Cranbrook
Timber Supply Area

Interim Silviculture Strategy

-- Version 1.2 --

British Columbia

Ministry of Forests

Funded By

Forest Renewal BC

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1. EXECUTIVE SUMMARY

Note: See page 58 for a list of abbreviations used.

Purpose

This strategy is intended to help optimize the application of available funding for silviculture activities towards the goals of improving the future quantity and quality of both habitat and timber supply. The strategy will be considered as one of several inputs in decisions on funding allocations and treatment activities. The degree to which the overall strategy ultimately proves appropriate and is achieved will also be the degree to which the expressed targets will be achieved.

Objectives

1. Because the TSR2 analysis is not yet available it is difficult to identify with any precision both the silvicultural opportunities and their relative importance. In its stead, the workshop participants relied on their own local knowledge of issues and opportunities as well as some indication of what TSR2 may look like based on the RLUPS forecast. The RLUPS forecast is considerably more optimistic than the TSR1 forecast in that it suggests the existing harvest level can be maintained for many decades. In contrast, forest companies are having difficulty finding available wood for harvest, the major reasons being the low merchantability of heavily stocked younger mature Pl stands and the unavailability of older mature stands due to their being reserved to meet forest cover requirements for older forests. The first objective of this strategy, therefore, is to undertake silvicultural actions that will enhance short term timber supply, both in terms of availability and physical extent. Workshop analysis indicates there is a substantial late rotation fertilization opportunity.
2. The is some uncertainty about whether a mid term harvest shortfall will occur. Both the TSR1 and the RLUPS forecasts indicate one. However, the TSR1 forecast is strongly influenced by an age class gap that does not exist and the RLUPS forecast shows a shortfall very late in the planning horizon, which is difficult to explain. Nevertheless, the shortage of older forests would indicate that a mid term shortfall will be likely because there is not sufficient older forest to span the time until managed 2nd growth stands become available for harvest. A mid term objective, therefore, is to increase the quantity of the timber to be available for harvesting in this time period. Programs of spacing, and fertilization can accomplish this.
3. In the long term, starting about 100 years from now, workshop analysis indicates improved estimates of the productivity of forest land as well as silvicultural activities can result in harvest levels of at least equal to if not greater than current levels. Confirmation of this, however, must await TSR2 analysis. In the absence of this analysis, a long term objective is to maximize timber production within a context of sound multiple resource stewardship. Workshop analysis indicates that silvicultural activities can contribute significantly to this objective.
4. Based on a clear log definition of being able to produce 25% clear lumber by volume, 2nd growth managed stands will have no clear logs. A second long term objective is to create a long term timber supply yielding at least 1% clear logs on a total harvest volume basis.

Accomplishing these objectives requires an incremental silviculture program substantially above historic levels. Some changes in basic silviculture activities also present opportunities to contribute to the objectives.

Product Objectives

The following are product objectives at the log level for the Cranbrook TSA.

Quality Class	Species	Characteristics
Premium Log:	All	32.5+ cm minimum average stand diameter at breast height (DBH).
Sawlog:	All	27.5+ cm minimum average stand DBH.

Silvicultural Strategies

The strategies listed below are those considered in the workshop and follow-up analysis to be appropriate towards achieving the working targets. Other strategies that were considered but found to have no opportunity area are documented in the report.

Some of the following are not within the traditional scope of silviculture but are included here for completeness. Some practices are pre free-growing and are not likely to be undertaken by licensees without funding assistance if free growing obligations can be achieved without them.

No.	Strategy	Priority
Surveys	Conduct approximately 18 000 ha/yr of silviculture surveys in support of all strategies.	0

SHORT TERM

Objectives:

- enhance short term timber supply, both in terms of availability and physical extent.

Working Targets:

- Maintain the current harvest level for at least 20 years.

Strategies:

ST1 Late rotation fertilize 800 ha/yr to produce approximately 12 000 m3/yr of additional harvest volume by the 2nd decade. (2)

No.	Strategy	Priority

MID TERM

Objectives:

- Increase the quantity of timber to be available for harvesting.
- Improve the quality of the timber to be harvested.

Working Targets:

- Generate an additional 1.7 million m3 to mid-term timber supply.

Strategies:

MT1	Late rotation fertilize 1 600 ha/yr to produce approximately 9 000 m3/yr of additional timber.	4.5
MT2	Reduce minimum harvest ages of younger existing stands 10 years, or alternatively improve the quality of the timber supply, by:	
(b1)	Spacing 8 000 ha of stands harvested before 1987 having a stocking level > 6 000 sph at the rate of 800 ha/yr.	4
(b2)	Spacing stands harvested after 1987 having a stocking level > 6 000 sph at the rate of 1 000 ha/yr.	4
(b3)	Spacing stands having a stocking level < 6 000 sph at the rate of 1 000 ha/yr.	7
(c)	fertilizing 3 800 ha/yr on a 15 year repeat cycle.	4.5

LONG TERM

Objectives:

- Maximize long term timber production within a context of sound multiple resource stewardship.
- Improve the quality of the timber to be harvested.

Working Targets:

- Increase long term timber supply by at least 16%.
- Generate at least 5% of total harvest volume in premium large logs (no current silviculture strategy implications).
- Generate at least 1% of total harvest volume in clear premium logs (clear logs will generally also be large logs).

Strategies:

LT1	Maintain the timber harvesting land base by:	
(a)	Treating approximately 1 250 ha of backlog NSR.	1
(b)	Maintaining approximately 1 300 ha of previously reforested backlog plantations.	5

No.		Strategy	Priority
	(c)	Survey 4 000 ha/yr of pre-1987 SR area to ensure they remain fully stocked.	4
LT2		Increase the timber harvesting land base by 0.5% by:	
	(b1)	Rehabilitating 400 ha of non-merch Pl stands at the rate of 1 000 ha/yr.	3
	(b2)	Survey 20 000 ha of problem forest type areas at the rate of 4 000 ha/yr for 5 years.	1
LT3		Increase the volume of regenerated stands by 16% by:	
	(b)	By 2007, expanding the use of improved seed to include Pl, with the expected result of a 10% gain in LTHL.	0.5
	(h)	Repeat fertilizing 1 600 ha/yr, rising gradually over about 60 years to 13 200 ha/yr as more stands come under management, for an expected result of a 6% gain in LTHL. (Note: The initial 1 600 ha/yr are the same stands as in M1. This rises to 3 800 ha/yr under MT2 (c).)	4.5
Q2		First-lift prune 200 ha/yr.	8

Illustration of Working Targets

Chart not available – pending TSR2 analysis results.

Silviculture Regimes & Investment Priorities

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

Regimes	Strategy	Opportunity Area	Opportunity Area (Ha/Yr)	Timber Supply Effects Short	Medium	Long	Quality	Habitat	Jobs Days/ha	Cost $/ha[1]	Wkshp Rank
1 Surveys (general)		19350	19350						0.1	20	1
Survey - PFT	L2b	4000	4000						0.3	60	3
Survey - pre 1987 SR	L1c	4000	4000						0.1	20	6
2 Backlog reforestation	L1a	400	400 /3yr		++	+++			3	1500	3
3 Backlog brushing	L1b	250	250		++	+++		+/-	2.5	600	8
4 Rehab PFT	L2b	1000	1000	-	++	+++		+/-	3	2000	5
5 improved seed	L3b	1440	1440						0	70	2
6 space younger existing stands	Q1, M2b	800	800-1800		+++		+		2	500	6
7 space sph < 6000	M2b	1000	1000		+++		+		1.5	500	9
8 fertilization repeat	L3h, M1, M2c	2000	1600-13200		+++	++			0.02	200	7
9 fertilze existing late rotation	S1,M1c	800	800	+	+				0.02	300	4
10 Pruning 1st lift	Q2	200	200				+++		4	800	10

Incremental Silviculture Program

The following annualized program will contribute to achieving the above goals and strategies. This program is considerably above historic levels and some activities may require phasing in.

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Program Table - Ha, Cranbrook TSA.

		Backlog		Rehab	Improved	Space	Prune	Fertilize	
Year	Surveys*	Establish	Maintain	PFT	Seed	-	-	-	Total
1	27,350	400	250	1,000	1,440	1,800	200	2,800	33,800
2	27,350	400	250	1,000	1,440	2,050	200	2,800	34,050
3	27,350	400	250	1,000	1,440	2,300	200	2,800	34,300
4	27,350	-	250	1,000	1,440	2,550	200	2,800	34,150
5	27,350	-	250	1,000	1,440	2,800	200	2,800	34,400
Subtot Yr 1 - 5	136,750	1,200	1,250	5,000	7,200	11,500	1,000	14,000	170,700
6 - 10	136,750	-	1,250	5,000	7,200	14,000	1,000	14,000	179,200
Total Yr 1 - 10	273,500	1,200	2,500	10,000	14,400	25,500	2,000	28,000	357,100

* Includes prescription and layout

Program Table - $ 000s, Cranbrook TSA.

		Backlog		Rehab	Improved	Space	Prune	Fertilize	
Year	Surveys*	Establish	Maintain	PFT	Seed	-	-	-	Total
1	707	600	150	2,000	101	900	160	1,480	6,098
2	707	600	150	2,000	101	1,025	160	1,480	6,223
3	707	600	150	2,000	101	1,150	160	1,480	6,348
4	707	-	150	2,000	101	1,275	160	1,480	5,873
5	707	-	150	2,000	101	1,400	160	1,480	5,998
Subtot Yr 1 - 5	3,535	1,800	750	10,000	504	5,750	800	7,400	30,539
6 - 10	3,535	-	750	10,000	504	7,000	800	7,400	29,989
Total Yr 1 - 10	7,070	1,800	1,500	20,000	1,008	12,750	1,600	14,800	60,528

Job Creation

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.

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.

Short term employment associated with undertaking the silviculture activity, in person years, Cranbrook TSA.

		Backlog		Rehab	Improved	Space	Prune	Fertilize	
Year	Surveys*	Establish	Maintain	PFT	Seed	-	-	-	Total
1	17.7	6.0	3.1	15.0	-	15.5	4.0	0.3	62
2	17.7	6.0	3.1	15.0	-	17.7	4.0	0.3	64
3	17.7	6.0	3.1	15.0	-	19.8	4.0	0.3	66
4	17.7	-	3.1	15.0	-	22.0	4.0	0.3	62
5	17.7	-	3.1	15.0	-	24.1	4.0	0.3	64
Subtot Yr 1 - 5	88.4	18.0	15.6	75.0	-	99.0	20.0	1.4	317
6 - 10	88.4	-	15.6	75.0	-	120.6	20.0	1.4	321
Total Yr 1 - 10	176.8	18.0	31.3	150.0	-	219.6	40.0	2.8	638

Note: Assumes 200 days of harvesting, silviculture work, and timber processing = 1 job

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

	Harvest	Incremental Jobs	
	Increment	per year	per decade
Decade	('000 m3)	Region[2]	Region[2]
1	(158)	(621)	(6,209)
2	(158)	(621)	(6,209)
3	(158)	(621)	(6,209)
4	(158)	(621)	(6,209)
5	(158)	(621)	(6,209)
6	(158)	(621)	(6,209)
7	(204)	(802)	(8,017)
8	(204)	(802)	(8,017)
9	(116)	(456)	(4,559)
10	(116)	(456)	(4,559)
11	(40)	(157)	(1,572)
12	(40)	(157)	(1,572)
13	(40)	(157)	(1,572)
14	(40)	(157)	(1,572)
15	(40)	(157)	(1,572)
16	(128)	(503)	(5,030)
17	(167)	(656)	(6,563)
18	(167)	(656)	(6,563)
19	(167)	(656)	(6,563)
20	(167)	(656)	(6,563)
21	(167)	(656)	(6,563)
22	(167)	(656)	(6,563)
23	(167)	(656)	(6,563)
24	(167)	(656)	(6,563)
25	(167)	(656)	(6,563)
Total			(134,367)

Notes:

1. Assumes continuation of the silviculture 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 strategy development.

2. Assumes 3.93 TSA level direct (harvesting, silviculture, processing), indirect and induced (PYs) per 1000 cubic metre. (Source: TFL 23 MP #9 Timber Supply Analysis Report, p.39)

Further Research and Information 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 "Workshop Review of Potential Strategies," page 28).

1. Undertake fertilization trials to examine the potential of fertilization to bring age class 3 Pl to merchantable size sooner. (ST2B)
2. Compare the actual growth and piece sizes (diameters?) of age class 4 Pl with those projected by VDYP. (ST2B)
3. Following TSR2 analysis, further examine the impacts/potential of spacing to determine which are the most cost-effective treatments (what landscape units, sites, species). (MT2 (b))
4. Following TSR2 analysis, examine grizzly bear and ungulate winter range impacts and opportunities. (MT3)
5. Undertake operational partial harvesting and commercial thinning trials, so that the necessary G&Y information will be available when the managed stands become suitable. (MT4)
6. Examine excluded areas for opportunities to bring into the THLB through rehabilitation or reclassification. (LT2)
7. Lobby for more and better improved seed. (LT3 (b))
8. Examine seed planning zone guidelines for opportunities for modification to expand improved seed into the East Kootenays. (LT3 (b))
9. Complete surveys for voids to get a measure of the actual area in voids. (LT3 (c))
10. Survey and assess backlog sites to get better information on stocking distribution into voids and clumps, together with their potential for fill planting the void areas and spacing the clumpy areas. (LT3 (c))
11. Improve information on the # of years for trees to reach breast height. (LT3 (d))
12. Evaluate the potential for spacing to increase long term harvest levels under Type II silviculture analysis. (LT3 (g))
13. Fertilization trials are needed to determine if the fertilizable land base should include spruce and larch species. (LT3 (h))
14. Further study of root rot management and to confirm the OAF2 factor. (LT4)

2. Introduction

2.1 About the Interim Strategy

This strategy, and the process on which it is founded, is intended to help optimize the application of available funding for silviculture activities towards the goals of improving the future quantity and quality of both habitat and timber supply. The strategy will be considered as one of several inputs in decisions on funding allocations and treatment activities.

The limitations of time, budget and available information have tended to cause the focus in this first version of the strategy to be on the future quantity of the timber resource. It is expected that as the strategy development process evolves and as better and more information becomes available, the strategy will have more regard to the matters of future timber quality and the future quantity and quality of habitat supply.

To achieve the optimization objective, the opportunity evaluation process recorded herein is not limited by factors such as the availability of funding, funding source (e.g., public vs. private), or the ability to deliver a program. Because of this, the strategy generally illustrates the plausible high end of the potential of the timber resource. Within this context as well as a broad context of cost-effectiveness, available treatment opportunities, and operational realities -- all of which were explored in general terms in the workshop -- potential treatment activities are ranked. The end result hopefully points to the most effective and efficient means of at least partially achieving the working targets. The degree to which the overall strategy ultimately proves appropriate and is achieved will also be the degree to which the expressed targets will be achieved. This, of course, could also be affected by future unknowns, such as major changes in forest policy, land base available for timber production, or market demand.

Although this strategy focuses primarily on silviculture, it is recognized that silviculture is part of a suite of potential strategies which together may influence the future quality and quantity of habitat and timber supply.

This strategy should not be confused with the allowable annual cut (AAC)[1] 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. Again, 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.

[1] See "Abbreviations," page 58 for a full listing of abbreviations used.

2.2 Methodology

This strategy was prepared through the following process:

1. Prior to the district workshop, in co-operation with district office personnel, L. P. Atherton & Associates undertook preliminary research to identifying issues and opportunities relevant to improving the future quantity and quality of timber supply.
2. A district workshop was held July 28 & 29, 1999 in Cranbrook, attended by representatives of the organizations and forest companies listed below. Larry Atherton of L. P. Atherton & Associates and Doug Williams of Cortex Consultants Inc. led the session. Participants reviewed the potential opportunities 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 Ministry of Forests (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.)

2.3 Acknowledgements

The participation of representatives of the following organizations at the district workshop is gratefully acknowledged.

Organization	*Participant's Name*	*Title*
Ministry of Forests, Cranbrook Forest District		
	Denis Petryshen	Silviculture Officer
	Lyn Konowalyk	Incremental Silviculture Forester
	Mike Black	Planning Forester
Ministry of Forests, Nelson Forest Region		
	Ivan Listar	Incremental Silviculture Forester
Ministry of Forests, Forest Practices Branch		
	Ralph Winter	Stand Management Officer
Crestbrook Forest Industries Ltd.		
	Marcie Belcher	FRBC Coordinator
	Jeff Alan	Contractor, (representing CFI)
	Allison Wager	Prescription Forester
Galloway Lumber Co.		
	Jeff Mycock	FRBC Coordinator, Interior Reforestation (representing Galloway)
Forest Renewal BC		
	Rick Allen	Project Development Officer

The project was directly managed by Ivan Listar of the Ministry of Forests, Nelson Forest Region. Funding was provided by Forest Renewal BC under a contract between the Ministry of Forests, Nelson Forest Region, and Cortex Consultants, Inc.

3. Higher Level Goals and Objectives

3.1 Provincial Goals and Objectives

The *Incremental Silviculture Strategy For British Columbia (Interim)* states the Ministry of Forests' provincial level strategy. The strategy's executive summary is reprinted below. The provincial strategy was considered in the development of this TSA strategy.

Version 1.0

STRATEGY AT A GLANCE

Purpose	This strategy provides guidance to the application of available funds for incremental silviculture activities. It is not tied to a specified funding level.
Government's Goals	• Sustainable Use • Community Stability • A Strong Forest Sector
Key Principles	1. Because the distant future cannot be foretold, the best and only course of action in managing the timber resource is that which minimizes risk and maintains options. 2. British Columbia's forests are important locally, provincially, nationally and globally and should be managed in this context. 3. Each generation of British Columbians becomes the steward of the province's forest resources and has a moral obligation to preserve this heritage for future generations.
Working Targets	Within the context of the guiding principles: WT 1: Minimize the anticipated interim reduction in timber supply so that provincial annual harvests of at least 65 million m^3 can be achieved during this period. WT 2: Create a long term timber supply capable of supporting a steady long term provincial harvest level of at least 75 million m^3. WT 3: Over the long term, maintain the production of premium quality logs at or above 10% of total harvest.
Major Silvicultural Strategies	• Increase the use of alternative silvicultural systems and commercial thinning. • Achieve earlier green-up of harvested areas. • Increase regenerated stand volumes 20%. • Eliminate all pre-1982 good and medium site backlog NSR and all 1982 to 1987 backlog NSR. • Initiate a long rotation quality management program for stands where harvesting must be delayed. Other silvicultural and non-silvicultural strategies must also be implemented to achieve the working targets.
Strategy Implementation	Regional and management unit strategies must be developed, followed by programs and plans to implement them.

It is recognized that not every management unit has the same capability to contribute to these interim objectives. Further, it is recognized that these objectives may not be attainable at current funding levels. Their purpose is to provide general guidance to the application of available funds.

3.2 Regional Objectives

The region has not set out formal regional silviculture objectives. In the interim, the provincial objectives are accepted as being broadly applicable within the region.

3.3 Higher Level Plans

Formal higher level plans are strategic plans defined by the Forest Practices Code, however, there are currently no approved higher level plans covering the Cranbrook Forest District. The Kootenay Boundary Land Use Plan (KBLUP) has been approved but the decision whether to make it a higher level plan has not been finalized. Until that time it provides guidance for management practices.

There are other plans that exist at a higher level which are strategic (policies and guidelines), or operational that provide direction to any lower level of plans, prescriptions, or forest practices. These, however, are not higher level plans as defined under the Code.

4. Basic Data

4.1 Land Area

Description	Area (ha)	Area %
Total Area of TSA	1 483 100	100
Total Productive Crown Forest	775 700	52
Net Timber Harv. Land Base	439 200	30

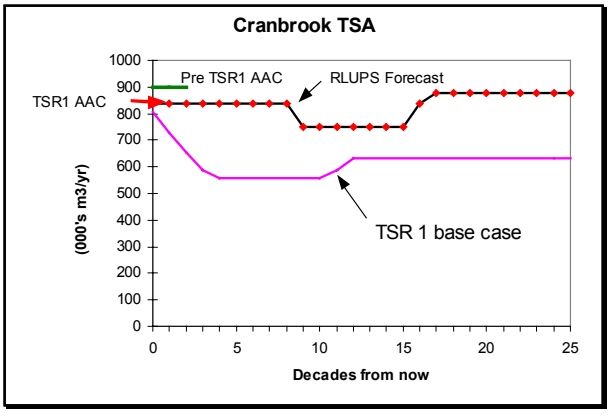
Source: Preliminary TSR2 data - rounded to nearest 100 ha.

4.2 AAC

AAC Type	Pre-TSR	TSR1*	Change (%)
Conventional	900 947	850 000	-5.7
Deciduous	-	-	
Insect/Disease	-	-	
Marginal	-	-	
Total	900 947	850 000	-5.7
Woodlot AAC			

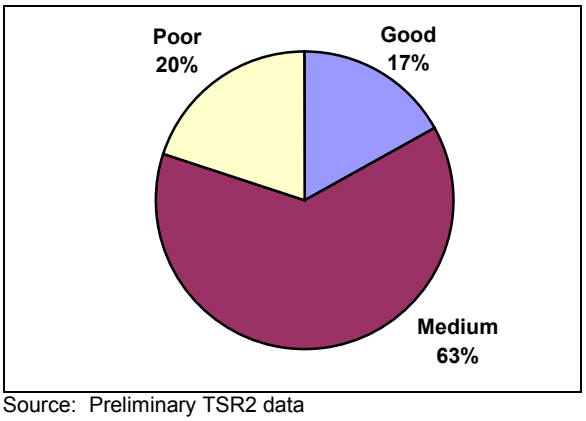
*effective March 1/96

4.3 Harvest Forecast



RLUPS: Regional Landscape Unit Planning System

4.4 Site Class

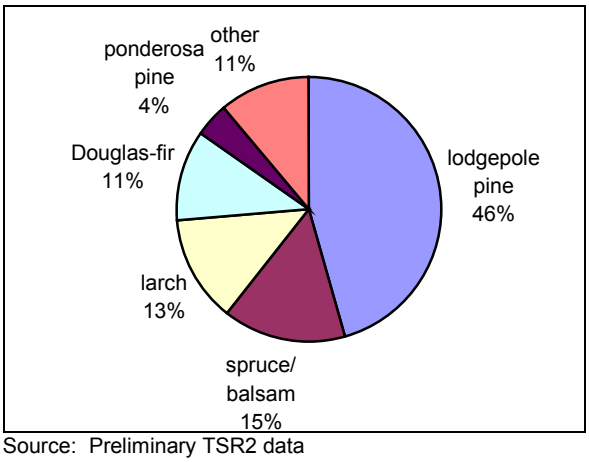


Source: Preliminary TSR2 data

4.5 Age Class

TSR2 Data Not Available

4.6 Tree Species



Source: Preliminary TSR2 data

5. Incremental Silviculture History

Treatment	TSR2 Status (Source 1999 Data Package)	Current Status (1999) Source: CFD[2]
Backlog	Of 5 380 ha in ISIS, half (2 690 ha) is considered operable. Assumed to be restocked over 9 yrs at rate of 300 ha/yr. Yields are projected for 2 stocking levels (breakpoint 420 sph).	Total treated area = 13 138 ha. Approximately 900 ha have been identified for treatment. About 1 250 ha require assessment, of which about an estimated 350 ha will require treatment. Total remaining for treatment = (900 + 350=) 1 250 ha. An additional 1 300 ha require brushing to ensure free growing is achieved.
Conversion	None.	None
Commercial Thin	None.	None
Space	TIPSY will be used for all existing stands < 30 yrs old. 30% of pure Pl and 50% of Pl leading stands will be assigned yield tables that reflect past stocking control (DP:40-41). Remaining stands will be assigned yield tables that have 45-4800 sph densities. Initial and target densities specified for stands > 30 yrs old (DP:38), but no info on assignment to yield tables based on stocking levels.	Total treated area = 20 096 ha (5% of TSR2 THLB). Max past program 2 800 ha/yr in1995. Recent level 700 ha/yr.
Prune		Total treated area = 1 216 ha's 1st lift pruned. Max past program 200 ha/yr. Recent level 0.
Fertilize		Total treated area = 5 931 ha's , including 1 100 ha's fertilized 2X. Max past program 1100 ha/yr. Recent level 0.

[2] CFD - Cranbrook Forest District

6. Timber Harvesting Trends

The TSR1 base case analysis forecasted approximately 3 200 ha/yr to be harvested over time (MoF, 1995:22). This level was associated with a forecast decline in timber harvesting. The TSR2 data package indicates that about 80% of recent harvesting has been even aged silvicultural systems (MoF, 1999: 34). If the TSR 2 forecast total harvest area remains similar to TSR1, then approximately 2 600 ha/yr would be harvested under even-aged silvicultural systems in the future.

On the other hand, the MoF's Major Licence Silviculture Information System (MLSIS) indicates that recent timber harvesting has been about 4 000 ha/yr, the majority of which has been under even-aged management. Furthermore, the Regional Landscape Unit Planning System (RLUPS) timber harvest forecast indicates the current harvest level may be maintained for some time (see "Figure 1. Harvest Forecasts," page 17).

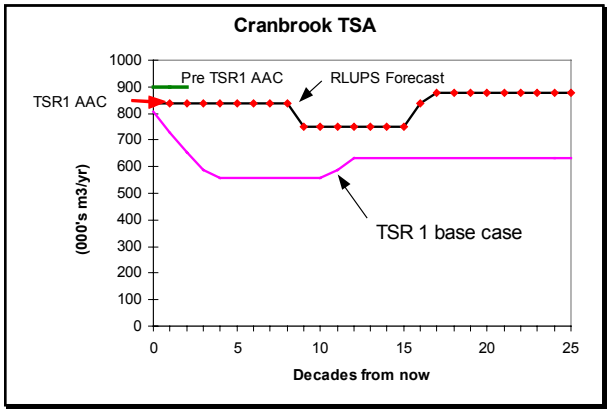
For the purposes of this strategy, the average future harvest level is assumed to be the same as the current level, i.e., 4 000 ha/yr. Workshop participants indicated that the area of partial harvesting is declining, mostly in response to using timber harvesting to emulate the role of fire in maintaining certain ecosystems. For simplicity, therefore, for the purposes of this strategy, all harvesting is assumed to be even-aged. Workshop participants estimate about 60% of the annual area harvested, or 2 400 ha/yr, is planted.

7. Issues and Silvicultural Opportunities

7.1 Discussion of Issues and Opportunities

TSA modelling in support of silviculture planning has not yet been undertaken. Normally, information from the timber supply analysis process can be used instead. However, at the time this strategy was prepared information from the 2nd timber supply review (TSR2) was not yet available and information from the 1st timber supply review (TSR1) was considered too dated for use. Instead, this interim strategy addresses the issues identified by workshop participants along with preliminary indications of TSR2 analysis results.

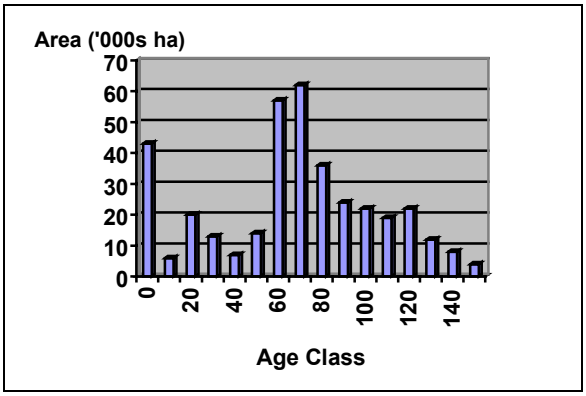
Figure 1. Harvest Forecasts



The TSR2 base case harvest forecast is not yet available. It is expected to be more similar to the RLUPS forecast than the TSR1 forecast. Given the unknowns, silviculture strategies chosen under this interim strategy should be valid across the possible range in forecasts. Both forecasts are consistent in having a mid term dip below the long term harvest level.

Normally, harvest levels rise out of the mid term dip at the point when harvesting is largely in managed stands. The dip in the RLUPS forecast is extraordinarily late. It is expected that the TSR2 forecast will also show a dip but that it will be sooner than that of the RLUPS forecast, probably ending at around 100 years.

Figure 2. TSR1 Present Age Class Structure



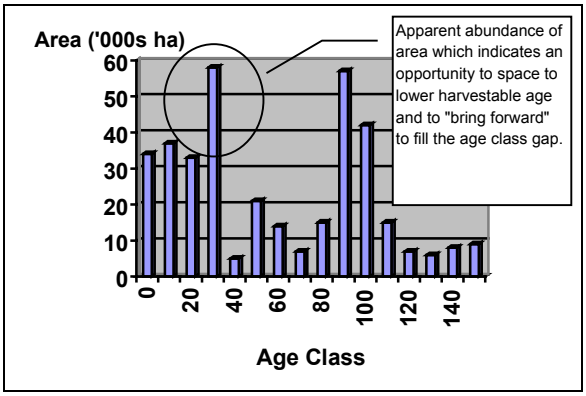
Source: TSR1 Analysis Report, Figure 13.

Figure 2 shows the TSR1 present age chart (MoF, 1995:25). About 43 000 ha is age 0 but only about 6 000 ha is aged 1-10. This means only 600 ha/yr were harvested and regenerated in the previous decade, which is obviously incorrect. The logical conclusion would be that a substantial portion of the age 0 stands must be older and belong in older age classes.

The TSR1, 50 yrs from now age class chart also appears incorrect (reproduced to the left as Figure 3). Age class 0 in Figure 2 (the current age chart) is advanced by only 30 years in Figure 3 (the 50 years from now chart), but also grows in size to about 58 000 ha. Thus the age class error is not only extended but also worsened.

Current age class data (Figure 4) supports the above conjecture that TSR1 age class data is incorrect. The TSR1 bulge associated with stands currently age class 0 does not show on this chart. In fact, age classes 0 to 3 in Figure 4 show remarkable evenness. It is likely that some stands shown as age 0 will be reclassified follow-

Figure 3. Age Class Structure in 50 Years



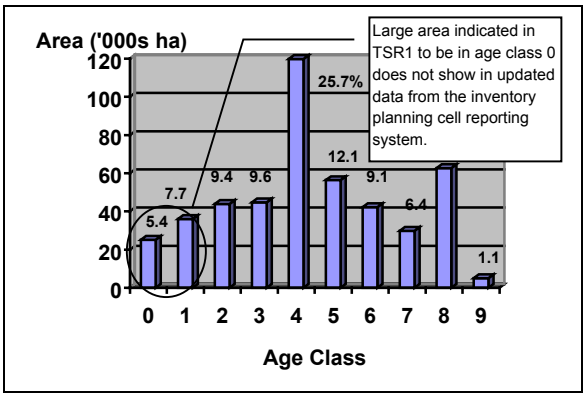
Source: TSR1 Analysis Report, Figure 13. Note: Visually, the age classes appear to be advanced only 30 yrs over those in Figure 2, not 50 years as the caption states.

ing regeneration or FG survey into age class 1, further smoothing out the age class distribution. Unlike in TSR1 which showed an ultimate normal forest distribution of about 30 000 ha in each 10 yr age class, the current age structure is trending towards a normal forest of about 22 000 ha in each.

The age class gap assumed during the workshop may not exist. A mid term shortfall, if one occurs in the TSR2 base case, more likely will be the product of not having enough existing timber to span the time until managed stands become available than being the result of an age class gap.

Spacing and repeat fertilizing suitable stands currently aged less than 30 years old and stands established over the next 20 years could help shorten the span of any mid term shortfall harvest level.

Figure 4. Current Age Class Structure from PCRS (20 yr age classes from 1-7)



Current Difficulties in Finding Harvestable Timber Supply

Workshop participants reported difficulty in finding available wood for harvesting. This was attributed largely to old and mature seral state requirements and to the non-merchantability of mature but small diameter lodgepole pine stands. Fertilizing small-diameter stands may accelerate stand development and mortality and increase the diameters of residual stems making them merchantable. However, the dense stands are likely to also have small live crowns, making them less able to respond to fertilization.

Changes in Existing Stand Volumes

An inventory audit found existing stand volumes to be over-estimated by 5.8%. The effects of this will be assessed in TSR2 analysis by means of a sensitivity test.

Typically, reducing existing stand volumes causes the transition from the initial harvest level to begin earlier than in a base case forecast. This is because there is less existing timber to span the period until managed second growth stands become available. Also, decreasing the volume/ha

can magnify the impact of forest cover constraints. Lower volumes/ha require more area to be harvested to obtain the same volume. This increases the area not greened-up at a faster rate and the limits of forest cover constraints are reached sooner.

The TSA has a large fertilizable land base. A single late-rotation fertilization of suitable existing stands would increase their volumes and could contribute to extending or increasing the initial harvest level.

Sensitivity to Changes in Minimum Harvestable Ages and Implications for Timber Quality Management

TSR2 minimum harvestable ages are based on species, site index, slope, minimum volume and minimum average diameter criteria. The TSR2 min harvest age slope and DBH criteria by species can be generalized as follows (MoF, 1999a:30-31):

Species	min avg DBH for Slope	
	< 40%	40%+
Pl	20	25
S/B	25	28
F/L	25	28
Hi Elev	25	25

The TSR2 minimum harvestable ages for future stands can be generalized as follows (MoF, 1999a:30-31):

	min harv. age for slope & site					
	< 40%			40%+		
Species	G	M	P	G	M	P
Pl	55	70	105	80	123	175
Pl, PA	52	75	100	83	120	155
S/B	66	91	127	80	92	127
L	73	88	123	90	100	135
F	77	88	118	90	100	145

Growing forests to older ages generally improves their quality. For most TSA's the objective of growing forests longer for quality is usually compatible over the very long term. This is likely true in the Cranbrook TSA where increasing harvest levels (based on RLUPS) are unlikely to suffer from extended ages.

TSR2 sensitivity tests for changes to minimum harvest ages were not yet available at the time this strategy was prepared. See comments opposite Figure 2, page 17.

Sensitivity to an Increase in Regenerated Stand Volumes

For most TSA's increasing regenerated stand volumes by a certain percentage results in a corresponding increase in the long term harvest level (LTHL) over the base case forecast. This was the case in the Cranbrook TSR1 analysis and therefore such a response is assumed to be the case for the purposes of this interim strategy.

Many silvicultural practices can be used to achieve an increase in regenerated stand volumes, including practices to reduce losses to root disease.

Sensitivity to Changes in Green-up Ages

TSR2 green-up sensitivity tests are not yet available.

TSR2 green-up requirements will be as follows (MoF, 1999a:46,47,49):

Zone	% THLB	Ht	Age	%allowed below age
IRM		2		33-40
Caribou		3		25
Watershed		9		25-30
VQO		slope		5-25
Recreation		3-6		5-25
FMER*		2		33
Open Forest		N/A		N/A

*FMER – fire maintained ecosystem restoration

TSR2 green-up ages by species, height and good-to-poor site index ranges are as follows (MoF, 1999a:46-49):

	Ht (m)		
Species	2	3	9
Pl	10-13	12-17	23-39
S/B	17-25	19-30	32-57
L	10-17	12-22	26-47
F	11-15	13-19	26-44

Many silvicultural practices can be used to reduce the time until green-up. There is little risk to focusing on green-up issues in the short term, because these same practices will also serve to increase regenerated stand volumes which would be of considerable long term benefit.

Forest Cover Constraints

The TSA has a multiplicity of forest cover constraints (see tables in preceding section). However, without the benefit of TSR 2 sensitivity analysis, it is not possible to determine which ones may affect the timber supply and where resultant silvicultural opportunities may be. If licensees are having difficulty locating available timber for harvesting, this would be cause for addressing FCC's in the short term. However, this is not necessarily an indication that FCC's will be a mid or long term problem.

In TSR2 or subsequent analysis, it would be useful for silviculture planning purposes to vary forest cover constraints by management emphasis zone. This would help pinpoint which zones are

the most limiting. Also, once zones are pinpointed it would be useful to apply the sensitivity analyses by various time periods to determine when the sensitivity is at its greatest.

Workshop participants believe forest cover constraints moderately contribute to the current difficulty in finding harvestable stands.

Older Forest Constraints

The TSR2 base case will be subject to substantial older forest constraints. Mature plus old minimum retention requirements vary from about 20% must be 120 yrs of age or older to about 28% being 100 years or older. Old seral requirements vary from about 11% > 140 yrs old to 14% > 250 yrs old. These requirements are gradually implemented over 3 rotations, with the lowest levels of requirement being applied in the first 70 yrs (MoF, 1999a:44).

Silvicultural practices such as fertilization and commercial thinning may be used to accelerate stand structure so that the desired older forest attributes are achieved at an earlier age. This could potentially free up some timber supply that may otherwise be unavailable.

Changes in the Size of the Timber Harvesting Land Base

Subsequent to the TSR1 analysis, the Kootenay-Boundary Land Use Plan has reduced the land base of the TSA. TSR sensitivity tests of changes to the land base typically indicate corresponding changes in the harvest forecast.

Silvicultural practices may be used to increase the size of the THLB through conversion of unutilized stands to merchantable species and to increase the productivity of low sites.

Opportunity area consists of the areas deducted from the TSR2 THLB. These include:

Type	Area	Equiv % THLB
Low site	38 500	8.8
NCC	3 800	0.9
Non Merch (PFT's)	21 700	4.9
Excluded (1999a:26)	27 000	6.1

Descriptions are from 1999a: 15, 25-28. Data from Black, pers comm.

There is little remaining treatable backlog NSR.

7.2 Summary of Issues and Silvicultural Opportunities

7.2.1 Limitations of Available Information

The disparities between the TSR1 and the RLUPS forecasts are evidence that timber supply forecasts must be used cautiously in silviculture planning. Stand level models are used to predict

yields that are then used in the TSA level model; in other words, models are used to feed models. The probability of the exact sequence of harvested ages and stands that the TSA model selects to form a harvest forecast actually occurring is virtually nil. Yet certain features of the TSA can be expected to hold consistent across both present and future analyses. Such features should be the primary focus of a silviculture strategy. These features in the Cranbrook TSA are:

1. A physical scarcity of timber in the short term, related to biodiversity requirements to maintain older forests and to the non/low merchantability of the large area in Pl stands presently 60-80 years old.
2. A mid term harvest level shortfall below the long term harvest level, probably occurring about the time indicated by the TSR1 base case harvest forecast, probably more related to the lack of available existing stands for harvesting than to an age class gap.
3. Increases in yields of managed stands will directly translate into increases in long term harvest levels.
4. Older forest requirements will be very tight, if not outright limiting.

While all factors can be influenced by silvicultural actions, the fourth factor can also be influenced by policy changes.

7.2.2 The Silviculture Planning Harvest Forecast

To ensure the appropriateness of silvicultural strategies, it is necessary to hypothesize a "most likely" harvest forecast. This silviculture planning harvest forecast is often different from the TSR base case harvest forecast because it incorporates some speculation about factors that may affect estimates of future timber supply. In the TSR process, such factors are addressed through sensitivity analyses. If the sensitivity does not affect short term harvest levels, it is usually considered not relevant to an AAC determination and the base case is left unchanged. However, such factors may be highly relevant to silviculture planning which, unlike the AAC determination process, is more focused on the future than on the present.

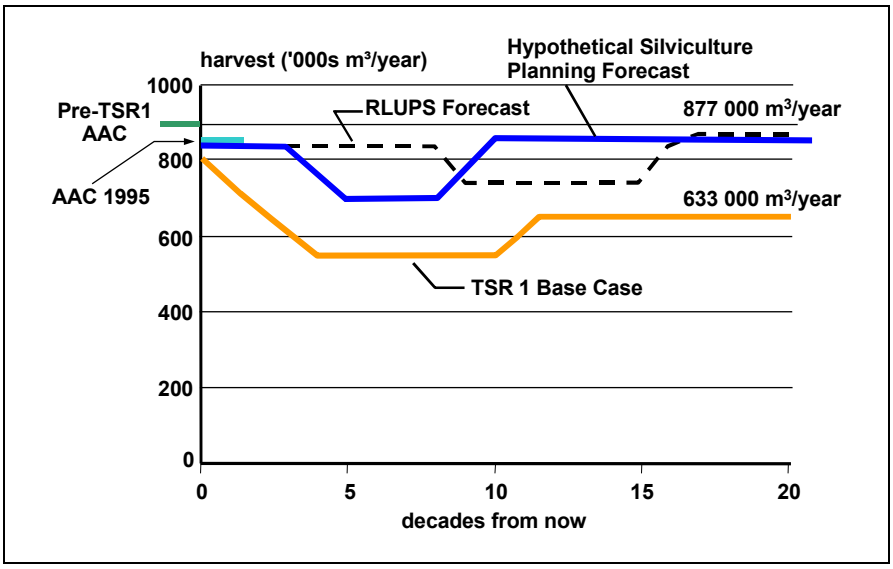
At the time this interim strategy was prepared, the timber supply analysis report for the second timber supply review (TSR2) for the Cranbrook TSA was not available. The TSR 2 timber supply will likely be less sensitive to changes in many factors than observed in the TSR1 analysis because there is less pressure on the harvest forecast. The AAC 'ceiling' was lowered from 900 947 (pre-TSR1) to 850 000 m3/yr (TSR1) and the TSR2 long term harvest level (LTHL) 'floor' is expected to rise to about the current AAC level as indicated by the RLUPS planning process. Also, the TSR2 forecast has better resource information in the base case - for example, biodiversity and other forest practices code requirements are now incorporated.

Figure 5 below illustrates the silviculture planning harvest forecast for the Cranbrook TSA. This forecast was not presented in the district workshop but the elements were implicit in discussions during the course of the workshop. For the purposes of this interim silviculture strategy, it is assumed that future timber supply forecasts will likely show an ability to maintain the current harvest level for several decades, similar to the RLUPS forecast. The shortage of stands presently aged 30-50 years will continue to be a significant factor, contributing to the mid term shortfall period of the forecast. Although highly speculative, the shortfall period will possibly be for a lesser time span than indicated by both RLUPS and TSR1 and will likely be initiated at about the same time as indicated by TSR1 (i.e, much sooner than RLUPS). Future long term harvest levels (LTHL) are expected to be significantly above the TSR1, base case forecast and in the range of the RLUPS forecast. Higher managed stand yields, improved estimates of site productivity and

the volume gains resulting from tree improvement programs, will more than offset any potential reductions that may be needed in order to maintain more area in an older forest condition.

Note: Post-workshop follow-up indicates the age class gap assumed during the workshop may not exist. A mid term shortfall, if one occurs in the TSR2 base case, more likely will be the product of not having enough existing timber to span the time until managed stands become available than being the result of an age class gap – see discussion opposite Figure 2, page 17.

Figure 5. Silviculture Planning Harvest Forecast



Because the TSR2 information is not yet available, the Cranbrook Forest District has indicated what it expects to be the forest management issues for the Cranbrook TSA. These issues were confirmed at the district workshop. The issues are summarized below by time period.

7.2.3 Future Timber Volumes (Quantity)

Short Term (1 - 20 years)

The short term period is somewhat arbitrarily defined as the next 20 years.

The TSR2 base case is expected to indicate that harvest levels can be maintained at the current AAC throughout the short term period.

Short term harvest levels are largely governed by the need to extend existing timber supply until managed stands become available. Thus factors that affect the existing timber supply can affect the ability to maintain the initial harvest level for longer or shorter than in the base case. These are discussed under "Mid Term (21 - 100 years)" below.

In the absence of TSR 2 information, there is likely to be little opportunity to use silviculture to directly effect change in short term harvest levels, other than perhaps to fertilize suitable stands 10-15 years prior to harvest to give a volume boost. Workshop participants indicated the primary issue in the short term is finding available timber for harvesting. Unlike most other TSA's with this problem, however, green-up/adjacency requirements were not felt to be the major cause of this. Rather it is largely due to a combination of:

- much wood 60-80 years old is densely stocked lodgepole pine and therefore not yet merchantable; and,
- stands older than this often are unavailable because they are needed to meet old- and mature-seral biodiversity requirements.

Mid Term (21 - 100 years)

The mid term period begins at the end of the short term period (i.e., 21 years from now) and continues until the transition from harvesting in existing natural stands to harvesting mainly in 2nd growth managed stands is complete. Until the TSR2 analysis is available it is not known when the end of the transition period will be. For the purposes of this interim strategy, it is set at 100 years. In TSR1, the end of transition was 120 years from 1992, the date to which the inventory had been updated.

The mid term is likely to be characterized by a shortfall below the long term harvest level. This characteristic was displayed by both the TSR1 and the RLUPS forecasts. However, as discussed opposite Figure 2, page 17, the shortfall is more likely a product of a need to make existing stands last until the first of the managed stands become available for harvest than from an age class imbalance (gap).

Silvicultural actions to increase the availability of existing stands or improve the timing of the onset of the managed stands could potentially increase mid term harvest levels, perhaps even to the extent of eliminating the anticipated mid term harvest shortfall. Alternatively, silvicultural actions could be oriented to improving the quality of the late mid term and long term timber supply. Because the same actions, such as spacing and fertilizing appropriate stands, could potentially achieve either objective, the ultimate end-use does not have to be chosen now.

The most significant factor affecting both short and mid term harvest levels is likely to be the estimate of existing stand volumes. Higher volumes will raise harvest levels, lower volumes will lower them. As in the short term, fertilizing suitable stands 10-15 years prior to harvest to give a volume boost will be a positive benefit to mid term timber supplies.

Long Term (101 + years)

The long term period is the time when harvesting is primarily in managed 2nd growth stands and is characterized by a steady state harvest level.

In the absence of TSR2 information, the long term is assumed to be sensitive to changes in managed stand volumes, the size of the timber harvesting land base, and the amount of losses to root rot diseases.

7.2.4 Future Timber Quality

To date there has been little attention to the matter of future timber quality. The focus of the timber supply review on AAC determination has resulted in the planning emphasis being solely on timber volumes. Until recently, there has been little higher-level policy guidance with respect to managing for future timber quality.

Using age as a surrogate measure of timber quality, the expected decline in harvest ages towards minimum harvestable ages indicates future timber quality will be generally be lower than to-

day's. The future timber supply will be much smaller in average diameter and, without pruning, there will be little, if any, clear wood. On the positive side, other than areas affected by root rot, most harvested second growth timber will be sound wood with little or no decay.

Lower quality stands present some future market risk. In low market periods it is often only the readily accessible, higher-quality timber that is profitable to harvest. Also, a narrow portfolio of small diameter timber offers less opportunity for creating a range of value-added forest products.

8. Opportunities to Increase Timber Supply

8.1 Potential Silviculture Strategies

Prior to the district workshop, information in the previous sections was used to identify the following silvicultural strategies as having potential to either maintain or increase future timber supply at the TSA level. Each of these was discussed in detail in the district workshop, the results of which are recorded in "Workshop Review of Potential Strategies," page 28, along with additional strategies that arose during the meeting. Strategies that are ultimately adopted are noted in "Silviculture Strategies," page 49.

8.1.1 Short Term (1 - 20 yrs)

ST 1: Fertilize ____ ha/yr of existing stands scheduled for harvest in the 2nd decade to increase their volumes. (increase)[3]

ST 2:

8.1.2 Mid Term (21 - 100 yrs)

MT 1: Fertilize ____ ha/yr of existing stands scheduled for harvest 20 to 70 years from now to increase their volumes (continuation of ST 1). (increase)

MT 2: Reduce minimum harvest ages of younger existing stands 10 years, or alternatively improve the quality of the timber supply, by:

(a) spacing ____ ha/yr of pine stands subject to repression;

(b) spacing ____ ha/yr of _____ stands; or

(c) repeat fertilizing ____ ha/yr on a 15 year return cycle.

MT 3: Strategies to reduce the impact of wildlife habitat constraints?

MT 4: Strategies related to commercial thinning?

MT 5:

[3] (Increase) means oriented to increasing harvest levels above those indicated by the TSR2 base case. (Maintain) means oriented to maintaining the harvest level indicated by the TSR 2 base case.

8.1.3 Long Term (101+ yrs)

LT 1: Increase the THLB by

(a) Planting ____ ha of backlog NSR; and

(b) Maintaining ____ ha of existing backlog plantations.

LT 2: Increase the THLB by:

(a) converting/rehabilitating ____ ha/yr of deciduous stands; (increase)

(b) converting/rehabilitating ____ ha/y of non-merchantable ____?____ stands; (increase)

(c) assessing _____ ha of low-site stands for proper classification; or

(d) improve the site productivity of low-site stands by _____ (fertilization?). (increase/maintain)

LT 3: Increase regenerated stand volumes by:

(a) site preparing ____ ha/yr.

(b) using improved seed; (increase)

(c) managing stocking so voids do not account for more than 10% of the area; (increase)

(d) using larger planting stock; (increase)

(e) fertilizing at the time of planting; (increase)

(f) brushing _____ ha/yr for growth enhancement (i.e., not only for survival); (increase)

(g) juvenile spacing _____ ha/yr; (maintain) or

(h) repeat fertilize _____ ha/yr on a 15 yr return cycle.

LT 4: Reduce losses to root rot by: (maintain?)

(a) pushover logging/stumping _____ ha/yr;

(b) planting alternate/mixed species on _____ ha/yr; or

(c) pop-up spacing on _____ ha/yr.

LT 5:

LT 6:

LT 7:

8.2 Workshop Review of Potential Strategies

Potential strategies were reviewed in the workshop according to the response time frames of short, mid and long term time periods. Each response time frame is the period in which the anticipated result of a potential strategy is expected, not the period in which actions must necessarily commence.

Workshop discussions are documented in the following tables. The contents of each column are further described below.

Column Number	Note
1	Strategy numbers correspond with the numbers recorded earlier in "Potential Silviculture Strategies," page 26. Items followed by an asterisk (*) were added during the district workshop.
2	Information is largely from the district workshop, combined with information presented earlier in this document.
3	Anticipated results are calculated using a variety of methods.

At the end of each time period is a summary of the anticipated responses for all strategies proposed for the period. A potential harvest forecast is prepared under this summary. This forecast is highly speculative and requires confirmation through computerized management unit level analysis.

8.2.1 Short Term (1 - 20 years)

Number	Potential Strategy/Action	Discussion / Current Status	Anticipated Result
ST 1	1. Late rotation fertilize all suitable stands scheduled for harvest in the 2nd decade to increase their volumes. (increase)	1. Participants had little confidence in being able to identify areas to be harvested in 10 years. Assuming this could be overcome, the following potential gain was calculated in the workshop. TSR1 data indicates about 156 000 ha in age class 60-80. Preliminary TSR2 data indicates that 85% of the TSA could be fertilizable on a species basis (all species, including Pl, Fdi, Lw & S, except those classified as "other") and about 60% on a site classification basis (all medium site and the lower ¼ of good site). Applying these factors against 156 000 ha indicates about (.85 X .6 X 156 000 =) 80 000 ha could be fertilizable. If only 10% of this proved available and suitable (e.g., there is little info on the efficacy of fertilizing S & Lw), would net to 8 000 ha. Treating this over a 10 yr period = 800 ha/yr. If a 5% vol gain is achieved, = .05 X 180 m3/ha = 9 m3/ha X 800 ha/yr = 7 200 m3/yr boost = about 1% of current harvest level. Post-workshop information from R. Brockley (1999) indicates this volume gain estimate could be conservative. Volume gains elsewhere have ranged from 7 to 34 m3/ha. A 15 m3/ha gain would yield 15 X 800 = 12 000 m3/yr gain.	1. 12 000 m3/yr, commencing in the 2nd decade.
ST 2A	2A. Reduce the time until green-up is achieved in recently regenerated and about to be regenerated stands.*	2A. This potential strategy was added during the workshop. Workshop discussions concluded that green-up constraints were not the major problem in finding available timber for harvesting. Rather, availability was more determined by the fact that many of the 60-80 year old stands were not yet merchantable (higher density and lower diameters – see ST2B below) and that stands older than this were often required to meet old- and mature-seral biodiversity requirements.	2A. Not applicable.
ST 2B	2B. Examine the opportunities to make age class 3 and 4 Pl merchantable sooner.	2B. This potential strategy was added post-workshop in order to more clearly express the workshop discussions on the topic. See 2A above. A need to undertake fertilization trials to examine the potential of fertilization to bring age class 3 Pl to merchantable size sooner was identified. This need is noted under "Summary of Information and Research Needs," page 56. A need to compare the actual growth and piece sizes (diameters?) of age class 4 Pl with those projected by VDYP was identified. It is suspected that VDYP over-estimates these. This need is noted under "Summary of Information and Research Needs," page 56.	2B. Additional information requirements noted.

Number	Potential Strategy/Action	Discussion / Current Status	Anticipated Result
ST 3	3. Overcome adjacency constraints by: (a) harvest in larger blocks; (b) increase the area of partial harvesting; and (c) commercial thinning stands.	3. (a-b) Potential strategies (a) and (b) are not of themselves silviculture strategies, but do have implications for the choice of silviculture strategies that may be adopted. If, for example, these can be successfully employed the need for silvicultural actions to shorten the time until regenerated stands reach the greened-up state becomes diminished. The need to meet NDT 4 management objectives has over the past several years resulted in a trend towards larger openings. This has helped relieve adjacency constraints to the point where adjacency is not perceived as a driving short term issue. See ST2 above. (c) There is little potential for CT. Stands in the right age group have poor structure and market demand for smaller wood is limited. Companies may be pushed into CT if wood supply is really constrained, but are more likely to do partial harvesting.	3. (a-b) Current practice. (c) No opportunity.
	Short Term Harvest Forecast Summary	Potential Strategy # — Effect **ST1** Late rotation fertilize 800 ha/yr — 12 000 m3/yr **ST2** Reduce green-up time — Not applicable **ST3** Overcome adjacency constraints by: (a) harvesting in larger blocks sizes — Current practice (b) increase partial harvesting; and — Current practice (c) commercial thinning stands — No opportunity	
	Conclusion	Of the potential strategies examined, only late rotation fertilization has the potential to increase harvested volumes in the short term - by 12 000 m3/yr. In situations where harvest levels are forecast to decline, as in the Cranbrook TSA, harvest flow objectives will typically apply the "gain" to extending the current harvest level for a longer period of time. Thus, the short term harvest forecast can be expected to be similar to the RLUPS forecast. Even if not harvested under an increased AAC, increasing timber volume in the 2nd decade also improves overall timber availability and improves the likelihood that the RLUPS forecast will be attainable.	

8.2.2 Mid Term (21 - 100 years)

Number	Potential Strategy/Action	Discussion / Current Status	Anticipated Result
MT 1	1. *Repeat* fertilize ____ ha/yr of existing stands scheduled for harvest 20 to 70 years from now to increase their volumes (continuation of ST 1). (increase).	1. Effectively, this strategy is an extension of ST 1. However, because the stands discussed below are spaced and younger, they are suited for repeat fertilization, rather than simply a single late rotation fertilization. The word "repeat" was therefore added to the potential strategy. Many stands in the early part of this time period, like in the short term, are generally too old to fertilize. It is expected that the program noted under ST1 would continue into the early part of the mid term in those remaining older stands that are suited to a single late rotation fertilization. At some point, probably earlier rather than later in the mid term, harvesting will transition into younger existing stands, of which there are about 20 000 ha of spaced stands that are presently 20-50 years old. Estimate that about 80% of these stands (16 000 ha) are suitable for multiple fertilization on a 10 year cycle = **an annual program of 16 000/10 = 1 600 ha/yr**. This program could commence immediately. The oldest of these stands (i.e., current age 50) are likely to receive only 2 fertilizations, while the youngest (i.e., age 20) would receive 3 or more fertilizations. 3 fertilizations X 15 m3/fert X 16 000 ha = 720 000 m3 additional harvest volume. Over the 80 yr span of the mid term = (720 000/80 =) 9 000 m3/yr. Over the mid term time period, as more stands are harvested and regenerated to managed stands, the area under repeat fertilization would expand, first to the level determined under MT2(c), and ultimately to the level determined under LT 3 (h).	1. 9 000 m3/yr during years 21 – 100.
MT 2	2. Reduce minimum harvest ages of younger existing stands 10 years, or alternatively improve the quality of the timber supply, by:	2. TSR2 assumptions for minimum ages are noted on page 19. The district has already spaced about 20 100 ha. Without TSR2 analysis, it is not possible to accurately determine the effect of this strategy on raising mid term harvest levels. However, without doubt, spacing and fertilizing young existing stands will ensure stands at the beginning of the long term harvest queue (decades 8 & 9) are merchantable and therefore available for harvest.	
MT 2	(a) spacing ____ ha/yr of pine stands subject to repression;	(a) Most of the repressed stands from recent fires have been treated. Few stands harvested since 1987 have repression levels of stocking. Post '87 harvested areas that have over 10 000 sph are required by law to be spaced. Older repressed Pl stands are considered problem forest types and are not suited to spacing.	(a) Most repressed Pl areas have been treated. Benefits likely already factored into timber supply forecasts.
MT 2	(b) spacing ____ ha/yr of _____ stands; or	(b) Suitable stands are those 15-20 yrs old. Stands with 2 200 – 5 000 sph are lower priority; those over 6 000 are high priority. Post-spacing densities are typically 1 800-2 000 sph for Pl and 1 200 sph for Fdi/Lw. Pl post-spacing densities are high to allow for the high risk associated with these stands in the SE corner of the province. Pl stands are at substantial risk to fire, insect and animal losses. <u>Pre-87, > 6 000 sph:</u> About 40% of 20 000 ha of pre-87 stands are suitable for spacing = 8 000 treatable ha. These should be treated soon before the spacing window closes. **A**	(b) Estimate the 20 100 ha of existing spacing + 28 000 ha of future spacing will lower the minimum ages of all stands currently aged 0 – 30 yrs by 20 to 45 years at the stand level

Number	Potential Strategy/Action	Discussion / Current Status	Anticipated Result
		10 yr program = 800 ha/yr. Post-87, > 6 000 sph: About 25% of harvested areas would be suitable for spacing; = .25 X 4 000 ha harvested/yr = **1 000 ha/yr.** Pre and post 87 spacing would overlap. Spacing program would start at 800 ha/yr, rise to 1 800 ha/yr in about 5 yrs and then drop back to 1 000 ha/yr in year 11. Stands with < 6 000 sph: Estimate that there are sufficient stands to support **a program of about 1 000 ha/yr.** Total area currently spaced + spaced under this potential strategy over the next 10 years = 20 100 + 8 000 + 10 000 + 10 000 = 48 100 ha. Assume these stands are in current age classes 0 – 3. PCRS data indicates the total current area in these ages to be approx. 83 000. Therefore, about 48/83 ≅ 50% of stands will have had stocking control. Because there may not be sufficient funds to do all of the identified spacing, there is a need following the TSR2 analysis to further examine the impacts/potential of spacing to determine which are the most cost-effective treatments (what landscape units, sites, species). This need is noted under "Summary of Information and Research Needs," page 56. Table 1, page 45, indicates that spacing Pl from 5 000 sph down to 1 300 sph, or from 9 000 sph down to 1 600 sph reduces the 27.5 cm DBH technical rotation age by 51 and 45 years respectively. At the technical rotation ages, MAI of the spaced stands is significantly greater than that of the unspaced stands (3.01 for 9000/spaced to 1600 vs 2.33 for 9000/unspaced), but is well below the MAI of biological culmination (3.58 for 9000/unspaced) which occurs at about 80 years regardless of whether the stands are spaced or not. Spacing Fdi and spruce from 3 000 sph down to 1 200 sph lowers the age to achieving 27.5 cm DBH by 38 years and 42 years respectively. Because the technical target of 27.5 is higher than the min merch DBH standards for Pl (20 cm for slopes < 40% and 25 cm for slopes 40%+) the effect of spacing on lowering the min ages to meet these targets is about half that noted previously, or about 20-25 years. That for spruce and Fdi is in the range of the min age cut-offs. The TSA-level effect on lowering minimum harvestable ages of spacing 50% of stands can be calculated as: 50% spaced X (60% Pl by species X 20 yrs + 40% other species X 45 years) = 15 yr lower minimum harvest age overall.	and 15 years overall at the TSA level.
MT 2	(c) repeat fertilizing ____ ha/yr on a 15 year return cycle.	(c) MT1 defines the fertilization program level based on 20 100 ha of existing spaced stands. This potential strategy extends the fertilization program to include both existing spaced stands as well as newly spaced stands under MT2 (b) above. Using the same rationale as in MT1, i.e., that 80% of spaced stands would be suitable for fertilization on a 10 year cycle, and that 3 fertilizations adds 45 m3/ha to harvest volumes, then the potential fertilization program could rise to (.8 X 48 100 X 45 =) 1.73 million m3. Rationing this over the 80 yr span of the mid term = 1.73/80 = 21 600 m3/yr. **The associated fertilization program level would be (.8 X 48 100/10 =) 3 800 ha/yr.** On a 15 yr cycle the program level would be about 2 600 ha/yr. This program and increased yield incorporates that of MT1 (i.e., is not in addition to MT1). Program would not reach this level until after all stands have been spaced, so MT1 level is the starting level.	(c) Increasing the spaced and fertilized area potentially adds 21 600 m3/yr to mid tern harvests.

Number	Potential Strategy/Action	Discussion / Current Status	Anticipated Result
MT 3	3. Strategies to reduce the impact of wildlife habitat constraints?	3. Awaiting TSR2 analysis results. Once the results are available, there is a need to examine grizzly bear and ungulate winter range impacts and opportunities. Noted under "Summary of Information and Research Needs," page 56.	3. Await TSR2 analysis results.
MT 4	4. Strategies related to commercial thinning?	4. There are no stands suitable for commercial thinning. Much of the older Pl is too dense, having small diameters and small live crowns. Markets for small diameter material are poor. Root rot can also be an issue. CT is only likely to occur if there are no other alternatives, which is not currently the case. Stands are more likely to be partial harvested than commercially thinned, due both to stand structure and to lower harvesting costs. As managed stands become older, there will be more opportunities for commercial thinning. However, there is little, if any, growth and yield information on CT'd or partially harvested stands. Operational trials should be undertaken now, so that the necessary G&Y information will be available when the managed stands become suitable. This information need is noted under "Summary of Information and Research Needs," page 56.	4. No opportunity.
	Mid Term Harvest Forecast Summary	Potential Strategy # — Effect **MT1** Late rotation/repeat fert existing spaced. — 9 000 m3/yr. Improves availability. **MT2** Reduce min ages of young existing stands by: (a) spacing repressed Pl — Treatments already completed and embedded in harvest forecasts. (b) spacing stands — Total existing and planned spacing of 48 100 ha. Improves availability. Sets up stands for fertilization. Reduces min ages 20-45 yrs at stand level and 15 yrs at TSA level. (d) repeat fertilizing — Including MT1, adds 21 600 m3/yr to mid term. **MT3** Reduce impact of wildlife constraints — Awaiting TSR2 analysis results. **MT4** Commercial thinning — No opportunity.	
	Conclusion	The potential exists to add 21 600 m3/yr (1.7 million m3 total) to mid-term harvest levels through programs of spacing and fertilization. Significant opportunities exist to increase timber supply availability, particularly in the latter part of the mid term period.	

8.2.3 Long Term (101+ years)

<table>
<tr><th>Number</th><th>Potential Strategy/Action</th><th>Discussion / Current Status</th><th>Anticipated Result</th></tr>
<tr><td>LT 1</td><td>1. Maintain the THLB by
(a) Treating approx. 1 250 ha of backlog NSR; (maintain) and
(b) maintaining approx. 400 ha of previously reforested backlog plantations.* (maintain)</td><td>1. (a) About 1 250 ha of backlog NSR require assessment. Estimate about 350 ha of this will require treatment. About 900 ha have already been identified for treatment for a total treatable of 1 250 ha. See table below for treatment program.
(b) About 1 300 ha of previously reforested area requires brushing to ensure free growing is achieved. The program shown below is required.
<table><tr><th></th><th colspan="4">Area (ha)</th></tr><tr><th></th><th></th><th></th><th colspan="2">Brush</th><th></th></tr><tr><th>Year</th><th>Site Prep</th><th>Plant</th><th>New</th><th>Existing</th><th>Total</th></tr><tr><td>1</td><td>100</td><td>400</td><td>0</td><td>250</td><td>250</td></tr><tr><td>2</td><td>100</td><td>400</td><td>0</td><td>250</td><td>250</td></tr><tr><td>3</td><td>100</td><td>400</td><td>0</td><td>250</td><td>250</td></tr><tr><td>4</td><td></td><td></td><td>0</td><td>250</td><td>250</td></tr><tr><td>5</td><td></td><td></td><td>0</td><td>250</td><td>250</td></tr><tr><td>6-10</td><td></td><td></td><td>0</td><td>0</td><td>0</td></tr></table>Issues are reliability of survey data and what to do with marginal stands.</td><td>1. (a) (b) (c) Maintain base case LTHL. Area requiring treatment totals 2 550 ha ≅ 0.6% of THLB. Failure to treat would result in a 0.6% drop in LTHL.</td></tr>
<tr><td></td><td>(c) Surveying 4000 ha/yr of pre-1987 SR area to ensure they remain fully stocked.*</td><td>(c) This potential strategy was added during the workshop. Plantations previously found to be stocked may subsequently fall back into an NSR status due to tree mortality. A survey program of 4 000 ha/yr is necessary to monitor these areas.</td><td></td></tr>
<tr><td>LT 2</td><td>2. Increase the THLB by:</td><td>2.<table><tr><th></th><th>Area (ha)</th><th>%prod area</th><th>%THLB</th></tr><tr><td>(a) Decid</td><td colspan="3">Included in non-merch</td></tr><tr><td>(b) Non-merch/PFT</td><td>21 700</td><td></td><td>4.9</td></tr><tr><td>(c-d) Low site</td><td>38 500</td><td></td><td>8.8</td></tr><tr><td>(e) NCC</td><td>3 800</td><td></td><td>0.9</td></tr><tr><td>(f) excluded</td><td>27 000</td><td></td><td>6.1</td></tr></table></td><td>2. Summary. Little potential identified other than a possible 0.5% LTHL gain from rehabilitating 2 000 ha of Pl non-merch stands. Surveys of Pl stands required.</td></tr>
<tr><td>LT 2</td><td>(a) converting /rehabilitating ____ ha/yr of deciduous stands; (increase)</td><td>(a) Decid. Part of the excluded category. Important for wildlife and for contributing to biodiversity (MoF, 1999a:26). No opportunity.</td><td>(a) No opportunity.</td></tr>
</table>

Number	Potential Strategy/Action	Discussion / Current Status	Anticipated Result
LT 2	(b) converting/rehabilitating non-merchantable hemlock and cedar stands; (increase)	(b) Non-merch. These stands are mostly short, small diameter Pl (MoF, 1999a:28). Although they equal 4.9% of the THLB some stands may prove merchantable in periods of high pulp prices. The consensus of workshop participants was to initially rehab about 10% of the most non-merch of the stands or 2 000 ha. **Rehab program would be 1 000 ha/yr for 2 yrs**. [Note: Discussion subsequent to the workshop indicated that dropping the rehab program to 400 ha per year was advisable.] **A survey program of 4 000 ha/yr over the next 5 years is needed to assess all stands and select the ones for treatment.**	(b) Rehab 2 000 ha ≅ 0.5% of THLB, ≅ 0.5% increase in LTHL.
LT 2	(c) assessing _____ ha of low-site stands for proper classification; or (d) improve the site productivity of low-site stands by _____ (fertilization?). (increase/maintain)	(c) Low site. Many low site areas have been reclassified and/or included in the THLB. Those that are still excluded are the "worst of the worst." There is no potential for silvicultural treatments to increase the productivity of these stands.	(c-d) No opportunity.
LT 2	(e) rehabilitating areas classified as non-commercial cover (NCC)*.	(e) This potential strategy was added during the workshop. No opportunity	(e) No opportunity.
LT 2	(f) Bringing excluded areas into the THLB.*	(f) This potential strategy was added during the workshop. Excluded areas consist of old, non-merchantable cedar, hemlock, spruce and balsam stands, deciduous stands (see (a) above), or high elevation stands. The old forests can contribute to old growth management areas and biodiversity requirements. No immediate opportunity was identified, however, there is a need to further examine excluded areas for opportunities to bring into the THLB through rehabilitation or reclassification. This need is noted under "Summary of Information and Research Needs," page 56.	(f) No opportunity.
LT 3	3. Increase the volume of regenerated stands by 20% over those used at the base case by:	3.	3. See "Summary" below.
LT 3	(a) site preparing ____ ha/yr.	(a) Current site prep is: Company — ha/yr Galloway 250 SBFEP 200 CFI 1000 Total 1450 Total is about 1500/2400 planted = ≅ 60% of area planted. No additional opportunity.	(a) No opportunity.
LT 3	(b) using improved seed;	(b) All even-aged managed areas are planted (2 400 ha/yr). In 1998 some planted area was improved S but the volume gain is low, estimated between 2 – 12% (average 5%). Some S orchards are showing as much as 22% gain, however. In 2000-01, 20% of all planted areas will use improved seed.	(b) stand level Vol gain – up to 25% GU red'n (7m)– 2 yrs

<table>
<tr><th>Number</th><th>Potential Strategy/Action</th><th>Discussion / Current Status</th><th>Anticipated Result</th></tr>
<tr><td></td><td></td><td>
Future tree improvement gains by 2007 are estimated to be:
<table>
<tr><th>Future% THLB</th><th>Species</th><th>% vol gain (stand level) Now</th><th>2007</th><th>% gain (TSA level)</th><th>seed (million/yr) need</th><th>production</th></tr>
<tr><td>15</td><td>Sx</td><td>5</td><td>14-25</td><td>3</td><td></td><td></td></tr>
<tr><td>10</td><td>Lw</td><td>0</td><td>4</td><td>1</td><td></td><td></td></tr>
<tr><td>60</td><td>Pl</td><td>0</td><td>12*</td><td>7</td><td></td><td>2.0</td></tr>
<tr><td>10</td><td>Fdi</td><td>-</td><td>-</td><td>0</td><td></td><td></td></tr>
<tr><td>Total</td><td></td><td></td><td></td><td>11</td><td></td><td></td></tr>
</table>
*Information available during the workshop was that there were no plans for Pli improved seed for the East Kootenay. Post-workshop follow-up indicated that there should be seed available by 2007. No info available on potential volume gain, so W. Kootenay estimate of 12% used.

About 60% of harvested areas are planted, so the LTHL gain across the entire TSA = .9 X .11 ≅ 10%.

There is substantial variation over the above estimates. For example, some spruce orchards are exhibiting 25% gains. The best of the improved seed for each species should be targeted to areas needing quick green-up.

A need to lobby for more and better improved seed is noted under “Summary of Information and Research Needs,” page 56, along with the need to examine seed planning zone guidelines to expand improved seed into the East Kootenays.

Time to green-up reduction and reduction in minimum harvest ages was not directly estimated in the workshop. Estimates reflect calculations/findings in other TSA’s.
</td><td>
min age red’n - 10 yrs

TSA level
Vol gain – 10%
GU red’n (7m)– - yr
min age red’n - - yrs

See “Summary” below.
</td></tr>
<tr><td>LT 3</td><td>(c) managing stocking so voids do not account for more than 10% of the area; (increase)</td><td>(c) TIPSY standard OAF1 factor for voids is 15%. Objective is to reduce this to 10%. Current free growing requirements will result in < 15% in voids, however the actual amount is unknown. About 30% of the total land area of the TSA is within the THLB. This implies a reasonable amount of favourable terrain, so an OAF1 of 15% may be high. There is a need for completion of surveys for voids to get a measure of the actual area in voids (noted under “Summary of Information and Research Needs,” page 56).

Galloway is spacing dense clumps and fill planting voids in between. The need to survey backlog sites to get better information on voids/clumpiness in these stands, together with their potential for fill planting is noted under “Summary of Information and Research Needs,” page 56). Voids can be desirable for wildlife habitat, so intensive void management may not be practicable on all areas.</td><td>(c) Surveys required. See “Summary” below.</td></tr>
</table>

Number	Potential Strategy/Action	Discussion / Current Status	Anticipated Result
LT 3	(d) using larger planting stock; (increase)	(d) Pre free-growing item, although as considered here could be incremental to achieving free growing. Current practice is to plant 410 or 412 stock. Larger stock is not possible due to shallow/ rocky/cold soils. Concern was expressed about the lack of information on the # of years for trees to reach breast height. This time estimate affects site index equations and estimates of years until green-up hts are reached. The need to examine opportunities to improve this information is noted under "Summary of Information and Research Needs," page 56.	(d) Current practice. No additional opportunity.
LT 3	(e) fertilizing at the time of planting; (increase)	(e) Pre free-growing item, although as considered here could be incremental to achieving free growing. Not presently eligible for FRBC funding and not likely to be voluntarily undertaken unless necessary to achieve FG. Some fert at planting is being done on a trial basis on rehab of roads, landings and skid trails. No other opportunities identified. Note: Results elsewhere are inconclusive. One trial found a general favourable response, but also that certain formulations and certain species had a negative response. Fertilization did not prevent a brushing on brush sites.	(e) No opportunity.
LT 3	(f) brushing _____ ha/y for growth enhancement (i.e., not only for survival); (increase)	(v) Pre free-growing item, although as considered here could be incremental to achieving free growing. Not presently eligible for FRBC funding and not likely to be voluntarily undertaken unless necessary to achieve FG. Brush is not a major factor in the TSA. No opportunities identified.	(f) No opportunity.
LT 3	(g) juvenile spacing _____ ha/yr; (maintain) or	(g) Virtually no basic spacing is necessary. See MT2 (b). With high min harvest ages to obtain merchantable stands, spaced stands can generate considerable MAI gains over unspaced stands. For example, for spruce stands on slopes > 40%, the min avg DBH must be 28 cm before they are considered merchantable (see page 19). TIPSY results in Table 1 on page 45 show that for SI 15 spruce stands, spacing from 3000 sph down to 1200 sph not only achieves a 27.5 cm avg stand DBH 42 years earlier, <u>but also considerably increases MAI (from 2.76 unspaced to 3.29 spaced – an almost 20% increase</u>). This potential for spacing to increase long term harvest levels should be evaluated under Type II silviculture analysis. Noted under "Summary of Information and Research Needs," page 56.	(g) <u>stand level</u> Vol gain – 0% GU red'n – 0yrs min age red'n - 20-45 yrs <u>TSA level</u> Vol gain – ???% GU red'n – 0 yr min age red'n - 15 yrs See "Summary" below.
LT 3	(h) repeat fertilize _____ ha/yr on a 15 yr return cycle.	(h) Estimate that 85% of the TSA could be fertilizable on a species basis (all species, including Pl (46% of THLB), Fdi (11%), Lw (13%) & S (15%) except those classified as "other") and about 60% on a site classification basis (all medium site (60%) and the lower ¼ of good site (15%)). Availability is estimated at 60%. Fertilizable land base = (.85 X .6 X .6 =) 30% of THLB = (.3 X 440 000 =) 132 000. **On a 10 year return cycle, this requires a program of (132 000/10 =) 13 200 ha/yr**. Cost at $200/ha would be $2.6 million/yr. (On a 15 year cycle, would be 8 800 ha/yr at a cost of $1.76 million/yr.) [Discussion subse-	(h) <u>stand level</u> Vol gain – 20% GU red'n – 0 yrs min age red'n - 10 yrs

<table>
<tr><th>Number</th><th>Potential Strategy/Action</th><th>Discussion / Current Status</th><th>Anticipated Result</th></tr>
<tr><td></td><td></td><td>quent to the workshop indicated that a 15 year cycle was advisable.]

Probably 3 applications would be required, with the first occurring after juvenile spacing. Each application is estimated to add 15 m3/ha of growth, so 3 applications yields an additional 45 m3/ha. This is a 20% volume gain on a base stand yield of 225 m3/ha. A 20% volume gain across 30% of the THLB would increase long term harvest levels (0.2 X 0.3 =) 6%.

Guesstimate in the workshop that a repeat fert program giving a 20% stand level volume gain would alternatively enable at least a 10 yr stand level reduction in min ages. If this were applicable across 30% of the THLB, would be a 3 yr min age reduction.

There is little experience in fertilizing spruce or larch. Given that these are major species components of the THLB, fertilization trials are needed to determine if the fertilizable land base should include these species (noted under “Summary of Information and Research Needs,” page 56).</td><td>TSA level

Vol gain – 6%
GU red’n – 0 yr
min age red’n - 3 yr

See “Summary” below.</td></tr>
<tr><td>LT 3</td><td>SUMMARY</td><td>The following summarizes the estimated effects of strategy LT3. Effects at the TSA level are prorated based on the opportunity area as a percentage of the TSA’s THLB. Totals are estimated using best judgement with respect to potential overlapping effects. The volume gain in the form of larger logs and the min age reductions cannot both be captured at the same time. (However, a volume gain in the form of a higher MAI and therefore a higher LTHL can occur at the same time as a min. age reduction.) Benefits must be allocated based on TSA need.

<table>
<tr><th rowspan="2">Strategy</th><th colspan="2">Volume Gain (%)</th><th colspan="2">Green-up age red’n(yrs)</th><th colspan="2">Min Harv. Age red’n(yrs)</th></tr>
<tr><th>Stand</th><th>TSA</th><th>Stand</th><th>TSA</th><th>Stand</th><th>TSA</th></tr>
<tr><td>(a) incr. site prep</td><td colspan="6">no opportunity</td></tr>
<tr><td>(b) improved seed</td><td>14-25</td><td>10</td><td>2</td><td>-</td><td>10</td><td>-</td></tr>
<tr><td>(c) reduce voids</td><td>5</td><td>-</td><td colspan="4">Surveys required</td></tr>
<tr><td>(d) large stock</td><td colspan="6">current practice – no add’l opportunity</td></tr>
<tr><td>(e) fert at planting</td><td colspan="6">no opportunity</td></tr>
<tr><td>(f) brush for growth</td><td colspan="6">no opportunity</td></tr>
<tr><td>(g) spacing</td><td>0</td><td>???</td><td>0</td><td>0</td><td>20-45</td><td>15</td></tr>
<tr><td>(i) repeat fert</td><td>20</td><td>6</td><td>0</td><td>0</td><td>10</td><td>3</td></tr>
<tr><td>Total</td><td>50?</td><td>16?</td><td>2</td><td>0</td><td>30+?</td><td>18+?</td></tr>
</table></td><td>5. Summary

Significant improvement in timber availability.

The objective of increasing the volume of regenerated stands by 20% cannot be fully attained at the above level of program. However, further yield gains may develop depending on the outcome of site index estimation studies and upon the outcome of an expanded tree improvement program or from higher tree improvement program yield gains.</td></tr>
<tr><td>LT 4</td><td>4. Reduce losses to root rot by: (maintain)

(a) pushover logging / stumping_____ ha/yr;

(b) planting alternate species on _____ ha/yr; or

(c) pop-up spacing on _____ ha/yr.</td><td>4. For TSR2, an additional 2% will be added to TIPSY OAF2 factor to account for armillaria root rot (OAF2 will be 7%).

Due to limited time availability in the workshop, root rot management activities were not individually reviewed. Activities (a) and (b) will occur through basic silviculture where necessary. Shallow or calcarious soils often limit the use of stumping.

The need for further study of root rot management and to confirm the OAF2 factor noted under “Summary of Information and Research Needs,” page 56.</td><td>4. N/A</td></tr>
</table>

Number	Potential Strategy/Action	Discussion / Current Status	Anticipated Result
	Long Term Harvest Forecast Summary	Potential Strategy # — Effect **LT1** Backlog NSR — Maintain base case LTHL **LT2** Increase the THLB (a) convert decid — No opportunity (b) rehab non-merch — Rehab 2 000 ha for 0.5% increase in LTHL (c) assess L site classifications — No opportunity (d) fert L site stands — No opportunity (e) rehab NCC — No opportunity **LT3** Incr. regenerated stand vol's — Potential 16% LTHL increase. Better site index estimates & tree improvement may increase this further. **LT4** Root rot — N/A.	
	Conclusion	A 16% LTHL gain can be expected with current tree improvement program plans, plus a very large repeat fertilization program that would commence at a low level and increase gradually as more area becomes occupied by managed stands. Additional tree improvement and possible site index adjustments may increase this further.	

8.3 Potential Harvest Forecast

Workshop and post-workshop analyses indicate the following potential relative harvest forecast for each time period. This forecast is highly speculative and requires confirmation through computer-based modelling and analysis. It also includes silvicultural activities that are not within the traditional scope of incremental silviculture. Modelling may indicate more precise timing, targeting and program levels associated with incremental silviculture activities than could be developed in this interim strategy.

Short Term	Of the potential strategies examined, only late rotation fertilization has the potential to increase harvested volumes in the short term - by 12 000 m3/yr. In situations where harvest levels are forecast to decline, as in the Cranbrook TSA, harvest flow objectives will typically apply the "gain" to extending the current harvest level for a longer period of time. Thus, the short term harvest forecast can be expected to be similar to the RLUPS forecast. Even if not harvested under an increased AAC, increasing timber volume in the 2nd decade also improves overall timber availability and improves the likelihood that the RLUPS forecast will be attainable.
Mid Term	The potential exists to add 21 600 m3/yr (1.7 million m3 total) to mid-term harvest levels through programs of spacing and fertilization. Significant opportunities exist to increase timber supply availability, particularly in the latter part of the mid term period.
Long Term	A 16% LTHL gain can be expected with current tree improvement program plans, plus a very large repeat fertilization program that would commence at a low level and increase gradually as more area becomes occupied by managed stands. Additional tree improvement and possible site index adjustments may increase this further.

A graphical representation of the potential harvest forecast is not available, pending TSR2 analysis results.

9. Opportunities to Improve Timber Quality

The effects of incremental silviculture on the future quality of the timber resource is not analyzed in the timber supply review. Information in this section was gathered during the district working session.

9.1 Product Objectives

The following are product objectives at the log level for the Cranbrook TSA.

Quality Class	Species	Characteristics
Premium Log:	All	32.5+ cm minimum average stand diameter at breast height (DBH).
Sawlog:	All	27.5+ cm minimum average stand DBH.

9.2 Potential Strategies by Response Time Frame

The following strategies have potential to increase timber quality. These were identified in the district working session, except the large log calculation was performed later. 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 older 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 - 100 yrs)	As above.	As above.	As above.	Steady decline to long term level.
Long Term (101 + yrs)	Q1. space _____ ha/yr to increase average stand $DBHg_{all}$ from ___ cm to ___ cm.	Q1. Spacing for quality strategies are intertwined with spacing for volume. See MT2(b).		
	Q2. 1st lift prune __ ha/yr to 3.5 m.	2. Max historic program has been 200 ha/yr. Currently 1,216 ha have been 1st lift pruned. An annual program of 200 ha/yr would equal (200/4000 ha/yr harvested =) 5% of THLB. If 3.5 m = 15% of tree vol, (.05 X .15 =) 1%/yr of future harvest volume will be clear logs resulting from pruning. There is a concern about being able to track pruned stands so that their value can be captured at harvest.	2.	1% clear log content. See also the large log analysis below.

9.3 Large Premium Log Analysis

Two large log analyses are reported below, both based on an annual spacing program of 1 200 ha/yr. This is equal to spacing one-half of the 2 400 hectares harvested and planted annually under an even-aged management system. The tables do not include an estimate for the premium log content from harvests in the uneven-aged management zone.

All tables were generated using TIPSY version 2.1e with standard OAF's, to a 12.5 cm utilization standard for all species. Because TIPSY has no mechanism for in-growth following planting, unspaced stands having a stocking level of 5 000+ sph were assumed to be naturally regenerated. Stands with a stocking level of ≤ 3 000 sph were assumed to be planted. The difference between the # sph actually planted and the # used in the table is assumed ingrowth (e.g.; 3 000 sph planted = 1 400 sph planted + 1 600 sph ingrowth).

The tables are based on the expected future species mix derived from Petryshen (1999). The site indices used are weighted averages from Martin (1999) and can be considered inclusive of an OGSI site index adjustment. They do not, however, incorporate gains from stand management activities proposed under the strategies to improve the quantity of future timber supply.

Table 1 illustrates the effects of spacing on achieving a technical rotation (sawlog target of 27.5 cm DBH). For example, rows 3 & 4 show that by spacing a Pl stand from 5 000 sph to 1 300 sph, a 27.5 cm DBH avg diameter target can be reached 51 years earlier, at 115 years vs at 166 years for the unspaced stand. The MAI of the spaced Pl stand is 26% higher than that of the unspaced stand, indicating that spacing would also substantially increase the harvest level over time at this technical rotation. Under the assumptions employed, even with spacing, only **5.1%** (row 20) of annual harvested volumes in the long term will be large premium logs (32.5+ cm DBH). This number is probably higher than can be expected, given that it is based on harvest ages that are well in excess of the average harvest age of about 120 years indicated in the TSR1 analysis (MoF, 1995:23).

Table 2 shows the effects of managing stands to younger harvest ages (Pl – 65, other species – 90). This would be representative of the harvest profile at about the time of transition from existing stands to managed stands, about 90-100 years from now, with minimum harvest ages reduced about 15 years below culmination for Pl and about 30 years for other species. Under this scenario the large premium log content falls to **0.9%**. Offsetting this, Table 2 shows that, at younger harvest ages, spacing significantly reduces the number of smaller trees in the stand and increases those in the middle size range, while still maintaining about the same overall stand volume. For example, spacing Pl from 9 000 sph to 1 600 sph (row 2 vs row 1) reduces the # stems/ha in the 15-20 cm class by over 300 and almost doubles the # stems/ha in the 25-30 cm DBH class from 195 to 356 sph. Total stand volume at 1 600 sph is 12 m3 greater than at 9 000 sph. Average stand DBH increases by almost 5 cm, creating a merchantable stand, whereas the unspaced stand would not be merchantable. Also significant, the MAI of the spaced stand at the target harvest age of 65 years is the same as that of the unspaced stand at 80 years.

With regard to Fdi, Table 2 TIPSY results indicate that MAI changes very little across the range of stocking levels shown in the table at age 90. Diameter distributions, however, are significantly affected by stocking. An unspaced stand with 3 000 sph at establishment has 44% of its stems below the 12.5cm merchantability limit. Were the limit 17.5, which is current practice, likely more than 50% of total stems would not be merchantable. This has some implications to harvesting costs, fire hazards, plantability, aesthetics, etc. and depending on the local situation may or may not be relevant to the decision to space. More relevant to log quality and harvesting costs is the shift in of the number of stems in the smallest merchantability group (15-20 cm) into the mid-range group (25-30 cm). Spacing from 3 000 sph down to 900 sph, for example, reduces the number of stems and the % total volume in the smallest merchantable size grouping by about half. Unspaced, fully 60% of the stand's volume is

in the smallest diameter grouping, while, with spacing, this falls to about 30% of total volume. At the same time, the volume in the mid-sized grouping (25-30 cm) increases by more than 2/3rd's.

For spruce, Table 2 indicates spacing again significantly reduces the number of stems in the non-merch and small-merch diameter groups, but, differently from Pl and Fdi, significantly shifts volume into the large-diameter group (from 5% of total volume of unspaced stands to 20% spaced). The spaced stand, however, has 17m3/ha (6%) less total volume than the unspaced stand.

Table 1. Large log analysis – 27.5 cm DBH target harvest diameter

	Target - 27.5 cm DBHg						Reference			Target				Total		Largest 250		DBH class[1]												5m large
Row	Species	%inv	SI[2]	Regime	Area	Space frm/to:	Cul	Cul	Cul	DBHg	Harv	MAI	LRF	Vol	Trees	Vol	DBHg	0 - 10 cm		15 - 20 cm				25 - 30 cm				35+ cm				log [3]-
#				spaced	no space		Age	Vol	MAI	-all	Age		bf/m3	(12.5cm util)				# trees	% tot trees	# trees	% tot trees	vol	% tot vol	# trees	% tot trees	vol	% tot vol	# trees	% tot trees	vol	% tot vol	% tot hrvst vol
1	**Pl**	**60**	**18**	**360**		**nat9000/1600**	**78**	**292**	**3.74**	**27.5**	**142**	**3.01**	**252**	**490**	**784**	**231**	**34.5**	**2**	**0**	**186**	**24**	**44**	**9**	**467**	**60**	**251**	**51**	**128**	**16**	**130**	**27**	**1.0**
2	comparison					nat9000/unspaced	80	286	3.58	27.5	187	2.33	257	435	693	261	34.6	0	0	177	26	50	11	397	57	243	56	119	17	143	33	N/A
3				**220**		**nat5000/1300**	**82**	**285**	**3.48**	**27.5**	**115**	**3.26**	**243**	**375**	**761**	**206**	**34.6**	**2**	**0**	**204**	**27**	**43**	**11**	**413**	**54**	**204**	**54**	**142**	**19**	**127**	**34**	**0.8**
4	comparison					nat5000/unspaced	79	286	3.62	27.5	166	2.58	258	429	724	245	34.5	1	0	189	26	52	12	405	56	239	56	128	18	139	32	N/A
5	comparison					nat5000/900	89	289	3.25	27.5	84	3.24	231	272	650	161	33.5	5	1	144	22	27	10	381	59	161	59	119	18	86	32	N/A
6				**140**		**plt3000/900**	**81**	**270**	**3.34**	**27.5**	**85**	**3.33**	**229**	**283**	**667**	**162**	**33.3**	**6**	**1**	**146**	**22**	**27**	**10**	**405**	**61**	**174**	**61**	**101**	**15**	**82**	**29**	**0.4**
7					**360**	**plt3000/unspaced**	**74**	**269**	**3.64**	**27.5**	**187**	**2.21**	**248**	**414**	**689**	**247**	**34.3**	**0**	**0**	**166**	**24**	**46**	**11**	**407**	**59**	**237**	**57**	**116**	**17**	**130**	**31**	**1.2**
8					**360**	**plt2000/unspaced**	**75**	**272**	**3.63**	**27.5**	**167**	**2.48**	**244**	**414**	**748**	**233**	**34.4**	**0**	**0**	**176**	**24**	**45**	**11**	**448**	**60**	**242**	**58**	**123**	**16**	**127**	**31**	**1.2**
9	Subtot.			720	720																										4.5
10	**Fd/L**	**20**	**16**	**240**		**plt3000/1200**	**129**	**298**	**2.31**	**27.5**	**183**	**2.18**	**245**	**400**	**726**	**299**	**38.6**	**38**	**5**	**275**	**38**	**44**	**11**	**208**	**29**	**113**	**28**	**205**	**28**	**242**	**61**	**1.5**
11	comparison					plt3000/unspaced	126	295	2.34	27.5	exceeds TIPSY data: max's out at DBHg =25.3 at age 229								#####		#####		#####		#####		#####		#####		#####	N/A
12	alternative					plt3000/900	132	298	2.26	27.5	145	2.25	238	326	633	234	35.8	25	4	186	29	31	10	263	42	139	43	161	25	158	48	N/A
13					**240**	**plt1600/unspaced**	**130**	**296**	**2.28**	**26.9[5]**	219	**2.00**	**251**	**438**	**816**	**339**	**40.2**	**48**	**6**	**365**	**45**	**57**	**13**	**193**	**24**	**106**	**24**	**211**	**26**	**275**	**63**	**1.6**
14	Subtot.			240	240																										
15	**Sw,Bl[4]**	**20**	**15**	**240**		**plt3000/1200**	**118**	**388**	**3.29**	**27.5**	**118**	**3.29**	**239**	**388**	**798**	**228**	**36.4**	**12**	**2**	**249**	**31**	**49**	**13**	**366**	**46**	**176**	**45**	**171**	**21**	**162**	**42**	**1.0**
16	comparison					plt3000/unspaced	106	356	3.36	27.5	160	2.76	246	441	767	269	36.4	2	0	240	31	57	13	374	49	208	47	151	20	176	40	N/A
17					**240**	**plt1600/unspaced**	**114**	**384**	**3.37**	**27.5**	**146**	**3.06**	**243**	**447**	**848**	**255**	**36.8**	**4**	**0**	**260**	**31**	**56**	**13**	**416**	**49**	**210**	**47**	**169**	**20**	**180**	**40**	**1.0**
18	Subtot.			240	240																										
19																															
20	**Total**			**1200**	**1200**																										**5.1**

[1] Actual ranges are 0 - 12.5 cm, 12.6 - 22.5 cm, 22.6 - 32.5, and 32.6 + cm

[2] From Martin, 1999. *ISIS Polygon Area by Site Index Class*

[3] 1st 5 m log assumed to be 25% of tree volume. Volume calculated is a % of total harvest volume based on proportion of annual harvested area under a particular regime, **not** a % of stand volume.

[4] Modeled as all planted Sw due to TIPSY limitations.

[5] Exceeds TIPSY data: max's out at DBHg =26.9 at age 219

Table 2. Large log analysis - Target harvest ages

	Target - Harvest at age 90 (Pl - 65)																																
							Reference (12.5cm)				Target			Total		Largest 250		DBH class[1]														5m large
Row	Species	%inv	SI[2]	Regime	Area	Space frm/to:	Cul	Cul	Cul	DBHg	Harv	MAI	LRF	Vol	Trees	Vol	DBHg	0 - 10 cm		15 - 20 cm				25 - 30 cm				35+ cm				log [3]-
#				spaced	no space		Age	Vol	MAI	-all (0.0+)	Age	(12.5cm util)	bf/m3	(12.5cm util)	-all (0.0+)	(12.5cm util)	(12.5cm util)	# trees	% tot trees	# trees	% tot trees	vol	% tot vol	# trees	% tot trees	vol	% tot vol	# trees	% tot trees	vol	% tot vol	% tot hrvst vol
1	**Pl**	**60**	**18**	**360**		**nat9000/1600**	**78**	**292**	**3.74**	**20.5**	**65**	**3.58**	**203**	**233**	**1145**	**99**	**27.2**	**99**	**9**	**683**	**60**	**106**	**45**	**356**	**31**	**123**	**53**	**6**	**1**	**4**	**2**	**0.1**
2	comparison					nat9000/unspaced	80	286	3.58	15.8	65	3.39	195	221	1959	91	25.1	769	39	992	51	147	67	195	10	73	33	2	0	2	1	N/A
3				**220**		**nat5000/1300**	**82**	**285**	**3.48**	**22.0**	**65**	**3.26**	**207**	**212**	**928**	**104**	**28.8**	**71**	**8**	**462**	**50**	**71**	**33**	**373**	**40**	**128**	**60**	**22**	**2**	**14**	**7**	**0.2**
4	comparison					nat5000/unspaced	79	286	3.62	17.2	65	3.45	195	224	1648	93	26.0	464	28	925	56	133	59	247	15	87	39	5	0	4	2	N/A
5	comparison					nat5000/900	89	289	3.25	24.8	65	2.99	215	194	675	112	30.4	18	3	229	34	37	19	387	57	133	69	40	6	24	12	N/A
6				**140**		**plt3000/900**	**81**	**270**	**3.34**	**25.0**	**65**	**3.16**	**213**	**205**	**688**	**115**	**30.3**	**14**	**2**	**222**	**32**	**36**	**18**	**412**	**60**	**145**	**71**	**41**	**6**	**25**	**12**	**0.2**
7					**360**	**plt3000/unspaced**	**74**	**269**	**3.64**	**17.4**	**65**	**3.53**	**185**	**226**	**1673**	**92**	**25.7**	**421**	**25**	**1014**	**61**	**144**	**64**	**235**	**14**	**84**	**37**	**3**	**0**	**2**	**1**	**0.0**
8					**360**	**plt2000/unspaced**	**75**	**272**	**3.63**	**19.3**	**65**	**3.51**	**190**	**228**	**1339**	**94**	**26.6**	**177**	**13**	**853**	**64**	**122**	**54**	**302**	**23**	**102**	**45**	**6**	**0**	**3**	**1**	**0.0**
9	Subtot.			720	720																												0.5
10	**Fd/L**	**20**	**16**	**240**		**plt3000/1200**	**129**	**298**	**2.31**	**20.1**	**90**	**2.12**	**195**	**190**	**878**	**109**	**26.9**	**130**	**15**	**478**	**54**	**81**	**43**	**264**	**30**	**105**	**55**	**6**	**1**	**5**	**3**	**0.1**
11	comparison					plt3000/unspaced	126	295	2.34	15.6	90	2.17	181	195	1669	98	25.1	735	44	747	45	120	62	185	11	75	38	2	0	1	1	N/A
12	comparison					plt3000/900	132	298	2.26	22.2	90	2.03	203	183	673	114	27.7	44	7	322	48	57	31	297	44	118	64	9	1	6	3	N/A
13					**240**	**plt1600/unspaced**	**130**	**296**	**2.28**	**18.2**	**90**	**2.09**	**190**	**188**	**1117**	**99**	**25.7**	**238**	**21**	**674**	**60**	**107**	**57**	**198**	**18**	**76**	**40**	**8**	**1**	**6**	**3**	**0.1**
14	Subtot.			240	240																												
15	**Sw/Bl[4]**	**20**	**15**	**240**		**plt3000/1200**	**118**	**388**	**3.29**	**23.6**	**90**	**2.94**	**217**	**265**	**898**	**143**	**31.7**	**48**	**5**	**413**	**46**	**68**	**26**	**367**	**41**	**144**	**54**	**71**	**8**	**52**	**20**	**0.5**
16	comparison					plt3000/unspaced	106	356	3.36	18.6	90	3.13	193	282	1623	120	28.3	332	20	960	59	143	51	312	19	169	60	20	1	15	5	N/A
17					**240**	**plt1600/unspaced**	**114**	**384**	**3.37**	**21.5**	**90**	**3.04**	**207**	**274**	**1168**	**127**	**29.9**	**85**	**7**	**659**	**56**	**102**	**37**	**391**	**33**	**147**	**54**	**33**	**3**	**26**	**9**	**0.2**
18	Subtot.			240	240																												
19																																	
20	**Total**			**1200**	**1200**																												**0.9**

[1] Actual ranges are 0 - 12.5 cm, 12.6 - 22.5 cm, 22.6 - 32.5, and 32.6 + cm

[2] From Martin, 1999. *ISIS Polygon Area by Site Index Class*

[3] 1st 5 m log assumed to be 25% of tree volume. Volume calculated is a % of total harvest volume based on proportion of annual harvested area under a particular regime, **not** a % of stand volume.

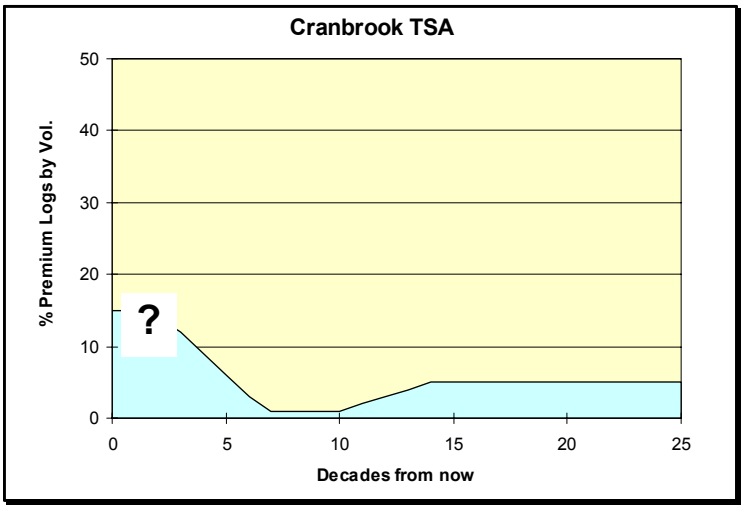
[4] Modeled as all planted Sw due to TIPSY limitations.

9.4 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. In the absence of more precise analysis, it is assumed that premium log content will fall to about 1% in the later mid term and recover to about 5% in the long term. Contributions from partially harvested areas may increase these estimates slightly. Data for the current local percentage of harvest that is in premium logs is not available, but could readily be obtained from local sawmills. In the interim it is assumed to be about 15%, the figure used in the provincial interim strategy document (MoF, 1999).

Postponing harvest to ages that are past culmination age would increase the large dimension component of premium logs.

Figure 6. Potential Quality Forecast, Cranbrook TSA



This quality forecast is for a combination of clear logs and large-premium logs. Best estimate is that large premium logs will likely form 1-5% of future harvests.

Clear logs could form about 1% of future harvest volumes (based on 1st lift pruning 200 ha/yr). Most clear logs will also be large logs. Without pruning there will be no clear logs from the majority of the 2nd growth forests.

10. Incremental Silviculture Strategy

This section synthesizes the preceding background information, workshop discussion and post-workshop analysis into an incremental silviculture strategy for the TSA.

10.1 General Strategy

Because the TSR2 analysis is not yet available it is difficult to identify with any precision both the silvicultural opportunities and their relative importance. In its stead, the workshop participants relied on their own local knowledge of issues and opportunities as well as some indication of what TSR2 may look like based on the RLUPS forecast. The RLUPS forecast is considerably more optimistic than the TSR1 forecast in that it suggests the existing harvest level can be maintained for many decades. In contrast, forest companies are having difficulty finding available wood for harvest, the major reasons being the low merchantability of heavily stocked younger mature Pl stands and the unavailability of older mature stands due to their being reserved to meet forest cover requirements for older forests. The first objective of this strategy, therefore, is to undertake silvicultural actions that will enhance short term timber supply, both in terms of availability and physical extent. Workshop analysis indicates there is a substantial late rotation fertilization opportunity.

The is some uncertainty about whether a mid term harvest shortfall will occur. Both the TSR1 and the RLUPS forecasts indicate one. However, the TSR1 forecast is strongly influenced by an age class gap that does not exist and the RLUPS forecast shows a shortfall very late in the planning horizon, which is difficult to explain. Nevertheless, the shortage of older forests would indicate that a mid term shortfall will be likely because there is not sufficient older forest to span the time until managed 2nd growth stands become available for harvest. A mid term objective, therefore, is to increase the quantity of the timber to be available for harvesting in this time period. Programs of spacing, and fertilization can accomplish this.

In the long term, starting about 100 years from now, workshop analysis indicates improved estimates of the productivity of forest land as well as silvicultural activities can result in harvest levels of at least equal to if not greater than current levels. Confirmation of this, however, must await TSR2 analysis. In the absence of this analysis, a long term objective is to maximize timber production within a context of sound multiple resource stewardship. Workshop analysis indicates that silvicultural activities can contribute significantly to this objective.

Based on a clear log definition of being able to produce 25% clear lumber by volume, 2nd growth managed stands will have no clear logs. A second long term objective is to create a long term timber supply yielding at least 1% clear logs on a total harvest volume basis.

Accomplishing these objectives requires an incremental silviculture program substantially above historic levels. Some changes in basic silviculture activities also present opportunities to contribute to the objectives.

10.2 Log Product Objectives

The following are product objectives at the log level for the Cranbrook TSA.

Quality Class	Species	Characteristics
Premium Log:	All	32.5+ cm minimum average stand diameter at breast height (DBH).
Sawlog:	All	27.5+ cm minimum average stand DBH.

10.3 Silviculture Strategies

The following strategies have identified potential to maintain and/or increase the quantity and quality of the timber supply of the Cranbrook TSA. Strategy numbers correspond with those recorded earlier.

10.3.1 Strategies to Increase the Quantity and Quality of Future Timber Supply

Some of the following are not within the traditional scope of incremental silviculture but are included here for completeness. Some practices are pre free-growing and are not likely to be undertaken by licensees without funding assistance if free growing obligations can be achieved without them.

These strategies are supported by specific silvicultural regimes listed on page 52 along with investment priorities.

No.	Strategy	Priority
Surveys	Conduct approximately 18 000 ha/yr of silviculture surveys in support of all strategies.	0

SHORT TERM

Objectives:

- enhance short term timber supply, both in terms of availability and physical extent.

Working Targets:

- Maintain the current harvest level for at least 20 years.

Strategies:

ST1 Late rotation fertilize 800 ha/yr to produce approximately 12 000 m3/yr of additional harvest volume by the 2nd decade. (2)

No.	Strategy	Priority

MID TERM

Objectives:

- Increase the quantity of timber to be available for harvesting.
- Improve the quality of the timber to be harvested.

Working Targets:

- Generate an additional 1.7 million m3 to mid-term timber supply.

Strategies:

MT1	Late rotation fertilize 1 600 ha/yr to produce approximately 9 000 m3/yr of additional timber.	4.5
MT2	Reduce minimum harvest ages of younger existing stands 10 years, or alternatively improve the quality of the timber supply, by:	
(b1)	Spacing 8 000 ha of stands harvested before 1987 having a stocking level > 6 000 sph at the rate of 800 ha/yr.	4
(b2)	Spacing stands harvested after 1987 having a stocking level > 6 000 sph at the rate of 1 000 ha/yr.	4
(b3)	Spacing stands having a stocking level < 6 000 sph at the rate of 1 000 ha/yr.	7
(c)	fertilizing 3 800 ha/yr on a 15 year repeat cycle.	4.5

LONG TERM

Objectives:

- Maximize long term timber production within a context of sound multiple resource stewardship.
- Improve the quality of the timber to be harvested.

Working Targets:

- Increase long term timber supply by at least 16%.
- Generate at least 5% of total harvest volume in premium large logs (no current silviculture strategy implications).
- Generate at least 1% of total harvest volume in clear premium logs (clear logs will generally also be large logs).

Strategies:

LT1	Maintain the timber harvesting land base by:	
(a)	Treating approximately 1 250 ha of backlog NSR.	1
(b)	Maintaining approximately 1 300 ha of previously reforested backlog plantations.	5

No.		Strategy	Priority
	(c)	Survey 4 000 ha/yr of pre-1987 SR area to ensure they remain fully stocked.	4
LT2		Increase the timber harvesting land base by 0.5% by:	
	(b1)	Rehabilitating 400 ha of non-merch Pl stands at the rate of 1 000 ha/yr.	3
	(b2)	Survey 20 000 ha of problem forest type areas at the rate of 4 000 ha/yr for 5 years.	1
LT3		Increase the volume of regenerated stands by 16% by:	
	(b)	By 2007, expanding the use of improved seed to include Pl, with the expected result of a 10% gain in LTHL.	0.5
	(h)	Repeat fertilizing 1 600 ha/yr, rising gradually over about 60 years to 13 200 ha/yr as more stands come under management, for an expected result of a 6% gain in LTHL. (Note: The initial 1 600 ha/yr are the same stands as in M1. This rises to 3 800 ha/yr under MT2 (c).)	4.5
Q2		First-lift prune 200 ha/yr.	8

10.3.2 Working Target Illustration

A graphical representation of the potential harvest forecast is not available, pending TSR2 analysis results.

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

The following strategy has identified potential to increase the quality or quantity of the habitat supply of the Cranbrook TSA.

No.	Strategy	Priority
	No specific strategies proposed at this time. See “Silviculture Regimes and Investment Priorities,” page 52 for implications of specific silvicultural activities for habitat.	

11. Silviculture Regimes and Investment Priorities

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

Regimes	Strategy	Opportunity Area	Opportunity Area (Ha/Yr)	Timber Supply Effects Short	Medium	Long	Quality	Habitat	Jobs Days/ha	Cost $/ha[1]	Wkshp Rank
1 Surveys (general)		19350	19350						0.1	20	1
Survey - PFT	L2b	4000	4000						0.3	60	3
Survey - pre 1987 SR	L1c	4000	4000						0.1	20	6
2 Backlog reforestation	L1a	400	400 /3yr		++	+++			3	1500	3
3 Backlog brushing	L1b	250	250		++	+++		+/-	2.5	600	8
4 Rehab PFT	L2b	1000	1000	-	++	+++		+/-	3	2000	5
5 improved seed	L3b	1440	1440						0	70	2
6 space younger existing stands	Q1, M2b	800	800-1800		+++		+		2	500	6
7 space sph < 6000	M2b	1000	1000		+++		+		1.5	500	9
8 fertilization repeat	L3h, M1, M2c	2000	1600-13200		+++	++			0.02	200	7
9 fertilze existing late rotation	S1,M1c	800	800	+	+				0.02	300	4
10 Pruning 1st lift	Q2	200	200				+++		4	800	10

12. Incremental Silviculture Program

The following annualized program will contribute to achieving the above goals and strategies. This program is considerably above historic levels and some activities may require phasing in.

Program Table - Ha, Cranbrook TSA.

		Backlog		Rehab	Improved	Space	Prune	Fertilize	
Year	Surveys*	Establish	Maintain	PFT	Seed	-	-	-	Total
1	27,350	400	250	1,000	1,440	1,800	200	2,800	33,800
2	27,350	400	250	1,000	1,440	2,050	200	2,800	34,050
3	27,350	400	250	1,000	1,440	2,300	200	2,800	34,300
4	27,350	-	250	1,000	1,440	2,550	200	2,800	34,150
5	27,350	-	250	1,000	1,440	2,800	200	2,800	34,400
Subtot Yr 1 - 5	136,750	1,200	1,250	5,000	7,200	11,500	1,000	14,000	170,700
6 - 10	136,750	-	1,250	5,000	7,200	14,000	1,000	14,000	179,200
Total Yr 1 - 10	273,500	1,200	2,500	10,000	14,400	25,500	2,000	28,000	357,100

* Includes prescription and layout

Program Table - $ 000s, Cranbrook TSA.

		Backlog		Rehab	Improved	Space	Prune	Fertilize	
Year	Surveys*	Establish	Maintain	PFT	Seed	-	-	-	Total
1	707	600	150	2,000	101	900	160	1,480	6,098
2	707	600	150	2,000	101	1,025	160	1,480	6,223
3	707	600	150	2,000	101	1,150	160	1,480	6,348
4	707	-	150	2,000	101	1,275	160	1,480	5,873
5	707	-	150	2,000	101	1,400	160	1,480	5,998
Subtot Yr 1 - 5	3,535	1,800	750	10,000	504	5,750	800	7,400	30,539
6 - 10	3,535	-	750	10,000	504	7,000	800	7,400	29,989
Total Yr 1 - 10	7,070	1,800	1,500	20,000	1,008	12,750	1,600	14,800	60,528

13. 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.

Short term employment associated with undertaking the silviculture activity, in person years, Cranbrook TSA.

		Backlog		Rehab	Improved	Space	Prune	Fertilize	
Year	Surveys*	Establish	Maintain	PFT	Seed	-	-	-	Total
1	17.7	6.0	3.1	15.0	-	15.5	4.0	0.3	62
2	17.7	6.0	3.1	15.0	-	17.7	4.0	0.3	64
3	17.7	6.0	3.1	15.0	-	19.8	4.0	0.3	66
4	17.7	-	3.1	15.0	-	22.0	4.0	0.3	62
5	17.7	-	3.1	15.0	-	24.1	4.0	0.3	64
Subtot Yr 1 - 5	88.4	18.0	15.6	75.0	-	99.0	20.0	1.4	317
6 - 10	88.4	-	15.6	75.0	-	120.6	20.0	1.4	321
Total Yr 1 - 10	176.8	18.0	31.3	150.0	-	219.6	40.0	2.8	638

Note: Assumes 200 days of harvesting, silviculture work, and timber processing = 1 job

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

Decade	Harvest Increment ('000 m3)	Incremental Jobs per year Region[2]	Incremental Jobs per decade Region[2]
1	(158)	(621)	(6,209)
2	(158)	(621)	(6,209)
3	(158)	(621)	(6,209)
4	(158)	(621)	(6,209)
5	(158)	(621)	(6,209)
6	(158)	(621)	(6,209)
7	(204)	(802)	(8,017)
8	(204)	(802)	(8,017)
9	(116)	(456)	(4,559)
10	(116)	(456)	(4,559)
11	(40)	(157)	(1,572)
12	(40)	(157)	(1,572)
13	(40)	(157)	(1,572)
14	(40)	(157)	(1,572)
15	(40)	(157)	(1,572)
16	(128)	(503)	(5,030)
17	(167)	(656)	(6,563)
18	(167)	(656)	(6,563)
19	(167)	(656)	(6,563)
20	(167)	(656)	(6,563)
21	(167)	(656)	(6,563)
22	(167)	(656)	(6,563)
23	(167)	(656)	(6,563)
24	(167)	(656)	(6,563)
25	(167)	(656)	(6,563)
Total			(134,367)

Notes:

1. Assumes continuation of the silviculture 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 strategy development.

2. Assumes 3.93 TSA level direct (harvesting, silviculture, processing), indirect and induced (PYs) per 1000 cubic metre. (Source: TFL 23 MP #9 Timber Supply Analysis Report, p.39)

14. 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 "Workshop Review of Potential Strategies," page 28).

15. Undertake fertilization trials to examine the potential of fertilization to bring age class 3 Pl to merchantable size sooner. (ST2B)
16. Compare the actual growth and piece sizes (diameters?) of age class 4 Pl with those projected by VDYP. (ST2B)
17. Following TSR2 analysis, further examine the impacts/potential of spacing to determine which are the most cost-effective treatments (what landscape units, sites, species). (MT2 (b))
18. Following TSR2 analysis, examine grizzly bear and ungulate winter range impacts and opportunities. (MT3)
19. Undertake operational partial harvesting and commercial thinning trials, so that the necessary G&Y information will be available when the managed stands become suitable. (MT4)
20. Examine excluded areas for opportunities to bring into the THLB through rehabilitation or reclassification. (LT2)
21. Lobby for more and better improved seed. (LT3 (b))
22. Examine seed planning zone guidelines for opportunities for modification to expand improved seed into the East Kootenays. (LT3 (b))
23. Complete surveys for voids to get a measure of the actual area in voids. (LT3 (c))
24. Survey and assess backlog sites to get better information on stocking distribution into voids and clumps, together with their potential for fill planting the void areas and spacing the clumpy areas. (LT3 (c))
25. Improve information on the # of years for trees to reach breast height. (LT3 (d))
26. Evaluate the potential for spacing to increase long term harvest levels under Type II silviculture analysis. (LT3 (g))
27. Fertilization trials are needed to determine if the fertilizable land base should include spruce and larch species. (LT3 (h))
28. Further study of root rot management and to confirm the OAF2 factor. (LT4)

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16. Abbreviations

The following abbreviations may be used.

AAC	allowable annual cut
CF	chief forester
CT	commercial thinning
DBH	diameter at breast height
ESSF	engelmann spruce - subalpine fir (ecological zone)
FCC	forest cover constraints
FG	free growing
FMER	fire maintained ecosystem restoration
FRBC	Forest Renewal BC
ICH	interior cedar-hemlock (ecological zone)
IHL	initial harvest level
IRM	integrated resource management
KBLUP	Kootenay-Boundary Land Use Plan
LT	long term
LTHL	long term harvest level
LRSY	long run sustained yield
MLSIS	major licensee silviculture information system
MoELP	Ministry of Environment, Lands and Parks
MoF	Ministry of Forests
MS	montane spruce (ecological zone)
MT	mid term
NCBr	non-commercial brush
NSR	not satisfactorily restocked
OAF	operational adjustment factor
OLB	operable land base
PCRS	planning cell reporting system
RLUPS	regional landscape unit planning system
SBFEP	small business forest enterprise program
SI	site index
ST	short term
TFL	tree farm licence
THLB	timber harvesting land base
TIPSY	table interpolation program for stand yields
TSA	timber supply area
TSR	timber supply review
VDYP	variable density yield projection
VQO	visual quality objective
WT	working target

Species abbreviations: B or Ba - balsam fir; Cw - western redcedar; Fd - Douglas-fir; Fdi - interior Douglas-fir; Hw - western hemlock; Pl - lodgepole pine; S - spruce species.

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