of decline thereafter. No effect beyond 4th decade. Increase: (+10%) Moderately sensitive. Starting harvest level reduced 2%. Rate of decline over next 2 decades increased about 2%. Mid term about 2% lower.

[1] Source: MoF Chilliwack Forest District. Hereafter noted in the text as (CFD).

	Decreases availability of stands for harvesting in the short term, which also reduces flexibility for dealing with periodic timber supply shortfalls in the future.
♦ Silvicultural Systems	(From TSR1: Vancouver Region has issued a requirement for harvesting 10% of the overall volume by alternate silviculture systems. However, little performance at the time of analysis.) No indication in analysis2 report as to silvicultural systems. Table on p 102 indicates all areas except hemlock leading are planted. Hemlock leading stands are regenerated using a combination of planting and natural regimes. **All stands are assumed to have their density controlled by free-to-grow** (analysis2, 102).
♦ Estimates of Timber Volumes	VDYP used for all existing unmanaged stands and for all managed deciduous stands. TIPSY used for all managed existing stands (all stands harvested over the last 10 years, Hw stands harvested over the last 20 yrs, Fdc stands harvested up to 30 yrs age) and all stands to be harvested in the future. (analysis2, 14) TIPSY yields about 15% higher than VDYP (analysis2, 23). *Existing unmanaged stand volumes*: Sensitivity test for ± 10% in volume. (analysis2, 36) Increase: (+10%) Starting harvest level increased 3%. Rate of decline in decades 2 & 3 reduced 3%. **Mid term level increased 10%**. Long term insensitive. Decrease: (-10%) Starting harvest level decreased 4%. Rate of decline in decades 2 & 3 increased 4%. **Mid term level decreased 10%**. Long term insensitive. *Managed stand volumes*: OAF1 - 15%, OAF2 - 5% (analysis2, 102). Sensitivity test for ± 20% in volume. Short term insensitive to either. Highly sensitive to both in long term. (analysis2, 37) Increase: (+20%) **LTHL 20% higher** and achieved 30 years earlier, rising 41% 80 years from now. This creates a significant opportunity for commercial thinning. Decrease: (-20%) **Mid term 8% lower** because proportion of managed stands is steadily increasing. **LTHL 20% lower**, extended at the same harvest level as the mid term.
♦ Site Productivity	Estimated site index for all existing old-growth stands were increased about 7 m, which is the maximum potential increase based on recent research. This increased regenerated stand volumes 15%, reduced green-up ages 1 year and reduced min harvest ages by a range of 0 -80 years. Result - short term harvest levels increase 2% due to earlier min harv ages and green-up ages. Mid term about 4% higher (visual estimate from chart). LTHL about 15% higher, due to increased managed stand volumes. Results must be viewed with caution. Further analysis indicates that after this adjustment, the oldest age grouping has the highest site productivity when compared to younger groupings. This is counter-intuitive because the most productive old-growth sites tend to have been harvested first, not last. (analysis2, 43-44)

Summary of Issues by Period

The Fraser TSA is in a process of continuing adjustment to a wide host of significant factors. The THLB was reduced 90 000 ha between the 1984 and 1993 analysis and increased approximately 20 000 ha between the 1993 and the 1998 analysis. Between the 1993 and 1998 analyses several large parks were created, a spotted owl management plan was completed, an inventory audit found the volumes for existing stands 60 years and older were overestimated an average of 23%, and the Forest Practices Code implemented. Offsetting these downward influences on timber supply were:

- the inclusion of 15 000 ha incorrectly excluded from the last analysis, more stands of marginal timber quality, and 10 000 ha of deciduous stands;
- changes in VQO's; and
- reduced minimum harvesting ages due to higher productivity in stands.

There appears to be relatively little opportunity to use incremental silviculture to effect changes upon the short term timber supply. A general strategy would be to focus efforts on minimizing the mid term shortfall and increasing long term harvest levels.

Short Term (1 - 20 years)

In the short term, harvests are still largely in existing older forests (predominantly higher elevation mountain hemlock), with approximately 20% of harvests in this period coming from second growth stands (CFD). Normally, factors which influence the availability of this timber would strongly affect the short term forecast. However, this is somewhat tempered in the Fraser TSA due to the need to reserve some older timber to deal with supply problems later in the forecast. This "reserve" gives the TSA some resiliency with respect to such factors. Nevertheless, the TSA exhibits its strongest downward response to a 10% decrease in the area not allowed below green-up in the general management zone, from 30% down to 20%. In this case the starting harvest level must be decreased immediately by 17%. Increasing partial harvesting or commercial thinning activities would guard against such a drop, should more stringent requirements come into effect. There is still a pronounced effect if existing unmanaged stand volumes are overestimated 10%, but this is less than in previous analysis - partly due to the significantly reduced harvest levels.

Most mature timber on which harvesting will depend in the short term is on poor growing sites. As a consequence, more area must be harvested due to low volumes/ha.

Reclassification of VQO's has resulted in a significant change in sensitivity to forest cover constraints in these areas. In the previous analysis, timber supply exhibited a high sensitivity to changes in adjacency or green-up. In contrast, in the 1998 analysis, harvesting opportunities have been increased in these areas by accounting for factors such as improved harvesting design, the differing ability of areas to "absorb" the visual effects of harvesting, and the level of recreational use in an area (analysis2, 53).

If harvesting does not occur in deciduous stands, short term harvests must be reduced 2%.

Mid Term (21 - 110 years)

Given the current structure and configuration of the timber supply, a mid term shortfall below the long term harvest level is unavoidable. However, the mid term level exhibits a relatively high degree of stability.

The mid term is most sensitive to changes in existing unmanaged stand volumes. Were these volumes to still prove overestimated by 10%, a 10% lower mid term supply would result.

A 10% increase in unmanaged existing stand volume estimates increases mid term harvests by about 10%. The abundance of existing stands suitable for fertilization presents an opportunity to increase supplies during this period. In hindsight, many areas spaced in earlier decades were spaced to densities too low to allow for commercial thinning activities in the early part of this time period. The higher spacing densities of more recent spacing will enable commercial thinning in the later part of this time frame.

In the analysis, a 20% increase in managed stand volume estimates results in a shortening of the mid term period by 3 decades and a dramatic 41% rise in a single decade (a proverbial "wall of wood"). Clearly, if a 20% gain can be realized, there is a significant opportunity to bring

the harvest of some of these second growth stands forward in time through spacing and commercial thinning practices to help mitigate the mid term shortfall.

If harvesting does not occur in deciduous stands, mid term harvests must be reduced 4%, largely because the modeled conversion of ¾'s of these stands to Douglas-fir would not occur.

Long Term (110 + years)

The long term is most sensitive to changes in the yields of regenerated stands. This sensitivity is virtually on a 1:1 ratio; for every 1% increase or decrease in regenerated stand volumes there is a corresponding 1% increase or decrease in the LTHL.

If harvesting or non-harvest stand conversion does not occur in deciduous stands, long term harvests must be reduced 4%, largely because the modeled conversion of ¾'s of these stands to Douglas-fir would not occur.

Future

The future of this timber supply area now appears relatively stable.

Incremental Silviculture History

Approximately 2 500 ha are harvested annually (analysis2, 25).

Treatment	TSR1 Status (1994)		Current Status (1998)
	Incorporated in Timber Supply Analysis	**Not Incorporated in Timber Supply Analysis**	Source: CFD[2]
♦ Backlog	All NSR is assumed restocked within the first 10 years (analysis2, 104).		There is about 2 500 ha of backlog NSR, about 300 of which require planting.
♦ Conversion	¾'s of the 10 000 ha of harvestable decid assumed converted to Fdc (analysis2, 51).		Approximately 80ha/yr. are currently harvested from this profile and there is little potential to harvest more annual volume here. Since 1990 there has been virtually no non-harvest stand conversion.
♦ Commercial Thin			Little performance to date. Current market conditions are not conducive, and few stands have been of suitable age.
♦ Space	Stands have had density control as follows (analysis2, 103): Species % spaced at ages 1-10 11-20 21-30		An average of 1 250 ha/yr have been spaced over the last 10 years.

[2] CRFD - Chilliwack Forest District

Treatment	TSR1 Status (1994)				Current Status (1998)
	Incorporated in Timber Supply Analysis			Not Incorporated in Timber Supply Analysis	Source: CFD[2]
	Fdc	100	100	100	
	Hw/Ba	100	100		
	cedar	100			
	pine/larch	100			
	spruce	100			
	To reflect this management, these stands are assigned TIPSY yields.				
♦ Prune					Approx. 500 ha/yr pruned from 1991 to 1997 inclusive.
♦ Fertilize					Approx. 1 400 ha/yr fertilized from 1992 to 1996 inclusive. None in 1997.
♦ Space/ Prune				Combinations not indicated.	Only spaced stands are pruned.
♦ Space /Fertilize				"	Generally, only spaced stands are fertilized.
♦ Space/ Prune/Fert				None indicated.	This is a common regime in this TSA.

Higher Level Goals and Objectives

This section documents higher level goals and objectives relevant to an incremental silviculture strategy for the TSA.

Provincial Goals

Fundamentally, government's goals can be characterized as:

- sustainable use;
- community stability; and
- a strong forest sector. (MoF, 1998a)

Provincial Objectives

Until provincial targets for timber quantity and quality are established, management unit strategies are to consider the following interim provincial strategic objectives (MoF, 1998a). Incremental silviculture strategies must also be in keeping with higher level plans under the Forest Practices Code.

Objective 1: Maintain current harvest levels as long as possible without creating disruptive shortfalls in future timber supply.

Objective 2: Create a long term timber supply capable of supporting a steady long term provincial harvest level similar to current levels.

Objective 3: Minimize the interim shortfall in provincial harvest anticipated before a steady long term timber supply is achieved.

Objective 4: Create a long term timber supply which will enable the timber quality profile of future harvests to be optimized in the context of stands, site productivity and funding available.

It is recognized that not every management unit has the same capability to contribute to these interim objectives. Further, it is recognized that the land base's to achieve these objectives is expected to outstrip current and projected funding levels. Their purpose is to provide general guidance to the application of available funds.

Regional Objectives

The objectives of the regional incremental silviculture strategy are to:

- Ensure a long term sustainable harvest which approximates the current harvest value and volume levels and that produces a diversified mix of products necessary to create and maintain sustainable forest employment.
- Balance treatments that enhance growth and yield such as fertilizing, spacing and forest health activities with those that increase the value of the wood such as pruning.
- Utilize incremental silviculture treatments to contribute to sustainable management of non-timber values at the landscape level. (MoF, 1998b)

Opportunities to Increase Timber Supply

The Fraser TSA has limited opportunity to increase short term timber supply but substantial opportunity in the mid and long terms. Fertilizing stands scheduled for harvest in the second decade offers some potential to increase the volumes harvested from them. Unfortunately, fertilization opportunities are limited because much of the harvesting in this time frame is in older, high-elevation hemlock stands. In the mid and long terms, a general strategy of increasing younger existing stand and managed stand volumes, together with making this volume available for earlier harvest through spacing and/or commercial thinning, will help mitigate anticipated reduced harvest levels in these periods.

Opportunities Indicated Through TSR Sensitivity Analyses

TSA modelling in support of planning incremental silviculture has not yet been undertaken. In its absence, sensitivity analyses from the **TSR2** analysis report are the best source of information as to the opportunities for incremental silviculture to increase future timber supply. The following are selected sensitivity analsysis charts from the **TSR2** analysis report, to which opportunity information is added. Detailed analyses are required to confirm the indicated effects.

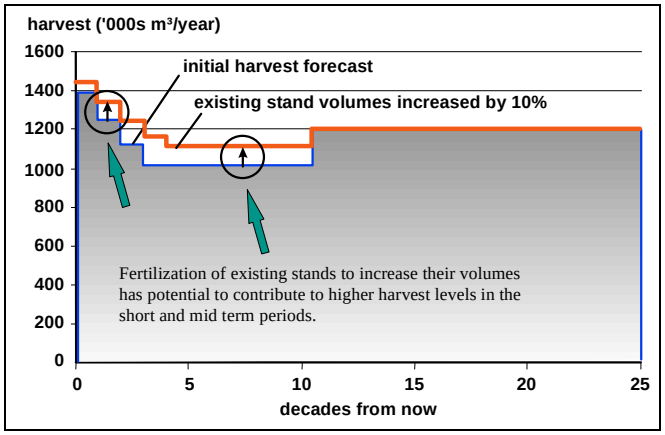


Figure 1. Changes in existing stand volumes, Fraser TSA

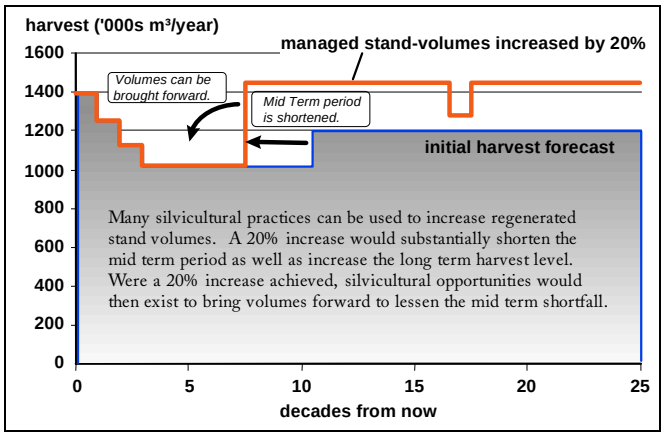


Figure 2. Changes in regenerated stand volumes, Fraser TSA

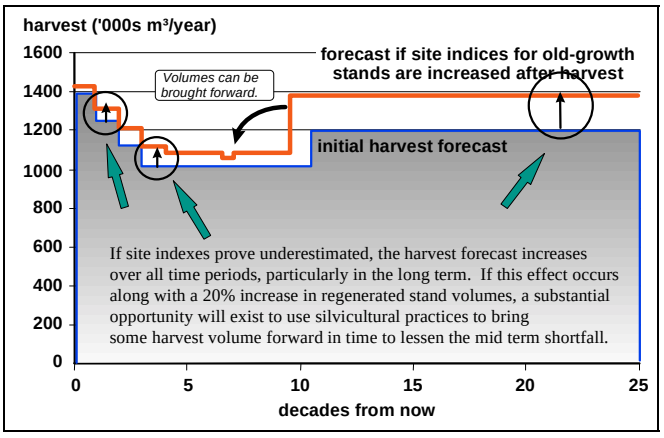


Figure 3. Changes in old growth site indexes, Fraser TSA

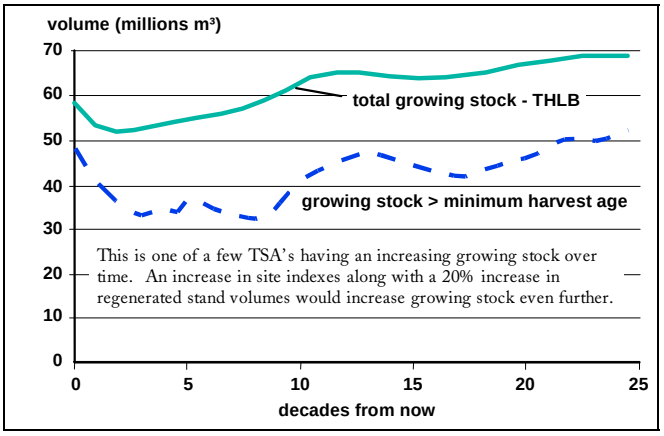


Figure 4. Changes in growing stock, Fraser TSA

Preliminary Identification of Silviculture Opportunities

Information in the previous sections indicates the following silvicultural strategies may have potential to increase future timber supply. Each of the potential strategies was discussed in detail in the district working session, the results of which are recorded in "Potential Strategies by Response Time Frame," page 13, along with additional strategies that arose during the meeting. Strategies that are ultimately adopted are noted in "Silviculture Strategies," page 24.

♦ Short Term (1 - 20 yrs)

ST 1: achieve green -up 2 years earlier through a variety of actions;

ST 2: fertilize all suitable stands scheduled for harvest in the 2nd decade to increase their volumes.

ST 3: overcome adjacency limitations by implementing partial harvesting/CT regimes in VQO zones.

ST 4: Complete site index and existing stand volume estimation studies.

♦ Mid Term (21 - 160 yrs)

MT 1: fertilize all suitable existing stands scheduled for harvest 20 to 80 years from now to increase their volumes.

MT 2: increase the volume of regenerated stands by 20% through a variety of actions.

MT 3: move volume forward from the long term to the mid term by using CT/fertilization regimes commencing in about 50 years (has implications for today's spacing regimes).

♦ Long Term (161+ yrs)

LT 1: increase the volume of regenerated stands by 20% as in MT 3 above.

Available Information Regarding Potential Treatments and Treatable Area

This section summarizes available information directly relevant to the potential treatments for the TSA.

Treatment	Comment/Potential Treatment Regime	Treatable Area
♦ Fertilization	Approximately ¼ of poor, all medium, and ¼ of good site Fdc stands are suitable for fertilization. To date, hemlock response to fertilization has proven variable. Increasing the fertilization program may present opportunities to: • increase long term timber supplies; • offset mid term falldown and reductions in long-term timber supply if forest cover constraints become more restricting in the future; • when combined with thinning or commercial thinning, improve volumes in stands to bring them to merchantable size earlier; • assist in meeting requirements for mature forest cover and for achieving old-growth characteristics earlier.	Approximately 40% of forests in the THLB have Fdc as the leading species. Approx. 65% of the THLB is in the desirable site class range for fert. Assuming the distribution of sites is equal across all species, approx. (.4 X .65 X 100) 26% of the THLB may be suitable for fertilization.
♦ Spacing	Spacing has been applied in younger existing stands, therefore managed stand yields are applied to these stands in the analysis. There is debate in professional circles regarding the benefits of spacing. However, actual stand measurements of trials at Shawnigan Lake, as opposed to modeled projections, are showing increases in mean diameters with little or no loss in total volume, 24 years after treatment.	
♦Conversion	1. Timber supply analysis assumes ¾'s of deciduous forest types will be converted over the long term to good site Fdc. 2. Opportunity to rehabilitate brush areas not addressed in	Harvestable area estimated to 1000ha. And other treatable areas estimated to be 3500 ha. .

Treatment	Comment/Potential Treatment Regime	Treatable Area
	TSR, however there is relatively little area of brush, some of which no doubt contributes to wildlife habitat objectives.	943 ha brush
♦ Commercial Thinning	Little performance to date. Offers some potential to increase short term harvest levels by overcoming adjacency constraints. Offers mid-term potential when combined with an aggressive program to increase regenerated volumes.	Approx. 17% or 48 000 ha of forests in the THLB are 41-80 years old and may be candidates for commercial thinning. Fraser TSA is almost 100% roaded, giving a high degree of stand access.
♦ Backlog NSR	Current back log of 2060 ha. will be regenerated within first half of the first decade.	

Potential Strategies by Response Time Frame

Explanatory notes with respect to the following tables.

Column Number	Note
1	The response time frame is the period in which the anticipated result is expected, not the period in which actions must necessarily commence.
2	Strategy numbers correspond with the numbers recorded earlier in "Preliminary Identification of Silviculture Opportunities," page 11. Items followed by an asterisk (*) were added during the district working session.
3	Information is largely from a meeting of ministry personnel and forest licensees held July 22 & 23, 1998, (the "district working session") combined with information presented earlier in this document.
4	Anticipated results are typically calculated using the timber supply response indicated by **TSR2** sensitivity analyses.
5	The harvest forecast for the short term uses the TSR2 initial harvest level (1.32 million m3/yr) as the starting level in the first decade, and this level less 15% for the 2nd decade (as per the TSR2 base case). Mid and long term harvest forecasts take the base case levels from the **TSR2** analysis report as their starting levels. The harvest forecast column was not thoroughly reviewed during the district meeting. *Results are largely conjecture and are meant to illustrate the potential of the strategies.*

In the TSR1 AAC rationale, the chief forester identified a number of potential downward influences on timber supply. Some of these are now incorporated in the TSR2 analysis. For those that are not, for the purposes of this strategy a status quo is assumed. Should any arise, the following strategies would serve to mitigate their effects rather than increase timber supply.

Response Time Frame	Potential Strategy/Action	Current Status	Anticipated Result	Harv Forecast (000 000s m3/yr)
♦ Short Term (1 - 20 yrs)	1. Achieve green-up 2 years earlier in the VQ zones by: (a) Planting large genetically improved stock; (b) reducing regeneration delay 1 yr;*[3] (c) brushing for growth enhancement;* and/or (d) spacing and fertilizing suitable regenerated stands in VQ zones.	1. (a) Approx. 90%+ of harvested areas are planted. All Fdc and S seed is "A" class. 1st gen seed has 3-5% yield gain, but effect on earlier green-up is unknown. Assume 1 yr. (b) The TSR2 analysis uses regen delays of 2-3 yrs for all species except for H/B poor site, which is 4 yrs. Licensees plant w/in 1 yr of harvest. MoF small business is longer due to unknowns of when sale holders will harvest. Not much room for improvement. (c) Brushing is currently for survival - unlikely to change w/in current funding structure, but could offer opportunity to reach green-up sooner. Assume 1 yr. (d) Spacing would have little effect on green up as trees are not in serious competition for much of this time. Some potential for fertilization at time of planting (not presently eligible for FRBC funding and not likely to be voluntarily undertaken unless necessary to achieve FG), as well as post FG / pre 5 m green-up (which can be funded by FRBC). See MT3. Assume 2 yr reduction in ages for 5 m greenup. The above indicates that, on the whole, a 2 yr earlier green-up is attainable.	1. Timber supply analysis indicates a 2 yr earlier green-up yields an approximately 2% increase in harvest levels in the 2nd decade. Assume 2 yr earlier green-up can be achieved on ½ of areas (0.5 X 2%) ⇒ 1%.	1.32 1st dec. 1.12 2nd dec. 0.01 grn-up 0.01 fert 1.14 total
♦ ST 2	2. Fertilize all suitable stands scheduled for harvest in the 2nd decade.	2. Target stands are Douglas-fir ¼ P, all M and ¼ G site, currently aged 41-80 yrs and having suitable density. TS analysis predicts 20% of stands harvested in 2nd decade will be age class 3 & 4. A net down of suitable stands indicates **250 ha/yr could be fertilized**.	2. Approx 10% of stands planned for harvest are treatable (250 ha suitable/2500 avg area harvested). Assume 5% gain (0.1 X 0.05 =0.005%) ⇒ ≅ 1% overall.	

[3] * Indicates potential strategies that were raised in the district working session.

Response Time Frame	Potential Strategy/Action	Current Status	Anticipated Result	Harv Forecast (000 000s m3/yr)
♦ ST 3	3. Implement partial harvesting regimes in VQO zones.	3. Limited partial harvesting currently taking place. Visual quality zones are being avoided but also current harvesting is in older high elevation stands which are not necessarily in the VQO zone. Partial harvesting will likely increase when there is no alternative to harvesting in areas limited by forest cover constraints. Effect of CT of current age class 3 & 4 is not possible to tell without modelling. If it is in stands slated for clearcutting that can't otherwise be logged due to forest cover constraints, then this would allow some short term harvest, capture mortality, and postpone the remaining stand volumes to the mid term. This would be good for the MT. On the other hand, if the stand is slated for harvest in the MT, CT would transfer volume from mid term to short term, making the mid term shortfall worse. In either event, post CT fertilization would help increase total volume recovered. **Program level estimated at 150 ha/yr.**	3. No TSR info available on which to make an estimate of possible increase. However, more partial harvesting would guard against a severe indicated decline (-17%) which would occur were current standards to be tightened by 10%. Modelling required.	
♦ ST 4	4. Complete site index estimation studies.	4. Studies are currently underway. The need for their completion is noted under "Summary of Information and Research Needs," page 25.	4. Not factored into this harvest forecast. Studies may prove neutral.	
♦ Mid Term (21 - 110 yrs)				
♦ MT 1	1. Repeat fertilize all suitable existing stands scheduled for harvest 20 to 80 years from now to: (a) raise existing stand volumes; and	1. (a) No fertilization at present because FRBC is not funding. Suitable stands are spaced Fdc, ∴limited to stands aged 30 yrs or less. Approx. ¼ P, all M and ¼ G site show good response. About 45 000 ha meet this criteria. **A program of 3 000 ha/yr (of 5 000 available based on a 7 yr return cycle) in age classes 1 & 2 is required**. (See ST 2 re fertilization of age classes 3 & 4). (b) TSR 2 indicates little sensitivity to a 10% reduction in	1. (a) 45 000 ha constitutes 1/3 of the area harvested in the period 20 to 80 yrs from now (60 yrs X 2 500 ha/yr = 150 000 ha; 45/150 = 1/3). Assume 10% volume gain from repeat fert. (.33 X .1) ⇒ 3% increase. (b) N/A	

Response Time Frame	Potential Strategy/Action	Current Status	Anticipated Result	Harv Forecast (000 000s m3/yr)
	(b) lower min harvest ages by 10% (CT required prior to fert?).	minimum ages (1%/decade lower rate of decline, no change to base case shortfall level). Not a consideration.		
♦ MT 2	2. Increase regenerated stand volumes 20% by:	2.	2.	
	(a) reducing time to regeneration;	(a) See ST 1. It does not appear possible to reduce regen delays further.	(a) N/A	
	(b) using A class seed or better;	(b) 90%+ of harvested areas are planted. All Fdc and S seed is "A" class. Latest estimates of yield gains are (%):[4] Species — 1st gen — 2nd gen Doug-fir — 3-5 — 15 Hemlock — 3 — 20 Cedar — 3 — 10 Yield gains were not included in TSR 2.	(b) Provided 2nd gen seed is produced in the near future a 10 - 20% increase can be anticipated. Conservative estimate ⇒ 10%	
	(c) using large planting stock;	(c) Basic silviculture item. Larger stock could be used but not likely in current economic conditions.	(c) No estimate available of the potential. Could potentially take 2 years off an 80 yr. rotation. 2/80 ⇒ 3%	
	(d) managing stocking to reduce voids 5%;	(d) Voids can be desirable for wildlife habitat. Guesstimate that intensive void management could be practiced on ½ of areas. Current free growing requirements will result in < 15% in voids, however amount is unknown as must also account for area not in the net area to be reforested (other than allowable roads & landings) and for voids that open up later on. The need for completion of surveys for voids is noted under "Summary of Information and Research Needs," page 25.	(d) If practiced on ½ of areas and voids reduced by 5% = .5 X .05 ⇒ 3%	
	(e) fertilizing regenerated stands where efficacy is proven.	(e) Licensees do not currently fertilize seedlings at time of planting. Not likely to fertilize prior to FG w/o funding assistance. Post FG could be done with FRBC funding, however no funding in 1997. Stands could fall under extension of the program under MT 1	(e) See MT 1. Ultimately 20% of the THLB could be repeat fertilized. Assume 10% gain (.2 X .1) ⇒ 3%. Unknown if effects are additive or	

[4] Source: participants at district meeting.

Response Time Frame	Potential Strategy/Action	Current Status	Anticipated Result	Harv Forecast (000 000s m3/yr)
		after portions of existing age class 1 & 2 are harvested. Also overlaps with MT 3 (b) below.	perhaps compounded. Increased site productivity may further compound these effects. On the whole, a 20% increase appears possible to achieve. Sensitivity analysis indicates the effect of a 20% increase in regen stand volumes is to shorten the mid term period by 3 decades- ends at 80 vs 110 years.	
♦ MT 3	3. Bring forward volumes from the long term into the mid term to reduce the mid term shortfall by using spacing, CT &/or fertilizing regimes. Three possible regimes. (a) Existing or newly regenerated, unspaced, post-FG, Fdc and (i) suitable for CT; or (ii) not suitable for CT. (b) Fertilize suitable existing spaced Fdc stands 30 yrs or less in age. These stands unsuitable for CT. (c) Space all suitable post FG stands to bring forward harvest into mid term.	3. Other than as a partial harvesting method for overcoming adjacency limits (see ST 3) CT will be a future action commencing in a significant way about 40 years from now. Planning ahead for this has implications for current spacing and fertilization programs. Timberline study indicates substantial possibility. (a) (i) Regime would be space/ fert/ CT/ fert/ fert. Estimate 5% of annual area harvested over the next 20 yrs (125 - 150 ha/yr) suitable for this regime (netted down for cutting mostly in Hw and for suitable site classes). (ii) Regime would be space and fert. The total of the two regimes requires an **annual spacing program of 840 ha/yr**. See regime table for more detail. (b) Overlaps with MT1& MT 2. (c) Requires an **annual spacing program of 420 ha for Hw and 140 ha for other species**. See regime table for more detail.	3. Requires modelling. In general, need to have more precise information as to where species and age groups lie in the harvest queue. Assume volume brought forward = 10% of MT base case level.	1.02 base 0.03 Fert 0.10 br fwd 1.16 total end mid term shortfall at 80 yrs vs 110.

Response Time Frame	Potential Strategy/Action	Current Status	Anticipated Result	Harv Forecast (000 000s m3/yr)
♦ MT 4	5. Conduct extensive fertilization trials in hemlock stands.	5. No fertilization currently taking place. Identify characteristics of hemlock stands that show a fertilization response so treatable area can be expanded. Noted under "Summary of Information and Research Needs," page 25.	5. N/A	
♦ Long Term (110 + yrs)	1. Increase regenerated stand volumes 20% by continuing MT 3. 2. Root rot management in Doug-fir?? 3. Plant 300 ha of backlog NSR and maintain 225 ha of backlog plantations through brushing.	1. See MT 3. 2. (Not adequately discussed in district meeting.) 3. This will eliminate all backlog.	1. On the whole, a 20% increase appears possible to achieve. Sensitivity analysis indicates the effect of a 20% increase in regen stand volumes is to increase LTHL by 20%. 2. N/A 3. N/A. Impacts already included in the TSR base case.	1.20 base 0.24 rgn vol 1.44 total 0.10 transfer to mid term over first 5 decades. decade vol 8 1.34 9 1.34 10 1.34 11 1.34 12 1.34 13 1.44 etc.

Potential Harvest Forecast

Figure 5 graphs the potential harvest level that may be attained through implementation of the silvicultural strategies in the preceding tables. This forecast is highly speculative and requires confirmation through computer-based modeling and analysis. It also includes silvicultural activities that are not within the traditional scope of incremental silviculture. Modeling may indicate more precise timing, targeting and program levels associated with incremental silviculture activities than could be developed in this interim strategy.

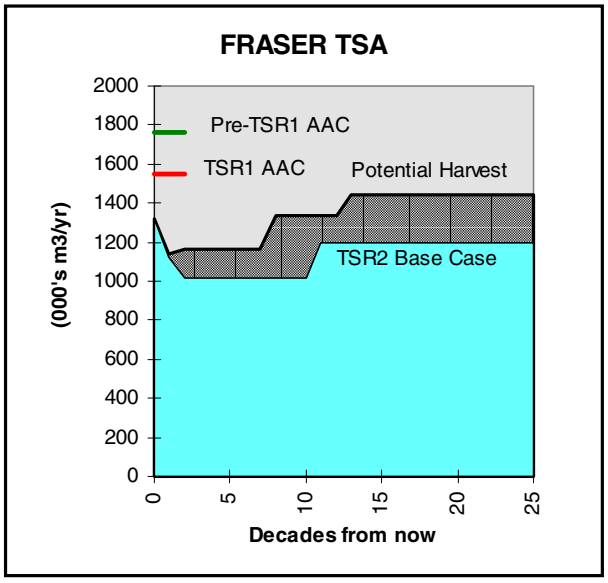


Figure 5. Potential harvest forecast, Fraser TSA

Opportunities to Improve Timber Quality

The effects of incremental silviculture on the future quality of the timber resource were not analyzed in either TSR1 or 2. Information in this section was gathered during the district working session.

Product Objectives

The following are simplified product objectives used for the purpose of this analysis. Comprehensive site specific product regimes can be found in the Chilliwack Forest District Enhanced Forest Resource Management Plan - Interim Approach.

Quality Class	Species	Characteristics
Premium Log:	Douglas-fir, clear, pruned	45+ cm min DBH, pruned, min 5 m log.
	Douglas-fir, large timber	45+ cm min DBH, unpruned.
	Hem/Bal/Spruce, large timber	45+ cm min DBH, unpruned.
	Cedar, large timber	45+ cm min DBH, unpruned.

Sawlog: Minimum average stand DBH of 30 cm and min. stand vol. of 350 m3/ha. A large timber log is presently 55 - 60 cm, however, is expected to decrease to 45+ cm in the future.

Available Information Regarding Potential Treatments and Treatable Area

Treatment	Comment/ Potential Treatment Regimes	Treatable Area/
♦ Spacing		
♦ Commercial Thinning	Not current practice.	
♦ Pruning	Substantial amount of pruning done in TSA.	
♦ Space/ Prune		
♦ Space/ Prune/Fert		
♦ Other		

Potential Strategies by Response Time Frame

The following strategies have potential to increase timber quality. These were identified in the district working session. The response time frame is the period in which the anticipated result is expected, not the period in which actions must necessarily commence.

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result	Premium Log Forecast
♦ Short Term (1 - 20 yrs)	None	Short term harvests will come from existing very old stands which are not treatable to improve quality.	Quality profile of existing old growth will prevail. Assume this is equal to a recent coast-wide estimate of 15%.	15%?
♦ Mid Term (21 - 160 yrs)	Q1. Prune 250 ha/yr in 2 lifts to yield a 5 m log.	1. Normal regime is to prune in 2 lifts to 5.5 m, Dfc good and medium site only. Requires a total program of 500 ha/yr - **250 1st lift and 250 2nd**. Currently, species and age class distributions limit treatable area; could go higher in the future.	1. 250 ha is approx 10% of annual area harvested. Assume 5 m log is 20% of tree vol. (.10 X .20) ⇒ 2%.	2% clear log content.
	Q2. Manage for large dimension timber through spacing 1400 ha/yr and prepare stands for fertilization and pruning.	2. Avg. annual area harvested = 2 500 ha % > 50 cm is from TIPSY stock table, rounded to nearest 5%. Bottom 5m log = 20% of tree vol. % large = (Area/2500) X (% > 45 cm) X (20% of tree vol.)	2. 8% premium log content, 5% from spaced stands and 3% from unspaced stands.	8% premium logs, ¼ of which will be clear (or 2% of total future vol.)
♦ Long Term (161 + yrs)	As above.	As above.	As above.	8%

Species	SI	Cul Age	Space frm/to:	Area	% > 50cm	% large
Fdc	30	80	1200/700	840	50	3
			unspaced	160	35	0
Hw/othr	27.5	100	4000/800	560	55	2
			unspaced	940	40	3
Total				2500		8

Timber Quality Forecast

The foregoing analysis indicates the premium log content of harvests in the mid and long term will be lower than today's levels (8% forecast vs. current estimate of 15%). Also, a large timber log is presently 55 - 60 cm, however, is expected to decrease to 45+ cm in the future.

A higher level of pruning program than currently planned would serve to improve future timber quality, however, there is a current lack of treatable stands due to species and age distributions. Postponing harvest to ages that are past culmination age would increase the large dimension component of premium logs. However, this is unlikely, given the need to maintain sawlog volumes.

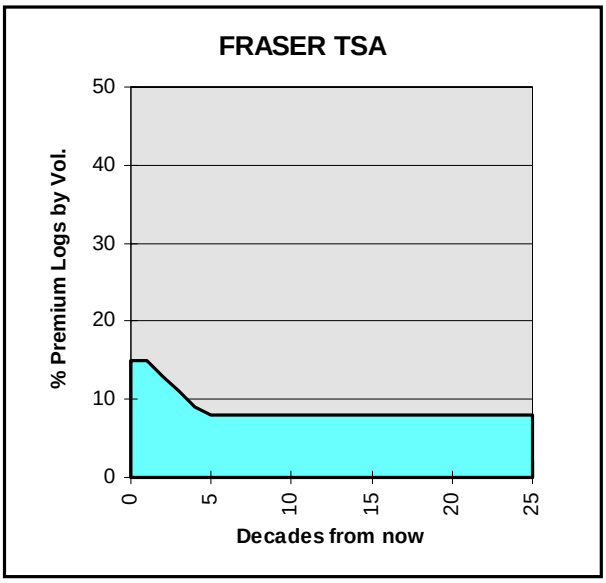


Figure 6. Potential Quality Forecast, Fraser TSA

This quality forecast is for large dimension premium logs. Approximately ¼ of these will be clear logs, or 2% of entire volume.

Incremental Silviculture Strategy

This section synthesizes the preceding background information and analysis into an incremental silviculture strategy for the TSA.

General Strategy

The Fraser TSA has limited ability to overcome forecast reductions in timber supply in the mid term. Long term timber supply, however, has the potential to be brought back to near current levels. Central to increasing future timber supply is the use of 2nd generation or better improved seedlings. Ensuring future timber quality is particularly important, given the indicated trend toward lower premium log harvest levels in the

future. Spacing is needed to increase piece size, reduce future harvesting costs, and prepare stands for pruning. Pruning is needed to ensure at least a minimal level of premium clear logs in the future.

Working Targets

The preceding analysis indicates the following working targets are attainable. Figure 7 illustrates these.

WT 1 (Quantity): Manage mid-term timber supplies to yield a harvest of approximately 1.16 million m3/yr and long term supplies to yield 1.44 million m3/yr.

WT 2 (Quality): Manage regenerated stands to yield at least 8% premium logs by volume, with the majority of the remainder being of sawlog quality.

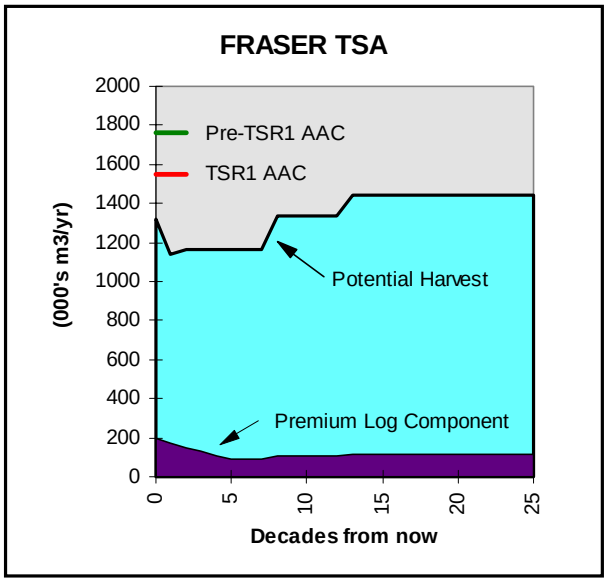


Figure 7. Combined Potential Quantity and Quality Harvest Forecasts, Fraser TSA

Log Product Objectives

The following are simplified product objectives used for the purpose of this analysis. Comprehensive site specific product regimes can be found in the Chilliwack Forest District Enhanced Forest Resource Management Plan - Interim Approach.

Quality Class	Species	Characteristics
Premium Log:	Douglas-fir, clear, pruned	45+ cm min DBH, pruned, min 5 m log.
	Douglas-fir, large timber	45+ cm min DBH, unpruned.
	Hem/Bal/Spruce, large timber	45+ cm min DBH, unpruned.
	Cedar, large timber	45+ cm min DBH, unpruned.
Sawlog:	Minimum average stand DBH of 30 cm and min. stand vol. of 350 m3/ha.	

A large timber log is presently 55 - 60 cm, however, is expected to decrease to 45+ cm in the future.

Silviculture Strategies

♦ Strategies to Increase the *Quantity* of Future Timber Supply

The following strategies have identified potential to increase the quantity of the timber supply of the Fraser TSA. (Strategy numbers correspond with those recorded earlier.)

No.	Strategy
ST1	Achieve green-up 2 years earlier in VQ zones by: (a) planting large genetically improved stock; (c)brushing for growth enhancement; and (d) fertilizing regenerated stands to increase their growth. (Note: Some of these are pre free growing silviculture activities, not within the traditional scope of incremental silviculture. Where licensees can meet their free-growing obligations without undertaking such activities they are not likely to voluntarily undertake them due to the extra cost. In such cases, funding assistance would likely be necessary.)
ST2	Fertilize 250 ha/yr of Douglas-fir stands scheduled for harvest in the 2nd decade.
ST3	Implement partial harvesting / commercial thinning regimes in VQ zones, fertilizing 150 ha/yr post CT. (Effects require modelling.)
MT2	Repeat fertilize approximately 45 000 ha of Douglas-fir stands on an annual program of 3 000 ha/yr to raise mid term harvest volumes.
MT3	Increase regenerated stand volumes 20% by: (b) using (2nd generation) A class seed or better; (c) using large planting stock; (d) managing stocking to reduce voids 5%, and (e) fertilizing suitable regenerated stands (by extension of MT2). (Note: some of these are pre free growing silviculture activities. Licensees will not

generally do them if free growing obligations can be achieved without it. (In such cases, funding assistance would likely be necessary.)

MT5 Space 1 400 ha/yr of Douglas-fir, hemlock and other stands to either set up for commercial thinning or to bring forward harvest the harvest of stand from the long term into the mid term.

LT1 Increase regenerated stand volumes 20% by continuing MT3 above.

LT3 Plant 300 ha of backlog NSR and maintain XX ha of backlog plantations through brushing.

Tree improvement is critical to achievement of a number of the preceding strategies.

♦ Strategies to Increase the *Quality* of Future Timber Supply

The following strategies have identified potential to increase the quality of the timber supply of the Fraser TSA.

No.	Strategy
Q1	Prune 250 ha/yr to 5.5 m in two lifts (requires and annual program of 500 ha) to produce 2% clear wood in long term harvests.
Q2	Space 1 400 ha/yr to increase average piece sizes and prepare stands for fertilization and pruning. (The spacing program under strategy MT5 above will contribute to this strategy. The dual objectives of increased piece size and earlier harvest may be conflicting. Modelling is required to determine the best balance.)

♦ Strategies to Increase the *Quantity* or *Quality* of Future Habitat Supply

Upon completion of the Northern Spotted Owl Resource Management Plans there may be the opportunity to space 250 ha of age class 1 and 2 stands and fertilize 100 ha of age class 1 to 4 stands, as part of a regime to create spotted owl habitat. However, until the plans are finalized these are will not be the focus of investment related incremental forest management activities because of the uncertainty of future harvest potential.

Summary of Information and Research Needs

During the assessment process, the following needs for further information and research became apparent. The outcome of these have implications for an incremental silviculture strategy. Bracketed numbers refer to the strategy numbers under which the need is identified (see tables in “Potential Strategies by Response Time Frame,” page 13.

1. Old growth site index estimation studies require completion. It is anticipated that site indexes may be underestimated. (MT1)
2. OAF 1 factor of 15% requires confirmation. Survey techniques are available. Requires statistical validity at the management unit level if to be used for AAC determination. (MT3)

3. Hemlock response to fertilization is variable. Were the causes for this determined there may be considerable potential for hemlock fertilization to improve the harvest forecast. (MT5)

Silviculture Regimes and Investment Priorities

The following table indicates incremental silviculture regimes which are suitable to attaining the above working targets and strategies.

Regime Table, Fraser TSA, August 1998

Regimes	Strategy	Opportunity Area (Ha/Yr)	Timber Supply Effects Short	Medium	Long	Quality	1st Nations	Fish	Wildlife	VQO	Jobs Days/ha	Direct Cost $/ha[1]	Priority Ranking MoF	MoE	1st Nat	Ind	ALL
Backlog																	
1 Survey		8000	0	0	+	0	0	0	0	0	0.1	100	1	2	2	1	
2 establishment	LT3	150	+	0	+	0	0	+	+	+	2	1500	1	2	2	1	1
3 maintainance	LT3	260	0	0	+	0	-	-	-	0	0.3	500 (700)	1	6	6	1	
Stand conversion																	
4 surveys		500	0	0	+	0	-	-	-	-	0.1	100	1	7	7	1	5
5 Non-harvest treatment		200	0	0	+	0	-	-	-	-	5	1000 (1500)	1	7	7	1	
Spacing																	
6 surveys		3000	0	0	+	0	0	0	0	0	0.1	100	3	2	1	5	
7 Fdc Sl 23+ no CT	MT4, Q2	840	0	+	0	+	0	0	+	0	5	600 (1400)	4	2	1	5	
8 Fdc Sl 23+ CT >1500 to 600-800	MT4, Q2		0	+	0	+	0	0	+	0	5	600 (1400)	3	2	1	5	3
9 Hw Si 28+ >3000 to 700-750	MT4, Q2	420	0	+	0	+	0	0	+	0	5	1000 (1500)	7	4	1	6	
10 Hw Si 23-27 >3000 to 700-900	MT4, Q2		0	+	0	+	0	0	+	0	5	1000 (1600)	7	4	1	6	
11 Other	MT4, Q2	140	0	+	0	+	0	0	+	0	5	1000 (1700)	8	4	1	6	
Pruning																	
12 surveys		500	0	0	+	0	0	0	0	0	0.1	100	4	5	4	5	
13 Fd leading 1st	Q1	250	0	0	0	++	0	0	0	0	8	1000 (1800)	4	5	4	5	4
14 Fd leading 2nd	Q1	250	0	0	0	++	0	0	0	0	10	1500 (2100)	4	5	4	5	
Fertilization																	
Fd Sl 23-30, moisture >1 <6																	
15		4000	0	0	+	0	0	0	0	0	0.1	100	2	3	5	2	
16 Age class 1 & 2	T1, MT2,3,4, LT	3000	0	+	+	+	+/-	+/-	+/-	+	0.1	200 (300)	3	3	5	4	2
17 Age class 3 & 4 post ct	ST3	150	0	+	+	+	+/-	+/-	+/-	+	0.1	200 (300)	2	3	5	3	
18 Age class 3 & 4 normal harvest	ST2	250	+	0	0	+	+/-	+/-	+/-	+	0.1	200 (300)	2	3	5	2	
Owl Habitat Enhancement																	
19 space age class 1 & 2	H1	250	0	+	+	0	0	0	+	+	5	600 (1000)	?	1	3	?	?
20 fertilize age class 1-4	H1	100	0	0	0	0	+/-	+/-	+	+	0.1	200 (3000)	?	1	3	?	

1 Direct costs are pre-NEWFO with NEWFO costs in parentheses

? Without owl RMP cannot rank against other priorities

Incremental Silviculture Program

The following annualized program will contribute to achieving the above goals and strategies.

Program Table - Ha, Fraser TSA, August 1998

Year	Surveys*	Backlog Planting	Backlog Brushing	Backlog Conversion	Space Df leading	Space Hw leading	Prune 1st lift	Prune 2nd lift	Fertilize	Owl Habitat Space	Owl Habitat Fertilize
1	12,500	100	250	50	420	400	250	300	800	-	-
2	16,500	100	200	100	740	520	250	250	2,000	?	?
3	12,500	100	200	100	740	520	250	250	3,400	?	?
4	9,500	-	100	200	740	520	250	250	3,400	?	?
5	9,500	-	100	200	740	520	250	250	3,400	?	?
Subtot Yr 1 - 5	60,500	300	850	650	3,380	2,480	1,250	1,300	13,000	?	?
6 - 10	60,500	-	500	1,000	3,380	2,480	1,250	1,300	13,000	?	?
Total Yr 1 - 10	121,000	300	1,350	1,650	6,760	4,960	2,500	2,600	26,000	-	-
Unit cost ($/ha)	100	1,500	500	2,500	600	1,000	1,000	1500	200	600	200

* Includes prescription and layout

Program Table - $ 000s, Fraser TSA, August 1998

Year	Surveys	Backlog Planting	Backlog Brushing	Backlog Conversion	Space Df	Space Hw	Prune 1st lift	Prune 2nd lift	Fertilize	Owl Habitat Space	Owl Habitat Fertilize	Total
1	1,250	150	125	125	252	400	250	450	160	-	-	3,162
2	1,650	150	100	250	444	520	250	375	400	-	-	4,139
3	1,250	150	100	250	444	520	250	375	680	-	-	4,019
4	950	-	50	500	444	520	250	375	680	-	-	3,769
5	950	-	50	500	444	520	250	375	680	-	-	3,769
Subtot Yr 1 - 5	6,050	450	425	1,625	2,028	2,480	1,250	1,950	2,600	-	-	18,858
6 - 10	6,050	-	250	2,500	2,028	2,480	1,250	1,950	2,600	-	-	19,108
Total Yr 1 - 10	12,100	450	675	4,125	4,056	4,960	2,500	3,900	5,200	-	-	37,966

Job Outcomes

The following are the anticipated job outcomes associated with the preceding program, assuming the program is maintained into the future as necessary to achieve the working targets.

Program Job Outcomes, Fraser TSA, August 1998

Short term *employment associated with undertaking the silviculture activity, in person years*

Year	Surveys*	Backlog Planting	Backlog Brushing	Backlog Conversion	Space Df	Space Hw	Prune 1st lift	Prune 2nd lift	Fertilize	Owl Habitat Space	Owl Habitat Fertilize	Total
1	7	1	0	1	12	11	11	17	0	-	-	60
2	7	1	0	1	12	11	11	17	0	-	-	60
3	7	1	0	1	12	11	11	17	0	-	-	60
4	7	1	0	1	12	11	11	17	0	-	-	60
5	7	1	0	1	12	11	11	17	0	-	-	60
Subtot Yr 1 - 5	35	6	2	7	58	56	56	83	2	-	-	302
6 - 10	34	-	1	28	94	69	56	72	7	-	-	353
Total Yr 1 - 10	68	5.6	2.9	34.7	152.2	124.4	111.1	155.6	9.4	-	-	655

Note: Assumes 180 days of silviculture work = 1 job (Source: Jobs and Timber Accord)

Long term *employment associated with improved quality and quantity of the timber resource*[1]

Decade	Harvest Increment ('000 m3)	Incremental Jobs per year by decade TSA[2]	per year by decade Prov[3]	Total by decade TSA[2]	Total by decade Prov[3]
1	-	-	-		
2	140	125	164	1,246	1,638
3	140	125	164	1,246	1,638
4	140	125	164	1,246	1,638
5	140	125	164	1,246	1,638
6	140	125	164	1,246	1,638
7	140	125	164	1,246	1,638
8	320	285	374	2,848	3,744
9	320	285	374	2,848	3,744
10	320	285	374	2,848	3,744
11	140	125	164	1,246	1,638
12	140	125	164	1,246	1,638
13	240	214	281	2,136	2,808
14	240	214	281	2,136	2,808
15	240	214	281	2,136	2,808
16	240	214	281	2,136	2,808
17	240	214	281	2,136	2,808
18	240	214	281	2,136	2,808
19	240	214	281	2,136	2,808
20	240	214	281	2,136	2,808
21	240	214	281	2,136	2,808
22	240	214	281	2,136	2,808
23	240	214	281	2,136	2,808
24	240	214	281	2,136	2,808
25	240	214	281	2,136	2,808
Total				46,280	60,840

Notes:

1. Assumes continuation of on the incremental silvicltures program beyond the first 10 years, in accordance with the strategy. The total harvest increment is associated with all the silvicultural practices documented in the "Opportunities" section and is only partly attributable to spacing and fertilization practices. Some of the increase may be associated with pre-free growing silviculture that was not current practice at the time of TSR1.

2. Assumes 0.89 TSA level harvesting and prcessing jobs (PYs) per 1000 cubic metre (Source: Fraser TSR1 SEA)

3. Assumes 1.17 Provincial level harvesting and prcessing jobs (PYs) per 1000 cubic metre (Source: Fraser TSR1 SEA)

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