

**Preferred Silviculture Program
for the
Cranbrook Timber Supply Area**

Prepared for:
Ministry of Forests
Cranbrook Forest District

May 2002

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Preferred Silviculture Program for the Cranbrook Timber Supply Area

1. Introduction

This document describes a Preferred Silviculture Program for the Cranbrook TSA. The intention of the program is to assist forest planners in the selection of silviculture management regimes that provide the greatest net benefit to the TSA.

This Report has evolved through a defined process. Initially, several potentially beneficial silviculture management regimes were formulated and discussed amongst forestry stake-holders residing in the Cranbrook TSA. These discussions led to the development of a Type I Silviculture Strategy. Management regimes identified in the Silviculture Strategy were conceived with three objectives in mind:

- Increase or maintain the current, mid-term and future timber supply,
- Maintain or improve timber quality,
- Improve wildlife habitat.

Direction from the Type I Silviculture Strategy was used to develop a Type II Silviculture Analysis that quantitatively and to some extent qualitatively, analyzed the impact of several management regime options. The Type II Analysis Report for the Cranbrook TSA was completed in April 2002. This Report provided the framework for the development of a preferred list of silviculture management regimes; and ultimately in the selection of a preferred silviculture program for the TSA.

2. Working towards a Preferred Silviculture Program

The results from a Type II Forest Estate Analysis in support of an Incremental Silviculture Program for the Cranbrook TSA, Industrial Forestry Service Ltd, April 2002 were used in the development of this report. Specifically, Section 5 of the Type II Analysis provided tabular descriptions of the value and cost of each of the silviculture management regimes investigated. The value of each management regime was completed using the quantitative results of the Analysis Report, as well as subjective evaluation of social and economic factors. The cost of each regime was determined using \$/ha estimates from the Type I Silviculture Strategy and the amount of treatable area quantified in the Type II Analysis.

The cost and value of each silviculture management regime was described in Tables 4

and 5 of the Type II Analysis Report. For convenience, both Tables 4 and 5 have been appended to this report.

Table 1 below consolidates Tables 4 and 5 and re-organizes the information in order of ranking preference. The result is a working table from which to allocate treatment area and funding. The distribution of the budget is influenced by the ranking of the treatment regimes and a desire to diversify investments between several management options. In addition to the three primary objectives noted on page 1, consideration was also given employment opportunities.

Table 1 Preferred Incremental Silviculture Program

Silviculture Regime		Point Ranking above the Base Case ¹	Treatment Area (ha/year) ²	Budget Allocation ³ (,000's \$/year)	Proportion of Budget (%)	Silviculture Employment ⁴ (FTE jobs/yr)
1	Data Base Record Keeping & Harvest Scheduling	n/a	n/a	100	7.33	0
2	Plant Class A Seed	8	1500	105	7.69	0
3	Stand Rehabilitation	8	200	400	29.3	3
4	Space (PCT) with / Early Fertilization 3 applications	7	500	350	25.64	5.05
5	Pre-Harvest Fertilization of unmanaged stands ⁵	5	1000	200	14.65	0.1
6	Pre-commercial Thinning (PCT with no fertilization)	5	300	150	10.99	3
7	Clumpy Planting	3	200	60	4.4	2
Total Proposed Budget			3700	1365	100	13.15

Notes:

1. The Base Case resulted in a point ranking value of 9. This column denotes the relative value of the regime above the Base Case. See Table 4 in Appendix I for more information on the ranking scheme.
2. Treatment Area was determined subjectively.
3. Budget allocation was calculated by multiplying the treatment area by the cost per treatment in \$/ha. These values are provided in Table 5 of Appendix I.
4. Silviculture Employment was determined using the values provided in Table 18 of the Type I Silv. Strategy. This Table is replicated in Appendix I.
5. Stands scheduled for harvest over the next 10-15 years are fertilized for an immediate short term gain of approximately 15m³/ha.

The program described in Table 1 is diversified across many of the silviculture management regimes investigated in the Type II Analysis. Only regimes which provided a positive net gain above the Base Case were included. Regimes that provided no gain above the Base Case were discounted as potential strategies. The 'data base' regime was not explicitly modeled in the Type II Analysis; however it recognizes two vital components to a successful management plan.

1. Constructing and preserving a comprehensive data base of stands influenced by

an incremental silviculture treatment, is vital to reaping future benefits from costs associated with the treatment.

2. Improved harvest scheduling (rather than a random 'unplanned' approach as modeled in the Type II Analysis) provides the greatest net short and mid-term gain in the forecast harvest flow.

The program describe in Table 1 is roughly double the current program underway in the Cranbrook TSA. Historically, from 400 to 2,800 hectares are spaced (pre-commercial thinned) annually at an average estimated cost of \$700,000¹. The preferred program would cost approximately \$1.37 million annually.

Improved harvest scheduling, use of the best genetic material available at time of seedlot selection, rehabilitation of problem forest types, and stand fertilization are all management regimes that will provide significant improvement in the forecast harvest flow.

Continuing the pre-commercial thinning program will help to alleviate some of the need to improve future log piece sizes, by increasing average stand diameter at harvest. However, although companies are concerned about log quality, the issue will not present itself directly for the next 100 years. Of greater concern is the more immediate fall in harvest levels (i.e., reductions in harvestable volume) if certain programs are not initiated as soon as possible.

Maintenance and improvement of wildlife habitat is also an objective of this preferred management program. Sustainable timber harvesting plans have the ability to provide significantly enhanced landscape diversity. Social and economic reality dictates that such activities will continue to be an important element throughout the Cranbrook TSA. The opportunity to provide improved wildlife habitat, where there is no significant net loss to the forecast harvest flow, is addressed in this preferred program through clumpy planting. Clumpy planting can be used to maintain or create wildlife habitat integral to harvest areas, with little or no impact on the short or mid-term harvest levels.

The program described in Table 1 will help to alleviate the mid-term fall-down in the harvest flow by a significant extent. The compound impact of all of the management regimes described in Table 1 was not simulated in the Type II Analysis. Instead, through interpolative estimates, Figure 1 estimates the harvest flow as a result of the preferred program. The following conservative assumptions were used to estimate this harvest flow:

1. Improved harvest scheduling = extend current AAC 1 decade

¹ Reference Table 5 from: *Cranbrook TSA Silviculture Strategy* – version 1.3 – March 31,2002. Ministry of Forests

2. Utilizing improved genetic seed = +5.5% mid and long-term
3. Rehabilitation of problem forest types (200 ha/year) = +4% mid-term, +1.5% long-term
4. Spacing and repeat fertilization of existing managed stands (500 ha/yr) = extend current AAC 1 decade, +0.8% mid-term increase
5. Late fertilization of existing unmanaged stands – (1000 ha/year) = Extend current AAC 1 decade, +4% mid-term increase
6. Pre-commercial thin (space additional 300 ha/year) = +0.2% long-term gain
7. Clumpy planting (200ha/yr) = no significant impact

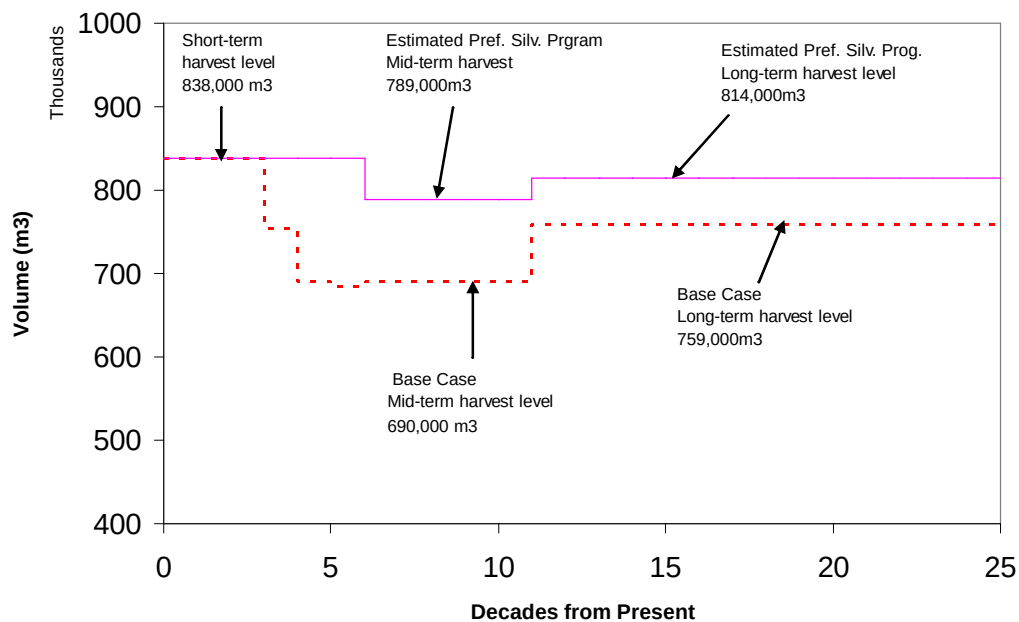


Figure 1 Estimated harvest flow resulting from the Preferred Incremental Silviculture Program

Figure 1 shows that the activities selected from this preferred silviculture program should result in the ability to maintain the current AAC for an additional 3 decades. This would be followed by a 6 percent decline to a mid-term harvest level of 789,000m³/year (i.e., 14% above the Base Case). The long-term harvest flow is estimated to be 7% higher than the Base Case.

3. Incremental Silviculture Activities

Not all of the activities described in the program are available to be undertaken at this time. This Report acknowledges several of these shortcomings and addresses each of the Program activities briefly as follows.

3.1. Data Base Management and Harvest Scheduling

The Type I Silviculture Strategy for the Cranbrook TSA indicated that the maintenance of a data base to record management practices and monitor results was fundamental to the strategy. This undertaking should be expanded to create a data base that:

- Spatially identifies candidate stands for the application of treatment regimes.
- Spatially identifies candidate stands for harvesting, in a manner that schedules the relative oldest stands as a priority, while maintaining landscape level seral objectives.
- Monitors and tracks the application of incremental silviculture regimes to ensure that the costs associated with a treatment are recovered in the shortest time possible.

These three objectives are imperative to safeguard the professional and fiscal responsibilities involve with undertaking silviculture treatment regimes that occupy a long planning horizon. As is apparent from the following sections, all activities require a varying degree of data base planning.

Harvest planning rules modeling in the Type II Analysis involved a random selection of stands eligible for harvesting. This can be a very inefficient forest-planning scheme and can result in an extremely conservative harvest flow. Alternative harvest rules include oldest stands first, relative oldest stands first ², or selection based upon *maximizing mean annual increment* (MAI) ³. An alternative operational approach to short-term stand selection is incorporation of a strategic 20-Year Plan into the timber supply analysis. As a layer in the inventory, a harvest priority can be placed on the proposed cut-blocks in this plan.

² Relative oldest first measures the difference in time between a stands current age and the stands minimum harvest age.

³ Maximizing mean annual increment is not a harvest rule available in FSSIM.

3.2. Class A Seed

Class A Seed is currently not available for most of the TSA. This program advocates a slight change to the funding for Class A seed in the short-term, to guarantee the development of this seed for use in the TSA as soon as possible. Currently, enhanced availability is anticipated by the year 2007. Availability may be improved by examining seed planning zone guidelines for opportunities to expand improved seed into the East Kootenays. Monitoring the progress of the future availability of Class A seed should also be a priority.

3.3. Stand Rehabilitation

A partition to the current AAC was incorporated as part of the Cranbrook TSA's last AAC Determination. The selection of problem forest type stands that will be suitable for stand rehabilitation is currently lacking. Prior to the commencement of this program an inventory is required to identify these stands spatially, to ensure rehabilitation is focused in the "Working Forest". This should reduce the risk of these stands later being restricted from harvesting for other resource emphasis needs.

3.4. Fertilization

Growth and yield assumptions around stand fertilization are weak, as this practice has seen little operational performance across B.C. The selection of suitable stands, the monitoring and scheduling of eligible stands and tracking performance results are essential to a successful program. The short-term harvest flow results described in the fertilization scenarios of the Type II Analysis Report were partially inconclusive, in-so-much that the "random harvest rule" selected non-fertilized stands in an order that was considerably different from the Base Case. The absolute measure of such a treatment regime is better address under a defined set of harvesting criteria.

Notwithstanding the lack of pure 'hard' data in support of fertilization, this preferred program makes use of two fertilization treatment regimes. Pre-harvest fertilization of existing mature or near-mature stands 10-15 years prior to harvest is estimated to improve stand yields by 15m³/ha. Repeat fertilization of immature, spaced stands is also incorporated into the preferred program at an average rate of 500 ha/year. This treatment is estimated to improve stand yields by 45m³/ha. Gains from this treatment will accrue over the next 30 to 100 years.

3.5. Pre-commercial thinning (spacing)

The TSA has a history of pre-commercial thinning. Effort in this regard should be maintained and supported with fertilization⁴ of medium site pine and Douglas Fir stands, where low biodiversity emphasis option landscape units and integrated resource management zones overlap. The total amount of spacing allocated under this program is 800 ha per year (i.e., 500 ha/year of stands scheduled for fertilization and 300 ha /year not fertilized).

3.6. Clumpy planning

The practice of clumpy planting has seen usage within the TSA. This activity should be maintained in areas where wildlife habitat values are at an obvious premium. The interaction between forest planners and biologists should result in a program which provides improved habitat and enhances future timber quality at no net loss to either resource.

3.7. Other Inventories

Although not explicitly part of an incremental silviculture program, other options exist that may have a dramatic impact on the harvest flow for the TSA. Provincially, it has been demonstrated that site quality, based upon age and height characteristics, are often underestimated. The development of site information based upon site series mapping can have a very large impact on the predicted future growth of managed stands.

Wildlife habitat values are difficult to model without corresponding quality data. Data in the form of terrain ecosystem mapping (TEM) and predictive ecosystem mapping (PEM) allows for the construction of wildlife habitat ratings for critical species. This information is vital if there is a desire to proceed towards a Type III analysis that spatially quantifies wildlife habitat values over time.

⁴ If spacing is not carried out in conjunction with fertilization, many of the costs and benefits of fertilization are lost due to natural stem mortality that will occur after fertilization.

4. Jobs, Income and Revenue

Benefits from the Preferred Silviculture Program include the creation of employment opportunities for forest workers in and around the Cranbrook TSA. Opportunities would accrue in the maintenance of existing harvesting and milling employment and an increase in the amount of employment involved with silviculture activities.

Assuming that there is no current spacing program, immediate employment creation in silviculture is estimated to be 13.2 full-time equivalent jobs (FTE) ⁵. Using standard economic multipliers of two indirect or induced jobs for each direct job, additional employment is estimated at 26.4 FTE jobs. The total net short-term benefit of the Program is 39.6 FTE jobs.

The mid-term will still see forest employment drop. Using a multiplier of one harvest and milling job per 1000 m³ harvested, the Base Case would see a loss of 148 direct jobs (444 FTE direct and indirect jobs lost) from the Cranbrook TSA in 30 years time. The Preferred Silviculture Program would also see a decline in employment in the TSA; however, this decline is not forecast to occur for at least 60 years. When the mid-term harvest level is reached, the equivalent of 49 direct jobs would be lost in harvesting and milling⁶. This loss is partially offset by silviculture spacing treatments that carry into the future. When these are factored in we see a net loss of 44 FTE direct jobs.

Direct employment jobs are reasonably well paid. Assuming an income tax rate of \$10,000 to \$14,000 per direct job and half that rate for indirect jobs, estimated annual government tax revenue of \$316 thousand would accrue from the silviculture program.

Average government stumpage revenue in the southern interior of British Columbia is estimated at \$30/m³. In the short-term, there will be no increase in revenues generated. In the 'early years' of the mid-term (years 31-60) the program will save government \$3.9 million annually from revenues which will otherwise be lost due to excessive fall down in the harvest flow.

Revenue costs and benefits from this program are provided in Appendix I. Over a 60-year time horizon the return on investment is 3.81%. Over the first 30 years of the program, net revenues are negative due to the cost of the management regimes

⁵ Since 400ha of area was spaced in 2001, the total net benefit would drop to 9.2 full time equivalent jobs. However, for comparative purposes, the Base Case assumed no spacing at the present time.

⁶ Assuming a drop in the mid-term harvest level of 48,900 m³/year

and as a result of no change in harvest. After year 30, the impact of the management program is increasingly realized, through significant revenue savings in Crown stumpage.

Additional benefits include the long-term social stability fundamental to the maintenance of well paid employment opportunities, and the improved wildlife habitat that will exist across the landscape.

Appendix I

Reference Tables

Table 4 Weighting Treatment Regimes (extracted from the Type II Analysis Report for the Cranbrook TSA)

Regime Description	Timber				Wildlife	Economic Return	Employment		Current Activity Focus	Aggregate Ranking
	Short Term Supply	Medium Term Supply	Long Term Supply	Long- term Quality	Habitat		Short Term	Long Term		
Base Case (no spacing)	L	L	L	L	L	L	L	L	L	9
Space 1000 ha/yr	L	M	L	M	L	N/A	M	M	H	14
Space 1300 ha/yr	L	M	L	M	L	N/A	M	M	M	13
Space/fertilize 1 application	M	L	L	M	L	H	M	L	L	14
Space/Fertilize 3 applications	M	M	L	M	L	M	M	M	L	15
Late Fertilization of natural stands	L	H	L	L	L	M	H	L	L	14
Stand rehabilitation	L	H	M	L	M	M	H	M	L	17
Plant Class A Seed	L	H	H	H	L	M	L	L	M	17
Increase stand Voids	L	L	N/A	L	M	L	L	L	L	9
Clumpy Planting	L	L	L	M	M	L	L	L	M	12
Apply Full Old BEO	N/A	N/A	L	N/A	M	L	L	L	L	7

N/A = 0, L= 1, M = 2, H = 3

Table 5 Silviculture Investment Costs (extracted from the Type II Analysis Report for the Cranbrook TSA)

Silviculture Treatment	Candidate Area (ha/year)	Regime Cost (\$/ha)	Investment Opportunity Cost (\$/yr)	Maximum Regimes Cost (\$/year)
Space 1000 ha/yr	1000	500	500,000	n/a
Space 1300 ha/yr	1300	500	650,000	650,000
Fertilize 1 application	500	528	264,000	n/a
Fertilize 3 applications	500	528	264,00	264,000
Late Fertilization	1700	528	897,600	897,600
Stand rehabilitation	500	2000	1,000,000	1,000,000
Plant Class A Seed	1500	70	105,000	105,000
Increase Stand Voids	2000	300	600,000	600,000
Clumpy Planting	550	300	165,000	165,000
Apply Full Old BEO	n/a	n/a	0	0
Total Cost				3,681,600

Table 18: Incremental Silviculture Strategy Investment Priorities

(extracted from the Type I Silviculture Strategy for the Cranbrook TSA)

Regimes	Jobs Days/Ha	Cost \$/Ha	Priority Ranking
1. Database record-keeping			1
2. Surveys (general)	0.1	20	2
Surveys – PFT	0.3	60	7
Surveys – Pre 1987 SR	0.1	20	9
3. Backlog Reforestation	3	1 500	4
4. Backlog Brushing	2.5	600	4
5. Rehab PFT	3	2 000	8
6. Improved Seed	0	70	3
7. Space > 6000 existing SPH	2	500	5
8. Repeat Fertilization	0.02	200	6
9. Pruning 1 st Lift	4	800	10
10. Clumpy Planting/Increase Voids	2	1 200	10

Calculation of Net Present Value

Year	Activity Cost (\$)							Employment		Change in Harvest (m3)	Revenue			Net Present Value	
	Records	Class A Seed	Rehab	Space /Fertilize	Pre-harvest fertilize	Spacing	Clumpy planting	Direct Jobs Created	Indirect Jobs		income taxes, direct	Stumpage saved	Net Revenue (\$)	Factor	Future Income Streams (\$)
2000	100000	32000	0	0	0	150000	0	3	6	0	\$72,000	0	-210,000	0.963	-\$202,285
2001	100000	32000	0	0	0	150000	0	3	6	0	\$72,000	0	-210,000	0.928	-\$194,854
2002	100000	32000	400000	350000	0	150000	60000	13.05	26.1	0	\$313,200	0	-778,800	0.894	-\$696,084
2003	100000	32000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-978,560	0.861	-\$842,497
2004	100000	32000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-978,560	0.829	-\$811,546
2005	100000	32000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-978,560	0.799	-\$781,733
2006	100000	32000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-978,560	0.770	-\$753,015
2007	100000	105000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-1,051,560	0.741	-\$779,463
2008	100000	105000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-1,051,560	0.714	-\$750,828
2009	100000	105000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-1,051,560	0.688	-\$723,245
2010	100000	105000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-1,051,560	0.663	-\$696,676
2011	100000	105000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-1,051,560	0.638	-\$671,083
2012	100000	105000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-1,051,560	0.615	-\$646,430
2013	100000	105000	400000	350000	200000	150000	60000	13.06	26.12	0	\$313,440	0	-1,051,560	0.592	-\$622,682
2014	100000	105000	400000	350000	0	150000	60000	13.05	26.1	0	\$313,200	0	-851,800	0.570	-\$485,864
2015	100000	105000	400000	350000	0	150000	60000	13.05	26.1	0	\$313,200	0	-851,800	0.549	-\$468,016
2016	100000	105000	400000	350000	0	150000	60000	13.05	26.1	0	\$313,200	0	-851,800	0.529	-\$450,822
2017	100000	105000	400000	350000	0	150000	60000	13.05	26.1	0	\$313,200	0	-851,800	0.510	-\$434,261
2018	100000	105000	400000	350000	0	150000	60000	13.05	26.1	0	\$313,200	0	-851,800	0.491	-\$418,308
2019	100000	105000	400000	350000	0	150000	60000	13.05	26.1	0	\$313,200	0	-851,800	0.473	-\$402,940
2020	100000	105000	400000	350000	0	150000	60000	13.05	26.1	0	\$313,200	0	-851,800	0.456	-\$388,138
2021	100000	105000	400000	350000	0	150000	60000	13.05	26.1	0	\$313,200	0	-851,800	0.439	-\$373,879
2022	100000	105000	400000	350000	0	150000	60000	13.05	26.1	0	\$313,200	0	-851,800	0.423	-\$360,144
2023	100000	105000	200000	350000	0	150000	60000	11.55	23.1	0	\$277,200	0	-687,800	0.407	-\$280,121
2024	100000	105000	200000	350000	0	150000	60000	11.55	23.1	0	\$277,200	0	-687,800	0.392	-\$269,831
2025	100000	105000	200000	350000	0	150000	60000	11.55	23.1	0	\$277,200	0	-687,800	0.378	-\$259,918
2026	100000	105000	200000	350000	0	150000	60000	11.55	23.1	0	\$277,200	0	-687,800	0.364	-\$250,370
2027	100000	105000	200000	350000	0	150000	60000	11.55	23.1	0	\$277,200	0	-687,800	0.351	-\$241,172
2028	100000	105000	200000	350000	0	150000	60000	11.55	23.1	0	\$277,200	0	-687,800	0.338	-\$232,312
2029	100000	105000	200000	350000	0	150000	60000	11.55	23.1	0	\$277,200	0	-687,800	0.325	-\$223,778
2030	100000	105000	200000	350000	0	150000	60000	11.55	23.1	0	\$277,200	0	-687,800	0.313	-\$215,557

